

Chapter

13

ADVANCED CAPITAL BUDGETING DECISIONS

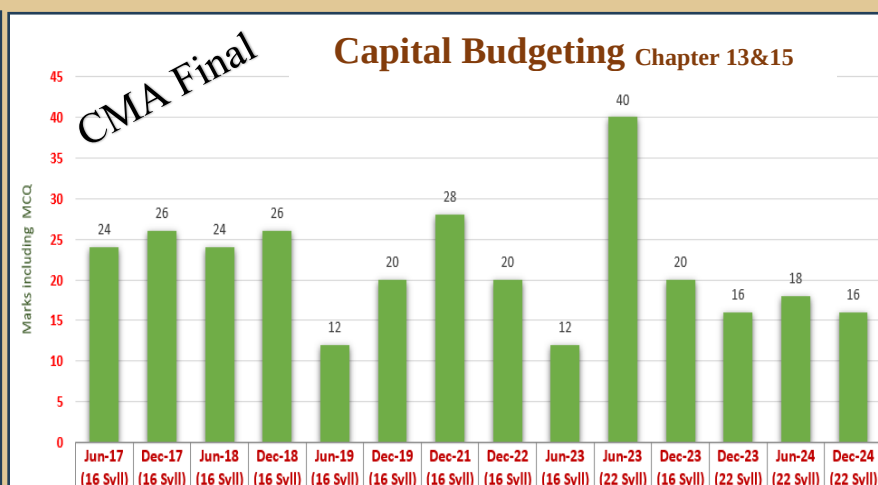
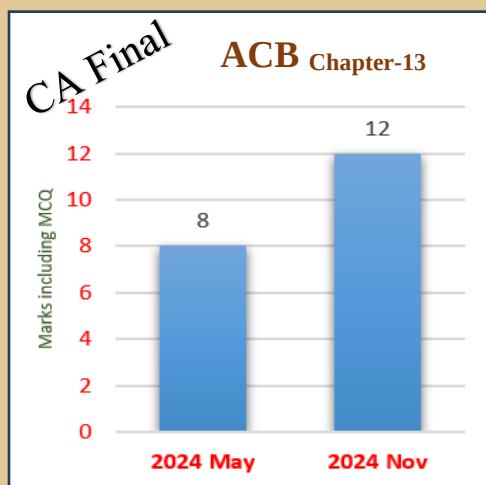


EVALUATION OF RISKY PROPOSALS FOR INVESTMENT DECISIONS (CMA)

LEARNING OUTCOMES

After going through the chapter student shall be able to understand

- ☐ Current trends in Capital Budgeting
- ☐ Dealing with Risk in Investment Decisions
- ☐ Internal and External Factors affecting capital budgeting decision
- ☐ Methods of incorporating risk in Capital Budgeting
- ☐ Adjusted Present Value
- ☐ Optimum Replacement Cycle



BASIC CONCEPT OF CAPITAL BUDGETING

Question No. - 0A [\[N24-8M\]](#)

PQ Ltd. expects sales of ₹ 100 lakhs in the year 1. The same will increase by ₹ 20 lakhs per year over the next four years. At the end of 5 years the project would be wound up. The Depreciation will be charged at 20% p.a. on straight line method. The expenses excluding the depreciation will be 40% of the sales. There will be no salvage value of the plant. PQ Ltd. proposes to invest in the plant an amount where the Net Present Value will be Zero.

Corporate Tax rate is 30%.

You are required to calculate the investment which can be made in the plant.

IMPACT OF INFLATION ON CAPITAL BUDGETING

Question No. - 1A [\[SM-2023\]](#)

A certain project is expected to generate year end annual net cash inflows of ₹5,00,000 for four years. The cost of capital (real discount rate is 10%). Inflation rate is 5% p.a.

- What are the nominal cash flows and real cash flows of the second year's inflows which occur at the end of year 2?
- What is the present value of the inflow of the second year that you would use in determining the NPV of the project?

(You are not required to calculate the values. You are only required to substitute the values in appropriate formulae for the answers).

[\[CMA-June-2018-4M\]](#)

Ans: (i) 5,00,000/(1.05) (ii) Nominal: 5,00,000/1.155; Real: 5,00,000/1.05 ÷ 1.1

Question No. - 1B [\[SM-2023\]](#) [\[Nov-2019-Old-8M\]](#)

Determine NPV of the project with the following information:

Initial Outlay of project	₹40,000
Annual revenues (Without inflation)	₹30,000
Annual costs excluding depreciation (Without inflation)	₹10,000
Useful life	4 Years
Salvage value	Nil
Tax Rate	50%
Cost of Capital (Including inflation premium of 10%)	12%

Ans: NPV = ₹17369 [SM]; Correct NPV =

Question No. - 1C [\[SM-2023\]](#) [\[Nov-2016-Old-8M\]](#) [\[Nov-2020-Old-8M\]](#)

XYZ Ltd. requires ₹8,00,000 for an Unit.

Useful life of project is 4 years.

Salvage value - NIL.

Depreciation charge ₹ 2,00,000 p.a.

Expected revenues and costs (excluding depreciation) ignoring inflation:

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

Tax rate is 60%.

Cost of capital 10% (Including inflation premium)

Calculate NPV of the project if inflation rate for revenues and costs are as follows:

Year	Revenues	Costs
1	10%	12%
2	9%	10%
3	8%	9%
4	7%	8%

Ans: ₹106,738

Question No.-1D

A Ltd company has undertaken market research at a cost of ₹ 4 Lakhs in order to forecast the future cash Flows of an Investment Project with an expected life of four years as follows:

Year	1	2	3	4
Sales Revenue	₹ 25,00,000	₹ 51,40,000	₹ 1,37,80,000	₹ 9,06,000
Costs	₹ 10,00,000	₹ 20,00,000	₹ 50,00,000	₹ 35,00,000

These forecast cash flows are before considering inflation of 4.7% p.a. The Capital cost of the project, payable at the start of first year will be ₹ 40 Lakhs. The Investment Project will have zero scrap value at the end of the fourth year. The level of working capital investment at the start of each year is expected to be 10% of the sales revenue in that year.

Capital allowances would be available on the Capital Cost of the investment Project on a 25 % reducing balances basis. A Ltd. pays tax on Profit at an annual rate of 30% per year with tax being paid one year in arrears.

A Ltd. has a nominal (money terms) after tax Cost of Capital of 12% per year.

Discount Factor at 12% is as under:

Year	1	3	3	4	5
Discount Factor	0.893	0.797	0.712	0.636	0.567

Calculate the net present value of the Investment Project in nominal terms and comment on its financial acceptability.

[\[CMA-June-2015-10M\]](#)

Ans: ₹2,873.58

✂ TEST YOUR KNOWLEDGE

Question No. -1.1 [\[SM-2023\]](#) [\[May-2005-old-8 Marks\]](#) [\[RTP-May-2013\]](#) [\[MTP-Nov-2020\]](#)

A firm has projected the following cash flows from a project under evaluation:

Year	₹ lakhs
0	(70)
1	30
2	40
3	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%.

Show how the viability of the project is to be evaluated.

Requirement in [\[CMA-PTP-Dec-2014-8M\]](#) / [\[CMA-PTP-June-2015-New-8M\]](#)

Show how the viability of the project is to be evaluated using both nominal rate of discount and real rate of discount.

Ans: NPV = 5.45 Lakh. (You may calculate either adjusting cash flows or rate, Answer will become same)

Question No. - 1.2

A company is considering a cost saving project. This involves purchasing a machine costing ₹ 7,000, which will result in annual savings on wage costs of ₹ 1,000 and on material costs of ₹ 400.

The following forecasts are made of the rates of inflation each year for the next 5 years:

Wages costs 10%, Material costs 5%, General prices 6%

The cost of capital of the company, in monetary terms, is 15%.

Evaluate the project, assuming that the machine has a life of 5 years and no scrap value.

[\[CMA-SM22\]](#) [\[CMA-WB-2018\]](#)

Ans: (-) ₹1,067



CONVENTIONAL TECHNIQUES OF RISK ANALYSIS

CERTAINTY EQUIVALENT APPROACH & RADR

Question No. - 2A [\[Nov-1999-old- 6 Marks\]](#)

The Globe Manufacturing Company Ltd. is considering an investment in one of the two mutually exclusive proposals – Projects X and Y, which require cash outlays of ₹ 3,40,000 and ₹ 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 riskless rate. The expected net cash flows and their certainty-equivalents are as follows:

Year-end	Project Y		Project X	
	Cash flow	C.E.	Cash flow	C.E.
	₹		₹	
1	1,80,000	.8	1,80,000	.9
2	2,00,000	.7	1,80,000	.8
3	2,00,000	.5	2,00,000	.7

Present value factors of Re. 1 discounted at 8% at the end of year 1, 2 and 3 are .926, .857 and .794 respectively.

Required:

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



[\[CMA-MTP-J23-10M\]](#) [\[CMA-SM22\]](#) [\[CMA-Compendium\]](#)

Ans: (i) NPV: X = 44580, Y = 27.24; Accept-X

(ii) Project Y should be analysed with higher rate because project Y is more risky.

↓

Question No. - 2B [\[SM-2023\]](#) [\[May-1999-Old-6M\]](#) [\[As Nov-2005-Old-6 Marks\]](#) [\[CS-June-2005-10M\]](#)

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

	A	B	C
Net cash outlays (₹)	1,00,000	1,20,000	2,10,000
Project life	5 years	5 years	5 years
Annual cash inflow (₹)	30,000	42,000	70,000
Coefficient of variation	0.4	0.8	1.2

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

Coefficient of variation	Risk adjusted rate of discount	Present value factor 1 to 5 years at risk adjusted rate of discount
0.0	10%	3.791
0.4	12%	3.605
0.8	14%	3.433
1.2	16%	3.274
1.6	18%	3.127
2.0	22%	2.864
More than 2.0	25%	2.689

[\[CMA-MTP-D23-6M\]](#) [\[CMA-SM22\]](#) [\[CMA-WB-2018\]](#)

Ans: Risk Adjusted NPV: A = ₹8,150; B = ₹24,186; C = ₹19,180

Question No. - 2C [\[SM-2023\]](#) [\[May-2016-10M\]](#) [\[Nov-2009-old-10 Marks\]](#)

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

	P-I	P-II	P-III
Cost	15,00,000	11,00,000	19,00,000
Inflows - Year 1	6,00,000	6,00,000	4,00,000
Year 2	6,00,000	4,00,000	6,00,000
Year 3	6,00,000	5,00,000	8,00,000
Year 4	6,00,000	2,00,000	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 risk adjusted discount rate (RADR) for these projects.
- Which project is best?

Ans: RADR: P-I = 19%; P-II = 15%; P-III = 13%; (ii) NPV: P-I = 83151; P-II = 167800; P-III = 213800

Hint: Use RADR = Risk free rate + Risk index × (K_e - R_f)

Question No. – 2D [July-2021-5M]

M/s. SKPD Ltd. employs certainty-equivalent approach in the evaluation of risky investments. The finance department of the company has developed the following information regarding a new project:

Year	Expected CFAT (₹)	Certainty equivalent quotient
(Initial Outlays)	300,000	1.0
1	140,000	0.8
2	130,000	0.7
3	120,000	0.6
4	115,000	0.4
5	80,000	0.3

Following is the other information:

- The firm's cost of equity capital is 18%;
- Cost of debt is 9%;
- Present risk free rate of interest in the Market on the treasury bonds is 6%, which will rise by 200 basis points from 4th year onwards.

Year (t)	1	2	3	4	5
PVIF (6%, t)	0.943	0.890	0.840	0.792	0.747
PVIF (8%, t)	0.926	0.857	0.794	0.735	0.681

You are required to:

- To find out the viability of the project; and
- To advise on the popularity of this method.

Ans: (i) NPV = - 2,760; Do not accept;

(ii) In Certainty Equivalent approach, we incorporate risk to proposal so as to reflect the risk element and also adjust future cash flows rather than discount rates. But the procedure for reducing the forecasts of cash flows is implicit and likely to be inconsistent from one investment to another. Therefore, it is not popular.

TEST YOUR KNOWLEDGE

Question No. – 2.1 [SM-2023] [MTP-M24-8M] [Nov-2003-Old-12 Marks]

The Textile Manufacturing Company Ltd. is considering one of two mutually exclusive proposals, Projects M and N, which require cash outlays of ₹ 8,50,000 and ₹ 8,25,000 respectively. The certainty-equivalent (C.E) approach is used in incorporating risk in capital budgeting decisions. The current yield on government bonds is 6% and this is used as the risk-free rate. The expected net cash flows and their certainty equivalents are as follows:

Year-end	Project M		Project N	
	Cash Flow ₹	C.E.	Cash Flow ₹	C.E.
1	4,50,000	0.8	4,50,000	0.9
2	5,00,000	0.7	4,50,000	0.8
3	5,00,000	0.5	5,00,000	0.7

Present value factors of Re. 1 discounted at 6% at the end of year 1, 2 and 3 are 0.943, 0.890 and 0.840 respectively.

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?

Ans: (i) NPV: M = 10,980; N = 1,71,315; Accept project – N;
(ii) Project M should be appraised with a higher rate as it is more-risky.

Question No. - 2.2

VATSAN LTD. is considering a project with the following expected cash flows:

Initial investment: ₹1,00,000

Year	1	2	3
Expected Cash Inflows	70,000	60,000	45,000

Due to uncertainty of future cash flows, the management decides to reduce the cash inflows to certainty equivalent (CE) by taking only 80% for 1st year, 70% for 2nd year and 60% for 3rd year respectively.

The cost of capital is 10%. Required: Is it worthwhile to take up the project?

[\[CMA-Dec-2013-5 Marks\]](#) [\[CMA-Dec-2009-5 Marks\]](#) [\[CMA-MTP-June-2014-New-5M\]](#)

Ans: ₹5873

Question No. - 2.3

JASPAL Ltd. is currently considering two mutually exclusive projects, A and B. The following are some of the information concerning the two projects:

Year	Project A	Project B
Initial investment	₹ 15,000	₹ 20,000
Project life	3 years	3 years
Annual cash inflow	₹ 7,000	₹ 10,000
Risk index	0.4	1.8

In addition, the firm uses two different techniques to adjust for the different risk levels of projects: certainty equivalent factors and risk adjusted discount rate. Additional information is provided below:

Certainty equivalent factors		
Year	Project A	Project B
0	100	100
1	0.95	0.90
2	0.90	0.85
3	0.90	0.70

Risk index	RADR (%)	Risk index	RADR (%)
0.0	7.0	1.0	12.0
0.2	8.0	1.2	13.0
0.4	9.0	1.4	14.0
0.6	10.0	1.6	15.0
0.8	11.0	1.8	16.0

The company's cost of capital is 10%.

- Calculate the NPV of Project A and Project B at 10% discount rate.
- Determine the NPV of Project A and Project B using certainty equivalent (CE) to account for Risk.
- Determine the NPV of Project A and Project B using Risk Adjusted Discount Rate (RADR) to account for Risk.
- Compare and explain your findings in (i), (ii) and (iii)

[\[CMA-Dec-2019-10M\]](#)

Question No. - 2.4 [RTP-Nov-2020]

Airborne Ltd. wants to take advantage of a new government scheme of connecting smaller towns and wants to purchase one-turboprop airplane at a cost of ₹ 5 crores. It has obtained permission to fly on 4 sectors.

The company had provided the following estimates of its costs and revenues. The cost of capital is 16% and the company depreciates its assets over a period of 25 years on a straight-line basis. Currently it is operating in a 30% tax regime and under the new government scheme it enjoys a 100% tax waiver for the first 3 years.

- Passenger Capacity of the aircraft: 60 passengers
- Expected Operational Capacity: 80%
- Per aircraft no. of trips on a daily basis: 4

	Amount in (₹)
Average realization per passenger	2,000
Annual Cost of Manpower	2,50,00,000
Airport handling charges - Fixed per day	10,000
Annual Repairs and Maintenance	5,00,00,000
Daily Operating Costs	75,000

The costs with the exception of Airport handling charges are expected to increase 10% year on year and the Operational Capacity would go up to 90% from Year 3.

The certainty of achieving the projected cash flows in the first five years are 0.8, 0.9, 0.75, 0.7 and 0.7 and PV at 16% are 0.862, 0.743, 0.641, 0.552, 0.476 respectively.

Advise the management on the feasibility of the project, assuming the aircraft operates on all the 365 days in a year.

[Ans: NPV=₹1,02,21,515]

★ STATISTICAL TECHNIQUES OF RISK ANALYSIS

EXPECTED NPV, VARIANCE, SD & CV

Question No. - 3A [SM-2023] [June-2009-old-14 Marks] [May-1999-14 Marks] [Study Mat.]

A company is considering two mutually exclusive projects X and Y. Project X costs ₹30,000 and Project Y ₹36,000. You have been given below the net present value, probability distribution for each project:

Project X		Project Y	
NPV Estimate	Probability	NPV Estimate	Probability
₹		₹	
3,000	0.1	3,000	0.2
6,000	0.4	6,000	0.3
12,000	0.4	12,000	0.3
15,000	0.1	15,000	0.2

- Compute the expected net present value of Projects X and Y.
- Compute the risk attached to each project i.e., Standard Deviation of each probability distribution.
- Which project do you consider riskier and why?
- Compute the profitability index of each project.

[CMA-MTP-J24-7M] [CMA-D23-8M] [CMA-SM22/WB] [CMA-D03-20M] [CMA-Compendium]
[CMA-June-2014-10M] [CMA-RTP-Dec-2014]

Ans: (i) Expected NPV (X) = 9,000; Y = 9,000 (ii) $\sigma_x = 3795$; $\sigma_y = 4,450$; (iii) Project Y is more risky.
(iv) PI: X = 1.30; Y = 1.25

Question No. - 3B [\[SM-2023\]](#) [\[Nov-2006-old-16 Marks\]](#)

Following are the estimates of the net cash flows and probability of a new project of M/s X Ltd.:

	Year	P=0.3	P=0.5	P=0.2
Initial investment	0	4,00,000	4,00,000	4,00,000
Estimated net after tax cash 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 (a) perfectly dependent overtime; (b) 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 X Ltd. 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 X Ltd?

[\[CMA-TP-Dec-2013-20M\]](#)

Ans: (i) Expected NPV = 39,813; (ii) Best NPV = 92,060; Worst NPV = - 8,580; (iii) 0.3; (0.3)⁵ (iv) 35,800; CV = 0.90; (v) Expected NPV = 51,851.

Question No. - 3C [\[SM-2023\]](#) [\[May-2003-3M\]](#)

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 coefficient of variation as a measure of risk.
- Which measure is more appropriate in this situation and why?

[\[CMA-SM22\]](#) [\[Point \(ii\)-CMA-PTP-June-2015-2M\]](#) [\[CMA-PTP-Dec-2014-2M\]](#)

Question No. - 3D [\[SM-2023\]](#) [\[MTP-N24-6M\]](#) [\[May-2018-5M\]](#)

KLM Ltd., is considering taking up one of the two projects-Project-K and Project-So Both the projects having same life require equal investment of ₹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 ₹)	Probability	Cash Flow (in ₹)	Probability
11	0.10	09	0.10
13	0.20	13	0.25
15	0.40	17	0.30
17	0.20	21	0.25
19	0.10	25	0.10

Required:

- (i) Calculate variance, standard deviation and co-efficient of variance for both the projects.
 (ii) Which of the two projects is More-risky?

Ans: Project K: Var = 4.8; SD = 2.19; CV = 0.146; Project S: Var = 20.8; SD = 4.56; CV = 0.268

TEST YOUR KNOWLEDGE

Question No. – 3.1 [\[SM-2023\]](#) [\[Nov-2002-14M\]](#) [\[As Nov-2010-12M\]](#) [\[As May-2013-8M\]](#) [\[RTP-May-2020/21\]](#) [\[MTP-May-2019-8M\]](#)

Skylark Airways is planning to acquire a light commercial aircraft for flying class clients at an investment of ₹ 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 factors relating to an airline operation. The company wants to know:

- (i) The expected NPV of this venture assuming independent probability distribution with 6 per cent risk free rate of interest.
 (ii) The possible deviation in the expected value.

[\[CMA-SM22\]](#) [\[CMA-PTP-June-2014/2015-10M\]](#) [\[CMA-RTP-Dec-2014\]](#) [\[CMA-PTP-Dec-2014-10M\]](#)

Ans: (i) NPV = 24.974 (ii) $\sigma_{\text{Project (Cash flows)}}$ = 14.3695

Question No. – 3.2 [\[SM-2023\]](#) [\[May-2003-3M\]](#)

Cyber Company is considering two mutually exclusive projects. Investment outlay of both the projects is ₹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:

Cash Flow (₹)			
Situation	Probabilities	Project A	Project B
Good	0.3	6,00,000	5,00,000
Normal	0.4	4,00,000	4,00,000
Worse	0.3	2,00,000	3,00,000

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

[\[CMA-SM22\]](#) [\[CMA-MTP-D24-7M\]](#) [\[CMA-MTP-June-2014-5M\]](#)

Question No. – 3.3

The following information is given in respect of two projects X and Y:

	X		Y	
Initial outlay at the beginning of the first year	6000		5000	
After Tax year end cash inflows with probabilities:	Cash inflow	Probability	Cash inflow	Probability
Year 1	2000	0.4	800	0.2
	3000	0.6	2000	0.8
Year 2	4000	0.3	2000	0.4
	2000	0.7	1000	0.6
Year 3	3000	0.5	2025	0.2
	2200	0.5	4000	0.8

The risk-free discount rate is 10% and the risk adjusted discount rate is 14.13%.

Assume that cash flows are independent from year to year.

It is given that the annual standard deviation of cash inflows for X are 490, 916.5 and 400 and for Y are 480, 490 and 790.

- Find the NPVs for both the projects and based on this, which would you choose?
- Which project would you prefer in terms of risk? Why?

[CMA-Dec-2017-8M]

Ans: NPV of both: 463.6; SD (X): 928.1291; SD (Y): 840.2684

Question No. – 3.4 [SM-2023] [May-2005-12M]

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

Project X: Investment (year 0) ₹ 70 lakhs

Probability weights	0.30	0.40	0.30
Years	₹ lakhs	₹ lakhs	₹ lakhs
1	30	50	65
2	30	40	55
3	30	40	45

Project Y: Investment (year 0) ₹ 80 lakhs.

Probability weighted	Annual cash flows through life
	₹ lakhs
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.

Ans: (a) NPV: X = 37.28; Y = 33.11; (b)

Question No.- 3.5 [\[SM-2023\]](#) [\[MTP-May-2014-10M\]](#)

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

Annual cash inflow (₹)	20,000	30,000	40,000
Probability	0.1	0.7	0.2

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

Question No.- 3.6

The following table presents the proposed cash flows for projects M and N with their associated probabilities. Which project has a higher preference for acceptance?

Possibilities	Project-M		Project-N	
	Cash flow (₹ lakhs)	Probability (₹ lakhs)	Cash flow (₹ lakhs)	Probability (₹ lakhs)
1	21,000	0.10	36,000	0.10
2	24,000	0.20	24,000	0.10
3	27,000	0.30	18,000	0.10
4	30,000	0.20	12,000	0.20
5	33,000	0.20	6,000	0.50

[\[CMA-MTP-Dec-2019-8M\]](#)**PROBABILITY OF RANGE OF NPV****Question No.-4A**

A project has a mean NPV of ₹ 40 and standard deviation of NPV is 20. The finance manager wants to determine the probability of the NPV under the following ranges:

- Zero or less
- Greater than zero
- Between the range of ₹ 25 and ₹ 45

[\[CMA-SM\]](#)**Question No. – 4B**

Diamond industries is considering investment in specialized moulds which cost ₹1.00 lakh, with a life of 2 Years, after which there is no expected value. The possible incremental cash flows (Post tax are

Year 1		Year 2	
Cash flows	Probability	Cash flows	Probability
60,000	0.2	50,000	0.2
70,000	0.5	60,000	0.5
80,000	0.3	70,000	0.3

The risk - free rate of return required by the company is 10%.

Required:

- Assume that the cash flows are perfectly correlated. Calculate the net present value and the standard deviation of the net present. What is the probability of the investment providing a negative NPV?
- Recalculate standard deviation if the cash flows were independent. What would be the probability of the NPV being negative?

[\[CMA-SM22\]](#)

Ans: (a) NPV=14925; SD = 12145; Prob = 10.93%; (b) SD = 8597.63; Prob = 4.09%.

✂ TEST YOUR KNOWLEDGE

Question No. - 4.1

The project has a mean NPV of ₹800, S.D. of ₹400. The management wants to determine the probability of the NPV under the following ranges.

- Zero or less
- Greater than zero
- Between the range of ₹500 and ₹900
- Between the range of ₹300 and ₹600

[CMA-SM22]

Question No. - 4.2

The project involves an initial cash outlay of ₹20,000. The mean or expected value and standard deviation of the cash-flows are as follows:

Year	1	2	3	4
Exp. Cashflow (₹)	10,000	6,000	8,000	6,000
S.D of Cashflow (₹)	3,000	2,000	4,000	1,200

Risk free rate of interest is 6%.

- Calculate the expected NPV and S.D of NPV assuming that the cashflows are perfectly correlated.
- Calculate the expected NPV and S.D of NPV assuming that the cashflows are uncorrelated.

[CMA-MTP-J23-12M]

Ans: Variance of the Project =18,510
probability that the project will be successful is 92.92%.

Question No. - 4.3

M Ltd. is attempting to decide whether or not to invest in a project that requires an initial outlay of ₹ 4 lakhs. The cash flows of the project are known to be made up of two parts, one of which varies independently over time and the other one which display perfect positive correlation. The cash flows of the six-year life of the project are

Year	Perfectly Correlated Components		Independent Component	
	Mean	Standard Deviation	Mean	Standard Deviation
1	40,000	4,400	42000	4000
2	50,000	4,500	50000	4400
3	48,000	3,000	50000	4800
4	48,000	3,200	50000	4000
5	55,000	4,000	52000	4000
6	60,000	4,000	52000	3600

- Find out the expected value of the NPV and its standard deviation, using a discount rate of 10%
- Also find the probability that the project will be successful, i.e. $P(NPV > 0)$ and state the assumptions under which this probability can be determined.

[CMA-SM22]

Ans: Variance of the Project =18,510; Probability that the project will be successful is 92.92%.

CAPITAL BUDGETING BASED ON UTILITIES

Question No.-5A [\[SM-2023\]](#) [\[RTP-N24\]](#) [\[May-2011-8 Marks\]](#) [\[MTP-II-Nov-2021-8M\]](#)

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

Cash Flows in ₹	-15,000	-10,000	-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 (₹)	-15,000	-10,000	15,000	10,000	5,000
Probability	0.10	0.20	0.40	0.20	0.10

Project B

Cash flow (₹)	-10,000	-4,000	15,000	5,000	10,000
Probability	0.10	0.15	0.40	0.25	0.10

Which project should be selected and why?

Ans: Project B would be selected [Expected utilities A = 2; Expected utilities B = 17.55]

Question No.- 5B [\[Read with Portfolio Concept\]](#)

ABC Ltd., is a consumer goods company which earns expected return of 14% on its existing operations subject to standard deviation of 20%. The company is owned by a family and the family has no other investment. New project is under consideration and the new project is expected to give a return of 18% subject to standard deviation of 32%. The new project has a correlation of 0.25 with ABC's existing operations.

The new project is likely to account for 25% of ABC's operations. ABC is identified a utility function to apprise risky project. The function is as under: -

Shareholder's utility = $100R - \sigma^2$; Where, R = Expected Return (in %); σ = Standard deviation of return (in %)

The project can be accepted only if total utility goes up. Evaluate the project.

[\[CMA-MTP-June-2014-6M\]](#)

Ans: Shareholders utility without the project = $(100 \times 14) - 20^2 = 1000$ units
Shareholders utility with the project = $(100 \times 13) - (18.68)^2 = 1151$ units
Hence, Project will be accepted as it will increase the Utility.

DECISION TREE APPROACH

Question No. - 6A [\[SM-2023\]](#) [\[Nov-1999-14 Marks\]](#) [\[As May-2004-16 Marks\]](#) [\[MTP-Nov-2013-8M\]](#)

A firm has an investment proposal, requiring an outlay of ₹ 40,000. The investment proposal is expected to have 2 years' economic life with no salvage value. In year 1, there is a 0.4 probability that cash inflow after tax will be ₹ 25,000 and 0.6 probability that cash inflow after tax will be ₹ 30,000. The probabilities assigned to cash inflows after tax for the year II are as follows:

The Cash inflow year I	₹ 25,000	₹ 30,000
The Cash inflow year II	Probability	Probability
₹ 12,000	0.2	₹ 20,000 0.4
₹ 16,000	0.3	₹ 25,000 0.5
₹ 22,000	0.5	₹ 30,000 0.1

The firm uses a 10% discount rate for this type of investment.

SENSITIVITY ANALYSIS / WHAT IF ANALYSIS

Question No. - 7A [\[SM-2023\]](#) [\[RTP-M24\]](#)

X Ltd. is considering its new project with the following details:

Sr. No.	Particulars	Figures
1	Initial capital cost	₹ 400 Cr
2	Annual unit sales	5 Cr
3	Selling price per unit	₹ 100
4	Variable cost per unit	₹ 50
5	Fixed costs per year	₹ 50 Cr
6	Discount Rate	6%

Required:

- (1) Calculate the NPV of the project.
- (2) Compute the impact on the project's NPV considering a 2.5 per cent adverse variance in each variable.
Which variable is having maximum effect?

Consider Life of the project as 3 years.

Ans: Change in NPV: IC= -7.43%; AUS= -12.41%; SP = -24.82%; VC=-12.41%; FC = -2.48%

Question No. - 7B [\[SM-2023\]](#) [\[Nov-2009-10M\]](#) [\[MTP-May-2020-5M\]](#)

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

Initial project cost	₹ 120,000
Annual cash inflow	₹ 45,000
Project Life	4 Years
Cost of capital	10%

To which of the three factors, the project is most sensitive?

(Use annuity factors for 10% = 3.169 and 11% = 3.102)

[\[CMA-Dec-2021-10M\]](#)

Ans: NPV = 22605; (ii) Sensitivity, Cost = 53.08%; CIF = 63.08%, CC = 13.34%

Question No. - 7C [\[SM-2023\]](#) [\[MTP-N24-10M-MCQ\]](#) [\[May-2008-16M\]](#)

XYZ Ltd. is considering a project for which the following estimates are available:

	₹
Initial Cost of the project	10,00,000
Sales price/unit	60
Cost/unit	40
Sales volumes	
Year 1	20000 units
Year 2	30000 units
Year 3	30000 units

Discount rate 10% p.a.

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

- | | |
|-----------------------|------------------------|
| (a) Sales Price/unit; | (b) Unit cost |
| (c) Sales volume; | (d) Initial outlay and |
| (e) Project lifetime | |

Taxation may be ignored.

Question No.- 7D [\[SM-2023\]](#) [\[Nov-2013-8M\]](#)

The Easygoing Company Ltd. 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 ₹ 60/- per unit; Annual cash flow ₹ 57500/-

Ignore depreciation on initial investment and impact of taxation.

Calculate:

- (i) Initial investment of the project;
- (ii) Net present value of the project
- (iii) Annual fixed cost
- (iv) Estimated annual unit of sales
- (v) 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

[\[CMA-June-2019-8M\]](#)

✂ TEST YOUR KNOWLEDGE

Question No. - 7.1

From the following project details calculate the sensitivity of the:

- (a) Project cost, (b) Annual cash flow, and (c) Cost of capital.

Which variable is the most sensitive?

Project cost ₹12,000 Annual cash flow ₹ 4,500

Life of the project 4 years Cost of capital 14%

The annuity factor at 14% for 4 years is 2.9137 and at 18% for 4 years is 2.6667.

[\[CMA-SM22\]](#)

Question No. - 7.2

From the following project details, calculate the sensitivity of the

- (i) Project cost
- (ii) Cash inflows
- (iii) Which variable is more sensitive ?

Project cost	₹ 12,000
Life of the project	4 years
Salvage value	Nil
Cost of capital	14%

Cash inflows after tax :

end of year 1: Rs. 5,000

end of year 2: Rs. 5,000

end of year 3: 10% increase over year 1 inflow

end of year 4: 10% increase over year 1 inflow

- (iv) Would you conclude that cost of capital is more sensitive than (i) or (ii) above?

[\[CMA-Dec-2018-New-8M\]](#)

Question No. - 7.3 [\[SM-2023\]](#) [\[MTP-M24-8M\]](#)

Red Ltd. Is considering a project with the following cash flows (in ₹)

Years	Cost of plant	Recurring cost	Savings
0	10000		
1		4000	12000
2		5000	14000

The cost of capital is 9% Measure the sensitivity of the project to changes in the levels of plant value, running cost and savings (considering each factor at a time) such that NPV becomes Zero. The P.V. factor at 9% are as under:

Years	0	1	2
Factor	1	0.917	0.842

Which factor is the most sensitivity to affect the acceptability of the project?

[\[CMA-TP-Dec-2013-10M\]](#)

Question No. - 7.4 [\[SM-2023\]](#) [\[RTP-May-2014\]](#)

Unnat Ltd. is considering investing ₹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 ₹ 30.00 per unit. It is expected that the variable costs to be 16.50 per unit and fixed costs to be ₹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 that 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.

Ans: Sensitivity (Change in factor where NPV will be Zero) (i) 5.23%; (ii) 11.59%; (iii) 9.51%;

Expected NPV = 885163; Worst NPV = -88188; Best NPV = 2345188;

There are 30% chance that NPV will be negative and 70% chance that NPV will be positive since acceptable level of risk is 20% and there are 30% chance of -ve NPV. Hence project should not be accepted

Question No. - 7.5 [\[RTP-May-2021\]](#)

LX Ltd. is manufacturing cosmetic products. The company received a proposal from a cosmetic making machine supplier based in France for supplying an improved/ more efficient version of machine currently it is using. Hence, LX Ltd. is considering the replacement of its existing machine with a new machine. The Purchase price of the New machine is € 6 Million, and its expected Life is 8 years. The company follows straight-line method of depreciation on the original investment (scrap value is not to be considered for the purpose of depreciation).

The other expenses to be incurred for the New Machine are as under:

- One-time fees paid to the consultant for his advice to buy New Machine ₹12,00,000.

(ii) Additional Working Capital required ₹34,00,000. (will be released after 8 years).

(iii) Installation Charges ₹18,00,000.

The written down value of the existing machine is ₹1,52,00,000, and its Cash Salvage Value is ₹25,00,000. The dismantling of this machine would cost ₹9,00,000. The Annual Savings (before depreciation) from the New Machine would amount to ₹12,83,75,000. Income tax rate is 35%. The following additional information is also available:

Spot Exchange Rate 1€ = ₹ 90.00

Company's Required Rate of Return 13%

Tax Rate for STCG/ STCL 25%

You are required to advise on the viability of the proposal.

Also determine the sensitivity of Foreign Exchange Rate of € assuming fees paid to consultant as sunk cost.

SCENARIO ANALYSIS

Question No. - 8A [SM-2023]

XYZ Ltd. is considering a project "A" with an initial outlay of ₹14,00,000 and the possible three cash inflow attached with the project 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 in first two years but uncertain about the third year's cash flow, analyze what will be the NPV expecting worst scenario in the third year.

Ans: NPV: W = -110.15; M = 100.85; B = 311.85; NPV in expected scenario = ₹ 23,871

Question No.- 8B

A manager is trying to decide which of the three mutually exclusive projects to undertake. Each of the projects could lead to varying net profits which are classified as outcomes I, II and III. The manager has constructed the following pay-off table or matrix (a conditional profit table).

Net profit if outcome turns out to be:

Outcomes		Project		
(Net Profit)	Probability	A	B	C
I (Worst)	0.2	50,000	70,000	90,000
II (Most likely)	0.5	85,000	75,000	1,00,000
III (Best)	0.3	1,30,000	1,40,000	1,10,000

Which project should be undertaken? Which project is profitable, if minimax regret rule is applicable?

[CMA-SM22] [CMA-D23-7M] [CMA-MTP-J23-4M]

Question No.- 8C [MTP-N24-8M]

The ABC Startup has the following expected profits under different scenarios along respective probabilities:

Year	Best Case		Base Case		Worst Case	
	Revenue	Expenses	Revenue	Expenses	Revenue	Expenses
1	₹ 1,00,00,000	₹ 80,00,000	₹ 1,00,00,000	₹ 90,00,000	₹ 1,00,00,000	₹ 95,00,000
2	₹ 1,20,00,000	₹ 92,40,000	₹ 1,10,00,000	₹ 95,70,000	₹ 1,02,00,000	₹ 98,94,000
3	₹ 1,44,00,000	₹ 1,08,00,000	₹ 1,21,00,000	₹ 1,02,85,000	₹ 1,04,04,000	₹ 1,01,95,920
Probability	30%		60%		10%	

You are required to suggest the value of ABC Startup using **First Chicago Method** assuming that:

1. Applicable discounting rate is 20%.
2. Startup is located in Tax-free Zone.
3. The multiple for Terminal is 10.
4. No depreciable assets are held by the ABC Startup.

Note: Present Value Factor (PVF)

Year	1	2	3
PVF @20%	0.8333	0.6944	0.5787

TEST YOUR KNOWLEDGE

Question No.- 8.1

Spark Ltd. is a company that specializes in building tracks for high-speed trains. The company is the process of bidding for a new interstate train project. The chief bidding engineer has come up with a net present value estimate of ₹814.5 Crore. His inputs include the company's weighted average cost of capital of 8%, cash inflows of ₹2,000 crore which are expected at the end of 3rd year, annual expenditures for year 1, 2 and 3 of ₹300 crore per year. As the chief investment officer, you have made the following predictions:

For the best-case scenario, you predicted a WACC of 6.5%, cash inflows of ₹2,100 crore at the end of 2nd year and cash outflows of ₹400 crore at the end of 1st year and ₹500 crore at the end of second year. For the worst-case scenario, you predicted a WACC of 9%, cash inflows of ₹1,200 crore at the end of 4th year and cash outflows of ₹200 crore at the end of each year for 4 years. The initial investment is 0 in all scenarios.

Find the best-case scenario and worst-case scenario.

[CMA-SM22] [CMA-J24-7M]

Ans: NPV of the project is expected to be between ₹202 crore and ₹1,035 crore

MONTE CARLO SIMULATION ANALYSIS

Question No. - 9A [SM-2023]

Annual Net Cash Flow & Life of the project with their probability distribution are as follows:

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

Risk free rate is 10%, and Initial Investment is ₹1,30,000. Calculate Simulated NPV in 10 trial Run.

Ans: Run 1 = 42800; Run 2 = 85070.50; Run 3 = -8300; Run 4 = -66600; Run 5 = -21130;
Run 6 = 40390; Run 7 = 16050.26; Run 8 = 16050.26; Run 9 = 21630.5; Run 10 = 650.78

Various Random Number generated are as follows (Random Number Table)

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

Question No. -9B

X Co. is evaluating an investment proposal which has uncertainty associated with the three important aspects: original cost, useful life and annual net cash flows. The three probability distributions for these variables are shown below:

Original Cost		Useful life		Annual net cash inflows	
Value	Probability	Value	Probability	Value	Probability
₹ 60,000	0.30	5 years	0.40	₹10,000	0.10
₹ 70,000	0.60	6 years	0.40	₹ 15,000	0.30
₹ 90,000	0.10	7 years	0.20	₹ 20,000	0.40
				₹ 25,000	0.20

The company wants to perform five simulation runs of this project's life. The firm's cost of capital is 15% and the risk-free rate is 6%; for simplicity it is assumed that these two values are known with certainty and will remain constant over the life of the project.

To simulate the probability distribution of original cost, useful life and annual net cash inflows, are the following are the sets of random numbers:

09, 84, 41, 92, 65; 24, 38, 73, 07, 04; and 07, 48, 57, 64, 72 respectively each of the five simulation runs.

[CMA-SM22] [CMA-D24-7M]

Ans: 1: ₹ -17,880; 2: ₹14, 240; 3: ₹ 28,340; 4: ₹ -5760; 5: ₹ 14,240

✂ TEST YOUR KNOWLEDGE

Question No. - 9.1

The management of ABC company is considering the question of marketing a new product. The fixed cost required in the project is ₹4,000. Three factors are uncertain viz., the selling price, variable cost and the annual sales volume. The product has a life of only one year. The management has the data on these three factors as under:

Selling price ₹	Probability	Variable cost ₹	Probability	Sales Volume	Probability
3	0.2	1	0.3	2000	0.3
4	0.5	2	0.6	3000	0.3
5	0.3	3	0.1	5000	0.4

Consider the following sequence of thirty random numbers:

81, 32, 60, 04, 46, 31, 67, 25, 24, 10, 40, 02, 39, 68, 08, 59, 66, 90, 12, 64, 79, 31, 86, 68, 82, 89, 25, 11, 98, 16

Using the sequence (First 3 random numbers for the first trial etc.) simulate the average profit for the above project on the basis of 10 trials.

[\[CMA-SM\]](#)

Ans: ₹2100

Question No.-9.2

The Manager (Accounts) of MULTSOFT LTD. has studied his varying monthly cash Flows and has arrived at the probabilities of cash inflows and outgo as detailed below:

Cash Inflows (₹)	Probabilities	Cash Outgo	Probabilities
1,40,000	0.35	1,10,000	0.15
150,000	0.20	120,000	0.25
160,000	0.15	130,000	0.30
1,70,000	0.14	140,000	0.15
1,80,000	0.11	150,000	0.11
1,90,000	0.05	1,70,000	0.04

The manager at the beginning (April) of the year has ₹20,000 in Bank. The manager can avail of temporary overdraft facilities to cover any cash shortage.

Required:

- (a) Simulate the process to compute sales (cash inflow) and expenses (cash outgo) of the company over a financial year (April to March) using the following two series of random numbers:

Series-1: 34, 84, 38, 82, 36, 92, 73, 91, 63, 29, 27, 26

Series-2: 96, 57, 99, 84, 51, 29, 41, 11, 66, 30, 41, 80

- (b) How much money does the Manager has at the end (March) of the year?

[\[CMA-June-2010-10M\]](#)

Ans: Manager has ₹3,00,000 after 1 year

Question No. - 9.3 [RTP-May-2012]

A company manufactures 3000 units of 'Product P' per day. The sale of this product depends upon demand which has the following distribution.

Sales(Units)	2700	2800	2900	3000	3100	3200
Prob.	0.10	0.15	0.20	0.35	0.15	0.05

The production cost and sale price of each unit are ₹4 and ₹5 respectively. Any unsold product is to be disposed off at a loss of ₹1.50 per unit. There is a penalty of ₹0.50 per unit if demand is not met.

Using the following random numbers estimate total profits/loss for the company for next 10 days: 11, 98, 66, 97, 95, 01, 79, 12, 17, 21.

If the company decides to produce 2900 items per day, what is profit/loss position of the company

Ans: Total Profit for next 10 days (for 3000 items) = ₹26,950; If produce 2900 items profit shall remain unchanged

Question No.-9.4

A publishing house has bought out a new monthly magazine which sells at ₹ 25 per copy. The cost of purchasing it by newsstand is ₹ 20 per copy. A newsstand estimates the sales pattern of the magazine as under:

Demand Copies	Probability
0 < 200	0.18
200 < 400	0.32
400 < 600	0.25
600 < 800	0.15
800 < 1000	0.06
1000 < 1200	0.04

The newsstand has contracted for 500 copies of the magazine per month from the publisher. The unsold copies are returnable to the publisher who will take them back at cost less ₹ 2 per copy for handling charges.

The newsstand manager wants to simulate the pattern of demand and profitability.

The following random number may be used for simulation of sales pattern of each month.

26 14 55 17 97 70
51 33 60 82 96 68

You are required to:

- Allocate random numbers to the demand pattern forecast by the newsstand.
- Simulate twelve months sales and calculate the monthly and annual profit/loss.
- Calculate the loss on lost sales.

[\[CMA-PTP-June-2014-10M\]](#)

Question No.-9.5

A Production Manager is planning to produce a new product and he wishes to estimate the raw material requirement for that new product. On the basis of usage for a similar product introduced previously, he has developed a frequency distribution of demand in tonnes per day for a two-month period. Use this data to simulate the raw material usage requirements for 7 days. Compute also expected value and comment on the result.

Demand Tonnes/Day	Frequency No of Days
10	6
11	18
12	15
13	12
14	6
15	3

Random Number: 27, 13, 80, 10, 54, 60, 49.

[\[CMA-PTP-June-2015-6M\]](#) [\[CMA-MTP-Dec-2019-8M\]](#)

Question No.-9.6

Infoway Ltd. is considering the purchase of an automatic packing machine to replace the 2 machines which are currently used to pack Product X. The new machine would result in reduced labour costs because of the more automated nature of the process and in addition, would permit production levels to be increased by creating greater capacity at the packing stage with an anticipated rise in the demand for Product X, it has been estimated that the new machine will lead to increased profits in each of the next 3 years. Due to uncertainty in demand however, the annual cash flows (including savings) resulting from purchase of the new machine cannot be fixed with certainty and have therefore, been estimated probabilistically as follows:

Annual cashflows:

(₹ '000)

Year 1	Probability	Year 2	Probability	Year 3	Probability
10	0.3	10	0.1	10	0.3
15	0.4	20	0.2	20	0.5
20	0.3	30	0.4	30	0.2
		40	0.3		

Due to the overall uncertainty in the sales of Product X, it has been decided that only 3 years' cash flows will be considered in deciding whether to purchase the new machine. After allowing for the scrap value of the existing machines, the net cost of the new machine will be ₹42,000. The effects of taxation should be ignored.

Required:

- (a) Ignoring the time value of money, identify which combinations of annual cash flows will lead to an overall negative net cash flow, and determine the total probability of this occurring.
- (b) On the basis of the average cash flow for each year, calculate the net present value of the new machine given that the company's cost of capital is 15%. Relevant discount factors are as follows:

Year	Discount factor
1	0.8696
2	0.7561
3	0.6575

- (c) Analyse the risk inherent in this situation by simulating the net present value calculation. You should use the random number given at the end of the illustration in 5 sets of cash flows. On the basis of your simulation results what is the expected net present value and what is the probability of the new machine yielding a negative net present value?

	Set 1	Set 2	Set 3	Set 4	Set 5
Year 1	4	7	6	5	0
Year 2	2	4	8	0	1
Year 3	7	9	4	0	3

[\[CMA-SM22\]](#)

REAL OPTION In Study Material this topic is covered in Derivative Chapter

Question No. – 10A [\[May-2013-5M\]](#)

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 ₹ 600 lakhs or ₹1025 lakhs respectively. Current market price for each apartment unit is ₹ 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 ₹ 91 lakhs, if it is sluggish, the sale price for the same will be ₹ 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 ₹ 7 lakhs and the risk-free interest rate is 10% p.a.

Assume that the Construction cost will remain unchanged.

Ans:**Question No. – 10B** [\[May-2017-5M\]](#)

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 ₹ 150 crores (After considering scrap value at the end of life of project). 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 ₹ 100 crores. If risk free rate of interest is 8%, what will be present value of put option?

Ans: PV = 2.907 crore; This is the value of abandonment option (Put Option).

Question No. – 10C [\[SM-2023\]](#)

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

$$\ln(1.336) = 0.2897$$

$$e^{-1.0005} = 0.3677 \text{ and } e^{-1.17} = 0.3104$$

Question No. – 10D [\[SM-2023\]](#) [\[N24-4M\]](#) [\[MTP-N24-4M\]](#)

IPL already in production of Fertilizer is considering a proposal of building a new plant to produce pesticides. Suppose the PV of proposal is ₹ 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 of for ₹ 80 crore.

If the risk-free rate of interest is 8% then what will be value of abandonment option.

 TEST YOUR KNOWLEDGE

Question No. – 10.1 [\[SM-2023\]](#)

Suppose MIS Ltd. is considering installation of solar electricity generating plant for light the staff quarters. The plant shall cost ₹ 2.50 crore and shall lead to saving in electricity expenses at the current tariff by ₹ 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 ₹ 12 lakh or ₹ 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.

Question No. - 10.2 [\[Nov-2004-20M\]](#)

You own an unused Gold mine that will cost ₹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 ₹ 5,000 an ounce, and each year the price is equally likely to rise or fall by ₹ 500 from its level at the start of year. The extraction cost is ₹4,600 an ounce and the discount rate is 10 per cent.

Required:

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

Question No. - 10.3 [\[MTP-Nov-2013-5M\]](#)

Government of India through one of its agency has developed a new type of vaccine to cure the dengue. Among various companies' pharmaceutical companies, applies for license a USA based MNC has been granted license to produce vaccine at its plant situated at Noida in India. The license has been granted on the condition that company shall start producing vaccine after 2 years when GOI will launch a drive to vaccinate the children in metropolitan cities.

The project shall require an initial investment of ₹190 crore and it is expected to produce a negative NPV of ₹15 crore @ cost of capital of 16%. Therefore, company's CEO Brian is of view that it is not financial viable to produce vaccine and therefore the company should surrender back the license to GOI.

In recent Board meeting it was decided that the traditional approach to capital budgeting is highly uncertain and on the basis of concept of real option the views of CEO to surrender back the license needs a relook. The current yield on treasury bonds is 5%. Further expected standard deviation of future cash flows is 20%.

Suppose you have been appointed as financial consultant and you are required to:

- Determine the value of call option of delaying the commencement of production of the vaccine.
- Give your recommendation about the acceptability of the project.

Given: Area under normal curve $N(0.20) = 0.5793$ and $(-0.08) = 0.4681$ and $e^{-0.1} = 0.904837$ company is considering a cost saving

Question No. - 10.4

A company is considering bidding for the exclusive rights to undertake a project, which will initially cost ₹35 lakh. The company has forecast the following end of year cash flows for the four-year project.

Year	1	2	3	4
Cash flow (₹ in lakhs)	20	15	10	5

The relevant cost of capital for this project is 11% and the risk-free rate is 4.5%. The likely volatility (standard deviation) of the cash flows is estimated to be 50%.

[\[CMA-SM22\]](#)

Ans: NPV without delay = ₹5.8 Lakh; NPV when Delay by 2Y = 33.1 Lakh; Did as much as ₹9.6 lakh instead of ₹5.8 lakh

Question No. - 10.5

X Ltd. is considering a capital project with the following characteristics:

The initial outlay is ₹5,00,000.

Project life is 6 years.

Annual after-tax operating cash flows have a 50 percent probability of being ₹80,000 for the four years and a 50 percent probability of being ₹1,40,000.

Salvage value at project termination is 0.

The required rate of return is 12 percent.

In one year, after realizing the first-year cash flow, the company has the option to abandon the project and receive the salvage value of ₹4,00,000.

- Compute the project NPV assuming no abandonment.
- What is the optimal abandonment strategy? Compute the project NPV using that strategy.

[\[CMA-SM22\]](#)

Question No. – 10.6

Agarwal Group, an elite Nepalese Investor Group, has hired you in order to value a gold mining company's lease on a gold mine that is located in remote areas of India and is currently not operating. It would cost \$1,000,000 for the company to reopen the mine and it is expected to produce 100,000 ounces of gold at the end of next year. The forward contract price on a one-year gold forward contract is \$268.40 / ounce and the current one-year risk-free rate is 5%. Extraction costs are estimated to be \$260/ounce.

Required:

- i) Assuming the per-ounce gold price in the spot market one year from now is forecasted to be either \$300 or \$230, calculate the composition of a portfolio of T-bills and gold forward contracts that would replicate the cash flows from the mine, and the "real options" value of the mine lease.
- ii) Assuming the per-ounce gold price in the spot market one year from now is forecasted to be either \$280 or \$250, calculate the composition of a portfolio of T-bills and gold forward contracts that would replicate the cash flows from the mine, and the "real options" value of the mine lease.
- iii) What do answers in Parts (i) and (ii) tell about the effect that the volatility of future gold prices has on the current value of the mine lease?

[\[ICAN-D24-10M\]](#)**ADJUSTED PRESENT VALUE****Question No. – 11A** [\[RTP-May-2010-Old\]](#)

TLC is considering a perpetual project with initial investment is ₹10,00,00,000, and the expected cash inflow is ₹85,00,000 a year in perpetuity. The opportunity cost of capital with all-equity financing is 10 percent, and cost of debt is 8%. Since the project is based on the solar technology Government is subsidizing the cost of debt by 1%.

Corporate tax rate is 35%. Use APV (Adjusted Present Value) to calculate this project's value assuming that.

- (a) First that the project will be partly financed with ₹ 4,00,00,000 of debt and that the debt amount is to be fixed and perpetual.
- (b) The initial borrowing will be increased or reduced in proportion to changes in the future market value of this project.

Also explain the reasons difference between above two answers.

Ans: (a) Base case NPV = - ₹150 Lakh; ANPV = - ₹10,00,000; (b) ANPV = - ₹52,00,000

Question No. - 11B [\[RTP-N24\]](#) [\[MTP-M23-8M\]](#) [\[Nov-2020-8M\]](#)

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 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

✂ TEST YOUR KNOWLEDGE

Question No. – 11.1

A firm is considering a project requiring ₹50 lakh of investment. Expected cash flow is ₹10 lakh per annum for 8 years. The rate of return required by the equity investors from the project is 15%. The firm is able to raise ₹ 24 lakh of debt finance carrying 14% interest for the project. The debt is repayable in equal annual instalments over the eight-year period (the first to be paid at the end of the first year). The tax rate is 40%.

Assume, Issue cost of Equity is 5%.

Calculate Base case NPV and Adjusted NPV.

[CMA-SM22]

Ans: ₹(-)512700; ₹(-)246367

REPLACEMENT DECISION

Question No. - 12A [Nov-1996-old-12 Marks]

A Company named Roby's cube decided to replace the existing Computer system of their organisation. Original cost of old system was ₹ 25,000 and it was installed 5 years ago. Current market value of old system is ₹ 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 ₹ 50,000.

Estimated Salvage value of the new system is ₹ 1,000. Estimated cost savings with new system is ₹ 5,000 per year. Increase in sales with new system is assumed at 10% per year based on original total sales of ₹ 10,00,00. Company follows straight line method of depreciation. Cost of capital of the company is 10% whereas tax rate is 30%.

Question No. – 12B [Nov-1996-old-12 Marks]

Nine Gems Ltd. has just installed Machine – R at a cost of ₹ 2,00,000. The machine has a five-year life with no residual value. The annual volume of production is estimated at 1,50,000 units, which can be sold at ₹6 per unit. Annual operating costs are estimated at ₹ 2,00,000 (excluding depreciation) at this output level. Fixed costs are estimated at ₹ 3 per unit for the same level of production.

Nine Gems Ltd. has just come across another model called Machine – S capable of giving the same output at an annual operating cost of ₹ 1,80,000 (exclusive of depreciation). There will be no change in fixed costs. Capital cost of this machine is ₹ 2,50,000 and the estimated life is for five years with nil residual value.

The company has an offer for sale of Machine – R at ₹ 1,00,000. But the cost of dismantling and removal will amount to ₹ 30,000. As the company has not yet commenced operations, it wants to sell Machine – R and purchase Machine – S.

Nine Gems Ltd. will be a zero-tax company for seven years in view of several incentives and allowances available.

The cost of capital may be assumed at 14%. P.V. factors for five years are as follows:

Year	1	2	3	4	5
P.V. Factors	0.877	0.769	0.675	0.592	0.519

- Advise whether the company should opt for the replacement.
- Will there be any change in your view, if Machine-R has not been installed but the company is in the process of selecting one or the other machine?

Support your view with necessary workings.

[CMA-MTP-D23-7M] [CMA-SM22] [CMA-Dec-2018-8M] [CMA-Dec-2013-10M]

Ans: (i) NPV = -111360; (ii) R = 6,58,000; S = 6,76,640

Question No. – 12C

Electronics Pvt. Ltd. is considering a proposal to replace one of its machines. In this connection, the following information is available:

The existing machine was purchased 3 years ago for ₹ 20 Lakh. It was depreciated 20 per cent per annum on reducing balance basis. It has remaining useful life of 5 years, but its maintenance cost is expected to increase by ₹ 1 Lakh per year from the end of sixth year of its installation. Its present realizable value is ₹ 12 Lakh. The company has several machines having 20% depreciation.

The new machine costs ₹30 Lakh and is subject to the same rate and basis of depreciation. On sale after 5 years, it is expected to realize ₹18 Lakh. With the new machine, the annual pre-tax operating costs (excluding depreciation) are expected to decrease by ₹2 Lakh. In addition, the machine would increase productivity on account of which net pre-tax revenues would increase by ₹3 Lakh annually

(reckoned at year end). The tax rate applicable to the company is 40% and the cost of capital is 10 per cent.

Advise the company on the choice of the machine from a financial perspective on the basis of NPV.

Year	1	2	3	4	5
P.V. Factors @10%	0.909	0.826	0.751	0.683	0.621

Present an incremental analysis of using the existing machine versus replacing the machine with a new one. Present annual discounted cash flows in your answers with separate calculation showing annual discounted cash flows on account of incremental depreciation without netting off capital asset outflows or inflows. Calculations are to be presented to the nearest rupee. P.V. factors with above decimal places should be used.

[CMA-June-2018-10M]

Question No. – 12D [May-2019-Old-5M] [RTP-Nov-2020-Old]

SS Company is considering the replacement of its existing machine with a new machine. The Purchase price of the New machine is ₹26 Lakhs and its expected Life is 8 years. The company follows straight-line method of depreciation on the original investment (scrap value is not considered for the purpose of depreciation). The other expenses to be incurred for the New Machine are as under:

- (i) Installation Charges ₹9,000
- (ii) Fees paid to the consultant for his advice to buy New Machine ₹6,000.
- (iii) Additional Working Capital required ₹17,000. (will be released after 8 years)

The written down value of the existing machine is ₹76,000, and its Cash Salvage Value is ₹12,500. The dismantling of this machine would cost ₹4,500. The Annual Earnings (before tax but after depreciation) from the New Machine would amount to ₹3,15,000. Income tax rate is 35%. The Company's required Rate of Return is 13%.

You are required to advise on the viability of the proposal. PVIF (13%, 8) = 0.376; PVIFA (13%, 8) = 4.80

[CMA-D23-7M]

Question No. – 12E [Nov-2008-New-8 Marks]

Company has to replace one of its machines which has become unserviceable. Two options are available:

- (i) A more expensive machine (EM) with 12 years of life,
- (ii) A less expensive machine (LM) with 6 years of life.

If machine LM is chosen, it will be replaced at the end of 6 years by another LM machine. The pattern of maintenance, running costs and prices are as under:

Particulars	EM	LM
Purchase price	10,00,000	7,00,000
Scrap value at the end of life	1,50,000	1,50,000
Overhauling is due at the end of	8th year	4th year
Overhauling costs	2,00,000	1,00,000
Annual repairs	1,00,000	1,40,000
Cost of capital - 14%		

You are required to recommend with supporting calculations which of the machines should be purchased.



End of 4th year	0.5921
End of 6th year	0.4556
End of 8th year	0.3506
End of 12th year	0.2076
Years 1 to 6	3.8890
Years 1 to 12	5.6600

[CMA-WB-2018] [CMA-Dec-2019-8M]

Ans: Annualised value EM: ₹2,83,565; LM: ₹3,17,647; Replace existing machine with EM

TEST YOUR KNOWLEDGE

Question No. - 12.1 [As Dec-2021-Old-8M]

Apex Enterprises is interested in assessing the cash flows associated with the replacement of the old machine by a new machine. The old machine has a book value of ₹ 90,000 which can be sold for the same amount. It has a remaining life of 5 years, after which the salvage value is expected to be 'nil'. It is being depreciated annually @ 10% using the written down value method.

The new machine costs ₹ 4 lakhs, and has a resale value of ₹2.5 lakhs at the end of 5 years. The new machine is expected to save manufacturing costs of ₹ 1 lakh p.a. Investment in working capital remains same. The tax rate applicable to the firm is 50%.

You, as a Project Analyst, are required to work out the incremental cashflows associated with the replacement of the old machine and to prepare a statement to be presented to the management for consideration.

[CMA-WB-2018]

Question No. – 12.2 [SM-2023] [Nov-2008-8M] [As MTP-II-May-2019-8M]

A manufacturing company has an old machine having no book value which can be sold now for ₹ 1,00,000. It can be used for another five years after which it will have to be condemned without any sale value. The company is examining the following options:

Option I: To upgrade the existing machine at a cost of ₹ 20 lacs and continue operations for a further 5 years at the end of which the ₹ 20 lacs would have also fully been depreciated equally over the next 5 years and will fetch a sale value of ₹ 50,000 at the end of the 5th year.

Option II: To replace the old machine with a new one costing ₹ 40 lacs which will have a useful life of 5 years, during which it will be fully depreciated equally. At the end of the 5th year, this machine will have a resale value of ₹ 10 lacs.

The following figures are the after-tax cash profits in rupees without the depreciation shield and the salvage values for the existing situation and the fresh options:

End of year	Existing Machine	Upgraded Machine	New Machine
1	10,00,000	11,00,000	12,00,000
2	10,80,000	11,80,000	12,80,000
3	11,20,000	12,20,000	13,80,000
4	12,00,000	13,00,000	14,80,000
5	13,00,000	14,00,000	16,00,000

The hurdle rate used for evaluation is 15%.

Consider that the salvage values and profits will be subjected to tax at the normal tax rate of 40%.

Present an incremental analysis of options I and II and state which is better.

Evaluate the better option above over continuing with the old machine without upgrading. [CMA-Dec-2017-8M]

Question No. - 12.3 [\[May-2002-14M\]](#)

X Ltd. an existing profit-making company, is planning to introduce a new product with a projected life of 8 years. Initial equipment cost will be ₹ 120 lakhs and additional equipment costing ₹ 10 lakhs will be needed at the beginning of 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 ₹ 1 lakhs. Working Capital of ₹ 15 lakhs will be needed. The 100% capacity of the plant is of 4,00,000 units per annum, but the production and sales-volume expected are as under:

Year	Capacity in percentage
1	20
2	30
3-5	75
6-8	50

A sale price of ₹ 100 per unit with a profit-volume ratio of 60% is likely to be obtained. Fixed Operating Cash Cost are likely to be ₹ 16 lakhs per annum. In addition to this the advertisement expenditure will have to be incurred as under:

Year	1	2	3-5	6-8
Expenditure in ₹ lakhs each year	30	15	10	4

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?

[\[CMA-SM22\]](#) [\[CMA-MTP-J24-7M\]](#) [\[CMA-MTP-D23-10M\]](#) [\[CMA-Compendium\]](#) [\[CMA-RTP-D14\]](#)

Question No. – 12.4

Das Ltd. A manufacturing company produces 25000 liters of special lubricants in its plant. The existing plant is not fully depreciated for tax purposes and has a book value of ₹3 lakhs (it was bought for ₹6 lakh six year ago). The cost of the product is as under:

Particulars	Cost/liter (₹)
Variable costs	60.00
Fixed overheads	15.00
	75.00

It is expected that the old machine can be used for further period of 10 years by carrying out suitable repairs at a cost of ₹2 lakh annually.

A manufacturer of machinery is offering a new machine with the latest technology at ₹10 lakhs after trading off the old plant (machine) for ₹1 lakh. The projected cost of the product will then be:

Particulars	Cost/Liter (₹)
Variable costs	45.00
Fixed overheads	20.00
	65.00

The fixed overheads are allocations from other department plus the depreciation of plant and machinery. The old machine can be sold for ₹2 lakh in the open market. The new machine is expected to last for 10 years at the end of which, its salvage value will be ₹1 lakhs. Rate of corporate taxation is 50%. For tax purposes, the cost of the new machine and that of the old one may be depreciated that in future the demand for the product will remain at 25000 liters.

Advise whether the new machine can be purchased Ignore capital gain taxes.

[Given: PVIFA (10%, 10 years) = 6.145, PVIF (10%, 10 years) = 0.386]

[\[CMA-TP-Dec-2013-10M\]](#)

Question No. – 12.5 [May-1997-20M]

Excel Ltd. manufactures a special chemical for sale at ₹ 30 per kg. The variable cost of manufacture is ₹ 15 per kg. Fixed cost excluding depreciation is ₹ 2,50,000. Excel Ltd. is currently operating at 50% capacity. It can produce a maximum of 1,00,000 kgs at full capacity.

The Production Manager suggests that if the existing machines are fully replaced the company can achieve maximum capacity in the next five years gradually increasing the production by 10% per year.

The Finance Manager estimates that for each 10% increase in capacity, the additional increase in fixed cost will be ₹ 50,000. The existing machines with a current book value of ₹ 10,00,000 can be disposed of for ₹ 5,00,000. The Vice-President (finance) is willing to replace the existing machines provided the NPV on replacement is about ₹ 4,53,000 at 15% cost of capital after tax.

(i) You are required to compute the total value of machines necessary for replacement.

For your exercise you may assume the following:

- (a) The company follows the block assets concept and all the assets are in the same block. Depreciation will be on straight-line basis and the same basis is allowed for tax purposes.
- (b) There will be no salvage value for the machines newly purchased. The entire cost of the assets will be depreciated over five year period.
- (c) Tax rate is at 40%.
- (d) Cash inflows will arise at the end of the year.
- (e) Replacement outflow will be at the beginning of the year (year 0).

Year	0	1	2	3	4	5
Discount Factor at 15%	1	0.87	0.76	0.66	0.57	0.49

(ii) On the basis of data given above, the managing director feels that the replacement, if carried out, would at least yield post tax return of 15% in the three years provided the capacity build up is 60%, 80% and 100% respectively. Do you agree?

[\[CMA-Compendium\]](#) [\[CMA-RTP-Dec-2013\]](#) [\[CMA-MTP-June-2014-12M\]](#)

Question No. - 12.6 [May-1998-20M]

S Engineering Company is considering to replace or repair a particular machine, which has just broken down. Last year this machine costed ₹ 20,000 to run and maintain. These costs have been increasing in real terms in recent years with the age of the machine. A further useful life of 5 years is expected, if immediate repairs of ₹ 19,000 are carried out. If the machine is not repaired it can be sold immediately to realize about ₹ 5,000 (Ignore loss/gain on such disposal).

Alternatively, the company can buy a new machine for ₹ 49,000 with an expected life of 10 years with no salvage value after providing depreciation on straight line basis. In this case, running and maintenance costs will reduce to ₹ 14,000 each year and are not expected to increase much in real term for a few years at least. S Engineering Company regard a normal return of 10% p.a. after tax as a minimum requirement on any new investment. Considering capital budgeting techniques, which alternative will you choose? Take corporate tax rate of 50% and assume that depreciation on straight line basis will be accepted for tax purposes also.

Given cumulative present value of Re. 1 p.a. at 10% for 5 years ₹ 3.791, 10 years ₹ 6.145.

[\[CMA-SM22\]](#) [\[CMA-Compendium\]](#) [\[CMA-D23-8M\]](#)

Question No. - 12.7 [RTP-Dec-2019-Old]

ABC Ltd. has an investment proposal with information as under:

₹	
Existing Asset:	
Current Book-Value	6,00,000
Annual Revenue from this Asset	25,00,000
Annual Cash Outflow (expenses) on this Asset	18,00,000
Depreciation of this Assets per annum	1,50,000
New Asset to be purchased:	
Cost	27,00,000
Installation charges	3,00,000
Depreciation on 90% of ₹ 30,00,000 as under for new asset:	
Year 1	8,00,000
Year 2	7,00,000
Year 3	6,00,000
Year 4	6,00,000
Annual Revenue from this Asset (for each of four years)	70,00,000
Annual Cash Outflow (expenses) on this Asset	28,00,000
Additional Workings Capital required	5,00,000
The Scrap (Salvage) value of this Asset at the end of Year 4	8,00,000

The company has Tax Rate for both Revenues and Capital Gain/Loss of 34%. You are required to find Net Annual Incremental Cash Flows. Also, show computation of Terminal Cash flow.

Note: Show calculation of amount to the nearest Rupee.

Question No. - 12.8

ABC Company Ltd. has been producing a chemical product by using machine Z for the last two years. Now the management of the company is thinking to replace this machine either by X or by Y machine. The following details are furnished to you:

Particulars	Z (₹)	X (₹)	Y (₹)
Books Value	1,00,000	-	-
Resale Value now	1,10,000	-	-
Purchase value	-	1,80,000	2,00,000
Annual fixed costs (including depreciation)	92,000	1,08,000	1,32,000
Variable running costs (including labour) per unit	3	1.50	2.50
Production per hour (unit)	8	8	12

You are also provided with the following details:

Selling price per unit	₹ 20
Cost of materials per unit	₹ 10
Annual operating hours	2,000
Working life of each of the three machines (as from now)	5 Years
Salvage value of machines Z ₹ 10,000, X ₹ 15,000, Y ₹ 18,000	

The company charges depreciation using straight line method. It is anticipated that an additional cost of ₹8,000 per annum would be incurred on special advertising to sell the extra output of machine. Assume tax rate of 40% and cost of capital 10%. The present value of ₹1 to be received at the end of the year at 10% is as under:

Year	1	2	3	4	5
Present Value	0.909	0.826	0.751	0.683	0.621

Required: Using NPV method, you are required to analyse the feasibility of the proposal and make recommendations.

[\[CMA-SM22\]](#)

Question No. - 12.9

A product is currently manufactured on a machine that is not fully depreciated for tax purposes and has a book value of ₹70,000. It was purchased for ₹2,10,000 twenty years ago. The cost of the product are as follows:

Unit Cost	(₹)
Direct labour	28.00
Indirect labour	14.00
Other variable overhead	10.50
Fixed overhead	17.50
	70.00

In the past year 10,000 units were produced. It is expected that with suitable repairs the old machine can be used indefinitely in future. The repairs are expected to average ₹75,000 per year.

An equipment manufacturer has offered to accept the old machine as a trade in for a new equipment. The new machine would cost ₹4,20,000 before allowing for ₹1,05,000 for the old equipment. The Project costs associated with the new machine are as follows:

Unit Cost	(₹)
Direct labour	14.00
Indirect labour	21.00
Other variable overhead	7.00
Fixed overhead	22.75
	64.75

The fixed overhead costs are allocations for other departments plus the depreciation of the equipment. The old machine can be sold now for ₹50,000 in the open market. The new machine has an expected life of 10 years and salvage value of ₹20,000 at that time. The current corporate income tax rate is assumed to be 50%. For tax purposes cost of the new machine and the book value of the old machine may be depreciated in 10 years. The minimum required rate is 10%. It is expected that the future demand of the product will stay at 10,000 units per year.

The present value of an annuity of ₹1 for 9 years @ 10% discount factor = 5.759. The present value of ₹1 received at the end of 10th year @ 10% discount factor is = 0.386. Should the new equipment be purchased?

[\[CMA-SM22\]](#)

Question No. - 12.10

SYAIN Ltd., a manufacturing company is considering the purchase of a new, fully automated machine to replace a manually operated one.

Information about the old machine is as follows:

- It originally had an expected life of 10 years and is now five years old.
- It was purchased five years back at ₹4,00,000.
- Depreciation is calculated on the basis of straight line method.

- Currently it has a book value of ₹2,00,000.
- It can now be sold for ₹2,20,000.
- The difference between book value and sale value of machine will be charged to tax at 34%.
- It takes one person to operate the machine and he earns ₹2,90,000 per year in salary.
- The annual cost of maintenance is ₹1,00,000.

The replacement machine being considered has a purchase price of ₹7,50,000 and an expected salvage value of ₹1,50,000 at the end of its five year life. There will also be shipping and installation expenses of ₹60,000. Because the new machine would work faster, investment in net working capital would increase by a total of ₹30,000. The company expects that annual maintenance cost on the new machine will be ₹70,000.

The required rate of return for this project is 15% and the company's marginal tax rate is 34%.

[Given: Present Value factors]

Year	1	2	3	4	5	6	7
Present Value factor at 15%	0.8696	0.7561	0.6575	0.5718	0.4972	0.4323	0.3759
PVIFA (15%)	-	-	-	-	3.3522	-	-

Required:

- Analyse the annual Cash Saving and Net Present Value of Cash inflows.
- Advise SYAIN Ltd., whether they should replace the existing machine with a new replacement. (New machine)

[\[CMA-D24-7M\]](#)

REPLACEMENT AT OPTIMAL POINT & OPTIMUM REPLACEMENT CYCLE

Question No. - 13A [\[SM-2023\]](#) [\[June-2009-Old-10 Marks\]](#) [\[May-2004-old-10 Marks\]](#) [\[RTP-May-2014\]](#)

A & Co. is contemplating whether to replace an existing machine or to spend money on overhauling it. A & Co. currently pays no taxes. The replacement machine costs ₹ 90,000 now and requires maintenance of ₹ 10,000 at the end of every year for eight years. At the end of eight years, it would have a salvage value of ₹ 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	Salvage
Present	0	40000
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 & Co. is 15%

Required:

When should company replace the machine?

(Note: Present value of an annuity of ₹1 per period for 8 Years at interest rate of 15%: 4.4873; Present value of ₹1 to be received after 8 years at interest rate of 15%: 0.3269)

[\[CMA-SM22\]](#) [\[As CMA-June-2017-8M\]](#)

Ans: Equivalent annual cost if replace the machine: 28,600

[Cost to continue Y1 = 31,000; Y2 = 33,750; Y3 = 37,250; Y4 = 51,500]; Decision: Replace immediately

Question No. – 13.3 [\[ISM-2023\]](#) [\[RTP-NOV-2013\]](#) [\[MTP-Nov-2013-5M\]](#)

Trouble free solution (TFS) is an authorized service center of a reputed domestic air conditioner manufacturing company. All complaints/service related matter of Air conditioner are attended by this service centre. The service centre employs a large number of mechanics travels approximately 40,000 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 periods. The fleet of bike is due for replacement shortly in near future.

The purchase price of latest model bike is ₹55000. Resale value of used bike at current price in market is as follows:

Period	₹
1 year old	35000
2 year old	21000
3 year old	9000

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

Year	Road Taxes Insurance Co. (₹)	Petrol Repair Maintenance etc. (₹)
1	3000	30000
2	3000	35000
3	3000	43000

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

Question No. – 13.4 [\[RTP-NOV-2014\]](#) [\[MTP-May-2014-5M\]](#)

XYZ Food Pvt. Ltd., a franchisee of Domino's (World famous food chain for delivering pizza at home) is considering a proposal of acquiring a fleet of motorbikes for delivery of pizzas at home of customers. Since pizzas are also delivered in late night and bikes are handled by different delivery boys (due shift working) the use of fleet will be very heavy. Hence it is expected that the motorbike shall be virtually worthless and scrapped after a period of 3 years. However, they are taken out of services before 3 years there will be a positive 'abandonment' cash flow.

The initial cost of the bike will be ₹1,00,000. The expected post tax benefit (cash inflows) from the use of bike and abandonment cash inflows are as follows:

Year	Operating Cash Flows (₹)	Abandonment Cash Flows at end of year (₹)
1	42,000	62,000
2	40,000	40,000
3	35,000	0

The cost of capital of XYZ Pvt. Ltd. is 10%. You are required to evaluate the proposal of acquisition of bikes and recommend preferable life of the same.

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