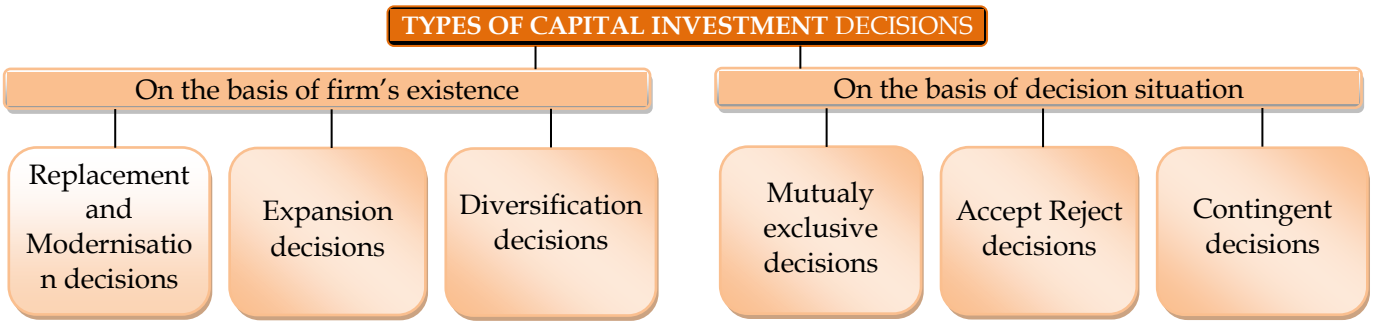
CHAPTER - 5

Investment Decisions

1. TYPES OF CAPITAL INVESTMENT DECISIONS



1.1 STEPS OF CAPITAL BUDGETING PROCEDURE

1. **Estimation** of Cash flows over the entire life for each of the projects under consideration.
2. **Evaluate** each of the alternative, using different decision criteria.
3. **Determining** the minimum required rate of return (i.e., WACC) to be used as discount rate.

Accordingly, this chapter is divided into two sections:

1. Estimation of Cash Flows
2. Capital Budgeting Techniques

2. ESTIMATION OF PROJECT CASH FLOWS

- One of the most important tasks in capital budgeting is **estimating future cash flows for a project.**
- Capital Budgeting analysis considers only **incremental cash flows** from an investment likely to result due to acceptance of any project.
- Though one of the techniques i.e., Accounting Rate of Return (ARR) evaluates profitability of a project on the basis of accounting profit, but accounting profit has its own limitations.
- Timings of cash flow may not match with the period of profit.
- Further, non-cash items like depreciation have no immediate cash outflow.
- The cash flows are estimated on the basis of inputs provided by various departments such as Production department, Finance department, Marketing department, etc.
- The project cash flow stream consists of cash outflows and cash inflows. The costs are denoted as "cash outflows" whereas the benefits are denoted as "cash inflows".
- **The life of the project** may be determined by taking into consideration the following factors:
  - (i) Technological obsolescence;
  - (ii) Physical deterioration; and
  - (iii) Decline in demand for the output of the project

CALCULATING CASH FLOWS – IMPORTANT POINTS:

(a) **DEPRECIATION:**

- Depreciation is a **non-cash item** and itself does not affect the cash flow.
- However, we must consider tax shield or benefit from depreciation in our analysis.
- Since this benefit reduces cash outflow for taxes, it is considered as cash inflow.
- To understand how depreciation acts as tax shield, let us consider following example:

EXAMPLE - 1

X Ltd. manufactures electronic motors fitted in desert coolers. It has an annual turnover of ₹ 30 crore and cash expenses to generate this much of sale is ₹ 25 crore. Suppose applicable tax rate is 30% and depreciation is ₹ 1.50 crore p.a.

- The table below is showing Tax shield due to depreciation under two scenarios i.e., with and without depreciation:

	No Depreciation is Charged (₹ Crore)	Depreciation is Charged (₹ Crore)
Total Sales	30.00	30.00
Less: Cost of Goods Sold	(25.00)	(25.00)
	5.00	5.00
Less: Depreciation	-	1.50
Profit before tax	5.00	3.50
Less: Tax @ 30%	1.50	1.05
Profit after Tax	3.50	2.45
Add: Depreciation*	-	1.50
Cash Flow	3.50	3.95

- *Being non- cash expenditure depreciation has been added back while calculating the cash flow.
- As we can see in the above table that due to depreciation under the second scenario, a tax saving of ₹ 0.45 crore (₹1.50 - ₹1.05) was made.
- This is called tax shield. The tax shield is considered while estimating cash flows.

b) OPPORTUNITY COST:

- Opportunity cost is **foregoing of a benefit** due to choosing an alternative investment option.
- This opportunity cost can occur both at the time of initial outlay and during the tenure of the project.
- Opportunity costs are considered for estimation of cash outflows.

EXAMPLE : 2

- If a company owns a piece of land acquired 10 years ago for ₹ 1 crore can be sold for ₹ 10 crore.
- If the company uses this piece of land for a project, then its sale value i.e. ₹ 10 crore forms the part of initial outlay as by using the land the company has foregone ₹ 10 crore which could be earned by selling it.

c) SUNK COST:

- Sunk cost is an outlay of cash that has **already been incurred** in the past and cannot be reversed in present.
- These costs do not have any impact on decision making.
- These should be excluded from capital budgeting analysis.

EXAMPLE : 3

- If a company has paid a sum of ₹ 1,00,000 for consultancy fees to a firm to prepare a Project Report for analysing a particular project.
- Then the consultancy fee paid is irrelevant and is not considered for estimating cash flows as it has already been paid and shall not affect our decision whether project should be undertaken or not.

d) WORKING CAPITAL:

- While evaluating the projects, **initial working capital requirement** should be treated as **cash outflow and at the end of the project its release should be treated as cash inflow**.
- It is important to note that no depreciation is provided on working capital though it might be possible that at the time of its release its value might have been reduced.
- Additional working capital may also be required during the life of the project.
- Additional working capital required is treated as cash outflow at that period of time.

- Similarly, any reduction in working capital shall be treated as cash inflow.
- **It may be noted that, if nothing has been specifically mentioned for the release of working capital it is assumed that full amount has been realized at the end of the project.**
- However, adjustment on account of increase or decrease in working capital needs to be incorporated.

e) ALLOCATED OVERHEADS:

- Allocated overheads are charged on the basis of some **rational basis** such as machine hour, labour hour, direct material consumption etc.
- Since, expenditures already incurred are allocated to new proposal, they should not be considered as cash flows.
- However, if it is expected that overhead cost shall increase due to acceptance of any proposal then incremental overhead cost shall be treated as cash outflow.

f) ADDITIONAL CAPITAL INVESTMENT:

- It is not necessary that capital investment shall be required in the beginning of the project.
- It can also be required during the continuance of the project.
- In such cases, it shall be treated as cash outflows at that period of time.

CATEGORIES OF CASH FLOWS:

It is helpful to place project cash flows into three categories:

A) INITIAL CASH OUTFLOW: The initial cash outflow for a project depends upon the type of capital investment decision as follows:

i) If decision is related to investment in a **fresh proposal** or an expansion decision, then initial cash outflow shall be calculated as follows:

		Amount	Amount
	Cost of new Asset(s)		xxx
Add:	Installation/Set-Up Costs	xxx	
Add:	Investment in Working Capital	xxx	xxx
	Initial Cash Outflow		**xxx**

ii) If decision is related to **replacement decision**, then initial cash outflow shall be calculated as follows:

		Amount	Amount
	Cost of new Asset(s)		xxx
Add:	Installation/Set-Up Costs	xxx	
Add/(less):	Increase (Decrease) in net Working Capital level	xxx	
Less:	Net Proceeds from sale of old assets	(xxx)	
Add/(less):	Tax expense (saving/ loss) due to sale of Old Asset	xxx	xxx
	Initial Cash Outflow		**xxx**

B) INTERIM CASH FLOWS:

- After making the initial cash outflow that is necessary to begin implementing a project, the firm hopes to get benefit from the future cash inflows generated by the project.
- The initial cash outflow for a project depends upon the type of capital investment decision as follows:

(i) If analysis is related to a fresh or completely a **new project** then interim cash flow is calculated as follows:

		Amount	Amount
	Profit after Tax (PAT)		xxx
Add:	Non-Cash expenses (e.g. Depreciation)	xxx	

Add/(less):	Net decrease (increase) in Working Capital	xxx	xxx
	Interim net cash flow for the period		**xxx**

(ii) Similarly, interim cash flow in case of replacement decision shall be calculated as follows:

		Amount	Amount
	Net increase (decrease) in Operating Revenue		xxx
Add/(less):	Net decrease (increase) in operating expenses		xxx
	Net changes in income before taxes		xxx
Add/(less):	Net decrease (increase) in taxes		xxx
	Net change in income after taxes		xxx
Add/(less):	Net decrease (increase) in depreciation charges		xxx
	Incremental net cash flow for the period		**xxx**

TERMINAL-YEAR INCREMENTAL NET CASH FLOW:

For calculating the Incremental net cash flow at the terminal year, we will first calculate the incremental net cash flow for the period as calculated in point (b) above and further, we will make adjustments to it as follows:

		Amount	Amount
	Final salvage value (disposal costs) of asset		xxx
Add:	Interim Cash Flow	xxx	
Add/(less):	Tax savings (tax expenses) due to sale or disposal of asset (Including depreciation)	xxx	
Add:	Release of Net Working Capital	xxx	xxx
	Terminal Year incremental net cash flow		**xxx**

3.1 BASIC PRINCIPLES FOR MEASURING PROJECT CASH FLOWS

For developing the project cash flows, the following principles must be kept in mind

3.1.1 BLOCK OF ASSETS AND DEPRECIATION

- Taxable income is calculated as per the provisions of Income Tax or similar Act of a country.
- The treatment of deprecation is based on the concept of "Block of Assets", which means a group of assets falling within a particular class of assets.
- This class of assets can be building, machinery, furniture etc. in respect of which depreciation is charged at same rate.
- The treatment of tax depends on the fact whether block of asset consist of one asset or several assets.
- To understand the concept of block of asset, let us discuss an example as follows:
- Depreciation for initial 4 years shall be common and WDV at the beginning of the 5th year shall be computed as follows:

	₹
Purchase Price of Machinery	1,00,000
Less: Depreciation @ 20% for year 1	20,000
WDV at the end of year 1	80,000
Less: Depreciation @ 20% for year 2	16,000
WDV at the end of year 2	64,000
Less: Depreciation @ 20% for year 3	12,800
WDV at the end of year 3	51,200

Less: Depreciation @ 20% for year 4	10,240
WDV at the end of year 4	40,960

i) **Case 1 - There is no other asset in the Block:** When there is only one asset in the block and block shall cease to exist at the end of 5thyear, then no deprecation shall be charged in 5thyear and tax benefit/loss on short term capital loss/ gain shall be calculated as follows:

	₹
WDV at the beginning of year 5	40,960
Less: Sale value of Machine	10,000
Short Term Capital Loss (STCL)	30,960
Tax Benefit on STCL @ 30%	9,288

ii) **Case 2 - More than one asset exists in the Block:** When more than one asset exists in the block, then deprecation shall be charged in the terminal year (5th year) in which asset is sold. The WDV on which depreciation be charged shall be calculated by deducting sale value from the WDV in the beginning of that year. Tax benefit on depreciation shall be calculated as follows:

	₹
WDV at the beginning of year 5	40,960
Less: Sale value of Machine	10,000
WDV	30,960
Depreciation @ 20%	6,192
Tax Benefit on Depreciation @ 30%	1,858

Now suppose if in above two cases, sale value of machine is ₹ 50,000, then no depreciation shall be provided in Case 2 because the WDV at the beginning of 5th year is only ₹ 40,960 i.e., less than sale value of ₹ 50,000 and tax loss on STCG in Case 1 shall be computed as follows:

	₹
WDV at the beginning of year 5	40,960
Less: Sale value of Machine	50,000
Short Term Capital Gain (STCG)	9,040
Tax Loss on STCG @ 30%	2,712

3.2 EXCLUSION OF FINANCING COSTS PRINCIPLE

- When cash flows relating to long-term funds are being defined, financing costs of long-term funds (interest on long-term debt and equity dividend) should be excluded from the analysis.
- The interest and dividend payments are reflected in the weighted average cost of capital.
- Hence, if interest on long-term debt and dividend on equity capital are deducted in defining the cash flows, the cost of long-term funds will be counted twice.
- The **exclusion** of financing costs principle means that:
  - **(i)** **The interest on long-term debt** is ignored while computing profits and taxes.
  - **(ii)** **The expected dividends** are deemed irrelevant in cash flow analysis.
- While dividends pose no difficulty as they come only from profit after taxes, interest needs to be handled properly.
- Since interest is usually deducted in the process of arriving at profit after tax, an amount equal to 'Interest (1 - Tax rate)' should be added back to the figure of Profit after Tax as shown below:
  - = Profit Before Interest and Tax x (1 - Tax rate)
  - = (Profit Before Tax + Interest) (1 - Tax rate)

= (Profit Before Tax) (1 - Tax rate) + (Interest) (1 - Tax rate)

= Profit After Tax + Interest (1 - Tax rate)

- Thus, whether the tax rate is applied directly to the profit before interest and tax figure or whether the tax - adjusted interest, which is simply interest (1 - tax rate), is added to profit after tax, we get the same result only.

If interest payable is ₹ 5,000 and tax rate is 30%, then the profit after tax excluding financing cost shall be as follows:

	Year 1 (₹)	Year 2 (₹)	Year 3 (₹)	Year 4 (₹)
Profit before Interest and Tax	10,000	20,000	40,000	50,000
Less: Interest	(5,000)	(5,000)	(5,000)	(5,000)
	5,000	15,000	35,000	45,000
Less: Tax @ 30%	(1,500)	(4,500)	(10,500)	(13,500)
Profit after Tax (PAT)	3,500	10,500	24,500	31,500
Add: Interest (1- t)	3,500	3,500	3,500	3,500
PAT excluding financing cost	7,000	14,000	28,000	35,000

Alternatively

	Year 1 (₹)	Year 2 (₹)	Year 3 (₹)	Year 4 (₹)
Profit before Interest and Tax	10,000	20,000	40,000	50,000
Less: Tax @ 30%	3,000	6,000	12,000	15,000
PAT excluding financing cost	7,000	14,000	28,000	35,000

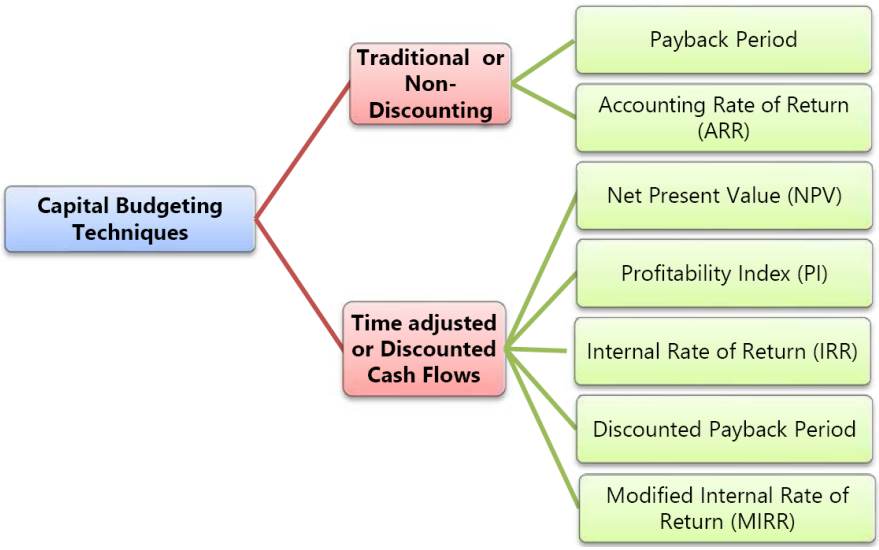
3.4 POST-TAX PRINCIPLE

- Tax payments like other payments must be properly deducted in deriving the cash flows.
- That is, cash flows must be defined in post-tax terms.
- **It is always better to avoid using pre-tax cash flows and using pre-tax discounting rate.**
- **The discounting rate and the cash flows, both must be post-tax only.**
- **Statement showing the calculation of Cash Inflow After Tax (CFAT)**

Particulars	(₹)	(₹)
Sales value		xxx
Less: Variable Cost		xxx
Contribution		xxx
Less: Fixed Cost		
(a) Fixed Cash Cost (excluding Interest)	xxx	
(b) Depreciation	xxx	xxx
Earning Before Tax (EBT)		xxx
Less: Tax		xxx
Earning After Tax (EAT)		xxx
Add: Depreciation		xxx
Cash Inflow After Tax (CFAT)		xxx

3.5 CAPITAL BUDGETING TECHNIQUES

There are a number of techniques available for appraisal of investment proposals and can be classified as presented below:



4. TRADITIONAL OR NON-DISCOUNTING TECHNIQUES

- These techniques do not discount the future cash flows.
- There are two such traditional techniques:
  1. Payback Period and
  2. Accounting Rate of Return.

4.1 PAYBACK PERIOD

- **Time required to recover the initial cash-outflow** is called pay-back period.
- The payback period of an investment is the length of time required for the cumulative total net cash flows from the investment to equal the total initial cash outlays.
- At that point in time (payback period), the investor has recovered all the money invested in the project.
- **STEPS IN PAYBACK PERIOD TECHNIQUE:**

  a) The first step in calculating the payback period is determining the total initial capital investment (cash outflow).

  b) The second step is calculating/estimating the annual expected after-tax cash flows over the useful life of the project.

1. UNIFORM CASH FLOWS:

When the cash inflows are uniform over the useful life of the project, the number of years in the payback period can be calculated using the following equation:

$$\text{Payback period} = \frac{\text{Total initial capital investment}}{\text{Annual expected after - tax net cash flow}}$$

The first step would be to calculate the cash inflow from this project. The cash inflow is calculated as follows:

Particulars	(₹)
Profit before tax	3,00,000
Less: Tax @ 50%	1,50,000
Profit after tax	1,50,000
Add: Depreciation written off	2,50,000
Total cash inflow	4,00,000

While calculating cash inflow, depreciation is added back to profit after tax since it does not result in cash outflow. The cash generated from a project therefore is equal to profit after tax plus depreciation.

The payback period of the project shall be:

Payback period = ₹ 20,00,000 / 4,00,000 = 5 Years

2. NON-UNIFORM CASH FLOWS:

- When the annual cash inflows are not uniform, the cumulative cash inflow from operations must be calculated for each year.
- The payback period shall be corresponding period when total of cumulative cash inflows is equal to the initial capital investment.
- However, if exact sum does not match, then the period in which it lies should be identified. After that we need to compute the fraction of the year.
- This method can be understood with the help of an example:

Year	Annual Cash Inflows (₹)
1	80,000
2	60,000
3	60,000
4	20,000

It's payback period shall be computed by using cumulative cash flows as follows:

Year	Annual Cash Inflows (₹)	Cumulative Cash Inflows (₹)
1	80,000	80,000
2	60,000	1,40,000
3	60,000	2,00,000
4	20,000	2,20,000

In 3rd year, cumulative cash inflows equal to initial cash outlay i.e., ₹ 2,00,000. Hence, payback period is 3 years.

Suppose if in above example, the initial outlay is ₹ 2,05,000, then:

Payback period shall lie between 3 to 4 years. Since up to 3 years, a sum of ₹ 2,00,000 shall be recovered and balance of ₹ 5,000 shall be recovered in the part (fraction) of 4th year, computation is as follows:

$$\text{Part of } 4^{th} \text{ year} = = \frac{\text{Balance Cash outlay}}{\text{Commulative Cash Inflow at } 4^{th} \text{ year}} = \frac{₹\ 5,000}{₹\ 20,000} = \frac{1}{4} \text{ year}$$

Thus, total cash outlay of ₹ 2,05,000 shall be recovered in 3 1/4 years' time i.e 3.25 years.

ADVANTAGES OF PAYBACK PERIOD

- Easy to compute.
- Easy to understand as it **provides a quick estimate of the time** needed for the organization to recoup the cash invested.
- The length of the payback period can also **serve as an estimate of a project's risk;** the longer the payback period, the riskier the project as long-term predictions are less reliable.
- In some industries with high obsolescence risk like software industry or in situations where an organization is short on cash, short payback periods often become the determining factor for investments.

LIMITATIONS OF PAYBACK PERIOD

- It ignores the time value of money. As long as the payback periods for two projects are the same, the payback period technique considers them equal as investments, even if one project generates most of its net cash inflows in the early years of the project while the other project generates most of its net cash inflows in the latter years of the payback period.
- Failure to consider an investment's total profitability; it only considers cash inflows up-to the period in which initial investment is fully recovered and ignores cash flows after the payback period.

- Payback technique places much emphasis on short payback periods thereby ignoring long-term projects.

4.1.1 PAYBACK RECIPROCAL

- As the name indicates, it is the reciprocal of payback period.
- A major drawback of the payback period method of capital budgeting is that it does not indicate any cut off period for the purpose of investment decision.
- It is, however, argued that the reciprocal of the payback would be a close approximation of the Internal Rate of Return (later discussed in detail) if the life of the project is at least twice the payback period and the project generates equal amount of the annual cash inflows.
- In practice, the payback reciprocal is a helpful tool for quick estimation of rate of return of a project provided its life is at least twice the payback period.

The payback reciprocal can be calculated as follows:

$$\text{Payback Reciprocal} = \frac{\text{Average annual cash in flow}}{\text{Initial investment}}$$

EXAMPLE - 5

Suppose a project requires an initial investment of ₹ 20,000 and it would give annual cash inflow of ₹ 4,000. The useful life of the project is estimated to be 10 years.

$$\text{In this example, payback reciprocal} = \frac{₹\ 4,000 \times 100}{₹\ 20,000} = 20\%$$

The above payback reciprocal provides a reasonable approximation of the internal rate of return, i.e. 20%.

4.1.2 ACCOUNTING (BOOK) RATE OF RETURN (ARR) OR AVERAGE RATE OF RETURN (ARR)

- The accounting rate of return of an investment measures the **average annual net income** of the project (incremental income) as a percentage of the investment.

$$\text{Accounting rate of return (ARR)} = \frac{\text{Average annual net income}}{\text{Investment}}$$

- The numerator is the average annual net income generated by the project over its useful life.
- The denominator can be either the initial investment (including installation cost) or the average investment over the useful life of the project.
- Average investment means the average amount of fund remained blocked during the lifetime of the project under consideration.
- Further, ARR can be calculated in a number of ways as shown in the following example:

EXAMPLE - 6

Suppose Times Ltd. is going to invest in a project a sum of ₹ 3,00,000 having a life span of 3 years. Salvage value of machine is ₹ 90,000. The profit before depreciation for each year is ₹1,50,000.

The Profit after Tax and value of Investment in the Beginning and at the End of each year shall be as follows:

Year	Profit Before Depreciation (₹)	Depreciation (₹)	Profit after Depreciation (₹)	Value of Investment in (₹')	
				Beginning	End
1	1,50,000	70,000	80,000	3,00,000	2,30,000
2	1,50,000	70,000	80,000	2,30,000	1,60,000
3	1,50,000	70,000	80,000	1,60,000	90,000

The ARR can be computed by following methods as follows:

a) Version 1: Annual Basis

$$ARR = \frac{\text{Profit after Depreciation}}{\text{Investment in the begining of the year}}$$

Year	
1	$\frac{80,000}{3,00,000} = 26.67\%$
2	$\frac{80,000}{2,30,000} = 34.78\%$
3	$\frac{80,000}{1,60,000} = 50\%$

$$\text{Average ARR} = \frac{26.67\% + 34.78\% + 50.00\%}{3} = 37.15\%$$

(b) Version 2: Total Investment Basis

$$ARR = \frac{\text{Average Annual Profit}}{\text{Investment in the begining}} \times 100$$

$$= \frac{(80,000 + 80,000 + 80,000)/3}{3,00,000} \times 100 = 26.67\%$$

(c) Version 3: Average Investment Basis

$$ARR = \frac{\text{Average Annual Profit}}{\text{Average Investment}} \times 100$$

Average Investment = (₹ 3,00,000 + ₹ 90,000)/2 = ₹ 1,95,000

Or, Average Investment = ½ (Initial Investment – Salvage Value) + Salvage Value

= ½ (₹ 3,00,000 – ₹ 90,000) + ₹ 90,000 = ₹ 1,95,000

$$ARR = \frac{80,000}{1,95,000} \times 100 = 41.03\%$$

Further, it is important to note that project may also require additional working capital during its life in addition to initial working capital. In such situation, formula for the calculation of average investment shall be modified as follows:

1/2(Initial Investment - Salvage Value) + Salvage Value + Additional Working Capital

Continuing above example, suppose a sum of ₹ 45,000 is required as additional working capital during the project life, then average investment shall be:

= 1/2 (₹3,00,000 - ₹ 90,000) + ₹ 90,000 + ₹ 45,000 = ₹ 2,40,000 and

$$ARR = \frac{80,000}{2,40,000} \times 100 = 33.33\%$$

Some organizations prefer the initial investment because it is objectively determined and is not influenced by either the choice of the depreciation method or the estimation of the salvage value.

Either of these amounts is used in practice but it is important that the same method be used for all investments under consideration.

ADVANTAGES OF ARR

- This technique uses readily available data that is routinely generated for financial reports.
- Does not require any special procedures to generate data.
- This method may also mirror the method used to evaluate performance on the operating results of an investment and management performance. Using the same procedure in both decision-making and performance evaluation ensures consistency.
- Calculation of the accounting rate of return method considers all net incomes over the entire life of the project and provides a measure of the investment's profitability.

LIMITATIONS OF ARR

- The accounting rate of return technique ignores the time value of money.
- The technique uses accounting numbers that are dependent on the organization's choice of accounting procedures, and different accounting procedures, e.g., depreciation methods, can lead to substantially different amounts for an investment's net income and book values.
- The method uses net income rather than cash flows; while net income is a useful measure of profitability, the net cash flow is a better measure of an investment's performance.
- Furthermore, inclusion of only the book value of the invested asset ignores the fact that a project can require commitments of working capital and other outlays that are not included in the book value of the project.

5. DISCOUNTING TECHNIQUES

- Discounting techniques consider time value of money and discount the cash flows to their Present Value.
- These techniques are also known as Present Value techniques.
- These are namely Net Present Value (NPV), Internal Rate of Return (IRR) and Profitability Index (PI), Discounted Payback Period.

DETERMINING DISCOUNT RATE

- The discount rate or **desired rate of return** on an investment is the rate of return the firm would have earned by investing the same funds in the best available alternative investment that has the same risk.
- An organization may establish a minimum rate of return that all capital projects must meet; this minimum could be based on an industry average or the cost of other investment opportunities.
- Many organizations choose to use the overall cost of capital or Weighted Average Cost of Capital (WACC) that an organization has incurred in raising funds or expects to incur in raising the funds.

5.1 NET PRESENT VALUE TECHNIQUE (NPV)

- The net present value technique is a discounted cash flow method that considers the time value of money in evaluating capital investments.
- The net present value method uses a specified discount rate to bring all subsequent cash inflows after the initial investment to their present values (the time of the initial investment is year 0).
- **Net present value = Present value of net cash inflow - Total net initial investment**
- Since it might be possible that some additional investment may also be required during the life time of the project, then appropriate formula shall be:
- **Net present value = Present value of cash inflows - Present value of cash outflows**

Steps for calculating Net Present Value (NPV):

The steps for calculating net present value are:

1. **Determine** the net cash inflow in each year of the investment.
2. **Select** the desired rate of return or discounting rate or Weighted Average Cost of Capital.
3. **Find** the discount factor for each year based on the desired rate of return selected.
4. **Determine** the present values of the net cash flows by multiplying the cash flows by respective discount factors of respective period called Present Value (PV) of Cash flows
5. Total the amounts of all **PVs of Cash Flows.**

Decision Rule:

If NPV $\geq$ 0	Accept the Proposal
If NPV $\leq$ 0	Reject the Proposal

The NPV method can be used to select between mutually exclusive projects; the one with the higher NPV should be selected.

ADVANTAGES OF NPV

- NPV method takes into account the time value of money. The NPV uses the discounted cash flows i.e.,

expresses cash flows in terms of current rupees.

- The whole stream of cash flows is considered.
- The net present value can be seen as the addition to the wealth of shareholders. The criterion of NPV is thus in conformity with basic financial objectives.
- The NPVs of different projects therefore can be compared. It implies that each project can be evaluated independent of others on its own merit.

LIMITATIONS OF NPV

- It involves **difficult calculations.**
- The application of this method necessitates forecasting cash flows and the discount rate. Thus, **accuracy of NPV depends on accurate estimation** of these two factors which may be quite difficult in practice.
- The decision under NPV method is based on absolute measure. It **ignores the difference in initial outflows,** size of different proposals etc. while evaluating mutually exclusive projects.

5.2 PROFITABILITY INDEX/DESIRABILITY FACTOR/PRESENT VALUE INDEX METHOD (PI)

- In certain cases, we have to compare a number of proposals, each involving different amounts of cash inflows.
- One of the methods of comparing such proposals is to work out what is known as the **'Desirability factor'**, or **'Profitability Index'** or **'Present Value Index Method'.**
- Mathematically:
- The Profitability Index (PI) is calculated as below:

$$\text{Profitability Index (PI)} = \frac{\text{Sum of discounted cash in flows}}{\text{Initial cash outlay or Total discounted cash outflow (as the case may)}}$$

Decision Rule:

If PI > 1	Accept the Proposal
If PI < 1	Reject the Proposal

In case of mutually exclusive projects, project with higher PI should be selected.

ADVANTAGES OF PI

- The method also uses the concept of time value of money.
- In the PI method, since the present value of cash inflows is divided by the present value of cash outflow, it is a relative measure of a project's profitability.

LIMITATIONS OF PI

- Profitability index fails as a guide in resolving capital rationing where projects are indivisible.
- Once a single large project with high NPV is selected, possibility of accepting several small projects which together may have higher NPV than the single project is excluded.
- Also, situations may arise where a project with a lower profitability index selected may generate cash flows in such a way that another project can be taken up one or two years later, the total NPV in such case being more than the one with a project with highest Profitability Index.

5.3 INTERNAL RATE OF RETURN METHOD (IRR)

- The internal rate of return method considers the time value of money, the initial cash investment, and all cash flows from the investment.
- The internal rate of return method estimates the discount rate that makes the present value of subsequent cash inflows equal to the initial investment.
- This discount rate is called IRR.
- **IRR Definition:** IRR **is the discount rate that equates the present value of the expected cash inflows with the initial cash outflow.**
- This IRR is then compared to a criterion rate of return that can be the organization's desired rate of return for **evaluating capital investments.**

- **Calculation of IRR:** The procedures for computing the internal rate of return vary with the pattern of net cash flows over the useful life of an investment.

SCENARIO 1:

For an investment with uniform cash flows over its life, the following equation is used:

Step 1: Total initial investment = Annual cash inflow x Annuity discount factor of the discount rate for the number of periods of the investment's useful life

If A is the annuity discount factor, then:

$$A = \frac{\text{Total initial cash disbursements and commitments for the investment}}{\text{Annual (equal) cash inflows from the investment}}$$

Step 2: Once A is calculated, the interest rate corresponding to project's life, the value of A is searched in Present Value Annuity Factor (PVAF) table. If exact value of 'A' is found the respective interest rate shall be IRR. However, it rarely happens therefore we follow the steps discussed below:

Step 1: Compute approximate payback period also called fake payback period.

Step 2: Locate this value in PVAF table corresponding to period of life of the project. The value may be falling between two discounting rates.

Step 3: Discount cash flows using these two discounting rates.

Step 4: Use following Interpolation Formula:

$$LR + \frac{NPV \text{ at } LR}{NPV \text{ at } LR - NPV \text{ at } HR} \times (HR - LR)$$

Or

$$LR + \frac{PV \text{ at } LR - CI}{PV \text{ at } LR - PV \text{ at } HR} \times (HR - LR)$$

Where,

LR = Lower Rate

HR = Higher Rate

CI = Capital Investment

PROBLEM : 1

A company proposes to install machine involving a capital cost of ₹3,60,000. The life of the machine is 5 years and its salvage value at the end of the life is nil. The machine will produce the net operating income after depreciation of ₹ 68,000 per annum. The company's tax rate is 45%.

The Net Present Value factors for 5 years are as under:

Discounting rate	14	15	16	17	18
Cumulative factor	3.43	3.35	3.27	3.20	3.13

You are required to COMPUTE the internal rate of return of the proposal.

(Study Material+ May 2020 – MTP – 5 Marks)

SOLUTION : 1

Computation of Cash inflow per annum ₹

Particulars	(₹)
Net operating income per annum	68,000
Less: Tax @ 45%	(30,600)
Profit after tax	37,400
Add: Depreciation (' 3,60,000 / 5 years)	72,000
Cash inflow	1,09,400

The IRR of the investment can be found as follows:

NPV = – ₹ 3,60,000 + ₹ 1,09,400 ($PVAF_{5, r}$) = 0

or $PVAF_{5,r}$ (Cumulative factor) = $\frac{₹3,60,000}{₹1,09,400} = 3.29$

Computation of Internal Rate of Return

	Discounting Rate	
	15%	16%
Cumulative factor	3.35	3.27
PV of Inflows (₹)	3,66,490 (₹ 1,09,400x3.35)	3,57,738 (₹ 1,09,400x3.27)
Less: Initial outlay (₹)	3,60,000	3,60,000
NPV (₹)	6,490	(2,262)

$$IRR = 15 + \left[\frac{6,490}{6,490+2,262}\right] \times (16-15) = 15 + 0.74 = 15.74\%.$$

*****

5.3.1 ACCEPTANCE RULE

- The use of IRR, as a criterion to accept capital investment decision involves a comparison of IRR with the required rate of return known as cut-off rate.
- The project should the accepted if IRR is greater than cut-off rate.
- If IRR is equal to cutoff rate the firm is indifferent.
- If IRR less than cut off rate the project is rejected. Thus,

If IRR > Cut-off Rate or WACC	Accept the Proposal
If IRR < Cut-off Rate or WACC	Reject the Proposal

5.4 DISCOUNTED PAYBACK PERIOD METHOD

- This is similar to Payback period except that the cash flows here are discounted at predetermined rate.
- The payback period so calculated is called **Discounted payback period**.
- This technique is considered superior to simple payback period method because it takes into account time value of money.

Year	Cash Flow (₹)	PVF@15%	PV (₹)	Cumulative PV (₹)
1	6,000	0.870	5,220	5,220
2	6,000	0.756	4,536	9,756
3	6,000	0.658	3,948	13,704
4	6,000	0.572	3,432	17,136
5	6,000	0.497	2,982	20,118
6	6,000	0.432	2,592	22,710
7	6,000	0.376	2,256	24,966
8	6,000	0.327	1,962	26,928
9	6,000	0.284	1,704	28,632
10	6,000	0.247	1,482	30,114

The cumulative total of discounted cash flows after ten years is ₹ 30,114.

Therefore, our discounted payback is approximately 10 years as opposed to 5 years under simple payback.

It should be noted that **as the required rate of return increases, the distortion between simple payback and discounted payback grows**.

5.5 MODIFIED INTERNAL RATE OF RETURN (MIRR)(ALSO CALLED TERMINAL VALUE METHOD)

- There are several limitations attached with the concept of the conventional Internal Rate of Return (IRR).
- The MIRR addresses some of these deficiencies e.g.,
  - ⇨ it eliminates multiple IRR rates;
  - ⇨ it addresses the reinvestment rate issue and produces results which are consistent with the Net Present Value method.
- **This method is also called Terminal Value method.**
  - ⇨ Under this method, all cash flows, apart from the initial investment, are brought to the terminal value using an appropriate discount rate (usually the Cost of Capital).
  - ⇨ This results in a single stream of cash inflow in the terminal year.
  - ⇨ **The MIRR is obtained by assuming a single outflow in the zeroth year and the terminal cash inflow as mentioned above.**
  - ⇨ **The discount rate which equates the present value of the terminal cash inflow to the zeroth year outflow is called the MIRR.**
- The decision criterion of MIRR is same as IRR i.e. you accept an investment if MIRR is larger than required rate of return and reject if it is lower than the required rate of return.

PROBLEM : 2

An investment of ₹ 1,36,000 yields the following cash inflows (profits before depreciation but after tax). DETERMINE MIRR considering 8% as cost of capital.

Year	(₹)
1	30,000
2	40,000
3	60,000
4	30,000
5	20,000
	1,80,000

(Study Material)

SOLUTION : 2

Year 0 - Cash outflow = ₹ 1,36,000

The MIRR is calculated on the basis of investing the inflows at the cost of capital. The table below shows the value of the inflows, if they are immediately reinvested at 8%.

Year	Cash flow	@ 8% reinvestment rate factor	(₹)
1	30,000	1.3605*	40,815
2	40,000	1.2597	50,388
3	60,000	1.1664	69,984
4	30,000	1.0800	32,400
5	20,000	1.0000	20,000
			2,13,587

*Investment of ₹ 1 at the end of the year 1 is reinvested for 4 years (at the end of 5 years) shall become 1(1.08)4 = 1.3605.

Similarly, reinvestment rate factor for remaining years shall be calculated.

Please note that the investment at the end of 5th year shall be reinvested for zero year, hence, reinvestment rate factor shall be 1.

The total cash outflow in year 0 (₹ 1,36,000) is compared with the possible inflow at year 5 and the resulting figure = 1,36,000 / 2,13,587 = 0.6367 is the discount factor in year 5.

By looking at the year 5 row in the present value tables, you will see that this gives a return of 9%.

This means that the ₹2,13,587 received in year 5 is equivalent to ₹ 1,36,000 in year 0 if the discount rate is 9%.

Alternatively, we can compute MIRR as follows:

$$\text{Total return} = \frac{2,13,587}{1,36,000} = 1.5705$$

$$\text{MIRR} = \sqrt[1/5]{1.5705} - 1 = 9\%.$$

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6. SUMMARY OF DECISION CRITERIA OF CAPITAL BUDGETING TECHNIQUES

Techniques		For Independent Project	For Mutually Exclusive Projects
Non Discounted	**Pay Back**	(i) When Payback period < Maximum Acceptable Payback period: **Accepted** (ii) When Payback period > Maximum Acceptable Payback period: **Rejected**	Project with least Payback period should be selected
	Accounting Rate of Return (ARR)	(i) When ARR> Minimum Acceptable Rate of Return: **Accepted**	Project with the maximum ARR should be selected.
		(ii) When ARR < Minimum Acceptable Rate of Return: **Rejected**	
Discounted	**Net Present Value (NPV)**	(iii) When NPV> 0: **Accepted** (iv) When NPV< 0: **Rejected**	Project with the highest positive NPV should be selected
	Profitability Index (PI)	(v) When PI > 1: **Accepted** (vi) When PI < 1: **Rejected**	When Net Present Value is same project with Highest PI should be selected
	Internal Rate of Return (IRR)	i. When IRR >K: **Accepted** ii. When IRR <K: **Rejected**	Project with the maximum IRR should be selected

7. SPECIAL CASES

7.1 CAPITAL BUDGETING UNDER CAPITAL RATIONING

If project has positive NPV, it should be accepted with an objective of maximisation of wealth of shareholders.

However, there may be a situation due to resource (capital) constraints (rationing) a firm may have to select some projects among various projects, all having positive NPVs.

Broadly two scenarios may influence the method of evaluation to be adopted.

(i) **Divisible projects - Projects are independent of each other and are divisible in nature:**

(ii) **Indivisible Projects - Projects are not divisible:**

Nature of Project	Indivisible	Divisible
Meaning	Investment should be made in full. Partial or Proportionate investment is not possible.	Partial Investment is possible and proportionate NPV can be generated.
Steps involved in Decision Making	Determine the combination of projects to utilise amount available. Compute NPV of each combination. Select the combination with maximum NPV.	Compute PI of various projects and rank them. Projects are selected based on maximum Profitability Index.

PROBLEM 3

Shiva Limited is planning its capital investment programme for next year. It has five projects all of which give a positive NPV at the company cut-off rate of 15 percent, the investment outflows and present values being as follows:

Project	Investment (₹)	NPV @ 15% (₹)
A	(50,000)	15,400
B	(40,000)	18,700
C	(25,000)	10,100
D	(30,000)	11,200
E	(35,000)	19,300

The company is limited to a capital spending of ₹ 1,20,000.

You are required to ILLUSTRATE the returns from a package of projects within the capital spending limit. The projects are independent of each other and are divisible (i.e., part- project is possible)(Study Material)

SOLUTION : 3

Computation of NPVs per ₹ 1 of Investment and Ranking of the Projects

Project	Investment	NPV@ 15%	NPV per ₹ 1 invested	Ranking
	₹ 000	₹ 000		
A	(50)	15.4	0.31	5
B	(40)	18.7	0.47	2
C	(25)	10.1	0.40	3
D	(30)	11.2	0.37	4
E	(35)	19.3	0.55	1

Building up of a Programme of Projects based on their Rankings

Project	Investment	NPV @ 15%
	₹ 000	₹ 000
E	(35)	19.3
B	(40)	18.7
C	(25)	10.1
D	(20)	7.5
	120	55.6

(2/3 of project total)

Thus, Project A should be rejected and only two-third of Project D be undertaken. If the projects are not divisible then other combinations can be examined as:

	Investment	NPV @ 15%
	₹ 000	₹ 000
E + B + C	100	48.1
E + B + D	105	49.2

In this case E + B + D would be preferable as it provides a higher NPV despite D ranking lower than C.

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7.1.1 PROJECTS WITH UNEQUAL LIVES

Sometimes firm may be faced with any of the following problems:

(i) **Retaining** an old asset **or replace** it with new one.

(ii) Choosing one proposal among two proposals **(Mutually Exclusive)**.

Although, while evaluating the proposals in the above scenarios, do not pose any special problem if they have same life period. But problem arises in case projects have unequal lives. In such situations we can deal with the problem by following any of the following method:

(i) Replacement Chain Method

(ii) Equivalent Annualized Criterion

PROBLEM 4

R Pvt. Ltd. is considering modernizing its production facilities and it has two proposals under consideration. The expected cash flows associated with these projects and their NPV as per discounting

rate of 12% and IRR is as follows:

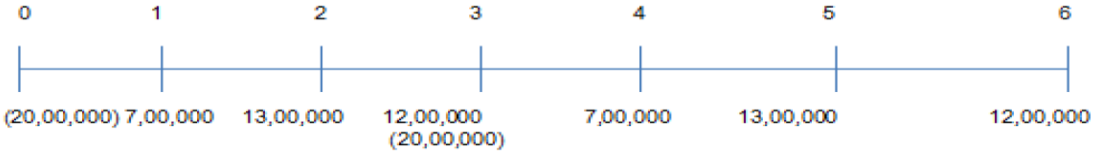
Year	Cash Flow	
	Project A (₹)	Project B (₹)
0	(40,00,000)	(20,00,000)
1	8,00,000	7,00,000
2	14,00,000	13,00,000
3	13,00,000	12,00,000
4	12,00,000	0
5	11,00,000	0
6	10,00,000	0
NPV @12%	6,49,094	5,15,488
IRR	17.47%	25.20%

IDENTIFY which project should R Pvt. Ltd. accept? **(Study Material)**

SOLUTION : 4

Although from NPV point of view, Project A appears to be better but from IRR point of view, Project B appears to be better. Since, both projects have unequal lives, selection on the basis of these two methods shall not be proper. In such situation, we shall use any of the following method:

i) **Replacement Chain (Common Life) Method:** Since the life of the Project A is 6 years and Project B is 3 years, to equalize lives, we can have second opportunity of investing in project B after one time investing. The position of cash flows in such situation shall be as follows:



NPV of extended life of 6 years of Project B shall be ₹ 8,82,403 and IRR of 25.20%.

Accordingly, with extended life NPV of Project B it appears to be more attractive.

ii) **Equivalent Annualized Criterion:** The method discussed above has one drawback when we have to compare two projects with one has a life of 3 years and other has 5 years. In such case, the above method shall require analysis of a period of 15 years i.e. common multiple of these two values. The simple solution to this problem is use of Equivalent Annualised Criterion involving following steps:

(a) Compute NPV using the WACC or discounting rate.

(b) Compute Present Value Annuity Factor (PVAF) of discounting factor used above for the period of each project.

(c) Divide NPV computed under step (a) by PVAF as computed under step (b) and compare the values.

Accordingly, for proposal under consideration:

	Project A	Project B
NPV @ 12%	₹ 6,49,094	₹ 5,15,488
PVAF @12%	4.112	2.402
Equivalent Annualized Criterion	₹1,57,854	₹ 2,14,608

Thus, Project B should be selected.

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PROBLEM : 5

Following data has been available for a capital project:

Annual cash inflows	**₹ 1,00,000**
Useful life	**4 years**
Salvage value	**0**
Internal rate of return	**12%**
Profitability index	**1.064**

You are required to CALCULATE the following for this project:

(i) Cost of project

(ii) Cost of capital

(iii) Net present value

(iv) Payback period

PV factors at different rates are given below:

Discount factor	12%	11%	10%	9%
1 year	0.893	0.901	0.909	0.917
2 year	0.797	0.812	0.826	0.842
3 year	0.712	0.731	0.751	0.772
4 year	0.636	0.659	0.683	0.708

(Study Material)

SOLUTION : 50

(i) Cost of the Project

At 12% internal rate of return (IRR), the sum of total cash inflows = cost of the project i.e initial cash outlay

Annual cash inflows = ₹ 1,00,000

Useful life = 4 years

Considering the discount factor table @ 12%, cumulative present value of cash inflows for 4 years is 3.038 (0.893 + 0.797 + 0.712 + 0.636).

Hence, Total Cash inflows for 4 years for the Project is:

₹ 1,00,000 x 3.038 = ₹ 3,03,800

Hence, Cost of the Project = ₹ 3,03,800

(ii) Cost of Capital

$$\text{Profitability index} = \frac{\text{Sum of Discounted Cash in flows}}{\text{Cost of the Project}}$$

$$1.064 = \frac{\text{Sum of Discounted Cash inflows}}{₹\ 3,03,800}$$

From the discount factor table, at discount rate of 9%, the cumulative discount factor for 4 years is 3.239 (0.917 + 0.842 + 0.772 + 0.708).

Hence, Cost of Capital = 9% (approx.)

iii) Net Present Value (NPV)

NPV = Sum of Present Values of Cash inflows - Cost of the Project

= ₹ 3,23,243.20 - ₹ 3,03,800 = ₹ 19,443.20'

iv) Payback Period

$$\text{Payback period} = \frac{\text{Cost of the Project}}{\text{Annual Cash Inflows}} = \frac{₹\ 3,03,800}{₹\ 1,00,000} = 3.038 \text{ years}$$

*****

PROBLEM : 6

Lockwood Limited wants to replace its old machine with a new automatic machine. Two models A and B are available at the same cost of ₹ 5 lakhs each. Salvage value of the old machine is ₹ 1 lakh. The utilities of the existing machine can be used if the company purchases model A. Additional cost of utilities to be purchased in this case will be '₹1 lakh. If the company purchases B, then all the existing utilities will have to be replaced with new utilities costing ₹ 2 lakhs. The salvage value of the old utilities will be ₹ 0.20 lakhs. The earnings after taxation are expected to be:

Year	Cash inflows of A (₹)	Cash inflows of B (₹)	P.V. Factor @ 15%
1	1,00,000	2,00,000	0.870

2	1,50,000	2,10,000	0.756
3	1,80,000	1,80,000	0.658
4	2,00,000	1,70,000	0.572
5	1,70,000	40,000	0.497
Salvage Value at the end of Year 5	50,000	60,000	

The targeted return on capital is 15%. You are required to (i) COMPUTE, for the two machines separately, net present value, discounted payback period and desirability factor and (ii) STATE which of the machines is to be selected? (Study Material)

SOLUTION : 6

Working:

Calculation of Cash -outflow at year zero

Particulars	A (₹)	B (₹)
Cost of Machine	5,00,000	5,00,000
Cost of Utilities	1,00,000	2,00,000
Salvage value of Old Machine	(1,00,000)	(1,00,000)
Salvage of value Old Utilities	-	(20,000)
Total Expenditure (Net)	5,00,000	5,80,000

(i) (a) Calculation of NPV

		Machine A		Machine B	
Year	PV Factor @ 15%	Cash Inflows (₹)	Discounted value of inflows (₹)	Cash Inflows (₹)	Discounted value of inflows (₹)
0	1.000	(5,00,000)	(5,00,000)	(5,80,000)	(5,80,000)
1	0.870	1,00,000	87,000	2,00,000	1,74,000
2	0.756	1,50,000	1,13,400	2,10,000	1,58,760
3	0.658	1,80,000	1,18,440	1,80,000	1,18,440
4	0.572	2,00,000	1,14,400	1,70,000	97,240
5	0.497	1,70,000	84,490	40,000	19,880
Salvage	0.497	50,000	24,850	60,000	29,820
Net Present Value			42,580		18,140

Since the Net present Value of both the machines is positive both are acceptable.

b) Discounted Pay-back Period (Amount in ₹)

Year	Machine A		Machine B	
	Discounted Cash inflows	Cumulative Discounted Cash inflows	Discounted Cash inflows	Cumulative Discounted Cash inflows
1	87,000	87,000	1,74,000	1,74,000
2	1,13,400	2,00,400	1,58,760	3,32,760
3	1,18,440	3,18,840	1,18,440	4,51,200
4	1,14,400	4,33,240	97,240	5,48,440
5	1,09,340*	5,42,580	49,700*	5,98,140

* Includes salvage value.

Discounted Payback Period (For A and B):

$$\text{Machine A} = 4 \text{ years} + \left(\frac{5,00,000 - 4,33,240}{1,09,340}\right) = 4.61 \text{ years}$$

$$\text{Machine B} = 4 \text{ years} + \left(\frac{5,80,000 - 5,48,440}{49,700}\right) = 4.63 \text{ years}$$

(c) Desirability Factor or Profitability Index:

$$\text{Profitability Index (PI)} = \frac{\text{Sum of present value of net cash inflow}}{\text{Initial cash outflow}}$$

$$\text{Machine A} = \frac{₹\,5,42,580}{₹\,5,00,000} = 1.08; \quad \text{Machine B} = \frac{₹\,5,98,140}{₹\,5,80,000} = 1.03$$

ii) Since the absolute surplus in the case of A is more than B and also the desirability factor, it is better to choose A.

The discounted payback period in both the cases is almost same, also the net present value is positive in both the cases, but the desirability factor (profitability index) is higher in the case of Machine A, it is therefore better to choose Machine A.

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QUESTION : 7

PQR Limited is considering buying a new machine which would have a useful economic life of five years, at a cost of ₹ 40,00,000 and a scrap value of ₹ 5,00,000, with 80 per cent of the cost being payable at the start of the project and 20 per cent at the end of the first year. The machine would produce 80,000 units per annum of a new product with an estimated selling price of ₹ 400 per unit. Direct costs would be ₹ 375 per unit and annual fixed costs, including depreciation calculated on a straight- line basis, would be ₹ 10,40,000 per annum.

In the first year and the second year, special sales promotion expenditure, not included in the above costs, would be incurred, amounting to ₹ 1,25,000 and ₹ 1,75,000 respectively.

EVALUATE the project using the NPV method of investment appraisal, assuming the company's cost of capital to be 12 percent. **(Nov. 2023 RTP)**

SOLUTION :- 7

Calculation of Net Cash flows

Contribution = (400 - 375) x 80,000 = ₹ 20,00,000

Fixed costs = 10,40,000 - [(40,00,000 - 5,00,000)/5] = ₹ 3,40,000

Year	Capital	Contribution	Fixed costs	Promotion	Net cash flow
	(₹)	(₹)	(₹)	(₹)	(₹)
0	(32,00,000)				(32,00,000)
1	(8,00,000)	20,00,000	(3,40,000)	(1,25,000)	7,35,000
2		20,00,000	(3,40,000)	(1,75,000)	14,85,000
3		20,00,000	(3,40,000)		16,60,000
4		20,00,000	(3,40,000)		16,60,000
5	5,00,000	20,00,000	(3,40,000)		21,60,000

Calculation of Net Present Value

Year	Net cash flow (₹)	12% discount factor	Present value (₹)
0	(32,00,000)	1.000	(32,00,000)
1	7,35,000	0.893	6,56,355
2	14,85,000	0.797	11,83,545
3	16,60,000	0.712	11,81,920
4	16,60,000	0.636	10,55,760
5	21,60,000	0.567	12,24,720
			21,02,300

The net present value of the project is ₹21,02,300.

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