8. RISK ANALYSIS IN CAPITAL BUDGETING

NO. OF PROBLEMS IN 41.5E OF CA INTER: CLASSROOM -14, ASSIGNMENT – 14

NO. OF PROBLEMS IN 42E OF CA INTER: CLASSROOM - 17, ASSIGNMENT – 18

NO. OF PROBLEMS IN 42.5E OF CA INTER: CLASSROOM - 10, ASSIGNMENT - 10

MODEL WISE ANALYSIS OF PAST EXAM PAPERS OF CA INTER (PROBLEMS)

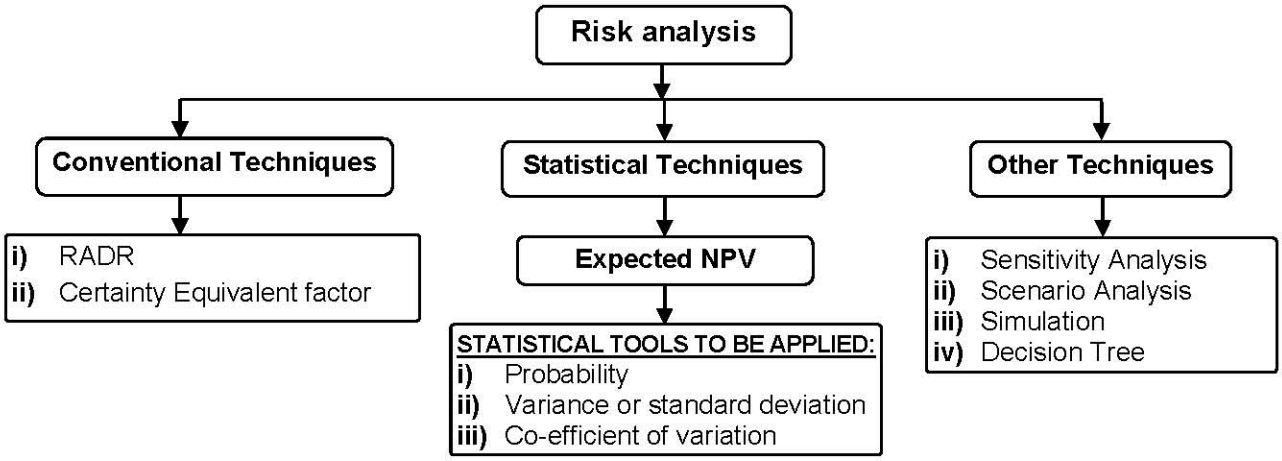
MODEL NO.	N-19 (N)	M-19 (N	M-18 (N)	N-18 (N)	RTP M18 (N)	RTP N18 (N)	RTP M19 (N)	RTP N19 (N)	MTP1 M18 (N)	MTP2 M18 (N)	MTP1 N18 (N)	MTP2 N18 (N)	MTP1 M19 (N)	MTP2 M19 (N)	MTP1 N19 (N)
1. Probability and Expected Cash Flow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Expected NPV	5	5	-	-	-	-	-	-	-	-	-	-	-	-	5
3. S.D, Variance & Co-efficient of Variance	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
4. Risk Adjusted Discount Rate (RADR)	-	-	-	-	-	-	5	5	-	5	5	-	5	-	-
5. Certainty Equivalent (CE) Method for Risk Analysis	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
6. Sensitivity Analysis	-	-	-	5	5		-	-	-	-	-	-	-	-	-
7. Scenario Analysis	-	-	-	-		-	-	-	-	-	-	-	-	-	-
8. Decision Tree Analysis	-	-			-	-	-	-	-	-	-	-	-	-	-
9. Monte Carlo Simulation	-			-	-	-	-	-	-	-	-	-	-	-	-

INTRODUCTION TO RISK ANALYSIS IN CAPITAL BUDGETING:

- In capital budgeting techniques, we assumed that the investment proposals do not involve any risk and cash flows of the project are known with certainty.
- This assumption was taken to simplify the understanding of the capital budgeting techniques. However, in practice, this assumption is not correct. In fact, investment projects are exposed to various degrees and types of risks.

RISK AND UNCERTAINTY:

- A decision to take up or leave out a project depends on expectations of future cash flows from the project. Such expectations are based on information that is currently available.
- The 'future' by definition is uncertain. Therefore, cash flows when they occur are likely to differ from what were expected. This uncertainty about future cash flows gives rise to risk.
- But risk is not the same as uncertainty. Risk can be measured but uncertainty cannot be measured. Risk applies where the decision maker is willing to act on probabilities. There can be three types of decision making:
  - i) **Decision making under certainty:** When cash flows are certain
  - ii) **Decision making involving risk:** When cash flows involve risk and probability can be assigned.
  - iii) **Decision making under uncertainty:** When the cash flows are uncertain and probability cannot be assigned.



PROBLEMS FOR CLASSROOM DISCUSSION

MODEL 1: PROBABILITY & EXPECTED CASH FLOW

- Probability is the chance of occurrence or non-occurrence of an outcome.
- The aggregate of probabilities of all possible outcomes associated with an event is 1.
- For example, if there is a 70% chance that it would rain today, the probability associated with rain is 0.7. Since the only two possible outcomes are "Rain" and "No rain", the probability associated with "No rain" is 0.3.

Probability distribution:

- Suppose a range of different outcomes is possible. Suppose that the chance of occurrence of each such outcome is different.
- We can express this position meaningfully by assigning appropriate numerical values to chances of occurrence.
- The resulting representation of all the possible outcomes is known as 'Probability distribution'.

PROBLEM 1: (PRINTED SOLUTION AVALIABLE)

Assumption	Cash Flows (Rs.)	Probability
Best guess	3,00,000	0.3
High guess	2,00,000	0.6
Low guess	1,20,000	0.1

Compute expected cash flow based on above probability? *(C) (NEW SM)*

(ANS.: EXPECTED NET CASH FLOWS (ENCF): RS. 2,32,000) (SOLVE PROBLEM NO. 1 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: _____

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MODEL 2: EXPECTED NPV

HOW TO COMPUTE EXPECTED NPV:

Step 1: Find out Expected Cash Flows (Cash Flow x Respective Probability)

Step 2: Find out Present Value of Expected Cash Flows using Cost of Capital

Step 3: Find out Expected NPV of the Project ($\sum$Step 2 – Investment)

PROBLEM 2: (PRINTED SOLUTION AVALIABLE) Probabilities for Net cash flows for 3 years of a project are as follows:

Year 1		Year 2		Year 3	
Cash Flow (Rs.)	Probability	Cash Flow (Rs.)	Probability	Cash Flow (Rs.)	Probability
2,000	0.1	2,000	0.2	2,000	0.3
4,000	0.2	4,000	0.3	4,000	0.4
6,000	0.3	6,000	0.4	6,000	0.2
8,000	0.4	8,000	0.1	8,000	0.1

Calculate the expected net cash flows. Also calculate the Net Present Value of the expected cash flow, using 10 per cent discount rate. Initial Investment is Rs. 10,000. *(A) (NEW SM)(MTP2 MAY 19(N))*

(ANS.: EXPECTED NET PRESENT VALUE-RS. 2,573) (SOLVE PROBLEM NO. 2 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: _____

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MODEL NO 3: STANDARD DEVIATION, VARIANCE & COEFFECIENT OF VARIANCE

- Project cash flows are **forecasts**. A forecast **cannot be accurate** and there can be a **margin of error.**
- The risk associated with a project can be expressed, as the **extent to which the actual value of outcome will differ / deviate from the expected value.**
- This **risk is measured** with the help of a statistical tool known as **Standard Deviation.**
- Standard Deviation is a **standardized unit of deviation from mean**. This measure is denoted by the symbol σ. The **square of Standard Deviation (σ^2) is known as variance of distribution**.
- Higher the standard deviation (σ), Higher will be the risk involved in the project.

How to compute Standard Deviation:

Following Steps are involved in computation of Standard Deviation

Step 1: Compute Expected Value.

Step 2: Compute deviation from expected value (d_x)

Step 3: Add: Aggregate Result of Step (2). The resultant value is known as variance.

Step 4: Find out σ

$$\sigma = \sqrt{\text{Variance}} = \sqrt{\sum_{i=1}^{n} p \times dx^2}$$

COEFFICIENT OF VARIATION

- The standard deviation is a useful measure of calculating **the risk associated** with the estimated cash inflows from an Investment.
- However, in Capital Budgeting decisions, **the management in several times faced with choosing between many investments avenues.**
- Under such situations, it becomes difficult for the management to compare the risk associated with different projects using Standard Deviation as **each project has different estimated cash flow values. In such cases, the Coefficient of Variation becomes useful.**
- The Coefficient of Variation calculates the **risk borne for every percent of expected return. It is calculated as:**

$$\text{Coefficient of variation} = \frac{\text{Standard Deviation}}{\text{Expected Return / Expected Cash Flow}}$$

- Higher the COV, Higher will be the risk involved in the project.

PROBLEM 3: (PRINTED SOLUTION AVALIABLE)

Project A			Project B	
Possible Event	Cash Flow (Rs.)	Probability	Cash Flow (Rs.)	Probability
A	8,000	0.10	24,000	0.10
B	10,000	0.20	20,000	0.15
C	12,000	0.40	16,000	0.50
D	14,000	0.20	12,000	0.15
E	16,000	0.10	8,000	0.10

Calculate variance, standard deviation (σ) and coefficient of variance for the projects based on the above information? Which project is more risky? *(A) (NEW SM)(MTP NOV 19(N))*

(ANS.: VARIANCE & S.D. FOR PROJECT A AND PROJECT B ARE 48,00,000; 2190.9 AND 1,76,00,000; 4195.23 RESPECTIVELY, COEFFICIENT OF VARIANCE: 0.183, 0.262) (SOLVE PROBLEM NO. 3 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: _____

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PROBLEM 4: (PRINTED SOLUTION AVALIABLE) Shivam Ltd. is considering two mutually exclusive projects A and B. Project A costs Rs. 36,000 and project B Rs. 30,000. You have been given below the net present value probability distribution for each project.

Project A		Project B	
NPV estimates (Rs.)	Probability	NPV estimates (Rs.)	Probability
15,000	0.2	15,000	0.1
12,000	0.3	12,000	0.4
6,000	0.3	6,000	0.4
3,000	0.2	3,000	0.1

i) Compute the expected net present values of projects A and B.

ii) Compute the risk attached to each project i.e. standard deviation of each probability distribution.

iii) Compute the profitability index of each project.

iv) Which project do you recommend? State with reasons. *(A) (NEW SM)*

(ANS.: (I) EV FOR PROJECT A & B ARE 9,000 AND 9,000 RESPECTIVELY, (II) S.D. FOR A IS 4,450 AND B IS 3,795, (III) PROJECT A IS 1.25, B IS 1.30 (IV) PROJECT B IS PREFERABLE) (SOLVE PROBLEM NO.4 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: _____

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PROBLEM 5: (PRINTED SOLUTION AVALIABLE) A company is considering Projects X and Y with following information:

Project	Expected NPV (Rs.)	Standard deviation
X	1,22,000	90,000
Y	2,25,000	1,20,000

i) Which project will you recommend based on the above data?

ii) Explain whether your opinion will change, if you use coefficient of variation as a measure of risk.

iii) Which measure is more appropriate in this situation and why? *(A) (CA FINAL OLD PM)*

(ANS.: (I) ON THE BASIS OF STANDARD DEVIATION PROJECT X BE CHOSEN, (II) ON THE BASIS OF CO-EFFICIENT OF PROJECT Y SHOULD BE ACCEPTED, (III) NPV METHOD) (SOLVE PROBLEM NO. 5 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: _____

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MODEL 4: RISK ADJUSTED DISCOUNT RATE (RADR)

- The discount- rates in capital budgeting represents the expected rate of return from the project.
- Projects with higher risk are generally expected to provide a higher return. And projects with relatively lower risk are expected to provide a lower rate of return, consequently all projects should not be discounted at the same rate, namely the company's cost of capital.
- Hence the cut-off discount rate should be adjusted upwards or downward to take care of the additional (or lower) risk element. This is referred to as **risk adjusted discount rate**.

How to compute NPV under RADR approach:

Step 1: Identify cash flows.

Step 2: Compute RADR, **(RADR = Cost of capital ± Premium for risk)**

Step 3: Discount the cash flows at RADR and find out NPV

Decision Rule: If the project yields a positive NPV, it can be accepted otherwise reject.

PROBLEM 6: (PRINTED SOLUTION AVALIABLE) An enterprise is investing Rs. 100 lakhs in a project. The risk-free rate of return is 7%. Risk premium expected by the Management is 7%. The life of the project is 5 years. Following are the cash flows that are estimated over the life of the project.

Year	Cash flows (Rs. in lakhs)
1	25
2	60
3	75
4	80
5	65

Calculate Net Present Value of the project based on Risk free rate and also on the basis of Risks adjusted discount rate.

(A) (NEW SM, RTP M19 (N), similar Nov- 19, MTP2 M18 (N) - 5M, MTP1 N18 (N) Nov-19) - 5M)

(ANS.: NPV BASED ON RISK FREE RATE IS 144.34 AND ON THE BASIS OF RISK ADJUSTED RATE IS 99.79)

(SOLVE PROBLEM NO. 6 OF ASSIGNMENT PROBLEMS AS REWORK)

PROBLEM 7: (PRINTED SOLUTION AVALIABLE) Determine the risk adjusted net present value of the following projects:

Particulars	X	Y	Z
Net cash outlays (Rs.)	2,10,000	1,20,000	1,00,000
Project life	5 years	5 years	5 years
Annual Cash inflow (Rs.)	70,000	42,000	30,000
Coefficient of variation	1.2	0.8	0.4

The Company selects the risk-adjusted rate of discount on the basis of the coefficient of variation.

Coefficient of Variation	Risk-Adjusted Rate of Return	P.V. 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

(A) (NEW SM – TYK, MTP1 M19 (N) - 5M) (NPV: X: RS. 19,180, Y: RS. 24,186, Z: RS. 8,150)

(SOLVE PROBLEM NO. 7 OF ASSIGNMENT PROBLEMS AS REWORK)

MODEL 5: CERTAINTY EQUIVALENT (CE) METHOD FOR RISK ANALYSIS

- Certainty Equivalent Factor (CEF) is **the ratio of assured (or certain) cash flows to uncertain cash flows.**
- Under this approach, the cash flows expected in a project are converted into **risk- less equivalent** amounts. The adjustment factor used is called Certainty Equivalent Co-efficient factor.
- While employing this method, the decision maker estimates the sum he must be assured of receiving, in order that he is indifferent between as **"assured sum"** and **expected values of "risky sum".**
- **This varies between 0 and 1**. A coefficient of 1 indicates that the cash flows are certain.
- The greater the risk in a cash flow the smaller will be the CE factor for 'receipts' and Larger will be the CE factor for 'payments'.
- Since the risk involved in cash flows is already incorporated, the **appropriate discount rate** for project evaluation will **be the risk free rate.** **(M18 (N) - 4M)**

How to compute NPV under CE approach

Step 1: Convert uncertain cash flows to certain cash flows by multiplying it with the certainty equivalent factor.

Step 2: Discount the certain cash flows at the risk free rate to arrive at NPV.

Step 3: If the resultant NPV is positive, the project can be accepted.

DIFFERENCE BETWEEN RADR AND CEF APPROACHES

Point	Certainty Equivalent Method	Risk Adjusted Discount Rate Method
a) Factor Adjusted	This method adjusts the cash flows of a project for risk.	This method adjusts the discount rate (WACC) for risk.
b) Time effect	Cash flows are adjusted for Risk over time under this method.	This method assumes that risk increases with at a constant rate.
c) Ease	It is difficult to specify a series of CE Co- efficient.	It is comparatively easier to adjust discount rates.
d) Accuracy	This is superior to the RADR Approach, as it can measure risk more accurately.	Risk is adjusted only in the discount rates and is not recognised in the cash flows. However, cash flows are more uncertain than the cost of capital.

PROBLEM 8: (PRINTED SOLUTION AVALIABLE) The Textile Manufacturing Company Ltd., is considering one of two mutually exclusive proposals, Projects M and N, which require cash outlays of Rs. 8,50,000 and Rs. 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 (Rs.)	C.E.	Cash Flow (Rs.)	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 Rs. 1 discounted at 6% at the end of year 1, 2 and 3 are 0.943, 0.890 and 0.840 respectively.

Required:

i) Which project should be accepted?

ii) If risk adjusted discount rate method is used, which project would be appraised with a higher rate and why? *(A) (NEW SM - TYK)*

(ANS.: I. PROJECT N SHOULD BE ACCEPTED; RISK ADJUSTED NPV: 10,980; 1,71,315, II. PROJECT M, SINCE "HIGHER THE RISKINESS OF A CASH FLOWS THE LOWER WILL BE THE C.E FACTOR")

(SOLVE PROBLEM NO. 8 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:_____

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MODEL 6: SENSITIVITY ANALYSIS

MEANING:

- Sensitivity analysis is one of the **methods of analysing the risk surrounding the capital expenditure** decision, and **enables the firm to assess** how responsive the project's NPV is to changes in those variables based on which NPV is computed.
- We know that NPV is **computed based on set of critical variables (**like: selling price, sales volume, discount rate, initial cost, operating costs, or estimated Benefits). During a project's life, **any one or more of these input parameters may undergo a change.**
- Such changes are **natural because each of these elements is only an** estimate. **An adverse change** can result in originally computed **NPV turning zero.**
- If this happens, the decision - maker would be hit hard. Hence the decision-maker is keen to ensure that **estimates contain a reasonable buffer to absorb unforeseen changes in the critical variables of the project.**

METHOD OF COMPUTATION: Sensitivity is computed as the ratio of downside change in input parameter to the value of initial parameter.

- Each input variable is considered separately and all other assumptions are held constant.
- The extent of change in an input parameter that would result in zero NPV is computed.
- The extent of change so determined is expressed as a percentage.
- The process is repeated for all critical variables to test their sensitivity.

DECISION RULE: The lower the change percentage the higher is the sensitivity of the project to the input parameter. This is because a small change in input parameter leads to a reversal of investment decision.

PROBLEM 9: (PRINTED SOLUTION AVALIABLE) The following information applies to a new project:

Initial Investment	1,25,000
Selling price per Unit	100
Variable costs per unit	30
Fixed costs for the period	100,000
Sales volume	2,000 units
Life	5 years
Discount rate	10%
PVAF(10%, 5)	3.791
PVAF(10%, 4)	3.170
PVAF(18%, 5)	3.127

Required: Project's NPV and show how sensitive (Which makes NPV is zero)the results are to various input factors. namely Initial Investment, Life, Discount rate and Cash flows

(A) (CA FINAL OLD SM) (ANS.: PROJECTS NPV IS RS. 26,640 AND INITIAL COST - 21.28% AND DISCOUNT RATE 80%, LIFE: 20%, Cash flows: 17.56%)

(SOLVE PROBLEM NO. 9 OF ASSIGNMENT PROBLEMS AS REWORK)

PROBLEM 10: : (PRINTED SOLUTION AVALIABLE) 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 (Rs.)	1,20,000
Annual Cash Inflow (Rs.)	45,000
Project Life (Years)	4
Cost of Capital	10%

To which of the three factors (Initial Project Cost, Annual Cash Inflow and Cost of Capital) the project is most sensitive if the variable is adversely affected by 10%? (Use annuity factors: for 10% 3.169 and 11% 3.103)

(A) (NEW SM, RTP M18 (N)) (ANS.: NPV: RS. 22,605, PROJECT IS MORE SENSITIVE TO ANNUAL CASH INFLOW)

(SOLVE PROBLEM NO. 10 OF ASSIGNMENT PROBLEMS AS REWORK)

PRINTED SOLUTIONS TO CLASS ROOM PROBLEMS

PROBLEM NO:1

Assumption (1)	Cash Flows (RS) (2)	Probability (3)	Expected cash flow(2*3)(Rs)
Best guess	3,00,000	0.3	3,00,000 × .3= 90,000
High guess	2,00,000	0.6	2,00,000 × .6=1,20,000
Low guess	1,20,000	0.1	1,20,000 × .1=12,000
Expected Net cash flow (ENCF)			2,32,000

PROBLEM NO:2

Year 1			Year 2			Year 3		
Cash Flow	Proba-bility	Expected Value	Cash Flow	Proba-bility	Expected Value	Cash Flow	Proba-bility	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	1,600
6,000	0.3	1,800	6,000	0.4	2400	6,000	0.2	1,200
8,000	0.4	3,200	8,000	0.1	800	8,000	0.1	800
ENCF		6,000			4,800			4,200

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

$$\text{Present Value of cash flow} = \frac{ENCF1}{(1+k)1} + \frac{ENCF2}{(1+k)2} + \frac{ENCF3}{(1+k)3}$$

$$\frac{6000}{(1.1)1} + \frac{4,800}{(1.1)2} + \frac{4,200}{(1.1)3}$$

= (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

= 12,573 –10,000 =Rs 2,573.

PROBLEM NO:3

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

Project A:

Variance (σ^2) = $(8,000 - 12,000)^2$ (0.1) + $(10,000 - 12,000)^2$ (0.2) + $(12,000 - 12000)^2$ (0.4) + $(14,000 - 12,000)^2$ (0.2) + $(16000 - 12,000)^2$ (0.1) = 48,00,000

Standard Deviation(s) = $\sqrt{48,00,000} = 2190.90 = 2190.90$

Project B:

Variance (σ^2) = $(24,000 - 16,000)^2 (0.1) + (20,000 - 16,000)^2(0.15) + (16,000 - 16,000)^2 (0.5) + (12,000 - 16,000)^2 (0.15) + (8,000 - 16,000)^2 (0.1) = 44,00,000$

Standard Deviation (s) = $\sqrt{1,76,00,000} = 4195.23 = 4195.23$

Projects	Coefficient of variation	Risk	Expected value
A	$\frac{2190.90}{12,000} = 0.1826$	Less	Less
B	$\frac{4195.23}{16,000} = 0.2622$	More	More

PROBLEM NO: 4

i) Statement showing computation of Expected Net Present Value of Projects A and B:

Project A			Project B		
NPV Estimate (Rs.)	Probability	Expected Value	NPV Estimate (Rs.)	Probability	Expected Value
15,000	0.2	3,000	15,000	0.1	15,000
12,000	0.3	3,600	12,000	0.4	4,800
6,000	0.3	1,800	6,000	0.4	2,400
3,000	0.2	600	3,000	0.1	300
	10	EV = 9,000		10	EV = 9,000

ii) Computation of Standard Deviation of each project:

Project A

P	X	(X - EV)	P (X- EV)²
0.2	15,000	6,000	72,00,000
0.3	12,000	3,000	27,00,000
0.3	6,000	- 3,000	27,00,000
0.2	3,000	- 6,000	72,00,000
			Variance = 1,98,00,000

Standard Deviation of Project A = $\sqrt{1,98,00,000}$ = Rs.4,450

Project B

P	X	(X - EV)	P (X- EV)²
0.1	15,000	6,000	36,00,000
0.4	12,000	3,000	36,00,000
0.4	6,000	-3,000	36,00,000
0.1	3,000	- 6,000	36,00,000
		Variance = 1,44,00,000	

Standard Deviation of Project B = $\sqrt{1,44,00,000}$ = Rs. 3,795

iii) Computation of profitability of each project

Profitability index = Discount cash inflow / Initial outlay

In case of Project A: PI = $\frac{9,000 + 36,000}{36,000} = \frac{45,000}{36,000} = 1.25$

In case of Project B: PI = $\frac{9,000 + 30,000}{30,000} = \frac{39,000}{30,000} = 1.30$

iv) Measurement of risk is made by the possible variation of outcomes around the expected value and the decision will be taken in view of the variation in the expected value where two projects have the same expected value, the decision will be the project which has smaller variation in expected value. In the selection of one of the two projects A and B, Project B is preferable because the possible profit which may occur is subject to less variation (or dispersion). Much higher risk is lying with project A.

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) $CV_X = \frac{SD}{ENPV} = \frac{90,000}{1,22,000} = 0.738$

$CV_Y = \frac{1,20,000}{2,25,000} = 0.533$

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 the best measure to evaluate risk of proposals having different expected NPV and SD

PROBLEM NO:6

The Present Value of the Cash Flows for all the years by discounting the cash flow at 7% is calculated as below

Year	Cash flows Rs. in lakhs	Discounting Factor @7%	Present value of Cash Flows Rs. in Lakhs
1	25	0.935	23.38
2	60	0.873	52.38
3	75	0.816	61.20
4	80	0.763	61.04
5	65	0.713	46.35
	Total of present value of Cash flow		244.34
	Less: Initial investment		100
	Net Present Value (NPV)		144.34

Now when the risk-free rate is 7 % and the risk premium expected by the Management is 7%. So the risk adjusted discount rate is 7 % + 7 % =14%.

Discounting the above cash flows using the Risk Adjusted Discount Rate would be as below

Year	Cash flows Rs. in Lakhs	Discounting Factor @14%	Present Value of Cash Flows Rs. in lakhs
1	25	0.877	21.93
2	60	0.769	46.14
3	75	0.675	50.63
4	80	0.592	47.36
5	65	0.519	33.74
Total of present value of Cash flow			199.80
Initial investment			100
Net present value (NPV)			99.80

PROBLEM NO: 7

Statement showing the determination of the risk adjusted net present value

Projects	Net cash outlays	Co-efficient of variation	Risk adjusted discount rate	Annual cash inflow	PV factor 1-5 years	Dis-counted cash inflow	Net present value
	(Rs)			(Rs		(Rs)	(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: 8

Year end	Cash Flow (Rs) (a)	C.E. (b)	Adjusted Cash flow (Rs) (c) = (a) × (b)	Present value factor at 6%(d)	Total Present value (Rs) (e) = (c) ×(d)
1	4,50,000	0.8	3,60,000	0.943	3,39,480
2	5,00,000	0.7	3,50,000	0.890	3,11,500
3	5,00,000	0.5	2,50,000	0.840	2,10,000
					8,60,980
Less: Initial Investment					8,50,000
Net Present Value					10,980

Statement Showing the Net Present Value of Project N

Year end	Cash Flow (Rs) (a)	C.E. (b)	Adjusted Cash flow (Rs) (c) = (a) × (b)	Present value factor (d)	Total Present value (RS) (e) = (c) ×(d)
1	4,50,000	0.9	4,05,000	0.943	3,81,915
2	5,00,000	0.8	3,60,000	0.890	3,20,400
3	5,00,000	0.7	3,50,000	0.840	2,94,000
					9,96,000
Less: Initial Investment					8,25,000
Net Present Value					1,71,315

Decision : Since the net present value of Project N is higher, so the project N should be accepted.

(ii) Certainty - Equivalent (C.E.) Co-efficient of Project M (2.0) is lower than Project N (2.4). This means Project M is riskier than Project N as "higher the riskiness of a cash flow, the lower will be the CE factor". If risk adjusted discount rate (RADR) method is used, Project M would be analysed with a higher rate

PROBLEM NO: 9

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. **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%

3. **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

4. **Cash Flow:**

Maximum permissible change in NPV with respect to Cash flow

Let 'a' be the CFAT

If NPV is zero, then

Sum of P.V of cash inflows = Investment

a x PVAF (5 ,10%) = 1,25,000

a x 3.791 = 1,25,000

a = Rs.32,975

Percentage change in Cash flows = (40,000 – 32,975)/40,000

= 17.56%

PROBLEM NO: 10

Calculation of NPV through Sensitivity Analysis

Particulars	(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	[Rs. 40,500(revised cash flow) ×	(Rs. 22,605 - Rs. 8,345) / Rs.

adversely by 10%	3.169) - (Rs. 1,20,000)] = Rs. 8,345	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'.

ASSIGNMENT PROBLEMS

MODEL 1: PROBABILITY & EXPECTED CASHFLOW

PROBLEM 1:

Assumption	Cash Flows (Rs.)	Probability
Best case	9,00,000	0.3
Most likely	5,00,000	0.4
worst case	2,00,000	0.3

Compute Expected cash flow based on above probability. *(C) (ANS.: EXPECTED CF: RS. 5,30,000)*

MODEL 2: EXPECTED NPV

PROBLEM 2: Probabilities for Net cash flows for 3 years of a project are as follows:

Year 1		Year 2		Year 3	
Cash Flow (Rs.)	Probability	Cash Flow (Rs.)	Probability	Cash Flow (Rs.)	Probability
3,000	0.1	4,000	0.3	5,000	0.4
6,000	0.2	6,000	0.4	10,000	0.2
9,000	0.3	9,000	0.2	13,000	0.1
12,000	0.4	12,000	0.1	16,000	0.3

Calculate the expected net cash flows. Also calculate the Net Present Value of the expected cash flow, using 12 per cent discount rate. Initial Investment is Rs. 15,000.

(A) (ANS.: EXPECTED NET PRESENT VALUE: RS. 5,488)

MODEL 3: STANDARD DEVIATION, VARIANCE & COFFECIENT OF VARIANCE

PROBLEM 3:

Project M			Project N	
Possible Event	Cash Flow (Rs.)	Probability	Cash Flow (Rs.)	Probability
P	12,000	0.10	14,000	0.30
Q	15,000	0.30	16,000	0.20
R	18,000	0.20	18,000	0.20
S	21,000	0.30	20,000	0.10
T	24,000	0.10	22,000	0.20

Calculate variance, standard deviation (σ) and coefficient of variance for the projects based on the above information? Which project is more risky?

(A) (ANS.: VARIANCE & S.D. FOR PROJECT A AND PROJECT B ARE 1,26,00,000; 3,549.64 AND 88,40,000; 2,973.21 RESPECTIVELY, COEFFICIENT OF VARIANCE: 0.1972, 0.1708)

PROBLEM 4: Below is given for the two cement projects in south and north in India.

NPV (Rs. in Lacs)	Probability	NPV (Rs. in Lacs)	Probability
3	0.05	3	0.15

5	0.30	5	0.25
6	0.30	6	0.25
12	0.30	12	0.25
15	0.05	16	0.10

i) Compute the expected net present value of Projects.

ii) Compute the risk attached to each project i.e., Standard Deviation of each probability distribution.

iii) Which project do you consider riskier and why?

(A) (ANS.: I) EXPECTED NPV: 7.80, SD:3.516; II) EXPECTED NPV: 7.80, SD: 4.167; III) NORTH PROJECT IS RISKIEST PROJECT)

PROBLEM 5: A company is considering projects X and Y with the following information:

	Project X	Project Y
Expected NPV	Rs. 60,000	Rs. 2,27,000
Standard Deviation	40,000	1,35,000

a) Which project will you recommend based on standard deviation?

b) Will your answer change if you use different use coefficient of variation as a measure of a risk instead of standard deviation?

c) Which measure is more appropriate? *(A) (ANS.: A) PROJECT X; B) PROJECT Y (COV): 0.595; C) PROJECT Y)*

MODEL 4: RISK ADJUSTED DISCOUNT RATE (RADR)

PROBLEM 6: An investment will have an initial outlay of Rs. 1,00,000. It is excepted to generate cash inflows as under:

Year	1	2	3	4
Cash in flows	40,000	50,000	15,000	30,000

Risk free rate of interest is 10%. Risk premium is 10% (the risk characterizing the project)

a) Compute the NPV using risk free rate

b) Compute NPV using risk - adjusted discount rate *(C) (RM) (ANS.: A) RS. 9,415; B) RS. (8,835))*

PROBLEM 7: Determine the Risk Adjusted Net Present Value of the following projects:

Particulars	P	Q	R
Net cash outlays (Rs.)	4,00,000	1,80,000	2,50,000
Project life	3 years	3 years	3 years
Annual Cash inflow (Rs.)	2,00,000	80,000	1,25,000
Coefficient of variation	1.6	2.0	1.2

The Company selects the risk-adjusted rate of discount on the basis of the coefficient of variation.

Coefficient of Variation	Risk-Adjusted Rate of Return	P.V. 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

(A) (NEW SM - TYK, MTP1 M19 (N) - 5M) (NPV: P: RS. 2,25,400; Q: RS. 49,120; R: RS. 1,59,250)

MODEL 5: CERTAINTY EQUIVALENT (CE) METHOD FOR RISK ANALYSIS

PROBLEM 8: The globe manufacturing company ltd. Is considering an investment in one of the two mutually exclusive proposals-project X and Y, which require cash outlays of Rs.3,40,000 and Rs.3,30,000 respectively. The certainty-equivalent (C.E.) approach is used in incorporating risk in capital budgeting decisions. Risk free rate is 8%, and risk adjusted rate is 10%. The expected net cash flows and their certainty equivalents are as follows:

Year - end	Project X		Project Y	
	Cash flow (Rs.)	C.E.	Cash flow (Rs.)	C.E.
1	1,80,000	0.8	1,80,000	0.9
2	2,00,000	0.7	1,80,000	0.8
3	2,00,000	0.5	2,00,000	0.7

Present value factor of Rs.1 discounted at 8% at the end of year 1, 2 and 3 are 0.926, 0.857 and 0.794 respectively.

a) Which project should be accepted under CE approach?

b) If risk adjusted discount rate method is used, which project would be appraised with a higher rate and why? *(A) (CA FINAL OLD PM) (ANS.: NPV: PROJECT X: RS. (7,276), PROJECT Y: RS. 54,580; B. PROJECT X)*

MODEL 6: SENSITIVITY ANALYSIS

PROBLEM 9: X Ltd is considering its New Product with the following details.

S.No.	Particulars	Figures (in Rs.)
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%

a) Calculate the NPV of the project.

b) Find the impact on the project's NPV of a 2.5 per cent adverse variance in Investment, Fixed Cost and Volume. Which variable is having maximum effect? *(A) (NEW SM)*

(ANS.: A) NPV: RS. 134.60, B) -7.43%, - 2.48%, -12.41%)

Note:_____

_____

PROBLEM 10: From the following details relating to a project, analyse the sensitivity of the project to changes in the Initial Project Cost, Annual Cash Inflow and Cost of Capital:

Particulars	
Initial Project Cost	Rs. 2,00,00,000
Annual Cash Inflow	Rs. 60,00,000
Project Life	5 years
Cost of Capital	10%

To which of the 3 factors, the project is most sensitive if the variable is adversely affected by 10?

Cumulative Present Value Factor for 5 years for 10% is 3.791 and for 11% is 3.696. *(A) (N18 (N) - 5M)*

(ANS.: PROJECT NPV: RS.27,46,000; INITIAL PROJECT COST (72.83%), ANNUAL CASH FLOW 82.83%, COST OF CAPITAL: 20.76%; PROJECT IS MOST SENSITIVE TO ANNUAL CASH INFLOW)

THE END