**Practice Questions and Solutions for Virtual Coaching Classes**

**Paper 8A: Financial Management**

**Topic: Risk Analysis in Capital Budgeting**

**Illustration-1**

*Possible net cash flows of Projects A and B at the end of first year and their probabilities are given as below. Discount rate is 10 per cent. For both the project initial investment is ₹10,000. From the following information, CALCULATE the expected net present value for each project. State which project is preferable?*

| *Possible Event* | *Project A* | | *Project B* | |
|---|---|---|---|---|
| | *Cash Flow (₹)* | *Probability* | *Cash Flow (₹)* | *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* |

**Solution:**

**Calculation of Expected Value for Project A and Project B**

| | **Project A** | | | **Project B** | | |
|---|---|---|---|---|---|---|
| **Possible Event** | **Net Cash Flow (₹)** | **Probability** | **Expected Value (₹)** | **Cash Flow (₹)** | **Probability** | **Expected Value (₹)** |
| A | 8,000 | 0.10 | 800 | 24,000 | 0.10 | 2,400 |
| B | 10,000 | 0.20 | 2,000 | 20,000 | 0.15 | 3,000 |
| C | 12,000 | 0.40 | 4,800 | 16,000 | 0.50 | 8,000 |
| D | 14,000 | 0.20 | 2,800 | 12,000 | 0.15 | 1,800 |
| E | 16,000 | 0.10 | 1,600 | 8,000 | 0.10 | 800 |
| ENCF | | | 12,000 | | | 16,000 |

The net present value for Project A is (0.909 × ₹ 12,000 – ₹ 10,000) = ₹ 908

The net present value for Project B is (0.909 × ₹ 16,000 – ₹10,000) = ₹ 4,544.

**Illustration-2**

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

| *Year 1* | | *Year 2* | | *Year 3* | |
|---|---|---|---|---|---|
| ***Cash Flow (₹)*** | ***Probability*** | ***Cash Flow (₹)*** | ***Probability*** | ***Cash Flow (₹)*** | ***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 net present value of the project using expected cash flows using 10 per cent discount rate. Initial Investment is ₹ 10,000.*

**Solution:**

| Year 1 | | | Year 2 | | | Year 3 | | |
|---|---|---|---|---|---|---|---|---|
| **Cash Flow (₹)** | **Probability** | **Expected Value (₹)** | **Cash Flow (₹)** | **Probability** | **Expected Value (₹)** | **Cash Flow (₹)** | **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 | 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:

Present Value of cash flow $= \frac{ENCF_1}{(1+k)^1} + \frac{ENCF_2}{(1+k)^2} + \frac{ENCF_3}{(1+k)^3}$

$= \frac{6,000}{(1.1)} + \frac{4,800}{(1.1)^2} + \frac{4,200}{(1.1)^3}$

= (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 = ₹ 2,573.

**Illustration-3**

*Continuing Illustration 1, Calculate Variance and Standard Deviation of both the project.*

**Solution:**

**Project A**

Variance ($\sigma^2$) = (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)

= 16,00,000 + 8,00,000 + 0 + 8,00,000 + 16,00,000 = 48,00,000

Standard Deviation ($\sigma$) = $\sqrt{\text{Variance}(\sigma^2)}$ = $\sqrt{48,00,000}$ = 2,190.90

**Project B:**

Variance($\sigma^{2)}$ = (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)

= 64,00,000 + 24,00,000 + 0 + 24,00,000 + 64,00,000 = 1,76,00,000

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

**Illustration-4**

*Continuing Illustration 3, Calculate Coefficient of Variation of both the project.*

**Solution:**

| Projects | Coefficient of variation | Risk | Expected Value |
|---|---|---|---|
| A | $\frac{2,190.90}{12,000} = 0.1826$ | Less | Less |
| B | $\frac{4,195.23}{16,000} = 0.2622$ | More | More |

In project A risk per rupee of cash flow is Rs. 0.18 while in project B it is Rs. 0.26. Therefore, Project A is better than Project B.

**Illustration-5**

*An enterprise is investing ₹ 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 (₹ 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.*

**Solution:**

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 ₹ in lakhs | Discounting Factor @7% | Present value of Cash Flows ₹ 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 | | | 100.00 |
| 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 ₹ in Lakhs | Discounting Factor@14% | Present Value of Cash Flows ₹ 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 | | | 199.79 |
| Initial investment | | | 100.00 |
| Net present value (NPV) | | | 99.79 |

**Illustration-6**

*If Investment proposal is ₹ 45,00,000 and risk free rate is 5%, CALCULATE net present value under certainty equivalent technique.*

| *Year* | *Expected cash flow (₹)* | *Certainty Equivalent coefficient* |
|---|---|---|
| *1* | *10,00,000* | *0.90* |

| | | |
|---|---|---|
| *2* | *15,00,000* | *0.85* |
| *3* | *20,00,000* | *0.82* |
| *4* | *25,00,000* | *0.78* |

**Solution:**

$$NPV = \frac{10,00,000 \times (0.90)}{(1.05)} + \frac{15,00,000 \times (0.85)}{(1.05)2} + \frac{20,00,000 \times (0.82)}{(1.05)3} + \frac{25,00,000 \times (0.78)}{(1.05)4} - 45,00,000$$

= ₹ 5,34,570

**Illustration-7**

*X Ltd is considering its New Product 'with the following details:*

| Sr. No. | Particulars | Figures |
|---|---|---|
| *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%* |

*Required:*

1. *CALCULATE the NPV of the project.*
2. *COMPUTE the impact on the project's NPV of a 2.5 per cent adverse variance in each variable. Which variable is having maximum effect. Consider Life of the project as 3 years.*

**Solution:**

**1. Calculation of Net Cash Inflow per year:**

| | Particulars | Amount (₹) |
|---|---|---|
| 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 × D) | ₹ 250 Cr. |
| F | Fixed Cost Per Year | ₹ 50 Cr. |
| G | Net Cash Inflow Per Year (G = E - F) | ₹ 200 Cr. |

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

| Year | Year Cash Flow (₹ in Cr.) | Discounting @ 6% | Present Value (PV) (₹ in Cr.) |
|---|---|---|---|
| 0 | (400.00) | 1.000 | (400.00) |
| 1 | 200.00 | 0.943 | 188.60 |
| 2 | 200.00 | 0.890 | 178.00 |
| 3 | 200.00 | 0.840 | 168.00 |
| 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 ₹ 410 crore | Selling Price per Unit Reduced to ₹ 97.5 | Variable Cost Per Unit increased to ₹ 51.25 | Fixed Cost Per Unit increased to ₹ 51.25 | Units sold per year reduced to 4.875 crore |
|---|---|---|---|---|---|---|---|
| | **Particulars** | **Amount ₹** | **Amount ₹** | **Amount ₹** | **Amount ₹** | **Amount ₹** | **Amount ₹** |
| 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 | 48.75 | 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 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 can be calculated. Thus, it can be seen that the change in selling price has the maximum effect on the NPV by 24.82 %.

**Illustration-8**

*XYZ Ltd. is considering a project "A" with an initial outlay of ₹14,00,000 and the possible three cash inflow attached with the project as follows:*

*(₹000)*

| *Particular* | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| *Worst case* | *450* | *400* | *700* |
| *Most likely* | *550* | *450* | *800* |
| *Best case* | *650* | *500* | *900* |

*Assuming the cost of capital as 9%, determine NPV in each scenario. If XYZ Ltd is certain about the most likely result but uncertain about the third year's cash flow, ANALYSE what will be the NPV expecting worst scenario in the third year.*

**Solution:**

The possible outcomes will be as follows:

| Year | PVF @ 9% | Worst Case | | Most likely | | Best case | |
|---|---|---|---|---|---|---|---|
| | | Cash Flow ₹ 000 | PV ₹ 000 | Cash Flow ₹ 000 | PV ₹ 000 | Cash Flow ₹ 000 | PV ₹000 |
| 0 | 1 | (1400) | (1400) | (1400) | (1400) | (1400) | (1400) |
| 1 | 0.917 | 450 | 412.65 | 550 | 504.35 | 650 | 596.05 |
| 2 | 0.842 | 400 | 336.80 | 450 | 378.90 | 500 | 421.00 |
| 3 | 0.772 | 700 | 540.40 | 800 | 617.60 | 900 | 694.80 |
| NPV | | | -110.15 | | 100.85 | | 311.85 |

Now suppose that CEO of XYZ Ltd. is bit confident about the estimates in the first two years, but not sure about the third year's high cash inflow. He is interested in knowing what will happen

to traditional NPV if 3rd year turn out the bad contrary to his optimism.

The NPV in such case will be as follows:

$$= -₹14,00,000 + \frac{5,50,000}{(1+0.09)} + \frac{4,50,000}{(1+0.09)^2} + \frac{7,00,000}{(1+0.09)^3}$$

= − ₹14,00,000 + ₹ 5,04,587 + ₹ 3,78,756 + ₹ 5,40,528 = ₹ 23,871

**Illustration-9**

*DETERMINE the risk adjusted net present value of the following projects:*

| | X | Y | Z |
|---|---|---|---|
| Net cash outlays (₹) | 2,10,000 | 1,20,000 | 1,00,000 |
| Project life | 5 years | 5 years | 5 years |
| Annual Cash inflow (₹) | 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 |

**Solution:**

**Statement showing the determination of the risk adjusted net present value**

| Projects | Net cash outlays | Coefficient of variation | Risk adjusted discount rate | Annual cash inflow | PV factor 1-5 years | Discounted cash inflow | Net present value |
|---|---|---|---|---|---|---|---|
| | (₹) | | | (₹) | | (₹) | (₹) |
| 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 |

**Illustration-10**

*A Ltd. is considering two mutually exclusive projects X and Y.*

*You have been given below the Net Cash flow probability distribution of each project:*

| *Project-X* | | *Project-Y* | |
|---|---|---|---|
| *Net Cash Flow (₹)* | *Probability* | *Net Cash Flow (₹)* | *Probability* |
| *50,000* | *0.30* | *1,30,000* | *0.20* |
| *60,000* | *0.30* | *1,10,000* | *0.30* |
| *70,000* | *0.40* | *90,000* | *0.50* |

*(i) Compute the following :*

*(a) Expected Net Cash Flow of each project.*

*(b) Variance of each project.*

*(c) Standard Deviation of each project.*

*(d) Coefficient of Variation of each project.*

*(ii) Identify which project do you recommend? Give reason.*

**Solution:**

**(i) (a) Calculation of Expected Net Cash Flow (ENCF) of Project X and Project Y**

| Project X | | | Project Y | | |
|---|---|---|---|---|---|
| **Net Cash Flow (₹)** | **Probability** | **Expected Net Cash Flow (₹)** | **Net Cash Flow (₹)** | **Probability** | **Expected Net Cash Flow (₹)** |
| 50,000 | 0.30 | 15,000 | 1,30,000 | 0.20 | 26,000 |
| 60,000 | 0.30 | 18,000 | 1,10,000 | 0.30 | 33,000 |
| 70,000 | 0.40 | 28,000 | 90,000 | 0.50 | 45,000 |
| **ENCF** | | **61,000** | | | **1,04,000** |

**(b) Variance of Projects**

**Project X**

Variance ($\sigma^2$) = $(50,000 – 61,000)^2 \times (0.3) + (60,000 - 61,000)^2 \times (0.3) + (70,000 – 61,000)^2 \times (0.4)$

= 3,63,00,000 + 3,00,000 + 3,24,00,000 **= 6,90,00,000**

**Project Y**

Variance($\sigma^{2)}$ = $(1,30,000 – 1,04,000)^2 \times (0.2) + (1,10,000 – 1,04,000)^2 \times (0.3) + (90,000 – 1,04,000)^2 \times (0.5)$

= 13,52,00,000 + 1,08,00,000 + 9,80,00,000 **= 24,40,00,000**

**(c) Standard Deviation of Projects**

**Project X**

Standard Deviation (σ) = $\sqrt{\text{Variance}(\sigma^2)}$ = $\sqrt{6,90,00,000}$ **= 8,306.624**

**Project Y**

Standard Deviation (σ) = $\sqrt{\text{Variance}(\sigma^2)}$= $\sqrt{24,40,00,000}$ **= 15,620.499**

**(d) Coefficient of Variation of Projects**

| Projects | Coefficient of variation $\left(\frac{\text{Standard Deviation}}{\text{Expected Net Cash Flow}}\right)$ | Risk | Expected Net Cash Flow |
|---|---|---|---|
| X | $\frac{8,306.24}{61,000}$ **= 0.136 or 13.60%** | Less | Less |
| Y | $\frac{15,620.499}{1,04,000}$ **= 0.150 or 15.00%** | More | More |

**(ii)** In project X risk per rupee of cash flow is 0.136 (approx.) while in project Y it is 0.15 (approx.). Therefore, Project X is better than Project Y.