Capital Budgeting 5

This Module Includes

Capital Budgeting

SLOB Mapped against the Module:

To develop critical thinking and problem-solving competencies so that students can assist the management in ensuring optimum management of working capital and capital expenditure in existing as well as new projects.

Module Learning Objectives:

After studying this module, the students will be able to –

- Know the basic concept of capital budgeting;
- Explain the nature of capital budgeting;
- Explain the need of capital budgeting decision;
- Discuss the significance of capital budgeting;
- Understand the process of capital budgeting;
- Compute, interpret and evaluate the traditional capital budgeting techniques (non-discounted);
- Compute, interpret and evaluate the modern capital budgeting techniques (discounted);
- Understand the difference between NPV and IRR method.

Introduction to Capital Budgeting

5.1

Success of finance mainly depends on proper decision making in respect of investment of funds. In general decision-making means selecting the best alternatives among all available alternatives based on analysing the positive sides and negative sides of each alternative. In financial management, capital budgeting is decision making technique. Capital budgeting decision may be defined as firm's decisions to invest its current funds most efficiently in long term activities in anticipation of an expected flow of future benefits over a series of year.

On behalf of financial management, an effective decision should be taken on how and where the available fund be invested. Successful operation of any business depends upon the investment of resources in such a way as to bring in benefits or best possible returns from any investment. An investment can be simply defined as an expenditure in cash or its equivalent during one or more time periods in anticipation of enjoying a net inflow of cash or its equivalent in some future time period or periods. An appraisal of investment proposals is necessary to ensure that the investment of resources will bring in desired benefits in future. If the financial resources were in abundance, it would be possible to accept several investment proposals which satisfy the norms of approval or acceptability. Since resources are limited, a choice has to be made among the various investment proposals by evaluating their comparative merit. It is apparent that some techniques should be followed for making appraisal of investment proposals. Capital Budgeting is one of the appraising techniques of investment decisions. Capital budgeting is defined as the firm's decision to invest its current funds most efficiently in long term activities in anticipation of an expected flow of future benefits over a series of years. It should be remembered that the investment proposal is common both for fixed assets and current assets. Mainly, the firm's capital budgeting decisions will include addition, disposition, modification and replacement of fixed assets.

Some important definitions of capital budgeting are:

Charles. T. Horngren defined capital budgeting as 'long-term planning for making and financing proposed capital out lay.'

According to **Keller and Ferrara**, 'capital Budgeting represents the plans for the appropriation and expenditure for fixed asset during the budget period.'

Robert N. Anthony defined as 'capital budget is essentially a list of what management believes to be worthwhile projects for the acquisition of new capital assets together with the estimated cost of each product.'

5.1.1 Nature of Capital Budgeting Decisions

The term capital budgeting is used interchangeably with capital expenditure decision, capital expenditure management, long-term investment decision, management of fixed assets and so on. Mainly, capital budgeting decisions related to fixed assets or long-term assets which by definition refer to assets which are in operation, and yield a return, over a period of time, usually, exceeding one year. They, therefore, involve a current outlay or series of outlays of cash resources in return for an anticipated flow of future benefits. In other words, the system

of capital budgeting is employed to evaluate expenditure decisions which involve current outlays but are likely to produce benefits over a period of time longer than one year. These benefits may be either in the form of increased revenues or reduced costs. Capital expenditure management, therefore, includes addition, disposition, modification and replacement of fixed assets. From the preceding discussion may be deduced the following basic features of capital budgeting: (i) potentially large anticipated benefits; (ii) a relatively high degree of risk; and (iii) a relatively long time period between the initial outlay and the anticipated returns.

5.1.2 Importance or Need of Capital Budgeting Decisions

An organisation has huge of fund to invest. As a finance manager, what you will do? You have to select the fund where you will invest your fund. Here, the capital budgeting decisions plays an important role. Capital budgeting is important because it creates accountability and measurability. Any organisation that seeks to invest its resources in a project without understanding the risks and returns involved would be held as irresponsible by its owners or shareholders. If this decision proves wrong, it may result huge loss forthe organisation. The selection of the most profitable project of capital investment is the key function of financial manager or finance team of any organisation.

The decisions taken by the management in this area affect the operations of the firm for many years. Capital budgeting decisions may be generally needed for the following purposes:

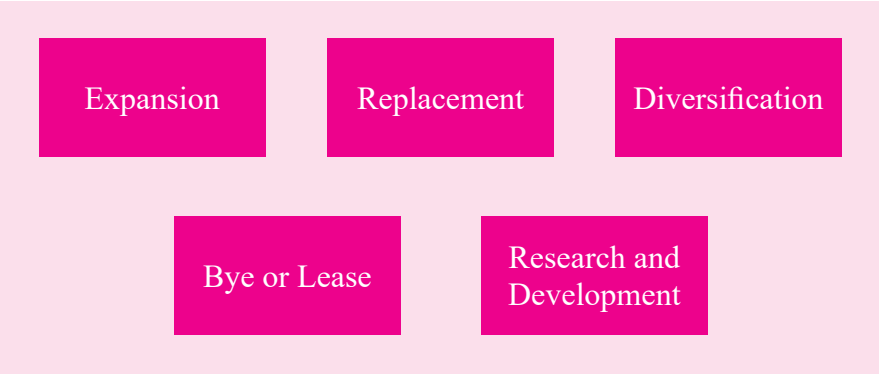

figure 5.1: Need of Capital Budgeting Decisions

(a) Expansion: The firm requires additional funds to invest in fixed assets when it intends to expand the production facilities in view of the increase in demand for their product in near future. Accordingly, the current assets will increase. In case of expansion the existing infrastructure – like plant, machinery and other fixed assets is inadequate, to carry out the increased production volume. Thus, the firm needs funds for such project.

This will include not only expenditure on fixed assets (infrastructure) but also an increase in working capital (current assets).

(b) Replacement: The machines and equipment used in production may either wear out or may be rendered obsolete due to new technology. The productive capacity and competitive ability of the firm may be adversely affected. The firm needs funds or modernization of a certain machines or for renovation of the entire plant etc., to make them more efficient and productive. Modernization and renovation will be a substitute for total replacement, where renovation or modernization is not desirable or feasible, funds will be needed for replacement.

(c) Diversification: If the management of the firm decided to diversify its production into other lines by adding a new line to its original line, the process of diversification would require large funds for long-term investment. For example, ITC and Philips company for their diversification.

(d) Buy or Lease: This is a most important decision area in financial management whether the firm acquire the desired equipment and building on lease or buy it. If the asset is acquired on lease, there have to be made a series of annual or monthly rental payments. If the asset is purchased, there will be a large initial commitment of funds, but not further payments. The decision–making area is which course of action will be better to follow? The costs and benefits of the two alternative methods should be matched and compared to arrive at a conclusion.

(e) Research and Development: The existing production and operations can be improved by the application of new and more sophisticated production and operations management techniques. New technology can be borrowed or developed in the laboratories. There is a greater need of funds for continuous research and development of new technology for future benefits or returns from such investments.

5.1.3 Significance of Capital Budgeting Decisions

The key function of the financial management is the selection of the most profitable portfolio of capital investment. It is the most important area of decision-making of the financial manager because any action taken by the manger in this area affects the working and the profitability of the firm for many years to come. Capital budgeting decisions are considered important for many reasons. Some of them are discussed below:

(a) Crucial Decisions: Capital budgeting decisions are crucial, affecting all the departments of the firm. So, the capital budgeting decisions should be taken very carefully.

(b) Long-run Decisions: The implications of capital budgeting decisions extend to a longer period in the future. The consequences of a wrong decision will be disastrous for the survival of the firm.

(c) Large Amount of Funds: Capital budgeting decisions involve spending large amount of funds. As such proper care should be exercised to see that these funds are invested in productive purchases.

(d) Rigid: Capital budgeting decision cannot be altered easily to suit the purpose. Because of this reason, when once funds are committed in a project, they are to be continued till the end, loss or profit no matter.

(e) 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.

(f) Wealth-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 maximization of equity share-holders.

(g) Helps in Policy Making: It facilitates the management in making of the long-term plans to assist in the formulation of general policy.

5.1.4 Process of Capital Budgeting

Capital budgeting process refers to the total process of generating, evaluating, selecting and following up on capital expenditure alternatives. The firm allocates or budgets financial resources to new investment proposals. Basically, the firm may be confronted with three types of capital budgeting decisions: (i) the accept-reject decision; (ii) the mutually exclusive choice decision; and (iii) the capital rationing decision.

The major steps in the capital budgeting process are given below. These are (a) Generation of project; (b) Evaluation of the project; (c) Selection of the project and (d) Execution of the project. The capital budgeting process may include a few more steps. As each step is significant, they are usually taken by the top management.

The Steps are discussed below:

(a) Generation of Project: Depending upon the nature of the firm, investment proposals can emanate from a variety of sources. Projects may be classified into five categories.

(i) New products or expansion of existing products.

(ii) Replacement of equipment or buildings.

(iii) Research and development.

(iv) Exploration.

(v) Others like acquisition of a pollution control device etc.

Investment proposals should be generated for the productive employment of firm's funds. However, a systematic procedure must be evolved for generating profitable proposals to keep the firm healthy.

(b) Evaluation of the Project: The evaluation of the project may be done in two steps. First the costs and benefits of the project are estimated in terms of cash flows and secondly the desirability of the project is judged by an appropriate criterion. It is important that the project must be evaluated without any prejudice on the part of the individual. While selecting a criterion to judge the desirability of the project, due consideration must be given to the market value of the firm.

(c) Selection of the Project: After evaluation of the project, the project with highest return should be selected. There is no hard and fast rule set for the purpose of selecting a project from many alternative projects. Normally the projects are screened at various levels. However, the final selection of the project vests with the top-level management.

(d) Execution of Project: After selection of a project, the next step in capital budgeting process is to implement the project. Thus, the funds are appropriated for capital expenditures. The funds are spent in accordance with appropriations made in the capital budget funds for the purpose of project execution should be spent only after seeking format permission for the controller. The follow–up comparison of actual performance with original estimates ensures better control.

Thus, the top management should follow the above procedure before taking anycapital expenditure decision.

5.1.5 Capital Budgeting Decisions (Situation Decisions)

On the basis of situation decision, firm may be confronted with three types of capital budgeting decisions: (a) Accept-reject Decision; (b) Mutually Exclusive Project Decisions and (iii) Capital Rationing Decision. These are discussed below:

(a) Accept-reject Decision

Business firm is confronted with alternative investment proposals. That means you have to take decision whether the project is accepted or rejected. So, accept-reject decision is a fundamental decision in capital budgeting. If the project is accepted, the firm would invest in it, if the proposal is rejected, the firm does not invest in it. In general, all those proposals which yield a rate of return greater than a certain required rate of return or cost of capital are accepted and the rest are rejected. By applying this criterion, all independent projects are accepted. Under this decision criterion, all independent projects that satisfy the minimum investment criterion should be implemented.

(b) Mutually Exclusive Project Decision

'Mutually exclusive projects' is used generally in the capital budgeting process where the firms choose a single project on the basis of certain parameters out of the set of the projects where acceptance of one project will lead to rejection of the other projects. In case of mutually exclusive projects, the project with highest net present value or the highest IRR or the lowest payback period is preferred and a decision to invest in that select project excluded all other projects from consideration even if they individually have positive NPV or higher IRR than hurdle rate or shorter payback period than the reference period.

(c) Capital Rationing Decision

Capital rationing refers to the choice of investment proposals under financial constraints in terms of a given size of capital expenditure budget. The objective of capital rationing is to select the combination of projects would be the maximisation of the total NPV. It is concerned with the selection of a group of investment proposals out of many investment proposals acceptable under the accept-reject decision. Capital rationing employs ranking of the acceptable investment projects. The projects can be ranked on the basis of a predetermined criterion such as the rate of return. The projects are ranked in the descending order of the rate of return.

Identification of Cash Flows and Forecasting

5.2

Capital budgeting is concerned with investment decisions which yield return over a period of time in future. As we know, capital budgeting decision mainly focuses on cash flows rather than profits. Capital budgeting involves identifying the cash in flows and cash out flows rather than accounting revenues and expenses flowing from the investment. So, capital budgeting involves in determination of cash flows.

Cash flows are the most important factor in a capital investment decision. Investment decision has to take place at present, not in future and therefore capital expenditure is a cash-flow concept, rather than a profit-based concept. That's why computation of cash flow decides the success or failure of any investment decision.

The cash flows associated with a proposal may be classified into: (i) Initial Cash Flow, (ii) Subsequent Cash Flow and (iii) Terminal Cash Flow. These are discussed below:

(i) Initial Cash Flow:

Any long-term investment decision will involve large amount of initial cash outlay. It reflects the cash spent for acquiring the asset, known as initial cash outflow. For estimating the initial cash outflow, the following aspects are taken into consideration.

(a) The cost of the asset, installation cost, transportation cost and any other incidental cost, i.e., all the costs to be incurred for the asset in order to bring it to workable condition, are to be taken into consideration.

(b) Sunk cost which has already been incurred or committed to be incurred, hence, which has no effect on the present or future decision, will be ignored as it is irrelevant cost for the decision.

c) For investment decisions relating to replacement of an existing asset usually involve salvage value which is considered as cash inflow and subtracted from the cash outflow relating to the installation of the new asset. If the existing asset is the only asset in the concerned block of asset, the incidence of income tax on gain or loss on sale of the existing asset is also to be considered, as the block of asset will cease to exist due to sale of the asset. The tax impact on gain on sale of asset represent burden of tax, hence cash outflow and tax impact on loss on sale represent savings of tax, hence, cash inflow. Therefore, tax on gain on sale of asset has to be added and tax on loss on sale has to be subtracted in order to determine initial cash outflow. However, if there are other assets in the same block, the question of gain or loss on sale of asset will not arise, only the sale proceed from sale of old asset will be deducted from the total initial cash outflow.

(d) Change in working capital requirement due to the new investment decision requires to be considered. If additional working capital is required, it will increase the initial cash outflow. On the other hand, in a replacement situation, if requirement of working capital is decreased, such decrease in working capital requirement will reduce the total initial cash outflow.

Initial Cash Outflow:

Cost of the new asset including installation, transportation and other incidental costs related to the asset

(±) Change in working capital requirement (Addition for increase, Subtraction for decrease)

(–) Salvage value of the old asset (in case of replacement of old asset)

(–) Tax savings for loss on sale of asset (if the block ceases to exist due to sale of old asset), or

(+) Tax payable for profit on sale of asset (if the block ceases to exist due to sale of old asset)

(ii) Subsequent Cash Flow:

In conventional cash flow, cash outflow occurs at the initial period and a series of cash inflows occur in the subsequent periods. On the other hand, non-conventional cash flow involves intermittent cash outflows in the subsequent periods also for major repairing, additional working capital requirement, etc. Therefore, apart from estimating initial cash flow, subsequent cash flows are also required to be estimated. For estimating future cash inflows, i.e., cash inflows of the subsequent periods, the following aspects need to be considered.

Cash inflows are to be estimated on an after-tax basis.

Depreciation being a non-cash item is to be added back to the amount of profit after taxes.

Interest being financial charge will be excluded for estimating cash inflow for investment decisions (Interest Exclusion Principal). However, interest (on debt capital) is taken into consideration for determining weighted average cost of capital which is used for discounting the cash inflows to arrive at its present value.

Calculation of Net Cash Inflow after Taxes (CFAT)

Particulars	Amount (₹)	Amount (₹)
Net Sales Revenue		xxx
Less: Cost of Goods Sold	xxx	
Less: General Expenses (other than Interest)	xxx	
Less: Depreciation	xxx	xxx
Profit before Interest and Taxes (PBIT or EBIT)		xxx
Less: Taxes		xxx
Profit after Taxes (excluding Interest) [PAT]		xxx
Add: Depreciation		xxx
Net Cash Inflow after Taxes [CFAT = EBIT (1 – t) + Depreciation [where, t is income tax rate] If PAT is taken from accounting records, which is arrived at after charging Interest, 'Interest Net of Taxes' is to be added back along with the amount of Depreciation, i.e., PAT after charging Interest		xxx
Add: Depreciation		xxx
Add: Interest Net of Taxes (i.e., Total Interest – Tax on Interest)		xxx
Net Cash Inflow after Taxes		xxx

Illustration 1

From the following information calculate Net Cash Inflow after Taxes.

Particulars	Amount (₹)	Amount (₹)
Net Sales Revenue		10,00,000
Less:		
Cost of Goods Sold	5,00,000	
Operating Expenses	2,00,000	
Depreciation	1,00,000	8,00,000
PBIT or EBIT		2,00,000
Less: Interest		50,000
PBT or EBT		1,50,000
Less: Tax (30%)		45,000
PAT		1,05,000

Solution:

Calculation of Net Cash Inflow after Taxes

Particulars	Amount (₹)
EBIT	2,00,000
Less: Tax (30%)	60,000
	1,40,000
Depreciation	1,00,000
Net Cash Inflow after Taxes	2,40,000

Alternatively,

Particulars	Amount (₹)	Amount (₹)
PAT		1,05,000
Add: Depreciation		1,00,000
		2,05,000
Add: Interest Net of Taxes		
Total Interest	50,000	
Less: Tax on Interest (30%)	15,000	35,000
Net Cash Inflow after Taxes		2,40,000

(iii) Terminal Cash Flow:

In the last year, i.e., at the end of the economic life of the asset or at the time of termination of the project, usually some additional cash inflows occur in addition to the operating cash inflows, viz., salvage value of the asset, release of working capital (the working capital that is introduced at the beginning will no longer be required at the end of the life of the asset or at the termination of the project). Moreover, tax impact on gain or loss on sale of the asset if the block of asset ceases to exist.

Terminal Cash Inflow:	
Salvage or Scrap Value	xxx
Add: Tax Savings on Loss on Sale of Asset	xxx
Or	
Less: Tax Burden on Gain on Sale of Asset	xxx
Add: Release of Working Capital	xxx

Cash Flow vs Profit of the Firm

5.3

The foremost requirement for evaluation of any capital investment proposal is to estimate the future benefits accruing from the investment proposal. Theoretically, two alternative criteria are available to quantify the benefits: (i) accounting profit, and (ii) cash flows. Cash flow and profit are both important financial measures in any business organisation, but cash flow and profit are not the same things. It is critical to understand the difference between them to make key decisions regarding a business's performance and financial health.

Cash flow refers to the net balance of cash moving into and out of a business at a specific point in time. Cash flow can be positive or negative. Positive cash flow indicates that a company has more money moving into it than out of it. Negative cash flow indicates that a company has more money moving out of it than into it. On the other hand, profit is typically defined as the balance that remains when all of a business's operating expenses are subtracted from its revenues. Accounting profit is to be adjusted for non-cash expenditures to determine the actual cash inflow. The cash flow approach of measuring future benefits of a project is superior to the accounting approach as cash flows are theoretically better measures of the net economic benefits of costs associated with a proposed project.

However, changes in profits do not necessarily mean changes in cash flows. It is not difficult to find examples of firms in practice that experience cash shortages in spite of increasing profits. Cash flow and profit are not same in many reasons. The important reasons are:

(i) Profit, as measured is based on accrual concept— revenue (sales) is recognized when it is earned, rather than when cash is received, and expense is recognized when it is incurred rather than when cash is paid. In other words, profit includes cash revenues as well as receivables and excludes cash expenses as well as payable.

(ii) For computing profit, expenditures are arbitrarily divided into revenue and capital expenditures. Revenue expenditures are entirely charged to profits while capital expenditures are not. Capital expenditures are capitalized as assets (investments), and depreciated over their economic life. Only annual depreciation is charged to profit. Further, depreciation (DEP) is an accounting entry and does not involve any cash flow. Thus, the measurement of profit excludes some cash flows such as capital expenditures and includes some non-cash items such as depreciation.

We can explain differences between profit and cash flow.

Assume that a firm is entirely equity-financed, and it receives its revenues (REV) in cash and pays its expenses (EXP) and capital expenditures (CAPEX) also in cash. Further, assume that taxes do not exist. Under these circumstances, profit can be expressed in the following equation:

Profit = Revenues − Expenses – Depreciation

Profit = REV − EXP − DEP ..... (1)

Cash flow can be shown in the following equation:

Cash flow = Revenues – Expenses – Capital Expenditure

Cash flow (CF) = REV – EXP – CAPEX ..... (2)

It may be noticed from Equations (1) and (2) that profit does not deduct capital expenditures as investment outlays are made. Instead, depreciation is charged on the capitalized value of investments. Cash flow, on the other hand, ignores depreciation since it is a non-cash item and includes cash paid for capital expenditures. In the accountant's book, the net book value of capital expenditures will be equal to their capitalized value minus depreciation.

We can obtain the following definition of cash flows if we adjust Equation (2) for relationships given in Equation (1):

CF = (REV − EXP − DEP) + DEP − CAPEX

CF = Profit + DEP − CAPEX ..... (3)

From Equation (3), it makes clear that even if revenues and expenses are expressed in terms of cash flow, still profit will not be equal to cash flows. It overstates cash inflows by excluding capital expenditures and understates them by including depreciation. Thus, profits do not focus on cash flows.

The objective of a firm is not to maximize profits or earnings per share, rather it is to maximize the shareholders' wealth, which depends on the present value of cash flows available to them.

Evaluation Techniques – Non-Discounted and Discounted Cash Flow Methods

5.4

The capital budgeting appraisal methods or techniques for evaluation of investment proposals will help the company to decide the desirability of an investment proposal, depending upon their relative income generating capacity and rank them in order if their desirability. These methods provide the company a set of normal method should enable to measure the real worth of the investment proposal. Appraisal of investment proposals are based on objective, quantified and economic costs and benefits.

Characteristics of an Appraisal Method

The appraisal methods should possess several good characteristics, which are mentioned as under.

(a) It should help the company to rank the investment proposals in order of their desirability.

(b) It should provide a technique for distinguishing between an acceptable and non-acceptable project.

(c) It should provide criteria to solve the problem of choosing among alternative projects.

(d) It should recognize the importance of time value of money i.e. bigger benefits are preferable to smaller ones and early benefits are preferable to later benefits.

(e) It should provide the criteria for the selection of investment proposals.

(f) It should take into account the pattern of cash flows.

The methods of appraising capital expenditure proposals can be classified into two broad categories:

(a) Traditional or Non-Discounted Cash Flow (Non-DCF) Techniques

1. Payback Period
2. Payback Reciprocal
3. Payback Profitability
4. Average or Accounting Rate of Return (ARR)

(b) Discounted Cash Flow (DCF) or Time-Adjusted Techniques

1. Net Present Value (NPV)
2. Profitability Index
3. Internal Rate of Return (IRR)
4. Discounted Payback Period
5. Modified NPV
6. Modified IRR
7. Adjusted Present Value

5.4.1 Non-discounted or Traditional Techniques

These methods are based on the principles to determine the desirability of an investment project on the basis of its useful life and expected returns. These methods depend upon the accounting information available from the books of accounts. These will not take into account the concept of 'time value of money' which is a signification factors to desirability of a project in terms of present value.

1. Payback Period (PBP) Method

The PBP method is the simplest way to budget for a new project. It measures the amount of time it will take to earn enough cash inflows from your project to recover what you invested. It is the most popular and widely recognized traditional methods of evaluating the investment proposals. It can be defined as the number of years to recover the original capital invested in a project. According to Weston and Brigham, the PBP is the number of years it takes for the firm to recover its original investment by net returns before depreciation, but after taxes:

(a) **When cash flows are uniform:** If the proposed project's cash inflows are uniform the following formula can be used to calculate the payback period.

$$\text{Payback Period} = \frac{\text{Annual Cash Inflows}}{\text{Initial Investment}}$$

(b) **When cash flows are not uniform:** When the project's cash inflows are not uniform, but vary from year to year payback period is calculated by the process of cumulating cash inflows till the time when cumulative cash flows become equal to the original investment outlay.

Advantages: The following are the advantages of the payback period method:

(i) **(Easy to calculate:** It is one of the easiest methods of evaluating the investment projects. It is simple to understand and easy to compute.

(ii) **Knowledge:** The knowledge of payback period is useful in decision-making, the shorter the period better the project.

(iii) **Protection from loss due to obsolescence:** This method is very suitable to such industries where mechanical and technical changes are routine practice and hence, shorter payback period practice avoids such losses.

(iv) **Easily availability of information:** It can be computed on the basis of accounting information, what is available from the books.

Disadvantages: However, the payback period method has certain disadvantages and limitations:

(i) **Failure in taking cash flows after payback period:** This method is not taking into account the cash flows received by the company after the payback period.

(ii) **Not considering the time value of money:** It does not take into account the time value of money.

(iii) **Non-considering of interest factor:** It does not take into account the interest factor involved in the capital outlay.

(iv) **Maximisation of market value not possible:** It is not consistent with the objective of maximizing the market value of share.

(v) **Failure in taking magnitude and timing of cash inflows:** It fails to consider the pattern of cash inflows i.e., the magnitude and timing of cash inflows.

Accept-Reject Decision:

The payback period can be used as an accept or reject criterion as well as a method of ranking projects. The payback period is the number of years to recover the investment made in a project. If the payback period calculated for a project is less than the maximum payback period set-up by the company, it can be accepted. As a ranking method it gives the highest rank to a project which has the lowest payback period, and the lowest rank to a project with the highest payback period. Whenever a company faces the problem of choosing among two or more mutually exclusive projects, it can select a project on the basis of payback period, which has shorter period than the other projects.

With equal and unequal cash flows

Illustration 2

Pioneer Ltd. is considering two mutually-exclusive projects. Both require an initial cash outlay of ₹ 10,000 each for machinery and have a life of 5 years. The company's required rate of return is 10% and it pays tax at 50%. The projects will be depreciated on a straight-line basis. The net cash flows (before taxes) expected to be generated by the projects and the present value (PV) factor (at 10%) are as follows:

(₹ in '000)

	2020 (Year 1)	2021 (Year 2)	2022 (Year 3)	2023 (Year 4)	2024 (Year 5)
Project 1 (₹)	4,000	4,000	4,000	4,000	4,000
Project 2 (₹)	6,000	3,000	3,000	5,000	5,000
PV factor (at 10%)	0.909	0.826	0.751	0.683	0.621

You are required to calculate the Payback Period of each project.

Solution:

(₹ in '000)

Payback Period of Project - 1					
Year	2020 (Year 1)	2021 (Year 2)	2022 (Year 3)	2023 (Year 4)	2024 (Year 5)
Cash Flows (₹)	4,000	4,000	4,000	4,000	4,000
Less: Depreciation (₹)	2,000	2,000	2,000	2,000	2,000
Earnings before Tax (EBT) (₹)	2,000	2,000	2,000	2,000	2,000
Less: Tax at 50% (₹)	1,000	1,000	1,000	1,000	1,000
Net Income (₹)	1,000	1,000	1,000	1,000	1,000
Cash flows after tax (₹)	3,000	3,000	3,000	3,000	3,000
Cumulative cash flows (₹)	3,000	6,000	9,000	12,000	15,000

Payback period would be the time when initial investment is recovered in cash. The investment is ₹ 10,000.

Payback period would be between 3 and 4 years.

$$\text{Payback Period} = 3 + \frac{₹\ 10,000 - ₹\ 9,000}{₹\ 9,000}$$

$$= 3.11 \text{ years}$$

(₹)

Payback Periods of Project - 2					
Year	2020 (Year 1)	2021 (Year 2)	2022 (Year 3)	2023 (Year 4)	2024 (Year 5)
Cash Flows	6,000	3,000	2,000	5,000	5,000
Less: Depreciation	2,000	2,000	2,000	2,000	2,000
Earnings before Tax (EBT)	4,000	1,000	0	3,000	3,000
Less: Tax at (50%)	2,000	500	0	1,500	1,500
Net Income	2,000	500	0	1,500	1,500
Cash flows after tax	4,000	2,500	2,000	3,500	3,500
Cumulative cash flows	4,000	6,500	8,500	12,000	15,500

A project with an initial investment of ₹ 50 Lakh and life of 10 years, generates CFAT of ₹ 10 Lakh per annum. Calculate Payback Reciprocal of the project.

Solution:

$$\text{Payback Reciprocal} = \frac{₹\ 10\ \text{lakh}}{₹\ 50\ \text{lakh}} = 20\%$$

3. Payback Profitability

As the profitability beyond the Payback Period is not taken into consideration in Payback Period method, the projects with higher Payback period are rejected though such projects with longer life may generate higher benefits after recovering its initial investment. In Payback Profitability method, the profitability beyond the payback period is considered and projects generating higher benefits after the recovery of initial investment are considered for selection.

Payback Profitability = Net Cash Inflow after Taxes after recovering the Initial Investment, i.e., Total Net Cash Inflow after Taxes – Initial Investment

4. Accounting or Average Rate of Return (ARR) Method

This technique uses the accounting information revealed by the financial statements to measure the profitability of an investment proposal. It can be determined by dividing the average income after taxes by the average investment. According to Solomon, Accounting Rate of Return can be calculated as the ratio of average net income to the initial investment.

On the basis of this method, the company can select all those projects whose ARR is higher than the minimum rate established by the company. It can reject the projects with an ARR lower than the expected rate of return.

This method also helps the management to rank the proposal on the basis of ARR.

Accounting Rate of Return (ARR) = Average Net Income / Original Investment

Or,

Accounting Rate of Return (ARR) = Average Net Income / Average Investment

Advantages: The following are the advantages of ARR method:

(i) It is very simple to understand and calculate;

(ii) It can be readily computed with the help of the available accounting data;

(iii) It uses the entire stream of earnings to calculate the ARR.

Disadvantages: This method has the following limitations:

(i) It is not based on cash flows generated by a project;

(ii) This method does not consider the objective of wealth maximization;

(iii) It ignores the length of the project's useful life;

(iv) If does not take into account the fact that the profile can be re-invested; and

(v) It ignores the time value of money.

Accept-Reject Decision

With the help of the ARR, the financial decision maker can decide whether to accept or reject the investment proposal. As an accept-reject criterion, the actual ARR would be compared with a pre-determined or a minimum required rate of return or cut-off rate. A project would qualify to be accepted if the actual ARR is higher than the minimum desired ARR. Otherwise, it is liable to be rejected. Alternatively, the ranking method can be used to select or reject proposals. Thus, the alternative proposals under consideration may be arranged in the descending order of magnitude, starting with the proposal with the highest ARR and ending with the proposal having the lowest ARR. Obviously, projects having higher ARR would be preferred to projects with lower ARR.

Illustration 4

Determine the average rate of return from the following data of two machines, A and B.

(₹ in "000)

Particulars	Machine - A (₹)	Machine - B (₹)
Cost	56,125	56,125
Annual estimated income after depreciation and income tax:		
Year 1	3,375	11,375
Year 2	5,375	9,375
Year 3	7,375	7,375
Year 4	9,375	5,375
Year 5	11,375	3,375
Total	**36,875**	**36,875**
Estimated life (years)	5	5
Estimated salvage value	3,000	3,000

Depreciation has been charged on straight line basis.

Solution:

ARR	=	(Average income/Average investment) x 100
Average income of Machines A and B	=	(₹ 36,875/5)
	=	₹7,375
Average investment	=	Salvage value + [1/2 (Cost of machine – Salvage value)]
	=	₹ 3,000 + [1/2 (₹ 56,125 – ₹3,000)]
	=	₹ 29,562.50
ARR (for machines A and B)	=	(₹ 7,375/₹ 29563.50) × 100
	=	24.9 %

5.4.2 Discounted Cash Flow Techniques

The discounted cash flow methods provide a more objective basis for evaluating and selecting an investment project. These methods consider the magnitude and timing of cash flows in each period of a project's life. Discounted cash flow methods enable us to isolate the differences in the timing of cash flows of the project by discounting them to know the present value. The present value can be analyses to determine the desirability of the project. These techniques adjust the cash flows over the life of a project for the time value of money.

The distinguishing characteristics of the discounted cash flow capital budgeting techniques is that they take into consideration the time value of money while evaluating the costs and benefits of a project. In one form or another, all these methods require cash flows to be discounted at a certain rate, that is, the cost of capital. The cost of capital (k) is the minimum discount rate earned on a project that leaves the market value unchanged. The second commendable feature of these techniques is that they take into account all benefits and costs occurring during the entire life of the project.

However, the popular discounted cash flows techniques are:

1. Net Present Value (NPV)
2. Internal Rate of Return (IRR)
3. Profitability Index (PI)
4. Discounted Payback Period (DPBP)
5. Modified NPV
6. Modified Internal Rate of Return (MIRR)
7. Adjusted Present Value

Present Value:

It is very important to have idea about present value for applying discounted cash flows techniques. The concept of present value has already been discussed in Time Value of Money chapter in detail. Present value states that an amount of money today is worth more than the same amount in the future. In other words, present value shows that money received in the future is not worth as much as an equal amount received today. The present value or the discounted cash flow procedure recognizes that cashflow streams at different time periods differ in value and can be compared only when they are expressed in terms of a common denominator, that is, present values. It, thus, takes into account the time value of money.

The value of a firm depends upon the net cash inflows generated by the firm assets and also on future returns. The amount of cash inflows and risk associated with the uncertainty of future returns forms the basis of valuation. To get the present value, cash inflows are to be discounted at the required rate of return i.e., minimum rate expected by the investor to account for their timing and risk. The cash inflows and outflows of an investment decision are to be compared at zero time period or at the same value by discounting them at required rate of return. The following formula can be used to discount the future inflows of a project to compare with its cash outflows.

The present value (PV) formula is **$PV=FV/(1+i)^n$**, where you divide the future value (FV) by a factor of 1 + i for each period between present and future dates. Here, i = PVIF/Rate of Discount and n = No. of Periods.

1. Net Present Value (NPV) Method

Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project. In other words, it is a method of calculating the present value of cash flows (inflows and outflows) of an investment proposal using the cost of capital as an appropriate discounting rate. According to Ezra Solomon, 'it is a present value of the cast of the investment.'

This method correctly postulates that cash flows arising at time periods differ in value and are comparable only with their equivalents i.e., present values.

Steps of computation of Net Present Value (NPV):

(i) Estimation of future cash inflows.

(ii) An appropriate rate of interest should be selected to discount the cash flows. Generally, this will be the "cost of capital" of the company, or required rate of return.

(iii) The present value of inflows and outflows of an investment proposal has to be computed by discounting them with an appropriate cost of capital.

(iv) The net value is the difference between the present value of cash inflows and the present value of cash outflows.

The formula for the net present value can be written as:

Net Present Value (NPV)

$$NPV = \frac{C_1}{(1+k)^1} + \frac{C_2}{(1+k)^2} + \frac{C_3}{(1+k)^3} \ldots\ldots\ldots\ldots\ldots + \frac{C_n}{(1+k)^n} - I$$

Where,

C = Annual Cash inflows

Cn = Cash inflow in the year n

k = Cost of Capital

I = Initial Investment

Or

$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1+i)^t} - I$$

Where,

C_t = Net cash inflow – outflows during a single period t.

i = Discount rate or return that could be earned in alternative investments.

t = Number of periods.

I = Initial Investment

Accept-Reject Decision:

If the NPV is positive or at least equal to zero, the project can be accepted. If it is negative, the proposal can be rejected. Among the various alternatives, the project which gives the highest positive NPV should be selected.

NPV is positive = A positive NPV indicates that the projected earnings generated by a project or investment.

Cash inflows are generated at a rate higher than the minimum required by the firm.

NPV is zero = Cash inflows are generated at a rate equal to the minimum required.

NPV is negative = An investment with a negative NPV will result in a net loss. Cash inflows are generated at a rate lower than the minimum required by the firm.

The market value per share will increase if the project with positive NPV is selected.

The accept/reject criterion under the NPV method is as follows:

If, NPV>Zero then, Accept

If, NPV<Zero then, Reject

If, NPV=0 then, May accept or reject

Advantages: The following are the advantages of the net present value (NPV) methods:

(i) Consideration to total Cash Inflows: The NPV methods considers the total cash inflows of investment opportunities over the entire life-time of the projects unlike the payback period methods.

(ii) Recognition to the Time Value of Money: This method explicitly recognizes the time value of money, which is investable for making meaningful financial decisions.

(iii) Changing Discount Rate: Due to change in the risk pattern of the investor different discount rates can be used.

(iv) Best decision criteria for Mutually Exclusive Projects: This Method is particularly useful for the selection of mutually exclusive projects. It serves as the best decision criteria for mutually exclusive choice proposals.

(v) Maximisation of the Shareholders Wealth: Finally, the NPV method is instrumental in achieving the objective of the maximization of the shareholders' wealth. This method is logically consistent with the company's objective of maximizing shareholders' wealth in terms of maximizing market value of shares, and theoretically correct for the selections of investment proposals.

Disadvantages: The following are the disadvantages of the net present value method:

(i) It is difficult to understand and use.

(ii) The NPV is calculated by using the cost of capital as a discount rate. But the concept of cost of capital itself is difficult to understand and determine.

(iii) It does not give solutions when the comparable projects are involved in different amounts of investment.

(iv) It does not give correct answer to a question when alternative projects of limited funds are available, with unequal lives.

Illustration 5

A project requires an initial investment of ₹ 2,25,000 and is expected to generate the following net cash inflows:

Year 1: ₹ 95,000; Year 2: ₹ 80,000; Year 3: ₹ 60,000; Year 4: ₹ 55,000. Compute net present value of the project if the minimum desired rate of return is 12%.

Solution:

Computation of PVECF **(₹)**

Period	Cash Inflows Amount (₹)	PVIF @ 12%	Present Value (₹)
Year 1	95,000	0.893	84,835
Year 2	80,000	0.797	63,760
Year 3	60,000	0.712	42,720
Year 4	55,000	0.636	34,980
PVECF (Total)			**2,26,295**

Here, Initial investment = ₹ 2,25,000.

Now, **NPV = PVECF – Initial Investment**

Where,

= ₹ (2,26,295 – 2,25,000)

= ₹ 1,295

The project seems attractive because its net present value is positive.

Illustration 6

Parrot Ltd. is the manufacturer of a low-end consumer durable N. In order to modernize the manufacturing facility, Parrot Ltd. wants to buy a new machinery costing ₹ 10,00,000 at cash price. The annual cash flow before tax over the entire life span of the company is ₹ 3,00,000 p.a. The marginal rate of tax is 30% and cost of capital is 10% p.a. The scrap value at the end of the useful life of the machinery is negligible. The company is currently following a straight-line method of charging depreciation on machineries. Do you think the project is financially viable?

The company has an alternative to charge accelerated depreciation @ 30% of the depreciable amount each for the first three years and @ 10% for the fourth year. Does it change your suggestion?

Solution:

Computation of NPV (Under Straight Line Method of Depreciation) (₹)

Year	CFBT (₹)	Depreciation (₹)	Taxable Profit (₹)	Tax (₹)	CFAT (₹)	PVIF @10%	PV (₹)
(1)	(2)	(3)	(4)=(2) – (3)	(5)= (4)×30%	(6)=(4)-(5)+(3)	(7)	(8)=(6)×(7)
1	3,00,000	2,00,000 (10,00,000/5)	1,00,000	40,000	2,60,000	0.909	2,36,340
2	3,00,000	2,00,000	1,00,000	40,000	2,60,000	0.826	2,14,760
3	3,00,000	2,00,000	1,00,000	40,000	2,60,000	0.751	1,95,260
4	3,00,000	2,00,000	1,00,000	40,000	2,60,000	0.683	1,77,580
5	3,00,000	2,00,000	1,00,000	40,000	2,60,000	0.621	1,61,460
Total PV*							9,85,400
Less. Initial investment							10,00,000
NPV							**(14,600)**

Note: * Alternatively, Total PV = CFAT p.a.× PVIFA (10%, 5 Years) = ₹2,60,000 × 3.79 = ₹ 9,85,400.

Since the NPV is negative, the decision of buying the machine is not viable.

Computation of NPV (Under Straight Line Method of Depreciation) (₹)

Year	CFBT (₹)	Depreciation (₹)	Taxable Profit (₹)	Tax (₹)	CFAT (₹)	PVIF @10%	PV (₹)
(1)	(2)	(3)	(4)=(2) – (3)	(5)= (4)×30%	(6)=(4)-(5)+(3)	(7)	(8)=(6)×(7)
1	3,00,000	3,00,000 (10,00,000 × 30%)	0	0	3,00,000	0.909	2,72,700
2	3,00,000	3,00,000	0	0	3,00,000	0.826	2,47,800
3	3,00,000	3,00,000	0	0	3,00,000	0.751	2,25,300
4	3,00,000	1,00,000 (10,00,000 × 10%)	2,00,000	80,000	2,20,000	0.683	1,50,260
5	3,00,000	0	3,00,000	1,20,000	1,80,000	0.621	1,11,780
Total PV							10,07,840
Less. Initial Investment							10,00,000
NPV							**7,840**

Since the NPV is positive, the decision of buying the machine is viable.

2. Profitability Index (PI) Method

Profitability index method measures the present value of benefits for every rupee investment. In other words, it involves the ratio that is created by comparing the ratio of the present value of future cash flows from a project to the initial investment in the project. This method is also known as 'Benefit Cost Ratio'. According to Van Horne, the Profitability Index of a project is the ratio of the present value of future net cash inflows to the present value of cash outflows.

Actually, the profitability index is just a fraction. The profitability index is equal to the present value of future cash flows divided by the cost of the investment. Present value of future cash flows simply means the money that you expect to make from the investment. Initial investment refers to the money that the firm have to put down to make that money.

The formula for the net present value can be written as:

$$\text{Profitability Index} = \frac{\text{Present value of the expected cash inflow}}{\text{Present value of cash outflow or Initial Investment}}$$

Accept-Reject Decision:

If the Profitability Index (PI) is greater than or equal to one, the project should be accepted otherwise rejected. Specifically, if the PI is greater than 1, the project generates value and the company may want to proceed with the project. If the PI is less than 1, the project destroys value and the company should not proceed with the project. If the PI is equal to 1, the project breaks even and the company is indifferent between proceeding or not proceeding with the project.

So, the higher the profitability index, the more attractive the investment.

The accept/reject criterion under the PI method is as follows:

If, PI > 1	then, Accept
If, PI < 1	then, Reject
If, PI = 0	then, May accept or reject

Advantages: The advantages of this method are:

(i) It takes into account the time value of money

(ii) It helps to accept / reject investment proposal on the basis of value of the index.

(iii) It is useful to rank the proposals on the basis of the highest /lowest value of the index.

(iv) It takes into consideration the entire stream of cash flows generated during the life of the asset.

Disadvantages: However, this technique suffers from the following disadvantages:

(i) It is somewhat difficult to compute.

(ii) It is difficult to understand the analytical of the decision on the basis of profitability index.

Illustration 7

A project requires an initial investment of ₹ 225,000 and is expected to generate the following net cash inflows:

Year 1: ₹ 95,000; Year 2: ₹ 80,000; Year 3: ₹ 60,000; Year 4: ₹ 55,000. Compute profitability index of the project if the appropriate discount rate for this project is 12%.

Solution:

Computation of PV of expected Cash Flows (PVECF)

Period	Cash Inflows Amount (₹)	PVIF @ 12%	Present Value (₹)
Year 1	95,000	0.893	84,835
Year 2	80,000	0.797	63,760
Year 3	60,000	0.712	42,720
Year 4	55,000	0.636	34,980
(PVECF)			**2,26,295**

Here, Initial investment i.e. PVICF = ₹ 2,25,000.

Now, **PI** **= PVECF ÷ PVICF**

Where,

PVECF = Present value of the expected cash inflows

PVICF = Present value of invested cash outflows

or, = (₹2,26,295 ÷ ₹2,25,000)

= 1.00058

The project seems attractive because its profitability index is greater than 1.

3. Internal Rate of Return (IRR) Method

Internal Rate of Return (IRR) is one such technique of capital budgeting. It is the rate of return at which the net present value of a project becomes zero. We call it 'internal' because it does not take any external factor (like inflation etc.) into consideration. IRR method follows discounted cash flow technique which takes into account the time value of money. The internal rate of return is the interest rate which equates the present value of expected future cash inflows with the initial capital outlay. In other words, it is the rate at which NPV is equal zero.

Whenever a project report is prepared, IRR is to be worked out in order to ascertain the viability of the project. This is also an important guiding factor to financial institutions and investors.

For the computation of the internal rate of return, we use the same formula as NPV. To derive the IRR, we apply trial and error method to make the difference between the present value of expected future cash inflows with the initial investment zero.

IRR refers to that discount rate (i) such that

Present value of cash inflows = Present value of cash outflows

Or, Present value of cash inflows – present value of cash outflows = 0

Or, NPV = 0

Therefore, at IRR, NPV = 0 and PI = 1.

The formula for computation of IRR using NPV is written as under:

$$C = \frac{A_1}{(1+r)^1} + \frac{A_2}{(1+r)^2} + \frac{A_3}{(1+r)^3} \ldots\ldots\ldots\ldots\ldots + \frac{A_n}{(1+r)^n}$$

Where,

C = Initial Capital outlay

A_1 , A_2 , A_3 etc. = Expected future cash inflows at the end of year 1, 2, 3 and so on.

r = Internal Rate of Return

n = Number of years of project

$$\text{IRR} = \frac{\text{Present value of the expected cash inflows}}{(1+i)^n} + \text{Initial Investment}$$

Where,

i = Discount rate

n = No. of periods

In the above equation 'r' is to be solved in order to find out IRR.

Computation of IRR

The IRR is to be determined by trial-and-error method. The following steps can be used for its computation.

(i) Compute the present value of the cash flows from an investment, by using arbitrary by selected interest rate.

(ii) Then compare the present value so obtained with capital outlay.

(iii) If the present value is higher than the cost, then the present value of inflows is to be determined by using higher rate.

(iv) This procedure is to be continued until the present value of the inflows from the investment are approximately equal to its outflow.

(v) The interest rate that brings about equality is the internal rate of return.

The rate at which the cost of investment and the present value of future cash flows match will be considered as the ideal rate of return. A project that can achieve this is a profitable project. In other words, at this rate the cash outflows and the present value of inflows are equal, making the project attractive.

Remember, the internal rate of return is using the interpolation technique to calculate it and it is very important to understand this concept so that you can get a better understanding of how IRR works. In order to find out the exact IRR between two near rates, the following formula is to be used.

$$\text{IRR} = L + \frac{P_1 - C_0}{P_1 - P_2} \times D$$

Where, L = Lower rate of interest

P_1 = Present value at lower rate of interest

P_2 = Present value at higher rate of interest

C_0 = Cash outlay

D = Difference in rate of interest

Illustration 8

Calculate IRR by using interpolation technique when initial investment is ₹ 56,000.

10%	₹60,000
11%	₹50,000

Solution:

10%	₹60,000
IRR = ?	₹56,000
11%	₹50,000

$$IRR = L + \frac{P_1 - C_0}{P_1 - P_2} \times D$$

Where, L = Lower rate of interest = 10%

P_1 = Present value at lower rate of interest = ₹ 60,000

P_2 = Present value at higher rate of interest = ₹ 50,000

C_0 = Cash outlay or initial investment = ₹ 56,000

D = Difference in rate of interest = 11% - 10% = 1%

$$= 10 + \frac{60000 - 56000}{60000 - 50000} \times 1$$

$$= 10.4\%$$

Accept-Reject Decision:

If the internal rate of return exceeds the required rate of return, then the project will be accepted. If the project's IRR is less than the required rate of return, it should be rejected. In case of ranking the proposals the technique of IRR is significantly used. The projects with highest rate of return will be ranked as first compared to the lowest rate of return projects.

Thus, the IRR acceptance rules are -

Accept if	**IRR > k**
Reject if	**IRR < k**
May accept or reject if	**IRR = k**

Where, 'k' is the cost of capital.

Advantages: The following are the advantages of the IRR method:

(i) **Consideration of time of money:** It considers the time value of money.

(ii) **Consideration of total Cash Flows:** It taken into account the cash flows over the entire useful life of the asset.

(iii) **(Maximising of shareholders' wealth:** It is in conformity with the firm's objective of maximizing owner welfare.

(iv) **Provision for risk and uncertainty:** This method automatically gives weight to money values which are nearer to the present period than those which are distant from it. Conversely, in case of other methods like

'Payback Period' and 'Accounting Rate of Return', all money units are given the same weight which is unrealistic. Thus, the IRR is more realistic method of project valuation. This method improves the quality of estimates reducing the uncertainty to minimum.

(v) **Elimination of pre-determined discount rate:** Unlike the NPV method, the IRR method eliminates the use of the required rate of return which is usually a pre-determined rate of cost of capital for discounting the cash flow consistent with the cost of capital. Therefore, the IRR is more reliable measure of the profitability of the investment proposals.

Limitation: The following are the limitations of the IRR:

(i) It is very difficult to understand and use

(ii) It involves a very complicated computational work

(iii) It may not give unique answer in all situations.

(iv) The assumption of re-investment of cash flows may not be possible in practice.

(v) In evaluating the mutually exclusive proposals, this method fails to select the most profitable project which is consistent with the objective of maximization of shareholders wealthy.

Both NPV and IRR are sound analytical tools of capital budgeting.Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. By contrast, the internal rate of return (IRR) is a calculation used to estimate the profitability of potential investments.

Similarities:

(i) NPV and IRR both are two discounted cash flow methods used for evaluating investments or capital projects.

(ii) Both recognize the time value of money.

(iii) Both take into account the cash flows over the entire life of the project.

(iv) Both are consistent with the objective of maximizing the wealth of shareholders.

(v) Both are difficult to calculate.

(vi) Both techniques may often give contradictory result in the case of alternative proposals which are mutually exclusive.

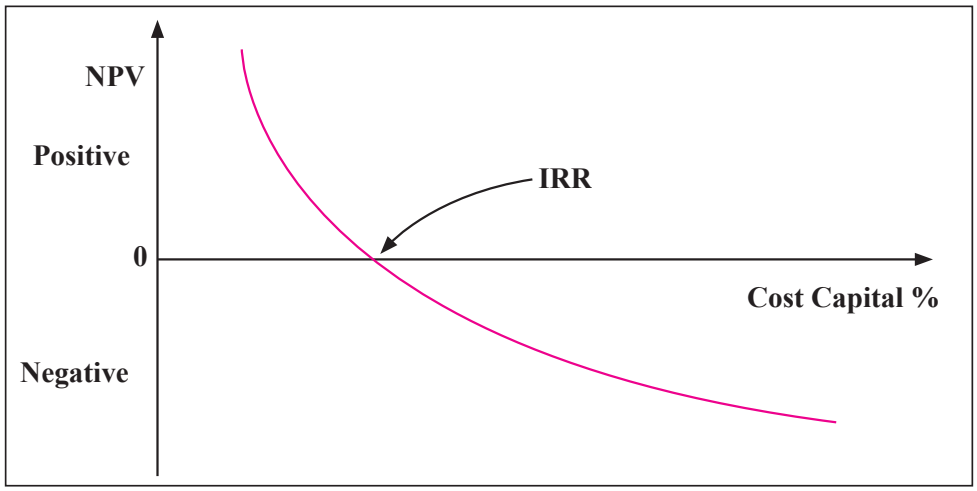

Figure 5.2: Accept Reject – Decisions

Contrast, i.e., Points of Difference –

(i) NPV uses the firm's cost of capital as interest rate. Unless the cost of capital is known, NPV method cannot be used. Calculating cost of capital is not required for computing IRR.

(ii) NPV may mislead when dealing with alternative projects or limited funds under the conditions of unequal lives. IRR allows a sound comparison of the project having different lives and different timings of cash inflows.

(iii) NPV may give different ranking in case of complicated projects as compared to IRR method.

(iv) NPV assumes that intermediate cash flows are re-invested at firm's cost of capital whereas IRR assumes that intermediate cash inflows are reinvested at the internal rate of the project.

(v) The results of IRR method may be inconsistent compared to NPV method, if the projects differ in their (a) expected lives or (b) investment or (c) timing of cash inflow.

(vi) IRR method favours short-lived project so long as it promises return in excess of cut-off rate whereas NPV method favours long-lived projects.

(vii) Sometimes IRR may give negative rate or multiple rates. NPV does not suffer from the limitation of multiple rates.

Recommendations -

The NPV method is generally considered to be superior theoretically because:

(i) It is simple to calculate as compared to IRR.

(ii) It does not suffer from the limitation of multiple rates.

(iii) NPV assumes that intermediate cash flows are reinvested at firm's cost of capital. The reinvestment assumption of NPV is more realistic than IRR method.

But IRR method is favoured by some analysts because:

(i) It is easier to visualize and to interpret as compared to NPV.

(ii) Even in the absence of cost of capital, IRR gives an idea of project's profitability. **Note -** Unless the cost of capital is known, NPV cannot be used.

(iii) IRR method is preferable to NPV in the evaluation of risky projects.

4. Discounted Payback Period (DPBP) Method:

The discounted payback period is a capital budgeting procedure used to determine the profitability of a project. A discounted payback period gives the number of years it takes to break even from undertaking the initial expenditure, by discounting future cash flows and recognizing the time value of money. Under this method the discounted cash inflows are calculated and where the discounted cash flows are equal to original investment then the period which is required is called discounting Payback period. While calculating discounting cash inflows the firm's cost of capital has been used.

The period of time that a project or investment takes for the present value of future cash flows to equal the initial cost provides an indication of when the project or investment will break even. The point after that is when cash flows will be above the initial cost.

Procedure for computation of Discounted Payback Period

Step 1: Determine the Total Cash Outflow of the project. (Initial Investment)

Step 2: Determine the Cash Inflow after Taxes (CFAT) for each year.

Step 3: Determine the present value of net cash inflow after taxes (CFAT)

= CFAT of each year x PV Factor for that year.

Step 4: Determine the cumulative present value of CFAT of every year.

Step 5:

- Find out the Discounted Payback Period as the time at which cumulative DCFAT equals Initial Investment.
- This is calculated on "time proportion basis" (usually following simple interpolation method).

The formula for the DPBP can be written as:

$$\textbf{DPBP} = \frac{\text{Total Investment}}{\text{Discounted annual cash inflows}}$$

[When cash flows are uniform]

When the project's cash inflows are not uniform, that means vary from year to year, payback period is calculated by the process of cumulating cash inflows till the time when cumulative cash flows become equal to the original investment outlay. If necessary, we have to use interpolation technique to find out the fraction of payback period.

$$\text{DPBP} = \text{Year before the discounted pay back period occurs} + \frac{\text{Cumulative cash flow in year before recovery}}{\text{Discounted cash flow in year after recovery}}$$

[When cash flows are not uniform]

Accept-Reject Decision:

The shorter a discounted payback period is means the sooner a project or investment will generate cash flows to cover the initial cost. A general rule to consider when using the discounted payback period is to accept projects that have a payback period that is shorter than the target timeframe. So, out of two projects, selection should be based on the period of discounting payback period (lesser payback period should be preferred.)

The shorter the discounted payback period, the quicker the project generates cash inflows and breaks even. While comparing two mutually exclusive projects, the one with the shorter discounted payback period should be accepted.

Advantages: Following are the advantages of discounted payback period:

(i) The discounted payback period is used as part of capital budgeting to determine which projects to take on.

(ii) More accurate than the standard payback period calculation, the discounted payback period factors in the time value of money.

(iii) The discounted payback period formula shows how long it will take to recoup an investment based on observing the present value of the project's projected cash flows.

(iv) The shorter a discounted payback period is, means the sooner a project or investment will generate cash flows to cover the initial cost.

Disadvantages: Following are the disadvantages of discounted payback period:

(i) One of the disadvantages of discounted payback period analysis is that it ignores the cash flows after the payback period.

(ii) Both payback and discounted payback method do not take into account the full life of the project. The overall benefit and profitability of a project cannot be measured under these methods because any cash flows beyond the payback period is ignored.

(iii) It may become a relative measure. In some situations, the discounted payback period of the project may be longer than the maximum desired payback period of the management but other measures like accounting rate of return (ARR) and internal rate of return (IRR) etc. may favor the project.

(iv) The accuracy of the output only depends upon the accuracy of the input provided, like the accuracy of figures of cash flows, the estimation of the timing of cash flows which affects their present values, and the accuracy of the discount rate to be used etc.

Illustration 9

Assume a business that is considering a given project. Below are some selected data from the discounted cash flow model created by the company's financial analysts:

A project requires an initial investment of ₹1,91,315 and is expected to generate the following net cash inflows:

Year 1: ₹95,000; Year 2: ₹80,000; Year 3: ₹60,000; Year 4: ₹55,000. Compute discounted payback period of the project if the appropriate discount rate for this project is 12%.

Solution:

We can calculate the discounted payback period as follows:

Computation of DPBP

Period	Cash Inflows Amount (₹)	PVIF @ 12%	Present Value (₹)	Cumulative Present Value (₹)
Year 1	95,000	0.893	84,835	84,835
Year 2	80,000	0.797	63,760	1,48,595
Year 3	**60,000**	**0.712**	**42,720**	**1,91,315**
Year 4	55,000	0.636	34,980	2,26,295

In this case, we see that the project's payback period is 3 years.

Payback Period Vs. Discounted Payback Period

The payback period is the amount of time for a project to break even in cash collections in financial value of money. Alternatively, the discounted payback period reflects the amount of time necessary to break even in a project, based not only on what cash flows occur but when they occur and the prevailing rate of return in the market. The discounted payback period follows time value of money whereas payback period does not.

These two calculations, although similar, may not return the same result due to the discounting of cash flows. For example, projects with higher cash flows toward the end of a project's life will experience greater discounting due to compound interest. For this reason, the payback period may return a positive figure, while the discounted payback period returns a negative figure.

5. Modified Net Present Value (MNPV)

One of the limitations of NPV method is that reinvestment rate in case of NPV is Cost of Capital (k). However, in case of MNPV, different reinvestment rates for the cash inflows over the life of the project may be used. Under this modified approach, terminal value of the cash inflows is calculated using such expected reinvestment rate (s). Thereafter, MNPV is determined with present value of such terminal value of the cash inflows and present value of the cash outflows using cost of capital (k) as the discounting factor.

Terminal value is the sum of the compounded value of cash inflows of different years at the end of the life of the project. If the life of the project is 'n' years, cash inflow of period 't' is CF_t and reinvestment rate is 'r', the terminal value will be $\sum(CF_t)^{n-t}$.

6. Modified Internal Rate of Returns (MIRR)

The modified internal rate of return (MIRR) is a financial measure of an investment's attractiveness. It is used in capital budgeting to rank alternative investments of equal size. As the name implies, MIRR is a modification of the internal rate of return (IRR) and as such aims to resolve some problems with the IRR.

IRR assumes that interim positives cash flows are reinvested at the rate of returns as that of the project that generated them. This is usually an unrealistic scenario. To overcome this draw back a new technique emerges. Under MIRR the earlier cash flows are reinvested at firm's rate of return and finding out the terminal value. MIRR is the rate at which present value of terminal values equal to outflow (Investment).

The procedure for calculating MIRR is as follows:

$$\textbf{MIRR} = \textbf{(Future value of positive cash flows / present value of negative cash flows)} \left(\frac{1}{n}\right) - \textbf{1.}$$

Advantages:

(i) The standard internal rate of return calculation may overstate the potential future value of a project.

(ii) MIRR can distort the cost of reinvested growth from stage to stage in a project.

(iii) MIRR allows for adjusting the assumed rate of reinvested growth for different stages of a project.

Disadvantages:

The disadvantage of MIRR is that it asks for two additional decisions, i.e., determination of financing rate and cost of capital.

Illustration 10

M Ltd. for a construction company and asked you to calculate the MIRR for two mutually exclusive projects to determine which project should be selected.

Project X has a total life of 3 years with a cost of capital 12% and a financing cost 14%.

Project Y has a total life of 3 years with a cost of capital 15% and a financing cost 18%.

The expected cash flows of the projects are in the table below: (₹)

Year	Project X	Project Y
0	-1,000	-800
1	-2,000	-700
2	4,000	3,000
3	5,000	1,500

Solution:

M Ltd. calculates the future value of the positive cash flows discounted at the cost of capital.

Project X: ₹4,000 × (1 + 12%)1 + ₹5,000 = ₹9,480

Project Y: ₹3,000 × (1 + 15%)1 + ₹1,500 = ₹4,950

Then, it calculates the present value of the negative cash flows discounted at the financing cost.

Project X: ₹ –1,000 + ₹(–2,000) / (1 + 14%)1 = ₹–3,000

Project Y: ₹ – 800 + ₹(–700 / 1 + 18%)1 = ₹–1,500

To calculate the MIRR for each project M Ltd. uses the formula:

MIRR = (Future value of positive cash flows / present value of negative cash flows) (1/n) – 1.

Therefore,

Project X: ₹9,480 / (₹3,000)1/3 -1 = 5.3%

Project Y: ₹ 4,950 / (₹1,500)1/3 -1 = 10.0%

Given that these are mutually exclusive projects and project Y should be undertaken because it has a higher MIRR than project X.

7. Adjusted Net Present Value

For determining NPV, weighted average cost of capital is used as the discounting factor, based on the assumption that every project is financed by the same proportions of debt and equity as found in the capital structure of the firm. However, that may not be true. Moreover, tax advantages (savings in tax) due to use of borrowed fund is not usually considered in financial appraisal of investment proposals discussed so far. But impact of debt financing can be incorporated using Adjusted Present Value Method with an adjustment of tax aspects of debt financing with the Base Case NPV.

Base Case NPV is the NPV under the assumption that the project is all-equity financed.

Adjusted NPV = Base case NPV + NPV of Tax Shields arising out of financing decisions associated with the project.

Illustration 11

A firm is considering a project requiring ₹50 lakh of investment. Expected cash flow is ₹10 lakh per annum for 8 years. The rate of return required by the equity investors from the project is 15%. The firm is able to raise ₹ 24 lakh of debt finance carrying 14% interest for the project. The debt is repayable in equal annual installments over the eight-year period – the first to be paid at the end of the first year. The tax rate is 40%. You are required to calculate adjusted NPV. Assume equity cost is 5%.

Solution:

Base case NPV = ₹ (–) 50,00,000 + ∑ ₹ 10,00,000 / 1.158 = ₹ (–) 5,12,700

Equity Finance ₹ 26 lakh, Debt Finance ₹ 24 lakh.

Equity Issue Cost is assumed to be 5%.

Therefore, to get ₹ 26 lakh, total equity issue = ₹ 26 / 0.95 = ₹ 27.37 lakh

Difference of ₹ (27.37 – 26) lakh = ₹ 01.37 lakh is the cost of underwriting, brokerage, etc. for the issue.

(₹ in lakh)

Year	1	2	3	4	5	6	7	8
Outstanding Debt at the beginning	24	21	18	15	12	09	06	03
Interest	3.36	2.94	2.52	2.10	1.68	1.26	0.84	0.42
Tax Shield	1.344	1.176	1.008	0.840	0.672	0.504	0.336	0.168
PV of Tax Shield	1.179	0.9049	0.6804	0. 497	0.349	0.230	0.134	0.059

(Discounting at 14%, cost of debt) Total PV of Tax Shield: 4.0333

Adjusted NPV = Base case NPV – Issue Cost + Present Value of Tax Shield

= ₹ (– 5,12,700 – 1,37,000 + 4,03,333) = ₹ (–) 2,46,367

Hurdle Rate in a Conglomerate Environment

5.5

Conglomerates are companies that either partially or fully own a number of other companies. Here, conglomerate means large company. In case of investment in or by the large company environment, hurdle rate is an important criterion. Hurdle rate will guide us to make effective investment decision. A hurdle rate, which is also known as benchmark or cut-off rate or the minimum required rate of return or target rate that investors are expecting to receive on an investment. The rate is determined by assessing the cost of capital, risks involved, current opportunities in business expansion, rates of return for similar investments, and other factors that could directly affect an investment.

In other words, before accepting and implementing a certain investment project, its internal rate of return (IRR) should be equal to or greater than the hurdle rate. Any potential investments must possess a return rate that is higher than the hurdle rate in order for it to be acceptable in the long run.

As we find in practical, most companies use their Weighted Average Cost of Capital (WACC) as a hurdle rate for investments. Generally, it is utilized to analyze a potential investment, taking the risks involved and the opportunity cost of foregoing other projects into consideration. One of the main advantages of a hurdle rate is its objectivity, which prevents management from accepting a project based on non-financial factors. Some projects get more attention due to popularity, while others involve the use of new and exciting technology. Another way of looking at the hurdle rate is that it's the required rate of return investors demand from a company. Therefore, any project the company invests in must be equal to or ideally greater than its cost of capital.

In conglomerate environment, at present, the most common way to use the hurdle rate to evaluate an investment is using a discounted cash flow (DCF) technique. The DCF technique uses the concept of the time value of money (opportunity cost) to forecast all future cash flows and then discount them back to today's value to provide the net present value.

NPV Vs. IRR

In case of mutually exclusive projects, financial appraisal using NPV & IRR methods may provide conflicting results. The reasons for such conflicts may be attributed to

(i) Difference in timing / pattern of cash inflows of the alternative proposals (Time Disparity),

(ii) Difference in their amount of investment (Size Disparity) and

(iii) Difference in the life of the alternative proposals (Life Disparity).

Capital Rationing

There may be situations where a firm has a number of independent projects that yield a positive NPV or having IRR more than it's cut off rate, PI more than 1, i.e., the projects are financially viable, hence, acceptable. However, the most important resource in investment decisions, i.e., funds, are not sufficient enough to undertake all the projects. In such a case, the projects are selected in such a way so that NPV becomes maximum in order to maximize wealth of shareholders. Investment planning in such situation is Capital Rationing.

There are two possible situations of Capital Rationing

(i) Generally, firms fix up maximum amount that can be invested in capital projects, during a given period of time, say a year. This budget ceiling imposed internally is called as Soft Capital Rationing or Internal Capital Rationing.

(ii) There may be a market constraint on the amount of funds available for investment during a period. This inability to obtain funds from the market, due to external factors is called Hard Capital Rationing or External Capital Rationing.

Different proposals may be classified into **two categories**:

Divisible and Indivisible

In case of divisible projects, part acceptance of the project is possible. Indivisible projects are either to be accepted in its entirety or to be rejected, i.e., part acceptance is not possible. For divisible projects, **PI** approach help in selecting the proposals providing the **highest NPV**. For indivisible projects, through trial-and-error methods, best combination of the projects with the **highest NPV** may be ascertained.

For Divisible Projects

Rank the projects following PI and arrange them in descending order. Go on selecting the projects till the fund is available.

For Indivisible Projects

Determine all the feasible combinations of the projects and rank them according to total NPV of the combinations. Select the combination with the highest NPV.

Illustration 12

X Ltd. has a capital budget of ₹ 1.5 crore for the year. From the following information relating to six independent proposals, select the projects if (i) the projects are divisible and (ii) the projects are indivisible.

Proposal	Investments (₹)	NPV (₹)
A	70,00,000	30,00,000
B	25,00,000	16,00,000
C	50,00,000	20,00,000
D	20,00,000	10,00,000
E	55,00,000	45,00,000
F	75,00,000	-25,00,000

If the projects are divisible

Projects are ranked according to PI and arranged in descending order.

Proposal Rank NPV (₹)	Investments (₹)	PV of Inflows (NPV+I)	PI	Rank	NPV (₹)
A	70,00,000	1,00,00,000	100/70 = 1.43	(4)	30,00,000
B	25,00,000	41,00,000	41/25 = 1.64	(2)	16,00,000
C	50,00,000	70,00,000	70/50 = 1.4	(5)	20,00,000
D	20,00,000	30,00,000	30/20 = 1.5	(3)	10,00,000
E	55,00,000	1,00,00,000	100/55 = 1.8	(1)	45,00,000
F	75,00,000	50,00,000	50/75 = 0.67		-25,00,000

Proposal	Investments (₹)	Cum. Inv. (₹)	NPV (₹)	Cum. NPV
E	55,00,000	55,00,000	45,00,000	45,00,000
B	25,00,000	80,00,000	16,00,000	61,00,000
D	20,00,000	100,00,000	10,00,000	71,00,000
A*	70,00,000	170,00,000	30,00,000	92,42,857*
C	50,00,000	220,00,000	20,00,000	

*Only ₹50,00,000 can be invested in Project A, i.e., $5/7^{th}$ of the total investment can be made. Proportionate NPV is 5/7 × ₹30,00,000 = ₹21,42,857

- So selected projects are E, B, D and 5/7th part of A

If the projects are indivisible

Feasible Sets	Investments (₹)	NPV (₹)
EBDC	1,50,00,000	91,00,000
EBA	1,50,00,000	91,00,000
BAC	1,45,00,000	66,00,000
DAC	1,40,00,000	60,00,000
EBC	1,30,00,000	81,00,000

Either EBDC or EBA, which provides the maximum NPV, may be undertaken.

Illustration 13

A limited company is considering investing a project requiring a capital outlay of ₹ 2,00,000. Forecast for annual income after depreciation but before tax is as follows:

Year	(₹)
1	1,00,000
2	1,00,000
3	80,000
4	80,000
5	40,000

Depreciation may be taken as 20% on original cost and taxation at 50% of net income.

You are required to evaluate the project according to each of the following methods:

(a) Payback period method

(b) Rate of return on original investment method

(c) Rate of return on average investment method

(d) Discounted cash flow method taking cost of capital as 10%

(e) Net present value index method

(f) Internal rate of return method.

(g) Modified internal rate of return method.

Solution:

Working Notes:

Year	Profit before tax (₹)	Profit after tax @ 50% (₹)	Cash inflows after tax [PAT + Dep] (₹)	Cumulative cash inflows (₹)	Discounting factor @ 10%	Present Value (₹)	Discounting factor @ 20%	Present value @20% (₹)	Discounting factor @ 30%	Present Value @30% (₹)	Discounting factor @ 32%	Present value @32% (₹)
1	1,00,000	50,000	90,000	90,000	0.9091	81,819	0.8333	74,997	0.7692	69,228	0.7576	68,184
2	1,00,000	50,000	90,000	1,80,000	0.8264	74,376	0.6944	62,496	0.5917	53,253	0.5739	51,651
3	80,000	40,000	80,000	2,60,000	0.7513	60,104	0.5787	46,296	0.4552	36,416	0.4348	34,784
4	80,000	40,000	80,000	3,40,000	0.6830	54,640	0.4823	38,584	0.3501	28,008	0.3294	26,352
5	40,000	20,000	60,000	4,00,000	0.6209	37,254	0.4019	24,114	0.2693	16,158	0.2495	14,970
						308193		**246487**		**203063**		**195941**

(a) Payback Period Method

Payback period = 2 + ₹ 20,000/₹ 80,000

= 2.25 years (or) 2 years 3 months

(b) Rate of Return on Original Investment Method

ARR = (Average Profit after Tax / Investment) × 100

= (₹ 40,000 / ₹ 2,00,000) × 100

= 20%

(c) Rate of Return on Average Investment Method

ARR = (Average Profit after Tax / Average Investment) × 100

= ₹ 40,000 / (₹ 2,00,000 + 0/2) × 100

= 40%

(d) Discounted Cash Flow Method taking Cost of Capital as 10%

Present value of cash inflows after tax (₹)	3,08,193
Less: Outflow (₹)	2,00,000
Net Present Value (₹)	1,08,193

(e) Profitability Index

Profitability Index = P.V of Cash Inflows / Cash Outflow

= ₹ 3,08,193 / ₹ 2,00,000

= 1.54

Since PI is more than 1 the company can accept the project.

(f) Internal Rate of Return Method

IRR = L + [P1 – I / P1 – P2] × d

= 30 + (2,03,063 – 2,00,000) / (2,03,063 – 1,95,941) × 2

= 30 + 0.8602

= 30.8602%

(g) Modified Internal Rate of Return (MIRR)

	1	2	3	4	5	Total
Cash inflow after tax (₹)	90,000	90,000	80,000	80,000	60,000	--
Re-investment period	4	3	2	1	0	
Re-investment at	10%	10%	10%	10%	10%	
Future value factor	(1.1)4	(1.1)3	(1.1)2	(1.1)	1	
Future value (₹)	1,31,769	1,19,790	96,800	88,000	60,000	4,96,359

At MIRR = 2,00,000 [1 + MIRR]5 = ₹ 4,96,359

= [1 + MIRR]5 = ₹ 4,96,359 /₹ 2,00,000 = 2.48

MIRR = 20% (Please see Annuity Tables)

Illustration 14

A company has just installed a machine Model A for the manufacture of a new product at capital cost of ₹ 1,00,000. The annual operating costs are estimated at ₹ 50,000 (excluding depreciation) and these costs are estimated on the basis of an annual volume of 1,00,000 units of production. The fixed costs at this volume of 1,00,000 units of output will amount to ₹ 4,00,000 p.a. The selling price is ₹ 5 per unit of output. The machine has a five-year life with no residual value.

The company has now come across another machine called Super Model which is capable of giving, the same volume of production at an estimated annual operating cost of ₹ 30,000 exclusives of depreciation. The fixed costs will however, remain the same in value. This machine also will have a five-year life with no residual value. The capital cost of this machine is ₹ 1,50,000.

The company has an offer for the sale of the machine Model A (which has just been installed) at ₹ 50,000 and the cost of removal thereof will amount to ₹ 10,000. Ignore tax.

In view of the lower operating cost, the company is desirous of dismantling of the machine Model A and installing the Super Model Machine. Assume that Model A has not yet started commercial production and that the time lag in the removal thereof and the installation of the Super Model machine is not material.

The cost of capital is 14% and the P.V. Factors for each of the five years respectively are 0.877, 0.769, 0.675, 0.592 and 0.519.

State whether the company should replace Model A machine by installing the Super Model machine. Will there be any change in your decision if the Model A machine has not been installed and the company is in the process of consideration of selection of either of the two models of the machine? Present suitable statement to illustrate your answer.

Solution:

(A) Appraisal of Replacement Decision under NPV method

Step 1:

Calculation of Present value of net cash outflow or net investment required.	(₹)	
Cost of super model		1,50,000
Less: Sale proceeds of Model A	50,000	
(-) Cost of removal	10,000	40,000
Net investment required		1,10,000

Step 2:

Calculation of present value of incremental operating cash flows:

Particulars	Model A	Super Model	Incremental
Sales p.a. (units)	1,00,000	1,00,000	
Sales p.a. [₹] [1,00,000 × 5] [a]	5,00,000	5,00,000	
Less: Expenses (₹)			
Operating cost (₹)	50,000	30,000	
Fixed cost (₹)	4,00,000	4,00,000	
Total Cost (₹) [b]	**4,50,000**	**4,30,000**	
Cash Inflows(₹) [a – b]	**50,000**	**70,000**	**20,000**

Step 3:

Present value of terminal cash inflow [Salvage value] - NIL

Step 4:

Calculation of NPV		(₹)
Present value of total cash inflows (Recurring + Salvage)	=	68,660
Less: Outflow	=	1,10,000
Net Present Value	=	(41,340)

Comment:

As net present value is negative, the replacement decision is not financially feasible.

Working Notes:

* 1. Total incremental cash inflows = ₹ 20,000

Present value of incremental recurring cash inflows for 5 years

= ₹ 20,000 × PVAF 5 years 14%

= ₹ 20,000 × 3.433

P.V of cash flows = ₹ 68,660

(B) Appraisal of Mutually Exclusive Decision under NPV method

Alternative I – Model A

Calculation of NPV under Alternative I

Step 1:

Calculation of Present value of cash outflow

Cost of machine = ₹ 1,00,000

Step 2:

Calculation of present value of recurring cash inflows or operating cash inflows

Cash inflows after tax (as above) – ₹ 50,000

PV of operating cash inflows for 5 years = ₹ 50,000 × PVAF 5 years 14%

= ₹ 50,000 × 3.433

= ₹ 1,71,650

Step 3:

Calculation of PV of terminal cash inflows = Nil

Step 4:

Calculation of NPV		(₹)
PV of total cash inflows	=	1,71,650
Less: Outflow	=	1,00,000
Net Present Value (under alternative I)	=	**71,650**

Alternative II : Super Model

Calculation of NPV under Alternative II

Step 1:

Calculation of Present value of cash outflow

Cost of Machine = ₹ 1,50,000

Step 2:

Calculation of operating cash inflows or PV of recurring cash inflows

PV of operating cash inflows for 5 years = ₹ 70,000 × PVAF 5 years 14% = ₹ 70,000 × 3.433 = ₹ 2,40,310

Step 3:

Calculation of PV of terminal cash inflow – NIL

Step 4:

Calculation of NPV	(₹)
PV of total cash inflow [₹ 2,40,310 + 0]	= 2,40,310
Less: Cash Outflow	= 1,50,000
Net Present Value (under alternative II)	= **90,310**

Comment: As NPV of Super Model is more [₹ 90,310] than that of Model A [₹ 71,650], it is advised to select Super Model.

Illustration 15

A chemical company is considering replacing an existing machine with one costing ₹ 65,000. The existing machine was originally purchased two years ago for ₹ 28,000 and is being depreciated by the straight-line method over its seven-year life period. It can currently be sold for ₹ 30,000 with no removal costs. The new machine would cost ₹ 10,000 to install and would be depreciate over five years. The management believes that the new machine would have a salvage value of ₹ 5,000 at the end of year 5. The management also estimates an increase in net working capital requirement of ₹ 10,000 as a result of expanded operations with the new machine. The firm is taxed at a rate of 55% on normal income and 30% on capital gains. The company's expected after-tax profits for next 5 years with existing machine and with new machine are given as follows:

Expected after-tax profits (₹)		
Year	**With existing machine**	**With new machine**
1	2,00,000	2,16,000
2	1,50,000	1,50,000
3	1,80,000	2,00,000
4	2,10,000	2,40,000
5	2,20,000	2,30,000

(a) Calculate the net investment required by the new machine.

(b) If the company's cost of capital is 15%, determine whether the new machine should be purchased.

Solution:

Appraisal of Replacement Decision under NPV method

Step 1:

Calculation of present value of net investment required:	(₹)	(₹)
Cost of new asset		65,000
Add: Installation cost		10,000
		75,000
Add: Additional WC		10,000
		85,000
Less: Sale proceeds of old machine	30,000	
Less: Tax	5,000	
[8,000 × 55/100 + 2000 × 30/100]		25,000
Net Investment required		60,000

Step 2:

Calculation of Present Value of Incremental Operating cash inflows for 5 years.

Year	CIAT (PAT + Dep) (₹)	New (₹)	Incremental (₹)	PV factor at 15%	Present Value (₹)
1	2,04,000	2,30,000	26,000	0.8696	22,609
2	1,54,000	1,64,000	10,000	0.7561	7,561
3	1,84,000	2,14,000	30,000	0.6575	19,725
4	2,14,000	2,54,000	40,000	0.5718	22,872
5	2,24,000	2,44,000	20,000	0.4972	9,944
PV of cash inflows for 5 years					**82,711**

Step 3:

Calculation of PV of terminal cash inflow		(₹)
Salvage value of asset		5,000
[No tax because book value and salvage value are equal]		
Working capital recovered [100% recovered]		10,000
Terminal cash inflows		15,000
Its PV at the end of 5th year	= ₹15,000 × 0.4972	= 7,458

Step 4:

Calculation of NPV		(₹)
PV of total cash inflows [₹82,711 + ₹7,458]	=	90,169
(–) Outflow	=	60,000
NPV	=	**30,169**

Comment:

As NPV is positive, it is advised to replace.

Note 1: Depreciation for old Machine = ₹28,000 / 7 = ₹ 4,000

$$\text{Depreciation for new Machine} = \frac{65000+10000-5000}{5} = ₹14,000$$

Illustration 16

A project costing ₹ 5,60,000 is expected to produce annual net cash benefits (CFAT) of ₹ 80,000 over a period of 15 year. Estimate the internal rate of return (IRR). Also, find the payback period and obtain the IRR from it. How do you compare this IRR with the one directly estimated?

Solution:

$$\text{Payback value} = \frac{₹\ 5,60,000}{₹\ 80,000} = ₹\ 7.000$$

The factors closet to ₹ 7,000 are 7.191 at 11% rate of discount and 6.811 at 12% rate of discount against 15 years The actual IRR would be between 11 and 12%.

Using interpolation, the IRR would be 0.11 + 0.005 (0.19 ÷0.38 = 11.5%.

IRR determination through PB period:

The reciprocal of the Payback period is a good approximation of the IRR if,

(i) the life of the project is at least twice the PB period, and

(ii) the project generates annuity cash inflows. Accordingly, IRR would be the reciprocal of the PB period, i.e. 1/7 = 0.1428 = 14.28%.

Comparison: The two IRRs are different. But the IRR which is directly estimated is correct as at this rate of discount, NPV of cash flow stream of the project would be zero. The NPV cannot be zero at 14.28%. The IRR through the Payback period is only an approximate measure.

Illustration 17

A plastic manufacturer has under consideration the proposal of production of high-quality plastic glasses. The necessary equipment to manufacture the glasses would cost ₹ 1 lakh and would last 5 year The tax relevant rate of depreciation is 20% on written down value. There is no other asset in this block. The expected salvage value is ₹ 10,000. The glasses can be sold at ₹ 4 each. Regardless of the level of production, the manufacturer will incur cash cost of ₹ 25,000 each year if the project is undertaken. The overhead costs allocated to this new line would be ₹ 5,000. The variable costs are estimated at ₹ 2 per glass. The manufacturer estimates it will sell about 75,000 glasses per year; the tax rate is 35%. Should the proposed equipment be purchased? Assume 20% cost of capital and additional working requirement, ₹ 50,000.

Solution:

Cash outflows	
Cost of production equipment (₹)	1,00,000
Additional working capital requirement (₹)	50,000
Cash outflows (₹)	1,50,000

Determination of CFAT and NPV					
Particulars	**Years**				
	1 (₹)	**2 (₹)**	**3 (₹)**	**4 (₹)**	**5 (₹)**
Sales revenue (75,000 × ₹4)	3,00,000	3,00,000	3,00,000	3,00,000	3,00,000
Less: Costs					
Variable costs (75,000 × 2)	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000
Additional fixed costs	25,000	25,000	25,000	25,000	25,000
Depreciation (D)	20,000	16,000	12,800	10,240	Nil *
Earnings before taxes	1,05,000	1,09,000	1,12,200	1,14,760	1,25,000
Less: Taxes	36,750	38,150	39,270	40,166	43,750
Earnings after taxes (EAT)	68,250	70,850	72,930	74,594	81,250
CFAT (EAT + D)	88,250	86,850	85,730	84,834	81,250
Add: Recovery of Working Capital					50,000
Add: Salvage value (SV)					10,000
Add: Tax benefit on short term capital loss **					10,836
					1,52,086
Multiplied by PV factor @ 0.20	0.833	0.694	0.579	0.482	0.402
PV (CFAT × PV factor)	73,512	60,274	49,638	40,890	61,139
Total PV (t = 1 – 5)					2,85,453
Less: Cash outflows					1,50,000
NPV					1,35,453

* As the block consists of single asset, no depreciation is to be charged in the terminating year as the asset has been sold in the year.

** (₹ 1,00,000 – ₹ 59,040 accumulated depreciation – ₹ 10,000, SV) × 0.35 = ₹ 10,836.

Recommendation: The company is advised to buy the proposed equipment

Illustration 18

Modern Enterprises Ltd. is considering the purchase of a new computer system for its research and development division, which would cost ₹ 35 lakh. The operation and maintenance costs (excluding depreciation) are expected to be ₹ 7 lakh per annum. It is estimated that the useful life of the system would be 6 years, at the end of which the disposal value is expected to be ₹ 1 lakh.

The tangible benefits expected from the system in the form of reduction in design and draftsmanship costs would be ₹ 12 lakh per annum. The disposal of used drawing office equipment and furniture initially is anticipated to net ₹ 9 lakh.

As capital expenditure in research and development, the proposal would attract a 100% write-off for tax purposes. The gains arising from disposal of used assets may be considered tax free. The effective tax rate is 35%. The average cost of capital of the company is 12%.

After appropriate analysis of cash flows, advise the company of the financial viability of the proposal. Ignore tax on salvage value.

Solution:

Assessment of Financial Viability of proposal	(₹ in lakh)
Incremental cash outflows	
Cost of new computer system	35
Less: Sale proceeds from drawing office equipment and furniture	9
	26
Incremental CFAT and NPV:	
(a) Cost savings (years 1–6)	
Reduction in design and draftsmanship costs	12
Less: Operation and maintenance costs	7
Cost savings (earnings) before taxes	5
Less: Taxes (0.35)	**1.75**
Earnings after taxes (CFAT)	3.25
(×) PV factor of annuity for 6 years (0.12)	× 4.111
Total PV of cost savings	13.36
(b) Tax savings on account of depreciation	
Cost of new computer system (₹ 35 lakhs × 0.35)	12.25
(×) PV factor for year 1	× 0.892
Total PV	9.93
(c) Terminal salvage value at the end of year 6 (₹ 1 lakh × 0.507)	**0.507**
(d) Gross PV of CFAT [(a) + (b) + (c)]	**24.797**
Less: Cash outflows	**26.000**
NPV	**(1.203)**

Illustration 19

A textile company is considering two mutually exclusive investment proposals. Their expected cashflow streams (CFAT) are given as follows:

Year	Proposal X (₹in thousand)	Proposal Y (₹ in thousand)
0	(500)	(700)
1	145	100
2	145	110

Year	Proposal X (₹in thousand)	Proposal Y (₹ in thousand)
3	145	130
4	145	150
5	145	160
6	145	150
7		120
8		120
9		110
10		100

The company employs the risk-adjusted method of evaluating risky projects and selects the appropriate required rate of return as follows:

Project payback	Required rate of return (percentage)
Less than 1 year	8
1 to 5 years	10
5 to 10 years	12
Over 10 years	15

Which proposal should be acceptable to the company?

Solution:

i. **Payback period (PB) for Proposal X** = ₹ 5,00,000/₹ 1,45,000 = 3.448 year

The appropriate risk adjusted rate of return for payback period of 3.448 years is 0.10.

ii. **Payback period for proposal Y**

Year	Cash flows (₹ in thousand)	Cumulative cash flows (₹ in thousand)
1	100	100
2	110	210
3	130	340
4	150	490
5	160	650
6	150	800

The payback period for Proposal Y is 5 years and 4 months and the appropriate risk adjusted rate of return is 0.12.

iii. **Net present value of proposal X**

Years	CFAT		Total PV
1-6	₹ 1,45,000	4.355	₹ 6,31,475
Less: Cash utflows			5,00,000
NPV			1,31,475

iv. **Net present value of proposal Y**

Year	CFAT (₹ thousand)	PV factor (at 0.12)	Total PV (₹)
1	100	0.893	89,300
2	110	0.797	87,670
3	130	0.712	92,560
4	150	0.636	95,400
5	160	0.567	90,720
6	150	0.507	76,050
7	120	0.452	54,240
8	120	0.404	48,480
9	110	0.361	39,710
10	100	0.322	32,200
Total PV			7,06,330
Less: Cash outflows			7,00,000
NPV			6,330

Proposal X should be acceptable to the company as its NPV is higher than that of Proposal Y.

Illustration 20

A machine costing ₹ 110 lakh has a life of 10 years, at the end of which its scrap value is likely to be ₹ 10 lakh. The firm's cut-off rate is 12 %. The machine is expected to yield an annual profit after tax of ₹ 10 lakh, depreciation being reckoned on straight line basis for tax purposes. At 12%, the PV of the rupee received annually for 10 years is 5.650, and the value of one rupee received at the end of the tenth year is 0.322. Ascertain the NPV of the project.

Solution:

Net Present Value (NPV)

Particulars	Amount (₹)
1. Profit after Tax (PAT)	10,00,000
2. Add: Depreciation (₹1,00,00,000 ÷ 10 years)	10,00,000
3. CFAT (1 + 2) for years 1-10	20,00,000
4. PV factor (annuity) for 10 years (at 0.12) = 5.650	
5. Total PV (3 × 4)	1,13,00,000
6. (a) CFAT in year 10 = ₹ 10,00,000 (b) Relevant PV factor = 0.322 (c) Additional PV in year 10 (a × b)	3,22,000
7. Total PV (5 + 6)	1,16,22,000
8. Project cost (t = 0)	1,10,00,000
9. NPV (7 – 8)	6,22,000

Illustration 21

A company has to replace one of its machines, which has become unserviceable. Two options are available to the company:

(i) A more expensive machine (EM) with 12 years life.

(ii) A less expensive machine (LM) with 6 years life.

If machine LM is chosen, it will be replaced at the end of 6 years by another LM machine.

The pattern of maintenance, running costs and prices as under:

Particulars	EM (₹)	LM (₹)
Purchase price	20,00,000	14,00,000
Scarp value at end of life	3,00,000	3,00,000
Overhauling is due at the end of	8th Year	4th Year
Overhauling cost	4,00,000	2,00,000
Annual repairing expenses	2,00,000	2,80,000

Cost of capital is 14%.

You are required to recommend which of the machines should be purchased.

Given, Present Value Interest Factor, PVIF (14%)

Year	4	6	8	12
PV Factor	0.5921	0.4556	0.3506	0.2076

Present Value Interest Factor for an Annuity, PVIFA (14%)

Year	1 to 6 Years	1 to 12 Years
PV Factor	3.8899	5.6600

Solution:

Machine EM -12 Year's Life

Particulars	Year	Cost (₹)	Discount Factor	Present Value (₹)
Purchase price	0	20,00,000	1.000	20,00,000
Overhauling cost	8	4,00,000	0.3506	1,40,240
Annual repairing expenses	1-12	2,00,000	5.6600	11,32,000
Scrap value	12	3,00,000	0.2076	(62,280)
Total NPV outflow				32,09,960

Machine LM -6 Year's Life

Particulars	Year	Cost (₹)	Discount Factor	Present Value (₹)
Purchase price	0	14,00,000	1.000	14,00,000
Overhauling cost	4	2,00,000	0.5921	1,18,420
Annual repairing expenses	6	2,80,000	3.8890	10,88,920
Scrap value	12	3,00,000	0.4556	(1,36,680)
Total NPV outflow				24,70,660

Equated annual values: EM = ₹ 32,09,960/5.6600 = ₹ 5,67,130

LM = ₹ 24,70,660/3.889 = ₹ 6,35,647

Decision: Since, annualized value of EM is less, it is suggested to replace existing machine with Machine EM.

Illustration 22

Electronics Pvt. Ltd. is considering a proposal to replace one of its machines. In this connection, the following information is available.

The existing machine was purchased 3 years ago for ₹ 20 Lakh. It was depreciated 20% per annum on reducing balance basis. It has remaining useful life of 5 years, but its annual maintenance cost is expected to increase by ₹ 1 Lakh form the sixth year of its installation. Its present realizable value is ₹ 12 Lakh. The company has several machines, having 20% depreciation.

The new machine costs ₹ 30 Lakh and is subject to the same rate of depreciation. On sale after 5 years, it is expected to realize ₹ 18 Lakh. With the new machine, the annual operating costs (excluding depreciation) are expected to decrease by ₹ 2 Lakh. In addition, the machine would increase productivity on account of which net revenues would increase by ₹ 3 Lakh annually. The tax rate applicable to the company is 40% and the cost of capital is 10%.

Is the proposal financially viable? Advise the company on the basis of NPV of the proposal.

PV Factors (10%)

Year	1	2	3	4	5
PV Factor	0.909	0.826	0.751	0.683	0.620

Solution:

A. Calculation of Incremental Cash outflows

Cost of new machine	₹ 30,00,000
Less: Sale value of existing machine	₹ 12,00,000
	₹ 18,00,000

B. Determination of Cash Flows after Taxes (CFAT) (Operating) (₹)

Year (1)	Incremental cash profits before taxes (2)	Incremental depreciation (3)	Taxable income (4) = [2-3]	Taxes @ 40% (5)	Earnings after Tax (EAT) (6) = [4-5]	Cash Flows After Taxes (CFAT) (7) = [6+3]
1	5,00,000	3,60,000	1,40,000	56,000	84,000	4,44,000
2	5,00,000	2,88,000	2,12,000	84,800	1,27,200	4,15,200

3	6,00,000	2,30,400	3,69,600	1,47,840	2,21,760	4,52,160
4	6,00,000	1,84,320	4,15,680	1,66,272	2,49,408	4,33,728
5	6,00,000	1,47,456	4,52,544	1,81,018	2,71,526	4,18,982

C. Determination of Net Present Value (NPV)

Year	Cash Flows After Taxes (₹)	PV Factor (0.10)	Total PV (₹)
1	4,44,000	0.909	4,03,596
2	4,15,200	0.826	3,42,955
3	4,52,160	0.751	3,39,572
4	4,33,728	0.683	2,96,236
5	4,18,982	0.620	2,59,769
6	9,00,000 (Net Salvage Value)	0.620	5,58,000
Total Present Value			**2,200,129**
Less: Incremental Cash Outflows			1,800,000
NPV			4,00,129

Working Notes

(i) WDV of existing machine in the beginning of year 5

	(₹)
Initial cost of machine	20,00,000
Less: Depreciation @ 20% in year 1	4,00,000
WDV at beginning of year 2	16,00,000
Less: Depreciation @20% in year 2	320,000
WDV at beginning of year 3	1,280,000
Less: Depreciation @20% in year 3	256,000
WDV at beginning of year 4	1,024,000

(ii) Depreciation base of new machine	**(₹)**
WDV of existing machine	1,024,000
Add: Cost of new machine	3,000,000
	4,024,000
Less: Sale proceeds of existing machine	1,200,000
	2,824,000

(iii) Base of incremental depreciation	**(₹)**
Depreciation base of new machine	2,824,000
Less: Depreciation base of existing machine	1,024,000
	1,800,000

(iv) Incremental Depreciation

Year	Incremental asset cost base (₹)	Depreciation @20% (₹)
1	1,800,000	360,000
2	1,440,000	288,000
3	1,152,000	230,400
4	921,600	184,320
5	737,280	147,456

(v) Incremental cash profit before taxes (in terms of decrease in operating costs and increase in revenues) owing to the new machine

Year	Saving in Operating cost (₹)	Increase in Revenue (₹)	Incremental cash profit before taxes (₹)
1	200,000	300,000	500,000
2	200,000	300,000	500,000
3	300,000*	300,000	600,000
4	300,000	300,000	600,000
5	300,000	300,000	600,000

*Maintenance expenses of existing machine are expected to increase by ₹ 1,00,000 from sixth year of installation.

Illustration 23

A manufacturing company has an old machine having no book value which can be sold for ₹ 100,000. The company is thinking to choose one of the following two alternatives:

(i) To incur additional cost of ₹ 20,00,000 to upgrade the existing old machine.

(ii) To replace old machine with a new machine costing of ₹ 40,00,000 along with installation cost of ₹ 100,000.

The above two alternatives envisage useful life to be 5 years. The expected after-tax profits for three alternatives are as under:

Year	Old Existing Machine (₹)	Upgraded Machine (₹)	New Machine (₹)
1	10,00,000	11,00,000	12,00,000
2	10,80,000	11,80,000	12,80,000
3	11,60,000	12,20,000	13,80,000
4	12,40,000	13,00,000	14,80,000
5	13,20,000	14,00,000	16,00,000

The tax rate is 40%. The company follows straight line depreciation and the cost of capital is to be taken 15%.

You are required to advice the company as to which alternative is to be adopted.

Present value of One Rupee

Year/Rate	1	2	3	4	5
15%	0.870	0.756	0.658	0.572	0.497

Solution:

There are three possibilities, coming out from the analysis:

(i) Retain the existing machine

(ii) Upgrade the existing machine

(iii) Replace the old with machine

The incremental approach would be adopted for 2nd and 3rd options. In case the NPV of this incremental approach of both options turn negative, then reject both options and accept the 1st option, else choose a better option.

Cash outflows

(i) In case of machine is upgraded:

Upgradation cost: ₹ 20,00,000

(ii) In case of new machine installed

	(₹)
Cost	40,00,000
Add: Installation Cost	1,00,000
Total Cost	41,00,000
Less: Disposal of old machine (100,000 – 40% Tax)	60,000
Total cash outflow	**40,40,000**

Depreciation

Depreciation in case of machine is upgraded: ₹ 20,00,000/5 = ₹ 400,000

Depreciation in case of new machine is installed: ₹ 41,00,000/5 = ₹ 820,000

Old existing machine – Book Value is zero hence no depreciation

Incremental Cash Inflows after Taxes (CFAT) of Upgraded Old Machine

	Old Machine	Upgraded Machine			
Year	PAT/CFAT (₹)	PAT (₹)	Depreciation (₹)	CFAT (₹)	Incremental CFAT=5-2 (₹)
(1)	(2)	(3)	(4)	(5)	(6)
1	10,00,000	11,00,000	4,00,000	15,00,000	5,00,000
2	10,80,000	11,80,000	4,00,000	15,80,000	5,00,000
3	11,60,000	12,20,000	4,00,000	16,20,000	4,60,000
4	12,40,000	13,00,000	4,00,000	17,00.000	4,60,000
5	13,20,000	14,00,000	4,00,000	18,00,000	4,80,000
Total	**58,00,000**				

Incremental Cash Inflows after Taxes (CFAT) of New over Old Machine

	Old Machine	Upgraded Machine			
Year	PAT/CFAT (₹)	PAT (₹)	Depreciation (₹)	CFAT (₹)	Incremental CFAT=5-2 (₹)
(1)	(2)	(3)	(4)	(5)	(6)
1	10,00,000	12,00,000	8,20,000	20,20,000	10,20,000
2	10,80,000	12,80,000	8,20,000	21,00,000	10,20,000
3	11,60,000	13,80,000	8,20,000	22,00,000	10,40,000
4	12,40,000	14,80,000	8,20,000	23,00,000	10,60,000
5	13,20,000	16,00,000	8,20,000	24,20,000	11,00,000
Total	58,00,000				

Calculation of NPV of both options

Year	Upgraded Machine			New Machine		
	Incremental CFAT (₹)	PVF	Total PV (₹)	Incremental CFAT (₹)	PVF	Total PV (₹)
1	5,00,000	0.870	4,35,000	10,20,000	0.870	8,87,400
2	5,00,000	0.756	3,78,000	10,20,000	0.756	7,71,120
3	4,60,000	0.658	3,02,680	10,40,000	0.658	6,84,320
4	4,60,000	0.572	2,63,120	10,60,000	0.572	6,06,320
5	4,80,000	0.497	2,38,560	11,00,000	0.497	5,46,700
			16,17,360			34,95,860
Less: Cash Outflows			20,00,000			40,40,000
NPV			-3,82,640			-5,54,140

Decision: As the NPV in both the alternatives are negative, the company should continue with the existing old machine.

Illustration 24

Vedika Ltd., with a limited investment funds of ₹ 6,00,000 is evaluating the desirability of 5 (five) investment proposals. Their profiles are summarized below:

	Project Investment (₹)	Annual Cash flow (after tax) (₹)	Life (in years)
M	1,00,000	36,000	10
N	2,00,000	1,00,000	4
O	2,40,000	60,000	8
P	3,00,000	80,000	16
Q	4,00,000	60,000	25

Project N and Q are mutually exclusive. The cost of funds is 10%.

Find out the feasible combination of projects and rank them on the basis of Net Present Value (NPV).

PVIFA

Year	10	4	8	16	25
PVIFA at 10%	6.145	3.170	5.335	7.824	9.077

Solution:

Calcualtion of NPV of the Projects

Project	Investment (₹)	Cash flow (₹)	Annuity	PV (Cash flow × annuity) (₹)	NPV (PV – invest.) (₹)
M	1,00,000	36,000	6.145	2,21,220	1,21,220
N	2,00,000	1,00,000	3.170	3,17,000	1,17,000
O	2,40,000	60,000	5.335	3,20,100	80,100
P	3,00,000	80,000	7.824	6,25,920	3,25,920
Q	4,00,000	60,000	9.077	5,44,620	1,44,620

Life of project is not relevant in determination of NPV.

Statement of feasible combination

Combination Rank		Investment (₹)	NPV
M, N & P	6,00,000	5,64,140	1
M, N & O	5,40,000	3,18,320	4
O & P	5,40,000	4,06,020	3
M & Q	5,00,000	2,65,840	5
N & P	5,00,000	4,42,920	2

Illustration 25

Vedavyas Ltd. is considering two manually exclusive projects M and project N. The Finance Director thinks that the project with the higher NPV should be chosen, whereas the Managing Director thinks that the one with the higher IRR should be undertaken, especially as both projects have the same initial outlay and length of life. The company anticipates a cost of 10% and the net after-tax cash flow of the projects are as follows:

Year	0	1	2	3	4	5
Cash Flows (₹)	(₹)	(₹)	(₹)	(₹)	(₹)	(₹)
Project M	(4,00,000)	70,000	1,60,000	1,80,000	1,50,000	40,000
Project N	(4,00,000)	4,36,000	20,000	20,000	8,000	6,000

You are required to:

i. Calculate the NPV and IRR of each project.

ii. State with reasons, which project you would recommend.

iii. Explain the inconsistency in the ranking of the two projects.

Present value table is given:

Year	0	1	2	3	4	5
PVIF at 10%	1000	0.909	0.826	0.751	0.683	0.621
PVIF at 20%	1000	0.833	0.694	0.579	0.482	0.402

Solution:

(i) Calculation of NPV and IRR

NPV of Project M					
Year	**Cash Flows (₹)**	**Discount factor (10%)**	**Discount Values (₹)**	**Discount Factor (20%)**	**Discounted Value (₹)**
0	(4,00,000)	1.000	(4,00,000)	1000	(4,00,000)
1	70,000	0.909	63,630	0.833	58,310
2	1,60,000	0.826	1,32,160	0.694	1,11,040
3	1,80,000	0.751	1,35,180	0.579	1,04,220
4	1,50,000	0.683	1,02,450	0.482	72,300
5	40,000	0.621	24,840	0.402	16,080
NPV			58,260		(38,050)

IRR of Project M:

At 20% NPV is (-) ₹38050 and at 10% NPV is ₹58,260

$$\text{So, IRR} = 10 + \frac{58260}{58260 + 38050} \times 10$$

$$= 16.05\%$$

NPV of Project N					
Year	**Cash Flows (₹)**	**Discount factor (10%)**	**Discount Values (₹)**	**Discount Factor (20%)**	**Discounted Value (₹)**
0	(4,00,000)	1000	(4,00,000)	1000	(4,00,000)
1	4,36,000	0.909	3,96,324	0.833	3,63,188
2	20,000	0.826	16,520	0.694	13,880
3	20,000	0.751	15,020	0.579	11,580
4	8,000	0.683	5,464	0.482	3,856
5	6,000	0.621	3,726	0.402	2,412
NPV			37,054		(5,084)

IRR of Project M:

At 20% NPV is (-) ₹5084 and at 10% NPV is ₹37054

$$\text{So, IRR} = 10 + \frac{37054}{37054 + 5084} \times 10$$

$$= 18.79\%$$

(ii) Since, both the projects are generating the positive NPV at the company's cost of capital at 10% hence, they are acceptable. IF company follows NPV method, then the company will have to select Project M because it has higher NPV.

If the company follows IRR method, then Project N should be selected because of higher Internal Rate of Return (IRR), but when NPV and IRR give contradictory results. A project with higher NPV is generally preferred because of higher return in absolute terms. Hence, Project M should be selected.

(iii) Because of the difference in the pattern of the cash flows the inconsistency in the ranking of the projects arises. Project M's major cash flow occur mainly in the middle three years whereas project N generated the major cash flow in the first year itself.

Illustration 26

Information of two projects is given below:

Project	A	B
Cash Inflows (₹ '000) Year-end		
1	50	282
2	300	250
3	360	180
4	208	NIL
Initial Investment – beginning of year 1	535	540

Evaluate which project is better under each of the following criteria taking discount rate as 10% p.a.

(i) NPV

(ii) Discounted Payback period

(iii) Profitability Index

Solution: **(₹ in '000)**

Year	PV factor @ 10%	Cash flows of Project A	Present Value of Project A	Cumulative PV of Project A	Cash flows of Project B	Present value of Project B	Cumulative PV of Project B
0	1.00	(535)	(535)	-	(540)	(540)	-
1	0.909	50	45.45	45.45	282	256.338	256.338
2	0.826	300	247.80	293.25	250	206.50	462.838
3	0.751	360	270.36	563.61	180	135.18	598.018
4	0.683	208	142.06	705.67	-	-	598.018

(i) Net Present Value of Project A = PV of inflows – PV of outflows
= 705.67 – 535
= 170.67 (₹ in '000)

Net Present Value of Project B = PV of inflows – PV of outflows
= 598.018 - 540
= 58.018 (₹ in '000)

Project A is better, since, it has higher NPV.

(ii) Discounted payback period

Project A = $2 + \frac{241.75}{270.36}$ = 2.89 Years

Project B (Payback period) = $2 + \frac{77.162}{135.18}$ = 2.57 Years

Project B is better. Since, it has lower payback period.

(iii) Profitability Index = $\frac{\text{Present value of inflow}}{\text{Present value of outflow}}$

Project A (Profitability Index) = $\frac{705.67}{535}$ = 1.32 (₹ in '000)

Project B (Profitability Index) = $\frac{598.018}{540}$ = 1.12 (₹ in '000)

Comment: Project A is better, since, it has lower Profitability Index.

Illustration 27

Lokesh Ltd. is considering buying a machine costing ₹ 15,00,000 which yields the following annual income:

End of year	1	2	3	4	5
Annual Income after Depreciation but before tax	3,50,000	3,72,000	3,10,000	1,75,000	1,10,000
PV Factor at 12% of ₹ 1	0.893	0.797	0.712	0.636	0.567

Corporate tax rate applicable is 30%. Depreciation is on straight line basis for 5 year There is no scrap value.

Normal rate of return is 12%. Round off calculations to the nearest rupee and calculate:

(a) Payback Period

(b) Discounted Payback Period

(c) Net Present Value

(d) Profitability Index

Solution:

Calculation of Present Value **(₹)**

Year	Profit before tax	Profit after tax	Cash Inflows (PAT + Dep)	Cumulative Cash Inflows	Discounting factors @ 12%	Present Value	Cumulative Present value
1	3,50,000	2,45,000	5,45,000	5,45,000	0.893	4,86,685	4,86,685
2	3,72,000	2,60,000	5,60,400	11,05,400	0.797	4,46,639	9,33,324
3	3,10,000	2,17,000	5,17,000	16,22,400	0.712	3,68,104	13,01,428
4	1,75,000	1,22,500	42,2,500	20,44,900	0.636	2,68,710	15,70,138
5	1,10,000	77,000	3,77,000	24,21,900	0.567	2,13,759	17,83,897

(a) Payback Period = 2 + 3,94,600/5,17,000 = 2.76 Years

(b) Discounted Payback Period = 3 + 1,98,572 / 2,68,710 = 3.74 Years

(c) Net Present Value = Present value of cash inflows – Present value of cash outflows

= ₹17,83,897 – ₹15,00,000 = ₹ 2,83,897

(d) Profitability Index = Present value of cash inflows / Present value of cash outflows

= ₹17,83,897 / ₹15,00,000 = 1.19

Note:

Depreciation $= \frac{\text{Cost - Scrap Value}}{\text{Life}} = \frac{₹\ 15,00,000 - 0}{5}$ = ₹ 3,00,000

Illustration 28

Robin Ltd. is examining two manually exclusive investment proposals. The management uses Net Present Value method to evaluate new investment proposals. Depreciation is charged using Straight line Method. Other details relating to these proposals are:

Particulars	Proposal X	Proposal Y
Annual Profit before tax (₹)	13,00,000	24,50,000
Cost of the Project (₹)	90,00,000	1,80,00,000
Salvage value (₹)	1,20,000	1,50,000
Working Life	4 Years	5 Years
Cost of Capital	10%	10%
Corporate Tax Rate	30%	30%

The present value of ₹ 1 at 10% discount rates at the end of first, second, third, fourth and fifth year are 0.9091; 0.8264; 0.7513; 0.683; and 0.6209 respectively.

You are required to advise the company on which proposal should be taken up by it.

Solution:

	Proposal X (₹)	Proposal Y (₹)
Earnings before Interest and Taxes	13,00,000	24,50,000
Less: Tax @ 30%	3,90,000	7,35,000
Earnings after Tax	9,10,000	17,15,000
Add: Depreciation	22,20,000	35,70,000
Cash inflow (a)	31,30,000	52,85,000
Present value annuity factor @ 10% (b)	3.1698	3.7907
Present Value of cash inflow (a) × (b)	99,21,474	2,00,33,850
Add: Present value of salvage value:		
Proposal X: ₹1,20,000 × 0.683	81,960	-
Proposal Y: ₹1,50,000 × 0.6209	-	93,135
Total Present Value	1,00,03,434	2,01,26,985
Less: Initial Outflow	90,00,000	1,80,00,000
Net Present Value	10,03,434	21,26,985

Working Note:

	X	Y
Depreciation		
Cost (₹)	90,00,000	1,80,00,000
Less: Salvage Value (₹)	1,20,000	1,50,000
	88,80,000	1,78,50,000
Working Life	4 Year	5 Year
Depreciation per annum (₹)	22,20,000	35,70,000

Advice – Annualized Net Present Value is more in case of Project Y hence, we should accept project Y.

Illustration 29

ABC Ltd. wishes to evaluate two mutually exclusive proposals to acquire a machine. Machines M and N are being considered, each costing ₹ 2,00,000 and having an estimated life of 5 years and 4 years respectively. Both have nil salvage value. The anticipated cash flows after adjustment of taxes for M and N are given below:

End of Year	Machine M (₹)	Machine N(₹)
1	70,000	1,00,000
2	60,000	90,000
3	60,000	80,000
4	50,000	40,000
5	90,000	NIL

Find the accounting rate of return and net present value for both the machines and advise ABC Ltd., which machine should be bought. The required rate of return is 10% p.a.

Present Value factor for 10%:

End of year	1	2	3	4	5
	0.909	0.826	0.751	0.683	0.621

Solution:

Ranking of Proposals:

Year	Cash Inflow (₹)		PV Factor	Total PV (₹)	
	M	N	(10% p.a.)	M	N
1	70,000	1,00,000	0.909	63,630	90,900
2	60,000	90,000	0.826	49,560	74,340
3	60,000	80,000	0.751	45,060	60,080
4	50,000	40,000	0.683	34,150	27,320
5	90,000	-	0.621	55,890	-
				2,48,290	2,52,640
Less: Cash Outflow				2,00,000	2,00,000
Net PV				48,290	52,640

$$\text{Average Rate of Return} = \frac{\text{Average Profit}}{\text{Average Investment}} \times 100$$

Note: [For evaluation of ARR the average investment has been taken at half of the initial cost for all the two machines]

M = ₹70,000 + ₹60,000 + ₹60,000 + ₹50,000 + ₹90,000 = ₹3,30,000 ÷ 5 = ₹ 66,000

N = ₹1,00,000 + ₹90,000 + ₹80,000 + ₹40,000 = ₹3,10,000 ÷ 4 = ₹ 77,500

$$\text{M} \quad \text{ARR} = \frac{\text{AV Profit}}{\text{AV Investment}} \times 100$$

$$= \frac{\text{Average Cash Inflow - Depreciation}}{\text{Average Investment}} \times 100$$

$$= \frac{66000 - 40000}{100000} \times 100 = 26\%$$

N $$= \frac{77500 - 50000}{100000} \times 100 = 27.5\%$$

Rank: Machine 'N' to be selected under both the methods as it generates higher NPV and average rate of return.

Illustration 30

FB Chemical Ltd. has three potential projects, all with an initial cost of ₹ 20,00,000 and estimated life of five year The capital budget for the year will only allow the company to accept one of the three projects.

Given the discount rates and the future cash flows of each project, which project should the company accept?

Project 1 has an annual cash flow of ₹ 5,00,000 and discount rate of 6%.

Project 2 has an annual cash flow of ₹ 6,00,000 and discount rate of 9%.

Project 3 has the following cash inflows and discount rate of 15%

Year	1	2	3	4	5
Cash Inflows ₹	10,00,000	8,00,000	6,00,000	2,00,000	1,00,000

Solution:

NPV = PV of Inflow – PV of Outflow

Project 1's NPV = ₹ [5,00,000 (0.943 + 0.889 + 0.839 + 0.792 + 0.747) – 20,00,000]

= ₹ 1,05,000

Project 2's NPV = ₹ [6,00,000 (0.917 + 0.841 + 0.772 + 0.708 + 0.649) – 20,00,000]

= ₹ 3,32,200

Project 3's NPV = ₹ 20,31,900 – 20,00,000 = ₹31,900.

Project 2 should be accepted as its NPV is maximum.

Illustration 31

P Ltd. has four potential projects all with an initial cost of ₹ 15,00,000. The capital budget for the year will only allow the company to take up only one of the three projects. Given the discount rates and the future cash flows of each project, which project should they accept?

Project	Annual Net Cash Flows per year for five years (₹)	Discount Rates
A	3,50,000	4%
B	4,00,000	8%
C	5,00,000	10%

Solution:

Cash outflow = ₹ 15,00,000

Life of the Project = 5 Years

1. Calculation of NPV of Project A

NPV = PV of Cash Inflow (CI) – PV of cash outflow

PV of CI = CI × PV of Annuity factor for 5 years @ 4%

= ₹ 3,50,000 × 4.452 = ₹ 15,58,200

NPV = ₹ 15,58,200 – ₹ 15,00,000

= ₹ 58,200

2. Calculation of NPV of Project B

PV of CI = CI × PV of Annuity factor for 5 years @ 8%

= ₹ 4,00,000 × 3.993 = ₹ 15,97,200

NPV = ₹ 15,97,200 – ₹ 15,00,000

= ₹ 97200

3. Calculation of NPV of Project C

PV of CI = CI × PV of Annuity factor for 5 years @ 10%

= ₹ 5,00,000 × 3.791 = ₹ 18,95,500

NPV = ₹ 18,95,500 – ₹ 15,00,000

= ₹ 3,95,500

Recommendation: The management of P Ltd. may be advised to select Project C as its NPV is more than NPV of Project A & B.

Solved Case 1

A company is considering an investment proposal to install new milling controls at a cost of ₹ 50,000. 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 (CFBT) from the investment proposal are as follows:

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

Compute the following:

(i) Payback period,

(ii) Average rate of return,

(iii) Internal rate of return,

(iv) Net present value at 10% discount rate,

(v) Profitability index at 10% discount rate.

Solution:

Determination of cash flows after taxes (CFAT)						
Year	CFBT ₹	Depreciation (₹ 50,000/5)	Profits before tax (Col.2 – Col.3)	Taxes (0.35)	EAT (Col.4 – Col.5)	CFAT (Col.6+Col.3)
1	2	3	4	5	6	7
1	10,000	10,000	Nil	Nil	Nil	₹10,000
2	10,692	10,000	₹692	₹242	₹450	10,450
3	12,769	10,000	2,769	969	1,800	11,800
4	13,462	10,000	3,462	1,212	2,250	12,250
5	20,385	10,000	10,385	3,635	6,750	16,750
					11,250	61,250

(i) Payback (PB) period

Year	CFAT (₹)	Cumulative CFAT (₹)
1	10,000	₹10000
2	10,450	20,450
3	11,800	32,250
4	12,250	44,500
5	16,750	61,250

The recovery of the investment falls between the fourth and fifth years. Therefore, the PB is 4 years plus a fraction of the fifth year. The fractional value = ₹ 5,500 ÷ ₹ 16,750 = 0.328. Thus, the PB is 4.328 years.

(ii) Average rate of return (ARR) $= \frac{\text{Average income}}{\text{AverageInvestment}} \times 100$

$= \frac{₹\ 2250\ (₹\ 11250 \div 5)}{₹\ 25000\ (₹\ 50000 \div 2)} \times 100 \quad = 9\%$

(iii) Internal rate of return (IRR) $₹50000 = \frac{₹\ 10,000}{(1+r)^1} + \frac{₹\ 10,450}{(1+r)^2} + \frac{₹\ 11,800}{(1+r)^3} + \frac{₹\ 12,250}{(1+r)^4} + \frac{₹\ 16,750}{(1+r)^5}$

The fake payback period = 4.0816 (₹ 50,000 / ₹ 12,250). The value closest to the fake payback period of 4.0816 against 5 years is 4.100 against 7%. Since the actual cash flow stream is the initial years are slightly below the average cash flow stream, the IRR is likely to be lower than 7%. Let us try with 6%.

Year	CFAT	PV factor		Total PV	
		(0.06)	(0.07)	(0.06) (₹)	(0.07)
1	₹10,000	0.943	0.935	₹9,430	9350
2	10,450	0.890	0.873	9,300	9,123
3	11,800	0.840	0.816	9,912	9,629
4	12,250	0.792	0.763	9,702	9,347
5	16,750	0.747	0.713	12,512	11,942
Total PV				50,856	49,391
Less: Initial outlay				50,000	50,000
NPV				856	(609)

The IRR is between 6% and 7%. By interpolation, IRR = 6.6%.

(iv) Net present value (NPV)

Year	CFAT (₹)	PV factor (0.10)	Total PV (₹)
1	10,000	0.909	9,090
2	10,450	0.826	8,632
3	11,800	0.751	8,862
4	12,250	0.683	8,367
5	16,750	0.621	10,401
Total PV			45,352
Less: Initial outlay			50,000
NPV			(4,648)

(v) Profitability Index (PI) $= \frac{\text{PV of cash inflows}}{\text{PV of cash outflows}} = \frac{₹\ 45,352}{₹\ 50,000} = 0.907$

Solved Case 2

The H Ltd is considering investment in a new product. The information for one year is given as follows:

Particulars		(₹)
(a)	Sales	1,00,000
(b)	Manufacturing cost of sales (including ₹ 10,000 of depreciation)	40,000
(c)	Selling and administrative expenses (directly associated with the product)	20,000
(d)	Decrease in contribution of other products	2,000
(e)	Increase in accounts receivable	7,000
(f)	Increase in inventories	10,000
(g)	Increase in current liabilities	15,000
(h)	Income taxes associated with product income	6,000

You are required to compute the relevant cash flows of the year to be considered in evaluating this investment proposal.

Solution:

Relevant cash flows	(₹)	(₹)
a. Incremental cash inflows		
Sales		1,00,000
b. Incremental cash outflows		
Manufacturing cost of sales	30,000	
Selling and administrative expenses	20,000	
Decrease in contribution of other products	2,000	
Income taxes associated with product income	6,000	58,000
Net cash inflows (CFAT) for one year		42,000
b. Cash outflows due to additional working capital requirement in the beginning of the year		
Increase in accounts receivable	7,000	
Plus increase in inventories	10,000	
Less increase in current liabilities	15,000	2,000
Net increase in working capital		2,000

Exercise

A. Theoretical Questions:

⊙ Multiple Choice Questions

1. Capital Budgeting is a part of:
   (a) Investment Decision
   (b) Working Capital Management
   (c) Marketing Management
   (d) Capital Structure.
2. Capital Budgeting deals with:
   (a) Long-term Decisions
   (b) Short-term Decisions
   (c) Both (a) and (b)
   (d) Neither (a) nor (b).
3. Which of the following is not used in Capital Budgeting?
   (a) Time Value of Money
   (b) Sensitivity Analysis
   (c) Net Assets Method
   (d) Cash Flows.
4. Capital Budgeting Decisions are:
   (a) Reversible
   (b) Irreversible
   (c) Unimportant
   (d) All of the above.
5. Which of the following is not incorporated in Capital Budgeting?
   (a) Tax-Effect
   (b) Time Value of Money
   (c) Required Rate of Return
   (d) Rate of Cash Discount.
6. Which of the following is not a capital budgeting decision?
   (a) Expansion Programme
   (b) Merger
   (c) Replacement of an Asset
   (d) Inventory Level.

7. A sound Capital Budgeting technique is based on:
   (a) Cash Flows
   (b) Accounting Profit
   (c) Interest Rate on Borrowings
   (d) Last Dividend Paid.
8. Which of the following is not a relevant cost in Capital Budgeting?
   (a) Sunk Cost
   (b) Opportunity Cost
   (c) Allocated Overheads
   (d) Both (a) and (c) above.
9. Capital Budgeting Decisions are based on:
   (a) Incremental Profit
   (b) Incremental Cash Flows
   (c) Incremental Assets
   (d) Incremental Capital.
10. Which of the following does not effect cash flows proposal?
   (a) Salvage Value
   (b) Depreciation Amount
   (c) Tax Rate Change
   (d) Method of Project Financing.
11. Cash Inflows from a project include:
   (a) Tax Shield of Depreciation
   (b) After-tax Operating Profits
   (c) Raising of Funds
   (d) Both (a) and (b).
12. Which of the following is not true with reference capital budgeting?
   (a) Capital budgeting is related to asset replacement decisions
   (b) Cost of capital is equal to minimum required return
   (c) Existing investment in a project is not treated as sunk cost
   (d) Timing of cash flows is relevant.

13. Which of the following is not followed in capital budgeting?
    (a) Cash flows Principle
    (b) Interest Exclusion Principle
    (c) Accrual Principle
    (d) Post-tax Principle.
14. Depreciation is incorporated in cash flows because it:
    (a) Is unavoidable cost
    (b) Is a cash flow
    (c) Reduces Tax liability
    (d) Involves an outflow.
15. Which of the following is not true for capital budgeting?
    (a) Sunk costs are ignored
    (b) Opportunity costs are excluded
    (c) Incremental cash flows are considered
    (d) Relevant cash flows are considered.
16. Which of the following is not applied in capital budgeting?
    (a) Cash flows be calculated in incremental terms
    (b) All costs and benefits are measured on cash basis
    (c) All accrued costs and revenues be incorporated
    (d) All benefits are measured on after-tax basis.
17. Evaluation of Capital Budgeting proposals is based on Cash Flows because:
    (a) Cash Flows are easy to calculate
    (b) Cash Flows are suggested by SEBI
    (c) Cash is more important than profit
    (d) Cash Flows are suggested by RBI
18. Which of the following is not included in incremental A flows?
    (a) Opportunity Costs
    (b) Sunk Costs
    (c) Change in Working Capital
    (d) Inflation effect

19. A proposal is not a Capital Budgeting proposal if it:
    (a) is related to Fixed Assets
    (b) brings long-term benefits
    (c) brings short-term benefits only
    (d) has very large investment
20. In Capital Budgeting, Sunk cost is excluded because it is:
    (a) of small amount
    (b) not incremental
    (c) not reversible
    (d) All of the above
21. Savings in respect of a cost is treated in capital budgeting as:
    (a) An Inflow
    (b) An Outflow
    (c) Opening balance
    (d) Closing balance
22. _____ ignores the time value of money.
    (a) IRR
    (b) ARR
    (c) NPV
    (d) PI
23. The discounted cash flows techniques are:
    (a) Net Present Value (NPV)
    (b) Internal Rate of Return (IRR)
    (c) Profitability Index (PI)
    (d) All of the above
24. If the NPV is positive or at least equal to zero, the project can be _____.
    (a) break even situation
    (b) accepted or rejected
    (c) rejected
    (d) accepted

25. The following information is given for a project:

    Annual cash inflow ₹ 8,00,000

    Useful life 4 years

    Payback period 2.855 years

    The cost of the project would be -

    (a) ₹ 22,80,000

    (b) ₹ 22,84,000

    (c) ₹ 22,86,000

    (d) ₹ 22,87,800

26. Initial investment ₹ 20 Lakh. Expected annual cash flows ₹ 6 Lakh for 10 years. Cost of capital @15%. Profitability Index (PI) is - (Cumulative discounting factor @ 15% for 10 years = 5.019)

    (a) 1.51

    (b) 1.71

    (c) 2.51

    (d) 2.91

27. Annual Cost Saving ₹ 4,00,000; Useful life 4 years; Cost of the Project ₹ 11,42,000. The Payback period would be -

    (a) 2 years 8 months

    (b) 2 years 11 months

    (c) 3 years 2 months

    (d) 3 year 10 months

28. A project has a 10% discounted payback of 2 years with annual after-tax cash inflows commencing from year end 2 to 4 of ₹ 400 lakh. How much would have been the initial cash outlay which was fully made at the beginning of year 1?

    (a) ₹ 400 lakh

    (b) ₹ 422 lakh

    (c) ₹ 452 lakh

    (d) ₹ 497.20 lakh

29. In mutually exclusive projects, projects which are selected for comparison must have

    (a) positive net present value

    (b) negative net present value

    (c) zero net present value

    (d) none of the above

30. In a single projects situation, results of internal rate of return and net present value lead to

    (a) cash flow decision

    (b) cost decision

    (c) same decisions

    (d) different decisions

31. The discount rate which forces net present values to become zero is classified as

    (a) positive rate of return

    (b) negative rate of return

    (c) external rate of return

    (d) internal rate of return

32. A point where profile of net present value crosses horizontal axis at plotted graph indicates project

    (a) costs

    (b) cash flows

    (c) internal rate of return

    (d) external rate of return

33. Payback period in which an expected cash flows are discounted with help of project cost of capital is classified as

    (a) discounted payback period

    (b) discounted rate of return

    (c) discounted cash flows

    (d) discounted project cost

34. Number of years forecasted to recover an original investment is classified as

    (a) payback period

    (b) forecasted period

    (c) original period

    (d) investment period

35. In proper capital budgeting analysis we evaluate incremental

    (a) Accounting income

    (b) Cash flow

    (c) Earnings

    (d) Operating profit

36. The term mutually exclusive investments mean:

    (a) Choose only the best investments.

    (b) Selection of one investment precludes the selection of an alternative.

    (c) The elite investment opportunities will get chosen.

    (d) There are no investment options available.

37. While evaluating projects with different initial outlay, which of the following methods is more appropriate than NPV?

    (a) Payback Period

    (b) Accounting Rate of Return

    (c) Profitability Index

    (d) Discounted Payback Period

38. Which of the following features is not associated with capital budgeting decision?

    (a) Long term

    (b) Large Capital Outlay

    (c) Reversibility

    (d) High Risk

39. With respect to NPV, which of the following is incorrect?

    (a) When NPV is zero, PI will be 1

    (b) When NPV is zero, IRR = Cost of Capital

    (c) When NPV is zero, we get the PBP

    (d) When NPV is zero, we get Discounted PBP

40. Initial Investment ₹ 20 lakh. Expected annual cash flows ₹ 6 lakh for 10 years. Cost of capital @ 15%. What is the Profitability Index? The cumulative discounting factor @ 15% for 10 years = 5.019.

    (a) 1.51

    (b) 1.15

    (c) 5.15

    (d) 0.151

41. The following details relate to an investment proposal of XYZ Ltd.

    Investment outlay— ₹ 100 lakhs

    Lease Rentals are payable at ₹ 180 per ₹ 1,000

    Term of lease—8 years

    Cost of capital—12%

What is the present value of lease rentals, if lease rentals are payable at the end of the year? *[Given PV factors at 12% for years (1-8) is 4.9676.]*

(a) ₹ 98,14,680

(b) ₹ 89,41,680

(c) ₹ 94,18,860

(d) ₹ 96,84,190

42. Given for a project: Annual Cash inflow ₹80,000 Useful life 4 years Pay-Back period 2.855 years What is the cost of the project?

(a) ₹ 2,28,500

(b) ₹ 2,28,400

(c) ₹ 2,28,600

(d) ₹ 2,28,700

43. The following is not a Discounted Cash Flow Technique:

(a) NPV

(b) PI

(c) Accounting of Average Rate of Return

(d) IRR

44. Which of the following is not incorporated in Capital Building?

(a) Tax-Effect

(b) Time Value of Money

(c) Required Rate of Return

(d) Rate of Cash Discount

45. Which of the following variables is not known in Internal Rate of Return?

(a) Initial Cash Flows

(b) Discount Rate

(c) Terminal Inflows

(d) Life of the Project

46. Capital Budgeting techniques which considers the time value of money is based on

(a) Cash Flows of the organization

(b) Accounting Profit of the organization

(c) Interest Rate on Borrowings

(d) Last Dividend Paid

47. Internal Rate of return is the discounting factor which :

(a) Ensures that the present value of Net Cash Inflow is > the Net Cash Outflow

(b) Ensures that the present value of Net Cash Inflow is < the Net Cash Outflow

(c) Equates the present value of Net Cash Inflow to the Net Cash Outflow

(d) None of these

48. A company has obtained quotes from two different manufacturers for an equipment. The details are as follows :

PRODUCT	COST (₹Millions)	ESTIMATED LIFE [YEARS]
MAKE A	4.5	10
MAKE B	6	15

Ignoring operation and maintenance cost, which one would be cheaper ? The company's cost of capital is 10%. [Given : PVIFA (10%, 10 years) = 6.1446 and PVIFA (10%, 15 years) = 7.6061]

(a) Make A will be cheaper

(b) Make B will be cheaper

(c) Cost will be the same

(d) None of the above.

49. Investment in a project is ₹ 200 lakhs and Net Present Value is ₹ 50 lakhs. Then the amount of inflows is :

(a) ₹ 150 lakhs

(b) ₹ 200 lakhs

(c) ₹ 100 lakhs

(d) ₹ 250 lakhs

50. Present value of inflows ₹ 10 lakhs from a project and initial investment is ₹ 7.5 lakhs. The NPV is:

(a) ₹ 17.5 lakhs

(b) ₹ 7.5 lakhs

(c) ₹10 Lakhs

(d) ₹ 2.5 lakhs

51. In mutually exclusive projects, project which is selected for comparison with others must have

(a) higher net present value

(b) lower net present value

(c) zero net present value

(d) none of above

52. A project whose cash flows are more than capital invested for rate of return then net present value will be

    (a) positive

    (b) independent

    (c) negative

    (d) zero

53. NPV is positive indicates :

    (a) Cash inflows are generated at a rate higher than the minimum required by the firm.

    (b) Cash inflows are generated at a rate equal to the minimum required

    (c) Cash inflows are generated at a rate lower than the minimum required by the firm.

    (d) None of the above

Answers:

1	a
4	b
7	a
10	d
13	c
16	c
19	c
22	b
25	b
28	c
31	d
34	a
37	c
40	a
43	c
46	a
49	d
52	a

2	a
5	d
8	d
11	d
14	c
17	c
20	c
23	d
26	a
29	a
32	c
35	b
38	c
41	b
44	d
47	c
50	d
53	a

3	c
6	d
9	b
12	c
15	b
18	b
21	a
24	d
27	b
30	c
33	a
36	b
39	c
42	b
45	b
48	a
51	a

⊙ State True or False

1. Two mutually exclusive projects (A and B) have been evaluated. Project A has an NPV of ₹ 8 lakh and an IRR of 16%; Project B has NPV of ₹ 7 lakh but has IRR or 18%. Since Project B has higher IRR, it should be selected.

2. The cost of capital for new projects is 15%. Two competing projects (X and Y) respectively have IR₹ of 14% and 12% respectively; since IRR of project X is higher, it should be selected.

3. Two competing projects have the following NPVs: Project X, + ₹ 5 lakh (with initial outlay of ₹ 25 lakh) and Project Y, + ₹ 4,20,000 (with initial outlay of ₹ 20,00,000). The company should opt for project X as it has higher NPV.
4. A project requires an initial investment of ₹ 10,00,000. The estimated cash inflows from the project are as follows: ₹ 3 lakh (year 1),₹ 1 lakh (year 2), ₹ 3 lakh (year 3), ₹ 6 lakh (Year 4) and ₹ 4 lakh (year 5). The Payback of the project is 4 years.
5. A project requires an investment of ₹ 20 lakh. The estimated profit after tax for years 1-5 are: ₹ 3 lakh, ₹ 3 lakh, ₹ 3 lakh, ₹ 6 lakh and ₹ 8 lakh. The accounting rate of return is 21%
6. In the case of independent investment projects, if the NPV of the project is zero, IRR is equal to cost of capital.
7. A company has evaluated 3 investment proposals under IRR method, yielding different rates of return. Though the IRR values are varying, reinvestment rate of intermediate cash inflows is assumed to be the same for all these 3 proposals.
8. Since IRR is expressed in percentage figure, it is the best method for evaluating capital budgeting projects.
9. The more distant the CFAT, the higher is the present value of such cash flows.
10. NPV is the best method of evaluating long-term investment proposals.
11. Investment decisions and capital budgeting are same.
12. Capital budgeting decisions are long term decisions.
13. Capital budgeting decisions are reversible in nature.
14. Capital budgeting decisions do not affect the future Stability of the firm.
15. There is a time element involved in capital budgeting.
16. An expansion decision is not a capital budgeting decision
17. In mutually exclusive decision situation, the firm can accept all feasible proposals.
18. Capital budgeting and capital rationing are alternative to each other.
19. Correct capital budgeting decisions can be taken by comparing the cost with future benefits.
20. Future expected profits from investments are taken as returns from the investment for capital budgeting.
21. Cash flows are the appropriate measure of costs and benefits from an investment proposal.
22. Sunk cost is a relevant cost in capital budgeting.
23. The opportunity cost of an input is always considered, in capital budgeting.
24. Allocated overhead costs are not relevant for capital budgeting.
25. Cash flows and accounting profits are different.
26. Cash flows are same as profit before tax.
27. Net cash flow is on after-tax basis.
28. The term capital budgeting is used interchangeably with capital expenditure decision.
29. The key function of the financial management is the selection of the most profitable portfolio of capital investment.
30. Capital budgeting decisions are crucial, affecting all the departments of the firm.

Answer:

1	F
4	F
7	F
10	T
13	F
16	F
19	F
22	F
25	T
28	T

2	F
5	F
8	F
11	F
14	F
17	F
20	F
23	F
26	F
29	T

3	T
6	T
9	F
12	T
15	T
18	F
21	T
24	T
27	T
30	T

B. Fill in the Blanks

1. _____ _____ present value tables can be used only when cashflows are uniform to determine NPV.
2. In the case of mixed stream of cash flows, _____ present value tables are used to determine NPV.
3. _____ determines the number of years required to recover initial investment outlay.
4. In the case of _____ investment proposals, IRR and NPV method provides the same result.
5. In the case of conflict in ranking. _____ method provides better result than _____ method.
6. Capital budgeting is concerned with _____ decisions.
7. Cash flow can be _____.
8. The Internal rate of return is to be determined by _____method.
9. The shorter a discounted payback period is means the _____ (sooner/longer) a project or investment will generate cash flows to cover the initial cost.

Answers:

1	Annuity
4	Independent
7	positive or negative

2	Simple
5	NPV, IRR
8	trial and error

3	Payback method
6	investment
9	sooner

⊙ **Short Essay Type Questions**

1. Discuss the basic concept of capital budgeting.
2. Discuss the nature of capital budgeting.
3. State the need of capital budgeting decision.
4. Discuss the significance of capital budgeting.

5. Evaluate the process of capital budgeting.
6. Distinguish between Cash flow and Profit of the firm.
7. What is mutually exclusive project decision? Explain.
8. Write a note on the traditional capital budgeting techniques (non-discounted).
9. Write a note on the modern capital budgeting techniques (discounted).
10. Make differences between NPV and IRR method.

⊙ Essay Type Questions

1. Why is it important to evaluate capital budgeting projects on the basis of after-tax cash incremental flows? Why we not use accounting data instead of cash flow?
2. What are the components of net cash outlay in the capital budgeting decision? At what time is such an outlay incurred in the case of conventional cash flows?
3. How should working capital and sunk costs be treated in analysing investment opportunities? Explain with suitable examples.
4. Explain clearly the concept of block of assets vis-a-vis depreciation in the context of replacement situations of capital budgeting.
5. Suppose a firm is considering replacing an old machine with a new one. The firm does not anticipate that any new revenues will be created by the replacement since demand for the product generation by both the machines is the same. However, in the CFAT work sheet used in evaluating the proposal, the analyst shows positive CFBT in the operating cash flow section. What creates operating CFBT in this situation?
6. It is said that only cash costs are relevant for capital budgeting decision. However, depreciation which is a non-cash cost is a prominent part of cash flow analysis for such an investment decision. How do you explain this paradox?
7. What is payback period? Also, discuss the utility of the Payback period in determining the internal rate of return.
8. What are the critical factors to be observed while making replacement investment decision?
9. What does the profitability index signify? What is the criterion for judging the worth of investments in the capital budgeting technique based on the profitability index?
10. Do the profitability index and the NPV criterion of evaluating investment proposals lead to the same acceptance-rejection and ranking decisions?
11. Discuss the advantages and disadvantages of all the evaluation techniques of capital budgeting.

B. Numerical Questions :

⊙ Comprehensive Numerical Problems

1. One project of XYZ Ltd. is doing poorly and is being considered for replacement. Three mutually exclusive projects A, B and C have been proposed. The projects are expected to require ₹2,00,000 each, and have an estimated life of 5 years, 4 years and 3 years, respectively, and have no salvage value. The company's required rate of return is 10%. The anticipated cash inflows after taxes (CFAT) for the three projects are as follows:

Year	CFAT		
	A (₹)	B (₹)	C (₹)
1	50,000	80,000	1,00,000
2	50,000	80,000	1,00,000
3	50,000	80,000	10,000
4	50,000	30,000	--
5	1,90,000	--	--

(a) Rank each project applying the methods of PB, NPV, IRR and profitability index (PI).

(b) What would the profitability index be if the IRR equaled the required return on investment? What is the significance of a profitability index less than one?

(c) Recommend the project to be adopted and give reasons.

2. Royal Industries Ltd. is considering the replacement of one of its moulding machines. The existing machine is in good operating condition, but is smaller than required if the firm is to expand its operations. The old machine is 5 years old, has a current salvage value of ₹ 30,000 and a remaining depreciable life of 10 years.

   The machine was originally purchased for ₹ 75,000 and is being depreciated at ₹ 5,000 per year for tax purposes.

   The new machine will cost ₹ 1,50,000 and will be depreciated on a straight line basis over 10 years, with no salvage value. The management anticipates that, with the expanded operations, there will be need of an additional net working capital of ₹ 30,000. The new machine will allow the firm to expand current operations, and thereby increase annual revenues of ₹ 40,000, and variable operating costs from ₹ 2,00,000 to ₹ 2,10,000. The company's tax rate is 35% and its cost of capital is 10%. Should the company replace its existing machine? Assume that the loss on sale of existing machine can be claimed as short-term capital loss in the current year itself.

3. Arvind Mills Ltd. is considering two mutually exclusive investment proposals for its expansion programme. Proposal A requires an initial investment of ₹ 7,50,000 and yearly cash operating costs of ₹ 50,000. Proposal B requires an initial investment of ₹ 5,00,000 and yearly cash operating costs of ₹ 1,00,000. The life of the equipment used in both the investment proposals will be 12 years, with no salvage value; depreciation is on the straight-line basis for tax purposes. The anticipated increase in revenues is ₹ 1,50,000 per year in both the investment proposals. The firm's tax rate is 35% and its cost of capital is 15%. Which investment proposal should be undertaken by the company?

4. Initial investment is ₹ 100 lakh is same for both the projects A & B. The net cash inflows after taxes for project A is ₹ 25 lakh per annum for 5 years and those for project B over its life of 5 years are ₹ 20 lakh, ₹ 25 lakh, ₹ 30 lakh, ₹ 30 lakh and ₹ 20 lakh respectively. Find out payback period of both the projects.

5. Z Ltd. has two projects under consideration A & B, each costing ₹ 60 lakh. The projects are mutually exclusive. Life for project A is 4 years & project B is 3 years. Salvage value NIL for both the projects. Tax Rate 33.99%. Cost of Capital is 15%.

Cash Inflows **(₹ in Lakh)**

At the end of the year	Project A	Project B	PV @ 15%
1	60	100	0.870
2	110	130	0.756
3	120	50	0.685
4	50	-	0.572

Which project will be accepted by the company?

Answers:

1	(i) PB: C, B, A; NPV: A, B; IRR: A, B (ii) The profitability index would be 1. The significance of a PI less than 1 is that NPV is negative and the project should not be undertaken. (iii) Project A, because its NPV is the highest.
2	NPV ₹9,915. The company should replace the existing machine.
3	Proposal B should be accepted, since NPV is negative.
4	Project A: 4 Years and Project B: 3.75 Years
5	NPV of Project A: ₹ 117.18 lakh and NPV of Project B: ₹ 100.621; As Project "A" has a higher Net Present Value, it has to be taken up)

Unsolved Case(s)

1. The cost of a project is ₹ 50,000 and it generates cash inflows of ₹ 20,000, ₹ 15,000, ₹ 25,000, and ₹ 10,000 over four years.

   Required: Using the present value index method, appraise the profitability of the proposed investment, assuming a 10% rate of discount, charged semi-annually.

2. The cost of a plant is ₹ 50,000. It has an estimated life of 5 years after which it would be disposed of (scrap value is nil). Profit Before Depreciation, Interest and Taxes (PBIT) is estimated to be ₹ 17,500 p.a. Calculate the yearly cash flow from the plant when tax rate is 30%.

3. Oxford Ltd. has decided to diversify its production and wanted to invest its surplus funds on the most profitable project. It has only two projects under consideration – 'X' and 'Y'. The cost of project 'X' is ₹ 100 lacs and that of 'Y' is ₹ 10 lacs. Both projects are expected to have a life of 8 years only and at the end of this period 'X' will have a salvage value of ₹ 4 lacs and 'B' ₹ 14 lacs. The running expenses of 'X' will be ₹ 35 lacs per year and that of 'Y' ₹ 20 lacs per year. In either case, the company expects a rate of return of 10%. The company's tax rate is 50%. Depreciation is charged on straight line basis. Which project is profitable?

4. A firm is considering an introduction of a new product which will have a life of five years. Two alternatives of promoting the product have been identified:

   Option 1: This involves hiring many agents. An immediate investment of ₹ 5,00,000 is required to promote the product. This will result in a net cash inflow of ₹ 3,00,000 at the end of each year for the next five years.

However, agents need to pay ₹ 50,000 per year. After the contract is terminated, the agent has to pay a lump sum of ₹ 1,00,000 at the end of the fifth year.

Option 2: Under this alternative, the firm will not employ agents but will sell directly to the customers. The initial cost of advertising is ₹ 2,50,000. This earns cash at the end of each year ₹ 1,50,000. However, this alternative comes with a sales administration fee of ₹ 50,000. The firm also proposes to allocate fixed costs worth ₹ 20,000 per year to this product if this alternative is pursued.

Required:

(i) Advise the management, which method of promotion is to be adopted? You may assume that the firm's cost of capital is 20%.

(ii) Calculate the internal rate of return (IRR) for option 2.

References:

- Bierman, H., and S. Smidt, The Capital Budgeting Decision, Macmillan, New York, 1974.
- Bodie, Zvi et al, Investments, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2002.
- Chambers, Donald R., and Nelson J. Lacey. "Corporate Ethics and Shareholder Wealth Maximization." Financial Practice and Education 6 (Spring–Summer 1996), 93– 96.
- Chandra Prasanna, Financial Management, Theory and Practice, McGraw Hill., 2019.
- Emery, D R and J D Finnerty, Corporate Financial Management, Prentice–Hall International, London, 1997.
- Fama, Eugene F; French, Kenneth R (Summer 2004). The Capital Asset Pricing Model: Theory and Evidence.
- Journal of Economic Perspectives. 18 (3): 25–46.
- Fischer Donald E, and Jordon Ronald J., Security Analysis and Portfolio Management, PHI.
- Francis, Jack Clark, Investments: Analysis and Management, McGraw-Hill, Inc. New York: 1991.
- H. Markowitz, Portfolio Selection: Efficient Diversification of Investments, John Wiley & Sons, 1959.
- Khan, M Y and P K Jain, Financial Management- Text, Problems and Cases, McGraw-Hill Publishing Co., New Delhi, 2019.
- Pandey I.M., Financial Management, Pearson, 12th Edition, 2021.
- Ross, Stephen. A, "The Arbitrage Theory of Capital Asset Pricing," Journal of Economic Theory, Vol. 13, (December, 1976).
- Solomon, E, Theory of Financial Management, Columbia University Press (New York), 1969.
- Van Horne James C. and Wachowicz John M., Jr. Fundamentals of Financial Management, Prentice Hall, 13th Edition, 2008.