8. RISK ANALYSIS IN CAPITAL BUDGETING

ASSIGNMENT SOLUTIONS

PROBLEM NO: 1

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	2,10,000	1.20	16%	70,000	3.274	2,29,180	19,180
Y	1,20,000	0.80	14%	42,000	3.433	1,44,186	24,186
Z	1,00,000	0.40	12%	30,000	3.605	1,08,150	8,150

PROBLEM NO: 2

Step1: compute expected

	Net CFAT(Rs.)	Probability	Amount/Rs.	
Year 1	4,00,000	0.30	1,20,000	
	3,50,000	0.40	1,40,000	
	2,50,000	0.30	75,000	3,35,000
Year 2	3,50,000	0.25	87,500	
	4,50,000	0.35	1,57,500	
	5,00,000	0.40	2,00,000	4,45,000
Year 3	2,60,000	0.45	1,17,000	
	3,20,000	0.25	80,000	
	4,10,000	0.30	1,23,000	3,20,000

Step 2: Compute RADR. This is given as 17%

Step 3: Compute NPV using a RADR of 17%.

Year	Cash flow (Rs.)	DF @ 17%	PV (Rs.)
0	(12,00,000)	1.000	(12,00,000)
1	3,35,000	0.855	2,86,425
2	4,45,000	0.731	3,25,295
3	3,20,000	0.624	1,99,680
4	3,20,000	0.534	1,70,880
5	3,20,000	0.456	1,45,920
			NPV: (71,800)

Step 4: Decision-The NPV of the project, at a RADR of 17% is negative. Hence project should be rejected.

Step 5: Maximum project cost. For acceptance, the project cost, should be curtailed and revised downwards to Rs.11, 28,200 (Rs.12.00 lakhs, less Rs. 71,800).

PROBLEM NO: 3

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.(200,000)	1.000	(Rs.2,00,000)

1	Rs. 1,60,000	0.8	Rs.128,000	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: 4

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: 5

Part I:

Step1: Ascertain the discount rate.

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

Step2: 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

Step3: 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: 6

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	Selling Price per Unit Reduced to Rs. 97.5	Variable Cost Per Unit increased to Rs. 51.25	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.**	**Amount Rs.**	**Amount Rs.**
A	Selling Price Per Unit (A)	100	100	97.5	100	100	100
B	Variable Cost Per Unit (B)	50	50	50	51.25	50	50
C	Contribution Per Unit (C = A-B)	50	50	47.5	4.875	50	50
D	Number of Units Sold Per Year (in Crores)	5	5	5	5	5	4.875
E	Total Contribution (E = C × D)	250	250	237.5	243.75	250	243.75
F	Fixed Cost Per Year (in Crores)	50	50	50	50	51.25	50
G	Net Cash Inflow Per Year (G =E - F)	200	200	187.5	193.75	198.75	193.75
H	(G × 2.673)	534.60	534.60	501.19	517.89	531.26	517.89
I	Initial Cash Flow	400	410	400	400	400	400
J	NPV	134.60	124.60	101.19	117.89	131.26	117.89
K	Percentage Change in NPV		-7.43%	-24.82%	-12.41%	-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: 7

Calculation of NPV through Sensitivity Analysis

	(Rs.)
PV of cash inflows (Rs. 45,000 × 3.169)	1,42,605
Initial Project Cost	(1,20,000)
NPV	22,605

Situation	NPV	Changes in NPV
Base (present)	Rs. 22,605	
If initial project cost is varied adversely by 10%	(Rs. 1,42,605 - Rs. 1,32,000) = Rs. 10,605	(Rs. 22,605 – Rs. 10,605)/ Rs. 22,605 = (53.08%)
If annual cash inflow is varied adversely by 10%	[Rs. 40,500(revised cash flow) × 3.169) – (Rs. 1,20,000)] = Rs. 8,345	(Rs. 22,605 – Rs. 8,345) / Rs. 22,605=63.08%
If cost of capital is varied adversely by 10% i.e. it becomes 11%	(Rs. 45,000 × 3.103) – Rs. 1,20,000 = Rs. 19,635	(Rs. 22,605 – Rs. 19,635) / Rs. 22,605 = 13.14%

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

PROBLEM NO: 8

Calculation of Expected cash flow:

Assumption	Cash flow	Probability	Expected cash flow
Best case	9,00,000	0.3	2,70,000
Most likely	5,00,000	0.4	2,00,0000
Worst case	2,00,000	0.3	60,000
			5,30,000

PROBLEM NO: 9

Probabilities for net cash flows for 3 years a project are as follows:

Year 1			Year 2			Year 3		
Cash Flow (Rs.)	Probability	Expected Value	Cash Flow (Rs.)	Probability	Expected Value	Cash Flow (Rs.)	Probability	Expected Value
2,000	0.1	200	2,000	0.2	400	2,000	0.3	600
4,000	0.2	800	4,000	0.3	1200	4,000	0.4	1600
6,000	0.3	1,800	6,000	0.4	2400	6,000	0.2	1200
8,000	0.4	32,000	8,000	0.1	800	8,000	0.1	800
ENCF		6,000			4,800			4200

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

Present Value of cash flow:

$$= \frac{ENCF_1}{(1+K)^1} + \frac{ENCF_2}{(1+K)^2} + \frac{ENCF_3}{(1+K)^3}$$

$$= \frac{6000}{(1.1)^1} + \frac{4800}{(1.1)^2} + \frac{4,200}{(1.1)^3}$$

= (6,000 × 0.909) + (4,800 × 0.826) + (4,200 + 0.751) = 12,573

Expected Net Present value = Present Value of cash flow - Initial Investment = Rs. 12,573 – Rs. 10,000 = Rs. 2,573.

PROBLEM NO: 10

The calculation of NPV of the proposal can be made as follows:

Year	C. flows	Prob.	Prob. x C. flows	Exp. value	PVF(15%,n)	PV
0	-6,000	1.0	-6,000	-6,000	1.000	-6,000
1	1,000	0.1	100			
	1,500	0.2	300			

	2,000	0.4	800			
	2,500	0.2	500			
	3,000	0.1	300	2,000	0.870	1,740
2	2,000	0.2	400			
	2,500	0.3	750			
	2,700	0.2	540			
	2,800	0.3	840	2530	0.756	1,913
3	1,500	0.1	150			
	2,200	0.1	220			
	2,800	0.7	1,960			
	3,500	0.1	350	2,680	0.658	1,763
				NPV=		-584

As the NPV of the proposal is negative, the proposal is not worthwhile.

PROBLEM NO: 11

SOUTH PROJECT:

i) Computation of Expected NPV & Standard Deviation

NPV(X)	Probability	Expected NPV (X)	Dx (X-X)	DX^2	PDX^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

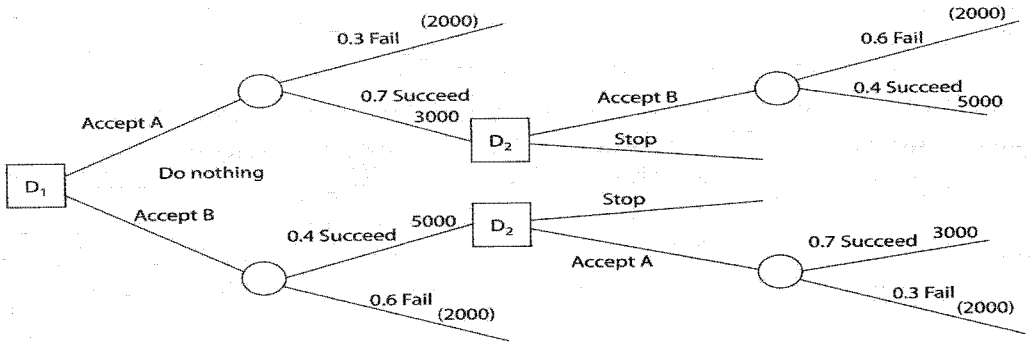
ii)

NPV(X)	Probability	Expected NPV	Dx (X-X)	DX^2	PDX^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
15	0.10	1.60	7.2	51.84	5.184
		7.80			ΣPdx^2=15.82

Standard Deviation = $\sqrt{\sum Pdx^2} = \sqrt{15.82}$ = σ NPV = 3.977

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: 12



The required decision tree is as shown below: There are three decision points in this tree. these are indicated as 1, 2, 3

Evaluation of decision point 3:

1. **Accept A**

outcome	Probability	Conditional values	Expected values
Success	0.7	3,000	2,100
Failure	0.3	-2,000	- 600
			1,500

2. **Stop:** Expected value = 0

Evaluation of decision point 2:

1. **Accept B**

outcome	Probability	Conditional values	Expected values
Success	0.4	5,000	2,000
Failure	0.6	-2,000	-1,200
			800

2. **Stop:** Expected value = 0

Evaluation of decision point 1:

1. **Accept A:**

outcome	Probability	Conditional values	Expected values
Success	0.7	3,000 + 800	2,660
Failure	0.3	-2,000	-600
			2,060

2. **Accept B:**

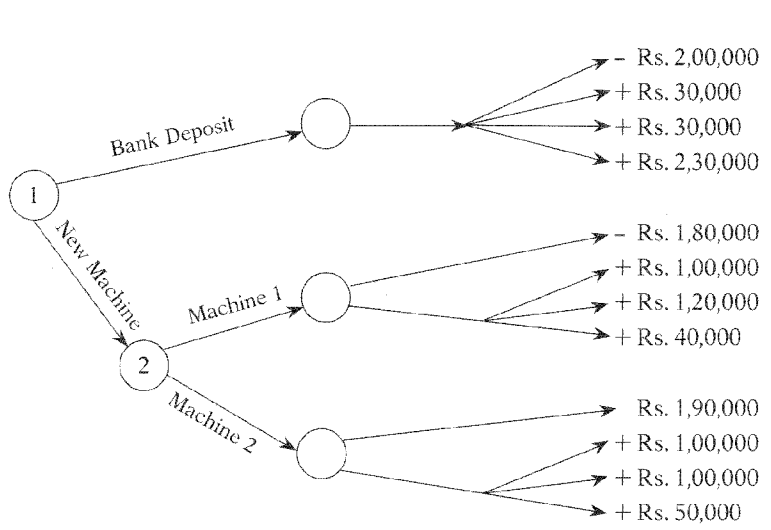
outcome	Probability	Conditional values	Expected values
Success	0.4	5,000 + 1,500	2,600
Failure	0.6	-2,000	-1,200
			1,400

3. **Do nothing:** Expected value = 0

Hence, the best strategy is to accept A first, and if is successful, then accept B.

PROBLEM NO: 13

The above situation can be presented in the form of a decision tree as given in Figure:



	PVF @ 15%	PV (Rs.)
	1.000	-2,00,000
	.870	+ 26,100
	.756	+ 22,680
	.658	+ 1,51,340
	NPV =	120
	1.000	-1,80,000
	.870	+ 87,000
	.756	+ 90,720
	.658	+ 26,320
	NPV =	24,040
	1.000	- 1,90,000
	.870	+ 87,000
	.756	+ 75,600
	.658	+ 32,900
	NPV =	5,500

On the basis of Figure 9.6, it may be mentioned that the present situation is a two stage decision process. At stage 1, the firm has to decide whether to keep money in liquid form by depositing in a bank @ 12% or to buy a machine for the production of the new product. If the firm selects not to deposit the money in the bank, then to select, in the second stage whether to buy machine 1 or machine 2. It may be noted that if at stage 1, the firm decides to go for bank deposit, then evaluation of machine 1 and machine 2 is not required at all.

PROBLEM NO: 14

Step 1: Assessing least likely cash flow and corresponding investment

Step 2: parameters: project life and cost of capital exogenous variables: Demand, CFAT per unit and Initial investment.

Step 3 & 4: Assign values for parameters. Project life is 7 years, and cost of capital is 9 %

- Assign probability distribution and cumulative probability for each exogenous variable; Generate random number class intervals, for each exogenous value.
- Assign random number and ascertain values.
- These are shown in table 1, 2 and 3.

Table 1: Demand

Demand	Probability	Cum Prob.	Random digit allocation	Trial	Random Number	Range	Simulated Demand
37,500	0.05	0.05	00-04	1	28	15-34	52,500
45,000	0.10	0.15	05-14	2	57	35-64	60,000
52,500	0.20	0.35	15-34	3	60	35-64	60,000
60,000	0.30	0.65	35-64	4	17	15-34	52,500
67,500	0.20	0.85	65-84	5	64	35-64	60,000
75,000	0.10	0.95	85-94	6	20	15-34	52,500
82,500	0.05	1.00	95-99	7	27	15-34	52,500
				8	58	35-64	60,000
				9	61	35-64	60,000
				10	30	15-34	52,500

Table 2: CFAT per unit

CFAT Rs. per unit	Probability	Cum Prob.	Random Digit Allocation	Trial	Random Number	Range	Simulated CFAT (Rs. Per unit)
3.00	0.10	0.10	00-09	1	19	10-29	5.00
5.00	0.20	0.30	10-29	2	07	00-09	3.00
7.00	0.40	0.70	30-69	3	90	90-99	10.00
9.00	0.20	0.90	70-89	4	02	00-09	3.00
10.00	0.10	1.00	90-99	5	57	30-69	7.00
				6	28	10-29	5.00
				7	29	10-29	5.00
				8	83	70-89	9.00
				9	58	30-69	7.00
				10	41	30-69	7.00

Table 3: Investment levels

Investment Rs. Lakhs	Probability	Cum Prob.	Random Digit Allocation	Trial	Random Number	Range	Simulated Investment (Rs. Per unit)
30.00	0.25	0.25	00-24	1	18	00-24	30.00
40.00	0.50	0.75	25-74	2	67	25-74	40.00
50.00	0.25	1.00	75-99	3	16	00-24	30.00

				4	71	25-74	40.00
				5	43	25-74	40.00
				6	68	25-74	40.00
				7	47	25-74	40.00
				8	24	00-24	30.00
				9	19	00-24	30.00
				10	97	75-99	50.00

Step 5: Determine of least CFAT per unit, and corresponding investment

Trial	Demand	CFAT (Rs.)	Total CFAT (Rs. 000's)	Investment Rs. lakhs	Identifying Least CFAT	Corresponding Investment
1	52,500	5.00	262.50	30.00		
2	60,000	3.00	180.00	40.00		
3	60,000	10.00	600.00	30.00		
4	52,500	3.00	157.50	40.00	157.50	40,00,000
5	60,000	7.00	420.00	40.00		
6	52,500	5.00	262.50	40.00		
7	52,500	5.00	262.50	40.00		
8	60,000	9.00	540.00	30.00		
9	60,000	7.00	420.00	30.00		
10	52,500	7.00	367.50	50.00		

Decision:

Net Least CFAT is Rs.1,57,500; Life is 7 years; Cost of capital is 9%

PV of CFAT, using a PVAF of 5.033, is Rs. 7,92,698.

Project is not worth taking up. Maximum investment should be such as will throw up a net PV, which is positive at least nominally. In this case, the project can be taken up only if the investment does not exceed the above estimated level of Rs. 7.92 lakhs.

THE END