

ADVANCED FINANCIAL MANAGEMENT

QUESTION BANK

BY CA. DINESH JAIN

**DEDICATED TO MY LOVABLE
FATHER [RAMESH JAIN]**

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This book is useful for CA Final (New) students and comes with the following features:

- ❖ **One-stop solution:** The book has extensive coverage of theory and practical problems. I have considered the important problems of institute study material, RTP, MTP and suggested answers while preparing the book. This book can act as one-stop solution for students and they need not refer multiple sources for preparation of AFM. It covers 600+ questions and includes relevant questions from old syllabus study material as well
- ❖ **Theory coverage:** The material has extensive coverage of AFM theory in a simple bullet point format. Last day revision notes for theory in concise format has also been provided
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Any suggestions/feedback will be highly appreciated and incorporated in future editions.

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Summary of syllabus

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4	Replacement Decision and Life Disparity	Chapter 3
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6	Adjusted Present Value	Chapter 3
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S.No	Topic	Chapter No.
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Note: Covers all questions from ICAI Study Material, Mock Test Paper till Nov 2024, RTP till Nov 2024 and Suggested Answers till May 2024

Chapter 2 – Risk Management**Author's Note:**

- Please refer problems in this chapter post completion of Portfolio Management. You will need understanding of Standard Deviation concept to solve questions in this chapter

1. Simple problem on VAR [Nov 2019, SM]

Consider a portfolio consisting of a Rs.200,00,000 investment in share XYZ and a Rs. 200,00,000 investment in share ABC. The daily standard deviation of both shares is 1% and that the coefficient of correlation between them is 0.3. You are required to determine the 10-day 99% value at risk for the portfolio?

Answer:**WN 1: Computation of SD of portfolio:**

Variance = $(W_{XYZ} \times \sigma_{XYZ})^2 + (W_{ABC} \times \sigma_{ABC})^2 + 2W_{XYZ}W_{ABC}\sigma_{XYZ}\sigma_{ABC}\text{COR}_{ABCXYZ}$
Variance = $(0.5 \times 1)^2 + (0.5 \times 1)^2 + 2(0.5)(0.5)(1)(1)(0.3)$
Variance = $0.25 + 0.25 + 0.15 = 0.65\%$
Standard Deviation = $\sqrt{0.65} = 0.8062\%$

WN 2: Computation of Value at Risk:

Daily standard deviation (in Rs.) = $0.8062\% \times 400 \text{ lacs} = 3.2248 \text{ lacs}$
VAR for single day = Daily SD in rupees x Multiple for 99% VAR
VAR for single day = $3.2248 \times 2.33 = 7.5138 \text{ lacs}$
VAR for ten days = Loss for single day x $\sqrt{10}$
VAR for ten days = $7.5138 \times \sqrt{10} = \text{Rs. } 23.7607 \text{ lacs}$

2. Determination of maximum loss [May 2018]

Suppose you hold Rs.2 Crores shares of X Limited whose market price standard deviation is 2% per day. Assuming 252 trading days a year, determine maximum loss over the period of 1 trading day and 10 trading days with 99% confidence level. Assuming share prices are normally for level of 99%, the equivalent Z score from Normal table of Cumulative Area shall be 2.33

Answer:

Daily std deviation in %	2%
Daily std deviation in Rs	$200 \text{ Lakhs} \times 2\% = 4 \text{ Lakhs}$
Daily loss at 99% (VAR)	$4 \text{ Lakhs} \times 2.33 = 9.32 \text{ Lakhs}$
Maximum loss for 10 days	$\text{Daily loss} \times \sqrt{10} = 9.32 \times \sqrt{10} = 29.47 \text{ Lakhs}$

3. Determination of portfolio risk:

ABC Limited is holding the portfolio of XYZ shares that is worth Rs.18,480. The volatility of the returns on the share is 21% per annum. How could you measure the risk of the portfolio over the next one month?

Answer:

Annual SD in %	21%
Annual SD in Rs	$18,480 \times 21\% = \text{Rs. } 3,880.80$
VAR at 95% confidence level for a year	$\text{Rs. } 3,880.80 \times 1.65 = \text{Rs. } 6,403$
VAR at 99% confidence level for a year	$\text{Rs. } 3,880.80 \times 2.33 = \text{Rs. } 9,042$
VAR at 95% confidence level for a month	VAR for year = $\frac{6,403}{\sqrt{12}} = \frac{\sqrt{12}}{\sqrt{12}} = \text{Rs. } 1,848$
VAR at 99% confidence level for a month	VAR for year = $\frac{9,042}{\sqrt{12}} = \frac{\sqrt{12}}{\sqrt{12}} = \text{Rs. } 2,610$

4. Computation of maximum possible investment [Nov 2020, Nov 2024 MTP]

On Tuesday morning (before opening of the capital market) an investor, while going through his bank statement, has observed that an amount of Rs. 7 lakhs is lying in his bank account. This amount is available for use from Tuesday till Friday. The Bank requires a minimum balance of Rs. 1000 all the time. The investor desires to make a maximum possible investment where Value at Risk (VaR) should not exceed the balance lying in his bank account. The standard deviation of market price of the security is 1.5 per cent per day. The required confidence level is 99 per cent.

Answer:

- The bank account has balance of Rs.7,00,000. We are required to maintain a minimum balance of Rs.1,000
- Acceptable VAR (Loss) = Rs.7,00,000 - 1,000 = Rs.6,99,000

Let us assume investment to be A

Daily std deviation in %	1.5%
Daily std deviation in Rs	(A) × 1.5% = 0.015A
Multiple for 99% confidence interval	2.33
Daily loss at 99% (VAR)	0.015A × 2.33 = 0.03495A
Maximum loss for 4 days [Tuesday to Friday]	0.03495A × $\sqrt{4}$ = 6,99,000 0.0699A = 6,99,000
Maximum investment	$\frac{6,99,000}{0.0699} = \text{Rs. } 1,00,00,000$

5. Computation of Maximum Investment (May 2023) [Concept Revision]

Mr. Bull is a rational risk taker. He takes his position in a single stock for 4 days in a week. He does not take a position on Friday to avoid weekend effect and takes position only for four days in a week i.e. Monday to Thursday. He transfers the amount on Monday morning and withdraws the balance on Friday morning. He desires to make a maximum investment where Value At Risk (VAR) should not exceed the balance lying in his bank account. The position by his manager, as per standing instructions, is taken on the free balance lying in the bank account in the morning on each Monday.

On Monday morning (before opening of the capital market) he has transferred an amount of Rs. 11 Crore to his bank account. A fixed deposit also matured on this Monday. The maturity amount of Rs. 63,42,560 was also credited to his account by the bank in the morning of the Monday. However, Mr. Bull received the intimation of the same in the evening. The bank needs a minimum balance of Rs. 1,000 all the time. The value of Z score, at the required confidence level of 99 percent is 2.33.

The other information with respect to stocks X and Y, which are under consideration for this week, is as under:

X		Y	
Return	Probability	Return	Probability
6	0.10	4	0.10
7	0.25	6	0.20
8	0.30	8	0.40
9	0.25	10	0.20
10	0.10	12	0.10

You are required to recommend a single stock, where maximum investment can be made

Answer:

WN 1: Computation of Standard Deviation of X and Y

Security X

Return	Prob	Product	Deviation	Pd ²
6	0.1	0.6	-2	0.4
7	0.25	1.75	-1	0.25
8	0.3	2.4	0	0
9	0.25	2.25	1	0.25
10	0.1	1	2	0.4
Total		8		1.3
SD				1.14%

Security Y

Return	Prob	Product	Deviation	Pd ²
4	0.10	0.40	-4	1.60
6	0.20	1.20	-2	0.80

8	0.40	3.20	0	0
10	0.20	2.00	2	0.80
12	0.10	1.20	4	1.60
Total		8.00		4.80
SD				2.19%

WN 2: Computation of maximum investment:

Particulars	Security X	Security Y
Amount available in bank	11,00,00,000	11,00,00,000
Maturity proceeds of FD	63,42,560	63,42,560
Less: Minimum balance in Bank Account	(1,000)	(1,000)
Maximum Value at Risk	11,63,41,560	11,63,41,560
SD for one day	0.0114	0.0219
SD for four days (SD for one day $\times \sqrt{4}$)	0.0228	0.0438

Security X:

$$11,63,41,560 = \text{Investment} \times 0.0228 \times 2.33$$

$$\text{Investment} = \frac{11,63,41,560}{0.0228 \times 2.33} = \text{Rs. 219 Crores}$$

Security Y:

$$11,63,41,560 = \text{Investment} \times 0.0438 \times 2.33$$

$$\text{Investment} = \frac{11,63,41,560}{0.0438 \times 2.33} = \text{Rs. 114 Crores}$$

Recommendation: Position should be taken in X

Chapter 3 – Advanced Capital Budgeting Decisions**Practical Problems****Overview:**

- Part I – Basics of Capital Budgeting
- Part II – Investment Decision
- Part III – Replacement Decision and Life Disparity
- Part IV – Long-term Funds versus equity approach
- Part V – Adjusted Present Value
- Part VI – Inflation in Capital Budgeting
- Part VII – Expected NPV, Standard Deviation and Co-efficient of Variation
- Part VIII – RADR and CEF
- Part IX – Sensitivity Analysis and Scenario Analysis
- Part X – Decision Tree and Simulation
- Part XI – Option in Capital Budgeting

Part 1 - Basics of Capital Budgeting**1. Techniques of capital budgeting:**

Lockwood Limited wants to replace its old machine with a new automatic machine. Two models A and B are available at the same cost of Rs.5 lakhs each. Salvage value of the old machine is Rs.1 lakh. The utilities of the existing machine can be used if the company purchases A. Additional cost of utilities to be purchased in that case are Rs.1 lakh. If the company purchases B then all the existing utilities will have to be replaced with new utilities costing Rs.2 lakhs. The salvage value of the old utilities will be Rs.0.20 lakhs. The cash flows are expected to be:

Year	Project A	Project B	PVF @ 15%
1	1,00,000	2,00,000	0.87
2	1,50,000	2,10,000	0.76
3	1,80,000	1,80,000	0.66
4	2,00,000	1,70,000	0.57
5	1,70,000	40,000	0.50
Salvage value at end of year 5	50,000	60,000	

The targeted return on capital is 15%. You are required to

- (i) Compute, for the two machines separately, net present value, payback, Accounting Rate of Return, discounted payback period and desirability factor and (ii) Advice which of the machines is to be selected?

Answer:**WN 1: Analysis of Project A:**

Year	CF	CCF	PVF @ 15%	DCF	CDCF
0	-5,00,000	-5,00,000	1.00	-5,00,000	-5,00,000
1	1,00,000	-4,00,000	0.87	87,000	-4,13,000
2	1,50,000	-2,50,000	0.76	1,14,000	-2,99,000
3	1,80,000	-70,000	0.66	1,18,800	-1,80,200
4	2,00,000	1,30,000	0.57	1,14,000	-66,200
5	2,20,000	3,50,000	0.50	1,10,000	43,800

Note:

- Initial outflow = Purchase price of Rs.5,00,000 – Inflow of Rs.1,00,000 (sale value of old machine) + Purchase of utilities of Rs.1,00,000 = Rs.5,00,000
- Year 5 inflow = Rs.1,70,000 + Rs.50,000 (salvage value) = Rs.2,20,000
- Total Profits of the project = Inflows – Outflows = 8,50,000 – 5,00,000 = Rs.3,50,000
- Average profit per year = Rs.70,000

Particulars	Calculation	Answer
Payback	Base year + $\frac{\text{Unrecovered cash flow of Base year}}{\text{Cash flow of next year}}$	3.35 years (or) 3 years and 4.2 months

	$= 3 + \frac{70,000}{2,00,000} = 3 + 0.35$	
Discounted Payback	$\text{Base year} + \frac{\text{Unrecovered discounted cash flow of Base year}}{\text{Discounted flow of next year}}$ $= 4 + \frac{66,200}{1,10,000} = 4 + 0.60$	4.60 years (or) 4 years and 7 months
ARR on initial investment	$\frac{\text{Average Profit After Tax}}{\text{Initial Investment}} \times 100 = \frac{70,000}{5,00,000} \times 100$	14.00%
ARR on average investment	$\frac{\text{Average Profit After Tax}}{\text{Average Investment}} \times 100 = \frac{70,000}{\left(\frac{5,00,000 + 50,000}{2}\right)} \times 100$	25.45%
NPV	$= \text{PV of inflows} - \text{PV of outflow}$ $= 5,43,800 - 5,00,000$	43,800
Desirability factor (in %)	$\frac{\text{PV of inflows}}{\text{PV of outflows}} \times 100 = \frac{5,43,800}{5,00,000} \times 100$	108.76%
Desirability factor (in Times)	$\frac{\text{PV of inflows}}{\text{PV of outflows}} = \frac{5,43,800}{5,00,000}$	1.09 Times

WN 2: Analysis of Project B:

Year	CF	CCF	PVF @ 15%	DCF	CDCF
0	-5,80,000	-5,80,000	1.00	-5,80,000	-5,80,000
1	2,00,000	-3,80,000	0.87	1,74,000	-4,06,000
2	2,10,000	-1,70,000	0.76	1,59,600	-2,46,400
3	1,80,000	10,000	0.66	1,18,800	-1,27,600
4	1,70,000	1,80,000	0.57	96,900	-30,700
5	1,00,000	2,80,000	0.50	50,000	19,300

Note:

- Initial outflow = Purchase price of Rs.5,00,000 - Inflow of Rs.1,00,000 (sale value of old machine) + Purchase of utilities of Rs.2,00,000 - inflow of Rs.20,000 (sale value of utilities) = Rs.5,80,000
- Year 5 inflow = Rs.40,000 + Rs.60,000 (salvage value) = Rs.1,00,000
- Total Profits of the project = Inflows - Outflows = 8,60,000 - 5,80,000 = Rs.2,80,000
- Average profit per year = Rs.56,000

Particulars	Calculation	Answer
Payback	$\text{Base year} + \frac{\text{Unrecovered cash flow of Base year}}{\text{Cash flow of next year}}$ $= 2 + \frac{1,70,000}{1,80,000} = 2 + 0.94$	2.94 years (or) 2 years and 11.33 months
Discounted Payback	$\text{Base year} + \frac{\text{Unrecovered discounted cash flow of Base year}}{\text{Discounted flow of next year}}$ $= 4 + \frac{30,700}{50,000} = 4 + 0.61$	4.61 years (or) 4 years and 7 months
ARR on initial investment	$\frac{\text{Average Profit After Tax}}{\text{Initial Investment}} \times 100 = \frac{56,000}{5,80,000} \times 100$	9.66%
ARR on average investment	$\frac{\text{Average Profit After Tax}}{\text{Average Investment}} \times 100 = \frac{56,000}{\left(\frac{5,80,000 + 60,000}{2}\right)} \times 100$	17.50%
NPV	$= \text{PV of inflows} - \text{PV of outflow}$ $= 5,99,300 - 5,80,000$	19,300
Desirability factor (in %)	$\frac{\text{PV of inflows}}{\text{PV of outflows}} \times 100 = \frac{5,99,300}{5,80,000} \times 100$	103.33%

Desirability factor (in Times)	$\frac{\text{PV of inflows}}{\text{PV of outflows}} = \frac{5,99,300}{5,80,000}$	1.03 Times

Conclusion:

We should go ahead with Project A as it has better NPV and profitability index. Discounted payback for both projects is almost similar.

2. Calculation of IRR

- Find the IRR of a project with a cash outflow of Rs.20,000 in year 0 and a cash inflow two years later of Rs.25,992
- Find the IRR of a project with a cash outflow in year 0 of Rs.50,000 and which produces cash inflows in perpetuity of Rs.8,750
- Find the IRR of a project with a cash outlay of Rs.50,000 and a four year annuity inflow of Rs.15,500
- Find the IRR of the project whose cash flow is as under

Year	0	1	2	3
Cash flow	(1000)	450	425	400

Answer:**Question No.2a****Basic Information:**

Present value (outflow)	20,000
IRR (rate of interest)	?
n (time period)	2 years
Future value (Amount)	25,992

$$\text{Amount} = P \times (1 + r)^n$$

$$25,992 = 20,000 \times (1 + r)^2$$

$$(1 + r)^2 = \frac{25,992}{20,000} = 1.2996$$

$$(1 + r) = 1.14; r = 14\%$$

Hence IRR of the cash flow is 14%.

Question No.2b:**Basic information:**

Type of cash flow	Perpetuity
Perpetuity Amount	8,750
n (time period)	NA
r (rate of interest)	?
Present value of Perpetuity	50,000
Growth rate	0%

$$\text{Present value} = \frac{\text{Perpetuity Amount}}{\text{Rate of Interest} - \text{Growth Rate}}$$

$$50,000 = \frac{8,750}{\text{Rate of Interest} - 0\%}$$

$$\text{Rate of interest} = \frac{8,750}{50,000} = 0.175 \text{ (or) } 17.50\%$$

Hence IRR of the cash flow is 17.50%.

Question No.2c:**WN 1: Computation of initial guess rate for IRR computation:**

Particulars	Calculation	Amount
Initial outflow		50,000
Sum of inflows	$15,500 \times 4$	62,000
Total profit of project		12,000
Average profit of project	$\frac{12,000}{4}$	3,000

Average investment	$\frac{50,000 + 0}{2}$	25,000
ARR on average investment	$\frac{3,000}{25,000} \times 100$	12%
Initial guess rate	$\frac{2}{3} \times 12$	8%

- In order to compute IRR, we need one positive and one negative NPV. We need to start with some rate for discounting. We take that as $2/3^{\text{rd}}$ of ARR on average investment as final IRR is expected to be closer to this number.

WN 2: Computation of IRR:

Let us assume an initial discount rate of 8 percent and compute NPV

Year	Cash flow	PVF @ 8%	DCF	PVF @ 10%	DCF
0	-50,000	1	-50,000	1	-50,000
1 to 4	15,500	3.312	51,336	3.17	49,135
			1,336		-865

- We have to increase the discount rate if NPV is positive and discount rate is to be reduced if initial NPV is negative. We will need one positive and one negative NPV to compute IRR.

IRR computation:

$$\text{IRR} = L_1 + \frac{\text{NPV at } L_1}{\text{NPV at } L_1 - \text{NPV at } L_2} \times (L_2 - L_1)$$

$$\text{IRR} = 8\% + \frac{1,336}{1,336 - (-865)} \times (10\% - 8\%) = 8\% + 1.21\% = 9.21\%$$

Note:

- L1 = Lower discount rate
- NPV at L1 = NPV at lower rate
- L2 = Higher discount rate
- NPV at L2 = NPV at higher rate

Question No.2d:**WN 1: Computation of initial guess rate for IRR computation:**

Particulars	Calculation	Amount
Initial outflow		1,000
Sum of inflows		1,275
Total profit of project		275
Average profit of project	$\frac{275}{3}$	92
Average investment	$\frac{1,000 + 0}{2}$	500
ARR on average investment	$\frac{92}{500} \times 100$	18.40
Initial guess rate	$\frac{2}{3} \times 18.40$	12.27 ~ 12%

WN 2: Computation of IRR

Let us assume an initial discount rate of 12 percent and compute NPV

Year	Cash flow	PVF @ 12%	DCF	PVF @ 14%	DCF
0	-1,000	1	-1,000.00	1	-1,000.00
1	450	0.893	401.85	0.877	394.65
2	425	0.797	338.73	0.769	326.83
3	400	0.712	284.80	0.675	270.00
			25.38		-8.52

IRR computation:

$$\text{IRR} = L_1 + \frac{\text{NPV at } L_1}{\text{NPV at } L_1 - \text{NPV at } L_2} \times (L_2 - L_1)$$

$$\text{IRR} = 12\% + \frac{25.38}{25.38 - (-8.52)} \times (14\% - 12\%) = 12\% + 1.50\% = \mathbf{13.50\%}$$

3. NPV for step-up discount rate [Homework]

Project A require investment of Rs.10,00,000 and will yield an after cash inflow of Rs.1,20,000, Rs.3,00,000, Rs.6,00,000, Rs.4,00,000 and Rs.2,00,000 over the next five years. Cost of dismantling the asset is Rs.3,00,000 and salvage value of assets is Rs.1,00,000.

- ❖ Ascertain NPV if the cost of capital is 12% over 5 years
- ❖ Ascertain the NPV if the cost of capital for year 1 is 12% and is expected to go up by 2 percent every year upto the 5th year. Should the project be accepted? What if there is no dismantling cost at the end of the project?

Answer:

WN 1: Computation of NPV if discount rate is 12% over 5 years:

Year	CF	PVF @ 12%	DCF
0	-10,00,000	1.000	-10,00,000
1	1,20,000	0.893	1,07,160
2	3,00,000	0.797	2,39,100
3	6,00,000	0.712	4,27,200
4	4,00,000	0.636	2,54,400
5	-	0.567	-
NPV			27,860

- Cash flow of year 5 = 2,00,000 + 1,00,000 – 3,00,000(dismantling cost) = 0

WN 2: Computation of NPV in case of change in discount rate:

Year	CF	PVF	DCF
0	-10,00,000	1.000	-10,00,000
1	1,20,000	0.893	1,07,160
2	3,00,000	0.783	2,34,900
3	6,00,000	0.675	4,05,000
4	4,00,000	0.572	2,28,800
5	-	0.477	-
NPV			-24,140

- Projected will be rejected as the same has negative NPV of Rs.24,140

Note:

$$\text{PVF of year 2} = \frac{\text{PVF of year 1}}{1 + 14\%} = \frac{0.893}{1.14} = 0.783$$

$$\text{PVF of year 3} = \frac{\text{PVF of year 2}}{1 + 16\%} = \frac{0.783}{1.16} = 0.675$$

WN 3: Computation of NPV in case of no dismantling cost:

Year	CF	PVF	DCF
0	-10,00,000	1.000	-10,00,000
1	1,20,000	0.893	1,07,160
2	3,00,000	0.783	2,34,900
3	6,00,000	0.675	4,05,000
4	4,00,000	0.572	2,28,800
5	3,00,000	0.477	1,43,100
NPV			1,18,960

- Project will be accepted as the same has positive NPV if the company does not incur dismantling cost

4. Calculation of breakeven sales

ABC Limited is considering whether to invest in a project which would entail immediate expenditure on capital equipment of Rs.40,000. Feasibility study at a cost of Rs.8,000 indicates the following expected sales:

Probability	Sales volume
0.10	2,000
0.25	6,000

0.40	8,000
0.15	10,000
0.10	14,000

Once sales are established at a certain volume in the first year, they will continue at the same level in subsequent years. The unit selling price will be Rs.10 and the variable cost is Rs.6. The project will have the following fixed cost:

- ❖ Rent of a factory of Rs.10,000. Annual rental of Rs.10,000 would be payable only as long as the new product is manufactured
- ❖ Head-office apportioned expense of Rs.10,000
- ❖ Other expenses of Rs.10,000

The project will have a life of 6 years, after which the equipment would be sold as scrap which would fetch Rs.3,000. The cost of capital is 10%. Ignore taxes. You are required to find:

- ❖ Expected value of the NPV of the project
- ❖ Minimum volume of sales per annum required to justify the project

Answer:

WN 1: Computation of expected sales volume:

Expected sales volume = $(0.10 \times 2,000) + (0.25 \times 6,000) + (0.40 \times 8,000) + (0.15 \times 10,000) + (0.10 \times 14,000)$

Expected sales volume = 7,800 units

WN 2: Computation of cash flows:

Note 1: Initial outflow

Particulars	Amount
Capital expenditure	-40,000
Feasibility study (sunk cost)	0
Working capital	0
Initial outflow	-40,000

Note 2: In-between flows (Year 1 to 6)

Particulars	Amount
Contribution from 7,800 units $[7,800 \times 4]$	31,200
Less: Rent (incremental cost)	-10,000
Less: Apportioned cost (irrelevant)	0
Less: Other expenses	-10,000
PBDT/CFAT	11,200

Note 3: Terminal flow (Year 6):

Particulars	Amount
Salvage value	3,000
Recapture of working capital	0
Terminal flow	3,000

WN 3: Computation of NPV:

Year	CF	PVF @ 10%	DCF
0	-40,000	1.000	-40,000
1 to 6	11,200	4.355	48,776
6	3,000	0.564	1,692
NPV			10,468

WN 4: Minimum value of sales to justify the project:

- Project will be acceptable if the NPV is ≥ 0 . Hence, we should compute the sales volume which leads to NPV of 0.

Computation of in-between inflow which will lead to zero NPV:

Year	CF	PVF @ 10%	DCF
0	-40,000	1.000	-40,000
1 to 6	8,796	4.355	38,308 (b/f)

	[38,308/4.355]		
6	3,000	0.564	1,692
NPV			0

Computation of sales volume which would lead to CFAT of Rs.8,796:

Particulars	Amount
Target contribution (reverse working)	28,796
Less: Rent (incremental cost)	-10,000
Less: Apportioned cost (irrelevant)	0
Less: Other expenses	-10,000
PBDT/CFAT	8,796

- No of units to be sold (minimum sales volume) = $28,796/4 = 7,199$ units

Part 2 – Investment Decision**5. Revenue Enhancement:**

X Ltd. an existing profit making company is planning to introduce a new product with a projected life for 8 years. Initial equipment cost will be Rs.120 lacs and additional equipment costing Rs.10 lacs will be needed at the beginning of the third year. At the end of the 8 years, the original equipment will have resale value equivalent to the cost of removal, but the additional equipment would be sold for Rs.1 lac. Working capital of Rs.15 lacs will be needed. The 100% capacity of the plant is of 4,00,000 units per annum but the production and sales volume are as under:

Year	1	2	3-5	6-8
Capacity Utilization	20	30	75	50
Advertisement expenditure (in lacs) per year	30	15	10	4

A sale price of Rs.100 per unit with a profit volume ratio of 60% is likely to be obtained. Fixed operating costs are likely to be Rs.16 lacs per annum. In addition to this the advertisement expenditure will have to be incurred as mentioned in the above table.

The company is subject to 50% tax, straight line method of depreciation (permissible for tax purposes also) and taking 12% as appropriate after-tax cost of capital should the project be accepted?

Answer:**Answer:****WN 1: Initial outflow:**

Particulars	Amount (in lacs)
Capital expenditure	(120)
Working capital	(15)
Initial outflow	(135)

WN 2: In-between cash flows:

(in lacs)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Units sold [4 x capacity utiln]	0.80	1.20	3.00	3.00	3.00	2.00	2.00	2.00
Selling price	100	100	100	100	100	100	100	100
Revenues [Units x SP]	80.00	120.00	300.00	300.00	300.00	200.00	200.00	200.00
Less: Variable cost [Units x 40]	-32.00	-48.00	-120.00	-120.00	-120.00	-80.00	-80.00	-80.00
Less: Fixed cost	-16.00	-16.00	-16.00	-16.00	-16.00	-16.00	-16.00	-16.00
Less: Advertisement	-30.00	-15.00	-10.00	-10.00	-10.00	-4.00	-4.00	-4.00
PBDT	2.00	41.00	154.00	154.00	154.00	100.00	100.00	100.00
Less: Depreciation	-15.00	-15.00	-16.50	-16.50	-16.50	-16.50	-16.50	-16.50
PBT	-13.00	26.00	137.50	137.50	137.50	83.50	83.50	83.50
Less: Tax	6.50	-13.00	-68.75	-68.75	-68.75	-41.75	-41.75	-41.75
PAT	-6.50	13.00	68.75	68.75	68.75	41.75	41.75	41.75

Add: Depreciation	15.00	15.00	16.50	16.50	16.50	16.50	16.50	16.50
CFAT	8.50	28.00	85.25	85.25	85.25	58.25	58.25	58.25
Less: Purchase of additional machine		-10.00						
Revised CFAT	8.50	18.00	85.25	85.25	85.25	58.25	58.25	58.25

- Depreciation on original equipment (all 8 years) = $(120 - 0)/8 = 15$ lacs
- Depreciation on additional equipment (3 to 8 years) = $(10 - 1)/6 = 1.5$ lacs
- Company makes loss in year 1. It is an existing profit-making company and hence would save taxes due to loss
- Additional machine has been purchased at beginning of year 3. Beginning of year 3 will be taken as end of year 2 in cash flow analysis. This is because it is generally assumed that cash flows happen at end of the year

WN 3: Terminal cash flow:

Particulars	Amount (in lacs)
Net salvage value of original machine	0.00
Net salvage value of additional machine	1.00
Recapture of working capital	15.00
Total terminal flow	16.00

Note: Computation of Net Salvage Value:

Particulars	Original	Additional
Sale value	0.00	1.00
Less: Book value	0.00	1.00
Capital gain/loss	0.00	0.00
Tax paid/saved	0.00	0.00
Net salvage value	0.00	1.00

WN 4: Consolidation of cash flows and computation of NPV:

(in lacs)

Year	Cash flow	PVF @ 12%	DCF
0	-135.00	1.000	-135.00
1	8.50	0.893	7.59
2	18.00	0.797	14.35
3	85.25	0.712	60.70
4	85.25	0.636	54.22
5	85.25	0.567	48.34
6	58.25	0.507	29.53
7	58.25	0.452	26.33
8	74.25 [58.25 + 16.00]	0.404	30.00
NPV			136.06

Conclusion: The company should go ahead with project as it results in positive NPV of Rs.136.06 lacs.

6. Evaluation of a new project

ABC Limited is considering building an additional amusement park that will have a wild-water wave pool, buildings and restaurants. Since the firm's sales are in cash, the cash inflow from sales and gross revenues are identical. The firm's variable costs amount to 50% of the revenue, with 60% of these cost paid in cash and 40% paid on credit for one year. The new investment is Rs.200 million (Rs.100 million in equipment and Rs.100 million in buildings), plus Rs.10 million in net working capital (mainly cash).

ABC Limited will depreciate the equipment by the accelerated method (by which relatively high proportions of the asset's values are depreciated in early years) over four years, the buildings will be depreciated over

31.5 years. The buildings will be placed in service in January. The annual depreciation percentages are as follows:

Years	1	2	3	4
Equipment (%)	33.33	44.45	14.81	7.41
Buildings (%)	3.042	3.175	3.175	3.175

ABC Limited estimates annual sales at Rs.400 million for each of the next four years. As a result of the new project, the after-tax cash inflow from other amusement parks will decline by Rs.20 million a year. The firm has already paid Rs.25 million on an after tax cost basis for research and development of the new project. The value of buildings is expected to increase to an estimated Rs.110 million after four years of operation. The value of equipment after four years of use will be zero. Assume that the after tax cost of capital is 15% and the corporate tax is 34%. The firm uses vacant land for the new attraction and it has no alternative use the land for the next four years. Should the company proceed with project?

Answer:

WN 1: Initial outflow:

Particulars	Amount (in million)
Equipment cost	-100.00
Building cost	-100.00
Working capital	-10.00
Initial Outflow	-210.00

WN 2: In-between flows:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Revenues	400.00	400.00	400.00	400.00	
Less: Variable cost	-200.00	-200.00	-200.00	-200.00	
Less: Depreciation on equipment	-33.33	-44.45	-14.81	-7.41	
Less: Depreciation on building	-3.04	-3.18	-3.18	-3.18	
Profit before tax	163.63	152.37	182.01	189.41	0.00
Less: Tax @ 34%	-55.63	-51.81	-61.88	-64.40	
Profit after tax	108.00	100.56	120.13	125.01	0.00
Add: Depreciation	36.37	47.63	17.99	10.59	
Less: Opportunity cost	-20.00	-20.00	-20.00	-20.00	
Add: variable cost not paid of that year	80.00	80.00	80.00	80.00	
Less: Variable cost paid of previous year		-80.00	-80.00	-80.00	-80.00
Revised Cash flow after tax	204.37	128.19	118.12	115.60	-80.00

WN 3: Terminal flow:

Particulars	Amount
Recapture of working capital	10.00
Net salvage value (Note 1)	102.32
Total Terminal Flow	112.32

Note 1: Computation of Net Salvage Value:

Particulars	Equipment	Building
Sale value	0.00	110.00
Less: Book value	0.00	87.42
Capital gain	0.00	22.58
Tax paid	0.00	7.68
Net salvage value	0.00	102.32

WN 4: Consolidation of cash flows and computation of NPV:

Year	Cash flow	PVF @ 15%	DCF
0	-210.00	1.000	-210.00
1	204.37	0.870	177.80
2	128.19	0.756	96.91

3	118.12	0.658	77.72
	227.92		
4	[115.60 + 112.32]	0.572	130.37
5	-80.00	0.497	-39.76
NPV			233.04

Conclusion: The company should go ahead with project as the same results in positive NPV of Rs.233.04 lacs

7. Investment Decision [Homework]

ABC Ltd., a profit-making company, is engaged in the business of car manufacturing. In order to be independent in terms of its electricity needs, the company's management has proposed to put up a Solar Power Plant to generate the electricity. The details of the proposal are as follows:

- (1) Cost of the power plant = Rs.280 lacs
- (2) Cost of land = Rs.30 lacs
- (3) Subsidy of Rs.25 lakhs from state government to be received at the end of first year of installation.
- (4) Sale of electricity to State Electricity Board will be at Rs.2.25 per unit in year 1. This will increase by Rs.0.25 per unit every year till year 7. After that it will increase by Rs.0.50 per unit every year.
- (5) Maintenance cost will be Rs.4 lakhs in year 1 and the same will increase by Rs.2 lakhs every year.
- (6) Estimated life is 10 years.
- (7) Cost of capital 15%.
- (8) Residual value of power plant is nil. However, land value will go up to Rs.90 lakhs at the end of year 10.
- (9) Depreciation will be 100% of the cost of the power plant in year 1 (entire Rs.280 lakhs is to be depreciated in year 1 without considering subsidy) and the same will be allowed for tax purposes.
- (10) Gross electricity generated will be 25 lakhs units per annum. 4% of this electricity generated will be committed free to the State Electricity Board as per the agreement.
- (11) Tax rate is 50%.

You are required to suggest the viability of the proposal by calculating the 'Net Present Value' while ignoring the tax on capital profit. Assume that the tax savings, if any, are utilized in the year of their occurrence.

Answer:

WN 1: Initial outflow:

Particulars	Amount (in lacs)
Capital expenditure - Power Plant	(280.00)
Capital expenditure - Land	(30.00)
Working capital	0
Initial outflow	(310.00)

WN 2: In-between cash flows:

Particulars	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
Units generated	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Less: Free electricity [4% x 25]	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
Units sold	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Selling price	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.25	4.75	5.25
Sales	54.00	60.00	66.00	72.00	78.00	84.00	90.00	102.00	114.00	126.00
Less: Maintenance cost	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00
Less: Depreciation	280.00	-	-	-	-	-	-	-	-	-
Profit/loss before tax	-230.00	54.00	58.00	62.00	66.00	70.00	74.00	84.00	94.00	104.00
Add/ Less: Tax paid/ saved @ 50%	-115.00	27.00	29.00	31.00	33.00	35.00	37.00	42.00	47.00	52.00
Profit/loss after tax	-115.00	27.00	29.00	31.00	33.00	35.00	37.00	42.00	47.00	52.00

Add:										
Depreciation	280.00									
Add: Subsidy	25.00									
Cash flow after taxes	190.00	27.00	29.00	31.00	33.00	35.00	37.00	42.00	47.00	52.00

Note:

- Depreciation is entirely charged in year 1. The company is an existing profit-making company and hence the loss can be set-off against other existing profits. Therefore, it will save tax of Rs.115 lacs in year 1.

WN 3: Terminal flow:

Particulars	Amount (in lacs)
Salvage value of land (Tax on capital profit is ignored as per question)	90.00
Salvage value of power plant	0.00
Recapture of working capital	0.00
Total terminal flow	90.00

WN 4: Consolidation of cash flows and computation of NPV:**(in lacs)**

Year	Cash flow	PVF @ 15%	DCF
0	-310.00	1.000	-310.000
1	190.00	0.870	165.300
2	27.00	0.756	20.412
3	29.00	0.658	19.082
4	31.00	0.572	17.732
5	33.00	0.497	16.401
6	35.00	0.432	15.120
7	37.00	0.376	13.912
8	42.00	0.327	13.734
9	47.00	0.284	13.348
10	142.00 [52.00 + 90.00]	0.247	35.074
NPV			20.115

The proposed project has NPV of Rs.20,11,500 and is viable to undertake

8. Comprehensive problem [Homework]

A large profit making company is considering the installation of a machine to process the waste produced by one of its existing manufacturing process to be converted into a marketable product. At present, the waste is removed by a contractor for disposal on payment by the company of Rs.150 lakh per annum for the next four years. The contract can be terminated upon installation of the aforesaid machine on payment of a compensation of Rs.90 lakh before the processing operation starts. This compensation is not allowed as deduction for tax purposes.

The machine required for carrying out the processing will cost Rs.600 lakh. At the end of the 4th year, the machine can be sold for Rs.60 lakh and the cost of dismantling and removal will be Rs.45 lakh.

Sales and direct costs of the product emerging from waste processing for 4 years are estimated as under:

Year	1	2	3	4
Sales	966	966	1,254	1,254
Material consumption	90	120	255	255
Wages	225	225	255	300
Other expenses	120	135	162	210
Factory overheads	165	180	330	435

Depreciation (as per income tax rules)	150	114	84	63

Initial stock of materials required before commencement of the processing operations is Rs.60 lakh at the start of year 1. The stock levels of materials to be maintained at the end of year 1, 2 and 3 will be Rs.165 lakh and the stocks at the end of year 4 will be nil. The storage of materials will utilise space which would otherwise have been rented out for Rs.30 lakh per annum. Labour costs include wages of 40 workers, whose transfer to this process will

reduce idle time

payments of Rs.45 lakh in the year- 1 and Rs.30 lakh in the year- 2. Factory overheads include apportionment of general factory overheads except to the extent of insurance charges of Rs.90 lakh per annum payable on this venture. The company's tax rate is 30%. Consider cost of capital @ 14% and ignore tax on capital gains.

ADVISE the management on the desirability of installing the machine for processing the waste. All calculations should form part of the answer

Answer:

WN 1: Initial outflow:

Particulars	Amount (in lacs)
Capital expenditure	(600.00)
Compensation paid	(90.00)
Working capital (material)	(60.00)
Initial outflow	(750.00)

WN 2: In-between flows:

Particulars	Year 1	Year 2	Year 3	Year 4
Sales	966.00	966.00	1,254.00	1,254.00
Saving in contractor charges	150.00	150.00	150.00	150.00
Less: Material cost	-90.00	-120.00	-255.00	-255.00
Less: Wages	-180.00	-195.00	-255.00	-300.00
Less: Other expenses	-120.00	-135.00	-162.00	-210.00
Less: Factory OH	-90.00	-90.00	-90.00	-90.00
Less: Opportunity cost	-30.00	-30.00	-30.00	-30.00
Less: Depreciation	-150.00	-114.00	-84.00	-63.00
Profit before tax	456.00	432.00	528.00	456.00
Less: Tax @ 30%	-136.80	-129.60	-158.40	-136.80
Profit after tax	319.20	302.40	369.60	319.20
Add: Depreciation	150.00	114.00	84.00	63.00
Less: Increase in working capital	-105.00	-	-	-
Cash flow after taxes	364.20	416.40	453.60	382.20

WN 3: Terminal cash flows:

Particulars	Amount
Recapture of working capital	165.00
Salvage value	15.00
Total terminal flow	180.00

WN 4: Computation of NPV:

Year	Cash flow	PVF @ 14%	DCF
0	-750.00	1.000	-750.00
1	364.20	0.877	319.40
2	416.40	0.769	320.21
3	453.60	0.674	305.73
4	562.20	0.592	332.82
NPV of Project			528.16

Advice: Since the net present value of cash flows is Rs.528.16 lakh which is positive the management should install the machine for processing the waste

DL Services is in the business of providing home Services like plumbing, sewerage line cleaning etc. There is a proposal before the company to purchase a mechanized sewerage cleaning line for a sum of Rs. 20 lacs. The life of the machine is 10 years. The present system of the company is to use manual labour for the job. You are provided the following information:

Cost of machine	Rs.20 lakhs
Depreciation	20% p.a. straight line
Operating cost	Rs.5 lacs per annum
Present system	
Manual labour	200 persons
Cost of manual labour	Rs.10,000 (ten thousand) per person per annum

The company has an after tax cost of funds of 10% per annum. The applicable rate of tax inclusive of surcharge and cess is 35%. Based on the above you are required to:

- ❖ State whether it is advisable to purchase the machine.
- ❖ Compute the savings/additional cost as applicable, if the machine is purchased.

Answer:

WN 1: Initial Outflow:

Particulars	Amount
Capital expenditure	(20,00,000)
Working capital	0
Initial outflow	(20,00,000)

WN 2: In-between cash flows:

Particulars	Year 1 to 5	Year 6 to 10
Revenue/cost reduction		
Savings in labour cost (10,000 × 200)	20,00,000	20,00,000
Less: Operating cost	(5,00,000)	(5,00,000)
Profit before Depreciation and Tax (PBDT)	15,00,000	15,00,000
Less: Depreciation (20,00,000 × 20%)	(4,00,000)	-
Profit before tax (PBT)	11,00,000	15,00,000
Less: Tax @ 35%	(3,85,000)	(5,25,000)
Profit after tax (PAT)	7,15,000	9,75,000
Add: Depreciation	4,00,000	-
Cash flow after taxes (CFAT)	11,15,000	9,75,000

WN 3: Terminal cash flow:

Particulars	Amount
Net salvage value	-
Recapture of working capital	-
Total terminal flow	-

Note: Computation of Net Salvage Value:

Particulars	Amount
Sale value	0.00
Less: Book value	0.00
Capital gain/loss	0.00
Tax paid/saved	0.00
Net salvage value	0.00

WN 4: Computation of NPV:

Year	Cash flow	PVF @ 10%	DCF
0	-20,00,000	1.000	-20,00,000
1 to 5	11,15,000	3.791	42,26,965
6 to 10	9,75,000	2.354	22,95,150
10	-	0.386	-
NPV			45,22,115

Conclusion: The company should go ahead with purchase of machine as NPV is positive.

10. Venture capital investment

TMC is a venture capital financier. It received a proposal for financing requiring an investment of Rs.45 crore which returns Rs.600 crore after 6 years if succeeds. However, it may be possible that the project may fail at any time during the six years. The following table provide the estimates of probabilities of the failure of the projects.

Year	1	2	3	4	5	6
Probability of failure	0.28	0.25	0.22	0.18	0.18	0.10

In the above table the probability that the project fails in the second year is given that it has survived throughout year 1. Similarly for year 2 and so forth. TMC is considering an equity investment in the project. The beta of this type of project is 7. The market return and risk free rate of return are 8% and 6% respectively. You are required to compute the expected NPV of the venture capital project and advice the TMC.

Answer:

WN 1: Computation of probability of success of project:

- Probability of success till 6th year = (Probability of success in year 1 x Probability of success in year 2 x Probability of success in year 3 x Probability of success in year 4 x Probability of success in year 5 x Probability of success in year 6)
- Probability of success till 6th year = (72% x 75% x 78% x 82% x 82% x 90%) = 25.4893%

Note: Project will be successful only if it is able to succeed for all six years and hence we have to compute the joint probability of success till year 6.

WN 2: Computation of NPV

- Expected cash flow of year 6 = Rs.600 crores x 25.4893% = Rs.152.9358 crores

Year	Cash flow	PVF @ 20%	DCF
0	-45.0000	1.000	-45.0000
6	152.9358	0.335	51.2335
NPV			6.2335

- NPV of the project is positive and hence TMC can go ahead with the investment.

11. Calculation of utility value - May 2017 RTP, Nov 2024 RTP, SM

Jumble Consultancy Group has determined relative utilities of cash flows of two forthcoming projects of its client company as follows:

Cash flow	-15000	-10000	-4000	0	15000	10000	5000	1000
Utilities	-100	-60	-3	0	40	30	20	10

The distribution of cash flows of project A and Project B are as follows:

Project A					
Cash flow	-15000	-10000	15000	10000	5000
Probability	0.1	0.2	0.4	0.2	0.1
Project B					
Cash flow	-10000	-4000	15000	5000	10000
Probability	0.1	0.15	0.4	0.25	0.1

Which project should be selected and why?

Answer:

Project A					
Cash flow	-15000	-10000	15000	10000	5000
Probability	0.1	0.2	0.4	0.2	0.1
Utility	-100	-60	40	30	20
Expected utility	-10	-12	16	6	2
Project B					
Cash flow	-10000	-4000	15000	5000	10000
Probability	0.1	0.15	0.4	0.25	0.1

Utility	-60	-3	40	20	30
Expected utility	-6	-0.45	16	5	3

- Total utility value of project A = 2
- Total utility value of project B = 17.55
- Project B should be selected as its expected utility is more

Part 3 – Replacement Decision and Life Disparity

12. Type 1 - Replacement Decision [SM]

A Company named Roby's cube decided to replace the existing Computer system of their organisation. Original cost of old system was Rs. 25,000 and it was installed 5 years ago. Current market value of old system is Rs. 5,000. Depreciation of the old system was charged with life of 10 years with Estimated Salvage value as Nil. Depreciation of the new system will be charged with life over 5 years. Present cost of the new system is Rs. 50,000. Estimated Salvage value of the new system is Rs. 1,000. Estimated cost savings with new system is Rs. 5,000 per year. Increase in sales with new system is assumed at 10% per year based on original total sales of Rs. 1,00,000. Company follows straight line method of depreciation. Cost of capital of the company is 10% whereas tax rate is 30%.

Required:

Advise whether the company should go ahead with replacement?

Answer:

WN 1: Initial outflow:

Particulars	Amount
NSV of existing machine	7,250
Working capital blocked	0
Capital expenditure	-50,000
Total outflow	-42,500

Note 1: Computation of existing machine on day 0:

Particulars	Amount
Sale value	5,000
Less: Book value [25,000 – 2,500 x 5 years]	-12,500
Capital loss	-7,500
Tax saved @ 30%	2,250
Net salvage value	7,250

WN 2: In-between cash flows:

Particulars	Amount
Increase in revenues [1,00,000 x 10%]	10,000
Saving in cost	5,000
Less: Incremental depreciation [9,800 – 2,500]	-7,300
Profit before tax	7,700
Less: Tax @ 30%	-2,310
Profit after tax	5,390
Add: Depreciation	7,300
Incremental CFAT	12,690

WN 3: Terminal flow:

Particulars	Existing	New
Net salvage value	0	1,000
Recapture of working capital	0	0
Total terminal flow	0	1,000

- Incremental cash flow = New – Old = Rs.1,000

WN 4: Consolidation of cash flows and computation of NPV:

Year	Cash flow	PVF @ 10%	DCF
0	-42,750	1.000	-42,750
1 to 5	12,690	3.791	48,108
5	1,000	0.621	621
NPV			5,979

Conclusion: Since NPV is positive we should accept the proposal to replace the machine.

13. Type 1 - Replacement Decision [SM] [Concept Revision]

A company has an old machine having book value zero – which can be sold for Rs. 50,000. The company is thinking to choose one from following two alternatives:

- To incur additional cost of Rs. 10,00,000 to upgrade the old existing machine.
- To replace old machine with a new machine costing Rs. 20,00,000 plus installation cost of Rs. 50,000.

Both above proposals envisage useful life to be five years with salvage value to be nil. The expected after tax profits for the above three alternatives are as under:

Year	Old existing machine	Upgraded Machine	New Machine
1	5,00,000	5,50,000	6,00,000
2	5,40,000	5,90,000	6,40,000
3	5,80,000	6,10,000	6,90,000
4	6,20,000	6,50,000	7,40,000
5	6,60,000	7,00,000	8,00,000

The tax rate is 40 per cent. The company follows straight line method of depreciation. Assume cost of capital to be 15 per cent. P.V.F. of 15%, 5 = 0.870, 0.756, 0.658, 0.572 and 0.497. You are required to advise the company as to which alternative is to be adopted.

Answer:

WN 1: Evaluation of upgrading option:**Note 1: Computation of cash flows:**

Year	PAT/CFAT of Existing machine	Upgraded Machine			Incremental CFAT
		PAT	Depreciation	CFAT	
1	5,00,000	5,50,000	2,00,000	7,50,000	2,50,000
2	5,40,000	5,90,000	2,00,000	7,90,000	2,50,000
3	5,80,000	6,10,000	2,00,000	8,10,000	2,30,000
4	6,20,000	6,50,000	2,00,000	8,50,000	2,30,000
5	6,60,000	7,00,000	2,00,000	9,00,000	2,40,000

Note 2: Computation of NPV

Year	Cash flow	PVF @ 15%	DCF
0	-10,00,000	1.000	-10,00,000
1	2,50,000	0.870	2,17,500
2	2,50,000	0.756	1,89,000
3	2,30,000	0.658	1,51,340
4	2,30,000	0.572	1,31,560
5	2,40,000	0.497	1,19,280
NPV			-1,91,320

- NPV of upgradation option is negative and hence the same is not feasible

WN 2: Evaluation of new purchase option:**Note 1: Initial outflow**

Particulars	Amount
NSV of existing machine on year 0 (Note 2)	30,000
Working capital blocked	0
Capital expenditure	-20,50,000

Total outflow	-20,20,000

Note 2: Computation of NSV of existing machine on day 0:

Particulars	Amount
Sale value	50,000
Less: Book value	0
Capital gain	50,000
Tax paid @ 40%	20,000
Net salvage value	30,000

Note 3: Computation of cash flows:

Year	PAT/CFAT of Existing machine	New machine			Incremental CFAT
		PAT	Depreciation	CFAT	
1	5,00,000	6,00,000	4,10,000	10,10,000	5,10,000
2	5,40,000	6,40,000	4,10,000	10,50,000	5,10,000
3	5,80,000	6,90,000	4,10,000	11,00,000	5,20,000
4	6,20,000	7,40,000	4,10,000	11,50,000	5,30,000
5	6,60,000	8,00,000	4,10,000	12,10,000	5,50,000

Note 4: Computation of NPV

Year	Cash flow	PVF @ 15%	DCF
0	-20,20,000	1.000	-20,20,000
1	5,10,000	0.870	4,43,700
2	5,10,000	0.756	3,85,560
3	5,20,000	0.658	3,42,160
4	5,30,000	0.572	3,03,160
5	5,50,000	0.497	2,73,350
NPV			-2,72,070

- NPV of new purchase option is also negative and hence the same is not feasible
- As the NPV in both the proposals is negative, the company should continue with the existing old Machine.

14. Type 1 - Replacement Decision

XYZ is interested in assessing the cash flows associated with the replacement of an old machine by a new machine. The old machine bought a few years ago has a book value of Rs.90,000 and it can be sold for Rs.90,000. It has a remaining life of five years after which its salvage value is expected to be nil. It is being depreciated annually at the rate of 20 per cent (written down value method.)

The new machine costs Rs.4,00,000. It is expected to fetch Rs.2,50,000 after five years when it will no longer be required. It will be depreciated annually at the rate of 33 1/3 per cent (written down value method.) The new machine is expected to bring a saving of Rs.1,00,000 per annum in manufacturing costs. Investment in working capital would remain unaffected. The tax rate applicable to the firm is 50 per cent. Find out the relevant cash flow for this replacement decision. (Tax on capital gain/loss to be ignored)

Answer:**WN 1: Initial outflow**

Particulars	Amount
NSV of existing machine on day 0	90,000
Working capital blocked	-
Capital expenditure	(4,00,000)
Total outflow	(3,10,000)

WN 2: In-between flows:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5

Saving in cost	1,00,000	1,00,000	1,00,000	1,00,000	1,00,000
Less: Depreciation [Note 1]	-1,15,333	-74,489	-47,739	-30,290	-18,964
PBT	-15,333	25,511	52,261	69,710	81,036
Less: Tax @ 50%	7,667	-12,756	-26,131	-34,855	-40,518
PAT	-7,666	12,755	26,130	34,855	40,518
Add: Depreciation	1,15,333	74,489	47,739	30,290	18,964
CFAT	1,07,667	87,244	73,869	65,145	59,482

Note 1: Computation of incremental depreciation:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Existing machine:					
Opening WDV	90,000	72,000	57,600	46,080	36,864
Less: Depreciation	-18,000	-14,400	-11,520	-9,216	-7,373
Closing WDV	72,000	57,600	46,080	36,864	29,491
New Machine:					
Opening WDV	4,00,000	2,66,667	1,77,778	1,18,519	79,013
Less: Depreciation	-1,33,333	-88,889	-59,259	-39,506	-26,337
Closing WDV	2,66,667	1,77,778	1,18,519	79,013	52,676
Incremental depreciation	1,15,333	74,489	47,739	30,290	18,964

WN 3: Terminal flow:

Particulars	Existing	New
NSV of asset in year 5	-	2,50,000
Working capital released	-	0
Total terminal flow	-	2,50,000

- Incremental terminal flow = 2,50,000 - 0 = Rs.2,50,000

WN 4: Consolidation of relevant cash flows:

Year	Incremental
0	-3,10,000
1	1,07,667
2	87,244
3	73,869
4	65,145
5	3,09,482
5	[59,482 + 2,50,000]

15. Type 1 - Replacement Decision:

MNP Limited is thinking of replacing its existing machine by a new machine, which would cost Rs.60 lakhs. The company's current production is 80,000 units, and is expected to increase to 1,00,000 units, if the new machine is bought. The selling price of the product would remain unchanged at Rs.200 per unit. The following is the cost of production one unit of product using both the existing and new machine:

	Existing Machine (80,000 units)	New Machine (1,00,000 units)	Unit cost (Rs.) Difference
Materials	75.00	63.75	(11.25)
Wages & Salaries	51.25	37.50	(13.75)
Supervision	20.00	25.00	5.00
Repairs and Maintenance	11.25	7.50	(3.75)
Power and Fuel	15.50	14.25	(1.25)
Depreciation	0.25	5.00	4.75
Allocated Corporate Overheads	10.00	12.50	2.50
	183.25	165.50	(17.75)

The existing machine has an accounting book value of Rs.1,00,000 and it has been fully depreciated for tax purpose. It is estimated that machine will be useful for 5 years. The supplier of the new machine has offered

to accept the old machine for Rs.2,50,000. However, the market price of old machine today is Rs.1,50,000 and it is expected to be Rs.35,000 after 5 year. The new machine has a life of 5 years and a salvage value of Rs.2,50,000 at the end of its economic life. Assume corporate Income-tax rate at 40% and depreciation is charged on straight line basis for Income-tax purpose. The opportunity cost of capital of the Company is 15%.

Required:

Estimate net present value of the replacement decision.

Answer:**WN 1: Initial outflow**

Particulars	Amount
NSV of existing machine on day 0 [Note 1]	1,50,000
Working capital blocked	0
Capital expenditure	(60,00,000)
Total outflow	(58,50,000)

Note 1: Computation of NSV of existing machine on day 0:

Particulars	Amount
Sale value	2,50,000
Less: Book value	0
Capital gain	2,50,000
Tax paid @ 40%	1,00,000
Net salvage value	1,50,000

- Asset has been fully depreciated under Income Tax Act and hence the book value will be taken as zero for computing capital gains

WN 2: In-between flows:

Particulars	Existing	New
Sales	1,60,00,000	2,00,00,000
Less: Material cost	-60,00,000	-63,75,000
Less: Wages and salaries	-41,00,000	-37,50,000
Less: Supervision	-16,00,000	-25,00,000
Less: Repairs and maintenance	-9,00,000	-7,50,000
Less: Power and fuel	-12,40,000	-14,25,000
Less: Allocated corporate Overheads	-	-
PBDT	21,60,000	52,00,000
Less: Depreciation	-	-11,50,000
PBT	21,60,000	40,50,000
Less: Tax @ 40%	-8,64,000	-16,20,000
PAT	12,96,000	24,30,000
Add: Depreciation	-	11,50,000
CFAT	12,96,000	35,80,000

Note:

- Allocated corporate overheads are an irrelevant expenditure and hence not considered in cash flow computation
- Depreciation has been computed as per Income Tax Act and not companies' books

WN 3: Terminal flow:

Particulars	Existing	New
NSV of asset in year 5	21,000	2,50,000
Working capital released	0	0
Total terminal flow	21,000	2,50,000

Particulars	Existing	New
Sale value	35,000	2,50,000

Less: Book value	0	2,50,000
Capital gain/loss	35,000	0
Tax paid/saved @ 40%	14,000	0
Net salvage value	21,000	2,50,000

WN 4: Computation of incremental cash flows and NPV:

Year	Existing	New	Incremental	PVF @ 15%	DCF
0	-1,50,000	-60,00,000	-58,50,000	1.0000	-58,50,000
1 to 5	12,96,000	35,80,000	22,84,000	3.3522	76,56,425
5	21,000	2,50,000	2,29,000	0.4972	1,13,859
Incremental NPV					19,20,284

Conclusion: The company should go ahead with replacement decision as the project generates positive NPV of Rs.19,20,284.

16. Type 1 - Replacement Decision [Homework]

WX Limited has a machine which has been in operation for 3 years. Its remaining estimated useful life is 5 years with no salvage value in the end. Its current market value is Rs.2,00,000. The company is considering a proposal to purchase a new model of machine to replace the existing machine. The relevant information is as follows:

Particulars	Existing Machine	New Machine
Cost of machine	3,30,000	10,00,000
Estimated life	8 years	5 years
Salvage value	Nil	40,000
Annual output	30,000 units	75,000 units
Selling price per unit	Rs.15	Rs.15
Annual operating hours	3,000	3,000
Material cost per unit	Rs.4	Rs.4
Labour cost per hour	Rs.40	Rs.70
Indirect cash cost per annum	Rs.50,000	Rs.65,000

The company uses written down value of depreciation @ 20% and it has several other machines in the block of assets. The Income tax rate is 30 per cent and it does not make any investment, if it yields less than 12 per cent. Advise whether existing machine is to be replaced or not.

Answer:

WN 1: Initial outflow

Particulars	Amount
NSV of existing machine on day 0	2,00,000
Working capital blocked	-
Capital expenditure	(10,00,000)
Total outflow	(8,00,000)

Note: Capital gain tax is ignored as the company follows block of assets method and there are other assets in the block

WN 2: In-between flows:**Note 1: Computation of incremental PBDT**

Particulars	Existing	New
Sales [Units x SP]	4,50,000	11,25,000
Less: Material cost [Units x Material cost per unit]	-1,20,000	-3,00,000
Less: Labour cost [Hours x Cost per hour]	-1,20,000	-2,10,000
Less: Indirect cash cost	-50,000	-65,000
PBDT	1,60,000	5,50,000

Note:

- Incremental PBDT = 5,50,000 - 1,60,000 = Rs.3,90,000

Note 2: Computation of net increase in asset block to compute incremental depreciation:

Particulars	Calculation	Amount

WDV of existing machine		
Original cost of existing machine		3,30,000
Less: Depreciation of year 1	$3,30,000 \times 20\%$	-66,000
Less: Depreciation of year 2	$66,000 \times 80\%$	-52,800
Less: Depreciation of year 3	$52,800 \times 80\%$	-42,240
WDV of existing machine		1,68,960
Depreciation base of new machine:		
Cost of new machine		10,00,000
Add: WDV of existing machine		1,68,960
Less: Sale value of existing machine		-2,00,000
Depreciation base of new machine		9,68,960
Base for incremental depreciation	$9,68,960 - 1,68,960$	8,00,000
Incremental depreciation of year 1	$8,00,000 \times 20\%$	1,60,000
Incremental depreciation of year 2	$1,60,000 \times 80\%$	1,28,000
Incremental depreciation of year 3	$1,28,000 \times 80\%$	1,02,400
Incremental depreciation of year 4	$1,02,400 \times 80\%$	81,920
Incremental depreciation of year 5	$81,920 \times 80\%$	65,536

Note 3: Computation of cash flows:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
PBDT	3,90,000	3,90,000	3,90,000	3,90,000	3,90,000
Less: Depreciation	-1,60,000	-1,28,000	-1,02,400	-81,920	-65,536
PBT	2,30,000	2,62,000	2,87,600	3,08,080	3,24,464
Less: Tax	-69,000	-78,600	-86,280	-92,424	-97,339
PAT	1,61,000	1,83,400	2,01,320	2,15,656	2,27,125
Add: Depreciation	1,60,000	1,28,000	1,02,400	81,920	65,536
CFAT	3,21,000	3,11,400	3,03,720	2,97,576	2,92,661

WN 3: Terminal flow:

Particulars	Existing	New
NSV of asset in year 5	0	40,000
Working capital released	0	0
Total terminal flow	0	40,000

WN 4: Computation of NPV:

Year	Cash flows	PVF @ 12%	DCF
0	-8,00,000	1.000	-8,00,000
1	3,21,000	0.893	2,86,653
2	3,11,400	0.797	2,48,186
3	3,03,720	0.712	2,16,249
4	2,97,576	0.636	1,89,258
5	3,32,661	0.567	1,88,619
NPV of replacement			3,28,965

Conclusion: The company should go ahead with replacement decision as the project generates positive NPV

17. Concept of EAC [SM] [Concept Revision]

ABC Limited is forced to choose between two machines A and B. The two machines are designed differently, but have identical capacity and do exactly the same job. Machine A costs Rs.1,50,000 and will last for 3 years. It costs Rs.40,000 per year to run. Machine B is an 'economy' model costing only Rs.1, 00,000 but will last only for 2 years, and costs Rs.60,000 per year to run. Ignore tax. Opportunity cost of capital is 10%. Which machine ABC Ltd. should buy?

Answer:

WN 1: Computation of PV of outflow of Machine A and B:

Machine A:

Year	Cash flow	PVF @ 10%	DCF
0	1,50,000	1.000	1,50,000
1 to 3	40,000	2.487	99,480
PV of outflow			2,49,480

Machine B:

Year	Cash flow	PVF @ 10%	DCF
0	1,00,000	1.000	1,00,000
1 to 2	60,000	1.736	1,04,160
PV of outflow			2,04,160

WN 2: Computation of Equated Annual Cost (EAC):

- Life of two projects is different and hence we have to compute EAC

Particulars	Machine A	Machine B
PV of outflow	2,49,480	2,04,160
Life	3 year	2 years
PVAF	2.487	1.736
$EAC = \frac{PV \text{ of outflow}}{PVAF}$	1,00,314	1,17,604

Conclusion: Company should go ahead with Machine A as it has lower Equated Annual Cost.

18. Type 2 - Timing of replacement [SM] [Concept Revision]

X Ltd. is a taxi operator. Each taxi cost to company Rs. 4,00,000 and has a useful life of 3 years. The taxi's operating cost for each of 3 years and salvage value at the end of year is as follows:

	Year 1	Year 2	Year 3
Operating cost	1,80,000	2,10,000	2,38,000
Resale value	2,80,000	2,30,000	1,68,000

You are required to determine the optimal replacement period of taxi if cost of capital of X Ltd. is 10%.

Answer:**PV of outflow and EAC if replaced at end of year 1:**

Year	Cash flow	PVF @ 10%	DCF
0	-4,00,000	1.000	-4,00,000
1	1,00,000 [2,80,000 - 1,80,000]	0.909	90,900
PV of outflow			-3,09,100
Life			1 year
PVAF (1 year and 10%)			0.909
EAC			3,40,044

PV of outflow and EAC if replaced at end of year 2:

Year	Cash flow	PVF @ 10%	DCF
0	-4,00,000	1.000	-4,00,000
1	-1,80,000	0.909	-1,63,620
2	20,000 [2,30,000 - 2,10,000]	0.826	16,520
PV of outflow			-5,47,100
Life			2 years
PVAF (2 years and 10%)			1.735
EAC			3,15,331

PV of outflow and EAC if replaced at end of year 3:

Year	Cash flow	PVF @ 10%	DCF
0	-4,00,000	1.000	-4,00,000
1	-1,80,000	0.909	-1,63,620
2	-2,10,000	0.826	-1,73,460

3	-70,000 [-2,38,000 + 1,68,000]	0.751	-52,570
PV of outflow			-7,89,650
Life			3 years
PVAF (3 years and 10%)			2.486
EAC			3,17,639

Conclusion: The company incurs lowest EAC if taxi is used for 2 years; Hence the optimum replacement cycle to replace taxi in 2 years

19. Type 2 - Timing of replacement:

ABC uses 10% discount rate for project appraisal. It is planning to purchase a machine which has effective life of 3 years. However, the productivity drops and hence the machine can also be replaced at the end of year 1 or year 2. The financial details are as follows:

Year	0	1	2	3
Outlay	-2,00,000			
Revenues		1,80,000	1,60,000	1,40,000
Costs		80,000	70,000	70,000
Scrap value		1,30,000	80,000	30,000

Which is the appropriate replacement cycle? Rework the problem in case the company wants to decide on when to abandon the project?

Answer:

WN 1: Replacement Analysis:

Option 1: Replace at end of year 1:

Year	Cash flow	PVF @ 10%	DCF
0	-2,00,000	1.000	-2,00,000
1	2,30,000 [1,00,000 + 1,30,000]	0.909	2,09,070
NPV			9,070
Life			1 year
PVAF (1 year and 10%)			0.909
EAB			9,978

Option 2: Replace at end of year 2:

Year	Cash flow	PVF @ 10%	DCF
0	-2,00,000	1.000	-2,00,000
1	1,00,000	0.909	90,900
2	1,70,000 [90,000 + 80,000]	0.826	1,40,420
NPV			31,320
Life			2 year
PVAF (2 year and 10%)			1.735
EAB			18,052

Option 3: Replace at end of year 3:

Year	Cash flow	PVF @ 10%	DCF
0	-2,00,000	1.000	-2,00,000
1	1,00,000	0.909	90,900
2	90,000	0.826	74,340
3	1,00,000 [70,000 + 30,000]	0.751	75,100
NPV			40,340
Life			3 years
PVAF (3 years and 10%)			2.486
EAB			16,227

Conclusion: EAB is the highest when machine is replaced at end of year 2. Hence the optimum replacement cycle is of 2 years.

WN 2: Evaluation of abandonment decision:

- EAB approach works when we are planning to repeat the exercise of buying the asset.
- In case of an abandonment decision the company does not plan to buy the machine again and hence the decision should be done on the basis of absolute NPV
- NPV is highest in third option and hence we should abandon the asset at end of year 3

20. Type 2 - Optimum replacement cycle [May 2024, SM] [Homework]

A machine used on a production line must be replaced at least every four years. Costs incurred to run the machine according to its age are:

Age of the Machine (years)					
	0	1	2	3	4
Purchase price (in Rs.)	60,000				
Maintenance (in Rs.)		16,000	18,000	20,000	20,000
Repair (in Rs.)		0	4,000	8,000	16,000
Scrap Value (in Rs.)		32,000	24,000	16,000	8,000

Future replacement will be with identical machine with same cost. Revenue is unaffected by the age of the machine. Ignoring inflation and tax, determine the optimum replacement cycle. PV factors of the cost of capital of 15% for the respective four years are 0.8696, 0.7561, 0.6575 and 0.5718.

Answer:

WN 1: Replacement Analysis:

Option 1: Replace at end of year 1:

Year	Cash flow	PVF @ 15%	DCF
0	-60,000	1.0000	-60,000
1	16,000 [-16,000 + 32,000]	0.8696	13,914
PV of outflow			-46,086
Life			1 year
PVAF (1 year and 15%)			0.8686
EAC			52,997

Option 2: Replace at end of year 2:

Year	Cash flow	PVF @ 15%	DCF
0	-60,000	1.0000	-60,000
1	-16,000	0.8696	-13,914
2	2,000 [-22,000 + 24,000]	0.7561	1,512
PV of outflow			-72,402
Life			2 years
PVAF (2 year and 15%)			1.6257
EAC			44,536

Option 3: Replace at end of year 3:

Year	Cash flow	PVF @ 15%	DCF
0	-60,000	1.0000	-60,000
1	-16,000	0.8696	-13,914
2	-22,000	0.7561	-16,634
3	-12,000 [-28,000 + 16,000]	0.6575	-7,890
PV of outflow			-98,438
Life			3 years
PVAF (3 year and 15%)			2.2832

EAC	43,114

Option 4: Replace at end of year 4:

Year	Cash flow	PVF @ 15%	DCF
0	-60,000	1.0000	-60,000
1	-16,000	0.8696	-13,914
2	-22,000	0.7561	-16,634
3	-28,000	0.6575	-18,410
4	-28,000 [-36,000 + 8,000]	0.5718	-16,010
PV of outflow			-1,24,968
Life			4 years
PVAF (4 years and 15%)			2.8550
EAC			43,772

Conclusion: EAC is lowest when machine is replaced at end of year 3. Hence the optimum replacement cycle is of 3 years.

21. Type 2 - Optimal replacement period [SM] [Homework]

Trouble Free Solutions (TFS) is an authorized service center of a reputed domestic air conditioner manufacturing company. All complaints/service related matters of Air conditioner are attended by this service center. The service center employs a large number of mechanics, each of whom is provided with a motor bike to attend the complaints. Each mechanic travels approximately 40000 kms per annum. TFS decides to continue its present policy of always buying a new bike for its mechanics but wonders whether the present policy of replacing the bike every three year is optimal or not. It is of believe that as new models are entering into market on yearly basis, it wishes to consider whether a replacement of either one year or two years would be better option than present three year period. The fleet of bike is due for replacement shortly in near future.

The purchase price of latest model bike is Rs. 55,000. Resale value of used bike at current prices in market is as follows:

Period	Rs.
1 Year old	35,000
2 Year old	21,000
3 Year old	9,000

Running and Maintenance expenses (excluding depreciation) are as follows:

Year	Road Taxes Insurance etc. (Rs.)	Petrol Repair Maintenance etc. (Rs.)
1	3,000	30,000
2	3,000	35,000
3	3,000	43,000

Using opportunity cost of capital as 10% you are required to determine optimal replacement period of bike.

Answer:

WN 1: Replacement Analysis:**Option 1: Replace at end of year 1:**

Year	Cash flow	PVF @ 10%	DCF
0	-55,000	1.000	-55,000
1	2,000 [35,000 - 33,000]	0.909	1,818
PV of outflow			-53,182
Life			1 year
PVAF (1 year and 10%)			0.909
EAC			58,506

Option 2: Replace at end of year 2:

Year	Cash flow	PVF @ 10%	DCF
0	-55,000	1.000	-55,000
1	-33,000	0.909	-29,997
2	-17,000 [21,000 – 38,000]	0.826	-14,042
PV of outflow			-99,039
Life			2 years
PVAF (2 year and 10%)			1.735
EAC			57,083

Option 3: Replace at end of year 3:

Year	Cash flow	PVF @ 10%	DCF
0	-55,000	1.000	-55,000
1	-33,000	0.909	-29,997
2	-38,000	0.826	-31,388
3	-37,000 -46,000 + 9,000]	0.751	-27,787
PV of outflow			-1,44,172
Life			3 years
PVAF (3 year and 10%)			2.486
EAC			57,993

Conclusion: EAC is lowest if replacement is done at end of two years and hence the optimal replacement period is 2 years.

22. Type 3 - Optimum replacement time [SM] [Concept Revision]

A & Company is contemplating whether to replace an existing machine or to spend money on overhauling it. A & Company currently pays no taxes. The replacement machine costs Rs.90,000 now and requires maintenance of Rs 10,000 at the end of every year for eight years. At the end of eight years it would have a salvage value of Rs. 20,000 and would be sold. The existing machine requires increasing amounts of maintenance each year and its salvage value falls each year as follows;

Year	Maintenance cost	Salvage value
Today	0	40,000
1	10,000	25,000
2	20,000	15,000
3	30,000	10,000
4	40,000	0

The opportunity cost of capital for A & Company is 15%. When should the company replace the machine?

Answer:

WN 1: Computation of Equated Annual Cost of New Machine:

Year	Cash flow	PVF @ 15%	DCF
0	-90,000	1.000	-90,000
1 to 8	-10,000	4.487	-44,870
8	20,000	0.327	6,540
PV of outflow			-1,28,330
Life			8 years
PVAF (8 years and 15%)			4.487
EAC			28,600

WN 2: Evaluation of optimum replacement time:

- The machine can be replaced today or at end of each of the next four years. We should compute the amount of PV of outflow to decide the optimum option

Replace immediately:

- Old machine would be used for 0 years and new machine would be used for 4 years. (New machine has utility even beyond 4 years but we restrict our cash flow analysis only for first four years to compare the cash flows across multiple options)

Year	Cash flow	PVF @ 15%	DCF
0	40,000	1.000	40,000
1 to 4	-28,600	2.855	-81,653
PV of outflow			-41,653

Replace at end of year 1:

- Old machine would be used for 1 years and new machine would be used for 3 years.

Year	Cash flow	PVF @ 15%	DCF
1	15,000 [-10,000 + 25,000]	0.870	13,050
2 to 4	-28,600	1.985	-56,771
PV of outflow			-43,721

Replace at end of year 2:

- Old machine would be used for 2 years and new machine would be used for 2 years.

Year	Cash flow	PVF @ 15%	DCF
1	-10,000	0.870	-8,700
2	-5,000 [-20,000 + 15,000]	0.756	-3,780
2 to 4	-28,600	1.229	-35,149
PV of outflow			-47,629

Replace at end of year 3:

- Old machine would be used for 3 years and new machine would be used for 1 years.

Year	Cash flow	PVF @ 15%	DCF
1	-10,000	0.870	-8,700
2	-20,000	0.756	-15,120
3	-20,000 [-30,000 + 10,000]	0.658	-13,160
4	-28,600	0.572	-16,359
PV of outflow			-53,339

Replace at end of year 4:

- Old machine would be used for 4 years and new machine would be used for 0 years.

Year	Cash flow	PVF @ 15%	DCF
1	-10,000	0.870	-8,700
2	-20,000	0.756	-15,120
3	-30,000	0.658	-19,740
4	-40,000	0.572	-22,880
PV of outflow			-66,440

Conclusion:

- Machine should be replaced immediately as the same has lowest PV of outflow.

23. Type 3 - Optimum replacement time [SM]

Company Y is operating an elderly machine that is expected to produce a net cash inflow of Rs. 40,000 in the coming year and Rs. 40,000 next year. Current salvage value is Rs. 80,000 and next year's value is Rs. 70,000. The machine can be replaced now with a new machine, which costs Rs. 1,50,000, but is much more efficient and will provide a cash inflow of Rs. 80,000 a year for 3 years. Company Y wants to know whether it should replace the equipment now or wait a year with the clear understanding that the new machine is the best of the available alternatives and that it in turn be replaced at the optimal point. Ignore tax. Take opportunity cost of capital as 10 per cent. Advise with reasons.

Answer:

WN 1: Identification of alternatives:

- Alternative 1 – Replace the machine today
- Alternative 2 – Replace the machine at the end of year 1

WN 2: Evaluation of Alternative 1:

Year	CF	PVF @ 10%	DCF
0	-70,000	1.000	-70,000
1	80,000	0.909	72,720
2	80,000	0.826	66,080
3	80,000	0.751	60,080
NPV			1,28,880

Note:

- Cash flow in year 0 = Purchase price of new machine of Rs.1,50,000 – Sale value of old machine of Rs.80,000 = Net outflow of Rs.70,000

WN 3: Evaluation of Alternative 2:

Year	CF	PVF @ 10%	DCF
0	-	1.000	-
1	-40,000	0.909	-36,360
2	80,000	0.826	66,080
3	80,000	0.751	60,080
4	80,000	0.683	54,640
NPV			1,44,440

Note:

- No cash flow in year 0 as the replacement is not done immediately
- Old machine will be used for one year and then replaced at end of year 1. Cash flow of year 1 = Inflow of Rs.40,000 from old machine + Sale value of Rs.70,000 of old machine – purchase price of Rs.1,50,000 of new machine = -40,000

WN 4: Selection of Alternative:**ICAI Solution:**

- Since Total NPV is higher in case of Replacement after one year Machine should be replaced after 1 year.

Author Solution (Logical Solution)

- Alternative 1 has life of 3 years whereas Alternative 2 has life of 4 years. Selection of alternative will be based on equated annual benefit

Particulars	Alt 1	Alt 2
NPV	1,28,880	1,44,440
Life	3 years	4 years
PVAF	2.486	3.169
EAB [NPV/PVAF]	51,842	45,579

Conclusion: Company should go ahead with Alternative 1 as it has higher Equated Annual Benefit and the machine should be replaced immediately.

Part 4 – Long-term funds versus equity approach**24. Project IRR and Equity IRR**

XYZ Ltd., an infrastructure company is evaluating a proposal to build, Operate and Transfer a section of 35kms of road at a project cost of Rs 200 Cr. to be financed as follows: Equity share capital Rs50 Cr. loans at the rate of interest of 15%p.a from financial Institutions Rs150 Cr. The project after completion will be opened to traffic and a toll will be collected for a period of 15 years from the vehicles using the road. The company is also required to maintain the road during the above 15 years and after the collections of that Period; it will be handed over to the highway authorities at zero value. It is estimated that the toll revenue will be Rs. 50 Cr. per annum and the annual toll collection expenses including maintenance of the road will amount 5%p.a of the project cost. The company considers to write-off the total cost of the project straight line basis. For corporate income-tax purposes the company is allowed to take depreciation @10% on WDV basis. The

financial institutions are agreeable for the repayment of the loan in 15 equal annual instalment consisting of principal and interest. Calculate project IRR and Equity IRR. Ignore corporate taxation.

Answer:

WN 1: Computation of cash flows:

Particulars	Long-term funds	Equity shareholders
Initial outflow:		
Capital expenditure	-200.00	-200.00
New loans taken	0.00	150.00
Net outflow	-200.00	-50.00
In-between cash flow:		
Toll revenues	50.00	50.00
Less: Toll expenses	-10.00	-10.00
Less: Annual loan repayment (Note 1)	0.00	-25.65
Net cash inflow	40.00	14.35

Note 1: Computation of annual loan repayment:

$$\text{Equated loan instalment} = \frac{\text{Loan Amount}}{\text{PVA}(15\%, 15 \text{ years})} = \frac{150}{5.84737} = 25.65 \text{ Crores}$$

WN 2: Computation of Project IRR (using long-term funds approach):

Year	Cash flow	PVF @ 18%	DCF	PVF @ 20%	DCF
0	-200.00	1.000	-200.00	1.000	-200.00
1 to 15	40.00	5.092	203.68	4.675	187.00
NPV			3.68		-13.00

$$\text{Project IRR} = 18 + \left(\frac{3.68}{3.68 - (-13.00)} \times (20 - 18) \right) = 18 + 0.44 = 18.44\%$$

WN 3: Computation of Equity IRR (using Equity shareholders cash flows)

Year	Cash flow	PVF @ 28%	DCF
0	-50.00	1.000	-50.00
1 to 15	14.35	3.483	50.00
NPV			0.00

Equity IRR = 28.00%

Part 5 - Adjusted Present Value

25. Adjusted Present Value

A Project involves an initial capital expenditure of Rs.10,00,000. The annual CFAT is Rs.2,00,000 for the next 10 years. The opportunity cost of capital is 12% which reflects the project's business risk. Issue costs are 5% of the gross proceeds of the issue. The firm can borrow upto Rs.5,00,000. The cost of debt is 6% and is payable in 10 equal annual installments of principal. Tax rate is 50%.

- Compute base case NPV
- Compute adjusted NPV

Answer:

WN 1: Computation of base-case NPV:

- Base case NPV is computed by discounting the cash flows at cost of equity assuming the project is fully funded with equity

Year	Cash flow	PVF @ 12%	DCF
0	-10,00,000	1.000	-10,00,000
1 to 10	2,00,000	5.650	11,30,000
NPV			1,30,000

WN 2: Computation of adjusted NPV:

- Adjusted NPV = Base case NPV - Issue costs + PV of financing benefit
- Adjusted NPV = 1,30,000 - 52,632 + 65,992 = Rs.1,43,360

Note 1: Computation of issue costs:

- Issue costs has been considered on the entire amount raised (debt + equity). We can alternatively consider issue costs only for the debt component.
- Issue cost is 5% of gross proceeds. Hence net amount raised is 95%
- Issue costs = $10,00,000 \times (5/95) = \text{Rs.}52,632$

Note 2: Computation of PV of financing benefit:

Year	Opening balance	Interest	Principal repayment	Closing balance	Tax saved	PVF @ 6%	DCF
1	5,00,000	30,000	50,000	4,50,000	15,000	0.943	14,145
2	4,50,000	27,000	50,000	4,00,000	13,500	0.890	12,015
3	4,00,000	24,000	50,000	3,50,000	12,000	0.840	10,080
4	3,50,000	21,000	50,000	3,00,000	10,500	0.792	8,316
5	3,00,000	18,000	50,000	2,50,000	9,000	0.747	6,723
6	2,50,000	15,000	50,000	2,00,000	7,500	0.705	5,288
7	2,00,000	12,000	50,000	1,50,000	6,000	0.665	3,990
8	1,50,000	9,000	50,000	1,00,000	4,500	0.627	2,822
9	1,00,000	6,000	50,000	50,000	3,000	0.592	1,776
10	50,000	3,000	50,000	-	1,500	0.558	837
PV of tax saved on interest							65,992

- **Tax saving on interest is discounted at pre-tax cost of debt.** This is because tax saving comes from the debt instrument and should be discounted at the risk seen in the debt. In this case investor are expecting interest of 6 percent and hence the risk associated with debt is of 6 percent.

26. Adjusted Net Present Value Method [Nov 2020, May 2023 MTP, Nov 2024 RTP] [Concept Revision]

The Management of a multinational company TL Ltd. is engaged in construction of Infrastructure Project. A proposal to construct a Toll Road in Nepal is under consideration of the Management.

The following information is available:

- The initial investment will be in purchase of equipment costing USD 250 lakhs. The economic life of the equipment is 10 years. The depreciation on the equipment will be charged on straight line method.
- EBIDTA to be collected from the Toll Road is projected to be USD 33 lakhs per annum for a period of 20 years.
- To encourage investment Nepalese government is offering a 15 year term loan of USD 150 lakhs at an interest rate of 6 per cent per annum. The interest is to be paid annually. The loan will be repaid at the end of 15 year in one tranche.
- The required rate of return for the project under all equity financing is 12 per cent per annum.
- Post tax cost of debt is 5.6 per cent per annum. Corporate Tax Rate is 30 per cent. All cash Flows will be in USD. Ignore inflation.

You are required to advise the management on the viability of the proposal by using Adjusted Net Present Value method.

Given PVIFA (12%, 10) = 5.650, PVIFA (12%, 20) = 7.469, PVIFA (8%,15) = 8.559, PVIF (8%, 15) = 0.315

Note: Make calculations in USD Lakhs and round off them upto 3 decimal points.

Answer:

Adjusted NPV = Base case NPV – Issue costs + PV of financing benefits

WN 1: Computation of Base case NPV:

- Base case NPV of the project is computed as if the project is solely funded out of equity.

Computation of cash flows:

Particulars	Year 1 to 10	Year 11 to 20
EBITDA	33.00	33.00
Less: Depreciation	-25.00	-

EBIT/EBT	8.00	33.00
Less: Tax @ 30%	-2.40	-9.90
EAT	5.60	23.10
Add: Depreciation	25.00	-
CFAT	30.60	23.10

Base Case NPV computation:**(in lacs)**

Year	Cash flow	PVF @ 12%	DCF
0	-250.00	1.000	-250.000
1 to 10	30.60	5.650	172.89
11 to 20	23.10	1.819	42.019
Base Case NPV			-35.091

WN 2: PV of financing benefits:**ICAI Solution in Nov 2024 RTP – Incorrect solution according to me**

Particulars	Period	USD lacs	PVF @ 8%	PV (USD Lacs)
Tax saving on interest	1 to 15	2.70	8.559	23.109
PV of financing benefit				23.109

- Adjusted Present Value of the Project = Base NPV + PV of Tax Shield on Interest
- APV = - US\$ 35.091 + US \$ 23.109 lakh = - US\$ 11.982 lakh
- Advise: Since APV is negative, TL Ltd. should not accept the project.**

ICAI Solution in Nov 2020 Suggested answers – Logical solution according to me:

- In this case the normal interest rate on borrowing is 8% (5.6/70%). However, the company has borrowed loan at 6 percent and hence company saves interest of 2 percent as well as get tax saving on interest. The same is being calculated as under:

Particulars	Period	USD lacs	PVF @ 8%	PV (USD Lacs)
Tax saving on interest	1 to 15	2.70	8.559	23.109
Interest saving [150 lacs x 2%]	1 to 15	3.00	8.559	25.677
PV of financing benefit				48.786

WN 3: Adjusted NPV

- Adjusted NPV = Base case NPV + PV of financing benefits
- Adjusted NPV = -35.090 + 48.786 = 13.696 lacs
- The company can go ahead with the project as the adjusted NPV is positive at USD 13.696 lacs

Part 6 – Inflation in capital budgeting**27. Inflation (May 2013 RTP, SM)**

Shashi Co. Limited has projected the following cash flows from a project under evaluation:

Year	0	1	2	3
Cash flow (in '000s)	(72)	30	40	30

The above cash flows have been made at expected prices after recognizing inflation. The firm's cost of capital is 10%. The expected annual rate of inflation is 5%. State how the viability of the project is to be evaluated.

Answer:

- It is assumed that cost of capital given in question is real discount rate
- Cash flows given are in money terms and hence we will need money discount rate to compute NPV
- $(1 + \text{RDR}) \times (1 + \text{Inflation Rate}) = (1 + \text{MDR})$
- $(1 + 10\%) \times (1 + 5\%) = (1 + \text{MDR})$
- Money discount rate = 15.50%

Computation of NPV:

Year	Cash flow	PVF @ 15.50%	DCF
0	-72,000	1.000	-72,000
1	30,000	0.866	25,980
2	40,000	0.750	30,000

3	30,000	0.649	19,470
NPV			3,450

- Project has positive NPV and hence the company can go ahead with the project.

28. Inflation [SM]

Determine NPV of the project with the following information:

Initial Outlay of project	Rs.40,000
Annual revenues (Without inflation)	Rs.30,000
Annual costs excluding depreciation (Without inflation)	Rs.10,000
Useful life	4 years
Salvage value	Nil
Tax rate	50%
Cost of capital (including inflation premium of 10%)	12%

Answer:

WN 1: Computation of nominal cash flows:

Year	Real cash flow	Calculation	Nominal Cash flow
1	15,000	$15,000 \times 1.10$	16,500
2	15,000	$15,000 \times 1.10 \times 1.10$	18,150
3	15,000	$15,000 \times 1.10 \times 1.10 \times 1.10$	19,965
4	15,000	$15,000 \times 1.10 \times 1.10 \times 1.10 \times 1.10$	21,962

Note 1: Computation of real cash flow:

Particulars	Amount
Revenues	30,000
Less: Costs	-10,000
Less: Depreciation	-10,000
Profit before tax	10,000
Less: Tax @ 50%	-5,000
Profit after tax	5,000
Add: Depreciation	10,000
Cash flow after tax	15,000

WN 2: Computation of NPV:

Year	Cash flow	PVF @ 12%	DCF
0	-40,000	1.000	-40,000
1	16,500	0.893	14,735
2	18,150	0.797	14,466
3	19,965	0.712	14,215
4	21,962	0.636	13,968
NPV			17,384

Note: Alternatively, we can adjust the discount rate to real discount rate and compute NPV using real cash flows.

29. Inflation [SM] [Concept Revision]

XYZ Ltd. requires Rs.8,00,000 for a new project. Useful life of project - 4 years. Salvage value -Nil. Depreciation Charge Rs.2,00,000 p.a. Expected revenues & costs (excluding depreciation) ignoring inflation.

Year	1	2	3	4
Revenues	6,00,000	7,00,000	8,00,000	8,00,000
Costs	3,00,000	4,00,000	4,00,000	4,00,000

If applicable Tax Rate is 60% and cost of capital is 10% then calculate NPV of the project, if inflation rates for revenues & costs are as follows:

Year	Revenues	Costs
1	10%	12%
2	9%	10%
3	8%	9%

4	7%	8%

Answer:**WN 1: Computation of inflation adjusted revenues:**

- It is assumed that cost of capital given in the question is nominal discount rate. Cash flows given in the question are real cash flows and hence we should convert the same into nominal cash flows by compounding at inflation rate

Year	Cash flow	Inflation rate	Calculation	Inflation adjusted cash flows
1	6,00,000	10%	$6,00,000 \times (1+10\%)$	6,60,000
2	7,00,000	9%	$7,00,000 \times (1+10\%) \times (1+9\%)$	8,39,300
3	8,00,000	8%	$8,00,000 \times (1+10\%) \times (1+9\%) \times (1+8\%)$	10,35,936
4	8,00,000	7%	$8,00,000 \times (1+10\%) \times (1+9\%) \times (1+8\%) \times (1+7\%)$	11,08,452

WN 2: Computation of inflation adjusted outflows:

Year	Cash flow	Inflation rate	Calculation	Inflation adjusted outflows
1	3,00,000	12%	$3,00,000 \times (1+12\%)$	3,36,000
2	4,00,000	10%	$4,00,000 \times (1+12\%) \times (1+10\%)$	4,92,800
3	4,00,000	9%	$4,00,000 \times (1+12\%) \times (1+10\%) \times (1+9\%)$	5,37,152
4	4,00,000	8%	$4,00,000 \times (1+12\%) \times (1+10\%) \times (1+9\%) \times (1+8\%)$	5,80,124

WN 3: Computation of cash flows after tax:

Particulars	Year 1	Year 2	Year 3	Year 4
Revenues	6,60,000	8,39,300	10,35,936	11,08,452
Less: Costs	-3,36,000	-4,92,800	-5,37,152	-5,80,124
PBDT	3,24,000	3,46,500	4,98,784	5,28,328
Less: Depreciation	-2,00,000	-2,00,000	-2,00,000	-2,00,000
PBT	1,24,000	1,46,500	2,98,784	3,28,328
Less: Tax	-74,400	-87,900	-1,79,270	-1,96,997
PAT	49,600	58,600	1,19,514	1,31,331
Add: Depreciation	2,00,000	2,00,000	2,00,000	2,00,000
CFAT	2,49,600	2,58,600	3,19,514	3,31,331

WN 4: Computation of NPV:

Year	Cash flow	PVF @ 10%	DCF
0	-8,00,000	1.000	-8,00,000
1	2,49,600	0.909	2,26,886
2	2,58,600	0.826	2,13,604
3	3,19,514	0.751	2,39,955
4	3,31,331	0.683	2,26,299
NPV			1,06,744

Part 7 – Expected NPV, Standard Deviation and co-efficient of variation**30. Calculation of NPV and Standard Deviation [SM]**

Shivam Ltd. is considering two mutually exclusive projects A and B. Project A costs Rs. 36,000 and project B Rs. 30,000. You have been given below the net present value probability distribution for each project.

Project A		Project B	
NPV estimate	Probability	NPV estimate	Probability
15,000	0.2	15,000	0.1
12,000	0.3	12,000	0.4
6,000	0.3	6,000	0.4
3,000	0.2	3,000	0.1

- ❖ Compute the expected net present values of projects A and B.
- ❖ Compute the risk attached to each project i.e. standard deviation of each probability distribution.
- ❖ Compute the profitability index of each project.
- ❖ Which project do you recommend? State with reasons.

Answer:

WN 1: Computation of risk and return of Project A:

(in '000s)

NPV	Probability	Product	Deviation	Pd ²
15	0.20	3.00	6.00	7.20
12	0.30	3.60	3.00	2.70
6	0.30	1.80	-3.00	2.70
3	0.20	0.60	-6.00	7.20
Total		9.00		19.80

- Product = NPV x Probability
- Deviation = Column 1 – Sum of product
- Column 5 = Product x Deviation x Deviation

Risk and return:

Expected NPV	Sum of products	9,000
Standard deviation	$\sqrt{Pd^2} = \sqrt{19.80}$	4,450

WN 2: Computation of risk and return of Project B:

(in '000s)

NPV	Probability	Product	Deviation	Pd ²
15	0.10	1.50	6.00	3.60
12	0.40	4.80	3.00	3.60
6	0.40	2.40	-3.00	3.60
3	0.10	0.30	-6.00	3.60
Total		9.00		14.40

Risk and return:

Expected NPV	Sum of products	9,000
Standard deviation	$\sqrt{Pd^2} = \sqrt{14.40}$	3,795

WN 3: Computation of Profitability index

$$\text{Profitability Index} = \frac{\text{PV of Inflow}}{\text{PV of outflow}}$$

Particulars	Project A	Project B
PV of outflow	36,000	30,000
NPV	9,000	9,000
PV of inflow (NPV + Outflow)	45,000	39,000
Profitability Index (Inflow/Outflow)	1.25 Times	1.30 Times

Selection of project:

- Measurement of risk is made by the possible variation of outcomes around the expected value and the decision will be taken in view of the variation in the expected value where two projects have the same expected value, **the decision will be the project which has smaller variation in expected value.**

- In the selection of one of the two projects A and B, **Project B is preferable** because the possible profit which may occur is subject to less variation (or dispersion). Much higher risk is lying with project A.

31. Co-efficient of variation calculation [SM]

A company is considering projects X and Y with following information:

Project	Expected NPV	Standard Deviation
X	1,22,000	90,000
Y	2,25,000	1,20,000

- ❖ Which project will you recommend based on the above data?
- ❖ Explain whether your opinion will change, if you use co-efficient of variation as a measure of risk
- ❖ Which measure is more appropriate in this situation and why?

Answer:

Part 1:

- Selection of project will depend on risk appetite of the investor
- An aggressive investor would focus on increasing the returns and he would go for Project Y as it has higher returns
- A conservative investor would focus on reducing the risk and he would go for Project X as it has lower risk

Part 2: Computation of co-efficient of variation:

Particulars	Project X	Project Y
Risk (A)	90,000	1,20,000
Return (B)	1,22,000	2,25,000
Co-efficient of variation (A/B)	0.7377	0.5333

- The company should go ahead with Project Y as it has lower co-efficient of variation.

Part 3:

However, the NPV method in such conflicting situation is best because the NPV method is in compatibility of the objective of wealth maximisation in terms of time value.

32. Co-efficient of variation [Nov 2024 MTP] [Homework]

XYZ Ltd. is considering taking up one of the two projects-Project-X and Project-Y. Both the projects having same life require equal investment of Rs. 1600 lakhs each. Both are estimated to have almost the same yield. As the company is new to this type of business, the cash flow arising from the projects cannot be estimated with certainty. An attempt was therefore, made to use probability to analyse the pattern of cash flow from other projects during the first year of operations. This pattern is likely to continue during the life of these projects. The results of the analysis are as follows:

Project X		Project Y	
Cash flow (lacs)	Probability	Cash Flow (lacs)	Probability
220	0.10	180	0.10
260	0.20	260	0.25
300	0.40	340	0.30
340	0.20	420	0.25
380	0.10	500	0.10

Required: Evaluate which of the two projects bears more risk for every percent of expected return.

Answer:

Project X:

Cash flow (lacs)	Probability	Product	Deviation	Pd ²
220	0.1	22	-80	640
260	0.2	52	-40	320
300	0.4	120	0	0

340	0.2	68	40	320
380	0.1	38	80	640
Total		300		1,920

Expected Cash flow	300 lacs
SD	$\sqrt{1920} = 43.82$ lacs
CV (risk per unit of return)	$\frac{43.82}{300} = 0.1461$ or 14.61%

Project Y:

Cash flow (lacs)	Probability	Product	Deviation	Pd ²
180	0.1	18	-160	2,560
260	0.25	65	-80	1,600
340	0.3	102	0	0
420	0.25	105	80	1,600
500	0.1	50	160	2,560
Total		340		8,320

Expected Cash flow	340 lacs
SD	$\sqrt{8,320} = 91.21$ lacs
CV (risk per unit of return)	$\frac{91.21}{340} = 0.2683$ or 26.83%

Conclusion: Project Y bears more risk for every percent of expected return.

33. Standard Deviation computation: [Nov 2016 RTP, SM] [Concept Revision]

Jet Airways is planning to acquire a light commercial aircraft for flying class clients at an investment of Rs.50,00,000. The expected cash flow after tax for the next three years is as follows:

Year 1		Year 2		Year 3	
CFAT	Probability	CFAT	Probability	CFAT	Probability
14,00,000	0.1	15,00,000	0.1	18,00,000	0.2
18,00,000	0.2	20,00,000	0.3	25,00,000	0.5
25,00,000	0.4	32,00,000	0.4	35,00,000	0.2
40,00,000	0.3	45,00,000	0.2	48,00,000	0.1

The Company wishes to take into consideration all possible risk factor relating to an airline operations. The company wants to know:

1. The expected NPV assuming with 6 % risk free rate of interest.
2. The possible deviation in the expected value
 - a) If the cash flows are independent
 - b) If the cash flows are dependent
3. How would standard deviation of the present value distribution help in Capital Budgeting decisions?

Answer:

WN 1: Computation of expected cash flow and standard deviation of year 1, 2 and 3:

Year 1:

(in lacs)

Cash flow	Probability	Product	Deviation	Pd ²
14	0.1	1.40	-13.00	16.90
18	0.2	3.60	-9.00	16.20
25	0.4	10.00	-2.00	1.60
40	0.3	12.00	13.00	50.70
Total		27.00		85.40

Expected cash flow and SD:

Expected cash flow	Sum of products	27.00
Standard deviation	$\sqrt{Pd^2} = \sqrt{85.40}$	9.24

Year 2:**(in lacs)**

Cash flow	Probability	Product	Deviation	Pd^2
15	0.1	1.50	-14.30	20.45
20	0.3	6.00	-9.30	25.95
32	0.4	12.80	2.70	2.92
45	0.2	9.00	15.70	49.30
Total		29.30		98.62

Expected cash flow and SD:

Expected cash flow	Sum of products	29.30
Standard deviation	$\sqrt{Pd^2} = \sqrt{98.62}$	9.93

Year 3:**(in lacs)**

Cash flow	Probability	Product	Deviation	Pd^2
18	0.2	3.60	-9.90	19.60
25	0.5	12.50	-2.90	4.21
35	0.2	7.00	7.10	10.08
48	0.1	4.80	20.10	40.40
Total		27.90		74.29

Expected cash flow and SD:

Expected cash flow	Sum of products	27.90
Standard deviation	$\sqrt{Pd^2} = \sqrt{74.29}$	8.62

WN 2: Computation of expected NPV:**(in lacs)**

Year	Cash flow	PVF @ 6%	DCF
0	-50.00	1.000	-50.00
1	27.00	0.943	25.46
2	29.30	0.890	26.08
3	27.90	0.840	23.44
Expected NPV			24.98

- Expected NPV = Rs.24,98,000

WN 3: Computation of Standard deviation:

Year	SD	PVF @ 6%	DSD [SD x PVF]	DSD ²
1	9.24	0.943	8.71	75.86
2	9.93	0.890	8.84	78.15
3	8.62	0.840	7.24	52.42
Total			24.79	206.43

Note:

- Dependent cash flows are considered to be riskier. In this case a weak cash flow will always be followed by a weak cash flow and a good cash flow will always be followed by a good cash flow
- Hence SD of dependent cash flows is always higher than cash flows of independent cash flows
- Sum of Discounted standard deviation (Col 4) gives the SD of dependent cash flows
- Column 5 is basically square of column 4. We square the number and sum them. Post this we take a square root. This would be called as SD if cash flows are independent

Expected SD:

SD if cash flows are dependent	Sum of DSD	Rs.24.79 lacs
SD if cash flows are independent	$\sqrt{\text{DSD}^2} = \sqrt{206.43}$	Rs.14.37 lacs

Utility of Standard Deviation:

- Standard deviation is **a statistical measure of dispersion**; it measures the deviation from a central number i.e. the mean.
- In the context of capital budgeting decisions especially where we **take up two or more projects giving somewhat similar mean cash flows, by calculating standard deviation in such cases**, we can measure in each case the extent of variation. It can then be used to identify which of the projects is least risky in terms of variability of cash flows.
- A project, which has a lower coefficient of variation will be preferred if sizes are heterogeneous.
- Besides this, if we assume that probability distribution is approximately normal we are able to calculate the probability of a capital budgeting project **generating a net present value less than or more than a specified amount.**

34. Selection of project [SM]

Cyber Company is considering two mutually exclusive projects. Investment outlay of both the projects is Rs. 5,00,000 and each is expected to have a life of 5 years. Under three possible situations their annual cash flows and probabilities are as under:

Situation	Probabilities	Cash Flow (Rs.)	
		Project A	Project B
Good	0.30	6,00,000	5,00,000
Normal	0.40	4,00,000	4,00,000
Worse	0.30	2,00,000	3,00,000

The cost of capital is 7 per cent, which project should be accepted? Explain with workings.

Answer:**WN 1: Computation of expected cash flow and standard deviation of every year:****Year 1 to 5 of Project A:****(in lacs)**

Cash flow	Probability	Product	Deviation	Pd ²
6	0.3	1.80	2.00	1.20
4	0.4	1.60	0.00	0
2	0.3	0.60	-2.00	1.20
Total		4.00		2.40

Expected cash flow and SD:

Expected cash flow	Sum of products	4.00
Standard deviation	$\sqrt{\text{Pd}^2} = \sqrt{2.40}$	1.55

Year 1 to 5 of Project B:**(in lacs)**

Cash flow	Probability	Product	Deviation	Pd ²
5	0.3	1.50	1.00	0.30
4	0.4	1.60	0.00	0
3	0.3	0.90	-1.00	0.30

Total		4.00		0.60

Expected cash flow and SD:

Expected cash flow	Sum of products	4.00
Standard deviation	$\sqrt{Pd^2} = \sqrt{0.60}$	0.77

WN 2: Computation of NPV and standard deviation of Project A:**(in lacs)**

Year	Cash flow	PVF @ 7%	DCF
0	-5.00	1.000	-5.00
1 to 5	4.00	4.100	16.40
Expected NPV			11.40

- Expected NPV = Rs.11,40,000

Computation of Standard deviation of Project A:

Year	SD	PVF @ 7%	DSD [SD x PVF]	DSD ²
1	1.55	0.935	1.45	2.10
2	1.55	0.873	1.35	1.82
3	1.55	0.816	1.26	1.59
4	1.55	0.763	1.18	1.39
5	1.55	0.713	1.11	1.23
Total			6.35	8.13

Expected SD:

SD if cash flows are dependent	Sum of DSD	Rs.6.35 lacs
SD if cash flows are independent	$\sqrt{DSD^2} = \sqrt{8.13}$	Rs.2.85 lacs

WN 3: Computation of NPV and standard deviation of Project B:**(in lacs)**

Year	Cash flow	PVF @ 7%	DCF
0	-5.00	1.000	-5.00
1 to 5	4.00	4.100	16.40
Expected NPV			11.40

- Expected NPV = Rs.11,40,000

Computation of Standard deviation of Project A:

Year	SD	PVF @ 7%	DSD [SD x PVF]	DSD ²
1	0.77	0.935	0.72	0.52
2	0.77	0.873	0.67	0.45
3	0.77	0.816	0.63	0.40
4	0.77	0.763	0.59	0.35
5	0.77	0.713	0.55	0.30
Total			3.16	2.02

Expected SD:

SD if cash flows are dependent	Sum of DSD	Rs.3.16 lacs
SD if cash flows are independent	$\sqrt{DSD^2} = \sqrt{2.02}$	Rs.1.42 lacs

Conclusion:

NPV in both projects being the same, the project should be decided on the basis of standard deviation and hence project 'B' should be accepted having lower standard deviation, means less risky.

35. NPV and Standard Deviation [SM] [Homework]

KLM Ltd., is considering taking up one of the two projects-Project-K and Project-S. Both the projects having same life require equal investment of Rs. 80 lakhs each. Both are estimated to have almost the same yield. As the company is new to this type of business, the cash flow arising from the projects cannot be estimated with certainty. An attempt was therefore, made to use probability to analyse the pattern of cash flow from other projects during the first year of operations. This pattern is likely to continue during the life of these projects. The results of the analysis are as follows:

Project K		Project S	
Cash Flow (in Rs.)	Probability	Cash Flow (in Rs.)	Probability
11	0.1	9	0.1
13	0.2	13	0.25
15	0.4	17	0.3
17	0.2	21	0.25
19	0.1	25	0.1

Required:

- Calculate variance, standard deviation and co-efficient of variance for both the projects.
- Which of the two projects is riskier?

Answer:

WN 1: Computation of Variance, SD and Co-efficient of variation or Project K

Cash flow	Probability	Product	Deviation	Pd ²
11	0.1	1.1	-4	1.6
13	0.2	2.6	-2	0.8
15	0.4	6	0	0
17	0.2	3.4	2	0.8
19	0.1	1.9	4	1.6
Total		15		4.8

Solution:

Expected cash flow	Sum of products	15.00
Variance		4.80
Standard deviation	$\sqrt{Pd^2} = \sqrt{4.80}$	2.19
Co-efficient of variation	$\frac{2.19}{15.00}$	0.146

WN 2: Computation of Variance, SD and Co-efficient of variation or Project S

Cash flow	Probability	Product	Deviation	Pd ²
9	0.10	0.90	-8.00	6.40
13	0.25	3.25	-4.00	4.00
17	0.30	5.10	0.00	0.00
21	0.25	5.25	4.00	4.00
25	0.10	2.50	8.00	6.40
Total		17.00		20.80

Solution:

Expected cash flow	Sum of products	17.00
Variance		20.80
Standard deviation	$\sqrt{Pd^2} = \sqrt{20.80}$	4.56

Co-efficient of variation	$\frac{4.56}{17.00}$	0.268

Project S is riskier as it has higher Coefficient of Variation

36. NPV and standard deviation [May 2019 MTP, Nov 2019, May 2018 RTP, SM] [Homework]

Project X and Project Y are under the evaluation of XY company. The estimated cash flows and their probabilities are as below:

Project X: Investment of Rs.70 lacs in year 0

Probability weights	0.30	0.40	0.30
Years	Rs.Lacs	Rs.Lacs	Rs.Lacs
1	30	50	65
2	30	40	55
3	30	40	45

Project Y: Investment of Rs.80 lacs in year 0; Life = 3 years

Probability weights	Annual cash flows through life
Years	Rs.Lacs
0.20	40
0.50	45
0.30	50

- Which project is better based on NPV, criterion with a discount rate of 10%?
- Compute the standard deviation of the present value distribution and analyse the inherent risk of the projects

Answer:

WN 1: Computation of expected cash flow and standard deviation of Project X for year 1, 2 and 3:

Year 1:

(in lacs)

Cash flow	Probability	Product	Deviation	Pd ²
30	0.3	9.00	-18.50	102.68
50	0.4	20.00	1.50	0.90
65	0.3	19.50	16.50	81.67
Total		48.50		185.25

Expected cash flow and SD:

Expected cash flow	Sum of products	48.50
Standard deviation	$\sqrt{Pd^2} = \sqrt{185.25}$	13.61

Year 2:

(in lacs)

Cash flow	Probability	Product	Deviation	Pd ²
30	0.3	9.00	-11.50	39.68
40	0.4	16.00	-1.50	0.90
55	0.3	16.50	13.50	54.67
Total		41.50		95.25

Expected cash flow and SD:

Expected cash flow	Sum of products	41.50
Standard deviation	$\sqrt{Pd^2} = \sqrt{95.25}$	9.76

Year 3:

(in lacs)

Cash flow	Probability	Product	Deviation	Pd ²

30	0.3	9.00	-8.50	21.68
40	0.4	16.00	1.50	0.90
45	0.3	13.50	6.50	12.67
Total		38.50		35.25

Expected cash flow and SD:

Expected cash flow	Sum of products	38.50
Standard deviation	$\sqrt{Pd^2} = \sqrt{35.25}$	5.94

WN 2: Computation of expected NPV of Project X:**(in lacs)**

Year	Cash flow	PVF @ 10%	DCF
0	-70.00	1.000	-70.00
1	48.50	0.909	44.09
2	41.50	0.826	34.28
3	38.50	0.751	28.91
Expected NPV			37.28

- Expected NPV = Rs.37,28,000

WN 3: Computation of Standard deviation of Project X:

Year	SD	PVF @ 10%	DSD [SD x PVF]	DSD ²
1	13.61	0.909	12.37	153.02
2	9.76	0.826	8.06	64.96
3	5.94	0.751	4.46	19.89
Total			24.89	237.87

Expected SD:

SD if cash flows are dependent	Sum of DSD	Rs.24.89 lacs
SD if cash flows are independent	$\sqrt{DSD^2} = \sqrt{237.87}$	Rs.15.42 lacs

WN 4: Computation of expected cash flow and standard deviation of Project Y for year 1, 2 and 3:**Year 1 to 3:****(in lacs)**

Cash flow	Probability	Product	Deviation	Pd ²
40	0.2	8.00	-5.50	6.05
45	0.5	22.50	-0.50	0.13
50	0.3	15.00	4.50	6.07
Total		45.50		12.25

Expected cash flow and SD:

Expected cash flow	Sum of products	45.50
Standard deviation	$\sqrt{Pd^2} = \sqrt{12.25}$	3.50

WN 5: Computation of expected NPV of Project Y:**(in lacs)**

Year	Cash flow	PVF @ 10%	DCF
0	-80.00	1.000	-80.00
1 to 3	45.50	2.487	113.16

Expected NPV	33.16

- Expected NPV = Rs.33,16,000

WN 6: Computation of Standard deviation of Project Y:

Year	SD	PVF @ 10%	DSD [SD x PVF]	DSD ²
1	3.50	0.909	3.18	10.11
2	3.50	0.826	2.89	8.35
3	3.50	0.751	2.63	6.92
Total			8.70	25.38

Expected SD:

SD if cash flows are dependent	Sum of DSD	Rs.8.70 lacs
SD if cash flows are independent	$\sqrt{\text{DSD}^2} = \sqrt{25.38}$	Rs.5.04 lacs

37. Best-case and worst-case NPV [SM] [Concept Revision]

Following are the estimates of the net cash flows and probability of a new project of ABC Limited:

	Year	P = 0.3	P = 0.5	P = 0.2
Initial investment	0	4,00,000	4,00,000	4,00,000
Inflows per year	1 to 5	1,00,000	1,10,000	1,20,000
Estimated salvage value (after tax)	5	20,000	50,000	60,000

Required rate of return from the project is 10%. Find:

- The expected NPV of the project.
- The best case and the worst case NPVs.
- The probability of occurrence of the worst case if the cash flows are perfectly dependent overtime and independent overtime.
- Standard deviation and coefficient of variation assuming that there are only three streams of cash flow, which are represented by each column of the table with the given probabilities.
- Coefficient of variation of ABC Limited on its average project which is in the range of 0.95 to 1.0. If the coefficient of variation of the project is found to be less risky than average, 100 basis points are deducted from the Company's cost of Capital Should the project be accepted by ABC Limited

Answer:**WN 1: Computation of different NPV:**

Year	Cash flow			PVF @ 10%	DCF		
	P = 0.3	P = 0.5	P = 0.2		P = 0.3	P = 0.5	P = 0.2
0	-4,00,000	-4,00,000	-4,00,000	1.000	-4,00,000	-4,00,000	-4,00,000
1 to 5	1,00,000	1,10,000	1,20,000	3.791	3,79,100	4,17,010	4,54,920
5	20,000	50,000	60,000	0.621	12,420	31,050	37,260
Total					-8,480	48,060	92,180

WN 2: Computation of expected NPV, SD and Coefficient of variation:

NPV	Probability	Product	Deviation	Pd ²
-8,480	0.30	-2,544	-48,402	70,28,26,081
48,060	0.50	24,030	8,138	3,31,13,522
92,180	0.20	18,436	52,258	54,61,79,712
Total		39,922		128,21,19,315

Risk, return and CV:

Expected NPV [Part i]	Sum of products	39,922
Standard deviation [Part iv]	$\sqrt{\text{Pd}^2} = \sqrt{128,21,19,315}$	35,807
Co-efficient of variation [Part iv]	$\frac{\text{SD}}{\text{NPV}} = \frac{35,807}{39,922}$	0.8969

WN 3: Best case, worst case and Probability Analysis:

- Best case NPV [Part ii] = Rs.92,180 [Maximum of three NPV computed in WN 1]
- Worst case NPV [Part ii] = Rs.-8,480 [Lowest of three NPV computed in WN 1]

Probability:

- **Probability of worst case NPV if cash flows are dependent:** This would mean cash flows of year 2 is dependent on what happens in year 1. Probability of worst cash flow is 0.3 and if the cash flows are dependent then the company would continue to get worst cash flow every year. Hence overall probability of worst case NPV is 30% [0.30]
- **Probability of worst case NPV if cash flows are independent:** In this case there is no dependency between cash flow of one year with another year. We should get worst cash flows in every year to get the worst case NPV. **Probability of worst case NPV = $0.30 \times 0.30 \times 0.30 \times 0.30 \times 0.30 = 0.00243$ (or) 0.243%**

Computation of revised NPV:

- Co-efficient of variation of a typical project is in the range of 0.95 to 1.0. This project has lower co-efficient of variation as reflected in CV of 0.8969
- Lower CV indicates lower risk. Normal project has discount rate of 10% and this project will have discount rate of 9%

Year	Cash flow			PVF @ 9%	DCF		
	P = 0.3	P = 0.5	P = 0.2		P = 0.3	P = 0.5	P = 0.2
0	-4,00,000	-4,00,000	-4,00,000	1.000	-4,00,000	-4,00,000	-4,00,000
1 to 5	1,00,000	1,10,000	1,20,000	3.890	3,89,000	4,27,900	4,66,800
5	20,000	50,000	60,000	0.650	13,000	32,500	39,000
Total					2,000	60,400	1,05,800

- Revised NPV of project = $(2,000 \times 0.30) + (60,400 \times 0.50) + (1,05,800 \times 0.20) = \text{Rs.}51,960$

Conclusion: Project would continue to be accepted as the same makes positive NPV of Rs.51,960.

38. Best and worst case NPV [May 2022 RTP]

ASG Ltd. is considering a project "Z" with an initial outlay of Rs.15,00,000 and life of 5 years. The estimates of project are as follows:

Particulars	Lower estimates	Base	Upper estimates
Sales (units)	9,000	10,000	11,000
	Amount	Amount	Amount
Selling price per unit	175	200	225
Variable cost per unit	100	125	150
Fixed cost	1,00,000	1,50,000	2,00,000

Depreciation included in Fixed cost is Rs.70,000 and corporate tax is 25%. Assuming the cost of capital as 15%, DETERMINE NPV in three scenarios i.e worst, base and best case scenario.

Answer:

Answer:

WN 1: Computation of CFAT under different scenarios:

- Best case = Highest units (11,000), highest SP (225), lowest VC (100) and lowest FC (1,00,000)
- Worst case = Lowest units (9,000), lowest SP (175), highest V (150) and highest FC (2,00,000)
- Base case = As given in question

Particulars	Worst	Base	Best
Sales (units)	9,000	10,000	11,000
Selling price	175	200	225
Less: VC per unit	150	125	100
Contribution per unit	25	75	125
Total Contribution	2,25,000	7,50,000	13,75,000

Less: Fixed cost	-2,00,000	-1,50,000	-1,00,000
Profit before tax	25,000	6,00,000	12,75,000
Less: Tax @ 25%	-6,250	-1,50,000	-3,18,750
Profit after tax	18,750	4,50,000	9,56,250
Add: Depreciation	70,000	70,000	70,000
Cash flow after tax	88,750	5,20,000	10,26,250

WN 2: Computation of NPV:

Particulars	Worst	Base	Best
Initial outlay	15,00,000	15,00,000	15,00,000
Cash inflow per year	88,750	5,20,000	10,26,250
Cumulative PVF for 5 years	3.353	3.353	3.353
PV of cash inflows	2,97,579	17,43,560	34,41,016
NPV	-12,02,421	2,43,560	19,41,016

39. Best case NPV and worst case NPV [Nov 2015 RTP, Nov 2021 MTP, SM] [Homework]

XY Limited has under its consideration a project with an initial investment of Rs.1,00,000. Three probable cash inflow scenarios with their probabilities of occurrence have been estimated as follows:

Annual cash inflow	20,000	30,000	40,000
Probability	0.10	0.70	0.20

The present life is 5 years and the desired rate of return is 20%. The estimated terminal values of the project assets under the three probability alternatives, respectively, are Rs.0, Rs.20,000 and Rs.30,000

You are required to:

- Find the probable NPV
- Find the worst-case NPV and the best-case NPV and
- State the probability occurrence of the worst case, if the cash flows are perfectly positively correlated over time

Answer:**WN 1: Computation of different NPV:**

(in '000s)

Year	Cash flow			PVF @ 20%	DCF		
	P = 0.1	P = 0.7	P = 0.2		P = 0.1	P = 0.7	P = 0.2
0	-100	-100	-100	1.000	-100.00	-100.00	-100.00
1 to 5	20	30	40	2.991	59.82	89.73	119.64
5	0	20	30	0.402	0.00	8.04	12.06
Total					-40.18	-2.23	31.70

WN 2: Computation of probable NPV:

NPV	Probability	Product
-40.18	0.10	-4.02
-2.23	0.70	-1.56
31.70	0.20	6.34
Total		0.76

WN 3: Solution:

Probable NPV (WN 2)	760
Worst-case NPV (WN 1)	-40,180
Best-case NPV (WN 1)	31,700
Probability of worst-case NPV [Cash flows are dependent]	10%

40. RADR [May 2018 MTP, Nov 2018 MTP, May 2019 RTP, Nov 2019 RTP, May 2022 MTP, SM] [Homework]

An enterprise is investing Rs.100 lakhs in a project. The risk-free rate of return is 7%. Risk premium expected by the management is 7%. The life of the project is 5 years. Following are the cash flows that are estimated over the life of the project.

Year	Cash flows (in lacs)
1	25
2	60
3	75
4	80
5	65

Calculate NPV of the project based on risk-free rate and also on the basis of risk adjusted discount rate.

Answer:

Answer:

WN 1: Computation of NPV based on risk-free rate of 7%:

Year	Cash flow (in lacs)	PVF @ 7%	DCF (in lacs)
0	-100.00	1.000	-100.00
1	25.00	0.935	23.38
2	60.00	0.873	52.38
3	75.00	0.816	61.20
4	80.00	0.763	61.04
5	65.00	0.713	46.35
NPV			144.34

WN 2: Computation of NPV based on RADR of 14%:

- Risk-free rate is 7% and there is a risk premium of 7%. Hence risk-adjusted discount rate is 14%

Year	Cash flow (in lacs)	PVF @ 14%	DCF (in lacs)
0	-100.00	1.000	-100.00
1	25.00	0.877	21.93
2	60.00	0.769	46.14
3	75.00	0.675	50.63
4	80.00	0.592	47.36
5	65.00	0.519	33.74
NPV			99.80

41. RADR Approach (July 2021) [Homework]

K.P. Ltd. is investing Rs.50 lakhs in a project. The life of the project is 4 years. Risk free rate of return is 6% and risk premium is 6%, other information is as under

Sales of 1 st year	Rs.50,00,000
Sales of 2 nd year	Rs.60,00,000
Sales of 3 rd year	Rs.70,00,000
Sales of 4 th year	Rs.80,00,000
PVR (same in all years)	50%
Fixed cost (excluding depreciation) of first year	Rs.10,00,000
Fixed cost (excluding depreciation) of second year	Rs.12,00,000
Fixed cost (excluding depreciation) of third year	Rs.14,00,000
Fixed cost (excluding depreciation) of fourth year	Rs.16,00,000

Ignoring interest and taxes. You are required to calculate NPV of given project on the basis of Risk Adjusted Discount Rate.

Answer:

WN 1: Computation of project cash flows:

Particulars	Year 1	Year 2	Year 3	Year 4
Sales	50,00,000	60,00,000	70,00,000	80,00,000
Contribution [Sales x PVR]	25,00,000	30,00,000	35,00,000	40,00,000
Less: Fixed cost	-10,00,000	-12,00,000	-14,00,000	-16,00,000
PBDT/CFAT	15,00,000	18,00,000	21,00,000	24,00,000

Note: Interest and taxes are to be ignored and hence PBDT would be equal to CFAT.

WN 2: Computation of Risk-adjusted NPV:

Year	Cash flow	PVF @ 12%	DCF
0	-50,00,000	1.000	-50,00,000
1	15,00,000	0.893	13,39,500
2	18,00,000	0.797	14,34,600
3	21,00,000	0.712	14,95,200
4	24,00,000	0.636	57,95,700
NPV of project			7,95,700

42. Risk Adjusted Discount Rate [May 2016, SM] [Concept Revision]

ABC Limited is evaluating 3 projects, P-I, P-II, P-III. Following information is available in respect of these projects:

Particulars	P-I	P-II	P-III
Cost	Rs.15,00,000	Rs.11,00,000	Rs.19,00,000
Inflows-Year1	Rs.6,00,000	Rs.6,00,000	Rs.4,00,000
Year 2	Rs.6,00,000	Rs.4,00,000	Rs.6,00,000
Year 3	Rs.6,00,000	Rs.5,00,000	Rs.8,00,000
Year 4	Rs.6,00,000	Rs.2,00,000	Rs.12,00,000
Risk Index	1.80	1.00	0.60

Minimum required rate of return of the firm is 15% and applicable tax rate is 40%. The risk-free interest rate is 10%.

Required:

- Find out the risk-adjusted discount rate (RADR) for these projects.
- Which project is the best?

Answer:

WN 1: Computation of Risk-adjusted discount rate:

$$\text{RADR} = R_f + \text{Risk index} \times (R_m - R_f)$$

$$\text{RADR of P1} = 10 + 1.80 \times (15 - 10) = 19.00\%$$

$$\text{RADR of P2} = 10 + 1.00 \times (15 - 10) = 15.00\%$$

$$\text{RADR of P3} = 10 + 0.60 \times (15 - 10) = 13.00\%$$

WN 2: Computation of NPV:

Project 1

Year	Cash flow	PVF @ 19%	DCF
0	-15,00,000	1.000	-15,00,000
1	6,00,000	0.840	5,04,000
2	6,00,000	0.706	4,23,600
3	6,00,000	0.593	3,55,800
4	6,00,000	0.499	2,99,400
Risk-adjusted NPV			82,800

Project 2:

Year	Cash flow	PVF @ 15%	DCF
0	-11,00,000	1.000	-11,00,000

1	6,00,000	0.870	5,22,000
2	4,00,000	0.756	3,02,400
3	5,00,000	0.658	3,29,000
4	2,00,000	0.572	1,14,400
Risk-adjusted NPV			1,67,800

Project 3:

Year	Cash flow	PVF @ 13%	DCF
0	-19,00,000	1.000	-19,00,000
1	4,00,000	0.885	3,54,000
2	6,00,000	0.783	4,69,800
3	8,00,000	0.693	5,54,400
4	12,00,000	0.613	7,35,600
Risk-adjusted NPV			2,13,800

Conclusion:

- The company should go ahead with Project 3 as it has highest risk-adjusted NPV

43. RADR [May 2019 MTP, SM] [Homework]

Determine the risk adjusted net present value of the following projects:

Particulars	X	Y	Z
Net cash outlays	2,10,000	1,20,000	1,00,000
Project life	5 years	5 years	5 years
Annual cash inflow	70,000	42,000	30,000
Coefficient of variation	1.20	0.80	0.40

The company selects the risk-adjusted rate of discount on the basis of the co-efficient of variation:

Coefficient of variation	RADR	PV factor of 1 to 5 years at RADR
0.0	10%	3.791
0.4	12%	3.605
0.8	14%	3.433
1.2	16%	3.274
2.0	22%	2.864
More than 2.0	25%	2.689

Answer:**WN 1: Identification of discount rate for different projects:**

Project	Coefficient of variation	RADR
X	1.20	16%
Y	0.80	14%
Z	0.40	12%

WN 2: Computation of NPV:**Project X:**

Year	Cash flow	PVF @ 16%	DCF
0	-21,0,000	1.000	-2,10,000
1 to 5	70,000	3.274	2,29,180
Risk-adjusted NPV			19,180

Project Y:

Year	Cash flow	PVF @ 14%	DCF
0	-1,20,000	1.000	-1,20,000
1 to 5	42,000	3.433	1,44,186
Risk-adjusted NPV			24,186

Project Z:

Year	Cash flow	PVF @ 12%	DCF
0	-1,00,000	1.000	-1,00,000
1 to 5	30,000	3.605	1,08,150
Risk-adjusted NPV			8,150

44. Certainty equivalent approach [May 2021 MTP, Nov 2020 RTP, May 2024 MTP, SM] [Concept Revision]

Oil country tubular Ltd. is considering an investment in one of the two mutually exclusive proposals – Projects X and Y, which require cash outlays of Rs.3, 40,000 and Rs.3, 30,000 respectively. The certainty-equivalent (C.E.) approach is used in incorporating risk in capital budgeting decisions. The current yield on government bond is 8% and this be used as the risk free rate. The expected net cash flows and their certainty-equivalents are as follows:

	Project X		Project Y	
Year-end	Cash flow	C.E.F	Cash flow	C.E.F
1	1,80,000	0.8	1,80,000	0.9
2	2,00,000	0.7	2,00,000	0.8
3	2,00,000	0.5	2,00,000	0.7

Required:

- Which project should be accepted?
- If risk adjusted discount rate method is used, which project would be appraised with a higher rate and why?

Answer:

WN 1: Computation of NPV of Project X using Certainty equivalent factor approach:

Year	Cash flows			PVF @ 8%	DCF
	Uncertain	CEF	Certain		
0	-3,40,000	1.0	-3,40,000	1.000	-3,40,000
1	1,80,000	0.8	1,44,000	0.926	1,33,344
2	2,00,000	0.7	1,40,000	0.857	1,19,980
3	2,00,000	0.5	1,00,000	0.794	79,400
Expected NPV					-7,276

Note:

- Certain cash flow = Uncertain cash flow x CEF
- DCF = Certain cash flow x PVF

WN 2: Computation of NPV of Project Y using certainty equivalent factor approach:

Year	Cash flows			PVF @ 8%	DCF
	Uncertain	CEF	Certain		
0	-3,30,000	1.0	-3,30,000	1.000	-3,30,000
1	1,80,000	0.9	1,62,000	0.926	1,50,012
2	2,00,000	0.8	1,60,000	0.857	1,37,120
3	2,00,000	0.7	1,40,000	0.794	1,11,160
Expected NPV					68,292

Conclusion:

- The company should go ahead with Project Y as it results in better NPV

Usage of RADR Approach:

- Cumulative CEF of 3 years is 2.0 and 2.4 for Project X and Project Y respectively
- This means Project M is riskier than Project N as "higher the riskiness of a cash flow, the lower will be the CE factor". **If risk adjusted discount rate (RADR) method is used, Project M would be analysed with a higher rate.**

- RADR is based on the premise that riskiness of a proposal may be taken care of, by adjusting the discount rate. **The cash flows from a more risky proposal should be discounted at a relatively higher discount rate as compared to other proposals whose cash flows are less risky.** Any investor is basically risk averse. However, he may be ready to take risk provided he is rewarded for undertaking risk by higher returns. So, more risky the investment is, the greater would be the expected return. The expected return is expressed in terms of discount rate which is also the minimum required rate of return generated by a proposal if it is to be accepted. Therefore, there is a positive correlation between risk of a proposal and the discount rate

45. CEF Approach [Jan 2021, Nov 2018 RTP, May 2020 RTP, SM] [Homework]

A project requires an outlay of Rs.3,00,000. The company uses certainty equivalent method approach to evaluate the project. The risk-free rate is 7%. Following information is available:

Year-end	Cash flow	C.E.F
1	1,00,000	0.90
2	1,50,000	0.80
3	1,15,000	0.60
4	1,00,000	0.55
5	50,000	0.50

Evaluate the above. Is investment in the project beneficial?

Answer:

Computation of NPV of Project X using Certainty equivalent factor approach:

Year	Cash flows			PVF @ 7%	DCF
	Uncertain	CEF	Certain		
0	-3,00,000	1.00	-3,00,000	1.000	-3,00,000
1	1,00,000	0.90	90,000	0.935	84,150
2	1,50,000	0.80	1,20,000	0.873	1,04,760
3	1,15,000	0.60	69,000	0.816	56,304
4	1,00,000	0.55	55,000	0.763	41,965
5	50,000	0.50	25,000	0.713	17,825
Expected NPV					5,004

Note:

- Certain cash flow = Uncertain cash flow x CEF
- DCF = Certain cash flow x PVF

Conclusion:

Since the NPV of the project is positive, it is beneficial to invest in the project

Part 9 - Sensitivity Analysis and Scenario Analysis

46. Sensitivity analysis [May 2021 RTP, SM, May 2024 RTP] [Concept Revision]

X Limited is considering its new product with the following details:

Initial capital cost	Rs.400 Crores
Annual unit sales	5 Crores
Selling Price Per unit	Rs.100
Variable cost per unit	Rs.50
Fixed costs per year	Rs.50 Crores
Discount rate	6%

- ❖ Tabulate the NPV of the project. Does it represent the actual outcome? Comment
- ❖ Find the impact on the project's NPV of a 2.5 percent adverse variance in each variable. Which variable is having maximum effect

Consider life of the project as 3 years

Answer:**WN 1: Computation of base NPV:****Part 1: Computation of cash flows:**

Particulars	Amount (in cr)
Units sold	5.00
Selling price	100.00
Sales (A)	500.00
Variable cost per unit	50.00
Total variable cost (B)	250.00
Total Fixed cost (C)	50.00
Profit/Cash flow (A - B - C)	200.00

Part 2: Computation of NPV:**(in crores)**

Year	Cash flow	PVF @ 6%	DCF
0	-400.00	1.000	-400.00
1 to 3	200.00	2.673	534.60
Expected NPV			134.60

Here, NPV represent the most likely outcomes and not the actual outcomes. The actual outcome can be lower or higher than the expected outcome

WN 2: Sensitivity analysis and NPV Impact:**(in crores)**

Particulars	CC	Unit	SP	VC	FC
Units sold	5.00	4.875 [5.00-2.5%]	5.00	5.00	5.00
Selling price	100.00	100.00	97.50 [100-2.5%]	100.00	100.00
Sales (A)	500.00	487.50	487.50	500.00	500.00
Variable cost per unit	50.00	50.00	50.00	51.25 [50+2.5%]	50.00
Total variable cost (B)	250.00	243.75	250.00	256.25	250.00
Total Fixed cost (C)	50.00	50.00	50.00	50.00	51.25 [50+2.5%]
Profit/Cash flow [A - B - C]	200.00	193.75	187.50	193.75	198.75
PVF	2.673	2.673	2.673	2.673	2.673
PV of inflows [Cash flow x PVF]	534.6	517.89	501.19	517.89	531.26
Initial capital cost	410.00 [400+2.5%]	400.00	400.00	400.00	400.00
NPV	124.60	117.89	101.19	117.89	131.26
Change in NPV [Old NPV - New NPV]	10.00	16.71	33.41	16.71	3.34
% Change in NPV	7.43	12.41	24.82	12.41	2.48

Conclusion:

- The project is most sensitive to selling price as 2.5 percent change in SP will impact NPV by 24.82%

47. Sensitivity Analysis [May 2018 RTP, Nov 2018, SM] [Homework]

From the following details relating to a project, analyze the sensitivity of the project to changes in the initial project cost, annual cash inflow and cost of capital:

Particulars	Amount
Initial Project Cost	2,00,00,000
Annual cash inflow	60,00,000
Project life	5 years
Cost of capital	10%

To which of the 3 factors, the project is most sensitive if the variable is adversely affected by 10 percent?

Answer:

Sensitivity Analysis:

Particulars	Base case	Project cost	Cash inflow	Cost of capital
Annual inflow	60,00,000	60,00,000	54,00,000 [60,00,000-10%]	60,00,000
Discount rate	10%	10%	10%	11% [10% + 10 of 10%]
PVAF	3.791	3.791	3.791	3.696
PV of inflow (A)	2,27,46,000	2,27,46,000	2,04,71,400	2,21,76,000
Initial outflow (B)	2,00,00,000	2,20,00,000 [2,00,00,000 + 10%]	2,00,00,000	2,00,00,000
NPV (A-B)	27,46,000	7,46,000	4,71,400	21,76,000
Change in NPV	NA	20,00,000	22,74,600	5,70,000
% Change in NPV	NA	72.83	82.83	20.76

- Project is most sensitive to annual cash inflow as 10 percent change in inflow leads to 82.83 percent change in NPV

48. Sensitivity Analysis [May 2018 RTP, May 2024 MTP, SM]

PNR Limited is considering a project with the following cash flows:

Year	Cost of Plant	Running Cost	Savings
0	20,000		
1		8,000	24,000
2		10,000	28,000

The cost of capital is 9%. Evaluate the sensitivity of the project in respect of all factors except time such that:

(i) NPV become zero and (ii) adversely varying factors value by 10%.

Note: Round off calculation upto 2 decimal points.

Answer:

WN 1: Computation of NPV of Project:

Year	Cash Flow			PVF @ 9%	DCF		
	Cost of Plant	Running cost	Savings		Cost of Plant	Running cost	Savings
0	-20,000			1.000	-20,000	0	0
1		-8,000	24,000	0.917	0	-7,336	22,008
2		-10,000	28,000	0.842	0	-8,420	23,576
Total					-20,000	-15,756	45,584

- NPV of project = -20,000 - 15,756 + 45,584 = Rs.9,828

WN 2: Computation of sensitivity of different parameters so that NPV becomes zero:

Plant cost:

- The project will have zero NPV if the cost of plant increases by Rs.9,828 (amount of NPV). This is because any increase in cost of plant will reduce NPV and finally it will become zero

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{9,828}{20,000} \times 100 = 49.14\%$$

- Base represents current plant cost of Rs.20,000

Running cost:

- The project will have zero NPV if the PV of running cost increases by Rs.9,828 (amount of NPV). This is because any increase in running cost will reduce NPV and finally it will become zero

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{9,828}{15,756} \times 100 = 62.38\%$$

- Base represents current running cost of Rs.15,756

Savings:

- The project will have zero NPV if the PV of savings decline by Rs.9,828 (amount of NPV). This is because any decline in savings will reduce NPV and finally it will become zero

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{9,828}{45,584} \times 100 = 21.56\%$$

- Base represents current savings cost of Rs.45,584

Conclusion: Hence, savings factor is the most sensitive to affect the acceptability of the project as in comparison of other two factors a slight % change in this fact shall more affect the NPV than others.

WN 3: Sensitivity analysis for 10 percent variation in factor:

Particulars	Original	Plant cost	Recurring cost	Savings
Initial outflow	-20,000	-22,000	-20,000	-20,000
PV of recurring cost	-15,756	-15,756	-17,332	-15,756
PV of Savings	45,584	45,584	45,584	41,026
NPV	9,828	7,828	8,252	5,270
% fall in NPV		-20.35	-16.04	-46.38

Hence, savings factor is the most sensitive to affect the acceptability of the project.

49. Sensitivity Analysis [SM]

ABC Limited is considering a project for which the following estimates are available:

Particulars	Amount
Initial Cost of the project	10,00,000
Sales price/unit	60
Cost/unit	40
Sales volumes	
Year 1	20,000 units
Year 2	30,000 units
Year 3	30,000 units

Discount rate 10% p.a.

You are required to measure the sensitivity of the project in relation to each of the following parameters:

- Sales Price/unit
 - Unit cost
 - Sales value
 - Initial outlay and
 - Project lifetime
- Taxation may be ignored.

Answer:**WN 1: Computation of base NPV:**

Year	Initial outlay	Sales	Costs	PVF @ 10%	PV of Plant	PV of Sales	PV of costs
0	-10,00,000	-	-	1.000	-10,00,000	-	-

1	0	12,00,000	-8,00,000	0.909	-	10,90,800	-7,27,200
2	0	18,00,000	-12,00,000	0.826	-	14,86,800	-9,91,200
3	0	18,00,000	-12,00,000	0.751	-	13,51,800	-9,91,200
Total					-10,00,000	39,29,400	-26,19,600

- NPV of project = -10,00,000 + 39,29,400 - 26,19,600 = Rs.3,09,800

WN 2: Sensitivity Analysis:**Selling price:**

- The project will have zero NPV if the present value of sales decline by Rs.3,09,800. This is because any decrease in selling price will negatively impact the NPV

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{3,09,800}{39,29,400} \times 100 = 7.88\%$$

- Selling price with zero NPV = 60 - 7.88% = Rs.55.27

Unit cost:

- The project will have zero NPV if the present value of cost increases by Rs.3,09,800. This is because any increase in cost will negatively impact the NPV

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{3,09,800}{26,19,600} \times 100 = 11.83\%$$

- Unit cost with zero NPV = 40 + 11.83% = Rs.44.73

Sales value:

- Any decrease in sales will also result in decrease in cost and hence net cash inflow (Sales - cost) needs to decline by Rs.3,09,800 for the project to have zero NPV.

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{3,09,800}{(39,29,400 - 26,19,600)} \times 100 = 23.65\%$$

Initial Outlay:

- The project will have zero NPV if the initial outflow increase by Rs.3,09,800

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{3,09,800}{10,00,000} \times 100 = 30.98\%$$

Project Lifetime:

- We are required to compute the life of the project at which the project will have zero NPV. Discounted payback is basically the life at which project recovers the initial investment considering time value of money.
- Hence, we will have to first compute discounted payback.

Computation of discounted Payback:

Year	CF	PVF @ 10%	DCF	CDCF
0	-10,00,000	1	-10,00,000	-10,00,000
1	4,00,000	0.909	3,63,600	-6,36,400
2	6,00,000	0.826	4,95,600	-1,40,800
3	6,00,000	0.751	4,50,600	3,09,800

$$\text{Discounted Payback} = \text{Base year} + \frac{\text{Unrecovered CF of base year}}{\text{Discounted CF of next year}} = 2 + \frac{1,40,800}{4,50,600} = 2.312 \text{ years}$$

- Hence project will have zero NPV if life of project declines by 0.688 years (3 - 2.312)

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{0.688}{3} \times 100 = 22.93\%$$

50. Sensitivity analysis [SM] [Concept Revision]

Easygoing Company Limited is considering a new project with initial investment, for a product "Survival". It is estimated that IRR of the project is 16% having an estimated life of 5 years. Financial Manager has studied the project with sensitivity analysis and informed that annual fixed cost sensitivity is 7.8416%, whereas cost of capital (discount rate) sensitivity is 60%.

Other information available are:

- ❖ Profit Volume Ratio (P/V) is 70%,
- ❖ Variable cost Rs. 60/- per unit
- ❖ Annual Cash Flow Rs. 57,500/-

Ignore Depreciation on initial investment and impact of taxation.

Calculate

- ❖ Initial Investment of the Project
- ❖ Net Present value of the Project
- ❖ Annual Fixed Cost
- ❖ Estimated annual unit of sales
- ❖ Break Even Units

Cumulative discounting factor for 5 years:

8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%
3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127

Answer:**WN 1: Computation of discount rate:**

- IRR of the project is 16% and hence project will generate NPV of 0 at discount rate of 16%
- Cost of capital sensitivity is 60% and hence the same would mean that 60% increase in cost of capital would result in zero NPV
- We can therefore conclude that IRR is equal to 160% of cost of capital
- $16\% = 160\%$ of cost of capital
- **Cost of capital = 10.00%**

WN 2: Computation of Initial Investment:

- NPV will be zero at discount rate of 16% (IRR)

Year	CF	PVF @ 16%	DCF
0	-1,88,255	1.000	-1,88,255 (b/f)
1 to 5	57,500	3.274	1,88,255
NPV			0

- Initial Investment = Rs.1,88,255

WN 3 Computation of NPV:

Year	CF	PVF @ 10%	DCF
0	-1,88,255	1.000	-1,88,255
1 to 5	57,500	3.791	2,17,983
NPV			29,728

WN 4: Computation of Annual Fixed Cost:

- Annual fixed cost sensitivity is 7.8416% and hence 7.8416% increase in fixed cost would lead to zero NPV

$$\text{Annual increase in fixed cost} = \frac{29,728}{3.791} = \text{Rs. 7,841.60}$$

- 7.8416% increase in fixed cost = Rs.7,841.60
- Hence annual fixed cost = Rs.1,00,000

WN 5: Computation of units sold and break-even point:

Particulars	Calculation	Amount
Variable cost		Rs.60.00
PVR		70.00%
Variable cost ratio		30.00%
Selling price	60/30.00%	Rs.200.00
Contribution		1,57,500
Contribution per unit		140.00
No of units sold	$\frac{1,57,500}{140}$	1,125 units
Break-even point	$\frac{1,00,000}{140}$	714.29 units

- There is no tax in company and hence annual cash flow is equal to PBDT.
- Contribution = PBDT + Fixed cost = 57,500 + 1,00,000 = Rs.1,57,500

51. Sensitivity Analysis [SM] [Concept Revision] [Homework]

Unnat Ltd. is considering investing Rs. 50,00,000 in a new machine. The expected life of machine is five years and has no scrap value. It is expected that 2,00,000 units will be produced and sold each year at a selling price of Rs. 30.00 per unit. It is expected that the variable costs to be Rs. 16.50 per unit and fixed costs to be Rs. 10,00,000 per year. The cost of capital of Unnat Ltd. is 12% and acceptable level of risk is 20%. You are required to measure the sensitivity of the project's net present value to a change in the following project variables:

- sale price;
- sales volume;
- variable cost;
- On further investigation it is found that there is a significant chance that the expected sales volume of 2,00,000 units per year will not be achieved. The sales manager of Unnat Ltd. suggests that sales volumes could depend on expected economic states which could be assigned the following probabilities:

State of Economy	Annual Sales (in Units)	Prob.
Poor	1,75,000	0.30
Normal	2,00,000	0.60
Good	2,25,000	0.10

Calculate expected net present value of the project and give your decision whether company should accept the project or not.

Answer:

WN 1: Computation of Base NPV:

Particulars	Calculation	Amount
PV of sales	60,00,000 x 3.605	2,16,30,000
Less: PV of variable cost	33,00,000 x 3.605	-1,18,96,500
PV of contribution		97,33,500
Less: PV of fixed cost	10,00,000 x 3.605	-36,05,000
PV of cash inflows		61,28,500
Less: Initial outlay		-50,00,000
Base NPV		11,28,500

WN 2: Sensitivity Analysis:

Selling price:

- The project will have zero NPV if the present value of sales decline by Rs.11,28,500. This is because any decrease in selling price will negatively impact the NPV

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{11,28,500}{2,16,30,000} \times 100 = 5.22\%$$

- Selling price with zero NPV = 30 - 5.22% = Rs.28.43

Sales volume:

- Any decrease in sales will also result in decrease in variable cost and hence contribution (Sales – variable cost) needs to decline by Rs.11,28,500 for the project to have zero NPV.

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{11,28,500}{97,33,500} \times 100 = 11.59\%$$

Variable cost:

- The project will have zero NPV if the present value of variable cost increase by Rs.11,28,500. This is because any increase in variable cost will negatively impact the NPV

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{11,28,500}{1,18,96,500} \times 100 = 9.49\%$$

- Variable cost with zero NPV = 16.50 + 9.49% = Rs.18.07

WN 3: Computation of expected NPV:

- Expected sales volume = (1,75,000 × 0.30) + (2,00,000 × 0.60) + (2,25,000 × 0.10) = 1,95,000 units

Particulars	Calculation	Amount
Contribution	1,95,000 × 13.50	26,32,500
Less: Fixed cost		-10,00,000
Annual cash inflow		16,32,500
PVFAF (12%,5)		3.605
PV of inflows		58,85,163
Less: Initial outflow		-50,00,000
NPV		8,85,163

Further NPV in worst and best cases will be as follows:

- NPV in worst case = [1,75,000 × 13.50 – 10,00,000] × 3.605 – 50,00,000 = -88,188
- NPV in best case = [2,25,000 × 13.50 – 10,00,000] × 3.605 – 50,00,000 = Rs.23,45,188

Conclusion: Thus, there are 30% chances that the rise will be a negative NPV and 70% chances of positive NPV. **Since acceptable level of risk of Unnat Ltd. is 20% and there are 30% chances of negative NPV hence project should not be accepted.**

52. Scenario Analysis [Nov 2020 MTP, SM] [Homework]

XYZ Limited is considering a Project A with an initial outlay of Rs.14,00,000 and the possible three cash flow attached with the project are as follows:

Particulars	Year 1	Year 2	Year 3
Worst case	450	400	700
Most Likely	550	450	800
Best case	650	500	900

Assuming the cost of capital as 9%, determine NPV in each scenario. If XYZ Ltd is certain about the most likely result but uncertain about the third year's cash flow, what will be the NPV expecting worst scenario in the third year.

Answer:**WN 1: Computation of NPV for worst case, most likely and best-case scenario:**

Year	Cash flow			PVF @ 9%	DCF		
	Worst	Likely	Best		Worst	Likely	Best
0	-14,00,000	-14,00,000	-14,00,000	1.000	-14,00,000	-14,00,000	-14,00,000
1	4,50,000	5,50,000	6,50,000	0.917	4,12,659	5,04,350	5,96,050
2	4,00,000	4,50,000	5,00,000	0.842	3,36,800	3,78,900	4,21,000
3	7,00,000	8,00,000	9,00,000	0.772	5,40,400	6,17,600	6,94,800
Expected NPV					-1,10,141	1,00,850	3,11,850

WN 2: Scenario Analysis:

- It is given that most likely scenario will happen. However, there is uncertainty about third year and for that year we are going to assume worst case scenario

Year	Cash flow	PVF @ 9%	DCF
0	-14,00,000	1.000	-14,00,000
1	5,50,000	0.917	5,04,350
2	4,50,000	0.842	3,78,900
3	7,00,000	0.772	5,40,400
Expected NPV			23,650

Part 10 - Decision Tree and Simulation

53. Decision Tree [SM] [Concept Revision]

A firm has an investment proposal, requiring an outlay of Rs. 80,000. The investment proposal is expected to have two years economic life with no salvage value. In year 1, there is a 0.4 probability that cash inflow after tax will be Rs. 50,000 and 0.6 probability that cash inflow after tax will be Rs. 60,000. The probability assigned to cash inflow after tax for the year 2 is as follows:

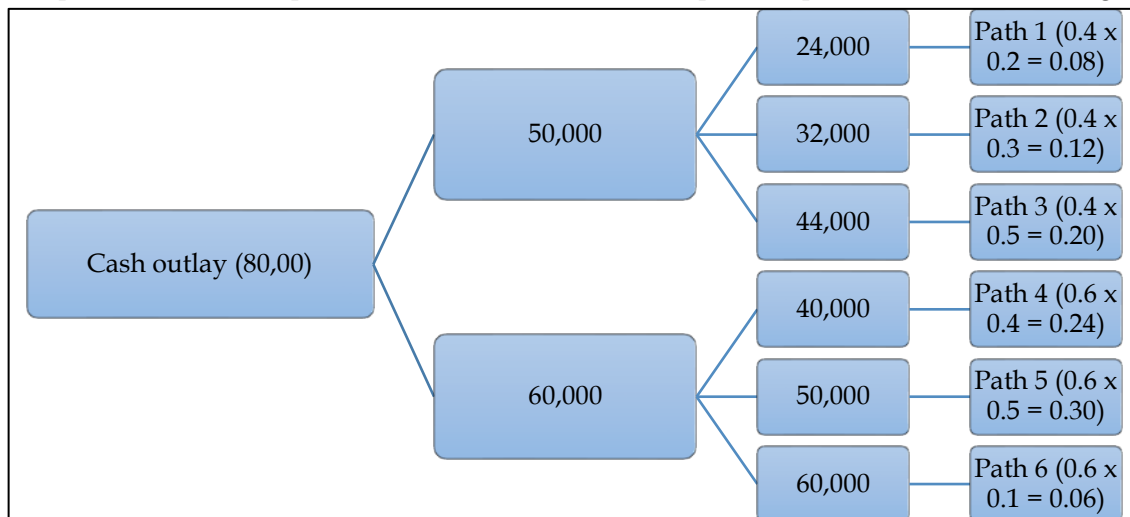
The cash inflow year 1	Rs. 50,000		Rs. 60,000	
The cash inflow year 2	Probability		Probability	
	Rs. 24,000	0.20	Rs. 40,000	0.40
	Rs. 32,000	0.30	Rs. 50,000	0.50
	Rs. 44,000	0.50	Rs. 60,000	0.10

ABC limited uses a 10% discount rate for this type of investment. Required:

- What net present value will the project yield if worst outcome is realized? What is the probability of occurrence of this NPV?
- What will be the best and the probability of that occurrence?
- Will the project be accepted?

Answer:

The decision tree diagram is presented in the chart, identifying various paths and outcomes, and the computation of various paths/outcomes and NPV of each path are presented in the following tables:



NPV computation:

Path	Year 1 cash flow	Year 2 cash flow	Total cash inflow	Outflow	NPV
1	50,000 × 0.909 = 45,450	24,000 × 0.826 = 19,824	65,274	-80,000	-14,726
2	50,000 × 0.909 = 45,450	32,000 × 0.826 = 26,432	71,882	-80,000	-8,118
3	50,000 × 0.909 = 45,450	44,000 × 0.826 = 36,344	81,794	-80,000	1,794
4	60,000 × 0.909 = 54,540	40,000 × 0.826 = 33,040	87,580	-80,000	7,580
5	60,000 × 0.909 = 54,540	50,000 × 0.826 = 41,300	95,840	-80,000	15,840
6	60,000 × 0.909 = 54,540	60,000 × 0.826 = 49,560	1,04,100	-80,000	24,100

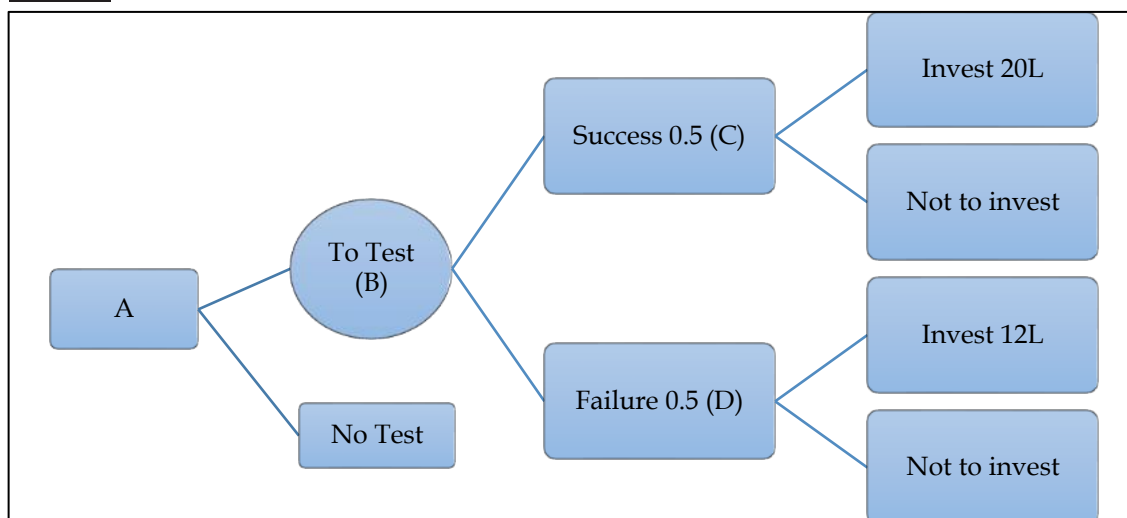
Solution:

Expected NPV	$(-14,726 \times 0.08) + (-8,118 \times 0.12) + (1,794 \times 0.20) + (7,580 \times 0.24) + (15,840 \times 0.30) + (24,100 \times 0.06) = \text{Rs.6,224}$
Worst NPV	-14,726
Probability of worst NPV	Path 1 = 8%
Best NPV	24,100
Probability of best NPV	Path 6 = 6%
Selection of project	Project should be accepted as the same has resulted in expected positive NPV of Rs.6,224

54. Decision tree (May 2016 RTP, SM)

L&R Limited wishes to develop new virus-cleaner software. The cost of the pilot project would be Rs. 2,40,000. Presently, the chances of the product being successfully launched on a commercial scale are rated at 50%. In case it does succeed L&R can further invest a sum of Rs. 20 lacs to market the product. Such an effort can generate perpetually, an annual net after tax cash income of Rs. 4 lacs. Even if the commercial launch fails, they can make an investment of a smaller amount of Rs. 12 lacs with the hope of gaining perpetually a sum of Rs. 1 lac. Evaluate the proposal, adopting decision tree approach. The applicable discount rate is 10%.

Answer:



- There are four nodes which need to be valued and the decision tree is valued from right to left

Value of Decision Node (C) is higher of the following

- Invest Rs.20,00,000 and get perpetual income of Rs.4,00,000. $NPV = (4,00,000/0.10) - 20,00,000 = \text{Rs.20,00,000}$
- Not to invest will lead to NPV of 0
- Hence value of Node C is Rs.20,00,000

Value of Decision Node (D) is higher of the following

- Invest Rs.12,00,000 and get perpetual income of Rs.1,00,000. $NPV = (1,00,000/0.10) - 12,00,000 = -2,00,000$
- Not to invest will lead to NPV of 0
- Hence value of Node D is 0

Value of Chance Node B is sum of expected cash flows

- Value = $(20,00,000 \times 0.50 + 0 \times 0.50) = \text{Rs.10,00,000}$

Value of Decision Node A is higher of the following

- To conduct test = $10,00,000 - 2,40,000 = \text{Rs.7,60,000}$
- Not to conduct test = 0

Conclusion: The preferred choice is, therefore, investing a sum of Rs. 2,40,000 and undertaking the test.

55. Simulation [SM] [Concept Revision]

Following are the expected Annual Cash flows and Project life:

Annual Cash Flow		Project Life	
Value	Probability	Value (year)	Probability
10,000	0.02	3	0.05
15,000	0.03	4	0.10
20,000	0.15	5	0.30
25,000	0.15	6	0.25
30,000	0.30	7	0.15
35,000	0.20	8	0.10
40,000	0.15	9	0.03
		10	0.02

Random Number

53479	81115	98036	12217	59526
97344	70328	58116	91964	26240
66023	38277	74523	71118	84892
99776	75723	03172	43112	83086
30176	48979	92153	38416	42436
81874	83339	14988	99937	13213
19839	90630	71863	95053	55532
09337	33435	53869	52769	18801
31151	58295	40823	41330	21093
67619	52515	03037	81699	17106

Risk-free rate = 10%

Required:

Using simulation process over ten trials compute the NPV?

Answer:

WN 1: Random number tables:

RN table for Cash flow:

Value	Probability	Cum Probability	Random Number
10,000	0.02	0.02	00-01
15,000	0.03	0.05	02-04
20,000	0.15	0.20	05-19
25,000	0.15	0.35	20-34
30,000	0.30	0.65	35-64
35,000	0.20	0.85	65-84
40,000	0.15	1.00	85-99

RN table for Project life:

Value (year)	Probability	Cum Probability	Random Number
3	0.05	0.05	00-04
4	0.10	0.15	05-14
5	0.30	0.45	15-44
6	0.25	0.70	45-69
7	0.15	0.85	70-84
8	0.10	0.95	85-94
9	0.03	0.98	95-97
10	0.02	1.00	98-99

WN 2: Simulation exercise:

For random numbers, we can begin from any-where taking at random from the table and read any pair of adjacent columns, column/row wise. For the first simulation run we need two digit random numbers (1) For

Annual Cash Flow (2) For Project Life. The numbers are 53 & 97 and corresponding value of Annual Cash Flow and Project Life are Rs. 3,000 and 9 years respectively.

Run	Cash flow		Project Life			NPV CF x PVAF - 1,30,000
	RN	Corresponding Cash flow	RN	Corresponding Life	PVAF @ 10%	
1	53	30,000	97	9	5.759	42,770
2	66	35,000	99	10	6.145	85,075
3	30	25,000	81	7	4.868	-8,300
4	19	20,000	09	4	3.170	-66,600
5	31	25,000	67	6	4.355	-21,125
6	81	35,000	70	7	4.868	40,380
7	38	30,000	75	7	4.868	16,040
8	48	30,000	83	7	4.868	16,040
9	90	40,000	33	5	3.791	21,640
10	58	30,000	52	6	4.355	650

56. Simulation [Homework]

ABC Limited is evaluating an investment opportunity that will enable them to introduce a new product. A market survey shows the following demand levels and cash flow per unit and the likely investment required and probability distribution of these uncertain variables.

Demand		Cash flow after tax per unit		Likely Investment	
Number	Probability	Rupees	Probability	Amount in lacs	Probability
37,500	0.05	3.00	0.10	8.00	0.25
45,000	0.10	5.00	0.20	16.00	0.50
52,500	0.20	7.00	0.40	24.00	0.25
60,000	0.30	9.00	0.20		
67,500	0.20	10.00	0.10		
75,000	0.10				
82,500	0.05				

Risk-free rate = 10%; Life = 8 years

Using simulation process over five trials,

- Assess the least likely cash flow and the corresponding value of investment and
- What is the maximum recommended investment level, if the least CFAT materializes
- What is the expected NPV

Use the following random number series, to be used in groups of five for each of the three uncertain variables:

28	57	60	17	6
19	07	90	02	57
18	67	16	71	43

Answer:

WN 1: Random Number Tables:

RN table for demand:

Demand			
Number	Probability	Cum prob	RN
37,500	0.05	0.05	00-04
45,000	0.1	0.15	05-14
52,500	0.2	0.35	15-34
60,000	0.3	0.65	35-64
67,500	0.2	0.85	65-84
75,000	0.1	0.95	85-94
82,500	0.05	1	95-99

RN table for CFAT:

Cash flow after tax per unit

Rupees	Probability	Cum prob	RN
3	0.1	0.1	00-09
5	0.2	0.3	10-29
7	0.4	0.7	30-69
9	0.2	0.9	70-89
10	0.1	1	90-99

RN table for initial investment:

Likely Investment			
Amount in lacs	Probability	Cum prob	RN
8	0.25	0.25	00-24
16	0.5	0.75	25-74
24	0.25	1	75-99

WN 2: Simulation exercise:

Experiment	Demand	CFAT	Total CFAT	PVAF	DCF	Outflow	NPV
1	52,500	5	2,62,500	5.335	14,00,418	8,00,000	6,00,418
2	60,000	3	1,80,000	5.335	9,60,287	16,00,000	-6,39,713
3	60,000	10	6,00,000	5.335	32,00,956	8,00,000	24,00,956
4	52,500	3	1,57,500	5.335	8,40,251	16,00,000	-7,59,749
5	45,000	7	3,15,000	5.335	16,80,502	16,00,000	80,502
Average NPV							3,36,483

Experiment 1

- RN of 28 correspond to demand of 52,500 units, RN of 19 correspond to CFAT per unit of Rs.5 and RN of 18 correspond to initial outflow of Rs.8,00,000

Experiment 2:

- RN of 57 correspond to demand of 60,000 units, RN of 07 correspond to CFAT per unit of Rs.3 and RN of 67 correspond to initial outflow of Rs.16,00,000
- Other experiments are done in similar manner and the values are updated in above table

Solution:

- Least likely cash inflow = Rs.1,57,500 and corresponding investment = Rs.16,00,000
- Maximum recommended investment level if least cash flow materializes would be equal to present value of cash inflows and the same in this case is Rs.8,40,251
- Expected NPV over 5 experiments = Rs.3,36,483

Part 11 - Option in Capital Budgeting**57. Valuation of option:**

ABC Limited is considering a new drug. To develop the drug and to market it on a regional basis will cost Rs.120 lakhs over the next two years, as Rs.60 lakhs in each year. Expected cash inflows associated with the project for the next 6 years are as follows:

Year	Cash inflow in lakhs
3	10
4	20
5	40
6	40
7	30
8	10

If the project is successful, at the end of year 5 the company will have the option to invest an additional Rs.100 lakhs to secure a national market. The probability of success is 0.60. If the project is not successful then the company will not invest additional amount. If successful, the cash inflow will be better by Rs.60 lakhs per

annum in each of the years through year 10. That is the project will be elongated by 2 more years than scheduled. The chance of better cash inflow by Rs.60 lakhs is 0.50 with other 0.50 for a cash inflow better only by Rs.40 lakhs. In both cases the life will be elongated by 2 years. The company's cost of capital is 14%.

- ❖ What is the NPV of the initial project lasting for 6 years after 2 years? Is it acceptable?
- ❖ What is the worth of the project if we take account of the option to expand? Is this project acceptable?

Answer:

WN 1: Computation of NPV of initial project:

Year	CF	PVF@ 14%	DCF
1	-60.00	0.877	-52.62
2	-60.00	0.769	-46.14
3	10.00	0.675	6.75
4	20.00	0.592	11.84
5	40.00	0.519	20.76
6	40.00	0.456	18.24
7	30.00	0.400	12.00
8	10.00	0.351	3.51
NPV			-25.66

- NPV of the initial project is negative 25.66 lacs and hence the project is not acceptable.

WN 2: Valuation of option to expand:

Year	CF	PVF@ 14%	DCF
5	-100.00	0.519	-51.90
6	50.00	0.456	22.80
7	50.00	0.400	20.00
8	50.00	0.351	17.55
9	50.00	0.308	15.40
10	50.00	0.270	13.50
NPV of option			37.35
Probability of option			0.60
Final value of option to expand [37.35 x 0.60]			22.41

- Value of project with option = -25.66 + 22.41 = -3.25 lacs
- Option to expand is feasible as the same has positive value. However, the project continues to have negative NPV even with expansion option and hence company cannot take up this project.

58. Valuation of option [Homework]

A project with an initial cost of Rs.2,50,000 provides an annual CFAT of Rs.42,500 for 15 years. If the project proves favorable – chances for which are rated at 50% - an expansion at a cost of Rs.5,00,000 could be taken up at the end of the 4th year. The incremental CFAT will be Rs.62, 500 from years 5 to 15. Assume that the cost of capital is 8%. Advise:

- a. Will you invest in the initial project?
- b. What is the value of option?
- c. What is the worth of the project with the option? Is it acceptable?

Answer:

WN 1: Computation of NPV of initial project:

Year	Cash flow	PVF @ 8%	DCF
0	-2,50,000	1.000	-2,50,000
1 to 15	42,500	8.559	3,63,758
NPV of initial project			1,13,758

- We will invest in initial project as the same has positive NPV of Rs.1,13,758

WN 2: Valuation of option:

Year	Cash flow	PVF @ 8%	DCF
4	-5,00,000	0.735	-3,67,500

5 to 15	62,500	5.247	3,27,938
NPV of option to expand			-39,562
Value of option $[-39,562 \times 50\%]$			-19,781

WN 3: Worth of the project with option:

- Worth of project with option = $1,13,758 - 19,781 = \text{Rs.}93,977$
- Project continues to remain acceptable. However, the option is not feasible and hence the company should do the initial project and not exercise the expansion option

Alternate answer:

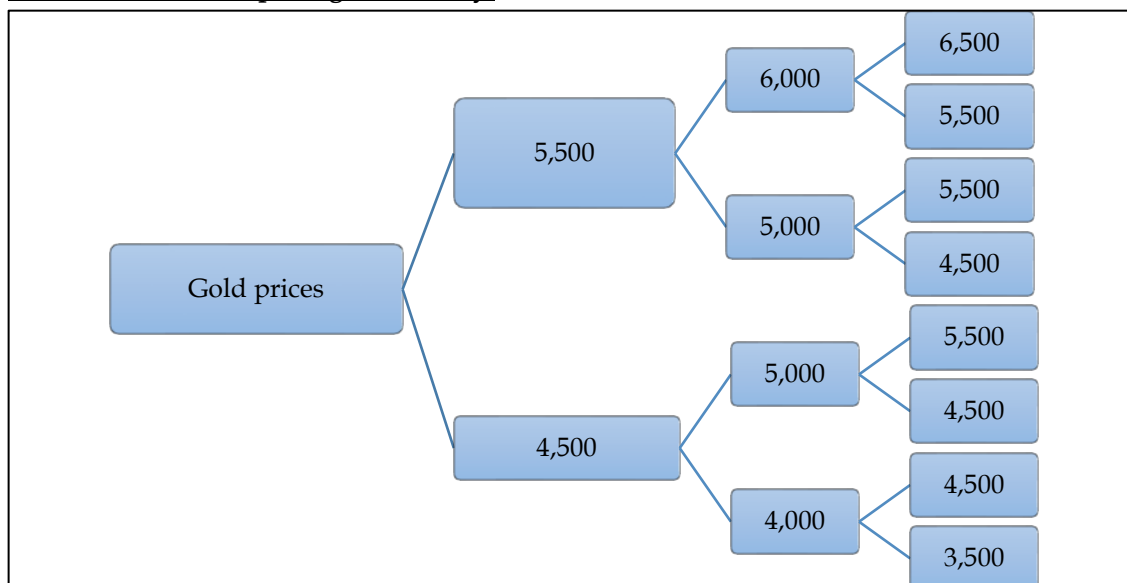
- Worth of project with option = $1,13,758$
- The value of expansion option is negative and hence we can say that the same has no value for the company. Accordingly, the NPV of the project continues to be the initial NPV of Rs.1,13,758 and the project is not to be accepted.

59. Valuation of abandonment option:

You own an unused Gold mine that will cost Rs. 10,00,000 to reopen. If you open the mine, you expect to be able to extract 1,000 ounces of Gold a year for each of three years. After that the deposit will be exhausted. The Gold price is currently Rs. 5,000 an ounce, and each year the price is equally likely to rise or fall by Rs. 500 from its level at the start of year. The extraction cost is Rs.4,600 an ounce and the discount rate is 10 per cent. Required:

(a) Should you open the mine now or delay one year in the hope of a rise in the Gold price?

(b) What difference would it make to your decision if you could costlessly (but irreversibly) shut down the mine at any stage? Show the value of abandonment option

Answer:**WN 1: Decision on opening mine today:**

- Gold prices are likely to move up or down by Rs.500 in every year and hence the expected prices of each of the year is Rs.5,000
- Expected cash flow of each year = $1,000 \times (5,000 - 4,600) = \text{Rs.}4,00,000$

Year	Cash flow	PVF @ 10%	DCF
0	-10,00,000	1.000	-10,00,000
1 to 3	4,00,000	2.487	9,94,800
NPV			-5,200

Because the NPV is negative, we should not open the mine at $t = 0$.

WN 2: Decision on opening mine in t1:

- Price of the mine can either reach 5,500 or 4,500 by end of year 1

NPV if price reaches 5,500 (50% probability):

- Investment of Rs.10,00,000 will happen in year 1
- Expected cash flow of year 2 to 4 = $1,000 \times (5,500 - 4,600) = \text{Rs.}9,00,000$

Year	Cash flow	PVF @ 10%	DCF
1	-10,00,000	0.909	-9,09,000
2 to 4	9,00,000	2.261	20,34,900
NPV if price reaches 5,500			11,25,900

NPV if price reaches 4,500 (50% probability)

- Investment will not happen as the project will have negative NPV. Price of 4,500 will translate into losses in every year
- NPV if price reaches 4,500 = 0

Expected NPV of opening the mine in year 1:

- Expected NPV = $(11,25,900 \times 0.50) = (0 \times 0.50) = \text{Rs.}5,62,950$
- Hence company can wait for one year and open the mine if the price touches Rs.5,500. This strategy would lead to an expected NPV of Rs.5,62,950

WN 3: Evaluation of abandonment option if mine is opened today:

- Abandonment option gives the flexibility to the company to close the mine at any time in case the prices are not favourable for the company.

Year 1				
Price	Probability	Profit	Expected cash flow	Overall Cash flow
5,500	0.50	900	450	4,50,000
4,500	0.50	-100	-50	-50,000
Cash flow of year 1				4,00,000

- The company will continue to run mines at both prices in year 1. This is because if the price reaches 4,500 then there is a possibility of price touching 5,000 which can lead to profits

Year 2				
Price	Probability	Profit	Expected cash flow	Overall Cash flow
6,000	0.25 [0.50 x 0.50]	1,400	350	3,50,000
5,000	0.25 [0.50 x 0.50]	400	100	1,00,000
5,000	0.25 [0.50 x 0.50]	400	100	1,00,000
4,000	0.25 [0.50 x 0.50]	-600	-150	-1,50,000
Cash flow of year 2				4,00,000

- The company will shut-down mine by end of year 2 if the price touches 4,000. This is because even with increase in price to 4,500 in year 3 the company would be making losses. Hence company will exercise abandonment in year 2 if price touches 4,000 (25% probability of it happening)

Year				
Price	Probability	Profit	Expected cash flow	Overall Cash flow
6,500	0.125 [0.50 x 0.50 x 0.50]	1,900	237.50	2,37,500
5,500	0.125 [0.50 x 0.50 x 0.50]	900	112.50	1,12,500
5,500	0.125 [0.50 x 0.50 x 0.50]	900	112.50	1,12,500
4,500	0.125 [0.50 x 0.50 x 0.50]	-100	-12.5	-12,500
5,500	0.125 [0.50 x 0.50 x 0.50]	900	112.50	1,12,500
4,500	0.125	-100	-12.5	-12,500

	[0.50 x 0.50 x 0.50]		
4,500	0.125 [0.50 x 0.50 x 0.50]	Mine is closed	
3,500	0.125 [0.50 x 0.50 x 0.50]	Mine is closed	
Cash flow of year 3			5,50,000

- Expected cash flow of year 3 has increased from Rs.4,00,000 to Rs.5,50,000 due to abandonment option. This is because company has closed down mine in year 2 when prices are unfavorable and hence is saved from the losses.

NPV with abandonment option:

Year	Cash flow	PVF @ 10%	DCF
0	-10,00,000	1.000	-10,00,000
1	4,00,000	0.909	3,63,600
2	4,00,000	0.826	3,30,400
4	5,50,000	0.751	4,13,050
NPV with abandonment option			1,07,050
NPV without abandonment option			-5,200
Value of abandonment option [1,07,050 - (-5,200)]			1,12,250

Chapter 4 – Security Analysis**1. Test of market efficiency [Nov 2018 MTP, Nov 2008, May 2016 MTP, May 2021 MTP, Nov 2023 RTP, SM] [Concept Revision]**

The closing value of Sensex for the month of October, 2007 is given below

Date Closing	Sensex
1.10.07	2800
3.10.07	2780
4.10.07	2795
5.10.07	2830
8.10.07	2760
9.10.07	2790
10.10.07	2880
11.10.07	2960
12.10.07	2990
15.10.07	3200
16.10.07	3300
17.10.07	3450
19.10.07	3360
22.10.07	3290
23.10.07	3360
24.10.07	3340
25.10.07	3290
29.10.07	3240
30.10.07	3140
31.10.07	3260

You are required to test the weak form of efficient market hypothesis by applying the run test at 5% and 10% level of significance.

Following value can be used:

- Value of t at 5% is 2.101 at 18 degrees of freedom
- Value of t at 10% is 1.734 at 18 degrees of freedom
- Value of t at 5% is 2.086 at 20 degrees of freedom
- Value of t at 10% is 1.725 at 20 degrees of freedom.

Answer:

Answer:

WN 1: Computation of positive changes and negative changes:

Date	Sensex	Sign of Price Change
1.10.07	2800	
3.10.07	2780	-
4.10.07	2795	+
5.10.07	2830	+
8.10.07	2760	-
9.10.07	2790	+
10.10.07	2880	+
11.10.07	2960	+
12.10.07	2990	+
15.10.07	3200	+
16.10.07	3300	+
17.10.07	3450	+
19.10.07	3360	-
22.10.07	3290	-
23.10.07	3360	+
24.10.07	3340	-
25.10.07	3290	-
29.10.07	3240	-
30.10.07	3140	-

31.10.07	3260	+

- ❖ No of positive changes(n_1) = 11
- ❖ No of negative changes(n_2) = 8
- ❖ No of times sign has changed from positive to negative (r) = 8

WN 2: Computation of upper and lower limit for test of significance:

Particulars	Formula	Calculation	Amount
μ_r	$\frac{2n_1n_2}{n_1 + n_2} + 1$	$\frac{2(11)(8)}{11 + 8} + 1$	10.26
σ_r	$\sqrt{\frac{(Mean - 1)(Mean - 2)}{n - 1}}$	$\sqrt{\frac{(10.26 - 1)(10.26 - 2)}{19 - 1}}$	2.06
Test of significance at 5%			
Lower Limit	$\mu_r - (\sigma_r \times t\text{-value})$	$10.26 - (2.06 \times 2.101)$ (Note 1)	5.932
Upper Limit	$\mu_r + (\sigma_r \times t\text{-value})$	$10.26 + (2.06 \times 2.101)$	14.588
Test of significance at 10%			
Lower Limit	$\mu_r - (\sigma_r \times t\text{-value})$	$10.26 - (2.06 \times 1.734)$	6.688
Upper Limit	$\mu_r + (\sigma_r \times t\text{-value})$	$10.26 + (2.06 \times 1.734)$	13.832

Conclusion:

Computed r lies between the limits and hence the market exhibits weak form of efficiency.

Note:

- Test of significance is to be checked for $n-1$ degree of freedom. This concept is based on Bessel's correction which indicates that $n-1$ provides a better estimate, especially when dealing with small samples.
- n = No of positive changes + No of negative changes = $11 + 8 = 19$. Hence $n-1$ degree of freedom would be 18

2. Exponential moving average [May 2018 MTP, May 2018, Nov 2019, Nov 2017 MTP, May 2017 RTP, May 2024, SM]

Closing values of BSE Sensex from 6th to 17th day of the month of January of the year 200X were as follows:

Day	Date	Day	Sensex
1	6	THU	14522
2	7	FRI	14925
3	8	SAT	No trading
4	9	SUN	No trading
5	10	MON	15222
6	11	TUE	16000
7	12	WED	16400
8	13	THU	17000
9	14	FRI	No Trading
10	15	SAT	No Trading
11	16	SUN	No Trading
12	17	MON	18000

Calculate Exponential Moving Average (EMA) of Sensex during the above period. The 30 days simple moving average of Sensex can be assumed as 15,000. The value of exponent for 30 days EMA is 0.062. Give detailed analysis on the basis of your calculations.

Answer:**Computation of Exponential Moving Average:**

Date	Sensex	EMA of previous day	Change (Col 2 - Col 3)	EMA Adjustment (Col 3 x 30-day exponent)	New EMA (Col 3 + Col 5)
6	14,522	15,000.00	-478	-29.64	14,970.36
7	14,925	14,970.36	-45.36	-2.81	14,967.55

10	15,222	14,967.55	254.45	15.78	14,983.33
11	16,000	14,983.33	1,016.67	63.03	15,046.36
12	16,400	15,046.36	1,353.64	83.93	15,130.29
13	17,000	15,130.29	1,869.71	115.92	15,246.21
17	18,000	15,246.21	2,753.79	170.73	15,416.94

Conclusion: The market is bullish as the value of EMA is on increasing trend. The market is likely to remain bullish for short term to medium term if other factors remain the same. On the basis of this indicator (EMA) the investors/brokers can take long position.

3. EMA [May 2022] [Concept Revision]

Closing values of BSE Sensex from 3rd to 12th day of the month of January 2022 are as follows:

Day	Date	Sensex
1	3	17626
2	4	17805
3	5	17925
4	6	17746
5	7	17813
6	10	18003
7	11	18056
8	12	18212

The simple moving average of SENSEX Index for the month of December 2021 was 17174.

You are required to calculate

- The value of exponent for 15 days EMA.
- The exponential moving average (EMA) of SENSEX during the above period. (Calculations to be done up to 2 decimals only)
- Analyse the buy & sell signal on the basis of your calculations

Answer:

Part (i): Value of exponent for 15 days EMA:

$$\text{Exponent} = \frac{2}{n+1} = \frac{2}{15+1} = 0.125$$

Computation of Exponential Moving Average:

Date	Sensex	EMA of previous day	Change (Col 2 - Col 3)	EMA Adjustment (Col 3 x 15-day exponent)	New EMA (Col 3 + Col 5)
3	17,626.00	17,174.00	452.00	56.50	17,230.50
4	17,805.00	17,230.50	574.50	71.81	17,302.31
5	17,925.00	17,302.31	622.69	77.84	17,380.15
6	17,746.00	17,380.15	365.85	45.73	17,425.88
7	17,813.00	17,425.88	387.12	48.39	17,474.27
10	18,003.00	17,474.27	528.73	66.09	17,540.36
11	18,056.00	17,540.36	515.64	64.45	17,604.81
12	18,212.00	17,604.81	607.19	75.90	17,680.71

Conclusion: A buy (bullish) signal is generated when actual price line (SENSEX in the give case) rises through the moving average, while a sell a (bearish) signal is generated when actual SENSEX level declines through the moving averages. In the case under consideration the price line of SENSEX never breaches the 15-day EMA line. In-fact it is hovering around the 15-day EMA line only

4. Auto-Correlation Test [Jan 2021]

Mr. X is of the opinion that market has recently shown the Weak Form of Market Efficiency. In order to test the validity of his impression he has collected the following data relating to the movement of the SENSEX for the last 20 days.

Days	Open	High	Low	Close
1	33470.94	33492.44	33449.44	33453.99

2	33453.64	33476.34	33430.94	33434.83
3	33414.06	33437.96	33390.16	33431.93
4	33434.94	33460.04	33409.84	33383.41
5	33372.92	33399.22	33346.62	33370.93
6	33375.85	33403.35	33348.35	33340.75
7	33340.89	33369.59	33312.19	33330.98
8	33326.84	33356.74	33296.94	33335.08
9	33307.16	33338.26	33276.06	33301.97
10	33298.64	33330.94	33266.34	33259.03
11	33260.04	33293.54	33226.54	33251.53
12	33255.92	33290.62	33221.22	33285.89
13	33288.86	33324.76	33252.96	33329.28
14	33335.00	33372.10	33297.90	33284.17
15	33293.83	33332.13	33255.53	33298.78
16	33300.02	33339.52	33260.52	33325.38
17	33323.36	33364.06	33282.66	33329.95
18	33322.81	33364.71	33280.91	33319.67
19	33317.51	33360.61	33274.41	33302.32
20	33290.86	33335.16	33246.56	33319.61

You are required to test the Weak Form of Market Efficiency using Auto-Correlation test, taking time lag of 10 days.

Answer:

WN 1: Computation of change in values for period 1 to 10 and 11 to 20:

Period	Value	Change	Period	Value	Change
1	33453.99		11	33251.53	
2	33434.83	-19.16	12	33285.89	34.36
3	33431.93	-2.90	13	33329.28	43.39
4	33383.41	-48.52	14	33284.17	-45.11
5	33370.93	-12.48	15	33298.78	14.61
6	33340.75	-30.18	16	33325.38	26.60
7	33330.98	-9.77	17	33329.95	4.57
8	33335.08	4.10	18	33319.67	-10.28
9	33301.97	-33.11	19	33302.32	-17.35
10	33259.03	-42.94	20	33319.61	17.29

Note:

- Change of Period 2 = Value of Period 2 – Value of Period 1
- Change of Period 12 = Value of Period 12 – Value of Period 11

WN 2: Computation of Co-relation coefficient:

Prob	Period 1 to 10				Period 11 to 20				Pd ₁ d ₂
	Change	Product	Deviation	Pd ²	Change	Product	Deviation	Pd ²	
0.1111	-19.16	-2.13	2.50	0.69	34.36	3.82	26.79	79.74	7.44
0.1111	-2.90	-0.32	18.76	39.10	43.39	4.82	35.82	142.56	74.66
0.1111	-48.52	-5.39	-26.86	80.16	-45.11	-5.01	-52.68	308.35	157.22
0.1111	-12.48	-1.39	9.18	9.36	14.61	1.62	7.04	5.51	7.18
0.1111	-30.18	-3.35	-8.52	8.07	26.60	2.96	19.03	40.24	-18.02
0.1111	-9.77	-1.09	11.89	15.71	4.57	0.51	-3.00	1.00	-3.96
0.1111	4.10	0.46	25.76	73.73	-10.28	-1.14	-17.85	35.40	-51.09
0.1111	-33.11	-3.68	-11.45	14.57	-17.35	-1.93	-24.92	69.00	31.70
0.1111	-42.94	-4.77	-21.28	50.32	17.29	1.92	9.72	10.50	-22.98
Total		-21.66		291.71		7.57		692.30	182.15

Note:

- Concept of computation of correlation coefficient would be explained in detail in portfolio management chapter
- Change for period 1 to 10 and Period 11 to 20 is taken as per WN 1
- We have total of nine observations. We have taken equal probability for all years and hence probability = $1/9 = 0.1111$ Time
- Product = Change $\times$ Probability
- Deviation = Value of Change – sum of products
- Pd^2 = Probability $\times$ Deviation $\times$ Deviation
- Pd_1d_2 = Probability $\times$ Deviation of Period 1 to 10 $\times$ Deviation of Period 11 to 20

Computation of Co-relation coefficient:

Co-variance	=	182.15
SD of Period 1 to 10	=	$\sqrt{291.71} = 17.08\%$
SD of Period 11 to 20	=	$\sqrt{692.30} = 26.31\%$
Correlation co-efficient	=	$\frac{\text{Co - variance}_{12}}{\sigma_1 \sigma_2} = \frac{182.15}{17.08 \times 26.31} = 0.405 \text{ Times}$

Conclusion:

There is moderate degree of correlation between the returns of two periods hence it can be concluded that the market does not show the weak form of efficiency.

5. Moving Averages:

Compute 5-day moving averages from the following data:

Day	Price
1	74
2	62
3	77
4	46
5	40
6	59
7	49
8	38
9	50
10	74
11	76
12	72
13	45
14	58
15	73

Answer:**Computation of 5-day moving averages:**

Day	Price	5-days total	5-days average [5-days total/5]
1	74		
2	62		
3	77		
4	46		
5	40	299	59.8
6	59	284	56.8
7	49	271	54.2
8	38	232	46.4
9	50	236	47.2
10	74	270	54
11	76	287	57.4

12	72	310	62
13	45	317	63.4
14	58	325	65
15	73	324	64.8

- 5-day total = Total of prices of last 5 observations
- Day 5 total = Prices of Day 1 to Day 5
- Day 6 total = Prices of Day 2 to Day 6

6. Breadth Index:

Compute breadth index and interpret the same:

No of securities advanced	400
No of securities declined	300
No of securities unchanged	200

Answer:

Particulars	Amount
Net advances (400 - 300)	100
Total securities	900
Breadth index $(100/900) \times 100$	11.11

Interpretation:

- If the breadth index supports the movement of the Dow Jones Averages, it indicates technical strength. **This means that a significant number of securities are advancing, which aligns with the positive movement of the Dow Jones Averages.** It suggests that the market is likely to continue moving in the same direction as the Dow Jones Averages.
- If the breadth index contradicts the movement of the Dow Jones Averages, it indicates technical weakness. **This means that the breadth of the market is not supporting the movement of the Dow Jones Averages.** It suggests that the market may move in a direction opposite to the Dow Jones Averages, indicating potential weakness or a trend reversal.

7. Confidence index:

Compute Confidence index and interpret the same:

Yield on high-grade bonds	4%
Yield on low-grade bonds	6%

Answer:

Particulars	Amount
Confidence index	$\frac{\text{Yield on high grade bond}}{\text{Yield on low grade bond}} = \frac{4}{6} \times 100 = 66.67$

Interpretation:

- A rising confidence index is **expected to precede a rising stock market**. It indicates that investors are more willing to take risks in the market, **as the yields on high-grade bonds are relatively lower compared to low-grade bonds**. This suggests that investors have confidence in the overall market and are likely to invest more in stocks.
- A fall in the confidence index is **expected to precede a drop in stock prices**. It signifies that the yields on low-grade bonds **are rising faster** or falling more slowly than the yields on high-grade bonds. This indicates a decrease in investor confidence and suggests a potential shift towards safer investments, possibly leading to a decline in stock prices

8. RSI Index:

Compute RSI Index from the following information:

Day	Price
1	74
2	62
3	77
4	46

5	40
6	59
7	49
8	38
9	50
10	74
11	76
12	72
13	45
14	58
15	73

Answer:

Day	Price	Change	Gain	Loss
1	74			
2	62	-12	0	12
3	77	15	15	0
4	46	-31	0	31
5	40	-6	0	6
6	59	19	19	0
7	49	-10	0	10
8	38	-11	0	11
9	50	12	12	0
10	74	24	24	0
11	76	2	2	0
12	72	-4	0	4
13	45	-27	0	27
14	58	13	13	0
15	73	15	15	0
Average			7.14	7.21

$$\text{Relative Strength} = \frac{\text{Average gain}}{\text{Average loss}} = \frac{7.14}{7.21} = 0.99$$

$$\text{Relative Strength Index} = 100 - \left(\frac{100}{1 + \text{RS}} \right) = 100 - \left(\frac{100}{1 + 0.99} \right) = 100 - 50.25 = 49.75$$

Interpretation:

- The RSI ranges from 0 to 100, **with values above 70 typically considered overbought (indicating a potential reversal or correction) and values below 30 indicating oversold conditions (suggesting a potential upward price movement).**

Chapter 5 – Security Valuation**Practical Problems****Overview:**

- Part I – Valuation of equity shares
- Part II – Rights issue and buyback
- Part III – Valuation of convertible instruments
- Part IV – Bond valuation
- Part V – Enterprise Valuation
- Part VI – Money Market Instruments

Part I – Valuation of equity shares**1. Walter's model [Nov 2009, Nov 2010, Nov 2020]**

The earnings per share of a company is Rs.10 and the rate of capitalisation applicable to it is 10 per cent. The company has three options of paying dividend i.e.(i) 50%, (ii)75% and (iii)100%. Calculate the market price of the share as per Walter's model if it can earn a return of (a) 15, (b) 10 and (c) 5 per cent on its retained earnings.

Answer:**Computation of share price under different scenarios:**

$$\text{Price} = \left(\frac{D}{K_e} \right) + \left(\frac{\left(\frac{r}{K_e} \right) \times (E - D)}{K_e} \right)$$

ROE/PR	PR = 50%	PR = 75%	PR = 100%
ROE = 15%	$\left(\frac{5}{0.10} \right) + \left(\frac{\left(\frac{0.15}{0.10} \right) \times (10 - 5)}{0.10} \right)$ = 50 + 75 = Rs.125	$\left(\frac{7.5}{0.10} \right) + \left(\frac{\left(\frac{0.15}{0.10} \right) \times (10 - 7.5)}{0.10} \right)$ = 75 + 37.50 = Rs.112.50	$\left(\frac{10}{0.10} \right) + \left(\frac{\left(\frac{0.15}{0.10} \right) \times (10 - 10)}{0.10} \right)$ = 100 + 0 = Rs.100
ROE = 10%	$\left(\frac{5}{0.10} \right) + \left(\frac{\left(\frac{0.10}{0.10} \right) \times (10 - 5)}{0.10} \right)$ = 50 + 50 = Rs.100	$\left(\frac{7.5}{0.10} \right) + \left(\frac{\left(\frac{0.10}{0.10} \right) \times (10 - 7.5)}{0.10} \right)$ = 75 + 25 = Rs.100	$\left(\frac{10}{0.10} \right) + \left(\frac{\left(\frac{0.10}{0.10} \right) \times (10 - 10)}{0.10} \right)$ = 100 + 0 = Rs.100
ROE = 5%	$\left(\frac{5}{0.10} \right) + \left(\frac{\left(\frac{0.05}{0.10} \right) \times (10 - 5)}{0.10} \right)$ = 50 + 25 = Rs.75	$\left(\frac{7.5}{0.10} \right) + \left(\frac{\left(\frac{0.05}{0.10} \right) \times (10 - 7.5)}{0.10} \right)$ = 75 + 12.50 = Rs.87.50	$\left(\frac{10}{0.10} \right) + \left(\frac{\left(\frac{0.05}{0.10} \right) \times (10 - 10)}{0.10} \right)$ = 100 + 0 = Rs.100

ROE/PR	PR = 50%	PR = 75%	PR = 100%
ROE = 15%	Rs.125	Rs.112.50	Rs.100
ROE = 10%	Rs.100	Rs.100	Rs.100
ROE = 5%	Rs.75	Rs.87.50	Rs.100

2. Walter's model – Target Payout Ratio [May 2005]

The following figures are collected from the annual report of XYZ Ltd.:

Particulars	Amount
Net Profit	30 lakhs
Outstanding 12% preference shares	100 lakhs
No. of equity shares	3 lakhs
Return on Investment	20%
Cost of Equity	16%

What should be the approximate dividend pay-out ratio so as to keep the share price at Rs.42 by using Walter model?

Answer:**Computation of dividend payout ratio to get share price of Rs.42:**

Note 1: Computation of EPS:

Particulars	Amount
Net Profit	30,00,000
Less: Preference Dividend (12% x 100 lacs)	(12,00,000)
Earnings available to equity shareholders	18,00,000
No of shares	3,00,000
Earnings per share (EAES/No of shares)	6

Computation of Dividend Payout Ratio:

Price	=	$\left(\frac{D}{K_e}\right) + \left(\frac{\left(\frac{r}{K_e}\right) \times (E - D)}{K_e}\right)$
42	=	$\left(\frac{D}{0.16}\right) + \left(\frac{\left(\frac{0.20}{0.16}\right) \times (6 - D)}{0.16}\right)$
42 x 0.16	=	D + 1.25 (6 - D)
6.72	=	D + 7.50 - 1.25D
0.25D	=	0.78
D	=	0.78 ÷ 0.25 = 3.12 per share

- ❖ Dividend Payout Ratio = (DPS/EPS) x 100;
- ❖ Dividend Payout Ratio = (3.12/6.00) x 100 = 52%

3. Walter's model - Limiting value and computation of cost of equity [May 2012] [Homework]

X Ltd has an internal rate of return of 20%. It has declared dividend @ 18% on its equity shares, having face value of Rs.10 each. The payout ratio is 36% and Price Earning Ratio is 7.25. Find the cost of equity according to Walter's Model and hence determine the limiting value of its shares in case the payout ratio is varied as per the said model.

Answer:**WN 1: Computation of Cost of Equity:****Base data:**

Particulars	Calculation	Amount
Return on equity	Given	20%
Dividend per share	Rs.10 x 18%	1.80
Earnings per share	1.80/36%	5.00
Market price	EPS x PE Multiple 5 x 7.25	36.25

Note:

- Cost of equity cannot be taken as inverse of PE Multiple in this question as the requirement of question is to compute cost of equity. **This approach would make the question very simple and would defeat the purpose of the question**

Computation of cost of equity:

Price	=	$\left(\frac{D}{K_e}\right) + \left(\frac{\left(\frac{r}{K_e}\right) \times (E - D)}{K_e}\right)$
36.25	=	$\left(\frac{1.80}{K_e}\right) + \left(\frac{\left(\frac{0.20}{K_e}\right) \times (5 - 1.80)}{K_e}\right)$
36.25	=	$\left(\frac{1.80}{K_e}\right) + \left(\frac{0.64}{K_e^2}\right)$
36.25	=	$\left(\frac{1.80K_e + 0.64}{K_e^2}\right)$
36.25K _e ²	=	1.80K _e + 0.64
Final equation	=	36.25K _e ² - 1.80K _e + 0.64 = 0

Solving the quadratic equation:

- ❖ We will need two numbers when added become -1.80 and when multiplied becomes Rs.23.20 (36.26×0.64)
- ❖ Two numbers satisfying the above conditions are 4 and -5.80
- ❖ $36.25K_e^2 - 5.80K_e + 4K_e + 0.64 = 0$
- ❖ $36.25K_e(K_e - 0.16) + 4(K_e - 0.16) = 0$
- ❖ $(36.25K_e + 4)(K_e - 0.16) = 0$
- ❖ $K_e = -11.03\%$ (or) $K_e = 16\%$
- ❖ **Final cost of equity is equal to 16% as cost of equity cannot be negative**

WN 2: Computation of limiting value:

- ❖ The return on equity is 20% whereas cost of equity is 16%. The optimum payout ratio in this case is 0%
- ❖ **Limiting value will be calculated at a payout ratio which is opposite of optimum payout ratio.**
- ❖ In this question limiting value will be calculated at payout ratio of 100%

Price	=	$\left(\frac{D}{K_e}\right) + \left(\frac{\left(\frac{r}{K_e}\right) \times (E - D)}{K_e}\right)$
Price	=	$\left(\frac{5}{0.16}\right) + \left(\frac{\left(\frac{0.20}{0.16}\right) \times (5 - 5)}{0.16}\right)$
Price	=	31.25 + 0
Limiting value	=	Rs.31.25 per share

4. Gordon's model [May 2015, May 2021 RTP]

The following information is collected from the annual reports of J Limited:

Profit before tax	Rs.2.50 Crores
Tax rate	40 percent
Retention ratio	40 percent
Number of outstanding shares	50,00,000
Equity capitalization rate	12 percent
Rate of return on investment	15 percent

The market price of the share of the company in the bull market was somewhere around Rs.28 per share. Advice, whether the share of the Golden Ltd. should be purchased or not. Further, also suggest the form of Market prevalent as per EMH Theory.

Answer:**Base data**

Particulars	Amount
Profit before tax	2,50,00,000
Less: Tax @ 40%	(1,00,00,000)
Profit after tax/Earnings available to equity shareholders	1,50,00,000
No of shares	50,00,000
Earnings per share (EAES/No of shares)	3.00
Dividend per share (EPS x Payout ratio)	1.80
Growth rate (ROI x Retention ratio) = (15% x 40%)	6%

Computation of share price:

- ❖ **One important assumption under Gordon's model is on Dividend per share. DPS of Rs.1.80 can either be assumed as Nearby Dividend (D0) or Distant Dividend (D1)**
- ❖ **Nearby dividend is also called as current year dividend and is expected to be paid within 3 months (near term). Distant dividend is also called as next year dividend and is expected to be paid over longer period (>3 months)**
- ❖ **Majority of ICAI answers we will have assumption of taking dividend as D1 and hence that would be our primary answer and alternate answer would be by taking the dividend as D0**
- ❖ **In this question we are assuming DPS of Rs.1.80 as distant Dividend (D1)**

Price	=	$\left(\frac{D_1}{K_e - G}\right)$

Price	=	$\left(\frac{1.80}{12\% - 6\%}\right)$
Price	=	Rs.30.00

Alternate answer if DPS of Rs.1.80 is assumed as nearby dividend (D0):

Price	=	$\left(\frac{D_1}{K_e - G}\right)$
Price	=	$\left(\frac{1.80 + 6\%}{12\% - 6\%}\right)$
Price	=	Rs.31.80

Advice: Despite the fact that market price of share of the company during bull was around Rs.28, it is worth to purchase the same as intrinsic value of share is higher than market price even in bull phase. **The form of market is weak form of market as it is not discounting all information**

5. Walter/Gordon Model [Nov 2011, Nov 2020, SM] [Concept Revision]

A company has a book value per share of Rs.137.80. Its return on equity is 15% and it follows a policy of retaining 60% of its earnings. If the opportunity cost of capital is 18%, compute is the price of the share today using both Dividend Growth Model and Walter's Model?

Answer:

WN 1: Computation of share price as per Gordon's model (Dividend Growth Model)

Base data:

Particulars	Calculation	Amount
Book value per share	Given	137.80
Return on equity	Given	15%
Earnings per share	Book value per share x ROE 137.80 x 15%	20.67
Dividend per share	20.67 x 40%	8.27
Growth rate	IRR/ROE x Retention ratio 15% x 60%	9%

Note:

❖ It is assumed that Dividend per share of Rs.8.27 as D1 (Distant dividend)

Price	=	$\left(\frac{D_1}{K_e - G}\right)$
Price	=	$\left(\frac{8.27}{18\% - 9\%}\right)$
Price	=	Rs.91.89

Alternate answer if DPS of Rs.8.27 is assumed as D0(Nearby Dividend):

Price	=	$\left(\frac{D_1}{K_e - G}\right)$
Price	=	$\left(\frac{8.27 + 9\%}{18\% - 9\%}\right)$
Price	=	Rs.100.16

WN 2: Valuation of share as per Walter's model:

Price	=	$\left(\frac{D}{K_e}\right) + \left(\frac{\left(\frac{r}{K_e}\right) \times (E - D)}{K_e}\right)$
Price	=	$\left(\frac{8.27}{0.18}\right) + \left(\frac{\left(\frac{0.15}{0.18}\right) \times (20.67 - 8.27)}{0.18}\right)$
Price	=	45.94 + 57.41
Price	=	Rs.103.35 per share

6. Cost of equity and market price computation [May 2005, Nov 2013, Nov 2018, May 2011, Nov 2023 RTP, May 2024 MTP, SM]

Shares of Voyage Limited are being quoted at a price-earning ratio of 8 times. The company retains 45% of its earnings. The company's EPS is Rs.5 per share.

You are required to compute:

- The cost of equity to the company if the market expects a growth rate of 15% p.a.
- If the anticipated growth rate is 16% per annum, calculate the indicative market price with the same cost of capital
- If the company's cost of capital is 20% p.a. & the anticipated growth rate is 19% p.a., calculate the market price per share

Answer:

Part 1: Computation of cost of equity:

Note 1: Computation of Dividend (D1):

- ❖ Dividend per share = Rs.5 per share $\times$ 55% = Rs.2.75 per share
- ❖ It is assumed that Rs.2.75 per share as distant dividend (D1).

Note 2: Computation of market price:

- ❖ Market price = Earnings per share $\times$ PE Multiple
- ❖ Market price = 5 $\times$ 8 times = Rs.40 per share

Note 3: Computation of cost of equity:

Rate of return (or) Cost of equity (K_e)	$\frac{D1}{P_0} + \text{Growth rate}$	$\frac{2.75}{40} + 15\%$	$0.0687 + 0.1500 = 0.2187$ or 21.87%

Part 2: Computation of market price:

Market Price	$\frac{D1}{(K_e - G)}$	$\frac{2.75}{(21.87\% - 16\%)}$	Rs.46.85 per share

Part 3: Computation of market price:

Market Price	$\frac{D1}{(K_e - G)}$	$\frac{2.75}{(20\% - 19\%)}$	Rs.275 per share

Alternative solution: DPS of Rs.2.75 per share assumed as D0 of the company

Computation of cost of equity:

Rate of return (or) Cost of equity (K_e)	$\frac{D1}{P_0} + \text{Growth rate}$	$\frac{2.75 \times 1.15}{40} + 15\%$	$0.0791 + 0.1500 = 0.2291$ or 22.91%

Part 2: Computation of market price:

Market Price	$\frac{D1}{(K_e - G)}$	$\frac{2.75 \times 1.16}{(22.91\% - 16\%)}$	Rs.46.17 per share

Part 3: Computation of market price:

Market Price	$\frac{D1}{(K_e - G)}$	$\frac{2.75 \times 1.19}{(20\% - 19\%)}$	Rs.327.25 per share

7. Impact of new project on share price [Nov 2017]

Rahim Enterprises is a manufacturer and exporter of woolen garments to European countries. Their business is expanding day by day and in the previous financial year the company has registered a 25% growth in export business. The company is in the process of considering a new investment project. It is an all equity financed company with 10,00,000 equity shares of face value of Rs. 50 per share. The current issue price of this share is Rs. 125 ex-divided. Annual earning are Rs. 25 per share and in the absence of new investments will remain constant in perpetuity. All earnings are distributed at present. A new investment is available which will cost Rs. 1,75,00,000 in one year's time and will produce annual cash inflows thereafter of Rs. 50,00,000. Analyse the effect of the new project on dividend payments and the share price.

Answer:

WN 1: Computation of impact of new project on Dividends:

Year	Earnings	Investment	Dividends	DPS
1	2,50,00,000	1,75,00,000	75,00,000	7.50

	$[10,00,000 \times 25]$			$[75,00,0000/10,00,000]$
2 to ∞	$3,00,00,000$ $[2,50,00,000 + 50,00,000]$	0	3,00,00,000	30.00 $[3,00,00,000/10,00,000]$

WN 2: Computation of impact on share price:**Part 1: Computation of Cost of equity:**

Cost of equity (Ke)	$\frac{D1}{P0} + \text{Growth rate}$	$\frac{25}{125} + 0\%$	$0.20 + 0.00 = 0.20$ (or) 20%

Part 2: Computation of Share Price:

Year	Cash flow	PVF @ 20%	DCF
1	7.50	0.8333	6.25
1	150 [Note 1]	0.8333	125
Expected share price			131.25

Note 1: Computation of PV of Dividends of 2 to ∞

- ❖ Dividends is expected to remain same from year 2 till infinity. We can use Gordon's formula and calculate the share price at the end of year 1

P1	$\frac{D2}{(Ke - G)}$	$\frac{30}{(20\% - 0\%)}$	Rs.150 per share

Conclusion:

Share price will increase from Rs.125 to Rs.131.25 due to the new project.

8. Maintenance of dividend income [May 2018 MTP, May 2018 RTP, May 2016, Nov 2020 MTP, May 2022 MTP, Nov 2022 MTP, SM]

SAM Ltd has just paid a dividend of Rs. 2 per share and it is expected to grow @ 6% p.a. After paying dividend, the Board declared to take up a project by retaining the next three annual dividends. It is expected that this project is of same risk as the existing projects. The results of this project will start coming from the 4th year onward from now. The dividends will then be Rs. 2.50 per share and will grow @ 7% p.a. An investor has 1,000 shares in SAM Ltd. and wants a receipt of atleast Rs. 2,000 p.a. from this investment. Show that the market value of the share is affected by the decision of the Board. Also show as to how the investor can maintain his target receipt from the investment for first 3 years and improved income thereafter, given that the cost of capital of the firm is 8%.

Answer:**WN 1: Impact on market price:****Before Project:**

Market Price	$\frac{D1}{(Ke - G)}$	$\frac{2 + 6\%}{(8\% - 6\%)}$	Rs.106 per share

After new project:

P3	$\frac{D4}{(Ke - G)}$	$\frac{2.50}{(8\% - 7\%)}$	Rs.250 per share
P2	$\frac{P3}{(1 + K_e)}$	$\frac{250}{(1 + 8\%)}$	Rs.231.48 per share
P1	$\frac{P2}{(1 + K_e)}$	$\frac{231.48}{(1 + 8\%)}$	Rs.214.33 per share
P0	$\frac{P1}{(1 + K_e)}$	$\frac{214.33}{(1 + 8\%)}$	Rs.198.45 per share

- ❖ Share price will increase from Rs.106 to Rs.198.45 due to new project

WN 2: Maintenance of Dividend Receipt:

Year	Income needed	Share price	No of shares to be sold
1	2,000	214.33	9.33 shares rounded to 10 shares
2	2,000	231.48	8.64 shares rounded to 9 shares
3	2,000	250.00	8 shares

Note: The investor needed minimum income of Rs.2,000 and hence 9.33 shares have been rounded upwards to 10 shares. 9 shares would not have provided the receipt of Rs.2,000

$$\text{Dividend income of Year 4} = 2.50 \times (1,000 - 10 - 9 - 8) = \text{Rs.2,432.50}$$

Conclusion:

- ❖ The investor can maintain target receipt of Rs.2,000 by selling shares in first three years and thereafter he can earn higher dividend income of Rs.2,432.50 growing at the rate of 7%

9. Valuation of share – Beta and cost of equity [May 2005, May 2017 RTP, SM] [Homework]

A Company pays a dividend of Rs.2.00 per share with a growth rate of 7%. The risk free rate is 9% and the market rate of return is 13%. The Company has a beta factor of 1.50. However, due to a decision of the Finance Manager, beta is likely to increase to 1.75. Find out the present as well as the likely value of the share after the decision.

Answer:

Computation of share price before and after decision:

Particulars	Before	After
Risk free rate	9%	9%
Market return	13%	13%
Beta	1.50	1.75
Cost of equity [$K_e = R_f + \beta(R_m - R_f)$]	15%	16%
Current Dividend (D_0)	2	2
Dividend of next year (D_1)	2.14	2.14
Share price = $\left(\frac{D_1}{K_e - G}\right)$	$\left(\frac{2.14}{15\% - 7\%}\right)$ Rs.26.75	$\left(\frac{2.14}{16\% - 7\%}\right)$ Rs.23.78

Note:

- Dividend of Rs.2 per share can also be assumed as distant dividend (D_1) and the share price would be Rs.25 and Rs.22.22 before and after decision.

10. Decision on holding/buy/sell of shares [Nov 2014, May 2024, SM] [Concept Revision]

An investor is holding 5,000 shares of X Limited. Current year dividend rate is Rs.3/share. Market price of the share is Rs.40 each. The investor is concerned about several factors which are likely to change during the next financial year as indicated below:

Particulars	Current Year	Next Year
Dividend paid/anticipated per share	3	2.5
Risk free rate	12%	10%
Market risk premium	5%	4%
Beta value	1.3	1.4
Expected growth	9%	7%

In view of the above, advise whether the investor should buy, hold or sell the shares

Answer:

WN 1: Computation of fair price as per existing conditions:

Note 1: Computation of Cost of Equity:

- ❖ Cost of Equity (K_e) = $R_f + \text{Beta} \times (R_m - R_f)$
- ❖ $K_e = 12\% + 1.3 (5\%) = 18.5\%$

Note 2: Computation of fair market price:

Fair Market Price	$\frac{D_1}{(K_e - G)}$	$\frac{3 + 9\%}{(18.5\% - 9\%)}$	Rs.34.42 per share

WN 2: Computation of fair price as per revised conditions:

Note 1: Computation of Cost of Equity:

- ❖ Cost of Equity (K_e) = $R_f + \text{Beta} \times (R_m - R_f)$
- ❖ $K_e = 10\% + 1.4 (4\%) = 15.6\%$

Note 2: Computation of fair market price:

Fair Market Price	$\frac{D_1}{(K_e - G)}$	$\frac{2.5 + 7\%}{(15.6\% - 7\%)}$	Rs.31.10 per share

Market price of share of Rs.40 is higher in comparison to current fair market price of Rs.34.42 and revised fair market price of Rs.31.10. Hence the investor should sell the share

11. Valuation of share [Nov 2015 RTP, May 2015 MTP, Dec 2021, Nov 2022 RTP]

Two companies X Ltd. and Y Ltd. paid a dividend of Rs. 3.50 per share. Both are anticipating that dividend shall grow @ 8%. The beta of X Ltd. and Y Ltd. are 0.95 and 1.42 respectively. The yield on GOI Bond is 7% and it is expected that market shall increase at an annual rate of 13%.

You are required to determine:

- Value of share of both companies.
- Why there is a difference in the value of shares of two companies.
- If current market price of share of A Ltd. and B Ltd. are Rs. 74 and Rs. 55 respectively. As an investor what course of action should be followed?

Answer:

WN 1: Computation of value of share of both companies:

Note 1: Computation of Cost of Equity:

- ❖ Cost of Equity (K_e) = $R_f + \text{Beta} \times (R_m - R_f)$
- ❖ K_e of X Limited = $7\% + 0.95 (13\% - 7\%) = 12.70\%$
- ❖ K_e of Y Limited = $7\% + 1.42(13\% - 7\%) = 15.52\%$

Note 2: Computation of fair market price:

Value of A Limited	$\frac{D_1}{(K_e - G)}$	$\frac{3.5 + 8\%}{(12.7\% - 8\%)}$	Rs.80.43 per share
Value of B Limited	$\frac{D_1}{(K_e - G)}$	$\frac{3.5 + 8\%}{(15.52\% - 8\%)}$	Rs.50.27 per share

Reason for difference in value of shares of two companies:

- ❖ The valuation of share of B Ltd. is lower because of systematic risk (beta) is higher though both have same growth rate.

Decision on purchase of shares:

- ❖ If the price of share of A Ltd. is Rs. 74, the share is undervalued and it should be bought.
- ❖ If price of share of B Limited is Rs. 55, it is overvalued and should not be bought.

12. Share buy/Sell decision [May 2018 MTP, Nov 2015 MTP, May 2016, SM] [Homework]

An investor is holding 1,000 shares of Asian paints Company. Presently the rate of dividend being paid by the company is Rs.2 per share and the share is being sold at Rs.25 per share in the market. However, several factors are likely to change during the course of the year as indicated below:

	Existing	Revised
Risk free rate	12%	10%
Market risk premium	6%	4%
Beta value	1.4	1.25
Expected growth rate	5%	9%

In view of the above factors whether the investor should buy, hold or sell the shares? And why?

Answer:

Computation of fair market price:

$$P_0 = \frac{D_1}{K_e - G}$$

Particulars	Existing scenario	Revised scenario
1. Dividend of next year (D_1)	2.10 [2 + 5%]	2.18 [2 + 9%]
2. Cost of equity ($R_f + \text{Beta} \times (R_m - R_f)$)	= 12% + (1.4 × 6%) = 20.40%	= 10% + (1.25 × 4%) = 15%
3. Growth rate	5%	9%
4. Fair market price	13.63	36.33

- Under the existing scenario the share is overvalued. However, with change in expectations fair market price increases to Rs.36.33 per share. Share will be undervalued and we should buy the share

Note:

- Existing fair price of Rs.13.63 will not impact the decision. However, ICAI solution calculates both existing and revised fair market price and the final decision would be based on revised market price. It is advised that both existing and revised fair market prices are computed in exam.

13. Valuation of share and CAPM [May 2018, May 2019 MTP, Nov 2023 MTP, Nov 2014, SM]

The risk free rate of return R_f is 8 percent. The expected rate of return on the market portfolio R_m is 12 percent. The expected rate of growth for the dividend of Platinum Ltd is 6 percent. The last dividend paid on the equity stock of firm A was Rs.5.00. The beta of Platinum Ltd equity Stock is 1.5.

- What is the equilibrium price of equity stock of Platinum Limited?
- Evaluate the impact of following factors jointly on the equilibrium price of equity stock of Platinum Limited
 - ❖ The inflation premium increases by 2 percent
 - ❖ The expected growth rate increases by 2 percent in absolute terms
 - ❖ The beta of Platinum Ltd's rises to 1.8
 - ❖ Market return remains the same

Answer:

Computation of fair market price:

$$P_0 = \frac{D_1}{K_e - G}$$

Particulars	Existing scenario	Revised scenario
1. Dividend of next year (D_1)	5.30 [5 + 6%]	5.40 [5 + 8%]
2. Cost of equity ($R_f + \text{Beta} \times (R_m - R_f)$)	= 8% + 1.5 (12% - 8%) = 14.00%	= 8.16% + 1.8 (12% - 8.16%) = 15.072%
3. Growth rate	8%	4%
4. Equilibrium price	66.25 5.30 <u>14% - 6%</u>	76.36 5.40 <u>15.072% - 8%</u>

Notes:

- Inflation premium increases by 3 percent. Inflation forms part of risk-free rate. Inflation premium will increase risk-free rate from 8% to 8.16% (8% + (2% of 8%) = 8.16%)

Thus, the equilibrium price is increased by ₹ 10.13 per share

14. Step-up growth model [May 2017 MTP, Nov 2015, May 2019 RTP, May 2020 RTP]

X Limited is a shoes manufacturing company. It is all equity financed and has a paid-up capital of Rs.10,00,000 (Rs.10 per share). X Limited has hired swastika consultants to analyse the future earnings. The report of swastika consultants states as follows:

- ❖ The earnings and dividend will grow at 25% for the next two years
- ❖ Earnings are likely to grow at the rate of 10% from 3rd year onwards
- ❖ Further, if there is reduction in earnings growth, dividend payout ratio will increase to 50%

The other data related to the company are as follows:

Year	EPS	Net Dividend per share	Share Price
2010	6.30	2.52	63.00
2011	7.00	2.80	46.00
2012	7.70	3.08	63.75
2013	8.40	3.36	68.75
2014	9.60	3.84	93.00

You may assume that the tax rate is 30% (not expected to change in future) and post tax cost of capital is 15%.

By using the dividend valuation model, calculate

- ❖ Expected market price per share
- ❖ P/E Ratio

Answer:

WN 1: Computation of Dividends till the first year of stabilization phase:

- ❖ Earnings and dividends will grow at 25% for two years. Growth will stabilize at 10% from third year. Hence, we should compute dividends till third year

Year	EPS	DPS

1	12.00 [9.60 + 25%]	4.80 [3.84 + 25%]
2	15.00 [12 + 25%]	6.00 [4.80 + 25%]
3	16.50 [15 + 10%]	8.25 [16.50 x 50%]

WN 2: Valuation of share:

Year	Cash flow	PVF @ 15%	DCF
1	4.80	0.870	4.18
2	6.00	0.756	4.54
2	165 [Note 1]	0.756	124.74
Expected share price			133.46

Note 1: Computation of PV of Dividends of 3 to ∞

- ❖ Dividends is expected to grow at constant rate of 10 percent from year 3. We can use Gordon's formula and calculate the share price at the end of year 2

P2	$\frac{D_3}{(K_e - G)}$	$\frac{8.25}{(15\% - 10\%)}$	Rs.165 per share

WN 3: Computation of PE Multiple:

Particulars	Amount
Expected Price	133.46
EPS of current year	9.60
PE Multiple (MPS/EPS)	13.90 Times

15. Step-up growth model [May 2019, SM] [Homework]

The shares of G Ltd. we currently being traded at Rs.46. The company published its results for the year ended 31st March 2019 and declared a dividend of Rs.5. The company made a return of 15% on its capital and expects that to be the norm in which it operates. G Ltd. Also expects the dividends to grow at 10% for the first three years and thereafter at 5%. You are required to advise whether the share of the company is being traded at a premium or discount.

PVIF @ 15% for the next 3 years is 0.870, 0.756 and 0.658 respectively.

Answer:**WN 1: Computation of Dividends till the first year of stabilization phase:**

- ❖ Dividends will grow at 10% for three years. Growth will stabilize at 5% from fourth year. Hence, we should compute dividends till fourth year

Year	DPS
1	5.50 [5.00 + 10%]
2	6.05 [5.50 + 10%]
3	6.655 [6.05 + 10%]
4	6.988 [6.655 + 5%]

WN 2: Valuation of share:

Year	Cash flow	PVF @ 15%	DCF
1	5.50	0.870	4.785
2	6.05	0.756	4.574
3	6.655	0.658	4.379
3	69.88 [Note 1]	0.658	45.98
Expected share price			59.72

- Company made a return of 15% on its capital and the same has been taken as cost of equity in absence of any other information regarding cost of equity

Conclusion:

Hence, it is clear that shares are being traded at discount i.e. undervalued because intrinsic value of share is more than the market price

Note 1: Computation of PV of Dividends of 4 to ∞

- Dividends is expected to grow at constant rate of 10 percent from year 3. We can use Gordon's formula and calculate the share price at the end of year 2

P3	$\frac{D_4}{(K_e - G)}$	$\frac{6.988}{(15\% - 5\%)}$	Rs.69.88 per share

16. Valuation of shares as per step-up growth model [May 2019 RTP, Nov 2018 MTP]

Seawell Corporation, a manufacturer of do-it-yourself hardware and housewares, reported earnings per share of € 2.10 in 2003, on which it paid dividends per share of €0.69. Earnings are expected to grow 15% a year from 2004 to 2008, during this period the dividend payout ratio is expected to remain unchanged. After 2008, the earnings growth rate is expected to drop to a stable rate of 6%, and the payout ratio is expected to increase to 65% of earnings. The firm has a beta of 1.40 currently, and is expected to have a beta of 1.10 after 2008. The market risk premium is 5.5%. The Treasury bond rate is 6.25%.

Required:

- What is the expected price of the stock at the end of 2008?
- What is the value of the stock, using the two-stage dividend discount model?

Answer:**WN 1: Computation of Dividend till first year of stabilization phase:**

- Earnings are expected to grow at 15% for 2004 to 2008 and the stabilization will happen from 2009 onwards. Hence, we need to calculate dividends till 2009.

Year	Earnings	Dividend
2004	2.42	0.79
2005	2.78	0.91
2006	3.19	1.05
2007	3.67	1.21
2008	4.22	1.39
2009	4.48	2.91
	[4.22 + 6%]	[4.48 x 65%]

WN 2: Computation of market price at last year before stabilization phase:

- Growth stabilizes from 2009 and hence Market price has to be calculated at end of 2008

Market Price (2008)	$\frac{\text{Dividend of 2009}}{(K_e - G)}$	$\frac{2.91}{(12.30\% - 6\%)}$	Rs.46.19 per share

- We are computing the market price at end of 2008 and hence we should dividends of 2009 and cost of equity which would prevail post 2009

Note 1: Computation of cost of equity for 2004 to 2008

- Cost of Equity (K_e) = $R_f + \text{Beta} \times (R_m - R_f)$
- $K_e = 6.25\% + (1.4 \times 5.5\%) = 13.95\%$

Note 2: Computation of cost of equity post 2008:

- Cost of Equity (K_e) = $R_f + \text{Beta} \times (R_m - R_f)$
- $K_e = 6.25\% + (1.1 \times 5.5\%) = 12.30\%$

WN 3: Computation of fair market price:

Year	Cash flow	PVF @ 13.95%	DCF
2004	0.79	0.878	0.70
2005	0.91	0.771	0.70
2006	1.05	0.677	0.70
2007	1.21	0.594	0.72
2008	1.39	0.521	0.72

2008	46.19	0.521	24.06
Fair market price			27.60

Final Solution:

- ❖ Expected price at end of 2008 = Rs.46.19 per share
- ❖ Current market price as per two-stage dividend discount model = Rs.27.60 per share

17. Valuation of share [Nov 2020, May 2023, Nov 2021 MTP, May 2023] [Concept Revision]

An investor is considering purchasing equity shares of Alpha Ltd., whose current Market price is Rs.172.45. The company is proposing a dividend of Rs.6 for the year ending 31st March, 2024. Alpha Ltd. is expected to grow @ 20 percent per annum for the next four years. Thereafter, the growth, over the next three years, will decline linearly by 100 basis points per annum. Thereafter, it will stabilize at a certain growth rate per annum infinitely. The required rate of return for the investor is 20%. Dividend value is to be taken in 2 decimal points only.

You are required: (i) To calculate the stable growth rate of Alpha Ltd. after the end of 7 years. (ii) To advise whether it is worth to purchase the share at this price if the investor has a stable target growth rate of 15% per annum

Note: PVF is to be taken in 4 Decimals

Answer:**WN 1: Computation of Dividend till first seven years:**

- ❖ Dividends are expected to grow at 20% for 4 years. Then growth will fall by 1% for the next three years

Particulars	Dividend
Year 1	6
Year 2 (6 + 20%)	7.20
Year 3 (7.20 + 20%)	8.64
Year 4 (8.64 + 20%)	10.37
Year 5 (10.37 + 19%)	12.34
Year 6 (12.34 + 18%)	14.56
Year 7 (14.56 + 17%)	17.04

WN 2: Computation of market price at end of seven years (P7):

Year	Cash flow	PVF @ 20%	DCF
1	6	0.8333	5.00
2	7.20	0.6944	5.00
3	8.64	0.5787	5.00
4	10.37	0.4823	5.00
5	12.34	0.4019	4.96
6	14.56	0.3349	4.88
7	17.04	0.2791	4.76
PV of Dividends			34.60
Current market price			172.45
PV of Price of seventh year			137.85
PVF of year 7			0.2791
Price at end of year 7 $\left(\frac{137.85}{0.2791} \right)$			493.91

WN 3: Computation of stable growth rate:

$$P_7 = \frac{D_8}{K_e - G}; 493.91 = \frac{17.04 \times (1 + G)}{0.20 - G}; 98.782 - 493.91G = 17.04 + 17.04G$$

$$81.742 = 510.95G; G = \frac{81.742}{510.95} = 0.16 \text{ (or) } 16\%$$

Part (ii)

Since growth rate is more than target growth rate it is worth to purchase the share

18. Valuation of share [Nov 2019, Jan 2021] [Concept Revision]

The current EPS of M/s VEE Ltd. is Rs. 4. The company has shown an extraordinary growth of 40% in its earnings in the last few year This high growth rate is likely to continue for the next 5 years after which growth rate in earnings will decline from 40% to 10% during the next 5 years and remain stable at 10% thereafter. The decline in the growth rate during the five year transition period will be equal and linear. Currently, the company's pay-out ratio is 10%. It is likely to remain the same for the next five years and from the beginning of the sixth year till the end of the 10th year, the pay-out will linearly increase and stabilize at 50% at the end of the 10th year. The post tax cost of capital is 17%. You are required to calculate the intrinsic value of the company's stock based on expected dividend. If the current market price of the stock is Rs.125, suggest if it is advisable for the investor to invest in the company's stock or not.

Answer:**WN 1: Computation of EPS and DPS till first year of stabilization phase (11th year):**

Year	Growth rate	EPS	Payout Ratio	DPS
1	40%	5.60	10%	0.56
2	40%	7.84	10%	0.78
3	40%	10.98	10%	1.10
4	40%	15.37	10%	1.54
5	40%	21.51	10%	2.15
6	34%	28.82	18%	5.19
7	28%	36.89	26%	9.59
8	22%	45.00	34%	15.30
9	16%	52.20	42%	21.92
10	10%	57.42	50%	28.71
11	10%	63.16	50%	31.58

Note:

- Growth rate is 40% for year 5 and the same falls to 10% by year 10. This would mean fall of 30% for 5 years and yearly fall of 6% in growth rate
- Payout ratio is 10% for year 5 and the same increases to 50% by year 10. This would mean increase of 40% for 5 years and yearly increase of 8% in growth rate

WN 2: Valuation of share at the beginning of stabilization phase:

- Growth of company stabilized at the beginning of year 10 and hence we can compute the value of share at end of year 9

$$P_9 = \frac{D_{10}}{K_e - G}; P_9 = \frac{28.71}{17\% - 10\%} = \text{Rs. 410.14}$$

WN 3: Valuation of share:

Year	Cash flow	PVF @ 17%	DCF
1	0.56	0.855	0.48
2	0.78	0.731	0.57
3	1.10	0.625	0.69
4	1.54	0.534	0.82
5	2.15	0.456	0.98
6	5.19	0.390	2.02
7	9.59	0.333	3.19
8	15.30	0.285	4.36
9	21.92	0.244	5.35
10	410.14	0.244	100.07
Total			118.53

- Intrinsic value of share = Rs.118.53
- Current market price is Rs.125 whereas fair market price is Rs.118.53. Share is currently overvalued and hence we should not invest in share.

19. H Model:

Calculate value of equity share using H Model from the following information:

Dividend paid in last year	Rs.25
Cost of equity	8%

High-growth rate (short-term growth)	12%
Long-term growth rate	5%
Number of years for transition from high-growth to normal rate	5 years

Answer:

$$P_0 = \frac{D_0(1 + g_n)}{r - g_n} + \frac{D_0 H_1 (g_c - g_n)}{r - g_n}$$

$$P_0 = \frac{25(1 + 0.05)}{0.08 - 0.05} + \frac{25 \times 2.5 (0.12 - 0.05)}{0.08 - 0.05} = 875 + 145.83 = \text{Rs. } 1,020.33$$

20. Valuation of shares as per PE Multiple and Earnings growth model [Nov 2007, Nov 2012, May 2015 MTP, Jan 2021, May 2024 MTP, SM]

Given the following information:

Current Dividend	5.00
Discount rate	10.5%
Growth rate	4%

Required:

- Calculate the present value of the stock
- Is the stock overvalued if the price is Rs.70, ROE = 18% and EPS(E0) = Rs.4.50 applying
 - PE Multiple approach and
 - Earnings Growth model (using discount rate of 10.50%)

Answer:**Part one:**

Market Price	$\frac{D_1}{(K_e - G)}$	$\frac{5 + 4\%}{(10.5\% - 4\%)}$	Rs.80.00 per share

Part two:**Valuation of share as per PE Multiple Approach:**

Particulars	Amount
Return on equity	18%
PE Multiple (1/ROE)	5.56
EPS	4.50
Fair market price (EPS × PE Multiple)	25.02

Since, Actual Stock Price is higher, hence it is overvalued.

Valuation of share as per Earnings Growth Model:

Market Price	$\frac{E_1}{(K_e - G)}$	$\frac{4.50 + 4\%}{(10.50\% - 4\%)}$	Rs.72 per share

Note:

Since, Actual Stock Price is lower, hence it is slightly undervalued

21. Valuation of share [Nov 2018, May 2021 MTP, May 2020 MTP]

A company has an EPS of Rs.2.50 for the last year and the DPS of Rs.1. The earnings are expected to grow at 2% a year in long run. Currently it is trading at 7 times its earnings. IF the required rate of return is 14%, compute the following:

- An estimate of the P/E ratio using Gordon growth model
- The Long-term growth rate implied by the current P/E ratio

Answer:**WN 1: Estimation of PE Multiple using Gordon growth model:**

Market Price	$\frac{D_1}{(K_e - G)}$	$\frac{1 + 2\%}{(14\% - 2\%)}$	Rs.8.50 per share

❖ PE Multiple = (MPS/EPS) = 8.50/2.50 = 3.40 Times

WN 2: Computation of growth rate:

- ❖ The share is quoting at PE multiple of 7 times. Current market price on EPS of 2.50 and PE Multiple of 7 times would be Rs.17.50 per share

17.50	=	$\frac{1+G}{(0.14-G)}$
0.14 - G (17.50)	=	1+G
2.45 - 17.50G	=	1+G
1.45	=	18.50G
Growth rate	=	1.45/18.50
Growth rate	=	7.84%

22. Computation of maximum purchase price [May 2010, Nov 2019 RTP, May 2019 MTP, Nov 2022 MTP, SM]

Mr. A is thinking of buying shares at Rs. 500 each having face value of Rs. 100. He is expecting a bonus at the ratio of 1:5 during the fourth year. Annual expected dividend is 20% and the same rate is expected to be maintained on the expanded capital base. He intends to sell the shares at the end of seventh year at an expected price of Rs. 900 each. Incidental expenses for purchase and sale of shares are estimated to be 5% of the market price. He expects a minimum return of 12% per annum.

Should Mr. A buy the share? If so, what maximum price should he pay for each share? Assume no tax on dividend income and capital gain

Answer:

WN 1: Decision on purchase of share:

Year	Cash flow	PVF @ 12%	DCF
1	20	0.893	17.86
2	20	0.797	15.94
3	20	0.712	14.24
4	24	0.636	15.26
5	24	0.567	13.61
6	24	0.507	12.17
7	24	0.452	10.85
7	1026	0.452	463.75
PV of future cash inflows			563.68
Less: Purchase price (500 x 1.05)			(525)
Net gain			38.68

Note:

- ❖ Selling price at end of year 7 is Rs.900. Investor buying one share would get 1.2 shares and hence the gross sale proceeds would be Rs.1080. Selling expenses are 5% and hence net selling price is Rs.1,026
- ❖ Dividend of Rs.24 per share has been taken from year 4 as bonus issue is made in fourth year. Alternatively, higher dividend can be considered from fifth year

WN 2: Computation of maximum purchase price:

- ❖ PV of future dividends and sale proceeds = Rs.563.68; Maximum purchase outflow should therefore be Rs.563.68
- ❖ The investor needs to pay 5 percent expenses on purchase of shares
- ❖ **Maximum purchase price = (Rs.563.68/105%) = Rs.536.84**

23. Calculation of Number of GDR and Cost of GDR [May 2018 MTP, May 2018, Nov 2014, May 2017 MTP, Nov 2017 MTP, May 2021 MTP, May 2021 RTP, May 2022 RTP, May 2022, Nov 2023 RTP, May 2022 MTP, May 2024, SM] [Concept Revision]

Odessa Limited has proposed to expand its operations for which it requires funds of \$ 15 million, net of issue expenses which amount to 2% of the issue size. It proposed to raise the funds through a GDR issue. It considers the following factors in pricing the issue:

- ❖ The expected domestic market price of the share is Rs.300
- ❖ 3 shares underly each GDR
- ❖ Underlying shares are priced at 10% discount to the market price
- ❖ Expected exchange rate is Rs.60/\$

You are required to:

- compute the number of GDR's to be issued and cost of GDR to Odessa Limited, if 20% dividend

is expected to be paid with a growth rate of 20%.

- What is your suggestion if the company receives an offer from a US Bank willing to provide an equivalent loan with an interest rate of 12%?
- How much company can save by choosing the option as recommended by you?

Answer:

WN 1: Computation of number of GDR's to be issued:

Particulars	Calculation	\$
Money to be raised		1,50,00,000
Issue expenses		2%
Gross amount to be raised	$\frac{1,50,00,000}{98\%}$	1,53,06,122
Issue price per GDR	Note 1	13.50
Number of GDR to be issued	$\frac{1,53,06,122}{13.50}$	11,33,787

Note:

1. One GDR (Global Depository Receipt) consist of 3 shares. Current market price of a share is Rs.300. Hence issue price of one GDR is expected to be Rs.900. Company plans to price issue at 10 percent discount and hence issue price will be Rs.810. Exchange rate is 1 USD = Rs.60. Consequently, issue price of one GDR is Rs.810 (or) \$ 13.50

WN 2: Computation of cost of GDR:

- GDR is an instrument having the same characteristics as that of equity. GDR will get dividends income like equity and cost of GDR can be computed using Gordon formula

$$K_e = \frac{D_1}{P_0 - F} + \text{Growth rate}; K_e = \frac{6}{810 - 2\% \text{ of } 810} + 20\%;$$

$$K_e = 0.76\% + 20\% = 20.76\%$$

Note:

- It is assumed that face value of share is Rs.10 and hence 20% dividend would be Rs.2 per share. One GDR has 3 shares and hence dividend per GDR would be Rs.6
- Issue price is Rs.810 and floatation cost is 2% and hence net proceeds for cost of GDR computation is Rs.793.80 per GDR
- We can convert dividend as well as net proceeds in USD and do the calculations. However, answer would remain same

Part (ii) and (iii):

- If the company receives an offer from US Bank willing to provide an equivalent amount of loan with interest rate of 12%, it should accept the offer.
- If the offer is accepted there will be net saving of 8.76% [20.76 – 12.00]

24. Calculation of cost of equity [Nov 2018 RTP, SM]

Piyush Loonker and Associates presently pay a dividend of Re. 1.00 per share and has a share price of Rs.20.00.

- i. If this dividend were expected to grow at a rate of 12% per annum forever, what is the firm's expected or required return on equity using a dividend-discount model approach?
- ii. Instead of this situation in part (i), suppose that the dividends were expected to grow at a rate of 20% per annum for 5 years and 10% per year thereafter. Now what is the firm's expected, or required, return on equity?

Answer:

WN 1: Computation of required rate of return:

- Required rate of return on equity is known as cost of equity (K_e)

K_e	$\frac{D_1}{P_0} + \text{Growth rate}$	$\frac{1.12}{20} + 0.12$	$0.056 + 0.12 = 0.176 \text{ or } 17.60\%$

WN 2: Computation of required rate of return if growth rate is 20% for 5 years and then the growth rate is 10 percent post 5 years:

- Growth rate is 20 percent for 5 years and then growth rate reduces to 10 percent. We cannot use the

above formula and calculate cost of equity due to multiple growth rates

- We need to assume discount rate and calculate NPV of cash flows. If NPV is zero, then assumed discount rate is IRR of cash flows. IRR basically indicates the return earned by the investor and the same would be taken as expected or required return (Cost of equity)

Let us assume Discount rate to be 18% (Discount rate closer to earlier Ke of 17.60%):

Note 1: Computation of dividends till sixth year (first year of stabilization phase):

Year	Calculation	Dividends
1	1 + 20%	1.20
2	1.20 + 20%	1.44
3	1.44 + 20%	1.73
4	1.73 + 20%	2.08
5	2.08 + 20%	2.50
6	2.50 + 10%	2.75

Note 2: Computation of NPV if discount rate is 18%

Year	Cash flow	PVF @ 18%	DCF
0	(20)	1.000	(20.00)
1	1.20	0.847	1.02
2	1.44	0.718	1.03
3	1.73	0.609	1.05
4	2.08	0.516	1.07
5	2.50	0.437	1.09
5	34.38 [Note 3]	0.437	15.02
NPV			0.28

Note 3: Computation of PV of Dividends of 6 to ∞

- ❖ Dividends is expected to grow at constant rate of 10 percent from year 6. We can use Gordon's formula and calculate the share price at the end of year 5

P5	$\frac{D_6}{(K_e - G)}$	$\frac{2.75}{(18\% - 10\%)}$	Rs.34.38 per share

Note 4: Let us assume discount rate to be 19% (discount rate is increased as we got positive NPV at 18%):

Computation of NPV if discount rate is 19%

Year	Cash flow	PVF @ 19%	DCF
0	(20)	1.000	(20.00)
1	1.20	0.840	1.01
2	1.44	0.706	1.02
3	1.73	0.593	1.03
4	2.08	0.499	1.04
5	2.50	0.419	1.05
5	30.56 [Note 5]	0.419	12.80
NPV			-2.06

Note 5: Computation of PV of Dividends of 6 to ∞

- ❖ Dividends is expected to grow at constant rate of 10 percent from year 6. We can use Gordon's formula and calculate the share price at the end of year 5

P5	$\frac{D_6}{(K_e - G)}$	$\frac{2.75}{(19\% - 10\%)}$	Rs.30.56 per share

Note 6: Computation of IRR/Cost of equity:

- Share has positive NPV of 0.28 at discount rate of 18% and negative NPV of 2.06 at discount rate of 19%

IRR	$L_1 + \frac{\text{NPV at } L_1}{\text{NPV at } L_1 - \text{NPV at } L_2} \times (L_2 - L_1)$	$18 + \frac{0.28}{0.28 - (-2.06)} \times (19 - 18)$	18.12%

25. Valuation of share – dividend discount model [May 2013, May 2014 MTP, May 2018 MTP, Nov 2014 MTP, Nov 2018 RTP, May 2021 RTP, Nov 2019 MTP, SM] [Homework]

X Limited, just declared a dividend of Rs.14.00 per share. Mr. B is planning to purchase the share of X Limited, anticipating increase in growth rate from 8% to 9%, which will continue for three years. He also expects the market price of this share to be Rs. 360.00 after three years. You are required to determine:

- I. the maximum amount Mr. B should pay for shares, if he requires a rate of return of 13% per annum.
- II. the maximum price Mr. B will be willing to pay for share, if he is of the opinion that the 9% growth can be maintained indefinitely and require 13% rate of return per annum.
- III. the price of share at the end of three years, if 9% growth rate is achieved and assuming other conditions remaining same as in (ii) above.

Answer:

WN 1: Computation of maximum amount Mr.B can pay:

Note 1: Computation of Dividends for first three years:

Year	DPS
1	15.26 [14 + 9%]
2	16.63 [15.26 + 9%]
3	18.13 [16.63 + 9%]

Note 2: Maximum price to be paid:

Year	Cash flow	PVF @ 13%	DCF
1	15.26	0.885	13.51
2	16.63	0.783	13.02
3	378.13	0.693	262.04
Expected share price			288.57

WN 2: Computation of maximum price if growth rate of 9 percent can be maintained for indefinite period:

P0	$\frac{D1}{(Ke - G)}$	$\frac{15.26}{(13\% - 9\%)}$	Rs.381.50 per share

WN 3: Computation of price at end of three years if growth rate of 9 percent can be maintained for indefinite period:

P3	$\frac{D4}{(Ke - G)}$	$\frac{19.76}{(13\% - 9\%)}$	Rs.494 per share

- Dividend of year 4 = Dividend of year 3 + 9% = Rs.19.76 per share

26. Valuation of share [Homework]

In the past year, ABC paid a dividend of Rs.1.40. An analyst expects dividend to grow annually at 9.3 percent for next four years. At the end of year 4, the analyst expects the dividend to equal 40 percent of EPS and the PE multiple to be 11. If the required return on ABC Limited stock is 11.5 percent, calculate the current market price.

Answer:

WN 1: Computation of Dividends till year 4:

- ❖ Dividends will grow at 9.3 percent for four year and price at end of year 4 can be computed based on PE Multiple of 11 times

Year	DPS
1	1.53 [1.4 + 9.3%]
2	1.67 [1.53 + 9.3%]
3	1.83 [1.67 + 9.3%]

4	2.00 [1.83 + 9.3%]

WN 2: Computation of share price at end of year 4:

- DPS for year 4 is Rs.2.00 per share. Dividend is equal to 40 percent of EPS and hence EPS is Rs.5.00 per share [2/40%]
- Share is expected to quote at price earning multiple of 11 times and expected share price at end of year 4 is Rs.55 [5 x 11 times]

WN 3: Valuation of share:

Year	Cash flow	PVF @ 11.50%	DCF
1	1.53	0.897	1.37
2	1.67	0.804	1.34
3	1.83	0.721	1.32
4	57.00	0.647	36.88
Expected share price			40.91

27. Valuation of share

A company has an EPS of Rs.10 and the opportunity cost of capital for its equity shareholders is 16%. If the share is now trading at Rs.80, calculate the present value of growth opportunities.

Answer:**Value of share with no growth opportunities:**

P0	$\frac{D1}{(Ke - G)}$	$\frac{10}{(16\% - 0\%)}$	Rs.62.50 per share

- Payout ratio will be 100 percent if there is no growth and hence DPS is equal to EPS

Present value of growth opportunities (PVGO):

- PVGO = Current market price - Share price with no growth
- PVGO = Rs.80 - Rs.62.50 = Rs.17.50 per share

28. Subjective assessment of cost of equity [Nov 2018 MTP, Nov 2003, May 2017 RTP, SM] [Concept Revision]

Capital structure of Sun Ltd., as at 31.3.2003 was as under:

Particulars	Rs. (in lakhs)
Equity share capital (Rs.100 each)	80
8% preference share capital	40
12% debentures	64
Reserves	32

Sun Ltd., earns a profit of Rs.32 lakhs annually on an average before deduction of income-tax, which works out to 35%, and interest on debentures. Normal return on equity shares of companies similarly placed is 9.6% provided:

- ❖ Profit after tax covers fixed interest and fixed dividends at least 3 times.
- ❖ Capital gearing ratio is 0.75.
- ❖ Yield on share is calculated at 50% of profits distributed and at 5% on undistributed profits.

Sun Ltd., has been regularly paying equity dividend of 8%. Compute the value per equity share of the company assuming:

- 1% for every one time of difference for Interest and Fixed Dividend Coverage.
- 2% for every one time of difference for Capital Gearing Ratio.

Answer:**WN 1: Income statement of Sun Limited:**

Particulars	Amount
Profit before Interest and Taxes	32,00,000
Less: Interest on debentures (64,00,000 x 12%)	(7,68,000)
Profit before tax	24,32,000
Less: Tax @ 35% (24,32,000 x 35%)	(8,51,200)
Profit after tax	15,80,800

Less: Preference Dividend (40,00,000 × 8%)	(3,20,000)
Earnings available to equity shareholders	12,60,800
Less: Equity Dividend (80,00,000 × 8%)	(6,40,000)
Retained earnings	6,20,800

WN 2: Computation of fixed interest and fixed dividend coverage:

$$\text{Fixed interest and fixed dividend coverage} = \frac{\text{PAT} + \text{Fixed interest}}{\text{Fixed interest} + \text{Fixed Dividend}}$$

$$\text{Fixed interest and fixed dividend coverage} = \frac{15,80,800 + 7,68,000}{7,68,000 + 3,20,000} = \mathbf{2.16 \text{ Times}}$$

Note:

- PAT should cover interest and dividend atleast 3 times. We have added fixed interest to PAT while calculating the ratio as we need to find out how much cash flows are available for paying interest and dividend. PAT is already post deduction of interest and hence the same has been added back

WN 3: Computation of capital gearing ratio:

$$\text{Capital gearing ratio} = \frac{\text{Fixed charge bearing funds}}{\text{Equity shareholder funds}} = \frac{\text{Debentures} + \text{Preference capital}}{\text{Equity} + \text{Reserves}}$$

$$\text{Capital gearing ratio} = \frac{40 + 64}{80 + 32} = \mathbf{0.93 \text{ Times}}$$

WN 4: Computation of required yield (in %):

Particulars	%
Required yield of similarly placed companies	9.6
Add: Extra yield due to weaker capital gearing [0.93 – 0.75] × 2	0.36
Add: Extra yield due to weaker interest and dividend coverage [3–2.16] × 1	0.84
Target yield for Sun Limited	10.80

WN 5: Computation of yield (in Rs.):

Particulars	Amount
50% of distributed profits [6,40,000 × 50%]	3,20,000
5% of undistributed profits [6,20,800 × 5%]	31,040
Total Yield (A)	3,51,040
No of shares (B)	80,000
Yield per share (A/B)	4.388

WN 6: Computation of value per share:

Particulars	Amount
Yield per share (in Rs.)	4.388
Yield per share (in %)	10.80%
Value per share (Yield in Rs./Yield in %)	40.63

29. Valuation of share – Free cash flow approach [May 2009, Nov 2018 MTP, May 2015 MTP, Nov 2015 MTP, Nov 2016 MTP, Nov 2014 RTP, May 2020 RTP, May 2022, SM, May 2024 RTP, Nov 2024 MTP] [Concept Revision]

Mr. Amit is happy with the investment in a company as it is paying good dividend for the last few years. Last year it paid a dividend of Rs.2 per share. The share is currently trading at Rs.150 per share. He is of view that if he applies dividend discount model, the share is undervalued. As a financial expert examine his view that dividend discount model represents the fair value.

You being an expert is required to evaluate the market value of the share of the company.

Profit of the company	Rs. 290 crores
Equity capital of company'	Rs.1,300 crores
Par value of share	Rs.40 each
Debt ratio of company	27
Long run growth rate of the company	8%

Beta 0.1; risk free interest rate	8.7%
Market return	10.3%
Capital expenditure per share	Rs. 47
Depreciation per share	Rs. 39
Change in working capital	Rs. 3.45 per share

Answer:**WN 1: Computation of Free Cash Flow per share:**

- Question has given data on depreciation, capital expenditure, working capital per share and hence we can compute Free Cash Flow per share approach to value shares

Particulars	Calculation	Amount
Total Profit		290 crores
No of shares	[1,300/40]	32.50 crores
EPS	290/32.50	8.9231
Capex per share		47
Depreciation per share		39
Net capex per share		8
WC requirement per share		3.45
Total capex and WC per share		11.45
Funded with debt (Note 1)	27% x 11.45	3.0915
Funded with equity	73% x 11.45	8.3585
Free cash flow per share	8.9231 - 8.3585	0.5646

Note:

- The term debt ratio indicates proportion of capital employed represented by debt. The company has total funding requirement of 11.45 per share. 27% of the funding will come from debt and balance 73% of funding will come from equity
- $K_e = R_f + \beta \times (R_m - R_f)$; $K_e = 8.7 + 0.1 \times (10.3 - 8.7)$; $K_e = 8.86\%$

WN 2: Valuation of equity share:

$$P_0 = \frac{FCFE_1}{K_e - \text{Growth}} = \frac{0.5646 \times 1.08}{8.86\% - 8\%} = 70.90 \text{ per share}$$

WN 3: Valuation of share as per Dividend Discount Model:

$$P_0 = \frac{D_1}{K_e - \text{Growth}} = \frac{2 \times 1.08}{8.86\% - 8\%} = 251.16 \text{ per share}$$

Comments:

- From the above we can see that value per share on the basis of dividend discount model is more than the value per share on the basis of free cash flow to equity model.
- In the dividend discount model, the analyst considers the stream of expected dividends to value the company's stock. It is assumed that the company follows a consistent dividend payout ratio which can be less than the actual cash available with the firm
- A stock's intrinsic value based on the dividend discount model may not represent the fair value for the shareholders because dividends are distributed in the form of cash from profits. **In case the company is maintaining healthy cash in its balance sheet then it means that dividend pay-out is low which could result in undervaluation of the stock.**
- In the case of free cash flow to equity model a stock is valued on the cash flow available for distribution **after all the reinvestment needs of capex and incremental working capital are met.**
- Thus, using the free cash flow to equity model provides a better measure for valuations in comparison to the dividend discount model. Thus, the view of Mr. Amit that dividend discount model represents the fair value is incorrect. The share is not under-valued rather it is overvalued if we take "free cash flow to equity model" into consideration**

30. Valuation of share [May 2019, July 2021, SM]

Following Financials are available for PQR Ltd. for the year 2008:

	Rs. In lakhs
8% Debentures	125
10% bonds (2007)	50

Equity shares (Rs.10 each)	100
Reserves and surplus	300
Total assets	600
Assets turnover ratio	1.1
Effective interest rate	8%
Effective tax rate	40%
Operating margin	10%
Dividend payout ratio	16.67%
Current market price of share	Rs.14
Required rate of return of investors	15%

You are required to:

- Draw income statement for the year
- Calculate its sustainable growth rate
- Calculate the fair price of the Company's share using dividend discount model, and
- What is your opinion on investment in the company's share at current price

Answer:

WN 1: Income statement of PQR Limited of next year:

Particulars	Calculation	Amount
Sales (Note 1)		660
Less: Operating expenses	$660 \times 90\%$	(594)
Operating profit/EBIT		66
Less: Interest (Note 2)	$175 \times 8\%$	(14)
Earnings before tax		52
Less: Tax @ 40%	$52 \times 40\%$	(20.80)
Earnings after tax/EAES		31.20
Equity dividend	$31.20 \times 16.67\%$	5.20
Retained earnings	$31.20 - 5.20$	26.00

Note:

- Assets turnover ratio is 1.1 Times. This would mean that assets are rotated 1.1 times in a year and sales will be 1.1 times of total assets. Hence sales is 660 lacs
- The company has 8% debentures and 10% bonds. Interest should have been calculated based on these percentages. However, question also provides effective rate of interest and hence calculation has been done at 8%. This is possible if some debt is issued mid of year

WN 2: Computation of growth rate:

Particulars	Calculation	Amount
Return on equity	$\frac{\text{EAES}}{\text{Amount of equity}} = \frac{31.20}{400} \times 100$	7.80%
Retention ratio	$100\% - \text{Payout ratio}; 100\% - 16.67\%$	83.33%
Growth	ROE x Retention ratio $7.80\% \times 83.33\%$	6.50%

WN 3: Computation of fair price:

Particulars	Calculation	Amount
Dividend per share	$\frac{5.20}{10}$	0.52
Cost of equity		15%
Fair price	$\frac{D_1}{K_e - G} = \frac{0.52 + 6.5\%}{15\% - 6.50\%}$	6.52

Note:

- It is assumed that Dividend of 0.52 per share as current dividend(D₀) and hence growth rate of 6.5 percent is added to compute fair price

Conclusion:

Since the current market price of share is Rs. 14, the share is overvalued. Hence the investor should not invest in the company

31. Valuation of Share [Nov 2019, May 2021 MTP] [Homework]

You are interested in buying some equity stocks of RK Ltd. The company has 3 divisions operating in different industries. Division A captures 10% of its industries sales which is forecasted to be Rs. 50 crore for the industry. Division B and C captures 30% and 2% of their respective industry's sales, which are expected to be Rs. 20 crore and Rs. 8.5 crore respectively. Division A traditionally had a 5% net income margin, whereas divisions B and C had 8% and 10% net income margin respectively. RK Ltd. has 3,00,000 shares of equity stock outstanding, which sell at Rs. 250.

The company has not paid dividend since it started its business 10 years ago. However from the market sources you come to know that RK Ltd. will start paying dividend in 3 years time and the pay-out ratio is 30%. Expecting this dividend, you would like to hold the stock for 5 year. By analysing the past financial statements, you have determined that RK Ltd.'s required rate of return is 18% and that P/E ratio of 10 for the next year and on ending P/E ratio of 20 at the end of the fifth year are appropriate.

Required:

- Would you purchase RK Ltd. equity at this time based on your one year forecast?
- If you expect earnings to grow @ 15% continuously, how much are you willing to pay for the stock of RK Ltd?

Answer:**WN 1: Computation of EPS of RK Limited for Year 0:**

Division	Industry Sales	Market share	Company sales	Margin	Company Profit
A	50,00,00,000	10%	5,00,00,000	5%	25,00,000
B	20,00,00,000	30%	6,00,00,000	8%	48,00,000
C	8,50,00,000	2%	17,00,000	10%	1,70,000
Total Profit					74,70,000
No of shares					3,00,000
EPS (74,70,000/3,00,000)					24.90

Note: It is assumed that EPS of the company will continue to be the same in year 1 as there is no information on growth for part 1 of the question.

WN 2: Computation of price based on one-year forecast:

- Fair price at end of year 1 = EPS of Year 1 x PE Multiple of next year
- Fair price at end of year 1 = 24.90 x 10 Times = Rs.249

$$\text{PV of share price} = \frac{249}{1.18} = 211.01$$

Conclusion:

- Actual market price is Rs.250 whereas fair market price is Rs.211.01. Share is currently overvalued and hence the same is not to be bought

WN 3: Valuation of share based on growth rate of 15%:**Computation of Dividend Per share till first year of stabilization phase**

Year	Growth rate	EPS	Payout Ratio	DPS
1	15%	28.64	-	0
2	15%	32.93	-	0
3	15%	37.87	30%	11.36

Note:

- Growth rate has been steady at 15 percent for all years. However, the payout has stabilized at 30% in year 3 and hence cash flows have been calculated till year 3

Valuation of share at the beginning of stabilization phase

$$P_2 = \frac{D_3}{K_e - G}; P_2 = \frac{11.36}{18\% - 15\%} = \text{Rs. } 378.67$$

Valuation of share:

Year	Cash flow	PVF @ 18%	DCF
1	0	0.847	0

2	378.67	0.718	271.89
Fair value of share			271.89

32. Valuation of share [Nov 2019] [Homework]

Following information is available for M/s TS Limited:

Particulars	Rs. Crores
PBIT	5.00
Less: Interest on debt (10%)	1.00
PBT	4.00
Less: Tax @ 25%	1.00
PAT	3.00
No of outstanding shares	40 lacs
EPS	7.50
Market price per share	75
PE Ratio	10 Times

TS Ltd. has an undistributed reserves of Rs. 8 crores. The company requires Rs. 3 crores for the purpose of expansion which is expected to earn the same rate of return on capital employed as present. However, if the debt to capital employed ratio is higher than 35%, then P/E ratio is expected to decline to 8 Times and rise in the cost of additional debt to 14%. Given this data which of the following options the company would prefer, and why?

Option (i) : If the required amount is raised through debt, and

Option (ii) : If the required amount is raised through equity and the new shares will be issued at a price of Rs. 25 each.

Answer:

WN 1: Computation of new EBIT:

Particulars	Existing	Revised
EBIT (A)	5.00	5.6825 (22 cr x 22.73%)
Capital Employed (B)	22.00	25.00
Share capital (40 lacs x 10)	4.00	4.00
Reserves and surplus	8.00	8.00
Borrowing (1 cr/10%)	10.00	10.00
New fund raised		3.00
ROCE (A/B) x 100	22.73%	22.73%

WN 2: Computation of debt to capital employed for both options:

Particulars	Option 1	Option 2
Debt	13	10
Capital Employed	25	25
Debt to capital employed	52%	40%
Applicable PE Multiple	8	8

WN 3: Computation of market price of both options:

Particulars	Option 1	Option 2
EBIT	5.6825	5.6825
Less: Interest	1.4200 (1.00 + 0.42)	1.0000
EBT	4.2625	4.6825
Less: Tax @ 25%	1.0656	1.1706
PAT	3.1969	3.5119
No of shares	40 lacs	52 lacs
EPS	7.99	6.75
PE Multiple	8	8
New share price	63.92	54.00

Note:

- Interest under option 1 = 1 crores + (3 crores x 14%) = Rs.1.42 Crores
- No of shares under option 2 = 40 lacs + (3 crores/25) = 52 lacs

Conclusion:

- We should go ahead with option 1 due to higher Market Price Per Share

**33. Stock Lending [Jan 2021, May 2022 RTP, May 2023 MTP, Nov 2024 RTP] [Concept Revision]
[Homework]**

Mr. A is holding 1000 shares of face value of Rs.100 each of M/s. ABC Ltd. He wants to hold these shares for long term and have no intention to sell.

On 1st January 2020, M/s XYZ Ltd. Has made short sales of M/s. ABC Ltd.'s shares and approached Mr. A to lend his shares under Stock Lending Scheme with following terms:

- Shares to be borrowed for 3 months from 01-01-2020 to 31-03-2020,
- Lending Charges/Fees of 1% to be paid every month on the closing price of the stock quoted in Stock Exchange and
- Bank Guarantee will be provided as collateral for the value as on 01-01-2020.

Other Information:

- Cost of Bank Guarantee is 8% per annum,
- ABC Limited had declared dividend of Rs.25 per share in the interim period
- On 29-02-2020 M/s. ABC Ltd.'s share quoted in Stock Exchange on various dates are as follows:

Date	Share Price in Scenario -1 Bullish	Share Price in Scenario - 2 Bullish
01-01-2020	1,000	1,000
31-01-2020	1,020	980
29-02-2020	1,040	960
31-03-2020	1,050	940

You are required to find out:

- Earning of Mr. A through Stock Lending Scheme in both the scenarios,
- Total Earnings of Mr. A during 01-01-2020 to 31-03-2020 in both the scenarios,
- What is the Profit or loss to M/s. XYZ by shorting the shares using through Stock Lending Scheme in both the scenarios?

Answer:**WN 1: Computation of Earning of Mr.A through stock lending scheme:**

Particulars	Scenario - 1	Scenario - 2
January Month	10,200 [1,000 shares x 1,020 x 1%]	9,800 [1,000 shares x 980 x 1%]
February Month	10,400 [1,000 shares x 1,040 x 1%]	9,600 [1,000 shares x 960 x 1%]
March Month	10,500 [1,000 shares x 1,050 x 1%]	9,400 [1,000 shares x 940 x 1%]
Total earning from Lending	31,100	28,800

WN 2: Computation of total earning of Mr.A:

Particulars	Scenario - 1	Scenario - 2
Earning from lending	31,100	28,800
Dividend income	25,000 [1,000 x 25]	25,000 [1,000 x 25]
Total earning of Mr.A	56,100	53,800

WN 3: Profit/loss to XYZ Limited:

Particulars	Scenario - 1	Scenario - 2
Profit/loss on short-sell	-50,000 [1,000 - 1,050] x 1,000	60,000 [1,000 - 940] x 1,000
Lending fees [WN 1]	-31,100	-28,800
Bank guarantee charges [1,000 shares x 1,000] x 8% x (3/12)	-20,000	-20,000
Profit/loss to XYZ Limited	-1,01,100	11,200

34. Computation of Dividend [July 2021, Nov 2024 MTP]

NM Ltd. (NML) is aspiring to enter the capital market in a three years' time. The Board wants to attain the target price of Rs. 70 for its shares at the end of three years. The present value of its shares is Rs. 52.03. The dividend is expected to grow at a rate of 15% for the next three years. NML uses dividend growth model for its projections. The required rate of return is 15%.

You are required to calculate the amount of dividend to be declared by the board in the base year so as to achieve the target price.

Period (t)	1	2	3
PVIF (15%,t)	0.8696	0.7561	0.6575

Answer:

Let us assume Dividend of base year (year 0) to be A

Year	Cash flow	PVF @ 15%	DCF
1	1.15A	0.8686	A
2	1.3225A	0.7561	A
3	1.5209A	0.6575	A
3	70	0.6575	46.03
PV of Share			52.03

- Hence $3A + 46.03 = 52.03$
- $A = \text{Rs.2 per share}$
- Hence Dividend for the base year will be Rs.2 per share

Part II - Rights Issue and Buyback

35. Rights issue [Nov 2010, May 2014 MTP, Nov 2014 RTP, Nov 2018 RTP, May 2021 RTP]

ABC Limited has issued 75,000 equity shares of Rs.10 each. The current market price per share is Rs. 24. The company has a plan to make a rights issue of one new equity share at a price of Rs.16 for every four share held.

You are required to:

- ❖ Calculate the theoretical post-rights price per share;
- ❖ Calculate the theoretical value of the right alone;
- ❖ Show the effect of the rights issue on the wealth of a shareholder, who has 1,000 shares assuming he sells the entire rights; and
- ❖ Show the effect, if the same shareholder does not take any action and ignores the issue.

Answer:

WN 1: Computation of post-rights price:

$$\text{Ex - rights Price} = \frac{(\text{Existing shares} \times \text{existing price}) + (\text{New shares} \times \text{rights price})}{\text{Existing shares} + \text{New shares}}$$

$$\text{Ex - rights Price} = \frac{(75,000 \times 24) + (18,750 \times 16)}{75,000 + 18,750} = \text{Rs. 22.40 per share}$$

WN 2: Computation of value of right:

Particulars	Amount
Ex-rights price	22.40
Rights Price	16
Value of one right	6.40
Value of one right (per share)	1.60 [6.40/4]

WN 3: Effect on shareholder's wealth:

Particulars	Sells rights	Ignores the issue
Existing shares	1,000	1,000
Existing Price	24	24
Existing wealth	24,000	24,000
Rights acquired (1,000/4)	250	0
Sales price of right (WN 2)	6.40	0
Money earned by selling rights[A]	1,600	0
Shares held post rights issue	1,000	1,000

Ex-rights price	22.40	22.40
Value of shares post rights issue [B]	22,400	22,400
Revised Wealth [A+B]	24,000	22,400
Impact on shareholder's wealth	0	Fall by Rs.1,600

36. Rights issue [May 2012 RTP, Nov 2018 RTP, Nov 2004, May 2014 RTP, May 2021 RTP, SM, Nov 2023] [Homework]

AB Limited's shares are currently selling at Rs.130 per share. There are 10,00,000 shares outstanding. The firm is planning to raise Rs.2 Crores for finance new project.

Required:

What is ex-rights price of shares and value of a right, if:

- The firm offers one right share for every two shares held
- The firm offers one right share for every four shares held
- How does the shareholder's wealth change from (i) to (ii)? How does rights issue increase shareholder's wealth?
- Suppose Mr. A who is holding 100 shares in AB Ltd. is not interested in subscribing to the right issue, then advice what should he do.

Answer:

WN 1: Computation of ex-rights price and value of a right for two situations:

Particulars	Offer I	Offer II
Amount to be raised	2,00,00,000	2,00,00,000
Rights ratio	1:2	1:4
No of rights shares to be issued	5,00,000 [10,00,000 x (1/2)]	2,50,000 [10,00,000 x (1/4)]
Rights Price	Rs.40 [2,00,00,000/5,00,000]	Rs.80 [2,00,00,000/2,50,000]
Existing shares	10,00,000	10,00,000
Existing Price	130	130

Ex-rights price calculation:

$$\text{Ex - rights Price} = \frac{(\text{Existing shares} \times \text{existing price}) + (\text{New shares} \times \text{rights price})}{\text{Existing shares} + \text{New shares}}$$

$$\text{Situation 1} = \frac{(10,00,000 \times 130) + (5,00,000 \times 40)}{10,00,000 + 5,00,000} = \text{Rs. 100}$$

$$\text{Situation 2} = \frac{(10,00,000 \times 130) + (2,50,000 \times 80)}{10,00,000 + 2,50,000} = \text{Rs. 120}$$

Value of right calculation:

Particulars	Offer I	Offer II
Ex-rights price	100	120
Rights Price	40	80
Value of one right	60	40
Value of one right (per share)	30 [60/2]	10 [40/4]

WN 2: Impact on shareholder's wealth:

Let us assume the shareholder owns 100 shares

Particulars	Offer I	Offer II
Existing shares	100	100
Existing Price	130	130
Existing wealth	13,000	13,000
Rights shares acquired	50	25
Rights Price	40	80
Amount paid for purchasing shares [A]	2,000	2,000
Revised shares post rights issue	150	125

Ex-rights price	100	120
Value of shares post rights issue [B]	15,000	12,500
Revised Wealth [B-A]	13,000	13,000

Shareholder's wealth remains same before and after rights issues in both offers. Hence rights issue has no impact on shareholder's wealth

Part (iv):

If Mr. A is not interested in subscribing to the right issue, he can renounce his right eligibility and earn income on sale of rights

37. Rights issue [RTP Nov 2010]

ABC Limited has paid-up ordinary share capital of Rs.2,00,00,000 represented by 4,00,000 shares of Rs.50 each. Earnings after tax in the most recent year were Rs.75,00,000 of which Rs.25,00,000 was distributed as dividend. The current PE multiple is 8. The company is planning a major investment that will cost Rs.202.50 lacs and is expected to produce additional after tax earnings over the foreseeable future at the rate of 15% on the amount invested. It was proposed by CFO of company to raise necessary finance by a rights issue to the existing shareholders at a price 25% below the current market price of the company's shares.

You have been appointed as a management consultant and are required to calculate:

- The current market price of the shares already in issue
- The price at which the rights issue will be made
- The number of new shares that will be issued
- The price at which the shares of the entity should theoretically be quoted on completion of the rights issue assuming no incidental costs and that the market accepts the entity's forecast of incremental earnings

It has been said that, provided the required amount of money is raised and that the market is aware of the earning power of the new investment, the financial position of existing shareholders should be the same whether or not they decide to subscribe for the rights they are offered. You are required to illustrate that there will be no change in the existing shareholder's wealth.

Answer:**WN 1: Computation of current market price:**

Particulars	Calculation	Amount
Total earnings	Given	75,00,000
No of shares	Given	4,00,000
Earnings per share	75,00,000/4,00,000	18.75
PE Multiple		8
Market price	18.75 x 8	Rs.150

WN 2: Computation of price at which rights issue will be made and no of shares issued:

Particulars	Calculation	Amount
Current market price	WN 1	150
Rights issue price	150 x 75%	112.50
Funds to be raised		202.50 lacs
Shares to be issued	202.50 lacs/112.50	1,80,000

WN 3: Expected price post rights issue:**Note 1: Computation of NPV of Project:**

Particulars	Calculation	Amount
Cost of project	Given	202.50 lacs
Earning of project	202.50 x 15%	30.375 lacs
PE Multiple		8 Times
Value of project	30.375 lacs x 8	243 lacs
Less: Cost of project		(202.50 lacs)
NPV of Project		40.50 lacs

Note 2: Computation of ex-rights price:

$$\text{Ex - rights Price} = \frac{(\text{Existing shares} \times \text{existing price}) + (\text{New shares} \times \text{rights price}) + \text{NPV of Project}}{\text{Existing shares} + \text{New shares}}$$

$$\text{Ex - rights Price} = \frac{(4 \text{ lacs} \times 150) + (1.8 \text{ lacs} \times 112.50) + 40.50 \text{ lacs}}{4 \text{ lacs} + 1.80 \text{ lacs}} = \frac{843 \text{ lacs}}{5.80 \text{ lacs}}$$

Ex – rights Price = Rs. 145.34 per share

WN 3: Impact on shareholder's wealth:

There will be change in shareholder's wealth in this case but the change is due to positive NPV of new project and not due to rights issue.

Particulars	Buys shares	Sells rights
Existing shares (assumed)	1,000	1,000
Existing Price	150	150
Existing wealth	1,50,000	1,50,000
Rights shares purchased (1,000 x 1.80 lacs/4 lacs)	450	NA
Purchase price of share (WN 1)	112.50	NA
Money paid for buying shares (A)	50,625 [450 x 112.50]	NA
Rights sold (1,000 x 1.80 lacs/4 lacs)	NA	450
Sale value of one right (145.34 - 112.50)	NA	32.84
Money earned from selling rights (B)	NA	14,778
Shares held post rights issue	1,450	1,000
Ex-rights price	145.34	145.34
Value of shares post rights issue [C]	2,10,743	1,45,340
Revised Wealth [C+B-A]	1,60,118	1,60,118
Impact on shareholder's wealth (Revised wealth - Existing wealth)	10,118	10,118
Impact on wealth:		
Due to NPV of new project		
NPV of new project	40,50,000	40,50,000
Number of shares	4,00,000	4,00,000
NPV per share	10.125	10.125
Number of shares (pre-rights issue)	1,000	1,000
Total impact on wealth (1,000 x 10.125)	10,125	10,125
Impact due to rights issue	0	0

38. New issue versus rights issue [Nov 2015 RTP] [Concept Revision]

Telbel Limited is considering undertaking a major expansion involving outlay of Rs.150 Crores. The Board of Director of company are expecting to generate an additional profit of Rs.15.30 crore after a period of one year. Further, it is expected that this additional profit shall grow at the rate of 4% for indefinite period in future. Presently, Telbel Ltd. is completely equity financed and has 50 crore shares of Rs.10 each. The current market price of each share is Rs. 22.60 (cum dividend). The company has declared a dividend of Rs. 1.40 per share in last year. For the last few years dividend is increasing at a compound rate of 6% p.a. and it is expected to be continued in future also. This growth rate shall not be affected by expansion project in any way. Board of Directors are considering following ways of financing the possible expansion:

- ❖ A right issue on ratio of 1:5 at price of Rs.15 per share.
- ❖ A public issue of shares.

In both cases the dividend shall become payable after one year. You as a Financial Consultant required to:

- a) Determine whether it is worthwhile to undertake the project or not.
- b) Calculate ex-dividend market price of share if complete expansion is financed from the right issue.
- c) Calculate the number of new equity shares to be issued and at what price assuming that new shareholders do not suffer any loss after subscribing new shares.
- d) Calculate the total benefit from expansion to existing shareholders under each of two financing option.

Answer:

WN 1: Computation of NPV of new project:

Part 1: Computation of Cost of equity:

Cost of equity (Ke)	$\frac{D_1}{P_0} + \text{Growth rate}$	$\frac{1.40 + 6\%}{21.20} + 6\%$	0.07 + 0.06 = 0.13 (or) 13%

Note: Market price in Gordon's model is ex-dividend price. This is because share will quote at ex-dividend price once the dividends are paid out by the company

Part 2: Computation of NPV:

Particulars	Calculation	Amount
Cost of project	Given	150 crores
Value of Project	$\frac{CF_1}{K_e - \text{Growth}} = \frac{15.30 \text{ cr}}{13\% - 4\%}$	170 crores
NPV of Project		20 Crores

- ❖ The company should go ahead with project as the same generates positive NPV of Rs.20 Crores

WN 2: Computation of ex-rights price:

$$\text{Ex - rights Price} = \frac{(\text{Existing shares} \times \text{existing price}) + (\text{New shares} \times \text{rights price}) + \text{NPV of Project}}{\text{Existing shares} + \text{New shares}}$$

$$\text{Ex - rights Price} = \frac{(50 \text{ cr} \times 21.20) + (10 \text{ cr} \times 15) + 20 \text{ cr}}{50 \text{ cr} + 10 \text{ cr}} = \frac{1230 \text{ cr}}{60 \text{ Cr}} = \text{Rs. 20.50 per share}$$

WN 3: Computation of shares to be issued and issue price for new issue:

- ❖ Let us assume issue price as x
- ❖ No of shares to be issued = (150 Crores/x)
- ❖ We need to ensure that issue price and post-issue price as same. This will ensure that there is no loss for new shareholder

Particulars	Calculation	Amount
Post-issue market capitalization		1,230 crores
No of shares post issue		$50 \text{ Crores} + \frac{150 \text{ Cr}}{X}$
Post issue price (X)	=	$\frac{(1,230)}{(50 + (\frac{150}{X}))}$

$X = \frac{(1,230)}{(50 + (\frac{150}{X}))}$
$X (50 + (\frac{150}{X})) = 1,230$
$50X + 150 = 1,230$
$50X = 1,080$
$X = 21.60 \text{ per share}$

- ❖ Issue price for public issue = Rs.21.60 per share
- ❖ No of shares to be issued = (150 cr/21.60) = 6.94 Crores

WN 4: Computation of net benefit from expansion for existing shareholders:

Particulars	Rights issue	New issue
Existing wealth:		
No of shares	50 Crores	50 Crores
Market price	21.20	21.20
Existing wealth	1,060 Crores	1,060 Crores
Revised wealth		
No of shares held by existing shareholders	60 Crores	50 Crores
Market price	20.50	21.60
Value of shares (A)	1,230 Crores	1,080 Crores
Amount borrowed to buy rights issue shares (B)	150 Crores	
Net wealth (A - B)	1,080 Crores	1,080 Crores
Increase in wealth (New wealth - Existing wealth)	20 Crores	20 Crores

39. Rights issue [July 2021, Nov 2022 MTP] [Concept Revision]

Aggressive Ltd., is proposing to fund its expansion plan of Rs. 12 crore by making a rights issue. The current market price (CMP) is Rs. 40. The Board is willing to offer a discount of 20% on the CMP for the rights issue. The Board is also desirous that the fall in Ex-right price of the shares be restricted to 10% of CMP. You are required to calculate:

- The number of new equity shares to be offered for each rights held,
- Theoretical value of right and
- The total number of equity shares to be issued.

Answer:

WN 1: Computation of rights ratio:

Let us assume existing shares to be 1 and new share issued to be A

$$\text{Ex - rights Price} = \frac{(\text{Existing shares} \times \text{existing price}) + (\text{New shares} \times \text{rights price})}{\text{Existing shares} + \text{New shares}}$$

$$36 = \frac{(1 \times 40) + (A \times 32)}{1 + A}; 36 + 36A = 40 + 32A; 4A = 4; A = 1$$

- Hence the company would issue one share for every one existing share

WN 2: Value of right and number of shares issued:

- Value of right = Ex-rights price - Rights issue price = 36 - 32 = Rs.4 per right
- Number of shares issued = 12 crores/32 = 37,50,000 shares

40. Buyback of shares [Nov 2017 RTP, May 2018 MTP, Nov 2010, May 2006, Nov 2016 MTP, Nov 2013 RTP, July 2021, Nov 2022 RTP, Nov 2022 MTP, SM] [Concept Revision]

Rahul Ltd. has surplus cash of Rs. 100 lakhs and wants to distribute 27% of it to the shareholders. The company decides to buy back shares. The Finance Manager of the company estimates that its share price after re-purchase is likely to be 10% above the buyback price-if the buyback route is taken. The number of shares outstanding at present is 10 lakhs and the current EPS is Rs. 3. You are required to determine:

- The price at which the shares can be re-purchased, if the market capitalization of the company should be Rs. 210 lakhs after buyback,
- The number of shares that can be re-purchased, and
- The impact of share re-purchase on the EPS, assuming that net income is the same.

Answer:

WN 1: Computation of buyback price:

- ❖ Let us assume the buyback price to be x
- ❖ The price after buyback will be 10 percent higher and hence the post buyback price will be 1.1x

Particulars	Calculation	Amount
Surplus cash		100 lacs
Buyback size	100 lacs x 27%	27 lacs
Buyback price		X
No of shares bought back		$\frac{27 \text{ lacs}}{x}$
Post-buyback market capitalization		210 lacs
Shares post buyback		$10 \text{ lacs} - \left(\frac{27 \text{ lacs}}{x}\right)$

Post buyback price = $\frac{\text{Market capitalization}}{\text{No of shares}}$
$1.1X = \frac{210}{\left(10 - \left(\frac{27}{x}\right)\right)}$
$1.1x \left(10 - \left(\frac{27}{x}\right)\right) = 210$
$11x - 29.7 = 210$
$11x = 239.70$
X = 21.79 per share

- ❖ Hence the buyback price will be Rs.21.79 per share

WN 2: Computation of shares to be bought back:

Particulars	Calculation	Amount

Buyback size		27,00,000
Buyback price	WN 1	21.79
Shares bought back	$\frac{27,00,000}{21.79}$	1,23,910 shares

WN 3: Computation of EPS post buyback:

Particulars	Calculation	Amount
Existing EPS		3
Existing shares		10,00,000
Existing earnings	3 x 10,00,000	30,00,000
Shares post buyback	10,00,000 - 1,23,910	8,76,090
New EPS	$\frac{30,00,000}{8,76,090}$	Rs.3.42 per share

41. Buyback Analysis [July 2021, May 2023]

SM Limited has a market capitalization of Rs. 3,000 crore and the current earnings per share (EPS) is Rs. 200 with a price earnings ratio (PER) of 15. The Board of directors is considering a proposal to buy back 20% of the shares at a premium which can be supported by the financials of the company. The Board expects post buy back market price per share (MPS) of Rs. 3057. Post buy back PER will remain same. The company proposes to fund the buy back by availing 8% bank loan since available resources are committed for expansion plans. Applicable income tax rate is 30%. You are required to calculate:

- The interest amount which can be paid for availing the bank loan,
- The loan amount to be raised and
- The premium per share and percentage premium paid over the current MPS.

Answer:**WN 1: Comparison of existing and post-buyback position:****(in crores)**

Particulars	Existing	Post-buyback
PAT	200	163.04
No of shares	1.00	0.80
EPS	200	203.80
PE Multiple	15	15
MPS	3,000	3,057
No of shares	1.00	0.80
Market value of Firm	3,000	2,445.60

Note:

- Existing MPS = $200 \times 15 = 3,000$
- Existing no of shares = $3,000 \text{ crores} / 3,000 = 1 \text{ crore}$
- Existing PAT = $200 \times 1 \text{ crore} = 200 \text{ crores}$
- Revised no of shares = $1 \text{ crore} - 20\% = 0.80 \text{ crore}$
- Revised EPS = $3,057 / 15 = \text{Rs.}203.80 \text{ per share}$
- Revised PAT = $203.80 \times 0.80 = 163.04 \text{ crores}$

Solution:

Particulars	Calculation	Amount (in cr)
Allowable post-tax interest expense	$200 \text{ cr} - 163.04 \text{ cr}$	36.96
Interest amount which can be paid (pre-tax)	$\frac{36.96}{0.70}$	52.80
Loan amount to be raised	$\frac{52.80}{8\%}$	660.00
Number of shares bought back		0.20
Buy-back price per share	$\frac{660}{0.20}$	3,300
Current market price per share		3,000
Premium paid per share		300

Percentage premium over current MPS	$\frac{300}{3,000} \times 100$	10.00%

42. Computation of post-buyback EPS [Nov 2018, May 2021 MTP] [Homework]

Eager Ltd. has a market capitalization of Rs. 1,500 crores and the current market price of its share is Rs. 1,500. It made a PAT of 200 crores and the Board is considering a proposal to buy back 20% of the shares at a premium of 10% to the current market price. It plans to fund this through a 16% bank loan. You are required to calculate the post buy back Earnings Per Share (EPS). The company's corporate tax rate is 30%.

Answer:

Particulars	Amount
Market capitalization	1,500 crores
Current Market Price	1,500
Existing shares (1,500 crores/1,500)	1 Crore
Shares to be bought back	20 lacs [1 crore x 20%]
Buy-back price	1,650 [1,500 + 10%]
Buy-back size	330 crores [1,650 x 20 lacs]
Interest on loan (330 crores x 16%)	52.8 crores
Post-tax interest cost (52.8 crores x 70%)	36.96 crores
Revised PAT [200 crores – 36.96 crores]	163.04 crores
Revised shares (1 crore – 0.2 crores)	0.8 crores
Post-buyback EPS [163.04/0.8]	203.8

Part III – Valuation of Convertible Instruments**43. Convertible bond [Nov 2018, Nov 2018 MTP, Nov 2016 RTP, Nov 2021 RTP, Nov 2024 MTP] [Concept Revision]**

The following data is related to 8.5% fully convertible (into equity shares) debentures issued by ABC Limited at Rs.1000.

Market Price of Debenture	Rs.900
Conversion Ratio	30
Straight value of Debenture	Rs.700
Market price of equity share	Rs.25
Expected dividend per share	Rs.1

You are required to calculate:

- ❖ Conversion value of debenture
- ❖ Market conversion price
- ❖ Conversion premium per share
- ❖ Ratio of conversion premium
- ❖ Premium over straight value of debenture
- ❖ Favorable income differential per share
- ❖ Premium pay-back period

Answer:

Particulars	Calculation	Amount
Conversion value	CMP of share x conversion ratio 25 x 30	750
Market conversion price (or) Conversion parity price	$\frac{\text{CMP of bond}}{\text{Conversion ratio}} = \frac{900}{30}$	30
Conversion premium		
Per debenture	900 – 750	Rs.150 per debenture
Per equity share	$\frac{150}{30}$	Rs.5 per equity share
Ratio of conversion premium	$\frac{150}{750} \times 100$	20% of conversion value

Premium over straight value:		
Premium over SV (in rupees)	CMP – straight value 900 – 700	Rs.200 per debenture
Premium over SV (in %)	$\frac{200}{700} \times 100$	28.57% of straight value
Favorable income differential:		
Interest income per bond	1,000 x 8.5%	Rs.85 per debenture
Dividend income per share		Rs.1
Dividend income for 30 shares		Rs.30
Favorable income differential per bond	Rs.85 – Rs.30	Rs.55 per bond
Favorable income differential per share	$\frac{55}{30}$	Rs.1.833 per share
Premium payback period	$\frac{\text{Conversion premium per share}}{\text{Income differential per share}}$	$\frac{5}{1.83} = 2.73 \text{ years}$

44. Convertible bond [May 2018 MTP, Nov 2018 MTP, May 2014, May 2017 RTP, May 2018, Nov 2022, Nov 2023 MTP, SM]

GHI Ltd., AAA rated company has issued, fully convertible bonds on the following terms, a year ago

Face value of bond	Rs.1000
Coupon (interest rate)	8.5%
Time to maturity (remaining)	3 years
Interest payment	Annual, at the end of year
Principal repayment	At the end of bond maturity
Conversion ratio (Number of shares per bond)	25
Current market price per share	Rs.45
Market price of convertible bond	Rs.1175

AAA rated company can issue plain vanilla bonds without conversion option at an interest rate of 9.5%.

Required:

- Straight value of bond
- Stock value of the bond
- Conversion premium
- Percentage of downside risk
- Conversion parity price

Answer:

WN 1: Computation of straight value:

- Straight value refers to the present value of future cash flows of convertible instrument discounted at investor's required rate of return.
- In this case we should discount bond's cash flows at comparable rate of 9.5%

Year	Cash flow	PVF @ 9.5%	DCF
1	85	0.913	77.61
2	85	0.834	70.89
3	1,085	0.762	826.77
			975.27

WN 2: Computation of conversion value and conversion premium:

Particulars	Calculation	Amount
Conversion value	CMP of share x conversion ratio 45 x 25	Rs.1,125
Conversion premium		
Per debenture	1,175 – 1,125	Rs.50 per debenture
Per equity share	$\frac{50}{25}$	Rs.2 per equity share
% of conversion value	$\frac{50}{1,125} \times 100$	4.44% of conversion value

WN 3: Computation of percentage of downside risk:

Particulars	Calculation	Amount

Downside risk in Rs.	CMP – Straight value	1,175 – 975.27 = Rs.199.73
Downside risk (%)		
% of straight value	$\frac{199.73}{975.27} \times 100$	20.48% of straight value
% of CMP	$\frac{199.73}{1,175} \times 100$	17.00% of CMP

WN 4: Computation of conversion parity price:

- Conversion parity price refers to the target price per equity share at which the investor will have no loss on conversion

$$\text{Conversion parity price} = \frac{1,175}{25} = \text{Rs. 47 per share}$$

45. Issue of convertible preference shares [Nov 2009, May 2019 MTP, May 2017, Nov 2023 RTP] [Homework]

XYZ company has current earnings of Rs.3 per share with 5,00,000 shares outstanding. The company plans to issue 40,000, 7% convertible preference shares of Rs. 50 each at par. The preference shares are convertible into 2 shares for each preference shares held. The equity share has a current market price of Rs. 21 per share.

- What is preference share's conversion value?
- What is conversion premium?
- Assuming that total earnings remain the same, calculate the effect of the issue on the basic earning per share (a) before conversion (b) after conversion.
- If profits after tax increases by Rs. 1 million what will be the basic EPS (a) before conversion and (b) on a fully diluted basis?

Answer:**WN 1: Computation of conversion value and conversion premium:**

Particulars	Calculation	Amount
Conversion value	CMP of share x conversion ratio 21 x 2	Rs.42
Conversion premium		
Per preference share	50 -42	Rs.8 per preference share
Per equity share	$\frac{8}{2}$	Rs.4 per equity share
% of conversion value	$\frac{8}{42} \times 100$	19.05% of conversion value

Note:

- Conversion premium can be expressed as per convertible instrument/per equity share/as a % of conversion value

WN 2: Computation of EPS if overall earnings remain same:

Particulars	Before conversion	After Conversion
Profit after tax (5,00,000 x 3)	15,00,000	15,00,000
Less: Preference Dividend (20,00,000 x 7%)	(1,40,000)	-
Earnings available to equity shareholders	13,60,000	15,00,000
Number of equity shares	5,00,000	5,80,000 [5,00,000 + 40,000 x 2]
Earnings per share (EAES/No of shares)	2.72	2.59

WN 3: Computation of EPS if overall earnings increase by Rs.10,00,000:

Particulars	Before conversion	After Conversion
Profit after tax [15,00,000 + 10,00,000]	25,00,000	25,00,000
Less: Preference Dividend (20,00,000 x 7%)	(1,40,000)	-
Earnings available to equity shareholders	23,60,000	25,00,000
Number of equity shares	5,00,000	5,80,000 [5,00,000 + 40,000 x 2]
Earnings per share (EAES/No of shares)	4.72	4.31

46. Conversion parity price and conversion premium: [Nov 2008, Nov 2015 MTP, Nov 2019 RTP, July 2021, May 2018 MTP, Nov 2023 MTP]

Following information is related to the Convertible Bond of A Ltd. which is currently priced at Rs.1060 per Bond:

- Conversion Parity Price = Rs.53
- Conversion Premium = 10.41667%
- Percentage of downside risk with respect to Straight value of Bond = 12.766%

Calculate:

- No. of shares on Conversion.
- Current Market Price Per Share of A Ltd.
- Straight Value of Bond

Answer:

WN 1: Computation of No of shares on conversion:

$$\text{Conversion Parity Price} = \frac{\text{CMP}}{\text{Conversion Ratio}}$$

$$53 = \frac{1,060}{\text{Conversion Ratio}}; \text{Conversion Ratio} = 20$$

- Hence no of shares on conversion = 20 shares

WN 2: Computation of current market price:

$$\begin{aligned} \text{CMP} &= \text{Conversion Value} + 10.41667\% \text{ of conversion Value} \\ 1,060 &= \text{Conversion Value} + 0.1041667 \text{ Conversion Value} \\ 1.1041667 \text{ Conversion Value} &= \text{Rs. } 1,060 \\ \text{Conversion Value} &= \frac{1,060}{1.1041667} = \text{Rs. } 960 \\ \text{Conversion Value} &= \text{CMP} \times \text{conversion ratio} \\ 960 &= \text{CMP} \times 20; \text{CMP} = \text{Rs.48 per share} \end{aligned}$$

WN 3: Computation of straight value:

$$\begin{aligned} \% \text{ of downside risk CMP} &= \frac{\text{CMP} - \text{Straight Value}}{\text{Straight Value}} \\ 0.12766 &= \frac{1060 - \text{SV}}{\text{SV}} \\ 1.12766 \text{ SV} &= 1,060; \text{SV} = \frac{1060}{1.12766} = \text{Rs. } 940 \end{aligned}$$

47. Convertible instruments [May 2022 MTP] [Homework]

The following data is related to 9% fully convertible (into equity shares) debentures issued by ABC Limited at Rs.1000.

Market Price of Debenture	Rs.1,000
Conversion Ratio	25
Straight value of Debenture	Rs.800
Market price of equity share on the date of conversion	Rs.30
Expected dividend per share	Rs.1

ANALYSE the value of Debenture both from cost and payback period angle for an investor who is considering to adopt the route of conversion to acquire the shares of the company

Answer:

Particulars	Calculation	Amount
Conversion value of debentures	25 shares x 30	Rs.750
Conversion premium		
Per debenture	1,000 - 750	Rs.250 per debenture
Per equity share	$\frac{250}{25}$	Rs.10 per equity share
Favorable income differential:		
Interest income per bond	1,000 x 9.0%	Rs.90 per debenture
Dividend income per share		Rs.1
Dividend income for 25 shares		Rs.25
Favorable income differential per bond	Rs.90 - Rs.25	Rs.65 per bond

Favorable income differential per share	$\frac{65}{25}$	Rs.2.60 per share
Premium payback period	$\frac{\text{Conversion premium per share}}{\text{Income differential per share}}$	$\frac{10}{2.60} = 3.85 \text{ years}$

Analysis:

Thus from above it can be analysed that:

- The Conversion Value of Debenture is less than the Market Value of Debenture because the Coupon Interest Rate is higher than Yield as Straight Value is somewhat near about the conversion value.
- If the investor adopts the route of Convertible Debenture for acquiring shares he/ she will have to pay premium over the market price.
- So far as the recovery of the premium paid for acquiring one share is concerned approximate it will take about 4 years.
- However, in case if the market price of the share is increased then of course the premium will be reduced and hence the payback period. Reverse will happen in case if the prices of the share goes below Rs. 30 per share.

48. Calculation of Minimum Price [May 2015 RTP] [Homework]

Suppose Mr. A is offered a 10% Convertible Bond (par value Rs. 1,000) which either can be redeemed after 4 years at a premium of 5% or get converted into 25 equity shares currently trading at Rs. 33.50 and expected to grow by 5% each year. You are required to determine the minimum price Mr. A shall be ready to pay for bond if his expected rate of return is 11%.

Answer:**Computation of minimum price:**

- Minimum price refers to the present value of bond computed using certain cash flows. Redemption value under certain cash flow is computed by taking principal as redemption value.
- In case of convertible bond, redemption value will be taken as higher of principal value and expected value of shares. However, for minimum price we should only take principal value as redemption value

Year	Cash flow	PVF @ 11%	DCF
1 to 4	100	3.103	310.30
4	1,050	0.659	691.95
Minimum price of bond			1,002.25

49. Decision on conversion [May 2018, Nov 2009, SM]

Sabanam Limited has issued convertible debentures with coupon rate of 11%. Each debenture has an option to convert to 16 equity shares at any time until the date of maturity. Debentures will be redeemed at Rs.100 on maturity of 5 years. An investor generally requires a rate of return of 8% p.a. on a 5-year security. As an advisor, when will you advise the investor to exercise conversion for given market prices of the equity share of (i) Rs.5, (ii) Rs.6 and (iii) Rs.7.10.

Answer:**WN 1: Computation of current market price of bond**

Year	Cash flow	PVF@8%	DCF
1 to 5	11	3.993	43.923
5	100	0.681	68.100
Value of bond			112.023

Note 1: Computation of redemption value:

- ❖ Redemption value of convertible bond on maturity date would be higher of the following:
 - **Conversion value of bond:** The details on share price on maturity date is not available and hence this cannot be computed
 - **Redemption as bond:** The bond can be redeemed on maturity date at par value of Rs.100
- ❖ Redemption value in this case would be taken as Rs.100 due to absence of information on conversion value of bond on maturity date.

WN 2: Decision on conversion of bond:

Market Price	Conversion ratio	Conversion value
Rs.5	16:1	Rs.80

Rs.6	16	Rs.96
Rs.7.10	16	Rs.113.60

Hence, unless the market price is Rs.7.10 conversion should not be exercised.

50. Computation of break-even price (Nov 2021)

B International Ltd. (BIL) has purchased 5 years 15.28% convertible debentures on 1.04.2021. The convertible debentures will mature on 31.03.2026. Each debenture can be converted into 20 equity shares of face value of Rs. 1 at any point of time but before maturity. Debentures will be redeemed at Rs. 100 on maturity. The required rate of return of BIL is 10% per annum on a 5-year security. The Reputed, a consultant has projected the following price behaviour of the shares:

Period		Price Range		
From	To	Passive	Most Likely	Optimistic
1.04.2021	31.12.2022	4.00	4.50	5.00
1.01.2023	30.06.2025	4.50	6.50	7.00
1.07.2025	31.03.2026	3.50	5.00	5.50

BIL, as a matter of policy, rounds up the amount.

You are required to calculate.

- The break-even price at which the debentures can be converted
- The ideal period in which BIL shall convert and dispose of the shares

Note: Use four decimals for present value factors

Answer:

WN 1: Computation of fair value of debentures:

Year	Cash flow	PVF @ 10%	DCF
1 to 5	15.28	3.7908	57.92
5	100.00	0.6209	62.09
Fair value of debentures			120.01

Note: Maturity value would be higher of the following:

- Redemption as debt = Rs.100
- Conversion into equity = 20 shares x Rs.5 (most likely price) = Rs.100

$$\text{Break even price} = \frac{\text{Fair price}}{\text{Conversion Ratio}} = \frac{120.01}{20} = \text{Rs. 6 per share}$$

- Hence the debentures can be converted into equity shares if the value of equity share is Rs.6 per share

Part (ii):

The ideal period in which BIL should convert and dispose of share will be 01.01.23 to 30.06.25 as during this period the market price of share is most likely to exceed its Break-even price.

51. Convertible bond [Nov 2016, Nov 2019 MTP] [Homework]

A Limited has issued convertible bonds, which carries a coupon rate of 14%. Each bond is convertible into 20 equity shares of the company A Limited. The prevailing interest rate for similar credit rating bond is 8%. The convertible bond has 5 years maturity. It is redeemable at par at Rs.100.

You are required to estimate:

- Current market price of the bond, assuming it being equal to its fundamental value
- Minimum market price of equity share at which bond holder should exercise conversion option and
- Duration of the bond

Answer:

WN 1: Computation of current market price and duration

Year	Cash flow	PVF @ 8%	DCF	Weight	Product
1	14	0.926	12.96	0.105	0.105
2	14	0.857	12	0.097	0.194
3	14	0.794	11.12	0.09	0.27
4	14	0.735	10.29	0.083	0.332
5	114	0.681	77.63	0.626	3.13
Market value			124	Duration	4.03 years

Note 1: Computation of redemption value:

- ❖ Redemption value of convertible bond on maturity date would be higher of the following:
 - **Conversion value of bond:** The details on share price is not available and hence this cannot be computed
 - **Redemption as bond:** The bond can be redeemed on maturity date at par value of Rs.100
- ❖ Redemption value in this case would be taken as Rs.100 due to absence of information on conversion value of bond on maturity date.

Minimum market price at which the bond holder should exercise conversion option:

- ❖ Minimum market price is basically the conversion parity price
- ❖ Minimum price = (CMP of bond/Conversion ratio) = (124/20) = Rs.6.20 per share

Part IV – Bond Valuation**52. Bond valuation [May 2014 MTP, Nov 2019, SM]**

Nominal value of 10% bonds issued by a company is Rs.100. The bonds are redeemable at Rs.110 at the end of year 5. Determine the value of the bond if required yield is

- a) 5%
- b) 10%

What will be the price of the bond at the end of each of the next five years in case the required yield is 5%?

Answer:**WN 1: Valuation of bond if required yield is 5%:**

- Price of bond is present value of future cash flows (Interest + Principal) discounted at investor's required rate of return of 5%

Year	Cash flow	PVF @ 5%	DCF
1 to 5	10	4.330	43.30
5	110	0.784	86.24
Value of bond			129.54

WN 2: Valuation of bond if required yield is 10%:

Year	Cash flow	PVF @ 10%	DCF
1 to 5	10	3.790	37.90
5	110	0.621	68.31
Value of bond			106.21

WN 3: Valuation of bond at end of each of next five years in case required return is 5%:

Particulars	Calculation	Amount
Price on day 0 (P ₀)		129.54
Price in year 1:		
Day 0 price		129.54
Add: Required return of 5%	129.54 × 5%	6.48
Target price in year 1		136.02
Less: Interest earned in year 1		(10)
Expected price in year 1		126.02
Price in year 2:		
Year 1 Price		126.02
Add: Required return of 5%	126.02 × 5%	6.30
Target price in year 2		132.32
Less: Interest earned in year 2		(10)
Expected price in year 2		122.32
Price in year 3:		
Year 2 Price		122.32
Add: Required return of 5%	122.32 × 5%	6.11
Target price in year 3		128.43
Less: Interest earned in year 3		(10)

Expected price in year 3		118.43
Price in year 4:		
Year 3 Price		118.43
Add: Required return of 5%	$118.43 \times 5\%$	5.92
Target price in year 4		124.35
Less: Interest earned in year 4		(10)
Expected price in year 4		114.35
Price in year 5:		
Year 4 Price		114.35
Add: Required return of 5%	$114.35 \times 5\%$	5.72
Target price in year 5		120.07
Less: Interest earned in year 4		(10)
Redemption value of year 5		110.07#

Redemption value for year 5 should be Rs.110. However, difference of Rs.0.07 is due to rounding-off issues.

53. Bond Valuation [Nov 2022]

Mr. X wants to invest Rs. 1,00,000 in the 7 years 8% bonds in the market (Face Value Rs. 100) which were issued 2 years ago.

- (i) You are requested to advise him what is the maximum price for bonds to be paid in the following scenarios:
 - a. If Mr. X is expecting minimum 9% return on the bonds
 - b. If Mr. X is expecting minimum 7% return on the bonds
 - c. If the present rate of similar bonds issued is 8.25%
 - d. If the present rate of similar bonds issued is 7.75%
- (ii) If the bonds are available at par and 1% is the transaction cost, what is the effective yield?
- (iii) Find the number of days required to breakeven transaction cost if the bonds are available at par and 2% is the transaction cost.

Answer:

WN 1: Computation of maximum price if Mr.X is expecting minimum 9% return on the bonds:

Year	Cash flow	PVF @ 9%	DCF
1 to 5	8	3.890	31.12
5	100	0.650	65.00
Total			96.12

WN 2: Computation of maximum price if Mr.X is expecting minimum 7% return on the bonds:

Year	Cash flow	PVF @ 7%	DCF
1 to 5	8	4.100	32.80
5	100	0.713	71.30
Total			104.10

WN 3: Computation of maximum price if return on similar bonds is 8.25%

Year	Cash flow	PVF @ 8.25%	DCF
1 to 5	8	3.967	31.74
5	100	0.673	67.30
Total			99.04

WN 4: Computation of maximum price if return on similar bonds is 7.75%

Year	Cash flow	PVF @ 7.75%	DCF
1 to 5	8	4.019	32.15
5	100	0.689	68.90
Total			101.05

WN 5: Effective yield if 1% is the transaction cost:

- If bonds are trading at par, then yield on bond is equal to coupon rate. Hence Yield of the bond is expected to be 8%
- Yield post transaction cost = $8 \times (1 - 0.01) = 7.92\%$

WN 6: Number of days to break-even if the transaction cost is 2%:

- If bonds are trading at par, then yield on bond is equal to coupon rate. Hence Yield of the bond is expected to be 8%

$$\text{No of days to break – even} = \left(\frac{2}{8}\right) \times 365 \text{ days} = 91 \text{ days}$$

54. Bond valuation [Nov 2009, Nov 2016 MTP, SM] [Concept Revision]

An investor is considering the purchase of the following Bond:

Face value Rs.100

Coupon rate 11%

Maturity 3 years

- If he wants a yield of 13% what is the maximum price he should be ready to pay for?
- If the bond is selling for Rs.97.60, what would be his yield?

Answer:

WN 1: Computation of maximum price if investor needs yield of 13%:

Year	Cash flow	PVR @ 13%	DCF
1	11	0.885	9.74
2	11	0.783	8.61
3	111	0.693	76.92
Maximum purchase price			95.27

WN 2: Computation of yield if the bond is currently selling for Rs.97.60:

- Yield refers to the return earned by the investor and the same would be equal to IRR of investment

Yield under short-cut method:

$$\text{Yield} = \frac{\text{Interest} + \text{Average other income}}{\text{Average funds employed}}$$

Interest = Rs.11

$$\text{Average other income} = \frac{100 - 97.60}{3} = 0.80$$

$$\text{Average funds employed} = \frac{100 + 97.60}{2} = 98.80$$

$$\text{Yield} = \frac{11 + 0.80}{98.80} \times 100 = 11.94\%$$

- Final IRR is expected to be closer to 11.94% and hence we will take initial guess rate of 12 percent to compute NPV and then compute IRR

Computation of NPV at initial guess rate of 12%:

Year	Cash flow	PVR @ 12%	DCF
0	(97.60)	1	(97.60)
1	11	0.893	9.82
2	11	0.797	8.77
3	111	0.712	79.03
NPV			0.02

Conclusion:

- NPV of above cash flows is equal to 0 (0.02 is due to rounding-off) and hence IRR of the above cash flows is 12%. **This would mean that investor is earning return of 12%.**

55. Bond valuation [Nov 2010, SM]

Calculate the market price of:

- 10% Government of India Security currently quoted at Rs.110, but yield is expected to go up by 1%
- A bond with 7.5% coupon interest, Face Value of Rs.10,000 & term to maturity of 2 years presently yielding 6%. Interest payable half yearly

Answer:

Part (a):

Computation of market price:

Current yield	$\frac{\text{Interest}}{\text{Current market price}} \times 100$	$\frac{10}{110} \times 100 = 9.09\%$
Yield is expected to increase by 1% and hence the revised yield will be 10.09%		
Market price	$\frac{\text{Interest}}{\text{Revised Yield}}$	$\frac{10}{10.09\%} = \text{Rs. 99.11}$

Note:

- It is assumed that face value is Rs.100 and hence interest @ 10% amounts to Rs.10

Part (b):**Computation of market price:**

- Bond is paying interest half-yearly and hence we should do half-yearly discounting. **We should ensure that discounting frequency is same as interest payment frequency. The answer to this question will change if we do annual discounting at 6%**
- Yield to maturity is 6%. The given YTM is for a year and half-yearly yield to maturity is 3% per half year

Period	Cash flow	PVF @ 3%	DCF
1 to 4	375	3.717	1,393.88
4	10,000	0.888	8,880.00
Value of bond			10,273.88

56. Bond valuation

What is the value of 5 year 11.6% coupon bond if the appropriate discount rate for discounting each cash flow is as follows:

Year	1	2	3	4	5
Discount rate	11.8	12.8	13.2	13.8	14.6

Answer:

Let us assume the face value of the bond is Rs.100

Year	Cash flow	PVF	DCF
1	11.6	0.894	10.37
2	11.6	0.793	9.20
3	11.6	0.701	8.13
4	11.6	0.616	7.15
5	111.6	0.538	60.04
Value of bond			94.89

Note:

- Discount rate varies for every year and the computation of DCF will be done in the following manner

$$\text{DCF of year 1} = \frac{1}{1 + 11.8\%} = 0.894$$

$$\text{DCF of year 2} = \frac{\text{DCF of year 1}}{1 + 12.8\%} = 0.793$$

$$\text{DCF of year 3} = \frac{\text{DCF of year 2}}{1 + 13.2\%} = 0.701$$

- DCF of year 4 and 5 will be calculated in the above manner

Possible mistake:

- Student should take care when they work with differential discount rate. PVF for year 2 should not be calculated in this manner:

$$\text{PVF of year 2} = \frac{1}{(1 + 12.8\%)^2} = 0.786$$

57. Bond Valuation [May 2021 MTP, May 2018 MTP, May 2020 MTP]

ABC Ltd. wants to issue 9% Bonds redeemable in 5 years at its face value of Rs. 1,000 each. The annual spot yield curve for similar risk class of Bond is as follows:

Year	Interest Rate
1	12%
2	11.62%
3	11.33%

4	11.06%
5	10.80%

(i) Evaluate the expected market price of the Bond if it has a Beta value of 1.10 due to its popularity because of lesser risk.

(ii) Interpret the nature of the above yield curve and reasons for the same.

Note: Use PV Factors upto 4 decimal points and value in Rs. upto 2 decimal points.

Answer:

WN 1: Computation of intrinsic value of bond:

Year	Cash flow	PVF	DCF
1	90.00	0.8929	80.36
2	90.00	0.8026	72.23
3	90.00	0.7247	65.22
4	90.00	0.6573	59.16
5	1,090.00	0.5988	652.69
Intrinsic Value			929.66

Note:

PVF is computed in the following manner:

$$\text{PVF of Year 1} = \frac{1}{1 + 12\%}$$

$$\text{PVF of Year 2} = \frac{1}{(1 + 11.62\%)^2}$$

$$\text{PVF of Year 3} = \frac{1}{(1 + 11.33\%)^3}$$

- The given interest rates are direct yield for two years/three years/four years/five years. This should not be confused with forward future rates. In case of forward rates, we will use step-down discount rate concept and PVF is computed differently
- Here we directly apply the yield for respective years and compute PVF

Expected Price:

Expected Price of Bond = Intrinsic value of Bond x Beta Value

Expected Price of Bond = 929.66 x 1.10 = Rs.1,022.63

Nature of Yield curve:

The given yield curve is inverted yield curve. The main reason for this shape of curve is expectation for forthcoming recession **when investors are more interested in Short-term rates over the long term**

58. Bond valuation [May 2018 MTP, Nov 2013] [Concept Revision] [Homework]

ABC Ltd. issued 9%, 5 year bonds of Rs. 1,000/- each having a maturity of 3 years. The present rate of interest is 12% for one year tenure. It is expected that Forward rate of interest for one year tenure is going to fall by 75 basis points and further by 50 basis points for every next year in further for the same tenure. This bond has a beta value of 1.02 and is more popular in the market due to less credit risk. Calculate the intrinsic value of bond and expected price of bond?

Answer:

Computation of intrinsic value:

Year	Cash flow	PVF	DCF
1	90	0.893	80.37
2	90	0.803	72.27
3	1,090	0.725	790.25
Intrinsic value of bond			942.89

Note:

$$\text{PVF of year 1} = \left(\frac{1}{1.12} \right) = 0.893$$

$$\text{PVF of year 2} = \left(\frac{\text{PVF of year 1}}{1.1125} \right) = 0.803$$

$$\text{PVF of year 3} = \left(\frac{\text{PVF of year 2}}{1.1075} \right) = 0.725$$

Expected price of Bond:

Expected price of bond = Intrinsic value of bond x Beta = 942.89 x 1.02 = Rs.961.74

Note:

- There is no logic of applying the above formula to compute expected price of bond. In-fact high beta bond carries more risk and logically will have lower price. However this question has been tested multiple times and hence we can follow above formula if asked in exam.

59. Bond valuation [Nov 2003, May 2016, May 2020 RTP]

M/s Agfa Industries is planning to issue a debenture series on the following terms

Face value	Rs.100
Term of maturity	10 years
Yearly coupon rate	
Years	
1-4	9%
5-8	10%
9-10	14%

The current market rate on similar debentures is 15 percent per annum. The company proposes to price the issue in such a manner that it can yield 16 percent compounded rate of return to the investors. The company also proposes to redeem the debentures at 5 percent premium on maturity. Determine the issue price of the debentures.

Answer:**Computation of issue price of debentures:**

- Interest rate on similar debentures is 15%. However, the company proposes to issue the price in such a manner the investor can earn 16 percent return. Hence, we should discount the cash flows at 16 percent to compute the issue price of debentures

Year	Cash flow	PVF@16%	DCF
1	9	0.862	7.76
2	9	0.743	6.69
3	9	0.641	5.77
4	9	0.552	4.97
5	10	0.476	4.76
6	10	0.410	4.10
7	10	0.354	3.54
8	10	0.305	3.05
9	14	0.263	3.68
10	119	0.227	27.01
Issue price of debentures			71.33

60. Calculation of YTM [May 2014 MTP]

If the market price of the bond is Rs.95; years to maturity = 6 years; coupon rate = 13% p.a. (paid annually) and issue price is Rs.100. What is the yield to maturity?

Answer:**Yield under short-cut method:**

$$\text{Yield} = \frac{\text{Interest} + \text{Average other income}}{\text{Average funds employed}}$$

Interest = Rs.13

$$\text{Average other income} = \frac{100 - 95}{6} = 0.83$$

$$\text{Average funds employed} = \frac{100 + 95}{2} = 97.50$$

$$\text{Yield} = \frac{13 + 0.83}{97.50} \times 100 = 14.18\%$$

- Final IRR is expected to be closer to 14.18% and hence we will take initial guess rate of 14 percent to compute NPV and then compute IRR

Computation of NPV:

Year	Cash flow	PVF @14%	DCF	PVF @15%	DCF
0	(95)	1.000	(95.00)	1.000	(95.00)
1 to 6	13	3.888	50.54	3.785	49.21
6	100	0.456	45.60	0.432	43.20
			1.14		(2.59)

- We initially started with discount rate of 14% and got positive NPV of Rs.1.14. We need to increase the rate as there is positive NPV
- NPV has been re-computed at 15 percent and NPV is negative 2.59.
- We can now compute IRR as we have one positive and one negative NPV

$IRR = L_1 + \frac{NPV \text{ at } L_1}{NPV \text{ at } L_1 - NPV \text{ at } L_2} \times (L_2 - L_1)$					
L1 = Lower rate of 14%; NPV at L1 = 1.16					
L2 = Higher rate of 15%; NPV at L2 = -2.59					
$IRR = 14 + \frac{1.14}{1.14 - (-2.59)} \times (15 - 14); IRR = 14 + \frac{1.14}{3.73} \times (1); IRR = 14 + 0.31 = 14.31\%$					

61. Calculation of YTM [May 2004, Nov 2015 MTP] [Concept Revision]

There is a 9% 5-year bond issue in the market. The issue price is Rs.90 and the redemption price is Rs.105. For an investor with marginal income tax rate of 30% and capital gains tax rate of 10% (assuming no indexation), what is the post-tax yield to maturity?

Answer:

Yield under short-cut method:

$\text{Yield} = \frac{\text{Interest} + \text{Average other income}}{\text{Average funds employed}}$					
• Post-tax Interest = $(9 \times 70\%) = \text{Rs.}6.30$ per year • Redemption value = Rs.105; Capital gain = $105 - 90 = \text{Rs.}15$; • Tax on capital gain = $15 \times 10\% = \text{Rs.}1.50$; • Post-tax redemption value = $105 - 1.50 = \text{Rs.}103.50$					
$\text{Average other income} = \frac{103.50 - 90}{5} = 2.70$					
$\text{Average funds employed} = \frac{103.50 + 90}{2} = 96.75$					
$\text{Yield} = \frac{6.30 + 2.70}{96.75} \times 100 = 9.30\%$					

- Final IRR is expected to be closer to 9.30% and hence we will take initial guess rate of 9 percent to compute NPV and then compute IRR

Computation of NPV:

Year	Cash flow	PVF@9%	DCF	PVF@10%	DCF
0	(90)	1.000	(90.00)	1.000	(90.00)
1 to 5	6.3	3.889	24.50	3.790	23.88
5	103.50	0.650	67.28	0.621	64.27
NPV			1.78		(1.85)

$IRR = L_1 + \frac{NPV \text{ at } L_1}{NPV \text{ at } L_1 - NPV \text{ at } L_2} \times (L_2 - L_1)$					
$IRR = 9 + \frac{1.78}{1.78 - (-1.85)} \times (10 - 9); IRR = 9 + \frac{1.78}{3.63} \times (1); IRR = 9 + 0.49 = 9.49\%$					

- Post-tax yield to maturity is 9.49%

62. Calculation of YTM and market price [Nov 2007]

MP Ltd issued a new series of bonds on Jan 1, 2010. The bonds were sold at par (Rs.1000), having a coupon rate of 10% per annum and maturing on 31st December 2025. Coupon payments are made semi-annually on June 30 and Dec 31st each year. Assume that you purchased an outstanding MP Ltd bond on 1st March 2018 when the going interest rate was 12%.

- What was the YTM of MP Ltd Bonds as on Jan 1, 2010

- ii. What amount you should pay to complete the transaction?
- iii. Of that amount how much should be accrued interest and how much would represent bond's basic value?

Answer:

WN 1: Computation of YTM:

- Bonds are issued at par and hence the interest rate on bond would be equal to YTM of bond
- YTM of bond would therefore be equal to 10 percent per annum

WN 2: Computation of amount to be paid on March 1, 2018:

- Interest is paid half-yearly in the month of June and December. We can compute present value of future cash flows and calculate the value of bond
- We can compute the price as on Jan 1, 2018 using the technique of discounting of future cash flows

Period	Cash flow	PVF @ 6%	DCF
1 to 16	50	10.106	505.30
16	1,000	0.394	394.00
Value of bond as on Jan 1, 2018			899.30

- Accrued interest for Jan and Feb = $1,000 \times 5\% \times (2/6) = 16.67$
- **Value of bond as on March 1, 2018 = $899.30 + 16.67 = \text{Rs.}915.97$**
- Accrued interest part of purchase price = Rs.16.67
- Basic price of bond = Rs.899.30

63. Calculation of realized YTM

Rs.1000 par value bond carries a coupon rate of 10% payable annually and has a remaining maturity of 4 years. The bond is presently selling for Rs.1020. The reinvestment rate applicable for the future cash flow of the bond is 9% per annum. What is the realized YTM?

Answer:

WN 1: Computation of maturity cash flow:

- In case of realized YTM, we are required to compute the maturity cash flow assuming reinvestment rate. In this question reinvestment rate is given as 9%

Year	Cash flow	Reinvestment period	FVF @ 9%	FCF
1	100	3	1.295	129.5
2	100	2	1.188	118.8
3	100	1	1.09	109.0
4	1,100	0	1	1,100
Maturity cash flow in year 4				1,457.3

WN 2: Computation of realized YTM (realized IRR):

- The current market price of bond is Rs.1,020. This is invested on day 0 and same matures to Rs.1,457.30 in year 4
- Realized YTM refers to the rate at which 1,020 grows to 1,457.30 in 4 years

$$FV = PV \times (1 + r)^n; 1,457.30 = 1,020 \times (1 + r)^4$$

$$\frac{1,457.30}{1,020} = (1 + r)^4; 1.4287 = (1 + r)^4$$

$$1.1953 = (1 + r)^2; (1 + r) = 1.0933$$

$$r = 0.0933 \text{ or } 9.33\%$$

Therefore, realized YTM is 9.33%

64. Calculation of realized YTM

A Rs.1,00,000 par five year maturity bond with a 9% coupon rate currently sells at a YTM of 8%. A portfolio manager wants to forecast the total return on the bond over the coming two years, as his horizon is two years. He believes that two years from now, three year maturity bonds will sell at a yield of 7% and the coupon income can be reinvested in short term securities over the next two years at a rate of 6%. What is the expected annualized rate of return over the two year period?

Answer:

WN 1: Computation of cash flows:

Note 1: Computation of investment price:

- Investment is made in a 5-year bond which is currently selling at YTM of 8%
- Investment price would be present value of 5-year bond discounted at YTM of 8%

Year	Cash flow	PVF @ 8%	DCF
1 to 5	9,000	3.993	35,937
5	1,00,000	0.681	68,100
Investment value on day 0			1,04,037

Note 2: Computation of sale value at end of year 2:

- Post two years, three-year bond will quote at yield of 7% and the investor would sell the bond after 2 years. Value of bond after 2 years is calculated by discounting the future cash flows

Year	Cash flow	PVF @ 7%	DCF
1 to 3	9,000	2.624	23,616
3	1,00,000	0.816	81,600
Investment value on day 0			1,05,216

Note 3: Cash flows of bond investment:

Year	Cash flow
0	(1,04,037)
1	9,000
2	1,14,216 [9,000 + 1,05,216]

WN 2: Computation of maturity cash flows:

Year	Cash flow	Reinvestment Period	FVF	Maturity value
1	9,000	1	1.06	9,540
2	1,14,216	0	1	1,14,216
Maturity value at end of year 2				1,23,756

WN 3: Computation of realized YTM:

- Question wants us to calculate the expected annualized yield for next two months. The same can be computed by calculating realized YTM or normal YTM
- Realized YTM is used in this scenario as there is reinvestment rate given in problem

$$\begin{aligned}
 FV &= PV \times (1 + r)^n; 1,23,756 = 1,04,037 \times (1 + r)^2 \\
 \frac{1,23,756}{1,04,037} &= (1 + r)^2; 1.1895 = (1 + r)^2 \\
 (1 + r) &= 1.0907 \\
 r &= 0.0907 \text{ or } 9.07\% \\
 \text{Therefore, realized YTM is } &9.07\%
 \end{aligned}$$

65. Computation of reinvested interest [May 2015 MTP] [Concept Revision] [Homework]

Mr. X purchases a 5 years 8.5% coupon bond for a price of Rs.907.60 (Face Value of Rs.1,000) that has a YTM of 11%. You are required to compute reinvested interest amount on this bond.

Answer:

Year	Interest	Reinvestment period	FVF @ 11%	Future Value	Reinvested interest
1	85	4	1.518	129.03	44.03
2	85	3	1.368	116.28	31.28
3	85	2	1.232	104.72	19.72
4	85	1	1.11	94.35	9.35
5	85	0	1	85	0
Total				529.38	104.38

Note:

- ❖ Reinvestment is assumed to happen at YTM.
- ❖ Reinvestment period = Maturity period of 5 years – year of interest receipt
- ❖ Future value = Interest x Future value factor
- ❖ Reinvested interest = Future value – Interest

66. Calculation of current yield, YTM & Intrinsic value [May 2019 RTP, Nov 2008, Nov 2011]

Based on the credit rating, Mr. Bond has decided to apply the following discount rates for valuing bonds:

Credit Rating	Discount Rate
AAA	364 day T bill rate + 3% spread
AA	AAA + 2% spread
A	AAA + 3% spread

He is considering investing in AA rated, Rs.1, 000 face value bond currently selling at Rs.1, 025.86. The bond has five years to maturity and the coupon rate on the bond is 15% p.a. payable annually. The next interest payment is due one year from today and the bond is redeemable at par. (The 364 day T-bill rate to be 9%). You are required to calculate the intrinsic value of the bond for Mr. Bond should he invest in the bond? Also calculate the current yield and the Yield to Maturity (YTM) of the bond.

Answer:

WN 1: Computation of intrinsic value:

- Mr. Bond is investing in AA rated bond. Required return for AA rated bond is AAA rated + 2% spread
- Required return for AAA rated bond is 9% + 3% = 12%
- Required return for AA rated bond is 12% + 2% = 14%

Year	Cash flow	PVF @ 14%	DCF
1 to 5	150	3.433	514.95
5	1,000	0.519	519.00
Fair value of bond			1,033.95

Conclusion:

- CMP of bond is Rs.1,025.86 whereas fair value of bond is Rs.1,033.95. Bond is currently undervalued and we should invest in bond

WN 2: Computation of Yield to Maturity:

Year	Cash flow	PVF @ 14%	DCF	PVF@ 15%	DCF
0	-1,025.86	1	-1,025.86	1	-1,025.86
1	150.00	3.433	514.95	3.352	502.80
5	1,000.00	0.519	519.00	0.497	497.00
NPV			8.09		-26.06

$$IRR = L_1 + \frac{NPV \text{ at } L_1}{NPV \text{ at } L_1 - NPV \text{ at } L_2} \times (L_2 - L_1)$$

$$IRR = 14 + \frac{8.09}{8.09 - (-26.06)} \times (15 - 14); IRR = 14 + \frac{8.09}{34.15} \times (1); IRR = 14 + 0.24 = 14.24\%$$

- Yield to maturity = 14.24%

WN 3: Computation of current yield:

$$\text{Current yield} = \frac{\text{Interest}}{\text{Current Market Price}} = \frac{150}{1,025.86} \times 100 = 14.62\%$$

67. Bond valuation [May 2011 RTP] [Homework]

ABC Limited has the following outstanding bonds:

Bond	Coupon	Maturity
Series X	8%	10 years
Series Y	Variable changes annually comparable to prevailing rate	10 years

Initially these bonds were issued at face value of Rs.10,000 with yield to maturity of 8%. Assuming that:

- After 2 years from the date of issue, interest on comparable bonds is 10%, then what should be the price of each bond?
- If after two additional years, the interest rate on comparable bond is 7%, then what should be the price of each bond?
- What conclusions you can draw from the prices of Bonds, computed above

Answer:

WN 1: Valuation of bonds if interest rate increases to 10%

Series X Bond:

Year	Cash flow	PVF@10%	DCF
1 to 8	800	5.335	4,268
8	10,000	0.467	4,670
Value of Bond			8,938

Series Y Bond:

Since Bond-series Y has a variable interest rates, so the interest amount will increase and decrease with the movement of interest rates. As given presently rate of interest is 10%, the value of Bond will be:

Year	Cash flow	PVF@10%	DCF
1 to 8	1,000	5.335	5,335
8	10,000	0.467	4,670
Value of Bond			10,005

WN 2: Valuation of bonds if interest rate decreases to 7%**Series X Bond:**

Year	Cash flow	PVF@7%	DCF
1 to 6	800	4.767	3,814
6	10,000	0.666	6,660
Value of Bond			10,474

Series Y Bond:

Since Bond-series Y has a variable interest rates, so the interest amount will increase and decrease with the movement of interest rates. As given presently rate of interest is 7%, the value of Bond will be:

Year	Cash flow	PVF@7%	DCF
1 to 6	700	4.767	3,337
6	10,000	0.666	6,660
Value of Bond			9,997

Conclusion:

From above prices, it can be concluded that price of Bond-Series X moves inversely with change in interest rate. Whereas, the price of Bond Series Y does not fluctuate, reason being its interest (coupon) adjusted according to change in interest rates.

68. Computation of Yield to Maturity (Nov 2020 RTP):

Today being 1st January 2019, Ram is considering to purchase an outstanding Corporate Bond having a face value of Rs. 1,000 that was issued on 1st January 2008 which has 9.5% Annual Coupon and 20 years of original maturity (i.e. maturing on 31st December 2027). Since the bond was issued, the interest rates have been on downside and it is now selling at a premium of Rs. 125.75 per bond.

Determine the prevailing interest on the similar type of Bonds if it is held till the maturity which shall be at Par. PV factors of 6% and 8% is to be used for computing prevailing interest rate

Answer:**WN 1: Computation of NPV at 6% and 8%:**

Year	Cash flow	PVF @ 6%	DCF	PVF@ 8%	DCF
0	-1,125.75	1	-1,125.75	1	-1,125.75
1 to 9	95.00	6.801	646.10	6.246	593.37
9	1,000.00	0.592	592.00	0.500	500.00
NPV			112.35		-32.38

$$IRR = L_1 + \frac{NPV \text{ at } L_1}{NPV \text{ at } L_1 - NPV \text{ at } L_2} \times (L_2 - L_1)$$

$$IRR = 6 + \frac{112.35}{112.35 - (-32.38)} \times (8 - 6); IRR = 6 + \frac{112.35}{144.73} \times (2); IRR = 6 + 1.55 = 7.55\%$$

YTM = 7.55% and thus, prevailing interest rate on similar type of Bonds shall be approx. 7.55%

69. Computation of spread of yield from comparable bond [Nov 2019 RTP, May 2018 MTP, May 2019 MTP]

A hypothetical company ABC Limited issued a 10% debenture (Face value of Rs.1,000) of the duration of 10 years is currently trading at Rs.850 per debenture. The bond is convertible into 50 equity shares being currently quoted at Rs.17 per share. Calculate the spread of yield of the above bond from this comparable bond, if equivalent yield of the same is 11.80%. Use PVF of 11% and 13% to compute YTM

Answer:**Computation of NPV at 11% and 13%:**

Year	Cash flow	PVF@11%	DCF	PVF@13%	DCF
0	(850)	1	(850)	1	(850)
1 to 10	100	5.889	588.90	5.426	542.60
10	1,000	0.352	352.00	0.295	295.00
NPV of Bond			90.90		-12.40

Computation of YTM:

YTM (IRR)	=	$L1 + \left(\frac{NPV \text{ at } L1}{NPV \text{ at } L1 - NPV \text{ at } L2} \right) \times (L2 - L1)$
YTM	=	$11 + \frac{90.90}{90.90 - (-12.40)} \times (13 - 11)$
YTM	=	11 + 1.76
YTM	=	12.76%

Spread from comparable bond:

- ❖ Spread from comparable bond = Spread of this bond – yield of comparable bond
- ❖ Spread from comparable bond = 12.76% - 11.80% = 0.96%

70. Duration [May 2007]

Find the current market price of a bond having face value Rs.1,00,000 redeemable after 6 year maturity with YTM at 16% payable annually and duration 4.3202 years?

Answer:**WN 1: Computation of interest rate on bond:**

Let us assume the annual interest inflow to be X

Year	Cash flow	PVF @ 16%	DCF	Weight	Product
1	X	0.862	0.862X	0.862X	0.862X
				<u>3.684X + 41,000</u>	<u>3.684X + 41,000</u>
2	X	0.743	0.743X	0.743X	1.486X
				<u>3.684X + 41,000</u>	<u>3.684X + 41,000</u>
3	X	0.641	0.641X	0.641X	1.923X
				<u>3.684X + 41,000</u>	<u>3.684X + 41,000</u>
4	X	0.552	0.552X	0.552X	2.208X
				<u>3.684X + 41,000</u>	<u>3.684X + 41,000</u>
5	X	0.476	0.476X	0.476X	2.380X
				<u>3.684X + 41,000</u>	<u>3.684X + 41,000</u>
6	1,00,000 + X	0.410	0.41X + 41,000	0.41X + 41,000	2.46X + 2,46,000
				<u>3.684X + 41,000</u>	<u>3.684X + 41,000</u>
Total			3.684X + 41,000		11.319X + 2,46,000
					<u>3.684X + 41,000</u>

Computation of interest rate:

Duration = Sum of products
4.3202 years = $\frac{11.319X + 2,46,000}{3.684X + 41,000}$
11.319X + 2,46,000 = 15.916X + 1,77,128
4.597X = 68,872
X = 14,981.90 rounded off to Rs.15,000
Interest rate = 15,000/1,00,000 = 15%

WN 2: Computation of current market price:

Current market price = $3.684X + 41,000$
 Current market price = $3.684(15,000) + 41,000$
Current market price = Rs.96,260

71. Duration and volatility [Nov 2005, Nov 2015, Jan 2021] [Concept Revision]

The following data is available for a bond:

Face value	Rs.1,000
Coupon Rate	11%
Years to maturity	6
Redemption value	Rs.1,000
Yield to Maturity	15%

Calculate the following in respect of the bond:

- Current market price
- Duration of the bond
- Volatility of the bond
- Expected market price if increase in required yield is by 100 basis points
- Expected market price if decrease in required yield is by 75 basis points

Answer:

WN 1: Computation of Current Market Price and Duration:

Year	Cash flow	PVF @ 15%	DCF	Weight	Product
1	110	0.870	95.70	0.1128	0.1128
2	110	0.756	83.16	0.0980	0.1960
3	110	0.658	72.38	0.0853	0.2559
4	110	0.572	62.92	0.0742	0.2968
5	110	0.497	54.67	0.0644	0.3220
6	1,110	0.432	479.52	0.5652	3.3912
			848.35		4.5747

- Current market price = Rs.848.35
- Duration = 4.5747 years

WN 2: Computation of volatility:

$$\text{Volatility} = \frac{\text{Duration}}{1 + \text{YTM}} = \frac{4.5747}{1 + 15\%} = 3.97$$

WN 3: Computation of expected price if the yield increases by 100 bps:

- Volatility of 3.97 would mean that bond price will change by 3.97% for 1% change in yield
- Yield has increase by 1 percent and hence bond price will fall by 3.97%
- New price = $848.35 - 3.97\% = \text{Rs.}814.67$

WN 4: Computation of expected price if the yield decreases by 75 bps:

- Yield has fallen by 0.75% and hence price will increase by 2.98% (3.97×0.75)
- New price = $848.35 + 2.98\% = \text{Rs.}873.63$

72. Concept based on duration (May 2014 RTP):

Mr.A is planning for making investment in bonds of one of the two companies X Limited and Y Limited. Duration of bond X is 4.9 years and that of bond Y is 4.63 years. Mr.A considers duration as the basis for decision making, you are required to decide which Bond should Mr.A invest in?

Answer:

- Duration of Bond Y is lower and hence the same will have low volatility. Hence Mr.A should go ahead with Bond Y due to lower duration

73. YTM of Bond [July 2021, May 2023 MTP]

An investor has recently purchased substantial number of 7 year 6.75% Rs. 1,000 bond with 5% premium payable on maturity at a required Yield to Maturity (YTM) of 9%. However, due to a financial crunch he is looking to sell these bonds and has got a proposal from another investor, who is willing to purchase these

bonds by shelling out a maximum amount of Rs. 897 per bond. Investors follow intrinsic value method for valuation of bonds.

- (i) You are required to determine
 - a. The Market price, Duration and Volatility of the Bond and
 - b. Required YTM of the new investor
- (ii) What is the relationship between the price of the bond and YTM?

Answer:

WN 1: Computation of market price, Duration and Volatility of the Bond:

Year	Cash flow	PVF @ 9%	DCF	Weight	Product
1	67.500	0.917	61.898	0.0677	0.0677
2	67.500	0.842	56.835	0.0622	0.1244
3	67.500	0.772	52.110	0.0570	0.1710
4	67.500	0.708	47.790	0.0523	0.2092
5	67.500	0.650	43.875	0.0480	0.2400
6	67.500	0.596	40.230	0.0440	0.2640
7	1,117.500	0.547	611.273	0.6688	4.6816
Total			914.011		5.7579

- Market price = Rs.914.011
- Duration of Bond = 5.7579 years
- Volatility of Bond = $5.7579 / (1+9\%) = 5.28$

WN 2: Computation of YTM of new investor:

Year	Cash flow	PVF @ 9%	DCF	PVF @ 12%	DCF
0	-897.000	1.000	-897.000	1.000	-897.000
1 to 7	67.500	5.032	339.660	4.564	308.070
7	1,050.000	0.547	574.350	0.452	474.600
			17.010		-114.330

$$\text{YTM(or)IRR} = 9 + \left(\frac{17.010}{17.010 - (-114.330)} \times (12 - 9) \right) = 9 + 0.39 = 9.39\%$$

Relationship:

Relationship between the price of the bond & YTM is opposite or inverse

74. Duration and Volatility (May 2023)

An investor, in the beginning of 2022, has purchased substantial number of 8 year 7.50%, Rs.1000 bond with 5% premium on maturity at a required Yield to Maturity (YTM) of 8.50 %. However, due to the continuing war in Europe, the inflation is running very high in the economies of the countries. The yield on the bonds is decreasing. The risk averse investor wants to protect himself from further loss and decides to sell the bonds in 2023. He has got a proposal from another investor who is willing to purchase these bonds by shelling out a maximum amount of Rs.797.50 per bond. Investor follows intrinsic value method for valuation of the Bonds.

You are required to determine

- (i) The Market price, Duration and Volatility of the bond.
- (ii) Will it be a right decision of the new investor if he is looking for Required Yield to Maturity (YTM) as 12% p.a.?

Note: Use four decimals PVF for calculations

Answer:

WN 1: Computation of market price, Duration and Volatility today (2023):

Year	Cash flow	PVF @ 8.5%	DCF	Weight	Product
1	75	0.9217	69.128	0.071	0.071
2	75	0.8495	63.713	0.065	0.13
3	75	0.7829	58.718	0.06	0.18
4	75	0.7216	54.12	0.055	0.22

5	75	0.665	49.875	0.051	0.255
6	75	0.6129	45.968	0.047	0.282
7	1125	0.5649	635.513	0.651	4.557
Total			977.035		5.695

Solution:

Market Price	Rs.977.04
Duration	5.695 Years
Volatility $\left(\frac{5.695}{1.085}\right)$	5.249

WN 2: Computation of market price of the bond at YTM of 12%

Bond Price = $75 \times \text{PVAF}(7 \text{ years}, 12\%) + 1,050 \times \text{PVF}(7 \text{ years}, 12\%)$

Bond Price = $(75 \times 4.5637) + (1,050 \times 0.4523) = \text{Rs.}817.20$

Since, Intrinsic Value of Bond is Rs.817.20 the decision of new investor is right at purchase price of Rs.797.50.

75. Duration:

A 12% coupon bond has a maturity of 5 years. It pays interest semi-annually. Its yield to maturity is 5% per half-year period. What is its duration?

Answer:

Let us assume the face value of bond to be Rs.1,000

Period	Cash flow	PVF	DCF	Weight	Product
1	60	0.952	57.12	0.0530	0.0530
2	60	0.907	54.42	0.0505	0.1010
3	60	0.864	51.84	0.0481	0.1443
4	60	0.823	49.38	0.0458	0.1832
5	60	0.784	47.04	0.0437	0.2185
6	60	0.746	44.76	0.0415	0.2490
7	60	0.711	42.66	0.0396	0.2772
8	60	0.677	40.62	0.0377	0.3016
9	60	0.645	38.70	0.0359	0.3231
10	1060	0.614	650.84	0.6041	6.0410
Total			1077.38		7.8919

- Duration = 7.8919 half-years (or) 3.946 years

76. Duration:

- A 3 year annuity has a yield of 10 percent. What is its duration?
- A perpetual bond has an YTM of 10 percent. What is its duration?

Answer:**Part (a): Duration of annuity bond:**

Let us assume face value of bond to be Rs.1,000

$$\text{Annual cash flow} = \frac{\text{FV of bond}}{\text{PVAF}(10\%, 3)} = \frac{1,000}{2.487} = 402.09$$

Year	Cash flow	PVF @ 10%	DCF	Weight	Product
1	402.09	0.909	365.45	0.3656	0.3656
2	402.09	0.826	332.13	0.3322	0.6644
3	402.09	0.751	301.97	0.3021	0.9053
Total			999.60		1.9365

Duration of bond = 1.9365 years

Part (b)

$$\text{Duration of perpetual bond} = \frac{1 + \text{YTM}}{\text{YTM}} = \frac{1 + 0.10}{0.10} = \mathbf{11 \text{ years}}$$

77. Zero-coupon Bond:

A zero coupon bond of Rs.10, 000 has a term to maturity of 8 years and a market yield of 10% at the time of issue.

- ❖ What is the issue price of the bond?
- ❖ YTM of the bond if today's price is Rs.4, 000?
- ❖ What is the duration of the bond?
- ❖ What is the modified duration of the bond?
- ❖ What will be the percentage change in price of the bond if the yield declines by 0.5 percentage?

Answer:

WN 1: Computation of issue price of bond:

Year	Cash flow	PVF @ 10%	DCF
8	10,000	0.467	4,670
Issue price			4,670

WN 2: Computation of YTM of bond if issue price is Rs.4,000:

$$FV = PV \times (1 + r)^n; 10,000 = 4,000 \times (1 + r)^8$$

$$\frac{10,000}{4,000} = (1 + r)^8; 2.50 = (1 + r)^8$$

$$(1 + r)^4 = 1.5811; (1 + r)^2 = 1.2574; (1 + r) = 1.1213$$

$$r = 0.1213 \text{ (or) } 12.13\%$$

Therefore, YTM is 12.13%

WN 3: Duration of bond:

- Duration of zero-coupon bond is equal to life of bond
- Hence duration is equal to 8 years

WN 4: Modified duration:

$$\text{Modified Duration} = \frac{\text{Duration}}{1 + \text{YTM}} = \frac{8}{1 + 12.13\%} = 7.13$$

WN 5: Computation of percentage change in price of bond if the yield declines by 0.5 percentage:

- Modified duration (volatility) of 7.13 indicates that for every 1% change in yield, price of bond will change by 7.13%
- In this case, yield declines by 0.5 percent and hence the price of the bond will increase by 3.57% (7.13 x 0.5)

78. Duration [May 2018 RTP, Nov 2008, May 2012 RTP] [Homework]

ABC Ltd. has made an issue of 14 % non-convertible debentures on January 1, 2007. These debentures have a face value of Rs.100 and are currently traded in the market at a price of Rs. 90. Interest on these NCDs will be paid through post-dated cheque dated June 30 and December 31. Interest payments for the first 3 years will be paid in advance through post-dated cheque while for the last 2 years post-dated cheque will be issued at the third year. The bond is redeemable at par on December 31, 2011 at the end of 5 years.

Required:

- a) Estimate the current yield & the YTM of the bond.
- b) Calculate the duration of the NCD.
- c) Assuming that intermediate coupon payments are, not available for reinvestment. Calculate the realized yield on the NCD.

Answer:

WN 1: Computation of current yield:

$$\text{Current Yield} = \frac{\text{Interest}}{\text{Current Market Price}} = \frac{7}{90} \times \frac{12}{6} \times 100 = 0.1555 \text{ or } 15.55\%$$

WN 2: Computation of Yield to Maturity:

Period	Cash flow	PVF @ 8%	DCF	PVF @ 9%	DCF
0	(90)	1.000	(90.00)	1.000	(90.00)
1 to 10	7	6.710	46.97	6.417	44.92
10	100	0.463	46.30	0.422	42.20
NPV			3.27		-2.88

$IRR = L_1 + \frac{NPV \text{ at } L_1}{NPV \text{ at } L_1 - NPV \text{ at } L_2} \times (L_2 - L_1)$	
$IRR = 8 + \frac{3.27}{3.27 - (-2.88)} \times (9 - 8); IRR = 8 + \frac{3.27}{6.15} \times (1); IRR = 8 + 0.53 = 8.53\%$	

- YTM = 8.53 percent per half year (or) 17.06 percent per year

WN 3: Computation of duration:

Period	Cash flow	PVF @ 8.53%	DCF	Weight	Product
1	7	0.921	6.45	0.0717	0.0717
2	7	0.849	5.94	0.066	0.132
3	7	0.782	5.47	0.0608	0.1824
4	7	0.721	5.05	0.0561	0.2244
5	7	0.664	4.65	0.0517	0.2585
6	7	0.612	4.28	0.0476	0.2856
7	7	0.564	3.95	0.0439	0.3073
8	7	0.52	3.64	0.0405	0.324
9	7	0.479	3.35	0.0372	0.3348
10	107	0.441	47.19	0.5245	5.245
Total			89.97		7.3657

- Duration = 7.3657 half-years (or) 3.6829 years

WN 4: Computation of realized YTM if intermediate cash flows are not available for reinvestment:

- The bond will earn interest of Rs.14 per year and will earn Rs.70 for 5 years. These amounts are not available for reinvestment and hence the value at the end of five years is Rs.70
- We would receive principal of Rs.100 and hence the maturity value at end of five years is Rs.170
- Investment made today is Rs.70
- The life of instrument is five years and hence we cannot take square root and find realized YTM. We will have to do it in the same manner as that of IRR calculation

Period	Cash flow	PVF @ 6%	DCF	PVF @ 6.5%	Product
0	(90)	1.000	(90.00)	1.000	(90.00)
10	170	0.558	94.86	0.508	86.36
NPV			4.86		(3.64)

$IRR = L_1 + \frac{NPV \text{ at } L_1}{NPV \text{ at } L_1 - NPV \text{ at } L_2} \times (L_2 - L_1)$	
$IRR = 6 + \frac{4.86}{4.86 - (-3.64)} \times (7 - 6); IRR = 6 + \frac{4.86}{8.50} \times (1); IRR = 6 + 0.57 = 6.57\%$	

- Realized YTM will be 6.57 percent per half year (or) 13.14 percent per year

79. YTM of a convertible bond

ABC Limited issues partly convertible debentures of Rs.600, carrying an interest rate of 10%. Rs.200 will get compulsorily converted into two equity shares of ABC Limited, an year from now. The expected price per share of the company's equity an year from now would be Rs.150. The non-convertible portion will be redeemed into two equal installments of Rs.200 each at the end of year 5 and 6 respectively.

- What is the pretax rate of return earned by the debenture holders?
- What is the post tax cost of convertible debentures to the company?

Assume that tax rate of the company is 30% and the net price per share of the company would realize for the equity after an year would be Rs.120

Answer:**WN 1: Computation of pre-tax rate of return by the debenture holders:**

Year	CF	PVF @ 14%	DCF	PVF @ 16%	DCF
0	-600	1.000	-600.00	1.000	-600.00

1	360	0.877	315.72	0.862	310.32
2	40	0.769	30.76	0.743	29.72
3	40	0.675	27.00	0.641	25.64
4	40	0.592	23.68	0.552	22.08
5	240	0.519	124.56	0.476	114.24
6	220	0.456	100.32	0.410	90.20
NPV			22.04		-7.80

Note:

- Cash flow for year 1 = 2 equity shares of Rs.150 each + Interest of Rs.60
- Cash flow for year 2 to 4 = 400 x 10% = Rs.40
- Cash flow for year 5 = Principal redemption of Rs.200 + Interest of Rs.40
- Cash flow for year 6 = Principal redemption of Rs.200 + Interest of Rs.20
- Rate of 14 percent has been taken as initial guess rate. This has been taken closer to 10 percent and possibility of receiving equity shares at higher value of Rs.150 per share

$IRR = L_1 + \frac{NPV \text{ at } L_1}{NPV \text{ at } L_1 - NPV \text{ at } L_2} \times (L_2 - L_1)$					
$IRR = 14 + \frac{22.04}{22.04 - (-7.80)} \times (16 - 14); IRR = 14 + \frac{22.04}{29.84} \times (2); IRR = 14 + 1.48 = 15.48\%$					

WN 2: Computation of post-tax cost of convertible debentures:

Year	Cash flow	PVF @ 8%	DCF	PVF @ 9%	DCF
0	600	1.000	600.00	1.000	600.00
1	-282	0.926	-261.13	0.917	-258.59
2	-28	0.857	-24.00	0.842	-23.58
3	-28	0.794	-22.23	0.772	-21.62
4	-28	0.735	-20.58	0.708	-19.82
5	-228	0.681	-155.27	0.650	-148.20
6	-214	0.630	-134.82	0.596	-127.54
NPV			-18.03		0.65

Note:

- Cash flow in year 1 = 2 shares of Rs.120 each + Post-tax interest of Rs.42 (60 x 70%)
- Cash flow in year 2 to 4 = 400 x 10% x 70% = Rs.28
- Cash flow in year 5 = Principal redemption of Rs.200 + Interest of Rs.28
- Cash flow in year 6 = Principal redemption of Rs.200 + Interest of Rs.14
- This is a cash flow where inflow happens on day 0 and outflow happens throughout the life of the instrument. In such cases, we should use the logic opposite of the normal logic
- We got negative NPV when rate was 8% and we should increase the rate so that we get positive NPV

$IRR = L_1 + \frac{NPV \text{ at } L_1}{NPV \text{ at } L_1 - NPV \text{ at } L_2} \times (L_2 - L_1)$					
$IRR = 8 + \frac{-18.03}{-18.03 - (0.65)} \times (9 - 8); IRR = 8 + \frac{-18.03}{-18.68} \times (1); IRR = 8 + 0.97 = 8.97\%$					

80. Portfolio creation based on duration [Nov 2018 MTP, Nov 2015, Nov 2021 RTP, May 2022 MTP, SM]**ICAI Question:**

Mr. A will need Rs.1,00,000 after two years for which he wants to make one time necessary investment now. He has a choice of two types of bonds. Their details are as below:

	Bond X	Bond Y
Face value	Rs.1000	Rs.1000
Coupon	7% payable annually	8% payable annually
Years to maturity	1	4

	Current price	Rs.972.73	Rs.936.52
	Current yield	10%	10%
Advice Mr. A whether he should invest all his money in one type of bond or he should buy both the bonds and, if so, in what quantity? Assume that there will not be any call risk or default risk.			
Modified question: "Current Yield should be replaced with Yield to Maturity in the question"			

Answer:**WN 1: Computation of Duration of Bond X and Bond Y:**

- Investor wants money after two years and hence his investment horizon is for two years. We can immunize his portfolio if the weighted duration of Mr.A's portfolio is of 2 years

Duration of Bond X:

- Life of Bond X is of 1 year and hence it will have single cash flow. Consequently, duration of Bond X will be equal to 1 year

Duration of Bond Y:

Year	Cash flow	PVF @ 10%	DCF	Weight	Product
1	80	0.909	72.72	0.078	0.078
2	80	0.826	66.08	0.071	0.142
3	80	0.751	60.08	0.064	0.192
4	1,080	0.683	737.64	0.788	3.152
Total			936.52		3.564

WN 2: Computation of investment in Bond X and Bond Y:

- Let us assume W1 to be the proportion of investment in Bond X and (1-W1) to be the proportion of investment in Bond Y

Bond	Weight	Duration	Product
X	W1	1	W1
Y	1-W1	3.564	3.564 - 3.564W1
Total	1		W1 + 3.564 - 3.564W1 = 2

$$W1 + 3.564 - 3.564W1 = 2$$

$$-2.564W1 = -1.564$$

$$W1 = \left(\frac{1.564}{2.564} \right) = 0.6099 \sim 0.61$$

Proportion of investment in Security 1 = 0.61

Proportion of investment in Security 2 = 0.39

WN 3: Computation of number of bonds to be purchased:

Particulars	Calculation	Amount
1. Money required after two years		1,00,000
2. Money to be invested today	$\frac{1,00,000}{1.10^2}$	82,600
3. Amount to be invested in Bond X	82,600 x 61%	50,386
4. Amount to be invested in Bond Y	82,600 x 39%	32,214
5. Number of bonds of X to be purchased	$\frac{50,386}{972.73}$	52
6. Number of bonds of Y to be purchased	$\frac{32,214}{936.52}$	34

81. Immunizing portfolio [Nov 2018, May 2021 MTP] [Concept Revision]

The following data are available for three bonds A, B and C. These bonds are used by a bond portfolio manager to fund an outflow scheduled in 6 years. Current yield is 9%. All bonds have face value of Rs.100 each and will be redeemed at par. Interest is payable annually.

Bond	Maturity (Years)	Coupon Rate
A	10	10%
B	8	11%

C	5	9%

- Calculate the duration of each bond
- The bond portfolio manager has been asked to keep 45% of the portfolio money in Bond A. Calculate the percentage amount to be invested in bonds B and C that need to be purchased to immunize the portfolio
- After the portfolio has been formulated, an interest rate change occurs, increasing the yield to 11%. The new duration of these bonds are: Bond A = 7.15 years, Bond B = 6.03 years and Bond C = 4.27 years. Is the portfolio still immunized? Why or why not?
- Determine the new percentage of B and C bonds that are needed to immunize the portfolio. Bond A remains at 45% of the portfolio.

Answer:**WN 1: Computation of duration of bond:****Computation of Duration of Bond A:**

Year	Cash flow	PVF @ 9%	DCF	Weight	Product
1	10	0.917	9.17	0.086	0.086
2	10	0.842	8.42	0.079	0.158
3	10	0.772	7.72	0.073	0.219
4	10	0.708	7.08	0.067	0.268
5	10	0.65	6.5	0.061	0.305
6	10	0.596	5.96	0.056	0.336
7	10	0.547	5.47	0.051	0.357
8	10	0.502	5.02	0.047	0.376
9	10	0.46	4.6	0.043	0.387
10	110	0.422	46.42	0.436	4.36
Total			106.36		6.852

- Duration of Bond A = 6.85 years

Computation of Duration of Bond B:

Year	Cash flow	PVF @ 9%	DCF	Weight	Product
1	11	0.917	10.09	0.091	0.091
2	11	0.842	9.26	0.083	0.166
3	11	0.772	8.49	0.076	0.228
4	11	0.708	7.79	0.07	0.28
5	11	0.65	7.15	0.064	0.32
6	11	0.596	6.56	0.059	0.354
7	11	0.547	6.02	0.054	0.378
8	111	0.502	55.72	0.502	4.016
Total			111.08		5.833

- Duration of Bond B = 5.83 years

Computation of Duration of Bond C:

Year	Cash flow	PVF @ 9%	DCF	Weight	Product
1	9	0.917	8.25	0.083	0.083
2	9	0.842	7.58	0.076	0.152
3	9	0.772	6.95	0.07	0.21
4	9	0.708	6.37	0.064	0.256
5	109	0.65	70.85	0.709	3.545
Total			100		4.246

- Duration of Bond C = 4.25 years

WN 2: Computation of percentage amount to be invested in Bond B and C to immunize the portfolio:

- The portfolio manager has scheduled outflow after 6 years and hence his investment horizon will be of 6 years. We should ensure the weighted duration of portfolio is of 6 years
- Let us assume b to be the proportion of investment in Bond B
- Proportion of investment in Bond C = $1 - 0.45 - b$

Bond	Weight	Duration	Product
A	0.45	6.85	3.0825

B	b	5.83	5.83b
C	1 - 0.45 - b	4.25	4.25 - 1.9125 - 4.25b
Total			5.42 + 1.58b = 6

Investment in Bond B:

$$5.42 + 1.58b = 6; 1.58b = 0.58; b = \frac{0.58}{1.58} = 0.3671$$

- Hence 36.71 percent of investment is to be made in Bond B

Investment in Bond C:

- Investment in Bond C = 100 - 45% - 36.71% = 18.29%
- Hence 18.29 percent of investment is to be made in Bond C

WN 3: Checking on immunization with revised duration:

Bond	Weight	Duration	Product
A	0.45	7.15	3.2175
B	0.3671	6.03	2.2136
C	0.1829	4.27	0.7810
Total			6.2121

- Portfolio is not immunized as the duration of the portfolio has increased from 6 years to 6.21 years

WN 4: Computation of percentage investment to immunize the portfolio with revised duration of bonds:

- Let us assume b to be the proportion of investment in Bond B
- Proportion of investment in Bond C = 1 - 0.45 - b

Bond	Weight	Duration	Product
A	0.45	7.15	3.2175
B	b	6.03	6.03b
C	1 - 0.45 - b	4.27	4.27 - 1.9215 - 4.27b
Total			5.566 + 1.76b = 6

Investment in Bond B:

$$5.566 + 1.76b = 6; 1.76b = 0.434; b = \frac{0.434}{1.76} = 0.2466$$

- Hence 24.66 percent of investment is to be made in Bond B

Investment in Bond C:

- Investment in Bond C = 100 - 45% - 24.66% = 30.34%
- Hence 30.34 percent of investment is to be made in Bond C

82. Bond refunding [Nov 2005, Nov 2018, Nov 2009, Nov 2016 RTP, Nov 2022 RTP, Nov 2021 MTP] [Concept Revision]

ABC Ltd. is contemplating calling Rs. 3 crores of 30 year Rs. 1,000 bond issued 5 years ago with a coupon interest rate of 14 %. The bonds have a call price of Rs. 1,140 and had initially collected proceeds of Rs. 2.91 crores due to a discount of Rs. 30 per bond. The initial floating cost was Rs. 3, 60,000. The Company intends to sell Rs. 3 crores of 12% coupon rate, 25 years bonds to raise funds for retiring the old bonds. It proposes to sell the new bonds at their par value of Rs. 1,000. The estimated floatation cost is Rs. 4, 00,000. The company is paying 40% tax and it's after cost of debt is 8 %. As the new bonds must first be sold and their proceeds, then used to retire old bonds, the company expects a two months period of overlapping interest during which interest must be paid on both the old and new bonds. What is the feasibility of refunding bonds?

Answer:**WN 1: Initial Outflow:**

Particulars	Calculation	Amount (in lacs)
Redemption value of old bond	$\left(\frac{300}{1,000}\right) \times 1,140$	(342)
Tax premium on redemption of old bonds	42 x 40%	16.80

Tax benefit on write-off of discount on old bond	$\frac{9}{30} \times 25 \times 40\%$	3.00
Tax benefit on write-off of floatation cost of old bond	$\frac{3.60}{30} \times 25 \times 40\%$	1.20
Inflow from new bonds	$300 - 4$	296
Overlapping interest (Note 1)	$300 \times 14\% \times \frac{2}{12} \times 60\%$	(4.2)
Initial Outflow		(29.20)

Note:

- Overlapping interest is the extra interest to be paid due to delay in redemption of old bond. During this period, interest would be paid for both old and new bonds. Under bond refunding, the assumption is that we have redeemed the old bond and replaced with new bond. Hence any interest paid on old bond will be called as overlapping interest

WN 2: In-between flows:

(in lacs)

Particulars	Old Bond	New Bond
Interest cost	42 [300 × 14%]	36 [300 × 12%]
Tax on interest	(16.80) [42 × 40%]	(14.40) [36 × 40%]
Tax on floatation cost	(0.048) [3.6/30 × 40%]	(0.064) [4/25 × 40%]
Tax on discount	(0.12) [9/30 × 40%]	-
Net cash flow	25.032	21.536

- Annual cash flow savings = 25.032 – 21.536 = 3.496 lacs

WN 3: Terminal flow:

(in lacs)

Particulars	Old Bond	New Bond
Redemption value	(300)	(300)

- Net incremental cash flow = 0

WN 4: Computation of NPV:

(in lacs)

Year	Cash flow	PVF @ 8%	DCF
0	(29.20)	1.000	(29.20)
1 to 25	3.496	10.675	37.32
NPV			8.12

- The company should go ahead with bond refunding as it results in positive NPV of Rs.8.12 lacs

83. Bond refunding [May 2013, May 2018 MTP, Dec 2021, May 2024 MTP]

M/s. Earth Limited has 11% bond worth of Rs. 2 crores outstanding with 10 years remaining to maturity. The company is contemplating the issue of a Rs. 2 crores 10 year bond carrying the coupon rate of 9% and use the proceeds to liquidate the old bonds. The unamortized portion of issue cost on the old bonds is Rs. 3 lakhs which can be written off no sooner the old bonds are called. The company is paying 30% tax. Should Earth Limited liquidate the old bonds? You may assume that the issue cost of the new bonds will be Rs. 2.5 lakhs and the call premium is 5%

Answer:**WN 1: Computation of initial outflow:**

Particulars	Calculation	Amount (in lacs)
Cash flows relating to old bond:		
Value of old bonds redeemed		(200)
Call premium on old bonds	$200 \times 5\%$	(10)
Tax benefit on write off of call premium of old bonds	$10 \times 30\%$	3
Tax benefit on write off of issue cost of old bonds	$3 \times 30\%$	0.9
Cash flows relating to new bond:		

Value of issue of new bond		200
Issue cost of new bond		(2.5)
Net initial outflow		8.6

Note:

- ❖ All items associated with old bond will be written off on day 0 and the company would get tax benefit on the same. Items to be written off are floatation cost and call premium on old bond

WN 2: Computation of in-between cash flows:

Particulars	Old bond	New bond
Interest outflow	22 (200 × 11%)	18 (200 × 9%)
Less: Tax saving on interest	(6.6)	(5.4)
Less: Tax benefit on w/o off floatation cost	0.09 [3 lacs/10 years × 30%]	0.075 [2.5 lacs/10 years × 30%]
Net outflow	15.31	12.525

- ❖ Net annual savings = 15.31 lacs - 12.525 lacs = 2.785 lacs

WN 3: Computation of NPV of refunding decision:**(in lacs)**

Year	Cash flow	PVF @ 6.3%	DCF
0	(8.6)	1	(8.6)
1 to 10	2.785	7.257	20.21
NPV of refunding decision			11.61

Decision: The bond should be refunded as the same generates positive NPV

Note: Discount rate is not given in question and hence the same would be equal to after-tax cost of new debt. The same would be 6.3% (9 × 70%)

84. Valuation of share and Bond Refunding [May 2019 RTP] [Homework]

The directors of Implant Inc. wishes to make an equity issue to finance a \$10 m (million) expansion scheme which has an expected Net Present Value of \$2.2m and to re-finance an existing \$6 m 15% Bonds due for maturity in 5 years time. For early redemption of these bonds there is a \$3,50,000 penalty charges. The Co. has also obtained approval to suspend these pre-emptive rights and make a \$15 m placement of shares which will be at a price of \$0.5 per share. The floatation cost of issue will be 4% of Gross proceeds. Any surplus funds from issue will be invested in IDRs which is currently yielding 10% per year. The Present capital structure of Co. is as under:

Particulars	'000
Ordinary share (USD 1 per share)	7,000
Share premium	10,500
Free reserves	25,500
Total equity	43,000
15% term bonds	6,000
11% debentures (2012 – 2020)	8,000
Total capital	57,000

Current share price is \$2 per share and debenture price is \$ 103 per debenture. Cost of capital of Co. is 10%. It may be further presumed that stock market is semi -strong form efficient and no information about the proposed use of funds from the issue has been made available to the public. You are required to calculate expected share price of company once full details of the placement and to which the finance is to be put, are announced.

Answer:**Computation of expected share price:**

Particulars	Calculation	Amount (in '000s)
Existing Networth	7,000 × 2	14,000
New issue made		15,000
Less: Issue expenses	15,000 × 4%	-600
NPV of new project		2,200

NPV of bond refunding	Note 1	787.90
Expected Networth (A)		31,387.90
No of shares (B)	7,000 + (15,000/0.50)	37,000
Expected price (A/B)		0.8483

Note 1: Computation of NPV of bond refunding:

Year	Cash flow	PVF @ 10%	DCF
0	-6,350	1.000	-6,350.00
1 to 5	900	3.791	3,411.90
5	6,000	0.621	3,726.00
NPV of bond refunding			787.90

- The company will have to pay 6,350 today for bond refunding (6 million + 3,50,000)
- The company will save interest of 900 for a period of 5 years and will save principal payment of 6,000 at end of five years
- Cost of capital is 10%

85. Bond valuation [Nov 2017 MTP, May 2015]

On 31st March 2013, the following information about Bonds is available:

Name of Security	Face Value	Maturity Date	Coupon Rate	Coupon Dates
Zero coupon	10,000	31 st March, 2023	N.A.	N.A.
T-Bill	1,00,000	20 th June, 2013	N.A.	N.A.
10.71% GOI 2023	100	31 st March, 2023	10.71	31 st March
10% GOI 2018	100	31 st March, 2018	10.00	31 st March and 31 st October

Calculate:

- If 10 years yield is 7.5 percent p.a. what price the zero coupon bond would fetch on 31st March, 2013?
- What will be the annualized yield if the T-Bill is traded @98500?
- If 10.71% GOI 2023 Bond having yield to maturity is 8%, what price would it fetch on April 1, 2013 (after coupon payment on 31st March)?
- If 10% GOI 2018 Bond having yield to maturity is 8%, what price would it fetch on April 1, 2013 (after coupon payment on 31st March)?

Answer:**WN 1: Valuation of Zero-Coupon Bond:**

Year	Cash flow	PVF @ 7.5%	DCF
10	10,000	0.4852	4,852
Value of Bond			4,852

WN 2: Computation of annualized yield of treasury bill:

- Investment of Rs.98,500 today will become Rs.1,00,000 in 81 days

$$\text{Return} = \frac{1,00,000 - 98,500}{98,500} \times \frac{365}{81} \times 100 = 6.86\%$$

WN 3: Valuation of 10.71% GOI 2023 Bond:

Year	Cash flow	PVF @ 8%	DCF
1 to 10	10.71	6.710	71.86
10	100	0.463	46.30
Value of bond			118.16

WN 4: Valuation of 10% GOI 2018 Bond:

Period	Cash flow	PVF @ 4%	DCF
1 to 10	5	8.110	40.55
10	100	0.676	67.60
Value of bond			108.15

Note:

- Bond pays half-yearly interest and hence we should half-yearly discounting. Discount rate is 8% per annum and same would be equal to 4% per half-year

86. Valuation of debt [Nov 2017 MTP, Nov 2017 RTP] [Concept Revision]

Based on the following data, estimate the Net Asset Value (NAV) on 1st July 2016 on per unit basis of a Debt Fund:

Name of security	Face Value	Purchase Price	Maturity Date	No of securities	Coupon Dates	Duration of bonds
10.71% GOI 2028	100	104.78	31 st March 2028	1,00,000	31 st March	7.3494
10% GOI 2023	100	100.00	31 st March, 2023	50,000	31 st March & 30 th September	5.086
9.5% GOI 2021	100	97.93	31 st December 2021	40,000	30 th June & 31 st December	4.3949
8.5% SGL 2025	100	91.36	30 th June 2025	20,000	30 th June	6.5205

Number of units (Rs.10 face value each): 1,00,000

All securities were purchased at a time when applicable yield to maturity (YTM) was 10%. On NAV date, the required yield increased by 75 basis point and cash in hand and accrued expenses were Rs.6,72,800 and Rs.2,37,400 respectively.

Answer:**WN 1: Computation of accrued interest:**

- ❖ 10.71% GOI 2028 and 10% GOI 2023 would have last paid interest on March 31, 2016 and hence interest for the period April 1, 2016 to June 30, 2016 (3 months) would be accrued interest on NAV valuation date

Bond	Calculation	Amount
10.71% GOI 2028	$1,00,000 \times 100 \times 10.71\% \times (3/12)$	2,67,750
10% GOI 2023	$50,000 \times 100 \times 10\% \times (3/12)$	1,25,000
Total accrued interest		3,92,750

WN 2: Valuation of securities:

Name of security	Purchase Amount	Duration	Volatility (Duration/(1 + YTM%))	% change (Volatility x 0.75%)	Amount of change	Revised value
10.71% GOI 2028	1,04,78,000	7.3494	6.6813 [7.3494/1.10]	-5.0110	-5,25,053	99,52,947
10% GOI 2023	50,00,000	5.086	4.8438 [5.086/1.05]	-3.6329	-1,81,645	48,18,355
9.5% GOI 2021	39,17,200	4.3949	4.1856 [4.3949/1.05]	-3.1392	-1,22,969	37,94,231
8.5% SGL 2025	18,27,200	6.5205	5.9277 [6.5205/1.10]	4.4456	-81,230	17,45,970
Total value of all securities						2,03,11,503

Note:

- Numerator for duration will be always as duration in terms of years. However the denominator for half-yearly bond will be half-yearly YTM and for a quarterly bond will be quarterly YTM

WN 3: Computation of NAV:

Particulars	Amount
Value of securities (WN 2)	2,03,11,503
Accrued interest (WN 1)	3,92,750
Cash in hand	6,72,800
Total Assets (A)	2,13,77,050
Less: Expenditure accrued	(2,37,400)
Net Assets	2,11,39,650
No of units	1,00,000
NAV per unit (2,11,39,650/1,00,000)	Rs.211.40

87. Valuation of debt and preference portfolio [Nov 2014 MTP, May 2017 RTP, Nov 2023 RTP]
[Homework]

John inherited the following securities on his uncle's death:

Types of security	Nos.	Annual Coupon %	Maturity Years	Yield %
Bond A (Rs.1,000)	10	9	3	12
Bond B (Rs.1,000)	10	10	5	12
Preference shares C (Rs.100)	100	11	*	13*
Preference shares D (Rs.100)	100	12	*	13*

* likelihood of being called at a premium over par.
 Compute the current value of his uncle's portfolio.

Answer:

Types of security	Note	Value
Bond A (Rs.1,000)	1	9,282
Bond B (Rs.1,000)	2	9,275
Preference shares C (Rs.100)	3	8,462
Preference shares D (Rs.100)	4	9,231
Total value		36,250

Note 1: Valuation of Bond A:

Year	Cash flow	PVF @ 12%	DCF
1 to 3	90	2.402	216.20
3	1,000	0.712	712.00
Expected price of 1 bond			928.2
Expected price of 10 bonds			9,282

Note 2: Valuation of Bond B:

Year	Cash flow	PVF @ 12%	DCF
1 to 5	100	3.605	360.50
5	1,000	0.567	567.00
Expected price of 1 bond			927.5
Expected price of 10 bonds			9,275

Note 3: Valuation of Preference Shares C:

- ❖ Details on life of preference shares is not given and hence preference shares would be treated like a perpetuity.
- ❖ PV of perpetuity = $\left(\frac{\text{Perpetuity Amount}}{\text{Investor Expectation}} \right) = \frac{11}{13\%} = 84.62$ per share
- ❖ Value of 100 shares = Rs.8,462

Note 4: Valuation of Preference Shares D:

- ❖ PV of perpetuity = $\left(\frac{\text{Perpetuity Amount}}{\text{Investor Expectation}} \right) = \frac{12}{13\%} = 92.31$ per share
- ❖ Value of 100 shares = Rs.9,231

88. Computation of forward rates [May 2010, Nov 2007, Nov 2018 MTP, Nov 2015 RTP] [Concept Revision]

Consider the following data for Government Securities:

Face Value	Interest Rate (%)	Maturity (years)	Current Price
1,00,000	0	1	91,000
1,00,000	10.5	2	99,000
1,00,000	11.0	3	99,500
1,00,000	11.5	4	99,900

Calculate the forward interest rates

Answer:

WN 1: Computation of forward rate of year 1(r1):

Analysis of 1-year bond

Year	Cash flow	PVF	DCF
0	(91,000)	1.000	(91,000)

1	1,00,000	0.91	91,000
			0

Note:

- Current market price of 1-year bond is Rs.91,000. The bond does not pay any interest and hence on maturity we will receive 1,00,000
- r_1 will be the forward rate for year 1 and should be the discount rate at which the PV of 1,00,000 is Rs.91,000 (Today's value)
- From above calculation we can find that PVF for year 1 is 0.91

$$\frac{1}{1+r_1} = 0.91; 1+r_1 = \frac{1}{0.91}; 1+r_1 = 1.0989; r_1 = \mathbf{0.0989 \text{ or } 9.89\%}$$
- From above calculations we can conclude that forward rate for year 1 is 9.89%

WN 2: Computation of forward rate of year 2(r_2):**Analysis of 2-year bond**

Year	Cash flow	PVF	DCF
0	(99,000)	1.000	(99,000)
1	10,500	0.91	9,555
2	1,10,500	0.8095	89,445
Total			0

Note:

- We need to first populate the cash flows of the bond. Year 0 is current market price, year 1 would be interest income & year 2 would be interest + principal redemption
- PVF for year 1 would be 0.91 based on forward rate of 9.89%
- PVF for year 2 is taken as balancing figure. PVF of year 2 = $89,445/1,10,500 = 0.8095$; 89,445 is taken as balancing figure to make the total of DCF as 0
- We can now compute r_2 using the below calculation

$$\frac{\text{PVF of year 1}}{1+r_2} = 0.8095; 1+r_2 = \frac{0.91}{0.8095}; 1+r_2 = 1.1242; r_2 = \mathbf{0.1242 \text{ (or) } 12.42\%}$$
- From above calculations we can conclude that forward rate of year 2 is 12.42%

WN 3: Computation of forward rate of year 3 (r_3):**Analysis of 3-year bond:**

Year	Cash flow	PVF	DCF
0	(99,500)	1.000	(99,500)
1	11,000	0.91	10,010
2	11,000	0.8095	8,905
3	1,11,000	0.7260	80,585
Total			0

Note:

- PVF for year 1 and year 2 is taken as per WN 2
- PVF for year 3 is taken as balancing figure. PVF of year 3 = $80,585/1,11,000 = 0.7256$; 80,585 is taken as balancing figure to make the total of DCF as 0
- We can now compute r_3 using the below calculation

$$\frac{\text{PVF of year 2}}{1+r_3} = 0.7256; 1+r_3 = \frac{0.8095}{0.7260}; 1+r_3 = 1.1150; r_3 = \mathbf{0.1150 \text{ or } 11.50\%}$$
- From above calculations we can conclude that forward rate of year 3 is 11.50%

WN 4: Computation of forward rate of year 4(r_4):**Analysis of 4-year bond:**

Year	Cash flow	PVF	DCF
0	(99,900)	1.000	(99,900)
1	11,500	0.91	10,465
2	11,500	0.8095	9,309
3	11,500	0.7260	8,349
4	1,11,500	0.6437	71,777
Total			0

Note:

- We can now compute r_4 using the below calculation

$$\frac{\text{PVF of year 3}}{1 + r_4} = 0.6437; 1 + r_4 = \frac{0.7260}{0.6437}; 1 + r_4 = 1.1279; r_4 = 0.1279 \text{ (or) } 12.79\%$$
- From above calculations we can conclude that forward rate of year 4 is 12.79%

89. Calculation of forward rates [Nov 2008] [Homework]

The following is the yield structure of AAA rated debenture:

❖ 3 Months	:	8.5%
❖ 6 months	:	9.25%
❖ 1 year	:	10.50%
❖ 2 years	:	11.25%
❖ 3 years and above	:	12.00%

Required:

- Based on the expectation theory calculate the implicit one-year forward rates in year 2 and year 3
- If the interest rate increases by 50 basis points, what will be the percentage change in the price of the bond having a maturity of 5 years? Assume that the bond is fairly priced at the moment at Rs. 1,000

Answer:

WN 1: Computation of implicit one-year forward rate in year 2 and year 3:

Forward rate in year 2:

$$\text{Forward rate in year 2} = \frac{\text{FVF for year 2}}{\text{FVF for year 1}} - 1$$

$$\text{Forward rate in year 2} = \frac{(1 + 11.25\%)^2}{(1 + 10.50\%)} - 1 = 1.1200 - 1 = 12.00\%$$

Forward rate in year 3:

$$\text{Forward rate in year 3} = \frac{\text{FVF for year 3}}{\text{FVF for year 2}} - 1$$

$$\text{Forward rate in year 2} = \frac{(1 + 12.00\%)^3}{(1 + 11.25\%)^2} - 1 = 1.1352 - 1 = 13.52\%$$

WN 2: Computation of percentage change in bond prices if interest rate increases by 0.50%:

- 5-year bond has required yield of 12 percent. The bond is fairly priced at Rs.1,000. Bond is quoted at par and hence interest rate on bond should be equal to yield of bond. The required yield of bond increases by 0.50% and the revised yield of bond would be 12.50%

New price of bond:

Year	Cash flow	PVF @ 12.50%	DCF
1 to 5	120	3.561	427.32
5	1,000	0.555	555.00
Revised Price			982.32

$$\% \text{ fall in price} = \frac{1,000 - 982.32}{1,000} \times 100 = 1.77\%$$

Note: The change in price can also be computed with the help of duration and volatility.

Alternative solution: (This has been presented as ICAI solution)

$$\text{Bond price} = \frac{1,000 \times 1.12^5}{1.125^5} = \text{Rs. } 978$$

$$\% \text{ fall in price} = \frac{1,000 - 978}{1,000} \times 100 = 2.20\%$$

Comments:

- The above solution is also logical but it assumes that all our intermediate cash flows will be reinvested at the rate of 12% and based on the maturity cash flow, we have computed the fair price of the bond. This approach is similar to realized YTM of Bond.

90. Forward rate computation [Jan 2021] [Concept Revision]

Following are the yields on zero coupon bonds having a face value of Rs.1,000

Maturity	Yield to Maturity (YTM)
1	10%
2	11%
3	12%

Assume that the term structure of interest rate will remain the same. You are required to

(i) Calculate the implied one year forward rates

(ii) Expected Yield to Maturity and prices of one year and two-year Zero Coupon Bonds at the end of the first year

Answer:

WN 1: Computation of implied one year forward rates:

$$\text{Forward rate for year 1 to year 2} = \frac{\text{FVF for year 2}}{\text{FVF for year 1}} - 1$$

$$\text{Forward rate for year 1 to year 2} = \frac{(1 + 11\%)^2}{(1 + 10\%)} - 1 = \frac{1.2321}{1.10} - 1 = \mathbf{0.1201 \text{ (or) } 12.01\%}$$

$$\text{Forward rate for year 2 to year 3} = \frac{\text{FVF for year 3}}{\text{FVF for year 2}} - 1$$

$$\text{Forward rate for year 2 to year 3} = \frac{(1 + 12\%)^3}{(1 + 11\%)^2} - 1 = \frac{1.404928}{1.2321} - 1 = \mathbf{0.1403 \text{ (or) } 14.03\%}$$

WN 2: Computation of expected yield to maturity and prices of one year and two-year ZCB:

One-year bond:

- Yield of one-year ZCB would be equal to forward rate of year 1 to 2 of 12.01%
- Price of one-year bond = $1,000 / (1 + 12.01\%) = \mathbf{Rs.892.78}$

Two-year bond:

- Bond has two-year life at the end of one year. This would basically earn returns in year 2 to year 3 (if we compare from today's date)

$$\text{FVF for Year 1 to Year 3} = \frac{\text{FVF for year 3}}{\text{FVF for year 1}} = \frac{1.404928}{1.10} = 1.2772$$

$$\text{Annualized YTM} = \sqrt[2]{1.2772} - 1 = 1.1301 - 1 = \mathbf{0.1301 \text{ (or) } 13.01\%}$$

$$\text{Price of bond} = \frac{1,000}{(1.1201) \times (1.1403)} = \mathbf{Rs. 782.93}$$

91. Decision on buyback of debentures [Nov 2005, May 2023 RTP, SM] [Homework]

Following information is available in respect of dividend, market price and market condition after one year

Market condition	Probability	Market Price	Dividend per share
Good	0.25	115	9
Normal	0.50	107	5
Bad	0.25	97	3

The existing market price of an equity share is Rs.106 (Face value of Rs.1), which is cum 10% debentures of Rs.6 each, per share. M/s. X Finance company Limited had offered the buy-back of debentures at face value. Find out the expected return and variability of returns of the equity shares. And also advise-whether to accept buyback offer?

Answer:

Author's Note:

Students are advised to refer to this question post completion of basics of portfolio management (computation of risk and return)

Computation of expected return and standard deviation:

Market condition	Capital appreciation	Dividend	Return (in Rs.)	Return in %	Prob	Product	Deviation	Pd ²
Good	15	9	24	24	0.25	6	12	36
Normal	7	5	12	12	0.50	6	0	0
Bad	-3	3	0	0	0.25	0	-12	36
Total						12		72

Note:

- ❖ Capital appreciation = Expected market price - current market price. Current market price is taken as Rs.100 as CMP of Rs.106 include debentures of Rs.6
- ❖ Return in % = Return in Rs./CMP of 100

- ❖ Expected return = Sum of product = 12%
- ❖ Standard deviation = $\sqrt{Pd^2} = \sqrt{72} = 8.49\%$

Decision on buyback offer:

- M/s X Finance company has offered the buyback of debenture at face value. There is reasonable 10% rate of interest compared to expected return 12% from the market.
- **Considering the dividend rate and market price the creditworthiness of the company seems to be very good.** The decision regarding buy-back should be taken considering the maturity period and opportunity in the market.
- **Normally, if the maturity period is low say up to 1 year better to wait otherwise to opt buy back option**

Author's Note:

- The above answer has been given as per ICAI Solution
- Decision on buyback is normally done based on alternative opportunity in the market. If there is alternative opportunity in market then we should go ahead with buyback and vice-versa.

92. Convexity:

Compute convexity, convexity adjustment and new price if the yield is increased by 1%

Particulars	Amount
Face value	100
Rate of interest	10%
YTM	10%
Life	5 years

Answer:**WN 1: Computation of Duration and Current Market price of Bond:**

Year	Cash flow	PVF @ 10%	DCF	Weight	Product
1	10	0.9091	9.091	0.0909	0.0909
2	10	0.8264	8.264	0.0826	0.1652
3	10	0.7513	7.513	0.0751	0.2253
4	10	0.6830	6.83	0.0683	0.2732
5	110	0.6209	68.299	0.683	3.415
			99.997		4.1696

Duration = 4.1696 Years

$$\text{Volatility} = \frac{4.1696}{1 + 10\%} = 3.7905$$

WN 2: Computation of Convexity and Convexity Adjustment:**Note 1: Computation of MPS with 1% increase and decrease in yield**

Year	Cash flow	PVF @ 11%	DCF	PVF @ 9%	DCF
1 to 5	10	3.6959	36.959	3.8897	38.897
5	100	0.5935	59.350	0.6499	64.990
Total			96.309		103.887

$$\text{Convexity} = \frac{V_+ + V_- - 2V_0}{2V_0(\Delta y^2)} = \frac{96.309 + 103.887 - 2(99.997)}{2(99.997)(0.01)(0.01)} = 10.1003$$

$$\text{Convexity Adjustment (in Rs.)} = \text{Convexity} \times V_0 \times (\Delta y^2) = 10.1003 \times 99.997 \times 0.01 \times 0.01 = 0.1010$$

$$\text{Convexity Adjustment (in \%)} = \frac{0.1010}{99.997} \times 100 = 0.1010\%$$

WN 3: Computation of new price if yield increases to 11%

New Price = Current price – Change due to yield increase + Convexity adjustment

$$\text{New Price} = 99.997 - 3.7904 + 0.1010 = \text{Rs. } 96.3076$$

Change due to price increase:

- Duration of the bond is 4.1696. Volatility of the bond will be 3.7905. This would mean that bond price will fall by 3.7905% for 1% increase in yield
- Change due to yield increase = $99.997 \times 3.7905\% = 3.7904$

Note: Convexity adjustment will always be added even if there is a fall/rise in yield.

93. Bond Valuation (Nov 2020, May 2022 RTP, May 2023 RTP, May 2022 MTP, SM) [Concept Revision]

The following data are available for a bond:

Face Value Rs. 10,000 to be redeemed at par on maturity

Coupon rate 8.5 per cent per annum

Years to Maturity 5 years

Yield to Maturity (YTM) 10 per cent

You are required to calculate:

- Current market price of the Bond,
- Macaulay's Duration,
- Volatility of the Bond,
- Convexity of the Bond,
- Expected market price, if there is a decrease in the YTM by 200 basis points
 - By Macaulay's Duration based estimate
 - By Intrinsic Value Method.

Answer:

Base computation:

Year	Cash flow	PVF @ 10%	DCF	Weight	Product
1	850	0.909	772.65	0.0819	0.0819
2	850	0.826	702.10	0.0744	0.1488
3	850	0.751	638.35	0.0677	0.2031
4	850	0.683	580.55	0.0616	0.2464
5	10,850	0.621	6,737.85	0.7144	3.572
			9,431.50		4.2522

Solution:

Current market price		Rs.9,431.50
Macaulay duration		4.2522 years
Volatility	$\frac{\text{Duration}}{1 + \text{YTM}} = \frac{4.2522}{1 + 10\%}$	3.8656%
Convexity	Note 1	9.9799
Convexity adjustment	Note 1	37.65
Convexity adjustment (%)	Note 1	0.3992%

Note 1: Computation of Convexity:

- In order to compute Convexity, we need to compute bond price with increase/decrease in yield. Question has mentioned about 200 bps change and hence we shall compute intrinsic value of bond at 12% and 8% YTM

Year	Cash flow	PVF @ 12%	DCF	PVF @ 8%	DCF
1 to 5	850	3.605	3,064.25	3.993	3,394.05
5	10,000	0.567	5,670.00	0.681	6,810.00
			8,734.25		10,204.05

$$\text{Convexity} = \frac{V_+ + V_- - 2V_0}{2V_0(\Delta y^2)} = \frac{8734.25 + 10204.05 - 2(9,431.50)}{2(9,431.50)(0.02)(0.02)} = 9.9799$$

$$\text{Convexity Adjustment (in Rs.)} = \text{Convexity} \times V_0 \times (\Delta y^2) = 9.9799 \times 9,431.50 \times 0.02 \times 0.02 = \text{Rs. } 37.65$$

$$\text{Convexity Adjustment (in \%)} = \frac{37.65}{9,431.50} \times 100 = 0.3992\%$$

Computation of new price through duration estimate:

Decrease in yield by 200 bps:

- Volatility of 3.8656 would mean that bond price will change by 3.8656% for 2% change in yield
- Yield has decreased by 2 percent and hence bond price will increase by 7.7312%
- New price = $9,431.50 + 7.7312\% = \text{Rs.}10,160.67$

Note: New price can also be calculated by taking convexity adjustment into consideration and same is computed as under:

New Price = Current price + Change due to yield fall + Convexity adjustment

New Price = 9,431.50 + 7.7312% + 37.65 = 10,198.32

New price under intrinsic value method = 10,204.05

94. Valuation of Warrant:

A company has issued a warrant which can be converted into 10 equity shares by paying Rs.50 per share. The current market price of the share is Rs.80. How much is the value of warrant?

Answer:

Value of warrant = $(\text{CMP} - \text{EP}) \times \text{Ratio} = (80 - 50) \times 10 = \text{Rs.}300$

Part V - Enterprise Value

95. Computation of Enterprise Value [SM]

Calculate Enterprise value from the following information:

Non-current assets	1000
Trade receivables	500
Cash and cash equivalents	500
Total assets	2000
Shareholders' funds	800
Long-term debt	200
Current liabilities and provisions	1000
Total liabilities	2000

The shares are actively traded and the current market price is Rs.12 per share. Shareholder funds represent 70 shares of 10 each and the rest is retained earnings.

Answer:

Computation of enterprise value:

Particulars	Calculation	Amount
Market value of equity	70 shares x 12	840
Market value of debt		200
Less: Cash and cash equivalents		(500)
Enterprise Value		540

96. Computation of EV/EBITDA multiple:

An analyst gathered the following data of ABC Limited

Recent share price	Rs.22.50
Shares outstanding	40 million
Market value of debt	Rs.137 million
Cash and marketable securities	Rs.62.3 million
Investments	Rs.327 million
Net income	Rs.137.5 million
Interest expense	Rs.6.9 million
Depreciation and amortization	Rs.10.4 million
Taxes	Rs.95.9 million

Based on this information calculate EV/EBITDA ratio for ABC Limited.

Answer:

WN 1: Computation of Enterprise Value:

Particulars	Calculation	Amount
Market value of equity	40 million x 22.50	900
Market value of debt		137
Less: Cash and cash equivalents		(62.30)
Less: Investments		(327)
Enterprise Value		647.70

WN 2: Computation of EBITDA:

Particulars	Amount
Net income (PAT)	137.50
Add: Tax	95.90
Profit before tax	233.40
Add: Depreciation	10.40
Add: Interest	6.90
EBITDA	250.70
EV/EBITDA Multiple [647.70/250.70]	2.58

Part VI – Money Market Instruments**97. Calculation of issue price [SM]**

RBI sold a 91 day T-bill of face value of Rs.100 at an yield of 6%. What was the issue price?

Answer:

- Let us assume the issue price to be X
- X will become Rs.100 in 91 days with annual yield being 6%

$$\frac{100 - X}{X} \times \frac{365}{91} \times 100 = 6$$

$$\frac{36,500 - 365X}{91X} = \frac{6}{100}; 36,500 - 365X = 0.06(91X)$$

$$36,500 - 365X = 5.46X; 36,500 = 370.46X$$

$$X = \frac{36,500}{370.46} = \text{Rs. } 98.53$$

- Hence the issue price of treasury bill would be Rs.98.53

98. Calculation of net receipt [Nov 2021 MTP, SM] [Concept Revision]

Z Co. Ltd issues commercial paper worth Rs.10 Crores as per the following details:

Date of issue	16 th January 2009
Date of maturity	17 th April 2009
No. of days	91
Interest rate	12.04% p.a.

What was the net amount received by the company on issue of CP? (Charges of intermediary may be ignored)

Answer:

- Let us assume the net amount received to be X
- X will become Rs.1,000 lacs in 91 days with annual yield being 12.04%

$$\frac{1,000 - X}{X} \times \frac{365}{91} \times 100 = 12.04$$

$$\frac{3,65,000 - 365X}{91X} = \frac{12.04}{100}; 3,65,000 - 365X = 0.1204(91X)$$

$$3,65,000 - 365X = 10.9564X; 3,65,000 = 375.9564X$$

$$X = \frac{3,65,000}{375.9564} = \text{Rs. } 970.8573 \text{ lacs}$$

Hence the net amount received on commercial paper is Rs.9.708573 Crores

99. Calculation of net investment

ABC Limited has to make payments of Rs.20 lacs on 16th April. It has surplus money today (January 15, 2018) and the company has decided to invest in certificate of deposits (CD) of a leading nationalized bank at 8 percent. What money is required to be invested now?

Answer:

- Let us assume the amount invested to be X
- X will become Rs.20 lacs in 91 days [16 days of January + 28 days of February + 31 days of March + 16 days of April] with annual yield being 8.00%

$$\frac{20 - X}{X} \times \frac{365}{91} \times 100 = 8.00$$

$$\frac{7,300 - 365x}{91x} = \frac{8.00}{100}; 7,300 - 365X = 0.08(91X)$$

$$7,300 - 365X = 7.28X; 7,300 = 372.28X$$

$$X = \frac{7,300}{372.28} = \text{Rs. } 19.60890 \text{ lacs}$$

- Hence amount to be invested today is Rs.19,60,890

100. Effective rate of interest of a CP issue [Nov 2020, May 2023 RTP] [Concept Revision]

From the following particulars, calculate the effective rate of interest p.a. as well as the total cost of funds to Bhaskar Ltd., which is planning a CP issue:

Issue Price of CP	Rs.97,550
Face Value	Rs.1,00,000
Maturity Period	3 Months
Issue expenses:	
Brokerage	0.15% for 3 months
Rating charges	0.50% p.a.
Stamp Duty	0.175% for 3 months

Answer:

WN 1: Computation of interest cost on commercial paper:

- Rs.97,550 has become Rs.1,00,000 in 3 months

$$\text{Nominal Interest} = \frac{1,00,000 - 97,550}{97,550} \times \frac{12}{3} \times 100 = 10.05\%$$

$$\text{Effective interest} = \left(1 + \frac{0.1005}{4}\right)^4 - 1 = 10.435\%$$

WN 2: Computation of total cost of funds:

Particulars	Amount
Effective interest cost	10.435%
Brokerage cost (0.15 x 4)	0.60%
Rating charges	0.50%
Stamp duty (0.175 x 4)	0.70%
Total cost of funds	12.235%

101. Commercial paper

ABC Limited is considering raising Rs.15 crores by issuing commercial paper for 120 days. Commercial paper will be sold at a discount of 11.25 percent. Stamp duty charges will be 0.5 percent of the size of the issue. The issuing and other charges will amount to Rs.3.75 lacs and rating charges are 0.40 percent of the issue size. Calculate the effective cost of CP?

Answer:

WN 1: Computation of amount raised:

- Let us assume the amount raised to be X
- X will become Rs.15 crores in 120 days with annual yield being 11.25%

$$\frac{15 - X}{X} \times \frac{365}{120} \times 100 = 11.25$$

$$\frac{5,475 - 365x}{120x} = \frac{11.25}{100}; 5,475 - 365X = 0.1125(120X)$$

$$5,475 - 365X = 13.50X; 5,475 = 378.50X$$

$$X = \frac{5,475}{378.50} = \text{Rs. } 14.46499 \text{ crores}$$

- Hence amount raised today will be Rs.14.46499 Crores

WN 2: Computation of effective cost of Commercial Paper:

Particulars	Amount (in cr)
Interest [15.00 - 14.46499]	0.53501

Stamp duty [15 x 0.50%]	0.07500
Issuing and other charges	0.03750
Rating charges [15 x 0.40%]	0.06000
Total cost (in Crores)	0.70751
Amount raised	
Amount raised	14.46499
Less: Stamp duty, rating and other charges	0.17250
Effective amount raised	14.29249

$$\text{Effective cost of CP} = \frac{0.70751}{14.29249} \times \frac{365}{120} \times 100 = 15.06\%$$

102. Commercial paper [Concept Revision]

ABC Limited is able to issue commercial paper of Rs.50,00,000 every 4 months at a rate of 12.5 percent per annum. The cost of placement of commercial paper issue is Rs.2,500 per issue. ABC Limited is required to maintain line of credit of Rs.1,50,000 in bank balance. The tax rate is 30%. What is the cost of funds (after taxes) to ABC Limited for commercial paper issue? The maturity of the commercial paper was 4 months

Answer:

WN 1: Computation of amount raised:

- Let us assume the amount raised to be X
- X will become Rs.50 lacs in 4 months with annual yield being 12.50%

$$\frac{50 - X}{X} \times \frac{12}{4} \times 100 = 12.50$$

$$\frac{600 - 12x}{4x} = \frac{12.50}{100}; 600 - 12x = 0.1250(4X)$$

$$600 - 12X = 0.50X; 600 = 12.50X$$

$$X = \frac{600}{12.50} = \text{Rs. 48 lacs}$$

- Hence amount raised today will be Rs.48 lacs

WN 2: Computation of effective cost of Commercial Paper:

Particulars	Amount (in lacs)
Interest [50.00 - 48.00]	2.000
Cost of placement	0.025
Total cost (in lacs)	2.025
Net amount raised through CP	
Amount raised	48.000
Less: Line of credit to be maintained	(1.500)
Less: Cost of placement	(0.025)
Effective amount raised	46.475

$$\text{Effective cost of CP (pre - tax)} = \frac{2.025}{46.475} \times \frac{12}{4} \times 100 = 13.07\%$$

$$\text{Effective cost of CP (post - tax)} = 13.07 \times 70\% = 9.15\%$$

103. Calculation of break-even period [SM] [Homework]

Wonderland Limited has excess cash of Rs.20 lakhs, which it wants to invest in short term marketable securities. Expenses relating to investment will be Rs. 50,000. The securities invested will have an annual yield of 9 %. The company seeks your advice.

- As to the period of investment so as to earn a pre-tax income of 5 %.
- The minimum period for the company to break even its investment expenditure over Time value of money.

Answer:

WN 1: Computation of period of investment to earn pre-tax income of 5%:

Particulars	Amount
Net return to be earned [20 lacs x 5%]	1,00,000
Expenses relating to investment	50,000
Gross return to be earned	1,50,000
% return to be earned [1,50,000/20,00,000]	7.50%
Return for a year	9%
Period of investment to earn return of 5% $\frac{7.50\%}{9\%} \times 12 \text{ months}$	10 months

WN 2: Computation of break-even period:

Particulars	Amount
Net return to be earned	0
Expenses relating to investment	50,000
Gross return to be earned	50,000
% return to be earned [50,000/20,00,000]	2.50%
Return for a year	9%
Period of investment to break-even $\frac{2.50\%}{9\%} \times 12 \text{ months}$	3.33 months

104. Calculation of Dirty Price [Jan 2021, May 2021 MTP, Nov 2023 MTP, May 2024 MTP, SM]

Bank A enters into a Repo for 14 days with Bank B in 10% GOI Bonds 2017 at a rate of 5.65% for Rs.8 Crores. Assuming that the clean price will be Rs.99.42, initial margin be 2% and days of accrued interest be 262, you are required to determine:

- ❖ Dirty Price
- ❖ Start Proceeds (First Leg)
- ❖ Repayment at maturity (Second Leg)

Assume number of days be 360

Answer:**WN 1: Computation of Dirty Price:**

Dirty Price = Clean Price + Accrued Interest
Accrued interest = $100 \times 10\% \times \frac{262}{360} = 7.28$
Dirty price = $99.42 + 7.28 = \text{Rs.}106.70$

Note: Accrued interest is computed as per the base security. In this case the base security is GOI bonds which has an interest rate of 10%

WN 2: Computation of start proceeds and repayment at maturity:

Start Proceeds = $8,00,00,000 \times \frac{106.70}{100} \times 98\% = \text{Rs.} 8,36,52,800$
Interest on repo = $8,36,52,800 \times 5.65\% \times \frac{14}{360} = \text{Rs.} 1,83,804$
Repayment at maturity = $8,36,52,800 + 1,83,804 = \text{Rs.} 8,38,36,604$

Note: Interest on repo is charged based on repo interest rate of 5.65%

105. Clean price and Dirty price (reverse working) - July 2021, Nov 2022 MTP, Nov 2024 RTP [Concept Revision]

The Bank BK enters into a Repo for 9 days with Bank NE in 6% Government bonds 2022 for an amount of Rs. 2 crore. The other relevant details are as follows:

First Leg Payment (Start Proceeds)	Rs.2,00,06,750
Second Leg Payment (Repayment proceeds)	Rs.2,00,31,759
Initial margin	1.25%
Days of accrued interest	240

Assume 360 days in a year.

You are required to calculate:

- (i) Repo Rate
- (ii) Dirty Price and

(iii) Clean Price

Answer:**WN 1: Computation of Repo Rate:**

Particulars	Amount
Start proceeds	2,00,06,750
End proceeds	2,00,31,759
Interest for repo period (9 days)	25,009

$$\text{Interest on repo} = 2,00,06,750 \times \text{Rate} \times \frac{9}{360}$$

$$25,009 \times 40 = 2,00,06,750 \times \text{Rate}$$

$$\text{Rate} = \frac{25,009 \times 40}{2,00,06,750} = 0.0500 \text{ (or) } 5.00\%$$

- Hence Repo Rate = 5.00%

WN 2: Computation of Dirty Price:

$$\text{Start Proceeds} = 2,00,00,000 \times \frac{\text{Dirty Price}}{100} \times 98.75\%$$

$$2,00,06,750 = 1,97,50,000 \times \frac{\text{Dirty Price}}{100}$$

$$\text{Dirty Price} = \frac{2,00,06,750}{1,97,50,000} \times 100 = \text{Rs. } 101.30$$

WN 3: Computation of Clean Price:

Dirty Price = Clean Price + Accrued Interest
Accrued interest = $100 \times 6\% \times \frac{240}{360} = 4.00$
Clean Price = 101.30 - 4.00 = Rs.97.30

Chapter 6 – Portfolio Management**Practical Problems****Overview:**

- Part I – Basics of Portfolio Theory
- Part II – Security and Portfolio Beta
- Part III – Systematic and Unsystematic Risk
- Part IV – Characteristic Line, CML and SML
- Part V – Factor Sensitivity Analysis and Arbitrage Pricing Theory
- Part VI – Optimum weights for risk reduction
- Part VII – Beta and Leverage
- Part VIII – Portfolio Strategies
- Part IX – Real Estate Valuation

Part I – Basics of Portfolio Theory
1. Calculation of expected return and standard deviation [Nov 2009, May 2017, May 2023 RTP, SM]
[Concept Revision]

A stock costing Rs.120 pays no dividends. The possible prices that the stock might sell for at the end of the year with the respective probabilities are:

Price	Probability
115	0.1
120	0.1
125	0.2
130	0.3
135	0.2
140	0.1

Required:

- Calculate the expected return
- Calculate the standard deviation of returns

Answer:

Computation of expected return and standard deviation:

Price	Probability	Return (in Rs.)	Return (in %)	Product	Deviation	Pd ²
115	0.1	-5.00	-4.17	-0.42	-11.25	12.66
120	0.1	0.00	0.00	0.00	-7.08	5.01
125	0.2	5.00	4.17	0.83	-2.91	1.69
130	0.3	10.00	8.33	2.50	1.25	0.47
135	0.2	15.00	12.50	2.50	5.42	5.88
140	0.1	20.00	16.67	1.67	9.59	9.2
				7.08		34.91

Note:

- Return (in Rs.) = Expected price – 120
- Return (in %) = Return in Rs./120
- Product = Probability × Return (in %)
- Deviation = Return in % - Expected return (sum of product)
- Pd² = Probability × Deviation × Deviation

Expected return (%)	7.08%
Standard deviation (%)	$\sqrt{34.91} = 5.91\%$
Expected return (in Rs.)	= Price × Expected return in % = 120 × 7.08% = Rs.8.50
Standard deviation (in Rs.)	= Price × Standard Deviation in % = 120 × 5.91% = Rs.7.09

2. Calculation of Risk and Return [Nov 2017]

The following is the return of two securities for the past five years. Calculate the expected return and risk

Year	Security A	Security B
1	10.6	20.5
2	11.6	-10.9
3	-14	28.4
4	17.6	-2.8
5	10	5.8

Answer:

- Probability is not given in question and hence we are assuming equal probability for all years. This assumption would help us to solve all risk and return questions in same format

Security A

Year	Return	Probability	Product	Deviation	Pd ²
1	10.6	0.2	2.12	3.44	2.37
2	11.6	0.2	2.32	4.44	3.94
3	-14	0.2	-2.80	-21.16	89.55
4	17.6	0.2	3.52	10.44	21.8
5	10	0.2	2.00	2.84	1.61
Total			7.16		119.27

Expected return (%)	7.16%
Standard deviation (%)	$\sqrt{119.27} = 10.92\%$

Security B

Year	Return	Probability	Product	Deviation	Pd ²
1	20.5	0.2	4.10	12.30	30.26
2	-10.9	0.2	-2.18	-19.10	72.96
3	28.4	0.2	5.68	20.20	81.61
4	-2.8	0.2	-0.56	-11.00	24.2
5	5.8	0.2	1.16	-2.40	1.15
Total			8.20		210.18

Expected return (%)	8.20%
Standard deviation (%)	$\sqrt{210.18} = 14.50\%$

3. Calculation of portfolio return and standard deviation [May 2020 RTP, May 2018, Nov 2008, Nov 2010, Nov 2014 MTP, Jan 2021, SM] [Concept Revision]

Consider the following information on two stocks, A and B:

Year	Return on A (%)	Return on B (%)
2006	10	12
2007	16	18

You are required to determine:

- ❖ The expected return on a portfolio containing A and B in the proportion of 40% and 60% respectively
- ❖ The standard deviation from each of these two stocks
- ❖ The co-variance of returns from the two stocks
- ❖ Co-relation co-efficient between the returns of the two stocks
- ❖ Standard deviation of the portfolio

Answer:**Base calculation:**

Year	Prob	Security A				Security B				Pd _a d _b
		Return	Product	Deviation	Pd ²	Return	Product	Deviation	Pd ²	
2006	0.5	10	5	-3	4.5	12	6	-3	4.5	4.5
2007	0.5	16	8	3	4.5	18	9	3	4.5	4.5
Total			13		9		15		9	9

Portfolio return	=	Weighted average of individual security return
Portfolio return	=	$(0.4 \times 13\%) + (0.6 \times 15\%) = 14.20\%$

Standard deviation of A	=	$\sqrt{Pd^2} = \sqrt{9} = 3\%$
Standard deviation of B	=	$\sqrt{Pd^2} = \sqrt{9} = 3\%$
Co-variance of stocks	=	Sum of $Pd_a d_b = 9\%$
Co-relation coefficient	=	$\frac{CO - variance_{AB}}{\sigma_A \sigma_B} = \frac{9}{3 \times 3} = 1$
Portfolio Variance	=	$(\sigma_a W_a)^2 + (\sigma_b W_b)^2 + 2\sigma_a W_a \sigma_b W_b COR_{ab}$
Portfolio Variance	=	$(3 \times 0.4)^2 + (3 \times 0.6)^2 + 2(3)(0.4)(3)(0.6)(1)$
Portfolio Variance	=	$1.44 + 3.24 - 4.32 = 9\%$
Portfolio SD	=	$\sqrt{9} = 3\%$

4. Calculation of portfolio return and standard deviation [May 2019 RTP, Nov 2006, May 2008, May 2014 MTP, Dec 2021, May 2019 MTP, May 2022 MTP, SM]

X Ltd. Invested on 1.4.2009 in certain equity shares as below:

Name of company	No. of shares	Cost
M Limited	1000 (Rs. 100 each)	2, 00,000
N Limited	500 (Rs. 10 each)	1, 50,000

In September 2009, 10% dividend was paid out by M Limited and in October, 2009, 30% dividend paid out by N Limited. On 31.3.2010 market quotations showed a value of Rs. 220 and Rs. 290 per share for M Limited and N Limited respectively.

On 1.4.2010, investment advisors indicate

- ❖ that the dividend from M Limited and N Limited for the year ending 31.3.2011 are likely to be 20% and 35% respectively and
- ❖ that the probabilities of the market quotations on 31.3.2011 are as below:

Probability	Price per share of M Limited	Price per share of N Limited
0.20	220	290
0.50	250	310
0.30	280	330

You are required to:

- Calculate the average return from the portfolio for the year ended 31.3.2010
- Calculate the average expected return from the portfolio for the year 2010-11
- Calculate comparative risk in the two investments by calculating the standard deviation in each case.

Answer:

WN 1: Computation of return of portfolio for 2009-10

Return of Security M	=	$\frac{(D_1) + (P_1 - P_0)}{P_0} = \frac{10 + (220 - 200)}{200} \times 100 = 15\%$
Return of Security N	=	$\frac{(D_1) + (P_1 - P_0)}{P_0} = \frac{3 + (290 - 300)}{300} \times 100 = -2.33\%$

Portfolio Return:

Security	Return	Weight	Product
M	15%	2,00,000	30,000
N	-2.33%	1,50,000	-3,500
Portfolio	7.57%	3,50,000	26,500

- Portfolio return of 2009-10 = 7.57%

WN 2: Computation of risk and return of Security M for 2010-11

Return of Security M	=	$\frac{(D_1) + (P_1 - P_0)}{P_0} \times 100$
Probability of 0.2	=	$\frac{(20) + (220 - 220)}{220} \times 100 = 9.09\%$
Probability of 0.5	=	$\frac{(20) + (250 - 220)}{220} \times 100 = 22.73\%$
Probability of 0.3	=	$\frac{(20) + (280 - 220)}{220} \times 100 = 36.36\%$

Return and risk calculation:

Return	Probability	Product	Deviation	Pd ²
9.09	0.2	1.82	-15.01	45.06
22.73	0.5	11.37	-1.37	0.94
36.36	0.3	10.91	12.26	45.09
Total		24.10		91.09

Expected return (%)	24.10%
Standard deviation (%)	$\sqrt{91.09} = 9.54\%$
Standard deviation (in Rs.)	$9.54\% \times 220 = \text{Rs.}21.00$

WN 3: Computation of risk and return of Security N for 2010-11

Return of Security N	=	$\frac{(D_1) + (P_1 - P_0)}{P_0} \times 100$
Probability of 0.2	=	$\frac{(3.5) + (290 - 290)}{290} \times 100 = 1.21\%$
Probability of 0.5	=	$\frac{(3.5) + (310 - 290)}{290} \times 100 = 8.10\%$
Probability of 0.3	=	$\frac{(3.5) + (330 - 290)}{290} \times 100 = 15\%$

Return and risk:

Return	Probability	Product	Deviation	Pd ²
1.21	0.2	0.24	-7.58	11.49
8.1	0.5	4.05	-0.69	0.24
15	0.3	4.50	6.21	11.57
		8.79		23.30

Expected return (%)	8.79%
Standard deviation (%)	$\sqrt{23.30} = 4.83\%$
Standard deviation (in Rs.)	$4.83\% \times 290 = \text{Rs.}14.00$

WN 4: Portfolio Return for 2010-11

Security	Return	Weight	Product
M	24.10%	2,20,000 [1,000 × 220]	53,020
N	8.79%	1,45,000 [500 × 290]	12,746
Portfolio	18.02%	3,65,000	65,766

- Portfolio return of 2010-11 = 18.02%

5. Security return and risk (Nov 2020 MTP) [Homework]

An investor has planned to invest in X Limited. Following are the probabilities of dividends for the year ending 31.03.2016:

Probability	Dividend from X Limited (%)
0.20	10
0.30	15
0.50	20

Expected prices for the year ending 31.03.2016 are as under:

Probability	X Limited
0.20	220
0.50	250
0.30	280

- Price as on 31.03.2015 was Rs.220 for X Limited
- Face value of X Limited is Rs.100

Required:

- Compute the expected return and standard deviation of X Limited

Answer:**WN 1: Computation of different possible returns of X Limited:**

Dividend	Probability	Price	Probability	Capital appreciation	Total return	Total return %	Joint Probability
10	0.20	220	0.20	-	10	4.55	0.04
10	0.20	250	0.50	30	40	18.18	0.10
10	0.20	280	0.30	60	70	31.82	0.06
15	0.30	220	0.20	-	15	6.82	0.06
15	0.30	250	0.50	30	45	20.45	0.15
15	0.30	280	0.30	60	75	34.09	0.09
20	0.50	220	0.20	-	20	9.09	0.10
20	0.50	250	0.50	30	50	22.73	0.25
20	0.50	280	0.30	60	80	36.36	0.15

WN 2: Computation of risk and return of X Limited:

Return	Probability	Product	Deviation	Pd^2
4.55	0.04	0.18	-17.95	12.89
18.18	0.10	1.82	-4.32	1.87
31.82	0.06	1.91	9.32	5.21
6.82	0.06	0.41	-15.68	14.75
20.45	0.15	3.07	-2.05	0.63
34.09	0.09	3.07	11.59	12.09
9.09	0.10	0.91	-13.41	17.98
22.73	0.25	5.68	0.23	0.01
36.36	0.15	5.45	13.86	28.81
Total		22.50		94.24

Answer:

Particulars	Calculation	Amount
Expected return of X Limited (in %)		22.50%
Expected return of X Limited (in Rs.)	$220 \times 22.50\%$	Rs.49.50
Risk of X Limited (in %)	$\sqrt{94.24}$	9.71%
Risk of X Limited (In Rs.)	$220 \times 9.71\%$	Rs.21.36

6. Calculation of portfolio return and standard deviation [Nov 2008, Nov 2020, Nov 2021 RTP, May 2022 RTP, Nov 2021 MTP, May 2022 MTP, SM] [Homework]

Mr. A is interested to invest Rs.1, 00,000 in the securities market. He selected two securities B and D for this purpose. The risk return profile of these securities is as follows:

Security	Risk	Expected Return
B	10%	12%
D	18%	20%

Co-efficient of correlation between B and D is 0.15.

You are required to calculate the portfolio return of the following portfolios of B and D to be considered by A for his investment.

- 100 percent investment in B only;
- 50 percent of the fund in B and the rest 50 percent in D;
- 75 percent of the fund in B and the rest 25 percent in D; and
- 100 percent investment in D only.

Also indicate that which portfolio is best for him from risk as well as return point of view?

Answer:**Computation of portfolio return and risk:**

Combination	Portfolio Return	Portfolio Risk
100 % in B	12%	10%
50% in B and 50% in D	$= (0.5 \times 12) + (0.5 \times 20)$ $= 16\%$	$= (\sigma_b W_b)^2 + (\sigma_d W_d)^2 + 2\sigma_b W_b \sigma_d W_d \text{COR}_{bd}$ $= (10 \times 0.5)^2 + (18 \times 0.5)^2 + 2(10)(0.5)(18)(0.5)(0.15)$ $= 25 + 81 + 13.5 = 119.50$ Portfolio risk $= \sqrt{119.50} = 10.93\%$
75% in B and 25% in D	$(0.75 \times 12) + (0.25 \times 20)$ $= 14\%$	$= (10 \times 0.75)^2 + (18 \times 0.25)^2 +$ $2(10)(0.75)(18)(0.25)(0.15)$ $= 56.25 + 20.25 + 10.13 = 86.63$ Portfolio risk $= \sqrt{86.63} = 9.31\%$
100% in D	20%	18%

- A person looking for return would invest 100% in Security D
- A conservative investor (minimizes risk) will invest 75% in B and 25% in D

7. Efficient portfolio [Nov 2017 RTP, May 2021 MTP, May 2018 MTP, SM]

Given the following risky securities:

Particulars	U	V	W	X	Y	Z
Return %	10	10	15	5	11	10
Risk %	5	6	13	5	6	7

- ❖ Recommend at least three securities which shall be selected among the six securities mentioned above
- ❖ Assuming perfect correlation, evaluate whether it is preferable to invest 80% in security U and 20% in security W or to invest 100% in Y

Answer:

WN 1: Identification of efficient and inefficient securities

- Security U dominates Security V as it generates same return with lower risk. Hence Security V is inefficient.
- Security U dominates Security X as it generates higher return with same risk. Hence Security X is inefficient.
- Security U dominates Security Z as it generates same return with lower risk. Hence Security Z is inefficient.
- Security U, W and Y are efficient securities

Part (II):

Particulars	Return	Risk
80% in U and 20% in W	$(10 \times 80\%) + (15 \times 20\%) = 11.00\%$	$(6 \times 80\%) + (13 \times 20\%) = 7.40\%$
100% in Y	11.00%	6.00%

- We should opt for 100% investment in Security Y as it generate same return with lower risk

8. Constructing an efficient portfolio [May 2017 MTP]

If the rate of return and Standard Deviation of Market Portfolio (Index) is 8% and 6% respectively and the risk-free rate of return is 5%, you are required to:

- Construct an efficient portfolio which produces expected return of 7.5%
- Calculate the risk of above portfolio
- Suppose if Mr.X has Rs.1,00,000 of his personal funds, then how he would construct his portfolio giving expected return of 10% and what will be the risk of this portfolio

Answer:

WN 1: Computation of efficient portfolio which gives return of 7.5%

Let us assume X to be the proportion of investment in market and (1-X) to be the proportion of investment in Risk-free security

Security	Return	Weight	Product
Market	8	X	8X
Risk-free	5	1-X	5-5X
Total	7.5	1	7.5

- ❖ The investor wants overall return of 7.5% and hence overall return in above table is 7.5. Based on weight of 1 product total should add to 7.5

- ❖ Total of product = 7.5
- ❖ $8X + 5 - 5X = 7.5$
- ❖ $3X = 2.5$; $X = 83.33\%$
- ❖ Hence investor should invest 83.33% in market portfolio and 16.67% in risk-free security

WN 2: Computation of risk of above portfolio:

Risk of portfolio	=	$(W1SD1)^2 + (W2SD2)^2 + 2W1W2SD1SD2COR_{12}$
Variance of Portfolio	=	$(0.8333 \times 6)^2 + (0.1667 \times 0)^2 + (2 \times 0.8333 \times 0.1667 \times 6 \times 0 \times 0)$
Variance of Portfolio	=	25
SD of portfolio	=	5%

WN 3: Computation of efficient portfolio with expected return of 10%

Let us assume X to be the proportion of investment in market and (1-X) to be the proportion of investment in Risk-free security

Security	Return	Weight	Product
Market	8	X	8X
Risk-free	5	1-X	5-5X
Total	10	1	10

- ❖ The investor wants overall return of 10% and hence overall return in above table is 10.
- ❖ Total of product = 10
- ❖ $8X + 5 - 5X = 10$
- ❖ $3X = 5$; $X = 166.67\%$
- ❖ Hence investor should invest 166.67% in market portfolio and borrow 66.67% from risk-free security
- ❖ Investment in market security = Rs.1,66,667; Borrowing from market = Rs.66,667

WN 4: Computation of risk of above portfolio:

Risk of portfolio	=	$(W1SD1)^2 + (W2SD2)^2 + 2W1W2SD1SD2COR_{12}$
Variance of Portfolio	=	$(1.6667 \times 6)^2 + (-0.6667 \times 0)^2 + (2 \times 1.6667 \times -0.6667 \times 6 \times 0 \times 0)$
Variance of Portfolio	=	100
SD of portfolio	=	10%

9. Impact of diversification [May 2016 MTP, Nov 2012 RTP, May 2024 MTP, SM]

Suppose that economy A is growing rapidly and you are managing a global equity fund and so far, you have invested only in developed-country stocks only. Now you have decided to add stocks of economy A to your portfolio. The table below shows that expected rates of return, standard deviations, and correlation coefficients (all estimates are in aggregate stock market of developed countries and stock market of Economy A).

Particulars	Developed country stocks	Stocks of Economy A
Expected rate of return (%)	10	15
Risk (Standard deviation)	16	30
Correlation coefficient	0.30	

Assuming the risk-free interest rate to be 3%, you are required to determine:

- (a) What percentage of your portfolio should you allocate to stocks of Economy A and if you want to increase the expected rate of return on your portfolio by 0.5%?
- (b) What will be the standard deviation of your portfolio assuming that stocks of Economy A are included in the portfolio as calculated above?
- (c) Also show how well the Fund will be compensated for the risk undertaken due to inclusion of stocks of Economy A in the portfolio

Answer:**WN 1: Computation of efficient portfolio which gives return of 7.5%**

Let us assume X to be the proportion of investment in developed country and (1-X) to be the proportion of investment in Economy A

Security	Return	Weight	Product
Developed Country	10	X	10X
Economy A	15	1-X	15 - 15X
Total	10.5	1	10.5

- ❖ The investor wants overall return of 10.5% and hence overall return in above table is 10.5. Based on weight of 1 product total should add to 10.5
- ❖ $10X + 16 - 15X = 10.5$
- ❖ $5X = 4.5$; $X = 90\%$
- ❖ Hence investor should invest 90% in developed country and 10% in Economy A

WN 2: Computation of risk of above portfolio:

Risk of portfolio	=	$(W1SD1)^2 + (W2SD2)^2 + 2W1W2SD1SD2COR_{12}$
Variance of Portfolio	=	$(0.90 \times 16)^2 + (0.10 \times 30)^2 + (2 \times 0.90 \times 0.10 \times 16 \times 30 \times 0.30)$
Variance of Portfolio	=	242.28
SD of portfolio	=	15.57% or 15.60%

WN 3: Computation of how well the fund have been compensated for the risk undertaken:

- ❖ We can compute Sharpe Ratio to understand how fund has been compensated for the risk undertaken

Sharpe Ratio	=	$\left(\frac{\text{Actual Return} - \text{Risk Free Return}}{\text{Standard Deviation}} \right)$
Sharpe Ratio of Developed Economy	=	$\frac{10 - 3}{16} = 0.437$
Sharpe Ratio of revised portfolio	=	$\frac{10.5 - 3}{15.60} = 0.481$

Sharpe Ratio has improved by 0.04 times due to addition of Economy A in revised portfolio.

10. Portfolio Creation [Nov 2022] [Homework]

Following is the information related to return on shares of three different companies:

Years	A Limited	B Limited	C Limited
2018	2%	3%	5%
2019	6%	8%	7%
2020	13%	14%	15%
2021	7%	9%	11%

Required:

- Construct maximum number of portfolio and its return, if each portfolio consists of any two Company's shares in proportion of 65% and 35% and suggest which portfolio provides highest return.
- Calculate portfolio return and beta (β), if Mr. X invests Rs. 65,000 in A Ltd. having beta (β) of 0.45; Rs. 20,000 in B Ltd. having beta (β) of 1.15 and Rs. 15,000 in C Ltd. having beta (β) of 1.8.

Answer:**WN 1: Computation of security return:**

$$\text{Return of A Limited} = \frac{2 + 6 + 13 + 7}{4} = 7.00\%$$

$$\text{Return of B Limited} = \frac{3 + 8 + 14 + 9}{4} = 8.50\%$$

$$\text{Return of C Limited} = \frac{5 + 7 + 15 + 11}{4} = 9.50\%$$

WN 2: Creation of multiple portfolios:

Portfolio 1	65% in A and 35% in B	$(0.65 \times 7) + (0.35 \times 8.50)$	7.525%
Portfolio 2	35% in A and 65% in B	$(0.35 \times 7) + (0.65 \times 8.50)$	7.975%
Portfolio 3	65% in A and 35% in C	$(0.65 \times 7) + (0.35 \times 9.50)$	7.875%
Portfolio 4	35% in A and 65% in C	$(0.35 \times 7) + (0.65 \times 9.50)$	8.625%
Portfolio 5	65% in B and 35% in C	$(0.65 \times 8.50) + (0.35 \times 9.50)$	8.85%
Portfolio 6	35% in B and 65% in C	$(0.35 \times 8.50) + (0.65 \times 9.50)$	9.15%

Since maximum return is under Combination - 6 i.e. 65% investment in C Ltd. and 35% in B Ltd. hence it should be opted for.

WN 3: Computation of portfolio return and Beta:

Security	Beta	Weight	Product	Return	Product
A Limited	0.45	65,000	29,250	7.00%	4,550

B Limited	1.15	20,000	23,000	8.50%	1,700
C Limited	1.80	15,000	27,000	9.50%	1,425
Overall	0.7925	1,00,000	79,250	7.675%	7,675

Part II – Security and Portfolio Beta

11. Calculation of Beta [May 2019 MTP, SM]

Given below is information of market rates of return and data from two companies A and B:

	Year 2007	Year 2008	Year 2009
Market (%)	12.0	11.0	9.0
Company A (%)	13.0	11.5	9.8
Company B (%)	11.0	10.5	9.5

You are required to calculate Beta of company A and company B

Answer

Probability is not given in question and hence we can use formula 1 to compute Beta

WN 1: Computation of Beta of Company A:

Year	Company A return (X)	Market return (Y)	XY	Y ²
2007	13	12	156	144
2008	11.5	11	126.5	121
2009	9.8	9	88.2	81
Sum	34.3	32	370.7	346
Average	11.43	10.67		

$$\text{Beta} = \frac{(\sum XY - n(\text{Mean of X})(\text{Mean of Y}))}{\sum Y^2 - n(\text{Mean of Y})^2}$$

$$\text{Beta} = \frac{(370.7 - 3(11.43)(10.67))}{346 - 3(10.67^2)} = \frac{4.8257}{4.4533} = 1.0836 \text{ Times}$$

WN 2: Computation of Beta of Company B:

Year	Company B return (X)	Market return (Y)	XY	Y ²
2007	11	12	132	144
2008	10.5	11	115.5	121
2009	9.5	9	85.5	81
Sum	31	32	333	346
Average	10.33	10.67		

$$\text{Beta} = \frac{(\sum XY - n(\text{Mean of X})(\text{Mean of Y}))}{\sum Y^2 - n(\text{Mean of Y})^2}$$

$$\text{Beta} = \frac{(333 - 3(10.33)(10.67))}{346 - 3(10.67^2)} = \frac{2.3367}{4.4533} = 0.5247 \text{ Times}$$

12. Calculation of Beta [Nov 2011 RTP] [Concept Revision]

The following information is available for the share of X limited and market index for the past four years:

Years	X Ltd share price	X Limited Dividend Yield	Index of stock exchange	Dividend yield of market	Return from Government
Present year	197.00	10%	2182	16%	15%
1 year ago	164.20	12%	1983	15%	15%
2 year ago	155.00	8%	1665	16%	16%
3 year ago	121.00	10%	1789	10%	14%
4 year ago	95.00	10%	1490	18%	15%

With above information available please calculate:

- ❖ Expected return of X limited share
- ❖ Expected return on market index
- ❖ Risk free rate of return

- ❖ Beta of X Limited

Answer:

WN 1: Computation of return of X Limited:

- This is a tricky question and the prices have been given in the reverse order. Let us change the order and compute the return. It is assumed that present year is 2020

Year	Price	Capital appreciation	Capital appn % (Column 3/ Price of last year)	Dividend %	Return of X
2016	95	NA	NA	10	NA
2017	121	26	27.37	10	37.37
2018	155	34	28.1	8	36.1
2019	164.2	9.2	5.94	12	17.94
2020	197	32.8	19.98	10	29.98
Expected return on X Limited share (Average)					30.35%

- Capital appreciation of 2017 = $26/95 = 27.37\%$
- Capital appreciation of 2018 = $34/121 = 28.10\%$
- Return of X = Capital appreciation % + Dividend %

WN 2: Computation of return of Market Index:

Year	Price	Capital appreciation	Capital appn %	Dividend %	Return of market
2016	1490	NA	NA	18	NA
2017	1789	299	20.07	10	30.07
2018	1665	-124	-6.93	16	9.07
2019	1983	318	19.1	15	34.1
2020	2182	199	10.04	16	26.04
Expected return on Market Index (Average)					24.82%

WN 3: Computation of risk-free rate of return:

$$\text{Risk free rate of return} = \frac{15 + 15 + 16 + 14 + 15}{5} = 15\%$$

WN 4: Computation of Beta:

Year	Company X return (X)	Market return (Y)	XY	Y ²
2017	37.37	30.07	1123.72	904.2
2018	36.1	9.07	327.43	82.26
2019	17.94	34.1	611.75	1162.81
2020	29.98	26.04	780.68	678.08
Sum	121.39	99.28	2843.58	2827.35
Average	30.35	24.82		

$$\text{Beta} = \frac{(\sum XY - n(\text{Mean of X})(\text{Mean of Y}))}{\sum Y^2 - n(\text{Mean of Y})^2}$$

$$\text{Beta} = \frac{(2843.58 - 4(30.35)(24.82))}{2827.35 - 4(24.82^2)} = \frac{-169.57}{363.22} = -0.4669 \text{ Times}$$

Note:

- Answer does not match with ICAI solution. In ICAI solution Beta has been computed by substituting security return, market return and risk-free return in CAPM equation

- Beta as per ICAI solution:**

Rf + Beta x (Rm – Rf) = Return of security

$$15 + \text{Beta} \times (24.82 - 15) = 30.35$$

$$\text{a. Beta} = 15.35; \text{Beta} = \frac{15.35}{9.82} = 1.56 \text{ Times}$$

- This answer has been presented just to give ICAI solution. Beta as per me should be computed using the above formula and same would be -0.4669 Times

13. Computation of Beta [May 2017, May 2019 MTP, May 2022, SM] [Homework]

The following information are available with respect of Krishna Limited:

Year	Krishna Limited Average Price	Dividend Per Share	Average Market Index	Dividend Yield	Return on Govt bonds
2012	245	20	2013	4%	7%
2013	253	22	2130	5%	6%
2014	310	25	2350	6%	6%
2015	330	30	2580	7%	6%

Compute Beta Value of the Krishna Limited at the end of 2015 and state your observation.

Answer:

WN 1: Computation of return of security 2013, 2014 and 2015:

Year	Krishna Limited Average Price	Capital Appreciation	Dividend Per Share	Total return	Return in % [Total return/Last year price]
2012	245	NA	20	NA	NA
2013	253	8	22	30	12.24% [30/245]
2014	310	57	25	82	32.41% [82/253]
2015	330	20	30	50	16.13% [50/310]

WN 2: Computation of return of market for 2013, 2014 and 2015:

Year	Average Market Index	Capital appreciation	Capital appreciation %	Dividend Yield	Total return %
2012	2013	NA	NA	4%	NA
2013	2130	117	5.81% [117/2130]	5%	10.81%
2014	2350	220	10.33% [220/2130]	6%	16.33%
2015	2580	230	9.79% [230/2350]	7%	16.79%

WN 3: Computation of Beta:

Year	Security return [X]	Market Index [Y]	XY	Y ²
2012-13	12.24	10.81	132.31	116.86
2013-14	32.41	16.33	529.25	266.67
2014-15	16.13	16.79	270.82	281.90
Total	60.78	43.93	932.38	665.43
Average	20.26	14.64		

$$\text{Beta} = \frac{(\sum XY - n\bar{X}\bar{Y})}{\sum Y^2 - n(\bar{Y})^2} = \frac{932.38 - 3 \times 20.26 \times 14.64}{665.43 - 3 \times 14.64^2} = 1.897$$

Observation:

Year	Expected return	Actual Return	Action
2012-13	6% + 1.897(10.81% - 6%) = 15.12%	12.24%	Sell
2013-14	6% + 1.897(16.33% - 6%) = 25.60%	32.41%	Buy
2014-15	6% + 1.897(16.79% - 6%) = 26.47%	16.13%	Sell

14. Calculation of Beta [May 2020 RTP, May 2006, Nov 2020 RTP, SM] [Concept Revision]

The distribution of return of security 'F' and the market portfolio 'P' is given below:

Probability	Return of F (%)	Return of P (%)
0.30	30	-10
0.40	20	20
0.30	0	30

You are required to calculate the expected return of security 'F' and the market portfolio 'P', the covariance between the market portfolio and security and beta of the security

Answer:

Computation of expected return of security, market, covariance and Beta:

Prob	Security F			Market P			Pd ²	Pd _f d _p
	Return	Product	Deviation	Return	Product	Deviation		
0.3	30	9	13	-10	-3	-24	172.8	-93.6
0.4	20	8	3	20	8	6	14.4	7.2
0.3	0	0	-17	30	9	16	76.8	-81.6
Total		17			14		264	-168

Return of Security F	=	17%
Return of Market P	=	14%
Covariance of security and market	=	-168
Beta of security	$\frac{\text{Covariance of security and Market}}{\text{Variance of Market}}$	$\frac{-168}{264} = -0.6364$

15. Standard deviation calculation [May 2019 MTP, May 2016 MTP, May 2013 RTP, SM]

The following information is available in respect of security X

Equilibrium Return	15%
Market Return	15%
7% Treasury Bond Trading at	\$ 140
Co-variance of market return and security return	2.25%
Coefficient of correlation	0.75

You are required to determine the standard deviation of market return and security return.

Answer:

- Equilibrium return refers to the return to be earned by security as per CAPM
- Equilibrium return (15%) = $R_f + \text{Beta} \times (R_m - R_f)$

Calculating risk free rate:

- Risk free security is providing interest of 7 percent and is quoting at 140 \$
- Let us assume face value of treasury bond to be \$ 100
- Treasury bond would provide income of 7\$ on current market price of \$140

$$\text{Value of bond} = \frac{\text{Interest}}{\text{investor expectation}}; 140 = \frac{7}{\text{Investor expectation}}$$

$$\text{Investor expectation} = \frac{7}{140} = 0.05 \text{ or } 5\%; \text{Risk free rate} = 5\%$$

Computing Beta of Security:

- Equilibrium return (15%) = 5% + Beta (15% - 5%)
- 10% = 10%Beta
- Beta = 1 time

Computing standard deviation of market:

$$\text{Beta} = \frac{\text{Co - variance of security and market}}{\text{variance of market}}$$

$$1 = \frac{0.0225}{\text{Variance of market}}; \text{Variance of market} = 0.0225; \text{SD of market} = 0.15 \text{ or } 15\%$$

Computing standard deviation of security:

$$\text{Beta} = \frac{\text{SD of security}}{\text{SD of market}} \times \text{Correlation coefficient}$$

$$1 = \frac{\text{SD of security}}{0.15} \times 0.75; \text{SD of security} = \frac{1 \times 0.15}{0.75} = 0.20 \text{ or } 20\%$$

16. Computation of intrinsic value and required return [May 2016, May 2024, SM] [Homework]

XYZ Limited paid a dividend of Rs.2 for the current year. The dividend is expected to grow at 40% for the next 5 years and at 15% per annum thereafter. The return on 182 days T-bills is 11% per annum and the market return is expected to be around 18% with a variance of 24%. The co-variance of XYZ's return with that of the market is 30%. You are required to calculate the required rate of return and intrinsic value of the stock.

Answer:

WN 1: Computation of required rate of return on stock (Ke):

Note 1: Computation of Beta:

Beta	=	$\frac{\text{Co - variance of security and market}}{\text{Variance of market}}$
Beta	=	$\frac{30}{24}$
Beta	=	1.25 Times

Note 2: Computation of required return:

Ke	=	$R_f + \text{Beta} \times (R_m - R_f)$
Ke	=	$11 + 1.25 \times (18 - 11)$
Ke	=	19.75%

WN 2: Computation of intrinsic value:

Note 1: Computation of Dividend till first year of stabilization phase:

- ❖ Dividends are expected to grow at 40% for 5 years. Growth will stabilize from sixth year onwards at 15%. Hence, we should calculate Dividends for first six years

Particulars	Dividend
Year 0	2
Year 1	2.80
Year 2	3.92
Year 3	5.49
Year 4	7.68
Year 5	10.76
Year 6	12.37

WN 2: Computation of market price at last year before stabilization phase:

- ❖ Growth stabilizes from sixth year and hence we should calculate market price at end of year 5

Market Price (P5)	$\frac{D_6}{(K_e - G)}$	$\frac{12.37}{(19.75\% - 15\%)}$	Rs.260.42

WN 3: Computation of fair market price:

Year	Cash flow	PVF @ 19.75%	DCF
1	2.80	0.825	2.34
2	3.92	0.697	2.73
3	5.49	0.582	3.19
4	7.68	0.486	3.73
5	271.18 [10.76+260.42]	0.406	110.10
Fair market price of share			122.09

17. Computation of Beta [SM]

Pearl Limited expects that considering the current market prices, the equity share holders should get a return of atleast 15.50% while the current return on the market is 12%. RBI has closed the latest auction for Rs.2,500 crores of 182 days bills for the lowest bid of 4.3% although there were bidders at a higher rate of 4.6% also for lots less than Rs.10 Crores. What is Pearl Limited's Beta?

Answer:

Determining Risk free rate: Two risk free rates are given. The aggressive approach would be to consider 4.6% while the conservative approach would be to take 4.3%. If we take the moderate value then the simple average of the two (4.45%) would be considered

Computation of Beta:

Required return	=	$R_f + \text{Beta} \times (R_m - R_f)$
15.50	=	$4.45 + \text{Beta} \times (12 - 4.45)$
11.05	=	7.55 Beta
Beta	=	$\frac{11.05}{7.55} = 1.464 \text{ times}$

18. Share buy/sell decision [Nov 2009, Nov 2015 RTP, SM]

An investor holds two stocks A and B. The probability distribution of the returns is:

Economic scenario	Probability	Conditional returns %		
		A	B	Market
Growth	0.40	25	20	18
Stagnation	0.30	10	15	13
Recession	0.30	-5	-8	-3

The risk free rate during the next year is expected to be around 11%. Determine whether the investor should liquidate his holdings in stocks A and B or on the contrary make fresh investments in them.

Answer:

- We are required to decide whether company can make fresh investments/liquidate its holdings. This can be done by computing Beta of A and B
- Beta combined with CAPM would give the required return of security. The same would be then compared with actual return to decide on fresh investments

WN 1: Computation of Beta of Company A:

Prob	Security A			Market			Pd ²	Pd _a d _m
	Return	Product	Deviation	Return	Product	Deviation		
0.4	25	10	13.5	18	7.2	7.8	24.34	42.12
0.3	10	3	-1.5	13	3.9	2.8	2.35	-1.26
0.3	-5	-1.5	-16.5	-3	-0.9	-13.2	52.27	65.34
Total		11.5			10.2		78.96	106.2

$$\text{Beta of Company A} = \frac{\text{Covariance of A and Market}}{\text{Variance of Market}} = \frac{106.20}{78.96} = 1.3450 \text{ Times}$$

WN 2: Computation of Beta of Company B:

Prob	Security B			Market			Pd ²	Pd _b d _m
	Return	Product	Deviation	Return	Product	Deviation		
0.4	20	8	9.9	18	7.2	7.8	24.34	30.89
0.3	15	4.5	4.9	13	3.9	2.8	2.35	4.12
0.3	-8	-2.4	-18.1	-3	-0.9	-13.2	52.27	71.68
Total		10.1			10.2		78.96	106.69

$$\text{Beta of Company B} = \frac{\text{Covariance of B and Market}}{\text{Variance of Market}} = \frac{106.69}{78.96} = 1.3512 \text{ Times}$$

WN 3: Decision on investment/redemption:

Particulars	Security A	Security B
1. Beta	1.3450	1.3512
2. Required return	9.9240 [11 + 1.3450 × [10.20 - 11]]	9.9190 [11 + 1.3512 × [10.20 - 11]]
3. Actual Return	11.50	10.10
4. Alpha	1.5760	0.1810

Conclusion:

- Security A and B generates higher return than expected return. This is also reflected in positive Alpha. Hence both are under-valued and we should make additional investment in company A and B

19. Portfolio Beta (Nov 2022 RTP, Nov 2022 MTP, SM)

A Ltd has an expected return of 22% and standard deviation of 40%. B Ltd has an expected return of 24% and standard deviation of 38%. A Ltd has a beta of 0.86 and B Ltd has a beta of 1.24. The correlation between the return of A Ltd and B Ltd is 0.72. The standard deviation of the market return is 20%. Suggest

- Is investing in B Ltd better than A Ltd.
- If you invest 30% in B Ltd and 70% in A Ltd, what is your expected rate of return and how much is the portfolio standard deviation?
- What is the market portfolios rate of return and how much is the risk-free rate.
- What is the β of a portfolio if A Ltd weight is 70% and B Ltd is 30%

Answer:

WN 1: Investment decision:

- B Limited dominates A Limited because it generates higher return with lower risk. Therefore it is preferable to invest in B Limited

WN 2: Computation of portfolio return and portfolio SD:

Portfolio return	=	$(0.7 \times 22) + (0.3 \times 24) = 22.6\%$
Portfolio Variance	=	$(\sigma_a W_a)^2 + (\sigma_b W_b)^2 + 2\sigma_a W_a \sigma_b W_b \text{COR}_{ab}$ $(0.40 \times 0.7)^2 + (0.38 \times 0.3)^2 + 2 \times 0.40 \times 0.7 \times 0.38 \times 0.3 \times 0.72$ $0.0784 + 0.012996 + 0.045965 = 0.137361$
Portfolio SD	=	$\sqrt{0.137361} = 37.06\%$

WN 3: Computation of market return and risk-free rate:

CAPM return = $R_f + \text{Beta} \times (R_m - R_f)$
Return of A (22) = $R_f + 0.86 \times (R_m - R_f)$ -----equation 1
Return of B (24) = $R_f + 1.24 \times (R_m - R_f)$ -----equation 2
Subtracting equation 1 from equation 2
$2 = 0.38 (R_m - R_f); (R_m - R_f) = (2/0.38) = 5.26\%$
Substituting $(R_m - R_f)$ in equation 1
$22 = R_f + (0.86 \times 5.26)$
$R_f = 22 - 4.52; R_f = 17.48\%$
$(R_m - R_f) = 5.26$
$R_m - 17.48 = 5.26$
$R_m = 22.74\%$

WN 4: Computation of portfolio Beta:

Portfolio Beta = $(0.86 \times 0.7) + (1.24 \times 0.3) = 0.974$ Times

20. Portfolio Beta [May 2023 MTP]

You have Rs.10,00,000 to invest in a stock portfolio. Your choices are Stock A where you invest Rs.2,80,000, Stock B where you invest Rs.3,20,000 and stock C and risk free asset where you invest the balance. Given the beta of stock A is 0.9, stock B is 1.2 and Stock C is 1.6 and the overall beta is that of whole market, how much money you will invest in stock C and risk free asset.

Answer:

Computation of investment in Security C and Risk-free asset:

Let us assume A and B to be the investment in Security C and Risk-free asset

Security	Beta	Weight	Product
A	0.9	2,80,000	2,52,000
B	1.2	3,20,000	3,84,000
C	1.6	A	1.6A
Risk-free asset	0	B	0
Total	1	10,00,000	10,00,000 [10,00,000 x 1]

Note:

Computation of A:

- $2,52,000 + 3,84,000 + 1.6A = 10,00,000$
- $A = 3,64,000/1.60 = \text{Rs.}2,27,500$

Computation of B:

- $2,80,000 + 3,20,000 + 2,27,500 + B = 10,00,000$

- B = Rs.2,72,500

Conclusion:

- We should invest Rs.2,27,500 and Rs.2,72,500 in Security C and risk-free asset to have Beta of that of whole market (Beta of 1)

21. Portfolio Beta [May 2018 MTP, Nov 2018 RTP, Nov 2012, Nov 2015 MTP, Nov 2016 MTP, SM]

Mr. Fed-up wants to invest an amount of Rs.520 lakhs and had approached his Portfolio Manager. The Portfolio Manager had advised Mr. Fed-up to invest in the following manner:

Security	Moderate	Better	Good	Very Good	Best
Amount (in Rs. Lakhs)	60	80	100	120	160
Beta	0.5	1	0.8	1.2	1.5

You are required to advise Mr. FedUp in regard to the following, using Capital Asset Pricing Methodology:

- Expected return on the portfolio, if the Government Secs are at 8% and NIFTY is yielding 10%.
- Advisability of replacing Security 'Better' with NIFTY.

Answer:**WN 1: Computation of Portfolio Beta and Portfolio Return:**

Security	Beta	Weight	Product
Moderate	0.5	60	30
Better	1	80	80
Good	0.8	100	80
Very good	1.2	120	144
Best	1.5	160	240
Total	1.1038	520	574

- Portfolio Beta = 1.1038 Times
- Portfolio Return = $8\% + 1.1038 \times (10\% - 8\%) = 8\% + 2.21\% = 10.21\%$

Advise on replacing Security 'Better' with NIFTY:

- As computed above the expected return from Better is 10% same as from Nifty, hence there will be no difference even if the replacement of security is made. The main logic behind this neutrality is that the beta of security 'Better' is 1 which clearly indicates that this security shall yield same return as market return

22. Portfolio Beta [May 2018 MTP, Nov 2007, May 2014 MTP, May 2014 RTP, May 2021 RTP, SM]

XYZ Limited has substantial cash flow and until the surplus funds are utilized to meet the future capital expenditure, likely to happen after several months are invested in a portfolio of short term equity investments, details for which are given below:

Investment	No. of shares	Beta	MPS	Expected yield
A Ltd	60,000	1.16	4.29	19.5%
B Ltd	80,000	2.28	2.92	24%
C Ltd	1,00,000	0.90	2.17	17.5%
D Ltd	1,25,000	1.50	3.14	26%

The current market return is 19% and the risk free rate is 11%. Required to:

- Calculate the risk of the XYZ Ltd portfolio relative to market.
- Whether XYZ Limited should change the composition of its portfolio.

Answer:**WN 1: Computation of Actual Beta and Actual Return:**

Security	Beta	Weight	Product	Return	Product
A Limited	1.16	2,57,400	2,98,584	19.50%	50,193
B Limited	2.28	2,33,600	5,32,608	24.00%	56,064
C Limited	0.90	2,17,000	1,95,300	17.50%	37,975
D Limited	1.50	3,92,500	5,88,750	26.00%	1,02,050
Total	1.4677	11,00,500	16,15,242	22.38%	2,46,282

- Overall beta = Sum of Product (Column 4)/Sum of weights
- Overall return = Sum of Product (Column 6)/Sum of weights

WN 2: Computation of equilibrium (fair) Beta:

$$\begin{aligned}\text{Return} &= R_f + \text{Beta} \times (R_m - R_f) \\ 22.38 &= 11 + \text{Beta} \times (19 - 11) \\ 11.38 &= 8\text{Beta} \\ \text{Fair Beta} &= \frac{11.38}{8} = 1.4225 \text{ Times}\end{aligned}$$

Comment on risk of portfolio:

- Actual Beta of Portfolio is 1.4677 Times whereas fair Beta is 1.4225 Times. This indicates that Portfolio carries more risk than required as actual Beta is higher than Fair Beta. Hence Portfolio is relatively more risky

WN 3: Advise on change in composition of Portfolio:

Security	Beta	CAPM Return [$R_f + \text{Beta} \times (R_m - R_f)$]	Actual Return	Decision
A Ltd	1.16	20.28	19.50	Sell as actual return is lower than CAPM return
B Ltd	2.28	29.24	24.00	Sell as actual return is lower than CAPM return
C Ltd	0.90	18.20	17.50	Sell as actual return is lower than CAPM return
D Ltd	1.50	23.00	26.00	Buy/hold as actual return is higher than CAPM return

23. Return for Portfolio using CAPM [Nov 2021 MTP] [Logical Question] [Concept Revision]

Suppose one of your HNI clients is holding the following portfolio as per his risk appetite:

Particulars	Securities
Equity Shares:	
G Limited	1,000
S Limited	1,000
B Limited	500
PSU Bonds	20,000

The other data related to each of these securities is as follows:

Cost	Dividend/Interest	Market Price	Beta
10,000	1,725	9,800	0.60
15,000	1,000	16,200	0.80
28,000	1,400	28,300	0.60
1,800	180	1,725	0.10

Your client is interested in investing some more funds in Bonds issued by GOI.

- Estimate the minimum rate of return that your client would expect from these Bonds keeping in view his risk appetite and assuming Market Return as 12.70%.
- Analyze whether this portfolio has out-performed the market or not assuming Risk Free Rate of Return as 7%.

Answer:**WN 1: Computation of Portfolio Beta and Portfolio Return:**

Security	Beta	Weight	Product	Return per unit			Overall Return
				Dividend	Cap Appn	Total	
G Limited	0.60	1,00,00,000	60,00,000	1,725	-200	1,525	15,25,000
S Limited	0.80	1,50,00,000	1,20,00,000	1,000	1,200	2,200	22,00,000
B Limited	0.60	1,40,00,000	84,00,000	1,400	300	1,700	8,50,000
PSU Bonds	0.10	3,60,00,000	36,00,000	180	-75	105	21,00,000
Total		7,50,00,000	3,00,00,000				66,75,000

$$\text{Portfolio Beta} = \frac{\text{Sum of Product}}{\text{Sum of weights}} = \frac{3,00,00,000}{7,50,00,000} = 0.40 \text{ Times}$$

$$\text{Portfolio Return} = \frac{66,75,000}{7,50,00,000} \times 100 = 8.90\%$$

WN 2: Computation of risk-free rate of return:

$$\text{Return} = R_f + \text{Beta} \times (R_m - R_f)$$

$$8.90 = R_f + 0.40 \times (12.70 - R_f)$$

$$8.90 = R_f + 5.08 - 0.40R_f$$

$$3.82 = 0.60R_f$$

- Risk-free rate = 6.37%

Thus keeping in view the present risk appetite, the client would expect at least a return of 6.37% on Bonds.

WN 3: Performance of portfolio:

$$\text{Expected Return} = R_f + \text{Beta} \times (R_m - R_f)$$

$$\text{Expected return} = 7.00 + 0.40 \times (12.70 - 7.00) = 9.28\%$$

Since the actual return is 8.90% which is quite lower than expected return considering the systematic risk borne by the investor and hence portfolio has not outperformed the market rather has underperformed

24. Return for portfolio using CAPM [May 2024 MTP]

ICAI Question:

Your client is holding the following securities:

Particulars	Cost	Dividends/Interest	Market price at end of holding period	Beta
G Limited	20,000	1,450	19,600	0.6
S Limited	30,000	1,000	30,400	0.8
B Limited	28,000	1,400	32,000	0.6
GOI Bonds	72,000	5,060	71,980	0.01

Evaluate:

- Risk free rate of return.
- Expected rate of return of each security (except GOI Bond), using the Capital Asset Pricing Model (CAPM).

Note:

- Use weighted average Beta in calculations.
- Round off calculations upto 3 decimal points

Modified Question:

- Compute Beta on the basis of market value weights should be added in this question

Answer:

WN 1: Computation of Risk-free Return

$$\text{Risk free return (GOI Bonds)} = \frac{71,980 - 72,000 + 5,060}{72,000} \times 100 = 7.00\%$$

WN 2: Computation of Portfolio return

Security	Investment	Dividends	Capital gains
G Limited	19,600	0.6	-400
S Limited	30,400	0.8	400
B Limited	32,000	0.6	4,000
GOI Bonds	71,980	0.01	-20
Total	1,50,000	8,910	3,980

$$\text{Portfolio Return} = \frac{8,910 + 3,980}{1,50,000} = 8.593\%$$

WN 2: Computation of Portfolio Beta:

Security	Market Price	Beta	Product
G Limited	19,600	0.6	11,760
S Limited	30,400	0.8	24,320
B Limited	32,000	0.6	19,200
GOI Bonds	71,980	0.01	720
Total	1,53,980	0.364	56,000

Note:

- ICAI solution has computed Beta on the basis of market price in this question. We normally compute this on the basis of cost price. Technically both approaches are fine and it is similar to computing WACC based on book value and market value weights.

WN 3: Computation of Market Return:

$$\text{Portfolio Return} = R_f + \text{Beta} \times (R_m - R_f)$$

$$8.593 = 7.00 + 0.364 \times (R_m - 7.00)$$

$$1.593 = 0.364R_m - 2.548; 0.364R_m = 4.141$$

$$R_m = \frac{4.141}{0.364} = 11.376\%$$

WN 4: Computation of expected return of each security:

Security	Calculation $R_f + \text{Beta} \times (R_m - R_f)$	Return
G Limited	$7.00 + 0.60 \times (11.376 - 7.00)$	9.626%
S Limited	$7.00 + 0.80 \times (11.376 - 7.00)$	10.501%
B Limited	$7.00 + 0.60 \times (11.376 - 7.00)$	9.626%

25. Return for portfolio using CAPM [Nov 2005, Nov 2013, May 2015, May 2018, SM]

Your client is holding the following securities:

Securities	Cost Rs.	Dividends/ Interest Rs.	Market price Rs.	Beta
Equity Shares:				
Gold Ltd.	10,000	1,725	9,800	0.6
Silver Ltd.	15,000	1,000	16,200	0.8
Bronze Ltd.	14,000	700	20,000	0.6
PSU Bonds	36,000	3,600	34,500	0.01

Average return on the portfolio is 15.7%. Calculate

(i) Expected rate of return in each, using the Capital Asset Pricing Model (CAPM)

(ii) Risk free rate of return

Author's Note:

- This question lacks accuracy and we will be making lots of contradictory assumption. However, this is frequently tested in exam and hence students should not ignore this problem

WN 1: Computation of Return of Market:

- Let us assume market comprises of 1 share of Gold Limited, Silver Limited, Bronze Limited and 1 PSU Bonds

Security	Cost	Market price	Capital Appreciation	Dividends	Total return
Gold Ltd	10,000	9,800	-200	1,725	1,525
Silver Ltd	15,000	16,200	1,200	1,000	2,200
Bronze Ltd	14,000	20,000	6,000	700	6,700
PSU Bonds	36,000	34,500	-1,500	3,600	2,100
Total	75,000				12,525

$$\text{Return of market} = \frac{12,525}{75,000} \times 100 = 16.70\%$$

WN 2: Computation of Risk-free rate:

- Let us now consider the given portfolio as our portfolio and compute average Beta (Average is taken as simple average; weighted average can also be done)

$$\text{Beta of Portfolio} = \frac{0.6 + 0.8 + 0.6 + 0.01}{4} = 0.50 \text{ Times}$$

$$\text{Return of Portfolio} = R_f + \text{Beta} \times (R_m - R_f)$$

$$15.70 = R_f + 0.50 \times (16.70 - R_f)$$

$$15.70 = R_f + 8.35 - 0.5R_f$$

$$7.35 = 0.50R_f; R_f = \frac{7.35}{0.50} = 14.70\%$$

WN 3: Computation of expected rate of return for each security:

Particulars	Calculation	Amount
1. Gold Limited	$R_f + \text{Beta} \times (R_m - R_f)$ $14.70 + 0.6 \times (16.70 - 14.70)$	15.90%

2. Silver Limited	$14.70 + 0.8 \times (16.70 - 14.70)$	16.30%
3. Bronze Limited	$14.70 + 0.6 \times (16.70 - 14.70)$	15.90%
4. PSU Bonds	$14.70 + 0.01 \times (16.70 - 14.70)$	14.72%

26. Return for portfolio using CAPM [May 2008, May 2015 MTP, SM]

A holds the following portfolio:

Share/Bond	Beta	Initial Price	Dividends	Market price at the end of year
Epsilon Ltd	0.8	25	2	50
Sigma Ltd	0.7	35	2	60
Omega Ltd	0.5	45	2	135
GOI Bonds	0.01	1,000	140	1,005

Calculate:

- ❖ The expected return on his portfolio using capital asset pricing method
- ❖ The average return on his portfolio

Risk free return is 14%

Answer:

Author's Note:

- This question also lacks accuracy. Again, we are doing this in ICAI manner as the same is frequently tested in exam
- I do not find any difference in expected return and average return. However both are asked and are done differently in suggested answers

WN 1: Computation of Market return/expected return of portfolio:

- Let us assume market comprises of one share of Epsilon Limited, Sigma Limited, Omega Limited and one GOI Bonds

Security	Cost	Market price	Capital appreciation	Dividends	Total return
Epsilon Limited	25	50	25	2	27
Sigma Limited	35	60	25	2	27
Omega Limited	45	135	90	2	92
GOI Bonds	1,000	1,005	5	140	145
Total	1,105				291

$$\text{Return of market} = \frac{291}{1,105} \times 100 = 26.33\%$$

$$\text{Expected return of portfolio} = 26.33\%$$

WN 2: Computation of average return of portfolio:

Particulars	Calculation	Amount
1. Epsilon Limited	$R_f + \text{Beta} \times (R_m - R_f)$ $14 + 0.80 \times (26.33 - 14.00)$	23.86%
2. Sigma Limited	$14 + 0.70 \times (26.33 - 14.00)$	22.63%
3. Omega Limited	$14 + 0.80 \times (26.33 - 14.00)$	20.17%
4. GOI Bonds	$14 + 0.01 \times (26.33 - 14.00)$	14.12%
Average return of portfolio		20.20%

27. Return based on CAPM [July 2021, May 2022 RTP, Nov 2022 MTP]

Mr. X is having 1 lakh shares of M/s. Kannayaka Ltd. The beta of the company is 1.40. Mr. Y a financial advisor has suggested having the following portfolio:

Security	Beta	% of holding
S	1.20	10
K	0.75	10
P	0.40	30
D	1.40	50

Market Return is 12% Risk free rate is 8%

You are required to calculate the following for the present investment and suggested portfolio:

- (i) What is the expected return based on CAPM and also
- If the market goes up by 2.5%.
 - If the market goes down by 2.5%
 - If the market gives Negative Returns of 2.5%
- (ii) If the probability of market giving negative return is more, please advise Mr. X whether to continue the holdings of M/s. Kanniyaka Ltd. or to buy the portfolio as per the suggestion of Mr. Y. If so why?

Answer:**WN 1: Computation of Beta of Portfolio:**

Beta of Portfolio = $(1.20 \times 10\%) + (0.75 \times 10\%) + (0.40 \times 30\%) + (1.40 \times 50\%) = 1.015$ Times

WN 2: Computation of expected return of portfolio and present investment:

Situation	R _f	R _m	Present investment		Portfolio	
			Beta	Return	Beta	Return
Original	8	12	1.40	$= 8 + 1.40 \times (12 - 8)$ $= 8 + 5.60 = 13.60\%$	1.015	$= 8 + 1.015 \times (12 - 8)$ $= 8 + 4.06 = 12.06\%$
Market up by 2.5%	8	14.50	1.40	$= 8 + 1.40 \times (14.50 - 8)$ $= 8 + 9.10 = 17.10\%$	1.015	$= 8 + 1.015 \times (14.50 - 8)$ $= 8 + 6.60 = 14.60\%$
Market down by 2.5%	8	10.50	1.40	$= 8 + 1.40 \times (9.50 - 8)$ $= 8 + 2.10 = 10.10\%$	1.015	$= 8 + 1.015 \times (9.50 - 8)$ $= 8 + 1.52 = 9.52\%$
Market gives negative 2.5%	8	-2.50	1.40	$= 8 + 1.40 \times (-2.50 - 8)$ $= 8 - 14.70 = -6.70\%$	1.015	$= 8 + 1.015 \times (-2.50 - 8)$ $= 8 - 10.66 = -2.66\%$

Advise: If the probability of market giving negative return is more, it is advisable to Mr. X to buy the portfolio suggested by Mr. Y because Beta of the portfolio is less than of Kanniyaka Ltd.

28. Portfolio Beta [Nov 2022, July 2021, May 2023 MTP, SM]

M/s. Siri Ltd. Has a surplus amount of Rs. 3 crores to invest and has shortlisted the following equity shares:

Company	Beta
S Limited	1.60
K Limited	1.00
P Limited	-0.30
D Limited	2.00
C Limited	0.60

Required:

- If M/s. Siri Ltd. invests an equal amount in all securities, what is the beta of the portfolio?
- If M/s. Siri Ltd. invests 15% of its investment in S Ltd., 15% in P Ltd., 10% in C Ltd. and the balance in equal amount in the other two securities, what is the beta of the portfolio?
- If the expected return of market portfolio is 12% at a beta factor of 1.0, what will be the portfolios expected return in both the situations given above?
- If the Company changes its policy to invest in any 3 securities with a minimum of 20% in each of these 3 securities to diversify risk, you are requested to advise the company to have a right mix of securities to maximize the return in the following two scenarios and also calculate the expected return:
 - Bull Phase: Expected Market returns 10%
 - Bear Phase: Expected Market returns – 5%

Answer:**WN 1: Portfolio Beta with equal investment:**

Security	Beta	Weight	Product
S Limited	1.60	0.20	0.32
K Limited	1.00	0.20	0.20
P Limited	-0.30	0.20	-0.06
D Limited	2.00	0.20	0.40
C Limited	0.60	0.20	0.12
Overall Beta			0.98

WN 2: Portfolio Beta with given proportion:

Security	Beta	Weight	Product

S Limited	1.60	0.15	0.24
K Limited	1.00	0.30	0.30
P Limited	-0.30	0.15	-0.045
D Limited	2.00	0.30	0.60
C Limited	0.60	0.10	0.06
Overall Beta			1.155

WN 3: Portfolio return for the above composition:

- Return for part one = Beta x Return of Market = $0.98 \times 12 = 11.76\%$
- Return for part two = Beta x Return of Market = $1.155 \times 12 = 13.86\%$

WN 4: Portfolio composition during bull phase and bear phase:

- We should invest maximum in securities having higher Beta to maximize returns in bull phase
- We are required to invest in three securities with minimum investment of 20%. Hence we can invest 60% in highest Beta Security, 20% in next security and balance 20% in third security.

Security	Beta	Weight	Product
S Limited	1.60	0.20	0.32
K Limited	1.00	0.20	0.20
P Limited	-0.30	0.00	0.00
D Limited	2.00	0.60	1.20
C Limited	0.60	0.00	0.00
Overall Beta			1.72

- Returns in bull market = $1.72 \times 10\% = 17.20\%$

Portfolio under Bear Phase:

- We should invest maximum in securities having lower Beta to minimize losses in bear phase
- We are required to invest in three securities with minimum investment of 20%. Hence, we can invest 60% in lowest Beta Security, 20% in next security and balance 20% in third security.

Security	Beta	Weight	Product
S Limited	1.60	0.00	0.00
K Limited	1.00	0.20	0.20
P Limited	-0.30	0.60	-0.18
D Limited	2.00	0.00	0.00
C Limited	0.60	0.20	0.12
Overall Beta			0.14

- Returns in bear market = $0.14 \times -5.00\% = -0.70\%$

Part III – Systematic and Unsystematic Risk**29. Systematic and unsystematic risk [May 2019 MTP, Nov 2009, Nov 2015 RTP, Nov 2020 RTP, SM]**

A study by a Mutual fund has revealed the following data in respect of three securities:

Security	S.D. (%)	Correlation with index
A	20	0.60
B	18	0.95
C	12	0.75

The standard deviation of market portfolio (BSE Sensex) is observed to be 15%.

- What is the sensitivity of returns of each stock with respect to the market?
- What is the covariance among the various stocks?
- What would be the risk of portfolio consisting of all the three stocks equally?
- What is the beta of the portfolio consisting of equal investment in each stock?
- What is the total, systematic and unsystematic risk of the portfolio in (d)?

Answer:**WN 1: Computation of Beta:**

- Sensitivity of returns with respect to market is known as Beta

Beta of security	=	$\frac{\sigma_s}{\sigma_m} \times \text{COR}_{sm}$
Beta of A	=	$\frac{20}{15} \times 0.60 = 0.80 \text{ Times}$
Beta of B	=	$\frac{18}{15} \times 0.95 = 1.14 \text{ Times}$
Beta of C	=	$\frac{12}{15} \times 0.75 = 0.60 \text{ Times}$

WN 2: Computation of co-variance between stocks:

Co-variance between 1 and 2	=	Beta of 1 x Beta of 2 x variance of Market
Co-variance between 1 and 2	=	0.80 x 1.14 x 225 = 205.20
Co-variance between 1 and 3	=	Beta of 1 x Beta of 3 x Variance of Market
Co-variance between 1 and 3	=	0.80 x 0.60 x 225 = 108
Co-variance between 2 and 3	=	Beta of 2 x Beta of 3 x Variance of Market
Co-variance between 2 and 3	=	1.14 x 0.60 x 225 = 153.90

WN 3: Computation of Portfolio risk with equal investment in all three stocks:

Portfolio Variance	=	$(SD_a \times W_a)^2 + (SD_b \times W_b)^2 + (SD_c \times W_c)^2 + 2(W_a)(W_b)(COV_{ab}) + 2(W_a)(W_c)(COV_{ac}) + 2(W_b)(W_c)(COV_{bc})$
Portfolio variance	=	$(20 \times 0.3333)^2 + (18 \times 0.3333)^2 + (12 \times 0.3333)^2 + 2(0.3333)(0.3333)(205.20) + 2(0.3333)(0.3333)(108) + 2(0.3333)(0.3333)(153.90)$
Portfolio variance	=	44.44 + 36 + 16 + 45.59 + 24 + 34.19 = 200.22
Portfolio SD	=	14.15

WN 4: Computation of Beta of Portfolio consisting of all stocks equally:

$$\text{Portfolio Beta} = \frac{0.60 + 0.80 + 1.14}{3} = 0.8467 \text{ Times}$$

WN 5: Computation of total risk, systematic risk and unsystematic risk:

- Systematic and unsystematic risk can be computed under variance as well as SD approach. Variance approach is preferred if the problem is silent.

Particulars	Variance Approach	SD approach
1. Total risk	200.22	14.15
2. Systematic risk (SD of Market x Beta of Portfolio)	161.29 $(0.8467 \times 15)^2$	12.70 (0.8467×15)
3. Unsystematic risk (bal figure)	38.93	1.45

30. Systematic and unsystematic risk [May 2016 RTP, SM]

The following details are given for X and Y companies' stocks and the Bombay Sensex for a period of one year. Calculate the systematic and unsystematic risk for the companies' stocks. What would be the portfolio risk if equal amount of money is allocated between these stocks?

	X Stock	Y Stock	Sensex
Average return	0.15	0.25	0.06
Variance of return	6.30	5.86	2.25
Beta	?	0.685	
Co-efficient of determination (r^2)	0.18	?	

Answer:**WN 1: Analysis of systematic and unsystematic risk:**

- Coefficient of determination (r^2) is given in the question. This would mean coefficient of determination under variance approach. If the same was mentioned as r then the same would be under SD approach

Particulars	Stock X	Stock Y
1. Total risk	6.30	5.86
2. Systematic risk	1.134 $[6.30 \times 0.18]$	1.056 $[0.685 \times 0.685 \times 2.25]$

3. Unsystematic risk	5.166	4.804
4. Co-efficient of determination (r^2)	0.18	0.18 [1.056/5.86]
5. Beta $\left(\sqrt{\frac{\text{Systematic risk}}{\text{Variance of Market}}}\right)$	0.7099 $\sqrt{\frac{1.134}{2.25}}$	0.685

WN 2: Computation of Portfolio risk:**Markowitz Approach:**

Portfolio Variance	=	$(\sigma_x W_x)^2 + (\sigma_y W_y)^2 + 2W_x W_y \text{COV}_{xy}$
Portfolio Variance	=	$(6.30 \times 0.5 \times 0.5) + (5.86 \times 0.5 \times 0.5) + 2(0.5)(0.5)(1.09)$
Portfolio variance	=	$1.58 + 1.47 + 0.55 = 3.60$
Portfolio SD	=	$\sqrt{3.60} = 1.90$

Computation of co-variance of X and Y:

Co-variance between X and Y = Beta of X x Beta of Y x Variance of Market

Co-variance between X and Y = $(0.7099) \times (0.6850) \times 2.25 = 1.09$

Sharpe Approach:

Particulars	Portfolio variance
1. Systematic risk (Note 1)	1.09
2. Unsystematic risk (Note 2)	2.49
3. Total Risk	3.58
4. Portfolio SD	1.89

Note 1: Computation of systematic risk:

Systematic risk = $(0.6975 \times 0.6975 \times 2.25) = 1.09$

Note 2: Computation of unsystematic risk:

Unsystematic risk = $(5.166 \times 0.5^2) + (4.804 \times 0.5^2) = 2.49$

31. Portfolio Beta [Nov 2018 MTP, May 2018 RTP, Nov 2017 MTP, May 2015, Jan 2021, Nov 2024 MTP, SM] [Concept Revision]

Following are the details of a portfolio consisting of three shares:

Share	Portfolio Weight	Beta	Expected return in %	Total Variance
A	0.20	0.40	14	0.015
B	0.50	0.50	15	0.025
C	0.30	1.10	21	0.100

Standard deviation of market portfolio returns is 10%. You are given the following additional data:

Covariance (A, B) = 0.030

Covariance (A, C) = 0.020

Covariance (B, C) = 0.040

Calculate the following:

- ❖ The Portfolio Beta
- ❖ Residual variance of each of the three shares
- ❖ Portfolio variance considering co-movement between securities due to change in the market index
- ❖ Portfolio variance using correlation between each pair of securities

Answer:**WN 1: Computation of Portfolio Beta:**

Portfolio Beta = $(0.20 \times 0.40) + (0.50 \times 0.50) + (0.30 \times 1.10) = 0.66$

WN 2: Computation of residual variances:

Particulars	Share A	Share B	Share C
1. Total risk (variance)	0.0150	0.0250	0.1000
2. Systematic risk (Beta x Beta x variance of market)	0.0016	0.0025	0.0121

3. Unsystematic risk (Residual variance)	0.0134	0.0225	0.0879

WN 3: Computation of Portfolio variance as per Sharpe Index Model:

Portfolio variance considering co-movement between securities due to change in the market index is basically variance as per Sharpe Index Model

Particulars	Portfolio variance
1. Systematic risk (Note 1)	0.004356
2. Unsystematic risk (Note 2)	0.014072
3. Total Risk	0.018428

Note 1: Computation of systematic risk:

Systematic risk = $(0.66 \times 0.66 \times 0.1 \times 0.1) = 0.004356$

Note 2: Computation of unsystematic risk:

Unsystematic risk = $(0.0134 \times 0.2^2) + (0.0225 \times 0.5^2) + (0.0879 \times 0.3^2) = 0.014072$

WN 4: Computation of Portfolio Variance as per Markowitz approach:

Portfolio variance using correlation between each pair of securities is variance as per Markowitz Approach

Portfolio Variance	=	$(SD_a \times W_a)^2 + (SD_b \times W_b)^2 + (SD_c \times W_c)^2 + 2(W_a)(W_b)(COV_{ab}) + 2(W_a)(W_c)(COV_{ac}) + 2(W_b)(W_c)(COV_{bc})$
Portfolio variance	=	$(0.015 \times 0.20 \times 0.20) + (0.025 \times 0.50 \times 0.50) + (0.100 \times 0.30 \times 0.30) + 2(0.20)(0.50)(0.030) + 2(0.20)(0.30)(0.020) + 2(0.50)(0.30)(0.040)$
Portfolio variance	=	$0.0006 + 0.00625 + 0.009 + 0.006 + 0.0024 + 0.012$
Portfolio variance	=	0.03625

32. Portfolio standard deviation [May 2012, Nov 2018 MTP, Nov 2016 RTP, May 2022 MTP, SM]

A portfolio has been constructed with the following features:

Security	B	Random Error, σ_i	Weight
A	1.50	6	.3
B	1.10	10	.2
C	1.30	4	.2
D	0.80	12	.2
E	0.90	7	.1

Find out the risk of the portfolio given that the standard deviation of the market index is 20%.

Answer:**WN 1: Computation of Portfolio Beta and Portfolio Unsystematic risk:**

Security	Beta	Weight	Product	Random error (SD)	Product
A	1.5	0.3	0.45	6	3.24
B	1.1	0.2	0.22	10	4
C	1.3	0.2	0.26	4	0.64
D	0.8	0.2	0.16	12	5.76
E	0.9	0.1	0.09	7	0.49
Total			1.18		14.13

- Random error is basically unsystematic risk (SD based unsystematic risk as the value is not squared)
- Product for column 6 = Random error x Random error x Weight x weight
- Beta of Portfolio = 1.18 Times
- Unsystematic risk of portfolio = 14.13 (weighted average of individual unsystematic risk; Random error is equal to unsystematic risk)

WN 2: Computation of Portfolio risk:

Particulars	Amount
1. Systematic risk $(1.18 \times 1.18 \times 20 \times 20)$	556.96
2. Unsystematic risk (Note 2)	14.13
3. Total Risk (Portfolio Variance)	571.09

4. Portfolio SD

$$\sqrt{571.09} = 23.90$$

33. Portfolio return and risk [May 2011 RTP] [Homework]

Following information is available regarding expected return, standard deviation and beta of 6 shares are available in the stock market:

Security	Expected Return	Beta	S.D (%)
1	5	0.70	9
2	10	1.05	14
3	11	0.95	12
4	12.5	1.10	20
5	15	1.40	17.5
6	16	1.70	25

Suppose risk free rate of return is 4% and Market return is 6% and standard deviation is 10%. You are required to compute:

- (i) Which security is under-valued and which is over-valued?
- (ii) Assuming that funds are equally invested in these six stocks, then compute
 - a. Return of portfolio
 - b. Risk of portfolio
- (iii) Suppose if above portfolio is invested in with margin of 40% and cost of borrowing is 4% then what will be the position.

Answer:**WN 1: Determination of under-valued and over-valued securities:**

Using CAPM we shall calculate the expected return of security and based on the same we can find the under-valued and over-valued securities

Security	Beta	Return as per CAPM	Expected Return	Status
1	0.70	$4 + 0.70 (6 - 4) = 5.4\%$	5	Over valued
2	1.05	$4 + 1.05 (6 - 4) = 6.1\%$	10	Under valued
3	0.95	$4 + 0.95 (6 - 4) = 5.9\%$	11	Under valued
4	1.10	$4 + 1.10 (6 - 4) = 6.2\%$	12.5	Under valued
5	1.40	$4 + 1.40 (6 - 4) = 6.8\%$	15	Under valued
6	1.70	$4 + 1.70 (6 - 4) = 7.4\%$	16	Under valued

Security 2 to 6 are under-valued as the expected return is higher than required return as per CAPM. Security 1 is overvalued as expected return is lower than required return as per CAPM.

WN 2: Computation of portfolio return and portfolio Beta:

Security	Expected Return	Beta
1	5	0.70
2	10	1.05
3	11	0.95
4	12.5	1.10
5	15	1.40
6	16	1.70
Average	11.58%	1.15

WN 3: Computation of portfolio risk:

- ❖ Portfolio Risk = Systematic risk of portfolio + Unsystematic risk of portfolio
- ❖ Systematic Risk = $(\text{Beta} \times \text{SD of Market})^2 = (1.15 \times 10)^2 = 132.25$
- ❖ Unsystematic Risk of Portfolio = 24.9 (refer Note 1)
- ❖ Portfolio Risk (Variance) = $132.25 + 24.9 = 157.15$
- ❖ Portfolio SD = $\sqrt{157.75} = 12.54\%$

Note 1: Computation of unsystematic Risk:

Security	S.D (%)	Variance	Beta	Systematic Risk (Beta x SD of Market) ²	Unsystematic Risk [Total Risk - Systematic Risk]	W ² x unsys Risk
1	9	81	0.7	49	32	0.89

2	14	196	1.05	110.25	85.75	2.38
3	12	144	0.95	90.25	53.75	1.49
4	20	400	1.1	121	279	7.75
5	17.5	306.25	1.4	196	110.25	3.06
6	25	625	1.7	289	336	9.33
Total						24.9

WN 4: Position of the investor if the above portfolio has been invested with margin of 40%:

Portfolio return = $1.40 \times 11.58 + (-0.4) \times 4 = 14.612\%$
Portfolio Risk = $1.40 \times 12.54 = 17.56\%$

34. Systematic and Unsystematic Risk [Nov 2019]:

Following are risk and return estimates for two stocks

Stock	Expected Return (%)	Beta	Specific SD of Expected Return (%)
A	14	0.8	35
B	18	1.2	45

The market index has a Standard Deviation (SD) of 25% and risk-free rate on Treasury Bills is 6%.

You are required to calculate:

- The standard deviation of expected returns on A and B.
- Suppose a portfolio is to be constructed with the proportions of 25%, 40% and 35% in stock A, B and Treasury Bills respectively, what would be the expected return, standard deviation of expected return of the portfolio?

Answer:

WN 1: Computation of standard deviation of A and B:

- Specific SD of expected return refers to Unsystematic Risk

Particulars	A	B
Systematic risk (Beta x SD of Market) ²	400 (0.8×25) ²	900 (1.2×25) ²
Unsystematic risk	1225 (35) ²	2025 (45) ²
Total Risk (Variance)	1625	2925
Standard Deviation	40.31%	54.08%

WN 2: Computation of expected return and standard deviation of portfolio:

- Expected Return of portfolio = $(14 \times 0.25) + (18 \times 0.40) + (6 \times 0.35) = 12.80\%$
- Beta of Portfolio = $(0.80 \times 0.25) + (1.20 \times 0.40) + (0 \times 0.35) = 0.68$ Times
- Systematic risk of portfolio = $(0.68 \times 25)^2 = 289$
- Unsystematic risk of portfolio = $(35 \times 0.25)^2 + (45 \times 0.40)^2 + (0 \times 0.35)^2 = 400.56$
- Total risk of portfolio = $289 + 400.56 = 689.56$
- SD of portfolio = SQRT (689.56) = 26.26%**

35. Computation of systematic/unsystematic/sharpe/treynor [Nov 2020 RTP, May 2019 MTP, Nov 2016, May 2024 MTP, SM] [Concept Revision]

Mr. Abhishek is interested in investing Rs.4,00,000 for which he is considering following three alternatives:

- Invest Rs.4,00,000 in Security A
- Invest Rs.4,00,000 in Security B
- Invest Rs.2,40,000 in Security A and Rs.1,60,000 in Security B

Average annual return earned by Security A and Security B is 15% and 14% respectively. Risk free rate of return is 10% and market rate of return is 12%.

Co-variance of returns of Security A, Security B and Market portfolio are as follow:

Particulars	Security A	Security B	Market
Security A	4.800	4.300	3.370
Security B	4.300	4.250	2.800
Market	3.370	2.800	3.100

You are required to calculate:

- Expected Return of Security A, B and Portfolio.
- Variance of return of Security A, Security B and Market.
- Variance and Standard Deviation of Portfolio
- Systematic and Unsystematic Risks of Security A, Security B and Portfolio.

Answer:**WN 1: Computation of variance of Security A, Security B and Market**

Variance of Security A	=	Co-variance between Security A and Security A	4.800
Variance of Security B	=	Co-variance between Security B and Security B	4.250
Variance of Market	=	Co-variance of Market and Market	3.100

WN 2: Computation of Return of Security A, Security B and Portfolio

Beta of Security A	=	$\frac{\text{Co - variance of Security A and market}}{\text{Variance of market}}$	$\frac{3.370}{3.100} = 1.087$
Beta of Security B	=	$\frac{\text{Co - variance of Security B and market}}{\text{Variance of market}}$	$\frac{2.800}{3.100} = 0.903$
Expected return of A	=	$10\% + 1.087(12\% - 10\%)$	12.17%
Expected Return of B	=	$10\% + 0.903(12\% - 10\%)$	11.81%
Return of Market	=	$0.60 \times 12.17\% + 0.40 \times 11.81\%$	12.03%

WN 3: Variance and SD of Portfolio:

Portfolio variance	=	$(W_X \times SD_X)^2 + (W_Y \times SD_Y)^2 + 2W_X W_Y COV_{XY}$	
Portfolio variance	=	$(0.60)^2 \times 4.800 + (0.40)^2 \times (4.250) + 2(0.60)(0.40)(4.300)$	4.472
Portfolio SD	=	$\sqrt{4.472}$	2.115

WN 4: Systematic and Unsystematic Risks of Security A, Security B and Portfolio:

Particulars	Portfolio	Security A	Security B
Total risk	4.472	4.80	4.250
Systematic risk [$\beta^2 \times \text{variance of market}$]	$(1.013)^2 \times 3.10$ = 3.181	$(1.087)^2 \times 3.10$ = 3.663	$(0.903)^2 \times 3.10$ = 2.528
Unsystematic risk [Total risk - Sys risk]	1.291	1.137	1.722

36. Mutual Funds - Performance Evaluation [Nov 2019]:

The returns of a Portfolio A and market portfolio for the last 12 months are indicated as follows:

Month	Portfolio A	Market Portfolio
January	-0.52	0.82
February	2.20	0.04
March	2.17	2.80
April	4.17	1.72
May	2.04	0.27
June	3.00	0.39
July	1.99	1.95
August	4.00	0.64
September	-1.38	1.53
October	2.67	2.70
November	3.99	2.52
December	1.86	2.09
Standard Deviation	1.6223	0.9498

- You are required to find out the monthly returns attributable to the sheer skill of the Portfolio Manager.
 - What part of the monthly return is attributable to the higher risk assumed by the Portfolio Manager?
- Assume that the risk-free rate of return is 12% per annum and the portfolio is fully diversified.

Answer:**WN 1: Computation of Average Portfolio and Market Return:**

Month	Portfolio A	Market Portfolio
Total return for 12 months	26.19	17.47
No of months	12	12
Return per month	2.1825	1.4558

WN 2: Computation of monthly return attributable to sheer skill of portfolio manager:

- Portfolio is fully diversified and hence we should compute the required return of portfolio as per CAPM
- The same should be compared with actual return and the excess return (Alpha) is considered as the return attributable to sheer skill of portfolio manager

Part 1: Beta of Portfolio:

- Portfolio is fully diversified and hence it will not carry any unsystematic risk. The standard deviation of the portfolio would be equal to its systematic risk

Systematic Risk = Beta of Security x SD of Market

$$1.6223 = \text{Beta of Security} \times 0.9498$$

$$\text{Beta of Security} = \frac{1.6223}{0.9498} = 1.7080 \text{ Times}$$

Part 2: Computation of required return as per CAPM:

$$\text{CAPM return} = R_f + \text{Beta} \times (R_m - R_f)$$

$$\text{CAPM return} = 1 + 1.7080 \times (1.4558 - 1)$$

$$\text{CAPM return} = 1.7785\%$$

Part 3: Excess return (Alpha) due to brilliance of portfolio Manager:

Particulars	Amount
Actual Return per month	2.1825%
CAPM required return per month	1.7785%
Excess return (Alpha) per month	0.4040%

WN 3: Computation of return attributable to higher risk of portfolio manager:

- Security A has Beta of 1.7080 Times as compared to market Beta of 1 Time. This would mean that portfolio manager is taking higher risk as compared to market
- Return of market is 1.4558% for Beta of 1 Time. Required return of Security A is 1.7785% for Beta of 1.7080 Times
- Excess return due to higher risk = $1.7785 - 1.4558 = 0.3227\%$ per month

Part IV – Characteristic Line, CML and SML

37. Characteristic line [May 2009, Nov 2016, SM]

The returns on stock A and market portfolio for a period of 6 years are as follows:

Year	Return on A (%)	Return on market portfolio (%)
1	12	8
2	15	12
3	11	11
4	2	-4
5	10	9.5
6	-12	-2

You are required to determine:

- Characteristic line for stock A
- The systematic and unsystematic risk of stock A.

Answer:**WN 1: Characteristic line:****Computation table for Beta:**

- Probability is not given in the question and hence we are assuming equal probability. Beta can also be computed under formula 1. However we need total risk of security for solving systematic and unsystematic risk

Prob	Security A				Market				Pd _a d _m
	Return	Product	Deviation	Pd ²	Return	Product	Deviation	Pd ²	
0.1667	12	2.00	5.67	5.36	8	1.33	2.26	0.85	2.14
0.1667	15	2.50	8.67	12.53	12	2.00	6.26	6.53	9.05
0.1667	11	1.83	4.67	3.64	11	1.83	5.26	4.61	4.09

0.1667	2	0.33	-4.33	3.13	-4	-0.67	-9.74	15.8	7.03
0.1667	10	1.67	3.67	2.25	9.5	1.58	3.76	2.36	2.3
0.1667	-12	-2.00	-18.33	56.01	-2	-0.33	-7.74	9.99	23.65
Total		6.33		82.92		5.74		40.15	48.26

Particulars	Calculation	Amount
1. Beta of Security (Covariance of security and Market/Variance of Market)	$\left(\frac{48.26}{40.15}\right)$	1.20
2. Required return (Beta x R _m)	(1.20 x 5.74)	6.89
3. Actual return		6.33
4. Alpha (Actual return - required return)		-0.56
5. Characteristic line (Alpha + (Beta x R _m))		-0.56 + 1.20 R _m

WN 2: Computation of systematic risk and unsystematic risk:

Particulars	Variance Approach	SD Approach
1. Total Risk	82.92	9.11
2. Systematic risk (Beta x SD of Market)	57.82	7.60
3. Unsystematic risk (balancing figure)	25.10	1.51

38. Security market line & capital market line [May 2018 RTP, May 2007, May 2015 MTP, Nov 2018 MTP, May 2014 RTP, May 2019 RTP, Nov 2019 MTP, May 2020 MTP, Nov 2023 MTP, SM] [Concept Revision]

Expected returns on two stocks against BSE SENSEX returns are given in the following table under two scenarios-bullish and bearish:

Market Return	Scenario -1: Bullish Case	Scenario -2: Bearish Case
BSE Sensex	25%	-5%
Stock R	32%	-4%
Stock Z	18%	-3%

You are required to calculate:

- The Betas of two stocks R and Z.
- Expected return on each stock, if the likelihood of market achieving Scenario-1 is thrice the likelihood of the market achieving Scenario-2.
- The Security Market Line (SML), if the risk free rate is 8% and likelihood of the market return achieving the bullish base returns of 25% is thrice that of achieving -5% returns.
- The Alphas of the two stocks based on Sharpe Index Model.
- Capital Market Line

Answer:**WN 1: Computation table for Beta:****Security R:**

Prob	Stock R				Market				Pd _a d _m
	Return	Product	Deviation	Pd ²	Return	Product	Deviation	Pd ²	
0.75	32	24	9	60.75	25	18.75	7.5	42.1875	50.625
0.25	-4	-1	-27	182.25	-5	-1.25	-22.5	126.5625	151.875
Total		23		243		17.5		168.75	202.5

Security Z:

Prob	Stock Z				Market				Pd _b d _m
	Return	Product	Deviation	Pd ²	Return	Product	Deviation	Pd ²	
0.75	18	13.5	5.25	20.6719	25	18.75	7.5	42.1875	29.5313
0.25	-3	-0.75	-15.75	62.0156	-5	-1.25	-22.5	126.5625	88.5937
Total		12.75		82.6875		17.5		168.75	118.1250

WN 2: Beta, Expected return and SML:

Particulars	Calculation	Amount
1. Beta of Stock R	(202.50/168.75)	1.20 Times

2. Beta of Stock Z	(118.1250/168.75)	0.70 Times
3. Expected return of Stock R	WN 1	23%
4. Expected return of Stock Z	WN 1	12.75%
5. Security Market Line	$R_f + \text{Beta} \times (R_m - R_f)$ $8.00 + \text{Beta} \times (17.50 - 8.00)$	$8.00 + 9.50 \text{ Beta}$

WN 3: Computation of Alpha

Particulars	Stock R	Stock Z
1. Required return	21.00 [Beta x Rm]	12.25 [Beta x Rm]
2. Actual Return	23.00	12.75
3. Alpha	2.00%	0.50%

WN 4: Capital Market Line:

$$\text{Capital Market Line} = R_f + \frac{\text{SD of Security}}{\text{SD of Market}} \times (R_m - R_f) = 8.00\% + \left(\frac{\text{SD of Security}}{13.00\%} \right) \times 9.50\%$$

39. Security market line [May 2012 RTP] [Homework]

Assuming that two securities X and Y are correctly priced on SML and expected return from these securities are 9.40% (Return of X) and 13.40% (Return of Y) respectively. The Beta of these securities is 0.80 and 1.30 respectively. Mr. A, an investment manager states that the return on market index is 9%. You are required to determine:

- ❖ Whether the claim of Mr.A is right. If not then what is the correct return on market index?
- ❖ Risk Free Rate of Return

Answer:

Expected return of X = $R_f + \text{Beta} \times (R_m - R_f)$ $9.40 = R_f + 0.80 \times (R_m - R_f)$ Equation 1
Expected return of Y = $R_f + \text{Beta} \times (R_m - R_f)$ $13.40 = R_f + 1.30 \times (R_m - R_f)$ Equation 2
Subtracting 1 from equation 2: $4.00 = 0.50 \times (R_m - R_f); (R_m - R_f) = 8.00$
Substituting risk premium in equation 1 $9.40 = R_f + 0.80 \times 8; R_f = 3\%$
$(R_m - R_f) = 8\%; (R_m - 3\%) = 8\%; R_m = 11\%$

- Claim of Mr.A is not right. The correct return of market is 11%
- Risk-free rate is 3%

Part V - Factor Sensitivity Analysis and Arbitrage Pricing Theory**40. Miscellaneous - Factor sensitivity analysis [Nov 2018, Nov 2009, May 2021 MTP, May 2023 MTP, Nov 2024 MTP, SM]**

Mr. X own a portfolio with the following characteristics:

Particulars	Security A	Security B	Risk Free Security
Factor 1 sensitivity	0.80	1.50	0
Factor 2 sensitivity	0.60	1.20	0
Expected Return	15%	20%	10%

It is assumed that security returns are generated by a two factor model.

- a) If Mr. X has Rs. 1, 00,000 to invest and sells short Rs. 50,000 of security B and purchases Rs. 1, 50,000 of security A what 'is the sensitivity of Mr. X's portfolio to the two factors?
- b) If Mr. X borrows Rs. 1, 00,000 at the risk free rate and invests the amount he borrows along with the original amount of Rs. 1, 00,000 in security A and B in the same proportion as described in part (i), what is the sensitivity of the portfolio to the two factors?
- c) What is the expected return premium of part 2?

Answer:**WN 1: Computation of sensitivity of Portfolio to Factor 1 and Factor 2:**

Security	Weight	Factor 1 Beta	Product	Factor 2 Beta	Product
Security A	1,50,000	0.80	1,20,000	0.60	90,000

Security B	-50,000	1.50	-75,000	1.20	-60,000
Total	1,00,000	0.45	45,000	0.30	30,000

- Factor 1 sensitivity of Portfolio = $45,000/1,00,000 = 0.45$ Times
- Factor 2 sensitivity of Portfolio = $30,000/1,00,000 = 0.30$ Times

WN 2: Computation of sensitivity of Portfolio to Factor 1 and Factor 2:

Security	Weight	Factor 1 Beta	Product	Factor 2 Beta	Product
Security A	3,00,000	0.80	2,40,000	0.60	1,80,000
Security B	-1,00,000	1.50	-1,50,000	1.20	-1,20,000
Risk-free security	-1,00,000	0.00	0	0.00	0
Total	1,00,000	0.90	90,000	0.60	60,000

- Factor 1 sensitivity of Portfolio = $90,000/1,00,000 = 0.90$ Times
- Factor 2 sensitivity of Portfolio = $60,000/1,00,000 = 0.60$ Times

WN 3: Computation of return premium:

Return = $R_f + (\text{Beta}_1 \times \text{RP}_1) + (\text{Beta}_2 \times \text{RP}_2)$
$15 = 10 + 0.80 \text{ RP}_1 + 0.60 \text{ RP}_2$ Equation 1
$20 = 10 + 1.50 \text{ RP}_1 + 1.20 \text{ RP}_2$ Equation 2
Equation 1 x 2
$30 = 20 + 1.60 \text{ RP}_1 + 1.20 \text{ RP}_2$
Subtracting equation 2 from above equation
$10 = 10 + 0.10 \text{ RP}_1$; $\text{RP}_1 = 0$
Substituting RP 1 in equation 1
$15 = 10 + 0 + 0.60 \text{ RP}_2$
$\text{RP}_2 = 5/0.60 = 8.33\%$
Return Premium of Factor 1 = 0%
Return Premium of Factor 2 = 8.33%
Return Premium for Part 2:
Return Premium = $(0.90 \times 0) + (0.60 \times 8.33) = 5\%$

41. Factor sensitivity analysis:

Mr. S owns the portfolio with the following characteristics:

Particulars	Security A	Security B	Risk Free Security
Factor 1 sensitivity	0.50	1.50	0
Factor 2 sensitivity	0.80	1.40	0
Expected Return	15%	20%	10%

It is assumed that the security's returns are generated by two factor model:

- ❖ In what combination one should invest in A and B, that the overall portfolio is insensitive to changes in factor 2?
- ❖ In what combination we should invest in A, B and risk free asset so that the overall portfolio is insensitive to changes in factor 2 and has sensitivity of 1 to factor 1?

Answer:**WN 1: Computation of combination of A and B to have Portfolio Factor 2 Beta of 0**

Let us assume W1 to be the investment in Security A and (1 - W1) to be the investment in Security B

Security	Beta	Weight	Product
Security A	0.80	W1	0.80W1
Security B	1.40	1 - W1	1.40 - 1.40W1
Total	0	1	0

- $0.80W1 + 1.40 - 1.40W1 = 0$
- $0.60W1 = 1.40$
- $W1 = (1.40/0.60) = 2.3333$
- Investment in Security A = 2.3333; Investment in Security B = -1.3333

WN 2: Computation of weights of Security A, Security B and Risk free asset to have Factor 1 Beta of 1 and Factor 2 Beta of 0:

Let us assume a and b to be the proportion of investment in Security A and Security B

Security	Weight	Factor 1 Beta	Product	Factor 2 Beta	Product
Security A	a	0.50	0.50a	0.80	0.80a
Security B	b	1.50	1.50b	1.40	1.40b
Risk-free security	$1 - a - b$	0	0	0	0
Total	1		0.50a + 1.50b = 1		0.80a + 1.40b = 0

$0.50a + 1.50b = 1$ Equation 1
$0.80a + 1.40b = 0$ Equation 2
Equation 1 x 1.60 $0.80a + 2.40b = 1.60$
Subtracting equation 2 from above equation $b = 1.60$ Times
Substituting b in equation 1 $0.50a + 1.50(1.60) = 1$ $0.50a + 2.40 = 1$ $0.50a = -1.40$ $a = -2.80$ Times
Weight of security A = -2.80 Times Weight of Security B = 1.60 Times Weight of Risk-free asset = 2.20 Times

42. Factor sensitivity analysis [Homework]

Assume that only two macro-economic factors, factor 1 and factor 2, impact security returns. Investments A, B and C have the following sensitivities to these two factors:

Investment	Beta of factor 1	Beta of factor 2
A	1.75	0.25
B	-1.00	2.00
C	2.00	1.00

We are given the expected risk premium is 4% on factor 1 and 8% on factor 2. According to the APT, what is the risk premium on each of the three stocks? Suppose we buy Rs.2,00,000 of A, Rs.50,000 of B and sell Rs.1,50,000 of C. What is the sensitivity of the portfolio to each of the two factors? What is the expected risk premium?

Answer:

WN 1: Computation of Risk Premium:

Risk Premium of Security = (Factor 1 Beta x RP of Factor 1) + (Factor 2 Beta x RP of Factor 2)
Risk Premium of Security A = $(1.75 \times 4) + (0.25 \times 8) = 9\%$
Risk Premium of Security B = $(-1.00 \times 4) + (2 \times 8) = 12\%$
Risk Premium of Security C = $(2 \times 4) + (1 \times 8) = 16\%$

WN 2: Computation of Portfolio Sensitivity:

Security	Weight	Factor 1 Beta	Product	Factor 2 Beta	Product
Security A	2,00,000	1.75	3,50,000	0.25	50,000
Security B	50,000	-1.00	-50,000	2.00	1,00,000
Security C	-1,50,000	2.00	-3,00,000	1.00	-1,50,000
Total	1,00,000	0	0	0	0

- Factor 1 Beta = $0/1,00,000 = 0$
- Factor 2 Beta = $0/1,00,000 = 0$
- Risk premium of portfolio = 0

43. Arbitrage pricing theory [Nov 2018 MTP, May 2011, May 2013 RTP, SM, Nov 2023] [Concept Revision]

An investor has categorized all the available stock in the market into the following types and the estimated weights of the categories of stocks in the market index are given below. Further, the sensitivity of returns of these categories of stocks to two factors Inflation and Stock market are also given below:

Category		Factor 1 (Inflation)	Factor 2 (Stock Market)

	Weight in market index	Beta 1	Expected value in %	Actual value in %	Beta 2	Expected value in %	Actual value in %
Small cap	20%	1.20	6.70	6.70	0.80	10.00	10.50
Medium Cap	30%	1.75	4.50	6.00	0.90	7.00	8.00
Large cap	15%	1.30	6.75	8.00	1.165	9.00	10.00
Flexi cap	35%	1.70	7.00	6.50	0.85	8.85	9.75

Risk Free Rate of Interest is 7.50%. Round off to 2 decimal.

You are required to calculate:

- Expected return on the market index for both the factors.
- Expected return on the market index under Arbitrage Pricing Theory (Existing Scenario).
- Expected return on the market index under Arbitrage Pricing Theory if the composition of the Portfolio is changed to 25% equally in all four categories.
- Which alternative (Existing or Changed) will be more profitable?

Answer:

WN 1: Computation of Expected return on the market index for both factors:

- Factor 1 = $(0.20 \times 6.70) + (0.30 \times 4.50) + (0.15 \times 6.75) + (0.35 \times 7.00) = 6.15\%$
- Factor 2 = $(0.20 \times 10.00) + (0.30 \times 7.00) + (0.15 \times 9.00) + (0.35 \times 8.85) = 8.55\%$

WN 2: Return of Market Index under APT:

- Return under APT = Risk free rate + (Factor 1 Beta $\times$ (AV - EV)) + (Factor 2 Beta $\times$ (AV - EV))

Particulars	Calculation	Amount
Small cap	$7.50 + (1.20 \times 0) + (0.80 \times (10.50 - 10.00))$	7.90%
Medium Cap	$7.50 + (1.75 \times (6.00 - 4.50)) + (0.90 \times (8.00 - 7.00))$	11.03%
Large Cap	$7.50 + (1.30 \times (8.00 - 6.75)) + (1.165 \times (10.00 - 9.00))$	10.29%
Flexi Cap	$7.50 + (1.70 \times (6.50 - 7.00)) + (0.85 \times (9.75 - 8.85))$	7.42%
Market Return	$(7.90 \times 0.20) + (11.03 \times 0.30) + (10.29 \times 0.15) + (7.42 \times 0.35)$	9.03%
Market return (equal weights)	$(7.90 \times 0.25) + (11.03 \times 0.25) + (10.29 \times 0.25) + (7.42 \times 0.25)$	9.16%

As per the above calculation, the investors by investing 25% equally in all four categories, is profitable compared to the existing composition. As the proposed composition gives rate of return of 9.16% per annum when compared to the existing return of the present portfolio which is 9.03%.

44. Arbitrage Pricing Theory [Nov 2019 RTP, May 2022 MTP, SM] [Concept Revision]

Mr. Nirmal Kumar has categorized all the available stock in the market into the following types:

- Small cap growth stocks
- Small cap value stocks
- Large cap growth stocks
- Large cap value stocks

Mr. Nirmal Kumar also estimated the weights of the above categories of stocks in the market index. Furthermore, the sensitivity of returns on these categories of stocks to the three important factor are estimated to be:

Category of stocks	Weight in the market index	Factor I (Beta)	Factor II (Price Book)	Factor III (Inflation)
Small cap growth	25%	0.80	1.39	1.35
Small cap value	10%	0.90	0.75	1.25
Large cap growth	50%	1.165	2.75	8.65
Large cap value	15%	0.85	2.05	6.75
Risk premium		6.85%	-3.5%	0.65%

The rate of return on treasury bonds is 4.5%.

Required:

- Using arbitrage pricing theory, determine the expected return on the market index
- Using CAPM, determine the expected return on the market index
- Mr. Nirmal Kumar wants to construct a portfolio constituting only the 'small cap value' and 'large cap growth' stocks. If the target beta for the desired portfolio is 1, determine the composition of his portfolio.

Answer:**WN 1: Computation of Market index return using APT:**

Return under APT = $R_f + (\text{Factor 1 Beta} \times \text{RP}_1) + (\text{Factor 2 Beta} \times \text{RP}_2) + (\text{Factor 3 Beta} \times \text{RP}_3)$
Small cap growth = $4.5 + (0.80 \times 6.85) + (1.39 \times -3.50) + (1.35 \times 0.65) = 5.9925\%$
Small cap value = $4.5 + (0.90 \times 6.85) + (0.75 \times -3.50) + (1.25 \times 0.65) = 8.8525\%$
Large cap growth = $4.5 + (1.165 \times 6.85) + (2.75 \times -3.50) + (8.65 \times 0.65) = 8.4778\%$
Large cap value = $4.5 + (0.85 \times 6.85) + (2.05 \times -3.50) + (6.75 \times 0.65) = 7.535\%$
Return of Market Index = $(5.9925 \times 0.25) + (8.8525 \times 0.10) + (8.4778 \times 0.50) + (7.535 \times 0.15) = 7.7525\%$

WN 2: Computation of Market Index return using CAPM:

Return under CAPM = $R_f + (\text{Beta} \times \text{RP})$
Small cap growth = $4.5 + (0.80 \times 6.85) = 9.98\%$
Small cap value = $4.5 + (0.90 \times 6.85) = 10.665\%$
Large cap growth = $4.5 + (1.165 \times 6.85) = 12.4803\%$
Large cap value = $4.5 + (0.85 \times 6.85) = 10.3225\%$
Return of Market Index = $(9.98 \times 0.25) + (10.665 \times 0.10) + (12.4803 \times 0.50) + (10.3225 \times 0.15) = 11.35\%$

WN 3: Computation of portfolio weights for Beta of 1 Time:

Let us assume W1 to be the weight of small cap value and $(1 - W1)$ to be the weight of large cap Growth

Security	Beta	Weight	Product
Small cap value	0.90	W1	$0.90W1$
Large cap Growth	1.165	$1 - W1$	$1.165 - 1.165W1$
Total		1	$1.165 - 0.265W1 = 1$

$$\text{Weight of Small cap value} = \frac{0.165}{0.265} = 62.26\%$$

$$\text{Weight of Large cap growth} = 100 - 62.26\% = 37.74\%$$

45. Arbitrage pricing theory [SM] [Homework]

With the help of following data, determine the return of the security X

Factor	Risk premium associated with the factor	Beta
Market	4%	1.30
Growth rate of GDP	1%	0.30
Inflation	-4%	0.20

Risk free rate of return is 8%

Answer:

- Return under APT = Risk free return + (Factor 1 Beta x Risk Premium of Factor 1) + (Factor 2 Beta x Risk Premium of Factor 2) + (Factor 3 Beta x Risk Premium of Factor 3)
- Return under APT = $8.00 + (1.30 \times 4) + (0.30 \times 1.00) + (0.20 \times -4.00)$
- Return under APT = 12.70%**

Part VI - Optimum Weights for Risk Reduction**46. Risk reduction [Nov 2015 MTP, May 2019 RTP, Nov 2010, Nov 2016 MTP, Nov 2012 RTP, SM, May 2024 RTP, May 2024]**

An investor has decided to invest to invest Rs.1,00,000 in the shares of two companies, namely, ABC and XYZ. The returns and their probability is given below:

Probability	ABC (%)	XYZ (%)
0.20	-5	15
0.50	10	25
0.30	15	-10

- Comment on return and risk of investment in individual shares.
- Compare the risk and return of these two shares with a Portfolio of these shares in equal proportions.
- Find out the proportion of each of the above shares to formulate a minimum risk portfolio.

Answer:

WN 1: Computation of risk and return of individual securities:

Prob	Security ABC				Security XYZ				$Pd_{abc}d_{xyz}$
	Return	Product	Deviation	Pd^2	Return	Product	Deviation	Pd^2	
0.2	-5	-1	-13.5	36.45	15	3	2.5	1.25	-6.75
0.5	10	5	1.5	1.125	25	12.5	12.5	78.125	9.375
0.3	15	4.5	6.5	12.675	-10	-3	-22.5	151.875	-43.875
Total		8.5		50.25		12.5		231.25	-41.25

Return of ABC	=	8.50%
Risk of ABC	$\sqrt{50.26}$	7.09%
Return of XYZ	=	12.50%
Risk of XYZ	$\sqrt{231.26}$	15.21%

Comments:

- Security XYZ provides higher return than ABC. However, the same is offset by higher risk

WN 2: Computation of Portfolio return and Portfolio Risk:

Portfolio return	=	$(0.5 \times 8.50) + (0.5 \times 12.50) = 10.50\%$
Portfolio Variance	=	$(\sigma_a W_a)^2 + (\sigma_x W_x)^2 + 2W_a W_x COV_{ax}$
Portfolio Variance	=	$0.50 \times 0.50 \times 50.25 + 0.50 \times 0.50 \times 231.25 + 2(0.5)(0.5)(-41.25)$
Portfolio Variance	=	$12.563 + 57.813 - 20.625 = 49.75\%$
Portfolio SD	=	$\sqrt{49.75} = 7.05\%$

	Return	Risk	Return to Risk Ratio	Ranking
ABC Limited	8.50%	7.09%	1.20	2
Y Limited	12.50%	15.21%	0.82	3
Portfolio	10.50%	7.05%	1.48	1

Note: ICAI has answered this on basis of return to risk ratio. Alternatively, we can even compute risk to return ratio (Coefficient of variation)

WN 3: Computation of weights for minimum risk portfolio:

Weight of security 1	=	$\frac{\text{Variance of Security 2} - \text{Covariance of 1 \& 2}}{\text{Variance of Security 1} + \text{Variance of Security 2} - 2\text{Covariance of 1 \& 2}}$
Weight of security 1	=	$\frac{231.25 + 41.25}{50.25 + 231.25 + 2(41.25)} = \frac{272.50}{364} = 0.75$
Weight of security 2	=	$\frac{\text{Variance of Security 1} - \text{Covariance of 1 \& 2}}{\text{Variance of Security 1} + \text{Variance of Security 2} - 2\text{Covariance of 1 \& 2}}$
Weight of security 2	=	$\frac{50.25 + 41.25}{50.25 + 231.25 + 2(41.25)} = \frac{91.50}{364} = 0.25$

Optimum weights for risk reduction:

- Weight of ABC = 0.75 or 75%
- Weight of XYZ = 0.25 or 25%

47. Minimum variance portfolio [May 2009, May 2023, May 2024 MTP, SM]

The Portfolios have three securities each with following weights:

	WA	WB	WC
Portfolio X	0.30	0.40	0.30
Portfolio Y	0.20	0.50	0.30

What would be the weight for each stock for a portfolio constructed by investing Rs.5,000 in portfolio X and Rs.3000 in portfolio Y?

- a) Suppose the investor invests Rs.4,000 out of Rs.8,000 in security A. How he will allocate the balance between Security B and Security C?

Answer:**WN 1: Computation of weight of A, B and C:**

Particulars	Security A	Security B	Security C
Investment in Portfolio X [5,000]	1,500	2,000	1,500

Investment in Portfolio Y [3,000]	600	1,500	900
Total investment [8,000]	2,100	3,500	2,400
Weight of investment [Investment/8,000]	0.2625	0.4375	0.3000

WN 2: Computation of investment to be made in Security B and Security C:**Critical line between Security A and Security B:**

- Weight of Security A = a + b (Weight of Security B)
- $0.30 = a + 0.40b$ Equation 1
- $0.20 = a + 0.50b$ Equation 2
- Equation 2 – Equation 1: $-0.10 = 0.10b$; **b = -1**
- Substituting b in equation 1: $0.30 = a + 0.40(-1)$; **a = 0.70**
- **Weight of Security A = 0.70 - 1(Weight of Security B)**

Finding optimum weights:

Weight of security A	=	$\frac{4,000}{8,000} = 0.50$ Times
Weight of Security B	=	$0.50 = 0.70 - \text{Weight of Security B}$ Weight of Security B = 0.20 Times
Weight of Security C	=	$1 - 0.50 - 0.20 = 0.30$ Times

48. Building portfolio [May 2010, May 2016 MTP, SM]

Ramesh wants to invest in stock market and has provided the following information:

Security	Expected Return	Beta	σ^2_{ci}
A	15	1.5	40
B	12	2	20
C	10	2.5	30
D	09	1	10
E	08	1.2	20
F	14	1.5	30

Market index variance is 10 percent and the risk free rate of return is 7%. What should be the optimum portfolio assuming no short sales?

Answer:**Author's Note:**

- This is an area which is different from normal questions and students normally find it difficult to remember steps. I would advise students to revise this day before exam so that they can answer in exams if it is tested

WN 1: Computation of Treynor Ratio for all securities (Step 1)

Security	Expected Return	Beta	σ^2_{ci}	Excess return [Expected – Risk free]	Excess return Beta	Rank
A	15	1.5	40	8	5.33	1
B	12	2	20	5	2.50	3
C	10	2.5	30	3	1.20	5
D	9	1	10	2	2.00	4
E	8	1.2	20	1	0.83	6
F	14	1.5	30	7	4.67	2

$$\text{Treynor ratio} = \frac{\text{Excess return}}{\text{Beta}}$$

WN 2: Arranging the securities in the order of Treynor Ratio and computation of cumulative values

Security	Beta	σ^2_{ci}	Treynor Ratio (TR)	Sys Risk ($B^2 \times \sigma^2_m$)	$\frac{SR}{USR}$	TR x $\frac{SR}{USR}$	Cum Values (A)	Cum $\frac{SR}{USR}$	1 + Cum $\frac{SR}{USR}$ (B)	Cut-off (A/B)
A	1.5	40	5.33	22.50	0.5625	3.00	3.00	0.56	1.56	1.923

F	1.5	30	4.67	22.50	0.7500	3.50	6.50	1.31	2.31	2.814
B	2	20	2.50	40.00	2.00	5.00	11.50	3.31	4.31	2.668
D	1	10	2.00	10.00	1.00	2.00	13.50	4.31	5.31	2.542
C	2.5	30	1.20	62.50	2.0833	2.50	16.00	6.39	7.39	2.165
E	1.2	20	0.83	14.400	0.72	0.60	16.60	7.11	8.11	2.047

WN 3: Computation of Z-value and proportion of investment:

- Maximum cut-off point is 2.811 and hence securities till F (A and F) will form part of final portfolio.

Z-value computation:

$$Z - \text{value} = \left(\frac{\text{Beta}}{\sigma^2_{ci}} \right) \times (\text{Treynor ratio} - \text{Maximum cutoff point})$$

$$Z - \text{value for Security A} = \left(\frac{1.5}{40} \right) \times (5.33 - 2.811) = 0.0945$$

$$Z - \text{value for Security F} = \left(\frac{1.5}{30} \right) \times (4.67 - 2.811) = 0.0930$$

Proportion of investment:

Security	Z-value	Proportion of investment
A	0.0945	$\frac{0.0945}{0.1875} \times 100 = 50.40\%$
F	0.0930	$\frac{0.0930}{0.1875} \times 100 = 49.60\%$
Total	0.1875	

- We should invest 50.40% of investment in Security A and 49.60% investment in Security F for us to have the lowest risk

Part VII – Beta and Leverages**49. Beta calculation [May 2015 RTP, Nov 2021 MTP, Nov 2022 MTP, SM]**

The total market value of the equity share of O.R.E. company is Rs.60,00,000 and the total value of the debt is Rs.40,00,000. The treasurer estimate that the beta of the stock is currently 1.5 and the expected risk premium on the market is 10 percent. The treasury bill rate is 8 percent.

Required:

- ❖ What is the Beta of company's existing portfolio of assets?
- ❖ Estimate the company's cost of capital and the discount rate to be used for expansion of the company's present business?
- ❖ What discount rate to be used for diversification into new business?

Answer:

- Beta of Assets side will be equal to Beta of liabilities side

Source	Beta	Weight	Product
Equity	1.50	60,00,000	90,00,000
Debt	0.00	40,00,000	0
Overall	0.90	1,00,00,000	90,00,000

- Beta of company's existing assets = 0.90 Times
- Cost of capital = $R_f + \text{Beta} \times (R_m - R_f) = 8 + 0.90 \times 10 = 17\%$
- Expansion:** The company should use discount rate of 17% for expansion
- Diversification:** However, in case of diversification into new business the risk profile of new business is likely to be different. Therefore, different discount factor has to be worked out for such business

50. Proxy Beta

ABC Limited is considering a shipping project for which it proposes to employ a debt-equity ratio of 2:1. The tax rate is 30 percent.

There are three firms, A, B and C engaged wholly in shipping. Their tax rate is 35 percent. Their equity betas and debt-equity ratios are as follows:

	Equity Beta	Debt-equity ratio
A	1.40	2.0
B	1.20	1.8

C	1.1	1.5

The risk-free rate is 8 percent and the expected return on the market portfolio is 14 percent. What is the average asset beta of the three firms A, B and C? Compute cost of equity of ABC Limited?

Answer:

WN 1: Computation of Asset Beta:

Firm A:

Source	Beta	Weight	Product
Equity	1.40	1	1.40
Debt	0	1.3	0
Overall	0.6087	2.3	1.40

- Weight for debt = $2 \times (1 - 0.35) = 1.30$ Times
- Overall beta = Sum of product/Sum of weights
- Overall Beta = $1.40/2.30 = 0.6087$ Times

Firm B:

Source	Beta	Weight	Product
Equity	1.20	1	1.20
Debt	0	1.17	0
Overall	0.5530	2.17	1.20

Firm C:

Source	Beta	Weight	Product
Equity	1.10	1	1.10
Debt	0	0.975	0
Overall	0.5570	1.975	1.10

$$\text{Average of Asset Beta} = \frac{0.6097 + 0.5530 + 0.5570}{3} = 0.5729 \text{ Times}$$

WN 2: Computation of equity Beta of ABC Limited:

Let us assume equity beta of ABC Limited to be A

Source	Beta	Weight	Product
Equity	A	1	A
Debt	0	1.40	0
Overall	0.5729	2.40	1.375 [0.5729 x 2.40]

- $A + 0 = 1.375$
- Equity Beta = 1.375 Times
- Cost of equity = $8 + 1.375 \times (14 - 8) = 8 + 8.25 = 16.25\%$

51. Computation of proxy Beta [Concept Revision]

Excellent Ltd. is a frozen food packaging company and is looking to diversify its activities into the electronics business. The project it is considering has a return of 18% and Excellent Ltd. is trying to decide whether the project should be accepted or not. To help it decide it is going to use the CAPM. Tax rate is 35%. Risk free rate of return is 10% and market return is 14%. The company has to find a proxy beta for the project and has the following information on three companies in the electronics business:

a) Superior Ltd.

Equity beta of 1.33. Financed by 50% debt and 50% equity.

b) Admirable Ltd.

Admirable Ltd. has an equity beta of 1.30, but it has just taken on a totally unrelated project, accounting for 20% of the company's value, that has an asset beta of 1.4. The company is financed by 40% and 60% equity.

c) Meritorious Ltd.

Equity beta of 1.05. Financed by 35% debt and 65% equity.

Answer:

WN 1: Computation of Beta of Superior Limited:

Security	Beta	Weight	Product
Equity	1.33	0.50	0.665
Debt	0.00	0.325	0

Firm	0.8061	0.825	0.665

WN 2: Computation of Beta of Admirable Limited:

Security	Beta	Weight	Product
Equity	1.30	0.60	0.78
Debt	0.00	0.26	0
Firm	0.9070	0.86	0.78

Analysis of asset side beta of Admirable Limited:

Project	Beta	Weight	Product
Related project	0.784	0.80	0.6270
Unrelated project	1.40	0.2	0.2800
Firm	0.9070	1	0.9070

- ❖ Overall Beta of assets side and liabilities side would remain same. Some part of asset beta is due to unrelated project and removing the effect of that we get related project beta as 0.784 times

WN 3: Computation of Beta of Meritorius:

Security	Beta	Weight	Product
Equity	1.05	0.65	0.6825
Debt	0.00	0.2275	0
Firm	0.778	0.8775	0.6825

WN 4: Computation of average beta for the project and required return:

- ❖ Average asset beta = $(0.8061 + 0.784 + 0.778) / 3 = 0.789$ times
- ❖ Required return of project = $R_f + \text{Beta} \times (R_m - R_f) = 10 + 0.789 \times (14 - 10) = 13.16\%$
- ❖ The project is giving a return of 18% and hence we should go ahead with the project

52. Beta calculation through Proxy [Nov 2017 RTP, Nov 2015 MTP] [Concept Revision]

ABC Limited manufactures Car Air Conditioners (ACs), Window ACs and Split ACs constituting 60%, 25% and 15% of total market value. The stand-alone standard deviation and coefficient of correlation with market return of Car AC and Window AC is as follows:

	Standard Deviation	Coefficient of Correlation
Car AC	0.30	0.6
Window AC	0.35	0.7

No data for stand-alone SD and Coefficient of Correlation of Split AC is available. However a company who derives its half value from Split AC and half from Window AC has a SD of 0.50 and Coefficient of correlation with market return is 0.85. Index has a return of 10% and has SD of 0.20. Further the risk-free rate of return is 4%.

You are required to determine:

- ❖ Beta of ABC Limited
- ❖ Cost of Equity of ABC Limited

Assuming that ABC Limited wants to raise debt of an amount equal to half of its market value then determine equity Beta, if yield of debt is 5%.

Answer:**WN 1: Computation of Beta of Car AC, Window AC and Proxy Company:**

Beta	=	$\frac{\sigma_s}{\sigma_m} \times \text{COR}_{sm}$
Beta of car AC	=	$\frac{0.30}{0.20} \times 0.60 = 0.90$ Times
Beta of window AC	=	$\frac{0.35}{0.20} \times 0.70 = 1.225$ Times
Beta of Proxy company	=	$\frac{0.50}{0.20} \times 0.85 = 2.125$ Times

WN 2: Computation of Beta of Split AC Business:

Let us assume Beta of Split AC business to be A

Source	Beta	Weight	Product
Split AC	A	0.50	0.50A

Window AC	1.225	0.50	0.6125
Overall	2.125	1.00	2.125

- $0.50A + 0.6125 = 2.125$
- $0.50A = 1.5125$
- $A = 1.5125/0.50 = 3.025$ Times
- **Beta of Split AC business = 3.025 Times**

WN 3: Computation of Beta of ABC Limited (Assets side):

Source	Beta	Weight	Product
Car AC	0.90	0.60	0.5400
Split AC	3.025	0.15	0.45375
Window AC	1.225	0.25	0.30625
Overall	1.30	1	1.30

- Beta of ABC Limited = 1.30 Times

WN 4: Computation of equity Beta of ABC Limited:

Let us assume equity beta of ABC Limited to be A

Source	Beta	Weight	Product
Equity	A	0.50	0.50A
Debt	0.1667	0.50	0.0833
Total	1.30	1.00	1.30

- $0.50A + 0.0833 = 1.30$
- $A = 1.2167/0.50 = 2.4333$
- **Equity Beta of ABC Limited = 2.4333 Times**

Note 1: Computation of Debt Beta:

$$\text{Return} = R_f + B \times (R_m - R_f)$$

$$5 = 4 + \text{Beta} \times (10 - 4)$$

$$1 = 6 \text{ Beta}$$

$$\text{Debt Beta} = \frac{1}{6} = 0.1667 \text{ Times}$$

WN 5: Computation of cost of equity:

$$\text{Cost of equity} = R_f + \text{Beta} \times (R_m - R_f)$$

$$\text{Cost of equity} = 4 + 2.4333 \times (10 - 4)$$

$$\text{Cost of equity} = 4 + 14.60 = 18.60\%$$

53. Computation of Beta [May 2020 MTP, Nov 2019, May 2021 RTP] [Homework]

Equity of KGF Limited (KGFL) is Rs.410 crores, its debt, is worth Rs.170 Crores. Printer Division segments value is attributable to 74%, which has an Asset Beta of 1.45, balance value is applied to spares and consumables Division, which has an Asset beta of 1.20. KGFL Debt beta is 0.24.

You are required to calculate:

- Equity beta
- Ascertain Equity Beta, if KGF Limited decides to change its Debt Equity position by raising further debt and buying back of equity to have its Debt Equity Ratio at 1.90. Assume that the present Debt Beta is 0.35 and any further funds raised by way of Debt will have a Beta of 0.40
- Whether the new Equity Beta justifies increase in the value of equity on account of leverage?

Answer:**WN 1: Computation of Asset Beta of KGF Limited**

Source	Beta	Weight	Product
Printer	1.45	0.74	1.073
Spares	1.20	0.26	0.312
Total	1.385	1.00	1.385

- Asset Beta of KGF Limited = 1.385 Times

WN 2: Computation of equity Beta of KGF Limited

Let us assume equity Beta of KGF Limited to be A

Source	Beta	Weight	Product
Equity	A	410	410A
Debt	0.24	170	40.80
Total	1.385	580	803.30

- $410A + 40.80 = 803.30$
- $410A = 762.50$
- **Equity Beta = 1.8596 Times (762.50/410)**

WN 3: Computation of equity Beta post buy-back:

Let us assume equity Beta to be A

Source	Beta	Weight	Product
Equity	A	200	200A
Old Debt	0.35	170	59.50
New Debt	0.40	210	84.00
Total	1.385	580	803.30

- $200A + 59.50 + 84.00 = 803.30$
- $200A = 659.80$
- **Equity Beta = 3.299 Times (659.80/200)**

Note: Computation of debt raised

- Total capital of company (existing) = $410 + 170 = 580$ Crores
- Target debt equity ratio = 1.90 Times
- Debt = 1.90 Equity
- Debt + Equity = 580; $1.90\text{Equity} + \text{Equity} = 580$; $2.90\text{Equity} = 580$; Equity = 200 Crores
- Debt = 380 crores
 - Old debt = 170 Crores
 - New debt = 210 Crores

Conclusion:

- Increase in equity Beta is justified due to higher leverage. Equity Beta has increased from 1.8596 Times to 3.299 Times

Part VIII - Portfolio Strategies**54. Constant ratio plan vs buy and hold strategy [Nov 2022, Nov 2021 MTP, SM]**

Mr. A is working with an MNC at Mumbai. She wants to invest in a fund which consist of equities only and the ending NAV's for the last 10 months are given below:

Month	Ending NAV	Month	Ending NAV
December 2015	40.00	May 2016	37.00
January 2016	25.00	June 2016	42.00
February 2016	36.00	July 2016	43.00
March 2016	32.00	August 2016	50.00
April 2016	38.00	September 2016	52.00

Assume Mr. A has invested a notional amount of Rs.2 lakhs equally in the equity fund and a conservative portfolio (of bonds) in the beginning of December 2015 and the total portfolio was being rebalanced each time the NAV of the fund increased or decreased by 15%. You are required to

- Determine the value of the portfolio for each level of NAV following the constant ratio plan.
- Compare the value of the portfolio with buy and hold policy and state whether there are any errors in the technique developed by Mr.A? If so briefly explain.

Answer:**Computation of value of portfolio for each level of NAV:**

Month	NAV	% change	Rebalance	Units	Equity	Bond	Total value
Dec	40.00	NA	NA	2,500.00	1,00,000	1,00,000	2,00,000
Jan before	25.00	-37.50	Yes	2,500.00	62,500	1,00,000	1,62,500
Jan after	25.00	-37.50	NA	3,250.00	81,250	81,250	1,62,500
Feb before	36.00	44.00	Yes	3,250.00	1,17,000	81,250	1,98,250

Feb after	36.00	44.00	NA	2,753.47	99,125	99,125	1,98,250
March	32.00	-11.11	No	2,753.47	88,111.11	99,125	1,87,236
Apr before	38.00	18.75	Yes	2,753.47	1,04,632	99,125	2,03,757
Apr after	38.00	18.75	NA	2,681.01	1,01,879	1,01,878	2,03,757
May	37.00	-2.63	No	2,681.01	99,198	1,01,878	2,01,076
June	42.00	13.51	No	2,681.01	1,12,603	1,01,878	2,14,481
July	43.00	2.38	No	2,681.01	1,15,284	1,01,878	2,17,162
Aug before	50.00	16.28	No	2,681.01	1,34,051	1,01,878	2,35,929
Aug after	50.00	16.28	NA	2,359.29	1,17,965	1,17,964	2,35,929
Sep	52.00	4.00	No	2,359.29	1,22,683	1,17,964	2,40,647

Explanation of different columns:

Column	Explanation
1	Month
2	NAV of the month
3	Change in NAV/Opening NAV
4	Rebalance will be yes if the change is more than 15%
5	Opening units + Purchase - Redemption as per action table
6	Value of equity = Units x NAV
7	Value of bond
8	Total value = Value of equity + Value of bond

Action in different months:

Month	Action
December	We will buy 2,500 units of MF to start with 50:50 mix
January	- NAV has changed by 37.50 percent and hence we should opt for rebalancing. The value of portfolio before re-balancing is Rs.1,62,500. Post re-balancing value of equity and bond will become Rs.81,250 - Number of units = $(81,250/25.00) = 3,250$ - We should buy 750 units to make the number of units as 3,250
February	- NAV has changed by 44 percent and hence we should opt for rebalancing. The value of portfolio before re-balancing is Rs.1,98,250. Post re-balancing value of equity and bond will become Rs.99,125 - Number of units = $(99,125/36.00) = 2,753.47$ - We should sell 496.53 units to make the number of units as 2,753.47
March	NAV has changed by 11.11 percent and hence there is no need for rebalancing
April	- NAV has changed by 18.75 percent and hence we should opt for rebalancing. The value of portfolio before re-balancing is Rs.2,03,757. Post re-balancing value of equity and bond will become Rs.1,01,878 - Number of units = $(1,01,878/38.00) = 2,681.01$ - We should sell 72.46 units to make the number of units as 2,681.01
May	NAV has changed by 2.63 percent and hence there is no need for rebalancing
June	NAV has changed by 13.51 percent and hence there is no need for rebalancing
July	NAV has changed by 2.38 percent and hence there is no need for rebalancing
August	- NAV has changed by 16.28 percent and hence we should opt for rebalancing. The value of portfolio before re-balancing is Rs.2,35,929. Post re-balancing value of equity and bond will become Rs.1,17,965 - Number of units = $(1,17,965/50.00) = 2,359.29$ - We should sell 321.72 units to make the number of units as 2,359.29
September	NAV has changed by 4.00 percent and hence there is no need for rebalancing

Part two:

- Value under buy and hold policy = $[1,00,000 + [1,00,000 \times 52/40]] = \text{Rs.}2,30,000$
- Value of portfolio as per technique is higher than Buy & Hold Strategy

- Even if the value under the strategy was lesser then also there is no error. This is because if the market has been bearish then the value would be lesser than Buy & Hold Strategy

55. Portfolio re-balancing [May 2019 RTP, May 2012, Nov 2023 RTP, May 2023 MTP, Nov 2024 RTP]
[Concept Revision]

Indira has a fund of Rs.3 lacs which she wants to invest in share market with rebalancing target after every 10 days to start with for a period of one month from now. She has 3 close friends who have advised following different strategies: (i) Buy and Hold strategy (ii) Constant Ratio (iii) CPPI

Suppose she immediately starts with investment in Bonds (non-fluctuating) and Equity and decides to rebalance her portfolio after each 10 days and to invest in Nifty as equity component changes in tandem with that of Nifty. Further, Bond has no Beta

As on date (i.e. beginning of month) Nifty is 5326 and minimum Nifty within a month can be most be 4793.40. If she chooses CPPI she will use "2" as the multiplier. If she chooses Constant Ratio plan she will maintain the ratio of 60:40 in Equity and Bonds respectively. Further, portfolio will be rebalanced each time Nifty is changed by 5% as compared to the previous Nifty.

You are required to evaluate Portfolio Position of Indira under each of the Strategies suggested by her friends and highlight the course of action to be taken if in the coming month after a gap of 10 days Nifty happened: (1) 10 days later-being the 1st day of rebalancing if NIFTY falls to 5122.96. (2) 10 days further from the above date if the NIFTY touches 5539.04.

Answer:

CPPI:

Note 1: Computation of investment in equity on day 0

Particulars	Calculation	Amount
Maximum decline in NIFTY	$\frac{5,326 - 4,793.40}{5,326}$	10%
Floor value	$3,00,00 - 10\%$	2,70,000
Investment in equity	$2 \times [3,00,000 - 2,70,000]$	60,000

Note 2: Rebalancing of portfolio:

Particulars	Equity	Bond	Total
Day 0	60,000	2,40,000	3,00,000
Day 10:			
Before rebalancing	57,713	2,40,000	2,97,713
Day 20:			
Before rebalancing	62,400	2,40,000	3,02,400
After rebalancing	64,800	2,37,600	3,02,400

- Investor should purchase 2,400 of equity by selling bonds

Note:

Day 10:

$$\text{Value of equity on day 10} = 60,000 \times \frac{5,122.96}{5,326} = 57,713$$

$$\% \text{ fall in Nifty} = \frac{5,326 - 5,122.96}{5,122.96} = 3.81\%$$

- Fall is less than 5% and hence rebalancing is not required

Day 20:

$$\text{Value of equity on day 20} = 57,713 \times \frac{5,539.04}{5,122.96} = 62,400$$

$$\% \text{ change in Nifty} = \frac{5,539.04 - 5,122.96}{5,122.96} = 8.12\%$$

- Increase in nifty is more than 5% and hence rebalancing is required
- Value of portfolio will be Rs.3,02,400. We need to rebalance the same as per CPPI

- Investment in equity = $2 \times [3,02,400 - 2,70,000] = 64,800$

Buy and Hold Strategy:

- Investment in equity = $3,00,000 \times 10\% = \text{Rs.}30,000$

Particulars	Equity	Bond	Total
Day 0	30,000	2,70,000	3,00,000
Day 10	28,856 ($30,000 \times 5,122.96/5,326$)	2,70,000	2,98,856
Day 20	31,200 ($28,856 \times 5,539.04/5,122.96$)	2,70,000	3,01,200

Constant Ratio:

Particulars	Equity	Bond	Total
Day 0	1,80,000	1,20,000	3,00,000
Day 10	1,73,138 ($1,80,000 \times 5,122.96/5,326$)	1,20,000	2,93,138
Day 20			
Before	1,87,200 ($1,73,138 \times 5,539.04/5,122.96$)	1,20,000	3,07,200
After	1,84,320 [$3,07,200 \times 60\%$]	1,22,880 [$3,07,200 \times 40\%$]	3,07,200

- Investor should offload 2,880 of equity to Bonds

56. Rebalancing of portfolio [May 2018 MTP] [Homework]

Ms. Kiran had a surplus fund of Rs.2,00,000 on 31.03.2016. She is interested in constructing a portfolio of shares of the core sectors to be weighted equally in rupee value terms. Her friend Shaila based on research advised her to purchase following shares:

Company	No of shares	Price per share
O Limited	100	400
H Limited	1000	40
A Limited	320	125
R Limited	400	100
T Limited	200	200

On April 1, 2016, the prices of these stocks were as follows:

Company	Price per share
O Limited	300
H Limited	60
A Limited	120
R Limited	150
T Limited	125

You are required to exhibit how Kiran can rebalance her portfolio on 1.4.2016 so that here exposure to individual stock is maintained at original level in terms of rupee value

Answer:**WN 1: Rebalancing action:**

Company	Price per share	No of shares	Revised portfolio	Target value [2,13,400/5]	Target shares [Target value/Price]	Shares to be bought/sold
O Limited	300	100	30,000	42,680	142.27	Buy 42.27
H Limited	60	1000	60,000	42,680	711.33	Sell 288.67
A Limited	120	320	38,400	42,680	355.67	Buy 35.67
R Limited	150	400	60,000	42,680	284.53	Sell 115.47
T Limited	125	200	25,000	42,680	341.44	Buy 141.44
Total			2,13,400	2,13,400		

- Initially we had made equal investment of Rs.40,000 in all shares and hence plan is to make equal investment of Rs.42,680 on rebalancing date

Chapter 8 – Mutual Funds**Practical Problems****Overview:**

- Part I – MF Return
- Part II – Calculation of NAV
- Part III – Mutual Funds – Performance Evaluation

Part I – MF Return**1. Calculation of return [Nov 2003, May 2013 RTP, SM]**

Mr. A can earn a return of 16 percent by investing in equity shares on his own. Now he is considering a recently announced equity based mutual fund scheme in which initial expenses are 5.5 percent and annual recurring expense are 1.5 percent.

- ❖ How much should the fund earn to provide Mr. A return of 16 percent?
- ❖ Ascertain the target expense ratio in case the Mutual Fund earn 18%?
- ❖ Ascertain the initial expense ratio in case the MF can earn 19%?

Answer:**WN 1: Computation of MF return to earn individual return of 16 percent:**

$$\text{MF return} = \frac{\text{Own return}}{1 - \text{Initial expense ratio}} + \text{Annual expense ratio}$$

$$\text{MF return} = \frac{16\%}{1 - 0.055} + 1.5\% = 16.93\% + 1.5\% = 18.43\%$$

WN 2: Computation of target expense ratio if MF can earn 18%:

$$\text{MF return} = \frac{\text{Own return}}{1 - \text{Initial expense ratio}} + \text{Annual expense ratio}$$

$$18\% = \frac{16\%}{1 - 0.055} + \text{Annual expense ratio}$$

$$18\% = 16.93\% + \text{Annual expense ratio}$$

$$\text{Target Annual expense ratio} = 1.07\%$$

WN 3: Computation of initial expense ratio if MF can earn 19%:

$$\text{MF return} = \frac{\text{Own return}}{1 - \text{Initial expense ratio}} + \text{Annual expense ratio}$$

$$19\% = \frac{16\%}{1 - \text{Initial expense ratio}} + 1.5\%$$

$$17.5\% = \frac{16\%}{1 - \text{Initial expense ratio}}$$

$$1 - \text{Initial expense ratio} = \frac{16\%}{17.5\%} = 0.9143$$

$$\text{Initial expense ratio} = 1 - 0.9143 = 0.0857 \text{ (or) } 8.57\%$$

2. MF Return Versus Own Return [Nov 2019]:

Mr. Alex, a practicing Chartered Accountant, can earn a return of 15 percent by investing in equity shares on his own. He is considering a recently announced equity based mutual fund scheme in which initial expenses are 6 percent and annual recurring expenses are 2 percent.

(i) How much should the mutual fund earn to provide Mr. Alex a return of 15 percent per annum?

(ii) Mr. Alex's current Annual Professional Income is Rs. 40 Lakhs. His portfolio value is Rs. 50 Lakhs and now he is spending 10% of his time to manage his portfolio. If he spends this time on profession, his professional income will go up in same proportion. He is thinking to invest his entire portfolio into a Multicap Fund, assuming the fund's NAV will grow at 13% per annum (including dividend). You are requested to advise Mr. Alex, whether he can invest the portfolio into Multicap Funds ? If so, what is the net financial benefit?

Answer:**WN 1: Computation of MF return to earn individual return of 15 percent:**

$$\text{MF return} = \frac{\text{Own return}}{1 - \text{Initial expense ratio}} + \text{Annual expense ratio}$$

$$\text{MF return} = \frac{15\%}{1 - 0.06} + 2\% = 15.96\% + 2.0\% = 17.96\%$$

WN 2: Computation of net financial benefit of investing in Multicap Fund:

Particulars	Calculation	Amount
Benefits:		
Income from Mutual Fund	50,00,000 × 13%	6,50,000
Additional income due to usage of 10% time in profession	$\frac{40,00,000}{90\%} \times 10\%$	4,44,444
Total Benefits		10,94,444
Opportunity cost:		
Loss of 15 percent income due to shifting to MF	50,00,000 × 15%	7,50,000
Net financial benefit of investing in Multicap Fund	10,94,444 - 7,50,000	3,44,444

Note:

- ICAI solution to this question takes additional income due to usage of 10% time in profession as Rs.4,00,000 [40,00,000 × 10%]. However logical solution would be to take the same as Rs.4,44,444. This is because we have earned Rs.40,00,000 with 90% of time and hence extra 10% time would give additional income of Rs.4,44,444

3. Calculation of return [May 2010, May 2009, May 2014 MTP, Nov 2016 MTP, SM]

A mutual fund, that had a net asset value of Rs.20 at the beginning of the month, made income and capital gain distribution of Rs.0.0375 and Rs.0.03 per unit respectively during the month and then ended the month with a net asset value of Rs.20.06. Compute the monthly return?

Answer:

$$\text{Monthly return} = \frac{(\text{NAV}_1 - \text{NAV}_0) + D_1 + \text{CG}_1}{\text{NAV}_0} \times 100$$

$$\text{Monthly return} = \frac{(20.06 - 20) + 0.0375 + 0.03}{20} \times 100 = \mathbf{0.6375\% \text{ per month}}$$

4. Calculation of Return [May 2024, SM]

Mr. A, has invested in the Growrich Mutual Fund's Scheme. The details of the Mutual Fund Scheme are given below:

- Asset value at the beginning of the month = Rs.78.50
- Annualized Return = 16%
- Distribution in the form of CG and income = Rs.0.40 and Rs.0.30 per unit

You are required to:

- Calculate the month end Net Asset Value of the Growrich Mutual Fund Scheme (Round off to 2 decimals)
- Provide a brief comment on the month end NAV.

Answer:

$$\text{Return} = \frac{(\text{NAV}_1 - \text{NAV}_0) + D_1 + \text{CG}_1}{\text{NAV}_0} \times \frac{12}{m}$$

$$16\% = \frac{(\text{NAV}_1 - 78.50) + 0.40 + 0.30}{78.50} \times \frac{12}{1}$$

$$16\% \times 78.50 \times \frac{1}{12} = (\text{NAV}_1 - 78.50) + 0.70$$

$$1.05 = \text{NAV}_1 - 78.50 + 0.70; \mathbf{\text{NAV}_1 = 78.85}$$

- Month-end NAV = Rs.78.85
- Comment:** - Closing NAV is increased by Rs. 0.35 i.e. (Rs. 78.85 - Rs. 78.50). So, there is slight change in NAV.

5. Calculation of return [May 2011, Nov 2011, May 2018 MTP, May 2019 MTP, Nov 2018, May 2006, Nov 2018 MTP, May 2016 MTP, Nov 2014 MTP, Nov 2017 MTP, May 2016 RTP, Nov 2019 MTP, Nov 2023 MTP, Nov 2022 MTP, SM] [Concept Revision]

Mr. X, an investor purchased 300 units of ABC Mutual Fund at rate of Rs.12.25 per unit, one year ago. Over the year Mr.X received Rs.1.25 as dividend and had received a capital gains distribution of Rs.1.00 per unit. You are required to find out:

- Mr.X's holding period return assuming that this no load fund has a NAV of Rs.13.00 as on today
- Mr.X's holding period return, assuming all the dividends and capital gains distributions are reinvested into additional units as at average price of Rs.12.50 per unit.
- What difference would it make in terms of returns available and which option is preferable by the investors?

Answer:

WN 1: Computation of return with dividend payout option:

$$\text{Return} = \frac{(\text{NAV}_1 - \text{NAV}_0) + D_1 + \text{CG}_1}{\text{NAV}_0} \times 100$$

$$\text{Return} = \frac{(13.00 - 12.25) + 1.25 + 1.00}{12.25} \times 100 = 24.49\% \text{ per annum}$$

Note:

- Return can be computed using the above formula for a single unit. Return percentage would remain same irrespective of the number of units purchased by the investor

WN 2: Computation of return with dividend re-investment option:

Particulars	Calculation	Amount
Dividend per unit		2.25
No of opening units		300
Dividend in rupees	300 x 2.25	675
Re-investment NAV		12.50
Units received due to dividend reinvestment	$\frac{675}{12.50}$	54
Closing units	300 + 54	354
Closing NAV		13.00
Closing value	354 x 13	Rs.4,602

$$\text{Return} = \frac{\text{Closing value} - \text{Opening investment}}{\text{Opening investment}} \times 100$$

$$\text{Return} = \frac{4,602 - (300 \times 12.25)}{(300 \times 12.25)} \times 100 = \frac{927}{3,675} \times 100 = 25.22\%$$

From the above, it can be said that reinvestment option is better

6. Calculation of return [Nov 2015 MTP] [Homework]

The NAV of per unit of XYZ Mutual Fund (a Close Ended Funds) on 1.1.2014 was Rs. 28. The value on 31.12.2014 comes to Rs. 28.80. On the same date unit was trading in market at a premium of 3% though on 1.1.2014 same was trading at a discount at 5%. On 31.12.2014, XYZ distributed a sum of Rs. 2.80 as incomes and capital gains. You are required to compute rate of return to the investor during the year.

Answer:

$$\text{Return} = \frac{(\text{NAV}_1 - \text{NAV}_0) + D_1 + \text{CG}_1}{\text{NAV}_0} \times 100$$

$$\text{Return} = \frac{(29.664 - 26.60) + 2.80}{26.60} \times 100 = 22.05\%$$

Note:

- Closing NAV = 28.80 + 3% premium = Rs.29.664
- Opening NAV = 28.00 - 5% discount = Rs.26.60

7. Calculation of return [May 2018 RTP, Nov 2005, Nov 2008, Nov 2019, SM] [Concept Revision]

Sun Moon Mutual Fund sponsored open-ended equity oriented scheme "Chanakya Opportunity Fund". There were three plans viz. 'A' - Dividend Re-investment Plan, 'B' - Bonus Plan & 'C' - Growth Plan. At the time of initial public offer on 1.4.1999, Mr. Anand, Mr. Bacchan & Mrs. Charu, three investors invested Rs.1,00,000 each & chosen 'B', 'C' & 'A' Plan respectively. The history of the fund is as follows:

Date	Dividend %	Bonus Ratio	Net Asset Value per unit (FV of Rs.10)		
			Plan A	Plan B	Plan C

28.07.2003	20		30.70	31.40	33.42
31.03.2004	70	5:4	58.42	31.05	70.05
31.10.2007	40		42.18	25.02	56.15
15.03.2008	25		46.45	29.10	64.28
31.03.2008		1:3	42.18	20.05	60.12
24.03.2009	40	1:4	48.10	19.95	72.40
31.07.2009			53.75	22.98	82.07

On 31st July all three investors redeemed all balance units. Calculate annual rate of return to each of the investors.

Consider:

- ❖ Long-term capital gain is exempt from Income tax
- ❖ Short-term capital gain is subject to 10% Income tax
- ❖ Security Transaction Tax 0.2 percent only on sale/redemption of units
- ❖ Ignore education cess

Answer:

WN 1: Computation of return of Mr. Anand (Plan B):

Calculation of units on maturity:

Particulars	Opening Balance	Bonus Allotment	Closing units
Bonus on 31.03.2004	10,000	12,500	22,500
Bonus on 31.03.2008	22,500	7,500	30,000
Bonus on 24.03.2009	30,000	7,500	37,500

Calculation of Annual Return:

Particulars	Calculation	Amount
Value of units sold	(37,500 * 22.98)	8,61,750
Less: STT	(value of units sold * 0.2%)	1,724
Less: Cost of acquisition		1,00,000
Less: Tax on STCG	(7,500 * {(22.98 - 0)} x 10%)	17,235
Net returns from investment		7,42,791
Holding Period		124 months
Annual Return	$\left(\frac{7,42,791}{1,00,000} \right) \times \left(\frac{12}{124} \right) \times 100$	71.88%

Note:

- Cost of acquisition for bonus units has been taken as zero

WN 2: Computation of returns of Mr. Bachhan (Growth Plan):

Particulars	Calculation	Amount
Value of units sold	(10,000 * 82.07)	8,20,700
Less: STT	(value of units sold * 0.2%)	(1641)
Less: Cost of acquisition		(1,00,000)
Net returns from investment		7,19,059
Holding Period		124 months
Annual Return	$\left(\frac{7,19,059}{1,00,000} \right) \times \left(\frac{12}{124} \right) \times 100$	69.59%

WN 3: Computation of return of Mrs. Charu (Dividend Reinvestment Plan):

Calculation of units on maturity:

Date	Opening Balance	Amount of dividend	Units allotted	Closing Balance
01.04.1999	10,000.00	-	0	10000

28.07.2003	10,000.00	20,000	651.47	10651.47
31.03.2004	10,651.47	74,560	1,276.28	11927.75
31.10.2007	11,927.75	47,711	1,131.13	13058.88
15.03.2008	13,058.88	32,647	702.85	13761.73
24.03.2009	13,761.72	55,047	1,144.43	14906.16

Note:

- Amount of dividend = Opening balance x Dividend % x Face value (Rs.10)
- Units allotted = Amount of dividend/NAV on dividend date
- Closing balance = Opening balance + Units allotted

Computation of return:

Particulars	Calculation	Amount
Value of units sold	$(14,906.16 \times 53.75)$	8,01,206
Less: STT	$(8,01,206 \times 0.2\%)$	(1,602)
Less: Cost of acquisition		(1,00,000)
Less: Tax on STCG	$(1,144.43 \times 53.75 - 48.10) \times 10\%$	(647)
Net returns from investment		6,98,958
Holding Period		124 months
Annual Return	$\left(\frac{6,98,958}{1,00,000}\right) \times \left(\frac{12}{124}\right) \times 100$	67.64%

Author's Note:

- ICAI Solution has reduced STT while computing the taxable capital gain. However, the same is not correct as Securities Transaction Tax is not allowed as deduction.

8. MF Return [Nov 2010, May 2019, May 2024 MTP, SM] [Homework]

A mutual fund company introduces two schemes i.e. Dividend Plan (Plan-D) and Bonus Plan (Plan-B). The face value of the unit is Rs.10. On 1-4-2005 Mr.K invested Rs.2,00,000 each in Plan-D and Plan-B when the NAV was Rs.38.20 and Rs.35.60. Both the plans matured on 31-3-2010.

Particulars of dividend and bonus declared over the period are as follows:

Date	Dividend %	Bonus Ratio	NAV of Plan D	NAV of Plan B
30-09-2005	10		39.10	35.60
30-06-2006		1:5	41.15	36.25
31-03-2007	15		44.20	33.10
15-09-2008	13		45.05	37.25
30-10-2008		1:8	42.70	38.30
27-03-2009	16		44.80	39.10
11-04-2009		1:10	40.25	38.90
31-03-2010			40.40	39.70

What is the effective yield per annum in respect of the above two plans?

Note:

- Use following PV Factors: PVIF (2%,5) = 0.9057, PVIF (4%,5) = 0.8219, PVIF (8%,5) = 0.6806, PVIF (13%,5) = 0.5428
- Round off calculations upto 2 decimal points.

Answer:**WN 1: Computation of return of Plan-D:****Note 1: Computation of units on maturity:**

Date	Unit held	Dividend		Reinvestment rate	New units	Total units
		%	Amount			
01.04.2005	5235.60					5235.60
30.09.2005	5235.60	10	5235.6	39.1	133.90	5369.50
31.03.2007	5369.50	15	8054.25	44.2	182.22	5551.72
15.09.2008	5551.72	13	7217.24	45.05	160.20	5711.92

27.03.2009	5711.92	16	9139.07	44.8	204.00	5915.92

- Value of units on maturity = $5,915.92 \times 40.40 = \text{Rs.} 2,39,003.17$

Note 2: Computation of return:

$$\text{Approximate return} = \frac{2,39,003.17 - 2,00,000}{2,00,000} \times \frac{12}{60} \times 100 = 3.90\%$$

Year	Cash flow	PVF@2%	DCF	PVF@4%	DCF
0	-2,00,000	1	(2,00,000)	1	(2,00,000)
5	2,39,003.17	0.9057	2,16,465.17	0.8219	1,96,436.71
NPV			16,465.17		(3,563.29)

IRR	=	$L1 + \left(\frac{\text{NPV at L1}}{\text{NPV at L1} - \text{NPV at L2}} \right) \times (L2 - L1)$
IRR	=	$2 + \frac{14,465.17}{14,465.17 - (-3,563.29)} \times (4 - 2)$
IRR	=	$2 + 1.64$
IRR	=	3.64%

WN 2: Computation of return of Plan-B:**Note 1: Computation of units on maturity:**

Date	Unit held	Bonus ratio	Bonus units	Total units
01.04.2005	5617.98			5617.98
30.06.2006	5617.98	1:5	1123.60	6741.58
30.10.2008	6741.58	1:8	842.70	7584.28
11.04.2009	7584.28	1:10	758.43	8342.71

- Value of units on maturity = $8,342.71 \times 39.70 = \text{Rs.} 3,31,205.59$

Note 2: Computation of return:**Approximate Return:**

$$\text{Approximate return} = \frac{3,31,205.59 - 2,00,000}{2,00,000} \times \frac{12}{60} \times 100 = 13.12\%$$

Year	Cash flow	PVF@8%	DCF	PVF@13%	DCF
0	-2,00,000	1	-2,00,000	1	-2,00,000
5	3,31,205.59	0.6806	2,25,418.52	0.5428	1,79,778.39
NPV			25,418.52		(20,221.61)

IRR	=	$L1 + \left(\frac{\text{NPV at L1}}{\text{NPV at L1} - \text{NPV at L2}} \right) \times (L2 - L1)$
IRR	=	$8 + \frac{25,418.52}{25,418.52 - (-20,221.61)} \times (13 - 8)$
IRR	=	$8 + 2.78$
IRR	=	10.78%

9. Reverse-working: [Nov 2020, May 2023 RTP, May 2023, Nov 2023 MTP, Nov 2022 MTP] [Concept Revision]

M/S. Corpus an AMC, on 1.04.2015 has floated two schemes viz. Dividend Plan and Bonus Plan. Mr. X, an investor has invested in both the schemes. The following details (except the issue price) are available

Date	Dividend (%)	Bonus ratio	NAV	
			Dividend Plan	Bonus Plan
1.04.2015			?	?
31.12.2016		1:4 (One unit on 4 units held)	47	40
31.03.2017	12		48	42

31.03.2018	10		50	39
31.12.2018		1:5 (one unit on 5 units held)	46	43
31.03.2019	15		45	42
31.03.2020	-	-	49	44

Additional details:

Investment	9,20,000	10,00,000
Average profit	27,748.60	
Average yield (%)		6.40

You are required to calculate the issue price of both the schemes as on 1.04.2015.

Answer:**WN 1: Analysis of Dividend plan:**

- It is assumed that the given plan is dividend reinvestment plan

Note 1: Computation of maturity value and maturity units:

Particulars	Calculation	Amount
Average profit (assumed annual profit)		27,748.60
Investment period		5 years
Total profit	27,748.60 x 5	1,38,743
Investment made		9,20,000
Maturity value	9,20,000 + 1,38,743	10,58,743
NAV on 31.03.2020		49
Units on maturity		21,607

Note 2: Analysis of dividend as on 31.03.2019:

Particulars	Calculation	Amount
Units before re-investment	Assumed	A
Dividend in rupees	Face value assumed as 10 $A \times 10 \times 15\%$	1.5A
Dividend in units		$\frac{1.5A}{45}$
Closing units		$A + \frac{1.5A}{45} = 21,607$

$$A + \frac{1.5A}{45} = 21,607$$

$$46.5A = 21,607 \times 45$$

$$A = \frac{21,607 \times 45}{46.5} = 20,910 \text{ units}$$

- Hence, we can find that no of units before re-investment on 31.03.2019 is 20,910 units

Note 3: Analysis of dividend as on 31.03.2018

Particulars	Calculation	Amount
Units before re-investment	Assumed	A
Dividend in rupees	Face value assumed as 10 $A \times 10 \times 10\%$	1A
Dividend in units		$\frac{1A}{50}$
Closing units		$1A + \frac{1A}{50} = 20,910$

$$A + \frac{A}{50} = 20,910$$

$$51A = 20,910 \times 50$$

$$A = \frac{20,910 \times 50}{51.00} = 20,500 \text{ units}$$

- Hence, we can find that no of units before re-investment on 31.03.2018 is 20,500 units

Note 4: Analysis of dividend as on 31.03.2017

Particulars	Calculation	Amount

Units before re-investment	Assumed	A
Dividend in rupees	Face value assumed as 10 $A \times 10 \times 12\%$	1.2A
Dividend in units		$\frac{1.2A}{48}$
Closing units		$1A + \frac{1.2A}{48} = 20,500$

$$A + \frac{1.2A}{48} = 20,500$$

$$49.2A = 20,500 \times 48$$

$$A = \frac{20,500 \times 48}{49.2} = 20,000 \text{ units}$$

- Hence, we can find that no of units before re-investment on 31.03.2017 is 20,000 units

Calculation of entry price:

Particulars	Amount
Amount invested	9,20,000
No of units purchased	20,000
Issue price on entry date [9,20,000/20,000]	46.00

WN 2: Analysis of Bonus Plan:

Note 1: Computation of units on maturity:

Particulars	Calculation	Amount
Average yield		6.40%
Investment period		5 years
Total yield	$6.40\% \times 5$	32.00%
Investment made		10,00,000
Total profit	$10,00,000 \times 32\%$	3,20,000
Maturity value	$10,00,000 + 3,20,000$	13,20,000
NAV on 31.03.2020		44
Units on maturity		30,000

Note 2: Computation of units on entry date:

Analysis of bonus as on 31.12.2018:

Particulars	Calculation	Amount
Units before bonus	Assumed	A
Bonus units		0.2A
Closing units		$1.2A = 30,000$
Units before bonus issue	$\frac{30,000}{1.20}$	25,000 units

Analysis of bonus as on 31.12.2016:

Particulars	Calculation	Amount
Units before bonus	Assumed	A
Bonus units		0.25A
Closing units		$1.25A = 25,000$
Units before bonus issue	$\frac{25,000}{1.25}$	20,000 units

Computation of issue price:

Particulars	Amount
Amount invested	10,00,000
No of units purchased	20,000
Issue price on entry date [10,00,000/20,000]	50.00

10. MF charges [Nov 2019 RTP, May 2024 MTP, SM] [Concept Revision]

XYZ Plan, a hedge fund currently has assets of Rs. 40 crore. Mr. A, the manager of fund charges fee of 0.10% of portfolio asset. In addition to it he charges an incentive fee of 2%. The incentive will be linked to gross

return each year in excess of the portfolio maximum value since the inception of fund. The maximum value the fund achieved so far since inception of fund about one and half year ago was Rs. 42 crores. Evaluate:

- (i) Benchmark Return to make Mr. A eligible for incentive fee.
- (ii) The fee payable to Mr. A if return on the fund this year turns out to be :
 - a. 29%
 - b. 4.5%

Answer:

WN 1: Computation of Benchmark Return

$$\text{Benchmark Return} = \frac{42 - 40}{40} \times 100 = 5.00\%$$

WN 2: Calculation of fee payable if return is 29%

Particulars	Amount
Opening hedge fund	40.00 cr
Add: Return earned (40 cr x 29%)	11.60 cr
Closing value	51.60 cr
Return in excess of 42 Cr	9.60 cr
Variable incentive fee (2% x 9.6 Cr)	19,20,000
Fixed incentive fee (0.1% x 40 Cr)	4,00,000
Total incentive	23,20,000

WN 3: Calculation of fee payable if return is 4.5%

Particulars	Amount
Variable incentive fee	-
Fixed incentive fee (0.1% x 40 Cr)	4,00,000
Total incentive	4,00,000

11. Front-end load and back-end load [May 2018, SM]

The unit price of Equity Linked Savings Scheme (ELSS) of a mutual fund is Rs.10. The public offer price (POP) of the unit is Rs.10.204 and the redemption price is Rs.9.80.

Calculate:

- (i) Front-end Load
- (ii) Back-end Load

Answer:

Computation of front-end load:

$$\text{Public offer price} = \frac{\text{NAV}}{1 - \text{Front end Load}}$$

$$10.204 = \frac{10}{1 - \text{Front end Load}}; \text{Front end Load} = 0.0199 \text{ or } 2\%$$

Computation of Back-end Load:

$$\text{Redemption price} = \frac{\text{NAV}}{1 - \text{Back end Load}}$$

$$9.80 = \frac{10}{1 - \text{Back end Load}}; \text{Back end Load} = 0.0204 \text{ or } 2.04\%$$

Alternative answer:

$$\text{Front End load} = \frac{10.204 - 10.00}{10.00} = 0.0204 \text{ or } 2.04\%$$

$$\text{Back End load} = \frac{10.00 - 9.80}{10.00} = 0.02 \text{ or } 2.00\%$$

12. Computation of amount of investment [Nov 2018] [Homework]

During the year 2017 an investor invested in a mutual fund. The capital gain and dividend for the year was Rs. 3.00 per unit, which were re-invested at the year end NAV of Rs. 23.75. The investor had total units of 26,750 as at the end of the year. The NAV had appreciated by 18.75% during the year and there was an entry load of Rs. 0.05 at the time when the investment was made. The investor lost his records and wants to find out the amount of investment made and the entry load in the mutual fund.

Answer:

Opening NAV	$\frac{23.75}{118.75\%}$	Rs.20
No of units at beginning		X
Amount of dividend		3X
Dividend in units		$\frac{3X}{23.75}$
Closing units	Opening units + Dividend	26,750
Computation of opening units:	$X + \frac{3X}{23.75} = 26,750$ $\frac{23.75X + 3X}{23.75} = 26,750$ $\frac{26.75X}{23.75} = 26,750$ $X = \frac{26,750 \times 23.75}{26.75}$	23,750 units
Opening investment	$23,750 \times (20 + 0.05)$	Rs.4,76,187.50
Amount of entry load	$23,750 \times 0.05$	Rs.1,187.50

Part II – Calculation of NAV**13. NAV calculation [Nov 2019 RTP, May 2018, May 2012, May 2016 MTP, May 2018 MTP, Nov 2013 RTP, May 2021 MTP, Nov 2020, Nov 2018 MTP, May 2022 MTP, SM]**

On 1st April 2009, ABC MF has the following assets and prices at 4:00 PM

Shares	No of shares	Market Price Per share
A Limited	10000	19.70
B Limited	50000	482.60
C Limited	10000	264.40
D Limited	100000	674.90
E Limited	30000	25.90
No of units of fund		8,00,000

Calculate the following:

- NAV of the Fund
- Assuming Mr.X, send a cheque of Rs.50,00,000 to the fund and Fund manager purchases 18000 shares of C Limited and the balance is held in bank. Then what will be the position of the fund
- Calculate the New NAV if on 2nd April 2009 at 4:00 PM, the market price of share is as follows:
 - A Limited Rs.20.30
 - B Limited Rs.513.70
 - C Limited Rs.290.80
 - D Limited Rs.671.90
 - E Limited Rs.44.20

Answer:**WN 1: Computation of NAV of the Fund:**

Shares	No of shares	Market Price Per share	Market value of shares (in lacs)
A Limited	10,000	19.70	1.97
B Limited	50,000	482.60	241.30
C Limited	10,000	264.40	26.44
D Limited	1,00,000	674.90	674.90
E Limited	30,000	25.90	7.77
Total value of assets			952.38
No of units			8.00
NAV/unit (952.38/8.00)			119.0475

WN 2: Position of fund post purchase by Mr.X:

- Mr. X gives a cheque for Rs.50 lacs. It is assumed that the fund manager buys 18,000 shares of C Limited at closing price of Rs.264.40. This will involve investment of Rs.47,59,200 (18,000 x 264.40) and the balance Rs.2,40,800 (50,00,000 – 47,59,200) is held in the bank account
- Mr. X will get fresh units allotted at NAV of RS.119.0475 and he would get 42,000 units [50,00,000/119.0475]

Shares	No of shares	Market Price Per share	Market value of shares (in lacs)
A Limited	10,000	19.70	1.9700
B Limited	50,000	482.60	241.3000
C Limited	28,000	264.40	74.0320
D Limited	1,00,000	674.90	674.9000
E Limited	30,000	25.90	7.7700
Cash (50 lacs - value of C purchased)			2.4080
Total value of assets			1,002.3800
No of units (8 lacs + (50 lacs/119.05))			8.4200
NAV/unit			119.0475

WN 3: Computation of New NAV as on April 2, 2019:

Shares	No of shares	Market Price Per share	Market value of shares (in lacs)
A Limited	10,000	20.30	2.0300
B Limited	50,000	513.70	256.8500
C Limited	28,000	290.80	81.4240
D Limited	1,00,000	671.90	671.9000
E Limited	30,000	44.20	13.2600
Cash (50 lacs - value of C purchased)			2.4080
Total value of assets			1,027.8720
No of units (8 lacs + (50 lacs/119.05))			8.4200
NAV/unit			122.0751

14. Return calculation [Nov 2009, Nov 2004, May 2013, Nov 2012 RTP, July 2021, May 2023 MTP, May 2024, SM]

Mr. Sinha has invested in three mutual fund schemes as per details below:

Particulars	Scheme X	Scheme Y	Scheme Z
Date of investment	01.12.2010	01.01.2011	01.03.2011
Amount of investment	Rs.5,00,000	Rs.1,00,000	Rs.50,000
NAV at entry date	Rs.10.50	Rs.10.00	Rs.10.00
Dividend received upto 31.03.2011	Rs.9,500	Rs.1,500	Nil
NAV at 31.03.2011	Rs.10.40	Rs.10.10	Rs.9.80

You are required to calculate the effective yield on per annum basis in respect of each of the three schemes to Mr. Sinha upto 31.03.2011?

Provide a brief comment on the course of action he should take for future period

Answer:

Computation of effective yield:

Particulars	Scheme X	Scheme Y	Scheme Z
1. Amount invested	5,00,000	1,00,000	50,000
2. NAV at entry date	10.50	10.00	10.00
3. No of units purchased (1/2)	47,619.05	10,000.00	5,000.00
4. Closing NAV	10.40	10.10	9.80
5. Value as on 31.03.2011 (3 x 4)	4,95,238.12	1,01,000	49,000
6. Capital appreciation (5 - 1)	(4,761.88)	1,000	(1,000)

7. Dividend income	9,500	1,500	-
8. Return (in rupees) (6 + 7)	4,738.12	2,500.00	-1,000.00
9. Holding Period Return $(8/1) \times 100$	0.9476%	2.50%	-2.00%
10. No of days of investment	120	89	30
11. Annual Yield $(HPR \times 365/\text{No of days})$	2.88%	10.25%	(24.33%)

Note:

- Holding period return does not consider the time period of investment and it just calculates return as income earned/amount invested
- For Annualized yield, we need to consider the time period of investment and then calculate the return.
- Number of days = Last date (31st March 2011) - Date of investment. Normally units get allotted by end of day and hence date of investment is ignored in days computation
- Annualized yield can also be calculated by multiplying holding period return with 12/no. of months of investment. ICAI has calculated return with no. of days in this question

Comments:

Since the Effective Yield in Scheme Z is negative and that of Scheme X is much lower than Scheme Y, it is advised that Mr. K should redeem the investments in Scheme X and Scheme Z and the proceeds should be invested in Scheme Y in the next period

15. Effective yield - reverse working [May 2018, May 2022, Nov 2020 MTP, Nov 2023 SM] [Concept Revision]

Mr. Y has invested in the three mutual funds (MF) as per the following details:

Particulars	MF 'X'	MF 'Y'	MF 'Z'
Amount of investment	2,00,000	5,00,000	4,00,000
NAV at the time of purchase	10.00	25.00	20.00
Dividend Yield upto 31.03.2022	3%	5%	4%
NAV as on 31.03.2022	10.50	22.80	20.80
Annualized Yield as on 31.03.2022	9.733%	-11.185%	15%

Assume 1 Year = 365 days

Mr. Y has misplaced the documents of his investment. Help him in finding the date of his original investment after ascertaining the following:

- Number of units in each scheme
- Value of his investments as on 31.03.2022
- Holding period of his investments in number of days as on 31.03.2022
- Dates of original investments
- Total Return on investments,
- Assuming past performance of all three schemes will continue for next one year, what action the investor should take? What will be the expected return for the next one year after the above action?
- Will your answer as above point no. (vi) changes if the Mutual fund charges exit load of 5% if the investment is redeemed within one year? If so, advise the investor what and when the action to be taken to optimize the returns

Answer:**WN 1: Computation of number of units and value of investments as on 31.03.2022**

Particulars	Calculation	No of units	NAV as on 31.03.2022	Value as on 31.03.2022 [No of units x NAV]
MF 'X'	$\frac{2,00,000}{10.00}$	20,000.00	10.50	2,10,000
MF 'Y'	$\frac{5,00,000}{25.00}$	20,000.00	22.80	4,56,000
MF 'Z'	$\frac{4,00,000}{20.00}$	20,000.00	20.80	4,16,000
Total				10,82,000

WN 2: Calculation of Yield of each fund, total yield, period of holding and date of original investment:

Particulars	MF 'X'	MF 'Y'	MF 'Z'	Total
Initial investment	2,00,000	5,00,000	4,00,000	11,00,000

Capital gain	10,000	-44,000	16,000	-18,000
Dividends [Investment x Dividend Yield%]	6,000	25,000	16,000	47,000
Total return	16,000	-19,000	32,000	29,000
Holding period return (%) [Total return/investment] x 100	8.00	-3.80	8.00	2.64
Annual Yield	9.733	-11.185	15.00	
Period of holding (days)	$\left(\frac{8.00}{9.733}\right) \times 365$ = 300 Days	$\left(\frac{-3.80}{-11.185}\right) \times 365$ = 124 Days	$\left(\frac{8.00}{15.00}\right) \times 365$ = 195 Days	
Date of original investment	04.06.21	27.11.21	17.09.21	

Part (vi):

If past returns of all three schemes will continue for next one year, the investor should redeem the units of MFs 'X' and 'Y' and invest the proceeds in MF 'Z'. The expected return next will be 15%.

Part (vii):

If the Mutual funds are charging exit load of 5%, if investment is redeemed within one year, then investor should get redeemed units of MF 'Y' now and units of MF 'X' after 65 days.

**16. Missing NAV [Nov 2006, Nov 2013, May 2017 MTP, Nov 2015, May 2019 RTP, Nov 2023 RTP, SM]
[Concept Revision]**

On 01-07-2016, Mr. X Invested Rs.50,000/- at initial offer in Mutual Funds at a face value of Rs.10 each per unit. On 31-03-2017, a dividend was paid @ 10% and annualized yield was 120%. On 31-03-2018, 20% dividend and capital gain of Rs.0.60 per unit was given. Mr. X redeemed all his 6271.98 units when his annualized yield was 71.50% over the period of holding. Calculate NAV as on 31-03-2017, 31-03-2018 and 31-03-2019.

For calculations consider a year of 12 months

Answer:**WN 1: Computation of NAV as on 31.03.2008**

- The investor has earned an annualized yield of 120.00% for 1.7.2016 to 31.3.2017
- He has invested for a period of 9 months. The holding period return for 9 months is calculated below:

$$\text{Holding Period Return} = \text{Annual Return} \times \left(\frac{9}{12}\right)$$

$$\text{Holding Period Return} = 120.00\% \times \left(\frac{9}{12}\right) = 90\%$$

Particulars	Calculation	Amount
1. Amount of investment		50,000
2. Holding period return (in %)		90%
3. Holding period return (in Rs.)	50,000 x 90%	45,000
4. Value of investment as on 31.03.2017		95,000
5. No of units	$\frac{50,000}{10}$	5,000
6. NAV per unit before dividend payment	$\frac{95,000}{5,000}$	19.00
7. Less: Dividend	10 x 10%	1.00
8. NAV per unit post dividend payment	19.00 - 1.00	18.00

WN 2: Calculation of NAV as on 31.03.2018:

Particulars	Calculation	Amount
1. Dividend paid on 31.03.2017	5,000 x 1	5,000
2. Units allotted	$\left(\frac{5,000}{18.00}\right)$	277.78
3. Total units post dividend re-investment		5,277.78
4. Dividend as on 31.03.2018	5,277.78 x 20% x 10 + 5,277.78 x 0.60	13,722.23
5. Units allotted as on 31.3.2018 (Note 1)	6,271.98 - 5,277.78	994.20

6. NAV/unit as on 31.3.2018	$\left(\frac{13,722.23}{994.20}\right)$	13.80

Note 1:

- The investor has redeemed 6,271.98 units as on 31.03.2019. However, he had 5,277.78 units as on 31.03.2017. Hence extra units would have been allotted on 31.3.2018 due to dividend re-investment

WN 3: Computation of NAV as on 31.03.2019:

- Mr. X has earned an annualized yield of 71.50%. He has invested from 1.7.2016 to 31.3.2019 and the investment period is 33 months
- Holding period return for 33 months is calculated below:

$$\text{Holding Period Return} = \text{Annual Return} \times \left(\frac{9}{12}\right)$$

$$\text{Holding Period Return} = 71.50\% \times \left(\frac{33}{12}\right) = 196.625\%$$

Particulars	Calculation	Amount
1. Amount of investment		50,000
2. Holding period return (in %)		196.625%
3. Holding period return (in Rs.)	50,000 x 196.625%	98,312.50
4. Value of investment as on 31.03.2019		1,48,312.50
5. No of units		6,271.98
6. NAV as on 31.03.2019	$\frac{1,48,312.50}{6,271.98}$	23.65

17. Calculation of NAV [Nov 2009, May 2014 MTP, May 2015 MTP, May 2017 RTP, May 2022, Nov 2023 MTP, SM]

A mutual fund made and issue of 10,00,000 units of Rs.10 each on January 01, 2021. No entry load was charged. It made the following investments:

Particulars	Amount
25,000 equity shares of Rs.100 each @ 320	80,00,000
5% Government securities	4,00,000
10% Debentures (unlisted)	5,00,000
8% Debentures (Listed)	10,00,000

During the year, dividends of Rs.8,00,000 were received on equity shares. Interest on all types of debt securities was received as and when due. On 31st December 2021 equity shares were appreciated by 15% while listed debentures were quoted at 20% premium. XYZ Ltd., on 15th December 2021 in its AGM declared the interim dividend of 10% and bonus shares at 1:10 with the record date of 28th December 2021.

- Find out the NAV per unit as on 31st December given that the operating expenses paid during the year amounting to Rs. 3,00,000.
- Find out the NAV, if the MF had distributed a dividend of, Rs. 0.50 per unit during the year to the investors.
- If you are the investor, find out what is the annualised return you have got.

Answer:**WN 1: Calculation of cash balance as on December 31, 2008:**

Particulars	Calculation	Amount (in lacs)
1. Inflow from unit holders	10,00,000 x 10	100.00
2. Purchase of investments		(99.00)
3. Dividends received		8.00
4. Interest on 5% security	4 lacs x 5%	0.20
5. Interest on 10% debt	5 lacs x 10%	0.50
6. Interest on 8% debt	10 lacs x 8%	0.80
7. Interim dividend	25,000 x 10	2.50
8. Operating expenses		(3.00)
9. Closing cash balance		10.00

Note: Interim dividend will be received only on original shares as the bonus shares are allotted post dividend declaration.

WN 2: Computation of NAV as on 31.12.2008:

Particulars	Calculation	Amount (in lacs)
Assets:		
Equity shares	$27,500 \times 320 \times 115\%$	101.20
5% Securities		4.00
10% debentures		5.00
8% debentures	$10.00 \times 120\%$	12.00
Cash balance		10.00
Total Assets (A)		132.20
Liabilities (B)		0
Net assets (A - B)		132.20
No of units		10
NAV/unit	$\left(\frac{132.20}{10}\right)$	11.551

- NAV/unit before declaration of dividend = Rs.13.22
- NAV/units after declaration of dividend = $13.22 - 0.50 = \text{Rs.}12.72$

WN 3: Annualized return:

$$\text{Return} = \frac{(\text{NAV}_1 - \text{NAV}_0) + D_1 + \text{CG}_1}{\text{NAV}_0} \times 100$$

$$\text{Return} = \frac{(12.72 - 10.00) + 0.50}{10.00} \times 100 = \mathbf{32.20\% \text{ per annum}}$$

18. Calculation of NAV [Nov 2018 RTP, May 2010, May 2014, Nov 2015 MTP, Nov 2018 MTP, Nov 2016 RTP, May 2022 MTP, SM] [Homework]**ICAI Question:**

Based on the following data, estimate the Net Asset Value (NAV) on per unit basis of a Regular Income Scheme of a mutual fund on 31.03.2016

Particulars	Amount (in lakhs)
Listed equity shares at cost (ex-dividend)	20.00
Cash in hand	1.23
Bonds & debentures at cost	4.30
Of these, Bonds not listed and not quoted	1.00
Other fixed interest securities at cost	4.50
Dividend accrued	0.80
Amount payable on shares	6.32
Expenditure accrued	0.75

Current realizable value of fixed income securities of face value Rs.100 is Rs.106.50. Number of units (Rs.10 face value) = 2,00,000

All the listed equity shares were purchased at a time when the market portfolio index was 1,000. On the NAV date market portfolio index was 2,300. There has been a diminution of 20% in unlisted bonds and debentures valuation and Other fixed interest securities are valued at cost. Value of listed bonds on NAV date is Rs.8 lacs.

Modified Question:

"Current realizable value of fixed income securities of face value Rs.100 is Rs.106.50 should be removed from the question as it contradicts the line of other fixed securities are valued at cost"

Answer:**Computation of NAV:**

Particulars	Calculation	Amount
Assets:		
Listed equity shares	$20 \times \left(\frac{2,300}{1,000}\right)$	46.00
Cash in hand	Given	1.23
Listed bonds and debentures		8.00
Unlisted bonds and debentures	$1.00 - 20\%$	0.80

Other fixed interest securities	Cost	4.50
Accrued dividends (assumed to be receivable)		0.80
Total Assets (A)		61.33
Liabilities:		
Amount payable on shares		6.32
Expenditure accrued		0.75
Total Liabilities (B)		7.07
Net Assets (A - B)		54.26
No of units		2.00
NAV/unit	54.26 2.00	27.13

19. Calculation of NAV and repurchase price [Nov 2018 MTP, Nov 2015, Nov 2018 RTP, Jan 2021, May 2022 RTP, May 2019 MTP, May 2023 MTP, Nov 2024 MTP, SM] [Concept Revision]

On 1st April an open ended scheme of mutual fund had 300 Lakh units outstanding with Net Assets Value (NAV) of Rs.18.75. At the end of April, it issued 6 lakhs units at opening NAV plus 2% load adjusted for dividend equalization. At the end of May, 3 Lakh units were repurchased at opening NAV less 2 % exit load adjusted for dividend equalization. At the end of June, 70 % of its available income was disturbed. In respect of April-June quarter, the following additional information are available.

	Rs (In lakhs)
Portfolio value appreciation	425.47
Income of April	22.950
Income of May	34.425
Income for June	45.450

You are required to calculate

- Income available for distribution;
- Issue price at the end of April;
- Repurchase price at the end May; and
- Net asset value (NAV) as on 30th June.

Answer:

WN 1: Computation of income available for distribution:

Particulars	No of units (lacs)	Per unit	Amount (in lacs)
Income of April	300	0.0765 [22.95/300]	22.95
Add: Inflow from April MF buyers	6	0.0765	0.459
Total income till April	306	0.0765	23.409
Income of May	306	0.1125 [34.425/306]	34.425
Total income till May	306	0.189	57.834
Less: Redemption in May	3	0.189	0.567
Revised income till May	303	0.189	57.267
Income of June	303	0.15 [45.45/303]	45.45
Income available for distribution	303	0.339	102.717

Note:

- MF is earning income every month. In practice, NAV is calculated every day. However here we are not doing it.
- Hence NAV will get adjusted by dividend equalization. New unit holders will have to pay extra amount towards dividend equalization.
- In case of unit redemptions, unit holders will get extra amount as part of dividend equalization

WN 2: Computation of issue price for April:

- Issue price = (Opening NAV + 2%) + Dividend equalization of April
- Issue price = (18.75 + 2%) + 0.0765 = Rs. 19.2015

WN 3: Computation of Repurchase price at end of May:

- Repurchase price = (Opening NAV - 2%) + Divided equalization for April and May
- Repurchase price = $(18.75 - 2\%) + 0.1890 = \text{Rs.}18.564$

WN 4: Computation of NAV as on June 30:

Particulars	Calculation	Amount (in lacs)
Net assets on April 1	300×18.75	5,625.000
Add: Income of April	Given	22.950
Add: Inflow from unit buyers	6×19.2015	115.209
Add: Income of May	Given	34.425
Less: Payment to unit sellers	3×18.564	(55.692)
Add: Income of June	Given	45.450
Add: Portfolio appreciation	Given	425.470
Less: Dividends paid	$70\% \times 102.717$	(71.902)
Net Assets as on June 30		6,140.91
No of units		303
NAV per unit	$\left(\frac{6,140.91}{303} \right)$	20.2670

20. Calculation of NAV [May 2018 RTP, May 2013, May 2019 MTP, Nov 2014 RTP, May 2021 MTP, Nov 2022 RTP, May 2020 MTP, SM]

On 1-4-2012 ABC Mutual Fund issued 20 lakh units at Rs.10 per unit. Relevant initial expenses involved were Rs.12 lakhs. It invested the fund so raised in capital market instruments to build a portfolio of Rs.185 lakhs. During the month of April, 2012 it disposed of some of the instruments costing Rs.60 lakhs for Rs.63 lakhs and used the proceeds in purchasing securities for Rs.56 lakhs. Fund management expenses for the month of April, 2012 was Rs.8 lakhs of which 10% in arrears. In April, 2012 the fund earned dividends amounting to Rs.2 lakhs and it distributed 80% of the realized earnings. On 30-04-2012 the market value of the portfolio was Rs.198 lakhs. Mr.Akash, an investor, subscribed to 100 units on 1-4-2012 and disposed of the same at closing NAV on 30-04-2012. What was his annual rate of earning?

Answer:**WN 1: Computation of closing cash balance:**

Particulars	Calculation	Amount (in lacs)
Inflow from unit holders	$20 \text{ lacs} \times 10$	200
Less: Initial expenses		(12)
Less: Purchase of investments		(185)
Add: sale of shares		63
Less: Purchase of investments		(56)
Less: Fund management expenses		(7.2)
Add: Receipt of dividends		2
Less: Payment of dividends	Note 1	(4)
Closing cash balance		0.80

Note 1:

- The company has paid 80% of realized earnings as dividends. Realized earnings = Capital gain of Rs.3 lacs + Dividends of Rs.2 lacs. Dividends paid = $80\% \times 5 \text{ lacs} = \text{Rs.}4 \text{ lacs}$

WN 2: Computation of NAV:

Particulars	Calculation	Amount (in lacs)
Assets:		
Market value of portfolio		198
Cash balance	WN 1	0.80
Total Assets (A)		198.80
Less: Liabilities		(0.80)
Net Assets		198
No of units		20
NAV per unit	$198/20$	9.90

WN 3: Computation of annual rate of earning:

$$\text{Annual rate of earning} = \frac{(\text{NAV}_1 - \text{NAV}_0) + D_1 + \text{CG}_1}{\text{NAV}_0} \times \frac{12}{m} \times 100$$

$$\text{Annual rate of earning} = \frac{(9.90 - 10.00) + \left(\frac{4}{20}\right)}{10.00} \times \frac{12}{1} \times 100$$

$$\text{Annual rate of earning} = \frac{0.10}{10.00} \times \frac{12}{1} \times 100 = 12\% \text{ per annum}$$

21. NAV computation and expense ratio [May 2019, May 2021 RTP]

The following particulars relating to Vishnu Fund Schemes:

Particulars	Value in Crores
Investment in shares (at cost)	
Pharmaceutical companies	79
Construction industries	31
Service sector companies	56
IT Companies	34
Real Estate Companies	10
Investment in Bonds (Fixed Income)	
Listed Bonds (8000, 14% Bonds of Rs.15,000 each)	12
Unlisted Bonds	7
No of units outstanding (crores)	4.2
Expenses payable	3.5
Cash and Cash equivalents	1.5
Market expectations on listed Bonds	8.842%

Particulars relating to each sector are as follows:

Sector	Index on purchase date	Index on valuation date
Pharmaceutical companies	260	465
Construction Industries	210	450
Service sector companies	275	480
IT Companies	240	495
Real Estate Companies	255	410

The funds has incurred the following expenses:

- Consultancy and management fees Rs.480 lacs
- Office expenses Rs.150 lacs
- Advertisement expenses Rs.38 lacs

You are required to calculate the following:

- Net Asset Value of the fund
- Net Asset Value per unit
- If the period of consideration is 2 years, and the fund has distributed Rs.3 per unit per year as cash dividend, ascertain the net return (annualized)
- Ascertain the expense ratio

Answer:

WN 1: Computation of Net Asset value of the fund and Net Asset Value per unit:

Particulars	Calculation	Amount (in Cr)
Assets:		
Pharma Companies	$79 \times \left(\frac{465}{260}\right)$	141.2885
Construction	$31 \times \left(\frac{450}{210}\right)$	66.4286
Service sector	$56 \times \left(\frac{480}{275}\right)$	97.7455
IT Companies	$34 \times \left(\frac{495}{240}\right)$	70.1250
Real estate	$10 \times \left(\frac{410}{255}\right)$	16.0784
Listed bonds	$8,000 \times \left(\frac{15,000 \times 14\%}{8.842\%}\right)$	19.0002

Unlisted bonds		7.0000
Cash		1.5000
Total Assets (A)		419.1662
Less: Liabilities		
Expenses payable		(3.5000)
Net Asset Value of Fund		415.6662
No of units		4.2000
NAV per unit	415.6662 4.2000	98.9681

WN 2: Computation of Return:

$$\text{Annual rate of earning} = \frac{(\text{NAV}_1 - \text{NAV}_0) + D_1 + \text{CG}_1}{\text{NAV}_0} \times \frac{12}{m} \times 100$$

$$\text{Annual rate of earning} = \frac{(98.9681 - 54.5238) + 6}{54.5238} \times \frac{12}{24} \times 100$$

$$\text{Annual rate of earning} = \frac{50.4443}{54.5238} \times \frac{12}{24} \times 100 = 46.26\% \text{ per annum}$$

Note:**Computation of opening NAV:**

Particulars	Calculation	Amount (in Cr)
Assets:		
Pharma Companies		79.00
Construction		31.00
Service sector		56.00
IT Companies		34.00
Real estate		10.00
Listed bonds		12.00
Unlisted bonds		7.00
Cash		-
Total Assets (A)		229.00
Less: Liabilities		
Expenses payable		-
Net Asset Value of Fund		229.00
No of units		4.2000
NAV per unit	229.00 4.2000	54.5238

WN 3: Computation of expense ratio:

Particulars	Calculation	Amount
1. Expenses for two years (assumed) (in crores)	4.80 + 1.50 + 0.38	6.68
2. Expenses for one year (in crores)	$\frac{6.68}{2}$	3.34
3. No of units (in crores)		4.2
4. Annual expense per unit	$\frac{3.34}{4.2}$	0.7952
5. Annual expense ratio (on closing NAV)	$\frac{0.7952}{98.9681} \times 100$	0.80%
6. Annual expense ratio (on opening NAV)	$\frac{0.7952}{54.5238} \times 100$	1.46%
7. Annual expense ratio (on average NAV)	$\frac{0.7952}{76.7460} \times 100$	1.04%

Part III - Mutual Funds - Performance Evaluation

22. Sharpe & Treynor ratio [Nov 2018 RTP, May 2016, Nov 2018 RTP, May 2019 RTP, Nov 2022, Nov 2020 MTP, Nov 2022 MTP, SM]

The following are the data on five mutual funds

Fund	Return	Standard Deviation	Beta
A	15	7	1.25
B	18	10	0.75
C	14	5	1.40
D	12	6	0.98
E	16	9	1.50

You are required to compute reward to variability and reward to volatility ratio and rank the portfolio.

Assume risk free rate as 6%

Answer:

WN 1: Computation of reward to variability (Sharpe Ratio) and ranking:

$$\text{Sharpe Ratio} = \frac{\text{Return of security} - \text{Risk-free return}}{\text{SD of security}}$$

Fund	Return	Excess return (Return - Risk free)	SD	Reward to variability (Col 3/Col 4)	Rank
A	15	9	7	1.29	2
B	18	12	10	1.2	3
C	14	8	5	1.6	1
D	12	6	6	1	5
E	16	10	9	1.11	4

WN 2: Computation of reward to volatility (Treynor Ratio) and ranking:

$$\text{Treynor Ratio} = \frac{\text{Return of security} - \text{Risk-free return}}{\text{Beta of security}}$$

Fund	Return	Excess return (Return - Risk free)	Beta	Reward to Volatility (Col 3/Col 4)	Rank
A	15	9	1.25	7.2	2
B	18	12	0.75	16	1
C	14	8	1.4	5.71	5
D	12	6	0.98	6.12	4
E	16	10	1.5	6.67	3

23. Calculation of Expected NAV [May 2019 RTP, May 2018 MTP, May 2015, Nov 2021 MTP, May 2023 MTP, SM, May 2024 RTP]

There are two Mutual Funds, D Mutual Fund Limited and K Mutual Fund Limited, each having close ended equity schemes. NAV as on 31-12-2014 of equity schemes of D Mutual Fund Limited is Rs.70.71 (consisting 99% equity and remaining cash balance) and that of K Mutual Fund Limited is Rs.62.50 (consisting 96% equity and balance in cash).

Following is the other information:

Particulars	Equity Schemes	
	D Mutual Fund Limited	K Mutual Fund Limited
Sharpe Ratio	2	3.3
Treynor Ratio	15	15
Standard deviation	11.25	5
Risk-free return	7%	

There is no change in portfolios during the next month and annual average cost is Rs.3 per unit for the schemes of both the mutual funds.

Required:

- Tabulate the expected NAVs of both the schemes if share market goes down by 5% within a month.
- Advise which mutual fund should an investor choose from the perspective of risk per unit of return.

For calculation, consider 12 months in a year and ignore number of days for particular month.

Answer:

WN 1: Computation of Beta of D Mutual Fund and K Mutual Fund:

Particulars	D Mutual Fund	K Mutual Fund

1. Sharpe Ratio	2	3.3
2. Standard deviation	11.25	5
3. Excess return (Return – Risk free) [1 x 2]	22.50	16.50
4. Treynor Ratio	15	15
5. Beta (3/4)	1.50	1.10

- Beta of 1.50 times would mean that if market falls by 1%, mf will fall by 1.50%. In this question, the market has fallen by 5%
- Equity component of D Mutual Fund and K Mutual Fund will fall by 7.5% (5 x 1.5) & 5.5% (5 x 1.1) respectively

WN 2: Computation of NAV:

Particulars	D Mutual Fund	K Mutual Fund
1. <u>Opening NAV</u>	70.71	62.50
Represented by equity	70.00 [70.71 x 99%]	60.00 [62.50 x 96%]
Represented by cash	0.71 [70.71 x 1%]	2.50 [62.50 x 4%]
2. <u>Closing NAV</u>	65.21 [64.75 + 0.46]	58.95 [56.70 + 2.25]
Represented by equity	64.75 [70 - 7.5%]	56.70 [60 - 5.5%]
Represented by cash	0.46 [0.71 - 0.25]	2.25 [2.5 - 0.25]

- Equity component of NAV has been reduced by 7.5% and 5.5%
- Annual expense is Rs.3 per unit. Monthly expense will be Rs.0.25 per unit and hence cash component has been reduced by Rs.0.25 per unit

Computation to find out more beneficial mutual fund:

Particulars	D Mutual Fund	K Mutual Fund
1. Excess Return	22.50	16.50
2. Risk-free return	7.00	7.00
3. Actual Return of MF	29.50	23.50
4. Standard Deviation (Risk)	11.25	5.00
5. Risk per unit of return (4/5)	0.38	0.21

Since risk per unit return of D is more than K, hence investor shall choose K Mutual fund from the perspective of risk per unit of return.

24. Computation of Jensen's Alpha [May 2017, SM]

The five portfolios of a mutual fund experienced following result during last 10 years:

Portfolio	Average Annual Return %	Standard Deviation	Correlation with the market return
A	20.0	2.3	0.8869
B	17.0	1.8	0.6667
C	18.0	1.6	0.600
D	16.0	1.8	0.867
E	13.5	1.9	0.5437

- ❖ Market risk : 1.2
- ❖ Market rate of return : 14.3%
- ❖ Risk free rate : 10.1%

Beta may be calculated only upto two decimal. Rank the portfolio using JENSEN's ALPHA Method.

Answer:**WN 1: Computation of Beta:**

$$\text{Beta} = \frac{\text{Standard deviation of portfolio}}{\text{Standard deviation of market}} \times \text{Correlation coefficient}$$

Portfolio	Standard Deviation	Correlation with the market return	Beta
A	2.3	0.8869	1.70
B	1.8	0.6667	1.00

C	1.6	0.600	0.80
D	1.8	0.867	1.30
E	1.9	0.5437	0.86

WN 2: Computation of Jensen's Alpha:

Portfolio	Beta	Expected return Rf + beta x (Rm - Rf)	Actual Return	Jensen's Alpha	Rank
A	1.70	17.24	20.0	2.76	II
B	1.00	14.30	17.0	2.70	III
C	0.80	13.46	18.0	4.54	I
D	1.30	15.56	16.0	0.44	IV
E	0.86	13.71	13.5	-0.21	V

25. MF - Performance measures [May 2023] [Concept Revision]

Mr. Potential has made investments in two mutual funds. The following information is available:

Mutual Fund	Smart	Growth
Jensen Alpha	1.10%	1.50%
Treynor's Ratio	0.0714	0.0775
Actual Return	8.50%	9.10%
Risk Premium		4%

You are required to calculate: (i) Beta (β) for both the funds (ii) Risk free Rate (iii) Security Market Line

Answer:

WN 1: Computation of CAPM return:

Mutual Fund	Smart	Growth
Jensen Alpha	1.10%	1.50%
Actual Return	8.50%	9.10%
CAPM return	7.40%	7.60%

Note: CAPM return would be lower than actual return as the funds are generating positive Alpha

WN 2: Computation of Beta:

Smart:

$$\text{Treynor Ratio} = \frac{\text{Actual Return} - \text{Risk-free rate}}{\text{Beta}}$$

$$0.0714 = \frac{0.085 - R_f}{\text{Beta}}; 0.0714 \text{ Beta} = 0.085 - R_f \dots \dots \dots \text{Equation 1}$$

$$\text{CAPM Return} = R_f + \text{Beta} \times (R_m - R_f)$$

$$0.0740 = R_f + \text{Beta} \times (0.04) \dots \dots \dots \text{Equation 2}$$

Solving equation 1 and 2, we get;

- Beta = 0.35 and Risk-free rate = 6%

Growth:

$$\text{Treynor Ratio} = \frac{\text{Actual Return} - \text{Risk-free rate}}{\text{Beta}}$$

$$0.0775 = \frac{0.091 - 0.06}{\text{Beta}}; \text{Beta} = \frac{0.031}{0.0775} = 0.40 \text{ Times}$$

Solution:

- Beta of Smart Mutual Fund is 0.35 and Growth Mutual Fund is 0.40.
- Risk free Rate = 6%
- Security Market Line for Smart = $0.06 + 0.04\beta$
- Security Market Line for Growth = $0.06 + 0.04\beta$

26. MF - Performance Evaluation [Nov 2020, May 2023 MTP] [Homework]

The following are the details of three mutual funds of MFL:

	Growth Fund	Balanced Fund	Regular Fund	Market
Average return (%)	7	6	5	9
Variance	92.16	54.76	40.96	57.76
Co-efficient of determination	0.3025	0.6561	0.9604	

The yield on 182 days Treasury Bill is 9 per cent per annum.

You are required to:

- Rank the funds as per Sharpe's measure.
- Rank the funds as per Treynor's measure.
- Compare the performance with the market

Answer:

WN 1: Evaluation as per Sharpe Ratio:

$$\text{Sharpe Ratio} = \frac{\text{Return of security} - \text{Risk-free return}}{\text{SD of security}}$$

Fund	Return	Excess return (Return - Risk free)	Variance	SD	Sharpe Ratio	Rank
Growth	7.00	-2.00	92.16	9.60	-0.2083	1
Balanced	6.00	-3.00	54.76	7.40	-0.4054	2
Regular	5.00	-4.00	40.96	6.40	-0.6250	3
Market	9.00	0.00	57.76	7.60	-0.0000	NA

Note:

- Lower negative Sharpe ratio has been ranked 1 and so on. Alternatively, we need not do any ranking as the same is of not much use

WN 2: Computation of Beta of different funds:

Particulars	Growth	Balanced	Regular
Variance	92.16	54.76	40.96
Coefficient of determination (assumed to be r^2)	0.3025	0.6561	0.9604
Systematic risk [Variance x coefficient of determination]	27.8784	35.9280	39.3380
Variance of market	57.76	57.76	57.76
Beta ² $\frac{\text{[Systematic risk]}}{\text{[Variance of market]}}$	0.4827	0.6220	0.6811
Beta	0.6948	0.7887	0.8253

WN 3: Evaluation as per Treynor Ratio:

$$\text{Treynor Ratio} = \frac{\text{Return of security} - \text{Risk-free return}}{\text{Beta of security}}$$

Fund	Return	Excess return (Return - Risk free)	Beta	Treynor Ratio	Rank
Growth	7.00	-2.00	0.6948	-2.8785	1
Balanced	6.00	-3.00	0.7887	-3.8037	2
Regular	5.00	-4.00	0.8253	-4.8467	3
Market	9.00	0.00	1.0000	-0.0000	NA

WN 4: Comparison of performance with market:

- Market has Sharpe and Treynor ratio of 0 times. However, the ratio for other mutual funds is negative. Hence, we can conclude that funds have performed weaker than the market

Chapter 9 – Derivatives Analysis and Valuation**Practical Problems****Overview:**

- Part I – Valuation of Futures
- Part II – Hedging with Futures
- Part III – Maintenance Margin
- Part IV – Basics of Option
- Part V – Payoff table and Payoff graph
- Part VI – Option Valuation
- Part VII – Delta Hedging
- Part VIII – Credit Derivatives
- Part IX – Option Greeks
- Part X – Exotic Options
- Part XI – CDO

Part I – Valuation of Futures**1. Pricing future [Nov 2018 RTP, May 2004, Nov 2009, May 2015 MTP, Nov 2014 MTP, May 2021 RTP, Nov 2022 MTP, SM]**

The following data relate to Anand Ltd.'s share price:

Current price per share Rs.1800

6 months future's price/share Rs.1950

Assuming it is possible to borrow money in the market for transactions in securities at 12% per annum, you are expected:

- ❖ To calculate the theoretical minimum price of a 6-months forward purchase and
- ❖ To explain arbitrage opportunity

Answer:**WN 1: Computation of Fair Futures Price:****Base data:**

Spot price	Rs.1,800
Time period	6 months (or) 1 half year (or) 0.5 year
Rate of interest	12% per annum (or) 6% per half year
Dividend	0
Storage cost	0
Type of compounding	Half-yearly (Note)

Note:

- Compounding frequency is normally continuous. However, in case e^x values /CCRFI is not mentioned in the question then we can follow normal compounding. Normal compounding frequency would be equal to period of the contract (half-year) and hence frequency is half-yearly

Fair Futures Price:

$$\begin{aligned} \text{Futures Price} &= \text{Spot Price} \times (1 + r)^n \\ \text{Futures Price} &= 1,800 \times (1 + 6\%)^1 \\ \text{Futures Price} &= 1,908 \end{aligned}$$

- Theoretical minimum price for 6-months forward contract = Rs.1,908

WN 2: Arbitrage mechanism:

- Fair futures price is Rs.1,908 whereas actual futures price is Rs.1,950. This would mean that futures are over-valued
- We should sell in the futures market and buy in the spot market to exploit arbitrage opportunity
- Arbitrage gain = Difference between FFP and AFP = Rs.42

Arbitrage steps:

Particulars	Amount
<u>Day 0:</u>	

• Take a loan for 6 months @ 12% per annum	1,800
• Buy share in spot market with proceeds from loan	1,800
• Enter into futures contract to sell share at Rs.1,950 after 6 months	1,950
Month 6:	
• Sell share at contracted price of Rs.1,950	1,950
• Repay loan along with interest (1,800 + Interest of 6%)	(1,908)
• Arbitrage gain	42

2. Calculation of today's price [Nov 2006, Nov 2011, SM]

The 6-months forward price of a security is Rs.208.18. The borrowing rate is 8% per annum payable with monthly rests. What should be the spot price? Rework if the borrowing rate has quarterly compounding, half-yearly compounding and continuous compounding?

Answer:

WN 1: Computation of spot price with monthly compounding:

Base data:

Spot price	?
Time period	6 months
Rate of interest	8% per annum (or) 0.6667% per month
Dividend	0
Storage cost	0
Type of compounding	Monthly

- Compounding frequency should always be continuous for futures valuation. However, question specifically has mentioned monthly rest and hence we are considering monthly compounding

Spot price computation:

$$\begin{aligned}\text{Futures Price} &= \text{Spot Price} \times (1 + r)^n \\ 208.18 &= \text{Spot Price} \times (1 + 0.6667\%)^6 \\ 208.18 &= \text{Spot Price} \times 1.040675 \\ \text{Spot Price} &= \frac{208.18}{1.040675} = \text{Rs. } 200.04\end{aligned}$$

- Spot price will be Rs.200.04 in case compounding frequency is monthly

WN 2: Computation of spot price with quarterly compounding:

Base data:

Spot price	?
Time period	6 months (or) 2 quarters
Rate of interest	8% per annum (or) 2% per quarter
Dividend	0
Storage cost	0
Type of compounding	Quarterly

Spot price computation:

$$\begin{aligned}\text{Futures Price} &= \text{Spot Price} \times (1 + r)^n \\ 208.18 &= \text{Spot Price} \times (1 + 2\%)^2 \\ 208.18 &= \text{Spot Price} \times 1.0404 \\ \text{Spot Price} &= \frac{208.18}{1.0404} = \text{Rs. } 200.10\end{aligned}$$

- Spot price will be Rs.200.10 in case compounding frequency is quarterly

WN 3: Computation of spot price with half-yearly compounding:

Base data:

Spot price	?
Time period	6 months (or) 1 half year
Rate of interest	8% per annum (or) 4% per half year

Dividend	0
Storage cost	0
Type of compounding	Half-yearly

Spot price computation:

$$\begin{aligned}\text{Futures Price} &= \text{Spot Price} \times (1 + r)^n \\ 208.18 &= \text{Spot Price} \times (1 + 4\%)^1 \\ 208.18 &= \text{Spot Price} \times 1.04 \\ \text{Spot Price} &= \frac{208.18}{1.04} = \text{Rs. } 200.17\end{aligned}$$

- Spot price will be Rs.200.17 in case compounding frequency is half-yearly

WN 4: Computation of spot price with continuous compounding:**Base data:**

Spot price	?
Time period	6 months (or) 0.50 year
Rate of interest	8% per annum
Dividend	0
Storage cost	0
Type of compounding	Continuous

Spot price computation:

$$\begin{aligned}\text{Futures Price} &= \text{Spot Price} \times e^{rt} \\ 208.18 &= \text{Spot Price} \times e^{(0.08)(0.5)} \\ 208.18 &= \text{Spot Price} \times 1.040811 \\ \text{Spot Price} &= \frac{208.18}{1.040811} = \text{Rs. } 200.02\end{aligned}$$

- Spot price will be Rs.200.02 in case compounding frequency is continuous

Conclusion:

Compounding Frequency	Spot Price
Monthly	200.04
Quarterly	200.10
Half-yearly	200.17
Continuous	200.02

3. Pricing future and arbitrage opportunity [Nov 2017 RTP, May 2009, Nov 2022 MTP] [Homework]

The share of X Ltd. is currently selling for Rs.300. Risk free interest rate is 0.8% per month. A three months futures contract is selling for Rs.312. Develop an arbitrage strategy and show what your riskless profit will be 3 month hence assuming that X Ltd. will not pay any dividend in the next three months.

Answer:**WN 1: Computation of fair futures price:****Base data:**

Spot price	Rs.300
Time period	3 months (or) 0.25 year
Rate of interest	0.8% per month (or) 9.6% per annum
Dividend	0
Storage cost	0
Type of compounding	Monthly

Fair Futures Price:

$$\text{Fair Futures Price} = \text{Adjusted Spot Price} \times (1 + r)^t$$

$$\text{Fair Futures Price} = 300 \times (1 + 0.80\%)^3 = 300.00 \times 1.0242 = \text{Rs. } 307.26$$

WN 2: Strategy if actual futures price is Rs.312:

- Fair futures price is Rs.307.26 whereas actual futures price is Rs.312. This would mean that futures are over-valued
- We should sell in the futures market and buy in the spot market to exploit arbitrage opportunity
- **Arbitrage gain = Difference between FFP and AFP = 4.74**

Arbitrage steps:

Particulars	Amount
Day 0	
1. Take loan of Rs300.00 for 3 months @0.80% per month. This would be repaid out of sell proceeds of share	300.00
2. Buy 1 share in spot market	300.00
3. Enter into futures contract to sell share at Rs.312	312.00
Day 90	
4. Sell share at contracted price and receive Rs.312	312.00
5. Repay loan of Rs.300.00 along with interest	307.26
6. Arbitrage gain (312 – 307.26)	4.74

4. Pricing future –Dividend paying stock – Dividend in Rupees

Calculate the price of a 6 months futures contract on a share that is currently priced at Rs.75. The share is expected to pay a Rs.2 dividend four months from today. The continuously compounded risk-free rate is 12 percent per annum. The contract size is 100. If the contract value is Rs.7400 what action would follow? In case it is Rs.7800 what would you do?

Answer:**Computation of fair futures price:****Base data:**

Spot price	Rs.75
Time period	6 months (or) 0.5 year
Rate of interest	12% per annum
Dividend	Rs.2 in Month 4
Storage cost	0
Type of compounding	Continuous

Computation of PV of Dividend Income:

Amount of Dividend	Rs.2
Time period	4 months (or) 0.3333 years
Rate of interest	12% per annum
Type of compounding	Continuous

$$\text{Present value} = \frac{\text{Future value}}{e^{rt}}$$

$$\text{Present value} = \frac{2}{e^{(0.12)(0.3333)}} = \frac{2}{e^{0.04}} = \frac{2}{1.040811} = 1.92$$

Fair Futures Price:

$$\text{Fair Futures Price} = \text{Adjusted Spot Price} \times e^{rt}$$

$$\text{Fair Futures Price} = 73.08 \times e^{(0.12)(0.5)} = 73.08 \times e^{0.06} = 73.08 \times 1.061836 = \text{Rs. 77.60}$$

Note:

- Adjusted spot price = Spot Price – PV of Dividend Income
- Adjusted spot price = 75 – 1.92 = Rs.73.08

WN 2: Strategy if actual futures price is Rs.7,400:

- Fair futures price is Rs.7,760 (77.60 x 100) whereas actual futures price is Rs.7,400. This would mean that futures are under-valued

- We should buy in the futures market and sell in the spot market to exploit arbitrage opportunity
- **Arbitrage gain = Difference between FFP and AFP = Rs.360**

Arbitrage steps:

Particulars	Amount
Day 0	
1. Short-sell 100 shares in spot market for Rs.7500	7,500
2. Create fixed deposit of 192 for 4 months @ 12% CCRFI (this is created so that we can pay dividend of Rs.200 after 4 months – this is basically present value of dividend income)	192
3. Create fixed deposit for balance Rs.7,308 for 6 months @ 12% CCRFI	7,308
4. Enter into futures contract to buy 100 shares for Rs.7,400	7,400
Day 120	
5. Company declared dividend, we redeem FD and pay dividend to buyer of the share (this is because we do not own share and we did short-sell and hence we need to pay dividend to buyer of share)	200
Day 180	
6. Redeem fixed deposit of Rs.7,308 and get Rs.7760	7,760
7. Buy 100 shares at contracted price and deliver shares to the buyer of shares	7,400
8. Arbitrage gain	360

WN 3: Strategy if actual futures price is Rs.7,800:

- Fair futures price is Rs.7,760 (77.60×100) whereas actual futures price is Rs.7,800. This would mean that futures are over-valued
- We should sell in the futures market and buy in the spot market to exploit arbitrage opportunity
- **Arbitrage gain = Difference between FFP and AFP = Rs.360**

Arbitrage steps:

Particulars	Amount
Day 0	
1. Take loan of Rs.192 for 4 months (this loan will be repaid with dividend income and hence we are taking this loan only for four months – we are buyer of share and hence we would get dividend income)	192
2. Take loan of Rs.7,308 for 6 months @ 12% CCRFI	7,308
3. Buy 100 shares in spot market	7,500
4. Enter into futures contract to sell 100 shares for Rs.7800	7,800
Day 120	
5. Receive dividend of Rs.200 and repay loan of 192 with interest	200
Day 180	
6. Sell 100 shares at contracted price of Rs.78	7,800
7. Repay loan of Rs.7,308 along with interest	7,760
8. Arbitrage gain	40

5. FFP Computation – Dividend in Rupees and Cost to Carry [Nov 2012 RTP]

Suppose that there is a future contract on a share presently trading at Rs.1000. The life of future contract is 90 days and during this time the company will pay dividends of Rs.7.50 in 30 days, Rs.8.50 in 60 days and Rs.9.00 in 90 days. Assuming that the CCRFI is 12%, you are required to find out:

- ❖ Fair value of the contract if no arbitrage opportunity exists
- ❖ Value of cost to carry

Answer:**WN 1: Computation of fair futures price:****Base data:**

Spot price	Rs.1,000
Time period	90 days (or) 0.25 years

Rate of interest	12% per annum
Dividend	Rs.7.50 in M1 Rs.8.50 in M2 Rs.9.00 in M3
Storage cost	0
Type of compounding	Daily or continuous

Computation of PV of Dividend Income:

Amount of Dividend	Rs.7.50	Rs.8.50	Rs.9.00
Time period	1 month (or) 0.0833 years	2 month (or) 0.1667 year	3 month (or) 0.25 year
Rate of interest	12% per annum	12% per annum	12% per annum
Type of compounding	Continuous	Continuous	Continuous
PV of Dividend	$\frac{7.50}{e^{(0.12)(0.0833)}} = \frac{7.50}{e^{0.01}} = 7.43$	$\frac{8.50}{e^{(0.12)(0.1667)}} = \frac{7.50}{e^{0.02}} = 8.33$	$\frac{9.00}{e^{(0.12)(0.25)}} = \frac{9.00}{e^{0.03}} = 8.73$

PV of dividend income = 7.43 + 8.33 + 8.73 = 24.49

Adjusted spot price:

Adjusted spot price = Spot Price - PV of dividend income = 1,000 - 24.49 = Rs.975.51

Fair Futures Price:

Fair Futures Price = Adjusted Spot Price $\times e^{rt}$
Fair Futures Price = 975.51 $\times e^{(0.12) \times 0.25}$
Fair Futures Price = 975.51 $\times e^{0.03}$
Fair Futures Price = 975.51 $\times 1.030455$
Fair Futures Price = Rs.1,005.22

WN 2: Computation of cost to carry:

- Cost to Carry = Fair Futures Price - Spot Price
- Cost to Carry = 1,005.22 - 1,000 = Rs.5.22

6. Pricing future - Dividend Adjustment [May 2018 RTP, Nov 2008, Nov 2019 RTP, Nov 2023 MTP, SM, May 2024 RTP] [Homework]

The price of ACC stock on 31 December 2022 was Rs. 220 and the Futures price on the same stock on the same date, i.e., 31 December 2022 for March 2023 was Rs. 222. Other features of the Futures contract and related information are as follows:

Time to Expiration	3 Months (0.25 Year)
Borrowing rate	15% per annum
Annual dividend on the stock	25% payable before 31.03.2023
Face value of the stock	Rs.10

Advise the investor the course of action to be followed by him so as to earn Risk free income if he can sell the stock short at spot price.

Answer:**WN 1: Computation of fair futures price:****Base data:**

Spot price	Rs.220
Time period	3 months (or) 0.25 year
Rate of interest	15 percent per annum
Dividend	Rs.2.50 in Month 3 (Note 1)
Storage cost	0
Type of compounding	Once in three months

Note 1: Dividend Income:

- Dividend rate of 25 percent on face value of Rs.10 = Rs.2.50 in Month 3

Computation of PV of Dividend Income:

Amount of Dividend	Rs.2.50
Time period	3 months (or) 0.25 year
Rate of interest	15% per annum
Type of discounting	Once in three months

$$\text{Present value} = \frac{\text{Future value}}{(1 + r)^t}$$

$$\text{Present value} = \frac{2.50}{(1 + 3.75\%)^1} = \frac{2.50}{1.0375} = 2.41$$

Fair Futures Price:

$$\text{Fair Futures Price} = \text{Adjusted Spot Price} \times (1 + r)^t$$

$$\text{Fair Futures Price} = 217.59 \times (1 + 3.75\%)^1 = 217.59 \times 1.0375 = \text{Rs. 225.75}$$

Note:

- Adjusted spot price = Spot Price – PV of Dividend Income
- Adjusted spot price = 220 – 2.41 = Rs.217.59

WN 2: Strategy if actual futures price is Rs222:

- Fair futures price is Rs.225.75 whereas actual futures price is Rs.222. This would mean that futures are under-valued
- We should buy in the futures market and sell in the spot market to exploit arbitrage opportunity
- Arbitrage gain = Difference between FFP and AFP = 3.75**

Arbitrage steps:

Particulars	Amount
Day 0	
1. Short-sell shares in spot market for Rs.220	220.00
2. Create fixed deposit of 2.41 for 3 months @ 15% (this is created so that we can pay dividend of Rs.2.50 after 3 months – this is basically present value of dividend income)	2.41
3. Create fixed deposit for balance Rs.217.59 for 3 months @ 15%	217.59
4. Enter into futures contract to buy share for Rs.222	222.00
Day 90	
5. Company declared dividend, we redeem FD and pay dividend to buyer of the share (this is because we do not own share and we did short-sell and hence we need to pay dividend to buyer of share)	2.50
6. Redeem fixed deposit of Rs.217.59 and get Rs.225.75	225.75
7. Buy 1 share through futures contract and deliver shares to the buyer of shares	222.00
8. Arbitrage gain	3.75

7. Price future – Dividend paying stock – Dividend in %

Consider a 3-months futures contract on New Gen Bank Ltd. quoting at Rs.1100. The continuously compounded risk-free rate of return is 12 percent per annum and the continuously yield on the share is 4 percent per annum.

- Find the value of the futures contract?
- What action would follow if futures are available at 1110?
- Will your position change if futures are available at 1150?

Answer:**WN 1: Computation of fair futures price:****Base data:**

Spot price	Rs.1,100
Time period	3 months (or) 0.25 years

Rate of interest	12% per annum
Dividend	4 % per annum
Storage cost	0
Type of compounding	Continuous

Fair Futures Price:

Fair Futures Price = Spot Price $\times e^{(r-y)t}$
Fair Futures Price = $1,100 \times e^{(0.12-0.04)(0.25)}$
Fair Futures Price = $1,100 \times e^{0.02}$
Fair Futures Price = $1,100 \times 1.0202$
Fair Futures Price = Rs.1,122.22

WN 2: Strategy if actual futures price is Rs.1,110:

- Fair futures price is Rs.1,122.22 whereas actual futures price is Rs.1,110. This would mean that futures are under-valued
- We should buy in the futures market and sell in the spot market to exploit arbitrage opportunity
- Arbitrage gain = Difference between FFP and AFP = Rs.12.22**

Arbitrage steps:

Particulars	Amount
Day 0	
1. Sell 1 share in spot market for Rs.1100	1,100
2. Create fixed deposit for 3 months @ 12% CCRFI	1,100
3. Enter into futures contract to buy share @ 1,110 in 3 months	1,110
Day 1 to Day 90	
4. Company will declare dividend, we will pay dividend out of interest on fixed deposit, and hence net interest on FD will be 8 percent	
Day 90	
5. Redeem fixed deposit along with interest of 8 percent	1,122.22
6. Buy share at contracted price of Rs.1110	1,110.00
7. Arbitrage gain	12.22

WN 3: Strategy if actual futures price is Rs.1,150:

- Fair futures price is Rs.1,122.22 whereas actual futures price is Rs.1,150. This would mean that futures are over-valued
- We should sell in the futures market and buy in the spot market to exploit arbitrage opportunity
- Arbitrage gain = Difference between FFP and AFP = Rs.27.78**

Arbitrage steps:

Particulars	Amount
Day 0	
1. Take a bank loan for Rs.1,100 @ 12% CCRFI for 3 months	1,100
2. Buy share in spot market	1,100
3. Enter into contract to sell share @ 1150 after 3 months	1,150
Day 1 to Day 90	
4. Company declared dividend, use the same to pay interest of 4 percent and hence net interest cost will be 8 percent	
Day 90	
5. Sell share at contracted price of Rs.1,150	1,150.00
6. Repay loan along with net interest of 8 percent	1122.22
7. Arbitrage gain	27.78

8. Pricing futures – Dividend Yield in Percent [May 2012, May 2012 RTP, SM]

On 31-8-2011, the value of stock index was Rs.2,200. The risk-free rate of return has been 8% per annum. The dividend yield on this stock index is as under:

Month	Dividend Paid p.a.
January	3%
February	4%
March	3%
April	3%
May	4%
June	3%
July	3%
August	4%
September	3%
October	4%
November	3%
December	3%

Assuming that interest is compounded daily, find out the future price of contract deliverable on 31-12-2011. Given $e^{0.01583} = 1.01593$

Answer:

Computation of Fair Futures Price:**Base data:**

Spot price	Rs.2,200
Time period	4 months (or) 0.33 years
Rate of interest	8% per annum
Dividend	$3.25\% \frac{[3\% + 4\% + 3\% + 3\%]}{4}$
Storage cost	0
Type of compounding	Daily or continuous

Note:

- Dividend yield has been considered for four months of September to December. It has been taken as average of 3.25% per annum which is average of these four months

Fair Futures Price:

$$\begin{aligned} \text{Fair Futures Price} &= \text{Spot Price} \times e^{(r-y)t} \\ \text{Fair Futures Price} &= 2,200 \times e^{(0.08-0.0325) \times 0.3333} \\ \text{Fair Futures Price} &= 2,200 \times e^{0.01583} \\ \text{Fair Futures Price} &= 2,200 \times 1.01593 \\ \text{Fair Futures Price} &= \text{Rs.2,235.05} \end{aligned}$$

9. Pricing future – Storage costs in Rupees and Percentage

Gold futures have been opened up in India recently. A 3-month gold futures is available at Rs.800 per gram. Suppose the current price of gold is Rs.775 per gram and that it costs Rs.5 per gram in arrears for the 3-monthly period to store gold.

- What is the fair price if the CCRFI is 8% per annum?
- If the rental is 4 percent per annum instead of Rs.5 per gram and the CCRFI is 8% per annum, what is the fair price of gold futures?
- If the futures price of Rs.770 per gram is to be considered as fair then what is the implicit convenience yield. Consider this as continuation of part (ii) of the question.

Answer:

WN 1: Computation of fair futures price if rental is Rs.5 per gram**Base data:**

Spot price	Rs.775
Time period	3 months (or) 0.25 years
Rate of interest	8% per annum
Dividend	0

Storage cost	Rs.5 in Month 3
Type of compounding	Continuous

Computation of PV of Storage Costs:

Amount of storage cost	Rs.5
Time period	3 months (or) 0.25 year
Rate of interest	8% per annum
Type of compounding	Continuous

$$\text{Present value} = \frac{\text{Future value}}{e^{rt}}$$

$$\text{Present value} = \frac{5}{e^{(0.08)(0.25)}} = \frac{5}{e^{0.02}} = \frac{5}{1.0202} = 4.90$$

Adjusted spot price:

$$\text{Adjusted Spot Price} = \text{Spot Price} + \text{PV of storage costs} = 775 + 4.90 = \text{Rs.779.90}$$

Fair Futures Price:

Fair Futures Price = Adjusted Spot Price $\times e^{rt}$
Fair Futures Price = $779.90 \times e^{0.08 \times 0.25}$
Fair Futures Price = $779.90 \times e^{0.02}$
Fair Futures Price = 779.90×1.0202
Fair Futures Price = Rs.795.65

WN 2: Computation of fair futures price if rental is 4 percent per annum:**Base data:**

Spot price	Rs.775
Time period	3 months (or) 0.25 years
Rate of interest	8% per annum
Dividend	0
Storage cost	4% per annum
Type of compounding	Continuous

Fair Futures Price:

Fair Futures Price = Adjusted Spot Price $\times e^{(r+s)t}$
Fair Futures Price = $775 \times e^{(0.08+0.04)0.25}$
Fair Futures Price = $775 \times e^{0.03}$
Fair Futures Price = 775×1.030455
Fair Futures Price = Rs.798.60

WN 3: Computation of convenience yield if fair futures price is Rs.770:

- Cost to Carry = Fair Futures price as per formula – Spot Price
- Cost to Carry = $798.60 - 775.00 = \text{Rs.23.60}$

Convenience yield:

Fair Futures Price (given in question) = Spot Price + Cost to carry – Convenience yield
$770 = 775 + 23.60 - \text{Convenience Yield}$
Convenience Yield = Rs.28.60

10. Convenience Yield (May 2011 RTP):

The following information is available about standard gold.

- Spot Price (SP) = Rs.15,600 per 10 Grams
- Future Price (FP) = Rs.17,100 for one-year future contract
- Risk free interest Rate (Rf) = 8.5%
- Present Value of Storage Cost = Rs. 900 per year

From the above information you are requested to calculate the Present Value of Convenience yield (PVC) of the standard gold.

Answer:**WN 1: Computation of Fair Futures Price:****Base data:**

Spot price	Rs.15,600
Time period	1 year
Rate of interest	8.5% per annum
Dividend	0
Storage cost	Rs.900 in day 0
Type of compounding	Once in a year

Adjusted spot price:

Adjusted Spot Price = Spot Price + PV of storage costs = 15,600 + 900 = Rs.16,500

Fair Futures Price:

Fair Futures Price = Adjusted Spot Price $\times (1 + r)^n$
 Fair Futures Price = 16,500 $\times (1 + 8.5\%)^1$
 Fair Futures Price = Rs. 17,902.50

WN 2: Computation of convenience yield if futures price is Rs.17,100:

- Cost to Carry = Fair Futures price as per formula - Spot Price
- Cost to Carry = 17,902.50 - 15,600 = Rs.2,302.50

Convenience yield:

Fair Futures Price (given in question) = Spot Price + Cost to carry - Convenience yield
 17,100 = 15,600 + 2,302.50 - Convenience Yield
 Convenience Yield = Rs.802.50

PV of convenience Yield:

PV of Convenience Yield = $\frac{\text{Convenience Yield}}{(1 + r)^n} = \frac{802.50}{(1 + 8.5\%)^1} = \text{Rs. } 739.63$

11. Futures and arbitrage opportunity [Nov 2014 MTP]

The BSE's Market Index is currently trading at 27,000 whose 6 months future's value is trading at 27,810. The Current price of Anand Ltd.'s share listed on BSE is Rs. 1,800. The beta of share is 1.80.

Assuming it is possible to borrow money in the market for transactions in securities at 10% per annum, you are required:

- To calculate 6 months future's value and the theoretical minimum price of a 6months forward purchase of Anand Ltd.'s share; and
- To find arbitrage opportunity, if any possible.

Answer:**WN 1: Computation of 6 months futures value:**

Particulars	Calculation	Amount
Spot price of share	Given	1,800
Change in Market for 6-month period	$\frac{27,810 - 27,000}{27,000} \times 100$	3.00%
Beta of Share		1.80
Expected change in share price	$1.80 \times 3\%$	5.40%
6 months futures value of Anand Ltd	$1,800 + 5.40\%$	1,897.20

Note: The above computed price has been taken as actual futures price.

WN 2: Computation of theoretical minimum price of 6-month contract:**Base data:**

Spot price	Rs.1,800
Time period	6 months (or) 1 half year (or) 0.5 year
Rate of interest	10% per annum (or) 5% per half year
Dividend	0

Storage cost	0
Type of compounding	Half-yearly (equal to time period of contract)

Forward Price:

Forward Price = Spot Price $\times (1 + r)^n$
Forward Price = $1,800 \times (1 + 5\%)^1$
Forward Price = 1,890

- Theoretical minimum price for 6-months forward contract = Rs.1,908

Note: The above price as per futures formula is taken as fair futures price.

WN 3: Arbitrage strategy:

- Fair futures price is Rs.1,890 whereas actual futures price is Rs.1,897.20. This would mean that futures are over-valued
- We should sell in the futures market and buy in the spot market to exploit arbitrage opportunity
- Arbitrage gain = Difference between FFP and AFP = Rs.7.20

Arbitrage steps:

Particulars	Amount
Day 0:	
• Take a loan for 6 months @ 10% per annum	1,800.00
• Buy share in spot market with proceeds from loan	1,800.00
• Enter into futures contract to sell share at Rs.1,897.20 after 6 months	1,897.20
Month 6:	
• Sell share at contracted price of Rs.1,897.20	1,897.20
• Repay loan along with interest (1,800 + Interest of 5%)	(1,890.00)
• Arbitrage gain	7.20

12. Concept of Implied Risk-free Rate [Nov 2013 RTP] [Concept Revision]

Suppose current price of an index is Rs.13,800 and yield on index is 4.8% (p.a.). A 6-month future contract on index is trading at Rs.14,340. Assuming that Risk Free Rate of Interest is 12%, show how Mr. X (an arbitrageur) can earn an abnormal rate of return irrespective of outcome after 6 months. You can assume that after 6 months index closes at Rs. 10,200 and Rs. 15,600 and 50% of stock included in index shall pay dividend in next 6 months. Also calculate implied risk free rate.

Answer**WN 1: Computation of fair futures price:**

Particulars	Amount
Spot price	13,800
Rate of interest (r)	12% per annum (or) 6% per half year
Dividend (y)	4.8% per annum (or) 2.4% per half year
N	6 months or 1 half year
Compounding frequency	Half-yearly

$$\text{FFP} = \text{Spot Price} \times (1 + (r - y))^n$$

$$\text{FFP} = 13,800 \times (1 + (6\% - 2.4\%))^1 = \text{Rs. 14,296.80}$$

WN 2: Computation of return earned if index turns out to be 10,200 and 15,600:

- ❖ Fair futures price is Rs.14,296.80 whereas actual futures price is Rs.14,340. Futures are overvalued and hence we should sell futures and buy spot market

Arbitrage steps:

Particulars	Index turns out to be 10,200	Index turns out to be 15,600
Day 0		
1. Buy shares in spot market	Rs.13,800	Rs.13,800
2. Enter into futures contract to sell share @ 14,340	Rs.14,340	Rs.14,340

Day 0 to Day 180		
3. Dividend earned on shares	331.20 [13,800 × 2.4%]	331.20 [13,800 × 2.4%]
Day 180		
4. Profit/loss from futures position	4,140 [14,340 – 10,200]	-1,260 [14,340 – 15,600]
5. Profit/loss from cash position	-3,600 [10,200 – 13,800]	1,800 [15,600 – 13,800]
Total Profit [3+4+5]	871.20	871.20
Implied risk free rate	12.63% $\frac{871.20}{13,800} \times \left(\frac{12}{6}\right) \times 100$	12.63% $\frac{871.20}{13,800} \times \left(\frac{12}{6}\right) \times 100$

Note:

- Profit/loss = Selling price – Purchase price
- Futures position = Selling price is 14,340 and purchase price is either 10,200 or 15,600. This is because we sold futures at Rs.14,340 and now we will buy it back at 10,200 or 15,600
- Cash position = Purchase price is 13,800 and selling price is either 10,200 or 15,600. This is because we bought in cash market at Rs.13,800 and now we will sell it either 10,200 or 15,600

13. Net Settlement - Calculation of profit/loss:

Mr. X bought NIFTY futures of Rs.10,00,000 on January 1, 2017 for delivery on March 31, 2017. The nifty lot size is 200. Calculate the profit/loss if NIFTY future on maturity date is:

- ❖ 6,000
- ❖ 4,500

Answer:**WN 1: Computation of Profit/Loss if NIFTY on maturity date is 6,000:**

Date	Position	Action	Reference Date	Rate
Jan 1, 2017	Original Position	Buy	Mar 31, 2017	(5,000) [10,00,000/200]
Mar 31, 2017	Opposition Position	Sell	Mar 31, 2017	6,000
Gain per unit of NIFTY				1,000
Gain per lot (1,000 × 200)				2,00,000

WN 2: Computation of Profit/Loss if NIFTY on maturity date is 4,500:

Date	Position	Action	Reference Date	Rate
Jan 1, 2017	Original Position	Buy	Mar 31, 2017	(5,000) [10,00,000/200]
Mar 31, 2017	Opposition Position	Sell	Mar 31, 2017	4,500
Loss per unit of NIFTY				500
Loss per lot (500 × 200)				1,00,000

14. Net Settlement - Computation of profit/loss:

A sold one January Nifty futures contract for Rs. 3,40,000 on January 15, For this he had paid an initial margin of Rs. 34,000 to his broker. Each Nifty futures contract is for the delivery of 200 Nifties. On January 25, the index was closed on 1850. How much profit/loss A has made?

Answer:

Date	Position	Action	Reference Date	Rate
Jan 15	Original Position	Sell	XX date	1,700 [3,40,000/200]
Jan 25	Opposition Position	Buy	XX date	(1,850)
Loss per unit of NIFTY				150
Loss per lot (150 × 200)				30,000

15. Valuation and arbitrage with futures [Nov 2019] [Concept Revision]

The NSE-50 Index futures are traded with rupee value being Rs. 100 per index point. On 15th September, the index closed at 1195, and December futures (last trading day December 15) were trading at 1225. The historical dividend yield on the index has been 3% per annum and the borrowing rate was 9.5% per annum.

- i. Determine whether on September 15, the December futures were underpriced or overpriced?
- ii. What arbitrage transaction is possible to gain out this mispricing?
- iii. Calculate the gains and losses if the index on 15th December closes at
 - a. 1260
 - b. 1175.

Assume 365 days in a year for your calculations.

Answer:

WN 1: Computation of Fair Futures Price:

Base information:

Spot price	1195
Time period	15 days + 31 days + 30 days + 15 days = 91 days
Rate of interest	9.5% per annum (or) 2.3685% per 91 days
Dividend	3% per annum (or) 0.7479% per 91 days
Storage cost	0
Type of compounding	Once in 91 days

$$FFP = \text{Spot Price} \times (1 + (r - y))$$

$$FFP = 1195 \times (1 + (2.3685\% - 0.7479\%))$$

$$FFP = 1195 \times (1 + 1.6206\%) = 1,214.37$$

- Fair futures price is Rs.1,214.37 whereas actual futures price is Rs.1,225. Actual futures price is higher than fair futures price and hence futures are overpriced

WN 2: Arbitrage strategy:

- Fair futures price is Rs.1,21,437 (1,214.37 x 100) whereas actual futures price is Rs.1,22,500 (1,225 x 100). This would mean that futures are over-valued
- We should sell in the futures market and buy in the spot market to exploit arbitrage opportunity
- Arbitrage gain = Difference between FFP and AFP = 1,22,500 - 1,21,437 = Rs.1063**

Arbitrage steps:

Particulars	Amount
Day 0	
1. Take a bank loan for Rs.1,19,500 @ 9.5% for 91 days	1,19,500
2. Buy shares worth of index in spot market	1,19,500
3. Enter into contract to sell index @ 1,22,500 after 91 days	
Day 1 to Day 91	
4. Company declared dividend, use the same to pay interest of 3 percent and hence net interest cost will be 6.50 percent	
Day 91	
5. Sell index for Rs.1,22,500	1,22,500
6. Repay loan along with net interest of 6.5 percent (1,19,500 + (1,19,500 x 6.5% x (91/365)))	1,21,437
7. Arbitrage gain	1,063

WN 3: Computation of arbitrage gain if index closes at 1,260 and 1,175:

Index closes at Rs.1,260:

Particulars	Amount
Day 0	
1. Take a bank loan for Rs.1,19,500 @ 9.5% for 91 days	1,19,500
2. Buy shares worth of index in spot market	1,19,500
3. Enter into contract to sell index @ 1,22,500 after 91 days	
Day 1 to Day 91	
4. Company declared dividend, use the same to pay interest of 3 percent and hence net interest cost will be 6.50 percent	
Day 91	
5. Sell index for Rs.1,26,000 (1,260 x 100)	1,26,000

6. Loss in futures contract (Selling price was Rs.1,225; Opposite purchase price is Rs.1,260) Loss (100 x (1,225 – 1,260))	(3,500)
7. Repay loan along with net interest of 6.5 percent (1,19,500 + (1,19,500 x 6.5% x (91/365)))	1,21,437
8. Arbitrage gain	1,063

Index closes at Rs.1,175:

Particulars	Amount
Day 0	
1. Take a bank loan for Rs.1,19,500 @ 9.5% for 91 days	1,19,500
2. Buy shares worth of index in spot market	1,19,500
3. Enter into contract to sell index @ 1,22,500 after 91 days	
Day 1 to Day 91	
4. Company declared dividend, use the same to pay interest of 3 percent and hence net interest cost will be 6.50 percent	
Day 91	
5. Sell index for Rs.1,17,500 (1,175 x 100)	1,17,500
6. Gain in futures contract (Selling price was Rs.1,225; Opposite purchase price is Rs.1,175) Loss (100 x (1,225 – 1,175))	5,000
7. Repay loan along with net interest of 6.5 percent (1,19,500 + (1,19,500 x 6.5% x (91/365)))	1,21,437
8. Arbitrage gain	1,063

16. Valuation of futures [Nov 2019, May 2021 MTP] [Concept Revision]

A future contract is available on R Ltd. that pays an annual dividend of Rs. 4 and whose stock is currently priced at Rs. 125. Each future contract calls for delivery of 1,000 shares to stock in one year, daily marking to market. The corporate treasury bill rate is 8%.

Required:

- Given the above information, what should the price of one future contract be ?
 - If the company stock price decreases by 6%, what will be the price of one futures contract ?
 - As a result of the company stock price decrease, will an investor that has a long position in one futures contract of R Ltd. realizes a gain or loss ? What will be the amount of his gain or loss ?
- (Ignore margin and taxation, if any)

Answer:

WN 1: Computation of fair futures price:**Base data:**

Spot price	Rs.125
Time period	1 year
Rate of interest	8% per annum
Dividend	Rs.4 in year 1
Storage cost	0
Type of compounding	Yearly

Note: It is assumed that dividend will be paid at the end of year 1

Computation of PV of Dividend Income:

Amount of Dividend	Rs.4
Time period	1 year
Rate of interest	8% per annum
Type of compounding	Yearly

$$\text{Present value} = \frac{4}{1.08} = 3.70$$

Fair Futures Price:

$$\text{Fair Futures Price} = \text{Adjusted Spot Price} \times (1 + r)^n$$

$$\text{Fair Futures Price} = 121.30 \times (1.08)^1 = \text{Rs. 131}$$

Price of one contract = $131 \times 1,000 = \text{Rs.}1,31,000$

Note:

- Adjusted spot price = Spot Price - PV of Dividend Income
- Adjusted spot price = $125 - 3.70 = \text{Rs.}121.30$

WN 2: Computation of fair futures price if stock price decreases by 6%**Base data:**

Spot price	$\text{Rs.}125 \times 94\% = \text{Rs.}117.50$
Time period	1 year
Rate of interest	8% per annum
Dividend	Rs.4 in year 1
Storage cost	0
Type of compounding	Yearly

Fair Futures Price:

Fair Futures Price = Adjusted Spot Price $\times (1 + r)^n$

Fair Futures Price = $113.80 \times (1.08)^1 = \text{Rs.}122.90$

Price of one contract = $122.90 \times 1,000 = \text{Rs.}1,22,900$

Note:

- Adjusted spot price = Spot Price - PV of Dividend Income
- Adjusted spot price = $117.50 - 3.70 = \text{Rs.}113.80$

WN 3: Computation of gain or loss:

- If the investor has taken a long position, decrease in price will result in loss for the investor.
- Amount of loss will be: $\text{Rs.}1,31,000 - \text{Rs.}1,22,900 = \text{Rs.}8,100$

17. Concept of Contango and Backwardation [Nov 2020 RTP] [Concept Revision]

Mr. SG sold five 4-Month Nifty Futures on 1st February 2020 for Rs. 9,00,000. At the time of closing of trading on the last Thursday of May 2020 (expiry), Index turned out to be 2100. The contract multiplier is 75.

Based on the above information calculate:

- The price of one Future Contract on 1st February 2020.
- Approximate Nifty Sensex on 1st February 2020 if the Price of Future Contract on same date was theoretically correct. On the same day Risk Free Rate of Interest and Dividend Yield on Index was 9% and 6% p.a. respectively.
- The maximum Contango/ Backwardation.
- The pay-off of the transaction.

Note: Carry out calculation on month basis.

Answer:

Particulars	Calculation	Amount
Price of one contract	$\frac{9,00,000}{5}$	Rs.1,80,000
Nifty on Feb 1, 2020:		
Fair futures price	$\frac{1,80,000}{75}$	2,400
Spot price calculation	$\begin{aligned} \text{SP} \times (1 + (r - y)^t) &= 2,400 \\ \text{SP} \times \left(1 + \left(\left(\frac{0.09}{3}\right) - \left(\frac{0.06}{3}\right)\right)^1\right) &= 2,400 \\ \text{SP} \times (1 + 0.01) &= 2,400 \\ \text{SP} &= \frac{2,400}{1.01} \end{aligned}$	Rs.2,376.24
Contango/backwardation:		
Basis	Spot price - futures price $2,376.24 - 2,400$	-23.76
Contango	Note 1	23.76
Pay-off (profit)	Note 2	Rs.1,12,500

Note 1:

If Basis is negative the market is said to be in Contango and when it is positive the market is said to be Backwardation. Since current Spot Price is 2400 and Nifty Index is 2376.24, the Basis is negative and hence there is Contango Market and maximum Contango shall be 23.76

Note 2:

Date	Position	Action	Reference Date	Rate
Feb 1	Original Position	Sell	May 2020	2,400
May 2020	Opposition Position	Buy	May 2020	(2,100)
Profit				300
Total Profit [300 x 75 x 5]				1,12,500

Part II - Hedging with Futures

18. Hedging with futures [Nov 2007, May 2018 MTP, Nov 2014 MTP, Nov 2017 MTP, May 2016 RTP, May 2019 RTP, Nov 2020, July 2021, May 2022 RTP, Nov 2022 MTP, SM] [Concept Revision]

BSE	5,000
Value of portfolio	10,10,000
Risk free interest rate	9% per annum
Dividend yield on index	6% per annum
Beta of portfolio	1.5

We assume that a future contract on the BSE index with four months maturity is used to hedge the value of portfolio over next three months. One future contract is for delivery of 50 times the index. Based on the above information calculate:

- ❖ Price of future contract.
- ❖ The gain on short futures position if index turns out to be 4,500 in three months.

Answer:**WN 1: Computation of fair futures price:****Base data:**

Spot price	Rs.5,000
Time period	4 months (or) 0.33 year
Rate of interest	9% per annum (or) 3% per 4 months
Dividend	6% per annum (or) 2% per 4 months
Storage cost	0
Type of compounding	Once in four months

Fair Futures Price:

Fair Futures Price = Adjusted Spot Price $\times (1 + (r - y))^t$

Fair Futures Price = 5,000 $\times (1 + (0.03 - 0.02))^1$ = 5,000 $\times 1.01$ = Rs. 5,050

WN 2: Computation of no of contracts taken for hedging:

- The investor wants to hedge the portfolio for another three months. He plans to use four months BSE index futures for hedging the portfolio. This is an acceptable strategy as the four months futures contract would remain active till the hedging period of three months
- We are planning for hedging the portfolio and that would make the beta of portfolio to 0 from current 1.5 times

Security	Beta	Weight	Product
Portfolio	1.50	10,10,000	15,15,000
BSE futures	1.00	(15,15,000)	(15,15,000)
Total	0.00	10,10,000	0

Note:

- Investor currently has invested Rs.10,10,000. Portfolio has beta of 1.5 times and hence risk-adjusted portfolio value is Rs.15,15,000
- We need Beta of 0 times and hence sum of product will be zero. This would make the product of BSE futures as balancing figure and same would be -15,15,000. Beta of BSE futures is 1 (market beta) and hence weight is -15,15,000

- We will not be adding BSE futures weight while adding the overall weights. This is because money of Rs.15,15,000 will not be blocked in BSE futures and only the margin for the same would be blocked
- We need to take position of -15,15,000 in BSE futures. Negative would indicate that we need to sell BSE futures

$$\text{No of contracts to be sold} = \frac{15,15,000}{50 \times 5,050} = 6 \text{ Contracts}$$

WN 3: Computation of profit/loss:

Date	Position	Action	Reference Date	Rate
Day 1	Original position	Sell	Day 120	5,050.00
Day 90	Opposite position	Buy	Day 120	(4,511.25)
Profit per BSE				538.75
Profit per contract (538.75 x 60)				26,937.50
Profit for 6 contracts (26,937.50 x 6)				1,61,625

Note: Computation of futures price on day 90 for day 120:**Base data:**

Spot price	Rs.4,500
Time period	1 month
Rate of interest	9% per annum (or) 0.75% per month
Dividend	6% per annum (or) 0.50% per month
Storage cost	0
Type of compounding	Monthly

Fair Futures Price:

$$\text{Fair Futures Price} = \text{Adjusted Spot Price} \times (1 + (r - y))^t$$

$$\text{Fair Futures Price} = 4,500 \times (1 + (0.0075 - 0.0050))^1 = 4,500 \times 1.0025 = \text{Rs. 4,511.25}$$

19. Hedging with futures [Nov 2018 MTP, May 2019 MTP, May 2011, May 2015 MTP, Nov 2014 RTP, SM] [Homework]

A Mutual Fund is holding the following assets

Investments in diversified equity shares Rs.90 Crores

Cash and Bank Balances Rs.10 Crores

The Beta of the share portfolio is 1.1. The index future is selling at 4300 level. The Fund Manager apprehends that the index will fall at the most by 10%. How many index futures he should short for perfect hedging? One index future consists of 50 units. Substantiate your answer assuming the Fund Manager's apprehension will materialize.

Answer:**WN 1: Computation of number of contracts for hedging:**

Security	Beta	Weight	Product
Equity shares	1.10	90,00,00,000	99,00,00,000
Cash	0.00	10,00,00,000	-
Index futures	1.00	(99,00,00,000)	(99,00,00,000)
Total	0	100,00,00,000	0

$$\text{No of contracts for hedging} = \frac{99,00,00,000}{4,300 \times 50} = 4,605 \text{ Contracts}$$

WN 2: Impact of hedging if the index falls by 10 percent:

- Beta of equity shares is 1.1 times. This would mean that if index falls by 10 percent, equity shares will fall by 11 percent
- We have purchased equity shares of Rs.90 crores and fall in share price will lead to loss. Loss in equity portfolio = 90 crores x 11% = Rs.9.9 crores
- Index has fallen by 10 percent. We have sold equity shares and this will lead to profit for the company. Gain in futures = (4,605 contracts x 4,300 x 50) x 10% = Rs.9.9 Crores

- Net gain/loss = 0. This proves that hedge has enabled the fund manager to save from loss despite 10 percent fall in index

20. Hedging with futures [Nov 2013, Nov 2019 MTP, Nov 2016 RTP, Jul 2021, May 2024 MTP, SM]

ICAI Question:

A trader is having in its portfolio shares worth Rs.85 lakhs at current price and cash Rs.15 lakhs. The beta of share portfolio is 1.6. After 3 months the price of shares dropped by 3.2%. Determine:

- ❖ Current portfolio beta
- ❖ Portfolio beta after 3 months if the trader on current date goes for long position on Rs. 100 lakhs Nifty futures.

Modified:

Part (ii) of the question should state as Portfolio Beta if the trader on current date goes for long position on Rs.100 lacs Nifty Futures

Answer:

WN 1: Computation of portfolio Beta:

Security	Beta	Weight	Product
Shares	1.60	85,00,000	1,36,00,000
Cash	0.00	15,00,000	-
Total	1.36	1,00,00,000	1,36,00,000

$$\text{Portfolio Beta} = \frac{\text{Sum of product}}{\text{Sum of weights}} = \frac{1,36,00,000}{1,00,00,000} = 1.36 \text{ Times}$$

WN 2: Computation of portfolio Beta if the trader goes on long position on Rs.100 lacs Nifty futures:

Security	Beta	Weight	Product
Shares	1.60	85,00,000	1,36,00,000
Cash	0.00	15,00,000	-
Nifty futures	1.00	1,00,00,000	1,00,00,000
Total	2.36	1,00,00,000	2,36,00,000

$$\text{Portfolio Beta} = \frac{2,36,00,000}{1,00,00,000} = 2.36 \text{ Times}$$

Alternative answer:

- Market has fallen by 2%. We have gone long on Rs.100 lacs of index futures and hence loss would be Rs.2 lacs from futures
- Beta of stock is 1.6 and hence shares would have fallen by 3.2%. Loss in shares = 85,00,000 × 3.2% = Rs.2,72,000
- Total loss = Rs.2,00,000 + Rs.2,72,000 = Rs.4,72,000
- % loss = (4,72,000/100,00,000) × 100 = 4.72%

$$\text{Beta} = \frac{\% \text{ loss in portfolio}}{\% \text{ change in market}} = \frac{4.72\%}{2\%} = 2.36 \text{ Times}$$

21. Hedge ratio [May 2012, May 2018 MTP, Nov 2014 MTP, May 2017 RTP, Nov 2021 RTP, Nov 2023 RTP, Nov 2020 MTP]

A company is long on 10 MT of copper @ Rs. 534 per kg (spot) and intends to remain so for the ensuing quarter. The variance of change in its spot and future prices are 16% and 36% respectively, having correlation coefficient of 0.75. The contract size of one contract is 1,000 kgs.

Calculate:

- Calculate the Optimal Hedge Ratio for perfect hedging in Future Market.
- Advice the position to be taken in Future Market for perfect hedging.
- Determine the number and the amount of the copper futures to achieve a perfect hedge.

Answer:

WN 1: Computation of Beta (optimal hedge ratio):

$$\text{Beta} = \frac{\text{SD of changes in spot market}}{\text{SD of changes in in futures market}} \times \text{Correlation coefficient}$$

$$\text{Beta} = \frac{\sqrt{16}}{\sqrt{36}} \times 0.75 = 0.50$$

WN 2: Position to be taken:

Since the company is long position in Spot (Cash) Market it shall take Short Position in Future Market

WN 3: Computation of futures position for perfect hedge:

Security	Beta	Weight	Product
Spot market	0.50	53,40,000 (534 × 10,000)	26,70,000
Futures	1.00	(26,70,000)	(26,70,000)
Total	0.00	53,40,000	0

- We have to short futures worth Rs.26,70,000 for perfect hedge
- Size of one contract = 1,000 kgs × 534 = Rs.5,34,000
- No of contracts for perfect hedge = (26,70,000/5,34,000) = 5 Contracts

22. Hedging with futures [May 2020 RTP, May 2019 MTP, May 2013, May 2015 MTP, Nov 2023 MTP, SM]

On January 1, 2013 an investor has a portfolio of 5 shares as given below:

Security	Price	No. of Shares	β
A	349.30	5,000	1.15
B	480.50	7,000	0.40
C	593.52	8,000	0.90
D	734.70	10,000	0.95
E	824.85	2,000	0.85

The cost of capital to the investor is 10.5% per annum. You are required to calculate.

- The beta of his portfolio.
- The theoretical value of the NIFTY futures for February 2013.
- The number of contracts of NIFTY the investors needs to sell to get a full hedge until February for his portfolio if the current value of NIFTY is 5900 and NIFTY futures are trading lot requirement of 200 units. Assume that the futures are trading at their fair value.
- The number of future contracts the investor should trade if he desire to reduce the beta of his portfolios to 0.6

(No. of days in a year be treated as 365. Given: $\ln(1.105) = 0.0998$ e $(0.015858) = 1.01598$)

Answer:**WN 1: Computation of Beta of portfolio:**

Security	Beta	Weight	Product
A	1.15	17,46,500	20,08,475
B	0.40	33,63,500	13,45,400
C	0.90	47,48,160	42,73,344
D	0.95	73,47,000	69,79,650
E	0.85	16,49,700	14,02,245
Total	0.8491	1,88,54,860	1,60,09,114

$$\text{Portfolio Beta} = \frac{\text{Sum of product}}{\text{Sum of weights}} = \frac{1,60,09,114}{1,88,54,860} = 0.8491 \text{ Times}$$

WN 2: Computation of fair futures price:**Base data:**

Spot price	Rs.5,900
Time period	58 days (or) 58/365 years
Rate of interest	10.50% normal rate (or) 9.98% continuous compounded rate per annum (Note 1)
Dividend	0
Storage cost	0
Type of compounding	Continuous

Note 1:

- Cost of capital of the company is 10.50 percent per annum. This can be converted into CCRFI rate using natural log values ($\ln$)

- $\ln(1.105) = 0.0998$. This would mean that normal cost of capital of 10.50 per annum can be converted into continuous compounded rate of 9.98 percent per annum

Fair Futures Price:

$$\begin{aligned}\text{Fair Futures Price} &= \text{Spot Price} \times e^{rt} \\ \text{Fair Futures Price} &= 5,900 \times e^{(0.0998)(\frac{58}{365})} \\ \text{Fair Futures Price} &= 5,900 \times e^{0.015858} \\ \text{Fair Futures Price} &= 5,900 \times 1.01598 \\ \text{Fair Futures Price} &= \text{Rs. 5,994.28}\end{aligned}$$

WN 3: Calculation of number of contracts for perfect hedging:

Security	Beta	Weight	Product
Portfolio	0.8491	1,88,54,860	1,60,09,114
Futures	1.00	(1,60,09,114)	(1,60,09,114)
Total	0	1,88,54,860	0

- We should sell NIFTY futures worth Rs.1,60,09,114 for perfect hedge

$$\text{No of contracts to be sold} = \frac{1,60,09,114}{200 \times 5,994.28} = 13.35 \text{ rounded off to 13 contracts}$$

WN 4: Calculation of number of contracts to reduce beta to 0.6 Times:

Security	Beta	Weight	Product
Portfolio	0.8491	1,88,54,860	1,60,09,114
Futures	1.00	(46,96,198)	(46,96,198)
Total	0.60	1,88,54,860	1,13,12,916

- We should sell NIFTY futures worth Rs.46,96,198 to reduce Beta to 0.6 Times

$$\text{No of contracts to be sold} = \frac{46,96,198}{200 \times 5,994.28} = 3.917 \text{ rounded off to 4 contracts}$$

23. Hedging with futures [Nov 2018 MTP, May 2018 MTP, Nov 2015, SM, Nov 2023]

On April 1, 2015, an investor has portfolio consisting of eight securities as shown below:

Security	Price	No. of shares	β
A	29.40	400	0.59
B	318.70	800	1.32
C	660.20	150	0.87
D	5.20	300	0.35
E	281.90	400	1.16
F	275.40	750	1.24
G	514.60	300	1.05
H	170.50	900	0.76

The cost of capital for the investor is given to be 20% per annum. The investor fears a fall in the prices of the shares in the near future. Accordingly, he approaches you for advice. You can make use of the following information/assumptions:

- ❖ The current S&P CNX Nifty value is 8500.
- ❖ S&P CNX Nifty futures can be traded in units of 25 only.
- ❖ The May futures are currently quoted at 8700 and the June Futures are being quoted at 8850.

You are required to:

- Calculate the beta of his portfolio.
- Calculate the theoretical value of the futures contracts according to the investor for contracts expiring in (1) May, (2) June. [Given $e^{0.03} = 1.03045$; $e^{0.04} = 1.04081$; $e^{0.05} = 1.05127$]
- Calculate the number of units of S&P CNX Nifty that he would have to sell if he desires to hedge until June (1) his total portfolio, (2) 50% of his portfolio and (3) 120% of his portfolio.

Answer:**WN 1: Computation of Beta of portfolio:**

Security	Beta	Weight	Product
A	0.59	11,760	6,938
B	1.32	2,54,960	3,36,547

C	0.87	99,030	86,156
D	0.35	1,560	546
E	1.16	1,12,760	1,30,802
F	1.24	2,06,550	2,56,122
G	1.05	1,54,380	1,62,099
H	0.76	1,53,450	1,16,622
Total	1.1019	9,94,450	10,95,832

$$\text{Beta} = \frac{\text{Sum of Product}}{\text{Sum of weights}} = \frac{10,95,832}{9,94,450} = 1.1019 \text{ Times}$$

WN 2: Computation of Fair Futures Price:**Contract expiring in May:****Base data:**

Spot price	8,500
Time period	2 months (or) 0.16667 year
Rate of interest	20%
Dividend	0
Storage cost	0
Type of compounding	Continuous

Fair Futures Price:

Fair Futures Price = Spot Price $\times e^{rt}$
Fair Futures Price = $8,500 \times e^{(0.20)(0.16667)}$
Fair Futures Price = $8,500 \times e^{0.03333}$
Fair Futures Price = $8,500 \times 1.03387$
Fair Futures Price = Rs. 8,788

Note: Computation of $e^{0.03333}$:

$e^{0.03333}$ shall be computed using interpolation formula as follows

$e^{0.03}$	=	1.03045
$e^{0.04}$	=	1.04081
$e^{0.01}$	=	0.01036
$e^{0.0033}$	=	0.00342 (0.01036 $\times$ 33/100)
$e^{0.0067}$	=	0.00694 (0.01036 $\times$ 67/100)
$e^{0.0333}$	=	1.03045 + 0.00342 = 1.03387
(or)		
$e^{0.0333}$	=	1.04081 - 0.00694 = 1.03387

Contract expiring in June:**Base data:**

Spot price	8,500
Time period	3 months (or) 0.25 year
Rate of interest	20%
Dividend	0
Storage cost	0
Type of compounding	Continuous

Fair Futures Price:

Fair Futures Price = Spot Price $\times e^{rt}$
Fair Futures Price = $8,500 \times e^{(0.20)(0.25)}$
Fair Futures Price = $8,500 \times e^{0.05}$
Fair Futures Price = $8,500 \times 1.05127$
Fair Futures Price = Rs. 8,935.80

WN 3: Computation of number of contracts for hedging portfolio till June:

Scenario 1: Hedging full portfolio:

- Investor wants to hedge full portfolio and hence the Beta will come down to zero

Security	Beta	Weight	Product
Security	1.1019	9,94,450	10,95,832
Nifty futures	1	(10,95,832)	(10,95,832)
Total	0	9,94,450	0

$$\text{No of contracts to sell} = \frac{10,95,832}{25 \times 8,850} = 4.95 \sim 5 \text{ contracts}$$

Scenario 2: Hedging 50% portfolio:

$$\text{No of contracts to sell} = 4.95 \times 0.50 = 2.475 \sim 2 \text{ or } 3 \text{ contracts}$$

Scenario 3: Hedging 120% portfolio:

$$\text{No of contracts to sell} = 4.95 \times 1.20 = 5.94 \sim 6 \text{ contracts}$$

24. Futures hedging [Dec 2021] [Concept Revision]

A future contract on BSE Index with 4 months maturity is used to hedge the value of the portfolio over the next 3 months. One future contract for delivery is 50 times of the index. The following information is available:

Value of Portfolio	1,16,00,000
BSE sensex on 1 st Jan 2022 [Anticipated on 1 st Sep 2021]	58,580
BSE sensex on 1 st Jan 2022 [Anticipated on 1 st Dec 2021]	56,641.25
Dividend yield of index	6% p.a.
181 days treasury bill rate	9% p.a.
Beta of the portfolio	1.5

You are required to calculate:

- The present value of the Sensex as on 1st September 2021
- Turned out value of the Sensex as on 1st December 2021
- The number of contracts to hedge the portfolio

Answer:**WN 1: Computation of present value of sensex on 1st Sep 2021 [Spot Price]**

Spot price	?
Time period	4 months (or) 0.33 year
Rate of interest	9% per annum (or) 3% per 4 months
Dividend	6% per annum (or) 2% per 4 months
Storage cost	0
Type of compounding	Once in four months
Futures price	58,580

Computation of Spot price:

$$\text{Fair Futures Price} = \text{Spot Price} \times (1 + (r - y))^t$$

$$58,580 = \text{Spot price} \times (1 + (0.03 - 0.02))^1$$

$$\text{Spot price} = \frac{58,580}{1.01} = 58,000$$

WN 2: Computation of present value of sensex on 1st Dec 2021 [Spot Price]

Spot price	?
Time period	1 month
Rate of interest	9% per annum (or) 0.75% per month
Dividend	6% per annum (or) 0.50% per month
Storage cost	0
Type of compounding	Monthly
Futures price	56,641.25

Computation of Spot price:

Fair Futures Price = Adjusted Spot Price $\times (1 + (r - y))^t$

$$56,641.25 = \text{Spot price} \times (1 + (0.0075 - 0.0050))^1$$

$$\text{Spot Price} = \frac{56,641.25}{1.0025} = \text{Rs. } 56,500$$

WN 3: Computation of number of contracts for hedging:

Security	Beta	Weight	Product
Portfolio	1.50	1,16,00,000	1,74,00,000
BSE futures	1.00	(1,74,00,000)	(1,74,00,000)
Total	0.00	1,16,00,000	0

$$\text{Number of contracts to be sold} = \frac{1,74,00,000}{50 \times 58,580} = 5.94 \text{ Contracts} \sim 6 \text{ Contracts}$$

25. Hedging of stock position [Dec 2021]

On 1st July 2021 Mr. P has made the following investment:

Name of Company	No of equity shares	Beta	Purchase Price per Equity Share
ML Limited	1,000	1.25	Rs.700

He wants to hold the investment till end of September 2021 with an expectation of huge dividends to be announced in the AGM. On the date of investment, September Nifty Futures are quoting at 17500 and tradeable with lot size of 50 for each contract.

You are the Investment advisor to Mr. P,

- Please advise Mr. P how to hedge his market exposure using the available data.
- Calculate the profit or loss of Mr. P during the expiry of September 2021 futures in following situation:
 - Nifty Future rise by 10% (b) ML Ltd. falls by 5%
- Is it possible stock as well as nifty to rise or fall at the same percentage? Please state the reason.

Answer:**WN 1: Creation of hedge:**

Security	Beta	Weight	Product
ML Limited	1.25	7,00,000	8,75,000
Nifty futures	1.00	-8,75,000	-8,75,000
Total	0.00	7,00,000	0

$$\text{Number of contracts to be sold} = \frac{8,75,000}{17,500 \times 50} = 1 \text{ Contracts}$$

WN 2: Computation of profit/loss:**Nifty raises by 10 percent:**

- If Nifty has increased by 10 percent, then ML Limited will increase by 12.50 percent

Particulars	Calculation	Amount
Profit on ML Limited shares	7,00,000 $\times$ 12.50%	87,500
Loss on Nifty futures	8,75,000 $\times$ 10%	-87,500
Net profit/loss		0

ML Limited falls by 5 percent:

ML Limited has fallen by 5 percent and hence Nifty will fall by 4 percent [5/1.25]

Particulars	Calculation	Amount
Loss on ML Limited shares	7,00,000 $\times$ 5%	-35,000
Profit on Nifty futures	8,75,000 $\times$ 4%	35,000
Net profit/loss		0

Part (iii):

Normally it is not possible that Nifty to rise or fall by same percentage because of systematic risk i.e. Beta may not be the same as of market. It can change by same percentage only if the Beta of the security is 1 time.

26. Hedging with futures [Nov 2016, May 2021 RTP, Nov 2021 RTP, Nov 2022, May 2019 MTP, Nov 2019 MTP, May 2022 MTP, May 2023 MTP, SM] [Homework]

Details about portfolio of shares of an investor is as below:

Shares	No of shares (lakh)	Price per share	Beta
A Limited	3.00	500	1.40
B Limited	4.00	750	1.20
C Limited	2.00	250	1.60

The investor thinks that the portfolio is carrying a very high risk as compared to the market risk and hence interested to reduce the portfolio's systematic risk to 0.91. He is considering two below mentioned alternative strategies:

- Dispose off a part of his existing portfolio to acquire risk free securities, or
- Take appropriate position on Nifty Futures which are currently traded at Rs.8,125 and each Nifty points is worth Rs.200

You are required to determine:

- Interpret the opinion of investor, whether it is correct or not.
- Calculate the existing systematic risk of the portfolio
- The value of risk free securities to be acquired
- The number of shares of each company to be disposed off
- The number of Nifty contracts to be bought/sold and
- Calculate the new systematic risk of portfolio if the company has taken position in Nifty Futures and there is 2% rise in Nifty

Answer:

Yes, the apprehension of investor is correct as the current portfolio is more riskier than market as the beta (Systematic Risk) of market portfolio is as computed as follows

Shares	Beta	Weight	Product
A Limited	1.40	1,500	2,100
B Limited	1.20	3,000	3,600
C Limited	1.60	500	800
Overall	1.30	5,000	6,500

- Overall Beta (systematic risk) of Portfolio = 1.3 Times

WN 2: Computation of risk-free securities to be acquired to get target Beta of 0.91 times:

Particulars	Beta	Weight	Product
Equity portfolio	1.30	3,500	4,550
Risk-free securities	0	1,500	0
Overall	0.91	5,000	4,550

- ❖ The company needs target beta of 0.91 times and we first update that. Based on target Beta of 0.91 times and weight of 5,000 we should get overall product of 4,550
- ❖ Product for risk-free security will be zero irrespective of weight and hence product for equity portfolio will be 4,550
- ❖ Weight for equity portfolio = $4,550 / 1.30 = 3,500$
- ❖ Weight for risk-free security = $5,000 - 3,500 = 1,500$
- ❖ Hence, we should buy risk-free securities of 1,500 lacs

WN 3: Computation of number of shares to be disposed-off:

- ❖ The company currently has a share portfolio of 5,000 lacs and the revised portfolio is 3,500 lacs. Hence, we should dispose 30 percent of share portfolio to reduce Beta.

Shares	Existing shares (in lacs)	Shares to be disposed-off (in lacs)
A Limited	3.00	0.90
B Limited	4.00	1.20
C Limited	2.00	0.60

WN 4: Adjustment of Beta through Nifty Futures:

Particulars	Beta	Weight	Product
Equity portfolio	1.30	5,000	6,500
Nifty Futures	1.00	-1,950	-1,950
Overall	0.91	5,000	4,550

- ❖ The company currently has portfolio of 5,000 lacs and the risk adjusted value (product) for the same is 6,500 lacs

- ❖ The company can reduce the risk through Nifty Futures. The overall Beta has to be 0.91 and the product will be 4,550 lacs
- ❖ Nifty futures will have Beta of 1 time and weight for the same will not appear in total of weights. This is because the portfolio value will continue to be 5,000 lacs despite entering into long/short Nifty Futures
- ❖ Value of Nifty Futures = 4,550 – 6,500 = -1,950 lacs; Answer is negative and hence we should go for short position

$$\text{No of contracts to be short} = \frac{1,950 \text{ lacs}}{8,125 \times 200} = 120 \text{ contracts}$$

WN 5: Computation of Beta for 2% rise in Nifty:

- ❖ The share portfolio will improve by 2.6% (2% x 1.3 times) for a 2% rise in Nifty. Profit on portfolio is equal to Rs.130 lacs (5,000 x 2.6%)
- ❖ Nifty futures will have a loss of 2 percent as the investor has entered into short position. Loss on Nifty Futures is equal to Rs.39 lacs (1,950 x 2%)
- ❖ **Overall profit = Rs.91 lacs or 1.82% of portfolio**

$$\text{Beta} = \frac{\text{change in portfolio}}{\text{Change in market}} = \frac{1.82}{2.00} = 0.91 \text{ Times}$$

27. Hedging with futures [May 2018 MTP]

On 1 April 2015, Sunidhi was holding a portfolio of 10 securities whose value was Rs. 9,94,450, the weighted average of beta of 9 securities was 1.10.

Since she was expecting a fall in the prices of the shares in near future to hedge her portfolio she sold 5 contract of NIFTY Futures (Multiplier of 25) expiring in May 2015, which was trading at 8767.07 on 1 April.

- Calculate the beta of the 10th security.
- Reconcile the reasons in spite of 2% fall in the market as per Sunidhi's apprehension if she would have earned some profit on her cash position.

Answer:

WN 1: Computation of overall beta of 10 securities:

Security	Beta	Weight	Product
10 securities	1.102	9,94,450	10,95,881
Nifty futures	1.00	(10,95,881)	(10,95,881)
Total	0	9,94,450	0

Note:

- Beta for Nifty futures will be 1 time
- Weight for Nifty futures = -5 x 25 x 8,767.07 = Rs.10,95,881
- We have fully hedged the portfolio and hence total of product will be zero. Hence weight for 10 securities will be balancing figure of Rs.10,95,881

$$\text{Overall Beta} = \frac{10,95,881}{9,94,450} = 1.102 \text{ Times}$$

WN 2: Computation of Beta of 10th Security:

- ❖ It is assumed that there is equal investment in all securities and hence weight of 9 securities will be 0.9 and weight of 10th security will be 0.1

Security	Beta	Weight	Product
9 Security	1.1	0.9	0.99
10 th Security	1.12	0.1	0.112
Total	1.102	1.0	1.102

Note:

- Overall product is 1.102 Times
- Product for 10th security = 1.102 – 0.99 = 0.112
- Beta of 10th security = 0.112/0.1 = 1.12 Times

WN 3: Reason for earning some profit despite hedging:

The main reason for the profit in cash position might be due to reason that contrary to her expectation of fall in the value of cash position there may be increase in value of cash position.

28. Hedging with futures [May 2021 MTP, Nov 2021 RTP, May 2020 RTP, May 2020 MTP, SM]
[Concept Revision]

A portfolio manager has the following five stocks in his portfolio

Security	No of shares	Price/share	Beta
A	10000	50	1.2
B	5000	20	2.0
C	8000	25	0.7
D	1000	100	1.0
E	500	200	1.3

- Compute portfolio beta?
- If the manager wants to reduce the beta to 0.8, how much risk free investment would he bring in? What will be the new portfolio?
- If the manager wants to increase the beta to 1.4, how much of risk free investment should he sell? What will be the new portfolio?
- Suppose Nifty spot is 1200 points and Nifty futures is 1250 points and futures have a contract multiplier of 200, how can he obtain the same position as in (ii) by dealing in Nifty futures?
- How can he obtain the same position as in (iii) by dealing in Nifty futures?

Answer:

WN 1: Computation of portfolio Beta:

Security	Beta	Weight	Product
A	1.20	5,00,000	6,00,000
B	2.00	1,00,000	2,00,000
C	0.70	2,00,000	1,40,000
D	1.00	1,00,000	1,00,000
E	1.30	1,00,000	1,30,000
Total	1.17	10,00,000	11,70,000

- Portfolio Beta = 1.17 Times

WN 2: Reducing Beta to 0.8 Times:

It is assumed that investment in shares would continue to be Rs.10,00,000 and the investor would bring in additional money for risk-free investment

Security	Beta	Weight	Product
Portfolio	1.17	10,00,000	11,70,000
Risk-free	0.00	4,62,500	0
Total	0.80	14,62,500	11,70,000

Note:

- Beta of risk-free asset is zero and hence product of risk-free asset will be zero
- Total of product = 11,70,000 + 0 = 11,70,000
- Overall beta = 0.8 Times
- Total of weights = 11,70,000/0.80 = Rs.14,62,500
- Weight of risk-free asset = 14,62,500 – 10,00,000 = Rs.4,62,500
- Investor needs to bring risk-free investment of Rs.4,62,500 to reduce beta to 0.8 times

WN 3: Increasing Beta to 1.4 Times:

Security	Beta	Weight	Product
Portfolio	1.17	10,00,000	11,70,000
Risk-free	0.00	(1,64,286)	0
Total	1.40	8,35,714	11,70,000

- Investor should borrow Rs.1,64,286 to increase beta to 1.4 times

WN 4: Changing beta through futures:

Reducing beta to 0.8 times:

Security	Beta	Weight	Product
Portfolio	1.17	10,00,000	11,70,000
Futures	1.00	(3,70,000)	(3,70,000)
Total	0.80	10,00,000	8,00,000

$$\text{No of contracts to be sold} = \frac{3,70,000}{200 \times 1,250} = 1.48 \sim 1 \text{ or } 2 \text{ contracts}$$

Increasing beta to 1.4 times:

Security	Beta	Weight	Product
Portfolio	1.17	10,00,000	11,70,000
Futures	1.00	2,30,000	2,30,000
Total	1.40	10,00,000	14,00,000

$$\text{No of contracts to be bought} = \frac{2,30,000}{200 \times 1,250} = 0.92 \sim 1 \text{ contract}$$

29. Hedging with futures [Nov 2004, SM]

Which position on the index future gives a speculator, a complete hedge against the following transactions:

- ❖ The share of Right Limited is going to rise. He has a long position on the cash market of Rs. 50 lakhs on the Right Limited. The beta of the Right Limited is 1.25.
- ❖ The share of Wrong Limited is going to depreciate. He has a short position on the cash market of Rs. 25 lakhs on the Wrong Limited. The beta of the Wrong Limited is 0.90.
- ❖ The share of Fair Limited is going to stagnant. He has a short position on the cash market of Rs. 20 lakhs of the Fair Limited. The beta of the Fair Limited is 0.75.

Answer:**Computation of index futures to get complete hedge:**

Security	Beta	Weight	Product
Right Limited	1.25	50,00,000	62,50,000
Wrong Limited	0.90	-25,00,000	-22,50,000
Fair Limited	0.75	-20,00,000	-15,00,000
Index futures	1.00	-25,00,000	-25,00,000
Total	0	5,00,000	0

The speculator needs to sell index futures worth Rs.25,00,000 to have a complete hedge for all transactions

30. Beta calculation – reverse working [May 2015 RTP, Nov 2013, Nov 2018 RTP, Jan 2021, Nov 2022 RTP, May 2023 RTP]**ICAI Question:**

Mr. Careless was employed with ABC Portfolio Consultants. The work profile of Mr. Careless involves advising the clients about taking position in Future Market to obtain hedge in the position they are holding. Mr. ZZZ, their regular client purchased 100,000 shares of X Inc. at a price of \$22 and sold 50,000 shares of A plc for \$40 each having beta 2. Mr. Careless advised Mr. ZZZ to take short position in Index Future trading at \$1,000 each contract. Though Mr. Careless noted the name of A plc along with its beta value during discussion with Mr. ZZZ but forgot to record the beta value of X Inc.

On next day Mr. ZZZ closed out his position when:

- ❖ Share price of X Inc. dropped by 2%
- ❖ Share price of A plc appreciated by 3%
- ❖ Index Future dropped by 1.5%

Mr. ZZZ, informed Mr. Careless that he has made a loss of \$114,500 due to the position taken. Since record of Mr. Careless was incomplete he approached you to help him to find the number of contract of Future contract he advised Mr. ZZZ to be short to obtain a complete hedge and beta value of X Inc. You are required to find these values.

Modification in Question:

“Mr. Careless advised Mr. ZZZ to take short position in Index Future trading at \$1,000 each contract – It should be long position and not short-position”

Answer:**WN 1: Analysis of loss of \$ 1,14,500:**

Security	Amount bought/sold	% change	Profit/loss
X Inc	22,00,000	(2%)	(44,000) [22,00,000 x -2%]
A Inc	(20,00,000)	3%	(60,000) [-20,00,000 x 3%]

Index Futures	7,00,000 [-10,500/-1.5%]	(1.5%)	(10,500) [1,14,500 - 44,000 - 60,000]
Total			(1,14,500)

- ❖ The investor has made loss of \$ 1,14,500. He has made loss of 44,000 in X Inc and 60,000 in A Inc. Hence the balance loss of 10,500 would be in index futures
- ❖ Index futures have fallen by 1.5% and hence amount of index futures dealt was 7,00,000 [-10,500/-1.5%]

$$\text{No of contracts to be bought} = \frac{7,00,000}{1,000} = 700 \text{ Contracts}$$

WN 2: Computation of Beta of A Inc:

Security	Beta	Weight	Product
X Inc	1.5 [33,00,000/22,00,000]	22,00,000	33,00,000
A Inc	2	(20,00,000)	(40,00,000)
Nifty Futures	1	7,00,000	7,00,000
Total	0	2,00,000	0

- ❖ The investor has obtained a perfect hedge and hence overall Beta and total of products will be zero.
- ❖ Reverse working we will get total of X Inc to be 33,00,000
- ❖ Beta of X Inc = 33,00,000/22,00,000 = 1.5 Times

31. Profit/Loss Computation – May 2019 MTP, Nov 2020 MTP, SM [Homework]

Ram buys 10,000 shares of X Ltd. at a price of Rs. 22 per share whose beta value is 1.5 and sells 5,000 shares of A Ltd. at a price of Rs. 40 per share having a beta value of 2. He obtains a complete hedge by Nifty futures at Rs. 1,000 each. He closes out his position at the closing price of the next day when the share of X Ltd. dropped by 2%, share of A Ltd. appreciated by 3% and Nifty futures dropped by 1.5%.

Calculate the overall profit/loss to Ram?

Answer:

WN 1: Computation of Nifty futures taken for hedging:

Security	Beta	Weight	Product
X Limited	1.50	2,20,000	3,30,000
A Limited	2.00	-2,00,000	-4,00,000
Nifty Futures	1.00	70,000	70,000
Total	0	20,000	0

WN 2: Computation of overall profit/loss:

Security	Position	Change	Profit/loss [Position x Change]
X Limited	2,20,000	-2%	-4,400
A Limited	-2,00,000	+3%	-6,000
Nifty Futures	70,000	-1.5%	-1,050
Total	0		-11,450

32. Computation of net realization [Nov 2020 RTP, May 2013 RTP, May 2023] [Concept Revision]

A Rice Trader has planned to sell 22000 kg of Rice after 3 months from now. The spot price of the Rice is Rs. 60 per kg and 3 months Future on the same is trading at Rs. 59 per kg. Size of the contract is 1000 kg. The price is expected to fall as low as Rs. 56 per kg, 3 months hence.

Required:

- to interpret the position of trader in the Cash Market.
- to advise the trader the trader should take in Future Market to mitigate its risk of reduced profit.
- to demonstrate effective realized price for its sale if he decides to make use of future market and after 3 months, spot price is Rs. 57 per kg and future contract price for closing the contract is Rs. 58 per kg.

Answer:

Part 1:

- Since trader has planned to sell after 3 months now it implies, he is in Long Position in Cash or Spot Market.

Part 2:

- Since the trader is in Long Position in Cash Market, he can mitigate its risk of reduced profit by hedging his position by selling Rice Futures i.e. Short Position in Future Market.

Part 3:**Computation of futures profit/loss:**

Date	Position	Action	Reference Date	Rate
Day 0	Original Position	Sell	3 months	59.00
3 months	Opposite Position	Buy	3 months	(58.00)
Net profit per Kg in futures market				1.00

- ❖ Investor originally entered into contract to sell rice at the rate of Rs.59.00 in futures market. The same would be cancelled in month 3 to get the net profit/loss
- ❖ The contract would be cancelled in month 3 at the futures rate of Rs.58.00 and hence the net profit per Kg of rice is Rs.1.00

Computation of effective realized price:

Particulars	Amount
Realization in the spot market	57.00
Futures Profit	1.00
Effective realization	58.00

33. Benefit of hedging:

ABC Technologies is expecting to receive a sum of USD 4,00,000 after 3 months. The company decided to go for future contract to hedge against the risk. The standard size of future contract available in the market is USD 1,000. As on date spot and futures contract are quoting at Rs.44.00 and Rs.45.00 respectively. Suppose after 3 months the company closes out its position futures are quoting at Rs.44.50 and spot rate is also quoting at Rs.44.50. You are required to calculate effective realization for the company while selling the receivable.

Answer:**WN 1: Computation of number of contracts:**

The company can hedge position by selling future contracts as it will receive amount from outside.

$\text{No of contracts} = \frac{4,00,000}{1,000} = 400 \text{ contracts}$

WN 2: Computation of Profit/loss on futures:

Date	Position	Action	Reference Date	Rate
Day 0	Original Position	Sell	Day 90	45.00
Day 90	Opposite Position	Buy	Day 90	(44.50)
Net profit per USD in futures market				0.50
Overall Profit (0.50 x 400 contracts x 1,000)				2,00,000

WN 3: Computation of effective realized price:

Particulars	Calculation	Amount
Realization in the spot market	4,00,000 x 44.50	1,78,00,000
Futures Profit		2,00,000
Total realization		1,80,00,000
No of dollars		4,00,000
Realization per USD	1,80,00,000/4,00,000	45.00

34. Swap agreement [May 2018 RTP, May 2017 MTP, Nov 2017 MTP, Nov 2021 MTP] [Homework]

TMC Holding Ltd. has a portfolio of shares of diversified companies valued at Rs. 400 crore enters into a swap arrangement with None Bank on the terms that it will get 1.15% quarterly on notional principal of Rs. 400 crore in exchange of return on portfolio which is exactly tracking the Sensex which is presently 21,600. You are required to determine the net payment to be received/ paid if Sensex turns out to be 21,860, 21,780, 22,080 and 21,960 at the end of each quarter.

Answer:**WN 1: Computation of net-payment to be received/paid for every quarter:**

Quarter	Sensex	Sensex Return %	Amount payable (Rs. Crore)	Fixed return receivable (Rs. Crore)	Net payment(-) /receipt(+)

0	21,600	-	-	-	-
1	21,860	1.2037	4.8148 [400 cr x 1.2037%]	4.6000 [400 cr x 1.15%]	-0.2148
2	21,780	-0.3660	-1.4640	4.6000	+6.0640
3	22,080	1.3774	5.5096	4.6000	-0.9096
4	21,960	-0.5435	-2.1740	4.6000	6.7740

Part III – Maintenance Margin

35. Maintenance of margin – Mark to Market [Nov 2019 RTP, May 2015 RTP, Nov 2018 RTP, May 2022 MTP, Nov 2024 MTP, SM] [Concept Revision]

Sensex futures are traded at a multiple of 50. Consider the following quotations of sensex futures in the 10 trading days during February, 2017:

Day	High	Low	Closing
4-2-09	3306.4	3290.0	3296.50
5-2-09	3298.00	3262.50	3294.40
6-2-09	3256.20	3227.00	3230.40
7-2-09	3233.00	3201.50	3212.30
10-2-09	3281.50	3256.00	3267.50
11-2-09	3283.50	3260.00	3263.80
12-2-09	3315.00	3286.30	3292.00
14-2-09	3315.00	3257.10	3309.30
17-2-09	3278.00	3249.50	3257.80
18-2-09	3118.00	3091.40	3102.60

You have bought one sensex futures contract on February 04. The average daily absolute change in the value of the contract is Rs.10,000 and standard deviation of these changes is Rs.2,000. The maintenance margin is 75% of initial margin. You are required to determine the daily balances in the margin account and payment of margin calls, if any.

Answer:

- Initial margin = Daily absolute change + (3 x standard deviation)
- Initial margin = 10,000 + (3 x 2,000) = Rs.16,000
- Maintenance margin = 16,000 x 75% = Rs.12,000

Date	Price	Profit/Loss	Margin balance	Deposit/ withdrawal	Revised balance
Feb 4	3296.50	0	16,000	0	16,000
Feb 5	3294.40	-105	15,895	0	15,895
Feb 6	3230.40	-3,200	12,695	0	12,695
Feb 7	3212.30	-905	11,790	4,210	16,000
Feb 10	3267.50	2,760	18,760	0	18,760
Feb 11	3263.80	-185	18,575	0	18,575
Feb 12	3292.00	1,410	19,985	0	19,985
Feb 14	3309.30	865	20,850	0	20,850
Feb 17	3257.80	-2,575	18,275	0	18,275
Feb 18	3,102.60	-7,760	-10,515	5,485	16,000

Note:

- Feb 5 and Feb 6 balance has reduced from 16,000 but the same was maintained above maintenance margin. Hence this was not replenished back to 16,000
- On Feb 7, the balance fell below Rs.12,000 and hence the same was replenished back to Rs.16,000 (initial margin)

36. MTM Profits/losses on futures [Jan 2021, May 2023 MTP]

The price of March Nifty Futures Contract on a particular day was 9170. The minimum trading lot on Nifty Futures is 50. The initial margin is 8% and the maintenance margin is 6%. The index closed at the following levels on next five days:

Day	1	2	3	4	5

Settlement Price	9380	9520	9100	8960	9140

- (i) Mark to market cash flows and daily closing balances on account of
- An investor who has taken a long position at 9170
 - An investor who has taken a short position at 9170
- (ii) Net profit/ loss on each of the contracts

Answer:

WN 1: Computation of initial margin and maintenance margin:

- Initial Margin = Value of one contract $\times$ 8% = $9,170 \times 50 \times 8\%$ = Rs.36,680
- Maintenance margin = Value of one contract $\times$ 6% = $9,170 \times 50 \times 6\%$ = Rs.27,510

WN 2: Mark to market cash flows for investor taking long position:

Day	Price	Profit/loss	Margin balance	Deposit/withdrawal	Revised balance
1	9380	10,500 [210 $\times$ 50]	47,180 [36,680 + 10,500]		47,180
2	9520	7,000 [140 $\times$ 50]	54,180 [47,180 + 7,000]		54,180
3	9100	-21,000 [420 $\times$ 50]	33,180 [54,180 - 21,000]		33,180
4	8960	-7,000 [140 $\times$ 50]	26,180 [33,180 - 7,000]	10,500 [36,680 - 26,180]	36,680
5	9140	9,000 [180 $\times$ 50]	45,680 [36,680 + 9,000]	-	45,680

- Margin balance should not fall below maintenance margin. It has fallen below maintenance margin on Day 4, and hence a margin call was made and the amount was replenished back to initial margin
- Overall profit/loss = 10,500 + 7,000 - 21,000 - 7,000 + 9,000 = -1,500**
- Hence the investor will make loss of Rs.1,500**

WN 3: Mark to market cash flows for investor taking short position:

Day	Price	Profit/loss	Margin balance	Deposit/withdrawal	Revised balance
1	9380	-10,500 [210 $\times$ 50]	26,180 [36,680 - 10,500]	10,500	36,680
2	9520	-7,000 [140 $\times$ 50]	29,680 [36,680 - 7,000]	-	29,680
3	9100	21,000 [420 $\times$ 50]	50,680 [29,680 + 21,000]	-	50,680
4	8960	7,000 [140 $\times$ 50]	57,680 [50,680 + 7,000]	-	57,680
5	9140	-9,000 [180 $\times$ 50]	48,680 [57,680 - 9,000]	-	48,680

- Overall profit/loss = -10,500 - 7,000 + 21,000 + 7,000 - 9,000 = Rs.1,500**

Hence the investor will make profit of Rs.1,500

37. Initial and maintenance margin [Dec 2021] [Homework]

On 31/08/2021 Mr. R has taken a Long position of Two lots of Nifty Futures at 17300. One lot of Nifty future is 50 units. Initial Margin required is 10% of Contract Value. Maintenance Margin required is 80% of Initial Margin. The closing price of 5 days are given below-

Date	Closing price of NIFTY Futures
01/09/2021	17340
02/09/2021	17180
03/09/2021	16990
06/09/2021	16900
07/09/2021	17120

You are required to

- Prepare a statement showing the daily balances in the margin account & payment on margin calls, if any.
- Compute the Gain or Loss of Mr. R, if contract squared off on 07/09/2021.
- What would be the Gain or Loss if Mr. R, had taken the short position?

Answer:

WN 1: Computation of initial margin and maintenance margin:

- Value of two contracts = $17,300 \times 50 \times 2 = \text{Rs.}17,30,000$
- Initial margin = 10% of 17,30,000 = Rs.1,73,000
- Maintenance Margin = $\text{Rs.}1,73,000 \times 80\% = \text{Rs.}1,38,400$

WN 2: Margin Account:

Date	Price	Profit/Loss	Margin balance	Deposit/ withdrawal	Revised balance
Sep-01	17,340	4,000	1,77,000	0	1,77,000
Sep-02	17,180	-16,000	1,61,000	0	1,61,000
Sep-03	16,990	-19,000	1,42,000	0	1,42,000
Sep-06	16,900	-9,000	1,33,000	40,000 (Deposit)	1,73,000
Sep-07	17,120	22,000	1,95,000	0	1,95,000

- Gain/loss = $100 \times [\text{Selling Price} - \text{Purchase Price}]$
- Gain/loss = $100 \times [17,120 - 17,300] = \text{Loss of Rs.}18,000$

WN 3: Gain/loss if Mr. R had taken short position:

- Gain/loss = $100 \times [\text{Selling Price} - \text{Purchase Price}]$
- Gain/loss = $100 \times [17,300 - 17,120] = \text{Profit of Rs.}18,000$

Part IV - Basics of Option**38. Spot the option terms**

The Infosys stock is selling at Rs.5,000. Mr.X has a negative view about the stock. He decides to go through the option route to take advantage of the situation. He buys an option from Mr.A which will entitle him to sell 100 shares on or before 30th December at Rs.4,500 per share for which has to pay Rs.20 per share today.

Identify:

- Type of option
- Exercise price
- Expiry date
- Option premium
- Buyer of the option
- Writer of the option
- Underlying asset and
- Current market price

Answer:

Type of option	American put option
Exercise price	Rs.4,500 per share
Expiry date	December 30
Option premium	Rs.20 per share (or) Rs.2,000 per contract
Buyer of option	Mr. X
Writer of option	Mr. A
Underlying asset	Stock of Infosys
Current market price	Rs.5,000

39. Spot the option terms

The WIPRO stock is selling at Rs.700. Mr.Z thinks that the stock price will rise. He decides to go through the option route to take advantage of the situation. He buys an option from Mr.K which will entitle him to buy 100 shares on or before 30th December at Rs.725 per share for which has to pay Rs.10 per share today. Identify type of option, exercise price, expiry date, option premium, buyer of the option, writer of the option, underlying asset and the current market price?

Answer:

Type of option	American call option
Exercise price	Rs.725 per share
Expiry date	December 30
Option premium	Rs.10 per share (or) Rs.1,000 per contract
Buyer of option	Mr. Z

Writer of option	Mr. K
Underlying asset	Stock of Wipro
Current market price	Rs.700

40. Option status

State whether each one of the following is in the money, at the money or out of the money

Option	Exercise Price	Stock Price	Status
Call	60	55	
Call	50	50	
Call	110	105	
Call	30	35	
Put	110	100	
Put	105	105	
Put	12	15	
Put	25	20	

Answer:

Option	Exercise Price	Stock Price	Status
Call	60	55	Out the money
Call	50	50	At the money
Call	110	105	Out the money
Call	30	35	In the money
Put	110	100	In the money
Put	105	105	At the money
Put	12	15	Out the money
Put	25	20	In the money

41. Intrinsic value

Consider the data relating to a stock contained in the following table. Determine both the intrinsic value and the time value in each of the cases.

Option	Exercise	Asset Price	Option Price	Intrinsic value	Time value
Call	90	100	15		
Call	110	100	2		
Put	200	100	140		
Put	90	100	4		
Put	150	125	30		
Call	150	125	30		

Answer:

Option	Exercise	Asset Price	Option Price	Intrinsic value	Time value
Call	90	100	15	10	5
Call	110	100	2	0	2
Put	200	100	140	100	40
Put	90	100	4	0	4
Put	150	125	30	25	5
Call	150	125	30	0	30

- Intrinsic value = Gross payoff of option if it is exercised
- Time value = Option price - Intrinsic value. Time value cannot be negative

Part V -Payoff table and Payoff graph

42. Payoff for call option

The September option on AB corp stock at a strike price of Rs.130 is available at a call option price of Rs.10. The contract size is 100 shares. The price of the stock today in 15 June is Rs.140. A range of prices beginning from 110 and ending with 160 with intervals of 10 is possible as at the expiry date.

- What is the payoff for the call holder on expiration?
- Draw the payoff graph
- What is the call writer's payoff on expiration

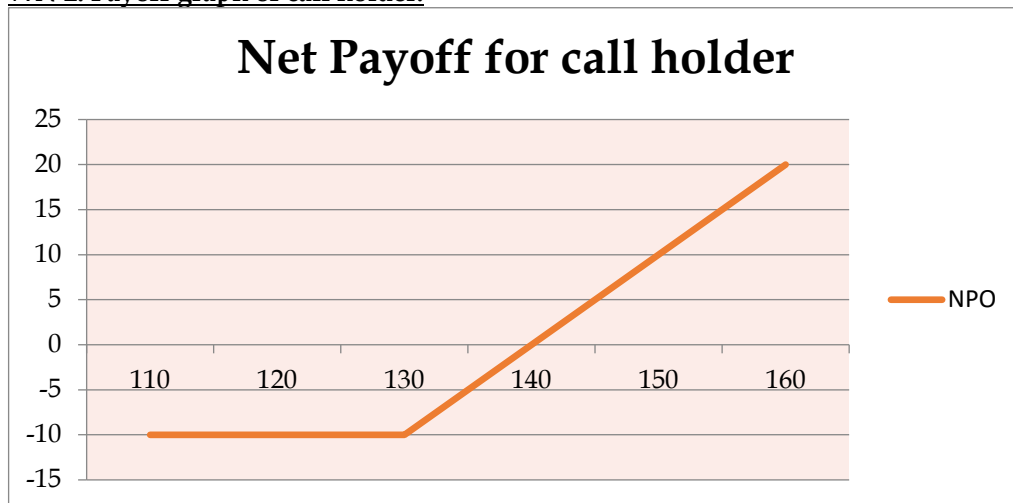
iv. Draw the payoff table and the payoff graph

Answer:

WN 1: Pay-off table for call holder:

Price	110	120	130	140	150	160
Exercise price	130	130	130	130	130	130
Action	Lapse	Lapse	Lapse	Exercise	Exercise	Exercise
GPO	0	0	0	10	20	30
Premium	-10	-10	-10	-10	-10	-10
NPO	-10	-10	-10	0	10	20

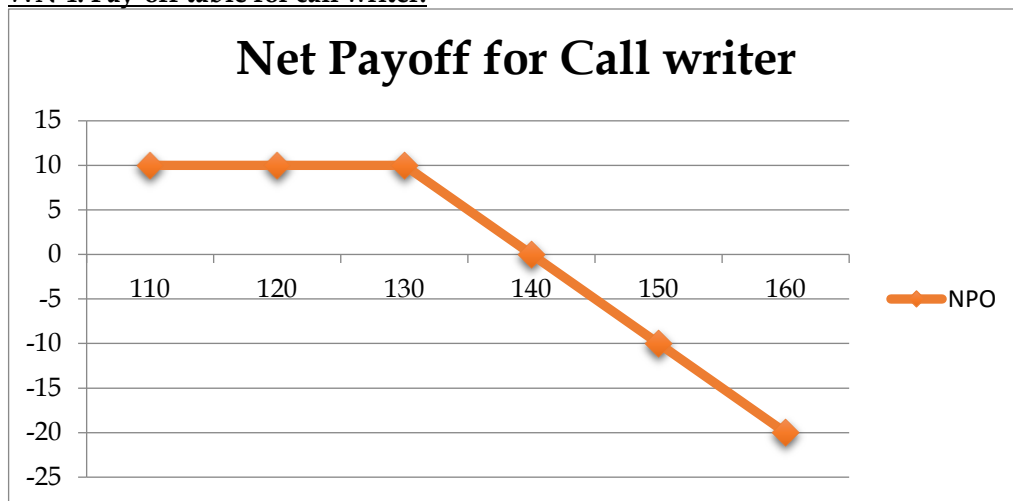
WN 2: Payoff graph of call holder:



WN 3: Pay-off table for call writer:

Price	110	120	130	140	150	160
Exercise price	130	130	130	130	130	130
Action	Lapse	Lapse	Lapse	Exercise	Exercise	Exercise
GPO	0	0	0	-10	-20	-30
Premium	10	10	10	10	10	10
NPO	10	10	10	0	-10	-20

WN 4: Pay-off table for call writer:



43. Payoff for put option

The September put option on JB Ltd stock at a strike price of Rs.110 is available at a price of Rs.10. The contract size is 100 shares. The price of the stock today on 15 June is Rs.115. A range of prices beginning from 90 and ending with 140 with intervals of 10 is possible as at the expiry date.

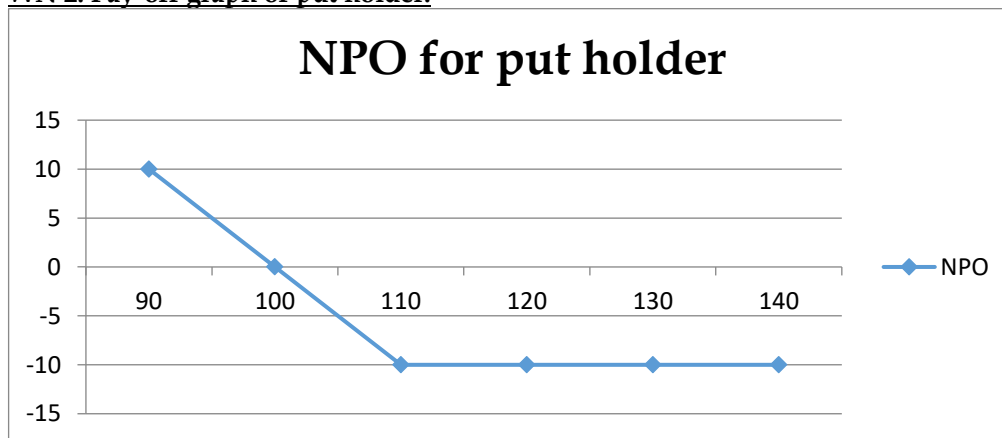
- What is the payoff for the put holder on expiration?
- Draw the payoff graph
- What is the put writer's payoff on expiration?
- Draw the payoff table and the payoff graph

Answer:

WN 1: Pay-off table for put holder:

Price	90	100	110	120	130	140
EP	110	110	110	110	110	110
Action	Exercise	Exercise	Lapse	Lapse	Lapse	Lapse
GPO	20	10	0	0	0	0
Premium	-10	-10	-10	-10	-10	-10
NPO	10	0	-10	-10	-10	-10

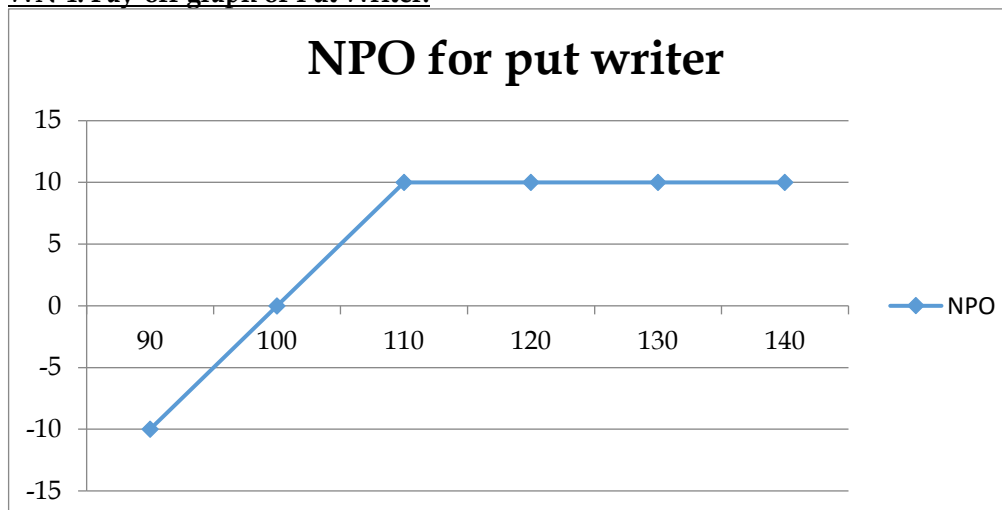
WN 2: Pay-off graph of put holder:



WN 3: Pay-off table for put writer:

Price	90	100	110	120	130	140
EP	110	110	110	110	110	110
Action	Exercise	Exercise	Lapse	Lapse	Lapse	Lapse
GPO	-20	-10	0	0	0	0
Premium	10	10	10	10	10	10
NPO	-10	0	10	10	10	10

WN 4: Pay-off graph of Put Writer:



44. Application of option strategy [Concept Revision]

Mr. A is considering writing a 30-day option on ABC Limited which is currently trading at Rs.60 per share. The exercise price of the share is also Rs.60 and the premium received on the option will be Rs.3.75. At what share prices will he make money, at what price will he start to lose money and at what prices will he lose Rs.5 and Rs.10 on each option that is written?

Answer:

- Type of option is not mentioned in the question. It is assumed that it is a call option

Particulars	Make money	Lose money	Loss of Rs.5	Loss of Rs.10
Actual price	63.74	63.76	68.75	73.75
Exercise price	60.00	60.00	60.00	60.00
Gross payoff	-3.74	-3.76	-8.75	-13.75
Premium	3.75	3.75	3.75	3.75
Net payoff	0.01	-0.01	-5.00	-10.00

Note:

- We have first filled net payoff. Making money (0.01), starting to lose money (-0.01) and loss of Rs.5 and Rs.10.
- GPO is negative for writer. Option will be exercised if actual market price is higher than exercise price
- Price at which profit would be earned = Price below 63.75 (63.75 is break-even price at which profit/loss would be zero)
- Price at which loss would be incurred = Price above 63.75
- Price at which loss will be Rs.5 = Rs.68.75
- Price at which loss will be Rs.10 = Rs.73.75

45. Payoff for option strategy [Nov 2018, May 2009, Nov 2019 RTP, Nov 2019 MTP, Nov 2024 RTP, SM]

The equity share of VCC Ltd. is quoted at Rs. 210. A 3-month call option is available at a premium of Rs. 6 per share and a 3-month put option is available at a premium of Rs. 5 per share. The strike price in both cases is Rs.220 and the share price on the exercise day is Rs.200, 210, 220, 230 and 240.

Required:

- Ascertain the net payoffs to the optionholder of a call option and a put option.
- Indicate the price range at which the call and the put options may be gainfully exercised
- Mr.A is holding 100 shares of VCC Limited and is interested in hedging downside risk of his holding as he is going to sell them after 3-months. Suggest the position Mr.A should take in the option market to hedge his holding in the VCC Ltd

Answer:**WN 1: Pay-off table for call holder:**

Price	200	210	220	230	240
Exercise price	220	220	220	220	220
Action	Lapse	Lapse	Lapse	Exercise	Exercise
GPO	0	0	0	10	20
Premium	-6	-6	-6	-6	-6
NPO	-6	-6	-6	4	14

- Break-even price = Exercise price + Premium = 220 + 6 = Rs.226
- Option can be gainfully exercised if the price is greater than Rs.226

WN 2: Pay-off table for put holder:

Price	200	210	220	230	240
Exercise price	220	220	220	220	220
Action	Exercise	Exercise	Lapse	Lapse	Lapse
Gross payoff	20	10	0	0	0
Premium	-5	-5	-5	-5	-5
Net payoff	15	5	-5	-5	-5

- Break-even price = Exercise price – Premium = Rs.220 – 5 = Rs.215
- Option can be gainfully exercise if the price is lower than Rs.215

Hedging strategy of Mr.A:

Since Mr.A holds 100 equity shares, he should buy equal no. of Put option i.e. 100 put options in the same stock to hedge his position.

46. Payoff for option [Nov 2014 MTP, May 2019 RTP, May 2006, May 2024 MTP, May 2024, SM]

The market received some information about ABC Ltd's tie up with a Multinational Company. This has induced the market price to move up. If the information is false, the ABC Ltd.'s stock price will probably fall dramatically. To protect from this, an investor has bought the call and put options. He purchased one 3 month's call with a striking price of Rs. 45 for Rs. 3 premium and paid Rs. 2 per share premium for a 3 month's put with a striking price of Rs. 42. Assume 100 shares for call and put option.

- ❖ Determine the Investor's position if the tie up offer bids the price of ABC Corporation's stock up to Rs.44 in 3 months.
- ❖ Determine the Investor's ending position, if the tie up programme fails and the price of the stocks falls to Rs.34 in 3 months.
- ❖ To determine the investor's position if the tie up offer program is successful and the price of the stocks rise up to Rs. 46 in 3 months.

Answer:

Particulars	Price of 44	Price of 34	Price of 46
GPO of call option	0	0	100
GPO of put option	0	800	0
Total GPO	0	800	100
Premium	-500	-500	-500
Net profit/loss	-500	300	-400

47. Option strategy [Nov 2018 MTP, May 2018, May 2010, Nov 2008, Nov 2009, Nov 2011, May 2018 RTP, Nov 2020, May 2022 RTP, May 2022 MTP, SM, May 2024 RTP]

Mr. X established the following spread on the Delta Corporation's stock :

Purchased one 3-month call option with a premium of Rs. 30 and an exercise price of Rs. 550. Purchased one 3-month put option with a premium of Rs. 5 and an exercise price of Rs. 450. Corporation's stock is currently selling at Rs. 500. Determine profit or loss, if the price of Delta Corporation's :

- ❖ remains at Rs.500 after 3 months.
- ❖ falls at Rs.350 after 3 months.
- ❖ rises to Rs.600.

Assume the size option is 100 shares of Delta Corporation.

Answer:

Particulars	Price of 500	Price of 350	Price of 600
GPO of call option	-	-	5,000
GPO of put option	-	10,000	-
Total GPO	-	10,000	5,000
Premium	-3,500	-3,500	-3,500
Net profit/loss	-3,500	6,500	1,500

48. Decision making [Nov 2018 RTP, Nov 2021 MTP, May 2023 MTP]

Ram holding shares of Reliance Industries Limited which is currently selling at Rs.1,000. He is expecting that this price will further fall due to lower than expected level of profits to be announced after one month. As on following option contract are available in Reliance share.

Strike Price	Option	Premium
1030	Call	40
1010	Call	35
1000	Call	30
990	Put	35
970	Put	20
950	Put	8

930	Put	5

Ram is interested in selling his stock holding as he cannot afford to lose more than 5% of its value. Recommend a hedging strategy with option and show how his position will be protected.

Answer:

Instead of selling the stock of Reliance Limited, Ram must cover his risk by buying or long position in Put option with appropriate strike price. Since Ram's risk appetite is 5%, the most suitable strike price in put option shall be Rs.950 (Rs.1,000 – 5% of Rs.1,000). Impact of hedging will be as under:

- ❖ If the price is less than Rs.950, then investor can sell the stock for Rs.950. He would be paying premium of Rs.8 and hence net realization will be. Rs.942
- ❖ If the price is more than Rs.950, then investor can sell the stock for market price. He would be paying premium of Rs.8 and hence net realization will be Market price - Premium
- ❖ Thus, from the above, it can be seen that the value of holding of Ram shall never be less than Rs.942 as put option will compensate for loss below price of Rs.950. However, this strategy will involve a cost of Rs.8

Author's Note:

- Buying a put option with an exercise price of Rs.970 will ensure net inflow of Rs.950. However, this is not advisable as the investor is agreeing to 5% fall in price and hence the relevant exercise price is Rs.950
- This leads to lower premium. In case the price does not fall, the investor gets the required protection at lower premium cost

Part VI – Option Valuation**49. Put call parity**

Three-month call and three-month put are available on Multan Ltd's stock. The exercise price is Rs.100. The CCRFI is 12% p.a.

- i. If the put rules at Rs.5, and the share is worth Rs.95, Compute the value of the call.
- ii. If the put quotes Rs.3 and the call is worth Rs.4 what is the share worth?
- iii. If the market price of the call is Rs.8 and the market price of the share is Rs.102, what is the value of the put?
- iv. Rework the above three scenarios in case dividend of Rs.1 is to be paid at the end of first month.

Answer:**WN 1: Valuation of call option:**

Share + Put = Call + Present value of exercise price

$$95 + 5 = \text{Call} + \frac{100}{e^{rt}}$$

$$95 + 5 = \text{Call} + \frac{100}{e^{(0.12)(0.25)}}; 100 = \text{Call} + \frac{100}{1.03045}$$

$$100 = \text{Call} + 97.04$$

Call = Rs. 2.96

WN 2: Valuation of share:

Share + Put = Call + Present value of exercise price

$$\text{Share} + 3 = 4 + 97.04$$

Share = Rs. 98.04

WN 3: Valuation of put option:

Share + Put = Call + Present value of exercise price

$$102 + \text{Put} = 8 + 97.04$$

Put = Rs. 3.04

WN 4: Rework of three scenarios if dividend of Rs.1 is to be paid at the end of first month:

- Dividend of Rs.1 will be paid at the end of first month. In such a scenario we need to replace stock with price with adjusted stock price in the formula
- Adjusted stock price = Share price – Present value of dividend income

$$\text{PV of Dividend Income} = \frac{1}{e^{(0.12)(\frac{1}{12})}} = \frac{1}{e^{0.01}} = \frac{1}{1.01005} = \text{Rs. 0.99}$$

Valuation of call option of Part 1:

Adjusted stock price = $95 - 0.99 = \text{Rs.}94.01$

Share + Put = Call + Present value of exercise price

$94.01 + 5 = \text{Call} + 97.04$

Call = Rs. 1.97

Valuation of share of Part 2:

- Adjusted share price = Rs.98.04
- Adjusted share price = Share price - PV of dividend income
- $98.04 = \text{Share price} - 0.99$
- Share price = Rs.99.03**

Valuation of put option of Part 3:

- Share price = Rs.102
- Adjusted share price = $102 - 0.99 = \text{Rs.}101.01$

Share + Put = Call + Present value of exercise price

$101.01 + \text{Put} = 8 + 97.04$

Put = Rs. 4.05

50. Risk Neutral model [Nov 2018 MTP, May 2011, May 2013 RTP, Nov 2022 MTP, SM] [Concept Revision]

The current market price of an equity share of Penchant Ltd is Rs.420. Within a period of 3 months, the maximum and minimum price of it is expected to be Rs. 500 and Rs. 400 respectively. If the risk free rate of interest be 8% p.a., what should be the value of a 3 months Call option under the "Risk Neutral" method at the strike rate of Rs. 450 ? Given $e^{0.02} = 1.0202$

Answer:**WN 1: Computation of upside and downside probability:**

Expected share price = $PV \times e^{rt}$

Expected share price = $420 \times e^{(0.08)(0.25)} = 420 \times e^{0.02} = 420 \times 1.0202 = \text{Rs.}428.48$

Let us assume p to be the probability of price reaching Rs.400 and 1-p to be the probability of price reaching Rs.500

Price	Probability	Product
400	P	400P
500	1-P	500 - 500P
Total		400P+500-500P = 428.48

$$400P + 500 - 500P = 428.48; -100P = -71.52; P = \frac{71.52}{100} = 0.7152$$

- Hence 0.7152 is the probability of price reaching Rs.400 and 0.2848 (1 - 0.7152) is the probability of price reaching Rs.500

WN 2: Valuation of call option:

Price	IV	Probability	Product
400	0	0.7152	0
500	50	0.2848	14.24
Value of call at end of M3			14.24

- Value of call on maturity date = Rs.14.24
- Today's value of call option = $(14.24/1.0202) = \text{Rs.}13.96$**

51. Option valuation [Nov 2017]

A call option on gold with exercise price of Rs.26,000 per ten gram and three months to expire is being traded at a premium of Rs.1,010 per ten gram. It is expected that in three months' time the spot price might change to Rs.27,300 or Rs.24,700 per ten gram. At present this option is at-the-money and the rate of interest with simple compounding is 12% per annum. Is the current premium for the option justified? Evaluate the option and comments.

Answer:

WN 1: Computation of probability:

Let us assume p to be the probability of price touching Rs.27,300 and 1-p to be the probability of price touching Rs.24,700

PV	Probability	Product
27,300	P	27,300P
24,700	1-P	24,700 - 24,700P
Expected Price		26,780

- ❖ The exercise price of Gold is Rs.26,000. The option is at the money and hence exercise price is equal to current market price.
- ❖ Interest rate is 12% per annum and hence the same for three months will be 3%
- ❖ Expected price at end of 3 months = Rs.26,780 (26,000 + 3%)
- ❖ $27,300P - 24,700 - 24,700P = 26,780$
- ❖ $2,600P = 2,080$
- ❖ $P = 2,080 / 2,600 = 0.80$
- ❖ Probability of price touching Rs.27,300 is 0.80 and probability of price touching 24,700 is 0.20

WN 2: Computation of value of call option:

PV	EP	GPO	Probability	Product [GPO x Prob]
27,300	26,000	1,300	0.80	1,040
24,700	26,000	0	0.20	0
Future value of Call				1,040
Present value of Put = $\frac{1,040}{1.03}$				1,010

Hence the current premium of Rs.1,010 is justified as fair option price is Rs.1,010

52. Calculation of probability of price rise [Nov 2017 RTP, Nov 2018 MTP, May 2012, SM]

Sumana wanted to buy shares of EIL which has a range of Rs.411 to Rs.592 a month later. The present price per share is Rs.421. Her broker informs her that the price of this share can sore up to Rs. 522 within a month or so, so that she should buy a one month CALL of EIL. In order to be prudent in buying the call, the share price should be more than or at least Rs. 522 the assurance of which could not be given by her broker. Though she understands the uncertainty of the market, she wants to know the probability of attaining the share price Rs. 592 so that buying of a one month CALL of EIL at the execution price of Rs. 522 is justified. Advice her. Take the one-month risk free interest to be 3.60% and $e^{0.036} = 1.037$

Answer:**Computation of upside and downside probability:**

Expected share price = $PV \times e^{rt}$

Expected share price = $421 \times e^{(0.036)(1)} = 420 \times e^{0.036} = 420 \times 1.037 = \text{Rs. } 436.58$

Note: It is assumed that risk-free interest rate of 3.60% is the per month

Let us assume p to be the probability of price reaching Rs.411 and 1-p to be the probability of price reaching Rs.592

Price	Probability	Product
411	P	411P
592	1-P	592 - 592P
Total		411P+592-592P = 436.58

$$411P + 592 - 592P = 436.58; -181P = -155.42; P = \frac{155.42}{181} = 0.8587$$

- Hence 0.8587 is the probability of price reaching Rs.411 and 0.1413 (1 - 0.8587) is the probability of price reaching Rs.592
- **Probability of price reaching Rs.592 = 14.13%**

53. Binomial model

The current share price is Rs.20 and share price volatility has been estimated to be either 10% up or down. The risk-free interest rate is 12% p.a. Using two period binomial, estimated the fair price of 6 months call option with a strike price of Rs.21.

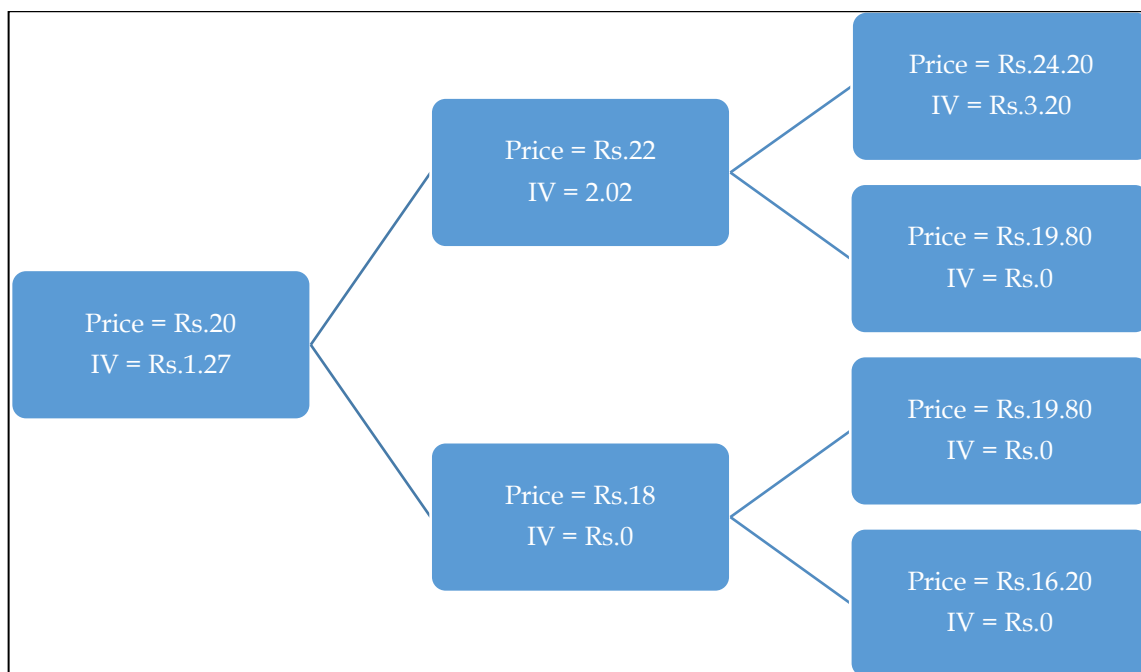
Answer:**WN 1: Computation of upside and downside probability:**

- Let us assume P to be the probability of price increase by 10% and 1-P to be the probability of price fall by 10%
- Risk-free rate of interest is 12% per annum. 6 month period has two binomial of three months. Proportionate risk-free rate of return for 3 months is 3%
- Expected price at end of month 3 = $20 + 3\% = \text{Rs.}20.60$

Price	Probability	Product
22	P	22P
18	1-P	18-18P
Total		22P+18-18P=20.60

$$22P + 18 - 18P = 20.60; 4P = 2.60; P = \frac{2.60}{4}; P = 0.65$$

- Hence probability of price raise is 65% and probability of price fall is 35%

WN 2: Valuation of option:**Note:**

- Share price is expected to either go up by 10% or fall by 10% over the next three months and then the same would be repeated from M3 to M6
- Intrinsic values in M6 is equal to Gross payoff of call option
- Value in month 3:
 - When price is Rs.22 = $[(3.20 \times 65\%) + (0 \times 35\%)]/1.03 = \text{Rs.}2.02$
 - When price is Rs.18 = $(0 \times 65\%) + (0 \times 35\%) = \text{Rs.}0$
- Valuation in Month 0 = $[(2.02 \times 65\%) + (0 \times 35\%)]/1.03 = \text{Rs.}1.27$
- Final value of Call = Rs.1.27**

54. Binomial model [Concept Revision]

A stock is currently priced at Rs.50. It is known that in the first 6 months of current year from now prices will either rise by 20% or go down by 20%, further in the later half of the year prices may again up by 20% or go down by 20%. Suppose risk free rate is 5% continuous compounded and strike rate is Rs.52. Calculate value of European Put option? Also calculate the value of European call option

Answer:**WN 1: Computation of upside and downside probability:**

- Let us assume P to be the probability of price increase by 20% and 1-P to be the probability of price fall by 20%
- Risk-free rate of interest is 5% per annum CCRFI

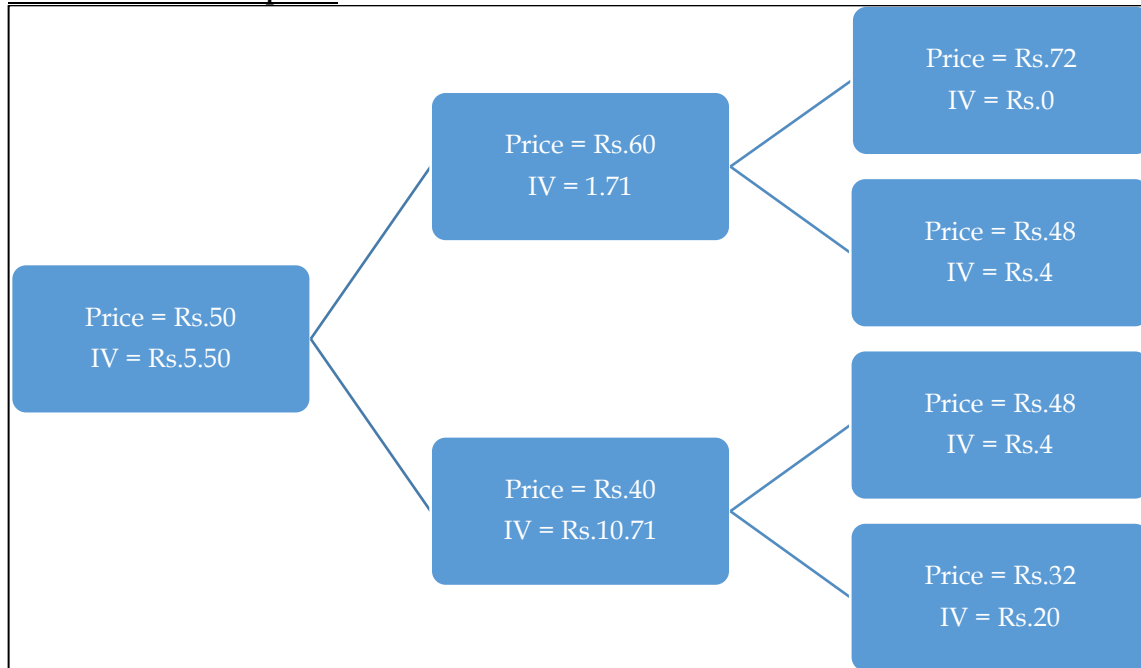
- Expected price at end of month 6 = $50 \times e^{(0.05)(0.5)} = 50 \times e^{0.025} = 50 \times 1.0253 = 51.27$

Price	Probability	Product
60	P	60P
40	1-P	40-40P
Total		60P+40-40P=51.27

$$60P + 40 - 40P = 51.27; 20P = 11.27; P = \frac{11.27}{20} = 0.5635$$

- Hence probability of price raise is 56.35% and probability of price fall is 43.65%

WN 2: Valuation of option:



Note:

- Share price is expected to either go up by 20% or fall by 20% over the next six months and then the same would be repeated from M6 to M12
- Intrinsic values in M12 is equal to Gross payoff of put option
- Value in month 6:
 - When price is Rs.60 = $[(0 \times 56.35\%) + (4 \times 43.65\%)] / e^{0.025} = \text{Rs.}1.71$
 - When price is Rs.40 = $[(4 \times 56.35\%) + (20 \times 43.65\%)] / e^{0.025} = \text{Rs.}10.71$
- Valuation in Month 0 = $[(1.71 \times 56.35\%) + (10.71 \times 43.65\%)] / e^{0.025} = \text{Rs.}5.50$
- Final value of Put Option = Rs.5.50**

WN 3: Valuation of call option using PCPT:

Share + Put = Call + Present value of exercise price

$$50 + 5.50 = \text{Call} + \frac{52}{e^{rt}}$$

$$50 + 5.50 = \text{Call} + \frac{52}{e^{0.05}}; 55.51 = \text{Call} + 49.46$$

$$\text{Call} = \text{Rs. } 6.04$$

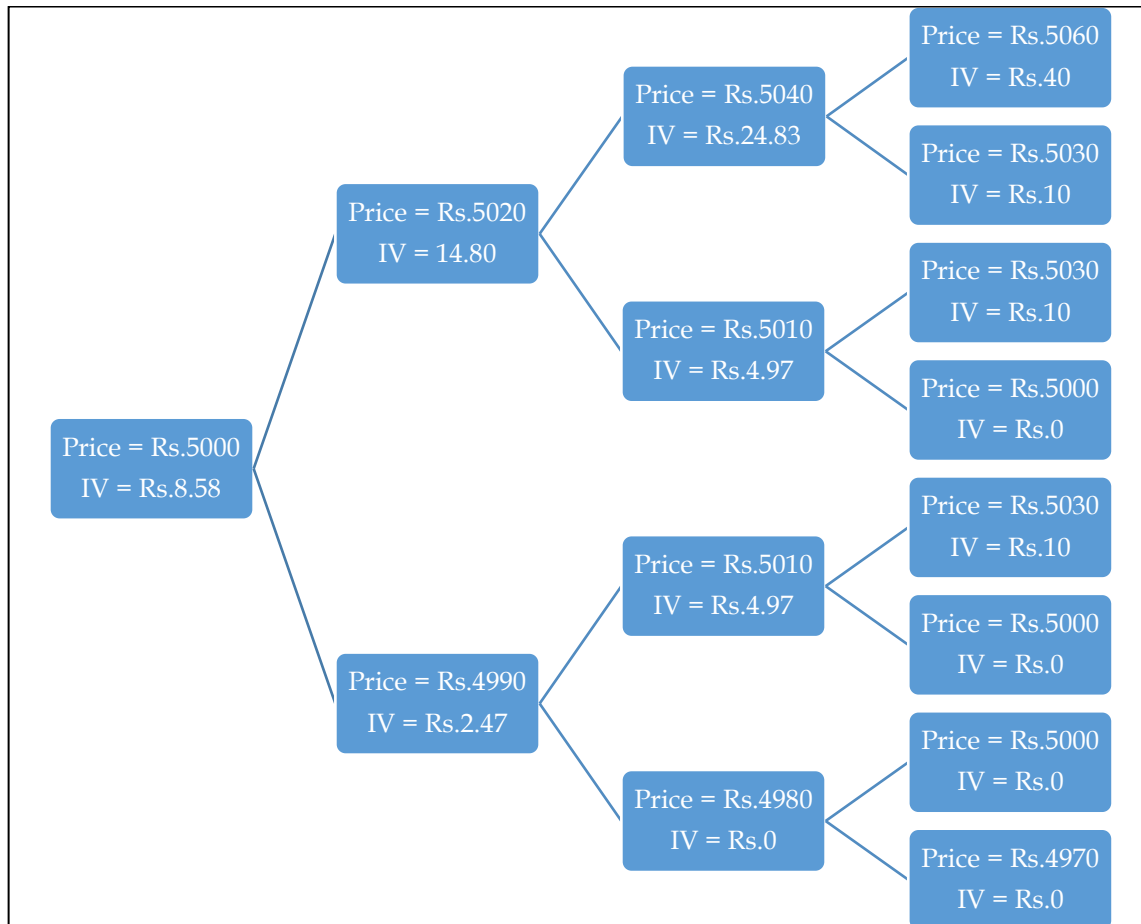
55. Binomial model

A stock index is at 5000 points. There is a 50% probability that it will change either up by 20 points or down by 10 points in each month. Consider an American call option on this index with an exercise price of 5020, which will expire in three months.

- Find the value of the American call if risk free rate is 8%?
- If the actual price of the call were Rs.12, what strategy would you adopt?
- If the actual price of the call were Rs.8, what strategy would you adopt?

Answer:

WN 1: Valuation of American call option:



- In an American option, we have a choice to exercise the option immediately or on expiry.
- Value of any node will be higher of immediate exercise (GPO on that day) or later exercise (weighted average of its branches)
- Valuation of Rs.5,040 in Month 2 will be higher of the following:
 - Immediate exercise: $GPO = 5,040 - 5,020 = Rs.20$
 - **Later exercise:** $[(40 \times 0.5) + (10 \times 0.5)] / (1 + 0.67\%) = Rs.24.83$
- Valuation of Rs.5,010 in Month 2 will be higher of the following:
 - Immediate exercise: $GPO = 0$
 - **Later exercise:** $[(10 \times 0.5) + (0 \times 0.5)] / (1 + 0.67\%) = Rs.4.97$
- Valuation of Rs.4,980 in Month 2 will be higher of the following:
 - Immediate exercise: $GPO = 0$
 - **Later exercise:** $(0 \times 0.5) + (0 \times 0.5) = Rs.0$
- Valuation of Rs.5,020 in Month 1 will be higher of the following:
 - Immediate exercise: $GPO = 0$
 - **Later exercise** = $[(24.83 \times 0.5) + (4.97 \times 0.5)] / (1 + 0.67\%) = Rs.14.80$
- Valuation of Rs.4,990 in Month 1 will be higher of the following:
 - Immediate exercise: $GPO = 0$
 - **Later exercise** = $[(4.97 \times 0.5) + (0 \times 0.5)] / (1 + 0.67\%) = Rs.2.47$
- Valuation of Rs.5,000 in Month 0 will be higher of the following:
 - Immediate exercise: $GPO = 0$
 - **Later exercise** = $[(14.80 \times 0.5) + (2.47 \times 0.5)] / (1 + 0.67\%) = Rs.8.58$
- **Final value of call option = Rs.8.58**

WN 2: Strategy of the investor:

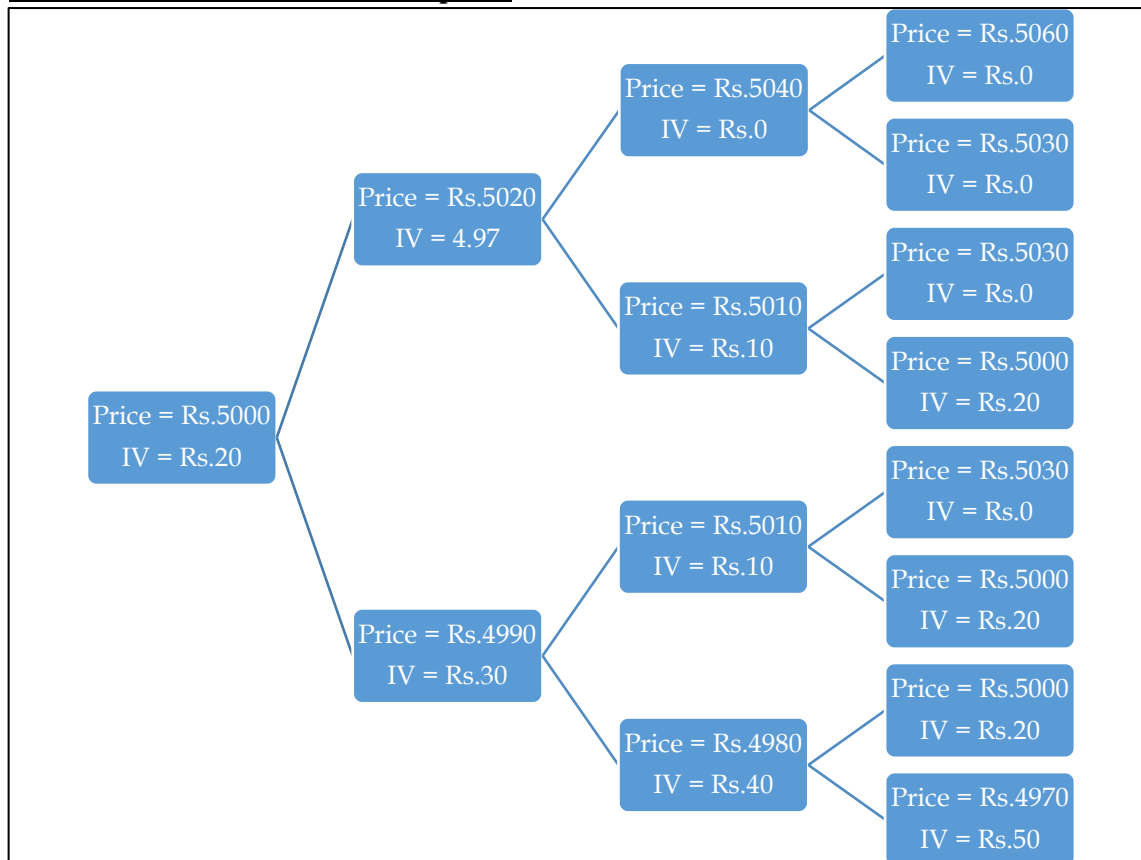
Actual call price of Rs.12	• Fair value of call is Rs.8.58 whereas actual value of call is Rs.12. This would mean that call is currently over-valued • We should sell over-valued securities and hence call option will be written
Actual call price of Rs.8	• Fair value of call is Rs.8.58 whereas actual value of call is Rs.8. This would mean that call is currently under-valued • We should buy under-valued securities and hence call option will be bought

56. Binomial model [Homework]

A stock index is at 5000 points. There is a 50% probability that it will change either up by 20 points or down by 10 points in each month. Consider an American put option on this index with an exercise price of 5020, which will expire in three months.

- Find the value of the American put if risk-free interest rate is 8%?
- If the actual price of the put were Rs.12, what strategy would you adopt?
- If the actual price of the put were Rs.28, what strategy would you adopt?

Answer:

WN 1: Valuation of American Put option:

- In an American option, we have a choice to exercise the option immediately or on expiry.
- Value of any node will be higher of immediate exercise (GPO on that day) or later exercise (weighted average of its branches)
- Valuation of Rs.5,040 in Month 2 will be higher of the following:
 - Immediate exercise: GPO = 0
 - Later exercise: $(0 \times 0.5) + (0 \times 0.5) = \text{Rs.}0$
- Valuation of Rs.5,010 in Month 2 will be higher of the following:
 - Immediate exercise: GPO = 10**
 - Later exercise: $[(0 \times 0.5) + (20 \times 0.5)] / (1 + 0.67\%) = \text{Rs.}9.93$
- Valuation of Rs.4,980 in Month 2 will be higher of the following:
 - Immediate exercise: GPO = 40**
 - Later exercise: $[(20 \times 0.5) + (50 \times 0.5)] / (1 + 0.67\%) = \text{Rs.}34.77$
- Valuation of Rs.5,020 in Month 1 will be higher of the following:
 - Immediate exercise: GPO = 0
 - Later exercise = $[(0 \times 0.5) + (10 \times 0.5)] / (1 + 0.67\%) = \text{Rs.}4.97$**
- Valuation of Rs.4,990 in Month 1 will be higher of the following:
 - Immediate exercise: GPO = 30**
 - Later exercise = $[10 \times 0.5) + (40 \times 0.5)] / 1.0067 = \text{Rs.}24.83$
- Valuation of Rs.5,000 in Month 0 will be higher of the following:
 - Immediate exercise: GPO = 20**
 - Later exercise = $[(4.97 \times 0.5) + (30 \times 0.5)] / 1.0067 = \text{Rs.}17.37$

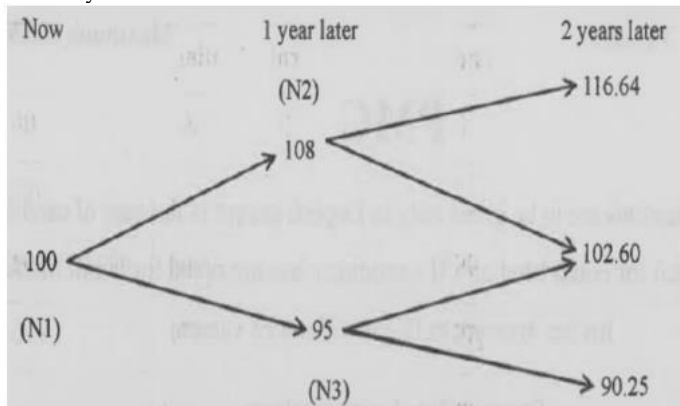
- Final value of Put = Rs.20

WN 2: Strategy of the investor:

Actual put price of Rs.12	• Fair value of put is Rs.20 whereas actual value of put is Rs.12. This would mean that put is currently under-valued • We should buy under-valued securities and hence put option will be bought
Actual put price of Rs.28	• Fair value of put is Rs.20 whereas actual value of put is Rs.28. This would mean that put is currently over-valued • We should sell over-valued securities and hence put option will be written

57. Binomial model – American Option – May 2023 RTP, May 2023 RTP [Concept Revision]

A two-year tree for a share of stock in ABC Ltd., is as follows:



Consider a two years American call option on the stock of ABC Ltd., with a strike price of Rs. 98. The current price of the stock is Rs. 100. Risk free return is 5 per cent per annum with a continuous compounding and $e^{0.05} = 1.05127$.

Assume two time periods of one year each. Using the Binomial Model, calculate:

- The probability of price moving up and down;
- Expected pay offs at each nodes i.e. N1, N2 and N3 (round off upto 2 decimal points).

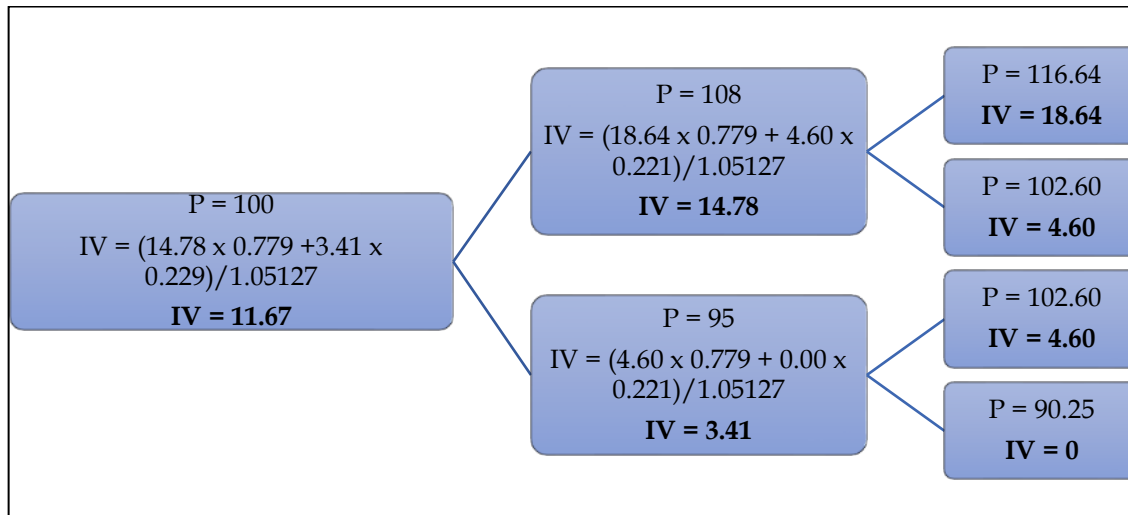
Answer:**WN 1: Computation of upside and downside probability:**

Let us assume p to be the probability of price touching 33 and $1-p$ to be the probability of price touching 27.

PV	Probability	Product
108	P	$108P$
95	$1-P$	$95-95P$
Expected Price		105.127

- ❖ Expected price at end of year = $100 \times 1.05127 = 105.127$
- ❖ $108P + 95 - 95P = 105.127$
- ❖ $13P = 10.127$
- ❖ $P = 10.127/13 = 0.779$ or 77.90%
- ❖ Probability of price touching moving up is 77.90% and price moving down is 22.10%

WN 2: Valuation of call option:



- ❖ Option under binomial model is valued from left to right. Value in sub-period 2 is the difference between current market price and exercise price
- ❖ Value when price is 108 is higher of
 - Immediate exercise = Rs.8
 - **Later exercise = Rs.14.78**
- ❖ Value when price is 95 is higher of
 - Immediate exercise = 0
 - **Later exercise = Rs.3.41**
- ❖ Value today = Weighted average of possible intrinsic value (IV) with probability being the assigned weight. The value was thereafter discounted at time value of money.

58. Binomial model [May 2009, Nov 2019 RTP, SM] [Homework]

Consider a two year American call option with a strike price of Rs. 50 on a stock the current price of which is also Rs. 50. Assume that there are two time periods of one year and in each year the stock price can move up or down by equal percentage of 20%. The risk free interest rate is 6%. Using binominal option model, calculate the probability of price moving up and down. Also draw a two step binomial tree showing prices and payoffs at each node.

Answer:

WN 1: Computation of upside and downside probability:

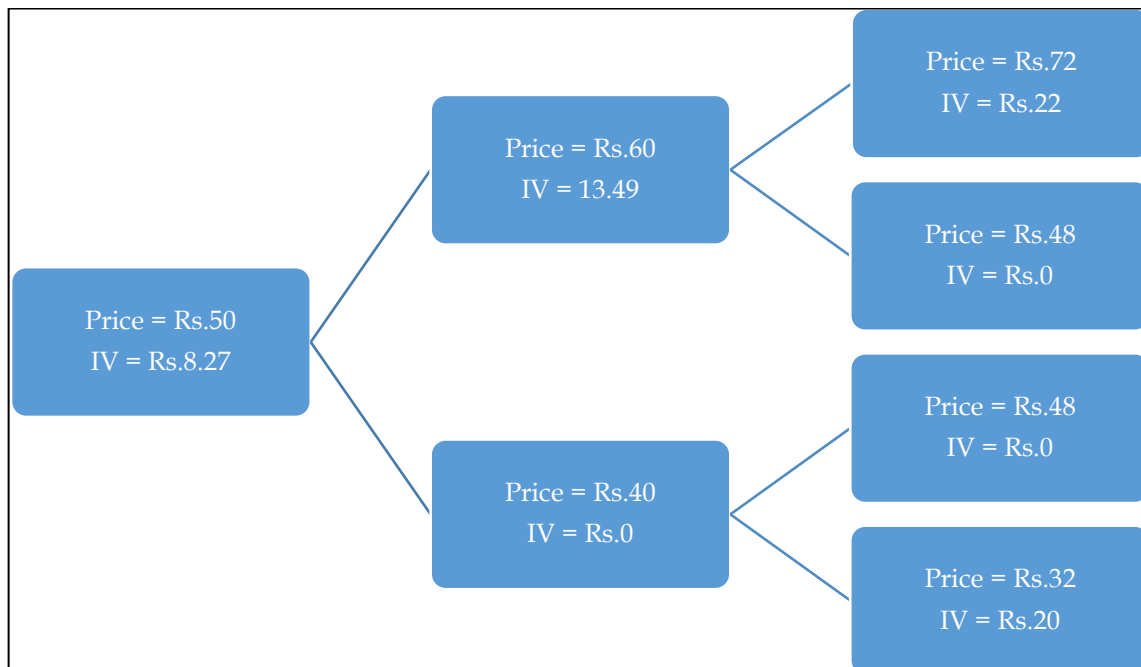
- Let us assume P to be the probability of price increase by 20% and 1-P to be the probability of price fall by 20%
- Risk-free rate of interest is 6% per annum
- Expected price at end of year = $50 + 6\% = \text{Rs. } 53$

Price	Probability	Product
60	P	60P
40	1-P	40-40P
Total		60P+40-40P=53

$$60P + 40 - 40P = 53; 20P = 13; P = \frac{13}{20} = 0.65$$

- Hence probability of price raise is 65% and probability of price fall is 35%

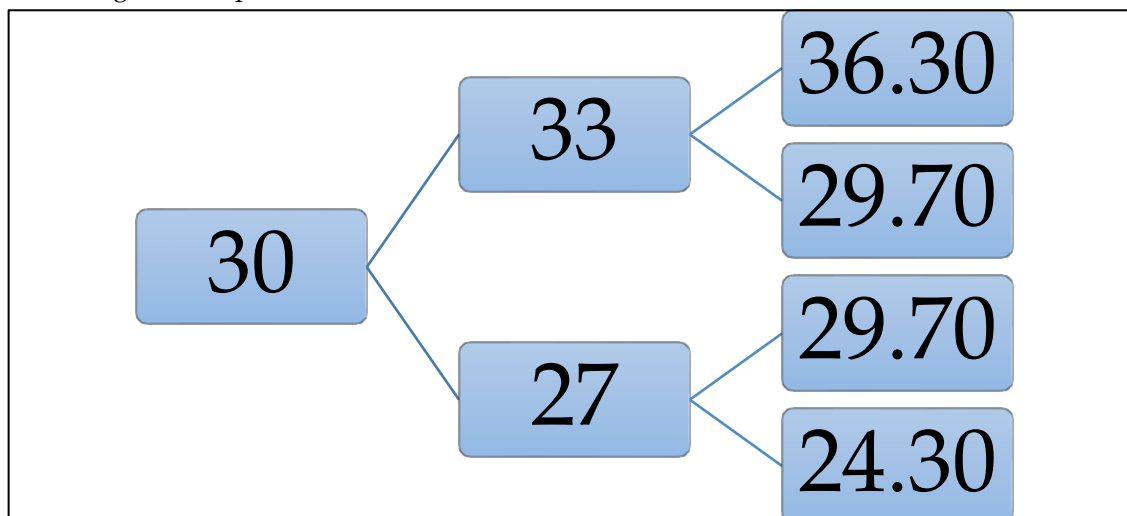
WN 2: Valuation of call option:

**Note:**

- Valuation of Rs.60 in year 1 will be higher of the following:
 - Immediate exercise: GPO = Rs.10
 - Later exercise: $[(22 \times 0.65) + (0 \times 0.35)]/1.06 = \text{Rs.13.49}$
- Valuation of Rs.40 in year 1 will be higher of the following:
 - Immediate exercise: GPO = 0
 - Later exercise: $(0 \times 0.65) + (0 \times 0.35) = \text{Rs.0}$
- Valuation of Rs.50 in year 0 will be higher of the following:
 - Immediate exercise: GPO = 0
 - Later exercise: $[(13.49 \times 0.65) + (0 \times 0.35)]/1.06 = \text{Rs.8.27}$
- Final value of call = Rs.8.27**

59. Binomial model [Nov 2020, SM] [Homework]

Following is a two-period tree for a share of stock in CAB Limited:



Using the binomial model, calculate the current fair value of a regular call option on CAB stock with the following characteristics. $X = \text{Rs.28}$, Risk free rate = 2.5 percent (per sub period). You should also indicate the composition of the implied riskless hedge portfolio at the valuation date.

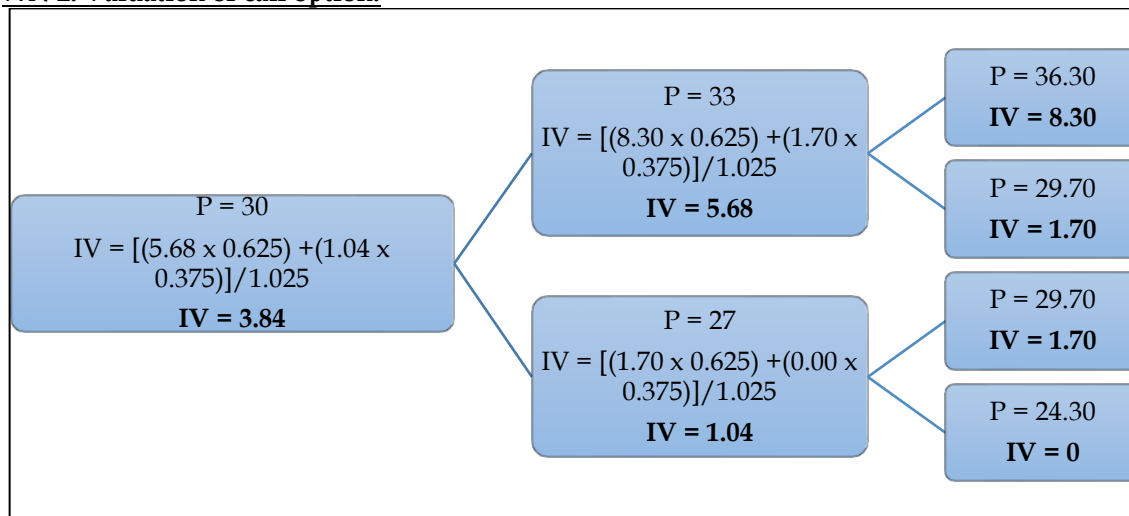
Answer:**WN 1: Computation of upside and downside probability:**

Let us assume p to be the probability of price touching 33 and $1-p$ to be the probability of price touching 27.

PV	Probability	Product

33	P	33P
27	1-P	27 - 27P
Expected Price		30.75

- ❖ Expected price at end of sub-period will be Rs.30.75 [30 + 2.5%]
- ❖ $33P + 27 - 27P = 30.75$
- ❖ $6P = 3.75$
- ❖ $P = 3.75/6 = 0.625$
- ❖ Probability of price touching 33 is 0.625 and probability of price touching 27 is 0.375

WN 2: Valuation of call option:**Note:**

- ❖ Option under binomial model is valued from left to right. Value in sub-period 2 is the difference between current market price and exercise price
- ❖ Value in sub-period 1 = Weighted average of possible intrinsic value (IV) with probability being the assigned weight
- ❖ Value today = Weighted average of possible intrinsic value (IV) with probability being the assigned weight

WN 3: Formation of riskless hedge portfolio:

$$\text{Delta} = \frac{\text{Spread in option price}}{\text{Spread in stock price}} = \frac{5 - 0}{33 - 27} = 0.8333 \text{ times}$$

- ❖ Delta of option is 0.8333 times. This would mean that option price change would be 0.8333 times of the change in share price.
- ❖ Hence a combination of 1 option and 0.8333 shares can create a riskless hedge portfolio. Alternatively a combination of 1 share and 1.20 options (1/0.8333) will create a riskless hedge portfolio.

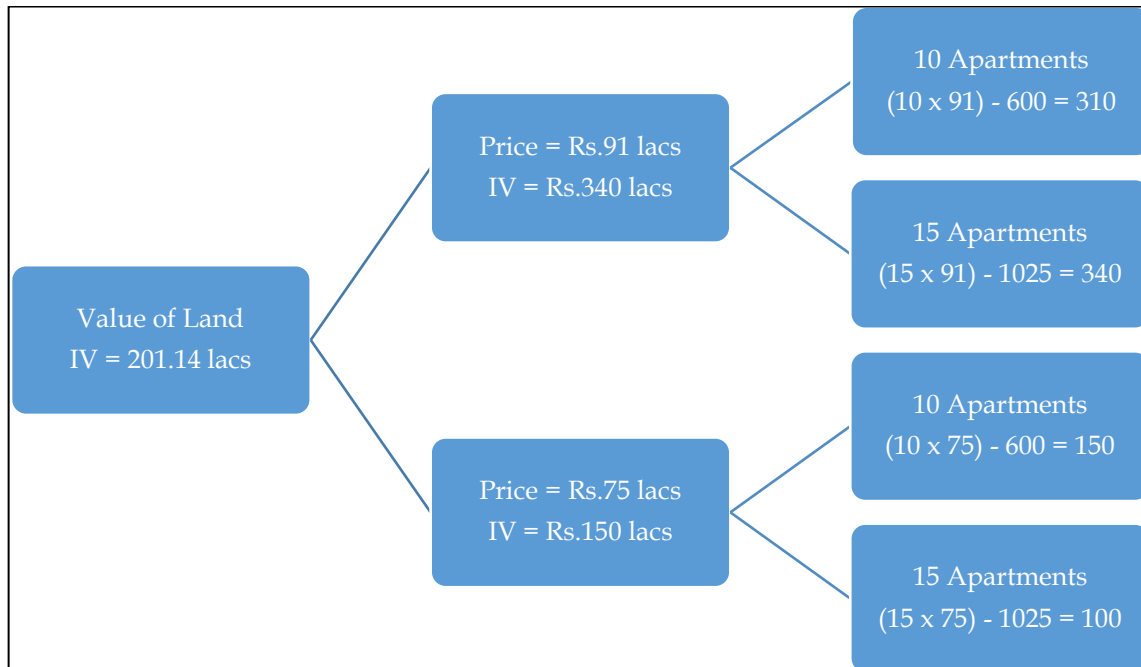
60. Valuation of option [Nov 2015 MTP, May 2013] [Concept Revision]

Ramesh owns a plot of land on which he intends to construct apartment units for sale. No. of apartment units to be constructed may be either 10 or 15. Total construction costs for these alternatives are estimated to be Rs. 600 lakhs or Rs. 1025 lakhs respectively. Current market price for each apartment unit is Rs. 80 lakhs. The market price after a year for apartment units will depend upon the conditions of market. If the market is buoyant, each apartment unit will be sold for Rs. 91 lakhs, if it is sluggish, the sale price for the same will be Rs. 75 lakhs. Determine the current value of vacant plot of land. Should Ramesh start construction now or keep the land vacant? The yearly rental per apartment unit is Rs. 7 lakhs and the risk free interest rate is 10% p.a. Assume that the construction cost will remain unchanged.

Answer:**WN 1: Analysis of the question:**

- Vacant plot of land is like an American option. The person can decide to start the construction immediately (exercising of option on day 0) or wait for a year and do construction (exercising of option at end of year 1)

WN 2: Valuation of Vacant Plot of Land (Option):

**Note:**

- Price of the Apartment at end of year can be either Rs.91 lacs or Rs.75 lacs. The company can decide on construction of 10 or 15 apartments depending on which is more beneficial
- Price of Rs.91 lacs:** The company can either earn Rs.310 lacs from 10 apartments or earn Rs.340 lacs from 15 apartments. The company will choose to construct 15 apartments and hence the intrinsic value will be Rs.340 lacs when price is Rs.91 lacs
- Price of Rs.75 lacs:** The company can either earn Rs.150 lacs from 10 apartments or earn Rs.100 lacs from 15 apartments. The company will choose to construct 10 apartments and hence the intrinsic value will be Rs.150 lacs when price is Rs.75 lacs
- Value of land on day 0 will be higher of immediate construction or later construction
 - Immediate construction:** The company can either earn Rs.200 lacs from 10 apartments (10 x 80 lacs – 600 lacs) or earn Rs.175 lacs from 15 apartments (15 x 80 lacs – 1025 lacs). The company will choose to construct 10 apartments and hence the intrinsic value will be Rs.200 lacs if company opts to do immediate construction
 - Later construction:** Weighted average of Rs.340 lacs and Rs.150 lacs with probability being the assigned weights. Value of later construction = (340 lacs x 0.375) + (150 lacs x 0.625) = Rs.221.25. We need to discount this value to day 0 to compare the same with immediate construction value. **Present value of later construction = (221.25/1.10) = Rs.201.14 lacs**
- The company should wait for construction and should exercise option at end of year 1 (construction at end of year 1). The value of vacant plot of land is Rs.201.14 lacs

Computation of upside and downside probability:

- Let us assume P to be the probability of price increasing to Rs.91 lacs and 1-P to be the probability of price falling to Rs.75 lacs
- Risk-free rate of interest is 10% per annum
- Expected price at end of year = (80 + 10%) – 7 = Rs. 81 lacs
- Current price of Apartment is Rs.80 lacs. We need 10 percent return from Apartment and the same would be Rs.8 lacs. We earn rental income of Rs.7 lacs and hence capital appreciation is expected to be Rs.1 lac. Hence expected price of Apartment at end of year 1 is Rs.81 lacs

Price	Probability	Product
91	P	91P
75	1-P	75-75P
Total		91P+75-75P=81

$$91P + 75 - 75P = 81; 16P = 6; P = \frac{6}{16} = 0.375$$

- Hence probability of price raise is 37.50% and probability of price fall is 62.50%

61. Valuation of option [May 2016 RTP, Nov 2017 MTP, Nov 2024 MTP, SM] [Concept Revision]

IPL already in production of Fertilizer is considering a proposal of building a new plant to produce pesticides. Suppose, the PV of proposal is Rs. 100 crore without the abandonment option. However, if market conditions for pesticide turns out to be favourable the PV of proposal shall increase by 30%. On the other hand market conditions remain sluggish the PV of the proposal shall be reduced by 40%. In case company is not interested in continuation of the project it can be disposed off for Rs. 80 crore. If the risk free rate of interest is 8% then what will be value of abandonment option

Answer:

WN 1: Analysis of option:

- The PV of proposal is Rs.100 crores. This would be like the current market price of the share
- Share price can increase by 30% to Rs.130 crores or fall by 40% to Rs.60 crores. Question has not mentioned information on the time period over which the change is to happen. It is assumed that increase of 30%/decrease of 40% would happen over a period of one year
- The company can dispose the project for Rs.80 crores if the market conditions are not favourable. This is similar to put option with exercise price of Rs.80 crores

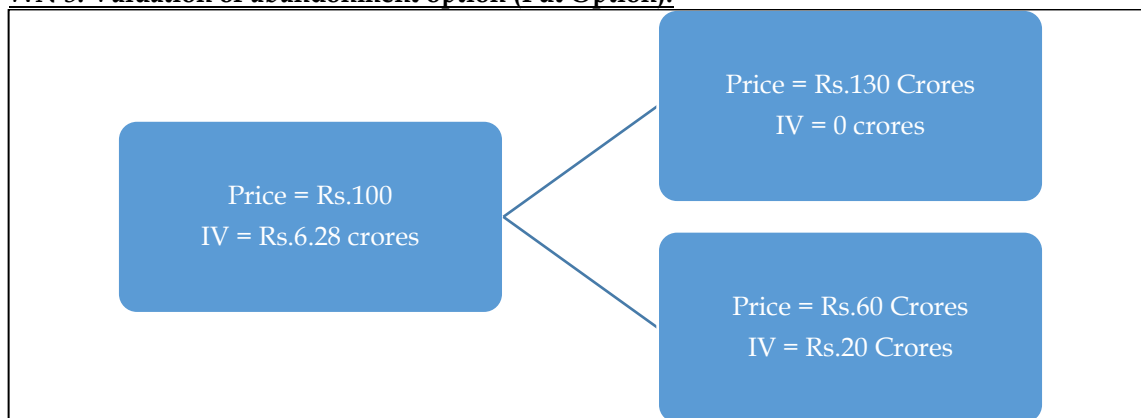
WN 2: Computation of upside and downside probability:

- Let us assume P to be the probability of price increasing to Rs.130 crores and 1-P to be the probability of price falling to Rs.60 crores
- Risk-free rate of interest is 8% per annum
- Expected price at end of year = $(100 + 8\%) = \text{Rs. } 108 \text{ crores}$

Price	Probability	Product
130	P	130P
60	1-P	60-60P
Total		130P+60-60P=108

$$130P + 60 - 60P = 108; 70P = 48; P = \frac{48}{70} = 0.686$$

- Hence probability of price raise is 68.60% and probability of price fall is 31.40%

WN 3: Valuation of abandonment option (Put Option):

Note:

- Value of option in year 1 is as per GPO of Put option
- Value of option today = $[(0 \times 0.686) + (20 \times 0.314)] / 1.08 = \text{Rs. } 5.81 \text{ Crores}$
- Final value of abandonment option = Rs.5.81 Crores

62. Option valuation [May 2017, May 2017 RTP]

Ram chemical is in production line of chemicals and considering a proposal of building new plant to produce pesticides. The Present value (PV) of new proposal is Rs.150 crores. Since this is a new product market, survey indicates following variation in present value (PV):

Condition favourable in first year	PV will increase 30% from original estimate
Condition sluggish in first year	PV will decrease by 40% from original figures

In addition Rama chemical has a option to abandon the project at the end of year and dispose it at Rs.100 Crores. If risk free rate of interest is 8%, what will be the present value of put option?

Answer:

WN 1: Computation of probability:

Let us assume p to be the probability of PV touching 195 crores and 1-p to be the probability of price touching 90 crores.

PV	Probability	Product
195	P	195P
90	1-P	90-90P
Expected PV		162

- ❖ Expected PV at end of the year will be Rs.162 Crores [150 crores + 8%]
- ❖ $195P + 90 - 90P = 162$
- ❖ $105P = 72$
- ❖ $P = 72/105 = 0.6857$
- ❖ Probability of PV touching Rs.195 Crores is 0.6857 and probability of PV touching 90 Crores is 0.3143

WN 2: Computation of value of put option:

PV	EP	GPO	Probability	Product [GPO x Prob]
195	100	0	0.6857	0
90	100	10	0.3143	3.143
Future value of Put				3.143
Present value of Put = $\frac{3.143}{1.08}$				2.91 Crores

63. Valuation of option [SM] [Concept Revision]

Suppose MIS Ltd. is considering installation of solar electricity generating plant for light the staff quarters. The plant shall cost Rs. 2.50 crore and shall lead to saving in electricity expenses at the current tariff by Rs. 21 lakh per year forever. However, with change in Government in state, the rate of electricity is subject to change. Accordingly, the saving in electricity can be of Rs. 12 lakh or Rs. 35 lakh per year and forever. Assuming WACC of MIS Ltd. is 10% and risk-free rate of rate of return is 8%. Decide whether MIS Ltd. should accept the project or wait and see.

Answer:

ICAI Solution:

WN 1: Evaluation of project today:

Particulars	Calculation	Amount
PV of cash inflows	$\frac{21,00,000}{10\%}$	2,10,00,000
Less: Cost of project		-2,50,00,000
NPV of project		-40,00,000

Since NPV is negative, it does not worth to accept the project

WN 2: Analysis after one year:

Particulars	Saving of 12 lacs	Saving of 35 lacs
PV of cash inflows	1,20,00,000	3,50,00,000
Less: Cost of project	-2,50,00,000	-2,50,00,000
NPV of project	-1,30,00,000	1,00,00,000
Rate of return on project [NPV/Cost of project]	-52.00%	40.00%
Probability	0.348	0.652
Expected Value	-45,24,000	65,20,000

- Expected NPV after one year = $-45,24,000 + 65,20,000 = \text{Rs.}19,96,000$
- Expected NPV (in today's value) = $19,96,000/1.10 = \text{Rs.}18,14,545$
- Thus, it shall be advisable to wait and see as NPV may turn out to be positive after one year

Note: Computation of probability:

- Let us assume P to be the probability of earning return of 40% and (1-P) to be the probability of earning return of -52%
- Risk-free rate of interest is 8% per annum

Price	Probability	Product

40	P	40P
-52	1-P	52P - 52
Total		92P - 52 = 8

$$92P = 60; P = \frac{60}{92} = 0.652$$

- Hence probability of 40% return is 0.652 and probability of -52% return is 0.348

Author Solution:

- WN 1 = No change

WN 2: Analysis after one-year:

- Current electricity savings are Rs.21 lacs and the same can increase to Rs.35 lacs (or) Rs.12 lacs by end of the year
- Let us assume P to be the probability of saving increasing to Rs.35 lacs and 1-P to be the probability of savings becoming Rs.12 lacs
- Expected savings at end of year = $21 + 8\% = \text{Rs.}22.68$

Price	Probability	Product
35	P	35P
12	1-P	12-12P
Total		23P+12 = 22.68

$$23P = 10.68; P = \frac{10.68}{23.00} = 0.4643$$

- Hence 46.43% is the probability of savings increasing to Rs.35 lacs and 53.57% is the probability of savings declining to Rs.12 lacs

Particulars	Saving of 12 lacs	Saving of 35 lacs
PV of cash inflows	1,20,00,000	3,50,00,000
Less: Cost of project	-2,50,00,000	-2,50,00,000
NPV of project	-1,30,00,000	1,00,00,000
Probability	53.57%	46.43%
Expected Value	0	46,43,000

- Expected NPV after one year = Rs.46,43,000
- Expected NPV (in today's value) = $46,43,000/1.10 = \text{Rs.}42,20,909$
- Thus, it shall be advisable to wait and see as NPV may turn out to be positive after one year

Note: If the savings are Rs.12 lacs per annum then the company will not do the project and hence the expected NPV of the option is zero

64. Black-scholes model [Nov 2008]

Following information is available for X Ltd's shares:

Current share price	185
Option exercise price	170
Risk free interest rate	7%
Time of the expiry of option	3 years
Standard deviation	0.18

Calculate the value of the option using Black-Scholes formula. Rework the problem if dividend of Rs.2 is expected at end of year 1, 2 & 3.

Answer:**WN 1: Valuation of option:**

- Type of option is not given in the question and hence we will first value the call option as per Black-scholes model. Post this we can value put option as per PCPT

Call Option:

$$\text{Value of call option} = (S_0 \times N(d_1)) - (PV_{EP} \times N(d_2))$$

$$\text{Value of call option} = (185 \times 0.8644) - (137.80 \times 0.7849)$$

$$\text{Value of call option} = \text{Rs.} 51.75$$

Put Option:

$$\text{Share} + \text{Put} = \text{Call} + \text{Present Value of Exercise Price}$$

$$185 + \text{Put} = 51.75 + 137.80$$

$$\text{Put option} = \text{Rs.} 4.55$$

Note:**Computation of D1:**

$$d_1 = \frac{\left(\text{Naturallog} \left(\frac{S_0}{E} \right) + rt + 0.5\sigma^2 t \right)}{\sigma\sqrt{t}} = \frac{\left(\text{Naturallog} \left(\frac{185}{170} \right) + (0.07 \times 3) + (0.5 \times 0.18 \times 0.18 \times 3) \right)}{0.18\sqrt{3}}$$

$$d_1 = \frac{(\text{Naturallog}(1.0882) + (0.21) + (0.0486))}{0.18(1.732051)} = \frac{0.08452 + 0.21 + 0.0486}{0.311769} = 1.1006$$

$$PV_{EP} = \frac{\text{Exercise price}}{e^{rt}} = \frac{170}{e^{0.21}} = 137.80$$

Computation of D2:

$$d_2 = d_1 - \sigma\sqrt{t} = 1.1006 - 0.311769 = 0.7888$$

Note: Computation of Natural-log of 1.0882 (using Interpolation):

Natural-log (1.08)	0.07696
Natural-log (1.09)	0.08618

Above values are taken from Natural-Log Tables and we are then using interpolation technique.

Computation:

Data 1	1.08	0.07696
Data 2	1.09	0.08618
Difference	0.01	0.00922

0.00922 is the increase in value for 0.01

	Calculation	Amount
Target NL Value		1.0882
Difference in Value (From lower level)	1.0882 - 1.0800	0.0082
Increase in value for 0.0082	0.01 = 0.00922 0.0082 = ?	0.00756
Value for 1.0882	0.07696 + 0.00756	0.08452

Note: Computation of N (d1) (using Interpolation):

N(1.10)	0.8643
N(1.11)	0.8665

Above values are taken from Z Tables and we are then using interpolation technique.

Computation:

Data 1	1.10	0.8643
Data 2	1.11	0.8665
Difference	0.01	0.0022

0.0022 is the increase in value for 0.01

	Calculation	Amount
Target Z Value		1.1006
Difference in Value (From lower level)	1.1006 - 1.1000	0.0006
Increase in value for 0.0006	0.01 = 0.0022 0.0006 = ?	0.0001
Value for 1.1006	0.8643 + 0.0001	0.8644

Note: Computation of N (d2) (using Interpolation):

N(0.78)	0.7823
N(0.79)	0.7852

Above values are taken from Z Tables and we are then using interpolation technique.

Computation:

Data 1	0.78	0.7823
Data 2	0.79	0.7852
Difference	0.01	0.0029

0.0029 is the increase in value for 0.01

	Calculation	Amount

Target Z Value		0.7888
Difference in Value (From lower level)	0.7888 – 0.7800	0.0088
Increase in value for 0.0088	0.01 = 0.0029 0.0088 = ?	0.0026
Value for 0.7888	0.7823 + 0.0026	0.7849

WN 2: Valuation of option in rework scenario:

- Dividend of Rs.2 will be declared at end of each of year 1,2 and 3. In this scenario share price will be replaced with adjusted share price
- Adjusted share price = Share price – PV of dividend income

$$\text{PV of dividend} = \frac{2}{e^{0.07}} + \frac{2}{e^{0.14}} + \frac{2}{e^{0.21}} = 1.8648 + 1.7387 + 1.6212 = \text{Rs. } 5.22$$

- Adjusted share price = 185 – 5.22 = Rs.179.78

Call Option:

$$\text{Value of call option} = (S_0 \times N(d_1)) - (PV_{EP} \times N(d_2))$$

$$\text{Value of call option} = (179.78 \times 0.8435) - (137.80 \times 0.7571)$$

$$\text{Value of call option} = \text{Rs. } 47.32$$

Put Option:

$$\text{Share} + \text{Put} = \text{Call} + \text{Present Value of Exercise Price}$$

$$179.78 + \text{Put} = 47.32 + 137.80$$

$$\text{Put option} = \text{Rs. } 5.34$$

Note:**Computation of D1:**

$$d_1 = \frac{\left(\text{Naturallog} \left(\frac{S_0}{E} \right) + rt + 0.5\sigma^2 t \right)}{\sigma\sqrt{t}} = \frac{\left(\text{Naturallog} \left(\frac{179.78}{170} \right) + (0.07 \times 3) + (0.5 \times 0.18 \times 0.18 \times 3) \right)}{0.18\sqrt{3}}$$

$$d_1 = \frac{\left(\text{Naturallog}(1.0575) + (0.21) + (0.0486) \right)}{0.18(1.732051)} = \frac{0.0559 + 0.21 + 0.0486}{0.311769} = 1.0088$$

Computation of D2:

$$d_2 = d_1 - \sigma\sqrt{t} = 1.0088 - 0.311769 = 0.6970$$

Note: Computation of Natural-log of 1.0882 (using Interpolation):

Natural-log (1.05)	0.04879
Natural-log (1.06)	0.05827
Natural Log (1.0575)	0.05590
	[0.04879 + 0.00711]

Note: Computation of N (d1) (using Interpolation):

N(1.00)	0.8413
N(1.01)	0.8438
N(1.0088)	0.8435
	[0.8413 + 0.0022]

Note: Computation of N (d2) (using Interpolation):

N(0.69)	0.7549
N(0.70)	0.7580
N(0.6970)	0.7571
	[0.7549 + 0.0022]

65. Black-scholes model [Nov 2006, May 2020 RTP, May 2020 MTP, SM]

From the following details find the value of call option

Current share price	80
Option exercise price	75
Risk free interest rate	12%
Maturity period	6 months
Standard deviation	0.40

Given:

Number of SD from mean	Area of the left or right (one tail)
0.25	0.4013
0.30	0.3821
0.55	0.2912
0.60	0.2743

$$e^{0.06} = 1.062$$

$$\ln 1.0667 = 0.0646$$

Answer:

Call Option:

$$\text{Value of call option} = (S_0 \times N(d_1)) - (PV_{EP} \times N(d_2))$$

$$\text{Value of call option} = (80 \times 0.7196) - (70.62 \times 0.6176)$$

$$\text{Value of call option} = \text{Rs. 13.95}$$

Note:

Computation of D1:

$$d_1 = \frac{\left(\text{Naturallog} \left(\frac{S_0}{E} \right) + rt + 0.5\sigma^2 t \right)}{\sigma\sqrt{t}} = \frac{\left(\text{Naturallog} \left(\frac{80}{75} \right) + (0.12 \times 0.05) + (0.5 \times 0.40 \times 0.40 \times 0.5) \right)}{0.40\sqrt{0.5}}$$

$$d_1 = \frac{\left(\text{Naturallog}(1.0667) + (0.06) + (0.04) \right)}{0.2828} = \frac{0.0646 + 0.06 + 0.04}{0.2828} = 0.5820$$

$$PV_{EP} = \frac{\text{Exercise price}}{e^{rt}} = \frac{75}{e^{0.12(0.5)}} = \frac{75}{1.062} = 70.62$$

Computation of D2:

$$d_2 = d_1 - \sigma\sqrt{t} = 0.5820 - 0.2828 = 0.2992$$

Note 1: Computation of N(d1):

Z value	Given Prob	Residual prob (1 - Given Prob)
0.55	0.2912	0.7088
0.60	0.2743	0.7257

Note:

- Probability for positive Z values will be higher than 0.5. However, the given probability is less than 0.5 and this is because of single tail values
- Actual probability = 1 - Given Probability

$$\text{Prob of 0.5820} = \text{Prob of 0.55} + \left((\text{Prob of 0.60} - \text{Prob of 0.55}) \times \frac{0.5820 - 0.55}{0.60 - 0.55} \right)$$

$$\text{Prob of 0.5820} = 0.7088 + \left((0.7257 - 0.7088) \times \frac{0.0320}{0.0500} \right) = 0.7196$$

Note 2: Computation of N(d2):

Z value	Given Prob	Residual prob (1 - Given Prob)
0.25	0.4013	0.5987
0.30	0.3821	0.6179

$$\text{Prob of 0.2992} = \text{Prob of 0.25} + \left((\text{Prob of 0.30} - \text{Prob of 0.25}) \times \frac{0.2992 - 0.2500}{0.3000 - 0.2500} \right)$$

$$\text{Prob of 0.2992} = 0.5987 + \left((0.6179 - 0.5987) \times \frac{0.0492}{0.0500} \right) = 0.6176$$

66. Black-scholes model of valuation (Nov 2022 MTP, SM)

- The shares of TIC Ltd. are currently priced at Rs. 415 and call option exercisable in three months' time has an exercise rate of Rs. 400. Risk free interest rate is 5% p.a. and standard deviation (volatility) of share price is 22%. Based on the assumption that TIC Ltd. is not going to declare any dividend over the next three months, is the option worth buying for Rs. 25?
- Calculate value of aforesaid call option based on Black Scholes valuation model if the current price is considered as Rs. 380.
- What would be the worth of put option if current price is considered Rs. 380.
- If TIC Ltd. share price at present is taken as Rs. 408 and a dividend of Rs. 10 is expected to be paid in the two months time, then, calculate value of the call option.

Answer:

WN 1: Computation of value of call option as per Black Scholes Model:**Call Option:**

$$\text{Value of call option} = (S_0 \times N(d_1)) - (PV_{EP} \times N(d_2))$$

$$\text{Value of call option} = (415 \times 0.6927) - (395.03 \times 0.6529)$$

$$\text{Value of call option} = \text{Rs. 29.56}$$

Fair value of option is Rs.29.56 and current value is Rs.25.00. Call option is undervalued and hence it is better to buy the option.

Note:**Computation of D1:**

$$d_1 = \frac{\left(\text{Naturallog} \left(\frac{S_0}{E} \right) + rt + 0.5\sigma^2 t \right)}{\sigma\sqrt{t}} = \frac{\left(\text{NL} \left(\frac{415}{400} \right) + (0.05 \times 0.25) + (0.5 \times 0.22 \times 0.22 \times 0.25) \right)}{0.22\sqrt{0.25}}$$

$$d_1 = \frac{(\text{Naturallog}(1.0375) + (0.0125) + (0.006050))}{0.11} = \frac{0.0368 + 0.0125 + 0.006050}{0.11} = 0.5033$$

$$PV_{EP} = \frac{\text{Exercise price}}{e^{rt}} = \frac{400}{e^{0.05(0.25)}} = 395.03$$

Computation of D2:

$$d_2 = d_1 - \sigma\sqrt{t} = 0.5033 - 0.1100 = 0.3933$$

Note: Computation of N (d1) (using Interpolation):

N(0.50)	0.6915
N(0.51)	0.6950
N(0.5033)	0.6927
	[0.6915 + 0.0012]

Note: Computation of N (d2) (using Interpolation):

N(0.39)	0.6517
N(0.40)	0.6554
N(0.3933)	0.6529
	[0.6517 + 0.0012]

WN 2: Computation of value of call and put option if CMP is Rs.380:**Call Option:**

$$\text{Value of call option} = (S_0 \times N(d_1)) - (PV_{EP} \times N(d_2))$$

$$\text{Value of call option} = (380 \times 0.3830) - (395.03 \times 0.3418)$$

$$\text{Value of call option} = \text{Rs. 10.52}$$

Put Option

$$\text{Share} + \text{Put} = \text{Call} + \text{Present Value of Exercise Price}$$

$$380 + \text{Put} = 10.52 + 395.03$$

$$\text{Put option} = \text{Rs. 25.55}$$

Note:**Computation of D1:**

$$d_1 = \frac{\left(\text{Naturallog} \left(\frac{S_0}{E} \right) + rt + 0.5\sigma^2 t \right)}{\sigma\sqrt{t}} = \frac{\left(\text{NL} \left(\frac{380}{400} \right) + (0.05 \times 0.25) + (0.5 \times 0.22 \times 0.22 \times 0.25) \right)}{0.22\sqrt{0.25}}$$

$$d_1 = \frac{(\text{Naturallog}(0.9500) + (0.0125) + (0.006050))}{0.11} = \frac{-0.05129 + 0.0125 + 0.006050}{0.11} = -0.2976$$

Computation of D2:

$$d_2 = d_1 - \sigma\sqrt{t} = -0.2976 - 0.1100 = -0.4076$$

Note: Computation of N (d1) (using Interpolation):

N(-0.29)	0.3859
N(-0.30)	0.3821
N(-0.2976)	0.3830
	[0.3859 - 0.0029]

Note: Computation of N (d2) (using Interpolation):

N(-0.40)	0.3446
N(-0.41)	0.3409
N(-0.4076)	0.3418
	[0.3446 - 0.0028]

WN 3: Computation of value of call option if CMP is Rs.408 and Dividend of Rs.10 will be paid in two months**Call Option:**

$$\text{Value of call option} = (S_0 \times N(d_1)) - (PV_{EP} \times N(d_2))$$

$$\text{Value of call option} = (398.08 \times 0.5497) - (395.03 \times 0.5060)$$

$$\text{Value of call option} = \text{Rs. 18.94}$$

$$\text{Adjusted Spot price} = \text{Spot Price} - \text{Present Value of Dividends}$$

$$\text{Adjusted Spot price} = 408 - 9.92 = \text{Rs. 398.08}$$

$$PV \text{ of Dividend} = 10 \times e^{(-0.05)(\frac{2}{12})} = \text{Rs. 9.92}$$

Note:**Computation of D1:**

$$d_1 = \frac{\left(\text{Naturallog} \left(\frac{S_0}{E} \right) + rt + 0.5\sigma^2 t \right)}{\sigma\sqrt{t}} = \frac{\left(\text{NL} \left(\frac{398.08}{400} \right) + (0.05 \times 0.25) + (0.5 \times 0.22 \times 0.22 \times 0.25) \right)}{0.22\sqrt{0.25}}$$

$$d_1 = \frac{(\text{Naturallog}(0.9952) + (0.0125) + (0.006050))}{0.11} = \frac{-0.00481 + 0.0125 + 0.006050}{0.11} = 0.1249$$

Computation of D2:

$$d_2 = d_1 - \sigma\sqrt{t} = 0.1249 - 0.1100 = 0.0149$$

Note: Computation of N (d1) (using Interpolation):

N(0.12)	0.5478
N(0.13)	0.5517
N(0.1249)	0.5497
	[0.5478 + 0.0019]

Note: Computation of N (d2) (using Interpolation):

N(0.01)	0.5040
N(0.02)	0.5080
N(0.0149)	0.5060
	[0.5040 + 0.0020]

67. Real option [SM] [Concept Revision]

ABC Ltd. is a pharmaceutical company possessing a patent of a drug called 'Aidrex', a medicine for aids patient. Being an approach drug ABC Ltd. holds the right of production of drugs and its marketing. The period of patent is 15 years after which any other pharmaceutical company produce the drug with same formula. It is estimated that company shall require to incur \$ 12.5 million for development and market of the drug. As per a survey conducted the expected present value of cashflows from the sale of drug during the period of 15 years shall be \$ 16.7 million. Cash flow from the previous similar type of drug have exhibited a variance of 26.8% of the present value of cashflows. The current yield on Treasury Bonds of similar duration (15 years) is 7.8%.

Determine the value of the patent.

Given $\ln(1.336) = 0.2897$ $e^{1.0005} = 0.3677$ and $e^{-1.17} = 0.3104$

Answer:**Valuation of Patent as per Black-Scholes Model:****Basic information:**

CMP = Present value of cash flows	16.70
EP = Cost of development formula	12.50
Dividend Yield per annum	6.67%
Risk-free rate	7.80%
Variance of cash flows	0.268
Standard deviation	0.5177
Time period	15 years

Note:

- Benefit of patent will be earned over 15 years and hence annual cash inflow/dividend yield is 6.67% (1/15)

$$\text{Value of Patent} = (S_0 \times N(d_1)) - (PV_{EP} \times N(d_2))$$

$$\text{Value of Patent} = (6.1406 \times 0.8910) - (3.8800 \times 0.2196)$$

$$\text{Value of Patent} = \text{Rs. 4.6192 million}$$

Note:

$$\text{Adjusted share price} = 16.70 \times e^{-0.0667 \times 15} = 16.70 \times 0.3677 = 6.1406$$

Computation of D1:

$$d_1 = \frac{\left(\ln\left(\frac{S_0}{E}\right) + (r - y)t + 0.5\sigma^2 t \right)}{\sigma\sqrt{t}} = \frac{\left(\ln\left(\frac{16.70}{12.50}\right) + (0.078 - 0.0667 \times 15) + (0.5 \times 0.2680 \times 15) \right)}{0.5177\sqrt{15}}$$

$$d_1 = \frac{(\text{Naturallog}(1.336) + (0.1700) + (2.01))}{2.0050} = \frac{0.2897 + 0.1695 + 2.0100}{2.0050} = 1.2315$$

Computation of D2:

$$d_2 = d_1 - \sigma\sqrt{t} = 1.2315 - 2.0050 = -0.7735$$

$$\text{Present Value of Exercise Price} = 12.50 \times e^{-0.78 \times 15} = 12.50 \times e^{-1.17} = 12.50 \times 0.3104 = 3.8800$$

Note: Computation of N (d1) (using Interpolation):

N(1.23)	0.8907
N(1.24)	0.8925
N(1.2315)	0.8910
	[0.8907 + 0.0003]

Note: Computation of N (d2) (using Interpolation):

N(-0.77)	0.2206
N(-0.78)	0.2177
N(0.7735)	0.2196
	[0.2206 - 0.0010]

68. Expected value of option [May 2018 MTP, Nov 2010, Nov 2012, May 2014 MTP, May 2015 MTP, May 2022, May 2022 MTP, May 2024 MTP, SM]

You as an investor had purchased a 3 month call option on the equity shares of X Ltd. of Rs.30, of which the current market price is Rs. 560 and the exercise price Rs. 590. You expect the price to range between Rs.540 to Rs.640. The expected share price of X Ltd. and related probability is given below:

Expected Price	540	560	580	600	620	640
Probability	0.10	0.15	0.05	0.35	0.20	0.15

Compute the following:

- ❖ Expected Share price at the end of 3 months.
- ❖ Value of Call Option at the end of 3 months, if the exercise price prevails.
- ❖ In case the option is held to its maturity, what will be the expected value of the call option?
- ❖ Find out the price of the shares quoted at the stock exchange to get the value of the call option as computed in (iii) above.

Answer:**Computation of expected share price and value of call option:**

Expected Price	Probability	Product	Intrinsic value	Product
540	0.10	54.00	0.00	0.00
560	0.15	84.00	0.00	0.00
580	0.05	29.00	0.00	0.00
600	0.35	210.00	10.00	3.50
620	0.20	124.00	30.00	6.00
640	0.15	96.00	50.00	7.50
Expected value		597.00		17.00

- Expected share price at end of month 3 = Rs.597.00
- Expected value of call option at end of month 3 = Rs.17.00
- If the exercise price prevails on the maturity date then the share price will be equal to exercise price. If both are same, option will lapse and value of call option will be zero
- Price to be quoted at the stock exchange to get the value of the call option = Rs.590 + Rs.17 = Rs.607

69. Replication Model - Option valuation [Nov 2015, May 2018 MTP, Nov 2018 MTP, May 2021 MTP, Nov 2022 RTP, Nov 2022 MTP, SM] [Concept Revision]

Mr. Dayal is interested in purchasing equity shares of ABC Ltd. which are currently selling at Rs. 600 each. He expects that price of share may go upto Rs. 780 or may go down to Rs. 480 in three months. The chances of occurring such variations are 60% and 40% respectively. A call option on the shares of ABC

Ltd. can be exercised at the end of three months with a strike price of Rs. 630.

- ❖ What combination of share and option should Mr. Dayal select if he wants a perfect hedge?
- ❖ Explain how the investor will be able to maintain identical position regardless of the share price
- ❖ What should be the value of option today (the risk free rate is 10% p.a.)?
- ❖ What is the expected rate of return on the option?

Author's Note:

- All model of option valuation will give the same answer. In this question the probabilities given in the question are incorrect. We have solved this question under portfolio replication model. However, if the same was solved under Risk-Neutral Model we will get a different answer. The correct probabilities for this question should be 45% and 55%

Answer:

WN 1: Valuation of option:

- Call option can be valued either using risk neutral model or portfolio replication model
- Any option valued under risk neutral model will give expected rate of return as equal to risk-free rate. Hence third part of the question will be redundant if option is valued as per risk neutral method
- Hence, we are going ahead with valuation of option as per portfolio replication model

Computation of intrinsic values at two judgement prices:

Judgement price	Intrinsic value
780	150
480	0

Computation of no of calls:

$$\text{No of calls} = \frac{\text{Spread in stock price}}{\text{Spread in Intrinsic value}} = \frac{780 - 480}{150 - 0} = 2 \text{ calls}$$

Valuation of option:

Month 3:

Using price of Rs.780

Share price = (2 x calls) + Risk-free investment

$$780 = (2 \times 150) + \text{Risk-free investment}$$

Risk-free investment (M3) = Rs.480

Using price of Rs.480

Share price = (2 x calls) + Risk-free investment

$$380 = (2 \times 0) + \text{Risk-free investment}$$

Risk-free investment (M3) = Rs.480

Month 0

$$\text{PV of risk - free investment} = \frac{480}{1 + 2.5\%} = \text{Rs. 468.29}$$

Substitute this in the above equation:

Share price = (2 x calls) + Risk-free investment

$$600 = (2 \times \text{call}) + 468.29$$

Call premium = Rs.65.86

WN 2: Combination of share and option should Mr. Dayal select if he wants a perfect hedge

- No of calls to be bought as per the above computation is 2 calls
- Hence combination of 2 calls and 1 share will lead to perfect hedge. Alternatively, we can say that we should purchase 0.50 shares for every 1 call option

Maintenance of same position irrespective of price touching Rs.480 and Rs.780:

Particulars	Price of Rs.480	Price of Rs.780
Cash flow from 0.5 shares	240 [480 x 0.5]	390 [780 x 0.5]
Loss on account of short option	0	(150) [780 - 630]
Net cash flow	240	240

- Perfect hedge would involve taking opposite position. Hence, we can assume that we are buying 0.50 shares and selling 1 option
- **Price of Rs.480:** Net cash flow = 240 – 0 = Rs.240
- **Price of Rs.780:** Net cash flow = 390 – 150 = Rs.240
- The above analysis validates that investor will be able to maintain same position irrespective of the price touching Rs.480 or Rs.780.

WN 3: Expected return on option:

- Expected value of call option at end of M3 = $(150 \times 0.60) + (0 \times 0.40) = \text{Rs.90}$

$$\text{Return on call option} = \frac{90 - 65.86}{65.86} \times 100 = \mathbf{36.65\% \text{ per 3 months (or) } 146.60\% \text{ p. a.}}$$

70. Binomial model vs Risk Neutral Model [Nov 2023]

Following is the information available pertaining to shares of Omni Ltd.:

Current Market Price	Rs.420.00
Strike Price	Rs.450.00
Maximum price expected in next 3 months' time	Rs.525.00
Minimum price expected in next 3 months' time	Rs.378.00
Continuously Compounded Rate of Interest (p.a.) (%)	8.00%
e^{rt}	1.0202

From the above:

- Calculate the 3 months call option by using Binomial Method and Risk Neutral Method. Are the calculated values under both the models are same?
- State also clearly the basis of Valuation of options under these models

Answer:**WN 1: Valuation under Binomial Model (using the concept of Portfolio Replication Model)****Computation of intrinsic values at two judgement prices:**

Judgement price	Intrinsic value
525	75
378	0

Computation of Delta:

$$\text{Delta} = \frac{\text{Spread in Intrinsic value}}{\text{Spread in Option Price}} = \frac{75 - 0}{525 - 378} = 0.51$$

- This would mean that 1 call option is equivalent of 0.51 shares

Valuation of option:

Month 3: Using price of Rs.780 Share price = Call + Risk-free investment $0.51 \times 525 = 75 + \text{Risk-free investment}$ Risk-free investment (M3) = Rs.192.75
Using price of Rs.480 Share price = Call + Risk-free investment $0.51 \times 378 = 0 + \text{Risk-free investment}$ Risk-free investment (M3) = Rs.192.78
Month 0 $\text{PV of risk-free investment} = \frac{192.78}{1.0202} = \text{Rs. } 188.96$ Substitute this in the above equation: Share Price = Call + Risk-free investment $(0.51 \times 420) = \text{Call} + 188.96$ Value of Call = Rs.25.24

WN 2: Valuation of Option using Risk Neutral Method:**Note 1: Computation of Expected Share Price:**

$$\text{Expected share price} = \text{PV} \times e^{rt}$$

Expected share price = $420 \times e^{(0.08)(0.25)} = 420 \times e^{0.02} = 420 \times 1.0202 = \text{Rs. } 428.48$

Let us assume p to be the probability of price reaching Rs.378 and 1-p to be the probability of price reaching Rs.525

Price	Probability	Product
378	P	378P
525	1-P	525 - 525P
Total		378P + 525 - 525P = 428.48

$$378P + 525 - 525P = 428.48; -147P = -96.52; P = \frac{96.52}{147} = 0.6566$$

- Hence 0.6566 is the probability of price reaching Rs.378 and 0.3434 (1 - 0.6566) is the probability of price reaching Rs.525

Note 2: Valuation of call option:

Price	IV	Probability	Product
378	0	0.6566	0
525	75	0.3434	25.755
Value of call at end of M3			25.755
Present value of call (25.755/1.0202)			25.24

Yes, the value of option under both Models is same.

Basis of valuation of options:

- Binomial model uses an approach called "**Risk-less Hedge Approach**" to find the price of the option, by creating a portfolio which will have same value at expiration irrespective of any price. Hedge means to create an equal and opposite position for protecting the value of portfolio.
- In Risk Neutral Model, **valuation of options is based on arbitrage** and is therefore independent of risk preferences; one should be able to value options assuming any set of risk preferences and get the same answer

Part VII – Delta Hedging

71. Delta Hedging:

A trader sold 20 option contracts (2000 options) on a certain stock. The option price is USD 10, the stock price is USD 100 and option delta is 0.6.

- ❖ Suggest a hedge strategy to make the portfolio delta neutral
- ❖ Suppose due to share price increase, the delta changes to 0.65, under a dynamic hedge strategy, what should the trader do?

Answer:

WN 1: Hedge strategy to make portfolio delta neutral:

Security	Number	Delta	Adjusted Delta
Option	-2,000	0.6	-1,200
Shares	1,200	1	1,200
			0

- The above table indicates that the investor should buy 1,200 shares to make portfolio delta neutral

WN 2: Action to be taken under dynamic hedging:

Security	Number	Delta	Adjusted Delta
Option	-2,000	0.65	-1,300
Shares	1,300	1	1,300
			0

- Investor should buy additional 100 shares to make the portfolio delta neutral

72. Delta computation [Homework]

Calculate delta of an at-the-money six month European call option for a non-dividend paying stock when the risk free rate is 10% per annum and the stock price volatility is 25%. What should be the delta if this is a

European put option?

Answer:

WN 1: Computation of call and put delta:

- Delta of call option = $N(d_1)$ of Black Scholes model
- Delta of Put option = Call Delta - 1

$$d_1 = \frac{\left(\text{Naturallog} \left(\frac{S_0}{E} \right) + (r + 0.5\sigma^2)t \right)}{\sigma\sqrt{t}}$$

Term	Calculation	Amount
S ₀ (CMP)	Assumed	100
Exercise Price	At the money option and hence CMP will be equal to EP	100
$\frac{S_0}{E}$	$\frac{100}{100}$	1
$\text{Naturallog} \left(\frac{S_0}{E} \right)$		0.0000
$r + 0.5\sigma^2$	$0.1 + 0.5 \times 0.25 \times 0.25$	0.1313
$(r + 0.5\sigma^2)t$	0.1313×0.5	0.0657
$\sigma\sqrt{t}$	$0.25\sqrt{0.5}$	0.1768
d_1	$\frac{0 + 0.0657}{0.1768}$	0.3716
$N(d_1)$	= Prob of 0.37 + 16% of (Prob of 0.38 - Prob of 0.37) = $0.6443 + 16\% \times (0.6480 - 0.6443)$	0.6449
Call Delta		0.6449
Put delta	$0.6449 - 1$	-0.3551

73. Valuation of option and calculation of Delta [Nov 2010] [Concept Revision]

X Ltd.'s share is currently trading at Rs. 220. It is expected that in six months some if could double or halved (equivalent to a $\sigma=98\%$). One year call option on X Ltd.'s share has an exercise price of Rs. 165. Assuming risk free rate of interest to be 20%, calculate.

- Value of call option on X Ltd's share.
- Option Delta for the second six month, in case stock price rises to Rs. 440 or falls to Rs. 110.
- Now suppose in 6 months the share price is Rs. 110. How at this point we can replicate portfolio of call options and risk-free lending.

Answer:

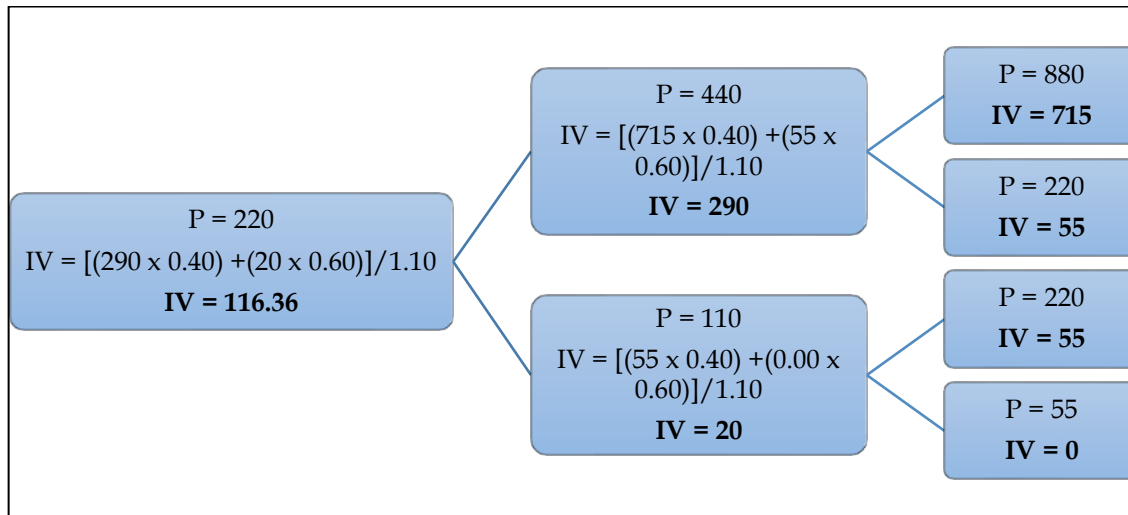
WN 1: Computation of upside and downside probability:

Let us assume p to be the probability of price touching 440 and 1-p to be the probability of price touching 110.

Price	Probability	Product
440	P	440P
110	1-P	110 - 110P
Expected Price		242

- ❖ Interest rate is 20% for a year and hence it will be 10% for 6 months
- ❖ Expected price at end of 6 months will be Rs.242 [$220 + 10\%$]
- ❖ $440P + 110 - 110P = 242$
- ❖ $330P = 132$
- ❖ $P = 132/33 = 0.4$
- ❖ Probability of price touching 440 is 0.400 and probability of price touching 110 is 0.600

WN 2: Valuation of call option:

**WN 2: Option delta in case stock price touches 440**

$$\text{Delta} = \frac{\text{Spread in option price}}{\text{Spread in stock price}} = \frac{715 - 55}{880 - 220} = 1 \text{ Time}$$

WN 3: Option delta in case stock price touches 110:

$$\text{Delta} = \frac{\text{Spread in option price}}{\text{Spread in stock price}} = \frac{55 - 0}{220 - 55} = 0.33 \text{ Times}$$

WN 4: Creation of riskless portfolio if price touches 110 at end of 6 months:

- ❖ Delta of option is 0.33 times. This would mean that option price change would be 0.33 times of the change in share price.
- ❖ Hence a combination of 1 option and 0.33 shares can create a riskless hedge portfolio. Alternatively, a combination of 1 share and 3 options (1/0.33) will create a riskless hedge portfolio.

Part VIII - Credit Derivatives**Example of CDS Transaction:**

Let's consider a simple example of a Credit Default Swap (CDS) transaction involving three parties: a company (Company A), a bank (Bank B), and an investor (Investor C).

- **Company A:** This is the underlying company and the Company A issues bonds to raise funds, and these bonds are traded in the market.
- **Bank B:** This is the financial institution that acts as the protection seller in the CDS transaction. It assumes the risk of Company A defaulting on its bond payments.
- **Investor C:** This is the investor who wants to hedge against the risk of Company A defaulting. Investor C buys protection from Bank B in the form of a CDS contract.
- **CDS Contract Agreement:** Investor C approaches Bank B to enter into a CDS contract to hedge against the default risk of Company A. They agree on the terms, including the notional amount, premium (also known as the CDS spread), and maturity date.
- **Notional Exposure:** The notional amount is the hypothetical or reference amount on which the CDS contract is based. It represents the face value of the bonds that Company A has issued. Let's say the notional amount is Rs.10,00,000.
- **Premium (CDS Spread):** Investor C agrees to pay Bank B a periodic premium or spread for the duration of the CDS contract. The premium is typically expressed as a percentage of the notional amount. For example, if the CDS spread is 2%, then Investor C pays Rs.20,000 annually (Rs.10,00,000 x 2%) to Bank B as the premium.

- **Default Event:** If Company A defaults on its bond payments during the term of the CDS contract, Bank B will be required to compensate Investor C for the loss incurred due to the default.
- **Cash Settlement:** If a credit event (default) occurs, the CDS contract is triggered. Bank B will pay Investor C an amount equal to the notional amount (Rs.10,00,000 in this case) minus the recovery value of the defaulted debt. The recovery value is the percentage of the bond's face value that the investor expects to recover after the default. For example, if the recovery value is 40%, then Bank B would pay Investor C: Rs.6,00,000 [10,00,000 – 40%]
- **Physical Settlement:** This is the traditional method of settlement. It involves the delivery of Bonds or debts of the reference entity by the buyer to the seller and seller pays the buyer the par value. For example, as mentioned above suppose Company A defaults then Bank B will pay Rs.10,00,000 to Investor C and Investor C will deliver Rs.10,00,000 face value of Bonds to Bank B
- **No Default:** If Company A does not default during the term of the CDS contract, Investor C will continue to pay the agreed premium to Bank B, and the contract will expire at the maturity date without any payment for default events.

74. Basic terms

Company A has issued 10% bonds of Rs.50,00,000. Investor A has purchased bonds worth Rs.10,00,000 but is worried about the risk of default. He therefore wants protection against the risk of default and hence has purchased protection from Axis Bank in terms of CDS contract. The CDS spread for the transaction is 1% per annum. Compute the following:

- a) Amount of annual premium to be paid
- b) Company A has defaulted on the debt and the bonds are now trading at 15% of face value. How much settlement would Bank B give to the investor
- c) Company A has not defaulted and the bonds have been redeemed in accordance with debenture terms. Investor A has paid premium for 5 years. How much would the settlement be from Axis Bank to investor A on maturity date?
- d) Another investor wants to buy the protection and has approached Axis Bank for premium and the bank has now quoted a premium of 2.5%. What is the inference on credit quality based on this?

Answer:

Annual premium = $10,00,000 \times 1\% = \text{Rs.}10,000$
Cash settlement: • Company A has defaulted on debt obligations and hence now Axis Bank has to give settlement to investor A • Bonds are trading at 15% of face value and hence recovery rate of the bond is 15% • Cash settlement = $10,00,000 - 15\% = \text{Rs.}8,50,000$
Repayment of debt: • Company A has repaid debt on time and there has been no default. In this case there will be no settlement from Axis bank to investor A. Premiums paid for five years will not be returned as the same as paid for bearing the credit risk.
Increase in premium: • Premium percentage has increased from 1% to 2.5%. Higher premium basically indicates deterioration in credit quality of underlying asset (Bonds of Company A) • Premium increase basically is due to increase in default risk. Axis Bank would now be needing a higher compensation as they believe there has been a deterioration in credit quality

75. Index CDS

Gill Westmore is the fixed income portfolio manager for Allied Insurance. Westmore has bought protection using a 2-year CDS on CDX-IG (125 constituent) index. The notional is Rs.200 crores. Company X, an index constituent defaults and trades at 25% of par. Compute the payoff on the CDS on account of default of X and the notional principal of the CDS after default?

Answer:

Notional principal of company X = $200 \text{ crores} / 125 = \text{Rs.}1.6 \text{ crores}$
Settlement amount = $1.6 \text{ crores} - 25\% = \text{Rs.}1.2 \text{ crores}$
Notional principal of CDS post default = $200 \text{ crores} - 1.6 \text{ crores} = \text{Rs.}198.4 \text{ crores}$

76. Cash settlement

The Rose Foundation enters into a 2-year CDS on a notional amount of Rs.10,00,000 of 5-year bonds issued by the Crescent Corporation as a protection buyer. The swap specifies an annual premium of 55 basis points and cash settlement. Assume that the Crescent Corporation defaults at the end of the first year when the bonds are trading at 60 paise on one rupee. Calculate the cash flows associated with the credit default swap.

Answer:

- The Rose Foundation would pay Rs.5,500 ($0.0055 \times \text{Rs.}10,00,000$) at the beginning of the first year to the seller of the CDS.
- If Crescent defaults after one year, the Rose Foundation would receive a payment of Rs.4,00,000 [$10,00,000 - 60\%$]. This would basically represent the decline in value of bonds

77. Profit/loss due to change in credit spread

An investor buys Rs.10,00,000 of five-year protection and the CDS contract has a duration of four years. The company's credit spread was originally 500 bps and the same has now widened to 800 bps.

You are required to answer the following:

- Does the investor (credit protection buyer) benefit or lose from the change in credit spreads
- Estimate the CDS price change and estimated profit to the investor

Answer:**Part (a):**

- Credit protection buyer will see a profit with the change in credit spread. This is because contracted premium is 500 bps and the current premium is 800 bps.
- Hence, he would gain due to the increase in the credit premium

Part (b):

- Price change of CDS = Change in spread $\times$ Duration = $3\% \times 4 = 12\%$
- Profit to the investor = $12\% \times 10,00,000 = \text{Rs.}1,20,000$

78. CDS spread through POD and recovery rate

A company issues one-year bond and the same has a probability of default of 2%. The expected recovery rate is 20%. How much would the CDS spread for this bond?

Answer:

- CDS spread = Probability of default $\times$ (1 - Recovery rate)
- CDS spread = $2\% \times (1 - 20\%) = 1.60\%$

79. Probability of Default and Probability of Survival

Assume that a company's hazard rate is a constant 8% per year or 2% per quarter. An investor sells five-year CDS protection on the company with the premiums paid quarterly over the next five years. You are required to compute:

- What is the probability of survival for first quarter?
- What is the conditional probability of survival for the second quarter?
- What is the probability of survival through second quarter?

Answer:

Probability of survival for first quarter = $1 - \text{Probability of default of first quarter}$

Probability of survival for first quarter = $1 - 2\% = 98\%$

Note: Hazard rate is basically the risk of default

Conditional probability of survival for second quarter is also 98% because the hazard rate is constant at 2%. In other words, conditional on the company having survived the first quarter, there is a 2% probability of default in the second quarter

- Probability of survival in first two quarters = Survival in first quarter $\times$ Survival in second quarter
- Probability of survival in first two quarters = $98\% \times 98\% = 96.04\%$
- Alternatively, we can also say that 3.96% is the probability of default in the first two quarters

Part IX - Option Greeks

Delta	It is the degree to which an option price will move given a small change in the underlying stock price. For example, an option with a delta of 0.5 will move half a rupee for every full rupee movement in the underlying stock.
Gamma	It measures how fast the delta changes for small changes in the underlying stock price. i.e. the delta of the delta. If you are hedging a portfolio using the delta-hedge technique described under "Delta", then you will want to keep gamma as small as possible, the smaller it is the less often you will have to adjust the hedge to maintain a delta neutral position
Theta	The change in option price given a one day decrease in time to expiration. Basically it is a measure of time decay
Rho	The change in option price given a one percentage point change in the risk-free interest rate. It is sensitivity of option value to change in interest rate. Rho indicates the absolute change in option value for a one percent change in the interest rate.
Vega	Sensitivity of option value to change in volatility. Vega indicates an absolute change in option value for a one percent change in volatility

Example:

Spot Price	20,000
Strike Price	19,000
Today Date	September 14, 2023
Expiry Date	December 31, 2023
Volatility (SD)	18
Risk-free Interest rate	7
Dividend	0.00
Values:	
Call option premium	1,648.74
Put Option Premium	255.68
Call option Delta	0.783
Put Option Delta	-0.217
Option Gamma	0.0001
Call option Theta	-5.337
Put Option Theta	-1.769
Call Option Rho	41.856
Put Option Rho	-13.710
Option Vega	32.086

Interpretation:**Call option Delta:**

A call option delta of 0.783 indicates that for every one rupee increase in the value of the underlying asset, the option premium is expected to increase by 0.783. Conversely, if the value of the underlying asset decreases by one rupee, the call premium is expected to decrease by 0.783

Spot Price	20,000	20,001	19,999
Call Premium	1,648.74	1,649.52 [1,648.74 + 0.783]	1,647.96 [1,648.74 - 0.783]

Put Option Delta:

A put option delta of -0.217 indicates that for every one rupee increase in the value of the underlying asset, the option premium is expected to decrease by 0.217. Conversely, if the value of the underlying asset decreases by one rupee, the call premium is expected to increase by 0.217

Spot Price	20,000	20,001	19,999
Put Premium	255.68	255.46 [255.68 - 0.217]	255.90 [255.68 + 0.217]

Option Gamma:

Option Gamma indicates changes in delta with changes in the value of underlying asset.

Option Gamma = 0.0001

Spot Price	20,000	20,010	19,990
Call Delta	0.783	0.784 [0.783 + (0.0001 x 10)]	0.782 [0.783 + (0.0001 x -10)]

Put Delta	-0.217	-0.216 [-0.217 + (0.0001 x 10)]	-0.218 [-0.217 + (0.0001 x -10)]

Theta:
Theta Basically measures the changes in the value of the option with one day decrease in time to expiration. Value of both call and put option will decrease with decrease in time to expiration.
Call Theta = -5.337; Put Theta = -1.769

Current Date	Sep 14, 2023	Sep 15, 2023
Call option Premium	1,648.74	1,643.40 [1,648.74 - 5.337]
Put Option Premium	255.68	253.91 [255.68 - 1.769]

Rho:
Rho indicates the change in option price due to change in interest rates. Increase in interest rates will have favorable impact on call price and adverse impact on put price.
Call Rho = 41.856; Put Rho = -13.710

Risk-free rate	7%	8%	6%
Call Premium	1,648.74	1,690.60 [1,648.74 + 41.856]	1,606.88 [1,648.74 - 41.856]
Put Premium	255.68	241.97 [255.68 - 13.71]	269.39 [255.68 + 13.71]

Vega:
Vega measures changes in option prices due to changes in volatility. Increase in volatility will increase value of both call and put option.
Option Vega = 32.086

Risk-free rate	18%	19%	17%
Call Premium	1,648.74	1,680.83 [1,648.74 + 32.086]	1,616.65 [1,648.74 - 32.086]
Put Premium	255.68	287.77 [255.68 + 32.086]	223.59 [255.68 - 32.086]

Part X – Exotic Options

- **Chooser Options:** This option provides a right to the buyer of option after a specified period of time to decide **whether purchased option is a call option or put option**. It is to be noted that the decision can be made within a specified period prior to the expiration of contracts
- **Compound Options:** Also called split fee option or '**option on option**'. As the name suggests this option provides a right or choice not an obligation **to buy another option at specific price on the expiry of first maturity date**. Thus, it can be said in this option the underlying is an option. Further the payoff depends on the strike price of second option.
- **Barrier options:** Though it is similar to plain vanilla call and put options, but unique feature of this option is **that contract will become activated only if the price of the underlying reaches a certain price** during a predetermined period
- **Binary Options:** Also known as 'Digital Option', this option contract guarantees the pay-off **based on the happening of a specific event**. If the event has occurred, the pay-off shall be pre-decided amount and if event it has not occurred then there will be no pay-off
- **Asian Options:** These are the option contracts whose pay off are determined by the **average of the prices of the underlying over a predetermined period** during the lifetime of the option.
- **Bermuda Option:** It is somewhat a compromise between a European and American options. Contrary to American option where it can be exercised at any point of time, **the exercise of this option is restricted to certain dates** or on expiration like European option.
- **Basket Options:** In this type of contracts the value of option instead of one underlying depends on **the value of a portfolio i.e., a basket**. Generally, this value is computed based on the weighted average of underlying constituting the basket.
- **Spread Options:** As the name suggests the payoff of these type of options depend on **difference between prices of two underlying**.
- **Look back options:** Unlike other type of options whose exercise prices are pre-decided, in this option on maturity date the **holder of the option is given a choice to choose a most favourable strike price**

(or) actual market price depending on the minimum and maximum price of an underlying achieved during the life time of option.

Example:

Chooser Option:	
Date of Purchase of option	September 8, 2022
Date of Decision (To Decide whether it is Call option or Put option)	May 31, 2023
Date of Expiry	September 8, 2023
Price on September 8, 2022	3,169.65
Price on May 31, 2023	3,289.50
Price on Sep 8, 2023	3,441.90
Strike Price of Option	3,400.00
Decision taken on May 31, 2023	Put Option as the Market price was lower than exercise price
Decision on Sep 8, 2023	Option will lapse as the market price was higher than exercise price
Compound Option:	
Strike price of Original Option [Option 1]	Rs.100
Strike price of Call-on-Call Option [Option 2] (Option to buy above option of strike price of Rs.100 at end of year 1)	Rs.10
Price on Date of expiry	Rs.120
Action Taken	- Exercise option 1 and earn Rs.20 - Exercise call-on-call option and buy the option 1 by paying Rs.10. Thereafter exercise the option and get Rs.20
Price on Date of expiry	Rs.90
Action Taken	- Option 1 will lapse - Option 2 will also lapse
Barrier Option:	
Date of Purchase of option	September 8, 2022
Barrier Price for call option	Rs.3,600
Barrier Price for Put option	Rs.3,000
Date of Expiry	September 8, 2023
Price on September 8, 2022	3,169.65
Maximum Price in one year	3,558.05
Minimum Price in one year	2,982.05
Price on Sep 8, 2023	3,441.90
Strike Price of Option	3,400.00
Status of barrier (Call option)	Option did not get activated as the price did not touch the barrier price of Rs.3,600. Hence option will lapse on maturity date irrespective of option being in the money on maturity date
Status of barrier (Put option)	Put option has barrier price of Rs.3,000 and the option got activated as the price fell below Rs.3,000. Option will lapse on maturity date as the current market price is higher than strike price
Binary Option:	
Date of Purchase of option	September 8, 2022
Fixed Payoff	Rs.1,000 (or) 0
Date of Expiry	September 8, 2023
Price on September 8, 2022	3,169.65
Price on Sep 8, 2023	3,441.90
Strike Price of Option	3,400.00

Status of call option	Call option will be exercised and the payoff will be Rs.1,000		
Status of put option	Put option will lapse and the payoff will be 0		
Asian Option:			
Date of Purchase of option	September 8, 2022		
Date of Expiry	September 8, 2023		
Price on September 8, 2022	3,169.65		
Price on Sep 8, 2023	3,441.90		
Average price over last one year	3,286.78		
Strike Price of Option	3,400.00		
Status of call option	Call option will lapse as the strike price is higher than average price		
Status of put option	Put option will be exercised. Payoff of put option = 3,400 - 3,286.78 = 113.22		
Bermuda Option:			
Date of Purchase of option	September 8, 2022		
Date of Expiry	September 8, 2023		
Exercised Dates	December 8, 2022; March 8, 2023; June 8, 2023 and September 8, 2023		
Price on September 8, 2022	3,169.65		
Price on Dec 8, 2023	3,350.55		
Price on Mar 8, 2023	3,390.40		
Price on Jun 8, 2023	3,236.45		
Price on Sep 8, 2023	3,441.90		
Strike Price of Option	3,400.00		
Payoff of Call option	Date	Price	Payoff
	Dec 8, 2023	3,350.55	0
	Mar 8, 2023	3,390.40	0
	Jun 8, 2023	3,236.45	0
	Sep 8, 2023	3,441.90	41.90
Payoff of Put option	Date	Price	Payoff
	Dec 8, 2023	3,350.55	49.45
	Mar 8, 2023	3,390.40	9.60
	Jun 8, 2023	3,236.45	163.55
	Sep 8, 2023	3,441.90	0.00
Basket Option:			
A basket consists of 1,000 shares of ICICI Bank, 500 shares of TCS, 250 shares of Infosys, 500 shares of SBI, 2,000 shares of Reliance Industries			
Date of Purchase of option	September 8, 2022		
Date of Expiry	September 8, 2023		
Value of Portfolio as on September 8, 2022	Rs.150 lacs		
Value of Portfolio as on September 8, 2023	Rs.200 lacs		
Strike Price of Option	Rs.175 lacs		
Payoff of Call option	Call option will be exercised as the CMP (200 lacs) is higher than Strike price (175 lacs). Payoff of call option is Rs.25 lacs		
Payoff of Put option	Put option will lapse as the CMP (200 lacs) is higher than Strike price (175 lacs). Payoff of put option is zero		
Spread Option:			
Spread option = Spread between Price of ICICI Bank and TCS			
Date of Purchase of option	September 8, 2022		
Date of Expiry	September 8, 2023		
Price as on Sep 8, 2022	TCS = 3,169.65; ICICI = Rs.898.80		
Value of Portfolio as on September 8, 2023	TCS = 3,441.90; ICICI = Rs.970.55		
Strike Price of Option	Rs.2,300		

Spread on Sep 8, 2023	Rs.2,471.35 (3,441.90 – 970.55)
Payoff of Call option	Call option will be exercised. Payoff = Rs.171.35
Payoff of Put option	Put option will lapse
Barrier Option:	
Date of Purchase of option	September 8, 2022
Strike Price for Call Option	Minimum price over one year
Strike price for put option	Maximum price over one year
Date of Expiry	September 8, 2023
Price on September 8, 2022	3,169.65
Maximum Price in one year	3,558.05
Minimum Price in one year	2,982.05
Price on Sep 8, 2023	3,441.90
Payoff of call option	3,441.90 – 2,982.05 = Rs.459.85
Payoff of Put option	3,558.05 – 3,441.90 = Rs.116.15

Part XI – CDO

Introduction:

- CDOs typically **pool together various debt instruments**, such as bonds, loans, and other fixed-income assets, to create a diversified portfolio of assets. The cash flows generated from these assets are used to pay **interest and principal to the investors** of different tranches.

Types of CDOs:

- Cash Flow Collateralized Debt Obligations (Cash CDOs):** Cash CDO is CDO which is backed by cash market debt or securities which normally **have low risk weight**. This structure mainly relies on the collateral's risk weight and collateral's ability to generate sufficient cash to pay off the securities issued by SPV
- Synthetic Collateralized Debt Obligations:** Synthetic CDOs **do not typically hold actual debt instruments as collateral**. Instead, they use credit derivatives, **such as credit default swaps (CDS)**, to replicate the performance of a portfolio of reference assets. Accordingly, this structure is mainly **used to hedge the risk rather than balance sheet funding**. Further, for banks, this structure also allows **the customer's relations to be unaffected**. This was started mainly by banks who want to **hedge the credit risk but not interested in taking administrative burden of sale of** assets through securitization. Synthetic CDOs can also be categorized as follows:
 - Unfunded:** It will be comprised only CDs.
 - Fully Funded:** It will be through issue of Credit Linked Notes (CLN)
 - Partially Funded:** It will be partially through issue of CLN and partially through CDs
- Arbitrage CDOs:** Basically, in Arbitrage CDOs, the issuer **captures the spread between the return realized collateral underlying the CDO and cost of borrowing to purchase these collaterals**. In addition to this issuer also collects the fee for the management of CDOs. This arbitrage arises due to acquisition of relatively high yielding securities with large spread from open market.

Example:

Cash CDO:

ICICI Bank has following assets in its balance sheet:

- Personal loans (Interest rate = 14%) = Rs.200 Crores
- Housing loans (Interest rate = 11%) = Rs.400 Crores
- Investments in Bonds (Interest rate = 9%) = Rs.300 Crores
- Investments in other fixed income assets (Interest rate = 10%) = Rs.300 Crores

ICICI Bank is in need of money and hence they plan to transfer the assets to cash CDO. The CDO will be managed by ICICI Securities. The CDO will pay compensation of Rs.1,200 crores today. CDO will fund the same through following investments from the investors:

Senior Tranche (Interest rate = 8%)	Rs.500 Crores	Receives payments before other tranches
Mezzanine Tranche (Interest rate = 9%)	Rs.300 Crores	Receives payments after senior tranche but before equity
Equity Tranche (Invested by ICICI Bank)	Rs.400 Crores	Receives payments after senior and mezzanine tranche

Cash flows in Year 1:

Particulars	Amount
Interest income on personal loan (195 crores x 14%) Note: 5 crores have defaulted	27.30
Interest income on housing loans (390 crores x 11%) Note: 10 crores have defaulted	42.90
Interest income on bonds (300 crores x 9%)	27.00
Interest income on fixed income assets (300 crores x 10%)	30.00
Total Income	127.20
Less: Operating expenses	-10.00
Less: CDO fees for managing assets	-5.00
Income available for distribution to investors	112.20
Less: Amount paid to senior tranche (500 x 8%)	-40.00
Less: Amount paid to Mezzanine Tranche (300 x 9%)	-27.00
Balance amount for equity tranche	45.20
Return for equity tranche (45.20/400 x 100)	11.30%

Synthetic CDO (unfunded):

ICICI Bank has following assets in its balance sheet:

- Personal loans (Interest rate = 14%) = Rs.200 Crores
- Housing loans (Interest rate = 11%) = Rs.400 Crores
- Investments in Bonds (Interest rate = 9%) = Rs.300 Crores
- Investments in other fixed income assets (Interest rate = 10%) = Rs.300 Crores

ICICI Bank is worried about the default risk and hence wants to purchase CDS (credit protection). The CDS will be issued by Synthetic CDO. ICICI Bank will pay annual premium of Rs.24 Crores to CDO.

Issues made by CDO:

Senior Tranche (Interest rate = 8%)	Rs.50 Crores	Receives payments before other tranches
Mezzanine Tranche (Interest rate = 9%)	Rs.20 Crores	Receives payments after senior tranche but before equity
Equity Tranche (Invested by ICICI Bank)	Rs.10 Crores	Receives payments after senior and mezzanine tranche

Particulars	Year 1	Year 2	Year 3
Premium income from CDS	24.00	24.00	24.00
Interest income on investment made by CDS [80 Crore x 5%]	4.00	4.00	4.00
Less: Payment made to ICICI Bank (due to default)	-10.00	-20.00	-24.00
Less: Operating expenses	-1.00	-1.00	-1.00
Less: Management expenses	-0.50	-0.50	-0.50
Income available for distribution to investors	16.50	6.50	2.50
Less: Amount paid to senior tranche (50 x 8%)	-4.00	-4.00	-2.50
Less: Amount paid to Mezzanine Tranche (20 x 9%)	-1.80	-1.80	0.00
Balance amount for equity tranche	10.70	0.70	0.00
Return for equity tranche	107.00%	7.00%	0.00%

Synthetic CDO (Funded):

ICICI Bank has following assets in its balance sheet:

- Personal loans (Interest rate = 14%) = Rs.200 Crores
- Housing loans (Interest rate = 11%) = Rs.400 Crores
- Investments in Bonds (Interest rate = 9%) = Rs.300 Crores
- Investments in other fixed income assets (Interest rate = 10%) = Rs.300 Crores

ICICI Bank is worried about the default risk and hence wants to purchase CDS (credit protection). The CDS will be issued by Synthetic CDO. ICICI Bank will pay annual premium of Rs.24 Crores to CDO.

Issues made by CDO in form of CLN:

Senior Tranche (Interest rate = 8%)	Rs.500 Crores	Receives payments before other tranches

Mezzanine Tranche (Interest rate = 9%)	Rs.300 Crores	Receives payments after senior tranche but before equity
Equity Tranche (Invested by ICICI Bank)	Rs.400 Crores	Receives payments after senior and mezzanine tranche

Particulars	Year 1	Year 2	Year 3
Premium income from CDS	24.00	24.00	24.00
Interest income on investment made by CDS [1200 Crore x 8%]	96.00	96.00	96.00
Less: Payment made to ICICI Bank (due to default)	-10.00	-20.00	-24.00
Less: Operating expenses	-1.00	-1.00	-1.00
Less: Management expenses	-0.50	-0.50	-0.50
Income available for distribution to investors	108.50	98.50	94.0
Less: Amount paid to senior tranche (500 x 8%)	-40.00	-40.00	-40.00
Less: Amount paid to Mezzanine Tranche (300 x 9%)	-27.00	-27.00	-27.00
Balance amount for equity tranche	41.50	31.50	27.50
Return for equity tranche	10.38%	7.88%	6.88%

Synthetic CDO (Partially Funded):

ICICI Bank has following assets in its balance sheet:

- Personal loans (Interest rate = 14%) = Rs.200 Crores
- Housing loans (Interest rate = 11%) = Rs.400 Crores
- Investments in Bonds (Interest rate = 9%) = Rs.300 Crores
- Investments in other fixed income assets (Interest rate = 10%) = Rs.300 Crores

ICICI Bank is worried about the default risk and hence wants to purchase CDS (credit protection). The CDS will be issued by Synthetic CDO. ICICI Bank will pay annual premium of Rs.24 Crores to CDO.

Issues made by CDO in form of CLN:

Senior Tranche (Interest rate = 8%)	Rs.200 Crores	Receives payments before other tranches
Mezzanine Tranche (Interest rate = 9%)	Rs.200 Crores	Receives payments after senior tranche but before equity
Equity Tranche (Invested by ICICI Bank)	Rs.200 Crores	Receives payments after senior and mezzanine tranche

Particulars	Year 1	Year 2	Year 3
Premium income from CDS	24.00	24.00	24.00
Interest income on investment made by CDS [600 Crore x 8%]	48.00	48.00	48.00
Less: Payment made to ICICI Bank (due to default)	-10.00	-20.00	-24.00
Less: Operating expenses	-1.00	-1.00	-1.00
Less: Management expenses	-0.50	-0.50	-0.50
Income available for distribution to investors	60.50	50.50	46.50
Less: Amount paid to senior tranche (200 x 8%)	-16.00	-16.00	-16.00
Less: Amount paid to Mezzanine Tranche (200 x 9%)	-18.00	-18.00	-18.00
Balance amount for equity tranche	26.50	16.50	12.50
Return for equity tranche	13.25%	8.25%	6.25%

Arbitrage CDO:

ICICI Securities is planning to create a CDO as they have found safer debt securities available at high YTM due to mispricing in the market. It is planning to acquire following assets from the market:

- AAA rated Bond (Yield of 8%) = Rs.100 Crores
- AA rated Bond (Yield of 10%) = Rs.100 Crores
- A rated Bond (Yield of 12%) = Rs.100 Crores
- Other Bonds (Yield of 18%) = Rs.100 Crores

It will be able to raise funds from the following investors:

Senior Tranche (Interest rate = 7%)	Rs.150 Crores	Receives payments before other tranches

Mezzanine Tranche (Interest rate = 8%)	Rs.150 Crores	Receives payments after senior tranche but before equity
Equity Tranche (Invested by Promoter of ICICI Securities)	Rs.100 Crores	Receives payments after senior and mezzanine tranche

Returns earned:

Particulars	Amount
Interest income on AAA rated Bond (100 Cr x 8%)	8.00
Interest income on AA rated Bond (100 Cr x 10%)	10.00
Interest income on A rated Bond (98 cr x 12%)	11.76
Interest income on other bonds (95 cr x 18%)	17.10
Total Income	46.86
Less: Credit losses (2 Cr + 5Cr)	-7.00
Less: Operating expenses	-2.00
Less: CDO fees for managing assets	-1.00
Income available for distribution to investors	36.86
Less: Amount paid to senior tranche (150 x 7%)	-10.50
Less: Amount paid to Mezzanine Tranche (150 x 8%)	-12.00
Balance amount for equity tranche	14.36
Return for equity tranche (12.36/100 x 100)	14.36%

Chapter 10 – Foreign Exchange Exposure and Risk Management**Practical Problems****Overview:**

- Part I – Basics of International Finance
- Part II – Premium/discount and appreciation/depreciation
- Part III – IRPT and PPT
- Part IV – Arbitrage
- Part V – Currency Invoicing
- Part VI – Leading and Lagging
- Part VII – Netting
- Part VIII – Forward Contract
- Part IX – Money Market Hedge
- Part X – Exchange Position and Cash Position
- Part XI – Currency Futures and Options
- Part XII – Currency Swaps
- Part XIII – Multiple Forex Hedging Strategies

Part I – Basics of International Finance**1. Direct & Indirect quote**

A Mumbai banker has given the following quotes. Identify whether they are direct or indirect. For each direct quote give the corresponding indirect quote and vice versa

Currency	Rate	Currency
Danish Kroner	8.8438	Rs. per kroner
AUD	0.03038	AUD per Rs
UAE Dirham	14.3038	Rs. per dirham
SA Rand	7.08	Rs per rand
Euro	0.015	Euro per Re
Pounds	82.0385	Rs. per pound

Answer:

- We are analyzing from the point of view of Mumbai banker and hence any quote which has INR(home currency) as the first currency in the quote will be direct quote

Given Quote	Nature	Other Quote
INR 8.8438/DKR	Direct	DKR 0.1131/INR
AUD 0.03038/INR	Indirect	INR 32.9164/ AUD
INR 14.3038/ AED	Direct	AED 0.0699/INR
INR 7.08/Rand	Direct	Rand 0.1412/INR
EUR 0.015/INR	Indirect	INR 66.67/EUR
INR 82.0385/GBP	Direct	GBP 0.0122/INR

2. Bid, Ask, Spread and Middle rate

The following are direct quotes

Rs. per GBP	82.20 – 70

Identify:

- The country where the quote is made and identify the indirect quote in that country
- The bid, ask, spread (in amount) and middle rates
- The currency being bought by the bank in the case of Bid and in the case of Ask
- The currency being bought by you from the bank in the case of Bid and in the case of Ask

Answer:

Particulars	INR per GBP
1. Given quote (Note 1 and 2)	Rs.82.20-82.70 per GBP
2. Country where quote is made	India
3. Indirect quote	GBP 0.1209 - 0.1217 per INR

Bid rate (1/Ask rate)	$\frac{1}{82.70} = 0.1209$
Ask rate (1/Bid rate)	$\frac{1}{82.20} = 0.1217$
4. Bid rate	Rs.82.20/GBP
5. Ask rate	Rs.82.70/GBP
6. Spread rate (in amount)	Rs.0.50/GBP
7. Middle rate (Bid + Ask)/2	Rs.82.45/GBP
8. Currency bought by Bank:	
Bid rate	GBP
Ask rate	INR
9. Currency bought by us:	
Bid rate	INR
Ask rate	GBP

Note:

1. Quote given in question is Rs.82.20 – 70. In a two-way quote normally only the pips portion is quoted. So, in this case 70 has been interpreted as pips and hence the quote is interpreted as Rs.82.20 – 82.70

3. Cross rates

Consider the following quotes and derive the cross rates

Quote I	Quote II	Quote III	Required
Rs./GBP 82.0385	Rs./USD 52.70	NA	USD/GBP
USD/AUD 0.6160	Rs./AUD 32.3990	NA	USD/Rs. & Rs/USD
Rs./OMR 135.500	AUD/OMR 4.1791	AUD/CAD 1.254	Rs./CAD
Rs./USD 52.50-70	Rs./GBP 82.50-80	NA	USD/GBP

Answer:**Part 1:**

$$\frac{\text{USD}}{\text{GBP}} = \frac{\text{USD}}{\text{INR}} \times \frac{\text{INR}}{\text{GBP}}$$

$$\frac{\text{USD}}{\text{GBP}} = \frac{1}{52.70} \times 82.0385 = \text{USD } 1.5567/\text{GBP}$$

Note:

- Cross-rates are arrived through a process of cross-multiplication. In this question the common connecting currency is INR and that was used to expand the quote. The quote is expanded in such a manner that if we cancel INR, the balance part will become USD/GBP
- INR/GBP is directly available in the question whereas USD/INR is not available. Hence for USD/INR we have taken 1/(INR/USD) quote

Part 2:

$$\frac{\text{USD}}{\text{INR}} = \frac{\text{USD}}{\text{AUD}} \times \frac{\text{AUD}}{\text{INR}}$$

$$\frac{\text{USD}}{\text{INR}} = 0.6160 \times \frac{1}{32.3990} = \text{USD } 0.0190/\text{INR}$$

$$\frac{\text{INR}}{\text{USD}} = \frac{1}{\frac{\text{USD}}{\text{INR}}} = \frac{1}{0.0190} = \text{INR } 52.6316/\text{USD}$$

Part 3:

$$\frac{\text{INR}}{\text{CAD}} = \frac{\text{INR}}{\text{OMR}} \times \frac{\text{OMR}}{\text{AUD}} \times \frac{\text{AUD}}{\text{CAD}}$$

$$\frac{\text{INR}}{\text{CAD}} = 135.50 \times \frac{1}{4.1791} \times 1.254$$

Final quote = INR 40.6588/CAD

Part 4:

Bid rate:

$$\text{BID} \left(\frac{\text{USD}}{\text{GBP}} \right) = \text{BID} \left(\frac{\text{USD}}{\text{INR}} \right) \times \text{BID} \left(\frac{\text{INR}}{\text{GBP}} \right)$$

$$\text{BID} \left(\frac{\text{USD}}{\text{GBP}} \right) = \frac{1}{\text{ASK} \left(\frac{\text{INR}}{\text{USD}} \right)} \times \text{BID} \left(\frac{\text{INR}}{\text{GBP}} \right)$$

$$\text{BID} \left(\frac{\text{USD}}{\text{GBP}} \right) = \frac{1}{52.70} \times 82.50$$

Final Bid rate = USD 1.5655/GBP

Ask rate:

$$\text{Ask} \left(\frac{\text{USD}}{\text{GBP}} \right) = \text{Ask} \left(\frac{\text{USD}}{\text{INR}} \right) \times \text{Ask} \left(\frac{\text{INR}}{\text{GBP}} \right)$$

$$\text{Ask} \left(\frac{\text{USD}}{\text{GBP}} \right) = \frac{1}{\text{Bid} \left(\frac{\text{INR}}{\text{USD}} \right)} \times \text{Ask} \left(\frac{\text{INR}}{\text{GBP}} \right)$$

$$\text{Ask} \left(\frac{\text{USD}}{\text{GBP}} \right) = \frac{1}{52.50} \times 82.80$$

Final Ask rate = USD 1.5771/GBP

Final quote: USD 1.5655-1.5771/GBP (or) USD 1.5655-771/GBP

4. Indirect quote

Following spot rates are available in the London Forex market.

Currency	Rate	Rate
Euro	1.24	1.40
Danish Kroner	9.274	9.356
Japanese Yen	147.636	147.650
USD	1.5606	1.5650

Since these currencies were in short supply, you are required to operate only through sterling which is quoted at Rs.75.25-35 in Mumbai. Compute:

- ❖ The quantum of Euro and DKR that you can buy, if you have a sum of Rs.1,20,000
- ❖ What is the likely rate of Yen against US Dollar

Answer:**Part 1:**

The given quotations are considered to be in indirect terms for GBP. This is because of the following two reasons:

- JPY is a cheaper currency as compared to GBP and hence quote will be JPY/GBP and same logic will be followed for other currencies
- Internationally all exchange rates are given in indirect terms for USD (INR/USD, JPY/USD) except GBP. GBP with USD would be in direct term for USD and hence quote will be USD/GBP

Quantum of Euros that can be purchased with Rs.1,20,000:

- Known component = Rs.1,20,000 (Rs.1,20,000 is called as known component as we know that we have Rs.1,20,000 and we need to buy Euros with that)
- Unknown component = ? Euros (we are planning to buy Euros but how many Euros is not known and hence Euros is called as unknown component)

Unknown component = Known component x ?
Euro = INR x $\left(\frac{\text{Euro}}{\text{INR}} \right)$
Note: We have written Euro/INR in the formula. This is stage one of formula expansion. In this case INR and INR will get cancelled and we will get Euro = Euro
Deciding Bid rate/Ask Rate:
We need to check what the customer is doing with denominator currency (INR). Customer is going to sell INR and bank is going to buy INR. Bank buys INR at Bid rate and hence bid rate will be used in the formula
Euro = INR x BID $\left(\frac{\text{Euro}}{\text{INR}} \right)$
Expanding the formula:

EURO/INR is not directly available in the question and we will use connecting currency GBP to expand and get the answer

$$\text{Euro} = \text{INR} \times \text{BID} \left(\frac{\text{Euro}}{\text{GBP}} \right) \times \text{BID} \left(\frac{\text{GBP}}{\text{INR}} \right)$$

$$\text{Euro} = 1,20,000 \times 1.24 \times \frac{1}{75.35}$$

$$\text{Euros} = 1,974.78$$

Quantum of DKR that can be purchased with Rs.1,20,000

- Known component = Rs.1,20,000 (Rs.1,20,000 is called as known component as we know that we have Rs.1,20,000 and we need to buy DKR with that)
- Unknown component = ? DKR (we are planning to buy DKR but how many DKR is not known and hence DKR is called as unknown component)

Unknown component = Known component x ?

$$\text{DKR} = \text{INR} \times \left(\frac{\text{DKR}}{\text{INR}} \right)$$

Deciding Bid rate/Ask Rate:

We need to check what the customer is doing with denominator currency (INR). Customer is going to sell INR and bank is going to buy INR. Bank buys INR at Bid rate and hence bid rate will be used in the formula

$$\text{DKR} = \text{INR} \times \text{BID} \left(\frac{\text{DKR}}{\text{INR}} \right)$$

$$\text{DKR} = \text{INR} \times \text{BID} \left(\frac{\text{DKR}}{\text{GBP}} \right) \times \text{BID} \left(\frac{\text{GBP}}{\text{INR}} \right)$$

$$\text{DKR} = 1,20,000 \times 9.274 \times \frac{1}{75.35}$$

$$\text{DKR} = 14,769.48$$

Part 2 - Likely rate of Yen against USD:

- We are required to find the rate of Yen. Yen is basically the product and hence we are required to calculate (USD/Yen)

Bid rate	Ask rate
$\text{Bid} \left(\frac{\text{USD}}{\text{Yen}} \right) = \text{Bid} \left(\frac{\text{USD}}{\text{GBP}} \right) \times \text{Bid} \left(\frac{\text{GBP}}{\text{Yen}} \right)$ $\text{Bid} \left(\frac{\text{USD}}{\text{Yen}} \right) = 1.5606 \times \frac{1}{147.650} = 0.01057$	$\text{Ask} \left(\frac{\text{USD}}{\text{Yen}} \right) = \text{Ask} \left(\frac{\text{USD}}{\text{GBP}} \right) \times \text{Ask} \left(\frac{\text{GBP}}{\text{Yen}} \right)$ $\text{Ask} \left(\frac{\text{USD}}{\text{Yen}} \right) = 1.5650 \times \frac{1}{147.636} = 0.01060$

USD/Yen rate = USD 0.01057 - 0.01060/Yen

5. Cross rate [Nov 2018, Nov 2018 RTP, May 2005, Nov 2011, May 2014, May 2017 RTP, May 2024 MTP, SM] [Concept Revision]

On January 28, 2012 an importer customer requested a bank to remit Singapore Dollar (SGD) 25,00,000 under an irrevocable LC. However, due to bank strikes, the bank could affect the remittance only on February 4, 2012. The interbank market rates were as follows:

	January, 28	February 4
Bombay US\$1	Rs. 45.85/45.90	Rs.45.91/45.97
London Pound 1	\$1.7840/1.7850	\$1.7765/1.7775
Pound 1 =	SGD 3.1575/3.1590	SGD 3.1380/3.1390

The bank wishes to retain an exchange margin of 0.125%. How much does the customer stand to gain or lose due to the delay?

Answer:

Computation of likely outflow if payment was done on January,28:

- Known component = SGD 25,00,000 (SGD 25,00,000 is called as known component as we know that we have to buy SGD 25,00,000 and we need to use INR to buy the same)
- Unknown component = ? INR (we are planning to sell INR but how many INR needed is not known and hence INR is unknown component)

Unknown component = Known component x ?

$$\text{INR} = \text{SGD} \times \left(\frac{\text{INR}}{\text{SGD}} \right)$$

Deciding Bid rate/Ask Rate:

We need to check what the customer is doing with denominator currency (SGD). Customer is going to buy SGD and bank is going to sell SGD. Bank sells SGD at Ask rate and hence Ask rate will be used in the formula

$$\text{INR} = \text{SGD} \times \text{Ask} \left(\frac{\text{INR}}{\text{SGD}} \right)$$

$$\text{INR} = \text{SGD} \times \text{Ask} \left(\frac{\text{INR}}{\text{USD}} \right) \times \text{ASK} \left(\frac{\text{USD}}{\text{GBP}} \right) \times \text{ASK} \left(\frac{\text{GBP}}{\text{SGD}} \right)$$

$$\text{INR} = 25,00,000 \times \left\{ \left[45.90 \times 1.7850 \times \frac{1}{3.1575} \right] + 0.125\% \right\}$$

$$\text{INR} = 25,00,000 \times \{ [25.94822] + 0.125\% \}$$

$$\text{INR} = 25,00,000 \times 25.98066$$

$$\text{INR outflow} = \text{Rs.6,49,51,650}$$

Note:

- Exchange margin is an additional income for banker and the same would increase the spread between bid and ask rate. Exchange margin is added to ask rate which increases customer outflow and the same is deducted from bid rate leading to lower inflow for customer.
- Exchange margin can be applied individually on the quote which has INR in it (or) we apply it finally on the cross quote. In this question we have applied it finally on cross quote

Computation of actual outflow when payment was done on February, 04:

$$\text{INR} = \text{SGD} \times \text{Ask} \left(\frac{\text{INR}}{\text{USD}} \right) \times \text{ASK} \left(\frac{\text{USD}}{\text{GBP}} \right) \times \text{ASK} \left(\frac{\text{GBP}}{\text{SGD}} \right)$$

$$\text{INR} = 25,00,000 \times \left\{ \left[45.97 \times 1.7775 \times \frac{1}{3.1380} \right] + 0.125\% \right\}$$

$$\text{INR} = 25,00,000 \times \{ [26.03941] + 0.125\% \}$$

$$\text{INR} = 25,00,000 \times 26.07196$$

$$\text{INR outflow} = \text{Rs.6,51,79,900}$$

Computation of loss:

Loss = Actual Payment on February 04 – Probable payment on January 28

$$\text{Loss} = \text{Rs.6,51,79,900} - \text{Rs.6,49,51,650} = \text{Rs.2,28,250}$$

6. Cross rates [Nov 2005, May 2013, May 2014, Nov 2014, Nov 2020, Nov 2024 MTP, SM]

You sold Hong Kong Dollar 1,00,00,000 value spot to your customer at Rs.5.70 & covered yourself in London market on the same day, when the exchange rates were US\$ 1 = H.K.\$ 7.5880-7.5920. Local interbank market rates for US\$ were Spot US\$ 1 = Rs.42.70- 42.85

- Calculate cover rate
- Ascertain the profit or loss in the transaction.
- Do you agree with the views of the Internal Auditor the above transaction has a speculative nature?

Answer:

- The bank has sold HKD 1,00,00,000 at the rate of Rs.5.70 and hence the sale proceeds would be Rs.5,70,00,000
- The bank now needs to cover the transaction. Covering the transaction would mean taking an opposite position and hence the bank has to buy HKD 1,00,00,000

Known component = HKD 1,00,00,000; Unknown component = ? INR

Unknown component = Known component x ?

$$\text{INR} = \text{HKD} \times \left(\frac{\text{INR}}{\text{HKD}} \right)$$

Deciding Bid rate/Ask Rate:

- In this question the bank is going to deal with some other bank. The bank would be considered similar to normal customer when dealing with another bank.
- Bank needs to buy HKD 1,00,00,000. This would be sold by another bank and the other bank will be selling this at Ask rate

$$\text{INR} = \text{HKD} \times \text{Ask} \left(\frac{\text{INR}}{\text{HKD}} \right)$$

$$\text{INR} = \text{HKD} \times \text{Ask} \left(\frac{\text{INR}}{\text{USD}} \right) \times \text{Ask} \left(\frac{\text{USD}}{\text{HKD}} \right)$$

$$\text{INR} = 1,00,00,000 \times 42.85 \times \frac{1}{7.5880}$$

$$\text{INR} = 1,00,00,000 \times 5.64707$$

INR = Rs. 5,64,70,700
Cover rate = Rs.5.64707/HKD
Profit = 5,70,00,000 - 5,64,70,700 = Rs.5,29,300
To some extent, we agree with views of Internal Auditor as the gain on the same transaction is bit lesser keeping in view the amount involved.

7. Forward gain/loss [May 2009, May 2014 MTP, Nov 2014 RTP, Nov 2019 MTP, SM]

Your forex dealer had entered into a cross currency deal and had sold USD 10,00,000 against EURO at USD 1 = EURO 1.4400 for spot delivery. However, later during the day, the market became volatile and the dealer in compliance with his management's guidelines had to square-up the position when the quotations were:

Spot USD 1	INR 31.4300/4500
1 month margin	25/20
2 months margin	45/35
Spot USD 1	EURO 1.4400/4450
1 month forward	1.4425/4490
2 months forward	1.4460/4530

What will be the gain or loss in the transaction?

Answer:

- Squaring up means that we have to take opposite position. The forex dealer has sold USD 10,00,000 and hence he has to now buy 10,00,000 USD
- The forex dealer has sold 10,00,000 USD and he would get 14,40,000 EUROS (10,00,000 x 1.4400)
- In order to square up the position, the dealer has to buy 10,00,000 USD

Known component = USD 10,00,000; Unknown component = ? EUROS
Unknown component = Known component x ?
$\text{EUR} = \text{USD} \times \left(\frac{\text{EUR}}{\text{USD}} \right)$
Deciding Bid rate/Ask Rate: We need to check what the forex dealer is doing with denominator currency (USD). Forex dealer is going to buy USD and the other bank is going to sell USD. Bank sells USD at ASK rate and hence ASK rate will be used in the formula $\text{EUR} = \text{USD} \times \text{ASK} \left(\frac{\text{EUR}}{\text{USD}} \right)$ $\text{EUR} = 10,00,000 \times 1.4450$ Euros outflow = EUR 14,45,000
Net loss of forex dealer = Receipt of EUR 14,40,000 - Payment of EUR 14,45,000 = EUR 5,000
The dealer has made a loss of 5,000 EUROS and he should buy the same by paying INR. It is assumed that forex dealer is based out of India and hence loss is finally converted into INR
Known component = EUR 5,000; Unknown component = ? INR
Unknown component = Known component x ?
$\text{INR} = \text{EUR} \times \left(\frac{\text{INR}}{\text{EUR}} \right)$
Deciding Bid rate/Ask Rate: We need to check what the forex dealer is doing with denominator currency (EUR). Forex dealer is going to buy EUR and the other bank is going to sell EUR. Bank sells EUR at ASK rate and hence ASK rate will be used in the formula $\text{INR} = \text{EUR} \times \text{ASK} \left(\frac{\text{INR}}{\text{EUR}} \right)$ $\text{INR} = \text{EUR} \times \text{ASK} \left(\frac{\text{INR}}{\text{USD}} \times \frac{\text{USD}}{\text{EUR}} \right)$ $\text{INR} = 5,000 \times 31.4500 \times \frac{1}{1.4400}$ Loss in INR = Rs.1,09,201.39

8. Computation of cover rate and profit and loss [Nov 2013, May 2015 MTP, SM]

You, a foreign exchange dealer of your bank, are informed that your bank has sold a T.T. on Copenhagen for Dankish Kroner 10,00,000 at the rate of Danish Kroner 1 = Rs.6.5150. You are required to cover the transaction either in London or New York market. The rate on that date are as under:

Mumbai-London	Rs.74.3000	Rs.74.3200

Mumbai-New York	Rs.49.2500	Rs.49.2625
London-Copenhagen	DKK 11.4200	DKK 11.4350
New York - Copenhagen	DKK 7.5670	DKK 7.5840

In which market will you cover the transaction, London or New York, and what will be the exchange profit or loss in the transaction?

Answer:

WN 1: Covering in New York Market:

- ❖ Known component = 10,00,000 DKK
- ❖ Unknown component = ? INR

$INR = DKK \times ASK \left(\frac{INR}{DKK} \right)$
$INR = 10,00,000 \times ASK \left(\frac{INR}{USD} \times \frac{USD}{DKK} \right)$
$INR = 10,00,000 \times \left(49.2625 \times \frac{1}{\text{Bid} \left(\frac{DKK}{USD} \right)} \right)$
$INR = 10,00,000 \times \left(49.2625 \times \frac{1}{7.5670} \right)$
$INR = 10,00,000 \times (6.510176)$
$INR = 65,10,176$
Profit/Loss = $(10,00,000 \times 6.5150) - (10,00,000 \times 6.510176)$
Profit/Loss = 65,15,000 - 65,10,176 = Rs.4,824

WN 2: Covering in London Market:

- ❖ Known component = 10,00,000 DKK
- ❖ Unknown component = ? INR

$INR = DKK \times ASK \left(\frac{INR}{DKK} \right)$
$INR = 10,00,000 \times ASK \left(\frac{INR}{GBP} \times \frac{GBP}{DKK} \right)$
$INR = 10,00,000 \times \left(74.3200 \times \frac{1}{\text{Bid} \left(\frac{DKK}{GBP} \right)} \right)$
$INR = 10,00,000 \times \left(74.3200 \times \frac{1}{11.4200} \right)$
$INR = 10,00,000 \times (6.507881)$
$INR = 65,07,881$
Profit/Loss = $(10,00,000 \times 6.5150) - (10,00,000 \times 6.507881)$
Profit/Loss = 65,15,000 - 65,07,881 = Rs.7,119

Conclusion:

- ❖ The transaction should be covered in London Market
- ❖ The cover rate is Rs.6.507881/DKK and the profit is Rs.7,119

9. Computation of quoted rate [May 2018, SM] [Concept Revision]

An importer customer of your bank wishes to book a forward contract with your bank on 3rd September for sale to him of SGD 5,00,000 to be delivered on 30th October. The spot rates on 3rd September are USD/INR 49.3700/3800 and USD/SGD 1.7058/68. The swap points are:

USD/INR		USD/SGD	
Spot/September	0300/0400	1 st month forward	48/49
Spot/October	1100/1300	2 nd month forward	96/97
Spot/November	1900/2200	3 rd month forward	138/140
Spot/December	2700/3100		
Spot/January	3500/4000		

Calculate the rate to be quoted to the importer by assuming an exchange margin of 5 paise.

Answer:

Note: The given quotes have been interpreted as INR/USD and SGD/USD as per current exchange rates

Note 1: Computation of relevant rates:

INR/USD

Particulars	Bid rate	Ask Rate
Spot rate	49.3700	49.3800
Add: Swap points for October	0.1100	0.1300
Forward Rate for October 31	49.4800	49.5100

SGD/USD:

Particulars	Bid rate	Ask Rate
Spot rate	1.7058	1.7068
Add: Swap points for October	0.0096	0.0097
Rate for October 31	1.7154	1.7165

Note 2: Computation of quoted rate:

- ❖ Known component = SGD
- ❖ Unknown component = INR
- ❖ Required quote = (INR/SGD)

$\frac{\text{INR}}{\text{SGD}} = \frac{\text{INR}}{\text{USD}} \times \frac{\text{USD}}{\text{SGD}}$
$\text{ASK} \left(\frac{\text{INR}}{\text{SGD}} \right) = \text{ASK} \left(\frac{\text{INR}}{\text{USD}} \times \frac{\text{USD}}{\text{SGD}} \right)$
$\text{ASK} \left(\frac{\text{INR}}{\text{SGD}} \right) = \text{ASK} \left(49.5100 \times \frac{1}{\text{BID} \left(\frac{\text{USD}}{\text{SGD}} \right)} \right)$
$\text{ASK} \left(\frac{\text{INR}}{\text{SGD}} \right) = \left(49.5100 \times \frac{1}{1.7154} \right)$
$\text{ASK} \left(\frac{\text{INR}}{\text{SGD}} \right) = 28.8621$
ER post Margin = 28.8621 + 0.0500 = 28.9121

10. Calculation of security return [May 2012, Nov 2018 MTP, SM]

If the price of the bond in the beginning of the period is USD 100 and it is USD 105 at the end of the period. The coupon interest during the period is USD 7. USD appreciates during the period by 3%. Find the ROI in terms of home currency

Answer:**Computation of ROI in terms of home currency:**

- Let us assume today's exchange rate is Rs.50/USD. Today's investment is Rs.5,000 (USD 100 x Rs.50)
- USD has appreciated by 3 percent and the same would be Rs.51.50/USD
- Investment of USD 100 will become USD 112 by end of period. This would include interest income of USD 7 and principal value of USD 105
- Maturity value of investment is equal to Rs.5,768 (USD 112 x Rs.51.50)

$$\text{Return in home currency (INR)} = \frac{5,768 - 5,000}{5,000} \times 100 = 15.36\%$$

Alternative way of computing return:

- Foreign currency return = 12%. This is because 100 USD has become 112 USD

$$(1 + \text{Home currency return}) = (1 + \text{Foreign currency return}) \times (1 + \text{Appreciation/Depreciation})$$

$$(1 + \text{Home currency return}) = (1 + 12\%) \times (1 + 3\%)$$

$$(1 + \text{Home currency return}) = 1.1536$$

$$\text{Home currency return} = 1.1536 - 1 = 0.1536 \text{ (or) } 15.36\%$$

11. Computation of return [May 2016 MTP, May 2019 MTP] [Concept Revision]

With the relaxation of investment norms in India in international market upto USD 2,80,000 Mr.X to hedge himself against the risk of declining Indian economy and weakening of Indian Rupee during last few year decided to diversify into International market.

Accordingly, Mr.X invested a sum of Rs.1.58 Crores on 1.1.2011 in S&P Index. On 1.1.2012, Mr.X sold his investment. The other relevant data is given below:

Particulars	1.1.2011	1.1.2012
Index of stock market in India	7395	?
S&P Index	2028	1919

Exchange rate	62.00/62.25	67.25/67.50

You are required to:

- Determine the return for a US investor
- Determine return of Mr.X of holding period
- Determine the value of index of stock market in India as on 1.1.2012 at which Mr.X would be indifferent between investment in S&P Index and Indian Stock Market

Answer:

WN 1: Computation of return for US Investor:

$$\text{Return} = \frac{\text{Ending Index} - \text{Opening index}}{\text{Opening Index}} \times 100$$

$$\text{Return} = \frac{1,919 - 2,028}{2,028} \times 100 = -5.37\%$$

WN 2: Return of Mr.X for holding period:

Particulars	Calculation	Amount
Amount of investment		Rs.1,58,00,000
Investment in USD	$1,58,00,000 \times \left(\frac{1}{62.25}\right)$	USD 2,53,815.26
Purchase price of S&P		2,028
Ending price of S&P		1,919
Proceeds realized in USD	$2,53,815.26 \times \left(\frac{1919}{2028}\right)$	USD 2,40,173.32
Exchange rate on 1.1.2012		67.25
INR realization on 1.1.2012	$2,40,173.32 \times 67.25$	Rs.1,61,51,655
Return in INR	$1,61,51,655 - 1,58,00,000$	3,51,655
Return in %	$\frac{3,51,655}{1,58,00,000} \times 100$	2.23%

WN 3: Computation of indifferent level of index for investment in Indian stock market:

- ❖ The investor is earning a return of 2.23% in US market. He would want to earn the same rate of return in Indian market
- ❖ Closing index value = $7,395 + 2.23\% = 7,560$

12. Return from USD investment [July 2021, May 2022 RTP, Nov 2022 MTP]

Mr. Mammen, an Indian investor invests in a listed bond in USA. If the price of the bond at the beginning of the year is USD 100 and it is USD 103 at the end of the year. The coupon rate is 3% payable annually.

Find the return on investment in terms of home country currency if:

- USD is Flat.
- USD appreciates during the year by 3%.
- USD depreciates during the year by 3%.
- Indian Rupee appreciates during the year by 5%.
- Will your answer differs if Mr. Mammen invests in the bond just before the interest payable.

Answer:

USD is flat:

$$\text{Return} = \frac{3 + 103 - 100}{100} \times 100 = 6\%$$

USD appreciates by 3%:

$$(1 + \text{INR return}) = (1 + \text{USD return}) \times (1 + \text{USD Appreciation})$$

$$(1 + \text{INR return}) = (1 + 6\%) \times (1 + 3\%)$$

$$\text{INR return} = [(1.06) \times (1.03)] - 1 = 0.0918 \text{ (or) } 9.18\%$$

USD depreciates by 3%:

$$(1 + \text{INR return}) = (1 + \text{USD return}) \times (1 + \text{USD Appreciation})$$

$$(1 + \text{INR return}) = (1 + 6\%) \times (1 - 3\%)$$

$$\text{INR return} = [(1.06) \times (0.97)] - 1 = 0.0282 \text{ (or) } 2.82\%$$

INR appreciates by 5%:

$$(1 + \text{USD return}) = (1 + \text{INR return}) \times (1 + \text{INR Appreciation})$$

$$(1 + 6\%) = (1 + \text{INR return}) \times (1 + 5\%)$$

$$\text{INR Return} = \frac{1.06}{1.05} - 1 = 0.95\%$$

Impact of investment before interest payable date:

No, our answer will not differ even if Mr. Mammen invests in bond just before the interest is payable

Part II - Premium/Discount and Appreciation/Depreciation

13. Premium/discount

The spot rate for INR/AUD is 29.45 - 29.90 and the three-month forward rate is 29.36 - 29.80. Identify the following:

- ❖ Which currency is appreciating and which is depreciating
- ❖ Which currency is trading at a discount and which at a premium
- ❖ Compute the annual percentage premium or discount

Answer:

- The forward rate for INR/AUD is declining and this indicates that AUD is depreciating. Hence INR is appreciating
- INR is at premium and AUD is at discount

Computation of Annual premium or discount percentage:

- Spot rate = INR 29.45-29.90/AUD
- Three-month forward = INR 29.36-29.80/AUD

Calculation for AUD:

Premium or discount %	$\frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{12}{m} \times 100$	
Using BID Rate	$\frac{29.36 - 29.45}{29.45} \times \frac{12}{3} \times 100$	-1.22% (depreciation)
Using ASK Rate	$\frac{29.80 - 29.90}{29.90} \times \frac{12}{3} \times 100$	-1.34% (depreciation)

Calculation for INR:

Given Spot Quote	INR 29.45 - 29.90/AUD	
Indirect spot quote	$\left(\frac{1}{29.90} - \frac{1}{29.45}\right) = \text{AUD } 0.033445 - 0.033956 \text{ per INR}$	
Given Forward Quote	INR 29.36-29.80/AUD	
Indirect Forward Rate	$\left(\frac{1}{29.36} - \frac{1}{29.80}\right) = \text{AUD } 0.033557 - 0.034060 \text{ per INR}$	
Premium or discount %	$\frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{12}{m} \times 100$	
Using BID Rate	$\frac{0.033557 - 0.033445}{0.033445} \times \frac{12}{3} \times 100$	1.34% (appreciation)
Using ASK Rate	$\frac{0.034060 - 0.033956}{0.033956} \times \frac{12}{3} \times 100$	1.23% (appreciation)

14. Appreciation/depreciation

Compute the annual percentage appreciation (or depreciation) of rupee and foreign currencies in the following cases:

Quote in Mumbai for	Spot	6 Months Forward
Rand	6.53 - 6.90	20/15
GBP	78	80

Answer:

The given quotations are considered to be in direct terms for INR. This is because INR is a cheaper currency as compared to GBP and hence quote will be INR/GBP and same logic will be followed for other currencies

WN 1: Analysis of INR/RAND Quote:

- Spot rate = INR 6.53-6.90 per Rand

- 6-month Swap points = 20/15
- Swap points are in descending order and hence they have to be deducted to get the forward rate
- Forward rate = INR 6.33/6.75 per Rand

Calculation for RAND:

Premium or discount %	$\frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{12}{m} \times 100$	
Using BID Rate	$\frac{6.33 - 6.53}{6.53} \times \frac{12}{6} \times 100$	-6.13% (depreciation)
Using ASK Rate	$\frac{6.75 - 6.90}{6.90} \times \frac{12}{6} \times 100$	-4.35% (depreciation)

Calculation for INR:

Given Spot Quote	INR 6.53 - 6.90/RAND	
Indirect spot quote	$\left(\frac{1}{6.90} - \frac{1}{6.75}\right) = \text{RAND } 0.144928 - 0.153139 \text{ per INR}$	
Given Forward Quote	INR 6.33 - 6.75/RAND	
Indirect Forward Rate	$\left(\frac{1}{6.75} - \frac{1}{6.33}\right) = \text{RAND } 0.148148 - 0.157978 \text{ per INR}$	
Premium or discount %	$\frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{12}{m} \times 100$	
Using BID Rate	$\frac{0.148148 - 0.144928}{0.144928} \times \frac{12}{6} \times 100$	4.44% (appreciation)
Using ASK Rate	$\frac{0.157978 - 0.153139}{0.153139} \times \frac{12}{6} \times 100$	6.32% (appreciation)

WN 2: Analysis of INR/GBP Quote:

- Spot rate = INR 78/GBP [OR] GBP 0.012821/INR
- Forward rate = INR 80/GBP [OR] GBP 0.0125/INR

Premium or discount % For GBP	$\frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{12}{m} \times 100$ $\frac{80 - 78}{78} \times \frac{12}{6} \times 100$	5.13% (appreciation)
Premium or discount % For INR	$\frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{12}{m} \times 100$ $\frac{0.0125 - 0.012821}{0.012821} \times \frac{12}{6} \times 100$	-5.01% (depreciation)

15. Computation of premium/discount % [May 2019 MTP, Nov 2016, Nov 2022 RTP, SM] [Concept Revision]

On April 3, 2016, a Bank quotes the following:

- ❖ Spot exchange rate (USD 1) = INR 66.2525/67.5945
- ❖ 2 months' swap points = 70/90
- ❖ 3 months' swap points = 160/186

In a spot transaction, delivery is made after two days. Assume spot date as April 5, 2016 and 1 swap point = 0.0001.

You are required to:

- (i) Ascertain swap points for 2 months and 10 days (For June 15, 2016)
- (ii) Determine foreign exchange rate for June 15, 2016 and
- (iii) Compute the annual rate of premium/discount of USD on INR, on an average rate

Answer:**WN 1: Computation of swap points for 2 months and 15 days:**

Particulars	Bid	Ask
Swap points for 2 months	70	90
Swap points for 3 months	160	186
Swap points for 30 days	90	96
Swap points for 10 days	30	32

Swap points for 30 days x $\left(\frac{10}{30}\right)$		
Swap points for 2 months and 15 days	100	122

WN 2: Computation of exchange rate for June 15, 2016:

Particulars	Bid	Ask
Spot rate	66.2525	67.5945
Add: Swap points for 2 months and 10 days	0.0100	0.0122
Exchange rate for June 15, 2016	66.2625	67.6067

WN 3: Computation of premium/discount percentage of USD:

Particulars	Bid	Ask
Spot rate	66.2525	67.5945
Exchange rate for June 15, 2016	66.2625	67.6067
Premium	0.0100	0.0122
Average rate (Spot + Forward)/2	66.2575	67.6006
Premium %	$\frac{0.0100}{66.2575} \times \frac{12}{2.333} \times 100 = 0.0776\%$	$\frac{0.0122}{67.6006} \times \frac{12}{2.3333} \times 100 = 0.0928\%$

16. Swap points [May 2019 MTP, May 2009, May 2023 MTP, SM]

You have following quotes from Bank A and Bank B:

	Bank A	Bank B
SPOT	CHF/USD 1.4650/55	CHF/USD 1.4653/60
3 Months	5/10	
6 Months	10/15	
SPOT	USD/GBP 1.7645/60	USD/GBP 1.7640/50
3 Months	25/20	
6 Months	35/25	

Calculate:

- How much minimum CHF amount you have to pay for 1 Million GBP spot?
- Considering the quotes from Bank A only, for CHF/GBP what are the implied swap points for spot over 3 months?

Answer:**WN 1: Computation of minimum CHF amount to buy 1 million GBP:**

Known component = GBP 10,00,000; Unknown component = ? CHF
Unknown component = Known component x ?
$\text{CHF} = \text{GBP} \times \left(\frac{\text{CHF}}{\text{GBP}}\right)$
Deciding Bid rate/Ask Rate:
We need to check what the customer is doing with denominator currency (GBP). Customer is going to buy GBP and bank is going to sell GBP. Bank sells GBP at ASK rate and hence ASK rate will be used in the formula
$\text{CHF} = \text{GBP} \times \text{ASK} \left(\frac{\text{CHF}}{\text{GBP}}\right)$
$\text{CHF} = \text{GBP} \times \text{ASK} \left(\frac{\text{CHF}}{\text{USD}} \times \frac{\text{USD}}{\text{GBP}}\right)$
$\text{CHF} = 10,00,000 \times (1.4655 \times 1.7650)$
CHF outflow = CHF 25,86,607.50

Note:

- Since there are two banks, the customer can choose either of the two banks. The customer should choose a bank which leads to lower outflow and higher inflow
- For CHF/USD we are using Bank A as it has lower ASK rate and for USD/GBP we are using Bank B as it has lower ASK rate

WN 2: Computation of implied swap points for CHF/GBP rate:**Spot rates:**

$$\text{BID} \left(\frac{\text{CHF}}{\text{GBP}} \right) = \text{BID} \left(\frac{\text{CHF}}{\text{USD}} \right) \times \text{BID} \left(\frac{\text{USD}}{\text{GBP}} \right)$$

$$\text{BID} \left(\frac{\text{CHF}}{\text{GBP}} \right) = 1.4650 \times 1.7645 = 2.5850$$

$$\text{ASK} \left(\frac{\text{CHF}}{\text{GBP}} \right) = \text{ASK} \left(\frac{\text{CHF}}{\text{USD}} \right) \times \text{ASK} \left(\frac{\text{USD}}{\text{GBP}} \right)$$

$$\text{ASK} \left(\frac{\text{CHF}}{\text{GBP}} \right) = 1.4655 \times 1.7660 = 2.5881$$

3-month Forward rates:

$$\text{BID} \left(\frac{\text{CHF}}{\text{GBP}} \right) = \text{BID} \left(\frac{\text{CHF}}{\text{USD}} \right) \times \text{BID} \left(\frac{\text{USD}}{\text{GBP}} \right)$$

$$\text{BID} \left(\frac{\text{CHF}}{\text{GBP}} \right) = 1.4655 \times 1.7620 = 2.5822$$

$$\text{ASK} \left(\frac{\text{CHF}}{\text{GBP}} \right) = \text{ASK} \left(\frac{\text{CHF}}{\text{USD}} \right) \times \text{ASK} \left(\frac{\text{USD}}{\text{GBP}} \right)$$

$$\text{ASK} \left(\frac{\text{CHF}}{\text{GBP}} \right) = 1.4665 \times 1.7640 = 2.5869$$

Swap points:

Particulars	BID Rate	ASK Rate
Spot rate	2.5850	2.5881
3-month forward rate	2.5822	2.5869
3-month swap points	0.0028 (or) 28	0.0012 (or) 12

17. Discount computation [Nov 2019 RTP, Nov 2004, Nov 2018, SM] [Homework]

Excel Exporters are holding an Export bill in United States Dollar (USD) 1,00,000 due 60 days hence. They are worried about the falling USD value which is currently at Rs.45.60 per USD. The concerned export consignment has been priced on an exchange rate of Rs.45.50 per USD. The firm's banker have quoted a 60-day forward rate of Rs.45.20.

Calculate:

- Rate of discount quoted by the bank
- The probable loss of operating profit if the forward sale is agreed to

Answer:**WN 1: Computation of rate of discount quoted by the bank:**

$$\text{Rate of discount} = \frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{365}{60} \times 100$$

$$\text{Rate of discount} = \frac{45.20 - 45.60}{45.60} \times \frac{365}{60} \times 100 = 5.34\%$$

WN 2: Probable loss of operating profit:

Particulars	Calculation	Amount
Amount billed	1,00,000 x 45.50	45,50,000
Expected realization	1,00,000 x 45.20	45,20,000
Loss of operating profit		30,000

Part III - IRPT and PPT**18. IRPT [Nov 2012, May 2004, May 2019 MTP, SM] [Concept Revision]**

The US dollar is selling in India at Rs.55.50. If the interest rate in India is 10% per annum and the corresponding rate in USA is 4%

- Do you expect that USD will be at a premium or at discount in the Indian forex market?
- What will be the expected forward rate for US dollar in India after six months and 1 year?
- What will be the rate of forward premium or discount?

Answer:**Part a:**

- Interest rate in USA is lower than that of India. High interest rates in India will be offset by depreciation of INR. Hence the USD will be at a premium in the Indian forex market

Part b:**6-month forward rate:**

Spot rate = INR 55.50/USD
Home currency = INR
R _h (Indian rate) = 5% per half year
Foreign currency = USD
R _f (USA rate) = 2% per half year
$\frac{1 + R_h}{1 + R_f} = \frac{F_1}{e_0}; \frac{1 + 5\%}{1 + 2\%} = \frac{F_1}{55.50}$
$F_1 = \frac{55.50 \times 1.05}{1.02} = \text{RS. } 57.13 \text{ per USD}$

1-year forward rate:

Spot rate = INR 55.50/USD
Home currency = INR
R _h (Indian rate) = 10% per year
Foreign currency = USD
R _f (USA rate) = 4% per year
$\frac{1 + R_h}{1 + R_f} = \frac{F_1}{e_0}; \frac{1 + 10\%}{1 + 4\%} = \frac{F_1}{55.50}$
$F_1 = \frac{55.50 \times 1.10}{1.04} = \text{Rs. } 58.70 \text{ per USD}$

Part c:**Computation of forward premium or discount:****Using 6-month rates:**

- Spot rate = INR 55.50/USD (OR) USD 0.018018/INR
- 6-Month Forward Rate = INR 57.13/USD (OR) 0.017504/INR

Premium or discount % For USD	Forward rate – Spot rate $\frac{57.13 - 55.50}{55.50} \times \frac{12}{6} \times 100$	5.87% (appreciation)
Premium or discount % For INR (price)	Forward rate – Spot rate $\frac{0.017504 - 0.018018}{0.018018} \times \frac{12}{6} \times 100$	-5.71% (depreciation)

Using 1-year rates:

- Spot rate = INR 55.50/USD (OR) USD 0.018018/INR
- One-year Forward Rate = INR 58.70/USD (OR) USD 0.017036/INR

Premium or discount % For USD	Forward rate – Spot rate $\frac{58.70 - 55.50}{55.50} \times \frac{12}{12} \times 100$	5.77% (appreciation)
Premium or discount % For INR	Forward rate – Spot rate $\frac{0.017036 - 0.018018}{0.018018} \times 100$	-5.45% (depreciation)

19. IRPT

The following table shows interest rates for USD and EURO. Spot exchange rate is 0.8006 EURO per dollar. Complete the missing entries:

Particulars	6 Months
USD interest p.a.	8%
France interest p.a.	XX
Forward Euro per dollar	XX
Forward discount on Euro percent per year	(4%)

Answer:**WN 1: Computation of forward rate:**

- Spot exchange rate = 0.8006 EURO per USD
- Forward discount on EURO is 4% per year and the same would be 2% for 6 months
- Forward discount/premium can be applied only to the product only to get the forward rate
- In the above quote USD is the product and hence we should convert this into the other quote
- 0.8006 EURO per USD = 1.2491 USD/EURO
- Forward rate = 1.2491 - 2% = 1.2241 USD/EURO (or) 0.8169 EURO/USD**

WN 2: Computation of France Interest:

Spot rate = EUR 0.8006 per USD
Home currency = EUR
R _h (France rate) = ?
Foreign currency = USD
R _f (USA rate) = 8% per year (or) 4% per half-year
$\frac{1 + R_h}{1 + R_f} = \frac{F_1}{e_0}; \frac{1 + X}{1 + 4\%} = \frac{0.8169}{0.8006}$
$1 + X = \frac{0.8169 \times 1.04}{0.8006}; 1 + X = 1.0612$
X = 6.12%;
France Interest rate = 6.12% per half-year (or) 12.24% per annum

20. IRPT [Homework]

Shoe Company sells to a wholesaler in Germany. The purchase price of a shipment is 50,000 deutsche marks with term of 90 days. Upon payment, Shoe Company will convert the DM to dollars. The present spot rate for DM per dollar is 1.71, whereas the 90-day forward rate is 1.70.

You are required to calculate and explain:

- If Shoe Company were to hedge its foreign-exchange risk, what would it do? What transactions are necessary?
- Is the deutsche mark at a forward premium or at a forward discount?
- What is the implied differential in interest rates between the two countries?

Answer:

- Part A:** The shoe company can hedge its foreign exchange risk by taking a forward contract. The forward contract would be for selling 50,000 DM
- Part B:** The spot rate is DM 1.71/USD whereas the forward rate is DM 1.70/USD. This indicates that USD is depreciating and hence DM is appreciating.
- Part C:** Implied differential in exchange rates would be equal to appreciation or depreciation of currency

Premium or discount % For USD	$\frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{365}{d} \times 100$ $\frac{1.70 - 1.71}{1.71} \times \frac{365}{90} \times 100$	-2.37% (depreciation)

- USD has annual depreciation of 2.37%. This would mean that interest rate in USA will be higher than that of Germany. Hence Interest rate in USA would be 2.37% higher than that of Germany

21. IRPT (Nov 2023 RTP)

The following table shows interest rates for the United States dollar and French francs. The spot exchange rate is 7.05 francs per dollars complete the missing entries:

Particulars	3 months	6 months	1 year
Dollar interest rate (Annually compounded)	11.5%	12.25%	?
Franc interest rate (Annually compounded)	19.5%	?	20%
Forward France per Dollar	?	?	7.5200
Forward discount per Franc p.a.	?	-6.30%	

Answer:**WN 1: Computation of 3-Month missing entries:**

Spot rate = 7.05 FFR/USD
Home currency = FFR
Rh (Franc) = 19.5% per annum (or) 4.875% per 3 months
Foreign currency = USD
Rf (Dollar rate) = 11.5% per year (or) 2.875% per 3 months
$1 + R_h = \frac{F_1}{e_0}; 1 + 4.875\% = \frac{F_1}{7.05}$
$F_1 = \frac{7.05 \times 1.04875}{1.02875} = 7.19$
3-month forward rate = 7.19 FFR/USD

Computation of Forward Discount for FFR

- Spot rate = 7.05 FFR/USD (OR) USD 0.141844/FFR
- 3-Month Forward Rate = 7.19 FFR/USD (OR) USD 0.139082/FFR

Premium or discount % For FFR	Forward rate – Spot rate $\frac{12}{m} \times 100$ $\frac{0.139082 - 0.141844}{0.141844} \times \frac{12}{3} \times 100$	-7.79% (Depreciation)

WN 2: Computation of 6-Month missing entries:

Spot rate = 7.05 FFR/USD (or) 0.141844 USD/FFR
Forward discount on Franc per year = 6.3% per year
Forward discount on Franc per 6-months = 3.15% per half-year
6-month Forward rate = 0.141844 USD/FFR - 3.15%
6-month Forward rate = 0.137376 USD/FFR (or)
6-month Forward rate = 7.28 FFR/USD
Home currency = FFR
Rh (Franc) = ?
Foreign currency = USD
Rf (Dollar rate) = 12.25% per year (or) 6.125% per 6 months
$1 + R_h = \frac{F_1}{e_0}; \frac{1 + X}{1 + 6.125\%} = \frac{7.28}{7.05}$
$1 + X = \frac{7.28 \times 1.06125}{7.05} = 1.0959$
X = 9.59%; Franc interest rate = 9.59% per 6 months (or) 19.18% per annum

WN 3: Computation of 1-year missing entries:

Spot rate = 7.05 FFR/USD
1-year Forward rate = 7.52 FFR/USD
Home currency = FFR
Rh (Franc) = 20%
Foreign currency = USD
Rf (Dollar rate) = ?
$1 + R_h = \frac{F_1}{e_0}; \frac{1 + 20\%}{1 + X} = \frac{7.52}{7.05}$
$1 + X = \frac{7.05 \times 1.20}{7.52} = 1.125$
X = 12.50%; USD Interest rate = 12.50% per annum

WN 4: Solution:

Particulars	3 months	6 months	1 year
Dollar interest rate (Annually compounded)	11.5%	12.25%	12.50%
Franc interest rate (Annually compounded)	19.5%	19.18%	20%
Forward France per Dollar	7.19	7.28	7.5200
Forward discount per Franc p.a.	7.79%	-6.30%	

22. Law of one price – estimating future rate

A laptop bag is priced at USD 105.00 in New York. The same bag is priced at Rs.4,200 in Mumbai.

- ❖ Determine exchange rate in Mumbai.
- ❖ Determine the price of the bag in both the cities if next year price increases by 7 percent in Mumbai and by 4 percent in New York

Answer:

WN 1: Computation of spot exchange rate and forward exchange rate:

Spot exchange rate:

Price of bag in India = Rs.4,200
Price of bag in USA = USD 105
Price of Bag in India = Price of Bag in USA Rs.4,200 = USD 105; Rs.40 = USD 1
Spot exchange rate = Rs.40/USD

Forward exchange rate after 1 year:

Price of bag in India = Rs.4,200 + 7% = Rs.4,494
Price of bag in USA = USD 105 + 4% = USD 109.20
Price of Bag in India = Price of Bag in USA Rs.4,494 = USD 109.20; Rs.41.15 = USD 1
1-year forward rate = Rs.41.15/USD

23. Estimating future rate [May 2010, Nov 2008, SM] [Concept Revision]

The rate of inflation in India is 8% per annum and in the USA it is 4%. The current spot rate for USD in India is Rs.46. What will be the expected rate after 1 year and after 4 years applying the purchasing power parity theory.

Answer:

WN 1: Computation of 1-year forward rate:

Spot rate = Rs.46 per USD
Home currency = INR
I_h (India) = 8% per annum
Foreign currency = USD
I_f (USA rate) = 4% per annum
$1 + I_h = \frac{F_1}{e_0} \cdot \frac{1 + 8\%}{1 + 4\%} = \frac{F_1}{46}$
$F_1 = \frac{46 \times 1.08}{1.04} = 47.77$
1-year forward rate = Rs.47.77 per USD

WN 2: Computation of 4-year forward rate:

Spot rate = Rs.46 per USD
Home currency = INR
I_h (India) = 8% per annum
Foreign currency = USD
I_f (USA rate) = 4% per annum
$\frac{(1 + I_h)^4}{(1 + I_f)^4} = \frac{F_4}{e_0} \cdot \frac{(1 + 8\%)^4}{(1 + 4\%)^4} = \frac{F_4}{46}$
$F_4 = \frac{46 \times 1.08^4}{1.04^4} = 53.50$
4-year forward rate = Rs.53.50 per USD

Part IV – Arbitrage

24. Space arbitrage [SM]

In International Monetary Market an international forward bid for December, 15 on pound sterling is \$ 1.2816 at the same time that the price of IMM sterling future for delivery on December 15, is \$ 1.2806. The contract

size of pound sterling is 62,500. How could the dealer use arbitrage in profit from this situation and how much profit is earned?

Answer:

- In the forward market, the exchange rate is USD 1.2816 per GBP
- In the futures market, the exchange rate is USD 1.2806 per GBP.
- In order to exploit the arbitrage opportunity, the dealer can buy pounds in futures market at USD 1.2806 per GBP. He can also enter into a forward contract for selling pounds at USD 1.2816 per GBP
- Arbitrage profit = Contract size x (Selling price – Purchase price)
- Arbitrage profit = GBP 62,500 x (1.2816 – 1.2806) = USD 62.50

25. Arbitrage (Nov 2020 RTP) [Concept Revision]

Citi Bank quotes JPY/ USD 105.00 -106.50 and Honk Kong Bank quotes USD/JPY 0.0090 - 0.0093.

(a) Are these quotes identical if not then how they are different.

(b) Is there a possibility of arbitrage?

(c) If there is an arbitrage opportunity, then show how would you make profit from the given quotation in both cases if you are having JPY 1,00,000 or US\$ 1,000.

Answer:

Part 1:

No, while Citi Bank's quote is a Direct Quote for JPY (i.e. for Japan) the Hong Kong Bank quote is a Direct Quote for USD (i.e. for USA)

Part 2:

To decide on arbitrage, we need to convert the quote in similar terms and hence we can convert USD/JPY quote of Honk Kong Bank into JPY/USD rate

BID $\left(\frac{\text{JPY}}{\text{USD}}\right)$	$= \frac{1}{0.0093}$	JPY 107.53/USD
BID $\left(\frac{\text{USD}}{\text{JPY}}\right)$	$= \frac{1}{0.0090}$	JPY 111.11/USD

- Arbitrage opportunity would exist as we can buy USD at the rate of JPY 106.50/USD in Citi Bank and sell the same at JPY 107.53/USD in Hong Kong Market

Part 3:

Profit if we start with JPY 1,00,000

Particulars	Calculation	Amount
Sell 1,00,000 JPY and buy USD at the rate of 106.50 (Citi Bank)	$= \frac{1,00,000}{106.50}$	USD 939.97
Sell USD 939.97 in Hong Kong Market	939.97×107.53	JPY 1,00,967.44
Arbitrage gain	1,00,967.44 – 1,00,000	JPY 967.44

Profit if we start with USD 1,000:

Particulars	Calculation	Amount
Sell 1,000 USD in Hong Kong Market	$1,000 \times 107.53$	JPY 1,07,530
Sell JPY 1,07,530 in Citi Bank	$\frac{1,07,530}{106.50}$	USD 1,009.67
Arbitrage gain	1,009.67 – 1,000	USD 9.67

26. Speculation [Nov 2018 RTP, Nov 2020 RTP]:

The current spot exchange rate is \$1.35/£ and the three-month forward rate is \$1.30/£. According to your analysis of the exchange rate, you are quite confident that the spot exchange rate will be \$1.32/£ after 3 months.

(i) Suppose you want to speculate in the forward market then what course of action would be required and what is the expected dollar Profit (Loss) from this speculation?

(ii) What would be your Profit (Loss) in Dollar terms on the position taken as per your speculation if the spot exchange rate turns out to be \$1.26/£.

Assume that you would like to buy or sell £1,000,000.

Answer:

- i) If you believe the spot exchange rate will be \$ 1.32/£ in three months, you should buy £ 1,000,000 forward for \$1.30/£ and sell at \$ 1.32/£ 3 months hence. Your expected profit will be: £1,000,000 × (\$1.32 - \$1.30) = \$20,000
- (ii) If the spot exchange rate turns out to be \$1.26/£ in three months, your loss from the long position in Forward Market will be: £ 1,000,000 × (\$ 1.26 - \$1.30) = \$ 40,000

27. Time arbitrage [May 2006, Nov 2010, May 2016, May 2018, May 2018 MTP, Nov 2014 MTP, Nov 2019 MTP]

The interest rate on pounds is 12 percent in UK and 7 percent in US. The pound spot rate is 1.79 and the one-year forward rate is 1.68. Check whether arbitrage opportunity exists.

Answer:

The given quote has been interpreted as USD/GBP. This is because GBP is costlier currency as compared to USD

WN 1: Computation of Fair Forward Rate:

Spot rate = USD 1.79/GBP
1-year forward rate = USD 1.68/GBP
Home currency = USD
Interest rate in USA = 7% per annum
Foreign currency = GBP
R _f (UK) rate = 12% per annum
$1 + R_h = \frac{F_1}{e_0} \times \frac{1 + 7\%}{1 + 12\%} = \frac{F_1}{1.79}$
$F_1 = \frac{1.79 \times 1.07}{1.12} = 1.71$
Fair Forward Rate = USD 1.71/GBP

WN 2: Arbitrage mechanism:

- Actual forward rate is lower than fair forward rate. This would mean that product currency (GBP) is getting undervalued and hence we will take a loan in undervalued currency. In order to exploit the arbitrage opportunities, we should borrow money from UK and invest in USA.

Particulars	Amount
Day 0:	
Borrow 1,00,000 GBP @ 12% for 1 year	GBP 1,00,000
Convert GBP into USD at spot rate (1,00,000 × 1.79)	USD 1,79,000
Invest USD 1,79,000 @ 7% for 1 year	USD 1,79,000
Enter into forward contract to convert investment proceeds @ USD 1.68 per GBP after one year	
Day 365:	
Redeem USD deposit along with interest (1,79,000 + 7%)	USD 1,91,530
× Convert USD into GBP at pre-agreed forward rate (1,79,000/1.68)	GBP 1,14,005.95
Repay GBP loan along with interest (1,00,000 + 12%)	GBP 1,12,000
Arbitrage gain	GBP 2,005.95

- Final Arbitrage gain = GBP 2,005.95 (or) USD 3,370 (2,005.95 × 1.68)

28. Time arbitrage [May 2012 RTP]

The risk free rate of interest rate in USA is 8% per annum and in UK is 5% per annum. The spot exchange rate between USD and GBP is 1 USD = GBP 0.75. Assume that interest is compounded on daily basis then what should be the forward rate of 2 year? Further show how an investor could make risk-less profit, if two year forward price is 1 USD = 0.85 GBP.

Given $e^{-0.06} = 0.9413$; $e^{-0.016} = 0.852$; $e^{0.16} = 1.1735$; $e^{-0.1} = 0.9051$

Answer:

WN 1: Computation of forward rate as per IRPT:

- ❖ Spot rate = GBP 0.75/USD
- ❖ Home rate = Interest rate in UK = 5% per annum or 10% per 2 years
- ❖ Foreign rate = Interest rate in USA = 8% per annum or 16% per 2 years
- ❖ Forward rate after 2 years = ?

Forward rate calculation:

$\frac{1 + R_h}{1 + R_f} = \frac{F_1}{e_0}$
$\frac{e^{0.10}}{e^{0.16}} = \frac{F_1}{0.75}$
$\frac{1.1049}{1.1735} = \frac{F_1}{0.75}$
$F_1 = \frac{0.75 \times 1.1049}{1.1735}$
F₁ = GBP 0.706/USD

WN 2: Arbitrage opportunity if the actual exchange rate is GBP 0.85/USD:

- ❖ Actual exchange rate of GBP 0.85/USD is higher than fair exchange rate of GBP 0.706/USD. This would mean that dollar is going to costlier than what the fair rate suggests. Hence we should go ahead and invest in USD and borrow in GBP.

Arbitrage steps:

Particulars	Calculation	Amount
Day 0:		
1. Borrow 1,00,000 GBP for 2 years at 5% CCRFI		GBP 1,00,000
2. Convert GBP into USD at spot rate	1,00,000/0.75	USD 1,33,333
3. Invest USD 1,33,333 for 2 years at 8% CCRFI		USD 1,33,333
4. Enter into forward contract to sell USD at the rate of GBP 0.85/USD		USD 1,33,333
Year 2:		
5. Redeem USD deposit along with interest	1,33,333 x 1.1735	USD 1,56,466
6. Convert USD into GBP at forward rate	1,56,466 x 0.85	GBP 1,32,996
7. Repay GBP loan along with interest	1,00,000 x 1.1049	GBP 1,10,490
8. Arbitrage gain		GBP 22,506

- Final arbitrage gain = GBP 22,506 (or) USD 26,477.65 (22,506/0.85)

29. Arbitrage opportunity [Nov 2018, SM]

Spot rate 1 USD = Rs.68.50; USD premium on a six month forward is 3%. The annualized interest in USA is 4% and 9% in India. Is there any arbitrage possibility? If yes, how a trader can take advantage of the situation if he is willing to borrow USD 3 million.

Answer:**WN 1: Computation of fair interest rate of home currency:**

- ❖ Spot rate = INR 68.50/USD
- ❖ Actual Forward rate = INR 70.555/USD (Spot rate + 3%)
- ❖ Actual Interest rate of home country = 9%
- ❖ Actual interest rate of foreign country = 4%

$\frac{1 + R_h}{1 + R_f} = \frac{F_1}{e_0}$
$\frac{1 + 4.5\%}{1 + 2\%} = \frac{F_1}{68.50}$
$F_1 = \frac{1.045 \times 68.50}{1.02}$
F₁ = 70.18

Fair forward rate of Rs.70.18 per USD is lower than actual forward rate of Rs.70.555 per USD. This means product currency is being overvalued in the market and hence we should create investment in USD currency. So we would borrow in India and invest in USA.

Particulars	Calculation	Amount (in lacs)
Day 0:		
1. Borrow INR equivalent of 3 million USD for 6 months at 4.5%	30 lacs x 68.50	INR 2,055
2. Convert INR into USD at spot rate	2,055/68.50	USD 30
3. Invest USD 30 lacs for 6 months at 2%		USD 30
4. Enter into forward contract to convert USD into INR at INR 70.555/USD		USD 30

<u>Year 2:</u>		
5. Redeem USD deposit along with interest	30 + 2%	USD 30.60
6. Convert USD into INR at forward rate	30.60 × 70.56	INR 2,159.136
7. Repay INR loan along with interest	2,055 + 4.5%	INR 2,147.475
8. Arbitrage gain		INR 11.661

❖ Arbitrage gain = Rs.11,66,100 (or) USD 16,526 (11,66,100/70.56)

30. Decision on forward cover [May 2012 RTP] [Concept Revision] [Homework]

True Blue Cosmetics Ltd. is an old line producer of cosmetics products made up of herbals. Their products are popular in India and all over the world but are more popular in Europe. The company invoice in Indian Rupee when it exports to guard itself against the fluctuation in exchange rate. As the company is enjoying monopoly position, the buyer normally never objected to such invoices. However, recently, an order has been received from a whole-saler of France for FFr 80,00,000. The other conditions of the order are as follows:

(a) The delivery shall be made within 3 months.

(b) The invoice should be FFr.

Since, company is not interested in losing this contract only because of practice of invoicing in Indian Rupee. The Export Manager Mr. E approached the banker of Company seeking their guidance and further course of action.

The banker provided following information to Mr. E.

(a) Spot rate 1 FFr = Rs. 6.60

(b) Forward rate (90 days) of 1 FFr = Rs. 6.50

(c) Interest rate in India is 9% and in France is 12%.

Mr. E entered in forward contract with banker for 90 days to sell FFr at above mentioned rate. When the matter come for consideration before Mr. A, Accounts Manager of company, he approaches you. You as a Forex consultant is required to comment on:

(i) Whether there is an arbitrage opportunity exists or not.

(ii) Whether the action taken by Mr. E is correct and if bank agrees for negotiation of rate, then at what forward rate company should sell FFr to bank.

Answer:

WN 1: Computation of forward rate as per IRPT:

❖ Spot rate = Rs.6.60/FFR

❖ Home rate = Interest rate in India = 9% per annum or 2.25% per 90 days

❖ Foreign rate = Interest rate in France= 12% per annum or 3% per 90 days

❖ 90 days forward rate = ?

Forward rate calculation:

$\frac{1 + R_h}{1 + R_f} = \frac{F_1}{e_0}$
$\frac{1 + 2.25\%}{1 + 3\%} = \frac{F_1}{6.60}$
$F_1 = \frac{1.0225 \times 6.60}{1.03}$
$F_1 = 6.55 \text{ INR/FFR}$

WN 2: Arbitrage opportunity if the actual exchange rate is INR 6.50/FFR

❖ Actual exchange rate of INR 6.50/FFR is lower than fair exchange rate of INR 6.55/FFR. This would mean that FFR is going to cheaper than what the fair rate suggests. Hence we should go ahead and borrow in FFR and invest in INR.

WN 3: Rate to be renegotiated with bank:

❖ The Fair forward rate is INR 6.55/FFR. The actual forward rate is INR 6.50/FFR.

❖ The company can renegotiate the rate with bank for a higher realization of INR 6.55/FFR

31. Asymmetrical rates

Following are the rates quoted at Mumbai for Pounds Sterling

Rs/GBP 82.03-90

3 month forward 20-30

Interest rates (3months)		
	Rupees	Pounds

Investment	8%	5%
Borrowing	10%	8%

- ❖ Verify whether there is any scope for covered interest arbitrage if you borrow rupees
- ❖ Verify whether there is any scope for covered interest arbitrage if you borrow pounds

Answer:

It is assumed that borrowing rates given in the question are annual rates applicable for 3-month borrowing.

WN 1: Check on arbitrage opportunity if we borrow in INR:

Particulars	Amount
Day 0:	
Borrow 1,00,000 INR @ 10% for 3 months	INR 1,00,000
Convert INR into GBP at spot rate (1,00,000 / 82.90)	GBP 1,206.27
Invest GBP 1,206.27 @ 5% for 3 months	GBP 1,206.27
Enter into forward contract to convert investment proceeds @ INR 82.23-83.20 per GBP after 3-months	
Day 90:	
Redeem GBP deposit along with interest (1,206.27 + 1.25%)	GBP 1,221.35
Convert GBP into INR at pre-agreed forward rate (1,221.35 x 82.23)	INR 1,00,431.61
Repay INR loan along with interest (1,00,000 + 2.5%)	INR 1,02,500
Arbitrage gain/loss	(INR 2,068.39)

- There is no arbitrage opportunity if we borrow money in INR

WN 2: Check on arbitrage opportunity if we borrow in GBP:

Particulars	Amount
Day 0:	
Borrow 1,00,000 GBP @ 8% for 3 months	GBP 1,00,000
Convert GBP into INR at spot rate (1,00,000 x 82.03)	INR 82,03,000
Invest INR 82,03,000 @ 8% for 3 months	INR 82,03,000
Enter into forward contract to convert investment proceeds @ INR 82.23-83.20 per GBP after 3-months	
Day 90:	
Redeem INR deposit along with interest (82,03,000 + 2%)	INR 83,67,060
Convert INR into GBP at pre-agreed forward rate (83,67,060 / 83.20)	GBP 1,00,565.63
Repay GBP loan along with interest (1,00,000 + 2%)	GBP 1,02,000
Arbitrage gain/loss	(GBP 1,434.37)

- There is no arbitrage possibility if we borrow money in GBP

32. Triangular arbitrage [Nov 2008, Nov 2016 MTP, May 2020 RTP, Nov 2024 MTP, SM]

Followings are the spot exchange rates quoted at three different forex markets:

INR/USD	Rs.48.30 in Mumbai
INR/GBP	Rs.77.52 in London
USD/GBP	USD 1.6231 in New York

The arbitrageur has USD 1,00,00,000. Assuming that there are no transaction costs, explain whether there is any arbitrage gain possible from the quoted spot exchange rates

Answer:

- The arbitrageur has USD 1,00,00,000. He can convert this into other currency and convert it back into USD in following two ways:
 - USD – INR – GBP – USD
 - USD – GBP – INR – USD

Option 1: USD – INR – GBP – USD:

Particulars	Amount
USD available	USD 1,00,00,000
Convert USD into INR (1,00,00,000 x 48.30)	INR 48,30,00,000
Convert INR into GBP (48,30,00,000 / 77.52)	GBP 62,30,650
Convert GBP into USD (62,30,650 x 1.6231)	USD 1,01,12,968
Arbitrage gain (USD 1,01,12,968 – USD 1,00,00,000)	USD 1,12,968

- Above approach can lead to arbitrage gain of USD 1,12,968

Option 2: USD - GBP - INR - USD:

Particulars	Amount
USD available	USD 1,00,00,000
Convert USD into GBP (1,00,00,000 / 1.6231)	GBP 61,61,050
Convert GBP into INR (61,61,050 x 77.52)	INR 47,76,04,596
Convert INR into USD (47,76,04,596 / 48.30)	USD 98,88,294
Arbitrage gain (USD 98,88,294 - USD 1,00,00,000)	(USD 1,11,706)

- This approach is not preferable as the same leads to loss

Conclusion:

- The company should use approach 1 and the same can help in earning USD 1,12,968

33. Triangular Arbitrage [Nov 2014 RTP, Nov 2020] [Concept Revision]

Following are the spot exchange rates quoted at three different forex markets:

- USD/INR = 59.25/59.35 in Mumbai
- GBP/INR = 102.50/103.00 in London
- GBP/USD = 1.70/1.72 in New York

The arbitrageur has USD 1,00,00,000. Assuming that the bank wishes to retain an exchange margin of 0.125%, explain whether there is any arbitrage gain possible from the quoted spot exchange rates.

Answer:

- The company has USD 1,00,00,000. It can convert this into other currency and convert it back into USD in following two ways:
 - USD - INR - GBP - USD
 - USD - GBP - INR - USD

Option 1: USD - INR - GBP - USD:

Particulars	Amount
USD available	USD 1,00,00,000
Convert USD into INR (1,00,00,000 x (59.25 - 0.125%) = (1,00,00,000 x 59.18)	INR 59,18,00,000
Convert INR into GBP $\frac{59,18,00,000}{103 + 0.125\%} = \frac{59,18,00,000}{103.13}$	GBP 57,38,388
Convert GBP into USD (57,38,388) x (1.70 - 0.125%) = (57,38,388 x 1.6979)	USD 97,43,209
Arbitrage loss (97,43,209 - 1,00,00,000)	USD 2,56,791

- Above approach can lead to arbitrage loss of USD 2,56,791

Option 2: USD - GBP - INR - USD:

Particulars	Amount
USD available	USD 1,00,00,000
Convert USD into GBP $\frac{1,00,00,000}{1.72 + 0.125\%} = \frac{1,00,00,000}{1.722}$	GBP 58,07,200
Convert GBP into INR (58,07,200 x (102.50 - 0.125%) = 58,07,200 x 102.37	INR 59,44,83,064
Convert INR into USD $\frac{59,44,83,064}{59.35 + 0.125\%} = \frac{59,44,83,064}{59.42}$	USD 1,00,04,763
Arbitrage gain (USD 1,00,04,763 - 1,00,00,000)	USD 4,763

- This approach leads to arbitrage gain of USD 4,763

Conclusion:

- The company should use approach 2 and the same can help in earning USD 4,763

34. Currency invoicing

Gupta Garments exports goods to US. It can elect to bill either in Dollars or in Euro. Payment terms are 90 days. The 90 dollar swap is 1 – 0.5 and for Euro is 1.5 – 2. Help the company decide.

Answer:

- The company is exporting goods and hence a receivable(asset) would be created
- Gupta Garments should choose a currency which is expected to appreciate (assets should appreciate)
- The 90-day dollar swap is in descending order and hence dollar is expected to depreciate. Similarly, 90-day euro swap is in ascending order and hence Euro is expected to appreciate
- The company should opt for billing in Euros (appreciating currency)

35. Currency invoicing

XYZ Limited has imported a machinery worth USD 5,00,000. It can have it invoiced either in Dollars or in Euro. The comparable rates agreed are Rs.52 per USD and Rs.65 per Euro. The 6 months rate for USD is Rs.53 – 55. The USD per Euro is 1.2 – 1.25. The 6 month rate for Euro is Rs.80-81. In which currency should XYZ accept invoicing?

Answer:

- The company has an option of going for dollar or Euro invoicing. We should accept invoicing in a currency which will lead to lower outflow of INR

Billing in USD:

Known component = USD 5,00,000; Unknown component = ? INR
Unknown component = Known component x ?
$INR = USD \times \left(\frac{INR}{USD}\right)$
$INR = USD \times ASK \left(\frac{INR}{USD}\right)$
$INR = 5,00,000 \times 55$
INR outflow = Rs.2,75,00,000

Billing in EUROS:

Amount of billing in USD = 5,00,000; USD rate = Rs.52 per USD
EURO rate = Rs.65 per USD; Billing in EUROS = $5,00,000 \times (52/65) = \text{EUR } 4,00,000$
Known component = EUR 4,00,000; Unknown component = ? INR
Unknown component = Known component x ?
$INR = EUR \times \left(\frac{INR}{EUR}\right)$
$INR = EUR \times ASK \left(\frac{INR}{EUR}\right)$
$INR = 4,00,000 \times 81$
INR outflow = Rs.3,24,00,000

- The company should opt for dollar invoicing as the same leads to lower outflow of INR

36. Currency Invoicing [July 2021, Nov 2023 MTP] [Concept Revision]

XP Pharma Ltd., has acquired an export order for Rs. 10 million for formulations to a European company. The Company has also planned to import bulk drugs worth Rs. 5 million from a company in UK. The proceeds of exports will be realized in 3 months from now and the payments for imports will be due after 6 months from now. The invoicing of these exports and imports can be done in any currency i.e. Dollar, Euro or Pounds sterling at company's choice. The following market quotes are available.

Quote	Spot Rate	Annualized Premium
INR/USD	67.10/67.20	USD – 7%
INR/EURO	63.15/63.20	EURO – 6%
INR/GBP	88.65/88.75	GBP – 5%

Advice XP Pharma Ltd. about invoicing in which currency. (Calculation should be upto three decimal places).

Answer:**WN 1: Identification of currency for export transaction:**

Currency	Invoice value at spot rate	Expected rate after 3 months	Realization after 3 months
USD	$\frac{1,00,00,000}{67.10} = 1,49,031.297$	$67.10 \times \left(1 + \frac{0.07}{4}\right) = 68.27$	$1,49,031.297 \times 68.27$ $= \text{Rs.}1,01,74,367$

EURO	$\frac{1,00,00,000}{63.15} = 1,58,353.127$	$63.15 \times \left(1 + \frac{0.06}{4}\right) = 64.10$	$1,58,353.127 \times 64.10$ = Rs.1,01,50,435
GBP	$\frac{1,00,00,000}{88.65} = 1,12,803.158$	$88.65 \times \left(1 + \frac{0.05}{4}\right) = 89.76$	$1,12,803.158 \times 89.76$ = Rs.1,01,25,211

Conclusion:

- Since INR inflow is highest in USD billing we should opt for USD billing

Note:

- The above solution has been presented as per ICAI working. However, we can answer this question even without doing above calculation. We should opt for billing in the currency which has maximum appreciation (asset) and the same in this case is USD

WN 2: Identification of currency for import transaction:

Currency	Invoice value at spot rate	Expected rate after 6 months	Realization after 3 months
USD	$\frac{50,00,000}{67.20} = 74,404.762$	$67.20 \times \left(1 + \frac{0.07}{2}\right) = 69.55$	$74,404.762 \times 69.55$ = Rs.51,74,851
EURO	$\frac{50,00,000}{63.20} = 79,113.924$	$63.20 \times \left(1 + \frac{0.06}{2}\right) = 66.10$	$79,113.924 \times 66.10$ = Rs.51,50,316
GBP	$\frac{50,00,000}{88.75} = 56,338.028$	$88.75 \times \left(1 + \frac{0.05}{2}\right) = 90.97$	$56,338.028 \times 90.97$ = Rs.51,25,070

Conclusion:

- Since INR inflow is lowest in GBP billing we should opt for GBP billing

Note:

- The above solution has been presented as per ICAI working. However, we can answer this question even without doing above calculation. We should opt for billing in the currency which has minimum appreciation (liability) and the same in this case is GBP

Part VI - Leading and Lagging**37. Leading and lagging**

JK Limited has accepted an invoice of 10 lakh yen. Spot rate is Rs.0.50 per Yen and the 90 day forward rate is Rs.0.52 per Yen.

- Advise JK Limited on whether they should avail the full credit of 90 days or lead the payment if the interest rate in India is
 - 6% p.a.
 - 18% p.a.
- Will the position change if the company is running a cash surplus?
- What would be the position if JK Limited had raised rather than accepted an invoice?

Answer:**WN 1: Leading vs Lag Analysis if interest rate is 6% per annum:**

Particulars	Pay Today	Pay after 90 days
Today outflow	5,00,000 (10,00,000 × 0.50)	-
Interest on loan for 3 months	7,500 (5,00,000 × 6% × 3/12)	-
Outflow after 90 days	-	5,20,000 (10,00,000 × 0.52)
Total outflow	5,07,500	5,20,000

- We are adding interest to option 1 to make it comparable to option 2. We are basically bringing both cash flows to end of day 90
- The company should make the payment today

WN 2: Leading vs Lag Analysis if interest rate is 18% per annum:

Particulars	Pay Today	Pay after 90 days
Today outflow	5,00,000 (10,00,000 × 0.50)	-
Interest on loan for 3 months	22,500	-

	$(5,00,000 \times 18\% \times 3/12)$	
Outflow after 90 days	-	5,20,000 $(10,00,000 \times 0.52)$
Total outflow	5,22,500	5,20,000

- The company should make the payment at end of day 90

WN 3: Position if the company has cash surplus:

- If the company is running a cash surplus, then the decision would remain the same assuming borrowing and investment rates are same. Basically, we should consider opportunity cost as interest in the above statements. With our assumption of same borrowing and investment rates, the above calculation would remain same and hence decision would remain same

WN 4: If JK Limited has raised an invoice:

- If the company has raised an invoice, then it would be an exporter and would be receiving money. We should choose an option leading to higher inflow of INR
- Interest rate of 6%:** We should lag the receipt and collect in 90 days as the same has higher inflow of INR
- Interest rate of 18%:** We should lead the receipt and collect the money immediately. It is assumed that there would be no cash discount offered to customer for early payment.

38. Leading and lagging [May 2009, Nov 2018 MTP, May 2019 RTP, May 2022, SM] [Homework]

The following 2-way quotes appear in the foreign exchange market

Spot rate Rs.46.00/46.25 per USD
2-months forward rate Rs.47.00/ 47.50 per USD

Required:

- How many US dollars should a firm sell to get Rs.25 lacs after 2 months?
- How many rupees is the firm required to pay to obtain USD 2,00,000 in the spot market?
- Assume the firm has USD 69,000 in current account earning no interest. ROI on rupee investment is 10% p.a. Should the firm encash the USD now or 2 months later?

Answer:

WN 1: Computation of USD to buy Rs.25 lacs after two months:

Known component = INR 25,00,000; Unknown component = ? USD
Unknown component = Known component x ?
$USD = INR \times \left(\frac{USD}{INR} \right)$
$USD = INR \times ASK \left(\frac{USD}{INR} \right)$
$USD = 25,00,000 \times \left(\frac{1}{47} \right)$
USD outflow = 53,191,49

WN 2: Computation of INR required to buy USD 2,00,000 in spot market:

Known component = USD 2,00,000; Unknown component = ? INR
Unknown component = Known component x ?
$INR = USD \times \left(\frac{INR}{USD} \right)$
$INR = 2,00,000 \times ASK \left(\frac{INR}{USD} \right)$
$INR = 2,00,000 \times 46.25$
INR outflow = INR 92,50,000

WN 3: Decision on redeeming USD deposit:

Particulars	Redeem today	Redeem after 2 months
INR receipt today on conversion	31,74,000 $(69,000 \times 46)$	-
Interest income for 2 months	52,900 $(31,74,000 \times 10\% \times 2/12)$	-
INR receipt on conversion in M2	-	32,43,0000

		(69,000 × 47)
Total inflow in INR	32,26,900	32,43,000

- The company should wait and redeem USD deposit into INR at end of 2 months

39. Leading and lagging (Nov 2012)

Z Ltd. importing goods worth USD 2 million, requires 90 days to make the payment. The overseas supplier has offered a 60 days interest free credit period and for additional credit for 30 days and interest of 8% p.a. The bankers of Z Ltd offer a 30 days loan at 10% per annum and their quote for foreign exchange is as follows:

Spot 1 USD Rs. 56.50

60 days forward for 1 USD Rs. 57.10

90 days forward for 1 USD Rs. 57.50

You are required to evaluate the following options

- Pay the supplier in 60 days, or
- Avail the supplier's offer of 90 days credit.

Answer:

Computation of INR outflow:

Particulars	Pay in 60 days	Pay in 90 days
INR outflow with payment in day 60	11,42,00,000 (20,00,000 × 57.10)	-
Interest on loan for 30 days	9,51,667 (11,42,00,000 × 10% × 30/360)	-
USD interest for 30 days supplier credit		13,333 (20,00,000 × 8% × 30/360)
USD to be paid on day 90		20,13,333
INR outflow on day 90	-	11,57,66,648 (20,13,333 × 57.50)
Total inflow in INR	11,51,51,667	11,57,66,648

- We should make the payment in 60 days

40. Offer from Foreign Branch [May 2022, May 2023 RTP, SM] [Concept Revision]

M/s. Daksh Ltd is planning to import multipurpose machine from USA at a cost of \$15000. The company can avail loans at 19% Interest per annum with quarterly rests with which it can import the machine. However, there is an offer from New York branch of an Indian based bank extending credit of 180 days at 2% per annum against opening of an irrevocable letter of credit. Other Information: Spot rate US\$ 1 = Rs. 75 180 days forward rate US \$ 1 = Rs. 77 Commission charges for letter of credit at 2% per 12 months.

- Justify why the offer from the foreign branch should be accepted?
- Based on the present market condition company is not interested to take the risk of currency fluctuations and wanted to hedge with an additional expenses of Rs. 30,000, if so, what is your advise to the company?

Assume 360 days in the year

Answer:

WN 1: Financing the equipment with loan in India:

Particulars	Calculation	Amount
Payment on day 0	15,000 USD × 75	11,25,000
Interest for quarter 1	11,25,000 × 19% × 3/12	53,438
Interest for quarter 2	11,78,438 × 19% × 3/12	55,976
Total outflow		12,34,414

- Interest has been computed separately for quarter 1 and 2. This is because of quarterly compounding of interest rates

WN 2: Offer of foreign branch:

Part 1: Cost of letter of credit:

Particulars	Calculation	Amount
LC commission on day 0	15,000 × 75 × 2% × (180/360)	11,250
Interest	11,250 × 19% × (180/360)	1,069
Total outflow		12,319

Part 2: Payment to foreign branch:

Particulars	Calculation	Amount)
Loan taken		USD 15,000
Interest for 6 months	$15,000 \times 2\% \times 180/360$	USD 150
Total payment at end of M6		USD 15,150
INR outflow	$15,150 \times 77$	11,66,550

- Total outflow in option 2 = 12,319 + 11,66,550 = 11,78,869

Conclusion:

- Option 2 is cheaper by (Rs. 12,34,413 – Rs. 11,78,869) lakh or Rs. 55,544. Hence, the offer may be accepted

Part (ii):

If company is not interested to take the risk of currency fluctuations and wanted to hedge with an additional expense of Rs. 30,000 then it can do so because even taking forward position is resulting in increased cash outflow by the same amount.

41. Leading and lagging [Nov 2011, Nov 2019 RTP, May 2019 MTP, SM]

An Indian importer has to settle an import bill for USD 1,30,000. The exporter has given the Indian importer two options:

- ❖ Pay immediately without any interest charges
- ❖ Pay after three months with interest at 5 percent per annum

The importer's bank charges 15 percent per annum on overdrafts. The exchange rates in the market are as follows:

Spot rate Rs.48.35/48.36 per USD

3-months forward rate Rs.48.81/48.83 per USD

The importer seeks your advice on the option to be selected.

Answer:**Computation of INR Outflow:**

Particulars	Pay Today	Pay after 3 months
Today outflow	62,86,800 (1,30,000 × 48.36)	-
Interest on loan for 3 months	2,35,755 (62,86,800 × 15% × 3/12)	-
USD interest @ 5%		1,625 (1,30,000 × 5% × 3/12)
USD to be paid at end of M3		1,31,625
Outflow after 90 days	-	64,27,249 (1,31,625 × 48.83)
Total outflow	65,22,555	64,27,249

- Since outflow of cash is least in (ii) option, it should be opted for

42. Leading and Lagging:

BC Export co are holding an export bill in USD 1,00,000 due 60 days hence. Rate at which deal was finalized @ Rs.47.50 per USD. The company is worried about the fluctuating exchange rate. The firm's bankers have agreed to make advance against the bill after deduction of interest @ 9% per annum and quoted a 60-days forward rate of Rs.48.10. The cost of capital for the exporter is 15% p.a. Advise whether the exporter will agree to the banker's offer.

Answer:**Evaluation of option 1 – Acceptance of banker's offer:**

Particulars	Calculation	Amount
USD asset on day 0		USD 1,00,000
Less: Discounting charges	$1,00,000 \times 9\% \times (2/12)$	USD 1,500
Net USD realization on day 0		USD 98,500
INR realization on day 0	$98,500 \times 47.50$	INR 46,78,750
Interest saving at cost of capital of 15% for 60 days	$46,78,750 \times 15\% \times (2/12)$	INR 1,16,969
Effective INR realization at end of day 60		INR 47,95,719

Evaluation of option 2 – Rejection of banker's offer:

Particulars	Calculation	Amount
USD asset on day 0		USD 1,00,000
Forward rate		48.10
INR realization at end of day 60	1,00,000 x 48.10	INR 48,10,000

Conclusion: Exporter should not agree to banker's offer and realize the proceeds using forward rate.

43. Leading and Lagging [Nov 2020 MTP, Nov 2021 RTP, May 2022 MTP, Nov 2022 MTP] [Concept Revision]

XYZ Ltd. has imported goods to the extent of US\$ 8 Million. The payment terms are as under:

- 1% discount if full amount is paid immediately or
- 60 days interest free credit. However, in case of a further delay up to 30 days, interest at the rate of 8% p.a. will be charged for additional days after 60 days. M/s XYZ Ltd. has Rs. 25 Lakh available and for remaining it has an offer from bank for a loan up to 90 days @ 9.0% p.a.

The quotes for foreign exchange rates are as follows:

- Spot rate (INR/USD) = Rs.66.98
- 60 days forward rate (INR/USD) = Rs.67.16
- 90 days forward rate (INR/USD) = Rs.68.03

Advise which one of the following options would be better for XYZ Ltd.

(i) Pay immediately after utilizing cash available and for balance amount take 90 days loan from bank.

(ii) Pay the supplier on 60th day and avail bank's loan (after utilizing cash) for 30 days.

(iii) Avail supplier offer of 90 days credit and utilize cash available.

Further presume that the cash available with XYZ Ltd. will fetch a return of 4% p.a. in India till it is utilized.

Assume year has 360 days. Ignore Taxation. Compute your working upto four decimals and cash flows in Rs. in Crore

Answer:

WN 1: Computation of total outflow if payment is done immediately:

Particulars	Calculation	Amount
Amount payable in 60 days		USD 8 million
Amount payable today	8 million x 99%	USD 7.92 million
Amount required as per day 0 spot rate	7.92 million x 66.98	Rs.53.0482 crores
Less: Cash available		Rs.0.2500 Crores
Amount to be borrowed		Rs.52.7982 Crores
Interest on loan @ 9%	52.7982 x 9% x (90/360)	Rs.1.1880 Crores
Total Outflow		Rs.53.9862 Crores

WN 2: Computation of total outflow if payment is done in 60 days:

Particulars	Calculation	Amount
Amount payable in 60 days		USD 8 million
Amount required as per day 60 spot rate	8.00 million x 67.16	Rs.53.7280 Crores
Less: Cash available		Rs.0.2500 Crores
Amount to be borrowed		Rs.53.4780 Crores
Interest on loan @ 9%	53.4780 x 9% x (30/360)	Rs.0.4011 Crores
Less: Interest income on 0.25 Crores for 60 days	0.25 x 4% x (60/360)	(Rs.0.0017 Crores)
Net Outflow		Rs.53.8774 Crores

WN 3: Computation of total outflow if payment is done in 90 days:

Particulars	Calculation	Amount
Amount payable in 60 days		USD 8 million
Add: Interest payable @ 8% for 30 days	8 x 8% x (30/360)	USD 0.0533 million
Total amount payable in 90 days		USD 8.0533 million
Amount required as per day 90 spot rate	8.0533 x 68.03	Rs.54.7866 Crores
Less: Cash available		(Rs.0.2500 Crores)
Less: Interest income on 0.25 Crores for 90 days	0.25 x 4% x (90/360)	(Rs.0.0025 Crores)
Net Outflow		Rs.54.5341 Crores

Decision: Cash outflow is least in case of Option (ii) same should be opted for.

Note: Current cash available of Rs.25 lacs is paid out in all options and is shown as deduction in outflow. This can be alternatively be considered as part of the outflow. We have followed ICAI solution where this amount has been treated as sunk cost.

Part VII – Netting

44. Multilateral netting [Concept Revision]

A group of companies is controlled from UK. This group has subsidiaries in Belgium, France and USA. Cash flow forecasts indicate inter-company dues, as follows:

- French subsidiary to pay Belgian subsidiary – BF 144,381,000
- Belgian subsidiary to pay US subsidiary – USD 1,060,700
- US subsidiary to pay EURO 14,438,000 to French subsidiary
- French subsidiary to pay USD 800,000 to US subsidiary

In terms of Group policy, inter-company dues are netted off, and net payments are made. Relevant exchanges rates in terms of pound sterling 1 are USD 1.415, Euro 1.3834 and BF 68.10. Quantify the payments to be authorized by HQ, the entities who would remit the payments and the entities who would receive the payments.

Answer:

Particulars	French	Belgian	US
FS to BS (14,43,81,000/68.10)	-21,20,132.16	21,20,132.16	
BS to US (10,60,700/1.415)		-7,49,611.31	7,49,611.31
US to FS (1,44,38,000/1.3834)	1,04,36,605.46		-1,04,36,605.46
FS to US (8,00,000/1.415)	-5,65,371.02		5,65,371.02
Net Amount	77,51,102.28	13,70,520.85	-91,21,623.13

- US Subsidiary should pay 77.51.102.88 GBP to French subsidiary
- US subsidiary should pay 13,70,520.85 GBP to Belgian subsidiary

45. Netting [May 2007, Nov 2015 RTP]

AMK Ltd. an Indian based company has subsidiaries in U.S. and U.K.

Forecasts of surplus funds for the next 30 days from two subsidiaries are as below:

US	USD 12.5 million
UK	GBP 6 million

Following exchange rate information is obtained

	USD/INR	GBP/INR
Spot	0.0215	0.0149
30 days forward	0.0217	0.0150

Annual borrowing/deposit rates (simple) are available:

- ❖ INR = 6.4%/6.2%
- ❖ USD = 1.6%/1.5%
- ❖ GBP = 3.9%/3.7%

The Indian operation is forecasting a deficit of Rs.500 million. It is assumed that interest rates are based on a year of 360 days.

- Calculate the cash balance at the end of 30 days period is INR for each company under each of the following scenarios:
 - Each company invests/finances its own cash balances/deficits in local currency independently
 - Cash balances are pooled immediately in India and the net balances are invested/borrowed for the 30 days period
- Which method do you think is preferable from the parent company's point of view?

Answer:

WN 1: Cash balance in INR if the companies act independently:

(in lacs)

Entity	Surplus/ Deficit	Invest/ Borrow	Interest rate	Maturity value	Maturity value (INR)
US	125 USD	Invest	1.5%	125.1625	5,767.569
UK	60 GBP	Invest	3.7%	60.185	4,012.333
India	(5,000) INR	Borrow	6.4%	(5,026.667)	(5,026.667)
Net cash balance on day 30					4,753.235

- Maturity value (col 5) = Surplus + Interest for 1 month
- Maturity value (INR) = Maturity value (col 5)/exchange rate

WN 2: Immediate cash pooling:

Entity	Surplus/ Deficit	Surplus/ Deficit (INR)	Invest/ borrow	Interest rate	Maturity value (INR)
US	125 USD	5,813.953			
UK	60 GBP	4026.846			
India	(5,000) INR	(5,000)			
Net balance		4,840.799	Invest	6.2%	4,865.810

- Surplus/deficit (INR) = Col 2/Exchange rate
- Maturity value = Col 3 + Interest for 1 month

Conclusion:

- The company should go for immediate cash pooling as the same has resulted in higher INR at end of day 30

46. Computation of net exposure [Nov 2006, Nov 2019 RTP, SM] [Homework]

Following are the details of cash inflows and outflows in foreign currency denominations of MNP co. an Indian export firm, which have no foreign subsidiaries:

Currency	Inflow	Outflow	Spot rate	Forward rate
USD	4,00,00,000	2,00,00,000	48.01	48.82
French Franc	2,00,00,000	80,00,000	7.45	8.12
GBP	3,00,00,000	2,00,00,000	75.57	75.98
JPY	1,50,00,000	2,50,00,000	3.20	2.40

- Determine the net exposure of each foreign currency in terms of Rupees
- Are any of the exposure positions offsetting to some extent

WN 1: Computation of net exposure:

Currency	Inflow	Outflow	Net exposure	Spot rate	Net exposure at spot rate	Forward rate	Net exposure at forward rate	Spread	Net exposure at spread
USD	40	20	20	48.01	960.20	48.82	976.40	0.81	16.20
FFR	20	8	12	7.45	89.40	8.12	97.44	0.67	8.04
GBP	30	20	10	75.57	755.70	75.98	759.80	0.41	4.10
JPY	15	25	-10	3.20	-32.00	2.40	-24.00	-0.80	8.00
Total exposure					1,773.30		1,809.64		36.34

- In Japanese Yen, the net exposure is payable, and the forward rate is quoted at a discount, effectively offsetting the position. Likewise, in the remaining currencies, the net exposures are in receivables, and the related currencies are at a premium, offsetting the positions in their respective currencies.

Part VIII - Forward Contract**47. FC - Borrowing [Nov 2003, Jan 2021, May 2023 RTP, SM]**

XYZ has taken a six-month loan from its foreign collaborator for USD 2 millions. Interest is payable on maturity @ LIBOR plus 1%. The following information is available:

Spot Rate	INR/USD	68.5275
6 Months Forward Rate	INR/USD	68.4575
6 Months LIBOR for USD	2%	
6 Months LIBOR for INR	6%	

- What would be their total commitment in Rupees, if they enter into a forward contract?

- Will you advise them to do so? Explain giving reasons.
- What will be your opinion if spot rate of INR/USD is 68.4275?
- What will be your opinion if the interest rate of INR is not given in question and hence fair forward rate cannot be computed as per IRPT?

Answer:

Part (i):

- Loan maturity along with interest = 20,00,000 + (20,00,000 × 3% × 6/12) = USD 20,30,000
- Total commitment in INR = 20,30,000 × 68.4575 = Rs.13,89,68,725

Part (ii)

Forward Rate as per IRPT:

$$\frac{1 + I_h}{1 + I_f} = \frac{\text{Forward Rate}}{\text{Spot Rate}}$$

$$\frac{1 + 3\%}{1 + 1\%} = \frac{\text{Forward Rate}}{68.5275}$$

Fair Forward Rate = INR 69.8845/USD

The company should take forward cover because as per Interest Rate Parity, the rate after 6 months is expected to be higher than forward rate.

Part (iii)

$$\frac{1 + 3\%}{1 + 1\%} = \frac{\text{Forward Rate}}{68.4275}$$

Fair Forward Rate = INR 69.7825/USD

Thus, still the company should take forward cover

Part (iv):

- The forward rate indicates that INR will appreciate over the next 6 months
- If the company believes that INR appreciation would be more than the forward rate, then the company should not enter into a forward contract
- If the company believes that INR will depreciate or appreciation would be less than forward rate, then it should enter into forward contract
- If the company has no view on exchange rates, then it should enter into forward contract for risk reduction. Given the interest rate differential between India and USA it would be unwise to expect continuous depreciation of dollar. The US Dollar is a stronger currency than the Indian Rupee based on past trends and it would be advisable to cover the exposure.

48. Profit/loss on forward contract [Nov 2016, Nov 2020, Nov 2012 RTP, May 2008, Nov 2015 MTP, Dec 2021, May 2023 MTP, Nov 2024 RTP, SM] [Concept Revision]

A company is considering hedging its foreign exchange risk. It has made a purchase on 1st July, 2016 for which it has to make a payment of USD 60,000 on December 31, 2016. The present exchange rate is Rs.65/USD. It can purchase forward 1USD at Rs.64. The company will have to make an upfront premium @ 2% of the forward amount purchased. The cost of funds to the company is 12% per annum. In the following situations, compute the profit/loss the company will make if it hedges its foreign exchange risk with the exchange rate on 31st December 2016 as:

- Rs.68 per USD
- Rs.62 per USD
- Rs.70 per USD
- Rs.65 per USD

Answer:

WN 1: Computation of cover rate:

Particulars	Amount
Forward Rate	INR 64.00/USD
Forward premium (64 × 2%)	INR 1.28/USD
Interest on forward premium (1.28 × 12% × (6/12))	INR 0.0768/USD
Cover rate	INR 65.3568/USD

WN 2: Computation of profit/loss under different scenarios:

Particulars	Rs.68/USD	Rs.62/USD	Rs.70/USD	Rs.65/USD

Foreign currency exposure	60,000 USD	60,000 USD	60,000 USD	60,000 USD
Cover rate	65.3568	65.3568	65.3568	65.3568
Payment made under forward contract [A]	39,21,408	39,21,408	39,21,408	39,21,408
Spot rate	68.00	62.00	70.00	65.00
Payment made under spot rate [B]	40,80,000	37,20,000	42,00,000	39,00,000
Profit/Loss [B-A]	1,58,592	(2,01,408)	2,78,592	(21,408)

49. FC – Exporter [May 2018 MTP, Nov 2018 MTP, May 2016, SM] [Homework]

A company expects to receive 500,000 CD falling due six months from now. The finance manager decides to hedge the transaction using forward contracts. Interest rate in Canada is 15 % while that in UK is 12%. Current spot rate is 1 GBP = 2.5 CD. Evaluate the situation if CD was to

- Gain 4%
- Lose 2%
- Remain stable at present level

Assume that the forward exchange rate differential reflects the interest rate parity analysis of forward rates.

Answer:

WN 1: Computation of cover rate using IRPT:

Spot rate = CD 2.50/GBP
Home currency = CD
R _h (CD) = 15% per annum (or) 7.5% per half-year
Foreign currency = GBP
R _f (GBP rate) = 12% per annum (or) 6% per half-year
$\frac{1 + R_h}{1 + R_f} = \frac{F_1}{e_0}; \frac{1 + 7.5\%}{1 + 6\%} = \frac{F_1}{2.50}$
$F_1 = \frac{2.50 \times 1.075}{1.06} = 2.5354 \text{ CD/GBP}$

WN 2: Computation of profit/loss for three scenarios:

Particulars	Gain of 4%	Loss of 2%	No change
Current Spot rate	2.5CD/GBP	2.5CD/GBP	2.5CD/GBP
Current Spot rate	0.4GBP/CD	0.4GBP/CD	0.4GBP/CD
Future spot rate	0.416GBP/CD	0.392GBP/CD	0.4GBP/CD
Forward rate (cover rate)	2.5354CD/GBP	2.5354CD/GBP	2.5354CD/GBP
Realization:			
Hedged (Forward rate) (5,00,000/Forward rate)	1,97,209.30	1,97,209.30	1,97,209.30
Unhedged (Future spot rate) (5,00,000 x Future Spot Rate)	2,08,000.00	1,96,000.00	2,00,000.00
Profit/Loss due to hedging (Hedged - Unhedged)	10,790.70	1,209.30	-2,790.70

Note:

- Any appreciation/depreciation percentage is to be applied only on product. In this case GBP is the product and appreciation/depreciation percentage is given for CD. Hence we have converted the quote and then applied the appreciation/depreciation percentage.

50. FC – Importer [Nov 2003, Dec 2021, SM]

A company operating in Japan has today effected sales to an Indian company, the payment being due 3 months from the date of invoice. The invoice amount is 108 lakhs yen. At today's spot rate, it is equivalent to Rs.30 lakhs. It is anticipated that the exchange rate will decline by 10% over the 3 months period and in order to protect the yen payments, the importer proposes to take appropriate action in the foreign exchange market. The 3 months forward rate is presently quoted as 3.3 yen per rupee. You are required to calculate the expected loss and to show how it can be hedged by a forward contract.

Answer:

WN 1: Computation of expected loss:

Particulars	Calculation	Amount
Amount of exposure		YEN 108 lacs
Outflow today		INR 30 lacs

Today exchange rate	$\frac{\text{YEN 108}}{\text{INR 30}}$	YEN 3.60/INR
Expected exchange rate	3.60 – 10%	YEN 3.24/INR
Expected outflow after 3 months	$\frac{108}{3.24}$	INR 33.33 lacs
Expected loss	30 lacs – 33.33 lacs	INR 3.33 lacs

WN 2: Hedging through forward contract:

Particulars	Calculation	Amount
Amount of exposure		YEN 108 lacs
Forward rate		YEN 3.30/INR
Expected outflow after 3 months	$\frac{108}{3.30}$	INR 32.73 lacs
Expected loss	30 lacs – 32.73 lacs	INR 2.73 lacs

- The company can take a forward contract at YEN 3.30 per INR. This would reduce the loss from Rs.3.33 lacs to Rs.2.73 lacs.

51. Decision on hedging [May 2015 MTP, May 2014, Nov 2018 RTP, SM, May 2024 RTP] [Concept Revision] [Homework]

JKL Ltd., an Indian company has an export exposure of JPY 10,000,000 payable receivable December 31, 2022. Japanese Yen (JPY) is not directly quoted against Indian Rupee. The current spot rates are:

INR/US \$ = Rs. 82.22

JPY/US\$ = JPY 132.34

It is estimated that Japanese Yen will depreciate to 154 level and Indian Rupee to depreciate against US \$ to Rs. 85. Forward rates for August 2014 are

INR/US \$ = Rs. 86.50

JPY/US\$ = JPY 140.35

Required:

- Evaluate the expected loss based on estimated rates if the hedging is not done.
- Justify the decision to take forward cover even if actual rates on December 31, 2022 happens to be as follows:

INR/US \$ = Rs. 86.25

JPY/US\$ = JPY 140.85

Note: Make calculation of ¥ rate in Rs. upto 4 decimal points.

Answer:**WN 1: Computation of collections as per different rates:****Collection as per current spot rates:**

❖ Known component = 1,00,00,000 JPY

❖ Unknown component = ? INR

$\text{INR} = \text{JPY} \times \left(\frac{\text{INR}}{\text{JPY}} \right)$
$\text{INR} = 1,00,00,000 \times \left(\frac{\text{INR}}{\text{USD}} \times \frac{\text{USD}}{\text{JPY}} \right)$
$\text{INR} = 1,00,00,000 \times \left(82.22 \times \frac{1}{132.34} \right)$
$\text{INR} = 1,00,00,000 \times (0.6213)$
INR = 62,13,000

Collection as per expected spot rates:

❖ Known component = 1,00,00,000 JPY

❖ Unknown component = ? INR

$\text{INR} = \text{JPY} \times \left(\frac{\text{INR}}{\text{JPY}} \right)$
$\text{INR} = 1,00,00,000 \times \left(\frac{\text{INR}}{\text{USD}} \times \frac{\text{USD}}{\text{JPY}} \right)$
$\text{INR} = 1,00,00,000 \times \left(85 \times \frac{1}{154} \right)$
$\text{INR} = 1,00,00,000 \times (0.5519)$

INR = 55,19,000

Collection as per forward rates:

- ❖ Known component = 1,00,00,000 JPY
- ❖ Unknown component = ? INR

$INR = JPY \times \left(\frac{INR}{JPY}\right)$
$INR = 1,00,00,000 \times \left(\frac{INR}{USD} \times \frac{USD}{JPY}\right)$
$INR = 1,00,00,000 \times \left(86.50 \times \frac{1}{140.35}\right)$
$INR = 1,00,00,000 \times (0.6163)$
INR = 61,63,000

Collection as per actual spot rates:

- ❖ Known component = 1,00,00,000 JPY
- ❖ Unknown component = ? INR

$INR = JPY \times \left(\frac{INR}{JPY}\right)$
$INR = 1,00,00,000 \times \left(\frac{INR}{USD} \times \frac{USD}{JPY}\right)$
$INR = 1,00,00,000 \times \left(86.25 \times \frac{1}{140.85}\right)$
$INR = 1,00,00,000 \times (0.6124)$
INR = 61,24,000

WN 2: Computation of expected loss and decision on forward cover:

Expected loss w/o hedging = Realization on expected spot rates – Realization on current spot rates
Expected loss w/o hedging = 55,19,000 – 62,13,000
Expected loss w/o hedging = Rs.6,94,000
Expected loss with hedging = Realization on forward rates – Realization on current spot rates
Expected loss with hedging = 61,63,000 – 62,13,000
Expected loss with hedging = Rs.50,000
Benefit of forward cover = Realization on forward rates – Realization on actual spot rates
Benefit of forward cover = 61,63,000 – 61,24,000
Benefit of forward cover = Rs.39,000

The company has benefitted due to forward cover and hence the decision to take forward cover is justified.

52. FC – Exporter [SM]

In March, 2012, the Multinational Industries makes the following assessment of dollar rates per British pound to prevail as on 1.9.2012:

\$/£	Probability
1.60	0.15
1.70	0.20
1.80	0.25
1.90	0.20
2.00	0.20

- (i) What is the expected spot rate for 1.9.2012?
- (ii) If, as of March, 2012, the 6-month forward rate is \$ 1.80, should the firm sell forward its dollar receivables due in September, 2012?

Answer:**WN 1: Computation of expected spot rate:**

USD/GBP	Probability	Product
1.60	0.15	0.24
1.70	0.20	0.34
1.80	0.25	0.45
1.90	0.20	0.38
2.00	0.20	0.40

Expected spot rate	1.81

- Expected spot rate = USD 1.81/GBP

WN 2: Decision on hedging pound receivables:

- Let us assume the company would be receiving 1,00,000 USD
- Inflow under forward contract = $1,00,000 / 1.80 = \text{GBP } 55,555.56$
- Inflow if forward contract is not taken = $1,00,000 / 1.81 = \text{GBP } 55,248.62$
- The company should take the forward contract for its dollar receivables as the same leads to higher inflow of GBP

53. Honor of forward contract

A limited has imported goods worth 1 lakh Euros from B Limited payable on 31st December. A limited has entered into a forward contract maturing on 31st December when the rate offered was Rupee per Euro was Rs.66 – 68.

- ❖ Today is 31st December. A Limited wants to honour the contract. What action will follow?
- ❖ Today is 30th November. Spot rate is Rupees per Euro: 65-66. The 1 month forward rate is Euro 66.5 – 67.5. What action will follow if he wants to honour today?
- ❖ Today is 15th November. The company wants to honor the contract on 30th November. Spot rate is INR 66-66.5 / Euro. The forward rate for 30th November is INR 67-67.5 / Euro. The forward rate for 31st December is INR 67.5-68.5/Euro. What action will follow?

Answer:**Importer Analysis:****Situation A:**

- A Limited has entered into a contract to buy 1 lac euros at Rs.68. On 31st December, A Limited should pay (Ask rate) Rs.68 lacs and get 1 lac Euros from Bank

Situation B:

- The company wants to honour the contract on November 30. This would basically involve cancellation of original contract and then honouring the contract at spot rate of November 30

Date	Position	Action	Reference Date	Rate
Original date	Original Position	Buy (ASK)	December 31	-68.00
November 30	Opposite Position	Sell (BID)	December 31	66.50
November 30	New Position	Buy (ASK)	November 30	-66.00
Effective rate				-67.50
Loss on cancellation per USD			$-68.00 + 66.50$	-1.50
Total loss on cancellation			$-1.50 \times 1,00,000$	-1,50,000
Effective gain per USD			$-67.50 - (-68.00)$	0.50
Total effective gain			$0.50 \times 1,00,000$	50,000

Note:

- Cancellation would involve taking an opposite position to that of the original position
- BID rate on Nov 30 for December 31:** This is basically one-month forward rate of Rs.66.50. We should always ensure reference date remains same as that of original position. Original contract was taken for December 31 and hence the cancellation rate will also be of December 31.
- ASK rate on Nov 30 for Nov 30:** This is basically spot ask rate on November 30
- The company will have to pay Rs.66,00,000 to honour the contract on November 30. It also needs to pay 1,50,000 $(68 - 66.50) \times 1,00,000$ for cancelling the original contract.
- The company has to effectively pay Rs.67,50,000 $(1,00,000 \times 67.50)$ for honouring the contract on November 30
- Cancellation loss is computed by comparing original position and opposite position
- Effective loss is computed by comparing original contracted rate with effective rate. Originally company wanted to pay Rs.68 per EURO but they have effectively paid only Rs.67.50 per EURO and hence they gain Rs.0.50 per EURO.

Situation C:

- The company wants to honour the contract on November 30. The company has informed the bank about this on November 15. This would basically involve cancellation of original contract and then honouring the contract at forward rate of November 30

Date	Position	Action	Reference Date	Rate

Original date	Original Position	Buy (ASK)	December 31	-68.00
November 15	Opposite Position	Sell (BID)	December 31	67.50
November 15	New Position	Buy (ASK)	November 30	-67.50
Effective rate			-68 + 67.50 - 67.50	-68.00
Loss on cancellation per USD			-68.00 + 67.50	-0.50
Total loss on cancellation			-0.50 x 1,00,000	-50,000
Effective loss per USD			-68.00 - (-68.00)	0
Total effective loss			0 x 1,00,000	0

- The company will have to pay Rs.67,50,000 to honour the contract on November 30. It also needs to pay 50,000 $(68 - 67.50) \times 1,00,000$ for cancelling the original contract.
- The company has to effectively pay Rs.68,00,000 $(1,00,000 \times 68.50)$ for honouring the contract

Note: Interest cost has not been considered for early honour as the question does not provide information on interest cost.

54. Early cancellation [Nov 2004, SM]

A customer with whom the Bank had entered into 3 months' forward purchase contract for Swiss France 10,000 at the rate of Rs. 27.25 comes to the bank after 2 months and request cancellation of the contract. On this date, the rates, prevailing, are:

- ❖ Spot CH 1 = Rs. 27.30 27.35
- ❖ One-month forward Rs. 27.45 27.52

What is the loss/gain to the customer on cancellation?

Answer:

Computation of cancellation gain/loss:

Date	Position	Action	Reference Date	Rate
Original date	Original Position	Sell (BID)	Month 3	27.25
Month 2	Opposite Position	Buy (ASK)	Month 3	-27.52
Loss on cancellation per USD			27.25 - 27.52	-0.27
Total loss on cancellation			-0.27 x 10,000	2,700

Note:

- A customer with whom the bank has entered into forward purchase contract. This would mean that the bank has entered into purchase contract and customer has entered into sell contract

55. Early cancellation [Nov 2015, Nov 2023 MTP] [Concept Revision]

A bank enters into a forward purchase covering the export bill for Swiss France 1,00,000 at Rs 32.4000 due on 25th April and converted itself for same delivery in the local interbank market at Rs.32.4200. However, on 25th March exporter sought for cancellation of the contract as the tenor of the bill is changed.

In Singapore market, Swiss Francs were quoted against US dollars as under

- ❖ Spot USD 1=Sw.Fcs.1.5076/1.5120
- ❖ One-month forward 1.5150/1.5160
- ❖ Two months forward 1.5250/1.5270
- ❖ Three months forward 1.5415/1.5445

And in the interbank market US dollars were quoted as under:

- ❖ Spot USD 1=Rs.49.4302/.4455
- ❖ Spot/April .4100/.4200
- ❖ Spot/May .4300/4400
- ❖ Spot/June .4500/4600

Calculate the cancellation charges payable by the customer if exchange margin required by the bank is 0.10% on buying and selling.

Answer:

Computation of cancellation gain/loss:

Date	Position	Action	Reference Date	Rate
Original date	Original Position	Sell (BID)	April 25	32.4000
March 25	Opposite Position	Buy (ASK)	April 25	-32.9474
Loss on cancellation per USD			32.4000 - 32.9432	-0.05474
Total loss on cancellation			-0.05474 x 1,00,000	54,740

Note:

- It is assumed that original contract rate of 32.4000 is after including exchange margin of 0.10%
- Buy rate on March 25 for April 25 (one-month forward rate) is calculated as under:

$$\text{ASK} \left(\frac{\text{INR}}{\text{CHF}} \right) = \text{ASK} \left(\frac{\text{INR}}{\text{USD}} \right) \times \text{ASK} \left(\frac{\text{USD}}{\text{CHF}} \right)$$

$$\text{ASK} \left(\frac{\text{INR}}{\text{CHF}} \right) = 49.9154 \times \frac{1}{1.5150} = 32.9474$$

- 1-month forward ASK(INR/USD) rate = $(49.4455 + 0.4200) + 0.10\% = 49.9154$
- Exchange margin is applicable only for interbank market rate and not considered for Singapore market. Hence USD/CHF rate has not been adjusted for exchange margin of 0.10%

56. Leading and lagging & FC-Cancellation [May 2018 RTP, May 2012, Nov 2019 MTP, SM] [Homework]

NP and Co. has imported goods for US\$ 7,00,000. The amount is payable after three months. The company has also exported goods for US\$ 4,50,000 and this amount is receivable in two months. For receivable amount a forward contract is already taken at Rs. 48.90.

The market rates for Rupee and Dollar are as under:

Spot	Rs.48.50/70
Two months	25/30 points
Three months	40/45 points

The company wants to cover the risk and it has two options as under:

- To cover payables in the forward market and
- To lag the receivables by one month and cover the risk only for the net amount. No interest for delaying the receivables is earned. Evaluate both the options if the cost of Rupee Funds is 12%. Which option is preferable?

Answer:

WN 1: Evaluation of option of covering payables in the forward market:

Particulars	Calculation	Amount (in lacs)
Day 0: Enter into forward contract to buy 7,00,000 USD in M3 at Rs.49.15 per USD (48.70 + 0.45)		
Month 2: Receive 4,50,000 USD at contracted rate of 48.90	4.5×48.90	220.05
Day 60 to 90: Interest earned/saved for one month on Rs.220.05 lacs	$220.05 \times 1\%$	2.20
Day 90: Payment of 7,00,000 USD in M3	7×49.15	-344.05
Net outflow		-121.80

WN 2: Evaluation of option of lagging the receivables:

- The company plans to lag the receivables by one month. In this option the company will have to cover payables of 2,50,000 USD as balance 4,50,000 USD will be paid out of export proceeds
- Under this option the company will have to cancel the forward contract as they will not be able to honour the same in month 2

Calculation of cancellation gain or loss:

Date	Position	Action	Reference Date	Rate
Original date	Original Position	Sell (BID)	Month 2	48.90
Day 0	Opposite Position	Buy (ASK)	Month 2	-49.00
Loss on cancellation per USD			$48.90 - 49.00$	-0.10
Total loss on cancellation			$-0.10 \times 4.5 \text{ lacs}$	0.45 lacs

Total outflow:

Particulars	Calculation	Amount (in lacs)
Day 0: Enter into forward contract to buy 2,50,000 USD in M3 at Rs.49.15 per USD (48.70 + 0.45)		
Day 0: Payment of cancellation loss		-0.45
Day 0 to Day 90: Interest on cancellation loss for 3 months	$0.45 \times 3\%$	-0.01
Day 90: Payment of 2,50,000 USD in M3	2.5×49.15	-122.88
Net outflow		-123.34

Conclusion:

- The company should go for option 1 as the same has lower net outflow. Hence we should go for covering the entire payables

57. Roll over - exporter

L Limited exported goods worth USD 300,000 to U Limited on 1st August and immediately took a three month forward cover. On that date spot rate is Rupee per USD: 52.56 – 52.76. 3M forward rate is Rupee per USD : 52.25 – 52.55. The sum is expected to be realized on 31st October.

- On 30th September, U Limited informs of further 1 month delay from due date. Spot rate is Rupee per USD : 52.35 – 52.60. One month forward rate is 52.50 – 52.80. Two month forward rate is 52.65 – 52.80. What are the implications?
- If U Limited informs L of a further 1 month delay only on 31st October and the 1 month forward rate on that date were to be 52.85-53.00. The spot rate on 31st October was 52.50-80. What are the implications?

Answer:

WN 1: Extension of one-month on Sep 30:

Date	Position	Action	Reference Date	Rate
August 1	Original Position	Sell (BID)	October 31	52.25
Sep 30	Opposite Position	Buy (ASK)	October 31	-52.80
Sep 30	New Position	Sell (BID)	November 30	52.65
Effective rate			52.25-52.80+52.65	52.10
Loss on cancellation per USD			52.25-52.80	-0.55
Total loss on cancellation			-0.55 x 3,00,000	-1,65,000
Effective loss per USD			52.10 – 52.25	-0.15
Total effective loss			-0.15 x 3,00,000	-45,000

WN 2: Extension of one-month on Oct 31:

Date	Position	Action	Reference Date	Rate
August 1	Original Position	Sell (BID)	October 31	52.25
Oct 31	Opposite Position	Buy (ASK)	October 31	-52.80
Oct 31	New Position	Sell (BID)	November 30	52.85
Effective rate			52.25-52.80+52.85	52.30
Loss on cancellation per USD			52.25-52.80	-0.55
Total loss on cancellation			-0.55 x 3,00,000	-1,65,000
Effective gain per USD			52.30 – 52.25	0.05
Total effective gain			0.05 x 3,00,000	15,000

58. Roll over - importer [Nov 2010, May 2015 MTP, Nov 2016 MTP, Nov 2018 MTP, May 2015 RTP, SM]

An importer requests his bank to extend the forward contract for US\$ 20,000 which is due for maturity on 30 October, 2010, for a further period of 3 months. He agrees to pay the required margin money for such extension of the contract.

Contracted Rate – US\$ 1= Rs. 42.32

The US Dollar quoted on 30-10-2010:-

- ❖ Spot – 41.5000/41.5200
- ❖ 3 months' Premium -0.87% /0.93%
- ❖ Margin money for buying and selling rate is 0.075% and 0.20% respectively.

Compute:

- The cost to the importer in respect of the extension of the forward contract, and
- The rate of new forward contract.

Answer:

WN 1: Computation of cancellation gain/loss:

Date	Position	Action	Reference Date	Rate
Original date	Original Position	Buy (ASK)	October 31	-42.32
Oct 31	Opposite Position	Sell (BID)	October 31	41.47
Oct 31	New Position	Buy (ASK)	November 30	-41.99
Effective rate			-42.32+41.47-41.99	-42.81
Loss on cancellation per USD			-42.32+41.47	-0.85

Total loss on cancellation	-0.85 x 20,000	-17,000
Effective loss per USD	-42.81 - (-42.32)	0.49
Total effective loss	0.49 x 20,000	-9,800

- Cost to the importer in respect of extension of forward contract = Rs.17,000 (Loss on cancellation). However, the effective loss for the importer is Rs.9,800
- Rate of new forward contract = Rs.41.99

Note:**BID rate on October 31 for October 31:**

- BID rate on October 31 = $41.50 - 0.075\% = 41.50 - 0.0311 = \text{Rs.}41.4689 \sim \text{Rs.}41.47$
- It is assumed that margin money percentage of buying and selling rate is to be interpreted from banker point of view. Hence margin of 0.075% is considered for Banker buying rate (BID rate) and 0.20% is considered for Banker selling rate (ASK Rate)

ASK rate on October 31 for November 30:

- Spot ask rate = 41.52
- 3-month forward rate without exchange margin = $41.52 + 0.93\% = 41.9061$
- Final 3-month forward rate with exchange margin = $41.9061 + 0.20\% = 41.9899 \sim \text{Rs.}41.99$

59. Cancellation of forward contract [SM]

On 15th January 2015 you as a banker booked a forward contract for USD 2,50,000 for your import customer deliverable on 15th March 2015 at Rs.65.3450. On due date customer request you to cancel the contract. On this date quotation for USD in the inter-bank market is as follows:

❖ Spot rate	=	Rs.65.2900/2975 per USD
❖ Spot/April	=	3000/3100
❖ Spot/May	=	6000/6100

Assume that the flat charges for the cancellation is Rs.100 and exchange margin is 0.10%, then determine the cancellation charges payable by the customers.

WN 1: Computation of cancellation gain/loss:

Date	Position	Action	Reference Date	Rate
Jan 15	Original Position	Buy	March 15	(65.3450)
Mar 15	Opposite Position	Sell	March 15	65.2247
Loss per USD				0.1203
Loss for 2,50,000 USD			2,50,000 x 0.1203	Rs.30,075

Note 1: Sell rate on March 15:

- ❖ Sell rate on March 15 (bid rate) is Rs.65.2900/USD. Exchange margin is 0.10% and the same will be deducted for calculating bid rate. Bid rate = $65.2900 - 0.06529 = \text{Rs.}65.2247/\text{USD}$

Note 2: Cancellation charges:

- ❖ Cancellation charges payable by customer = $30,075 + 100 = \text{Rs.}30,175$

60. Early cancellation [SM]**ICAI Question:**

Suppose you are a banker and one of your export customer has booked a USD 1,00,000 forward sale contract for 2 months with you at the rate of Rs.62.5200 and simultaneously you covered yourself in the interbank market at Rs.62.5900. However on due date, after 2 months your customer comes to you and requests for cancellation of the contract and also requests for extension of the contract by one month. On this date quotation for USD in the market was as follows:

❖ Spot rate	=	Rs.62.7200/62.6800
❖ 1 month forward	=	Rs.62.6400/62.7400

Determine the extension charges payable by the customer assuming exchange margin of 0.10% on buying as well as selling.

Modified Question:

- Spot rate = $62.6800/62.7200$ - This is because Ask Rate should be higher than Bid Rate. In solution ICAI has considered 62.7200 as Ask Rate and 62.6800 as Bid Rate

Answer:

Date	Position	Action	Reference Date	Rate

Day 0	Original Position	Sell	Month 2	62.5200
Month 2	Opposite Position	Buy	Month 2	(62.7827)
Month 2	New Position	Sell	Month 3	62.5774
Effective rate			62.52 – 62.7827 + 62.5774	62.3147
Loss on cancellation per USD			62.5200 – 62.7827	0.2627
Total loss on cancellation			0.2627 x 1,00,000	26,270
Effective loss per USD			62.52 – 62.3147	0.2053
Total effective loss			0.2053 x 1,00,000	20,530

Note 1: Buy rate on Month 2:

- ❖ Buy rate in Month 2 (ask rate) for Month 2 is 62.7200. Exchange margin is 0.10% and the same will be added to get ask rate. Ask rate = $62.7200 + 0.06272 = 62.7827$

Note 2: Sell rate in Month 2 for Month 3:

- ❖ Sell rate in Month 2 (bid rate) for Month 3 (1-month forward) is 62.6400. Exchange margin is 0.10% and the same will be deducted to get bid rate. Bid rate = $62.6400 - 0.06264 = 62.5774$

Summary:

- ❖ Cancellation loss = Rs.26,270
- ❖ New rate = Rs.62.5774

61. Extension before due date [SM] [Homework]

Suppose you as a banker entered into a forward purchase contract for USD 50,000 on 5th March with an export customer for 3 months at the rate of Rs.59.6000. On the same day you also covered yourself in the market at Rs.60.6025. However on 5th May your customer comes to you and requests extension of the contract to 5th July. On this date (5th May) quotation for USD in the market is as follows:

- ❖ Spot rate = Rs.59.1300/1400 per USD
- ❖ Spot/5th June = Rs.59.2300/2425 per USD
- ❖ Spot/5th July = Rs.59.6300/6425 per USD

Assuming a margin of 0.10% on buying and selling, determine the extension charges payable by the customer and the new rate quoted to the customer.

Note: Rates to be rounded off to 4 decimals in multiples of 0.0025

Answer:

Date	Position	Action	Reference Date	Rate
March 5	Original Position	Sell	June 5	59.6000
May 5	Opposite Position	Buy	June 5	(59.3025)
May 5	New Position	Sell	July 5	59.5700
Effective rate			59.6000 – 59.3025 + 59.5700	59.8675
Gain on cancellation per USD			59.6000 – 59.3025	0.2975
Total gain on cancellation			0.2975 x 50,000	14,875
Effective gain per USD			59.8675 – 59.6000	0.2675
Total effective gain			0.2675 x 50,000	13,375

Note 1: June 5 buy rate on May 5:

- ❖ Buy rate on May 5 (ask rate) for June 5 is 59.2425. Exchange margin is 0.10% and the same will be added to get ask rate. Ask rate = $59.2425 + 0.0592 = 59.3017$. This is rounded off to 59.3025

Note 2: Sell rate on May 5 for July 5:

- ❖ Sell rate on May 5 (bid rate) for July 5 (2-month forward) is 59.6300. Exchange margin is 0.10% and the same will be deducted to get bid rate. Bid rate = $59.6300 - 0.0596 = 59.5704$. This is rounded off to 59.5700

Summary:

- ❖ Cancellation gain = Rs.14,875
- ❖ New rate = Rs.59.5700

62. Customer not appearing on due date [May 2018 RTP, May 2015, May 2018, Nov 2020, SM]

An importer booked a forward contract with his bank on 10th April for USD 2,00,000 due on 10th June @

Rs. 64.4000. The bank covered its position in the market at Rs. 64.2800.

The exchange rates for dollar in the interbank market on 10th June and 13th June were:

	June 10	June 13
Spot USD 1	63.8000/8200	63.6800/7200
Spot/June	63.9200/9500	63.8000/8500
July	64.0500/0900	63.9300/9900
August	64.3000/3500	64.1800/2500
September	64.6000/6600	64.4800/5600

Exchange Margin 0.10% and interest on outlay of funds @ 12%. The importer requested on 13th June for extension of contract with due date on 10th August. Rates rounded to 4 decimal in multiples of 0.0025. On 10th June, Bank Swaps by selling spot and buying one month forward. Calculate:

- ❖ Cancellation rate
- ❖ Amount payable on \$ 2,00,000
- ❖ Swap loss
- ❖ Interest on outlay of funds, if any
- ❖ New contract rate
- ❖ Total Cost

Answer:

WN 1: Evaluation from importer point of view:

Date	Position	Action	Reference Date	Rate
Apr 10	Original Position	Buy (ASK)	June 10	-64.4000
June 13	Opposite Position	Sell (BID)	June 13	63.6175
June 13	New Position	Buy (ASK)	Aug 10	-64.3150
Effective rate			-64.40+63.6175-64.3150	-65.0975
Loss on cancellation per USD			-64.40+63.6175	-0.7825
Total loss on cancellation			-0.7825 x 2,00,000	-1,56,500
Effective loss per USD			-65.0975 - (-64.40)	-0.6975
Total effective loss			-0.6975 x 2,00,000	-1,39,500

Note:

BID rate on June 13 (Spot rate):

- BID rate = 63.6800 - 0.10% = 63.6163 ~ 63.6175 (multiples of 0.0025)

ASK rate on June 13 for August 10:

- Ask rate without exchange rate = 64.2500
- Final Ask rate = 64.25 + 0.10% = 64.31425 ~ 64.3150

WN 2: Computation of swap loss (evaluation from bank point of view):

Date	Position	Action	Reference Date	Rate
Apr 10	Original Position	Buy (ASK)	June 10	-64.28
June 10	Opposite Position	Sell (BID)	June 10	63.80
June 10	New Position	Buy (ASK)	June 30	-63.95
Effective rate			-64.28+63.80-63.95	-64.43
Loss on cancellation per USD			-64.28+63.80	-0.48
Total loss on cancellation			-0.48 x 2,00,000	-96,000
Effective loss per USD			-64.43 - (-64.28)	-0.15
Total effective loss			-0.15 x 2,00,000	-30,000

Note:

- The customer did not come on due date and is yet to give instructions to the company on honour/instruction/cancellation
- As per FEDAI Rule 8 a forward contract which remains overdue without any instructions from the customers on or before due date shall stand automatically cancelled on 3rd day from the date of maturity.
- However, customer can ask for honour/cancellation/extension within 3 days and hence the bank is required to roll-over his contract with the next available contract. The process of extension has been presented in WN 2 and the effective loss of the bank will be recovered from the customer in the form of swap loss

WN 3: Final solution:

Particulars	Calculation	Amount
Cancellation rate	WN 1	63.6175
Amount payable on USD 2,00,000	WN 1	1,56,500
Swap loss	WN 2	30,000
Interest on outlay of funds (This is banker outflow on cancellation due to non-receipt of instructions from customer)	$96,000 \times 12\% \times \left(\frac{3}{365}\right)$	95
New Contract rate	WN 1	64.3150
Total cost	$1,56,500 + 30,000 + 95$	1,86,595

63. Customer not appearing on due date [Nov 2016, Nov 2023]

An import customer booked a forward contract with the bank on 10th April for USD 20,000 due on 10th June at Rs. 49.4000. The bank covered its position in the market at Rs. 49.2800. The exchange rate for dollar in the interbank market on 10th June and 20th June were:

Particulars	10 th June	20 th June
Spot	USD 1 = Rs. 48.8000/8200	48.6800/7200
Spot/June	48.9200/9500	48.8000/8500
Spot/July	49.0500/0900	48.9300/9900
Spot/August	49.3000/3500	49.1800/2500
Spot/September	49.6000/6600	49.4800/5600
Exchange margin is 0.10%		
Interest on outlay of funds 12%		

Calculate how the bank will react, if the customer requires on 20th June:

- To cancel the contract.
 - Exchange difference,
 - Swap loss,
 - Interest on outlay of funds and
 - Cancellation charges
- To Execute the contract.
- To Extend the contract with due date to fall on 10th August.

Author's Note:

- A forward contract has a grace period of 3 days, after which it is automatically cancelled. However, since the date of June 13 is unavailable in this question, the contract will be cancelled using the June 20 rate, and interest will be calculated for 10 days.

Answer:**WN 1: Evaluation from importer point of view:**

Date	Position	Action	Reference Date	Rate
Apr 10	Original Position	Buy (ASK)	Jun 10	-49.4000
Jun 20	Opposite Position	Sell (BID)	Jun 20	48.6313
Loss on cancellation per USD			$-49.4000 + 48.6313$	-0.7687
Total loss on cancellation			$-0.7687 \times 20,000$	15,374

Note:**BID rate on Jun 20 (Spot rate):**

- BID rate = $48.6800 - 0.10\% = 48.7512$

WN 2: Computation of swap loss (evaluation from bank point of view):

Date	Position	Action	Reference Date	Rate
Apr 10	Original Position	Buy (ASK)	Jun 10	-49.28
Jun 10	Opposite Position	Sell (BID)	Jun 10	48.80
Jun 10	New Position	Buy (ASK)	Jun 30	-48.95
Effective rate			$-49.28 + 48.80 - 48.95$	-49.43
Loss on cancellation per USD			$-49.28 + 48.80$	-0.48
Total loss on cancellation			$0.48 \times 20,000$	9,600
Swap loss per USD			$48.80 - 48.95$	-0.15
Total swap loss			$-0.15 \times 20,000$	3,000

WN 3: Cost to be paid for cancellation/extension/honour:

Particulars	Calculation	Amount
Cancellation loss	WN 1	15,374
Swap loss	WN 2	3,000
Interest on outlay of funds (This is banker outflow on cancellation due to non-receipt of instructions from customer)	$9,600 \times 12\% \times \left(\frac{10}{365}\right)$	32
Total cost		18,406

WN 4: Action under different scenarios:**Situation 1: Cancel the contract:**

- The customer has to pay Rs.18,406 towards cancellation of contract.

Situation 2: Execute the contract:

- The customer has to pay Rs.18,406 towards cancellation of contract.
- Execution of the contract will happen at the spot rate of Jun 20. Ask rate on Jun 20 = $48.72 + 0.10\% = \text{Rs.}48.7687$. Total payment for purchase of 20,000 USD = $20,000 \times 48.7687 = \text{Rs.}9,75,374$
- Total payment = Rs.9,75,374 + Rs.18,406 = Rs.9,93,780**

Situation 3: Extend the contract:

- The customer has to pay Rs.18,406 towards cancellation of contract.
- New contract rate = $49.25 + 0.10\% = \text{Rs.}49.2992$

64. Late extension of forward contract [Nov 2021 MTP, May 2023 MTP] [Concept Revision]

Z has to remit USD \$1,00,000 for her daughter's education on 4th April 2021. Accordingly, she has booked a forward contract with his bank on 4th January 2021 @ Rs. 73.8775. The Bank has covered its position in the market @ Rs. 73.7575.

The exchange rates for USD \$ in the interbank market on 4th, 7th and 14th April 2021 were:

Particulars	April 4	April 7	April 14
Spot USD = 1	73.2775/73.3975	73.1575/73.1975	73.1375/73.1775
Spot/April	73.3975/73.4275	73.2775/73.3275	73.2575/73.3075
May	73.5275/73.5675	73.4075/73.4650	73.3875/73.4475
June	73.7775/73.8250	73.6575/73.7275	73.6375/73.7050
July	74.0700/74.1325	73.9575/74.0675	73.9500/74.0525

Exchange margin of 0.10 percent and interest outlay of funds @ 12 percent are applicable. The remitter, due to rescheduling of the semester, has requested on 14th April 2021 for extension of contract with due date on 14th July 2021.

Calculate:

- Cancellation Rate;
- Amount Payable on \$ 100,000;
- Swap loss;
- Interest on outlay of funds, if any;
- New Contract Rate; and
- Total Cost

Note: Rates must be rounded to 4 decimal places in multiples of 0.0025 and assume 365 days in a year.

Answer:**WN 1: Evaluation from importer point of view:**

Date	Position	Action	Reference Date	Rate
Jan 4	Original Position	Buy (ASK)	Apr 4	-73.8775
Apr 7	Opposite Position	Sell (BID)	Apr 7	73.0850
Apr 14	New Position	Buy (ASK)	Jul 14	-74.1275
Effective rate			-73.8775 + 73.0850 - 74.1275	-74.9200
Loss on cancellation per USD			-73.8775+73.0850	-0.7925
Total loss on cancellation			-0.7925 x 1,00,000	-79,250
Effective loss per USD			-74.9200 - (-73.8775)	-1.0425
Total effective loss			-1.0425 x 1,00,000	-1,04,250

Note:

- Customer had appeared on 14th April. However as per rule, the bank will wait for 3 days of grade period (April 4 to April 7) and will automatically cancel the contract on April 7 if the customer does not appear.

BID rate on Apr 7 (Spot rate):

- BID rate = $73.1575 - 0.10\% = 73.0843 \sim 73.0850$ (multiples of 0.0025)

ASK rate on Apr 14 for July 14:

- Ask rate without exchange rate = 74.0525
- Final Ask rate = $74.0525 + 0.10\% = 74.1266 \sim 74.1275$

WN 2: Computation of swap loss (evaluation from bank point of view):

Date	Position	Action	Reference Date	Rate
Jan 4	Original Position	Buy (ASK)	Apr 4	-73.7575
Apr 4	Opposite Position	Sell (BID)	Apr 4	73.2775
Apr 4	New Position	Buy (ASK)	Apr 30	-73.4275
Effective rate			-73.7575+73.2775-73.4275	-73.9075
Loss on cancellation per USD			-73.7575+73.2775	-0.48
Total loss on cancellation			-0.48 x 1,00,000	-48,000
Effective loss per USD			-73.9075 - (-73.7575)	-0.15
Total effective loss			-0.15 x 1,00,000	-15,000

Note:

- The customer did not come on due date and is yet to give instructions to the company on honour/instruction/cancellation
- As per FEDAI Rule 8 a forward contract which remains overdue without any instructions from the customers on or before due date shall stand automatically cancelled on 3rd day from the date of maturity.
- However, customer can ask for honour/cancellation/extension within 3 days and hence the bank is required to roll-over his contract with the next available contract. The process of extension has been presented in WN 2 and the effective loss of the bank will be recovered from the customer in the form of swap loss

WN 3: Final solution:

Particulars	Calculation	Amount
Cancellation rate	WN 1	73.0850
Amount payable on USD 2,00,000	WN 1	79,250
Swap loss	WN 2	15,000
Interest on outlay of funds (This is banker outflow on cancellation due to non-receipt of instructions from customer)	$48,000 \times 12\% \times \left(\frac{3}{365}\right)$	47
New Contract rate	WN 1	74.1275
Total cost	$79,250 + 15,000 + 47$	94,297

Note: Interest is charged for the period between due date and the actual date of cancellation or 3 days whichever is later. The contract will be auto-cancelled on April 7 and hence interest is charged from April 4 to April 7

65. Honor of forward contract [Early Honour - Nov 2018 MTP, May 2021 MTP, July 2021] [Concept Revision]

On 1st October, 2020 Mr. Guru, an exporter, enters into a forward contract with the Bank to sell USD 1,00,000 on 31st December 2020 at INR/USD 75.40. However, at the request of the importer, Mr. Guru received the amount on 30th November, 2020. Mr. Guru requested the bank take delivery of the remittance on 30th November, 2020 i.e. before due date.

The inter-bank rate on 30th November 2020 was as follows:

- Spot INR/USD 75.22-75.27
- One Month Premium 10/15

Assume 365 days in a year.

- (i) If bank agrees to take early delivery then what will be net inflow to Mr. Guru assuming that the prevailing prime lending rate is 18% per annum.
- (ii) If Mr. Guru can deploy these funds in USD, he gets return at the rate of 3% per annum. Which is better ? Why ?

Answer:

WN 1: Computation of net inflow if early delivery is done:

Note 1: Analysis from customer's point of view:

Date	Position	Action	Reference Date	Rate
Oct 1	Original Position	Sell (BID)	December 31	75.40
Nov 30	Opposite Position	Buy (ASK)	December 31	-75.42
Nov 30	New position	Sell (BID)	Nov 30	75.22
Effective rate			75.40 - 75.42 + 75.22	75.20
Swap loss per USD			75.40 - 75.20	0.20
Total Swap loss			0.20 x 1,00,000	20,000

❖ Swap loss is the difference between effective rate - original rate

Note 2: Computation of interest cost:

Analysis from bank's point of view:

Particulars	Amount
Nov 30 - Bank will buy from customer	-75.40
Nov 30 - Bank will sell at spot rate to some other Bank	75.22
Outflow for banker	0.18
Total outflow for banker (1,00,000 x 0.18)	18,000
Interest cost to be recovered (18,000 x 18% x 31/365)	275

Note 3: Total outflow for early honour:

Particulars	Amount
Swap loss	20,000
Interest charges	275
Total recovery from customer	20,275

Note 4: Net realization for customer:

Particulars	Amount
Sale of 1,00,000 USD at original rate (1,00,000 x 75.40)	75,40,000
Less: Charges (Note 3)	(20,275)
Net realization for customer	75,19,725

WN 2: Computation of net inflow if funds are invested in USD:

Particulars	Amount
Amount received on Nov 30	USD 1,00,000
Interest on USD deposit [1,00,000 x 3% x 31/365]	USD 254.79
Total receipt on Dec 31	USD 1,00,254.79
Inflow in INR	
Originally contracted amount [1,00,000 x 75.40]	75,40,000
Interest amount converted at forward rate [254.79 x 75.32]	19,191
Inflow in INR on Dec 31	75,59,191

Selection of option:

Particulars	Early delivery	Delivery on Dec 31
Inflow in INR	75,19,725	75,59,191
Add: Interest saving for 31 days at 18% [75,19,725 x 18% x 31/365]	1,14,959	-
Total cash inflow	76,34,684	75,59,191

Advice: Since Cash Inflow will be higher in early delivery, option the same should be chosen

66. Forward contract – Early Delivery [May 2019, Nov 2018 MTP, May 2021 MTP, Nov 2023 MTP, SM]

On 1 October 2015 Mr. X an exporter enters into a forward contract with a BNP Bank to sell US\$ 1,00,000 on 31 December 2015 at Rs.65.40/\$. However, due to the request of the importer, Mr. X received amount on 28 November 2015. Mr. X requested the bank the take delivery of the remittance on 30 November 2015 i.e., before due date. The inter-banking rates on 28 November 2015 was as follows:

- ❖ Spot rate = Rs.65.22/65.27
- ❖ One month premium = 10/15

If bank agrees to take early delivery then what will be net inflow to Mr. X assuming that the prevailing prime lending rate is 18%

Answer:

WN 1: Computation of swap loss:**Analysis from customer's point of view:**

Date	Position	Action	Reference Date	Rate
Oct 1	Original Position	Sell	Dec 31	65.40
Nov 30	Opposite Position	Buy	Dec 31	(65.42)
Nov 30	New position	Sell	Nov 30	65.22
Effective rate			65.40 – 65.42 + 65.22	65.20
Swap loss per USD			65.40 – 65.20	0.20
Total Swap loss			0.20 x 1,00,000	20,000

- ❖ Swap loss is the difference between effective rate – original rate
- ❖ The spot rate is the rate paid for delivery within two business days. Hence the rate of November 28 is applicable for settlement on November 30

WN 2: Computation of interest cost:**Analysis from bank's point of view:**

Particulars	Amount
Nov 30 – Bank will buy from customer	(65.40)
Nov 30– Bank will sell at spot rate to some other Bank	65.22
Outflow for banker	0.18
Total outflow for banker (1,00,000 x 0.18)	18,000
Interest cost to be recovered (18,000 x 18% x 31/365)	275

Note: Interest is calculated from December 1 to December 31

WN 3: Total outflow for early honour:

Particulars	Amount
Swap loss	20,000
Interest charges	275
Total recovery from customer	20,275

WN 4: Net realization for customer:

Particulars	Amount
Sale of 1,00,000 USD at original rate (1,00,000 x 65.40)	65,40,000
Less: Charges (WN 3)	(20,275)
Net realization from customer	65,19,725

Comment:

- ❖ Net realization is basically to be computed at effective rate of 65.20 per USD. Hence it can also be calculated as Rs.65,20,000 (1,00,000 x 65.20)
- ❖ Net realization = 65,20,000 – Interest cost (275) = Rs.65,19,725

67. Forward contract – Early Delivery [Nov 2018]

On 19th January, Bank A entered into forward contract with a customer for forward sale of USD 7,000, delivery 20th March at Rs.46.67. On the same day, it covered its position by buying forward from the market due 19th March at the rate of Rs.46.655. On 19th February, the customer, approaches the bank and requests for early delivery of USD. Rates prevailing in the interbank markets on that date are as under:

- ❖ Spot rate = Rs.46.5725/5800
- ❖ March = Rs.46.3550/3650

Interest on outflow of funds is 16% and on inflow of funds is 12%. Flat charges for early delivery are Rs.100. What is the amount that would be recovered from the customer on the transaction?

Note: Calculation are to be made on months basis than on days basis.

Answer:

WN 1: Computation of swap loss:

Analysis from customer's point of view:

Date	Position	Action	Reference Date	Rate
Jan 19	Original Position	Buy	March 19	(46.67)
Feb 19	Opposite Position	Sell	March 19	46.3550
Feb 19	New position	Buy	Feb 19	(46.5800)
Effective rate			-46.6700 + 46.3550 - 46.5800	-46.8950
Swap loss per USD			46.8950 - 46.67	0.225
Total Swap loss			0.225 x 7,000	1,575

❖ Swap loss is the difference between effective rate – original rate

WN 2: Computation of interest cost:

Analysis from bank's point of view:

Particulars	Amount
Feb 19 – Bank will sell to customer at original contracted rate	46.67
Feb 19 – bank will have to buy in spot market from other bank to make the above sale	(46.58)
Inflow for banker	0.09
Total inflow for banker (0.09 x 7,000)	630
Interest to be paid to customer (630 x 12% x 1/12)	6.30

WN 3: Total outflow for early honour:

Particulars	Amount
Swap loss	1,575
Flat charges	100
Interest to be paid to customer	(6.30)
Total recovery from customer	1,668.70

WN 4: Net payment by customer:

Particulars	Amount
Purchase of 7,000 USD at original rate (7,000 x 46.67)	3,26,690
Add: Charges (WN 3)	1,668.70
Total outflow for customer	3,28,358.70

68. Time value and currency fluctuation component [Nov 2017 RTP] [Homework]

India Imports co., purchased USD 100,000 worth of machines from a firm in New York, USA. The value of the rupee in terms of the Dollar has been decreasing. The firm in New York offers 2/10, net 90 terms. The spot rate for the USD is Rs. 55; the 90 days forward rate is Rs. 56.

- Compute the Rupee cost of paying the account within the 10 days.
- Compute the Rupee cost of buying a forward contract to liquidate the account in 90 days.
- The difference between part a and part b is the result of the time value of money (the discount for prepayment) and protection from currency value fluctuation. Determine the magnitude of each of these components.

Answer:

(i) Rupee cost of paying the account within 10 days = 98,000 USD x Rs.55 = Rs.53,90,000

Note:

- ❖ 2/10 net 90 would mean that the company will get 2 percent discount if the payment is done in 10 days. Hence the company will be making a payment of only 98,000 USD
- ❖ It is assumed that current spot rate would be applicable for day 10 as well

(ii) Rupee cost of paying in 90 days = 1,00,000 USD x 56 = Rs.56,00,000

(iii) Computation of the difference in part (a) and part (b) and the magnitude of components:

Particulars	Calculation	Amount
Difference in part (a) and Part (b)	56,00,000 - 53,90,000	2,10,000

Time value of money component (difference between 1,00,00 USD and 98,000 USD)	$(1,00,000 - 98,000) \times 56$	1,12,000
Currency value fluctuation component (difference between spot rate and forward rate)	$98,000 \times (56 - 55)$	98,000

69. Decision on hedging exposure – [Nov 2019, Nov 2018 MTP, Nov 2007, SM] [Homework]

Following information relates to M/s A Ltd. which is a manufacturing-cum-exporting unit. It is exporting some electronic components to Japan, USA and Europe on 90 days credit terms:

Cost and Sales information:

Particulars	Japan	USA	Europe
Variable cost per unit	Rs.225	Rs.395	Rs.510
Export sale price per unit	Yen 650	USD 10.23	EUR 11.99
Receipts from sale due in 90 days	YEN 78,00,000	USD 1,02,300	EUR 95,920
Foreign exchange rate information:	YEN/INR	USD/INR	EUR/INR
Spot market	2.417-2.437	0.0214-0.0217	0.0177-0.0180
3 months forward	2.397-2.427	0.0213-0.0216	0.0176-0.0178
3 months spot	2.423-2.459	0.02144-0.02156	0.0177-0.0179

Advise the company by calculating average contribution to sales ratio whether it should hedge its currency risk or not.

Author's Note:

- The question requires the calculation of the average contribution to the sales ratio, leading to a decision on whether to hedge all currencies or not.
- It is important to note that this decision pertains to an overall approach rather than individually hedging specific currencies. The focus is on making a collective decision regarding hedging strategies.

Answer:**Decision on whether to hedge the forex exposure:**

Particulars	Japan	USA	Europe	Total
Receipts from sale due in 90 days	YEN 78,00,000	USD 1,02,300	EUR 95,920	
Export sale price per unit	Yen 650	USD 10.23	EUR 11.99	
No of units sold	12,000	10,000	8,000	
Variable cost per unit	225	395	510	
Total variable costs	Rs.27,00,000	Rs.39,50,000	Rs.40,80,000	Rs.1,07,30,000
Realization if exposure is hedged:				
3-month forward rate	2.427	0.0216	0.0178	
Realization in INR (Exposure/rate)	Rs.32,13,844	Rs.47,36,111	Rs.53,88,764	Rs.1,33,38,719
Contribution				26,08,719
Contribution to sales ratio				19.56%
Realization if exposure is not hedged:				
3-month spot rate	2.459	0.02156	0.0179	
Realization in INR (Exposure/rate)	31,72,021	47,44,898	53,58,659	1,32,75,578
Contribution				25,45,578
Contribution to sales ratio				19.17%

Decision: A Ltd. is advised to hedge its foreign currency exchange risk.

70. Exporter hedging [Jan 2021]

M/s. Sky products Ltd., of Mumbai, an exporter of sea foods has submitted a 60 days bill for EUR 5,00,000 drawn under an irrevocable Letter of Credit for negotiation. The company has desired to keep 50% of the bill amount under the Exchange Earners Foreign Currency Account (EEFC). The rates for Rs./USD and USD/EUR in inter-bank market are quoted as follows:

Particulars	INR/USD	USD/EUR
Spot	67.8000-67.8100	1.0775-1.8000
1 month forward	10/11 paise	0.20/0.25 cents
2 months forward	21/22 paise	0.40/0.45 cents
3 months forward	32/33 paise	0.70/0.75 cents

Transit Period is 20 days. Interest on post shipment credit is 8% p.a. Exchange Margin is 0.1%. Assume 365 days in a year.

You are required to calculate:

- (i) Exchange rate quoted to the company
- (ii) Cash inflow to the company
- (iii) Interest amount to be paid to bank by the company

Answer:

WN 1: Computation of exchange rate quoted to the company:

- The company plans to sell euros and hence we would need BID (INR/EUR) rate for realization
- The amount will be realized in 80 days (including transit period of 20 days). It will have to be rounded off to the lower of months and hence 2 months forward bid rate is to be taken

$$\text{BID} \left(\frac{\text{INR}}{\text{EUR}} \right) = \text{BID} \left(\frac{\text{INR}}{\text{USD}} \right) \times \text{BID} \left(\frac{\text{USD}}{\text{EUR}} \right)$$

$$\text{BID} \left(\frac{\text{INR}}{\text{EUR}} \right) = 67.9420 \times 1.0815 = \text{INR } 73.4793 \text{ per EUR}$$

Note:

Particulars	INR/USD	USD/EUR
Spot rate	67.8000	1.0775
Add: Swap points	0.2100	0.0040
Forward rate without exchange margin	68.0100	1.0815
Less: Exchange margin @ 0.1%	-0.0680	-
Final forward bid rate	67.9420	1.0815

- Exchange margin has been applied only on INR/USD rate. It is assumed that USD/EUR rate is the final merchant rate and hence exchange margin is not applicable on the same

Solution:

- Exchange rate quoted = INR 73.4793 per EUR
- Realization = EUR 2,50,000 × 73.4793 = Rs.1,83,69,825 [Only half of EUR 5,00,000 will be realized and balance half will be transferred to EEFC account]
- Interest for 80 days @ 8% = 1,83,69,825 × 8% × (80/365) = Rs.3,22,101

Author's Note:

- We can solve this question by doing interpolation formula and computing the forward rate for 80 days. However, ICAI solution has done the computation by rounding-off of number of months and hence we have followed the same

Part IX – Money Market Hedge

71. **MMH exporter** [May 2019 RTP, Nov 2008, Nov 2009, Nov 2015 MTP, Nov 2017 MTP, SM, May 2024 RTP]

An exporter is a UK based company. Invoice amount is \$3,50,000. Credit period is three months. Exchange rates in London are :

- ❖ Spot Rate (\$/£) 1.5865 – 1.5905
- ❖ 3-month Forward Rate (\$/£) 1.6100 – 1.6140

Rates of interest in Money Market :

	Deposit	Loan
\$	7%	9%
£	5%	8%

Justify your stand to choose money market hedge (including steps) instead of Forward Contract.

Answer:

WN 1: Creation of Money Market Hedge:

Particulars	Calculation	Amount
Day 0:		
Identify a foreign currency asset/liability – Foreign currency Asset		USD 3,50,000.00
Create a matching liability – we will take a USD loan which will mature to USD 3,50,000	$\frac{3,50,000}{1 + 2.25\%}$	USD 3,42,298.29
Convert USD 3,42,298.29 into GBP at spot rate	$3,42,298.29 \times \left(\frac{1}{1.5905} \right)$	GBP 2,15,214.27

Invest GBP 2,15,214.27 for three months at the rate of 5%		GBP 2,15,214.27
Day 90:		
Receive USD 3,50,000 from customer and repay USD Loan		USD 3,50,000.00
Redeem GBP deposit along with interest	2,15,214.27 + 1.25%	GBP 2,17,904.45

- **Net inflow with money market hedge = GBP 2,17,904.45**

WN 2: Computation of inflow under forward contract:

$$\text{GBP} = \text{USD} \times \left(\frac{\text{GBP}}{\text{USD}} \right); \text{GBP} = \text{USD} \times \text{BID} \left(\frac{\text{GBP}}{\text{USD}} \right)$$

$$\text{GBP} = 3,50,000 \times \frac{1}{\text{ASK} \left(\frac{\text{USD}}{\text{GBP}} \right)} = 3,50,000 \times \frac{1}{1.6140} = \text{GBP } 2,16,852.54$$

Conclusion:

- By following the prescribed steps under hedging we found the exporter receives £ 2,16,852.54 by using forward cover while he receives £ 2,17,904.45 through money market hedge. Thus, money market hedge helps exporter to receive £ 1051.91 more than the amount received using Forward contract. Hence it is more beneficial.

72. MMH importer [Concept Revision]

A UK Company owes a German Company 25 lakhs Euros payable in 3 months. The spot rate EURO/GBP is 1.25-1.27. The company can borrow pounds @ 8% and deposit pounds @6%. It can borrow Euro @12% and deposit Euro@10%.

- How much is the cost of money market hedge?
- What is the forward rate?
- What should the company do?

Answer:

WN 1: Cost of Money Market Hedge:

Particulars	Calculation	Amount
Day 0:		
Identify a foreign currency asset/liability - Foreign currency Liability		EUR 25,00,000
Create a matching asset- we need to create a EUR deposit which will mature to EUR 25,00,000 Deposit rate = 2.5% per quarter	$\frac{25,00,000}{1 + 2.50\%}$	EUR 24,39,024
Take a GBP loan at 2% per 3 months which will help in buying EUR 24,39,024	$24,39,024 \times \left(\frac{1}{1.25} \right)$	GBP 19,51,219
Convert GBP 19,51,219 into Euros and create Euro deposit		EUR 24,39,024
Day 90:		
Redeem Euro deposit along with interest	$24,39,024 + 2.5\%$	EUR 25,00,000
Pay supplier with deposit proceeds		EUR 25,00,000
Repay GBP loan along with interest of 2%	$19,51,219 + 2\%$	GBP 19,90,243

WN 2: Computation of forward rate:

EUR 25,00,000 = GBP 19,90,243
EUR 1.2561 = GBP 1
Forward rate = EUR 1.2561/GBP

WN 3: Decision of the company:

- The decision of Money Market Hedge would depend on the company's view on exchange rates
- If the company believes that the exchange rate would be equal to or more than EUR 1.2561/GBP, then the company should leave the exposure open
- If the company believes that the exchange rate would be less than EUR 1.2561/GBP, then the exposure should be covered through MMH
- If the company has no view on the exchange rates, then also it should cover using MMH

73. MMH - exporter [Nov 2018 MTP, Nov 2008, Nov 2012 RTP, SM] [Homework]

An Indian exporting firm, Rohit and Bros., would like to cover itself against a likely depreciation of pound sterling. The following data is given:

- ❖ Receivables of Rohit and Bros : £ 500,000
- ❖ Spot rate : Rs.56.00/£
- ❖ Payment date : 3-months
- ❖ 3 months interest rate : India: 12 % per annum, UK: 5 % per annum

What should the exporter do?

Answer:

- The company has a foreign currency Asset of GBP 5,00,000. The company is likely worried about depreciation of pound. This would lead to depreciation of asset and hence the company is worried about it
- The company can go for money market hedge option to cover the forex exposure of GBP 5,00,000

Particulars	Calculation	Amount
Day 0:		
Identify a foreign currency asset/liability - Foreign currency Asset		GBP 5,00,000
Create a matching liability - we will take a GBP loan which will mature to GBP 5,00,000	$\frac{5,00,000}{1 + 1.25\%}$	GBP 4,93,827
Convert GBP 4,93,827 into INR at spot rate	$4,93,827 \times 56$	INR 2,76,54,312
Invest INR 2,76,54,312 for three months at the rate of 12%		INR 2,76,54,312
Day 90:		
Receive GBP 5,00,000 from customer and repay GBP Loan		GBP 5,00,000
Redeem INR deposit along with interest	$2,76,54,312 + 3\%$	INR 2,84,83,941

- **The company will have INR receipt of Rs.2,84,83,941 through Money Market Hedge route**
- From the calculations. It is clear that the money market operation has resulted into a net gain of Rs. 483,941 (Rs.28,483,941 – GBP 500,000 × 56).
- If pound sterling has depreciated in the meantime. The gain would be even bigger.

Part X- Exchange Position Versus Cash Position

74. Exchange position versus cash position [Nov 2018, Nov 2005, May 2013 RTP, Nov 2020 MTP, May 2022 MTP, SM] [Concept Revision]

You as a dealer of foreign exchange have the following position in Swiss Francs on October 31, 2009:

	Swiss Francs
Balance in the Nostro Account Credit	1,00,000
Opening position overbought	50,000
Purchased a bill on Zurich	80,000
Sold forward TT	60,000
Forward purchase contract cancelled	30,000
Remitted by TT	75,000
Draft on Zurich cancelled	30,000

What steps would you take, if you are required to maintain a credit balance of Swiss Francs 30,000 in the Nostro Account and keep as overbought position on Swiss Francs 10,000?

Answer:

WN 1: Exchange position account (swiss franc):

Particulars	Purchase/ Inflow	Sales/ Outflow
Opening balance	50,000	
Purchase of bill	80,000	
Forward sale		60,000
Cancellation of forward purchase		30,000
Remittance by TT		75,000
Cancellation of demand draft	30,000	
Total	1,60,000	1,65,000
Purchase of swiss franc	5,000	-
Revised total	1,65,000	1,65,000

WN 2: Cash position account (swiss franc):

Particulars	Receipt/ Inflow	Payment/ Outflow
Opening balance	1,00,000	
Remittance by TT		75,000
Purchase of swiss franc	5,000	
Total	1,05,000	75,000
Closing balance		30,000

Analysis on exchange position:

- The company needs closing cash position of 30,000. There was SFR 25,000 and now they can buy SFR 5,000 in spot market to make the balance as 30,000.
- The closing exchange position is zero as inflow and outflow total matches
- The company wants an overbought position of Swiss Franc 10,000. The company can do a forward purchase of Swiss Franc 10,000 to make the overbought position as 10,000

75. Exchange position versus cash position [Nov 2024 RTP]

Suppose you are a dealer of ABC Bank and on 20.10.2014 you found that balance in your Nostro Account with XYZ Bank in London is GBP 65,000 and you had overbought GBP 35,000. During the day following transaction have taken place:

Particulars	GBP
DD Purchased	12,500
Purchased a bill on London	40,000
Sold forward TT	30,000
Forward purchase contract cancelled	15,000
Remitted by TT	37,500
Draft on London cancelled	15,000

What steps would you take, if you are required to maintain a credit balance of GBP 7,500 in the Nostro Account and keep as overbought position on GBP 7,500?

Answer:**WN 1: Exchange Position:**

Particulars	Purchase	Sale
Opening balance overbought	35,000	
DD Purchased	12,500	
Purchased a bill on London	40,000	
Sold forward TT		30,000
Cancellation of forward purchase contract		15,000
Remitted by TT		37,500
Draft on London cancelled	15,000	
Remittance in spot market		20,000
Forward purchase to get target overbought position (balancing figure)	7,500	
Net overbought position		7,500
Total	1,10,000	1,10,000

WN 2: Cash Position:

Particulars	Receipt	Payment	Balance
Opening Balance			65,000
Remitted by TT		37,500	27,500
Sales done in spot market to get target balance (27,500 – 7,500)		20,000	7,500

76. Exposure types [Nov 2009, May 2019 MTP, SM]

Omega Electronics Limited exports air conditioners to Germany by importing all the components from Singapore. The company is exporting 2,400 units at a price of € 500 per unit. The cost of imported components is S\$ 800 per unit. The fixed cost and other variables cost per unit are Rs. 1,000 and Rs.1,500 respectively. The cash flows in foreign currencies are due in six months. The current exchange rates are as follows:

- ❖ Rs./€ 51.50/55
- ❖ Rs./S\$ 27.20/25

After six months the exchange rates turn out as follows:

- ❖ Rs./€ 52.00 - 05
- ❖ Rs./SG\$ 27.10 - 75

Required:

- a) You are required to calculate loss/gain due to transaction exposure.
- b) Based on the following additional information calculate the loss/gain due to transaction and operating exposure if the contracted price of air conditioners is Rs.25,000:
 - a. The current exchange rate changes to
 - i. Rs./€ 51.75/80
 - ii. Rs./S\$ 27.10/15
 - b. Price elasticity of demand is estimated to be 1.5
 - c. Payments and receipts are to be settled at the end of six months

Answer:

ICAI Solution:

WN 1: Computation of gain/loss due to transaction exposure:

- Transaction exposure refers to gain/loss due to change in exchange rates. Euro and SGD exchange rates undergo changes over the next 6 months
- Gain/loss due to transaction exposure = Profit at spot rates - Profit at future rates

(in lacs)

Particulars	Spot Rates	Future Rates
Sales	618.00 (2,400 x 500 Euros x 51.50)	624.00 (2,400 x 500 Euros x 52.00)
Less: Imported component cost	-523.30 (2,400 x 800 SGD x 27.25)	-532.80 (2,400 x 800 SGD x 27.75)
Less: Variable cost	-36.00 (2,400 x 1,500)	-36.00 (2,400 x 1,500)
Less: Fixed cost	-24.00 (2,400 x 1,000)	-24.00 (2,400 x 1,000)
Profit	34.80	31.20

- The company would have made profits of Rs.34,80,000 as per current spot rates. However, the profits as per futures spot rates will be Rs.31,20,000
- **Loss due to transaction exposure = 34,80,000 - 31,20,000 = Rs.3,60,000**

WN 2: Computation of gain/loss due to transaction and operating exposure:

- Transaction exposure would be fall/increase in profits due to change in exchange rates
- Operating exposure would be fall/increase in profits due to change in price of conditions and demand

(in lacs)

Based on New Exchange Rates:

Particulars	Spot Rates	Future Rates
Sales	600.00 (2,400 x 25,000)	600.00 (2,400 x 25,000)
Less: Imported component cost	-521.28 (2,400 x 800 SGD x 27.15)	-532.80 (2,400 x 800 SGD x 27.75)
Less: Variable cost	-36.00 (2,400 x 1,500)	-36.00 (2,400 x 1,500)
Less: Fixed cost	-24.00 (2,400 x 1,000)	-24.00 (2,400 x 1,000)
Profit	18.72	7.20

- **Loss due to transaction exposure = 18,72,000 - 7,20,000 = Rs.11,52,000**

Based on changed scenario:

Particulars	Amount
Sales	604.25000

	(2,417 x 25,000)
Less: Imported component cost	-536.57400 (2,417 x 800 SGD x 27.75)
Less: Variable cost	-36.25500 (2,417 x 1,500)
Less: Fixed cost	-24.00 (2,400 x 1,000)
Profit	7.42100

- Loss due to operating exposure = [Existing Profit as per spot rate – Revised profit as per spot rates] = 18,72,000 – 7,42,100 = Rs.11,29,900

Note: Computation of units sold:

Particulars	Amount
Earlier selling price (25,000/51.50]	485.44
New selling price	483.09
Fall in selling price	2.35
% fall in selling price (2.35/485.44 x 100)	0.48%
% increase in units sold (0.48% x 1.50)	0.72%
Revised units sold (2,400 + 0.72%)	2,417

- Price elasticity of demand is 1.5 times. This would mean that if price falls by 1 percent then volume would increase by 1.5 percent. In this question price has fell by 3.38% and hence volumes will increase by 5.07%
- The above computation has logical gaps and we should use current selling price as 500 x 51.75 and compare the same with Rs.25,000. The same is presented in the below solution

Author Solution:

WN 1: No Change

WN 2: Computation of gain/loss due to transaction and operating exposure:

- Transaction exposure would be fall/increase in profits due to change in exchange rates
- Operating exposure would be fall/increase in profits due to change in price of conditions and demand

(in lacs)

Particulars	Spot Rates	Future Rates
Sales	630.50000 (2,522 x 25,000)	630.50000 (2,522 x 25,000)
Less: Imported component cost	-547.77840 (2,522 x 800 SGD x 27.15)	-559.88400 (2,522 x 800 SGD x 27.75)
Less: Variable cost	-37.83000 (2,522 x 1,500)	-37.83000 (2,522 x 1,500)
Less: Fixed cost	-24.00 (2,400 x 1,000)	-24.00 (2,400 x 1,000)
Profit	20.89160	8.78600

- Loss due to operating exposure = [Existing Profit as per spot rate – Revised profit as per spot rates] = 34,80,000 – 20,89,160 = Rs.13,90,840
- Loss due to transaction exposure = [Revised profit as per spot rate – Revised profit as per futures spot rates] = [20,89,160 – 8,78,600] = Rs.12,10,560

Note: Computation of units sold:

Particulars	Amount
Earlier selling price (500 EUROS x 51.75]	25,875
New selling price	25,000
Fall in selling price	875
% fall in selling price (875/25,875 x 100)	3.38%
% increase in units sold (3.38% x 1.50)	5.07%
Revised units sold (2,400 + 5.07%)	2,522

- Price elasticity of demand is 1.5 times. This would mean that if price falls by 1 percent then volume would increase by 1.5 percent. In this question price has fell by 3.38% and hence volumes will increase by 5.07%

77. Computation of transaction exposure [Mar 2016 MTP, Nov 2021 MTP] [Homework]

Shanti exported 200 pieces of designer jewellery to USA at \$ 200 each. To manufacture and design this jewellery she imported raw material from Japan of the cost of JP¥ 6000 for each piece. The labour cost and variable overhead incurred in producing each piece of jewellery are Rs. 1,300 and Rs. 650 respectively.

Suppose Spot Rates are:

- ❖ Rs./ US\$ Rs. 65.00 – Rs. 66.00
- ❖ JP¥/ US\$ JP¥ 115 – JP¥ 120

Shanti is expecting that by the time the export remittance is received and payment of import is made the expected Spot Rates are likely to be as follows:

- ❖ Rs./ US\$ Rs. 68.90 – Rs. 69.25
- ❖ JP¥/ US\$ JP¥ 105 – JP¥ 112

You are required to calculate the resultant transaction exposure.

Answer:

WN 1: Computation of profit as per current spot rates:

Particulars	Calculation	Amount
Sales revenues	(USD 200 x 200 x 65)	26,00,000
Less: Cost of imported raw material	$\left(200 \times \left(\frac{6000}{115}\right) \times 66\right)$	(6,88,696)
Labour cost	(200 x 1,300)	(2,60,000)
Variable overheads	(200 x 650)	(1,30,000)
Profit		15,21,304

WN 2: Computation of profit as per expected spot rates:

Particulars	Calculation	Amount
Sales revenues	(USD 200 x 200 x 68.90)	27,56,000
Less: Cost of imported raw material	$\left(200 \times \left(\frac{6000}{105}\right) \times 69.25\right)$	(7,91,429)
Labour cost	(200 x 1,300)	(2,60,000)
Variable overheads	(200 x 650)	(1,30,000)
Profit		15,74,571
Increase in profit due to transaction exposure	1,74,571 – 15,21,304	53,267

- ❖ Transaction exposure is the change in profit due to variation in exchange rate. The same is calculated as difference between profit as per expected exchange rate – profit as per current exchange rates

78. Nostro, Vostro and Loro account [Nov 2013, May 2015 MTP, Nov 2017 MTP, May 2019 RTP, SM]

XYZ Bank, Amsterdam, wants to purchase Rs.25 million against GBP for funding their Nostro account and they have credited LORO account with Bank of London, London.

Calculate the amount of GBP credited. Ongoing inter-bank rates are per \$, Rs.61.3625/3700 and per GBP, \$ 1.5260/70

Answer:

- The bank wants to buy Rs.25 million by paying GBP
- Known component = Rs.25 million
- Unknown component = ? GBP

$$\text{GBP} = \text{INR} \times \left(\frac{\text{GBP}}{\text{INR}}\right); \text{GBP} = \text{INR} \times \text{ASK} \left(\frac{\text{GBP}}{\text{INR}}\right); \text{GBP} = \text{INR} \times \text{ASK} \left[\left(\frac{\text{GBP}}{\text{USD}}\right) \times \left(\frac{\text{USD}}{\text{INR}}\right)\right]$$

$$\text{GBP} = 2,50,00,000 \times \left(\frac{1}{1.5260}\right) \times \left(\frac{1}{61.3625}\right) = \text{GBP } 2,66,982$$

Part XI – Currency Futures and Options

79. Forex futures

Dart Ltd exports agricultural products. They have branch in London. This London office has concluded a deal with Giants USA. Sale is to take place in December. Payment is due in January. Value of sales is 15 lakh US \$. Remittance will come from Giants USA to the London branch of the Indian company. Spot rate in London for Dollar/Pound is 1.5050.

Dart Ltd is concerned about a distinct possibility of sterling gaining in the interim against dollar. Taking a "FUTURES" contract is explored. Pound 62,500 (trading unit), for Jan/Feb futures is quoted at \$ 1.50 per pound. Spot price on futures by end Jan moves to \$ 1.52 pound. Advise if Dart Ltd can authorize their London office to take a position in Dollar/Sterling futures?

Answer:

- Dart Limited plans to export in USD. Hence, they will have asset(receivable) in USD
- Dart Limited believes that GBP will appreciate and this would mean that USD will depreciate. Dart Limited is concerned as its assets (USD) are expected to depreciate
- Spot rate is USD 1.5050/GBP whereas futures rate is USD 1.50/GBP. Futures quote indicate that GBP will depreciate and USD will appreciate. Dart Limited should go ahead with Futures contract as that will help in appreciation of its receivable asset

Computation of net inflow under Futures contract:

Note 1: Computation of no of contracts:

Particulars	Amount
1. Amount of exposure	USD 15,00,000
2. Amount of exposure in GBP (15,00,000/1.50)	GBP 10,00,000
3. Size of one contract	GBP 62.50
4. No of contracts (10,00,000/62.50)	16,000

- The company should enter into 16,000 contracts of buying pounds (selling USD)

Note 2: Futures settlement:

Date	Position	Action	Reference Date	Rate
Day 0	Original Position	Buy	Jan 31	(1.50 USD/GBP)
Jan 31	Opposite Position	Sell	Jan 31	1.47 USD/GBP
Profit per GBP				0.02 USD/GBP
Profit for 16,000 contracts (0.02 x 62.50 x 16,000)				USD 20,000

Note 3: Total realizations:

Particulars	Calculation	Amount
1. Spot realization	15,00,000/1.52	GBP 9,86,842.11
2. Gain from futures	20,000/1.52	GBP 13,157.89
3. Total Realization		GBP 10,00,000

80. Currency futures for hedging receivables

On January 5, an Indian firm exported goods to an US firm for a consideration of USD 4,00,000 receivable on 15th of February. The spot exchange rate is Rs.44/USD and a March dollar future is trading at Rs.45/USD. Suggest a strategy to the Indian firm to hedge its receivable exposure. On 15th February if the exchange rate in cash market drops to Rs.39/USD and in the futures markets it is trading at Rs.41/USD. Redo the computations if the spot exchange rate on February 15 is Rs.47 and the dollar futures are trading on that day at Rs.46. For computations assume futures contract size to be USD 1000.

Answer:

WN 1: Hedge strategy:

- The company has receivables exposure of USD 4,00,000. Strike price of March futures contract is Rs.45/USD.
- The futures contract can help in buying/selling USD at the rate of Rs.45/USD.
- The company should enter into futures contract to sell USD at the rate of Rs.45/USD

WN 2: No of contracts:

Particulars	Amount
1. Amount of exposure	USD 4,00,000
2. Size of one contract	USD 1,000

3. No of contracts (4,00,000/1,000)	400

WN 3 Futures settlement:

Date	Position	Action	Reference Date	Rate
Jan 5	Original Position	Sell	March 31	Rs.45/USD
Feb 15	Opposite Position	Buy	March 31	(Rs.41/USD)
Profit per USD				Rs.4/USD
Profit for 400 contracts (Rs.4 x 1,000 x 400)				Rs.16,00,000

WN 4: Total realizations:

Particulars	Calculation	Amount
1. Spot realization	4,00,000 x 39	1,56,00,000
2. Gain from futures	WN 3	16,00,000
3. Total Realization		1,72,00,000

Rework scenario:**Note 1: Futures settlement:**

Date	Position	Action	Reference Date	Rate
Jan 5	Original Position	Sell	March 31	Rs.45/USD
Feb 15	Opposite Position	Buy	March 31	(Rs.46/USD)
Loss per USD				Rs.1/USD
Loss for 400 contracts (Rs.1 x 1,000 x 400)				Rs.4,00,000

Note 2: Total realizations:

Particulars	Calculation	Amount
1. Spot realization	4,00,000 x 47	1,88,00,000
2. Loss from futures	Note 1	(4,00,000)
3. Net Realization		1,84,00,000

81. Currency futures hedging – Payables

Today is March 1. A UK firm is planning to import chemicals worth USD 6 million from US. The payment is due on June 1. The spot USD/GBP rate is 1.5765 and the three month forward rate is 1.5685. Futures are currently trading at 1.5695/GBP. Explain how the firm can hedge its payable by using futures. The contract size for futures is GBP 62,500. On June 1 the USD/GBP spot rate turns out to be 1.5875 and June futures price is 1.5850. Explain why the futures hedge did not turn out to be a perfect hedge. In retrospect, would a forward hedge have been better?

Answer:**WN 1: Hedging through futures contract:**

- The company has forex payable of USD 6 million. Size of one contract is GBP 62,500
- Contract currency for futures is GBP. This would mean that we can buy or sell GBP at the rate of USD 1.5695/GBP
- The company should enter into futures contract of selling GBP at the rate of USD 1.5695/GBP

Computation of net outflow under Futures contract:**Note 1: Computation of no of contracts:**

Particulars	Amount
1. Amount of exposure	USD 60,00,000
2. Amount of exposure in GBP (60,00,000/1.5695)	GBP 38,22,874
3. Size of one contract	GBP 62,500
4. No of contracts	61.17 ~ 61

- The company should enter into 61 contracts of selling pounds (buying USD)

Note 2: Futures settlement:

Date	Position	Action	Reference Date	Rate
March 1	Original Position	Sell	June 1	USD 1.5695/GBP
June 1	Opposite Position	Buy	June 1	(USD 1.5850/GBP)
Loss per GBP				USD 0.0155/GBP

Overall loss (0.0155 x 61 x 62,500)	USD 59,094

Note 3: Total payment:

Particulars	Calculation	Amount
1. Spot payment	60,00,000/1.5875	GBP 37,79,528
2. Futures settlement	59,094/1.5875	GBP 37,225
3. Total payment	37,79,528 + 37,225	GBP 38,16,753

Comments:

- The company's original plan was to pay GBP 38,22,874. However, they have paid GBP 38,16,753. This indicates that hedge is not perfect
- Hedge is not perfect due to following two reasons:
 - Not covering the entire amount:** The company has taken 61 contracts as compared to requirement of 61.17 contracts
 - Difference in futures and cash market rate on maturity date:** On June 1, the futures rate is USD 1.5850/GBP whereas spot market rate is USD 1.5875/GBP

WN 2: Hedging through forward contract:

Particulars	Calculation	Amount
1. Amount of exposure		USD 60,00,000
2. Forward rate		USD 1.5685/GBP
3. Outflow under forward contract	60,00,000/1.5685	GBP 38,25,311

Comments:

- Futures contract will be beneficial than forward contract due to lower outflow

82. Forex Options [Nov 2023]

A Japanese company imports hi-tech printer cartridges from US worth \$1 million. The chief financial officer of the company wishes to know the best strategy for protection against uncertainty, for the payment that has to be made at the end of 3 months. Financial team of the company has collected the following options for evaluation:

Table-1: Exchange rates quoted in FOREX Market:

¥/\$ Quotations	Bid Price	Offer/Ask Price
Spot Rates	146.03	146.63
3M - Forward Rate	144.04	145.00
6M - Forward Rates	146.35	146.70

Table-2: Options Market rates for European options with 3 months expiry :

Type of Option	Strike Price (X) (¥/\$)	Premium (%) for Call & Put Options
Call & Put	145.20	1.6766% (Call) & 1.7414% (Put)
Call & Put	146.00	1.3505% (Call) & 2.1006% (Put)

The expected spot price at expiry is ¥/\$: 144.90/145.05

Suggest the best strategy for CFO of the Japanese Company to protect against uncertainty, with respect to the following alternatives :

- Forward Hedge
- Buy 3 months call, X = 145.20
- Sell 3 months put, X = 145.20
- Buy call & sell put both having X = 146.00

Answer:**WN 1: Outflow under forward contract:**

Yen = USD x ASK $\left(\frac{\text{YEN}}{\text{USD}}\right) = 10,00,000 \times 145.00 = \text{YEN } 145 \text{ Million}$

WN 2: Buy 3 months call with strike price of 145.20

Particulars	Calculation	Amount
Premium on day 0	10,00,000 x 145.20 x 1.6766%	YEN 2.43 million
Outflow on maturity	10,00,000 x 145.05	YEN 145.05 million

	[Option is not exercised]	
Total outflow		YEN 147.48 Million

WN 3: Sell 3 months Put with strike price of 145.20

Particulars	Calculation	Amount
Premium on day 0 (inflow)	$10,00,000 \times 145.20 \times 1.7414\%$	YEN 2.53 million
Outflow on maturity	$10,00,000 \times 145.20$ [Put option exercised by holder]	YEN 145.20 million
Net outflow		YEN 142.67 Million

WN 4: Buying call and selling Put with strike price of 146.00

Particulars	Calculation	Amount
Premium on call option (outflow)	$10,00,000 \times 146.00 \times 1.3505\%$	YEN 1.9717 Million
Premium on put option (inflow)	$10,00,000 \times 146.00 \times 2.1006\%$	YEN 3.0669 Million
Outflow on maturity (Call option not exercised but put option exercised by holder and hence we have to pay 146.00)	$10,00,000 \times 146$	YEN 146.00 million
Net outflow		YEN 144.905 Million

Part XII – Currency Swaps**83. Advantage of swap arrangement:**

The following is the interest rates at which ABC Limited and DEF Limited can borrow in two currencies:

Company	USD	AUD
ABC Limited	5%	12.6%
DEF Limited	7%	13%

ABC Limited wants to borrow in AUD and DEF wants to borrow in USD. A financial institution has offered to arrange for a currency swap with dealers margin of 0.2%. Explain how swap can be structured to the benefit of all the parties. Under the following situations:

- ❖ Financial institution bears the exchange rate risk. How it can hedge?
- ❖ DEF Limited bears the exchange rate risk and the financial institution earns 0.2% dealers margin in dollars

Answer:**WN 1: Structure of interest rates:**

Particulars	USD	AUD
ABC Limited	5%	12.6%
DEF Limited	7%	13%

- Total interest rate of combination 1 [ABC Limited (USD) & DEF Limited (AUD)] = $5\% + 13\% = 18\%$
- Total interest rate of combination 2 [ABC Limited (AUD) & DEF Limited (USD)] = $12.6\% + 7\% = 19.6\%$
- **Ideal combination:** Combination 1 – ABC Limited should borrow in USD and DEF Limited should borrow in AUD
- **Actual scenario:** Combination 2 – ABC Limited wants to borrow in AUD and DEF Limited wants to borrow in USD
- Scope for Currency cum interest rate swap exist as the actual scenario does not match with ideal scenario
- **Amount of swap gain** = $19.6\% - 18\% = 1.6\%$
- **Share of swap gain:**
 - Dealer's margin (Share) = 0.2%
 - ABC Limited's share = 0.7%
 - DEF Limited's share = 0.7%

WN 2: Structuring of swap:

Particulars	ABC Limited	DEF Limited

	Currency	%	Currency	%
1. Payment to bank as per ideal scenario	USD	5%	AUD	13%
2. Receive from swap intermediary	USD	(5%)	AUD	(13%)
3. Pay to swap intermediary (balancing figure)	AUD	11.9%	USD	6.3%
4. Effective cost (original - swap gain)	AUD	11.9%	USD	6.3%

- Swap intermediary will receive a net amount of 1.3% in USD and pay a net amount of 1.1% in AUD

WN 3: Structuring of swap if DEF Limited is willing to take exchange rate risk

Particulars	ABC Limited		DEF Limited	
	Currency	%	Currency	%
1. Payment to bank as per ideal scenario	USD	5%	AUD	13%
2. Receive from swap intermediary	USD	(5%)	AUD	(11.9%)
3. Pay to swap intermediary (balancing figure)	AUD	11.9%	USD	5.2%
4. Effective cost (original - swap gain)	AUD	11.9%	USD & AUD	5.2% & 1.1%

84. Currency swaps [Homework]

Companies A and B face the following interest rates:

Particulars	A	B
US Dollars (Floating rate)	LIBOR + 0.5%	LIBOR + 1.0%
Canadian (Fixed rate)	5.0%	6.5%

Assume that A wants to borrow USD at floating rate of interest and B wants to borrow Canadian dollars at a fixed rate of interest. A financial institution is planning to arrange a swap and requires a 50-basis point spread. If the swap is equally attractive to A and B, what rates of interest will A and B end up paying?

Answer:

WN 1: Identification of interest rate benefit:

Particulars	Calculation	Amount
Total cost of combination 1 [A (USD) and B (Canadian dollars)]	LIBOR + 0.5% + 6.5%	LIBOR + 7%
Total cost of combination 2 [A (CAD) and B (USD)]	5% + LIBOR + 1%	LIBOR + 6%

- ❖ Ideal combination as per the above table is combination 2 as the same has lower net cost. Therefore, Company A should borrow in CAD and company B should borrow in USD. However, the actual borrowing requirement is opposite and hence the opportunity for interest rate swap exists
- ❖ Swap will have total gain of 1 percent. The swap intermediary will charge 50 basis point and the balance 50 bps will be shared. Net gain for A Limited is 25 bps and Net gain for B Limited is 25 bps

WN 2: Structuring Interest Rate Swap (IRS):

Particulars	Company A	Company B
Borrow from bank as per ideal combination	CAD 5%	USD LIBOR + 1%
Receive from swap intermediary (receive what is paid to bank)	CAD 5%	USD LIBOR + 1%
Pay to swap intermediary (bal figure)	USD LIBOR + 0.25%	CAD 6.25%
Effective cost (original planned cost - swap gain)	USD LIBOR + 0.25%	CAD 6.25%

- ❖ Net receipt for swap intermediary in USD = USD LIBOR + 0.25% - USD LIBOR + 1% = (USD LIBOR + 0.75%)
- ❖ Net receipt for swap intermediary in CAD = 6.25% - 5% = 1.25%
- ❖ Hence swap intermediary will have net receipt of 1.25 percent in CAD and net payment of 0.75% for USD

85. Currency swap [May 2011, May 2020 RTP, SM, May 2024 RTP]

A Inc. and B Inc. intent to borrow \$ 2,00,000 and \$2,00,000 in JPY respectively for a time horizon of one year. The prevalent interest rates are as follows:

Company	YEN Loan	USD Loan
A Inc	5%	9%
B Inc	8%	10%

The prevalent exchange rate is USD 1 = YEN 120.

They entered in a currency swap under which it is agreed that B Inc will pay A Inc @ 1% over the YEN loan interest rate which the later will have to pay as a result of the agreed currency swap whereas A Inc will reimburse interest to B Inc only to the extent of 9%. Keeping the exchange rate invariant, quantity the opportunity gain or loss component of the ultimate outcome, resulting from the designed currency swap.

Answer:

WN 1: Structuring of swap arrangement:

Particulars	Company A	Company B
Borrow from bank	YEN 5%	USD 10%
B to A	(YEN 6%)	YEN 6%
A to B	USD 9%	(USD 9%)
Effective borrowing cost	USD 9% and negative YEN (1%)	YEN 6% and USD 1%
Effective original borrowing cost	USD 9%	YEN 8%
Net gain in swap arrangement	YEN 1%	YEN 2% but pay extra USD 1%
Net gain in % terms	1%	1%

WN 2: Cash flows of swap arrangement:

Particulars	Company A	Company B
Payment to bank	YEN 12,00,000 [2,40,00,000 x 5%]	USD 20,000 [2,00,000 x 10%]
B to A	YEN 14,40,000 [2,40,00,000 x 6%]	YEN 14,40,000 [2,40,00,000 x 6%]
A to B	USD 18,000 [2,00,000 x 9%]	USD 18,000 [2,00,000 x 9%]
Effective borrowing cost	Pay USD 18,000 and receipt of YEN 2,40,000	Pay USD 2,000 and YEN 14,40,000

Net Benefit for Company A:

- ❖ Company A is receiving YEN of 2,40,000. The same will be converted into USD 2,000
- ❖ Net borrowing cost for company A is USD 16,000
- ❖ Original borrowing cost as per given rates is USD 18,000 [2,00,000 x 9%]
- ❖ Net gain of Swap arrangement is USD 2,000 [1%]

Net Benefit for Company B:

- ❖ Company A is paying USD 2,000. The same will be converted into YEN 2,40,000
- ❖ Total borrowing cost is YEN 16,80,000
- ❖ Rate as per original borrowing rate is YEN 19,20,000 [2,40,00,000 x 8%]
- ❖ Net gain of swap arrangement is YEN 2,40,000 [1%]

86. Hedging currency exposure [May 2016 MTP, May 2013 RTP, May 2019 RTP, SM] [Concept Revision]

ABC Limited, a US based company, has won a contract in India for drilling oil field. The project will require an initial investment of Rs.500 Crores. The oil field along with equipments will be sold to Indian Government for Rs.740 crores in one year time. Since the Indian Government will pay for the amount in Indian Rupee, the company is worried about exposure due to exchange rate volatility. You are required to:

- ❖ Construct a swap that will help ABC Limited to reduce the exchange rate risk
- ❖ Assume that Indian Government offers a swap at a spot rate which is 1 USD = Rs.50 in one year, then should the company opt for this option or should it do nothing. The spot rate after one year is expected to be 1 USD = Rs.54. Further you may also assume that the ABC Limited can also take a USD loan at 8% p.a.

Answer:

WN 1: Construction of swap:

Currency swap can be created by following the below steps:

- ABC Limited to borrow USD 10 Crores in USA
- Swap USD 10 Crores with INR 500 Crores on day 0. This swap will be done with Government of India
- Swap back INR 500 Crores with USD 10 Crores on day 365. This will ensure that company is impacted only to the extent of profit

WN 2: Benefit of swap arrangement:

Particulars	Without Swap	With Swap
1. INR receipt on day 365	740 crores	740 crores
2. Swap Rs.500 crores with 10 Crores USD at agreed rate of Rs.50	NA	USD 10 Cr
3. Swap balance at rate of Rs.54	USD 13.7037 cr	USD 4.4444 Cr
4. Total USD earned	13.7037 Cr	14.4444 Cr
5. USD loan to be repaid	10.80 cr	10.80 cr
6. Net gain	2.9037 Crores	3.6444 Crores

- Company should go ahead with swap arrangement as the same has higher net gain

Part XIII – Multiple Forex Hedging Strategies**87. Comprehensive [May 2018 MTP, May 2007, May 2015 MTP, Nov 2015, May 2019, SM] [Concept Revision]**

XYZ Limited, a US firm will need GBP 3,00,000 in 180 days. In this connection, the following information is available

Spot rate 1 GBP = USD 2.00

180 days forward rate 1 GBP = USD 1.96

Interest rates are as follows:

	UK	US
180 days deposit rate	4.5%	5%
180 days borrowing rate	5%	5.5%

A call option on GBP that expires in 180 days has an exercise price of USD 1.97 and a premium of USD 0.04.

XYZ limited has forecasted the spot rates 180 days hence as below:

Future rate	Probability
USD 1.91	25%
USD 1.95	60%
USD 2.05	15%

Which of the following strategies would be most preferable to XYZ Limited?

- A forward contract
- A money market hedge
- An option contract
- No hedging

Answer:**WN 1: Computation of USD outflow in case of forward contract:**

- 180 days forward rate for 1.96 USD/GBP. The company needs to pay 3,00,000 GBP in 180 days
- Outflow in USD = 3,00,000 x 1.96 = USD 5,88,000**

WN 2: Computation of USD outflow in case of Money Market Hedge:

- The company has a foreign currency liability of GBP 3,00,000. XYZ Limited should create a matching GBP deposit which will mature to GBP 3,00,000 in 180 days

Particulars	Calculation	Amount
Day 0		
1. Amount of GBP deposit to be created	$\frac{3,00,000}{1 + 4.5\%}$	GBP 2,87,081
2. USD loan to be taken on day 0	$2,87,081 \times 2$	USD 5,74,162
3. Take USD loan and create GBP deposit		
Day 180		
4. Redeem GBP deposit and pay supplier		GBP 3,00,000
5. USD outflow on day 180	$5,74,162 + 5.5\%$	USD 6,05,741

Note:

- It is assumed that given interest rates are applicable for 180 days period. Hence, we have directly taken the given rate for computation. Alternatively, this can be assumed for a year and we can calculate proportionate rate.

WN 3: Computation of USD outflow in case of option contract:

Expected rate	Outflow (incl premium)	Probability	Product
USD 1.91	USD 1.95	0.25	0.4875
USD 1.95	USD 1.99	0.60	1.1940
USD 2.05	USD 2.01	0.15	0.3015
Effective rate			1.983
Total Outflow	3,00,000 × 1.983		5,94,900
Interest on premium	(0.04 × 3,00,000 × 5.5%)		660
Final Outflow			5,95,560

WN 4: Computation of USD outflow in case of no hedge:

Expected rate	Probability	Product
USD 1.91	0.25	0.4775
USD 1.95	0.60	1.1700
USD 2.05	0.15	0.3075
Effective rate		1.955

USD outflow on day 180 = 3,00,000 × 1.955 = USD 5,86,500

Conclusion:

The company should opt for no hedge route as USD outflow is lowest in case of no hedge.

88. Comprehensive [May 2019 RTP, Nov 2006, Nov 2014 MTP, Nov 2016 RTP, May 2021 RTP, May 2023, Nov 2018 MTP, May 2022 MTP, Nov 2024 MTP, SM] [Concept Revision]

XYZ Ltd. is an export oriented business house based in Mumbai. The Company invoices in customers' currency. Its receipt of US \$ 1,00,000 is due on September 1, 2009.

Market information as at June 1, 2009 is:

Exchange rates		Currency futures	Contract size Rs.4,72,000
USD /INR		USD/INR	
Spot	0.02140	June	0.02126
1 month forward	0.02136	September	0.02118
3 months forward	0.02127		

	Initial Margin	Interest rates in India
June	Rs.10,000	7.50%
September	Rs.15,000	8.00%

On September 1, 2009 the spot rate US \$Re. is 0.02133 and currency future rate is 0.02134. Comment which of the following methods would be most advantageous for XYZ Ltd.

- Using forward contract
- Using currency futures
- Not hedging currency risks

It may be assumed that variation in margin would be settled on the maturity of the futures contract.

Answer:**WN 1: Computation of INR inflow in case of forward contract:**

- September 1 forward rate is USD 0.02127/INR. The company will receive 1,00,000 USD on September 1
- Inflow in INR = 1,00,000/0.02127 = INR 47,01,457

Computation of INR inflow under Futures contract:**Note 1: Computation of no of contracts:**

Particulars	Amount
1. Amount of exposure	USD 1,00,000
2. Amount of exposure in INR (1,00,000/0.02118)	INR 47,21,435
3. Size of one contract	INR 4,72,000
4. No of contracts	10

- The company should enter into 10 contracts of buying INR (selling USD)
- Margin money paid on day 0 = 15,000 × 10 = Rs.1,50,000
- Interest on Margin Money = 1,50,000 × 8% × (3/12) = Rs.3,000

Note 2: Futures settlement:

Date	Position	Action	Reference Date	Rate
June 1	Original Position	Buy	Sep 01	(USD 0.02118/INR)
Sep 1	Opposite Position	Sell	Sep 01	USD 0.02134/INR
Profit per INR				USD 0.00016/INR
Total Profit (0.00016 x 10 x 4,72,000)				USD 755.20

Note 3: Final Realization:

Particulars	Calculation	Amount
1. Spot realization	1,00,000/0.02133	Rs.46,88,233
2. Futures settlement	755.20/0.02133	Rs.35,406
3. Interest on margin money		(Rs.3,000)
4. Net realization		47,20,639

WN 3: Computation of INR inflow in case of no hedge:

- September 1 spot rate is USD 0.021233/INR. The company will receive 1,00,000 USD on September 1
- Inflow in INR = 1,00,000/0.02133 = Rs.46,88,233**

Conclusion:

- The company should go ahead with futures contract for hedging

89. Comprehensive [May 2018 MTP, May 2010, May 2015 MTP, Nov 2016 RTP, Nov 2022 RTP, May 2019 MTP, SM]

A Ltd. of U.K. has imported some chemical worth of USD 3,64,897 from one of the U.S. suppliers. The amount is payable in six months time. The relevant spot and forward rates are:

- ❖ Spot rate USD 1.5617-1.5673
- ❖ 6 months' forward rate USD 1.5455 -1.5609

The borrowing rates in U.K. and U.S. are 7% and 6% respectively and the deposit rates are 5.5% and 4.5% respectively. Currency options are available under which one option contract is for GBP 12,500. The option premium for GBP at a strike price of USD 1.70/GBP is USD 0.037 (call option) and USD 0.096 (put option) for 6 months period.

The company has 3 choices:

- Forward cover
- Money market cover and
- Currency option

Which of the alternatives is preferable by the company?

Answer:**WN 1: Computation of GBP outflow in case of forward contract:**

- 6 months forward rate = USD 1.5455 - 1.5609/GBP
- GBP outflow on day 180 = 3,64,897/1.5455 = GBP 2,36,102.88**

WN 2: Computation of GBP outflow in case of Money Market Hedge:

- The company has foreign currency (USD) liability and hence has to create USD deposit for money market hedge

Particulars	Calculation	Amount
Day 0		
1. Amount of USD deposit to be created	3,64,897/(1+2.25%)	USD 3,56,867.48
2. GBP loan to be taken on day 0	3,56,867.48 x (1/1.5617)	GBP 2,28,512.19
3. Take GBP loan, convert into USD and create USD deposit		
Day 180		
4. Redeem USD deposit and pay supplier		USD 3,64,897
5. GBP outflow after 6 months	2,28,512.19 + 3.5%	GBP 2,36,510.12

WN 3: Computation of GBP outflow in case of Option Contract:

- The strike price of option is USD 1.70/GBP. Product currency is GBP and hence we can buy/sell GBP with option contract
- The company needs to buy USD. This can also be considered as selling GBP.
- **The company plans to sell GBP and hence we should opt for Put option**

Note 1: Computation of no of contracts:

Particulars	Amount
1. Amount of exposure	USD 3,64,897
2. Amount of exposure in GBP (3,64,897/1.70)	GBP 2,14,645
3. Size of one contract	GBP 12,500
4. No of contracts (2,14,645/12,500)	17.17 ~ 17

Note 2: Computation of premium:

Particulars	Amount
1. Premium per GBP	USD 0.096
2. Premium per contract (12,500 x 0.096)	USD 1,200
3. Premium for 17 contracts (1,200 x 17)	USD 20,400
4. Premium in GBP (20,400/1.5617)	GBP 13,062.69
5. Interest on premium (13,062.69 x 7% x 6/12)	GBP 457.19

Note: It is assumed that A Limited is running a cash deficit and hence interest on premium is considered at borrowing rates.

Note 3: Final outflow:

Particulars	Amount
1. Sale of GBP of 17 contracts (17 x 12,500 x 1.70)	USD 3,61,250
2. GBP outflow for above 3,61,250 USD (17 x 12,500)	GBP 2,12,500
3. Balance USD required (3,64,897 - 3,61,250)	USD 3,647
4. Purchase of above USD using forward rate (3,647/1.5455)	GBP 2,359.75
5. Premium paid	GBP 13,062.69
6. Interest on premium	GBP 457.19
7. Final outflow (2 + 4 + 5 + 6)	GBP 2,28,379.63

Conclusion:

The company should go ahead with option contract for hedging the exposure

90. Comprehensive [Nov 2011, Nov 2016 MTP, Nov 2017 MTP, May 2020 RTP, May 2021 RTP, SM] [Homework]

Nitrogen Ltd, is in the process of negotiating an order amounting €4 Mln with a large German retailer on 6 months credit. If successful this will be the first time that Nitrogen Ltd has exported goods into highly competitive market. The following three alternatives are being considered for managing the transaction risk before the order is finalized.

- Invoice the German firm in sterling using the current exchange rate to calculate the invoice amount.
- Alternative of invoicing the German firm in € and using a forward foreign exchange contract to hedge the transaction risk.
- Invoice the German first in € and use sufficient 6months sterling future contracts (to the nearly whole number) to hedge the transaction risk.

- ❖ Spot rate € 1.1750-1.1770/£
- ❖ 6 months forward premium 0.60-0.55 Euro cents
- ❖ 6 months future contract is available at €1.1760/£
- ❖ 6 month future contract size is £62500
- ❖ Spot rate and 6 months futures rate €1.1785/£

Required:

- Calculate to the nearest £ the receipt for Nitrogen Ltd. Under each of the three proposals.
- In your opinion, which alternative would you consider to be the most appropriate and thereof

Answer:**WN 1: Hedging through forward contract:**

- Spot rate is EURO 1.1750 – 1.1770/GBP
- 6 months forward premium EURO 0.0060 – 0.0055/GBP [1 cent = 0.01 EURO]
- Swap points are in descending order. However, the question says premium and hence these points need to be added to get forward rate
- **6 months forward rate = EURO 1.1810 – 1.1825/GBP**
- **Inflow in GBP = 40,00,000/1.1825 = GBP 33,82,664**

WN 2: Hedging using futures contract:**Note 1: Computation of no of contracts:**

Particulars	Amount
1. Amount of exposure	EUR 40,00,000
2. Amount of exposure in GBP (40,00,000/1.1760)	GBP 34,01,361
3. Size of one contract	GBP 62,500
4. No of contracts	54 Contracts

Note: The company should enter into 54 contracts of buying pounds (selling EUROS)

Note 2: Futures settlement:

Date	Position	Action	Reference Date	Rate
Day 0	Original Position	Buy	Day 180	(EURO 1.1760/GBP)
Day 180	Opposite Position	Sell	Day 180	EURO 1.1785/GBP
Profit per GBP				EURO 0.0025
Total Profit (0.0025 x 62,500 x 54)				EURO 8,437.50

Note 3: Final Realization:

Particulars	Calculation	Amount
1. Spot realization	40,00,000/1.1785	GBP 33,94,145
2. Futures settlement	8,437.50/1.1785	GBP 7,160
3. Total realization		GBP 34,01,305

WN 3: Hedging through Currency invoicing

- Under currency invoicing, the billing will happen in GBP
- It is assumed that Ask rate of EURO 1.1770/GBP is used for finding the amount to be billed
- **Amount to be billed = 40,00,000/1.1770 = GBP 33,98,471**
- **Amount realized after 6 months = GBP 33,98,471**

Conclusion:

- The company should go ahead with futures contract for hedging as the same has higher GBP inflow

91. Options versus forward contracts [Nov 2013, Nov 2021 MTP, May 2022 MTP, Nov 2022 MTP, SM]**[Homework]**

An American firm is under obligation to pay interests of Can\$ 1010000 and Can\$ 705000 on 31st July and 30th September respectively. The Firm is risk averse and its policy is to hedge the risks involved in all foreign currency transactions. The Financial Manager of the firm is thinking of hedging the risk considering two methods i.e. fixed forward or option contracts.

It is now June 30. Following quotations regarding rates of exchange, US\$ per Can\$, from the firm's bank were obtained:

Spot	1 Month Forward	3 Months Forward
0.9284 – 0.9288	0.9301	0.9356

Price for a Can\$ / US\$ option on U.S. stock exchange (cents per Can\$, payable on purchase of the option, contract size Can\$ 50000) are as follows:

Strike Price	Calls		Puts	
(US \$ / Can \$)	July	Sept.	July	Sept.
0.93	1.56	2.56	2.56	1.75
0.94	1.02	1.05	NA	NA
0.95	0.65	1.64	1.92	2.34

According to the suggestion of financial manager if options are to be used, one month option should be bought at a strike price of 94 cents and three month option at a strike price of 95 cents and for the remainder uncovered by the options the firm would bear the risk itself. For this, it would be appropriate for the American firm to hedge its foreign exchange risk on two interest payments.

Recommend which of the above two methods would be appropriate for the American Firm to hedge its foreign exchange risk on the two interest payments

Answer:

WN 1: Hedging of exposure of CA\$ 10,10,000 payable on 31st July:

Option 1: Forward Contract:

- July 31 forward rate = USD 0.9301/CAD
- **Outflow in USD = 10,10,000 × 0.9301 = USD 9,39,401**

Option 2: Option contract:

- Relevant strike price = USD 0.94/CAD
- Product currency is CAD and this is a contract to buy/sell CAD
- **The company has to buy CAD and hence we should go for call option**

Note 1: Computation of no of contracts:

Particulars	Amount
1. Amount of exposure	CAD 10,10,000
2. Size of one contract	CAD 50,000
3. No of contracts	20

Note 2: Computation of premium:

Particulars	Amount
1. Premium per CAD	USD 0.0102/CAD
2. Premium per contract (50,000 × 0.0102)	USD 510
3. Premium for 20 contracts (510 × 12)	USD 10,200

Note: Interest on premium is ignored as the rate of interest is not given in problem

Note 3: Final outflow:

Particulars	Amount
1. Purchase of 10,00,000 CAD using call option [10,00,000 × 0.94]	USD 9,40,000
2. Purchase of balance 10,000 CAD using future spot rate [10,000 × 0.9301]	USD 9,301
3. Premium Paid	USD 10,200
4. Total outflow [1+2+3]	USD 9,59,501

Conclusion:

The company should go ahead with forward contract for hedging the exposure

WN 2: Hedging of exposure of CA\$ 7,05,000 payable on 30th September:

Option 1: Forward Contract:

- September 30 forward rate = USD 0.9356/CAD
- **Outflow in USD = 7,05,000 × 0.9356 = USD 6,59,598**

Option 2: Option contract:

- Relevant strike price = USD 0.95/CAD
- Product currency is CAD and this is a contract to buy/sell CAD
- **The company has to buy CAD and hence we should go for call option**

Note 1: Computation of no of contracts:

Particulars	Amount
1. Amount of exposure	CAD 7,05,000
2. Size of one contract	CAD 50,000
3. No of contracts	14

Note 2: Computation of premium:

Particulars	Amount
1. Premium per CAD	USD 0.0164/CAD
2. Premium per contract (50,000 × 0.0164)	USD 820
3. Premium for 14 contracts (820 × 14)	USD 11,480

Note: Interest on premium is ignored as the rate of interest is not given in problem

Note 3: Final outflow:

Particulars	Amount
1. Purchase of 7,00,000 CAD using call option [7,00,000 × 0.95]	USD 6,65,000
2. Purchase of balance 5,000 CAD using future spot rate [5,000 × 0.9356]	USD 4,678
3. Premium Paid	USD 11,480
4. Total outflow [1+2+3]	USD 6,81,158

Conclusion:

The company should go ahead with forward contract for hedging the exposure

92. FC versus option [Nov 2015, Nov 2021 MTP, May 2024 MTP, SM] [Concept Revision]

XYZ an Indian firm, will need to pay JAPANESE YEN (JY) 5, 00,000 on 30th June. In order to hedge the risk involved in foreign currency transaction, the firm is considering two alternative methods i.e. forward market cover and currency option contract.

On 1st April, following quotations (JY/INR) are made available:

Spot	3 months forward
1.9516/1.9711	1.9726/1.9923

The prices for forex currency option on purchase are as follows:

- ❖ Strike Price JY 2.125
- ❖ Call option (June) JY 0.047
- ❖ Put option (June) JY 0.098

For excess or balance of JY covered, the firm would use forward rate as future spot rate. You are required to recommend cheaper hedging alternative for XYZ.

Answer:**WN 1: Hedging through forward contract:**

- The company needs to pay JPY 5,00,000 on 30th June. The same can be covered through 3-month forward contract

$$\text{INR} = \text{JPY} \times \text{ASK} \left(\frac{\text{INR}}{\text{JPY}} \right); \text{INR} = 5,00,000 \times \frac{1}{1.9726} = \text{RS. } 2,53,472.57$$

WN 2: Hedging through option contract:

- Relevant strike price = JPY 2.125/INR
- Product currency is INR and this is a contract to buy/sell INR
- The company has to sell INR and hence we should go for put option

Note 1: Computation of no of contracts:

Particulars	Amount
1. Amount of exposure	JPY 5,00,000
2. Amount of exposure in INR [5,00,000/2.125]	INR 2,35,294.12
3. Size of one contract	INR 1
4. No of contracts	2,35,294

Note 2: Computation of premium:

Particulars	Amount
1. Premium per INR	JPY 0.098
2. Premium for 2,35,294 contracts (2,35,294 × 0.098)	JPY 23,058.81
3. Premium in INR (JPY 23,058.81/1.9516)	INR 11,815.34

Note: Interest on premium is ignored as the rate of interest is not given in problem

Note 3: Final outflow:

Particulars	Amount
1. Sale of 2,35,294 INR (2,35,294 x 2.125)	JPY 5,00,000.00
2. Outflow in INR for purchase of 5,00,000 JPY	INR 2,35,294.00
3. Premium paid	INR 11,815.34
4. Total Premium (2+3)	INR 2,47,109.34

Conclusion:

The company should go ahead with option contract for hedging the exposure

93. Investment decision [May 2018 RTP, Nov 2013, May 2017 MTP, Nov 2015 MTP, Nov 2021 RTP, Nov 2023 MTP, SM]

Your bank's London office has surplus funds to extent of USD 5, 00,000/- for a period of 3 months. The cost of the funds to the bank is 4% p.a. it proposes to invest these funds in London. New York or Frankfurt and obtain the best yield, without any exchange risk to the bank. The following rates of interest are available at the three centers for investment of domestic funds there at for a period of 3 months.

- ❖ London 5% p.a.
- ❖ New York 8% p.a.
- ❖ Frankfurt 3% p.a.

The market rates in London for US dollars and Euro are as under:

London on New York

- ❖ Spot 1.5350/90
- ❖ 1 month 15/18
- ❖ 2 month 30/35
- ❖ 3 month 80/85

London on Frankfurt

- ❖ Spot 1.8260/90
- ❖ 1 month 60/55
- ❖ 2 month 95/90
- ❖ 3 month 145/140

At which center, will the investment be made & what will be the net gain (to the nearest pound) to the bank on the invested funds?

Answer:

WN 1: Computation of net gain if investment is made in New York (USD):

Particulars	Calculation	Amount
1. Amount of surplus/amount invested		USD 5,00,000
2. Interest earned	$5,00,000 \times 8\% \times (3/12)$	USD 10,000
3. Amount on maturity		USD 5,10,000
4. Amount required to be earned	$5,00,000 + (5,00,000 \times 4\% \times 3/12)$	USD 5,05,000
5. Gain in USD		USD 5,000
6. Gain in GBP	$5,000 \times \frac{1}{1.5475}$	GBP 3,231.02

WN 2: Computation of net gain if investment is made in London (GBP):

Particulars	Calculation	Amount
1. Amount of surplus		USD 5,00,000
2. Surplus in GBP/ Amount invested	$5,00,000 \times \frac{1}{1.5390}$	GBP 3,24,886
3. Interest earned	$3,24,886 \times 5\% \times (3/12)$	GBP 4,061
4. Amount on maturity		GBP 3,28,947
5. Less: GBP needed to buy 5,05,000 USD	$5,05,000 \times \frac{1}{1.5430}$	GBP 3,27,285
6. Gain in GBP (4-5)		GBP 1,662

WN 3: Computation of net gain if investment is made in Frankfurt (Euros):

Particulars	Calculation	Amount
1. Amount of surplus		USD 5,00,000

2. Surplus in Euros/ Amount invested	$5,00,000 \times 1.8260 \times \frac{1}{1.5390}$	EUR 5,93,242
3. Interest earned	$5,93,242 \times 3\% \times (3/12)$	EUR 4,449
4. Amount on maturity		EUR 5,97,691
5. Less: Euros needed to buy 5,05,000 USD	$5,05,000 \times 1.8150 \times \frac{1}{1.5430}$	EUR 5,94,021
6. Gain in Euros (4-5)		EUR 3,670
7. Gain in GBP	$3,670 \times \frac{1}{1.8150}$	GBP 2,022

Conclusion:

The company should invest the surplus in New York as the same leads to maximum gain in GBP

94. Investment decision [May 2019, Nov 2019] [Concept Revision]

KGF Bank's Sydney branch has surplus funds of USD \$ 7,00,000 for a period of 2 months. Cost of funds to the bank is 6% p.a. They propose to invest these funds in Sydney, New York or Tokyo and obtain the best yield, without any exchange risk to the bank. The Following rates of interest are available at the three centres for investment of domestic funds there for a period of 2 Months.

- ❖ Sydney 7.5%p.a.
- ❖ New York 8%p.a.
- ❖ Tokyo 4%p.a.

The market rates in Australia for US Dollars and Yen are as under:

Sydney on New York:

- ❖ Spot 0.7100/0.7300
- ❖ 1 Months 10/20
- ❖ 2 Months 25/30

Sydney on Tokyo:

- Spot 79.0900/79.2000
- 1 Months 40/30
- 2 Months 55/50

At which centre, will the investment be made & what will be the net gain to the bank on the invested funds?

Answer:**WN 1: Computation of net gain if the investment is made in Sydney:**

Particulars	Calculation	Amount
Surplus funds		USD 7,00,000
Investment in Sydney (Aus \$)	$\frac{7,00,000}{0.73}$	A \$ 9,58,904
Add: Interest in Sydney	$9,58,904 \times 7.5\% \times (2/12)$	A \$ 11,986
Total amount at end of Month 2		A \$ 9,70,890
Target funds in USD at end of Month 2	$7,00,000 + (7,00,000 \times 6\% \times 2/12)$	USD 7,07,000
Target funds in A \$ at end of Month 2	$7,07,000 / 0.7125$	A \$ 9,92,281
Net loss	$9,70,890 - 9,92,281$	A \$ 21,391

WN 2: Computation of net gain if investment is made in New York:

Particulars	Calculation	Amount
Surplus funds		USD 7,00,000
Add: Interest in New York	$7,00,000 \times 8\% \times 2/12$	USD 9,333.33
Total amount at end of Month 2		USD 7,09,333.33
Target funds in USD at end of Month 2	$7,00,000 + (7,00,000 \times 6\% \times 2/12)$	USD 7,07,000
Net gain		USD 2,333.33
Net gain in A \$	$2,333.33 / 0.7330$	A \$ 3,183

WN 3: Computation of net gain if investment is made in Tokyo:

Particulars	Calculation	Amount
Surplus funds in USD		USD 7,00,000
Surplus funds in JPY (Note 1)		JPY 7,58,39,726
Add: Interest in Tokyo	$7,58,39,726 \times 4\% \times 2/12$	JPY 5,05,598

Total amount at end of Month 2		JPY 7,63,45,324
Total amount at end of Month 2 in AUD (Note 2)		AUD 9,64,017
Target funds in A \$ at end of Month 2 (WN 1)		A \$ 9,92,281
Net loss in A \$	9,64,017 - 9,92,281	A \$ 28,264

Note 1: Computation of surplus funds in JPY:

$$\text{JPY} = \text{USD} \times \text{BID} \left(\frac{\text{JPY}}{\text{USD}} \right); \text{JPY} = \text{USD} \times \text{BID} \left(\frac{\text{JPY}}{\text{AUD}} \times \frac{\text{AUD}}{\text{USD}} \right)$$

$$\text{JPY} = 7,00,000 \times (79.0900 \times \left(\frac{1}{0.73} \right)) = \text{JPY } 7,58,39,726$$

Note 2: Computation of maturity funds in AUD:

$$\text{AUD} = \text{JPY} \times \text{BID} \left(\frac{\text{AUD}}{\text{JPY}} \right); \text{AUD} = 7,63,45,324 \times \left(\frac{1}{79.1950} \right); \text{AUD} = 9,64,017$$

Conclusion: The investment should be made in New York as the company makes gain while investing in New York.

95. Benefit of netting [Nov 2018 RTP, May 2016 MTP, Nov 2020 RTP, Nov 2023 RTP]

Suppose you are a treasurer of XYZ plc in the UK. XYZ have two overseas subsidiaries, one based in Amsterdam and one in Switzerland. The Dutch subsidiary has surplus Euros in the amount of 725,000 which it does not need for the next three months but which will be needed at the end of that period (91 days). The Swiss subsidiary has a surplus of Swiss Francs in the amount of 998,077 that, again, it will need on day 91. The XYZ plc in UK has a net balance of £75,000 that is not needed for the foreseeable future.

❖ Spot Rate (€)	£0.6858- 0.6869
❖ 91 day Pts	0.0037 0.0040
❖ Spot Rate (£)	CHF 2.3295- 2.3326
❖ 91 day Pts	0.0242 0.0228

Interest rates for the Deposits:

Amount of currency	91 day Interest rate % p.a.		
	GBP	EURO	CHF
0 to 1,00,000	1	0.25	0
1,00,001 to 5,00,000	2	1.5	0.25
5,00,001 to 10,00,000	4	2	0.50
Over 10,00,000	5.375	3	1

You have been approached by your banker wherein the above-mentioned surplus was lying, requesting you to swap the surplus lying with other two subsidiaries and place them in deposit with them.

Determine the minimum interest rate per annum (upto 3 decimal points) that should be offered by the bank to your organization so that your organization is ready to undertake such swap arrangement

Answer:

WN 1: Individual investment and then final swapping into GBP:

Currency	Surplus	Interest rate	Interest earned (Amount x rate x 91/365)	Maturity Amount	Conversion rate	GBP Maturity Amount
EURO	7,25,000	2%	3,615.07	7,28,615.07	0.6895 [0.6858 + 0.0037]	5,02,380.09 [7,28,615.07 x 0.6895]
CHF	9,98,077	0.50%	1,244.18	9,99,321.18	2.3098 [2.3326 - 0.0228]	4,32,644.03 [9,99,321.18 / 2.3098]
GBP	75,000	1%	186.99	75,186.99	1	75,186.99
Maturity value at end of day 91						10,10,211.11

WN 2: Immediate swap and investment in GBP:

Currency	Surplus	Conversion rate	GBP on day 0	GBP Maturity Amount
EURO	7,25,000	0.6858	4,97,205 [7,25,000 x 0.6858]	
CHF	9,98,077	2.3326	4,27,881.76	

			[9,98,077/2.3326]	
GBP	75,000	1	75,000	
Total GBP balance			10,00,086.76	10,10,211.11

$$\text{Minimum interest rate} = \frac{10,10,211.11 - 10,00,086.76}{10,00,086.76} \times \frac{365}{91} \times 100 = 4.061\%$$

96. Investment decision [Nov 2018, Nov 2020, May 2021 MTP, May 2023, May 2020 MTP] [Concept Revision]

ICL an Indian MNC is executing a plant in Sri Lanka. It has raised Rs. 400 billion. Half of the amount will be required after six months' time. ICL is looking an opportunity to invest this amount on 1st April, 2020 for a period of six months. It is considering two underlying proposals:

Particulars	Japan	USA
Nature of investment	Index Fund (JPY)	Treasury Bills (USD)
Dividend (in billions)	25	-
Income from stock lending (in billions)	11.9276	-
Discount on initial investment at the end	2%	-
Interest	-	5 percent per annum
Exchange rate (1 st April 2020)	JPY/INR 1.58	USD/INR 0.014
Exchange rate (30 th September 2020)	JPY/INR 1.57	USD/INR 0.013

You, as an Investment Manager, is required to suggest the best course of option.

Answer:

WN 1: Computation of INR at end of 6 months if investment is made in JPY:

Particulars	Calculation	Amount (in billions)
1. Amount of surplus		INR 200.0000
2. Surplus in JPY/ Amount invested	200 x 1.58	JPY 316.0000
Amount on maturity:		
3. Dividend income		JPY 25.0000
4. Stock lending income		JPY 11.9276
5. Value of shares sold	316.00 x 98%	JPY 309.6800
6. Total amount on maturity (3+4+5)		JPY 346.6076
7. Amount on maturity (INR)	$\frac{346.6076}{1.57}$	INR 220.76917
8. Gain		20.76917

WN 2: Computation of INR at end of 6 months if investment is made in USD:

Particulars	Calculation	Amount (in billion)
1. Amount of surplus		INR 200.0000
2. Surplus in USD/ Amount invested	200 x 0.014	USD 2.8000
3. Interest earned	2.8000 x 5% x (6/12)	USD 0.0700
4. Amount on maturity (USD)		USD 2.8700
5. Amount on maturity (INR)	$\frac{2.8700}{0.013}$	INR 220.76923
6. Gain		20.76923

- The equivalent amount at the end of 6 months shall be almost same in both the options.
- The bank can go for any of the options. However, from risk perspective, the investment in fixed income desk of US is more beneficial as the chance of variation in fixed income securities is less as compared to Equity Desk.

97. Forward contract versus money market hedge [May 2015 RTP, SM] [Homework]

Columbus Surgicals Inc. is based in US, has recently imported surgical raw materials from the UK and has been invoiced for GBP 4,80,000, payable in 3 months. It has also exported surgical goods to India and France. The Indian customer has been invoiced for GBP 1,38,000, payable in 3 months, and the French customer has been invoiced for EUR 5,90,000, payable in 4 months.

Current spot and forward rates are as follows:

❖ Spot GBP/USD 0.9830-0.9850

❖ Three month forward GBP/USD	0.9520-0.9545
❖ Spot USD/EUR	1.8890-1.8920
❖ Four months forward	1.9510-1.9540

Current money market rates are as follows:

UK	10.0%-12.0%p.a.
❖ France	14.0%-16.0%p.a.
❖ USA	11.5%-13.0%p.a.

You as a treasury manager are required to show how the company can hedge its foreign exchange exposure using Forward Markets and Money markets hedge and suggest which the best hedging technique is

Answer:

WN 1: Hedging of payables exposure:

GBP Exposure: Since Columbus has a GBP receipt (1,38,000) and payment of (4,80,000) maturing at the same time, it can match them against each other leaving a net liability of GBP 3,42,000 to be hedged

Option 1- Forward Market Hedge:

$$\text{USD} = \text{GBP} \times \text{ASK} \left(\frac{\text{USD}}{\text{GBP}} \right) = 3,42,000 \times \frac{1}{\text{BID} \left(\frac{\text{GBP}}{\text{USD}} \right)} = 3,42,000 \times \left(\frac{1}{0.9520} \right) = \text{USD } 3,59,244$$

Option 2- Money Market Hedge:

Particulars	Calculation	Amount
Day 0:		
Identify foreign currency liability		GBP 3,42,000
Create a matching asset that will mature to 3,42,000 GBP	$\frac{\text{GBP } 3,42,000}{1 + 2.5\%}$	GBP 3,33,659
Borrow USD loan with which we can create GBP deposit of 3,33,659 Known component = GBP 3,33,659; Unknown component = ? $\text{USD} = \text{GBP} \times \text{ASK} \left(\frac{\text{USD}}{\text{GBP}} \right); \text{USD} = 3,33,659 \times \left(\frac{1}{0.9830} \right)$		USD 3,39,429
Borrow USD loan and create GBP deposit		
Day 90		
Redeem GBP deposit along with interest and pay supplier		GBP 3,42,000
USD repayment along with interest @ 3.25%	$3,39,429 \times 1.0325$	USD 3,50,460

Conclusion: The company should go ahead with MMH route for hedging the forex payable of GBP 3,42,000

WN 2: Hedging of receivables exposure:

Foreign exchange exposure = EUR 5,90,000

Option 1 - Forward Market Hedge:

$$\text{USD} = \text{EUR} \times \text{BID} \left(\frac{\text{USD}}{\text{EUR}} \right) = 5,90,000 \times 1.9510 = \text{USD } 11,51,090$$

Option 2 - Money Market Hedge:

Particulars	Calculation	Amount
Day 0:		
Identify foreign currency asset		EUR 5,90,000
Create a matching liability that will mature to 5,90,000 EUR	$\frac{\text{EUR } 5,90,000}{1 + 5.33\%}$	EUR 5,60,144
Borrow EUR 5,60,144 and convert into USD at spot rate Known component = EUR 5,60,144; Unknown component = ? $\text{USD} = \text{EUR} \times \text{BID} \left(\frac{\text{USD}}{\text{EUR}} \right); \text{USD} = 5,60,144 \times 1.8890$		USD 10,58,112
Create USD deposit of 10,58,112 for four months		
Day 90		
Receive EUR 5,90,000 from customer and repay EURO loan		EUR 5,90,000
USD deposit maturity along with interest	$10,58,112 + 3.83\%$	USD 10,98,637

Conclusion: The company should go ahead with Forward Market Hedge route for hedging the receivable of EUR 5,90,000

98. Exposure management strategy matrix [Nov 2018 RTP] [Homework]

Place the following strategies by different persons in the Exposure Management Strategies Matrix.

Strategy 1: Kuljeet a wholesaler of imported items imports toys from China to sell them in the domestic market to retailers. Being a sole trader, he is always so much involved in the promotion of his trade in domestic market and negotiation with foreign supplier that he never pays attention to hedge his payable in foreign currency and leaves his position unhedged.

Strategy 2: Moni, is in the business of exporting and importing brasswares to USA and European countries. In order to capture the market he invoices the customers in their home currency. Lavi enters into forward contracts to sell the foreign exchange only if he expects some profit out of it other-wise he leaves his position open.

Strategy 3: TSC Ltd. is in the business of software development. The company has both receivables and payables in foreign currency. The Treasury Manager of TSC Ltd. not only enters into forward contracts to hedge the exposure but carries out cancellation and extension of forward contracts on regular basis to earn profit out of the same. As a result management has started looking Treasury Department as Profit Centre.

Strategy 4: DNB Publishers Ltd. in addition to publishing books are also in the business of importing and exporting of books. As a matter of policy the movement company invoices the customer or receives invoice from the supplier immediately covers its position in the Forward or Future markets and hence never leave the exposure open even for a single day.

Answer:

- ❖ **Strategy 1:** This strategy is covered by High Risk: Low Reward category and worst as it leaves all exposures unhedged. Although this strategy does not involve any time and effort, it carries high risk.
- ❖ **Strategy 2:** This strategy covers Low Risk: Reasonable reward category as the exposure is covered wherever there is anticipated profit otherwise it is left.
- ❖ **Strategy 3:** This strategy is covered by High Risk: High Reward category as to earn profit, cancellations and extensions are carried out. Although this strategy leads to high gains but it is also accompanied by high risk.
- ❖ **Strategy 4:** This strategy is covered by Low Risk: Low Reward category as company plays a very safe game.

99. Multiple forex hedging strategies [Homework]

CQS plc is a UK company that sells goods solely within UK. CQS plc has recently tried a foreign supplier in Netherland for the first time and need to pay €250,000 to the supplier in six months' time. You as financial manager are concerned that the cost of these supplies may rise in Pound Sterling terms and has decided to hedge the currency risk of this account payable. The following information has been provided by the company's bank:

- ❖ Spot rate (€ per £): 1.998 ± 0.002
- ❖ Six months forward rate (€ per £): 1.979 ± 0.004

Money market rates available to CQS plc:

- ❖ One year Pound Sterling interest rates: 6.1%-5.4%
- ❖ One year Euro interest rates: 4.0%-3.5%

Assuming CQS plc has no surplus cash at the present time you are required to evaluate whether a money market hedge, a forward market hedge or a lead payment should be used to hedge the foreign account payable

Answer:

WN 1: Forward contract hedge:

$$\text{GBP} = \text{EURO} \times \text{ASK} \left(\frac{\text{GBP}}{\text{EUR}} \right); \text{GBP} = 2,50,000 \times \left(\frac{1}{\text{BID} \left(\frac{\text{EUR}}{\text{GBP}} \right)} \right) = \frac{2,50,000}{1.975} = \text{GBP } 1,26,582$$

WN 2: Money Market Hedge:

Particulars	Calculation	Amount
Day 0:		
Identify foreign currency liability		EUR 2,50,000
Create a matching asset that will mature to 2,50,000 EUR	$\frac{\text{EUR } 2,50,000}{1 + 1.75\%}$	EUR 2,45,700
Borrow GBP loan with which we can create EUR deposit of 2,45,700		GBP 1,23,096

Known component = GBP 2,45,700; Unknown component = ? $\text{GBP} = \text{EUR} \times \text{ASK} \left(\frac{\text{GBP}}{\text{EUR}} \right); \text{GBP} = 2,45,700 \times \left(\frac{1}{1.996} \right)$		
Borrow GBP loan and create EUR deposit		
Day 180		
Redeem EUR deposit along with interest and pay supplier		EUR 2,50,000
GBP repayment along with interest @ 3.05%	1,23,096 + 3.05%	GBP 1,26,850

WN 3: Lead Payment:

Particulars	Calculation	Amount
Day 0:		
Borrow GBP loan with which we can get EUR 2,50,000 and pay supplier Known component = GBP 2,50,000; Unknown component = ? $\text{GBP} = \text{EUR} \times \text{ASK} \left(\frac{\text{GBP}}{\text{EUR}} \right); \text{GBP} = 2,50,000 \times \left(\frac{1}{1.996} \right)$		GBP 1,25,251
Day 180		
GBP repayment along with interest @ 3.05%	1,25,251 + 3.05%	GBP 1,29,071

Evaluation of hedges: The relative costs of the three hedges can be compared since they have been referenced to the same point in time, i.e. six months in the future. The most expensive hedge is the lead payment, while the cheapest is the forward market hedge. Using the forward market to hedge the account payable currency risk can therefore be recommended.

100. Determination of financing currency [May 2020 MTP, Nov 2018, Jan 2021, May 2021 MTP]

An Indian Company obtains the following quotes (Rs./USD):

- ❖ Spot Rate 35.90/36.10
- ❖ 3 months forward rate 36.00/36.25
- ❖ 6 months forward rate 36.10/36.40

The company needs \$ funds for six months. Determine whether the company should borrow in USD or INR. Interest rates are:

- ❖ 3 months interest rate : INR:12%, USD:6%
- ❖ 6 months interest rate : INR:11.50%, USD:5.5%

Also determine what should be the rate of interest after 3-months to make the company indifferent between 3-months borrowing and 6-months borrowing in the case of:

- i. Rupee Borrowing
- ii. Dollar Borrowing

Note: For the purpose of calculation you can take the units of dollar and rupee as 100 each.

Answer:**WN 1: Decision making on borrowing currency:****Computation of outflow if the borrowing is in USD:**

Particulars	Calculation	Amount
USD borrowing on day 0		USD 100
Add: Interest for 6 months	$100 \times 5.5\% \times 6/12$	USD 2.75
Total payment on Month 6		USD 102.75
6 month forward rate		36.40
Total outflow in INR	102.75×36.40	Rs.3,740.10

Computation of outflow if borrowing is in INR:

Particulars	Calculation	Amount
USD needed on Day 0		USD 100
INR loan taken on day 0	100×36.10	Rs.3,610
Add: Interest for 6 months	$3,610 \times 11.50\% \times 6/12$	Rs.207.58
Total payment on Month 6		Rs.3,817.58

Conclusion: Since cash outflow is lower in USD borrowing, the company should opt for USD borrowing.

WN 2: Computation of indifferent interest rate for month 3 to month 6 (3x6 FRA):**INR borrowing:**

Interest rate for 3 months = 12.00%
Interest rate for 6 months = 11.50%
$(1 + \text{Int rate for 3 months}) \times (1 + \text{Interest rate for 3 to 6}) = (1 + \text{Int rate for 6 months})$
$(1 + 3\%) \times (1 + \text{Interest rate for 3 to 6}) = (1 + 5.75\%)$
$(1 + \text{Interest rate for 3 to 6}) = \frac{(1 + 5.75\%)}{1 + 3\%}$
Interest rate for 3 to 6 = 2.67% for 3 months (or) 10.68% per annum

USD borrowing:

Interest rate for 3 months = 6.00%
Interest rate for 6 months = 5.50%
$(1 + \text{Int rate for 3 months}) \times (1 + \text{Interest rate for 3 to 6}) = (1 + \text{Int rate for 6 months})$
$(1 + 1.5\%) \times (1 + \text{Interest rate for 3 to 6}) = (1 + 2.75\%)$
$(1 + \text{Interest rate for 3 to 6}) = \frac{(1 + 2.75\%)}{1 + 1.5\%}$
Interest rate for 3 to 6 = 1.23% for 3 months (or) 4.92% per annum

101. Money Market Hedge Versus Forward Contract [Nov 2019]:

H Ltd. is an Indian firm exporting handicrafts to North America. All the exports are invoiced in US\$. The firm is considering the use of money market or forward market to cover the receivable of \$50,000 expected to be realized in 3 months time and has the following information from its banker:

Particulars	Exchange Rate
Spot	Rs.72.65/73
3-month forward	Rs.72.95/73.40

The borrowing rates in US and India are 6 % and 12% p.a. and the deposit rates are 4% and 9% p.a. respectively.

(i) Which option is better for H Ltd. ?

(ii) Assume that H Ltd. anticipates the spot exchange rate in 3-months time to be equal to the current 3-months forward rate. After 3-months the spot exchange rate turned out to be Rs./\$: 73/73.42. What is the foreign exchange exposure and risk of H Ltd.?

Answer:**WN 1: Computation of inflow under forward contract:**

- 3 months forward rate = Rs.72.95/73.40 per USD
- INR inflow at end of M3 = $50,000 \times 72.95 = \text{Rs.}36,47,500$

WN 2: Computation of inflow in case of Money Market Hedge:

- The company has foreign currency (USD) asset and hence has to create USD loan for money market hedge

Particulars	Calculation	Amount
Day 0		
1. Amount of USD loan to be taken	$\frac{50,000}{1 + 1.5\%}$	USD 49,261.08
2. Conversion of USD into INR	$49,261.08 \times 72.65$	INR 35,78,817
3. Create INR deposit for 3 months at 9% per annum		INR 35,78,817
Month 3		
4. Receive money from customer and repay loan		USD 50,000
5. Redeem INR deposit with interest	$35,78,817 + 2.25\%$	INR 36,59,340

Conclusion: The company should go with money market hedge option as the inflow is higher under MMH.

WN 3: Computation of foreign exchange exposure risk:

Particulars	Calculation
Expected realization considering future spot rate ($50,000 \times 72.95$)	36,47,500
Actual realization considering actual spot rate ($50,000 \times 73$)	36,50,000
Gain due to foreign exchange risk	2,500

102. Spot vs Non-deliverable forward contract [May 2021 MTP]

On 1st February 2020, XYZ Ltd. a laptop manufacturer imported a particular type of Memory Chips from SKH Semiconductor of South Korea. The payment is due in one month from the date of Invoice, amounting to 1190 Million South Korean Won (SKW). Following Spot Exchange Rates (1st February) are quoted in two different markets:

USD/INR	75.00/75.50	in Mumbai
USD/SKW	1190.00/1190.75	in New York

Since hedging of Foreign Exchange Risk was part of company's strategic policy and no contract for hedging in SKW was available at any in-shore market, it approached an off-shore NonDeliverable Forward (NDF) Market for hedging the same risk.

In NDF Market a dealer quoted one-month USD/ SKW at 1190.00/1190.50 for notional amount of USD 1,000,000 to be settled at reference rate declared by Bank of Korea. After 1 month (1st March 2020) the dealer agreed for SKW 1185/ USD as rate for settlement and on the same day the Spot Rates in the above markets were as follows:

USD/INR	75.50/75.75	in Mumbai
USD/SKW	1188.00/1188.50	in New York

Analyze the position of company under each of the following cases, comparing with Spot Position of 1st February:

- (i) Do Nothing.
- (ii) Opting for NDF Contract.

Note: Both Rs./ SKW Rate and final payment (to be computed in Rs. Lakh) to be rounded off upto 4 decimal points

Answer:

Note: The rates have been interpreted as INR/USD and SKW/USD as per current exchange rates

WN 1: Analysis of No-hedge scenario:

Outflow on Feb 1:

- ❖ Known component = 11,900 Lacs SKW
- ❖ Unknown component = ? INR

$INR = SKW \times \left(\frac{INR}{SKW} \right)$
$INR = SKW \times ASK \left(\frac{INR}{SKW} \right)$
$ASK \left(\frac{INR}{SKW} \right) = ASK \left(\frac{INR}{USD} \times \frac{USD}{SKW} \right)$
$ASK \left(\frac{INR}{SKW} \right) = 75.50 \times \left(\frac{1}{1,190} \right) = 0.0634$
$INR = 11,900 \times 0.0634 = INR 754.4600 \text{ Lacs}$

Outflow on Mar 1:

- ❖ Known component = 11,900 Lacs SKW
- ❖ Unknown component = ? INR

$INR = SKW \times \left(\frac{INR}{SKW} \right)$
$INR = SKW \times ASK \left(\frac{INR}{SKW} \right)$
$ASK \left(\frac{INR}{SKW} \right) = ASK \left(\frac{INR}{USD} \times \frac{USD}{SKW} \right)$
$ASK \left(\frac{INR}{SKW} \right) = 75.75 \times \left(\frac{1}{1,188} \right) = 0.0638$
$INR = 11,900 \times 0.0638 = INR 759.2200 \text{ Lacs}$
Loss under no-hedge scenario = 754.4600 lacs – 759.2200 lacs
Loss under no-hedge scenario = INR 4.7600 lacs

WN 2: Analysis of Non-deliverable forward contract:

- Under a forward contract the delivery is normally made and hence the settlement at the end of contract happens by delivery of foreign currency
- However, in case of NDF, the delivery will not happen and hence from analysis point of view it will be same as futures. It will involve profit/loss on NDF position and actual settlement will happen at spot rate

Note 1: NDF settlement:

- Investor has entered into a notional contract for 10,00,000 USD. We are planning to buy SKW and hence we will be selling USD

Date	Position	Action	Reference Date	Rate
Feb 1	Original Position	Sell (BID)	Mar 1	SKW 1,190/USD
Mar 1	Opposite Position	Buy (ASK)	Mar 1	(SKW 1,185/USD)
Profit per USD				SKW 5.00/USD
Total Profit (5.00 x 10,00,000)				SKW 50,00,000
Conversion of Profit into USD				USD 4,219
$\left(50,00,000 \times \frac{1}{1,185}\right)$ (Using settlement rate)				

Note 2: Final payment:**Outflow on Mar 1:**

Outflow for 11,900 lacs SKW = INR 759.2200 lacs (WN 1)
NDF Profit = USD 4,219 x 75.50 = INR 3.1853 lacs
Net cash outflow = 759.2200 – 3.1853 = 756.0347 lacs
Loss under NDF scenario = 754.4600 lacs – 756.0347 lacs
Loss under no-hedge scenario = INR 1.5747 lacs

Decision: Since Exchange Loss is less in case of NDF same can be opted for.

Chapter 11 – International Financial Management**1. International capital budgeting [Nov 2019 RTP, Nov 2006, May 2018 MTP, Nov 2015 MTP, Nov 2016 MTP, May 2013 RTP, SM]**

ABC Ltd. is considering a project in US, which will involve an initial investment of USD1,10,00,000. The project will have 5 years of life. Current spot exchange rate is Rs.48 per US \$. The risk-free rate in US is 8% and the same in India is 12%. Cash inflow from the project is as follows:

Year	Cash inflow
1	US\$20,00,000
2	US\$25,00,000
3	US\$30,00,000
4	US\$40,00,000
5	US\$50,00,000

Required rate of return on this project is 14%.

- ❖ Calculate the NPV of the project using foreign currency approach.
- ❖ Re-calculate the NPV of the project using home currency approach

Answer:

WN 1: Computation of required rate of return in USD:

- It is assumed that required rate of return of 14% is INR return
- Risk premium of the project is computed as under:

$$(1 + R_f) \times (1 + \text{risk premium}) = (1 + \text{risky rate})$$

$$(1 + 0.12) \times (1 + \text{risk premium}) = (1 + 0.14)$$

$$(1 + \text{risk premium}) = \frac{1.14}{1.12} = 1.0179; \text{Risk premium} = 0.0179 \text{ (or) } 1.79\%$$

- Required return in USD is computed as under:

$$(1 + R_f) \times (1 + \text{risk premium}) = (1 + \text{risky rate})$$

$$(1 + 0.08) \times (1 + 0.0179) = (1 + \text{risky rate})$$

$$(1 + \text{risky rate}) = 1.0993; \text{Risky rate} = 0.0993 \text{ (or) } 9.93\%$$

- Hence the required return for USD cash flows is 9.93% and return for INR cash flows is 14%

WN 2: Computation of NPV using foreign currency approach:

- ABC Limited is assumed to be based out of India and hence foreign currency is USD

Year	Cash flow	PVF @ 9.93%	DCF
0	-1,10,00,000	1.000	-1,10,00,000
1	20,00,000	0.910	18,20,000
2	25,00,000	0.827	20,67,500
3	30,00,000	0.753	22,59,000
4	40,00,000	0.685	27,40,000
5	50,00,000	0.623	31,15,000
NPV in USD			10,01,500

WN 3: Computation of NPV using home currency approach:

- Home currency is INR. The same can be computed as under:
- NPV in INR = NPV in USD x Exchange rate
- NPV in INR = 10,01,500 x 48.00 = Rs.480.72 lacs

2. Capital budgeting with withholding taxes [Jan 2021] [Concept Revision] [Homework]

X Ltd., an Indian company, is considering a proposal to make an investment of USD 1,65,00,000 in Latin America. The project will have a life of 5 years. The current spot exchange rate is INR/USD 72. All investments and revenues will occur in USD. The USD and INR risk free rates are 8% and 12% respectively. The following cash flow is expected from the project

Year	Cash inflow (USD)
1	30,00,000
2	37,50,000
3	45,00,000
4	60,00,000

5	75,00,000

Assume required rate of return on the project as 14%.

You are required to calculate:

- The viability of the project using foreign currency approach.
- What will be the impact if there is a withholding tax of 10% applicable on the project.

Answer:

WN 1: Computation of required rate of return in USD:

- It is assumed that required rate of return of 14% is INR return
- Risk premium of the project is computed as under:
 $(1 + R_f) \times (1 + \text{risk premium}) = (1 + \text{risky rate})$
 $(1 + 0.12) \times (1 + \text{risk premium}) = (1 + 0.14)$
 $(1 + \text{risk premium}) = \frac{1.14}{1.12} = 1.0179$; **Risk premium = 0.0179 (or) 1.79%**
 - Required return in USD is computed as under:
 $(1 + R_f) \times (1 + \text{risk premium}) = (1 + \text{risky rate})$
 $(1 + 0.08) \times (1 + 0.0179) = (1 + \text{risky rate})$
 $(1 + \text{risky rate}) = 1.099$; Risky rate = 0.099 (or) 9.90%
 - Hence the required return for USD cash flows is 9.90% and return for INR cash flows is 14%

WN 2: Computation of NPV using foreign currency approach:

- X Limited is assumed to be based out of India and hence foreign currency is USD

Year	Cash flow	PVF @ 9.90%	DCF
0	-1,65,00,000	1.000	-1,65,00,000
1	30,00,000	0.910	27,30,000
2	37,50,000	0.828	31,05,000
3	45,00,000	0.753	33,88,500
4	60,00,000	0.686	41,16,000
5	75,00,000	0.624	46,80,000
NPV in USD			15,19,500

- Company can go ahead with project as NPV is positive

WN 3: Computation of revised NPV with withholding tax of 10%:

Particulars	Calculation	Amount
PV of inflows [WN 2]		1,80,19,500
Less: Withholding tax @ 10%		-18,01,950
Revised cash inflows		1,62,17,550
Less: Cost of project		-1,65,00,000
NPV in USD		-2,82,450

- Project is not viable as the same has negative NPV

3. Home currency and foreign currency approach [Dec 2021, May 2024 MTP]

DK Ltd. is considering an investment proposal in Sri Lanka involving an initial investment of LKR 25 billion. The current spot exchange rate is INR/LKR 0.37. The risk free rate in India is 6% and the same in Sri Lanka is 5.02%. The project will generate a cash flow of LKR 5 billion in the first year. The cash flow will increase by LKR 1 billion each year for the next 4 years. The project will bind up on completion of 5 years with no salvage value.

The required rate of return for the project is 8%

- You are required to find out the investment worth of the project by (1) Home Currency Approach (2) Foreign Currency Approach
- Compare the outcome under both the approaches.

Note: Use five decimal for PVF

Answer:

WN 1: Computation of NPV under home currency approach (INR):

Note 1: Computation of forward exchange rates:

Year 0		INR 0.37/LKR

Year 1	$0.37 \times \frac{1.06}{1.052}$	INR 0.373/LKR
Year 2	$0.373 \times \frac{1.06}{1.052}$	INR 0.376/LKR
Year 3	$0.376 \times \frac{1.06}{1.052}$	INR 0.380/LKR
Year 4	$0.380 \times \frac{1.06}{1.052}$	INR 0.384/LKR
Year 5	$0.384 \times \frac{1.06}{1.052}$	INR 0.388/LKR

Note 2: Computation of NPV:

Year	LKR CF	ER	INR CF	PVF @ 8%	DCF
0	-25.00	0.370	-9.2500	1.00000	-9.2500
1	5.00	0.373	1.8650	0.92593	1.7269
2	6.00	0.376	2.2560	0.85734	1.9342
3	7.00	0.380	2.6600	0.79383	2.1116
4	8.00	0.384	3.0720	0.73503	2.2580
5	9.00	0.388	3.4920	0.68058	2.3766
NPV of Project					1.1573

Note: It is assumed that given return of 8 percent is INR return

WN 2: Computation of NPV using foreign currency approach:**Note 1: Computation of LKR Discount Rate:**

$$(1 + R_f) \times (1 + \text{risk premium}) = (1 + \text{risky rate})$$

$$(1 + 0.06) \times (1 + \text{risk premium}) = (1 + 0.08)$$

$$(1 + \text{risk premium}) = \frac{1.08}{1.06} = 1.0189; \text{Risk premium} = 0.0189 \text{ (or) } 1.89\%$$

- Required return in LKR is computed as under:

$$(1 + R_f) \times (1 + \text{risk premium}) = (1 + \text{risky rate})$$

$$(1 + 0.0502) \times (1 + 0.0189) = (1 + \text{risky rate})$$

$$(1 + \text{risky rate}) = 1.0700; \text{Risky rate} = 0.07 \text{ (or) } 7.00\%$$

Note 2: Computation of NPV in LKR:

Year	LKR CF	PVF @ 7%	DCF
0	-25.00	1.00000	-25.0000
1	5.00	0.93457	4.6729
2	6.00	0.87344	5.2406
3	7.00	0.81630	5.7141
4	8.00	0.76290	6.1032
5	9.00	0.71299	6.4169
NPV in LKR			3.1477

Comparison of NPV:

$$\text{NPV in INR} = \text{NPV in LKR} \times \text{Current Spot rate}$$

$$\text{NPV in INR} = 3.1477 \times 0.3700 = \text{INR 1.1646 billion}$$

Conclusion:

NPV is positive and hence project is worth investing.

4. Capital Budgeting [Jan 2021, May 2023 MTP]

A proposed foreign investment involves creation of a plant with an annual output of 1 million units. The entire production will be exported at a selling price of USD 10 per unit. At the current rate of exchange dollar cost of local production equals to USD 6 per unit. Dollar is expected to decline by 10% or 15%. The change in local cost of production and probability from the expected current level will be as follows:

Decline in value of USD (%)	Reduction in local cost of production (USD/unit)	Probability
0	-	0.40
10	0.30	0.40

15	0.15 [Additional Reduction]	0.20

The plant at the current rate of exchange will have a depreciation of USD 1 million annually. Assume local Tax rate as 30%.

You are required to find:

- Annual Cash Flow After Tax (CFAT) under all the different scenarios of exchange rate.
- Expected value of CFAT assuming no repatriation of profits.
- Viability of the investment proposal assuming an initial investment of USD 25 million on plant and working capital with a required rate of return of 11% on investment and on the basis of CFAT arrived under option (ii). The CFAT will grow @ 3% per annum in perpetuity.

Answer:

WN 1: Computation of CFAT under different scenarios:

Particulars	Scenario 1	Scenario 2	Scenario 3
Annual output	10,00,000	10,00,000	10,00,000
Selling price	10.00	10.00	10.00
Cost price	-6.00	-5.70 [6 - 0.30]	-5.55 [5.70 - 0.15]
Gross profit per unit	4.00	4.30	4.45
Total gross profit	40,00,000	43,00,000	44,50,000
Less: Depreciation	-10,00,000	-9,00,000 [10,00,000 - 10%]	-8,50,000 [10,00,000 - 15%]
Profit before tax	30,00,000	34,00,000	36,00,000
Less: Tax @ 30%	-9,00,000	-10,20,000	-10,80,000
Profit after tax	21,00,000	23,80,000	25,20,000
Add: Depreciation	10,00,000	9,00,000	8,50,000
Cash flow after taxes	31,00,000	32,80,000	33,70,000

WN 2: Computation of expected value of CFAT:

- Expected CFAT = $(31,00,000 \times 0.40) + (32,80,000 \times 0.40) + (33,70,000 \times 0.20)$
- Expected CFAT = USD 32,26,000

WN 3: Analysis of viability of investment proposal:

Particulars	Calculation	Amount
PV of inflow [growing perpetuity]	$\frac{(32,26,000 + 3\%)}{11\% - 3\%}$	4,15,34,750
Less: Investment cost		-2,50,00,000
NPV of Project		1,65,34,750

- Since NPV is positive, project is viable

Note: It is assumed that 32,26,000 is current CFAT and hence growth of 3 percent is applied

5. International capital budgeting [Nov 2018 MTP, Nov 2015, May 2020 RTP, Nov 2022, SM] [Concept Revision]

XYZ Ltd., a company based in India, manufactures very high quality modern furniture and sells to a small number of retail outlets in India and Nepal. It is facing tough competition. Recent studies on marketability of products have clearly indicated that the customer is now more interested in variety and choice rather than exclusively and exceptional quality. Since the cost of quality wood in India is very high, the company is reviewing the proposal for import of woods in bulk from Nepalese Supplier.

The estimate of net Indian (Rs) and Nepalese Currency (NC) cash flows for this proposal is shown below:

Net cash Flows (in millions)

Year	0	1	2	3
NC	-25.000	2.600	3.800	4.100
INR	0	2.869	4.200	4.600

The following information is relevant:

- XYZ Ltd evaluates all investments by using a discount rate of 9% p.a All Nepalese customers are involved in NC. NC cash flows are converted to Indian (Rs) at the forward rate and discounted at the Indian rate.

- b) (ii) Inflation rates in Nepal and India are expected to be 9% and 8% p.a respectively. The current exchange rate is Rs. = NC 1.6

Assuming that you are the finance manager of XYZ Ltd. Calculate the net present value (NPV) and modified internal rate of return (MIRR) of the proposal.

Answer:

WN 1: Computation of forward rates using PPT:

Year	Calculation	Rate
0		NC 1.6000/INR
1	$\frac{1.60 \times 1.09}{1.08}$	NC 1.6148/INR
2	$\frac{1.6148 \times 1.09}{1.08}$	NC 1.6298/INR
3	$\frac{1.6298 \times 1.09}{1.08}$	NC 1.6449/INR

WN 2: Computation of project cash flows in INR:

Year	INR CF	NCF	ER	Equivalent INR CF	Total INR CF
0	-	-2,50,00,000	1.6000	-1,56,25,000	-1,56,25,000
1	28,69,000	26,00,000	1.6148	16,10,107	44,79,107
2	42,00,000	38,00,000	1.6298	23,31,574	65,31,574
3	46,00,000	41,00,000	1.6449	24,92,553	70,92,553

WN 3: Computation of NPV in INR:

Year	Cash flow	PVF	DCF
0	-1,56,25,000	1.000	-1,56,25,000
1	44,79,107	0.917	41,07,341
2	65,31,574	0.842	54,99,585
3	70,92,553	0.772	54,75,451
Project NPV in INR			-5,42,623

WN 4: Computation of modified IRR:

Part 1: Calculation of maturity cash flow with reinvestment rate of 9% (cost of capital):

Year	Cash flow	Reinvestment period	FVF @ 9%	Maturity cash flow
1	44,79,107	2	1.1881	53,21,627
2	65,31,574	1	1.0900	71,19,416
3	70,92,553	0	1.0000	70,92,553
Maturity Cash Flow				1,95,33,596

Part 2: Computation of Modified IRR:

Year	Cash flow	PVF @ 8%	DCF	PVF @ 7%	DCF
0	-1,56,25,000	1.000	-1,56,25,000	1.000	-1,56,25,000
3	1,95,33,596	0.794	1,55,09,675	0.816	1,59,39,414
NPV			-1,15,325		3,14,414

- Project gives positive NPV at discount rate of 7 percent and negative NPV at discount rate of 8%

$$\text{Modified IRR} = L_1 + \frac{\text{NPV at } L_1}{\text{NPV at } L_1 - \text{NPV at } L_2} \times (L_2 - L_1)$$

$$\text{Modified IRR} = 7 + \frac{3,14,414}{3,14,414 - (-1,15,325)} \times (8 - 7) = 7 + 0.73 = 7.73\%$$

- Modified IRR = 7.73%**

6. International capital budgeting [May 2018 RTP, Nov 2007, May 2015 MTP, Nov 2012 RTP, Nov 2022 RTP, SM]

A USA based company is planning to set up a software developing unit in India. Software development at the Indian unit will be bought back by the US parent at a transfer price of US \$ 10 million. The unit will

remain in existence in India for one year; the software is expected to get developed within this time frame. The US based company will be subjected to corporate tax of 30 per cent and with – holding tax of 10% in India and will not be eligible for tax credit in the US. The software developed will be sold in the US market for US \$ 12.0 million. Other establishments are as follows

Rent for fully furnished unit with necessary hard ware in India	Rs.15,00,000
Man power cost (80 software professional will be working for 10 hours each day)	Rs. 400 per man hour
Administrative and other costs	Rs. 12,00,000

Advise the US Company on financial viability of the project. The rupee-dollar rate is Rs.48/\$.

Answer:

Computation of cost of Developing the Project:

Particulars	Calculation	Amount (in lacs)
Revenues	100 x 48	4,800.00
Less: Costs		
Rent		-15.00
Manpower cost	$(365 \times 10 \times 400 \times 80) / 1,00,000$	-1,168.00
Admin cost		-12.00
Profit before tax		3,605.00
Less: Tax @ 30%	$3,605 \times 30\%$	-1,081.50
Profit after tax		2,523.50
Less: Withholding tax @ 10%	$2,523.50 \times 10\%$	-252.35
Amount repatriated		2,271.15
Cost of development	Amount paid – amount repatriated 4,800.00 – 2,271.15	2,528.85
Cost of development (USD)	$2,528.85 / 48$	52.6844

- The cost of development is therefore USD 5.26844 million and the same would be sold for USD 12 million. Hence the project is financially viable

7. Withholding taxes – Eligible for tax credit [Nov 2021 RTP, SM] [Homework]

A USA based company is planning to set up a software developing unit in India. Software development at the Indian unit will be bought back by the US parent at a transfer price of US \$ 10 million. The unit will remain in existence in India for one year; the software is expected to get developed within this time frame. The US based company will be subjected to corporate tax of 30 per cent and with – holding tax of 10% in India and will be eligible for tax credit in India. The software developed will be sold in the US market and many companies are ready to acquire the same. Other estimates are as follows

Rent for fully furnished unit with necessary hard ware in India	Rs.18,75,000
Man power cost (80 software professional will be working for 10 hours each day)	Rs. 500 per man hour
Administrative and other costs	Rs. 15,00,000

Advise the US Company the minimum amount it should charge from the prospective buyer. The rupee-dollar rate is Rs.60/\$.

Answer:

Computation of cost of Developing the Project:

Particulars	Calculation	Amount (in lacs)
Revenues	100 x 60	6,000.000
Less: Costs		
Rent		-18.750
Manpower cost	$(365 \times 10 \times 500 \times 80) / 1,00,000$	-1,460.000
Admin cost		-15.000
Profit before tax		4,506.250
Less: With-holding tax @ 10%	$4,506.25 \times 10\%$	-450.625
Earnings after with-holding tax		4,055.625
Less: Tax @ 30%	$4,055.625 \times 30\% - 450.625$ (with-holding tax is eligible for credit)	-901.250
Amount repatriated		3,154.375
Cost of development	Amount paid – amount repatriated 6,000.00 – 3,154.375	2,845.625

Cost of development (USD)	2,845.625/60	47,42,708

The cost of development is USD 47,42,708 and hence the minimum amount to be charged would be the same.

8. International capital budgeting [Nov 2018 MTP, May 2013, May 2018 MTP, Nov 2014 MTP, Nov 2015 RTP, Nov 2023 MTP, SM]

XY Limited is engaged in large retail business in India. It is contemplating for expansion into a country of Africa by acquiring a group of stores having the same line of operation as that of India. The exchange rate for the currency of the proposed African country is extremely volatile. Rate of inflation is presently 40% a year. Inflation in India is currently 10% a year. Management of XY Limited expects these rates likely to continue for the foreseeable future. Estimated projected cash flows, in real terms, in India as well as African country for the first three years of the project are as follows:

Particulars	Year -0	Year-1	Year-2	Year-3
Cash flows in INR ('000s)	-50,000	-1,500	-2,000	-2,500
Cash flows in African Rands ('000s)	-2,00,000	+50,000	+70,000	+90,000

XY Ltd. Assumes the year 3 nominal cash flows will continue to be earned each year indefinitely. It evaluates all investments using nominal cash flows and a nominal discounting rate. The present exchange rate is African Rand 6 to Rs. 1. You are required to calculate the net present value of the proposed investment considering the following:

African Rand cash flows are converted into rupees and discounted at a risk adjusted rate. All cash flows for these projects will be discounted at a rate of 20% to reflect its high risk.

Answer:

WN 1: Computation of forward rates using PPT:

Year	Calculation	Rate
0		Rand 6.00/INR
1	$\frac{6.00 \times 1.40}{1.10}$	Rand 7.64/INR
2	$\frac{7.64 \times 1.40}{1.10}$	Rand 9.72/INR
3	$\frac{9.72 \times 1.40}{1.10}$	Rand 12.37/INR

WN 2: Computation of nominal cash flows by compounding at inflation rate:

(in '000s)

Year	African Rand (40%)		INR (10%)	
	Real	Nominal	Real	Nominal
0	-2,00,000	-2,00,000	-50,000	-50,000
1	50,000	70,000	-1,500	-1,650
2	70,000	1,37,200	-2,000	-2,420
3	90,000	2,46,960	-2,500	-3,328

Nominal Cash flow = Real cash flow x (1 + Inflation rate)ⁿ

WN 3: Computation of project cash flows in INR:

Year	INR CF	Rand CF	ER	Equivalent INR CF	Total INR CF
0	-50,000	-2,00,000	6.00	-33,333	-83,333
1	-1,650	70,000	7.64	9,162	7,512
2	-2,420	1,37,200	9.72	14,115	11,695
3	-3,328	2,46,960	12.37	19,964	16,636

- Year 3 cash flows will be earned every year and hence the same takes the character of a perpetuity.

$$\text{Valuation of perpetuity (Y3)} = \frac{\text{Y4 cash flow}}{K_0 - \text{Growth}} = \frac{16,636}{20\% - 0\%} = \text{Rs. 83,180}$$

WN 4: Computation of NPV in INR:

Year	Cash flow	PVF @ 20%	DCF
0	-83,333	1.000	-83,333
1	7,512	0.833	6,257

2	11,695	0.694	8,116
3	99,816	0.579	57,793
Project NPV in INR			-11,167

- Project will get rejected as the same has negative NPV

9. International capital budgeting [Nov 2018 MTP, Nov 2018 RTP, Nov 2019, May 2017 RTP, July 2021, Dec 2021, May 2023 RTP, May 2020 MTP, Nov 2022 MTP, Nov 2024 MTP, SM] [Concept Revision]

A multinational company is planning to set up a subsidiary company in India (where hitherto it was exporting) in view of growing demand for its product and competition from other MNCs. The initial project cost (consisting of Plant and Machinery including installation) is estimated to be US\$ 500 million. The net working capital requirements are estimated at US\$ 50 million. The company follows straight line method of depreciation. Presently, the company is exporting two million units every year at a unit price of US\$ 80, its variable cost per unit being US\$ 40. The Chief Financial Officer has estimated the following operating cost and other data in respect of proposed project:

- ❖ Variable operating cost will be US \$ 20 per unit of production;
- ❖ Additional cash fixed cost will be US \$ 30 million p.a. and project's share of allocated fixed cost will be US \$ 3 million p.a. based on principle of ability to share;
- ❖ Production capacity of the proposed project in India will be 5 million units;
- ❖ Expected useful life of the proposed plant is five years with no salvage value
- ❖ Existing working capital investment for production & sale of two million units through exports was US \$ 15 million;
- ❖ Export of the product in the coming year will decrease to 1.5 million units in case the company does not open subsidiary company in India, in view of the presence of competing MNCs that are in the process of setting up their subsidiaries in India;
- ❖ Applicable Corporate Income Tax rate is 35%, and
- ❖ Required rate of return for such project is 12%.

Assuming that there will be no variation in the exchange rate of two currencies and all profits will be repatriated, as there will be no withholding tax, estimate Net Present Value (NPV) of the proposed project in India.

Answer:

WN 1: Initial outflow:

Particulars	Amount (million USD)
Capital expenditure	-500.00
Working capital (50 - 15)	-35.00
Initial outflow	-535.00

WN 2: In-between cash flows (million USD)

Particulars	Existing	Revised
Units sold	1.50	5.00
Revenues	120	400
Less: Variable cost	-60	-100
Less: Fixed cost	0	-30
PBDT	60	270
Less: Depreciation	0	-100
PBT	60	170
Less: Tax @ 35%	-21	-59.50
PAT	39	110.50
Add: Depreciation	0	100.00
CFAT	39	210.50

- Incremental CFAT = 210.50 - 39 = USD 171.50 million

WN 3: Terminal Cash flow:

Particulars	Amount (million USD)
Net salvage value	0.00

Recapture of working capital (50 – 15)	35.00
Terminal flow	35.00

WN 4: Computation of NPV:

Year	Cash flow	PVF @ 12%	DCF
0	-535.00	1.000	-535.00
1 to 5	171.50	3.605	618.26
5	35.00	0.567	19.85
Project NPV			103.11

- The company should go ahead with the project as the same has resulted in positive NPV of USD 103.11 million

10. International Capital Budgeting (Nov 2023 MTP):**ICAI Question:**

VK Ltd. is an Indian company which is planning to set up a manufacturing plant through its subsidiary in the small country Farland, (where hitherto it was exporting) in view of growing demand for its product and competition from other MNCs. The currency of Farland is the Farroh (Fr.).

An initial investment of Fr. 80 million in plant and machinery would be required. In addition to that the initial investment in working capital of Fr. 6 million would be also required which shall be financed through a loan from a local bank of Farland, at interest rate of 10% p.a. The working capital shall also be subject to inflation. At the end of 5 years, the subsidiary would be taken over by the Govt. of Farland for a price of Fr. 2 million. The part of the proceeds would be used to pay off the bank loan.

It is expected that subsidiary shall produce Net Cash Flows from Operations of Fr. 30 million per year at current price level over the five-year period, before allowing for Farland inflation of 8% per year. Depreciation on Plant and Machinery shall be charged at 20% per year on straight line basis. As a result of setting up the subsidiary, VK Ltd. expects to lose after-tax export income from Farland of INR 8,00,000 per year in current price terms, before allowing for India inflation of 3%. Profits in Farland are taxed at a rate of 20% after allowing deduction for interest and depreciation. All after-tax cash profits are remitted to the India at the end of each year. Indian tax @ 30% is charged on profit earned, but due to tax treaty between Farland and the India the tax paid in Farland is allowed to be set off against any India Tax liability. Taxation is paid in the year in which the liability arises. VK Ltd. requires foreign investments to be discounted at 12%. The current exchange rate is Fr.2.5/INR and the Farroh is expected to depreciate against INR by 5% per year. Advise should VK Ltd. undertake the investment in Farland or not.

Note:

- Present Figures in thousands multiple
- Round off all calculations.

Modified question:

Farroh is expected to depreciate against INR by 5% per year should be replaced with **INR is expected to appreciate by 5% per year**

Answer:**WN 1: Initial outflow:**

Particulars	Amount (in Fr '000s)
Capital Expenditure	-80,000
Working capital	-6,000
Loan taken	6,000
Initial outflow	-80,000

WN 2: In-between flows/Terminal flow

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
PBDT	32,400	34,992	37,791	40,815	44,080
Less: Interest (6,000 x 10%)	-600	-600	-600	-600	-600
Less: Depreciation	-16,000	-16,000	-16,000	-16,000	-16,000

Profit before tax	15,800	18,392	21,191	24,215	27,480
Less: Farland tax @ 20%	-3,160	-3,678	-4,238	-4,843	-5,496
Profit after tax	12,640	14,714	16,953	19,372	21,984
Add: Depreciation	16,000	16,000	16,000	16,000	16,000
Less: Loan repayment					-6,000
Less: Increase in WC	-480	-518	-560	-605	-653
Add: Sale of subsidiary					2,000
Net cash flows in FR	28,160	30,196	32,393	34,767	33,331

- **PBDT:** Value of PBDT before inflation is FR 30 million (30,000 thousands). The same will increase at the rate of 8% every year
- **Increase in WC:** First year = $6,000 \times 8\% = \text{FR } 480$; Second year increase = $480 + 8\% = 518$ and so on
- **Terminal flow:** Sale of subsidiary for 2 million is the terminal inflow. There is no recapture of working capital or net salvage value in this question

WN 3: Computation of Expected Exchange Rates:

Particulars	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
PBDT	2.50	$2.50 \times 1.05 = 2.63$	$2.50 \times 1.05^2 = 2.76$	$2.50 \times 1.05^3 = 2.89$	$2.50 \times 1.05^4 = 3.04$	$2.50 \times 1.05^5 = 3.19$

WN 4: Computation of tax paid in India:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
PBT (Fr)	15,800	18,392	21,191	24,215	27,480
Tax @ 10%	1,580	1,839	2,119	2,422	2,748
Exchange rate	2.63	2.76	2.89	3.04	3.19
Tax outflow in INR	601	666	733	797	861

- **Note:** Farland has a tax rate of 20%, and similarly, India imposes a tax rate of 30%. Consequently, the company will be subject to an additional 10% tax in India, considering the credit allowed for taxes paid in Farland

WN 5: Computation of cash flows in INR

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Amount repatriated	28,160	30,196	32,393	34,767	33,331
Exchange rate	2.63	2.76	2.89	3.04	3.19
Cash flow in INR	10,707	10,941	11,209	11,437	10,449
Less: Tax paid in India	-601	-666	-733	-797	-861
Net cash flow	10,106	10,275	10,476	10,640	9,588
Less: Export income loss	-824	-849	-874	-900	-927
Parent cash flow	9,282	9,426	9,602	9,740	8,661

- **Note:** The parent company is presently generating export income amounting to INR 800,000. This figure is anticipated to grow at a rate of 3 percent annually, representing the opportunity cost associated with establishing the new plant

WN 6: Computation of NPV

Year	Cash flow	PVF @ 12%	DCF
0	-32,000	1	-32,000
1	9,282	0.893	8,289
2	9,426	0.797	7,513
3	9,602	0.712	6,837
4	9,740	0.636	6,195
5	8,661	0.567	4,911
NPV			1,745

Decision: NPV of the project is positive and hence the same should be accepted

Mr. Vishwas, a friend of Mr. Pramod who is one of the Directors of Ashirwad Limited, is a citizen of Mauritius. His immediate family members including his parents, born in India are residing in India. He has many friends in different parts of India, due to which he happens to visit India on frequent basis. He along with Mr. Pramod evince interest in setting up business in India and formally incorporate a company to commence their operations. Accordingly, a company is called "Aerious Private Ltd." got incorporated in Mumbai.

To start with he received a business proposal from one of his friends Nimish a consultant. It is estimated that in equivalent terms the business shall require an initial investment of MUR 100 Million and thereafter MUR 2 Million each year will be needed as working capital fund.

He wished to evaluate whether the business proposal is viable or not. The information related to exchange rate and inflation rate is as follows:

- Spot Rate for 1 Mauritian Dollar (MUR) = 1.88 Indian Rupee (INR)
- The inflation in India is 6% and in Mauritius is 5%.
- It is expected that this inflation rate will remain unchanged for the next 4 years.
- INR 8 Crore out of initial investment shall be required for setting up a plant. The useful life of the plant is 4 years. At the end of 4th year estimated salvage value of this plant shall be INR 80 lakhs. Depreciation of the plant shall be charged on the basis of straight-line method.
- 40 % of the investment shall be through debt funds from Mauritius at the cost of 10% (post tax) while remaining funds shall be arranged by him and his friends. They expect a rate of return of 12% on their funds.

Expected revenues & costs (excluding depreciation) in real term are as under:

Year	1	2	3	4
Revenues (in crores)	6.00	7.00	8.00	8.00
Costs (in crores)	3.00	4.00	4.00	4.00

Assume that applicable tax rate in India is 30%. Since there is Double tax avoidance agreement between India and Mauritius, the company is not required to pay tax in Mauritius if tax has been paid in India.

The applicable inflation rates for revenues & costs are as follows:

Year	Revenues	Costs
1	10%	12%
2	9%	10%
3	8%	9%
4	7%	8%

He wants an expert opinion for the same investment proposal. Demonstrate whether investment in this project is viable option or not.

Note:

1. Round off calculations upto 4 decimal points.
2. Show INR calculations in Crore and MUR calculations in Million.

Answer:

WN 1: Computation of forward rates using PPT:

Year	Calculation	Rate
0		INR 1.88/MUR
1	$\frac{1.88 \times 1.06}{1.05}$	INR 1.8979/MUR
2	$\frac{1.8979 \times 1.06}{1.05}$	INR 1.9160/MUR
3	$\frac{1.9160 \times 1.06}{1.05}$	INR 1.9342/MUR
4	$\frac{1.9342 \times 1.06}{1.05}$	INR 1.9526/MUR

WN 2: Capital expenditure and working capital

Year	Calculation	Rate
0	MUR 100 million $\times$ 1.88	INR 18.80 Crores
1	MUR 2 million $\times$ 1.8979	INR 0.3796 Crores

2	MUR 2 million x 1.9160	INR 0.3832 Crores
3	MUR 2 million x 1.9342	INR 0.3868 Crores
4	MUR 2 million x 1.9526	INR 0.3905 Crores

WN 3: Computation of inflation adjusted revenues:

Year	Cash flow	Inflation rate	Calculation	Inflation adjusted cash flows
1	6.00	10%	$6.00 \times (1+10\%)$	6.6000
2	7.00	9%	$7.00 \times (1+10\%) \times (1+9\%)$	8.3930
3	8.00	8%	$8.00 \times (1+10\%) \times (1+9\%) \times (1+8\%)$	10.3594
4	8.00	7%	$8.00 \times (1+10\%) \times (1+9\%) \times (1+8\%) \times (1+7\%)$	11.0845

WN 4: Computation of inflation adjusted outflows:

Year	Cash flow	Inflation rate	Calculation	Inflation adjusted outflows
1	3.00	12%	$3.00 \times (1+12\%)$	3.3600
2	4.00	10%	$4.00 \times (1+12\%) \times (1+10\%)$	4.9280
3	4.00	9%	$4.00 \times (1+12\%) \times (1+10\%) \times (1+9\%)$	5.3715
4	4.00	8%	$4.00 \times (1+12\%) \times (1+10\%) \times (1+9\%) \times (1+8\%)$	5.8012

WN 5: Computation of cash flows after tax (in INR)

Particulars	Year 1	Year 2	Year 3	Year 4
Revenues	6.6000	8.3930	10.3594	11.0845
Less: Costs	-3.3600	-4.9280	-5.3715	-5.8012
Less: Depreciation	-1.8000	-1.8000	-1.8000	-1.8000
PBT	1.4400	1.6650	3.1879	3.4833
Less: Tax	-0.4320	-0.4995	-0.9564	-1.0450
PAT	1.0080	1.1655	2.2315	2.4383
Add: Depreciation	1.8000	1.8000	1.8000	1.8000
CFAT	2.8080	2.9655	4.0315	4.2383

WN 6: Computation of WACC:

WACC = $40\% \times 10\% + 60\% \times 12\% = 11.20\%$

WN 7: Computation of NPV:

Particulars	Year 0	Year 1	Year 2	Year 3	Year 4
Initial investment (in Rs. Cr)	-18.80				
Working capital (in Rs. Cr)		-0.3796	-0.3832	-0.3868	-0.3905
Scrap value (in Rs. Cr)					0.8000
Working capital recovered (in Rs. Cr)					1.5401
CFAT (in Rs. Cr)		2.8080	2.9655	4.0315	4.2383
Cash flow in INR Crores	-18.8000	2.4284	2.5823	3.6447	6.1879
Exchange rate	1.8800	1.8979	1.9160	1.9342	1.9526
Cash flow in MUR Millions	-100.000	12.7952	13.4776	18.8434	31.6906
PVF @ 11.20%	1.0000	0.8993	0.8087	0.7273	0.6540
Present value in MUR Millions	-100.0000	11.5067	10.8993	13.7048	20.7257

Net Present Value = - MUR 43.1635 Million

Advise: Since NPV of the project is negative the proposal is not a viable option for investment

12. International capital budgeting [Concept Revision]

An Indian company is planning to set up a subsidiary in US. The initial project cost is estimated to be US \$40 million; Working Capital required is estimated to be \$4 million. The finance manager of company estimated the data as follows:

Variable Cost of Production (Per Unit Sold) USD 2.50

Fixed cost per annum	USD 3 million
Selling Price	USD 10
Production capacity	5 million units
Expected life of Plant	5 years
Method of Depreciation	SLM
Salvage Value at the end of 5 years	NIL

The subsidiary of the Indian company is subject to 40% corporate tax rate in the US and the required rate of return of such types of project is 12%. The current exchange rate is Rs.48/US\$ and the USD is expected to appreciate by 3% per annum for next five years.

The subsidiary company shall be allowed to repatriate 70% of the CFAT every year along with the accumulated arrears of blocked funds at the end of 5 years, the withholding taxes are 10%. The blocked fund will be invested in the USA money market by the subsidiary, earning 4% (free of taxes) per year. Determine the feasibility of having a subsidiary company in the USA, assuming no tax liability in India on earnings received by the parent company from the US subsidiary.

Answer:

WN 1: Initial outflow:

Particulars	Amount (in million)
Plant and Machinery	40
Working capital	4
Total outflow in USD	44
Exchange rate	48
Total outflow in INR	2,112

WN 2: In-between flows:

Particulars	Calculation	Amount
Sales revenues	5 million x 10	50.00
Less: Variable cost	5 million x 2.5	(12.50)
Less: Fixed cost		(3.00)
Less: Depreciation		(8.00)
Profit before tax		26.50
Less: Tax @ 40%		(10.60)
Profit after tax		15.90
Add: Depreciation		8.00
CFAT		23.90
Repatriable amount	23.90 x 70%	16.73
Less: Withholding tax @ 10%	16.73 x 10%	-1.673
Amount repatriated		15.057

WN 3: Terminal cash flow:

Particulars	Amount
Non-repatriated amount of year 1 (7.17×1.04^4)	8.39
Non-repatriated amount of year 2 (7.17×1.04^3)	8.07
Non-repatriated amount of year 3 (7.17×1.04^2)	7.76
Non-repatriated amount of year 4 (7.17×1.04^1)	7.46
Normal cash flow of year 5	23.90
Total non-repatriated amount of year 1 to 4	55.58
Less: Withholding tax @ 10%	-5.56
Operating cash flow repatriable in year 5	50.02
Add: Release of working capital	4.00
Amount repatriated in year 5	54.02

WN 4: Computation of NPV:

Year	Cash flow (USD)	Exchange rate	Cash flow (INR)	PVF @ 12%	DCF
0	-44	48	-2112	1	-2112
1	15.057	49.44	744.42	0.893	664.77

2	15.057	50.92	766.7	0.797	611.06
3	15.057	52.45	789.74	0.712	562.29
4	15.057	54.02	813.38	0.636	517.31
5	54.02	55.64	3005.67	0.567	1704.21
					1947.64

Conclusion: The company should go ahead with the investment as the project generates positive NPV.

13. Computation of NPV [Dec 2021]

A US company wants to setup a manufacturing plant in India which requires an initial outlay of Rs. 8 Million. It is expected to have a useful life of 5 years with a salvage of Rs. 2 Million. The company follows straight line method of depreciation. To support additional level of activity, investment would require one-time additional working capital of Rs. 1 Million.

Since the cost of production lower in India, the variable cost of production would be Rs. 30 per unit. Additional fixed cost per annum is estimated at Rs. 0.5 Million. The company is projecting its annual sales to 80,000 units at the price of Rs. 100 per unit. Applicable tax rate to the company is 34% and its cost of capital is 8%.

Inflation rates in US and India are expected to be 8% and 9% respectively. The current exchange rate is Rs. 72 per US Dollar.

Assuming that all profit will be repatriated every year and there will be no withholding taxes, estimate the net present value of the proposed project in India and evaluate its feasibility.

Answer:

WN 1: Computation of cash flows in INR:

Step 1: Initial outflow:

Particulars	Amount
Capital expenditure	-80,00,000
Working capital	-10,00,000
Initial outflow	-90,00,000

Step 2: In-between flows:

Particulars	Amount
Revenues (80,000 x 100)	80,00,000
Less: Variable cost (80,000 x 30)	-24,00,000
Less: Fixed cost	-5,00,000
Less: Depreciation	-12,00,000
Profit before tax	39,00,000
Less: Tax @ 34%	-13,26,000
Profit after tax	25,74,000
Add: Depreciation	12,00,000
Cash flow after tax	37,74,000

Step 3: Terminal flow:

Particulars	Amount
Net salvage value	20,00,000
Recapture of Working capital	10,00,000
Terminal flow	30,00,000

WN 2: Computation of exchange rates:

Year 0		INR 72.00/USD
Year 1	$72.00 \times \frac{1.09}{1.08}$	INR 72.67/USD
Year 2	$72.67 \times \frac{1.09}{1.08}$	INR 73.34/USD
Year 3	$73.34 \times \frac{1.09}{1.08}$	INR 74.02/USD

Year 4	$74.02 \times \frac{1.09}{1.08}$	INR 74.71/USD
Year 5	$74.71 \times \frac{1.09}{1.08}$	INR 75.40/USD

WN 3: Computation of NPV in USD:

Year	INR CF	ER	USD CF	PVF @ 8%	DCF
0	-90,00,000	72.00	-1,25,000.00	1.000	-1,25,000.00
1	37,74,000	72.67	51,933.40	0.926	48,090.33
2	37,74,000	73.34	51,458.96	0.857	44,100.33
3	37,74,000	74.02	50,986.22	0.794	40,483.06
4	37,74,000	74.71	50,515.33	0.735	37,128.77
5	67,74,000	75.40	89,840.85	0.681	61,181.62
NPV of Project					1,05,984.11

Since the NPV of the project is positive, it is feasible

14. International capital budgeting (Nov 2021 MTP, SM)

Perfect Inc., a U.S. based Pharmaceutical Company has received an offer from Aidsure Ltd., a company engaged in manufacturing of drugs to cure Dengue, to set up a manufacturing unit in Baddi (H.P.), India in a joint venture.

As per the Joint Venture agreement, Perfect Inc. will receive 55% share of revenues plus a royalty @ US \$0.01 per bottle. The initial investment will be Rs.200 crores for machinery and factory. The scrap value of machinery and factory is estimated at the end of five (5) year to be Rs.5 crores. The machinery is depreciable @ 20% on the value net of salvage value using Straight Line Method. An initial working capital to the tune of Rs.50 crores shall be required and thereafter Rs.5 crores each year.

As per GOI directions, it is estimated that the price per bottle will be Rs.7.50 and production will be 24 crores bottles per year. The price in addition to inflation of respective years shall be increased by Rs.1 each year. The production cost shall be 40% of the revenues.

The applicable tax rate in India is 30% and 35% in US and there is Double Taxation Avoidance Agreement between India and US. According to the agreement tax credit shall be given in US for the tax paid in India. In both the countries, taxes shall be paid in the following year in which profit have arisen.

The Spot rate of \$ is Rs.57. The inflation in India is 6% (expected to decrease by 0.50% every year) and 5% in US. As per the policy of GOI, only 50% of the share can be remitted in the year in which they are earned and remaining in the following year.

Though WACC of Perfect Inc. is 13% but due to risky nature of the project it expects a return of 15%. Determine whether Perfect Inc. should invest in the project or not (from subsidiary point of view).

Answer:**WN 1: Initial Outflow:**

Particulars	Amount (in INR Cr)
Capital expenditure	-200.00
Working capital	-50.00
Initial outflow	-250.00

WN 2: In-between flows:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Revenues (Note 1)	118.75	132.27	145.61	158.61	171.55	
Less: Costs	-41.98	-47.36	-52.70	-57.92	-63.15	
PBDT	76.77	84.91	92.91	100.69	108.40	
Less: Depreciation (200-5)/5	-39.00	-39.00	-39.00	-39.00	-39.00	

PBT	37.77	45.91	53.91	61.69	69.40	
Less: Tax		-11.33	-13.77	-16.17	-18.51	-20.82
PAT	37.77	34.58	40.14	45.52	50.89	-20.82
Add: Depreciation	39.00	39.00	39.00	39.00	39.00	-
CFAT	76.77	73.58	79.14	84.52	89.89	-20.82
Less: Increase in working capital	-5.00	-5.00	-5.00	-5.00		
Revised CFAT	71.77	68.58	74.14	79.52	89.89	-20.82
Tax paid in India (IN USD) (Tax paid/Exchange rate)		-0.1960	-0.2382	-0.2811	-0.3249	-0.3707

Note:

- Production cost = 40% of parent share revenues as per Note 1. Production cost is not considered for Royalty Revenues
- Taxes are paid one year in arrears. Hence tax for profits of year 1 is paid in year 2 and so on
- Taxes paid in India is converted into USD for computing the tax payable in USA. Tax paid in India can be claimed as tax credit as per DTAA

Note 1: Computation of revenues:

(in INR Crores)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
1. Units sold	24	24	24	24	24
2. Pre-inflation adjusted price	7.5	8.5	9.5	10.5	11.5
3. Inflation rate	6%	5.50%	5%	4.50%	4%
4. Final selling price	7.95	8.97	9.98	10.97	11.96
5. Revenues (1 x 4)	190.8	215.28	239.52	263.28	287.04
6. Parent share (55% of 5)	104.94	118.4	131.74	144.8	157.87
7. Add: Royalty (Note 2)	13.81	13.87	13.87	13.81	13.68
8. Final revenues (6 + 7)	118.75	132.27	145.61	158.61	171.55

Note 2: Computation of Royalty:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
1. Inflation in India (home country)	6%	5.50%	5%	4.50%	4%	3.50%
2. Inflation in USA (Foreign country)	5%	5%	5%	5%	5%	5%
3. Exchange rate as per PPT	57.54	57.81	57.81	57.53	56.98	56.17
4. Royalty in USD crores	0.24	0.24	0.24	0.24	0.24	
5. Royalty in INR Crores	13.81	13.87	13.87	13.81	13.68	

WN 3: Terminal flow:

Particulars	Amount (in Cr)
1. Net salvage value	5
2. Recapture of working capital (50 Cr + 5 cr x 4 years)	70
Total terminal flow	75

WN 4: Repatriation Analysis:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
CFAT (WN 2)	71.77	68.58	74.14	79.52	164.89	-20.82	
50% of current year	35.89	34.29	37.07	39.76	82.45	-20.82	
50% of previous year		35.89	34.29	37.07	39.76	82.45	
Total inflow to parent (in INR)	35.89	70.18	71.36	76.83	122.21	61.63	
Total inflow to parent (in USD)	0.6237	1.214	1.2344	1.3355	2.1448	1.0972	
Tax payable in USA		0.2183	0.4249	0.432	0.4674	0.7507	0.3823
Tax credit as per DTAA (WN 2)		0.196	0.2382	0.2811	0.3249	0.3707	0

Final tax paid		0.0223	0.1867	0.1509	0.1425	0.38	0.3823
Net cash flow	0.6237	1.1917	1.0477	1.1846	2.0023	0.7172	-0.3823

Note:

- 50% of current year profit can be repatriated in same year and balance 50% will be repatriated in next year.
- Cash flows in WN 2 is project's earning and what can be repatriated is computed in line 4 of above WN
- Cash flow in INR is converted into cash flow in using exchange rate as per Note 2
- Tax payable in USA = 35% of profits of previous year. This is because taxes are paid in the following year in which profit has arisen
- However, tax payable in USA will be adjusted for tax paid in India as per DTAA and final tax paid is computed
- Net cash flow in USD = Total inflow to parent in USD – Final tax paid in USD

WN 5: Computation of NPV in USD (Crores):

Year	Cash flow	PVF @ 15%	DCF
0	-4.386	1	-4.386
1	0.6237	0.8696	0.5424
2	1.1917	0.7561	0.901
3	1.0477	0.6575	0.6889
4	1.1846	0.5718	0.6774
5	2.0023	0.4972	0.9955
6	0.7172	0.4323	0.31
7	-0.384	0.3759	-0.1443
NPV in USD Crores			-0.4151

- The project is not be accepted as the same has resulted in negative NPV

15. International capital budgeting [SM]

Opus Technologies Ltd., an Indian IT company is planning to make an investment through a wholly owned subsidiary in a software project in China with a shelf life of two years. The inflation in China is estimated as 8 percent. Operating cash flows are received at the year end.

For the project an initial investment of Chinese Yuan (CN¥) 30,00,000 will be in a piece of land. The land will be sold after the completion of project at estimated value of CN¥ 35,00,000. The project also requires an office complex at cost of CN¥ 15,00,000 payable at the beginning of project. The complex will be depreciated on straight-line basis over two years to a zero salvage value. This complex is expected to fetch CN¥ 5,00,000 at the end of project.

The company is planning to raise the required funds through GDR issue in Mauritius. Each GDR will have 5 common equity shares of the company as underlying security which are currently trading at Rs. 200 per share (Face Value = Rs. 10) in the domestic market. The company has currently paid a dividend of 25% which is expected to grow at 10% p.a. The total issue cost is estimated to be 1 percent of issue size.

The annual sales is expected to be 10,000 units at the rate of CN¥ 500 per unit. The price of unit is expected to rise at the rate of inflation. Variable operating costs are 40 percent of sales. Current Fixed Operating costs is CN¥ 22,00,000 per year which is expected to rise at the rate of inflation.

The tax rate applicable in China for business income and capital gain is 25 percent and as per GOI Policy no further tax shall be payable in India. The current spot rate of CN¥ 1 is Rs. 9.50. The nominal interest rate in India and China is 12% and 10% respectively and the international parity conditions hold.

You are required to

- Identify expected future cash flows in China and determine NPV of the project in CN¥.
- Determine whether Opus Technologies should go for the project or not, assuming that there neither there is any restriction nor any charges/taxes payable on the transfer of funds from China to India.

Answer:**WN 1: Computation of initial outflow:**

Particulars	Amount (CNY)
Land	30,00,000
Office Complex	15,00,000
Total Outflow	45,00,000

WN 2: In-between cash flows:

Particulars	Year 1	Year 2
Annual units	10,000	10,000
Selling price	540.00	583.20
Sales	54,00,000	58,32,000
Less: Variable cost (40%)	(21,60,000)	(23,32,800)
Less: Depreciation (15,00,000/2)	(7,50,000)	(7,50,000)
Less: Fixed Cost	(23,76,000)	(25,66,080)
Profit before tax	1,14,000	1,83,120
Less: Tax @ 25%	(28,500)	(45,780)
Profit After Tax	85,500	1,37,340
Add: Depreciation	7,50,000	7,50,000
CFAT	8,35,500	8,87,340

WN 3: Terminal Cash Flow:

Particulars	Land	Building
Sale value	35,00,000	5,00,000
Less: Book value	(30,00,000)	0
Capital gain	5,00,000	5,00,000
Tax paid @ 25%	1,25,000	1,25,000
Net salvage value	33,75,000	3,75,000

WN 4: Computation of cost of capital:

$$K_e = \left(\frac{D_1}{P_0 - F} \right) + \text{Growth rate}$$

$$K_e = \left(\frac{2.75 \times 5}{1,000 - 10} \right) + 0.10 = 0.1139 \text{ (or) } 11.39\%$$

WN 5: Computation of NPV in CNY:

Year	Cash flow	PVF @ 11.39%	DCF
0	(45,00,000)	1	(45,00,000)
1	8,35,500	0.898	7,50,279
2	46,37,340 [8,87,340+33,75,000+3,75,000]	0.806	37,37,696
NPV in CNY			(12,025)

Conclusion: The project should not be accepted as the project has negative NPV.

WN 6: Analysis of NPV in INR:**Note 1: Computation of Exchange Rate:**

Year	Calculation	Rate
1	$9.50 \times \frac{1.12}{1.10}$	9.67
2	$9.67 \times \frac{1.12}{1.10}$	9.85

Note 2: Computation of INR Discount rate:**CNY rate analysis:**

$$(1 + R_f) \times (1 + R_p) = (1 + \text{Risky Rate})$$

$$(1 + 10\%) \times (1 + R_p) = (1 + 11.39\%)$$

$$(1 + R_p) = \frac{1 + 11.39\%}{1 + 10\%}; 1 + R_p = 1.0126; \text{Risk Premium} = 1.26\%$$

INR Rate Analysis:

$$(1 + 12\%) \times (1 + R_p) = (1 + \text{Risky Rate})$$

$$(1 + 12\%) \times (1 + 1.26\%) = (1 + \text{Risky Rate})$$

$$1 + \text{Risky Rate} = 1.1341; \text{Risky Rate} = 13.41\%$$

Note 3: Computation of NPV in INR:**Option 1: Cash flows in CNY are repatriated in the same year:**

Year	CNY CF	Exchange rate	INR CF	PVF @ 13.41%	DCF
0	(45,00,000)	9.50	(4,27,50,000)	1	(4,27,50,000)
1	8,35,500	9.67	80,79,285	0.882	71,25,929
2	46,37,340	9.85	4,56,77,799	0.777	3,54,91,650
Project NPV					(1,32,421)

Conclusion: The company should not go ahead with project as the project has negative NPV of Rs.1,32,421

Option 2: Cash flows in CNY are repatriated at end of the project:

Year	CNY CF	Exchange rate	INR CF	PVF @ 13.41%	DCF
0	(45,00,000)	9.50	(4,27,50,000)	1	(4,27,50,000)
1		9.67		0.882	
2	54,72,840	9.85	5,39,07,474	0.777	4,18,86,107
Project NPV					(8,63,893)

Conclusion: The company should not go ahead with project as the project has negative NPV of Rs.8,63,893

ICAI Solution:

ICAI solution to this question is wrong and they have taken nominal interest rate of 12% for computation of NPV in INR.

Option 1: Cash flows in CNY are repatriated in the same year:

Year	CNY CF	Exchange rate	INR CF	PVF @ 12.00%	DCF
0	(45,00,000)	9.50	(4,27,50,000)	1	(4,27,50,000)
1	8,35,500	9.67	80,79,285	0.893	72,14,802
2	46,37,340	9.85	4,56,77,799	0.797	3,64,05,206
Project NPV					8,70,008

Option 2: Cash flows in CNY are repatriated at end of the project:

Year	CNY CF	Exchange rate	INR CF	PVF @ 13.41%	DCF
0	(45,00,000)	9.50	(4,27,50,000)	1	(4,27,50,000)
1		9.67		0.882	
2	54,72,840	9.85	5,39,07,474	0.777	4,29,64,257
Project NPV					2,14,257

Though in terms of CN¥ the NPV of the project is negative but in Rs. it has positive NPV due to weakening of Rs. in comparison of CN¥. Thus, Opus can accept the project.

16. International capital budgeting [SM]

Its Entertainment Ltd., an Indian Amusement Company is happy with the success of its Water Park in India. The company wants to repeat its success in Nepal also where it is planning to establish a Grand Water Park with world class amenities. The company is also encouraged by a marketing research report on which it has just spent Rs. 20,00,000.

The estimated cost of construction would be Nepali Rupee (NPR) 450 crores and it would be completed in one years time. Half of the construction cost will be paid in the beginning and rest at the end of year. In addition, working capital requirement would be NPR 65 crores from the year end one. The after tax realizable value of fixed assets after four years of operation is expected to be NPR 250 crores. Under the Foreign Capital Encouragement Policy of Nepal, company is allowed to claim 20% depreciation allowance per year on reducing balance basis subject to maximum capital limit of NPR 200 crore. The company can raise loan for theme park in Nepal @ 9%.

The water park will have a maximum capacity of 20,000 visitors per day. On an average, it is expected to achieve 70% capacity for first operational four years. The entry ticket is expected to be NPR 220 per person. In addition to entry tickets revenue, the company could earn revenue from sale of food and beverages and fancy gift items. The average sales expected to be NPR 150 per visitor for food and beverages and NPR 50 per visitor for fancy gift items. The sales margin on food and beverages and fancy gift items is 20% and 50% respectively. The park would open for 360 days a year.

The annual staffing cost would be NPR 65 crores per annum. The annual insurance cost would be NPR 5 crores. The other running and maintenance costs are expected to be NPR 25 crores in the first year of operation which is expected to increase NPR 4 crores every year. The company would apportion existing overheads to the tune of NPR 5 crores to the park.

All costs and receipts (excluding construction costs, assets realizable value and other running and maintenance costs) mentioned above are at current prices (i.e. 0 point of time) which are expected to increase by 5% per year.

The current spot rate is NPR 1.60 per Rs. The tax rate in India is 30% and in Nepal it is 20%. The current WACC of the company is 12%. The average market return is 11% and interest rate on treasury bond is 8%. The company's current equity beta is 0.45. The company's funding ratio for the Water Park would be 55% equity and 45% debt.

Being a tourist Place, the amusement industry in Nepal is competitive and very different from its Indian counterpart. The company has gathered the relevant information about its nearest competitor in Nepal. The competitor's market value of the equity is NPR 1850 crores and the debt is NPR 510 crores and the equity beta is 1.35.

State whether Its Entertainment Ltd. should undertake Water Park project in Nepal or not.

Answer:

WN 1: Computation of Asset Beta of Competitor:

Security	Beta	Weight	Product
Equity	1.35	1850	2,497.50
Debt	0	408 [510 x 0.80]	0
Firm	1.106	2,258	2,497.50

Note: We have used tax rate of Nepal for computing weight of debt in Nepal. This is because the competitor is based out of Nepal

WN 2: Computation of Equity Beta of Its Entertainment Limited:

Security	Beta	Weight	Product
Equity	1.83	0.55	1.006
Debt	0	0.36 [0.45 x 0.80]	0
Firm	1.106	0.910	1.006

Note: Weight for Debt is taken as Debt x (1 - Tax rate of Nepal)

WN 3: Computation of WACC of Project:

Source	Cost	Weight	Product
Equity	13.49	0.55	7.42
Debt	7.20 [9% x 0.80]	0.45	3.24
Firm			10.66

$$\diamond \text{ Cost of equity} = R_f + \beta \times (R_m - R_f) = 8\% + 1.83 \times (11\% - 8\%) = 13.49\%$$

WN 4: Initial outflow:

Particulars	Amount (in Cr)
Construction cost (450/2)	-225
Total initial outflow	-225

WN 5: In-between cash flows:

(in crores)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Annual visitors (20,000 x 70% x 360)		0.504	0.504	0.504	0.504
Ticket price (220 of Y0 plus inflation)		242.55	254.68	267.41	280.78
Profit on beverages (30 of Y0 plus inflation)		33.08	34.73	36.47	38.29
Profit on fancy items (25 of Y0 plus inflation)		27.56	28.94	30.39	31.91
Revenue per visitor		303.19	318.35	334.27	350.98
Total revenues (No of visitors x revenues/visitor)		152.81	160.45	168.47	176.89
Less: Staff cost [65 Cr of Y0 plus inflation)		71.66	75.25	79.01	82.96
Less: Insurance cost [5 Cr of Y0 plus inflation)		5.51	5.79	6.08	6.38
Less: Running and maintenance cost		25.00	29.00	33.00	37.00
Less: Depreciation (Note 1)		40.00	32.00	25.60	20.48
Profit before tax		10.64	18.41	24.78	30.07
Less: Tax @ 20%		-2.13	-3.68	-4.96	-6.01
Profit after tax		8.51	14.73	19.82	24.06
Add: Depreciation		40.00	32.00	25.60	20.48
CFAT	0.00	48.51	46.73	45.42	44.54
Less: Construction cost	-225.00				
Less: Working capital	-65.00	-3.25	-3.41	-3.59	
Revised CFAT	-290.00	45.26	43.32	41.83	44.54

Note 1: Computation of depreciation:

Particulars	Year 2	Year 3	Year 4	Year 5
Opening balance	200.00	160.00	128.00	102.40
Less: Depreciation @ 20%	40.00	32.00	25.60	20.48
Closing balance	160.00	128.00	102.40	81.92

Note 2: Computation of working capital requirement:

Particulars	Year 2	Year 3	Year 4
Opening balance	65.00	68.25	71.66
Closing balance (Opening + Inflation)	68.25	71.66	75.25
Increase in working capital	3.25	3.41	3.59

WN 6: Terminal flow:

Particulars	Amount
Realizable value of fixed assets	250
Recapture of working capital	75.25
Total terminal flow	325.25

WN 7: Computation of NPV:

Year	Cash flow	PVF @ 10.66%	DCF
0	-225	1	-225.00
1	-290	0.904	-262.16
2	45.26	0.817	36.98
3	43.32	0.738	31.97
4	41.83	0.667	27.91
5	369.79	0.603	222.98
			-167.32

Conclusion: The company should not go ahead with project as the same generates negative NPV of NPR 167.32 crores.

17. Computation of effective borrowing rate [May 2019] [Concept Revision]**ICAI Question:**

K Ltd. currently operates from 4 different buildings and wants to consolidate its operations into one building which is expected to cost Rs. 90 crores. The Board of K Ltd. had approved the above plan and to fund the above cost, agreed to avail an External Commercial Borrowing (ECB) of GBP 10 m from G Bank Ltd. on the following conditions:

- The Loan will be availed on 1st April, 2019 with interest payable on half yearly rest.
- Average Loan Maturity life will be 3.4 years with an overall tenure of 5 years.
- Upfront Fee of 1.20%.
- Interest Cost is GBP 6 months LIBOR + Margin of 2.50%.
- The 6-month LIBOR is expected to be 1.05%.

K Ltd. also entered into a GBP-INR hedge at 1 GBP = INR 90 to cover the exposure on account of the above ECB Loan and the cost of the hedge is coming to 4.00% p.a. As a Finance Manager, given the above information and taking the 1 GBP = INR 90:

(i) Calculate the overall cost both in percentage and rupee terms on an annual basis.

(ii) What is the cost of hedging in rupee terms?

(iii) If K Ltd. wants to pursue an aggressive approach, what would be the net gain/loss for K Ltd. if the INR depreciates/appreciates against GBP by 10% at the end of the 5 years assuming that the loan is repaid in GBP at the end of 5 years?

Ignore time value and taxes and calculate to two decimals.

Modified Question:

INR depreciates/appreciates against GBP by 10% should be replaced with **GBP appreciates/depreciates against INR by 5%**

Answer:

WN 1: Computation of overall cost both in percentage and rupee terms:

Particulars	Calculation	Amount
Upfront premium	10 million × 1.20%	GBP 0.12 million
Interest cost	10 million × 3.55% × 3.4 years	GBP 1.207 million
Hedging cost	10 million × 4% × 3.4 years	GBP 1.36 million
Total cost for 3.4 years		GBP 2.687 million
Total cost for 1 year	2.687/3.4	GBP 0.7903 million
Loan Taken		GBP 10 million
Effective rate (%)	(0.7903/10) × 100	7.903%
Effective cost (INR) for 3.4 years	2.687 × 90	INR 241.83 million
Effective cost (INR) per annum	241.83/3.4 years	INR 71.127 million

WN 2: Computation of cost of hedging in rupee terms:

- Hedging cost for 3.4 years = GBP 1.36 million
- Hedging cost in INR = 1.36 million × 90 = INR 122.40 million
- Hedging cost per year = GBP 10 million × 4% × 90 = INR 36 million

WN 3: Gain/loss if INR depreciates by 10%

- The company has taken a loan in GBP. They have taken an aggressive approach and this would mean that hedging is not done
- Liability of company is in GBP.
- Spot rate is INR 90/GBP
- GBP has appreciated by 10% and hence the new exchange rate is INR 99/GBP and loan liability is Rs.99 Crores
- Loss due to currency movement = Rs.9 crores
- The company has not hedged the loan exposure and hence they will save annual hedging cost of Rs.3.6 crores
- **Net Loss = 9 Crores – 3.6 Crores = Rs.5.4 Crores**

Note: The company will save hedging cost for all five years. However, we are considering the analysis only for the last year and hence the hedging cost of one-year has been considered in above calculations.

WN 4: Gain/loss if INR appreciates by 10%:

- The company has taken a loan in GBP. They have taken an aggressive approach and this would mean that hedging is not done.

- Liability of company is in GBP.
- Spot rate is INR 90/GBP
- GBP has depreciated by 10% and hence new exchange rate is INR 81/GBP and loan liability is Rs.81 Crores
- Gain due to currency movement = Rs.9 crores
- The company has not hedged the loan exposure and hence they will save annual hedging cost of Rs.3.6 crores
- **Total gain = 3.6 crores + 9.00 Crores = Rs.12.60 Crores**

18. International financial management:

An MNC company in USA has surplus funds to the tune of USD 10 million for six months. The finance director of the company is interested in investing in EURO for higher returns. There is DTAA in force between USA and Germany. The company received the following information from London:

Particulars	Amount
EURO/USD Spot	0.4040/41
6 months forward	67/65
Rate of interest for 6 months (p.a.)	5.95%-6.15%
Withholding tax applicable for interest income	22%
Tax as per DTAA	10%

If the company invests in EUR, what is the gain for the company?

Answer:

Computation of net gain for the company:

Particulars	Calculation	Amount
Surplus in USD		1,00,00,000 USD
Euro investment	$1,00,00,000 \times 0.4040$	40,40,000 EUR
Interest earned	$40,40,000 \times 5.95\% \times 6/12$	1,20,190 EUR
Less: Withholding tax as per DTAA	$1,20,190 \times 10\%$	-12,109 EUR
Net interest earned		1,08,171 EUR
Net amount available for repatriation	$40,40,000 + 1,08,171$	41,48,171 EUR
Amount converted into USD at forward rate	$\frac{41,48,171}{0.3976}$	1,04,33,026 USD
Amount earned in USD		4,33,026 USD

Chapter 12 – Interest rate risk Management**Practical Problems****Overview:**

- Part I – Interest rate futures and options
- Part II – Forward Rate Agreements
- Part III – Interest Rate Swaps

Part I – Interest rate futures and options**1. Interest rate caps and floors [May 2013 RTP, May 2014 MTP]**

Suppose that a 1-year cap has a cap rate of 8% and a notional amount of Rs.100 Crores. The frequency of settlement is quarterly and the reference rate is 3-months MIBOR. Assume that 3-month MIBOR for the next four quarters is shown below:

Quarters	3-months MIBOR
1	8.70
2	8.00
3	7.80
4	8.20

You are required to compute payoff for each quarter

Answer:

- Cap option restricts the maximum interest outflow and will be exercised if the actual interest rate is higher than strike rate

Quarter	Interest rate	Exercise	Pay-off
1	8.70	Yes	17,50,000 (100,00,00,000 × 0.70% × 3/12)
2	8.00	No	0
3	7.80	No	0
4	8.20	Yes	5,00,000 (100,00,00,000 × 0.20% × 3/12)

2. Interest rate caps and floors [May 2013 RTP]

Suppose that a 1-year floor has a floor rate of 4% and a notional amount of Rs.100 Crores. The frequency of settlement is quarterly and the reference rate is 3-months MIBOR. Assume that 3-month MIBOR for the next four quarters is shown below:

Quarters	3-months MIBOR
1	4.70
2	4.40
3	3.80
4	3.40

You are required to compute payoff for each quarter

Answer:

- Floor option provided for minimum interest inflow and will be exercised if the actual interest rate is lower than the strike rate

Quarter	Interest rate	Exercise	Pay-off
1	4.70	No	0
2	4.40	No	0
3	3.80	Yes	5,00,000 (100,00,00,000 × 0.20% × 3/12)
4	3.40	Yes	15,00,000 (100,00,00,000 × 0.60% × 3/12)

3. Interest rate caps and floors [May 2014 RTP, Nov 2018 MTP, May 2019 RTP]

XYZ Limited issues a GBP 10 million floating rate loan on July 1, 2013 with resetting of coupon rate every 6 months equal to LIBOR + 0.50%. XYZ is interested in a collar strategy by selling a floor and buying a cap. XYZ buys 3 years cap and sell 3 years floor as per the following details on July 1, 2013.

- ❖ Notional principal amount : GBP 10 million

- ❖ Reference rate : 6 months LIBOR
- ❖ Strike rate : 4% for floor and 7% for cap
- ❖ Premium : 0 as premium paid on cap is compensated by premium receive on floor

Using the following data you are required to determine:

- ❖ Effective interest paid out at each reset date
- ❖ The average overall effective rate of interest

Reset Date	LIBOR (%)
31-12-2013	6.00
30-06-2014	7.00
31-12-2014	5.00
30-06-2015	3.75
31-12-2015	3.25
30-06-2016	4.25

Answer:

- Buying a cap will restrict maximum interest outflow and selling a floor will provide for minimum interest inflow.
- Collar strategy will ensure that interest outflow for all reset periods will be between 4 to 7%

Interest outflow for every reset period:

Reset date	No of days	LIBOR	Int outflow	Cap receipt	Floor payment	Total cost
31-Dec-13	184	6.00	3,27,671	0	0	3,27,671
30-Jun-14	181	7.00	3,71,918	0	0	3,71,918
31-Dec-14	184	5.00	2,77,260	0	0	2,77,260
30-Jun-15	181	3.75	2,10,753	0	12,397	2,23,150
31-Dec-15	184	3.25	1,88,525	0	37,705	2,26,230
30-Jun-16	182	4.25	2,36,202	0	0	2,36,202
Total	1,096					16,62,431

Note:

- No of days = Current reset date – Earlier reset date. For example ,184 days for December 31, 2013 is time gap between June 30, 2013 and December 31, 2013
- Interest outflow = $1,00,00,000 \times (\text{LIBOR} + 0.50\%) \times (\text{No of days}/365 \text{ or } 366)$. For last two reset periods denominator will be taken as 366 as the same is of leap year
- Cap receipt is applicable when LIBOR exceed 7%.
- Floor payment is applicable when LIBOR is below 4%. This is breached for June 2015 and we will have floor payment as $1,00,00,000 \times 0.25\% \times (181/365)$. Additionally it was breached in December 2015 and we will have floor payment as $1,00,00,000 \times 0.75\% \times (184/366)$
- Total cost = Interest outflow – cap receipt + Floor Payment

Computation of overall effective rate of interest:

$$\text{Overall effective rate of interest} = \left(\frac{16,62,421}{1,00,00,000} \right) \times \left(\frac{365}{1,096} \right) \times 100 = 5.54\%$$

4. Interest Rate Collar [May 2022] [Concept Revision]

XYZ Limited issues a Rs.50 million floating rate loan on July 1, 2018 with resetting of coupon rate every 6 months equal to LIBOR + 0.50%. XYZ is interested in a collar strategy by selling a floor and buying a cap. XYZ buys 3 years cap and sell 3 years floor as per the following details on July 1, 2018.

- ❖ Notional principal amount : Rs.50 Million
- ❖ Reference rate : 6 months LIBOR
- ❖ Strike rate : 5% for floor and 8% for cap
- ❖ Premium : 0 as premium paid on cap is compensated by premium receive on floor

Using the following data you are required to determine:

- ❖ Effective interest paid out at each reset date (Round off to nearest rupee)
- ❖ The average overall effective rate of interest (round off to 2 decimals)

Reset Date	LIBOR (%)
31-12-2018	7.00
30-06-2019	8.00
31-12-2019	6.00
30-06-2020	4.75
31-12-2020	4.25
30-06-2021	5.25

Answer:**Interest outflow for every reset period:**

Reset date	Date of Payment	No of days	LIBOR	Int outflow	Cap receipt	Floor payment	Total cost
31-Dec-18	30-Jun-19	181	7.00	18,59,589	0	0	18,59,589
30-Jun-19	31-Dec-19	184	8.00	21,42,466	0	0	21,42,466
31-Dec-19	30-Jun-20	182	6.00	16,16,120	0	0	16,16,120
30-Jun-20	31-Dec-20	184	4.75	13,19,672	0	62,842	13,82,514
31-Dec-20	30-Jun-21	181	4.25	11,77,740	0	1,85,959	13,63,699
30-Jun-21	31-Dec-21	184	5.25	14,49,315	0	0	14,49,315
Total		1,096					98,13,703

Note:

- No of days = Date of Payment – Reset Date. For example ,181 days for December 31, 2018 is time gap between June 30, 2019 and December 31, 2018
- Interest outflow = 5,00,00,000 x (LIBOR + 0.50%) x (No of days/365 or 366). For third and fourth reset period denominator is taken as 366 due to leap year.
- Floor payment is applicable when LIBOR is below 5%. This is breached for fourth reset period and fifth reset period
- Total cost = Interest outflow – cap receipt + Floor Payment

Computation of overall effective rate of interest:

$$\text{Overall effective rate of interest} = \left(\frac{98,13,703}{5,00,00,000} \right) \times \left(\frac{365}{1,096} \right) \times 100 = 6.54\%$$

Author's Note:

- Loan has been taken on July 1, 2018 and hence the first payment should have been on December 31, 2018. However, ICAI solution has assumed the reset rate to be applicable for next six months and hence the first loan repayment happens on June 30, 2019. This should be technically considered as incorrect.

5. Caps [Nov 2016 RTP, May 2018 MTP, Nov 2018 MTP, May 2013, Nov 2022 RTP, Nov 2019 MTP, May 2020 MTP, SM] [Concept Revision]

XYZ Limited borrows £15 Million of six months LIBOR + 10.00% for a period of 24 months. The company anticipates a rise in LIBOR, hence it proposes to buy a Cap Option from its Bankers at the strike rate of 8.00%. The lumpsum premium is 1.00% for the entire reset periods and the fixed rate of interest is 7.00% per annum. The actual position of LIBOR during the forthcoming reset period is as under:

Reset Period	LIBOR
1	9.00%
2	9.50%
3	10.00%

You are required to show how far interest rate risk is hedged through Cap Option. For calculation, work out figures at each stage up to four decimal points and amount nearest to £. It should be part of working notes.

Answer:**WN 1: Computation of premium:**

Lump-sum Premium = 1,50,00,000 x 1% = GBP 1,50,000
Premium per reset period = $\frac{\text{Total premium}}{\text{PVAF}(r, n)} = \frac{1,50,000}{\text{PVAF}(3.5\%, 4)} = \frac{1,50,000}{3.673} = 40,839$

Note:

- Premium will be amortized based on the fixed rate of interest. Fixed rate of interest is 7% per annum

and the same will be 3.5% per half-year (reset period). Reset period is taken as six months as the borrowing is at six-month LIBOR

- Option is for a period of 24 months and hence the same will have 4 reset periods of 6 months

WN 2: Computation of interest outflow:

Period	LIBOR	Int paid to bank	Cap receipt	Premium	Net Payment
I	9.00%	14,25,000	75,000	40,839	13,90,839
II	9.50%	14,62,500	1,12,500	40,839	13,90,839
III	10.00%	15,00,000	1,50,000	40,839	13,90,839
		43,87,500	3,37,500	1,22,517	41,72,517

- Interest paid to Bank = $1,50,00,000 \times (\text{LIBOR} + 10\%) \times (6/12)$
- Cap receipt is applicable if the LIBOR rate is higher than 8%. LIBOR is higher than 8% for all reset periods and the difference between 8% and LIBOR is cap receipt
- Net payment = Interest paid to Bank + Premium – Cap receipt

Conclusion:

- The company would have paid extra interest of 3,37,500 (cap receipt) due to increase in interest rates. However due to cap receipt the interest payout for a reset period does not exceed 18% (LIBOR (8%) + 10%). However, in order to save this 3,37,500 the company has pay premium of 1,22,517
- Hence, the company is able to reduce the interest rate risk amount by 2,14,893 by using cap option

Author's Note:

- ICAI has given data for three reset periods and hence the computation has been done for only three periods. If the data was given for fourth reset period, then computation for the same will also be done.

6. Interest rate futures

In two months-time, ABC Limited will receive Rs.3.9 million which it wants to deposit in money market for three months. ABC Limited at present can deposit at 8% per annum, but the treasurer fears a decrease in interest rate after two months and hence wishes to hedge using interest rate futures. Three months futures are currently priced at 93. The standard contract size in the futures market is 0.5 million.

- ❖ What strategy should the treasurer adopt to hedge the interest rate risk?
- ❖ If after two months, the futures are priced at 90.75 and interest rate increases to 10.5%, what would be the effective interest income earned by ABC Limited due to adoption of this strategy?
- ❖ If after two months, the futures are priced at 94.25 and interest rate falls to 6.5%, what would be the effective interest income earned by ABC Limited due to adoption of this strategy?

Answer:

Part 1:

- The company wants to invest Rs.39,00,000 after two months. They can hedge the interest rate risk through interest rate futures
- No of contracts to be taken = $(39,00,000 / 5,00,000) = 7.8 \sim 8$ contracts.
- The company will take the interest rate futures which will enable them to invest the money at the rate of 7% (100 – 93)

Part 2:

Computation of effective interest income:

Net settlement in futures:

Date	Position	Action	Ref date	Rate
Day 0	Original	Lend	Day 60	7%
Day 60	Opposite	Borrow	Day 60	-9.25%
Loss in %				-2.25%
Loss in rupees $(5,00,000 \times 8 \times 2.25\% \times 3/12)$				-22,500

- Interest rates have increased in the market and hence the company will earn higher interest income in spot market. However, part of the gains will be offset by loss in futures position

Effective interest income:

Particulars	Calculation	Amount
Interest income	$39,00,000 \times 10.5\% \times (3/12)$	1,02,375
Loss in futures		-22,500
Effective interest income		79,875

Part 3:**Computation of effective interest income:****Net settlement in futures:**

Date	Position	Action	Ref date	Rate
Day 0	Original	Lend	Day 60	7%
Day 60	Opposite	Borrow	Day 60	-5.75%
Gain in %				1.25%
Gain in rupees $(5,00,000 \times 8 \times 1.25\% \times 3/12)$				12,500

- Interest rates have declined in the market and hence the company will earn lower interest income in spot market. However, part of the losses will be offset by gain in futures position

Effective interest income:

Particulars	Calculation	Amount
Interest income	$39,00,000 \times 6.5\% \times (3/12)$	63,375
Gain in futures		12,500
Effective interest income		75,875

7. Interest rate futures

The monthly cash budget of ABC Limited shows that the company is likely to need Rs.18 million in two month's time for a period of four months. Financial markets have recently been volatile, and the finance director fears that short term interest rates could rise by as much as 150 ticks (1.5%). LIBOR is currently 6.5% and ABC can borrow at LIBOR + 0.75%.

The 3 months futures prices (contract size = Rs.5,00,000) are as follows:

- ❖ December 93.40
- ❖ March 93.10
- ❖ June 92.75

Assume that it is now 1 December and that exchange traded futures contracts expire at the end of the month. You are required to estimate the result of undertaking an interest rate futures hedge if LIBOR increases by 150 ticks (1.5%) and March future increases by 130 ticks (1.3%).

Answer:

- The company plans to borrow Rs.18 million in 2 months for a period of 4 months. The borrowing period therefore is from Month 2 to Month 6
- The finance director is worried about the potential increase in interest rates and hence wants to hedge this through futures market
- Today's date is December 1 and the borrowing is to be done on January 31. We do not have January futures and hence the closest available live futures would be March
- The company wants to borrow Rs.18 million for 4 months. Futures interest is computed for 3 months. Hence the amount to be hedged will be higher than Rs.18 million
- Amount to be hedged = $18 \text{ million} \times (4/3) = \text{Rs.24 million}$
- Contract size of one futures contract = Rs.0.5 million
- No of contracts = $(24/0.5) = 48 \text{ contracts}$
- The company will enter into 48 contracts of Rs.5 lacs each. This will enable the company to borrow money at 6.90% ($100 - 93.10$)

Action on maturity date:

- LIBOR has increased by 1.5 percent and hence the company will have to borrow at 8.75% (LIBOR of 8% + 0.75%)
- Interest expense = $(180 \text{ lacs} \times 8.75\% \times (4/12)) = \text{Rs.5,25,000}$
- Net interest expense = $5,25,000 - 78,000 \text{ (futures gain)} = \text{Rs.4,47,000}$

$$\text{Net interest rate} = \frac{4,47,000}{1,80,00,000} \times \frac{12}{4} \times 100 = 7.4\%$$

Futures settlement:

Date	Position	Action	Ref date	Rate
Dec 1	Original	Borrow	March 31	-6.90%
Jan 31	Opposite	Invest	March 31	8.20%
Gain in %				1.30%
Gain in rupees (5,00,000 x 48 x 1.30% x 3/12)				78,000

Note: 3-month futures are there in the question and this would mean that interest for futures settlement would be computed for three-month period.

8. Interest rate hedging [Nov 2017, Nov 2017 RTP, May 2022 RTP, Nov 2023 MTP, Nov 2021 MTP, May 2022 MTP, May 2023 MTP, May 2024, SM]

A manufacturer of electronic components has taken floating interest rate loan of Rs. 2 Crore on 1st April, 2023. The rate of interest at the inception of loan is 9% per annum. Interest is to be paid every year on 31st March. In the month of October 2023, the Central Bank of the country releases the following projections about the interest rates likely to prevail in future.

(i) On 31st March, 2024 – 9.25% On 31st March, 2025 – 9.50% On 31st March, 2026 – 10.00% On 31st March, 2027 – 9.00% On 31st March, 2028 – 8.25% You are required to show how the borrower can hedge the risk using Option Cap arising out of expected rise in the rate of interest when he wants to peg his interest cost at 9% per annum.

(ii) Assume that the premium negotiated by both the parties is 0.80% to be paid at once on 1st October, 2023 and the actual rate of interest on the respective due dates happens to be as: On 31st March, 2024 – 9.50% On 31st March, 2025 – 11.00% On 31st March, 2026 – 9.25% On 31st March, 2027 – 9.00% On 31st March, 2028 – 8.50% You are required to show how the settlement will be executed on the respective interest due dates.

(iii) State whether this option is advantageous when compared to Interest Rate Collar option. Explain.

Answer:

WN 1: Hedging interest rate risk:

As borrower does not want to pay more than 9.0% p.a., on this loan where the rate of interest is likely to rise beyond this, hence, he has hedge the risk by entering into an agreement to buy interest rate caps with the following parameters:

- National Principal : Rs. 2,00,00,000/
- Strike rate: 9.0% p.a.
- Reference rate : the rate of interest applicable to this loan
- Calculation and settlement date : 31st March every year
- Duration of the caps : till 31st March 2028
- Premium for caps : negotiable between both the parties

To purchase the caps this borrower is required to pay the premium upfront at the time of buying caps. The payment of such premium will entitle him with right to receive the compensation from the seller of the caps as soon as the rate of interest on this loan rises above 9.0%. The compensation will be at the rate of the difference between the rate of none of the cases the cost of this loan will rise above 9.0% calculated on Rs. 2,00,00,000/-. This implies that in none of the cases the cost of this loan will rise above 9.0%. This hedging benefit is received at the respective interest due dates at the cost of premium to be paid only once.

The premium to be paid on 1st October 2023 is 1,60,000/- (Rs. 2,00,00,000 x 0.80/100). The payment of this premium will entitle the buyer of the caps to receive the compensation from the seller of the caps whereas the buyer will not have obligation

WN 2: Settlement on respective interest rates:

Date	Actual Rate	Option	Interest Payment	Settlement %	Settlement Amount	Net Interest
31 st March 2024	9.50%	Exercise	19,00,000	0.50%	1,00,000	18,00,000
31 st March 2025	11.00%	Exercise	22,00,000	2.00%	4,00,000	18,00,000
31 st March 2026	9.25%	Exercise	18,50,000	0.25%	50,000	18,00,000
31 st March 2027	9.00%	Lapse	18,00,000	-	-	18,00,000
31 st March 2028	8.50%	Lapse	17,00,000	-	-	17,00,000

Conclusion: From the discussion above it can be said that the overall interest cost for the borrower shall not exceed 9%.

Cap vs Collar: Comparing to Interest Rate Collar, Cap Option appears to be better because even though Collar may not involve initial outflow of cash on account of Premium but selling Put Option at 9% can lead to cash outflow if interest rate goes below 9%

9. Cheapest to Deliver Bond [May 2021 RTP, Nov 2023] [Concept Revision]

In March 2020, XYZ Bank sold some 7% Interest Rate Futures underlying Notional 7.50% Coupon Bonds. The exchange provides following details of eligible securities that can be delivered:

Security	Quoted Price of the Bonds	Conversion Factor
7.96 GOI 2023	1037.40	1.0370
6.55 GOI 2025	926.40	0.9060
6.80 GOI 2029	877.50	0.9195
6.85 GOI 2026	972.30	0.9643
8.44 GOI 2027	1146.30	1.1734
8.85 GOI 2028	1201.70	1.2428

Recommend the Security that should be delivered by the XYZ Bank if Future Settlement Price is 1000.

Answer:

- Cheapest to Deliver Bond is one which gives maximum profit to seller of interest rate futures
- Profit = (Futures settlement price x Conversion Factor) - Quoted spot price of bond

Security	Spot Price	Conversion Factor	Inflow (Spot Price x Conversion Factor)	Quoted Price of the Bonds [Outflow]	Profit [Inflow - Outflow]
7.96 GOI 2023	1,000	1.0370	1,037.00	1037.40	-0.40
6.55 GOI 2025	1,000	0.9060	906.00	926.40	-20.40
6.80 GOI 2029	1,000	0.9195	919.50	877.50	42.00
6.85 GOI 2026	1,000	0.9643	964.30	972.30	-8.00
8.44 GOI 2027	1,000	1.1734	1,173.40	1146.30	27.10
8.85 GOI 2028	1,000	1.2428	1,242.80	1201.70	41.10

Since maximum profit to the Bank is in case of 6.80 GOI 2029, same should be opted for

Part II - Forward Rate Agreements

10. Forward Rate Agreements [Nov 2019, May 2018 MTP, Nov 2018 RTP, May 2013, Nov 2022 MTP, SM] [Concept Revision]

P Ltd. is contemplating to borrow an amount of Rs. 50 crores for a period of 3 months in the coming 6 months time from now. The current rate of interest is 8% per annum but it may go up in 6 months time. The company wants to hedge itself against the likely increase in interest rate. The Company's Bankers quoted an FRA (Forward Rate Agreement) at 8.30% per annum.

Compute the effect of FRA and actual rate of interest cost to the company, if the actual rate of interest during consideration period happens to be (i) 8.60% p.a., or (ii) 7.80% p.a.

(Show your workings on the basis of months)

Answer:

ICAI Solution in Nov 2019 Exam:

WN 1: Computation of FRA settlement if rate of interest is 8.60% per annum:

- The company had entered into FRA agreement to borrow at the rate of 8.30%
- The borrowing rate has increased to 8.60% and they will have to borrow at higher rate. However this would be compensated by FRA settlement of 0.30%

FRA Settlement before discounting = 50 Crores x 0.30% x $\left(\frac{3}{12}\right)$ = Rs. 3,75,000

$$\text{Net FRA Settlement post discounting} = \frac{3,75,000}{1 + 2.15\%} = \text{Rs. 3,67,107}$$

Banker will pay Rs.3,67,107 to P Limited

Net interest outflow if rate is 8.60%:

Particulars	Calculation	Amount
Interest on loan at 8.60%	50 crores x 8.60% x (3/12)	1,07,50,000
Less: FRA settlement		(3,67,107)
Net Amount		1,03,82,893
Effective borrowing rate	$\left(\frac{1,03,82,893}{50,00,00,000}\right) \times \left(\frac{12}{3}\right) \times 100$	8.31%

Note: The above computation is not fully logical as FRA settlement happens on day 0 whereas actual interest is paid after 3 months. However, we have followed this approach as per ICAI solution

WN 2: Computation of FRA Settlement if rate of interest is 7.80% per annum:

- The company had entered into FRA agreement to borrow at the rate of 8.30%
- The borrowing rate has decreased to 7.80% and they will have to borrow at lower rate. However, rate would increase due to FRA settlement of 0.50%

$$\text{FRA Settlement before discounting} = 50 \text{ Crores} \times 0.50\% \times \left(\frac{3}{12}\right) = \text{Rs. 6,25,000}$$

$$\text{Net FRA Settlement post discounting} = \frac{6,25,000}{1 + 1.95\%} = \text{Rs. 6,13,046}$$

P Limited will have to pay Rs.6,13,046 to Banker.

Net interest outflow if rate is 8.60%:

Particulars	Calculation	Amount
Interest on loan at 7.80%	50 crores x 7.80% x (3/12)	97,50,000
Add: FRA settlement		6,13,046
Net Amount		1,03,63,046
Effective borrowing rate	$\left(\frac{1,03,63,046}{50,00,00,000}\right) \times \left(\frac{12}{3}\right) \times 100$	8.29%

ICAI Solution in Nov 2018 RTP (More logical Solution)

- No change in FRA Settlement Amount

Particulars	Rate of 8.60%	Rate of 7.80%
Interest on loan at 8.60%	1,07,50,000	97,50,000
Add/Less: FRA settlement (undiscounted)	-3,75,000	6,25,000
Net Amount	1,03,75,000	1,03,75,000
Effective borrowing rate	8.30%	8.30%

11. FRA [May 2018 RTP, May 2010, May 2019 MTP, May 2015 MTP, May 2017 RTP, Nov 2023 RTP]

The following market data is available:

Spot USD/JPY 116.00

Deposit rates p.a.	USD	JPY
3 months	4.50%	0.25%
6 months	5.00%	0.25%

Forward Rate Agreement (FRA) for Yen is nil.

- What should be 3 months FRA rate at 3 months forward?
- The 6 & 12 months LIBORS are 5% and 6.5% respectively. A bank is quoting 6/12 USD FRA at 6.50 – 6.75%. Is any arbitrage opportunity available?

Answer:

WN 1: Computation of FRA rate:

- The company wants 3 months FRA rate at 3 months forward. This would technically mean 3x6 FRA

$$3 \times 6 \text{ FRA} = \frac{\text{Future value factor for 6 months}}{\text{Future value factor for 3 months}} - 1$$

$$3 \times 6 \text{ FRA} = \frac{1 + 2.50\%}{1 + 1.125\%} - 1 = 1.0136 - 1 = 1.36\% \text{ per 3 months (or) } 5.44\% \text{ per annum}$$

WN 2: Computation of 6X12 FRA rate:

- We have been given 6 months and 12 months rate as 5% and 6.5%. We can use these rates and calculate 6X12 FRA rate

$$6 \times 12 \text{ FRA} = \frac{\text{Future value factor for 12 months}}{\text{Future value factor for 6 months}} - 1$$

$$6 \times 12 \text{ FRA} = \frac{1 + 6.50\%}{1 + 2.50\%} - 1 = 1.0390 - 1 = 3.90\% \text{ per 6 months (or) } 7.80\% \text{ per annum}$$

Creation of arbitrage:

- Fair FRA rate for month 6 to 12 is 7.80% per annum. Actual FRA rate is 6.50% - 6.75%.
- Actual FRA indicates that borrowing can be made at 6.75% and deposit can be created at 6.50% for month 6 to 12
- Actual borrowing rates are lower than Fair FRA rates and hence we should borrow money from month 6 to 12
- Arbitrage Mechanism:**
 - Borrow 1,00,000 USD for first 6 months
 - Create 1,00,000 USD deposit for 12 months
 - Borrow from M6 to M12 using FRA rate

Arbitrage steps:

Particulars	Calculation	Amount
Day 0		
1. Borrow 1,00,000 USD for 6 months @ 5%		1,00,000
2. Create 12-month deposit @ 6.50%		1,00,000
3. Enter into FRA to borrow money from M6 to M12 @ 6.75%		
Day 180		
4. Repay 6-month loan with fresh borrowing @ 6.75% as per FRA	$1,00,000 + (1,00,000 \times 5\% \times 6/12)$	1,02,500
Day 365:		
5. Maturity value of 12-month deposit	$1,00,000 + (1,00,000 \times 6.5\%)$	1,06,500
6. Repay loan along with interest	$1,02,500 + (1,02,500 \times 6.75\% \times 6/12)$	1,05,959
7. Arbitrage gain	$1,06,500 - 1,05,959$	541

12. FRA [Nov 2014 RTP, May 2019 RTP, Nov 2021 MTP] [Concept Revision]

Two companies ABC Limited and XYZ Limited approach DEF Bank for FRA (Forward Rate Agreement). They want to borrow Rs.100 Crores after 2 years for a period of 1 year. Bank has calculated yield curve of both companies as follows:

Year	XYZ Limited	ABC Limited
1	3.86	4.12
2	4.20	5.48
3	4.48	5.78

- ❖ Identify at least one reason for difference in the Yield Curve for the companies
- ❖ You are required to calculate the rate of interest DEF Bank would quote under 2v3 FRA, using the company's yield information as quoted above
- ❖ Suppose bank offers Interest rate guarantee for a premium of 0.1% of the amount of loan, you are required to calculate the interest payable by XYZ Limited if interest in 2 years turns out to be
 - 4.50%
 - 5.50%

Answer:**Difference in Yield Curve:**

- The difference in yield curve may be due to the lower credit rating of ABC Limited as compared to XYZ Limited

WN 1: Computation of FRA rate:

- The company wants to borrow after 2 years for a period of 1 year. The company therefore is looking at getting 2x3 FRA rate

XYZ Limited:

$$2 \times 3 \text{FRA} = \frac{\text{Future value factor for 3 years}}{\text{Future value factor for 2 years}} - 1 = \frac{(1 + 4.48\%)^3}{(1 + 4.20\%)^2} - 1 = 5.04\%$$

ABC Limited:

$$2 \times 3 \text{FRA} = \frac{\text{Future value factor for 3 years}}{\text{Future value factor for 2 years}} - 1 = \frac{(1 + 5.78\%)^3}{(1 + 5.48\%)^2} - 1 = 6.38\%$$

WN 2: Computation of actual interest with interest rate guarantee:

- Interest rate guarantee is either a cap or floor option depending on whether we are borrower or lender
- XYZ Limited is borrower and they would want to restrict the maximum interest outflow
- It is assumed that strike rate of option is equal to fair FRA rate of 5.04%

Particulars	4.50% - Allow to Lapse	5.50% - Exercise
Interest cost	4.50 crores [100 crores x 4.50%]	5.04 Crores [100 Crores x 5.04%]
Premium	0.10 Crores	0.10 Crores
Total Cost	4.60 Crores (or) 4.60%	5.14 Crores (or) 5.14%

13. FRA [May 2014 RTP, May 2018 RTP, Nov 2016 MTP, May 2021 RTP]

Electraspace is consumer electronics wholesaler. The business of the firm is highly seasonal in nature. In 6 months of a year, firm has a huge cash deposits and especially near Christmas time and other 6 months firm cash crunch, leading to borrowing of money to cover up its exposures for running the business. It is expected that firm shall borrow a sum of ₹50 million for the entire period of slack season in about 3 months. A Bank has given the following quotations:

- ❖ Spot 5.50% - 5.75%
- ❖ 3 × 6 FRA 5.59% - 5.82%
- ❖ 3 × 9 FRA 5.64% - 5.94%

3 month ₹50,000 future contract maturing in a period of 3 months is quoted at 94.15 (5.85%).

You are required to determine:

- ❖ How a FRA, shall be useful if the actual interest rate after 6 months turnout to be:
 - 4.5%
 - 6.5%
- ❖ Advise the position to be taken in Future Market by the firm to hedge its interest rate risk and demonstrate how 3 months Future contract shall be useful for the firm if interest rate turns out as mentioned in part (a) above.

Answer:**WN 1: Effect of FRA:**

- The company wants to borrow after 3 months for entire slack season of 6 months. This would mean borrowing from M3 to M9.
- The company should enter into 3x9 FRA to hedge interest rate risk
- Relevant 3x9 FRA borrowing rate is 5.94%**

Particulars	Actual rate of 4.50%	Actual rate of 6.50%
1. Payment to original lender	4.50%	6.50%
2. Payment by Electraspace to bank (FRA settlement)	1.44%	-
3. Receipt by Electraspace from Bank (FRA settlement)	-	(0.56%)
4. Net borrowing cost	5.94%	5.94%

5. FRA Payment/Receipt	3,60,000 [50 mn x 1.44% x ½]	(1,40,000) [50 mn x 0.56% x ½]
6. Interest on actual basis	11,25,000 [50 mn x 4.50% x ½]	16,25,000 [50 mn x 6.5% x ½]
7. Net outflow	14,85,000	14,85,000

Thus, by entering into FRA, the firm has committed itself to a rate of 5.94% shown as follows:

$$\frac{14,85,000}{50,00,000} \times 100 \times \frac{12}{6} = 5.94\%$$

WN 2: Hedging through interest rate futures:

- The company wants to borrow 50 million for 6 months. Futures contracts are available only for 3 months and hence we should adjust the value of futures contract
- Borrowing 50 million for 6 months is similar to borrowing 100 million for 3 months
- The company is a borrower and hence it should sell interest rate futures

$$\text{No of futures contracts} = \frac{\text{Amount to be hedged}}{\text{Size of one contract}} = \frac{100 \text{ million}}{50,000} = 2,000 \text{ Contracts}$$

Actual interest rate is 4.50%

Particulars	Calculation	Amount
1. Interest to be paid on original loan	50 million x 4.50% x 6/12	11,25,000
2. Futures settlement (Note 1)		3,37,500
3. Total outflow		14,62,500
4. Effective borrowing cost	$\frac{14,62,500}{50 \text{ million}} \times \left(\frac{12}{6}\right) \times 100$	5.85%

Note 1: Computation of futures settlement:

Date	Position	Action	Reference Date	Rate
Day 0	Original Position	Borrow	Day 90	5.85%
Day 90	Opposite Position	Lend	Day 90	4.50%
Loss in %				1.35%
Loss in rupees (100 million x 1.35% x $\left(\frac{3}{12}\right)$)				3,37,500

Actual interest rate is 6.50%

Particulars	Calculation	Amount
1. Interest to be paid on original loan	50 million x 6.50% x 6/12	16,25,000
2. Futures settlement (Note 1)		(1,62,500)
3. Total outflow		14,62,500
4. Effective borrowing cost	$\frac{14,62,500}{50 \text{ million}} \times \left(\frac{12}{6}\right) \times 100$	5.85%

Note 1: Computation of futures settlement:

Date	Position	Action	Reference Date	Rate
Day 0	Original Position	Borrow	Day 90	5.85%
Day 90	Opposite Position	Lend	Day 90	6.50%
Profit in %				0.65%
Profit in rupees (100 million x 0.65% x $\left(\frac{3}{12}\right)$)				1,62,500

Thus, the firm locked itself in interest rate of 5.85% using interest rate futures

14. Forward rate agreement [Nov 2012 RTP, May 2019 MTP, May 2016 MTP, SM]

TM Fincorp has bought a 6X9 Rs.100 crore Forward Rate Agreement (FRA) at 5.25%. On fixing date reference rate, MIBOR turns out to be as follows:

Period	Rate (%)

3 months	5.50
6 months	5.70
9 months	5.85

You are required to determine:

- Profit/Loss to TM Fincorp. In terms of basis points
- The settlement amounts

(Assume 360 days in a year)

Answer:

WN 1: Computation of profit/loss in terms of basis points:

- ❖ The company has taken a 6x9 FRA and hence the borrowing is from month 6 to month 9. We now have the actual rates for Month 6 and hence the relevant rate is for next 3 months. Therefore, the actual rate is 5.50%
- ❖ The company had taken FRA at 5.25% and the actual rate is 5.50%. Hence the company will be gaining 0.25% due to FRA

WN 2: Computation of profit/loss:

Particulars	Calculation	Amount
Profit in Forward Rate Agreement		0.25%
Amount of settlement (undiscounted)	100 crores $\times$ 0.25% $\times$ (3/12)	6,25,000
Amount of settlement (discounted)	$\frac{6,25,000}{\left(1 + \left(5.50\% \times \frac{3}{12}\right)\right)}$	6,16,523

Conclusion: Hence settlement on reference date will have to be done for Rs.6,16,523

15. Forward Rate Agreement [May 2014 MTP]

The treasurer of a company expects to receive a cash inflow of \$15,000,000 in 90 days. The treasurer expects short-term interest rates to fall during the next 90 days. In order to hedge against this risk, the treasurer decides to use an FRA that expires in 90 days and is based on 90-day LIBOR. The FRA is quoted at 1.5%. At expiration, LIBOR is 1.25%. Assume that the notional principal on the contract is \$15,000,000.

- Indicate whether the treasurer should take a long or short position to hedge interest rate risk.
- Using the appropriate terminology identify the type of FRA used here.
- Calculate the gain or loss to the company as a consequence of entering the FRA

Answer:

- The company needs to invest money and hence they should take a short position in FRA. We should not confuse the position with Interest rate futures. In case of FRA, borrower will take long position and investor will take short position.
- The company will receive money after 3 months. The investment is needed for a period of 3 months. Therefore, we should go for 3 $\times$ 6 FRA
- Computation of settlement:**

Particulars	Calculation	Amount
Profit in Forward Rate Agreement		0.25%
Amount of settlement (undiscounted)	150 lacs $\times$ 0.25% $\times$ (3/12)	9,375
Amount of settlement (discounted)	$\frac{9,375}{\left(1 + \left(1.25\% \times \frac{3}{12}\right)\right)}$	9,346

Part III - Interest Rate Swaps

16. Mechanism of Interest rate swap

A and B Limited have entered into a three year swap on March 5, 2010 wherein A agrees to pay a fixed rate of interest of 5 percent per annum and B agrees to pay LIBOR on a notional principal of 100 million USD. The agreement specifies the payment to be arranged every six months. The floating rate of interest on various reset dates happened to be as follows:

Date	Floating rate
5/3/10	4.2
5/9/10	4.8
5/3/11	5.3

5/9/11	5.5
5/3/12	5.6
5/9/12	5.9
5/3/13	6.4

- ❖ Calculate the net cash flow to A and B from the swap arrangement
- ❖ Comment upon A and B regarding their view on interest rates
- ❖ A Limited has borrowed money at a floating rate of LIBOR + 0.10% and B Limited has borrowed at fixed rate of 5.2%. A Limited wants to transform its floating rate loan into fixed rate and B Limited wants to transform its fixed rate to floating rate. Illustrate how swap has been structured and what is the effective borrowing cost post swap arrangement.

Answer:

WN 1: Computation of net cash flows from swap arrangement:

Date	No of days	Fixed rate	Floating rate	Amount to be paid by A	Amount to be paid by B	Net cash flows B to A
05-Sep-10	184	5%	4.80%	25,20,548	24,19,726	-1,00,822
05-Mar-11	181	5%	5.30%	24,79,452	26,28,219	1,48,767
05-Sep-11	184	5%	5.50%	25,20,548	27,72,603	2,52,055
05-Mar-12	182	5%	5.60%	24,86,339	27,84,699	2,98,360
05-Sep-12	184	5%	5.90%	25,13,661	29,66,120	4,52,459
05-Mar-13	181	5%	6.40%	24,79,452	31,73,699	6,94,247

Note:

- It is assumed that LIBOR on reset dates is applicable for previous six months interest computation. For example, LIBOR on September 5, 2010 is 4.8 percent and the same was used to calculate interest from March 5, 2010 to September 5, 2010
- Negative net cash flows will indicate amount payable by A Limited to B Limited

View on interest rates:

- A is willing to pay a fixed rate of 5 percent in return for LIBOR receipt. This would help A Limited in converting a floating rate loan to a fixed rate loan. A Limited want to pay effective fixed rate and hence they will have a view of interest rates going up
- B Limited plans to pay effective floating rate and hence they will have a view of interest rate coming down

WN 2: Computation of effective borrowing rate:

Particulars	A Limited	B Limited
1. Pay to banker as per original borrowed rate	LIBOR + 0.10%	5.20%
2. A Limited to B Limited	5%	(5%)
3. B Limited to A Limited	(LIBOR)	LIBOR
4. Effective borrowing rate	5.10%	LIBOR + 0.20%

17. Interest rate swap

Madagascar Limited is an Indian company. They are in the process of raising a US dollar loan and are negotiating the rates with a foreign bank. The company has been offered a fixed rate of 8 percent with a proviso that they should opt for a floating rate, the interest rate is likely to be linked to the bench mark rate of 60 basis points over 10 year US T Bill rate with interest refixation on a three-monthly basis. The expectations of Madagascar Limited are that the Dollar interest rates will fall and are inclined to have a flexible mechanism built into their interest rates. On enquiry they find that they could go for a swap arrangement with Syndicate India Limited who have been offered a floating rate of 120 basis points over 10 year T Bill rate as against a fixed rate of 9.20 percent. Describe the swap on the assumptions that

- The swap differential is shared between the two equally or
- The swap differential is shared between Madagascar and Syndicate in the ratio of 3:1
- The swap banker charges 0.1% as charges and swap benefits are shared equally

Answer:

WN 1: Structure of interest rates:

Particulars	Fixed rate	Floating rate
M Limited	8%	T+0.6%
S Limited	9.2%	T+1.2%

- Total interest rate of combination 1 [M limited (fixed) & S Limited (Floating)] = $8\% + T + 1.2\% = T + 9.2\%$
- Total interest rate of combination 2 [M limited (floating) & S Limited (fixed)] = $T + 0.6\% + 9.2\% = T + 9.8\%$
- Ideal combination = Combination 1; This would mean that M Limited should borrow at fixed rate and S Limited should borrow at floating rate
- **Actual scenario:** M Limited plans to borrow at floating rate and S Limited plans to borrow at fixed rate
- Scope for Interest rate swap exist as the ideal and actual scenario does not match
- Swap gain = Difference in total interest of combination 1 & 2 = $(T + 9.8\%) - (T + 9.2\%) = 0.6\%$
- **Share of swap gain (equal gain):**
 - M Limited = 0.30%
 - S Limited = 0.30%

WN 2: IRS structuring:

Particulars	M Limited	S Limited
1. Pay to banker as per ideal rate	8%	T + 1.2%
2. M Limited to S Limited	T	(T)
3. S Limited to M Limited (b/f)	(7.7%)	7.7%
4. Effective borrowing rate	T + 0.3%	8.9%

Notes:

- M Limited wanted to borrow at floating rate. They will be asked to pay Treasury bill rate to S Limited and this would swap their fixed loan to a floating loan
- Effective borrowing rate = Original rate – share of swap gain
- S Limited payment to M Limited will be taken as balancing figure

WN 3: IRS structuring if gain is shared in the ratio of 3:1**Share of swap gain:**

- M Limited = $0.60 \times (3/4) = 0.45\%$
- S Limited = $0.60 \times (1/4) = 0.15\%$

Particulars	M Limited	S Limited
1. Pay to banker as per ideal rate	8%	T + 1.2%
2. M Limited to S Limited	T	(T)
3. S Limited to M Limited (b/f)	(7.85%)	7.85%
4. Effective borrowing rate	T + 0.15%	9.05%

WN 4: IRS Structuring with swap intermediary:**Share of swap gain:**

- Intermediary = 0.10% (assumed to be combined charge from both companies)
- M Limited = 0.25%
- S Limited = 0.25%

Structuring for M Limited:

Particulars	M Limited
1. Pay to banker as per ideal rate	8%
2. M Limited to intermediary	T
3. Intermediary to M Limited (bal figure)	(7.65%)
4. Effective borrowing rate	T + 0.35%

Structuring for S Limited:

Particulars	S Limited

1. Pay to banker as per ideal rate	T + 1.20%
2. S Limited to intermediary (bal figure)	7.75%
3. Intermediary to S Limited	(T)
4. Effective borrowing rate	8.95%

18. Interest rate swap

Grades Limited enjoys a high credit rating and is capable of raising term funds either at a fixed rate of 10% p.a. or at a floating rate of 40 basis points over MIBOR. Level Limited enjoys a relatively lower credit rating and is able to borrow either at 80 basis points over MIBOR or at affixed rate of 10.5%. Level limited wants to borrow at fixed rate whereas Grades would like to enjoy a floating rate. Structure a swap arrangement such that Grades gains 2/3rd of the total gain. Assume that there are no intermediaries. What action would follow if Grades apprehends that interest rates will harden while Level believes that interest rates will soften?

Answer:**WN 1: Structure of interest rates:**

Particulars	Fixed rate	Floating rate
Grades Limited	10%	MIBOR + 0.40%
Level Limited	10.50%	MIBOR + 0.80%

- Total interest rate of combination 1 [Grades limited (fixed) & Level Limited (Floating)] = 10% + MIBOR + 0.8% = MIBOR + 10.80%
- Total interest rate of combination 2 [Grades limited (floating) & Level Limited (fixed)] = 10.50% + MIBOR + 0.40% = MIBOR + 10.90%
- Ideal combination = Combination 1; This would mean that Grades Limited should borrow at fixed rate and Level Limited should borrow at floating rate
- **Actual scenario:** Grades Limited plans to borrow at floating rate and Level Limited plans to borrow at fixed rate
- Scope for Interest rate swap exist as the ideal and actual scenario does not match
- Swap gain = Difference in total interest of combination 1 & 2 = 0.10%
- **Share of swap gain (2:1):**
 - Grades Limited = 0.07%
 - Level Limited = 0.03%

WN 2: IRS structuring:

Particulars	Grades Limited	Level Limited
1. Pay to banker as per ideal rate	10%	MIBOR + 0.80%
2. Grades Limited to Level Limited	MIBOR	(MIBOR)
3. Level Limited to Grades Limited (bal figure)	(9.67%)	9.67%
4. Effective borrowing rate	MIBOR + 0.33%	10.47%

Rework scenario:

- Grades Limited believes that interest rates will harden (go up) and hence they would opt for fixed rate loan. Level Limited believes that interest rates will soften (come down) and hence they would opt for floating rate loan
- The above scenario is in line with ideal combination and hence no scope for IRS exist

19. Interest rate swap [May 2019, May 2021 MTP, Nov 2020, May 2023, Nov 2021 MTP] [Concept Revision]

IM is an American firm having its subsidiary in Japan and JI is a Japanese firm having its subsidiary in USA. They face the following interest rates

Particulars	IM	JI
USD floating rate	LIBOR + 0.5%	LIBOR + 2.5%
JPY Fixed rate	2%	2.25%

JI wishes to borrow USD at floating rate and IM wishes to borrow JY at fixed rate. The amount required by both the companies is same at the current exchange rate. A Bank arranges a swap and requires 175 basis points as its commission, which is to be shared equally. IM requires a minimum gain of 75 basis points and JI requires a minimum gain of 75 basis points for structuring the deal. The Bank is very keen to structure the deal, even if, it has to forego a part of its commission.

You are required to find out

- (i) Whether a beneficial swap can be arranged?
- (ii) What rate of interest for both IM and JI?

Answer:

WN 1: Structure of interest rates:

Particulars	Fixed rate	Floating rate
IM	2%	LIBOR + 0.50%
JI	2.25%	LIBOR + 2.5%

- Total interest rate of combination 1 [IM limited (fixed) & JI Limited (Floating)] = 2% + LIBOR + 2.5% = LIBOR + 4.5%
- Total interest rate of combination 2 [IM limited (floating) & JI Limited (fixed)] = LIBOR + 0.5% + 2.25% = LIBOR + 2.75%
- Ideal combination = Combination 2; This would mean that IM Limited should borrow at floating rate and JI Limited should borrow at fixed rate
- **Actual scenario:** JI Limited plans to borrow at floating rate and IM Limited plans to borrow at fixed rate
- Scope for IRS exist. Benefit of swap = Difference in interest of two combinations = 1.75%
- Commission for swap intermediary = 0.25%; Net benefit of swap = 1.50% and the same is shared as 0.75%

Note:

Since, bank's commission is 1.75% which constitutes the entire gain, and it is mentioned that bank will forego a part of its commission to structure the deal. Thus, it will forego the minimum gain required by IM and JI i.e. 0.75% and 0.75% respectively. Hence the net commission will be 0.25%.

Swap Structuring:

Particulars	IM	JI
1. Pay to banker as per ideal rate	USD LIBOR + 0.5%	JPY 2.25%
2. Receive from swap intermediary	(USD LIBOR + 0.5%)	(JPY 2.25%)
3. Payment to swap intermediary	JPY 1.25%	USD LIBOR + 1.75%
4. Effective borrowing rate	JPY 1.25%	USD LIBOR + 1.75%

- Effective borrowing rate for JI = LIBOR + 2.5% - 0.75% = LIBOR + 1.75%
- Effective borrowing rate for IM = 2.00% - 0.75% = 1.25%

20. Interest rate swap

There are two firms A and B. Firm A has invested USD 100 million in fixed rate bonds yielding 8.5 percent. Firm A is not a highly rated firm and it has raised its loan for funding its assets through floating rate loan from bank at an interest rate of LIBOR + 0.50%. Firm B has invested USD 100 million in floating rate bond yielding LIBOR + 0.75% and it has raised its loan for funding its assets through fixed rate loan from bank at 6%. There is a big bank which offers interest rate swap with a spread of 0.10% as follows:

- ❖ Swap Bid = 6.4% for LIBOR
- ❖ Swap Ask = 6.5% for LIBOR
- a) Explain how the two companies can reduce the interest rate risk
- b) Calculate the companies locked in spread

Answer:

Hedging interest rate risk:

- Firm A has taken a floating rate loan and created a fixed rate deposit. Firm A will be impacted if interest rates go up. Firm A should enter into IRS with Big Bank. They should receive LIBOR and pay 6.5 percent to other party
- Firm B has taken a fixed rate loan and created a floating rate deposit. Firm B will be impacted if interest rates come down. Firm B should enter into IRS with Big Bank. They should pay LIBOR and receive 6.4 percent from other party

Computation of locked in spread:

Particulars	Firm A	Firm B
1. Investment rate	8.5%	LIBOR + 0.75%

2. Borrowing Rate	(LIBOR + 0.50%)	(6%)
3. Firm to Big Bank	(6.5%)	(LIBOR)
4. Big Bank to Firm	LIBOR	6.4%
5. Locked in spread	1.50%	1.15%

21. Interest rate swap [Nov 2016 RTP, Nov 2018, Nov 2008, Nov 2010, May 2021 MTP, July 2021, May 2023 RTP, Nov 2023, May 2024 MTP, SM] [Concept Revision]

Suppose a dealer bank quotes for a generic swap "AIC 8%/8.20% vs. 6M LIBOR Flat". Notional principal amount of swap is Rs. 1 Million, and the same is for a period of three years, reset after every six months. In this context, answer the following questions:

- Interpret the dealer bank quote.
- If a firm is buying a swap, what is the nature of cash flows?
- If a firm is selling a swap, what is the nature of cash flows?
- Calculate semi-annual fixed payment for the buyer of swap at the end of every six months.
- If the six month period from the effective date of swap to the settlement date comprises of 181 days and that the corresponding LIBOR was 5% on the effective date of swap, then what will be the first floating rate payment for the buyer?
- If the settlement is on "Net Basis", how much the buyer of swap has to pay or receive at the end of first six months?

[Assume 30/360 days basis]

Answer:

Interpretation of dealer bank quote:

- AIC in the dealer bank quote refers to 'All in cost' i.e. cost of swap all inclusive.
- First part of the quote i.e. '8%/8.20%' refers to the fixed leg part and the second part of the quote i.e. '6m LIBOR Flat' refers to the floating leg part.
- The difference in the fixed rates i.e. 20 bps refers to the margin charged by the Bank on the fixed leg of transactions.
- The term 'flat' on the floating leg quote, indicates that the Bank does not charge any commission on the floating leg. Therefore, bank charges 20 bps for transacting swap as a whole.

Buyer of the swap:

- A buyer of swap pays 'Fixed' cash flows and receives 'Floating'. As per the quote, the buyer would pay 8.2% (higher of 8%, 8.2%) to the Bank and would receive '6M LIBOR' against it.

Seller of the swap:

- A seller of swap pays 'floating' cash flows and receives 'fixed'. As per the quote, the seller would pay '6M LIBOR' to the bank and would receive 8% (lower of 8%, 8.2%) against it.

Semi-annual fixed payment of buyer of the swap:

$$\text{Semi - annual payment} = 10,00,000 \times 8.20\% \times \left(\frac{6}{12}\right) = \text{Rs. 41,000}$$

Floating rate payment:

$$\text{Floating payment} = 10,00,000 \times 5\% \times \left(\frac{181}{360}\right) = 25,139$$

Net settlement:

$$\text{Net payment by buyer of the swap} = 41,000 - 25,139 = \text{Rs. 15,861}$$

22. Evaluation of interest swap arrangement [Nov 2015 RTP]

NoBank offers a variety of services to both individuals as well as corporate customers. NoBank generates funds for lending by accepting deposits from customers who are paid interest at PLR which keeps on changing.

NoBank is also in the business of acting as intermediary for interest rate swaps. Since it is difficult to identify

matching client, NoBank acts counterparty to any party of swap. Sleepless approaches NoBank who already have Rs. 50 crore outstanding and paying interest @PLR+80bp p.a. The duration of loan left is 4 years. Since Sleepless is expecting increase in PLR in coming year, he asked NoBank for arrangement of interest of interest rate swap that will give a fixed rate of interest.

As per the terms of agreement of swap NoBank will borrow Rs.50 crore from Sleepless at PLR+80bp per annum and will lend Rs. 50 crore to Sleepless at fixed rate of 10% p.a. The settlement shall be made at the net amount due from each other. For this services NoBank will charge commission @0.2% p.a. if the loan amount. The present PLR is 8.2%.

You as a financial consultant of NoBank have been asked to carry out scenario analysis of this arrangement. Three possible scenarios of interest rates expected to remain in coming 4 years are as follows:

	Year 1	Year 2	Year 3	Year 4
Scenario 1	10.25	10.50	10.75	11.00
Scenario 2	8.75	8.85	8.85	8.85
Scenario 3	7.20	7.40	7.60	7.70

Assuming that cost of capital is 10%, whether this arrangement should be accepted or not.

Answer:

WN 1: Computation of NPV of scenario 1:

Year	PLR	Payment by Nobank PLR + 0.80%	Receipt by nobank 10.20%	Net payment/ receipt	PVF @ 10%	DCF
1	10.25%	5,52,50,000	5,10,00,000	(42,50,000)	0.909	(38,63,250)
2	10.50%	5,65,00,000	5,10,00,000	(55,00,000)	0.826	(45,43,000)
3	10.75%	5,77,50,000	5,10,00,000	(67,50,000)	0.751	(50,69,250)
4	11.00%	5,90,00,000	5,10,00,000	(80,00,000)	0.683	(54,64,000)
NPV of scenario 1						(1,89,39,500)

WN 2: Computation of NPV of scenario 2:

Year	PLR	Payment by Nobank PLR + 0.80%	Receipt by nobank 10.20%	Net payment/ receipt	PVF @ 10%	DCF
1	8.75%	4,77,50,000	5,10,00,000	32,50,000	0.909	29,54,250
2	8.85%	4,82,50,000	5,10,00,000	27,50,000	0.826	22,71,500
3	8.85%	4,82,50,000	5,10,00,000	27,50,000	0.751	20,65,250
4	8.85%	4,82,50,000	5,10,00,000	27,50,000	0.683	18,78,250
NPV of scenario 2						91,69,250

WN 3: Computation of NPV of scenario 3:

Year	PLR	Payment by Nobank PLR + 0.80%	Receipt by nobank 10.20%	Net payment/ receipt	PVF @ 10%	DCF
1	7.20%	4,00,00,000	5,10,00,000	1,10,00,000	0.909	99,99,000
2	7.40%	4,10,00,000	5,10,00,000	1,00,00,000	0.826	82,60,000
3	7.60%	4,20,00,000	5,10,00,000	90,00,000	0.751	67,59,000
4	7.70%	4,25,00,000	5,10,00,000	85,00,000	0.683	58,05,500
NPV of scenario 3						3,08,23,500

Conclusion:

- Nobank should go ahead with IRS if they believe Scenario 2/3 is likely scenario. However, if they believe scenario 1 will happen they should avoid IRS

23. Calculation of interest rate [May 2012 RTP, Nov 2017 RTP, May 2018, Nov 2010, May 2014 MTP, Nov 2017 MTP, Nov 2021 RTP, Nov 2020 MTP, Nov 2023 MTP, Nov 2022 MTP, May 2024 MTP, Nov 2024 RTP, SM] [Concept Revision]

Derivative Bank entered into a swap arrangement on a principal of Rs. 10 crores and agreed to receive MIBOR overnight floating rate for a fixed payment on the principal. The swap was entered into on

Monday, 2 August, 2010 and was to commence on 3 August, 2010 and run for a period of 7 days. Respective MIBOR rates for Tuesday to Monday were:

7.75%, 8.15%, 8.12%, 7.95%, 7.98%, 8.15%.

Required:

- The nature of this swap arrangement
- If Derivative Bank received Rs. 317 net on settlement, calculate Fixed rate and interest under both legs.

Notes:

- ❖ Sunday is Holiday.
- ❖ Work in rounded rupees and avoid decimal working.

Answer:

- The given swap arrangement is Plain Vanilla Overnight Index Swap (OIS).

WN 1: Computation of interest to be paid by floating rate payer:

Date	ROI	Opening balance	Interest	Closing balance
August 3 (Tuesday)	7.75%	10,00,00,000	21,233	10,00,21,233
August 4 (Wednesday)	8.15%	10,00,21,233	22,334	10,00,43,567
August 5 (Thursday)	8.12%	10,00,43,567	22,256	10,00,65,823
August 6 (Friday)	7.95%	10,00,65,823	21,795	10,00,87,618
August 7 (Saturday)	7.98%	10,00,87,618	43,764	10,01,31,382
August 9 (Monday)	8.15%	10,01,31,382	22,358	10,01,53,740
Total			1,53,740	

- Interest under floating leg = Rs.1,53,740
- Derivative bank is paying fixed rate and receiving floating rate. Under net settlement they are receiving Rs.317. This is possible if interest under fixed leg is lower than interest under floating leg
- Interest under fixed leg = 1,53,740 - 317 = 1,53,423

Computation of fixed rate:

Interest under fixed leg = 10 Crores x ROI x $\left(\frac{7}{365}\right) = 1,53,423$

$ROI = 1,53,423 \times \left(\frac{365}{7}\right) \times \left(\frac{1}{10 \text{ Crores}}\right) = 0.079999 \text{ (or) } 8\%$

24. Selection of source of funding [Nov 2019] [Homework]

A German subsidiary of an US based MNC has to mobilize 1,00,000 Euro's working capital for the next 12 months. It has the following options:

Loan from German Bank	5% per annum
Loan from US Parent Bank	4% per annum
Loan from Swiss Bank	3% per annum

Banks in Germany charge an additional 0.25% p.a. towards loan servicing. Loans from outside Germany attract withholding tax of 8% on interest payments. If the interest rates given above are market determined, examine which loan is the most attractive using interest rate differential.

Answer:

Computation of net cost under each of the options:

Cost in Germany	Borrowing rate + Loan servicing cost 5% + 0.25%	5.25%
Cost in USA	Borrowing rate $\pm$ Premium/Discount (4%) $\frac{1 - 0.08}{1 - 0.08} + 0.96\%$ 4.35% + 0.96%	5.31%
Cost in Switzerland	Borrowing rate $\pm$ Premium/Discount (3%) $\frac{1 - 0.08}{1 - 0.08} + 1.94\%$ 3.26% + 1.94%	5.20%

Conclusion:

- German Subsidiary should borrow money from Swiss Bank as the effective cost is lowest

Computation of exchange rate premium in USA and Switzerland:**Premium in USA:**

$$(1 + \text{Home Currency Rate}) = (1 + \text{Foreign Currency Rate}) \times (1 + \text{Premium})$$

$$(1 + 5\%) = (1 + 4\%) \times (1 + \text{Premium})$$

$$(1 + \text{Premium}) = \frac{1.05}{1.04}; (1 + \text{Premium}) = 1.0096$$

$$\text{Premium} = 0.0096 \text{ (or) } 0.96\%$$

Premium in Switzerland:

$$(1 + \text{Home Currency Rate}) = (1 + \text{Foreign Currency Rate}) \times (1 + \text{Premium})$$

$$(1 + 5\%) = (1 + 3\%) \times (1 + \text{Premium})$$

$$(1 + \text{Premium}) = \frac{1.05}{1.03}; (1 + \text{Premium}) = 1.0194$$

$$\text{Premium} = 0.0194 \text{ (or) } 1.94\%$$

Chapter 13 – Business Valuation**Practical Problems****Overview:**

- Part I – Economic Value Added
- Part II – Valuation of Business
- Part III – Market Value Added and Shareholder Value Added
- Part IV – Valuation of distressed companies
- Part V – Valuation of Start-ups
- Part VI – Valuation of Digital Platforms
- Part VII – Valuation of Professional/Consultancy firms
- Part VIII – Impact of ESG on valuation

Part I – Economic Value Added**1. Calculation of EVA [May 2012 RTP, Nov 2024 MTP]**

The following figures pertain to ABC Limited as on December 31, 2010

Particulars	Amount (in lacs)
Income from consultancy	935.00
EBIT	180.00
Less: Interest on loan	18.00
EBT	162.00
Tax @ 35%	56.70
EAT	105.30

Balance sheet as on December 31, 2010

Liabilities	Amount	Assets	Amount
Equity share capital of Rs.10 each	100	Land and Building	200
Reserves & Surplus	325	Computer & software	295
Loans	180	Current assets	290
Current liabilities	180		
	785		785

With the above information and following assumption you are required to compute:

- Economic value added
- Market value added

Assuming that:

- WACC is 12%
- The share of the company is currently quoted at Rs.50 each

Answer:**WN 1: Computation of Economic Value Added:**

- $EVA = [EBIT \times (1 - \text{Tax rate})] - (\text{Capital employed} \times \text{WACC})$
- $EVA = [180 \times (1 - 35\%)] - [(100 + 325 + 180) \times 12\%]$
- $EVA = 117 - 72.60$
- **EVA = 44.40 lacs**

WN 2: Computation of market value added:

- Market value added = Market value of firm – Book value of firm
- $MVA = [(10 \times 50 + 180)] - [100 + 325 + 180]$
- **MVA = Rs.75 lacs**

Note:

- **Value of Firm = Value of equity + Value of debt + Value of preference**

2. Calculation of EVA [May 2015 RTP]

ABC Limited has divisions A, B & C. The Division C has recently reported an annual operating profit of Rs.2020 lacs. This figure arrived at after charging Rs.300 lacs full cost of advertisement expenditure for launching a new product. The benefits of this expenditure is expected to be lasted for 3 years. The cost of capital of Division C is 11% and cost of debt is 8%. The Net Assets (Invested capital) of Division C as per

latest Balance Sheet is Rs.6000 lacs, but replacement cost of these assets is estimated at Rs.8400 lacs. You are required to compute EVA of Division C.

Answer:

Computation of Economic Value Added:

- $EVA = [EBIT \times (1 - \text{Tax rate})] - (\text{Capital employed} \times WACC)$
- $EVA = [2,220 \times (1 - 25\%)] - [8,400 \times 11\%]$
- $EVA = 1,665 - 924$
- **EVA = Rs.741 lacs**

Note 1: Computation of Adjusted EBIT:

Particulars	Amount
Reported EBIT	2,020
Add: Full Advertisement expenditure	300
Less: Annual advertisement charge (300/3)	-100
Adjusted EBIT	2,220

Note 2: Tax rates:

- It is assumed that tax rates are 25%

3. Concept of EVA dividend [May 2019 MTP, May 2011, Nov 2010, Nov 2015 RTP, Nov 2022 RTP, SM]

Delta Limited's current financial year's income statement reports its net income as Rs.15 lacs. Delta's marginal tax rate is 40% and its interest expense for the year was Rs.15 lacs. The company has Rs.100 lacs of invested capital, of which 60% is debt. In addition, Delta Limited tries to maintain a WACC of 12.6%.

- Compute the operating income or EBIT earned by Delta Limited in the current year
- What is Delta Limited EVA for the current year
- Delta Limited has 2,50,000 equity shares outstanding. According to the EVA you computed in (ii), how much can Delta pay in dividend per share before the value of the company would start to decrease? If Delta Limited does not pay any dividends what would happen to value of the company.

Answer:

WN 1: Computation of operating income (EBIT)

Particulars	Calculation	Amount
Net income (PAT)		15,00,000
Income tax		10,00,000
Profit before tax	15,00,000 1 - 0.4	25,00,000
Add: Interest		15,00,000
Earnings before interest and taxes		40,00,000

WN 2: Computation of Economic Value Added:

- $EVA = [EBIT \times (1 - \text{Tax rate})] - (\text{Capital employed} \times WACC)$
- $EVA = [40,00,000 \times (1 - 40\%)] - [1,00,00,000 \times 12.60\%]$
- $EVA = 24,00,000 - 12,60,000$
- **EVA = Rs.11,40,000**

WN 3: Computation of amount of dividend payment:

- The company has reported economic value added (excess earnings) of Rs.11,40,000. This entire EVA will go the equity shareholders
- $EVA \text{ per share} = (11,40,000 / 2,50,000) = \text{Rs.4.56 per share}$
- Therefore, the company can pay dividend of Rs.4.56 per share without any impact on the value of the company. If the company does not pay and dividends then the share price will increase by Rs.4.56 per share

4. WACC and EVA computation [May 2014, Nov 2015 MTP, SM] [Homework]

RST Limited's current financial year's income statement reported its net income as Rs.25,00,000. The applicable income tax rate is 30%. Following is the capital structure of RST Limited at the end of current financial year:

Particulars	Amount
Debt (Coupon rate = 11%)	40 lacs
Equity (Share capital + Reserves and Surplus)	125 lacs
Invested capital	165 lacs

Following data is given to estimate the cost of equity capital:

Particulars	Amount
Beta of RST Limited	1.36 Times
Risk-free rate	8.5%
Average market risk premium	9%

Required:

- Estimate weighted average cost of capital (WACC) of RST Limited and
- Estimate Economic Value Added (EVA) of RST Limited

Answer:

WN 1: Computation of WACC:

Source	Cost	Weight	Product
Equity	20.74%	125	25.925
Debt	7.7%	40	3.08
Total	17.58%	165	29.005

Note:

- ❖ Cost of equity = $R_f + \text{Beta} \times (R_m - R_f)$
- ❖ Cost of equity = $8.5\% + 1.36 \times 9\% = 20.74\%$

WN 2: Computation of EVA:

EVA	=	EBIT $\times$ (1 - Tax rate) - (WACC $\times$ Invested capital)
EVA	=	$40,11,429 \times (1 - 0.3) - (17.58\% \times 1,65,00,000)$
EVA	=	$28,08,000 - 29,00,700$
EVA	=	-92,700

Note: Computation of EBIT:

Net Income/PAT	=	25,00,000
PBT	=	$\frac{PAT}{1 - \text{Tax rate}} = \frac{25,00,000}{1 - 0.3} = 35,71,429$
EBIT	=	PBT + Interest
EBIT	=	$35,71,429 + 4,40,000 = 40,11,429$

5. EVA Computation [Nov 2020 MTP, Nov 2021 RTP] [Homework]

STR Limited's current financial year's income statement reported its net income after tax as Rs.50 Crores. Following is the capital structure of STR Limited at the end of current financial year:

Debt (Coupon rate = 11%)	80 Crores
Equity (Share capital + Reserves and Surplus)	250 Crores
Invested capital	330 Crores

Following data is given to estimate the cost of equity capital:

Asset Beta of STR Limited	1.11 Times
Risk-free rate of return	8.50%
Average market risk premium	9.00%

The applicable income tax rate is 30%. Estimated Economic Value Added of STR Limited in lacs

Answer:

WN 1: Computation of equity Beta of STR Limited:

Source	Beta	Weight	Product
Equity	1.36	250	339.66
Debt	0.00	56	0.00
Total	1.11	306	339.66

Note:

- Weight of debt = Amount of debt $\times$ (1 - Tax rate) = $80 \times (1 - 0.30) = \text{Rs.}56 \text{ Crores}$
- We are assuming debt to have beta of 0. Debt Beta can alternatively be calculated using CAPM. We have gone with debt beta as 0 in line with ICAI solution

- Equity Beta = $339.66/250 = 1.36$ Times

WN 2: Computation of WACC of STR Limited:

Source	Cost	Weight	Product
Equity	20.74%	250	51.85
Debt	7.7%	80	6.16
Total	17.58%	330	58.01

- Cost of equity = $8.5 + 1.36 \times 9 = 20.74\%$
- Cost of debt = $11 \times 70\% = 7.70\%$

WN 3: Computation of EVA:**(in lacs)**

EVA	=	EBIT $\times$ (1 – Tax rate) – (WACC $\times$ Invested capital)
EVA	=	$8,022.86 \times (1 - 0.3) - (17.58\% \times 33,000)$
EVA	=	$5,616 - 5,801.40$
EVA	=	-185.40 lacs

Note: Computation of EBIT:**(in lacs)**

Net Income/PAT	=	5,000
PBT	=	$\frac{PAT}{1 - Tax\ rate} = \frac{5,000}{1 - 0.3} = 7,142.86$
EBIT	=	PBT + Interest
EBIT	=	7,142.86 + 880 = Rs.8,022.86 lacs

6. Calculation of EVA [Nov 2013 RTP, May 2018 MTP, May 2010, May 2021 MTP, Nov 2019 MTP, May 2022 MTP, SM, May 2024 RTP, Nov 2023] [Concept Revision]

Consider the following operating information gathered from 3 companies that are identical except for capital structures

Particulars	P Limited	Q Limited	R Limited
Total invested capital	100,000	100,000	100,000
Debt/assets ratio	0.80	0.50	0.20
Shares outstanding	6,100	8,300	10,000
Before-tax cost of debt	14%	12%	10%
Cost of equity	26%	22%	20%
Operating income	25,000	25,000	25,000
Tax rate	35%	35%	35%

- Compute the weighted average cost of capital for each company
- Compute the EVA for each company
- Based on the results of your computation in part b, which company would be considered as best investment and why?
- Assume the industry P/E ratio generally is 15x. Using the industry norm, estimate the price for each share and market capitalization
- What factors would cause you to adjust the PE ratio value used in part d so that it is more appropriate?

Answer:**WN 1: Computation of weighted average cost of capital:****P Limited:**

Source	Cost	Weight	Product
Equity	26	0.2	5.2
Debt	9.1	0.8	7.28
WACC			12.48

- Cost of debt = $14\% \times (1 - 35\%) = 9.10\%$

Q Limited:

Source	Cost	Weight	Product

Equity	22	0.5	11
Debt	7.8	0.5	3.9
WACC			14.9

- Cost of debt = $12\% \times (1 - 35\%) = 7.80\%$

R Limited:

Source	Cost	Weight	Product
Equity	20	0.8	16
Debt	6.5	0.2	1.3
WACC			17.3

- Cost of debt = $10\% \times (1 - 35\%) = 6.50\%$

WN 2: Computation of Economic value added:

EVA = [EBIT x (1 - Tax rate)] - (Capital employed x WACC)

Particulars	Company P	Company Q	Company R
EBIT (operating income)	25,000	25,000	25,000
EBIT x (1 - Tax rate) (A)	16,250	16,250	16,250
Capital employed	1,00,000	1,00,000	1,00,000
WACC	12.48	14.90	17.30
Cost of capital employed (WACC x Capital employed) (B)	12,480	14,900	17,300
EVA (A - B)	3,770	1,350	-1,050

- Company P would be considered as the best investment since the EVA of the company is highest and its weighted average cost of capital is the lowest

WN 3: Computation of Market price per share:

Particulars	Company P	Company Q	Company R
EBIT	25,000	25,000	25,000
Less: Interest	-11,200	-6,000	-2,000
EBT	13,800	19,000	23,000
Less: Tax @ 35%	-4,830	-6,650	-8,050
EAT	8,970	12,350	14,950
No of shares	6,100	8,300	10,000
Earnings per share	1.4705	1.4880	1.495
PE Multiple	15	15	15
MPS (EPS x PE Multiple)	22.06	22.32	22.43
No of shares	6,100	8,300	10,000
Market capitalization	1,34,566	1,85,256	2,24,300

Comment on PE Multiple:

- The PE ratio can be adjusted for the change in capital structure of 3 companies. P Limited has a highly leverage capital structure. This will be considered as a risky company and hence will have lower PE Multiple
- R Limited has a better capital structure and hence it will be considered as less risky. This company will therefore have a higher PE Multiple

7. Computation of EVA [May 2019, Nov 2023 MTP, Nov 2024 RTP, SM] [Concept Revision]

Compute Economic value Added (EVA) of Good Luck Limited from the following information:

Particulars	Amount in lacs
Revenue from operations	1,500
Direct expenses	-585
Indirect expenses	-300
Profit before interest and tax	615
Interest	-15
Profit before tax	600
Tax	-180

Profit after tax	420
Balance sheet	
Shareholder funds	
Equity share capital	1,050
Reserves and surplus	150
Long term borrowings	150
Current Liabilities	600
Total liabilities	1,950
Assets	
Non-current assets	1,500
Current assets	450

Other information:

- Pre-tax Cost of debts is 12%
- Cost of equity (Shareholder's expected return) is 10%
- Bad debts provision of Rs.30 lacs is included in indirect expenses and Rs.30 lacs reduced from receivables in current assets.
- Note: Make calculation in Rs. lac and round off up to 2 decimal points

Answer:

WN 1: Computation of NOPAT:

Particulars	Calculation	Amount (in lacs)
Profit after tax		420
Add: Interest (net of tax)	15 x 70%	10.50
Add: Non-cash expenses		30
NOPAT		460.50

- EVA adjustments state that non-cash expenses (bad debt provision) need to be added back to profit
 - Tax expense will be based on 'cash taxes' rather than accruals-based tax used in financial reporting.
- It is assumed that Rs.231 lac is the actual tax outflow and hence no adjustment is made for the same

WN 2: Computation of WACC:

Source	Cost	Weight	Product
Debt	8.40 (12% x 70%)	150	12.60
Equity	10.00	1,200	120.00
Total	9.82%	1,350	132.60

$$\text{WACC} = \frac{\text{Sum of Products}}{\text{Sum of weights}} = \frac{132.60}{1,350} = 9.82\%$$

Note:

- Equity can alternatively be adjusted to give effect to the bad debt provision. Any non-cash item will be added to profits and will also finally get added to the equity of the company

WN 3: Computation of EVA:

- EVA = NOPAT - (Capital employed x WACC)
- EVA = 460.50 lacs - (1,380 x 9.82%)
- EVA = 460.50 lacs - 135.52 lacs
- **EVA = Rs.324.98 lacs**

8. Computation of EVA [Nov 2004, Nov 2012, Nov 2014 MTP, Nov 2016 MTP, SM] [Homework]

With the help of the following information of Jatayu Limited compute the Economic value Added:

Capital structure	Equity capital - Rs.160 lacs Reserves and surplus - Rs.140 lacs 10% debentures - Rs.400 lacs
Cost of equity	14%
Financial leverage	1.5 times
Income tax rate	30%

Answer:

Note 1: Computation of EBIT:

Financial leverage	=	$\frac{EBIT}{EBIT - Interest}$
1.5	=	$\frac{EBIT}{EBIT - 40 \text{ lacs}}$
1.5 EBIT - 60 lacs	=	EBIT
0.5 EBIT	=	60 lacs
EBIT	=	120 lacs

Note 2: Computation of WACC:

Source	Cost	Weight	Product
Equity	14%	300	42
Debt	7%	400	28
Total	10%	700	70

- ❖ Cost of debt should be post-tax cost of debt and the same would be $10\% \times (1 - 30\%) = 7\%$
- ❖ WACC = Sum of product/Sum of weights = $70/700 = 10\%$

Note 3: Computation of EVA:

EVA	=	$EBIT \times (1 - \text{Tax rate}) - (\text{WACC} \times \text{Invested capital})$
EVA	=	$120 \text{ lacs} \times (1 - 0.3) - (10\% \times 700)$
EVA	=	$84 \text{ lacs} - 70 \text{ lacs}$
EVA	=	14 lacs

9. EVA calculation [May 2018, SM]

Constant Engineering Ltd. has developed a high tech product which has reduced the Carbon emission from the burning of the fossil fuel. The product is in high demand. The product has been patented and has a market value of Rs. 100 Crore, which is not recorded in the books. The Net Worth (NW) of Constant Engineering Ltd. is Rs. 200 Crore. Long term debt is Rs. 400 Crore. The product generates a revenue of Rs. 84 Crore. The rate on 365 days Government bond is 10 percent per annum. Market portfolio generates a return of 12 percent per annum. The stock of the company moves in tandem with the market. Calculate Economic Value added of the company

Answer:**Computation of WACC:**

Source	Cost	Weight	Product
Equity	12%	300	36
Debt	10%	400	40
Total	10.86%	700	76

Note:

- ❖ The rate of Government Bond is given as 10 percent per annum. It is assumed that cost of debt is equal to risk-free rate. There is no information on tax rate and hence no adjustment for the same is made
- ❖ Company's stock moves in line with market and hence cost of equity would be equal to return of market. Bond portfolio gives return of 12% and hence K_e would be equal to 12%
- ❖ Networth of the company is currently 200 crores. Patent has not been recorded in books. The networth will increase to Rs.300 crores post recording of patent

Computation of EVA:

EVA	=	$EBIT \times (1 - \text{Tax rate}) - (\text{WACC} \times \text{Invested capital})$
EVA	=	$84 \text{ crores} - (10.86\% \times 700 \text{ crores})$
EVA	=	$84 \text{ crores} - 76 \text{ crores}$
EVA	=	8 crores

Note:

- ❖ It is assumed that revenues given in the question as EBIT of the product. Tax information is not given in the question and hence no adjustment for the same

10. Computation of EVA [May 2018, Nov 2020, May 2023 MTP, SM] [Homework]

Herbal World is a small, but profitable producer of beauty cosmetics using the plant Aloe Vera. Though it is not a high-tech business, yet Herbal's earnings have averaged around Rs. 18.5 lakh after tax, mainly on the

strength of its patented beauty cream to remove the pimples. The patent has nine years to run, and Herbal has been offered Rs. 50 lakhs for the patent rights. Herbal's assets include Rs. 50 lakhs of property, plant and equipment and Rs. 25 lakhs of working capital. However, the patent is not shown in the books of Herbal World. Assuming Herbal's cost of capital being 14 percent, calculate its Economic Value Added (EVA)

Answer:

EVA	=	EBIT x (1 - Tax rate) - (WACC x Invested capital)
EVA	=	18.5 lacs - (14% x 125 lacs)
EVA	=	18.5 lacs - 17.5 lacs
EVA	=	1 lac

Note:

- ❖ Capital employed = Fixed assets + Working capital + Patent = 50 lacs + 25 lacs + 50 lacs = 125 lacs
- ❖ Tax adjustment is not needed for earnings as the given information is post-tax

Author's Note:

- Many students have asked me doubt on why we are not adjusting depreciation on patent in EVA computation.
- My personal view is that the same should be adjusted. However, we have followed ICAI solution and in that the same has not been adjusted. Students are advised to follow ICAI solution in exam

Revised solution adjusting for depreciation on Patent:

- Depreciation on Patent = (50,00,000/9 years) = 5.56 lacs

EVA	=	EBIT x (1 - Tax rate) - (WACC x Invested capital)
EVA	=	(18.5 lacs - 5.56 lacs) - (14% x 125 lacs)
EVA	=	12.94 lacs - 17.5 lacs
EVA	=	-4.56 lacs

11. Computation of NOPAT and Capital Employed [Nov 2021]

Fragrance Ltd. has reported a Net Operating Profit after Tax (NOPAT) to Capital Employed as 2.5% plus Weighted Average Cost of Capital (WACC) for the year 31st March 2021. Economic Value added is Rs. 4 crore as on 31st March 2021.

You are required to calculate (i) The amount of Capital Employed (ii) NOPAT, if WACC is 10%

Answer:

EVA = NOPAT - [Capital Employed x WACC]
4,00,00,000 = [Capital employed x 12.50%] - [Capital employed x 10%]
4,00,00,000 = 2.5% of capital employed
Capital employed = 4,00,00,000/2.5% = Rs.160 Crores
NOPAT = 12.50% of capital employed
NOPAT = 12.50% x 160 Crores = Rs.20 Crores

12. Computation of EVA and MVA [Nov 2021, SM] [Homework]

Following is the information of M/s. DY Ltd. for the year ending 31/03/2021:

Particulars	Amount (in lacs)
Sales	1,000
Operating expenses including interest	620
8% debentures	250
Equity share capital (Face value of Rs.10)	250
Reserves and surplus	250
Market value of DY Limited	900
Corporate tax rate	30%
Risk free rate of return	7%
Market rate of return	12%
Equity Beta	1.40

You are required to

- i. Calculate Weighted Average Cost of Capital of DY Ltd.
- ii. Calculate Economic Value Added
- iii. Calculate Market Value Added

Answer:

WN 1: Computation of WACC:

- Cost of equity = $R_f + \text{Beta} \times (R_m - R_f) = 7 + 1.40 \times (12 - 7) = 14.00\%$
- Cost of debt = $\text{Interest} \times (1 - \text{Tax rate}) = 8\% \times (1 - 0.30) = 5.60\%$

Source	Cost	Weight	Product
Equity	14.00	500.00	70.00
Debt	5.60	250.00	14.00
Total		750.00	84.00

$$\text{WACC} = \frac{\text{Sum of Products}}{\text{Sum of Weights}} = \frac{84.00}{750} \times 100 = 11.20\%$$

Note: WACC has been computed based on book value weights

WN 2: Computation of EVA:

EVA = EBIT $\times$ (1 - Tax Rate) - [Capital employed $\times$ WACC]
EBIT = Sales of 1,000 lacs - Operating expenses of 600 lacs (20 lacs of interest not deducted) = Rs.400 lacs
EVA = 400 lacs $\times$ (1 - 0.30) - [750 lacs $\times$ 11.20%] = 280 lacs - 84 lacs = Rs.196 lacs

WN 3: Computation of MVA:

MVA = Market value of firm - Book value of firm
MVA = 900 lacs - (500 lacs + 250 lacs) = Rs.150 lacs

Part II - Valuation of Business

13. Valuation of business [May 2010, May 2019 MTP, May 2016 MTP, May 2022, May 2022 MTP, SM]
[Concept Revision]

Following information's are available in respect of Intellect design arena Ltd. which is expected to grow at a higher rate for 4 years after which growth rate will stabilize at a lower level:

Base year information:

- ❖ Revenue - Rs. 2,000 crores
- ❖ EBIT - Rs. 300 crores
- ❖ Capital expenditure - Rs. 280 crores
- ❖ Depreciation - Rs. 200 crores

Information for high growth and stable growth period are as follows:

Particulars	High Growth	Stable Growth
Growth in revenues and EBIT	20%	10%
Growth in capital expenditure and depreciation	20%	Capex offset by depreciation
Risk free rate	10%	9%
Equity beta	1.15	1
Market risk premium	6%	5%
Pre-tax cost of debt	13%	12.86%
Debt equity ratio	1:1	2:3

For all time, working capital is 25% of revenue and corporate tax rate is 30%. What is the value of the firm?

Answer:

WN 1: Computation of cash flows:

- Value of firm is the present value of free cash flow to firm (FCFF) discounted at cost of capital
- We will not be deducting interest cost while computing FCFF
- High growth phase will last for four years and growth will stabilize 5th year onwards. We should compute cash flows till the first year of stabilization phase (Year 5)

(in crores)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Revenues	2,400.00	2,880.00	3,456.00	4,147.20	4,561.92
EBIT	360.00	432.00	518.40	622.08	684.29
Tax	-108.00	-129.60	-155.52	-186.62	-205.29
PAT	252.00	302.40	362.88	435.46	479.00
Working capital increase	-100.00	-120.00	-144.00	-172.80	-103.68

Net capex	-96.00	-115.20	-138.24	-165.89	-
Free cash flow	56.00	67.20	80.64	96.77	375.32

Note:

- Revenues = Previous year revenues + Growth rate
- EBIT = Previous year EBIT + Growth rate
- Net capex = Capital expenditure - Depreciation
- Net capex of previous year = 280 crores - 200 crores = Rs.80 crores
- Capex of year 1 = 80 crores + 20% = Rs.96 crores. Capex is computed in similar manner for balance years
- Increase in working capital = Current year working capital - Previous year working capital
- WC increase for year 1 = (2,400 x 25%) - (2,000 x 25%). WC increase is computed in similar manner for other years

WN 2: Computation of WACC for high-growth and normal phase:**High-growth phase:**

Source	Cost	Weight	Product
Debt	9.10 (13 x 70%)	1	9.10
Equity	16.90	1	16.90
Total		2	26.00

$$WACC = \frac{\text{Sum of Products}}{\text{Sum of weights}} = \frac{26}{2} = 13.00\%$$

Note:

- Cost of equity = $R_f + \text{Beta} \times (R_m - R_f) = 10 + (1.15 \times 6) = 10 + 6.90 = 16.90\%$
- Discount rate will be taken as 13 percent for the cash flows from year 1 to 4 (High growth phase)

Normal phase:

Source	Cost	Weight	Product
Debt	9.00 (12.86 x 70%)	2	18.00
Equity	14	3	42.00
Total		5	60.00

$$WACC = \frac{\text{Sum of Products}}{\text{Sum of weights}} = \frac{60}{5} = 12.00\%$$

Note:

- Cost of equity = $R_f + \text{Beta} \times (R_m - R_f) = 9 + (1 \times 5) = 14\%$
- Discount rate will be taken as 14 percent for the cash flows from year 5 onwards (normal phase)

WN 3: Computation of value of firm:

Year	Cash flow	PVF	DCF
1	56.00	0.885	49.56
2	67.20	0.783	52.62
3	80.64	0.693	55.88
4	96.77	0.613	59.32
4	18,766.00	0.613	11,503.56
Value of Firm			11,720.94

Note:

- Growth rate stabilizes at 10 percent from year 5 onwards. This would therefore take the character of growing perpetuity. We can value the cash flows from year 5 onwards using Gordon model

$$\text{Year 4 value} = \frac{CF_5}{\text{Cost of capital} - \text{Growth rate}} = \frac{375.32}{12\% - 10\%} = \text{Rs. 18,766 Crores}$$

14. Valuation of Firm [Nov 2020 RTP, May 2014, Nov 2022, May 2024 MTP, SM] [Homework]

Following information is given in respect of WXY Ltd., which is expected to grow at a rate of 20% p.a. for the next three years, after which the growth rate will stabilize at 8% p.a. normal level, in perpetuity.

Particulars	For the year ended March 31, 2014
Revenues	Rs.7,500 Crores
COGS	Rs.3,000 crores
Operating expenses	Rs.2,250 Crores
Capital expenditure	Rs.750 Crores
Depreciation (included in operating expenses)	Rs.600 Crores

During high growth period, revenues & Earnings before Interest & Tax (EBIT) will grow at 20% p.a. and capital expenditure net of depreciation will grow at 15% p.a. From year 4 onwards, i.e. normal growth period revenues and EBIT will grow at 8% p.a. and incremental capital expenditure will be offset by the depreciation. During both high growth & normal growth period, net working capital requirement will be 25% of revenues. The Weighted Average Cost of Capital (WACC) of WXY Ltd. is 15%. Corporate Income Tax rate will be 30%. Required:

Estimate the value of WXY Ltd. using Free Cash Flows to Firm (FCFF) & WACC methodology.

Answer:

WN 1: Computation of free cash flows for year 1 to year 4:

Particulars	Year 1	Year 2	Year 3	Year 4
Revenues	9,000.00	10,800.00	12,960.00	13,996.00
COGS	-3,600.00	-4,320.00	-5,184.00	-5,598.72
Operating expenses (other than depreciation)	-1,980.00	-2,376.00	-2,851.20	-3,079.30
Depreciation	-720.00	-864.00	-1,036.80	-1,119.74
EBIT	2,700.00	3,240.00	3,888.00	4,199.04
Tax @ 30%	-810.00	-972.00	-1,166.40	-1,259.71
EAT	1,890.00	2,268.00	2,721.60	2,939.33
Less: Net capex (capex – depreciation)	-172.50	-198.38	-228.13	-
Less: Increase in working capital (increase in revenues x 25%)	-375.00	-450.00	-540.00	-259.20
Free cash flow (FCFF)	1,342.50	1,619.62	1,953.47	2,680.13

WN 2: Valuation of WXY Limited:

Year	Cash flow	PVF @ 15%	DCF
1	1,342.50	0.8696	1,167.44
2	1,619.62	0.7561	1,224.59
3	1,953.47	0.6575	1,284.41
3	38,287.57	0.6575	24,174.08
Value of WXY Limited			28,850.52

Note:

- The cash flows will remain be Rs.2,680.13 crores in year 4 and grow at the rate of 8%. This would take the character of growing perpetuity and the same is valued as under:

$$\text{Year 3 value} = \frac{\text{CF}_4}{\text{Cost of capital} - \text{Growth rate}} = \frac{2,680.13}{15\% - 8\%} = \text{Rs. 38,287.57 Crores}$$

15. Valuation of strategy [May 2017 RTP, Nov 2018, May 2020 RTP, Nov 2011, May 2014 MTP, May 2019 MTP, Nov 2021 MTP, SM] [Concept Revision]

ABC Co. is considering a new sales strategy for the next 4 years. They want to know the value of the new strategy. Following information relating to the year which has just ended, is available

Particulars	Amount (in '000s)
Sales	20,000
Gross margin (20%)	4,000
Accounting, Administration and Distribution expenses (10%)	2,000
Profit before tax	2,000
Tax at 30%	600
Profit after tax	1,400
Balance Sheet Information	
Fixed assets	8,000

Current assets	5,000
Equity	12,000
Current Liabilities	1,000

As per the new strategy, sales will grow at 20 percent per year for the next three years. The gross margin ratio, assets turnover ratio, capital structure and income tax rate will remain unchanged. Depreciation is to be at 10 percent on the value of the net fixed assets at the beginning of the year. Company's target rate of return is 15%. Determine if the strategy is financially viable.

Answer:**WN 1: Valuation of firm with new strategy:****Part 1: Computation of cash flows:**

- The firm will grow at 20 percent for first three years and thereafter revenues is expected to remain same
- Growth stabilizes from year 4 onwards and hence we should compute cash flows till year 4

(in '000s)

Particulars	Year 1	Year 2	Year 3	Year 4
Sales	24,000.00	28,800.00	34,560.00	34,560.00
Gross margin (20%)	4,800.00	5,760.00	6,912.00	6,912.00
Less: Admin expense (10%)	-2,400.00	-2,880.00	-3,456.00	-3,456.00
PBT	2,400.00	2,880.00	3,456.00	3,456.00
Less: Tax @30%	-720.00	-864.00	-1,036.80	-1,036.80
PAT	1,680.00	2,016.00	2,419.20	2,419.20
WC change	-800.00	-960.00	-1,152.00	-
Net capex	-1,600.00	-1,920.00	-2,304.00	-
FCFF	-720.00	-864.00	-1,036.80	2,419.20

Note:

- Revenues = Previous year revenues + Growth rate
- Gross margin = 20 percent of revenues
- PBT = 10 percent of revenues
- Asset turnover ratio will remain same. This would mean that if revenues increase by 20 percent, net fixed assets and working capital will also increase by 20%. Hence net increase in fixed assets would be equal to net capex.
- Net capex of year 1 = $(8,000 + 20\%) - 8,000 = 1,600$ Crores. Net capex for balance years is computed in same manner
- Increase in working capital = Current year working capital - Previous year working capital
- WC increase for year 1 = $(4,000 + 20\%) - (4,000) = 800$ crores. WC increase is computed in similar manner for other years

Part 2: Valuation of firm:

(in '000s)

Year	Cash flow	PVF @ 15%	DCF
1	-720.00	0.870	-626.40
2	-864.00	0.756	-653.18
3	-1,036.80	0.658	-682.21
3	16,128.00	0.658	10,612.22
Value with strategy			8,650.43

Note:

- The cash flows will remain stable at Rs.2,419.20 from year 4 onwards. This would take the character of perpetuity and the same is valued as under:

$$\text{Year 3 value} = \frac{\text{CF}_4}{\text{Cost of capital} - \text{Growth rate}} = \frac{2,419.20}{15\% - 0\%} = \text{Rs. 16,128}$$

WN 2: Valuation of firm without strategy:

- Cash flow = PAT + Depreciation - Capital expenditure
- The company is not going to grow and hence net fixed assets would remain stable at Rs.8,000. This would mean that depreciation would be offset by the amount of capital expenditure

- Cash flow = $1,400 + (10\% \times 8,000) - 800 = \text{Rs.}1,400$
- The cash flow will remain stable at Rs.1,400 for all years and hence this would take the character of perpetuity. The same is valued as under:

$$\text{Year 0 value} = \frac{CF_1}{\text{Cost of capital} - \text{Growth rate}} = \frac{1,400}{15\% - 0\%} = \text{Rs. } 9,333.33$$

Conclusion:

- Strategy is not financially viable as the value of the firm falls to Rs.8,650.43 thousands from Rs.9,333.33 thousands
- **Value of strategy = $8,650.43 - 9,333.33 = -682.90$ thousands**

16. Business valuation [Nov 2014 RTP, Nov 2018 RTP, Nov 2012, May 2014 MTP, Nov 2017 MTP, SM]

Yes Limited wants to acquire No Limited and the cash flows of Yes Limited and the merged entity are given below: (in lakhs)

Year	1	2	3	4	5
Yes Limited	175	200	320	340	350
Merged entity	400	450	525	590	620

Earnings would have witnessed 5% constant growth rate without merger and 6% with merger on account of economies of operations after 5 years in each case. The cost of capital is 15%. The number of shares outstanding in both the companies before the merger is the same and the companies agree to an exchange ratio of 0.5 shares of Yes Limited for each share of No Limited

You are required to:

- Compute the Value of Yes Limited before and after merger.
- Value of Acquisition and
- Gains to shareholders of Yes Limited

Answer:**WN 1: Valuation of Yes Limited before merger and after merger:**

Year	Cash flow		PVF @ 15%	DCF	
	Before	After		Before	After
1	175.00	400.00	0.870	152.25	348.00
2	200.00	450.00	0.756	151.20	340.20
3	320.00	525.00	0.658	210.56	345.45
4	340.00	590.00	0.572	194.48	337.48
5	350.00	620.00	0.497	173.95	308.14
5	3,675.00	7,302.22	0.497	1,826.48	3,629.20
Value of Yes Limited				2,708.92	5,308.47

Note:**Valuation of perpetuity for cash flows after year 5:**

$$\text{Before merger } P_5 = \frac{CF_6}{K_0 - G} = \frac{350 \times 1.05}{15\% - 5\%} = \text{Rs. } 3,675 \text{ lacs}$$

$$\text{After merger } P_5 = \frac{CF_6}{K_0 - G} = \frac{620 \times 1.06}{15\% - 6\%} = \text{Rs. } 7,302.22 \text{ lacs}$$

WN 2: Solution for Part (i) and (ii):

Particulars	Calculation	Amount (in lacs)
Value of Yes Limited before merger		2,708.92
Value of Yes Limited after merger		5,308.47
Value of acquisition	$5,308.47 - 2,708.92$	2,599.55

WN 3: Computation of gains to shareholders of Yes Limited:

- Number of shares in both companies are same. Let us assume that number of shares is 100 in Yes and No Limited before acquisition

Particulars	Calculation	Amount
Shares in Yes Limited		
Existing shareholders of Yes Limited		100
Shares allotted to shareholders of No Limited		50

Total shares post-merger		150
Price per share post-merger	$\frac{5,308.47}{150}$	35.3898
Consideration paid to No Limited	50 shares x 35.3898	1,769.49
Benefit of acquisition/ value of acquisition		2,599.55
Gain to shareholders of Yes Limited		830.06

- Yes Limited is acquiring a company worth Rs.2,599.55 lacs. However, they are paying consideration of only Rs.1,769.49 lacs. Hence the gain to shareholders of Yes Limited out of merger is Rs.830.06 lacs

17. Computation of merger NPV [May 2024 MTP]

The summarized balance sheet of R Co Limited as on 31st March 2006 is given below:

Liabilities	Amount	Assets	Amount
Equity share capital (2,00,000 @ Rs.10 each)	20,00,000	Fixed assets	19,00,000
13% Preference share capital	1,00,000	Investments	1,00,000
Retained earnings	4,00,000	Inventories	5,00,000
12% debentures	3,00,000	Debtors	4,00,000
Current liabilities	2,00,000	Bank	1,00,000
Total	30,00,000	Total	30,00,000

Negotiations for takeover of R Ltd. result in its acquisition by A Ltd.

The purchase consideration consists of :

- Rs.3,30,000 13% debentures of A Ltd., for redeeming the 12% debentures of R Ltd;
- Rs.1,00,000 12% convertible preference shares in A Ltd. for the payment of the preference share capital of R Ltd.;
- 1,50,000 equity shares of A Ltd. to be issued at its current market price of Rs.15; and
- A Ltd. would meet dissolution expenses of Rs.30,000. The breakup figures of eventual disposition by A Ltd., of unrequired assets and liabilities of R Ltd. are: investments- Rs.1,25,000; debtors- Rs.3,50,000; inventories- Rs.4,25,000; and payment of current liabilities – Rs.1,90,000.

The project is expected to generate yearly operating CFAT of Rs.7,00,000 for 6 years. It is estimated that fixed assets of R Ltd. would fetch Rs.3,00,000 at the end of 6th year. The firm's cost of capital is 15%. As a Financial Consultant, comment on the financial prudence of merger decision of A Ltd.

Answer:

WN 1: Computation of initial outflow (cost of acquisition):

Particulars	Amount
13% Debentures	3,30,000
12% convertible preference shares	1,00,000
Equity share capital (1,50,000 x 15)	22,50,000
Dissolution expenses of R Limited	30,000
Payment of current liabilities	1,90,000
Total outflows	29,00,000
Less: Realized proceeds from sale of assets	
Investments	1,25,000
Debtors	3,50,000
Inventories	4,25,000
Bank balance	1,00,000
Net consideration paid	19,00,000

WN 2: Computation of NPV:

Year	Cash flow	PVF @ 15%	DCF
0	(19,00,000)	1	(19,00,000)
1 to 6	7,00,000	3.784	26,48,800
6	3,00,000	0.432	1,29,600
NPV of acquisition			8,78,400

Comment: NPV is positive by Rs.8,78,400 and hence the merger is beneficial to A Ltd.

18. Valuation based on WACC [Nov 2013, Jan 2021, SM] [Homework]

M/S Tiger Limited wants to acquire M/S Leopard Limited. The balance sheet of Leopard Limited as on 31st March 2012 is as follows:

Liabilities	Amount	Assets	Amount
Equity capital (70,000 shares)	7,00,000	Cash	50,000
Retained earnings	3,00,000	Debtors	70,000
12% Debentures	3,00,000	Inventories	2,00,000
Creditors and other liabilities	3,20,000	Plants and equipment	13,00,000
	16,20,000		16,20,000

- ❖ Shareholders of Leopard Ltd. will get one share in Tiger Ltd. for every two shares. External liabilities are expected to be settled at Rs. 5,00,000. Shares of Tiger Ltd. would be issued at its current price of Rs. 15 per share. Debtors and inventories are expected to realize Rs. 2,00,000.
- ❖ Tiger Ltd. has decided to operate the business of Leopard Ltd. as a separate division. The division is likely to give cash flows (after tax) to the extent of Rs. 5,00,000 per year for 6 years. Tiger Ltd. has planned that, after 6 years, this division would be demerged and disposed of for Rs. 2,00,000.
- ❖ The company's cost of capital is 16%.

Make a report to the Board of the company advising them about the financial feasibility of this acquisition.

Answer:

WN 1: Computation of (Initial Outflow):

Particulars	Calculation	Amount
Shares allotted	35,000 shares x 15	5,25,000
Debentures allotted (Debentures would be allotted to the existing debenture holders)		3,00,000
Settlement of creditors		5,00,000
Less: Realization of debtors and inventory		-2,00,000
Less: Cash		-50,000
Net outflow		10,75,000

WN 2: Computation of NPV:

Year	Cash flow	PVF @ 16%	DCF
0	-10,75,000	1.000	-10,75,000
1	5,00,000	0.862	4,31,000
2	5,00,000	0.743	3,71,500
3	5,00,000	0.641	3,20,500
4	5,00,000	0.552	2,76,000
5	5,00,000	0.476	2,38,000
6	7,00,000	0.410	2,87,000
			8,49,000

Conclusion:

- The company should go ahead with the project as the same results in positive NPV of Rs.8,49,000

19. Valuation of business:

ABC (India) Ltd., a market leader in printing industry, is planning to diversify into defense equipment businesses that have recently been partially opened up by the GOI for private sector. In the meanwhile, the CEO of the company wants to get his company valued by a leading consultants, as he is not satisfied with the current market price of his scrip.

He approached consultant with a request to take up valuation of his company with the following data for the year ended 2009:

Share Price	Rs.66 per share
Outstanding debt	1934 lacs
Number of outstanding shares	75 lacs
Net income (PAT)	17.20 lacs
EBIT	245 lacs
Interest expenses	218.125 lacs

Capital expenditure	234.40 lacs
Depreciation	234.40 lacs
Working capital	44 lacs
Growth rate	8% (from 2010 to 2014)
Growth rate	6% (beyond 2014)
Free cash flow	240.336 lacs (year 2014 onwards)

The capital expenditure is expected to be equally offset by depreciation in future and the debt is expected to decline by 30% in 2014.

Required:

Estimate the value of the company and ascertain whether the ruling market price is undervalued as felt by the CEO based on the foregoing data. Assume that the cost of equity is 16%, and 30% of debt repayment is made in the year 2014.

Answer:**WN 1: Computation of FCFF:**

(in lacs)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
EBIT/EBT	264.60	285.77	308.63	333.32	359.99
Less: Tax	-95.26	-102.88	-111.11	-120.00	-129.59
PAT	169.34	182.89	197.52	213.32	230.40
Increase in WC	3.52	3.80	4.10	4.43	4.78
Free cash flow	165.82	179.09	193.42	208.89	225.62

Note:

- Interest is not to be deducted while computing FCFF
- Tax rate has been taken as 36 percent and the same is computed as under:

Particulars	2009
EBIT	245.000
Less: Interest	-218.125
EBT	26.875
Less: Tax (B/f)	9.675
EAT	17.200
Tax rate (9.675/26.875) x 100	36

- Capital expenditure is offset by depreciation and hence net capex is zero
- Working capital increase for year 1 = 44 lacs x 8% = Rs.3.52 lacs. Increase for year 2 = 3.52 + 8% = Rs.3.80 lacs. Increase is computed in similar manner for future years
- Repayment of debt will not impact the cash flows as new debt/repayment of debt is not considered in FCFF computation

WN 2: Computation of WACC**WACC from 2010 to 2014 (Year 1 to Year 5)**

Source	Cost	Weight	Product
Debt	7.22	1,934.00	139.60
Equity	16.00	4,950.00	792.00
	13.53	6,884.00	931.60

- WACC = $(931.60/6,884) \times 100 = 13.53\%$
- Weight of equity = 75 lacs x 66 = 4,950 lacs
- Pre-tax cost of debt $(218.125 \text{ lacs}/1,934) \times 100 = 11.28\%$
- Post-tax cost of debt = $11.28\% \times (1 - 36\%) = 7.22\%$

WACC from 2014 onwards (Year 6 onwards)

Source	Cost	Weight	Product
Debt	7.22	1,353.80	97.72
Equity	16.00	4,950.00	792.00
	14.11	6,303.80	889.72

- Weight of debt = 1,934 lacs x 70% = Rs.1,353.80 lacs

WN 3: Valuation of firm:

(in lacs)

Year	Cash flow	PVF	DCF
1	165.82	0.881	146.09
2	179.09	0.776	138.97
3	193.42	0.683	132.11
4	208.89	0.602	125.75
5	225.62	0.53	119.58
5	2963.45	0.53	1570.63
Value of Firm			2233.13

Note:

Value of growing perpetuity (Y6) = $\frac{240.336}{14.11\% - 6\%} = \text{Rs. } 2,963.45 \text{ lacs}$

- Discount factors have been taken at the rate of 13.53% for year 1 to year 5

WN 4: Valuation of equity

- Value of equity = Value of Firm – Value of debt
- Value of equity = 2,233.13 lacs – 1,934 lacs = Rs.299.13 lacs
- Fair value per share = 299.13 lacs/75 lacs = Rs.3.99 per share
- The current share price is Rs.66 per share whereas fair price is only Rs.3.99 per share. Hence the share price is currently overvalued in the market

Note:

- The answer does not match with ICAI solution as there are few errors in ICAI solution. Repayment of debt has been considered in FCFE computation. However, we should not deduct the same for computing FCFE

20. Valuation of firm and valuation of equity [May 2018 RTP, Nov 2012 RTP, Nov 2023 RTP]

BRS Inc deals in computer and IT hardwares and peripherals. The expected revenue for the next 8 years is as follows:

Years	Sales Revenue (USD Million)
1	8
2	10
3	15
4	22
5	30
6	26
7	23
8	20

Summarized financial position as on 31 March 2012 was as follows:

Liabilities	Amount (USD Million)	Assets	Amount (USD Million)
Equity stocks	12	Fixed assets	17
12% bonds	8	Current assets	3
Total	20	20	

Additional information:

(a) Its variable expenses is 40% of sales revenue and fixed operating expenses (cash) are estimates to be as follows

Period	Amount (USD Million)
1 to 4 years	1.6
5 to 8 years	2

(b) An additional advertisement and sales promotion campaign shall be launched requiring expenditure as per following details

Period	Amount (USD Million)
1 year	0.50
2 to 3 years	1.50
4 to 6 years	3.00

7 to 8 years	1.00

(C) Fixed assets are subject to depreciation at 15% as per WDV method

(d) The company has planned additional capital expenditure (in the beginning of each year) for the coming 8 years as follows:

Period	Amount (USD Million)
1	0.50
2	0.80
3	2.00
4	2.50
5	3.50
6	2.50
7	1.50
8	1.00

(e) Investment in working capital is estimated to be 20% of revenue

(f) Applicable tax rate for the company is 30%

(g) Cost of equity is estimated to be 16%

(h) The free cash flow of the firm is expected to grow at 5% per annum after 8 years.

With above information you are required to determine the:

(i) Value of Firm

(ii) Value of equity

Answer:

ICAI Solution:

WN 1: Computation of WACC:

Source	Cost	Weight	Product
Debt	8.40	8.00	0.672
Equity	16.00	12.00	1.920
	12.96	20.00	2.592

- Post-tax cost of debt = $12 \times (1 - 30\%) = 8.40\%$
- WACC = $(2.592 \text{ lacs}/20 \text{ lacs}) \times 100 = 12.96\% \sim 13.00\%$

WN 2: Schedule of Depreciation:

Year	Opening balance	Additions	Total	Depreciation @ 15%
1	17.00	0.50	17.50	2.63
2	14.87	0.80	15.67	2.35
3	13.32	2.00	15.32	2.30
4	13.02	2.50	15.52	2.33
5	13.19	3.50	16.69	2.50
6	14.19	2.50	16.69	2.50
7	14.19	1.50	15.69	2.35
8	13.34	1.00	14.34	2.15

WN 3: Determination of investment:

Year	For Capex	For WC (20% of revenue)	Total	Existing investment in CA	Additional investment required
1	0.50	1.60	2.10	3.00	0.00
2	0.80	2.00	2.80	2.50	0.30
3	2.00	3.00	5.00	2.00	3.00
4	2.50	4.40	6.90	3.00	3.90
5	3.50	6.00	9.50	4.40	5.10
6	2.50	5.20	7.70	6.00	1.70
7	1.50	4.60	6.10	5.20	0.90
8	1.00	4.00	5.00	4.60	0.40

Note:

- Capex is done at the beginning of the year. However, ICAI solution has considered the same in the respective year. The same is not correct and hence an alternate logical solution is also presented.
- Investment in CA in year 2 = Total investment of 3 million – capex of 0.5 million of previous year
- Investment in CA in year 3 onwards = Investment in CA of previous year

WN 4: Computation of FCFF:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Sales	8.00	10.00	15.00	22.00	30.00	26.00	23.00	20.00
VC	-3.20	-4.00	-6.00	-8.80	-12.00	-10.40	-9.20	-8.00
FC	-1.60	-1.60	-1.60	-1.60	-2.00	-2.00	-2.00	-2.00
Advertisement	-0.50	-1.50	-1.50	-3.00	-3.00	-3.00	-1.00	-1.00
Depreciation	-2.63	-2.35	-2.30	-2.33	-2.50	-2.50	-2.35	-2.15
Profit before Tax	0.07	0.55	3.60	6.27	10.50	8.10	8.45	6.85
Less: Tax	-0.02	-0.16	-1.08	-1.88	-3.15	-2.43	-2.54	-2.06
Profit after Tax	0.05	0.39	2.52	4.39	7.35	5.67	5.91	4.79
Add: Depreciation	2.63	2.35	2.30	2.33	2.50	2.50	2.35	2.15
Cash flow after Tax	2.68	2.74	4.82	6.72	9.85	8.17	8.26	6.94
Investment	0.00	0.30	3.00	3.90	5.10	1.70	0.90	0.40
FCFF	2.68	2.44	1.82	2.82	4.75	6.47	7.36	6.54

WN 5: Present value of perpetuity:

$$\text{Year 8 growing perpetuity} = \frac{6.54 \times 1.05}{13.00\% - 5\%} = \text{Rs. 85.8375 million}$$

WN 6: Valuation of firm and equity:

Year	Cash flow	PVF@ 13.00%	DCF
1	2.68	0.885	2.37
2	2.44	0.783	1.91
3	1.82	0.693	1.26
4	2.82	0.613	1.73
5	4.75	0.543	2.58
6	6.47	0.480	3.11
7	7.36	0.425	3.13
8	6.54	0.376	2.46
8	85.84	0.376	32.28
Value of Firm			50.83
Less: Value of debt			-8.00
Value of equity			42.83

Logical Solution**WN 1: Computation of FCFF:**

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Sales	8.00	10.00	15.00	22.00	30.00	26.00	23.00	20.00
VC	-3.20	-4.00	-6.00	-8.80	-12.00	-10.40	-9.20	-8.00
FC	-1.60	-1.60	-1.60	-1.60	-2.00	-2.00	-2.00	-2.00
Advertisement	-0.50	-1.50	-1.50	-3.00	-3.00	-3.00	-1.00	-1.00
Depreciation	-2.63	-2.35	-2.30	-2.33	-2.50	-2.50	-2.35	-2.15
Profit before Tax	0.07	0.55	3.60	6.27	10.50	8.10	8.45	6.85
Less: Tax	-0.02	-0.17	-1.08	-1.88	-3.15	-2.43	-2.54	-2.06
Profit after Tax	0.05	0.38	2.52	4.39	7.35	5.67	5.91	4.79
Add: Depreciation	2.63	2.35	2.30	2.33	2.50	2.50	2.35	2.15
Cash flow after Tax	2.68	2.73	4.82	6.72	9.85	8.17	8.26	6.94

Capex	-0.80	-2.00	-2.50	-3.50	-2.50	-1.50	-1.00	
Change in Work cap	1.40	-0.40	-1.00	-1.40	-1.60	0.80	0.60	0.60
FCFF	3.28	0.33	1.32	1.82	5.75	7.47	7.86	7.54

Note:

- Variable cost = 40% of revenues
- Advertisement and fixed cost are as per data given in question
- Depreciation has been taken as per below statement:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Opening Value	17.00	14.87	13.32	13.02	13.19	14.19	14.19	13.34
Addition	0.50	0.80	2.00	2.50	3.50	2.50	1.50	1.00
Depreciation	2.63	2.35	2.30	2.33	2.50	2.50	2.35	2.15
Closing value	14.87	13.32	13.02	13.19	14.19	14.19	13.34	12.19

- Depreciation = (Opening value + Addition) x 15%; Closing value = Opening value + Addition - Depreciation
- Capital expenditure is made at the beginning of the year. Hence, capex of year 2 has been taken as year 1 ending capex and for other years in similar manner. Alternatively, we can take capex in the same year with the assumption that payment for capex is made at the end of the year
- Working capital change has been computed as per below statement:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Revenues	8.00	10.00	15.00	22.00	30.00	26.00	23.00	20.00
WC investment @ 20%	1.60	2.00	3.00	4.40	6.00	5.20	4.60	4.00
Opening WC	3.00	1.60	2.00	3.00	4.40	6.00	5.20	4.60
Inc/decrease in WC	-1.40	0.40	1.00	1.40	1.60	-0.80	-0.60	-0.60

- Increase in working capital is an outflow and decrease in working capital will be an inflow

WN 2: Computation of WACC:

Source	Cost	Weight	Product
Debt	8.40	8.00	0.672
Equity	16.00	12.00	1.920
	12.96	20.00	2.592

- Post-tax cost of debt = $12 \times (1 - 30\%) = 8.40\%$
- WACC = $(2.592 \text{ lacs}/20 \text{ lacs}) \times 100 = 12.96\%$

WN 3: Computation of value of firm:

Year	Cash flow	PVF@ 12.96%	DCF
0	-0.50	1.000	-0.50
1	3.28	0.885	2.90
2	0.33	0.784	0.26
3	1.32	0.694	0.92
4	1.82	0.614	1.12
5	5.75	0.544	3.13
6	7.47	0.481	3.59
7	7.86	0.426	3.35
8	7.54	0.377	2.84
8	99.46	0.377	37.50
Value of Firm			55.10

- Cash flow of year 0 = Capex of 0.50 lacs at beginning of year 1
- Year 8 growing perpetuity = $\frac{7.54 \times 1.05}{12.96\% - 5\%} = \text{Rs. } 99.46 \text{ lacs}$
- Value of firm = Rs.55.10 lacs
- Value of equity = Rs.55.10 lacs - Rs.8 lacs (debt) = Rs.47.10 lacs

21. Range of valuation [Nov 2009, May 2013, May 2014 MTP, May 2021 MTP, Nov 2022 MTP, SM]

ABC Limited is considering acquisition of DEF Limited which has 3.10 crore shares issued and outstanding. The market price per share is Rs.440.00 at present. ABC Limited's average cost of capital is 12%. The cash inflows of DEF Limited for next three years are as under:

Year	Amount in crores
1	460.00
2	600.00
3	740.00

You are required to calculate the range of valuation that ABC Limited has to consider.

Answer:

WN 1: Valuation based on current market price:

❖ Value of Firm = No of shares x current market price = 3.10 crores x 440 = Rs.1,364 Crores

WN 2: Valuation based on discounted cash flows:

Year	Cash flow	PVF@ 12%	DCF
1	460	0.893	410.78
2	600	0.797	478.20
3	740	0.712	526.88
Value of business			1,415.86

Summary:

Range of valuation:

Particulars	Per share	Total
Minimum	440.00	1,364.00
Maximum	456.73 [1,415.86/3.10]	1,415.86

22. Computation of maximum price to be paid for acquisition [May 2016 MTP, Nov 2017 RTP]

[Homework]

Teer Ltd. is considering acquisition of Nishana Ltd. CFO of Teer Ltd. is of opinion that Nishana Ltd. will be able to generate operating cash flows (after deducting necessary capital expenditure) of Rs. 10 crore per annum for 5 years.

The following additional information was not considered in the above estimations.

(i) Office premises of Nishana Ltd. can be disposed of and its staff can be relocated in Teer Ltd.'s office not impacting the operating cash flows of either businesses. However, this action will generate an immediate capital gain of Rs. 20 crore.

(ii) Synergy Gain of Rs. 2 crore per annum is expected to be accrued from the proposed acquisition.

(iii) Nishana Ltd. has outstanding Debentures having a market value of Rs. 15 crore. It has no other debts.

(iv) It is also estimated that after 5 years if necessary, Nishana Ltd. can also be disposed of for an amount equal to five times its operating annual cash flow.

Calculate the maximum price to be paid for Nishana Ltd. if cost of capital of Teer Ltd. is 20%. Ignore any type of taxation.

Answer:

WN 1: Valuation of business of Nishana Limited:

(in crores)

Year	Cash flow	PVF @ 20%	DCF
0	20	1.000	20.00
1 to 5	12	2.990	35.88
5	50 [10 x 5]	0.402	20.10
Value of business			75.98
Less: Value of debt			(15.00)
Consideration to equity shareholders			60.98

Note: Terminal flow can also be considered as Rs.60 Crores [12 crores x 5]

23. Valuation of firm [Nov 2019] [Homework]

Mr. X, a financial analyst, intends to value the business of PQR Ltd. in terms of the future cash generating capacity. He has projected the following after tax cash flows:

Year	1	2	3	4	5
Cash flows (in lacs)	1,760	480	640	860	1,170

It is further estimated that beyond 5th year, cash flows will perpetuate at a constant growth rate of 8% per annum, mainly on account of inflation. The perpetual cash flow is estimated to be Rs. 10,260 lakh at the end of the 5th year.

Required:

- What is the value of the firm in terms of expected future cash flows, if the cost of capital of the firm is 20%.
- The firm has outstanding debts of Rs. 3,620 lakh and cash/bank balance of Rs. 2,710 lakh. Calculate the shareholder value per share if the number of outstanding shares is 151.50 lakh.
- The firm has received a takeover bid from XYZ Ltd. of Rs. 225 per share. Is it a good offer?

Answer:**WN 1: Valuation of firm based on future cash flows:****(In lacs)**

Year	Cash flow	PVF @ 20%	DCF
1	1,760	0.833	1,466.08
2	480	0.694	333.12
3	640	0.579	370.56
4	860	0.482	414.52
5	1,170	0.402	470.34
5	92,340	0.402	37,120.68
Value of Firm			40,175.30

Note:

$$\text{Perpetual Inflow (Y5)} = \frac{10,260 \times 1.08}{20\% - 8\%} = 92,340 \text{ lacs}$$

WN 2: Valuation of share:

Particulars	Amount In lacs
Value of Firm	40,175.30
Less: Value of debt	(3,620.00)
Value of equity	36,555.30
No of shares	151.50
Value per share	241.29

Takeover bid of Rs. 225 per share seems to be not a good offer as it is lesser than the intrinsic value i.e. value per share of Rs. 241.29.

Note: Cash balance has no impact on valuation of equity of the company. Under enterprise valuation concept cash balance would impact the value of equity

24. Valuation of share [Concept Revision]

ABC Limited earned EPS of Rs.3.50 per share. Investment in fixed assets was Rs.2.00 per share, depreciation was Rs.1.60 per share and the investment in working capital was Rs.0.50 per share. ABC Limited is currently operating at its target debt-to-assets ratio of 40%. Shareholders require a return of 14 percent on their investment and the expected growth rate is 4 percent. Calculate the value of share of ABC Limited.

Answer:

- Valuation of share can be based on free cash flow to equity shareholders (FCFE)

$FCFE_0 = \text{EPS} - \text{equity funding for net capex and working capital}$

$$FCFE_0 = 3.50 - (0.6 \times 0.90) = 3.50 - 0.54 = 2.96 \text{ per share}$$

$$\text{Value of share} = \frac{FCFE_1}{K_e - \text{Growth}} = \frac{2.96 \times 1.04}{14\% - 10\%} = \text{Rs. 30.78}$$

Note:

- The company incurs net capex of Rs.0.40 per share (2.00 -1.60) and working capital requirement of Rs.0.50 per share
- Total funding required is Rs.0.90 per share
- The company operates at debt to assets ratio of 40% and hence 40% funding will be in the form of debt and the balance 60 percent will be in the form of equity

25. Valuation with FCFF [Homework]

ABC Limited is expected to experience growth in three distinct stages in the future. Its most recent FCFE is Rs.0.90 per share. The following information has been compiled:

Particulars	High-growth	Transition Period	Stable-growth
Duration	3 years	3 years	Year 7 onwards
FCFE growth rate	30%	Will decline by 9 percent per year to the indicated stable growth rate	3%
Shareholders required return	20%	15%	10%

Calculate the fair value using the three-stage FCFE model.

Answer:

WN 1: Computation of growth rates and FCFE

Year	1	2	3	4	5	6	7
Growth rate	30%	30%	30%	21%	12%	3%	3%
FCFE	1.17	1.52	1.98	2.40	2.69	2.77	2.85

WN 2: Valuation of share as per FCFE approach:

Year	FCFF	PVF	DCF
1	1.17	0.833	0.97
2	1.52	0.694	1.05
3	1.98	0.579	1.15
4	2.40	0.503	1.21
5	2.69	0.437	1.18
6	2.77	0.380	1.05
6	40.71	0.380	15.47
Value of share			22.08

Note:

- Cost of equity for first three years is 20%. Then it falls to 15% for year 4 to 6 and the same falls to 10% from year 7 onwards
- PVF is computed in the following manner for year 4 to 6:

PVF of year 4 =	$\frac{\text{PVF of year 3}}{1 + 15\%}$
PVF of year 5 =	$\frac{\text{PVF of year 4}}{1 + 15\%}$
PVF of year 6 =	$\frac{\text{PVF of year 5}}{1 + 15\%}$

- Growth stabilizes from year 7 and hence we can use Gordon's formula to calculate the price at the end of year 6. Cost of equity has been taken as 10 percent as K_e from year 6 onwards is 10%

$$P_6 = \frac{\text{FCFE}_7}{K_e - G} = \frac{2.85}{10\% - 3\%} = \text{Rs. } 40.71$$

26. Range of business valuation [May 2010, Nov 2016 MTP, Nov 2016 RTP]

ABC, a large business house is planning to sell its wholly owned subsidiary KLM. Another large business entity XYZ has expressed its interest in making a bid for KLM. XYZ expects that after acquisition the annual earning of KLM will increase by 10%. Following information, ignoring any potential synergistic benefits arising out of possible acquisitions, are available:

- Profit after tax for KLM for the financial year which has just ended is estimated to be Rs.10 crore.
- KLM's after tax profit has an increasing trend of 7% each year and the same is expected to continue.
- Estimated post tax market return is 10% and risk free rate is 4%. These rates are expected to continue.
- Corporate tax rate is 30%.

	XYZ	ABC	Proxy entity
No of shares	100 lakhs	80 lakhs	
Current share price	Rs.287	Rs.375	

Dividend payout	40%	50%	50%
Debt: Equity at market values	1:2	1:3	1:4
PE ratio	10	13	12
Equity beta	1	1.1	1.1

Assume gearing level of KLM to be the same as for ABC and a debt beta of zero. You are required to calculate:

- ❖ Appropriate cost of equity for KLM based on the data available for the proxy entity.
- ❖ A range of values for KLM both before and after any potential synergistic benefits to XYZ of the acquisition.

Answer:

WN 1: Computation of cost of equity of KLM based on proxy entity:

- Beta of two companies operating in similar business would remain the same, irrespective of the capital structure
- In this question, we will first compute Beta of proxy entity and the same would be equated to Beta of KLM

Beta of Proxy Entity:

Source	Beta	Weight	Product
Debt	0	0.7	0
Equity	1.1	4	4.4
Total		4.7	4.4

$$\text{Beta of proxy entity} = \frac{\text{Sum of Product}}{\text{Sum of weights}} = \frac{4.4}{4.7} = \mathbf{0.9362 \text{ Times}}$$

- Weight for debt should be equal to weight $\times (1 - \text{Tax rate})$. Weights for debt and equity given in the question is 1:4.
- Weight for debt for Beta computation is 0.7 (1×0.7)

Equity Beta of KLM:

Source	Beta	Weight	Product
Debt	0	0.70	0
Equity	1.1546	3.00	3.4639
Total	0.9362	3.70	3.4639

- Beta of proxy entity is 0.9362 Times and hence the Beta of KLM would also be 0.9362 Times
- Total of product of KLM = $0.9362 \times 3.70 = 3.4639$
- Product of equity will be balancing figure and the same would be 3.4639

$$\text{Equity Beta} = \frac{3.4639}{3} = 1.1546 \text{ Times}$$

Cost of equity of KLM:

$$\text{Cost of equity} = R_f + \text{Beta} \times (R_m - R_f)$$

$$\text{Cost of equity} = 4 + 1.1546 \times (10 - 4)$$

$$\text{Cost of equity} = 4 + 6.93 = \mathbf{10.93\%}$$

WN 2: Valuation of company before and after synergy benefits:

Particulars	Pre-acquisition		Post-acquisition	
	Calculation	Amount (Crores)	Calculation	Amount (Crores)
Based on PE Multiple Approach:				
Proxy company PE Multiple	10 crores $\times$ 12	120.00	11 crores $\times$ 12	132.00
ABC's PE Multiple	10 crores $\times$ 13	130.00	11 crores $\times$ 13	143.00
XYZ's PE Multiple	10 crores $\times$ 10	100.00	11 crores $\times$ 10	110.00
Based on Dividend-Payout Ratio:				
40% Payout	$\frac{10.7 \times 40\%}{10.93\% - 7\%}$	108.91	$\frac{11 \times 1.07 \times 40\%}{10.93\% - 7\%}$	119.80
50% Payout	$\frac{10.7 \times 50\%}{10.93\% - 7\%}$	136.13	$\frac{11 \times 1.07 \times 50\%}{10.93\% - 7\%}$	149.75

Note:

- Current earnings of the company is Rs.10 Crores and it is assumed that same will increase to Rs.11 Crores due to acquisition. Growth of 7 percentage is then applied on the base of this Rs.10 or Rs.11 Crores
- ICAI solution has assumed that growth rate will remain same at 7 percent in both scenarios

Conclusion:

- Range of pre-synergy valuation = Rs.100 Crores to Rs.136.13 Crores
- Range of post-synergy valuation = Rs.110 Crores to Rs.149.75 Crores

27. Break-up value approach [Nov 2011, Nov 2018 MTP, Nov 2016 MTP, Nov 2017 MTP, May 2018 RTP, SM]

Using the chop-shop approach (or Break-up value approach), assign a value for Cranberry Ltd. whose stock is currently trading at a total market price of €4 million. For Cranberry Ltd, the accounting data set forth three business segments: consumer wholesale, retail and general centers. Data for the firm's three segments are as follows:

Business segment	Segment sales	Segment assets	Segment Operating Income
Wholesale	2,25,000	6,00,000	75,000
Retail	7,20,000	5,00,000	1,50,000
General	25,00,000	40,00,000	7,00,000

Industry data for "pure-play" firms have been compiled and are summarized as follows:

Business segment	Capitalization / Sales	Capitalization / Assets	Capitalization / Operating income
Wholesale	0.85	0.7	9
Retail	1.2	0.7	8
General	0.8	0.7	4

Answer:**WN 1: Valuation of company on basis of capitalization/sales multiple:**

Segment	Sales	Multiple	Capitalization
Wholesale	2,25,000	0.85	1,91,250
Retail	7,20,000	1.20	8,64,000
General	25,00,000	0.80	20,00,000
Value of company			30,55,250

WN 2: Valuation of company on the basis of capitalization/assets multiple:

Segment	Sales	Multiple	Capitalization
Wholesale	6,00,000	0.70	4,20,000
Retail	5,00,000	0.70	3,50,000
General	40,00,000	0.70	28,00,000
Value of company			35,70,000

WN 3: Valuation of company on the basis of capitalization/operating income multiple:

Segment	Sales	Multiple	Capitalization
Wholesale	75,000	9.00	6,75,000
Retail	1,50,000	8.00	12,00,000
General	7,00,000	4.00	28,00,000
Value of company			46,75,000

WN 4: Final valuation:

Value of Firm = Average values of three approaches

$$\text{Value of Firm} = \frac{30,55,250 + 35,70,000 + 46,75,000}{3} = \text{Rs. 37,66,750}$$

28. Valuation based on proxy company [Nov 2019, Nov 2021 MTP]:

XY Ltd., a Cement manufacturing Company has hired you as a financial consultant of the company. The Cement Industry has been very stable for some time and the cement companies SK Ltd. & AS Ltd. are similar in size and have similar product market mix characteristic. Use comparable method to value the equity of XY Ltd. In performing analysis, use the following ratios:

- (i) Market to book value
- (ii) Market to replacement cost
- (iii) Market to sales
- (iv) Market to Net Income

The following data are available for your analysis:

Particulars	SK Limited	AS Limited	XY Limited
Market Value	450	400	
Book value	400	300	250
Replacement cost	600	550	500
Sales	550	450	500
Net Income	18	16	14

Answer:

WN 1: Valuation based on Market to Book value approach:

Particulars	SK Limited	AS Limited	XY Limited
Market Value (A)	450	400	307.25 (250 × 1.2290)
Book value (B)	400	300	250
Market value to book value multiple (A/B)	1.125	1.333	1.2290 <u>1.125 + 1.333</u> 2

WN 2: Valuation based on Market to Replacement Cost:

Particulars	SK Limited	AS Limited	XY Limited
Market Value (A)	450	400	369.25 (500 × 0.7385)
Replacement Cost (B)	600	550	500
Market value to replacement cost multiple (A/B)	0.750	0.727	0.7385 <u>0.750 + 0.727</u> 2

WN 3: Valuation based on Market to Sales:

Particulars	SK Limited	AS Limited	XY Limited
Market Value (A)	450	400	426.75 (500 × 0.8535)
Sales (B)	550	450	500
Market value to sales (A/B)	0.818	0.889	0.8535 <u>0.818 + 0.889</u> 2

WN 4: Valuation based on Net Income:

Particulars	SK Limited	AS Limited	XY Limited
Market Value (A)	450	400	350 (25 × 14)
Net Income (B)	18	16	14
Market value to Net Income (A/B)	25	25	25 <u>25 + 25</u> 2

WN 5: Final valuation based on average of four approaches:

$$\text{Final Value of XY Limited} = \frac{307.25 + 369.25 + 426.75 + 350}{4} = \text{Rs. 363.31}$$

29. Valuation of company [Nov 2017 RTP, Nov 2018 RTP, May 2021 RTP] [Homework]

T Ltd. Recently made a profit of Rs. 50 crore and paid out Rs. 40 crore (slightly higher than the average paid in the industry to which it pertains). The average PE ratio of this industry is 9. As per Balance Sheet of T Ltd., the shareholder's fund is Rs. 225 crore and number of shares is 10 crore. In case company is liquidated,

building would fetch Rs. 100 crore more than book value and stock would realize Rs. 25 crore less. The other data for the industry is as follows:

❖ Projected Dividend Growth	=	4%
❖ Risk Free Rate of Return	=	6%
❖ Market Rate of Return	=	11%
❖ Average Dividend Yield	=	6%

The estimated beta of T Ltd. is 1.2.

You are required to calculate valuation of T Ltd. using

- (i) P/E Ratio
- (ii) Dividend Yield
- (iii) Valuation as per:
 - a. Dividend Growth Model
 - b. Book Value
 - c. Net Realizable Value

Answer:

WN 1: Valuation of company as per different methods:

Particulars	Calculation	Amount
PE Multiple based	50 crores x 9	Rs.450.00 crores
Dividend yield	$\frac{40 \text{ crores}}{6\%}$	Rs.666.70 Crores
Dividend growth model (Note below)	$\frac{40 \text{ crores} \times 1.04}{12\% - 4\%}$	Rs.520 Crores
Book value	Shareholder funds	Rs.225 Crores
Net realizable value	225 Cr + 100 Cr - 25 Cr	Rs.300 Crores

Note:

$$\text{❖ Cost of equity} = R_f + \text{Beta} \times (R_m - R_f) = 6\% + 1.2 \times (11\% - 6\%) = 12\%$$

30. Valuation of business [May 2019, Nov 2019 RTP]

The closing price of LX Limited is Rs.24 per share as on 31st March, 2019 on NSE Limited. The Price earnings ratio was 6. It was found that an amount of Rs.24 lacs as income and an extra ordinary loss of Rs.9 lacs were included in the books of accounts. The existing operations except for the extraordinary items are expected to continue in future. Further the company has launched a new product during the year with the following expectations:

Particulars	Amount (in lacs)
Sales	150
Material cost	40
Labour cost	34
Fixed cost	24

The company has 5,00,000 equity shares of Rs.10 each and 1,00,000 9% preference shares of Rs.100 each. The price earnings ratio is 6 times. Post tax cost of capital is 10 percent per annum. Tax rate is 34 percent. You are required to determine:

- i. Existing profit from old operations
- ii. The value of business

Answer:

WN 1: Computation of existing profit from old operations:

Particulars	Calculation	Amount
Market price per share		24
Price earning multiple		6
Earnings per share	24/6	4
No of shares		5,00,000
Earnings available to equity shareholders		20,00,000
Preference Dividend	1,00,000 x 100 x 9%	9,00,000
Profit after tax		29,00,000
Profit before tax	$\frac{29,00,000}{1 - 0.34}$	43,93,939
Less: Extraordinary Income		(24,00,000)
Add: Extraordinary losses		9,00,000

Existing profit from old operations		28,93,939
Profit from new product	150-40-34-24	52,00,000
Future Maintainable Profit before tax		80,93,939
Less: Tax @ 34%		(27,51,939)
Future Maintainable Profit		53,42,000
Capitalization rate		10%
Value of business	53,42,000/0.10	5,34,20,000

31. Valuation of business [May 2018 RTP, Nov 2018 RTP, May 2009, Nov 2012, May 2019 RTP, July 2021, May 2023 RTP, May 2018 MTP, Nov 2022 MTP, SM] [Concept Revision]

Eagle Limited reported a profit of Rs.77 lacs after 30% tax for the financial year 2011-12. An analysis of the accounts revealed that the income included extraordinary items of Rs.8 lacs and an extraordinary loss of Rs.10 lacs. The existing operations, except for the extraordinary items, are expected to continue in the future. In addition, the results of the launch of a new product are expected to be as follows:

Particulars	Amount (in lacs)
Sales	70
Material costs	20
Labour costs	12
Fixed costs	10

You are required to:

- Calculate the value of the business, given that the capitalization rate is 14%
- Determine the market price per equity share, with Eagle Limited's share capital being comprised of 1,00,000 13% preference shares of Rs.100 each and 50,00,000 equity shares of Rs.10 each and the P/E ratio being 10 times.

Answer:

WN 1: Computation of value of business:

Particulars	Calculation	Amount (in lacs)
Existing PAT		77
Existing PBT	77 lacs/(1-0.3)	110
Less: Extraordinary income		(8)
Add: Extraordinary loss		10
Profit from new product	70 - 20 - 12 - 10	28
Future maintainable PBT		140
Less: Tax @ 30%		(42)
Future maintainable PAT		98
Capitalization factor		0.14
Value of business	98/0.14	700

WN 2: Valuation of equity share:

Particulars	Calculation	Amount (in lacs)
Future maintainable PAT		98
Less: Preference dividend	1,00,000 x 13	(13)
Earnings available to equity shareholders		85
No of shares		50
EPS		1.7
P/E Multiple		10
Market price per equity share		17

Note: EPS and MPS can alternatively be computed based on existing profits

32. Net assets valuations and earnings capitalization [Nov 2012, Nov 2023 MTP, SM]

H limited agrees to buy over the business of B Limited effective 1st April, 2012. The summarized Balance Sheets of H Limited and B Limited as on 31st March 2012 are as follows: Balance Sheet as at 31st March, 2012 (In Crores of Rupees)

Liabilities	H Limited	B Limited
Equity Shares of Rs 100 each	350.00	
Equity Shares of Rs 10 each		6.50
Reserves & Surplus	950.00	25.00

Total liabilities	1,300.00	31.50
Assets:		
Net fixed assets	220.00	0.50
Net current assets	1,020.00	29.00
Deferred tax assets	60.00	2.00
Total	1,300.00	31.50

H Limited proposes to buy out B Limited and the following information is provided to you as part of the scheme of buying:

- The weighted average post tax maintainable profits of H Limited and B Limited for the last 4 years are Rs.300 crores and 10 crores respectively.
- Both the companies envisage a capitalization rate of 8%.
- H Limited has a contingent liability of Rs.300 crores as on 31st March, 2012.
- H Limited to issue shares of Rs.100 each to the shareholders of B Limited in terms of the exchange ratio as arrived on a Fair Value basis. (Please consider weights of 1 and 3 for the value of shares arrived on Net Asset basis and Earnings capitalization method respectively for both H Limited and B Limited)

You are required to arrive at the value of the shares of both H Ltd. and B Ltd. under:

- Net Asset Value Method
- Earnings Capitalization Method
- Exchange ratio of shares of H Limited to be issued to the shareholders of B Limited. On a Fair value basis (taking into consideration the assumption mentioned in point 4 above)

Answer:

WN 1: Valuation of share as per net assets method:

(in crores)

Particulars	H Limited	B Limited
Value of assets	1,300	31.50
Less: Liabilities (Note)	-300	-0
Net assets	1,000	31.50
No of shares	3.50	0.65
Value per share	285.71	48.46

Note:

- It is assumed that entire contingent liability will crystallize into actual liability

WN 2: Valuation of share as per Earnings capitalization method:

Particulars	H Limited	B Limited
Future maintainable profit	300	10
Capitalization rate	8%	8%
Value of company (FMP/Capitalization rate)	3,750	125
No of shares	3.50	0.65
Value per share	1,071.43	192.31

WN 3: Computation of fair value:

$$\text{Fair value} = \frac{(\text{Price as per Net assets method} \times 1) + (\text{Price as per Earnings method} \times 3)}{1 + 3}$$

$$\text{H Limited} = \frac{(285.71 \times 1) + (1,071.43 \times 3)}{1 + 3} = \text{Rs. 875 per share}$$

$$\text{B Limited} = \frac{(48.46 \times 1) + (192.31 \times 3)}{1 + 3} = \text{Rs. 156.35 per share}$$

WN 4: Exchange ratio on the basis of fair value:

Basis of exchange ratio		Fair Value
Base values	H Ltd: B Ltd	875: 156.35
Exchange ratio		156.35:875 (or) 0.1787:1

33. Net assets method and earnings capitalization method [May 2008, May 2017 RTP]

Given below is the balance sheet of S Limited as on March 31, 2008:

Liabilities	Rs. in lacs	Assets	Rs. in lacs
Share capital (of Rs.10 each)	100	Land and building	40
Reserves and surplus	40	Plant and machinery	80
Long term debts	30	Investments	10
		Stock	20
		Debtors	15
		Cash at Bank	5
	170		170

You are required to work out the value of the company's shares on the basis of Net Assets Method and Profit-earning capacity (capitalization) method and arrive at the fair price of the shares, by considering the following information:

- ❖ Profit for the current year Rs.64 lacs includes Rs.4 lacs extraordinary income and Rs.1 lac income from investments of surplus funds; such surplus funds are unlikely to recur
- ❖ In subsequent years, additional advertisement expenses of Rs.5 lacs are expected to be incurred each year
- ❖ Market value of Land and Building and Plant and Machinery has been ascertained at Rs.96 lacs and Rs.100 lacs respectively. This will entail additional depreciation of Rs.6 lacs each year
- ❖ Effective income tax rate is 30%
- ❖ The capitalization rate applicable to similar businesses is 15%

Answer:

WN 1: Valuation of company on the basis of net assets method:

Particulars	Amount (in lacs)
Value of assets:	
Land and building	96.00
Plant and machinery	100.00
Investments	10.00
Stock	20.00
Debtors	15.00
Cash at bank	5.00
Total value of assets	246.00
Less: Long term debt	-30.00
Value of net assets	216.00
No of shares	10
Value per share (216/10)	21.60

WN 2: Valuation of company on the basis of earnings capitalization method:

Particulars	Amount (in lacs)
Profit before tax	64.00
Less: Extraordinary income	-4.00
Less: Investment income	-1.00
Less: Additional advertisement	-5.00
Less: Additional depreciation	-6.00
Future maintainable PBT	48.00
Less: Tax @ 30%	-14.40
Future maintainable PAT	33.60
Capitalization rate	15%
Value of firm (33.60/15%)	224.00
Less: Debt	-30.00
Value of equity (33.60/15%)	194.00
No of shares	10.00
Value per share (224/10)	19.40

- It is assumed that profit given in the question is profit before tax
- It is assumed that interest has not been subtracted while computing FMP and hence computed value is that of firm. Amount of debt is deducted to get value of equity

WN 3: Computation of fair value:

$$\text{Fair value} = \frac{21.60 + 19.40}{2} = \text{Rs. 20.50 per share}$$

34. Divestiture of business [May 2017 MTP] [Homework]

MS Stones has different divisions of home interiors products. Recently, due to economic slowdown, the Managing Director of the Company expressed its desire to divestiture its ceramic tile business. The relevant financial details of this business are as follows:

- ❖ Estimated pre tax cash flow of next year = Rs.200 crore
- ❖ Book value of liabilities = Rs.780 crore

In an order to increase its share in the ceramic tile market, the Tripati Tiles Ltd. showed its interest in the acquisition of this unit and offered a proceed of Rs. 950 Crore for the same to MS Stones. The other data pertaining to the business are as follows:

- ❖ Tax rate = 30%
- ❖ Growth rate = 4%
- ❖ Applicable discount rate for tile business = 12%

If market value of liabilities are Rs. 40 Crore more than book value, you are required to advice MD whether she should go for divestiture of the tile business or not.

Answer:**WN 1: Valuation of tiles business:**

Particulars	C PLC
Pre-tax cash flow of next year	200 crores
Post-tax cash flow of next year	140 Crores
Cost of equity	12%
Growth rate	4%
Value of company $\left[\frac{\text{Net cash flow}}{K_e - G} \right]$	1,750 Crores
Less: Value of liabilities (780 + 40)	820 Crores
Net assets value	930 crores

Since, the Tripati tiles is offering Rs.950 Crores, more than Net Asset value of Rs.930 Crores, the company should go further with decision of divesture of tile business.

35. Valuation of company with floor value [May 2019, May 2015 RTP]

R Limited and S Limited operating in same industry are not experiencing any rapid growth but providing a steady stream of earnings. R Limited's management is interested in acquisition of S Limited due to its excess plant capacity. Share of S Limited is trading in market at Rs.3.20 each. Other data relating to S Limited is as follows:

Liabilities	Amount	Assets	Amount
Current Liabilities	1,59,80,000	Current Assets	2,48,75,000
Long term liabilities	1,28,00,000	Other assets	94,00,000
Reserves and surplus	2,79,95,000	Property Plants and equipments	3,45,00,000
Share capital (80 lacs shares)	1,20,00,000		
Total	6,87,75,000	Total	6,87,75,000

Particulars	R Limited	S Limited	Combined Entity
Profit after tax	86,50,000	49,72,000	1,21,85,000
Residual net cash flows per year	90,10,000	54,87,000	1,85,00,000
Required return on equity	13.75%	13.05%	12.50%

You are required to compute the following:

- i. Minimum price per share S Limited should accept from R Limited
- ii. Maximum price per share R Limited shall be willing to offer to S Limited
- iii. Floor value of per share of S Limited,. Whether it shall play any role in decision for its acquisition by R Limited

Answer:**WN 1: Valuation of company:**

Particulars	R Limited	S Limited	Combined entity

Residual net cash flow	90,10,000	54,87,000	1,85,00,000
Cost of equity	13.75%	13.05%	12.50%
Growth rate	0%	0%	0%
Value of company $\left[\frac{\text{Net cash flow}}{K_e - G} \right]$	6,55,27,273	4,20,45,977	14,80,00,000

WN 2: Minimum price per share S Limited should accept from R Limited:

Minimum price per share should be lower of the following:

- ❖ **Cash flow based:** Total consideration of Rs.4,20,45,977 (or) Rs.5.26 per share (4,20,45,977/80,00,000)
- ❖ **Book-value based:** Total consideration of Rs.3,99,95,000 (or) Rs. 5 per share (3,99,95,000/80,00,000)

Hence minimum price per share to be paid is Rs.5 per share (Book value)

WN 3: Computation of maximum price per share:

- ❖ Maximum consideration = Post-merger value – Pre-merger value
- ❖ Maximum consideration = 14,80,00,000 – 6,55,27,273
- ❖ Maximum consideration = Rs. 8,24,72,727
- ❖ Maximum price per share = Rs.10.31 (8,24,72,727/80,00,000)

WN 4: Relevance of floor value:

- Floor value of per share of S Ltd shall be Rs.3.20 (current market price) and it shall not play any role in decision for the acquisition of S Ltd. as it is lower than its current book value.

36. Impact of wrong WACC on valuation [May 2019 RTP, May 2018, Nov 2010, Nov 2014, Nov 2018, SM]

The valuation of Hansel Limited has been done by an investment analyst. Based on an expected free cash flow of Rs. 54 lakhs for the following year and an expected growth rate of 9 percent, the analyst has estimated the value of Hansel Limited to be Rs. 1800 lakhs. However, he committed a mistake of using the book values of debt and equity. The book value weights employed by the analyst are not known, but you know that Hansel Limited has a cost of equity of 20 percent and post tax cost of debt of 10 percent. The value of equity is thrice its book value, whereas the market value of its debt is nine-tenths of its book value. What is the correct value of Hansel Ltd?

Answer:**WN 1: Computation of wrong WACC used by the analyst:**

$$\text{Value of Firm} = \frac{FCF_1}{K_o - \text{Growth}}$$

$$1,800 \text{ lacs} = \frac{54 \text{ lacs}}{K_o - 0.09}; K_o - 0.09 = \frac{54}{1,800}; K_o = 0.03 + 0.09 = 0.12 \text{ (or) } 12\%$$

WN 2: Computation weighted used by the analyst:

Let us assume weight of equity to be X and weight of debt will be 1-X

Source	cost	Weight	Product
Equity	20	X	20X
Debt	10	1-X	10-10X
Total	12	1	20X+10-10X = 12

$$20X + 10 - 10X = 12; 10X = 2; X = 0.2 \text{ Times}$$

- Hence the weight of equity is 20% and weight of debt is 80%

WN 3: Computation of correct WACC with correct weights:

- Weight of equity = $0.20 \times 3 = 0.60$ Times
- Weight of debt = $0.80 \times (9/10) = 0.72$ Times

Source	cost	Weight	Product
Equity	20	0.60	12.00
Debt	10	0.72	7.20
Total		1.32	19.20

$$WACC = \frac{19.20}{1.32} = 14.55\%$$

WN 4: Correct valuation of Hansel Limited:

$$\text{Value of Firm} = \frac{FCF_1}{K_0 - \text{Growth}} = \frac{54}{14.55\% - 9\%} = \text{Rs. 972.97 lacs}$$

37. Valuation of firm [Nov 2024 MTP, SM] [Homework]

There is a privately held company X Pvt. Ltd that is operating into the retail space, and is now scouting for angel investors. The details pertinent to valuing X Pvt. Ltd are as follows –

The company has achieved break even this year and has an EBITDA of 90. The unleveraged beta based on the industry in which it operates is 1.8, and the average debt to equity ratio is hovering at 40:60. The rate of return provided by liquid bonds is 5%. The EV is to be taken at a multiple of 5 on EBITDA. The accountant has informed that the EBITDA of 90 includes an extraordinary gain of 10 for the year, and a potential write off of preliminary sales promotion costs of 20 are still pending. The internal assessment of rate of market return for the industry is 11%. The FCFs for the next 3 years are as follows:

Particulars	Y1	Y2	Y3
Future cash flows	100	120	150

The pre-tax cost of debt is 12%. Assume a tax regime of 30%. What is the potential value to be placed on X Pvt. Ltd?

Answer:**WN 1: Valuation as per EBITDA Multiple:**

- Enterprise value = Adjusted EBITDA x Multiple
- Adjusted EBITDA = 90 - extraordinary gain (10) - write-off (20) = 60
- Enterprise value = 60 x 5 = Rs.300

WN 2: Valuation based on cash flows:**Note 1: Computation of levered Beta (Equity Beta)**

Capital	Beta	Weight	Product
Debt	0	28 [40 x 0.7]	0
Equity	2.64 [158.40/60.00]	60	158.40
Overall	1.8	88	158.40

Part 2: WACC computation:

Capital	Beta	Weight	Product
Debt	8.4	40	3.36
Equity	20.84	60	12.504
Overall	15.864	100	15.864

$$\text{Cost of equity} = R_f + \text{Beta} \times (R_m - R_f) = 5 + 2.64 \times (11-5) = 20.84\%$$

Part 2: Discounting of cash flows:

Year	CF	PVF @ 15.864	DCF
1	100	0.863	86.30
2	120	0.745	89.40
3	150	0.643	96.45
			272.15

- Value of Firm = Rs.272.15

Conclusion:

- Potential value of Firm = Rs.272.15 to Rs.300

38. Venture capital financing [Nov 2007]

XY Ltd. which is specialized in manufacturing garments is planning for expansion to handle a new contract which it expects to obtain. An investment bank have approached the company and asked whether the Co.

had considered venture Capital financing. In 2001, the company borrowed Rs.100 lacs on which interest is paid at 10% p.a. The Company shares are unquoted and it has decided to take your advice in regard to the calculation of value of the Company that could be used in negotiations using the following available information and forecast. Company's forecast turnover for the year to 31st March, 2005 is Rs.2,000 lacs which is mainly dependent on the ability of the Company to obtain the new contract, the chance for which is 60%, turnover for the following year is dependent to some extent on the outcome of the year to 31st March, 2005. Following are the estimated turnovers and probabilities:

Year 2005		Year 2006	
Turnover (in lacs)	Probability	Turnover (in lacs)	Probability
2,000	0.60	2,500	0.70
		3,000	0.30
1,500	0.30	2,000	0.50
		1,800	0.50
1,200	0.10	1,500	0.60
		1,200	0.40

Operating costs inclusive of depreciation are expected to be 40% and 35% of turnover respectively for the years 31st March, 2005 and 2006. Tax is to be paid at 30%. It is assumed that profits after interest and taxes are free cash flows. Growth in earnings is expected to be 40% for the years 2007, 2008 and 2009 which will fall to 10% each year after that. Industry average cost of equity (net of tax) is 15%

Answer:

WN 1: Computation of expected turnover:

Particulars	Calculation	Amount
Year 2005	$(2,000 \times 0.60) + (1,500 \times 0.30) + (1,200 \times 0.10)$	1,770
Year 2006	$(2,500 \times 0.42) + (3,000 \times 0.18) + (2,000 \times 0.15) + (1,800 \times 0.15) + (1,500 \times 0.06) + (1,200 \times 0.04)$	2,298

Note: Concept of joint probability has been used for year 2006. Joint probability is equal to probability of year 1 x probability of year 2.

WN 2: Computation of free cash flows for 2005 and 2006:

FCFE approach has been used in this question as we don't have information to compute WACC. Amount of equity is missing in question for us to compute WACC

(in lacs)

Particulars	2005	2006
Turnover	1,770	2,298
Less: Operating costs @ 40% and 35%	(708)	(804)
Less: Interest (100 x 10%)	(10)	(10)
Profit before tax	1,052	1,484
Less: Tax @ 30%	(316)	(445)
Earnings/Cash flows	736	1,039

WN 3: Computation of free cash flows for 2007, 2008 and 2009:

Particulars	Amount
2007 cash flow (1,039 + 40%)	1,455
2008 cash flow (1,455 + 40%)	2,037
2009 cash flow (2,037 + 40%)	2,852

WN 4: Valuation of perpetuity:

$$\text{Value of perpetuity} = \frac{2,852 \times 1.10}{15\% - 10\%} = 62,744 \text{ lacs}$$

WN 5: Valuation of equity:

Year	Cash flow	PVF @ 15%	DCF
2005	736	0.870	640
2006	1039	0.756	785
2007	1455	0.658	957
2008	2037	0.572	1,165
2009	2852	0.497	1,417

2009	62,744	0.497	31,184
Value of Equity			36,148

39. Relative valuation [SM]

A Limited made a gross profit of Rs.10,00,000 and incurred indirect expenses of Rs.4,00,000. The number of issued equity shares is 1,00,000. The company has a debt of Rs.3,00,000 and Reserves to the tune of Rs.5,00,000. The market related details are as follows:

- Risk-free rate of return = 4.50%
- Market rate of return = 12.00%
- Beta of company = 0.90 Times

Determine:

- Per share earning value of company
- Equity value of the company if applicable EBITDA multiple is 5

Answer:

WN 1: Computation of earning value per share:

Note 1: Computation of discount rate:

- Capitalization rate = $R_f + \text{Beta} \times (R_m - R_f)$
- Capitalization rate = $4.50 + 0.90 \times (12.00 - 4.50) = 11.25\%$

Note 2: Computation of earning value per share:

Particulars	Amount
Gross profit	10,00,000
Less: Indirect expenses	-4,00,000
EBITDA	6,00,000
Earning value of company (6,00,000/11.25%)	53,33,333
Number of shares	1,00,000
Earning value per share	53.33

WN 2: Equity value of company if EBITDA multiple is 5 times:

Particulars	Amount
EBITDA	6,00,000
Enterprise valuation (6,00,000 x 5)	30,00,000
Less: Debt	(3,00,000)
Add: Surplus funds (Reserves)	5,00,000
Equity value of company	32,00,000

Author's Note:

- It is assumed surplus funds are available in form of cash and cash equivalents and hence adjusted in valuation of equity
- Computation of earning value per share is not fully logical and the solution has been presented as per ICAI Material

40. Valuation of units [Nov 2021] [Homework]

Strong Ltd., (SL), an all equity financed, conglomerate is in need to borrow Rs. 2,000 crore to finance expansion of its crore current operations. However, SL is susceptible to raise the amount from the market. The CFO has suggested for divesting one of the two nonprime units to reduce the overall borrowings from the market. The following data, after internal due diligence, has been placed for consideration of the Board:

(in crores)

Particulars	Unit 1	Unit 2
Reported Profit after tax	147	140
Extra ordinary gains	16	8
Extra ordinary losses	20	12
Expected profit from the launch of new product	56	12
Price earnings ratio	10	12.50
Tax rate	30	30

You are required to advise the Board on the following:

- (i) The price at which the units can be divested,
(ii) The unit which can be divested so as to minimise the borrowings from the market and
(iii) The amount of borrowing.

Answer:

WN 1: Valuation of business:

Particulars	Unit 1	Unit 2
Existing PAT	147.00	140.00
Existing PBT [PAT/70%]	210.00	200.00
Less: Extraordinary income	-16.00	-8.00
Add: Extraordinary loss	20.00	12.00
Profit from new product	56.00	12.00
Future maintainable PBT	270.00	216.00
Less: Tax @ 30%	-81.00	-64.80
Future maintainable PAT	189.00	151.20
Price-earnings ratio	10.00	12.50
Value of units [PAT x PE Multiple]	1890.00	1890.00

- Both units can be divested at Rs.1,890 Crores

Part (ii):

- The unit I can be divested as it has lower PE Ratio

Part (iii):

- Amount of borrowing = Rs.2,000 Crores – Rs.1,890 Crores = Rs.110 Crores

41. Valuation [Nov 2020, Nov 2024 MTP] [Concept Revision]

ICL is proposing to take over SVL with an objective to diversify. While ICL growth rate is 18%, the SVL growth rate is 15%. Both the companies pay dividend regularly. The summarized Profit & Loss Account of both the companies are as follows:

(in Crores)

Particulars	ICL	SVL
Net Sales	9,090	3,000
PBIT	5,960	1,440
Interest	1,500	50
Provision for Tax	2,880	890
PAT	1,580	500
Dividends	470	304.35

Particulars	ICL		SVL	
Fixed Assets				
Land and building (Net)	1,440		380	
Plant and Machinery (Net)	1,800		700	
Furniture and fittings (Net)	60	3,300	20	1,100
Current assets		1,550		1,160
Less: Current Liabilities				
Creditors	460		260	
Overdrafts	70		20	
Provision for tax	290		100	
Provision for dividends	120	940	100	480
Net Assets		3,910		1,780
Paid-up share capital (Rs.10 per share)	500		250	
Reserves and surplus	2,100	2,600	1,320	1,570
Borrowing		1,310		210
Capital employed		3,910		1,780
Market price per share		175		98
Cost of equity		25%		20%

ICL's Land & Buildings are stated at current prices. SVL's Land & Buildings are revalued three years ago. There has been an increase of 7.65 per cent per year in the value of Land & Buildings. SVL is expected to grow @ 18 per cent each year, after merger. ICL is interested to do justice to the shareholders of both the Companies. For the swap ratio weights are assigned to different parameters by the Board of Directors as follows:

Net Worth Per Share (after adjustment)	25%
EPS (Earnings per share)	30%
Share price as per Dividend Growth Model	20%
Market price per share	25%

You are required to suggest the swap ratio based on above weights and total number of shares.

Note: Round off calculations upto two decimal points

Answer:

WN 1: Computation of Networth per share (Book value per share)

Particulars	ICL	SVL
Networth	2,600.00	1,570.00
Adjustment for Land and building	-	94.05
Adjusted Networth	2,600.00	1,664.05
No of shares	50.00	25.00
Net worth per share	52.00	66.56

Note: Land and Building adjustment

- Land was revalued 3 years ago and the value of Land and building for SVL was Rs.380 Crores. There has been an increase of 7.65 percent per year and the current value of land and building is Rs.474.05 Crores. Hence there has to be an increase of Rs.94.05 Crores in Networth computation.

WN 2: Computation of EPS

Particulars	ICL	SVL
PAT	1,580.00	500.00
No of shares	50.00	25.00
Earnings per share	31.60	20.00

WN 3: Computation of share price as per Dividend Growth Model

Particulars	ICL	SVL
Dividends	470.00	304.35
No of shares	50.00	25.00
Dividend per share (D0)	9.40	12.17
Growth rate	18.00	15.00
Next year dividend (D1)	11.09	14.00
Cost of equity	25%	20%
Value per share	158.43 11.09 <u>25% - 18%</u>	280.00 14.00 <u>20% - 15%</u>

WN 4: Calculation of shares to be issued and swap ratio:

Particulars	Base values	Swap Ratio	Shares to be allotted	Weight	Product
NW per share	52.00:66.56	66.56:52.00	32.00 (25 Cr x 66.56/52)	0.25	8.00
EPS	31.60:20.00	20.00:31.60	15.82 (25 Cr x 20/31.60)	0.30	4.75
Dividend growth	158.43:280	280:158.43	44.18 (25 Cr x 280/158.43)	0.20	8.84
MPS	175:98	98:175	14.00 (25 Cr x 98/175.00)	0.25	3.50
No of shares to be issued					25.09 ~ 25.00

Swap ratio is for every one share of SVL, to issue 1 share of ICL.

The Balance Sheet of M/s. Sundry Ltd. as on 31-03-2020 is follows:

Liabilities	Amount (in lacs)	Assets	Amount (in lacs)
Share capital	300	Fixed assets	600
Reserves	200	Inventory	500
Long term loan	400	Receivables	240
Short term loan	300	Cash	60
Payables and provisions	200		
Total	1,400	Total	1,400

Sales for the year was Rs. 600 lakhs. The sales are expected to grow by 20% during the year. The profit margin and dividend pay-out ratio are expected to be 4% and 50% respectively. The company further desires that during the current year Sales to Short Term Loan and Payables and Provision should be in the ratio of 4:3. Ratio of fixed assets to Long Term Loans should be 1.5. Debt Equity Ratio should not exceed 1.5.

You are required to determine:

- The amount of External Fund Requirement (EFR)
- The amount to be raised from Short Term, Long Term and Equity funds.

Answer:

WN 1: Computation of external fund requirement:

Particulars	Calculation	Amount (in lacs)
Sales of next year	$600 + 20\%$	720.00
Profit	$720 \times 4\%$	28.80
Less: Dividend	$28.80 \times 50\%$	-14.40
Retained earnings		14.40
Fund required for growth of 20%	$[1,400 - 200] \times 20\%$	240.00
Balance funds to be met from external sources	240.00 - 14.40	225.60

Note:

- The company plans to grow 20 percent in current year. In order to support growth, working capital will grow by 20% and fixed assets will also increase by 20%
- Fixed assets + Working capital = 1,400 lacs - 200 lacs = 1,200 lacs

WN 2: Amount to be raised from short-term, long-term and equity funds:

Amount raised as short-term loan:

Particulars	Calculation	Amount (in lacs)
Sales of next year		720.00
Target short-term loans and payables	$720 \times \frac{3}{4}$	540.00
Less: Payables	$200 + 20\%$	-240.00
Target short-term loan		300.00
Existing short-term loan		300.00
New short-term loan raised		0.00

Amount raised as long-term loan:

Particulars	Calculation	Amount (in lacs)
Fixed assets of next year	$600 + 20\%$	720.00
Target long-term loan	$\frac{720}{1.50}$	480.00
Less: Existing long-term loan		400.00
New long-term loan to be raised		80.00

Amount raised as external equity:

Particulars	Calculation	Amount (in lacs)
Total external funds required	WN 1	225.60
Less: New short-term loan		0.00

Less: New long-term loan		80.00
Fresh issue of equity shares		145.60

Check on debt-equity ratio:

Particulars	Calculation	Amount (in lacs)
Closing equity	300 + 200 + 145.60 + 14.40	660.00
Closing debt	480 + 300	780.00
Debt-equity ratio	780/660	1.18

Conclusion:

- Debt-equity ratio does not exceed 1.50 times and hence the funds will be raised as:
 - External equity = 145.60
 - Retained earnings = 14.40
 - Long-term loan = 80.00
 - Short-term loan = 0.00

Part III - Market Value Added and Shareholder Value Added**43. Computation of market value added:**

The capital structure of ABC Limited is as under:

Particulars	Amount
Equity shares of Rs.100 each fully paid up	Rs.505 lacs
9% convertible preference shares of Rs.10 each	Rs.150 lacs
12% secured debentures of Rs.10 each	Rs.50 lacs
Reserves	Rs.101 lacs
Statutory fund	Rs.50.50 lacs

The statutory fund is required to be invested in Government securities. The ordinary shares are quoted at a premium of 500%. Preference shares are at Rs.30 per share and debentures are at par. You are required to compute the market value added

Answer:

- Market value added = Market value of firm – Book value of firm
- Market value of firm = Equity + Debt + Preference = $(505/100 \times 600) + (150/10 \times 30) + 50 = 3,030 + 450 + 50 = \text{Rs.}3,530 \text{ lacs}$
- Book value of Firm = 505 lacs + 150 lacs + 50 lacs + 101 lacs + 50.50 lacs = Rs.856.50 lacs
- Market value added = 3,530 lacs – 856.50 lacs = Rs.2,673.50 lacs**

44. Computation of Shareholder Value Added:

Compute the intrinsic value of equity using SVA approach from the following information:

- ❖ The company will earn EBIT of Rs.100 in year 1 and the same will grow at the rate of 5 percent per annum for a period of 4 years. The free cash flow of year 4 will continue to be earned perpetually
- ❖ Interest cost is expected to be 5 lacs, 6 lacs, 7 lacs and 8 lacs for the four years
- ❖ Tax rates of the company is 33 percent
- ❖ Depreciation will be 5 lacs, 5 lacs, 6 lacs and 7 lacs for the four years
- ❖ Capital investment will be 0 lacs, 12 lacs, 6 lacs and 9 lacs for the four years
- ❖ Net working capital requirement will be 5 lacs, 5 lacs, 6 lacs and 7 lacs for the four years
- ❖ WACC of the company is 12 percent
- ❖ Value of non-core assets is 35 lacs and the book value of debt is 19 lacs

Answer:**WN 1: Computation of Free Cash flow to Firm:**

(in lacs)

Particulars	Year 1	Year 2	Year 3	Year 4
EBIT	100.00	105.00	110.25	115.76
Less: Interest	0.00	0.00	0.00	0.00
EBT	100.00	105.00	110.25	115.76
Less: Tax @ 33%	-33.00	-34.65	-36.38	-38.20
EAT	67.00	70.35	73.87	77.56

Add: Depreciation	5.00	5.00	6.00	7.00
Less: Capex	0	-12.00	-6.00	-9.00
Less: Working capital	-5.00	-5.00	-6.00	-7.00
FCFF	67.00	58.35	67.87	68.56

$$\text{PV of perpetuity(Y4)} = \frac{\text{Year 5 cash flow}}{12\%} = \frac{68.56}{12\%} = 571.33$$

WN 2: Computation of value of Firm:

Year	Cash flow	PVF @ 12%	DCF
1	67.00	0.893	59.83
2	58.35	0.797	46.50
3	67.87	0.712	48.32
4	68.56	0.636	43.60
4	571.33	0.636	363.37
Value of Firm			561.62

- Intrinsic value of equity = Value of firm – Value of debt + Market value of non-core assets
- **Intrinsic value of equity = 561.62 lacs – 19 lacs + 35 lacs = Rs.577.62 lacs**

Part IV – Valuation of distressed companies**45. Modified Discounted Cash flow approach:**

Bhushan Power and steels limited is going through financial difficulties and has estimated the following projections:

(in crores)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Cash flow from operations	20.00	30.00	35.00	40.00	45.00
Capital expenditure	10.00	12.00	15.00	15.00	20.00

Additional information:

- There is a 20% probability of default in year 2
- There is a 40% probability of default in year 3
- Terminal growth rate (beyond year 5) is 3%
- The investor is looking at return of 20% to factor in high-risk of the company
- The company currently has debt of Rs.50 crores and has cash and cash equivalents of Rs.10 Crores

You are required to arrive at the equity valuation of Bhushan Power and Steels Limited.

Answer:**WN 1: Computation of adjusted cash flows:**

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Cash flow from operations	20.00	30.00	35.00	40.00	45.00
Less: Capital expenditure	-10.00	-12.00	-15.00	-15.00	-20.00
Free cash flows	10.00	18.00	20.00	25.00	25.00
Probability of default		20%	40%		
Expected cash flows [Free cash flows x (1 – POD)]	10.00	14.40	12.00	25.00	25.00

WN 2: Computation of terminal value:

$$\text{Terminal value} = \frac{CF_6}{K_0 - G} = \frac{25 \times 1.03}{20\% - 3\%} = \frac{25.75}{17\%} = \text{Rs. 151.47 crores}$$

WN 3: Valuation of company using FCFF approach:

Year	Cash flow	PVF @ 20%	DCF
1	10.00	0.833	8.33
2	14.40	0.694	9.99
3	12.00	0.579	6.95
4	25.00	0.482	12.05
5	25.00	0.402	10.05
5	151.47	0.402	60.89

Value of company	108.26

- Equity value = Value of company + Cash – Value of debt
- Equity value = 108.26 + 10 – 50 = Rs.68.26 Crores

46. DCF valuation + Distress Value:

XYZ Limited is currently going through financial distress and there is a 40% probability of the company defaulting. The analyst's forecast of free cash flow assuming the company is a going concern is shown below:

Particulars	2013	2014	2015	2016	2017	2018	2019	2020
Free cash flow	13.75	6.27	7.37	7.66	6.04	5.69	6.35	7.05

The cost of capital of the company is 15 percent and value of debt is Rs.4.92 crores. The analyst expects the cash flows to grow at 10 percent forever after 2020. In case the company defaults, then distress value is expected to be 20% of the going concern value.

Compute the value of equity of XYZ Limited.

Answer:

WN 1: Computation of valuation of XYZ Limited as a going concern:

Year	Cash flow	PVF @ 15%	DCF
1	13.75	0.87	11.96
2	6.27	0.756	4.74
3	7.37	0.658	4.85
4	7.66	0.572	4.38
5	6.04	0.497	3
6	5.69	0.432	2.46
7	6.35	0.376	2.39
8	7.05	0.327	2.31
8	155.1	0.327	50.72
Value of Firm			86.81

Note 1: Valuation of perpetuity cash flow

$$\text{Y8 perpetuity} = \frac{\text{FCFF}_9}{K_e - \text{Growth}} = \frac{7.05 \times 1.10}{15\% - 10\%} = \text{Rs. 155.10 Crores}$$

WN 2: Computation of financial distress company valuation:

- Financial distress company valuation = 20% of Going concern value
- Financial distress company valuation = 20% x 86.81 crores = Rs.17.36 Crores

WN 3: Final Valuation of XYZ Limited:

Final valuation = [Going concern value x Probability of survival] + [Distress value x Probability of default]
Final valuation = [86.81 x 60%] + [17.36 x 40%] = Rs. 59.03 Crores
Value of equity = 59.03 Crores – 4.92 Crores = Rs.54.11 Crores

47. Valuation of distressed companies [Concept Revision]

XYZ Ltd. is a distressed company operating in the manufacturing sector. The company has been experiencing financial difficulties and is on the verge of bankruptcy. You have been appointed as a consultant to assess the fair value of the distressed company. After conducting a thorough analysis, you have gathered the following information:

- The market capitalization of XYZ Ltd. is currently Rs.50 Crores.
- The company has a total debt of Rs.50 Crores. Debt is required to be repaid equally over next 5 years. Interest rate and tax rate is 10% and 30% respectively.
- The expected recovery rate for the distressed company's assets is 40% of their book value. Book value of the firm is Rs.100 Crores.
- The company's estimated liquidation expenses are Rs.10 Crores.
- The risk-free rate of return is 8%, and the distressed company's cost of equity is estimated to be 18%.
- The distressed company is expected to generate a free cash flow to the firm (FCFF) of Rs.15 Crores annually for the next five years, with no growth rate expected thereafter.
- Probability of default is 40% over the medium term.

Calculate the fair value of the distressed company using the Adjusted Present Value (APV) approach.

Answer:

WN 1: Valuation of un-levered firm:

Valuation of un-levered firm would be done by discounting the cash flows at cost of equity. The firm is likely to generate Rs.15 crores over the next five years and the same amount would continue even in future. Hence this is a case of perpetuity from day 1.

$$\text{Value of unlevered firm} = \frac{15}{18\% - 0} = \text{Rs. 83.33 crores}$$

WN 2: Computation of tax benefits of debt:

Year	Opening Debt	Interest 10%	Tax benefit 30%	PVF @ 10%	DCF
1	50.00	5.00	1.50	0.909	1.3635
2	40.00	4.00	1.20	0.826	0.9912
3	30.00	3.00	0.90	0.751	0.6759
4	20.00	2.00	0.60	0.683	0.4098
5	10.00	1.00	0.30	0.621	0.1863
Present value of tax saving					3.6267

WN 3: Computation of distress sale value:

- Gross distress sales value = 100 crores x 40% = Rs.40 crores
- Net distress sales value post liquidation expenses = 40 crores – 10 crores = Rs.30 crores

WN 4: Valuation of company:

- Expected bankruptcy cost = (Unlevered company value – Distress value) x POD
- Expected bankruptcy cost = (83.33 – 30) x 40% = Rs.21.33 crores
- Value of company = Value of unlevered company + Tax benefits – Expected bankruptcy cost
- Value of company = 83.33 + 3.62 – 21.33 = Rs.65.62 crores**

WN 5: Valuation of equity:

- Value of equity = Value of company – Value of debt
- Value of equity = 65.62 crores – 50 crores = Rs.15.62 crores**

48. APV Approach:

Yes Bank is currently into severe financial distress and you have been asked to arrive at fair value of equity shares. Following is the information about the Bank:

Amount of debt	Rs.80 crores
Unlevered cost of equity	15%
Tax Rate	30%
Probability of distress	20%
Distress sale value	Rs.40 crores
Free cash flow for next five years	Rs.15 Crores annually and same amount continuing thereafter

Answer:

WN 1: Computation of unlevered firm value:

The firm is likely to generate Rs.15 crores over the next five years and the same amount would continue even in future. Hence this is a case of perpetuity from day 1.

$$\text{Value of unlevered firm} = \frac{15}{15\% - 0} = \text{Rs. 100.00 crores}$$

WN 2: Tax benefits due to debt:

- Tax benefit = Amount of debt x Tax rate = Rs.80 crores x 30% = Rs.24 Crores

WN 3: Value of company using DCF valuation + Distress value approach:

Valuation = [Unlevered company value x Probability of survival] + [Distress value x Probability of default]
Valuation = [100.00 x 80%] + [40.00 x 20%] = Rs. 88.00 Crores
Valuation using APV approach = 88.00 crores + 24 crores = Rs.112.00 Crores

Alternative answer:

- Expected bankruptcy cost = (Unlevered company value – Distress value) x POD
- Expected bankruptcy cost = (10.00 – 40.00) x 20% = Rs.12.00 Crores
- Value of company = Value of unlevered company + Tax benefits – Expected bankruptcy cost
- Value of company = 100.00 + 24.00 – 12.00 = Rs.112.00 Crores

WN 4: Valuation of equity:

- Value of equity = Value of company – Value of debt
- Value of equity = 112.00 crores – 80 Crores = 32.00 crores

49. Relative valuation [Concept Revision]

BSNL Limited is in the telecom industry and is currently facing financial distress due to increased competition, declining revenues, and rising debt levels.

To value BSNL Limited, you have identified comparable companies in the Telecom industry. Let's consider three healthy companies: Company A, Company B, and Company C. These companies are similar in terms of their business model, market presence, and size.

Operating and Financial data:**(in Crores)**

Particulars	BSNL Limited	Company A	Company B	Company C
Market capitalization		1,00,000	2,00,000	2,50,000
No of shares	1,000	1,000	2,000	2,500
Revenues	10,000	20,000	25,000	62,500
PAT	-5,000	10,000	16,000	20,000
Book value per share	20	50	25	40

You have decided to apply the following ratios:

- Market to book value
- Market to Sales

It was decided to adjust market to book value and market to sales ratios by 40% and 50% to reflect the stress in the company.

Required:

Compute the fair value of BSNL Limited

Answer:**WN 1: Computation of average industry ratios:**

Particulars	Company A	Company B	Company C	Industry
Market to Book value ratio:				
Market capitalization	1,00,000	2,00,000	2,50,000	
No of shares (A)	1,000	2,000	2,500	
Book value per share (B)	50	25	40	
Overall book value (A x B)	50,000	50,000	1,00,000	
Market to Book value ratio [Market cap/Book value]	2.00	4.00	2.50	2.8333
Market to Sales Ratio:				
Market capitalization	1,00,000	2,00,000	2,50,000	
Sales	20,000	25,000	62,500	
Market to sales ratio [Market cap/Sales]	5.00	8.00	4.00	5.6667

WN 2: Valuation of BSNL Limited:

Particulars	Calculation	Amount (in Cr)
Market to Book value ratio:		
Book value of BSNL Limited	20 x 1,000	20,000
Adjusted ratio of industry	2.8333 – 40%	1.70
Value of BSNL Limited	60,000 x 1.70	34,000

Market to Sales Ratio:		
Sales of BSNL Limited	Given	10,000
Adjusted ratio of industry	5.6667 – 50%	2.8333
Value of BSNL Limited	10,000 x 2.8333	28,333
Final fair value of BSNL Limited	$\frac{34,000 + 28,333}{2}$	31,166.50

Part V – Valuation of Start-ups

50. Berkus Approach:

An investor is planning an investment in ABC Tech Limited which has provided the following information:

- **Basic value:** ABC Tech has a unique and innovative business idea that addresses a significant problem in the market
- **Technology:** ABC Tech has developed a working prototype of its software solution, showcasing its functionality and capabilities.
- **Execution:** The start-up has a highly skilled and experienced management team with a successful track record in the software industry.
- **Strategic relationships:** ABC Tech has formed partnerships with key industry players, providing access to a broader customer base and resources.
- **Production and consequent sales:** Although the start-up is still in the early stages, it has secured its first few clients and generated initial revenue

Methodology of valuation adopted by the investor:

Parameter	Range of Valuation	Score on a scale of 0 to 10
Basic value	0 to 20,00,000	8
Technology	0 to 10,00,000	6
Execution	0 to 15,00,000	8
Strategic relationships	0 to 40,00,000	9
Production and consequent sales	0 to 50,00,000	4

Arrive at fair value of ABC Tech Limited by following the above methodology of valuation.

Answer:

Parameter	Calculation	Amount
Basic value	$20,00,000 \times \frac{8}{10}$	16,00,000
Technology	$10,00,000 \times \frac{6}{10}$	6,00,000
Execution	$15,00,000 \times \frac{8}{10}$	12,00,000
Strategic relationships	$40,00,000 \times \frac{9}{10}$	36,00,000
Production and consequent sales	$50,00,000 \times \frac{4}{10}$	20,00,000
Overall value of ABC Tech		90,00,000

51. Cost-to-duplicate approach:

XYZ Tech is in the software development industry. The company has incurred the following expenses in building its business:

Particulars	Amount
Research and Development Cost	5,00,000
Cost of Physical Assets (Computers, Office equipment)	2,00,000
Intellectual Property costs (patent filings and copyrights)	1,00,000
Employee salaries and wages for the development team	3,00,000
Marketing and advertising expenses	1,50,000
Legal and administrative costs	50,000

Compute the value of XYZ Tech using the cost-to-duplicate approach

Answer:

Particulars	Amount
Research and Development Cost	5,00,000

Cost of Physical Assets (Computers, Office equipment)	2,00,000
Intellectual Property costs (patent filings and copyrights)	1,00,000
Employee salaries and wages for the development team	3,00,000
Marketing and advertising expenses	1,50,000
Legal and administrative costs	50,000
Total Value of XYZ Tech as per cost-to-duplicate approach	13,00,000

52. Comparable Transactions Method:

PharmaCo is a start-up operating in the pharmaceutical industry. There have been three recent comparable transactions in the pharma industry involving similar start-ups. The financial data and valuation multiples for these transactions are as follows:

(Amount in crores)

Particulars	Transaction 1	Transaction 2	Transaction 3
Transaction price	50.00	70.00	60.00
Revenues	10.00	15.00	12.00
EBITDA	4.00	6.00	5.00

PharmaCo has reported revenues and EBITDA of Rs.8 crores and Rs.3 crores in the recent year. Compute the value of PharmaCo

Answer:**WN 1: Computation of average ratios of past transactions:**

Particulars	Transaction 1	Transaction 2	Transaction 3	Average
Price to sales ratio				
Transaction price	50.00	70.00	60.00	
Sales	10.00	15.00	12.00	
Price to sales ratio	5.00	4.67	5.00	4.89
Price to EBITDA Ratio:				
Transaction price	50.00	70.00	60.00	
EBITDA	4.00	6.00	5.00	
Price to EBITDA ratio	12.50	11.67	12.00	12.06

WN 2: Valuation of PharmCo:

Particulars	Calculation	Amount (in Cr)
Price to Sales Ratio		
Sales of PharmaCo		8.00
Average ratio of industry		4.89
Value of PharmaCo	8.00 x 4.89	39.12
Price to EBITDA Ratio:		
EBITDA of PharmaCo		3.00
Average ratio of industry		12.06
Value of PharmaCo	3.00 x 12.06	36.18
Final fair value of Pharmaco	$\frac{39.12 + 36.18}{2}$	37.65

53. Comparable Transactions Method:

XYZ Ltd., a logistics startup, was acquired for Rs 560 crores. It had 28 crore, active users. Suppose you are valuing ABC Ltd, another logistics startup with 1.75 crore users. Arrive at fair value of ABC Limited.

Answer:

Value per user of XYZ Limited = $\frac{560}{28}$ = Rs. 20 per user
Value of ABC Limited = Rs.20 per user x 1.75 Crore users = Rs.35.00 Crores

54. Scorecard Valuation Method:

EduTech is operating in the education industry. The start-up is looking at fund raising and hence has approached you for arriving at valuation of the entity. You have compared Edu-tech with another start-up in the education sector whose valuation is Rs.200 Crores. The summary of your comparison is as under:

- **Management Team Experience (Weight: 30%):** The experience and expertise of the management team are crucial for the success of the start-up. EduTech's management team has extensive experience in the education and technology sectors, and it receives a score of 120% (Above-average)
- **Market Opportunity (Weight: 25%):** The size of the addressable market is an essential factor in determining the potential growth of the start-up. EduTech operates in a large and growing education market, and it receives a score of 100% (par)
- **Stage of Development (Weight: 20%):** The stage of development indicates the progress of the start-up towards commercialization. EduTech is in the early revenue-generating stage, and it receives a score of 80% (below-average)
- **Competitive Landscape (Weight: 15%):** The level of competition in the market can impact the start-up's ability to capture market share. EduTech faces moderate competition, and it receives a score of 60% (below-average)
- **Funding Secured (Weight: 10%):** The amount of funding raised by the start-up can influence its ability to execute its business plan. EduTech has not received funding till date, and it receives a score of 50% (below-average)

Answer:

WN 1: Computation of average score of Edu-tech as compared to the other start-up:

Parameter	Calculation	Amount
Management team experience	30% x 120%	0.36
Market opportunity	25% x 100%	0.25
Stage of development	20% x 80%	0.16
Competitive landscape	15% x 60%	0.09
Funding Secured	10% x 50%	0.05
Overall Score		0.91
Valuation of Edutech (in crores)	0.91 x 200	182.00

55. Valuation of Start-up – First Chicago Method [Nov 2024 MTP]

The ABC Startup has the following expected profits under different scenarios along respective probabilities:

Year	Best Case		Base Case		Worst Case	
	Revenues	Expenses	Revenues	Expenses	Revenues	Expenses
1	100,00,000	80,00,000	100,00,000	90,00,000	100,00,000	95,00,000
2	120,00,000	92,40,000	110,00,000	95,70,000	102,00,000	98,94,000
3	144,00,000	108,00,000	121,00,000	102,85,000	104,04,000	101,95,920
Probability	30%		60%		10%	

You are required to suggest the value of ABC Startup using First Chicago Method assuming that:

- Applicable discounting rate is 20%.
- Startup is located in Tax-free Zone.
- The multiple for Terminal is 10.
- No depreciable assets are held by the ABC Startup.
- Use 4 decimals for PVF

Answer:

WN 1: Valuation of company under different scenarios:

Year	Cash Flow			PVF @ 20%	DCF		
	Best	Base	Worst		Best	Base	Worst
1	20,00,000	10,00,000	5,00,000	0.8333	16,66,600	8,33,300	4,16,650
2	27,60,000	14,30,000	3,06,000	0.6944	19,16,544	9,92,992	2,12,486
3	36,00,000	18,15,000	2,08,080	0.5787	20,83,320	10,50,341	1,20,416
3	3,60,00,000	1,81,50,000	20,80,800	0.5787	2,08,33,200	1,05,03,405	12,04,159
Total					2,64,99,664	1,33,80,038	19,53,711

- Value of ABC Startup = $(2,64,99,664 \times 0.30) + (1,33,80,038 \times 0.60) + (19,53,711 \times 0.10) = \text{Rs.} 1,61,73,293$

56. Venture Capital Method [Concept Revision]

TMC is a venture capital financier. It received a proposal for financing requiring an investment of Rs.45 crore in ABC Limited. ABC Limited can earn Rs.600 crore after 6 years if succeeds. However, it may be possible that the company may fail at any time during the six years. The following table provide the estimates of probabilities of the failure of the projects.

Year	1	2	3	4	5	6
Probability of failure	0.28	0.25	0.22	0.18	0.18	0.10

In the above table the probability that the project fails in the second year is given that it has survived throughout year 1. Similarly for year 2 and so forth. TMC is considering an equity investment in the project. The beta of this type of project is 7. The market return and risk free rate of return are 8% and 6% respectively. You are required to compute the fair value of ABC Limited and compute the percentage stake which would be offered by ABC Limited to TMC for an investment of Rs.45 Crores.

Answer:**WN 1: Computation of probability of success of project:**

- Probability of success till 6th year = (Probability of success in year 1 x Probability of success in year 2 x Probability of success in year 3 x Probability of success in year 4 x Probability of success in year 5 x Probability of success in year 6)
- Probability of success till 6th year = (72% x 75% x 78% x 82% x 82% x 90%) = 25.4893%

Note: Project will be successful only if it is able to succeed for all six years and hence we have to compute the joint probability of success till year 6.

WN 2: Valuation of ABC Limited:

- Value of ABC Limited in year 6 = Rs.600 crores x 25.4893% = Rs.152.9358 Crores
- Discount rate = 6% + 7 x (8% - 6%) = 20.00%

Fair post money valuation of ABC Limited today = $\frac{152.9358}{1.20^6}$ = Rs. 51.2335 Crores

Particulars	Amount	Percentage Stake
Post-money valuation	51.2335	100.00%
Less: Amount contributed by TMC	-45.000	87.83%
Pre-money valuation	6.2335	12.17%

- TMC limited would be offered a stake of 87.83% for the investment of Rs.45 Crores in ABC Limited.

57. Venture Capital Method:

A venture capitalist is considering an investment in TechCo. The venture capitalist has a desired rate of return of 20x on their investment. The estimated exit value of TechCo at the time of exit (through an acquisition) is Rs.200 Crores. The venture capitalist plans to invest Rs.5 Crores in TechCo. Using the Venture Capital Method, we can calculate the post-money valuation and pre-money valuation of TechCo.

Answer:

Particulars	Calculation	Amount (Crores)
Post-money valuation	$\frac{200}{20}$	10.00
Less: Amount contributed by Venture capitalist		-5.00
Pre-money valuation		5.00

Part VI - Valuation of Digital Platforms**58. Income Approach:**

You are required to do a valuation of a digital platform "ShopHub" which connects buyers and sellers. Following is the information about the company's expected performance:

Particulars	Amount
Number of sellers in year 1	1,000
Average transactions per seller	300
Average transaction value per seller	1,000
Average transaction fees charged by ShopHub	5%
Operating expenses as % of revenues	80%
Tax rate	40%

Additional information:

- Number of sellers are expected to grow by 200 every year till year 5
- Average transaction per seller and transaction value per seller both will see an annual increase of 10% till year 5
- Transaction fees charged by ShopHub will increase by 0.5% for year 2 to year 5 and stabilize at 7%

- Cash flows from year 6 onwards will show a constant growth of 5%
- The return expected from investment in ShopHub is 20%

Compute fair value of ShopHub?

Answer:

WN 1: Computation of cash flows till year 5:

(in lacs)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Number of sellers (A)	1,000.00	1,200.00	1,400.00	1,600.00	1,800.00
Number of transactions (B)	300.00	330.00	363.00	399.30	439.23
Average transaction value (C)	1,000.00	1,100.00	1,210.00	1,331.00	1,464.10
Transaction value per seller (D = B X C)	3,00,000.00	3,63,000.00	4,39,230.00	5,31,468.30	6,43,076.64
Total transaction value (E = A x D)	3,000.00	4,356.00	6,149.22	8,503.49	11,575.38
Commission % (F)	5.00	5.50	6.00	6.50	7.00
Revenues of ShopHub (E x F)	150.00	239.58	368.95	552.73	810.28
Less: Operating expenses @ 80%	-120.00	-191.66	-295.16	-442.18	-648.22
Profit before tax	30.00	47.92	73.79	110.55	162.06
Less: Tax @ 40%	-12.00	-19.17	-29.52	-44.22	-64.82
Profit after tax/CFAT	18.00	28.75	44.27	66.33	97.24

WN 2: Computation of terminal value:

$$\text{Value}_5 = \frac{\text{Cash flow}_6}{K_0 - G} = \frac{97.24 \times 1.05}{20\% - 5\%} = \text{Rs. 680.68 lacs}$$

WN 3: Valuation of firm:

Year	Cash flow	PVF @ 20%	DCF
1	18.00	0.833	14.99
2	28.75	0.694	19.95
3	44.27	0.579	25.63
4	66.33	0.482	31.97
5	97.24	0.402	39.09
5	680.68	0.402	273.63
Value of ShopHub			405.26

59. Market Approach:

You are an investment analyst and have been asked to arrive at fair value of Google Inc with the following information:

Particulars	Google	Competitor
Number of users	10 Crores	5 Crores
Relevant search results (out of 10)	9	8
Time taken per search (in seconds)	0.1	0.2
Valuation	?	1,000 Crores

Additional information:

- Capitalization per User should be adjusted by 20% each for relevant search results and time taken per search

Answer:

Particulars	Calculation	Amount
Capitalization of competitor		1,000.00
Number of users		5.00
Capitalization per user	1,000/5.00	200
Add: Extra 20% for Google's favorable search results	200 x 20%	40
Add: Extra 20% for Google's favorable time taken per search	200 x 20%	40
Relevant capitalization per user for Google		280
Number of users		10

Valuation of Google	280 x 10	2,800

Part VII – Valuation of Professional/Consultancy firms

60. Valuation of Professional/Consultancy Firms:

Consultancy Solutions Pvt. Ltd provides management consulting services to clients. Following is the financial information about the company:

Particulars	Year 1	Year 2	Year 3
Operating Profit	5,00,000	6,00,000	7,00,000
Depreciation	50,000	50,000	50,000
Tax rate	40%	40%	40%
One-time legal charges	-	-	50,000

- Projected growth rate after Year 3 = 5%
- Discount rate = 10%

KPI's:

Particulars	Company	Industry
Client retention rate	90.00%	80.00%
New client acquisition rate	15.00%	20.00%
Utilization rate of consultants (Percentage of billable hours worked by consultants)	75%	80%
Revenue per consultant	15 lacs	20 lacs

You are required to value the company based on future cash flows and adjust the valuation based on the above-mentioned KPI's. You can make suitable assumptions.

Answer:

WN 1: Computation of adjusted future cash flows:

Particulars	Year 1	Year 2	Year 3
Operating Profit (EBIT/EBT)	5,00,000	6,00,000	7,00,000
Add: Non-recurring expenses	-	-	50,000
Adjusted EBT	5,00,000	6,00,000	7,50,000
Less: Tax @ 40%	-2,00,000	-2,40,000	-3,00,000
EAT	3,00,000	3,60,000	4,50,000
Add: Depreciation	50,000	50,000	50,000
Cash flow after tax	3,50,000	4,10,000	5,00,000

WN 2: Computation of terminal value:

$$\text{Value}_3 = \frac{\text{Cash flow}_4}{K_o - G} = \frac{5,00,000 \times 1.05}{10\% - 5\%} = \text{Rs. 105 lacs}$$

WN 3: Valuation of firm based on cash flows:

Year	Cash flow	PVF @ 10%	DCF
1	3,50,000	0.909	3,18,150
2	4,10,000	0.826	3,38,660
3	5,00,000	0.751	3,75,500
3	1,05,00,000	0.751	78,85,500
Value of Firm			89,17,810

WN 4: Adjustment of valuation:

- It is assumed that value of the firm will be increased by 10% for any favorable KPI and reduced by 10% for any adverse KPI

Particulars	Amount
Base valuation	89,17,810
Add: Favorable client retention rate [89,17,810 x 10%]	8,91,781
Less: Adverse client acquisition rate [89,17,810 x 10%]	-8,91,781
Less: Adverse utilization rate [89,17,810 x 10%]	-8,91,781
Less: Adverse revenue per consultant [89,17,810 x 10%]	-8,91,781
Final valuation of company	71,34,248

Part VIII – Impact of ESG on Valuation

61. ESG Impact:

Ecotech industries is currently producing eco-friendly products. The expected cash flows of the company for next five years are as under:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Cash flows (in crores)	10.00	12.00	14.00	15.00	16.00

- Discount rate (excluding ESG premium) is 10%
- EcoTech Industries faces the risk of potential regulatory changes due to climate-related policies. The analysis suggests a potential cost of Rs.1,00,00,000 annually to comply with stricter environmental regulations and maintain eco-friendly practices.
- EcoTech Industries actively invests in social initiatives, such as employee welfare, community development, and corporate social responsibility (CSR) activities. These initiatives are valued at Rs.50,00,000 annually, and they positively impact the company's brand reputation and employee retention.
- The company has a strong governance structure, but there is always a risk of compliance issues and penalties. A potential financial impact of Rs.30,00,000 per year is estimated due to governance risks.
- ESG premium to be considered in analysis is 2%
- Cash flows will grow at 4% after year 5 onwards

Answer:**WN 1: Computation of adjusted cash flows:**

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Normal cash flows	10.00	12.00	14.00	15.00	16.00
Less: Negative impact of Environmental risk	-1.00	-1.00	-1.00	-1.00	-1.00
Add: Favorable impact of social risk	0.50	0.50	0.50	0.50	0.50
Less: Negative impact of Governance risk	-0.30	-0.30	-0.30	-0.30	-0.30
Adjusted cash flows	9.20	11.20	13.20	14.20	15.20

WN 2: Valuation of terminal value:

- Discount rate = Normal discount rate + ESG premium
- Discount rate = 10% + 2% = 12.00%

$$\text{Value}_5 = \frac{\text{Cash flow}_6}{K_o - G} = \frac{15.20 \times 1.04}{12\% - 4\%} = \text{Rs. } 197.60 \text{ Crores}$$

WN 3: Valuation of firm based on cash flows:

Year	Cash flow	PVF @ 12%	DCF
1	9.20	0.893	8.22
2	11.20	0.797	8.93
3	13.20	0.712	9.40
4	14.20	0.636	9.03
5	15.20	0.567	8.62
5	197.60	0.567	112.04
Value of Firm			156.24

Chapter 14 – Mergers, Acquisitions & Corporate Restructuring**1. Cash deal and stock deal**

X Limited and Y Limited with perpetuity cash flows of Rs.36 lakhs and Rs.18 lakhs p.a. respectively, decide to merge. Consequent to merger there would be a Rs.6 lakhs p.a. cash savings every year. The cost of capital in the industry is 20 percent. X Limited plans to pay Y Limited rs.110 lakhs as merger consideration. Alternatively it is willing to offer a swap ratio of 5 shares for every 6 held. Currently the number of equity shares in X Limited is 10 lakhs and that in Y Limited is 6 lakhs respectively. You are required to ascertain:

- The gain from merger
- The cost of cash offer
- The cost of stock offer
- The NPV of cash offer
- The NPV of stock offer

Answer:

Particulars	Calculation	Amount
Value of X Limited	$\frac{36 \text{ lacs}}{20\%}$	180 lacs
Value of Y Limited	$\frac{18 \text{ lacs}}{20\%}$	90 lacs
Value of merged entity	$\frac{60 \text{ lacs}}{20\%}$	300 lacs
Gain of merger	300 lacs – 180 lacs – 90 lacs	30 lacs
Cash offer analysis:		
Consideration paid		110 lacs
Gross cost of cash offer		110 lacs
Net cost of cash offer	110 lacs – 90 lacs	20 lacs
NPV of cash offer	Synergy gain – Cost of cash offer 30 lacs – 20 lacs	10 lacs
Stock offer Analysis:		
No of shares issued	$6 \text{ lacs} \times \left(\frac{5}{6}\right)$	5 lacs
Post-merger share price	$\frac{300 \text{ lacs}}{10 \text{ lacs} + 5 \text{ lacs}}$	20
Consideration paid	5 lacs x 20	100 lacs
Gross cost of stock offer		100 lacs
Net cost of stock offer	100 lacs – 90 lacs	10 lacs
NPV of stock offer	Synergy gain – Cost of stock offer 30 lacs – 10 lacs	20 lacs

Note:

- Cash flow of merged entity = Cash flow of X (36 lacs) + Cash flow of Y (18 lacs) + Cash savings (6 lacs) = 60 lacs
- Present value of perpetuity has been used to value the company. Value = (Cash flow/Cost of capital)

2. Net cost of acquisition [July 2021, May 2023 MTP, Nov 2024 RTP] [Concept Revision]

Long Ltd., is planning to acquire Tall Ltd., with the following data available for both the companies:

Particulars	Long Limited	Tall Limited
Expected EPS	12	5
Expected DPS	10	3
No of shares	30,00,000	18,00,000
Current market price per share	180	50

As per an estimate Tall Ltd., is expected to have steady growth of earnings and dividends to the tune of 6% per annum. However, under the new management the growth rate is likely to be enhanced to 8% per annum without additional investment.

You are required to:

- Calculate the net cost of acquisition by Long Ltd., if Rs. 60 is paid for each share of Tall Ltd.
- If the agreed exchange ratio is one share of Long Ltd., for every three shares of Tall Ltd., in lieu of the cash acquisition as per (i) above, what will be the net cost of acquisition?

- (iii) Calculate Gain from acquisition.

Answer:

WN 1: Computation of net cost of acquisition in case of cash consideration:

Particulars	Calculation	Amount
Consideration paid	$18,00,000 \times 60$	10,80,00,000
Less: Value of Tall Limited	$18,00,000 \times 50$	(9,00,00,000)
Net cost of acquisition		1,80,00,000

WN 2: Computation of net cost of acquisition in case of share consideration:

Note 1: Valuation of merged entity:

Particulars	Calculation	Amount
Value of Long Limited	$30,00,000 \times 180$	54,00,00,000
Value of Tall Limited under new management	Note 2	13,50,00,000
Total value of merged entity		67,50,00,000
No of shares post-merger	$30,00,000 + 6,00,000$	36,00,000
Value per share	$\frac{67,50,00,000}{36,00,000}$	187.50
Amount of consideration paid	$187.50 \times 6,00,000$	11,25,00,000

Note 2: Value of Tall Limited business with increase in growth rate:

Particulars	Calculation	Amount
Existing cost of equity	$\frac{3}{50} + 6\%$	12.00%
Growth rate under new management		8.00%
Value per share under new management	$\frac{3}{12\% - 8\%}$	75.00
No of shares		18,00,000
Value of Tall Limited		13,50,00,000

Note 3: Net cost of acquisition:

Particulars	Calculation	Amount
Consideration paid	Note 1	11,25,00,000
Less: Value of Tall Limited	$18,00,000 \times 50$	(9,00,00,000)
Net cost of acquisition		2,25,00,000

WN 3: Gain from acquisition:

Particulars	Calculation	Amount
Post-merger Value	Note 1 of WN 2	67,50,00,000
Less: Pre-merger value	$54,00,00,000 + 9,00,00,000$	(63,00,00,000)
Gain from acquisition		4,50,00,000

3. Swap Ratio [May 2015 MTP, SM]

ABC Limited is determined to report EPS of Rs.2.67. It is therefore acquires DEF Limited. You are given the following information:

Particulars	ABC Limited	DEF Limited	Merged Entity
EPS	2	2.50	2.67
Price per share	40	25	?
PE Multiple	20	10	?
Number of shares	1,00,000	2,00,000	?
Total earnings	2,00,000	5,00,000	?
Total market value	40,00,000	50,00,000	?

There are no gains from merger. In exchange for DEF Limited shares, ABC Limited issues just enough of its own shares to ensure its Rs.2.67 earnings per share objective.

- ❖ Complete the above table for the merged firm
- ❖ How many shares of ABC Limited are exchanged for each share of DEF Limited
- ❖ What is the cost of merger to ABC Limited?

Answer:

WN 1: Completion of merger table:

Particulars	ABC Limited	DEF Limited	Merged company
PAT/EAES	2,00,000	5,00,000	7,00,000
No of equity shares	1,00,000	2,00,000	2,62,172
EPS	2	2.50	2.67
PE Multiple	20	10	20
MPS	40	25	53.40
No of equity shares	1,00,000	2,00,000	2,62,172
Market value of firm	40,00,000	50,00,000	1,40,00,000

Note:

- Problem on swap ratio and synergy gain can be solved using the above format wherein various inter-linkages can be established and missing information can be calculated

WN 2: Solution table

No of shares of merged company	$\frac{\text{Total earnings}}{\text{EPS}} = \frac{7,00,000}{2.67}$	2,62,172
MPS of merged company	$\text{EPS} \times \text{PE Multiple} = 2.67 \times 20$	Rs.53.40
MV of merged company	$\text{MPS} \times \text{No of shares} = 53.40 \times 2,62,172$	Rs.1,39,99,985 ~ Rs.1,40,00,000
Shares issued to DEF Limited	$2,62,172 - 1,00,000$	1,62,172
Share exchange ratio	$1,61,172 \text{ shares for } 2,00,000 \text{ shares}$	0.81086:1
Gross Cost of merger	$\text{Shares issued} \times \text{Issue price}$ $1,62,172 \times 53.40$	Rs.86,59,985~ Rs.86,60,000
Net cost of merger	$\text{Consideration paid} - \text{Pre merger value}$ $86,60,000 - 50,00,000$	Rs.36,60,000

Note:

- Pre-merger PE Multiple and post-merger PE Multiple of acquiring company (ABC Limited) would remain same in the absence of information

4. Swap Ratio [May 2018, Nov 2007, SM] [Concept Revision]

A Limited wants to acquire T Limited and has offered a swap ratio of 1:2 (0.5 shares for every one share of T Limited). Following information is provided:

Particulars	A Limited	T Limited
Profit after tax	18,00,000	3,60,000
Equity shares outstanding (Nos.)	6,00,000	1,80,000
EPS	3	2
PE ratio	10 Times	7 Times
Market price per share	Rs.30	Rs.14

Required:

- ❖ The number of equity shares to be issued by A Limited for acquisition of T Limited
- ❖ What is the EPS of A limited after the acquisition
- ❖ Determine the equivalent earnings per share of T Limited
- ❖ What is the expected market price per share of A Limited after the acquisition, assuming its PE multiple remains unchanged?
- ❖ Determine the market value of the merged firm
- ❖ What should be the exchange ratio to achieve EPS of Rs.3.5 in case post synergy benefits are expected to be 10% during post acquisition period

Answer:**WN 1: Completion of merger table:**

Particulars	A Limited	T Limited	Merged company
PAT/EAES	18,00,000	3,60,000	21,60,000
No of equity shares	6,00,000	1,80,000	6,90,000
EPS	3	2	3.1304
PE Multiple	10	7	10
MPS	30	14	31.304
No of equity shares	6,00,000	1,80,000	6,90,000
Market value of firm	1,80,00,000	25,20,000	2,16,00,000

WN 2: Solution:

Shares issued	$1,80,000 \times 0.50$	90,000
Post-merger EPS	$\frac{\text{Total earnings}}{\text{No of shares}} = \frac{21,60,000}{6,90,000}$	3.1304
Equivalent EPS of T Limited	3.1304×0.5	1.5652
MPS of merged company	$\text{EPS} \times \text{PE Multiple} = 3.1304 \times 10$	31.304
MV of merged company	$\text{MPS} \times \text{No of shares} = 31.304 \times 6,90,000$	Rs.2,15,99,760 ~ Rs.2,16,00,000
Exchange ratio to achieve EPS of Rs.3.5:		
Total earnings of merged company		21,60,000
Earnings with synergy gain	$21,60,000 + 10\%$	23,76,000
Target EPS		3.50
Target shares post-merger	$\frac{23,76,000}{3.50}$	6,78,857 Shares
Shares to be issued to T Limited	$6,78,857 - 6,00,000$	78,857 Shares
Share exchange ratio	78,857 shares for 1,80,000 shares	0.4381:1

5. Swap ratio [May 2005, May 2012, May 2014 MTP, Nov 2019, SM] [Homework]

XYZ Ltd., is considering merger with ABC Ltd. XYZ Ltd.'s shares are currently traded at Rs. 20. It has 2,50,000 shares outstanding and its earnings after taxes (EAT) amount to Rs. 5,00,000. ABC Ltd., has 1,25,000 shares outstanding; its current market price is Rs. 10 and its EAT are Rs. 1,25,000. The merger will be effected by means of a stock swap (exchange). ABC Ltd., has agreed to a plan under which XYZ Ltd., will offer the current market value of ABC Ltd.'s shares:

- What is the pre-merger earnings per share (EPS) and P/E ratios of both the companies?
- If ABC Ltd.'s P/E ratio is 6.4, what is its current market price? What is the exchange ratio? What will XYZ Ltd.'s post-merger EPS be?
- What should be the exchange ratio; if XYZ Ltd.'s pre-merger and post-merger EPS are to be the same?

Answer:**WN 1: Computation of pre-merger EPS and PE Multiple of both companies:**

Particulars	XYZ Limited	ABC Limited
PAT/EAES	5,00,000	1,25,000
No of equity shares	2,50,000	1,25,000
EPS	2	1
PE Multiple	10	10
MPS	20	10
No of equity shares	2,50,000	1,25,000
Market value of firm	50,00,000	12,50,000

WN 2: Computation of CMP, share exchange ratio and post-merger EPS:

MPS of ABC Limited	$\text{EPS} \times \text{PE Multiple} = 1 \times 6.4$	Rs.6.40
Exchange ratio		
Basis of exchange ratio		Market price
Base values	XYZ:ABC	20:6.40
Exchange ratio		6.40:20 (or) 0.32:1
Post-merger EPS:		
No of shares issued	$1,25,000 \times 0.32$	40,000 shares
Post-merger EPS	$\frac{\text{Total earnings}}{\text{No of shares}} = \frac{5,00,000 + 1,25,000}{2,50,000 + 40,000}$	2.1552

WN 3: Exchange ratio to maintain the same EPS:

- If the company wants to maintain the same EPS, then the exchange ratio should be on the basis of EPS
- Base values = XYZ:ABC = 2:1
- Exchange ratio = 1:2 (or) 0.5:1

6. Swap ratio [Nov 2018 MTP, Nov 2004, May 2009, Nov 2014 MTP, May 2018 RTP, May 2018] [Concept Revision]

The following information is provided relating to the acquiring firm Mark Limited and the target firm Mask Limited:

	Mark Limited	Mask Limited
Earnings after tax	2000 lakhs	400 lakhs
Number of shares outstanding	200 lakhs	100 lakhs
PE ratio	10	5

Required:

- What is the swap ratio based on current market prices?
- What is the EPS of mark limited after acquisition?
- What is the expected market price per share of Mark Limited after acquisition, assuming PE ratio of Mark Limited remains unchanged?
- Determine the market value of the merged firm
- Calculate gain/loss for shareholders of the two independent companies after acquisition

Answer:

WN 1: Completion of merger table:

(in lacs)

Particulars	Mark Limited	Mask Limited	Merged
PAT/EAES	2,000	400	2,400
No of equity shares	200	100	220
EPS	10	4	10.9091
PE Multiple	10	5	10
MPS	100	20	109.09
No of equity shares	200	100	220
Market value of firm	20,000	2,000	24,000

WN 2: Solution (Part a to d)

Exchange ratio		
Basis of exchange ratio		Market price
Base values	Mark: Mask	100:20
Exchange ratio		20:100 (or) 1:5
Post-merger EPS:		
No of shares issued	100 lacs x (1/5)	20 lacs
Post-merger EPS	$\frac{\text{Total earnings}}{\text{No of shares}} = \frac{2,000 + 400}{200 + 20}$	10.9091
Expected market price	$\text{EPS} \times \text{PE Multiple}$ 10.9091×10	109.09
MV of merged firm	$\text{MPS} \times \text{No of shares}$ 109.09×220	23,999.80 lacs ~ 24,000 lacs

WN 3: Computation of gain/loss for shareholders:

(in lacs)

Particulars	Mark Limited	Mask Limited
Pre-merger value	20,000	2,000
Post-merger value	21,818 (109.09 x 200)	2,182 (109.09 x 20)
Overall gain/loss (A)	1,818	182
Pre-merger no of shares (B)	200	100
Gain per share (A/B)	9.09	1.82

7. Share exchange ratio [Nov 2019 RTP, Nov 2021 RTP, Nov 2018 MTP, Nov 2023 MTP]:

ABC Ltd. is a company operating in the software industry. It is considering the acquisition of XYZ Ltd. which is also into software industry. The following information are available for the companies:

Particulars	ABC Limited	XYZ Limited
Earnings after tax	9,00,000	2,40,000
Number of equity shares	1,50,000	60,000
PE Ratio	14	10

ABC Ltd. is planning to offer a premium of 25% over the market price of XYZ Ltd.

Required:

- What is the swap ratio based on current market price?
- Find the number of shares to be issued by ABC Ltd. to the shareholders of XYZ Ltd.
- Compute the new EPS of ABC Ltd. after merger and comment on the impact of merger.
- Determine the market price of the share when P/E ratio remains unchanged.
- Compute the market price when P/E declines to 12 and comment on the results.

Figures are to be rounded off to 2 decimals.

Answer:

WN 1: Basic table:

Particulars	ABC Limited	XYZ Limited	Merged
Earnings after tax	9,00,000	2,40,000	11,40,000
Number of equity shares	1,50,000	60,000	1,85,714
EPS	6	4	6.14
PE Ratio	14	10	14
MPS	84	40	85.96

WN 2: Solution:

Swap ratio:

- Base values on the basis of MPS is ABC Limited (84) & XYZ Limited (40)
- Premium of 25 percent is to be paid and hence revised price of XYZ Limited is 50
- Revised base values = 84 & 50
- Exchange ratio = 50:84

Number of shares to be issued:

Number of shares to be issued = $60,000 \times \left(\frac{50}{84}\right) = 35,714$ shares

Impact of merger on new EPS:

Particulars	ABC Limited	XYZ Limited
Old EPS	6	4
New EPS	6.14	3.65 $6.14 \times \left(\frac{50}{84}\right)$
Increase/decrease in EPS	0.14	(0.35)

New MPS if PE Multiple remains same:

New MPS = $6.14 \times 14 = \text{Rs.}85.96$

New MPS if PE Multiple falls to 12:

New MPS = $6.14 \times 12 = \text{Rs.}73.68$

Comments on MPS:

Particulars	ABC Limited	XYZ Limited
Old MPS	84	40
New MPS	73.68	43.86 $73.68 \times \left(\frac{50}{84}\right)$
Increase/decrease in MPS	(10.32)	3.86

Comments: With the merger there is a decrease in the market price of shares for the shareholders of ABC Ltd and a gain for shareholders of XYZ Ltd.

8. Determination of exchange ratio [May 2004, Nov 2008, Nov 2003, SM]

A Limited is studying the possible acquisition of B Limited by way of merger. The following data are available:

Firm	After-tax earnings	No of equity shares	Market Price per share
A Limited	10,00,000	2,00,000	75
B Limited	3,00,000	50,000	60

- If the merger goes through by exchange of equity shares and the exchange ratio is set according to the current market prices, what is the new earnings per share for A Limited
- B Limited wants to be sure that its earning per share is not diminished by the merger. What exchange ratio is relevant to achieve the objective?

Answer:

WN 1: Valuation of A Limited, B Limited and Merged company:

Particulars	A Limited	B Limited	Merged Company
PAT	10,00,000	3,00,000	13,00,000
No of shares	2,00,000	50,000	2,40,000
EPS	5	6	5.42

Note:

- ❖ Shares to be issued are on market price basis. Base values are 75:60 and hence the swap ratio will be 60:75
- ❖ Shares to be issued = $50,000 \times (60/75) = 40,000$ shares

WN 2: Shares to be issued so that EPS is not diminished due to merger:

- ❖ The company should allot the shares in the ratio of EPS if it does not want EPS to be impacted by merger.
- ❖ The base values are 5:6 and hence the swap ratio will be 6:5

9. Determination of exchange ratio [May 2018 MTP, May 2019 RTP, May 2006, Nov 2012 RTP, Nov 2022 MTP, SM] [Homework]

Reliable Industries Limited (RIL) is considering a takeover of Sunflower Industries Limited (SIL). The particulars of 2 companies are given below:

Particulars	Reliable Industries Limited	Sunflower Industries Limited
Earnings after Tax	20,00,000	10,00,000
Equity shares outstanding	10,00,000	10,00,000
EPS	2	1
PE Ratio	10	5

Required:

- What is the market value of each company before merger?
- Assume that the management of RIL estimates that the shareholders of SIL will accept an offer of one share of RIL for four shares of SIL. IF there are no synergic effects, what is the market value of the post-merger RIL? What is the new price per share? Are the shareholders of RIL better or worse off than they were before the merger?
- Due to synergic effects, the management of RIL estimates that the earnings will increase by 20%. What are the new post-merger EPS and price per share? Will the shareholders be better off or worse off than before the merger?

Answer:

WN 1: Valuation of RIL, SIL and merged entity:

Particulars	RIL	SIL	Merged (part ii)	Merged (Part iii)
PAT	20,00,000	10,00,000	30,00,000	36,00,000
No of shares	10,00,000	10,00,000	12,50,000	12,50,000
EPS	2	1	2.4	2.88
PE Multiple	10	5	10	10
MPS	20	5	24	28.80
No of shares	10,00,000	10,00,000	12,50,000	12,50,000
Value of firm	2,00,00,000	50,00,000	3,00,00,000	3,60,00,000

WN 2: Computation of gains/loss to shareholders for Part (ii):

Particulars	RIL	SIL
Pre-merger value	2,00,00,000	50,00,000
Post-merger value	2,40,00,000 [10,00,000 × 24]	60,00,000 [2,50,000 × 24]

Gain to shareholders	40,00,000	10,00,000

Thus, the shareholders of RIL and SIL are better-off than before.

WN 3: Computation of gains/loss to shareholders for Part (iii):

Particulars	RIL	SIL
Pre-merger value	2,00,00,000	50,00,000
Post-merger value	2,88,00,000 [10,00,000 × 28.80]	72,00,000 [2,50,000 × 28.80]
Gain to shareholders	88,00,000	22,00,000

Thus, the shareholders of RIL and SIL are better-off than before.

10. Synergy gain and swap ratio [Nov 2010, May 2019 RTP, Nov 2020 MTP, SM] [Homework]

MK Limited is considering acquiring NN Limited. The following information is available:

Company	Earnings after Tax	No of equity shares	Market value per share
MK Limited	60,00,000	12,00,000	200.00
NN Limited	18,00,000	3,00,000	160.00

Exchange of equity shares for acquisition is based on current market value as above. There is no synergy advantage available.

- Find the earning per share for company MK Limited after merger and
- Find the exchange ratio so that shareholders of NN Limited would not be at a loss

Answer:

WN 1: Computation of EPS after merger:

Particulars	MK Limited	NN Limited	Merged
Earnings after tax	60,00,000	18,00,000	78,00,000
No of shares	12,00,000	3,00,000	14,40,000
Earnings per share	5	6	5.42

- ❖ Shares issued to NN Limited = $3,00,000 \times (160/200) = 2,40,000$
- ❖ Shares post-merger = $12,00,000 + 2,40,000 = 14,40,000$

WN 2: Computation of exchange ratio so that shareholders of NN Limited would not be at a loss:

- ❖ EPS of Company MK Limited = Rs.5; EPS of NN Limited = Rs.6
- ❖ Exchange ratio should be on the basis of EPS so that shareholders are not a loss
- ❖ Base values are 5:6 and hence the exchange ratio should be 6:5

11. Synergy gain and swap ratio [May 2013, Nov 2015 MTP, SM]

Longitude Limited is in the process of acquiring Latitude Limited on a share exchange basis. Following relevant data are available:

Particulars	Longitude Limited	Latitude Limited
PAT	140 lacs	60 lacs
Number of shares	15 lacs	16 lacs
Earnings per share	8	5
PE Multiple (ignore synergy)	15	10

You are required to determine:

- Pre-merger Market value per share, and
- The maximum exchange ratio Longitude Limited can offer without the dilution of
 - EPS and
 - Market Value per share

Calculate Ratio/s up to four decimal points and amounts and number of shares up to two decimal points

Answer:

WN 1: Computation of pre-merger market value per share:

Particulars	Longitude Limited	Latitude Limited
Earnings per share	8	5
PE Multiple	15	10
MPS	120	50

Note: PAT given in the question does not match with EPS figure given in the question and the same looks to be a mistake

WN 2: Computation of exchange ratio:

Target	Swap ratio Basis	Base Value	Exchange Ratio
No dilution in EPS	Exchange ratio should be on the basis of EPS to have no impact on EPS	8:5	5:8 (or) 0.625:1
No dilution in MPS	Exchange ratio should be on the basis of MPS to have no impact on MPS	120:50	50:120 (or) 0.4167:1

12. Post-merger MP for different PE Multiple:

Company Alpha is considering to acquire Company Beta. The financial data of the two companies are given in the following table:

Particulars	Company Alpha	Company Beta
PAT	40,000	8,000
Number of shares	10,000	4,000
EPS	4	2
Market value per share	60	15
PE Multiple	15	7.50
Total Market Capitalization	6,00,000	60,000

Company Alpha is considering to acquire Company Beta through exchange of shares in proportion to the market value per share.

If the price-earnings ratio is expected to be:

- (a) Pre-merger P/E ratio of Beta (7.50)
- (b) Pre-merger P/E ratio of Alpha (15)
- (c) Weighted average of Pre-merger P/E ratio of Alpha and Beta

What would be the impact on wealth of shareholders post-merger?

Answer:**WN 1: Computation of MPS post-merger for different scenarios:**

Particulars	Alpha	Beta	Merged (PE of 7.50)	Merged (PE of 15)	Merged (Weighted average PE)
PAT	40,000	8,000	48,000	48,000	48,000
Number of shares	10,000	4,000	11,000	11,000	11,000
EPS	4	2	4.36	4.36	4.36
PE Multiple	15	7.50	7.50	15	13.75
Market value per share	60	15	32.70	65.40	60
Total Market Capitalization	6,00,000	60,000	3,59,700	7,19,400	6,60,000

$$\text{Weighted average PE Multiple} = \frac{(40,000 \times 15) + (8,000 \times 7.50)}{48,000} = 13.75$$

$$\text{Shares to be issued to Beta} = (4,000 \times 15 / 60) = 1,000 \text{ shares}$$

WN 2: Computation of impact on shareholder's wealth for Part (a):

Particulars	Alpha	Beta
Pre-merger MPS	60	15
Post-merger MPS	32.70	8.175 [32.70 × 0.25]
Impact on MPS	(27.30)	(6.825)

WN 3: Computation of impact on shareholder's wealth for Part (b):

Particulars	Alpha	Beta
Pre-merger MPS	60	15
Post-merger MPS	65.40	16.35 [65.40 × 0.25]
Impact on MPS	5.40	1.35

WN 4: Computation of impact on shareholder's wealth for Part (c):

Particulars	Alpha	Beta
Pre-merger MPS	60	15
Post-merger MPS	60	15 [60 x 0.25]
Impact on MPS	0	0

13. Evaluation of merger [Jan 2021, May 2022 RTP]

B Ltd. wants to acquire S Ltd. and has offered a swap ratio of 2:3 (2 shares for every 3 share of S Ltd.)
Following information is available:

Particulars	B Limited	S Limited
Profit after tax	21,00,000	4,50,000
Equity shares outstanding	6,00,000	1,80,000
EPS	3.50	2.50
PE Ratio	10 Times	7 Time
Price quoting per share before the merger announcement	35	17.50

Required:

- The number of equity shares to be issued by B Ltd. for acquisition of S Ltd.
- What is the EPS of B Ltd. after the acquisition?
- Determine the equivalent earnings per share of S Ltd. and calculate per share gain or loss to shareholders of S Ltd.
- What is the expected market price per share of B Ltd. after the acquisition, assuming its PE Multiple remains unchanged?
- Determine the market value of the merged firm.
- After the announcement of merger, price of shares of S Ltd. rose by 10% on BSE. Mr. X, an investor, having 10,000 shares of S Ltd. is having another investment opportunity, which yields annual return of 14% is seeking your advise whether he needs to offload the shares in the market or accept the shares from B Ltd

Answer:**Valuation of individual and merged entity:**

Particulars	B Limited	S Limited	Merged
Profit after tax	21,00,000	4,50,000	25,50,000
Equity shares outstanding	6,00,000	1,80,000	7,20,000
Earnings per share	3.50	2.50	3.54
PE Multiple	10	7	10
MPS	35	17.50	35.40
No of shares	6,00,000	1,80,000	7,20,000
Value of firm	2,10,00,000	31,50,000	2,54,88,000

Solution:

- No of shares issued = $1,80,000 \times (2/3) = 1,20,000$ shares
- EPS post acquisition = Rs.3.54 per share

Equivalent EPS and gain/loss to shareholders of S Limited:

Particulars	Amount
Pre-merger EPS	2.50
Post-merger equivalent EPS	2.36 [3.54 x 2/3]
Loss in EPS per share	0.14

- New market price of B Limited = Rs.35.40
- Market value of merged firm = Rs.2,54,88,000

Decision on offloading the shares:

Particulars	Amount
Equivalent EPS per share for S Limited shareholders	2.36
Price per share of S Limited before merger announcement	17.50
Increase in price [17.50 x 105]	1.75
Price post-merger announcement	19.25
Return on market price per share [EPS/MPS x 100] = [2.36/19.25 x 100]	12.26%

As Mr. X is having another opportunity to earn 14% and expected return on S Ltd.'s share is 12.26%, it is advisable to offload in market.

14. Equivalent EPS/Decision on sale of shares [Nov 2022]

A Limited wants to acquire T Limited and has offered a swap ratio of 1:2 (0.5 shares for every one share of T Limited). Following information is provided:

Particulars	A Limited	T Limited
Profit after tax	18,00,000	3,60,000
Equity shares outstanding (Nos.)	6,00,000	1,80,000
EPS	3	2
PE ratio	10 Times	7 Times
Market price per share	Rs.30	Rs.14

Required:

- ❖ The number of equity shares to be issued by A Limited for acquisition of T Limited
- ❖ What is the EPS of A limited after the acquisition
- ❖ Determine the equivalent earnings per share of T Limited
- ❖ What is the expected market price per share of A Limited after the acquisition, assuming its PE multiple remains unchanged?
- ❖ Determine the market value of the merged firm
- ❖ If you are the shareholder of T Limited and holding 100 shares, will you be interested to sell your stake? Why?

Answer:

WN 1: Completion of merger table:

Particulars	A Limited	T Limited	Merged company
PAT/EAES	18,00,000	3,60,000	21,60,000
No of equity shares	6,00,000	1,80,000	6,90,000
EPS	3	2	3.1304
PE Multiple	10	7	10
MPS	30	14	31.304
No of equity shares	6,00,000	1,80,000	6,90,000
Market value of firm	1,80,00,000	25,20,000	2,16,00,000

WN 2: Solution:

Shares issued	$1,80,000 \times 0.50$	90,000
Post-merger EPS	$\frac{\text{Total earnings}}{\text{No of shares}} = \frac{21,60,000}{6,90,000}$	3.1304
Equivalent EPS of T Limited	3.1304×0.5	1.5652
MPS of merged company	$\text{EPS} \times \text{PE Multiple} = 3.1304 \times 10$	31.304
MV of merged company	$\text{MPS} \times \text{No of shares} = 31.304 \times 6,90,000$	Rs.2,15,99,760 ~ Rs.2,16,00,000

Decision on sale of shares:

Particulars	Calculation	Amount
Present market value of shares of T Limited	$100 \text{ shares} \times 14$	Rs.1,400
No of shares issued on merger	100×0.50	50
Value of shares post-merger	50×31.304	Rs.1,565
Increase in market value	1,565 - 1,400	Rs.165

No, I am not agreeing to sell the stake as there is increase in market value.

15. Swap Ratio [May 2022, Nov 2010, SM]

P Limited is considering take-over of R Limited by the exchange of five new shares in P Limited, for every eight shares in R Limited. The relevant financial details of the two companies prior to merger announcement are as follows:

	P Limited	R Limited
Profit before tax (Rs. Crores)	18	20.80
No of shares (Crores)	20	18
PE ratio	11	8

Corporate tax rate = 30%		

You are required to determine:

- Market value of both the company
- Value of original shareholders
- Price per share after merger
- Effect on share price of both the company if the Directors of P Limited expect their own pre-merger PE ratio to be applied to the combined earnings

Answer:

WN 1: Completion of merger table:

(in lacs)

Particulars	P Limited	R Limited	Merged Same PE
PBT	1,800	2,080	3,880
Less: Tax	-540	-624	-1,164
PAT	1,260	1,456	2,716
No of equity shares	2,000	1,800	3,125
EPS	0.63	0.81	0.87
PE Multiple	11	8	11
MPS	6.93	6.48	9.57
No of equity shares	2,000	1,800	Not reqd
Market value of firm	13,860	11,664	Not reqd

WN 2: Solution (part a to b)

(in lacs)

Market value of P Limited		13,860
Market value of R Limited		11,664
Value of combined firm for computation of original shareholders	13,860 + 11,664	25,524
Value of original shareholders:		
Original shareholders of P Ltd	$25,524 \times \left(\frac{2,000}{3,125}\right)$	16,335
Original shareholders of R Ltd	$25,524 \times \left(\frac{1,125}{3,125}\right)$	9,189

WN 3: Effect on share price and price after merger (Part c and d)

- Price after merger = Rs.9.57 (as per above table)

Particulars	P Limited	R Limited
Pre-merger price	6.93	6.48
Post-merger adjusted price	9.57	5.97 (9.57x (5/8))
Gain/loss per share	2.64	-0.51
% change	38.10% $\left[\frac{9.57 - 6.93}{6.93} \times 100\right]$	-7.87% $\left[\frac{5.97 - 6.48}{6.48} \times 100\right]$

16. Determination of exchange ratio [Nov 2019 RTP, Dec 2021, SM] [Homework]

XYZ Ltd. wants to purchase ABC Ltd. by exchanging 0.7 of its share for each share of ABC Ltd. Relevant financial data are as follows:

Particulars	XYZ Limited	ABC Limited
Equity shares outstanding	10,00,000	4,00,000
EPS	40	28
Market price per share	250	160

- Illustrate the impact of merger on EPS of both the companies.
- The management of ABC Ltd. has quoted a share exchange ratio of 1:1 for the merger. Assuming that P/E ratio of XYZ Ltd. will remain unchanged after the merger, what will be the gain from merger for ABC Ltd.?
- What will be the gain/loss to shareholders of XYZ Ltd.?
- Determine the maximum exchange ratio acceptable to shareholders of XYZ Ltd.

Answer:**WN 1: Valuation of XYZ, ABC and merged firm:**

Particulars	XYZ	ABC	Merged (i)	Merged (ii)
PAT/EAES	4,00,00,000	1,12,00,000	5,12,00,000	5,12,00,000
No of equity shares	10,00,000	4,00,000	12,80,000	14,00,000
EPS	40	28	40	36.57
PE Multiple	6.25	5.71	6.25	6.25
MPS	250	160	250	228.56

Part (i):**Impact of merger on EPS:**

Particulars	XYZ	ABC
Pre-merger EPS	40	28
Post-merger EPS	40	28 (40 x 0.7)
Gain/loss	-	-

Part (ii) & (iii)**Gain/loss from merger if ratio is 1:1**

Particulars	XYZ	ABC
Pre-merger MPS	250	160
Post-merger MPS	228.56	228.56
Gain/loss per share	(21.44)	68.56

Part (iv):

- Maximum exchange ratio should ensure that MPS remains Rs.250. MPS would remain at Rs.250 if EPS continues to be Rs.40
- EPS can be maintained if the exchange ratio is on the basis of EPS
- Base values = 40: 28
- **Exchange ratio = 28:40 (or) 0.70:1**

17. Reverse Working (May 2023) [Homework]

Big Ltd. (BL), a listed company, is enjoying a price earnings ratio (PER) of 15 on an Earnings Per Share (EPS) of Rs.5. The Total number of outstanding shares are 2,00,000.

BL is proposing to acquire Small Pvt. Ltd. (SPL) an unlisted company by issuing shares in the ratio 4:5 i.e. for 5 shares of SPL 4 shares of BL will be issued. The outstanding shares of SPL are 50,000. SPL will be listed before the actual merger to discover its value. The EPS of the merged entity will be 5.5.

No other information is available for SPL.

You are required to calculate:

- Pre-merger EPS of SPL.
- Expected Market Price per Share of SPL at the time of listing, if it expects a PER of 10 and,
- Number of shares of BL to be issued to SPL if pre-merger EPS of BL is to be maintained.

Answer:

Particulars	BL	SPL	Merged
PAT	10,00,000	3,20,000	13,20,000
No of shares	2,00,000	50,000	2,40,000
EPS	5.00	6.40	5.50
PE Multiple	15	10	
MPS	75.00	64.00	

- Pre-merger EPS of SPL = Rs.6.40
- Expected market price of SPL on listing = Rs.64.00
- Shares should be issued in the ratio of EPS to maintain pre-merger EPS. Hence base values are 5:6.40 and exchange ratio is 6.40:5
- Number of shares to be issued = 50,000 x (6.40/5.00) = 64,000 Shares

18. Computation of maximum exchange ratio [Concept Revision]

The share capital of Sun Ltd. consist of 3.5 lakhs Rs.10/- ordinary shares and that of Moon Ltd. consist of 2.2 lakh ordinary shares of Rs.10/- each.

Sun Ltd. is proposing to takeover Moon Ltd. The Pre-merger earnings are Rs.19 lakhs for Sun Ltd. and Rs.10 lakhs for Moon Ltd. The merger is expected to result into a synergy gains of Rs.4 lakhs in the form of Post tax cost savings. The Pre-merger P/E Ratios are 10 for Sun Ltd. and 8 for Moon Ltd. The possible combined P/E Ratios are 9 and 10.

You are required to calculate.

- Minimum combined P/E Ratio to justify the merger.
- Exchange ratio of shares if combined P/E ratio is 9.

Answer:

WN 1: Computation of minimum combined PE Multiple to justify the merger:

Particulars	Calculation	Amount
Pre-merger value of Sun Limited	19 lacs x 10	190 lacs
Pre-merger value of Moon Limited	10 lacs x 8	80 lacs
Total pre-merger value		270 lacs
Post-merger earnings	19 + 10 + 4	33 lacs
Minimum PE Multiple	$\frac{270 \text{ lacs}}{33 \text{ lacs}}$	8.18

WN 2: Computation of exchange ratio is combined PE Multiple is 9:

Particulars	Calculation	Amount
Post-merger value	33 lacs x 9	297 lacs
Minimum consideration (value of Moon Limited)		80 lacs
Maximum consideration (post-merger value - pre merger value)	297 - 190	107 lacs

Computation of minimum exchange ratio:

Particulars	Value	No of shares
Value of Moon Limited	80 lacs	1,29,032 $(3,50,000) \times \left(\frac{80}{217}\right)$
Value of Sun Limited	217 lacs	3,50,000
Value of merged entity	297 lacs	4,79,032

- ❖ No of shares allotted = 1,29,032
- ❖ Exchange ratio = 1,29,032:2,20,000 (or) 0.5865:1

Computation of maximum exchange ratio:

Particulars	Value	No of shares
Value of Moon Limited	107 lacs	1,97,105 $(3,50,000) \times \left(\frac{107}{190}\right)$
Value of Sun Limited	190 lacs	3,50,000
Value of merged entity	297 lacs	4,47,105

- ❖ No of shares allotted = 1,97,105
- ❖ Exchange ratio = 1,97,105: 2,20,000 (or) 0.8959:1

19. Computation of exchange ratio [May 2012 RTP]

AXE Ltd. is interested to acquire PB Ltd. AXE has 50,00,000 shares of Rs. 10 each, which are presently being quoted at Rs. 25 per share. On the other hand PB has 20,00,000 share of Rs. 10 each currently selling at Rs. 17. AXE and PB have EPS of Rs. 3.20 and Rs. 2.40 respectively.

You are required to:

- Show the impact of merger on EPS, in case if exchange ratio is based on relative proportion of EPS.
- Suppose, if AXE quote an offer of share exchange ratio of 1:1, then should PB accept the offer or not, assuming that there will be no change in PE ratio of AXE after the merger.
- The maximum ratio likely to acceptable to management of AXE.

Answer:

WN 1: Impact of merger on EPS:

- ❖ Swap ratio is based on EPS and hence the merger will have no impact on EPS. The same is being proved in the below calculation:

Particulars	AXE	PB	Merged (EPS Ratio)	Merged (1:1)
PAT	1,60,00,000	48,00,000	2,08,00,000	2,08,00,000
Number of shares	50,00,000	20,00,000	65,00,000	70,00,000
EPS	3.20	2.40	3.20	2.97
PE Multiple	7.8125	7.0833	7.8125	7.8125
Market value per share	25	17	25	23.20

- ❖ Base values for EPS 3.20:2.40; Swap ratio is 2.40:3.20. Hence shares allotted for part 1 is 20,00,000 × (2.40/3.20) = 15,00,000

Impact on merger:

Particulars	AXE	PB
Pre-merger EPS	3.20	2.40
Post-merger EPS	3.20	2.40 [3.20 × 0.75]
Impact on EPS	-	-

WN 2: Impact of merger on PB Limited if the exchange ratio is 1:1:

Particulars	Calculation	Amount
Pre-merger Value	20,00,000 × 17	3,40,00,000
Post-merger value	20,00,000 × 23.20	4,64,00,000
Merger gain		1,24,00,000

- ❖ Merger will be acceptable to shareholders of PB Limited as there is synergy gain of Rs.124 lacs

WN 3: Maximum ratio acceptable to shareholders of AXE Limited:

Particulars	Calculation	Amount
Post-merger value	208 lacs × 7.8125	16,25,00,000
Target share price	MPS should remain same post-merger	25
Target shares post-merger	1625 lacs/25	65,00,000
Existing shares of AXE Limited		50,00,000
Maximum shares that can be allotted		15,00,000

- ❖ The company can issue 15,00,000 shares.
❖ Swap ratio = 15,00,000/20,00,000 = 0.75:1

20. Computation of minimum and maximum exchange ratio [Nov 2018, May 2021 MTP, May 2021 RTP] [Concept Revision]

C Limited and D Limited are contemplating a merger deal in which C Limited will acquire D Limited. The relevant information about the firms are given as follows:

Particulars	C Limited	D Limited
Total earnings (in millions)	Rs.96	Rs.30
No of shares	20	14
EPS	4.80	2.143
Price Earnings Ratio	8	7
Market price per share	38.40	15

- What is the maximum exchange ratio acceptable to the shareholders of C Limited, if the PE ratio of the combined firm is 7?
- What is the minimum exchange ratio acceptable to the shareholders of D Limited, if the PE ratio of the combined firm is 9?

Answer:

WN 1: Computation of market value of merged entity:

Particulars	C LTD	D Ltd	Merged firm (Part 1)	Merged Firm (Part 2)
PAT	96	30	126	126
PE Multiple	8	7	7	9
Value of firm (PAT × PE Multiple)	768	210	882	1134

WN 2: Computation of maximum exchange ratio acceptable to shareholders of C Limited:

Particulars	Calculation	Amount (in million)

Pre-merger value of C Limited		768
Post-merger value of C Limited		882
Maximum consideration to D Ltd shareholders	882 – 768	114
Shares to be issued: 768 million of C Limited = 20 million shares 114 million of D Limited = ? Shares	$\frac{114 \times 20}{768}$	2.96875 million
Existing shares of C Limited shareholders		14 million
Exchange ratio		2.96875: 14 (or) 0.212:1

WN 3: Computation of minimum exchange ratio acceptable to shareholders of D Limited:

Particulars	Calculation	Amount (in million)
Post-merger value of C Limited		1134
Minimum consideration to D Ltd shareholders (pre-merger value)		210
Value of C Limited shareholders	1134-210	924
Shares to be issued: 924 million of C Limited = 20 million shares 210 million of D Limited = ? Shares	$\frac{210 \times 20}{924}$	4.54545 million
Existing shares of C Limited shareholders		14 million
Exchange ratio		4.5454:14 (or) 0.325:1

21. Minimum and maximum exchange ratio [Homework]

A Limited plan to acquire B Limited. The following information is provided:

Particulars	A Limited	B Limited
MPS	Rs.300	Rs.200
EPS	Rs.25	Rs.20
No of equity shares	20 lacs	10 lacs
PE Multiple	12	10

- ❖ What is the maximum exchange ratio acceptable to the shareholders of A Limited if the PE ratio after on acquisition is 11 with no synergy gain?
- ❖ What is the minimum exchange ratio acceptable if PE multiple is 11.50 and synergy is 5%?

Answer:

WN 1: Computation of maximum exchange ratio:**Completion of Merger table:**

(in lacs)

Particulars	A Limited	B Limited	Merged
PAT/EAES	500	200	700
No of equity shares	20	10	25.66923
EPS	25	20	27.2727
PE Multiple	12	10	11
MPS	300	200	300
No of equity shares	20	10	25.66923
Market value of firm	6,000	2,000	7,700

- Maximum exchange ratio is computed from acquiring company point of view (A Limited)
- A Limited will accept an exchange ratio which leads to price being at minimum of Rs.300
- Merged table is filled in the following manner
 - PAT = 500 + 200 = 700 lacs
 - PE Multiple = 11 Times
 - MPS = 300
 - EPS = 300/11 = 27.2727 Times
 - No of equity shares = 700/27.2727 = 25.66923 lacs
- No of shares to be issued in merger = 25.66923 lacs – 20 lacs = 5.66923 lacs
- Exchange ratio = 5.66923:10 (or) 0.566923:1

WN 2: Computation of minimum exchange ratio:

- Minimum exchange ratio is computed from target company point of view (B Limited).
- B Limited will accept an exchange ratio which leads to purchase consideration of Rs.2,000 lacs
- **Post-merger value of Firm = PAT of merged entity x PE Multiple = (700 lacs + 5%) x 11.50 = Rs.8,452.50 lacs**
- No of shares to be issued is computed in the below table:

Particulars	Value in lacs	No of Shares
Existing shareholders of A Limited	6,452.50	20,00,000
Existing shareholders of B Limited	2,000.00	6,19,915
Merged Entity	8,452.50	26,19,915

- Merged entity has value of Rs.8,452.50 lacs. Of this Rs.2,000 lacs are to be given to shareholders of B Limited and balance 6,452.50 lacs will belong to shareholders of A Limited

• 20,00,000 shares = 6,452.50 lacs • ? Shares = 2,000 lacs
No of shares to be issued = $\frac{2,000}{6,452.50} \times 20,00,000 = 6,19,915$ shares

- **Minimum Exchange ratio = 6,19,915:10,00,000 (or) 0.619915:1**

22. Calculation of true cost of merger [May 2016 MTP, Nov 2014, Nov 2024, SM]

Elrond Limited plans to acquire Doom Limited. The relevant financial details of the two firms prior to the merger announcement are:

Particulars	Elrond Limited	Doom Limited
Market price per share	Rs.50	Rs.25
Number of shares	20 lacs	10 lacs

The merger is expected to generate gains, which have a present value of Rs. 200 Lakhs. The exchange ratio agreed to is 0.5. What is the true cost of the merger from the point of view of Elrond Limited?

Answer:

Particulars	Calculation	Amount
Value of Elrond Limited	20 lacs x 50	1,000 lacs
Value of Doom Limited	10 lacs x 25	250 lacs
Synergy gain		200 lacs
Value of merged entity	1,000 lacs + 250 lacs + 200 lacs	1,450 lacs
No of shares issued to Doom Limited	10 lacs x 0.5	5 lacs
Post-merger share price	$\frac{1,450 \text{ lacs}}{20 \text{ lacs} + 5 \text{ lacs}}$	58
Consideration paid	5 lacs x 58	290 lacs
Gross cost of merger		290 lacs
True cost of merger	290 lacs - 250 lacs	40 lacs

23. Calculation of exchange ratio

If the cost of merger is Rs.277.5 lacs after acquiring DEF Limited, what is the exchange ratio worked out by the acquiring company ABC Limited from the following information

MPS of ABC Limited (Before acquisition)	Rs.192.50
MPS of DEF Limited (Before acquisition)	Rs.88
No of shares of ABC Limited (Before acquisition)	20 lacs
No of shares of DEF Limited (Before acquisition)	15 lacs

It is also estimated that the synergy value is measured at present value of Rs.687.5 lacs.

Answer:

Computation of exchange ratio:

Let us assume shares allotted to DEF Limited to be Y

(in lacs)

Particulars	Calculation	Amount
Value of ABC Limited	20 lacs x 192.50	3,850
Value of DEF Limited	15 lacs x 88	1,320
Synergy gain		687.50
Value of merged entity	3,850 + 1,320 + 687.50	5,857.50
No of shares issued to DEF Limited		Y

Post-merger share price		5,857.50 20 + Y
Cost of merger		277.50
Value of DEF Limited before merger		1,320
Consideration paid	1,320 + 277.50	1,597.50

Consideration paid = MPS post merger x No of shares issued

$$1,597.50 = \frac{5,857.50}{20 + Y} \times Y; 1,597.50(20 + Y) = 5,857.50Y; 31,950 + 1,597.50Y = 5,857.50Y$$

$$31,950 = 5,857.50Y - 1,597.50Y; 31,950 = 4,260Y; Y = \frac{31,950}{4,260} = 7.5$$

- No of shares issued to DEF Limited = 7.5 lacs
- Share exchange ratio = (7.5 lacs/15 lacs) = 0.5:1

24. Consideration to maintain EPS [May 2016, Nov 2018 RTP, May 2022 MTP, SM]

The CEO of a company thinks that shareholders always look for EPS. Therefore, he considers maximization of EPS as his company's objective. His company's current Net Profits are Rs. 80.00 lakhs and P/E multiple is 10.5. He wants to buy another firm which has current income of Rs. 15.75 lakhs & P/E multiple of 10.

What is the maximum exchange ratio which the CEO should offer so that he could keep EPS at the current level, given that the current market price of both the acquirer and the target company are Rs. 42 and Rs. 105 respectively?

If the CEO borrows funds at 15% and buys out Target Company by paying cash, how much cash should he offer to maintain his EPS? Assume tax rate of 30%.

Answer:

WN 1: Computation of Exchange Ratio:

(in lacs)

Particulars	Acquirer Company	Target Company
PAT	80	15.75
No of shares	20	1.50
EPS [MPS/PE Multiple]	4	10.50
P/E Multiple	10.5	10
MPS	42	105

- The company wants to maintain same EPS and hence exchange ratio should be on the basis of EPS
- Base values for EPS = 4:10.50; Exchange ratio based on EPS = 10.50:4 (or) 2.625:1

WN 2: Computation of cash consideration:

Particulars	Amount (in lacs)
Profit after Tax	15.75
Cost of debt (after tax)	10.50%
Maximum consideration [15.75 lacs/10.50%]	150

25. Impact of merger on EPS [May 2015 MTP, Nov 2009, SM] [Homework]

B Ltd. is a highly successful company and wishes to expand by acquiring other firms. Its expected high growth in earnings and dividends is reflected in its PE ratio of 17. The Board of Directors of B Ltd. has been advised that if it were to take over firms with a lower PE ratio than it own, using a share-for-share exchange, then it could increase its reported earnings per share. C Ltd. has been suggested as a possible target for a takeover, which has a PE ratio of 10 and 1,00,000 shares in issue with a share price of Rs. 15. B Ltd. has 5,00,000 shares in issue with a share price of Rs. 12. Calculate the change in earnings per share of B Ltd. if it acquires the whole of C Ltd. by issuing shares at its market price of Rs.12. Assume the price of B Ltd. shares remains constant.

Answer:

Particulars	B Limited	C Limited	Merged Entity
EAT [EPS x No of shares]	3,55,000	1,50,000	5,05,000
No of shares	5,00,000	1,00,000	6,25,000
EPS [MPS/PE Multiple]	0.71	1.50	0.808
PE Multiple	17	10	Not needed
MPS	12	15	Not needed

- EPS of B Limited has improved from 0.71 to 0.808 due to merger

- ❖ Shares issued in merger = $(1,00,000 \times 15) / 12 = 1,25,000$ shares. B Limited currently has 5,00,000 shares and hence post-merger there will be 6,25,000 shares

26. Valuation for take-over [Homework]

Big Limited a chain of restaurants is considering going private limited. The president Rajan Baba believes that with the elimination of Shareholder servicing costs and other costs associated with public ownership, the company could save Rs. 8,00,000 per annum before taxes. In addition, the company believes management incentives and hence performance will be higher as a private company. As a result, annual profits are expected to be 10% greater than present after-tax profits of Rs 9 million. The effective tax rate is 30%, the price / earnings ratio of the Share is 12, and there are 10 million shares outstanding. What is the present market price per share? What is the maximum Rupees premium above this price that the company could pay in order to take the company into private Limited?

Answer:

WN 1: Computation of MPS as Public Limited and Private Limited

Particulars	Public Limited	Private Limited
PAT	90,00,000	1,04,60,000
No. of shares	1,00,00,000	1,00,00,000
EPS	0.90	1.046
PE Multiple	12	12
MPS	10.80	12.552

- ❖ PAT of Private Limited = 90,00,000 + 10% increase (9,00,000) + cost savings (5,60,000) = Rs.1,04,60,000
- ❖ The company can pay a premium of Rs.1.75 per share to take the company into private limited.

27. Exchange ratio based on different basis:

A Limited want to take over B Limited and the financial details of both are as follows:

Particulars	A Limited	B Limited
Preference share capital	20,000	
Equity share capital of Rs.10 each	1,00,000	50,000
Share premium	-	2,000
Profit and Loss Account	38,000	4,000
10% Debentures	15,000	5,000
Total	1,73,000	61,000
Fixed assets	1,22,000	35,000
Current assets	51,000	26,000
Total	1,73,000	61,000
Profit after tax after preference dividend	24,000	15,000
Market Price	24	27

What should be share exchange ratio to be offered to the shareholders of B Limited based on

- net assets value
- EPS
- Market price

Which should be preferred from the point of view of A Limited.

Answer:

WN 1: Computation of exchange ratio based on net assets method:

Particulars	A Limited	B Limited
Total assets	1,73,000	61,000
Less: 10% Debentures	(15,000)	(5,000)
Less: Preference share capital	(20,000)	-
Net Assets	1,38,000	56,000
No of shares	10,000	5,000
Value per share	13.80	11.20

- ❖ Base values = 13.80:11.20
- ❖ Exchange ratio = 11.20:13.80 (or) 0.812:1

WN 2: Computation of exchange ratio based on EPS:

Particulars	A Limited	B Limited
EAES	24,000	15,000

No of shares	10,000	5,000
EPS	2.40	3.00

- ❖ Base values = 2.40: 3.00
- ❖ Exchange ratio = 3:00:2.40 (or) 1.25:1

WN 3: Computation of exchange ratio based on MPS:

- ❖ Base values = 24:27
- ❖ Exchange ratio = 27:24 (or) 1.125:1

Preferred ratio:

- ❖ Company A would prefer exchange ratio on the basis of net assets method as the same will lead to allotment of lower number of shares.

28. Computation of synergy gain [Homework]

Companies X and Y are in the same business line generating annual cash flows of Rs.15 lacs and Rs.8 lacs respectively. If the two firms decide to merge together, a post-tax cost saving of Rs.2 lacs every year is expected to occur. X Limited proposes to absorb Y Limited on paying a cash consideration of Rs.60 lacs. The cost of capital is 15%. What are the merger gains to be allocated to shareholders?

Answer:**WN 1: Computation of merger gain and post-merger value:**

Particulars	Amount (in lacs)
Pre-merger Value of X Limited (15 lacs/15%)	100
Pre-merger value of Y Limited (8 lacs/15%)	53.33
Synergy gain (2 lacs/15%)	13.33
Total value	166.66

WN 2: Synergy gains for shareholders:

Particulars	X Limited	Y Limited
Pre-merger value	100	53.33
Post-merger value/ Consideration paid	106.66	60
Synergy gain	6.66	6.67

29. Weighted swap ratio [May 2005, May 2011, May 2009, May 2017 MTP, May 2018 MTP, May 2020 RTP, Nov 2020, May 2023 RTP, SM] [Concept Revision]

The following information relating to the acquiring Company Abhiman Ltd. and the target Company Abhishek Ltd. are available. Both the Companies are promoted by Multinational Company, Trident Ltd. The promoter's holding is 50% and 60% respectively in Abhiman Ltd. and Abhishek Ltd. :

Particulars	Abhiman Limited	Abhishek Limited
Share capital	200 lakh	100 lakh
Free reserves and surplus	800 lakh	500 lakh
Paid up value per share	100	10
Free float market capitalization	400 lakh	128 lakh
PE ratio (times)	10	4

Trident Ltd. is interested to do justice to the shareholders of both the Companies. For the swap ratio weights are assigned to different parameters by the Board of Directors as follows:

- ❖ Book Value 25%
- ❖ EPS (Earning per share) 50%
- ❖ Market Price 25%

Required:

- a) What is the swap ratio based on above weights?
- b) What is the Book Value, EPS and expected Market price of Abhiman Ltd. After acquisition of Abhishek Ltd. (assuming P.E. ratio of Abhiman Ltd. remains unchanged and all assets and liabilities of Abhishek Ltd. are taken over at book value).
- c) **Calculate:**
 - a. Promoter's revised holding in the Abhiman Ltd.
 - b. Free float market capitalization.
 - c. Also calculate No. of Shares, Earning per Share (EPS) and Book Value (B.V.), if after acquisition of Abhishek Ltd., Abhiman Ltd. decided to :

- i. Issue Bonus shares in the ratio of 1 : 2; and
- ii. Split the stock (share) as Rs. 5 each fully paid.

Answer:

WN 1: Basic information:

(in lacs)

Particulars	Abhiman	Abhishek
PAT/EAES	80	80
No of equity shares	2	10
EPS	40	8
PE Multiple	10	4
MPS	400	32
No of equity shares	2	10
Market value of firm	800	320

Note:

- Free-float market capitalization refers to value of shareholding of non-promoters
- Total market value of firm for both companies is calculated as under:

Particulars	Abhiman	Abhishek
Free Float Market capitalization (A)	400	128
Non-promoter shareholding (B)	50%	40%
Total Value of firm (A/B)	800	320

- Based on total value of firm and no of equity shares we reverse work and get MPS. Based on MPS and PE Multiple, we get EPS. Based on EPS and no of shares we get PAT
- Book value per share for both companies is computed as under:

Particulars	Abhiman	Abhishek
Share capital	200	100
Reserves and surplus	800	500
Total Networth (A)	1,000	600
No of shares (B)	2	10
Book value per share (A/B)	500	60

WN 2: Computation of no of shares to be issued and exchange ratio:

Particulars	Base values	Swap Ratio	Shares to be allotted	Weight	Product
Book value	500:60	60:500	1,20,000 (10,00,000 × 60/500)	0.25	30,000
EPS	40:8	8:40	2,00,000 (10,00,000 × 8/40)	0.50	1,00,000
MPS	400:32	32:400	80,000 (10,00,000 × 32/400)	0.25	20,000
No of shares to be issued					1,50,000

- Exchange ratio = 1,50,000:10,00,000 (or) 0.15:1

WN 2: Computation of Book value, EPS and Market price post Acquisition:

Particulars	Amount (in lacs)
PAT/EAES (80 + 80)	160
No of equity shares (2 + 1.5)	3.5
EPS (160/3.5)	45.7143
PE Multiple	10
MPS (45.7143 × 10)	457.14
No of equity shares	3.5
Market value of firm (457.15 × 3.5)	1,600
Networth of merged entity (1,000 + 600)	1,600
No of shares of merged entity	3.5
Book value per share of merged entity	457.14

WN 3: Computation of revised holding of promoters and free-float market capitalization:

Revised holding of promoters:

Particulars	Abhiman	Abhishek	Total

Shares held by original shareholders in merged entity	2,00,000	1,50,000	3,50,000
Promoter holding	50%	60%	54.29%
Shares held by promoters	1,00,000	90,000	1,90,000

- Promoter shareholding in merged entity = $(1,90,000/3,50,000) \times 100 = 54.29\%$

Free-float market capitalization:

- Free-float market capitalization = $1,600 \text{ lacs} \times (100\% - 54.29\%) = \text{Rs.}731.36 \text{ lacs}$

WN 4: Computation of revised No of shares, EPS and Book value per share post bonus and split:

- The merged entity currently has 3,50,000 shares. The company plans to make bonus issue in the ratio of 1:2. This will increase the no of shares to 5,25,000 (3,50,000 + 1,75,000 bonus shares)
- The company plans to split Rs.100 share into Rs.5 share. This will lead to one share becoming 20 shares. Hence 5,25,000 shares will become 105 lacs shares
- No of shares post bonus and split = 105 lacs**
- EPS = (160 lacs/105 lacs) = Rs.1.52381 per share**
- Book value per share = (1,600 lacs/105 lacs) = Rs.15.2381**

30. Weighted average swap ratio [Nov 2023] [Homework]

The following information is provided relating to the acquiring Company R Ltd. And the target Company K Ltd.:

Particulars	R Limited	K Limited
Promoter Holding	50%	60%
Share Capital (Rs. in lakh)	100	50
Free Reserves & Surplus (Rs. in lakh)	400	250
Paid up value per share (Rs.)	100	10
Free Float Market Capitalization (Rs. in lakh)	200	64
P/E Ratio (times)	20	8

For deciding the swap ratio, weights are assigned to different parameters by the Board of Directors of both the companies as follows:

Book value	20%
EPS	60%
Market Price	20%

You are required to calculate:

- Swap ratio based on above weights.
- Book Value per share, EPS and expected market price of R Ltd. after acquisition of K Ltd. (Assuming PE multiple of K Ltd. remains unchanged and all assets and liabilities of K Ltd. are taken over at book value)
- Revised promoter's holding (%) in R Ltd. after acquisition.
- Post-acquisition Free Float Market Capitalization.

Author's Note:

- ICAI has cleverly modified the question, specifying that the PE Multiple of K Limited remains unchanged. As a result, the post-merger PE Multiple will be the **same as that of the target company (and not acquiring company)**

Answer:**WN 1: Basic information:**

(in lacs)

Particulars	R Limited	K Limited
PAT/EAES	20	20
No of equity shares	1	5
EPS	20	4
PE Multiple	20	8
MPS	400	32
No of equity shares	1	5
Market value of firm	400	160

Note:

- Free-float market capitalization refers to value of shareholding of non-promoters

- Total market value of firm for both companies is calculated as under:

Particulars	R Limited	K Limited
Free Float Market capitalization (A)	200	64
Non-promoter shareholding (B)	50%	40%
Total Value of firm (A/B)	400	160

- Based on total value of firm and no of equity shares we reverse work and get MPS. Based on MPS and PE Multiple, we get EPS. Based on EPS and no of shares we get PAT
- Book value per share for both companies is computed as under:

Particulars	R Limited	K Limited
Share capital	100	50
Reserves and surplus	400	250
Total Networth (A)	500	300
No of shares (B)	1	5
Book value per share (A/B)	500	60

WN 2: Computation of no of shares to be issued and exchange ratio:

Particulars	Base values	Swap Ratio	Shares to be allotted	Weight	Product
Book value	500:60	60:500	60,000 (5,00,000 × 60/500)	0.20	12,000
EPS	20:4	4:20	1,00,000 (5,00,000 × 4/20)	0.60	60,000
MPS	400:32	32:400	40,000 (5,00,000 × 32/400)	0.20	8,000
No of shares to be issued					80,000

- Exchange ratio = 80,000:5,00,000 (or) 0.16:1

WN 2: Computation of Book value, EPS and Market price post Acquisition:

Particulars	Amount (in lacs)
PAT/EAES (20 + 20)	40
No of equity shares (1 + 0.8)	1.80
EPS (40/1.80)	22.2222
PE Multiple	8
MPS (22.2222 × 20)	177.78
No of equity shares	1.80
Market value of firm (444.44 × 1.80)	800.00
Networth of merged entity (500 + 300)	800
No of shares of merged entity	1.80
Book value per share of merged entity	444.444

WN 3: Computation of revised holding of promoters and free-float market capitalization:

Revised holding of promoters:

Particulars	R Ltd	K Ltd	Total
Shares held by original shareholders in merged entity	1,00,000	80,000	1,80,000
Promoter holding	50%	60%	54.4444%
Shares held by promoters	50,000	48,000	98,000

- Promoter shareholding in merged entity = (98,000/1,80,000) × 100 = 54.4444%

Free-float market capitalization:

- Free-float market capitalization = 177.78 × (1,80,000 - 98,000) = Rs.145.76 lacs

31. Synergy gain [May 2007, Nov 2022 RTP, SM]

AFC Ltd. wishes to acquire BCD Ltd. The shares issued by the two companies are 10,00,000 and 5,00,000 respectively:

- a) Calculate the increase in the total value of BCD Ltd. resulting from the acquisition on the basis of the following conditions:

- ❖ Current expected growth rate of BCD Ltd. = 7%
- ❖ Expected growth rate under control of AFC Ltd., (without any additional capital investment and

without any change in risk of operations) = 8%

- ❖ Current Market price per share of AFC Ltd. = Rs.100
- ❖ Current Market price per share of BCD Ltd. = Rs.20
- ❖ Expected Dividend per share of BCD Ltd. = Rs.0.60

- b) On the basis of aforesaid conditions calculate the gain or loss to shareholders of both the companies, if AFC Ltd. were to offer one of its shares for every four shares of BCD Ltd.
- c) Calculate the gain to the shareholders of both the Companies, if AFC Ltd. pays Rs.22 for each share of BCD Ltd., assuming the P/E Ratio of AFC Ltd. does not change after the merger. EPS of AFC Ltd. is Rs.8 and that of BCD is Rs.2.50. It is assumed that AFC Ltd. invests its cash to earn 10%.

Answer:

WN 1: Computation of increase in value of BCD Limited due to merger:

- Growth rate of BCD Limited will increase from 7% to 8%. This will lead to higher valuation for BCD Limited as it will grow at higher rate under AFC Limited
- **Current cost of equity of BCD Limited is computed as per Gordon's model:**

$$P_0 = \frac{D_1}{K_e - G}; 20 = \frac{0.60}{K_e - 7\%}; K_e - 0.07 = \frac{0.60}{20}; K_e = 0.03 + 0.07 = 10\%$$

- The cost of equity of BCD Limited is 10%. However now the growth rate has increased from 7% to 8% and this will lead to higher valuation of share

$$P_0 = \frac{D_1}{K_e - G}; P_0 = \frac{0.6}{10\% - 8\%} = \frac{0.6}{2\%} = \text{Rs. } 30$$

- Share price is expected to increase from Rs.20 per share to Rs.30 per share. **Hence increase in value of BCD Limited due to acquisition = 5,00,000 x (30 - 20) = Rs.50,00,000**

WN 2: Computation of gain or loss to shareholders of both companies:

$$\text{Post merger MP} = \frac{(10,00,000 \times 100) + (5,00,000 \times 30)}{10,00,000 + 1,25,000} = 102.22 \text{ per share}$$

Particulars	AFC Limited	BCD Limited
Pre-merger value		
No of shares	10,00,000	5,00,000
Market price per share	100	20
Value of shareholders	10,00,00,000	1,00,00,000
Post-merger value		
No of shares	10,00,000	1,25,000
Market price per share	102.22	102.22
Value of shareholders	10,22,20,000	1,27,77,500
Overall gain/loss (A)	22,20,000	27,77,500
Pre-merger no of shares (B)	10,00,000	5,00,000
Gain per share (A/B)	2.22	5.55

WN 3: Computation of gain or loss if cash consideration is paid:

BCD Limited:

- The company pays cash consideration of Rs.22 per share. Their existing market price is Rs.20 per share and hence shareholders have a net gain of Rs.2 per share
- Overall gain = 2 x 5,00,000 shares = Rs.10,00,000

AFC Limited:

- Company is paying cash consideration and hence there will be no change in the number of shares. We should compute revised EPS and based on that revised MPS can be calculated

Particulars	Amount
Total earnings of AFC Limited (8 x 10,00,000)	80,00,000
Total earnings of BCD Limited (2.5 x 5,00,000)	12,50,000
Less: Loss in interest income on consideration paid (5,00,000 x 22 x 10%)	-11,00,000
Revised earnings of AFC Limited post acquisition	81,50,000
No of shares	10,00,000
Post-acquisition EPS	8.15

PE Multiple (100/8)	12.50
Post-acquisition MPS	101.875

- Value of share increases from Rs.100 to Rs.101.875. Hence gain per share = Rs.1.875
- Total gain = $1.875 \times 10,00,000 = \text{Rs.}18,75,000$

32. EPS/PE/ROE/Book value per share analysis [May 2018 MTP, Nov 2008, Nov 2018 MTP, May 2015, Jan 2021, SM]

BA Limited and DA Limited both the companies operate in the same industry. The Financial statements of both the companies for the current financial year are as follows:

Particulars	BA Limited	DA Limited
Current Assets	14,00,000	10,00,000
Fixed Assets (net)	10,00,000	5,00,000
Total Assets	24,00,000	15,00,000
Equity capital (Rs.10 each)	10,00,000	8,00,000
Retained earnings	2,00,000	-
14% long-term debt	5,00,000	3,00,000
Current Liabilities	7,00,000	4,00,000
Total Liabilities	24,00,000	15,00,000

Income statement:

Particulars	BA Limited	DA Limited
Net sales	34,50,000	17,00,000
Cost of goods sold	27,60,000	13,60,000
Gross Profit	6,90,000	3,40,000
Operating expenses	2,00,000	1,00,000
Interest	70,000	42,000
Earnings before taxes	4,20,000	1,98,000
Taxes @ 50%	2,10,000	99,000
Earnings after taxes	2,10,000	99,000
No of equity shares	1,00,000	80,000
Dividend Payout Ratio	40%	60%
Market price per share	40	15

Assume that both companies are in the process of negotiating a merger through an exchange of equity shares. You have been asked to assist in establishing equitable exchange terms and are required to:

- Decompose the share price of both the companies into EPS and P/E components; and also segregate their EPS figures into Return on Equity (ROE) and book value/intrinsic value per share components.
- Estimate future EPS growth rates for each company.
- Based on expected operating synergies BA Ltd. estimates that the intrinsic value of DA's equity share would be Rs.20 per share on its acquisition. You are required to develop a range of justifiable equity share exchange ratios that can be offered by BA Ltd. to the shareholders of DA Ltd. Based on your analysis in part (i) and (ii), would you expect the negotiated terms to be closer to the upper, or the lower exchange ratio limits and why?
- Calculate the post-merger EPS based on an exchange ratio of 0.4: 1 being offered by BA Ltd. and indicate the immediate EPS accretion or dilution, if any, that will occur for each group of shareholders.
- Based on a 0.4: 1 exchange ratio and assuming that BA Ltd.'s pre-merger P/E ratio will continue after the merger, estimate the post-merger market price. Also show the resulting accretion or dilution in pre-merger market prices.

Answer:

WN 1: Computation of EPS, PE, ROE and Book value per share:

Particulars	BA Limited	DA Limited	Merged Entity
EAT	2,10,000	99,000	3,09,000
No of shares	1,00,000	80,000	1,32,000
EPS	2.10	1.2375	2.3409
PE Multiple (MPS/EPS)	19.05	12.12	19.05
MPS	40	15	44.59
Book value per share (Equity/No of shares)	12	10	Not needed
ROE (EPS/BVPS) x 100	17.50%	12.37%	Not needed

WN 2: Computation of growth rates:

Particulars	BA Limited	DA Limited
Dividend payout ratio	40%	60%
Retention ratio	60%	40%
ROE	17.50%	12.37%
Growth rate (ROE x Retention ratio)	10.50%	4.95%

WN 3: Identification of justifiable exchange ratio:

Basis	Base value	Swap Ratio	Limit
Intrinsic value	40:20	20:40 (or) 0.5:1	Upper Limit
Market value	40:15	15:40 (or) 0.375:1	Lower Limit

Since, BA Limited has a higher EPS, ROE, PE Multiple and higher EPS growth expectations, the negotiable terms would be expected to be closer to the lower limit, based on the existing share prices.

WN 4: Computation of EPS/MPS accretion or dilution due to merger:

Particulars	BA Limited	DA Limited
Existing EPS	2.1000	1.2375
New EPS	2.3409	0.9364 [2.3409 x 40%]
Impact on EPS	0.2409	(0.3011)
Existing MPS	40	15
New Price	44.59	17.84 [44.59 x 40%]
Impact on MPS	4.59	2.84

33. Bank merger [Nov 2019 MTP, May 2022 MTP, Nov 2024 MTP SM] [Concept Revision]

During the audit of the weak Bank (W), RBI has suggested that the Bank should either merger with another bank or may close down. Strong Bank (S) has submitted a proposal of merger of weak bank with itself. The relevant information and Balance Sheets of both the companies are as under:

Particulars	Weak Bank	Strong Bank	Assigned Weight
Gross NPA (%)	40	5	30
CAR (Total capital/Risk weighted assets)	5	16	28
MPS	12	96	32
Book value			10
Trading on stock exchange	Irregular	Frequent	

Balance Sheet (Amount in lacs)

Particulars	Weak Bank	Strong Bank
Paid up share capital (Rs.10 per share)	150	500
Reserves and surplus	80	5,500
Deposits	4,000	44,000
Other liabilities	890	2,500
Total Liabilities	5,120	52,500
Cash in hand and with RBI	400	2,500
Balance with other bank	-	2,000
Investments	1,100	19,000
Advances	3,500	27,000
Other Assets	70	2,000
Preliminary expenses	50	-
Total Assets	5,120	52,500

You are required to

- Calculate swap ratio based on the above weights
- Ascertain the number of shares to be issued to weak bank

- (c) Prepare balance sheet after merger and
 (d) Calculate CAR and Gross NPA of strong Bank after merger

Answer:**WN 1: Computation of shares to be issued and swap ratio:**

Parameter	Base value	Swap Ratio	Shares to be issued	Weight	Product
Gross NPA	5:40	5:40	1,87,500	0.3	56,250
CAR	16:5	5:16	4,68,750	0.28	1,31,250
Market Price	96:12	12:96	1,87,500	0.32	60,000
Book value	120:12	12:120	1,50,000	0.1	15,000
Shares to be issued					2,62,500

Note:

- ❖ Swap Ratio is the swap of base values for all positive parameters like CAR, Market Price and Book value. However, for negative parameters like Gross NPA the base value and swap ratio would remain same
- ❖ Book value of Weak Bank = $(150 + 80 - 50)/15 = \text{Rs.12 per share}$
- ❖ Book value of Strong Bank = $(500 + 5,500)/50 = \text{Rs.120 per share}$
- ❖ **Final swap ratio = 2,62,500 for 15,00,000 shares. Hence it will be 0.175 shares for every one share.**
- ❖ **Swap ratio = 0.175:1**

WN 2: Computation of Goodwill/Capital Reserve on Acquisition:

Particulars	Amount (in lacs)
Shares issued	2.625
Issue price (par value)	10
Consideration paid	26.25
Assets taken over	180
Capital Reserve	153.75

WN 3: Balance Sheet post-merger:

Particulars	Merged Bank (in lacs)
Liabilities	
Paid up capital (Rs.10)	526.25
Capital Reserve	153.75
Other reserves and surplus	5,500
Deposits	48,000
Other liabilities	3,390
Total Liabilities	57,570
Cash in hand and with RBI	2,900
Balance with other banks	2,000
Investments	20,100
Advances	30,500
Other Assets	2,070
Total Assets	57,570

WN 4: Computation of Gross NPA post-merger:

Particulars	Weak Bank	Strong Bank	Merged Bank
Total Advances	3,500	27,000	30,500
GNPA (%)	40	5	9.02% [2,750/30,500]
GNPA (in lacs)	1,400 [3,500 x 40%]	1,350 [27,000 x 5%]	2,750 [1,400 + 1,350]

WN 5: Computation of CAR post-merger:

Particulars	Weak Bank	Strong Bank	Merged Bank
Total Capital	180	6,000	6,180
CAR (%)	5%	16%	15.04% [6,180/41,100]

Risk weighted assets (%)	3,600 [180/5%]	37,500 [6,000/16%]	41,100 [3,600 + 37,500]

34. Exchange ratio [May 2015 RTP, Nov 2017 MTP]

Hanky Limited and Shanky Limited operate in the same field, manufacturing newly born babies clothes. Although Shanky Limited also has interests in communication equipments, Hanky Limited is planning to take over Shanky Limited and the shareholders of Shanky Limited do not regard it as a hostile bid.

The following information is available about the two companies:

Particulars	Hanky Limited	Shanky Limited
Current earnings	6,50,00,000	2,40,00,000
Number of shares	50,00,000	15,00,000
Percentage of retained earnings	20%	80%
Return on new investment	15%	15%
Return required by equity shareholders	21%	24%

Dividends have just been paid and the retained earnings have already been reinvested in new projects. Hanky Limited plans to adopt a policy of retaining 35% of earnings after the takeover and expects to achieve a 17% return on investment. Savings due to economies of scale are expected to be Rs.85,00,000 per annum. Required return to equity shareholders will fall to 20% due to portfolio effects.

Required:

- Calculate the existing share prices of Hanky Limited and Shanky Limited
- Find the value of Hanky Limited after the takeover
- Advise Hanky Limited on the maximum amount it should pay for Shanky Limited

Answer:**WN 1: Computation of existing share prices:**

Particulars	Hanky Limited	Shanky Limited
PAT	6,50,00,000	2,40,00,000
Number of shares	50,00,000	15,00,000
EPS	13.00	16.00
Growth rate:		
Retention ratio	20%	80%
Return on new investment	15%	15%
Growth rate	3%	12%
DPS of next year:		
DPS (EPS x payout ratio)	10.40	3.20
DPS of next year (DPS + Growth)	10.712	3.584
Cost of equity	21%	24%
Existing price	59.51	29.87
	10.712	3.584
	21% - 3%	24% - 12%

WN 2: Value of Hanky Limited after takeover:**Note 1: Next year earnings of merged entity:**

Particulars	Amount
PAT of Hanky Limited	6,50,00,000
PAT of next year (6,50,00,000 x 1.03)	6,69,50,000
PAT of Shanky Limited	2,40,00,000
PAT of next year (2,40,00,000 x 1.12)	2,68,80,000
Cost savings	85,00,000
Next year earnings of merged entity [6,69,50,000 + 2,68,80,000 + 85,00,000]	10,23,30,000

- The company has already made invested in new projects and hence the next year PAT of individual entity has been computed based on individual growth rate and cost savings

Note 2: Valuation post-merger:

Particulars	Amount

PAT	10,23,30,000
Payout ratio	65%
Total Dividend	6,65,14,500
Growth rate:	
Retention ratio	35%
Return on new investment	17%
Growth rate	5.95%
Post-merger value 6,65,14,500 20% – 5.95%	Rs.47,34,12,811

WN 3: Computation of maximum consideration:

Particulars	Amount
Post-merger value	47,34,12,811
Pre-merger value (59.51 x 50,00,000)	29,75,50,000
Maximum consideration	17,58,62,811

35. Shares to be issued to comply with SEBI guidelines [Nov 2013, Nov 2016 MTP, May 2018, Nov 2021 MTP]

Trupti Co. Ltd. promoted by a Multinational group “INTERNATIONAL INC” is listed on stock exchange holding 84% i.e. 63 lakhs shares.

- ❖ Profit after Tax is Rs. 4.80 crores.
- ❖ Free Float Market Capitalisation is Rs. 19.20 crores

As per the SEBI guidelines promoters have to restrict their holding to 75% to avoid delisting from the stock exchange. Board of Directors has decided not to delist the share but to comply with the SEBI guidelines by issuing Bonus shares to minority shareholders while maintaining the same P/E ratio. **Calculate**

- (i) P/E Ratio
- (ii) Bonus Ratio
- (iii) Market price of share before and after the issue of bonus shares
- (iv) Free Float Market capitalization of the company after the bonus shares.

Answer:**WN 1: Computation of PE Multiple:**

Particulars	Amount (in lacs)
Profit after Tax	480
P/E Multiple [Total Market Cap/Profit after Tax] [Bal figure]	25 times [12,000/480]
Total Market Capitalization [Free Float Market Cap/Public holding%]	12,000 [1920/16%]

WN 2: Computation of Bonus Ratio:

Particulars	Amount
Existing shares by promoters	63 lacs
Existing shareholding of promoters	84%
Total Shares [63 lacs/84%]	75 lacs
Target shareholding of promoters	75%
Target total shares for 75% promoter holding [63 lacs/75%]	84 lacs
Bonus shares to be issued [84 lacs – 75 lacs]	9 lacs
Existing shares by public [75 lacs – 63 lacs]	12 lacs
Bonus Ratio	9:12 or 3:4

WN 3: Computation of Market Price before and after issue:

Particulars	Before issue	After Issue
Market capitalization	12,000	12,000
Number of shares	75 lacs	84 lacs
Market Price (Market cap/No of shares)	160	142.86

WN 4: Free Float Market Capitalization post bonus issue:

- ❖ Free Float market capitalization = Total market capitalization × % holding by public
- ❖ Free Float Market Capitalization = 12,000 lacs × 25% = Rs.3,000 lacs

36. Computation of available liquidity [Nov 2013 RTP, May 2015 RTP] [Homework]

A Ltd.'s (Acquirer company) equity capital is Rs. 2,00,00,000. Both A Ltd. and T Ltd. (Target Company) have arrived at an understanding to maintain debt equity ratio at 0.30 : 1 of the merged company. Pre-merger debt outstanding of A Ltd. stood at Rs. 20,00,000 and T Ltd at Rs. 10,00,000 and marketable securities of both companies stood at Rs. 40,00,000. You are required to calculate total fund requirements of A Ltd. to acquire T Ltd. against cash payment at mutually agreed price of Rs. 65,00,000.

Answer:

Particulars	Amount
Debt capacity of merged company (2,00,00,000 × 0.30)	60,00,000
Less: Debt of A Limited and T Limited	30,00,000
Balance debt can be raised	30,00,000
Add: Marketable securities	40,00,000
Total fund available	70,00,000

Since the combined liquidity of merged company shall remain comfortable, it shall be feasible to pay cash for acquiring T Limited against cash consideration of Rs.65,00,000.

37. Return on shares pre and post-merger [Nov 2015 RTP] [Concept Revision]

Two companies Bull Ltd. and Bear Ltd. recently have been merged. The merger initiative has been taken by Bull Ltd. to achieve a lower risk profile for the combined firm in spite of fact that both companies belong to different industries and disclose a little co-movement in their profit earning streams. Though there is likely to synergy benefits to the tune of Rs. 7 crore from proposed merger. Further both companies are equity financed and other details are as follows:

Company	Market Capitalization	Beta
Bull Limited	1,000 Crores	1.50
Bear Limited	500 Crores	0.60

Expected Market Return and Risk Free Rate of Return are 13% and 8% respectively. Shares of merged entity have been distributed in the ratio of 2:1 i.e. market capitalization just before merger. You are required to:

- (a) Calculate return on shares of both companies before merger and after merger.
- (b) Calculate the impact of merger on Mr. X, a shareholder holding 4% shares in Bull Ltd. and 2% share of Bear Ltd.

Answer:

WN 1: Computation of return on shares before merger and after merger:

Particulars	Beta	Calculation	Return on shares
Bull Limited (pre-merger)	1.50	8% + 1.50 × (13% - 8%)	15.50%
Bear Limited (pre-merger)	0.60	8% + 0.60 × (13% - 8%)	11.00%
Merged entity (post-merger)	1.20 (Note 1)	8% + 1.20 × (13% - 8%)	14.00%

Note 1: Computation of Beta of Merged Firm:

Security	Beta	Weight	Product
Bull Limited	1.50	1,000	1,500
Bear Limited	0.60	500	300
Merged Firm	1.20	1,500	1,800

WN 2: Impact of merger on Mr.X:

Note 1: Value of Mr.X holding pre-merger:

Particulars	Calculation	Amount
Bull Limited	4% × 1,000 Crores	40 Crores
Bear Limited	2% × 500 Crores	10 Crores
Value of holding		50 Crores

Note 2: Value of merged entity:

Particulars	Calculation	Amount in crores
Earnings of Bull Limited	15.50% × 1,000 crores	155
Earnings of Bear Limited	11% × 500 Crores	55

Synergy gain		7
Earnings of merged entity		217
Cost/return on equity		14%
Value of merged firm	217/14%	1,550

Note 3: Value of Mr.X post-merger:

Particulars	Calculation	Amount
Shareholding in Bull Limited		4%
Shareholding in Bear Limited		2%
Shareholding in merged entity	$\left(4\% \times \left(\frac{2}{3}\right) + 2\% \times \left(\frac{1}{3}\right)\right)$	3.333333%
Value of holding	3.333333% x 1,550	51.67 Crores

Impact: Value of Mr.X holding increases by 1.67 Crores post-merger.

38. Computation of shares to be issued [Nov 2017, Nov 2006, Nov 2017 RTP, Nov 2023 MTP, Nov 2021 MTP, SM] [Homework]

AB Ltd., is planning to acquire and absorb the running business of XY Ltd. The valuation is to be based on the recommendation of merchant bankers and the consideration is to be discharged in the form of equity shares to be issued by AB Ltd. As on 31.3.2006, the paid up capital of AB Ltd. consists of 80 lakhs shares of Rs.10 each. The highest and the lowest market quotation during the last 6 months were Rs.570 and Rs.430. For the purpose of the exchange, the price per share is to be reckoned as the average of the highest and lowest market price during the last 6 months ended on 31.3.06.

XY Limited's Balance Sheet as at 31.03.2006 is summarized below:

Particulars	Amount in lacs
Sources	
Share capital	
20 lacs equity shares of Rs.10 each fully paid	200
10 lacs equity shares of Rs.10 each, Rs.5 paid	50
Loans	100
Total	350
Uses	
Fixed assets (net)	150
Net current assets	200
Total	350

An independent firm of merchant bankers engaged for the negotiation, have produced the following estimates of cash flows from the business of XY Ltd.:

Year ended	Amount in lacs
31.03.07	105
31.03.08	120
31.3.09	125
31.3.10	120
31.3.11	100
Terminal value estimate	200

It is the recommendation of the merchant banker that the business of XY Ltd. may be valued on the basis of the average of (i) Aggregate of discounted cash flows at 8% and (ii) Net assets value.

You are required to:

- Calculate the total value of the business of XY Ltd.
- The number of shares to be issued by AB Ltd.; and
- The basis of allocation of the shares among the shareholders of XY Ltd.

Answer:

WN 1: Valuation of company on the basis of discounted cash flows:

Year	Cash flow	PVF @ 8%	DCF (in lacs)
1	105	0.93	97.65
2	120	0.86	103.20
3	125	0.79	98.75
4	120	0.74	88.80

5	300	0.68	204.00
Value of business			592.40

WN 2: Valuation of company on the basis of Net assets value:

Particulars	Amount (in lacs)
Fixed Assets	150
Current Assets	200
Less: Loans	(100)
Net Assets	250

WN 3: Computation of shares to be issued:

Particulars	Amount (in lacs)
Valuation on discounted cash flows	592.40
Valuation on net assets	250
Average value	421.20
Issue price (average of opening and closing)	500
No of shares to be issued (421.120/500)	84,240
Fully paid equivalent shares (20 lacs + 10 lacs x 50%)	25,00,000
Distribution of fully paid shareholders (84,240 x (20/25))	67,392
Distribution of partly paid shareholders (84,240 x (5/25))	16,848

39. Cash consideration and stock consideration [May 2019] [Homework]**ICAI Question:**

Given is the following information:

Particulars	Day Limited	Night Limited
Net earnings	Rs.5 Crores	Rs.3.5 Crores
No of equity shares	10,00,000	7,00,000

The shares of Day Limited and Night Limited trade at 20 and 15 times their respective P/E Ratios. Day Limited considers taking over Night Limited by paying Rs.55 Crores considering that the market price of Night Limited reflects its true value. It is considering both the following options:

- Takeover is funded entirely in cash
- Takeover is funded entirely in stock

You are required to calculate the cost of the takeover and advise Day Limited on the best alternative.

Modified Question:

Part (ii) of the question should state the following line "Takeover is funded entirely in stock by issuing shares at current market price of Day Limited"

Answer:**WN 1: Computation of value of Day Limited and Night Limited:**

Particulars	Day Limited	Night Limited
PAT	Rs.5 Crores	Rs.3.5 Crores
No of equity shares	10,00,000	7,00,000
Earnings per share	50	50
PE Multiple	20	15
MPS	1,000	750
No of shares	10,00,000	7,00,000
Market value	Rs.100 Crores	Rs.52.50 Crores

WN 2: Computation of true cost of merger:**Situation 1: Takeover funded with cash:**

- ❖ True cost of merger = Consideration paid - Value of Night Limited
- ❖ True cost of merger = Rs.55 Crores - Rs.52.50 Crores = Rs.2.50 Crores

Situation 2: Takeover funded with stock:

No of shares to be issued = 55 crores/1,000 = 5,50,000 shares
Post – merger MP = $\frac{\text{Value of company A} + \text{Value of company B}}{\text{No of shares}}$

Post – merger MP = $\frac{100 \text{ Crores} + 52.50 \text{ Crores}}{10,00,000 + 5,50,000} = \text{Rs. } 983.87$
Consideration for merger = Rs.983.07 x 5,50,000 shares = Rs.54.11 Crores
True cost of merger = Consideration paid - Value of Night Limited
True cost of merger = Rs.54.11 Crores - Rs.52.50 Crores = Rs.1.61 Crores

Conclusion: True cost of merger is lower in case of consideration in the form of stock and hence the takeover should be funded with stock.

40. Swap ratio and merger gain [May 2020 MTP] [Homework]

ICAI Question:

X Ltd. is studying the possible acquisition of Y Ltd. by way of merger. The following data are available in respect of both the companies.

Particulars	X Limited	Y Limited
Market capitalization (Rs.)	75,00,000	90,00,000
Gross Profit Ratio	20%	20%
Inventory Turnover Ratio	5 Times	4 Times
Debtors Turnover Ratio	3 Times	5 Times
12% Debentures	10,00,000	-
10% Debentures	-	14,40,000
No of equity shares	1,00,000	60,000
Operating expenses	86%	78%
Corporate Tax rate	30%	30%
Closing stock	15,00,000	5,00,000
Debtors	10,00,000	8,00,000

You are required to calculate:

- Swap ratio based on EPS & MPS respectively as weightage of 40% and 60%.
- Post Merger EPS
- Post Merger market price assuming same PE Ratio of X Ltd.
- Post Merger gain or loss in EPS.

Modified Question:

Data on Debtors Turnover Ratio is wrong and hence the same should not be given in question. Please remove that from the question

Answer:

WN 1: Computation of sales of X Limited and Y Limited:

Note 1: Computation of COGS:

Particulars	X Limited	Y Limited
Closing stock	15,00,000	5,00,000
Inventory Turnover Ratio	5	4
COGS (Stock x Inventory Turnover Ratio)	75,00,000	20,00,000

Note 2: Computation of Sales:

Particulars	X Limited	Y Limited
COGS	75,00,000	20,00,000
GP Ratio	20%	20%
COGS Ratio	80%	80%
Sales (COGS/80%)	93,75,000	25,00,000

WN 2: Income statement:

Particulars	X Limited	Y Limited
Sales	93,75,000	25,00,000
Less: Operating expenses (sales x Operating expenses ratio)	80,62,500	19,50,000
EBIT	13,12,500	5,50,000
Less: Interest	1,20,000	1,44,000
EBT	11,92,500	4,06,000
Less: Tax @ 30%	3,57,750	1,21,800
EAT	8,34,750	2,84,200

WN 3: Basic data:

Particulars	X Limited	Y Limited	Merged
EAT	8,34,750	2,84,200	11,18,950
No of shares	1,00,000	60,000	1,85,624
EPS	8.35	4.74	6.03
PE Multiple	8.98	31.65	8.98
MPS	75	150	54.15
No of shares	1,00,000	60,000	Not reqd
Market capitalization	75,00,000	90,00,000	Not reqd

Note 1: Computation of shares to be issued:

Parameter	Base values	Exchange ratio	Shares to be issued	Weight	Product
EPS	8.35:4.74	4.74:8.35	34,060 (60,000 × (4.74/8.35))	0.40	13,624
MPS	75:150	150:75	1,20,000 (60,000 × (150/75))	0.60	72,000
Shares to be issued					85,624

Solution:

- Swap ratio = 85,624 shares for 60,000 shares = 1.427:1
- Post-merger EPS = 6.03
- Post-merger MPS = 54.15

Post-merger gain or loss in EPS:

Particulars	ABC Limited	XYZ Limited
Old EPS	8.35	4.74
New EPS	6.03	8.60 $6.03 \times \left(\frac{1.427}{1}\right)$
Gain/loss in EPS	(2.32)	3.86

41. Valuation of debt & equity [May 2011, Nov 2016 MTP, May 2013 RTP, SM]

Centurion bank and Bank of Punjab are planning to merge. The total value of the companies is dependent on the fluctuating business conditions. The following information is given for the total value (debt + equity) structure of each of the two companies.

Business Condition	Probability	Centurion (in lacs)	Bank of Punjab (in lacs)
High growth	0.20	820	1050
Medium Growth	0.60	550	825
Slow growth	0.20	410	590

The current debt of Bank of Punjab is Rs.65 lacs and of Centurion bank is Rs.460 lacs. Calculate the expected value of debt and equity separately for the merged entity.

Answer:**WN 1: Computation of expected value of debt and equity of Centurion:**

(in lacs)

Business Condition	Probability	Total Value	Debt	Product	Equity	Product
High growth	0.20	820	460	92	360	72
Medium Growth	0.60	550	460	276	90	54
Slow growth	0.20	410	410	82	0	0
Total				450		126

Note:

- Total value will be first used for debt commitments and balance value will be for equity. Hence in case of slow growth scenario, total value of Rs.410 lacs is fully for debt as equity cannot be negative

WN 2: Computation of expected value of debt and equity of Bank of Punjab:

(in lacs)

Business Condition	Probability	Total Value	Debt	Product	Equity	Product

High growth	0.20	1,050	65	13	985	197
Medium Growth	0.60	825	65	39	760	456
Slow growth	0.20	590	65	13	525	105
Total				65		758

WN 3: Expected value of debt and equity of merged entity:

(in lacs)

Particulars	Debt	Equity	Total
Centurion	450	126	576
Bank of Punjab	65	758	823
Total	515	884	1,399

42. Evaluation of Merger [May 2021 MTP] [Homework]

C Ltd. and P Ltd. both companies operating in the same industry decided to merge and form a new entity S Ltd. The relevant financial details of the two companies prior to merger announcement are as follows:

Particulars	C Limited	P Limited
Annual earnings after tax [Rs. Lacs]	10,000	5,800
No of shares outstanding [lacs]	4,000	1,000
PE Ratio [No. of times]	8	10

The merger will be affected by means of stock swap (exchange) of 3 shares of C Ltd. for 1 share of P Ltd. After the merger it is expected that due to synergy effects, Annual Earnings (Post Tax) are expected to be 8% higher than sum of the earnings of the two companies individually. Further, it is expected that P/E Ratio of S Ltd. shall be average of P/E Ratios of two companies before the merger.

Evaluate the extent to which shareholders of P Ltd. will be benefitted per share from the proposed merger.

Answer:**Valuation of individual and merged entity:**

Particulars	C Limited	P Limited	Merged
Annual earnings after tax [Rs. Lacs]	10,000	5,800	17,064 [15,800 x 1.08]
No of shares outstanding [lacs]	4,000	1,000	7,000 [4,000 + (1,000 x 3)]
Earnings per share	2.50	5.80	2.4377
PE Multiple	8	10	9
MPS	20.00	58.00	21.9393
No of shares (in lacs)	4,000	1,000	7,000
Value of firm (in lacs)	80,000	58,000	1,53,575

Gain to shareholders:

Particulars	P Limited
Post-merger value	65,818 [3,000 x 21.9393]
Pre-merger value	58,000
Amount of gain [A]	7,818
Pre-merger number of shares [B]	1,000
Gain per share [A/B]	7.82

43. Computation of sustainable growth rate [Nov 2020 Exam]

AB Industries has Equity Capital of Rs. 12 Lakhs, total Debt of Rs. 8 Lakhs, and annual sales of Rs. 30 Lakhs. Two mutually exclusive proposals are under consideration for the next year. The details of the proposals are as under:

Particulars	Proposal No.1	Proposal No.2
Target Assets to Sales Ratio	0.65	0.62
Target Net Profit Margin (%)	4	5
Target Debt Equity Ratio (DER)	2:3	4:1
Target Retention Ratio (of earnings) (%)	75	-
Annual dividend (in lacs)	-	0.30
New equity raised (in lacs)	-	1.00

You are required to calculate sustainable growth rate for both the proposals.

Answer:

WN 1: Computation of return on equity for both options:

Proposal 1:

ROE as per Dupont Model = Net profit margin x Asset Turnover x Equity Multiplier

$$\text{ROE as per Dupont Model} = 4\% \times \left(\frac{1}{0.65}\right) \times \left(\frac{\text{Equity} + \text{Debt}}{\text{Equity}}\right)$$

$$\text{ROE as per Dupont Model} = 4\% \times \left(\frac{1}{0.65}\right) \times \left(\frac{3+2}{3}\right) = 10.26\%$$

Proposal 2:

$$\text{ROE as per Dupont Model} = 5\% \times \left(\frac{1}{0.62}\right) \times \left(\frac{\text{Equity} + \text{Debt}}{\text{Equity}}\right)$$

$$\text{ROE as per Dupont Model} = 5\% \times \left(\frac{1}{0.62}\right) \times \left(\frac{1+4}{1}\right) = 40.32\%$$

Note:

- ICAI answer has incorrect ROE as the equity multiplier formula is incorrect in ICAI suggested answers

WN 2: Computation of sustainable growth rate:

Sustainable growth rate = ROE x Retention Ratio
Option 1: SGR = 10.26% x 75% = 7.70%
Option 2: SGR = 40.32% x 94.28% (Note 1) = 38.01%

Note 1: Retention ratio for option 2:

Particulars	Amount
EAES (Equity x ROE)	5,24,160 [13,00,000 x 40.32%]
Dividend	30,000
Payout ratio	5.72% [30,000/5,24,160] x 100
Retention ratio	94.28% [100 - 5.72%]

**44. Calculation of purchase consideration [May 2010, Nov 2018 MTP, May 2018 RTP, Nov 2018, SM]
[Homework]**

T Limited and E Limited are in the same industry. The former is in negotiation for acquisition of the latter. Important information about the two companies as per their latest financial statements is given below:

Particulars	T Limited	E Limited
Rs.10 equity shares outstanding	12 lakhs	6 lakhs
Debt:		
10% Debentures (Rs. Lakhs)	580	
12.5% Institutional loan (Rs. Lakhs)		240
Earnings before interest, depreciation and tax (EBIDAT) Rs. Lakhs	400.86	115.71
Market price per share	220	110

T Limited plans to offer a price for E Limited, business as a whole which will be 7 times EBIDAT reduced by outstanding debt, to be discharged by own shares at market price. E Limited is planning to seek one share in T Limited for every 2 shares in E Limited based on the market price. Tax rate for the two companies may be assumed as 30%. Calculate and show the following under both alternatives – T Limited's offer and E Limited's plan:

- ❖ Net consideration payable.
- ❖ No. of shares to be issued by T Limited
- ❖ EPS of T Limited after acquisition.
- ❖ Expected market price per share of T Limited after acquisition.
- ❖ State briefly the advantages to T Ltd. from the acquisition

Calculations (except EPS) may be rounded off to 2 decimals in lakhs.

Answer:**Analysis of T Limited's offer and E Limited's plan:**

(in lacs)

Particulars	T Limited's offer	E Limited's plan
Net consideration	$(7 \times \text{EBIDAT}) - \text{Debt}$ $(7 \times 115.71) - 240$ = 569.97	$(6 \text{ lacs} \times 0.5) \times 220$ = 660 lacs
Issue price	220	220
No of shares issued	$\frac{569.97}{220} = 2.59$	$\frac{660}{220} = 3.00$
EPS post-merger:		
EBIDAT post-merger $(400.86 + 115.71)$	516.57	516.57
Less: Interest $(580 \times 10\% + 240 \times 12.5\%)$	-88.00	-88.00
EBT	428.57	428.57
Less: Tax @ 30%	-128.57	-128.57
EAT	300.00	300.00
No of shares $(12 + \text{new shares issued})$	14.59	15.00
EPS $(\text{EAT}/\text{No of shares})$	20.56	20.00
MPS post-merger:		
EPS	20.56	20.00
PE Multiple (Note 1)	11.00	11.00
MPS	226.16	220.00

Advantages of Acquisition:

Since the two companies are in the same industry, the following advantages could accrue:

- Synergy, cost reduction and operating efficiency.
- Better market share
- Avoidance of competition.

Note 1: PE Multiple:

- Post-merger PE Multiple will be taken as same as per-merger PE Multiple
- PAT before merger = $(400.86 - 58.00) \times 70\% = 240 \text{ lacs}$
- EPS before merger = $(240 \text{ lacs} / 12 \text{ lacs}) = \text{Rs.}20$
- PE Multiple before merger = $220 / 20 = 11 \text{ Times}$

45. Demerger [Nov 2005, May 2015 MTP, SM] [Concept Revision]

The following information is relating to Fortune India Ltd. having two division, viz. Pharma Division and Fast Moving Consumer Goods Division (FMCG Division). Paid up share capital of Fortune India Ltd. is consisting of 3,000 Lakhs equity shares of Re. 1 each. Fortune India Ltd. decided to de-merge Pharma Division as Fortune Pharma Ltd. w.e.f. 1.4.2009. Details of Fortune India Ltd. as on 31.3.2009 and of Fortune Pharma Ltd. as on 1.4.2009 are given below:

Particulars	Fortune Pharma Limited	Fortune India Limited
Outside liabilities		
Secured loans	400 lakh	3,000 lakh
Unsecured loans	2,400 lakh	800 lakh
Current liabilities & provisions	1,300 lakh	21,200 lakh
Assets		
Fixed assets	7,740 lakh	20,400 lakh
Investments	7,600 lakh	12,300 lakh
Current assets	8,800 lakh	30,200 lakh
Loans & advances	900 lakh	7,300 lakh
Deferred tax/Misc. expenses	60 lakh	(200 lakh)

Board of Directors of the Company have decided to issue necessary equity shares of Fortune Pharma Ltd. of Re. 1 each, without any consideration to the shareholders of Fortune India Ltd. For that purpose following points are to be considered:

- ❖ Transfer of Liabilities & Assets at Book value.
- ❖ Estimated Profit for the year 2009-10 is Rs.11,400 Lakh for Fortune India Ltd. & Rs.1,470 lakhs for Fortune Pharma Ltd.

- ❖ Estimated Market Price of Fortune Pharma Ltd. is Rs. 24.50 per share.
- ❖ Average P/E Ratio of FMCG sector is 42 & Pharma sector is 25, which is to be expected for both the companies.

Calculate:

- a) The Ratio in which shares of Fortune Pharma are to be issued to the shareholders of Fortune India Ltd.
- b) Expected Market price of Fortune India (FMCG) Ltd.
- c) Book Value per share of both the Companies immediately after Demerger.

Answer:

WN 1: Computation of shares to be issued and price post-merger:

(in lacs)

Particulars	Fortune Pharma	Fortune India FMCG
EAES	1,470	11,400
No of shares	1,500	3,000
EPS	0.98	3.8
PE Multiple	25	42
MPS	24.50	159.60

Note:

- Expected price of Fortune Pharma Limited = 24.50
- PE Multiple of Fortune Pharma Limited = 25
- Expected EPS of Fortune Pharma = $(24.50/25) = 0.98$ Times
- No of shares = $(EAES/EPs) = 1,470/0.98 = 1,500$ lacs

WN 2: Computation of book value per share after demerger:

Particulars	Fortune India (Merged)	Fortune Pharma (Demerged)	Fortune India FMCG
Total assets	70,000	25,100	44,900
Less: Outside liabilities	-25,000	-4,100	-20,900
Networth	45,000	21,000	24,000
No of shares	3,000	1,500	3,000
Book value per share	15	14	8

- Overall Networth of merged entity is captured in column 2. We have values separately for Fortune Pharma in question and hence Fortune India FMCG is taken as balancing figure

46. Corporate restructuring [Nov 2020 RTP, Nov 2018 MTP, Nov 2011, Nov 2018 RTP, Nov 2023 RTP, May 2023 MTP, SM] [Concept Revision]

The following is the Balance-sheet of Grape Fruit Company Limited as at March 31, 2011:

Liabilities	Amount (in lacs)	Assets	Amount in lacs
Equity shares of Rs.100 each	600	Land and Building	200
14% preference shares of Rs.100 each	200	Plant and Machinery	300
13% debentures	200	Furniture and fixtures	50
Debenture interest accrued and payable	26	Inventory	150
Loan from bank	74	Sundry debtors	70
Trade creditors	340	Cash at Bank	130
		Preliminary expenses	10
		Cost of issue of debentures	5
		Profit and Loss account	525
	1440		1440

The Company did not perform well and has suffered sizable losses during the last few years. However, it is felt the company could be nursed back to health by proper financial restructuring. Consequently the following scheme of reconstruction has been drawn up :

- (i) Equity shares are to be reduced to Rs. 25/- per share, fully paid up;
- (ii) Preference shares are to be reduced (with coupon rate of 10%) to equal number of shares of Rs. 50 each, fully paid up.
- (iii) Debenture holders have agreed to forgo the accrued interest due to them. In the future, the rate of interest on debentures is to be reduced to 9 percent.

- (iv) Trade creditors will forego 25 percent of the amount due to them.
- (v) The company issues 6 lakh of equity shares at Rs. 25 each and the entire sum was to be paid on application. The entire amount was fully subscribed by promoters.
- (vi) Land and Building was to be revalued at Rs. 450 lakhs, Plant and Machinery was to be written down by Rs. 120 lakhs and a provision of Rs.15 lakhs had to be made for bad and doubtful debts.

Required:

- (i) Show the impact of financial restructuring on the company's activities.
- (ii) Prepare the fresh balance sheet after the reconstructions is completed on the basis of the above proposals.

Answer:**WN 1: Computation of Capital reserve:**

Particulars	Calculation	Amount in lacs
Benefits to Grape Fruit company:		
Reduction in equity share capital	6 lacs x 75	450
Reduction in preference share capital	2 lacs x 50	100
Waiver of outstanding debenture interest		26
Waiver from trade creditors	340 lacs x 25%	85
Appreciation of land and building	450 lacs – 200 lacs	250
Total Benefits		911
Less: Assets written off		
Writing off P&L Account		525
Cost of issue of debentures		5
Preliminary expenses		10
Provision for bad and doubtful debts		15
Revaluation of P&M		120
Total assets written off		675
Capital reserve		236

WN 2: Balance Sheet of Grape Fruit company as at 31st March 2016 (after reconstruction)**(in lacs)**

Liabilities	Amount	Assets	Amount
12 lacs equity shares of Rs.25 each	300	Land and building	450
10% preference shares of Rs.50 each	100	Plant and machinery	180
Capital reserve	236	Furniture and fixtures	50
9% debentures	200	Inventory	150
Loan from Bank	74	Sundry debtors	55
Trade creditors (340 – 85)	255	Cash at Bank [130 + 150]	280
Total	1165	Total	1165

47. Consideration for promoters [Nov 2018 MTP, May 2014, Nov 2022 MTP, May 2024, SM]

The equity shares of XYZ Ltd. are currently being traded at Rs. 24 per share in the market. XYZ Ltd. has total 10,00,000 equity shares outstanding in number; and promoters' equity holding in the company is 40%. PQR Ltd. wishes to acquire XYZ Ltd. because of likely synergies. The estimated present value of these synergies is Rs. 80,00,000. Further PQR feels that management of XYZ Ltd. has been over paid. With better motivation, lower salaries and fewer perks for the top management, will lead to savings of Rs. 4,00,000 p.a. Top management with their families are promoters of XYZ Ltd. Present value of these savings would add Rs. 30,00,000 in value to the acquisition.

Following additional information is available regarding PQR Ltd.:

- ❖ Earnings per share = Rs.4
- ❖ Total number of equity shares outstanding = 15,00,000
- ❖ Market price of equity share = Rs.40

Required:

- ❖ What is the maximum price per equity share which PQR Ltd. can offer to pay for XYZ Ltd.?
- ❖ What is the minimum price per equity share at which the management of XYZ Ltd. will be willing to offer their controlling interest?

Answer:**WN 1: Computation of maximum price to be paid by PQR Limited:**

Particulars	Calculation	Amount

Current value of XYZ Limited	(10 lacs x 24)	2,40,00,000
Synergy benefits		80,00,000
Savings in top management salaries		30,00,000
Potential value of XYZ Limited		3,50,00,000
No of shares		10,00,000
Maximum price per share		Rs.35

WN 2: Computation of minimum price per share at which promoters will offer controlling interest:

Particulars	Calculation	Amount
Current value of holding	(10 lacs x 24) x 40%	96,00,000
Loss of higher salaries		30,00,000
Total value of holding		1,26,00,000
No of shares		4,00,000
Minimum price per share	126 lacs/4 lacs	31.50

- Promoters would lose the benefit of higher salaries once they offer their controlling interest and hence, they would want to get compensation for that as well. Hence Rs.30,00,000 have been added in computing minimum price per share

48. Range of valuation based on PE Multiple and EPS [Nov 2021 MTP] [Homework]

Snake Ltd. is taking over Lizard Ltd, both are listed companies. The PE Ratio of Lizard Ltd. has been low as 4 and high as 7 and is currently 5. Lizard Ltd.'s previous year EPS was Rs.3.40 and current expected EPS this year to be Rs.4.00. Determine the different range of values of shares using P/E Model.

Answer:

Method	EPS	PE Multiple	Value per share
1 (Last year EPS and High PE Multiple)	3.40	7.00	25.80
2 (Last year EPS and Low PE Multiple)	3.40	4.00	13.60
3 (Last year EPS and current PE Multiple)	3.40	5.00	17.00
4 (Expected EPS and High PE Multiple)	4.00	7.00	28.00
5 (Expected EPS and Low PE Multiple)	4.00	4.00	16.00
6 (Expected EPS and current PE Multiple)	4.00	5.00	20.00

Range of valuation = Rs.13.60 to Rs.28.00

Case Scenario - MCQs**Question No.1 [May 2024 RTP]**

Grow More Ltd. an NBFC is in the need of funds and hence it sold its receivables to MAC Financial Corporation (MFC) for Rs. 100 million. MFC created a trust for this purpose called General Investment Trust (GIT) through which it issued securities carrying a different level of risk and return to the investors. Further, this structure also permits the GIT to reinvest surplus funds for short term as per their requirement.

MFC also appointed a third party, Safeguard Pvt. Ltd. (SPL) to collect the payment due from obligor(s) and passes it to GIT. It will also follow up with defaulting obligor and if required initiate appropriate legal action against them.

Based on above scenario, answer the following questions:

- The securitized instrument issued for Rs. 100 million by the GIT falls under category of
 - Pass Through certificate (PTCs)
 - Pay Through Security (PTS)
 - Stripped Security
 - Debt Fund.
- In the above scenario, the Originator is.....
 - Grow More Ltd.
 - MAC Financial Corporation (MFC)
 - General Investment Trust (GIT)
 - Safeguard Pvt. Ltd.
- In the above scenario, the General Investment Trust (GIT) is a/an.....
 - Obligor
 - Originator
 - Special Purpose Vehicle (SPV)
 - Receiving and Paying Agent (RPA)
- In the above scenario, the Safeguard Pvt. Ltd. (SPL) is a/an.....
 - Obligor
 - Originator
 - Special Purpose Vehicle (SPV)
 - Receiving and Paying Agent (RPA)
- Which of the following statement holds true?
 - When Yield to Maturity in market rises, prices of Principle Only (PO) Securities tend to rise.
 - When Yield to Maturity in market rises, prices of Principle Only (PO) Securities tend to fall.
 - When Yield to Maturity in market falls, prices of Principle Only (PO) Securities tend to fall.
 - When Yield to Maturity in market falls, prices of Principle Only (PO) Securities remain the same.

Answer:

1. Pay Through Security
Explanation: PTS allows SPV to reinvest surplus funds for short-term as per their requirement
2. Grow More Limited
Note: ICAI Solution to this MCQ is wrong and they have updated Grow More Limited as Originator
3. Special Purpose Vehicle (SPV)
4. Receiving and Paying Agent (RPA)
5. When Yield to Maturity in market rises, prices of Principle Only (PO) Securities tend to fall.
Note: Yield and Price is inversely proportional and hence price will fall when Yield rise in market

Question No.2 [May 2024 RTP]

You are a financial analyst at a prominent investment firm and have been tasked with empirically verifying the weak form of Efficient Market Hypothesis (EMH) Theory for the XYZ Stock Index, a collection of diverse stocks. You decided to conduct three different tests to assess whether the stock market follows the principles of the weak form of EMH.

Test 1

For the past five years, you collected daily price changes of the stocks in the XYZ Stock Index. You calculated correlation coefficients for different lag periods and analyzed whether past price changes exhibit any significant correlation with future price changes. You considered price changes to be serially independent. The results indicated that most auto correlation coefficients are close to zero and statistically insignificant, suggesting those past price changes do not predict future price changes

Test 2

You further investigated the randomness of price changes in the XYZ Stock Index. Analyzing the sequence of daily price changes, you count the number of runs where price changes are consistently positive or negative. Upon comparing the observed number of runs with the expected number based on randomness, you find that they align closely, supporting the idea that price changes follow a random pattern.

Test 3

To examine the efficacy of trading strategies based on historical price trends, you implemented a simple trading rule for the XYZ Stock Index. The rule involves buying when the price crosses a moving average of 5% threshold and selling when it crosses another 7% threshold. Over a period of testing, you computed the returns generated by the trading strategy. The results revealed that the returns are not consistently better than random chance, implying that past price trends do not reliably predict future price movements.

Conclusion:

After conducting the three tests the evidence supports the weak form of Efficient Market Theory for the XYZ Stock Index you concluded that past price trends do not reliably predict future price movements.

Based on the above information answer the following questions:

1. Test 1 is
 - a) Serial Correlation test
 - b) Filter Rules test
 - c) Run Test
 - d) Variance Ratio Test
2. Test 2 is
 - a) Serial Correlation Test
 - b) Filter Rules Test
 - c) Run Test
 - d) Variance Ratio Test
3. Test is
 - a) Serial Correlation Test
 - b) Filter Rules Test
 - c) Run Test
 - d) Variance Ratio Test
4. The Filter Rule Test should not be applied for buy and hold strategy if.....
 - a) the behavior of stock price changes is predictable
 - b) the behavior of stock price changes is dependent on past trends.
 - c) the behavior of stock price changes is correlated
 - d) the behavior of stock price changes is random.
5. Results of your studies support the.....
 - a) Semi-strong EMH Theory
 - b) Strong EMH Theory
 - c) Random Walk Theory
 - d) Markowitz Theory

Answer:

1. Serial Correlation Test
2. Run Test

3. Filter Rules Test
4. the behavior of stock price changes is random.
5. Random Walk Theory

Question No.3 [May 2024 MTP]

Mr. Y has invested in the three mutual funds (MF) as per the following details:

Particulars	MF 'X'	MF 'Y'	MF 'Z'
Amount of investment	4,00,000	8,00,000	4,00,000
NAV at the time of purchase	10.30	10.10	10.00
Dividend received upto 31.03.2023	9,000	0	6,000
NAV as on 31.03.2023	10.35	10.00	10.30
Effective Yield per annum as on 31.03.2023 (percent)	9.66	-11.66	24.15

Assume 1 Year = 365 days

On the basis of above information, choose the most appropriate answer to the following questions:

Question No.1: Total NAV of MF 'Y' as on 31.03.2023 would be approximately	
a) 401941.73	b) 412000.00
c) 792079.20	d) 82500.00
Question No.2: Total Yield of MF 'X' in terms of Rs. would be approximately	
a) 10,941.73	b) 7,920.80
c) 18,000.00	d) 12,450.45
Question No.3: Number of days for which MF 'X' is held would be approximately	
a) 31 Days	b) 68 Days
c) 103 Days	d) 85 Days
Question No.4: Number of days for which MF 'Y' is held would be	
a) 31 Days	b) 68 Days
c) 103 Days	d) 85 Days

Answer:

Question No.1: Computation of Total NAV of MF "Y"		
Total NAV of MF Y = $\frac{8,00,000}{10.10} \times 10.00 = 7,92,079.20$		
Question No.2: Total Yield of MF X		
Particulars	Calculation	Amount
Amount invested		4,00,000
Value of closing units	$\left(\frac{4,00,000}{10.30}\right) \times 10.35$	4,01,941.75
Capital Gain		1,941.75
Dividends		9,000.00
Total Yield		10,941.75
• Total Yield of MF X = Rs.10,941.73		
Question No.3		
Particulars	Calculation	Amount
Total Yield		10,941.75
Amount invested		4,00,000
Holding period Return	$\frac{10,941.75}{4,00,000} \times 100$	2.7354%
Annual Return		9.66%
Period of holding	9.66% = 365 days 2.7354% = ? $\frac{2.7354}{9.66} \times 365$	103 Days
Question No.4		
Particulars	Calculation	Amount
Total Yield	7,92,079.20 - 8,00,000	-7,920.80
Amount invested		8,00,000
Holding period Return	$\frac{-7,920.80}{8,00,000} \times 100$	-0.99%
Annual Return		-11.66%

Period of holding	-11.66% = 365 days -0.99% = ? $\frac{-0.99}{-11.66} \times 365$	31 Days	

Question No.4 [May 2024 MTP]

ABC Ltd. is planning to expand its business and therefore raising fund by issuing a convertible bond of Rs. 10 crore. An investor "Mr. X" is interested to invest in the bond of ABC Ltd. Mr. X has following data related to the convertible bond.

Face value	Rs.250
Coupon (interest rate)	12%
No of shares per bond	20
Market price of share	Rs.12
Straight value of bond	Rs.235
Market price of convertible bond	Rs.265
Maturity	5 Years

You, being an expert of the matter, are required to answer his questions. Select the most appropriate alternative:

Question No.1: The percentage of downside risk of the bond is approximately	
a) 10.42%	b) 6.38%
c) 2.13%	d) 12.77%
Question No.2: The conversion premium in percentage term of the bond is	
a) 12.77%	b) 10.42%
c) 2.18%	d) 13.45%
Question No.3: The conversion parity price of the stock is	
a) Rs.11.75	b) Rs.12.00
c) Rs.13.25	d) Rs.12.50
Question No.4: If he wants a yield of 15% the maximum price he should be ready to pay for is	
a) 217.41	b) 224.81
c) 240.00	d) 232.32

Answer:

Question No.1			
Percentage of downside risk = $\frac{\text{CMP} - \text{Straight Value}}{\text{Straight Value}} = \frac{265 - 235}{235} \times 100 = 12.77\%$			
Question No.2			
- Conversion value = $20 \times 12 = \text{Rs.}240$ - Conversion premium = $265 - 240 = \text{Rs.}25.00$			
Ratio of Conversion value = $\frac{\text{Conversion premium}}{\text{Conversion Value}} \times 100 = \frac{25}{240} \times 100 = 10.42\%$			
Question No.3			
Conversion Parity Price = $\frac{\text{CMP of bond}}{\text{Conversion Ratio}} = \frac{265}{20} = \text{Rs.}13.25$ per share			
Question No.4			
Valuation of bond			
Year	Cash flow	PVF @ 15%	DCF
1 to 5	30.00	3.352	100.56
5	250.00	0.497	124.25
Intrinsic value (Max Price)			224.81

Question No.5 [May 2024 MTP]

Suppose you are a financial consultant and following 3 clients have approached to you seeking advise on the investment to be made in securities. All these clients have different background and risk appetite as well as perception to the market.

- Client A wants to invest in Fixed income avenues and therefore he is looking at the credit rating of the securities as well as financial ratios such as interest coverage, earning power etc and the general prospect of the industry.

- Client B wants to earn a fixed income over a period of time by holding the security till its maturity
- Client C wants to earn more by taking more risk. Therefore, he is more interested to invest in stocks. He believes that Price reflects all information found in the record of past prices and volumes.

On the basis of above information, choose the most appropriate answer to the MCQs

Question No.1: The main factor to be considered in selecting fixed income avenue for client A shall be	
a) Yield to Maturity	b) Risk of Default
c) Tax Shield	d) Liquidity
Question No.2: The main factor that have to be evaluated in the selection of Bond for Client B shall be	
a) Yield to Maturity	b) Risk of Default
c) Tax Shield	d) Liquidity
Question No.3: If Weak form efficiency is prevailing in the market then which approach is best for selection of Equity Shares?	
a) Technical Analysis	b) Fundamental Analysis
c) Random Selection Analysis	d) None of the above

Answer:

Question No.1: Risk of Default Explanation: Client A is primarily concerned with credit ratings and financial ratios like interest coverage and earning power, which are directly linked to the creditworthiness and ability of the issuer to repay. These factors point to the risk of default as the primary concern since fixed income investors like Client A are typically risk-averse and prefer secure investments over high returns.
Question No.2: Yield to Maturity Answer: Client B is looking for a fixed income and intends to hold the security until maturity. In this case, the yield to maturity (YTM) is the most relevant factor as it indicates the total return the investor can expect if the bond is held until it matures, taking into account interest payments and capital gains or losses.
Question No.3: Fundamental Analysis Answer: Under weak form market efficiency, past prices and volume data are already reflected in current stock prices, making technical analysis ineffective. However, fundamental analysis, which evaluates a company's financial health, earnings potential, and external economic factors, can still be useful for selecting equities in such a market environment. Therefore, Client C, who is risk-tolerant and interested in equities, would benefit most from fundamental analysis

Question No.6 [May 2024 MTP]

AES Ltd. wants to acquire DNF Ltd. and has offered a swap ratio of 1:2 (0.5 shares for every one share of DNF Ltd.). Following information is provided:

Particulars	AES Limited	DNF Limited
Profit after tax	36,00,000	7,20,000
Equity shares outstanding (Nos.)	12,00,000	3,60,000
PE ratio	10 Times	7 Times
Market price per share	Rs.30	Rs.14

On the basis of above information, choose the most appropriate answer to the following questions:

Question No.1: The number of equity shares to be issued by AES Ltd. for acquisition of DNF Ltd. would be	
a) 1,68,000	b) 1,80,000
c) 2,40,000	d) 3,00,000
Question No.2: The EPS of AES Ltd. after the acquisition would be	
a) Rs.2	b) Rs.3
c) Rs.3.13	d) Rs.4.00
Question No.3: The equivalent earnings per share of DNF Ltd. would be	
a) Rs.1.00	b) Rs.1.50
c) Rs.1.57	d) Rs.2.00
Question No.4: If AES Ltd. PE multiple remains unchanged then its expected market price per share after the acquisition would be	
a) Rs.14.00	b) Rs.30.00
c) Rs.31.30	d) Rs.40.00

Answer:

Merger Table:

Particulars	AES	DEF	Merged
PAT/EAES	36,00,000	7,20,000	43,20,000
No of equity shares	12,00,000	3,60,000	13,80,000
EPS	3.00	2.00	3.1304
PE Multiple	10	7	10
MPS	30.00	14.00	31.304
No of equity shares	12,00,000	3,60,000	13,80,000
Market value of firm	3,60,00,000	50,40,000	4,32,00,000

Answer:

- Question No.1 – $3,60,000 \times (1/2) = 1,80,000$ shares
- Question No.2 – Rs.3.13 per share
- Question No.3 – $\text{Rs.}3.13 \times (1/2) = \text{Rs.}1.57$ per share
- Question No.4 – Rs.31.304 per share

Question No.7 [May 2024 MTP]

During one business meeting at XYZ Ltd., one of the member pointed out that while evaluating the performance of any company one should not only see its Operating Income but should also analyse its Capital structure as well. Weighted Average Cost of Capital changes on the basis of capital structure keeping all other factors unchanged. He presented data relating to 3 companies Alpha Ltd., Beta Ltd. and Gama Ltd. whose operating Income are equal, but their capital structure is different. The following information relating to these 3 companies is as follows:

(in '000s)

Particulars	Alpha Limited	Beta Limited	Gama Limited
Total invested capital	20,00,000	20,00,000	20,00,000
Debt/ Assets Ratio	0.8	0.5	0.2
Shares outstanding	61,000	83,000	1,00,000
Pre-tax cost of debt	16%	13%	15%
Cost of equity	26%	22%	20%
Operating Income (EBIT)	5,00,000	5,00,000	5,00,000

The Tax rate is uniform 35% in all cases. The industry PE ratio is 11X. Based on above case scenario, choose the most appropriate answer of the following:

Question No.1: The weighted average cost of capital of Alpha Ltd. shall approximately be	
a. 13.520%	b. 15.225%
c. 17.950%	d. 18.000%
Question No.2: The Economic Valued Added (EVA) for Beta Ltd. is	
a. Rs.54,600 Thousand	b. Rs.20,500 Thousand
c. (-) Rs.34,000 Thousand	d. Rs.21,500 Thousand
Question No.3: The price per share of Gama Ltd. shall be	
a. Rs.28.60	b. Rs.31.90
c. Rs.31.46	d. Rs.29.45
Question No.4: The estimated market capitalisation for Alpha Ltd. is	
a. Rs. 26,47,700 Thousand	b. Rs. 31,46,000 Thousand
c. Rs. 17,44,600 Thousand	d. Rs. 23,73,800 Thousand
Question No.5: Earning per share of Beta Ltd. is	
a. Rs.2.60	b. Rs.2.90
c. Rs.2.86	d. Rs.2.15

Answer:

Question No.1			
WACC of Alpha Limited			
Source	Cost	Weight	Product
Equity	26.00	0.20	5.20
Debt	10.40	0.80	8.32
WACC			13.52
• Cost of debt = $16 \times (1 - 0.35) = 10.40\%$			
Question No.2			

WACC of Beta Limited

Source	Cost	Weight	Product
Equity	22.00	0.50	11.000
Debt	8.45	0.50	4.225
WACC			15.225

EVA Computation:

Particulars	Amount (in '000s)
EBIT (operating income)	5,00,000
EBIT x (1 - Tax rate) (A)	3,25,000
Capital employed	20,00,000
WACC	15.225
Cost of capital employed (WACC x Capital employed) (B)	3,04,500
EVA (A - B)	20,500

Question 3 to 5

Particulars	Alpha	Beta	Gama
EBIT	5,00,000	5,00,000	5,00,000
Less: Interest	(2,56,000) [16,00,000 x 16%]	(1,30,000) [10,00,000 x 13%]	(60,000) [4,00,000 x 15%]
EBT	2,44,000	3,70,000	4,40,000
Less: Tax @ 35%	-85,400	-1,29,500	-1,54,000
EAT	1,58,600	2,40,500	2,86,000
No of shares	61,000	83,000	1,00,000
Earnings per share	2.6000	2.8976	2.8600
PE Multiple	11	11	11
MPS (EPS x PE Multiple)	28.60	31.87	31.46

- Question No.3 - Rs.31.46
- Question no.4 - Market capitalization = 28.60 x 61,000 = 17,44,600 Thousands
- Question No.5 - Rs.2.90

Question No.8 [May 2024 MTP]

On 1 October 2023 Mr. X an exporter enters into a forward contract with a BNP Bank to sell US\$ 1,00,000 on 31 December 2023 at Rs. 85.40/\$. However, due to the request of the importer, Mr. X received the amount on 28 November 2023. Mr. X requested the bank to take delivery of the remittance on 30 November 2023 i.e., before due date. The inter-banking rates on 28 November 2023 was as follows:

- Spot = Rs.85.22/85.27
- One Month Premium = 10/15

Note:

(1) Consider 365 days in a year.

(2) Prevailing Prime Lending Rate is 12%

Based on above case scenario, choose the most appropriate answer of the following:

Question No.1: The bank may accept the request of customer of delivery before due date of forward contract provided the customer is ready to bear the loss if any consisting of	
a. Swap Difference	b. Interest on Outlay of Fund
c. Swap Difference Plus Interest on Outlay of Fund	d. Fixed Charges Plus Swap Difference and Interest on Outlay of Fund
Question No.2: In case of early delivery bank shall charge interest on outlay of fund at a rate not less than	
a. 8%	b. 10%
c. 12%	d. 18%
Question No.3: Swap Difference for US\$ 1,00,000 is	
a. Rs.5,000	b. Rs.20,000
c. Rs.18,000	d. Rs.8,000
Question No.4: Interest on outlay of funds shall be approximately	

a. Rs.92 payable by X	b. Rs.183 payable by X
c. Rs.183 payable by Bank	d. Rs.122 payable by bank
Question No.5: Net inflow to Mr. X is approximately	
a. Rs.85,42,183	b. Rs.85,20,000
c. Rs.85,19,817	d. Rs.85,40,000

Answer:

Question No.1 - Fixed Charges Plus Swap Difference and Interest on Outlay of Fund
Note: In this question fixed charges are not there, but they are also applicable on early delivery
Question No.2 - 12%
Question No.3 - Rs.20,000 (Note 1)
Question No.4 - Rs.183 payable by X (Note 2)
Question No.5 - Rs.85,19,817 (Note 4)

WN 1: Computation of net inflow if early delivery is done:**Note 1: Analysis from customer's point of view:**

Date	Position	Action	Reference Date	Rate
Oct 1	Original Position	Sell (BID)	December 31	85.40
Nov 30	Opposite Position	Buy (ASK)	December 31	-85.42
Nov 30	New position	Sell (BID)	Nov 30	85.22
Effective rate			85.40 - 85.42 + 85.22	85.20
Swap loss per USD			85.40 - 85.20	0.20
Total Swap loss			0.20 x 1,00,000	20,000

❖ Swap loss is the difference between effective rate - original rate

Note 2: Computation of interest cost:**Analysis from bank's point of view:**

Particulars	Amount
Nov 30 - Bank will buy from customer	-85.40
Nov 30 - Bank will sell at spot rate to some other Bank	85.22
Outflow for banker	0.18
Total outflow for banker (1,00,000 x 0.18)	18,000
Interest cost to be recovered (18,000 x 12% x 31/365)	183

Note 3: Total outflow for early honour:

Particulars	Amount
Swap loss	20,000
Interest charges	183
Total recovery from customer	20,183

Note 4: Net realization for customer:

Particulars	Amount
Sale of 1,00,000 USD at original rate (1,00,000 x 85.40)	85,40,000
Less: Charges (Note 3)	(20,183)
Net realization for customer	85,19,817

Question 9 [May 2024 MTP]

A US parent company has subsidiaries in France, Germany, UK and Italy. The amounts due to and from the affiliates is converted into a common currency viz. US dollar and entered in the following matrix.

Inter Subsidiary Payments Matrix**(US \$ Thousands)**

		Paying Affiliate				
		France	Germany	UK	Italy	Total
Receiving Affiliate	France	-----	80	120	200	400
	Germany	120	----	80	160	360
	UK	160	120	----	140	420
	Italy	200	60	120	----	380
	India	480	260	320	500	1560

The treasurer of US Parent company is suggesting that by applying Multilateral Netting system the company can save a lot of transfer/ exchange costs. The company's Board agreed with Treasurer's proposal. From the above case scenario, choose the most appropriate answer of following MCQs.

Question No.1: Before applying Multilateral Netting it is necessary to apply	
a. Unilateral Netting	b. Bilateral Netting
c. Multilateral Netting	d. Interest Rate Swapping
Question No.2: Through Multinational Netting these transfers will be reduced to	
a. USD 50,000	b. USD 1,00,000
c. USD 1,50,000	d. USD 2,00,000
Question No.3: The Net Payment/ Net Receipts for France after netting off shall be	
a. Net receipt of USD 40,000	b. Net payment of USD 80,000
c. Net Payment of USD 40,000	d. Net receipt of USD 80,000
Question No.4: The Net Payment/ Net Receipts for Italy after netting off shall be	
a. Net receipt of USD 60,000	b. Net payment of USD 1,20,000
c. Net payment of USD 60,000	d. Net receipt of USD 1,20,000
Question No.5: Suppose if the transfer charges are 0.01% of the amount transferred then by applying multilateral netting techniques there will be reduction in overall cost of transfer by	
a. USD 136	b. USD 156
c. USD 1,360	d. USD 1,560

Answer:

Question No.1 - Bilateral Netting
Question No.2 - USD 2,00,000 [80,000 + 1,20,000]
Question No.3 - Net payment of USD 80,000
Question No.4 - Net payment of USD 1,20,000
Question No.5 - USD 136
- Charges without netting = USD 15,60,000 x 0.01% = USD 156 - Charges with netting = USD 2,00,000 x 0.01% = USD 20 - Net saving with netting = USD 136

WN 1: Table after bilateral netting:

- France has to pay 120 USD to Germany and Germany has to pay 80 USD to France. Post netting the dues is 40.
- France has to pay 160 USD to UK and UK has to pay 120 USD to France. Post netting the dues is 40
- France has to pay 200 USD to Italy and Italy has to pay 200 USD to France. Both are netted off against each other
- Germany has to pay 120 USD to UK and UK has to pay 80 USD to Germany. Post netting the dues is 40
- Germany has to pay 60 USD to Italy and Italy has to pay 160 USD to Germany. Post netting the dues is 100
- UK has to pay 120 USD to Italy and Italy has to pay 140 USD to UK. Post netting the dues is 20 USD

Particulars	France	Germany	UK	Italy	Total
France	_____	80/0	120/0	200/0	0
Germany	120/40	_____	80/0	160/100	140
UK	160/40	120/40	_____	140/20	100
Italy	200/0	60/0	120/0	_____	0
Total	80	40	0	120	

WN 2: Multi-lateral netting

Entity	Receipt	Payment	Net amount
France	0	80	80 (Net payment)
Germany	140	40	100 (Net Receipt)
UK	100	0	100 (Net Receipt)

Italy	0	120	120 (Net Payment)

Question No.10 [Nov 2024 RTP]

Two friend Mr. A and Mr. N were discussing about the risks of market. While Mr. A is sort of risk averse, Mr. N is an aggressive investor and believes in taking risk. Mr. N said we cannot diversify the market risk at all, and he quoted the Modern Portfolio Approach. Both friends analyze the market data for the few months and came out with expected returns on two stocks for a particular market.

Market Return	Aggressive	Defensive
7%	4%	9%
25%	40%	18%

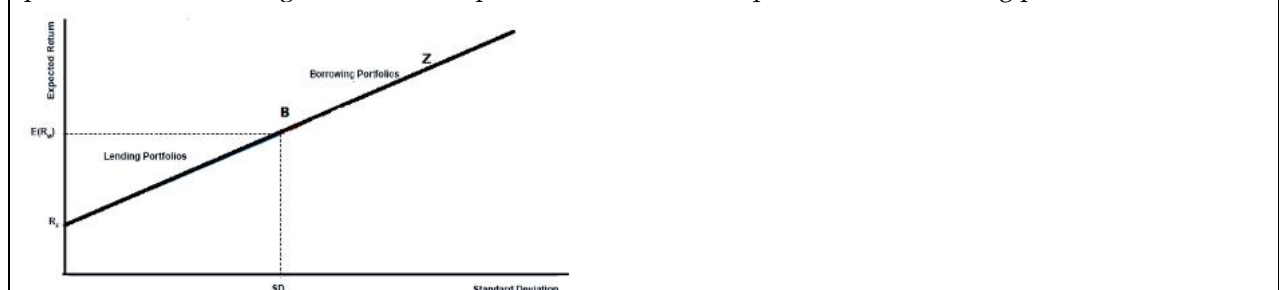
Based on above scenario, answer the following questions:

Question No.1: The Beta of Defensive stock is	
a. 2	b. 0.5
c. 4	d. 1
Question No.2: If the market return is equally likely to be 7% or 25% then expected return of Aggressive stock shall be	
a. 18%	b. 13.50%
c. 22%	d. 11%
Question No.3: The Alpha of the Defensive stocks is	
a. -10%	b. 22%
c. 5.50%	d. 12%
Question No.4: The Modern Portfolio Theory was propounded by	
a. William Sharpe	b. Black Scholes
c. Stephen Ross	d. Harry Markowitz
Question No.5: As per Capital Market Line (CML) Theory the Portfolios lying on the CML over the market portfolio are called	
e) Lending Portfolios	f) Borrowing Portfolios
g) Diversified Portfolios	h) Risk-free Portfolios

Answer:

• Question No.1 = 0.50 Times
• Question No.2 = 22%
• Question No.3 = 5.50%
• Question No.4 = Harry Markowitz
• Question No.5 = Borrowing Portfolio

Note: ICAI answer to this is wrong and it is mentioned as diversified portfolio. B represents market portfolio in below diagram and hence portfolio above market portfolio is borrowing portfolio in CML

**WN 1: Computation table for Beta:****Security Defensive:**

Prob	Aggressive				Market				$Pd_b d_m$
	Return	Product	Deviation	Pd^2	Return	Product	Deviation	Pd^2	
0.5	4	2	-18	162	7	3.5	-9	40.5	20.25
0.5	40	20	18	162	25	12.5	9	40.5	20.25
Total		22		324		16		81	40.5

Particulars	Calculation	Amount
1. Beta of Defensive	(40.50/81)	0.50 Times
2. Expected return of defensive	WN 1	13.50%
3. Required return of Defensive	Beta x Rm = 0.50 x 16%	8.00%
4. Alpha of Defensive stock	13.50% - 8.00%	+5.50%
5. Expected return of Aggressive	0.50 x 4 + 0.50 x 40	22%

Question No.11 [Nov 2024 RTP]

Mr. X on 1.7.2021, during the initial offer of some Mutual Fund invested in 10,000 units having face value of Rs. 10 for each unit. On 31.3.2022, the dividend paid by the M.F. was 10% and Mr. X found that his annualized yield was 153.33%. On 31.3.2023, 20% dividend was given. On 31.3.2024, Mr. X redeemed all his balance of 11,296.11 units when his annualized yield was 73.52%

Based on above scenario, answer the following questions:

Question No.1: NAV per unit of the Fund as on 31.03.2022 shall be approximately	
a. 19.50	b. 20.50
c. 21.50	d. 22.50
Question No.2: Total number of units as on 31.03.2022 shall be approximately	
a. 10487.80 units	b. 12585.65 units
c. 9465.35 units	d. 11575.40 units
Question No.3: Total Dividend received by Mr. X as on 31.03.2023 shall be	
a. Rs. 20,625.50	b. Rs. 20,870.45
c. Rs.20,975.60	d. Rs.21,565.75
Question No.4: NAV per unit as on 31.03.2023 shall be approximately	
a. Rs.24.65	b. Rs.24.85
c. Rs.25.95	d. Rs.26.45
Question No.5: NAV as on 31.03.2024 shall be approximately	
a) Rs.20.50	b) Rs.25.95
c) Rs.26.75	d) Rs.27.20

Answer:

• Question No.1 = 20.50
• Question No.2 = 10,487.80 units
• Question No.3 = Rs.20,975.60
• Question No.4 = Rs.25.95
• Question No.5 = Rs.26.75

WN 1: Computation of NAV as on 31.03.2022

- The investor has earned an annualized yield of 153.33% for 1.7.2021 to 31.3.2022
- He has invested for a period of 9 months. The holding period return for 9 months is calculated below:

$$\text{Holding Period Return} = \text{Annual Return} \times \left(\frac{9}{12}\right)$$

$$\text{Holding Period Return} = 153.33\% \times \left(\frac{9}{12}\right) = 115\%$$

Particulars	Calculation	Amount
1. Amount of investment		1,00,000
2. Holding period return (in %)		115%
3. Holding period return (in Rs.)	1,00,000 x 115%	1,15,000
4. Value of investment as on 31.03.2022		2,15,000
5. No of units	$\frac{1,00,000}{10}$	10,000
6. NAV per unit before dividend payment	$\frac{2,15,000}{10}$	21.50
7. Less: Dividend	10 x 10%	1.00
8. NAV per unit post dividend payment	21.50 - 1.00	20.50

WN 2: Calculation of units as on 31.03.2022, Dividend on 31.3.2023 and NAV as on 31.3.2023:

Particulars	Calculation	Amount
1. Dividend paid on 31.03.2022	$10,000 \times 1$	10,000
2. Units allotted	$\left(\frac{10,000}{20.50}\right)$	487.80
3. Total units post dividend re-investment		10,487.80
4. Dividend as on 31.3.2023	$10,487.80 \times 10 \times 20\%$	20,975.60
5. Units allotted as on 31.3.2023 (Note 1)	$11,296.11 - 10,487.80$	808.31
6. NAV/unit as on 31.3.2023	$\left(\frac{20,975.60}{808.31}\right)$	25.95

Note 1:

- The company has redeemed 11,296.11 units as on 31.03.2024. However, it had 10,487.80 units as on 31.03.2022. Hence extra units would have been allotted on 31.3.2023 due to dividend re-investment

WN 3: Computation of NAV as on 31.03.2024:

- Mr. X has earned an annualized yield of 73.52%. He has invested from 1.7.2021 to 31.3.2024 and the investment period is 33 months
- Holding period return for 33 months is calculated below:

$$\text{Holding Period Return} = \text{Annual Return} \times \left(\frac{9}{12}\right)$$

$$\text{Holding Period Return} = 73.52\% \times \left(\frac{33}{12}\right) = 202.18\%$$

Particulars	Calculation	Amount
1. Amount of investment		1,00,000
2. Holding period return (in %)		202.18%
3. Holding period return (in Rs.)	$1,00,000 \times 202.18\%$	2,02,180
4. Value of investment as on 31.03.2024		3,02,180
5. No of units		11,296.11
6. NAV as on 31.03.2024	$\frac{3,02,180}{11,296.11}$	26.75

Question No.12 [Nov 2024 MTP]

Bank A is in need of fund for a period of 14 days. To meet this financial need on 20th September 2023 Bank A enters into an agreement with Bank B under which it will sell 10% Government of India Bonds issued on 1st January 2023 @ 5.65% for Rs. 8 crore (Face value is Rs. 10,000 per Bond). The clean price of same Bond is Rs. 9,942 and the Initial Margin be 2% and the maturity date of Bond is 31st December 2028. Consider 360 days in a year and interest is payable annually. Based on above Case Scenario, answer the following questions:

Question No.1: The arrangement entered between Bank A and Bank B will be called	
a. Call Money Arrangement	b. Commercial Bill Arrangement
c. Commercial Paper	d. Repurchase option
Question No.2: Dirty Price of the Bond will approximately be	
a. Rs.10,353	b. Rs.10,670
c. Rs.10,499	d. Rs.10,816
Question No.3: The start proceeds of the transaction shall be approximately	
a. Rs.8,38,36,804	b. Rs. 8,36,53,000
c. Rs. 8,58,36,804	d. Rs.8,48,52,585
Question No.4: The second leg of the transaction shall be approximately	
a. Rs.8,38,36,804	b. Rs.8,36,53,000
c. Rs.8,58,36,804	d. Rs.8,48,52,585
Question No.5: The amount of Accrued Interest per Bond shall be approximately	
a. Rs.728	b. Rs.720
c. Rs.734	d. Rs.714

Answer:

• Question No.1 – Repurchase option
• Question No.2 – Rs.10,670
• Question No.3 – Rs.8,36,53,000

- | |
|----------------------------------|
| • Question No.4 – Rs.8,38,36,804 |
| • Question No.5 – Rs.728 |

WN 1: Computation of Dirty Price:

Dirty Price = Clean Price + Accrued Interest
Accrued interest = $10,000 \times 10\% \times \frac{262}{360} = 728$
Dirty price = $9,942 + 728 = \text{Rs.}10,670$

Note: Accrued interest is computed as per the base security. In this case the base security is GOI bonds which has an interest rate of 10%

WN 2: Computation of start proceeds and repayment at maturity:

Start Proceeds = $8,00,00,000 \times \frac{10,670}{10,000} \times 98\% = \text{Rs. } 8,36,52,800 \sim \text{Rs. } 8,36,53,000$
Interest on repo = $8,36,53,000 \times 5.65\% \times \frac{14}{360} = \text{Rs. } 1,83,804$
Repayment at maturity = $8,36,53,000 + 1,83,804 = 8,38,36,804$

Note: Interest on repo is charged based on repo interest rate of 5.65%

Question No.13 [Nov 2024 MTP]

The Asset Management Company of the mutual fund (MF) has declared a dividend of 9.98% on the units under the dividend reinvestment plan for the year ended 31st March 2021. The investors are issued additional units for the dividend at the rate of closing Net Asset Value (NAV) for the year as per the conditions of the scheme. The closing NAV was Rs. 24.95 as on 31st March 2021. An investor Mr. X who is having 20,800 units at the year-end has made an investment in the units before the declaration of the dividend at the rate of opening NAV plus an entry load of Rs. 0.04. The NAV has appreciated by 25% during the year. Assume the face value of the unit as Rs. 10.00. Based on above Case Scenario, answer the following questions:

Question No.1: The Opening NAV of the Asset Management Company shall be	
a. Rs.20.24	b. Rs.19.96
c. Rs.18.75	d. Rs.17.65
Question No.2: The Number of the units purchased shall be	
a. 18,750	b. 17,500
c. 20,450	d. 20,000
Question No.3: Original amount of the investment shall be	
a. Rs.4,00,000	b. Rs.6,50,000
c. Rs.3,55,000	d. Rs.5,65,000
Question No.4: Which of the following statement about Expense ratio is/ are incorrect:	
(i) It is the percentage of income that were spent to run a mutual fund.	
(ii) It includes advisory fees, travel costs, registrar fees , custodian fees, etc.	
(iii) It includes Brokerage costs for trading of Portfolio.	
(iv) High Expense Ratio can seriously undermine the performance of a mutual fund scheme.	
a. (i), (ii) and (iii)	b. (i) and (iii)
c. Only (iii)	d. Only (i)
Question No.5: _____ considers and uses downside deviation instead of total standard deviation in denominator	
a. Expense Ratio	b. Sharpe Ratio
c. Treynor Ratio	d. Sortino Ratio

Answer:

- | |
|---------------------------------|
| • Question No.1 – Rs.19.96 |
| • Question No.2 – 20,000 units |
| • Question No.3 – Rs.4,00,000 |
| • Question No.4 – (i) and (iii) |

Note:

- ICAI answer to this question is only (iii) – It is incorrect answer and hence has been rectified
- Expense ratio is the percentage of the assets that were spent to run a mutual fund and not the percentage of income.

- The Expense Ratio generally covers administrative fees, management fees, advertising, and operational costs like advisory fees, custodian fees, and legal expenses, but not the actual brokerage costs incurred during trading.
- Question No.5 – Sortino Ratio

Workings:

Opening NAV	$\frac{24.95}{125\%}$	Rs.19.96
No of units at beginning		X
Dividend per unit	$10 \times 9.98\%$	0.998
Amount of dividend	$0.998X$	$0.998X$
Dividend in units		$\frac{0.998X}{24.95}$
Closing units	Opening units + Dividend	20,800
Computation of opening units:	$X + \frac{0.998X}{24.95} = 20,800$ $X + 0.04X = 20,800$ $X = \frac{20,800}{1.04}$	20,000 units
Opening investment	$20,000 \times (19.96 + 0.04)$	Rs.4,00,000

Question No.14 [Nov 2024 MTP]

You as an investor had purchased a 4-month European Call Option on the equity shares of X Ltd. for Rs. 10, of which the current market price is Rs. 132 per share and the exercise price Rs. 150. You expect the price to range between Rs. 120 to Rs. 190. The expected share price of X Ltd. and related probability is given below:

Expected Price	120	140	160	180	190
Probability	0.05	0.20	0.50	0.10	0.15

Based on above case scenario answer the following questions:

Question No.1: Expected price of share of X Ltd. at the end of 4 months shall be	
a. Rs.160.00	b. Rs.160.50
c. Rs.158.00	d. Rs.140.00
Question No.2: Suppose if the exercise price prevails at the end of 4 months the Value of Call Option shall be	
a. Rs.0	b. Rs.18
c. Rs.10	d. Rs.14
Question No.3: In case the option is held to its maturity, the expected value of the call option shall be	
a. Rs.0	b. Rs.18
c. Rs.10	d. Rs.14
Question No.4: In the given different scenarios of expected prices of share of X Ltd. at the time of maturity the option shall be in-the-money in _____ scenarios	
a. Two	b. Three
c. Five	d. In none of the scenarios
Question No.5: In the given different scenarios of expected prices of share of X Ltd. at the time of maturity the option shall be at-the-money in scenarios	
a. Two	b. Three
c. Five	d. In none of the scenarios

Answer:

• Question No.1 – Rs.160.50
• Question No.2 – 0
• Question No.3 – Rs.14
• Question No.4 – Three
• Question No.5 – In none of the scenarios

Computation of expected share price and value of call option:

Expected Price	Probability	Product	Intrinsic value	Product
120	0.05	6.00	0.00	0.00

140	0.20	28.00	0.00	0.00
160	0.50	80.00	10.00	5.00
180	0.10	18.00	30.00	3.00
190	0.15	28.50	40.00	6.00
Expected value		160.50		14.00

- Expected share price at end of month 4 = Rs.160.50
- Expected value of call option at end of month 4 = Rs.14.00
- If the exercise price prevails on the maturity date then the share price will be equal to exercise price. If both are same, option will lapse and value of call option will be zero

Question No.15 [Nov 2024 MTP]

Suppose you are a risk manager at a financial institution, and your company has loaned a significant amount of Rs. 500 crore to a company X Ltd. for a period of 3 years at 6-month MCLR plus 200 bps. You are concerned about X Ltd.'s ability to repay the debt due to recent market volatility. To protect your institution from potential default, you decide to purchase a Credit Default Swap (CDS) from ABC Bank Ltd. for same notional amount at a premium quoted at 1% per year through cash settlement.

On the respective reset dates for the same period actual MCLR interest comes out as follows:

Reset	MCLR
1	9.75%
2	10.00%
3	10.25%
4	10.35%
5	10.50%
6	10.60%

Based on above case scenario answer the following questions:

Question No.1: The primary purpose of a Credit Default Swap (CDS) is	
a. to increase the value of bonds	b. to protect against default risk of a debt obligation
c. to provide guaranteed profit to the buyer	d. to create a new form of loan
Question No.2: Which of the following statements is true about CDS contracts?	
a. CDS contracts cannot be used for speculation	b. CDS contracts are governed by government regulations
c. CDS contracts are private agreements between two parties	d. CDS contracts eliminate all risks for the buyer
Question No.3: Which organization publishes the guidelines and rules for conducting Credit Default Swap transactions?	
a. Federal Reserve	b. International Swap and Derivative Association (ISDA)
c. Securities and Exchange Commission (SEC)	d. World Trade Organization (WTO)
Question No.4: Assuming no default occurs the total premium your company will pay during the designated loan period shall be	
a. Rs.5 Crores	b. Rs.10 Crores
c. Rs.15 Crores	d. Rs.30 Crores
Question No.5: Suppose if the lender defaults somewhere in the beginning of third year of loan (after payment of interest upto 2 years) and the market value of a reference loans falls to 75% of its par value, then ABC Bank will pay your company in a cash settlement	
a. Rs.15 Crores	b. Rs.30 Crores
c. Rs.125 Crores	d. Rs.500 Crores

Answer:

Question No.1	To Protect against default risk of a debt obligation
Question No.2	CDS contracts are private agreements between two parties
Question No.3	International Swap and Derivative Association (ISDA)
Question No.4	Rs.15 Crores [500 Crores x 1% x 3 Years]
Question No.5	Rs.125 Crores [500 Crores x 25% loss]

Note: Market value has fallen to 75% of par and hence the loss is 25% of loan

Question No.16 [Nov 2024 MTP]

XYZ Ltd. is a mid-sized manufacturing company that produces industrial equipment. The company is considering a new investment project—a state-of-the art automated production line, which is expected to improve production efficiency. The details of the same project are as follows:

Particulars	Amount
Initial Cost of the project	10,00,000
Sales price/unit	60
Cost/unit	40
Sales volumes	
Year 1	20,000 units
Year 2	30,000 units
Year 3	30,000 units

The applicable discount rate is 10% p.a. Based on above case scenario answer the following questions:

Question No.1: Sensitivity analysis helps to identify	
a. the exact profitability of the project	b. the break-even point
c. the degree to which a change in each variable affects the NPV	d. the amount of investment required
Question No.2: The sale price per unit so that the project would break even with zero NPV shall be approximately	
a. Rs.40.00	b. Rs.55.28
c. Rs.60.00	d. Rs.44.74
Question No.3: The cost per unit so that the project would break even with zero NPV shall be approximately	
a. Rs.40.00	b. Rs.55.28
c. Rs.60.00	d. Rs.44.74
Question No.4: Overall in the sale volume will lead to the project to break even with zero NPV	
a. Increase of 23.68%	b. Fall of 23.68%
c. Increase of 31.03%	d. Fall of 31.03%
Question No.5: A/an in the initial outlay will lead to the project to break even with zero NPV.	
a. Increase of 23.68%	b. Fall of 23.68%
c. Increase of 31.03%	d. Fall of 31.03%

Answer:

Question No.1	The degree to which a change in each variable affects the NPV
Question No.2	Rs.55.28 (WN 2)
Question No.3	Rs.44.74 (WN 2)
Question No.4	Fall of 23.68% (WN 2)
Question No.5	Increase of 31.03% (WN 2)

Note: Some rounding-off differences exist between the given option and the below answer and hence they have been rounded off to the closest answer.

Workings:**WN 1: Computation of base NPV:**

Year	Initial outlay	Sales	Costs	PVF @ 10%	PV of Plant	PV of Sales	PV of costs
0	-10,00,000	-	-	1.000	-10,00,000	-	-
1	0	12,00,000	-8,00,000	0.909	-	10,90,800	-7,27,200
2	0	18,00,000	-12,00,000	0.826	-	14,86,800	-9,91,200
3	0	18,00,000	-12,00,000	0.751	-	13,51,800	-9,91,200
Total					-10,00,000	39,29,400	-26,19,600

- NPV of project = -10,00,000 + 39,29,400 - 26,19,600 = Rs.3,09,800

WN 2: Sensitivity Analysis:**Selling price:**

- The project will have zero NPV if the present value of sales decline by Rs.3,09,800. This is because any decrease in selling price will negatively impact the NPV

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{3,09,800}{39,29,400} \times 100 = 7.88\%$$

- Selling price with zero NPV = 60 - 7.88% = Rs.55.27

Unit cost:

- The project will have zero NPV if the present value of cost increases by Rs.3,09,800. This is because any increase in cost will negatively impact the NPV

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{3,09,800}{26,19,600} \times 100 = 11.83\%$$

- Unit cost with zero NPV = 40 + 11.83% = Rs.44.73

Sales Volume:

- Any decrease in sales volume will also result in decrease in cost and hence net cash inflow (Sales - cost) needs to decline by Rs.3,09,800 for the project to have zero NPV.

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{3,09,800}{(39,29,400 - 26,19,600)} \times 100 = 23.65\%$$

Initial Outlay:

- The project will have zero NPV if the initial outflow increase by Rs.3,09,800

$$\text{Sensitivity \%} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{3,09,800}{10,00,000} \times 100 = 30.98\%$$

Question No.17 [Nov 2024 MTP]

You are an investment analyst working for a financial advisory firm. You have been asked to analyze the bond market's yield curve to assist your clients in making investment decisions. The yield curve represents the relationship between the interest rates (yield) and the time to maturity for debt securities, usually government bonds. For simplicity, assume the following yield data for government bonds over various maturities (measured in years):

Maturity (Years)	Yield (%)
1 Year	3.00%
2 Years	4.00%
3 Years	5.00%
5 Years	6.00%
7 Years	6.40%
10 Years	7.00%
15 Years	7.40%
30 Years	7.60%

Based on above case scenario answer the following questions:

Question No.1: The main characteristic of a normal yield curve is	
a. Short-term yields are higher than long-term yields	b. Short-term yields are lower than long-term yields
c. Yields remain the same across all maturities	d. Yields fluctuate randomly over different maturities
Question No.2: Based on the revised yield data, what is the yield spread between the 10year bond and the 1-year bond?	
a. 2.00%	b. 3.50%
c. 4.00%	d. 5.00%
Question No.3: An inverted yield curve typically indicates	

a. Economic Growth	b. Economic Uncertainty
c. An upcoming recession	d. Inflationary pressure
Question No.4: If an investor is looking to invest for 2 years starting 3 years from now, the forward rate he would expect shall be	
a. 7.41%	b. 7.52%
c. 7.76%	d. 7.93%
Question No.5: If an investor is looking to invest for 2 years starting 5 years from now, the forward rate he would expect shall be	
a. 7.41%	b. 7.52%
c. 7.76%	d. 7.93%

Answer:

1	Short-term yields are lower than long-term yield Note: In a normal yield curve long-term interest rates are higher than short-term interest rates and hence the correct answer is short-term yields are lower than long-term yield
2	4% (10 years yield of 7% - 1 year yield of 3%)
3	An upcoming recession Note: - An inverted yield curve occurs when long-term interest rates fall below short-term interest rates - It signals that investors expect economic growth to slow down, leading them to seek safety in long-term bonds, driving down long-term yields. - Historically, an inverted yield curve has preceded many recessions as it reflects pessimistic economic expectations
4	7.52% Note: Investment for 2 years starting 3 years from now is basically FRA 3 x 5 $FRA_{3 \times 5} = \frac{\text{FVF for 5 years}}{\text{FVF for 3 years}} - 1 = \frac{(1 + 6.00\%)^5}{(1 + 5.00\%)^3} - 1 = 15.60\% \text{ for 2 years}$ Effective rate of 2 years = $(1 + r)^2 - 1$; $0.1560 = (1 + r)^2 - 1$; $(1 + r)^2 = 1.1560$; $r = 7.52\%$
5	7.52% Note: Investment for 2 years starting 5 years from now is basically FRA 5 x 7 $FRA_{5 \times 7} = \frac{\text{FVF for 7 years}}{\text{FVF for 5 years}} - 1 = \frac{(1 + 6.40\%)^7}{(1 + 6.00\%)^5} - 1 = 15.36\% \text{ for 2 years}$ Effective rate of 2 years = $(1 + r)^2 - 1$; $0.1536 = (1 + r)^2 - 1$; $(1 + r)^2 = 1.1536$; $r = 7.41\%$