



UNIT-IV

CAPITAL & CAPITAL BUDGETING

Meaning of Capital:

Capital refers to the financial resources like cash, machinery, equipment and other resources that businesses can use to fund their operations. These are the assets that allow the business to produce a product or service to sell to customers.

Importance of Capital in Business and Economics:

Capital plays an important role in the production process. Indeed production process is not possible in the absence of capital. The Importance of Capital in Business and Economics is explained as follows:

- 1. Provision of tools and machines:** Capital provides various tools, machines and equipment required in production. Production of goods can be carried on large scale when these implements are provided to the workers. In the absence of capital, producers find it difficult to furnish the above implements.
- 2. Provision of subsistence:** This is another important function of capital. Labourers have to be paid salaries for their services rendered in production. Because of poverty they cannot wait for months together without salaries. Besides it takes a long time for marketing the finished goods. Meanwhile, capital helps the producers find it difficult to furnish the above implements. This paralyses the production process.
- 3. Provision of raw materials:** Capital makes it easy for the producers to buy raw-materials from the local market. The producers reserve a portion of their investment for the exclusive purpose of buying raw materials.
- 4. Provision of transport and communication facilities:** Transport and communication facilities can be provided and developed with the capital. New buildings, Roads and communication amenities can be provided when capital is available in plenty.
- 5. Continuous production:** Capital makes production a continuous process. It helps the producers to bridge the gap between income and expenditure. It helps them to invest on different programmes until they receive income from selling their goods in the market.
- 6. Increases production and productivity:** Capital enables the introduction of machinery. This further increases, production and productivity t the workers. Large scale industries are able to produce more output due to the employment of huge capital and installation of latest machinery.
- 7. Reduces cost of production:** Capital helps in reducing the cost of production. It enables the producers to employ skilled labourers and latest methods of production. As a result the producer gets the economies of scale.



8. Employment opportunities: Capital also increases the employment opportunities, new techniques, skilled labourers, latest technology etc. are Possible due to the investment of capital. The expansion of the size of the Industry leads to the provision of more employment opportunities. In this way capital performs several functions. Economic development and standard of living can be increased with the help of capital.

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SOURCES OF FINANCE (CAPITAL) FOR A FIRM

Finance is significant for business because it cannot carry out its operations even for a single day without finance. It is therefore important to search the sources from where funds can be collected. The selection of source depends upon the amount of funds required, nature of business, repayment period, debt-equity mix, etc. The selection of source also depends upon the purposes for which funds are needed.

Funds required for acquiring machine, land & building, etc., should be procured from such sources, the tenure of which must be between 5 and 10 years. Funds required for more than 1 year but less than 5 years should be financed from medium-term sources. Funds required for meeting day-to-day expenses should be acquired from short-term sources.

A firm can obtain funds from a variety of sources (see Figure 3.1), which may be classified as follows:

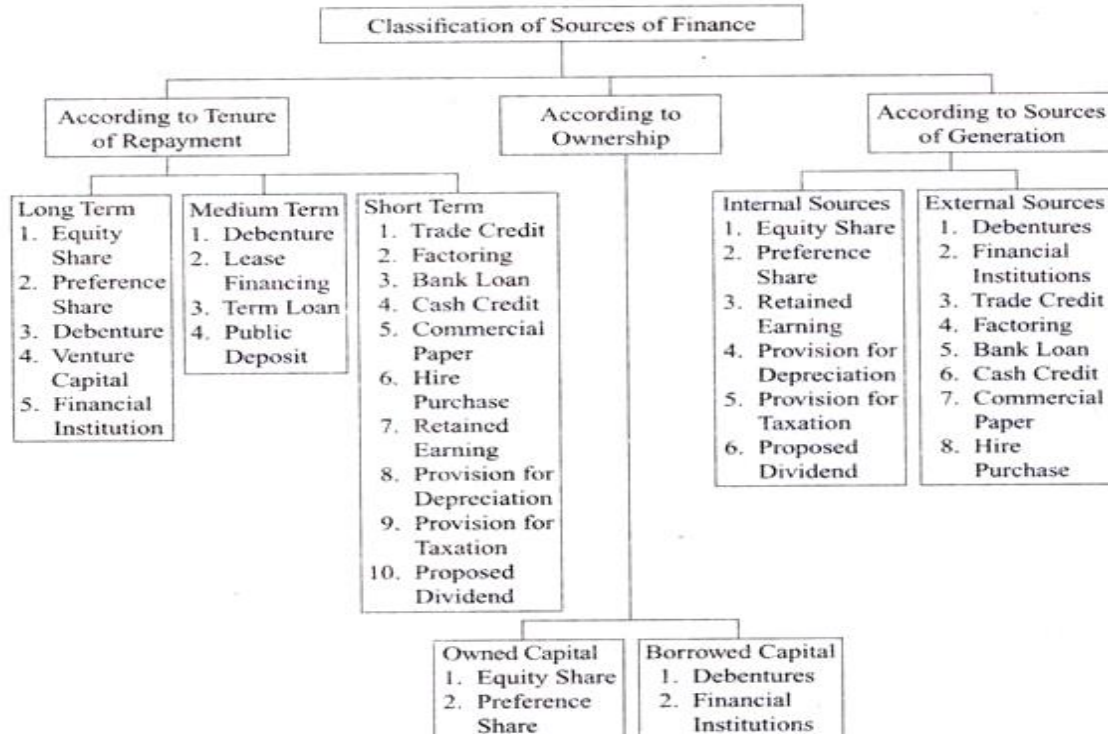


FIGURE 3.1 Classification of Sources of Finance

i. Long-term Sources: A firm needs funds to purchase fixed assets such as land, plant & machinery, furniture, etc. These assets should be purchased from those funds which have a



longer maturity repayment period. The capital required for purchasing these assets is known as fixed capital. So funds required for fixed capital must be financed using long-term sources of finance.

ii. Medium-term Sources: Funds required for say, a heavy advertisement campaign, the benefit of which lasts for more than one accounting period, should be financed through medium-term sources of finance. In other words expenditure that results in deferred revenue should be financed through medium-term sources.

iii. Short-term Sources: Funds required for meeting day-to-day expenses, i.e. revenue expenditure or working capital should be financed from short-term sources whose maturity period is one year or less.

iv. Owned Capital: Owned capital represents equity capital, retained earnings and preference capital. Equity share has a perpetual life and are entitled to the residual income of the firm but the equity shareholders have the right to control the affairs of the business because they enjoy the voting rights.

v. Borrowed Capital: Borrowed capital represents debentures, term loans, public deposits, borrowings from bank, etc. These are contractual in nature. They are entitled to get a fixed rate of interest irrespective of profit and are to be repaid on a fixed date.

vi. Internal Sources: If the funds are created internally, i.e. without using debt, such sources can be termed as internal sources. Examples of such could be: Ploughing back of profits, provision for depreciation, etc.

vii. External Sources: If funds are re-used through the sources which create some obligation to the firm, such sources can be termed as external sources, e.g. lease financing, hire purchase, etc.

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CONCEPT OF CAPITAL BUDGETING:

Capital Budgeting refers to the long-term investment decisions in various fixed assets (capital expenditure) which is occurred at present but the benefits are received after one year. In other words, capital budgeting is a method of identifying, evaluating, and selecting long-term investments like purchasing a new machinery, plant, and technology. The investment decision of the company is commonly called as capital budgeting decision or capital expenditure decisions.

Capital budgeting helps financial decision makers make informed financial decisions that require a large capital investment. Projects include:

- Investing in new equipment, technology, and buildings
- Upgrading existing equipment and technology
- Renovation projects
- Expanding the workforce



- Developing new products
- Expanding into new markets

Acc to Charles T. Horngren defines “capital budgeting is the long-term planning for making and financing proposed capital outlays”.

OBJECTIVES OF CAPITAL BUDGETING

Capital budgeting or capital expenditures are huge and have a long-term effect. Therefore, while performing a capital budgeting analysis an organization must keep the following objectives in mind:

(1) Selecting profitable projects: An organization comes across various profitable projects frequently. But due to capital restrictions, an organization needs to select the right mix of profitable projects that will increase its shareholders' wealth.

Capital expenditure control: Selecting the most profitable investment is the main objective of capital budgeting. However, controlling capital costs is also an important objective. Forecasting capital expenditure requirements and budgeting for it, and ensuring no investment opportunities are lost is the crux of budgeting.

Finding the right sources for funds: Determining the quantum of funds and the sources for procuring them is another important objective of capital budgeting. Finding the balance between the cost of borrowing and returns on investment is an important goal of Capital Budgeting.

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NATURE AND SCOPE OF CAPITAL BUDGETING

Capital budgeting decisions are of paramount importance in financial decision. The profitability of a business concern depends upon the level of investment made for long period. Moreover, the investments are made properly through evaluating the proposals by capital budgeting. So it needs special care. The Nature and scope of capital budgeting decisions are explained as follows:

Nature of Capital Budgeting

(1) Long-term Implications of Capital Budgeting: A capital budgeting decision has its effect over a long time span and inevitably affects the company's future cost structure and growth. A wrong decision can prove disastrous for the long-term survival of firm. On the other hand, lack of investment in asset would influence the competitive position of the firm. So the capital budgeting decisions determine the future destiny of the company.

(2) Involvement of large amount of funds in Capital Budgeting: Capital budgeting decisions need substantial amount of capital outlay. This underlines the need for thoughtful, wise and correct decisions as an incorrect decision would not only result in losses but also prevent the firm from earning profit from other investments which could not be undertaken.



(3) Irreversible decisions in Capital Budgeting: Capital budgeting decisions in most of the cases are irreversible because it is difficult to find a market for such assets. The only way out will be scrap the capital assets so acquired and incur heavy losses.

(4) Risk and uncertainty in Capital budgeting: Capital budgeting decision is surrounded by great number of uncertainties. Investment is present and investment is future. The future is uncertain and full of risks. Longer the period of project, greater may be the risk and uncertainty. The estimates about cost, revenues and profits may not come true.

(5) Impact Competitive Strength: The future competitive strength of the firm is also based on the future decisions. The future profit of the firm is determined by the decision which has been taken in the present and the cost of the product is also defined by the decisions. If the decision is in favour then the firm can sell the product at a higher price than the competition in the market and vice-Versa.

(6) Impact on Cost Structure: Cost structure is affected by the vital decisions, the firm has to fix the costs of the supervision, insurance, interest etc. If the investment does not generate returns then the profitability of the firm is affected. Future profitability of the company totally depends on the cost structure.

(7) Long term Effect on Profitability: Capital expenditures have great impact on business profitability in the long run. If the expenditures are incurred only after preparing capital budget properly, there is a possibility of increasing profitability of the firm.

(8) Difficulties of Investment Decisions: Generally, the long term investment proposals have more complicated in nature. Moreover, purchase of fixed assets is a continuous process. Hence, the management should understand the complexities connected with each projects.

(9) Maximize the worth of Equity Shareholders: A proper capital budget results in the optimum investment instead of over investment and under investment in fixed assets. The management chooses only most profitable capital project which can have much value. In this way, the capital budgeting maximize the worth of equity shareholders.

(10) Difficulties of Investment Decisions: The long term investments are difficult to be taken because decision extends several years beyond the current account period, uncertainties of future and higher degree of risk.

(11) National Importance: The selection of any project results in the employment opportunity, economic growth and increase per capita income. These are the ordinary positive impact of any project selection made by any company.

Scope of Capital Budgeting

(A) Use of Machinery: Capital budgeting helps in finding out the cost to acquire the machinery. Due to advancements in technology human are replaced by the machinery in production. These types of machinery can produce products at a cheaper rate.



(B) Decision Making: Capital budgeting helps in deciding whether to buy or lease a machinery for production and decision to replace old machinery with new. Other decisions are also made with information through capital budgeting.

(C) Increase Profits: Capital Budgeting directly influences the profitability of the business. It Help in reducing the cost of operations to business by taking decision for long term capital. It helps to provide proper information about current expenditure and future benefit that saves the unnecessary expenses.

(D) Improves Performance: Capital Budgeting has an effective role in accelerating the overall performance of business organizations. By providing the long term assets by acquiring Plant and machinery that Improves the Performance of the production department.

(E) Selection of Machinery: Various types of machines are available in the market for production. The cost of the machine is different based on their capacity. Capital Budgeting helps in deciding which one to buy for our organization.

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KINDS OF CAPITAL BUDGETING DECISIONS

Generally, the company's capital budgeting decisions include additions, disposition, modification and replacement of fixed assets. The capital budgeting decisions include the following proposals:

[A] Replacement: Replacement of fixed assets on account of the existing assets, either being worn out or become outdated.

[B] Expansion: The Company may have to expand its production capacities on account of high demand for its products. This will need additional capital investment.

[C] Diversification: A company may intend to reduce its risk by operating in several markets. In such case, capital investment may become necessary for purchase of new machinery and facilitates to handle the new products.

[D] Research & Development: where rapidly changes in the technology, industries needed large amount of money. So these are also included in the proposals of capital budgeting.

[E] Other Proposals: A company may have to invest money in projects which do not directly help in achieving profit oriented goals. For example: installation of pollution control equipment, may necessary on account of legal requirements hence funds will be required for such proposals.

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THE PROCESS OF CAPITAL BUDGETING

The process of capital budgeting involves following steps

1. Identification of Investment Proposals: The capital budgeting process begins with the identification of investment proposals. The proposal or the idea about potential investment opportunities may originate from the top management or may come from the rank and file worker of any department or from any officer of the organisation.

The departmental head analyses the various proposals in the light of the corporate strategies and submits the suitable proposals to the Capital Expenditure Planning Committee in case of large organisations or to the officers concerned with the process of long-term investment decisions.

2. Screening the Proposals: The Expenditure Planning Committee screens the various proposals received from different departments. The committee views these proposals from various angles to ensure that these are in accordance with the corporate strategies or selection criterion of the firm and also do not lead to departmental imbalances.

3. Evaluation of Various Proposals: The next step in the capital budgeting process is to evaluate the profitability of various proposals. There are many methods which may be used for this purpose such as payback period method, rate of return method, net present value method, internal rate of return method etc. All these methods of evaluating profitability of capital investment proposals.

4. Fixing Priorities: After evaluating various proposals, the unprofitable or uneconomic proposals may be rejected straight away. But it may not be possible for the firm to invest immediately in all the acceptable proposals due to limitation of funds. Hence, it is very essential to rank the various proposals and to establish priorities after considering urgency, risk and profitability involved therein.

5. Final Approval and Preparation of Capital Expenditure Budget: Proposals meeting the evaluation and other criteria are finally approved to be included in the Capital Expenditure Budget. However, proposals involving smaller investment may be decided at the lower levels for expeditious action. The capital expenditure budget lays down the amount of estimated expenditure to be incurred on fixed assets during the budget period.

6. Implementing Proposal: Preparation of a capital expenditure budgeting and incorporation of a particular proposal in the budget does not itself authorize to go ahead with the implementation of the project. A request for authority to spend the amount should further be made to the Capital Expenditure Committee which may like to review the profitability of the project in the changed circumstances.

Further, while implementing the project, it is better to assign responsibilities for completing the project within the given time frame and cost limit so as to avoid unnecessary delays and



cost over runs. Network techniques used in the project management such as PERT and CPM can also be applied to control and monitor the implementation of the projects.

7. Performance Review: The last stage in the process of capital budgeting is the evaluation of the performance of the project. The evaluation is made through post completion audit by way of comparison of actual expenditure on the project with the budgeted one, and also by comparing the actual return from the investment with the anticipated return.

The unfavourable variances, if any should be looked into and the causes of the same be identified so that corrective action may be taken in future.

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SIGNIFICANCE OF CAPITAL BUDGETING DECISIONS

The significance of capital budgeting can be emphasized taking into consideration the very nature of the capital expenditure such as heavy investment in capital projects, long-term implications for the firm, irreversible decisions and complicates of the decision making. Its importance can be illustrated well on the following other grounds:

(1) Indirect Forecast of Sales. The investment in fixed assets is related to future sales of the firm during the life time of the assets purchased. It shows the possibility of expanding the production facilities to cover additional sales shown in the sales budget. Any failure to make the sales forecast accurately would result in over investment or under investment in fixed assets and any erroneous forecast of asset needs may lead the firm to serious economic results.

(2) Comparative Study of Alternative Projects. Capital budgeting makes a comparative study of the alternative projects for the replacement of assets which are wearing out or are in danger of becoming obsolete so as to make the best possible investment in the replacement of assets. For this purpose, the profitability of each projects is estimated.

(3) Timing of Assets-Acquisition. Proper capital budgeting leads to proper timing of assets-acquisition and improvement in quality of assets purchased. It is due to the nature of demand and supply of capital goods. The demand of capital goods does not arise until sales impinge on productive capacity and such situation occur only intermittently. On the other hand, supply of capital goods with their availability is one of the functions of capital budgeting.

(4) Cash Forecast. Capital investment requires substantial funds which can only be arranged by making determined efforts to ensure their availability at the right time. Thus it facilitates cash forecast.

(5) Worth-Maximization of Shareholders. The impact of long-term capital investment decisions is far reaching. It protects the interests of the shareholders and of the enterprise because it avoids over-investment and under-investment in fixed assets. By selecting the most profitable projects, the management facilitates the wealth maximisation of equity shareholders.



(6) Other Factors. The following other factors can also be considered for the significance of capital budgeting decisions:

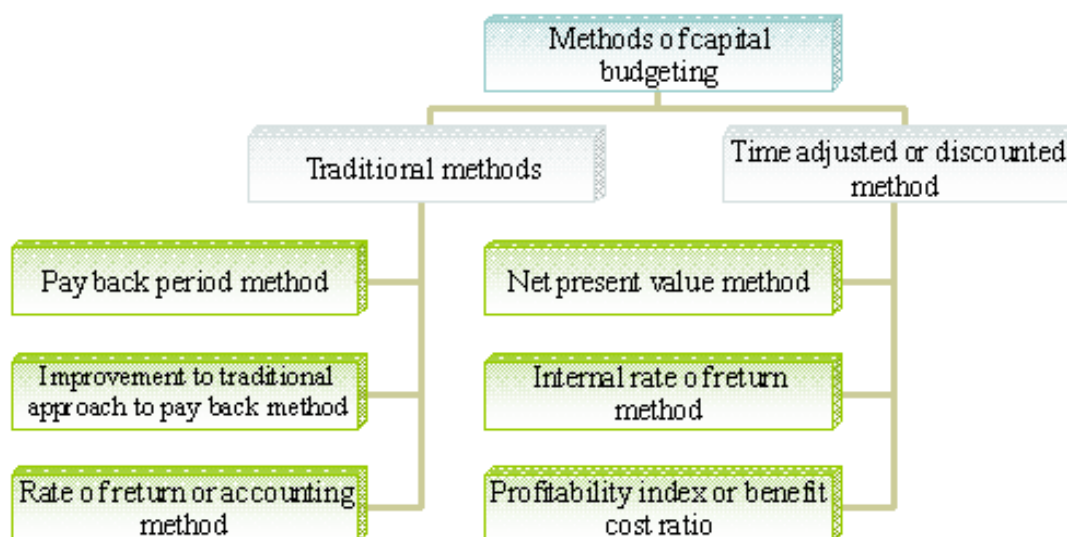
- It assist in formulating a sound depreciation and assets replacement policy.
- It may be useful n considering methods of cost reduction. A reduction campaign may necessitate the consideration of purchasing most up-to-date and modern equipment.
- The feasibility of replacing manual work by machinery may be seen from the capital forecast be comparing the manual cost and the capital cost.
- The capital cost of improving working conditions or safety can be obtained through capital expenditure forecasting.
- It facilitates the management in making of the long-term plans an assists in the formulation of general policy.
- It studies the impact of capital investment on the revenue expenditure of the firm such as depreciation, insure and there fixed assets.

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CAPITAL BUDGETING METHODS/TECHNIQUES

Companies have several different valuation methods they can use to determine whether a project is likely to be valuable and worth pursuing. Ideally, a company would come to the same conclusion about a project's value regardless of the valuation method they use, but each evaluation method may provide a different result. This means a company's decision-makers need to decide which capital budgeting method they prefer.

Capital budgeting can be classified into two types: traditional and discounted cash flow.





(I) Traditional Methods:

This technique has two methods. They include:

(a) Payback period: The payback (or pay-out) period is one of the most popular and widely recognized traditional methods of evaluating investment proposals, it is defined as 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 dividing cash outlay by the annual cash inflow.

$$\text{Payback period} = \text{Cash outlay (investment)} / \text{Annual cash inflow} = C / A$$

Advantages:

1. A company can have more favourable short-run effects on earnings per share by setting up a shorter payback period.
2. The riskiness of the project can be tackled by having a shorter payback period as it may ensure guarantee against loss.
3. As the emphasis in pay back is on the early recovery of investment, it gives an insight to the liquidity of the project.

Limitations:

1. It fails to take account of the cash inflows earned after the payback period.
2. It is not an appropriate method of measuring the profitability of an investment project, as it does not consider the entire cash inflows yielded by the project.
3. It fails to consider the pattern of cash inflows, i.e., magnitude and timing of cash inflows.
4. Administrative difficulties may be faced in determining the maximum acceptable payback period.

(b) Average rate of return (ARR): The accounting rate of return (ARR) method is also known as the return on investment (ROI) method. It uses accounting information obtained from financial statements to measure the profitability of a possible investment. Some companies prefer the ARR method since it considers the project's earnings over its entire economic life.

$$\text{ARR} = \text{Average income} / \text{Average Investment}$$

Advantages:

1. It is very simple to understand and use.
2. It can be readily calculated using the accounting data.
3. It uses the entire stream of incomes in calculating the accounting rate.



Limitations:

1. It uses accounting, profits, not cash flows in appraising the projects.
2. It ignores the time value of money; profits occurring in different periods are valued equally.
3. It does not consider the lengths of projects lives.
4. It does not allow for the fact that the profit can be reinvested.

(II) Modern or Discounted cash flow methods:

Discounted methods are also known as “time-adjusted techniques.” They consider the time value of money while evaluating the costs and benefits of a project. The cash flows associated with the project are discounted at the cost of capital. These methods also take into account all benefits and costs occurring during the project’s life cycle.

(a) Net present value method: The net present value (NPV) method is a process of calculating the present value of cash flows (inflows and outflows) of an investment proposal, using the cost of capital as the appropriate discounting rate, and finding out the net present value, by subtracting the present value of cash outflows from the present value of cash inflows.

The equation for the net present value, assuming that all cash outflows are made in the initial year (tg), will be:

$$\begin{aligned} NPV &= \left[\frac{A_1}{(1+k)^1} + \frac{A_2}{(1+k)^2} + \frac{A_3}{(1+k)^3} + \dots + \frac{A_n}{(1+k)^n} \right] - C \\ &= \sum_{t=1}^n \frac{A_t}{(1+k)^t} - C \end{aligned}$$

Where A1, A2.... represent cash inflows, K is the firm’s cost of capital, C is the cost of the investment proposal and n is the expected life of the proposal. It should be noted that the cost of capital, K, is assumed to be known, otherwise the net present, value cannot be known.

Advantages:

1. It recognizes the time value of money
2. It considers all cash flows over the entire life of the project in its calculations.
3. It is consistent with the objective of maximizing the welfare of the owners.

Limitations:

1. It is difficult to use
2. It presupposes that the discount rate which is usually the firm’s cost of capital is known. But in practice, to understand cost of capital is quite a difficult concept.



3. It may not give satisfactory answer when the projects being compared involve different amounts of investment.

(b) Internal Rate of Return Method: The internal rate of return (IRR) equates the present value cash inflows with the present value of cash outflows of an investment. The two project options are conflicting because the company needs only one site to expand operations. In this scenario, the company would choose the project that has a greater IRR percentage that exceeds the cost of investment percentage.

It is called internal rate because it depends solely on the outlay and proceeds associated with the project and not any rate determined outside the investment, it can be determined by solving the following equation:

$$\begin{aligned}C &= \frac{A_1}{(1+r)^1} + \frac{A_2}{(1+r)^2} + \frac{A_3}{(1+r)^3} + \dots + \frac{A_n}{(1+r)^n} \\C &= \sum_{t=1}^n \frac{A_t}{(1+r)^t} \neq C \\0 &= \sum_{t=1}^n \frac{A_t}{(1+r)^t} - C\end{aligned}$$

Advantages:

1. Like the NPV method, it considers the time value of money.
2. It considers cash flows over the entire life of the project.
3. It satisfies the users in terms of the rate of return on capital.
4. Unlike the NPV method, the calculation of the cost of capital is not a precondition.
5. It is compatible with the firm's maximising owners' welfare.

Limitations:

1. It involves complicated computation problems.
2. It may not give unique answer in all situations. It may yield negative rate or multiple rates under certain circumstances.
3. It implies that the intermediate cash inflows generated by the project are reinvested at the internal rate unlike at the firm's cost of capital under NPV method. The latter assumption seems to be more appropriate.

(c) Profitability index: Profitability index (PI) is one of the essential capital budgeting techniques. It is the ratio of the present value of future cash benefits, at the required rate of return to the initial cash outflow of the investment. It may be gross or net, net being simply gross minus one. It is mainly used for ranking projects. Using an accept-reject rule, or basically either one or the other, the company chooses the project with the greater PI. This technique is also known as "profit investment ratio (PIR)," "benefit-cost ratio (BCR)" and "value investment ratio (VIR)." The formula of profitability index (PI) is as follows.



PI = PV cash inflows/Initial cash outlay A,

$$= \frac{\sum_{t=1}^n \frac{A_t}{(1+k)^t}}{C}$$

Advantages:

1. The index signifies a relationship between the investment of the project and the payoff of the project.
2. It gives due consideration to the time value of money.
3. It requires more computation than the traditional method but less than the IRR method.
4. It can also be used to choose between mutually exclusive projects by calculating the incremental benefit cost ratio.

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TIME VALUE OF MONEY

Time value of money is defined as “the value derived from the use of money over a period of time as a result that the value of a sum of money received today is more than its value receivable after some time, conversely the sum of money received in future is less valuable than it is to-day, one reason is that money received today can be invested thus generating more money. It can also be referred to as “time preference for money”.

The whole process can be explained as follows:

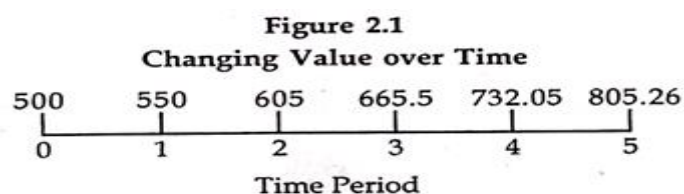
Suppose the rate of interest is 10 percent per annum. If we receive a sum of Rs. 500 now, it will earn an interest of Rs. 50 in one year and will become equal to Rs. 550 after 1 year. The same sum will earn an interest of Rs. 55 in the second year and will become equal to Rs. 605 after two years. How this money grows at different points of time can be calculated by the following compound interest formula?

$$A = P \left[1 + \frac{r}{100} \right]^t$$

Where

- A is the maturity/future value of money
- P is the principal sum or present value of the money
- r is the rate of interest percent
- t is the time period for which future sum is being calculated.

How does the value of a given sum of money change over the time scale is shown in the following figure.





Why People Have Time Preference for Money

Individuals generally prefer possession of a given amount of cash now rather than the same at some future time is known as 'Time Preference for Money'.

There are varied reasons for time preference for money.

(a) Availability of Better Investment Opportunities: There are investment opportunities, where people can invest their cash and earn some interest or return through lending or investment. A rupee invested today is more valuable than a rupee invested tomorrow, so they prefer to receive money today than to receive the same tomorrow.

(b) Due to Risk and Uncertainty of Cash Flows: Future is uncertain with plenty of risks. In this environment cash outflows (i.e., investment made at '0' period) are in investors control but the cash inflows (i.e. incomes earned from investments) return on investment and recovery of investments are not in investor's control. The receipt from outsiders is uncertain. Hence, the investors prefer to receive cash now rather than receiving the same in future.

(c) Due to Inflationary Conditions: In the inflationary condition the purchasing power of money is decreasing. In this condition a rupee today has more purchasing power than a rupee tomorrow. So people prefer to receive cash now rather than tomorrow.

(d) Preference for Present Consumption: It is human tendency to prefer present consumption of goods, commodities and services; than to postpone their consumption to future periods. Hence people prefer to possess cash for current consumption, rather to postpone or cancel.

(e) Due to Urgency/Emergency: People prefer to receive cash today than in some future date, to meet some urgent needs or to meet emergency requirements.

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Techniques for Estimating Time Value of Money

There are two techniques of estimating time value of money are explained as follows:

1. Discounting Technique or the Present Value Method
2. Compounding Technique or the Future Value Method

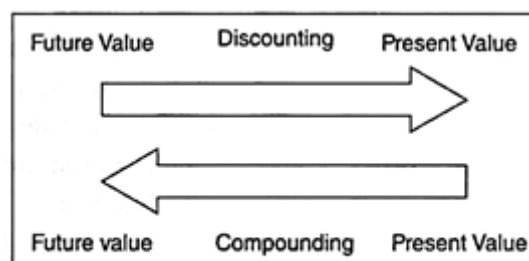


Figure 2.2 Techniques of Time Value of Money



1. Discounting or Present Value Method:

The current value of an expected amount of money to be received at a future date is known as Present Value. If we expect a certain sum of money after some years at a specific interest rate, then by discounting the Future Value we can calculate the amount to be invested today, i.e., the current or Present Value.

Hence, Discounting Technique is the method that converts Future Value into Present Value. The amount calculated by Discounting Technique is the Present Value and the rate of interest is the discount rate.

2. Compounding or Future Value Method:

Compounding is just the opposite of discounting. The process of converting Present Value into Future Value is known as compounding. Future Value of a sum of money is the expected value of that sum of money invested after n number of years at a specific compound rate of interest.

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Why is Significance Time Value of Money in Financial Decision Making?

The recognition of the time value of money is extremely significant in financial decision making because, most of financial decisions such as the acquisition of assets or procurement of funds, affect firm's cash flows in different time periods, for example, if a fixed asset is purchased, it will require an immediate cash outlays and will affect cash flows during many future periods.

Similarly if the firm borrows funds from a bank or from any other sources, it receives cash now and commits an obligation to pay interest and return principal sum in future. While taking decisions on these matters, the financial management must keep the time factor in mind.

If the timing of cash flows is not considered, the firm may make decisions which may falter its objective of maximising the owner's welfare.

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SOLVED PROBLEMS ON CAPITAL BUDGETING

(I) Traditional Methods

(A) Pay-back Period (PBP):

It defined as the number of years required to recover the initial investment (project cost).

Required values for calculation of PBP: Net Cash inflows after taxes before depreciation

$$\text{Formula: PBP} = \frac{\text{Cash investment or Cash outlay or Initial Investment}}{\text{Annual Cash inflows}}$$

$$\text{PBP} = \text{Years} + \frac{\text{Required Amount}}{\text{Next Year Amount}}$$

Decision Rule: $\text{PBP} \leq \text{Benchmark PBP}$ = Accept the Project

$\text{PBP} > \text{Benchmark PBP}$ = Reject the Project

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(1) A project costs Rs. 5, 00,000 and yields annual cash inflow of Rs. 1, 00,000 for 9 years. Calculate its Payback period.

Sol: Calculation of Payback Period

Year	Cash Inflows (After Tax Before Depreciation)	Cumulative Cash Inflows
1	1,00,000	1,00,000
2	1,00,000	2,00,000
3	1,00,000	3,00,000
4	1,00,000	4,00,000
5	1,00,000	5,00,000
6	1,00,000	6,00,000
7	1,00,000	7,00,000
8	1,00,000	8,00,000
9	1,00,000	9,00,000

Payback Period (PBP) = the number of years required to recover the initial investment

The Project Cost or Initial investment is Rs.5,00,000, it has to recovered on five years.
So the project Payback period is **5 years**.

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(2) The cost of a project is Rs. 50,000 which has an expected life of 5 years. The cash inflows for next 5 years are Rs. 24,000; Rs. 26,000; Rs. 20,000; Rs. 17,000 and Rs. 16,000 respectively. Determine the Payback period.

Sol: Calculation of Payback Period

Year	Cash Inflows (After Tax Before Depreciation)	Cumulative Cash Inflows
1	24,000	24,000
2	26,000	50,000
3	20,000	70,000
4	17,000	87,000
5	16,000	1,03,000

Payback Period (PBP) = the number of years required to recover the initial investment

The Project Cost is Rs.50,000, it recovered by two years.

So the project Payback period is **2 years**.

& & & &

(3) Determine Pay Back Period for the following projects:

Year	Cash Inflows (Rs.)
0	(2,50,000)
1	80,000
2	90,000
3	45,000
4	35,000
5	40,000

Sol: Calculation of Payback Period

Year	Cash Inflows (After Tax Before Depreciation)	Cumulative Cash Inflows
1	80,000	80,000
2	90,000	1,70,000
3	45,000	2,15,000
4	35,000	2,50,000
5	40,000	2,90,000

Payback Period (PBP) = the number of years required to recover the initial investment

The Project Cost is Rs.2,50,000, it recovered by four years.

So the project Payback period is **4 years**.



& & & &

(4) Determine Pay Back Period for the following projects:

	Rupees in Lakhs					
Year	Initial Cost	2017	2018	2019	2020	2021
Project-X	25.00	5.00	7.50	8.50	6.00	5.00
Project-Y	30.00	7.00	8.00	6.50	9.00	4.50

Sol: Calculation of Payback Period for two Projects-X & Y

Year	Project-X		Project-Y	
	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)
1 (2017)	5,00,000	5,00,000	7,00,000	7,00,000
2 (2018)	7,50,000	12,50,000	8,00,000	15,00,000
3 (2019)	8,50,000	21,00,000	6,50,000	21,50,000
4 (2020)	6,00,000	27,00,000	9,00,000	30,50,000
5 (2021)	5,00,000	32,00,000	4,50,000	35,00,000

Payback Period (PBP) = the number of years required to recover the initial investment

The Initial Investment of Project-X = 25,00,000

Project-Y = 30,00,000

Now Calculate the PBP using the formula

$$\text{PBP} = \text{Years} + \frac{\text{Required Amount}}{\text{Next Year Cash inflows}}$$

$$\text{Project-X} = 3\text{Years} + \frac{25,00,000 - 21,00,000}{6,00,000} = 3\text{ Years} + \frac{4,00,000}{6,00,000} = 3 + 0.67$$

Payback Period of **Project-X = 3.67 Years**

$$\text{Project-Y} = 3\text{Years} + \frac{30,00,000 - 21,50,000}{9,00,000} = 3\text{ Years} + \frac{8,50,000}{9,00,000} = 3 + 0.94$$

Payback Period of **Project-Y = 3.94 Years**

Conclusion: We are observing that above calculations, the Project-X payback period is lower than the Project-Y (i.e. $3.67 < 3.94$). So, the project-X is acceptable according to decision rules of PBP.

& & & &



(5) A choice is to be made between two competing proposals which require an equal investment of Rs. 50,000 and are expected in generating net cash flows as under:

Year	Project-I (Rs.)	Project-II (Rs.)
1	25,000	10,000
2	15,000	12,000
3	10,000	18,000
4	0	15,000
5	12,000	8,000
6	6,000	4,000

Select the project under Payable Method

Sol: Calculation of Payback Period for two Projects-I & II

Year	Project-I		Project-II	
	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)
1	25,000	25,000	10,000	10,000
2	15,000	40,000	12,000	22,000
3	10,000	50,000	18,000	40,000
4	0	50,000	15,000	55,000
5	12,000	62,000	8,000	63,000
6	6,000	68,000	4,000	67,000

Payback Period (PBP) = the number of years required to recover the initial investment

The Initial Investment of Project-X = 50,000

Project-Y = 50,000

Now Calculate the PBP using the formula

$$\text{PBP} = \text{Years} + \frac{\text{Required Amount}}{\text{Next Year Cash inflows}}$$

Project-X = 3Years

Payback Period of **Project-I = 3 Years**

$$\text{Project-Y} = 3\text{Years} + \frac{50,000 - 40,000}{15,000} = 3\text{ Years} + \frac{10,000}{15,000} = 3 + 0.67$$

Payback Period of **Project-II = 3.67Years**

Conclusion: We found that above calculations the Project-I payback period is lower than the Project-II (i.e. $3 < 3.67$). So, the project-I is acceptable according to decision rules of PBP.

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(B) Accounting Rate of Return (or) Average Rate of Return (ARR) or Return on Investment (ROI)

Which uses the accounting information revealed by the financial statements to measure the profitability of an investment proposal.

Required values for calculation of ARR: Cash Inflows after taxes, after depreciation

$$\text{Formula: ARR} = \frac{\text{Average Net Income}}{\text{Average Investment}} \times 100$$

$$(a) \text{ Average Net Income} = \frac{\text{Total Cash Inflows}}{\text{No. of Years}}$$

$$(b) \text{ Average Investment} = \frac{\text{Original Investment} - \text{Scrap Value}}{2} + \text{Additional Capital} + \text{Scrap Value}$$

Decision Rule: Highest ARR-Accept
Lowest ARR-Reject

& & & &

(1) Determine the Average Rate of Return from the following data of Machine-A & B.

Particulars	Machine-A	Machine-B
Project Cost (Rs.)	56,125	56,125
Additional Investment in net working capital (Rs.)	5,000	6,000
Estimated Salvage Value (Rs.)	3,000	3,000
Expected Life	4 Years	5 Years
Average Income Tax Rate (%)	55	55

Annual Estimated Income after Depreciation and Taxes

Year	Machine-A (Rs.)	Machine-B (Rs.)
1	3,375	11,375
2	5,375	9,375
3	7,375	7,375
4	9,375	5,375
5	11,375	3,375

Sol: Calculation of Average Rate of Return

Year	Annual Estimated Income after Depreciation and Taxes (Rs.)	
	Machine-A	Machine-B
1	3,375	11,375
2	5,375	9,375
3	7,375	7,375
4	9,375	5,375
5	11,375	3,375
Total CIF	36,875	36,875



$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}} \times 100$$

$$(a) \text{ Average Net Income} = \frac{\text{Total Cash Inflows}}{\text{No. of Years}}$$

$$\text{Machine-A} = \frac{36,875}{5} = \text{Rs.7,375}$$

$$\text{Machine-B} = \frac{36,875}{5} = \text{Rs.7,375}$$

$$(b) \text{ Average Investment} = \frac{\text{Original Investment} - \text{Scrap Value}}{2} + \text{Additional Capital} + \text{Scrap Value}$$

$$\text{Machine-A} = \frac{56,125 - 3,000}{2} + 5,000 + 3,000 = \frac{53,125}{2} + 8,000 = \text{Rs.34, 562.50}$$

$$\text{Machine-B} = \frac{56,125 - 3,000}{2} + 6,000 + 3,000 = \frac{53,125}{2} + 9,000 = \text{Rs.35, 562.50}$$

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}}$$

$$\text{ARR of Machine-A} = \frac{7,375}{34,562.50} \times 100 = 21.33 \%$$

$$\text{ARR of Machine-B} = \frac{7,375}{35,562.50} \times 100 = 20.738 \%$$

Conclusion: We are observing that above calculations, the Machine-A Average Rate Return (ARR) is higher than the Machine-B (i.e. 21.33 % > 20.738 %). Hence, the Machine-A is preferable as per the decision rules of ARR.

& & & &

(2) Calculate Average Rate of Return for Projects X and Y from the following.

Particular	Project-X	Project-Y
Investments	Rs.40,000	Rs.60,000
Expected Life	4 Years	5 Years

Projected Net Income (after interest, depreciation and taxes)

Year	Project-X (Rs.)	Project-Y (Rs.)
1	4,000	6,000
2	3,000	6,000
3	3,000	4,000
4	2,000	2,000
5	---	2,000

If the required rate of return is 10%, which projects should be undertaken?



Sol: Calculation of Average Rate of Return

Year	Projected Net Income (after interest, depreciation and taxes) (Rs.)	
	Project-X	Project-Y
1	4,000	6,000
2	3,000	6,000
3	3,000	4,000
4	2,000	2,000
5	---	2,000
Total CIF	12,000	20,000

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}} \times 100$$

$$(a) \text{ Average Net Income} = \frac{\text{Total Cash Inflows}}{\text{No. of Years}}$$

$$\text{Project-X} = \frac{12,000}{4} = \text{Rs. } 3,000$$

$$\text{Project-Y} = \frac{20,000}{5} = \text{Rs. } 4,000$$

$$(b) \text{ Average Investment} = \frac{\text{Original Investment} - \text{Scrap Value}}{2} + \text{Additional Capital} + \text{Scrap Value}$$

$$\text{Project-X} = \frac{40,000}{2} = \text{Rs. } 20,000$$

$$\text{Project-Y} = \frac{60,000}{2} = \text{Rs. } 30,000$$

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}}$$

$$\text{ARR of Project-X} = \frac{3,000}{20,000} \times 100 = 15\%$$

$$\text{ARR of Project-Y} = \frac{4,000}{30,000} \times 100 = 13.33\%$$

Conclusion: We found that above calculations, the Project-X Average Rate Return (ARR) is higher than the Project-Y (i.e. 15% > 13.33 %). So, the Project-X is acceptable according to the decision rules of ARR.

& & & &



(3) The directors of Alpha Ltd, are considering the purchase of a new machine. Two machines costing Rs.60,000 each are available. Each machine has an expected life of 5 Years. Net profit before tax during the expected life of each machine are as follows:

Year	Machine-X (Rs.)	Machine-Y (Rs.)
1	15,000	5,000
2	20,000	15,000
3	25,000	20,000
4	15,000	30,000
5	10,000	20,000

Following the method of Return on Investment ascertain which of the alternatives will be more profitable. The average rate of tax may be taken as 50%.

Sol: Calculation of Average Rate of Return

Year	Machine-X (Rs.)			Machine-Y (Rs.)		
	Net Profit before Tax (PBT)	Tax @ 50% on PBT	Net Profit after Tax (PAT)	Net Profit before Tax (PBT)	Tax @ 50% on PBT	Net Profit after Tax (PAT)
1	15,000	7,500	7,500	5,000	2,500	2,500
2	20,000	10,000	10,000	15,000	7,500	7,500
3	25,000	12,500	12,500	20,000	10,000	10,000
4	15,000	7,500	7,500	30,000	15,000	15,000
5	10,000	5,000	5,000	20,000	10,000	10,000
	Total CIF		42,500	Total CIF		45,000

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}} \times 100$$

$$(a) \text{ Average Net Income} = \frac{\text{Total Cash Inflows}}{\text{No. of Years}}$$

$$\text{Machine-X} = \frac{42,500}{5} = \text{Rs.8,500}$$

$$\text{Machine-Y} = \frac{45,000}{5} = \text{Rs.9,000}$$

$$(b) \text{ Average Investment} = \frac{\text{Original Investment} - \text{Scrap Value}}{2} + \text{Additional Capital} + \text{Scrap Value}$$

$$\text{Machine-X} = \frac{60,000}{2} = \text{Rs.30,000}$$

$$\text{Machine-Y} = \frac{60,000}{2} = \text{Rs.30,000}$$

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}}$$

$$\text{ARR of Machine-X} = \frac{8,500}{30,000} \times 100 = 28.33\%$$

$$\text{ARR of Machine-Y} = \frac{9,000}{30,000} \times 100 = 30\%$$

Conclusion: We found that above calculations, the Machine-Y ARR is higher than the Machine-X (i.e. 30% > 28.33%). So, the Machine-Y is preferable than Machine-X as per the decision rule of ARR.

& & & &



(II) Discounted Cash Flow / Time-adjusted / Modern methods of Capital Budgeting

(a) Net Present Value Method

It is useful to calculating the present value of cash flows (inflows and outflows) of an investment proposal.

Required values for calculation of NPV: Net Income after taxes before depreciation

Using the cost of capital as the appropriate discounting rate,

Formula: NPV = the present value of cash inflows (Σ PV) - the present value of cash outflows (Σ C)

Decision Rule: NPV > Zero or PV > C= Accept the Proposal

NPV < Zero or PV < C= Reject the Proposal

& & & &

(1) A project costing Rs.80000/- Annual cash inflows of Rs.40000/- after taxes for a period of six years. How much is the NPV if the firm expects 15% per annum.

Sol: Calculation of Net Present Value (NPV)

Year	Present Value (PV) Factor @ 15% ($\frac{1}{1.15}$)	Cash Inflows (CIF) (Rs.)	Present Value of Cash Inflows (PVCIF) (Rs.)
1	0.869	40,000	34,760
2	0.756	40,000	30,240
3	0.657	40,000	26,280
4	0.571	40,000	22,840
5	0.496	40,000	19,840
6	0.431	40,000	17,240
Total PVCIF			1,51,200
(-) Project Cost			80,000
Net Present Value (NPV)			71,200

Net Present Value (NPV) = the present value of cash inflows (Σ PVCIF) - the present value of cash outflows or Project Cost (Σ C).

& & & &

(2) A company has an investment opportunity costing Rs.1, 50,000 with the following expected net cash flow. Using 10% as the rate of discount determine i. Pay -back method ii. NPV method.

Year	Cash Flows Before Tax (Rs.)
1	16,000
2	34,000
3	44,000
4	54,000
5	54,000



Sol: (i) Calculation of Payback Period

Year	Cash Inflows (CIF) (Rs.)	Cumulative Cash Inflows (CCIF) (Rs.)
1	16,000	16,000
2	34,000	50,000
3	44,000	94,000
4	54,000	1,48,000
5	54,000	2,02,000

Payback Period (PBP) = the number of years required to recover the initial investment

The Initial Investment = Rs.1, 50,000

Now Calculate the PBP using the formula

$$\text{PBP} = \text{Years} + \frac{\text{Required Amount}}{\text{Next Year Cash inflows}}$$

$$\text{PBP} = 4\text{Years} + \frac{1,50,000 - 1,48,000}{54,000} = 4\text{ Years} + \frac{2,000}{54,000} = 4 + 0.037$$

Payback Period (PBP) = 4.037

(ii) Calculation of Net Present Value (NPV)

Year	PV Factor @ 10% ($\frac{1}{1.10}$)	(CIF) (Rs.)	(PVCIF) (Rs.)
1	0.909	16,000	14,544
2	0.826	34,000	28,084
3	0.751	44,000	33,044
4	0.683	54,000	36,882
5	0.621	54,000	33,534
	Total PVCIF		1,46,088
	(-) Project Cost		1,50,000
	Net Present Value (NPV)		(-) 3,912

(3) ABC company is considering the purchase of two machines A and B each costing Rs. 50,000/-. Earnings after taxes are expected to be as under :

Year	1	2	3	4	5
Machine-A	5,000	15,000	20,000	30,000	20,000
Machine-B	15,000	20,000	25,000	15,000	10,000

Estimate the two alternatives according to i. Pay-back Period ii. ARR method iii. NPV method a discount rate of 10%.



Sol: (i) Calculation of Payback Period for two Machine-A & B

Year	Machine-A		Machine-B	
	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)
1	5,000	5,000	15,000	15,000
2	15,000	20,000	20,000	35,000
3	20,000	40,000	25,000	60,000
4	30,000	70,000	15,000	75,000
5	20,000	90,000	10,000	85,000

Payback Period (PBP) = the number of years required to recover the initial investment

The Initial Investment of Machine-A = 50,000

Machine-B = 50,000

Now Calculate the PBP using the formula

$$\text{PBP} = \text{Years} + \frac{\text{Required Amount}}{\text{Next Year Cash inflows}}$$

$$\text{Machine-A} = 3\text{Years} + \frac{50,000 - 40,000}{30,000} = 3\text{ Years} + \frac{10,000}{30,000} = 3 + 0.33$$

Payback Period of **Machine-A = 3.33 Years**

$$\text{Machine-B} = 2\text{Years} + \frac{50,000 - 35,000}{25,000} = 2\text{ Years} + \frac{15,000}{25,000} = 2 + 0.6$$

Payback Period of **Machine-B = 2.6 Years**

Conclusion: We are observing that above calculations, the Machine-B payback period is lower than the Machine-A (i.e. $2.6 < 3.33$). So, the Machine-B is acceptable according to decision rules of PBP.

(ii) Calculation of Average Rate of Return

Year	Earnings after taxes (Rs.)	
	Machine-A	Machine-B
1	5,000	15,000
2	15,000	20,000
3	20,000	25,000
4	30,000	15,000
5	20,000	10,000
Total CIF	90,000	85,000

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}} \times 100$$

$$(a) \text{ Average Net Income} = \frac{\text{Total Cash Inflows}}{\text{No.of Years}}$$



$$\text{Machine-A} = \frac{90,000}{5} = \text{Rs.18, 000}$$

$$\text{Machine-B} = \frac{85,000}{5} = \text{Rs.17, 000}$$

$$(b)\text{Average Investment} = \frac{\text{Original Investment} - \text{Scrap Value}}{2} + \text{Additional Capital} + \text{Scrap Value}$$

$$\text{Machine-A} = \frac{50,000}{2} = \text{Rs.25, 000}$$

$$\text{Machine-B} = \frac{50,000}{2} = \text{Rs.25, 000}$$

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}}$$

$$\text{ARR of Machine-A} = \frac{18,000}{25,000} \times 100 = 72 \%$$

$$\text{ARR of Machine-B} = \frac{17,000}{25,000} \times 100 = 68 \%$$

Conclusion: We found that above calculations, the Machine-A Average Rate Return (ARR) is higher than the Machine-B (i.e.72 % > 68 %). Hence, the Machine-A is preferable as per the decision rules of ARR.

(iii) Calculation of Net Present Value (NPV)

Year	PV Factor @ 10% ($\frac{1}{1.10}$)	Machine-A		Machine-B	
		CIF (Rs.)	PVCIF (Rs.)	CIF (Rs.)	PVCIF (Rs.)
1	0.909	5,000	4,545	15,000	13,635
2	0.826	15,000	12,390	20,000	16,520
3	0.751	20,000	15,020	25,000	18,775
4	0.683	30,000	20,490	15,000	10,245
5	0.621	20,000	12,420	10,000	6,210
Total PVCIF			64,865		65,385
(-) Project Cost			50,000		50,000
Net Present Value (NPV)			14,865		15,385

Conclusion: We found that above calculations, the Machine-B Net Present Value (NPV) is higher than the Machine-A (i.e.Rs.15, 385 > 14,865). So, the Machine-B is acceptable as per the decision rules of NPV.

& & & &



(4) A firm whose cost of capital is 10% is considering two mutually exclusive projects X and Y, the details which are:

Particulars	Cash Flows (Rs.)	
	Project-X	Project-Y
0	70,000	70,000
1	10,000	50,000
2	20,000	30,000
3	30,000	40,000
4	40,000	10,000
5	50,000	10,000

Compute (a) Pay-back Period (ii) Accounting Rate of Return (iii) net present value and (iv) profitability index for the two projects.

Sol: (i) Calculation of Pay-back Period

Year	Project-X		Project-Y	
	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)
1	10,000	10,000	50,000	50,000
2	20,000	30,000	30,000	80,000
3	30,000	60,000	40,000	1,20,000
4	40,000	1,00,000	10,000	1,30,000
5	50,000	1,50,000	10,000	1,40,000

Payback Period (PBP) = the number of years required to recover the initial investment

The Initial Investment of Project-X = 70,000

Project-Y = 70,000

Now Calculate the PBP using the formula

$$\text{PBP} = \text{Years} + \frac{\text{Required Amount}}{\text{Next Year Cash inflows}}$$

$$\text{Project-X} = 3 \text{ Years} + \frac{70,000 - 60,000}{40,000} = 3 \text{ Years} + \frac{10,000}{40,000} = 3 + 0.25$$

Payback Period of Project-X = **3.25 Years**

$$\text{Project-Y} = 1 \text{ Year} + \frac{70,000 - 50,000}{30,000} = 1 \text{ Year} + \frac{20,000}{30,000} = 1 + 0.67$$

Payback Period of Project-Y = **1.67 Years**

Conclusion: We are observing that above calculations, the Project-Y payback period is lower than the Project-X (i.e. $1.67 < 3.25$). So, the Project-Y is preferable than Project-X according to decision rules of PBP.



(ii) Determine Average Rate of Return

Year	Earnings after taxes (Rs.)	
	Project-X	Project-Y
1	10,000	50,000
2	20,000	30,000
3	30,000	40,000
4	40,000	10,000
5	50,000	10,000
Total CIF	1,50,000	1,40,000

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}} \times 100$$

$$(a) \text{ Average Net Income} = \frac{\text{Total Cash Inflows}}{\text{No.of Years}}$$

$$\text{Project-X} = \frac{1,50,000}{5} = \text{Rs.}30,000$$

$$\text{Project-Y} = \frac{1,40,000}{5} = \text{Rs.}28,000$$

$$(b) \text{ Average Investment} = \frac{\text{Original Investment} - \text{Scrap Value}}{2} + \text{Additional Capital} + \text{Scrap Value}$$

$$\text{Project-X} = \frac{70,000}{2} = \text{Rs.}35,000$$

$$\text{Project-Y} = \frac{70,000}{2} = \text{Rs.}35,000$$

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}}$$

$$\text{ARR of Project-X} = \frac{30,000}{35,000} \times 100 = 85.71 \%$$

$$\text{ARR of Project-Y} = \frac{28,000}{35,000} \times 100 = 80 \%$$

Conclusion: We found that above calculations, the Project-X Average Rate Return (ARR) is higher than the Project-Y (i.e. 85.71 % > 80 %). Hence, the Project-X is preferable as per the decision rules of ARR.



(iii) Determine Net Present Value

Year	PV Factor @ 10% ($\frac{1}{1.10}$)	Project-X		Project-Y	
		CIF (Rs.)	PVCIF (Rs.)	CIF (Rs.)	PVCIF (Rs.)
1	0.909	10,000	9,090	50,000	45,450
2	0.826	20,000	16,520	30,000	24,780
3	0.751	30,000	22,530	40,000	30,040
4	0.683	40,000	27,320	10,000	6,830
5	0.621	50,000	31,050	10,000	6,210
Total PVCIF			1,06,510		1,13,310
(-) Project Cost			70,000		70,000
Net Present Value (NPV)			36,510		43,310

Conclusion: We observe that above calculations, the Project-Y Net Present Value (NPV) is higher than the Project-X (i.e. Rs.43,310 > 36,510). So, the Project-Y is acceptable as per the decision rules of NPV.

(iv) Calculation of Profitability Index (PI) or Benefit Cost Ratio (BCR)

Formula of PI or BCR = $\frac{\text{NPV}}{\text{Project Cost}}$

$$\text{Project-X} = \frac{36,510}{70,000} = 0.521$$

$$\text{Project-Y} = \frac{43,310}{70,000} = 0.618$$

Conclusion: According to the Profitability Index (PI) decision rule, the Project-Y is acceptable due to it is higher than the value of Project-X.

& & & &

(5) XYZ company is considering an investment proposal to install new drilling controls at a cost of Rs.1,00,000. The facility has a life expectancy of 5 years and no salvage value. The tax rate is 35%. Assume the firm uses straight line depreciation and the same is allowed for tax purposes. The estimated cash flows before depreciation and tax are as follows:

Year	Cash Flows before tax (Rs.)
1	20,000
2	21,384
3	25,538
4	26,924
5	40,770

Calculate: i) Pay Back Period ii) Average Rate of Return iii) NPV@ 10% discount rate iv) Profitability Index @10% discount rate.



Sol: Calculation of Cash Inflows after Tax

Year	Cash Flows before tax (CBT) (Rs.)	Tax @ 35% on CBT	Cash Flows After tax (CAT) (Rs.)
1	20,000	7,000	13,000
2	21,384	7,484.4	13,899.60
3	25,538	8,938.3	16,599.70
4	26,924	9,423.4	17,500.60
5	40,770	14,269.5	26,500.50

(i) Calculation of Pay-back Period

Year	Cash Inflows (After Tax Before Depreciation)	Cumulative Cash Inflows
1	13,000	13,000
2	13,899.60	26,899.60
3	16,599.70	43,499.30
4	17,500.60	60,999.90
5	26,500.50	87,500.40

Payback Period (PBP) = the number of years required to recover the initial investment

The Initial Investment = Rs.1, 00,000

Now Calculate the PBP using the formula

$$\text{PBP} = \text{Years} + \frac{\text{Required Amount}}{\text{Next Year Cash inflows}}$$

$$\text{PBP} = 5\text{Years} + \frac{1,00,000 - 87,500.40}{\text{Project life is 5 years}} = 5\text{ Years} + \frac{12,499.60}{0} =$$

Payback Period (PBP) = 5 years +

Conclusion: According to the calculations, the project cost is not recovered within its life time (5 years) and it is incurred loss i.e. Rs.12, 499.60. Hence, this project is not considerable.

(ii) Calculation of Accounting Rate of Return

Year	CIF (After Tax)
1	13,000
2	13,899.60
3	16,599.70
4	17,500.60
5	26,500.50
Total CIF	87,500.40



$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}} \times 100$$

$$(a) \text{ Average Net Income} = \frac{\text{Total Cash Inflows}}{\text{No. of Years}}$$

$$= \frac{87,500.40}{5} = \text{Rs. } 17,500.08$$

$$(b) \text{ Average Investment} = \frac{\text{Original Investment} - \text{Scrap Value}}{2} + \text{Additional Capital} + \text{Scrap Value}$$

$$= \frac{1,00,000}{2} = \text{Rs. } 50,000$$

$$\text{Average Rate Return (ARR)} = \frac{\text{Average Net Income}}{\text{Average Investment}}$$

$$\text{ARR} = \frac{17,500.08}{50,000} \times 100 = 35\%$$

(iii) Calculation of Net Present Value

Year	Present Value (PV) Factor @ 10% ($\frac{1}{1.10}$)	Cash Inflows (CIF) (Rs.)	Present Value of Cash Inflows (PVCIF) (Rs.)
1	0.909	13,000	11,817
2	0.826	13,899.60	11,481.07
3	0.751	16,599.70	12,466.37
4	0.683	17,500.60	11,952.91
5	0.621	26,500.50	16,456.81
	Total PVCIF		64,174.16
	(-) Project Cost		1,00,000
	Net Present Value (NPV)		(-) 35,825.84

(iv) Calculation Profitability Index (PI)

$$\text{Formula of PI or BCR} = \frac{\text{NPV}}{\text{Project Cost}}$$

$$\text{Project-X} = \frac{(-)35,825.84}{1,00,000} = (-) 0.358$$

& & & &



(B) Internal Rate of Return (IRR)

This method is based on the principle of present value.

This method used for appraising the investment projects.

It can be defined as the rate of interest/return that equates the present value of expected future receipts to the cost of the investment outlay.

It is to be determined by trial and error method

Required values for calculation of NPV: Net income after taxes before depreciation

To find out the exact IRR between two near rates, the following formula is to be used.

$$IRR = L_1 + \frac{P_1 - C}{P_1 - P_2} \times D$$

Where, L_1 = Lower rate of interest

P_1 = Present Value at lower rate of interest

P_2 = Present Value at higher rate of interest

C = Cash outlay or Project Cost

D = Difference in rate of interest ($L_2 - L_1$)

Decision Rule: $IRR >$ the required rate of return – Accept the proposal

$IRR <$ the required rate of return – Reject the proposal

& & & &

(1) Consider the case of the following company M/S Venkata Ramana with the following two investment alternatives each proposal of 6 lakhs. The Details of cash inflows as follows:

Year	1	2	3
Proposal-I (Rs.)	2,00,000	4,00,000	3,00,000
Proposal-II (Rs.)	3,00,000	2,00,000	4,00,000

The cost of the capital is 12% factor per year. Which one you will choose (a) NPV method
(b) IRR method

Sol: (i) Calculation of NPV and IRR using Trial and Error Method

Year	PV Factor @ 12% ($\frac{1}{1.12}$)	Proposal-I		Proposal-II	
		CIF (Rs.)	PVCIF (Rs.)	CIF (Rs.)	PVCIF (Rs.)
1	0.893	2,00,000	1,78,600	3,00,000	2,67,900
2	0.797	4,00,000	3,18,800	2,00,000	1,59,400
3	0.712	3,00,000	2,13,600	4,00,000	2,84,800
Total PVCIF			7,11,600		7,12,100
(-) Project Cost			6,00,000		6,00,000
Net Present Value (NPV)			1,11,600		1,12,100



Year	PV Factor @ 15% ($\frac{1}{1.15}$)	Proposal-I		Proposal-II	
		CIF (Rs.)	PVCIF (Rs.)	CIF (Rs.)	PVCIF (Rs.)
1	0.870	2,00,000	1,74,000	3,00,000	2,61,000
2	0.756	4,00,000	3,02,400	2,00,000	1,51,200
3	0.658	3,00,000	1,97,400	4,00,000	2,63,200
Total PVCIF			6,73,800		6,75,400
(-) Project Cost			6,00,000		6,00,000
Net Present Value (NPV)			73,800		75,400

Year	PV Factor @ 20% ($\frac{1}{1.20}$)	Proposal-I		Proposal-II	
		CIF (Rs.)	PVCIF (Rs.)	CIF (Rs.)	PVCIF (Rs.)
1	0.833	2,00,000	1,66,600	3,00,000	2,49,900
2	0.694	4,00,000	2,77,600	2,00,000	1,38,800
3	0.579	3,00,000	1,73,700	4,00,000	2,31,600
Total PVCIF			6,17,900		6,20,300
(-) Project Cost			6,00,000		6,00,000
Net Present Value (NPV)			17,900		20,300

Year	PV Factor @ 25% ($\frac{1}{1.25}$)	Proposal-I		Proposal-II	
		CIF (Rs.)	PVCIF (Rs.)	CIF (Rs.)	PVCIF (Rs.)
1	0.800	2,00,000	1,60,000	3,00,000	2,40,000
2	0.64	4,00,000	2,56,000	2,00,000	1,28,000
3	0.512	3,00,000	1,53,600	4,00,000	2,04,800
Total PVCIF			5,69,600		5,72,800
(-) Project Cost			6,00,000		6,00,000
Net Present Value (NPV)			(-) 30,400		(-) 27200

$$IRR = L_1 + \frac{P_1 - C}{P_1 - P_2} \times (L_2 - L_1)$$

Where, L_1 = Lower rate of interest

P_1 = Present Value at lower rate of interest

P_2 = Present Value at higher rate of interest

C = Cash outlay or Project Cost

D = Difference in rate of interest ($L_2 - L_1$)



Proposal-I: $L_1 = 20$, $L_2 = 25$, $P_1 = \text{Rs.} 6, 17,900$, $P_2 = \text{Rs.} 5, 69,600$ and $C = \text{Rs.} 6, 00,000$

Proposal-II: $L_1 = 20$, $L_2 = 25$, $P_1 = \text{Rs.} 6, 20,300$, $P_2 = \text{Rs.} 5, 72,800$ and $C = \text{Rs.} 6, 00,000$

$$\text{IRR of Proposal-I} = 20 + \frac{6,17,900 - 6,00,000}{6,17,900 - 5,69,600} \times (25 - 20) = 20 + \frac{17,900}{48,300} \times 5 = 20 + 1.853$$

IRR of Proposal-I = 21.853 %

$$\text{IRR of Proposal-II} = 20 + \frac{6,20,300 - 6,00,000}{6,20,300 - 5,72,800} \times (25 - 20) = 20 + \frac{20,300}{47,500} \times 5 = 20 + 2.137$$

IRR of Proposal-II = 22.137 %

Conclusion: According to the above calculations, the Proposal-II IRR is higher than Proposal-I. Hence, Proposal-II is considerable.

& & & &

(2) A company has to select one of the two alternative projects, the particulars in respect of which are given below:

Year	Net Cash Flows (Rs.)	
	Project-A	Project-B
0	1,20,000	1,10,000
1	70,000	20,000
2	50,000	40,000
3	30,000	50,000
4	20,000	40,000
5	10,000	20,000
6	Nil	10,000

The company can arrange fund at 15%. Compute the Net Present Value, Profitability Index and Internal Rate of Return of each project and comment on the result.

Sol: For Calculation of IRR, needed Nearest Positive and Negative Value of Project Cost. So, in this regard we are using Trial and Error Method and will get that result.

Year	PV Factor @ 15% ($\frac{1}{1.15}$)	Project-A		Project-B	
		CIF (Rs.)	PVCIF (Rs.)	CIF (Rs.)	PVCIF (Rs.)
1	0.870	70,000	60,900	20,000	17,400
2	0.756	50,000	37,800	40,000	30,240
3	0.658	30,000	19,740	50,000	32,900
4	0.572	20,000	11,440	40,000	22,880
5	0.497	10,000	4,970	20,000	9,940
6	0.432	0	0	10,000	4,320
Total PVCIF			1,34,850		1,17,680
(-) Project Cost			1,20,000		1,10,000
Net Present Value (NPV)			14,850		7,680



(ii) Calculation Profitability Index (PI)

$$\text{Formula of PI or BCR} = \frac{\text{NPV}}{\text{Project Cost}}$$

$$\text{Project-A} = \frac{14,850}{1,20,000} = 0.1237 \quad \text{Project-A} = \frac{7,680}{1,10,000} = 0.0698$$

Year	PV Factor @ 20% ($\frac{1}{1.20}$)	Project-A		Project-B	
		CIF (Rs.)	PVCIF (Rs.)	CIF (Rs.)	PVCIF (Rs.)
1	0.833	70,000	58,310	20,000	16,660
2	0.694	50,000	34,700	40,000	27,760
3	0.579	30,000	17,370	50,000	28,950
4	0.482	20,000	9,640	40,000	19,280
5	0.402	10,000	4,020	20,000	8,040
6	0.335	0	0	10,000	3,350
Total PVCIF			1,24,040		1,04,040
(-) Project Cost			1,20,000		1,10,000
Net Present Value (NPV)			4,040		(-) 5,600

(ii) Calculation Profitability Index (PI)

$$\text{Formula of PI or BCR} = \frac{\text{NPV}}{\text{Project Cost}}$$

$$\text{Project-A} = \frac{4,040}{1,20,000} = 0.034 \quad \text{Project-A} = \frac{(-)5,600}{1,10,000} = (-) 0.051$$

Project-A			
Year	PV Factor @ 22% ($\frac{1}{1.22}$)	CIF (Rs.)	PVCIF (Rs.)
1	0.819	70,000	57,330
2	0.672	50,000	33,600
3	0.551	30,000	16,530
4	0.451	20,000	9,640
5	0.369	10,000	3,690
6	0.303	0	0
Total PVCIF			1,26,790
(-) Project Cost			1,20,000
Net Present Value (NPV)			6,790



(ii) Calculation Profitability Index (PI)

$$\text{Formula of PI or BCR} = \frac{\text{NPV}}{\text{Project Cost}}$$

$$\text{Project-A} = \frac{6,970}{1,20,000} = 0.058$$

Project-A			
Year	PV Factor @ 23% ($\frac{1}{1.23}$)	CIF (Rs.)	PVCIF (Rs.)
1	0.813	70,000	56,910
2	0.661	50,000	33,050
3	0.537	30,000	16,110
4	0.437	20,000	8,740
5	0.355	10,000	3,550
6	0.289	0	0
	Total PVCIF		1,18,360
	(-) Project Cost		1,20,000
	Net Present Value (NPV)		(-) 1,640

(ii) Calculation Profitability Index (PI)

$$\text{Formula of PI or BCR} = \frac{\text{NPV}}{\text{Project Cost}}$$

$$\text{Project-A} = \frac{(-)1640}{1,20,000} = (-) 0.0137$$

(iii) Calculation of IRR

$$\text{IRR} = L_1 + \frac{P_1 - C}{P_1 - P_2} \times (L_2 - L_1)$$

Project-A: $L_1 = 22$, $L_2 = 23$, $P_1 = \text{Rs.} 1, 26,790$, $P_2 = \text{Rs.} 1, 18,360$ and $C = \text{Rs.} 1, 20,000$

Project-B: $L_1 = 15$, $L_2 = 20$, $P_1 = \text{Rs.} 1, 17,680$, $P_2 = \text{Rs.} 1, 04,040$ and $C = \text{Rs.} 1, 10,000$

$$\text{IRR of Project-A} = 22 + \frac{1,26,790 - 1,20,000}{1,26,790 - 1,18,360} \times (23 - 22) = 22 + \frac{6,790}{8,430} \times 1 = 22 + 0.805$$

IRR of Project-A = 22.085 %

$$\text{IRR of Project-B} = 15 + \frac{1,17,680 - 1,04,040}{1,17,680 - 1,04,040} \times (20 - 15) = 15 + \frac{5,600}{13,640} \times 5 = 15 + 2.053$$

IRR of Project-B = 17.053 %

Conclusion: According to the above calculations, the **Project-A** IRR is higher than **Project-B**. Hence, **Project-A** is considerable.

**EXERCISES**

(1) Mohan & Co. is considering the purchase of a machine. Two machines X and Y each costing Rs.50,000 are available. Earnings after taxation are expected to be as under:

Year	Machine-X	Machine-Y	Discount Factor @ 10%
1	15,000	5,000	0.9091
2	20,000	15,000	0.8264
3	25,000	20,000	0.7513
4	15,000	30,000	0.6830
5	10,000	20,000	0.6209

Estimate the two alternatives according to:

- (i) Pay-back method
- (ii) Return on investment method
- (iii) Net Present Value method a discount rate of 10% is to be used.

(2) Calculate the Payback period, average rate of return and net present value for a project, which requires an initial outlay of Rs.10,000 and generates year ending cash flows of Rs.6,000, Rs.3,000, Rs.2,000, Rs.5,000 and Rs.5,000 from the end of the first year to the end of fifth year. The required rate of return is 10% and pays tax at 50% rate. The project has a life of five years and depreciated on straight line basis.

Year	Discount Factor @ 10%
1	0.9091
2	0.8264
3	0.7513
4	0.6830
5	0.6209

(3) A project Cost of Rs.25, 000 and is expected to generate cash inflows as:

Year	Cash Inflows (Rs.)	Discount Factor @ 12%
1	10,000	0.893
2	8,000	0.797
3	9,000	0.712
4	6,000	0.636
5	7,000	0.567

Compute the (i) Payback Period (ii) ARR (iii) NPV of the Project.



(4) A project costs Rs.1,44,000. The average annual cash inflows are likely to be Rs.45,000 for a period of 5 years. Calculate the IRR for the project.

(5) Radhika enterprises ltd is contemplating the purchase of a machine. Two machines A and B are available each at Rs.2,50,000.

Year	Net Cash Inflows (Amt. in Rs.)	
	Machine A	Machine B
1	75,000	25,000
2	1,00,000	50,000
3	1,25,000	1,00,000
4	75,000	1,50,000
5	50,000	1,00,000

Calculate (i) Payback Period (ii) Accounting Rate of Return (iii) Net Present Value Method @10% and (iv) Profitability Index Method

(6) Examine the following proposals and evaluate them based on: i. ARR method (ARR on original investment) ii. NPV method. Initial investment is Rs.12, 00,000/- each for all the two projects, discount factor is 10 %.

Year	Net Cash Inflows (Amt. in Rs.)	
	Project A	Project B
1	6,00,000	5,00,000
2	5,00,000	3,00,000
3	2,00,000	2,00,000
4	0	3,00,000

(7) Company has two proposals each costing Rs. 9 Lakhs. The details are given below.

Year	Net Cash Inflows (Amt. in Rs.)	
	Project A	Project B
1	3,00,000	6,00,000
2	5,00,000	4,00,000
3	6,00,000	3,00,000
4	2,00,000	2,00,000

The cost of capital is 10% per year. Which one will you choose under Net present value method?



(8) Consider the case of PQR company with the following two investment alternatives each costing Rs. 12, 00,000/-. The details of the cash flows are as follows.

Year	Net Cash Inflows (Amt. in Rs.)	
	Project-I	Project-II
1	4,00,000	7,00,000
2	7,00,000	6,00,000
3	5,00,000	4,00,000

The cost of capital is 12 per cent per year. Which one will you choose?

According to a) Payback period and b) IRR method.

(9) ABC Co. Ltd. is proposing to undertake one project. Two projects A and B are available. The initial cost of the Project in each case is Rs. 4, 00,000/-. A discount factor of 10% is used to compare the projects. Cash flows after taxes are likely to be as under.

Year	Cash flows after Taxes (in Rs.)	
	Project-A	Project-B
1	1,50,000	50,000
2	2,00,000	1,50,000
3	2,50,000	2,00,000
4	1,50,000	3,00,000
5	1,00,000	2,00,000

Which one do you recommend under Net Present Value Index method?

(10) Rank the following investment proposals in order of their profitability according to Pay-Back Period and Internal rate of return methods assuming the cost of capital to be 10%.

Project	Initial Outlay (Rs.)	Annual Cash Flow (Rs.)	Life in years
A	25,000	3,000	10
B	3,000	1,000	5
C	12,000	2,000	8
D	20,000	4,000	10
E	40,000	8,000	12

(11) ABC Co. Ltd. is proposing to undertake one project. Two projects A and B are available. The initial cost of the Project in each case is Rs. 4, 00,000/-. A discount factor of 10% is used with Net Present Value method which one do you recommend?

Year	Cash flows after Taxes (in Rs.)	
	Project-A	Project-B
1	1,50,000	50,000
2	2,00,000	1,50,000
3	2,50,000	2,00,000
4	1,50,000	3,00,000
5	1,00,000	2,00,000



(12) A Project initial investment is 10 lakhs and cash inflows for five years are as follows.

Year	Cash Inflows (Rs.)
2008	2,00,000
2009	2,40,000
2010	3,00,000
2011	3,60,000
2012	4,00,000

The cost of capital is 12%. Compute NPV and IRR of the Project.

(13) Initial Investment for a project is 20 lakh. The Project life is 6 years and the cash inflows for six is as given below.

Year	Cash Inflows (Rs.)
1	3,50,000
2	4,00,000
3	5,00,000
4	5,50,000
5	6,00,000
6	5,00,000

The cost of capital of is 13%. Compute NPV, IRR and Payback period.

(14) A firm is considering an investment proposal which requires an initial cash outlay of Rs.8 lakh now and Rs. 2 lakh at the end of the third year. It is expected to generate cash flows as under:

Year	Cash Inflows (Rs.)
1	3,50,000
2	8,00,000
3	2,50,000

Apply the discount rate of 12 percent calculate profitability index.

(15) A project requires an initial outlay of Rs.1, 00,000. It is expected to generate the following cash inflows:

Year	Cash Inflows (Rs.)
1	50,000
2	50,000
3	30,000
4	40,000

What is the IRR of the project?



(16) Determine the payback period for the information given below:

- (i) The project cost is Rs.20,000
- (ii) The life of the project is 5 years
- (iii) The cash flows for the 5 years are Rs.10,000, Rs.12,000, Rs.13,000, Rs.11,000 and Rs.10,000 respectively.
- (iv) Tax rate is 20%.

(17) A project costs Rs.25,000 and is expected to generate cash inflows as follows:

Year	Cash Inflows (Rs.)
1	10,000
2	8,000
3	9,000
4	6,000
5	7,000

Compute the NPV of the project.

(18) The expected life of a project is 5 years which costs Rs. 80,000. In its expected life, the yield is Rs. 22,000, Rs. 28,000, Rs. 30,000 and Rs. 34,000 respectively. Find the Payback period.

(19) A company has two proposals for consideration (Y&Z). The cost of proposals in both the cases is Rs 5,00,000 each. A discount factor of 10% may be used to evaluate the proposals. The cash flows after taxes are as under.

Year	Cash flows after Taxes (in Rs.)	
	Proposal-Y	Proposal-Z
1	1,50,000	60,000
2	2,20,000	1,50,000
3	2,40,000	2,00,000
4	1,80,000	2,50,000
5	1,50,000	3,00,000

Which proposal can be undertaken under NPV?

(20) A company is considering an investment proposal to install new milling control at a cost of Rs. 55,000/-. The facility has a life expectancy of 5 years and no salvage value. The tax rate is 30%. Assume the firm uses single line depreciation and the same is allowed for tax purposes. The estimated cash flow before depreciation and tax (CFBT) from the investment proposal are as follows: Calculate Payback Period, ARR and IRR

Year	CFBT (Rs.)
1	13,600
2	15,590
3	14,769
4	13,660
5	24,855



(21) A company is considering an investment proposal to install new milling controls at a cost of Rs.50,000. The facility has a life expectancy of 5 years and no salvage value. The tax rate is 35 percent. Assume the firm uses straight line depreciation and the same is allowed for tax purposes. The estimated cash flows before depreciation and tax (CFBT) from the investment proposal are as follows:

Year	CFBT (Rs.)
1	10,000
2	10,692
3	12,769
4	13,462
5	20,385

Calculate the following: payback period, ARR and Profitability index at 10 percent discount rate.

(22) A project costing Rs.1,60,000/-, Annual cash inflows of Rs 80000/- after taxes for a period of six years. How much is the NPV if the firm expects 15% per annum (PVF 0.870, 0.756, 0.658, 0.572, 0.497, 0.432 for year one to six years respectively).

(23) ABC Company is considering the purchase of machine. Two machines X and Y each costing Rs.50,000 is available. Earnings after taxes in Rs are expected to be as under:

Year	Net Cash Inflows (Amt. in Rs.)	
	Machine X	Machine Y
1	15,000	5,000
2	20,000	15,000
3	25,000	20,000
4	15,000	30,000
5	10,000	20,000

Estimate the two alternatives according to: (i) Payback method, and (ii) NPV method a discount rate of 10% is to be used.



PRESENT VALUE TABLE

Present value of \$1, that is $(1 + r)^{-n}$ where r = interest rate; n = number of periods until payment or receipt.

Periods (n)	Interest rates (r)									
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909
2	0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826
3	0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751
4	0.961	0.924	0.888	0.855	0.823	0.792	0.763	0.735	0.708	0.683
5	0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621
6	0.942	0.888	0.837	0.790	0.746	0.705	0.666	0.630	0.596	0.564
7	0.933	0.871	0.813	0.760	0.711	0.665	0.623	0.583	0.547	0.513
8	0.923	0.853	0.789	0.731	0.677	0.627	0.582	0.540	0.502	0.467
9	0.914	0.837	0.766	0.703	0.645	0.592	0.544	0.500	0.460	0.424
10	0.905	0.820	0.744	0.676	0.614	0.558	0.508	0.463	0.422	0.386
11	0.896	0.804	0.722	0.650	0.585	0.527	0.475	0.429	0.388	0.350
12	0.887	0.788	0.701	0.625	0.557	0.497	0.444	0.397	0.356	0.319
13	0.879	0.773	0.681	0.601	0.530	0.469	0.415	0.368	0.326	0.290
14	0.870	0.758	0.661	0.577	0.505	0.442	0.388	0.340	0.299	0.263
15	0.861	0.743	0.642	0.555	0.481	0.417	0.362	0.315	0.275	0.239
16	0.853	0.728	0.623	0.534	0.458	0.394	0.339	0.292	0.252	0.218
17	0.844	0.714	0.605	0.513	0.436	0.371	0.317	0.270	0.231	0.198
18	0.836	0.700	0.587	0.494	0.416	0.350	0.296	0.250	0.212	0.180
19	0.828	0.686	0.570	0.475	0.396	0.331	0.277	0.232	0.194	0.164
20	0.820	0.673	0.554	0.456	0.377	0.312	0.258	0.215	0.178	0.149

Periods (n)	Interest rates (r)									
	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.706	0.694
3	0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.593	0.579
4	0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.499	0.482
5	0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.419	0.402
6	0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.352	0.335
7	0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.296	0.279
8	0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.249	0.233
9	0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.209	0.194
10	0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.176	0.162
11	0.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.148	0.135
12	0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.124	0.112
13	0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.104	0.093
14	0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.088	0.078
15	0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.079	0.065
16	0.188	0.163	0.141	0.123	0.107	0.093	0.081	0.071	0.062	0.054
17	0.170	0.146	0.125	0.108	0.093	0.080	0.069	0.060	0.052	0.045
18	0.153	0.130	0.111	0.095	0.081	0.069	0.059	0.051	0.044	0.038
19	0.138	0.116	0.098	0.083	0.070	0.060	0.051	0.043	0.037	0.031
20	0.124	0.104	0.087	0.073	0.061	0.051	0.043	0.037	0.031	0.026