Financial Management

Unit – 3

Capital Budgeting Decisions

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Unit Coverage

- Concept and Principles of Capital Budgeting;
- Methods of capital Budgeting:
- Payback Method,
- Accounting Rate of Return,
- Net Present Value (NPV),
- Net Terminal Value,
- Internal Rate of Return (IRR),
- Profitability Index;
- Capital budgeting under risk;

Nature of Investment Decisions

- The **investment decisions** of a firm are generally known as the **capital budgeting, or capital expenditure decisions.**
- The firm's investment decisions would generally include **expansion**, **acquisition**, **modernisation** and **replacement** of the long-term assets.
- Decisions like the change in the **methods of sales distribution**, or an **advertisement campaign** or a **research and development programme** have long-term implications for the firm's expenditures and benefits, and therefore, they should also be evaluated as investment decisions.

Features of Investment Decisions

- The exchange of current funds for future benefits.
- The funds are invested in long-term assets.
- The future benefits will occur to the firm over a series of years.

Importance of Investment Decisions

- Growth
- Risk
- Funding
- Irreversibility
- Complexity

Types of Investment Decisions

- One classification is as follows:
  - Expansion of existing business
  - Expansion of new business
  - Replacement and modernisation
- Yet another useful way to classify investments is as follows:
  - Mutually exclusive investments
  - Independent investments
  - Contingent investments

Investment Evaluation Criteria

- Three steps are involved in the evaluation of an investment:
  - Estimation of cash flows
  - Estimation of the required rate of return (the opportunity cost of capital)
  - Application of a decision rule for making the choice

Investment Decision Rule

- It should maximise the shareholders' wealth.
- It should consider all cash flows to determine the true profitability of the project.
- It should provide for an objective and unambiguous way of separating good projects from bad projects.
- It should help ranking of projects according to their true profitability.
- It should recognise the fact that bigger cash flows are preferable to smaller ones and early cash flows are preferable to later ones.
- It should help to choose among mutually exclusive projects that project which maximises the shareholders' wealth.
- It should be a criterion which is applicable to any conceivable investment project independent of others.

Investment Decision Rule

- Project A, B and C require an investment of Rs. 10000/- and will generate yearend cash flows of

Year	Project A	Project B	Project C
1	5000	1000	5000
2	3000	1000	5000
3	2000	2000	0
4	0	2000	0
5	0	4000	0
Payback Period	3 Yr	5 Yrs	2 yrs

Evaluation Criteria
(Techniques of Capital Budgeting)

- 1. ***Discounted Cash Flow (DCF) Criteria***
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)
  - Profitability Index (PI)
  - Discounted Payback Period (DPB)
- 2. ***Non-discounted Cash Flow Criteria***
  - Payback Period (PB)
  - Accounting Rate of Return (ARR)

1. Payback Period Method

- **Payback** is the number of years required to recover the original cash outlay invested in a project.
- If the project generates constant annual cash inflows, the payback period can be computed by dividing cash outlay by the annual cash inflow. That is:

$$\text{Payback} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}} = \frac{C_0}{C}$$

- Assume that a project requires an outlay of Rs 50,000 and yields annual cash inflow of Rs 12,500 for 7 years. The payback period for the project is: Rs. 50000
- PB = ---------- = 4 years

Rs. 12500

Example : Payback Period Method

- **Calculate the payback period of an investment proposal, requires an initial cash outlay of Rs. 350000/- and it generates cash inflow of Rs. 50000 every years for next 10 years.**

$$\text{Payback} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}} = \frac{C_0}{C}$$

Rs. 350000

- Payback =---------- = 7 years

Rs. 50000

Payback Period - Unequal cash flows

- **Unequal cash flows** In case of unequal cash inflows, the payback period can be found out by **adding up the cash inflows until the total is equal to the initial cash outlay**.
- Suppose that a project requires a cash outlay of Rs 20,000, and generates cash inflows of Rs 8,000; Rs 7,000; Rs 4,000; and Rs 3,000 during the next 4 years. What is the project's payback?

  3 years + **12 × (1,000/3,000) months**

  Payback Period = 3 years + 4 months

Acceptance Rule

- The project would be accepted if its payback period is less than the maximum or **standard payback** period set by management.
- As a ranking method, it gives highest ranking to the project, which has the shortest payback period and lowest ranking to the project with highest payback period.

Merits and Demerits of Payback Period Method

- Certain virtues:
  - Simplicity
  - Cost effective
  - Short-term effects
  - Risk shield
  - Liquidity
- Serious limitations:
  - Cash flows after payback
  - Cash flows ignored
  - Cash flow patterns
  - Administrative difficulties
  - Inconsistent with shareholder value

Payback Reciprocal and the Rate of Return

- The reciprocal of payback will be a close approximation of the internal rate of return if the following two conditions are satisfied:
  - The life of the project is large or at least twice the payback period.
  - The project generates equal annual cash inflows.

Discounted Payback Period

- The **discounted payback period** is the number of periods taken in recovering the investment outlay on the present value basis.
- The discounted payback period still fails to consider the cash flows occurring after the payback period.

3 DISCOUNTED PAYBACK ILLUSTRATED

	Cash Flows (Rs)					*Simple PB*	*Discounted PB*	*NPV at 10%*
	C0	*C1*	*C2*	*C3*	*C4*			
P	-4,000	3,000	1,000	1,000	1,000	2 yrs	–	–
PV of cash flows	-4,000	2,727	826	751	683		2.6 yrs	987
Q	-4,000	0	4,000	1,000	2,000	2 yrs	–	–
PV of cash flows	-4,000	0	3,304	751	1,366		2.9 yrs	1,421

2. Accounting Rate of Return Method

- Accounting rate of return is a capital budgeting metric that's useful if you want to calculate an investment's profitability quickly.
- Accounting Rate of Return (ARR) is the average net income an asset is expected to generate divided by its average capital cost, expressed as an annual percentage.

Accounting Rate of Return Method

- The accounting rate of return is the ratio of the average after-tax profit divided by the average investment. The average investment would be equal to half of the original investment if it were depreciated constantly.

$$\text{ARR} = \frac{\text{Average income}}{\text{Average investment}}$$

Where:

- Average Income = Total profit over Investment Period / Number of Years
- Average Investment = (Book Value at Year 1 + Book Value at End of Useful Life) / 2

ARR – Numerical Problem 1

- XYZ Company is looking to invest in some new machinery to replace its current malfunctioning one. The new machine, which costs Rs. 420,000, would increase annual revenue by Rs. 200,000 and annual expenses by Rs. 50,000. The machine is estimated to have a useful life of 12 years **and zero salvage** value.

Step 1: Calculate Average Annual Profit

Inflows, Years 1-12 = (200,000 x 12) = Rs. 2,400,000

Less: Annual Expenses = (50,000 x 12) = Rs. -600,000

Less: Depreciation = Rs. -420,000 -------- Value of Machine

Total Profit = Rs. 1,380,000 (in 12 years)

Average Annual Profit = (1,380,000/12) = Rs. 115,000 per year

Step 2: Calculate Average Investment

Average Investment = (Rs. 420,000 + Rs. 0)/2 = Rs. 210,000

Step 3: Use ARR Formula $\text{ARR} = \frac{\text{Average income}}{\text{Average investment}}$ = Rs.115,000/Rs.210,000 =.5476

= 54.76%

ARR – Numerical Problem 1

$$\text{ARR} = \frac{\text{Average income}}{\text{Average investment}}$$

Step 3: Use ARR Formula

$$= \frac{\text{Rs.115,000}}{\text{Rs.210,000}} \times 100 = 54.76\%$$

ARR – Numerical Problem 2

- Company is willing to purchase a new machine for Rs. 1,50,000. The usable life of the machine is 10 years, at the end of its usable life the machine can be sold for Rs. 50000/-. The machine will provide an additional profit of Rs. 80000 every year. Annual expenses on operating the machine is Rs. 30,000. calculate ARR of the investment in machine.

Step 1: Calculate Average Annual Profit

Inflows, Years 1-10 = (80,000 x 10) = Rs. 8,00,000

Less: Annual Expenses = (30,000 x 10) = – Rs. 3,00,000

Less: Depreciation = Rs. -1,00,000 ---- Dec. In the Value of Machine

Total Profit = Rs. 4,00,000 (in 10 years)

Average Annual Profit = (4,00,000/10) = Rs. 40,000 per year

Step 2: Calculate Average Investment

Average Investment = (Rs. 1,50,000 + Rs. 50000)/2 = Rs. 1,00,000

Step 3: Use ARR Formula = Rs.40,000/Rs.1,00,000 =.4

= 40%

ARR – Numerical Problem 3

- XYZ Company is considering investing in a project that requires an initial investment of Rs. 100,000 for some machinery.
- There will be net inflows of Rs. 20,000 for the first two years, Rs. 10,000 in years three and four, and Rs. 30,000 in year five. Finally, the machine has a salvage value of Rs. 25,000.

Income

Year	Amount
1	20000
2	20000
3	10000
4	10000
5	30000

Total : 90000

ARR – Numerical Problem 3

Step 1: Calculate Average Annual Profit

Inflows, Years 1 & 2	= (20,000 x 2)	= 40,000
Inflows, Years 3 & 4	= (10,000 x 2)	= 20,000
Inflow, Year 5	=	30,000

		90,000
Less: Depreciation		
(100,000-25,000)	=	-75,000
Total Profit	=	15,000
Average Annual Profit	=	(15,000/5) = 3,000

Step 2: Calculate Average Investment

Average Investment = (100,000 + 25,000) / 2 = 62,500

Step 3: Use ARR Formula

$$\text{ARR} = \frac{\text{Average income}}{\text{Average investment}}$$

ARR = 3,000/62,500 = 4.8%

Acceptance Rule

- This method will accept all those projects whose ARR is higher than the minimum rate established by the management and reject those projects which have ARR less than the minimum rate.
- This method would rank a project as number one if it has highest ARR and lowest rank would be assigned to the project with lowest ARR.

Merits and Demerits of ARR Method

- The ARR method may claim some merits
  - Simplicity
  - Accounting data
  - Accounting profitability
- Serious shortcoming
  - Cash flows ignored
  - Time value ignored
  - Arbitrary cut-off

3. Net Present Value Method

- Cash flows of the investment project should be forecasted based on realistic assumptions.
- Appropriate discount rate should be identified to discount the forecasted cash flows. The appropriate discount rate is the project's opportunity cost of capital.
- Present value of cash flows should be calculated using the opportunity cost of capital as the discount rate.
- The project should be accepted if NPV is positive (i.e., NPV > 0).

Present Value

- Calculate PV of following cash flows; Assume discounting rate is 10%.

Year	Cash Inflow	PV Factor	Present Value
1	1000	0.909	909
2	1000	0.826	826
3	1000	0.751	751

			2486

NPV

Ex. 4: Calculate NPV of following Proposal; Assume discounting rate is 10%. Initial Cash outlay Rs.1,00,000

Year	Cash Inflow	PV Factor	Present Value
1	20000	.909	18018
2	25000	.826	20650
3	30000	.751	22503
4	35000	.682	23870
5	20000	.620	12400

NPV = 97441-100000 = -2559

Project should not be accepted.

NPV

Ex. 5: Use NPV method to compare and analyse which Proposal is better to accept; Assume discounting rate is 10%.

Project	Cash Outflow	Cash Inflows		
	Year 0	Year 1	Year 2	Year 3
X	20000	30000	20000	10000
Y	20000	10000	20000	30000

NPV

Ex. 5: NPV for Project X

Year	Cash Inflow	PV Factor	Present Value
1	30000	.909	27027
2	20000	.826	16052
3	10000	.751	7510

NPV = 50589 – 20000 = 30589

NPV for Project Y

Year	Cash Inflow	PV Factor	Present Value
1	10000	.909	9090
2	20000	.826	16052
3	30000	.751	22530

NPV = 47672 – 20000 = 27672

Project “X” is having higher NPV; hence it should be preferred.

Present Value Tables

Formula: $PV = 1 / (1 + i)^n$

n / i	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696
2	0.9803	0.9612	0.9426	0.9246	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561
3	0.9706	0.9423	0.9151	0.8890	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931	0.6750	0.6575
4	0.9610	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133	0.5921	0.5718
5	0.9515	0.9057	0.8626	0.8219	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	0.5674	0.5428	0.5194	0.4972
6	0.9420	0.8880	0.8375	0.7903	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803	0.4556	0.4323
7	0.9327	0.8706	0.8131	0.7599	0.7107	0.6651	0.6227	0.5835	0.5470	0.5132	0.4817	0.4523	0.4251	0.3996	0.3759
8	0.9235	0.8535	0.7894	0.7307	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665	0.4339	0.4039	0.3762	0.3506	0.3269
9	0.9143	0.8368	0.7664	0.7026	0.6446	0.5919	0.5439	0.5002	0.4604	0.4241	0.3909	0.3606	0.3329	0.3075	0.2843
10	0.9053	0.8203	0.7441	0.6756	0.6139	0.5584	0.5083	0.4632	0.4224	0.3855	0.3522	0.3220	0.2946	0.2697	0.2472
11	0.8963	0.8043	0.7224	0.6496	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505	0.3173	0.2875	0.2607	0.2366	0.2149
12	0.8874	0.7885	0.7014	0.6246	0.5568	0.4970	0.4440	0.3971	0.3555	0.3186	0.2858	0.2567	0.2307	0.2076	0.1869
13	0.8787	0.7730	0.6810	0.6006	0.5303	0.4688	0.4150	0.3677	0.3262	0.2897	0.2575	0.2292	0.2042	0.1821	0.1625
14	0.8700	0.7579	0.6611	0.5775	0.5051	0.4423	0.3878	0.3405	0.2992	0.2633	0.2320	0.2046	0.1807	0.1597	0.1413
15	0.8613	0.7430	0.6419	0.5553	0.4810	0.4173	0.3624	0.3152	0.2745	0.2394	0.2090	0.1827	0.1599	0.1401	0.1229
16	0.8528	0.7284	0.6232	0.5339	0.4581	0.3936	0.3387	0.2919	0.2519	0.2176	0.1883	0.1631	0.1415	0.1229	0.1069
17	0.8444	0.7142	0.6050	0.5134	0.4363	0.3714	0.3166	0.2703	0.2311	0.1978	0.1696	0.1456	0.1252	0.1078	0.0929
18	0.8360	0.7002	0.5874	0.4936	0.4155	0.3503	0.2959	0.2502	0.2120	0.1799	0.1528	0.1300	0.1108	0.0946	0.0808
19	0.8277	0.6864	0.5703	0.4746	0.3957	0.3305	0.2765	0.2317	0.1945	0.1635	0.1377	0.1161	0.0981	0.0829	0.0703
20	0.8195	0.6730	0.5537	0.4564	0.3769	0.3118	0.2584	0.2145	0.1784	0.1486	0.1240	0.1037	0.0868	0.0728	0.0611

Net Present Value

- Assume a project requires a cash outlay of Rs. 2500/-, and generates year end cash inflows of Rs. 1000/- in the year 1 to 3. Calculate NPV. Assume discounting rate is 10%.

Year	Cash Inflow	PV Factor	Present Value
0	-2500		-2500
1	1000	0.909	909
2	1000	0.826	826
3	1000	0.751	751

NPV = Present Value of Cash inflows - Present Value of Cash Outflows

NPV = 2486 – 2500 = -14

Net Present Value Method

- Net present value should be found out by subtracting present value of cash outflows from present value of cash inflows. The formula for the net present value can be written as follows:

$$\text{NPV} = \left[\frac{C_1}{(1+k)} + \frac{C_2}{(1+k)^2} + \frac{C_3}{(1+k)^3} + \cdots + \frac{C_n}{(1+k)^n} \right] - C_0$$

$$\text{NPV} = \sum_{t=1}^{n} \frac{C_t}{(1+k)^t} - C_0$$

Calculating Net Present Value

- Assume that Project *X* costs Rs 2,500 now and is expected to generate year-end cash inflows of Rs 900, Rs 800, Rs 700, Rs 600 and Rs 500 in years 1 through 5. The opportunity cost of the capital may be assumed to be 10 per cent.

$$\text{NPV} = \left[\frac{\text{Rs } 900}{(1+0.10)} + \frac{\text{Rs } 800}{(1+0.10)^2} + \frac{\text{Rs } 700}{(1+0.10)^3} + \frac{\text{Rs } 600}{(1+0.10)^4} + \frac{\text{Rs } 500}{(1+0.10)^5}\right] - \text{Rs } 2{,}500$$

$$\text{NPV} = [\text{Rs } 900(\text{PVF}_{1,\,0.10}) + \text{Rs } 800(\text{PVF}_{2,\,0.10}) + \text{Rs } 700(\text{PVF}_{3,\,0.10})$$
$$+ \text{Rs } 600(\text{PVF}_{4,\,0.10}) + \text{Rs } 500(\text{PVF}_{5,\,0.10})] - \text{Rs } 2{,}500$$

$$\text{NPV} = [\text{Rs } 900 \times 0.909 + \text{Rs } 800 \times 0.826 + \text{Rs } 700 \times 0.751 + \text{Rs } 600 \times 0.683$$
$$+ \text{Rs } 500 \times 0.620] - \text{Rs } 2{,}500$$

$$\text{NPV} = \text{Rs } 2{,}725 - \text{Rs } 2{,}500 = + \text{Rs } 225$$

Net Present Value

Year	Cash Inflow	PV Factor	Present Value
0	-2500		-2500
1	900	0.909	818.1
2	800	0.826	660.8
3	700	0.751	525.7
4	600	0.683	409.8
5	500	0.620	310.0

NPV = Present Value of Cash inflows - Present Value of Cash Outflows

NPV = 2724.4 – 2500 = +224.4

Acceptance Rule

- Accept the project when NPV is positive NPV > 0
- Reject the project when NPV is negative NPV < 0
- May accept the project when NPV is zero NPV = 0
- The NPV method can be used to select between mutually exclusive projects; the one with the higher NPV should be selected.

Merits and Demerits of NPV Method

- NPV is most acceptable investment rule for the following reasons:
  - Time value
  - Measure of true profitability
  - Value-additivity
  - Shareholder value
- Limitations:
  - Involved cash flow estimation
  - Discount rate difficult to determine
  - Mutually exclusive projects
  - Ranking of projects

Internal Rate of Return Method

- The internal rate of return (IRR) is the rate that equates the investment outlay with the present value of cash inflow received after one period. This also implies that the rate of return is the discount rate which makes NPV = 0.

$$C_0 = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \cdots + \frac{C_n}{(1+r)^n}$$

$$C_0 = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t}$$

$$\sum_{t=1}^{n} \frac{C_t}{(1+r)^t} - C_0 = 0$$

Calculation of IRR

- **Uneven Cash Flows**: Calculating IRR by Trial and Error
  - The approach is to select any discount rate to compute the present value of cash inflows. If the calculated present value of the expected cash inflow is lower than the present value of cash outflows, a lower rate should be tried. On the other hand, a higher value should be tried if the present value of inflows is higher than the present value of outflows. This process will be repeated unless the net present value becomes zero.

Calculation of IRR

- **Level Cash Flows**
  - Let us assume that an investment would cost Rs 20,000 and provide annual cash inflow of Rs 5,430 for 6 years.
  - The IRR of the investment can be found out as follows:

$$\text{NPV} = -\text{Rs } 20{,}000 + \text{Rs } 5{,}430(\text{PVAF}_{6,r}) = 0$$

$$\text{Rs } 20{,}000 = \text{Rs } 5{,}430(\text{PVAF}_{6,\,r})$$

$$\text{PVAF}_{6,\,r} = \frac{\text{Rs } 20{,}000}{\text{Rs } 5{,}430} = 3.683$$

NPV Profile and IRR

	A	B	C
1	**NPV Profile**		
2	***Cash Flow***	***Discount rate***	***NPV***
3	-20000	0%	12,580
4	5430	5%	7,561
5	5430	10%	3,649
6	5430	15%	550
7	5430	16%	0
8	5430	20%	(1,942)
9	5430	25%	(3,974)

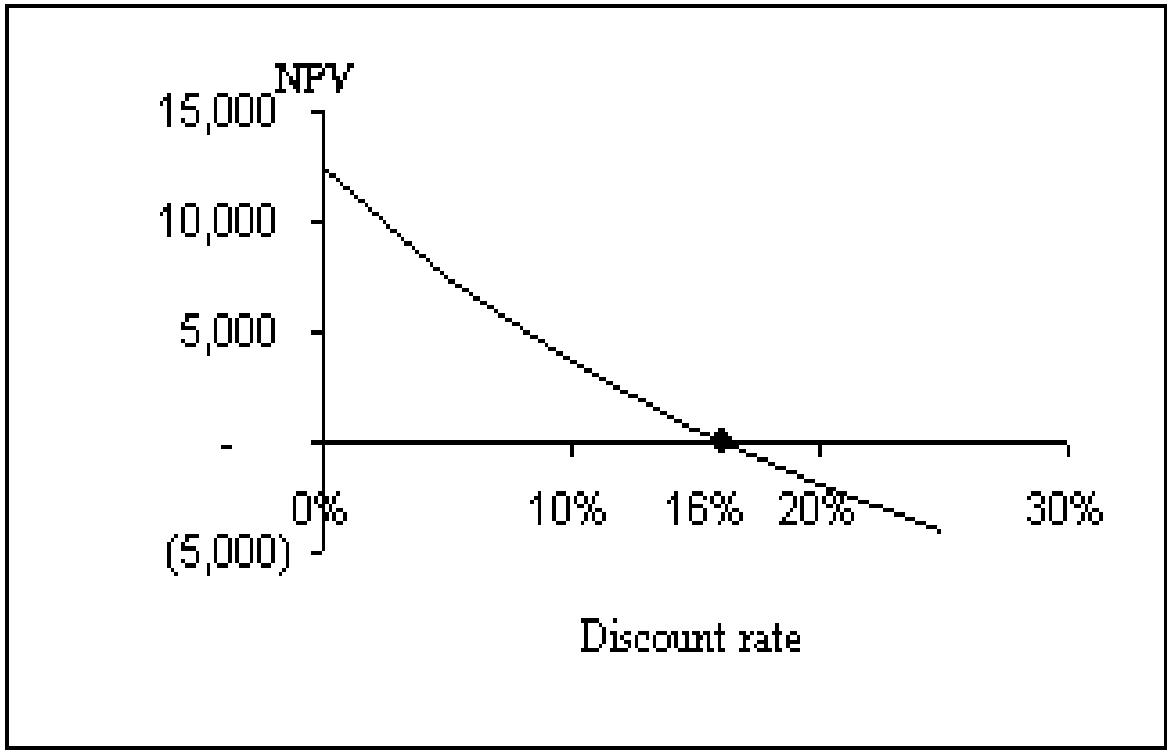

Figure 8.1 NPV Profile

Acceptance Rule

- Accept the project when $r > k$.
- Reject the project when $r < k$.
- May accept the project when $r = k$.
- In case of independent projects, IRR and NPV rules will give the same results if the firm has no shortage of funds.

Merits and Demerits of IRR Method

- IRR method has following merits:
  - Time value
  - Profitability measure
  - Acceptance rule
  - Shareholder value
- IRR method may suffer from:
  - Multiple rates
  - Mutually exclusive projects
  - Value additivity

Profitability Index

- Profitability index is the ratio of the present value of cash inflows, at the required rate of return, to the initial cash outflow of the investment.

Profitability Index

- The initial cash outlay of a project is Rs 100,000 and it can generate cash inflow of Rs 40,000, Rs 30,000, Rs 50,000 and Rs 20,000 in year 1 through 4. Assume a 10 per cent rate of discount. The PV of cash inflows at 10 per cent discount rate is:

$$PV = \text{Rs } 40{,}000(PVF_{1,0.10}) + \text{Rs } 30{,}000(PVF_{2,0.10}) + \text{Rs } 50{,}000(PVF_{3,0.10}) + \text{Rs } 20{,}000(PVF_{4,0.10})$$

$$= \text{Rs } 40{,}000 \times 0.909 + \text{Rs } 30{,}000 \times 0.826 + \text{Rs } 50{,}000 \times 0.751 + \text{Rs } 20{,}000 \times 0.68$$

$$NPV = \text{Rs } 112{,}350 - \text{Rs } 100{,}000 = \text{Rs } 12{,}350$$

$$PI = \frac{\text{Rs } 1{,}12{,}350}{\text{Rs } 1{,}00{,}000} = 1.1235.$$

Acceptance Rule

- The following are the PI acceptance rules:
  - Accept the project when PI is greater than one. $PI > 1$
  - Reject the project when PI is less than one. $PI < 1$
  - May accept the project when PI is equal to one. $PI = 1$
- The project with positive NPV will have PI greater than one.
- PI less than means that the project's NPV is negative.

Merits and Demerits of PI Method

- It recognises the time value of money.
- It is consistent with the shareholder value maximisation principle. A project with PI greater than one will have positive NPV and if accepted, it will increase shareholders' wealth.
- In the PI method, since the present value of cash inflows is divided by the initial cash outflow, it is a relative measure of a project's profitability.
- Like NPV method, PI criterion also requires calculation of cash flows and estimate of the discount rate. In practice, estimation of cash flows and discount rate pose problems.

Risk Analysis in Capital Budgeting

Nature of Risk

- **Risk** exists because of the inability of the decision-maker to make perfect forecasts.
- In formal terms, the risk associated with an investment may be defined as the variability that is likely to occur in the future returns from the investment.
- Three broad categories of the events influencing the investment forecasts:
  - ***General economic conditions***
  - ***Industry factors***
  - ***Company factors***

Risk Analysis in Practice

- Risk analysis gives management better information about the possible outcomes that may occur so that management can use their judgment and experience to accept an investment or reject it.
- Risk and uncertainty are quite inherent in capital budgeting decisions. This is so because investment decisions and capital budgeting are actions of today which bear fruits in future which is unforeseen.
- Future is uncertain and involves risk. The projection of probability of cash inflows made today is not certain to be achieved in the course of future.
- Seasonal fluctuations and business cycles both deliver heavy impact upon the cash inflows and outflows projected for different project proposals. The cost of capital which offers cut-off rates may also be inflated or deflated under business cycle conditions. Inflation and deflation are bound to effect the investment decision in future period rendering the degree of uncertainty more severe and enhancing the scope of risk.

Risk Analysis in Practice

- Most companies in India account for risk while evaluating their capital expenditure decisions. The following factors are considered to influence the riskiness of investment projects:
  - price of raw material and other inputs
  - price of product
  - product demand
  - government policies
  - technological changes
  - project life
  - inflation

Risk Analysis in Practice

- Out of these factors, four factors thought to be contributing most to the project riskiness are: selling price, product demand, technical changes and government policies.
- The most commonly used methods of risk analysis in practice are:
  - sensitivity analysis
  - conservative forecasts
- Sensitivity analysis allows to see the impact of the change in the behaviour of critical variables on the project profitability. Conservative forecasts include using short payback or higher discount rate for discounting cash flows.
- Except a very few companies most companies do not use the statistical and other sophisticated techniques for analysing risk in investment decisions.

Techniques for Risk Analysis

Following statistical/mathematical techniques of risk evaluation are used in capital budgeting:

a) Certainty Equivalent Approach
b) Probability Assignment
c) Expected Net Present Value
d) Standard Deviation
e) Coefficient of Variation
f) Sensitivity Analysis
g) Simulation
h) Probability Distribution Approach
i) Normal Probability Distribution
j) Linear Programming

Conventional Techniques of Risk Analysis

- Payback
- Risk-adjusted discount rate
- Certainty equivalent

Certainty Equivalent

- Certainty Equivalent Factor (CEF) is the ratio of assured cash flows to uncertain cash flows. Under this approach, the cash flows expected in a project are converted into risk-less equivalent amount.
- The adjustment factor used is called CEF. This varies between 0 and 1. A co-efficient of 1 indicates that cash flows are certain.
- The greater the risk in cash flow, the smaller will be CEF ‘for receipts’, and larger will be the CEF ‘for payments’.
- While employing this method, the decision maker estimates the sum he must be assured of receiving, in order that he is indifferent between an assured sum and expected value of a risky sum. Method of Computation under CE approach:
- Step 1: Convert uncertain cash flows to certain cash flows by multiplying it with the CEF.
- Step 2: Discount the certain cash flows at the risk free rate to arrive at NPV.

Certainty—Equivalent

- Reduce the forecasts of cash flows to some conservative levels.
- The certainty—equivalent coefficient assumes a value between 0 and 1, and varies inversely with risk.
- Decision-maker subjectively or objectively establishes the coefficients.
- The certainty—equivalent coefficient can be determined as a relationship between the certain cash flows and the risky cash flows.

$$\mathrm{NPV} = \sum_{t=0}^{n} \frac{\alpha_t \, \mathrm{NCF}_t}{(1+k_f)^t}$$

$$\alpha_t = \frac{\mathrm{NCF}_t^*}{\mathrm{NCF}_t} = \frac{\text{Certain net cash flow}}{\text{Risky net cash flow}}$$

Evaluation of Certainty—Equivalent

- This method suffers from many dangers in a large enterprise:
  - First, the forecaster, expecting the reduction that will be made in his forecasts, may inflate them in anticipation.
  - Second, if forecasts have to pass through several layers of management, the effect may be to greatly exaggerate the original forecast or to make it ultra-conservative.
  - Third, by focusing explicit attention only on the gloomy outcomes, chances are increased for passing by some good investments.

Certainty Equivalent

Illustration: NZ Ltd. is considering to take a new project. The management of the company use Certainty Equivalent (CE) approach to evaluate such type of projects.

Following information is available for the project:

Year	*CFAT*	*CE*
1	1,15,000	0.90
2	1,15,000	0.85
3	1,15,000	0.75
4	1,15,000	0.70
5	1,15,000	0.65

Projects requires initial investment of ₹ 3,00,000. The Company's cost of capital is 12% and risk free borrowing rate is 7%.

Advise the company whether it should take project or not?

Certainty Equivalent

Solution:

Year	CFAT	CE	Adjusted CFAT	PV Factor 7%	PV
1	1,15,000	0.90	1,03,500	0.935	96,772
2	1,15,000	0.85	97,750	0.873	85,336
3	1,15,000	0.75	86,250	0.816	70,380
4	1,15,000	0.70	80,500	0.763	61,422
5	1,15,000	0.65	74,750	0.713	53,297
Total Present Valve					3,67,207
(-) Initial Investment					(3,00,000)
Net present value					67,207

Since NPV is positive, project can be accepted.

Risk-Adjusted Discount Rate

- Risk-Adjusted Discount Rate (RADR) is sum total of two components. And these components are the risk-free rate and the risk premium.
- This rate comes in handy when an expert or investor needs to calculate/ascertain the present value of a risky investment.
- So, we can say that RADR is the return that investor expects for taking a higher risk.
- Simply stated RADR calculation formula is the summation of – Prevailing Risk free rate *Plus* Risk premium for the kind of risk proposed/expected.
- Under CAPM or capital asset pricing model

- Risk premium= (Market rate of return - Risk free rate) x beta of the project

Risk-Adjusted Discount Rate

- Risk-adjusted discount rate is the rate used in the calculation of the present value of a risky investment. It is calculated as follows:

Formula: $R_f + \beta (R_m - R_f)$

- The risk-adjusted discount rate is the total of the risk-free rate, i.e. the required return on risk-free investments, and the market premium, i.e. the required return of the market.
- Financial analysts use the risk-adjusted discount rate to discount a firm's cash flows to their present value and determine the risk that investor should accept for a particular investment

Risk-Adjusted Discount Rate

- *Risk-adjusted discount rate,* will allow for both *time preference* and *risk preference* and will be a sum of the risk-free rate and the risk-premium rate reflecting the investor's attitude towards risk.

$$\text{NPV} = \sum_{t=0}^{n} \frac{\text{NCF}_t}{(1+k)^t}$$

- Under CAPM, the risk-premium is the difference between the market rate of return and the risk-free rate multiplied by the beta of the project.

$$k = k_f + k_r$$

Evaluation of Risk-adjusted Discount Rate

- The following are the advantages of risk-adjusted discount rate method:
  - It is simple and can be easily understood.
  - It has a great deal of intuitive appeal for risk-averse businessman.
  - It incorporates an attitude (risk-aversion) towards uncertainty.

- This approach, however, suffers from the following limitations:
  - There is no easy way of deriving a risk-adjusted discount rate. As discussed earlier, CAPM provides for a basis of calculating the risk-adjusted discount rate. Its use has yet to pick up in practice.
  - It does not make any risk adjustment in the numerator for the cash flows that are forecast over the future years.
  - It is based on the assumption that investors are risk-averse. Though it is generally true, there exists a category of risk seekers who do not demand premium for assuming risks; they are willing to pay a premium to take risks.

Risk-adjusted Discount Rate Vs. Certainty–Equivalent

- The certainty—equivalent approach recognises risk in capital budgeting analysis by adjusting estimated cash flows and employs risk-free rate to discount the adjusted cash flows. On the other hand, the risk-adjusted discount rate adjusts for risk by adjusting the discount rate. It has been suggested that the certainty—equivalent approach is theoretically a superior technique.
- The risk-adjusted discount rate approach will yield the same result as the certainty—equivalent approach if the risk-free rate is constant and the risk-adjusted discount rate is the same for all future periods.