Question 3: [Class 2 CW Q2]

Nexus Development is planning to invest Rs.32 lakhs during April 2022 in "Smart Build" Project. Director (R&D) called a meeting on 15th January 2022. In that meeting, along with senior members of the project team, some external management consultants were also invited. In the meeting it is found that there is a 70% chance of the project being successfully completed by the end of first year. If the project is not completed by March 2023, the company may either choose to abandon the project for Rs.10 lakhs or incur an additional cost of Rs.18 lakhs to complete the project by next year. The chance of successful completion in the second year is 40%. In case the project is not completed by the end of second year, the project will be abandoned for Rs.10 lakhs.

On successful completion, annual cash inflows until the end of the life of project are expected to be as follows:

Cash inflow (Rs. in lakhs)	Probability
10	10%
15	20%
20	30%
25	40%

The life of the project, including the construction period, is 5 years. The opportunity cost of capital is 10%.

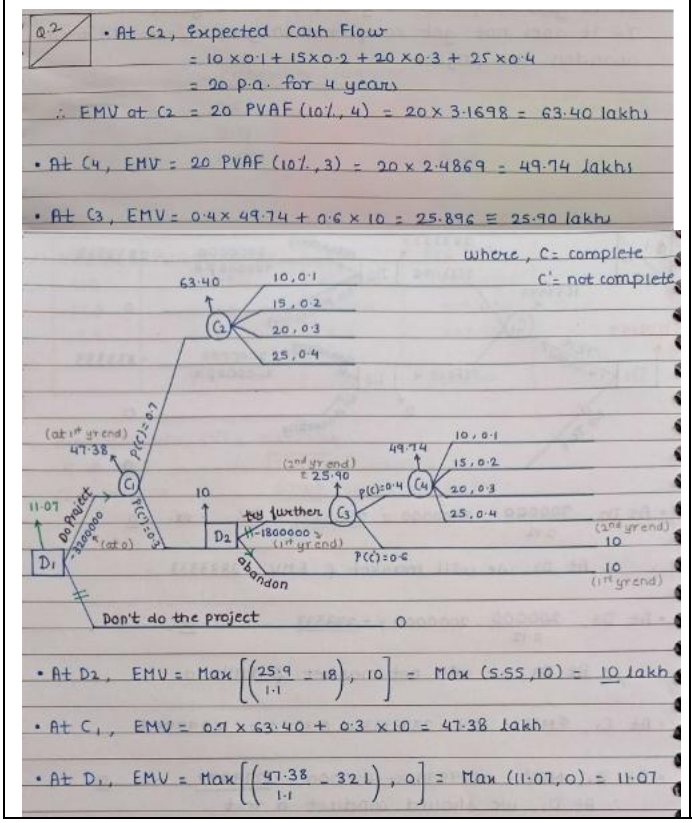
You are required to

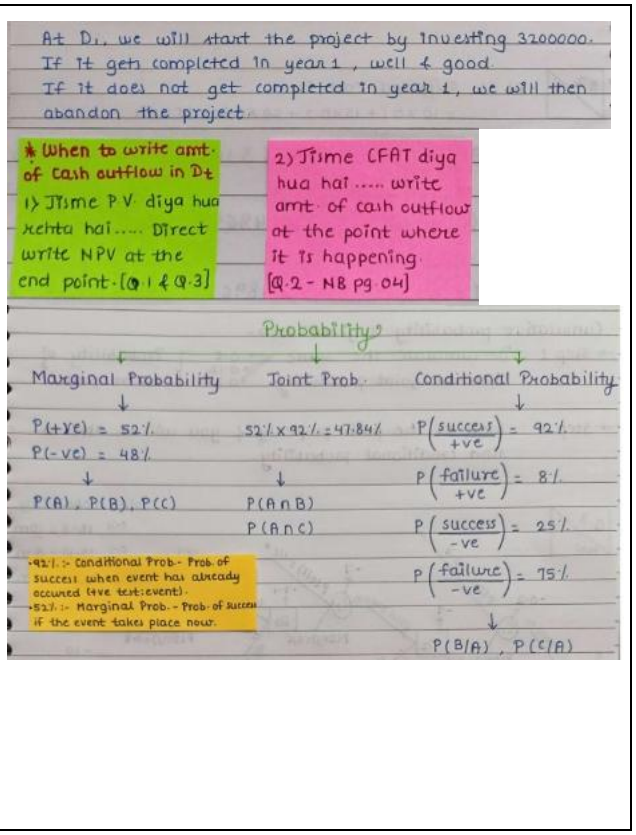
a. Construct a decision tree depicting the above situation.

b. Determine the optimal decision, considering the time value of money.

(Source: FOD)

ANSWER:





Question 4: [Class 2 CW Q3]

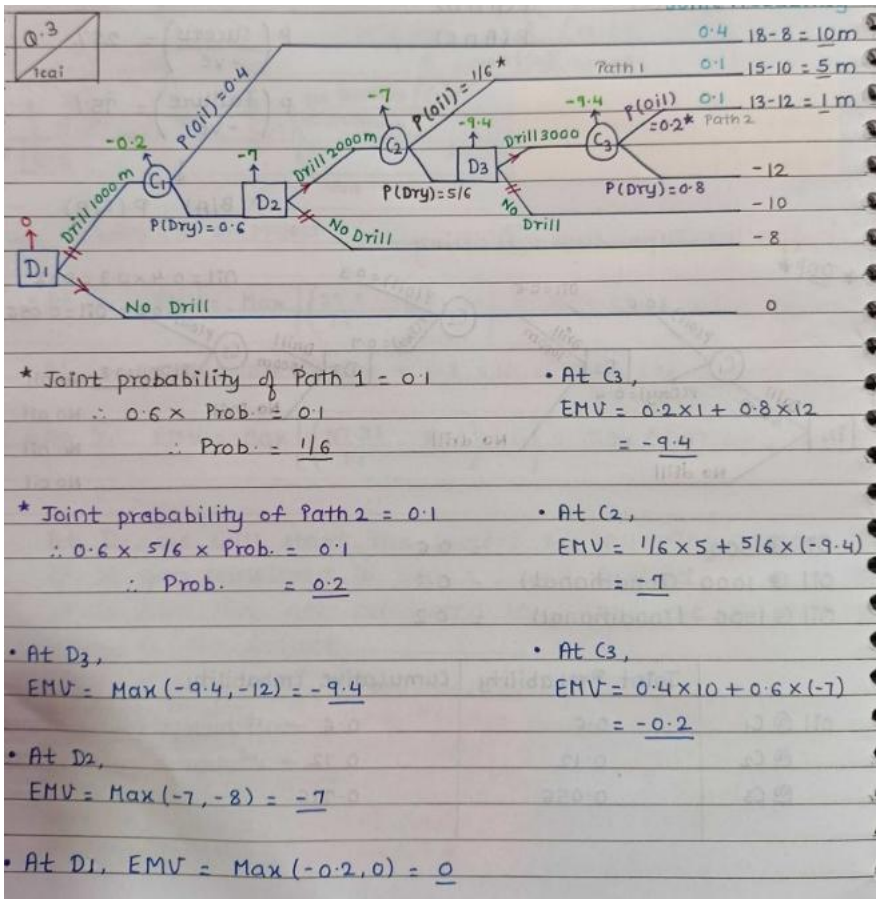
PetroTech Energy is wondering whether to drill for oil in Eastland County. The prospects is as follows:

Depth of Well Feet	Total Cost Millions of Dollars	Cumulative Probability of Finding Oil	PV of Oil (If found) Millions of Dollars
1,000	8	0.4	18
2,000	10	0.5	15
3,000	12	0.6	13

Draw a decision tree showing the successive drilling decisions to be made by PetroTech Energy. How deep should it be prepared to drill?

(Source: FOD)

ANSWER:



* Joint probability of Path 1 = 0.1
∴ 0.6 × Prob. = 0.1
∴ Prob. = 1/6

* Joint probability of Path 2 = 0.1
∴ 0.6 × 5/6 × Prob. = 0.1
∴ Prob. = 0.2

• At D_3,
EMV = Max (-9.4, -12) = -9.4

• At D_2,
EMV = Max (-7, -8) = -7

• At D_1, EMV = Max (-0.2, 0) = 0

• At C_3,
EMV = 0.2×1 + 0.8×12
= -9.4

• At C_2,
EMV = 1/6×5 + 5/6×(-9.4)
= -7

• At C_3,
EMV = 0.4×10 + 0.6×(-7)
= -0.2

Question 6: [Class 3 CW Q2]

Zenith Chemicals is evaluating an investment project whose net present value has been modeled as follows:

$$\sum_{t=1}^{n}\left[CF_t / (1+i)^t \right] - I$$

Where i→ Risk free interest rate, I→ initial investment are parameters, CF = Annual Cash Flow

With i = 12%, I = ₹2,50,000, CFt& n stochastic exogenous variables with the following distribution will be as under:

Annual Cash Flow		Project Life	
Value (₹)	Probability	Value (Year)	Probability
20,000	0.07	5	0.15
30,000	0.03	6	0.10
40,000	0.15	7	0.20
50,000	0.25	8	0.30
60,000	0.10	9	0.10
65,000	0.25	10	0.15
90,000	0.15		

The firm wants to perform ten simulation runs of its project's life and calculate expected NPV. You are required to simulate the probability distributions of Annual Cash Flow and Project Life, using the following sets of random numbers:

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

Note: For random numbers, begin from the top of the table on the left and read any pair of adjacent columns, column/row wise.

(Source: FOD)

Topic Sensitivity Analysis

Question 7: [Class 4 CW Q1]

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 is 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.

(Source: ICAI)

ANSWER:

Calculation of NPV

$$\text{NPV} = -10,00,000 + \frac{20,000\times 20}{1.1} + \frac{30,000\times 20}{1.21} + \frac{30,000\times 20}{1.331}$$

= - 10,00,000 + 3,63,636 + 4,95,868 + 4,50,789

= 13,10,293 – 10,00,000

= ₹3,10,293/-.

Measurement of sensitivity is as follows:

a. Sales Price:

Let the sale price/Unit be S so that the project would break even with 0 NPV.

$$\therefore 10,00,000 = \frac{20,000\times(S-40)}{1.1} + \frac{30,000\times(S-40)}{1.21} + \frac{30,000(S-40)}{1.331}$$

S – 40 = 10,00,000/65,514

S – 40 = ₹ 15.26

S = ₹ 55.26 which represents a fall of (60-55.26)/60

Or 0.079 or 7.9%

Alternative Method

$$\frac{10,00,000\ \times\ 20}{13,10,293} = ₹15.26$$

S = ₹ 40 + ₹ 15.26

= ₹ 55.26

Alternative Solution

If sale Price decreased by say 10%, then NPV (at Sale Price of ₹ 60 – ₹ 6 = ₹ 54)

$$\text{NPV} = -10,00,000 + \frac{20,000\times 14}{(1.1)^1} + \frac{30,000\times 14}{(1.1)^2} + \frac{30,000\times 14}{(1.1)^3}$$

= -10,00,000 +2,54,545 + 3,47,107 + 3,15,552

= -82,796

NPV decrease (%) = $\frac{3,10,293-(-82,796)}{3,10,293}\times 100 = 126.68\%$

b. Unit Cost:

If sales price = ₹ 60 the cost price required to give a margin of ₹ 15.26 is (₹ 60 – ₹ 15.26) or ₹ 44.74 which would represent a rise of 11.85% i.e., $\left(\frac{44.74-40}{40}\times 100\right)$

Alternative Solution

If unit cost increased by say 10%. The new NPV will be as follows:

NPV = -10,00,000 + $\frac{20,000\times 16}{(1.1)^1}+\frac{30,000\times 16}{(1.1)^2}+\frac{30,000\times 16}{(1.1)^3}$

= -10,00,000 + 2,90,909 + 3,96,694 + 3,60,631

= 48,234

NPV decrease (%) = $\frac{3,10,293-(48,234)}{3,10,293}\times 100 = 84.46\%$

c. Sales volume:

The requisite percentage fall is:
3,10,293/13,10,293 × 100 = 23.68%

Alternative Solution

If sale volume decreased by say 10%. The new NPV will be as follows:

NPV = -10,00,000 + $\frac{18,000\times 20}{(1.1)^1}+\frac{27,000\times 20}{(1.1)^2}+\frac{27,000\times 20}{(1.1)^3}$

= -10,00,000 + 3,27,272 + 4,46,281 + 4,05,710

= 1,79,263

NPV decrease (%) = $\frac{3,10,293 - 1,79,263}{3,10,293}\times 100 = 42.22\%$

d. Since PV of inflows remains at ₹13,10,293 the initial outlay must also be the same.

$\therefore$ Percentage rise = 3,10,293/10,00,000 × 100 = 31.03%.

Alternative Solution

If initial outlay increased by say 10%. The new NPV will be as follows:

NPV = -11,00,000 + $\frac{20,000\times 20}{(1.1)^1}+\frac{30,000\times 20}{(1.1)^2}+\frac{30,000\times 20}{(1.1)^3}$

= -11,00,000 + 3,63,636 + 4,95,868 + 4,50,789

= 2,10,293

NPV decrease (%) = $\frac{3,10,293-2,10,293}{3,10,293}\times 100 = 32.22\%$

e. Present value for 1st two years.

= - 10,00,000 + 4,00,000 x 0.909 + 6,00,000 x 0.826
= - 10,00,000 + 3,63,600 + 4,95,600
= - 10,00,000 + 8,59,200
= - 1,40,800

∴The project needs to run for some part of the third year so that the present value of return is ₹ 1,40,800. It can be computed as follows:

i. 30,000 units ×₹ 20 x 0.751 = ₹ 4,50,600

ii. Per day Production in (₹) assuming a year of 360 days = $\frac{₹4,50,600}{360} = ₹1,252$

iii. Days needed to recover ₹1,40,800 = $\frac{₹1,40,800}{₹1,252} = 112$

Thus, if the project runs for 2 years and 112 days then break even would be achieved representing a fall of $\frac{(3-2.311)}{3} \times 100 = 22.97\%$

Question 10: [Class 5 CW Q3]

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:

a. sale price;

b. sales volume;
c. variable cost;
d. 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	1,75000	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.

(Source: ICAI)

ANSWER:

Calculation of NPV = - ₹ 50,00,000 + [2,00,000 (₹ 30 – ₹ 16.50) – ₹ 10,00,000] PVIAF (12%,5)
= - ₹ 50,00,000 + [2,00,000 (₹ 13.50) – ₹ 10,00,000] 3.605
= - ₹ 50,00,000 + [₹ 27,00,000 – ₹ 10,00,000] 3.605
= - ₹ 50,00,000 + ₹ 61,28,500
= ₹ 11,28,500

Measurement of Sensitivity Analysis

a. Sales Price:

Let the sale price/Unit be S so that the project would break even with 0 NPV.
∴ ₹ 50,00,000 = [2,00,000 (S – ₹ 16.50) – ₹ 10,00,000] PVIAF (12%,5)
₹ 50,00,000 = [2,00,000S – ₹ 33,00,000 – ₹ 10,00,000] 3.605
₹ 50,00,000 = [2,00,000S – ₹ 43,00,000] 3.605
₹ 13,86,963 = 2,00,000S – ₹ 43,00,000
₹ 56,86,963 = 2,00,000S
S = ₹ 28.43 which represents a fall of (30 - 28.43)/30 or 0.0523 or 5.23%

b. Sales volume:

Let V be the sale volume so that the project would break even with 0 NPV.
∴ ₹ 50,00,000 = [V (₹ 30 – ₹ 16.50) – ₹ 10,00,000] PVIAF (12%,5)
₹ 50,00,000 = [V (₹ 13.50) – ₹ 10,00,000] PVIAF (12%,5)
₹ 50,00,000 = [₹ 13.50V – ₹ 10,00,000] 3.605
₹ 13,86,963 = ₹ 13.50V – ₹ 10,00,000
₹ 23,86,963 = ₹ 13.50V
V = 1,76,812 which represents a fall of (2,00,000 - 1,76,812)/2,00,000 or 0.1159 or 11.59%

c. Variable Cost:

Let the variable cost be V so that the project would break even with 0 NPV.
∴ ₹ 50,00,000 = [2,00,000(₹ 30 – V) – ₹ 10,00,000] PVIAF(12%,5)

₹ 50,00,000 = [₹ 60,00,000 – 2,00,000 V – ₹ 10,00,000] 3.605
₹ 50,00,000 = [₹ 50,00,000 – 2,00,000 V] 3.605
₹ 13,86,963 = ₹ 50,00,000 – 2,00,000 V
₹ 36,13,037 = 2,00,000V V = ₹ 18.07
Which represents a fall of (18.07 – 16.50)/16.50 or 0.0951 or 9.51%

d. Expected Net Present Value

(1,75,000 X 0.30) + (2,00,000 X 0.60) + (2,25,000 X 0.10) =1,95,000
NPV = [1,95,000 X ₹ 13.50 – ₹ 10,00,000] 3.605 – ₹ 50,00,000 = ₹ 8,85,163

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

Worst Case:

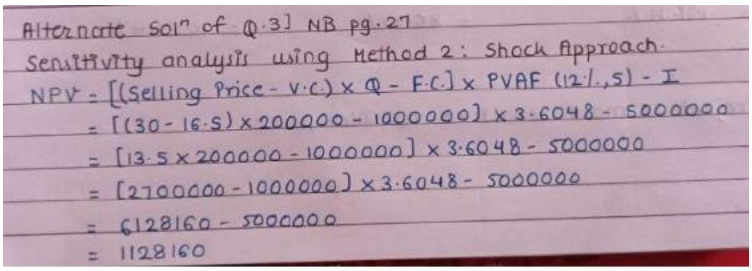
[1,75,000 X ₹ 13.50 – ₹ 10,00,000] 3.605 – ₹ 50,00,000 = - ₹ 88,188

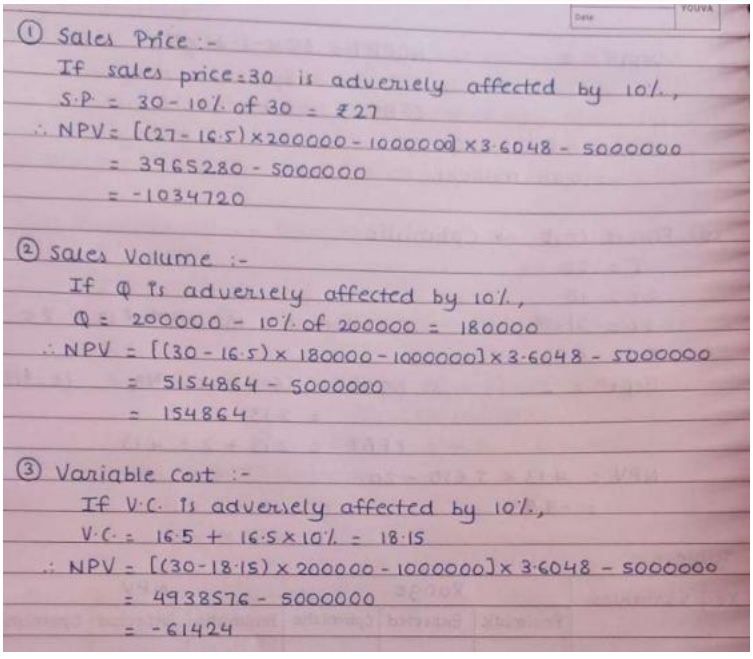
Best Case:

[2,25,000 X ₹ 13.50 – ₹ 10,00,000] 3.605 – ₹ 50,00,000 = ₹ 23,45,188

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.

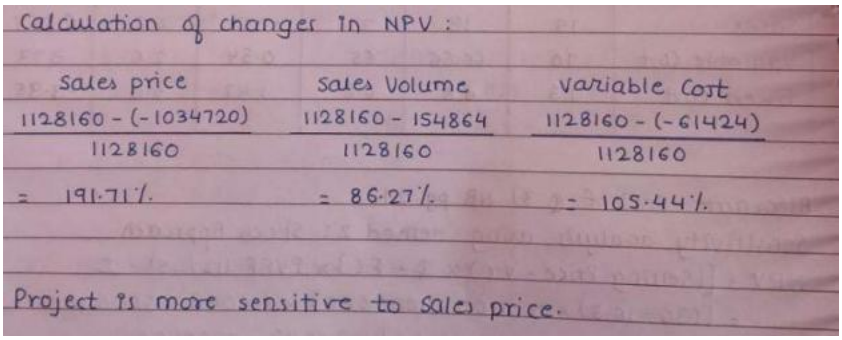
Alternative answer


Alternate Soln of Q.3] NB pg.27
Sensitivity analysis using Method 2: Shock Approach.
NPV = [(Selling Price - V.C.) x Q - F.C.] x PVAF (12%,5) - I
= [(30 - 16.5) x 200000 - 1000000] x 3.6048 - 5000000
= [13.5 x 200000 - 1000000] x 3.6048 - 5000000
= [2700000 - 1000000] x 3.6048 - 5000000
= 6128160 - 5000000
= 1128160


① Sales Price :-
If sales price=30 is adversely affected by 10%,
S.P = 30 - 10% of 30 = ₹27
∴ NPV = [(27 - 16.5) x 200000 - 1000000] x 3.6048 - 5000000
= 3965280 - 5000000
= -1034720

② Sales Volume :-
If Q is adversely affected by 10%,
Q = 200000 - 10% of 200000 = 180000
∴ NPV = [(30 - 16.5) x 180000 - 1000000] x 3.6048 - 5000000
= 5154864 - 5000000
= 154864

③ Variable Cost :-
If V.C. is adversely affected by 10%,
V.C. = 16.5 + 16.5 x 10% = 18.15
∴ NPV = [(30 - 18.15) x 200000 - 1000000] x 3.6048 - 5000000
= 4938576 - 5000000
= -61424



Calculation of changes in NPV :

Sales price	Sales Volume	Variable Cost
$\frac{1128160 - (-1034720)}{1128160}$	$\frac{1128160 - 154864}{1128160}$	$\frac{1128160 - (-61424)}{1128160}$
= 191.71%	= 86.27%	= 105.44%

Project is more sensitive to sales price.

Topic Adjusted Present Value (APV)

Question 12: [Class 6 CW Q1]

Swati Electronics Limited is evaluating a capital project requiring an outlay of Rs.120 lakhs. It is expected to generate a net cash inflow of Rs.28.5 lakhs for 7 years. The opportunity cost of capital is 15%. SwatiElectronics is planning to raise Rs.60 lakhs from term loan. The term loan carries an interest rate of 12% and would be repayable in 12 equal half yearly installments, the first installment falling due at the end of first-half of second year. The balance amount required for the project can be raised by issuing external equity. The issue cost is expected to be 5%. The tax rate for the company is 30%.

You are required to find out

a. Base case NPV
b. Adjusted NPV

(Source: FOD)

ANSWER:

a. Base case NPV = –120 + 28.5 × PVIFA (15,7)
= –120 + 28.5 × 4.160
= –1.44

∴ Base case NPV of capital project of Swati Electronics is Rs.–1.44 lakhs.

b. The company raises Rs.60 lakhs from debt @12%. The interest, repayment of loan and present value of tax shield are computed as follows:

Year	Half	Debt outstanding at the beginning	Interest	Tax shield	Present value of Tax shield	Repayment
1	1	60	3.60	1.08	1.02	0
	2	60	3.60	1.08	0.96	0
2	1	60	3.60	1.08	0.91	5
	2	55	3.30	0.99	0.78	5
3	1	50	3.00	0.90	0.67	5
	2	45	2.70	0.81	0.57	5
4	1	40	2.40	0.72	0.48	5
	2	35	2.10	0.63	0.39	5
5	1	30	1.80	0.54	0.32	5
	2	25	1.50	0.45	0.25	5
6	1	20	1.20	0.36	0.19	5
	2	15	0.90	0.27	0.13	5
7	1	10	0.60	0.18	0.08	5
	2	05	0.30	0.09	0.04	5

Total value of the tax shield = Rs.6.79 lakhs.

The company raises Rs.60 lakhs from equity.

As the issue cost is 5%, so to receive Rs.60 lakhs from equity the company has to issue equity of (60/0.95) or, value Rs.63.16 lakhs.

∴ Cost of issue = 63.16 – 60.00
= Rs.3.16 lakhs.

∴ Adjusted NPV = –1.44 – 3.16 + 6.79
= Rs.2.19 lakhs

Alternative Answer

1) Step 1 : Base Case NPV
= 28.5 × PVAF (15%, 7) – 120
= -1.428 lakhs
[Self note : Iska mtlb project unviable h agar purely equity financed h....)

∴ Base Case NPV = -1.428 lakhs

2) Step 2 : Adjusted NPV
→ Floatation cost = $\frac{60}{0.95} \times 0.05$ = 3.16 lakhs.

→ Tax Advantage of Debt disc. @ 12%.

6% 6 months ka hai toh saal ka effective int. = $(1.06)^2 - 1 = 12.36\%$

Yrs	Amount o/s	Interest @ 12%	Total Interest	Interest Tax Shield	P.V. @ 12.36%
1 : 1st 1/2	60	3.6	7.2	2.16 (7.2 × 0.3)	1.92
2nd 1/2	60	3.6			
2 : 1st 1/2	60	3.6	6.9	2.07 (6.9 × 0.3)	1.64
2nd 1/2	55	3.3			
3 : 1st 1/2	50	3.0	5.7	1.71 (5.7 × 0.3)	1.21
2nd 1/2	45	2.7			
4 : 1st 1/2	40	2.4	4.5	1.35 (5.7 × 0.3)	0.85
2nd 1/2	35	2.1			
5 : 1st 1/2	30	1.8	3.3	0.99 (3.3 × 0.3)	0.55
2nd 1/2	25	1.5			
6 : 1st 1/2	20	1.2	2.1	0.63 (2.1 × 0.3)	0.31
2nd 1/2	15	0.9			
7 : 1st 1/2	10	0.6	0.9	0.27 (0.9 × 0.3)	0.12
2nd 1/2	5	0.3			
			Tax Advantage of Debt = 6.60		

APV = Base Case NPV – Issue Cost + Tax advantage of debt
= -1.428 – 3.16 + 6.6
∴ APV = 2.012 lakhs

we have calculated ITS assuming we will get it at the end of each year & calculated its PV accordingly

Conclusion : So the project which was not viable with 100% equity financing is now viable given the tax advantage of debt.

Note : We have not considered tax shield on the issue cost. Alternatively, post tax issue cost = 3.16 × 0.7 = 2.21
∴ APV = -1428 – 2.21 + 6.6 = 2.962

Topic Utility Approach to Capital Budgeting

Question 15: [Class 7 CW Q1]

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

Cash Flow in ₹	-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	0.10	0.20	0.40	0.20	0.10

Project B

Cash Flow (₹)	- 10000	-4000	15000	5000	10000
Probability	0.10	0.15	0.40	0.25	0.10

Which project should be selected and why ?

(Source: ICAI)

ANSWER:

Evaluation of project utilizes of Project A and Project B

Cash flow (in ₹)	Project A		
	Probability	Utility	Utility value
-15,000	0.10	-100	-10
-10,000	0.20	-60	-12
15,000	0.40	40	16
10,000	0.20	30	6
5,000	0.10	20	2
			2

Cash flow (in ₹)	Project B		
	Probability	Utility	Utility value
-10,000	0.10	-60	-6
-4,000	0.15	-3	-0.45
15,000	0.40	40	16
5,000	0.25	20	5
10,000	0.10	30	3
			17.55

Project B should be selected as its expected utility is more.

Question 17: [Class 7 CW Q3]

Col. Rao, after retirement from the Indian army, is planning to start up an automobile service centre. Initial outlay for this project is Rs.60 lakhs. The expected cash-inflows of the project are as given below:

Year	1	2	3	4	5	6	7
Cash inflow (Rs. in Lakhs)	10	15	16	16	12	8	5

Risk free rate is 8%. A management consultant says that certainty equivalent factor in this business behaves as per the following equation

$$\alpha_{t+1} = \frac{\alpha_t\,(1.01+i)}{(1+k)}$$

where

i = risk free rate,

k = cost of capital,

α_t = certainty equivalent factor for year t

$\alpha_t + 1$ = certainty equivalent factor for year (t + 1)

α_0 = 1

You are required to find the maximum value of cost of capital for this project's financing at which the promoter is indifferent between acceptance and rejection of this project.

(Source: FOD)

ANSWER:

$\alpha_0 = 1$ as the cash flow in o^{th} year is certain

$\therefore$ NPV as per certainty equivalent method would be

$$-60+\frac{(1.09)\times10\times\text{PVIF}(8\%,1)}{(1+k)}+\frac{15\times(1.09)^2\times\text{PVIF}(8\%,2)}{(1+k)^2}+\frac{16\times(1.09)^3\times\text{PVIF}(8\%,3)}{(1+k)^3}+$$

$$\frac{16\times(1.09)^4\times\text{PVIF}(8\%,4)}{(1+k)^4}+\frac{12\times(1.09)^5\times\text{PVIF}(8\%,5)}{(1+k)^5}+\frac{8\times(1.09)^6\times\text{PVIF}(8\%,6)}{(1+k)^6}$$

$$\frac{5\times(1.09)^7\times\text{PVIF}(8\%,7)}{(1+k)^7}$$

$$= \quad -60+\frac{10.09}{(1+k)}+\frac{15.28}{(1+k)^2}+\frac{16.45}{(1+k)^3}+\frac{16.60}{(1+k)^4}+\frac{12.57}{(1+k)^5}+\frac{8.45}{(1+k)^6}+\frac{5.33}{(1+k)^7}$$

For maximum value of cost of capital the NPV should be zero when the promoter becomes indifferent between acceptance and rejection of the project.

at k = 10% R. H. S. = 0.80

k = 11% R. H. S. = –1.00

∴ by interpolating, we get

$$k = 11 - \frac{(0+1.00)}{(0.80+1.80)} = 10.44\%.$$

Topic Inflation & Capital Budgeting

Question 22: [Class 8 CW Q1]

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

Year	0	1	2	3
₹ (in lakhs)	(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%. Show how the viability of the project is to be evaluated. PVF at 10% for 1-3 years are 0.909, 0.826 and 0.751.

(Source: ICAI)

ANSWER:

Here the given cash flows have to be adjusted for inflation. Alternatively, the discount rate can be converted into nominal rate, as follows:-

Year 1 = $\frac{0.909}{1.05}$ = 0.866; Year 2 = $\frac{0.826}{(1.05)^2}$ or $\frac{0.826}{1.1025}$ = 0.749

Year 3 = $\frac{0.751}{(1.05)^3} = \frac{0.751}{1.1576}$ = 0.649

Year	Nominal Cash Flows (₹ in lakhs)	Adjusted PVF as above	PV of Cash Flows (₹ in lakhs)
1	30	0.866	25.98
2	40	0.749	29.96
3	30	0.649	19.47
Cash Inflow			75.41
Less: Cash Outflow			72.00
Net Present Value			3.41

With positive NPV, the project is financially viable.

Alternative Solution Assumption:

The cost of capital given in the question is "Real'.
Nominal cost of capital = (1.10) (1.05) -1 = 0.155 =15.50%
DCF Analysis of the project

(₹ Lakhs)

	Period	PVF @15.50%	CF	PV
Investment	0	1	-72	-72.00
Operation	1	0.866	30	+25.98
---do---	2	0.750	40	+30.00
---do---	3	0.649	30	+19.47
NPV				+3.45

The proposal may be accepted as the NPV is positive.

Question 23: [Class 8 CW Q2]

Sonal Textiles Limited is considering an investment of Rs.10 crore in a project. The project has a life of 5years and the salvage value of the project at the end of its life would be nil. The depreciation charge would be Rs.2 crore every year. The expected revenues and costs (excluding depreciation) ignoring the inflation would be as follows:

		(Rs in crore)
Year	Revenues	Costs
1	15.0	12.0
2	18.0	14.5
3	19.0	15.5
4	17.0	14.0
5	13.0	11.0

The inflation-adjusted cost of capital to the company is 13%. The expected inflation rates for revenues and costs would be as follows:

Year	Revenues (%)	Costs (%)
1	6.0	7.5
2	5.5	7.5
3	5.5	7.0
4	5.0	7.0
5	5.0	6.0

The tax rate applicable to the company is 35%.
You are required to calculate the inflation-adjusted net present value of the project.

(Source: FOD)

ANSWER:

Cash flows in different years are as follows:

Year (1)	Expected Revenue (2)	Expected cost (3)	Depreciation Tax-shield (4)	Net cash flow [(8) ± (3)] (1±T) + DT
1	15 × (1.06) = 15.9	12 × (1.075) = 12.9	0.7	2.65
2	18 (1.06) (1.055) = 20.13	14.5 × (1.075) × (1.075) = 16.76	0.7	2.89
3	19 (1.06) (1.055) (1.055)= 22.42	15.5 × (1.075) × (1.075) × (1.07) × = 19.17	0.7	2.81
4	17(1.06) (1.055) (1.055)(1.05) = 21.06	14.0 × (1.075) × (1.075) × (1.07) × (1.07) = 18.52	0.7	2.35
5	13 (1.06) (1.055) (1.055)(1.05) (1.05) = 16.91	11.0 × (1.075) × (1.075) × (1.07) × (1.07) × (1.06) = 15.43	0.7	1.66

$$\text{NPV} = \frac{2.65}{1.13}+\frac{2.89}{(1.13)^2}+\frac{2.81}{(1.13)^3}+\frac{2.35}{(1.13)^4}+\frac{1.66}{(1.13)^5}-10$$
$$= 2.35 + 2.26 + 1.95 + 1.44 + 0.90 - 10$$
$$= 8.9 - 10$$
$$= -1.10.$$

Topic Conceptual Sums

Question 24: [Class 9 CW Q6]

GNIT Ltd. is planning to set up an education division to offer commercial training in software development. The target debt-equity ratio of the company is 1.5 and tax rate is 30%. The cash flows expected from the division and their probabilities are as follows :

	Cash flow (Rs. lakhs)	Probability (%)
Year 1	10	30
	25	60

	20	10
Year 2	30	40
	35	20
	25	40
Year 3	40	15
	45	50
	35	35

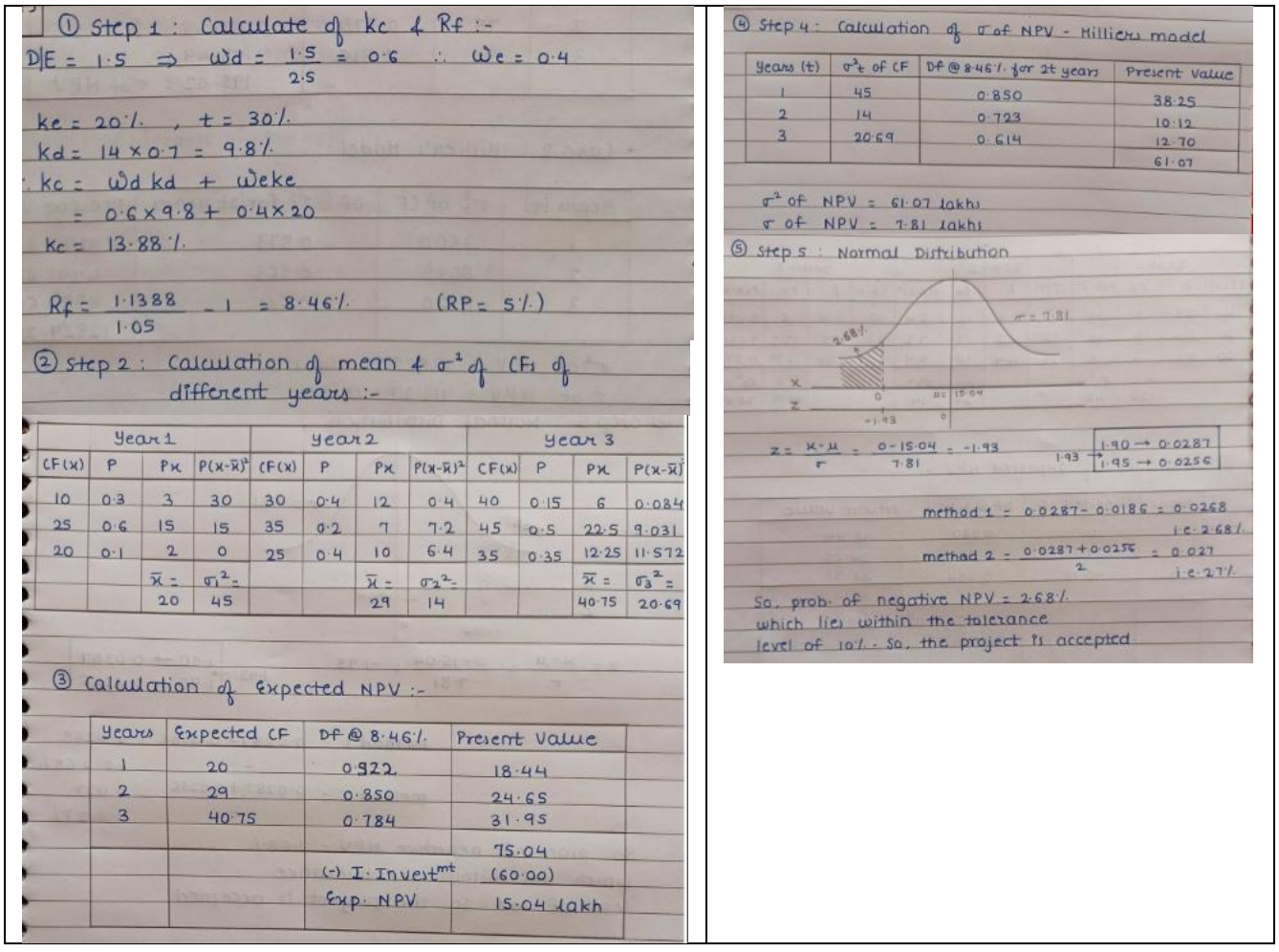
The initial investment required is Rs.60 lakhs. The analyst of the company estimates that:

- The long term fund providers of the company generally expect a premium of 5% on the risk-free rate.
- The cost of equity and debt are 20% and 14% respectively.
- The cash flows of different years are independent.
- The management of the company wants that the probability of the NPV being negative should not bemore than 10%.
- Assume Normal Distribution

Advise: Should the company proceed with the investment? Support your answer with relevant calculations.

(Source: FOD)

ANSWER:



① Step 1 : Calculate of kc & Rf :-

D/E = 1.5 ⇒ $W_d = \frac{1.5}{2.5} = 0.6$ ∴ $W_e = 0.4$

ke = 20%, t = 30%

kd = 14 × 0.7 = 9.8%

∴ kc = $W_d k_d + W_e k_e$

= 0.6 × 9.8 + 0.4 × 20

kc = 13.88%

$R_f = \frac{1.1388}{1.05} - 1 = 8.46\%$ (RP = 5%)

② Step 2 : Calculation of mean & σ^2 of CFs of different years :-

Year 1				Year 2				Year 3			
CF(x)	P	Px	$P(x-\bar{x})^2$	CF(x)	P	Px	$P(x-\bar{x})^2$	CF(x)	P	Px	$P(x-\bar{x})^2$
10	0.3	3	30	30	0.4	12	0.4	40	0.15	6	0.084
25	0.6	15	15	35	0.2	7	7.2	45	0.5	22.5	9.031
20	0.1	2	0	25	0.4	10	6.4	35	0.35	12.25	11.572
		$\bar{x}$ = 20	σ_1^2 = 45			$\bar{x}$ = 29	σ_2^2 = 14			$\bar{x}$ = 40.75	σ_3^2 = 20.69

③ Calculation of Expected NPV :-

Years	Expected CF	Df @ 8.46%	Present Value
1	20	0.922	18.44
2	29	0.850	24.65
3	40.75	0.784	31.95
			75.04
		(-) I. Investment	(60.00)
		Exp. NPV	15.04 lakh

④ Step 4 : Calculation of σ of NPV - Hillier's model

Years (t)	σ^2t of CF	Df @ 8.46% for 2t years	Present Value
1	45	0.850	38.25
2	14	0.723	10.12
3	20.69	0.614	12.70
			61.07

σ^2 of NPV = 61.07 lakhs

σ of NPV = 7.81 lakhs

⑤ Step 5 : Normal Distribution

$z = \frac{x-\mu}{\sigma} = \frac{0-15.04}{7.81} = -1.93$

1.93 → 1.90 → 0.0287, 1.95 → 0.0256

method 1 = 0.0287 − 0.0186 = 0.0268 i.e. 2.68%

method 2 = $\frac{0.0287+0.0256}{2}$ = 0.027 i.e. 2.7%

So, prob. of negative NPV = 2.68% which lies within the tolerance level of 10%. So, the project is accepted

Probability Tree

Question 29: [Class 10 CW Q5]

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:

i. The expected NPV of the project.
ii. The best case and the worst case NPVs.
iii. The probability of occurrence of the worst case if the cash flows are perfectly dependent overtime and independent overtime.
iv. 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.
v. 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?

(Source: ICAI)

ANSWER:

i. **Expected cash flows:-**

Year		Net cash flows	P.V.	PV. @ 10%
0	(4,00,000 x 1)	(-)4,00,000	1.000	(-)4,00,000
1 to 4	(1,00,000x0.3+1,10,000x0.5+ 1,20,000 x 0.2)	1,09,000	3.170	3,45,530
5	[1,09,000 + (20,000 x 0.3 + 50,000 x 0.5 +	1,52,000	0.621	94,392

	60,000 x 0.2)]			
		NPV=		39,922

ii. ENPV of the worst case

1,00,000 x 3.790 = ₹ 3,79,000 (Students may have 3.791 also the values will change accordingly)

20,000 x 0.621 = ₹ 12,420/-

ENPV = (-) 4,00,000 + 3,79,000 + 12,420 = (-) ₹ 8,580/-

ENPV of the best case

ENPV = (-) 4,00,000 + 1,20,000 x 3.790 + 60,000 x 0.621 = ₹ 92,060/-.

iii. a. Required probability = 0.3

b. Required probability = $(0.3)^5$ = 0.00243

iv. The base case NPV = (-) 4,00,000 + (1,10,000 x 3.79) + (50,000 x 0.621)= ₹ 47,950/-

ENPV = 0.30 x (-) 8580 + 0.5 x 47950 + 92060 x 0.20 = ₹ 39,813/-

Therefore,

$$\sigma_{ENPV} = \sqrt{0.3(-8580-39{,}813)^2 + 0.5(47950-39813)^2 + 0.2(92{,}060-39{,}813)^2} = ₹\ 35{,}800/-$$

Therefore, CV = 35,800/39,813 = 0.90

v. Risk adjusted out of cost of capital of X Ltd. = 10% - 1% = 9%.

NPV

Year	Expected net cash flow	PV @ 9%	
0	(-) 4,00,000	1.000	(-) 4,00,000
1 to 4	1,09,000	3.240	3,53,160
5	1,52,000	0.650	98,800
		ENPV =	51,960

Therefore, the project should be accepted.

Topic Replacement Project

Question 30: [Class 11 CW Q1]

The Mayfair Rubber Industry Ltd. (MRIL) manufactures small rubbers components for the local markets. It is presently using 8 machines which were acquired three years ago at a cost of Rs. 18 lakhs each having a useful life of 8 years with no salvage value. The policy of the company is to depreciate all machines in 5 years. There production capacity is 37 lakhs unit while the annual demand is 30 lakhs units. The MRIL has received an order from a leading automobile company of Singapore for the supply of 20 lakh rubber bushes at Rs. 15 per unit. The existing machines can be sold @ Rs. 12 lakh per machine. It is estimated that the removal cost of each machine would be Rs.

60,000. In order to meet the increase demand, the MRIL can acquire 3 new machines at an estimated cost of Rs. 100 lakh each which will have a combine production capacity of 52 lakh units.

The operating parameters of the existing machine are as follow:

i. Labour requirement (unskilled- 18; skilled- 18; supervisor-3;and maintenance – 2) and their per month salary are Rs. 3,500; Rs. 5,500; Rs. 6,500 and Rs. 5,000 each respectively with an increase of 10% to adjust inflation.
ii. Raw material cost, inclusive of wastage is 60% of revenues.
iii. Maintenance cost – years 1-5 (Rs 22.5 lakh) and years 6-8 (Rs. 67.5 lakh).
iv. Operating expenses – Rs. 52.10 lakh expected to increase annually by 5%.
v. Insurance cost/Premium – year 1,2% of the original cost of the machine, after wards discounted by 10%.
vi. Selling price – Rs. 15 per unit.

The projected operating parameters with the replacement by the new machines are as follows:

i. Additional working capital – Rs. 50 lakh.
ii. Savings in cost of utility – Rs. 2.5 lakh.
iii. Maintenance cost – years 1-2 (Rs. 7.5 lakh); years 3-5 (Rs. 37.5 lakh).
iv. Raw material cost – 55% of sales.
v. Employee requirement (6 skilled at monthly salary of Rs. 7000 each and one for maintenance at monthly salary of Rs 6500).
vi. Laying of cost of 34 workers – (unskilled – 18; skilled – 12; supervisors – 3; and maintenance – 1) Rs 9,21,000 that is equivalent to six month salary.
vii. Insurance cost /premium – 2% of the purchase cost of machines in the first year and discounted by 10% in subsequent years.
viii. Life of machines – 5 years and salvage value – Rs. 10 lakh per machine.

The company follows straight line method of depreciation and the same is accepted for tax purpose. Corporate tax rate is 35% and the cost of capital is 20%.

As the Finance manager of MRIL, prepare a report for submission to the top management with your recommendation about the financial viability of the replacement of the existing machine.

(Source: ICAI)

ANSWER:

Incremental CFAT and NPV

(₹ in lakhs)

Particulars	1	2	3	4	5
Sales	300	300	300	300	300
Add: Cost Savings:					
Maintenance (note 2)	15	15	30	30	30
Cost of utilities	2.5	2.5	2.5	2.5	2.5
Labour Costs (note 3)	17.16	18.87	20.76	22.84	25.12

Less: Incremental cost					
Raw materials (note 4)	142.5	142.5	142.5	142.5	142.5
Depreciation (note 5)	25.2	25.2	54	54	54
Insurance (note 6)	4.12	3.71	3.34	3	2.71
Earning before Tax	163.04	165.16	153.42	155.84	158.76
Less: Taxes (0.35)	57.064	57.806	53.607	54.544	55.426
Earning after taxes	105.976	107.354	99.723	101.296	102.934
CFAT (EAT + Depreciation)	130.976	132.354	153.723	155.296	156.934
Salvage Value					30
Release of working capital					50
(x)PV factor at .20	0.833	0.694	0.579	0.482	0.402
PV	109.10	91.85	89.01	74.85	95.25
Total present value (t = 1- 5)					460.06
Less: cash Outflow					276.55
NPV					183.51

FINANCIAL ANALYSIS WHETHER TO REPLACE THE EXISTION MACHINES (USING NPV METHOD)

Incremental cash outflows:

Cost of 3 new machines (₹ 100 lakh × 3)	300,00,000
Additional working capital	50,00,000
Less: Sale proceeds of existing machines	96,00,000
Add: Removal cost of existing machines	4,80,000
Tax on profit on sale of machine (working note1)	11,76,000
Cost of layng off 34 workers (₹ 921000 tax advantage @ .35 i.e. to ₹ 3,22,350)	5,98,650
Incremental cash outflows	2,76,54,650

Working Notes

1. Tax on profit on sale of existing machine:

Sale proceeds of existing machine:		96,00,000
	(8 × 12,00,000)	
Less: Book value	(₹ 18 lakh × 8 – Original Cost accumulated depreciation 28.80 × 3)	57,60,000
	Gross profit	**38,40,000**
Less: Removal Cost	(60,000 × 8)	4,80,000
	Net Profit	**33,60,000**
	Tax rate	0.35
	Taxes payable on profit	**11,76,000**

2. Saving in Maintenance cost: (₹ in lakhs)

Year	1	2	3	4	5
Old Machine	22.5	22.5	67.5	67.5	67.5
New Machine	7.5	7.5	37.5	37.5	37.5

Saving in cost	15	15	30	30	30

3. Savings in Labour cost:

Existing labour cost		
Unskilled	(18 × ₹ 3,500 × 12 months)	7,56,000
Skilled	(18 × ₹ 5,500 × 12 months)	11,88,000
Supervisor	(3 × ₹ 6,500 × 12 months)	2,34,000
Maintenance	(2 × ₹ 5,000 × 12 months)	1,20,000
		22,98,000
Proposed labor cost		
Skilled	(6 × ₹ 7,000 × 12 months)	5,04,000
Maintenance	(1 × ₹ 6,500 × 12 months)	78,000
	Cost savings	17,16,000
Savings in subsequent years will increase by 10%		

4. Incremental cost of raw material:

Raw material required for old machine:	
(3000000 × ₹ 15 per unit × 0.60)	2,70,00,000
Raw material required for new machine	
(5000000 × ₹ 15 per unit × 0.55)	4,12,50,000
Additional raw material Cost	1,42,50,000

5. Incremental Depreciation: (₹ in Lakhs)

Years	1 – 2	3 – 5
Depreciation (with new machine) (₹ 100 lakh × 3 – 10 × 3) / 5 years	54.00	54.00
Depreciation (with old machine) (₹ 18 lakh × 8/5 years)	28.80	-
Incremental Depreciation	25.20	54.00

6. Insurance: (₹ in lakhs)

Years	1	2	3	4	5
New Machine	6.00	5.40	4.86	4.37	3.94
Old Machine **(Wrong Calculation)**	**1.88**	**1.69**	**1.52**	**1.37**	**1.23**
Incremental Insurance	4.12	3.71	3.34	3.00	2.71