7. 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

Expected Investment: (Rs. 70,00,000 x 0.20) + (Rs. 80,00,000 x 0.40) + (Rs. 90,00,000 x 0.40)

= Rs.14,00,000 + Rs.32,00,000 + Rs.36,00,000 = Rs.82,00,000

PROBLEM NO: 3

No. of units (1)	Selling Price (2)	Probability (3)	Expected Selling Price (4)	Variable Cost (5)	Probability (6)	Expected Variable Cost (7)	Expected Cash Flow (Rs.) {1 x (4 - 7)}
40,000	10	0.3	3	5	0.25	1	80,000
40,000	20	0.4	8	10	0.35	3.5	1,80,000
40,000	30	0.3	9	15	0.40	6	1,20,000
Expected Cash Inflows							3,80,000
Less: Fixed Cost (P.a)							(1,20,000)
Less: Annual Depreciation							(50,000)
EBIT/ EBT							2,10,000
Less: Taxes @ 50%							(1,05,000)
EAT							1,05,000
Add: Depreciation							50,000
Expected CFAT							1,55,000

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

PROBLEM NO: 4

Possible event	Project X			Project Y		
	Net cash Flows (Rs.)	probability	Expected value	Net Cash Flows (Rs.)	probability	Expected Value (Rs.)
A	5,000	0.20	1,000	15,000	0.10	1,500
B	8,000	0.10	800	19,000	0.15	2,850
C	10,000	0.50	5,000	16,000	0.50	8,000
D	13,000	0.10	1,300	12,000	0.15	1,800
E	15,000	0.10	1,500	10,000	0.10	1,000
ENCF			9,600	ENCF		15,150

Expected NPV = Present Value of Expected Cash Inflows - Present Value of Expected Cash Outflows

The Net Present Value of Project X is (0.893 x Rs. 9,600 - Rs. 9,000) = Rs.(427)

The Net Present Value of Project Y is (0.893 x Rs. 15,150 - Rs. 9,000) = Rs. 4,529

Project Y is preferable

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

PROBLEM NO: 5

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:

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: 6

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	$P d_M^2$	Cash Flow (Rs.) (y)	Probability	Expected Cash Flow	d_N	$P d_N^2$
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: 7

The expected Value of cash flows of project X and Y may be calculated as follows:

Project X = 2,000 (0.3) + 4,000 (0.4) + 6,000 (0.3) = 4,000

Project Y = 1,000 (0.1) + 3,000 (0.1) + 5,000 (0.4) + 7,000 (0.3) + 9,000 (0.1) = 5,400

Now the standard deviations of two projects may be calculated as follows:

Project X				Project Y			
CF(Rs.)	EVCF	Prob.	$P(CF-EVCF)^2$	CF(Rs.)	EVCF	Prob.	$P(CF-EVCF)^2$
2,000	4,000	0.3	12,00,000	1,000	5,400	0.1	19,36,000
4,000	4,000	0.4	0	3,000	5,400	0.1	5,76,000
6,000	4,000	0.3	12,00,000	5,000	5,400	0.4	64,000
				7,000	5,400	0.3	7,68,000
				9,000	5,400	0.1	12,96,000
			24,00,000				46,40,000

Standard deviation for Project X = $\sqrt{24,00,000}$ = 1,549

Standard deviation for Project Y = $\sqrt{46,40,000}$ = 2,154

Projects	Coefficient of variation	Risk
X	$\frac{1,549}{4,000}=0.387$	Low
Y	$\frac{2,154}{5,400}=0.398$	High

PROBLEM NO: 8

SOUTH PROJECT:

i) Computation of Expected NPV & Standard Deviation

NPV(X)	Probability	Expected NPV (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
		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: 9

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: 10

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: 11

Determination of cost of debt and equity:

Volume of Debt and Equity at 50:50 works out to Rs. 1100 lakhs each. **(Rs. in Lakhs)**

Debt	1st Slab	2nd Slab	3rd Slab	4th Slab
a) Volume of funds	500	500	100	1100
b) Rate	10%	12%	15.72%	
c) Total Interest	50	60	15.72	125.72
d) Tax saving 30% (125.72 x 30%)				(37.72)
e) Post-tax cost (Int-tax)				88.00

K_d = I (1-t) / MV = 125.72 (1-0.3)/1100 =0.08 or 8%

Determination of weighted marginal cost of capital

Source	Cost %	Weight	Weight x Cost %
Debt	8.00	0.50	4.00
Equity	12.00	0.50	6.00
WMCC (cut-off rate)		1.00	10.00

Risk Adjusted rate = Cut off rate + Risk Premium = 10 + 2 = 12%

PROBLEM NO: 12

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: 13

Determination of NPV:

Year	Expected CFAT	Certainty equivalent (CE)	Adjusted CFAT (CFAT X CE)	PV factor (at 0.06)	Total PV
0	(Rs. 2,00,000)	1.0	Rs.(2,00,000)	1.000	(Rs.2,00,000)
1	Rs. 1,60,000	0.8	Rs.1,28,000	0.943	Rs.1,20,704
2	Rs. 1,40,000	0.7	Rs.98,000	0.890	Rs.87,220
3	Rs. 1,30,000	0.6	Rs.78,000	0.840	Rs.65,520
4	Rs. 1,20,000	0.4	Rs.48,000	0.792	Rs.38,016
5	Rs. 80,000	0.3	Rs.24,000	0.747	Rs.17,928
NPV					1,29,388

Since NPV is positive the project should be accepted.

PROBLEM NO: 14

NPV = 10,00,000 (0.90) / (1.05) + 15,00,000 (0.85) / $(1.05)^2$ + 20,00,000 (0.82) / $(1.05)^3$ + 5,00,000 (0.78) / $(1.05)^4$ - 45,00,000 = Rs.5,34,570

PROBLEM NO: 15

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: 16

Computation of CFAT:

Particulars	Amount (Rs.)
Selling Price Unit	100
Variable Cost per unit	30
A. Contribution per unit	70
B. Output	2,000 units
C. Total Contribution (A x B)	1,40,000
Less: Fixed Cost	1,00,000
PBDT/CFAT	**40,000**

Computation of NPV:

Years	Cash Flows	PVF/AF	P.V of Cash Flows
0	1,25,000	1	(1,25,000)
1-5	40,000	3.79	1,51,600
NPV			**26,600**

Sensitivity Analysis:

1. **Investment**

Maximum permissible change in NPV with respect to investment = $\frac{26,600}{1,25,000} \times 100$

= 21.28%

2. **Selling price unit and Variable Cost per unit**

Let 'a' be the C.P.U, at which NPV = '0'

Total cost (2,000 x a) = 2,000a

Less: Fixed Cost = (1,00,000)

PBDT = 2,000a – 1,00,000

AF = 3.79

PV of Cash inflow

3.79(2,000a – 1,00,000)= 7580a – 3,79,000

7580a – 3,79,000 = 1,25,000 (To make NPV = 0)

7580a = 5,04,000

a = 66.49

Maximum change in Selling price unit (66.49+30) = 3.51 (96.49-100)

Maximum permissible change = 3.51%

Maximum change in Variable cost per unit = 33.51

Maximum permissible change = 3.51/30 x 100 = 11.7%

3. **Volume:**

Let 'q' be the volume at which NPV is zero

Initial investment = 1,25,000

P.V of Cash inflows at 'q' volume is

[(100-30)q – 1,00,000] x 3.791 = (70q – 1,00,000) x 3.791

If NPV is zero then total investment = cash in flows

1,25,000 = (70q – 1,00,000) x 3.791

Then 70q – 1,00,000 = 1,25,000/3.791

70q – 1,00,000 = 32,973

q = 1,32,973/70

q = 1,900 units

Maximum permissible change = (1,900-2,000/2,000) x 100 = 5%

4. **Fixed cost**

Maximum permissible change in NPV with respect to fixed cost

1,25,000 = [(100-30) x 2,000 – F.C] x 3.791

F.C = 1,07,027

Permissible change in Fixed cost = (1,07,027 – 1,00,000/1,00,000) x 100

= 7.03%

5. **Life of the Project**

Maximum permissible change in NPV with respect to life

1,25,000 = [(100-30) x 2,000 – F.C] x AF (10%, n)

3.125 = AF (10%, n)

AF for four years at 10% is 3.17

Change in life is = 5-4/5 x 100 = 20%

6. **Discount rate**

Maximum permissible change in NPV with respect to Discount rate

1,25,000 = [(100-30) 2,000 – 1,00,000] x AF (5, a%)

3.125 = AF (5, a%)

From tables AF for 5 years at 18% is 3.127 so 'a' is approximately 18%

i.e An increase of 80% (18-10/10) before NPV is zero.

PROBLEM NO: 17

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	$\frac{(\text{Rs. } 27,46,000 - \text{Rs. } 7,46,000)}{\text{Rs. } 27,46,000}$ = (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'.

PROBLEM NO: 18

i) **Step - 1:**

The expected cash flows of the project are as follows:

Year	P_r = 0.2 (Rs.)	P_r = 0.6 (Rs.)	P_r = 0.2 (Rs.)	Total (Rs.)	PVF	Cash flow (Rs.)
0	(1,00,000)	(3,00,000)	(1,00,000)	(5,00,000)	1	(5,00,000)
1	30,000	1,20,000	50,000	2,00,000	0.8	1,60,000
2	30,000	1,20,000	50,000	2,00,000	0.64	1,28,000
3	30,000	1,20,000	50,000	2,00,000	0.512	1,02,400
4	30,000	1,20,000	50,000	2,00,000	0.4096	81,920
4	10,000	60,000	30,000	1,00,000	0.4096	40,960
NPV based on expected cash flows would be as follows						13,280

Alternatively:

NPV = 2,00,000 x (PVAF) +PV of terminal cash flow - PV of cash out flow

= 2,00,000 x (25%, 4 yrs.) +(1,00,000 x 0.4096) - 5,00,000

= 4,72,320 + 40,960 - 5,00,000

= 5,13,280 - 5,00,000

= 13,280

ii) For the worst case, the cash flows from the cash flow column farthest on the left are used to calculate NPV

$$= -Rs.5,00,000 + \frac{Rs.1,50,000}{(1+0.25)^1} + \frac{Rs.1,50,000}{(1+0.25)^2} + \frac{Rs.1,50,000}{(1+0.25)^3} + \frac{Rs.1,50,000}{(1+0.25)^4} + \frac{Rs.50,000}{(1+0.25)^4}$$

= - Rs. 5,00,000 + Rs. 1,20,000 + Rs. 96,000 + Rs. 76,800 + Rs. 61,440 + Rs. 20,480

NPV = - Rs. 1,25,280

For the best case, the cash flows from the cash flow column farthest on the right are used to calculated NPV.

$$= -Rs.5,00,000 + \frac{Rs.2,50,000}{(1+0.25)^1} + \frac{Rs.2,50,000}{(1+0.25)^2} + \frac{Rs.2,50,000}{(1+0.25)^3} + \frac{Rs.2,50,000}{(1+0.25)^4} + \frac{Rs.1,50,000}{(1+0.25)^4}$$

= - Rs.5,00,000 + Rs. 2,00,000 + Rs. 1,60,000 + Rs. 1,28,000 + Rs. 1,02,400 + Rs. 61,440

NPV = Rs. 1,51,840

THE END