(ii) The three projects can now be evaluated at 19%, 15% and 13% discount rate as follows:

Project P-I

Annual Inflows	₹ 6,00,000
PVAF (19%, 4)	2.639
PV of Inflows (₹ 6,00,000 × 2.639)	₹ 15,83,400
Less: Cost of Investment	₹ 15,00,000
Net Present Value	**₹ 83,400**

Project P-II

Year	Cash Inflow (₹)	PVF (15%,n)	PV (₹)
1	6,00,000	0.870	5,22,000
2	4,00,000	0.756	3,02,400
3	5,00,000	0.658	3,29,000
4	2,00,000	0.572	1,14,400
Total Present Value			12,67,800
Less: Cost of Investment			11,00,000
Net Present Value			1,67,800

Project P-III

Year	Cash Inflow (₹)	PVF (15%,n)	PV (₹)
1	4,00,000	0.885	3,54,000
2	6,00,000	0.783	4,69,800
3	8,00,000	0.693	5,54,400
4	12,00,000	0.613	7,35,600
Total Present Value			21,13,800
Less: Cost of Investment			19,00,000
Net Present Value			2,13,800

Project P-III has highest NPV. So, it should be accepted by the firm.

(ii) Certainty Equivalent Approach

Question – 09

The Textile Manufacturing Company Ltd., is considering one of two mutually exclusive proposals, Projects M and N, which require cash outlays of ₹ 8,50,000 and ₹ 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:

Project M			Project N	
Year-end	Cash Flow ₹	C.E.	Cash Flow ₹	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 ₹ 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?

(SM TYK – 14)

Solution:

(i) Statement Showing the Net Present Value of Project M

Year end	Cash Flow (₹) (a)	C.E. (b)	Adjusted Cash flow (₹) (c) = (a) × (b)	Present value factor at 6% (d)	Total Present value (₹) (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 (₹) (a)	C.E. (b)	Adjusted Cash flow (₹) (c) = (a) × (b)	Present value factor at 6% (d)	Total Present value (₹) (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
					9,96,315
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 analyzed with a higher rate.

RADR is based on the premise that riskiness of a proposal may be taken care of, by adjusting the discount rate. The cash flows from a more risky proposal should be discounted at a relatively higher discount rate as compared to other proposals whose cash flows are less risky. Any investor is basically risk averse. However, he may be ready to take risk provided he is rewarded for undertaking risk by higher returns. So, more risky the investment is, the greater would be the expected return. The expected return is expressed in terms of discount rate which is also the minimum required rate of return generated by a proposal if it is to be accepted. Therefore, there is a positive correlation between risk of a proposal and the discount rate.

(III) OTHER TECHNIQUES

(i) Sensitivity Analysis

Question – 10

From the following details relating to a project, analyze the sensitivity of the project to changes in initial project cost, annual cash inflow and cost of capital:

Initial Project Cost (₹)	1,20,000
Annual Cash Inflow (₹)	45,000
Project Life (Years)	4
Cost of Capital	10%

To which of the three factors, the project is most sensitive? (Use annuity factors: for 10% 3.169 and 11% 3.103).

(SM TYK – 10)

Solution:

Calculation of NPV

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

If initial project cost is varied adversely by 10%*

NPV (Revised) (₹ 1,42,605 – ₹ 1,32,000)	₹ 10,605
Change in NPV (₹ 22,605 – ₹ 10,605)/₹ 22,605 i.e.	53.08 %

If annual cash inflow is varied adversely by 10%*

Revised annual inflow	₹ 40,500
NPV (Revised) (₹ 40,500 × 3.169) – (₹ 1,20,000)	(+)₹ 8,345
Change in NPV (₹ 22,605 – ₹ 8,345)/₹ 22,605	63.08 %

If cost of capital is varied adversely by 10%*

NPV (Revised) (₹ 45,000 × 3.103) – ₹ 1,20,000	(+) ₹19,635
Change in NPV (₹ 22,605 – ₹19,635)/₹ 22,605	13.14 %

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

*Note: Students may please note that they may assume any other percentage rate other than 10 % say 15%, 20 % 25 % etc.

Question – 11

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.

(SM TYK – 09)

Solution:

Approach I

NPV = PVCI – PVCO

$$= 20 \times \left[\frac{20,000}{(1.10)^1} + \frac{30,000}{(1.10)^2} + \frac{30,000}{(1.10)^3}\right] - 10,00,000$$

$$= 20 \times 65,514.65 - 10,00,000$$

= ₹ 3,10,293

(a) Selling Price = 10% ↓ [60 × 10% = 6]

$$= 14 \times \left[\frac{20,000}{(1.10)^1} + \frac{30,000}{(1.10)^2} + \frac{30,000}{(1.10)^3}\right] - 10,00,000$$

= - 82,795

$$\text{Sensitivity} = \frac{3,10,293 - (-82,795)}{3,10,293} \times 100$$

= 126.68%

(b) Unit Cost 10% ↑

= 40 × 10% = 4

= 16 × 65,514.65 – 10,00,000 = 48,234

$$\text{Sensitivity} = \frac{3,10,293 - 48,234}{3,10,293} \times 100$$

= 84.46%

(c) Sales Volume 10% ↓

$$= 20 \times \left[\frac{18,000}{(1.10)^1} + \frac{27,000}{(1.10)^2} + \frac{27,000}{(1.10)^3}\right] - 10,00,000$$

= 1,79,264

$$\text{Sensitivity} = \frac{3,10,293 - 1,79,264}{3,10,293} \times 100$$

= 42.23%

(d) Initial Outlays 10% ↑

= 10,00,000 + 10% = 11,00,000

NPV = 20 × 65,514.65 – 11,00,000

= 2,10,293

$$\text{Sensitivity} = \frac{3,10,293 - 2,10,293}{3,10,293} \times 100$$

$$= 32.22\%$$

Project life 33.33% ↓

Life = 3 Years

Life = 3 – 33.33%

= 2 years

$$\text{NPV} = 20 \times \frac{20,000}{(1.10)^1} + \frac{30,000}{(1.10)^2} - 10,00,000$$

= -1,40,496

$$\text{Sensitivity} = \frac{3,10,293 - (-1,40,496)}{3,10,293} \times 100$$

= 145.28%

$$= \frac{145.28}{33.33} \times 10 = 43.59\%$$

Approach II

(a) Selling Price

$$0 = X \times \frac{20,000}{(1.10)^1} + \frac{30,000}{(1.10)^2} + \frac{30,000}{(1.10)^3} - 10,00,000$$

$$65,514.65\ x = 10,00,000$$

$$x = \frac{10,00,000}{65,514.65}$$

= ₹ 15.26

Contribution = S.P. – VC

15.26 = x – 40

x = 55.26

Sensitivity in selling price $= \frac{60 - 55.26}{60} \times 100$

$= 7.90\%$

(b) Sensitivity in Unit Cost

Contribution = 15.26

Contribution = S.P. – VC

15.26 = 60 – x

x = 44.74

Sensitivity in unit cost $= \frac{44.74 - 40}{40} \times 100$

$= 11.85\%$

(c) Sensitivity in Sales Volume

Alternative 1

Let assume no. of units be x

$= 20 \times \frac{2x}{(1.10)^1} + \frac{3x}{(1.10)^2} + \frac{3x}{(1.10)^3} - 10,00,000 = 0$

$= 20 \times 6.5515\ x = 10,00,000$

$x = \frac{10,00,000}{20 \times 6.5515} = 7,631.84$ units

1 Year = 7,631.84 × 2 = 15,263.68

2 Year = 7,631.84 × 3 = 22,895.52

1 Year = 7,631.84 × 3 = 22,895.52

= 61,054.72

Sensitivity in units $= \frac{80,000 - 61,054.72}{80,000} \times 100$

$= 23.68\%$

Alternative II (Best)

Assume P.V. of units be x

$= 20 \times x - 10,00,000 = 0$

x $= 50,000$ units

Sensitivity in units $= \frac{65,514.65 - 50,000}{65,514.65} \times 100$

$= 23.68\%$

ICAI

$= \frac{3,10,293}{13,10,293} \times 100 = 23.68\%$

(d) Initial Outlays

Sensitivity in project cost $= \frac{NPV}{\text{Initial Outlays}} \times 100$

$= \frac{3,10,293}{10,00,000} \times 100$

$= 31.03\%$

(e) Project Life

Life 3 years NPV = 3,10,293

Life 2 years NPV = -1,40,496

2 years	----------	(1,40,496)
3 years	----------	3,10,293
1 year		(4,50,789)

2 years $+ \left(\frac{1}{4,50,789} \times 1,40,496\right)$

2.31 years

Sensitivity in life $= \frac{3 - 2.31}{3} \times 100$

= 22.97%

Question – 12

Red Ltd. is considering a project with the following Cash flows:

Years	Cost of Plant	Recurring Cost	Savings
0	10,000		
1		4,000	12,000
2		5,000	14,000

The cost of capital is 9%. Measure the sensitivity of the project to changes in the levels of plant value, running cost and savings (considering each factor at a time) such that the NPV becomes zero. The P.V. factor at 9% are as under:

Year	Factor
0	1
1	0.917
2	0.842

Which factor is the most sensitive to affect the acceptability of the project?

(SM TYK – 11)

Solution:

P.V. of Cash Flows

Year 1	Running Cost	₹ 4,000 × 0.917	= (₹ 3,668)
	Savings	₹ 12,000 × 0.917	= ₹ 11,004
Year 2	Running Cost	₹ 5,000 × 0.842	= (₹ 4,210)
	Savings	₹ 14,000 × 0.842	= ₹ 11,788
			= ₹ 14,914
Year 0	Less: P.V. of Cash Outflow	₹ 10,000 × 1	= ₹ 10,000
	NPV		= ₹ 4,914

Sensitivity Analysis

(i) Increase of Plant Value by ₹ 4,914