



Engineering Economics

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Course Objectives :

After completing this course students will be able to:

- Understand and describe the basic concept of economics, cost accounting and time value of money.
- Assist in the valuation of engineering projects in the public and private sectors to take decisions.
- Analyzes the project risk and relate the concept of ecological limit and economic development.
- Calculate depreciation, taxation and its application in analysis.
- Identify different financing options and use to a limited extent, general accounting procedures.

Text book and References:

Text Book:

- Chan S. Park, *Contemporary Engineering Economics*, PHI Learning Private Limited.

References:

- E Paul De Garmo. William G Sullivan and James A. Bontadelli, *Engineering Economy*, MC Milan Publishing Company
- James L., Riggs, David D. Bedworth and Sabah U. Randhawa, *Engineering Economics*, Tata McGraw Hill Education Private Limited
- N. N. Borish and S. Kaplan, *Economics Analysis for Engineering and Managerial Decision Making*, MCGraw Hill Publishing Company
- Adhikari, D. *Principles of Engineering Economics Analysis*, Global Publication, Nepal
- Sen Gupta, Ramprasad, *Ecological Limits and Economic Development*, Oxford University Press.



Chapter 1: Basics of Engineering Economics

- Definition of Economics, Demand, the Law of Diminishing Utility, Marginal Utility, Supply, Law of Supply, Law of Supply and Demand
- Engineering Economics, Principles of Engineering Economy and its application



What is economics?

- *“Whenever six economists are gathered, there are seven opinions.”- Barbara Wootton.*
- *“Economics is the science of wealth.”-Adam Smith (Father of economics, Leader of Classical Economics, 1776)*
- *“Economics is on the one side, a study of wealth and on the other and more important side is a part of the study of man.”-Alfred Marshall (Leader of neo-classical economists).*
- *“Economics is the science which studies human behavior as a relationship between ends and scarce means which have alternative uses.”-Lionel Robbins (British Economist, 1932)*



Economics

- Economics is a social science which deals with human wants and their satisfaction. It is mainly concerned with the way in which a society chooses to employ its scarce resources which have alternative uses, for the production of goods for present and future consumption.
- Human wants are unlimited. So scarcity is the fundamental fact of life. As all wants are not of equal importance, this leads to choice. Economics is the science of choice. As there is scarcity of goods, we have to pay a price for them. So, economics studies about the pricing process. And, as prices are paid in money, we study about the part played by money in the economic life of a society. We study how people get and spend money, how they earn a living and how it affects their way of life and so on.
- All the scarce goods which satisfy our wants are known as wealth. So, in economics, we study about the production of wealth, exchange of wealth, distribution of wealth and consumption of wealth. As wealth is produced to promote human welfare, we study the relationship between wealth and welfare.



Adam Smith's Definition (Wealth Definition)

- Adam Smith (1723-90) defined economics as follows : “*Economics is the science of wealth*”. He is the author of the famous book “*Wealth of Nations*” (1776). He is known as the Father of Political Economy because he was the first person who put all the economic ideas in a systematic way. It is only after Adam Smith, we study economics as a systematic science.
- We study about consumption, production, exchange and distribution of wealth. J.S. Mill defined economics as “the practical science of the production and distribution of wealth”.



Alfred Marshall's Definition (Welfare Definition)

- ▶ Alfred Marshall (1842-1924) wrote a book *Principles of Economics* in 1890. In it, he defined economics as “a study of mankind in the ordinary business of life”. An altered form of this definition is: “Economics is a study of man’s actions in the ordinary business of life”.
- ▶ Marshall agrees that economics studies about wealth. But he does not accept the view that economics studies about wealth alone. In the words of Marshall, “Economics is on the one side a study of wealth, and on the other and more important side, a part of the study of man. Man is the centre of his study. According to him, the study of man is more important than the study of wealth.
- ▶ According to this definition, we may say that economics is the study of the causes of material welfare. Marshall’s definition is known as material welfare definition of economics because of its emphasis on welfare.

Lionel Robbins' definition (Scarcity Definition)

- Lionel Robbins has defined economics as follows: *"Economics is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses"*. Robbins has given the above definition in his book *"An Essay on the Nature and significance of Economic Science"*.
- The definition of Robbins is based on the following basic assumptions
- 1. Ends are various. The term "ends" mean wants. Human wants are unlimited.
- 2. Means are limited. Means like time, money and resources are limited.
- 3. We can put time and money to alternative uses. For example, though time is limited, we can use it for different purposes. We can use time for earning money or we may enjoy it as leisure, and
- 4. All wants are not of equal importance.
- Choice between alternatives is the basic principle underlying all economic activity. This is applicable to all economic systems – capitalism, socialism and mixed economy.
- Lionel Robbins' definition is also known as scarcity definition of economics.



Samuelson's Definition (Modern Definition of Economics)

- Samuelson's definition is known as a modern definition of economics. According to Samuelson, *"Economics is a social science concerned chiefly with the way society chooses to employ its resources, which have alternative uses, to produce goods and services for present and future consumption"*. The above definition is general in nature. There are many common points in the definitions of Robbins and Samuelson.
- Samuelson's definition tells us that economics is a social science and it is mainly concerned with the way how society employs its limited resources for alternative uses. All this we find in the definition of Robbins.
- But Samuelson goes a step further and discusses how a society uses limited resources for producing goods and services for present and future consumption of various people or groups.



Main Divisions of Economics

- There are four main divisions of economics.
- They are consumption, production, exchange and distribution.
- In modern times, economists add one more division and that is public finance. In public finance, we study about the economics of government. The economic functions of the modern State have increased to a great extent. So public finance has become an important branch of economics.
- All the above divisions are interrelated. And they are dependent on each other.



Micro-economics and Macro-economics

- Economic theory can be broadly divided into *micro economics* and *macroeconomics*. The term *micro* means small and *macro* means large.
- In microeconomics, we deal with problems such as the output of a single firm or industry, price of a single commodity and spending on goods by a single household.
- Macroeconomics studies the economic system as a whole. In it, we get a complete picture of the working of the economy. It is a study of the relations between broad economic aggregates such as total employment, saving and investment. We may also say that macro-economics is the theory of income, employment, prices and money.
- That is why macroeconomics is sometimes studied under the title “Income and Employment Analysis”.

Basic Terminologies (Refer to EE notes (doc. file) for more detail)

Demand:

- Desire with ability to pay and willingness to pay.
- Various quantities of an item that a buyer is willing to buy at alternative prices, other things being equal.

Supply:

- Desire with ability to sell and willingness to sell.
- Various quantities of an item that a seller is willing to sell at alternative prices, other things being equal.


Basic Terminologies

Utility:

- The level/power of satisfaction to a consumer by consuming goods and services.

Marginal Utility:

- The change in total utility due to one more/additional unit of consumption.
- It is the utility derived by single unit of consumption.
- $MU = TU_n - TU_{n-1}$
- **$MU = \text{Change in Total Utility} / \text{Change in quantity consumption}$**



Law of Demand

(Refer to EE notes (doc.) file for more detail)

- Law of demand states the relationship between quantity demanded and price of the commodity.
- It explain the inverse relationship between price and quantity demanded.
- It states: *“All other things being equal, demand varies inversely with price.”*
- It is defined as *“all other things remaining the same, the quantity demanded of commodity increases when its price decreases and vice versa.”*
- This law assumes all other factors are remained constant.

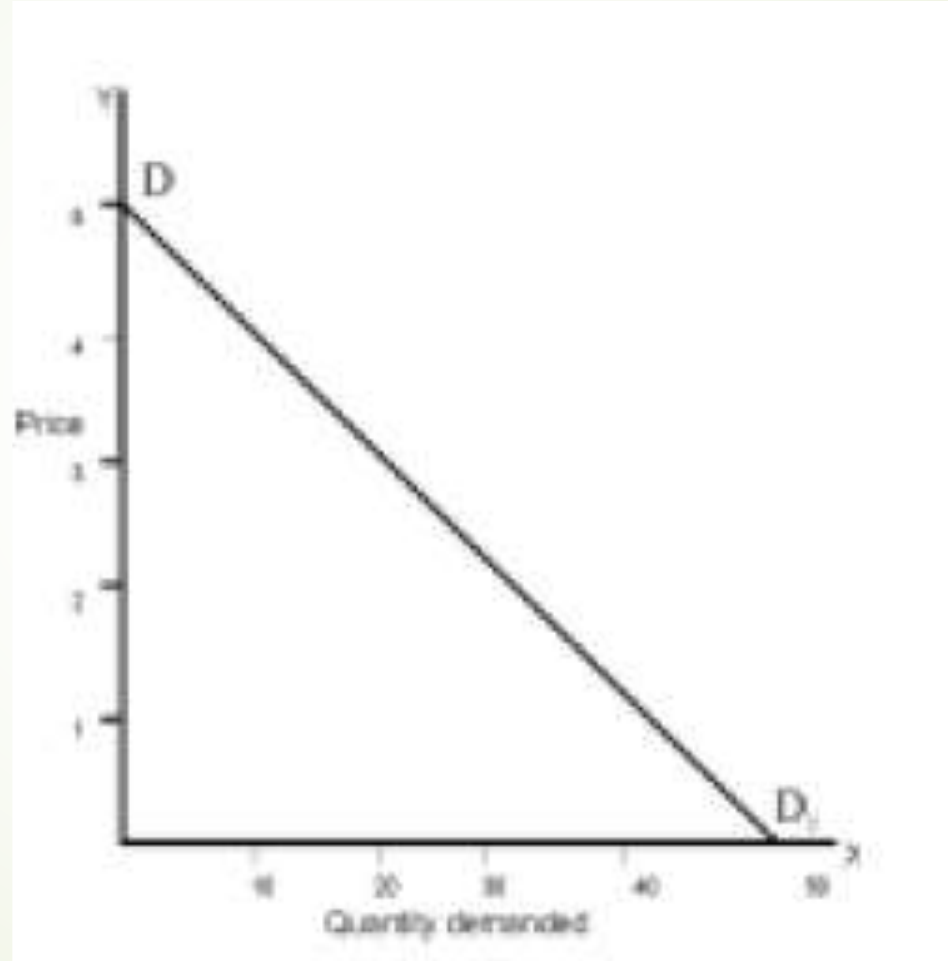
Demand Schedule

| Price of Potato (Rs/Kg) | Quantity demand (Kg) |
|-------------------------|----------------------|
| 20 | 20 |
| 30 | 16 |
| 40 | 12 |
| 50 | 8 |
| 60 | 4 |

Demand Curve

Demand curve is graphical representation of demand schedule. Demand curve always slopes downwards.


Demand Curve





Factors influencing demand

1. Price of commodity
2. Income of consumer
3. Price of related goods (competitive or complimentary)
4. Weather
5. Custom and fashion
6. Size of population
7. Future expectation etc.



Law of Supply

(Refer to EE notes (doc. file) for more detail)

- Law of supply states the relationship between quantity supplied and price of the commodity.
- It explain the positive relationship between price and quantity supplied.
- It states: *“All other things being equal, supply varies positively with price.”*
- It is defined as *“all other things remaining the same, the quantity supplied of commodity increases when its price increases and vice versa.”*
- This law assumes all other factors are remained constant.

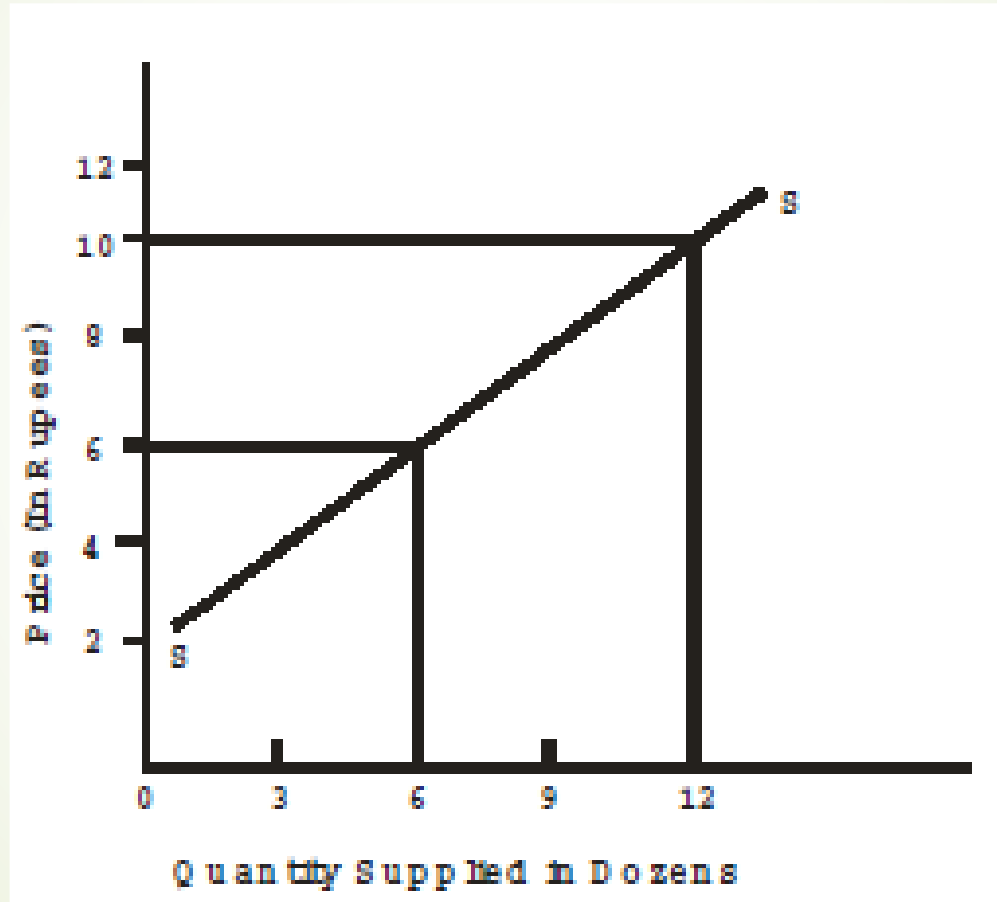
Supply Schedule

| Price of Onion (Rs/Kg) | Quantity if Supply (Kg) |
|------------------------|-------------------------|
| 20 | 40 |
| 30 | 60 |
| 40 | 80 |
| 50 | 100 |
| 60 | 120 |

Supply Curve

Supply curve is graphical representation of supply schedule. Supply curve always slopes upward.

Supply Curve





Factors influencing Supply

1. Price of commodity
2. Price of factor of production
3. Price of related goods (competitive/substitute or complimentary)
4. Production Technology
5. New inventions
6. Taxes and subsidies
7. Development of infrastructures
8. State of natural resources
9. Future expectation



Law of diminishing utility (Refer to EE notes (doc.) file for more detail)

- Also known as Law of diminishing marginal utility.
- It states that in the process of fulfilling human wants, when a consumer consumes additional units of commodity, the utility derived from each successive unit of the commodity goes decreasing.
- The law is based on certain assumptions:
 - Utility is measurable. The measurement unit is util.
 - Consumer taste and preferences unchanged.
 - Suitable and similar units of commodity.
 - Rational consumer.
 - Continuous consumption etc.

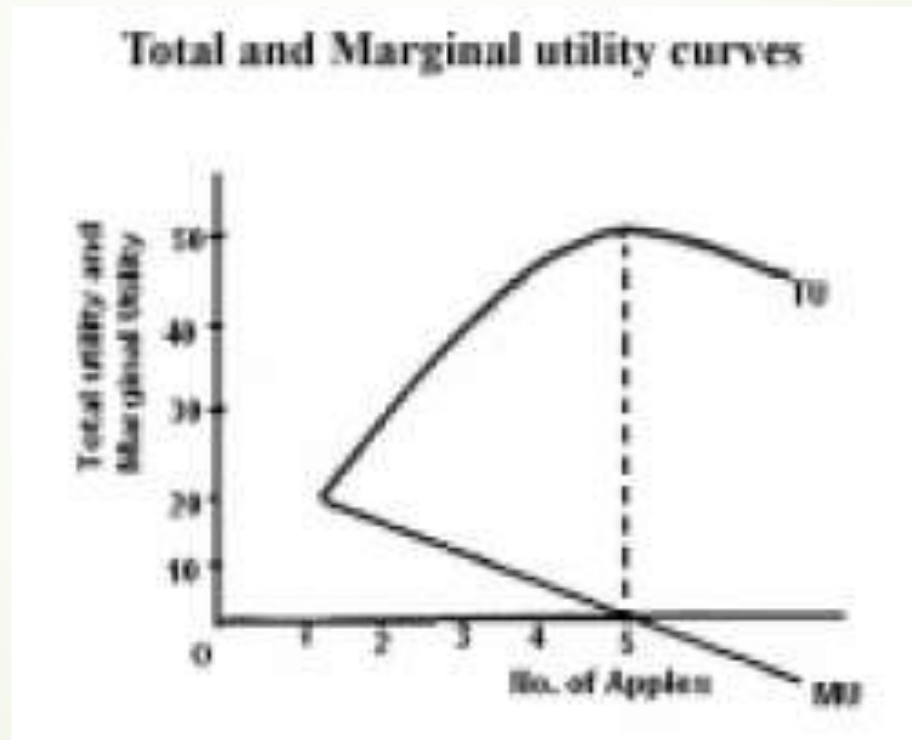
Law of diminishing utility

| Units of Apple | Total Utility | Marginal Utility |
|----------------|---------------|------------------|
| 1 | 10 | 10 |
| 2 | 18 | 8 |
| 3 | 24 | 6 |
| 4 | 28 | 4 |
| 5 | 30 | 2 |
| 6 | 30 | 0 |
| 7 | 28 | -2 |

The relationship between TU and MU

| | Marginal Utility | Total Utility |
|-------|------------------|-----------------|
| (i) | Declines | Increases |
| (ii) | Reaches zero | Reaches maximum |
| (iii) | Becomes negative | Declines |

Law of Diminishing Marginal Utility





Engineering Economics

- **Engineering Economics** is the applications of economic techniques to the evaluation of engineering alternatives. The role of engineering economics is to access the appropriateness of a given project, estimates its value and justify it from an engineering standpoint. –John M. Watts.
- The term **engineering economic decision** refers to any investment decision related to an engineering project. The facet of an economic decision that is of most interest from an engineer's point of view is the evaluation of costs and benefits associated with making a capital investment.-- Chan S. Park

Engineering Economy

- It deals with the concepts and techniques of analysis useful in evaluating the worth of systems, products, and services in relation to their costs
- It is used to answer many different questions
 - Which engineering projects are worthwhile?
 - Has the mining or petroleum engineer shown that the mineral or oil deposits is worth developing?
 - Which engineering projects should have a higher priority?
 - Has the industrial engineer shown which factory improvement projects should be funded with the available dollars?
 - How should the engineering project be designed?
 - Has civil or mechanical engineer chosen the best thickness for insulation?



Applications of Engineering Economics/ Common Types of Engineering Economic Decisions

- Project ideas can originate from many different levels in an organization. Since some ideas will be good, while others will not, we need to establish procedures for screening projects.
- Many large companies have a specialized project analysis division that actively searches for new ideas, projects, and ventures. Once project ideas are identified, EE decisions are typically classified as:
 1. **equipment or process selection,**
 2. **equipment replacement,**
 3. **new product or product expansion,**
 4. **cost reduction, and**
 5. **service or quality improvement**



Applications of Engineering Economics/ Common Types of Engineering Economic Decisions

- ▶ The above classification scheme allows management to address key questions:
 - ▶ Can the existing plant, for example, be used to attain the new production levels?
 - ▶ Does the firm have the knowledge and skill to undertake the new investment?
 - ▶ Does the new proposal warrant the recruitment of new technical personnel?
- ▶ The answers to these questions help firms screen out proposals that are not feasible, given a company's resources.



1. Equipment or Process Selection

- This class of engineering decision problems involves selecting the best course of action out of several that meet a project's requirements.
- For example, which of several proposed items of equipment shall we purchase for a given purpose? The choice often hinges on which item is expected to generate the largest savings (or the largest return on the investment).
- For example, the choice of material will dictate the manufacturing process for the body panels in the automobile. Many factors will affect the ultimate choice of the material, and engineers should consider all major cost elements, such as the cost of machinery and equipment, tooling, labor, and material. Other factors may include press and assembly, production and engineered scrap, the number of dies and tools, and the cycle times for various processes.



2. Equipment Replacement

- This category of investment decisions involves considering the expenditure necessary to replace worn-out or obsolete equipment.
- For example, a company may purchase 10 large presses, expecting them to produce stamped metal parts for 10 years. After 5 years, however, it may become necessary to produce the parts in plastic, which would require retiring the presses early and purchasing plastic molding machines.
- Similarly, a company may find that, for competitive reasons, larger and more accurate parts are required, making the purchased machines become obsolete earlier than expected.



3. New Product or Product Expansion

- Investments in this category increase company revenues if output is increased.
- One common type of expansion decision includes decisions about expenditures aimed at increasing the output of existing production or distribution facilities.
- In these situations, we are basically asking, “Shall we build or otherwise acquire a new facility?” The expected future cash inflows in this investment category are the profits from the goods and services produced in the new facility.
- A second type of expenditure decision includes considering expenditures necessary to produce a new product or to expand into a new geographic area. These projects normally require large sums of money over long periods.




4. Cost Reduction

- A cost-reduction project is a project that attempts to lower a firm's operating costs.
- Typically, we need to consider whether a company should buy equipment to perform an operation currently done manually or spend money now in order to save more money later.
- The expected future cash inflows on this investment are savings resulting from lower operating costs.



5. Improvement in Service or Quality


- Most of the examples in the previous sections were related to economic decisions in the manufacturing sector.
- The decision techniques we develop in this book are also applicable to various economic decisions related to improving services or quality of product.



Principles of Engineering Economics

(According to Chan S. Park)

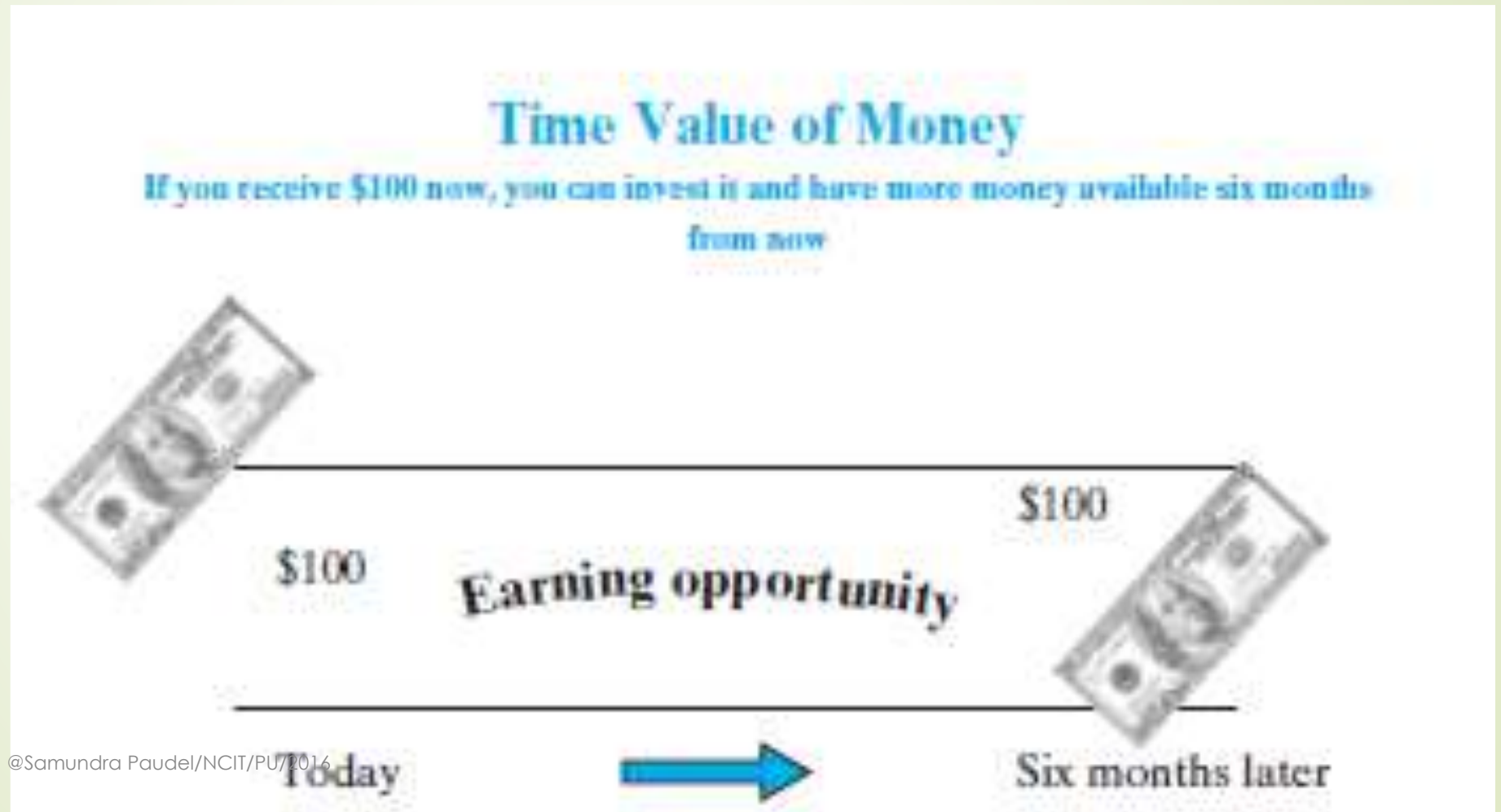
- Engineering Economics is focused on the principles and procedures engineers use to make sound economic decisions.
- To the first-time student of engineering economics, anything related to money matters may seem quite strange when compared to other engineering subjects.
- However, the decision logic involved in solving problems in this domain is quite similar to that employed in any other engineering subject.
- There are fundamental principles to follow in engineering economics that unite the concepts and techniques presented in any engineering economic book, thereby allowing us to focus on the logic underlying the practice of engineering economics.
- **According to Chan S. Park, there are four fundamental principles of Engineering Economic Decisions:**
 - (1) the time value of money,
 - (2) differential (incremental) cost and revenue,
 - (3) marginal cost and revenue, and
 - (4) the trade-off between risk and reward.




Principle 1: A nearby penny is worth a distant dollar (Time value of money)

- A fundamental concept in engineering economics is that money has a time value associated with it.
- Because we can earn interest on money received today, it is better to receive money earlier than later.
- This concept will be the basic foundation for all engineering project evaluation.

Principle 1: A nearby penny is worth a distant dollar (Time value of money)





Principle 2: All that counts are the differences among alternatives (differential (incremental) cost and revenue)


- An economic decision should be based on the *differences* among the alternatives considered. All that is common is irrelevant to the decision.
- Certainly, any economic decision is no better than the alternatives being considered.
- Thus, an economic decision should be based on the objective of making the best use of limited resources.
- Whenever a choice is made, something is given up. The opportunity cost of a choice is the value of the best alternative given up.

Principle 2: All that counts are the differences among alternatives (differential (incremental) cost and revenue)

Comparing Buy versus Lease
Whatever you decide, you need to spend the same amount of money on fuel and maintenance

| Option | Monthly Fuel Cost | Monthly Maintenance | Cash Outlay at Signing | Monthly Payment | Salvage Value at End of Year 3 |
|--------|-------------------|---------------------|------------------------|-----------------|--------------------------------|
| Buy | \$960 | \$550 | \$6,500 | \$350 | \$9,000 |
| Lease | \$960 | \$550 | \$2,400 | \$550 | 0 |

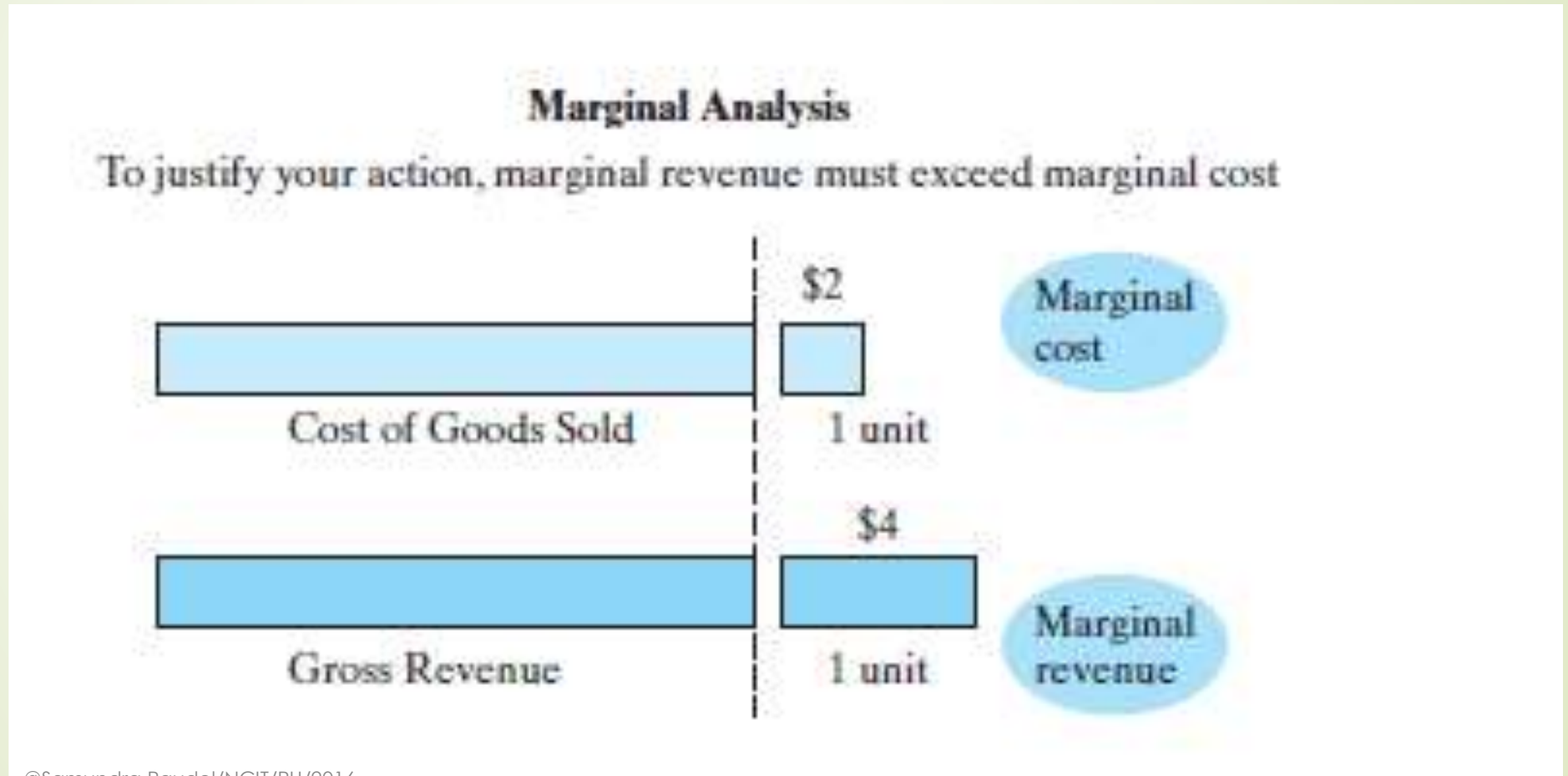
Irrelevant items in decision making




Principle 3: Marginal revenue must exceed marginal cost

- Effective decision making requires comparing the additional costs of alternatives with the additional benefits.
- Each decision alternative must be justified on its own economic merits before being compared with other alternatives.
- Any increased economic activity must be justified on the basis of the fundamental economic principle that marginal revenue must exceed marginal cost.
- Here, *marginal revenue* means the additional revenue made possible by increasing the activity by one unit (or small unit). *Marginal cost* has an analogous definition.
- Productive resources—the natural resources, human resources, and capital goods available to make goods and services—are limited.
- Therefore, people cannot have all the goods and services they want; as a result, they must choose some things and give up others.

Principle 3: Marginal revenue must exceed marginal cost





Principle 4: Additional risk is not taken without the expected additional return (the trade-off between risk and reward)

- For delaying consumption, investors demand a minimum return that must be greater than the anticipated rate of inflation or any perceived risk.
- If they didn't receive enough to compensate for anticipated inflation and the perceived investment risk, investors would purchase whatever goods they desired ahead of time or invest in assets that would provide a sufficient return to compensate for any loss from inflation or potential risk.

Principle 4: Additional risk is not taken without the expected additional return (the trade-off between risk and reward)

Risk and Return Trade-Off

Expected returns from bonds and stocks are normally higher than the expected return from a savings account

| Investment Class | Potential Risk | Expected Return |
|------------------------|----------------|-----------------|
| Savings account (cash) | Low/None | 1.5% |
| Bond (debt) | Moderate | 4.8% |
| Stock (equity) | High | 11.5% |




Principles of Engineering Economics

(According to W. Sullivan)

1. Develop Alternatives
2. Focus on the differences
3. Use a consistent viewpoint (Economic viewpoint)
4. Use common unit of measure
5. Consider all relevant criteria (Social and Environmental aspects)
6. Make uncertainty explicit
7. Revisit your decision (Self Evaluation)


If questions ask for principles of engineering economics, write detail from principles from earlier slides as given by Chan S. Park (quoting him) and also write above list only quoting W. Sullivan.

For More Detail: Refer William Sullivan (Engineering Economy) or Damodar Adhikari (Principles of Engineering Economics Analysis)



Why engineering students need to study engineering economics?

- In any organization, commonly, engineers are called upon to participate in a variety of strategic business decisions ranging from product design to marketing.
- In manufacturing, engineering is involved in every detail of a product's production, from conceptual design to shipping.
- Decisions made during the engineering design phase of product development determine the majority of the costs associated with the manufacturing of that product (some say that this value may be as high as 85%).
- With more increasing GDP (Gross Domestic Product) provided by the service sector worldwide, engineers work on various economic decision problems in the service sector as well.
- As design and manufacturing processes become more complex, engineers are making decisions that involve money more than ever before.



Why engineering students need to study engineering economics?

- The competent and successful engineer in the twenty-first century must have an improved understanding of the principles of science, engineering, and economics, coupled with relevant design experience.
- Engineers must consider the effective use of capital assets such as buildings and machinery.
- One of the engineer's primary tasks is to plan for the acquisition of equipment (**capital expenditure**) that will enable the firm to design and produce products economically.
- Engineers have to involve in different types of engineering economic decisions: **(1) equipment or process selection, (2) equipment replacement, (3) new product or product expansion, (4) cost reduction, and (5) improvement in service or quality.**
- Increasingly, in the new world economy, successful businesses will rely on engineers with such expertise.



Chapter 1: Assignments

- What do you mean by law of demand? Explain factors influencing demand.
- What do you mean by law of supply? Explain factors influencing supply.
- What do you mean by utility and marginal utility? State and explain the law of diminishing marginal utility with suitable example and figure.
- Define Engineering Economics. What are the basic principles of engineering economics?
- What is engineering economics? Why do you think studying this course is important for engineering students? Justify.
- “Engineering economics is all about decision making.” Explain.
- Explain primary applications of engineering economics.



Chapter 2: Cost Concepts

- Cost Terminology: Manufacturing Cost and Non- Manufacturing Cost
- Cost of Business Decision: Differential Cost and revenue; Opportunity cost, Sunk Cost and Marginal Cost



Cost Concepts

- In engineering economics, the term **cost** is used in many different ways. Because there are many types of costs, each is classified differently according to the immediate needs of management.
- **Manufacturing Cost**
- **Non-manufacturing Cost**



Manufacturing Cost

- In converting raw materials into finished goods, a manufacturer incurs various costs associated with operating a factory.
- Most manufacturing companies divide manufacturing costs into three broad categories:
 - direct raw material costs,
 - direct labor costs, and
 - manufacturing overhead.




Direct Raw Materials

- Direct raw materials are any materials that are used in the final product and that can be easily traced to it. Some examples are wood in furniture, steel in bridge construction, paper in printing firms, and fabric for clothing manufacturers. It is important to note that the finished product of one company can become the raw materials of another company.
- For example, the computer chips produced by Intel are a raw material used by Dell in its personal computers.



Direct Labor

- ▶ Like direct raw materials, direct labor incurs costs that go into the production of a product.
- ▶ The labor costs of assembly-line workers, for example, would be direct labor costs, as would the labor costs of welders in metal-fabricating industries, carpenters or bricklayers in home building, and machine operators in various manufacturing operations.



Manufacturing (Direct) Overhead (Indirect labor and materials)

- Manufacturing overhead, the third element of manufacturing cost, includes all costs of manufacturing except the costs of direct materials and direct labor.
- In particular, manufacturing overhead includes such items as the costs of indirect materials; indirect labor; maintenance and repairs on production equipment; heat and light, property taxes, depreciation, and insurance on manufacturing facilities; and overtime premiums.
- The most important thing to note about manufacturing overhead is the fact that, unlike direct materials and direct labor, it is not easily traceable to specific units of output. In addition, many manufacturing overhead costs do not change as output changes, as long as the production volume stays within the capacity of the plant.
- For example, depreciation of factory buildings is unaffected by the amount of production during any particular period. If, however, a new building is required to meet any increased production, manufacturing overhead will certainly increase.



Non-Manufacturing Cost

- Two additional costs incurred in supporting any manufacturing operation are (1) marketing or selling costs and (2) administrative costs.
- Marketing or selling costs include all costs necessary to secure customer orders and get the finished product or service into the hands of the customer.
- Breakdowns of these types of costs provide data for control over selling and administrative functions in the same way that manufacturing cost breakdowns provide data for control over manufacturing functions.
- **Indirect Overhead.** Heat and light, property taxes, and depreciation or similar items associated with the company's selling and administrative functions.
- **Marketing.** Advertising, shipping, sales travel, sales commissions, and sales salaries. Marketing costs include all executive, organizational, and clerical costs associated with sales activities.
- **Administrative functions.** Executive compensation, general accounting, public relations, and secretarial support, associated with the general management of an organization.



Cost of Business Decisions:

- Differential cost
- Differential revenue
- Opportunity Cost
- Sunk Cost
- Marginal Cost



Differential Cost and Revenue

- ▶ As we have seen throughout the text, decisions involve choosing among alternatives.
- ▶ In business decisions, each alternative has certain costs and benefits that must be compared with the costs and benefits of the other available alternatives.
- ▶ A difference in cost between any two alternatives is known as a **differential cost**.
- ▶ Similarly, a difference in revenue between any two alternatives is known as **differential revenue**.
- ▶ A differential cost is also known as an incremental cost, although, technically, an incremental cost should refer only to an increase in cost from one alternative to another.

Differential Cost and Revenue

- Cost-volume relationships based on differential costs find many engineering applications.
- In particular, they are useful in making a variety of short-term operational decisions.
- Many short-run problems have the following characteristics:
 - The base case is the status quo (the current operation or existing method), and we propose an alternative to the base case. If we find the alternative to have lower costs than the base case, we accept the alternative, assuming that non-quantitative factors do not offset the cost advantage.
 - The **differential (incremental) cost** is the difference in total cost that results from selecting one alternative instead of another. If several alternatives are possible, we select the one with the maximum savings from the base.
 - Problems of this type are often called trade-off problems, because one type of cost is traded off for another.
 - New investments in physical assets are not required.
 - The planning horizon is relatively short (a week or a month—certainly less than a year).
 - Relatively few cost items are subject to change by management decision.
- Some common examples of short-run problems and decisions are:
 - method changes,
 - operations planning, and
 - make-or-buy decisions.

Example: Differential Cost

| | Current Dies | Better Dies | Differential Cost |
|-----------------|---------------|---------------|-------------------|
| Variable costs: | | | |
| Materials | \$150,000 | \$170,000 | +\$20,000 |
| Machining labor | 85,000 | 64,000 | −21,000 |
| Electricity | 73,000 | 66,000 | −7,000 |
| Fixed costs: | | | |
| Supervision | 25,000 | 25,000 | 0 |
| Taxes | 16,000 | 16,000 | 0 |
| Depreciation | <u>40,000</u> | <u>43,000</u> | <u>+3,000</u> |
| Total | \$392,000 | \$387,000 | −\$5,000 |



Opportunity Cost

- Opportunity cost may be defined as the potential benefit that is given up as you seek an alternative course of action. In fact, virtually every alternative has some opportunity cost associated with it.
- For example, suppose you have a part-time job while attending college that pays you Rs. 20,000 per month. You would like to spend 1 month Annapurna Trail during spring break, and your employer has agreed to give you the month off. What would be the opportunity cost of taking the time off to be at the Annapurna Trail?
- The Rs. 20,000 in lost wages would be an opportunity cost.
- In an economic sense, opportunity cost could mean the contribution to income that is forgone by not using a limited resource in the best way possible.
- Or we may view opportunity costs as cash flows that could be generated from an asset the firm already owns, provided that such flows are not used for the alternative in question.
- In general, *accountants do not post opportunity cost in the accounting records of an organization. However, this cost must be explicitly considered in every decision.*



Opportunity Cost

- In sum, an opportunity cost arises when a project uses a resource that may already have been paid for by the firm.
- When a resource that is already owned by a firm is being considered for use in a project, that resource has to be priced on its next-best alternative use, which may be
 1. A sale of the asset, in which case the opportunity cost is the expected proceeds from the sale, net of any taxes on gains.
 2. Renting or leasing the asset out, in which case the opportunity cost is the expected present value of the after-tax revenue from the rental or lease.
 3. Some use elsewhere in the business, in which case the opportunity cost is the cost of replacing the resource.
 4. That the asset has been abandoned or is of no use. Then the opportunity cost is zero.



Sunk Costs

- A sunk cost is a cost that has already been incurred by past actions.
- Sunk costs are not relevant to decisions, because they cannot be changed regardless of what decision is made now or in the future.
- The only costs relevant to a decision are costs that vary among the alternative courses of action being considered.
- To illustrate a sunk cost, suppose you have a very old motorcycle that requires frequent repairs. You want to sell the motorcycle, and you figure that the current market value would be about Rs.1,20,000 at best. While you are in the process of advertising the car, you find that the motorcycle's engine is leaking. You decided to have the engine repaired, which cost you Rs. 8,000. A friend of yours is interested in buying your car and has offered Rs. 1,30,000 for it. Would you take the offer, or would you decline it simply because you cannot recoup the repair cost with that offer?
- In this example, the Rs. 8,000 repair cost is a sunk cost.
- You cannot change this repair cost, regardless of whether you keep or sell the car. Since your friend's offer is Rs. 10,000 more than the best market value, it would be better to accept the offer.



Marginal Cost

- Another cost term useful in cost–volume analysis is marginal cost.
- We define **marginal cost** as the added cost that would result from increasing the rate of output by a single unit.
- The accountant's differential-cost concept can be compared to the economist's marginal cost concept.
- In speaking of changes in cost and revenue, the economist employs the terms *marginal cost* and *marginal revenue*.
- The revenue that can be obtained from selling one more unit of product is called **marginal revenue**.
- The cost involved in producing one more unit of product is called **marginal cost**.

Numerical Problem (PU, 2015)

- Following are the cost data for the production of a 100 badminton racquets.

| | |
|----------------------------------|----------------------|
| Labor rate: | Rs. 40/hr. |
| Leather: | 50m at Rs. 200/metre |
| Gut: | 300m at Rs. 50/metre |
| Graphite: | 100Kg at Rs. 200/Kg |
| Total annual factory overhead: | Rs. 5,00,000 |
| Total annual direct labor hours: | 25,000 hrs. |
| Labor hours needed: | 200 hrs. |

Show the cost breakdown and calculate the total cost for per racquet.

Numerical Problem (PU, 2015)

➤ Solution:

| Cost | | Amount |
|---|-------------------|----------------------|
| Manufacturing Cost | | |
| Direct Material Cost | | |
| Leather | (50metre*Rs.200) | Rs.10,000 |
| Gut | (300metre *Rs.50) | Rs.15,000 |
| Graphite | (100Kg*Rs. 200) | Rs. 10,000 |
| Direct Labor Cost | (200hrs*Rs 40) | Rs. 8,000 |
| Direct Overhead Cost | | Rs. 5,00,000 |
| Non-manufacturing Cost | | --- |
| Marketing Administrative Indirect Overhead Cost | | |
| Total Cost (for 100 racquets) | | Rs. 543,000 |
| Per racquets cost (Rs. 543,000/100 racquets) | | Rs. 5,430 per raquet |

ABC Company manufactures a single product. Costs for the year 2018 for output levels of 1,000 and 2,000 units are as follows:

| Units Produced | 1000 | 2000 |
|------------------------------|--------|--------|
| Direct Labor (Rs.) | 30,000 | 30,000 |
| Administrative Cost: | | |
| Variable Portion (Rs.) | 12,000 | 24,000 |
| Fixed Portion (Rs.) | 36,000 | 36,000 |
| Direct Materials (Rs.) | 20,000 | 40,000 |
| Manufacturing Overhead (Rs.) | 10,000 | 20,000 |
| Selling and Marketing Cost | | |
| Variable Portion (Rs.) | 5,000 | 10,000 |
| Fixed Portion (Rs.) | 22,000 | 22,000 |

At 2000 units of output, compute the following:

- Total manufacturing cost and manufacturing cost per unit,
- Total non-manufacturing cost and non-manufacturing cost per unit,
- Total variable cost and total variable cost per unit,
- Total fixed cost and total fixed cost per unit,
- Total cost and total cost per unit.

Chapter 2: Assignments

- Explain concepts of manufacturing and non-manufacturing cost with suitable example.
- Explain the different types of cost involved in manufacturing of products with suitable example.
- Write short notes on:
 - Opportunity Cost
 - Marginal Cost
 - Sunk Cost
 - Differential Cost
 - Differential Revenue



Chapter 3: Time Value of Money

- Interest, Simple Interest, Compound Interest, Normal Rate of interest, Effective Rate of interest
- Economic Equivalence: Present Worth, Future Worth and Annual Worth
- Development of Formulas for Equivalence Calculation



Time value of money: Interest

- Most of us are familiar in a general way with the concept of interest.
- We know that money left in a savings account earns interest, so that the balance over time is greater than the sum of the deposits.
- We also know that borrowing to buy a car means repaying an amount over time, that that amount includes interest, and that it is therefore greater than the amount borrowed.
- The cost of money is established and measured by a **market interest rate**, a percentage that is periodically applied and added to an amount (or varying amounts) of money over a specified length of time.



Time value of money: Interest

- When money is borrowed, the **interest paid is the charge to the borrower for the use of the lender's property**; when money is lent or invested, the **interest earned is the lender's gain from providing a good to another**.
- **Interest**, then, may be **defined as the cost of having money available for use**.
- **Time value of money** is the idea that **a dollar today is worth more than a dollar in the future** because the dollar received today can earn interest.
- When lending or borrowing interest rates are quoted by financial institutions on the marketplace, those interest rates reflect the desired amounts to be earned, as well as any protection from loss in the future purchasing power of money because of inflation.

Elements of Transactions Involving Interest

- Many types of transactions (e.g., borrowing or investing money or purchasing machinery on credit) involve interest, but certain elements are common to all of these types of transactions:
 - • An initial amount of money in transactions involving debt or investments is called the **principal**.
 - • The **interest rate** measures the cost or price of money and is expressed as a percentage per period of time.
 - • A period of time, called the **interest period**, determines how frequently interest is calculated. (Note that even though the length of time of an interest period can vary, interest rates are frequently quoted in terms of an annual percentage rate.)
 - • A specified length of time marks the duration of the transaction and thereby establishes a certain **number of interest periods**.
 - • A **plan for receipts or disbursements** yields a particular cash flow pattern over a specified length of time. (For example, we might have a series of equal monthly payments that repay a loan.)
 - • A **future amount of money** results from the cumulative effects of the interest rate over a number of interest periods.



Methods of Calculating Interest

- Money can be lent and repaid in many ways, and, equally, money can earn interest in many different ways.
- Usually, however, at the end of each interest period, the interest earned on the principal amount is calculated according to a specified interest rate.
- The two computational schemes for calculating this earned interest are said to yield either **simple interest** or **compound interest**.
- ***Engineering economic analysis uses the compound-interest scheme almost exclusively.***

Simple Interest

- Simple interest is interest earned on only the principal amount during each interest period.
- In other words, with simple interest, the interest earned during each interest period does not earn additional interest in the remaining periods, *even though you do not withdraw it.*
- In general, for a deposit of P dollars at a simple interest rate of i for N periods, the total earned interest would be

$$I = (i*P)*N$$

- The total amount available at the end of N periods thus would be

$$F = P+I = P(1+i*N)$$

Compound Interest

- Under a compound-interest scheme, the interest earned in each period is calculated on the basis of the total amount at the end of the previous period.
- This total amount includes the original principal plus the accumulated interest that has been left in the account.
- In this case, you are, in effect, increasing the deposit amount by the amount of interest earned.
- Thus, **compound** means the ability of an asset to generate *earnings* that are then reinvested and generate their own earnings.
- This interest-earning process repeats, and after N periods the total accumulated value (balance) F will grow to

$$F = P(1 + i)^N.$$



Nominal Vs Effective Interest Rate

- In most of the examples, the implicit assumption was that payments are received *once a year, or annually*.
- However, some of the most familiar financial transactions, both personal and in engineering economic analysis, involve payments that are not based on one annual payment—for example, monthly mortgage payments and quarterly earnings on savings accounts.
- Thus, if we are to compare different cash flows with different compounding periods, we need to evaluate them on a common basis.
- This need has led to the development of the concepts of the **nominal interest rate** and the **effective interest rate**.

Nominal Interest Rates

- ▶ If you financed a new car recently, examine the loan contract. You will typically find the interest that the bank charges on your unpaid balance. Even if a financial institution uses a unit of time other than a year—say, a month or a quarter (e.g., when calculating interest payments)—the institution usually quotes the interest rate on an *annual basis*.
- ▶ Many banks, for example, state the interest arrangement for credit cards in this way: **18% compounded monthly**.
- ▶ This statement simply means that each month the bank will charge 1.5% interest on an unpaid balance. We say that 18% is the **nominal interest rate** or **annual percentage rate** (APR), and the compounding frequency is monthly (12). To obtain the interest rate per compounding period, we divide, 18% by 12, to get 1.5% per month.
- ▶ Although the annual percentage rate, or APR, is commonly used by financial institutions and is familiar to many customers, the APR does not explain precisely the amount of interest that will accumulate in a year.
- ▶ To explain the true effect of more frequent compounding on annual interest amounts, we will introduce the term *effective interest rate*, commonly known as *annual effective yield*, or *annual percentage yield* (APY).



Effective Interest Rates

- ▶ The **effective annual interest rate** is the one rate that truly represents the interest earned in a year.
- ▶ For instance, in our credit card example, the bank will charge 1.5% interest on any unpaid balance at the end of each month. Therefore, the 1.5% rate represents the effective interest rate per month.
- ▶ On a yearly basis, you are looking for a cumulative rate—1.5% each month for 12 months. This cumulative rate predicts the actual interest payment on your outstanding credit card balance.
- ▶ As you can see, depending on the frequency of compounding, the effective interest earned or paid by the borrower can differ significantly from the APR.
- ▶ Therefore, truth in-lending laws require that financial institutions quote both the nominal interest rate and the compounding frequency (i.e., the effective interest) when you deposit or borrow money.

Effective Interest Rates

- Certainly, more frequent compounding increases the amount of interest paid over a year at the same nominal interest rate.
- Assuming that the nominal interest rate is r , and M compounding periods occur during the year, we can calculate the effective annual interest rate

$$i_a = \left(1 + \frac{r}{M}\right)^M - 1.$$

- Calculate yearly effective interest rate, if nominal interest rate is 10% and compounded as follow :
 - Yearly
 - Semiannually
 - Quarterly
 - Monthly
 - Daily
 - Continuously (e^r)

Cash Flow

- Engineering projects generally have economic consequences that occur over an extended period of time
 - For example, if an expensive piece of machinery is installed in a plant were brought on credit, the simple process of paying for it may take several years
 - The resulting favorable consequences may last as long as the equipment performs its useful function
- Each project is described as cash receipts or disbursements (expenses) at different points in time

Categories of Cash Flows

- The expenses and receipts due to engineering projects usually fall into one of the following categories:
 - **First cost:** expense to build or to buy and install
 - **Operations and maintenance (O&M):** annual expense, such as electricity, labor, and minor repairs
 - **Salvage value:** receipt at project termination for sale or transfer of the equipment (can be a salvage cost)
 - **Revenues:** annual receipts due to sale of products or services
 - **Overhaul:** major capital expenditure that occurs during the asset's life

Cash Flow diagrams

- The costs and benefits of engineering projects over time are summarized on a cash flow diagram (CFD). Specifically, CFD illustrates the size, sign, and timing of individual cash flows, and forms the basis for engineering economic analysis
- A CFD is created by first drawing a segmented time-based horizontal line, divided into appropriate time unit. Each time when there is a cash flow, a vertical arrow is added – pointing down for costs and up for revenues or benefits. The cost flows are drawn to relative scale

Drawing a Cash Flow Diagram

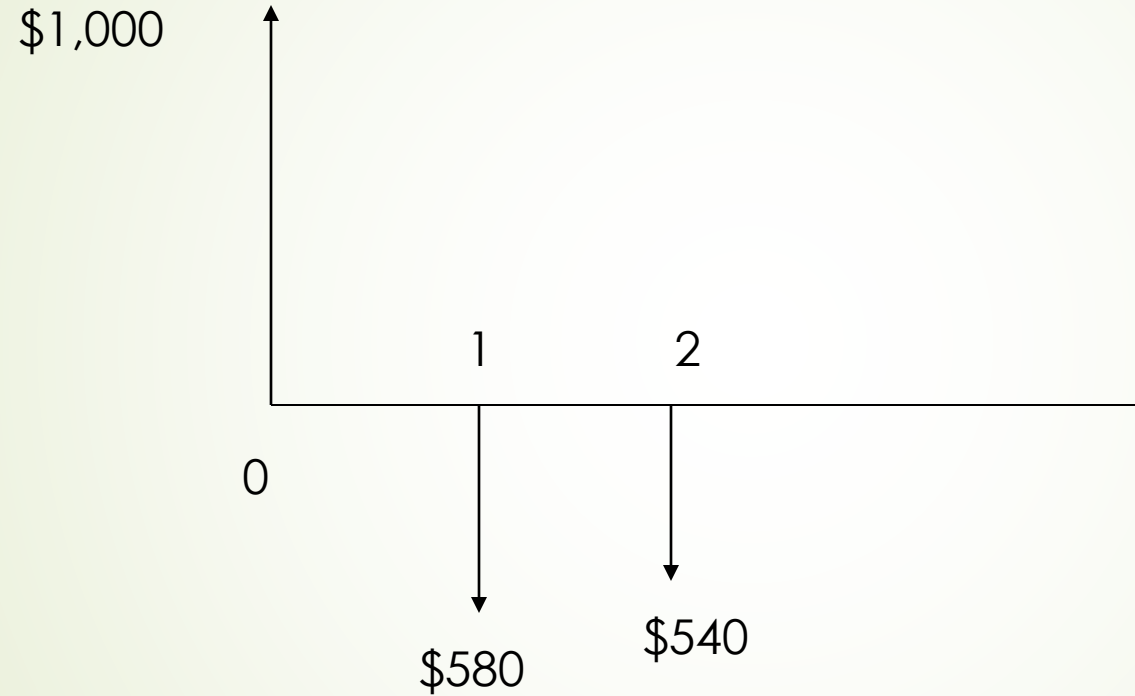
- In a cash flow diagram (CFD) the end of period t is the same as the beginning of period $(t+1)$
- **Beginning of period cash flows** are: rent, lease, and insurance payments
- **End-of-period cash flows** are: O&M, salvages, revenues, overhauls
- The choice of time 0 is arbitrary. It can be when a project is analyzed, when funding is approved, or when construction begins
- One person's cash outflow (represented as a negative value) is another person's inflow (represented as a positive value)
- It is better to show two or more cash flows occurring in the same year individually so that there is a clear connection from the problem statement to each cash flow in the diagram

An Example of Cash Flow Diagram

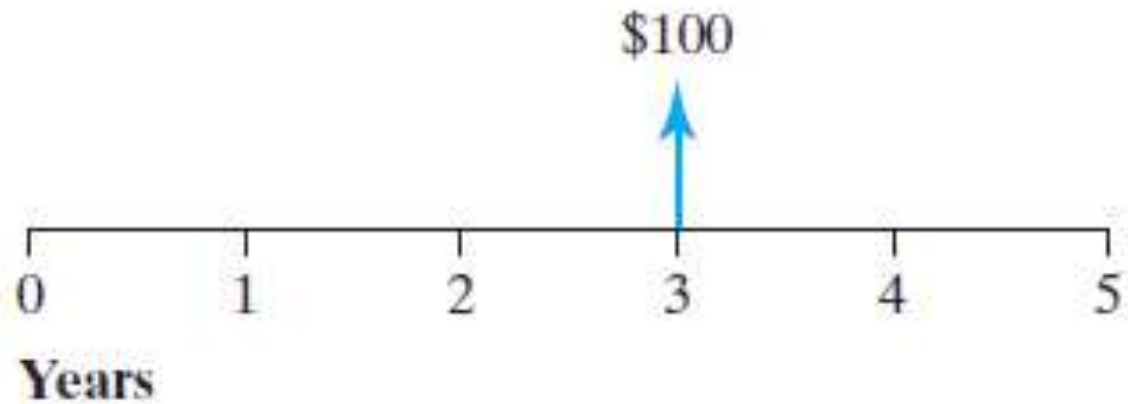
- ▶ A man borrowed \$1,000 from a bank at 8% interest. Two end-of-year payments: at the end of the first year, he will repay half of the \$1000 principal plus the interest that is due. At the end of the second year, he will repay the remaining half plus the interest for the second year.
- ▶ Develop cash flow diagram for this problem.

| End of year | Cash flow |
|-------------|------------------------|
| 0 | +\$1000 |
| 1 | -\$580 (-\$500 - \$80) |
| 2 | -\$540 (-\$500 - \$40) |

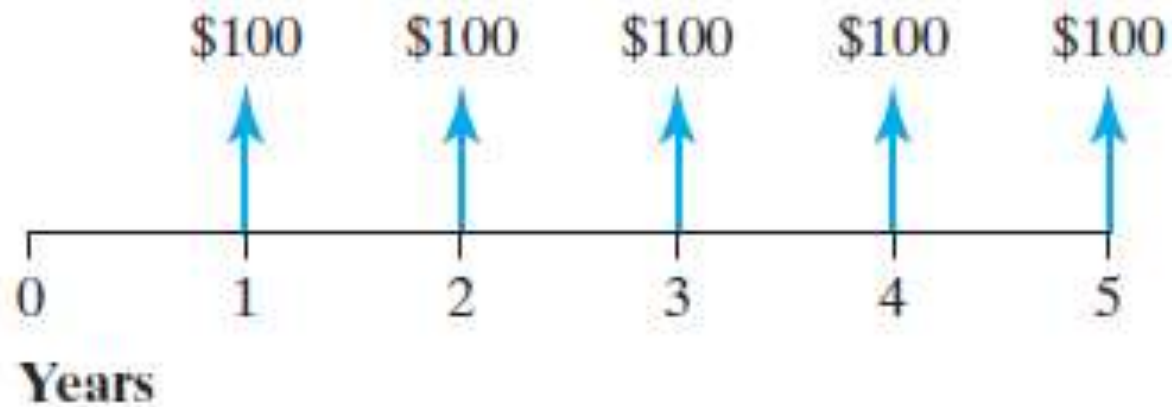
Cash Flow Diagram



Five Types of Cash Flows

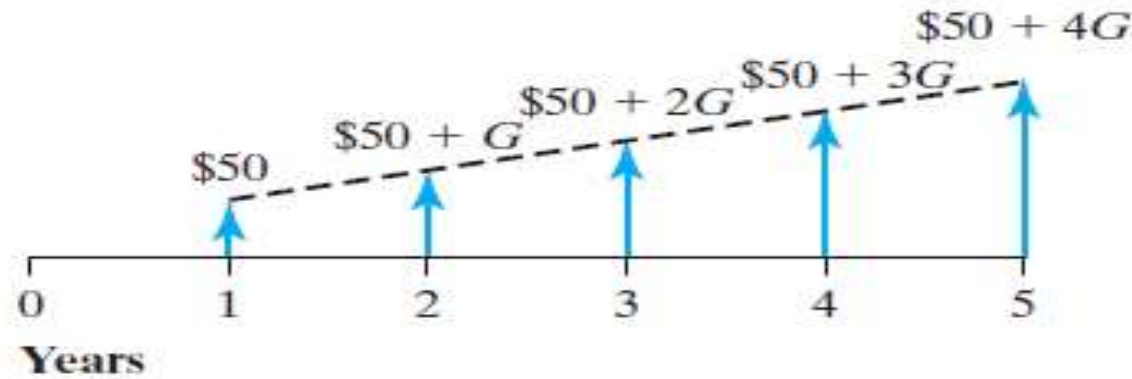


(a) Single cash flow

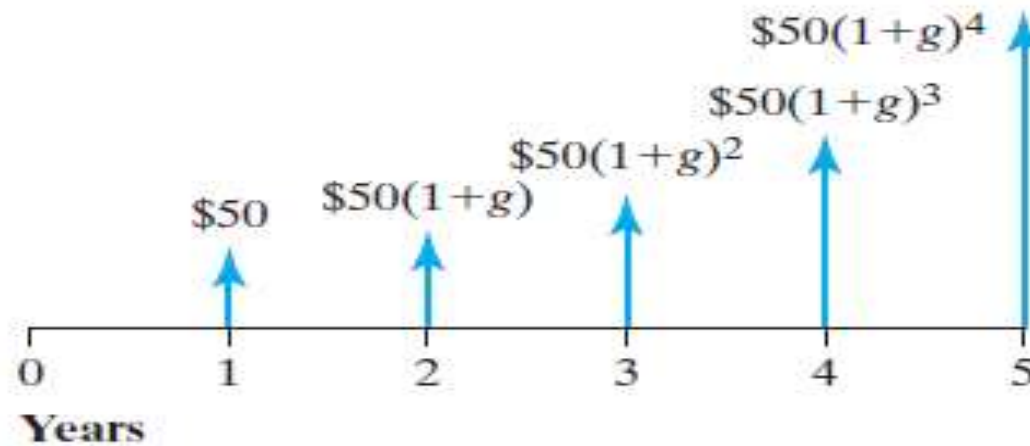


(b) Equal (uniform) payment series at regular intervals

Five Types of Cash Flows



(c) Linear gradient series, where each cash flow in the series increases or decreases by a fixed amount G

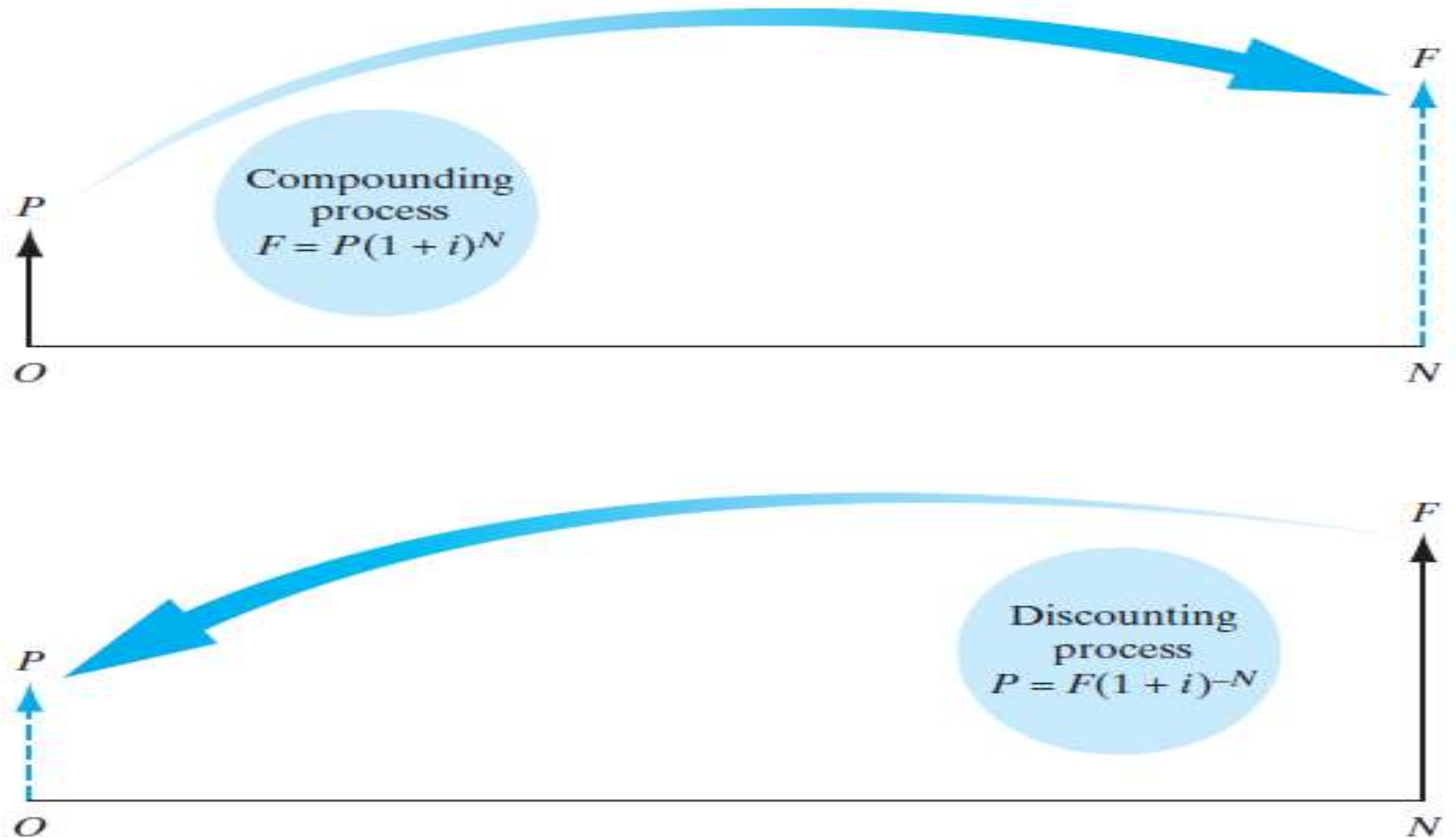


(d) Geometric gradient series, where each cash flow in the series increases or decreases by a fixed rate (percentage) g

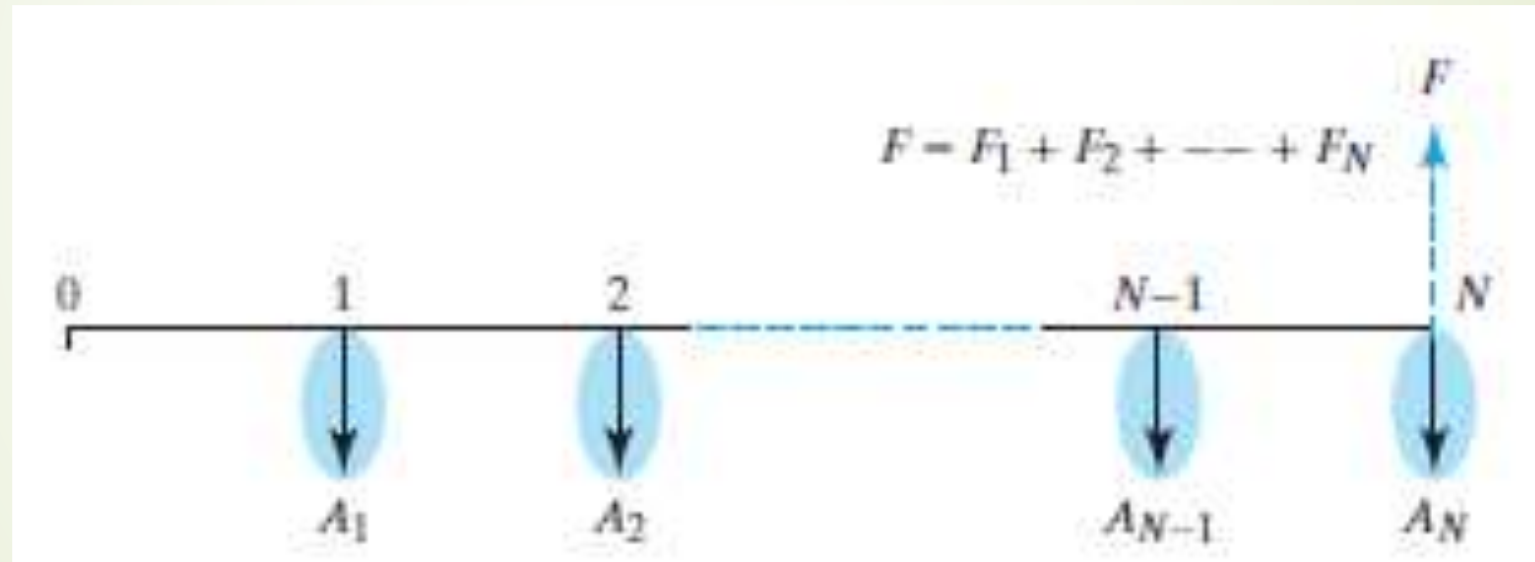


(e) Irregular payment series, which exhibits no regular overall pattern

Economic Equivalence: Present Worth, Future Worth



Economic Equivalence: Annual Worth; Capital Recovery Fund/Annuity Factor (Given P) and Sinking Fund Factor (Given F)



Development of Formulas for Equivalence Calculation

| Flow Type | Factor Notation | Formula | Excel Command | Cash Flow Diagram |
|------------------------|-------------------------------------|---|---|-------------------|
| SINGLE | Compound amount ($F/P, i, N$) | $F = P(1 + i)^N$ | <code>=FV($i, N, P, 0$)</code> | |
| | Present worth ($P/F, i, N$) | $P = F(1 + i)^{-N}$ | <code>=PV($i, N, F, 0$)</code> | |
| EQUALLY PAYMENT SERIES | Compound amount ($F/A, i, N$) | $F = A \left[\frac{(1 + i)^N - 1}{i} \right]$ | <code>=FV($i, N, A, 0$)</code> | |
| | Sinking fund ($A/F, i, N$) | $A = F \left[\frac{i}{(1 + i)^N - 1} \right]$ | <code>=PMT($i, N, P, F, 0$)</code> | |
| | Present worth ($P/A, i, N$) | $P = A \left[\frac{(1 + i)^N - 1}{i(1 + i)^N} \right]$ | <code>=PV($i, N, A, 0$)</code> | |
| | Capital recovery ($A/P, i, N$) | $A = P \left[\frac{i(1 + i)^N}{(1 + i)^N - 1} \right]$ | <code>=PMT(i, N, P)</code> | |

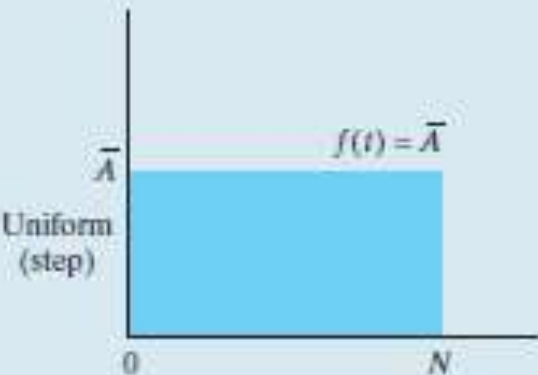
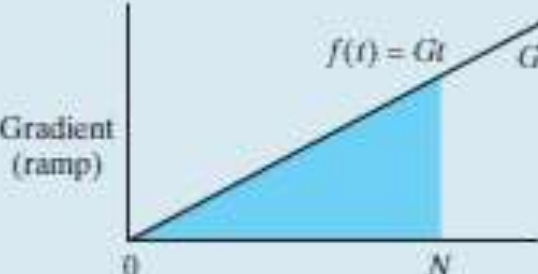
Development of Formulas for Equivalence Calculation

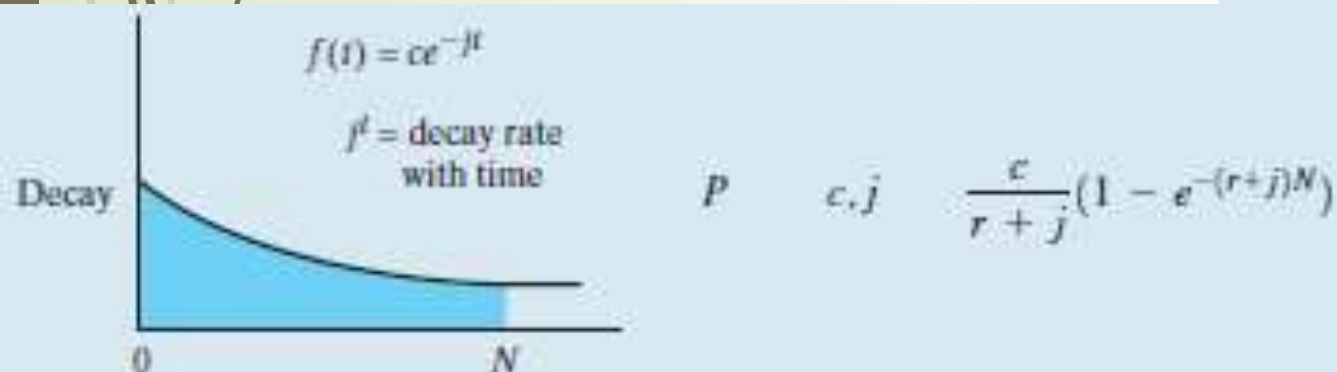
| | | | |
|--------------------------------------|--|---|--|
| G R A D I E N T | Linear gradient | | |
| | Present worth ($P/G, i, N$) | $P = G \left[\frac{(1+i)^N - iN - 1}{i^2(1+i)^N} \right]$ | |
| | Conversion factor ($A/G, i, N$) | $A = G \left[\frac{(1+i)^N - iN - 1}{i[(1+i)^N - 1]} \right]$ | |
| S E R I E S | Geometric gradient | | |
| | Present worth ($P/A_1, g, i, N$) | $P = \left[A_1 \left[\frac{1 - (1+g)^N(1+i)^{-N}}{i - g} \right] \right. \\ \left. A_1 \left(\frac{N}{1+i} \right) (\text{if } i = g) \right]$ | |

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Development of Formulas for Equivalence Calculation

TABLE 4.2 Summary of Interest Factors for Typical Continuous Cash Flows with Continuous Compounding

| Type of Cash Flow | Cash Flow Function | Parameters Find | Given | Algebraic Notation | Factor Notation |
|-------------------|--|-----------------|-----------|--|---------------------|
| Uniform (step) |  | P | \bar{A} | $\bar{A} \left[\frac{e^{rN} - 1}{re^{rN}} \right]$ | $(P/\bar{A}, r, N)$ |
| | | \bar{A} | P | $P \left[\frac{re^{rN}}{e^{rN} - 1} \right]$ | $(\bar{A}/P, r, N)$ |
| | | F | \bar{A} | $\bar{A} \left[\frac{e^{rN} - 1}{r} \right]$ | $(F/\bar{A}, r, N)$ |
| | | \bar{A} | F | $F \left[\frac{r}{e^{rN} - 1} \right]$ | $(\bar{A}/F, r, N)$ |
| Gradient (ramp) |  | P | G | $\frac{G}{r^2}(1 - e^{-rN}) - \frac{G}{r}(Ne^{-rN})$ | |



Given the choice of these two plans which would you choose?

| Year | Plan 1 | Plan 2 |
|-------|---------|---------|
| 0 | | \$5,000 |
| 1 | \$1,000 | |
| 2 | \$1,000 | |
| 3 | \$1,000 | |
| 4 | \$1,000 | |
| 5 | \$1,000 | |
| Total | \$5,000 | \$5,000 |

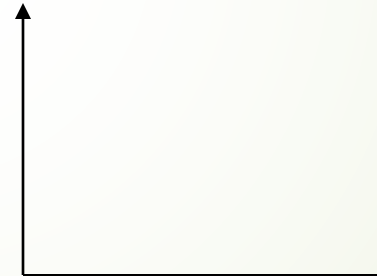
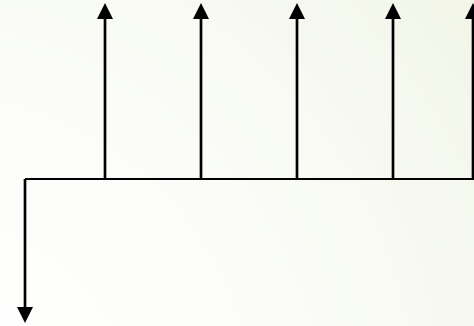
Resolving Cash Flows to Equivalent Present Values

➤ $P = \$1,000(P|A, 10\%, 5)$

➤ $P = \$1,000(3.791) = \$3,791$

➤ $P = \$5,000$

➤ Alternative 2 is better than alternative 1 since alternative 2 has a greater present value

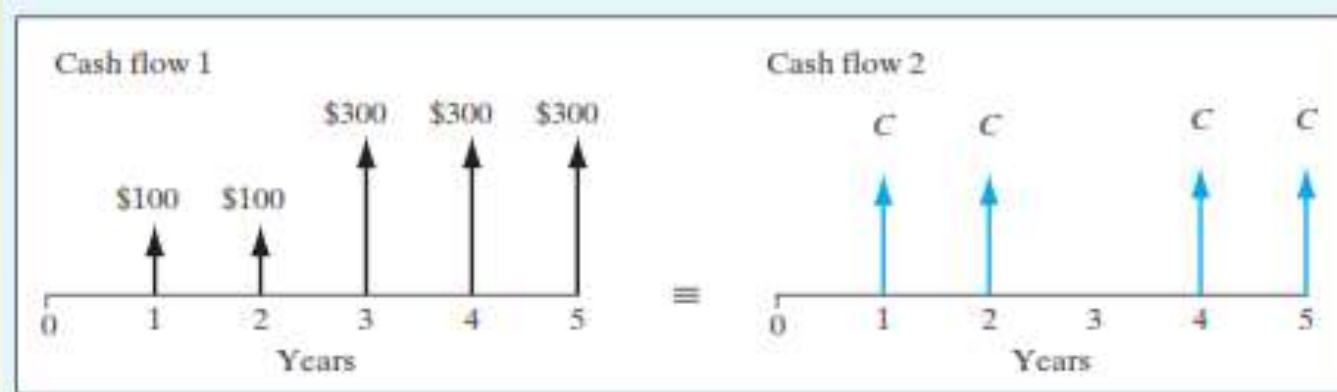


An Example of Future Value

- ▶ Example: If \$500 were deposited in a bank savings account, how much would be in the account three years hence if the bank paid 6% interest compounded annually?
- ▶ Given $P = 500$, $i = 6\%$, $n = 3$,
- ▶ Then, use $F = P(F/P, 6\%, 3) = 595.91$

An Example of Present Value

- Example: If you wished to have \$800 in a savings account at the end of four years, and 5% interest we paid annually, how much should you put into the savings account?
- $n = 4, F = \$800, i = 5\%, P = ?$
- $P = F(P/F, 5\%, 4) = \$658.16$
- You should put $P = \$658.16$



The two cash flows in Figure 3.38 are equivalent at an interest rate of 12% compounded annually. Determine the unknown value C .

SOLUTION

Given: Cash flows as in Figure 3.38; $i = 12\%$ per year.

Find: C .

- **Method 1.** Compute the present worth of each cash flow at time 0:

$$\begin{aligned}
 P_1 &= \$100(P/A, 12\%, 2) + \$300(P/A, 12\%, 3)(P/F, 12\%, 2) \\
 &= \$743.42;
 \end{aligned}$$

$$\begin{aligned}
 P_2 &= C(P/A, 12\%, 5) - C(P/F, 12\%, 3) \\
 &= 2.8930C.
 \end{aligned}$$

Since the two flows are equivalent, $P_1 = P_2$, and we have

$$743.42 = 2.8930C.$$

Solving for C , we obtain $C = \$256.97$.

- Sagar, a self-employed individual, is opening a retirement account at a bank. His goal is to have Rs.1,000,000 in his account in 20 years' time. He wishes to start with a deposit at the end of year 1 and increase the deposit at a rate of 6% each year thereafter. If bank is willing to pay 8% interest compounded annually throughout the 20 years, what should be the size of his first and last deposit. (Use formula of geometric gradient)

SOLUTION

Given: $F = \$1,000,000$, $g = 6\%$ per year, $i = 8\%$ per year, and $N = 20$ years.

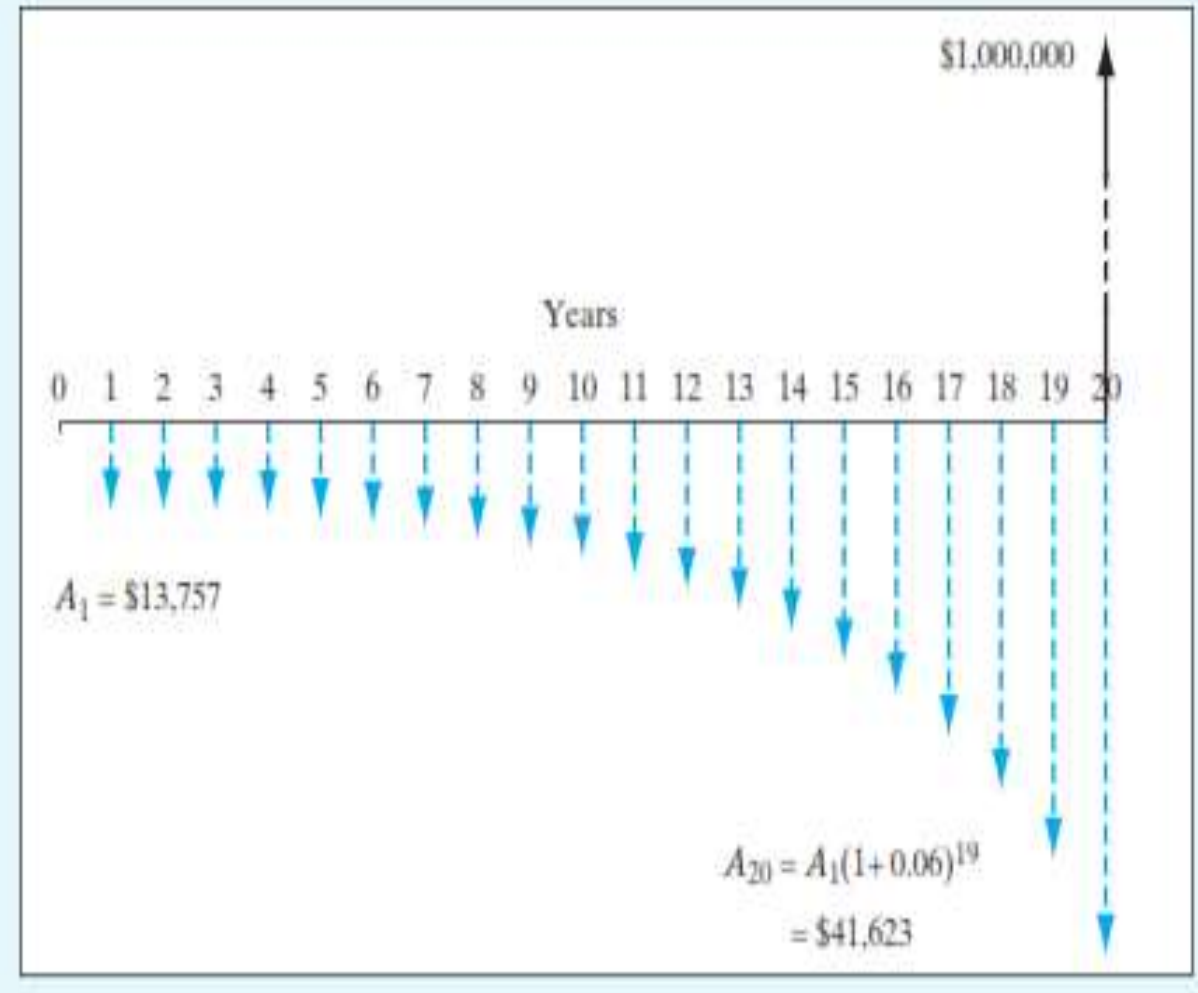
Find: A_1 as in Figure 3.35.

We have

$$\begin{aligned} F &= A_1(P/A_1, 6\%, 8\%, 20) (F/P, 8\%, 20) \\ &= A_1(72.6911). \end{aligned}$$

Solving for A_1 yields

$$A_1 = \$1,000,000 / 72.6911 = \$13,757.$$




Example:

- Calculate effective rate of interest when nominal rate of interest is 7% and compounding is i) Monthly iii) Daily ii) Quarterly iv) Continuously
- Your sister needs Rs. 6,00,000 at the end of 10th year for the study of +2 level. How much money should be deposited in the bank account at the end of each year for 7 continuous years from this year if bank provides 6% rate of interest per year? Make also cash flow diagram.
- You deposited Rs. 50,000 the beginning of each for 7 years. How much money will be in your account at the end of 10th year when rate of interest is 6% compounded quarterly. Make also cash flow diagram.
- Suppose that you make a series of annual deposits into a bank account that pays 10% interest. The initial deposit at the end of the first year is Rs.1,200. The deposit amounts decline by Rs. 200 in each of the next four years. How much would you have immediately after the fifth deposit?
- BioGen Company has borrowed Rs. 25,00,000 to purchase lab equipments. The loan carries 8% interest per year compounding quarterly and is to be repaid in equal annual installments over the next six years. Compute the amount of the annual installment. If university wants to negotiate with the bank to defer the first loan repayment until the end of year 2 (but still desires to make six equal installments at 8% interest), what should be the annual installment?

Chapter 3: Assignments

- What do you mean by time value of money? Differentiate between simple and compound interest rate.
- Explain nominal and effective interest rate? How do you derive effective interest rate on the basis of nominal interest rate?
- Write short notes on:
 - Time Value of money
 - Nominal Vs Effective interest rate
 - Simple Vs Compound interest rate
 - Present Worth Vs Future Worth
 - Sinking Fund Vs Capital Recovery Fund
- ***Numerical Questions***



Chapter 4: Basic Methods of Engineering Economic Studies

- Minimum Attractive Rate of Return- MARR
- Payback Period Method
 - Simple Payback Method
 - Discounted Payback Method
- Equivalent Worth Method
 - Present Worth (PW)
 - Future Worth (FW)
 - Annual Worth (AW)
- Rate of Return Method
 - Internal Rate of Return (IRR)
 - Modified Internal Rate of Return (MIRR)/External Rate of Return (ERR)
- Benefit Cost Ratio Method
 - Conventional BC Ratio
 - Modified BC Ratio

Minimum Attractive Rate of Return- MARR

- ▶ A company may borrow funds to invest in profitable projects, or it may return to (invest in) its **investment pool** any unused funds until they are needed for other investment activities.
- ▶ Here, we may view the borrowing rate as a marginal cost of capital (k). Suppose that all available funds can be placed in investments yielding a return equal to l , the **lending rate**. We view these funds as an investment pool.
- ▶ The firm may withdraw funds from this pool for other investment purposes, but if left in the pool, the funds will earn at the rate r (which is thus the opportunity cost).
- ▶ The MARR is thus related to either the borrowing interest rate or the lending interest rate.
- ▶ Thus, the minimum attractive rate of return (MARR) is the interest rate at which a firm can always earn or borrow money under a normal operating environment.
- ▶ Usually, selection of the MARR is a policy decision made by top management.
- ▶ It is the rate at which NPW analysis should be conducted.



Payback Period Method ~ Simple and Discounted

- One of the primary concerns of most businesspeople is whether and when the money invested in a project can be recovered.
- The **payback method** screens projects on the basis of how long it takes for net receipts to equal investment outlays.
- This calculation can take one of two forms: either ignore time-value-of-money considerations or include them.
- The former case is usually designated the **conventional/ simple payback method**, the latter case the **discounted payback method**.



Payback Period Method ~ Simple and Discounted

- If a company makes investment decisions solely on the basis of the payback period, it considers only those projects with a payback period *shorter* than the maximum acceptable payback period.
- This time limit is determined largely by management policy. For example, a high-tech firm, such as a computer chip manufacturer, would set a short time limit for any new investment, because high-tech products rapidly become obsolete.
- If the payback period is within the acceptable range, a formal project evaluation (such as a present-worth analysis) may begin.
- It is important to remember that **payback screening** is not an *end* in itself, but rather a method of screening out certain obviously unacceptable investment alternatives before progressing to an analysis of potentially acceptable ones.



Present worth Method

- Until the 1950s, the payback method was widely used as a means of making investment decisions.
- As flaws in this method were recognized, however, businesspeople began to search for methods to improve project evaluations.
- The result was the development of **discounted cash flow techniques (DCF)**, which take into account the time value of money.
- One of the DCFs is the net-present-worth, or net-present-value, method.
- Under the NPW criterion, the present worth of all cash inflows is compared against the present worth of all cash outflows associated with an investment project.
- The difference between the present worth of these cash flows, referred to as the **net present worth (NPW)**, **net present value (NPV)** determines whether the project is an acceptable investment.
- When two or more projects are under consideration, NPW analysis further allows us to select the best project by comparing their NPW figures.

Present worth Method: Basic Procedure

- Present worth is an equivalence method of analysis in which a project's cash flows are discounted to a single present value. It is perhaps the most efficient analysis method we can use in determining the acceptability of a project on an economic basis.
- Determine the interest rate that the firm wishes to earn on its investments. The interest rate you determine represents the rate at which the firm can always invest the money in its **investment pool**. This interest rate is often referred to as either a **required rate of return** or a **minimum attractive rate of return (MARR)**. Usually, selection of the MARR is a policy decision made by top management.
- Estimate the service life of the project.
- Estimate the cash inflow for each period over the service life.
- Estimate the cash outflow over each service period.
- Determine the net cash flows
- Find Present Worth (NPW)=Net Cash Flow=Net Cash Inflow-Net Cash Outflow

Present worth Method: Decision Criteria

- **Single Project Evaluation.** In this context, a positive NPW means that the equivalent worth of the inflows is greater than the equivalent worth of outflows, so the project makes a profit. Therefore, if the $PW(i)$ is positive for a single project, the project should be accepted; if the $PW(i)$ is negative, the project should be rejected. The decision rule is:
 - If $PW(i) > 0$, accept the investment.
 - If $PW(i) = 0$, remain indifferent.
 - If $PW(i) < 0$, reject the investment.

Future Worth Method

- Net present worth measures the surplus in an investment project at time 0. **Net future worth (NFW)** measures this surplus at a time other than 0.
- Net-future-worth analysis is particularly useful in an investment situation in which we need to compute the equivalent worth of a project at the end of its investment period, rather than at its beginning.
- As you might expect, the **decision rule** for the NFW criterion is the same as that for the NPW criterion: For a single project evaluation,
 - If $FW(i) > 0$, accept the investment
 - If $FW(i) = 0$, remain indifferent to the investment
 - If $FW(i) < 0$, reject the investment

Annual Worth Method

- The **annual equivalent worth (AE)** criterion provides a basis for measuring the worth of an investment by determining equal payments on an annual basis.
- Knowing that any lump-sum cash amount can be converted into a series of equal annual payments, we may first find the net present worth (NPW) of the original series and then multiply this amount by the capital recovery factor:

$$AE(i) = PW(i) (A>P, i, N)$$

- **Single-project evaluation:** The accept–reject selection rule for a single *revenue* project is as follows:
 - If $AE(i) > 0$, accept the investment.
 - If $AE(i) = 0$, remain indifferent to the investment.
 - If $AE(i) < 0$, reject the investment.

Present Worth Analysis

- **Example:** A construction enterprise is investigating the purchase of a new dump truck. Interest rate is 9%. The cash flow for the dump truck are as follows:
- First cost = \$50,000, annual operating cost = \$2000, annual income = \$9,000, salvage value is \$10,000, life = 10 years. Is this investment worth undertaking?
- **Given:**
- $P = \$50,000$, $A = \text{annual net income} = \$9,000 - \$2,000 = \$7,000$, $S = 10,000$, $n = 10$.
- Evaluate net present worth = present worth of benefits – present worth of costs

Present Worth Analysis

- Present worth of benefits = $\$9,000(P|A, 9\%, 10) = \$9,000(6.418) = \$57,762$
- Present worth of costs = $\$50,000 + \$2,000(P|A, 9\%, 10) - \$10,000(P|F, 9\%, 10) = \$50,000 + \$2,000(6.418) - \$10,000(.4224) = \$58,612$
- Net present worth = $\$57,762 - \$58,612 < 0 \Rightarrow$ do not invest
- ***What should be the minimum annual benefit for making it a worthy of investment at 9% rate of return?***

Annual Worth Analysis

- Present worth of benefits = $A(P|A, 9\%, 10) = A(6.418)$
- Present worth of costs = $\$50,000 + \$2,000(P|A, 9\%, 10) - \$10,000(P|F, 9\%, 10) = \$50,000 + \$2,000(6.418) - \$10,000(.4224) = \$58,612$
- Thus, Annual Worth of the project:
- $A(6.418) = \$58,612 \Rightarrow A = \$58,612 / 6.418 = \$9,312.44$

Example:

From the given cashflow, find PW, AW & FW when MARR= 9%.

| EOY | Cashflow |
|-----|-----------|
| 0 | -5,00,000 |
| 1 | 80,000 |
| 2 | 1,00,000 |
| 3 | 60,000 |
| 4 | 1,20,000 |
| 5 | 90,000 |
| 6 | 90,000 |
| 7 | 90,000 |
| 8 | 1,00,000 |

Rate of Return Method: Interest Rate of Return (IRR) Method

- ▶ A project's return is referred to as the internal rate of return (IRR) or the **yield** promised by an **investment project** over its **useful life**.
- ▶ *The rate of return is the break-even interest rate i^* that equates the present worth of a project's cash outflows to the present worth of its cash inflows, or*
 - ▶ $PW(i^*) = PW \text{ Cash inflows} - PW \text{ Cash outflow}$
- ▶ *The internal rate of return is the interest rate charged on the unrecovered project balance of the investment such that, when the project terminates, the unrecovered project balance will be zero.*

Internal Rate of Return: Trial and Error Method

- The first step in the trial-and-error method is to make an estimated **guess** at the value of i^* .
- For a simple investment, we use the “guessed” interest rate to compute the present worth of net cash flows and observe whether it is positive, negative, or zero.
- Whenever we reach the point where $PW(i)$ is bounded by one negative and one positive value, we use **linear interpolation** to approximate i^* .
- $i^* = LI + (HI - LI) * (\text{Amount at LI} - 0) / (0 - \text{Amount at HI})$
- If the IRR exceeds this MARR, we are assured that the company will more than break even.
- The decision rule for a pure project is as follows:
 - If $IRR > MARR$, accept the project.
 - If $IRR = MARR$, remain indifferent.
 - If $IRR < MARR$, reject the project.

Internal Rate of Return

➤ Benefits of using IRR

- Considers the time value of money
- Consistent with shareholder wealth maximization
- Intuitive appeal (rate feels better than absolute number because it is readily comparable with other rates)
- Doesn't require advance specification of the discount rate

➤ Disadvantages

- Reinvestment rate assumption (i.e. cash inflows are reinvested at the IRR) may be unreasonable
- Multiple IRRs possible where sign reversals occur in cash flow
- Requires detailed cash flow predictions over the entire life of the project.
- Only as accurate as the cash flow predictions.
- When scale differences exist, there can be a ranking conflict with the NPV method.

External / Modified Internal Rate of Return (ERR/MIRR) Method

- The **modified internal rate of return** (MIRR) is a financial measure of an investment's attractiveness.
- As the name implies, MIRR is a **modification** of the internal **rate of return** (IRR) and as such aims to resolve some problems with the IRR.
- Modified internal rate of return (MIRR) uses explicit reinvestment assumptions.
- The discount rate which equates the present value of the cash *outflows* (calculated on the basis of the finance rate or MARR) with the present value of the project's **terminal value**. Where the **terminal value** is the sum of the future values of the project's cash *inflows* compounded to the project's termination (at the reinvestment rate or MARR).
- **Decision Rules**
 - Accept projects with $MIRR \geq MARR$
 - Reject projects with $MIRR < MARR$
 - Where two projects are mutually exclusive, do not rank on MIRR values, accept the one with the higher **NPV**.

External / Modified Rate of Return (ERR/MIRR) Method

$$PV_{\text{outflows}} = PV_{\text{inflows}}$$

$$\sum_{t=0}^n \frac{ACOF_t}{(1+k)^t} = \frac{\sum_{t=0}^n ACIF_t (1+k)^{n-t}}{(1+MIRR)^n} = \frac{TV}{(1+MIRR)^n}$$

where

$ACIF_t$ = Annual net cash *inflow* in time period t

$ACOF_t$ = Annual net cash *outflow* in time period t

TV = the Terminal Value of all the cash inflows
compounded at the discount rate

k = the appropriate discount rate

$MIRR$ = the Modified Internal Rate of Return

n = the project's expected life

External / Modified Rate of Return (ERR/MIRR) Method

➤ Benefits of using MIRR

- Considers the time value of money
- Consistent with shareholder wealth maximisation
- Intuitive appeal (rate feels better than absolute number because it is readily comparable with other rates)
- Overcomes the reinvestment rate problem of IRR by allowing the reinvestment rate to be specified.

Disadvantages

- Requires detailed cash flow predictions over the entire life of the project.
- Only as accurate as the cash flow and reinvestment rate predictions.
- When scale differences exist, there can still be a ranking conflict with the NPV method.
- Multiple MIRR possible where sign reversals occur in cash flow.

External / Modified Rate of Return (ERR/MIRR) Method

Calculation

For example, if an initial investment of 10000 produces net cash flows of 4000 for 4 years and the discount rate is taken as 10%, the MIRR of this investment is:

| Time | Net cash flows | PV _{outflows} | TV (of inflows) |
|---------------------------------|----------------|------------------------|--------------------|
| Initial cash outlay (time 0) | -10000 | (Step 1) 10000 | |
| Year 1 | 4000 | → | 5324 |
| Year 2 | 4000 | → | 4840 |
| Year 3 | 4000 | → | 4400 |
| Year 4 | 4000 | → | 4000 |
| | | Total | (Step 2) 18664 |

Calculation

Step 1 (previous slide): calculate $PV_{outflows}$

Step 2 (previous slide): calculate TV of inflows

$$\text{Step 3: } PV_{outflows} = \frac{TV}{(1 + MIRR)^n}$$

$$10000 = \frac{18664}{(1 + MIRR)^4}$$

$$MIRR = 16.7\%$$

Benefit Cost Ratio Method

- Benefit cost ratio is defined as the ratio of the equivalent worth of benefits to the equivalent worth of costs. This is the ratio of discounted benefits to discounted costs of the projects. It is also known as investment ratio.
- This ratio consider the time value of money while evaluating the project.
- Two commonly used B/C ratio:
 - Conventional B/C Ratio
 - Modified B/C Ratio

Benefit Cost Ratio: Conventional Method

- ▶ With PW Formulation:

- ▶ $B/C \text{ Ratio} = PW(B) / (PW(I) - PW(S) + PW(O\&M))$

- ▶ With FW Formulation:

- ▶ $B/C \text{ Ratio} = FW(B) / (FW(I) - FW(S) + FW(O\&M))$

- ▶ With AW Formulation:

- ▶ $B/C \text{ Ratio} = AW(B) / (AW(I) - AW(S) + AW(O\&M)) = AW(B) / (CR + AW(O\&M))$

- ▶ Where, B=Benefit of the proposed projects

- ▶ O&M=Operation and Maintenance Cost

- ▶ S=Salvage Value

- ▶ I=Initial Investment

- ▶ CR=Capital Recovery Amount

Benefit Cost Ratio: Modified B/C Ratio

- With PW Formulation:
 - $B/C \text{ Ratio} = (PW(B) - PW(O\&M)) / (PW(I) - PW(S))$
- With FW Formulation:
 - $B/C \text{ Ratio} = (FW(B) - FW(O\&M)) / (FW(I) - FW(S))$
- With AW Formulation:
 - $B/C \text{ Ratio} = (AW(B) - AW(O\&M)) / ((AW(I) - AW(S)) = (AW(B) - AW(O\&M)) / CR$
- **The decision rule for a pure project is as follows:**
 - If B/C ratio > 1, accept the project.
 - If B/C ratio = 1, remain indifferent.
 - If B/C ratio < 1, reject the project.



Problems on Benefit Cost Ratio

- A project is viable and worth taking up when the BC ratio is more than 1. The main problem here is that BCR can be manipulated easily as its value is sensitive to the treatment and aggregation of costs and benefits.
- For example, taking benefit in the numerator net of a few cost items, which would have been otherwise accounted in the denominator, a different value for BCR may be obtained. Precisely for this reason, it becomes difficult to compare different projects unless a uniform method of aggregating benefits and costs is followed.
- Similarly, the ratio is also sensitive to the time span considered for project evaluation and comparing projects of different durations becomes untenable.
- Another problem is in its interpretation when applied to projects like watersheds where public funding and private benefits, non-correspondence between those who incur costs and those who benefit are the contentious issues.

Example: Basic Methods of EE (NEC, 2015)

- Cosmos College is considering to purchase a new photocopy machine costing Rs. 1,00,000 having salvage value of Rs. 25,000 at 10th year that needs Rs. 5,000 electricity cost per year where MARR 10% per year.
 - a) Find PW, AW& FW
 - b) Find IRR & Decide investment on photocopy
 - c) Find both types of B/C ratio by PW formulation
 - d) Find simple & discounted payback period
 - e) MIRR, if reinvestment rate is 20%

Example: Basic Methods of EE (NEC, 2015)

- Nepal Engineering College (NEC) is considering to purchase a new generator costing of Rs. 4,00,000 having salvage value Rs. 1,00,000 at the end of 5th year. The use of generator will increase Rs. 1,50,000 that needs fuel cost of Rs. 30,000 per year. Find the following when $MARR = 10\%$.
 - i. PW, AW & FW
 - ii. IRR. Also develop investment balance diagram and table.
 - iii. B\C ratio by PW formulation (Both Methods)
 - iv. Simple & discounted payback period
 - v. MIRR, if reinvestment rate is 20%

Solution:

➤ i) **PW (10%)** = $-4,00,000 + (,50,000-30,000) (P/A, 10\%, 5) + 1,00,000 (P/F, 10\%, 5) = 1,16,986$

AW (10%) = $-4,00,000 (A/P, 10\%, 5) + (,50,000-30,000) + 1,00,000 (A/F, 10\%, 5) = 30,860$

FW (10%) = $-4,00,000 (F/P, 10\%, 5) + (,50,000-30,000) (F/A, 10\%, 5) + 1,00,000 = 1,88,412$

ii) For IRR; Setting equation PW Formulation

$PW (10\%) = -4,00,000 + (,50,000-30,000) (P/A, i\%, 5) + 1,00,000 (P/F, i\%, 5)$

Using Trial and Error Method,

Try at, $i=10\%$; $PW (10\%) = -4,00,000 + (,50,000-30,000) (P/A, 10\%, 5) + 1,00,000 (P/F, 10\%, 5) = 1,16,986$

Try at, $i=18\%$; $PW (18\%) = -4,00,000 + (,50,000-30,000) (P/A, 18\%, 5) + 1,00,000 (P/F, 18\%, 5) = 26,844$

Try at $i=20\%$; $PW (20\%) = -4,00,000 + (,50,000-30,000) (P/A, 20\%, 5) + 1,00,000 (P/F, 20\%, 5) = -938$

Interpolation;

IRR = $18\% + 26,844 / (26,844 + 938) * 2\% = 19.93\%$; As MARR is 10% and IRR is 19.93%, accept the project.

Solution:

iv) Investment balance table

| End of Year | Net Cash Flow | Interest Factor @ 19.93% | Unrecovered Amount (Beginning of the year) | Unrecovered Investment (End of the year) | Cumulative (E-B) |
|-------------|---------------|--------------------------|--|--|------------------|
| 0 | -4,00,000 | | -4,00,000 | -4,00,000 | -400,000 |
| 1 | 1,20,000 | 1.1993 | -4,00,000 | -479,720 | -359,720 |
| 2 | 1,20,000 | 1.1993 | -359,720 | -431,412 | -311,412 |
| 3 | 1,20,000 | 1.1993 | -311,412 | -373,477 | -253,477 |
| 4 | 1,20,000 | 1.1993 | -253,476 | -303,994 | -183,994 |
| 5 | 2,20,000 | 1.1993 | -183,994 | 220,000 | 0 |

Solution:

iii) B/C ratio using PW formulation

We have, Conventional B/C Ratio = $PW(B) / (PW(I) - PW(S) + PW(O\&M))$

Modified B/C Ratio = $(PW(B) - PW(O\&M)) / (PW(I) - PW(S))$

Then, $PW(B) = 5,68,620$

$PW(I) = 4,00,000$

$PW(S) = 62,090$

$PW(O\&M) = 1,13,724$

Then, Conventional B/C ratio = $568,620 / (4,00,000 - 62,090 + 1,13,724) = 1.259 > 1$, So accept the project.

Modified B/C ratio = $(568,620 - 1,13,724) / (4,00,000 - 62,090) = 1.346 > 1$, So accept the project.

Solution:

iv) Using Simple and Discounted Payback Period

| End of Year | Net Cash Flow | Cumulative Cash Flow | Interest Factor @ 10% | Discounted Cash Flow | Cumulative Cash Flow |
|-------------|---------------|----------------------|-----------------------|----------------------|----------------------|
| 0 | -4,00,000 | -4,00,000 | 1 | -4,00,000 | -400,000 |
| 1 | 1,20,000 | -280,000 | 0.9091 | 1,09,090.9 | -2,90,909.09 |
| 2 | 1,20,000 | -1,60,000 | 0.8264 | 99,173.55 | -191,735.5 |
| 3 | 1,20,000 | -40,000 | 0.7513 | 90,157.776 | -1,01,577.7 |
| 4 | 1,20,000 | 80,000 | 0.6830 | 81,961.614 | -19,616.08 |
| 5 | 2,20,000 | 3,00,000 | 0.6209 | 1,36,602.69 | 1,16,986.6 |

Solution:

- Simple Payback Period = $3 + 40,000 / 1,20,000 = 3.333$ years
- Discounted Payback Period = $4 + 19,616 / 1,36,602 = 4.1435$ years

v) Using MIRR Method:

PV of outflow = 4,00,000

FV of inflow = $1,20,000 * (1.2)^4 + 1,20,000 * (1.2)^3 + 1,20,000 * (1.2)^2 + 1,20,000 * (1.2)^1 + 2,20,000 * (1.2)^0 = 992,992$

Then, For MIRR;

PV of cash outflow = FV of cash inflow / $(1 + \text{MIRR})^N$

$(1 + \text{MIRR})^5 = 992,992 / 4,00,000$; or $5 \log(1 + \text{MIRR}) = \log 2.48$; or $\text{MIRR} = 19.94\%$,

As $\text{MIRR}(19.94\%) > \text{MARR}(10\%)$, we accept the project.

Example: Basic Methods of EE (NEC, 2015)

- Your college is considering to purchase a new machine costing Rs. 3,00,000 that will have salvage value of Rs. 20,000 at the end of 8th year generates annual income of Rs. 80, 000 that needs Rs. 20,000 operating cost for each year where MARR= 10%. Find,
- i) PW, AW, & FW
- ii) IRR & interpret your result
- iii) Both types of B/C ratio by AW & FW formulation
- iv) Both types of payback period
- v) MIRR, if reinvestment rate is 20%

IRR (PU, 2009)

- Consider an investment project with the following cash flow. Compute the IRR for this investment and determine its acceptability at $MARR=10\%$ and draw also an investment balance diagram.


| End of Year | Net cash flows |
|-------------|----------------|
| 0 | -22,000 |
| 1 | -1,000 |
| 2 | 0 |
| 3 | 8,000 |
| 4 | 3,000 |
| 5 | 15,000 |

IRR (PU, 2016)

- Evaluate IRR of the following project and identify whether the project is feasible or not.
 - Initial investment =Rs. 5,00,000
 - Annual revenue =Rs. 2,30,000
 - Annual cost =Rs. 45,000
 - Useful life =8 yrs
 - Repair and maintenance cost at 4th and 6th year =Rs. 30,000
 - MARR =10% per year
- Also draw investment balance diagram.

Chapter 4: Assignments

- What do you mean by pay back period? Discuss simple and discounted payback period.
- Discuss PW, FW and AW method of project evaluation.
- What is IRR? Why MIRR is better than IRR for project evaluation?
- What do you mean by BC Ratio. Discuss conventional and modified method of B/C.
- ***Numerical Questions for each methods***



Chapter 5: Comparative Analysis of Alternatives

- Comparing Mutually Exclusive Alternatives having same useful life by Payback Period Method Equivalent Worth Method ;Rate of Return Method and Benefit Cost Ratio Method
- Comparing Mutually Exclusive Alternatives having different useful lives by Repeatability Assumption, Co-terminated Assumption, Capitalized Worth Method
- Comparing Mutually Exclusive, Contingent and Independent Project in Combination

Meaning of Independent Project

- Most firms have a number of unrelated investment opportunities available.
- An **independent project** is a project that may be accepted or rejected without influencing the accept-reject decision of another independent project. For example, the purchase of a milling machine, office furniture, and a forklift truck constitutes three independent projects.
- Only projects that are economically independent of one another can be evaluated separately.
- In other words, the decision regarding any one project has no effect on the decision to accept or reject another project. Such projects are said to be **independent**.
- **For a single project**, we have two investment alternatives: to accept or reject the project.
- **For two independent projects**, we can have four investment alternatives: (1) to accept both projects, (2) to reject both projects, (3) to accept only the first project, and (4) to accept only the second project.



Meaning of Dependent Project

- In many decision problems, several investment projects are related to one another such that the acceptance or rejection of one project influences the acceptance or rejection of others.
- Two such types of dependencies are **mutually exclusive** projects and **contingent** projects.

Meaning of Contingent Project

- ▶ We say that two or more projects are **contingent** if the acceptance of one requires the acceptance of the other.
- ▶ For example, the purchase of a computer printer is dependent upon the purchase of a computer, but the computer may be purchased without purchasing the printer.
- ▶ Suppose the acceptance of C is contingent on the acceptance of both A and B, and the acceptance of B is contingent on the acceptance of A. Then the number of decision alternatives can be formulated as follows:

| Alternative | X_A | X_B | X_C |
|-------------|-------|-------|-------|
| 1 | 0 | 0 | 0 |
| 2 | 1 | 0 | 0 |
| 3 | 1 | 1 | 0 |
| 4 | 1 | 1 | 1 |



Meaning of Mutually Exclusive Project

- Many engineering situations we face are with selecting the most economically attractive project from a number of alternative projects, all of which solve the same problem or meet the same need.
- It is unnecessary to choose more than one project in this situation, and the acceptance of one automatically entails the rejection of all of the others. Such projects are said to be **mutually exclusive**.
- Several alternatives are **mutually exclusive** when any one of them will fulfill the same need and the selection of one of them implies that the others will be excluded.
- Take, for example, buying versus leasing an automobile for business use; when one alternative is accepted, the other is excluded.

Comparing Mutually Exclusive Alternatives having same useful life: PW, AW, FW and B/C Ratio

- Compute the $PW(i)$ for each alternative and select the one with the largest $PW(i)$.
- When you compare mutually exclusive alternatives with the *same revenues*, they are compared on a *cost-only basis*. In this situation (because you are minimizing costs, rather than maximizing profits), you should accept the project that results in the *smallest, or least negative, NPW*.
- Similarly, use same decision criteria for AW, FW, and B/C Ratio method while comparing and selecting between multiple alternatives.

Comparing Mutually Exclusive Alternatives having different useful lives by Repeatability Assumption

- ▶ Two projects will have two different useful life, so comparing is difficult for them, Thus;
 - ▶ Assume that projects will be repeated for certain times so both projects will have same useful life
 - ▶ Times to be repeated for any project can be accessed by computing LCM of useful life of both projects
 - ▶ Their overall PW/FW will be accessed (including their repeated project cycle assuming they are repeated at the end of each cycle, till their useful life becomes same)
 - ▶ Compare PW/FW with each other and select best one.

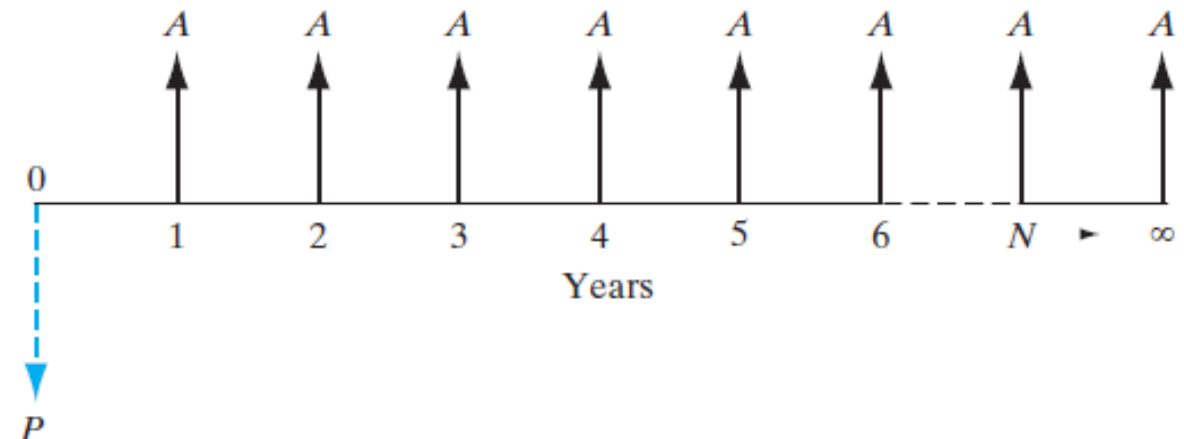
Comparing Mutually Exclusive Alternatives having different useful lives by Co-terminated Assumption

- Two projects will have two different useful life, so comparing is difficult for them, Thus;
 - Access shorter project's PW/FW (Project A)
 - For projects with longer useful life (Project B), assume this project will be terminated on shorter projects useful life, Thus;
 1. Find CR of initial investment and salvage value of Project B
 2. Find **PW of CR** (computed on above step) for remaining useful life of Project B beyond short project (Project A)
 3. Find PW/FW of overall project including **PW of CR** (accessed in step 2)
 4. Compare PW/FW with each other and select best one.

Comparing Mutually Exclusive Alternatives having perpetual lives by Capitalized Equivalent Method

- Another special case of the PW criterion is useful when the life of a proposed project is **perpetual** or the planning horizon is extremely long (say, 40 years or more).
- Many public projects, such as bridges, waterway structures, irrigation systems, and hydroelectric dams, are expected to generate benefits over an extended period (or forever).
- We will use the **capitalized equivalent** (CE(*i*)) method for evaluating such projects.

$$PW(i) = A(P/A, i, N \rightarrow \infty) = \frac{A}{i}.$$



Example: Use FW/PW/AW Formulation

Compare following projects by using repeatability & Co-terminated assumption when $MARR = 12\%$ per year.

| Items | Project A | Project B |
|-------|-----------|-----------|
| I | 1,50,000 | 2,00,000 |
| AR | 90,000 | 1,00,000 |
| AE | 20,000 | 22,000 |
| S | 50,000 | 1,00,000 |
| N | 2 years | 4 years |

Solution: Repeatability Assumption

- LCM of 2 and 4 years= 4 years

For Project A

- PW for 4 years= $-150,000 - 150,000(P/F, 10\%, 2) + (90,000 - 20,000)(P/A, 10\%, 4) + 50,000(P/F, 10\%, 2) + 50,000(P/F, 10\%, 4)$
 $= -150,000 - 150,000 * 0.8264 + 70,000 * 3.1699 + 50,000 * 0.8264 + 50,000 * 0.6830$
- =23,403

For Project B

- PW for 4 years= $-200,000 + (100,000 - 22,000)(P/A, 10\%, 4) + 100,000(P/F, 10\%, 4)$
- PW= $-2,00,000 + 78,000 * 3.1699 + 1,00,000 * 0.6830 = 1,15,552$

Then, PW of B > PW of A, So Select B.

Solution: Co-terminated Assumption

► For Project A

$$\begin{aligned}\text{PW of A} &= -1,50,000 + 70,000(P/A, 10\%, 2) + 50,000(P/F, 10\%, 2) \\ &= -150,000 + 70,000 * 1.7355 + 50,000 * 0.8264 = 12,805\end{aligned}$$

PW of B (Project B should be terminated at the end of 2nd year.)

$$\begin{aligned}\text{CR for Project B} &= 2,00(A/P, 10\%, 4) - 100,000(A/F, 10\%, 4) \\ &= 200,000 * (0.3155) - 100,000 * 0.2155 = 41,550\end{aligned}$$

PW of CR at the end of 2nd year

$$\text{PW of CR (10\%)} = 41550 (P/A, 10\%, 2) = 72110$$

PW of Project B terminating at the end of 2nd year

$$\begin{aligned}\text{PW(10\%)} &= -200,000 + 78,000(P/A, 10\%, 2) + 72,110(P/F, 10\%, 2) \\ &= -200,000 + 78,000 * 1.7355 + 72,110 * 0.8264 \\ &= -5,039\end{aligned}$$

Thus, PW of A > PW of B, So select Project A.



Chapter 5: Assignments

- What do you mean by mutually exclusive, independent and contingent projects, describe with suitable example.
- Write short notes on:
 - Co-terminated assumption for comparing alternatives
 - Repeatability assumption for comparing alternatives
- ***Numerical Questions for each methods***



Chapter 6: Risk Analysis

- Origin/Sources of Project Risks.
- Method of Describing Project Risks; Sensitivity Analysis, Breakeven Analysis, Scenario Analysis.



Origin/Sources of Project Risks

- In previous chapters, cash flows from projects were assumed to be known with complete certainty; our analysis was concerned with measuring the economic worth of projects and selecting the best ones to invest in.
- Although that type of analysis can provide a reasonable basis for decision making in many investment situations, we should certainly consider the more usual *uncertainty*.
- In this type of situation, management rarely has precise expectations about the future cash flows to be derived from a particular project.
- In fact, the best that a firm can reasonably expect to do is to estimate the range of possible future costs and benefits and the relative chances of achieving a reasonable return on the investment.



Origin/Sources of Project Risks

- The decision to make a major capital investment such as introducing a new product requires information about cash flow over the life of a project. The profitability estimate of an investment depends on cash flow estimations, which are generally uncertain.
- The factors to be estimated include the total market for the product; the market share that the firm can attain; the growth in the market; the cost of producing the product, including labor and materials; the selling price; the life of the product; the cost and life of the equipment needed; and the effective tax rates. Many of these factors are subject to substantial uncertainty.
- We use the term **risk** to describe an investment project whose cash flow is not known in advance with absolute certainty, but for which an array of alternative outcomes and their probabilities (odds) are known.



Origin/Sources of Project Risks

- We will also use the term **project risk** to refer to variability in a project's NPW.
- A greater project risk usually means a greater variability in a project's NPW, or simply that the *risk is the potential for loss*. This chapter begins by exploring the origins of project risk.
- In particular, managers have no way of determining either the probability that a project will lose money or the probability that it will generate large profits.
- Because cash flows can be so difficult to estimate accurately, project managers frequently consider a range of possible values for cash flow elements.
- If a range of values **Risk**: The chance that an investment's actual return will be different than expected.



Origin/Sources of Project Risks

- ▶ Boston Metal Company (BMC), a small manufacturer of fabricated metal parts, must decide whether to enter the competition to become the supplier of transmission housings for Gulf Electric, a company that produces the housings in its own in-house manufacturing facility, but that has almost reached its maximum production capacity. Therefore, Gulf is looking for an outside supplier. To compete, BMC must design a new fixture for individual cash flows is possible, it follows that a range of values for the NPW of a given project is also possible. Clearly, the analyst will want to gauge the probability and reliability of individual cash flows and, consequently, the level of certainty about the overall project worth
- ▶ A common approach is to make single-number “best estimates” for each of the uncertain factors and then to calculate measures of profitability, such as the NPW or rate of return for the project.
- ▶ This approach, however, has two drawbacks:
 - ▶ 1. No guarantee can ever ensure that the “best estimates” will match actual values.
 - ▶ 2. No provision is made to measure the risk associated with an investment, or the project risk.

Method of Describing Project Risks; Sensitivity Analysis, Breakeven Analysis, Scenario Analysis

- We may begin analyzing project risk by first determining the uncertainty inherent in a project's cash flows. We can do this analysis in a number of ways, which range from making informal judgments to calculating complex economic and statistical quantities.
- In this section, we will introduce three methods of describing project risk:
- **(1) sensitivity analysis,**
- **(2) break-even analysis, and**
- **(3) scenario analysis.**



Method of Describing Project Risks; Sensitivity Analysis

- One way to glean a sense of the possible outcomes of an investment is to perform a sensitivity analysis.
- This kind of analysis determines the effect on the NPW of variations in the input variables (such as revenues, operating cost, and salvage value) used to estimate after-tax cash flows.
- A **sensitivity analysis** reveals how much the NPW will change in response to a given change in an input variable.
- In calculating cash flows, some items have a greater influence on the final result than others. In some problems, the most significant item may be easily identified.
- For example, the estimate of sales volume is often a major factor in a problem in which the quantity sold varies with the alternatives. In other problems, we may want to locate the items that have an important influence on the final results so that they can be subjected to special scrutiny.



Method of Describing Project Risks; Sensitivity Analysis

- Sensitivity analysis is sometimes called “what-if” analysis, because it answers questions such as “What if incremental sales are only 1,000 units, rather than 2,000 units? Then what will the NPW be?”
- Sensitivity analysis begins with a base-case situation, which is developed by using the most likely values for each input. We then change the specific variable of interest by several specified percentage points above and below the most likely value, while holding other variables constant.
- Next, we calculate a new NPW for each of the values we obtained.
- A convenient and useful way to present the results of a sensitivity analysis is to plot **sensitivity graphs**.
- The slopes of the lines show how sensitive the NPW is to changes in each of the inputs: The steeper the slope, the more sensitive the NPW is to a change in a particular variable.
- Sensitivity graphs identify the crucial variables that affect the final outcome most.



Method of Describing Project Risks; Sensitivity Analysis

- Graphic displays provide a useful means to communicate the relative sensitivities of the different variables to the corresponding NPV value.
- However, **sensitivity graphs** do not explain any interactions among the variables or the likelihood of realizing any specific deviation from the base case.
- Certainly, it is conceivable that an answer might not be very sensitive to changes in either of two items, but very sensitive to combined changes in them.

Example: Sensitivity Analysis (PU, 2015)

- Perform sensitivity analysis over the range of $\pm 40\%$ by the parameters: i) Initial investment ii) Annual revenue iii) Useful life
- If $I = 11,500$; $AR = 3,000$; $N = 6$ years; $S = 1,000$; $MARR = 10\%$

Solution:

$$\begin{aligned}PW(10\%) &= -11,500 + 3,000(P/A, 10\%, 6) + 1,000(P/F, 10\%, 6) \\ &= -11,500 + 3,000(4.3552) + 1,000(0.5644) = 2,130.\end{aligned}$$

a. When initial investment varies $\pm 40\%$, the PW would be:

$$PW(10\%) = -11,500 + 3,000(P/A, 10\%, 6) + 1,000(P/F, 10\%, 6)$$

$$\text{At } I = +40\%, PW = -11,500(1.4) + 3,000(4.3552) + 1,000(0.5644) = -2,470.$$

$$\text{At } I = -40\%, PW = -11,500(0.6) + 3,000(4.3552) + 1,000(0.5644) = 6,730.$$

b. When Annual Revenue varies $\pm 40\%$, the PW would be:

$$\text{At } AR = +40\%, PW = -11,500 + 3,000(1.4)(4.3552) + 1,000(0.5644) = 7,356$$

$$\text{At } AR = -40\%, PW = -11,500 + 3,000(0.6)(4.3552) + 1,000(0.5644) = -3,096.$$

c. . When Useful life varies $\pm 40\%$, the PW would be:

$$\text{At } N = +40\%, PW(10\%) = -11,500 + 3,000(P/A, 10\%, 8.4) + 1,000(P/F, 10\%, 8.4)$$

$$\text{At } N = -40\%, PW(10\%) = -11,500 + 3,000(P/A, 10\%, 3.6) + 1,000(P/F, 10\%, 3.6)$$

Example: Sensitivity Analysis

Sensitivity Analysis Table

PW (10%) with sensitivity of $\pm 40\%$

| Parameters | -40% | 0% | +40% |
|---------------------|--------|-------|--------|
| Investment (I) | 6,730 | 2,130 | -2,470 |
| Annual Revenue (AR) | -3,096 | 2,130 | 7,356 |
| Useful life (N) | -2,077 | 2,130 | 5,476 |



Method of Describing Project Risks; Breakeven Analysis

- When we perform a sensitivity analysis of a project, we are asking how serious the effect of lower revenues or higher costs will be on the project's profitability.
- Managers sometimes prefer to ask instead how much sales can decrease below forecasts before the project begins to lose money. This type of analysis is known as **break-even analysis**.
- In other words, break-even analysis is a technique for studying the effect of variations in output on a firm's NPW (or other measures). We will present an approach to break-even analysis based on the project's cash flows.
- In this approach, the value of cash inflow equals to the cash outflow and this point is called as breakeven point and analysis is called as BEP Analysis.

Method of Describing Project Risks; Breakeven Analysis

- To illustrate the procedure of break-even analysis based on NPW, we use the generalized cash flow approach.
- We compute the PW of cash inflows as a function of an unknown variable (say, x), perhaps annual sales. For example,
 - PW of cash inflows = $f(x)_1$.
 - Next, we compute the PW of cash outflows as a function of x :
 - PW of cash outflows = $f(x)_2$
- NPW is, of course, the difference between these two numbers. Accordingly, we look for the break-even value of x that makes Note that this break-even value is similar to that used to calculate the internal rate of return when we want to find the interest rate that makes

$$F(x)_1 = f(x)_2 .$$

- the NPW equal zero. The break-even value is also used to calculate many other similar “cutoff values” at which a choice changes.

Breakeven Analysis for a Single Project

- ▶ The cost of producing a good can be split into two main parts:
 - ▶ Fixed Cost (FC)
 - ▶ Variable Cost (VC)=Variable cost per unit* Total no. of units (VCPU*X)

Total cost is the sum of fixed cost and variable cost

$$TC=FC+VC \text{ or, } TC=FC+VCPU*X$$

Again, Total Sales Revenue =Selling Price Per Unit* No of Units

$$TR=SPPU*X$$

For BEP, $TC=TR$; Net profit=0.

$$\text{Then, BEP units, } X=FC/(SPPU-VCPU)$$

Example: Breakeven Analysis for a Single Project

- Find BEP (volume) and BEP (amount) from following information. Also what would be the output if company wishes profit of Rs. 5,00,00.
- Fixed cost=Rs. 5,00,000
- Variable Cost Per Unit=Rs. 20,000
- Selling Price Per Unit=Rs. 30,000

Solution:

$$\text{BEP (volume)} = \text{FC} / (\text{SPPU} - \text{VCPU}) = 5,00,000 / (30,000 - 20,000) = 50 \text{ Units}$$

$$\text{BEP (amount)} = \text{SPPU} * \text{BEP (volume)} = 30,000 * 50 = \text{Rs. } 15,00,000$$

For Profit 5,00,000,

$$\text{Net Profit} = \text{TR} - \text{TC}; \text{ Net Profit} = \text{SPPU} * X - (\text{FC} + \text{VCPU} * X)$$

$$\text{Rs. } 500,000 = \text{Rs. } 30,000 * X - (\text{Rs. } 5,00,000 + \text{Rs. } 20,000 * X); \text{ or } 500,000 + 500,000 = 10,000X;$$

Or $X = 100$. Thus, for generating Rs, 5,00,000 profit, we need to sell 100 units of product.

Example: Breakeven Analysis for comparing two Alternatives (PU, 2011)

- From the following information, find that how many hours/year would the motors have to be operated at full load for annual costs to be equal if MARR is 15%?


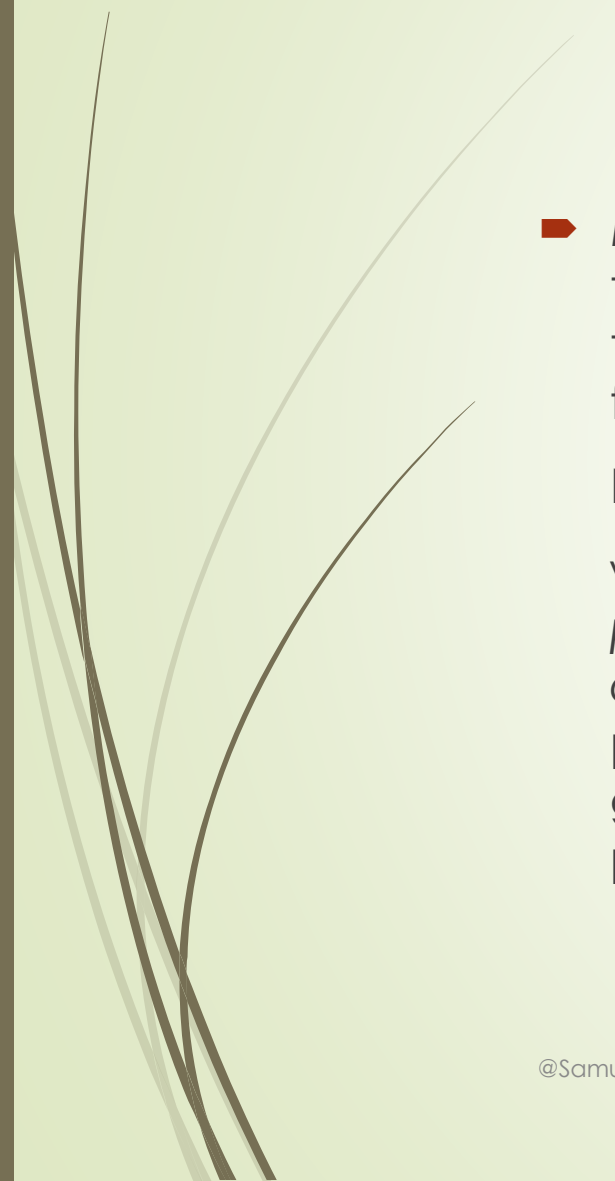
| | Motor A | Motor B |
|------------------|----------------|---------------|
| Purchase cost | Rs. 125000 | Rs. 160,000 |
| Efficiency | 74% | 92% |
| Life | 10 yrs | 10 yrs |
| Maintenance Cost | Rs. 5,000/year | Rs. 2500/year |

Annual tax and insurance: 1.5% of investment for both motors and electricity cost Rs. 5/KW hr. Power of both motors =100hp.

Solution: For Motor A,

Calculating annual equivalent cost:

1. Capital recovery cost= $125,000(A/P, 15\%, 10)$ =Rs. 24,906.5
2. Maintenance cost= Rs. 5,000

- 
- 
- Mike, an industrial engineer at Energy Conservation Service has found that the anticipated profitability of a newly developed water-heater temperature control device can be measured by present worth with the formula

$$NPW = 4.028V(2X - \$11) - 77,860,$$

where *V* is the number of units produced and sold and *X* is the sales price per unit. Mike also has found that the value of the parameter *V* could occur anywhere over the range from 1,000 to 6,000 units and that of the parameter *X* anywhere between \$20 and \$45 per unit. Develop a sensitivity graph as a function of the number of units produced and the sales price per unit.

Example: Breakeven Analysis

3. Tax and insurance=1.5% of 125,000=Rs. 1,875

4. Operating expenses for power (electricity cost),

We know that, Efficiency= Output/Input or Input=Output/Efficiency

Let X be the number of hours of operation per year.

Operating Expenses =Input*Rate*Hours of operation

=Output/Efficiency*Rate*Hours of Operation

=((100*0.746)/0.74) *5*X=504.05X (Note: 1HP=0.746KW)

Total annual cost for motor A (AW of A)

=Rs. 24,906.5+Rs. 5,000+Rs. 1,875+504.05X

=Rs. 31,781.5+504.05X----- (i)

For Motor B,

Calculating annual equivalent cost:

1. Capital recovery cost=160,000(A/P,15%,10)=Rs. 31,880.32

2. Maintenance cost= Rs. 2,500

3. Tax and insurance=1.5% of 160,000=Rs. 2,400

Example: Breakeven Analysis

4. Operating expenses for power (electricity cost),

Operating Expenses = Input * Rate * Hours of operation

= Output / Efficiency * Rate * Hours of Operation

= $((100 * 0.746) / 0.92) * 5 * X = 405.43X$ (Note: 1HP=0.746KW)

Total annual cost for motor B (AW of B)

= Rs. 31,880.32 + Rs. 2,500 + Rs. 2,400 + 405.43X

= Rs. 36,780.32 + 405.43X ----- (ii)

To get break even point,

AW of A = AW of B

Or, Rs. 31781.5 + 504.05X = Rs. 36,780.32 + 405.43X

Thus, X = 51 hours per year (break even hour)

If annual operation hour is more than 51 hours, motor B is selected and if it is less than 51 hours then motor A is selected.



Method of Describing Project Risks; Scenario Analysis

- Although both sensitivity and break-even analyses are useful, they have limitations. Often, it is difficult to specify precisely the relationship between a particular variable and the NPW. The relationship is further complicated by interdependencies among the variables.
- Holding operating costs constant while varying unit sales may ease the analysis, but in reality, operating costs do not behave in this manner. Yet, it may complicate the analysis too much to permit movement in more than one variable at a time.
- **Scenario analysis** is a technique that considers the sensitivity of NPW both to changes in key variables and to the range of likely values of those variables. For example, the decision maker may examine two extreme cases: a “worst-case” scenario (low unit sales, low unit price, high variable cost per unit, high fixed cost, and so on) and a “best-case” scenario.



Method of Describing Project Risks; Scenario Analysis

- The NPWs under the worst and the best conditions are then calculated and compared with the expected, or base-case, NPW.
- The need to estimate probabilities leads us directly to our next step: developing a probability distribution (or, put another way, the probability that the variable in question takes on a certain value).
- If we can predict the effects on the NPW of variations in the parameters, why should we not assign a probability distribution to the possible outcomes of each parameter and combine these distributions in some way to produce a probability distribution for the possible outcomes of the NPW?

Example: Scenario Analysis

- Calculate PW of Worst case, most likely case and best case based on following information. $I = \$1,25,000$, $MARR = 15\%$, $N = 5$ years (**CS Park, Example 12.3, Page: 595**)

| Variable Considered | Worst-Case Scenario | Most-Likely-Case Scenario | Best-Case Scenario |
|---------------------|---------------------|---------------------------|--------------------|
| Unit demand | 1,600 | 2,000 | 2,400 |
| Unit price (\$) | 48 | 50 | 53 |
| Variable cost (\$) | 17 | 15 | 12 |
| Fixed cost (\$) | 11,000 | 10,000 | 8,000 |
| Salvage value (\$) | 30,000 | 40,000 | 50,000 |
| PW(15%) | -\$5,856 | \$40,169 | \$104,295 |

Chapter 6: Assignments


- Describe project risk. Explain sensitivity analysis method of describing project risk.
- What do you mean by breakeven analysis? Why do we need to use breakeven analysis in engineering field?
- Write short notes on:
 - Project risk
 - Sensitivity analysis
 - Breakeven analysis
 - Scenario analysis
- ***Numerical Questions for each analysis***



Chapter 7: Ecological Limits and Economic Development

- Economic Theory and Ecological Limits
- Concepts of Sustainable Development
- Ecological Footprint
- Overcoming Ecological Limit

- ***Why do we spend so much for a better future world at the cost of present?"***
- Professor Ramprasad Sengupta formerly the Sukhamay Chakraborti Chair Professor in Centre for Economic Studies and Planning, Jawaharlal Nehru University, New Delhi has made a deeply significant contribution in economics and ecological economics through writing book: *Ecological Limits and Economic Development*.



Ecological Limits and Economic Development

- Ram Prasad Sengupta explain 'the environmental pressure on resources and ecosystem capacity as created by (a) growth of population and (b) the scale of an economy is really threatening.
- As a result of international trade, instead of being an 'engine of growth' as often claimed in different literatures, turned out to be a vanguard of depletion of nature at the same time.
- This is due to the incessant non-satiety of profit-hungry aspect of capitalism (classical and neo-classical economics).
- This is due to the microeconomic and macroeconomic visions of large scale growth which look rather thin for comprehending the problem of sustainability.
- Thus, he claimed that, emphasizing the role of ecology economics interdisciplinary inquiry is most important and urgent need for a paradigm shift.
- So before making any economic decisions, analytical investigations on ecology-environment-economy interaction should be done.

Economic Theory and Ecological Limits

- Micro and the macroeconomic theory focuses on resource scarcity and allocation of resources. They neglect different environmental aspects.
- Economic development has traditionally required a growth in the gross domestic product. This model focused on unlimited personal and GDP growth rate.
- But, environmental resources should be treated as important economic assets, called natural capital.
- Ecological constraints are limiting the availability of natural resources.
- In response to classical and neoclassical economics, the approaches of the two schools of thought - environmental economics and ecological economics –emerged.
- This two schools of thoughts are emerged in response to the challenges posed by the ecological limits on economic development.
- The environmental economics treats the natural environment as a separate sector for internationalizing the externalities.
- The ecological economics takes a more interdisciplinary approach of integrating the ecological factors governing resource regeneration and waste absorption into the economic models.

Concepts of Sustainable Development

- "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- **Sustainable development** is a process for meeting human development goals while sustaining the ability of natural systems to continue to provide the natural resources and ecosystem services upon which the economy and society depend.
- While the modern concept of sustainable development is derived most strongly from the 1987 Brundtland Report, it is rooted in earlier ideas about sustainable forest management and twentieth century environmental concerns.
- As the concept developed, it has shifted to focus more on economic development, social development and environmental protection.
- Sustainable development ties together concern for the carrying capacity of natural systems with the social, political, and economic challenges faced by humanity.
- There is an additional focus on the present generations' responsibility to regenerate, maintain and improve planetary resources for use by future generations

Concepts of Sustainable Development

- In 1980 the International Union for the Conservation of Nature published a world conservation strategy that included one of the first references to sustainable development as a global priority and introduced the term "sustainable development".
- In 1987 the United Nations World Commission on Environment and Development released the report *Our Common Future*, commonly called the Brundtland Report stated widely recognized definitions of Sustainable Development:
 - Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
 - The concept of 'needs', in particular, the essential needs of the world's poor, to which overriding priority should be given; and
 - The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

Concepts of Sustainable Development

- An unsustainable situation occurs when natural capital (the sum total of nature's resources) is used up faster than it can be replenished.
- Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally.
- Inherently the concept of sustainable development is intertwined with the concept of carrying capacity.
- Theoretically, the long-term result of environmental degradation is the inability to sustain human life.
- Such degradation on a global scale should imply an increase in human death rate until population falls to what the degraded environment can support.
- If the degradation continues beyond a certain tipping point or critical threshold it would lead to eventual extinction for humanity.
- Sustainable development is about improving the standard of living by protecting human health, conserving the environment, using resources efficiently and advancing long-term economic competitiveness.
- It requires the integration of environmental, economic and social priorities into policies and programs and requires action at all levels--citizens, industry, and governments.

Sustainable Development

- There are three dimensions to sustainable development: economic, social and environmental. These dimensions give rise to the need for the planning system to perform a number of roles:
- an economic role** – contributing to building a strong, responsive and competitive economy, by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth and innovation; and by identifying and coordinating development requirements, including the provision of infrastructure;
- a social role** – supporting strong, vibrant and healthy communities, by providing the supply of housing required to meet the needs of present and future generations; and by creating a high quality built environment, with accessible local services that reflect the community's needs and support its health, social and cultural well-being; and
- an environmental role** – contributing to protecting and enhancing our natural, built and historic environment; and, as part of this, helping to improve biodiversity, use natural resources prudently, minimise waste and pollution, and mitigate and adapt to climate change including moving to a low carbon economy.





Ecological Footprint

- Human activities consume resources and produce waste. As our populations grow and global consumption increases, it is essential that we measure nature's capacity to meet these demands on our planet. The **Ecological Footprint** has emerged as one of the world's leading measures of human demand on nature. It allows us to calculate human pressure on the planet and come up with facts such as: If everyone lived the lifestyle of the average American, we would need 5 planets.
- The **Ecological Footprint** is a resource accounting tool that measures how much biologically productive land and sea is used by a given population or activity, and compares this to how much land and sea is available. Productive land and sea areas support human demands for food, fiber, timber, energy, and space for infrastructure. These areas also absorb the waste products from the human economy.
- The Ecological Footprint measures the sum of these areas, wherever they physically occur on the planet. The Ecological Footprint is used widely as a management and communication tool by governments, businesses, educational institutions, and non-governmental organizations.

Ecological Footprint

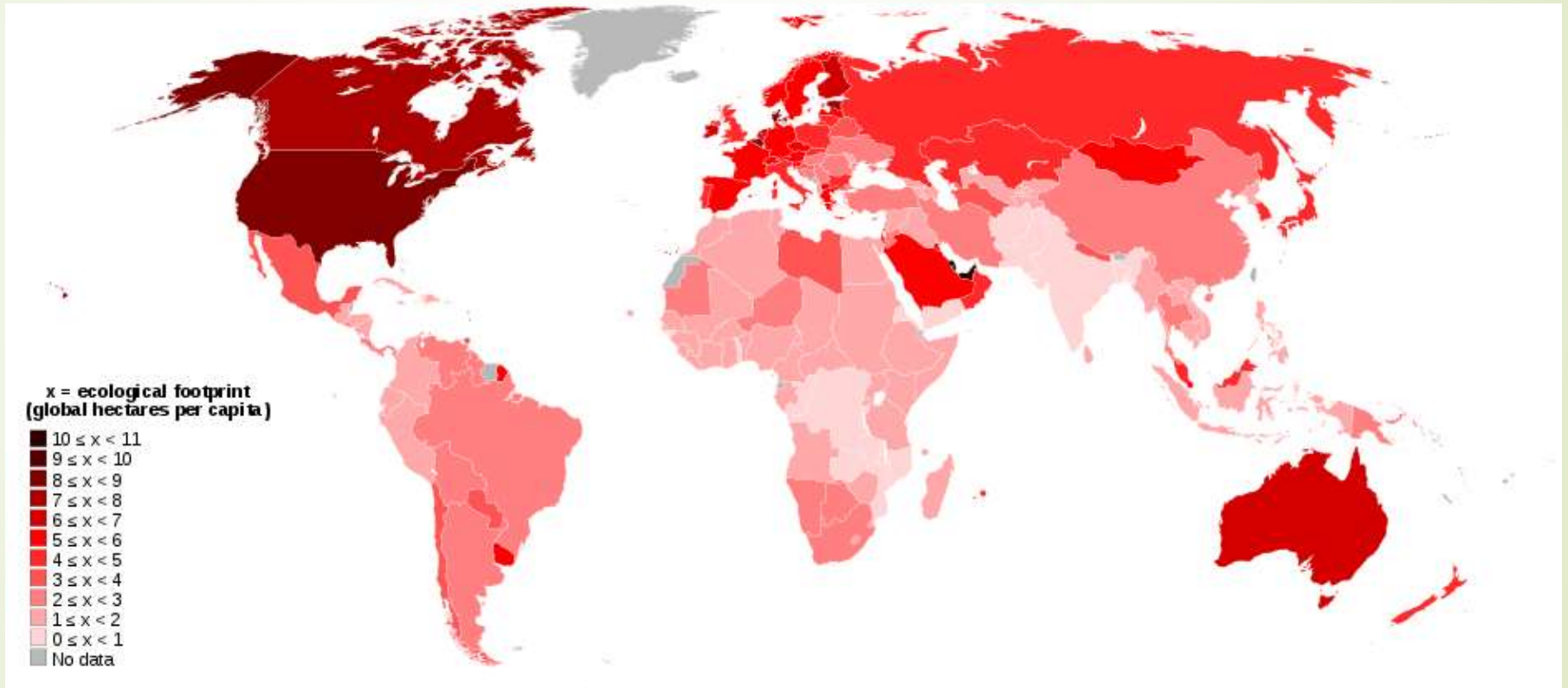
- Ecological Footprint measures the amount of biologically productive land and water area an individual, a city, a country, a region, or all of humanity uses to produce the resources it consumes and to absorb the waste it generates with today's technology and resource management practices. This demand on the biosphere can be compared to biocapacity, a measure of the amount of biologically productive land and water available for human use. Biologically productive land includes areas such as cropland, forest, and fishing grounds, and excludes deserts, glaciers, and the open ocean.
- An **ecological footprint** is a measure of human impact on Earth's ecosystems.
- Global hectares are hectares with world-average productivity for all productive land and water areas in a given year. Studies that are compliant with current **Ecological Footprint Standards use global hectares as a measurement unit**. This makes Ecological Footprint results globally comparable, just as financial assessments use one currency, such as dollars or Euros, to compare transactions and financial flows
- At a global scale, it is used to estimate how rapidly we are depleting natural capital. The Global Footprint Network calculates the global ecological footprint from UN and other data. They estimate that as of 2007 our planet has been using natural capital 1.5 times as fast as nature can renew it.

Ecological Footprint

- The world-average ecological footprint in 2012 was 1.8 global hectares per person. The average per country ranges from over 10 to under 1 hectares per person.
- There is also a high variation within countries, based on individual lifestyle and economic situation. The world-average ecological footprint in 2007 was 2.7 global hectares per person (18.0 billion in total).
- The U.S. footprint per capita was 9.0 gha, and that of Switzerland was 5.6 gha, while China's was 1.8 gha. The WWF claims that the human footprint has exceeded the biocapacity (the available supply of natural resources) of the planet by 20%.
- If a country does not have enough ecological resources within its own territory, then there is a local ecological deficit and it is called an ecological debtor country. Otherwise, it has an ecological remainder and it is called an ecological creditor country.

Ecological Footprint

https://en.wikipedia.org/wiki/List_of_countries_by_ecological_footprint



Overcoming Ecological Limit

- If sustainable development is considered possible as per the **holistic approach** which takes account of the interactive relation between the human system and the ecosystem, overcoming ecological limit is possible.
- **Technology and human values** can also play a significant role in creating space for economic development by relaxing the ecological constraints.
- Also, delinking economic growth and the environment through dematerialization of development, de-carbonisation of energy, development of the renewables as alternative energy sources, recycling of wastes, etc. **taking an organic view of technology and resource development** also help on overcoming ecological limit.
- Finally, the **role of institutions** in shaping the character and implementation of sustainable development by realizing the potential of such delinking of economic growth and the natural environment is important for overcoming ecological limit.
- Also, to overcome ecological limit, the **integration of the concerned ecological factors into primarily economic models** of development should be done.
- Further, the framework and the **methodological approach of neoclassical economics should be amended** to appropriate modifications required for addressing such issues.



Chapter 7: Assignments

- Define ecological footprint. Explain the concept of sustainable development.
- Define ecological limit. Explain the ways to overcome ecological limits.
- Write on short notes:
 - Economic Theory
 - Ecological Footprint
 - Sustainable Development
 - Ecological Limits
 - Overcoming ecological limit



Chapter 8: Depreciation and Corporate income taxes

- Depreciation and its causes, Asset Depreciation and Accounting Depreciation
- Basic Method of Depreciation, Straight Line Method, Declining Balance Method, Sinking Fund Method, Sum of Year Digit Method, Unit of Production Method, Modified Accelerated Cost Recovery System (MACRS)
- Introduction to Corporate Income Tax, Taxation Law, Depreciation Rate, Personal Tax, VAT
- After Tax Cash Flow Estimate, General Procedure for Making After Tax Economic Analysis



Depreciation

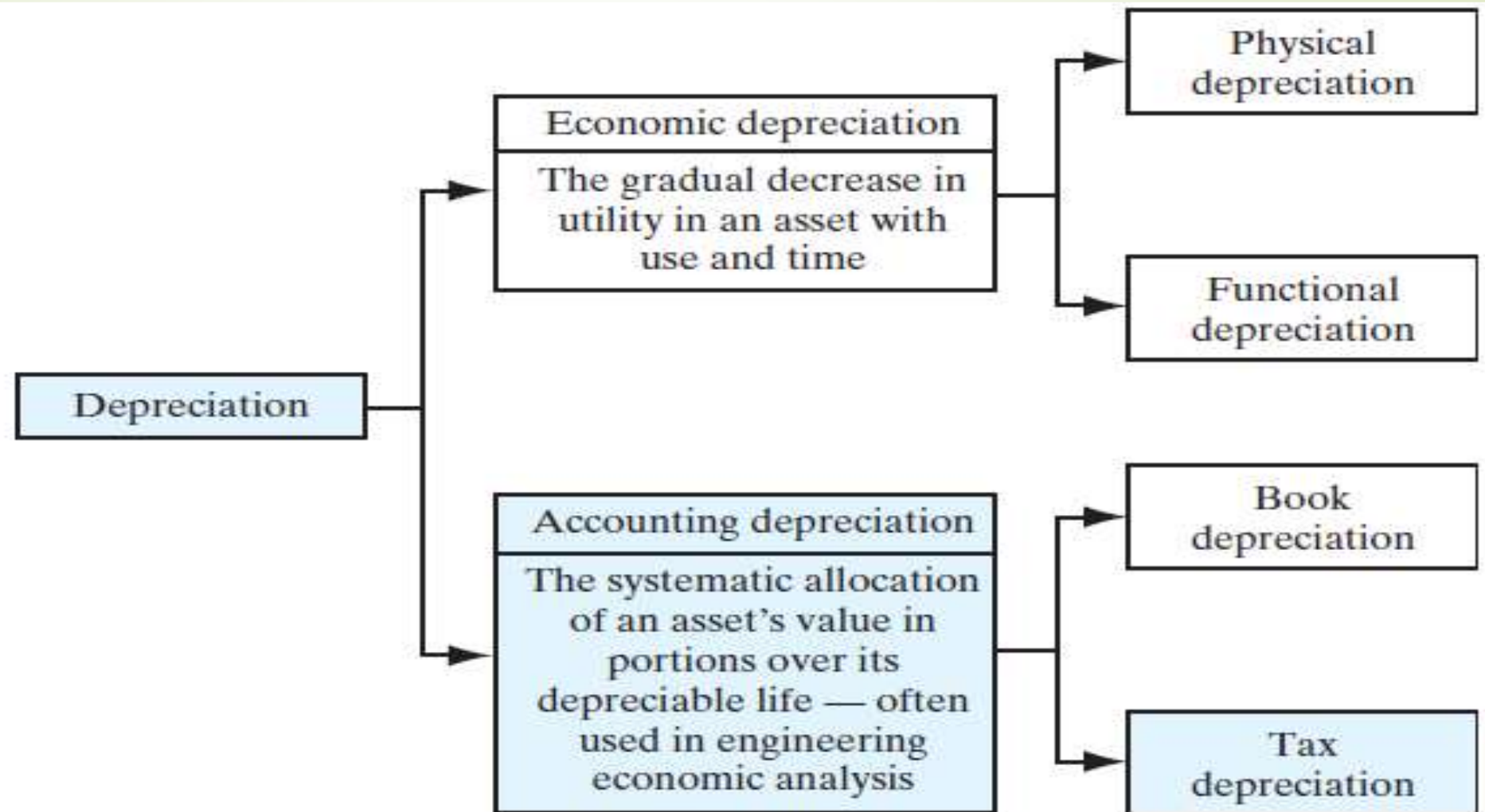
- Organization must deal with and account for different types of fixed assets like plant and machinery, buildings, equipment, furniture, vehicles etc.
- These assets lose their value due to use and the lapse of time. This loss of value is called as **depreciation**.
- *“**Depreciation** can be defined as a gradual decrease in the utility of fixed assets with use and time.”- Chan S. Park*
- Depreciation is the gradual and permanent decrease in the value of an asset from any causes.
- The reduction in value of such capital assets is known as depreciation.
- Organization considers the decreased value of capital assets for accounting purpose.
- This non-cash expense (loss) will be collected as depreciation fund for replacement of assets and get fair financial position of firm.



Depreciation

- **Depreciation accounting** is to account for the cost of fixed assets in a pattern that matches their decline in value over time.
- On a project level, engineers must be able to assess how the practice of depreciating fixed assets influences the investment value of a given project.
- To do this, the engineers need to estimate the allocation of capital costs over the life of the project, which requires an understanding of the conventions and techniques that accountants use to depreciate assets.

Depreciation



@Samundra Paudel/NCIT/PU/2016

Figure 9.1 Classification of types of depreciation.

Causes of Depreciation

➤ We can define **economic depreciation** as follows:

➤ **Economic depreciation = Purchase price - market value**

➤ Causes of Depreciation

1. Physical depreciation can be defined as a reduction in an asset's capacity to perform its intended service due to physical impairment. Physical depreciation can occur in any fixed asset in the form of

- a. **deterioration from interaction with the environment**, including such agents as corrosion, rotting, and other chemical changes, and
- b. **wear and tear** from use.
- c. **Accidental causes** due to natural disaster or by man made disaster

Physical depreciation leads to a decline in performance and high maintenance costs.

2. Functional depreciation occurs as a result of changes in the organization or in technology that decrease or eliminate the need for an asset.

- a. **obsolescence** attributable to advances in technology,
- b. a **declining need for the services** performed by an asset, and
- c. the **inability to meet increased quantity or quality** demands.
- d. Time: Decline in market value due to **passage of time**



Accounting Depreciation

- Accounting Depreciation is the systematic allocation of the initial cost of an asset in parts over a time, known as the asset's depreciable life.
- Because accounting depreciation is the standard of the business world, we sometimes refer to it more generally as **asset depreciation**.
- In engineering economic analysis, we use the concept of accounting depreciation exclusively. This is because accounting depreciation provides a basis for determining the income taxes associated with any project undertaken.

Factors affecting Depreciation amount

1. **Depreciable Property:** Properties with following features:

1. It must be used in business or must be held for the production of income.
 2. It must have a definite service life, and that life must be longer than 1 year.
 3. It must be something that wears out, decays, gets used up, becomes obsolete, or loses value from natural causes.
- Depreciable property includes buildings, machinery, equipment, and vehicles.
 - Inventories are not depreciable property, because they are held primarily for sale to customers in the ordinary course of business.
 - If an asset has no definite service life, the asset cannot be depreciated. For example, *you can never depreciate land.*



Factors affecting Depreciation amount

2. Total cost of property (Cost basis):

- The **cost basis** of an asset represents the total cost that is claimed as an expense over the asset's life (i.e., the sum of the annual depreciation expenses).
- The cost basis generally includes the actual cost of the asset and all other incidental expenses, such as freight, site preparation, and installation.
- This total cost, rather than the cost of the asset only, must be the depreciation basis charged as an expense over the asset's life.

3. Useful life:

- Historically, depreciation accounting included choosing a depreciable life that was based on the service life of an asset.

Factors affecting Depreciation amount

4. Salvage value:

- The **salvage value** is an asset's estimated value at the end of its life—the amount eventually recovered through sale, trade-in, or salvage.
- The eventual salvage value of an asset must be estimated when the depreciation schedule for the asset is established.
- If this estimate subsequently proves to be inaccurate, then an adjustment must be made.

5. Depreciation Methods: Book and Tax Depreciation:

- Most firms calculate depreciation in two different ways, depending on whether the calculation is:
 - (1) intended for financial reports (the **book depreciation method**), such as for the balance sheet or income statement, or
 - (2) for the Internal Revenue Service (IRS), for the purpose of determining taxes (the **tax depreciation method**).

Basic Methods of Depreciation

► Book Depreciation Methods

1. Straight Line Method,
2. Accelerated Method
 1. Double Rate (200%) Declining balance method,
 2. 150% Declining balance method
 3. Prescribed Depreciation Percentage
3. Declining Balance with Conversion to Straight-Line Depreciation
4. Sinking Fund Method
5. Sum of the year Digit (SOYD) Method
6. Unit of Production Method (Service Output Method)

► Tax depreciation Methods

1. As per MACRS Depreciation Rules(In USA)
2. As per Income Tax Act 2058 (In Nepal)

Book Depreciation Method: Straight Line Method

- The **straight-line (SL) method** of depreciation assumes that the asset provides an equal amount of service in each year of its useful life.
- Thus, this method charges an equal fraction or same or fixed amount expenses as depreciation each year.
- It is also known as fixed installment method and simplest method for charging depreciation.

$$\text{Annual Depreciation} = \frac{(\text{Original cost of asset} - \text{Estimated salvage value})}{\text{Estimated life of assets}}$$

If rate is given,

$$\text{Annual Depreciation} = \text{Total depreciable value} * (\text{Rate \%}) / 100$$

$$\text{Rate of depreciation} = (1/N) * 100, \text{ (Where, N = Life of asset)}$$

Example: Straight Line Method

- Consider the following data on an automobile: Cost basis of the asset, $I = \$10,000$; Useful life, $N = 5$ years; Estimated salvage value, $S = \$2,000$. Use the straight-line depreciation method to compute the annual depreciation and the resulting book values.
- **Solution:**
- Given: $I = \$10,000$, $S = \$2,000$, and $N = 5$ years
- Find: Annual depreciation and book value for 1 to 5 years
- Depreciation $= (I - S) / N = (10,000 - 2,000) / 5 = \$1,600$
- The asset would then have the following book values during its useful life:

| Year | Book Value at B | Depreciation | Book Value at E |
|------|-----------------|--------------|-----------------|
| 0 | - | - | 10,000 |
| 1 | 10,000 | 1,600 | 8,400 |
| 2 | 8,400 | 1,600 | 6,800 |
| 3 | 6,800 | 1,600 | 5,200 |
| 4 | 5,200 | 1,600 | 3,600 |
| 5 | 3,600 | 1,600 | 2,000 |



Book Depreciation Method: Declining Balance Method

- Some assets value may decrease greatest in the first year of an asset's service life and least in its last year.
- This pattern may occur because the mechanical efficiency of an asset tends to decline with age, because of the increasing likelihood that better equipment will become available and make the original asset obsolete or higher maintenance cost of original asset.
- For this type of assets, accelerated methods are used which charges a larger fraction of the cost as an expense of the early years than of the later years.
- A depreciation method, in which double the straight-line depreciation amount is taken the first year, and then that same percentage is applied to the undepreciated amount in subsequent years.

Book Depreciation Method: Declining Balance Method

- The most commonly used multipliers are:
 - 1.5 (called **150% DB**) and
 - 2.0 (called 200%, or **double-declining balance**, DDB).
 - **Then, Declining Balance Rate (R)=(1/N)*100* 2 or 1.5**
- As N increases, depreciation expenses decreases, resulting in a situation in which depreciation is highest in the first year and then decreases over the asset's depreciable life.
- If question asked to calculate declining balance method without giving any rate, then, calculate rate of depreciation first using following formula:
 - Rate of Depreciation (R)= $1 - \sqrt[N]{S/I}$,where, N =Useful life; S =Salvage Value; I = Initial Cost

Example: Declining Balance Method

- Use the double-declining-depreciation method to compute the annual depreciation allowances and the resulting book values of following information: Cost basis of the asset(I) = \$10,000; Useful life (N) = 5 years; Estimated salvage value, **S = \$778**. (CS Park, 9.4) (**Salvage Value=Book Value**)
- Given, I = \$10,000, **S = \$778**, N = 5 years; Depreciation and book value=?

Declining Balance Rate (R)=(1/N)*100*2=(1/5)*100*2=40%

| Year | Book Value at B (2) | Depreciation (40% of 2) | Book Value at E |
|------|---------------------|-------------------------|-----------------|
| 0 | - | - | 10,000 |
| 1 | 10,000 | 4,000 | 6,000 |
| 2 | 6,000 | 2,400 | 3,600 |
| 3 | 3,600 | 1,440 | 2,160 |
| 4 | 2,160 | 864 | 1,296 |
| 5 | 1,296 | 518 | 778 |

Example: Declining Balance Method

- Use the double-declining-depreciation method to compute the annual depreciation allowances and the resulting book values of following information: Cost basis of the asset(I) = \$10,000; Useful life (N) = 5 years; Estimated salvage value, **S = \$500**. (CS Park, 9.4) (**Salvage Value < Book Value**)
- Given, I = \$10,000, **S = \$500**, N = 5 years; Depreciation and book value=?

Declining Balance Rate (R) = $(1/N) * 100 * 2 = (1/5) * 100 * 2 = 40\%$

| Year | Book Value at B (2) | Depreciation (40% of 2) | Book Value at E |
|------|---------------------|-------------------------|-----------------|
| 0 | - | - | 10,000 |
| 1 | 10,000 | 4,000 | 6,000 |
| 2 | 6,000 | 2,400 | 3,600 |
| 3 | 3,600 | 1,440 | 2,160 |
| 4 | 2,160 | 864 | 1,296 |
| 5 | 1,296 | 1,296-500=796 | 500 |

Example: Declining Balance Method

- Use the double-declining-depreciation method to compute the annual depreciation allowances and the resulting book values of following information: Cost basis of the asset(I) = \$10,000; Useful life (N) = 5 years; Estimated salvage value, **S = \$1000**. (CS Park, 9.4) (**Salvage Value > Book Value**)

- Given, I = \$10,000, **S = \$1000**, N = 5 years; Depreciation and book value=?

Declining Balance Rate (R) = $(1/N) * 100 * 2 = (1/5) * 100 * 2 = 40\%$

| Year | Book Value at B (2) | Depreciation (40% of 2) | Book Value at E |
|------|---------------------|---------------------------|-----------------|
| 0 | - | - | 10,000 |
| 1 | 10,000 | 4,000 | 6,000 |
| 2 | 6,000 | 2,400 | 3,600 |
| 3 | 3,600 | 1,440 | 2,160 |
| 4 | 2,160 | 864 | 1,296 |
| 5 | 1,296 | 1,296 - 1000 = 296 | 1000 |

Example: Declining Balance Method

- Use the **declining-depreciation method** to compute the annual depreciation allowances and the resulting book values of following information: Cost basis of the asset(I) = \$10,000; Useful life (N) = 5 years; Estimated salvage value, **S = \$1000**. (CS Park, 9.4) **(Rate of depreciation not given)**
- Given, I = \$10,000, **S = \$1000**, N = 5 years; Depreciation and book value=?

$$\text{Rate of Depreciation (R)} = 1 - \sqrt[N]{(S/I)}, = 1 - \sqrt[5]{(1000/10000)} = 37\%$$

| Year | Book Value at B (2) | Depreciation (37% of 2) | Book Value at E |
|------|---------------------|-------------------------|-----------------|
| 0 | - | - | 10,000 |
| 1 | 10,000 | 3700 | 6300 |
| 2 | 6300 | 2331 | 3969 |
| 3 | 3969 | 1469 | 2500 |
| 4 | 2500 | 925 | 1575 |
| 5 | 1575 | 575 (adjusted) | 1000 |

Book Depreciation Method: Declining Balance with Conversion to Straight-Line Depreciation

- ▶ As declining balance method do not reach zero salvage value, declining balance with conversion to Straight line depreciation is used in such condition. This conversion will lead to asset value become to zero.
- ▶ According to this method, the switchover occurs in the year when, larger or equal depreciation amount is obtained from the straight line method in comparison to declining balance method.

Example: Declining Balance with Conversion to Straight-Line Depreciation

- Use the double-declining-depreciation method switchover to SL depreciation method to compute the annual depreciation allowances and the resulting book values of following information: Cost basis of the asset(I) = \$10,000; Useful life (N) = 5 years; Estimated salvage value, **S = 0**. (**Salvage Value = 0**)

- Given, I = \$10,000, **S = 0**, N = 5 years; Depreciation and book value=?

Declining Balance Rate (R) = $(1/N) * 100 * 2 = (1/5) * 100 * 2 = 40\%$

| Year | Book Value at B (2) | DB Depreciation | Switchover Decision | SL Dep. | Selected Dep. | Book Value at E |
|------|---------------------|-----------------|---------------------|--------------|---------------|-----------------|
| 0 | - | - | | | - | 10,000 |
| 1 | 10,000 | 4,000 | > | 2,000 | 4,000 | 6,000 |
| 2 | 6,000 | 2,400 | > | 1,500 | 2,400 | 3,600 |
| 3 | 3,600 | 1,440 | > | 1,200 | 1,440 | 2,160 |
| 4 | 2,160 | 864 | < | 1,080 | 1,080 | 1,080 |
| 5 | 1,080 | 432 | < | 1,080 | 1,080 | - |

Example: Declining Balance with Conversion to Straight-Line Depreciation

- Use the double-declining-depreciation method switchover to SL depreciation method to compute the annual depreciation allowances and the resulting book values of following information: Cost basis of the asset(I) = \$10,00; Useful life (N) = 5 years; Estimated salvage value, **S = 200**.
(Salvage Value = 200)

- Given, I = \$10,000, **S = 200**, N = 5 years; Depreciation and book value=?

Declining Balance Rate (R)=(1/N)*100*2=(1/5)*100*2=40%

| Year | Book Value at B (2) | DB Depreciation | Switchover Decision | SL Dep. | Selected Dep. | Book Value at E |
|------|---------------------|-----------------|---------------------|------------|---------------|-----------------|
| 0 | - | - | | | - | 10,000 |
| 1 | 10,000 | 4,000 | > | 1,960 | 4,000 | 6,000 |
| 2 | 6,000 | 2,400 | > | 1,450 | 2,400 | 3,600 |
| 3 | 3,600 | 1,440 | > | 1133.33 | 1,440 | 2,160 |
| 4 | 2,160 | 864 | < | 980 | 980 | 1,180 |
| 5 | 1,180 | 432 | < | 980 | 980 | 200 |

Book Depreciation Method: Sinking Fund Method

- This method considers the time value of money principle while calculating the depreciation amount of certain assets.
- This method calculates a fixed annual depreciation amount (fixed installment=annuity; considering the time value of money) for each year as well as the net depreciation amount based on the compound interest rate.
- The amount with compound interest earned over the life will be equal to the original cost of assets.
- This method shows that the book value of assets decreases at an increasing rate with respect to the life of the asset.
- Fixed annual depreciation amount $(A) = (I - S) * (A/F, i\%, n)$
- Net Depreciation Charges in year $K = A * (F/P, i\%, K-1)$
- Book value at the end of the year $K = I - (A * (F/A, i\%, K))$

Example: Sinking Fund Method

- Compute depreciation charge and book value of each year by using sinking fund method with following information: Salvage Value=Rs. 20,000, Initial cost of Asset=Rs. 100,000, Useful life of asset= 8 years, Interest Rate= 12%.

Solution:

Fixed Annual Depreciation $(A) = (I - S) * (A/F, 12\%, N) = (100,000 - 20,000) * 0.0813 = 6,504.22$

| Year (1) | Book Value at the beginning of year (2) | Fixed Dep. | Int. Factor (F/P, 12%, K-1) | Net Dep. (5) | Book Value at the end of year (2-5) |
|----------|---|------------|-----------------------------|--------------|-------------------------------------|
| 0 | - | - | - | - | 100,000 |
| 1 | 100,000 | 6,504 | 1 | 6,504 | 93,496 |
| 2 | 93,496 | 6,504 | 1.12 | 7,284.48 | 86,211.52 |
| 3 | 86,211.52 | 6,504 | 1.2544 | 8,158.62 | 78,052.90 |
| 4 | 78,052.90 | 6,504 | 1.4049 | 9,137.65 | 68,915.25 |
| 5 | 68,915.25 | 6,504 | 1.5735 | 10,234.17 | 58,681.08 |
| 6 | 58,681.08 | 6,504 | 1.7623 | 11,462.27 | 47,218.81 |
| 7 | 47,218.81 | 6,504 | 1.9738 | 12,837.74 | 34,381.07 |
| 8 | 34,381.07 | 6,504 | 2.2107 | 14,378.27 | 20,002.80 |

Book Depreciation Method: Sum of Year Digit Method

- According to this method, per year depreciation charge is calculated from the ratio of the sum of the years digit for the total useful life and remaining useful life at the beginning of the particular year.
- SOYD Depreciation=
$$\frac{\text{Remaining useful life at the beginning of the particular year}^* (I-S)}{\text{SOYD for the total useful life}}$$
- This method gives larger depreciation amount during the beginning years of assets and smaller depreciation amount as assets get old.

Example: SOYD Method

- We have just purchased a minicomputer at a cost of Rs. 20,000 with salvage value of Rs. 1,000 and a projected useful life of 6 years. Determine SOYD depreciation. (PU, 2013).

- **Solution:** Given,

Initial Investment (I)=Rs. 20,000; Salvage Value (S)=Rs. 1,000; Useful life (N)= 6 years

Sum Of Year Digit (SOYD)= $6+5+4+3+2+1=21$

Depreciation Proportion for each year: 6:5:4:3:2:1

| Year | Dep. Prop. | SOYD Calculation | Depreciation | Book Value at E |
|------|------------|---------------------------|-------------------|-----------------|
| 0 | - | - | - | 20,000 |
| 1 | 6 | $(6/21) * (20,000-1,000)$ | 5428.57 | |
| 2 | 5 | $(5/21) * (20,000-1,000)$ | 4523.81 | |
| 3 | 4 | $(4/21) * (20,000-1,000)$ | 3619.04 | |
| 4 | 3 | $(3/21) * (20,000-1,000)$ | 2714.28 | |
| 5 | 2 | $(2/21) * (20,000-1,000)$ | 1809.53 | |
| 6 | 1 | $(1/21) * (20,000-1,000)$ | 904.76 | 1,000 |
| | 21 | Total | Rs. 19,000 | |

Book Depreciation Method: Unit of Production Method

- Straight-line depreciation can be defended only if the machine is used for exactly the same amount of time each year.
- What happens when a punch press machine runs 1,670 hours one year and 780 the next or when some of its output is shifted to a new machining center?
- This leads us to a consideration of another depreciation method that views the asset as consisting of a bundle of service units; unlike the SL and accelerated methods, however, this one does not assume that the service units will be consumed in a time-phased pattern. Rather, the cost of each service unit is the net cost of the asset divided by the total number of such units.
- The depreciation charge for a period is then related to the number of service units consumed in that period. The result is the **units-of-production method**, according to which the depreciation in any year is given by
- $$\text{Depreciation} = \frac{\text{Units of production (used)} * (\text{Initial Value} - \text{Salvage Value})}{\text{Total working hours or production unit}}$$



Book Depreciation Method: Unit of Production Method

- When the units-of-production method is used, depreciation charges are made proportional to the ratio of the actual output to the total expected output. Usually, this ratio is figured in machine hours.
- The advantages of using the units-of-production method include the fact that depreciation varies with production volume, so the method gives a more accurate picture of machine usage.
- A disadvantage of the method is that collecting data on machine usage is somewhat tedious, as are the accounting methods. This method can be useful in depreciating equipment used to exploit natural resources if the resources will be depleted before the equipment wears out. It is not, however, considered a practical method for general use in depreciating industrial equipment.

Example: Unit of Production Method

- ▶ A truck for hauling coal has an estimated net cost of \$55,000 and is expected to give service for 250,000 miles, resulting in a \$5,000 salvage value. Compute the allowed depreciation amount for a truck usage of 30,000 miles.

SOLUTION

- ▶ Given: I = \$55,000, S = \$5,000, total service units = 250,000 miles and usage year = 30,000 miles.
- ▶ Depreciation amount in this year=?,

We have,

$$\text{Depreciation} = \frac{\text{Units of production (used)} * (\text{Initial Value} - \text{Salvage Value})}{\text{Total working hours or production unit}}$$

$$\text{Depreciation} = 30,000 \text{ miles} * (55,000 - 5,000) / 250,000 \text{ miles} = \$ 6,000.$$

Tax depreciation Method: Modified Accelerated Cost Recovery System (MACRS)

- In Us, prior to 1954, the straight-line method was required for tax purposes, but that year accelerated methods such as double-declining balance and sum-of-years'-digits were permitted.
- In 1981, US government replaced conventional methods by Accelerated Cost Recovery System (ACRS).
- In 1986, Congress modified the ACRS and introduced the MACRS. This method outdated conventional methods for use in tax purposes.
- In conventional methods, it was required to have estimated life of asset, but MACRS abandoned this and provide recovery period as per the property classification.
- Under the MACRS, *the salvage value of property is always treated as zero.*

MACRS Property Classification

| Recovery Period | ADR* Midpoint Class | Applicable Property |
|-----------------------|---------------------------|--|
| 3 years | $\text{ADR} \leq 4$ | Special tools for the manufacture of plastic products, fabricated metal products, and motor vehicles |
| 5 years | $4 < \text{ADR} \leq 10$ | Automobiles, [†] light trucks, high-tech equipment, equipment used for research and development, computerized telephone switching systems |
| 7 years | $10 < \text{ADR} \leq 16$ | Manufacturing equipment, office furniture, fixtures |
| 10 years | $16 < \text{ADR} \leq 20$ | Vessels, barges, tugs, railroad cars |
| 15 years | $20 < \text{ADR} \leq 25$ | Wastewater plants, telephone-distribution plants, similar utility property |
| 20 years | $25 < \text{ADR}$ | Municipal sewers, electrical power plant |
| $27\frac{1}{2}$ years | | Residential rental property |
| 39 years | | Nonresidential real property, including elevators and escalators |

MACRS Depreciation Percentage

| Class | | 3 | 5 | 7 | 10 | 15 | 20 |
|-------|-------------------|--------|--------|-------|-------|-------|--------|
| Year | Depreciation Rate | 200% | 200% | 200% | 200% | 150% | 150% |
| 1 | | 33.33 | 20.00 | 14.29 | 10.00 | 5.00 | 3.750 |
| 2 | | 44.45 | 32.00 | 24.49 | 18.00 | 9.50 | 7.219 |
| 3 | | 14.81* | 19.20 | 17.49 | 14.40 | 8.55 | 6.677 |
| 4 | | 7.41 | 11.52* | 12.49 | 11.52 | 7.70 | 6.177 |
| 5 | | | 11.52 | 8.93* | 9.22 | 6.93 | 5.713 |
| 6 | | | 5.76 | 8.92 | 7.37 | 6.23 | 5.285 |
| 7 | | | | 8.93 | 6.55* | 5.90* | 4.888 |
| 8 | | | | 4.46 | 6.55 | 5.90 | 4.522 |
| 9 | | | | | 6.56 | 5.91 | 4.462* |
| 10 | | | | | 6.55 | 5.90 | 4.461 |
| 11 | | | | | 3.28 | 5.91 | 4.462 |
| 12 | | | | | | 5.90 | 4.461 |
| 13 | | | | | | 5.91 | 4.462 |
| 14 | | | | | | 5.90 | 4.461 |
| 15 | | | | | | 5.91 | 4.462 |
| 16 | | | | | | 2.95 | 4.461 |
| 17 | | | | | | | 4.462 |
| 18 | | | | | | | 4.461 |
| 19 | | | | | | | 4.462 |
| 20 | | | | | | | 4.461 |
| 21 | | | | | | | 2.231 |

Example: MACRS

- A taxpayer wants to place in service a \$10,000 asset that is assigned to the five-year class. Compute the MACRS percentages and the depreciation amounts for the asset.
- **Solution:** Given, Life of Asset (N)= MACRS 5 year class; Cost (I)=\$10,000, DDB Rate= $(1/N) \times 100 \times 2 = (1/5) \times 100 \times 2 = 40\%$
- Then, MACRS Percentage and the depreciation amount are as follows:

| Year n | MACRS Percentage (%) | Depreciation Basis | Depreciation Amount (D_n) |
|--------|----------------------|--------------------|-------------------------------|
| 1 | 20 | $\times \$10,000$ | = \$2,000 |
| 2 | 32 | $\times 10,000$ | = 3,200 |
| 3 | 19.20 | $\times 10,000$ | = 1,920 |
| 4 | 11.52 | $\times 10,000$ | = 1,152 |
| 5 | 11.52 | $\times 10,000$ | = 1,152 |
| 6 | 5.76 | $\times 10,000$ | = 576 |

| Year | Calculation (%) | MACRS Percentage |
|------|---|--|
| 1 | $\frac{1}{2}$ -year DDB depreciation = $0.5(0.40)(100\%)$ | = 20% |
| 2 | DDB depreciation = $(0.40)(100\% - 20\%)$ | = 32% |
| | SL depreciation = $(1/4.5)(100\% - 20\%)$ | = 17.78% |
| 3 | DDB depreciation = $(0.40)(100\% - 52\%)$ | = 19.20% |
| | SL depreciation = $(1/3.5)(100\% - 52\%)$ | = 13.71% |
| 4 | DDB depreciation = $(0.40)(100\% - 71.20\%)$ | = 11.52% |
| | SL depreciation = $(1/2.5)(100\% - 71.20\%)$ | = 11.52% |
| 5 | SL depreciation = $(1/1.5)(100\% - 82.72\%)$ | = 11.52% |
| 6 | $\frac{1}{2}$ -year SL depreciation = $(0.5)(11.52\%)$ | = 5.76% |

Tax depreciation Method: Depreciation Rates in Nepal

- Income Tax Act 2058 provisioned depreciation rates for different types of assets in Nepal, which are as follows:

| Block | Assets | Rate (on base amount) |
|-------|---|--|
| A | Building, structures and similar asset of permanent nature | 5 % per year |
| B | Office equipment, fixtures, furniture, computer and data processing equipment | 25% per year |
| C | Automobile, Buses, Minibuses, and all other transport assets | 20% per year |
| D | Construction and earthmoving equipment and any other depreciable asset that are not included in other block | 15% per year |
| E | All Intangible assets including software | (Cost price-Salvage value)/Useful life |

- For first accounting year, asset purchased in different dates:

- Purchase from Shrawan 1-Poush 30= 100% of value
- Purchase from Magh 1-Chaitra 31=2/3 of value
- Purchase from Baishak 1-Asar 32=1/3 of value

Introduction to Corporate Income Tax

- Any individual and corporation have to pay income tax to government.
- Corporate income tax is tax levied by government to organization for their taxable income. The corporate income tax law allow deductions of the cost of goods sold, salaries and wages, rent, interest, advertising, depreciation, amortization, depletion, etc. as expenses.
- The corporate tax rate structure in US is relatively simple.
- There are four basic rate brackets (15%, 25%, 34%, and 35%), plus two surtax rates (5% and 3%), based on taxable incomes.
- U.S. tax rates are progressive; that is, businesses with lower taxable incomes are taxed at lower rates than those with higher taxable incomes.

| Item |
|--------------------------|
| Gross income |
| Expenses: |
| Cost of goods sold |
| Depreciation |
| Operating expenses |
| Taxable operating income |
| Income taxes |
| Net income |

Introduction to Corporate Income Tax

| Taxable Income (X) | Tax Rate | Tax Computation Formula |
|------------------------|----------|------------------------------------|
| \$0–\$50,000 | 15% | $\$0 + 0.15X$ |
| 50,001–75,000 | 25% | $7,500 + 0.25(X - \$50,000)$ |
| 75,001–100,000 | 34% | $13,750 + 0.34(X - 75,000)$ |
| 100,001–335,000 | 34% + 5% | $22,250 + 0.39(X - 100,000)$ |
| 335,001–10,000,000 | 34% | $113,900 + 0.34(X - 335,000)$ |
| 10,000,001–15,000,000 | 35% | $3,400,000 + 0.35(X - 10,000,000)$ |
| 15,000,001–18,333,333 | 35% + 3% | $5,150,000 + 0.38(X - 15,000,000)$ |
| 18,333,334 and up | 35% | $6,416,666 + 0.35(X - 18,333,333)$ |

➤ **Effective Tax Rate** = $(\text{Total Tax paid} / \text{Total taxable income}) * 100$

Example: Effective Tax Rate

- ▶ Calculate effective tax rate from the following information: (CS Park, Ex.-9.13)
 - ▶ Rent expenses=\$20,000
 - ▶ Gross Income=\$12,50,000
 - ▶ Depreciation=\$58,000
 - ▶ Supplies and operating expenses=\$840,000

Solution:

- ▶ Taxable income=Gross Income-All allowable deduction (expenses)
$$= \$12,50,000 - 20,000 - 58,000 - 8,40,000 = \$ 3,32,000$$

As, income is between 100,001 to 335,000 range,

Total Tax Amount=\$22,250+ 0.39(X-100,000)=\$22250+0.39(332,000-100,000)= \$112,730

Then,

Effective tax rate= (Tax Amount/Taxable income)*100=(112,730/332,000)*100
$$=33.95\%$$



Taxation Law in Nepal

- The political history of Nepal shows the existence of various forms of tax since the ancient period. "Taxes were imposed as per the Shastras, Kautilya Nitee, Manu Smriti, Yagyavalkya Smriti, during the ancient period.
- The Licchhavi rulers entered Nepal around the middle of the fifth century B.C. and ruled Nepal. They imposed three forms of Karas (taxes): Bhaga, tax on agriculture, Bhoga, tax on livestock and Kara, tax on trade.
- The Mallas replaced Licchhavi rulers and ruled Kathmandu Valley for almost three centuries from 1200 to 1484 B.C. They seem to be the first rulers who started imposing taxes on land.
- The subsequent Shah regime also continued the tax system of the Mallas, which was based on land and trade. After the unification of the country, different types of taxes i.e. land tax, transit tax, forest product tax, mining tax, and market duties were levied.

Taxation Law in Nepal

- For Ranas, the main source of government revenue was land tax, customs duty and excise duty. The tax system was based on a contract and *Amanat*. *Jimmal*, *Mukhiya*, *Dittha* etc. were the persons who used to collect taxes.
- The modern tax system, however, began only with the advent of democracy in the 1950s, with an overhaul of the tax system in 1951 as one of the first steps.
- The first income tax was introduced by first elected government in 2016 under finance act. Business and Employment Tax act 2019 enacted till 2031. The Income Tax Act 2031 replaced it, which was further replaced by Income Tax Act 2058, which is the modern tax regulation in Nepal.
- Today, the Inland Revenue Department (IRD) oversees the enforcement of tax laws and administration and also monitors the non-tax revenue such as dividends, royalties etc.
- Income tax, VAT, customs duty and excise duty are the major sources of government revenue in Nepal. Besides, the IRD taxes are also collected at the local level by the local bodies as per the Local Government Act 1999.



Types of Tax Revenue

- Direct Tax (Charging directly to person and reduces the wealth, directly paid by person who are taxed.)
 - Income Tax (Personal and Corporate)
 - Property Tax
 - Vehicle Tax
- Indirect Tax (Charging to person but payment burden shifted to another person/sellers.)
 - Value Added Tax
 - Excise Duty
 - Custom Duty



Income Tax in Nepal

- **Income tax, made up of:**
- **normal corporate tax:** at 25%. Certain sectors like hydropower are taxed at concessional rate of 20% and other sectors like banking are taxed at 30% (section 2(4), Schedule 1, Income Tax Act 2002 (ITA));
- **dividend:** at 5% (section 88 (2) (a), ITA); and
- **capital gains** (for the gain from the disposition of the shares of non-listed company) are subject to withholding tax at 10% for a natural person and at 15% for others (section 95A, ITA).

Corporate Tax in Nepal

| Corporation/Entity | Tax Rate |
|---|----------|
| The income from export and special industry | 20% |
| The income from petroleum industry, banks and financial institution | 30% |
| Income from industrial enterprises and related with infrastructure projects | 20% |
| Other general corporate organization | 25% |

Personal Tax in Nepal

- The taxable income of a resident individual for an income will be taxed at the following rates:
 - Up to Rs.250,000 – 1%;
 - Next Rs. 100,000– @ 15 %
 - Next Rs. 350,001 to Rs, 25,00,000 – @ 25%
 - Balance exceeding Rs. 25,00,000 -@ 35%
- The taxable income of a couple, if they chose to be treated as a couple will be taxed at the following rates:
 - Up to Rs.300,000 – 1%;
 - Next Rs. 100,000– @ 15 %
 - Next Rs. 400,001 to Rs, 25,00,000 – @ 25%
 - Balance exceeding Rs. 25,00,000 -@ 35%

Personal Tax in Nepal

- The business person who have registered own Proprietary firm should not pay above 1% tax.
- Any individual or couple having pension income can enjoy 25% of the normal exemption limit as an additional basic exemption.
- Any individual working in prescribed remote area is entitled to deduct prescribed amount as remote area allowance from taxable income.
- Any individual is entitled to deduct the following amount from taxable amount, if he is having investment insurance policy: Rs.20,000 amount or the actual premium paid, which ever is less.
- For the purposes of the Act, net gains from the disposal of non-business chargeable assets will be taxed at the rate of 10%.
- The presumptive tax for individuals conducting small businesses (who have a turnover of Rs.2 million or an income of Rs.200,000) in the Metropolitan or Sub-Metropolitans, Municipalities and anywhere else in Nepal amounts to Rs.5,000 Rs.2,500 and Rs.1,500 respectively.
- The taxable income of a non-resident individual is taxed at the rate of 25%.

Value Added Tax (VAT)

- VAT is the youngest member of the sales tax family. This tax was proposed for the first time by Dr. Wilhelm Von Siemens for Germany in 1919 as an improved turnover tax.
- It is a scientific tax system, which was first introduced in 1954 A.D. in France.
- Senegal, Denmark, Brazil, Netherlands, Sweden, USA, UK etc. introduced VAT in sixties and later. In the South Asian Association for Regional Cooperation (SAARC) region, VAT has been considered in great depth in India. This country introduced VAT in a different way under the name of modified value added tax (MODVAT) in 1986. Among the other members of the SAARC countries, Pakistan adopted VAT in 1990, Bangladesh in 1991, and Nepal in 1997 while Sri Lanka introduced VAT in 1998.
- Now this tax has become one of the mainstays of the tax system in over 145 countries.
- In Nepal VAT has come into consideration to replace of old indirect taxes. It was introduced on 16th November, 1997.

Value Added Tax (VAT)

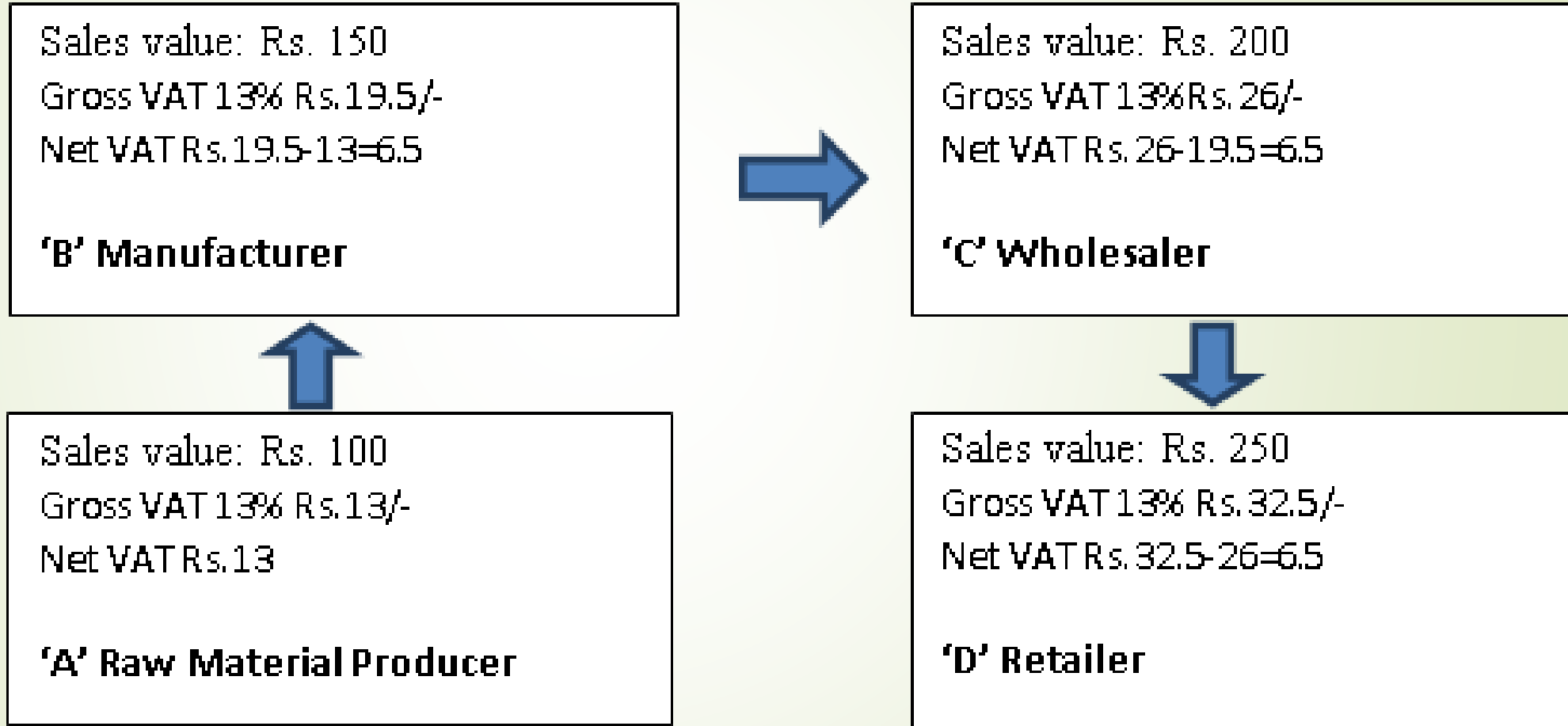
- ▶ **Value Added Tax (VAT)** is an indirect tax levied on the value creation or addition. Concept of VAT in Nepal was introduced in FY 2049/50 but the act was developed in BS 2050. VAT was implemented in 1998 and is the major source of government's revenue. It is administered by Inland Revenue Department of Nepal.
- ▶ There are two rates of VAT: Normal VAT rate is 13%, some goods or services are subject to VAT at 0%. In addition some goods or services are exempt from VAT.
- ▶ Suppliers of taxable goods and services are required to register under the VAT Act and collect this tax. It is, however, not necessary for them to register if they deal with only tax exempt goods and services. Similarly, small vendors falling below the registration threshold are also not required to register for VAT.
- ▶ The existing level of threshold is Rs.2 million. In the case of imports, traders having annual commercial imports below Rs.200,000 are not required to register.



Value Added Tax (VAT)

- It is a modern tax system intended, when fully operational, to improve the collection of taxes, to increase efficiency and to lessen tax evasion.
- VAT intended to replace the existing Sales Tax, the Contract Tax, the Hotel Tax and the Entertainment Tax. It has been designed to collect the same revenue as the four taxes it replaces.
- It is believe that successful implementation of VAT will helps to generate customs duties and income tax also and it is expected to enhance the revenue collection and it is closely associated with the GDP.
- The self-policing and catch up effect of vat has turned out to be the rationale of the VAT system.

Multistage (Calculation of) VAT





Scenario on VAT implementation in Nepal

- Indirect tax is a major source of the tax revenue in Nepal. It covers about 80% of tax revenue.
- The share of VAT revenue to total tax revenue is 34.10% in the FY 2011/12.
- VAT implementation is seen extremely challenging in Nepal.
- Resistance from the business community, ignorance of general people, lack of full support and commitments from the politicians and government officials forced the authority responsible for implementing VAT to make compromises on various aspects of VAT which has weakened the process of its implementation right from the beginning. The attitude of businessmen and tax administration also appear hostile to the effective implementation of VAT in Nepal.
- The culture of doing business without maintaining proper books of accounts or maintaining multiple sets of books of accounts have made implementation of VAT difficult. Due to the lack of experts and skilled manpower in the VAT administration, the auditing system, one of the most important aspects of VAT operation, is not effective.



Scenario on VAT implementation in Nepal

- The existing large amount of unauthorized trade with India has been posing a great threat for proper implementation of VAT. The illegal import is helping to black market channel resulting in a large-scale tax evasion; the scope for illegal trade and tax evasion has not been decreased even after the implementation of VAT because tax administration is not strong and efficient enough to check this situation.
- No billing, Lack of invoicing, incorrect value in billing is the main problems observed in invoicing system, leading weak VAT implementation.
- There is high level of corruption and tax evasion by the means of illegal alliance between Taxpayer and tax administration. It is say that 50 % tax is leakage due to above reason.
- One of the best features of VAT is the catch up effect which makes tax evasion impossible but this effect is not achieved because of illegal trade, undervalued transactions, transactions without invoices and lack of administrative capabilities to catch and destroy the illegal channels.

How can VAT implementation be improved?

- Strengthening the organizational capability, reform in revenue administration, with the co-operation of private sector, enlarging tax base, reform in tax system by applying e-Governance, developing fair and integrity tax administration are components to make VAT effectiveness.
- Consumer should be made aware of taking invoices, which is their fundamental right and responsibility to the state. Consumer awareness program should be launched through media, journals, magazines, newspapers, pamphlets, seminar, discussion, lottery program etc. effectively which encourages people for invoices after buying goods and services.
- There should be a close tripartite co-operation between the consumers, business persons and the government.
- Taxpayer should be provided better services in efficient and effective manner.
- To foster internal revenue policy, professional and corruption less administration should be developed. Reliable and predictable revenue policy is also required. Result oriented administration, healthy co-ordination; regular market monitoring mechanism should be developed.
- Effort should be concentrate to minimize tax leakage and evasion. For this purpose illegal alliance between Taxpayer and tax officials should be destroy.
- VAT itself is not more revenue generator, it is only transparent and scientific system of collecting revenue. It needs more administrative support and efforts. A bold vision, evolutionary leadership, efficient bureaucrats, honest taxpayers plus collectors and graft-free society are the invisible infrastructures required. So, all must think from a long- term perspective for effective VAT implementation.



General Procedure for Making After Tax Economic Analysis

- After tax economic analysis refers to the profitability measurement of any project including all income taxes. In another word it is the analysis of after tax cash flow estimates and profitability analysis of the projects.
- General Procedure for ATCF Estimates:
 1. Find gross income before depreciation expenses also known as BTCF
 2. Calculate depreciation expenses for each year
 3. Find Taxable income (Deduct depreciation from BTCF/gross income)
 4. Find taxes for each period
 5. Deduct tax amount from BTCF to get ATCF for each year
 6. Find NPW/NFW (Consider time value of money) and make economic analysis

After Tax Cash Flow (ATCF) Estimate

- Example: Purchase Price = Rs. 40,000, useful life 5 years class based on MACRS Method, Annual Revenue=20,000, Annual Cost=7,000, No salvage value. Estimate ATCF if company has to pay corporate tax @ of 40%. **(PU, 2017)**

Solution: Annual Profit = Annual Revenue - Annual Cost = 20,000 - 7,000 = 13,000

| Year | BTCF (Given) | MACRS Dep. Rate | Depreciation (Given) | Taxable income (BTCF-Depreciation) | Income Tax (40%) | ATCF (BTCF-Tax) |
|------|------------------------|-----------------|----------------------|------------------------------------|------------------|-----------------|
| 0 | -Rs. 40,000 | - | - | - | - | -40,000 |
| 1 | Rs. 13,000*0.5 = 6,500 | 20% | 8,000 | -1,500 | No Tax | 6,500 |
| 2 | Rs. 13,000 | 32% | 12,800 | 200 | 80 | 12,920 |
| 3 | Rs. 13,000 | 19.2% | 7,620 | 5,380 | 2,152 | 10,848 |
| 4 | Rs. 13,000 | 11.52% | ?? | ?? | ?? | ?? |
| 5 | Rs. 13,000 | 11.52% | ?? | ?? | ?? | ?? |
| 6 | Rs. 13,000*0.5 = 6,500 | 5.76% | ?? | ?? | ?? | ?? |

After Tax Cash Flow (ATCF) Estimate

- Example: Suppose an asset has been purchased for Rs. 200,000. It will expected to produce net cash inflows of Rs. 60,000 per year during 6 years. The effective tax rate is 25% as per the Income Tax Act 2058. Depreciation charges for the asset for next six years will be: Rs. 20,000; Rs. 40,000; Rs. 40,000; Rs. 40,000; Rs. 40,000; Rs. 20,000 respectively. Calculate after tax cash flow (ATCF) and do economic analysis based on PW at 10% interest rate.

Solution: Calculation of NPW (10%) of $ATCF = -2,00,000 + 50,000 \times (0.9091) + 55,000 \times (0.8264) + 55,000 \times (0.7513) + 55,000 \times (0.6830) + 55,000 \times (0.6209) + 50,000 \times (0.5645) = \text{???}$. Thus,

| Year | BTCF (Given) | Depreciation (Given) | Taxable income (BTCF-Depreciation) | Income Tax (40%) | ATCF (BTCF-Tax) |
|------|-----------------|-------------------------|---------------------------------------|---------------------|--------------------|
| 0 | -Rs. 2,00,000 | - | - | - | -Rs. 200,000 |
| 1 | Rs. 60,000 | Rs. 20,000 | Rs. 40,000 | Rs. 10,000 | Rs. 50,000 |
| 2 | Rs. 60,000 | Rs. 40,000 | Rs. 20,000 | Rs. 5,000 | Rs. 55,000 |
| 3 | Rs. 60,000 | Rs. 40,000 | Rs. 20,000 | Rs. 5,000 | Rs. 55,000 |
| 4 | Rs. 60,000 | Rs. 40,000 | Rs. 20,000 | Rs. 5,000 | Rs. 55,000 |
| 5 | Rs. 60,000 | Rs. 40,000 | Rs. 20,000 | Rs. 5,000 | Rs. 55,000 |
| 6 | Rs. 60,000 | Rs. 20,000 | Rs. 40,000 | Rs. 10,000 | Rs. 50,000 |

Chapter 8: Assignments

- What do you mean by depreciation? What are the main reasons for the allocation of depreciation funds?
- What is depreciation? Discuss causes of depreciation.
- Discuss basic methods of depreciation.
- What is value added tax? Explain effectiveness of vat implementation in Nepal.
- Discuss in detail about Taxation system of Nepal in reference of Nepalese law and policies.
- What do you mean by Value added tax? How do you calculate it?
- Write short notes on:
 - Accounting Vs Economic Depreciation
 - Direct and indirect tax
 - Value Added Tax (VAT)
 - Personal Tax and corporate tax
- **Numerical Questions for each depreciation method**
- **Numerical Questions for ATCF Estimates**



Chapter 9: Enterprise Financing and Capital Investment

- Method of Financing : Equity Financing, Debt Financing and Capital Structure
- Cost of Capital: Cost of Equity, Cost of Debt and Calculating Cost of Capital
- Project Funding Mechanism: Governmental Budget, Public Private Partnership and Private Investment
- FIRR, EIRR and Return on Equity




Method of Financing : Equity Financing, Debt Financing and Capital Structure

- In economic analysis, two broad decisions are taken: investment decisions and finance decisions.
- First the investment project is selected, and then the source of financing is considered. After the source is chosen, appropriate modifications to the investment decision are made.
- Under financing decision; the two broad choices a firm has for financing an investment project are **equity financing** and **debt financing**.



Equity Financing

- **Equity financing** can take one of two forms:
 - (1) the use of retained earnings otherwise paid to stockholders or
 - (2) the issuance of stock.
- Both forms of equity financing use funds invested by the current or new owners of the company



Equity Financing: Use of Retained Earnings

- Until now, most of our economic analyses presumed that companies had cash on hand to make capital investments; implicitly, we were dealing with cases of financing by retained earnings.
- If a company had not reinvested these earnings, it might have paid them to the company's owners—the stockholders—in the form of a dividend, or it might have kept these earnings on hand for future needs.

Equity Financing: The Issuance of Stock

- ▶ If a company does not have sufficient cash on hand to make an investment and does not wish to borrow in order to fund the investment, financing can be arranged by selling common stock to raise the required funds.
- ▶ Many small biotechnology and computer firms raise capital by going public and selling common stock.
- ▶ To do this, the company has to decide how much money to raise, the type of securities to issue (common stock or preferred stock), and the basis for pricing the issue.
- ▶ Once the company has decided to issue common stock, it must estimate **flotation costs**—the expenses it will incur in connection with the issue, such as investment bankers' fees, lawyers' fees, accountants' costs, and the cost of printing and engraving.
- ▶ Usually, an investment banker will buy the issue from the company at a discount, below the price at which the stock is to be offered to the public. The discount usually represents the *flotation costs*.



Equity Financing: The issuance of stock

- If the company is already publicly owned, the offering price will commonly be based on the existing market price of the stock.
- If the company is going public for the first time, no established price will exist, so investment bankers have to estimate the expected market price at which the stock will sell after the stock issue.
- Company should analyze how the flotation cost affects the cost of issuing common stock.
- Flotation costs are higher for small issues than for large ones due to the existence of fixed costs: Certain costs must be incurred regardless of the size of the issue, so the percentage of flotation costs increases as the size of the issue gets smaller.

EXAMPLE 15.1 Issuing Common Stock

Scientific Sports, Inc. (SSI), a golf club manufacturer, has developed a new metal club (Driver). The club is made out of titanium alloy, an extremely light and durable metal with good vibration-damping characteristics (Figure 15.1). The company expects to acquire considerable market penetration with this new product. To produce it, the company needs a new manufacturing facility, which will cost \$10 million. The company decided to raise this \$10 million by selling common stock. The firm's current stock price is \$30 per share. Investment bankers have informed management that the new public issue must be priced at \$28 per share because of decreasing demand, which will occur as more shares become available on the market. The flotation costs will be 6% of the issue price, so SSI will net \$26.32 per share. How many shares must SSI sell to net \$10 million after flotation expenses?

SOLUTION

Let X be the number of shares to be sold. Then total flotation cost will be

$$(0.06)(\$28)(X) = 1.68X.$$

To net \$10 million, we must have

$$\text{Sales proceeds} - \text{flotation cost} = \text{Net proceeds},$$

$$28X - 1.68X = \$10,000,000,$$

$$26.32X = \$10,000,000,$$

$$X = 379,940 \text{ shares.}$$

Now we can figure out the flotation cost for issuing the common stock. The cost is

$$1.68(379,940) = \$638,300.$$



Method of Financing : Debt Financing

- The second major type of financing a company can select is **debt financing**, which includes both short-term borrowing from financial institutions and the sale of long-term bonds, wherein money is borrowed from investors for a fixed period.
- With debt financing, the interest paid on the loans or bonds is treated as an expense for income-tax purposes.



Method of Financing : Debt Financing

- The two common debt-financing methods are as follows:
- **1. Bond Financing.** This type of debt financing does not involve the partial payment of principal; only interest is paid each year (or semiannually). The principal is paid in a lump sum when the bond matures. (See Section 4.6.3 for bond terminologies and valuation.) Bond financing is similar to equity financing in that flotation costs are involved when bonds are issued.
- **2. Term Loans.** Term loans involve an equal repayment arrangement according to which the sum of the interest payments and the principal payments is uniform; interest payments decrease, while principal payments increase, over the life of the loan. Term loans are usually negotiated directly between the borrowing company and a financial institution, generally a commercial bank, an insurance company, or a pension fund.

EXAMPLE 15.2 Debt Financing

Consider again Example 15.1. Suppose SSI has instead decided to raise the \$10 million by debt financing. SSI could issue a mortgage bond or secure a term loan. Conditions for each option are as follows:

- **Bond financing.** The flotation cost is 1.8% of the \$10 million issue. The company's investment bankers have indicated that a five-year bond issue with a face value of \$1,000 can be sold at \$985 per share. The bond would require annual interest payments of 12%.
 - **Term loan.** A \$10 million bank loan can be secured at an annual interest rate of 11% for five years; it would require five equal annual installments.
- (a) How many \$1,000 par value bonds would SSI have to sell to raise the \$10 million?
- (b) What are the annual payments (interest and principal) on the bond?
- (c) What are the annual payments (interest and principal) on the term loan?

SOLUTION

- (a) To net \$10 million, SSI would have to sell

$$\frac{\$10,000,000}{(1 - 0.018)} = \$10,183,300$$

worth of bonds and pay \$183,300 in flotation costs. Since the \$1,000 bond will be sold at a 1.5% discount, the total number of bonds to be sold would be

$$\frac{\$10,183,300}{\$985} = 10,338.38.$$

- (b) For the bond financing, the annual interest is equal to

$$10,338,380(0.12) = \$1,240,606.$$

Only the interest is paid each period; thus, the principal amount owed remains unchanged.

- (c) For the term loan, the annual payments are

$$\$10,000,000(A/P, 11\%, 5) = \$2,705,703.$$

Example: Debt Financing

Method of Financing : Capital Structure

- The ratio of total debt to total capital, generally called the **debt ratio**, or **capital structure**, represents the percentage of the total capital provided by borrowed funds. For example, a debt ratio of 0.4 indicates that 40% of the capital is borrowed and the remaining funds are provided from the company's equity (retained earnings or stock offerings). This type of financing is called **mixed financing**.
- Borrowing affects a firm's capital structure, and firms must determine the effects of a change in the debt ratio on their market value before making an ultimate financing decision. Even if debt financing is attractive, you should understand that companies do not simply borrow funds to finance projects.
- A firm usually establishes a **target capital structure**, or **target debt ratio**, after considering the effects of various financing methods.
- This target may change over time as business conditions vary, but a firm's management always strives to achieve the target whenever individual financing decisions are considered.
- On the one hand, the actual debt ratio is below the target level, any new capital will probably be raised by issuing debt. On the other hand, if the debt ratio is currently above the target, expansion capital will be raised by issuing stock.



Method of Financing : Capital Structure

How does a typical firm set the target capital structure?

- This is a rather difficult question to answer, but we can list several ***factors that affect the capital-structure policy.***
- **First, capital-structure policy involves a trade-off between risk and return.** As you take on more debt for business expansion, the inherent business risk also increases, but investors view business expansion as a healthy indicator for a corporation with higher expected earnings.
- When investors perceive higher business risk, the firm's stock price tends to be depressed. By contrast, when investors perceive higher expected earnings, the firm's stock price tends to increase. The optimal capital structure is thus the one that strikes a balance between business risk and expected future earnings. The greater the firm's business risk, the lower is its optimal debt ratio.
- Unlike equity financing, in which dividends are optional, debt interest and principal (face value) must be repaid on time. Also, uncertainty is involved in making projections of future operating income as well as expenses. In bad times debt can be devastating, but in good times the tax deductibility of interest payments increases profits to owners.



Method of Financing : Capital Structure

How does a typical firm set the target capital structure?

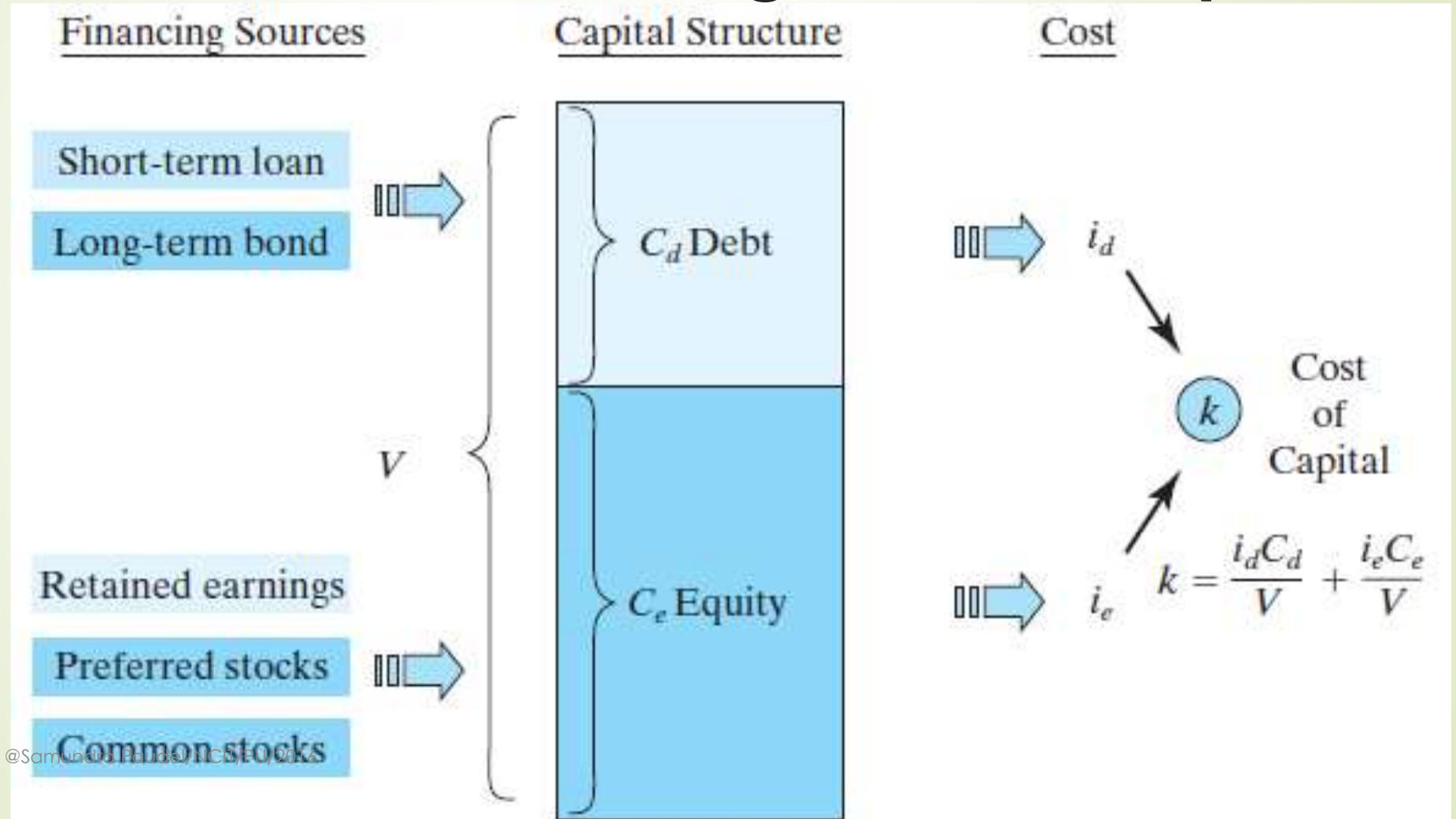
- **Second, a major reason for using debt is that interest is a deductible expense for business operations**, which lowers the effective cost of borrowing. Dividends paid to common stockholders, however, are not deductible. If a company uses debt, it must pay interest on this debt, whereas if it uses equity, it pays dividends to its equity investors (shareholders). A company needs \$1 in before-tax income to pay \$1 of interest, but if the company is in the 34% tax bracket, it needs $\$1 / (1 - 0.34) = \1.52 of before-tax income to pay a \$1 dividend.
- **Third, financial flexibility**—the ability to raise capital on reasonable terms from the financial market—is an important consideration. Firms need a steady supply of capital for stable operations. When money is tight in the economy, investors prefer to advance funds to companies with a healthy capital structure (lower debt ratio).
- **These three elements (business risk, taxes, and financial flexibility) are major factors that determine the firm's optimal capital structure.**



Cost of Capital: Cost of Equity, Cost of Debt and Calculating Cost of Capital

- In most of the capital-budgeting examples in earlier chapters, we assumed that the firms under consideration were financed entirely with equity funds.
- In those cases, the cost of capital may have represented the firm's required return on equity.
- However, most firms finance a substantial portion of their capital budget with long-term debt (bonds), and many also use preferred stock as a source of capital.
- In these cases, a firm's cost of capital must reflect the average cost of the various sources of long-term funds that the firm uses, not only the cost of equity.
- In this section, we will discuss the ways in which the cost of each individual type of financing (retained earnings, common stock, preferred stock, and debt) can be estimated, given a firm's target capital structure.

Cost of Capital: Cost of Equity, Cost of Debt and Calculating Cost of Capital





Cost of Capital: Cost of Equity

- Whereas debt and preferred stocks are contractual obligations that have easily determined costs, it is not easy to measure the cost of equity.
- In principle, the cost of equity capital involves an **opportunity cost**. In fact, the firm's after-tax cash flows belong to the stockholders. Management may either pay out these earnings in the form of dividends, or retain the earnings and reinvest them in the business.
- If management decides to retain the earnings, an opportunity cost is involved: Stockholders could have received the earnings as dividends and invested the money in other financial assets.
- Therefore, the firm should earn on its retained earnings at least as much as the stockholders themselves could earn in alternative, but comparable, investments.

Cost of Capital: Cost of Equity-Cost of Retained Earnings

➤ Cost of Retained Earnings (k_r):

$$k_r = \frac{D_1}{P_0} + g.$$

➤ Where, k_r = Cost of Retained Earnings

➤ D_1 = First Year dividend

➤ P_0 = Current Stock Price

➤ g = growth rate of dividend

Cost of Capital: Cost of Equity -Cost of Issuing New Common Stock

- Cost of Issuing New Common Stock

$$k_e = \frac{D_1}{P_0(1 - f_c)} + g,$$

- Where, k_e = Cost of Common Stock
 - D_1 = First Year dividend
 - P_0 = Current Stock Price
 - g = growth rate of dividend
 - f_c = flotation cost as a percentage of the stock price.

Cost of Capital : Example

- Total Investment = 80 L, Tax Rate = 30%
- CS = 25 L, C of CS = 17%, Weight of CS = $CS/TE = 25/50 = 0.5$
- PS = 15 L, C of PS = 14% Weight of PS = $PS/TE = 15/50 = 0.3$
- RE = 10 L, C of RE = 12% Weight of RE = $RE/TE = 10/50 = 0.2$
- TE = 50L
- WACE = Weight of CS * C of CS + Weight of PS * C of PS + Weight of RE * C of RE
- $WACE = 0.5 * 17\% + 0.3 * 14\% + 0.2 * 12\% = 15.1\%$
- Debt = 30 L, Before tax cost of Debt = Interest = $I = 10\%$
- After Tax cost of Debt = $I (1 - TR) = 10\% (1 - 0.3) = 7\%$
- WACC = weight of equity * cost of equity + weight of debt * After tax cost of debt
- $WACC = 50/80 * 15.1\% + 30/80 * 7\% = 12.06\%$

- Alternatively, $WACC = 25/80 * 17\% + 15/80 * 14\% + 10/80 * 12\% + 30/80 * 10\% (1 - 0.3) = 12.06\% = MARR$

Cost of Capital: Cost of Equity-Cost of Preferred Stock

- A preferred stock is a hybrid security in the sense that it has some of the properties of bonds and other properties that are similar to common stock.
- Like bondholders, holders of preferred stock receive a fixed annual dividend.
- In fact, many firms view the payment of the preferred dividend as an obligation just like interest payments to bondholders. It is therefore relatively easy to determine the cost of preferred stock.
- For the purposes of calculating the weighted average cost of capital, the specific cost of a preferred stock will be defined as:

$$k_p = \frac{D^*}{P^*(1 - f_c)},$$

- Where, D^* is the fixed annual dividend, P^* is the issuing price.

Cost of Capital: Cost of Equity

- Once we have determined the specific cost of each equity component, we can determine the weighted-average cost of equity for a new project. We have;

$$i_e = \left(\frac{c_r}{c_e} \right) k_r + \left(\frac{c_c}{c_e} \right) k_e + \left(\frac{c_p}{c_e} \right) k_p.$$

- Where c_r is the amount of equity financed from retained earnings, c_c is the amount of equity financed from issuing new stock, c_p is the amount of equity financed from issuing preferred stock, and $c_r + c_c + c_p = c_e$

Example: Cost of Equity

EXAMPLE 15.4 Determining the Cost of Equity

Alpha Corporation needs to raise \$10 million for plant modernization. Alpha's target capital structure calls for a debt ratio of 0.4, indicating that \$6 million has to be financed from equity.

- Alpha is planning to raise \$6 million from the following equity sources:

| Source | Amount | Fraction of Total Equity |
|-------------------|-------------|--------------------------|
| Retained earnings | \$1 million | 0.167 |
| New common stock | 4 million | 0.666 |
| Preferred stock | 1 million | 0.167 |

- Alpha's current common stock price is \$40, the market price that reflects the firm's future plant modernization. Alpha is planning to pay an annual cash dividend of \$5 at the end of the first year, and the annual cash dividend will grow at an annual rate of 8% thereafter.
- Additional common stock can be sold at the same price of \$40, but there will be 12.4% flotation costs.
- Alpha can issue \$100 par preferred stock with a 9% dividend. (This means that Alpha will calculate the dividend on the basis of the par value, which is \$9 per share.) The stock can be sold on the market for \$95, and Alpha must pay flotation costs of 6% of the market price.

Determine the cost of equity to finance the plant modernization.

SOLUTION

We will itemize the cost of each component of equity:

- Cost of retained earnings: With $D_1 = \$5$, $g = 8\%$, and $P_0 = \$40$,

$$k_r = \frac{5}{40} + 0.08 = 20.5\%.$$

- Cost of new common stock: With $D_1 = \$5$, $g = 8\%$, and $f_c = 12.4\%$,

$$k_e = \frac{5}{40(1 - 0.124)} + 0.08 = 22.27\%.$$

- Cost of preferred stock: With $D^* = \$9$, $P^* = \$95$, and $f_c = 0.06$,

$$k_p = \frac{9}{95(1 - 0.06)} = 10.08\%.$$

- Cost of equity: With $\frac{c_r}{c_e} = 0.167$, $\frac{c_c}{c_e} = 0.666$, and $\frac{c_p}{c_e} = 0.167$,

$$\begin{aligned} i_e &= (0.167)(0.205) + (0.666)(0.2227) + (0.167)(0.1008) \\ &= 19.96\%. \end{aligned}$$

Cost of Capital: Cost of Equity: Alternative way of determining cost of equity

➤ Cost of Equity:

$$i_e = r_f + \beta[r_M - r_f].$$

➤ Where, i_e =Cost of equity

- r_f = Risk free rate
- r_m = market rate of return
- β = firms beta risk

EXAMPLE 15.5 Determining the Cost of Equity by the Financial Market

Alpha Corporation needs to raise \$10 million for plant modernization. Alpha's target capital structure calls for a debt ratio of 0.4, indicating that \$6 million has to be financed from equity.

- Alpha is planning to raise \$6 million from the financial market.
- Alpha's β is known to be 1.99, which is greater than unity, indicating that the firm is perceived as more risky than the market average.
- The risk-free interest rate is 6%, and the average market return is 13%. (All these interest rates are adjusted to reflect inflation in the economy.)

Determine the cost of equity to finance the plant modernization.

SOLUTION

Given: $r_M = 13\%$, $r_f = 6\%$, and $\beta = 1.99$.

Find: i_e .

$$\begin{aligned} i_e &= 0.06 + 1.99(0.13 - 0.06) \\ &= 19.93\%. \end{aligned}$$

COMMENTS: In this example, we purposely selected the value of β to approximate the cost of equity derived from Example 15.4. What does this 19.93% represent? If Alpha finances the project entirely from its equity funds, the project must earn at least a 19.93% return on investment.

Cost of Capital: Cost of Debt

- Now let us consider the calculation of the specific cost that is to be assigned to the debt component of the weighted-average cost of capital. The calculation is relatively straightforward and simple.
- As we said earlier, the two types of debt financing are term loans and bonds. Because the interest payments on both are tax deductible, the effective cost of debt will be reduced.
- To determine the after-tax cost of debt (i_d) we evaluate the expression;

$$i_d = \left(\frac{c_s}{c_d} \right) k_s (1 - t_m) + \left(\frac{c_b}{c_d} \right) k_b (1 - t_m)$$

- where c_s is the amount of the short-term loan, k_s is the before-tax interest rate on the term loan, t_m is the firm's marginal tax rate, k_b is the before-tax interest rate on the bond, c_b is the amount of bond financing, and $c_s + c_b = c_d$.

EXAMPLE 15.6 Determining the Cost of Debt

Consider again Example 15.4, and suppose that Alpha has decided to finance the remaining \$4 million by securing a term loan and issuing 20-year \$1,000 par bonds under the following conditions:

| Source | Amount | Fraction | Interest Rate | Flotation Cost |
|-----------|-------------|----------|---------------|----------------|
| Term loan | \$1 million | 0.333 | 12% per year | |
| Bonds | 3 million | 0.667 | 10% per year | 6% |

If the bond can be sold to net \$940 (after deducting the 6% flotation cost), determine the cost of debt to raise \$4 million for the plant modernization. Alpha's marginal tax rate is 38%, and it is expected to remain constant in the future.

SOLUTION


First, we need to find the effective after-tax cost of issuing the bond with a flotation cost of 6%. The before-tax specific cost is found by solving the equivalence formula

$$\begin{aligned} \$940 &= \frac{\$100}{(1 + k_b)} + \frac{\$100}{(1 + k_b)^2} + \dots + \frac{\$100 + \$1,000}{(1 + k_b)^{20}} \\ &= \$100(P/A, k_b, 20) + \$1,000(P/F, k_b, 20). \end{aligned}$$

Solving for k_b , we obtain $k_b = 10.74\%$. Note that the cost of the bond component increases from 10% to 10.74% after the 6% flotation cost is taken into account.

The after-tax cost of debt is the interest rate on debt, multiplied by $(1 - t_m)$. In effect, the government pays part of the cost of debt because interest is tax deductible. Now we are ready to compute the after-tax cost of debt as follows:

$$\begin{aligned} i_d &= (0.333)(0.12)(1 - 0.38) + (0.667)(0.1074)(1 - 0.38) \\ &= 6.92\%. \end{aligned}$$



Cost of Capital: Calculating the Cost of Capital

- ▶ With the specific cost of each financing component determined, we are ready to calculate the tax-adjusted weighted-average cost of capital based on total capital. Then we will define the marginal cost of capital that should be used in project evaluation.
- ▶ **Weighted-Average Cost of Capital**
- ▶ Assuming that a firm raises capital on the basis of the target capital structure and that the target capital structure remains unchanged in the future, we can determine a **tax-adjusted weighted-average cost of capital** (or, simply stated, the **cost of capital**).
- ▶ This cost of capital represents a composite index reflecting the cost of raising funds from different sources.

Cost of Capital: Calculating the Cost of Capital

➤ The **weighted average cost of capital** is defined as:

$$k = \frac{i_d c_d}{V} + \frac{i_e c_e}{V}, \quad (15.7)$$

where c_d = Total debt capital (such as bonds) in dollars,

c_e = Total equity capital in dollars,

$V = c_d + c_e$,

i_e = Average equity interest rate per period, taking into account all equity sources,


i_d = After-tax average borrowing interest rate per period, taking into account all debt sources, and

k = Tax-adjusted weighted-average cost of capital.



Project Funding Mechanism: Governmental Budget, Public Private Partnership and Private Investment

- A project is a planned investment undertaken to deliver product/output, so it has set of activities to achieve specific objectives.
- In life cycle of project, various nature of cost will be incurred and such costs is funded by mainly three mechanism:
 - Governmental budget;
 - Public Private Partnership; and
 - Private investment.



Project Funding Mechanism: Governmental Budget

- Most of the development and public utility projects like road, water supply, electricity, gas, telephone, hospitals, etc are established and run by government funding through government budget.
- The funding made by local and national/central government agencies to produce and deliver various public utilities include in this heading.



Project Funding Mechanism: Public Private Partnership

- Public=Government institutions like; ministries, departments, municipalities, DDC, VDC, and state owned enterprises
- Private= Local and international privately held body that may include financial and technical expertise relevant to the project
- Partnership=Collaboration between two or more institution to perform certain task.
- PPP=Joint initiation of public and private sectors to provide public and semi public goods and services
- In PPP, government as well as private sector both active on commercial functions of the projects and work for their mutual benefits.
- PPP is widely accepted project funding mechanism throughout the world specially in the area of hydropower, water and sanitation, hospitals, stadium, air traffic control, prisons, railway, roads, airports, IT etc.



Project Funding Mechanism: Public Private Partnership

- Nepal has taken it as means of development since 1990s. Some of the municipalities are implementing PPP projects specially area of solid waste management, open space management, drinking water etc.
- Nepal has separate regulatory framework for managing PPP projects at local government level such as DDC, VDC, and municipalities as well as for ministries level.
- Through PPP, government can reduce cost and risk and private sector can generate business opportunities and general public can receive better and more accessible services.
- Benefits from PPP:
 - Improved service delivery
 - Cost effectiveness
 - Increase investment in public infrastructure
 - Reduce public sector risk
 - Better use of resources
 - Project acceleration



Project Funding Mechanism: Private Investment

- Private investment is another funding mechanism.
- Private investment/sector includes domestic and foreign private organization having financial and technical capabilities.
- All private companies and business projects are established and run by the private investment.
- Generally private sector choose low risk with high return low investment as well as short run projects.
- Market oriented development strategies encourages private sector involvement in development projects
- Government also emphasized globalization and liberalization policies to encourage private sectors for the development works.

Financial Internal Rate of Return (FIRR)

- Financial IRR is the concept of calculating Internal rate of return of the investment projects.
- Same projects (mega projects) may generate different financial inflows and outflows for different stakeholders and their internal rate of return for that investment project may be different.
- FIRR can be calculated by various stakeholders based on their investment (cash inflow and outflow) for same investment projects. Eg. Pokhara International Airport, Uppar Karnali Hydropower etc.
- This can be:
 - FIRR for project entity
 - FIRR for stockholder
 - FIRR for lenders/banks
 - FIRR for government
 - FIRR for lender and contractor

Economic Internal Rate of Return (EIRR)

- ▶ Profits are essential signaling mechanism for investment decisions. However financial profitability are important decision criteria for investment decisions for the firm, it may not be good measurement for the national economy.
- ▶ So, the projects should be analyzed based on EIRR (especially mega projects eg. East West Rail Route, Kathmandu-Pokhara-Lumbini Rail Route, Kathmandu Metro Rail, Kathmandu-Hetauda Tunnel Road, Pokhara International Airport, Pancheswor Hydropower etc.).
- ▶ EIRR considers following aspect of the projects:
 - ▶ Project boundary is financial but economic profitability will be different.
 - ▶ Market prices may underestimate economic benefit i.e. opportunity cost may be higher than real cost/consumer surplus.
 - ▶ Project may create externalities.
 - ▶ Distortion of the environment.
- ▶ FIRR can be used as proxy for EIRR:
 - ▶ If there is no any project boundary and externalities
 - ▶ Price and policy distortion is zero.

Economic Internal Rate of Return (EIRR)

- How to calculate EIRR?
 - $EIRR = FIRR + \text{Profitability associated with consumer/user (due to consumer surplus)} + \text{Profitability associated with externalities} + \text{Profitability associated with environment} + \text{Profitability associated with government surplus}$
 - The EIRR is calculated as the rate of discount for which the present value of the net benefit stream becomes zero, or at which the present value of the benefit stream is equal to the present value of the cost stream.
 - For a project to be acceptable, the EIRR should be greater than the economic cost of capital.

Return on Equity

- One popular measure of profitability is rate of return on common equity.
- This ratio shows the relationship between net income and common stockholders' investment in the company—that is, how much income is earned for every \$1 invested by the common stockholders.
- To compute the return on common equity, we first subtract preferred dividends from net income, yielding the net income available to common stockholders. We then divide this net income available to common stockholders by the average common stockholders' equity during the year.
- We compute average common equity by using the beginning and ending balances.
- For example: at the beginning of fiscal-year 2005, Dell's common equity balance was \$6,280 million; at the end of fiscal-year 2005, the balance was \$6,485 million. The average balance is then simply \$6,382.50 million, and we have
- $$\text{Return on common equity} = \frac{\text{Net income available to common stockholders}}{\text{Average common equity}}$$
- Preferred Stock:
 - Net income available for common stockholder = Net profit after tax - dividend to pf. Stock holder

Chapter 9: Assignments

- Explain cost of capital. Briefly explain the equity financing and debt financing.
- What is capital structure? Explain factors affecting capital structure policy.
- Discuss different project funding mechanisms.
- Explain cost of capital. How firm can calculate weighted average cost of capital?
- What is Economic IRR? Explain how EIRR is different than FIRR.
- Write short notes on:
 - FIRR and EIRR
 - Return on equity
- ***Numerical Questions for each methods of cost of capital***



Chapter 10: Basic Accounting Procedures

- Accounting Terminologies: Asset and Liabilities, Fundamental Equation of Accounting
- Financial Statements: The Balance Sheet, Income Statement and Cash Flow Statement
- Using ratios to make Decisions: Debt Ratio, Current Ratio, Quick Ratio-Acid Test Ratio, Inventory Turnover Ratio, Total Asset Turnover, Profit Margin on Sales, Return on Total Assets, Price Earnings Ratio and Book Value Per Share



Accounting Terminologies:

- Accounting
- Fundamental Equation of Accounting
- Assets
- Liabilities
- Capital



Accounting



- Accounting is the system of collecting, summarizing, analyzing, classifying, and interpreting, business information in financial and monetary terms.
- It is science of recording transaction of economic nature in a systematic manner as well as it is also art of analyzing and interpreting them.
- Process of Accounting:
 - Collection of source document
 - Recording of financial transactions: Day book
 - Classifying and Summarizing financial transaction: Ledger and Trail Balance
 - Preparation of financial statements: Income Statement, Balance Sheet, Cash Flow Statement
 - Analysis and interpretation of those statements,
 - Communicating the results of analysis to concerned parties (managers, owners, customers, investors, etc.) for further decision making and future plans.

Fundamental Equation of Accounting

- A company's balance sheet and financial statements are based on the most fundamental tool of accounting: the accounting equation.
- Assets, liabilities and owners equity (capital) are the three basic elements of every business transaction.
- The value of assets (resources) should be equal to sources of funds i.e. liabilities and capital.
- The **accounting equation** shows the relationship among assets, liabilities, and owners' equity:

$$\text{Assets} = \text{Liabilities} + \text{Owners' Equity}$$

- Change in one elements lead to corresponding change in same item or in other element.
- An accounting equation is also a foundation to double entry system of book keeping.
- The concept of double entry system refers *"For every debit, there is credit which results"* balance in accounting equation.
- It is also known as balance sheet equation.
- This equation shows that claims against assets are of two types: liabilities and stockholders' equity.



Asset

- The dollar amount shown in the assets portion of the balance sheet represents how much the company owns at the time it issues the report.
- We list the asset items in the order of their “liquidity,” or the length of time it takes to convert them to cash.
 - **Current Assets**
 - **Fixed Assets**
 - **Other Assets**

Asset: Current Asset

- **Current assets** can be converted to cash or its equivalent in less than one year. Current assets generally include three major accounts:
- **1.** The first is *cash*. A firm typically has a cash account at a bank to provide for the funds needed to conduct day-to-day business. Although assets are always stated in terms of dollars, only cash represents actual money.
- *Cash-equivalent* items are also listed and include marketable securities and short-term investments.
- **2.** The second account is *accounts receivable*—money that is owed the firm, but that has not yet been received. For example, when Dell receives an order from a retail store, the company will send an invoice along with the shipment to the retailer. Then the unpaid bill immediately falls into the accounts receivable category. When the bill is paid, it will be deducted from the accounts receivable account and placed into the cash category. A typical firm will have a 30- to 45-day accounts receivable, depending on the frequency of its bills and the payment terms for customers. (Bills Receivables, Debtors)
- **3.** The third account is *inventories*, which show the dollar amount that Dell has invested in raw materials, work in process, and finished goods available for sale.



Asset: Fixed Asset

- **Fixed assets** are relatively permanent and take time to convert into cash. Fixed assets reflect the amount of money Dell paid for its plant and equipment when it acquired those assets.
- The most common fixed asset is the physical investment in the business, such as land, buildings, factory machinery, office equipment, and automobiles.
- With the exception of land, most fixed assets have a limited useful life. For example, buildings and equipment are used up over a period of years.
- Each year, a portion of the usefulness of these assets expires, and a portion of their total cost should be recognized as a depreciation expense. The term *depreciation* denotes the accounting process for this gradual conversion of fixed assets into expenses.
- *Property, plant and equipment, net* thus represents the current book value of these assets after deducting depreciation expenses.



Asset: Other Asset

- Finally, **other assets** include investments made in other companies and intangible assets such as goodwill, copyrights, franchises, and so forth.
- Goodwill appears on the balance sheet only when an operating business is purchased in its entirety.
- Goodwill indicates any additional amount paid for the business above the fair market value of the business. Here the fair market value is defined as the price that a buyer is willing to pay when the business is offered for sale.



Liabilities

- The liabilities of a company indicate where the company obtained the funds to acquire its assets and to operate the business. Liability is money the company owes.
- **Current liabilities** are those debts which must be paid in the near future (normally, within one year). The major current liabilities include accounts and notes payable within a year. Also included are accrued expenses (wages, salaries, interest, rent, taxes, etc., owed, but not yet due for payment), and advance payments and deposits from customers.
- **Other liabilities** include *long-term liabilities*, such as bonds, mortgages, and long-term notes, that are due and payable more than one year in the future.

Owner's Equity

- Stockholders' equity is that portion of the assets of a company which is provided by the investors (owners). Therefore, stockholders' equity is the liability of a company to its owners.
- **Stockholders' equity** represents the amount that is available to the owners after all other debts have been paid. Generally, stockholders' equity consists of preferred and common stock, treasury stock, capital surplus, and retained earnings.
- Preferred stock is a hybrid between common stock and debt. In case the company goes bankrupt, it must pay its preferred stockholders after its debtors, but before its common stockholders. Preferred dividend is fixed, so preferred stockholders do not benefit if the company's earnings grow. In fact, many firms do not use preferred stock.
- The common stockholders' equity, or **net worth**, is a residual:
- $\text{Assets} - \text{Liabilities} - \text{Preferred stock} = \text{Common stockholders' equity}$

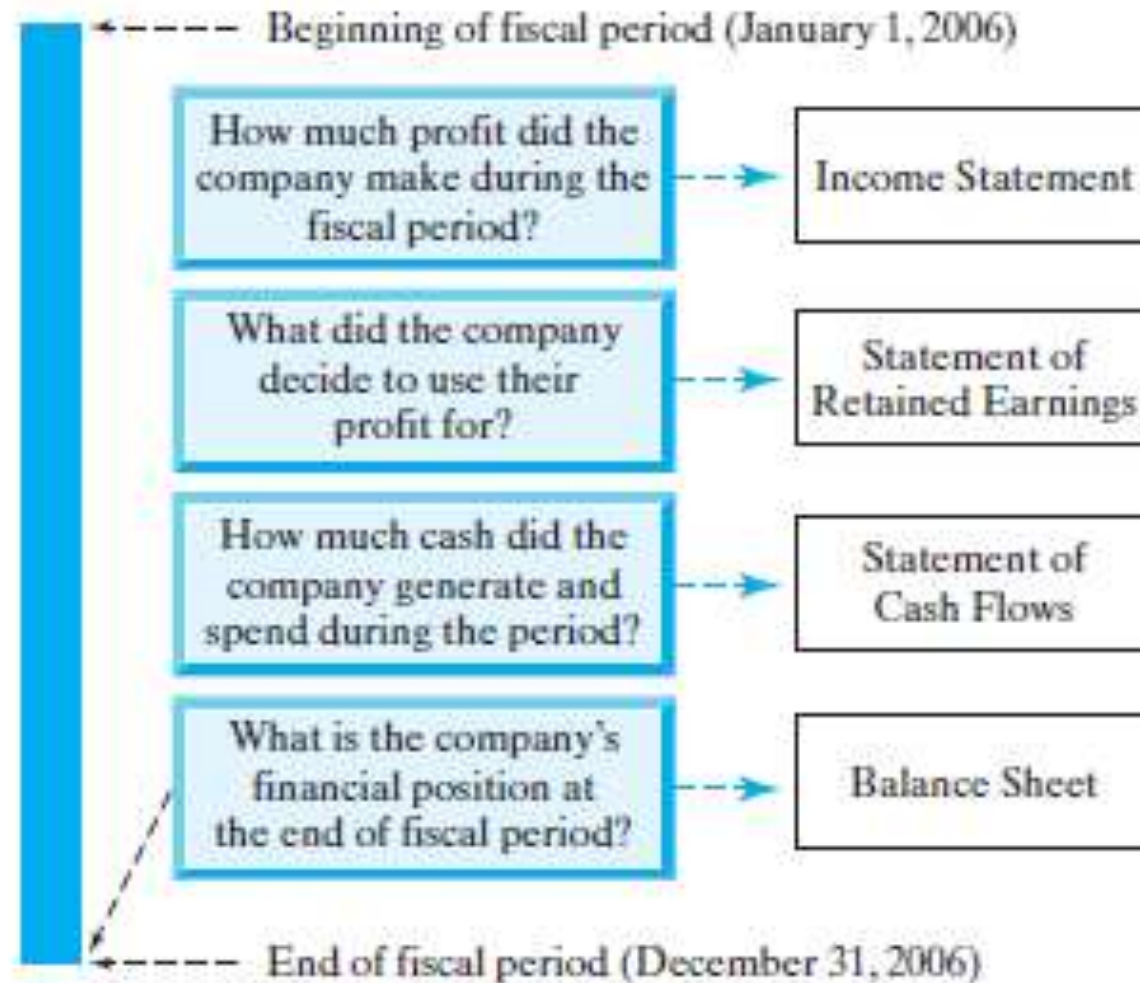


Owner's Equity



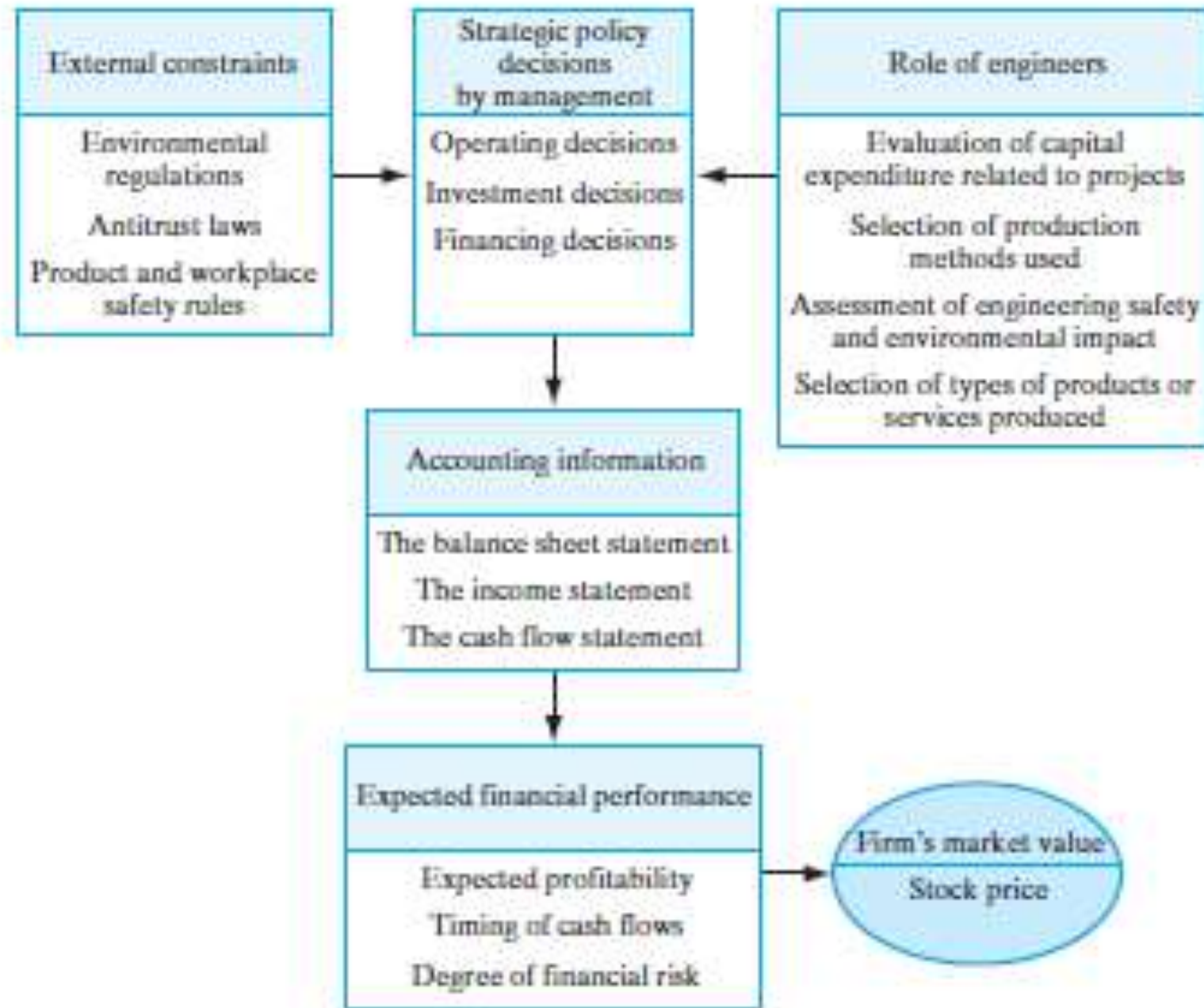
- ▶ **Common stock** is the **aggregate par value of the company's stock issued**. Companies rarely issue stocks at a discount (i.e., at an amount below the stated par). Normally, corporations set the par value low enough so that, in practice, stock is usually sold at a premium.
- ▶ **Paid-in capital** (capital surplus) is **the amount of money received from the sale of stock that is over and above the par value of the stock**. Outstanding stock is the number of shares issued that actually are held by the public. If the corporation buys back part of its own issued stock, that stock is listed as *treasury stock* on the balance sheet.
- ▶ **Retained earnings** represent **the cumulative net income of the firm since its inception, less the total dividends that have been paid to stockholders**. In other words, retained earnings indicate the amount of assets that have been financed by plowing profits back into the business. Therefore, retained earnings belong to the stockholders.

Financial Statements: The Balance Sheet, Income Statement and Cash Flow Statement



@Samundra Paudel/NCIT/PU/2016

Figure 2.2 Information reported on the financial statements.



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Figure 2.3 Summary of major factors affecting stock prices.



Balance Sheet

- ▶ What is the company's financial position at the end of the reporting period? We find the answer to this question in the company's **balance sheet statement**.
- ▶ A company's balance sheet, sometimes called its **statement of financial position**, reports three main categories of items: assets, liabilities, and stockholders' equity.
- ▶ It is a statement summarizing the financial position of a firm which is prepared at the end of the accounting period after completing the preparation of Income Statement.
- ▶ It is the statement of balance of ledger account which are not included in income statement, so it is called balance sheet.
- ▶ It is prepared at a given date (point of time) to reveal financial position of the firm on that certain date. It communicates information about assets, liabilities, owners equity, for a business firm of that specific date.
- ▶ In balance sheet, total of all assets will always be equal to the total of all liabilities and capital.

Format of Balance Sheet

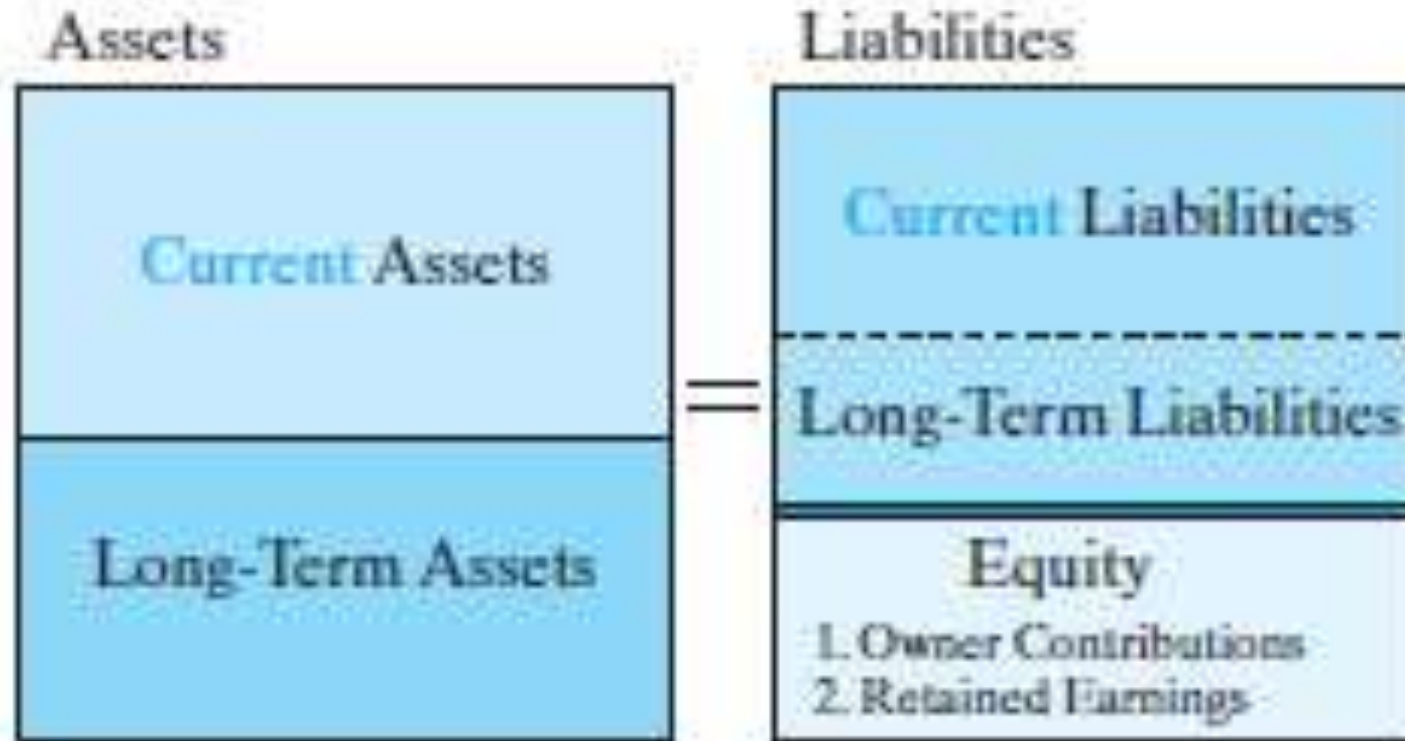


Figure 2.4 Using the four quadrants of the balance sheet.

Format of Balance Sheet

| Assets | |
|-------------------------------------|--|
| Current assets: | |
| Cash and cash equivalents | |
| Short-term investments | |
| Accounts receivable, net | |
| Inventories | |
| Other | |
| Total current assets | |
| Property, plant, and equipment, net | |
| Investments | |
| Other noncurrent assets | |
| Total assets | |

| Liabilities and Stockholders' Equity | |
|---|--|
| Current liabilities: | |
| Accounts payable | |
| Accrued and other | |
| Total current liabilities | |
| Long-term debt | |
| Other noncurrent liabilities | |
| Total liabilities | |
| Commitments and contingent liabilities (Note 8) | |
| Stockholders' equity: | |
| Preferred stock and capital in excess of \$.01 par value; shares issued and outstanding: none | |
| Common stock and capital in excess of \$.01 par value; shares authorized: 7,000; shares issued: 2,769 and 2,721, respectively | |
| Treasury stock, at cost; 284 and 165 shares, respectively | |
| Retained earnings | |
| Other comprehensive loss | |
| Other | |
| Total stockholders' equity | |
| Total liabilities and stockholders' equity | |

| As on | | Assets | |
|------------------------------------|-----|-------------------------------------|-----|
| Liabilities & Capital | Rs. | | Rs. |
| Opening capital | xxx | Fixed Assets: | |
| Less: Drawing | xxx | Land and Building | xxx |
| Add: Net profit | xxx | Plant and Machinery | xxx |
| Less: Net loss | xxx | Equipments | xxx |
| Reserve & Funds: | xxx | Furniture & Fixtures | xxx |
| General reserve | xxx | Vehicles | xxx |
| Capital resource | xxx | Live stocks | xxx |
| Specific reserve | xxx | Goodwill | xxx |
| Sinking fund | xxx | Patent, trademark & copyright | xxx |
| Other reserve & funds | xxx | Investment: | |
| Secured Loans: | | Investment in shares & debentures | xxx |
| Debtore | xxx | Investment in government-securities | xxx |
| Loan from bank | xxx | Current Assets: | |
| Other secured loan & advance | xxx | Sundry debtors | xxx |
| Mortgaged loan | xxx | Cash in hand | xxx |
| Bonds | xxx | Cash at bank | xxx |
| Unsecured Loan: | | Interest accrued on investment | xxx |
| Fixed deposits | xxx | Accrued incomes | xxx |
| Short-term loan from bank | xxx | Stores & spare parts | xxx |
| Bank overdraft | xxx | Loss tools | xxx |
| Current Liabilities: | | Closing stock | xxx |
| Bills payable | xxx | Loan & Advance: | |
| Sundry creditors/Accounts payable | xxx | Deposit with suppliers | xxx |
| Advance receipts | xxx | Bills receivables | xxx |
| Outstanding expenses | xxx | Prepaid expenses | xxx |
| Other current liabilities | xxx | Advance paid (tax, rates, etc) | xxx |
| Provisions: | | Miscellaneous Expenditures: | |
| Provision for taxation | xxx | Preliminary expenses | xxx |
| Provision for staff provident fund | xxx | Advertisement suspense | xxx |
| Pension fund | xxx | Unadjusted Development expenditure | xxx |
| Other provisions | xxx | | xxx |



Importance of Balance Sheet

- Balance sheet being the position statement at certain date, it reveals the different information for different stakeholders.
- It reveals the financial position of a business
- It helps to ascertain composition of assets and liabilities
- It depicts the solvency i.e. debt paying capacity of the firm
- It shows the position of the owners equity and capital.

Income Statement

- The second financial report is the **income statement**, which indicates whether the company is making or losing money during a stated *period*, usually a year.
- Most businesses prepare quarterly and monthly income statements as well. The company's accounting period refers to the period covered by an income statement.

Basic Income Statement Equation

Revenue

—

Expenses

Net Income (Loss)



Importance of Income Statement

- To ascertain gross and net profit
- To keep control on indirect expenses
- Basis for preparing balance sheet
- Basis for managerial decision

Reporting Format

- Typical items that are itemized in the income statement are as follows:
- • **Revenue** is the income from goods sold and services rendered during a given accounting period.
- • **Net revenue** represents gross sales, less any sales return and allowances.
- • Shown on the next several lines are the expenses and costs of doing business, as deductions from revenue. The largest expense for a typical manufacturing firm is the expense it incurs in making a product (such as labor, materials, and overhead), called the **cost of revenue** (or cost of goods sold).
- • Net revenue less the cost of revenue gives the **gross margin**.
- • Next, we subtract any other operating expenses from the operating income. These other operating expenses are expenses associated with paying interest, leasing machinery or equipment, selling, and administration. This results in the operating income.
- • Finally, we determine the **net income** (or net profit) by subtracting the income taxes from the taxable income. Net income is also commonly known as *accounting income*.

Net revenue

Cost of revenue

Gross margin

Operating expenses:

Selling, general, and administrative

Research, development, and engineering

Total operating expenses

Operating income

Investment and other income, net

Income before income taxes

Income tax provision

Net income

Format of Income Statement (Trading A/c and Profit and Loss A/c)

The general format of Trading Account is given below:

Trading Account of

For the year ending

| Dr. | Particulars | Rs. | Cr. | Particular | Rs. |
|--------------------------------|-------------|-----|-------------------------------|------------|-----|
| To Opening Stock | xxx | | By Sales | xxx | |
| To Purchase | xxx | | Less: Sales return or, | | |
| Less: Purchase return or, | | | Return inward or, | | |
| Return outward or, | | | Return from debtors | xxx | xxx |
| Return to creditors | xxx | xxx | By Closing Stock | | xxx |
| To Purchase Expenses: | | | (By Gross Loss Transferred to | | |
| Carriage/Carriage inward | xxx | | Profit and Loss Account) | xxx | |
| Freight/Freight inward | xxx | | | | |
| Carriage/Freight on purchase | xxx | | | | |
| Dock charges | xxx | | | | |
| Clearing charges | xxx | | | | |
| Coolie and cartage | xxx | | | | |
| Import duty | xxx | | | | |
| Custom duty on import | xxx | | | | |
| Packing on purchase, etc. | xxx | | | | |
| To Factory/Manufacturing | | | | | |
| Expenses: | | | | | |
| Wages/Salaries | xxx | | | | |
| Factory rent | xxx | | | | |
| Fuel and power | xxx | | | | |
| Coal, Gas and water | xxx | | | | |
| Heating and lighting | xxx | | | | |
| Store consumed (soap, | xxx | | | | |
| cotton, chemical, grease, | | | | | |
| paper, etc) | | | | | |
| Excise duty | xxx | | | | |
| Royalties | xxx | | | | |
| All other factory expenses | xxx | | | | |
| To Gross Profit Transferred to | xxx | | | | |
| Profit and Loss A/C (i.e. | | | | | |
| balancing figure) | | | | | |
| | xxx | | | | xxx |

A general format of profit and loss account is given below:

Profit and Loss Account of Company

For the year ending

| Dr. | Particulars | Rs | Cr | Particulars | Rs |
|---------------------------------|-------------|----|---------------------------------|-------------|----|
| To Gross Loss | | | By Gross Profit | | |
| To Office & Administrative | | | By Interest received | | |
| Expenses: | | | By Rent received | | |
| | | | By Dividend received | | |
| Salary & wages | | | By Discount received | | |
| Printing & Stationary | | | By Commission received | | |
| Rent & Taxes | | | By Bad debt recovered | | |
| Insurance & Interest | | | By Profit on sale of assets | | |
| Telephone & electricity | | | By Appreciation on fixed assets | | |
| Audit & license fee | | | By Net Loss Transferred to | | |
| Lighting & heating | | | Balance Sheet | | |
| Bonus & other official expenses | | | | | |
| To Selling & Distribution | | | | | |
| Expenses: | | | | | |
| Salesman salary & | | | | | |
| Commission | | | | | |
| Packing & Travelling expenses | | | | | |
| Advertising & Publicity | | | | | |
| Free sample & Ware house | | | | | |
| Carriage & Freight outwards | | | | | |
| Export duty & Discount allowed | | | | | |
| Research & Development | | | | | |
| expenses | | | | | |
| VAT & Bad debts etc. | | | | | |
| To Other Expenses & Losses: | | | | | |
| Depreciation | | | | | |
| Repair & Maintenance | | | | | |
| Abnormal loss on goods, | | | | | |
| machine | | | | | |
| To Net Profit Transferred to | | | | | |
| Balance Sheet | | | | | |

Example: Income Statement and Balance Sheet (PU 2015, Fall)

- The following is trial balance of Acharya Company.
- Value of closing stock=52,000; Net Profit=18,000
- **Required: Income Statement and Balance Sheet.**

| Particulars | Debit (Rs.) | Credit (Rs.) |
|------------------------------|-----------------|-----------------|
| Capitals | | 2,00,000 |
| Plant and Machinery | 50,000 | |
| Furniture and Fitting | 75,000 | |
| Motor Van | 24,000 | |
| Sundry Debtors | 40,000 | |
| Cash at Bank | 7,000 | |
| Wages | 1,50,000 | |
| Purchase and Sales | 2,13,000 | 4,00,000 |
| Bills receivable and payable | 35,000 | 15,000 |
| Sundry Creditors | | 20,000 |
| Salaries | 36,000 | |
| Drawings | 20,000 | |
| Discount received | | 10,000 |
| Bank loan | | 30,000 |
| General Reserve | | 20,000 |
| Opening Stock | 40,000 | |
| Bad Debt | 5,000 | |
| Total | 6,95,000 | 6,95,000 |

Solution: PU 2015, Fall

| Income Statement of Acharya Company | |
|-------------------------------------|---------------|
| Particulars | Amount (Rs.) |
| Sales | 4,00,000 |
| Closing Stock | 52,000 |
| Less: Opening Stock | 40,000 |
| Less: Purchase | 2,13,000 |
| Less: Wages | 1,50,000 |
| Gross Profit | 49,000 |
| Add: Discount Received | 10,000 |
| Less: Salaries | 36,000 |
| Less: Bad debt | 5,000 |
| Net Profit | 18,000 |

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| Balance Sheet of Acharya Company | |
|--------------------------------------|-----------------|
| Particulars | Amount (Rs.) |
| Assets | |
| Plant and Machinery | 50,000 |
| Furniture and Fittings | 75,000 |
| Motor Van | 24,000 |
| Bills Receivables | 35,000 |
| Sundry Debtors | 40,000 |
| Closing Stock | 52,000 |
| Cash at Bank | 7,000 |
| Total Asset | 2,83,000 |
| Liabilities and Capital | |
| General Reserve | 20,000 |
| Bank Loan | 30,000 |
| Bills Payable | 15,000 |
| Sundry Creditors | 20,000 |
| Total Liabilities | 85,000 |
| Capital | 2,00,000 |
| Add: Net Profit | 18,000 |
| Less: Drawings | 20,000 |
| Total Liabilities and Capital | 2,83,000 |

Example and Solution: Balance Sheet (PU 2014, Spring)

- Prepare balance sheet of ABC company from the following information as on 31st December 2014.

| | | | |
|------------------|--------|-------------------|--------|
| Capital | 40,000 | Building | 30,000 |
| Sundry Debtors | 15,000 | Furniture | 12,500 |
| Cash in hand | 4,000 | Cash at bank | 7,500 |
| Bank Overdraft | 8,500 | Bills receivables | 4,500 |
| Sundry Creditors | 3,500 | Closing Stock | 3,500 |
| Reserve Funds | 4,500 | Net Profit | 20,500 |

- Solution: Balance Sheet of ABC Company**

| Balance Sheet of ABC Company As on 31 st December 2014 | |
|--|---------------|
| Particulars | Amount (Rs.) |
| Assets | |
| Building | 30,000 |
| Furniture | 12,500 |
| Cash at Bank | 7,500 |
| Bills Receivable | 4,500 |
| Closing Stock | 3,500 |
| Sundry Debtors | 15,000 |
| Cash in hand | 4,000 |
| Total Asset | 77,000 |
| Liabilities and Capital | |
| Reserve Fund | 4,500 |
| Bank Overdraft | 8,500 |
| Sundry Creditors | 3,500 |
| Total Liabilities | 16,500 |
| Capital | 40,000 |
| Add: Net Profit | 20,500 |
| Total Liabilities and Capital | 77,000 |

Example: Income Statement and Balance Sheet (PU 2009, Fall)

- ▶ Moon and Moon Company has just completed preparing its trial balance as of June 2008.
- ▶ Prepare income statement, statement of retained earnings, and balance sheet

| Moon & Moon Company Trial Balance As of 30 June 2008 | | |
|--|---------------|---------------|
| Particulars | Debit (Rs.) | Credit (Rs.) |
| Cash | 6,200 | |
| Account Receivables | 10,400 | |
| Prepaid Rent | 4,400 | |
| Chemical Inventory | 9,400 | |
| Equipment | 18,200 | |
| Accumulated Depreciation | | 1,050 |
| Accounts Payable | | 1,180 |
| Capital Stock | | 5,000 |
| Retained Earnings | | 25,370 |
| Treatment Revenue | | 40,600 |
| Wages and Salaries | 22,500 | |
| Utility Expenses | 1,240 | |
| Advertising Expenses | 860 | 10,000 |
| Total | 73,200 | 73,200 |

Solution: Income Statement and Balance Sheet (PU 2009, Fall)

| Income Statement of Moon & Moon Company As of 30 June 2008 | |
|--|---------------|
| Particulars | Amount (Rs.) |
| Treatment Revenue | 40,600 |
| Less: Wages and Salaries | 22,500 |
| Gross Profit | 18,100 |
| Less: Utility Expenses | 1,240 |
| Less: Ad Expenses | 860 |
| Net Profit | 16,000 |

| Statement of Retained Earnings of Moon & Moon Company As of 30 June 2008 | |
|--|---------------|
| Particulars | Amount (Rs.) |
| Opening Retained Earnings | 25,370 |
| Add: Net Income | 16,000 |
| Closing Retained Earnings | 41,370 |

| Balance Sheet of Moon & Moon Company As on 30 June 2008 | |
|---|---------------|
| Particulars | Amount (Rs.) |
| Assets | |
| Cash | 6,200 |
| Account Receivables | 10,400 |
| Prepaid Rent | 4,400 |
| Chemical Inventory | 9,400 |
| Equipment | 18,200 |
| Total Asset | 48,600 |
| Liabilities and Capital | |
| Accumulated Depreciation | 1,050 |
| Account Payable | 1,180 |
| Total Liabilities | 2,230 |
| Capital | 5,000 |
| Add: Cl. Retained Earnings | 41,370 |
| Total Liabilities and Capital | 48,600 |

Example: P/L Account and Balance Sheet (PU 2006, Fall & PU 2005, Spring)

- From the following trial balance, prepare P/L account and balance sheet.

| Debit Balance | Amount (Rs.) | Credit Balance | Amount (Rs.) |
|----------------------------|-----------------|-------------------|-----------------|
| Closing Stock | 30,000 | Capital | 2,50,000 |
| Sundry Debtors | 50,000 | Gross Profit | 1,22,000 |
| Plant & Machinery | 2,25,000 | Dividend Received | 1,250 |
| Goodwill | 14,500 | Interest Received | 750 |
| Land & Building | 1,35,000 | Sundry Creditors | 39,000 |
| Salaries & Wages | 27,500 | Reserve Fund | 50,000 |
| Rent | 7,500 | Bank Loan | 50,000 |
| Selling Expenses | 12,500 | Bank overdraft | 23,500 |
| Cash at bank | 10,000 | | |
| Deposit with custom office | 7,500 | | |
| Advertisement | 5,000 | | |
| Investment | 12,000 | | |
| Total | 5,36,500 | Total | 5,36,500 |

Solution: P/L Account and Balance Sheet (PU 2006, Fall & PU 2005, Spring)

| Profit & Loss Account | |
|------------------------|---------------|
| Particulars | Amount (Rs.) |
| Gross Profit | 1,22,000 |
| Add: Dividend Received | 1,250 |
| Add: Interest Received | 750 |
| Less: Salaries & Wages | 27,500 |
| Less: Rent | 7,500 |
| Less: Selling Expenses | 12,500 |
| Net Profit | 76,500 |

| Balance Sheet | |
|--------------------------------------|-----------------|
| Particulars | Amount (Rs.) |
| Assets | |
| Closing Stock | 30,000 |
| Sundry Debtors | 50,000 |
| Plant & Machinery | 2,25,000 |
| Goodwill | 14,500 |
| Land & Buildings | 1,35,000 |
| Cash at bank | 10,000 |
| Deposit with Custom Office | 7,500 |
| Ad Suspense A/c | 5,000 |
| Investment | 12,000 |
| Total Asset | 4,89,000 |
| | |
| Liabilities and Capital | |
| Reserve Fund | 50,000 |
| Bank Loan | 50,000 |
| Bank Overdraft | 23,500 |
| Sundry Creditors | 39,000 |
| Total Liabilities | 1,62,500 |
| Capital | 2,50,000 |
| Add: Net Income | 76,500 |
| Total Liabilities and Capital | 4,89,000 |



Cash Flow Statement:

- The income statement explained in the previous section indicates only whether the company was making or losing money during the reporting period.
- Therefore, the emphasis was on determining the net income (profits) of the firm for supporting its operating activities.
- However, the income statement ignores two other important business activities for the period: financing and investing activities.
- Therefore, we need another financial statement—the cash flow statement, which details how the company generated the cash it received and how the company used that cash during the reporting period.



Cash Flow Statement:

- Cash Inflow= Issue of share, debentures, sale of fixed assets, sale of investments, receiving loans, etc.
- Cash Outflow=redemption of share, debenture, repayment of loan, purchase of fixed assets etc.
- The difference between inflow and outflow of cash and cash equivalent is termed as net increase and decrease in cash or cash equivalent.
- The cash flow statement reports cash flows during the period in 3 category:
 - Operating activities
 - Investing activities
 - Financing activities



Cash Flow Statement: Sources and Uses of Cash

- The difference between the sources (inflows) and uses (outflows) of cash represents the net cash flow during the reporting period. This is a very important piece of information, because investors determine the value of an asset (or, indeed, of a whole firm) by the cash flows it generates.
- Certainly, a firm's net income is important, but cash flows are even more important, particularly because the company needs cash to pay dividends and to purchase the assets required to continue its operations.
- The goal of the firm should be to maximize the price of its stock. Since the value of any asset depends on the cash flows produced by the asset, managers want to maximize the cash flows available to investors over the long run.
- Therefore, we should make investment decisions on the basis of cash flows rather than profits. For such investment decisions, it is necessary to convert profits (as determined in the income statement) to cash flows.



Importance of Cash Flow Statement

- To know the liquidity position of the firm
- To know the company's operating, investing and financing activities during accounting period
- To evaluate the financial policies of the firm
- To know the information about the changes in the cash position of the firm
- To know the cash payment and cash receipt of the firm during the accounting period
- To understand the reasons for variation in cash position of the firm
- To assist short term cash planning of the firm
- To help in planning of the repayment of loan, replacement of fixed assets and other long term planning etc.

Cash Flow Statement: Reporting Format

- In preparing the cash flow statement, many companies identify the sources and uses of cash according to the types of business activities. There are three types of activities:
- • **Operating activities.** We start with the net change in operating cash flows from the income statement. Here, operating cash flows represent those cash flows related to production and the sales of goods or services. All noncash expenses are simply added back to net income (or after-tax profits). For example, an expense such as depreciation is only an accounting expense (a bookkeeping entry). Although we may charge depreciation against current income as an expense, it does not involve an actual cash outflow. The actual cash flow may have occurred when the asset was purchased. (Any adjustments in **working capital** will also be listed here.)
- • **Investing activities.** Once we determine the operating cash flows, we consider any cash flow transactions related to investment activities, which include purchasing new fixed assets (cash outflow), reselling old equipment (cash inflow), and buying and selling financial assets.
- • **Financing activities.** Finally, we detail cash transactions related to financing any capital used in business. For example, the company could borrow or sell more stock, resulting in cash inflows. Paying off existing debt will result in cash outflows.
- By summarizing cash inflows and outflows from three activities for a given accounting period, we obtain the net change in the cash flow position of the company.

Format of Cash Flow Statement

| | |
|---|--------------|
| Cash flows from operating activities: | |
| Net income | \$ 3,043 |
| Adjustments to reconcile net income to net cash provided by operating activities: | |
| Depreciation and amortization | 334 |
| Tax benefits of employee stock plans | 249 |
| Effects of exchange rate changes on monetary assets and liabilities denominated in foreign currencies | (602) |
| Other | 78 |
| Changes in: | |
| Operating working capital | 1,755 |
| Noncurrent assets and liabilities | 453 |
| Net cash provided by operating activities | <u>5,310</u> |

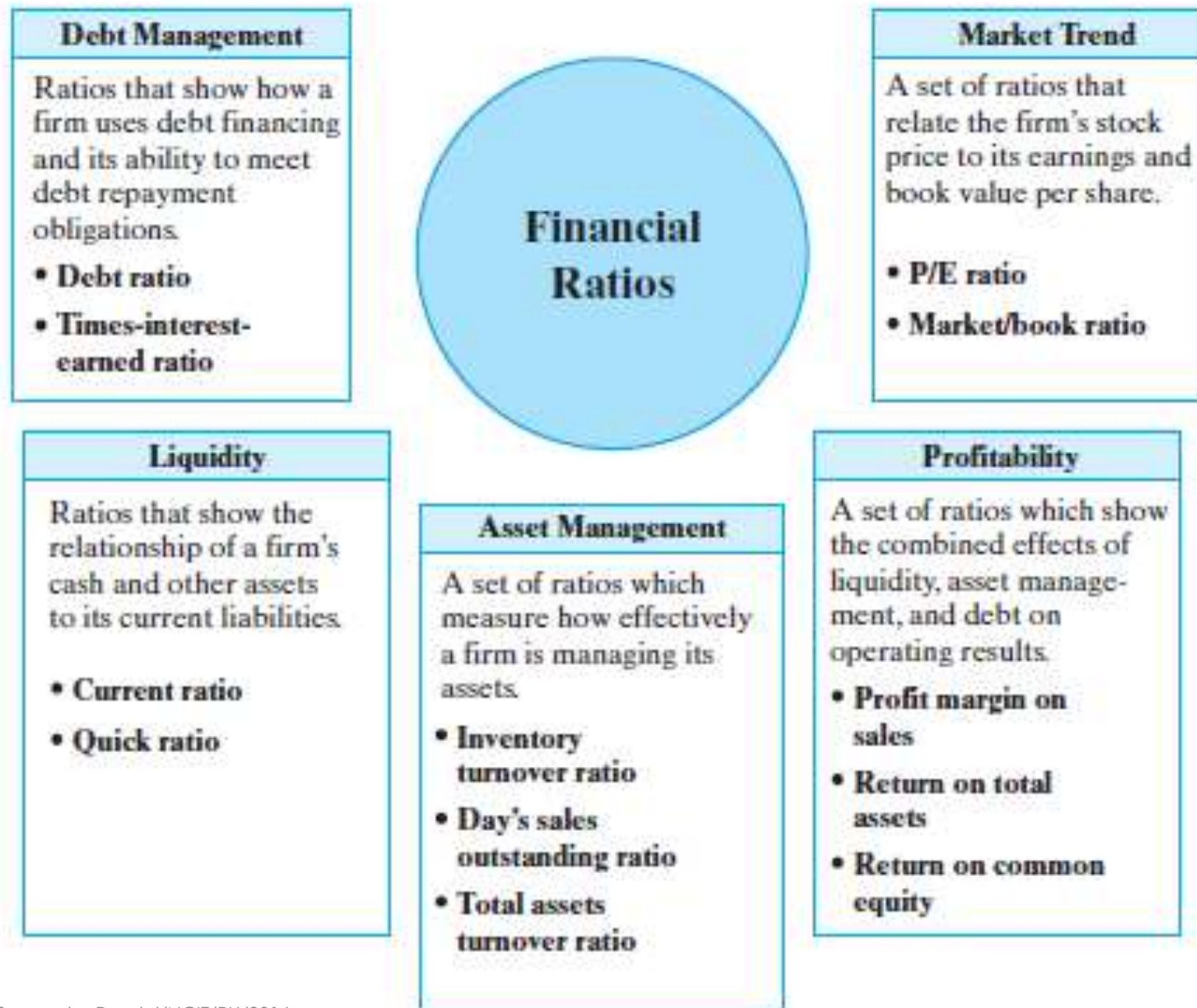
| | |
|--|----------------|
| Cash flows from investing activities: | |
| Investments: | |
| Purchases | (12,261) |
| Maturities and sales | 10,469 |
| Capital expenditures | (525) |
| Purchase of assets held in master lease facilities | — |
| Cash assumed in consolidation of Dell Financial Services, L.P. | — |
| Net cash used in investing activities | <u>(2,317)</u> |

| | |
|--|-----------------|
| Cash flows from financing activities: | |
| Repurchase of common stock | (4,219) |
| Issuance of common stock under employee plans and other | <u>1,091</u> |
| Net cash used in financing activities | <u>(3,128)</u> |
| Effect of exchange rate changes on cash and cash equivalents | <u>565</u> |
| Net increase in cash and cash equivalents | 430 |
| Cash and cash equivalents at beginning of period | <u>4,317</u> |
| Cash and cash equivalents at end of period | <u>\$ 4,747</u> |



Ratio Analysis

- Ratio is the mathematical relationship between two figures where one number is expressed in terms of another.
- In accounting, it is a technique of analysis and interpretation of the financial statement through mathematical expression.
- Ratio analysis can evaluate the performance of any business organization, so that **ratio analysis is an analysis of financial statement by the help of ratio between two accounting figures.**
- Importance of Ratio analysis:
 - Helpful in accessing operating efficiency of the business
 - Helpful in measuring financial solvency
 - Helpful in decision making
 - Helpful in future forecasting
 - Helpful in corrective action
 - Helpful in comparing inter-firm performance
 - Helpful in cost control



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Figure 2.5 Types of ratios used in evaluating a firm's financial health.



Using Ratios to make decisions:

- Debt Ratio,
- Current Ratio,
- Quick Ratio-Acid Test Ratio,
- Inventory Turnover Ratio,
- Total Asset Turnover,
- Profit Margin on Sales,
- Return on Total Assets,
- Price Earnings Ratio and
- Book Value Per Share

Debt Ratio

- The relationship between total liabilities and total assets, generally called the **debt ratio**, tells us the proportion of the company's assets that it has financed with debt:

$$\text{Debt ratio} = \frac{\text{Total debt}}{\text{Total assets}}$$

- Total debt includes both current liabilities and long-term debt. If the debt ratio is unity, then the company has used debt to finance all of its assets.
- Certainly, most creditors prefer low debt ratios, because the lower the ratio, the greater is the cushion against creditors' losses in case of liquidation.
- If a company seeking financing already has large liabilities, then additional debt payments may be too much for the business to handle.
- For such a highly leveraged company, creditors generally charge higher interest rates on new borrowing to help protect themselves.



Current Ratio

- We calculate the **current ratio** by dividing current assets by current liabilities:
Current ratio = Current assets/Current liabilities
- The **current ratio** measures a company's ability to pay its short-term obligations.
- If a company is getting into financial difficulty, it begins paying its bills (accounts payable) more slowly, borrowing from its bank, and so on.
- If current liabilities are rising faster than current assets, the current ratio will fall, and that could spell trouble.
- What is an acceptable current ratio?
- The answer depends on the nature of the industry. The general rule of thumb calls for a current ratio of 2 to 1. This rule, of course, is subject to many exceptions, depending heavily on the composition of the assets involved.

Quick (Acid Test) Ratio

- The quick ratio tells us whether a company could pay all of its current liabilities if they came due immediately.
- We calculate the quick ratio by deducting inventories from current assets and then dividing the remainder by current liabilities:

$$\text{Quick ratio} = (\text{Current assets} - \text{Inventories}) / \text{Current liabilities}$$

- The quick ratio measures how well a company can meet its obligations without having to liquidate or depend too heavily on its inventory. Inventories are typically the least liquid of a firm's current assets; hence, they are the assets on which losses are most likely to occur in case of liquidation.
- We often compare against industry average figures and should note at this point that an industry average is not an absolute number that all firms should strive to maintain.
- In fact, some very well managed firms will be above the average, while other good firms will be below it.
- However, if we find that a firm's ratios are quite different from the average for its industry, we should examine the reason for the difference.

Inventory Turnover Ratio

- The inventory turnover ratio measures how many times the company sold and replaced its inventory over a specific period—for example, during the year. We compute the ratio by dividing sales by the average level of inventories on hand.
- We compute the average inventory figure by taking the average of the beginning and ending inventory figures.

Inventory turnover ratio = Sales / Average inventory balance



Total Assets Turnover

- The total assets turnover ratio measures how effectively the firm uses its total assets in generating its revenues. It is the ratio of sales to all the firm's assets:

$$\text{Total assets turnover ratio} = \text{Sales} / \text{Total assets}$$



Profit Margin on Sales

- We calculate the profit margin on sales by dividing net income by sales.
- This ratio indicates the profit per dollar of sales:

Profit margin on sales = Net income available to common stockholders/Sales

- If two firms have identical operations in the sense that their sales, operating costs, and earnings before income tax are the same, but if one company uses more debt than the other, it will have higher interest charges.
- Those interest charges will pull net income down, and since sales are constant, the result will be a relatively low profit margin.

Return on Total Assets

- The return on total assets—or simply, return on assets (ROA)—measures a company's success in using its assets to earn a profit. The ratio of net income to total assets measures the return on total assets after interest and taxes:

Return on total assets =

$$\text{(Net income + interest expense (1 - tax rate)) / Average total assets}$$

- Adding interest expenses back to net income results in an adjusted earnings figure that shows what earnings would have been if the assets had been acquired solely by selling shares of stock.
- This high return on total assets results from (1) the company's high basic earning power and (2) its low use of debt, both of which cause its net income to be relatively high.



Price-to-Earnings Ratio

- The price-to-earnings (P/E) ratio shows how much investors are willing to pay per dollar of reported profits.

$$\text{P/E ratio} = \text{Price per share} / \text{Earnings per share}$$

- In general, P/E ratios are higher for firms with high growth prospects, other things held constant, but they are lower for firms with lower expected earnings.
- However, all stocks with high P/E ratios carry high risk whenever the expected growths fail to materialize.
- Any slight earnings disappointment tends to punish the market price significantly.

Book Value Per Share

- ▶ Another ratio frequently used in assessing the well-being of the common stockholders is the book value per share, which measures the amount that would be distributed to holders of each share of common stock if all assets were sold at their balance-sheet carrying amounts and if all creditors were paid off.
- ▶ We compute the book value per share for company's common stock as follows:

Book value per share = (Total stockholders' equity - preferred stock) / Shares outstanding

- ▶ Once again, though, market prices reflect expectations about future earnings and dividends, whereas book value largely reflects the results of events that occurred in the past. Therefore, the market value of a stock tends to exceed its book value.
- ▶ We can compare market value and book value and analyze overpricing and underpricing of share.

Example: Conduct and interpret Ratios:

Debt Ratio, Current Ratio, Quick Ratio-Acid Test Ratio, Inventory Turnover Ratio, Total Asset Turnover, Profit Margin on Sales, Return on Total Assets, Price Earnings Ratio and Book Value Per Share

Table P2.3 shows financial statements for Nano Networks, Inc. The closing stock price for Nano Network was \$56.67 (split adjusted) on December 31, 2005. On the basis of the financial data presented, compute the various financial ratios and make an informed analysis of Nano's financial health.

TABLE P2.3 Balance Sheet for Nano Networks, Inc.

| | Dec. 2005 U.S. \$ (000) (Year) | Dec. 2004 U.S. \$ (000) (Year) |
|------------------------------|--------------------------------------|--------------------------------------|
| Balance Sheet Summary | | |
| Cash | 158,043 | 20,098 |
| Securities | 285,116 | 0 |
| Receivables | 24,582 | 8,056 |
| Allowances | 632 | 0 |
| Inventory | 0 | 0 |
| Current assets | 377,833 | 28,834 |
| Property and equipment, net | 20,588 | 10,569 |

| | | |
|------------------------------|---------|--------|
| Depreciation | 8,172 | 2,867 |
| Total assets | 513,378 | 36,671 |
| Current liabilities | 55,663 | 14,402 |
| Bonds | 0 | 0 |
| Preferred mandatory | 0 | 0 |
| Preferred stock | 0 | 0 |
| Common stock | 2 | 1 |
| Other stockholders' equity | 457,713 | 17,064 |
| Total liabilities and equity | 513,378 | 36,671 |

Income Statement Summary

| | | |
|--------------------|---------------|----------------|
| Total revenues | 102,606 | 3,807 |
| Cost of sales | 45,272 | 4,416 |
| Other expenses | 71,954 | 31,661 |
| Loss provision | 0 | 0 |
| Interest income | 8,011 | 1,301 |
| Income pretax | -6,609 | -69 |
| Income tax | 2,425 | 2 |
| Income continuing | -9,034 | -30,971 |
| Net income | -9,034 | -30,971 |
| EPS primary | -\$0.1 | -\$0.80 |
| EPS diluted | -\$0.10 | -\$0.80 |
| | -\$0.05 | -\$0.40 |

(split adjusted) (split adjusted)

The balance sheet that follows summarizes the financial conditions for Flex, Inc., an electronic outsourcing contractor, for fiscal-year 2005. Unlike Nano Network Corporation in Problem 2.3, Flex has reported a profit for several years running. Compute the various financial ratios and interpret the firm's financial health during fiscal-year 2005.

Balance Sheet

Summary

| | Aug. 2005 U.S. \$ (000) (12 mos.) | Aug. 2004 U.S. \$ (000) (Year) |
|------------------------------|---|--------------------------------------|
| Cash | 1,325,637 | 225,228 |
| Securities | 362,769 | 83,576 |
| Receivables | 1,123,901 | 674,193 |
| Allowances | 5,580 | -3,999 |
| Inventory | 1,080,083 | 788,519 |
| Current assets | 3,994,084 | 1,887,558 |
| Property and equipment, net | 1,186,885 | 859,831 |
| Depreciation | 533,311 | -411,792 |
| Total assets | 4,834,696 | 2,410,568 |
| Current liabilities | 1,113,186 | 840,834 |
| Bonds | 922,653 | 385,519 |
| Preferred mandatory | 0 | 0 |
| Preferred stock | 0 | 0 |
| Common stock | 271 | 117 |
| Other stockholders' equity | 2,792,820 | 1,181,209 |
| Total liabilities and equity | 4,834,696 | 2,410,568 |

Income Statement

Summary

| | | |
|------------------|-----------|-----------|
| Total revenues | 8,391,409 | 5,288,294 |
| Cost of sales | 7,614,589 | 4,749,988 |
| Other expenses | 335,808 | 237,063 |
| Loss provision | 2,143 | 2,254 |
| Interest expense | 36,479 | 24,759 |

Example: Conduct and interpret Ratios:

Debt Ratio, Current Ratio, Quick Ratio-Acid Test Ratio, Inventory Turnover Ratio, Total Asset Turnover, Profit Margin on Sales, Return on Total Assets, Price Earnings Ratio and Book Value Per Share

| | | |
|--------------------|----------------|----------------|
| Income pretax | 432,342 | 298,983 |
| Income tax | 138,407 | 100,159 |
| Income continuing | 293,935 | 198,159 |
| Discontinued | 0 | 0 |
| Extraordinary | 0 | 0 |
| Changes | 0 | 0 |
| Net income | 293,935 | 198,159 |
| EPS primary | \$1.19 | \$1.72 |
| EPS diluted | \$1.13 | \$1.65 |

Chapter 10: Assignments

- Define accounting. How do you formulate accounting equation.
- What is income statement and balance sheet? How are they related to each other?
- What do you mean by income statement and cash flow statement? What are the relationships and differences between them?
- Explain major ratios that can be applied in decision making process.
- Define ratio analysis. Explain the role of ratios on making decisions.
- Write short notes on:
 - Format of balance sheet
 - Format of income statement
 - Format of cash flow statement
 - Assets
 - Liabilities
 - Capital
- **Numerical Questions for Income Statement, Balance Sheet, Cash Flow Statement and Ratio Analysis**



Thank You

for participating in teaching/
learning process of Engineering
Economics.

Enjoy Further Learnings !!!