

K D K College of Engineering
Department of Civil Engineering
III Sem. B. Tech. (Civil Engineering)
Subject: - Economics for Engineers
Notes of Unit – I
Introduction to Demand Analysis

Introduction to economics

Economics is concerned with aspects of the production, exchange, distribution, and consumption of commodities, but this claim and the terms it contains are many times considered as vague. Economics is much wider than what it is said.

The conception of the economy as a distinct object of study dates back to the 18th century. Aristotle addresses some problems that most would recognize as pertaining to economics are mainly as problems concerning how to manage a household.

Philosophers addressed ethical questions concerning economic behavior, and they condemned the subject as it gives importance for money. With the increasing importance of trade and of nation-states in the early modern period, 'mercantilist' philosophers stressed on the balance of trade and the regulation of the currency.

Wealth definition of Economics

Adam Smith is a Scotland economist. He was born in 1723 A.D and died in 1790 A.D. He published a "An inquiry into the nature and causes of the wealth of nation" in 1776 A.D. and with this publication economics got its independent identity. Adam Smith is known as Father of economics.

According to him, "Prosperity of the individuals constitute the prosperity of the nation. Gain of wealth or after acquiring, the man can achieve his satisfaction"

Thus Adam Smith regarded economics as the science which studies the production and consumption of wealth.

Production and expansion of wealth were the subject matter of study of economics. Over the period, David Ricardo shifted the emphasis from the production of wealth to distribution of wealth.

Alfred Marshall, a pioneer neoclassical economist, reoriented Economics towards the study of mankind and provided economic science with a more comprehensive definition. Marshall, in his famous book 'Principle of Economics' published in 1890, defines economics as follows:

"Political Economy or Economics is a study of mankind in the ordinary business of life. It examines that

part of individual & social action which is most closely connected with the attainment & with the use of material requisites of well-being".

Marshall opined that for economics, wealth is not an end, but human welfare should be the end. 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". Thus this definition deals with-

1. It is study of human beings.
2. It makes studies on the economic aspects of human life; it deals with economic aspect of human life to material welfare of how man earns money and how he spends it.
3. It studies human welfare- only of economic or material welfare of human life.

Good

Goods are material things wanted by human beings. They can be seen or touched. Services are non-material things. These cannot be seen or touched only their effects are felt.

Classification of Goods and Services:

Goods and services are of many types. However, these can be classified into some broad groups.

Economic goods and non economic goods- Economic goods are the goods which have a price and their supply is less in relation to its demand. The production of such goods requires scarce resources having alternative uses. These economic goods relate to the problem of economizing scarce resources for the fulfillment of human wants.

Non-economic goods are available free and are free gift of nature .they do not possess any price and are available in unlimited quantities. At times they also possess price like economic goods.

Types of Economics

The study of economics is generally broken down into two disciplines.

Microeconomics focuses on how individual consumers and firm make decisions; these individuals can be a single person, a household, a business/organization or a government agency. Analyzing certain aspects of human behavior, microeconomics tries to explain they respond to changes in price and why they demand what they do at particular price levels.

Microeconomics tries to explain how and why different goods are valued differently, how individuals make financial decisions, and how individuals best trade, coordinate and cooperate with one another.

Macroeconomics studies an overall economy on both a national and international level. Its focus can include a distinct geographical region, a country, a continent, or even the whole world. Topics studied include foreign trade, government fiscal and monetary policy, unemployment rates, the level of inflation and interest rates, the growth of total production output as reflected by changes in the Gross Domestic

Product (GDP), and business cycles that result in expansions, booms, recessions, and depressions.

Micro and macroeconomics difference

Basis for comparison	Microeconomics	Macroeconomics
Meaning	The branch of economics that studies the behavior of an individual consumer, firm, family is known as Microeconomics.	The branch of economics that studies the behavior of the whole economy, (both national and international) is known as Macroeconomics.
Deals with	Individual economic variables	Aggregate economic variables
Application	internal issues	issues
Tools	Demand and Supply	Aggregate Demand and Aggregate Supply
Assumption	It assumes that all macro- economic variables are constant.	It assumes that all micro- economic variables are constant.
Concerned with	Theory of Product Pricing, Theory of Factor Pricing, Theory of Economic Welfare.	Theory of National Income, Aggregate Consumption, Theory of General Price Level, Economic Growth.
Scope	Covers various issues like demand, supply, product pricing, factor pricing, production, consumption, economic welfare, etc.	Covers various issues like, national income, general price level, distribution, employment, money etc.
Importance	Helpful in determining the prices of a product along with the prices of factors of production (land, labor, capital, entrepreneurship etc.) within the economy.	Maintains stability in the general price level and resolves the major problems of the economy like inflation, deflation, reflation, unemployment and poverty as a whole.
Limitations	It is based on unrealistic	It has been analyzed that

Principles of economics

Overview of Economic Principles

1. People Face Trade-offs
2. The Cost of Something is What You Give Up to Get It
3. Rational People Think at the Margin
4. People Respond to Incentives
5. Trade Can Make Everyone Better Off
6. Markets Are Usually a Good Way to Organize Economic Activity
7. Governments Can Sometimes Improve Market Outcomes
8. A Country's Standard of Living Depends on Its Ability to Produce Goods and Services
9. Prices Rise When the Government Prints Too Much Money
10. Society Faces a Short-Run Trade-off Between Inflation and Unemployment

Principle 1 – People Face Trade-offs (Trade-Off)

Every decision involves trade-offs.

Example: A person has to decide between spending money on a vacation or saving for future needs.

Principle 2 – The Cost of Something is What You Give Up to Get It (Opportunity Cost)

Opportunity cost is the next best alternative forgone when a decision is made.

Example: If you choose to spend time studying economics, the opportunity cost is the time you could have spent with friends or engaging in another activity.

Principle 3 – Rational People Think at the margin. (Marginal Decision Making)

Rational individuals make decisions by comparing the marginal benefits to the marginal costs.

Example: Should you study for one more hour before an exam? You weigh the benefit of a higher grade against the cost of losing sleep or leisure time.

Principle 4 – People Respond to Incentives

Incentives can influence people's decisions.

Positive incentives (rewards) and negative incentives (penalties) impact choices.

Example: A tax on cigarettes discourages smoking; subsidies for education encourage college enrollment.

Principle 5 – Trade Can Make Everyone Better Off (Benefit of Trade)

Trade allows people to specialize in what they do best, leading to more efficient production and better outcomes for everyone.

Example: A country may specialize in producing wine while another specializes in producing computers. Both countries benefit from trading.

Principle 6 – Markets Are Usually a Good Way to Organize Economic Activity (The Power of Markets)

Market economies allocate resources through the interaction of buyers and sellers, guided by prices.

Example: In a free market, prices rise when demand is high and fall when demand is low, helping balance supply and demand.

Principle 7 – Governments Can Sometimes Improve Market Outcomes (Role of Government)

Governments can intervene in markets to promote efficiency or fairness (e.g., regulation, taxation, subsidies).

Example: Governments may impose taxes to correct negative externalities like pollution or subsidize education to improve society's welfare.

Principle 8 – A Country's Standard of Living Depends on Its Ability to Produce Goods and Services (Productivity and Living Standards)

A higher level of productivity leads to greater income and a higher standard of living.

Investing in education, technology, and infrastructure boosts productivity.

Principle 9 – Prices Rise When the Government Prints Too Much Money (Inflation and Money Supply)

Inflation occurs when too much money is circulating in the economy.

Example: Hyperinflation in Zimbabwe in the late 2000s resulted from excessive money printing.

Principle 10 – Society Faces a Short-Run Trade-off Between Inflation and Unemployment (The Phillips Curve)

In the short run, policies that reduce inflation often result in higher unemployment and vice versa.

Example: During a recession, governments may focus on stimulating employment, which could lead to higher inflation.

Meaning and Types of Market

What is a Market?

A market is any place or system where buyers and sellers interact to exchange goods and services.

Markets play a critical role in the allocation of resources, setting prices, and facilitating trade.

Key Components of a Market

Buyers: Individuals or businesses that purchase goods and services.

Sellers: Producers or suppliers of goods and services.

Goods & Services: The products being exchanged.

Price: The value at which the transaction occurs.

Information: Both buyers and sellers must have sufficient information to make informed decisions.

The Law of Demand (Demand in a Market)

Demand: The quantity of a good or service that consumers are willing and able to purchase at different prices.

Law of Demand: As the price of a good rises, the quantity demanded generally falls, and vice versa.

The law of demand states that other factors being constant price and quantity demand of any good and service are inversely related to each other.

When the price of a product increases, the demand for the same product will fall.

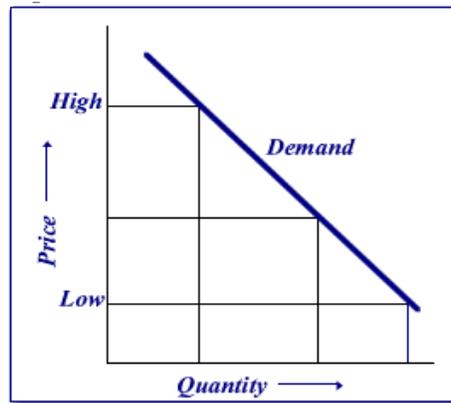


Fig. :- Law of Demand Curve

The Law of Supply (Supply in a Market):-

Supply: The quantity of a good or service that producers are willing and able to sell at different prices.

Law of Supply: As the price of a good rises, the quantity supplied generally increases, and vice versa.

The law of supply, when represented graphically, is depicted by an upward-sloping supply curve. This curve illustrates the positive relationship between price and quantity supplied, meaning that as the price of a good or service increases, the quantity that producers are willing to supply also increases, assuming all other factors remain constant.

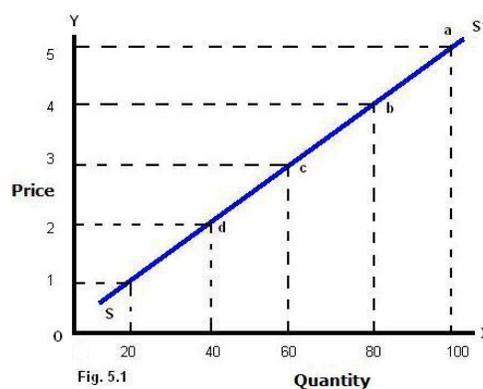


Fig. 5.1

Quantity

Fig.:-Law of Supply

Equilibrium Price and Quantity (Market Equilibrium)

Equilibrium: The point where the quantity demanded equals the quantity supplied.

Equilibrium Price: The price at which the market clears (no shortage or surplus).

Equilibrium Quantity: The quantity of goods bought and sold at the equilibrium price.

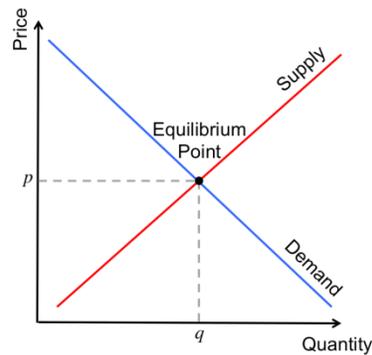


Fig.:- Demand and Supply curve showing equilibrium

The supply and demand curve is a visual representation of the relationship between the price of a good or service and the quantity that buyers are willing to purchase (demand) and sellers are willing to offer (supply).

It's a core concept in economics, used to understand how markets function and how prices are determined.

Market Shifts – Demand and Supply (How Markets Adjust)

Shift in Demand: When factors other than price (like income, preferences, or prices of related goods) change, the demand curve shifts.

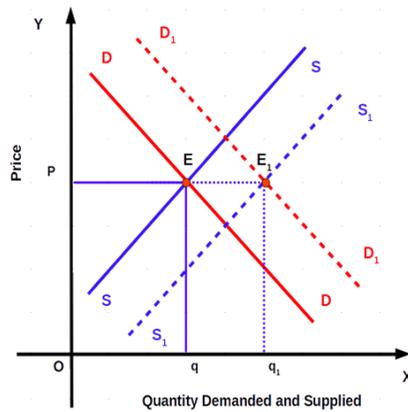
Example: A rise in income increases demand for normal goods.

Shift in Supply: When factors such as production costs, technology, or the number of sellers change, the supply curve shifts.

Example: A new technology that reduces production costs increases supply.

A shift in the demand or supply curve occurs when there is a change in the quantity demanded or supplied at every price level, due to factors other than the product's own price.

This is distinct from a movement along the curve, is solely caused by a change in price.

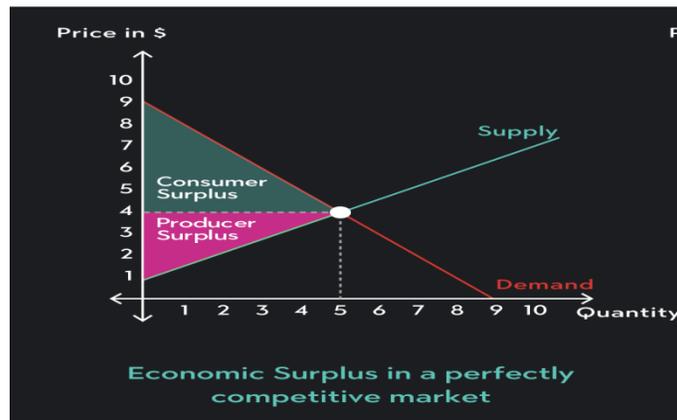


Market Efficiency

A market is efficient when it allocates resources in a way that maximizes the total benefit to society (consumer and producer surplus).

Consumer Surplus: The difference between what consumers are willing to pay and what they actually pay.

Producer Surplus: The difference between the price producers are willing to accept and the price they receive.



Market Failures (When Markets Fail):-

Markets don't always allocate resources efficiently. Market failure occurs when the market fails to deliver an efficient outcome.

Causes of market failure

Externalities: Costs or benefits not reflected in prices (e.g., pollution).

Public Goods: Goods that are non-rival and non-excludable (e.g., clean air).

Imperfect Competition: When one or a few sellers dominate the market.

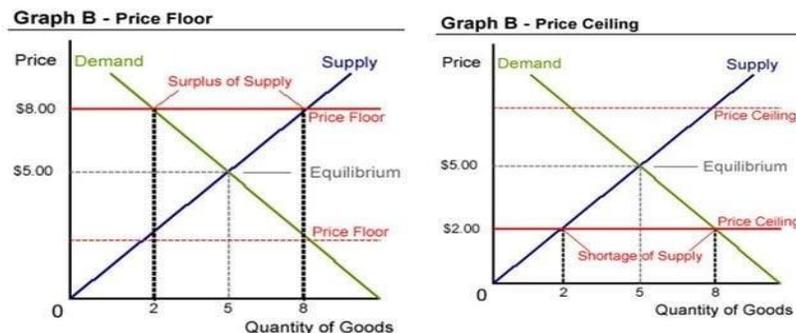
Information Asymmetry: When buyers or sellers have more information than the other party.

Price Controls – Price Floors and Ceilings (Government Intervention in Markets)

Price Floor: The minimum price set by the government (e.g., minimum wage). It can lead to a surplus if set above equilibrium.

Price Ceiling: The maximum price set by the government (e.g., rent control). It can lead to a shortage if set below equilibrium.

Graphs of Price Ceiling and Price Floor



Types of markets

Goods markets, labor markets, financial markets, etc.

The Role of Competition in Markets (The Power of Competition)

Perfect Competition: A market structure where many firms sell identical products, and no single firm has market power. This leads to efficient outcomes.

Monopoly: A market structure where a single seller controls the market, leading to inefficiency and higher prices.

Oligopoly: A market dominated by a few large sellers who may collude to set prices.

How Markets Respond to Changes (Dynamic Markets)

Markets are constantly adjusting in response to changes in supply, demand, and external factors.

Example: A rise in oil prices causes shifts in energy markets, affecting prices of gasoline and other goods.

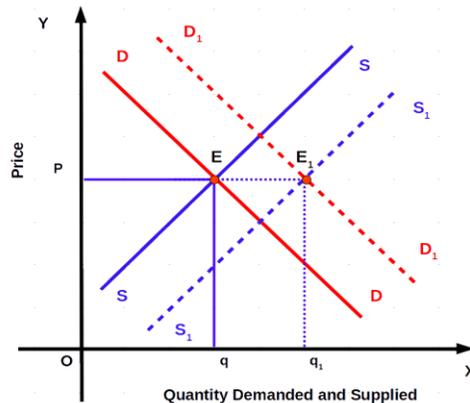


Fig.:-Show how a change in supply or demand leads to a new equilibrium.

The Importance of Market Understanding (Why Understanding Markets is Essential)

Understanding market dynamics helps businesses make better pricing, production, and investment decisions. It helps policymakers understand the impact of taxes, subsidies, and regulations on market behavior. Consumers benefit from understanding how supply and demand affect prices.

Meaning of Supply

Supply means the quantities that a seller is willing and able to sell at different prices. The supply refers to the schedule of the quantities of a good that the firms are able and willing to offer for sale at various prices. The amount of commodities that firms are able to supply depends upon on the availability of resources and the technology they employ to produce the goods. It is also determined by the willingness of the producer to supply the commodity at that price which determines his profit levels.

The term 'supply' refers to the entire relationship between the price of a commodity and the quantity supplied at various possible prices and can be illustrated by the supply curve or supply schedule. The supply of any good may then be defined "as a schedule of respective quantities of the good which people are ready to offer for sale at all possible prices."

Law of Supply

Law of supply expresses a relationship between the supply and price of a product. It states a direct relationship between the price of a product and its supply, while other factors are kept constant. “Other things remaining unchanged, the supply of a commodity rises i.e., expands with a rise in its price and falls i.e., contracts with a fall in its price.

In other words, it can be said that—”Higher the price higher the supply and lower the price lower the supply.

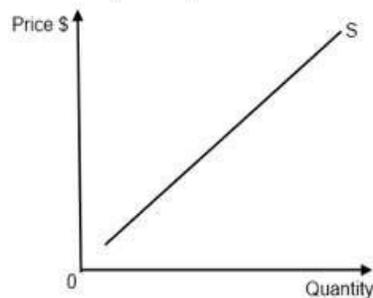
Assumptions of law of supply

1. Though the price of a product changes, but there will be no change in the cost of production.
2. There is no change in the technique of production. This is because the advanced technique would reduce the cost of production and make the seller supply more at a lower price.
3. There is no change in the scale of production.
4. The policies of the government will remain constant.
5. The transportation cost remains the same.
6. There is no speculation about prices in future, which otherwise can affect the supply of a product.

The law of supply can be derived with the help of supply schedule and supply curve. Supply Schedule: Supply schedule shows a tabular representation of law of supply. It presents the different quantities of a product that a seller is willing to sell at different price levels of that product. Supply Curve: The graphical representation of supply schedule is called supply curve.

Price Per Quantity	Quantity Supplied (in quintals)
500	100
510	150
520	200
530	225
540	250
550	275

The diagram -



In a graph, price of a product is represented on Y-axis and quantity supplied is represented on X- axis. As the price of the commodity increases, the seller will supply more commodities in the market. According to the law of supply, the quantity supplied of a commodity is directly or positively related to price. It is due to this positive relationship between price of a commodity and its quantity supplied that the supply curve of a commodity slopes upward to right as seen from supply curve SS. As the price of Commodity A rises from 520 to 530 per quintal, the quantity supplied of wheat in the market increases from 200 quintals to 225 quintals per period. It will be seen from the above table that when price of wheat is 500 per quintal, the 100 quintals of wheat are supplied in the market. When price of wheat rises to 510 per quintal, 150 quintals of wheat are supplied. When price of wheat goes up to 550 per quintals, its quantity supplied in the market rises to 275 quintal. By plotting the above supply schedule of wheat on a graph paper we have obtained supply curve SS.

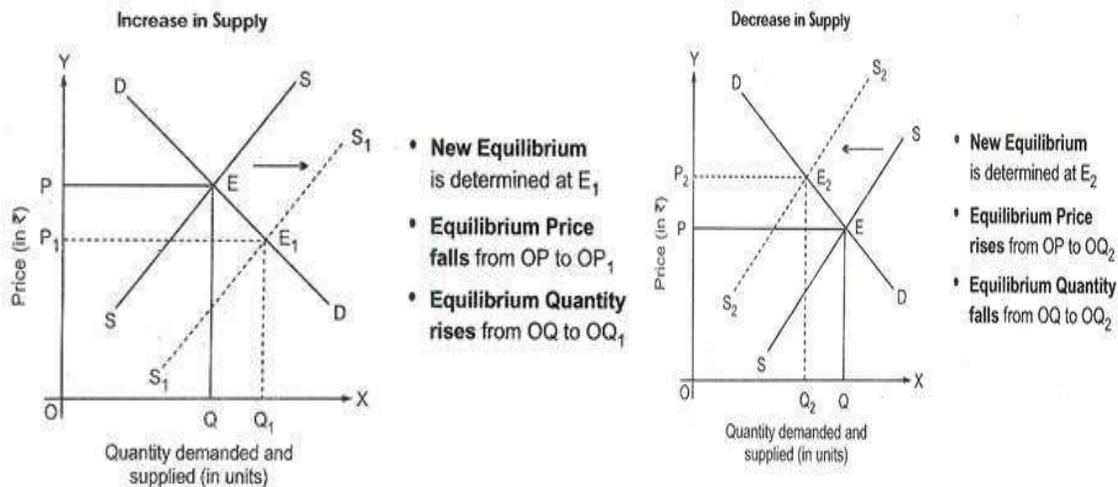
According to Law of Supply, other things remaining constant, an increase in price will increase the quantity supplied and vice versa. This relationship between price and quantity supplied under the given conditions is driven by profit motive of the producer /seller. The basic reason is that the cost chases as output expand as more is offered for sale. In this process, to produce more of a commodity, the firm has to devote more of its resources and when firm expands its production with increase in resources, the law of diminishing returns occurs. Thus more commodity is produced at higher cost sometimes and thus to cover the increase in cost it is supplied at higher price.

Increase and Decrease in Supply

The supply of a commodity in economics means the entire schedule or curve depicting the relationship between price and quantity supplied of the commodity, given the other factors influencing supply. These other factors are the state of technology, prices of inputs prices of other related commodities, etc., which are assumed constant when the relationship between price and quantity supplied of a commodity is

examined. It is the change in these factors other than price that cause a shift in the supply curve.

For example, when prices of inputs such as labor and raw materials used for the production of a commodity decline, this will result in lowering the cost of production which will induce the producers to produce and make available a greater quantity of the commodity in the market at each price. These increases in supply of a commodity due to the reduction in prices of inputs will cause the entire supply curve to shift to the right.



When there is an increase in supply, demand remaining unchanged, the supply curve shifts towards right from SS to S_1S_1 . When supply increases to S_1S_1 , it creates an excess supply at the old equilibrium price of OP . This leads to competition among sellers, which reduces the price. Decrease in price leads to rise in demand and fall in supply.

These changes continue till the new is established at point E_1 . Equilibrium price falls from OP to OP_1 and equilibrium quantity rises from OQ to OQ_1 .

When the supply decreases, demand remaining unchanged, then supply curve shifts to the left from SS to S_2S_2 . When supply decreases to S_2S_2 , it creates an excess demand at the old equilibrium price of OP . This leads to competition among buyers, which raises the price.

Increase in price leads to rise in supply and fall in demand. These changes continue till the new equilibrium is established at point E_2 . Equilibrium price rises from OP to OP_2 and equilibrium quantity falls from OQ to OQ_2 .

Factors determining supply- Supply does not depend only on the price of a commodity, but also on several other factors-

1. Production Technology- any change in production technology can bring about change cost of production. Adopting updated technology can reduce the cost of production.
2. Prices of factor inputs, changes in the price of any product input will bring about change in production cost.
3. Prices of other factors-these changes will cause substitution of one product for the other.
4. Objectives of the firms- supply here is determined by the aims of the firms, as to maximize sales or earn more profits.
5. Number of producers will determine the competition and availability of goods to be supplied in the market. More the number of producers higher will be the supply.
6. Future price expectations of sellers will also determine the supply of goods in the market.
7. Taxes and Subsidies also influence the supply of a product.

Meaning of Demand

The demand for any commodity, at a given price, is the quantity of it which will be bought per unit, of time at the price. From this definition of demand two things are quite clear:

Firstly, demand always refers to demand at a price. If demand is not related to price, it conveys no sense. To say that the demand for mangoes is 100 kg fails to convey any sense. It should be always related to price. Again in the words of Shearman, "To speak of the demand of a commodity in the sense of the mere amount that will be purchased without reference to any price will be meaningless."

Secondly, demand always means demand per unit of time. The time may be a day, a week or a month, etc.

Therefore, "the demand for any commodity or service is the amount that will be bought at any given price per unit of time."

There is a difference between 'desire' 'need' and 'demand'. A desire "will become demand only if a consumer has the means to buy a thing and also he is prepared to spend the money.. Suppose Ram has the desire of having a fan. But this desire will become demand only if he has 350 rupees and he is prepared to spend this money. Thus by demand -we mean the various quantities of a given commodity or service which -consumers would buy in the market in a given period of time at various prices. According to Pension, "Demand implies, three things (a) desire to possess a thing, (b) mean of purchasing it and (c) willingness to use those means for purchasing it."

Law of Demand

Law of demand establishes a relationship between the price and the quantity demanded of a commodity. Other things remaining the same, when the price of a commodity falls its demand will go up likewise when the price of a commodity rises its demand will fall. Price and demand move in opposite directions. There is no proportionate relationship between price and demand. A 10% fall in price will not necessarily lead to a 10% increase in demand.

In the words of Marshall, “The greater the amount to be sold, the smaller must be the price at which it is offered in order that it may find purchasers; or in other words, the amount demanded increases with a fall in price, and diminishes with a rise in price”.

According to Samuelson, “When the price of a good is raised; less of it will be demanded. People will buy more at lower price and buy-less at higher prices.”

According to Meyers, “People demand a larger quantity of goods and service only if a lower price than at a higher price.”

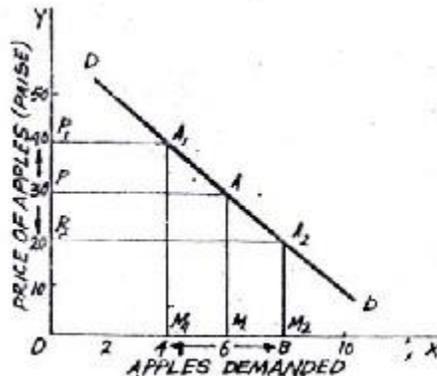
In simple words law of demand states that, other thing being equal, more will be demanded at lower, prices than at higher prices.

Law of demand can be shown with the help of the following table

Price of Apples (Paisa)	Demand for Apples (Unit)
50	2
40	4
30	6
20	8
10	10

When price is 30 Paisa, consumer demand is 6 apples. When price falls to 20 Paisa, he demands 8 apples and when price goes to 40 Paisa he demands 4 apples. Thus when price falls, demand expands and -when price rises, demand contracts.

Law of demand can - be shown with the help of the following diagram



We see that at OP price our demand increases to OP1 the demand falls to OM1. When the price falls to OP2 the demand increases to OM2.

Assumptions of the Law

The Law of Demand is based on the following assumptions :

1. Income of the buyer remains the same.
2. The taste of the buyer remains the same.
3. The prices of other goods—substitutes and complements— remain unchanged.
4. No close substitute is discovered.
5. There is no 'prestige value' for the product in question.

Only when these conditions are assumed constant, the Law of Demand will operate. In other words, the tastes, incomes and the prices of substitutes and complements are main determinants of price relationship. Hence I they are assumed constant.

Limitations of the Law/Exception to Law of Demand

1. Change in Habit, Customs and Income: Law of Demand tells us that demand goes up with a fall in price and goes down with a rise in price. But an increase in price will bring down the demand if at the same time the income of the consumer has also increased.
2. Necessaries of Life: Law of Demand is not applicable in the case of necessaries of life also. An increase in the price of flour will not bring down its demand. Likewise a fall in its price will not very much increase the demand for it.
3. Fear of Shortage in Future: If there is a fear of shortage of a commodity in future its demand

will increase in the present as people would start storing it. 'But according to the Law of Demand its demand should go up only when its price falls.

4. Fear of a Rise in Prices in Future: Similarly if the people think that the price of a particular, ^commodity will increase in future, they will store it. In other words, the demand of that commodity shall increase at the same price. But the Law of Demand states that demand should go up only if price will lower the demand.
5. Articles of Distinction This law does not hold good in case of those commodities which confer, social distinction. When the price of such commodities goes up, their demand shall also increase. For .example, an increase in the price of demand will raise its demand and a fall in price will lower the demand.

Price Elasticity of Demand

We have discussed in previous chapters that when the price of a good falls, its quantity demanded rises and when the price of the good rises, its quantity demanded falls. This is generally known as law of demand. This law of demand indicates only the direction of change in quantity demanded in response to a change in price. This does not tell us by how much or to what extent the quantity demanded of a good will change in response to a change in its price. This information as to how much or to what extent the quantity demanded of a good will change as a result of a change in its price is provided by the concept of elasticity of demand. The concept of elasticity has a very great importance in economic theory as well as in engineering economics.

Price elasticity of demand

Price elasticity means the degree of responsiveness or sensitiveness of quantity demanded of a good to changes in its prices. In other words, price elasticity of demand is a measure of the relative change in quantity purchased of a good in response to a relative change in its price. Price elasticity can be precisely defined as “the proportionate change in quantity demanded in response to a small change in price, divided by the proportionate change in price”.

Thus,

$$\text{Price Elasticity} = \frac{\text{Proportionate change in quantity demanded}}{\text{Proportionate change in price}}$$

Mathematically speaking, price elasticity of demand (e_p) is negative, since the change in quantity demanded is in opposite direction to the change in price. When price falls, quantity demanded rises and vice versa. But for the sake of convenience in understanding the magnitude of response of quantity demanded to the change in price we ignore the negative sign and take into account only the numerical value of the elasticity. Thus if 2% change in price leads to 4% change in quantity demanded of good A and 8% change in that of B, then the above formula of elasticity will give the value of price elasticity of good A equal to 2 and of good B equal to 4. It indicates that the quantity demanded of good B changes much more than that of good A in response to a given change in price. But if we had written minus signs before the numerical values of elasticity of two goods, that is, if we had written the elasticity as -2 and -4 respectively as strict mathematics would require us to do, then since -4 is smaller than -2, we would have been misled in concluding that price elasticity of demand of B is less than that of A.

Types of price elasticity

Different products react differently to the price change. A price change for an essential product such as rice has little impact on demand while the price change in other products has a huge impact on demand. This gives rise to the different types of price elasticity. Price elasticity are generally classified into the following categories.

- Perfectly elastic demand
- Absolutely inelastic demand or perfectly inelastic demand
- Unit elasticity of demand
- Relatively elastic demand
- Relatively inelastic demand

Interpretation:

- **Elastic Demand:** $PED > 1$ (Demand is sensitive to price changes)
- **Inelastic Demand:** $PED < 1$ (Demand is less sensitive to price changes)
- **Unitary Elastic Demand:** $PED = 1$ (Proportional change in quantity demanded and price)

Examples of Elastic and Inelastic Demand

- **Elastic Demand** ($PED > 1$):
Example: Luxury goods like high-end cars or designer clothes.
A small price increase leads to a significant decrease in quantity demanded.
- **Inelastic Demand** ($PED < 1$):
Example: Necessities like salt or basic medicines.
A price increase has little effect on the quantity demanded.

Price Elasticity of Supply (PES)

The price elasticity of supply (PES) is the measure of the responsiveness of the quantity supplied of a particular good to a change in price

$$PES = \% \text{ Change in QS} / \% \text{ Change in Price}$$

Interpretation:

- **Elastic Supply:** $PES > 1$ (Supply is responsive to price changes)
- **Inelastic Supply:** $PES < 1$ (Supply is not responsive to price changes)

Factors that affect PES:

- Time (short-run vs. long-run)
- Availability of factors of production
- Capacity to increase production

Examples of Elastic and Inelastic Supply

- **Elastic Supply** ($PES > 1$):

Example: Manufactured goods (e.g., smartphones, cars) where production can be ramped up.

- **Inelastic Supply** ($PES < 1$):

Example: Agricultural products (e.g., crops) where production is limited by factors like weather.

Income Elasticity of Demand (YED)

➤ **Income Elasticity of Demand (YED)**: Measures how the quantity demanded of a good responds to a change in consumer income.

$$YED = \frac{\% \text{Change in Quantity Demanded}}{\% \text{Change in Income}}$$

Interpretation:

- **Positive YED (Normal Goods)**: $YED > 0$ (Demand increases as income rises)
- **Negative YED (Inferior Goods)**: $YED < 0$ (Demand decreases as income rises)

Examples:

- **Normal Goods**: Organic food, electronics
- **Inferior Goods**: Instant noodles, generic brands

Cross-Price Elasticity of Demand (XED)

Cross-Price Elasticity of Demand (XED): Measures how the quantity demanded of one good responds to a change in the price of another good.

$$XED = \frac{\% \text{Change in Quantity Demanded of Good A}}{\% \text{Change in Price of Good B}}$$

Interpretation:

- **Positive XED (Substitutes)**: $XED > 0$ (An increase in the price of one good increases the demand for its substitute)
- **Negative XED (Complements)**: $XED < 0$ (An increase in the price of one good decreases the demand for its complement)

Examples:

- **Substitutes**: Tea and coffee
- **Complements**: Printers and ink cartridges

Applications of Elasticity in Business

Pricing Strategy: Businesses use elasticity to set prices. If demand is elastic, a price decrease may increase total revenue; if demand is inelastic, a price increase may increase total revenue.

Taxation: Governments use elasticity to predict the impact of taxes. If demand for a good is inelastic, consumers bear most of the tax burden.

Product Substitution: Understanding cross-price elasticity helps businesses identify competitive products and adjust pricing strategies.

Market Segmentation: Elasticity can help firms target different market segments based on income elasticity (e.g., premium vs. budget products).

Real-World Examples of Elasticity

Gasoline: Typically inelastic because people need it regardless of price changes.

Smartphones: Highly elastic, as consumers have many substitutes.

Movie Tickets: More elastic than gasoline, but less elastic than luxury items (e.g., designer handbags).

Elasticity and Public Policy

Taxation on Goods: Governments impose taxes on goods with inelastic demand to minimize economic distortions.

Price Controls: Understanding elasticity helps in setting price floors and ceilings (e.g., minimum wage, rent controls).

Subsidies: Governments subsidize goods with elastic demand to increase consumption (e.g., renewable energy).

Factors determining price elasticity of Demand

The elasticity of demand depends on the following factors namely

1. Nature of the product
2. Extent of usage
3. Availability of substitutes
4. Income level of people
5. Proportion of the income spent of the product
6. Urgency of demand and
7. Durability of a product.

Let us have a brief explanation of these points

Nature of the product

The demand for products that fall in the category of necessities (eg. Rice, salt, wheat etc) are usually inelastic. This is because their demand does not change even when there is a change in price. On the other hand the demands for luxuries (TV's, washing machines etc) are elastic where even a small change in price reflects on a huge change in the demand

Extent of usage

If a product has varied usage (eg. steel, aluminums, wood etc) then it has a comparatively elastic demand. For example, if the price of teak wood falls then its usage in many areas will be

increased and the opposite happens when the price rises, the usage in some quarters will be cut down while the usage in other and will be the same.

Availability of substitutes

When a product has many substitutes then its demand will be relatively elastic. This is because if the price of one substitute goes down then customers switch to that substitute and vice versa. Products without substitutes or has weak substitutes have relatively inelastic demand.

Income level of people

People with high income are less affected by price changes in products while people with low income, are highly affected by price rise. People with high income will not change their buying habits because of the increase in price of either essential commodities or luxuries while other will cut back on purchase of certain commodities to compensate for the essential commodities if there is a price increase.

Proportion of income spent on the commodity

When a person spends only a very small part of his income on certain products (match boxes, salt etc) the price change in these products does not materially affect his demand for the product. Here the demand is inelastic.

Urgency of Demand

If a person requires buying a product immediately no matter what or no other go but to-buy a product at that point of time, with no substitutes, the demand for that product becomes inelastic. For example if one is building a lodge and is in urgent need for completing the construction then, any price change in cement or bricks or steel etc will have little impact on the demand for those products.

Consumer's Equilibrium

Consumer's Equilibrium refers to the state where a consumer maximizes their satisfaction or utility, given their income and the prices of goods and services.

The consumer allocates their limited income in such a way that they get the maximum possible satisfaction from all goods and services they consume.

Utility and Total vs. Marginal Utility

Utility: The satisfaction or pleasure derived from consuming goods and services.

Total Utility (TU): The overall satisfaction a consumer gains from consuming a given quantity of a good or service.

Marginal Utility (MU): The additional satisfaction gained from consuming one more unit of a good or service.

Types of Marginal Utility

Based on the relationship between the total and the Marginal Utility, there are three types of marginal utility.

Positive

The marginal utility is positive when the consumption of an additional unit of a product results in the increase in the total utility. Getting a coupon of free hair spa is its example.

Negative

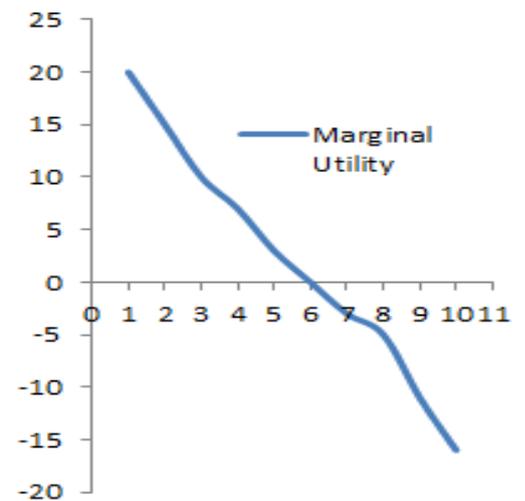
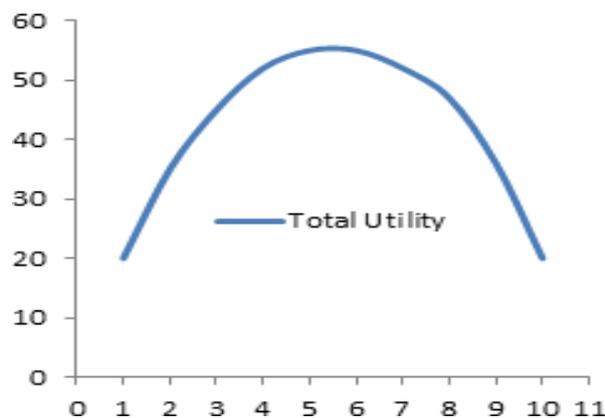
It is negative when the consumption of an additional unit of a product results in the decrease in the total utility. Taking more vitamin supplements or overtake of some medicine is its example.

Zero

It is zero when the consumption of an additional unit of a product results in no change in the total utility. Getting two copies of the same novel is one of the examples of zero marginal utility.

Suppose we have data for the marginal and the total utility for different units of ice creams. Let us see the relation between the two.

Units	Total Utility	Marginal Utility
1	20	20
2	35	15
3	45	10
4	52	7
5	55	3
6	55	0
7	52	-2
8	47	-5
9	36	-11
10	20	-16



Utility and its application

Law of Diminishing Marginal Utility

The law of diminishing marginal utility is comprehensively explained by Alfred Marshall. According to his definition of the law of diminishing marginal utility, the following happens:

“During the course of consumption, as more and more units of a commodity are used, every successive unit gives utility with a diminishing rate, provided other things remaining the same; although, the total utility increases.”

Utils: 'Utils' is considered as the measurable 'unit' of utility.

Explanation for the Law of Diminishing Marginal Utility

We can briefly explain Marshall's theory with the help of an example. Assume that a consumer consumes 6 apples one after another. The first apple gives him 20 utils (units for measuring utility). When he consumes the second and third apple, the marginal utility of each additional apple will be lesser. This is because with an increase in the consumption of apples, his desire to consume more apples falls.

Therefore, this example proves the point that every successive unit of a commodity used gives the utility with the diminishing rate.

We can explain this more clearly with the help of a schedule and diagram.

Conditions for Consumer's Equilibrium

1. The Equalization of Marginal Utility per Rupee Spent:

Consumers maximize their utility when the ratio of the marginal utility (MU) to the price (P) of all goods is the same.

2. Total Expenditure Equals Income:

The consumer's total expenditure on goods must be equal to their income.

The consumer maximizes total utility by equating the marginal utility per dollar spent on each good.

Illustration: Suppose a consumer has a choice between two goods, say Good 1 and Good 2:

If the marginal utility per dollar spent on Good 1 exceeds that of Good 2, the consumer will spend more on Good 1.

The consumer will continue reallocating their budget until the marginal utility per dollar is the same for both goods.

Budget Constraint

The Budget Line: A graphical representation of the different combinations of goods a consumer can afford with a given income.

Slope of the Budget Line: The ratio of the prices of two goods, showing the trade-off between them.

Consumers choose the point on the budget line that maximizes their utility.

A budget constraint represents the combinations of goods a consumer can afford given their income and the prices of those goods, while the consumption point of equilibrium is the point where the consumer maximizes their satisfaction (utility) within the limitations of their budget. This equilibrium point is reached when the budget line (representing the budget constraint) is tangent to the highest possible indifference curve (representing the consumer's preferences).

Changes in Consumer's Equilibrium

Change in Income:

An increase in income shifts the budget line outward, allowing the consumer to purchase more of both goods.

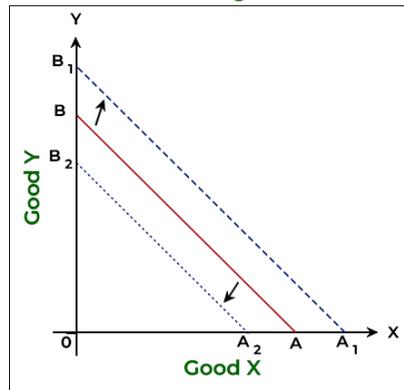
The consumer will reallocate spending to maintain the condition of equal marginal utility per Rupee.

Change in Prices:

A change in the price of a good changes the budget line's slope, causing the consumer to adjust their consumption of the affected good.

If the price of a good falls, the consumer will likely purchase more of that good.

Effect of change in Income on Budget Line



Limitations of the Consumer's Equilibrium Theory

Assumptions

Consumers aim to maximize utility.

Marginal utility is measurable and can be compared across goods.

Consumers have perfect knowledge of the prices and utility of all goods.

The theory assumes that consumer preferences are stable and rational.

Limitations:

Realistic Behavior: Consumers may not always behave rationally due to psychological, social, or other factors.

Measurement Problems: Measuring utility and marginal utility is difficult in practice.

Applications of Consumer's Equilibrium

Pricing Strategy: Businesses can understand how consumers allocate their budgets to maximize utility and use this information to set optimal prices.

Policy Making: Governments use this theory to design tax policies and subsidies.

Advertising and Marketing: Companies understand that consumers will maximize utility within their budget, influencing how products are marketed.

K D K College of Engineering
Department of Civil Engineering
III Sem. B. Tech. (Civil Engineering)
Subject: - Economics for Engineers
Unit – I: Question Bank

1. Define economics.
2. Discuss economics defined by diff. authors.
3. What are the principles of economics?
4. Elaborate the principles of economics with suitable examples.
5. What is market; explain in short the diff types of markets.
6. What are the key components of market, explain in short.
7. Define demand.
8. What are the imp aspects of demand?
9. State the law of demand? What factors have influenced on demand.
10. What are the market forces?
11. Define supply and also state the law of supply with suitable ex.
12. State the factors which have influenced on supply.
13. What is the meaning of market equilibrium, explain with the help of graph and also state the equilibrium price & quantity.
14. Explain surplus & shortages with reference to market equilibrium.
15. Describe the shift in demand & supply with proper graph.
16. What is the impact of shift on market equilibrium?
17. Give the real world ex. of supply & demand.
18. What is elasticity? State diff. types of elasticity.
19. Explain price elasticity of demand with suitable ex. also state the factors affecting price elasticity of demand.
20. Explain price elasticity of supply along with suitable ex. and also the factors affecting it.
21. Write short notes on income elasticity of demand & cross price elasticity of demand. Discuss the applications of elasticity in business.

22. Give the real world ex. of elasticity.
23. How elasticity is helpful in deciding the Gov. Policies.
24. What is consumer's equilibrium?
25. How does a consumer decide what combinations of goods to buy to Max Utility?
26. Define utility & marginal utility & state their relationship.
27. State law of diminishing marginal utility with suitable example.
28. Define budget line & explain it with suitable or graph.
29. What are the factors responsible for changes in consumer's equilibrium, explain?
30. State the assumptions and limitations of consumer's equilibrium theory along with Suitable examples.

Economics for Engineers

Unit – 2

Theory of Production, Costs & Firm

THE THEORY OF PRODUCTION

- The *firm* is an economic institution that transforms factors of production into consumer goods.
 - Organizes factors of production.
 - Produces goods and services.
 - Sells produced goods and services.
- Production involves transformation of inputs such as capital, equipment, labor, and land into output - goods and services
- Inputs are any thing that can be used in the production of goods and services. E.g. labor, land, capital & entrepreneurship.
- In this production process, the manager is concerned with *efficiency* in the use of the inputs
 - technical vs. economical efficiency

Two Concepts of Efficiency

- Economic efficiency:
 - occurs when the cost of producing a given output is as low as possible
- Technological efficiency:
 - occurs when it is not possible to increase output without increasing inputs

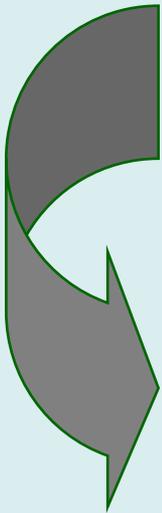
You will see that basic production theory is simply an application of constrained optimization:

the firm attempts either to minimize the cost of producing a given level of output

or

to maximize the output attainable with a given level of cost.

Both optimization problems lead to same rule for the allocation of inputs and choice of technology



Production Function

- A *production function* is purely technical relation which connects factor inputs & outputs. It describes the transformation of factor inputs into outputs at any particular time period.

$$Q = f(L, K, R, L_d, T, t)$$

where

Q = output

R= Raw Material

L= Labour

L_d = Land

K= Capital

T = Technology

t = time

For our current analysis, let's reduce the inputs to two, capital (K) and labor (L):

$$Q = f(L, K)$$

Production Table

Units of K Employed	Output Quantity (Q)							
	1	2	3	4	5	6	7	8
8	37	60	83	96	107	117	127	128
7	42	64	78	90	101	110	119	120
6	37	52	64	73	82	90	97	104
5	31	47	58	67	75	82	89	95
4	24	39	52	60	67	73	79	85
3	17	29	41	52	58	64	69	73
2	8	18	29	39	47	52	56	52
1	4	8	14	20	27	24	21	17

Same Q can be produced with different combinations of inputs, e.g. inputs are substitutable in some degree

Short-Run and Long-Run Production

- In the short run some inputs are fixed and some variable
 - e.g. the firm may be able to vary the amount of labor, but cannot change the amount of capital
 - in the short run we can talk about *factor productivity / law of variable proportion / law of diminishing returns*

- In the long run all inputs become variable
 - e.g. the long run is the period in which a firm can adjust *all* inputs to changed conditions
 - in the long run we can talk about *returns to scale*



Short-Run Changes in Production Factor Productivity

Units of K Employed	Output Quantity (Q)							
8	37	60	83	96	107	117	127	128
7	42	64	78	90	101	110	119	120
6	37	52	64	73	82	90	97	104
5	31	47	58	67	75	82	89	95
4	24	39	52	60	67	73	79	85
3	17	29	41	52	58	64	69	73
2	8	18	29	39	47	52	56	52
1	4	8	14	20	27	24	21	17
	1	2	3	4	5	6	7	8
	Units of L Employed							

How much does the quantity of Q change, when the quantity of L is increased?

Long-Run Changes in Production Returns to Scale

Units of K Employed	Output Quantity (Q)							
8	37	60	83	96	107	117	127	128
7	42	64	78	90	101	110	119	120
6	37	52	64	73	82	90	97	104
5	31	47	58	67	75	82	89	95
4	24	39	52	60	67	73	79	85
3	17	29	41	52	58	64	69	73
2	8	18	29	39	47	52	56	52
1	4	8	14	20	27	24	21	17
	1	2	3	4	5	6	7	8
	Units of L Employed							

How much does the quantity of Q change, when the quantity of both L and K is increased?

Relationship Between Total, Average, and Marginal Product: Short-Run Analysis

- Total Product (TP) = total quantity of output
- Average Product (AP) = total product per total input
- Marginal Product (MP) = change in quantity when one additional unit of input used

The Marginal Product of Labor

- The marginal product of labor is the increase in output obtained by adding 1 unit of labor but holding constant the inputs of all other factors

Marginal Product of L:

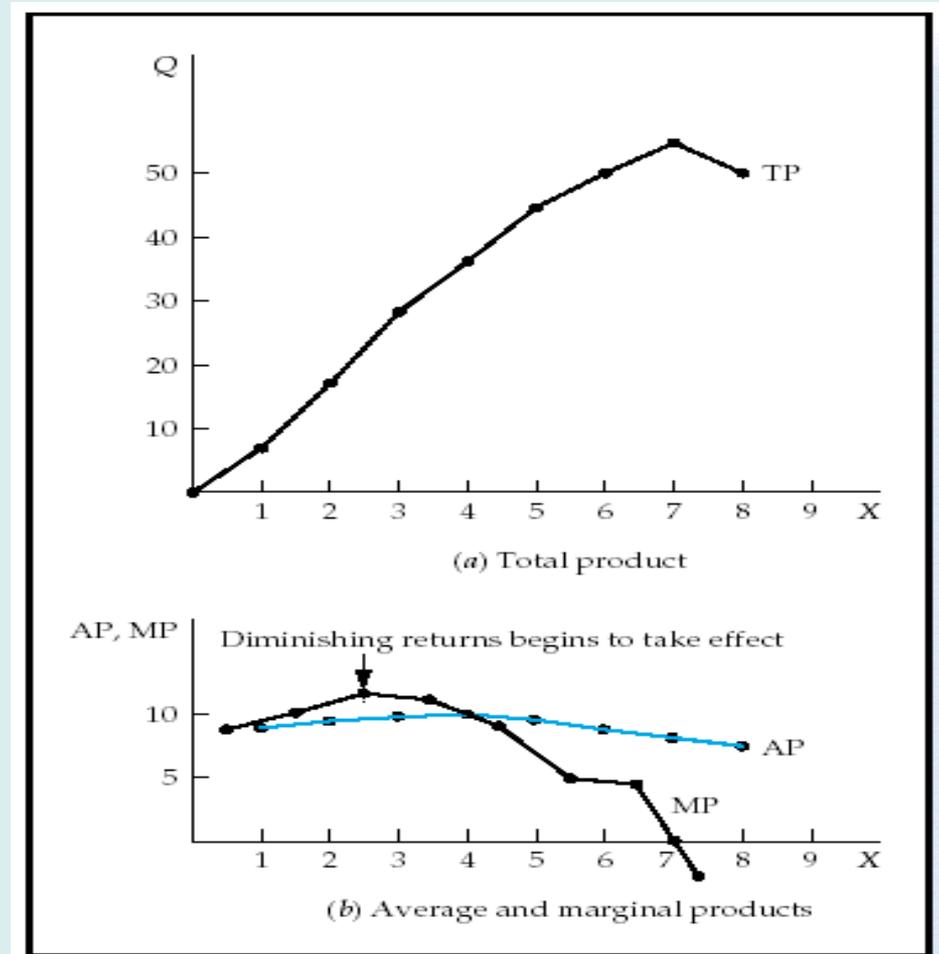
$$\begin{aligned}MP_L &= \Delta Q / \Delta L \quad (\text{holding } K \text{ constant}) \\ &= \delta Q / \delta L\end{aligned}$$

Average Product of L:

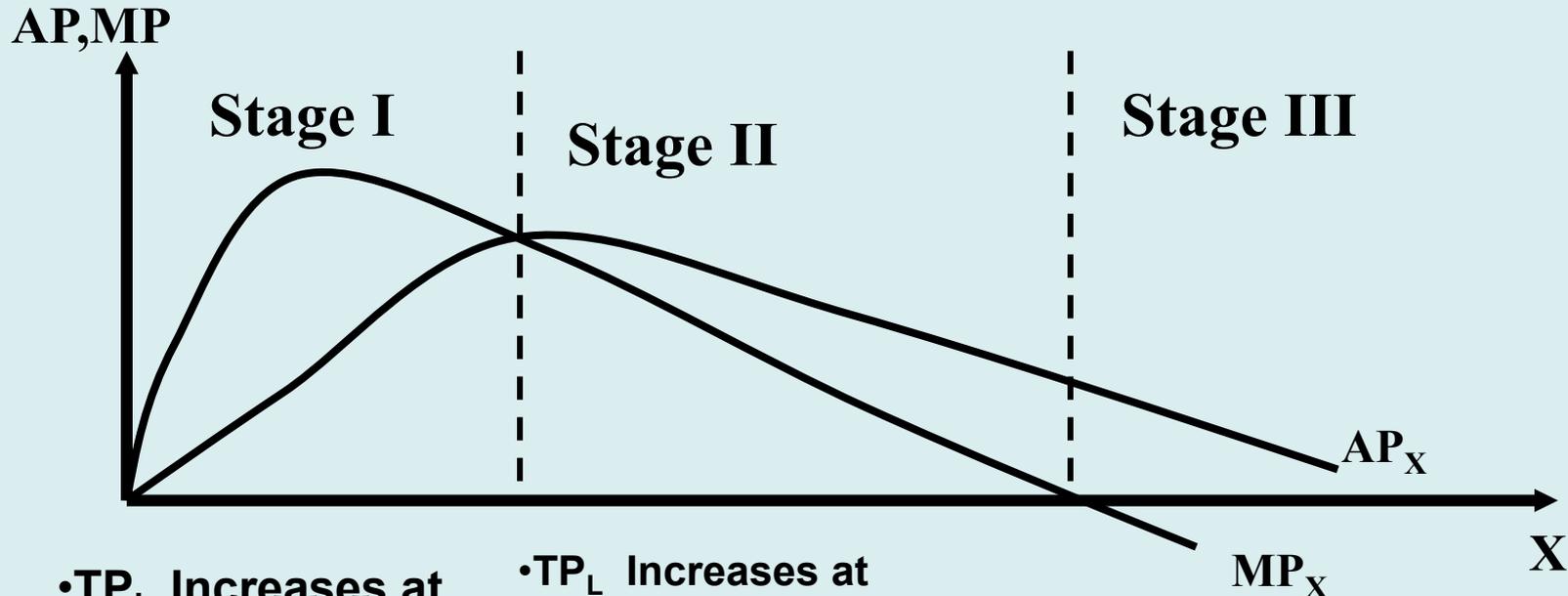
$$AP_L = Q / L \quad (\text{holding } K \text{ constant})$$

Short-Run Analysis of Total, Average, and Marginal Product

- If $MP > AP$ then AP is rising
- If $MP < AP$ then AP is falling
- $MP = AP$ when AP is maximized
- TP maximized when $MP = 0$



Three Stages of Production in Short Run



- TP_L Increases at increasing rate.

- MP Increases at decreasing rate.

- AP is increasing and reaches its maximum at the end of stage I

- TP_L Increases at Diminishing rate.

- MP_L Begins to decline.

- TP reaches maximum level at the end of stage II, $MP = 0$.

- AP_L declines

- TPL begins to decline

- MP becomes negative

- AP continues to decline

Three Stages of Production				
Labor Unit (X)	Total Product (Q or TP)	Average Product (AP)	Marginal Product (MP)	Stages of Production
1	24	24	24	
2	72	36	48	I
3	138	46	66	Increasing
4	216	54	78	Returns
5	300	60	84	
6	384	64	84	
7	462	66	78	
8	528	66	66	II
9	576	64	48	Diminishing
10	600	60	24	Returns
11	594	54	-6	III
12	552	46	-42	Negative Returns

Law of Diminishing Returns (Diminishing Marginal Product)

The law of diminishing marginal returns states that in the short run, if you increase one input while keeping other factors fixed, the additional output gained from each new unit of the input will eventually decrease.

Assumptions. The law of diminishing returns is based on the following assumptions: (i) the state of technology is given (ii) labour is homogenous and (iii) input prices are given.

For example, adding more workers to a fixed factory space can initially increase output, but eventually, the workers will get in each other's way, and each additional worker will contribute less to total production, leading to a decline in marginal output.

Application of Law of Diminishing Returns:

- It helps in identifying the rational and irrational stages of operations.
- It gives answers to question –
How much to produce?
What number of workers to apply to a given fixed inputs so that the output is maximum?

Production in the Long-Run

- All inputs are now considered to be variable (both L and K in our case)
- How to determine the optimal combination of inputs?

To illustrate this case we will use *production isoquants*.

An *isoquant* is a locus of all technically efficient methods or all possible combinations of inputs for producing a given level of output.

Cost

- ***Fixed costs*** are those that cannot be changed in the period of time under consideration regardless of output.
 - In the long run there are no fixed costs since all costs are variable.
 - In the short run, a number of costs will be fixed.

- ***Variable costs*** are costs that changes as output changes, such as the costs of labor and materials.
- The sum of the fixed costs and variable costs are total costs.

$$TC = FC + VC$$

- ***Average total cost*** (often called average cost) equals total cost divided by the quantity produced.

$$ATC = TC/Q$$

- ***Average fixed cost*** equals fixed cost divided by quantity produced.

$$AFC = FC/Q$$

- ***Average variable cost*** equals variable cost divided by quantity produced.

$$AVC = VC/Q$$

- Average total cost can also be thought of as the sum of average fixed cost and average variable cost.

$$ATC = AFC + AVC$$

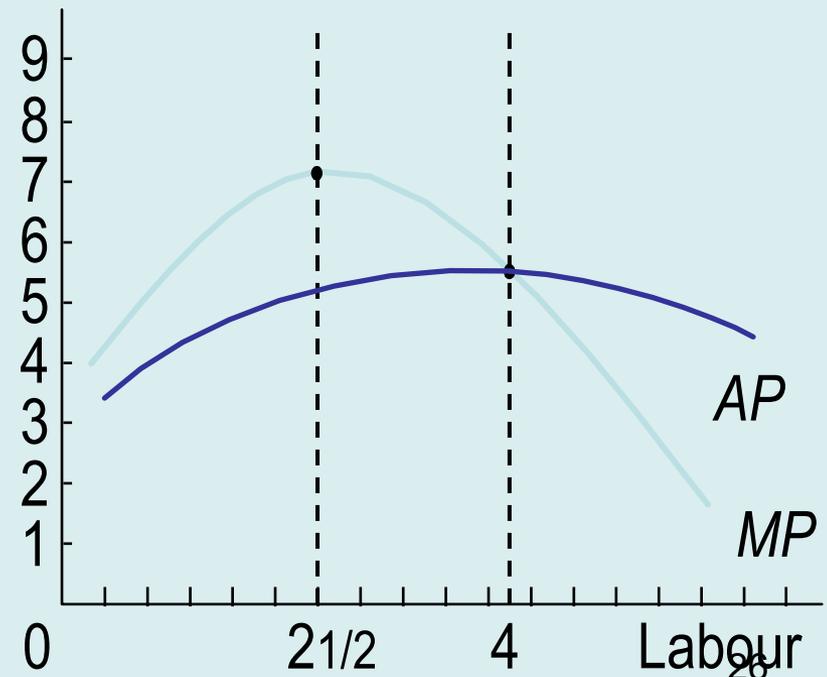
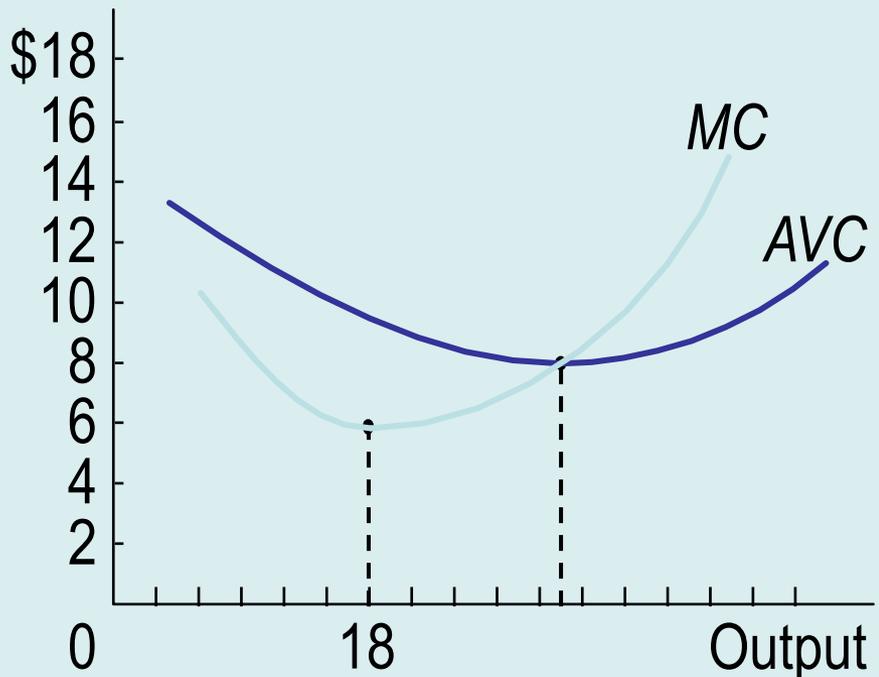
- ***Marginal cost*** is the increase in total cost of increasing the level of output by one unit,

$$MC = \Delta TC / \Delta Q$$

- In deciding how many units to produce, the most important variable is marginal cost.

Relationship Between Productivity and Costs

- The shapes of the cost curves are mirror-image reflections of the shapes of the corresponding productivity curves.



- The marginal cost and average cost curves are related.
 - When marginal cost exceeds average cost, average cost must be rising.
 - When marginal cost is less than average cost, average cost must be falling.
 - This relationship explains why marginal cost curves always intersect average cost curves at the minimum of the average cost curve.

- To summarize:

If $MC > ATC$, then ATC is rising.

If $MC = ATC$, then ATC is at its minimum.

If $MC < ATC$, then ATC is falling.

Cost and Revenue Behaviour

In production, costs generally increase with output, driven by variable costs like raw materials and labor, while fixed costs remain constant in the short run.

Revenue, the income from selling output, typically rises with increased production and sales, but its behavior is influenced by market demand and pricing.

The relationship between rising costs and increasing revenue determines profit, with firms aiming to maximize this difference through efficient resource allocation and pricing strategies.

Cost Behavior

Costs are expenses incurred to transform inputs into outputs.

Fixed Costs (FC): Costs that do not change with the level of output in the short run, such as rent for a factory or salaries of permanent staff.

Variable Costs (VC): Costs that change directly with the quantity of output produced, such as raw materials, direct labor, and utilities.

Total Cost (TC): The sum of fixed costs and variable costs ($TC = FC + VC$).

Marginal Cost (MC): The additional cost incurred from producing one more unit of output ($\Delta TC / \Delta Q$).

Revenue Behavior

Revenue is the income a firm earns from selling its products or services.

Total Revenue (TR): The total income generated from the sale of a specific quantity of output ($TR = \text{Price} \times \text{Quantity}$).

Average Revenue (AR): Revenue per unit of output ($AR = TR/Q$).

Marginal Revenue (MR): The additional revenue generated by selling one more unit of output.

Relationship between Costs and Revenue

The core objective of a firm is to maximize profit, which is the difference between total revenue and total cost.

Cost-Volume-Profit Analysis: Firms analyze how changes in production volume affect their costs and revenues to make informed decisions.

Economies of Scale: As production increases, firms can achieve economies of scale, leading to lower average costs per unit due to increased efficiency and specialization.

Law of Diminishing Returns: In the short run, adding more variable input (like labor) to fixed inputs can eventually lead to smaller increases in output, which raises the marginal cost per unit.

Key Aspects

Short Run vs. Long Run: In the short run, at least one input is fixed, while in the long run, all inputs are variable, allowing for significant changes in the scale of production.

Decision Making: Understanding cost and revenue behavior helps in decisions related to pricing, production levels, and resource allocation to achieve profitability.

Profit Maximisation: The optimal level of production occurs where marginal cost equals marginal revenue ($MC = MR$), ensuring that the firm maximizes its profit.

Resource optimization

Resource optimization in production is the strategic process of effectively using available assets—like labor, machinery, materials, and finances—to maximize efficiency, minimize waste, and achieve production goals.

It involves analysing current resource use, forecasting future needs, and implementing techniques such as resource levelling to ensure resources are allocated optimally for higher productivity and better financial outcomes.

Key Aspects of Resource Optimization

Strategic Allocation: Resources are matched to production schedules and project requirements to ensure the right resources are in the right place at the right time.

Waste Reduction: A primary goal is to identify and eliminate inefficiencies and unnecessary consumption of resources.

Improved Productivity: By using resources more effectively, organizations can increase output, improve overall operational performance, and meet organizational objectives.

Cost Savings: Optimizing resource usage leads to reduced costs for labor, materials, and machinery, contributing to a healthier bottom line.

Techniques and Tools

Resource levelling: Aims to adjust resource use to avoid peaks and troughs in demand by extending the project duration if necessary.

Resource Smoothing: Aims to smooth out resource usage by adjusting the project schedule within its original duration to keep resource demand constant.

Forecasting and Planning: Involves analyzing past data and future demand to predict resource needs accurately.

Software and Technology: Modern resource management software can help track resource availability, allocate resources, monitor utilization, and automate certain processes.

How It Improves Production

- Higher Output: Efficient resource utilization leads to greater productivity and output.
- Better Project Alignment: Ensures projects run more smoothly by aligning people, budgets, and tools, leading to less wasted effort.
- Enhanced Competitiveness: By improving efficiency and reducing costs, companies can become more competitive in the market.

Firm's behavior

Firm behavior in production centers on a company's decisions about how much to produce, focusing on profit maximization.

This involves understanding the relationship between inputs and outputs (the product function), analyzing costs, and applying marginal analysis (comparing marginal revenue to marginal cost) to find the output level that generates the most profit.

Firms also consider return to scale, which describe how output changes when inputs are increased, impacting long-term production decisions.

Key Elements of Firm Behavior in Production

- **Profit Maximization:** The primary goal is to produce and sell a quantity of goods that maximizes the firm's profit.
- **Production Function:** Firms use the production function, which shows how inputs (like labor, land, and capital) are transformed into outputs.
- **Cost Analysis:**
 - **Fixed vs. Variable Costs:** Firms consider costs that don't change with output (fixed) and costs that do (variable) when making decisions.
 - **Marginal Cost vs. Average Total Cost:** The relationship between marginal cost (cost of producing one more unit) and average total cost helps determine efficient output levels.
 - **Marginal Analysis:** The decision-making principle that firms use to find the profit-maximizing output is to produce where marginal revenue (MR) equals marginal cost (MC).
- **Returns to Scale:**
 - **Increasing Returns to Scale:** Output increases more than proportionately when all inputs are increased.
 - **Constant Returns to Scale:** Output increases by the same proportion as the increase in inputs.
 - **Decreasing Returns to Scale:** Output increases by less than the proportionate increase in inputs.

How These Elements Influence Production Decisions

1. **Input-Output Relationship:** Firms decide how much to produce by understanding how changes in inputs affect output.
2. **Cost and Revenue Optimization:** They weigh the cost of additional units of output against the revenue generated, seeking the balance point that leads to maximum profit.
3. **Supply Curve:** By analyzing their cost structure and profit-maximizing output at various prices, firms can derive their supply curve, which shows how much they are willing to produce at different market prices.
4. **Strategic Decisions:** Firms may change their behavior by adopting innovative technologies or participating in cluster development to increase productivity and profit.

Competitive Market

A competitive market in production is a market structure with many producers and consumers, where no single participant can influence market prices or quantities. Instead, prices and production levels are determined by the intersection of market supply and demand, a process that creates efficient allocation of resources and seeks to maximize benefits for both producers and consumers. Key characteristics include identical products (homogeneity), ease of entry and exit for firms, and each firm being a "price-taker," accepting the market price rather than setting it.

Key Characteristics of a Competitive Market

- **Many Buyers and Sellers:** A large number of participants ensures that no single entity can significantly control the market.
- **Homogeneous Products:** Producers offer identical or very similar goods and services, making them indistinguishable to buyers.
- **Free Entry and Exit:** Firms can easily enter or leave the market without significant barriers, allowing for dynamic adjustments in response to market conditions.
- **Price Takers:** Individual producers must accept the market-determined price for their product; trying to sell at a higher price will result in lost sales, while selling lower is unnecessary.
- **Market-Driven Prices:** The overall forces of supply and demand set the market price.
- **Profit Motive:** Producers are driven by the desire to make a profit, which encourages efficiency and innovation in a competitive environment.

How Competitive Production Works

- Supply and Demand Intersection: The market price is established at the point where the quantity of goods producers are willing to supply meets the quantity consumers demand.
- Firm-Level Decisions: Each individual firm then produces a quantity of goods where their marginal cost equals the market price to maximize their profit.
- Efficiency and Resource Allocation: In a competitive market, resources are allocated efficiently because firms produce at the lowest possible average total cost.
- Long-Run Equilibrium: In the long run, the freedom of entry and exit means that firms will operate where price equals the minimum average total cost, resulting in zero economic profits.
- In essence, the production in a competitive market is a dynamic process driven by competition, resulting in products that are priced according to market forces and produced with maximum efficiency to satisfy consumer demand.

Monopoly Market

A monopoly market in production is where one firm is the sole producer of a good or service with no close substitutes, allowing it to control supply, set prices (a "price maker"), and face high barriers to entry for potential competitors. Reasons for monopolies include exclusive control over resources, government restrictions or patents, and economies of scale where high fixed costs make it difficult for other firms to enter. In production, a monopolist maximizes profit by choosing a quantity where its marginal revenue equals its marginal cost, setting the price higher than in competitive markets, leading to potential inefficiencies and higher prices for consumers.

Key Characteristics

- **Single Seller:** Only one firm supplies the entire market.
- **No Close Substitutes:** Consumers have few, if any, alternative options.
- **High Barriers to Entry:** Obstacles, such as patents, high start-up costs, or exclusive rights, prevent other firms from entering the market.
- **Price Maker:** Unlike firms in competitive markets (price takers), a monopolist can influence or set the market price for its product.
- **Market Control:** The firm has significant control over the supply of the product.
- **Causes of Production Monopolies**
- **Exclusive Ownership:** A firm may control essential raw materials or resources needed for production.
- **Government Restrictions:** Governments can grant exclusive rights or licenses to a single company, such as in the case of public utilities or certain patents.

Key Characteristics...Contd

- Economics of Sale: High fixed costs can mean that a large, single firm can produce at a lower cost per unit than smaller competitors, effectively creating a natural monopoly.
- Patents and Intellectual Property: A firm can gain a monopoly by developing a unique product or technology and securing a patent or copyright.
- Implications for Production
- Profit Maximization: Monopolists aim to set prices and output levels that maximize their profits, typically by producing where marginal cost equals marginal revenue.
- Restricted Output and Higher Prices: Monopolies tend to produce less output and charge higher prices than a competitive market would, reducing consumer welfare.
- Potential for Inefficiency: Without competitive pressure, monopolies may not produce at their most cost-efficient level (not productively efficient) or provide the goods and services consumers truly want (not allocatively efficient).
- Long-Term Innovation: While monopolies can lead to static inefficiencies, the long-run profits they generate can sometimes fuel dynamic efficiency by funding research and development for new technologies and products.

Monopolistic competition

In production, monopolistic competition features many firms offering similar but not identical products, a characteristic known as product differentiation. This allows each firm a degree of pricing power, but they face competition from close substitutes. Production is not productively efficient, as firms operate with excess capacity, producing at a higher average cost and a lower quantity than in perfect competition.

Key Characteristics in Production:

- Product Differentiation: Firms create distinct products through branding, quality, or unique features to attract consumers. For example, different coffee shops offer distinct ambiances, flavors, and customer service.
- Downward-Sloping Demand Curve: Because of product differentiation, each firm faces a downward-sloping demand curve, meaning they can set their own price to a certain extent.
- Market Power (Limited): While firms have some control over their prices, this power is limited by the availability of close substitutes from competitors.
- Free Entry and Exit: There are no significant barriers to entry or exit, meaning new firms can enter the market if profits are being made. This ensures that in the long run, firms only earn normal profit.
- Implications for Production: Excess Capacity: Firms tend to produce less than the optimal quantity that would minimize their average total cost. This is because they limit output to maintain higher prices for their differentiated products.
- Inefficiency: Monopolistic competition is neither productively efficient (producing at the minimum average cost) nor allocatively efficient (producing at the quantity that maximizes social welfare) in the long run.
- Non-Price Competition: To attract customers, firms focus on strategies beyond price, such as advertising, branding, service, and product innovation.
- In essence, production in a monopolistically competitive market is a balancing act: firms try to differentiate their products to gain market power and profit, but they must also consider the presence of many close substitutes that limit their pricing and overall market share.

Oligopoly Market

In production, an oligopoly is a market situation dominated by a small number of large firms that produce similar or differentiated products, leading to high market concentration and interdependence among them. Key characteristics include [high barriers to entry](#), which limit new competitors, and a mutual influence where the pricing and output decisions of one firm significantly affect the others. Because of this interdependence, oligopolistic firms may engage in strategic competition through [product differentiation](#) and advertising, or attempt to form [cartels](#) to restrict output and raise prices, though explicit collusion is illegal and often breaks down due to individual incentives to cheat, a challenge often illustrated by game theory scenarios like the [prisoner's dilemma](#).

Examples of industries with an oligopolistic structure include the automobile industry, airlines, and the market for video game consoles.

Key Characteristics of Oligopoly in Production

- Few, Dominant Firms: The market is controlled by a small number of companies, often three to five, which control a majority of the market share.
- High Barriers to Entry: Significant hurdles prevent new firms from entering the market, such as high capital requirements, economies of scale, and legal protections like patents.
- Interdependence: Each firm's pricing and output decisions are directly influenced by the actions of its competitors, leading to a high degree of strategic interaction.
- Product Type: Products can be either similar (homogeneous) or differentiated, though many oligopolies involve product differentiation as a competitive strategy.
- Price Makers: Firms have some control over prices but must consider their rivals' reactions, unlike firms in a [perfectly competitive market](#).
- How Oligopolies Function in Production
- Strategic Pricing and Output: Firms use strategies like [price wars](#) or [price matching](#) to gain market share or deter competitors.
- Product Differentiation: Companies invest in advertising and product development to distinguish their offerings and build brand loyalty.
- Potential for Collusion: Firms may attempt to collude (form cartels) to limit production and keep prices high, mimicking a monopoly, but this is often difficult to maintain due to the temptation for individual firms to cheat on the agreement.
- Impact of Game Theory: Game theory, particularly the prisoner's dilemma, is used to model the strategic decisions firms face, showing why cooperation is beneficial but difficult to achieve.

End of Unit - 2

Unit - 3

Time Value of Money (TVM)

Introduction to TVM

The **Time Value of Money (TVM)** is a fundamental financial principle that states a sum of money available today is worth more than the *identical sum* in the future. This is due to money's **potential earning capacity**.

Core Principle: Money today is worth more than the same amount in the future due to:

- **Interest-earning potential** (investment returns).
- **Inflation** (reduces purchasing power).
- **Risk** (uncertainty of future cash flows).

Engineering Applications:

- Project feasibility analysis.
- Equipment purchase vs. lease decisions.
- ROI calculations for R&D investments.

Single Payment Problems

There are only two things you can do with a single sum of money: figure out its future value or figure out its present value.

1. Future Value (FV) of a Single Payment

- **The Question:** "If I have **Rs. X today** (a single present payment), what will it be worth in n periods in the future, if I can earn $r\%$ per period?"
- **The Concept:** This calculation involves **compounding**. You are moving a single sum *forward* on the timeline and calculating how much it will grow with interest.
- **Formula:** $FV = PV * (1 + r)^n$
 - FV = Future Value (what you're solving for)
 - PV = Present Value (the single payment you have today)
 - r = interest rate per period (e.g., 5% = 0.05)
 - n = number of periods (e.g., years, months)

Example: You have **Rs.1,000 today** (a single payment) and put it in a savings account earning 4% per year. What will it be worth in 5 years?

$$\text{FV} = \text{Rs.1,000} * (1 + 0.04)^5$$

$$\text{FV} = \text{Rs.1,000} * (1.21665)$$

$$\text{FV} = \text{Rs.1,216.65}$$

2. Present Value (PV) of a Single Payment

- **The Question:** "What is **Rs.X to be received in n periods in the future** (a single future payment) worth to me today, given a discount rate of **r%** per period?"
- **The Concept:** This calculation involves **discounting**. You are moving a single sum *backward* on the timeline to see its equivalent value today, considering the time value of money.
- **Formula:** $\text{PV} = \text{FV} / (1 + r)^n$
(This is just the Future Value formula rearranged to solve for PV).

Example: You will receive **Rs.1,500 in 3 years** (a single future payment). If the discount rate is 5%, what is the present value of that Rs.1,500?

- $\text{PV} = \text{Rs.1,500} / (1 + 0.05)^3$
- $\text{PV} = \text{Rs.1,500} / (1.1576)$
- $\text{PV} = \text{Rs.1,295.05}$

A **Single Payment** is the most basic element of TVM. It involves finding the economic relationship between **one sum of money today** and **one sum of money in the future**. All other financial instruments and calculations are constructed from this simple, foundational concept.

Uniform Series in TVM

A **Uniform Series** (also called an **Annuity**) is a sequence of **equal cash flows** that occur at **regular intervals** for a specific number of periods.

The characteristics are:

1. **Equal Amounts:** Every payment in the series is for the exact same amount (e.g., always Rs.100).
2. **Equal Intervals:** Payments occur at standard intervals (e.g., every year, every month).
3. **Finite Periods:** The series occurs for a limited, known number of periods.

Types of Uniform Series

The timing of the payments is crucial and leads to two main types:

1. Ordinary Annuity (Payments at the END of each period)

This is the most common type. Payments occur at the **end** of each compounding period.

Examples:

- Standard fixed-rate **mortgage payments**.
- **Car loan payments**.
- **Coupon payments** from a bond.
- Regular savings deposits into an account.

2. Annuity Due (Payments at the BEGINNING of each period)

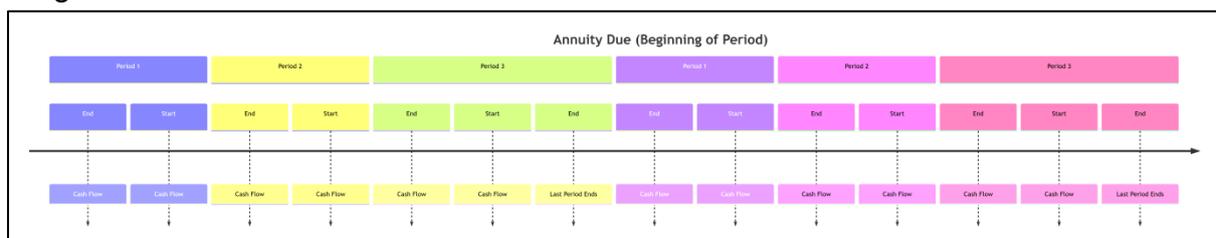
Payments occur at the **beginning** of each compounding period.

Examples:

- **Lease payments** for an apartment or car (you pay at the start of the month).
- **Insurance premiums**.
- Retirement withdrawals (if you take your annual payment on January 1st).
- subscriptions (paid at the start of the period).

The following timeline illustrates the difference:

Diagram



Calculations for a Uniform Series

Just like with single payments, we calculate either the **Future Value (FV)** or the **Present Value (PV)** of the entire series of cash flows.

1. Present Value of an Ordinary Annuity (PVA)

The Question: "What is the total value **TODAY** of a series of n equal future payments of amount PMT , discounted at rate r ?"

Formula: $PVA = PMT * [(1 - (1 + r)^{-n}) / r]$

Example: You win a lottery that pays **Rs.10,000 per year at the end of the year for 5 years**. Assuming a discount rate of 6%, what is the present value (lump-sum value today) of this prize?

$PMT = Rs.10,000$, $r = 0.06$, $n = 5$

$$PVA = Rs.10,000 * [(1 - (1.06)^{-5}) / 0.06]$$

$$PVA = Rs.10,000 * [(1 - 0.74726) / 0.06]$$

$$PVA = Rs.10,000 * [4.21236]$$

$$PVA = \mathbf{Rs.42,123.60}$$

(This is the lump-sum value today of the five Rs.10,000 payments.)

2. Future Value of an Ordinary Annuity (FVA)

The Question: "If I invest PMT at the **end** of every period for n periods at an interest rate r , what will the total value be **at the end** of the n periods?"

Formula: $FVA = PMT * [((1 + r)^n - 1) / r]$

Example: You save **Rs.200 per month at the end of the month** into a retirement account earning 1% per month (about 12.68% APY). What will the value be after 30 years (360 months)?

$PMT = Rs.200$, $r = 0.01$, $n = 360$

$$FVA = Rs.200 * [((1.01)^{360} - 1) / 0.01]$$

$$FVA = Rs.200 * [(35.9496 - 1) / 0.01]$$

$$FVA = Rs.200 * [34.9496 / 0.01]$$

$$FVA = Rs.200 * [3,494.96]$$

$$FVA = \mathbf{Rs.698,992}$$

(The power of compounding a long-term uniform series)

A **Uniform Series** (Annuity) is a core TVM concept for analyzing any situation involving **repeated, equal cash flows**—like loans, mortgages, savings plans, and retirement withdrawals.

TVM Factors

Factor	Impact on FV/PV
Higher Interest (i)	FV ↑, PV ↓
Longer Time (n)	FV ↑, PV ↓
More Frequent Compounding	FV ↑, PV ↓

Engineering Applications

A. Equipment Purchase vs. Lease

- **Purchase:** Compare upfront cost to future maintenance savings (use PV).
- **Lease:** Evaluate periodic payments (use PVOA).

B. Project Valuation

- Discount future cash flows to PV to compare projects.

C. Loan Amortization

- Calculate monthly payments for machinery loans.

Numerical Problems (for practice)

Problem 1 (Single Payment):

What is the FV of Rs.15,000 invested at 6% for 8 years?

$$FV=15,000 \times (1+0.06)^8 = \text{Rs.}23,908.48$$

Problem 2 (Annuity):

You need Rs.500,000 in 15 years. How much must you save annually at 9%?

$$P=500,000 \times 0.09(1+0.09)^{15}-1 = \text{Rs.}16,416.37$$

$$P=(1+0.09)^{15}-1500,000 \times 0.09 = \text{Rs.}16,416.37$$

Nominal and Effective Interest Rates

Imagine two banks offer you a loan, both quoting an interest rate of "12% per year." At first glance, they seem identical. However, one compounds interest monthly, and the other compounds annually. You will end up paying more for the loan that compounds monthly.

This is the difference between the **Nominal Rate** (the advertised, "illusory" rate) and the **Effective Rate** (the "real" rate you actually pay or earn).

1. Nominal Interest Rate (or Stated Rate)

Definition: The Nominal Interest Rate is the **advertised or stated annual interest rate** before accounting for compounding within that year. It is typically expressed on an annual basis (e.g., "per annum").

The Characteristics:

Does NOT account for compounding: It ignores how often the interest is applied to the principal balance

Cannot be used directly in TVM calculations: You cannot use the nominal rate in the formulas for Present Value (PV) or Future Value (FV) ($FV = PV * (1 + r)^n$). Using it directly will give you an incorrect answer.

It's a starting point: The nominal rate is used to *calculate* the periodic interest rate for compounding.

How it's presented: You will often see it written with a compounding period:

"12% per year compounded monthly"

"6% annually compounded quarterly"

The number before the compounding period (12%, 6%) is the **Nominal Rate**.

2. Effective Interest Rate (or Annual Equivalent Rate - AER)

Definition: The Effective Interest Rate is the **actual annual rate you earn or pay** once compounding is taken into account. It represents the true financial cost of a loan or the true return on an investment.

The Characteristics:

DOES account for compounding: This is its entire purpose

Allows for "apples-to-apples" comparisons: You can only accurately compare two financial products by looking at their Effective Annual Rates (EAR)

Reflects reality: This is the rate that actually gets applied to your growing balance over the year

The Mathematical Relationship:

The connection between the Nominal and Effective rates is given by this fundamental formula:

$$\text{Effective Annual Rate (EAR)} = [(1 + i/n)^n] - 1$$

Where:

i = Nominal Interest Rate (expressed as a decimal, e.g., 12% = 0.12)

n = Number of compounding periods **per year**

EAR = Effective Annual Rate (expressed as a decimal)

Step-by-Step Example: Putting It All Together

Scenario: Two loans are advertised at a **Nominal Rate of 12% per year**.

Loan A: Compounded **annually**.

Loan B: Compounded **monthly**.

Which loan is more expensive for the borrower?

Step 1: Calculate the Effective Rate for Each Loan

Loan A (Compounded Annually):

$$i = 12\% = 0.12$$

$$n = 1 \text{ (compounded once per year)}$$

$$\text{EAR} = [(1 + 0.12/1)^1] - 1$$

$$\text{EAR} = (1.12) - 1$$

$$\text{EAR} = 0.12 \text{ or } 12.00\%$$

In this unique case, since compounding happens only once, the nominal and effective rates are the same.

Loan B (Compounded Monthly):

$$i = 12\% = 0.12$$

$$n = 12 \text{ (compounded twelve times per year)}$$

$$\text{EAR} = [(1 + 0.12/12)^{12}] - 1$$

$$\text{EAR} = [(1 + 0.01)^{12}] - 1$$

$$\text{EAR} = [(1.01)^{12}] - 1$$

$$\text{EAR} = 1.126825 - 1$$

$$\text{EAR} = 0.126825 \text{ or } 12.6825\%$$

Step 2: Compare the Effective Rates

Loan A Effective Rate = **12.00%**

Loan B Effective Rate = **12.6825%**

Conclusion: Loan B is more expensive. The borrower will pay more over the course of the year with Loan B because interest is calculated and added to the principal balance more frequently, a phenomenon known as **compound interest**.

Why This Difference Matters

1. **Consumer Protection:** Regulations in many countries (e.g., Truth in Lending Act in the U.S.) require lenders to disclose the Effective Annual Rate (often called the Annual Percentage Rate or APR, though APR can include some fees) so borrowers can easily see the true cost and compare different offers.
2. **Informed Investing:** An investment that offers "8% compounded quarterly" is actually better than one offering "8% compounded annually." The effective rate reveals this truth.
3. $\text{EAR} = (1 + 0.08/4)^4 - 1 = 8.24\%$
4. **Financial Accuracy:** Using the correct **periodic rate** (nominal rate / number of periods) is essential for all accurate TVM calculations. For a nominal 12% compounded monthly, the periodic rate used in formulas is **1% per month** ($0.12 / 12 = 0.01$), *not* 12%.

Feature	Nominal Interest Rate	Effective Interest Rate (EAR)
Also Known As	Stated Rate, Quoted Rate	Annual Equivalent Rate (AER), True Rate
Accounts for Compounding?	No	Yes
Purpose	To advertise a rate; a starting point for calculation.	To reveal the true cost of debt or return on investment.

Use in TVM Formulas	Cannot be used directly. Must be divided by compounding periods.	Can be used directly for annual comparisons and calculations.
Magnitude	Always less than or equal to the Effective Rate.	Always greater than or equal to the Nominal Rate.

In short: The **Nominal Rate** is what you see advertised. The **Effective Rate** is what you actually get. Always compare Effective Rates to make sound financial decisions.

Present Worth Analysis

Present Worth Analysis (also known as **Present Value Analysis** or **Net Present Value Analysis**) is an economic analysis technique used to evaluate and compare alternatives by converting all their future cash flows (both costs and revenues) into a single, equivalent sum **today**—their **Present Worth (PW)** or **Net Present Value (NPV)**.

The core principle is the **Time Value of Money (TVM)**: a rupee today is worth more than a rupee in the future. By discounting all future cash flows to the present, we can make a fair "apples-to-apples" comparison between projects with different lifespans, cost timelines, and revenue patterns.

The Fundamental Principle: The Minimum Attractive Rate of Return (MARR)

A critical component of PW Analysis is the **discount rate**. This isn't just a random interest rate; it's the **Minimum Attractive Rate of Return (MARR)**.

What it is: The MARR is the minimum return a company or investor is willing to accept for an investment, considering its risk and the opportunity cost of capital (i.e., what else they could have done with the money).

Why it matters: In PW Analysis, the MARR is used as the discount rate (i). It is the hurdle that a project must overcome to be considered acceptable.

The Present Worth (PW) / Net Present Value (NPV) Formula

The general formula for calculating the Present Worth of a project is:

$$\text{PW or NPV} = \sum [\text{Cash Flow at time } t / (1 + i)^t]$$

Where:

PW or NPV = The total present worth of all cash flows.

\sum = The sum of all components.

Cash Flow at time t = The net cash flow (revenue - cost) in period t . (A negative cash flow is a cost).

i = The discount rate per period (the MARR).

t = The time period (e.g., year 0, 1, 2, 3... n).

Decision Rule:

If $\text{PW} \geq 0$: The project is economically acceptable. It is expected to generate a return **at or above** the MARR.

If $\text{PW} < 0$: The project is economically unacceptable. It is expected to generate a return **below** the MARR. The capital should be invested elsewhere.

Types of Alternatives Compared with PW Analysis

1. Mutually Exclusive Alternatives (Choose One)

You must choose only one option from a set. The goal is to select the alternative with the **highest PW** (as long as it's positive).

2. Independent Projects (Choose Any)

You can choose any number of projects, limited only by budget. The goal is to select **all projects with a $PW \geq 0$** .

Detailed Examples

Example 1: A Simple Independent Project (Yes/No Decision)

Scenario: A company is considering buying a new machine for Rs.15,000. It will generate annual revenue of Rs.7,000 for the next 3 years, with an annual operating cost of Rs.2,000. The machine will have no salvage value. The company's MARR is 10% per year. Should they buy the machine?

Step 1: Diagram the Cash Flows

Now (t=0): -Rs.15,000 (Initial investment, a cost)

End of Year 1 (t=1): +Rs.7,000 - Rs.2,000 = +Rs.5,000 (Net Cash Flow)

End of Year 2 (t=2): +Rs.5,000

End of Year 3 (t=3): +Rs.5,000

Step 2: Calculate the Present Worth (PW)

We discount each future net cash flow back to the present and sum them all, including the initial cost.

$$PW = -Rs.15,000 + Rs.5,000/(1+0.10)^1 + Rs.5,000/(1+0.10)^2 + Rs.5,000/(1+0.10)^3$$

$$PW = -Rs.15,000 + Rs.5,000/1.10 + Rs.5,000/1.21 + Rs.5,000/1.331$$

$$PW = -Rs.15,000 + Rs.4,545.45 + Rs.4,132.23 + Rs.3,756.57$$

$$PW = -Rs.15,000 + Rs.12,434.25 = -Rs.2,565.75$$

Decision: Since $PW < 0$, the project is not acceptable. The machine is expected to generate a return *below* the company's 10% MARR. The company should **not** invest.

Example 2: Mutually Exclusive Alternatives (Which One?)

Scenario: A factory needs a new forklift and has two options with the same capacity. The MARR is 8%.

Alternative	Initial Cost	Annual Operating Cost	Salvage Value	Life
Forklift A	Rs.20,000	Rs.4,000 per year	Rs.5,000	10 years
Forklift B	Rs.30,000	Rs.2,500 per year	Rs.8,000	10 years

Which forklift should they choose?

Step 1: Calculate the PW of each alternative.

We must compare them over the **same time period** (10 years). The salvage value is a positive cash inflow at the end of year 10.

PW of Forklift A:

Initial Cost (t=0): -Rs.20,000

Annual Op. Cost (t=1-10): This is a uniform series. Its PW is found using the P/A factor: $PW = A * [(1 - (1+i)^{-n}) / i]$

Salvage Value (t=10): This is a single future value. Its PW is found using the P/F factor: $PW = F / (1+i)^n$

$$PWA = -Rs.20,000 - Rs.4,000 * [(1 - (1.08)^{-10}) / 0.08] + Rs.5,000 / (1.08)^{10}$$

$$PWA = -Rs.20,000 - Rs.4,000 * (6.7101) + Rs.5,000 / (2.1589)$$

$$PWA = -Rs.20,000 - Rs.26,840.40 + Rs.2,316.35$$

$$\mathbf{PWA = -Rs.44,524.05}$$

PW of Forklift B:

$$PWB = -Rs.30,000 - Rs.2,500 * [(1 - (1.08)^{-10}) / 0.08] + Rs.8,000 / (1.08)^{10}$$

$$PWB = -Rs.30,000 - Rs.2,500 * (6.7101) + Rs.8,000 / (2.1589)$$

$$PWB = -Rs.30,000 - Rs.16,775.25 + Rs.3,706.16$$

$$\mathbf{PWB = -Rs.43,069.09}$$

Step 2: Compare the PWs

$$PWA = -Rs.44,524$$

$$PWB = -Rs.43,069$$

Decision: Since we are dealing with **costs**, we are looking for the **least negative** PW (the option with the lower present value of total costs). **Forklift B has**

the higher PW (less negative) and is the more economical choice. Choosing Forklift B is equivalent to saving Rs.1,455 in present value dollars compared to Forklift A.

Example:

A water treatment plant costs Rs.10M upfront and Rs.500K/year maintenance. At $i=5\%$:

$$PW = -10,000,000 + \frac{-500,000}{0.05} = -Rs.20M$$

Example:

A machine (Rs.50K initial cost, Rs.10K annual profit, Rs.5K salvage after 5 years, $i=10\%$):

$$PW = -50,000 + \frac{10,000}{1.1} + \dots + \frac{10,000}{1.1^5} + \frac{5,000}{1.1^5} = Rs.3,791$$

Practice Problem:

1. A solar farm costs Rs.1M upfront, generates Rs.200K/year for 10 years, and has Rs.50K salvage. At $i=7\%$, what's its PW? (Answer: Rs.432194)
2. A factory robot costs Rs.150K upfront, saves Rs.50K/year for 5 years, and has Rs.20K salvage value at $i=12\%$. (Answer: Rs.38589)

Annual Worth Analysis

Annual Worth (AW) Analysis is an economic analysis technique that converts all the costs and benefits of a project into an equivalent **uniform annual series** over the project's life. Instead of a single present value (like PW), it gives you an equivalent annual amount (e.g., rupees per year).

The core principle remains the **Time Value of Money (TVM)**. AW analysis is particularly useful when comparing alternatives with **different service lives**, as it avoids the need for the Least Common Multiple (LCM) approach required in Present Worth analysis.

The Annual Worth (AW) Value

The Annual Worth value can represent one of two things, depending on the context of the cash flows:

Equivalent Uniform Annual Cost (EUAC): Used when a project consists primarily of costs (e.g., initial investment, operating costs). The goal is to minimize the EUAC.

Equivalent Uniform Annual Revenue (EUAR) or Annual Worth (AW): Used when a project includes both *costs and revenues*. A positive AW indicates the project is profitable.

The Decision Rule is simple:

For **revenue projects** (where revenues > costs): Choose the alternative with the **highest AW** (if $AW \geq 0$).

For **service projects** (where only costs are considered): Choose the alternative with the **lowest EUAC** (the least negative AW).

The Relationship to Present Worth

Annual Worth is directly derived from Present Worth. You can think of it as a two-step process:

Calculate the Present Worth (PW) of all cash flows for a single project life.

"Spread" or "annualize" that PW value over the life of the project using the **A/P factor**.

The Fundamental AW Formula: $AW = PW * (A/P, i\%, n)$

Where:

$(A/P, i\%, n)$ is the **Capital Recovery Factor**. This factor calculates the equivalent annual amount required to recover a present investment over n periods at an interest rate i .

You can also calculate AW directly by converting every individual cash flow into its equivalent annual amount and summing them.

Why Use Annual Worth? The Advantage

The primary advantage of AW analysis is for comparing **alternatives with different lifetimes**.

PW Analysis Problem: Comparing a 5-year project with a 10-year project requires evaluating them over a 10-year period (LCM of 5 and 10), assuming the 5-year project is repeated. This can be cumbersome.

AW Analysis Solution: You only need to analyze *one life cycle* of each alternative. The AW value calculated for one life cycle is exactly the same as the AW for any number of repeated life cycles. This makes the comparison incredibly straightforward.

Detailed Examples

Example 1: Mutually Exclusive Alternatives with Different Lives

Scenario: A company is choosing between two machines for a process that will be needed for a long time (indefinitely). The MARR is 15% per year.

Machine	Initial Cost	Annual Operating Cost	Salvage Value	Life
Machine A	Rs.20,000	Rs.5,000 per year	Rs.4,000	5 years
Machine B	Rs.35,000	Rs.3,000 per year	Rs.7,000	10 years

Which machine should they select?

Analysis: The machines have different lives (5 yrs vs. 10 yrs). Using AW analysis avoids the need to find the LCM (10 years) and assume repetition. We can analyze just one life cycle of each.

Step 1: Calculate the AW for Machine A (5-year life)

The AW consists of three parts:

1. The annual equivalent of the initial cost: $-Rs.20,000 * (A/P, 15\%, 5)$
2. The annual operating cost: $-Rs.5,000$
3. The annual equivalent of the salvage value (it's a positive cash flow): $+Rs.4,000 * (A/F, 15\%, 5)$

(Note: $(A/P, i, n) = i(1+i)^n / [(1+i)^n - 1]$. $(A/F, i, n) = i / [(1+i)^n - 1]$. These values are found in tables or calculated.)

$$(A/P, 15\%, 5) = 0.29832$$

$$(A/F, 15\%, 5) = 0.14832$$

$$AW_A = [-20,000 * 0.29832] - 5,000 + [4,000 * 0.14832]$$

$$AW_A = -5,966.40 - 5,000 + 593.28$$

$$AW_A = -Rs.10,373.12$$

This is also the **EUAC** (Equivalent Uniform Annual Cost) for Machine A.

Step 2: Calculate the AW for Machine B (10-year life)

$$(A/P, 15\%, 10) = 0.19925$$

$$(A/F, 15\%, 10) = 0.04925$$

$$AW_B = [-35,000 * 0.19925] - 3,000 + [7,000 * 0.04925]$$

$$AW_B = -6,973.75 - 3,000 + 344.75$$

$$AW_B = -Rs.9,629.00 \text{ (This is the EUAC for Machine B)}$$

Step 3: Compare the AW values

Machine A AW (EUAC) = **-Rs.10,373 per year**

Machine B AW (EUAC) = **-Rs.9,629 per year**

Decision: Choose the alternative with the **lowest equivalent annual cost**, which is **Machine B**. Selecting Machine B is equivalent to saving **Rs.744 per year** (Rs.10,373 - Rs.9,629) compared to Machine A.

Example 2: A Revenue-Producing Project (Yes/No Decision)

Scenario: An investment of Rs.50,000 in new software is expected to increase efficiency and generate an additional Rs.18,000 in revenue per year for its 5-year useful life. It will have an additional annual maintenance cost of Rs.2,500. There is no salvage value. The company's MARR is 10%. Is this a good investment?

Step 1: Calculate the Net Annual Revenue

$$\begin{aligned} \text{Net Annual Revenue} &= \text{Annual Revenue} - \text{Annual Cost} = \text{Rs.18,000} - \text{Rs.2,500} \\ &= \text{Rs.15,500} \end{aligned}$$

Step 2: Calculate the Annual Worth (AW)

The AW consists of:

1. The annual equivalent of the initial cost: $-\text{Rs.50,000} * (A/P, 10\%, 5)$
2. The net annual revenue: $+\text{Rs.15,500}$

$$(A/P, 10\%, 5) = 0.26380$$

$$AW = [-50,000 * 0.26380] + 15,500$$

$$AW = -13,190 + 15,500$$

$$AW = +Rs.2,310$$

Decision: Since $AW > 0$, the project is economically acceptable. The software is expected to generate an equivalent annual profit of Rs.2,310 per year over its life, which exceeds the 10% MARR requirement.

Summary

Purpose: To compare alternatives by converting their cash flows into an equivalent uniform annual series.

Major Strength: Simplifies the comparison of alternatives with **different service lives**.

Decision Rule:

For costs: Choose the alternative with the **lowest AW** (which is the EUAC).

For profits: Choose the alternative with the **highest AW** (if $AW \geq 0$).

Interpretation: The AW value is the equivalent annual profit or cost, making it very intuitive for managers who often think in terms of annual budgets and performance.

Example:

A Rs.50K machine with Rs.5K salvage after 5 years at $i=10\%$:

$$CR = (50,000 - 5,000) \times 0.1 (1.1)^5 (1.1)^5 - 1 + 5,000 \times 0.1 = \text{Rs.}11,845$$
$$CR = (50,000 - 5,000) \times (1.1)^5 - 10.1 (1.1)^5 + 5,000 \times 0.1 = \text{Rs.}11,845$$

A Rs.200K machine saves Rs.45K/year for 8 years with Rs.25K salvage at $i=12\%$.

Solution:

1. Initial Cost: -200,000
2. Annual Savings: 45,000

Formula: $=PMT(12\%, 8, -200000, 25000) + 45000$

Result: $AW = \text{Rs.}9,427 \rightarrow \text{Profitable}$

Practice Problem:

A Rs.120K sensor system lasts 6 years, saves Rs.30K/year, and has Rs.10K salvage at $i=12\%$. What's its AW?

*(Answer: **Rs.-3,217** \rightarrow Not viable at this rate.)*

Rate of Return Analysis

Rate of Return (ROR) analysis determines the profitability of an investment by calculating the **interest rate** at which the present worth of costs equals the present worth of benefits. In other words, it is the discount rate that makes the **Net Present Value (NPV)** of a project exactly **zero**.

It answers the question: "**What percentage return am I earning on my invested money?**"

Unlike PW and AW, which require a pre-selected MARR, ROR *calculates* the project's inherent profitability, which you then *compare* to the MARR to make a decision.

The Terminology

Rate of Return (ROR): The interest rate earned on the **unrecovered balance** of an investment. It is not simply the annual profit divided by the initial investment.

Internal Rate of Return (IRR): This is the most common term for the ROR of a project. The terms are often used interchangeably.

Minimum Attractive Rate of Return (MARR): The minimum *required* return set by the company (also called the hurdle rate). This is the benchmark against which the IRR is compared.

Incremental Analysis: A required technique for comparing two or more mutually exclusive alternatives based on their IRR. You must analyze the difference in cash flows between them.

The Fundamental ROR Equation

The ROR is the interest rate i^* that satisfies the following equation:

$$\text{PW of Benefits} - \text{PW of Costs} = 0$$

or

$$\text{NPV} = 0$$

This means for a standard investment (costs first, then benefits):

$$\text{PW of Costs} = \text{PW of Benefits}$$

Decision Rules

For a Single Project:

- If $ROR \geq MARR$, the project is economically **acceptable**.
- If $ROR < MARR$, the project is economically **unacceptable**.

For Mutually Exclusive Alternatives:

1. Each alternative must first be acceptable on its own ($ROR \geq MARR$).
2. Choose the alternative that requires the **largest initial investment, provided the incremental ROR (ΔROR) on the extra investment is $\geq MARR$** . This is the most crucial and often-missed step.

Detailed Examples

Example 1: Calculating ROR for a Single Project

Scenario: An investment of Rs.10,000 today will yield returns of Rs.5,000 at the end of year 1, Rs.5,000 at the end of year 2, and Rs.3,000 at the end of year 3. What is the Rate of Return? Assume the MARR is 10%.

Step 1: Set up the NPV equation and set it to zero.

We need to find the interest rate i^* that makes the PW of all cash flows equal zero.

$$Rs.0 = -10,000 + \frac{5,000}{(1+i^*)} + \frac{5,000}{(1+i^*)^2} + \frac{3,000}{(1+i^*)^3}Rs.$$

Step 2: Solve for i^* (usually by trial and error or software)

This is a process of guessing values of i until the equation equals zero.

Try $i = 10\%$:

$$NPV = -10,000 + 5,000/1.10 + 5,000/1.21 + 3,000/1.331$$

$$NPV = -10,000 + 4,545 + 4,132 + 2,254 = \mathbf{+Rs.931}$$

(NPV is positive, so our guess is too low. We need a higher discount rate to bring the PV of benefits down.)

Try $i = 15\%$:

$$NPV = -10,000 + 5,000/1.15 + 5,000/1.322 + 3,000/1.521$$

$$NPV = -10,000 + 4,348 + 3,782 + 1,972 = \mathbf{+Rs.102}$$

(Still positive, but close to zero.)

Try $i = 16\%$:

$$NPV = -10,000 + 5,000/1.16 + 5,000/1.346 + 3,000/1.561$$

$$NPV = -10,000 + 4,310 + 3,714 + 1,922 = \mathbf{-Rs.54}$$

(Now NPV is negative.)

Step 3: Interpolate to find the exact i^* .

The ROR is between 15% and 16%. We can approximate:

At 15%, NPV = +Rs.102

- At 16%, NPV = -Rs.54
- The total change in NPV over the 1% range is Rs.102 - (-Rs.54) = Rs.156.
- We need to go from +Rs.102 down to Rs.0. This is a change of Rs.102.
- $ROR \approx 15\% + (102 / 156) * 1\% = 15.65\%$

Decision: Since the calculated ROR (15.65%) is **greater than** the MARR (10%), this project is **economically acceptable**.

Example 2: Incremental Analysis for Mutually Exclusive Alternatives

This is the most important application of ROR.

Scenario: You must choose between Project A and Project B. The MARR is 12%.

Project	Initial Investment	Annual Revenue	Life
A	Rs.10,000	Rs.3,000	5 years
B	Rs.15,000	Rs.4,200	5 years

Step 1: Check each project's ROR individually.

Project A: Solve $0 = -10,000 + 3,000(P/A, i^*, 5)$. The ROR for A is **~15.2%** (\geq MARR, so acceptable).

Project B: Solve $0 = -15,000 + 4,200(P/A, i^*, 5)$. The ROR for B is **~12.4%** (\geq MARR, so acceptable).

Both are acceptable. You cannot simply pick the one with the higher ROR (A), because B requires a larger investment. You must ask: **"Is the extra investment in B worth it?"**

Step 2: Set up the Incremental Cash Flow ($\Delta = B - A$)

- Δ Initial Investment: -Rs.15,000 - (-Rs.10,000) = **-Rs.5,000**
- Δ Annual Revenue: Rs.4,200 - Rs.3,000 = **+Rs.1,200**

Step 3: Calculate the Incremental ROR (ΔROR) on the extra Rs.5,000.

Set up the incremental NPV equation:

$Rs.0 = -5,000 + 1,200(P/A, i^*, 5)$ Rs.

Now, solve for i^* in this new equation. This i^* is the return on the extra Rs.5,000.

- $(P/A, i^*, 5) = 5,000 / 1,200 = 4.1667$
- Looking in a P/A factor table, $(P/A, 6\%, 5)=4.2124$ and $(P/A, 7\%, 5)=4.1002$.

- By interpolation, i^* (ΔROR) \approx **6.5%**

Step 4: Apply the Decision Rule for Mutually Exclusive Projects.

- The ΔROR on the extra investment is **6.5%**.
- Is $6.5\% \geq$ MARR (12%)? **No.**

Decision: The incremental investment of Rs.5,000 required for Project B only earns a 6.5% return, which is **less than** the company's MARR of 12%. Therefore, the extra investment is **not justified**. You should choose **Project A**.

This result often surprises students, as Project B had a positive ROR. The logic is: if you choose Project B, you are effectively earning 12.4% on Rs.15,000. But if you choose Project A, you earn 15.2% on Rs.10,000 and could theoretically invest the remaining Rs.5,000 elsewhere at the MARR of 12%. This combination (A + other investment) is better than putting all Rs.15,000 into Project B, which only returns 12.4% on the full amount.

Summary

- **ROR is a relative measure:** It gives a percentage, not an absolute rupee amount like PW or AW.
- **It's intuitive:** Managers and investors naturally think in terms of "return on investment."
- **Incremental Analysis is mandatory:** Never choose between mutually exclusive alternatives based solely on their individual RORs. You **must** perform an incremental analysis to see if the higher investment is worthwhile.

Practice Problem:

A Rs.120K investment returns Rs.30K/year for 5 years. What's its ROR?

*(Answer: **8.1%** – if MARR = 10%, reject.)*

A Rs.10,000 machine generates Rs.3,000/year for 5 years.

$$0 = -10,000 + 3,000(1+i) + \dots + 3,000(1+i)^5 = -10,000 + (1+i)3,000 + \dots + (1+i)^5 3,000$$

Solution: $i^* \approx$ **15.2%** (use trial-and-error).

Economics for Engineers

NOTES

Unit IV

Indian Economy

Nature of Indian Economy

The Indian economy is a developing mixed economy with a size of approximately \$4.3 trillion (nominal GDP), making it the world's fourth-largest economy. Its nature is defined by a blend of public and private sectors and a structure where the services sector contributes the most to GDP, while agriculture employs a significant portion of the population. It is also characterized as the fastest-growing major economy in the world.

The nature of the Indian economy is one of dynamic contrast and transition. It is a story of a traditional society rapidly modernizing, marked by impressive growth in its service and technology sectors, while simultaneously grappling with the age-old challenges of poverty, agricultural stagnation, and providing basic amenities to all its citizens.

- **Mixed economy:** The economy combines both public and private sector ownership and control, with a significant public sector in strategic areas.
- **Developing country:** India is classified as a developing economy, with ongoing efforts to develop its infrastructure and industrial base.
- **Sectoral structure:** The services sector is the largest contributor to GDP, while the agricultural sector, though declining in its share of GDP, still employs a large percentage of the population.
- **Growth driver:** India is currently the fastest-growing major economy, driven by public investment in infrastructure and rising household investments.

Size and Ranking:

- **Nominal GDP:** India's nominal GDP is approximately \$4.3 trillion, placing it as the fourth-largest economy globally.
- **GDP (PPP):** By purchasing power parity (PPP), the economy is the third-largest in the world.
- **Future outlook:** It is projected to become the third-largest economy by 2030.
- **Trade:** India has a significant foreign trade volume, with major export partners including the United States, the UAE, and China.

Salient Features of the Indian Economy

Feature	Description	Implication
Mixed Economy	Coexistence of public and private sectors.	Balances profit motive with social welfare.
Developing Economy	Low per capita income, agrarian dependency, poverty.	Primary goal is sustained and inclusive development.
Service-Sector Led	Services contribute over 50% to GDP.	Drives growth but creates a jobs challenge.
Agrarian Base	Majority of workforce in agriculture with low productivity.	Source of livelihood but faces issues of rural distress.
Dualism	Coexistence of advanced modern and primitive traditional sectors.	Leads to income disparities and informal employment.
High Population	Large and growing population.	Can be a demographic dividend or a burden.
Post-Reform Growth	Liberalized, market-friendly policies since 1991.	Higher growth, integration with global economy, and increased competition.
Regional Imbalance	Uneven development across states.	A challenge for federal cohesion and inclusive growth.

Size of the Indian Economy

The "size" of an economy is primarily measured by its Gross Domestic Product (GDP), which represents the total monetary value of all final goods and services produced within a country's borders in a specific time period. India's economy is characterized by its massive and rapidly growing size, making it one of the most significant economic forces in the world.

A. Gross Domestic Product (GDP)

This is the most common indicator. It can be measured in two primary ways:

- Nominal GDP (Current Prices):
 - The market value of goods and services calculated using current market prices in a given year.
 - Highly sensitive to inflation and exchange rates.
 - Used for international comparisons in USD terms.
- Real GDP (Constant Prices):

- The value of goods and services adjusted for inflation. It uses prices from a base year (e.g., 2011-12).
- Reflects the actual growth in the volume of output, stripping out the effect of price rises.
- Used to assess the true economic growth rate within a country.

B. Gross National Product (GNP) / Gross National Income (GNI)

- $GNP = GDP + \text{Net Income from Abroad}$ (Income earned by Indian residents from foreign investments minus income earned by foreigners in India).
- GNI is a very similar concept. For India, GNP/GNI is slightly lower than GDP because the country is a net payer to the rest of the world (e.g., repatriation of profits by foreign companies).

2. India's Current Economic Size and Global Rank

- Nominal GDP:
 - India is the 5th largest economy in the world (as of 2023/2024), behind the USA, China, Germany, and Japan.
 - Its nominal GDP is approximately \$3.7 trillion (FY 2023-24).
 - Projection: It is projected to become the 3rd largest economy by nominal GDP by 2027, overtaking Japan and Germany.
- Real GDP & Growth Rate:
 - India has been one of the fastest-growing major economies in the world, with an average annual growth rate of around 6-7% over the past two decades.
 - The Real GDP growth for FY 2023-24 was 7.6%.
 - This high growth rate is a key driver behind the rapid expansion of India's economic size.
- GDP by Purchasing Power Parity (PPP):
 - PPP adjusts for the differences in the cost of living between countries. It measures how much a country's currency can buy in terms of an international "basket of goods."
 - By this measure, India's economy is even larger. It is the 3rd largest economy in the world by GDP (PPP), after China and the USA, with a size of over \$13 trillion.
 - This highlights that money in India can buy more goods and services than the exchange rate with the US dollar might suggest.

Major Economic Problems of India

The Indian economy, despite its impressive growth and size, grapples with three persistent and interconnected problems: Poverty, Unemployment, and Inflation. Often referred to as the "triple affliction," these issues pose a significant threat to sustainable and inclusive development.

The Inter-linkage between the parameters

These three problems are deeply interconnected:

- Unemployment → Poverty: Lack of income leads to poverty.
- Poverty → Unemployment: The poor lack resources for education and skill development, perpetuating unemployment.
- Inflation → Poverty: It reduces the real income of the poor, pushing them deeper into poverty.
- Inflation & Unemployment (The Phillips Curve Trade-off): Sometimes, policies to curb inflation (like hiking interest rates) can slow down the economy and increase unemployment in the short run.

1. Poverty

A. Definition and Nature

Poverty is a state of deprivation where a section of society is unable to meet the basic minimum needs of life, including food, clothing, shelter, healthcare, and education.

- Absolute Poverty: Inability to attain a minimum standard of living. In India, it is measured through a poverty line based on consumption expenditure.
- Relative Poverty: A comparative measure of inequality, where individuals are considered poor relative to the average standard of living in a country.
- Multidimensional Poverty: The latest understanding, which includes deprivations in health, education, and standard of living (as measured by the Multidimensional Poverty Index - MPI).

B. Causes of Poverty in India

1. Low Economic Growth (Historically): For decades, the "Hindu rate of growth" (around 3.5%) was insufficient to lift the masses out of poverty.
2. High Population Growth: Rapid population increase dilutes the per capita availability of resources and the benefits of economic growth.
3. Agrarian Crisis: The high dependency on agriculture, coupled with low productivity, disguised unemployment, and dependence on monsoons, keeps rural incomes low.
4. Mass Unemployment and Underemployment: Lack of productive employment opportunities is a direct cause of poverty.
5. Inflation: Erodes the purchasing power of the poor, pushing those on the margins into poverty.
6. Social Factors: Lack of access to education and skills, historical social inequalities (caste system), and regional disparities perpetuate poverty across generations.

C. Measures to Control Poverty

The approach has evolved from welfare-based to empowerment-based.

1. Promoting Economic Growth: A fast-growing economy creates more resources and opportunities for wealth creation (the "trickle-down" effect).
2. Direct Benefit Transfer (DBT) Schemes:

- Pradhan Mantri Jan Dhan Yojana (PMJDY): Financial inclusion to ensure access to banking services.
 - Pradhan Mantri Kisan Samman Nidhi (PM-KISAN): Provides direct income support to farmers.
3. Employment Generation Schemes:
 - Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA): Provides legal guarantee for 100 days of wage employment in rural areas, acting as a safety net.
 4. Food Security:
 - National Food Security Act (NFSA), 2013: Provides subsidized food grains to approximately 67% of the population through the Public Distribution System (PDS).
 5. Asset Creation and Empowerment:
 - Pradhan Mantri Awas Yojana (PMAY): Housing for all.
 - Saubhagya Scheme: Universal household electrification.
 - Ayushman Bharat (PM-JAY): World's largest health insurance scheme for secondary and tertiary care.

2. Unemployment

A. Definition and Nature

Unemployment exists when individuals who are willing and able to work at the prevailing wage rate cannot find a job. India faces several unique types of unemployment:

- Disguised Unemployment: More people are engaged in a job than are optimally required (common in agriculture).
- Seasonal Unemployment: Occurs during specific seasons, typically in the agricultural sector.
- Structural Unemployment: Arises from a mismatch between the skills of the workforce and the requirements of the industries (e.g., an arts graduate unable to find a job in IT).
- Educated Unemployment: A severe problem where individuals with formal education and degrees are unable to find jobs.
- Cyclical Unemployment: Caused by a downturn in the business cycle (less common in India).

B. Causes of Unemployment in India

1. Slow Growth in Industrial and Manufacturing Sector: The manufacturing sector has not grown at a pace sufficient to absorb the labor force shifting out of agriculture.
2. Inappropriate Education System: The system is often theoretical and not aligned with the skill demands of the market.
3. Jobless Growth: A phenomenon where the economy grows, but employment does not grow proportionally, often seen in the capital-intensive service sector.
4. Low Labor Mobility: Social, linguistic, and cultural factors restrict the mobility of labor from one region to another.

5. Weaknesses in Agriculture: Seasonal nature and low productivity lead to widespread underemployment.

C. Measures to Control Unemployment

1. Employment-Led Growth Policies:
 - Make in India: Aims to boost the manufacturing sector, which is more labor-intensive than services.
 - Atmanirbhar Bharat (Self-Reliant India): Focus on promoting local manufacturing and MSMEs.
2. Skill Development:
 - Skill India Mission (Pradhan Mantri Kaushal Vikas Yojana): Aims to train over 400 million people in India in different skills by 2022.
3. Support to Small-Scale Enterprises:
 - MUDRA Yojana: Provides loans to non-corporate, non-farm small/micro enterprises, which are significant employment generators.
4. Public Works Programmes:
 - MGNREGA: Directly generates wage employment in rural areas, especially during lean agricultural seasons.
5. Educational Reforms: The new National Education Policy (NEP) 2020 emphasizes vocational training, skill integration, and multidisciplinary education to enhance employability.

3. Inflation

A. Definition and Nature

Inflation is a sustained rise in the general price level of goods and services in an economy over a period of time. It erodes purchasing power.

- Demand-Pull Inflation: Caused by an increase in aggregate demand exceeding aggregate supply ("too much money chasing too few goods").
- Cost-Push Inflation: Caused by an increase in the cost of production (e.g., rising wages, increased raw material costs, supply chain disruptions).
- Structural Inflation: Inherent to the structure of the Indian economy, such as agricultural bottlenecks and infrastructural deficits.

B. Causes of Inflation in India

1. Rise in Food Prices: A primary driver in India caused by factors like supply chain bottlenecks, hoarding, crop failures, and rising minimum support prices (MSP).
2. Fiscal Deficit: High government borrowing can increase money supply in the economy, leading to demand-pull inflation.
3. Global Factors: Rise in international prices of crude oil, edible oils, and other imported commodities (imported inflation).
4. Wage-Price Spiral: Increase in wages leads to higher costs for firms, who then raise prices, leading to demands for higher wages again.
5. Administered Prices: Government-led increases in prices of essential commodities like fuel, fertilizers, and electricity.

C. Measures to Control Inflation

Control is a joint responsibility of the Government (fiscal policy) and the Reserve Bank of India (monetary policy).

I. Monetary Policy Measures (by RBI):

1. Increase in Policy Rates (Repo Rate): Makes borrowing more expensive for commercial banks, which in turn raise interest rates for consumers and businesses. This discourages credit and cools demand.
2. Increase in Cash Reserve Ratio (CRR): The percentage of bank deposits that banks must keep with the RBI. An increase in CRR reduces the funds available with banks to lend, curbing money supply.

II. Fiscal Policy Measures (by Government):

1. Controlling Fiscal Deficit: Reducing non-essential government expenditure to avoid injecting excess money into the economy.
2. Effective Supply Management:
 - Buffer Stocks: Releasing food grains from buffer stocks (held by FCI) to cool down food prices.
 - Import-Export Policies: Easing import restrictions or imposing export restrictions on essential commodities (like pulses, edible oils) to boost domestic supply.
3. Inflation Targeting: Since 2016, the RBI has a formal mandate to maintain Consumer Price Index (CPI) inflation at 4% with a band of +/- 2%. This provides a clear anchor for inflation expectations.

Monetary Policy of India

The RBI uses both quantitative (general) and qualitative (selective) tools.

Policy Rates	
Repo Rate	<p>The rate at which the RBI lends short-term funds to commercial banks. This is the primary signalling tool.</p> <ul style="list-style-type: none">• To control Inflation: RBI increases the Repo Rate → Cost of borrowing for banks increases → Banks increase their lending rates → Demand for loans (for homes, cars, business expansion) falls → Money supply contracts → Inflationary pressure eases.• To spur Growth: RBI decreases the Repo Rate.
Reverse Repo Rate	<p>The rate at which the RBI borrows from commercial banks. It is the opposite of the repo rate. An increase in Reverse Repo Rate encourages banks to park more funds with the RBI, reducing money supply.</p>
Standing Deposit Facility (SDF) Rate	<p>Introduced in 2022, it is the floor of the Liquidity Adjustment Facility (LAF) corridor. Banks can park excess liquidity with the RBI overnight at this rate, without the need for collateral. It has become the de facto operational rate.</p>

Reserve Ratios	
Cash Reserve Ratio (CRR)	<p>The percentage of a bank's net demand and time liabilities (deposits) that it must maintain as cash reserves with the RBI.</p> <ul style="list-style-type: none">• Impact: No interest is paid on CRR. An increase in CRR directly reduces the amount of money banks have available to lend.
Statutory Liquidity Ratio (SLR)	<p>The percentage of a bank's net demand and time liabilities that it must maintain in the form of liquid assets like cash, gold, or government securities.</p> <ul style="list-style-type: none">• Impact: An increase in SLR locks up more bank funds in government securities, reducing their lending capacity.

Fiscal Policy of India

Fiscal policy involves the use of government revenue collection (taxation) and expenditure (spending) to influence the economy.

1. Government Expenditure:

- Revenue Expenditure: Day-to-day operational expenses (salaries, pensions, interest payments, subsidies). This is largely consumptive.
- Capital Expenditure (Capex): Spending on creating physical or financial assets (building roads, ports, railways, equity infusion in PSUs). This is considered growth-enhancing as it creates future capacity.

2. Government Revenue:

- Tax Revenue:
 - Direct Taxes: Paid directly by individuals/companies to the government (e.g., Income Tax, Corporate Tax). These are progressive in nature.
 - Indirect Taxes: Levied on goods and services, ultimately borne by the consumer (e.g., Goods and Services Tax (GST), Customs Duty).
- Non-Tax Revenue: Profits from Public Sector Undertakings (PSUs), interest receipts, fees, etc.

3. Public Debt:

- Borrowing by the government to finance its fiscal deficit. This includes internal debt (from within the country) and external debt.

4. Fiscal Indicators

- Fiscal Deficit: The total government expenditure *minus* its total receipts (excluding borrowings). It is the most watched indicator, showing the total borrowing requirement of the government.
 - Formula: $\text{Fiscal Deficit} = \text{Total Expenditure} - (\text{Revenue Receipts} + \text{Non-Debt Creating Capital Receipts})$
- Revenue Deficit: The excess of government's revenue expenditure over revenue receipts. It indicates that the government is borrowing to finance its consumption, not investment.
- Primary Deficit: Fiscal Deficit *minus* interest payments. It shows the government's fiscal stance excluding the legacy interest burden.