8. RISK ANALYSIS IN CAPITAL BUDGETING

ASSIGNMENT SOLUTIONS

PROBLEM NO: 1

Estimation of Expected Net Cash Flows:

Assumption (1)	Cash Flows (Rs.) (2)	Probability (3)	Expected cash flow(2x3) (Rs.)
Best guess	9,00,000	0.3	9,00,000 × 0.3 = 2,70,000
Most likely	5,00,000	0.4	5,00,000 × 0.4 = 2,00,000
Worst case	2,00,000	0.3	2,00,000 × 0.3 = 60,000
Expected Net cash flow (ENCF)			= 5,30,000

PROBLEM NO: 2

Year 1			Year 2			Year 3		
Cash Flow (Rs.)	Probability	Expected Value (Rs.)	Cash Flow (Rs.)	Probability	Expected Value (Rs.)	Cash Flow (Rs.)	Probability	Expected Value (Rs.)
3,000	0.1	300	4,000	0.3	1,200	5,000	0.4	2,000
6,000	0.2	1,200	6,000	0.4	2,400	10,000	0.2	2,000
9,000	0.3	2,700	9,000	0.2	1,800	13,000	0.1	1,300
12,000	0.4	4,800	12,000	0.1	1,200	16,000	0.3	4,800
ENCF		9,000			6,600			10,100

The present value of the expected value of cash flow at 10% discount rate has been determined as follows:

$$\text{Present Value of Cash Flow} = \frac{ENCF_1}{(1+k)^1} + \frac{ENCF_2}{(1+k)^2} + \frac{ENCF_3}{(1+k)^3} = \frac{9,000}{(1.12)^1} + \frac{6,600}{(1.12)^2} + \frac{10,100}{(1.12)^3}$$

= 9,000 x 0.893 + 6,600 x 0.797 + 10,100 x 0.712 = Rs. 20,488

Expected Net Present Value = Present Value of Cash Flow - Initial Investment

= Rs. 20,488 - Rs. 15,000 = Rs. 5,488

PROBLEM NO: 3

Estimation of Variance, Standard Deviation(s) & Co-efficient of variation of each of the projects:

Possible Event	Project M					Project N				
	Cash Flow (Rs.) (x)	Probability	Expected Cash Flow	d_M	Pd_M^2	Cash Flow (Rs.) (y)	Probability	Expected Cash Flow	d_N	Pd_N^2
P	12,000	0.10	1,200	6,000	36,00,000	14,000	0.30	4,200	3,400	34,68,000
Q	15,000	0.30	4,500	3,000	27,00,000	16,000	0.20	3,200	1,400	3,92,000
R	18,000	0.20	3,600	0	0	18,000	0.20	3,600	600	72,000
S	21,000	0.30	6,300	3,000	27,00,000	20,000	0.10	2,000	2,600	6,76,000
T	24,000	0.10	2,400	6,000	36,00,000	22,000	0.20	4,400	4,600	42,32,000
			18,000		1,26,00,000			17,400		88,40,000

Standard deviation for Project M = $\sqrt{1,26,00,000}$ = 3,549.64

Standard deviation for Project N = $\sqrt{88,40,000}$ = 2,973.21

Projects	Coefficient of variation	Risk
M	$\frac{3,549.64}{18,000} = 0.1972$	High
N	$\frac{2,973.21}{17,400} = 0.1708$	Low

Conclusion: Project N should be selected.

Note: Students are advised to rectify the hint answer given in our material

PROBLEM NO: 4

SOUTH PROJECT:

i) Computation of Expected NPV & Standard Deviation

NPV(X)	Probability	Expected NPV ($\bar{X}$)	D_x ($X-\bar{X}$)	D_x^2	PD_x^2
3	0.05	0.15	-4.8	23.04	1.152
5	0.30	1.50	-2.8	7.84	2.352
6	0.30	1.80	-1.8	3.24	0.972
12	0.30	3.60	4.2	17.64	5.292
15	0.05	0.75	7.2	51.84	2.592
		$\bar{X}$ = 7.80			ΣPdx^2=12.36

Standard Deviation of South Project= $\sqrt{\sum Pdx^2} = \sqrt{12.36}$ σ NPV=3.516

ii)

NPV(X)	Probability	Expected NPV	D_x ($X-\bar{X}$)	D_x^2	PD_x^2
3	0.15	0.45	-4.8	23.04	3.456
5	0.25	1.25	-2.8	7.84	1.960
6	0.25	1.50	-1.8	3.24	0.810
12	0.25	3.00	4.2	17.64	4.41
16	0.10	1.60	8.2	67.24	6.724
		7.80			ΣPdx^2=17.36

Standard Deviation = $\sqrt{\sum Pdx^2} = \sqrt{17.36}$ = SD of NPV = 4.167

iii) Risker: Since σ NPV for North project is more than the σ NPV of the South project. North project is considered as a Riskers project.

PROBLEM NO: 5

i) On the basis of standard deviation project X be chosen because it is less risky than Project Y having higher standard deviation.

ii) $CV_X = \frac{SD}{ENPV} = \frac{40,000}{60,000} = 0.67$

$CV_Y = \frac{SD}{ENPV} = \frac{1,35,000}{2,27,000} = 0.595$

On the basis of Co-efficient of Variation (C.V.) Project X appears to be more risky and Y should be accepted.

iii) COV is best measure to evaluate risk of proposals having different Expected NPV and SD(σ)

PROBLEM NO: 6

a) Using risk - free rate

Year	Cash flows (inflows) Rs.)	PV Factor at 10%	PV of Cash flows (in flows)
1	40,000	0.909	36,360
2	50,000	0.826	41,300

3	15,000	0.751	11,265
4	30,000	0.683	20,490
PV of Cash inflows			1,09,415
Less: PV of Cash outflows			(1,00,000)
NPV			**9,415**

b) Using risk - adjusted discount rate

Year	Cash flows (inflows) Rs.)	PV Factor at 10%	PV of Cash flows (in flows)
1	40,000	0.833	33,320
2	50,000	0.694	34,700
3	15,000	0.579	8,685
4	30,000	0.482	14,460
PV of Cash inflows			91,165
Less: PV of Cash outflows			(1,00,000)
NPV			(8,835)

- The project would be acceptable when no allowance is made for risk. But it will not be acceptable is risk premium is added to the risk free rate. It moves from positive NPV to negative NPV.
- If the firm were to use the internal rate of return, then the project would be accepted when IRR is greater than the risk - adjusted discount rate.

PROBLEM NO: 7

Statement showing the determination of the risk adjusted Net Present Value:

Projects	Net cash outlays (Rs.)	Coefficient of variation	Risk adjusted discount rate	Annual Cash inflow (Rs.)	PV factor 1-5 years	Discounted cash inflow (Rs.)	Net present value (Rs.)
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii) = (v) × (vi)	(viii) = (vii) – (ii)
X	4,00,000	1.6	18%	2,00,000	3.127	6,25,400	2,25,400
Y	1,80,000	2.0	22%	80,000	2.864	2,29,120	49,120
Z	2,50,000	1.2	16%	1,25,000	3.274	4,09,250	1,59,250

PROBLEM NO: 8

Part I:

Step 1: Ascertain the discount rate.

When CE approach is adopted, risk-free rate (i.e., 8% in this case) is relevant.

Step 2: Compute NPV of the project X

Year	Cash flow (Rs.)	Certainty factor	Certain cash flow (Rs.)	DF @ 8%	PV of cash flows (Rs.)
0	(3,40,000)	1.0	(3,40,000)	1.000	(3,40,000)
1	1,80,000	0.8	1,44,000	0.926	1,33,344
2	2,00,000	0.7	1,40,000	0.857	1,19,980
3	2,00,000	0.5	1,00,000	0.794	79,400
					NPV = (7,276)

Statement showing NPV of Project Y

Year	Cash flow (Rs.)	Certainty factor	Certain cash flow (Rs.)	DF @ 8%	PV of cash flows (Rs.)
0	(3,30,000)	1.0	(3,30,000)	1.000	(3,30,000)
1	1,80,000	0.9	1,62,000	0.926	1,50,012
2	1,80,000	0.8	1,44,000	0.857	1,23,408
3	2,00,000	0.7	1,40,000	0.794	1,11,160
					NPV = 54,580

Step 3: Decision: Since the NPV of project X is negative it should be rejected. Since the NPV of project Y is positive, it should be accepted.

PART II: Project for which RADR will be applied

Since the CE coefficient is lower in project X, it is deemed to be riskier than Project Y. Project X should, therefore, be evaluated by using RADR of 10%.

PROBLEM NO: 9

1. Calculation of Net Cash Inflow per year:

	Particulars	Amount (Rs.)
A	Selling Price Per Unit (A)	100
B	Variable Cost Per Unit (B)	50
C	Contribution Per Unit (C = A-B)	50
D	Number of Units Sold Per Year	5 Cr.
E	Total Contribution (E = C X D)	Rs. 250 Cr.
F	Fixed Cost Per Year	Rs. 50 Cr.
G	Net Cash Inflow Per Year (G =E - F)	Rs. 200 Cr.

Calculation of Net Present Value (NPV) of the Project:

Year	Year Cash Flow (Rs. in Cr.)	Discounting @ 6%	Present Value (PV) (Rs. in Cr.)
0	-400	1.000	-400
1	200	0.943	188.60
2	200	0.890	178
3	200	0.840	168
Net Present Value (188.60 + 178 + 168) - 400 =			134.60

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

2. Sensitivity Analysis considering 2.5 % Adverse Variance in each variable

	Changes in variable	Base	Initial Cash Flow increased to Rs. 410 crore	Fixed Cost Per Unit increased to Rs. 51.25	Units sold per year reduced to Rs. 4.875 crore
	Particulars	**Amount Rs.**	**Amount Rs.**	**Amount Rs.**	**Amount Rs.**
A	Selling Price Per Unit (A)	100	100	100	100
B	Variable Cost Per Unit (B)	50	50	50	50
C	Contribution Per Unit (C = A-B)	50	50	50	50
D	Number of Units Sold Per Year (in Crores)	5	5	5	4.875
E	Total Contribution (E = C × D)	250	250	250	243.75
F	Fixed Cost Per Year (in Crores)	50	50	51.25	50
G	Net Cash Inflow Per Year (G =E - F)	200	200	198.75	193.75
H	(G × 2.673)	534.60	534.60	531.26	517.89
I	Initial Cash Flow	400	410	400	400
J	NPV	134.60	124.60	131.26	117.89
K	Percentage Change in NPV		-7.43%	-2.48%	-12.41%

The above table shows that the by varying one variable at a time by 2.5% while keeping the others constant, the impact in percentage terms on the NPV of the project. Thus it can be seen that the change in selling price has the maximum effect on the NPV by 24.82 %.

PROBLEM NO: 10

Calculation of NPV through Sensitivity Analysis:

Particulars	Amount (Rs.)
PV of cash inflows (Rs. 60,00,000 × 3.791)	2,27,46,000
Initial Project Cost	2,00,00,000
NPV	27,46,000

Situation	NPV	Changes in NPV
Base (Present)	Rs. 27,46,000	
If initial project cost is varied adversely by 10%	(Rs. 2,27,46,000 - Rs. 2,20,00,000*) = Rs. 7,46,000	$\frac{(Rs.\ 27,46,000 - Rs.\ 7,46,000)}{Rs.\ 27,46,000}$ = (72.83%)
If annual cash inflow is varied adversely by 10%	[Rs. 54,00,000 (revised cash flow) ** × 3.791) - (Rs. 2,00,00,000)] = Rs. 4,71,400	$\frac{(Rs.27,46,000 - Rs.4,71,400)}{Rs.\ 27,46,000}$ = 82.83%
If cost of capital is varied adversely by 10% i.e. it becomes 11%	(Rs. 60,00,000 × 3.696) - Rs. 2,00,00,000 = Rs. 21,76,000	$\frac{(Rs.27,46,000 - Rs.21,76,400)}{Rs.\ 27,46,000}$ = 20.76%

*Revised initial project Cost = 2,00,00,000 × 110% = 2,20,00,000

**Revised Cash Flow = Rs. 60,00,000 x (100 - 10) % = Rs. 54,00,000

Conclusion: Project is most sensitive to 'annual cash inflow'.

THE END