UNIT 15 INVESTMENT APPRAISAL METHODS

Objectives

The objectives of this unit are to:

- develop an appreciation for the need for proper investment appraisal
- familiarise you with various methods of appraising capital projects, including their relative merits and demerits
- introduce some other concepts relevant in investment appraisal.

Structure

15.1 INTRODUCTION

One of the aspects of financial management is proper decision-making in respect of investment of funds. 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 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 any investment proposal 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. This would facilitate the identification of relatively superior proposals keeping in mind the limited available resources. It is apparent that some techniques should be followed for making appraisal of investment proposals. In this unit we shall describe the various appraisal methods and acquaint you with their relative merits so that you could identify the appropriate method for appraising investment proposals in different situations.

15.2 TYPES OF INVESTMENT PROPOSALS

According to the terminology used in financial management the terms `investment decision', `investment projects' and 'investment proposal' are generally associated with application of long-term resources. What is a `long terra'? There is no hard and fast rule to define it, but by common practice and in accordance with the financing policies, practices and regulations of the financial institutions and banks a period of ten years and above is generally treated as long term.

Thus all proposals or projects involving investment of funds for a period often years or more will fall in the category of investment proposals. Long-term investment of funds may be generally needed for the following purposes.

- Expansion of operation
- Diversification in operations
- Replacement/Modernisation of plant and machinery
- Research and Development

Expansion

A manufacturing unit, for example, is presently producing one-lakh units per year. If it intends to double the production this will obviously increase the need for funds. The variable cost in aggregate will increase. Accordingly, the current assets will increase. Thus the financial resources required for working capital will have to be increased. In case the production carried so far was less than the capacity, no additional investment of funds is needed for long term. In case the existing infrastructure-plant, machinery and other permanent or fixed assets-is inadequate, the proposal for doubling the production will involve additional investment of funds for long term. It must, however, be noted that the financial needs for such a project will include not only expenditure on fixed assets but also an increase in working capital.

Diversification

The management of an enterprise such as the Indian Tobacco Company (ITC), as it happened, decided to diversify its production into other lines by adding to its original business a new area of hoteliering. Philips, famous for radio and electric bulbs etc., diversified into production of other electrical appliances and television sets. This process of diversification would involve use of large financial resources for long-term investment.

Replacement

Machines used in production may either wear out or may be rendered obsolete on account of new technology. The productive capacity of he enterprise and its competitive ability may be adversely affected. Some funds maybe needed for modernisation of a certain class of machines or for renovation of the entire plant or building etc. To make them more efficient and productive. Modernisation and renovation will be a substitute for total replacement. Funds will obviously be invested for long-term. Where renovation/modernisation is not desirable or feasible, funds (obviously larger amounts) will be needed for replacement.

Research and Development

There has been a growing realisation that the efficiency of production and the total operations can be improved by application of new and more sophisticated techniques of production and management. New technology can be borrowed or developed. There is a greater realisation that investment of funds (obviously long term and large amounts) in constant research is very useful. productive and ultimately profitable though there may be no immediate benefits or returns from such investments.

Activity 15.1

Try to look for the expenditure of capital nature incurred by your organisation over the last 3-5 years. What necessitated this expenditure? Identify the nature of this expenditure in terms of the purposes mentioned in the above section. You may like to talk to a knowledgeable person in your organisation regarding the basis of the decision and the factors that went into it.

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1.5.3 NEED FOR APPRAISAL

You must have observed that the investment proposals: (i) involve large amount of funds (ii) involve greater amount of risk on account of unforeseen situation and (iii) often mean irreversibility once the investment decision is made. In view of these the task of appraising investment proposals is very important in financial management.

15.4 PROJECT REPORT

Preparation of a project report is a complicated process. It includes not only the projections of financial data related to outflow and inflow of cash, but also a meticulous exercise to assess the following aspects:

- Potentiality for the marketing of the project
- Technical feasibility of the project
- Availability of managerial skills
- Environmental impact
- Financial viability

In this unit we are mainly concerned with only the financial aspects for the appraisal of an investment proposal.

Relevant Data

The following need to be considered before appraisal is taken up:

- The amount and timing of initial investment outlays
- The amount and timing of subsequent investment outlays
- The economic life of the project
- Salvage value at the end of the project
- The amount and timing of cash inflows

1. Initial Investment Outlays

This covers the total cash required to implement the proposal. It includes expenditure on design, survey, consultancy fees and the working capital costs, such as costs of

maintaining stocks, contingency reserves to cover the cost of supporting additional debtors. Benefit of credit from suppliers will have the effect of reducing the quantum of additional working capital required.

2. Subsequent Investment Outlays

The cost of maintenance, replacement and updating exercises are to be treated as outflows during the period in which they are expected to be incurred.

3. Economic Life of a Project

The economic life of a project is to be distinguished from the life of an individual asset. A building may have a life of sixty years, plant may have a life of fifteen years and some equipment may have a life of five years only. The economic life of the project is determined by the duration of the `earnings flow' generated by the project.

The economic life may end:

a) When the cost of replacement or renovation becomes uneconomical **in** relation to the likely benefits;

b) When the viability *of* the project is adversely affected due to obsolescence,

c) When rising maintenance costs exceed the estimated disposal value; and

d) When the development *of* new technology necessitates new investment.

4. Salvage Value

Some equipments may have some value for the enterprise at the end of the life of the project or there may be an anticipated sale value of the equipment. Such amount is to be treated as an inflow at the end of the life of the project.

5. Operating Cash Flows

Three main areas are to be considered here:

a) **Sales revenue:** It is a function of sales volume and unit selling price. Any miscalculation of sales revenue may have a crucial impact on appraisal of an investment proposal. In assessing any investment opportunity, the additional or incremental revenues generated by it need to be considered. Investment may also be undertaken to reduce operating costs. For instance, an existing plant and machinery or equipment may be replaced by a newer model, which is more economical to operate. The new piece of equipment may either be more efficient (or more productive) or it may require relatively less consumption of electricity or maintenance costs, etc. It has to be noted that the ultimate impact of cost-saving equipment is the same as that of the new equipment for building up additional capacity, that is , the overall revenue is increased.

b) **Production costs:** A distinction between fixed and variable costs will be very meaningful to anticipate the likely behaviour of costs. Only incremental costs have to be considered.

c) **Other direct costs:** These costs will cover selling and promotion costs and additional rent, etc. The net inflow/outflow of cash can be worked out by allocating the aforesaid items period-wise. It may appear to you that in order to make an appraisal regarding the financial viability of an investment proposal, or to make a choice between two proposals, it will be enough to find out the net cash flow, that is the difference between total outflow (amount to be invested) and the inflow (net of Sales Revenue Expenditure + Salvage Value).

See for example the following situation:

Illustration 15.1

Year	Net Cash Flows (Rs. 000)	
	A	**B**
0	40	-360
1	150	200
2.	200	'300
3	220	400
4	230	450
5	370	600
Total	1210	1590

The preceding illustration tells us only that proposal B generates a total cash flow of Rs. 15,90,000 whereas proposal A brings in only Rs. 12,10,000. This alone does not help us in arriving at any appropriate decision, unless we know the total investment needed for each of them the time value of money and the desired acceptable rate of return on investment. Hence it will be useful to examine a few methods of assessing the return on investment.

15.5 METHODS OF APPRAISAL

The main methods used for evaluating investment proposals are:

- Pay Back Period
- Accounting Rate of Return

Discounted Cash Flow

- Net Present Value
- Internal Rate of Return
- Profitability Index

Pay Back Period

In simple terms it means the total period within which the total amount invested will be recovered throughout net cash flow (after tax). Suppose a sum of Rs. 5 lakh has to be invested in a project whose expected net cash flows are as follows:

Illustration 15.2

	Incremental Cash Flow (Rs. 000)	
Year	**Annual**	**Annual Cumulative**
	(-) 500	(-) 500
1	185	(-) 315
2	125	(-) 190
3	140	(-) 50
4	170	(-) 120
5	180	300

It is apparent that the total money invested is Rs. 5 lakh which is shown as a negative cash flow. This could be recovered during the fourth year. To be exact, the payback period is 3.29 years (i.e., three years and three and a half months approx.), as calculated below:

$$P=E+\frac{B}{C}$$

where P stands for payback period

E stands for number of years immediately preceding the year of final recovery

B stands for the balance amount still to the recovered

C stands for cash flow during the year of final recovery

Anybody can say that shorter the period the better it is. Early and certain results are better than more uncertain long-term estimates.

The Payback method is simple to calculate.

The greatest weakness of this method is that it ignores the timing and amount of all cash inflows. It does not take any cognizance of the cash flows after the payback period. Thus, this method is not appropriate either for absolute or comparative appraisal. Let us observe the following example of two projects.

Illustration 15.3

(Rs. 000)

Years	Project A		Project B	
	Cash Flow	Cumulative Cash Flow	Cash Flow	Cumulative Cash Flow
0	(-) 700	(-) 700	(-) 700	(-) 700
1	100	(-) 600	400	(-) 300
2	200	(-) 400	300	(-) 0
3	300	(-) 100	200	(-) 200
4	400	300	100	300
5	500	800	-	
Payback period		3.25 years		2 years

In both cases the investment is Rs. 7 lakhs, which is shown as negative cash flow in zero year. It is apparent that the payback period is shorter for project B and as such it may be preferred. Project A, being a slow starter in cash flows, is likely to be rejected. As we noted earlier, this method ignores the total benefits or cash inflows generated by projects. In this particular illustration, Project A generates cash flows for a period longer than B. Project B brings in returns for a lesser number of years and that too at a decreasing rate. The payback method thus concentrates only on the liquidity aspect and ignores the overall profitability of the project. It would be better not to depend solely on this method because it is simple. As this method does have some utility it need not be rejected totally but may be assigned the status of a secondary or subsidiary criterion. In this context, a maximum period of payback may be laid down and a project exceeding this period may not be entertained.

Accounting Rate of Return

This method of working out the rate of return on investment is based on the financial accounting practices of the company for working out the annual profits. The net annual profits are derived after deducting depreciation and taxes. The average of

annual profits thus derived is worked out on the basis of the period (number of years) of the life of the project.

Illustration 15.4

(Amount in Rupees)

Years (after tax)	Cash Flow	Depreciation	Interest
1	13,000	6,000	400
2	11,000	6,000	.400
3	9,000	6,000	400
4	'6,400	6,000	400
5	6,000	6,000	400
Total	45,800	30,000	2,000

The investment is Rs. 30,000. Accounting rate of return will be equal to the average of net cash flow (after depreciation, taxes, and interest) as a percentage of investment

$$\frac{(45,800\text{-}30,000\text{-}2,000)\times\frac{1}{5}}{30,000} = 9.2 \text{ Per cent}$$

In the above illustration the calculation of the return is based on the original (initial) investment in the project, which is Rs. 30,000. Since the investment in this Illustration is a depreciable asset and is estimated to have five years of useful life with no salvage value, it could be argued that the investment base for calculating ARR ought to be average investment which would be one-half of initial investment, in this case Rs. 30,000/2 = 15,000. The ARR based on average investment would be:

$$\frac{(45,800\text{-}30,000\text{-}2,000)\times\frac{1}{5}}{15,000} = 18.4 \text{ Per cent}$$

It will be seen that where there is no salvage value and the average investment is one-half the original investment, the rate of return will be double the rate calculated on the original investment.

In the calculation of ARR, working capital is usually not considered. Any additional working capital needed, however, should betaken into account in calculating the fund requirements of new investment. This method like the Payback Method ignores the time value of cash flows since it does not give any recognition to the timing (1st year, 2 nd year and so on) of the generation of income. The timing of cash flow is an important variable in investment decision-making. Higher earnings in earlier years and lower earnings in later years cannot be taken at par with lower earnings in earlier years and greater earnings in later years. The ARR method thus suffers from a serious drawback by neglecting the quality or pattern of benefits and by ignoring the time value of money. Further, it does not take into account the scrap value of asset (or project) at the end of its useful life. Finally, the calculation of profit is subject to varying practices. The attempts at window dressing and manipulation of accounting data have a distorting influence on the calculation of profit and consequently on the ARR. All these factors make ARR a less reliable method.

Discounted Cash Flow (DCF)

This concept is based on the premise of the `time value of money'. The flow income is spread over a few years. The real value of a rupee in your hand today is much more than that of a rupee which you will earn after a year. Why is it so? It is the value of time. The future income, therefore, has to be discounted in order to be associated with the current outflow of funds in the investment. Two methods of appraisal of investment project are based on this concept. These are Net Present Value method and Internal Rate of Return method.

Net Present Value Method

Calculation of the net present value of future income can be related to the understanding of the compounded rate of interest or the general formula of compounding. Sup-pose a sum of Rs. 100 (P) is invested for a period of one year at a rate of interest (r) of 10 per cent per annum. The investment at the end of one year will be equal to (you can refer to Table 3 given at the end of this block):

$$P\left(1+\frac{r}{100}\right)^{n}$$

$$= 100\left(1+\frac{10}{100}\right)^{n}$$

$$= \left(100+\frac{11}{100}\right)^{n=1}$$

$$= 110$$

It can also be stated that Rs. 110 in one year's time is worth only Rs. 100 today. Applying the compounding formula over the number of years to work out the present value (PV) of a future flow of income the formula will be reconstructed as

$$PV = \frac{P}{\frac{(1+r)^{n}}{100}}$$

Where P is the amount to be received in future (number of years = n) and r is the annual rate of interest. Suppose we want to know the PV of cash flow of Rs. 500 to be received at the end of five years discounted at 10% rate of interest. The PV will be:

$$\frac{P = 500}{\left(1+\frac{(r = 10)}{100}\right)^{n=5}} = \text{Rs. } 310.5$$

Rather than spending your time on calculations, see Table 1 (given at the end of this block) showing the discount factor for 10% over a period of 5 years in respect of the present value of one rupee. It is 0.621. By multiplying it with the expected future income of Rs. 500 the PV of this income will be 500 x 0.621$^{=}$ Rs. 310.5 If a person were to receive a series of equal amounts over a period of

five years, say Rs. 1,000 every year, the present value of these receipts can be calculated as given below

Years	Amount Rs.	Present Value Factor	Present Value Rs.
1	1,000	.909	909
2	1,000	.826	826
3	1,000	.751	751
4	1,000	.683	683
5	1,000	.621	621
			3790

The process of reducing future values according to the factors shown to determine the present value is called discounting. When the annual cash flows to be received over a period of time are equal in amount, as in the above case, a simple method of determining the present value is available through Table 2. Taking the above example, you could look in the 10 per cent column at the line for 5 years in Table 2 and find a factor of 3.790. Multiplying it by Rs. 1,000, you would find the present value to be the same i.e. Rs. 3,790 as determined by the longer method using Table I. Table 2. Contains factors which represent the present value of Rupee one received annually for the given number of years (this form of cash flows is commonly known as an **annuity).**

You will realise that by discounting the expected annual returns for each year the project has been covered and not a few years' return as covered under Payback Method. By adding the PV of the annual inflow of cash for each year of the expected life of the project we come to know the PV of the aggregate of the inflows. This can easily be compared with the cash outflow needed today for investment. The investment proposal can be acceptable if the aggregate PV of cash inflow is more than the current outflow. The decision to accept or reject the proposal or to accept the superior one (with higher PV against the same investment) out of two or more proposals can be taken more rationally with the Discounted Cash Flow - Net Present Value Method. We may illustrate the method by comparing two projects.

Illustration 15.5

Project	Initial	Net Cash Income (before depreciation but after Tax) (Rs. in Thousand)							
		Year							
	Rs.	1	2	3	4	5			8
A	20,000	4	4	4	8	2	-	-	-
B	20,000	8	6	2	2	2	2'	2	2

If the present value of the stream of net cash income exceeds the capital outlay, the firm can be assured of a surplus. When alternative projects are being considered, that project which has positive (or highest) net present value will be selected.

Year	Project A			Project B		
	Net Cash Income Rs.	Discount Factor*	PV Rs.	Net Cash Income Rs.	Discount Factor*	PV Rs.
1	4000	0.935	3,740	8000	0.935	7,480
2	4000	0.873	3,492	6000	0.873	5,238
3	4000	0.816	3,264	2000	0.816	1.632
4	8000	0.763	6,104	2000	0.763	1.526
5	2000	0.713	1,426	2000	0.713	1.426
6	-	-	-	2000	0.666	1.332
7	-	-	-	2000	0.623	1.246
8	-	-	-	2000	0.582	1.164
Total Present Value			18,026			21,044
Initial Cost			20,000			20,000
Net Present Value			(1,974)			1,044

* Refer to Table 1 (at the end of the book)

One important point should not escape your notice. In working out the NPV we used a discounting rate (in our Illustrations the rates were 10 per cent and 7 per cent), which is also known as the `cutoff' rate or `hurdle' rate or `required rate of return'. The discounting rate is particularly needed when more than one-investment proposals is to be appraised and the funds available for investment are not sufficient to accommodate all the proposals. Is the discounting rate chosen arbitrarily or is there any basis for its selection? Should it be the rate at which the firm would borrow or lend money, or should it be the current rate of return on capital employed? A business enterprise may set a target rate of return for appraising investment, which ordinarily would not be less than the cost (or interest rate) of funds needed for investment. It may however be stated that monetary interest rates do not reflect the additional risks which may be borne by the business. Logically speaking, therefore, the firm should select that rate of interest, which most adequately represents the risk of the project, i.e. a rate that is presumably close to, if not exactly equal to, the overall rate of return on capital employed. We shall further deal with this subject under `Cost of Capital' a little later. Apart from recognising the time value of money the NPV method considers total benefits of a proposed project over its life. This method is particularly useful for the selection of mutually exclusive projects. The method is in line with the objective of financial management i.e. maximization of the wealth of shareholders. The acceptance of the proposals with positive net present values are expected to have a positive impact on the market prices of shares.

Compared to pay back or ARR methods, NPV method is difficult to calculate and understand. What discounting rate is to be used in calculating present values may be difficult to decide. The selection of a particular discounting rate has a crucial effect on the desirability of a project. With a change in rate, a desirable project may turn into an undesirable one and vice-versa. As will be observed in a subsequent section, cost of capital is generally adopted as the basis for the discount rate. Further, NPV is an absolute measure. For projects involving different outlays the NPV method may not give dependable results. It may also not give satisfactory results where the

projects under competition have different lives. Other things being equal, a project with shorter pay back would be preferable.

Activity 15.2

a) How much money would you have to deposit in a savings account today in order to have Rs. 4,000 in that account at the end of five years if the bank pays a 5 per cent return calculated half-yearly? How much would you have to deposit if you wanted to have Rs.10,000 after five years.

b) How much money would you have in a Fixed Deposit Account after seven years if you deposit Rs. 1,000 today and the bank pays, an 11 per cent rate annually? How much would you have after seven years if you deposit Rs.4,500 today?

c) Suppose you have won a prize in a lottery, you have the opportunity to pick one of the two prizes?

Prize A: Rs. 50,000 a year for the next ten years, paid on December 3 1 of each year.
Prize B: Rs. 2,50,000 cash paid today, 'January 1

Assuming both prizes are tax-free and that you can earn an interest of 6 per cent per annum on your money (also tax-free), which prize would you pick?

Which prize would you pick if you could earn 10 per cent on your money? At about what interest rate would you consider the two prizes to be of equal value to you?

Internal Rate of Return

You have already observed the superiority of the Discounted Cash Flow technique over the Payback Period and the Accounting Rate of Return methods. The main point of difference is the recognition of the tune value of future inflows in the former.

The Internal Rate of Return is another method under the Discounted Cash Flow technique which is used for appraising the investment proposals. Under this method, we derive the discounting rate at which the aggregate of the PVs of all future cash inflows equals the present cash outflows for the proposal. The following illustration will make it clear for you.

Illustration 15.6

Year	Net Cash Flow	Present Value of Net Cash Flow			
		At Discount Rate 20%		At Discount Rate 10%	
		Discount Factor*	Rs.	Discount Factor*	Rs.
0	- 100	1.000	- 100.00	1.000	(-) 100.00
1	40	0.833	33.30	0.909	36.40
2	35	0.694	24.30	0.826	28.90
3	30	0.579	17.40	0.751	22.50
4	25	0.482	12.10	0.683	17.30
5	20	0.402	8.00	0.621	12.40
			(-) 4.90		17.30

*See Table 1

From the above illustration you will realise that at the discount rate of 20 %, the aggregate of the PVs (Rs. 95.10) of future cash inflows is Rs. 4.90 less than the current outflow of each investment of Rs. 100. At discount rate of 10 %, the

aggregate of PVs of future cash inflows is Rs. 17.30 more than the initial cash outflow. In order to equate the inflows and outflows, the rate of discount will be located by interpolation between the two aforesaid rates of 20% and 10 %: This can be done as shown below. Thus the two inflows will be equal if a discount rate of 17.8% is applied. Obviously if this discount rate is higher than the target rate or the interest rate used to work out the cost of funds, the investment project should be acceptable.

$$\text{IRR} = \text{LRD} + \frac{(\text{NPVL})}{\text{PV}} \times R$$

Where IRR is the Internal Rate of Return

LRD is the Lower rate of discount

NPVL is the Net Present Value at lower rate of discount (i.e. differences between present values of cash inflows and present value of cash outlay or outflows).

PV is the difference in present values at lower and higher discount rates
R is the difference between two rates of discount

Substituting the values, we get:

$$\text{IRR} = 10 + \frac{(17.30)}{(22.20)} \times 10 = 17.8$$

IRR through Payback Reciprocal

The calculation of IRR involves a trial and error procedure, which is tedious and time consuming. This problem can be overcome by using reciprocal of payback, which is a good approximation of the IRR. The method can be used in both the cases where a fixed cash flow is received over the life of the asset and where varying cash flows are received.

Where cash inflows are constant (or the same) every year (called annuity):

The procedure to calculate IRR is as under:

i) Determine the pay back period of the proposed project

ii) Look for the factor closest to the pay back period in the year row of Table 2 (the present value of annuity). The relevant year for the purpose would be equivalent to the life period of the project. For instance, if the life of the project is 6 years and its pay back period is 4 years, then we have to look for the factor closest to 4.000 for the year 6 in Table 2. According to Table 2 the factor closest to 4.0 for 6 years are 3.998 (13 % rate of interest) and 4.111 (12 % discount rate). The value closest to 4.0 is 3.998. Therefore, the actual value lies between 12 and 13 per cent, tilting on the side of 12 per cent. This value can be calculated by interpolation as shown in Illustration 15.6.

Where the stream of cash flows is of varying nature:

The calculation of IRR under such circumstances is a little more difficult. The way to simplify the process is to use a `fake annuity' as a starting point.

The following procedures may be followed:

i) Calculate the average annual cash flows to get a fake annuity.

ii) Determine `fake payback period' by dividing the initial outlay with the average annual cash flows after taxes (CFAT) as calculated in step (i).

iii) Look for the factor in Table 2 closest to the fake payback period in the same manner as in the case of annuity.

iv) Adjust the IRR obtained in step (iii) by comparing the pattern of average annual cash flows as per step (i) to the actual varying stream of cash flows. If the actual cash flow stream happens to be higher in the initial years of the project's life than the average stream, adjust the IRR a few percentage points upward. Conversely, if in the early years the actual cash flow is below the average, adjust the IRR a few percentage points downward.

v) Find out the present value of the uneven cash flows, taking the IRR as the discount rate as estimated in step (iv) by using Table 1.

vi) If by chance, the PV of CFAT equals the initial outlays, you have arrived at the right IRR. Otherwise repeat step (v), that is, if you have not struck the right rate of IRR. The net present value will either be positive or negative. If it is positive, work for another rate (i.e. higher rate) which will turn it into a negative figure. If the NPV is negative, work for another rate (i.e. lower rate) which will turn it into a positive figure., When two consecutive discount rates have been found out one of which causes the NPV to be positive and the other causes it to be negative, the actual IRR can be ascertained through the process of interpolation as explained in Illustration *15.6.*

In short, therefore, whether the cash inflows of a project are the same each year or are different, you should select two discounting rates in such a manner that the NPV result of the lower rate of discount is a positive amount and the NPV result of the higher discounting rate is a negative amount. You can then apply the interpolation formula and arrive at the correct IRR. If you are strong enough in your intuition and can, with a little effort, guess the two consecutive discounting rates, you need not even bother about what is mentioned in part (b) of the above discussion (viz., when the stream of cash flows is of varying nature).

IRR, like the NPV, takes into consideration time value of money and also the total cash inflows and outflows over the entire life of the project (asset). For managers it is easier to understand, as the calculation is always a percentage and not an absolute amount as under Net Present Value method. An added advantage is that it does not require a discounting rate. The method itself provides a rate of return. If projects are chosen with IRR greater than the required rate of return, the method would lead to the realisation of the objective of maximization of wealth of the shareholders.

However, IRR requires tedious calculations (based on trial and error procedure or interpolation), as you must have already noted. Under the IRR method it is assumed that cash flows are reinvested at the same rate as IRR. This also implies that if IRR of two projects is say 16% and 20%, the cash flows arising from these two projects will also be reinvested at their respective rates i.e. 16% and 20%. The reinvestment of cash flows at two different rates within the same company may sound rather unrealistic. Whether cash flows from projects would be reinvested in the company or used for other purposes may depend on several factors. In some cases the Cash generated may not be used internally.

Activity 15.3

An administrator of a hospital is considering a proposal to purchase a new machine. that will aid productivity in the X-ray department. The machine will cost Rs. 13,791 now and is expected to have a five-year useful life and a zero disposal value, and will result in operational savings of Rs. 4,000 annually. The hospital is not subject to income taxes.

The administrator has two alternatives; alternative A is to continue to operate the X-ray department without change (i.e. do nothing). Alternative B is to buy the new machine, which will reduce hand processing. Because no change in revenue is indicated, the cash savings is the difference between the cash operating costs under two alternatives.

1. Compute the project's expected net present value. Assume that the required rate of return (also referred to as the minimum desired rate of return or hurdle rate) is 6 per cent. (The relatively low interest rate is not unusual for a non-profit institution).

2. Compute the expected internal rate of return on the project.

Profitability Index

It may at times be observed that if we use Internal Rate of Return method, a proposal may be rejected because the IRR is less than that of the other one but actually the former may not be a bad proposal if NPV is worked out by the target rate of discount.

Project	Cash outflow in year 0	Cash inflow per annum for 5 years Rs.	IRR %	NPV at 10% Rs.
A	50,000	15,000	15.4	6,850
B	68,000	20,000	14.4	7,800

If the organisation has to, choose one of the two projects and it uses the IRR criterion, Project B will be rejected because it has lower IRR. On the other hand, if it uses a - target rate of 10 % , project B will be selected as it has higher NPV. However if target rate of 15 % is used, Project A will be selected as it looks better. You can yourself compute the figures and verify the results.

It has been explained earlier that if the PV of aggregate future cash inflows is higher than the present cash outflow by way of investment, the investment proposal is good. If we have to choose, between two proposals then the better proposal will be the one where the excess of discounted cash inflows over the cash outflow is larger.

Illustration 15.8

Proposal	PV of total inflows Rs.	Outflows Rs.	Surplus Rs.
A	4,50,000	4,00,000	50,000
B	1,20,000	1,00,000	20,000

Apparently, proposal A appeals because the net surplus over cash outflows is larger than in case of B. Please note that we are ignoring a very significant point and it is the `rate of return on investment'. The quantum of inflow is irrelevant unless it is viewed against the total amount of investment. Now by applying simple method of calculating rate of return we find that in case of A the return on investment is

$\frac{50,000 \times 100}{4,00,000}$ = 12.5 per cent, whareas in case of B it is

$\frac{20,000 \times 100}{1,00,000}$ = 20 per cent. Now it can be rationally stated that proposal B is superior to A.

The Profitability Index (PI) is the relationship between the present values of net cash inflows and the present value of cash outflows. It can be worked out either in unitary or in percentage terms. The formula is:

$$\text{Profitability Index} = \frac{\text{Present Value of Cash inflows}}{\text{Present Value of Cash outflows}}$$

If we apply this formula to the Illustration we find that profitability index for each of the two proposals is:

A 4,50,000 ÷ 4,00,000 = 1.125 or 112.5%

B 1,20,000 ÷ 1,00,000 = 1.20 or 120%

You will find that the result is identical as per the rate of return on investment calculated earlier. Proposal B, therefore, is superior.

Now, a question may be asked. If the result under both the aforesaid methods is identical, then why have two methods? Please note that in case there is a `cut off rate' prescribed by the management for approving investment proposals, a proposal will not be approved if the rate of return is less than the `cut off rate' or the minimum expected rate of return. The profitability index in the absence of a cut off rate may appear to have no relevance. However, if two or more investment proposals qualify this test, a choice may have to be made among these proposals because of resource constraints. Hence for choice making, a proposal with high profitability index may be approved. In case there is no basic cut off rate the profitability index can again be regarded as a good guide for choice making.

15.6 DEPRECIATION, TAX AND INFLOWS

It must be made clear that depreciation is excluded from Discounted Cash Flow (DCF) computations. A common error is to discount cash flows obtained after deducting the amount of depreciation. This type of error, in fact, shows lack of understanding of the basic idea involved in DCF. The DCF approach is fundamentally based on inflows and outflows of cash and not on the accrual concept of revenues and expenses. Depreciation does not involve any cash flow. It is merely a book entry to allocate the cost of the asset over its useful life. It has of course the effect of reducing the disposable income.

In the DCF approach, the initial cost of an asset is usually regarded as a lump sum outflow of cash at time zero. The cash inflows in our illustrations are assumed to be after income taxes. Depreciation, as you have noted, is not a factor in discounted cash-flow techniques. Nevertheless, depreciation has some bearing on the annual cash flows because of its connection with income tax. Probably, you are aware that depreciation is deductible as a regular business expense in the determination of the income tax payable.

Because depreciation does not require the repeated outlay of cash over the useful life of the asset, it does not reduce the cash earnings from a particular investment. But the incremental earnings from such an investment are taxed at the prevailing rate, and the incremental tax payments (paid in cash) reduce cash earnings. Since depreciation on the asset is a tax deduction, it reduces the tax payment. It thus acts to `shield' part of the cash inflow from the tax burden.

Illustration 15.9

Newlook company has the opportunity to purchase a piece of automatic equipment whose original cost is Rs. 12,000. Assuming the annual cash savings from using the automatic equipment to be Rs.5,600 before taxes, depreciation (straight line)-Rs.2,400

(based on the initial cost of Rs. 12,000), no salvage value, five-year life and the tax rate of 50 per cent, calculate cash inflow after taxes.

	Tax Purpose	Cash inflow
Gross annual cash cost savings	Rs. 5,600	Rs. 5,600
Less : Depreciation	2,400	
Net incremental income subject to tax	Rs. 3,200	
Income tax at 50% (payment in cash)	1,600	1,600
Net cash inflow after taxes		Rs. 4,000

Had depreciation not been deductible, the income tax on Rs.5,600 would have been Rs.2,800 and the net incremental cash inflow Rs. 2,800. As it is, Rs. 1,200 of cash flow is retained; the tax rate (50 per cent) applied to the depreciation deduction (Rs. 2,400) is thus regarded as a `tax shield'.

15.7 COST OF CAPITAL

The net present value techniques for investment appraisal require the use of a desired minimum rate of return which as you have already noted, is also called the **hurdle rate, discount rate, required rate of return,** or the **cost of capital.** The rate of return a project is expected to give should be at least equal to the opportunity cost rate, which is determined by what can be earned if the funds were invested elsewhere with similar risk.

In general, the riskier the project the higher the expected rate of return. Thus, each investment opportunity could have its own rate of return or cost of capital depending on its risk. In this context it will not be illogical to push up the Required Rate of Return (RRR) as the risk increases. The RRR in fact can be taken as the sum of the risk-free rate of interest plus a risk premium. In financial management, we often separate the investment and the financing decisions. We expect each investment project (with risk equal to the average for the firm) to earn a rate of return equal to at least the average cost of capital for the firm. Basically, there are two ways in which the desired minimum rate can be established.

l. The rate could be based on the operating performance of the company itself or the industry with which it is associated.

2. The rate could be based on the company's cost of funds.

Obviously, the former method is more subjective. Management may regard its own operating experience as a satisfactory standard to be used for undertaking new capital projects. If industry experience is better, management may decide to adopt this higher level for goal-getting purposes. In some cases, it may be the wish of management to set a ‘desired’ ate for cut-off purposes which is independent of either and reflective of a level of future profits (i.e. the target rate) intended to improve on both.

Cost of funds (or capital), on the other hand, places the minimum level at a point determined by what it costs the company for money in the market. Various methods are available for determining the cost of capital. The cost in the form of interest rate for borrowed funds (debt, loans or bonds) is fairly obvious and determinable. The cost of preference shares is the fixed dividend payable on them. The cost of equity funds is often less clear. The stated rate of dividends on preference shares may not be a proper guide to the cost of this type of capital, because preference stock bears many of the same characteristics as borrowed funds.

A difficult problem therefore lies in the treatment of common shareholders equity, particularly retained earnings. You could probably say that capital from this source has no cost, being internally generated. This thinking, however, may not be valid. The more persuasive argument is that earnings retained in business have an opportunity cost. If this part of capital cannot earn a satisfactory return by being ploughed back into the operations of the business, it ought to be paid to the shareholders in the form of dividends. One measure of this opportunity cost is the average return which share-holders would have earned on their dividends (after personal income taxes) if the company had not retained profits but had distributed them in dividends (or additional dividends) and the shareholders had invested them. The shareholders have to forego these returns if funds are retained in the business instead.

When a company's shares are listed on a stock exchange, the market price will usually reflect the earnings per share (after taxes) currently being earned by the company. The company's practice with respect to dividend payment and retention of earnings will also have an influence on the market price. Thus, one method of determining the cost of common equity capital for the firm with listed shares is to relate its earnings per share to the market value of the stock.

The company's cost of capital is a dynamic thing, affected by its current capital structure, its financing plans for the future and any changes in its rate of earnings. To determine an average cost of capital for firm it is necessary to include some provision for capital structure, the expected cost of borrowed funds, and the market-established cost of equity capital.

Illustration 15.10

Assume that a company has 40 per cent of its capital structure composed of debentures (with 14 per cent interest) and 60 per cent of equity shares which show a market value of Rs. 25 *per* equity share, reflecting current earnings per share (after taxes) of Rs. 7. Cost of capital determined by weighted average would be:

Type of capital	Weight	After-tax rate	Weighted average
Debentures	40%	7	2.8%
Common stock	60%	28	16.8%
	100%	-	19.6%

In this calculation, the rate of 7 per cent for debentures is the effective cost of interest after taxes, since interest is a deductible expense for tax purposes (i.e. 14 per cent rate before taxes x .50 per cent assumed tax rate). The effective rate of 28 per, cent for common stock (Rs.7 earnings per share/Rs.25 market price) is also taken after takes, so the weighted average of 19.6 per cent is an after-tax rate. In this case, management presumably would reject capital penditure proposals promising less than 19.6 (or say 20) percent return after taxes. Acceptance of those indicating higher returns would, of course, be subject to whatever other constraints management might impose, such as total budget limitations. The RRR or cost of capital thus plays a crucial role in determining the acceptability of an investment proposal.

15.8 LIMITATIONS OF INVESTMENT APPRAISAL TECHNIQUES

The investment appraisal techniques appear to be exact. However, it has to be appreciated that the true value of an investment proposal can only be approximated. The results arrived at are dependent upon estimated factors and this has to be constantly

borne in mind. The dependability of the results would, to a large extent, depend upon the extent of objectivity and reliability of the input data, Incessant inflation also complicates the picture. In estimating cash flows, it is important to take account of anticipated inflation.

There are essentially three factors in the quantitative techniques for investment appraisal: (1) capital investment, (2) return or cash flows, and (3) project or asset life.

While capital investment can be determined in some cases with a high degree of accuracy (e.g., the purchase price and installation cost of a piece of equipment), in other cases (e.g., development of a new product, opening a new sales territory), the amount can only be approximated.

The return factor (cash savings, incremental inflows or earnings) nearly always depends on estimates. And these estimates depend upon the subjective probabilities (in analysing risk), which are assigned to possible outcomes. With uncertainties pervading the future, projected cash flows may become, at best, half-truths. The source of most major errors is the estimate of sales volume and price. Determining the amount of cash savings, for example, from the use of labour-saving equipment requires that an experienced engineer or production executive estimates the number of labour man hours to be saved, the increase or decrease in maintenance cost, the effects on power consumption, and a host of other factors. Estimates of the contribution margin in increased sales volume resulting from the introduction of a new product, the opening of a new market, or an augmentation of the advertising programme, are always highly speculative.

Finally, the estimate of the useful or economic life of a project or asset is probably the most tenuous of all, for it depends upon several environmental factors technological and marketing. An engineer's guess as to the useful life of a productive asset can be fairly reliable only lithe rate of technological change and obsolescence can be properly estimated. The profitable career of a new product depends upon customer acceptance and competitors reactions-both highly speculative phenomena. Certain statistical techniques based on probability are helpful in minimising the errors of estimating under conditions of uncertainty, but they cannot eliminate uncertainty, and therefore error, entirely.

The soundness of the decision, therefore, would not only depend on the right choice (or combination) of appraisal technique (or techniques), but would also depend on sound common sense and judgement of the decision-makers.

15.9 SUMMARY

Effective deployment of capital over the long-term is one of the key means by which management attempts to achieve the objective of wealth maximisation. Decisions affecting investment in long-term capital projects or assets have a major impact on the future well being of the organisation. Apart from being uncertain, such decisions, typically, involve large commitments of funds. This unit focused on how investment decision can be made more effective in contributing to the health and growth of the firm. The use of the methods of analysis will enable the management to rank and choose intelligently among proposals competing for essentially scarce long-term funds.

The methods presently in common use are (i) the pay **back period,** (ii) the **accounting rate of return,** and (iii) **discounted cash flow** techniques.

The pay back is a `rough-and -ready' means of estimating how long it will take to recoup the original investment from the flow of cash earnings produced by the project. It suffers from a serious drawback i.e. it provides no measure of profitability. It concerns itself only with the liquidity of the investment.

The accounting rate of return is readily understood and easily determinable, but is subject to serious limitations. It averages cash flows, and fails to distinguish between projects with long lives and those with shorter lives and between those with uneven cash flows. Moreover, it overlooks the all important time value of money. This model is adequate where the return of a project plainly far exceeds the required rate or in case of projects which are not subject to close competition for funds from other projects.

The discounted cash-flow techniques are of two basic types: (l) the net present value and (2) the internal rate of return. The former employs some desired (or required) rate of return as a discount factor in determining the present worth of the cash inflows. The investment should show an excess of present value at the desired rate over the initial cost or investment. The latter is the rate of return, which discounts the stream of future cash inflows to the original cost of the investment, which produces them. Under many circumstances, both these DCF technique give identical answers.

Profitability index is the percentage relationship between present value of the cash inflows discounted at the desired rate and the cost of the investment. This device offers ready comparability between projects of unlike size and duration. In general, discounted cash flow techniques provide the most reliable appraisals of alternative investment proposals. The use of present value tables makes these techniques reasonably simple to employ.

Certain limitations underlie all capital budgeting appraisals. However, the three basic factors of the quantitative analytical-techniques - investment, return, and time - are all, to varying degrees, the results of estimates.. The estimate of future benefits is the key measurement in investment appraisal. Certain techniques like sensitivity analysis have been developed which help to narrow the margin of error of such estimates.

15.10 KEYWORDS

Accounting Rate of Return (ARR): A measure of rate of return for evaluating capital investment proposals, derived from accrual accounting. methods for income determination.

Cost of Capital: The cost of raising capital in the market, which may include interest on borrowed money or the relation of company's earnings to the market value of its equity shares.

Discounted Cash Flow: A measure of rate of return for evaluating capital investment proposals based on the concept of the time value of money.

Discounting: A reduction of some future amount of money to a present value at some appropriate rate in accordance with the concept of the time value of money.

Internal Rate of Return (IRR): That rate which equates the present value of the future cash inflows with the cost of the investment which produces them.

Net Present Value (NPV): A technique of discounted cash flow for capital expenditure evaluation which seeks to determine whether the present value of estimated future cash inflows at management's desired rate of return is greater or less than the cost of the proposal.

Payback Period: The length of time required to equate cash return with the initial cost of capital investment, which is determined by dividing the original investment by the annual cash inflows (cash savings after taxes).

Present Value: The amount of money which, if invested immediately at a stated rate, would yield one or more future payments reflecting the increased value of the investment in accordance with the time value of money. Conversely, it may be considered the value of a future stream of payments discounted at a given rate to the present time.

Profitability Index: The present value of future cash inflows divided by the present value of the initial outlay, also known as benefit-cost ratio.

Salvage Value: The residual value of a depreciable asset at the end of its useful life.

15.11 SELF-ASSESSMENT QUESTIONS/ EXERCISES

1. Examine different classes of capital projects and explain why they are often approached differently?
2. What data you would seek before you appraise any capital or asset acquisition, project?
3. Explain the concept of payback period. Why does this method enjoy a good deal of popularity among businessmen? What are its limitations?
4. Explain Accounting Rate of Return and discuss its limitation?
5. What is the meaning of Internal Rate of Return? Are Internal Rate and Payback related? Explain?
6. What is meant by Net Present Value? Why is Profitability Index considered useful?
7. "Discounted cash flow techniques may be fine for some projects, but they have one flaw - they ignore depreciation. Depreciation is an important factor in some types of capital investment. Therefore, discounted cash flow methods are useless when considering investment in depreciable assets". Discuss the logic of this position.
8. How does depreciation act as a tax shield?
9. What are the essential limiting factors in the reliability of capital budgeting measurement techniques including discounted cash flow? .
10. Explain the concept of `cost of capital' as a device for establishing a cut off point for capital investment proposals.
11. State whether the following statements are true or false:

a) Capital investment is not necessarily an investment in tangible property. ☐ Yes ☐ No

b) All investments are expected to yield inflows. ☐ Yes ☐ No

c) A comparison of the investment and the returns (or benefits) cannot be made unless all monetary amounts are stated on the same time basis. ☐ Yes ☐ No

d) The net amount invested in the new machine is the cost of the new machine minus the net amount received from the sale of old machine. ☐ Yes ☐ No

e) Net working capital that must be held to support the investment is a part of the total investment in an asset or project. ☐ Yes ☐ No

f) Depreciation on the asset is included as a cost in computing DCF returns. ☐ Yes ☐ No

g) The net working capital released on the termination of a project is not a return (or inflow) of the final year. ☐ Yes ☐ No

h) The costs incurred in the past have no bearing on the decisions to be made in future. ☐ Yes ☐ No

12 The Western India Company is considering the replacement of one of its machines with a newer model, which supposedly will reduce operating costs considerably. The company has prepared the following analysis of costs:

	Old Machine	**New Machine**
	Rs.	Rs.
Depreciation	10,000	18,000
Labour	12,000	6,000
Other Costs	10,000	4,000
Total Annual Costs	32,000	28,000

The old machine originally cost Rs. 80,000 and has been operated for three years out of an estimated eight-year life. The new machine, which has an estimated life of five years, can be acquired for Rs. 90,000 less a trade-in allowance of Rs. 20,000 for the old machine. The other costs listed above consist of repairs, power to operate the machine, lubrication and similar costs.

Which of the following statements is false?

a) Depreciation on the old machine is a sunk cost.

b) Depreciation on the old machine may be disregarded in deciding whether to replace the old machine.

c) Labour and other costs are out-of-pocket costs.

d) The payback period of the new-machine is seven and one-half years.

13. The Greatways Company is considering replacing an old machine with a newer model having lower maintenance costs. The old machine has a current book value of Rs. 9,000 and a (straight line) depreciation charge of Rs. 3,000 per year for the remaining life of 3 years including the current year. It will have no salvage value. However, at present the machine can be sold in the market for Rs. 6,000. The existing machine requires annual maintenance costs of Rs. 3,000. The new machine will cost Rs. 12,000 and require an annual maintenance costs of Rs.600. It's expected useful life is 3 years with no salvage value.

Assuming straight-line depreciation also for new machine and a tax rate of 50%, determine the incremental cash flows (both outflows and inflows) of the replacement decision.

14. Farewell Company has an investment opportunity costing Rs.30,000 with the following expected net cash flow (i.e. after taxes and before depreciation);

Year	**Net Cash flow**
1	Rs. 4,000
2	4,000
3	4,000
4	4,000
5	4,000
6	7,000
7	9,000
8	12,000
9	9,000
10	2,000

Using 10% as the cost of capital (rate of discount), determine the following:

a) Payback period

b) Net present value at 10 % discounting factor

c) Profitability index at 10% discounting factor.

d) Internal rate of return with the help of 10 % discounting factor and 15 % discounting factor.

15. The Deccan Corporation, which has a 50% tax rate and a 20% after-tax cost of capital, is evaluating a project which will cost Rs. 1,25,000 and will require an increase in the level of inventories and receivables of Rs. 25,000 over its life. The project will generate additional sale of Rs. 1,00,000 and will require cash expenses of Rs. 25,000 in each of its 5-year life. It will be depreciated on a straight-line basis. What are the net present value and internal rate of return for the project?

16. The management of Maratha udyog has two alternative projects under consideration. Project `A' requires a capital outlay of Rs. 3,00,000 but project `B' needs Rs. 4,20,000: Both are estimated to provide a cash flow for six years: A Rs. 80,000 per year and B Rs. 1,10,000 per year. The cost of capital is 12% . Show which of the two projects is preferable from the viewpoint of (i) Net Present Value and (ii) Internal Rate of Return.

17. Speedex Dry Cleaning Company is considering the purchase of new wash and dry equipment in. order to expand its operations. Two types of options are available: a Low Speed System (LSS) with a Rs. 40,000 initial cost and a High Speed System (HSS) with a Rs. 60,000 initial cost. Each system has a sixteen years life and no salvage value. The net cash flows after taxes (CFAT) associated with each investment proposals are:

CEAT for year 1 through 16	Low Speed System (LSS Rs. 8,000)	High Speed System (HSS) Rs. 12,000

Which speed system should be chosen by Speedex, assuming 15 % cost of capital/rate of discount?

18. Space Age Printers, a large and profitable printing press, is faced with the prospect of replacing a large printing system. Two systems currently being marketed will do the job satisfactorily. The Superior system costs Rs. 1,50,000 and will require cash running expenses of Rs. 60,000 per year. The Matchless system costs Rs. 2;25,000 but running expenses are expected to be only Rs. 45,000 per year. Both machines have a ten-year useful life with no salvage value and would be depreciated on a straight-line method.

    a) If the company pays a 40 % tax and has a 11 % after-tax required rate of return, which machine should it purchase?

    b) Would your answer be different if the required rate of return is 9% ?

19. Vishwa Bharti Company is examining two mutually exclusive proposals for new capital investment. The data on the proposals are as follows:

	Proposal A	**Proposal B**
Net cash outlay	Rs. 50,000	Rs. 60,000
Salvage value	2,000	NIL
Estimated life	5 years	6 years
Depreciation	Straight-line Method	Straight-line Method
Corporate income-tax	50%	50%
Cut-off rate used for appraisal	10%	10%

	Proposal A	Proposal B
Earning before Depreciation and taxes		
I st year	Rs. 13,000	Rs. 12,000
II nd year	15,000	16,000
Illrd year	18, 000	18,000
IVth year	22,000	24,000
Vth year	12,000	24,000
VIth year	-	20,000

Using both (a) present value method and (b) D C F rate of return (internal rate of return) calculations, you are asked to advise which proposal would be financially preferable, (you may calculate depreciation on the original cost without taking salvage value into account. You may also ignore income tax on salvage value received).

20. Arunachal Limited has been having a job performed by a neighbouring company on a part used in its project at a cost of Rs.5 per part. The annual average, production of this part is expected to be 6,000 pieces.

    The Arunachal Limited itself can perform this operation by bringing into operation two machines: spare lathe which has a net book value of Rs. 2,000 and a new machine which can be purchased at a price of Rs. 70,000.

    The new machine is expected to last 7 years. The old machine has a remaining physical life of at least 10 years and could be sold now for approximately Rs. 15,000. The final salvage value of both machine is considered negligible.

    In performing the operation itself, the Arunachal Limited will incur out-of-pocket costs for direct labour, power supply etc. of Rs. 2 per part.

    Prepare an analysis (including explanatory comments) which would help to determine whether it is profitable for the company to perform these operations itself. The company normally expects to earn a rate of return before taxes of about 15 % on its invested capital. Ignore income tax effect.

21. The Mahanagar Company, by purchasing and installing a small computer, expects to realise certain cash savings in its data processing operations.

    The direct cash expenses per month under the present manual-book-keeping machine system are:

	Rs.
Salaries - book-keeping and clerical	9.250
Forms and supplies	1,500
Overtime, payroll, taxes, fringes	2,250
Total	13,000

    The existing furniture and equipment are fully depreciated on the books of the company.

    The computer costs Rs, 1,60,000 including alterations, installation and accessory equipment.

    The department will be staffed as follows:

	Per year
Data processing supervisor	Rs. 20,000
Machine Operator	8,000
Programmer	8,500
Key-punch operators (2 @ Rs. 5, 500)	11,000
Other pay roll costs	4,500

It is expected that forms and supplies costs will remain unchanged.

The computer is expected to be obsolete in five years, having a salvage value of Rs. 10,000 at that time.

Assuming a 50 per cent tax rate:

a) Determine the annual cash flow reflecting the tax shield and

b) Decide whether or not to purchase the computer using discounted cash flow assuming a desired rate of return of 16 per cent after taxes.

22. The Frontline Manufacturing Company is considering the purchase of two different types of machines to manufacture auto speed guages, one of the many products it produces for industrial markets. The two machines are alike in the following ways: each requires an initial investment of Rs. 15,00,000, will last for five years after which the salvage value will be zero and has sufficient capacity to meet the projected steady demand. The main difference between the two machines is the timing and amount of operating cash flows. Machine A's operating cash costs would start out high and then decrease in subsequent years. For machine B, constant operating cash costs are predicted. The incremental net cash flows (revenues minus operating cash costs) for the two machines are expected to be as follows:

	After tax Cash Flow per year					
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Machine A.	15,00,000	2,00,000	4,00,000	4,00,000	6,00,000	11,00,000
Machine B	15,00,000	5,00,000	5,00,000	5,00,000	5,00,000	5,00,000

The company needs to determine which of the two machines it should buy to manufacture speed guages. Unsure of which method of evaluation to use, the Deputy Managing Director asks that calculations be made for the following methods:

1. Payback period (assume, for this calculation only, that cash flows are spread evenly throughout the year)
2. Accounting rate of return
3. Internal rate of return
4. Net present value (cost of capital = 10 per cent)
5. Net present value (cost of capital = 12 per cent)

a) Perform the above calculations for each machine. For each method state which machine looks like a better investment.

b) Why does the net present value method yield different decisions at the two different discount rates? Does the internal rate of return method exhibit the same phenomenon?

c) Comment on the usefulness of each of the above Methods for choosing between the two machines.

Answers to Questions/Exercises (11 through 22)

11. (a) T, (b) F, (c) T, (d) T, (e) T, (f) F, (g) F, (h) T.

12. (d) The payback period is approximately five and five-sixth year. The required outlay is Rs. 70,000 (90,000-20,000). The annual savings in out-of-pocket costs are 22,000 (12,000 + 10,000) less Rs. 10,000 (6,000 + 4,000), or 12,000. The payback period is then Rs. 70,000 ÷ 12,000.

13. Cash inflow due to sale of machine Rs 7,500
Net cash outflow Rs 4,500
Total cash inflow each year with new machine Rs 1,700

14. a) Payback period = Six years and four months
b) Net present value = Rs. 3,917
c) Profitability Index = Rs. 1.131 (or 113.1%)
d) Internal rate of Return = 12.75 (approx.)

15 NPV = Rs. 9,600
IRR = 22.78 (try interpolation between 20% and 24%)

16.

	NPV	**IRR**
Project A	28,880	15.34
Project B	32,210	14.68

Project B is preferable as its NPV is more than that of A. Project A is preferable on the basis of IRR.

17.

	LSS	**HSS**
NPV	7,632	11,448

The High Speed System should be chosen by the company as its NPV is greater than that of the Low Speed System. However, the profitability index of both the systems is the same, that is 119.08. per cent. On the basis of this criterion, the company could be indifferent between the two systems. The decision then would depend on other factors.

18. a) NPV = Rs. 4,332 (negative)
Since the NPV is negative, Matchless system should not be acquired. The company should buy the Superior system.
b) NPV = Rs. 2,016
Since the NPV is positive at 9% rate of discount the company should purchase the Matchless system. Therefore, the answer is definitely different.

19. a)

		Proposal A	**Proposal B**
	NPV (Rs.)	-948	1,879
b)	Average cash flow (Rs)	13,600	14,500
	Fake payback period	3.846	4.138
	IRR	9.274	11.024

Since the NPY and IRR of proposal B are higher than those of proposal A, proposal B would be financially preferable.

20. The present value of annual savings= Rs. 74,880
Investment required to produce the part (Rs. 70,000 + 15,000) = 85, 000 As the present value of savings is less than the present value of investment required, the part should continue to be purchased.

21.a) Net cash flew after taxes Rs. 58,000
Tax shield amount Rs. 15,000
b) Net present value (positive)
The computer should be purchased. Rs. 33,086

22.

		Machine A.	**Machine B**
1)	Payback period Machine B is preferable	3.83	3.00
2)	ARR	32%	26.7 %

(Note: Calculations are based on average investment) Machine B is preferable and can be purchased if 32 per cent is an acceptable ROI.

3) IRR 18.05 19.88%

Machine B can be purchased if 19.88 per cent is considered a sufficiently high IRR.

4) a) NPV (at 10 %) Rs. 4,05,500 Rs. 3,95,500

b) Machine A's cash inflows occur later than those of machine B. Therefore, at higher discount rates, machine A looks less attractive than machine B. But because machine A's total inflows are greater, at a low enough discount rate its NPV is greater than that of machine B. The crossover point occurs somewhere between the discount rates of 10 per cent and 12 per cent. The internal rate of return of machine B is higher than the crossover rate (beyond which this machine becomes more attractive than machine A), hence, machine B dominates machine A using IRR.

c) The payback period and ROI methods both ignore the time value of money. As the two machines differ mainly in the timing of their cash inflows, failure to consider the time value of money results in an incomplete comparison of cash flows. The internal rate of return method considers all the cash flows and the time value of money, but still does not always lead to the same decisions as the net present value method. As discussed in part (b), the IRR for each machine is constant, whereas the relative NPV's for the two machines depends on the firm's cost of capital. The most useful method for making the purchase decision is the net present value method with careful thought about the firm's measure of its cost of capital.

15.12 FURTHER READINGS

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