CAPITAL BUDGETING TECHNIQUES

Meaning of Capital Budgeting

- Capital budgeting addresses the issue of strategic long-term investment decisions.
- Capital budgeting can be defined as the process of analyzing, evaluating, and deciding whether resources should be allocated to a project or not.
- Process of capital budgeting ensure optimal allocation of resources and helps management work towards the goal of shareholders' wealth maximization.

Why Capital Budgeting is so Important?

- Involve massive investment of resources
- Are not easily reversible
- Have long-term implications for the firm
- Involve uncertainty and risk for the firm

Capital Budgeting Process

- It is a complex process, divided into following phases:
  1. Identification of potential investment opportunities
  2. Assembling of proposed investments
  3. Decision making
  4. Preparation of capital budget and appropriation
  5. Implementation
  6. Performance review

1. Identification of Potential Investment Opportunities

- Estimates of future sales for setting production targets, helps in identifying required investment in plant and equipment
- For identification of investment ideas it is helpful to:
  - i. Monitor external environment regularly,
  - ii. Formulate a well defined corporate strategy based on thorough analysis of strengths, weaknesses, opportunities and threats,
  - iii. Share corporate strategy and perspectives with persons who are involved in process of capital budgeting
  - iv. Motivate employees to make suggestions

2. Assembling of Investment Proposals

- Proposals are routed through several persons before assembling
  - it helps in creating a climate for bringing about coordination of interrelated activities
- To facilitate decision making, proposals are:
  - Replacement investments
  - Expansion investments
  - New product investments
  - Obligatory and welfare investments

3. Decision making

- A system of rupee gateways usually characterizes capital investment decision making
- Executives are vested with power to okay investment proposal up to certain limits
- Investments requiring higher outlays need the approval of the board of directors

4. Preparation of Capital Budget and Appropriation

- Projects involving small outlays are often appropriated for expeditious action
- Projects involving larger outlays require an appropriation order
- This check ensures the funds position of firm is satisfactory and review of project at the time of implementation

5. Implementation

- Delays in implementation lead to substantial cost overruns.
- For expeditious implementation, following are helpful:
  - *Adequate formulation of projects: preliminary studies, comprehensive and detailed formulation is necessary*
  - *Use of the Principle of Responsibility Accounting: assigning specific responsibilities; defined time frame and cost limits are helpful*
  - *Use of Network Techniques: like PERT and CPM for project planning and control*

6. Performance Review

- Post completion audit is a feedback device.
- Compares Actual performance with projected performance
- It is useful in several ways:
  i. Throws light on assumptions
  ii. Documented log of experience valuable for decision making
  iii. Uncovering judgmental bias
  iv. Induces desired caution among project sponsors

Project Classification

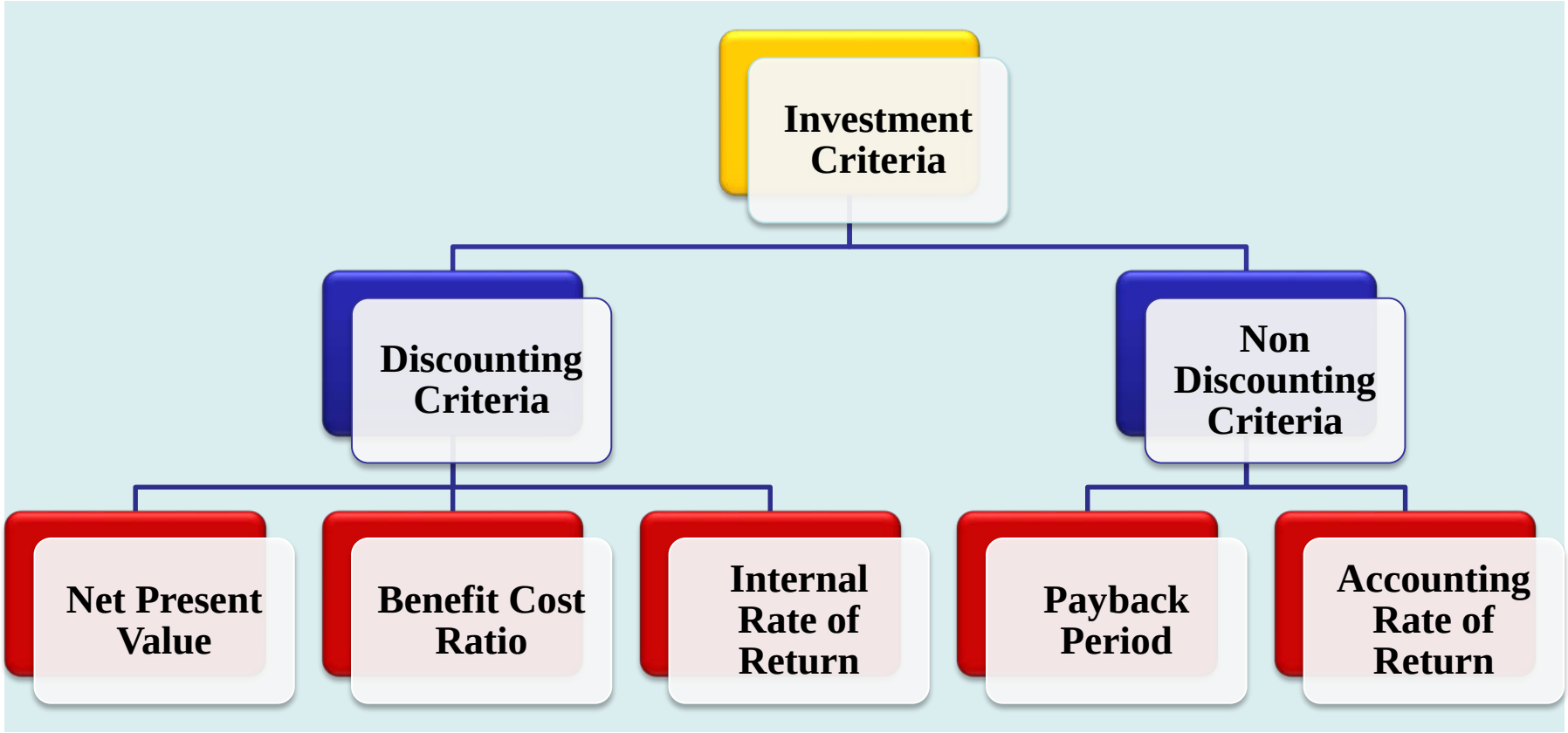
System of classification may vary from one firm to another, following are categories:

- **Mandatory Investments *(Govt. regulation)*:** *expenditures required to comply with statutory requirements, e.g., pollution control equipment, medical dispensary.*
  - ***Non revenue producing investments***
  - ***Cost-effective way of fulfilling the given need***
- **Replacement Projects:** *firms invest in equipments to replace obsolete & inefficient equipments, may be in a serviceable condition*
  - ***Reduces costs of labor, raw material and power***
  - ***Increase yield and improve quality***

Project Classification

- ***Expansion Projects:*** *to increase capacity and widen distribution networks.*
  - ***Such investments call for an explicit forecast of growth,***
  - ***Decisions taken by top management***
- **Diversification Projects:** *aimed at producing new products or services or entering into entirely new geographical areas.*
  - ***Often entails substantial risks, involve large outlays, and require managerial effort & attention***
  - ***Thorough evaluation both quantitative and qualitative***
  - ***Significant involvement of board of directors***
- **Research & Development Projects:** *R&D projects have a small proportion in Indian organizations. However, companies are now allocating more funds to R&D projects.*
  - ***R&D projects have numerous uncertainties and involve sequential decision making***
  - ***Projects are decided on managerial judgment***
  - ***Firms use decision tree analysis and option analysis to evaluate R&D projects***

Investment Criteria



Net Present Value (NPV)

- It is the sum of the present values of all the cash flows – positive as well negative – that are expected to occur over the life of the project

$$NPV of\ \text{Pr}oject = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} - Initial\quad Investment$$

- where, C_t = cash flow at the end of year t

  n = life of the project

  r = discount rate also known as cost of capital

Net Present Value (NPV)

Year	Cash Flow
0	Rs. (1,000,000)
1	200,000
2	200,000
3	300,000
4	300,000
5	350,000

where, r = 10%

$$NPV = -1000000 + 200000/(1.10)^1 + 200000/(1.10)^2 + 300000/(1.10)^3 + 300000/(1.10)^4 + 350000/(1.10)^5$$

$$= 5{,}273$$

- NPV represents net benefit over and above the compensation for time & risk

- **Decision rule:**
  - ✓ **If NPV is positive then Accept the Project or Proposal**
  - ✓ **If NPV is negative then Reject the Project or Proposal**
  - ✓ **If NPV = 0 then it is a matter of indifference**

Properties of the NPV Rule

- **NPV are Additive:** For two projects A & B, net present value of combined investment is: NPV (A) + NPV (B)
- This property has several implications:
  - Value of a firm = Σ Present value of projects + Σ NPV of expected future projects

    First term on right hand side of equation captures the value of ***assets in place*** & second term the value of ***growth opportunities***
  - When a firm terminates an existing project which has a negative NPV based on its expected future cash flows, the value of the firm increases by that amount.
  - Likewise, when a firm undertakes a new project that has a negative NPV, the value of the firm decreases by that amount.

Properties of the NPV Rule

- When a firm divests itself of an existing project, the price at which the project is divested affects, the value of the firm. If the price is greater/lesser than the present value of the anticipated cash flows of the project the value of the firm will increase/decrease with the divestiture.
  - A divestiture is when a company or government disposes of all or some of its assets by selling, exchanging, closing them down, or through bankruptcy.
  - As companies grow, they may become involved in too many business lines, so divestiture is the way to stay focused and remain profitable.
  - Divestiture allows companies to cut costs, repay their debts, focus on their core businesses, and enhance shareholder value.

- When a firm takes on a new project with a positive NPV, its effect on the value of the firm depends on whether its NPV is in line with expectation.

- When a firm makes an acquisition and pays a price in excess of the present value of the expected cash flows from the acquisition it is like taking on a negative NPV project and hence will diminish the value of the firm.

Properties of the NPV Rule

- **Intermediate Cash Flows are Invested at Cost of Capital:** NPV rule assumes that the intermediate cash flows of a project i.e., cash flows that occur between the initiation & termination of the project are reinvested at a rate of return equal to the cost of capital
- **NPV Calculation Permits Time Varying Discount Rates:** Assumed that the discount rate remains constant over time. But, NPV can be calculated using time-varying discount rates

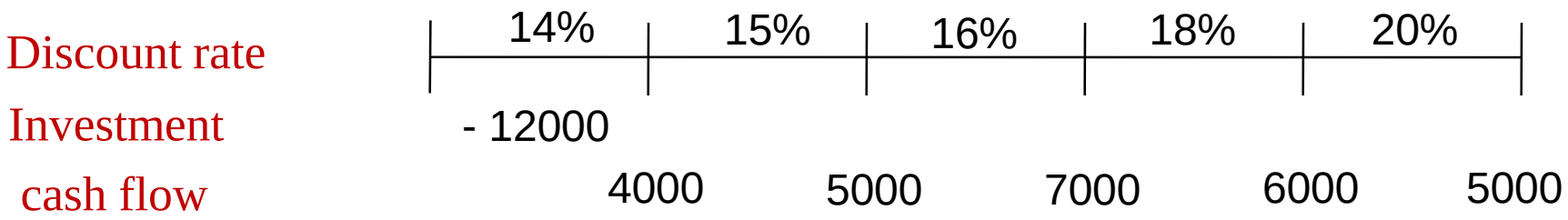
$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1+r_t)^t} - Initial \quad Investment$$

where, C_t = cash flow at the end of year t,
r_t = discount rate for year t

- Discount rate may change over time for following reasons:
  a. Level of interest rates may change over time
  b. Risk characteristics of project may change over time causing changes in cost of capital
  c. Financing mix of the project may vary over time causing changes in cost of capital

Properties of the NPV Rule

- Assume that you are evaluating a 5 year project involving software development. Technological uncertainty leads to higher discount rate.



- Present value of cash flows can be calculated as follows:

PV of C_1 = 4000 / 1.14 = 3509

PV of C_2 = 5000 / (1.14 x 1.15) = 3814

PV of C_3 = 7000 / (1.14 x 1.15 x 1.16) = 4603

PV of C_4 = 6000 / (1.14 x 1.15 x 1.16 x 1.18) = 3344

PV of C_5 = 5000 / (1.14 x 1.15 x 1.16 x 1.18 x 1.20) = 2322

NPV of Project = 3509 + 3814 + 4603 + 3344 + 2322 – 12000 = Rs. 5592

Limitations

- NPV is expressed in absolute terms rather than relative terms & hence does not factor in the scale of investment. Thus project A may have NPV of 5000 while project B has NPV of 2500 but A may require an investment of 50,000 while for B it is only 10,000.
  - Advocates of NPV argue that what matters is the surplus value, over & above the hurdle rate, irrespective of what the scale of investment is.
- NPV rule does not consider life of project. Hence, when mutually exclusive projects with different lives are being considered, the NPV rule is biased in favor of longer term projects.

Benefit Cost Ratio (Profitability Index)

- There are two ways of defining the relationship between benefits and cost:
  - Benefit-cost ratio: BCR = PVB / I
  - Net Benefit-cost ratio: NBCR = (PVB – I) / I = BCR – 1

  Where, PVB = present value of benefits = $NPV = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t}$

  I = Initial investment

- To illustrate the calculation of these measures, let us consider a project which is being evaluated by a firm that has cost of capital of 12%.

Benefit Cost Ratio

- Initial investment: Rs 100,000
- Benefits:

Year 1	25,000
Year 2	40,000
Year 3	40,000
Year 4	50,000

- $BCR = \dfrac{\frac{25000}{1.12} + \frac{40000}{(1.12)^2} + \frac{40000}{(1.12)^3} + \frac{50000}{(1.12)^4}}{100000} = 1.145$

- NBCR = BCR – 1 = 0.145

- It is the ratio of the present value of the net cash flows to the initial cost of the project i.e., profitability per dollar of investment which may be higher on the smaller project than on the larger project w.r.t to time (against their NPVs).

- In cases of capital rationing i.e., when the firm cannot undertake all the projects with positive NPV, the firm should rank projects according to their profitability index and choose the projects with the highest PIs rather than those with the highest NPVs.

Benefit Cost Ratio

- **Decision Rules:**

When BCR	*or NBCR*	*Rule is*
> 1	**> 0**	**Accept**
= 1	**= 0**	**Indifferent**
< 1	**< 0**	**Reject**

- **Evaluation:** Proponents of benefit-cost ratio argue since, benefit-cost ratio measures NPV per rupee of outlay, it can discriminate better between large & small investments and hence is preferable to the NPV criterion.

Benefit Cost Ratio

- **How valid is this argument?**
  - Weingartner, who examined this criterion theoretically finds that:
    - Under constrained conditions, benefit-cost ratio will accept and reject same projects as the NPV criterion.
    - When the capital budget is limited in the current period, the benefit-cost ratio may rank projects correctly in the order of decreasingly efficient use of capital. However, its use is not recommended because it provides no means for aggregating several smaller projects into a package that can be compared with a large project.
    - When cash outflows occur beyond the current period, the benefit-cost ratio is unsuitable as a selection criterion.

Internal Rate of Return (IRR)

- IRR is the discount rate which makes its NPV equal to zero. In other words, it is the discount rate which equals the present value of future cash flows with the initial investment. It is the value of r in following equation:

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

where, C_t = cash flow at the end of year t

r = internal rate of return (IRR)

n = life of the project

- In NPV calculation, we assume that the value of discount rate (cost of capital) is known & determine value of NPV

- **In IRR, calculation, we set NPV equal to zero & determine the discount rate that satisfies this condition**

Internal Rate of Return (IRR)

Year	0	1	2	3	4
Cash flow	100,000	30,000	30,000	40,000	45,000

IRR is the value of r which satisfies the following condition:

$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1+r_t)^t} - Initial\ \ Investment = 0, \text{ thus}$$

$$\text{Initial investment} = \sum_{t=1}^{n} \frac{C_t}{(1+r_t)^t}$$

$$100{,}000 = \frac{30000}{(1+r)} + \frac{30000}{(1+r)^2} + \frac{40000}{(1+r)^3} + \frac{45000}{(1+r)^4}$$

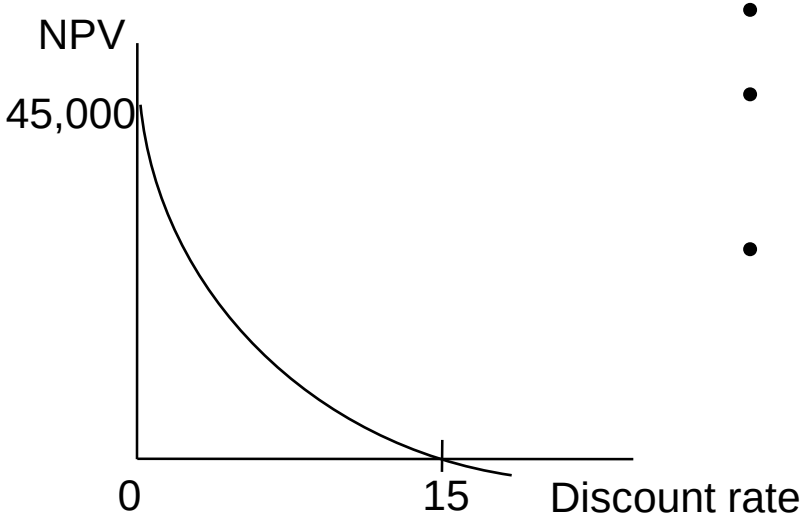
- Calculation of r involves process of trial and error. We try different values of r till, we find RHS value = LHS value (here value of r lies between 15 and 16%).

Internal Rate of Return (IRR)

- For more refined estimate of r:
  - Determine NPV of two closest r (i.e., for 15% & 16%).
  - NPV for 15% = 802 & for 16% = -1359
  - Find the sum of two values of NPV = 802 + 1359 = 2161
  - Calculate the ratio of NPV of smaller discount rate, i.e., 802 / 2161 = 0.37
  - Now, add this ratio value to the smaller r, = 15 + 0.37 = 15.37%
  - This value of r (15.37%) is very close approximation to the true internal rate of return
- **Decision Rule: Accept: If the IRR > cost of capital**

  Reject: If the IRR < cost of capital

NPV and IRR



- IRR rule is quite similar to NPV rule.
- NPV is plotted on the y-axis while discount rate on the x-axis.
- It gives valuable insights:
  - IRR is the point at which NPV profile crosses the x-axis
  - Slope of the NPV profile reflects how sensitive the project is to discount rate changes

Do the IRR & NPV lead to identical decisions?

- Yes, provided two conditions are satisfied:
  - *First*, cash flows of the project must be ***conventional*****,** implying that the first cash flow (initial investment) is negative & the subsequent cash flows are positive.
  - *Second*, project must be ***independent***, meaning that project can be accepted or rejected without reference to any other project.

Problems with IRR

- **Non-conventional cash flows:** when cash flows of the project are not conventional. It is difficult to define ‘what is IRR’
- In case of multiple IRR where NPV is zero at two discount rates, it is difficult to find the correct value of IRR. In such cases, IRR rule breaks down.
- There can also be cases in which no IRR exists. For e.g. a project has a positive NPV for all discount rates and hence no IRR.
- **Mutually Exclusive Projects:** when two or more projects are being compared to determine which one is the best. In such cases IRR may be misleading.
- Projects P (with NPV = 7857 & IRR = 100%) while Project Q (with NPV = 16964 & IRR = 50%). From NPV point of view Q is better than P but form IRR point of view P looks better than Q.
- Hence, the IRR rule seems unsuitable for ranking projects of different scale.
- IRR rule can be salvaged by considering the IRR on the incremental cash flow.

Problems with IRR

	Cash flow		IRR	NPV
Project	C_0	C_1		(assuming r = 12%)
P	- 10,000	20,000	100%	7,857
Q	- 50,000	75,000	50%	16,964

- Project P requires smaller outlay, is highly attractive because its IRR is 100%.
- What is the rate of return on incremental cash flow if we switch from P to Q, which is a high outlay project?
- Incremental cash flow, in such switch = (C_0/-40,000) (C_1/55000). IRR of this cash flow stream is 37.5% > 12% i.e., higher than cost of capital.
- Hence, it is desirable to switch from P to Q.

Problems with IRR

	Cash flow					IRR	NPV
Project	C_0	C_1	C_2	C_3	C_4		(r = 10%)
X	- 110,000	31,000	40,000	50,000	70,000	22%	36,613
Y	- 110,000	71,000	40,000	40,000	20,000	25%	31,314

- IRR is also unreliable for ranking projects which have different patterns of cash flow over time.
- Both Projects X and Y look good, with its higher NPV, yet from an IRR point of view Y looks more attractive. Hence, IRR rule can be misleading, when choice has to be made between mutually exclusive projects which have different patterns of cash flow over time.
- In this case, IRR rule can be salvaged by considering the IRR on the incremental cash flow.

Problems with IRR

- **Lending vs. Borrowing:** IRR cannot distinguish between lending and borrowing, hence high IRR need not be desirable
- Project B is more attractive than Project A, as IRR of B is higher than that of project A as per the figures. But Project B is a highly undesirable project resulting negative NPV.
- Project involves borrowing 4,000 at a rate of return of 75% while A involves investment of 4,000 at a rate of return of 50%.

	Cash flow		**IRR**	**NPV**
Project	C_0	C_1		(r = 10%)
A	- 4,000	20,000	50%	145
B	+ 4,000	75,000	75%	- 236

Problems with IRR

- **Differences between Short-term and Long-term Interest Rates:** IRR is difficult to apply when short-term interest rates differ from long-term interest rates.
- IRR rule says that a project be accepted if its IRR > cost of capital.
- But what should we do in case of several cost of capital. Should we compare IRR with r_1 or r_2 or r_3 …. or r_n.
- We have to compute a complex weighted average of various rates to get a number comparable to IRR, which is a much difficult task.
- **Given the limitations and problems of IRR (over NPV) it is suggested to simply calculate NPV than IRR.**

Redeeming Qualities: IRR

- Despite its deficiencies, IRR is immensely popular in practice, even more than NPV. Surveys reveal that IRR is the most popular investment evaluation technique.
- Managers and Financial Analysts want to think in terms of rate of return rather than absolute rupee values.
- IRR offers a practical advantage over NPV as NPV cannot be estimated without knowing the discount rate but IRR can still be calculated.
- The pros and cons of IRR are summarized below:

Pros	*Cons*
➢ Closely related to NPV	May lead to multiple rates of return
➢ Easy to understand & Interpret	May result into incorrect decisions in comparing mutually exclusive projects

Modified Internal Rate of Return (MIRR)

Suppose you are offered an investment costing $10,000 that promises cash flows of $1,000 after one year, $2,000 after two years, and returns the original $10,000 at the end of the second year. The return on this investment is the rate *i* that solves:

$$\$10{,}000 = \frac{\$1{,}000}{(1+i)^1} + \frac{\$2{,}000}{(1+i)^2} + \frac{\$10{,}000}{(1+i)^2}$$

- Combining the cash flows that occur at the end of the second year,

$$\$10{,}000 = \frac{\$1{,}000}{(1+i)^1} + \frac{\$12{,}000}{(1+i)^2}$$

- Discount rate that solves this problem is ***14.66%*** per year, annual return on this investment

- **The Reinvestment Assumption:** The discount rate that equates an investment's initial cost with value of the future cash flows it produces is the IRR

Modified Internal Rate of Return (MIRR)

Year	Cash Flow	Value at the End of the Second Year	
1	$1,000	$1,100	← $1,000 invested one period at 10%
2	$12,000	12,000	
Total		$13,100	

In this case, the return on your investment is:

$$i = \sqrt{\frac{\$13,100}{\$10,000}} - 1 = 14.46\% \text{ per year}$$

which is larger than mattress stuffing because the $1,000 earns $100 of interest during the second period.

But suppose you reinvest this $1,000 at a return = 14.66%?

Year	Cash Flow	Value at the End of the Second Year	
1	$1,000	$1,147	← $1,000 invested one period at 14.66%
2	$12,000	12,000	
Total		$13,147	

$$i = \sqrt{\frac{\$13,147}{\$10,000}} - 1 = 0.1466 \text{ or } 14.66\%$$

If we assume the cash flows are reinvested at a different return, the return on the investment is referred to as the ***modified internal rate of return*** (MIRR). For example, assuming reinvestment of the cash inflows at 10% provides us with a **MIRR of 14.46%,** which is less than the **IRR of 14.66%**

So, the Reinvestment assumption is changed the IRR is modified accordingly

Non-discounting Criteria: Payback Period

- It is the length of time required to recover the initial cash outlay on the project. For e.g., if project involves cash outlay of Rs. 600,000 & generates cash inflows of Rs.100,000, Rs.150,000, Rs. 150,000 & Rs. 200,000 in the first, second, third & fourth years respectively, its payback period is 4 years because the sum of cash inflows during 4 years is equal to the initial outlay.
- When the annual cash inflow is a constant sum, the payback period is simply the initial outlay divided by the annual cash inflow.

- According to the payback criterion, the shorter the payback period, the more desirable the project.
- Firms using this criterion specify the maximum acceptable payback period. If this is *n* years or less are deemed worthwhile and if payback period exceeding *n* years are considered unworthy.

Payback Period: Advantages

- It is simple, in concept and application. It does not use involved concepts and tedious calculations & has few hidden assumptions.

- It is a rough and ready method to dealing with risk. It favors projects which generate substantial cash inflows in earlier years & discriminates against projects which bring substantial cash inflows in later years but not in earlier years. Now, if risk tends to increase, with futurity - in general, this may be true – payback period may be helpful in weeding out risky projects.

- Since it emphasizes earlier cash inflows, it may be a sensible criterion when the firm is pressed with problems of liquidity.

Payback Period: Limitations

- It fails to consider time value of money. Cash inflows are simply added without suitable discounting. This violates the most basic principle of financial analysis which stipulates that cash flows occurring at different points of time can be added or subtracted only after suitable compounding/discounting.

- It ignores cash flows beyond the payback period. This leads to discrimination against projects which generate substantial cash inflows in later years.

- It is a measure of project's capital recovery, not profitability.

- Though it measures a project's liquidity, it does not indicate the liquidity position of the firm as a whole, which is more important.

Discounted Payback Period

- The ***discounted payback*** *period* is the time needed to pay back the original investment in terms of *discounted* future cash flows. Each cash flow is discounted back to the beginning of the investment at a rate that reflects both the time value of money and the uncertainty of the future cash flows

- This rate is the cost of capital—the return required by the suppliers of capital (creditors and owners) to compensate them for the time value of money and the risk associated with the investment. The more uncertain the future cash flows, the greater the cost of capital

- From the perspective of the investor, the cost of capital is the *required rate of return* (RRR), the return that suppliers of capital demand on their investment (adjusted for tax deductibility of interest). Because the cost of capital and the RRR are basically the same concept but from different perspectives, we sometimes use the terms interchangeably in our study of capital budgeting

Discounted Payback Period

Discounted Payback as an Evaluation Technique:

Discounted payback measures up against the three criteria

- **Criterion 1:** Does Discounted Payback Consider All Cash Flows?
- **Criterion 2:** Does Discounted Payback Consider the Timing of Cash Flows?
- **Criterion 3:** Does Discounted Payback Consider the Riskiness of Cash Flows?

Note: Refer to the pdf notes to understand these criteria with the help of working examples

Non-discounting Criteria: Accounting Rate of Return (ARR)

- Accounting rate of return or the average rate of return, is defined as:

  Profit after tax / Book value of the investment

- Numerator is the average annual post-tax profit over the life of the investment and denominator is the average book value of fixed assets committed to project.
  - Book value is the accounting value of a company's assets less liabilities. In other words, it is the expected value that a firm can expect if it were to sell all of the assets on its balance sheet and cover its outstanding debts and obligations.
  - A company's market value will usually be greater than its book value since the market price incorporates intangible assets such as intellectual property, human capital, and future growth prospects.
  - Value investors look for companies with relatively low book values but otherwise strong fundamentals as potentially underpriced stocks in which to invest.

Year	Book value of fixed investment	Profit after tax
1	90,000	20,000
2	80,000	22,000
3	70,000	24,000
4	60,000	26,000
5	50,000	28,000

The ARR is:
1/5 (20,000 + 22,000 + 24,000 + 26,000 + 28,000) /
1/5 (90,000 + 80,000 + 70,000 + 60,000 + 50,000
= 34 per cent

Higher the ARR, the better the project is.

In general, projects which have an ARR equal to or greater than a pre-specified cut off rate of return between 10% to 30% are accepted; others rejected.

Accounting Rate of Return

Advantages:

- It is simple to calculate.
- It is based on accounting information which is readily available and familiar to businessmen.
- While it considers benefits over the entire life of the project, it can be used even with limited data.

Limitations:

- It is based upon accounting profit, not cash flow.
- It does not take into account the time value of money.
- ARR measure is internally inconsistent. While the numerator of this measure represents profit belonging to equity & preference stockholders, its denominator represents fixed investment which is rarely, if ever, equal to the contribution of equity and preference stockholders.

Cost of Capital

- Firms can raise investments funds internally (i.e., from undistributed profits) and externally (i.e., by borrowing and from selling stocks)
- The cost of using internal fund is the opportunity cost or foregone return on these funds outside the firm
- The cost of external funds is the lowest rate of return that lenders and stockholders require to lend to or invest their funds in the firm
- Two costs: 1. Cost of Debt – cost of raising capital by borrowing
  2. Cost of Equity Capital – cost of raising capital by selling stocks

Weighted Cost of Capital

- In general, a firm is likely to raise capital from undistributed profits, by borrowing and by the sale of stocks, so the marginal cost of capital to the firm is a weighted average of the cost of raising various types of capital.
- Firms often try to maintain or achieve a particular long-term capital structure of debt to equity. For example, public utility companies may prefer a capital structure involving 60% debt and 40% equity.
- The particular debt/equity ratio that a frim prefers reflect the risk preferences of its managers and stockholders and the nature of the firm's business. Firms accepts a higher risk involved in a higher debt/equity ratio because of their more stable flow of earnings.
- When a firm needs to raise investment capital, it borrows and it sells stocks so as to maintain or achieve a desired debt/equity ratio.

Cost of Debt

- It is the return to lenders require to lend their funds to the firm
- Since, the interest payments made by the firm on borrowed funds are deductible from the firm's taxable income, the *after-tax* cost of borrowed funds to the firm (k_d) is given by the interest paid (r) multiplied by 1 minus the firm's marginal tax rate (t). Thus,

$$k_d = r\,(1 - t)$$

- For e.g., if the firm borrows at 12.5% interest rate & faces 40% marginal tax rate on its taxable income, the after-tax cost of debt capital to the firm is: 12.5 (1 – 0.40) = 7.5%
- To be noted is if the firm has no taxable income after all costs are deducted during a particular year, the firm's after-tax cost of debt is equal to its pre-tax interest rate charged on borrowed funds.
- Also, we are interested in the cost of new or marginal debt, not the average cost of debt, since it is the marginal cost of debt that is used to determine whether the firm should or should not undertake a particular investment project.

THE END