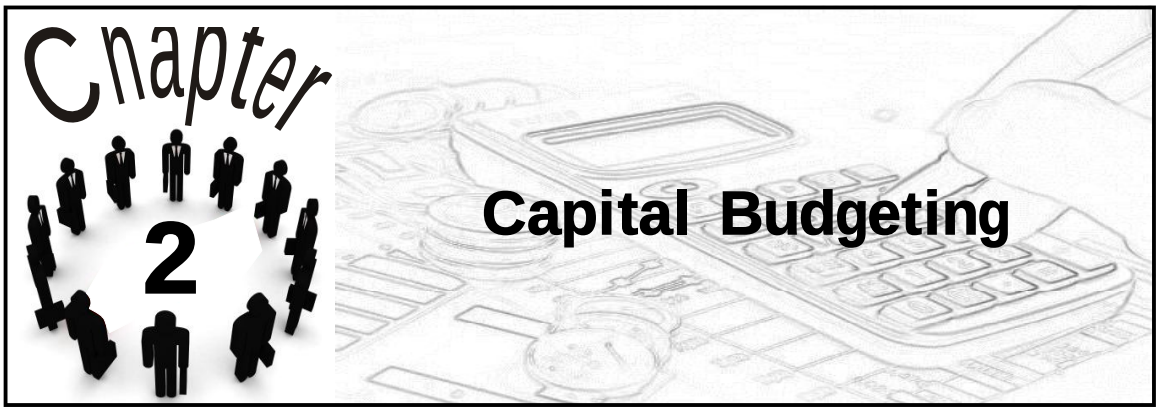


Introduction

Shri Shakti LPG Ltd., a Mumbai based company, put up facilities to import and market liquified petroleum gas, at an estimated cost of ` 103.50 crore.

1. Tata Metaliks has set up a new Mini Blast Furnace with associated systems for manufacture of foundry grade pig iron.
2. Lupin Chemicals Ltd. has set up a project to manufacture 'RIFAMPICIN', an anti-TB drug, at an estimated cost of ` 8,250 lakh.
3. The above items, which appeared in newspapers are typical Illustrations of capital expenditure decisions, also referred to as capital budgeting or investment decisions. Such a decision may be defined as the company's decision to invest its current funds most efficiently in long-term assets in anticipation of an expected flow of benefits over a series of years. Capital expenditure decisions occupy a very important place in corporate finance for the following reasons:
   - Once the decision is taken, it has far-reaching consequences which extend over a considerably long period, and influences the risk complexion of the firm.
   - These decisions involve huge amounts of money.
   - These decisions are irreversible once taken.
   - These decisions are among the most difficult to make when the company is faced with various potentially viable investment opportunities.

While capital expenditure decisions are extremely important, managers find it extremely difficult to analyze the pros and cons and arrive at a decision because:

1. Measuring costs and benefits of an investment proposal whether it be for a mini-steel plant or a library is difficult because all costs and benefits cannot be expressed in tangible terms.
2. The benefits of capital expenditure are expected to occur for a number of years in the future which is highly uncertain.

3. Because the costs and benefits occur at different points of time, investment proposal, for a proper analysis of the viability of the all these have to be brought to a common time-frame. Hence time value of money becomes very relevant here.

The investment decision starts with the identification of investment opportunities and culminates in performance review after the project is implemented and operations are stabilized.

Once the project has been implemented, the trial run is successful, and commercial production is started, a review of the actual performance with the performance projected in the feasibility study is required. This is an integral and vital part of project management because:

1. It throws light on how realistic were the assumptions underlying the project.
2. It is a valuable tool for decision-making in future.

MARKET APPRAISAL

The market appraisal is attempted to answer two important questions:

What is the size of the total market for the proposed product or service?

What will be the project's share of the total market?

Answers to both these questions are equally important because a dominant position in a rapidly shrinking market is certainly not a better proposition than a meagre share of a large market. To answer these questions, the market analyst compiles and analyzes the data relating to the following aspects:

- Past and present consumption trends
- Present and prospective supply position
- Level of imports and exports
- Structure of competition
- Price and cross-elasticity of demand
- Consumer requirements, and
- Production constraints.

Technical Appraisal: As the name suggests, this appraisal is done to ensure that all technical aspects related to the successful commissioning of the project have been taken care of. The important issues considered in this appraisal are:

- Availability of the required quality and quantity of raw materials and other inputs;
- Availability of utilities like power, water, etc.;
- Appropriateness of the plant design and layout;
- The proposed technology vis-à-vis the alternative state-of-the-art technologies available;
- Optimality of the scale of operations;

- The technical specifications of the plant and machinery in relation to the proposed technology; and
- Assembly line balancing.

Economic Appraisal: In addition to financial appraisal, most of the projects sponsored by government authorities are subjected to a social cost benefit analysis (otherwise known as economic appraisal) to adjudge whether the project is desirable from the social point of view. Some of the issues considered in this analysis are:

- Impact of the project on the distribution of income in society,
- Impact of the project on the level of savings and investment in the society, and
- Contribution of the project towards socially desirable objectives like self-sufficiency, employment, etc.
- For the successful implementation of a project, each step of the capital budgeting process is equally important. As students of Corporate Finance, we must be aware of all the aspects of Project Management, and be thoroughly proficient to appraise a project in relation to its financial aspects.

Financial Appraisal: The financial appraisal looks at return and risk characterising the project and examines whether the risk adjusted return exceeds the cost of financing the project. For this purpose, the financial analyst compiles data on the cost of project, means of financing, and projected revenues and costs. Based on this data, he works out the net cash flows expected from the project and appraises these cash flows in terms of various criteria of merit like payback, IRR, etc.

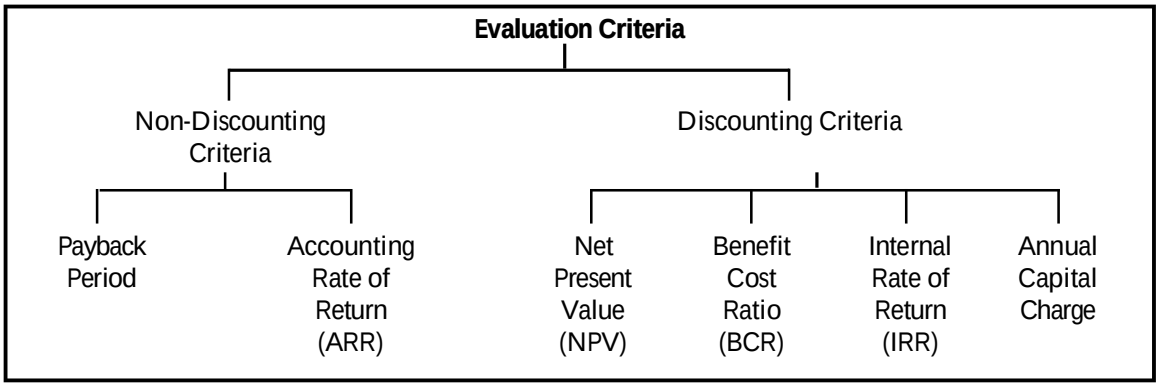
CAPITAL BUDGETING

- Capital Budgeting is a project selection exercise performed by the business enterprise.
- Capital budgeting uses the concept of present value to select the projects.
- Capital budgeting uses tools such as payback period, net present value, internal rate of return, profitability index to select projects.

Cash Outflow: it is also known as initial investment. original cost of the project

Cash Inflow: it is also known as return on the investment or profit on project ,however in capital budgeting cash profit need to consider for making decision cash profit exclude all non cash expenses i.e., depreciation in short CASH INFLOW = NPAT + DEPRECIATION.

Capital Budgeting Tools



- Payback Period
- Accounting Rate of Return
- Net Present Value
- Profitability Index
- Internal Rate of Return

1. Payback Period: Payback period is the time duration required to recoup the investment committed to a project. Business enterprises following payback period use "stipulated payback period", which acts as a standard for screening the project. Computation of Payback Period

When the cash inflows are uniform the formula for payback period is cash outflow divided by

- When the cash inflows are uneven, the cumulative cash inflows are to be arrived at and then the payback period has to be calculated through interpolation.

  Payback period formula =

  Year Prior to full recovery + Balance of initial out lay to be recovered

  Of initial out lay at the beginning of the year in which full recovery takes place

  Cash inflow of the year in which full recovery takes place

- Here payback period is the time when cumulative cash inflows are equal to the outflows.

  The payback period measures the length of time required to recover the initial outlay in the project. For example, if a project with a life of 5 years involves an initial outlay of ` 20 lakh and is expected to generate a constant annual inflow of ` 8 lakh, the payback period of the project = 20/8 = 2.5 years. On the other hand if the project is expected to generate annual inflows of, say ` 4 lakh, ` 6 lakh, ` 10 lakh, ` 12 lakh and ` 14 lakh over the 5 year period the payback period will be equal to 3 years because the sum of the cash inflows over the first three years is equal to the initial outlay.

In order to use the payback period as a decision rule for accepting or rejecting the projects, the firm has to decide upon an appropriate cut-off period. Projects with payback periods less than or equal to the cut-off period will be accepted and others will be rejected. The payback period is a widely used investment appraisal criterion for the following reasons:

- It is simple in both concept and application;
- It helps in weeding out risky projects by favoring only those projects which generate substantial inflows in earlier years.

The payback period criterion however suffers from the following serious shortcomings:

It fails to consider the time value of money, the importance of which has already been discussed at length

The payback period criterion however suffers from the following serious shortcomings:

It fails to consider the time value of money, the importance of which has already been discussed at length

- The cut-off period is chosen rather arbitrarily and applied uniformly for evaluating projects regardless of their life spans. Consequently the firm may accept too many short-lived projects and too few long-lived ones.
- Since the application of the payback criterion leads to discrimination against projects which generate substantial cash inflows in later years, the criterion cannot be considered as a measure of profitability.

To incorporate the time value of money in the calculation of payback period some firms compute what is called the "discounted payback period". In other words, these firms discount the cash flows before they compute the payback period. For instance if a project involves an initial outlay of ` 10 lakh, and is expected to generate a net annual inflow of ` 4 lakh for the next 4 years, the discounted pay back will be that value of 'n' for which

$4 \times PVIFA (12, n) = 10$ .....(1)

Assuming the cost of funds to be 12 per cent.

Equation (1) can be re-written as

$PVIFA (12, n) = 2.5$

From PVIFA Tables, we find that

$PVIFA (12,3) = 2.402$

$PVIFA (12,4) = 3.037$

Therefore, 'n' lies between 3 and 4 years and is approximately equal to 3.15 years1[6]. We find the discounted payback period is longer than the undiscounted payback period which will be 2.5 years in this case.

Evaluating the discounted payback period as an appraisal criterion, we find it to be a whisker better than the undiscounted payback period. It considers the time value of money

and thereby does not give an equal weight to all flows before the cut-off date. But it still suffers from the other shortcomings of the payback period. This criterion also depends on the choice of an arbitrary cut-off date and ignores all cash flows after that date. In practice, companies do not give much importance to the payback period as an appraisal criteria.

$$n = 3 + (4 - 3) \times \frac{2.500 - 2.402}{(3.037 - 2.402)} = 3.15$$

Illustration 1. The following details are available in respect of the cash flows of two projects A & B.

Year	Project A Cash flows (`)	Project B Cash flows (`)
0	(4,00,000)	(5,00,000)
1	2,00,000	1,00,000
2	1,75,000	2,00,000
3	25,000	3,00,000
4	2,00,000	4,00,000
5	1,50,000	2,00,000

Computer pay back period for A and B Solutions:

Year	Project A		Project B	
	Cash flows (`)	Cumulative cash flows	Cash flows (`)	Cumulative cash flows
1	2,00,000	2,00,000	1,00,000	1,00,000
2	1,75,000	3,75,000	2,00,000	3,00,000
3	25,000	4,00,000	3,00,000	6,00,000
4	2,00,000	6,00,000	4,00,000	10,00,000
5	1,50,000	7,50,000	2,00,000	12,00,000

From the cumulative cash flows column project A recovers the initial cash outlay of ` 4,00,000 at the end of the third year. Therefore, payback period of project A is 3 years.

From the cumulative cash flow column the initial cash outlay of ` 5,00,000 lies between 2nd year and 3rd year in respect of project B. Therefore, payback period for project B is:

$$= 2 + \frac{5,00,000 - 3,00,000}{3,00,000}$$

= 2.67 years

Merits:

1. Simple in concept and application.
2. Since emphasis is on recovery of initial cash outlay it is the best method for evaluation of projects with very high uncertainty.

3. With respect to accept or reject criterion pay back method favors a project which is less than or equal to the standard pay back set by the management. In this process early cash flows get due recognition than later cash flows. Therefore, payback period could be used as a tool to deal with the ranking of projects on the basis of risk criterion.
4. For firms with shortage funds this is preferred because it measures liquidity of the project.

Demerits:

1. It ignores time value of money.
2. It does not consider the cash flows that occur after the payback period.
3. It does not measure the profitability of the project.
4. It does not throw any light on the firm's liquidity position but just tells about the ability of the project to return the cash out lay originally made.
5. Project selected on the basis of pay back criterion may be in conflict with the wealth maximization goal of the firm.

Accept or Reject Criterion: (a) If projects are mutually exclusive, select the project which has the least payback period.

(b) In respect of other projects, select the project which have payback period less than or equal to the standard pay back stipulated by the management.

Illustration 2. Following details are available Payback period:

Project A = 3 years

Project B = 2.5 years

Standard set up by management = 3 years

If projects are mutually exclusive, accept project B which has the least payback period.

If projects are not mutually exclusive, accept both the project because both have payback period less than or equal to original to the standard payback period set by the management

Discounted Pay Back Period: The length in years required to recover the initial cash out lay on the present value basis is called the discounted payback period. The opportunity cost of capital is used for calculating present values of cash inflows.

Discounted payback period for a project will be always higher than simple payback period because the calculation of discounted payback period is based on discounted cash flows.

For example:

Year	Project A Cash flows	PV factor at 10%	PV of Cash flows	Cumulative positive Cash flows
0	(4,00,000)	1	(4,00,000)	–
1	2,00,000	0.909	1,81,800	1,81,800
2	1,75,000	0.826	1,44,550	3,26,350
3	25,000	0.751	18,775	3,45,125
4	2,00,000	0.683	1,36,600	4,81,725
5	1,50,000	0.621	93,150	5,74,875

Discounted Payback period:

$$3 + \frac{4,00,000 - 3,45,125}{1,36,600} = 3.4 \text{ years}$$

2. Accounting Rate of Return: Accounting rate of return is the rate arrived at by expressing the average annual net profit (after tax) as given in the income statement as a percentage of the total investment or average investment. The accounting rate of return is based on accounting profits. Accounting profits are different from the cash flows from a project and hence, in many instances, accounting rate of return might not be used as a project evaluation decision. Accounting rate of return does find a place in business decision making when the returns expected are accounting profits and not merely the cash flows.

The accounting rate of return or the book rate of return is typically defined as follows:

Accounting Rate of Return (ARR) = Average Profit after Tax/Average book value of the investment.

To use it as an appraisal criterion, the ARR of a project is compared with the ARR of the firm as a whole or against some external yard-stick like the average rate of return for the industry as a whole. To illustrate the computation of ARR consider a project with the following data:

(Amount in `)

Year	0	1	2	3
Investment	(90000)			
Sales Revenue		120000	100000	80000
Operating expenses (excluding depreciation)		60000	50000	40000
depreciation		30000	30000	30000
Annual Income		30000	20000	10000

Average annual income $= \frac{30,000 + 20,000 + 10,000}{3} = 20,000$

$$\text{Average net book value of investment} = \frac{90,000 + 0}{2} = 45,000$$

$$\text{Accounting rate of return} = \frac{(20,000)}{(45,000)} \times 100 = 44 \text{ per cent}$$

The firm will accept the project if its target average rate of return is lower than 44 per cent.

As an investment appraisal criterion, ARR has the following merits:

- Like payback criterion, ARR is simple both in concept and application. It appeals to businessmen who find the concept of rate of return familiar and easy to work with rather than absolute quantities.
- It considers the returns over the entire life of the project and therefore serves as a measure of profitability (unlike the payback period which is only a measure of capital recovery).

This criterion, however, suffers from several serious defects. First, this criterion ignores the time value of money. Put differently, it gives no allowance for the fact that immediate receipts are more valuable than the distant flows and results giving too much weight to the more distant flows. Second, the ARR depends on accounting income and not on the cash flows. Since cash flows and accounting income are often different and investment appraisal emphasizes cash flows, a profitability measure based on accounting income cannot be used as a reliable investment appraisal criterion. Finally, the firm using ARR as an appraisal criterion must decide on a yard-stick for judging a project and this decision is often arbitrary. Often firms use their current book-return as the yard-stick for comparison. In such cases if the current book return of a firm tends to be unusually high or low, then the firm can end up rejecting good projects or accepting bad projects.

ARR measures the profitability of investment (project) using information taken from financial statements:

$$\text{ARR} = \frac{\text{Average income}}{\text{Average investment}} - \frac{\text{Average of post tax operating profit}}{\text{Average investment}}$$

$$\text{Average investment} = \frac{\text{Book value of the investment in the begnning} + \text{Book value of investment of the .. the of prposal in investment}}{2}$$

Illustration 3.

The following particular refer to two projects:

	X	Y
Cost	40,000	60,000
Estimated life	5 years	5 years
Salvage value	` 3,000	` 3,000

Estimate income After tax	`	`
1	3,000	10,000
2	4,000	8,000
3	7,000	2,000
4	6,000	6,000
5	8,000	5,000
Total	28,000	31,000
Average	5,600	6,200
Average investment	21,500	31,500

$$ARR = \frac{5,600}{21,500} \quad \frac{6,200}{31,500}$$

$$= 26\% \qquad 19.7\%$$

Merits of Accounting Rate of Return:

1. It is based on accounting information.
2. Simple to understand.
3. It considers the profits of entire economic life of the project.
4. Since it is based on accounting information the business executives familiar with the accounting information understand this technique.

Demerits:

1. It is based on accounting income and not based on cash flows, as the cash flow approach is considered superior to accounting information based approach.
2. It does not consider the time value of money.
3. Different investment proposals which require different amounts of investment may have the same accounting rate of return. The ARR fails to differentiate projects on the basis of the amount required for investment.
4. ARR is based on the investment required for the project. There are many approaches for the calculation of denominator of average investment. Existence of more than one basis for arriving at the denominator of average investment may result in adoption of many arbitary bases.

Because of this the reliability of ARR as a technique of appraisal is reduced when two projects with the same ARR but with differing investment amounts are to be evaluated.

Accept or reject criterion: Any project which has an ARR more the minimum rate fixed by the management is accepted. If actual ARR is less than the cut rate (minimum rate specified by the management) then that project is rejected. When projects are to be ranked for deciding

on the allocation of capital on account of the need for capital rationing, project with higher ARR are preferred to the ones with lower ARR.

Discounted cash flow method: Discounted cash flow method or time adjusted technique is an improvement over the traditional techniques. In evaluation of the projects the need to give weightage to the timing of return is effectively considered in all DCF methods. DCF methods are cash flow based and take the cognizance of both the interest factors and cash flow after the payback period.

DCF Technique Involves the following:

1. Estimation of cash flows, both inflows and outflows of a project over the entire life of the project.
2. Discounting the cash flows by an appropriate interest factor (discount factor).
3. Sum of the present value of cash outflows is deducted from the sum of present value of cash inflows to arrive at net present value of cash flows. The most popular techniques of DCF methods are:

DCF methods are of 3 types:

1. The net present value.
2. The internal rate of return.
3. Profitability index.

3. Net Present Value (NPV): NPV method recognizes the time value of money. It correctly admits that cash flows occurring at different time periods differ in value. Therefore, there is the need to find out the present values of all cash flows.

NPV method is the most widely used technique among the DCF methods.

Steps involved in NPV method:

1. Forecast the cash flows, both inflows and outflows of the projects to be taken up for execution.
2. Decisions on discount factor or interest factor. The appropriate discount rate is the firm's cost of capital or required rate of return expected by the investors.
3. Compute the present value of cash inflows and outflows using the discount factor selected.
4. NPV is calculated by subtracting the PV of cash outflows from the present value of cash inflows.

Accept or Reject Criterion: If NPV is positive, the project should be accepted. If NPV is negative the project should be rejected.

Accept or reject criterion can be summarized as given below:

1. NPV > Zero = accept
2. NPV < Zero = reject

NPV method can be used to select between mutually exclusive projects by examining whether incremental investment generates a positive net present value.

Merits of NPV Method:

1. It takes into account the time value of money.
2. It considers cash flows occurring over the entire life of the project.
3. NPV method is consistent with the goal of maximizing the net wealth of the company.
4. It analyses the merits of relative capital investments.
5. Since cost of capital of the firm is the hurdle rate, the NPV ensures that the project generates profits from the investment made for it.

Demerits:

1. Forecasting of cash flows is difficult as it involves dealing with the effect of elements of uncertainties on operating activities of the firm.
2. To decide on the discounting factor, there is the need to assess the investor's required rate of return. But it is not possible to compute the discount rate precisely.
3. There are practical problems associated with the evaluation of projects with unequal lives or under funds' constraints.

For ranking of projects under NPV approach the project with the highest positive NPV is preferred to that with lower NPV.

We have already discussed the concept of present value and the method of computing the present value in the chapter on time value of money. The net present value is equal to the present value of future cash flows and any immediate cash outflow. In the case of a project, the immediate cash flow will be investment (cash outflow) and the net present value will be therefore equal to the present value of future cash inflows minus the initial investment. The following illustration illustrates this point.

Illustration 4. Consider the project cost ` 12,500 and expected inflow of ` 5,100, ` 5,100, ` 5,100, and ` 7,100 for 1, 2, 3 & 4 year respectively. Compute the net present value of the project, if the cost of funds to the firm is 12 per cent.

Solution: The net cash flows of the project and their present values are as follows:

Year	1	2	3	4
Net cash flow (`)	5100	5100	5100	7100
PVIF @ k = 12%	0.893	0.797	0.712	0.636
Present value (`)	4554	4065	3631	4516

Net present value = (–12,500) + (4,554 + 4,065 + 3,631 + 4,516)

= ` (–12,500 + 16,766)

= ` 4,266

The decision rule based on the NPV criterion is obvious. A project will be accepted if its NPV is positive and rejected if its NPV is negative. Rarely in real life situations, we encounter a project with NPV exactly equal to zero. If it happens, theoretically speaking, the decision-maker is supposed to be either indifferent in accepting or rejecting the project. But in practice, NPV in the neighborhood of zero, calls for a close review of the projections made in respect of such parameters that are critical to the viability of the project because even minor adverse variations can mar the viability of such marginally viable projects.

The NPV is a conceptually sound criterion of investment appraisal because it takes into account the time value of money and considers the cash flow stream in its entirety. Since net present value represents the contribution to the wealth of the shareholders, maximizing NPV is congruent with the objective of investment decision making viz., maximization of shareholders' wealth. The only problem in applying this criterion appears to be the difficulty in comprehending the concept per se. Most non-financial executives and businessmen find 'Return on Capital Employed' or 'Average Rate of Return' easy to interpret compared to absolute values like the NPV.

Illustration 5. A project costs ` 25,000 and is expected to generate cash inflows as:

Year	Cash in flows (`)
1	10,000
2	8,000
3	9,000
4	6,000
5	7,000

The cost of capital is 12%. The present value factors are:

Year	PV factor at 12%
1	0.893
2	0.797
3	0.712
4	0.636
5	0.567

Compute the NPV of the project.

Solution:

Year	Cash flows	PV factor at 12 %	PV of Cash flows
1	10,000	0.893	8,930
2	8,000	0.797	6,376
3	9,000	0.712	6,408
4	6,000	0.636	3,816
5	7,000	0.567	3,969

Sum of the present value of cash inflows	29,499
Less: Sum of the present value of cash outflows	25,500
NPV	4,499

The project generates a positive NPV of ` 4,499. Therefore, project should be accepted.

Illustration 6. A company is evaluating two alternatives for distribution within the plant. Two alternatives are:

1. C system with a high initial cost but low annual operating costs.
2. F system which costs less but have considerably higher operating costs.

The decision to construct the plant has already been made, and the choice here will have no effect on the overall revenues of the project. The cost of capital of the plant is 12% and the projects expected net cash costs are listed below:

Year	Expected Net C Systems	Cash Costs F Systems
0	(3,00,000)	(1,20,000)
1	(66,000)	(96,000)
2	(66,000)	(96,000)
3	(66,000)	(96,000)
4	(66,000)	(96,000)
5	(66,000)	(96,000)

What is the present value of costs of each alternative?

Which method should be chosen?

Solution: Computation of present value

Year	C Systems	F Systems	Incremental
1	(66,000)	(96,000)	30,000
2	(66,000)	(96,000)	30,000
3	(66,000)	(96,000)	30,000
4	(66,000)	(96,000)	30,000
5	(66,000)	(96,000)	30,000

Present value of incremental savings = 30,000 × PVIFA (12%, 5)

= 30,000 × 3.605 = 1,08,150

Incremental cash out lay $= \frac{1,80,000}{(71,850)}$

Since the present value of incremental net cash inflows of C system over F system is negative. C system is not recommended.

Therefore, F system is recommended.

Properties of the NPV:

1. NPVs are additive. If two projects A and B have NPV (A) and NPV (B) then by additive rule the net present value of the combined investment is NPV (A + B).
2. Intermediate cash inflows are reinvested at a rate of return equal to the cost of capital.

Demerits of NPV:

1. NPV expresses the absolute positive or negative present value of net cash flows. Therefore, it fails to capture the scale of investment.
2. In the application of NPV rule in the evaluation of mutually exclusive projects with different lives, bias occurs in favour of the long term projects.

4. Profitability Index: Profitability index (PI), also known as profit investment ratio (PIR), Benefit cost ratio (BCR) and value investment ratio (VIR), is the ratio of payoff to investment of a proposed project. It is a useful tool for ranking projects because it allows you to quantify the amount of value created per unit of investment. Profitability index is the ratio of the present value of cash inflows to initial cash outlay. The discount factor based on the required rate of return is used to discount the cash inflows.

$$PI = \frac{\text{Present value of cash inflows}}{\text{Initial cah out lay}}$$

Accept or Reject Criterion

1. Accept the project if PI is greater than 1
2. Reject the project if PI is less than 1

If profitability index is 1 then the management may accept the project because the sum of the present value of cash inflows is equal to the sum of present value of cash outflows. It neither adds nor reduces the existing wealth of the company.

Merits of PI:

1. It takes into account the time value of money
2. It is consistent with the principle of maximization of share holders wealth.
3. It measures the relative profitability.

Demerits:

1. Estimation of cash flows and discount rate cannot be done accurately with certainty.
2. A conflict may arise between NPV and profitability index if a choice between mutually exclusive projects has to be made.

For example, given:

- Investment = $40,000
- Life of the Machine = 5 Years

CFAT Year	CFAT
1	18000
2	12000
3	10000
4	9000
5	6000

Calculate Net present value at 10% and PI:

Year	CFAT	PV@10%	PV
1	18000	0.909	16362
2	12000	0.827	9924
3	10000	0.752	7520
4	9000	0.683	6147
5	6000	0.621	3726

Total present value	43679
(-) Investment	40000
NPV	3679

PI = 43679/40000

= 1.091

= >1

= Accept the project

Illustration 7.

	X	Y
PV of cash inflows	4,00,000	2,00,000
Initial cash outlay	2,00,000	80,000
NPV	2,00,000	1,20,000
Profitability index	2	2.5

As per NPV method project X should be accepted. As per profitability index project Y should be accepted. This leads to a conflicting situation. The NPV method is to be preferred to profitability index because the NPV represents the net increase in the firm's wealth.

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

Year	Cash inflows
1	3,50,000
2	8,00,000
3	2,50,000

Apply the discount rate of 12% and calculate profitability index.

Solution: Present Value of Cash out flows.

Year	PV factor at 12 %	Cash out flows	PV of Cash flows
1		` 8 lakhs	` 8 lakhs
2			
3	0.712	2 lakhs	1.424 lakhs
		Total	9.424 lakhs

Present Value of Cash inflows

Year	PVIF (12%)	Cash inflows	PV of Cash flows
1	0.893	3,50,000	3.1255 lakhs
2	0.797	8,00,000	6.376 lakhs
4	0.636	2,50,000	1.5900 lakhs
		Total	11.0915 lakhs

$$n = \frac{\text{Total of present value of cash inflows}}{\text{Total of present value of cash outflows}}$$

$$= \frac{11.0915}{9.424} = 1.177$$

For every Re. 1 invested the project is expected to give a cash inflow of ` 1.177 i,e for every rupee invested a profit of ` 0.177 is obtained.

5. Internal Rate of Return: The internal rate of return (IRR) is a rate of return used in capital budgeting to measure and compare the profitability of investments. It is also called the discounted cash flow rate of return (DCFROR) or simply the rate of return (ROR). In the context of savings and loans the IRR is also called the effective interest rate. The term internal refers to the fact that its calculation does not incorporate environmental factors (e.g., the interest rate or inflation).

IRR is also called yield on investment, managerial efficiency of capital, marginal productivity of capital, rate of return, time adjusted rate of return. IRR is the rate of return that a project earns.

Evaluation of IRR

1. IRR takes into account the time value of money.
2. IRR calculates the rate of return of the project, taking into account the cash flows over the entire life of the project.
3. It gives a rate of return that reflects the profitability of the project.
4. It is consistent with the goal of financial management i,e maximization of net wealth of share holders.
5. IRR can be compared with the firm's cost of capital.
6. To calculate the NPV the discount rate normally used is cost of capital. But to calculate IRR, there is no need to calculate and employ the cost of capital for discounting because the project is evaluated at the rate of return generated by the project. The rate of return is internal to the project.

Demerits:

1. IRR does not satisfy the additive principle.
2. Multiple rates of return or absence of a unique rate of return in certain projects will affect the utility of this techniques as a tool of decision making in project evaluation.
3. In project evaluation, the projects with the highest IRR are given preference to the ones with low internal rates.

   Application of this criterion to mutually exclusive projects may lead under certain situations to acceptance of projects of low profitability at the cost of high profitability projects.
4. IRR computation is quite tedious.

Accept or Reject Criterion: If the project's internal rate of return is greater than the firm's cost of capital, accept the proposal. Otherwise reject the proposal.

IRR can be determined by solving the following equation for r =

$$CF_0 = \sum \frac{C_1}{(1+r)^1} \text{ where, t = 1 to n}$$

CF_0 = Investment

Sum of the present values of cash inflows at the rate of interest of r =

$$CF_0 = \sum \frac{C_1}{(1+r)^1} \text{ where, t = 1 to n}$$

Illustration 9. A project requires an initial out lay of ` 1,00,000. It is expected to generate the following cash inflows:

Year	Cash inflows
1	50,000
2	50,000
3	30,000
4	40,000

What is the IRR of the project?

Step 1: Compute the average of annual cash inflows.

Year	Cash inflows
1	50,000
2	50,000
3	30,000
4	40,000
Total	1,70,000

$$\text{Average} = \frac{1,70,000}{4} = ` 42,500$$

Step 2: Divide the initial investment by the average of annual cash inflows:

$$= \frac{1,00,000}{42,500} = 235$$

Step 3: From the PVIFA table for 4 years, the annuity factor very near 2.35 is 25%. Therefore the first initial rate is 25%.

Year	Cash flows	PV factor at 25 %	PV of Cash flows
1	50,000	0.800	40,000
2	50,000	0.640	32,000
3	30,000	0.512	15,360
4	40,000	0.410	16,400
		Total	1,03,760

Since the initial investment of ` 1,00,000 is less than the computed value at 25% of ` 1,03,760 the next trial rate is 26%.

Year	Cash flows	PV factor at 25 %	PV of Cash flows
1	50,000	0.7937	39,685
2	50,000	0.6299	31,495
3	30,000	0.4999	14,997
4	40,000	0.3968	15,872
		Total	1,02,049

The next trial rate is 27%

Year	Cash flows	PV factor at 25 %	PV of Cash flows
1	50,000	0.7874	39,370
2	50,000	0.6200	31,000
3	30,000	0.4882	14,646
4	40,000	0.3844	15,376
		Total	1,00,392

The next trial rate is 28%

Year	Cash flows	PV factor at 25 %	PV of Cash flows
1	50,000	0.7813	39,065
2	50,000	0.6104	30,520
3	30,000	0.4768	14,3047
4	40,000	0.3725	14,900
		Total	98,789

Since initial investment of ` 1,00,000 lies between 98789 (28%) and 1,00,392 (27%) the IRR by interpolation.

$$= 27 + \frac{1,00,392 - 1,00,000}{1,00,392 - 98,789} \times 1$$

$$= 27 + \frac{392}{1,603} \times 1$$

$$= 27 + 0.2445$$

$$= 27.2445 = 27.24\ \%$$

Modified Internal Rate of Return

MIRR is a distinct improvement over the IRR. Managers find IRR intuitively more appealing than the rupees of NPV because IRR is expressed on a percentage rates of return. MIRR modifies IRR. MIRR is a better indicator of relative profitability of the projects.

MIRR is defined as

PV of Costs = PV of terminal value

$$PVC = \frac{TV}{(1 + MIRR)^n}$$

PVC = PV of costs

To calculate PVC, the discount rate used is the cost of capital.

To calculate the terminal value, the future value factor is based on the cost of capital.

Then obtain MIRR on solving the following equation.

$$\text{PV of Costs} = \frac{TV}{(1+MIRR)^n}$$

Superiority of MIRR over IRR

1. MIRR assumes that cash flows from the project are reinvested at the cost of capital. The IRR assumes that the cash flows from the project are reinvested at the projects own IRR. Since reinvestment at the cost of capital is considered realistic and correct, the MIRR measures the project's true profitability
2. MIRR does not have the problem of multiple rates which we come across in IRR.

Illustration 10.

Year	0	1	2	3	4	5	6
Cash flows (` in million)	(100)	(100)	30	60	90	120	130

Illustration 11. A project has the following pattern of cash flows:

Year	Cash flow (` in lakh)
0	(10)
1	5
2	5
3	3.08
4	1.20

What is the IRR of this project?

Solution: To determine the IRR, we have to compute the NPV of the project for different rates of interest until we find that rate of interest at which the NPV of the project is equal to zero or sufficiently close to zero. To reduce the number of iterations involved in this trial and error process, we can use the following short-cut procedure:

Step 1: Find the average annual net cash flow based on the given future net cash flows. In our illustration, the average annual net cash flow will be equal to:

(5 + 5 + 3.08 + 1.20)/4 = 3.57

Step 2: Divide the initial outlay by the average annual net cash flow i.e., 10/3.57 = 2.801

Step 3: From the PVIFA table find that interest rate at which the present value of an annuity of Re.1 will be nearly equal to 2.801 in 4 years i.e., the duration of the project. In our case, this rate of interest will be equal to 15%.

We use 15% as the initial value for starting the trial and error process and keep trying at successively higher rates of interest until we get an interest rate at which the NPV is marginally above zero and an interest rate at which the NPV is marginally below zero. Now

we know that IRR lies between the two rates of interest and using a linear approximation, we can determine the approximate value of the IRR. In the case of our project, the

NPV at r = 15% will be equal to:

$$-10 + (5 \times 0.870) + (5 \times 0.756) + (3.08 \times 0.658) + (1.2 \times 0.572)$$

$$= 0.84$$

NPV at r = 16% will be equal to:

$$-10 + (5 \times 0.862) + (5 \times 0.743) + (3.08 \times 0.641) + (1.2 \times 0.552) = 0.66$$

NPV at r = 18% will be equal to:

$$-10 + (5 + 9 \times 0.848) + (5 \times 0.719) + (3.08 \times 0.609) + (1.20 \times 0.516)$$

$$= 0.33$$

NPV at r = 20% will be equal to:

$$-10 + (5 \times 0.833) + (5 \times 0.694) + (3.08 \times 0.579) + (1.20 \times 0.482) = 0$$

We find that at r = 20%, the NPV is zero and therefore the IRR of the project is 20%.

To use IRR as an appraisal criterion, we require information on the cost of capital or funds employed in the project. If we define IRR as 'r' and cost of funds employed as 'k', then the decision rule based on IRR will be: Accept the project if 'r' is greater than k and reject the project if r is less than k. (If r = k, it is a matter of indifference).

IRR is a popular method of investment appraisal and has a number of merits like:

- It takes into account the time value of money.
- It considers the cash flow stream over the entire investment horizon.
- Like ARR, it makes sense to businessmen who prefer to think in terms of rate of return on capital employed.

This criterion however suffers from the following limitations:

IRR is uniquely defined only for a project whose cash flow pattern is characterized by cash outflow(s) followed by cash inflows (such projects are called simple investments). If the cash flow stream has one or more cash outflows interspersed with cash inflows, there can be multiple internal rates of return. This point can be clarified with the help of the following table 1 where four projects with different patterns of cash flows are given:

Table 1

(`in lakh)

Project	Cash Flow Stream (`)				
	Year 0	Year 1	Year 2	Year 3	Year 4
A	–20	5	10	15	15
B	–10	–10	15	15	15
C	–10	5	–10	20	20
D	–10	15	10	–5	20

- Projects A and B are simple investments and therefore will have unique IRR values. But projects C and D can have multiple internal rates of return because their cash inflows and outflows are interspersed. For such projects, IRR cannot be a meaningful criterion of appraisal.
- The IRR criterion can be misleading when the decision-maker has to choose between mutually exclusive projects that differ significantly in terms of outlays.

In spite of these defects, IRR is still the best criterion today to appraise a project financially. Financial Institutions insist that projects having substantial outlay specially in the medium and large scale sectors must show the computation of IRR in the Detailed Project Report, which they appraise before sanctioning financial assistance.

Illustration 12. Anand, a chemical engineer with 15 years of experience, and Prakash, a pharmacy graduate with 18 years of experience, are evaluating a pharmaceutical formulation. They have estimated the total outlay on the project to be as follows:

Plant & Machinery	:	` 36 lakh
Working Capital	:	` 24 lakh
The proposed scheme of financing is	:	
Equity Capital	:	` 16 lakh
Term Loan	:	` 26 lakh
Trade Credit	:	` 8 lakh
Working Capital Advance	:	` 10 lakh

The project has an expected life of 10 years. Plant & Machinery will be depreciated at the rate of $33^1/_3$ per cent per annum as per the written down value method. The expected annual sales would be ` 80 lakh, and the cost of sales (including depreciation but excluding interest) is expected to be ` 50 lakh per year. The tax rate of the company will be 50 per cent. Term-loan will carry 14 per cent interest and will be repayable in 5 equal annual installments, beginning from the end of the first year. Working capital advance will carry an interest rate of 17 per cent and, thanks to the 'rollover' phenomenon, will have an indefinite maturity. Define the cash flows for the first three years from the long-term funds point of view.

Solution: Net Cash Flows Relating to Long-term Funds.

(`in lakh)

Year		0	1	2	3
A.	Investment	(42.00)			
B.	Sales		80.00	80.00	80.00
C.	Operating costs (excluding depreciation)		38.00	42.00	44.67
D.	Depreciation		12.00	8.00	5.33
E.	Interest on working capital advance		1.70	1.70	1.70
F.	Profit before tax		28.30	28.30	28.30
G.	Tax		14.15	14.15	14.15
H.	Profit after tax		14.15	14.15	14.15
I.	Initial flow	(42.00)			
K.	Operating flow (= H + D) + I(1 – t)		26.15	22.15	19.48
L.	Net cash flow (= I + K)	(42.00)	26.15	22.15	19.48

Notes: The investment outlay has to be considered from the point of view of the suppliers of long-term funds. In the given Illustration, we find that ` 18 lakh out of the investment of ` 24 lakh in current assets is financed by way of trade-credit and working capital advance. The difference of ` 6 lakh is called the working-capital margin i.e., the contribution of the suppliers of long-term funds towards working capital. Therefore, the investment outlay relevant from the long-term funds point of view will be equal to investment in plant and machinery + working capital margin = ` 42 lakh.

Since depreciation is a non-cash charge which has to be added to the profit after tax, this charge must be disclosed separately in the cash flow statement and not clubbed with other operating costs. Further, the depreciation charge to be considered here will be the tax-relevant charge. In other words, the depreciation must be computed in accordance with the method and rate(s) prescribed by the Income Tax Act, 1961.

While interest on long-term debt must be excluded for reasons discussed earlier, interest on short-term bank borrowings must be included in the cash flow statement.

In the Illustration discussed above, we have defined the cash flows only over the first three years of the project's life. But in practice cash flows are defined over the entire project life or over a specified time horizon (if the project life is too long). If the cash flows are defined over the entire life of the project, then the estimated salvage value of the investment in plant and machinery and the working capital must be considered for determining the net cash flow in the terminal year. If the cash flows are defined over a specified time horizon, a notional salvage value is taken into account in the final year of the time horizon.

Illustration 13. A capital project involves the following outlays:

(`in lakh)

Plant and machinery	180
Working Capital	120

The proposed scheme of financing is as follows:

(`In lakh)

Equity	100
Long-term loans	104
Trade credit	36
Commercial banks	60

The project has a life of 10 years. Plant and machinery are depreciated at the rate of 15 per cent per annum as per the written down value method. The expected annual net sales is ` 350 lakh. Cost of sales (including depreciation, but excluding interest) is expected to be ` 190 lakh a year. The tax rate of the company is 60 per cent. At the end of 10 years plant and machinery will fetch a value equal to their book value and the investment in working capital will be fully recovered. The long-term loan carries an interest of 14 per cent per annum. It is repayable in eight equal annual installments starting from the end of the third year. Short-term advance from commercial banks will be maintained at ` 60 lakh; and will carry interest at 18 per cent per annum. It will be fully liquidated after 10 years. Trade credit will also be maintained uniformly at ` 36 lakh and will be fully paid back at the end of the tenth year. Calculate the cash flow stream from the long-term funds point of view.

Solution: Cash Flows Relating to Long-term Funds.

(` in lakh)

		0	1	2	3	4	5	6	7	8	9	10
A.	Investment	(204.00)										
B.	Sales		350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00
C.	Cost of sales		163.00	167.05	170.49	173.42	175.91	178.02	179.82	181.34	182.64	183.75
D.	Depreciation		27.00	22.95	19.51	16.58	14.09	11.98	10.18	8.66	7.36	6.25
E.	Profit before interest and taxes		160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00
F.	Interest on ST bank borrowing		10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80
G.	Profit before taxes		149.20	149.20	149.20	149.20	149.20	149.20	149.20	149.20	149.20	149.20
H.	Tax		89.52	89.52	89.52	89.52	89.52	89.52	89.52	89.52	89.52	89.52
I.	Profit after tax		59.68	59.68	59.68	59.68	59.68	59.68	59.68	59.68	59.68	59.68
J.	Net salvage value of fixed assets											35.44
K.	Net salvage of current assets											120.00
L.	Retirement of trade credit											(36.00)
M.	Payment of ST bank borrowing											(60.00)
N.	Net Cash Flow = –A + I + D + J + K – L M	(204.00)	86.68	82.63	79.19	76.26	73.77	71.66	69.86	68.34	67.04	125.37

Notes:

- Net salvage value of fixed assets will be equal to the salvage value of fixed assets less any income tax that may be payable on the excess of the salvage value over the book value. Likewise there will be a tax shield on the loss, if any, incurred at the time of disposing of the fixed assets. According to tax laws, the net salvage value of any individual item off plant and machinery has lost its significance and therefore for our purposes, we will ignore the impact of tax on the salvage value. In other words, we will take only the gross salvage value into consideration.

- The depreciation rate assumed in this problem is not indicative of the current rates in force. (The depreciation rates currently applicable to plant and machinery under the Income Tax Act are 25%, 40%, and 100%).
- In working out the cash flows, deduction available for a new project under Section 80 I of the Income Tax Act has been ignored.
- Our Illustrations have so far been focused on estimating cash flows for a new project. The following illustration illustrates estimation of cash flows for a replacement project.

Illustration 14. Sandals Inc. is considering the purchase of a new leather cutting machine to replace an existing machine that has a book value of ` 3,000 and can be sold for ` 1,500. The estimated salvage value of the old machine in four years would be zero, and it is depreciated on a straight-line basis. The new machine will reduce costs (before tax) by ` 7,000 per year, i.e., ` 7,000 cash savings over the old machine. The new machine has a four year life, costs ` 14,000 and can be sold for an expected amount of ` 2,000 at the end of the fourth year. Assuming straight-line depreciation, and a 40% tax rate, define the cash flows associated with the investment. Assume that the straight-line method of depreciation is used for tax purposes.

Solution: Cash Flows Associated with Replacement Decision

(in)

Year		0	1	2	3	4
1.	Net investment in new machine	(12,500)				
2.	Savings in costs		7,000	7,000	7,000	7,000
3.	Incremental depreciation		2,250	2,250	2,250	2,250
4.	Pre-tax profits		4,750	4,750	4,750	4,750
5.	Taxes		1,900	1,900	1,900	1,900
6.	Post-tax profits		2,850	2,850	2,850	2,850
7.	Initial flow (= (1))	(12,500)				
8.	Operating flow (= (6) + (3))		5,100	5,100	5,100	5,100
9.	Terminal flow					2,000
10.	Net cash flow (= (7) + (8) + (9))	(12,500)	5,100	5,100	5,100	7,100

Notes:

Computation of depreciation:

Existing leather-cutting machine

` 3,000/4 = ` 750 per annum

New leather-cutting machine

` 12,000/4 = ` 3,000 per annum

Incremental depreciation = ` 2,250 per annum.

Illustration 15. A firm is considering replacement of its existing machine by a new machine. The new machine will cost ` 1,60,000 and have a life of five years. The new machine will yield annual cash revenue of ` 2,50,000 and incur annual cash expenses of ` 1,30,000. The estimated salvage of the new machine at the end of its economic life is ` 8,000. The existing machine has a book value of ` 40,000 and can be sold for ` 20,000. The existing machine, if used for the next five years is expected to generate annual cash revenue of ` 2,00,000 and to involve annual cash expenses of ` 1,40,000. If sold after five years, the salvage value of the existing machine will be negligible.

The company pays tax at 30%. It writes off depreciation at 25% on the written down value. The company's cost of capital is 20%

Compute the incremental cash flows of replacement decisions.

Solution:

Initial Investment	
Gross investment for the new machine	(1,60,000)
Less: Cash received from the sale of	
Existing machine	20,000
Net cash outlay	(1,40,000)
Annual cash flows from operations	
Incremental cash flows from revenue	50,000
Incremental decrease in expenditure	(10,000)

Incremental Depreciation Schedule

Year	Depreciation (New Machine (`)	Depreciation (Old Machine)	Incremental Depreciation (`)
1	45,000	10,000	35,000
2	33,750	7,500	26,250
3	25,312	5,625	19,687
4	18,984	4,219	14,765
5	14,238	3,164	11,074

Depreciation is calculated as under

Book Value	40,000
Add: Cost of new machine	1,60,000
	2,00,000
Less: Sale proceeds of old machine	20,000
	1,80,000
Depreciation for I year 25%	45,000

	1,35,000
Depreciation for II year 25%	33,750
	1,01,250
Depreciation for III year 25%	25,312
	75,938
Depreciation for IV year 25%	18,984
	56,954
Depreciation for V year 25%	14,238
Book Value after 5 years	42,716

Statement of incremental Cash flows

Particulars	Year					
	0 `	1 `	2 `	3 `	4 `	5 `
1. Investment in new machine	(1,60,000)					
2. After tax salvage value of old machine	20,000					
3. Net cash out lay	(1,40,000)					
4. Increase in revenue		50,000	50,000	50,000	50,000	50,000
5. Decrease in expenses		10,000	10,000	10,000	10,000	10,000
6. Increase in depreciation		35,000	26,250	19,647	14,755	11,074
7. Increase in EBT		25,000	33,750	40,313	45,235	48,926
8. EBT (1 – T)		17,500	23,625	28,219	31,555	34,245
9. Incremental cash flows from operation (8 + 6)		52,500	49,575	47,906	46,430	45,322
10. Salvage value of near machine						8,000
11. Incremental cash flows	(1,40,000) negative	52,500	49,875	47,906	45,430	53,322

Illustration 16. Charlie Company Ltd. Wishes to buy a machine costing ` 2,00,000. The life of this machine is 10 yrs. And its scrap value would be ` 5,000.

The following details are provided;

Average Annual NPBT ` 20,000

Tax Rate 35%

Depreciation (already charged) SLM basis, Calculate:

(i) Payback period

(ii) Payback profitability

(iii) A.R.R. (Accounting Rate of Return Method)

Solution:

Statement of Annual Cash Inflow

	`
Annual NPBT	20,000
Less: Tax @ 35%	7000
NPAT	
Add: Depreciation already charged	
Cost – Scrap value	
2,00,000 – 5,000	
10 years	13000
Annual cash flow	19,500
	32,500

(i) Payback period = initial investment

Annual average cash flow

= 2,00,000

32500

= 6.154 years

(ii) Payback profitability = annual cash inflow × (estimated life – payback period)

= 32,500 – (10 – 6.154)

= ` 1,25,000

(+) Scrap 5,000

Payback profitability ` 1,30,000

(iii) Accounting rate of return = Annual PAT × 100

Average Investment

= 13,000 – 100

1,02,500

= 12.68 %

Average investment

Original investment – Scrap value

= + additional net + scrap value

2 working capital

= 2,00,000 – 5,000

+ NIL + 5,000

2

= 97,500 + 5,000

= ` 1,02,500

Illustration 17. The case flow streams for two alternative investment Tata and Bata are:

Year	Tata (`)	Bata (`)
0	(2,00,000)	(2,10,000)
1	50,000	80,000
2	80,000	60,000
3	1,00,000	80,000
4	80,000	60,000
5	60,000	80,000

Calculate the (i) Pay back period, (ii) Net present value using 11% discount rate and (iii) Benefit cost ratio using 11%discount rate, for the two alternatives. Which would you choose? Why?

Solution:

(i) Pay Back Period Method:

(When cash flows uneven)

Year	Tata		Bata	
	CFAT (`)	Cumulative CFAT (`)	CFAT (`)	Cumulative CAFT (`)
1	50,000	50,000	80,000	80,000
2	80,000	1,30,000	60,000	1,40,000
3	1,00,000	2,30,000	80,000	2,20,000
4	80,000	3,10,000	60,000	2,80,000
5	60,000	3,70,000	80,000	3,60,000

$= 2 \text{ years} + \frac{70,000}{1,00,000}$

= 2.7 years

Or

= 2 years and 8.4 months

$= 2 \text{ years} + \frac{70,000}{80,000}$

= 2.875 years

Or

= 2 years and 10.5 months

(ii) NPV

Years	PVF @ 11%	Tata		Bata	
		CFAT (`)	PVCFAT (`)	CFAT (`)	PVCFAT (`)
1	0.901	50,000	45,050	80,000	72,080
2	0.812	80,000	64,960	60,000	48,720
3	0.731	1,00,000	73,100	80,000	58,480
4	0.659	80,000	52,720	60,000	39,540
5	0.593	60,000	35,580	80,000	47,440
		PV of Cash Inflows	2,71,410		2,66,260
		Less: PV of Cash Outflows	2,00,000		2,10,000
		Net Present Values	71,410		56,260

(iii) B/C Ratio = $\frac{\text{Benefits}}{\text{Cost}} = \frac{\text{PV of Cash Inflows}}{\text{PV of Cash Outflows}}$

Tata

$= \frac{2,71,410}{2,00,000}$

= 1.35:1

Bata

$= \frac{2,66,260}{2,10,000}$

= 1.27:1

Illustration 18. Speed age Company Ltd. Is considering a project which costs ` 5,00,000.The estimated salvage value is zero. Tax rate is 55%.The company uses straight line depreciation and the proposed project has cash inflows before depreciation and tax (CFBDT) as follows:

Year end	Cash Inflows (`)
1	1,50,000
2	2,50,000
3	2,50,000
4	2,00,000
5	1,50,000

If the cost of capital is 12%, would you recommend the acceptance of the project under internal Rate of Return Method?

Solution:

Year	CFBBDT (`)	Dep. (`)	Net Earnings (`)	Tax @ 55% (`)	Net Earnings – Tax = EAT (`)	CFAT = EAT + Dep. (`)
1	1,50,000	1,00,000	50,000	27,500	22,500	1,22,500
2	2,50,000	1,00,000	1,50,000	67,500	67,500	1,67,500
3	2,50,000	1,00,000	1,50,000	67,500	67,500	1,67,500
4	2,00,000	1,00,000	1,00,000	45,000	45,000	1,45,000
5	1,50,000	1,00,000	50,000	22,500	22,500	1,22,500
					Total CFAT	7,25,000

$$\text{Fake Payback Period} = \frac{\text{Cash Outlays}}{\text{Average Annual Cash Inflows}}$$

$$= \frac{5,00,000}{\frac{(7,25,000)}{5 \text{ yrs.}}}$$

$$= 3.448$$

As per Annuity Table the PV Factors closest to 3.448 against 5 years are

At 12% 3.605

At 14% 3.433

Year	CFAT (`)	PV Factor @ 12%	PV of CFAT at 12% (`)	PV Factor @14%	PV of CFAT at 14% (`)
1	1,22,500	0.893	1,09,392.50	0.877	1,07,435.50
2	1,67,500	0.797	1,33,497.50	0.769	1,28,807.50
3	1,67,500	0.712	1,19,260.00	0.675	1,13,062.50
4	1,45,000	0.636	92,220.00	0.592	85,840.00
5	1,22,500	0.567	69,457.50	0.519	63,577.50
		Total of CFAT	5,23,827.50		4,96,720.00

$$\text{IRR} = D1 + \frac{\text{PV of CFAT D1} - \text{PV of cash outlays}}{\text{PV of CEFAT D1} - \text{PV of CFAT D2}} \times (D2 - D1)$$

$$= 12\% + \frac{5,23,827.50 - 5,00,000}{5,23,827.50 - 4,98,720} \times (14\% - 12\%)$$

$$= 12\% + \frac{23,827.50}{25,107.50} \times 2\%$$

IRR = 13.98% (approx.)

Since the IRR is higher than the cost of capital, the project is recommended to be accepted.

Illustration 19. A company is considering the two mutually exclusive projects. The finance director considers that the project with higher NPV should be chosen; whereas the managing Director thinks that one with higher rate of return should be considered. Both the projects have got a useful life of 5 years and the cost of capital is 10%. The initial outlay is ` 2 lakhs.

The Future Cash Inflow from Project X and Y are as under:

Year	Project X (`)	Project Y (`)	PV Factor @ 10%	PV Factor @ 20%
1	35,000	1,18,000	0.91	0.83
2	80,000	60,000	0.83	0.69
3	90,000	40,000	0.75	0.58
4	75,000	14,000	0.68	0.48
5	20,000	13,000	0.62	0.41

You are required to evaluate the projects and explain the inconsistency, if any, in the ranking of the projects.

Solution:

(a) Pay Back Period Method:

Year	Project X		Project Y	
	Cash inflows (`)	Cumulative Cash Inflows	Cash Inflows (`)	Cumulative Cash Inflows
1	35,000	35,000	1,18,000	1,18,000
2	80,000	1,15,000	60,000	1,78,000
3	90,000	2,05,000	40,000	2,18,000
4	75,000	2,80,000	14,000	2,32,000
5	20,000	3,00,000	13,000	2,45,000

Pay Back Period

$= 2 \text{ years} + \left(\frac{2,00,000 - 1,15,000}{90,000}\right)$

= 2.944 years or

= 2 years and 11.33 months or

= 2 years, 11 months and 10 days

$= 2 \text{ years} + \left(\frac{2,00,000 - 1,78,000}{40,000}\right)$

= 2.55 years or

= 2 years and 6.6 months or

= 2 years, 6 months and 18 days

Accept Project Y

(b) ARR:

Year	Project X			Project Y		
	Cash Inflows (`)	Depreciation	Profit After Tax (`)	Cash Inflows (`)	Depreciation	Profit After Tax (`)
1	2	3	2 – 3 = 4	5	6	5 – 6 = 7
1	35,000	40,000	(5,000)	1,18,000	40,000	78,000
2	80,000	40,000	40,000	60,000	40,000	20,000
3	90,000	40,000	50,000	40,000	40,000	Nil
4	75,000	40,000	35,000	14,000	40,000	(26,000)
5	20,000	40,000	(20,000)	13,000	40,000	(27,000)
			1,00,000			45,000

Assumption: Depreciation has been changed by Straight Line Method (SLM).

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

(Based on Original Investment)

Project X

$$= \frac{\frac{1,00,000}{5}}{2,00,000} \times 100$$

$= 10\%$

Project Y

$$= \frac{\frac{45,000}{5}}{2,00,000} \times 100$$

$= 4.5\%$

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

(Based on Average Investment)

Project X

$$= \frac{\frac{1,00,000}{5}}{\frac{2,00,000}{2}} \times 100$$

$= 20\%$

Project Y

$$= \frac{\frac{45,000}{5}}{\frac{2,00,000}{2}} \times 100$$

$= 9\%$

Accept project X

(c) Net Present Value:

Year	PV Factor @ 10%	Project X		Project Y	
		Cash Inflows (`)	PV of Cash Inflows (`)	Cash Inflows (`)	PV of Cash Inflows (`)
1	0.91	35,000	31,850	1,18,000	1,07,380
2	0.83	80,000	66,400	60,000	49,800
3	0.75	90,000	67,500	40,000	30,000
4	0.68	75,000	51,000	14,000	9,520
5	0.62	20,000	12,400	13,000	8,060
		PV of Cash Inflows	2,29,150		2,04,760
		Less: PV of Cash outflows	2,00,000		2,00,000
		Net Present Value	29,150		4,760

Accept Project X

(d) Profitability Index = $\frac{\text{PV of Cash Inflows}}{\text{PV of Cash Outflows}}$

Project X

$= \frac{2,29,150}{2,00,000}$

= 1.146

Project Y

$= \frac{2,04,760}{2,00,000}$

= 1.024

Accept Project X

(e) *Internal Rate of Return (IRR):* Since two discounting factors are given in the question, we will find out IRR using the given data.

Project X

Year	Cash Inflows (`)	PV Factor @ 10%	PV Cash Inflows @10% (`)	PV Factor @ 20%	PV Cash Inflows @ 20% (`)
1	35,000	0.91	31,850	0.83	29,050
2	80,000	0.83	66,400	0.69	55,200
3	90,000	0.75	67,500	0.58	55,200
4	75,000	0.68	51,000	0.48	36,000
5	20,000	0.62	12,400	0.41	8,200
		PV of Cash Inflows	2,29,150		1,80,650
		Less: PV of Cash outflows	2,00,000		2,00,000
		Net Present Value	29,150		(19,350)

$$IRR = D1 + \frac{\text{PV of CFAT D1} - \text{PV of cash outlays}}{\text{PV of CEFAT D1} - \text{PV of CFAT D2}} \times (D2 - D1)$$

$$= 10\% + \frac{2,29,150 - 2,00,000}{2,29,150 - 1,80,650} \times (20\% - 10\%)$$

$$= 10\% + \frac{29,150}{48,500} \times 10\%$$

$$= 16.01\% \text{ (approx.)}$$

Project Y

Year	Cash Inflows (`)	PV Factor @ 10%	PV Cash Inflows @10% (`)	PV Factor @ 20%	PV Cash Inflows @ 20% (`)
1	1,18,000	0.91	1,07,380	0.83	
2	60,000	0.83	49,800	0.69	
3	40,000	0.75	30,000	0.58	
4	14,000	0.68	9,520	0.48	
5	13,000	0.62	8,060	0.41	
		PV of Cash Inflows	2,29,150		1,80,650
		Less: PV of Cash outflows	2,00,000		2,00,000
		Net Present Value	29,150		(19,350)

$$IRR = 10\% + \frac{2,04,760 - 2,00,000}{2,04,760 - 1,74,590} \times (20\% - 10\%)$$

$$= 10\% + \frac{4,760}{30,170} \times 10\%$$

$$= 11.58\% \text{ (approx.)}$$

Accept Project X

Summary

Methods	Project X		Project Y	
	Rank		Rank	
(a) Pay Back Period	II	2.944 years	I	2.55 years
(b) ARR	I	10%	II	4.5%
(c) NPV	I	` 29,150	II	` 4,760
(d) PI	I	1.146	II	1,024
(e) IRR	I	16.01%	II	11.58%

Based on the above analysis Project X is recommended to be selected and Project Y to be rejected.

Illustration 20. A choice is to made between two competing projects which require an equal investment of ` 50,000 and are expected to generate net cash flows as under:

	Project I	Project II
End of year 1	` 25,000	` 10,000
End of year 2	` 15,000	` 12,000
End of year 3	` 10,000	` 18,000
End of year 4	` Nil	` 25,000
End of year 5	` 12,000	` 8,000
End of year 6	` 6,000	` 4,000
Tax Rate	50%	40%

Calculate:

1. Pay Back Period.
2. Average Ratio of Return.
3. Pay Back Profitability.

Solution:

Year	Project I			Project II		
	Cash Inflows (`)	Depreciation	Net Profit After Tax (`)	Cash Inflows (`)	Depreciation	Net Profit After Tax (`)
1	25,000	8,333	16,667	10,000	8,333	1,667
2	15,000	8,333	6,667	12,000	8,333	3,667
3	10,000	8,333	1,667	18,000	8,333	9,667
4	–	8,333	(8,333)	25,000	8,333	16,667
5	12,000	8,333	3,667	8,000	8,333	(333)
6	6,000	8,335	(2,335)	4,000	8,335	(4,335)
		50,000	18,000		50,000	27,000

$$\text{Depreciation p.a.} = \frac{OC - SV}{EL}$$

$$= \frac{50,000}{6}$$

$$= 8.333$$

$$\text{Average NPAT p.a} = \frac{\text{Total Profit}}{\text{No. of Years}}$$

$$\text{Project I} = \frac{18,000}{6}$$

= ` 3,000 p.a.

$$\text{Project II} = \frac{27,000}{6}$$

= ` 4,500 p.a.

1. Payback Period:

Year	Project I		Project II	
	Cash Inflows (`)	Cumulative Cash Inflows (`)	Cash Inflows (`)	Cumulative Cash Inflows (`)
1	25,000	25,000	10,000	10,000
2	15,000	40,000	12,000	22,000
3	10,000	50,000	18,000	40,000
4	–	50,000	25,000	65,000
5	12,000	62,000	8,000	73,000
6	6,000	68,000	4,000	77,000

Project I

Payback Period = 3 Years

Project II

Payback Period = 3 + ((50,000 – 40,000/(25,000))

$$= 3 + \frac{10,000}{25,000}$$

= 3.4 Years

2. $$\text{ARR (Original Investment)} = \frac{\text{Average Annual Net Profit After Tax}}{\text{Original Investment}} \times 100$$

Project I	Project II
$= \frac{3,000}{50,000} \times 100$	$= \frac{4,500}{50,000} \times 100$
= 6%	= 9%

$$\text{ARR (Average Investment)} = \frac{\text{Average Annual PAT}}{\text{Average Investment}} \times 100$$

Project I	Project II
$= \frac{3,000}{\frac{(50,000)}{2}} \times 100$	$= \frac{4,500}{\frac{(50,000)}{2}} \times 100$
= 12%	= 18%

3. Payback Profitability = Total Cash Inflow – Cash of Asset

Project I

= 68,000 – 50,000

= ` 18,000

Project II

= 77,000 – 50,000 = ` 27,000

Illustration 21. M/s. Onward Technology has short listed two projects A and B for final consideration. It wants to take up only one project of the two and not both. The investment required for project A is ` 190 Lakhs while that for Project B is ` 400 Lakhs. The other details related to project A and B are given below:

Project A

Year	Depreciation	Profit Before Tax	Profit After Tax
I	24	78	56
II	20	82	60
III	16	100	74

Project B

Year	Depreciation	Profit Before Tax	Profit After Tax
I	78	104	82
II	64	118	92
III	54	260	186

The cost of capital of company is 14% and the present value of Re.1 at the end of first, second and third year @ 14% rate is 0.8772, 0.7695 and 0.6750 respectively using Net Present Value Method, which project would you recommend.

What will be your answer under Pay Back Period Method?

Solution:

NVP Method

Project A

Year	PBT	Tax	PAT	Cash Inflows (PAT + Dep.)	PVF @ 14%	PV of Cash Inflows
1	78	22	56	80	0.8772	70.176
2	82	22	60	80	0.7695	61.560
3	100	26	74	90	0.6750	60.750
					PV of Cash Inflows	192.486
					Less: PV of Cash outflows	190.000
					Net Present Value	2.486

Project B

Year	PBT	Tax	PAT	Cash Inflows (PAT + Dep.)	PVF @ 14%	PV of Cash Inflows
1	104	22	82	160	0.8772	140.352
2	118	2	92	156	0.7695	120.042
3	260	74	186	240	0.6750	162.000
					PV of Cash Inflows	422.394
					Less: PV of Cash outflows	400.000
					Net Present Value	22.394

Project B is recommended since NPV is greater than Project A.

Pay Back Period Method:

Project A: Investment ` 190 Lacs

Year	PAT	Depreciation	Cash Inflows (PAT + Dep.)	Cumulative Cash Inflows
1	56	24	80	80
2	60	20	80	160
3	74	16	90	250

Pay Back Period = 2 years + $\left(\frac{30}{90} \times 10\right)$

Pay Back Period = 2 years and 4 months or 2.33 years or 2 years and 120 days

Project B: Investment ` 400 Lacs

Year	PAT	Depreciation	Cash Inflows (PAT + Dep.)	Cumulative Cash Inflows
1	82	78	160	160
2	92	64	156	316
3	186	54	240	556

Pay Back Period = 2 years + $\left(\frac{840}{240} \times 12\right)$

= 2 years and 4.2 months or 2.35 years or

= 2 years 4 months and 6 days or 2 years and 126 days

Project A will be selected since the payback period is lesser than Project B.

EXERCISE

Self Assessment Questions 1

1. _____ make or mar a business.
2. _____ decisions involve large outlay of funds now in anticipation of cash inflows in future.
3. Social, political, economic and technological forces make capital budgeting decisions _____.
4. _____ are very expensive.

Self Assessment Questions 2

1. Capital expenditure decisions are _____.
2. Forecasting of future operating cash flows suffers from _____ because the future is _____.

Self Assessment Questions 3

1. Post-completion audit is _____ in the phases of capital budgeting decisions.
2. Identification of investment opportunities is the _____ in the phases of capital budgeting decisions.

Self Assessment Questions 4

1. Analyzing the demand and supply conditions of the market for the company's products could be _____ of potential investment proposal.
2. Generation of ideas for capital budgets and screening the same can be considered _____ of capital budgetary decisions.

Self Assessment Questions 5

1. _____ decisions could be grouped into two categories.
2. _____ and revenue generation are the two important categries of capital budgeting.

Self Assessment Questions 6

1. _____ examines the project from the social point view.
2. All technical aspects of the implementation of the project are considered in _____.
3. _____ of a project is examined by financial appraisal.
4. Among the elements that are to be examined under commercial appraisal, the most crucial one is the _____.

Self Assessment Questions 7

1. Formulating is the third step in the evaluation of investment proposal.
2. A _____ is not a relevant cost for the project decision.
3. Effect of a project on the working of other parts of a firm is know as _____.
4. The essence of separation principle is the necessity to treat _____ of a project separately from that of _____.
5. Payback period _____ time value of money.
6. IRR gives a rate of return that reflects the _____ the project.

Answer for Self Assessment Questions

Self Assessment Questions 1

1. Capital budgeting
2. Capital budgeting
3. Highly complex
4. Capital budgeting decisions

Self Assessment Questions 2

1. Irreversible.
2. Uncertainty, highly uncertain.

Self Assessment Questions 3

1. Final step.
2. First step

Self Assessment Questions 4

1. A fertile source
2. The most crucial phase

Self Assessment Questions 5

1. Capital budgeting
2. Cost reduction

Self Assessment Questions 6

1. Economic appraisal
2. Technical appraisal
3. Financial viability
4. Demand for the product or service.

Self Assessment Questions 7

1. Decision criteria
2. Sunk cost
3. Externalities
4. Investment element; Financing element
5. Ignores
6. Profitability of

Terminal Questions

1. Examine the importance of capital budgeting.
2. Briefly examine the significance of identification of investment opportunities in capital budgeting process.
3. Critically examine the payback period as a technique of approval of projects.
4. Summaries the features of DCF techniques.

Terminal Questions

1. Mr. Vishwanathan is planning to buy a machine which would generate cash flow as follows:

Year	0	1	2	3	4
Cash flow	(25000)	6000	8000	15000	8000

   If discount rate is 10% is it worth to invest in machine? [**Ans.** Yes, NPV 3791]

2. Mr. Mehra has invested ` 50,000 on Xerox machine on 1st jan 2002. He estimates net cash income from Xerox machine in next 5 years as under

Year	Estimated inflows
2002	12,000
2003	15,000
2004	18,000
2005	25,000
2006	30,000

At the end of 5th year machine will be sold at scrap value of ` 5,000 advice him whether his project is viable , considering interest rate of 10% p.a.

[**Ans.** Yes, NPV ` 25,635]

3. XYZ & Co. Is considering investing in a project requiring a capital outlay of ` 2,00,000 Forecast for annual income after tax is as follows:

Year	1	2	3	4	5
Profit after tax (`)	1,00,000	1,00,000	80,000	80,000	40,000
Depreciation is 20% on straight line basis					

Evaluate the project on the basis of net present value taking 14% discounting factor and advise whether XYZ & co. Should invest in the project or not? The present value of Re. 1 at 14% discounting rate are 0.8772, 0.7695, 0.6750, 0.5921 and 0.5194. [**Ans.** Yes, NPV ` 2,24,142]

4. Miss Sonali is considering an investment opportunity which will give her cash inflow of ` 1,000, ` 1,200, ` 1,100 & ` 400 respectively at the end of each of the next 5 year. The initial investment is ` 4, 000. If the time, preference rate is 10%, state whether the investment is profitable or not. (Present value factor at 10% are 0.9091, 0.8264, 0.7513, 0.6830 and 0.6209) [**Ans.** Yes, NPV ` 49.92]

5. An investment of ` 40,000 made on 1/04/08 provides inflows as follows:

Date	Alternative I	Alternative II
01/04/08	20,000	10,000
01/04/09	10,000	20,000
01/04/10	10,000	10,000
01/04/11	10,000	10,000

Which alternative you would prefer if the investor's expected return is 10%. Give reasons for your preference. [**Ans.** Alternative I is preferred]

6. The share of Ridhi Ltd. (` 10) was quoting at ` 102 on 1.04.2002 and the price rose to ` 132 on 1.04.2005. Dividends were received at 10% on 30th June each year. Cost of Funds was 10% is it worthwhile investment, considering the time value of money (Present value of factor @ 10% were 0.909, 0.826, 0.751)

[**Ans.** No, NPV ` -0.382]

7. Mr. Vishwanathan is planning to buy a machine which would generate cash flow as follows:

Year	0	1	2	3	4
Cash flow	(25000)	6000	8000	15000	8000

If discount rate is 10% is it worth to invest in machine?

Year	1	2	3	4
Discount factor	0.909	0.826	0.751	0.683

[**Ans.** Yes, NPV ` 3,791]

8. The existing manufacturing Company has a Surplus of ` 25 Lacs. It has two option, namely:

Option 1: Go for new manufacturing equipments costing ` 254 lacs, having working life of 6 years and scrap value at the end of the working life will be ` 1 lacs.

The additional profits generated before depreciation and income tax in the very first year will be ` 6.50 lacs, which will grow by @ 10% over earlier year every year for next two years, and fall by 5% over earlier year in every subsequent year thereafter. The company will follow Straight Line method for charging depreciation and rate of income tax is to be assumed @ 30%

OR

Option 2: Alternatively, the company can invest ` 25 lacs in a joint venture wherein tax free returns @ 6% are guaranteed in first three years and thereafter returns will be @ 10% tax free.

You are required to present before the company:

(a) Year wise income statement under both the alternatives.

(b) Pay back period working and payback profitability statement if the company goes for first option.

(c) The risks involved if the company goes for the second option.

9. M/s Maha Sweet would like to setup a food – processing unit. The technology for the processing is always on improvement and hence the proposed unit would become obsolete within four years of operation and would be scrapped. The company estimates to achieve sales of ` 50 Lakhs in the first year of operation. This wills double every year. Net profit margin is 50%. Initial Outlay is ` 5 crores. Company will also pump – in initial working capital of ` 1 crores. Scrap value of the unit is ` 1 crores. Depreciation on SLM basis.

Present Value table of ` 1 is as follows:

Year	1	2	3	4
17%	0.855	0.731	0.624	0.534
18%	0.847	0.718	0.609	0.516

Calculate: (a) Payback Period, (b) Payback Profitability, (c) NPV at 17% discounting rate, (d) NPV at 18% discounting rate, and (e) IRR.

10. M/s. Onward Technology has short listed two projects A and B for final consideration. It wants to take up only one project of the two and not both. The investment required for project A is ` 190 Lakhs while that for Project B is ` 400 Lakhs. The other details related to project A and B are given below:

Project A

Year	Depreciation	Profit Before Tax	Profit After Tax
I	24	78	56
II	20	82	60
III	16	100	74

Project B

Year	Depreciation	Profit Before Tax	Profit After Tax
I	78	104	82
II	64	118	92
III	54	260	186

The cost of capital of company is 14% and the present value of Re. 1 at the end of first, second and third year @ 14% rate is 0.8772, 0.7695 and 0.6750 respectively using Net Present Value Method, which project would you recommend. What will be your answer under Pay Back Period Method?

11. A choice is to made between two competing projects which require an equal investment of ` 50,000 and are expected to generate net cash flows as under:

	Project I	Project II
End of year 1	` 25,000	` 10,000
End of year 2	` 15,000	` 12,000
End of year 3	` 10,000	` 18,000
End of year 4	` Nil	` 25,000
End of year 5	` 12,000	` 8,000
End of year 6	` 6,000	` 4,000
Tax Rate	50%	40%

Calculate: -Pay Back Period, -Average Ratio of Return, -Pay Back Profitability.

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