Introduction

Economics is a social science that studies people in society and how they interact with each other.

Economics is a social science, which is a study of people in society and how they interact with each other. In other words, economics is the study of how individuals and societies choose to utilize scarce resources to satisfy unlimited human wants. All the scarce resources are used to produce goods and services that we need or want. So, the quantity of goods and services produced is also limited. On the other hand, human wants and needs are unlimited. Therefore, there is a conflict between the scarce resources available and unlimited human wants. People cannot have everything they desire, so there must be some system of distributing the scarce resources. Economics studies how these scarce recourses are allocated to fulfill unlimited human wants. Hence, we can conclude that economics is the science of scarcity and choice.

To analyze the fundamental issues of economics, i.e. scarcity and choice, we divide economics into two parts: microeconomics and macroeconomics. These words in economics were first used by Prof. **Ragnar Frisch** Oslo university of Norway in 1933. The term 'micro' has been derived from the Greek word '*mikros*', which means small. Therefore, Microeconomics studies economic behaviour of individual decision makers, such as a consumer, a worker, a firm or a manager. It also analyses the behaviour of individual households, industries, markets, labour unions, or trade associations, etc. On the other hand, the term macroeconomics has also come from the Greek word '*makros*', which means large. Thus, macroeconomics studies economy as a whole or performance of the entire economy. It also examines aggregate level of income and employment, price level, the rate of inflation and the nature of business cycles in the economy. In this unit, we study concept and types of microeconomics and macroeconomics, difference between microeconomics and macroeconomics, and goals and instruments of macroeconomics.

Microeconomics

Concept of Microeconomics

Microeconomics
Microeconomics is the branch of economics that deals with small individual parts of an economy.

Microeconomics is defined as the branch of economics which deals with individual parts of an economy. In other words, it is the part of economic analysis, which is concerned with the behaviour of individual units: consumers, households and firms. It examines how consumers choose between goods and services, how workers choose between jobs, and how business firms decide what to produce, how to produce, how much to produce, and for whom to produce.

According to **K.E. Boulding**, "*Microeconomics is the study of particular firms, particular households, individual prices, wages, incomes, individual industries, particular commodities.*"

According to **M.C. Connel**, "*In microeconomics, we examine trees, not forest. Microeconomics is useful in achieving worm's eye view of some very specific components of our economic system.*"

In the words of **E.K. Browning** and **J.M. Browning**, "*Microeconomics is the branch of economics based on the economic behaviour of small economic units: consumers, workers, savers, business managers, firms, individual industries and markets and so on.*"

In view of **A.P. Lerner**, "*Microeconomics consists of looking economy through a microscope.*"

Microeconomics is also called price theory.

Thus, microeconomics is the branch of economics, which deals with very small units of the economy. It studies behaviour of individual units of the economy rather than economy as a whole. Microeconomics also tries to explain the effects of price change in the market due to the change in demand and supply conditions. It also studies how a firm determines price of its product. Therefore, microeconomics is also called *price theory*. In other words, microeconomics is also known as the price theory because it is mainly concerned with the determination of equilibrium price of goods and services in the market.

Microeconomics is also called microscopic analysis.

Microeconomics is also known as the slicing method.

Microeconomics is also known as the *slicing method* because it splits up the whole economy into small parts for the purpose of the study. Likewise, microeconomics is also known as the *microscopic analysis* because it is concerned with microscopic study of various elements of the economy. It is like the study of a single tree of the forest. And it gives worm's eye view analysis of the economic systems and economic variables.

The objective of microeconomics is to study pricing policies concerning the optimum allocation of resources. The economic efficiency can be achieved only through optimum allocation of resources, which is the basis of welfare economics. Hence, we can say that the heart of microeconomics is the study of problem of 'scarcity' and 'allocation of resources'.

The concept of microeconomics can be summarised as follows:

- Microeconomics studies the individual parts of an economy.
- Microeconomics is concerned with the individual firms and consumers.
- Microeconomics is based on the assumptions of full employment, partial equilibrium analysis and perfect competition.
- Microeconomics is applicable only in the free market economy.
- The major variables of microeconomics are relative price, individual demand and supply, output of an individual firm, etc.
- Microeconomics is also known as price theory because it studies how price of a product is determined.
- Microeconomic analysis is also known as the slicing method as well as microscopic analysis.
- Microeconomics is like study of a particular tree of the whole forest.

Types of Microeconomics

In microeconomics, equilibrium refers to a situation in which the market price reaches to the level at which quantity supplied equals quantity demanded. Equilibrium analysis in microeconomics is divided into following three types:

1. Micro Static Analysis

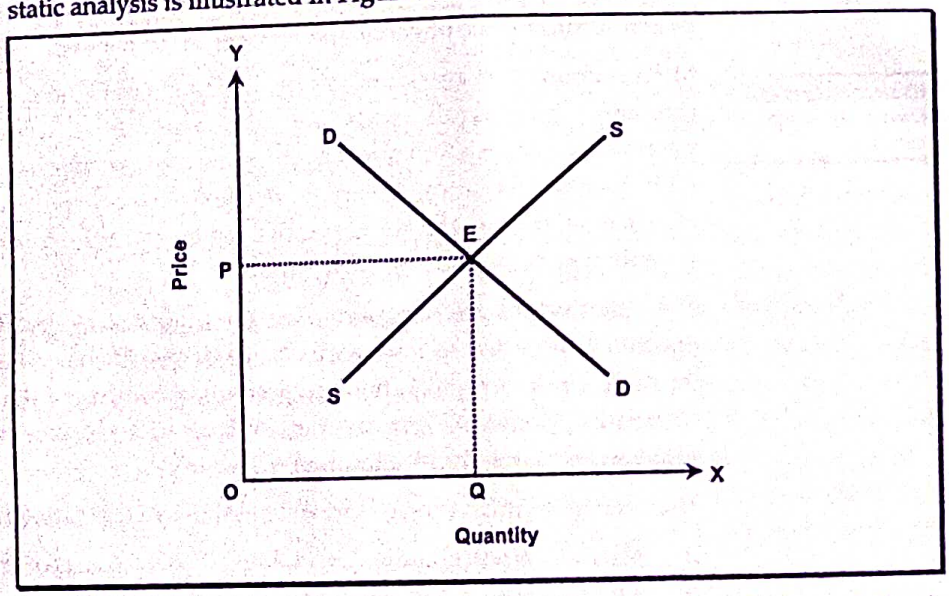
Micro Static Analysis
Micro static analysis is the static relationship between microeconomic variables whose values relate to the same point of time.

Micro static analysis is defined as the static relationship between microeconomic variables whose values relate to the same point of time or to the same period of time. It assumes that there will be no change in relationship between the variables. So, micro static analysis shows equilibrium situation at the specified time.

According to **J.A. Schumpeter,** "*Static analysis is a method of dealing with economic phenomena that tries to establish relation between elements of economic system, prices and quantities of commodities- all of which refer to the same point of time.*"

Thus, micro static analysis refers to the microeconomic phenomenon of same period. So, time factor has no role to play in micro static analysis. This type of micro economic analysis refers to a stable equilibrium. The concept of micro static analysis is illustrated in **Figure 1.1.**

FIGURE 1.1
Micro Static Analysis



In **Figure 1.1,** X-axis represents quantity demanded and supplied; and Y-axis represents price of the commodity. The downward sloping curve DD and upward sloping curve SS represent demand curve and supply curve respectively. These two curves are intersecting each other at point E. The point E is the equilibrium point because at this point both quantity demanded and supplied are equal. The equilibrium quantity is OQ and equilibrium price is OP. This is micro static analysis because price and quantity demanded and supplied are related to the same point of time.

2. Comparative Micro Static Analysis

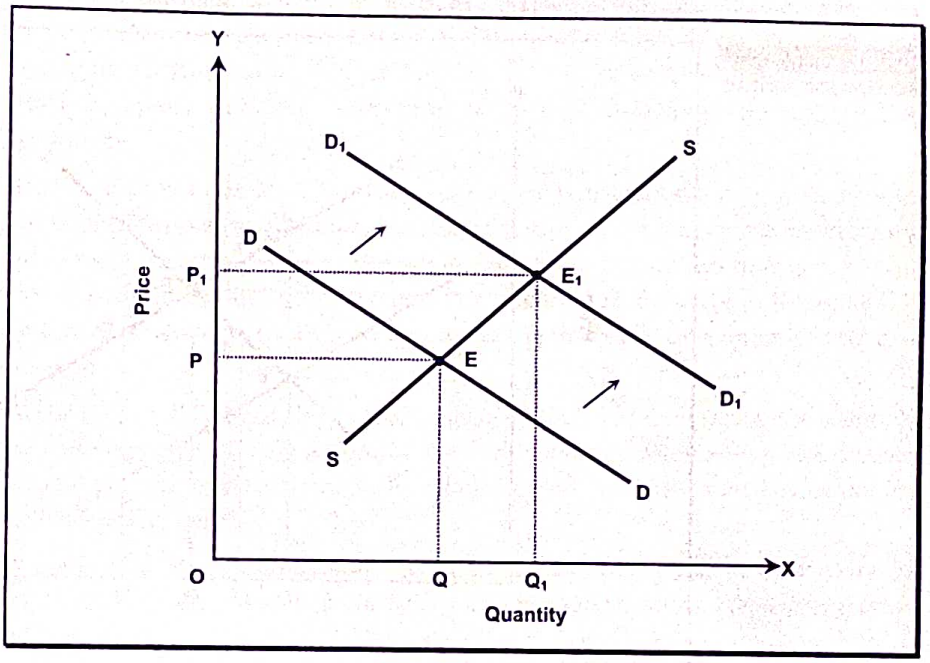
Comparative Micro Statics Analysis
Comparative micro static analysis is the comparative study between equilibrium positions determined from the interaction between microeconomic variables at different points of time.

Comparative micro static analysis is defined as the comparative study between different equilibrium positions determined from the interaction between microeconomic variables at different points of time. In other words, comparative micro static analysis compares the equilibrium positions at different periods of time.

According to **Prof. R.G. Lipsey,** "*Comparative statics involves a comparison of new equilibrium position due to the change in some economic variables.*"

Thus, comparative micro static analysis compares the equilibrium positions which occur due to change in microeconomic variables like demand or supply or both. It compares equilibrium positions but does not explain the process of how an initial equilibrium is disturbed and new equilibrium is achieved. It also does not involve the path and time through which new equilibrium in the market is established. The concept of comparative micro statics can be illustrated by Figure 1.2.

FIGURE 1.2
Comparative Micro Static Analysis



In Figure 1.2, the upward sloping curve SS represents supply curve and downward sloping curve DD represents initial demand curve. These two curves are intersecting at point E, which is the initial equilibrium point. Hence, initial equilibrium price and quantity are OP and OQ respectively. Let us suppose, due to the favourable change in some independent variables like income, price of related goods, etc. the initial demand curve shifts rightwards from DD to D_1D_1. The new demand curve D_1D_1 intersects supply curve SS at point E_1, which is the new equilibrium point. The new equilibrium price and quantity are OP_1 and OQ_1 respectively. The comparative study of these two equilibrium points is the comparative micro static analysis.

3. Micro Dynamic Analysis

Micro Dynamic Analysis
Micro dynamic analysis is the analysis of the process by which system moves from one equilibrium to another.

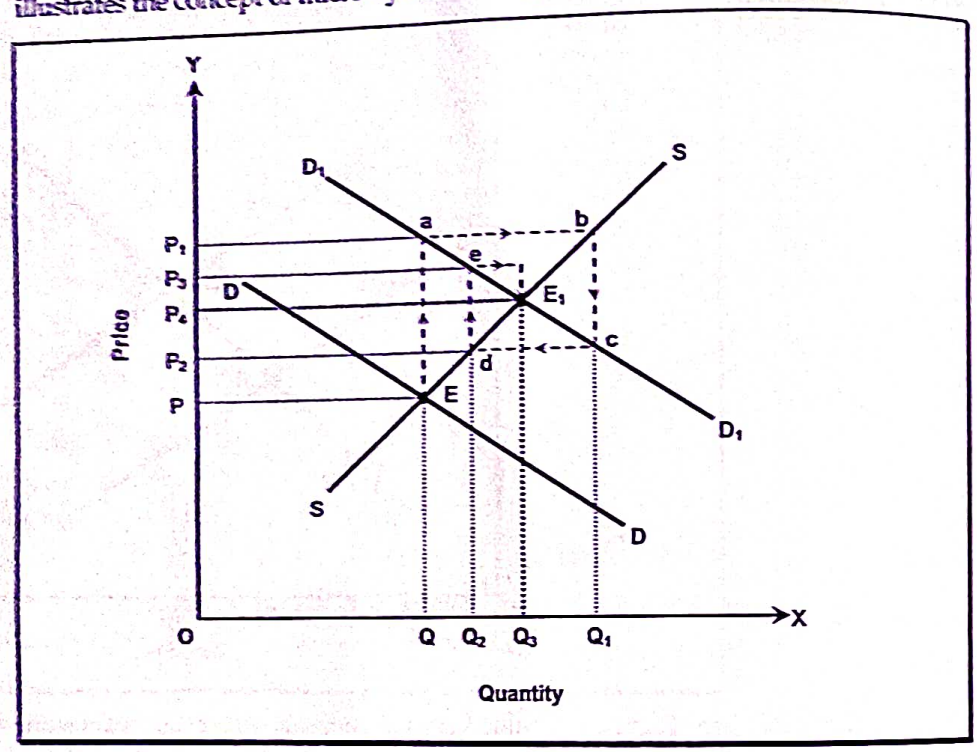
Micro dynamic analysis is defined as the analysis of the process through which the system moves from one equilibrium to another. In other words, micro dynamic analysis explains the lagged relationship between the microeconomic variables. It is concerned mainly with states of disequilibrium rather than equilibrium and takes time factor into consideration. It studies models involving time and path through which new equilibrium in the market is established. It provides answer to the causes of breaking initial equilibrium and establishing new equilibrium.

According to J.R. Hicks, *"Economic dynamics refers to that part of economic theory in which all quantities must be dated."*

Thus, we can conclude that time element occupies great importance in micro dynamic analysis. It means that microeconomic variables are related to different points of time.

Cobweb model is used to explain the micro dynamic analysis. Figure 1.3 illustrates the concept of micro dynamic analysis.

FIGURE 1.3
Micro Dynamic Analysis



In Figure 1.3, the downward sloping curve DD represents demand curve and upward sloping curve SS represents supply curve. These two curves are intersecting each other at point E. The point E is the initial equilibrium point. Hence, the initial equilibrium price is OP and the initial equilibrium quantity is OQ. Let us suppose, the initial demand curve DD shifts rightward to D_1D_1 due to the favourable change in any one factor determining demand at the constant price. Consequently, new equilibrium point E_1 is determined. Micro dynamics explains the process and path of how initial equilibrium point E moves to new equilibrium point E_1. At the beginning, when initial demand curve DD shifts rightward to D_1D_1, demand exceeds supply, which exerts upward pressure on price. This increases price from OP to OP_1. At price OP_1, supply exceeds demand by QQ_1, i.e. demand is OQ and supply is OQ_1. This results fall in price from OP_1 to OP_2. At this price, supply decreases to OQ_2. But, due to fall in price, demand increases, which results increase in price to OP_3. This process continues in different steps a, b, c, d, e, ... until new equilibrium E_1 is attained where the new equilibrium price OP_4 and new equilibrium quantity OQ_3 are determined. The arrows show the process and path of change. Thus, micro dynamic analysis

shows the process of adjustment from one equilibrium point to another breaking initial equilibrium and establishing a new equilibrium.

Macroeconomics

Concept of Macroeconomics

Macroeconomics
Macroeconomics is the branch of economics which deals economy as a whole. It studies the aggregate variables like national income, money, price level, unemployment, economic growth etc.

Macroeconomics is defined as the branch of economics which deals with economy as a whole. In other words, macroeconomics is the study of very large, economy-wide aggregate variables like *national income*, money, price level, unemployment, *economic growth* rate, etc. Therefore, it is also known as the aggregative economics.

In fact, macroeconomics is basically concerned with national aggregate or total values such as national income, aggregate consumption, aggregate saving, total investment, etc. that relates to the whole economy. It examines how *general price level* is determined and how resources are allocated at the level of the economic system as a whole. In short, macroeconomics is the study of economic system as a whole.

According to **K.E. Boulding**, *"Macroeconomics deals not with individual quantities but with aggregate of these quantities, not with individual incomes but with national income, not with individual prices but with price level, not with individual output but with national output."*

According to **P. A. Samuelson**, *"Macroeconomics is the study of behavior of the economy as a whole. It examines the overall level of national output, employment, prices and foreign trade."*

According to **Grander Ackley**, *"Macroeconomics concerns the overall dimension of economic life. More specifically, macroeconomics concerns with such variables as aggregate volume of an economy, with the extent to which its resources are employed, with size of national income and with the general price level."*

From the above definitions, it can be stated that macroeconomics is essentially study of the behaviour and performance of the economy as a whole. It studies relationship and interaction between forces that determine level and growth of national output and employment, price level and balance of payment position of an economy.

Since, *macroeconomics splits up the economy into big lumps for the purpose of study; it is also called the "Method of Lumping"*. It explains how the level of income and employment is determined and analyses the factors that bring about fluctuations in income and employment. It also explains how national income grows over time. Thus, macroeconomics deals with the phenomena related to the level and growth of national income and employment and various factors governing their trends. Therefore, macroeconomics is also known as the **"Theory of Income and Employment"**.

Types of Macroeconomics

Static Analysis (Macro Statics)

Static Analysis
Static analysis explains the final position of equilibrium of the whole economy at a particular point of time.

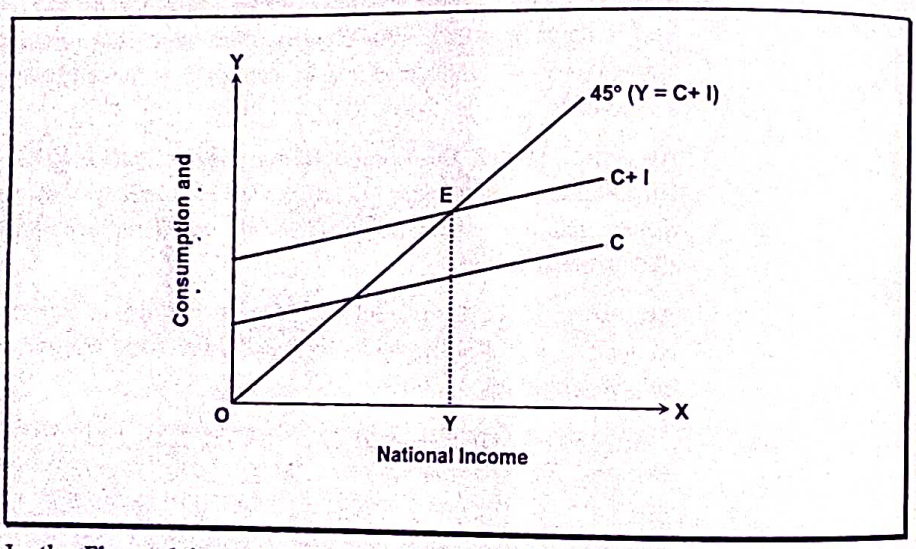
Static analysis (macro statics) explains the final position of equilibrium of the whole economy at a particular point of time. It shows a still picture of the economy as a whole. It also investigates the relation between macro variables in the final position of equilibrium. But it does not tell the process of adjustment to the final equilibrium. The following equation reflects the final position of equilibrium.

$$Y = C + I$$

Where,
Y = Aggregate income
C = Aggregate consumption
I = Aggregate investment

The concept of static analysis has been illustrated in the **Figure 1.4**

FIGURE 1.4
Static Analysis



In the **Figure 1.4**, aggregate demand curve (C+I) and aggregate supply curve (45° line) are intersected at point E. Point E is the equilibrium point where the equilibrium level of national income is OY. As aggregate demand and aggregate supply refer to the same point of time, it is static analysis.

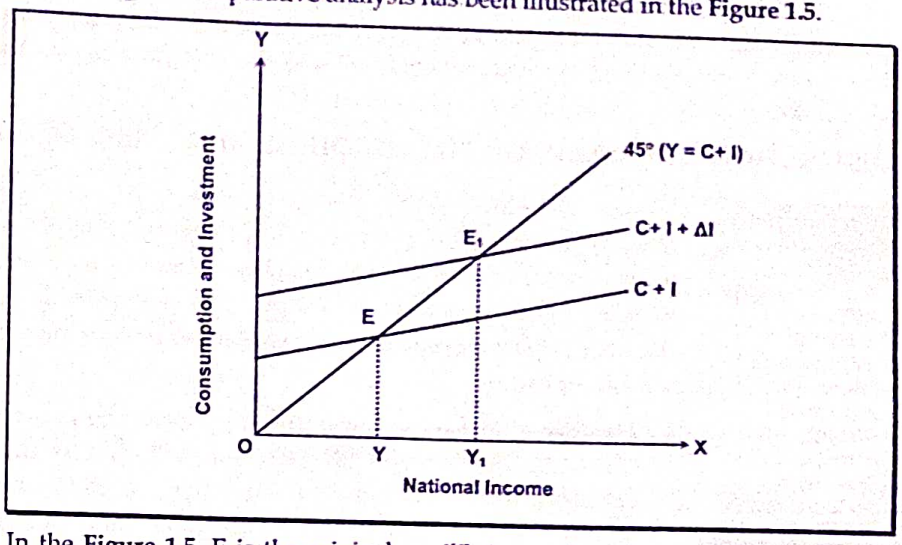
Comparative analysis
Comparative analysis is concerned with a comparative study of different equilibrium positions attained by the economy as a result of change in macroeconomic variables.

Comparative Analysis (Comparative Macro Statics)

Comparative analysis (comparative macro statics) is concerned with a comparative study of different equilibrium positions attained by the economy as a result of change in macroeconomic variables. It compares the new and old equilibrium attained by the economy. But it does not deal with the transitional period and process involved in the movement from one equilibrium point to another.

The concept of comparative analysis has been illustrated in the Figure 1.5.

FIGURE 1.5
Comparative Analysis



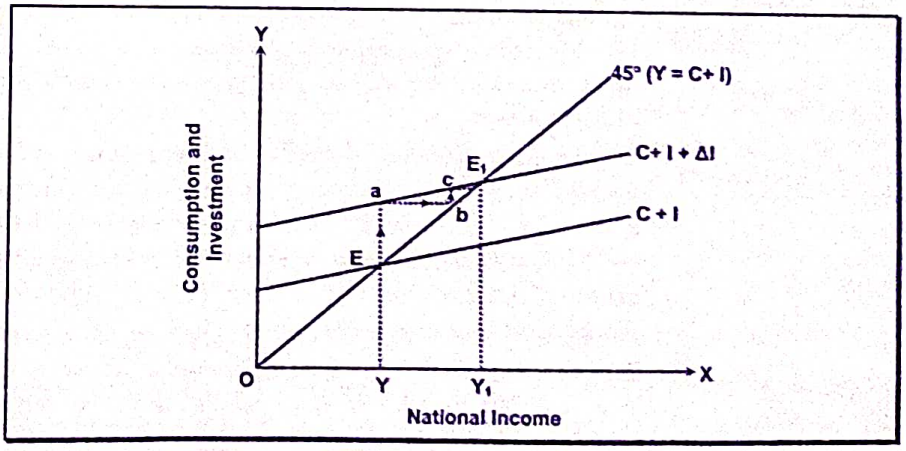
In the Figure 1.5, E is the original equilibrium point where aggregate demand curve (C + I) and aggregate supply curve (45° line) are intersected. OY is the equilibrium level of national income. When there is an increase in investment, the aggregate demand curve shifts to C + I + ΔI. Consequently, the new equilibrium point is E_1 and new equilibrium national income is OY_1. The comparative study of two equilibrium points E and E_1 is called comparative analysis. But it does not explain the process through which new equilibrium is attained.

Dynamics analysis
Dynamics analysis is the study of the process by which the economy moves from one equilibrium point to another as a result of change in macroeconomic variables.

Dynamic Analysis (Macro Dynamics)

Dynamics analysis (macro dynamics) is the study of the process by which the economy moves from one equilibrium point to another as a result of change in macroeconomic variables. The concept of dynamic analysis has been illustrated in the *Figure 1.6*.

FIGURE 1.6
Macro Dynamics



In the Figure 1.6, initial equilibrium point is E where the level of income is OY. With the increase in investment, initial equilibrium shifts from E to E_1 and level of income increases from OY to OY_1. When income increases due to increase in

investment, consumption demand also increases. This further increases investment to meet the increased demand. So the income goes on increasing till the final equilibrium is reached at E_1 through the path a, b and c.

Distinction between Microeconomics and Macroeconomics

Distinction between Microeconomics and Macroeconomics
1. Difference in nature
2. Difference in objectives
3. Difference in basis
4. Difference in assumptions
5. Difference in method of study
6. Area of study
7. Mortal and Immortal subject

Modern economic theory is broadly sub-divided into microeconomics and macroeconomics. This is because microeconomic analysis and macroeconomic analysis are the two distinct approaches adopted by modern economists in order to analyze and understand the various economic issues and problems of present day society. The main differences between microeconomics and macroeconomics are as follows:

1. **Difference in nature:** The nature of microeconomics is quite distinct from that of macroeconomics. Microeconomics studies the individual units of the economy like a consumer, a household, a firm, etc. On the contrary, macroeconomics deals with aggregates like national income, total consumption, total expenditure, etc. It studies the behaviour of the economy as a whole.
2. **Difference in objectives:** The objective of microeconomics on the demand side is to maximize utility whereas on the supply side is to maximize profits at the minimum cost. But, the main objectives of macroeconomics are full employment, price stability, economic growth and favourable balance of payment.
3. **Difference in basis:** The basis of microeconomics is price mechanism, which operates with the help of individual demand and supply. These forces help to determine the equilibrium price in the market. But the basis of macroeconomics is the general price level, which is determined by aggregate demand and aggregate supply.
4. **Difference in assumptions:** Microeconomics is based on the assumption of full employment of resources. Based on the assumption of full employment, microeconomics analyses how resources are allocated. But macroeconomics rejects the assumption of full employment and analyses how resources can be fully employed.
5. **Difference in method of study:** Microeconomics is based on the partial equilibrium analysis which helps to explain the equilibrium of an individual, a firm, an industry, etc. But macroeconomics is based on the general equilibrium analysis which is an extensive study of a number of economic variables and their interdependence for understanding the working of the economic system as a whole.
6. **Area of study:** Theory of value and theory of economic welfare are the major areas covered in microeconomics. The theory of value includes product pricing and factor pricing. But income and employment theory and monetary theory are the core topics of macroeconomics. Similarly, public finance, growth theories and international trade are also included in the field of macroeconomics.

7. **Mortal and immortal subject:** Microeconomics deals with individuals; and individuals are mortal because after passing some lifetime in the world, an individual dies. But macroeconomics deals with society as a whole and society never ends. Therefore, the subject-matter of macroeconomics is immortal.

The difference between microeconomics and macroeconomics can be summarized as shown in the following table:

Basis of Differences	Microeconomics	Macroeconomics
1. Nature	Microeconomics is a study of individual units of an economy.	Macroeconomics is a study of economy as a whole.
2. Area of study	Microeconomics studies individual economic units such as a consumer, a household, a firm, an industry, a commodity, etc.	Macroeconomics is a study of national aggregates such as national income, national output, general price level, level of employment, etc.
3. Problems	Microeconomics deals with determination of price of a commodity, a factor of production, satisfaction of a consumer, etc.	Macroeconomics deals with the problems of unemployment, trade cycles, international trade, economic growth, etc.
4. Partial/ General Equilibrium	Microeconomics is based on partial equilibrium analysis, other things remaining the same.	Macroeconomics is based on general equilibrium.
5. Mortal/ Immortal	The subject-matter of micro economics is mortal.	The subject-matter of macro economics is immortal.
6. Suitability	Microeconomics is suitable to study the problems of individual economic units.	Macroeconomics is suitable for the problems of economy as a whole.
7. Also called	Microeconomic is also called price theory or value theory.	Macroeconomic is also called Theory of Income and Employment or Keynesian Theory.

Goals and Instruments of Macroeconomics

Goals of Macroeconomics/ Macroeconomic Policy

Each and every country has macroeconomic goals which they want to achieve. These goals help to ensure long-term stable economic success. The macroeconomic goals that a country wants to achieve are explained below:

1. **Economic growth:** Economic growth refers to the percentage change in nominal or real GDP. It shows the percentage change in nation's output per

Goals of Macroeconomics
1. Economic growth
2. Control inflation
3. Reduce unemployment or achieve full employment
4. Balanced balance of payment
5. Reduce economic inequality
6. Stable foreign exchange rate
7. Reduce poverty

year. The economic growth may be positive or negative. It is largely influenced by the physical capital, human capital, labour force and technology available in the country. Every country wants to achieve non-inflationary economic growth. Stable and sustainable economic growth over a long term, is the non-inflationary growth. Increase in economic growth without rise in price level would be the objective of the government and central bank of a country.

2. **Control inflation:** Inflation is the percentage change in price level between two given periods. In other words inflation refers to the continuous and sustainable rise in general price level. Growth rate of GDP deflator is used to measure rate of inflation. The rate of inflation affects the purchasing power of money, influence our decisions to hold and to use money, shape of consumption and investment decisions, impact contract choices and outcomes. If price level rises, the value of money or purchasing power of money falls. The high rate of inflation makes the low income and fixed salaries people very difficult. Therefore, a goods government or central bank always tries to reduce the prices of goods and services to keep the rate of inflation under control.
3. **Reduce unemployment or achieve full employment:** Unemployment refers to the non-availability of jobs (works) for people able and willing to work at the existing wage rate. People who are either unfit for work due to mental or physical reasons or don't want to work, e.g. Sadhus, are excluded from the category of unemployment. It is the problem to both developed and developing countries. It creates problems like inequality, poverty, robbery, prostitutions, theft, crime, etc. The unemployed persons will not pay any tax to the government instead the government will have to pay them employment allowances. If unemployment is high, it will have a negative effect on the economy and if it is low, it will have positive effect on the economy. Therefore, reducing unemployment problem or creating employment opportunities or achieving full employment has been major objective in all economies in the world.
4. **Balanced balance of payment:** Balance of payment is defined as the systematic record of receipt and payment of a country with the rest of the world. It is a broader concept than balance of trade because it includes both imports and exports of visible and invisible items while balance of trade includes only exports and import of physical goods. The record of visible items is available in the port. Invisible items include all the services exported and imported such as banking, insurance, investment, donation, etc. If the total payments of a country exceed its total receipts, it is known as deficit of the balance of payment. If the total receipts of a country or exports and its total payments or imports are equal, it is known as balanced balance of payment. If the total receipts of a country exceed its total payment, it is known as the surplus of the balance of payment. Every country has the objective of achieving balanced balance of payment or achieving favourable balance of payment.
5. **Reduce economic inequality:** Economic inequality refers to the situation in which income and wealth are distributed unequally among the people of a

country. It also refers to the gap between rich and poor, income inequality, wealth disparity, wealth gap. Economic inequality varies between societies, historical periods, economic structures and systems (for example, capitalism or socialism) and between individual's abilities to create wealth. Therefore, a good government or monetary authority always tries to reduce economic inequality by using monetary and fiscal instruments.

6. **Stable foreign exchange rate:** Foreign exchange refers to the currency of another country. In other words, the money of one nation hold by citizens of another nation either in currency or a deposited in banks is called foreign exchange. The foreign exchange rate is the rate at which one country's money can be turned into another's. For example if the rate of exchange between US dollars and Nepalese rupees is $ 1 = NRs 120, this tells us that each US dollar we give up purchase 120 Nepalese rupees.

   Foreign exchange rate is the important determinant of the prices of exports and imports in international trade. The change in the exchange rate has direct impact on external trade balance and domestic economy. It provides us a basis for understanding the causes and impacts the performance of an economy. Hence, every country has the objective of to maintain stable foreign exchange rate.

7. **Reduce poverty:** Poverty refers to the inability to attain a minimum standard of living. In other words, it is an income below some minimum level to meet basic needs. The basic needs include foods, safe drinking, water, sanitation facilities, health, shelter, education and information. Hence, poverty is the situation of inadequate income, illiteracy, malnutrition, lack of social services like health care, sanitation and lack of social and political status. Therefore, poverty reduction is a major goals and issues mainly for the developing countries. Many international organizations such as United Nations and World Bank are also working with the objective of reducing poverty.

Instruments of Macroeconomics/ Macroeconomic Policy

The government of a country uses various instruments of macroeconomic policy in order to influence the goal variables in desired directions and degrees. There are mainly three types of instruments of macroeconomic policy:

1. Monetary Policy

Monetary Policy
Monetary policy is one of the important macroeconomic policy which is practiced by the monetary authority to achieve predetermined objectives through the changes in money supply, credit, and interest rate in the economy.

Monetary policy is concerned with the management of the money supply in the economy. It is employed for achieving certain given objectives of economic policy. The common objectives of economic policy are the attainment of full employment, price stability, balance of payment equilibrium and rapid economic growth. In the words of **Paul Einzing**, *"Monetary policy includes all monetary decisions and measures irrespective of whether their aims are monetary or non-monetary, and all non-monetary decisions and measures that aim at affecting the system."* The monetary authority plays key role in this regard.

Thus, in conclusion, the monetary policy is one of the important macroeconomic policies which is practiced by the monetary authority (Central Bank, NRB in Nepal) to achieve predetermined objectives through the changes in money supply, credit, and interest rate in the economy.

Types of Monetary Policy
1. Expansionary monetary policy
2. Contractionary monetary policy

The monetary policies are of two types. They are described below:

a. **Expansionary (or ease or cheaper) monetary policy:** An expansionary monetary policy is an action taken by the monetary authority (central Bank) to increase the money supply (i.e. to increase monetary base or its rate of growth). Monetary authority can use its tools, individually or collectively to expand the supply of money. Central bank can purchase treasury bills and bonds in open market, decrease the bank rate or discount rate and reduced the required reserve ratio to increase the money supply in the economy.

b. **Contractionary (or tight or dearer) monetary policy:** Contractionary monetary policy is opposite of expansionary monetary policy. It is an action taken by the monetary authority (central Bank) to decrease the money supply (i.e. to decrease monetary base or its rate of growth). Monetary authority can use its tools, individually or collectively to decrease the supply of money. Central bank can sell treasury bills and bonds in open market, increase the bank rate or discounted and increase the required reserve ratio to decrease the money supply in the economy.

2. Fiscal Policy

Fiscal Policy
Fiscal policy is the means by which a government adjusts its levels of spending in order to monitor and influence a nation's economy.

Fiscal policy is the means by which a government adjusts its levels of spending in order to monitor and influence a nation's economy. In other words, fiscal policy is the policy that involves the use of government spending, taxation and borrowing to affect the level and growth of aggregate demand, output and employment. Fiscal policy was taken as a policy that affected the public treasury until the great depression of 1930s. Before the great depression of 1930, fiscal policy was taken only as the means to mobilize the government resources. But with the change in time, the meaning of fiscal policy has also changed. Its meaning in present days is very wide. It is now taken as the government financial policies designed to benefit the economy.

Fiscal policy has been variously defined by economists.

According to **Smithies,** *"As a policy under which government uses its expenditure and revenue programs to produce desirable effects and avoid undesirable effects in the national income, production and employment.*

Accordingly to **G.K. Shaw,** *"Fiscal policy as any discretionary change in the level, composition or timing of government outlays whether upon goods and services or in the form of transfer payment; and equally any discretionary alteration in the burden, structure, or frequency of the tax payment."*

J.M. Keynes has made important contribution in the development of fiscal policy.

In the words of **J.M. Keynes,** *Fiscal policy is a policy that uses public finance as a balancing factor in the development of economy."*

Due to this, some economists are of the view that the name of public finance was converted into fiscal policy.

According to **S.K. Singh,** *"Public finance in now fiscal policy, fiscal policy is the use of government taxing, borrowing and spending powers to maintain full employment without inflation."*

Thus, fiscal policy is the use of instruments like public revenue, expenditure and borrowing to have beneficial effects and remove unbeneficial effects on the economy.

The fiscal policy is the policy for the government revenue, expenditure and borrowing to meet the goals targeted by the government. In fact, fiscal policy has become more popular measure after the depression of 1930's. Through its fiscal policy, a government changes the amount of its budgets needed and attempts to fulfill its targeted objectives.

Fiscal policy can be divided into two types:

Classification / Types of Fiscal Policy
a. Expansionary Fiscal Policy
b. Contractionary Fiscal Policy

a. **Expansionary Fiscal Policy:** The fiscal policy which increases aggregate demand by increasing government expenditure or by lowering taxes is called expansionary fiscal policy. This type of policy is reflected in the government budget. Due to expansion of government spending and lowering the taxes, expansionary fiscal policy either increases budget deficit or reduces the budget surplus. Such type of fiscal policy is adopted during economic depression.

b. **Contractionary Fiscal Policy:** The fiscal policy which reduces aggregate demand either by reducing government expenditure or by increasing taxes is called contractionary fiscal policy. Due to reduction in government expenditure and increase in taxes, contractionary fiscal policy results into either increased budget surplus or decreased budget deficit. Such kind of fiscal policy is used during inflationary pressure.

3. Exchange Rate

Foreign exchange refers to the currency (or interest bearing bonds) of another country. In other words, the money of one nation held by citizens of another nation either as currency or as deposits in banks is called foreign exchange.

Foreign exchange rate
Foreign exchange rate is the price of a currency in terms of another currency. The foreign currencies are exchanged or transferred in foreign exchange market.

Exchange rate is defined as the rate at which the currency of one country is exchanged with the currency of another country. For example, if the rate of exchange between US dollar and Nepalese Rupees is $1 = Rs. 118, this tells us that for each US dollar, we give up 118 Nepalese Rupees. The foreign currencies are exchanged in foreign exchange market.

According to **Crowther,** *"The rate of exchange measures the number of units of one currency which will change in the foreign exchange market for another."*

Thus, exchange rate is the value of one currency in terms of another currency. The foreign exchange rate is the important determinant of the prices of exports and imports in the international trade. The change in foreign exchange rate has direct impact on external trade balance and domestic economy. It provides us a basis for understanding the causes and impacts of fluctuation in foreign exchange rate on the performance of an economy. It is determined from the demand for and supply of currency in the foreign exchange market. If the demand for the currency increases, the exchange rate will rise. On other hand, if the supply of currency increases, the exchange rate will fall.

The market where foreign exchange is treated is called foreign exchange market. This includes both spot market for immediate dealing and future markets for

delivery on future dates at pre-arranged prices. There is no one place for this market, which operates via computers and telephone connections.

Types of Exchange Rate
a. Fixed exchange rate
b. Flexible exchange rate

Foreign exchange rate can be classified into two groups, i.e. fixed exchange rate and flexible exchange rate.

a. **Fixed exchange rate:** The fixed exchange rate system is one in which rate of currency or exchange rate is fixed in terms of another currency. This is also known as the pegged exchange rate system. It does not fluctuate with change in demand and supply of foreign currency. The exchange rate system between Nepal and India is fixed exchange rate system.

b. **Flexible exchange rate:** The flexible exchange rate system is one in which rates of currency or exchange rate is determined by the market forces of demand and supply. It is also known as the floating exchange rate system. In the flexible exchange rate system, government does not make any kind of interference. For example, the exchange rate system between Nepal and USA is flexible exchange rate. Most of the countries of the world have adopted flexible exchange rate system.

CHAPTER SUMMARY

■ **Concepts of Microeconomics**

Microeconomics is the branch of economics, which deals with very small units of the economy. It studies behaviour of individual units of the economy rather than economy as a whole.

■ **Types of Microeconomics**

Equilibrium analysis in microeconomics is divided into following three types.

1. **Micro Static Analysis:** Micro static analysis is defined as the static relationship between microeconomic variables whose values relate to the same point of time or to the same period of time.
2. **Comparative Micro Static Analysis:** Comparative micro static analysis is defined as the comparative study between different equilibrium positions determined from the interaction between microeconomic variables at different points of time.
3. **Micro Dynamic Analysis:** Micro dynamic analysis is defined as the analysis of the process through which the system moves from one equilibrium to another. In other words, micro dynamic analysis explains the lagged relationship between the microeconomic variables.

■ **Concepts of Macroeconomics**

Macroeconomics is the study of very large, economy-wide aggregate variables like national income, money, price level, unemployment, economic growth rate, etc.

■ **Types of Macroeconomics**

Equilibrium analysis in macroeconomics is divided into following three types.

1. **Static Analysis:** Static analysis explains the final position of equilibrium of the whole economy at a particular point of time.
2. **Comparative Analysis:** Comparative analysis is concerned with a comparative study of different equilibrium positions attained by the economy as a result of change in macroeconomic variables.
3. **Dynamics Analysis:** Dynamic analysis is the study of the process by which the economy moves from one equilibrium point to another as a result of change in macroeconomic variables.

■ **Goals of Macroeconomics**

1. Economic growth
2. Control inflation
3. Reduce unemployment or achieve full employment
4. Balanced balance of payment
5. Reduce economic inequality
6. Stable foreign exchange rate
7. Reduce poverty

■ **Instrument of Macroeconomics**

1. **Monetary Policy:** Monetary policy is one of the important macroeconomic policies which is practiced by the monetary authority (Central Bank, NRB in Nepal) to achieve predetermined objectives through the changes in money supply, credit, and interest rate in the economy.

   The types of monetary policy are as follows:

   a. Expansionary monetary policy
   b. Contractionary monetary policy

2. **Fiscal Policy:** The fiscal policy is the policy for the government revenues, public expenditures and borrowing to meet the goals targeted by the government. Through its fiscal policy, a government changes the amount of its budgets needed and attempts to fulfil its targeted objectives. The importance of fiscal policy is high in underdeveloped countries.

   The classification / types of fiscal policy are as follows:

a. Expansionary Fiscal Policy
b. Contractionary Fiscal Policy

3. **Exchange Rate:** Foreign exchange rate is the price of a currency in terms of another currency. The foreign currencies are exchanged or transferred in foreign exchange market. It is simply the rate at which one currency can be exchanged for another currency.
The types of exchange rate are as follows:
a. Fixed exchange rate
b. Flexible exchange rate

GLOSSARY

- **Allocation of resources:** The assignment of available resources to various uses
- **Centrally planned economy:** An economic system in which resources are allocated by the state authority or government
- **Cob-web model:** The model or theory that explains the causes of periodic fluctuation in price
- **Decision science:** Decision science is the quantitative technique used to inform decision making at the individual and population levels
- **Econometrics:** The empirical estimation and testing of economic relationship and models
- **Economic efficiency:** An economic state in which every resource is optimally allocated to serve each individual or entity in the best way while minimizing waste and inefficiency
- **Free market economy:** An economic system based on demand and supply with little or no government control
- **Inflation:** An increase in overall level of prices in the economy
- **Lagged relationship:** The relationship between two or more variables in different periods
- **Model:** A formal or mathematical statement of an economic theory
- **Relative price:** Price of a commodity in terms of another
- **Scarcity:** The limited nature of society's resources
- **Subsidy:** A benefit given to an individual or business by the government which can be in the form of a cash payment or reduction in tax
- **Taxation:** A system by which a government takes money from people and spends it on things such as education, health and defense
- **Welfare economics:** The study of how the allocation of resources affects the economic well-being

OBJECTIVE QUESTIONS

1. Who was first coined and used the words micro and macro?
   a. Adam Smith b. Prof. Ragnar Frisch
   c. Prof. Marshall d. Robbins
2. Microeconomics is also called
   a. Income and employment theory b. Price theory
   c. Slicing method d. both (b) and (c)
3. Macroeconomics is also called
   a. Theory of income and employment b. Aggregate economics
   c. Lumping method d. above all
4. Which does not fall under goals of macroeconomic policy?
   a. Economic growth b. Control inflation
   c. Stable exchange rate d. Price determination
5. Which is the instrument of macroeconomic policy?
   a. Reduce poverty b. Reduce economic inequality
   c. Monetary policy d. Reduce unemployment
6. Monetary policy is related to
   a. management of money supply b. management of money demand
   c. management of borrowing d. management of trade
7. Fiscal policy is related to
   a. government money demand b. government money supply
   c. government business d. government spending, taxation and borrowing

2

UNIT

ELASTICITY OF DEMAND AND SUPPLY

LEARNING OBJECTIVES...

On completion of this unit, students will be able to:

- give the concept of price, income and cross elasticity of demand.
- explain the types of price, income and cross elasticity of demand.
- describe the measurement of price, income and cross elasticity of demand: Total outlay method and point method.
- explain the uses of price, income and cross elasticity of demand.
- give the concept of elasticity of supply.
- describe the measurement of elasticity of supply.
- solve the numerical exercise using excel.

Introduction

The elasticity of demand and supply explain not only direction of change in price and quantity demanded and supplied but also degree of relationship between them.

The law of demand states that there is inverse relationship between price of a commodity and its quantity demanded, all other factors remaining the same. In other words, the law of demand explains that the demand for a commodity increases with fall in price and vice-versa. But this law only shows the direction of change in demand for a commodity due to change in its price. This law does not explain the degree of relationship between the change in price of the commodity and its quantity demanded. It is silent on the amount of change in demand at the given change in price. In other words, the law of demand shows only direction of change in demand for a commodity due to change in its price but this law does not explain by how much quantity demanded for a commodity changes in response to a given change in price. The explanation on how much or to what extent quantity demanded for a commodity changes as a result of change in price, we study in the elasticity of demand.

Similarly, law of supply states only the positive relationship between price of a commodity and its quantity supplied. The answer of this question is given by the elasticity of supply. In this contest, in this part of the unit, we begin our study with price elasticity of demand, its types and measurements. Thereafter, we study meaning, types and measurement of income and cross elasticity of demand. Finally, we study elasticity of supply, its types and measurement.

ELASTICITY OF DEMAND

Concept of Elasticity of Demand

Elasticity of Demand
A measure of responsiveness of quantity demanded to the change in its determinants.

The concept of elasticity of demand was first introduced by the classical economists **A.A. Cournot and J. S. Mill.** Latter on neo-classical economist **Alfred Marshall** developed it in the scientific way in his book **Principles of Economics.**

The elasticity of demand is the measure of responsiveness of demand for a commodity to the change in any of its determinants viz. price of the same commodity, price of the related commodity, consumer's income, tastes & preferences of the consumer, consumer's expectations regarding prices, etc.

According to the law of demand, there is inverse relationship between the price and the quantity demanded of a commodity. This law does not state the degree of change in demand due to change in price. To how much or to what extent the quantity demanded of a commodity will change because of a change in the price is provided by the concept of elasticity of demand. In other words, the elasticity of demand shows the rate of change in demanded in response to the change in the price. In simple words, the responsiveness of change in the quantity demanded due to change in its price is termed as elasticity of demand.

According to **Prof. Alfred Marshall,** "*The elasticity of demand in a market is great or small according as the amount demanded increases much or little for a given fall in price and diminishes much or little for a given rise in price.*"

According to **Prof. R.G. Lipsey,** "*Elasticity of demand may be defined as the ratio of the percentage change in demand to the percentage change in price.*"

Thus, the elasticity of demand refers to the responsiveness of change in demand to the change in factors determining demand.

Types of Elasticity of Demand

There are as many elasticity of demand as its determinants. The most important types of elasticity of demand are as follows:

1. Price elasticity of demand
2. Income elasticity of demand
3. Cross elasticity of demand
4. Advertisement elasticity of demand

Price Elasticity of Demand (E_P)

Price Elasticity of Demand (E_P)
A measure of how much the quantity demanded of a good responds to the change in price of that good is called price elasticity of demand.

Price elasticity of demand is defined as the responsiveness of change in quantity demanded of a commodity to the change in its price. In other words, the price elasticity of demand is defined as the ratio of percentage change in quantity demanded to the percentage change in price. Since, price and quantity demanded are inversely related; the coefficient of price elasticity of demand is negative. It can be expressed as

$$E_P = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$= \frac{\dfrac{\text{Change in quantity demanded}}{\text{Initial Quantity demanded}} \times 100}{\dfrac{\text{Change in price}}{\text{Initial Price}} \times 100}$$

$$= \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta P}{P} \times 100} = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

$$\therefore E_P = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

where

E_P = Coefficient of price elasticity of demand
Q = Initial quantity demanded
P = Initial price
ΔQ = Change in quantity demanded
ΔP = Change in price

Example 2.1 Let us suppose, that price of a commodity X decreases from Rs. 10 per-unit to Rs. 8 per-unit and quantity demanded of X increases from 50 units to 60 units. Then find out price elasticity of demand.

SOLUTION

Given
Initial Price (P) = Rs. 10
Initial Quantity (Q) = 50
New Price (P_1) = Rs. 8
New Quantity (Q_1) = 60
Change in price (ΔP) = $P_1 - P = 8 - 10 = -2$

Change in quantity $(\Delta Q) = Q_1 - Q = 60 - 50 = 10$

We know that

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \left(\frac{10}{-2}\right) \times \frac{10}{50} = -1$$

Hence, coefficient of price elasticity $(E_P) = -1$.

Interpretation: Since the coefficient of price elasticity of demand is – 1, one percentage increase in price results same percentage decrease in quantity demanded and vice-versa.

Types (Degrees) of Price Elasticity of Demand

Types (Degrees) of Price Elasticity of Demand
1. Perfectly Elastic Demand ($E_P = \infty$)
2. Perfectly Inelastic Demand ($E_P = 0$)
3. Unitary Elastic Demand ($E_P = 1$)
4. Relatively Elastic Demand ($E_P > 1$)
5. Relatively Inelastic Demand ($E_P < 1$)

There are five types of price elasticity of demand. They are as follows:

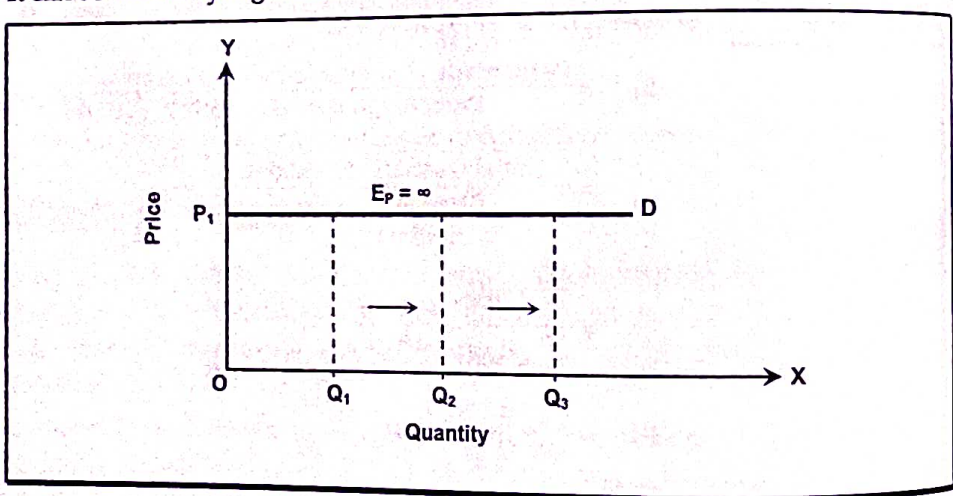
1. Perfectly Elastic Demand ($E_P = \infty$)

Demand is said to be perfectly elastic if negligible change in price leads to infinite change in the quantity demanded. Visibly, no change in price causes an infinite change in demand. Perfectly elastic demand is theoretical concept. It is hardly found in practice or real life.

$$E_P = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}} = \frac{\infty}{0} = \infty$$

It can be shown by Figure 2.1.

FIGURE 2.1
Perfectly Elastic Demand



In Figure 2.1, the quantity demanded may be OQ_1 or OQ_2 at price OP_1. Therefore, demand curve is horizontal straight line or parallel to the X-axis which shows perfectly elastic demand.

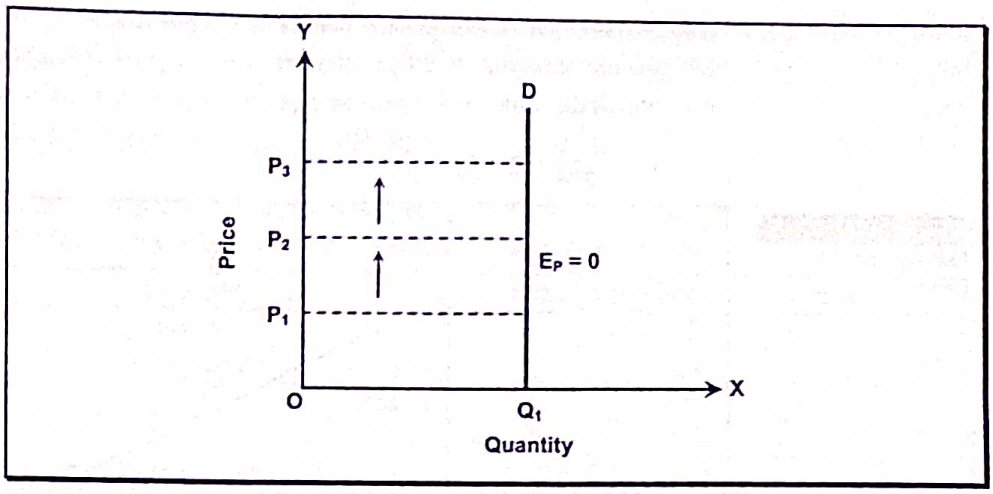
2. Perfectly Inelastic Demand ($E_P = 0$)

When the demand for a commodity does not change with the change in its price, the demand is said to be perfectly inelastic demand. For example, medicine and salt have perfectly inelastic demand.

$$E_P = \frac{0}{\text{Any amount}} = 0$$

It is shown by Figure 2.2.

FIGURE 2.2
Perfectly Inelastic Demand



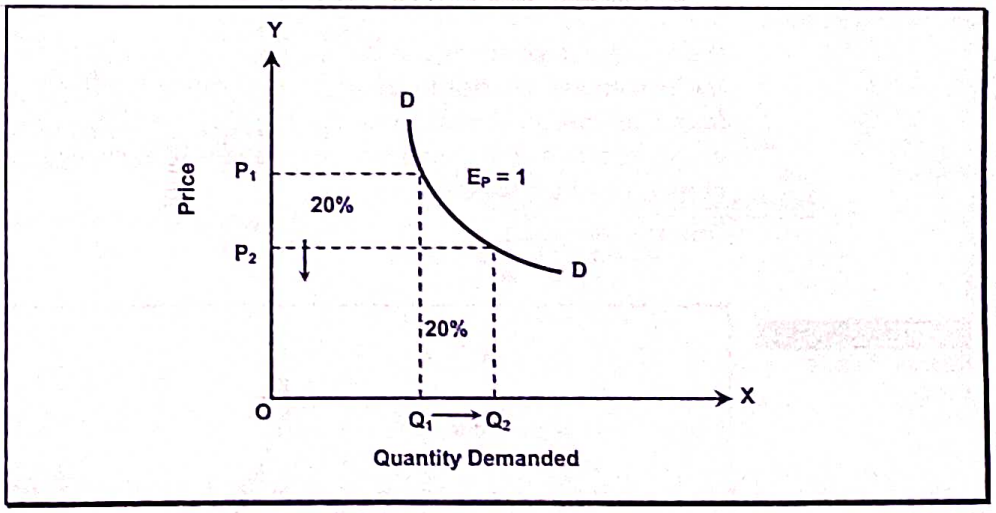
In Figure 2.2, even at the different prices OP_1 or OP_2 or OP_3, the quantity demanded is OQ_1. Therefore, demand curve becomes vertical straight line or parallel to the Y-axis which shows perfectly inelastic demand.

3. Unitary Elastic Demand ($E_P = 1$)

When the percentage change in the quantity demanded is equal to the percentage change in price, the demand for a commodity is said to be unitary elastic demand. For example, if a 20% change in price causes 20% change in demand, it is the case of unitary elastic demand.

$$E_P = \frac{20\%}{20\%} = 1$$

FIGURE 2.3
Unitary Elastic Demand



In Figure 2.3, the rectangular hyperbola curve DD represents unitary elastic demand. When the price falls from OP_1 to OP_2, the quantity demanded increases from OQ_1 to OQ_2, i.e. the percentage change in price is equal to the percentage change in quantity demanded. Hence, the demand curve DD represents unitary elastic demand.

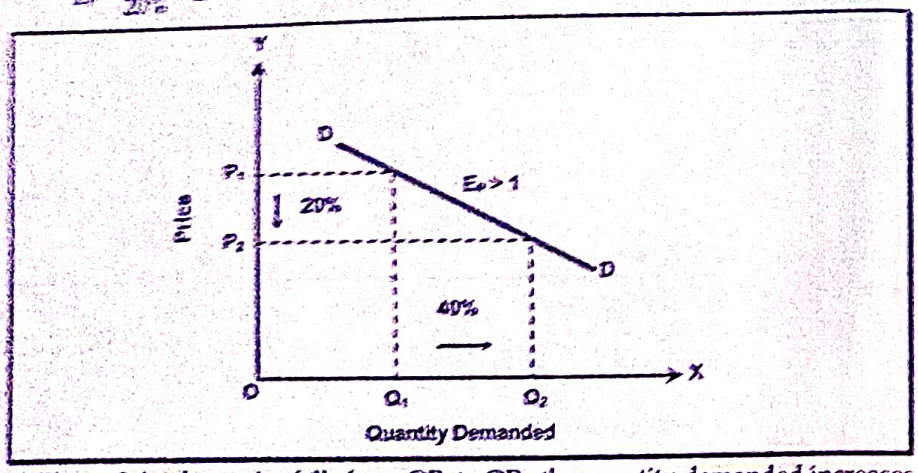
4. Relatively Elastic Demand ($E_P > 1$)

When the percentage change in the quantity demanded for a commodity is more than percentage change in its price, it is called relatively elastic demand. Such

kind of elasticity of demand is found in case of luxury goods like LED television, refrigerator, car, etc. If 20 percent change in price results 40 percent change in quantity demanded, it is the case of relatively elastic demand.

$$E_p = \frac{40\%}{20\%} = 2 > 1$$

FIGURE 2.4
Relatively Elastic Demand



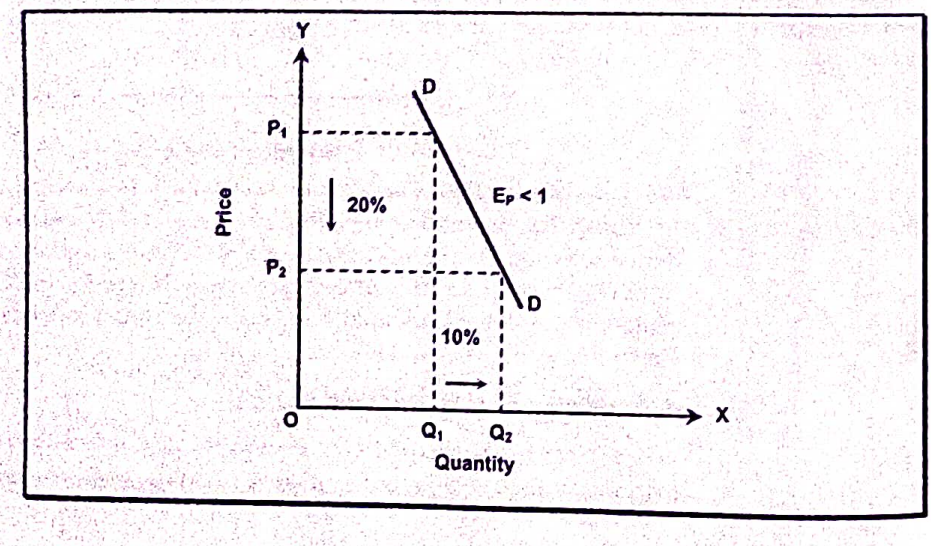
In Figure 2.4, when price falls from OP_1 to OP_2, the quantity demanded increases from OQ_1 to OQ_2, i.e. the percentage change in quantity demanded is more than the percentage change in price. Here, the increase in demand is more than the fall in price. Hence, the demand curve is flatter which shows relatively elastic demand.

5. Relatively Inelastic Demand ($E_P < 1$)

If the percentage change in the quantity demanded of a commodity is less than the percentage change in its price, it is called relatively inelastic demand. It is found in case of necessity or basic good like rice, vegetable, clothes, etc. For example, when 20% change in price causes 10%, change in demand, it is the case of relatively inelastic demand.

$$E_P = \frac{10\%}{20\%} = \frac{1}{2} = 0.5 < 1$$

FIGURE 2.5
Relatively Inelastic Demand



In Figure 2.5, when price falls from OP_1 to OP_2, the quantity demanded increase from OQ_1 to OQ_2, i.e. the percentage change in the quantity demanded is less than the percentage change in price. Consequently, demand curve DD is steeper which shows relatively inelastic demand.

Example 2.2 The following table shows estimated price elasticities of demand for selected commodities. Indicate from the price elasticities if the demand is elastic or inelastic.

Commodity	Coefficient of Price Elasticity of Demand
Potatoes	0.31
Green vegetable	0.42
Sugar	0.31
Electricity	1.20
Restaurant meals	2.27

SOLUTION

Commodity	Type of Demand
Potatoes	Inelastic
Green vegetable	Inelastic
Sugar	Inelastic
Electricity	Elastic
Restaurant meals	Elastic

Example 2.3 Calculate the price elasticity of demand and interpret the result when 25% increase price of potato results to decrease in quantity demanded from 5 kg to 4 kg.

SOLUTION

Given
Initial quantity demanded (Q) = 5 Kg.
New quantity demanded (Q_1) = 4 Kg.
Change in quantity demanded (ΔQ) = 4 – 5 = –1 Kg.
Percentage change in price = 25%
We know that

$$\text{Percentage change in quantity demanded} = \frac{\text{Change in quantity demanded}}{\text{Initial quantity demanded}} \times 100$$

$$= \frac{4-5}{5} \times 100\%$$

$$= \frac{-1}{5} \times 100$$

$$= -20\%$$

$$\text{Price Elasticity of demand } (E_P) = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in Price}}$$

$$= \left(\frac{-20\%}{25\%}\right)$$

$$= -\frac{4}{5} = -0.8$$

Interpretation: Since $E_P = -0.8$, the demand for potato is inelastic. Therefore, it indicates that potato is a necessity good.

Income Elasticity of Demand (E_Y)

Income Elasticity of Demand (E_Y)
A measure of how much the quantity demanded of a good responds to a change in consumers' income computed as the percentage change in quantity demanded divided by percentage in income.

Income elasticity of demand is defined as the degree of responsiveness of demand for a commodity to the change in the income of the consumer. In other words, income elasticity of demand is the ratio of the percentage change in demand for a commodity to the percentage change in income. Thus,

$$E_Y = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

$$= \frac{\dfrac{\text{Change in quantity demanded}}{\text{Initial quantity demanded}} \times 100}{\dfrac{\text{Change in income}}{\text{Initial income}} \times 100}$$

$$= \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta Y}{Y} \times 100}$$

$$= \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q}$$

where

E_Y = Coefficient of income elasticity of demand
Q = Initial quantity demanded
Y = Initial income
ΔQ = Change in quantity demanded
ΔY = Change in income

The income elasticity may be positive negative or zero depending upon the nature of a commodity. As a rise in income leads to an increase in demand for a commodity, the income elasticity is positive. A commodity, which has positive income elasticity, is a normal good. On the other hand, when a rise in income leads to a decrease in demand for a commodity, its income elasticity is negative. Such a commodity is called inferior good. If the quantity of a commodity purchased remains unchanged even at the change in income, the income elasticity of demand is zero.

Example 24 When consumer's income rises from Rs. 100 to Rs. 102, his demand for good X increases from 25 units per week to 30 units per week. Then find out income elasticity of demand for good X.

SOLUTION

Given
Initial income (Y) = Rs. 100
New income (Y_1) = Rs. 102
Initial demand for good (Q) = 25 units
New demand for good (Q_1) = 30units
Change in income (ΔY) = $Y_1 - Y$ = 102 – 100 = Rs. 2
Change in demand (ΔQ) = $Q_1 - Q$ = 30 – 25 = 5 units
We know that

$$E_Y = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q} = \frac{5}{2} \times \frac{100}{25} = 10$$

Interpretation: Since E_Y = 10. It means that 1 percent increase in income results 10 percent increase in demand and vice versa. It is the case of normal goods.

Types (Degrees) of Income Elasticity of Demand

Types of Income Elasticity of Demand
1. Positive income elasticity of demand ($E_Y > 0$)
   a. Income elasticity greater than unity ($E_Y > 1$)
   b. Income elasticity less than unity ($E_Y < 1$)
   c. Income elasticity equal to unity ($E_Y = 1$)
2. Zero income elasticity of demand ($E_Y = 0$)
3. Negative income elasticity of demand ($E_Y < 0$)

Income elasticity of demand can be divided into following three types:

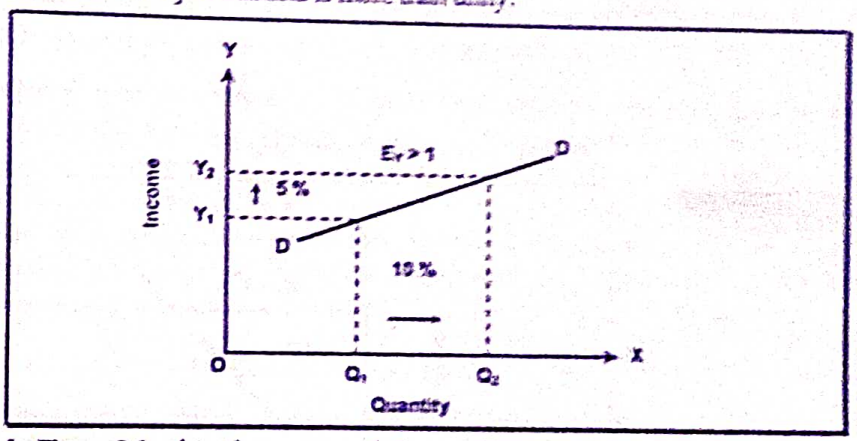
1. Positive Income Elasticity of Demand ($E_Y > 0$)

If income and demand for a commodity change into same direction, it is called positive income elasticity of demand. In other words, if increase in income leads to increase in demand for a commodity and decrease in income leads to decrease in demand for a commodity, it is called positive income elasticity of demand. The commodity, which has positive income elasticity is called normal good. Positive income elasticity can be divided into three types:

a. **Income elasticity greater than unity ($E_Y > 1$):** If the percentage increase in demand for a commodity is more than the percentage increase in income, it is called income elasticity greater than unity. Assuming, prices of all other goods as constant if the income of the consumer increased by 5% and as a result his purchase of the commodity increases by 10% then $E_Y = \frac{10\%}{5\%} = 2 > 1$.

It is the case of income elasticity greater than unity. In case of luxury goods, income elasticity of demand is more than unity.

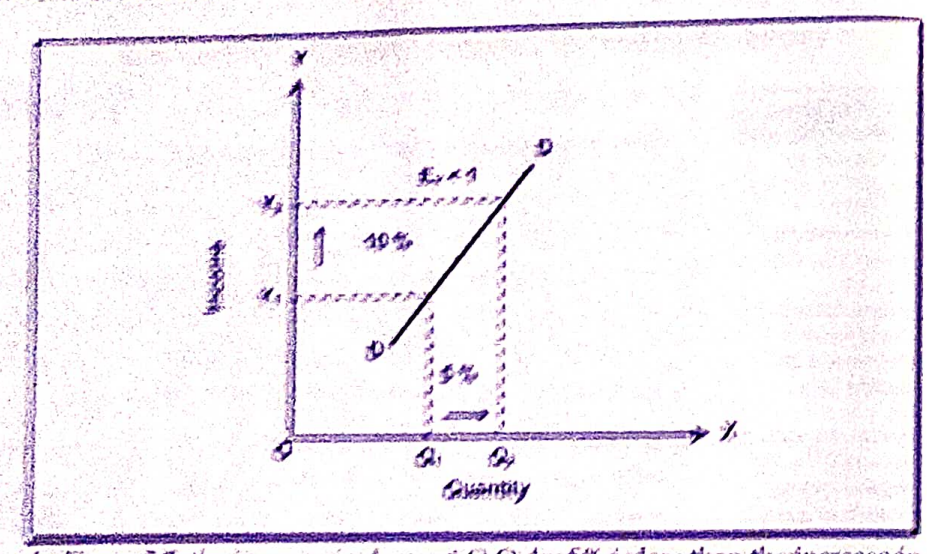
FIGURE 2.6
Income Elasticity Greater than Unity



In Figure 2.6, when the consumer's income increases by 5% from OY_1 to OY_2, the demand for a commodity increases by 10% from OQ_1 to OQ_2. Here, the increase demand for a commodity is more than the increase in income of the consumer. Hence, the demand curve DD shows a positive but elastic income demand.

b. **Income elasticity less than unity ($E_Y < 1$):** If the percentage increase in demand for a commodity is less than the percentage increase in income, it is called income elasticity less than unity. For example, if the quantity demand increases by 5% due to rise in income by 10%, then $E_Y = \frac{5\%}{10\%} = \frac{1}{2} < 1$. It is the case of income elasticity less than unity. In case of normal necessities, income elasticity of demand is less than unity.

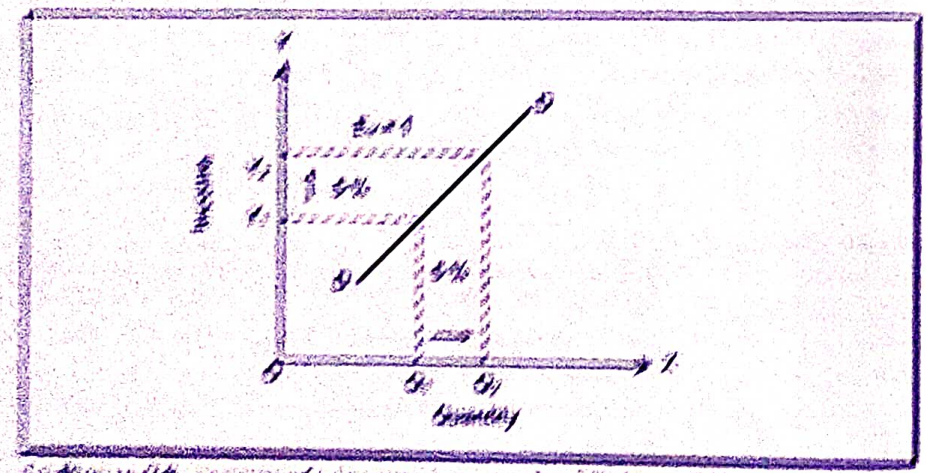
FIGURE 2.7
Income Elasticity and Elasticity



In Figure 2.7, the increase in demand (Q_1Q_2) by 5% is less than the increase in income (Y_1Y_2) by 10%. Hence, the demand curve (DD) shows a positive but inelastic demand.

c. Income elasticity equal to unity ($E_y = 1$): If the percentage increase in demand for a commodity is equal to the percentage increase in income, it is called income elasticity equal to unity. For example, 5% rise in income leads to 5% increase in demand $E_y = \frac{5\%}{5\%} = 1$. In case of comfortable goods, income elasticity of demand is equal to unity.

FIGURE 2.8
Income Elasticity Equal to Unity



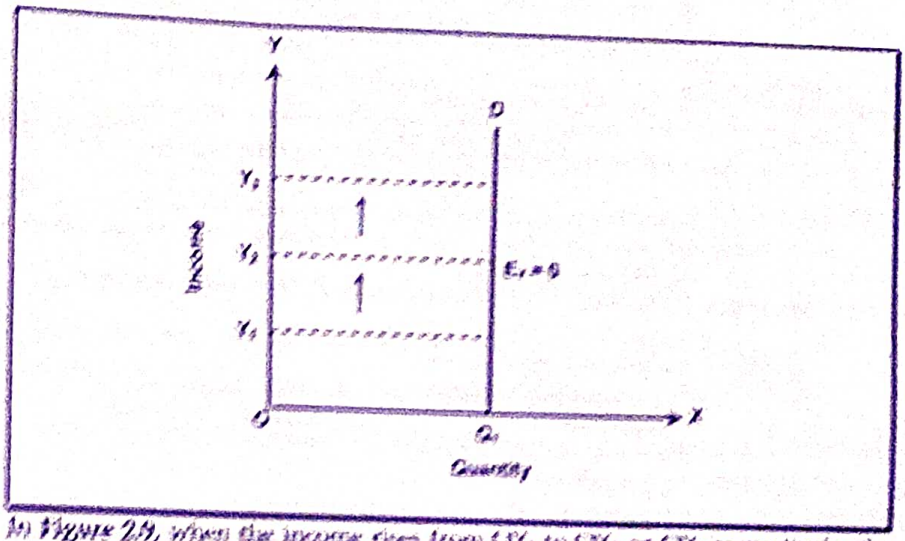
In Figure 2.8, consumer's income increases by 5% from OY_1 to OY_2 exactly equal to increase in demand by 5% from OQ_1 to OQ_2. Hence, the demand curve (DD) shows positive but unitary income demand.

2. Zero Income Elasticity of Demand ($E_y = 0$)

If quantity demanded remains unchanged despite change in income, the income elasticity is said to be zero. For example, if with 5% rise in income, there is no change in the quantity demanded, then $E_y = \frac{0}{5} = 0$. It is the case of zero income

elasticity of demand. In case of neutral goods like salt, income elasticity of demand is zero.

FIGURE 2.9
Zero Income Elasticity



In Figure 2.9, when the income rises from OY_1 to OY_2 or OY_3 respectively, the quantity demanded remains same at OQ_1 units. Therefore, income demand curve is vertical straight line which shows zero income elasticity of demand.

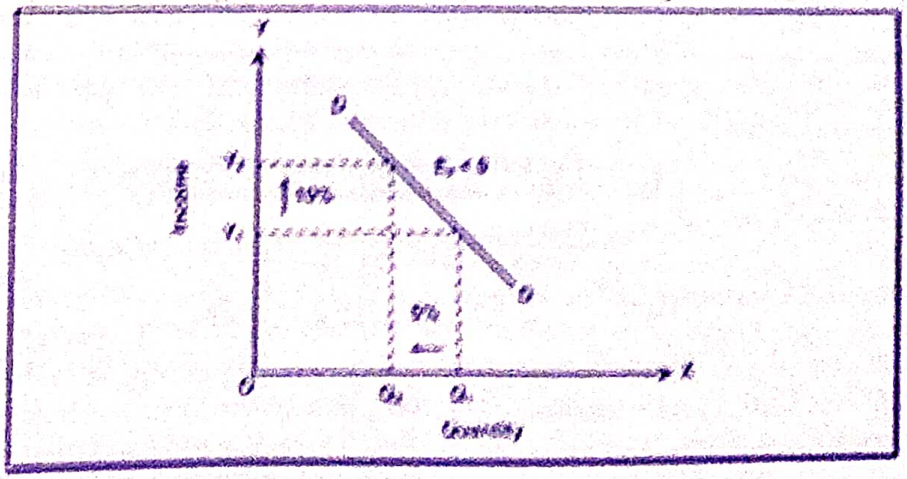
3. Negative Income Elasticity of Demand ($E_i < 0$)

When income and demand for a commodity change into opposite direction, it is called negative income elasticity of demand. In other words, when the consumer reduces his demand with the rise in income and vice versa, the income elasticity of demand is said to be negative. In the case of inferior goods, the income elasticity of demand is negative. For example, if 10% rise in income leads to 5% decrease in demand, it is negative income elasticity of demand. It is found in case of inferior or low quality goods.

$$E_i = -\frac{5\%}{10\%} = -0.5 < 0$$

In case of inferior goods, income elasticity of demand is negative.

FIGURE 2.10
Negative Income Elasticity



In Figure 2.10, when the income increase from OY_1 to OY_2, the quantity demand decreases from OQ_1 to OQ_2. Hence, the income demand curve DD is downward slopping which shows negative income elasticity.

Example 2.5

Consider the following table:

Consumer's Income (Y)	Demand for Commodity (Q)
Rs. 1500	10
Rs. 2000	15

Calculate the income elasticity of demand when income increases form Rs. 1500 to Rs. 2000 and interpret the result.

SOLUTION

Given
Initial income (Y) = Rs. 1500
New income (Y_1) = Rs. 2000
Change in income (ΔY) = $Y_1 - Y$ = Rs. 2000 – Rs. 1500 = Rs. 500
Initial demand (Q) = 10 units
New demand (Q_1) = 15 units
Change in demand (ΔQ) = $Q_1 - Q$ = 5 units

Income Elasticity of demand (E_Y) $= \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q} = \frac{5}{500} \times \frac{1500}{10} = \frac{3}{2} = 1.5 > 1$

Interpretation: Since the coefficient of income elasticity (E_Y) is positive and greater than 1, the commodity is normal or superior.

Note: Nature of commodities and Income Elasticity of Demand

E_Y	Nature/ Type of Commodity		
$E_Y = 0$	Neutral good		
$E_Y < 0$	Inferior good		
$E_Y > 0$	Normal good	$E_Y = 1$	Comforts
		$E_Y < 1$	Necessary
		$E_Y > 1$	Luxury

Cross Elasticity of Demand (E_{XY})

Cross Elasticity of Demand (E_{XY})
A measures of how much the quantity of one good responds to a change in price of another good, computed as the percentage change in quantity demanded of one.

The cross elasticity of demand is defined as the percentage change in the quantity demanded of good-X resulting from a percentage change in the price of Y. In other words, the ratio of percentage change in the quantity demanded of good–X to a given percentage changes in the price of good-Y. The cross elasticity of demand between good-X and Y is given below:

$$E_{XY} = \frac{\text{Percentage change in demand for good X}}{\text{Percentage change in price of good Y}}$$

$$= \frac{\frac{\text{Change in demand for good X}}{\text{Initalal demand for good X}} \times 100}{\frac{\text{Change in price of good Y}}{\text{Initial price of good Y}} \times 100}$$

$$= \frac{\frac{\Delta Q_X}{Q_X} \times 100}{\frac{\Delta P_Y}{P_Y} \times 100} = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X}$$

where

E_{XY} = Coefficient of cross elasticity of demand
Q_X = Quantity of good X
ΔQ_X = Change in the demand for good X
P_Y = Price of good Y,
ΔP_Y = Change in the price of good Y

If X and Y are substitutes, E_{XY} is positive. On the other hand, if X and Y are complements, E_{XY} will be negative and when goods are non related, $E_{XY} = 0$.

If X and Y are substitutes, E_{XY} is positive. On the other hand, if X and Y are complements, E_{XY} will be negative and when goods are non related, $E_{XY} = 0$.

Types (Degrees) of Cross Elasticity of Demand

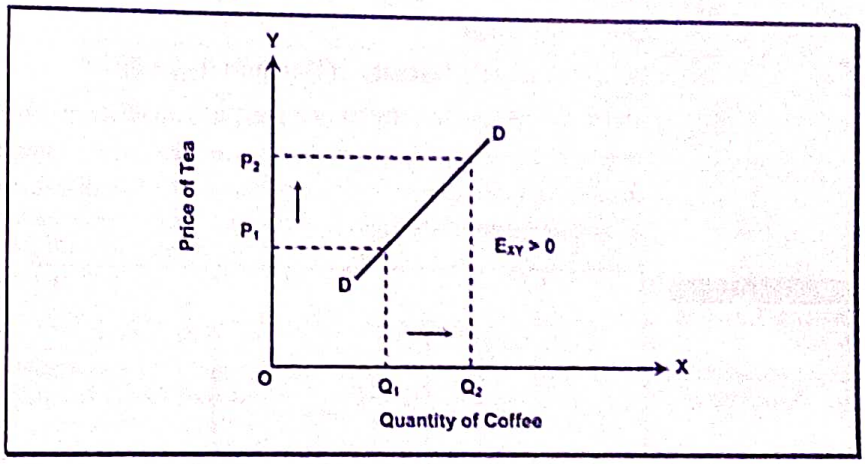
Types of Cross Elasticity of Demand
1. Positive Cross Elasticity of Demand ($E_{XY} > 0$)
2. Negative Cross Elasticity of Demand ($E_{XY} < 0$)
3. Zero Cross Elasticity of Demand ($E_{XY} = 0$)

There are three types of cross elasticity of demand. They are as follows:

1. Positive Cross Elasticity of Demand ($E_{XY} > 0$)

When the quantity demand of a commodity and price of related commodity change into same direction, the cross elasticity of demand is positive. In the case of substitute goods, the cross elasticity of demand is positive. For example, if the price of tea rises, it will lead to increase in the demand for coffee. Similarly, a fall in the price of tea will cause a decrease in the demand for coffee. Hence, tea and coffee are substitute goods.

FIGURE 2.11
Positive Cross Elasticity of Demand

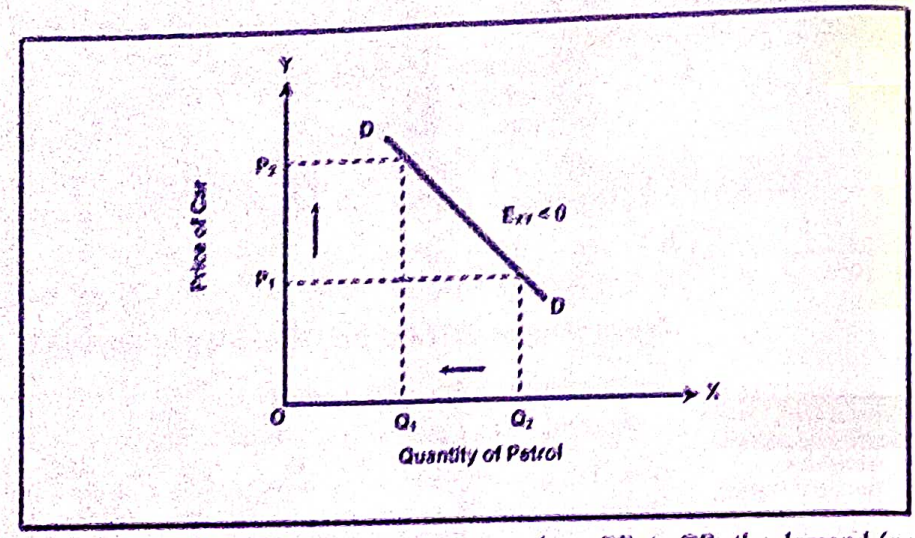


In Figure 2.11, when the price of tea rises from OP_1 to OP_2, the demand for coffee increases from OQ_1 to OQ_2. It means that tea and coffee are substitute goods. Therefore, the demand curve DD is upward slopping which shows positive relationship between the demand for coffee and the price of tea.

2. Negative Cross Elasticity of Demand ($E_{XY} < 0$)

When demand for a commodity and price of related commodity change into opposite direction, the cross elasticity of demand is negative. In the case of complementary goods, cross elasticity of demand is negative. For example, if the price of car falls, assuming the price of petrol remains constant, the demand for car and petrol both increase because both are used jointly used. In means that car and petrol are complementary goods.

FIGURE 2.12
Negative Cross Elasticity of Demand

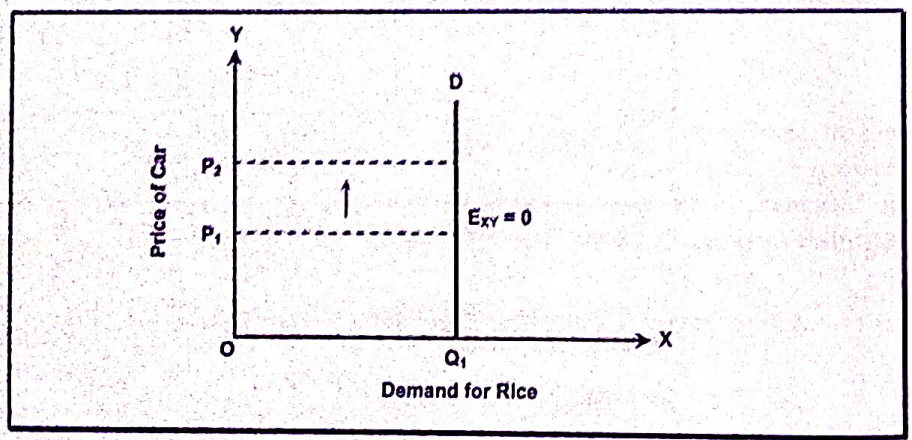


In **Figure 2.12**, when the price of car increases from OP_1 to OP_2, the demand for petrol will decrease from OQ_2 to OQ_1. It means that car and petrol are complementary goods. Therefore, the demand curve DD is downward slopping which shows the negative relationship between demand for petrol and price of car.

3. Zero Cross Elasticity of Demand ($E_{XY} = 0$)

When the change in price of one good has no effect on the demand for another good, the cross elasticity of demand is zero. For example, price of car and demand for rice have zero cross elasticity of demand. Such goods are also known as the unrelated goods.

FIGURE 2.13
Zero Cross Elasticity of Demand



In **Figure 2.13**, when the price of car rises from OP_1 to OP_2, the quantity demand for rice remains unchanged. Here, the demand curve is vertical straight line. It shows that car and rice are unrelated goods.

Example 2.6 Calculate the cross elasticity between Samosa and Pakauda using following table.

Commodity	Before		After	
	Price	Quantity	Price	Quantity
Samosa (X)	20	1	20	2
Pakauda (Y)	10	2	15	1

SOLUTION

Given

Initial demand for Samosa (Q_X) = 1 — New demand for Samosa (Q_{X1}) = 2

Initial price of Pakauda (P_Y) = Rs. 10 — New price of Pakauda (P_{Y1}) = Rs. 15

Change in demand for Samosa (ΔQ_X) = $Q_{X1} - Q_X$ = 2 - 1 = 1

Change in price of Pakauda (ΔP_Y) = $P_{Y1} - P_Y$ = 15 - 10 = Rs. 5

$$E_{XY} = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X} = \frac{1}{5} \times \frac{10}{1} = 2 > 0$$

Interpretation: Since, the coefficient of cross elasticity of demand between Samosa and Pakauda is positive, these two goods are substitutes. Moreover, E_{XY} = 2, one percentage increase in price of Pakauda results two percentage increase in demand for Samosa.

Example 2.7 Consider the following table and calculate cross elasticity between good X and Y. Also interpret the result.

Commodity	Before		After	
	Price	Quantity	Price	Quantity
X	100	5	100	2
Y	1000	2	2000	1

SOLUTION

Given

Initial demand for good - X (Q_X) = 5 — New demand for good - X (Q_{X1}) = 2

Initial price of good - Y (P_Y) = Rs. 1000 — New price of good - Y (P_{Y1}) = Rs. 2000

Change in demand for good - X (ΔQ_X) = $Q_{X1} - Q_X$ = 2 - 5 = - 3

Change in price of good - Y (ΔP_Y) = $P_{Y1} - P_Y$ = 2000 - 1000 = = Rs. 1000

$$E_{XY} = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X} = \frac{-3}{1000} \times \frac{1000}{5} = \frac{-3}{5} = -0.6$$

Interpretation: The negative sign indicates that good X and Y are complementary goods. If price of good Y increases by 1 percentage, the demand for good X will decrease by 0.6 percent and vice-versa.

Measurement of Price, Income and Cross Elasticity of Demand

Measurement of Price Elasticity of Demand by Total Outlay Method

Total outlay method is also known as the total expenditure method of measuring price elasticity of demand. Marshall developed this method to measure price elasticity of demand. According to this method, we compare total outlay of a consumer before and after the variations in price. It can be know whether his demand for a good is elastic, unitary elastic and inelastic. Total outlay is the price multiplied by the quantity of a good purchased. Thus,

Total outlay (Total Expenditure) = Price × Quantity Purchased

i. **Elasticity greater than unity ($E_P > 1$):** It is also called elastic demand. When total expenditure increases with the fall in price and decreases with the rise in price, the demand is said to be elastic demand.

ii. **Elasticity less than unity ($E_P < 1$):** It is also called inelastic demand. If with the fall in price, the total expenditure decreases and with the rise in price, the total expenditure increases, demand is said to be less than unity.

iii. **Elasticity equal to unity ($E_P = 1$):** It is also called unitary elastic demand. When the total expenditure remains unchanged with a fall or rise in price, the price elasticity of demand is said to be equal to unity.

It can be explained by the help of demand schedule and figure.

TABLE 2.1
Schedule of Total Expenditure

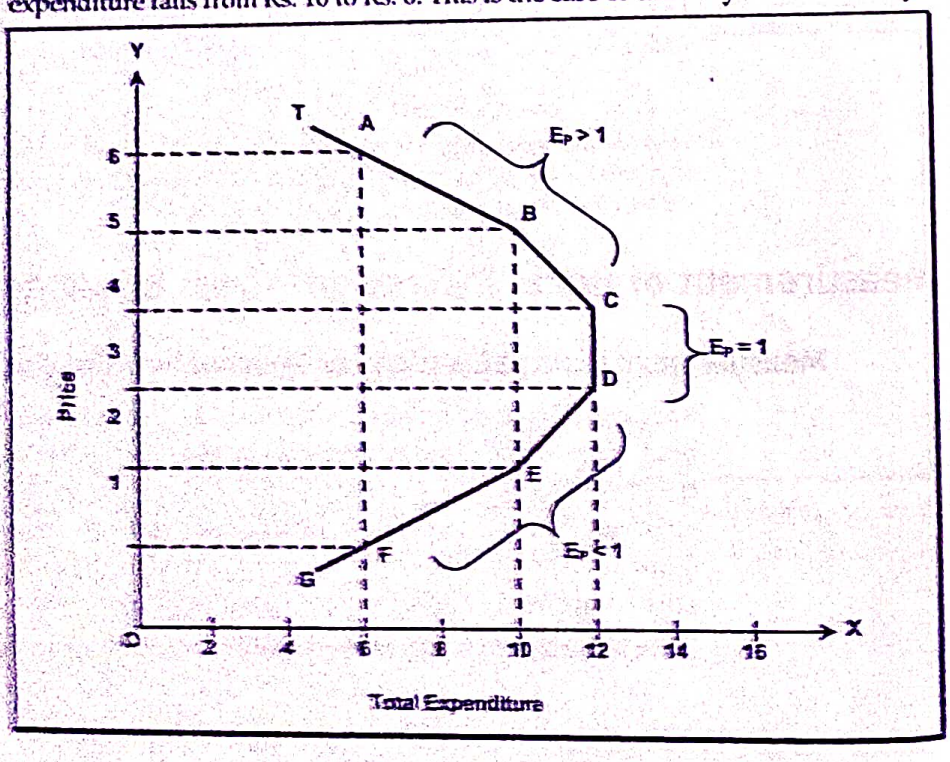
Situation	Price (in Rs.)	Quantity (in unit)	Total Expenditure TE = P · Q	E_P
I	6	1	6	$E_P > 1$
	5	2	10	
II	4	3	12	$E_P = 1$
	3	4	12	
III	2	5	10	$E_P < 1$
	1	6	6	

In the first situation, when the price falls from Rs. 6 to Rs. 5, the total expenditure increases from Rs. 6 to Rs. 10. In this situation, demand is greater than unity.

In the second situation, when the price falls from Rs. 4 to Rs. 3, the total expenditure remains unchanged. Thus, change in price has no effect on total expenditure. This situation shows the elasticity equal to unity.

In the third situation, when the price falls from Rs. 2 to Re. 1, the total expenditure falls from Rs. 10 to Rs. 6. This is the case of elasticity less than unity.

FIGURE 2.14
Total Expenditure Method



In Figure 2.14, total expenditure is measured on X-axis and the price is measured on Y-axis. TG curve is total expenditure curve. The AC part of TG curve represents elasticity of demand greater than unity because total expenditure increases with the fall in price. CD part of TG curve represents unitary elastic demand because with the rise or fall in price, total expenditure remains same. DF part of TG curve represents elasticity of demand less than unity because total expenditure decreases with the fall in price.

Example 2.8 Suppose, price of a commodity rises from Rs. 8 to Rs. 10, its quantity demanded falls from 200 to 120 units. Find out nature of elasticity of demand by total outlay or expenditure method.

SOLUTION

Price of the commodity (P_X)	Quantity demanded for the commodity (Q_X)	Total outlay ($P_X \times Q_X$)
Rs. 8	200	1600
Rs. 10	120	1200

Interpretation: From the above table, it is clear that price is rising but total expenditure is decreasing. It means that price elasticity of demand for the commodity is relatively elastic ($E_P > 1$).

Measurement of Price Elasticity of Demand by Point Method

Prof. Marshall developed point method for measuring price elasticity of demand at a point on a demand curve. Point elasticity is the measure of price elasticity at a particular point on a demand curve. In other words, point elasticity is the measure of the percentage change in quantity demanded in response to a very small percentage change in price. It may be symbolically expressed as

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

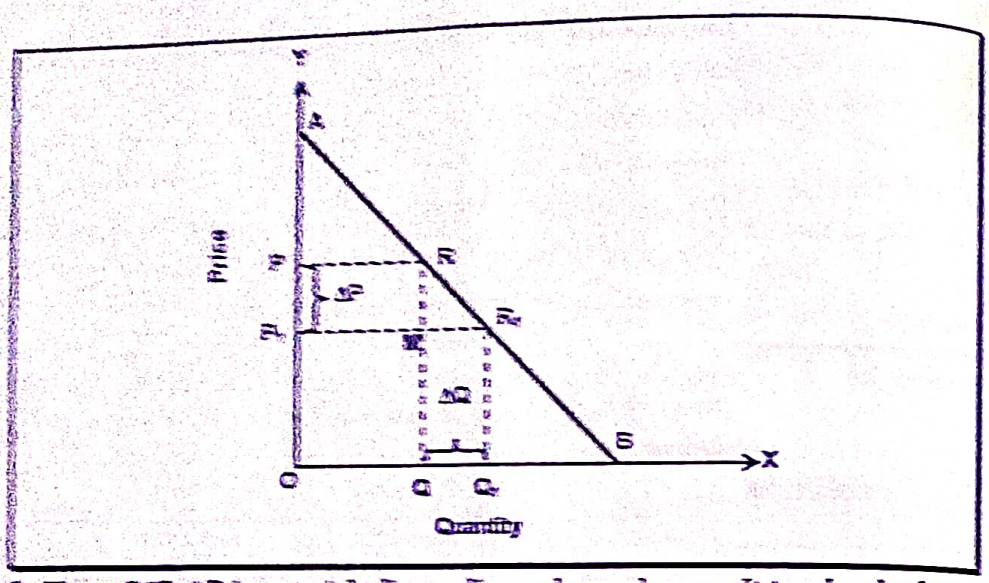
Q = Initial quantity
P = Initial price
ΔQ = Change in quantity demanded
ΔP = Change in price

The method of measuring price elasticity on linear and non-linear demand curve is explained below:

i. Point Elasticity on a Linear Demand Curve

According to this method, we take a point on a linear demand curve and measure the elasticity of demand between two points. Let, a linear demand curve AB be a given and it is required to measure elasticity at point R on this curve.

FIGURE 2.15
Point Elasticity of Demand on a Linear Demand Curve



In Figure 2.15, AB is a straight line or linear demand curve. It touches both the axes. Initial price is OP and initial quantity demanded is OQ.

When the price falls from OP to OP_1, the quantity demanded increases from OQ to OQ_1. This change in price (ΔP) by PP_1 causes change in quantity demanded (ΔQ) by QQ_1.

Substituting these in the following formula of price elasticity of demand, we get,

$$E_p = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

$$= \frac{QQ_1}{PP_1} \times \frac{OP}{OQ} \quad \text{— (i)}$$

Since, in Figure $QQ_1 = MR_1$ and $PP_1 = MR$ & $OP = QR$

$$E_p = \frac{MR_1}{MR} \times \frac{QR}{OQ} \quad \text{— (ii)}$$

Now, taking triangles RMR_1 and RQB,

$\angle MR_1R = \angle QBR$ (corresponding angles)

$\angle RMR_1 = \angle RQB$ (Right angles)

$\angle MRR_1$ is common to both the triangles

Therefore, ΔRMR_1 and ΔRQB are similar triangles. A property of similar triangles is that their corresponding sides are proportional to each other. Therefore,

$$\frac{MR_1}{RM} = \frac{QB}{QR}$$

Substituting $\frac{QB}{QR}$ in place of $\frac{MR_1}{RM}$ in equation (ii), we get,

$$E_p = \frac{QB}{QR} \times \frac{QR}{OQ}$$

$$\therefore \quad E_p = \frac{QB}{OQ} \quad \text{— (iii)}$$

Now, ΔQRB and ΔPAR are similar triangles because their corresponding angles are equal.

$$\therefore \quad \frac{QB}{PR} = \frac{RB}{RA} \qquad \text{... (iv)}$$

In figure, PR = OQ. Thus, substituting OQ for PR is equation (iv), we have,

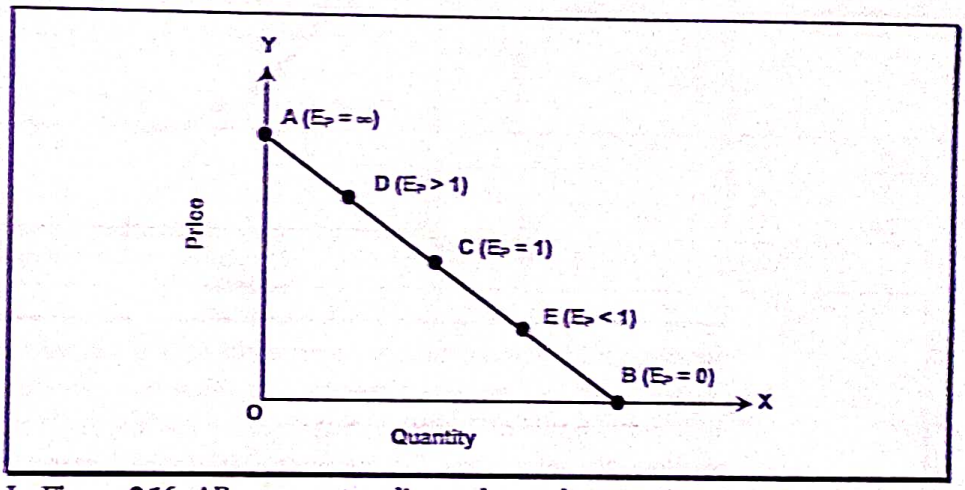
$$E_P = \frac{QB}{OQ} = \frac{RB}{RA}$$

Hence, from above we find that price elasticity at point R on the straight-line demand curve DD_1 is:

$$E_P = \frac{RB}{RA} = \frac{\text{Lower segment}}{\text{Upper segment}}$$

Thus, we can find out elasticity at any point along a demand curve by the help of the point method using above formula. The point elasticity of demand on a liner demand curve is different at different points of the demand curve. Figure 2.16 shows the different price elasticity of demand at different points along the same demand curve.

FIGURE 2.16
Point Method of Measuring Price Elasticity of Demand



In Figure 2.16, AB represents a linear demand curve. Let us suppose, C is the middle point of the demand curve. Using the formula of point elasticity of demand, we can find out coefficient of price elasticity as follows:

$$E_P \text{ at point C} \quad = \frac{\text{Lower segment}}{\text{Upper segment}} = \frac{CB}{AC} = 1 \ (\because AC = CB)$$

It is the case of unity elastic demand.

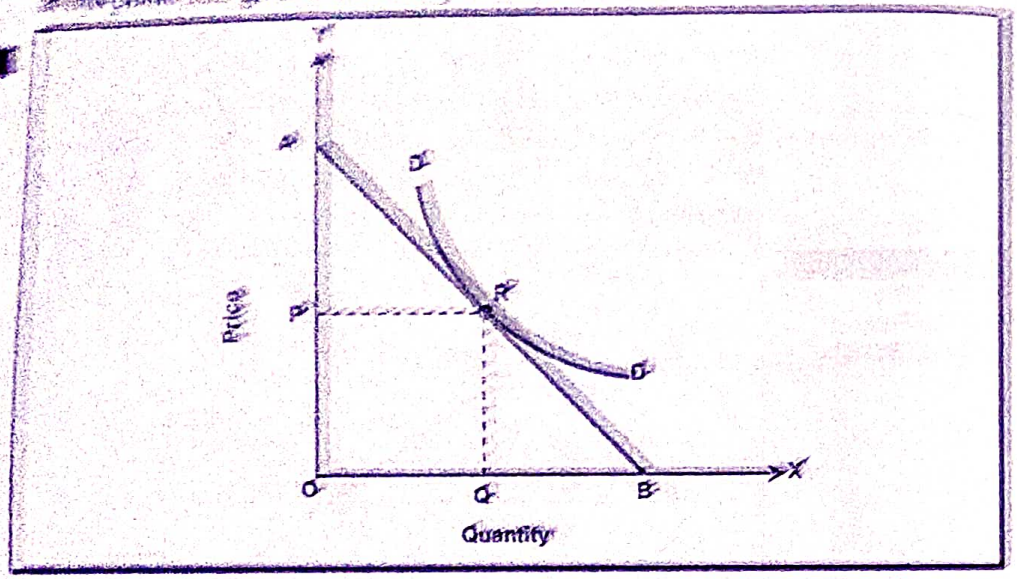
$$E_P \text{ at point A} \quad = \frac{\text{Lower segment}}{\text{Upper segment}} = \frac{AB}{0} = \infty$$

It is the case of perfectly elastic demand.

$$E_P \text{ at point D} \quad = \frac{\text{Lower segment}}{\text{Upper segment}} = \frac{DB}{AD} > 1 \quad (\because DB > AD)$$

It is the case of relatively elastic demand.

$$E_P \text{ at point E} \quad = \frac{\text{Lower segment}}{\text{Upper segment}} = \frac{EB}{AE} < 1 \quad (\because EB > AE)$$



Suppose, we want to measure the price elasticity of demand curve DD at point R in the figure. Let us draw a tangent line AB at point R of demand curve DD as shown in **Figure 2.17**. Since, demand curve DD and the tangent line AB passes through the same point (R), the price elasticity of demand curve DD at point R is equal to the elasticity to the tangent line AB at point R.

By measuring the price elasticity at point R on the tangent line AB, we get the elasticity at point R on the demand curve DD. The elasticity of the tangent AB at point R is given by

$$E_P = \frac{\text{Lower segment of the tangent line}}{\text{Upper segment of the tangent line}} = \frac{RB}{AR}$$

Example 2.9 Calculate the price elasticity of demand using point method at price Rs.100 for the following demand curve.

$$P = 300 - \frac{Q}{2}$$

Interpret the result.

SOLUTION

Given

$$P = 300 - \frac{Q}{2}$$

[illegible]

Differentiating the equation with respect to P, we get

$$\frac{dQ}{dP} = -2$$

Given the question, P = Rs. 100

Putting the value of P in equation (i), we get

$Q = 600 - 2P$

$Q = 600 - 2 \times 100$

$Q = 400$

We know that

$$E_P = \frac{dQ}{dP} \times \frac{P}{Q}$$

Now, putting the above values in the formula, we get

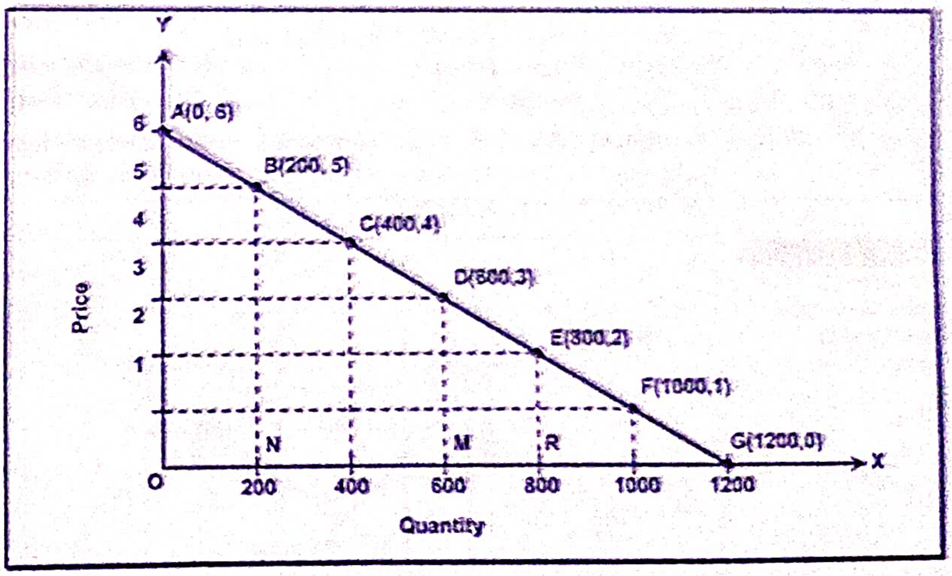
$$E_P = (-2) \times \frac{100}{400} = -0.5$$

Interpretation: Since $E_P = -0.5$, this implies that 1% change in price causes 0.5% change in quantity demanded but the change will be in opposite direction. It is the case of relatively inelastic demand. It is found in case of necessity goods.

Example 2.10 Consider the following market demand schedule:

Point	A	B	C	D	E	F	G
P_X	6	5	4	3	2	1	0
Q_X	0	200	400	600	800	1000	1200

Compute the price elasticity of demand at points D, B, E, A and G geometrically.



SOLUTION

According to point elasticity of demand,

$$E_P \text{ at point D} = \frac{MG}{DM} \times \frac{DM}{OM} = \frac{MG}{OM}$$

$$= \frac{1200 - 600}{600} = \frac{600}{600} = 1 \text{ (Unitary elastic demand)}$$

E_P at point E $= \frac{RG}{ER} \cdot \frac{ER}{OR} = \frac{RG}{OR}$

$= \frac{1200 - 800}{800} = \frac{400}{800} = 0.5 < 1$ (Relatively inelastic demand)

E_P at point B $= \frac{NG}{BN} \cdot \frac{BN}{ON} = \frac{NG}{ON}$

$= \frac{1200 - 200}{200} = \frac{1000}{200} = 5 > 1$ (Relatively elastic demand)

E_P at point A $= \frac{OG}{AO} \cdot \frac{AO}{O} = \frac{OG}{O} = \frac{1200}{0} = \infty$ (Perfectly elastic demand)

E_P at point G $= \frac{G}{G} \cdot \frac{G}{OG} = \frac{G}{OG} = \frac{0}{1200} = 0$ (Perfectly inelastic demand)

Measurement of Income Elasticity of Demand by Point Method

Income demand curve slopes upward in case of normal goods. But it slopes downward in case of inferior goods. Here, we will measure income elasticity at a point of income demand curve, which slopes upward from left to right. Income demand curve may be linear or non-linear. We measure point elasticity in both linear and non-linear income demand curve.

i. Point Elasticity on a Linear Income Demand Curve

Income elasticity of demand is the ratio of percentage change in demand and percentage change in income. Therefore, income elasticity of demand at a point is given as

$$E_Y = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q} \quad \text{... (i)}$$

where

E_Y = Coefficient of income elasticity of demand

ΔQ = Change in demand $\quad \Delta Y$ = Change in income

Q = Initial demand $\quad Y$ = Initial income

In **Figure 2.18**, DD curve represents linear income demand curve. Let us suppose, we have to measure income elasticity of demand at point A of the linear income demand curve DD.

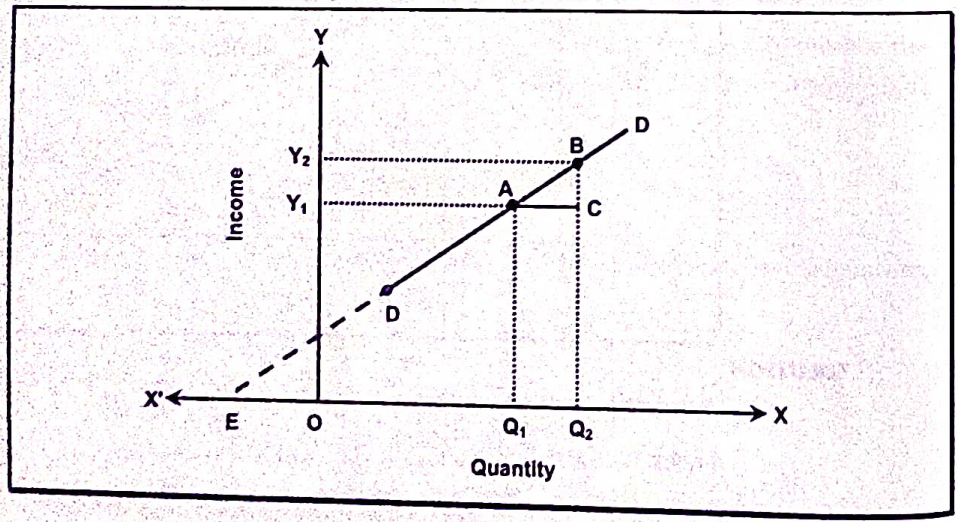


FIGURE 2.18
Measurement of Point Elasticity of demand along a Income Demand curve

In Figure 2.18,

Initial income (Y_1) = Q_1A New income (Y_2) = Q_2B

Change in Income (ΔY) = CB New demand (Q_1) = OQ_2

Initial demand (Q) = OQ_1 Change in demand (ΔQ) = Q_1Q_2

Putting these values in equation (i),

$$E_Y = \frac{Q_1Q_2}{BC} \times \frac{AQ_1}{OQ_1} \quad \text{... (ii)}$$

Since the triangles, ABC and Δ EQA are similar,

$$\frac{AC}{BC} = \frac{EQ_1}{AQ_1} \quad \text{... (iii)}$$

Again, in the figure,

$$Q_1Q_2 = AC \quad \text{... (iv)}$$

Putting $AC = QQ_1$, in equation (iii)

$$\frac{Q_1Q_2}{BC} = \frac{EQ_1}{AQ_1} \quad \text{... (v)}$$

Putting $\frac{Q_1Q_2}{BC} = \frac{EQ_1}{AQ_1}$ in equation (ii), we get,

$$E_Y \text{ at point A} = \frac{EQ_1}{AQ_1} \times \frac{AQ_1}{OQ_1}$$

$$\therefore \quad E_Y \text{ at point A} = \frac{EQ_1}{OQ_1}$$

Since $EQ_1 > OQ_2$, income elasticity at point A is relatively elastic or greater than one. Hence, it can be conclude that:

a. If income demand curve cuts Y–axis or it meets X– axis left of origin, $E_Y > 1$.

b. If income demand curve passes through the origin, income elasticity of demand will be unitary or $E_Y = 1$. It has been shown in the following Figure 2.19.

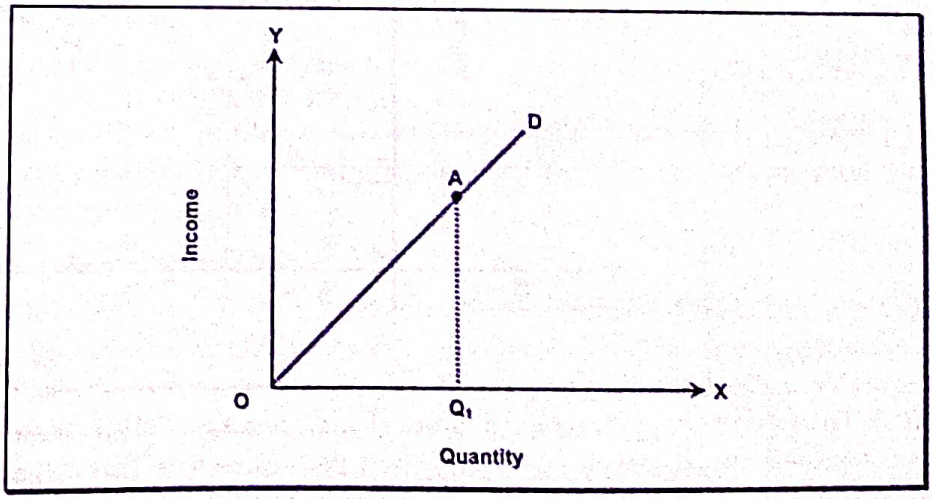


FIGURE 2.19
Measurement of Point Elasticity of demand along a Income Demand curve

$$E_Y \text{ at point A} = \frac{OQ_1}{OQ_1} = 1 \ (\because OQ_1 = OQ_1)$$

c. If income demand curve meets X-axis at any point right of the origin, income elasticity of demand will be relatively inelastic. It is shown in Figure 2.20.

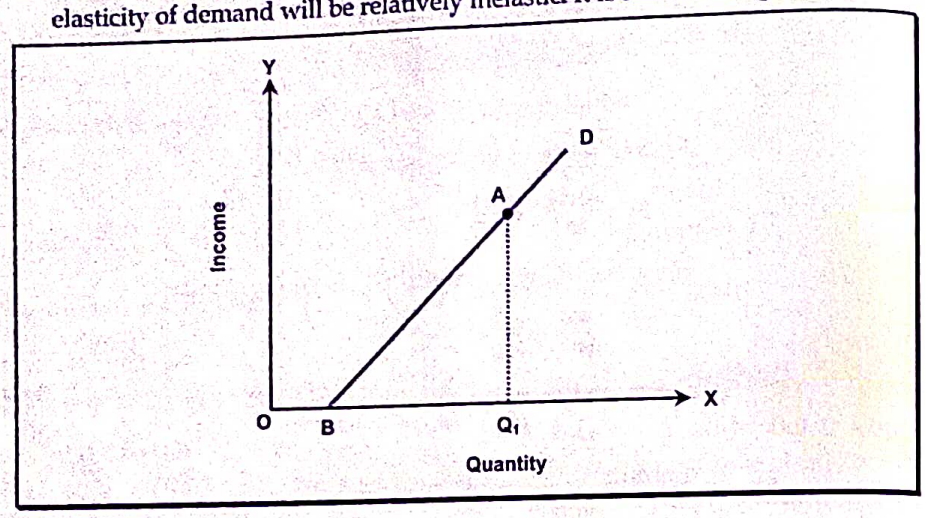


FIGURE 2.20
Point Elasticity of Income at a Linear Demand Curve

$$E_Y \text{ at point } A = \frac{BQ_1}{OQ_1} < 1 \ (\because BQ_1 < OQ_1)$$

ii. Income Elasticity of Demand at a Point on a Non-linear Income Demand Curve

If demand curve is non-linear, than the income elasticity of demand at a point can be computed by drawing tangent line to that point and apply the same formula that is used in case of linear demand curve.

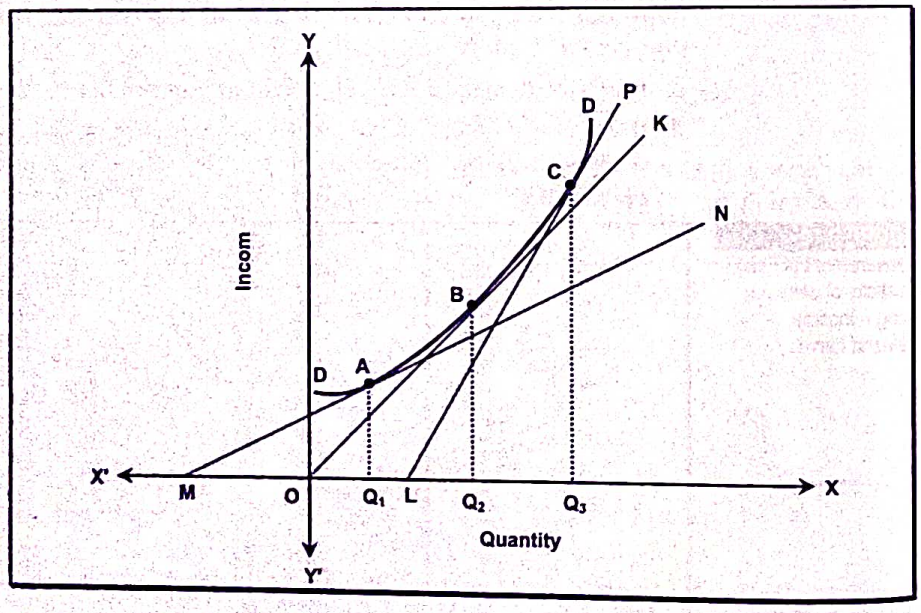


FIGURE 2.21
Point Elasticity of Demand at a Non-Linear Demand Curve

In Figure 2.21, DD is the non-linear income demand curve. There are three points A, B and C along the demand curve DD. The straight line MN is tangent at point A; the straight line OK is tangent at point B and the straight line LP is tangent at point C.

Hence,

$$E_Y \text{ at } B = \frac{OQ_2}{OQ_2} = 1 \qquad (\because OQ_2 = OQ_2)$$

$$E_Y \text{ at } A = \frac{MQ_1}{OQ_1} > 1 \qquad (\because MQ_1 > OQ_1)$$

$$E_Y \text{ at } C = \frac{LQ_3}{OQ_3} < 1 \qquad (\because LQ_3 < OQ_3)$$

It also shows that at the different point of a non-linear income-demand curve, there are different degrees of income elasticity of demand.

Measurement of Cross Elasticity of Demand by Point Method

Cross elasticity of demand can be calculated by the following two methods:

1. Percentage/ Proportionate Method

According to percentage method, cross elasticity of demand is measured dividing percentage change in demand for a good -X divided by percentage change in price of good-Y. Let us suppose, two related goods X and Y. Then,

$$E_{XY} = \frac{\text{Percentage change in demand for good X}}{\text{Percentage change in price of good Y}}$$

$$= \frac{\frac{\Delta Q_X}{Q_X} \times 100}{\frac{\Delta P_Y}{P_Y} \times 100}$$

$$= \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X}$$

where

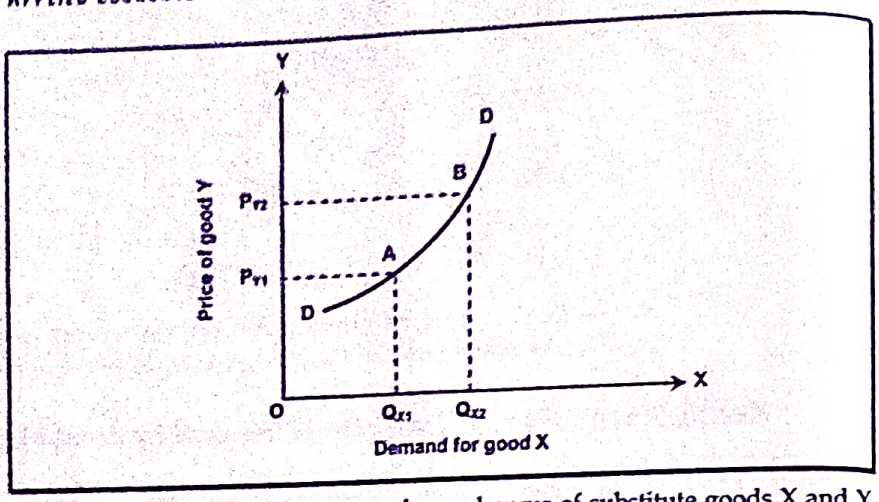
E_Y = Cross elasticity of demand between good -X and good Y
Q_X = Initial quantity of good X
P_Y = Initial price of good Y
ΔQ_X = change in demand for good X
ΔP_Y = Change in price of good Y

If $E_{XY} > 0$, the good X and good Y are substitute goods; if $E_{XY} < 0$, the good X and good Y are complementary goods and if $E_{XY} = 0$, the good X and good Y are non- related goods.

2. Average/ Arc Method

The coefficient of cross elasticity of demand between two points on a cross demand curve is called arc elasticity of demand. This method is used to measure the cross elasticity of demand when there is greater change in price and quantity demanded. According to this method, cross elasticity of demand is the coefficient or average between two points along a cross demand curve. Figure 2.22 shows the measurement of cross demand between two points A and B along the cross demand curve DD.

FIGURE 2.22
Average Method of Measuring Cross Elasticity of Demand



In Figure 2.22, DD represents cross demand curve of substitute goods X and Y. The cross elasticity between two points A and B is measured by using following formula:

$$E_{XY} = \frac{\left(\frac{\text{Change in demand for good X}}{\text{Average demand for good X}}\right)}{\left(\frac{\text{Change in Price of good Y}}{\text{Average Price of good Y}}\right)}$$

$$= \frac{\frac{\Delta Q}{\frac{Q_{X1} + Q_{X2}}{2}}}{\frac{\Delta P_Y}{\frac{P_{Y1} + P_{Y2}}{2}}}$$

$$= \frac{\Delta Q_X}{\Delta P_Y} \times \left(\frac{P_{Y1} + P_{Y2}}{Q_{X1} + Q_{X2}}\right)$$

$$= \left(\frac{Q_{X2} - Q_{X1}}{P_{Y2} - P_{Y1}}\right) \times \left(\frac{P_{Y1} + P_{Y2}}{Q_{X1} + Q_{X2}}\right)$$

where

E_{XY} = Coefficient of cross elasticity of demand
Q_{X1} = Initial demand for good X
P_{Y1} = Initial price of good Y
Q_{X2} = New demand for good X
P_{Y2} = New price of good Y

If good–X and good –Yare complementary goods, the cross demand curve will slope downward but method of measuring cross elasticity of demand by arc or average method will be same.

If $E_{XY} > 0$, the good–X and good – Y are substitute goods; if $E_{XY} < 0$, the good–X and good –Y are complementary goods and if $E_{XY} = 0$, the good –X and good –Y are non- related goods.

Uses of Price, Income and Cross Elasticity of Demand

Uses of Price Elasticity of Demand

Importance of Price Elasticity of Demand
1. Monopoly price determination
2. Price determination under discriminating monopoly
3. Price determination of public utilities
4. Price determination of joint products
5. Wage determination
6. International trade
7. Importance to finance minister

Price elasticity of demand has great practical importance in the formulation of economic policies and understanding economic problems.

1. **Monopoly price determination:** A monopolist while fixing the price of the product has to see whether the demand for the product is elastic or inelastic. If the demand for his product is elastic, he can get more profit by fixing a low price. If the demand for his product is inelastic, he can get more profit by fixing high price. Thus, a producer under monopoly competition has to study the degree of elasticity of demand in pricing his product.
2. **Price determination under discriminating monopoly:** Under discriminating monopoly, different prices for the same product are charged in different markets. Low price is charged for the products in the market having elastic demand and high price is charged in the market having inelastic demand.
3. **Price determination of public utilities:** The concept of price elasticity of demand is very useful to determine the price of public utilities such as postal services, drinking water, electricity, etc. The price of these services should be determined on the basis of elasticity of demand. If the demand for services is inelastic, a high price is charged. If the demand for service is elastic, a low price is charged.
4. **Price determination of joint products:** The price elasticity of demand is useful in the pricing of joint products like sheep and wool; paddy and straw; cotton and cotton seeds, etc. In such cases, the cost of production of each product cannot be calculated separately. Price of each product should be determined on the basis of elasticity of demand. Higher price is charged for the product with inelastic demand and the lower price is charged for the product with elastic demand.
5. **Wage determination:** The concept of price elasticity of demand is important in the determination of wages of a particular type of labor. If the demand for service of labor is inelastic, they can force the employer to increase the wage organizing strike. On the other hand, if demand for service of labor is elastic, strikes and other trade union tactics would not work.
6. **International trade:** Price elasticity of demand has great practical importance for determining terms of trade. The terms of trade depends upon relative elasticity of goods exported and imported between the countries. A country gains from international trade if it exports goods having inelastic demand in importing countries and imports goods for which demand is elastic in domestic market.
7. **Importance to finance minister:** The concept of price elasticity of demand is great importance to the finance minister. The finance minister has to find out

how he can collect more revenue to the state. Imposition of higher tax rate or goods with inelastic demand or necessary goods brings more revenue to the government as increase in price due to tax does not affect demand much. However, heavy tax on poor people is not socially justifiable. Hence, low rate of tax should be imposed on necessaries and high rate of tax should be imposed on luxuries goods.

Uses of Income Elasticity of Demand

Use or Importance of Income Elasticity of Demand
1. Useful to know about stage of trade cycle
2. Useful for forecasting demand
3. Useful for classification of normal and inferior goods
4. Useful for making marketing strategy

Some important uses of income elasticity of demand are as follows:

1. **Useful to know about stage of trade cycle:** Income elasticity of demand for necessary goods is low. Therefore, during prosperity, the sellers of such goods will not be benefited much and during depression, they are not affected much. During prosperity, income of the consumer increase and hence they are capable of affording goods that are more luxurious. The sellers of such goods are benefited. During depression period, demand for such goods decrease rapidly and sellers are adversely affected.
2. **Useful for forecasting demand:** The concept of income elasticity of demand can be used for forecasting demand for a product over a period. Therefore, it helps in estimating the required production level of different commodities at a certain point of time in the future. This knowledge is also important for economic planning.
3. **Useful for classification of normal and inferior goods:** The concept of income elasticity of demand can also be used to define the normal and inferior goods. The goods whose income elasticity is positive for all level of income are termed as normal goods. On the other hand, the goods for whose income elasticity is negative beyond a certain level of income are termed as inferior goods.
4. **Useful for making marketing strategy:** Concept of income elasticity of demand can be useful in making marketing strategy. For example, firm producing luxury items should concentrate its marketing efforts on media that reach the high-income group of the people.

Uses of Cross Elasticity of Demand

Uses or Importance of Cross Elasticity of Demand
1. Classification of goods
2. Classification of market
3. Pricing policy
4. Determination of boundaries between industries

The concept of cross elasticity is very useful to producer & businessman to make pricing decision. The major importance of cross elasticity of demand is given below:

1. **Classification of goods:** Goods are classified into substitute & complementary. If cross elasticity of demand between any two goods is positive, the goods may be considered as substitutes for each other. If the cross elasticity is greater, the goods are closer substitute. If it is infinite, they are perfect substitute. If the cross elasticity of demand for any two related goods is negative, the two goods may be considered as complementary for

each other. If the negative cross elasticity of demand is high, the degree of complementarily is also high.

2. **Classification of market:** Market structure has been classified by **Prof. Bain** on the basis of cross elasticity of demand. If the cross elasticity of demand is infinite, the market is perfectly competitive. If the cross elasticity is zero or almost zero, the market structure is monopoly. If the cross elasticity is high there is imperfect market.
3. **Pricing policy:** Large firms produce different related goods. For example, Nepal Liver Limited produces various brands of tooth paste & tooth brush. They are complementary goods. Similarly, Nepal Dairy Limited produces ice cream of different flavor. They are substitutes. Cross elasticity of demand helps firms to decide whether to increase price of related products or not.
4. **Determination of boundaries between industries:** Concept of cross elasticity of demand is useful in order to decide to which product should include in which industry. If related goods having negative cross elasticity (complementary goods), they belong to different industries. If the related goods having positive cross elasticity (substitute goods), they belong to one industry.

ELASTICITY OF SUPPLY

Concept of Elasticity of Supply

Price Elasticity of Supply
A measure of how much quantity supplied of a good responds to a change in price of that good, computed as the percentage change in quantity supplied divided by the percentage change in price.

The price elasticity of supply is defined as the responsiveness of quantity supplied of a commodity to the change in its price. The price elasticity of supply is also defined as the ratio between percentage change in quantity supplied and percentage change in price of a commodity. It can be expressed as

$$E_s = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$= \frac{\dfrac{\text{Change in quantity supplied}}{\text{Initial quantity supplied}} \times 100}{\dfrac{\text{Change in price}}{\text{Initial price}} \times 100}$$

$$= \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta P}{P} \times 100}$$

$$= \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

E_S = Coefficient of price elasticity of supply
Q = Initial quantity supplied
ΔQ = Change in quantity supplied
P = Initial price
ΔP = Change in price

Example 2.11 Calculate the price elasticity of supply when increase in price of milk from Rs. 50 per liter to Rs. 60 per liter rises its supply from 10,000 liters to 12,000 liters.

SOLUTION

Given
Initial price (P) = Rs. 50
New price (P_1) = Rs. 60
Change in price (ΔP) = $P_1 - P = 60 - 50$ = Rs. 10
Initial quantity supplied (Q) = 10,000
New quantity supplied (Q_1) = 12,000
Change in quantity supplied (ΔQ) = $Q_1 - Q = 12{,}000 - 10{,}000 = 2{,}000$ units
We know that

$$E_s = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

$$= \frac{2{,}000}{10} \times \frac{50}{10{,}000}$$

$$= 1$$

Interpretation: The price elasticity of supply equal to 1 indicates that the quantity supplied changes the same percentage as much as the percentage change in price.

Alternative Method

Given

Initial price (P) = Rs. 50

New price (P_1) = Rs. 60

Now

$$\text{Percentage change in price} = \frac{\text{Change in price}}{\text{Initial price}} \times 100$$

$$= \frac{(P_1 - P)}{P} \times 100$$

$$= \frac{(60 - 50)}{50} \times 100 = \frac{10}{50} \times 100 = 20\ \%$$

$$\text{Percentage change in quantity supplied} = \frac{\text{Change in quatity supplied}}{\text{Initial quantity supplied}} \times 100$$

$$= \frac{(Q_1 - Q)}{Q} \times 100$$

$$= \frac{(12000 - 10000)}{10000} \times 100$$

$$= \frac{2000}{10000} \times 100 = 20\ \%$$

We know that

$$E_s = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}} = \frac{20\%}{20\%} = 1$$

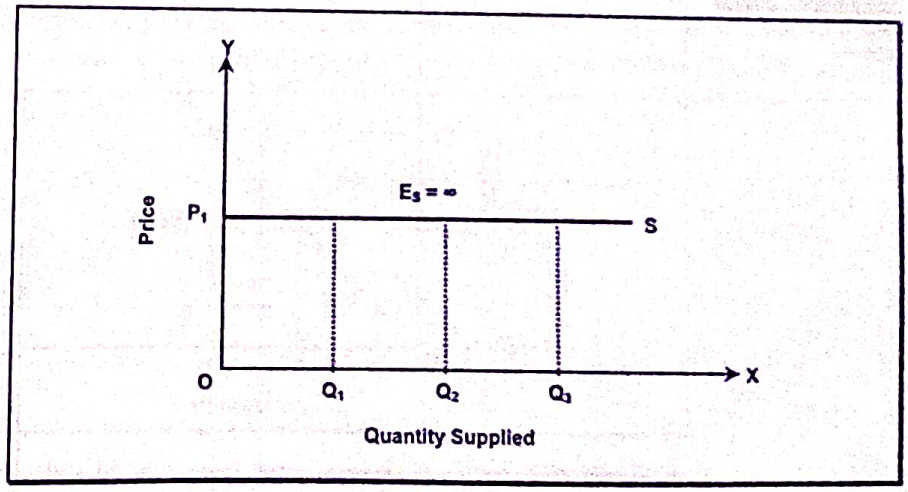
Types (Degrees) Price of Elasticity of Supply

Price elasticity of supply can be divided into five types, which are as follows:

1. Perfectly Elastic Supply ($E_S = \infty$)

Supply is said to be perfectly elastic if negligible change in price leads to infinite change in the quantity supplied. Visibly, no change in price causes infinite change in supply. It is shown in Figure 2.23.

FIGURE 2.23
Perfectly Elastic Supply

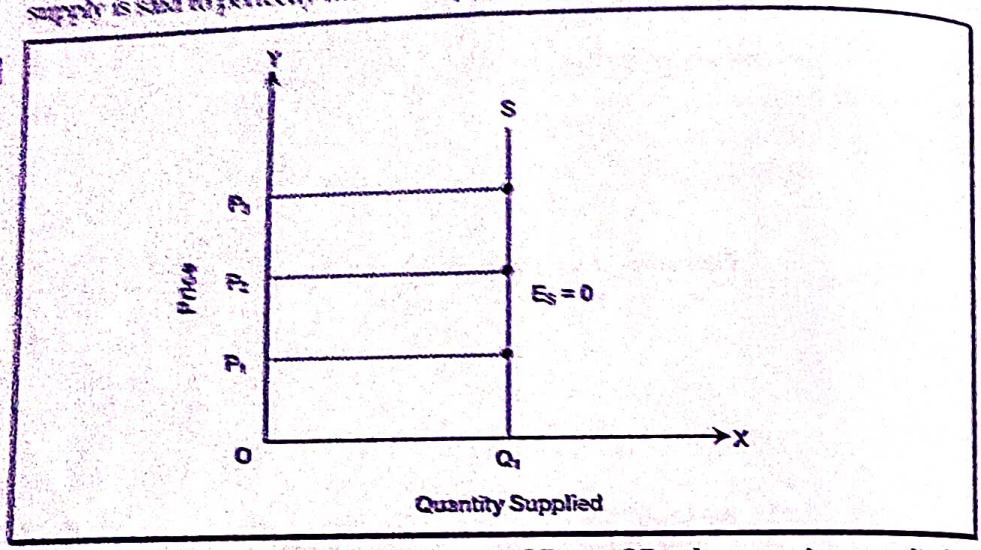


In Figure 2.23, the quantity supplied may be OQ_1 or OQ_2 or OQ_3 at price OP_1. Therefore, supply curve is horizontal straight line or parallel to the X-axis which shows perfectly elastic supply.

2. Perfectly Inelastic Supply ($E_S = 0$)

When the supply of a commodity does not change despite the change price, the supply is said to perfectly inelastic supply. It is shown by Figure 2.24.

FIGURE 2.24
Perfectly Inelastic Supply

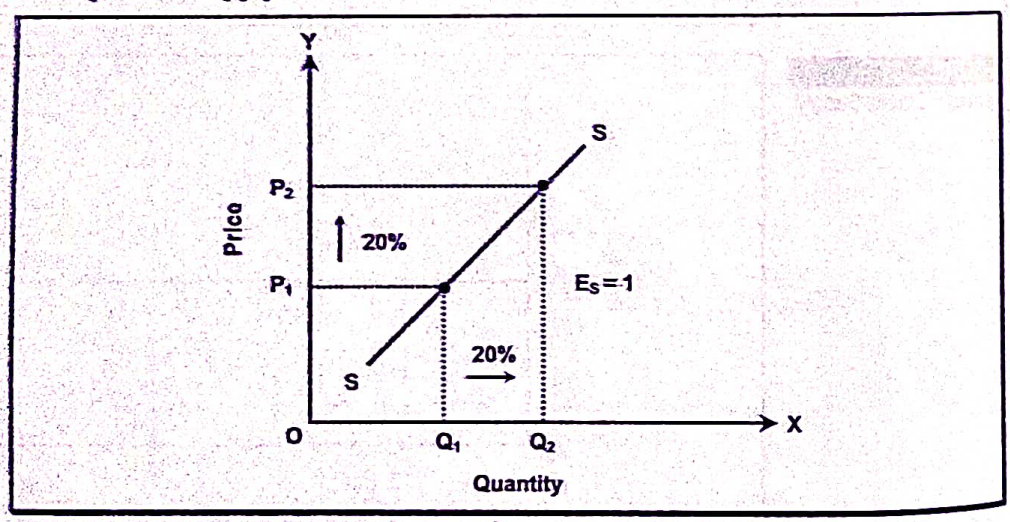


In Figure 2.24, at different prices OP_1 or OP_2 or OP_3, the quantity supplied is constant, i.e. OQ. Therefore, supply curve becomes vertical straight line or parallel to the Y-axis which shows perfectly inelastic supply.

3. Unitary Elastic Supply ($E_S = 1$)

When the percentage change in the quantity supplied is equal to the percentage change in price, the supply of a commodity is said to be unitary elastic. For example, a 20% change in price causes 20% change in supply, it is the case of unitary elastic supply.

FIGURE 2.25
Perfectly Inelastic Supply

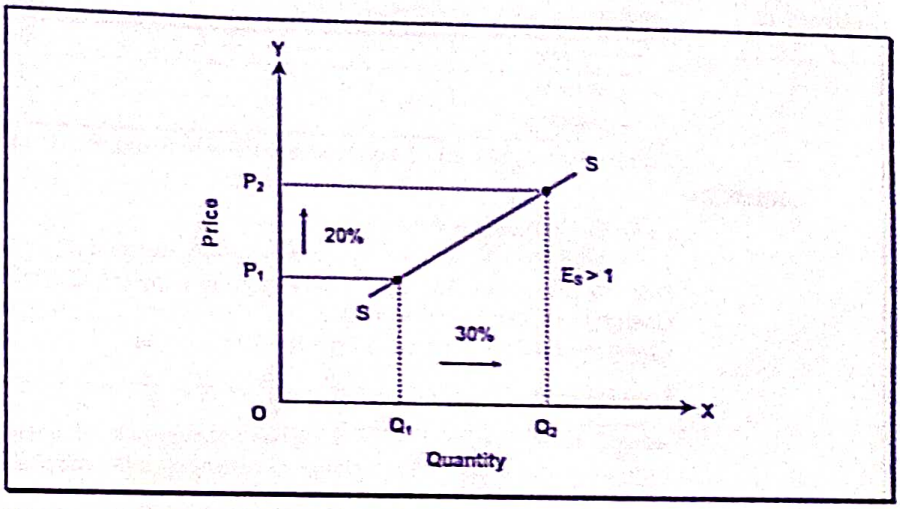


In Figure 2.25, when the price rises from OP_1 to OP_2, the quantity supply increases from OQ_1 to OQ_2 i.e., the percentage change in price is equal to the percentage change in supply. Hence, the supply curve SS shows unitary elastic supply.

4. Relatively Elastic Supply ($E_S > 1$)

When the percentage change in the quantity supplied of a commodity is more than the percentage change in price, it is called relatively elastic supply. It is also called elasticity greater than unity. For example, if 20% change in price results more than 20 percent change in quantity supplied, it is case of relatively elastic supply.

FIGURE 2.26
Relatively Elastic Supply

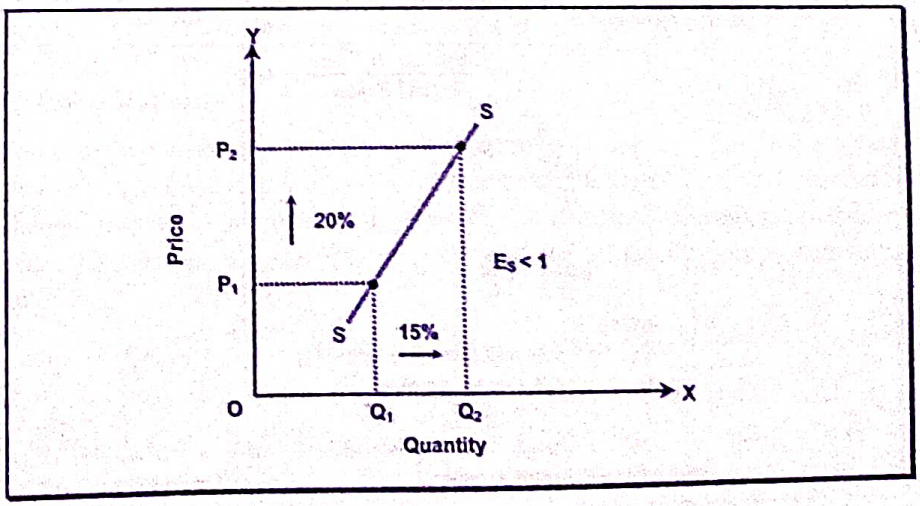


In Figure 2.26, when the price rises from OP_1 to OP_2 the quantity supplied increases from OQ_1 to OQ_2 i.e., the percentage change in quantity supplied is more than the percentage change in price. Therefore, the supply curve SS is flatter which shows relatively elastic supply.

5. Relatively Inelastic Supply ($E_S < 1$)

When the percentage change in the quantity supplied of a commodity is less than percentage change in price, it is called relatively inelastic supply. It is also called elasticity less than unity. For example, when 20% change in price causes less than 20% change in supply, then it is the case of relatively inelastic supply.

FIGURE 2.27
Relatively Inelastic Supply



In Figure 2.27, when the price rise from OP_1 to OP_2 the quantity supply increases from OQ_1 to OQ_2 i.e., the percentage change in the quantity supplied is less than the percentage change in price. Therefore, it is the case of relatively inelastic supply. Therefore, the supply curve SS is steeper which shows relatively inelastic supply.

Example 2.12 Consider the following supply schedule:

Points	A	B	C	D
Price (P_X)	0	5	10	15
Supply (Q_X)	10	20	30	40

Compute price elasticity of supply at the movement from B to C and interpret the result.

SOLUTION

According to question

Initial price (P_X) = Rs. 5 Initial quantity supplied (Q_X) = 20

New price (P_{X1}) = Rs. 10 New quantity supplied (Q_{X1}) = 30

Change in price (ΔP) = 10 – 5 = Rs. 5

Change in quantity supplied (ΔQ_X) = 30 – 20 = 10 units

$$\text{Price Elasticity of supply } (E_S) = \frac{\Delta Q_X}{\Delta P_X} \times \frac{P_X}{Q_X} = \frac{10}{5} \times \frac{5}{20} = \frac{1}{2} = 0.5 < 1$$

Interpretation: Since, $E_S < 1$, price elasticity of supply is relatively inelastic. 1 percentage increase in price results 0.5 percentage increasing quantity supplied and vice versa.

Measurement of Elasticity of Supply

The elasticity of supply is measured on the basis of slope and nature of supply curve. There are three methods of measuring elasticity of supply, which are as follows:

1. Percentage Method

According to this method, elasticity of supply is calculated dividing percentage change in quantity supplied divided by percentage change in price.

$$E_S = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$= \frac{\left(\frac{\text{Change in quantity supplied}}{\text{Initial quantity supplied}} \times 100\right)}{\left(\frac{\text{Change in Price}}{\text{Initial Price}} \times 100\right)}$$

$$= \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta P}{P} \times 100}$$

$$= \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

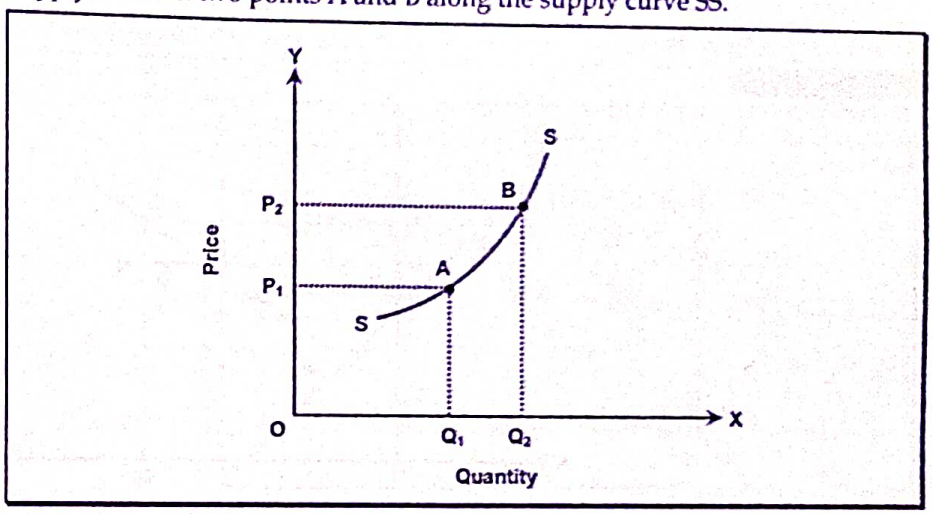
where

E_S = Coefficient of elasticity of supply
Q = Initial quantity supplied
P = Initial Price
ΔQ = Change in quantity supplied
ΔP = Change in price

2. Arc Method

The coefficient of elasticity of supply between two points on a supply curve is called arc elasticity of supply. This method is used to measure elasticity of supply when there is greater change in price and quantity supplied. According to this method, elasticity of supply is the coefficient of average between two points along a supply curve. Figure 2.28 shows the measurement of elasticity of supply between two points A and B along the supply curve SS.

FIGURE 2.28
Arc Elasticity of Supply



$$E_S = \frac{\left(\frac{\text{Change in quantity supplied}}{\text{Average quantity supplied}}\right)}{\left(\frac{\text{Change in Price}}{\text{Average Price}}\right)} = \frac{\left(\frac{\Delta Q}{\frac{Q_1 + Q_2}{2}}\right)}{\left(\frac{\Delta P}{\frac{P_1 + P_2}{2}}\right)}$$

$$= \frac{\Delta Q}{\Delta P} \times \left(\frac{P_1 + P_2}{Q_1 + Q_2}\right) = \left(\frac{Q_2 - Q_1}{P_2 - P_1}\right)\left(\frac{P_1 + P_2}{Q_1 + Q_2}\right)$$

where

E_S = Coefficient of elasticity of supply
Q_1 = Initial quantity supplied
Q_2 = New quantity supplied
P_1 = Initial price
P_2 = New price

3. Point Method

Point method is used to measure price elasticity of supply when there is very small change in price and quantity supplied. It is the measure of the percentage change in quantity supplied in response to a very small percentage change in price. To calculate the elasticity of supply at any point of a supply curve, the following formula is used:

$$E_S = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

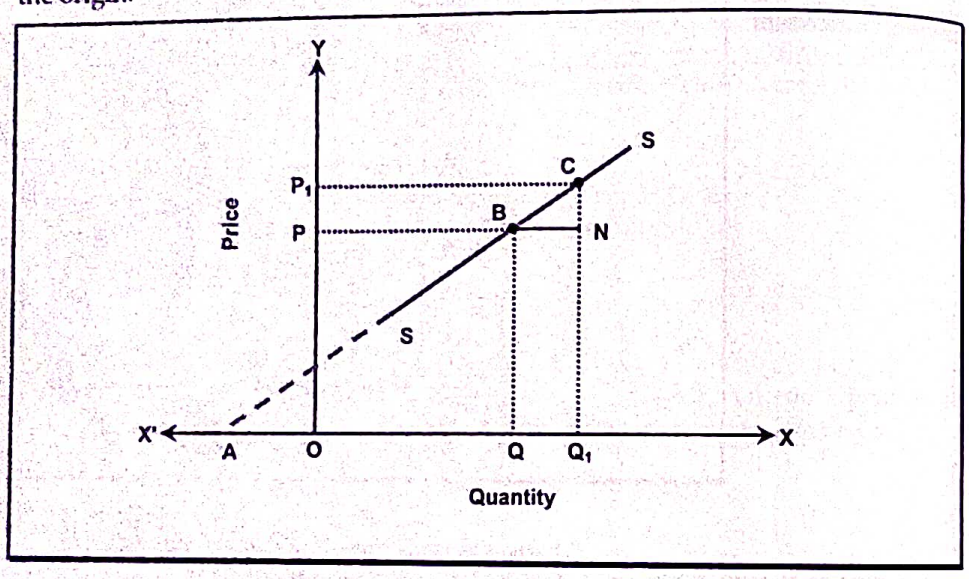
E_S = Coefficient of elasticity of supply
P = Initial price
ΔP = Change in price
Q = Initial quantity supplied
ΔQ = Change in quantity supplied

The elasticity of supply depends upon the nature and slope of the supply curve. Therefore, the measurement of elasticity of supply is varied as follows:

i. Point Elasticity on a Linear Supply Curve

In Figure 2.29, supply curve SS represents the linear supply curve and P is the point where elasticity of supply is to be measured. It shows that initial quantity supplied OQ at initial price QP. When price increases to P_1Q_1, quantity supplied increases to OQ_1. The supply curve SS meets at point A on the X-axis left from the origin.

FIGURE 2.29 Measurement of Price Elasticity of Supply by Point Method



Let,

Initial price (B) = OP = QB — New Price = $OP_1 = Q_1C$

Initial Quantity Supplied (Q) = OQ — New Quantity Supplied = OQ_1

Change in price (ΔP) = PP_1 = NC — Change in quantity supplied (ΔQ) = QQ_1

$$E_s \text{ at point B} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{QQ_1}{NC} \times \frac{QB}{OQ} \quad \text{... (i)}$$

Since, Δ BNC and Δ AQB are similar triangles,

$$\frac{BN}{NC} = \frac{AQ}{QB} \quad \text{... (ii)}$$

Again in the figure,

$$BN = QQ_1 \quad \text{... (iii)}$$

Putting $BN = QQ_1$ in equation (ii), we get,

$$\frac{QQ_1}{NC} = \frac{AQ}{QB} \quad \text{... (iv)}$$

Putting $\frac{QQ_1}{NC} = \frac{QB}{OQ}$ in equation (i), we get,

$$E_s \text{ at point B} = \frac{AQ}{QB} \times \frac{QB}{OQ} = \frac{AQ}{OQ} \quad \text{... (v)}$$

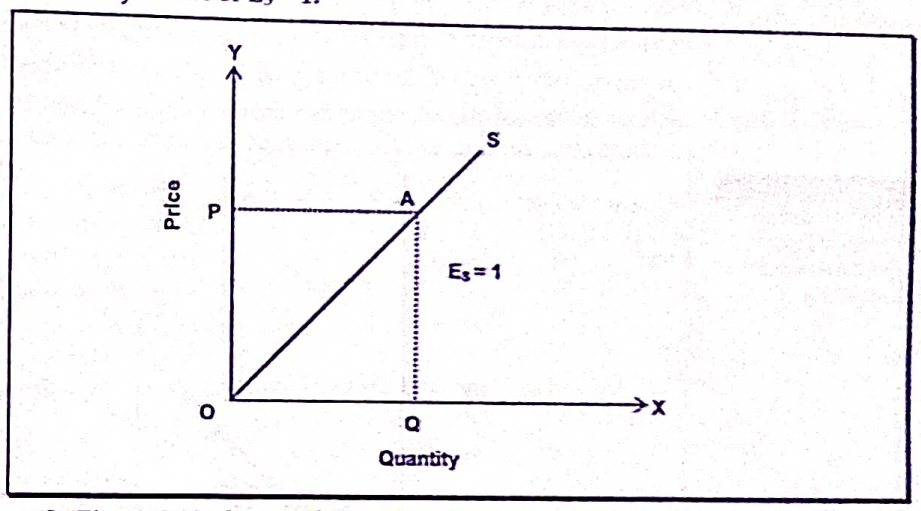
The above equation (v), clearly shows that at point B, price elasticity of supply is calculated dividing AQ by OQ. Hence, at point B, E_S is greater than one or relatively elastic. Hence, it can be concluded that

a. If supply curve meets X-axis left of origin, price elasticity of supply will be relatively elastic. In Figure 2.30,

$$E_S \text{ at point } B = \frac{AQ}{OQ} > 1 \ (\because AQ > OQ)$$

b. If linear supply curve passes through origin, price elasticity of supply will be unitary elastic or $E_S = 1$.

FIGURE 2.30
Unitary Elasticity of Supply

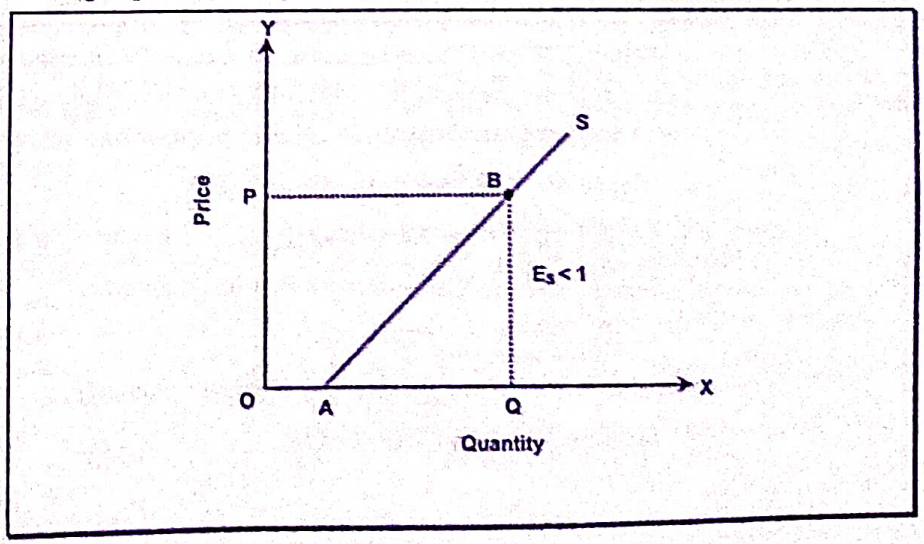


In Figure 2.30, the supply curve OS is passing through the origin. The supply elasticity at point A is the ratio between OQ and OQ. Therefore, the supply elasticity at point A is unitary elastic.

$$E_S \text{ at point } A = \frac{OQ}{OQ} = 1 \ (\because OQ = OQ)$$

c. If supply curve does not meet Y-axis or it meets X-axis rightward from the origin, price elasticity of supply will be relatively inelastic, i.e. $E_S < 1$.

FIGURE 2.31
Relatively Inelastic Supply



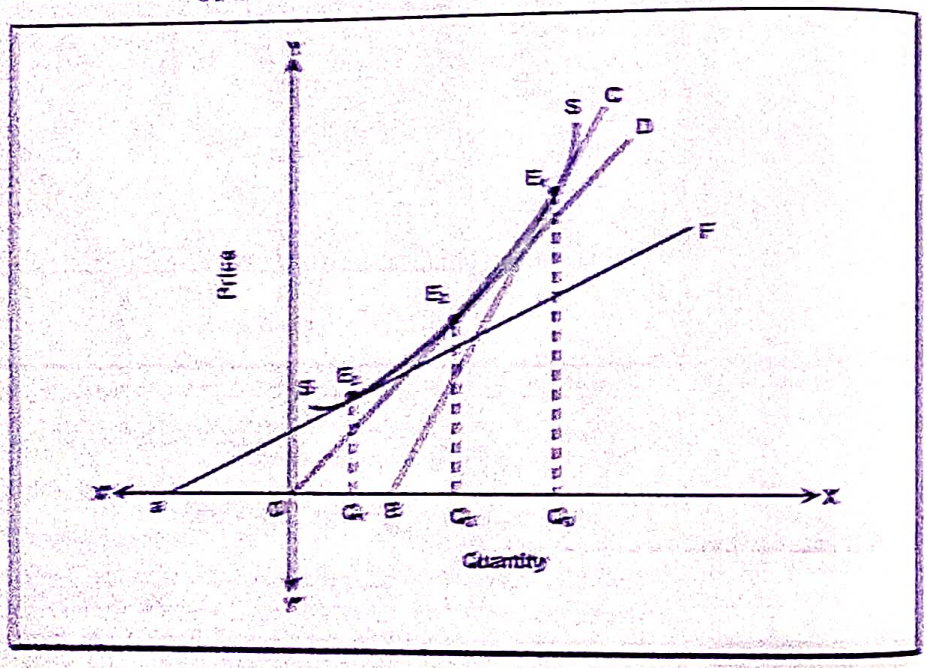
In the Figure 2.31, at point B, AQ is less than OQ. Therefore, the supply elasticity at point B is inelastic or less than unity. The supply elasticity at point B is the ratio between AQ & OQ, which is less than unity.

$$E_s \text{ at point } B = \frac{AQ}{OQ} < 1 \; (\because AQ < OQ)$$

ii. Point Elasticity on a Non-linear Supply Curve

When the supply curve is a real curve, the supply elasticity is measured by drawing a line tangent to the supply curve. When the tangent line cuts quantity axis, the supply elasticity will be inelastic; when the tangent line cuts price axis the supply elasticity will be elastic and when tangent line passes through origin the supply elasticity will be unitary elastic. The measurement of supply elasticity on non- linear supply curve can be shown in Figure 2.32.

Figure 2.32
Measurement of Elasticity of Supply along the Non-linear Supply Curve



In Figure 2.32, SS is a non-linear supply curve. To measure elasticity at point E_1, E_2 and E_3, three tangents TT, CD and XF are drawn along the supply curve. The coefficients of price elasticity at different points are as follows:

a. The elasticity at point E_1 is unity

i.e. $E_s = \frac{OT}{OT} = 1 \; (\because OQ_1 = OT)$

b. Similarly, the elasticity at point E_2 is less than unity

i.e. $E_s = \frac{BT}{OT} < 1 \; (\because OQ_2 > BT)$

c. At point E_3 the supply elasticity is greater than unity

i.e. $E_s = \frac{PT}{OT} > 1 \; (\because PQ_4 > OT)$

Example 2.13 Calculate the price elasticity of supply when increase in price of milk from Rs. 50 per liter to Rs. 60 per liter rises its supply from 10,000 liters to 12,000 liters.

SOLUTION

Given
Initial price (P) = Rs. 50
New price (P_1) = Rs. 60
Change in price (ΔP) = $P_1 - P$ = 60 - 50 = Rs. 10
Initial quantity supplied (Q) = 10,000
New quantity supplied (Q_1) = 12,000
Change in quantity supplied (ΔQ) = $Q_1 - Q$ = 12,000 – 10,000 = 2,000 units
We know that

$$E_s = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{2,000}{10} \times \frac{50}{10,000} = 1$$

Interpretation: The price elasticity of supply equal to 1 indicates that the quantity supplied changes at the same percentage as much as the percentage change in price.

Example 2.14 Calculate the price elasticity of supply by point method at price Rs. 100 with given supply function $Q_s = 20 + 5P$.

SOLUTION

Given
Supply function (Q_s) = $20 + 5P$
Initial price (P) = Rs. 100
At price Rs. 100, $Q = 20 + 5P = 20 + 5 \times 100 = 520$

$$\frac{dQ}{dP} = \frac{d(20 + 5P)}{dP} = 5$$

We know that

$$E_s = \frac{dQ}{dP} \times \frac{P}{Q} = 5 \times \frac{100}{520} = \frac{500}{520} = 0.96$$

Interpretation: Since, $E_s = 0.96 < 1$, price elasticity of supply is relatively inelastic.

CHAPTER SUMMARY

Price Elasticity of Demand

Price elasticity of demand relates to the responsiveness of quantity demanded of a good to the change in its price. In other words, the price elasticity of demand is defined as "the proportionate change in quantity demanded in response to a small change in price, divided by the proportionate change in price".

$$E_d = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

Types of Price Elasticity of Demand

1. Perfectly elastic demand
2. Perfectly inelastic demand
3. Unitary elastic demand
4. Relatively elastic demand
5. Relatively inelastic demand

Income Elasticity of Demand

Income elasticity of demand shows the degree of responsiveness of quantity demanded for a good to the change in the income of the consumer. The income elasticity of demand is defined as the ratio of the proportionate change in demand for a commodity to the proportionate change in income.

$$E_m = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q}$$

Types of Income Elasticity of Demand

1. Income elasticity greater than unity
2. Income elasticity less than unity
3. Income elasticity equal to unity
4. Zero income elasticity
5. Negative income elasticity

■ Cross Elasticity of Demand

The cross elasticity of demand is defined as the percentage change in the quantity demanded of X resulting from a percentage change in the price of Y. In other words, the ratio of percentage change in the quantity demand of X to a given percentage changes in the price of Y. The cross elasticity of demand between good X and Y is given below:

$$E_{xy} = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_y}{Q_x}$$

Types of Cross Elasticity of Demand

1. Positive Cross Elasticity of Demand
2. Negative Cross Elasticity of Demand
3. Zero Cross Elasticity of Demand

■ Measurement of Price, Income and Cross Elasticity of Demand

Measurement of Price Elasticity of Demand by Total Outlay Method

Total outlay method is also known as the total expenditure method of measuring price elasticity of demand.

Total outlay (Total Expenditure) = Price × Quantity Purchased

i. Elasticity greater than unity

ii. Elasticity less than

iii. Elasticity equal to unity

Measurement of Price Elasticity of Demand by Point Method

Prof. Marshall developed point method for measuring price elasticity of demand at a point on a demand curve. Point elasticity is the measure of price elasticity at a particular point on a demand curve.

$$E_p = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

Income demand curve slopes upward in case of normal goods. But it slopes downward in case of inferior goods. Here, we will measure income elasticity at a point of income demand curve, which slopes upward from left to right. Income demand curve may be linear or non-linear. We measure point elasticity in both linear and non-linear income demand curve.

Measurement of Cross Elasticity of Demand by Point Method

Cross elasticity of demand can be calculated by the following two methods:

1. **Percentage/ Proportionate Method:** According to percentage method, cross elasticity of demand is measured dividing percentage change in demand for a good –X, divided by percentage change in price of good Y. Let us suppose, two related goods X and Y. Then,

$$E_{xy} = \frac{\text{Percentage change in demand for good X}}{\text{Percentage change in price of good Y}}$$

2. **Average/ Arc Method:** The coefficient of cross elasticity of demand between two points on a cross demand curve is called arc elasticity of demand. This method is used to measure the cross elasticity of demand when there is greater change in price and quantity demanded.

■ Uses of Price, Income and Cross Elasticity of Demand

Use of Price Elasticity of Demand

1. Monopoly price determination
2. Price determination under discriminating monopoly
3. Price determination of public utilities
4. Price determination of joint products
5. Wage determination
6. International trade
7. Importance to finance minister

Use of Income Elasticity of Demand

1. Useful to know about stage of trade cycle
2. Useful for forecasting demand
3. Useful for classification of normal & inferior goods
4. Useful for making marketing strategy

Use of Cross Elasticity of Demand

1. Classification of goods
2. Classification of market
3. Pricing policy
4. Determination of boundaries between industries

■ Elasticity of Supply

The price elasticity of supply is defending as ra between percentage change in quantity supply a percentage change in price of a commodity. It can b expressed as:

$$E_s = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

■ Types of Elasticity of Supply

1. Perfectly elastic supply
2. Perfectly inelastic supply
3. Unitary elastic supply
4. Relatively elastic supply
5. Relatively inelastic Supply

■ Measurement of Elasticity of Supply

The elasticity of supply is measured on the basis slope and nature of supply curve. There are tha methods of measuring elasticity of supply, which a as follows:

1. **Percentage Method:** According to this metho elasticity of supply is calculated dividing percenta change in quantity supplied divided by percenta change in price.

$$E_s = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

2. **Arc Method:** The coefficient of elasticity of sup between two points on a supply curve is called a elasticity of supply. This method is used to measu elasticity of supply when there is greater change price and quantity supplied.

GLOSSARY

- **Complementary goods:** The goods which are demanded to satisfy particular want or need, such as car and petrol
- **Elasticity:** The responsiveness of one variable due to change in another variable
- **Giffen good:** A good for which an increases in the price raises the quantity demanded and vice-versa.
- **Inferior goods:** Those goods whose demand increases with fall in income and vice-versa
- **Luxury goods:** The goods which have income elasticity greater than unit Y, i.e. $E_Y > 1$
- **Neutral goods:** The goods which have zero income elasticity or whose demand does not change with change in income
- **Normal goods:** Those goods whose demand increases with increase in income and vice versa.
- **Normal necessities:** High quality necessary goods like meal, fruits, etc., which are demanded more at the higher income and vice-versa.
- **Perishable goods:** Those goods which cannot be preserved for a longtime, such as vegetables, fruits, etc.
- **Price level:** Average price of all goods and services that are consumed in the economy
- **Substitute goods:** Two goods in which one can be used in absence of another, such as tea and coffee

WORKED OUT NUMERICAL EXAMPLES

BRIEF ANSWER NUMERICAL EXAMPLES

Example 2.1 Suppose, price of a commodity rises from Rs. 8 to Rs. 10, its quantity demanded falls from 200 to 120 units. Find out nature of elasticity of demand by total outlay or expenditure method.

SOLUTION

Price of the commodity (P_X)	Quantity demanded for the commodity (Q_X)	Total outlay ($P_X \times Q_X$)
Rs. 8	200	1600
Rs. 10	120	1200

From the above table, it is clear that price is rising but total expenditure is decreasing. It means that price elasticity of demand for the commodity is relatively elastic ($E_P > 1$).

Example 2.2 As a result of 5% fall in price of good, its demand increase by 12%. Find out price elasticity of demand and say whether demand is elastic or inelastic.

SOLUTION

Given
Percentage change in price of food = 5%
Percentage change in demand for food = 12%
We know that

$$E_P = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}} = \frac{12\%}{5\%} = 2.4 > 1$$

Since $E_P > 1$, it is the case of relatively elastic demand.

Example 2.3 As a result of 20% increase in income demand for good X increases by 40%. Find income elasticity of demand and nature of the commodity.

SOLUTION

Given
Change in income = 20%

Change in demand = 40%

We know that

$$E_I = \frac{\text{Percentage change in demand}}{\text{Percentage change in income}} = \frac{40\%}{20\%} = 2$$

Since $E_I = 2$, the commodity X is normal.

Example 24 Find out price elasticity of demand at price Rs. 15 when demand function is $Q = 100 - 5P$.

SOLUTION

Given

Demand function: $Q = 100 - 5P$

Initial price (P) = Rs. 15

Initial quantity demanded (Q) = $100 - 5 \times 15 = 25$

$$\frac{dQ}{dP} = \frac{d(100 - 5P)}{dP} = -5$$

We know that

$$E_P = \frac{dQ}{dP} \times \frac{P}{Q} = -5 \times \frac{10}{25} = -2$$

SHORT/LONG ANSWER NUMERICAL EXAMPLES

Example 25 Suppose a demand schedule is given as follows:

Price (Rs.)	100	80	60	40	20	0
Quantity Demanded	100	200	300	400	500	600

a. Work out the elasticity for the fall in price from Rs. 80 to Rs. 60.

b. Calculate the elasticity for the increase in the price from Rs. 60 to Rs. 80.

c. Why is elasticity coefficient in the part (a) different from that in (b)?

SOLUTION

a. When price fall from Rs. 80 to 60

We know that

$$\text{Price elasticity of demand } (E_P) = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{100}{-20} \times \frac{80}{200} = -2$$

This implies that 1% change in price of the commodity will lead to 2% change in quantity demanded.

b. When price rises from Rs. 60 to 80

We know that

$$\text{Price elasticity of demand } (E_P) = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{-100}{20} \times \frac{60}{300} = -1$$

This implies that 1% change in price of the commodity will lead to 1% change in quantity demanded.

c. In the above two cases:

When price falls from Rs. 80 to Rs. 60, the coefficient of price elasticity of dem (E_P) = 2 and (ii) when price rises from Rs. 60 to Rs. 80, the coefficient of price elasti of demand (E_P) = 1. Thus, the coefficients are different. This difference is due difference in the base. We have taken different bases while computing the percent change in each case.

In the first case, when price falls from Rs. 80 to Rs. 60 then

$$\text{Percentage change in price} = \frac{60 - 80}{80} \times 100$$

$$= -25\% \text{ (i.e. fall in price by 25\%)}$$

Here, the base is Rs. 80

In the second case, when price rise from Rs. 60 to Rs. 80 then

Percentage change in price $= \frac{80 - 60}{60} \times 100$

$= 33.33\%$ (i.e. rise in price by 33.33%)

Here, the base is Rs. 60

Similarly, percentage change in quantity demanded is also different at different bases. Hence, coefficient of price elasticity of demand is different in the above two cases.

Example 2.6 The demand for a commodity is given by $Q = 20,000 - 300P$. The commodity is initially priced at Rs. 20 per unit. Compute the price elasticity of demand. If the objective is to increase total revenue, should the price be increased or decreased? Why?

SOLUTION

Given

$Q = 20,000 - 300P$ ... (i)

Differentiating this equation with respect to P, we get

$$\frac{dQ}{dP} = \frac{d}{dP}(20,000 - 300P) = -300$$

By the question, P = Rs. 20

Putting the value of P in equation (i), we get

$Q = 20,000 - 300P$

$Q = 20,000 - 300 \times 20 = 14,000$

We know that

$$E_P = \frac{dQ}{dP} \times \frac{P}{Q}$$

Now, putting the above values in the formula, we get

$$E_P = -300 \times \frac{20}{14,000} = -0.43$$

$\therefore \quad E_P = -0.43$

Now, as the value of E_P is less than 1, it is beneficial to increase price of the commodity to increase total revenue. It can be explained by the help of the following example.

Initially, when price was Rs.20

$Q = 20,000 - 300P$

$Q = 20,000 - 300 \times 20 = 14,000$

Total revenue (TR) $= P \times Q$

$= 20 \times 14,000 = 280,000$

If price rises from Rs. 20 to Rs. 30, then

$Q = 20,000 - 300 \times 30 = 11,000$

Total revenue (TR) $= P \times Q$

$= 30 \times 11,000 = 330,000$

Hence, total revenue increases from Rs. 280,000 to Rs. 330,000 when there is increase in price of the commodity from Rs. 20 to Rs.30

Example 2.7 Compute price elasticity of demand for oranges on the following observations:

Year	Quantity demanded	Price
2001	2000 tons per week	Rs. 20 per kg.
2002	1500 tons per week	Rs. 30 per kg.

What is the nature of the demand for oranges at this point?

SOLUTION

Given

Initial price (P) = Rs 20 Initial quantity demanded (Q) = 2,000

New price (P_1) = Rs 30 New quantity demanded (Q_1) = 1,500

$\Delta Q = Q_1 - Q = 1,500 - 2,000 = -500$

Change in demand = 40%

We know that

$$E_Y = \frac{\text{Percentage change in demand}}{\text{Percentage change in income}} = \frac{40\%}{20\%} = 2$$

Since $E_Y = 2$, the commodity X is normal.

Example 2.4 Find out price elasticity of demand at price Rs. 15 when demand function is $Q = 100 - 5P$.

SOLUTION

Given

Demand function: $Q = 100 - 5P$

Initial price (P) = Rs. 15

Initial quantity demanded (Q) = $100 - 5 \times 15 = 25$

$$\frac{dQ}{dP} = \frac{d(100 - 5P)}{dP} = -5$$

We know that

$$E_P = \frac{dQ}{dP} \times \frac{P}{Q} = -5 \times \frac{10}{25} = -2$$

SHORT/ LONG ANSWER NUMERICAL EXAMPLES

Example 2.5 Suppose a demand schedule is given as follows:

Price (Rs.)	100	80	60	40	20	0
Quantity Demanded	100	200	300	400	500	600

a. Work out the elasticity for the fall in price from Rs. 80 to Rs. 60.

b. Calculate the elasticity for the increase in the price from Rs. 60 to Rs. 80.

c. Why is elasticity coefficient in the part (a) different from that in (b)?

SOLUTION

a. When price fall from Rs. 80 to 60

We know that

$$\text{Price elasticity of demand } (E_P) = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{100}{-20} \times \frac{80}{200} = -2$$

This implies that 1% change in price of the commodity will lead to 2% change in its quantity demanded.

b. When price rises from Rs. 60 to 80

We know that

$$\text{Price elasticity of demand } (E_P) = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{-100}{20} \times \frac{60}{300} = -1$$

This implies that 1% change in price of the commodity will lead to 1% change in its quantity demanded.

c. In the above two cases,

When price falls from Rs. 80 to Rs. 60, the coefficient of price elasticity of demand (E_P) = 2 and (b) when price rises from Rs. 60 to Rs. 80, the coefficient of price elasticity of demand (E_P) = 1. Thus, the coefficients are different. This difference is due to difference in the base. We have taken different bases while computing the percentage change in each case.

In the first case, when price falls from Rs. 80 to Rs. 60 then

$$\text{Percentage change in price} = \frac{60 - 80}{80} \times 100$$

$$= -25\% \text{ (i.e. fall in price by 25\%)}$$

Here, the base is Rs. 80

In the second case, when price rise from Rs. 60 to Rs. 80 then

Percentage change in price $= \frac{80 - 60}{60} \times 100$

$= 33.33\%$ (i.e. rise in price by 33.33%)

Here, the base is Rs. 60

Similarly, percentage change in quantity demanded is also different at different bases. Hence, coefficient of price elasticity of demand is different in the above two cases.

Example 2.6 The demand for a commodity is given by $Q = 20{,}000 - 300P$. The commodity is initially priced at Rs. 20 per unit. Compute the price elasticity of demand. If the objective is to increase total revenue, should the price be increased or decreased? Why?

SOLUTION

Given

$Q = 20{,}000 - 300P$ ... (i)

Differentiating this equation with respect to P, we get

$\frac{dQ}{dP} = \frac{d}{dP}(20{,}000 - 300P) = -300$

By the question, P = Rs. 20

Putting the value of P in equation (i), we get

$Q = 20{,}000 - 300P$

$Q = 20{,}000 - 300 \times 20 = 14{,}000$

We know that

$E_p = \frac{dQ}{dP} \times \frac{P}{Q}$

Now, putting the above values in the formula, we get

$E_p = -300 \times \frac{20}{14{,}000} = -0.43$

$\therefore \quad E_p = -0.43$

Now, as the value of E_p is less than 1, it is beneficial to increase price of the commodity to increase total revenue. It can be explained by the help of the following example.

Initially, when price was Rs.20

$Q = 20{,}000 - 300P$

$Q = 20{,}000 - 300 \times 20 = 14{,}000$

Total revenue (TR) $= P \times Q$

$= 20 \times 14{,}000 = 280{,}000$

If price rises from Rs. 20 to Rs. 30, then

$Q = 20{,}000 - 300 \times 30 = 11{,}000$

Total revenue (TR) $= P \times Q$

$= 30 \times 11{,}000 = 330{,}000$

Hence, total revenue increases from Rs. 280,000 to Rs. 330,000 when there is increase in price of the commodity from Rs. 20 to Rs.30

Example 2.7 Compute price elasticity of demand for oranges on the following observations:

Year	Quantity demanded	Price
2001	2,000 tons per week	Rs. 20 per kg
2002	1,500 tons per week	Rs. 30 per kg

What is the nature of the demand for oranges at this point?

SOLUTION

Given

Initial price (P) = Rs 20

New price (P_1) = Rs 30

$\Delta Q = Q_1 - Q = 1{,}500 - 2{,}000 = -500$

Initial quantity demanded (Q) = 2,000

New quantity demanded (Q_1) = 1,500

$\Delta P = P_1 - P = 30 - 20 = 10$

We know that

Price elasticity of demand $(E_P) = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{-500}{10} \times \frac{20}{2000} = -\frac{1}{2} = -0.5$

This implies that 1% change in price of the commodity will lead to 0.5% chang quantity demanded but in the opposite direction.

Example 2.8 Suppose that your demand schedule for mango is as follows:

Price/Kg (in Rs.)	Quantity Demanded (in kg.) (Income = Rs. 10,000)	Quantity Demanded (in kg.) (Income = Rs. 15,000)
8	80	100
10	64	90
12	48	60
14	32	40
16	16	30

i. Calculate your price elasticity of demand as the price of mango increases from Rs. Rs. 14 if your income is Rs. 10,000.

ii. Calculate your income elasticity of demand as your income increases f Rs. 10,000 to Rs. 15,000 if price is Rs. 12 per kg.

SOLUTION

i. When income of the consumer is Rs 10,000,

Initial price (P) = Rs. 8 — Initial quantity demanded (Q) = 80

New price (P_1) = Rs. 14 — New quantity demanded (Q_1) = 32

$\Delta P = 14 - 8 = Rs. 6$ — $\Delta Q = 32 - 80 = -48$

We know that

Price elasticity of demand $(E_P) = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{-48}{6} \times \frac{8}{80} = -0.8$

ii. When price of the commodity is Rs 12 per kg,

Initial income (Y) = Rs 10,000 — Initial quantity demanded (Q) = 48

New income (Y_1) = Rs 15,000 — New quantity demanded (Q_1) = 60

$\Delta Y = 15,000 - 10,000 = Rs. 5,000$ — $\Delta Q = 60 - 48 = 12$

We know that

Income elasticity of demand $(E_Y) = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q} = \frac{12}{5,000} \times \frac{10,000}{48} = 0.5$

Example 2.9 Calculate E_P (i) when price falls from Rs. 5 to Rs. 3 (ii) when price rises Rs. 3 to Rs. 5.

Combination	Price (in Rs.) 1 per kg. of X	Quantity of X (in kg)
A	6	0
B	5	10
C	4	20
D	3	30
E	2	40
F	1	50
G	0	60

SOLUTION

i. Suppose the price of good X falls from Rs. 5 per kg to Rs. 3 per kg. and its quar demanded increases from 10 kg to 30 kg. Then,

Here,

P = Rs. 5; P_1 = Rs. 3 — Q = 10 Kg; Q_1 = 30 Kg

$\Delta P = 3 - 5 = -$ Rs. 2 — $\Delta Q = 30 - 10 = 20$

We know that

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \left(\frac{20}{-2}\right) \times \frac{5}{10} = -5$$

ii. Let us measure elasticity by moving in the reverse direction. Suppose the price of X rises from Rs. 3 per kg to Rs. 5 per kg. and the quantity demanded decreases from 30 kg. to 10 kgs. Then,

P = Rs. 3; P_1 = Rs. 5 $\qquad$ Q = 30 Kg; Q_1 = 10 Kg

$\Delta P = 5 - 3$ = Rs. 2 $\qquad$ $\Delta Q = 10 - 30 = -20$

We know that

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{(-20)}{2} \times \frac{3}{30} = -1$$

Example 2.10 Consider the following hypothetical table:

Combination	Price	Quantity Demanded
A	10	20
B	14	15
C	18	8
D	20	2

On the basis of information given above, calculate

a. Price elasticity of demand from A to B
b. Price elasticity of demand from D to C
c. Average elasticity of demand from B to D and interpret your result.

SOLUTION

a. Price elasticity of demand from A to B

$P = 10, P_1 = 14$ $\qquad$ $\Delta P = P_1 - P = 14 - 10 = 4$

$Q = 20, Q_1 = 15$ $\qquad$ $\Delta Q = Q_1 - Q = 15 - 20 = -5$

We know that

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{-5}{4} \times \frac{10}{20} = -\frac{5}{8} = -0.625$$

b. Price elasticity of demand from D to C

$P = 20, P_1 = 18$ $\qquad$ $\Delta P = P_1 - P = 18 - 20 = -2$

$Q = 2, Q_1 = 8$ $\qquad$ $\Delta Q = Q_1 - Q = 8 - 2 = 6$

We know that

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{6}{-2} \times \frac{20}{2} = -30$$

c. Average price elasticity of demand (arc elasticity of demand) from B to D

$P_1 = 14, P_2 = 20$ $\qquad$ $\Delta P = P_2 - P_1 = 20 - 14 = 6$

$Q_1 = 15, Q_2 = 2$ $\qquad$ $\Delta Q = Q_1 - Q = 2 - 15 = -13$

We know that

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{(P_1 + P_2)}{(Q_1 + Q_2)}$$

$$= \frac{-13}{6} \times \frac{(14 + 20)}{(15 + 2)} = \frac{-13}{6} \times \frac{34}{17} = \frac{-13}{3} = -4.33$$

This implies that 1% change in price of the commodity will bring 4.33% change in quantity demanded but in the opposite direction.

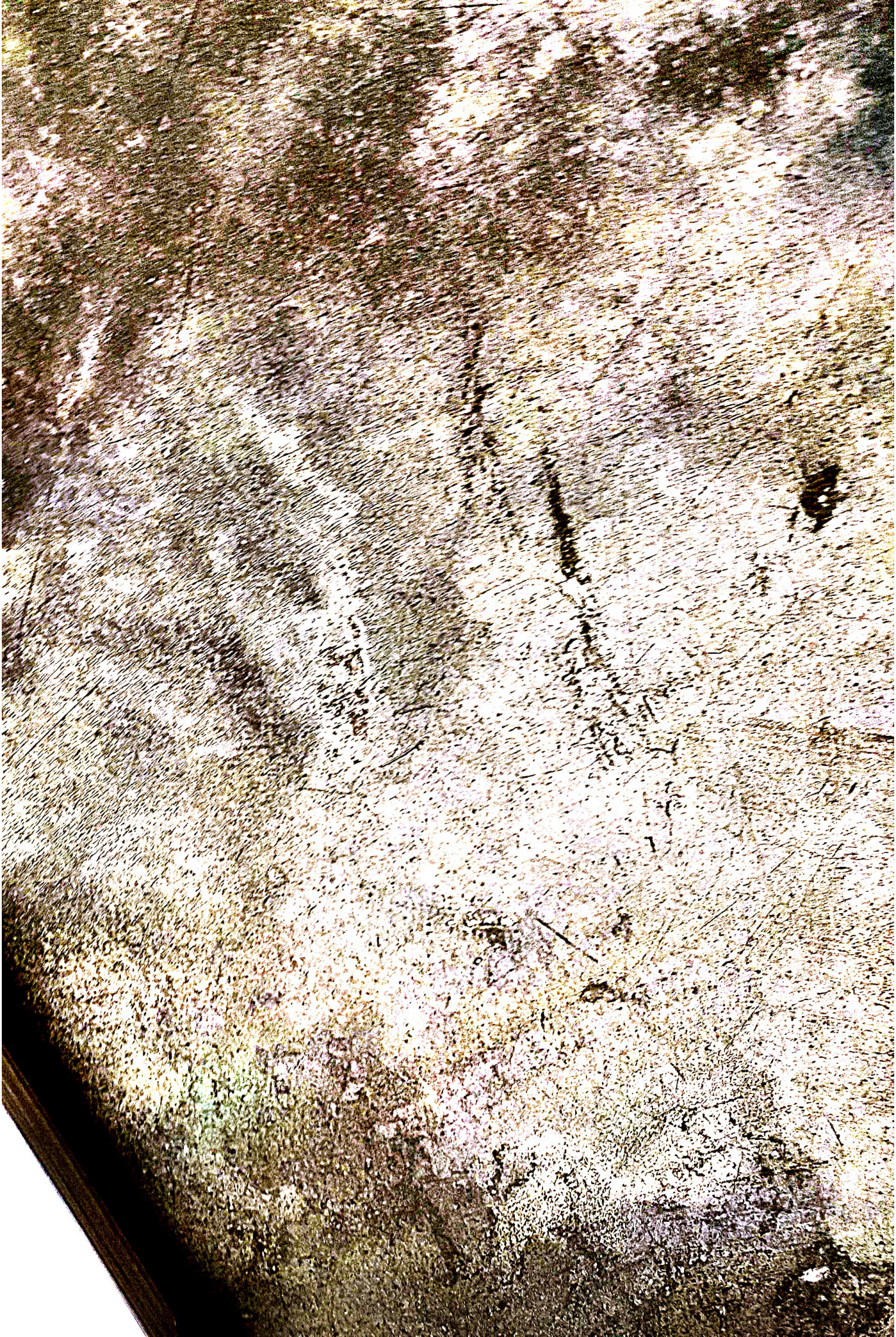
UNIT 3

THEORY OF CONSUMER BEHAVIOUR

LEARNING OBJECTIVES...

On completion of this unit, students will be able to:

- give the concept of cardinal and ordinal utility analysis.
- explain the assumptions of the consumer's equilibrium criticisms by using cardinal analysis and
- demand curve.
- ences curve and explain its properties.
- ts of substitution.
- the consumer's equilibrium by using indifference curve.
- ive PPC.
- ICC.
- oss of price effect into income effect and substitution



6. Consider the following table and find out cross elasticity of case:

Demand for Coke (Bottle/ per week)	1,200	1,400
Price of Pepsi	20	21

Also interpret the result.

Ans: E_{xy}

7. Consider the following table and find out cross elasticity of demand. Also, interpret the result.

Demand for Good X	10	8
Price of Good Y	Rs. 5,000	Rs. 8,000

Ans: $E_{xy} = -$

8. Find advertising elasticity of demand from the following table:

Year	Advertising Expenditure (Rs.)	Quantity Demanded (Units)
2016	50,000	4
2017	60,000	6

Ans: E_s

9. Consider the following supply schedule:

Points	A	B	C	D
Price (P_X)	0	5	10	15
Supply (Q_X)	10	20	30	40

a. Compute the price elasticity of supply at the movement from B to C by percentage method.

b. Compute the price elasticity of supply by average method between C and D.

Ans: (a) $E_s = 0.5$ (b) E_s

10. Suppose individual demand schedule for Suraj, Sunny and Sushila are given as:

Price	Suraj's Demand	Sunny's Demand	Sushila's Demand
10	160	80	40
20	80	40	20
30	40	20	10
40	20	10	0
50	0	0	0

Find:

a. Market demand schedule.

b. Elasticity of demand when price falls from Rs.30 to 20.

c. Elasticity of demand when price rises from Rs.20 to 30.

Ans: (b) – 3 (c)

3

UNIT

THEORY OF CONSUMER BEHAVIOUR

LEARNING OBJECTIVES...

On completion of this unit, students will be able to:

- give the concept of cardinal and ordinal utility analysis.
- explain the assumptions of the consumer's equilibrium criticisms by using cardinal analysis and derive demand curve.
- define indifference curve and explain its properties.
- describe marginal rate of substitution.
- explain the price line and the consumer's equilibrium by using indifference curve.
- explain the price effect, and derive PPC.
- explain the income effect and derive ICC.
- explain the substitution effect and decompose of price effect into income effect and substitution effect.
- derive demand curve (Hicksian approach)
- Solve numerical illustrations.

Introduction

The theory of consumer behaviour deals with how consumers decide how much commodity to buy at a given price and how they respond to the change in price.

In the previous units, we studied about the demand and supply, and their elasticities. We defined demand as the quantity of a commodity that a consumer is willing to buy at a given price and period of time. In this unit of the book, we are concerned with the questions: (i) How does a consumer decide how much of a commodity to buy at a given price? and (ii) How does the consumer respond to change in price of the commodity, given his/her income, and price of the related goods? These questions take us to the theory of consumer behaviour. The theory of consumer behaviour is based on a fundamental assumption that consumers always seek to maximise their total utility or satisfaction, under certain given conditions. This applies to both cardinal and ordinal utility approaches of consumer's behaviour. But economists have different views on whether utility is measurable in absolute terms. The classical and neo-classical economists held the view that utility is cardinally or quantitatively measurable. Modern economists, on the other hand, hold the view that utility can be measured in the ordinal terms, i.e. in terms of 'less than' or 'more than'. In this unit, we have discussed both cardinal and ordinal utility analysis. The unit begins with the concept of cardinal and ordinal utility analysis. Thereafter, we study indifference curve analysis, consumer's equilibrium, price effect, income effect and substitution effect. Finally, we study the derivation of demand curve for normal goods.

Concept of Utility Analysis

Utility Analysis
Utility is the want satisfying power of a commodity.

Utility is the want satisfying power of a commodity. The concept of utility was introduced by English Philosopher, Jeremy Bentham in 1789 to social thought and by William **Stanley Jevon** in 1871, **Walras** in 1874 and **Carl Mengar** in 1871 to economic thought. Here, the concept of utility is used to anlayse the consumer's tastes which is a crucial step in determining how a consumer maximizes satisfaction by spending his/her limited income.

In order to analyze utility obtained from the consumption of goods and services there are two basic approaches, i.e. cardinal and ordinal. Neoclassical economists believed that first utility can be measured cardinally. The unit of measurement of utility is **Util** which was coined by **Walras**. According to ordinal approach, utility is a psychological concept and only it can be ranked in order.

Cardinal Utility Approach

Cardinal Utility
Cardinal utility approach measures utility in terms of number like 1, 2, 3 ....

Initially, the concept of cardinal utility analysis was developed by **Hermann Heinrich Gossen** and popularized by famous neoclassical economist **Alfred Marshall**. According to **Marshall**, utility is a subjective phenomenon and it can be quantitatively measured by means of money as a measuring rod. It is based on the following assumptions:

1. **Rational consumers:** The consumer is assumed to be a rational. Therefore s/he always tries to maximize utility given his/her limited income and market prices. It means that s/he purchases first a commodity that yields the highest utility and s/he purchased last commodity that gives the least utility

2. **Cardinal measurement:** Utility is a cardinal concept. It means that utility can be measured quantitatively in terms of money. For example, the total utility derived by consuming a commodity can be expressed in terms of cardinal numbers as 6, 10, 12 utils and so on.
3. **Constant marginal utility of money:** The marginal utility of money remains constant whatever be the level of income because cardinal utility analysis used monetary unit as the measuring rod of utility. If the marginal utility of money changes with the change in income, the measuring rod for utility becomes like an elastic ruller.
4. **Diminishing marginal utility:** Cardinal utility analyses that as consumer consumes more and more units of a commodity, the utility derived from successive units of its goes on diminishing.
5. **Additivity of utility:** Utility is additive. Additivity implies utilities of different goods are assumed to be independent of one another. Therefore, utility obtained from the consumption of one commodity is not affected by the consumption of other commodities. For example, if the consumer has consumed n-commodities with quantities X_1, X_2, X_3, ..., X_n, then the total utility function is expressed as

   $U = f(X_1, X_2, X_3, ..., X_n)$

   Given the utility function, the total utility derived from n items can be expressed as

   $U = U_1(X_1) + U_2(X_2) + ... + U_n(X_n)$

Concept of Total Utility and Marginal Utility

1. **Total Utility (TU):** Total utility is the sum of the utility derived from the consumption of given units of a commodity. In other words, it is a sum of marginal utility. For example, if a consumer consumes n units, then his/her total utility from n units may be expressed as

   $TU = MU_1 + MU_2 + ... + MU_n$

   where

   TU = Total Utility

   MU = Marginal utility of the commodity
2. **Marginal Utility (MU):** Marginal utility is the change in the total utility resulting from the consumption of one additional unit. Symbolically, it can be expressed as

   $$MU = \frac{\Delta TU}{\Delta N}$$

   where

   ΔTU = Change in total utility

   ΔN = Change in units of consumption

   In other words, marginal utility is the addition to the total utility derived from the consumption of an additional unit of a commodity. Symbolically, it can be expressed as

   $MU = TU_n - TU_{n-1}$

   where

   TU_n = Total utility derived from the consumption of n^{th} unit of a commodity.

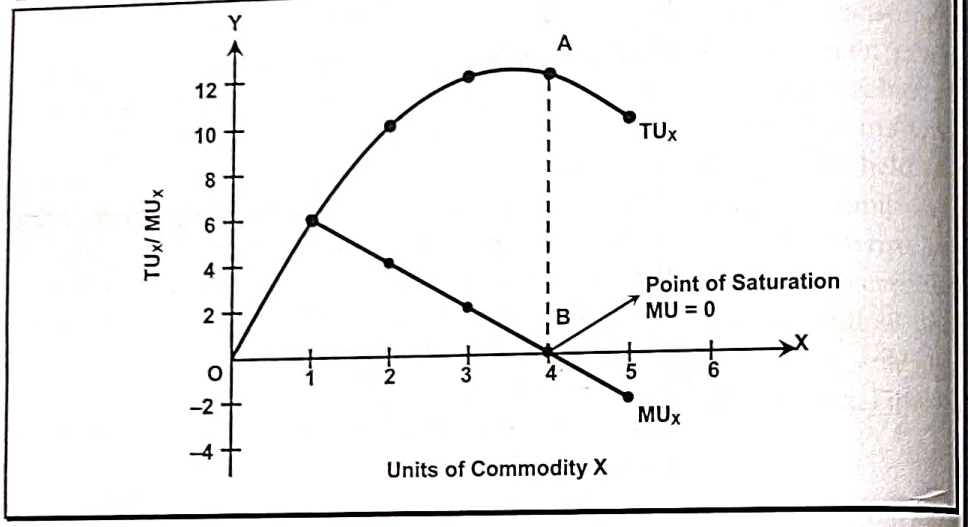
   TU_{n-1} = Total utility derived from the consumption of $(n-1)^{th}$ unit of a commodity.

The concept of total utility and marginal utility can be explained by the help of table and figure. It also shows the relationship between TU and MU.

TABLE 3.1 Relationship between TU and MU

Units of Commodity X	TU_X	MU_X
1	6	6
2	10	4
3	12	2
4	12	0
5	10	-2

FIGURE 3.1 Total and Marginal Utility



In **Figure 3.1**, TU_X represents total utility and MU_X represents marginal utility. Initially, TU_X is increasing at a diminishing rate and MU_X is declining with the increase in consumption of X commodity upto the 3rd unit. When the consumer consumes 4th unit of the commodity X, TU_X is maximized and MU_X is zero. When he consumes 5th unit of the X commodity, total utility is declined and marginal utility is negative. Therefore, initially, total utility curve is upward sloping and after reaching at its maximum point A, it is downward sloping whereas marginal utility curve is downward sloping and touches X-axis at point B. After point B, it lies below X-axis. So point E is the equilibrium point.

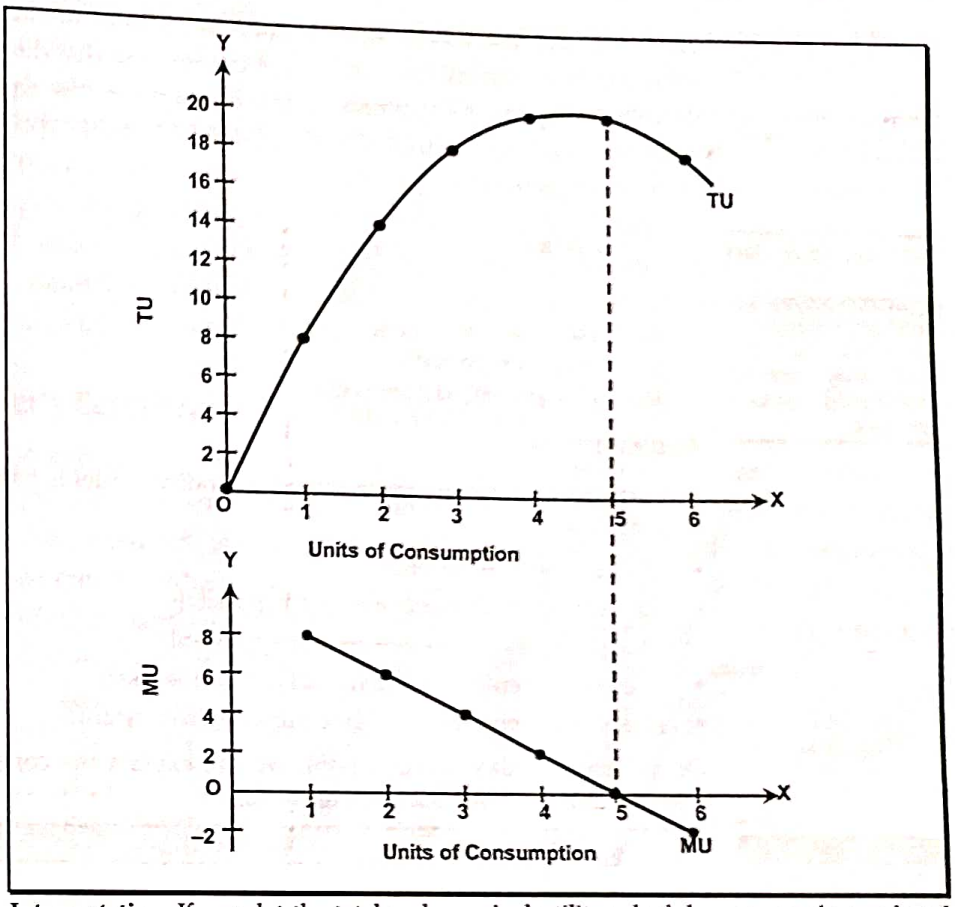
Example 3.1 The total utility schedule of individual consumer is given below. Derive his marginal utility schedule. Also plot it into graph.

Units	0	1	2	3	4	5	6
Total Utility	0	8	14	18	20	20	18

SOLUTION

As we know, $MU = \frac{\Delta TU}{\Delta N}$

Units	0	1	2	3	4	5	6
Total Utility	0	8	14	18	20	20	18
Marginal Utility	-	8	6	4	2	0	-2



Interpretation: If we plot the total and marginal utility schedules, we get the total and marginal utility curves. The point of maximum satisfaction is reached at the point where MU = 0. MU is zero at 5th unit. The falling MU curve illustrates the principle of diminishing marginal utility.

Consumer's Equilibrium under Cardinal Utility Approach

A consumer is in equilibrium position when s/he maximizes his/her total utility with given money income and market prices of goods consumed. At the equilibrium point, the consumer spends all his income among different goods and services and derives maximum satisfaction.

Consumer's Equilibrium: One Commodity Model

Law of Diminishing Marginal Utility
When a consumer consumes more and more units of a commodity, the marginal utility diminishes. This process is known as law of diminishing marginal utility.

In order to get utility/ satisfaction, a consumer consumes goods and services. In cardinal utility approach, the sum of the utility derived from the consumption of given units of a commodity is called total utility (TU). The additional utility derived from the consumption of an additional unit of a commodity is known as marginal utility. When a consumer consumes more and more units of the commodity, the marginal utility diminishes. This process is known as law of diminishing marginal utility. Consumer's equilibrium under one commodity model can be explained by the help of the law of diminishing marginal utility.

In this model, the consumer is in equilibrium when the marginal utility of the commodity is equated to its market price. Suppose that the consumer consumes X commodity. In this situation, the consumer is in equilibrium when the marginal utility of X commodity is equated to its market price (P_X). Symbolically, it can be expressed as

Consumer Equilibrium
A consumer is in equilibrium position when s/he maximizes his/her total utility with given money income and market prices of goods consumed.

$$\frac{MU_X}{P_X} = MUm$$

where
MUm = Marginal utility of money
P_X = Price of X commodity
MU_X = Marginal utility of X commodity

Assumptions

Consumer's equilibrium under one commodity model is based on the following assumptions:

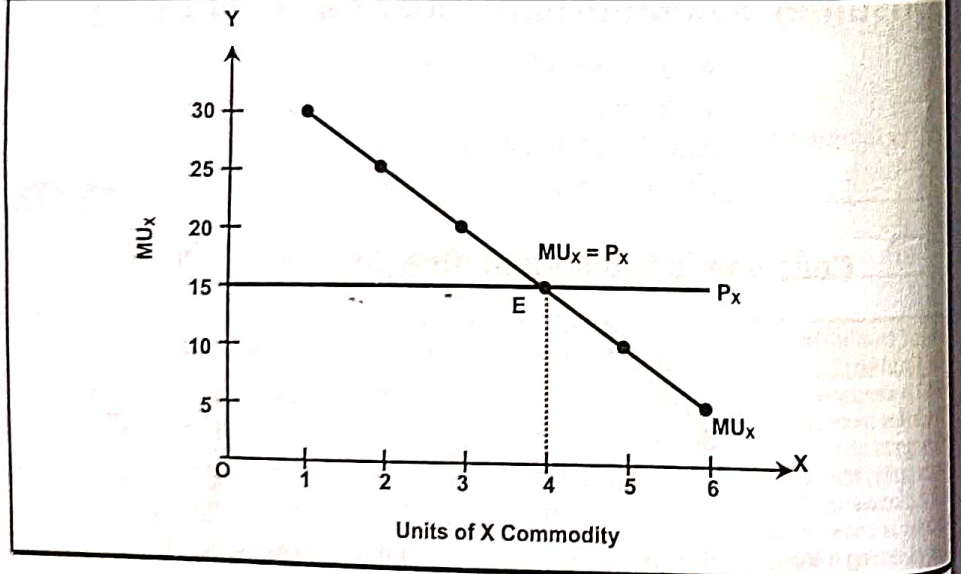
- The consumer is rational.
- Cardinal measurement of utility is possible.
- Marginal utility of money remains constant.
- The law of diminishing marginal utility operates.
- Prices of commodities are given or remain constant.

On the basis of these assumptions, we can explain the consumer's equilibrium with the help of **Table 3.2** and **Figure 3.2**.

TABLE 3.2
Schedule of MU and Price

Unit of X	MU_X (in Rs.)	P_X (in Rs.)	
1	30	15	
2	25	15	
3	20	15	
4	15	15	$MU_X = P_X$
5	10	15	
6	5	15	

FIGURE 3.2
Single Commodity Model



In Figure 3.2, P_X is the price line which shows the constant marginal utility of money and MU_X is the marginal utility curve of X-commodity which is downward sloping. The price line (P_X) and MU_X curve are intersecting each other at point E where $MU_X = P_X$. Therefore, the consumer is in equilibrium at point E. When $MU_X > P_X$, the consumer can increase his/her satisfaction by purchasing more units of X-commodity. Similarly, when $MU_X < P_X$, the consumer can increase his/her satisfaction by reducing purchase of X-commodity. Thus, at any point other than E, the consumer gets less satisfaction than maximum satisfaction.

Consumer's Equilibrium: Two Commodity Model

Two Commodity Model
A consumer is said to be in equilibrium when the ratio of marginal utility and price of each commodity is equivalent to marginal utility of money.

A consumer is said to be in equilibrium when the ratio of marginal utility and price of each commodity is equivalent to marginal utility of money. It means that consumer always tries to get equal marginal utility by consuming a commodity which is equal to money spent on that commodity. This is called law of equi-marginal utility or law of substitution. According to this law, consumer is in equilibrium position when the following condition is fulfilled:

$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y} = MU_M$$

where

MU_X = Marginal Utility of X Commodity
MU_Y = Marginal Utility of Y Commodity
P_X = Price of X Commodity
P_Y = Price of Y Commodity

Assumptions

Consumer's equilibrium under two commodity model is based on the following assumptions:

- The consumer is rational.
- Cardinal measurement of utility is possible.
- Marginal utility of money remains constant.
- The law of diminishing marginal utility operates.
- Prices of commodities and income of the consumer are given.
- Consumer spends his income in two goods.

On the basis of these assumptions, we can explain consumer's equilibrium in two commodity model as follows.

Suppose there are only two commodities X and Y on which a consumers has to spend a given money income. Let the prices of goods X and Y be Rs. 2 and Rs. 3 respectively and he has Rs. 24 to spend on the two goods. In the table, marginal utility of the two commodities with their price ratio are given.

In order to maximize his/her satisfaction/utility the consumer will not equate marginal utility of the goods because prices of the two goods are different. S/He will equate the ratio of marginal utility and price of two commodities X

and Y to the marginal utility of money. It can be shown by the help of table and figure.

TABLE 3.3
Marginal Utility of Goods X and Y with Money Expenditure

Units	MU_X (Utility)	MU_Y (Utility)	MU_X / P_X	MU_Y / P_Y
1	20	24	10	8
2	18	21	9	7
3	16	18	8	6
4	14	15	7	5
5	12	12	6	4
6	10	9	5	3

In **Table 3.3**, the consumer will be in equilibrium when s/he purchases 6 units of X and 4 units of Y because it satisfies the following condition required for consumer's equilibrium.

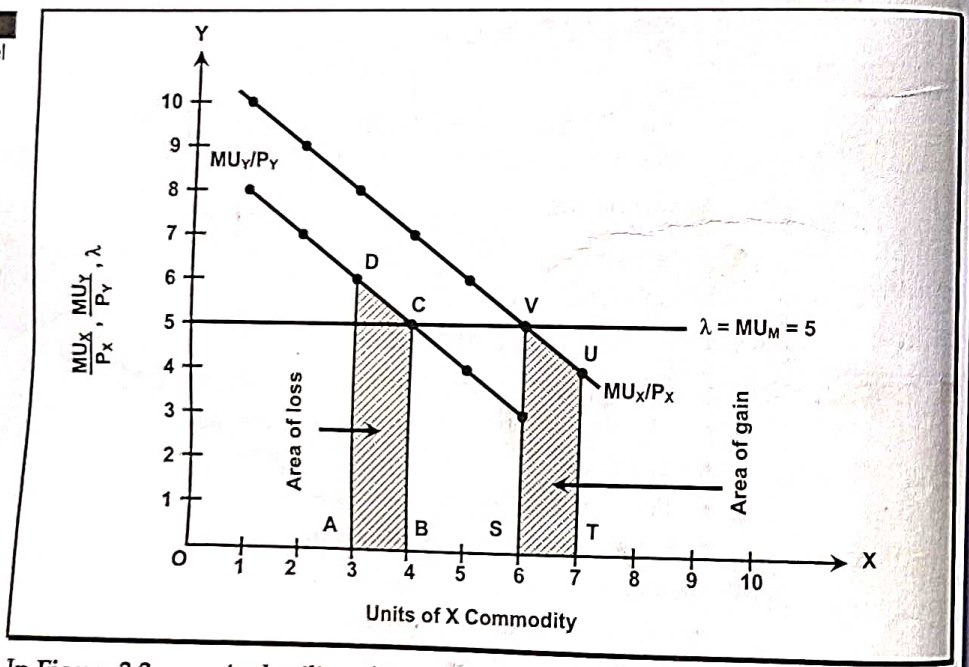
At the 6th unit of X and 4th unit of Y,

$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

or, $\frac{10}{2} = \frac{15}{3}$

$\therefore \; 5 = 5$

FIGURE 3.3
Two Commodity Model



In **Figure 3.3**, marginal utility of commodity with its price ratio is measured on the Y-axis and unit of X commodity is measured on the X-axis. A consumer will get maximum satisfaction or utility when s/he purchases 6 units of X commodity and 4 units of Y commodity because at the 6th unit of X and 4th unit of Y, $\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y} = MU_M = 5$. So, the consumer is in equilibrium when s/he purchases 6 units of X and 4 units of Y. No any other combinations will yield him/her greater utility than this combination. Suppose, if the consumer purchases one unit less of

Y, i.e. 3 units and one unit more of X, i.e. 7 units, this will lead to the decrease in total utility than before. When s/he purchases one unit less of Y, i.e. 3 units, there is a loss in utility by the shaded area ABCD and when s/he purchases one unit more of X, i.e. 7 units, there is a gain in utility by the shaded area STUV. Here, area of loss is greater than area of gain, i.e. ABCD > STUV. So, the consumer is in equilibrium at the point where $\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y} = MU_M$. This condition is satisfied when the consumer purchases 6 units of X and 4 units of Y.

Example 3.2 The following table gives an individual's marginal utility schedule for commodity X and Y. Suppose, the price of X and Y are Rs. 2 and Re. 1 respectively and the individuals has Rs. 12 which he spends all on X and Y. State the equilibrium condition for this method.

Units	1	2	3	4	5	6	7	8
MU_X	16	14	12	10	8	6	4	2
MU_Y	11	10	9	8	7	6	5	4

SOLUTION

For equilibrium, the consumer must satisfy the equilibrium condition, i.e.

$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

or, $\frac{12}{2} = \frac{6}{1}$

$\therefore \quad 6 = 6$

And $\quad P_X . X + P_Y . Y = M$

or $\quad 2(3) + 1\,(6) = 12$

$\therefore \quad 12 = 12$

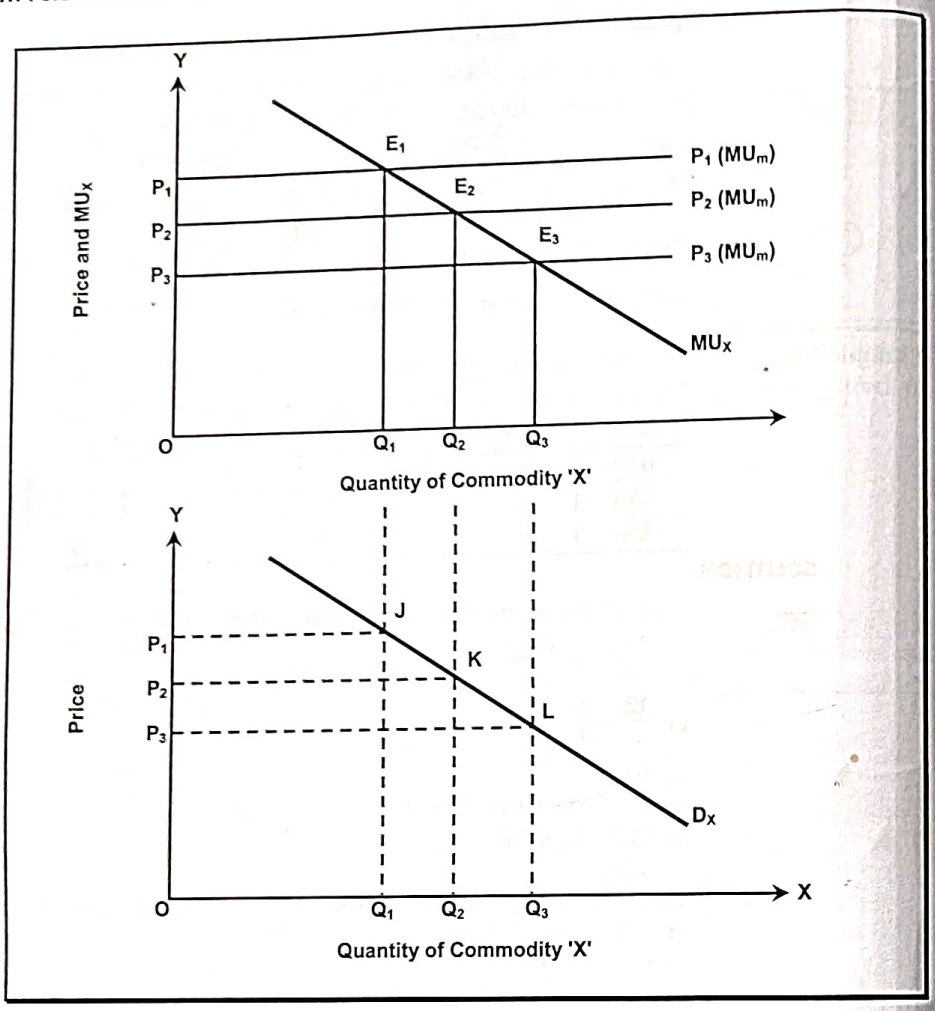
That is, the MU of the last rupee spent on X (6 utils) equals the MU of the last rupee spent on Y (6 utils), and the amount of money spend on X (Rs. 6) plus the amount of money spent on Y (Rs. 6) exactly equals the individual's money income (Rs. 12). Hence, the consumer is in equilibrium when he purchases 3 units of X and 6 units of Y.

Derivation of Demand Curve

1. One Commodity Model

In Cardinal utility approach, a consumer will be in equilibrium when marginal utility of a commodity equals to price of the commodity or marginal utility of money, i.e. $[MU_X = P_X\,(MU_m)]$. According to the law of diminishing marginal utility, as the quantity of the commodity increases with a consumer, marginal utility diminishes. Therefore, marginal utility curve is downward sloping. It implies that demand curve of the commodity is also downward sloping, i.e. as the price of the commodity falls, more of it will be bought to attain equilibrium. It can be shown by the help of **Figure 3.4.**

FIGURE 3.4
Derivation of demand curve one Commodity Model



In upper portion of **Figure 3.4**, MU curve represents the diminishing marginal utility of the commodity X. Initially, the consumer is in equilibrium at point E_1 where price of commodity 'X' is P_1 and $MU_X = P_1$ (MUm). At this equilibrium position, the equilibrium quantity is OQ_1 unit. If the price of the commodity X falls to P_2, the consumer will be in equilibrium at point E_2 where $MU_X = P_X$ (MUm). Here, the equilibrium quantity is OQ_2 units. Similarly, the consumer will be in equilibrium at point E_3 when price falls to P_3. At this price, the equilibrium quantity is OQ_3 units.

The lower portion of **Figure 3.4** shows the relationship between price and quantity demanded for X commodity. When price is P_1, consumer purchases OQ_1 unit of the commodity X. It is indicated by point J. Similarly, when price falls to P_2 and P_3, the quantity purchases increase to OQ_2 units and OQ_3 units respectively which are marked by points K and L respectively. If we join all these points, we get downward slopping demand curve D_X.

2. Two Commodity Model

The demand curve for two commodity can be derived with the help of the law of equi-marginal utility. According to this law, the consumer is in equilibrium by equalizing the ratios of marginal utility and price of each commodity to the marginal utility of money. It can be expressed as $\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y} = MU_m$.

Let us suppose that the price of commodity X falls whereas price of Y-commodity and income of the consumer are constant. $\frac{MU_X}{P_X}$ will become greater than $\frac{MU_Y}{P_Y}$ due to fall in price of X commodity. To restore the equilibrium, marginal utility of commodity X must be reduced. It is possible only by consuming more units of the commodity X. So, it is clear that when price of the commodity falls, the consumer must purchases more units of that particular commodity to attain the equilibrium. Hence, demand curve is downward sloping as shown in Figure 3.5.

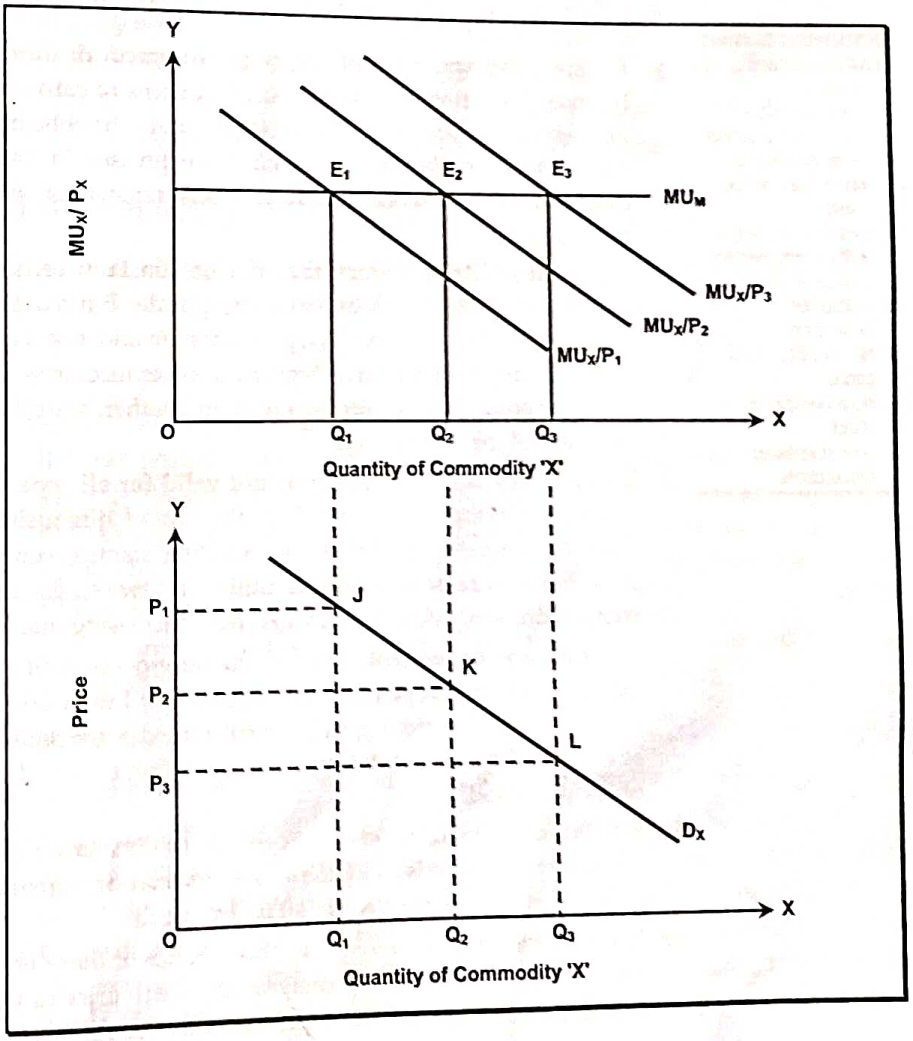


FIGURE 3.5
Derivation of demand curve two Commodity Model

In Figure 3.5, consumer's income is given; MU_m is the marginal utility of money which is constant. Therefore, MU_m curve is horizontal straight line. At price P_1, the consumer purchases OQ_1 unit of the commodity X where $\frac{MU_X}{P_1} = MU_m$. Hence, point E_1 is the initial equilibrium position. This gives the combination J in the lower portion of **Figure 3.5** where the consumer purchase OQ_1 unit at price P_1. As the price of X falls to P_2, the quantity purchased increases to OQ_2 units and the new equilibrium is established at point E_2 where $\frac{MU_X}{P_2} = MU_m$. This gives the combination K in the lower portion of **Figure 3.5**.

Similarly, as the price falls to P_3, the quantity purchase increases to OQ_3 units and the new equilibrium is obtained at point E_3 which gives combination K in the lower portion of **Figure 3.5**. By joining combinations J, K, and L, we get downward sloping demand curve D_X.

Criticisms (Limitations) of Cardinal Utility Approach

Criticisms of Cardinal Utility Approach
1. Cardinal measurement of utility is not practical
2. Marginal utility of money may not be constant
3. Diminishing marginal utility is not valid for all type of goods
4. Utilities are dependent
5. No classification of goods
6. No analysis of price effect
7. Less work more assumptions

The cardinal utility approach has been criticized on the following ground:

1. **Cardinal measurement of utility is not practical:** Cardinal utility analysis believes that utility can be measured in terms of cardinal numbers which is impossible because utility is a subjective and cannot be measured objectively. As a subjective phenomenon, utility is expressed in ordinal number rather than cardinal number. Cardinal measurement of utility is practically meaningless.
2. **Marginal utility of money may not be constant:** cardinal measurement is possible by using money as a measuring scale. But marginal utility of money differs from one income group to another and one consumer to another. Marginal utility of money is higher for lower income earners and vice-versa. If it changes from one income group to another, we cannot use money as a standard of measuring scale.
3. **Diminishing marginal utility is not valid for all type of goods:** There are some exceptional goods in which the law of diminishing marginal utility does not operate. The hobby of collecting stamps, coins, scarce goods etc. may have increasing marginal utility. Likewise, listening music, earning money, drinking wine etc. may also have increasing marginal utility.
4. **Utilities are dependent:** One of the strong assumption of this theory is utilities remain independent. But in practical life utilities remain dependent to each other. If various goods are consumed at the same time, consumption of one good can affect the level of satisfaction obtained by the consumption of another good.
5. **No classification of goods:** The cardinal utility analysis is not able to classify various type of goods like Giffen, normal, inferior, superior etc. but in ordinal utility analysis we can classify all type of goods
6. **No analysis of price effect:** In this approach, there is no analysis of price effect. But in ordinal utility analysis, change in price can be decomposed into two effects: income effect and substitution effect.

7. **Less work more assumptions:** This theory has more assumptions and explains less. Most of the assumptions are unrealistic which are criticized strongly in various grounds.

Ordinal Utility Analysis

Introduction

Ordinal Utility
Ordinal utility approach uses indifference curve to analyze consumers' behavior.

Ordinal utility approach uses indifference curve to analyze consumers' behavior. The indifference curve was invented and used by Francis **Y. Edgeworth** (1880) to show the possibility of commodity exchange between two individuals and not to explain consumer's demand. About a decade later, Irving Fisher used indifference curve in 1892 to explain consumer's equilibrium. Both **Edgeworth** and **Fisher** believed only in cardinal measurability of utility. Later **Vilfredo Pareto** introduced the ordinal utility hypothesis to the indifference curve analysis in 1906. For this utility many significant contributions were made by **Eugen E. Slutsky, W.E. Johnson** and **A.L. Bowley.** Indifference curve technique could not gain much ground in the analysis of consumer behavior till the early 1930s. In 1934 **John R. Hicks** and **R.G.D. Allen** developed the ordinal utility theory as a powerful analytical tool of consumer's analysis. Finally, **Hicks** provided a complete exposition of indifference curve technique.

Concept of Ordinal Utility

Ordinal Utility Approach
According to ordinal utility approach, utility is subjective phenomena. It can be ranked and put in order but cannot be measured in quantity.

The ordinal utility anlaysis believes that, as a subjective phenomena, utility only can be ranked and put in order. It is impossible to measure utility in cardinal number. It is only an expression of the consumer's preference for one commodity over another or for one basket of goods over another. The concept of ordinal utility is based on the following axioms.

- It is not possible for a consumer to express his utility in quantitative term. But it is always possible for him to tell which of any two goods he prefers. For example, an individual may not be able to specify how much utility he derives by eating a mango. But he can tell what he prefers between mango and apple.
- A consumer can list all the commodities he consumes in the order of his preference.

Assumptions

Assumptions of ordinal utility Analysis
1. The consumer must be rational
2. Ordinal measurement of utility
3. Diminishing marginal rate of substitution
4. Transitivity and consistency of choice
5. Non-satiety

The ordinal utility analysis is based on the following assumptions:

1. **The consumer must be rational:** A consumer is assumed to be rational. S/He always tries to maximize his/her utility, given his/her income and market prices. It is assumed that he has full knowledge of all relevant information.
2. **Ordinal measurement of utility:** It is assumed that the consumer can rank his preferences according to the satisfaction derived from each bundle of goods. He does not need to know the amount of satisfaction.

3. **Diminishing marginal rate of substitution:** The marginal rate of substitution is the rate at which a consumer is willing to substitute one commodity (X) for another (Y) so that his total satisfaction remains the same. This rate is given by $\frac{\Delta Y}{\Delta X}$. The assumption is $\frac{\Delta Y}{\Delta X}$ goes on decreasing, when the consumer continues to substitute X for Y.
4. **Transitivity and consistency of choice:** Consumer's choices are assumed to be transitive. Transitivity of choice means that if a consumer prefers A to B and B to C, he must prefer A to C.

   Symbolically,

   If A > B and B > C, then A > C.

   It is assumed that a consumer is consistent in his choice. Consistency of choice means that if the consumer prefers A to B in one period, he must not prefer B to A in another period.

   Symbolically,

   If A > B in one period, then B ≯ A in another.
5. **Non-satiety:** Non-satiety means that the consumer has not reached the point of saturation in case of any commodity. Therefore, a consumer always prefers a larger quantity of all the goods.

Indifference Curve

Indifference Curve
Indifference curve is the locus of different combinations of two goods which give the equal level of satisfaction to the consumer.

An indifference curve is the locus of all those combinations of two goods which yields the same level of utility/ satisfaction to the consumer, so that consumer is indifferent to purchase the particular combination s/he selects. It explains consumer's behaviour in terms of his/her preferences of ranking for different combination of two goods.

We know that one commodity serves as a substitute for another. It provides an opportunity to substitute one commodity for another. Therefore, a consumer can make various combinations of two goods which give him/her same level of satisfaction. When such combinations are plotted graphically it gives a curve. This curve is known as indifference curve. It is also called iso-utility curve or equal utility curve.

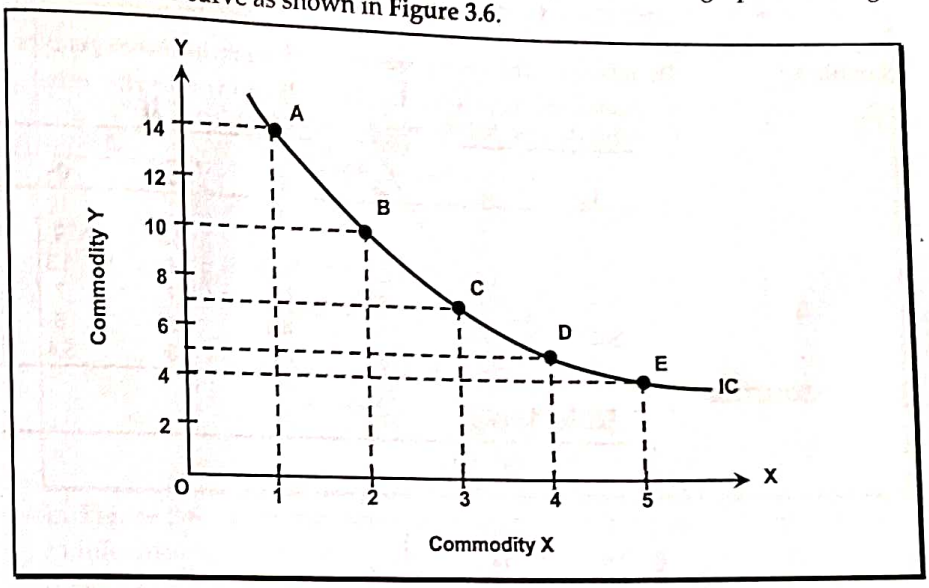
A table shows the various combinations of two goods that yield the same level of satisfaction to the consumer is called *indifference schedule*. **Table 3.4** is an example of indifference schedule which shows 5 different combinations A, B, C, D and E of two goods X and Y. All these combinations yield the same level of satisfaction to the consumer. Therefore, the consumer is indifferent between them.

TABLE 3.4
Indifference schedule.

Combinations	Commodity X	Commodity Y
A	1	14
B	2	10
C	3	7
D	4	5
E	5	4

In Table 3.4, all the combinations of X and Y gives the same level of satisfaction to the consumer. When indifference schedule is plotted in the graph we will get an indifference curve as shown in Figure 3.6.

FIGURE 3.6
Indifference curve



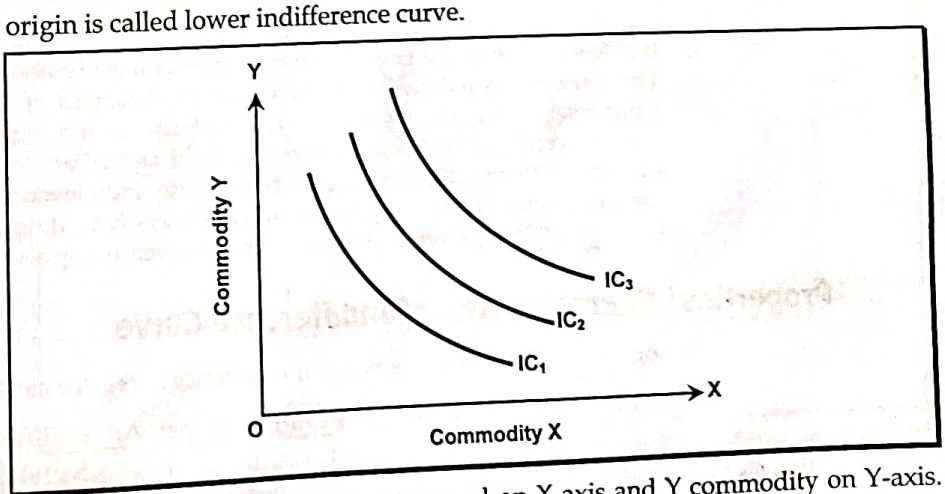
In Figure 3.6, X commodity is measured on X-axis and Y commodity is measured on Y-axis. The points A, B, C, D and E are different combinations of X and Y commodities which give the same level of satisfaction to the consumer. When we join these combinations, we will get a smooth and continuous curve. This curve is called indifference curve (IC).

Indifference Map

Indifference map
A set of indifference curves is known as indifference map.

A set of indifference curves is called indifference map. An indifference map shows different indifference curves which rank the preference of the consumer. Combinations which lie on an indifference curve give the same level of satisfaction to the consumer. However, higher indifference curve represents higher level of satisfaction than a lower indifference curve. An indifference curve far from the origin is called higher indifference curve and near to the origin is called lower indifference curve.

FIGURE 3.7
Indifference map



In Figure 3.7, commodity X is measured on X-axis and Y commodity on Y-axis. Indifference curve shows those combinations of two goods that yield the same

level of satisfaction to the consumer. IC_3 yields the higher satisfaction than IC_2. IC_1 yields the lowest level of satisfaction. This is because higher IC contains more units at least one commodity.

Example 3.3 The following table gives points on four different indifference curves for a consumer.

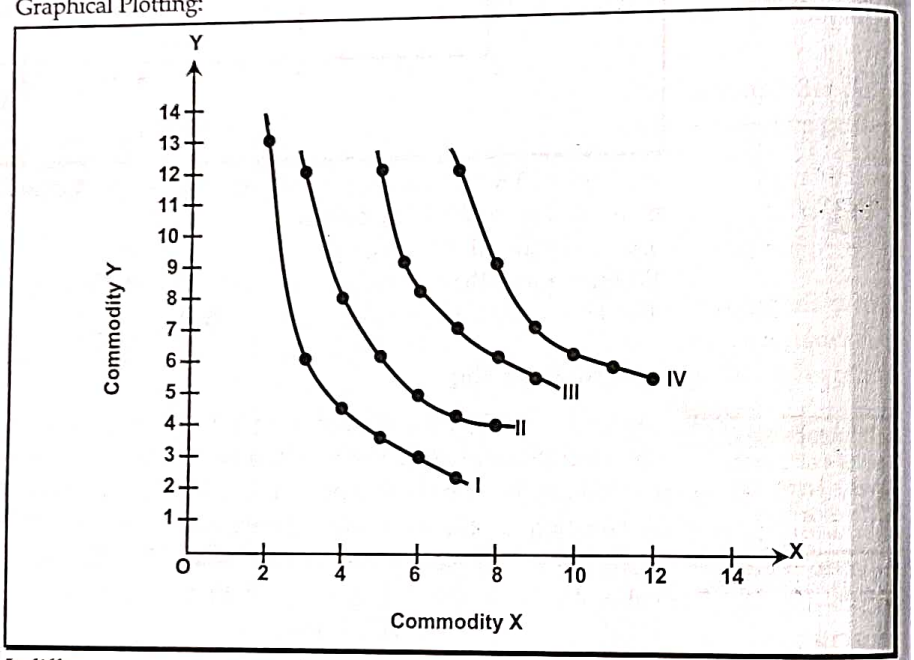
a. Sketch difference curves I, II, III and IV on the same set of axes.

b. What do these indifference curves show?

I		II		III		IV	
Q_X	Q_Y	Q_X	Q_Y	Q_X	Q_Y	Q_X	Q_Y
2	13	3	12	5	12	7	12
3	6	4	8	5.5	9	8	9
4	4.5	5	6.3	6	8.3	9	7
5	3.5	6	5	7	7	10	6.3
6	3	7	4.4	8	6	11	5.7
7	2.7	8	4	9	5.4	12	5.3

SOLUTION

a. Graphical Plotting:



b. Indifference curves are graphic representation of a consumer's taste and preference. The consumer is indifferent among all the combinations of X and Y on the same indifference curve. But he prefers the combinations on a higher indifference curve than the combinations on a lower one. I, II, III and IV are four indifference curves showing different level of satisfaction. These indifference curves give us the consumer's indifference map. Different consumers have different indifference map. When the tastes of a consumer change, the indifference map also changes.

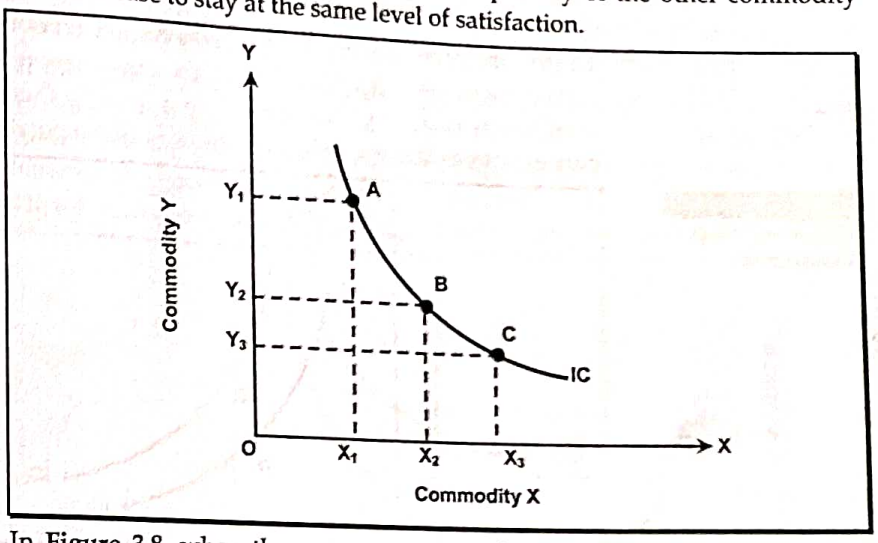
Properties/ Characteristics of Indifference Curve

The properties or characteristics of indifference curve are as follows:

1. **Indifference curve has a negative slope:** An indifference curve slopes downward from left to right, i.e., it has a negative slope. Negative slope implies that the two goods are substitutes for one another. Therefore, if the

quantity of one commodity decreases, the quantity of the other commodity must increase to stay at the same level of satisfaction.

FIGURE 3.8
Negatively Sloped Indifference curve

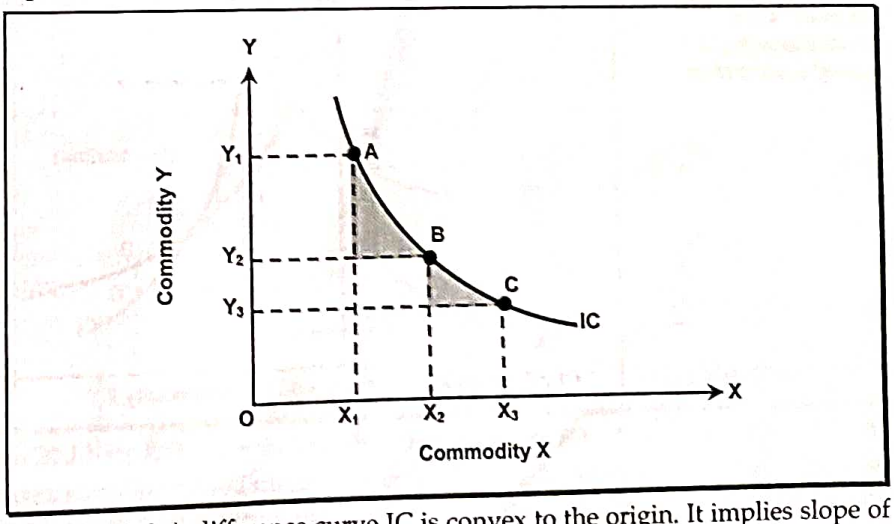


Properties of Indifference Curve
1. Indifference Curve has a negative slope
2. Convex to the origin
3. Higher indifference curve represents higher level of satisfaction than the lower ones
4. Two indifference curves never intersect to each other
5. Indifference curves are not necessarily parallel
6. Indifference curve does not touch either axis

In **Figure 3.8**, when the consumer moves from point A to B, on the same indifference curve IC, the quantity of Y decreases from Y_1 to Y_2 and the quantity of X increases from X_1 to X_2 keeping the level of satisfaction same. Same thing happens as the consumer moves from point B to C. But commodity Y decreases at a decreasing rate and commodity X increases at the same rate. Therefore, decrease in Y, i.e. Y_2Y_3 is less than Y_1Y_2 and increase in X, i.e. X_2X_3 is equal to X_1X_2.

2. **Convex to the origin:** Indifference curve for normal goods is convex to the origin. This implies that the two goods are imperfect substitutes for one another and the marginal rate of substitution between the two goods decreases as a consumer moves along an indifference curve. Diminishing marginal rate of substitution means that as the quantity of X increased by equal amount, the quantity of Y diminishes by smaller amount.

FIGURE 3.9
Indifference curve convex to the origin

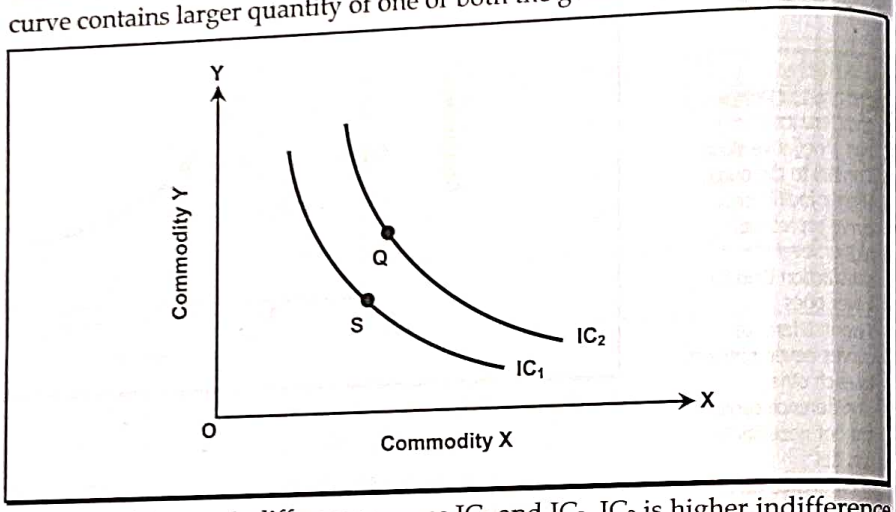


In **Figure 3.9**, indifference curve IC is convex to the origin. It implies slope of indifference curve diminishes because consumer gives up less and less units of Y in order to have equal additional unit of X. The slope of IC curve

measures the marginal rate of substitution (MRS). Therefore, MRS also diminishes.

3. **Higher indifference curve represents higher level of satisfaction than the lower ones:** A higher indifference curve represents higher level of satisfaction than the lower one. The reason is that an upper indifference curve contains larger quantity of one or both the goods than the lower one.

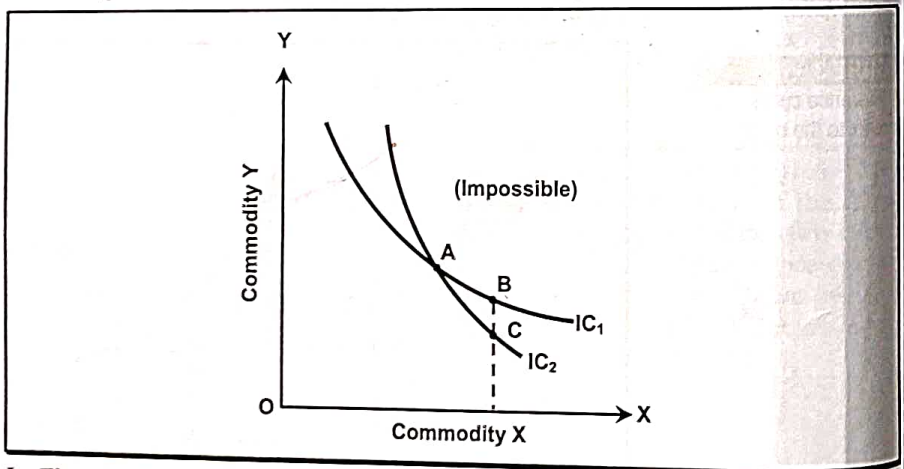
FIGURE 3.10
Indifference Curve of Different Levels



Let us consider two indifference curves IC_1 and IC_2. IC_2 is higher indifference curve than IC_1. Point Q lies on IC_2 and point S lies on IC_1. Combination Q will give more satisfaction to the consumer than the combination S because the combination Q contains more quantity of both goods than the combination S. Hence, by the assumption of non-satiety, the consumer prefers Q than S.

4. **Two indifference curves never intersect each other:** If two indifference curves intersect to each other, an indifference curve indicates two different level of satisfaction. It means that as two indifference curves intersect to each other, it gives conflicting result. It can be shown by **Figure 3.11**.

FIGURE 3.11
Indifference curve convex intersecting and Tangent to one another

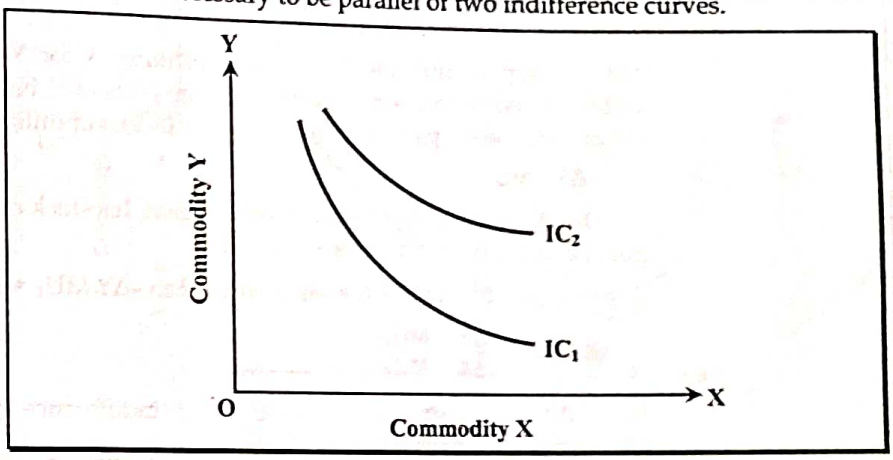


In **Figure 3.11**, two indifference curves IC_1 and IC_2 are intersecting to each other at point A. Point A lies on both indifference curves where point B and C lie on IC_1 and IC_2 curves respectively. Points A and B lie on the same indifference curve IC_1. It means that points A and B give the same level of satisfaction. Similarly, points A and C lie on the same indifference curve IC_2. It implies that points A and C give the same level of satisfaction. It shows

that utility from points B and C will also be the same. But it is a conflicting result because higher indifference curve yields higher level of satisfaction than lower one. Thus, two indifference curve cannot intersect to each other.

5. **Indifference curves are not necessarily parallel:** Though indifference curves are falling downward, the rate of fall will not be the same for all indifference curves. In other words, the diminishing marginal rate of substitution between the goods is not the same in the case of all indifference schedules. Therefore, no necessary to be parallel of two indifference curves.

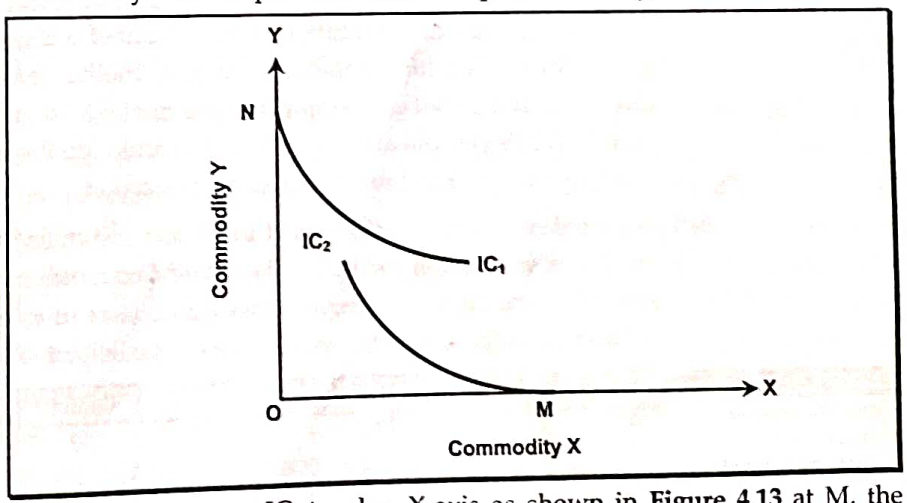
FIGURE 3.12
Non-parallel Indifference Curve



In Figure 3.12, the starting point of IC_1 and IC_2 is very near. When ICs are nearer to X axis their gap becomes higher and higher. The diminishing marginal rate of substation between X and Y commodity is not equal. So IC_1 and IC_2 are not parallel.

6. **Indifference curve does not touch either axis:** Indifference curve approach is a two commodity model. Therefore, we must have to two commodities. If IC touches any axis it implies that consumer purchases single commodity.

FIGURE 3.13
Indifference Curve does not touch X and Y axis



If indifference curve IC_2 touches X-axis as shown in **Figure 4.13** at M, the consumer will be having OM units of good X and no of Y. Similarly, if an indifference curve IC_1 touches the Y-axis at N, the consumer will be having only ON units of good Y and no of X. Such curves violate the assumption that the consumer buys two goods in a combination. Therefore, indifference curves do not touch either of the axes.

The Marginal Rate of Substitution (MRS)

Marginal Rate of Substitution
It is the rate at which one commodity can be substituted for another without affecting the total satisfaction.

The marginal rate of substitution is the rate at which one commodity can be substituted for another without affecting total satisfaction. The MRS is given by the slope of the Indifference curve. To explain the concept of MRS, let us suppose that a consumer consumes only two goods X and Y. The utility function of the consumer is given as

$$U = f(X, Y)$$

where X and Y are substitutes

Let us suppose that the consumer substitutes X for Y without affecting total utility. When the consumer sacrifices some units of Y, his stock of Y decreases by ΔY and he loses a part of his total utility. His loss of utility may be expressed as

$$-\Delta Y \cdot MU_Y$$

On the other hand, as a result of substitution, his stock of X increases by ΔX. His gain of utility from X equals $+\Delta X \cdot MU_X$

The total utility remains the same only when $-\Delta Y.MU_Y = \Delta X. MU_X$

$$MRS_{XY} = -\frac{\Delta Y}{\Delta X} = \frac{MU_X}{MU_Y}$$

Here, $\Delta Y/\Delta X$ is simply the slope of the indifference curve, which gives the MRS_{XY} when X is substituted for Y.

Similarly, $\Delta X/\Delta Y$ gives MRS_{YX} when Y is substituted for X.

Symbolically,

$$MRS_{YX} = -\frac{\Delta X}{\Delta Y} = \frac{MU_Y}{MU_X}$$

Principle of Diminishing MRS

The marginal rate of substitution is the amount of one good that an individual is willing to give up for an additional unit of another good without affecting the level of satisfaction. For example, the marginal rate of substitution of good X for good Y (MRS_{XY}) is the amount of Y that an individual is willing to exchange per unit of X by maintain the same level of satisfaction.

Marginal rate of substitution of X for Y diminishes as more and more units of good X is substituted for Y. In other words, as a consumer has more and more units of goods X he is willing to forgo less and less units of good Y. The principle of diminishing MRS can be explained with the help of table and figure.

TABLE 3.5
Diminishes Schedule of marginal rate of Substitution of X for Y

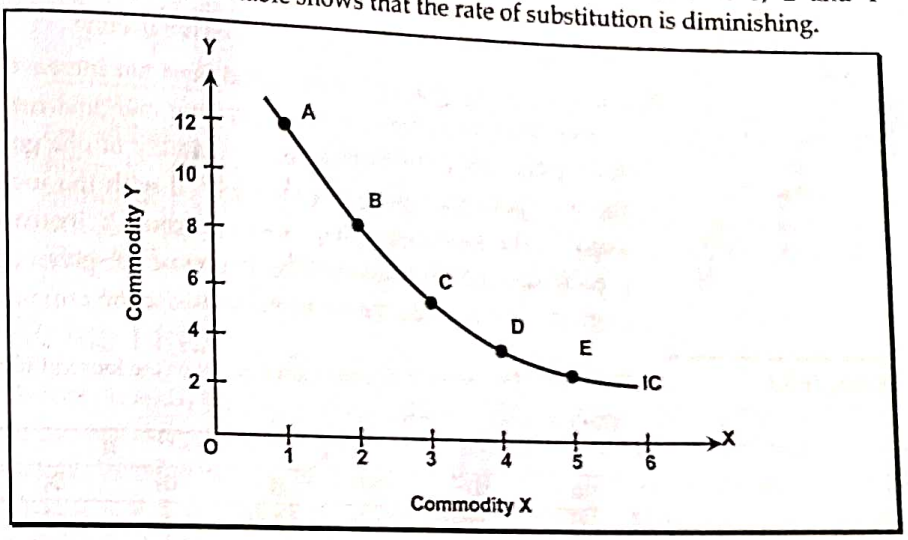
Combination	Good X	Good Y	MRS_{XY}
A	1	12	–
B	2	8	4
C	3	5	3
D	4	3	2
E	5	2	1

In **Table 3.5**, the rate of substitution of good X for good Y is shown. In the beginning, as the consumer moves from A to B, he is ready to give up 4 units of Y for the one extra unit of good X. In this process, his level of satisfaction

remains same. It follows that one unit gain in X fully compensates him for the loss of 4 units of Y. At this stage, marginal rate of substitution of X for Y is 4.

When the consumer moves from combinations B to C, C to D and D to E, he is willing to sacrifice 3 units, 2 units and 1 unit of good Y for the one additional unit of X. Hence, marginal rate of substitution of X for Y is 3, 2 and 1 respectively. So, the table shows that the rate of substitution is diminishing.

FIGURE 3.14
Diminishing Marginal Rate of Substitution



In Figure 3.14, starting at point A, the individual is willing to give up 4 units of Y for one additional unit of X and reaches point B on IC. Thus, $MRS_{XY} = 4$. Between points B and C, $MRS_{XY} = 3$, between C and D, $MRS_{XY} = 2$, between D and E, $MRS_{XY} = 1$. Thus, MRS_{XY} declines as the consumer moves down on the same indifference curve. As a result, IC is convex to the origin.

Why does MRS Diminish?

The following three factors are responsible for diminishing MRS:

1. **The particular want is satiable:** The want for a particular commodity is satiable so that as the consumer has more and more units of a commodity, the intensity of his want for that good goes on falling. Due to this reason, when the stock of a commodity, say X, increases with the consumer, he is willing to forgo less and less of another commodity, say Y, for every increase in X. In the beginning, when the consumer's stock of good Y is relatively large and his stock of good X is relatively small, consumer's marginal significance for good Y will be low while his marginal significance for good X will be high. Therefore, the consumer will be willing to give up a larger amount of Y for a unit increase in good X.

   But as the stock of good X increases the marginal significance for good X will diminish. On the other hand, as the stock of good Y decreases, the marginal significance for good Y will go up. As a result, as the individual substitute more and more of X for Y, he is prepared to give up less and less of Y for a unit increase in X.

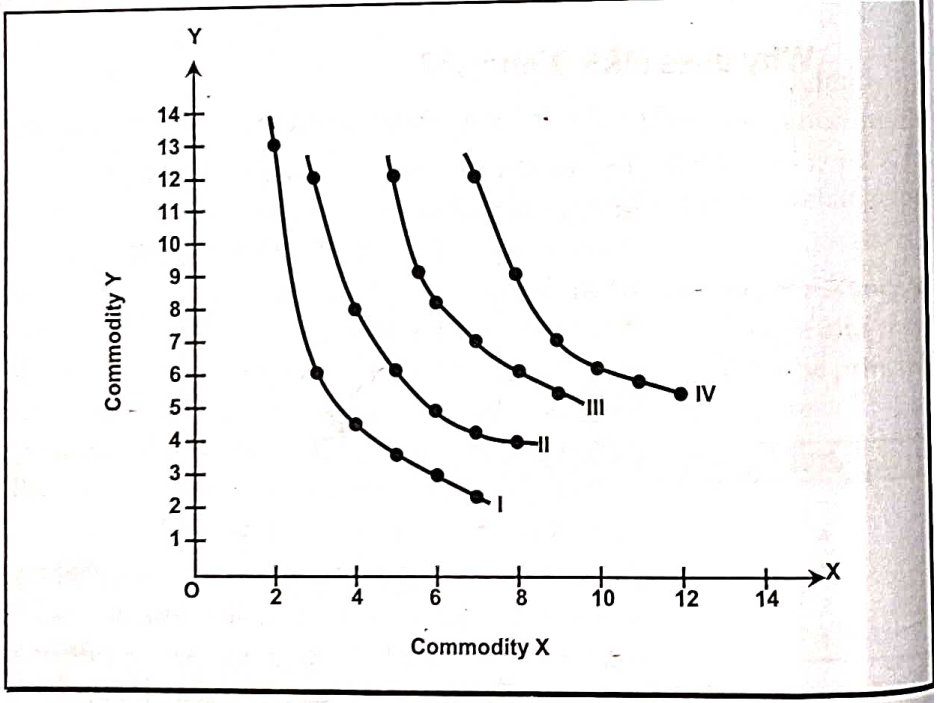
2. **Goods are not perfect substitute for each other:** Marginal rate of substitution diminishes because goods are not perfect substitute for each other. If the two goods are perfect substitute of each other, they are to be regarded as the one good and decrease in the quantity of the other good would not make any difference in the marginal rate of substitution of the goods. Hence, in case of perfect substitutability of goods, the marginal rate of substitution remains the same and does not decline.
3. **Increase in the quantity of one good does not increase the want satisfying of the other:** The principle of diminishing marginal rate of substitution will hold good only if the increase in the quantity of one good does not increase the want satisfying power of the other. If with the increase in the stock of good X, the want satisfying power of good Y increases, the greater and greater amount of good Y will be required to be given up for a unit increase in good X. As a result, the consumer's satisfaction remains same.

Example 3.4

a. Find the MRS_{XY} between all consecutive points on the four indifference curves.

b. What is the different between MRS_{XY} and MU_X?

I		II		III		IV	
Q_X	Q_Y	Q_X	Q_Y	Q_X	Q_Y	Q_X	Q_Y
2	13	3	12	5	12	7	12
3	6	4	8	5.5	9	8	9
4	4.5	5	6.3	6	8.3	9	7
5	3.5	6	5	7	7	10	6.3
6	3	7	4.4	8	6	11	5.7
7	2.7	8	4	9	5.4	12	5.3



SOLUTION

a.

I			II			III			IV		
Q_X	Q_Y	MRS_{XY}	Q_X	Q_Y	MRS_{XY}	Q_X	Q_Y	MRS_{XY}	Q_X	Q_Y	MRS_{XY}
2	13	–	3	12	–	5	12	–	7	12	–
3	6	7	4	8	4	5.5	9	6	8	9	3
4	4.5	1.5	5	6.3	1.7	6	8.3	1.4	9	7	2
5	3.5	1	6	5	1.3	7	7	1.3	10	6.3	0.7
6	3	0.5	7	4.4	0.6	8	6	1	11	5.7	0.6
7	2.7	0.3	8	4	0.4	9	5.4	0.6	12	5.3	0.4

b. The MRS_{XY} measures the amount of Y that a consumer is willing to give up to obtain one additional unit of X remaining on the same indifference curve. That is, the $MRS_{XY} = -(\Delta Q_Y/\Delta Q_X)$. MU_X measures the change in total utility by the change in quantity of X consumed by the 1 unit. That is, $MU_X = \Delta TU_X/\Delta Q_X$. In measuring the MRS_{XY}, both X and Y change. In measuring MU_X, the quantity of Y is kept constant. Thus, MRS_{XY} measures something different from the MU_X.

Budget Line (Price Line)

Budget line
Budget line is the locus of different combinations of two goods which can purchase by spending his/her given money income.

Budget line is the locus of different combinations of two goods which a consumer can purchase by spending his/her given money income and market prices. In other words, the budget line shows different combinations of two goods, which a consumer can purchase by spending his/her given money income and market prices. A consumer can purchase any combination of two goods that lies on the budget line with his/her given money income and market prices of goods.

Budget line can be presented by a budget equation. If the X and Y commodity are multiplied by their respective price and add, we get budget line. Consumer has a limited income (budget constraint). Due to the budget constraint, consumer needs to decrease one commodity to increase another commodity. So, budget line is downward sloping. Slope means change. So, the slope of budget line is the change in budget due to change in its determinants. Slope of the budget line is the first order derivative of budget equation. The budget constraint may be expressed as

$$P_X \cdot Q_X + P_Y \cdot Q_Y = M \quad \text{... (i)}$$

where

P_X = Price of X commodity
P_Y = Price of Y commodity
M = Money income (Budget)
Q_X = Quantity of X commodity
Q_Y = Quantity of Y commodity

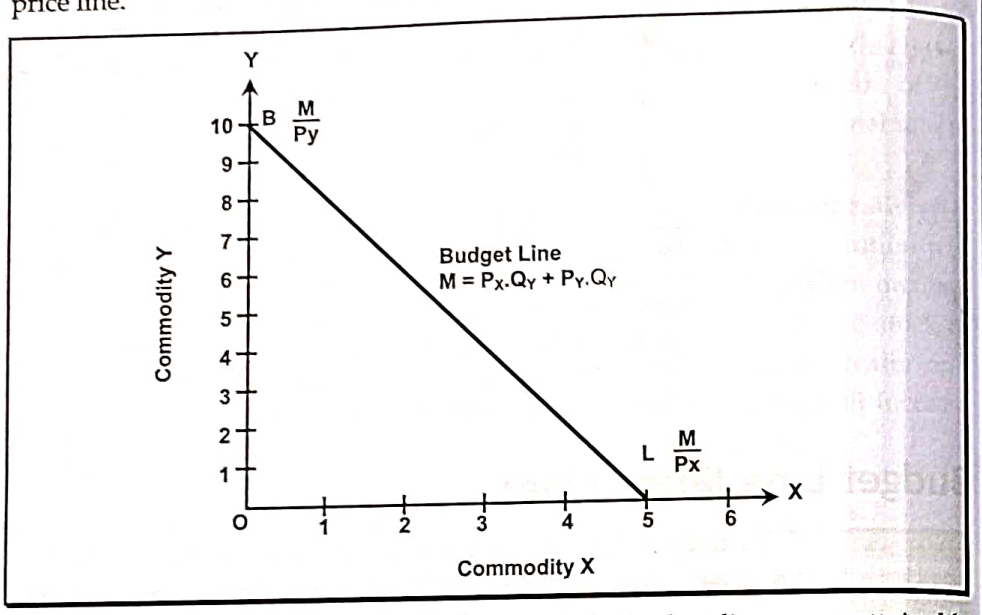
It is based on the following assumptions:

- Consumer consumes two goods.
- Consumer has to pay price for the goods.
- A consumer has a limited income.

Suppose, a consumer has Rs. 50 to spend on goods X and Y. Price of X is Rs. 10 per-unit and the price of Y is Rs. 5 per-unit. If the consumer spends all his/her money income on the purchase of good X, s/he would buy 5 units of X. If he spends all his income on the purchase of Y, he would buy 10 units of Y. If we

join these two combinations, we will get a line which is called budget line or price line.

FIGURE 3.15
Budget line



The combinations of goods lying to the right of the budget line are unattainable because income of the consumer is not sufficient to purchase those combinations. The combinations lying to the left of the budget line are attainable but not desirable.

The intercept OB on the Y-axis equals the amount of this entire income divided by the prices of commodity Y, i.e. OB = $\frac{M}{P_Y}$. Likewise, the intercept OL on the X-axis measures the total income divided by the price of commodity X. Thus, OL = $\frac{M}{P_X}$. If the consumer spends all his income on Y commodity, then $Q_Y = \frac{M}{P_Y}$ (since X = 0). Similarly, if he spends whole income on X commodity, then $Q_X = \frac{M}{P_X}$ (since, Y = 0). $\frac{M}{P_Y}$ shows the amount of commodity Y that can be purchased if the quantity of X is zero. $\frac{M}{P_X}$ shows the amount of commodity X that can be purchased if the quantity of Y is zero.

Slope of Price Line (Budget Line)

In order to obtain the slope of budget line, let's rewrite equation (i) as

$$Q_Y = \frac{M}{P_Y} - \frac{P_X}{P_Y} Q_X \qquad \text{... (ii)}$$

Differentiating equation (ii) with respect to X partially, we get the slope of budget line.

$$\frac{\partial Q_Y}{\partial Q_X} = -\frac{P_X}{P_Y}$$

Since, prices are always positive, the slope of the budget line is negative. Negative slope of the budget line indicates that if the consumer wants to spend

more on one commodity he must decrease the money expenditure for another commodity because of the budget constant.

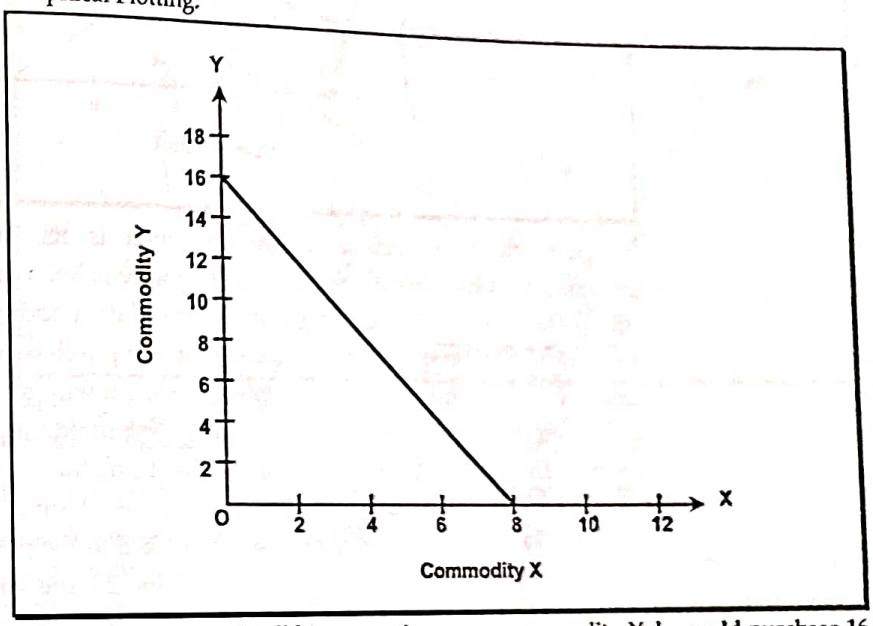
Example 3.5

Suppose the price of commodity Y is Re. 1 per unit and the price of commodity X is Rs. 2 per unit. Again suppose an individual's money income is Rs. 16 per time period and is spent all money income on X and Y.

a. Draw the budget constant line for consumer.
b. Explain the reason for the shape and the properties of the budget constant line in part 'a'.

SOLUTION

a. Graphical Plotting:



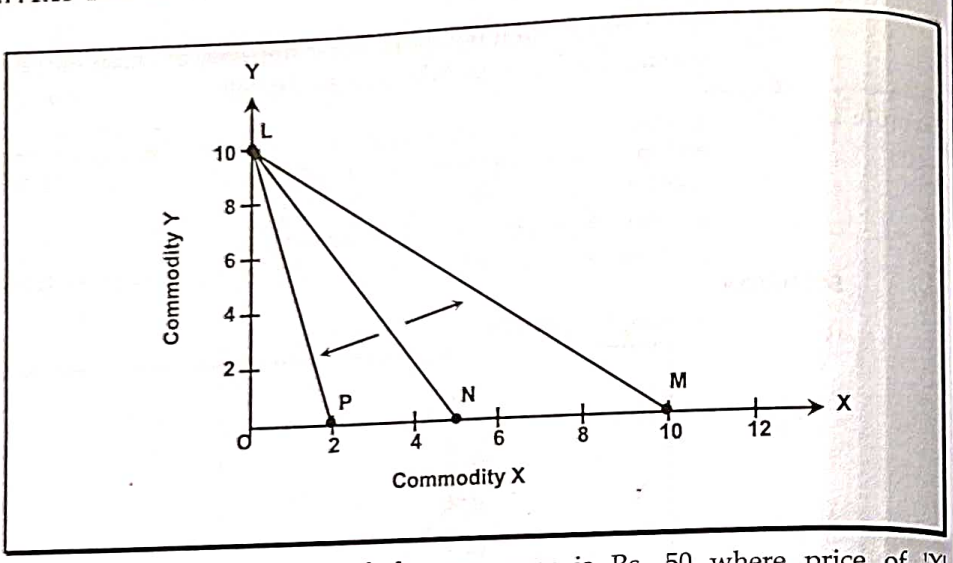
b. If the consumer spends all his money income on commodity Y, he could purchase 16 units of Y. If he spends all money income on commodity X, he could purchase 8 units of X. By joining these two points we get a straight line which is consumer's budgets constraint line. Budget line give us different combination of X and Y that the consumer could purchase. Thus, he could purchase 16Y and 0X, 14Y and 1X, 12Y and 2X, ..., 0Y and 8X. Here, consumer is ready to give up 2 units of Y for 1 additional units of X. The slope of the budget line is –2 and remains constant. All points of budget line indicate that the consumer is spending all his income on X and Y. That is $P_XQ_X + P_YQ_Y = M$ = Rs. 16.

Swing in Price Line (Budget Line)

Other things remaining the same, if price of particular commodity increase budget line swing downward and if price of the commodity decrease budget line swing upward.

Swing in budget line is the process of change in budget line where one point is constant and another point moves up and down. Other things remaining the same, if price of the particular commodity changes then budget line will swing upward or downward. If price of the commodity decreases then purchasing capacity of consumer will increase, which causes the upward swing in price line. Similarly, when price increases then purchasing capacity of a consumer will decrease, which causes downward swing in price line. It is clear from **Figure 3.16.**

FIGURE 3.16
Swing in Price Line



Suppose, the total income of the consumer is Rs. 50 where price of 'X' commodity is Rs. 10 and price of 'Y' commodity is Rs. 5. If the consumer spends all his/her money income on the purchase of commodity X, s/he would by 5 units of X. If s/he spends all his income on the purchase of Y, he would buy 10 units of Y. If we join these two combinations, we will get initial budget line LN as shown in **Figure 3.16**. Suppose, price of X commodity falls from Rs. 10 to 5, keeping the price of Y commodity and budget constraint, consumer increases the purchases of X commodity from 5 units to 10 units without reducing Y commodity. As a result, price line swing upward to the position LM. Similarly, if price of X commodity rises from Rs. 10 to Rs. 25, the consumer decreases the purchase of X commodity from 5 units to 2 units. Consequently, the price line swing downward to the position LP.

Example 3.6 If a consumer has money income Rs. 200 and price of X and Y goods are Rs.20 and 10 respectively, and then draw price line.

a. If the price of X falls from Rs. 20 to Rs. 10, what will be the position of price line?
b. If the price of X rises from Rs. 20 to Rs. 25, what will be the position of price line?

SOLUTION

If the consumer spends all of his money income on Y good, he can purchase 20 units of Y and zero units of X.

i.e. $20\,(0) + 10Y = 200$ $(\because X = 0)$

$Y = 20$

Hence, A(0 , 20)

If the consumer spends all his money income on X good, he can purchase 10 units of X and zero units of Y.

i.e. $20\,X + P_Y\,(0) = 200$ $(\because Y = 0)$

$X = 10$

Hence, B(10, 0)

By joining these two points, we get price line AB as shown in figure.

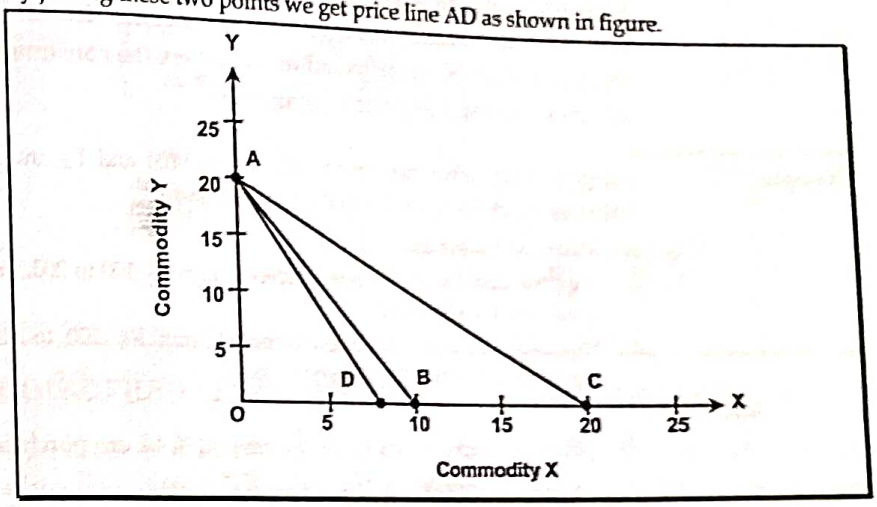
a. If the consumer spends all his income on X good, he can purchase 20 units

i.e. $10X + P_Y\,(0) = 200$ $(\because Y = 0)$

$X = 20$

Hence, A = (0, 20) to C (20, 0)
By joining these two points we get price line AC as shown in figure.

b If the consumer spends all his income on X good, he can purchase 8 units
i.e. $25 X + P_Y(0) = 200$ ($\because Y = 0$)
$X = 8$
Hence A (0, 20) and D(8, 0)
By joining these two points we get price line AD as shown in figure.

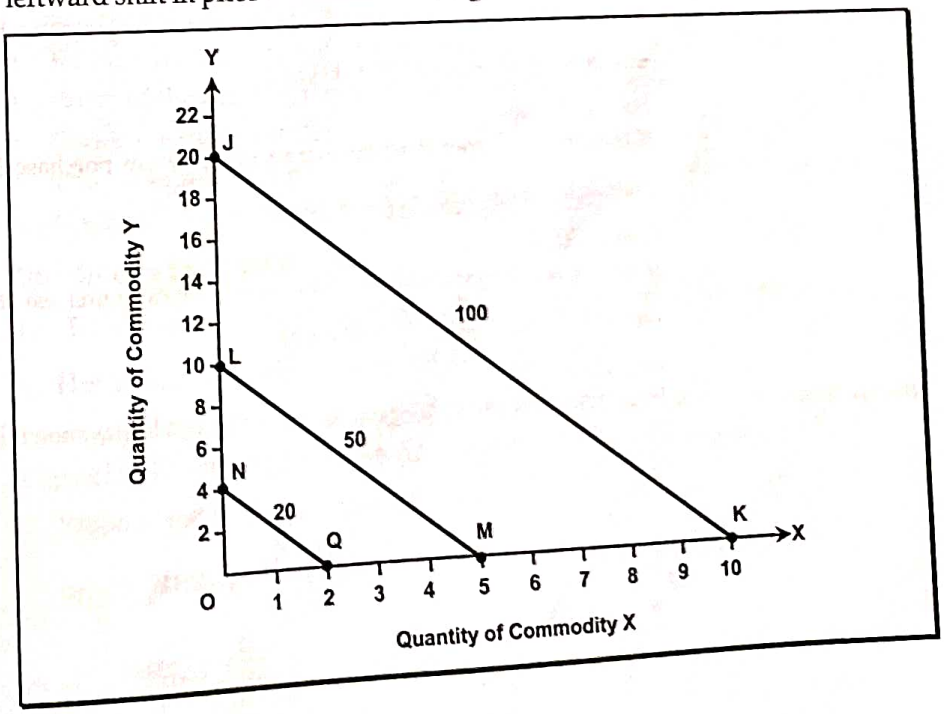


Shift in Price Line (Budget Line)

When income of the consume changes budget line shift, if income increases it shift right and vice-versa.

Shift is the process of change in position of budget line on the both axes. Other things remaining the same, when income of consumer changes, there is shift in budget or price line. When income increases, budget line will shift rightward, where consumer can consume more units of both X and Y commodity. On the other hand, if income decreases, consumption level decreases, which causes leftward shift in price line as shown in Figure 3.17.

FIGURE 3.17
Shift in Price Line



In Figure 3.17, the total income (budget) of the consumer is Rs. 50 where price of X commodity is Rs. 10 and price of Y commodity is Rs. 5. In the figure, LM is the initial budget line or price line. At this income, the consumer purchases 5 units of commodity X and 10 units of commodity Y. When consumer's income increases to Rs. 100 then the initial budget line LM shifts rightward to JK, where consumer can purchase 10 units of X commodity and 20 units of Y commodity. On the other hand, when consumer's income decreases to Rs. 20, the initial budget line LM shifts leftward to NQ where the consumer purchases 2 units of X commodity and 4 units of Y commodity.

Example 3.7 Suppose a consumer has money income Rs. 100 and P_X and P_Y are Rs. 10 and Rs. 5 respectively and he spent all his income on X and Y.

a. Draw the budget line.
b. Suppose, consumer's income increased from Rs. 100 to 200, price of X and Y remaining same. Draw budget line.
c. Suppose consumer's income decreased from Rs. 100 to Rs. 50, price of X and Y remaining the same. Draw budget line.

SOLUTION

a. If the consumer spends all his income on X, he can purchase 10 units of X and zero unit of Y (i.e. $Q_X = \frac{B}{PX} = \frac{100}{10} = 10$ units).

Hence, A(10, 0)
If the consumer spends all his income on Y, he can purchase 20 units of Y and zero unit of X (i.e. $Q_Y = \frac{B}{PY} = \frac{100}{5} = 20$ units).

Hence, B(0, 20)

b. If the consumer spends all his income on X, he can purchase 20 units of X and zero unit of Y (i.e. $Q_X = \frac{B}{PX} = \frac{200}{10} = 20$ units).

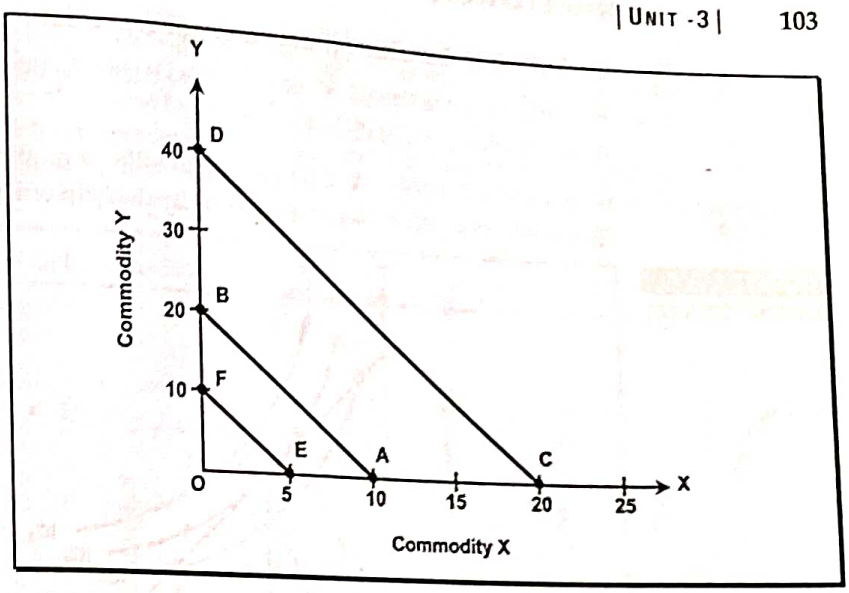
Hence, C(20, 0)
If the consumer spends all his income on Y, he can purchase 40 units of Y and zero unit of X (i.e. $Q_Y = \frac{B}{PY} = \frac{200}{5} = 40$ units).

Hence, D(0, 40)

c. If the consumer spends all his income on X, he can purchase 5 units of X and zero units of Y (i.e. $Q_X = \frac{B}{PX} = \frac{50}{10} = 5$ units).

Hence, E(5, 0)
If the consumer spends all his income on Y, he can purchase 10 units of Y and zero unit of X (i.e. $Q_Y = \frac{B}{PY} = \frac{50}{5} = 10$ units).

Hence, F(0, 10)
By joining these points we get price line or budget line as shown in figure.
A(10, 0) and B(0, 20)
C(20, 0) and D(0, 40)
E(5, 0) and F(0, 10)



Consumer's Equilibrium under Ordinal Utility Approach

Consumer's Equilibrium
A consumer is said be in equilibrium when indifference curve is tangent with budget line and at the same time indifference curve must be convex to the origin.

A consumer is said be in equilibrium when s/he maximizes his/her utility (satisfaction) given his/her income and market prices of the goods and services consumed. Equilibrium is the point where consumer maximized the satisfaction by consuming two goods with given money income and market prices.

Assumptions

In order to explain the consumer's equilibrium, we make the following assumptions:

- The consumer has an indifference map showing his scale of preferences for various combinations of two goods. This scale of preferences remains unchanged throughout the analysis.
- He has given or constant amount of money to spend on the goods.
- Prices of the goods in the market are given and constant.
- Goods are substitutable.
- The consumer is rational.
- Marginal rate of substitution must be diminishing.

Conditions for Equilibrium

The following two conditions must be fulfilled in order to attain equilibrium:

When indifference curve is tangent with budget line, necessary condition is fulfill.

1. Necessary Condition (First Order Condition)

The budget line should be tangent to the indifference curve. In other words, slope of indifference curve should be equal to the slope of budget line.

Slope of Indifference Curve = Slope of Budget Line

$$\text{or,} \quad (-MRS_{X,Y}) = \left(-\frac{P_X}{P_Y}\right)$$

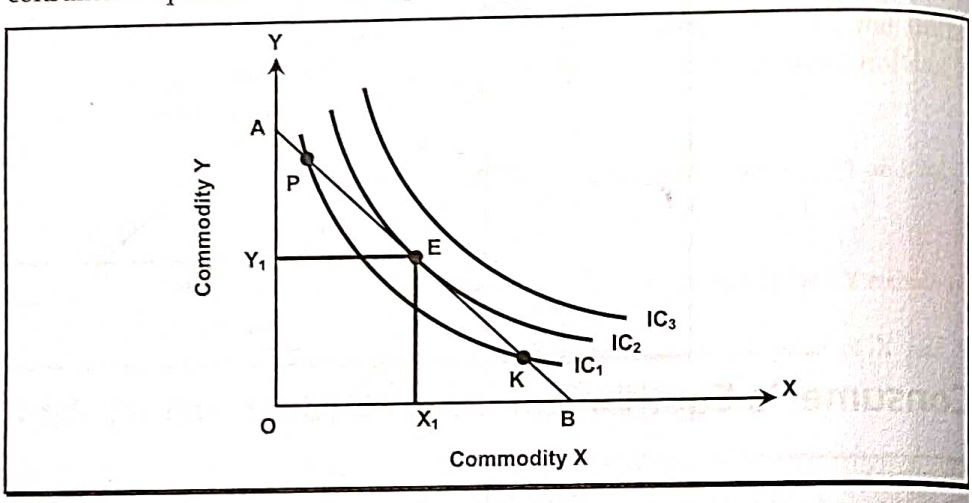
$$\therefore \quad MRS_{X,Y} = \frac{P_X}{P_Y}$$

2. Sufficient Condition (Second Order Condition)

Indifference curve should be convex to the origin. In other words, marginal rate of substitution must be diminishing.

On the basis of above assumptions and conditions required for equilibrium, the consumer's equilibrium can be explained by the help of **Figure 3.18**.

FIGURE 3.18
Consumer's Equilibrium



In **Figure 4.18**, X-axis represents quantities of good-X and Y-axis represents quantities of good-Y. AB is the budget line. The consumer will derive maximum satisfaction or will be in equilibrium at point E of indifference curve IC_2. At the tangent point E, the slope of the budget line AB and the indifference curve IC_2 are equal and indifference curve IC_2 is convex to the origin. It means that at point E, both conditions required for equilibrium are fulfilled. The slope of the indifference curve shows the marginal rate of substitution of X for Y while the slope of the budget line indicates the ratio between the prices of two goods X and Y. Thus, at equilibrium point E, the marginal rate of substitution is equal to the ratio of the commodity price. Any other points P and K which lie on the budget line, lie on the lower indifference curve, yield lower level of satisfaction. Highest indifference curve IC_3 is not attainable because of his budget constraint. Therefore, the point E is equilibrium point and the consumer derives maximum satisfaction by consuming OX_1 quantities of good-X and OY_1 quantities of good-Y.

At point E,

$$(-MRS_{X,Y}) = \left(-\frac{P_X}{P_Y}\right)$$

$$\text{or,} \quad MRS_{X,Y} = \frac{P_X}{P_Y}$$

$$\text{or,} \quad \frac{MU_X}{MU_Y} = \frac{P_X}{P_Y}$$

$$\therefore \quad \frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

where

MU_X = Marginal utility derived from good-X
MU_Y = Marginal utility derived from good-Y
P_X = Price of good-X
P_Y = Price of good-Y

It shows the equilibrium because ratios of marginal utilities and prices are equal.

Example 3.8

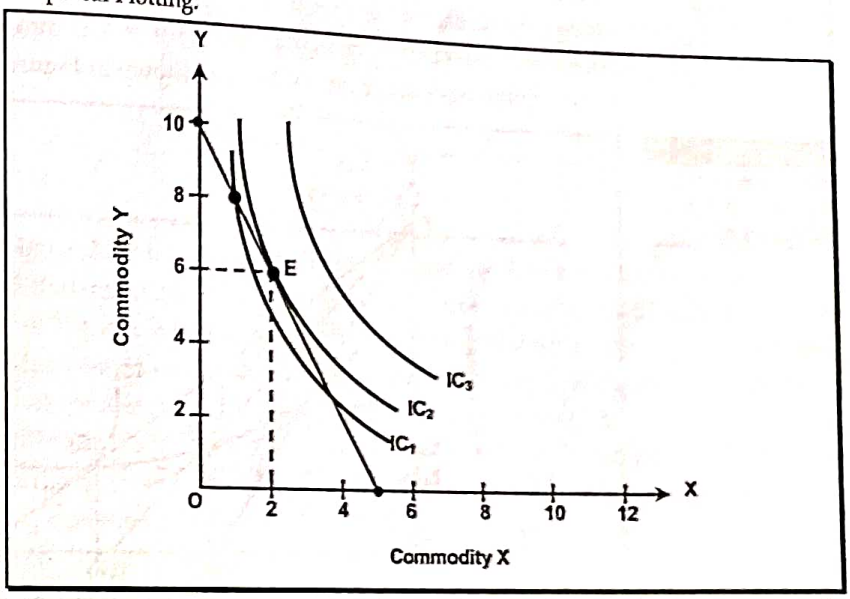
If the consumer's taste and preference are given by the indifference curves and total income and price constant by the budget line. P_X = Rs. 2, P_Y = Re. 1 and money income Rs. 10, consumer spent all his income on X and Y.

a. Find the geometrically the point at which the consumer is in equilibrium.

b. Explain, why this is an equilibrium; what is true of the slope of the indifference curve and budget line at equilibrium?

SOLUTION

a. Graphical Plotting:



b. The consumer is equilibrium at point E where, the budget line is tangent to the indifference curve IC_2. Indifference curve IC_2 is the highest indifference curve that the consumer can reach with his or her budget line. Thus, the consumer can purchase 2X of X and 6Y and Y. At point E, IC_2 is tangent to the budget line. Hence, the slope of indifference curve at point E, $MRS_{XY} = \frac{P_X}{P_Y} = 2$. It means that at point E, slope of budget line and indifference curve are equal. In the indifference map, one such point of tangency is assured.

Price Effect

Price Effect on Consumer's Equilibrium
Price effect explains how the consumer reacts to change in the price of a commodity, other things remaining the same.

Price effect explains how the consumer reacts to change in the price of a commodity, other things remaining the same. When the price of the commodity changes, consumer's equilibrium position would lie in higher or lower indifference curve accordingly to fall or rise in price respectively.

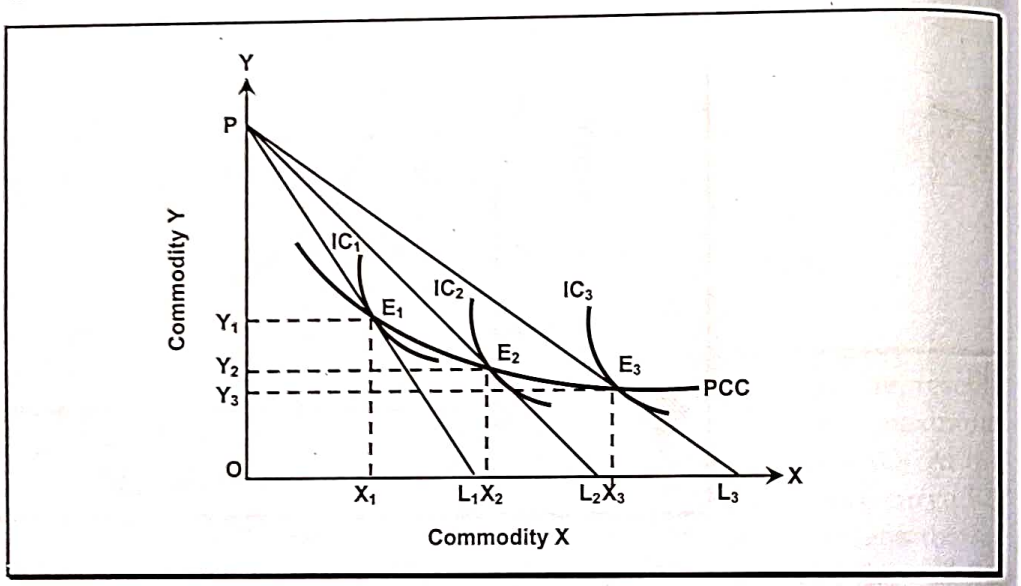
If price of the particular commodity falls, then the real income of the consumer will increase. It leads to rise in purchasing power of the consumer. It causes to upward swing in budget line where consumer reaches in new equilibrium at higher indifference curve. Similarly, if price of the particular commodity increases, consumer's real income decreases which results decrease in purchasing power of the consumer. It causes to downward swing in budget line where consumer reaches in new equilibrium at lower indifference curve.

The price effect in case of normal goods and Giffen goods is explained as follows:

Price Effect on Normal Goods

Those goods are normal goods whose price effect is negative, other things remaining the same. In case of normal goods, there is an inverse relationship between price of a commodity and its quantity demanded. It means that as the price of normal goods falls, the quantity demanded increases and vice-versa. To examine the price effect, let us take two commodities X and Y, and assuming change in price of commodity X, other things remaining the same. The consumer's response to change in the price of X commodity and the change in the combination of two commodities are shown in **Figure 3.19**.

FIGURE 3.19
PCC is downward slopping in case of substitute goods



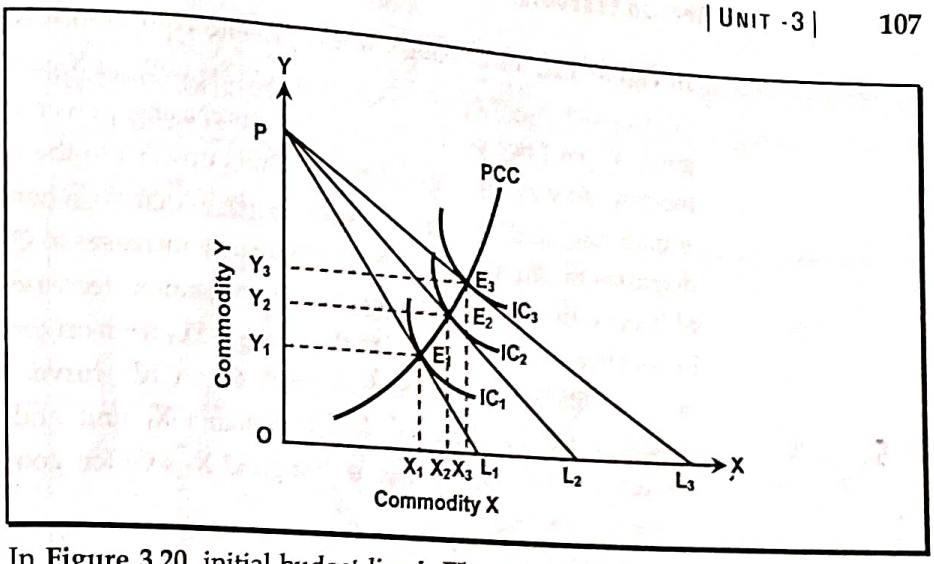
In **Figure 3.19**, the initial budget line is PL_2 where consumer is in equilibrium at point E_2 on IC_2 curve. At this equilibrium, consumer purchases OX_2 units of X good and OY_2 units of Y good. If price of X falls, the budget line will swing rightward to PL_3 and new equilibrium point will be obtained at point E_3 on indifference curve IC_3 where consumer purchases OX_3 units and OY_3 units of X and Y goods respectively. If the price of X rises, budget line will swing downward to PL_1 and the consumer is in equilibrium at point E_1. If we join these equilibrium points E_1, E_2 and E_3, we will get downward sloping price consumption curve (PCC). PCC is downward sloping because goods X and Y are substitutes. It indicates that the demand for commodity X is elastic. PCC explains price effect on the consumer's equilibrium.

Complementary Goods
Those goods are complementary goods which are jointly used to satisfy a particular want.

Price Effect on Complementary Goods

Those goods are complementary goods which are jointly used to satisfy a particular want. In case of complementary goods, there is inverse relationship between price of a good and demand for related good. Therefore, if the price of one good fall then the demand for related goods will increase and vice-versa. For example; let us suppose, X and Y are complementary goods. If price of good X falls, the demand for good Y increases and vice-versa. Therefore, in case of complementary goods, price consumption curve is upward sloping from left to right as shown in **Figure 3.20**.

FIGURE 3.20
PCC is upward slopping in case of complementary goods.



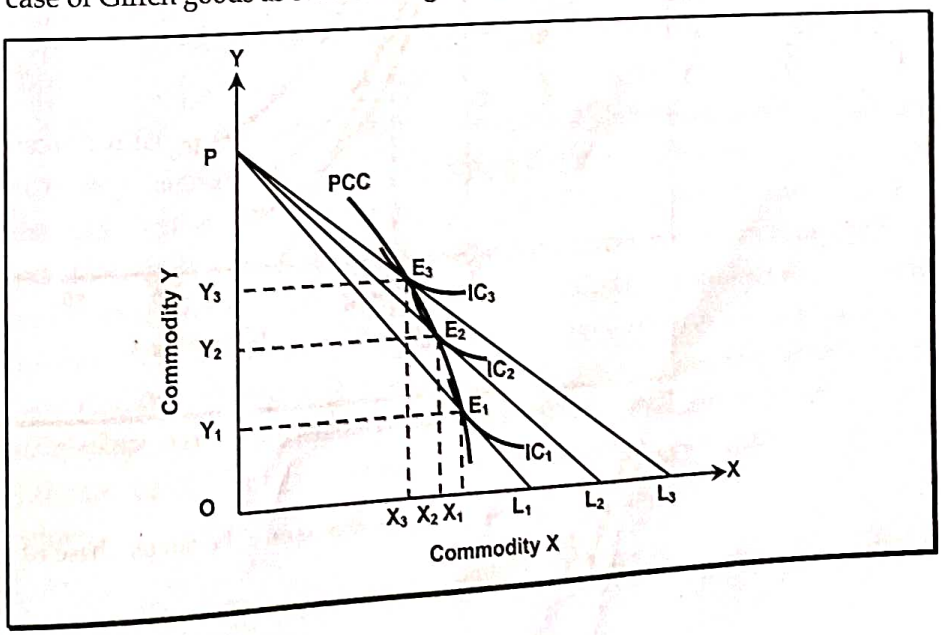
In **Figure 3.20**, initial budget line is PL_2 and equilibrium is obtained at point E_2 on difference curve IC_2 where consumer purchases OX_1 unit of X good and OY_1 unit of Y good. When price of X falls then the purchasing power of the consumer will increase. As a result, the budget line will swing upward to the position PL_3. At that condition, the consumer is in equilibrium at point E_3 on IC_2 curve. In this equilibrium point, purchase of both X and Y increase. When price of X rises, the purchasing power of the consumer decreases. Consequently, the budget line swing downward to the position PL_1 from initial position and the consumer is in equilibrium at point E_1 on IC_1 curve. At this equilibrium point, the purchase of both X and Y decrease.

Price Effect on Giffen Goods

Giffen Goods
Those goods are Giffen goods which have positive price effect.

Those goods are Giffen goods which have positive price effect. It means that price and demand for Giffen goods are positively related. For example, let us suppose that X is a Giffen good. Therefore, as the price of X falls, the purchase of X decreases but the purchase of Y increases. Hence, PCC slopes backward in case of Giffen goods as shown in **Figure 3.21.**

FIGURE 3.21
PCC is backward bending when the price of Giffen good decreases.



In Figure 3.21, initial budget line is PL_2 and equilibrium is obtained at point E_2 on IC_2 curve where consumer purchases OX_2 units of X good and OY_2 units of Y good. When price of X falls then the purchasing power of the consumer will increase. As a result, the budget line shifts upward to the position PL_3 and new equilibrium is established at point E_3 on IC_3 curve where the purchase of X decreases to OX_3 units and the purchase of Y increases to OY_3 units. When price of X rises, the purchasing power of the consumer decreases. Consequently, the budget line shifts downward to the position PL_1 from original position and again new equilibrium is obtained at point E_1 on IC_1 curve. At this equilibrium condition, the purchase of X increases to OX_1 unit and the purchase of Y decreases to OY_1 unit. It means that good X is Giffen good. Therefore, PCC is backward bending.

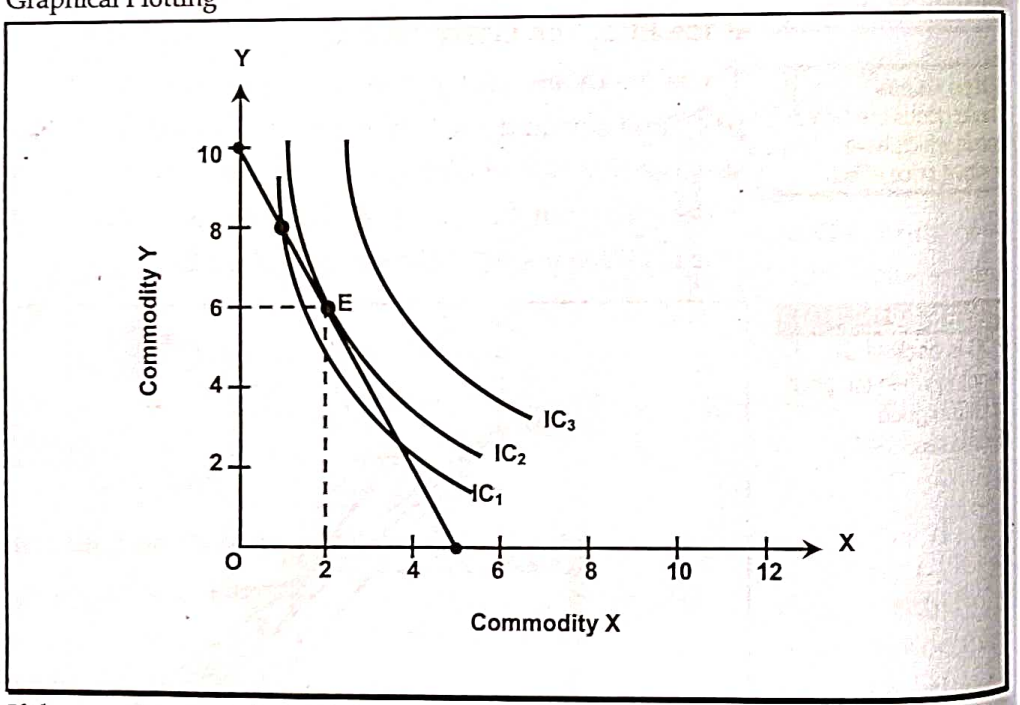
Example 3.9 If the consumer's taste and preference are given by the indifference curves and total income and price constraint by the budget line. (P_X = Rs. 2, P_Y = Re. 1) and money income Rs. 10, consumer spends all his income on X and Y.

a. Find equilibrium point of the consumer.

b. In the consumer's equilibrium, if the price of X falls from Rs. 2 per unit to Re. 1, find the new equilibrium point and sketch the price consumption curve of the consumer for commodity X.

SOLUTION

a. Graphical Plotting



If the consumer spends all his income on X, he can purchase 5 units of X, i.e.

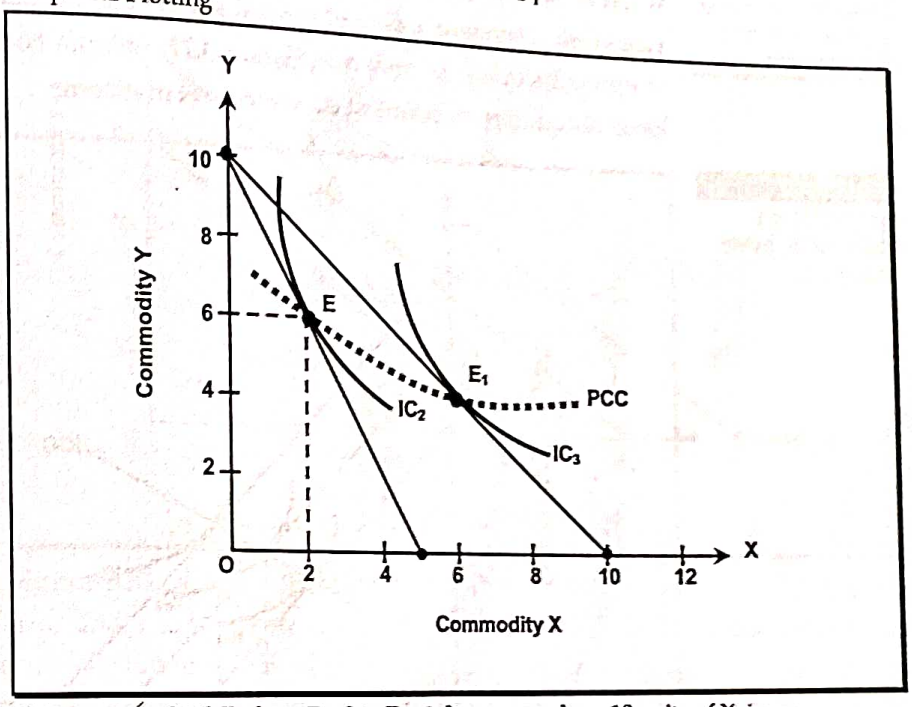
$$Q_X = \frac{B}{P_X} = \frac{10}{2} = 5 \text{ units.}$$

If the consumer spends all his income on Y, he can purchase 10 units of Y, i.e.

$$Q_Y = \frac{B}{P_Y} = \frac{10}{1} = 10 \text{ units.}$$

By joining these two points, we get budget line.
The consumer is in equilibrium at point E because at this point budget line is tangent to the indifference curve and at point E, $MRS_{XY} = \frac{P_X}{P_Y} = 2$.

b. Graphical Plotting



When price of X falls from Rs. 2 to Re. 1, he can purchase 10 units of X, i.e.

$$Q_X = \frac{B}{P_X} = \frac{10}{1} = 10 \text{ units.}$$

As a result, budget line swing rightward to the X-axis.

In the figure, point E is the original equilibrium point. With the fall in price of X from Rs. 2 to Re. 1 we get new budget line. The new budget line tangents to the indifference curve IC_3 at point E_1. Therefore, point E_1 is the new equilibrium point. By joining point E and E_1, we get a curve, PCC which is price consumption curve for commodity X.

Income Effect

Income Effect
Income effect is defined as the change in quantity purchased due to the change in money income, other things remaining the same.

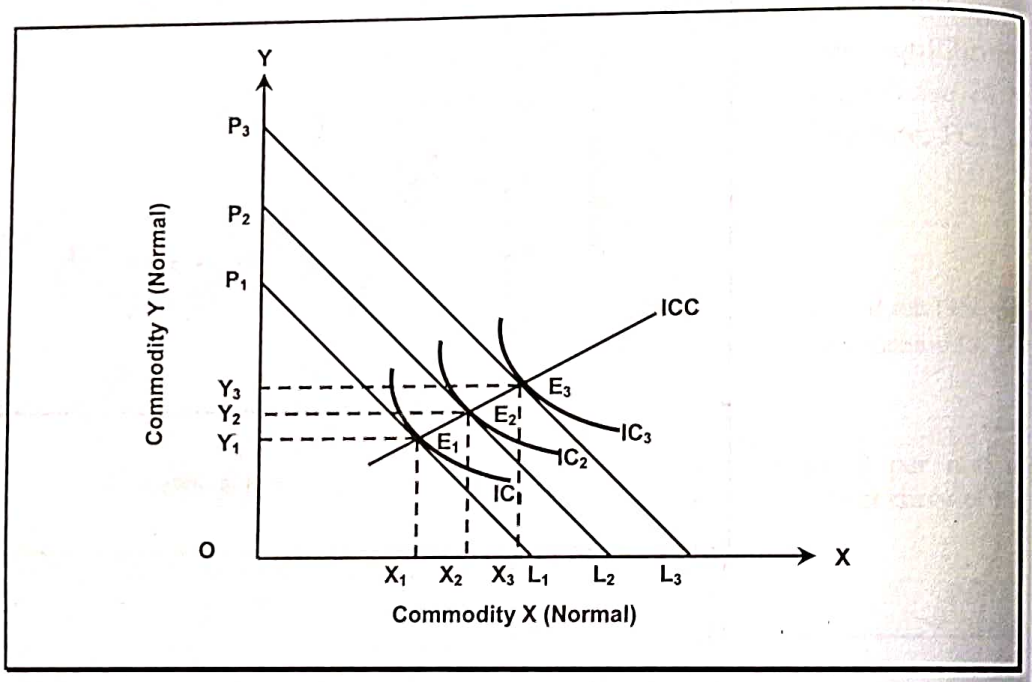
Income effect is defined as the change in quantity purchased due to the change in money income, other things remaining the same. If income of a consumer changes then original equilibrium point will also change. If money income increases, budget line shift upward where consumer will be in equilibrium at higher Indifference Curve. Similarly, if income decreases, budget line will shift downward where consumer will be in equilibrium at lower indifference curve. New equilibrium point will be set up giving higher or lower level of satisfaction as his/her income increases or decreases. The income effect is different for different goods. The income effect in case of different types of goods is explained below.

Income Effect on Normal Goods

Normal Goods
Those goods are normal goods whose income effect is positive.

Those goods are normal goods whose income effect is positive. It means that when income of a consumer increases, the quantity purchase also increases and vice-versa. Therefore, incase of normal goods, income consumption curve (ICC) is upward sloping as shown in **Figure 3.22**. Income consumption curve is the locus of equilibrium points at different level of income.

FIGURE 3.22
In case of normal goods, ICC is upward sloping



In **Figure 3.22**, P_2L_2 is the initial budget line and E_2 is the initial equilibrium point where a consumer purchases OX_2 units of X good and OY_2 units of Y good. Suppose, income of the consumer increases. As a result, the budget line will shift to the position P_3L_3 and the consumer will be in equilibrium at point E_3 on indifference curve IC_3 by purchasing OX_3 units of X and OY_3 units of Y. Again, suppose the income of the consumer decreases. Consequently, the budget line will shift to the position P_1L_1 from initial position. The equilibrium will be obtained at point E_1 on indifference curve IC_1 where the purchase of both X and Y decreases to OX_1 unit and OY_1 unit respectively. By joining these equilibrium points E_1, E_2 and E_3, we get a curve. This curve is called income consumption curve (ICC) which shows the income effect on consumer's equilibrium.

2. Income Effect on Inferior Goods

Inferior Goods
Those goods are inferior goods, whose income effect is negative.

Those goods are inferior goods, whose income effect is negative. It means that with the increase in income, the quantity purchase of inferior goods decreases because the consumer substitutes the inferior goods by superior goods. In case of inferior goods, the income consumption curve slopes backward to the left or downward to the right as shown in **Figure 3.23**.

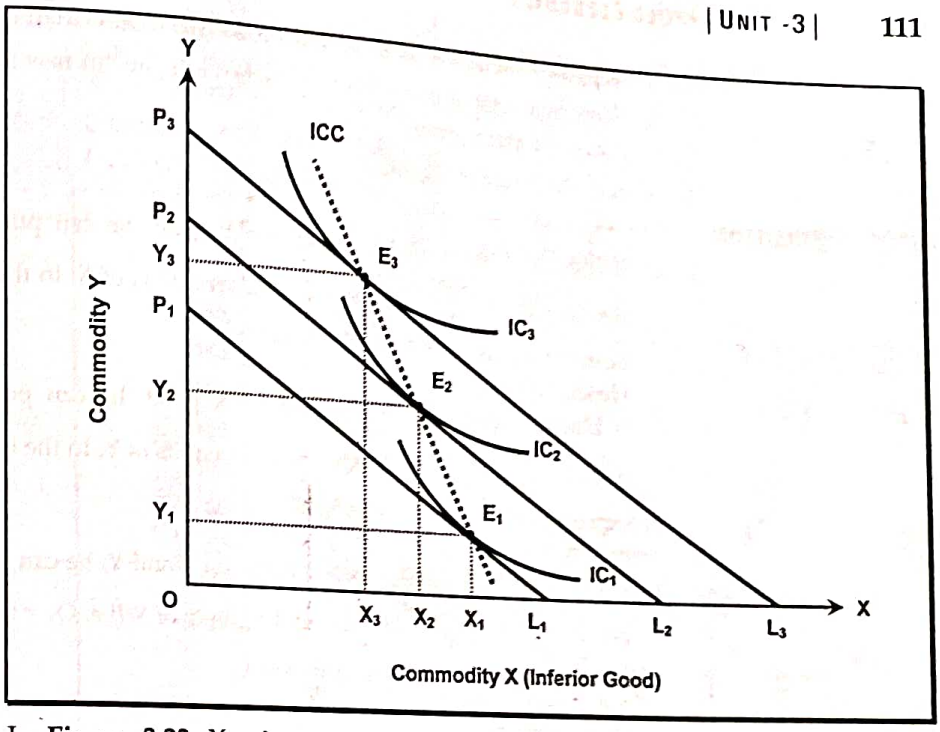


FIGURE 3.23
In case of inferior goods, ICC slopes backward to the left

In **Figure 3.23**, X-axis represents quantity of good X, which is assumed to be inferior and Y-axis represents quantity of Y good. P_2L_2 is the initial budget line and the consumer is in equilibrium at point E_2 on indifference curve IC_2. At this equilibrium point, the consumer purchases OX_2 units of good X and OY_2 units of good Y. When money income of the consumer increases, the initial budget line P_2L_2 will shift upward to P_3L_3. The new equilibrium is obtained at point E_3 at the higher indifference curve IC_3. At this point the purchase of good X decreases to OX_3 units and the purchase of good Y increases to OY_3 units. Similarly, when income decreases, the initial budget line will shift downward to P_1L_1 and new equilibrium is established at point E_1 at the lower indifference curve IC_1. At this point the purchase of good X increases to OX_1 unit and the purchase of good Y decreases to OY_1 unit. By joining equilibrium points, we get backward bending income consumption curve (ICC).

Thus, if we assumed good X is inferior and it is measured on X-axis, the ICC will bend backward or toward the Y-axis as shown in **Figure 3.23**. Similarly, if we assumed good Y is inferior good and it is measured on Y-axis, the ICC will bend downward or toward the X-axis.

Example 3.10

Suppose Mahdav has Rs. 5000 money income spending on goods X and Y for a month and price of X and Y are Rs. 100 and Rs. 50 respectively.

a. i. Draw Madhav's budget line/ income line.

ii. Assume Madhav splits his money income between X and Y at a given prices. Show where the household ends up on the budget constraint.

b. i. Let Madhav's income increases from Rs. 5000 to Rs. 8000. Draw Madhav's new budget line.

ii. Show the point of new equilibrium when he spends his new income equally on X and Y at given prices.

c. i. Suppose Madhav's income decreases to Rs. 4000. Draw Madhav's new budget line.

ii. Show that point of new equilibrium when he splits his new income equally on both goods at a given prices.

d. Identify the nature of X good.

SOLUTION

a. i. If Madhav spends all his income on Y good, he can purchase 100 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{5000}{50} = 100$ units.) and zero units of X. In the equation form it can be expressed as : $P_X(0) + 100P_Y = 5000$

Hence, A(0, 100)

If Madhav spends all his income on X good, he can purchase 50 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{5000}{100} = 50$ units.) and zero units of Y. In the equation form it can be expressed as : $50P_X + P_Y(0) = 5000$

Hence, B(50, 0)

ii. If he spends his money income equally on X and Y, he can purchase 25 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{2500}{100} = 25$ units) and 50 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{2500}{50} = 50$ units).

It can be expressed as in equation form:

$25P_X + 50P_Y = 5000$.

Hence, P(25, 50)

b. i. If he spends all his new income on Y, he can purchase 160 units of Y good (i.e. $Q_Y = \frac{B}{P_Y} = \frac{8000}{50} = 160$) and zero units of X. It can be expressed as in equation form: $P_X(0) + 160\ P_Y = 8000$

Hence, C(0, 160)

If he spends all his new income on X, he can purchase 80 units of X good (i.e. $Q_X = \frac{B}{P_X} = \frac{8000}{100} = 80$) and zero units of Y. It can be expressed as in equation form: $80P_X + P_Y(0) = 8000$

Hence, D(80, 0)

ii. If he spends his money income equally on X and Y, he can purchase 40 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{4000}{100} = 40$ units) and 80 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{4000}{50} = 80$ units). It can be expressed as in equation form:

$40P_X + 80P_y = 8000$.

Hence, Q(40, 80)

c. i. If he spends all his new income on Y, he can purchase 80 units of Y good (i.e. $Q_Y = \frac{B}{P_Y} = \frac{4000}{50} = 80$ units) and zero units of X. It can be expressed as in equation firm: $P_X(0) + 80P_Y = 4000$

Hence, E(0, 80)

If he spends all his new income on X, he can purchase 40 units of X good (i.e. $Q_X = \frac{B}{P_X} = \frac{4000}{100} = 40$ units) and zero units of Y. It can be expressed as in equation form: $40P_X + P_Y(0) = 4000$

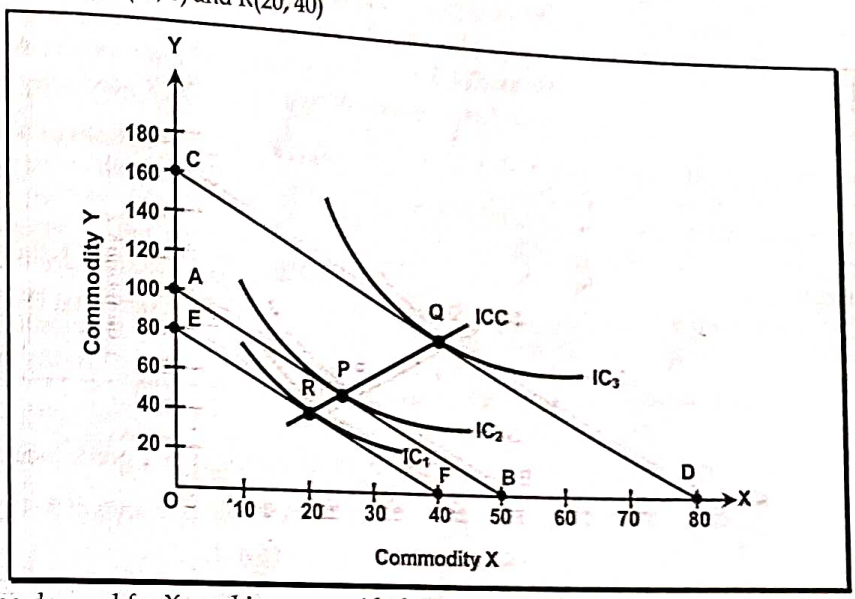
Hence, F(40, 0)

ii. If he spends his money income equally on X and Y, he can purchase 20 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{2000}{100} = 20$ units) and 40 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{2000}{50} = 40$ units). It can be expressed as in equation form:

$20P_X + 40P_Y = 4000$.

Hence, R(20, 40)

We can find nature of X good by plotting coordinates A, B and P; C, D and Q and E, F and R in the graph.
A(0, 100), B(50, 0) and P(25, 50)
C(0, 160), D(80, 0) and Q(40, 80)
E(0, 80), F(40, 0) and R(20, 40)



d. The demand for X good increases with the increase in income. Therefore, X good is a normal good.

Example 3.11 Suppose price of X good is Rs. 20 and Price of Y good is Rs. 50 and monthly income of a family is Rs. 2000 to spend on goods X and Y.

a. i. Draw budget line of the family.
ii. Suppose the family spends their income equally on X and Y. Show where the family ends up on income constraint.

b. i. Suppose, the family income increase to Rs. 3000. Draw new price line.
ii. Suppose after the change in income, the family spends Rs. 800 on Y and Rs. 2200 on X. Show where the family ends up on income constraint.

c. i. Suppose, the family income decrease from Rs. 2000 to Rs. 1500. Draw the new budget constraint.
ii. Suppose after the fall in income, the family spends Rs. 1000 on Y and Rs. 500 on X. Show where the family ends up on the budget constraint.

d. Identify the nature of Y good.

SOLUTION

a. i. If the family spends all their income on Y good, they can purchase 40 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{2000}{50} = 40$ units.) and zero units of X. In the equation form it can be expressed as : $P_X(0) + 40P_Y = 2000$
Hence, A(0, 40)
If the family spends all their income on X goods, they can purchase 100 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{2000}{20} = 100$ units.) and zero units of Y. In the equation form it can be expressed as : $100P_X + P_Y(0) = 2000$
Hence, B(100, 0)

ii. If the family spends their money income equally on X and Y, they can purchase 50 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{1000}{20} = 50$ units) and 20 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{1000}{50} =$ 20 units). It can be expressed as in equation form:

$50P_X + 20P_Y = 2000$.

Hence, P(50, 20)

b. i. If the family spends all their income on Y good, they can purchase 60 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{3000}{50} = 60$ units.) and zero units of X. In the equation form it can be expressed as : $P_X (0) + 60P_Y = 3000$

Hence, C(0, 60)

If the family spends all their income on X good, they can purchase 150 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{3000}{20} = 150$ units.) and zero units of Y. In the equation form it can be expressed as : $150P_X + P_Y(0) = 3000$

Hence, D(150, 0)

ii. If the family spends their money income on X and Y, they can purchase 110 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{2200}{20} = 110$ units) and 40 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{800}{50} = 16$ units). It can be expressed as in equation form:

$80P_X + 40P_y = 4000$.

Hence, Q(110, 16)

c. i. If the family spends all their income on Y good, they can purchase 30 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{1500}{50} = 30$ units.) and zero units of X. In the equation form it can be expressed as: $P_X (0) + 30P_Y = 1500$

Hence, E(0, 30)

If the family spends all their income on X good, they can purchase 75 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{1500}{20} = 75$ units.) and zero units of Y. In the equation form it can be expressed as: $75P_X + P_Y(0) = 1500$

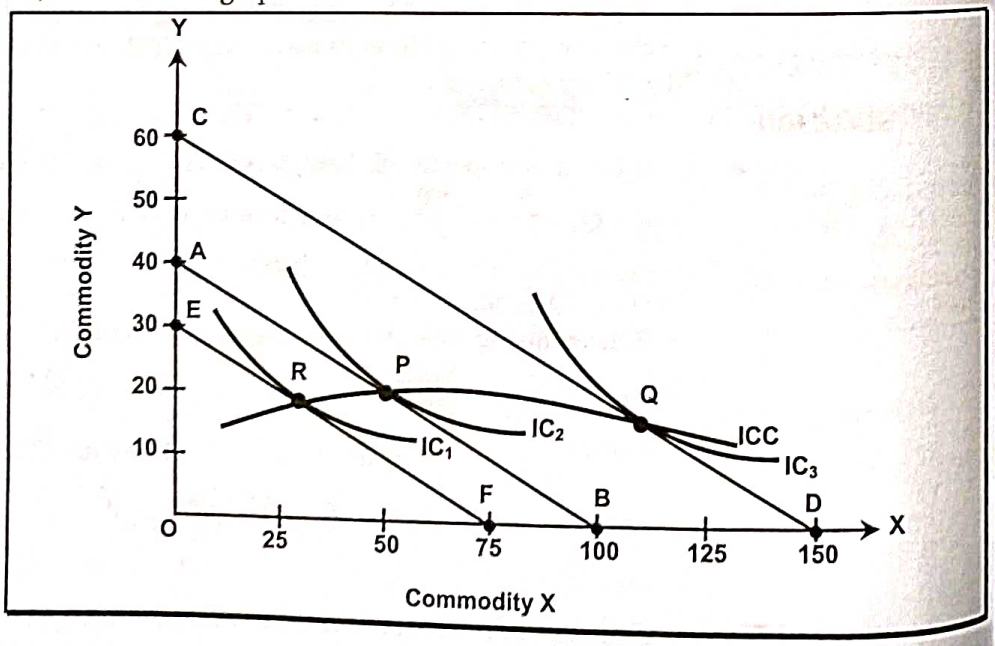
Hence, F(75, 0)

ii. If the family spends their money income on X and Y, they can purchase 30 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{600}{20} = 30$ units) and 18 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{900}{50} = 18$ units). It can be expressed as in equation form:

$30P_X + 18P_Y = 4000$.

Hence, R(30, 18)

We can find nature of X good by plotting coordinates A, B and P; C, D and Q and E, F and R in the graph.

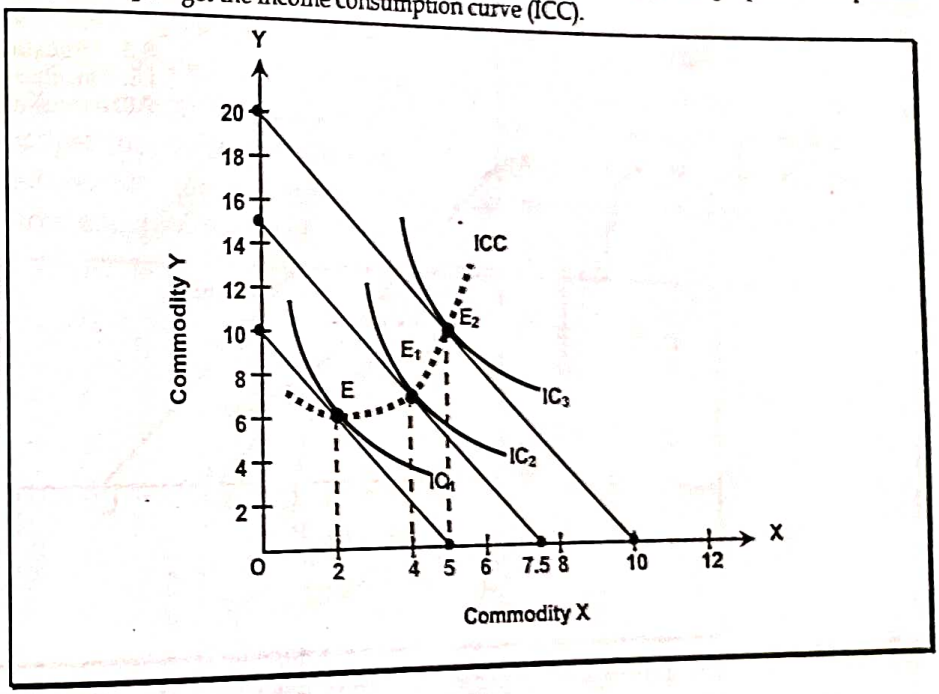


d. From the figure, it is cleared that, Y good is inferior good because demand for Y good varies negatively with income.

Example 3.12 If the consumer's tastes and preferences are given by indifference curve IC_1, IC_2 and IC_3, if the price of Y and price of X remains unchanged at Re. 1, and Rs. 2 respectively, and if the consumer's money income rises from Rs. 10 to Rs. 15 and then to Rs. 20 per time period, derive income consumption curve.

SOLUTION

In the figure, budget lines are parallel to each other. With an income of Rs. 10, budget line tangents to the indifference curve IC_1 at point E. Therefore, the consumer is in equilibrium at point E by purchasing 2X of X and 6Y of Y. With an income of Rs. 15, new budget line tangents to the indifference curve IC_2 at point E_1. Therefore, the consumer is in equilibrium at point E_1 by purchasing 4X of X and 7Y of Y. With an income of Rs. 20, new budget line tangents to the indifference curve IC_3 at point E_2. Therefore, the consumer is in equilibrium at point E_2 by purchasing 5X of X and 10Y of Y. By joining equilibrium points E, E_1 and E_2 we get the income consumption curve (ICC).



Substitution Effect
(Decomposition of Price Effect into Income and Substitution Effect)

Substitution Effect
Substitution effect can be obtained by deducting income effect from price effect.

Substitution effect is defined as the change in purchase of a commodity as a result of a change in relative prices alone, money income remaining constant. If the price of a commodity changes, the real income or purchasing power of a consumer also changes. If there is price effect, income and substation effects simultaneously occur. To find out the substitution effect, we must decompose price effect in to income and substitution effect. For this purpose, it is necessary to keep real income of the consumer constant. To keep real income constant, price change is compensated by a simultaneous change in money income, but how? We have two different approaches suggested by two different economists (i) Hicks and (ii) Slutsky.

In order to find out Slutsky's substitution effect, consumer's real income is so reduced (by way of taxation) that he returns to the original equilibrium point E_1 and s/he is able to purchase the original combination of goods X and Y at new price, if he so desires. For this purpose, a price line AB parallel to PL_2 has been drawn which passes through the original equilibrium point E_1. It means that income equal to PA in terms of Y or L_2B in terms of X has been taken away from the consumer. As a result, s/he can purchase the original combination E_1, if s/he so desires. But the consumer will not purchase the original combination E_1 because X has become relatively cheaper and Y has become relatively dearer than before. The imaginary price line AB is tangent to the indifference curve IC_3 at point E_3. Therefore, the consumer will be in equilibrium at a point E_3 on a higher indifference curve IC_3. The movement from equilibrium point E_2 to E_3 shows a fall in the purchase of X by X_2X_3. This is income effect. We can easily find out the substitution effect by subtracting the income effect from price effect as shown below:

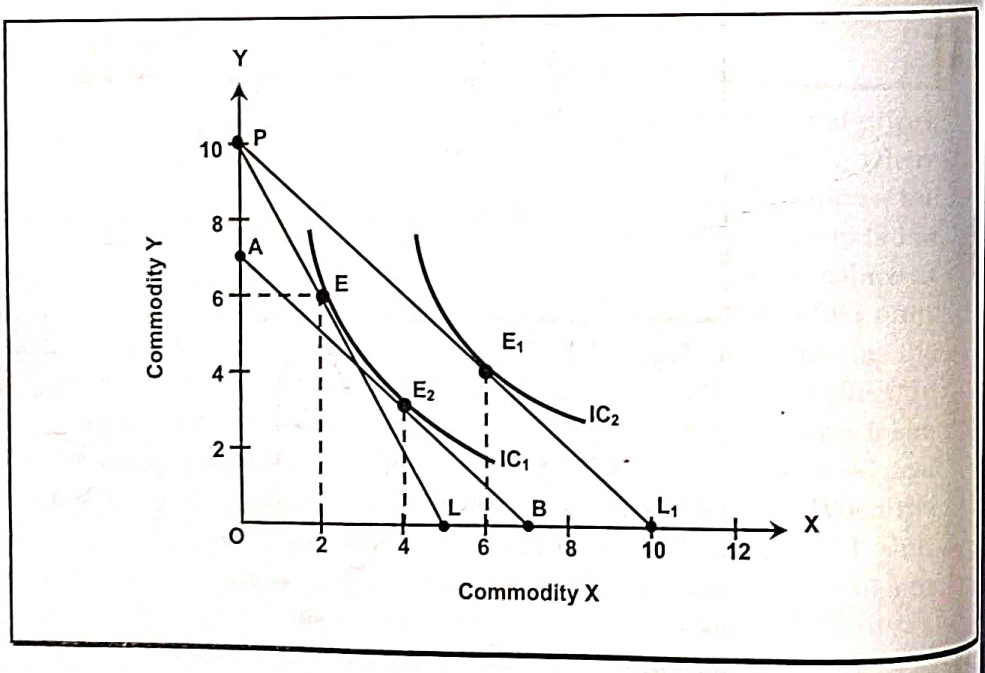
Substitution effect = Price effect – Income effect

$$\text{S.E.} = \text{P.E.} - \text{I.E.}$$
$$= X_1X_2 - X_2X_3$$
$$\therefore \quad \text{S.E.} = X_1X_3$$

In **Figure 3.25**, the movement from E_1 to E_3 and consequent increase in the quantity purchased of good X (i.e. X_1X_2) is the substitution effect and movement from E_3 to E_2 and the consequent increase in the quantity purchased of good X (i.e. X_3X_2) is the income effect.

Example 3.13 If Bibhuti's taste and preferences are given by the indifference curves and total income and price constraint by the budget line: P_X = Rs. 2, P_Y = Re. 1 and money income Rs. 10, consumer spent all his income on X and Y. Separate substitution effect resulting from the reduction in the price of X from Rs.2 to Re. 1 per unit.

SOLUTION



Initially Bibhuti is in equilibrium at point E on IC_1. At this equilibrium position, Bibhuti purchases 2 units of X commodity and 6 units of Y commodity. Suppose, the price of X falls from Rs. 2 to Re. 1, it increases real income (purchasing power). As a result, the price line swings towards X-axis to the position PL_1. The price line PL_1 tangents at point E_1 on IC_2. The movement from point E to E_1 is the price effect. To withdraw the increased real income, we have to reduce the money income to kept Bibhuti on the original indifference curve IC_1. For that we withdraw imaginary budget line AB which is parallel to the budget line PL_1. The imaginary budget line AB tangents at point E_2 on IC_1. The movement from E to E_2 is the substitution effect and movement from E_2 to E_1 is the income effect.

$\therefore$ Price effect = Substitution effect + Income effect

$EE_1 = EE_2 + E_2E_1$

$4X = 2X + 2X$

$4X = 4X$

Derivation of Demand Curve for Normal Goods

Those goods are normal goods whose price effect is negative. In case of normal goods, when price of a commodity falls, the quantity purchased of that commodity will increase and vice-versa. Therefore, demand curve for normal goods is downward sloping from left to right. But normal goods are two types. They are substitute goods and complementary goods. We separately explain the method of derivation of demand for substitute goods and complementary goods.

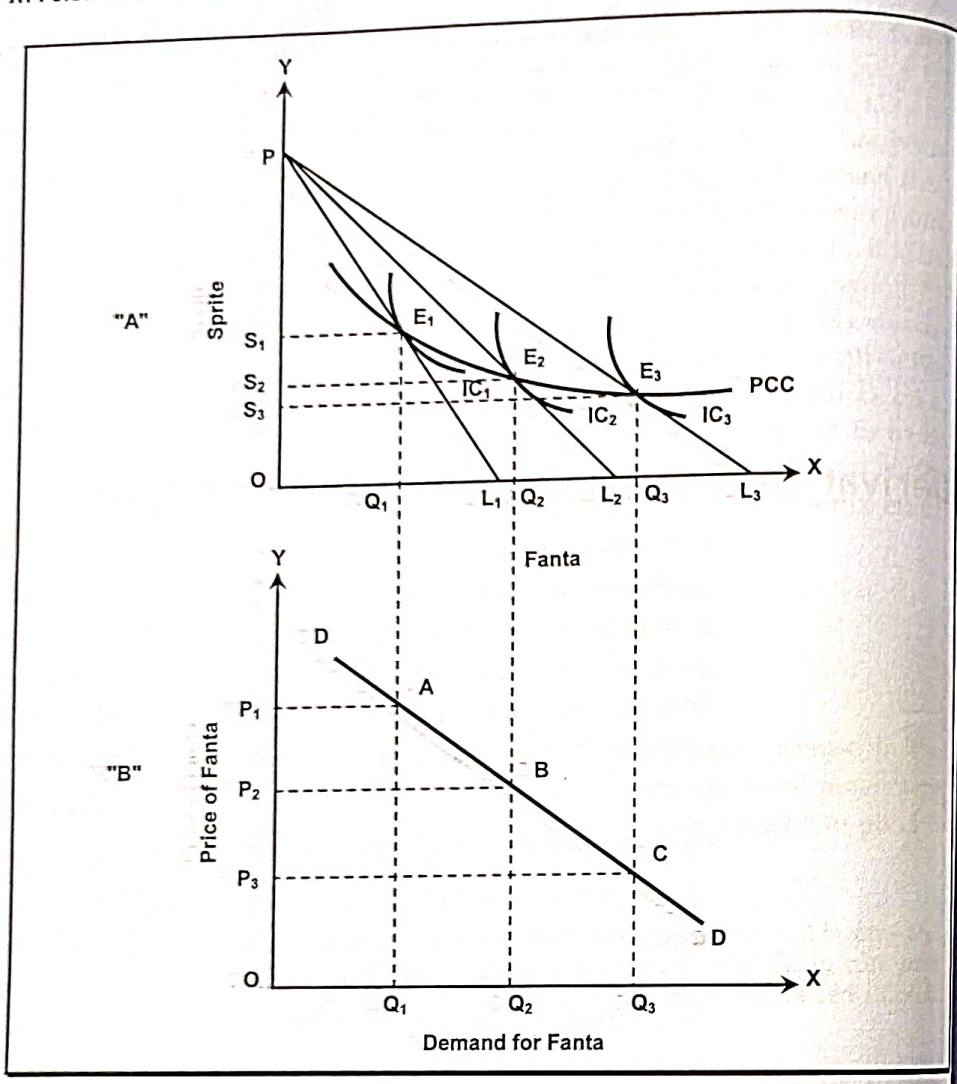
Derivation of Demand Curve for Substitute Goods

Those goods are substitute goods which can be used in the absence of other goods to satisfy a particular want. In case of substitute goods, there is positive relationship between price of a commodity and demand for related commodity. For example, let us suppose that Fanta and Sprite are substitute goods. If the price of Fanta is decrease, the demand for Sprite is also decrease and vice-versa. Therefore, price consumption curve (PCC) is downward sloping from left to right and demand curve for Fanta is also downward sloping as shown in **Figure 3.26**.

In **Figure 3.26** let PL_2 is the initial budget line and the consumer is in equilibrium at point E_2 on indifference curve IC_2. At this equilibrium, the quantity demand for Fanta is OQ_2 bottles and the quantity demand for Sprite is OS_2 bottles. If the price of Fanta falls, the budget line will swing rightward to PL_3 and new equilibrium point will be obtained at point E_3 on indifference curve IC_3 where the quantity demand for Fanta is OQ_3 bottles and the quantity demand for Sprite is OS_3 bottles. If the price of Fanta rises, the budget line will swing downward to PL_1 and the consumer is in equilibrium at point E_1 on indifference curve IC_1. At this equilibrium condition, the quantity demand for Fanta is OQ_1 bottle and the quantity demand for Sprite is OS_1 bottle. By joining these equilibrium points E_1, E_2 and E_3, we get downward sloping price consumption curve (PPC).

FIGURE 3.26
Demand Curve for Substitution goods

In substitution goods when price of particular commodity decrease, another commodity become relatively expensive as a result demand for particular commodity increase and demand curve become downward slopping.

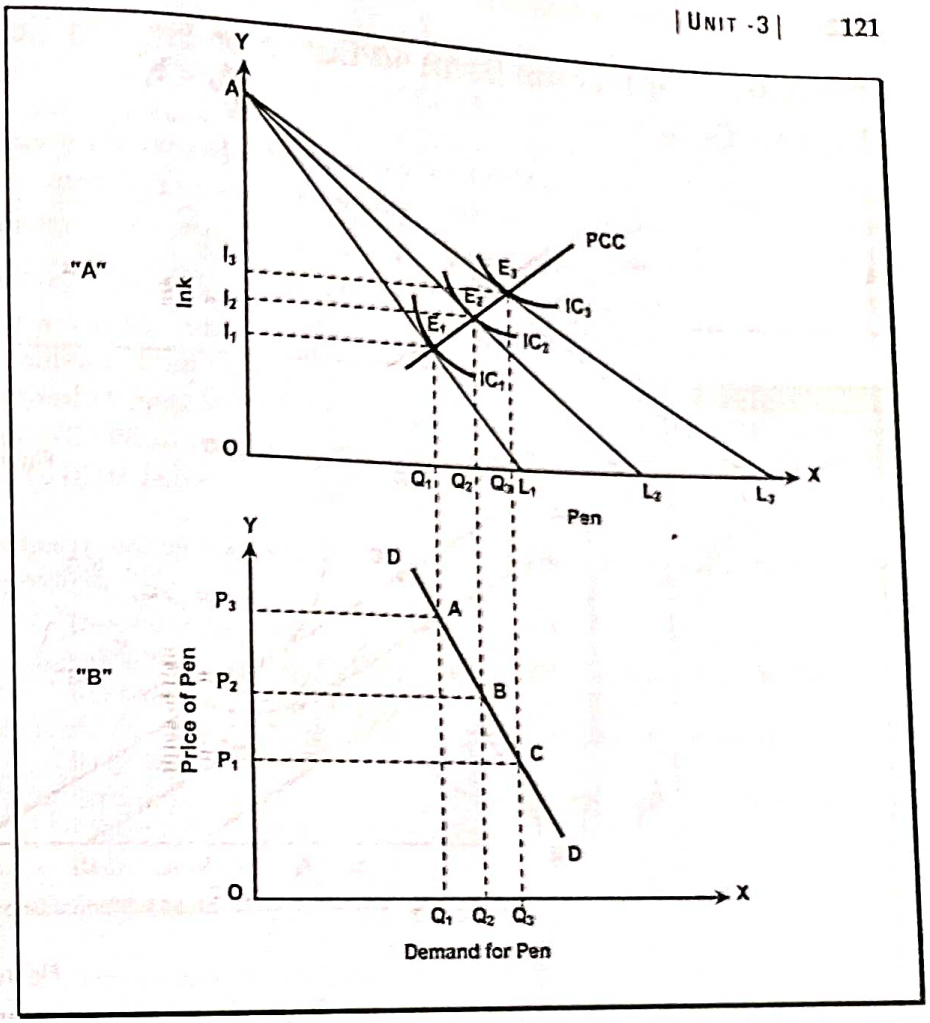


In **Figure 3.26 'B'**, the derivation of demand curve for Fanta by the helps of **Figure 3.26 'A'** is shown. According to equilibrium point E_1, OQ_1 bottle of Fanta is demanded (purchased) at price OP_1. It is indicated by point A in **Figure 3.26 'B'**. According equilibrium point E_2, OQ_2 bottles of Fanta is demanded at price OP_2. It is pointed by the point B in **Figure 3.26 'B'**. Similarly according to equilibrium point E_3, OQ_3 bottles of Fanta is demanded at price OP_3. It is marked by the point C in **Figure 3.26 'B'**. By joining these points A, B and C, we get downward sloping demand curve for Fanta.

Derivation of Demand Curve for Complementary Goods

Those goods are complementary goods which are jointly used to satisfy a particular want. In case of complementary goods, there is inverse relationship between price of a good and demand for related good. For example, let us suppose pen and ink are complementary goods. If the price of pen is falls, the demand for ink is increases and vice-versa. Therefore, price consumption curve is upward sloping from left to right and the demand curve is downward sloping as shown in **Figure 3.27 'A'**.

FIGURE 3.27
Demand Curve for Complementary Goods



Incase of, complimentary goods, when price of one commodity decrease demand for another commodity increase and vice-versa which cause downward slopping demand curve.

In **Figure 3.27 'A'**, initial budget line is PL_2 and equilibrium is obtained at point E_2 on indifference curve IC_2 where the quantity demanded for pen is OQ_2 units and the quantity demanded for ink is OI_2. When price of pen is fall, then the budget line will swing upward to PL_3. The consumer is in equilibrium at point E_3 on indifference curve IC_3 where the quantity demanded for pen increases to OQ_3 units and the quantity demanded for ink is OI_3. When price of pen rises, the budget line will swing to PL_1 from initial budget line P_2L_2. The consumer is in equilibrium at point E_1. At this equilibrium point, the quantity demanded for pen and ink decreases to OQ_1 unit and OI_1. By joining these equilibrium points E_1, E_2 and E_3, we get price consumption curve (PCC) which is upward sloping.

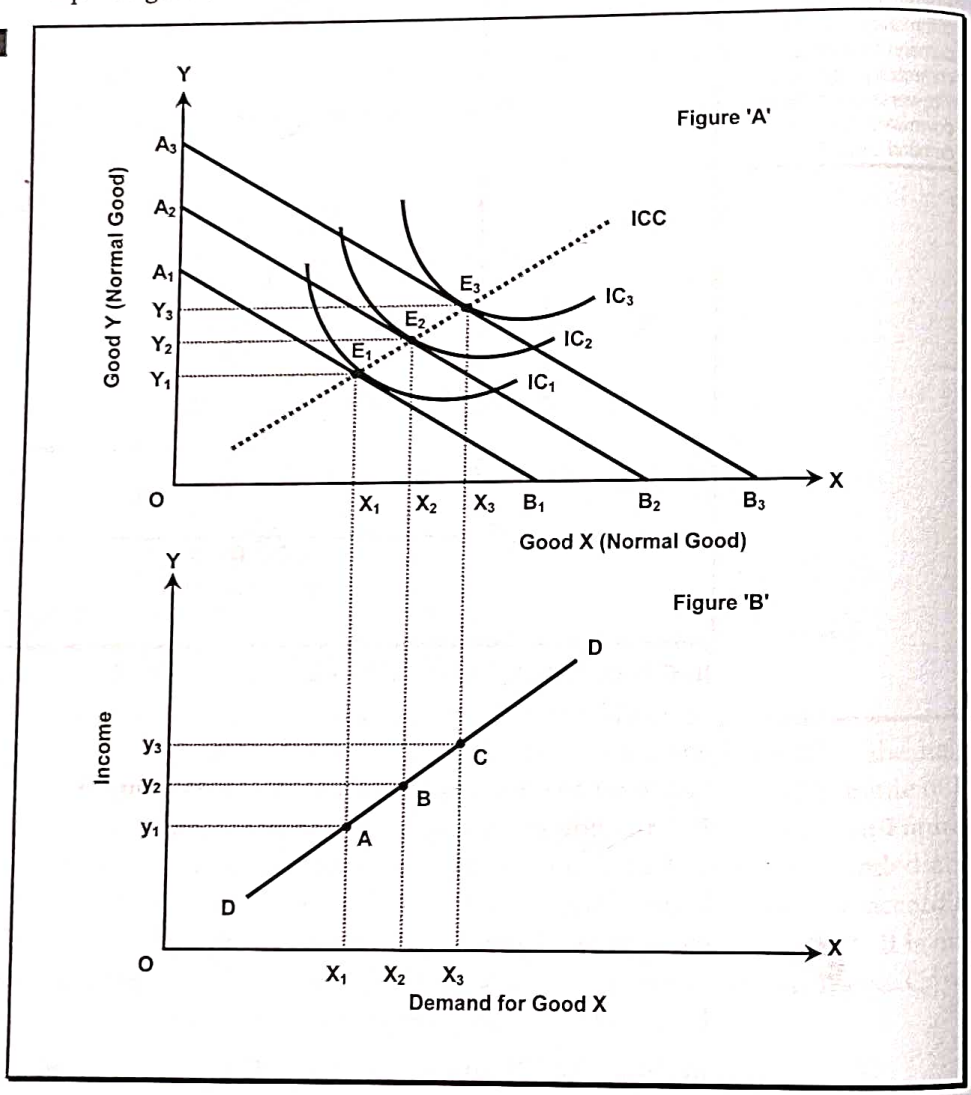
In **Figure 3.27 'B'** on the basis of equilibrium point E_1, the point A is obtained in **Figure 3.27 'B'** where the quantity demanded for pen is OQ_1 unit at price OP_1. On the basis of point E_2, the point B is derived in **Figure 3.27 'B'** where the quantity demanded for pen is OQ_2 units at price OP_2. Similarly, the point C is obtained on the basis of point E_3 where the quantity demanded for pen is OQ_3 units at price OP_3. By joining these points A, B and C, we get downward sloping demand curve DD for pen.

Derivation of Income Demand Curve or Engel's Curve for Normal Goods

Positive Income Effect
Positive income effect is found in case of normal goods.

Normal goods are those goods whose demand or consumption increases with increase in consumer's income and vice-versa. It means that in case of normal goods income effect is positive and income consumption curve (ICC) slopes upward from left to right. The positive income effect can be explained by the help of Figure 3.28.

FIGURE 3.28
Derivation of Income Demand Curve



In Figure 3.28, A_1B_1 is the initial budget line, which is tangent to the indifference curve IC_1 at point E_1. Hence, initial equilibrium point is E_1. Let us suppose, the income of the consumer increases. As a result, the initial budget line A_1B_1 will shift rightward to A_2B_2. With the budget line A_2B_2, the consumer is in equilibrium at point E_2 on higher indifference curve IC_2, which shows OX_2 units of good X and OY_2 units of good Y purchased by the consumer. Again, when income of the consumer increases, the consumer will be in equilibrium at point

E_3 on higher indifference curve IC_3, which shows OX_3 units of good X and OY_3 units of good Y purchased by the consumer. If equilibrium points E_1, E_2 and E_3 are joined, a curve is obtained, which is known as the income consumption curve (ICC).

With the help of consumer's equilibrium points shown in **Figure 3.28 (A), 3.28 (B)**. According to initial equilibrium point E_1, at income Oy_1, the demand for X good is OX_1 unit. It is denoted by point 'A'. Similarly, according to the equilibrium point E_2, at income Oy_2, the demand for good X is OX_2 units. It is denoted by point 'B'. Again, similarly, according to equilibrium point E_3, we get point 'C'. When points A, B and C are joined, income demand curve or Engel curve DD is derived.

Example 3.14

Suppose a consumer's money income is Rs. 8000. The price of X and Y are Rs. 40 and Rs. 50 respectively.

a. i. Draw the budget line.
   ii. Suppose he spends all his money income equally on X and Y goods. Show the consumer's equilibrium.

b. i. As price of X falls to Rs. 25, keeping income and price of Y constant, draw new budge line.
   ii. Suppose after the fall in price of X good, the consumer spends Rs. 3500 on X and Rs. 4500 on Y. Show consumer's new equilibrium.

c. i. Define nature of X.
   ii. Derive price demand curve for X good.

SOLUTION

a. i. If the consumer spends all his money income on Y good, he can purchase 160 units of Y (i.e. $Q_Y = \frac{B}{P_Y} = \frac{8000}{50} = 160$ units) and zero unit of X.

Hence, A(0 , 160)

If the consumer spends all his money income on X good, he can purchase 200 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{8000}{40} = 200$ units) and zero unit of Y.

Hence, B(200, 0)

ii. If the consumer spends his money income equally on X and Y goods, he can purchase 100 units of X good (i.e. $Q_X = \frac{B}{P_X} = \frac{4000}{40} = 100$ units) and 80 units of Y good (i.e. $Q_Y = \frac{B}{P_Y} = \frac{4000}{50} = 80$ units).

Hence, P(100, 80)

b. i. If the consumer spends all his money income on X goods, he can purchase 320 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{8000}{25} = 320$ unit).

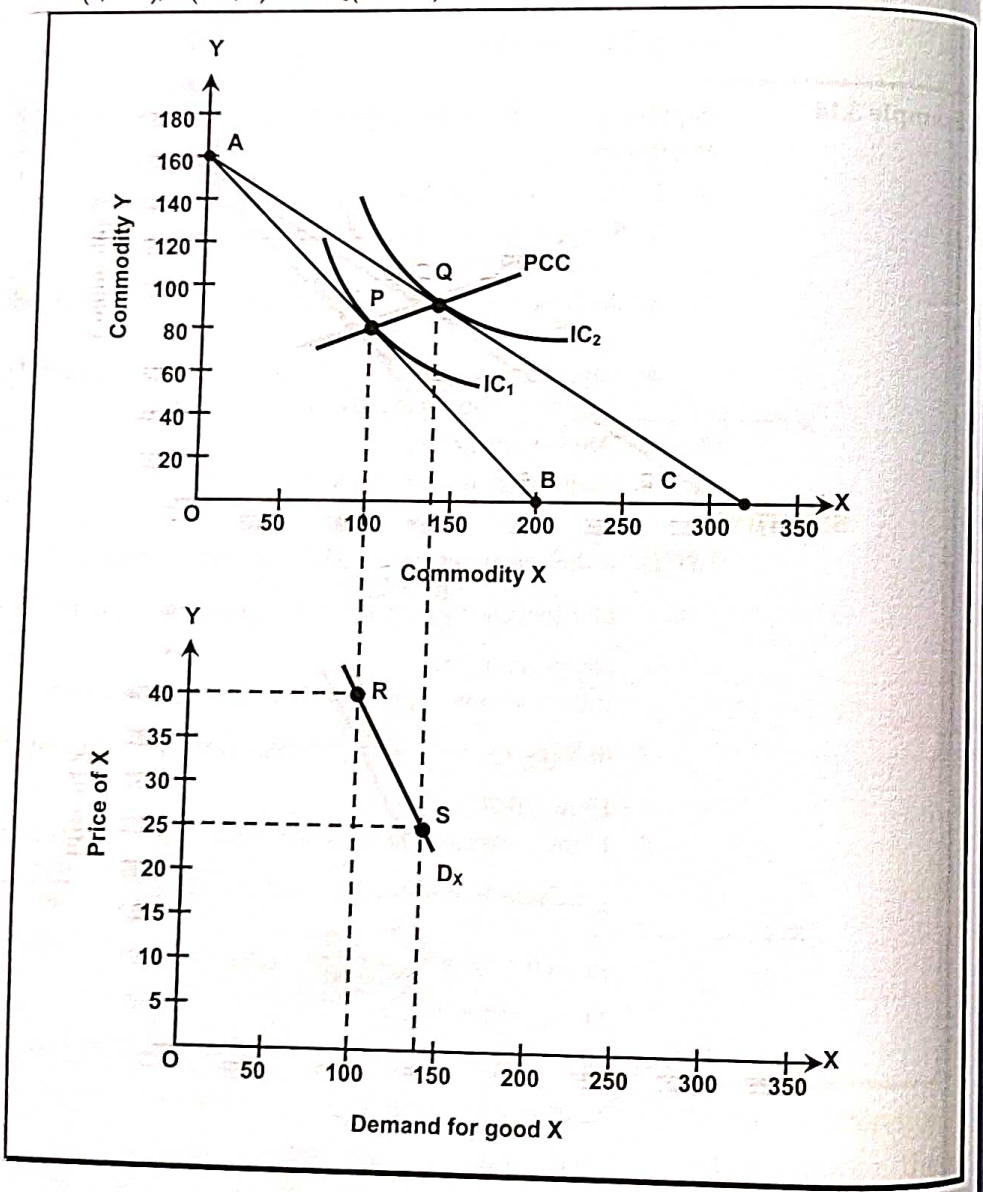
Hence, A(0, 160) and C(320, 0)

ii. If the consumer spends his money income equally on X and Y goods, he can purchase 140 units of X good (i.e. $Q_X = \frac{B}{P_X} = \frac{3500}{25} = 140$ units) and 90 units of Y good (i.e. $Q_Y = \frac{B}{P_Y} = \frac{4500}{50} = 90$ units).

Hence, Q(140, 90)

c. i. Relationship between price of X with demand for X and Y.
At P_X = Rs. 40, Q_Y = 80 units, Q_X = 100 units
Hence, R(100, 40)
At P_X = Rs. 25, Q_Y = 90 units, Q_x = 140 units
Hence, S(140, 25)
Good X and Y are complementary goods. Because demand for X and Y increases due to fall in price of X.

ii. By plotting points R and S in the figure, we get price demand curve for X good (D_X).
The price effect can be find out by plotting points A, B and P; A, C and Q in a graph as shown below.
A(0 , 160), B(200, 0) and P(100, 80)
A(0, 160), C(320, 0) and Q(140, 90)



Example 3.15 Suppose, a consumer's money income is Rs. 4000. The price of X and Y goods are Rs. 20 and 10 respectively.

a. i. Draw price line.

ii. Suppose he spends his income equally on X and Y. Show where consumer ends up on budget constraint.

b. i As price of X falls from Rs. 20 to Rs. 10, keeping income and price of Y constant, draw the price line.

ii. Let after the fall in price of X, the consumer spends Rs. 2400 on X and Rs. 1600 on Y. Show where the consumer ends up on the price line.

c. i. As price of X rises from Rs. 20 to 40, keeping income and price of y constant, draw new budget line.

ii. Let after the rises in price of X, the consumer spends Rs. 1600 on X and Rs. 2400 on Y. Show where the consumer ends up on the new price line.

d. i. Define the nature of good X.

ii. Drive price demand curve for X goods.

SOLUTION

a. i. If the consumer spends all his money income on Y good, he can purchase 400 units of Y and zero unit of X.

i.e. $20\,(0) + 10Y = 4000 \quad (\because X = 0)$

$Y = 400$

Hence, A(0, 400)

If the consumer spends all his money income on X good, he can purchase 200 units of X and zero unit of Y.

i.e. $20\,X + P_Y(0) = 4000 \quad (\because Y = 0)$

$X = 200$

Hence, B(200, 0)

By joining these two points we get price line AB as shown in figure.

ii. If the consumer spends his money income equally on X and Y goods, he can purchase 100 units of X good (i.e. $Q_X = \frac{B}{P_X} = \frac{2000}{20} = 100$ units) and 200 units of Y good (i.e. $Q_Y = \frac{B}{P_Y} = \frac{2000}{10} = 200$ units).

Hence, P(100, 200)

b. i. If the consumer spends all his money income on X good, he can purchase 400 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{4000}{10} = 400$ unit).

Hence, A(0, 400) and C (400, 0)

ii. If the consumer spends his money income equally on X and Y goods, he can purchase 240 units of X good (i.e. $Q_X = \frac{B}{P_X} = \frac{2400}{10} = 240$ units) and 160 units of Y good (i.e. $Q_Y = \frac{B}{P_Y} = \frac{1600}{10} = 160$ units).

Hence, Q(240, 160)

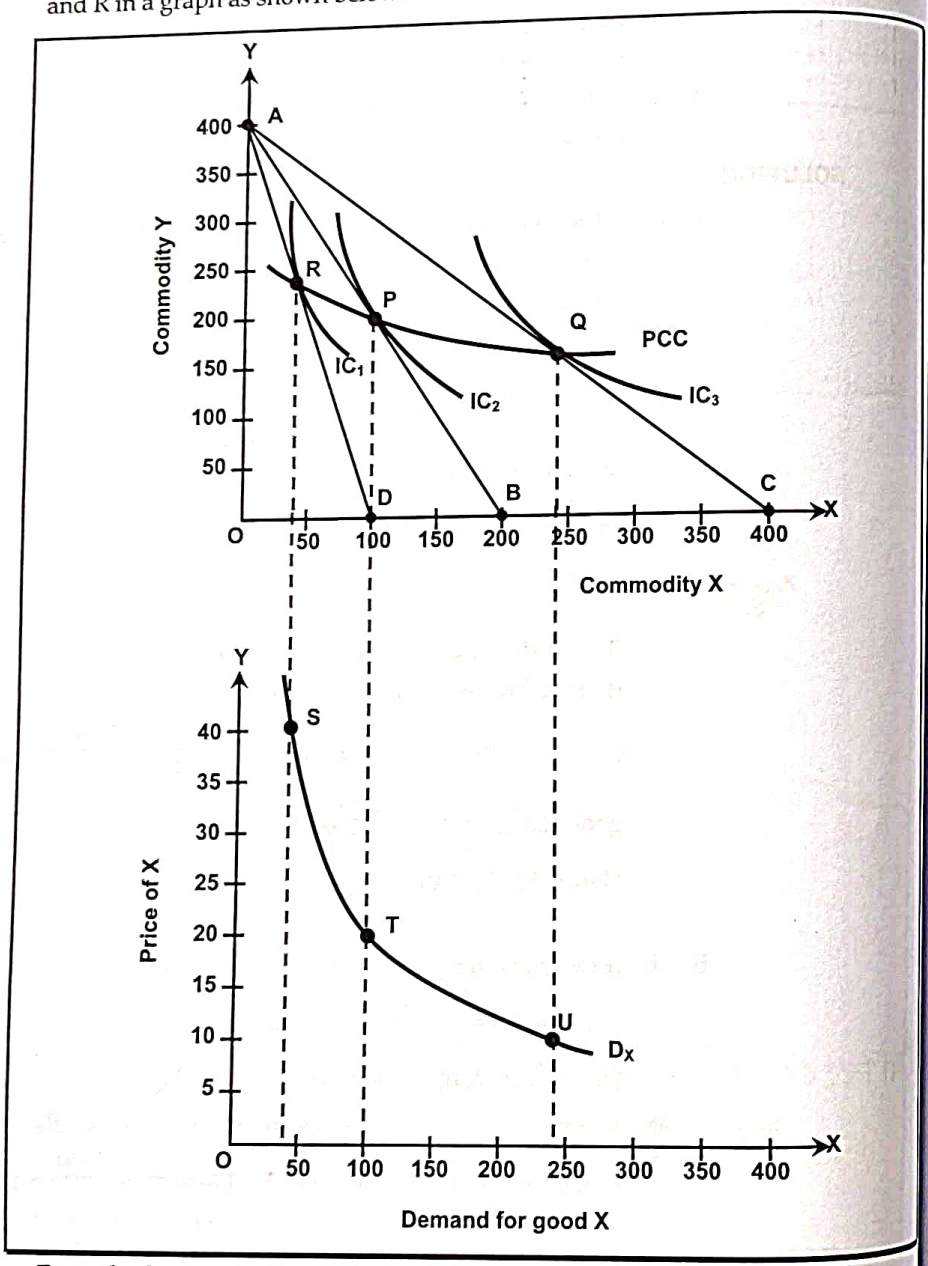
c. i. If the consumer spends all his money income on X good, he can purchase 100 units of X (i.e. $Q_X = \frac{B}{P_X} = \frac{4000}{40} = 100$ unit).

Hence, A(0, 400) and D (100, 0)

ii. If the consumer spends his money income equally on X and Y goods, he can purchase 40 units of X good (i.e. $Q_X = \frac{B}{P_X} = \frac{1600}{40}$ = 40 units) and 160 units of Y good (i.e. $Q_Y = \frac{B}{P_Y} = \frac{2400}{10}$ = 240 units).

Hence, R(40, 240)

The price effect can be find out by plotting points A, B and P; A, C and Q and A, D and R in a graph as shown below.



d. i. From the figure it is clear that X and Y goods are substitute goods.

ii. Relationship between price of X and demand for X.

At P_X = Rs. 20, Q_X = 100 units

At P_X = Rs. 10, Q_X = 240 units

At P_X = Rs. 40, Q_X = 40 units

By joining S, T and U in lower panel figure, we get demand curve for X good.

Criticism of Indifference Curve

Indifference curve/ordinal utility analysis can be criticized as follows:

Criticism of Indifference Curve
1. Two commodity model
2. Wrong assumption of rational consumer
3. No newness
4. Income, preference and habit change
5. Cannot explain about uncertainty
6. Unrealistic assumption of perfect competition

1. **Two commodity model:** Indifference curve only analyses the combinations of two goods at a time. But in reality, a consumer needs to consume many goods at the same time, which cannot be shown in a two dimension graph.
2. **Wrong assumption of rational consumer:** The indifference curve analysis assumes that the consumer acts rationally. But in this modern changing situation, it is very difficult for consumer to gather all necessary information. It is time consuming and costly. So, they are behaving whatever way they like. Therefore, consumers may not be rational.
3. **No newness: Professor Robertson** does not find anything new in the indifference curve technique and he regards it simply the old wine in a new bottle. It replaces introspective cardinalism by introspective ordinalism instead of the cardinal numbers such as 1, 2, 3, etc. ordinal numbers I, II, III, etc. are used to indicate consumer's preference. It substitutes marginal utility by marginal rate of substitution. Thus, this technique is failed to bring a positive change in the utility analysis and merely gives new name to the old concept.
4. **Income, preference and habit change:** The ordinal utility analysis is based on the assumption that income, preference and habit of the consumer remain same. But in this changing world, it is very hard to find a constant income, preference and habit of the consumers. It means that these elements change with the change in time.
5. **Cannot explain about uncertainty:** The ordinal utility theory is not capable of formulating consumers' behavior when their preferences involve risk or uncertainty in expectations.
6. **Unrealistic assumption of perfect competition:** The indifference curve technique is based on the unrealistic assumptions of perfect competition and homogeneity of gods. In reality, consumer is confronted with differentiated products and monopolistic competition. Since, the indifference curve analysis is based on unwarranted assumptions, it becomes unrealistic.

Difference between Cardinal and Ordinal Utility Analysis

1. The concept of cardinal utility analysis was developed by **H.H. Gossen**, and popularized by Alfred Marshall and other economists. According to cardinal economists, utility can be measured in number in term of money.

   The concept of ordinal utility analysis was developed by the economists **J.R. Hicks** and **R.G.D. Allen**. They have expressed that utility is only psychological or a subjective factor. So, this can be felt but not measured in a numerical form.
2. The cardinalists assumed that marginal utility of money is constant. But the ordinalists opposed this assumption. In practical life marginal utility of

money cannot be constant. It may change with the change in amount of money. Rather indifference technique analyzes the income effect when the income of the consumer changes.

3. As pointed by cardinalists, utility can be measured in terms of number. But the ordinalists rejected this assumption. The ordinal approach doesn't say that utility has to be measured by using cardinal number. It says that utility cannot be measured quantitatively.
4. The ordinal approach explains price effect into income effect and substitution effect which is not possible under cardinal utility analysis. It discusses the income effect when the consumer's income changes and the price effect when price of a good changes. Thus, it discusses dual effect in the form of the income and substitution effect. But cardinal approach cannot explain dual effect.
5. Ordinal approach explains that the two commodity model which discuss about the consumer's behavior in the case of substitutes, complementary and unrelated goods. But cardinal approach explains that single commodity model.
6. The ordinal analysis explains the law of demand more realistically by considering inferior and different goods as well. This makes the IC technique definitely superior to the cardinal utility analysis.

Similarities between Cardinal and Ordinal Utility Analysis

1. Both approaches assume the rational behavior of the consumer that he seeks to attain an equilibrium position by maximizing satisfaction.
2. Both techniques used the same proportionality rule for the consumer to maximise satisfaction or to reach in equilibrium position.

   According to cardinal utility analysis, the equilibrium condition is:

   $$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y} \qquad \text{... (i)}$$

   According to ordinal utility analysis, consumer is in equilibrium when his MRS is equal to price ratio, i.e.

   $$MRS_{XY} = \frac{P_X}{P_Y}$$

   But

   $$MRS_{XY} = \frac{MU_X}{MU_Y}$$

   Therefore,

   $$\frac{MU_X}{MU_Y} = \frac{P_X}{P_Y}$$

   $$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

   which is same with (i)

3. Both approaches assume diminishing utility, i.e. diminishing marginal utility in one case and diminishing marginal rate of substitution in another case.
4. Both approaches apply the psychological or introspective method. The law of diminishing utility which is psychological in nature lies at the bottom of law of demand being based on introspection. The indifference curve technique too, is based on introspection. Thus, both approaches are introspective.

Superiority of Ordinal Utility (Indifference Curve Approach)

Superiority of Ordinal Utility
1. More realistic measurement of utility
2. No assumptions of constant of marginal utility of money
3. Study of combination of two goods
4. Less assumptions
5. More general theory of demand
6. Closer analysis of price effect

Ordinal utility analysis is superior because of the following causes.

1. **More realistic measurement of utility:** Marshall examined consumer's behavior assuming that utility is measurable and additive. The consumer was assumed to be capable of assigning a number representing the amount of utility associated with it.

   On the other hand, indifference curve technique assumes ordinal measurement of utility. The consumer arranges the various combinations of goods in a scale of preference marked as first, second, third, etc. He can tell whether he prefers the first to the second or second to the first or he is indifferent between them. But he cannot tell by how much he prefers one to the other like in cardinal approach.

2. **No assumption of constant marginal utility of money:** Ordinal utility is not based on the assumption of constant marginal utility of money.

   Marshall ignored the income effect of a price change and thus failed to distinguish between the two components of the price effects. But indifference technique is able to draw a distinction between the income effect and substitution effect of price change.

3. **Study of combination of two goods:** The cardinal approach was a single good model in which utility of one commodity is regarded independent of the other. Marshall avoided the discussion of substitutes and complementary goods by grouping them together as one commodity. But it is far from reality because a consumer buys not one but combination of different goods at a time. The indifference curve technique is two commodity model which give importance to both goods.

4. **Less assumptions:** Indifference curve arrives at the same equilibrium condition for a consumer as the Marshallian analysis, but with less restrictive and fewer assumption than in Marshallian analysis.

5. **More general theory of demand:** Even with less restrictive and fewer assumptions, it gives us more general theory of demand. For the demand of Giffen goods, Marshallian utility theory fails to explain where indifference technique explains this.

6. **Closer analysis of price effect:** The indifference curve technique is also superior to the Marshallian utility analysis in the sense that it furnishes a closer analysis of the effect of a change in price on consumer demand for a good by bringing out clearly the distinction between the income effect and substitution effect.

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CHAPTER SUMMARY

Ordinal Utility

Ordinal utility only ranks the utility received form consuming various amount of a good or baskets of goods. Ordinal utility specifies that consuming two apples gives more utility than when consuming one apple, but it does not specify exactly how much additional utility the second apple provides. Similarly, ordinal utility would say only that three apples give more utility than two apples, but not how many more utils.

Assumptions of Ordinal Utility Analysis

1. Rationality
2. Ordinal utility
3. Diminishing marginal rate of substitution
4. Transitivity and consistency of choice
5. Non-satiety

Indifference Curve

An indifference curve shows the various combinations of two goods that give the consumer equal utility or satisfaction. A higher indifference curve refers to a higher level of satisfaction, and a lower indifference curve refers to less satisfaction. However, we have no indication as to how much additional satisfaction or utility a higher indifference curve indicates. That is, different indifference curves simply provide an ordering or ranking of the individual's preference.

Indifference Map

A set of indifference curve is called indifference map. An indifference map shows all the indifference curves which rank the preference of the consumer. Combinations of goods situated on an indifference curve give the same utility. Combination of goods situated on higher indifference curve gives higher level of satisfaction. Combinations of goods situated on lower indifference curve give lower level of satisfaction.

Properties of Indifference Curve

1. Indifference curve has a negative slope
2. Convex to the Origin
3. Indifference curves do not intersect each other
4. Higher indifference curve represents higher level of satisfaction than the lower ones
5. Indifference curves are not necessarily parallel
6. Indifference curve does not touch either axis

The Marginal Rate of Substitution (MRS)

MRS refers to the amount of one good that an individual is willing to give up for an additional unit of another good without affecting level of satisfaction or remaining on the same indifference curve. For example, the marginal rate of substitution of good X for good Y (MRS_{xy}) refers to the amount of Y that the individual is willing to exchange per unit of X and maintain the same level of satisfaction.

Why does MRS Diminish?

1. The particulars want is satiable:
2. Goods are not perfect substitute each other:
3. Increase in the quantity of one good does not increase the want satisfying of the other.

Consumer's Equilibrium

A consumer will be in equilibrium or get maximum satisfaction where an indifference curve is tangent to the budget line so that the slope of the indifference curve (the MRS_{xy}) is equal to the slope of the budget line (P_x/P_y).

Price effect: Price effect depicts the effect of a change in the price of a commodity on its purchase keeping the prices of all other commodities, the consumer's income, and tastes and preferences constant.

The price-consumption curve for good X is the locus of (i.e., joins) consumer optimum points resulting when only the price of good X varies.

Income effect: Income effect shows the effect on consumer's equilibrium position of a change in income, prices remaining constant.

The **income-consumption curve** is the locus of (i.e., joins) consumer optimum points resulting when only the consumer's income varies.

Substitution effect: The substitution of one commodity by another commodity due to a change in relative prices in order to maintain the original standard of living is known as the substation effect.

Criticism of Indifference Curve

1. Two Commodity Model
2. Wrong assumption of Rational Consume
3. No Newness
4. Income, Preference and habit changed
5. Cannot Explain about Uncertainty
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