MODULE 2

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.

Capital Budgeting Tools

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

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 annual cash inflow.

**Computation Of Payback Period**

- *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.*

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

\[ \sum \text{inflows} = \text{outflows} \]

**Payback Reciprocal Rate**

- *The payback period is stated in terms of years. This can be stated in terms of percentage also. This is the payback reciprocal rate.*

- *Reciprocal of payback period = \([1/\text{payback period}] \times 100\)
Decision Rules

A. Capital Rationing Situation

- Select the projects which have payback periods lower than or equivalent to the stipulated payback period.
- Arrange these selected projects in increasing order of their respective payback periods.
- Select those projects from the top of the list till the capital Budget is exhausted.

Decision Rules

C. Mutually Exclusive Projects

In the case of two mutually exclusive projects, the one with a lower payback period is accepted, when the respective payback periods are less than or equivalent to the stipulated payback period.

Determination Of Stipulated Payback Period

- Stipulated payback period, broadly, depends on the nature of the business/industry with respect to the product, technology used and speed at which technological changes occur, rate of product obsolescence etc.

- Stipulated payback period is, thus, determined by the management’s capacity to evaluate the environment vis-a-vis the enterprise’s products, markets and distribution channels and identify the ideal-business design and specify the time target.
Advantages Of Payback Period

- It is easy to understand and apply. The concept of recovery is familiar to every decision-maker.

- Business enterprises facing uncertainty - both of product and technology - will benefit by the use of payback period method since the stress in this technique is on early recovery of investment. So enterprises facing technological obsolescence and product obsolescence - as in electronics/computer industry - prefer payback period method.

- Liquidity requirement requires earlier cash flows. Hence, enterprises having high liquidity requirement prefer this tool since it involves minimal waiting time for recovery of cash outflows as the emphasis is on early recoupment of investment.

Disadvantages Of Payback Period

- The time value of money is ignored. For example, in the case of project

- A Rs.500 received at the end of 2nd and 3rd years are given same weightage. Broadly a rupee received in the first year and during any other year within the payback period is given same weight. But it is common knowledge that a rupee received today has higher value than a rupee to be received in future.

- But this drawback can be set right by using the discounted payback period method. The discounted payback period method looks at recovery of initial investment after considering the time value of inflows.
Another important drawback of the payback period method is that it ignores the cash inflows received beyond the payback period. In its emphasis on early recovery, it often rejects projects offering higher total cash inflow.

Disadvantages Of Payback Period (Cont..)

Investment decision is essentially concerned with a comparison of rate of return promised by a project with the cost of acquiring funds required by that project. Payback period is essentially a time concept; it does not consider the rate of return.

Example

There ARE TWO PROJECTS (Project A AND B) AVAILABLE FOR A COMPANY, WITH A LIFE OF 6 YEARS EACH AND REQUIRING A CAPITAL OUTLAY OF Rs.9,000/- EACH; AND ADDITIONAL WORKING CAPITAL OF Rs.1000/- EACH.

The cash inflows comprise of profit after tax + Depreciation + INTEREST (Tax adjusted) for five years and salvage value of Rs.500/- for each project plus working capital released in the 6th year. This company has prescribed a hurdle payback period of 3 years. Which of the two projects should be selected?
## Example – Data

<table>
<thead>
<tr>
<th></th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Cash inflow</td>
<td>6-years</td>
<td>6-years</td>
</tr>
<tr>
<td>Year -1</td>
<td>3,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Year -2</td>
<td>3,500</td>
<td>2,500</td>
</tr>
<tr>
<td>Year -3</td>
<td>3,500</td>
<td>2,500</td>
</tr>
<tr>
<td>Year -4</td>
<td>1,500</td>
<td>2,500</td>
</tr>
<tr>
<td>Year -5</td>
<td>1,500</td>
<td>3,000</td>
</tr>
<tr>
<td>Year -6</td>
<td>3,000</td>
<td>5,500</td>
</tr>
<tr>
<td></td>
<td>16,000</td>
<td>18,000</td>
</tr>
<tr>
<td>Payback period</td>
<td>3 years</td>
<td>4 years &amp; 2 months</td>
</tr>
</tbody>
</table>
Example

<table>
<thead>
<tr>
<th>Year</th>
<th>Project A</th>
<th>Cumulative cash inflows of Project A</th>
<th>Project B</th>
<th>Cumulative cash inflows of Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year -1</td>
<td>3,000</td>
<td>3,000</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Year -2</td>
<td>3,500</td>
<td>6,500</td>
<td>2,500</td>
<td>4,500</td>
</tr>
<tr>
<td>Year -3</td>
<td>3,500</td>
<td>10,000</td>
<td>2,500</td>
<td>7,000</td>
</tr>
<tr>
<td>Year -4</td>
<td>1,500</td>
<td>11,000</td>
<td>2,500</td>
<td>9,500</td>
</tr>
<tr>
<td>Year -5</td>
<td>1,500</td>
<td>13,000</td>
<td>3,000</td>
<td>12,500</td>
</tr>
<tr>
<td>Year -6</td>
<td>3,000</td>
<td>16,000</td>
<td>5,500</td>
<td>18,000</td>
</tr>
</tbody>
</table>

Example

- Payback period for Project A = 3 years (cumulative cash inflows = outflows)

- Payback period for Project B = 4 years + 500/3000 = 4 years and 2 months.

(Note: Interpolation technique is used here to identify the exact period at which cumulative cash inflows will be equal to outflows. The amount required to equate is Rs.500, while the returns from the 5th year is 3,000. Hence the addition time duration required to compute the payback period is (500/3000) x 12 which is 2 months. The interpolation technique is used based on the assumption that cash inflows accrue uniformly throughout the year.)
The investment decision will be to choose Project A with a payback period of 3 years and reject Project B with a payback period of 4 years and 2 months.

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.

Computation Of Accounting Rate Of Return

The accounting rate of return using total investment.

or

Sometimes average rate of return is calculated by using the following formula:

\[
\frac{\text{Net Profit After Tax}}{\text{Average Investment}}
\]

Where average investment = total investment divided by 2
Decision Rules

A. Capital Rationing Situation

- Select the projects whose rates of return are higher than the cut-off rate
- Arrange them in the declining order of their rate of return and
- Select projects starting from the top of the list till the capital available is exhausted.

B. No Capital Rationing Situation

Select all projects whose rate of return are higher than the cut-off rate.

C. Mutually Exclusive Projects

Select the one that offers highest rate of return.

Accounting Rate Of Return – Advantages

- It Is Easy To Calculate.
- The Percentage Return Is More Familiar To The Executives.

Accounting Rate Of Return – Disadvantages

- The definition of cash inflows is erroneous; it takes into account profit after tax only. It, therefore, fails to present the true return.

- Definition of investment is ambiguous and fluctuating. The decision could be biased towards a specific project, could use average investment to double the rate of return and thereby multiply the chances of its acceptances.
• Time value of money is not considered here.

Example

• There are two projects (Project A and B) available for a business enterprise, with a life of 6 years each and requiring a capital outlay of Rs.9,000/- each and additional working capital of Rs.1000/- each. The cash inflows comprise of profit after tax + depreciation + interest (Tax adjusted) for five years and salvage value of Rs.500/- for each project at year 6 plus working capital released also in the 6th year.

• The Profit (after tax) component of the cash inflows for each project are given in the next slide.

Example

Net Profit After Tax

<table>
<thead>
<tr>
<th>Year</th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,580</td>
<td>280</td>
</tr>
<tr>
<td>2</td>
<td>2,080</td>
<td>1,080</td>
</tr>
<tr>
<td>3</td>
<td>2,080</td>
<td>1,080</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td>1,080</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>2,580</td>
</tr>
<tr>
<td>6</td>
<td>80</td>
<td>1,880</td>
</tr>
<tr>
<td>Total Net Profit After Tax</td>
<td>5,980</td>
<td>7,980</td>
</tr>
<tr>
<td>Average Annual Net Profit</td>
<td>5,980/6 = 996.6</td>
<td>7,980/6 = 1330</td>
</tr>
</tbody>
</table>
Example

- Taking into account the working capital released in the 6th year and salvage value of the investment, the total investment will be (10,000-1,500) Rs.8500 and the average investment will be (8500/2) Rs.4250 for each project.

  The rate of return calculations are:
  Net profit after tax as a percentage of total investment

  Project A

  Project B

  $\frac{1130 \times 100}{8500} = 15.6\%$

  The investment decision will be to select Project B since its rate of return is higher than that of Project A if they are mutually exclusive. If they are independent projects both can be accepted if the minimum required rate of return is 11.7% or less.
Net Present Value (Npv)

Net present value of an investment/project is the difference between present value of cash inflows and cash outflows. The present values of cash flows are obtained at a discount rate equivalent to the cost of capital.

Computation Of Net Present Value (Npv)

- Let 'b' be the cash outflow in period 't' where $t = 0, 1, 2, ..., n$
- 'B' be the present value of cash outflows
- 'c' be the cash inflow in period 't' = $0, 1, 2, ..., n$
- 'C' be the present value of cash inflows
- 'K' be the cost of capital

Then

**Present value of cash inflows**

$$C = \sum_{t=0}^{n} \frac{c_t}{(1+k)^t}$$

**Present value of cash outflows**

$$B = \sum_{t=0}^{n} \frac{b_t}{(1+k)^t}$$

**Net present value (NPV)**

$$= (C - B)$$

or

$$= \sum_{t=0}^{n} \frac{(c_t \cdot b_t)}{(1+k)^t}$$
Computation Of Net Present Value (Npv)

- *When the cash outflow is required for only one year i.e., in the present year, then the Net present value is calculated as follows:*

\[
\text{Net present value} = \sum_{t=0}^{n} \frac{C_t}{(1+k)^t} - I
\]

- "I" is the initial investment (cash outflow) required by the project.

**Decision Rules**

**A. "Capital Rationing" situation**
Select projects whose NPV is positive or equivalent to zero.
Arrange in the descending order of NPVs.
Select Projects starting from the list till the capital budget allows.

**B. "No capital Rationing" Situation**
Select every project whose NPV >= 0

**C. Mutually Exclusive Projects**
Select the one with a higher NPV.

**Net Present Value (Npv) – Example**
Assuming that the cost of capital is 6% for a project involving a lumpsum cash outflow of Rs.8,200 and cash inflow of Rs.2,000 per annum for 5 years, the Net Present Value calculations are as follows:

a) Present value of cash outflows Rs.8200
b) Present value of cash inflows
   Present value of an annuity of Rs.1 at 6% for 5 years = 4.212
   Present value of Rs.2000 annuity for 5 years = 4.212 X 2000 = Rs.8424

   c) Net present value = present value of cash inflows - present value of cash outflows = 8424 - 8200 = Rs.224

   Since the net present value of the project is positive (Rs.224), the project is accepted.

**Internal Rate Of Return (IRR)**

The internal rate of return method is also known as the yield method. The IRR of a project/investment is defined as the rate of discount at which the present value of cash inflows and present value of cash outflows are equal.

   IRR can be restated as the rate of discount, at which the present value of cash flow (inflows and outflows) associated with a project equal zero.

**Computation Of Internal Rate Of Return (IRR)**

Let at be the cash flows (inflow or outflow) in period t

- Where t = 0,1,2......
- .... n years

Then IRR of the project is found out by solving for the value of ‘r’ in the following equation:

\[
\sum_{t=0}^{n} \frac{a_t}{(1+r)^t} = 0
\]

\[
\frac{a_0}{(1+r)^0} + \frac{a_1}{(1+r)^1} + \frac{a_2}{(1+r)^2} + \ldots + \frac{a_n}{(1+r)^n} = 0
\]  

Equation -1
Computation Of Internal Rate Of Return (Irr)

Let \( at \) be the cash flows (inflow or outflow) in period \( t \)

- In the special case where \( a_0 < 0 \) and \( at > 0 \), where \( t = 1,2,\ldots,n \)
- Then the IRR is

\[
a_0 = \sum_{t=0}^{n} \frac{a_t}{(1+r)^t} = 0
\]

Equation 2

Computation of Internal Rate Of Return (Irr)

When Trial and error method is used to solve for the IRR, two rates are computed one that gives a small positive NPV, another that gives a small negative NPV. The IRR using the trial and error method will be:

\[
\text{IRR} = r_1 + \left( \frac{N_1}{N_1 + N_2} \times (r_2 - r_1) \right)
\]

Where

- \( r_1 = \text{smallest rate of interest} \)
- \( r_2 = \text{highest rate of interest} \)
- \( N_1 = \text{NPV at smallest rate} \)
- \( N_2 = \text{NPV at highest rate} \)
Decision Rules

A. "Capital Rationing" Situation
Select those projects whose IRR \( (r) = k \), where \( k \) is the cost of capital. Arrange all the projects in the descending order of their Internal Rate of Return. Select projects from the top till the capital budget allows.

B. "No Capital Rationing" Situation
Accept every project whose IRR \( (r) = k \), where \( k \) is the cost of capital.

C. Mutually Exclusive Projects
Select the one with higher IRR.

Internal Rate Of Return (Irr) – Example

- A new machinery costs Rs.8,200 and generates cash inflow (after tax) per annum of Rs.2,000 during its life of 5 years.
- IRR method involves trial and error in the sense that one has to experiment with different rates of discount before arriving at the appropriate rate at which the equation 1 and 2 are satisfied. But when the cash inflows are by way of annuities the relevant interest factor is:

Internal Rate Of Return (Irr) - Example
Annuity Table Method:

- In the present case this is 8200 divided by 2000 = 4.1
- The interest factor 4.1 for a 5 year project corresponds to a discount rate of 7%. So the IRR of the project is 7%. An interest factor of 4.100 indicates that the present value of one Rupee annuity for 5 years at 7% is equivalent to 4 rupees and ten paise.
- The present value of Rs.2,000 annuity is 4.100 X 2000 = 8200.
- The present value of cash inflows = Rs.8200 and the present value of cash outflow = Rs.8200
• At 7% the present value of cash inflows is equivalent to the present value of cash outflows.

• Hence 7% is the IRR of the project.

Internal Rate Of Return (IRR) - Example

Trial And Error Method:

• Through the trial and error method, we can begin with a 10% discount rate. The net present value assuming a 10% discount rate is

\[(2000 \times 3.7908) - 8200 = 7581.6 - 8200 = -618.4.\]

• Since the NPV is negative, we need to reduce the discount rate to arrive at a positive NPV. Hence, let us assume a discount rate of 5%. The net present value assuming a 5% discount rate is

\[(2000 \times 4.3295) - 8200 = 8659 - 8200 = 459.\]

Internal Rate Of Return (IRR) – Example

• Now, we have to interpolate the IRR which lies between these two positive and negative NPV i.e., the discount rate that results in a 0 NPV.

• The IRR rule will be

\[5\% + \left(\frac{618.4}{1077.4}\right) \times 5\% = 5\% + 2\% = 7\%.\]

Internal Rate Of Return – Example (Decision Rule)

• If the cost of capital is less than or equal to 7% we will accept the investment of Rs.8200 in the new machine since it offers a return of 7%.

• Such projects whose IRR is equivalent to the cost of capital are called marginal projects since the company on accepting them, will neither be worse off nor better off. They will just pay for themselves.

• Where the cash inflows are not uniform series and/or where cash outflows occur at other periods besides the initial period, it is necessary to experiment different rates and the appropriate rate could be found out through interpolation.
Profitability Index (Pi)

Profitability ratio is otherwise referred to as Benefit/Cost ratio. This is an extension of the Net Present Value Method. This is a relative valuation index and hence is comparable across different types of projects requiring different quantum of initial investments.

Profitability index (Pi) is the ratio of present value of cash inflows to the present value of cash outflows. The present values of cash flows are obtained at a discount rate equivalent to the cost of capital.

Computation Of Profitability Index (Pi)

Profitability index is always expressed on net basis. Formula for profitability index (Pi) is:

\[
\text{Pi} = \frac{\text{Present Value of Cash inflows}}{\text{Present Value of Cash outflows}}
\]

\[
\text{Pi} = \frac{\sum_{t=0}^{n} \frac{a_t}{(1 + k_0)^t}}{a_0}
\]

Where at is the cash inflow in period 't' and t = 1,2,...,n

- \(k_0\) is cost of capital
- \(a_0\) is initial investment.
Decision Rule

A. "Capital Rationing" Situation

Select all projects whose profitability index is greater than or equivalent to 1.

Rank them in the descending order of their profitability indices and select projects starting from the top of the list till the capital budget amount is exhausted.

B. "No Capital Rationing" Situation

Select every project whose PI >= 1.

C. Mutually Exclusive Projects

Select the project with higher PI.

Profitability Index (Pi) – Example

• A new machinery costs Rs.8,200 and generates cash inflow (after tax) per annum of Rs.2,000 during its life of 5 years. Let us assume that the cost of capital for the company is 6%.

• The present value of the cash inflows at 6% discount rate is 2000 * 4.212 = 8424. The present value of outflows is 8,200. The profitability index is (8424/8200) = 1.027.

• The profitability index of 1.027 leads to an acceptance decision of the project, since it is greater than 1.
Profitability Index (Pi)

So far as "accept-reject" decisions are concerned, all the three discounted cash flow (DCF) methods lead to the same decision. But in the case of ranking mutually exclusive projects, sometimes there will be conflicting decisions between NPV and IRR.

In such situations, a choice has to be made between these methods. Since PI is a relative ranking method, this fits most suitably for evaluating mutually exclusive projects.