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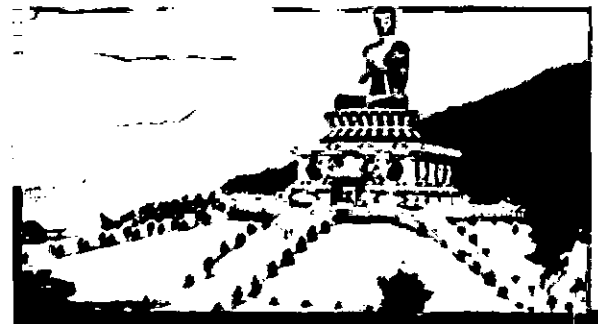


The Pathways To Higher Studies

Economics

Class-XII

ECONOMICS

CLASS 12

Content

1 FEATURES OF INDIAN ECONOMY

Module Content

Features of Indian Economy National and Per capita Income, Status of the Social sector, State of agriculture, Industry and foreign trade Meaning of Economic Planning, need for planning, objectives of planning, strategies of economic planning, achievements and drawbacks of Five-Year Plans in India, New Economic Policy 1991- Liberalization, Privatization & Globalization

Objective of the module

The main objective of this module is to make student understand about the concepts related to Indian economy. Concept of five-year plan and New Economic Policy 1991- Liberalization, Privatization & Globalization has also been explained in this module.

Introduction

Features of Indian Economy

1. **Strengths of Indian Economy**

1. ***India has a mixed economy***

   Indian economy is a typical example of mixed economy. This means both private and public sectors co-exist and function smoothly. On one side, some of the fundamental and heavy industrial units are being operated under the public sector, while, due to the liberalization of the economy, the private sector has gained importance. This makes it a perfect model for public – private partnership.

2. ***Agriculture plays the key role***

   Agriculture being the maximum pursued occupation in India, it plays an important role in its economy as well. Around 60% of the people in India depend upon agriculture for their livelihood. In fact, about 17% of our GDP today is contributed by the agricultural sector. Green revolution, ever green revolution and inventions in bio technology have made agriculture self sufficient and also surplus production. The export of agricultural products such as fruits, vegetables, spices, vegetable oils, tobacco, animal skin, etc. also add to forex earining through international trading.

3. ***An emerging market***

India has emerged as vibrant economy sustaining stable GDP growth rate even in the midst of global downtrend. This has attracted significant foreign capital through FDI and FII.India has a high potential for prospective growth. This also makes it an emerging market for the world.

4. ***Emerging Economy***

Emerging as a top economic giant among the world economy, India bags the ***seventh*** position in terms of nominal *Gross Domestic Product (GDP)* and ***third*** in terms of *Purchasing Power Parity (PPP)*. As a result of rapid economic growth Indian economy has a place among the G20 countries.

WORLD NATION IN G-20

1. Argentina	11. Italy
2. Australia	12. Japan
3. Brazil	13. Mexico
4. Canada	14. Russia
5. China	15. Saudi Arabia
6. European Union	16. South Africa
7. France	17. South Korea
8. Germany	18. Turkey
9. India	19. United Kingdom
10. Indonesia	20. United States

5. ***Fast Growing Economy***

India's economy is well known for high and sustained growth. It has emerged as the world's fastest growing economy in the year 2016 -17 with the growth rate of 7.1% in GDP next to People's Republic of China.

6. ***Fast growing Service Sector***

The service sector, contributes a lion's share of the GDP in India. There has been a high rise growth in the technical sectors like Information Technology, BPO etc. These sectors have contributed to the growth of the economy. These emerging service sectors have helped the country go global and helped in spreading its branches around the world.

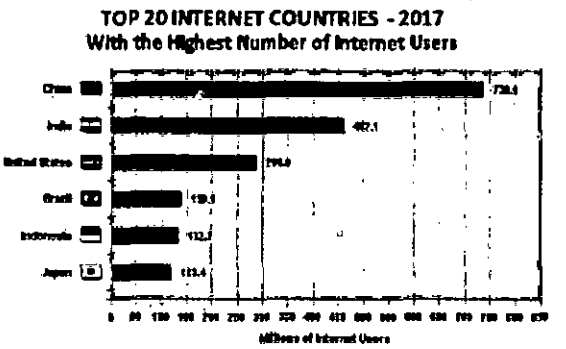


Diagram 7.2

7. ***Large Domestic consumption***

   With the faster growth rate in the economy the standard of living has improved a lot.

   This in turn has resulted in rapid increase in domestic consumption in the country. The standard of living has considerably improved and life style has changed.

8. ***Rapid growth of Urban areas***

   Urbanization is a key ingredient of the growth of any economy. There has been a rapid growth of urban areas in India after independence. Improved connectivity in transport and communication, education and health have speeded up the pace of urbanization.

9. ***Stable macro economy***

   The Indian economy has been projected and considered as one of the most stable economies of the world. The current year's Economic survey represents the Indian economy to be a ***"heaven of macroeconomic stability, resilience and optimism.*** According to the Economic Survey for the year 2014-15, 8%-plus GDP growth rate has been predicted, with actual growth turning out to be a little less (7.6%). This is a clear indication of a stable macroeconomic growth.

10. ***Demographic dividend***

    The human capital of India is young. This means that India is a pride owner of the maximum percentage of youth. The young population is not only motivated but skilled and trained enough to maximize the growth. Thus, human capital plays a key role in maximizing the growth prospects in the country. Also, this has invited foreign investments to the country and outsource opportunities too.

National Income

Some countries are rich, some are poor and yet some others are in-between. How do we measure the performance of an economy? Performance of an economy is related to the level of production (of goods and services) or total economic activity. Measures of national income and output are used in economics to estimate the total value of production in an economy. The standard measures of income and output are Gross National Product (GNP), Gross Domestic Product (GDP), Gross National Income (GNI), Net National Product (NNP), and Net National Income (NNI). In India, the Central Statistical Organisation has been estimating the national income.

You measure your academic performance in relation to other students by the percentage of the marks scored by you. Similarly, a country's economic performance has been measured by indicators of national income such as GDP or GNP. Further, measuring national income is essential for various purposes that include projection about the future course of the economy, assisting government as the basis to design

(or redesign) suitable development policies, helping firms in forecasting future demand for their products and facilitating international comparison.

National income per person or per capita income is often used as an indicator of people›s standard of living or welfare. However, many development economists have criticized that GNP as a measure of welfare has many limitations. They argued that human well-being does not depend on national income alone. As measures of GNP exclude poverty, literacy, public health, gender equity, and many human issues of well-being, they developed other measures of welfare such as the Human Development Index (HDI).

Some rich countries in terms of national income are poor in human development. Similarly, poor countries in terms national income have performed well in human development.

Per Capita Income

Per capita income (or) *output per person is an indicator to show the living standards of people in a country.* If real PCI increases, it is considered to be an improvement in the overall living standard of people. PCI is arrived at by dividing the GDP by the size of population. It is also arrived by making some adjustment with GDP.

GDP=PCI / Total number of people in a country

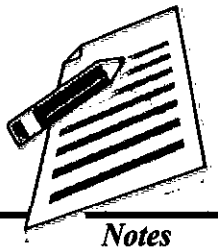
Agriculture in India:

History

- India has the History of cultivation of various crops since times immemorial.
- The crops like Wheat and Barley were cultivated in the Indian sub continent by 9000 BC.
- Some animals like sheep and Goat were also domesticated.
- There was also history of storing the grains in the granaries.
- By 5th millennium BC Cotton was cultivated.
- Some fruits like Mango were native to the Indian sub continent.
- Peas, Sesame and dates were cultivated by the Indus valley people.
- Even today the agriculture is considered to be the main stay of Indian economy.

Importance of Agriculture in Indian Economy:

- Agriculture is the predominant occupation in India employing more than 50% of the population In India.
- The **GDP** (Gross Domestic Product) is the indicator of the performance of an economy.
- At present (2010) the Indian GDP is $1.53 trillion.
- **By the year 2015** it is expected that the India's GDP would touch $ 2 trillion.



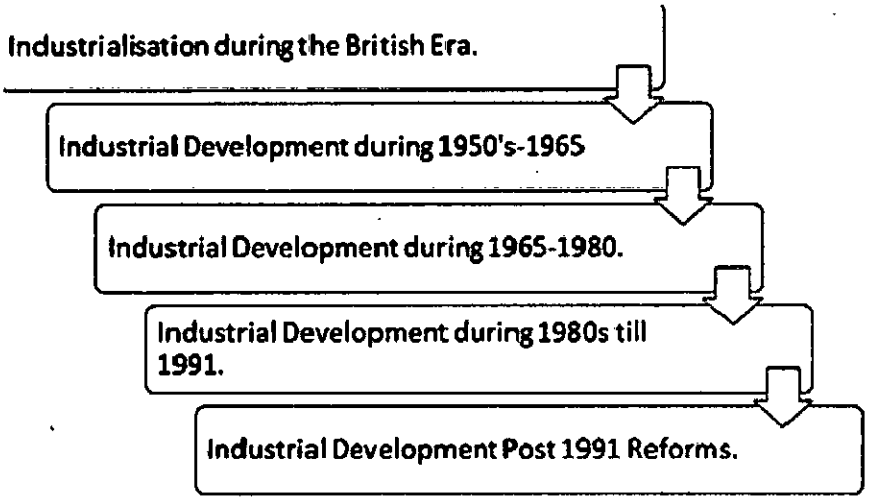
- The agriculture contributes about 18% to the India's GDP.
- Though the input into the agriculture is declining for past few years, the agriculture still continues to be the biggest contributor.
- This provides raw material to various agro-based (agriculture based) industries such as Sugar, Cotton textile, Jute etc.
- Through the system of transport, processing and marketing it contributes to the tertiary sector.
- Agriculture meets the food requirement of the people in India.
- The surplus produced is exported to other countries and can generate foreign exchange.
- It provides a large market for industrial goods like fertilizers, pesticides, machinery etc.
- Agriculture reduces the inequalities in income if the agricultural income is increased.

Progress of Agriculture in India since Independence:

- In 1947, the agricultural productivity was very low, about 50 million tonnes.
- The agriculture was mainly rained and was being done as a subsistence farming using mainly animate sources of farm power and traditional tools and equipment's.
- More than 80% of the population living in rural areas was dependent on agriculture for their livelihood.
- The ICAR (Indian Council of Agriculture Research) was set up in the year 1929.
- ICAR is located in New Delhi
- Up to 1947 the efforts in agricultural engineering research and education was very low.
- Agriculture requires developing equipment and technologies for mechanization of agriculture for maximizing efficiency of costly inputs like seeds, fertilizers, irrigation water, plant protection chemicals, and energy sources to increase higher production and productivity, reduction of drudgery; post-harvest technology and value addition, waste utilization, and generating income and employment in rural areas.
- Besides these research-cum-academic institutions, a good amount of research opportunity was opened up in the soil and water engineering with the establishment of the 1st river valley project, the Damodar Valley Corporation in 1949, to tackle the problems of soil and water conservation in Bihar and West Bengal.
- First five-year plan (1951 to 1956) gave high priority to agriculture

- Soil conservation centres at different regions of the country from the First Five-Year plan.
- Subsequently all these centres were administratively combined together as a Central Soil and Water Conservation Research Institute at Dehra Dun under the ICAR in 1975, with 6 regional centres.
- Some organizations other than the ICAR have shown interest in sponsoring research in different areas of agricultural engineering, by giving financial support and as integral part of the activity of these organizations.

Industrial Development in India



Industrialisation during the British Rule

Indian Industry had a global presence before the advent of Britishers in India. Before the advent of British in India, India accounted for a quarter of World's Industrial output.

The exports from India consisted of manufacturers goods like cotton, silk, artistic ware, silk and woollen cloth.

The impact of British Policies and the Industrial Revolution led to the decay of Indian handicraft industry. Post-Industrial revolution in Britain, machine-made goods starting flooding into the Indian markets.

The decline of traditional handicraft was not followed by the rise of modern Industrialisation in India due to the British policy of encouraging the imports of British made goods and exports of raw materials from India.

The Second Phase (1965-1980): The Period of Industrial Deceleration

The first three five-year plans mostly focused on the development of the Capital Good sector. As a result, the consumer goods sector was left neglected. The consumer goods sector also known as wage good sector is considered to be the backbone of the rural economy and its complete neglect had resulted in fall in the growth rate of industrial production as well as of the overall economy

Phase Three (1980-1991): Industrial Recovery

The period of the 1980s can be considered as the period of the Industrial recovery. The period saw a revival in the industrial growth rates. The period witnessed an industrial growth rate of more than 6 percent during the sixth plan and 8.5 percent during the seventh plan. The period was also marked by a significant recovery in the manufacturing and capital good sector. The most important observation from the revival of industrial sector was that the revival is closely associated with the increase in the productivity of Indian Industries.

Phase Four (Post Reform Period)

The year 1991 ushered a new era of economic liberalisation. India took major liberalisation decision to improve the performance of the industrial sector.

1. Abolishment of the Industrial Licensing.
2. Simplification of the procedures and regulatory requirement to start a business.
3. Reduction in the sector exclusively reserved for the Public sector.
4. Disinvestment of the selected Public-sector undertakings.
5. Foreign investors were allowed to invest in the Indian firms.
6. Liberalisation of the trade and exchange rate policies.
7. Rationalisation and massive reduction in the structure of Customs Duties.
8. Reduction in the excise duties.
9. Reduction in the Income and Corporate taxes to promote Business.

The Period since 2002-03:

The period since the new millennium witnessed a sharp recovery and revival of the industrial sector. The tenth and eleventh plan witnessed a high growth rate of industrial production.

The rate of growth of the industrial sector was 5 percent during the initial years of the Tenth Plan. The growth picked in the following years and reached 7% in 2003-04, 8% in 2004-05 and 11% in 2006-07. For the plan as a whole, the growth rate was 8.2 percent.

2 ECONOMIC PLANNING IN INDIA

Economic Planning in India

Economic Planning - A system where a central authority, in this case, Planning Commission, now NITI Ayog, in India sets a set of targets and mention sit programmes to be achieved within a specific period of time.

NEED OF PLANNING IN INDIA: Owing to the backwardness and stagnation in the economy it could not be left in the hands of market forces of supply and demand to make way for growth and development. A heavy investment supported by the government was required and therefore Planning in India was needed.

DIRECTIVE AND COMPREHENSIVE PLANNING

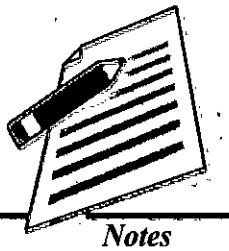
Directive Planning: System of planning where planning is just used to direct the forces of supply and demand. There is no direct participation of the state in the process of growth and is solely there for ensuring law and order. This principal is mostly pursued in capitalist economies.

Comprehensive Planning: System in which government participates in the process of growth and development. This planning is mostly pursued in mixed and socialist economies

Objectives of Economic Planning in India

The following were the original objectives of economic planning in India:

- Economic Development: This is the main objective of planning in India. Economic Development of India is measured by the increase in Gross Domestic Product (GDP) and Per Capita Income
- Increased Levels of Employment: An important aim of economic planning in India is to better utilise the available human resources of the country by increasing the employment levels.
- Self Sufficiency: India aims to be self-sufficient in major commodities and also increase exports through economic planning. The Indian economy had reached the take-off stage of development during the third five-year plan in 1961-66.
- Economic Stability: Economic planning in India also aims at stable market conditions in addition to the economic growth of India. This means keeping inflation low while also making sure that deflation in prices does not happen. If the wholesale price index rises very high or very low, structural



defects in the economy are created and economic planning aims to avoid this.

- Social Welfare and Provision of Efficient Social Services: The objectives of all the five year plans as well as plans suggested by the NITI Aayog aim to increase labour welfare, social welfare for all sections of the society. Development of social services in India, such as education, healthcare and emergency services have been part of planning in India.
- Regional Development: Economic planning in India aims to reduce regional disparities in development. For example, some states like Punjab, Haryana, Gujarat, Maharashtra and Tamil Nadu are relatively well developed economically while states like Uttar Pradesh, Bihar, Orissa, Assam and Nagaland are economically backward. Others like Karnataka and Andhra Pradesh have uneven development with world class economic centres in cities and a relatively less developed hinterland. Planning in India aims to study these disparities and suggest strategies to reduce them.
- Comprehensive and Sustainable Development: Development of all economic sectors such as agriculture, industry, and services is one of the major objectives of economic planning.
- Reduction in Economic Inequality: Measures to reduce inequality through progressive taxation, employment generation and reservation of jobs has been a central objective of Indian economic planning since independence.
- Social Justice: This objective of planning is related to all the other objectives and has been a central focus of planning in India. It aims to reduce the population of people living below the poverty line and provide them access to employment and social services.
- Increased Standard of Living: Increasing the standard of living by increasing the per capita income and equal distribution of income is one of the main aims of India's economic planning.

History of Economic Planning in India

Economic planning in India dates back to pre-Independence period when leaders of the freedom movement and prominent industrialists and academics got together to discuss the future of India after Independence which was soon to come. Noted civil engineer and administrator M. Visvesvaraya is regarded as a pioneer of economic planning in India. His book "Planned Economy for India" published in 1934 suggested a ten-year plan, with an outlay of Rs. 1000 crore and a planned increase of 600% in industrial output per annum based on economic conditions of the time.

The Industrial Policy Statement published just after independence in 1948 recommended setting up of a Planning Commission and following a mixed economic model. Here are the major milestones related to economic planning in India:

- Setting up of the Planning Commission: 15 March 1950
- First Five-Year Plan: 9 July 1951
- Dissolution of the Planning Commission: 17 August 2014
- Setting up of NITI (National Institution for Transforming India) Aayog: 1 January 2015

Setting up the NITI Aayog was a major step away from the command economy structure adopted by India till 1991. The Planning Commission's top-down model of development had become redundant due to present economic conditions and NITI Aayog approaches economic planning in a consultative manner with input from various state governments and think tanks.

SUCCESS (ACHIEVEMENT) OF PLANNING

1. **Increase in National Income**
   - Increase in National Income was seen during the First Plan and this gradually started increasing though not at a very fast pace and rate.
   - The economy was free from the deadlock and economic stagnation.
2. **Increase in Per Capita Income**
   - Per capita income was extremely low prior to the period of planning which started to increase on average basis now.
   - This increase in per capita income shows that there is the availability of goods and services to all sectors of society.
3. **Institutional and Technical Change in Agriculture**
   - Development of Agriculture took place through Land Reforms and Improvement in Technology.
   - Land reforms included the abolition of middle men between the state and tillers of the soil, moderation of rent, land ceilings, redistribution of land and consolidation of landholdings.
   - Improvement through the use of HYV seeds which resulted from rise in output and self - sufficiency in food grains.
4. **The rise in Savings and Investment**
   - Increase in both the principal elements of economic growth noted.
5. **Growth and Diversification of the Industry**.
   - Basic and capital goods industries like iron and steel started developing.
   - Self - sufficiency achieved in the consumer goods industries.
6. **Infrastructure (Social & Economic)**
   - Key elements of economic infrastructure like means of communication, transport, power generation, IT sector, etc. started showing significant growth.
   - Healthcare and educational facilities were improved and accessible which can be seen in the lower Death Rate and increased Life - Expectancy.

7. **Employment**
   - Several employment schemes introduced by the government in different Five Year Plans, which resulted in a decreased rate of unemployment.
8. **International Trade**
   - Volume and Value of India's foreign trade increased and the composition of exports imports was changed as well. India started exporting finished goods and importing inputs for industrial output

FAILURES OF PLANNING IN INDIA

1. **Abject Poverty**
   - Despite poverty alleviation was the central motive of planning still around 20% population in India lives below the poverty line and fifty percent of worlds absolutely poor reside in India.
2. **High Rate of Inflation**
   - Planning failed to control inflationary spiral in India.
3. **Unemployment Crisis**
   - Despite more employment opportunities, unemployment has not yet subsided which is a threat to social unrest and growth process.
4. **Inadequate Infrastructure**
   - Actual growth failed to meet the targets of growth even after 67 years of planning.
5. **Skewed Distribution**
   - Widening of an economic gap between the rich and the poor constantly leading to social inequality and therefore the requirements of reservations for weaker sections of society both socially and economically.

India's five-year plan summary

An overview of all plans implemented in India is given below. The first eight plans had their emphasis on growing the public sector with massive investments in basic and heavy industries, but since the launch of the Ninth Plan in 1997, attention has shifted towards making government a facilitator in growth.

Plan	Objective/Features	Assessment
First Five-year Plan (1951-56)	Rehabilitation of refugees, rapid agricultural development to achieve food self-sufficiency in the shortest possible time and control of inflation.	Targets and objectives more or less achieved. With active role of state in all economic sectors. Five Indian Institutes of Technology (IITs) were started as major technical institutions.

Plan	Objective/Features	Assessment
Second Five-year Plan (1956-61)	Nehru-Mahalanobis model was adopted. 'Rapid industrialisation with particular emphasis on the development of basic and heavy industries 'Industrial Policy of 1956 accepted the establishment of a socialistic pattern of society as the goal of economic policy.	Could not be implemented fully due to shortage of foreign exchange. Targets had to be pruned. Yet, Hydroelectric power projects and five steel mills at Bhilai, Durgapur, and Rourkela were established.
Third Five-year Plan (1961-66)	'establishment of a self-reliant and self-generating economy'	Failure. Wars and droughts. Yet, Panchayat elections were started. • State electricity boards and state secondary education boards were formed.
Annual Plan (1966-69)	crisis in agriculture and serious food shortage required attention	A new agricultural strategy was implemented. It involved distribution of high-yielding varieties of seeds, extensive use of fertilizers, exploitation of irrigation potential and soil conservation measures.
Fourth Five-year Plan (1969-74)	'growth with stability' and progressive achievement of self-reliance 'Garibi HataoTarget: 5.5 pc	Was ambitious. Big failure. Achieved growth of 3.5 percent but was marred by Inflation. The Indira Gandhi government nationalized 14 major Indian banks and the Green Revolution in India advanced agriculture.
Fifth Five-year Plan (1974-79)	'removal of poverty and attainment of self-reliance'	High inflation. Was terminated by the Janta govt. Yet, the Indian national highway system was introduced for the first time.
Sixth Five-year Plan (1980-85)	'direct attack on the problem of poverty by creating conditions of an expanding economy'	Most targets achieved. Growth: 5.5 pc. Family planning was also expanded in order to prevent overpopulation.
Seventh Five-year Plan (1985-1990)	Emphasis on policies and programmes that would accelerate the growth in food grains production, increase employment opportunities and raise productivity	With growth rate of 6 pc, this plan was proved successful in spite of severe drought conditions for first three years consecutively. This plan introduced programs like Jawahar Rozgar Yojana.

Plan	Objective/Features	Assessment
Annual Plans (1989-91)	No plan due to political uncertainties	It was the beginning of privatization and liberalization in India.
Eighth Five-year Plan (1992-97)	Rapid economic growth, high growth of agriculture and allied sector, and manufacturing sector, growth in exports and imports, improvement in trade and current account deficit. to undertake an annual average growth of 5.6%	Partly success. An average annual growth rate of 6.78% against the target 5.6% was achieved.
Ninth Five-year Plan (1997- 2002)	Quality of life, generation of productive employment, regional balance and self-reliance. Growth with social justice and equality. growth target 6.5%	It achieved a GDP growth rate of 5.4%, lower than target. Yet, industrial growth was 4.5% which was higher than targeted 3%. The service industry had a growth rate of 7.8%. An average annual growth rate of 6.7% was reached.
Tenth Five-year Plan (2002 – 2007)	To achieve 8% GDP growth rate, Reduction of poverty by 5 points and increase the literacy rate in the country.	It was successful in reducing poverty ratio by 5%, increasing forest cover to 25%, increasing literacy rates to 75 % and the economic growth of the country over 8%.
Eleventh Five-year Plan (2007 – 2012)	Rapid and inclusive growth. Empowerment through education and skill development. Reduction of gender inequality. Environmental sustainability. To increase the growth rate in agriculture, industry and services to 4%,10% and 9% resp. Provide clean drinking water for all by 2009.	India has recorded an average annual economic growth rate of 8%, farm sector grew at an average rate of 3.7% as against 4% targeted. Industry grew with annual average growth of 7.2% against 10% targeted.

The main objective of 12th Five Year Plan

The twelfth plan has the following objectives

- Basic objective: Faster, More inclusive, and Sustainable growth
- Is 10% growth feasible? Realistically, even 9% will need strong policy action. Could aim at 9.0 to 9.5 percent
- Energy, Water and Environment present major sectoral challenges. Can we address them without sacrificing growth?
- Can we find resources to create a world class infrastructure?

New Economic Policy 1991- Liberalization, Privatization & Globalization

Nature of Indian economy in the pre reform era:

Indian economic policy after independence was influenced by the colonial experience, which emphasised on **industrialization under state monitoring, state intervention** in labour and financial markets, a large public sector, **business regulation, and central planning.**

Indian economy was a closed one. Licence Raj was prevalent to set up business in India.

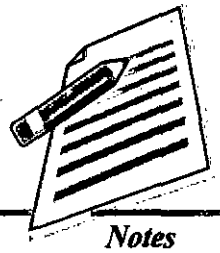
The **Indian rupee was inconvertible** and high tariffs and import licensing prevented foreign goods reaching the market.

The central pillar of the policy was **import substitution**, the **belief that India needed to rely on internal markets for development, not international trade**. There was **restriction of foreign investment and technology** and government-controlled finance and capital markets.

There were high duties and taxes with multiple rates and large dispersion. **PSUs were considered as the engine of growth.** There were **restrictions on Foreign Direct Investment (FDI)** and Multinational corporations (MNCs).

Factors which lead to 1991 economic reforms:

- **Rise in Prices:** The **inflation rate increased from 6.7% to 16.7%** due to rapid increase in money supply and the country's economic position became worse.
- **Rise in Fiscal Deficit:** Due to **increase in non-development expenditure** fiscal deficit of the government increased. Due to rise in fiscal deficit there was a rise in public debt and interest. **In 1991 interest liability became 36.4% of total government expenditure.**
- **Increase in Adverse Balance of Payments:** In 1980-81 it was Rs. 2214 crore and rose in 1990- 91 to Rs. 17,367 crores. To cover this deficit **large amount of foreign loans** had to be obtained and the interest payment got increased.
- **Iraq War:** In 1990-91, war in Iraq broke, which led to a rise in petrol prices. The flow of foreign currency from Gulf countries stopped and this further aggravated the problem.
- Dismal Performance of PSUs: These were not performing well due to political interference and became big liability for government.
- Fall in Foreign Exchange Reserves: India's foreign exchange reserve fell to low ebb in 1990-91 and it was insufficient to pay for an import bill for 2 weeks.



International events associated with Indian reforms:

- The **Soviet Union was collapsing** at the time, proving that more socialism could not be the solution for India's ills.
- **Deng Xiaoping had revolutionized China with market-friendly reforms.**
- **1990-91 Iraq war** led to the stoppage of flow of foreign currency from Gulf countries.
- To tide over the Balance of Payment **(BoP) issues**, India borrowed huge amount from **International Monetary Fund (IMF).**
- The **Asian financial crisis of 1997-99** laid India low.
- The **dot-com collapse and global recession of 2001,** and the huge global uncertainty created in the run-up to the **invasion of Iraq in 2003.**
- The **global boom of 2003-08 spearheaded by China.**

Nature and scope of reforms:

India's New Economic Policy was **announced on July 24, 1991 known as the LPG** or Liberalisation, Privatisation and Globalisation model.

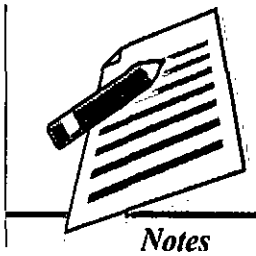
- **Liberalization-** It refers to the process of making policies less constraining of economic activity and also reduction of tariff or removal of non-tariff barriers.
- **Privatization-** It refers to the transfer of ownership of property or business from a government to a privately owned entity.
- **Globalization-** It refers to the expansion of economic activities across political boundaries of nation states.

The **main objective** was to plunge Indian economy into the arena of "Globalization" and to give it a new thrust on market orientation. The policy was intended to move **towards higher economic growth rate** and to build sufficient foreign exchange reserves.

It wanted to achieve **economic stabilization** and to convert the economy into a **market economy** by removing all kinds of unnecessary restrictions. The policy aimed at increasing the **participation of private players in all sectors** of the economy.

Salient features of LPG Policy:

- Abolition of Industrial licensing/ Permit Raj
- Public sector role diluted
- MRTP limit goes
- Beginning of privatisation
- Free entry to foreign investment and technology



- Industrial location policy liberalized
- Abolition of phased manufacturing programmes for new projects
- Removal of mandatory convertibility cause
- Reduction in import tariffs
- Deregulation of markets
- Reduction of taxes

Outcome of the LPG reforms:

Positive outcomes:

- **India's GDP growth rate increased.** During 1990-91 India's GDP growth rate was only 1.1% but after 1991 reforms GDP growth rate increased year by year and in 2015-16 it was estimated to be 7.5% by IMF.
- Since 1991, India has firmly established itself as a lucrative foreign investment destination and **FDI equity inflows in India** in 2019-20 (till August) stood at US$ 19.33 billion.
- In 1991 the unemployment rate was high but after India adopted new LPG policy **more employment got generated** as new foreign companies came to India and due to liberalisation, many new entrepreneurs started companies.
- **Per Capita income increased** due to an increase in employment.
- **Exports** have increased and stood at USD 26.38 billion as of October, 2019.

Negative outcomes:

- In 1991, agriculture provided employment to 72 percent of the population and contributed 29.02 percent of the GDP. Now the **share of agriculture in the GDP has gone down drastically to 18 percent.** This has resulted in a lowering the per capita income of the farmers and increasing the rural indebtedness.
- Due to opening up of the Indian economy to foreign competition, **more MNCs are competing local businesses and companies** which are facing problems due to financial constraints, lack of advanced technology and production inefficiencies.
- Globalization has also contributed to the **destruction of the environment** through pollution by emissions from manufacturing plants and clearing of vegetation cover. It further affects the health of people.
- LPG policies have led to **widening income gaps within the country.** The higher growth rate is achieved by an economy at the expense of declining incomes of people who may be rendered redundant.

Summary of the Chapter

The term economic planning is used to describe the long-term plans of the government of India to develop and coordinate the economy with efficient utilization of resources. Economic planning in India started after independence in the year 1950 when it was deemed necessary for economic growth and development of the nation.

Long term objectives of Five-Year Plans in India are:

- High Growth rate to improve the living standard of the residents of India.
- Economic stability for prosperity.
- Self-reliant economy.
- Social justice and reducing the inequalities.
- Modernization of the economy.

The idea of economic planning for five years was taken from the Soviet Union under the socialist influence of first Prime Minister Pt. Jawahar Lal Nehru.

The first eight five-year plans in India emphasised on growing the public sector with huge investments in heavy and basic industries, but since the launch of Ninth five-year plan in 1997, attention has shifted towards making government a growth facilitator.

EXERCISE

Multiple Choice Questions

1. The Planning commission of India is?
   (a) A constitutional body
   (b) An independent and autonomous body
   (c) A statutory body
   (d) A non-statutory body
   (e) None of these

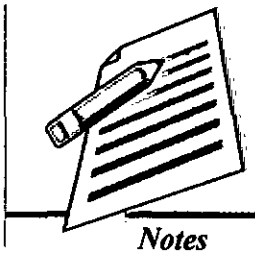
Answer (d) (A non-statutory body)

2. Mahalanobis Model has been associated with five-year plan?
   (a) First Five Year Plan
   (b) Second Five Year Plan
   (c) Third Five Year Plan
   (d) Fourth Five Year Plan
   (e) None of these

Answer (b) (Second Five Year Plan)

3. Which plan gave emphasis on removal of poverty for the first time?
   (a) Fourth (b) Fifth
   (c) Sixth (d) Seventh
   (e) None of these

Answer (b) (Fifth)



4. The Planning Commission of India was constituted in the year?
   (a) 1942
   (b) 1947
   (c) 1950
   (d) 1955
   - **None**

Answer(c) (1950)

5. A rolling plan refer to a plan which?
   (a) does not change it target every year
   (b) changes its allocation every year
   (c) changes its allocations and target every year
   (d) changes only its target every year
   - **None**

Answer (c) (changes its allocations and target every year)

6. In India the concept of 'minimum needs' and 'directed anti-poverty programmes' were the innovation of?
   (a) Fourth five-year plan
   (b) Fifth five-year plan
   (c) Sixth five-year plan
   (d) Seventh five-year plan
   (e) None of these

Answer (b) (Fifth five-year plan)

7- When was the planning commission established?
   (a) 10th March 1950
   (b) 15th March 1950
   (c) 20th March 1950
   (d) 16th March 1951
   (e) None of these

Answer (b) (15th March 1950)

Review Questions

Q1. what is economic planning and its objectives?
Q2. What is role of economic planning?
Q3. What do you underrated by the term five yrae planning?
Q4. Why are the limitations of economic planning in India?
Q5. What are the objectives of 12th five-year plan in India?
Q6. Give a brief overview of five-year plans in India?

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3 MEANING OF ECONOMIC GROWTH AND ECONOMIC DEVELOPMENT

Module Content

Meaning of Economic Growth and Economic Development. Difference between Economic Growth and Economic Development; Concept of Sustainable Economic Development; Concept of Human Development, Human Development Index, factors affecting economic growth, Common features of underdeveloped countries Meaning, Types and measures of unemployment, Causes of unemployment in India, Concept of Poverty line and estimates of Poverty, Causes of Poverty in India, Poverty alleviation and employment generation programmes in India, Inequality in income and Regional Inequality

Objective of the module

The main objective of this module is to make student understand about the basics of Economic Growth and Economic Development and their difference as well. Apart from that Types and measures of unemployment, causes of unemployment in India has also been explained in this module.

Introduction

Meaning of Economic Growth and Economic Development

Economic growth is the increase in goods & Services produced by an economy or nation, considered for a specific period of time. The rise in the country's output of goods and services is steady and constant and may be caused by an improvement in the quality of education, improvements in technology or in any way if there is a value addition in goods and services which is produced by every sector of the economy.

It can be measured as a percentage increase in real gross domestic product. Where a gross domestic product (GDP) is adjusted by inflation. GDP is the market value of final goods & services which is produced in an economy or nation.

Economic Development is the process focusing on both qualitative and quantitative growth of the economy. It measures all the aspects which include people in a country become wealthier, healthier, better educated, and have greater access to good quality housing. Economic Development can create more opportunities in the sectors of education, healthcare, employment and the conservation of the environment. It indicates an increase in the per capita income of every citizen. The standard of living includes various things like safe drinking water, improve sanitation systems, medical facilities, the spread of primary education to improve

literacy rate, eradication of poverty, balanced transport networks, increase in employment opportunities etc. Quality of living standard is the major indicator of economic development. Therefore, an increase in economic development is more necessary for an economy to achieve the status of a Developed Nation.

It can be measured by the Human Development Index, which considers the literacy rates & life expectancy which affect productivity and could lead to Economic Growth.

Economic Growth vs Economic Development

The basis of Comparison between Economic Growth vs Economic Development	Economic Development	Economic Growth
Concept	Economic development is a much broader concept than economic growth. Economic development = Economic Growth + Standard of Living	Economic Growth is a narrower concept than economic development.
Scope	Economic Development is considered as a Multidimensional phenomenon because it focuses on the income of the people and on the improvement of the living standards of the people of the country.	Economic Growth is considered as a single dimensional in nature as it only focuses on the income of the people of the country.
Term	Long-term process	Short term process
Measurement	Both Qualitative & Quantitative Terms: HDI (Human Development Index), gender-related index, Human poverty index, infant mortality, literacy rate etc.	Quantitative Terms: Increases in real GDP.
Related To	Economic Development is related to Underdeveloped and developing countries of the world.	Economic Growth is related to developed countries of the world.

Effect	Qualitative and Quantitative Impact on the economy. Improvement in life expectancy rate, infant, literacy rate, poverty rates, and mortality rate.	Brings a quantitative impact on the economy. Increase in the indicators like per capita income and GDP, etc.
Process Tenor	Continuous process	In a certain period

Conclusion – Economic Growth vs Economic Development

After examining the above information, we can say that Economic Growth is a subset of Economic development. Economic Development is a bigger concept than economic growth. Economic Development uses various indicators to measure the progress in an economy as a whole, however, Economic growth uses only specific indicators like the gross domestic product, individual income, etc for the calculation. Economic Growth is often contrasted with Economic Development, which can be defined as the increase in the economic wealth of an economy or nation, for the welfare of its residents. Here, you should know that economic growth is essential but not the only condition for economic development.

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Sustainable economic development

Economic growth occurs when **real output** increases over time. Real output is measured by Gross Domestic Product (GDP) at **constant prices**, so that the effect of price rises on the *value* of national output is removed.

Sustainable economic growth means a rate of growth which can be maintained without creating other significant economic problems, especially for future generations. There is clearly a *trade-off* between rapid economic growth today, and growth in the future. Rapid growth today may exhaust resources and create environmental problems for future generations, including the depletion of oil and fish stocks, and global warming.

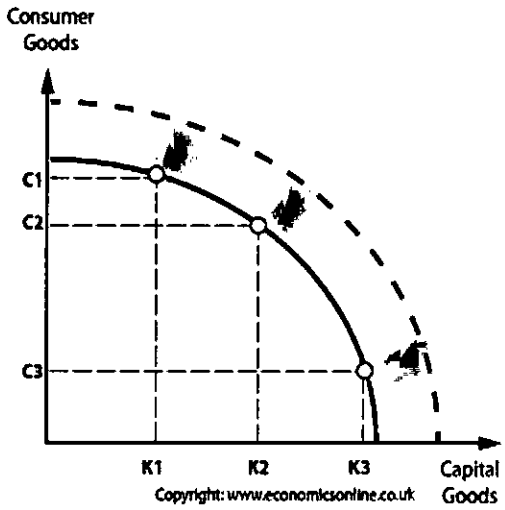
Periods of growth are often triggered by increases in **aggregate demand**, such as a rise in consumer spending, but sustained growth must involve an increase in **output**. If output does not increase, any extra demand will push up the **price level**.

Main features of sustainable economic development:

(i) Reduction in pollution
(ii) Quality of life of the future generation should not reduce.
(iii) Efficient use of natural resources.

PPFs and economic growth

For an economy to continue to grow in the future, it needs to increase its *capacity* to grow. An increase in an economy's productive potential can be shown by an outward shift in the economy's PPF.



Human Development:

The term 'human development' may be defined as an expansion of human capabilities, a widening of choices, 'an enhancement of freedom, and a fulfilment of human rights.

At the beginning, the notion of human development incorporates the need for income expansion. However, income growth should consider expansion of human capabilities. Hence development cannot be equated solely to income expansion.

Income is not the sum-total of human life. As income growth is essential, so are health, education, physical environment, and freedom. Human development should embrace human rights, socio-eco-politico freedoms. Based on the notion of human development. Human Development Index (HDI) is constructed. It serves as a more humane measure of development than a strictly. income-based benchmark of per capita GNP.

The first UNDP Human Development Report published in 1990 stated that: **"The basic objective of development is to create an enabling environment for people to enjoy long, healthy and creative lives."** It also defined human development as "a process of enlarging people's choices", "and strengthen human capabilities" in a way which enables them to lead longer, healthier and fuller lives.

From this broad definition of human development, one gets an idea of three critical issues involved in human development interpretation. These are: to lead a long and healthy life, to be educated, and to enjoy a decent standard of living. Barring these three crucial parameters of human development as a process enlarging people's choices, there are additional choices that include political freedoms, other guaranteed human rights, and various ingredients of self-respect.

One may conclude unhesistantly that the absence of these essential choices debars or blocks many other opportunities that people should have in widening their choices. Human development is thus a process of widening people's choices as well as raising the level of well-being achieved.

What emerges from- the above discussion is that economic growth measured in terms of per capita GNP focuses only on one choice that is income. On the other hand, the notion of human development embraces the widening of all human choices—whether economic, social, cultural or political. One may, however, contest GDP/GNP as a useful measure of development since income growth enables persons in expanding their range of choices.

This argument is, however, faulty. Most importantly, human choices go far beyond income expansion. There are so many choices that are not dependent on income. Thus, human development covers all aspects of development. Hence it is a holistic concept. **"Economic growth, as such becomes only a subset of human development paradigm."**

Objectives of Human Development:

In the traditional development economics, development meant growth of per capita real income. Later on, a wider definition of development came to be assigned that focused on distributional objectives. Economic development, in other words, came to be redefined in terms of reduction or elimination of poverty and inequality.

These are, after all, 'a goods-oriented' view of development. True development has to be 'people- centred'. When development is defined in terms of human welfare it means that people are put first. This 'people-oriented' view of development is to be called human development.

It is thus clear that per capita income does not stand as a true index of development of any country. To overcome this problem and to understand the dynamics of development, the United Nations Development Programme (UNDP) developed the concept of Human Development Index (HDI) in the 1990s. This index brought in revolutionary changes not only in development, but also in the policy environment in which the government was assigned a major role instead of market forces.

Economic development now refers to expanding capabilities. According to Amartya Sen, the basic objective of development is 'the expansion of human capabilities. The capability of a person reflects the various combinations of 'doings and beings' that one can achieve. It then reflects that the people are capable of doing or being. Capability thus describes a person's freedom to choose between different ways of living.

Components of Human Development:

The noted Pakistani economist Mahbub ul Haq considered four essential pillars of human development.

These are:

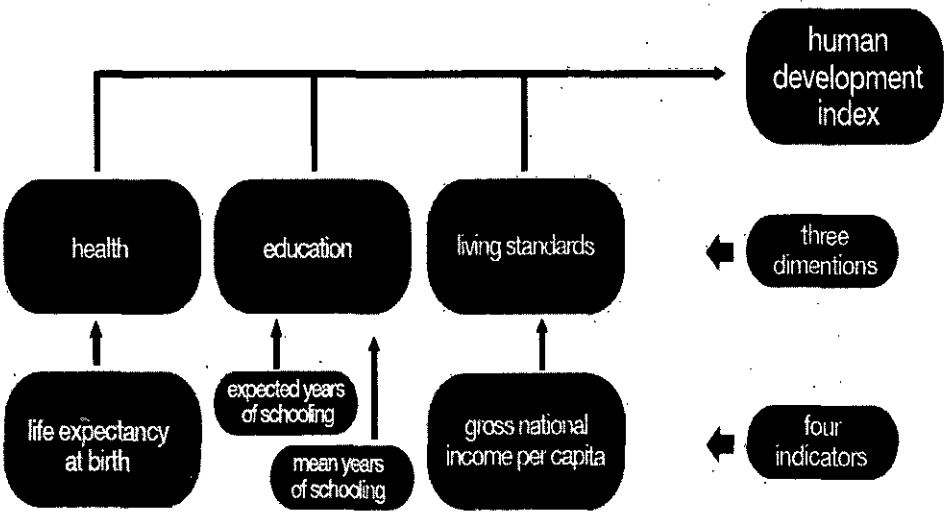
i. Equality, ii. Sustainability,
iii. Productivity, and iv. Empowerment.

Human Development Index

- Human development index (HDI) is defined as "a composite index combining indicators representing three dimensions — longevity (life expectancy at birth); knowledge (adult literacy rate and mean years of schooling); and income (real GDP per capita in purchasing power parityin US dollars)".
- Thus, the concept of HDI reflects achievements in the most basic human capabilities, viz., leading a long life, being knowledgeable and enjoying a decent standard of living. Hence, these three variables have been chosen to represent those dimensions.
- The HDI values ranges between 0 to 1. The HDI value for a country shows the distance that it has towards maximum possible value to 1 and also allows comparisons with other countries.

Various indicators under HDI

- Calculation of the index combines four major indicators: life expectancy for health, expected years of schooling, mean of years of schooling for education and GNI per capita for the standard of living.



India's position:

0. India's rank- 129. Last year's rank- 130.
1. Despite lifting 271 million people out of poverty between 2005-15, ***India still remains home to 28% (364 million) of the world's poor.***
2. Between 1990 and 2018, India's HDI value increased by 50 per cent (from 0.431 to 0.647), which places it above the average for countries in the medium human development group (0.634) and above the average for other South Asian countries (0.642).
3. This means that in the last three decades, life expectancy at birth in India increased by 11.6 years, whereas the average number of schooling years increased by 3.5 years. Per capita incomes increased 250 times.
4. India is only marginally better than the South Asian average on ***the Gender Development Index*** (0.829 vs 0.828), and ranks at a low 122 (of 162) countries on the 2018 ***Gender Inequality Index.***

India's neighbours:

Sri Lanka (71) and China (85),

Bhutan (134),

Bangladesh (135),

Myanmar (145),

Nepal (147),

Pakistan (152) and Afghanistan (170).

Underdevelopment: Concept and Meaning

World Development Report categorizes economies on the basis of income in three categories viz. *high income, middle income* and *low-income economies*. Usually,

high income countries are known as developed / advanced economies while low-income countries are known as underdeveloped economies. Developed or advanced economies are also characterised by high standard of living, universal and quality education, better health care facilities and high life expectancy.

However, all high-income economies may not be developed economies. Some of the middle- and low-income economies are developing faster than high income economies.

Further, the *underdeveloped economies showing high potential of growth in terms of their natural, physical and human resources are often referred to as developing economies*. Economists also use the terms, first world, second world and third world for the developed, socialist industrialist countries and underdeveloped economies respectively.

Criterion for Classifying Economies as Developed and Underdeveloped

Economies cannot be classified as developed and underdeveloped economies based on their natural resources, population and sectoral dependency. However, there is a set of common characteristics of underdeveloped economies such as low per capita income, low levels of living, high rate of population growth, illiteracy, technical backwardness, capital deficiency, dependence on backward agriculture, high level of unemployment, unfavourable institutions and so on. It is on the basis of these characteristics that we draw a line of distinction between developed and underdeveloped economies.

Meaning and Definition of Underdevelopment

Underdevelopment is low level of development characterized by low real per capita income, wide-spread poverty, lower level of literacy, low life expectancy and underutilisation of resources etc. The state in underdeveloped economy fails to provide acceptable levels of living to a large fraction of its population, thus resulting into misery and material deprivations. We need to note here that *underdevelopment is a relative concept but it sustains absolute poverty.*

Underdevelopment is a Relative Concept

The concept of underdevelopment is a relative one because it is the comparison of quality of life between the economies that differentiates them in underdeveloped and developed.

Underdevelopment Sustains Absolute Poverty

Although, concept of underdevelopment is a relative concept but it sustains absolute poverty. Absolute poverty refers to the state of poverty wherein the people fail to fulfil even their basic needs in terms of food, clothing and shelter. In fact, they are a class of people who are always striving to survive. Thus, underdevelopment and absolute poverty go together or underdevelopment sustains absolute poverty.

Characteristics of Underdeveloped Economies

It is difficult to find an underdeveloped economy representing all the representative characteristics of underdevelopment. While most of them are poor in nature, they have diverse physical and human resources, socio-political conditions and culture. Some of the common characteristics displayed by most of the underdeveloped countries in the world are as follows:

Low Per Capita Income

Almost all underdeveloped countries of the world show low per capita income in comparison to developed countries of the world.

Slow Growth Rate of Per Capita Income

Low per capita income and slow growth rate of per capita income are characteristics of these countries.

Economic Inequalities

High inequality of income and wealth is another common feature of underdeveloped countries. In these countries, large percentage of national income is shared by a small segment of the society while a large segment of the society gets barely enough to survive. Economic inequality exists even in developed countries but it is not as much as found in underdeveloped countries.

Low Level of Living

Level of living in the underdeveloped countries is low because of low per capita income. Low level of living of the people of underdeveloped countries is also reflected in Human Development Index prepared by the United Nation Development Programme (UNDP). HDI of developed countries is very high whereas for underdeveloped countries it is very low.

Low Rate of Capital Formation

Rate of capital formation is very low in underdeveloped economies due to low-income levels and high incidence of poverty.

Backward Techniques of Production

Underdeveloped economies use outdated technology for production. Lack of capital leads to less spending on research and development.

High Growth Rate of Population and Dependency Burden

These countries are characterised by high growth rate of population and high dependency burden.

Low Productivity of Labour

Underdeveloped economies are characterised by low labour productivity due to low level of skill set.

Underutilisation of Natural Resources

Natural resources are underutilised in underdeveloped economies. Their capability to exploit them is very low.

Large Scale Unemployment

Large scale unemployment is another characteristic feature of underdeveloped countries.

Dominance of Agriculture

Large section of people in underdeveloped economies depends on primary sector for employment. But the primary sector is not well-developed in those countries.

High Incidence of Poverty

Low per capita income results in high incidence of poverty in underdeveloped economies.

Infrastructural Backwardness

Economic infrastructure and social infrastructure are almost at their bottom level in underdeveloped countries.

Low Volume of Foreign Trade

Underdeveloped countries export primary products like, agricultural goods, minerals, petroleum oil, etc., and import finished products, especially consumer goods. Terms of trade are grossly unfavourable to underdeveloped countries.

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Difference between Developed and Underdeveloped Economies

The differentiating points between a developed and underdeveloped economy are summarised in the following table:

Basis of Difference	Developed Economy	Underdeveloped Economy
Per Capita Income	Per capita income is high.	Per capita income is low.
Standard of Living	Standard of living is high.	Standard of living is low.
Economic Inequality	Distribution of income is less skewed (unequal).	Distribution of income is highly skewed.
Capital Formation	Rate of capital formation is high.	Rate of capital formation is low. It is between 10 percent and 20 percent barring a few exceptions.
Agriculture	Dependence on agriculture is very low. Yet, agriculture is developed and advanced.	Dependence on agriculture is very high. Yet, agriculture is backward and undeveloped.
Foreign Trade and International Stability	Terms of trade are generally favourable. Finished products are exported and agricultural products or raw materials are imported. High degree of international stability.	Terms of trade are generally unfavourable. Agricultural products or raw materials are exported and finished products are imported. High degree of international vulnerability.
Growth Rate of Population	Growth rate of population is generally low. Overall size of population is small.	Growth rate of population is generally high. Overall size of population is very large.
Human Capital	High rate of human capital formation. Good health of the people. 90 percent of people are literate. Trained and skilled labour constitutes a high percentage of the total labour force. High productivity is the obvious consequence.	Low rate of human capital formation. Most of the people are unhealthy and unskilled. Skilled labour is a low percentage of the total labour force. Low productivity is the obvious consequence.
Unemployment	Less unemployment. It is by and large frictional and structural in nature. Accordingly, it is cyclical, not chronic.	Large-scale unemployment. Disguised unemployment is widely prevalent. It is chronic in nature.

Basis of Difference	Developed Economy	Underdeveloped Economy
Production Technique	Production technique is developed and advanced. More possibilities of research and innovations.	Production technique is backward. Little possibilities of research and innovations.
Capital Markets	Capital markets are developed, conducive to savings, and therefore industrial expansion.	Capital markets are underdeveloped or undeveloped, hindering productive use of savings and therefore industrial expansion.
Cultural Environment	Cultural environment is materialistic. Dignity of labour is high. Outlook is progressive.	Cultural environment is largely spiritualistic. Dignity of labour is low. Outlook is traditional and backward.

India as a Developing Economy

Though the Indian economy is growing, it is still lagging behind in terms of reducing poverty, unemployment, backwardness and hunger and in terms of low technological development. Some other culprits for low development include low per capita income, excessive dependency on primary sector and high pressure on natural resources.

The key reasons for low development in India include exploitation during colonial era, pressure of population, infrastructure bottlenecks, brain-drain, corruption in public offices, low farm productivity, unfriendly business environment, inefficiency of public sector, high ratio of non-development expenditure etc.

Summary of the Chapter

What is Economic Growth?

Economic growth can be referred to as that increase which is witnessed in the monetary value of all the goods and services that are produced in the economy during a time period. It is one type of quantitative measure which reflects the potential increase of the number of business transactions taking place in the economy.

Economic growth can be measured in terms of the increase in the aggregate market value of additional goods and services produced, using economic concepts such as GDP and GNP.

Economic growth is a much narrower concept when compared to Economic Development.

What is Economic Development?

Economic development refers to the process by which the overall health, well-being, and academic level of the general population of a nation improve. It also means improved production volume due to the advancements of technology.

It is the qualitative improvement in the life of citizens of a country and is most appropriately determined by the Human Development Index (HDI). The overall development of a country is based on many parameters such as the creation of job opportunities, technological advancements, standard of living, living conditions, per capita income, quality of life, improvement in self-esteem needs, GDP, industrial and infrastructural development, etc.

EXERCISE

Multiple Choice Questions

1. Which of the following explains the term economic growth?
   (a) Increase in per capita production
   (b) Increase in per capita real income
   (c) structural change in the economy
   (d) all the above are right

ANSWER: d. all the above are right

2. Economic development is characterized by
   (a) Structural change in the economy
   (b) Change in the occupational structure
   (c) Both a and b
   (d) None of the above

ANSWER: c. Both a and b

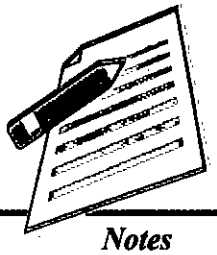
3. Which of the following explains the term economic development?
   (a) Improvement in the technology involved
   (b) Improvement in production
   (c) Improvement in distribution system
   (d) All the above

ANSWER: d. All the above

4. An underdeveloped economy is characterized by
   (a) High per capita real income
   (b) Large proportion of labor force in the tertiary sector
   (c) State of deprivation of large proportion of population
   (d) All the above

ANSWER: c. State of deprivation of large proportion of population

5. *Scarcity of capital, technological backwardness and unemployment are generally* found in
   (a) Developed countries
   (b) Underdeveloped countries
   (c) Both



(d) None of the above

ANSWER: b. Underdeveloped countries

6. Which of the following denotes an underdeveloped economy?
   (a) High level of inequalities
   (b) Low level of capital productivity
   (c) A relatively closed economy
   (d) All the above

ANSWER: d. All the above

7. Capital formation in underdeveloped countries is a major bottleneck. The reason can be
   (a) Small size of market with no incentive for investment
   (b) Low level of income
   (c) Demonstration effect
   (d) All the above

ANSWER: d. All the above

Review Questions

Q1. What is the Difference between Economic Growth and Economic Development?

Q2. Explain the Concept of Human Development

Q3. What is Human Development Index?

Q4. What are the components of Human Development Index?

Q5. what are the Common features of underdeveloped countries

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4 UNEMPLOYMENT

Unemployment

Unemployment occurs when a person who is actively searching for employment is unable to find work. Unemployment is often used as a measure of the health of the economy. The most frequent measure of unemployment is the unemployment rate, which is the number of unemployed people divided by the number of people in the labour force.

National Sample Survey Organization (NSSO) defines employment and unemployment on the following activity statuses of an individual:

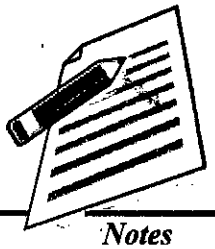
- Working (engaged in an economic activity) i.e., 'Employed'.
- Seeking or available for work i.e., 'Unemployed'.
- Neither seeking nor available for work.

The first two constitutes labour force and unemployment rate is the percent of the labour force that is without work.

Unemployment rate = (Unemployed Workers / Total labour force) × 100

Types of Unemployment in India

- **Disguised Unemployment:**
  - It is a phenomenon wherein more people are employed than actually needed.
  - It is primarily traced in the agricultural and the unorganised sectors of India.
- **Seasonal Unemployment:**
  - It is an unemployment that occurs during certain seasons of the year.
  - Agricultural labourers in India rarely have work throughout the year.
- **Structural Unemployment:**
  - It is a category of unemployment arising from the mismatch between the jobs available in the market and the skills of the available workers in the market.
  - Many people in India do not get job due to lack of requisite skills and due to poor education level, it becomes difficult to train them.
- **Cyclical Unemployment:**
  - It is result of the business cycle, where unemployment rises during recessions and declines with economic growth.



- Cyclical unemployment figures in India are negligible. It is a phenomenon that is mostly found in capitalist economies.

- **Technological Unemployment:**
  - It is loss of jobs due to changes in technology.
  - In 2016, World Bank data predicted that the proportion of jobs threatened by automation in India is 69% year-on-year.
- **Frictional Unemployment:**
  - The Frictional Unemployment also called as Search Unemployment, refers to the time lag between the jobs when an individual is searching for a new job or is switching between the jobs.
  - In other words, an employee requires time for searching a new job or shifting from the existing to a new job, this inevitable time delay causes the frictional unemployment. It is often considered as a voluntary unemployment because it is not caused due to the shortage of job, but in fact, the workers themselves quit their jobs in search of better opportunities.
- **Vulnerable Employment:**
  - This means, people working informally, without proper job contracts and thus sans any legal protection. These persons are deemed 'unemployed' since records of their work are never maintained.
  - It is one of the main types of unemployment in India.

Related Terms

- **Unemployment trap** is a situation when unemployment benefits discourage the unemployed to go to work. People find the opportunity cost of going to work too high when one can simply enjoy the benefits by doing nothing.
  - *Description:* While the purpose of social security and welfare systems is to provide relief to the unemployed, they end up providing them with an incentive not to return to work. An unemployment trap arises when opportunity cost of going to work is higher than the income received, discouraging people from returning to work and being productive.
- **Harmonised unemployment rates** define the unemployed as people of working age who are without work, are available for work, and have taken specific steps to find work. The uniform application of this definition results in estimates of unemployment rates that are more internationally comparable than estimates based on national definitions of unemployment.
  - This indicator is measured in numbers of unemployed people as a percentage of the labour force and it is seasonally adjusted. The labour force is defined as the total number of unemployed people plus those in civilian employment.

Measurement of Unemployment in India

National Sample Survey Office (NSSO), an organization under Ministry of Statistics and Programme Implementation (MoSPI) measures unemployment in India on following approaches:

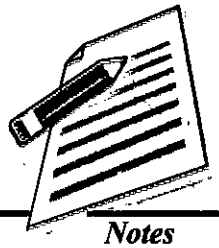
- **Usual Status Approach:** This approach estimates only those persons as unemployed who had **no gainful work for a major time during the 365 days** preceding the date of survey.
- **Weekly Status Approach:** This approach records only those persons as unemployed who **did not have gainful work even for an hour on any day of the week** preceding the date of survey.
- **Daily Status Approach:** Under this approach, unemployment status of a person is measured for each day in a reference week. A person having **no gainful work even for 1 hour in a day** is described as unemployed for that day.

Unemployment stats (based on findings from CMIE's latest data):

- The unemployment rate in India rose to 7.2 percent in February 2019, the highest since September 2016, and up from 5.9 percent in February 2018.
- The total number of employed persons in February 2019 is estimated at 400 million against 406 million in the year-ago period and 407.5 million employed in February 2017.
- The labour participation rate fell from 43.2% in January 2019 to 42.7% in February 2019.
    - **Labour Participation Rate** defines that section of working population in the economy which is currently employed or seeking employment.

Causes of Unemployment

- Large population.
- Low or no educational levels and vocational skills of working population.
- Inadequate state support, legal complexities and low infrastructural, financial and market linkages to small/ cottage industries or small businesses, making such enterprises unviable with cost and compliance overruns.
- Huge workforce associated with informal sector due to lack of required education/ skills, which is not captured in any employment data. For ex: domestic helpers, construction workers etc.
- **The syllabus taught in schools and colleges, being not as per the current requirements of the industries.** This is the main cause of structural unemployment.
- Inadequate growth of infrastructure and **low investments in manufacturing sector, hence restricting employment potential of secondary sector.**



- **Low productivity in agriculture sector combined with lack of alternative opportunities for agricultural worker which makes transition from primary to secondary and tertiary sectors difficult.**
- **Regressive social norms** that deter women from taking/continuing employment.

Impact

- The problem of unemployment gives rise to the **problem of poverty**.
- Young people after a long time of unemployment indulge in illegal and wrong activities for earning money. This also leads to **increase in crime in the country**.
- **Unemployed persons can easily be enticed by antisocial elements.** This makes them lose faith in democratic values of the country.
- It is often seen that unemployed people end up getting addicted to drugs and alcohol or attempts suicide, leading losses to the **human resources of the country**.
- It also affects **economy** of the country as the workforce that could have been gainfully employed to generate resources actually gets dependent on the remaining working population, thus **escalating socioeconomic costs** for the State. For instance, 1 percent increase in unemployment reduces the GDP by 2 percent

Steps Taken by Government

- **Integrated Rural Development Programme (IRDP)** was launched in 1980 to create full employment opportunities in rural areas.
- **Training of Rural Youth for Self-Employment (TRYSEM):** This scheme was started in 1979 with objective to help unemployed rural youth between the age of 18 and 35 years to acquire skills for self-employment. Priority was given to SC/ST Youth and Women.
- **RSETI/RUDSETI:** With the aim of mitigating the unemployment problem among the youth, a new initiative was tried jointly by Sri Dharmasthala Manjunatheshwara Educational Trust, Syndicate Bank and Canara Bank in 1982 which was the setting up of the "RURAL DEVELOPMENT AND SELF EMPLOYMENT TRAINING INSTITUTE" with its acronym RUDSETI near Dharmasthala in Karnataka. Rural Self Employment Training Institutes/ RSETIs are now managed by Banks with active co-operation from the Government of India and State Government.
- By merging the two erstwhile wage employment programme – National Rural Employment programme (NREP) and Rural Landless Employment Guarantee Programme (RLEGP) the **Jawahar Rozgar Yojana (JRY)** was started with effect from April, 1, 1989 on 80:20 cost sharing basis between the centre and the States.

- **Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA):**
  - It is an employment scheme that was launched in 2005 to provide social security by guaranteeing a minimum of 100 days paid work per year to all the families whose adult members opt for unskilled labour-intensive work.
  - This act provides Right to Work to people.
- **Pradhan Mantri Kaushal Vikas Yojana (PMKVY),** launched in 2015 has an objective of enabling a large number of Indian youth to take up industry-relevant skill training that will help them in securing a better livelihood.
- **Start Up India Scheme,** launched in 2016 aims at developing an ecosystem that promotes and nurtures entrepreneurship across the country.
- **Stand Up India Scheme,** launched in 2016 aims to facilitate bank loans between Rs 10 lakh and Rs. 1 crore to at least one SC or ST borrower and at least one women borrower per bank branch for setting up a greenfield enterprise.

Way Forward

- There are number of labour-intensive manufacturing sectors in India such as food processing, leather and footwear, wood manufacturers and furniture, textiles and apparel and garments. **Special packages, individually designed for each industry are needed to create jobs.**
- **Public investment in sectors like health, education, police and judiciary can create many government jobs.**
- **Decentralisation of Industrial activities** is necessary so that people of every region get employment.
- **Development of the rural areas** will help mitigate the migration of the rural people to the urban areas thus decreasing the pressure on the urban area jobs.
- Entrepreneurs generate employments to many in a country; therefore, **government needs to encourage entrepreneurship among the youth.**
- ***Concrete measures aimed at removing the social barriers for women's*** **entry** and their continuous participation in the job market is needed.
- Government needs to keep a **strict watch on the education system** and should try to implement new ways to generate skilled labour force.
- Effective implementation of present programs like Make in India, Skill India, Start up and Stand-Up India.
- There is a need for **National Employment Policy (NEP)** that would encompass a set of multidimensional interventions covering a whole range of social and economic issues affecting many policy spheres and not just

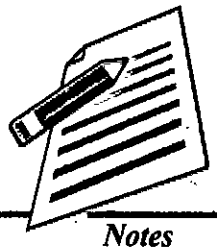
the areas of labour and employment. The policy would be a critical tool to contribute significantly to achieve the goals of the 2030 Agenda for Sustainable Development.

- The underlying principles for the National Employment Policy may include
  - enhancing human capital through skill development;
  - creating sufficient number of decent quality jobs for all citizens in the formal and informal sectors to absorb those who are available and willing to work;
  - strengthening social cohesion and equity in the labour market;
  - coherence and convergence in various initiatives taken by the government;
  - supporting the private sector to become the major investor in productive enterprises;
  - supporting self-employed persons by strengthening their capabilities to improve their earnings;

Summary of the Chapter

In India, there are seven types of unemployment. The types of unemployment are discussed below:

1. **Disguised Unemployment**: This is a type of unemployment where people employed are more than actually needed. Disguised unemployment is generally traced in unorganised sectors or the agricultural sectors.
2. **Structural Unemployment:** This unemployment arises when there is a mismatch between the worker's skills and availability of jobs in the market. Many people in India do not get job matching to their skills or due to lack of required skills they do not get jobs and because of poor education level, it becomes important to provide them related training.
3. **Seasonal Unemployment:** That situation of unemployment when people do not have work during certain seasons of the year such as labourers in India rarely have occupation throughout the year.
4. **Vulnerable Unemployment:** People are deemed unemployed under this unemployment. People are employed but informally i.e. without proper job contracts and thus records of their work are never maintained. It is one of the main types of unemployment in India.
5. **Technological Unemployment**: the situation when people lose their jobs due to advancement in technologies. In 2016, the data of the World Bank predicted that the proportion of jobs threatened by automation in India is 69% year-on-year.
6. **Cyclical Unemployment**: unemployment caused due to the business cycle, where the number of unemployed heads rises during recessions and declines with the growth of the economy. Cyclical unemployment figures in India are negligible.



7. **Frictional Unemployment**: this is a situation when people are unemployed for a short span of time while searching for a new job or switching between jobs. Frictional Unemployment also called Search Unemployment, is the time lag between the jobs. Frictional unemployment is considered as voluntary unemployment because the reason for unemployment is not a shortage of jobs, but in fact, the workers themselves quit their jobs in search of better opportunities.

EXERCISE

Multiple Choice Questions

1. Occupational structure refers to:
   (a) Distribution of working force among the different occupations
   (b) The nature of different occupations
   (c) Size of working force in a country
   (d) Number of people living in a country
2. Employment assurance scheme & Jawahar Gram Samridhi Yojna have been submerged into _____:
   (a) NFFWP (b) SGRY
   (c) SGSY (d) IAY
3. People who are unwilling to work at the existing wage rate are:
   (a) Voluntary unemployed
   (b) Frictional unemployed
   (c) Casual unemployed
   (d) Seasonal unemployed
4. The measure of National rural Employment Guarantee Bill is applicable to whole of India except_____:
   (a) J & K (b) Bihar
   (c) Mizoram (d) U.P.
5. Due to introduction of new technology, workers may be replaced by machines leading to:
   (a) Technological unemployment
   (b) Frictional unemployment
   (c) Seasonal unemployment
   (d) Disguised unemployed
6. Work force refers to that part of :
   (a) Labour force which is employed
   (b) Population which is unemployed
   (c) Population which is forced to work
   (d) Labour force which is unemployed
7. Most of the unemployment in India is:
   (a) Voluntary (b) Structural
   (c) Frictional (d) Technical

8. According to measure a person is said to be employed for a week even if he is employed only for a day during the week :
   (a) Usual status
   (b) Current weekly status
   (c) Current daily status
   (d) Current yearly status
9. Measure which generally gives the lowest estimated of unemployment especially *for poor economy:*
   (a) Usual status (b) CWS
   (c) CDS (d) CMS
10. _____ is defined as the number of persons in the labour force per 1000 persons:
   (a) WPF (b) LFPR
   (c) CWS (d) CDS

ANSWERS

1. (a) Distribution of working force among the different occupations
2. (b) SGRY
3. (a) Voluntary unemployed
4. (a) J & K
5. (a) Technological unemployment
6. (a) Labour force which is employed
7. (b) Structural
8. (b) Current weekly status
9. (a) Usual status
10. (b) LFPR

Review Questions

Q1. Explain the Types of unemployment,
Q2. *What are the causes* of unemployment
Q3. Discuss *the issue of unemployment in India*
Q4. How to resolve *the issue of Unemployment in India*
Q5. What is disguised unemployment?

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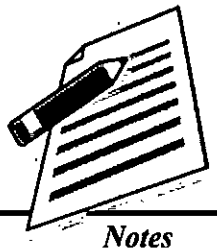


5 INTRODUCTION TO STATISTICS

Module Content

Need and scope of statistics, Meaning, functions and importance of statistics in economics, limitations of statistics. Primary and secondary data, collection of primary data, sources of secondary data; organization of data into arrays and frequency distribution. Tabulation, Bar diagrams and pie diagrams, Graphs – Line graph, histogram, Polygon and Ogive.

Objective of the module

The main objective of this module is to make student understand about the basics of Statistics and its application as well. Various types of data and its management is also explained in this module.

INTRODUCTION TO STATISTICS

Statistics is not a new discipline but is as old as the human activity itself. Its sphere of utility, however, has been increasing over the years. In the olden days, it was considered as the 'science of statecraft' and was regarded as a by-product of the administrative activity of the State thereby limiting its scope. The governments in those days used to keep records of population, birth, deaths, etc., for administrative purposes. In fact, the word 'statistics' seems to have been derived from the Latin word 'status' or Italian word 'statists' or the German word 'Statistic' each of which means a political state. Statistical methods are now widely used in various diversified fields such as agriculture, economics, sociology, business management, etc. In this unit you will study the meaning and definition of statistics, distinction between descriptive and inferential statistics, functions of statistics, importance and limitations of statistics, and distrust of statistics.

MEANING OF STATISTICS

The word 'statistics' has been used in a variety of ways. Sometimes it is used in the plural sense to refer to numerical statements of facts or data. On the other hand, it is also used in the singular sense to refer to a subject of study like any other subject such as (mathematics, economics, etc. For instance, when we refer to a few 'statistics' relating 'to our country like -there are 932 females per 1,000 males in India, the per capita national product at current prices has increased from Rs. 246 in 1950 651 to Rs. 2,596 in 1985-86 -we are using the word statistics in the plural sense (meaning data). To prepare these numerical statements, one must

be familiar with those methods and techniques which are used in data collection, organisation, presentation, analysis and interpretations. A study of these methods and techniques is the science of statistics. The use of the word statistics here is in the singular sense. In this sense the word statistics means statistical methods or the science of statistics. Now let us study in detail about these two approaches.

DESCRIPTIVE AND INFERENTIAL STATISTICS

AS you know, when used in singular sense, statistics is a study of the principles and methods used in the collection, presentation, analysis and interpretation of data in any sphere of enquiry. These methods and techniques are so diverse that statisticians generally categorise them into two: 1) descriptive statistics, and 2) inferential statistics.

Descriptive Statistics refer to various measures that are used to describe the characteristic features of the data. Such measures include measures of central tendency, measures of dispersion, etc. Graphs, tables and charts that display data are also examples of descriptive statistics. Suppose the number of first year B. Com students is 100 and you compute the average marks of these students. Here you are using descriptive statistics. Similarly, when you are computing the average marks of a sample of 25 students from the same class but without attempting any generalisation about the entire class, you are still using descriptive statistics.

Inferential Statistics on the other hand refer to statistical process of drawing valid inferences about the characteristics of population data on the basis of sample data. The word population in statistics does not mean only human population. It stands for totality of items related to any field of study. If the teacher, in the above example, decides to estimate the average marks of the entire class on the basis of the sample average, we would say that he is using inferential statistics. It is noteworthy that most of the time we use sample data to understand the features of the population data. Inferences about population drawn from sample measures may involve some error or discrepancy. The magnitude of such errors can be estimated on the basis of probability theory.

FUNCTIONS OF STATISTICS

You have studied the meaning and definitions of statistics. You have also learnt the difference between descriptive statistics and inferential statistics. Let us now discuss some of the important functions of statistics:

To present facts in a proper form: Statistical methods present general statements in a precise and definite form. For example, you may say that in India average yield of cotton per hectare is 180 Kg. This statement is more precise and convincing than saying that the average yield of cotton in India is very low.

To simplify unwieldy and complex data: Statistical methods simplify unwieldy and complex data to make them understandable easily. The raw data is often unintelligible. One cannot grasp their characteristics unless the data is classified

according to some common characteristics. Suppose, you are given the weekly wages of 1,000 workers in a factory. You will not be in a position to draw any inference from the data unless they are condensed through classification such as the following:

Weekly Wages	No. Of workers
Below -600	100
600-700	200
700-800	400
800-900	200
Above 900	100
Total:	1000

To provide the technique for making comparison: The primary purpose of statistics is to facilitate a comparative study of different phenomena either over time or space. For instance, the estimation of national income is not done for its own sake. But it is done to compare the income over time to get an idea whether the standard of living of people is rising or not. Suppose, as compared to 1987, the per-capita income in India has increased by 10% in 1988. On the basis of this information, we shall be in a position to throw some light on the standard of living of an Indian in 1988.

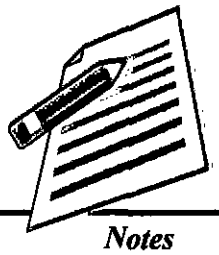
To formulate policies in different fields: Statistical methods are very useful in formulating various policies in social, economic, and business fields. The government for instance, utilises vital statistical data for formulating family planning programme. Similarly, the government utilises the information on consumer price indices for granting dearness allowance to its employees.

To study relationship between different phenomena: Statistical measures such as correlation and regression are used to study relationships between variables. Such relationships are important for making decisions. For instance, you may find a relationship between the demand of a product and its prices. In general, if the prices rise, the demand for the product is likely to decline.

To forecast future values: Some of the statistical techniques are used for forecasting future values of a variable. On the basis of sales figures of the last 10 years, a marketing manager can estimate the likely demand for his product during the next year.

To measure uncertainty: With the help of probability theory, you can measure the chance of occurrence of uncertain event. Probability concepts are quite useful in decision-making. Suppose, if you are interested in estimating the chance of your passing the B.Com examination, you may get an idea about it by studying the pass percentages of students during the last 10 years.

To test a hypothesis: Statistical methods are extremely useful in formulating and testing hypotheses and for the development of new theories. For instance,



a company is desirous of knowing the effectiveness of its new drug to control malaria. It could do so by using a statistical technique called Chi-square Test.

To draw valid inferences: Statistical methods are also useful in drawing inferences regarding the characteristics of the universe (population) on the basis of sample data.

IMPORTANCE OF STATISTICS

In the ancient times statistics was used as the science of statecraft only. Data on a wide range of activities such as population, births and deaths were collected by the State for administrative purposes. However, in recent years, the scope of statistics has widened considerably to bring to its fold social and economic phenomena. The developments in the statistical techniques over the years also widened its scope considerably. It is no longer considered to be a by-product of the administrative setup of the State but now it embraces practically all sciences, social, physical, and natural sciences. As a matter of fact, now statistics finds its applications in various diversified fields such as agriculture, business and industry, sociology; economics, biometry, etc. Thus, these days statistics finds its application in almost all spheres of human activity.

Statistics and State

In earlier times, the role of the State was confined to the maintenance of law and order. For that purpose, it used to collect data relating to manpower, crimes, income and wealth, etc., for formulating suitable military and fiscal policies. But the role of State has enlarged considerably with the inception of the concept of Welfare State. Thus, today statistical data relating to prices, product, production, consumption, income and expenditure, etc., are extensively used by the governments worldover for formulating their economic and other policies. To raise the standards of living of its population, developing countries such as India are following the policy of planned economic development. For that purpose the government must base its decisions on correct and sound analysis of statistical data. For instance, in formulating its five year plans, the government must have an idea about the availability of raw materials, capital goods, financial resources, the distribution of population according to various characteristics such as age, sex, income, etc., to evolve various policies.

Statistics in Economics

Statistical analysis is immensely useful in the solution of a variety of economic problems such as production, consumption, distribution, etc. For example, an analysis of data on consumption may reveal the pattern of consumption of various commodities by different sections of the society. Data on prices, wages, consumption, savings and investment, etc., are vital in formulating various economic policies. Likewise, data on national income and wealth are useful in formulating policies

for reducing disparities of income. Use of statistics in economics has led to the formulation of several economic laws such as Engel's Law of Consumption, Law of Income Distribution, etc. Statistical tools of index numbers, time series analysis, regression analysis, etc., are vital in economic planning. For instance, the consumer price index is used for grant of dearness allowance (DA) or bonus to workers. Demand forecasting could also be made by using time series analysis. For testing various economic hypotheses, statistical data is now being increasingly used.

Statistics in Business and Management

With the growing size and increasing competition, the activities of modern business enterprises are becoming more complex and demanding. The separation of ownership and management in the case of big enterprises has resulted in the emergence of professional management. The success of the managerial decision-making depends upon the timely availability of relevant information much of which comes from statistical data. Statistical data has, therefore, been increasingly used in business and industry in all operations like sales, purchases, production, marketing, finance, etc. Statistical methods are now widely applied in market and production research, investment policies, quality control of manufactured products, economic forecasting, auditing and many other fields. One element common to all problems faced by managers is the need to take decisions under uncertainty. And statistical methods provide techniques to deal with such situations. It is, therefore, not surprising when Wallis and Roberts say that "statistics may be regarded as a body of methods for making wise decisions in the face of uncertainty."

LIMITATIONS OF STATISTICS

We have discussed the importance and functions of statistics. Now we shall discuss about the limitations of statistics. The following are some of the limitations of statistical methods which should be kept in mind while using them:

Statistics deals only with the quantitative characteristics: Statistics deals with facts which are expressed in numerical terms. Therefore, those phenomena that cannot be described in numerical terms do not fall under the scope of statistics. Beauty, colour of eyes, intelligence, etc., are qualitative characteristics and hence cannot be studied directly. These characteristics can be studied only indirectly, by expressing them numerically after assigning particular scores. For example, we can study the level of intelligence of a group of persons by using intelligence quotients (IQ's).

Statistics does not deal with individuals: Since statistics deals with aggregate of facts, a single and isolated figure cannot be regarded as statistics. For example, the height of one individual is not of much relevance but the average height of a group of people is relevant from statistical point or view. In this context, you may recall the definition given by Secrist here.

Statistical laws are not exact: Unlike the laws of natural sciences, statistical laws are not exact. They are true under certain conditions and always some chance factor is associated with them for being true. Therefore, conclusions based on them are only approximate and not exact. They cannot be applied universally. Laws of pure sciences like Physics and Chemistry are universal in their application.

Statistical results are true only on an average: Statistical methods reveal only the average behaviour of a phenomenon. The average income of employees of a company will, therefore, not throw much light on the income of a specific individual. They are therefore, useful for studying a general appraisal of a phenomenon.

Statistics is only one of the methods of studying a problem: A problem can be studied by several methods. Statistical methods arc only onc of them. Under all circumstances, statistical tools do not provide the best solution. Quite often it is necessary to consider a problem in the light of social considerations like culture, region, etc. Therefore, statistical conclusions need to be supplemented by other evidences.

Statistics can be misused: The various statistical methods have their own limitations. If used without caution they are subject to wrong conclusions. So one of the main limitations of statistics is that, if put into wrong hands, it can be misused. This misuse can be, at times, accidental or intentional. Many government agencies and research organisations are tempted to use statistics to misrepresent the facts to prove their own point of view. Suppose you are told that during a year the number of car accidents in a city by women drivers is 10 while those committed by men drivers is 40. On the basis of this information, you may conclude that women are safe drivers. If you conclude like that you are misinterpreting the information. You must know the total number of drivers of both types before you could arrive at a correct conclusion.

DISTRUST OF STATISTICS

Despite its importance and usefulness, the science of statistics is looked upon with suspicion. Quite often it is discredited, by people who do not know its real purpose and limitations. We often hear statements such as: "There are three types of lies: lies, damned lies, and statistics". "Statistics can prove anything". "Statistics cannot prove anything". "Statistics are lies of the first order". These are expressions of distrust in statistics. By distrust of statistics, we mean lack of confidence in statistical data, statistical methods and the conclusions drawn. You may ask, why distrust in statistics? Some of the important reasons for distrust in statistics are as follows:

Arguments based upon data are more convincing. But data can be manipulated according to wishes of an individual. To prove a particular point of view, sometimes arguments are supported by inaccurate data.

Even if correct figures are used, they may be incomplete and presented in such a manner that the reader is misled. Suppose, it has been found that the number

of traffic accidents is lower in foggy weather than on clear weather days. It may be concluded that it is safer to drive in fog. The conclusion drawn is wrong. To arrive at a valid conclusion, we must take into account the difference between the rushes of traffic under the two weather conditions.

Statistical data does not bear on their face the label of their quality. Sometimes even unintentionally inaccurate or incomplete data is used leading to faulty conclusions.

The statistical tools have their own limitations. The investigator must use them with precaution. But sometimes these tools or methods are handled by those who have little or no knowledge about them. As a result, by applying wrong methods to even correct and complete data, faulty conclusions may be obtained. This is not the fault of statistical methods, but of the persons who use them.

We may conclude by taking an illustration. Suppose a child cuts his finger with a knife. His parents started blaming the knife. Here the fault does not lie with the knife but with the child who misused the knife. It should be kept in mind that statistics neither proves anything nor disproves anything. It is only a tool (i.e., a method of approach) which should be used with caution and by those who are knowledgeable in the subject.

Summary of the Chapter

Statistics is a mathematical science including methods of collecting, organizing and analyzing data in such a way that meaningful conclusions can be drawn from them. In general, its investigations and analyses fall into two broad categories called descriptive and inferential statistics.

Descriptive statistics deals with the processing of data without attempting to draw any inferences from it. The data are presented in the form of tables and graphs. The characteristics of the data are described in simple terms. Events that are dealt with include everyday happenings such as accidents, prices of goods, business, incomes, epidemics, sports data, population data.

Inferential statistics is a scientific discipline that uses mathematical tools to make forecasts and projections by analyzing the given data. This is of use to people employed in such fields as engineering, economics, biology, the social sciences, business, agriculture and communications.

EXERCISE

Multiple Choice Questions

1. A numerical value used as a summary measure for a sample, such as a sample mean, is known as a
   (a) Population Parameter (b) Sample Parameter
   (c) Sample Statistic (d) Population Mean

Answer: C

2. Statistics branches include
   (a) Applied Statistics
   (b) Mathematical Statistics
   (c) Industry Statistics
   (d) Both A and B

Answer: D

3. To enhance a procedure the control charts and procedures of descriptive statistics are classified into
   (a) Behavioural Tools
   (b) Serial Tools
   (c) Industry Statistics
   (d) Statistical Tools

Answer: A

4. Sample statistics are also represented as
   (a) Lower Case Greek Letter
   (b) Roman Letters
   (c) Associated Roman Alphabets
   (d) Upper Case Greek Letter

Answer: B

5. Individual respondents, focus groups, and panels of respondents are categorised as
   (a) Primary Data Sources
   (b) Secondary Data Sources
   (c) Itemised Data Sources
   (d) Pointed Data Sources

Answer: A

Review Questions

Q1. What is statistics and its importance?
Q2. What is inferential statistics?
Q3. What are the advantages of statistics?
Q4. What are the limitations of statistics?
Q5. What is relation of statistics with economics?

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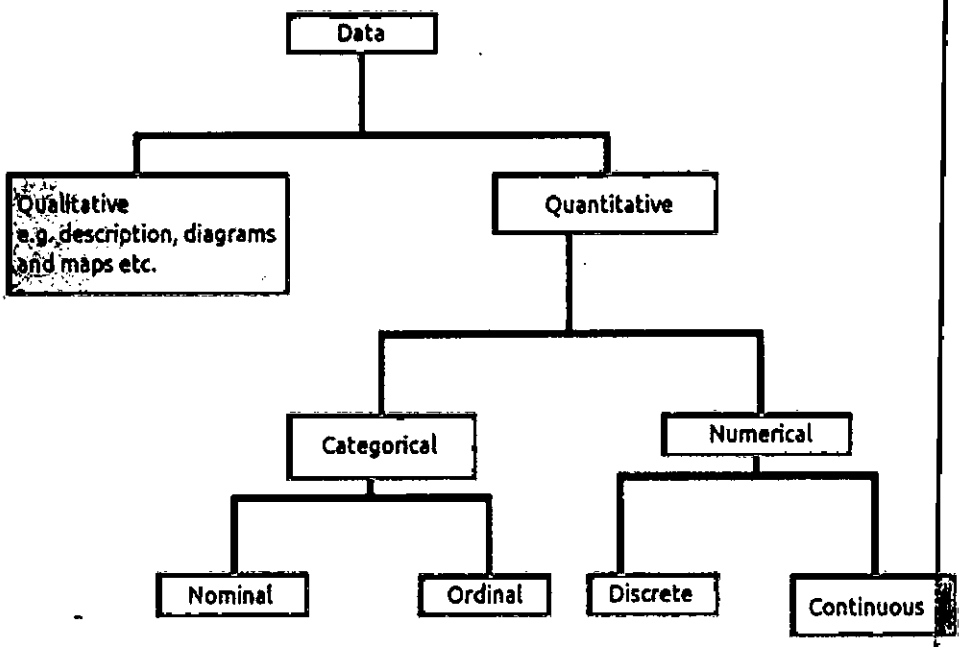
6 DATA AND ITS TYPES

Data and its types

Data is a set of values of subjects with respect to qualitative or quantitative variables. Data is raw, unorganized facts that need to be processed. Data can be something simple and seemingly random and useless until it is organized. When data is processed, organized, structured or presented in a given context so as to make it useful, it is called information.

Information, necessary for research activities are achieved in different forms.

- The main forms of the information available are:
  1. Primary data
  2. Secondary data
  3. Cross-sectional data
  4. Categorical data
  5. Time series data
  6. Spatial data
  7. Ordered data

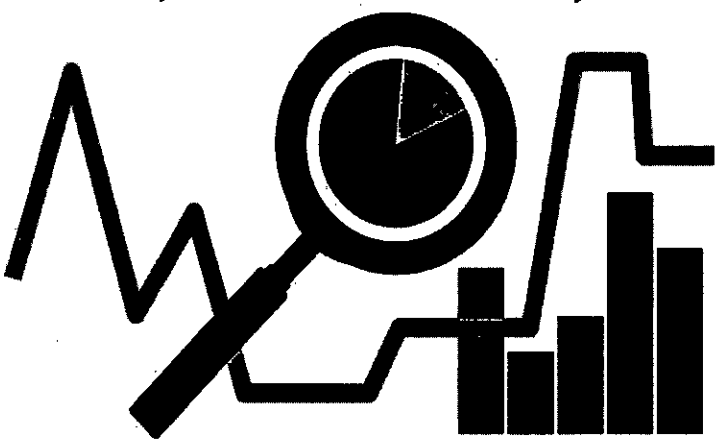


Primary Data and Secondary Data

- There are two major approaches to gathering information about a situation, person, problem or phenomenon.
- When you undertake a research study, in most situations, you need to collect the required information; however, sometimes the information required is already available and need only be extracted.

- Based on these broad approaches to information gathering, data can be categorized as:
  - Primary data
  - Secondary data.
- As the name suggests, primary data is one which is collected for the first time by the researcher while secondary data is the data already collected or produced by others.

Primary Data vs Secondary Data



Primary Data

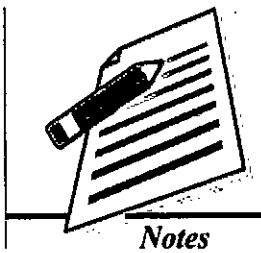
- It is the data collected by the investigator himself/ herself for a specific purpose.
- Data gathered by finding out first-hand the attitudes of a community towards health services, ascertaining the health needs of a community, evaluating a social program, determining the job satisfaction of the employees of an organization, and ascertaining the quality of service provided by a worker are the examples of primary data.

Advantages of using Primary data

- The investigator collects data specific to the problem under study.
- There is no doubt about the quality of the data collected (for the investigator).
- If required, it may be possible to obtain additional data during the study period.

Disadvantages of using Primary data

1. The investigator has to contend with all the hassles of data collection-
   - deciding why, what, how, when to collect
   - getting the data collected (personally or through others)
   - getting funding and dealing with funding agencies
   - ethical considerations (consent, permissions, etc.)



2. Ensuring the data collected is of a high standard-
   - all desired data is obtained accurately, and in the format, it is required in
   - there is no fake/ cooked up data
   - unnecessary/ useless data has not been included
3. Cost of obtaining the data is often the major expense in studies

Secondary Data

- Data collected by someone else for some other purpose (but being utilized by the investigator for another purpose).
- Gathering information with the use of census data to obtain information on the age-sex structure of a population, the use of hospital records to find out the morbidity and mortality patterns of a community, the use of an organization's records to ascertain its activities, and the collection of data from sources such as articles, journals, magazines, books and periodicals to obtain historical and other types of information, are examples of secondary data.

Advantages of using Secondary data

- The data is already there- no hassles of data collection
- It is less expensive
- The investigator is not personally responsible for the quality of data

Disadvantages of using Secondary data

- The investigator cannot decide what is collected (if specific data about something is required, for instance).
- One can only hope that the data is of good quality
- Obtaining additional data (or even clarification) about something is not possible (most often)

Primary Data vs Secondary Data

Primary data is an original and unique data, which is directly collected by the researcher from a source according to his requirements. As opposed to secondary data which is easily accessible but are not pure as they have undergone through many statistical treatments.

Character	Primary Data	Secondary Data
Definition	Primary data refers to the first-hand data gathered by the researcher himself.	Secondary data means data collected by someone else earlier.
Data	Real time data	Past Data
Process	Very Involved	Quick and easy

Source	Surveys, observations, experiments, questionnaire, personal interview, etc.	Government publications, websites, books, journal articles, internal records etc.
Cost-effectiveness	Expensive	Economical
Collection time	Long	Short
Specificity	Always specific to the researcher's needs.	May or may not be specific to the researcher's need.
Form	Available in the crude form	Available in the refined form
Accuracy and Reliability	More	Less

EXERCISE

Multiple Choice Questions

1. Primary data for the research process be collected through _____.
   a. Experiment b. Survey
   c. Both a and b d. None of the above

Answer c

2. The data obtained by conducting a survey is called:
   a. Primary data b. Secondary data
   c. Continuous data d. Qualitative data

Answer: a

3. The data collected from published reports is known as:
   a. Discrete data b. Arrayed data
   c. Secondary data d. Primary data

Answer: c

4. A survey in which information is collected from each and every individual of the population is known as:
   a. Sample survey b. Pilot survey
   c. Biased survey d. Census survey

Answer: d

5. Data used by an agency which is originally collected them are:
   a. Primary data b. Raw data
   c. Secondary data d. Grouped data

Answer: a

6. Which form of data below can usually be obtained more quickly and at a lower cost than the others?
   a. Primary b. Survey research
   c. Experimental research d. Secondary

Answer: d

7 CLASSIFICATION OF DATA

Classification of Data

Definition

Classification means arranging the mass of data into different classes or groups on the basis of their similarities and resemblances.

All similar items of data are put in one class and all dissimilar items of data are put in different classes. Statistical data is classified according to its characteristics. For example, if we have collected data regarding the number of students admitted to a university in a year, the students can be classified on the basis of sex.

In this case, all male students will be put in one class and all female students will be put in another class. The students can also be classified on the basis of age, marks, marital status, height, etc.

The set of characteristics we choose for the classification of the data depends upon the objective of the study. For example, if we want to study the religions mix of the students, we classify the students on the basis of religion.

Purpose of Classification:

Classification helps in achieving the following objectives:

(1) It helps in presenting the mass of data in a concise and simple form.
(2) It divides the mass of data on the basis of similarities and resemblances so as to enable comparison.
(3) It is a process of presenting raw data in a systematic manner enabling us to draw meaningful conclusions.
(4) It provides a basis for tabulation and analysis of data.
(5) It provides us a meaningful pattern in the data and enables us to identify the possible characteristics in the data.

Methods of Classification

There are two methods of classification: i) classification according to attributes, and ii) classification according to variables.

Classification According to Attributes

An attribute is a qualitative characteristic which cannot be expressed numerically. Only the presence or absence of an attribute can be known. For example. intelligence, religion, caste, sex, etc., are attributes. You cannot quantify these characteristics.

When classification is to be done on the basis of attributes, groups are differentiated either by the presence or absence of the attribute (e.g., male and female) or by its differing qualities. The qualities of an attribute can easily be differentiated by means of some natural line of demarcation.

Based on this natural difference, we can determine the group into which a particular item is placed. For instance, if we select colour of hair as the basis of classification, there will be a group of brown-haired people and another group of black-haired people. There are two types of classification based on attributes.

(1) Simple Classification: In simple classification the data is classified on the basis of only one attribute. The data classified on the basis of sex will be an example of simple classification.

(2) Manifold Classification: In this classification the data is classified on the basis of more than one attribute. For example, the data relating to the number of students in a university can be classified on the basis of their sex and marital.

Classification According to Variables

Variables refer to quantifiable characteristics of data and can be expressed numerically. Examples of variable are wages, age, height, weight, marks, distance etc.

All these variables can be expressed in quantitative terms. In this form of classification, the data is shown in the form of a frequency distribution.

A frequency distribution is a tabular Presentation that generally organises data into classes, and shows the number of observations (frequencies) falling into each of these classes. Based on the number of variables used, there are three categories of frequency distribution:

(1). uni-variate frequency distribution,

(2). bi-variate frequency distribution, and

(3). Multi-variate frequency distribution.

1) Uni-variate Frequency Distribution: The frequency distribution with one variable is called a uni-variate frequency distribution. For example, the students in a class may be classified on the basis of marks obtained by them.

2) Bi-variate Frequency Distribution: The frequency distribution with two variables is called bi-variate frequency distribution. If a frequency distribution shows two variables it is known as bi-variate frequency distribution.

3) Multi-variate Frequency Distribution: The frequency & distribution with more than two variables is called multivariate frequency distribution. For example, the students in a class may be classified on the basis of marks, age and sex.

8 PRESENTATION OF DATA

Introduction

Introduction to Data Handling

Data handling means to collect and present the data so that it could be used in further studies and to find some results.

Data

Any information collected in the form of numbers, words, measurements, symbols, or in any other form is called data.

Graphical Representation of Data

The grouped data can be represented graphically for its clear picture and it is the easiest way to understand the data.

Types of Graph

1. **Pictograph**

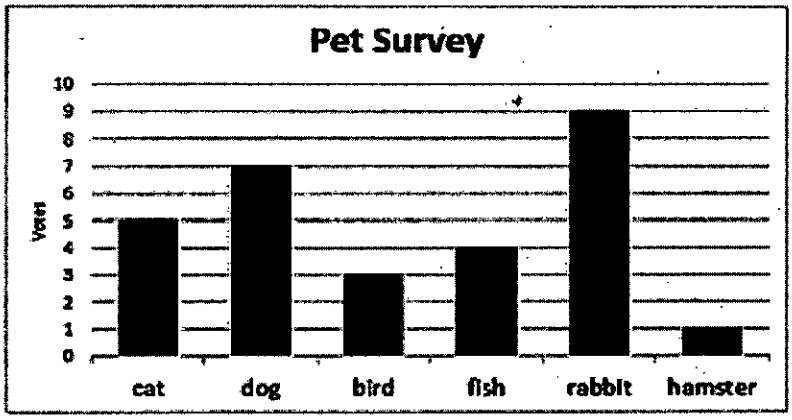
   When we represent the data through pictures or symbols then it is called **Pictograph.**

One represents 10 Trees	
Name	**Number of Trees**
Apple	
Peach	
Guava	
Pear	

   Here one tree represents 10 trees. And we can easily read the pictograph. The graph shows that there are 30 trees of apple and so on.

2. **Bar Graphs**

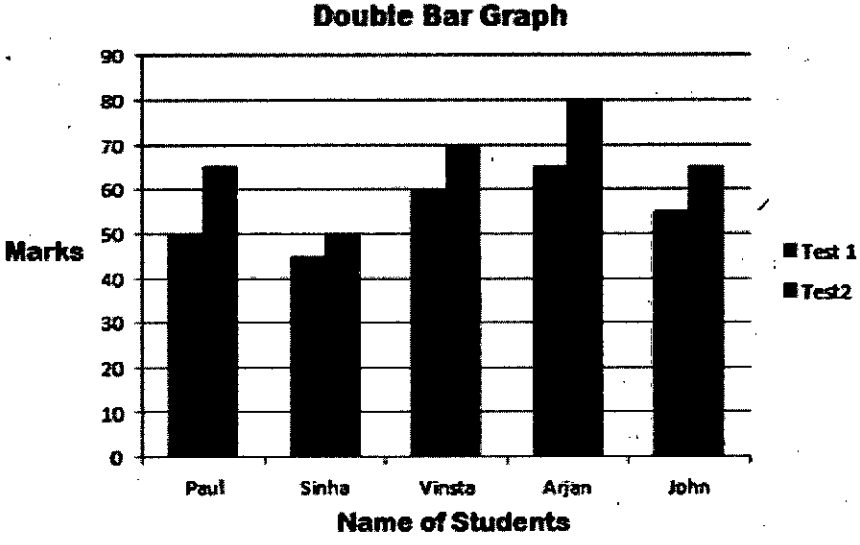
   In the bar graph, the information represented by the bars of the same width with equal gaps but the height of the bars represents the respective values.



Here, the names of pets are represented on the horizontal line and the values of the respective pets are shown by the height of the bars. There is an equal gap between each bar.

3. **Double Bar Graph**

To compare some data we can use the double bar graph as it shows the information of two quantities simultaneously.



Here, in the above graph, it represents the marks of the students in two different tests altogether. So we can compare the marks easily.

Organizing Data

Any data which is available in the unorganized form is called **Raw Data**.

This raw data is arranged or grouped in a systematic manner to make it meaningful which is called the **Presentation of Data**.

Terms Related to Data Organizing

1. **Frequency**

Frequency tells us the no. of times a particular quantity repeats itself.

2. **Frequency Distribution Table**

Frequency can be represented by the frequency distribution table.

Frequency of Colors in a Bag of Skittles		
Color Choices	Tally Marks	Frequency
Purple	IIII	4
Yellow	~~IIII~~ II	7
Red	~~IIII~~ II	7
Green	~~IIII~~ I	6
Blue	~~IIII~~	5
Orange	IIIII	4

The above table shows the no. of times a particular colour repeat in the bag of skittles.

Frequency can also be shown by the tally marks. A cut over four lines represents the number 5.

1. **Grouping Data**

If we have a large number of quantities then we need to group the observation and then make the table. Such a table is called a **Grouped Frequency Distribution Table**.

Some Important terms related to grouped Frequency Distribution Table

- **Class Interval or Class:** When all the observations are classified in several groups according to their size then these groups are called **Class Interval**
- **Lower-class Limit:** The lowest number in every class interval is known as its **Lower-class Limit**.
- **Upper-class Limit:** The highest number in every class interval is known as its **Upper-class Limit**.
- **Width or Size or Magnitude of the Class Interval:** The difference between the upper-class limit and the lower-class limit is called the **Size of the Class Interval**.

Example

There is a list of marks of 40 students in a school. Arrange this in grouped frequency distribution table.

55	63	44	37	50	57	44	57	42	46	33	44
58	40	54	65	39	27	28	56	38	45	70	60
30	35	56	78	55	27	50	28	44	28	60	61
39	37	65	43								

Solution

As we can see that the lowest number in the above data is 27 and the highest number is 78, so we can make intervals if 20 - 30, 30 - 40 so on.

Class (Rs.)	Tally Marks	Frequency Students
20 - 30	卌	5
30 - 40	卌 III	8
40 - 50	卌 IIII	9
50 - 60	卌 卌	10
60 - 70	卌 I	6
70 - 80	II	2
Total		40

Remark: As number 30 comes in two class intervals but we cannot count it in both the intervals. So it is to remember that the common observation will always be counted in the higher class. Hence 30 will come in 30-40, not in 20-30.

Histogram

Basically, the bar graph of the grouped frequency distribution or continuous class interval is called **Histogram**.

The class intervals are shown on the horizontal line and the frequency of the class interval is shown as the height of the bars.

There is no gap between each bar.

Example

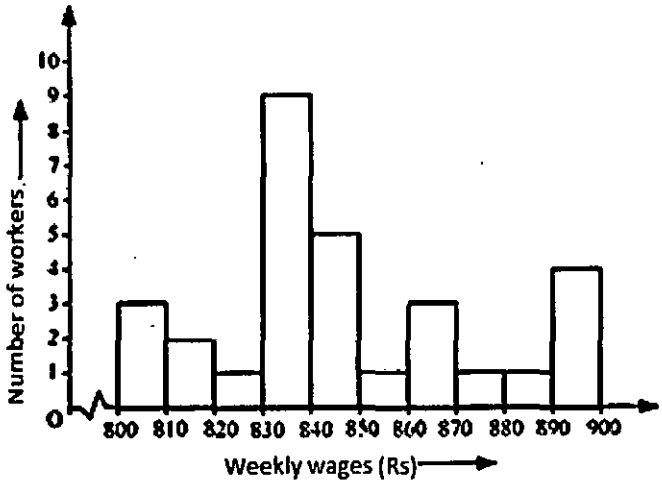
Draw a histogram for the wages of 30 workers in a company. The wages are as follows: 830, 840, 868, 890, 806, 840, 835, 890,840, 885, 835, 835, 836, 878, 810, 835, 836, 869, 845, 855, 845, 804, 808, 860, 832, 833, 812, 898, 890, 820.

Solution

Make the grouped frequency distribution of the given data.

Class Interval	Frequency
800 – 810	3
810 – 820	2
820 – 830	1
830 – 840	9
840 – 850	5
850 – 860	1
860 – 870	3
870 – 880	1
880 – 890	1
890 – 900	4

Draw the histogram by taking the class interval on the horizontal line and the frequency on the vertical line.



Remark: As the class interval does not start from zero, so we will put a jagged line which shows that there is no number between 0 – 800.

Circle Graph or Pie Chart

If we represent the data in a circle form then it is said to be a pie chart. This graph shows the relationship between the whole and its part. We have to divide the circle into sectors and each sector is proportional to its respective activity.

We use it when we have information on percentage or fraction.

Drawing of a Pie Chart

If we have the information in percentage then we need to calculate the respective angles to show them in the pie chart.

As we know that a complete circle is of 360°, so we need to calculate the fraction of 360° for every sector.

Example

Draw a pie chart of the following percentage of genres of movies liked by the public.

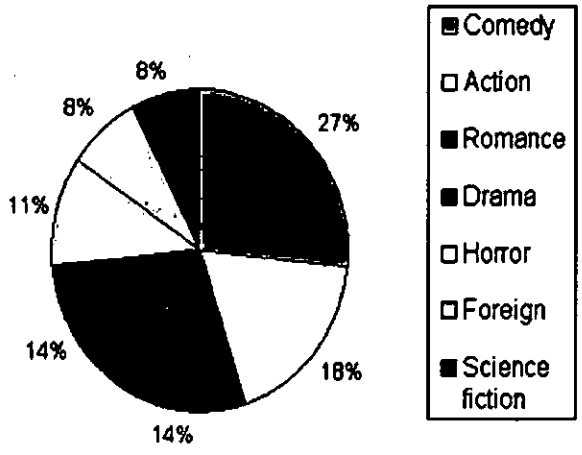
Genres of Movie	Percentage of the no. of people
Comedy	27%
Action	18%
Romance	14%
Drama	14%
Horror	11%
Foreign	8%
Science fiction	8%

Solution

To draw the pie chart first we need to calculate the angle by taking the fraction of 360°.

Genres of Movie	Percentage of the no. of people	In fractions	Fraction of 360°
Comedy	27%	27/100	27/100 × 360° = 97.2°
Action	18%	18/100	18/100 × 360° = 64.8°
Romance	14%	14/100	14/100 × 360° = 50.4°
Drama	14%	14/100	14/100 × 360° = 50.4°
Horror	11%	11/100	11/100 × 360° = 39.6°
Foreign	8%	8/100	8/100 × 360° = 28.8°
Science fiction	8%	8/100	8/100 × 360° = 28.8°

By using these angles draw a pie chart.



Cumulative frequency curve (Ogive)

Cumulative frequency curve (Ogive) is drawn to represent the cumulative frequency distribution. There are two types of Ogives such as 'less than Ogive curve' and 'more than Ogive curve'. To draw these curves, we have to calculate the 'less than' cumulative frequencies and 'more than' cumulative frequencies. The following procedure can be followed to draw the ogive curves:

Less than Ogive: Less than cumulative frequency of each class is marked against the corresponding upper limit of the respective class. All the points are joined by a free-hand curve to draw **the less than ogive** curve.

More than Ogive: More than cumulative frequency of each class is marked against the corresponding lower limit of the respective class. All the points are joined by a free-hand curve to draw the **more than ogive** curve.

Both the curves can be drawn separately or in the same graph. If both the curves are drawn in the same graph, then the value of abscissa (x-coordinate) in the point of intersection is the median.

If the curves are drawn separately, median can be calculated as follows:

Draw a line perpendicular to Y-axis at y=N/2. Let it meet the Ogive at C. Then, draw a perpendicular line to X-axis from the point C. Let it meet the X-axis at M. The abscissa of M is the median of the data.

Example 4.14

Draw the less than Ogive curve for the following data:

Daily Wages (in Rs.)	70- 80	80- 90	90-100	100-110	110-120	120-130	130-140	140-150
No. of workers	12	18	35	42	50	45	20	8

Also, find

i. The Median

ii. The number of workers whose daily wages are less than ₹ 125.

Solution:

Since we are displaying the distribution of Daily Wages and No. of workers, the Ogive curve is drawn, to provide better understanding about the wages and No. of workers.

The following procedure can be followed to draw Less than Ogive curve:

Step 1 : Daily wages are marked along the X-axis and labeled as "Wages(in `)".

Step 2 : No. of Workers are marked along the Y-axis and labeled as "No. of workers".

Step 3 : Find the less than cumulative frequency, by taking the upper class-limit of daily wages. The cumulative frequency corresponding to any upper class-limit of daily wages is the sum of all the frequencies less than the limit of daily wages.

Step 4 : The less than cumulative frequency of Number of workers are plotted as points against the daily wages (upper-limit). These points are joined to form less than ogive curve.

The Less than Ogive curve is presented in Fig 4.12.

Daily wages (less than)	No of workers
80	12
90	30
100	65
110	107
120	157
130	202
140	222
150	230

Daily Wages of Workers

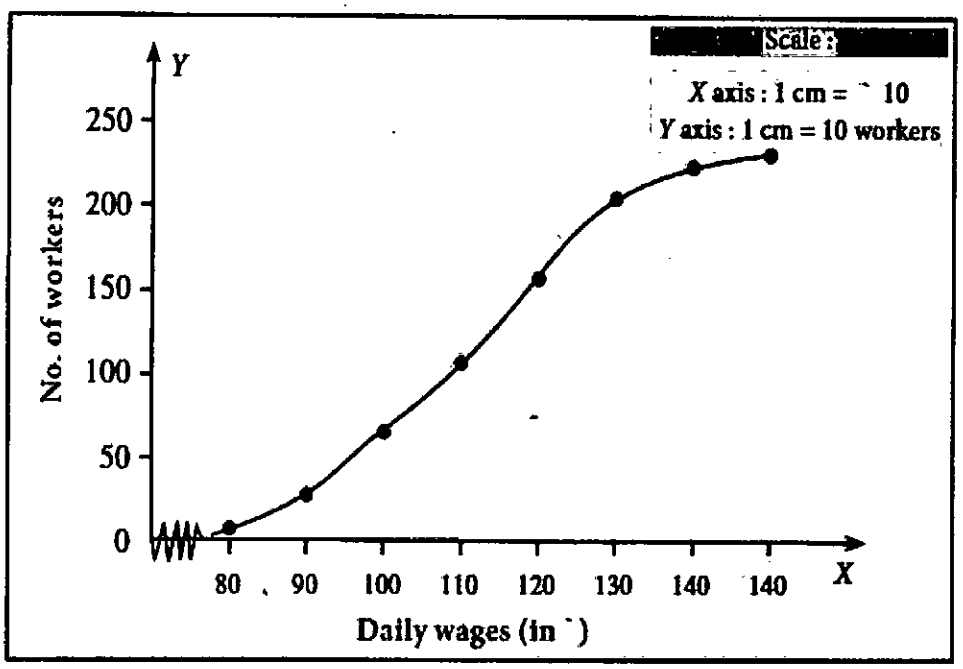


Fig 4.12 Less than Ogive curve for daily wages and number of workers

i. Median = ₹ 120

ii. 183 workers get daily wages less than ₹ 125

Example

The following table shows the marks obtained by 120 students of class IX in a cycle test-I . Draw the more than Ogive curve for the following data :

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
No. of students	2	6	8	20	30	22	18	8	4	2

Also, find

i. The Median

ii. The Number of students who get more than 75 marks.

Solution:

Since we are displaying the distribution marks and No. of students, the more than Ogive curve is drawn, to provide better understanding about the marks of the students and No. of students.

The following procedure can be followed to draw More than Ogive curve:

Step 1: Marks of the students are marked along the X-axis and labeled as 'Marks'.

Step 2 : No. of students are marked along the Y-axis and labeled as 'No. of students'.

Step 3 : Find the more than cumulative frequency, by taking the lower class-

limit of marks. The cumulative frequency corresponding to any lower class-limit of marks is the sum of all the frequencies above the limit of marks.

Step 4 : The more than cumulative frequency of number of students are plotted as points against the marks (lower-limit). These points are joined to form more than ogive curve.

The More than Ogive curve is presented in Fig 4.13.

Marks More than	No of Students
0	120
10	118
20	112
30	104
40	84
50	54
60	32
70	14
80	6
90	2

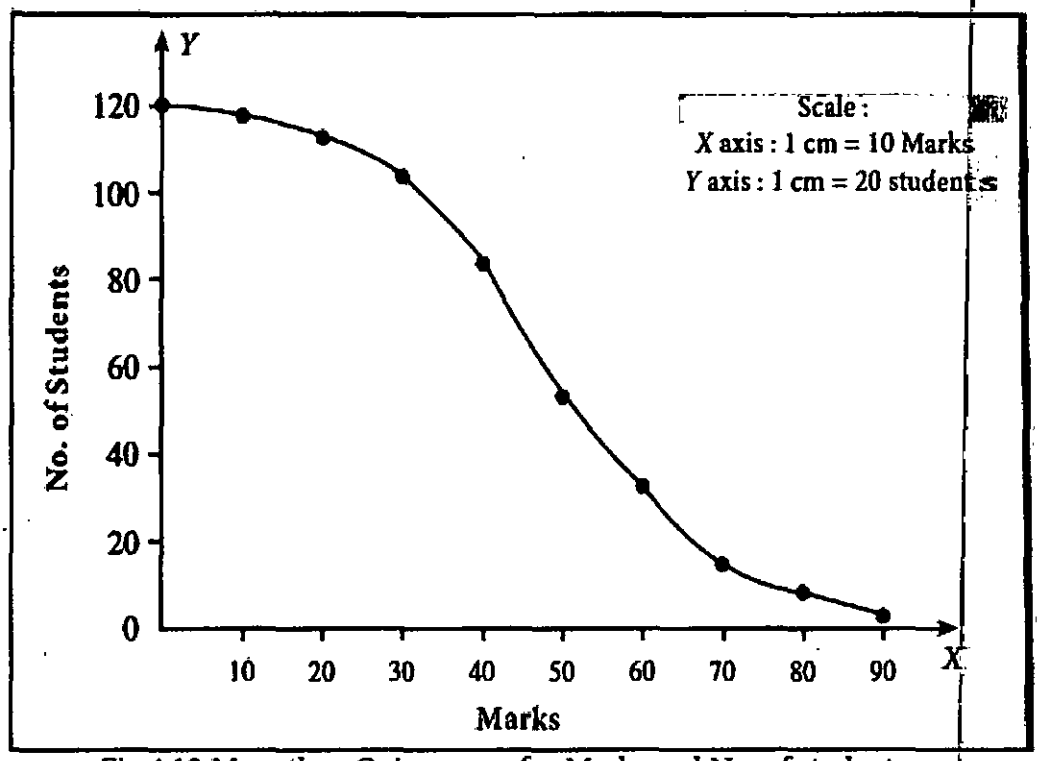


Fig 4.13 More than Ogive curve for Marks and No. of students

i. Median =42 students

ii. 7 students get more than 75 marks.

Example

The yield of mangoes was recorded (in kg) are given below:

Graphically,

i. finds the number of trees which yield mangoes of less than 55 kg.
ii. find the number of trees from which mangoes of more than 75 kg.
iii. find the median.

Draw the Less than and More than Ogive curves. Also, find the median using the Ogive curves

Yield (in kg)	No. of trees
40 – 50	10
50 – 60	15
60 – 70	17
70 – 80	14
80 – 90	12
90 – 100	2
Total	70

Solution:

Since we are displaying the distribution of Yield and No. of trees, the Ogive curve is drawn, to provide better understanding about the Yield and No. of trees

The following procedure can be followed to draw Ogive curve:

Step 1 : Yield of mangoes are marked along the X-axis and labelled as 'Yield (in Kg.)'.

Step 2: No. of trees are marked along the Y-axis and labelled as 'No. of trees'.

Step 3: Find the less than cumulative frequency, by taking the upper class-limit of Yield of mangoes. The cumulative frequency corresponding to any upper class-limit of Mangoes is the sum of all the frequencies less than the limit of mangoes.

Step 4: Find the more than cumulative frequency, by taking the lower class-limit of Yield of mangoes. The cumulative frequency corresponding to any lower class-limit of Mangoes is the sum of all the frequencies above the limit of mangoes.

Step 5: The less than cumulative frequency of Number of trees are plotted as points against the yield of mangoes (upper-limit). These points are joined to form less than ogive curve.

Step 6: The more than cumulative frequency of Number of trees are plotted as points against the yield of mangoes (lower-limit). These points are joined to form more than O give curve.

Less than Ogive		More than Ogive	
Yield less than	**No. of trees**	**Yield greater than**	**No. of trees**
50	10	40	70
60	25	50	60
70	42	60	45
80	56	70	28
90	68	80	14
100	70	90	2

The Ogive curve is presented in Fig 4.14.

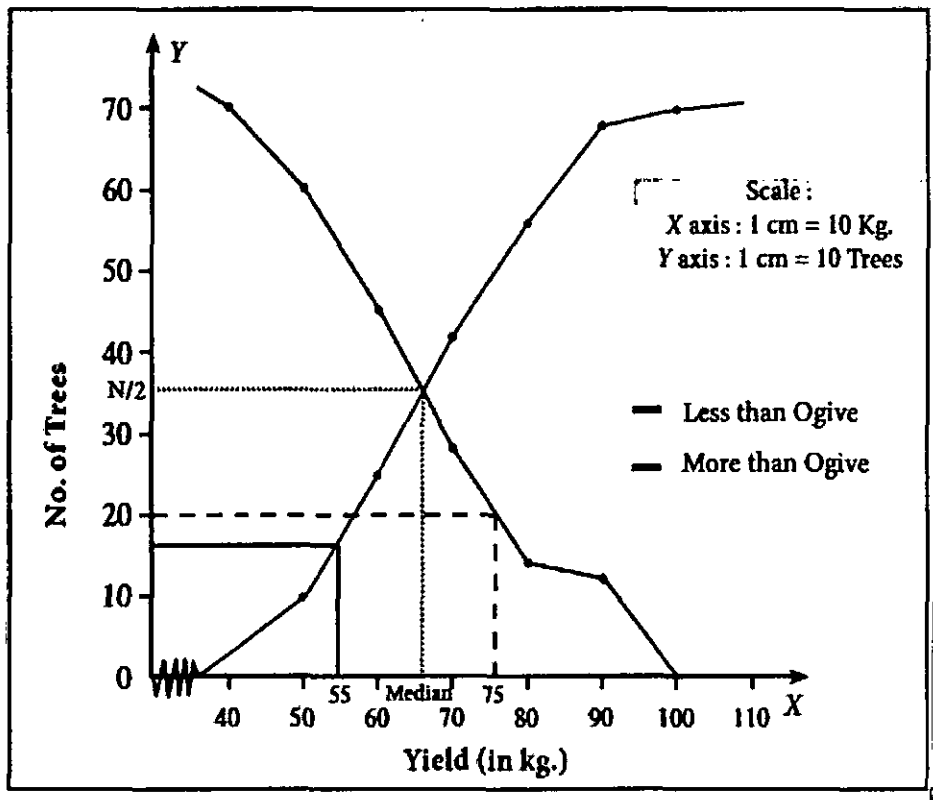


Fig 4.14 Ogive curve for Yield of mangoes and number of trees

i. 16 trees yield less than 55 kg
ii. 20 trees yield more than 75 kg
iii. Median =66 kg

Summary of the Chapter

Types of Diagrammatic Presentation:

1. **Geometric Form**
   - (a) Pie Diagram
     - i. Simple
     - iii. Sub Divided
   - (b) Bar Diagram
     - ii. Multiple
     - iv. Percentage
2. **Frequency Diagram**
   - (a) Histogram
   - (b) Frequency Polygon
   - (c) Frequency Curve
   - (d) Ogive curve

EXERCISE

Multiple Choice Questions

1. A sector diagram is also called:
   (a) Bar diagram (b) Histogram
   (c) Histogram **(d) Pie diagram**
2. Which of the following is not a one-dimensional diagram:
   (a) Simple bar diagram (b) Multiple bar diagram
   (c) Component bar diagram **(d) Pie diagram**
3. Which of the following is a two-dimensional diagram:
   (a) Sub-divided bar (b) Percentage component bar chart
   (c) Sub-divided rectangles (d) Multiple bar diagram
4. Pie diagram represents the components of a factor by:
   (a) Circles **(b) Sectors**
   (c) Angles (d) Percentages
5. The suitable diagram to represent the data relating to the monthly expenditure on different items by a family is:
   (a) Histogram (b) Histogram
   (c) Multiple bar diagram **(d) Pie diagram**
6. A graph of time series or historical series is called:
   (a) Histogram (b) Histogram
   (c) Frequency curve (d) Frequency polygon
7. The histogram is the graphical presentation of data which are classified:
   (a) Geographically (b) Numerically
   (c) Qualitatively **(d) According to time**
8. Histogram and histogram are:
   (a) Always same **(b) Not same**
   (c) Off and on same (d) Randomly same
9. A distribution in which the observations are concentrated at one end of the distribution is called a:
   (a) Symmetric distribution (b) Normal distribution
   (c) Skewed distribution (d) Uniform distribution

Review Questions

1. Width of bars in a bar diagram need not be equal (True/False).
2. Width of rectangles in a histogram should essentially be equal (True/ False).
3. Histogram can only be formed with continuous classification of data (True/False).
4. Histogram and column diagram are the same method of presentation of data. (True/False)
5. Mode of a frequency distribution can be known graphically with the help of histogram. (True/False)
6. Median of a frequency distribution cannot be known from the ogives. (True/False)
7. What kind of diagrams are more effective in representing the following?
   (i) Monthly rainfall in a year
   (ii) Composition of the population of Delhi by religion
   (iii) Components of cost in a factory

Space for notes

9 STATISTICAL TOOLS

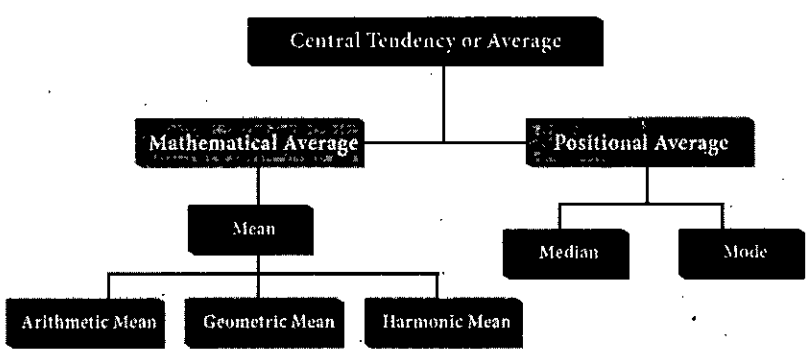
Module Content

Meaning of central tendency, computation of arithmetic mean, combined mean, weighted arithmetic mean, median, quartiles and mode. Meaning of dispersion, Measures and methods of computing dispersion, Range, quartile deviation mean deviation, standard deviation (Absolute and Relative measures), Lorenz curve. Meaning, Scatter diagram, Karl Pearson's coefficient of correlation, Spearman's Rank correlation. Meaning, types, Construction of simple and weighted index numbers, Laspeyer's, Paasche's and Fischer's wholesale price index, Consumer price index and index of industrial production, uses of index numbers

Objective of the module

The main objective of this module is to make student understand about the basics of

Various measures of central tendency



Arithmetic Mean

(a) To find A.M. for Raw data

For a raw data, the arithmetic mean of a series of numbers is sum of all observations divided by the number of observations in the series. Thus, if $x_1, x_2, ..., x_n$ represent the values of n observations, then arithmetic mean (A.M.) for n observations is: (direct method)

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

There are two methods for computing the A.M:

(i) Direct method (ii) Short cut method.

Example

The following data represent the number of books issued in a school library on selected from 7 different days 7, 9, 12, 15, 5, 4, 11 find the mean number of books.

Solution:

$$\bar{x} = \frac{1}{n}\sum_{i-1}^{n} x_i$$

$$\bar{x} = \frac{7+9+12+15+5+4+11}{7}$$

$$= \frac{63}{7} = 9$$

Hence the mean of the number of books is 9

Short-cut Method to find A.M.

Under this method an assumed mean or an arbitrary value (denoted by A) is used as the basis of calculation of deviations (d_i) from individual values. That is if $d_i = x_i - A$

Then

$$\bar{x} = A + \frac{\sum_{i=1}^{n} d_i}{n}$$

Example

A student's marks in 5 subjects are 75, 68, 80, 92, 56. Find the average of his marks.

Solution:

Let us take the assumed mean, A = 68

x_i	$d_i = x_i - 68$
75	7
68	0
80	12
56	-12
92	24
Total	**31**

$$\bar{x} = A + \frac{\sum_{i=1}^{n} d_i}{n}$$

$$= 68 + \frac{31}{5}$$

$$= 68+6.2 = 74.2$$

The arithmetic mean of average marks is 74.2

(b) To find A.M. for Discrete Grouped data

If $x_1, x_2, ..., x_n$ are discrete values with the corresponding frequencies $f_1, f_2, ..., f_n$. Then the mean for discrete grouped data is defined as (direct method)

$$\bar{x} = \frac{\sum_{i=1}^{n} f_i x_i}{N}$$

In the short cut method the formula is modified as

$$\bar{x} = A + \frac{\sum_{i=1}^{n} f_i d_i}{N} \quad \text{where} \quad d_i = x_i - A$$

Example

A proof reads through 73 pages manuscript The number of mistakes found on each of the pages are summarized in the table below Determine the mean number of mistakes found per page

No of mistakes	1	2	3	4	5	6	7
No of pages	5	9	12	17	14	10	6

Solution:

(i) Direct Method

x_i	f_i	$f_i x_i$
1	5	5
2	9	18
3	12	36
4	17	68
5	14	70
6	10	60
7	6	42
Total	N=73	299

$$\bar{x} = \frac{\sum_{i=1}^{n} f_i x_i}{N}$$

$$= \frac{299}{73}$$

$$= 4.09$$

The mean number of mistakes is 4.09

(ii) Short-cut Method

x_i	f_i	$d_i = x_i - A$	$f_i d_i$
1	5	-3	-15
2	9	-2	-18
3	12	-1	-12
4	17	0	0
5	14	1	14
6	10	2	20
7	6	3	18
	$\Sigma f_i = 73$		$\Sigma f_i d_i = 7$

$$\bar{x} = A + \frac{\sum_{i=1}^{n} f_i d_i}{N}$$

$$= 4 + \frac{7}{73}$$

$$= 4.09$$

The mean number of mistakes = 4.09

(c) Mean for Continuous Grouped data:

For the computation of A.M for the continuous grouped data, we can use direct method or short cut method.

Direct Method:

The formula is

$$\bar{x} = \frac{\sum_{i=1}^{n} f_i x_i}{N}, \quad x_i \text{ is the midpoint of the class interval}$$

Short cut method

$$\bar{x} = A + \frac{\sum_{i=1}^{n} f_i d_i}{N} \times C$$

$$d = \frac{x_i - A}{c}$$

where A - any arbitrary value

c - width of the class interval

x_i is the midpoint of the class interval.

Example

The following the distribution of persons according to different income groups

Income (in ` 1000)	0 – 8	8 – 16	16 – 24	24 – 32	32 – 40	40 – 48
No of persons	8	7	16	24	15	7

Find the average income of the persons.

Solution :

Direct Method:

Class	f_i	x_i	$f_i x_i$
0-8	8	4	32
8 – 16	7	12	84
16-24	16	20	320
24-32	24	28	672
32-40	15	36	540
40-48	7	44	308
Total	N =77		1956

$$\bar{x} = \frac{\sum_{i=1}^{n} f_i x_i}{N}$$

$$= \frac{1956}{77}$$

$$= 25.40$$

Short cut method:

Class	f_i	x_i	$d_i=(x_i-A)/c$	f_id_i
0 – 8	8	4	-3	-24
8 – 16	7	12	-2	-14
16 – 24	16	20	-1	-16
24 – 32	24	28 A	0	0
32 – 40	15	36	1	15
40 – 48	7	44	2	14
Total	N= 77			-25

$$\bar{x} = A + \frac{\sum_{i=1}^{n} f_i d_i}{N} \times C$$

$$= 28 + \frac{-25}{77} \times 8 = 25.40$$

Merits

- It is easy to compute and has a unique value.
- It is based on all the observations.
- It is well defined.
- It is least affected by sampling fluctuations.
- It can be used for further statistical analysis.

Limitations

- The mean is unduly affected by the extreme items (outliers).
- It cannot be determined for the qualitative data such as beauty, honesty etc.
- It cannot be located by observations on the graphic method.

When to use?

Arithmetic mean is a best representative of the data if the data set is homogeneous. On the other hand, if the data set is heterogeneous the result may be misleading and may not represent the data.

Weighted Arithmetic Mean

The arithmetic mean, as discussed earlier, gives equal importance (or weights) to each observation in the data set. However, there are situations in which values of individual observations in the data set are not of equal importance. Under these

circumstances, we may attach, a weight, as an indicator of their importance to each observation value.

Definition

Let $x_1, x_2, ..., x_n$ be the set of n values having weights $w_1, w_2, ..., w_n$ respectively, then the weighted mean is,

$$\overline{x_w} = \frac{w_1x_1 + w_2x_2 + ... + w_nx_n}{w_1 + w_2 + ... + w_n} = \frac{\sum_{i=1}^{n} w_ix_i}{\sum_{i=1}^{n} w_i}$$

Example

The weights assigned to different components in an examination or Component Weightage Marks scored

Component	Weightage	Marks scored
Theory	4	60
Practical	3	80
Assignment	1	90
Project	2	75
	10	

Calculate the weighted average score of the student who scored marks as given in the table

Solution:

Component	Marks scored (x_i)	Weightage (w_i)	w_ix_i
Theory	60	4	240
Practical	80	3	240
Assignment	90	1	90
Project	75	2	150
Total		10	720

Weighted average, $\overline{x} = \frac{\sum w_ix_i}{\sum w_i}$

$= 720/10$

$= 72$

Combined Mean:

Let $\bar{x}_1$ and $\bar{x}_2$ are the arithmetic mean of two groups (having the same unit of measurement of a variable), based on n1 and n2 observations respectively. Then the combined mean can be calculated using

$$\text{Combined Mean} = \bar{x}_{12} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

Remark: The above result can be extended to any number of groups.

Example

A class consists of 4 boys and 3 girls. The average marks obtained by the boys and girls are 20 and 30 respectively. Find the class average.

Solution:

$$n_1 = 4,\ \bar{x}_1 = 20,\ n_2 = 3,\ \bar{x}_2 = 30$$

$$\text{Combined Mean} = \bar{x}_{12} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

$$= \left[\frac{4 \times 20 + 3 \times 30}{4 + 3}\right]$$

$$= \left[\frac{80 + 90}{7} = \frac{170}{7}\right] = 24.3$$

Geometric Mean(GM)

(a) G.M. For Ungrouped data

The Geometric Mean (G.M.) of a set of n observations is the nth root of their product. If $x_1, x_2, \ldots, x_n$ are n observations then

$$\text{G. M.} = \sqrt[n]{x_1 . x_2 \ldots x_n} = (x_1 . x_2 \ldots x_n)^{\frac{1}{n}}$$

Taking the nth root of a number is difficult. Thus, the computation is done as under

$$\log \text{G.M.} = \log (x_1 . x_2 \ldots x_n)$$

$$= (\log x_1 + \log x_2 + \ldots + \log x_n)$$

$$= \frac{\sum_{i=1}^{n} \log x_i}{n}$$

$$\text{G.M.} = \text{Antilog} \frac{\sum_{i=1}^{n} \log x_i}{n}$$

Example

Calculate the geometric mean of the annual percentage growth rate of profits in business corporate from the year 2000 to 2005 is given below

50, 72, 54, 82, 93

Solution:

x_i	50	72	54	82	93	Total
$\log x_i$	1.6990	1.8573	1.7324	1.9138	1.9685	9.1710

$$\text{G.M.} = \text{Antilog}\ \frac{\sum_{i=1}^{n} \log x_i}{n}$$

$$= \text{Antilog}\ \frac{9.1710}{5}$$

$$= \text{Antilog}\ 1.8342$$

$$\text{G. M.} = 68.26$$

Geometrical mean of annual percentage growth rate of profits is 68.26

Example

The population in a city increased at the rate of 15% and 25% for two successive years. In the next year it decreased at the rate of 5%. Find the average rate of growt

Solution:

Let us assume that the population is 100

Percentage rise in population	Population at the end of year x_i	$\log x_i$
15	115	2.0607
25	125	2.0969
5	95	1.9777
		6.1353

$$\text{G.M} = \text{Antilog}\ \frac{\sum_{n}^{n} \log x_i}{n}$$

$$= \text{Antilog}\ \frac{(6.1353)}{3}$$

$$= \text{Antilog}\ (2.0451)$$

$$= 110.9$$

(b) G.M. For Discrete grouped data

If $x_1, x_2, \ldots\ldots x_n$ are discrete values of the variate x with corresponding frequencies $f_1, f_2, \ldots f_n$. Then geometric mean is defined as

$$\text{G. M.} = \text{Antilog } \frac{\sum_{i=1}^{n} f_i \log x_i}{N} \text{ with usual notations}$$

Example

Find the G.M for the following data, which gives the defective screws obtained in a factory.

Diameter (cm)	5	15	25	35
Number of defective screws	5	8	3	4

Solution:

x_i	f_i	$\log x_i$	$f_i \log x_i$
5	5	0.6990	3.4950
15	8	1.1761	9.4088
25	3	1.3979	4.1937
35	4	1.5441	6.1764
	N=20		23.2739

$$\text{G.M} = \text{Antilog}$$

$$= \text{Antilog } \frac{\sum_{i=1}^{n} f_i \log x_i}{N}$$

$$= \text{Antilog } \frac{23.2739}{20}$$

$$= \text{Antilog } 1.1637$$

$$\text{G.M} = 14.58$$

(c) **G.M. for Continuous grouped data**

Let x_i be the mid point of the class interval

$$\text{G. M.} = \text{Antilog}\left[\frac{\sum_{i=1}^{n} f_i \log x_i}{N}\right]$$

Example

The following is the distribution of marks obtained by 109 students in a subject in an institution. Find the Geometric mean.

Marks	4-8	8-12	12-16	16-20	20-24	24-28	28-32	32-36	36-40
No. of Students	6	10	18	30	15	12	10	6	2

Solution:

Marks	Mid point (x_i)	f_i	$\log x_i$	$f_i \log x_i$
4-8	6	6	0.7782	4.6692
8-12	10	10	1.0000	10.0000
12-16	14	18	1.1461	20.6298
16-20	15	30	1.2553	37.6590
20-24	22	15	1.3424	20.1360
24-28	26	12	1.4150	16.800
28-32	30	10	1.4771	14.7710
32-36	34	6	1.5315	9.1890
36-40	38	2	1.5798	3.1596
Total		N =109		137.1936

$$\text{G.M.} = \text{Antilog}\left[\frac{\sum_{i=1}^{n} f_i \log x_i}{N}\right]$$

$$= \text{Antilog}\left[\frac{137.1936}{109}\right] = \text{Antilog}\,[1.2587]$$

$$\text{G. M.} = 18.14$$

Geometric mean marks of 109 students in a subject is 18.14

Merits of Geometric Mean:

- It is based on all the observations
- It is rigidly defined
- It is capable of further algebraic treatment
- It is less affected by the extreme values
- It is suitable for averaging ratios, percentages and rates.

Limitations of Geometric Mean:

- It is difficult to understand
- The geometric mean cannot be computed if any item in the series is negative or zero.
- The GM may not be the actual value of the series
- It brings out the property of the ratio of the change and not the absolute difference of change as the case in arithmetic mean.

Harmonic Mean (H.M.)

Harmonic Mean is defined as the reciprocal of the arithmetic mean of reciprocals of the observations.

(a) H.M. for Ungrouped data

Let $x_1, x_2, ..., x_n$ be the n observations then the harmonic mean is defined as

$$\text{H. M.} = \frac{n}{\sum_{i=1}^{n}\left(\frac{1}{x_i}\right)}$$

Example

A man travels from Jaipur to Agra by a car and takes 4 hours to cover the whole distance. In the first hour he travels at a speed of 50 km/hr, in the second hour his speed is 64 km/hr, in third hour his speed is 80 km/hr and in the fourth hour he travels at the speed of 55 km/hr. Find the average speed of the motorist.

Solution:

x	50	65	80	55	Total
$1/x$	0.0200	0.0154	0.0125	0.0182	0.0661

$$\text{H. M.} = \frac{n}{\Sigma\left(\frac{1}{x_i}\right)}$$

$$= \frac{4}{0.0661} = 60.5 \text{ km/hr}$$

Average speed of the motorist is 60.5km/hr

(b) H.M. for Discrete Grouped data:

For a frequency distribution

$$\text{H. M.} = \frac{N}{\sum_{i=1}^{n} f_i\left(\frac{1}{x_i}\right)}$$

Example

The following data is obtained from the survey. Compute H.M

Speed of the car	130	135	140	145	150
No of cars	3	4	8	9	2

Solution:

x_i	f_i	$\frac{f_i}{x_i}$
130	3	0.0231
135	4	0.0091
140	8	0.0571
145	9	0.0621
150	2	0.0133
Total	N = 26	0.1648

$$\text{H. M.} = \frac{N}{\sum_{i=1}^{n} f_i\left(\frac{1}{x_i}\right)}$$

$$= \frac{26}{0.1648}$$

$$\text{H.M} = 157.77$$

(c) H.M. for Continuous data:

$$\text{The Harmonic mean H.M.} = \frac{N}{\sum_{i=1}^{n} f_i\left(\frac{1}{x_i}\right)}$$

Where x_i is the mid-point of the class interval

Example

Find the harmonic mean of the following distribution of data

Dividend yield (percent)	2 – 6	6 – 10	10 – 14
No. of companies	10	12	18

Solution:

Class Intervals	Mid-value (x_i)	No. of companies (f_i)	Reciprocal ($1/x_i$)	f_i ($1/x_i$)
2 – 6	4	10	¼	2.5
6 – 10	8	12	1/8	1.5
10 – 14	12	18	1/12	1.5
Total		N = 40		5.5

The harmonic mean is $\text{H.M.} = \dfrac{N}{\sum_{i=1}^{n} f_i\left(\frac{1}{x_i}\right)} = \dfrac{40}{5.5} = 7.27$

Merits of H.M:

- It is rigidly defined
- It is based on all the observations of the series
- It is suitable in case of series having wide dispersion
- It is suitable for further mathematical treatment
- It gives less weight to large items and more weight to small item

Limitations of H.M:

- All the values must be available for computation
- It is not popular due to its complex calculation.
- It is usually a value which does not exist in series

When to use?

Harmonic mean is used to calculate the average value when the values are expressed as value/unit. Since the speed is expressed as km/hour, harmonic mean is used for the calculation of average speed.

Relationship among the averages:

In any distribution when the original items are different the A.M., G.M. and H.M would also differ and will be in the following order:

A.M. ≥ G.M ≥ H.M

Median

Median is the value of the variable which divides the whole set of data into two equal parts. It is the value such that in a set of observations, 50% observations are above and 50% observations are below it. Hence the median is a positional average.

(a) Median for Ungrouped or Raw data:

In this case, the data is arranged in either ascending or descending order of magnitude.

(i) If the number of observations *n* is an odd number, then the median is represented by the numerical value of *x*, corresponds to the positioning point of n+1 / 2 in ordered observations. That is,

Median = value of $(n+1 / 2)^{th}$ observation in the data array

If the number of observations n is an even number, then the median is defined as the arithmetic mean of the middle values in the array That is,

$$\text{Median} = \frac{\textit{value of } \left(\frac{n}{2}\right)^{th} \textit{observation} + \textit{value of } \left(\frac{n}{2}+1\right)^{th} \textit{observation}}{2}$$

Example

The number of rooms in the seven five stars hotel in Chennai city is 71, 30, 61, 59, 31, 40 and 29. Find the median number of rooms

Solution:

Arrange the data in ascending order 29, 30, 31, 40, 59, 61, 71

n = 7 (odd)

Median = 7+1 / 2 = 4th positional value

Median = 40 rooms

Example

The export of agricultural product in million dollars from a country during eight quarters in 1974 and 1975 was recorded as 29.7, 16.6, 2.3, 14.1, 36.6, 18.7, 3.5, 21.3

Find the median of the given set of values

Solution:

We arrange the data in descending order

36.6, 29.7, 21.3, 18.7, 16.6, 14.1, 3.5, 2.3

$n = 8$ (*even*)

$$\text{Median} = \frac{4^{th}\text{ item} + 5^{th}\text{ item}}{2}$$

$$= \frac{18.7 + 16.6}{2}$$

$$= 17.65 \text{ million dollars}$$

Cumulative Frequency

In a grouped distribution, values are associated with frequencies. The cumulative frequencies are calculated to know the total number of items above or below a certain limit.This is obtained by adding the frequencies successively up to the required level. This cumulative frequencies are useful to calculate median, quartiles, deciles and percentiles.

(b) Median for Discrete grouped data

We can find median using following steps

i. Calculate the cumulative frequencies

ii. Find (N+1)/2, where N=Σ*f*=total frequencies

iii. Identify the cumulative frequency just greater than (N+1)/2

iv. The value of x corresponding to that cumulative frequency is the (N+1)/2 median.

Example

The following data are the weights of students in a class. Find the median weights of the students

Weight(kg)	10	20	30	40	50	60	70
Number of Students	4	7	12	15	13	5	4

Solution:

Weight (kg) x	Frequency f	Cumulative Frequency $c.f$
10	4	4
20	7	11
30	12	23
40	15	38
50	13	51
60	5	56
70	4	60
Total	N = 60	

Here, $N = \sum f = 60$

$$\frac{N+1}{2} = 30.5$$

The cumulative frequency greater than 30.5 is 38.The value of x corresponding to 38 is 40. The median weight of the students is 40 kgs

(c) Median for Continuous grouped data

In this case, the data is given in the form of a frequency table with class-interval etc., The following formula is used to calculate the median.

$$\text{Median} = l + \frac{\frac{N}{2} - m}{f} \times c$$

Where

l = Lower limit of the median class

N = Total Numbers of frequencies

f = Frequency of the median class

m = Cumulative frequency of the class preceding the median class

c = the class interval of the median class.

From the formula, it is clear that one has to find the median class first. Median class is, that class which correspond to the cumulative frequency just greater than N/2.

Example

The following data attained from a garden records of certain period Calculate the median weight of the apple

Weight in grams	410 – 420	420 – 430	430 – 440	440 – 450	450 – 460	460 – 470	470 – 480
Number of apples	14	20	42	54	45	18	7

Solution:

Weight in grams	Number of apples	Cumulative Frequency
410 – 420	14	14
420 – 430	20	34
430 – 440	42	76
440 – 450	54	130
450 – 460	45	175
460 – 470	18	193
470 – 480	7	200
Total	N = 200	

$$\frac{N}{2} = \frac{200}{2} = 100.$$

Median class is 440 – 450

$$\text{Median} = l + \frac{\frac{N}{2} - m}{f} \times c$$

$l = 440,\ \frac{N}{2} = 100,\ m = 76,\ f = 54,\ c = 10$

$$\text{Median} = 440 + \frac{100 - 76}{54} \times 10$$

$$= 440 + \frac{24}{54} \times 10 = 440 + 4.44 = 444.44$$

The median weight of the apple is 444.44 grams

Example

The following table shows age distribution of persons in a particular region:

Age (years)	No. of persons (in thousands)
Below 10	2
Below20	5
Below30	9
Below 40	12
Below 50	14
Below 60	15
Below 70	15.5
Below 80	15.6

Find the median age.

Solution:

We are given upper limit and less than cumulative frequencies. First find the class-intervals and the frequencies. Since the values are increasing by 10, hence the width of the class interval is equal to 10.

Age groups	No. of persons (in thousands) f	cf
0 – 10	2	2
10 – 20	3	5
20 – 30	4	9
30 – 40	3	12
40 – 50	2	14
50 – 60	1	15
60 – 70	0.5	15.5
70 – 80	0.1	15.6
Total	**N = 15.6**	

$$\left(\frac{N}{2}\right) = \frac{15.6}{2} = 7.8$$

Median lies in the 20 – 30 age group

$$\text{Median} = l + \frac{\frac{N}{2} - m}{f} \times c$$

$$= 20 + \frac{7.8 - 5}{4} \times 10$$

Median = 27 years

Example

The following is the marks obtained by 140 students in a college. Find the median marks

Marks	Number of students
10-19	7
20-29	15
30-39	18
40-49	25
50-59	30
60-69	20
70-79	16
80-89	7
90-99	2

Solution:

Class boundaries	*f*	*Cf*
9.5 -19.5	7	7
19.5-29.5	15	22
29.5- 39.5	18	40
39.5-49.5	25	65
49.5-59.5	30	95
59.5-69.5	20	115
69.5-79.5	16	131
79.5-89.5	7	138
89.5-99.5	2	140
Total	N =140	

$$\text{Median} = l + \left(\frac{\frac{N}{2} - m}{f}\right) \times c$$

$$\frac{N}{2} = \frac{140}{2} = 70$$

Here $l = 49.5,\ f = 30,\ m = 65,\ c = 10$

$$\text{Median} = 49.5 + \left(\frac{70 - 65}{30}\right) \times 10$$

$$= 49.5 + 1.67$$

$$= 51.17$$

Graphical method for Location of median

Median can be located with the help of the cumulative frequency curve or 'ogive'. The procedure for locating median in a grouped data is as follows:

Step 1 : The class intervals, are represented on the horizontal axis (x-axis)

Step 2 : The cumulative frequency corresponding to different classes is calculated. These cumulative frequencies are plotted on the vertical axis (y-axis) against the upper limit of the respective class interval

Step 3 : The curve obtained by joining the points by means of freehand is called the *'less than ogive'*.

Step 4 : A horizontal straight line is drawn from the value N/2 and N+1 / 2on the *y*-axis parallel to *x*- axis to meet the ogive. (depending on *N* is odd or even)

Step 5 : From the point of intersection, draw a line, perpendicular to the horizontal axis which meet the *x* axis at *m* say.

Step 6 : The value m at *x* axis gives the value of the median.

Remarks:

(i) Similarly 'more than' ogives, can be drawn by plotting more than cumulative frequencies against lower limit of the class. A horizontal straight line is drawn from the value $\frac{N}{2}$ or $\frac{N+1}{2}$ on the *y*-axis parallel to *x*-axis to meet the ogive. A line is drawn perpendicular to *x*-axis meets the point at m, say, the *X* coordinate of m gives the value of the median.

(depending on *N* is odd or even)

(ii) When the two ogive curves are drawn on the same graph, a line is drawn perpendicular to x-axis from the point of intersection, meets the point at m, say. The *x* coordinate m gives the value of the median.

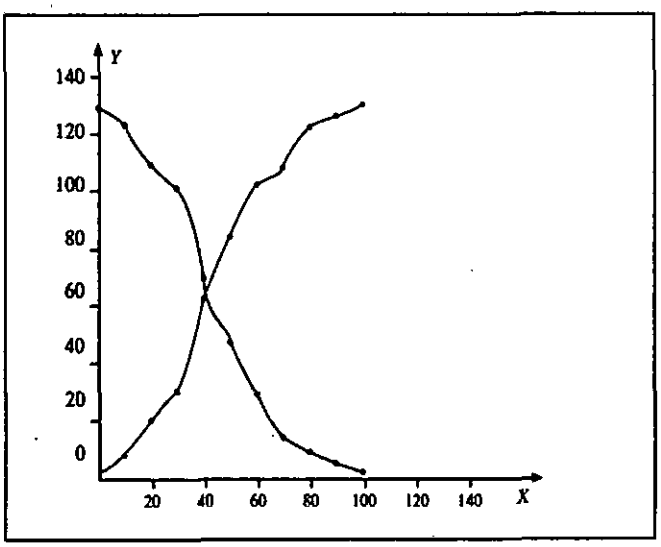
Example

Draw ogive curves for the following frequency distribution and determine the median.

Age groups	No. of people
0 – 10	6
10 – 20	12
20 – 30	10
30 – 40	32
40 – 50	22
50 – 60	18
60 – 70	15
70 – 80	5
80 – 90	4
90 – 100	3

Solution:

Class boundary	Cumulative Frequency	
	Less than	More than
0	0	127
10	6	121
20	18	109
30	28	99
40	60	67
50	82	45
60	100	27
70	115	12
80	120	7
90	124	3
100	127	0



The median value from the graph is 42

Mode

According to Croxton and Cowden, 'The mode of a distribution is the value at the point around which the items tend to be most heavily concentrated.

In a busy road, where we take a survey on the vehicle - traffic on the road at a place at a particular period of time, we observe the number of two wheelers is more than cars, buses and other vehicles. Because of the higher frequency, we say that the modal value of this survey is 'two wheelers'

Mode is defined as the value which occurs most frequently in a data set. The mode obtained may be two or more in frequency distribution

Computation of mode:

(a) For Ungrouped or Raw Data:

The mode is defined as the value which occurs frequently in a data set

Example

The following are the marks scored by 20 students in the class. Find the mode 90, 70, 50, 30, 40, 86, 65, 73, 68, 90, 90, 10, 73, 25, 35, 88, 67, 80, 74, 46

Solution:

Since the marks 90 occurs the maximum number of times, three times compared with the other numbers, mode is 90.

Example

A doctor who checked 9 patients' sugar level is given below. Find the mode value of the sugar levels. 80, 112, 110, 115, 124, 130, 100, 90, 150, 180

Solution:

Since each values occurs only once, there is no mode.

Example

Compute mode value for the following observations.

2, 7, 10, 12, 10, 19, 2, 11, 3, 12

Solution:

Here, the observations 10 and 12 occurs twice in the data set, the modes are 10 and 12.

For discrete frequency distribution, mode is the value of the variable corresponding to the maximum frequency.

Example

Calculate the mode from the following data

Days of Confinement	6	7	8	9	10
Number of patients	4	6	7	5	3

Solution:

Here, 7 is the maximum frequency, hence the value of x corresponding to 7 is 8. Therefore 8 is the mode.

(b) Mode for Continuous data:

The mode or modal value of the distribution is that value of the variate for which the frequency is maximum. It is the value around which the items or observations tend to be most heavily concentrated. The mode is computed by the formula.

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times c$$

Modal class is the class which has maximum frequency.

f_1 = frequency of the modal class

f_0 = frequency of the class preceding the modal class

f_2 = frequency of the class succeeding the modal class

c = width of the class limits

Remarks

(i) If $(2f_1 - f_0 - f_2)$ comes out to be zero, then mode is obtained by the following formula taking absolute differences $M_0 = l + \left(\frac{(f_1 - f_0)}{|f_1 - f_0| + |f_1 - f_2|} \times C\right)$

(ii) *If mode lies in the first class interval, then f_0 is taken as zero.*

(iii) The computation of mode poses problem when the modal value lies in the open-ended class.

Example

The following data relates to the daily income of families in an urban area. Find the modal income of the families.

Income (₹)	0-100	100-200	200-300	300-400	400-500	500-600	600-700
No.of persons	5	7	12	18	16	10	5

Solution:

Income (₹)	No.of persons (f)	
0-100	5	
100-200	7	
200-300	12	f_0
300-400	18	f_1
400-500	16	f_2
500-600	10	
600-700	5	

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times C$$

The highest frequency is 18, the modal class is 300-400

Here, $l = 300$, $f_0 = 12$, $f_1 = 18$, $f_2 = 16$,

$$\text{Mode} = 300 + \frac{18-12}{2 \times 18 - 12 - 16} \times 100$$

$$= 300 + \frac{6}{36-28} \times 100$$

$$= 300 + \frac{6}{8} \times 100$$

$$= 300 + \frac{600}{8} = 300 + 75 = 375$$

The modal income of the families is 375.

Determination of Modal class:

For a frequency distribution modal class corresponds to the class with maximum frequency. But in any one of the following cases that is not easily possible.

i. If the maximum frequency is repeated.

ii. If the maximum frequency occurs in the beginning or at the end of the distribution

iii. If there are irregularities in the distribution, the modal class is determined by the method of grouping

Steps for preparing Analysis table:

We prepare a grouping table with 6 columns

- In column I, we write down the given frequencies.
- Column II is obtained by combining the frequencies two by two.
- Leave the Ist frequency and combine the remaining frequencies two by two and write in column III
- Column IV is obtained by combining the frequencies three by three.
- Leave the Ist frequency and combine the remaining frequencies three by three and write in column V
- Leave the Ist and 2nd frequencies and combine the remaining frequencies three by three and write in column VI

Mark the highest frequency in each column. Then form an analysis table to find the modal class. After finding the modal class use the formula to calculate the modal value.

Example

Calculate mode for the following frequency distribution:

Size	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40
Frequency	9	12	15	16	17	15	10	13

Solution:

class	f	2	3	4	5	6
0-5	9					
		21		36		
5-10	12		27			
10-15	15					
		31			43	
15-20	16					48
20-25	17		33			
		32		48		
25-30	15					
30-35	10		25		42	38
		23				
35-40	13					

Analysis Table:

Columns	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40
1					1			
2					1	1		
3				1	1			
4				1	1	1		
5		1	1	1				
6			1	1	1			
Total		1	2	4	5	2		

The maximum occurred corresponding to 20-25, and hence it is the modal class.

$$\text{Mode} = l + \frac{f_1 f_0}{2f_1 - f_0 - f_2} \times C$$

Here, $l = 20$, $f_0 = 16$, $f_1 = 17$, $f_2 = 15$

$$= 20 + \frac{17-16}{2 \times 17 - 16 - 15} \times C$$

$$= 20 + \frac{1}{34-31} \times 5$$

$$= 20 + \frac{5}{3} = 20 + 1.67 = 21.67$$

Mode = 21.67

(d) Graphical Location of Mode

The following are the steps to locate mode by graph

- Draw a histogram of the given distribution.
- Join the rectangle corner of the highest rectangle (modal class rectangle) by a straight line to the top right corner of the preceding rectangle. Similarly the top left corner of the highest rectangle is joined to the top left corner of the rectangle on the right.
- From the point of intersection of these two diagonal lines, draw a perpendicular line to the x –axis which meets at M.
- The value of x coordinate of M is the mode.

Example

Locate the modal value graphically for the following frequency distribution

Class Interval	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Frequency	5	8	12	7	5	3

Solution:

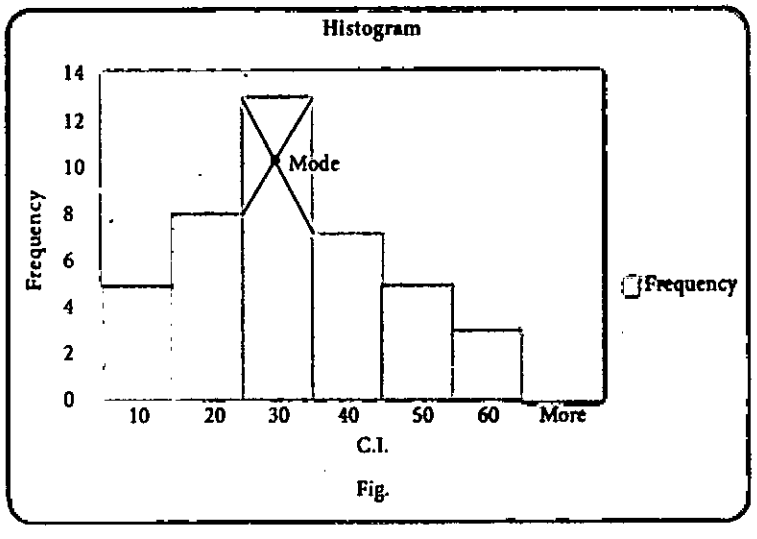


Fig.

Merits of Mode:

- It is comparatively easy to understand.
- It can be found graphically.
- It is easy to locate in some cases by inspection.
- It is not affected by extreme values.

10 MEASURES OF DISPERSION

Measures of Dispersion

The following data provide the runs scored by two batsmen in the last 10 matches.

Batsman A: 25, 20, 45, 93, 8, 14, 32, 87, 72, 4

Batsman B: 33, 50, 47, 38, 45, 40, 36, 48, 37, 26

$$\text{Mean of Batsman A} = \frac{25+20+45+93+8+14+32+87+72+4}{10} = 40$$

$$\text{Mean of Batsman B} = \frac{33+50+47+38+45+40+36+48+37+26}{10} = 40$$

The mean of both datas are same (40), but they differ significantly.

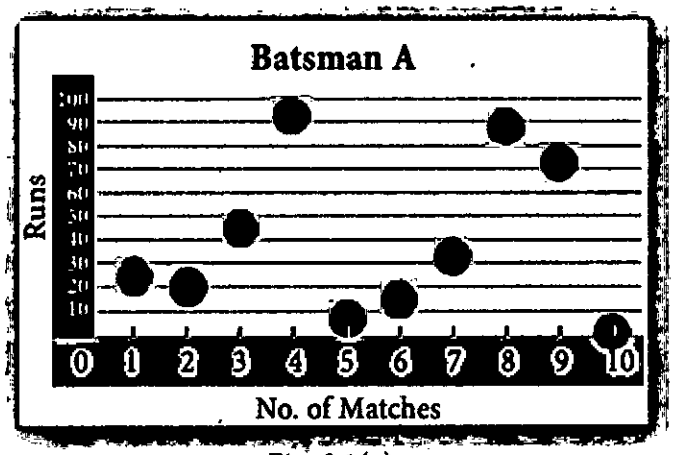


Fig. 8.1(a)

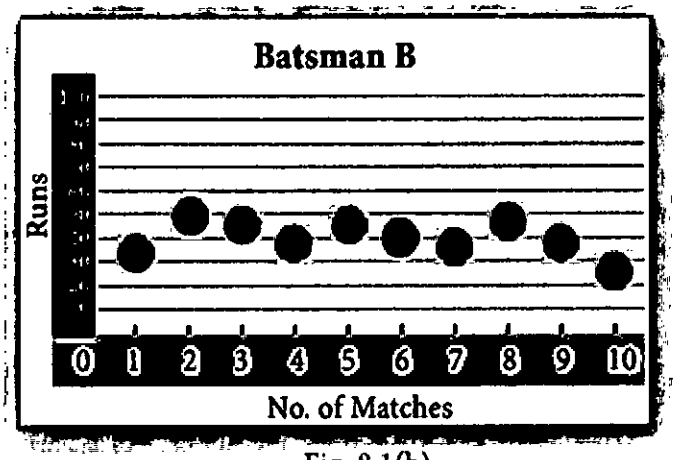


Fig. 8.1(b)

From the above diagrams, we see that runs of batsman *B* are grouped around the mean. But the runs of batsman *A* are scattered from 0 to 100, though they both have same mean.

Thus, some additional statistical information may be required to determine how the values are spread in data. For this, we shall discuss Measures of Dispersion.

Dispersion is a measure which gives an idea about the scatteredness of the values.

Measures of Variation (or) Dispersion of a data provide an idea of how observations spread out (or) scattered throughout the data.

Different Measures of Dispersion are

1. Range
2. Mean deviation
3. Quartile deviation
4. Standard deviation
5. Variance
6. Coefficient of Variation

1. Range

The difference between the largest value and the smallest value is called Range.

Range $R = L - S$

Coefficient of range = $(L - S) / (L + S)$

where L - Largest value; S - Smallest value

Example Find the range and coefficient of range of the following data: 25, 67, 48, 53, 18, 39, 44.

Solution Largest value $L = 67$; Smallest value $S = 18$

Range R = $L - S = 67 - 18 = 49$

Coefficient of range = $(L - S) / (L + S)$

Coefficient of range = $(67 - 18) / (67 + 18) = 49/85$

$= 0.576$

Example Find the range of the following distribution.

Age (in years)	16-18	18-20	20-22	22-24	24-26	26-28
Number of students	0	4	6	8	2	2

Solution Here Largest value $L = 28$

Smallest value $S = 18$

Range $R = L - S$

$R = 28 - 18 = 10$ Years

Example The range of a set of data is 13.67 and the largest value is 70.08. Find the smallest value.

Solution

Range $R = 13.67$

Largest value $L = 70.08$

Range $R = L - S$

$13.67 = 70.08 - S$

$S = 70.08 - 13.67 = 56.41$

Therefore, the smallest value is 56.41.

2. **Deviations from the mean**

   For a given data with n observations $x_1, x_2, \ldots x_n$, the deviations from the mean $\bar{x}$ are

   $x_1 - \bar{x},\ x_2 - \bar{x},\ \ldots,\ x_n - \bar{x}$.

3. **Squares of deviations from the mean**

   The squares of deviations from the mean $\bar{x}$ of the observations $x_1, x_2, \ldots, x_n$ are

   $$(x_1 - \bar{x})^2, (x_2 - \bar{x})^2, \ldots, (x_n - \bar{x})^2 \text{ or } \sum_{i=1}^{n}(x_i - \bar{x})^2$$

Note

We note that $(x_i - \bar{x})^2 \geq 0$ for all observations x_i, $i = 1,2,3,\ldots,n$. If the deviations from the mean $(x_i - \bar{x})$ are small, then the squares of the deviations will be very small.

4. **Variance**

   The mean of the squares of the deviations from the mean is called Variance. It is denoted by σ^2 (read as sigma square).

   Variance = Mean of squares of deviations

$$\text{Variance} = \text{Mean of squares of deviations}$$

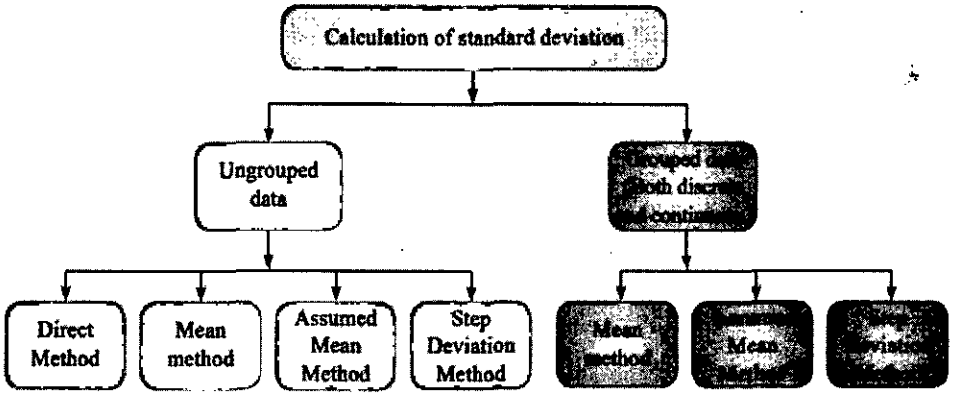
$$= \frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \ldots + (x_n - \bar{x})^2}{n}$$

$$\text{Variance } \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$$

5. Standard Deviation

The positive square root of Variance is called Standard deviation. That is, standard deviation is the positive square root of the mean of the squares of deviations of the given values from their mean. It is denoted by σ. Standard deviation gives a clear idea about how far the values are spreading or deviating from the mean.

$$\textbf{Standard deviation } \sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}}$$



1. Calculation of Standard Deviation for ungrouped data

(i) Direct Method

$$\text{Standard deviation } \sigma = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n}}$$

$$= \sqrt{\frac{\Sigma(x_i^2 - 2x_i\bar{x} + \bar{x}^2)}{n}}$$

$$= \sqrt{\frac{\Sigma x_i^2}{n} - 2\bar{x}\frac{\Sigma x_i}{n} + \frac{\bar{x}^2}{n} \times (1 + 1 + \cdots to\ n \text{ times})}$$

$$= \sqrt{\frac{\Sigma x_i^2}{n} - 2\bar{x} \times \bar{x} + \frac{\bar{x}^2}{n} \times n} = \sqrt{\frac{\Sigma x_i^2}{n} - 2\bar{x}^2 + \bar{x}^2} = \sqrt{\frac{\Sigma x_i^2}{n} - \bar{x}^2}$$

$$\text{Standard deviation, } \sigma = \sqrt{\frac{\Sigma x_i^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2}$$

Note

- While computing standard deviation, arranging data in ascending order is not mandatory.

- If the data values are given directly then to find standard deviation we can use the formula $\sigma = \sqrt{\frac{\Sigma x_i^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2}$
- If the data values are not given directly but the squares of the deviations from the mean of each observation is given then to find standard deviation we can use the formula $\sigma = \sqrt{\frac{\Sigma\left(x_i - \bar{x}\right)^2}{n}}$

Example The number of televisions sold in each day of a week are 13, 8, 4, 9, 7, 12, 10.

Find its standard deviation.

Solution

x_i	x_i^2
13	169
8	64
4	16
9	81
7	49
12	144
10	100
$\Sigma x_i = 63$	$\Sigma x_i^2 = 623$

Standard deviation

$$\sigma = \sqrt{\frac{\Sigma x_i^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2}$$

$$= \sqrt{\frac{623}{7} - \left(\frac{63}{7}\right)^2}$$

$$= \sqrt{89 - 81} = \sqrt{8}$$

Hence, $\sigma \simeq 2.83$

(ii) **Mean method**

Another convenient way of finding standard deviation is to use the following formula.

Standard deviation (by mean method) $\sigma = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n}}$

If $d_i = x_i - \bar{x}$ are the deviations, then $\sigma = \sqrt{\frac{\Sigma d_i^2}{n}}$

Example The amount of rainfall in a particular season for 6 days are given as 17.8 cm, 19.2 cm, 16.3 cm, 12.5 cm, 12.8 cm and 11.4 cm. Find its standard deviation.

Solution

Arranging the numbers in ascending order we get, 11.4, 12.5, 12.8, 16.3, 17.8, 19.2.

Number of observations $n = 6$

$$\text{Mean} = \frac{11.4+12.5+12.8+16.3+17.8+19.2}{6} = \frac{90}{6} = 15$$

x_i	$d_i = x_i - \bar{x}$ $= x - 15$	d_i^2
11.4	–3.6	12.96
12.5	–2.5	6.25
12.8	–2.2	4.84
16.3	1.3	1.69
17.8	2.8	7.84
19.2	4.2	17.64
		$\Sigma d_i^2 = 51.22$

$$\text{Standard deviation } \sigma = \sqrt{\frac{\Sigma d_i^2}{n}}$$

$$= \sqrt{\frac{51.22}{6}} = \sqrt{8.53}$$

Hence, $\sigma \simeq 2.9$

(iii) Assumed Mean method

When the mean value is not an integer (since calculations are very tedious in decimal form) then it is better to use the assumed mean method to find the standard deviation.

Let $x_1, x_2, x_3, \ldots, x_n$ be the given data values and let $\bar{x}$ be their mean.

Let d_i be the deviation of x_i from the assumed mean A, which is usually the middle value or near the middle value of the given data.

$d_i = x_i - A$ gives, $x_i = d_i + A$ ...(1)

$\Sigma d_i = \Sigma(x_i - A)$

$= \Sigma x_i - (A + A + A + \ldots$ to n times)

$\Sigma d_i = \Sigma x_i - A \times n$

$$\Sigma d_i = \Sigma x_i - A \times n$$

$$\frac{\Sigma d_i}{n} = \frac{\Sigma x_i}{n} - A$$

$$\bar{d} = \bar{x} - A \text{ (or) } \bar{x} = \bar{d} + A \qquad ...(2)$$

Now, Standard deviation

$$\sigma = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n}} = \sqrt{\frac{\Sigma(d_i + A - \bar{d} - A)^2}{n}} \quad \text{(using (1) and (2))}$$

$$= \sqrt{\frac{\Sigma(d_i - \bar{d})^2}{n}} = \sqrt{\frac{\Sigma(d_i^2 - 2d_i \times \bar{d} + \bar{d}^2)}{n}}$$

$$= \sqrt{\frac{\Sigma d_i^2}{n} - 2\bar{d}\frac{\Sigma d_i}{n} + \frac{\bar{d}^2}{n}(1+1+1+\cdots \text{ to } n \text{ times})}$$

$$= \sqrt{\frac{\Sigma d_i^2}{n} - 2\bar{d} \times \bar{d} + \frac{\bar{d}^2}{n} \times n} \quad \text{(since } \bar{d} \text{ is a constant)}$$

$$= \sqrt{\frac{\Sigma d_i^2}{n} - \bar{d}^2}$$

Standard deviation $\sigma = \sqrt{\frac{\Sigma d_i^2}{n} - \left(\frac{\Sigma d_i}{n}\right)^2}$

Thinking Corner

For any collection of n values, can you find the value of

(i) $\Sigma(x_i - \bar{x})$ (ii) $(\Sigma x_i) - \bar{x}$

Example

The marks scored by 10 students in a class test are 25, 29, 30, 33, 35, 37, 38, 40, 44, 48. Find the standard deviation.

Solution

The mean of marks is 35.9 which is not an integer. Hence we take assumed mean, $A = 35$, $n = 10$.

x_i	$d_i = x_i - A$ $d_i = x_i - 35$	d_i^2
25	–10	100
29	–6	36
30	–5	25
33	–2	4
35	0	0
37	2	4
38	3	9
40	5	25
44	9	81
48	13	169
	$\Sigma d_i = 9$	$\Sigma d_i^2 = 453$

Standard deviation

$$\sigma = \sqrt{\frac{\Sigma d_i^2}{n} - \left(\frac{\Sigma d_i}{n}\right)^2}$$

$$= \sqrt{\frac{453}{10} - \left(\frac{9}{10}\right)^2}$$

$$= \sqrt{45.3 - 0.81}$$

$$= \sqrt{44.49}$$

$$\sigma \simeq 6.67$$

(iv) Step deviation method

Let $x_1, x_2, x_3, \ldots x_n$ be the given data. Let A be the assumed mean.

Let c be the common divisor of $x_i - A$.

$$\text{Let} \quad d_i = \frac{x_i - A}{c}$$

$$\text{Then} \quad x_i = d_i c + A \qquad \ldots(1)$$

$$\Sigma x_i = \Sigma(d_i c + A) = c\Sigma d_i + A \times n$$

$$\frac{\Sigma x_i}{n} = c\frac{\Sigma d_i}{n} + A$$

$$\bar{x} = c\bar{d} + A \qquad \ldots(2)$$

$$x_i - \bar{x} = cd_i + A - c\bar{d} - A = c(d_i - \bar{d}) \quad \text{(using (1) and (2))}$$

$$\sigma = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n}} = \sqrt{\frac{\Sigma(c(d_i - \bar{d}))^2}{n}} = \sqrt{\frac{c^2\Sigma(d_i - \bar{d})^2}{n}}$$

$$\sigma = c \times \sqrt{\frac{\Sigma d_i^2}{n} - \left(\frac{\Sigma d_i}{n}\right)^2}$$

Note

We can use any of the above methods for finding the standard deviation

Example The amount that the children have spent for purchasing some eatables in one day trip of a school are 5, 10, 15, 20, 25, 30, 35, 40. Using step deviation method, find the standard deviation of the amount they have spent.

Solution We note that all the observations are divisible by 5. Hence we can use the step deviation method. Let the Assumed mean $A = 20$, $n = 8$.

x_i	$d_i = x_i - A$ $d_i = x_i - 20$	$d_i = \frac{x_i - A}{c}$ $c = 5$	d_i^2
5	−15	−3	9
10	−10	−2	4
15	−5	−1	1
20	0	0	0
25	5	1	1
30	10	2	4
35	15	3	9
40	20	4	16
		$\Sigma d_i = 4$	$\Sigma d_i^2 = 44$

Standard deviation

$$\sigma = \sqrt{\frac{\Sigma d_i^2}{n} - \left(\frac{\Sigma d_i}{n}\right)^2} \times c$$

$$= \sqrt{\frac{44}{8} - \left(\frac{4}{8}\right)^2} \times 5 = \sqrt{\frac{11}{2} - \frac{1}{4}} \times 5$$

$$= \sqrt{5.5 - 0.25} \times 5 = 2.29 \times 5$$

$$\sigma \simeq 11.45$$

Example

Find the standard deviation of the following data 7, 4, 8, 10, 11. Add 3 to all the values then find the standard deviation for the new values.

Solution

Arranging the values in ascending order we get, 4, 7, 8, 10, 11 and $n = 5$

x_i	x_i^2
4	16
7	49
8	64
10	100
11	121
$\Sigma x_i = 40$	$\Sigma x_i^2 = 350$

Standard deviation

$$\sigma = \sqrt{\frac{\Sigma x_i^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2}$$

$$= \sqrt{\frac{350}{5} - \left(\frac{40}{5}\right)^2}$$

$$\sigma = \sqrt{6} \simeq 2.45$$

When we add 3 to all the values, we get the new values as 7,10,11,13,14.

x_i	x_i^2
7	9
10	100
11	121
13	169
14	196
$\Sigma x_i = 55$	$\Sigma x_i^2 = 635$

Standard deviation

$$\sigma = \sqrt{\frac{\Sigma x_i^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2}$$

$$= \sqrt{\frac{635}{5} - \left(\frac{55}{5}\right)^2}$$

$$\sigma = \sqrt{6} \simeq 2.45$$

From the above, we see that the standard deviation will not change when we add some fixed constant to all the values.

Example

Find the standard deviation of the data 2, 3, 5, 7, 8. Multiply each data by 4. Find the standard deviation of the new values.

Solution

Given, $n = 5$

x_i	x_i^2
2	49
3	9
5	25
7	49
8	64
$\Sigma x_i = 25$	$\Sigma x_i^2 = 151$

Standard deviation

$$\sigma = \sqrt{\frac{\Sigma x_i^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2}$$

$$\sigma = \sqrt{\frac{151}{5} - \left(\frac{25}{5}\right)^2} = \sqrt{30.2 - 25} = \sqrt{5.2} \simeq 2.28$$

When we multiply each data by 4, we get the new values as 8, 12, 20, 28, 32.

x_i	x_i^2
8	64
12	144
20	400
28	784
32	1024
$\Sigma x_i = 100$	$\Sigma x_i^2 = 2416$

Standard deviation

$$\sigma = \sqrt{\frac{\Sigma x_i^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2}$$

$$= \sqrt{\frac{2416}{5} - \left(\frac{100}{5}\right)^2} = \sqrt{483.2 - 400} = \sqrt{83.2}$$

$$\sigma = \sqrt{16 \times 5.2} = 4\sqrt{5.2} \simeq 9.12$$

From the above, we see that when we multiply each data by 4 the standard deviation also get multiplied by 4.

Example

Find the mean and variance of the first n natural numbers.

Solution

$$\text{Mean } \bar{x} = \frac{\text{Sum of all the observations}}{\text{Number of observations}}$$

$$= \frac{\Sigma x_i}{n} = \frac{1+2+3+\ldots+n}{n} = \frac{n(n+1)}{2 \times n}$$

$$\text{Mean } \bar{x} = \frac{n+1}{2}$$

$$\text{Variance } \sigma^2 = \frac{\Sigma x_i^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2 \left[\begin{array}{l} \Sigma x_i^2 = 1^2 + 2^2 + 3^2 + \ldots + n^2 \\ (\Sigma x_i)^2 = (1+2+3+\ldots+n)^2 \end{array}\right]$$

$$= \frac{n(n+1)(2n+1)}{6 \times n} - \left[\frac{n(n+1)}{2 \times n}\right]^2$$

$$= \frac{2n^2+3n+1}{6} - \frac{n^2+2n+1}{4}$$

$$\text{Variance } \sigma^2 = \frac{4n^2+6n+2-3n^2-6n-3}{12} = \frac{n^2-1}{12}.$$

Calculation of Standard deviation for grouped data

(i) **Mean method**

$$\text{Standard deviation } \sigma = \sqrt{\frac{\Sigma f_i (x_i - \bar{x})^2}{N}}$$

Let, $d_i = x_i - \bar{x}$

$$\sigma = \sqrt{\frac{\Sigma f_i d_i^2}{N}}, \text{ where } N = \sum_{i=1}^{n} f_i$$

(f_i are frequency values of the corresponding data points x_i)

Example

48 students were asked to write the total number of hours per week they spent on watching television. With this information find the standard deviation of hours spent for watching television.

	6	7	8	9	10	11	12
	3	6	9	13	8	5	4

Solution

x_i	f_i	$x_i f_i$	$d_i = x_i - \bar{x}$	d_i^2	$f_i d_i^2$
6	3	18	–3	9	27
7	6	42	–2	4	24
8	9	72	–1	1	9
9	13	117	0	0	0
10	8	80	1	1	8
11	5	55	2	4	20
12	4	48	3	9	36
	$N = 48$	$\Sigma x_i f_i = 432$	$\Sigma d_i = 0$		$\Sigma f_i d_i^2 = 124$

Mean

$$\bar{x} = \frac{\Sigma x_i f_i}{N} = \frac{432}{48} = 9 \quad \left(\text{Since } N = \sum f_i\right)$$

Standard deviation

$$\sigma = \sqrt{\frac{\Sigma f_i d_i^2}{N}} = \sqrt{\frac{124}{48}} = \sqrt{2.58}$$

$$\sigma \simeq 1.6$$

(ii) Assumed Mean Medthod

Let $x_1, x_2, x_3, \ldots x_n$ be the given data with frequencies $f_1, f_2, f_3, \ldots f_n$ respectively. Let x be their mean and A be the assumed mean..

$$d_i = x_i - A$$

$$\text{Standard deviation, } \sigma = \sqrt{\frac{\Sigma f_i d_i^2}{N} - \left(\frac{\Sigma f_i d_i}{N}\right)^2}$$

Example

The marks scored by the students in a slip test are given below.

x	4	6	8	10	12
f	7	3	5	9	5

Find the standard deviation of their marks.

Solution

Let the assumed mean, $A = 8$

x_i	f_i	$d_i = x_i - A$	$f_i d_i$	$f_i d_i^2$
4	7	−4	−28	112
6	3	−2	−6	12
8	5	0	0	0
10	9	2	18	36
12	5	4	20	80
	$N = 29$		$\Sigma f_i d_i = 4$	$\Sigma f_i d_i^2 = 240$

Standard deviation

$$\sigma = \sqrt{\frac{\Sigma f_i d_i^2}{N} - \left(\frac{\Sigma f_i d_i}{N}\right)^2}$$

$$= \sqrt{\frac{240}{29} - \left(\frac{4}{29}\right)^2} = \sqrt{\frac{240 \times 29 - 16}{29 \times 29}}$$

$$\sigma = \sqrt{\frac{6944}{29 \times 29}}\ ; \quad \sigma \simeq 2.87$$

2. Calculation of Standard deviation for continuous frequency distribution

(i) Mean method

Standard deviation $\sigma = \sqrt{\frac{\Sigma f_i (x_i - \bar{x})^2}{N}}$ where x_i = Middle value of the i th class.

f_i = Frequency of the i th class.

(ii) Shortcut method (or) Step deviation method

To make the calculation simple, we provide the following formula. Let A be the assumed mean, x_i be the middle value of the ith class and c is the width of the class interval.

Let $$d_i = \frac{x_i - A}{c}$$

$$\sigma = c \times \sqrt{\frac{\Sigma f_i d_i^2}{N} - \left(\frac{\Sigma f_i d_i}{N}\right)^2}$$

Example

Marks of the students in a particular subject of a class are given below.

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Number of students	8	12	17	14	9	7	4

Find its standard deviation.

Solution

Let the assumed mean, $A = 35$, $c = 10$

Marks	Midvalue (x_i)	f_i	$d_i = x_i - A$	$d_i = \frac{x_i - A}{c}$	$f_i d_i$	$f_i d_i^2$
0-10	5	8	-30	-3	-24	72
10-20	15	12	-20	-2	-24	48
20-30	25	17	-10	-1	-17	17
30-40	35	14	0	0	0	0
40-50	45	9	10	1	9	9
50-60	55	7	20	2	14	28
60-70	65	4	30	3	12	36
		$N = 71$			$\Sigma f_i d_i = -30$	$\Sigma f_i d_i^2 = 210$

$$\text{Standard deviation } \sigma = c \times \sqrt{\frac{\Sigma f_i d_i^2}{N} - \left(\frac{\Sigma f_i d_i}{N}\right)^2}$$

$$\sigma = 10 \times \sqrt{\frac{210}{71} - \left(-\frac{30}{71}\right)^2} = 10 \times \sqrt{\frac{210}{71} - \frac{900}{5041}}$$

$$= 10 \times \sqrt{2.779}\ ; \quad \sigma \simeq 16.67$$

Thinking Corner

1. The standard deviation of a data is 2.8, if 5 is added to all the data values then the new standard deviation is ___.
2. If S is the standard deviation of values p, q, r then standard deviation of p-3, q-3, r-3 is ___.

Example 8.14

The mean and standard deviation of 15 observations are found to be 10 and 5 respectively. On rechecking it was found that one of the observation with value 8 was incorrect. Calculate the correct mean and standard deviation if the correct observation value was 23?

Solution

$$n = 15,\ \bar{x} = 10,\ \sigma = 5;\quad \bar{x} = \frac{\Sigma x}{n};$$

$$\Sigma x = 15 \times 10 = 150$$

Wrong observation value = 8, Correct observation value = 23.

Correct total = 150 − 8 + 23 = 165

$$\text{Correct mean } \bar{x} = \frac{165}{15} = 11$$

$$\text{Standard deviation } \sigma = \sqrt{\frac{\Sigma x^2}{n} - \left(\frac{\Sigma x}{n}\right)^2}$$

$$\text{Incorrect value of } \sigma = 5 = \sqrt{\frac{\Sigma x^2}{15} - (10)^2}$$

$$25 = \frac{\Sigma x^2}{15} - 100 \text{ gives, } \frac{\Sigma x^2}{15} = 125$$

$$\text{Incorrect value of } \Sigma x^2 = 1875$$

$$\text{Correct value of } \Sigma x^2 = 1875 - 8^2 + 23^2 = 2340$$

$$\text{Correct standard deviation } \sigma = \sqrt{\frac{2340}{15} - (11)^2}$$

$$\sigma = \sqrt{156 - 121} = \sqrt{35} \quad \sigma \simeq 5.9$$

11 CORRELATION

Introduction

Definitions of Correlation:

If the change in one variable appears to be accompanied by a change in the other variable, the two variables are said to be correlated and this interdependence is called correlation or covariation.

In short, the tendency of simultaneous variation between two variables is called correlation or covariation. For example, there may exist a relationship between heights and weights of a group of students, the scores of students in two different subjects are expected to have an interdependence or relationship between them.

To measure the degree of relationship or covariation between two variables is the subject matter of correlation analysis. Thus, correlation means the relationship or "going- togetherness" or correspondence between two variables.

In statistics, correlation is a method of determining the correspondence or proportionality between two series of measures (or scores). To put it simply, correlation indicates the relationship of one variable with the other.

Types of Correlation:

In a bivariate distribution, the correlation may be:

1. Positive, Negative and Zero Correlation; and
2. Linear or Curvilinear (Non-linear).

1. Positive, Negative or Zero Correlation:

When the increase in one variable (X) is followed by a corresponding increase in the other variable (Y); the correlation is said to be positive correlation. The positive correlations range from 0 to +1; the upper limit i.e. +1 is the perfect positive coefficient of correlation.

The perfect positive correlation specifies that, for every unit increase in one variable, there is proportional increase in the other. For example, "Heat" and "Temperature" have a perfect positive correlation.

If, on the other hand, the increase in one variable (X) results in a corresponding decrease in the other variable (Y), the correlation is said to be negative correlation.

The negative correlation ranges from 0 to – 1; the lower limit giving the perfect negative correlation. The perfect negative correlation indicates that for every unit increase in one variable, there is proportional unit decrease in the other.

Zero correlation means no relationship between the two variables X and Y; i.e. the change in one variable (X) is not associated with the change in the other variable (Y). For example, body weight and intelligence, shoe size and monthly salary; etc. The zero correlation is the mid-point of the range – 1 to + 1.

2. **Linear or Curvilinear Correlation:**

Linear correlation is the ratio of change between the two variables either in the same direction or opposite direction and the graphical representation of the one variable with respect to other variable is straight line.

Consider another situation. First, with increase of one variable, the second variable increases proportionately upto some point; after that with an increase in the first variable the second variable starts decreasing.

The graphical representation of the two variables will be a curved line. Such a relationship between the two variables is termed as the curvilinear correlation.

Methods of Computing Co-Efficient of Correlation:

In ease of ungrouped data of bivariate distribution, the following three methods are used to compute the value of co-efficient of correlation:

1. Scatter diagram method.
2. Pearson's Product Moment Co-efficient of Correlation.
3. Spearman's Rank Order Co-efficient of Correlation.

1. **Scatter Diagram Method:**

Scatter diagram or dot diagram is a graphic device for drawing certain conclusions about the correlation between two variables.

In preparing a scatter diagram, the observed pairs of observations are plotted by dots on a graph paper in a two-dimensional space by taking the measurements on variable X along the horizontal axis and that on variable Y along the vertical axis.

The placement of these dots on the graph reveals the change in the variable as to whether they change in the same or in the opposite directions. It is a very easy, simple but rough method of computing correlation.

The frequencies or points are plotted on a graph by taking convenient scales for the two series. The plotted points will tend to concentrate in a band of greater or smaller width according to its degree. 'The line of best fit' is drawn with a free hand and its direction indicates the nature of correlation. Scatter diagrams, as an example, showing various degrees of correlation are shown in Fig. 5.1 and Fig. 5.2.

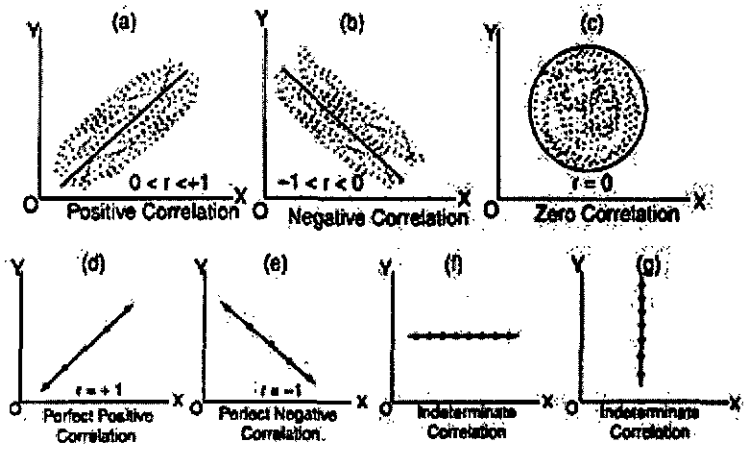


Fig. 5.1 Scatter Diagrams Showing Varying Degree of Relationship between X and Y.

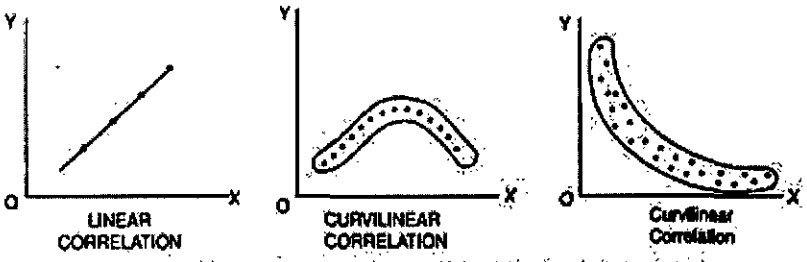


Fig. 5.2 Scatter Diagram Illustrating Linear and Curvilinear relationships.

If the line goes upward and this upward movement is from left to right it will show positive correlation. Similarly, if the lines move downward and its direction is from left to right, it will show negative correlation.

The degree of slope will indicate the degree of correlation. If the plotted points are scattered widely it will show absence of correlation. This method simply describes the 'fact' that correlation is positive or negative.

2. Pearson's Product Moment Co-efficient of Correlation:

The coefficient of correlation, r, is often called the "Pearson r" after Professor Karl Pearson who developed the product-moment method, following the earlier work of Gallon and Bravais.

Coefficient of correlation as ratio:

The product-moment coefficient of correlation may be thought of essentially as that ratio which expresses the extent to which changes in one variable are accompanied by—or dependent upon-changes in a second variable.

As an illustration, consider the following simple example which gives the paired heights and weights of five college students:

Students :	A	B	C	D	E
Height in inches :	72	69	66	70	68
Weight in Lbs. :	170	165	150	180	185

(1) Studetns	(2) HT in inches X	(3) WT in Lbs Y	(4) x	(5) y	(6) xy	(7) $\frac{x}{\sigma_x}$	(8) $\frac{y}{\sigma_y}$	(9) $\frac{x}{\sigma_x}\cdot\frac{y}{\sigma_y}$
A	72	170	3	0	0	1.34	.00	.00
B	69	165	0	– 5	0	.00	– .37	.00
C	66	150	– 3	– 20	60	–1.34	– 1.46	1.96
D	70	180	1	10	10	.45	.73	.33
E	68	185	– 1	15	– 15	– .45	1.10	– .49
					$\Sigma xy = 55$			$\Sigma\left(\frac{x}{\sigma_x}\cdot\frac{y}{\sigma_y}\right) = 1.80$

$M_X = 69$ in. $\sigma_x = 2.24$ in.

$M_Y = 170$ lbs. $\sigma_y = 13.69$ lbs. Correlation $= \frac{\Sigma\left(\frac{x}{\sigma_x}\cdot\frac{y}{\sigma_y}\right)}{N} = \frac{1.80}{5} = .36$

The mean height is 69 inches, the mean weight 170 pounds, and the o is 2.24 inches and o is 13.69 pounds, respectively. In the column (4) the deviation (x) of each student's height from the mean height, and in column (5) the deviation, (y) of each student's weight from the mean weight are given. The product of these paired deviations (xy) in column (6) is a measure of the agreement between individual heights and weights. The larger the sum of xy column the higher the degree of correspondence. In above example the value of $\sum xy/N$ is 55/5 or 11. Where perfect agreement, i.e. r = ± 1.00, the value of $\sum xy/N$ exceeds maximum limit.

The sum of the deviations from the mean (raised to some power) and divided by N is called a "moment". When corresponding deviations in x and y are multiplied together, summed, and divided by N $\left(\text{to give } \frac{\Sigma xy}{N}\right)$ the term "product-moment" is used.

Thus, $\sum xy/N$ would not yield a suitable measure of relationship between x and y. The reason is that such an average is not a stable measure, as it is not independent of the units in which height and weight have been expressed.

In consequence, this ratio will vary if centimeters and kilograms are employed instead of inches and pounds. One way to avoid the trouble-some matter of differences in units is to express each deviation as a σ score or standard score or Z score, i.e. to divide each x and y by its own σ.

Each x and y deviation is then expressed as a ratio, and is a pure number, independent of the test units. The sum of the products of the σ scores column (9) divided by N yields a ratio which is a stable expression of relationship. This ratio is the "product-moment" coefficient of correlation. In our example, its value

of .36 indicates a fairly high positive correlation between height and weight in this small sample.

The student should note that our ratio or coefficient is simply the average product of the σ scores of corresponding X and Y measures i.e.

$$r_{xy} = \frac{\Sigma Z_x Z_y}{N}.$$

Thus, the quotient is $r = \frac{\Sigma\left(\frac{x}{\sigma_x} \cdot \frac{y}{\sigma_y}\right)}{N}$ ...(26)

When this ratio is written $\frac{\Sigma xy}{N\sigma_x\sigma_y}$, it becomes the well-known expression for r, the product-moment coefficient of correlation.

Correlation Coefficient (r_{xy}):

$$r_{xy} = \frac{\text{Covariance (X, Y)}}{\sqrt{\text{Var. (X) . Var (Y)}}} = \frac{S_{XY}}{S_X S_Y}$$

$$= \frac{\Sigma xy/n}{\sqrt{\frac{\Sigma x^2}{n} \times \frac{\Sigma y^2}{n}}} = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}} = \frac{\Sigma xy}{N S_X S_Y} = \frac{\Sigma Z_x Z_y}{n}$$

In raw score form $r_{xy} = \frac{N\Sigma XY - \Sigma X \Sigma Y}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}}$

Nature of r_{xy}:

(i) r_{xy} is a product moment r $\left(r_{xy} = \frac{\Sigma Z_x Z_y}{n}\right)$.

(ii) r_{xy} is a ratio, = r_{xy}.

(iii) r_{xy} can be + ve or – ve bound by limits – 1.00 to + 1.00.

(iv) r_{xy} may be regarded as an arithmetic mean (r_{xy} is the mean of standard score products).

(v) r_{xy} is not affected by any linear transformation of scores on either X or Y or both.

(vi) When variables are in the standard score form, r gives a measure of the average amount of change in one variable associated with the change of one unit the other variable.

(vii) $r_{xy} = \sqrt{b_{yx}\, b_{xy}}$ where b_{yx} = regression coefficient of Y on X, b_{xy} = regression coefficient of X on Y. r_{xy} = square root of the slopes of the regression lines.

(viii) r_{xy} is not influenced by the magnitude of means (scores are always relative).

(ix) r_{xy} cannot be computed if one of the variables has no variance S^2x or $S^2Y = 0$

(x) r_{xy} of 60 implies the same magnitude of relationship as $r_{xy} = -.60$. The sign tells about the direction of relationship, and the magnitude about the strength of the relationship.

(xi) df for r_{xy} is N – 2, which is used for testing significance of r_{xy}. Testing significance of r is testing significance of regression. Regression line involves slope and intercept, hence 2 *df* is lost. So when N = 2, r_{xy} is either + 1.00 or – 1.00 as there is no freedom for sampling variation in the numerical value of r.

(a) Computation of r_{xy} (Ungrouped Data):

Here, using the formula for computation of r depends on "where from the deviations are taken". In different situations deviations can be taken either from actual mean or from zero or from A.M. Type of Formula conveniently applied for the calculation of coefficient correlation depends upon mean value (either in fraction or whole).

(i) The Formula of r when Deviations are taken from Means of the Two Distributions X and Y.

$$r_{xy} = \frac{\Sigma xy}{N\sigma_x \sigma_y} \quad \text{... (27)}$$

where r_{xy} = Correlation between X and Y

x = deviation of any X score from the mean in the test X

y = deviation of corresponding Y score from the mean in test Y.

$\sum xy$ = Sum of all the products of deviations (X and Y)

σ_x and σ_y = Standard deviations of the distribution of X and Y score.

If we write $\sqrt{\frac{\Sigma x^2}{N}}$ for σ_x and $\sqrt{\frac{\Sigma y^2}{N}}$ for σ_y, the N's cancel and formula becomes

$$r_{xy} = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} \quad \text{...(28)}$$

in which x and y are deviations from the actual means and $\sum x^2$ and $\sum y^2$ are the sums of squared deviations in x and y taken from the two means.

This formula is preferred:

i. When mean values of both the variables are not in fraction.

ii. When to find out correlation between short, ungrouped series (say, twenty-five cases or so).

iii. When deviations are to be taken from actual means of the two distributions.

The steps necessary are illustrated in Table 5.1. They are enumerated here:

Step 1: List in parallel columns the paired X and Y scores, making sure that corresponding scores are together.

Step 2: Determine the two means M_x and M_y. In table 5.1, these are 7.5 and 8.0, respectively.

Step 3: Determine for every pair of scores the two deviations x and y. Check them by finding algebraic sums, which should be zero.

Step 4: Square all the deviations, and list in two columns. This is for the purpose of computing σ_x and σ_y.

Step 5: Sum the squares of the deviations to obtain $\sum x^2$ and $\sum y^2$ Find xy product and sum these for $\sum xy$.

Step 6: From these values compute σ_x and σ_y.

Table 5.1 Computation of *r* when deviations are taken from Means

X	Y	x	y	x^2	y^2	xy
13	11	+5.5	+3	30.25	9	+16.5
12	14	+4.5	+6	20.25	36	+27.0
10	11	+2.5	+3	6.25	9	+7.5
10	7	+2.5	−1	6.25	1	−2.5
8	9	+0.5	+1	0.25	1	+0.5
6	11	−1.5	+3	2.25	9	−4.5
6	3	−1.5	−5	2.25	25	+7.5
5	7	−2.5	−1	6.25	1	+2.5
3	6	−4.5	−2	20.25	4	+9.0
2	1	−5.5	−7	30.25	49	+38.5
$\Sigma X = 75$ $M_X = 7.5$	$\Sigma Y = 80$ $M_Y = 8.0$	$\Sigma x = 0.0$	$\Sigma y = 0.0$	$\Sigma x^2 = 124.50$	$\Sigma y^2 = 144$	$\Sigma xy = 102.0$

$$\sigma_x = \sqrt{\frac{\Sigma x^2}{N}} = \sqrt{\frac{124.50}{10}} = \sqrt{12.450} = 3.528$$

$$\sigma_y = \sqrt{\frac{\Sigma y^2}{N}} = \sqrt{\frac{144}{10}} = \sqrt{14.4} = 3.795$$

Applying Formula (27) $r_{xy} = \frac{\Sigma xy}{N\sigma_x\sigma_y} = \frac{102.0}{(10)(3.528)(3.795)} = \frac{102.0}{133.90} = +.76$

An alternative and shorter solution:

There is an alternative and shorter route that omits the computation of σ_x and σ_y, should they not be needed for any other purpose.

Applying Formula (28):

$$r_{xy} = \frac{\Sigma xy}{\sqrt{(\Sigma x^2)(\Sigma y^2)}} \qquad \text{(Alternative formula for a Pearson } r\text{)}$$

$$= \frac{102.0}{\sqrt{(124.5)(144)}} = \frac{102.0}{\sqrt{17,928.0}} = \frac{102.0}{133.90} = +.76$$

(ii) The Calculation of r_{xy} from Original scores or Raw scores:

It is an another procedure with ungrouped data, which does not require the use of deviations. It deals entirely with original scores. The formula may look forbidding but is really easy to apply.

$$r_{xy} = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}} \qquad \ldots(29)$$

This formula is preferred:

i. When to compute r from direct raw scores.

ii. Original scores ft. when data are small ungrouped.

iii. When mean values are in fractions.

iv. When good calculating machine is available.

X and Y are original scores in variables X and Y. Other symbols tell what is done with them.

We follow the steps that are illustrated in Table 5.2:

Table 5.2 Computation of r from Original Scores

X	Y	X^2	Y^2	XY
13	7	169	49	91
12	11	144	121	132
10	3	100	9	30
8	7	64	49	56
7	2	49	4	14
6	12	36	144	72
6	6	36	36	36
4	2	16	4	8
3	9	9	81	27
1	6	1	36	6
$\Sigma X = 70$	$\Sigma Y = 65$	$\Sigma X^2 = 624$	$\Sigma Y^2 = 533$	$\Sigma XY = 472$

Step 1: Square all X and Y measurements.

Step 2: Find the XY product for every pair of scores.

Step 3: Sum the X's, the Y's, the X^2, the Y^2, and the XY.

Step 4: Apply formula (29):

$$r_{xy} = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}}$$

$$= \frac{(10 \times 472) - (70 \times 65)}{\sqrt{(10 \times 624 - 4{,}900)(10 \times 533 - 4{,}225)}} = \frac{170}{\sqrt{1{,}340 \times 1{,}105}}$$

$$= \frac{170}{\sqrt{1{,}480{,}700}} = \frac{170}{1216.84} = +.14$$

(ii) Computation of r_{xy} when deviations are taken from Assumed Mean: Formula (28) is useful in calculating r directly from two ungrouped series of scores, but it has the disadvantages as it requires "long method" of calculating means and σ's. The deviations x and y when taken from actual means are usually decimals and the multiplication and squaring of these values is often a tedious task.

For this reason—even when working with short ungrouped series—it is often easier to assume means, calculate deviations from these A.M.'s and apply the formula (30).

$$r_{xy} = \frac{\frac{\Sigma x'y'}{N} - C_x C_y}{\sigma'_x \sigma'_y} \qquad ...(30)$$

This formula is preferred:

i. When actual means are usually decimals and the multiplication and squaring of these values is often a tedious task.

ii. When deviations are taken from A.M.'s.

iii. When we are to avoid fractions.

The steps in computing r may be outlined as follows:

Step 1: Find the mean of Test 1 (X) and the mean of Test 2 (Y). The means as shown in Table 5.3 $M_X = 62.5$ and $M_Y = 30.4$ respectively.

Step 2: Choose A.M.'s of both X and Y i.e. $A.M._X$ as 60.0 and $A.M._Y$ as 30.0.

Step 3: Find the deviation of each score on Test 1 from its A.M., 60.0, and enter it in column x'. Next find the deviation of each score in Test 2 from its A.M., 30.0, and enter it in column y'.

Step 4: Square all of the x' and all of they' and enter these squares in column x'^2 and y'^2, respectively. Total these columns to obtain $\sum x'^2$ and $\sum y'^2$.

Step 5: Multiply x' and y', and enter these products (with due regard for sign) in the x'y' column. Total x'y' column, taking account of signs, to get $\sum x'y'$.

Step 6: The corrections, C_x and C_y, are found by subtracting AM_X from M_x and AM_y from M_y. Then, C_x found as 2.5 (62.5 – 60.0) and C_y as .4 (30.4 – 30.0).

Step 7: Substitute for $\sum x'y'$, 334, for $\sum x'^2$, 670 and for $\sum y'^2$, 285 in formula (30), as shown in Table 5.3, and solve for r_{xy}.

Table 5.3 Computation of r_{xy} when deviations are from A.M.

Subject	X	Y	x'	y'	x'^2	y'^2	$x'y'$
A	50	22	– 10	– 8	100	64	80
B	54	25	– 6	– 5	36	25	30
C	56	34	– 4	4	16	16	– 16
D	59	28	– 1	– 2	1	4	2
E	60	26	0	– 4	0	16	0
F	62	30	2	0	4	0	0
G	61	32	1	2	1	4	2
H	65	30	5	0	25	0	0
I	67	28	7	– 2	49	4	– 14
J	71	34	11	4	121	16	44
K	71	36	11	6	121	36	66
L	74	40	14	10	196	100	140
	$\Sigma X = 750$	$\Sigma Y = 365$			$\Sigma x'^2 = 670$	$\Sigma y'^2 = 285$	$\Sigma x'y' = 334$

$AM_X = 60.0$ $\quad$ $AM_Y = 30.0$ $\quad$ $\sigma_x' = 7.04$

$M_X = 62.5$ $\quad$ $M_Y = 30.4$ $\quad$ $\sigma_y' = 4.86$

$C_x = 2.5$ $\quad$ $C_y = .4$

$C_x^2 = 6.25$ $\quad$ $C_y^2 = .16$

Applying formula (30)

$$r_{xy} = \frac{\frac{\Sigma x'y'}{N} - C_x C_y}{\sigma'_x \sigma'_y} \qquad \sigma_x' = \sqrt{\frac{\Sigma x^2}{N} - Cx^2} = \sqrt{\frac{670}{12} - 6.25}$$

$$= \frac{\frac{334}{12} - 1.00}{7.04 \times 4.86} \qquad = \sqrt{55.85 - 6.25} = \sqrt{49.58} = 7.04$$

$$= \frac{27.83 - 1.00}{34.21} \qquad \sigma'_y = \sqrt{\frac{\Sigma y'^2}{N} - C_y^2} = \frac{26.83}{34.21}$$

$$r = \cdot 78$$

$$= \sqrt{\frac{285}{12} - .16} = \sqrt{23.75 - .16} = \sqrt{23.59} = 4.86$$

Properties of *r*:

1. **The value of the coefficient of correlation r remains unchanged when a constant is added to one or both variables:**

   In order to observe the effect on the coefficient correlation r when a constant is added to one or both the variables, we consider an example. Now, we add a score of 10 to each score in X and 20 to each score of Y and represent these scores by X' and Y' respectively.

The calculations for computing r for original and new pairs of observations are given in Table 5.4:

Table 5.4 Effect on *r* when a constant is added to variables

Sl. No.	Original Scores					New Scores				
	X	Y	X^2	Y^2	XY	X'	Y'	X'^2	Y'^2	X'Y'
1	1	4	1	16	4	11	24	121	576	264
2	3	3	9	9	9	13	23	169	529	299
3	5	7	25	49	35	15	27	225	729	405
4	6	8	36	64	48	16	28	256	784	448
N =4	ΣX =15	ΣY =22	ΣX^2 =71	ΣY^2 =138	ΣXY =96	ΣX' =55	ΣY' =102	$\Sigma X'^2$ =771	$\Sigma Y'^2$ =2618	ΣX'Y' =1416

By using formula (29), the coefficient of correlation of original score will be:

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}}$$

$$= \frac{4 \times 96 - 15 \times 22}{\sqrt{[4 \times 71 - (15)^2][4 \times 138 - (22)^2]}} = \frac{384 - 330}{\sqrt{[284 - 225][552 - 484]}}$$

$$= \frac{54}{63.34} = +0.85$$

The same formula for new scores can be written as:

$$r = \frac{N\Sigma X'Y' - (\Sigma X')(\Sigma Y')}{\sqrt{[N\Sigma X'^2 - (\Sigma X')^2][N\Sigma Y'^2 - (\Sigma Y')^2]}}$$

$$= \frac{4 \times 1416 - 55 \times 102}{[4 \times 771 - (55)^2][4 \times 2618 - (102)^2]}$$

$$= \frac{5664 - 5610}{\sqrt{[3084 - 3025][10472 - 10404]}} = \frac{54}{\sqrt{59 \times 68}} = \frac{54}{63.34} = +0.85$$

Thus, we observe that the value of the coefficient of correlation r remains unchanged when a constant is added to one or both variables.

2. **The value of the coefficient of correlation r remains unchanged when a constant is subtracted from one or both variables:**
   Students can examine this by taking an example. When each score of one or both variables are subtracted by a constant the value of coefficient of correlation r also remains unchanged.
3. **The value of the coefficient of correlation r remains unaltered when one or both sets of variate values are multiplied by some constant:**
   In order to observe the effect of multiplying the variables by some constant on the value of r, we arbitrarily multiply that original scores of first and second sets in the previous example by 10 and 20 respectively.

   The r between X' and Y' may then be calculated as under:

Table 5.5 Effect on *r* when variables are multiplied by some constant

	New Scores				
S.No.	X'	Y'	X'²	Y'²	X'Y'
1	10	80	100	6400	800
2	30	60	900	3600	1800
3	50	140	2500	19600	7000
4	60	160	3600	25600	9600
N=4	ΣX'=150	ΣY'=440	ΣX'²=7100	ΣY'²=55200	ΣX'Y'=19200

The correlation of coefficient between X' and Y' will be:

$$r = \frac{N\Sigma X'Y' - (\Sigma X')(\Sigma Y')}{\sqrt{[N\Sigma X'^2 - (\Sigma X')^2][N\Sigma Y'^2 - (\Sigma Y')^2]}}$$

Putting values from table,

$$r = \frac{4 \times 19200 - (150)(440)}{\sqrt{[4 \times 7100 - (150)^2][4 \times 55200 - (440)^2]}}$$

$$= \frac{10800}{\sqrt{5900 \times 27200}} = \frac{108}{126.68} = +0.85$$

Thus, we observe that the value of the coefficient of correlation r remains unchanged when a constant is multiplied with one or both sets of variate values.

4. **The value of r will remain unchanged even when one or both sets of variate values are divided by some constant:**

   Students can examine this by taking an example.

   (b) Coefficient of Correlation in Grouped Data:

   When the number of pairs of measurements (N) on two variables X and Y are large, even moderate in size, and when no calculating machine is available, the customary procedure is to group data in both X and Y and to form a scatter diagram or correlation diagram which is also called two-way frequency distribution or bivariate frequency distribution.

   The choice of size of class interval and limits of intervals follows much the same rules as were given previously. To clarify the idea, we consider a bivariate data concerned with the scores earned by a class of 20 students in Physics and Mathematics examination.

Preparing a Scatter diagram:

In setting up a double grouping of data, a table is prepared with columns and rows. Here, we classify each pair of variates simultaneously in the two classes, one representing score in Physics (X) and the other in Mathematics (Y) as shown in Table 5.6.

Student No.	Scores in Physics (X)	Scores in Mathematics (Y)	Student No.	Scores in Physics (X)	Scores in Mathematics (Y)
1	32	25	11	31	10
2	34	41	12	42	25
3	48	53	13	57	44
4	35	12	14	48	32
5	52	26	15	63	42
6	45	28	16	53	45
7	57	51	17	48	31
8	62	54	18	43	23
9	67	50	19	71	28
10	73	48	20	52	22

The scores of 20 students in both Physics (X) and Mathematics (Y) are shown in Table below:

Table 5.6 Bivariate Frequency Table

Y–Variate (Scores in Mathematics)

X–Variate (Scores in Physics)

C.I's	10-19	20-29	30-39	40-49	50-59	f_x
70-79		1 /		1 /		2
60-69				1 /	2 //	3
50-59		2 //		2 //	1 /	5
40-49		3 ///	2 //		1 /	6
30–39	2 //	1 /		1 /		4
f_y	2	7	2	5	4	N = 20

We can easily prepare a bivariate frequency distribution table by putting tallies for each pair of scores. The construction of a scattergram is quite simple. We have to prepare a table as shown in the diagram above.

Along the left hand margin the class intervals of X-distribution are laid off from bottom to top (in ascending order). Along the top of the diagram the c.i's of Y-distribution are laid off from left to right (in ascending order).

Each pair of scores (both in X and Y) is represented through a tally in the respective cell. No. 1 student has secured 32 in Physics (X) and 25 in Mathematics (Y). His score of 32 in (X) places him in the last row and 25 in (Y) places him in the second column. So, for the pair of scores (32, 25) a tally will be marked in the second column of 5th row.

In a similar way, in case of No. 2 student, for scores (34, 41), we shall put a tally in the 4th column of the 5th row. Likewise, 20 tallies will be put in the respective rows and columns. (The rows will represent the X-scores and the columns will represent the Y-scores).

Along the right-hand margin the f_x column, the number of cases in each c.i., of X-distribution are tabulated and along the bottom of the diagram in the f_y row the number of cases in each c.i., of Y-distribution are tabulated. The total of f_x column is 20 and the total of f_y row is also 20. It is in fact a bi-variate distribution because it represents the joint distribution of two variables. The scattergram is then a "correlation table."

3. Spearman's Rank Correlation Coefficient:

There are some situations in Education and Psychology where the objects or individuals may be ranked and arranged in order of merit or proficiency on two variables and when these 2 sets of ranks covary or have agreement between them, we measure the degrees of relationship by rank correlation.

Again, there are problems in which the relationship among the measurements made is non-linear, and cannot be described by the product-moment r.

For example, the evaluation of a group of students on the basis of leadership ability, the ordering of women in a beauty contest, students ranked in order of preference or the pictures may be ranked according to their aesthetic values. Employees may be rank-ordered by supervisors on job performance.

School children may be ranked by teachers on social adjustment. In such cases objects or individuals may be ranked and arranged in order of merit or proficiency on two variables. Spearman has developed a formula called Rank Correlation Coefficient to measure the extent or degree of correlation between 2 sets of ranks.

This coefficient of correlation is denoted by Greek letter ρ (called Rho) and is given as:

$$\rho = 1 - \frac{6 \times \Sigma D^2}{N(N^2 - 1)} \quad ...(32)$$

where, ρ = rho = Spearman's Rank Correlation Coefficient

D = Difference between paired ranks (in each case)

N = Total number of items/individuals ranked.

Characteristics of Rho (ρ):

1. In Rank Correlation Coefficient the observations or measurements of the bivariate variable is based on the ordinal scale in the form of ranks.
2. The size of the coefficient is directly affected by the size of the rank differences.
   (a) If the ranks are the same for both tests, each rank difference will be zero and ultimately D^2 will be zero. This means that the correlation is perfect; i.e. 1.00.
   (b) If the rank differences are very large, and the fraction is greater than one, then the correlation will be negative.

Assumptions of Rho (ρ):

i. N is small or the data are badly skewed.
ii. They are free, or independent, of some characteristics of the population distribution.
iii. In many situations Ranking methods are used, where quantitative measurements are not available.
iv. Though quantitative measurements are available, ranks are substituted to reduce arithmetical labour.
v. Such tests are described as non-parametric.
vi. In such cases the data are comprised of sets of ordinal numbers, 1st, 2nd, 3rd....Nth. These are replaced by the cardinal numbers 1, 2, 3,......, N for purposes of calculation. The substitution of cardinal numbers for ordinal numbers always assumes equality of intervals.

I. Calculating ρ from Test Scores:

Example 1:

The following data give the scores of 5 students in Mathematics and General Science respectively:

Compute the correlation between the two series of test scores by Rank Difference Method.

Table 5.8 Computation of ρ (Rho)

Student	Scores in Math.	Scores in Gen. Sci.	Rank in Test 1 R_1	Rank in Test 2 R_2	Diff. in ranks D R_1-R_2	D^2
A	8	10	2	1	1	1
B	7	8	3	2	1	1
C	9	7	1	3	−2	4
D	5	4	4	5	−1	1
E	1	5	5	4	1	1
N=5					ΣD=0	$\Sigma D^2=8$

$$\rho = 1 - \frac{6 \times \Sigma D^2}{N(N^2-1)} = 1 - \frac{6 \times 8}{5(5^2-1)} = 1 - \frac{48}{120} = 1 - .40 = +.60$$

The value of coefficient of correlation between scores in Mathematics and General Science is positive and moderate.

Steps of Calculation of Spearman's Co-efficient of Correlation:

Step 1: List the students, names or their serial numbers in column 1.

Step 2: In column 2 and 3 write scores of each student or individual in test I and II.

Step 3: Take one set of score of column 2 and assign a rank of 1 to the highest score, which is 9, a rank of 2 to the next highest score which is 8 and so on, till the lowest score get a rank equal to N; which is 5.

Step 4: Take the II set of scores of column 3, and assign the rank 1 to highest score. In the second set the highest score is 10; hence obtain rank 1. The next highest score of B student is 8; hence his rank is 2. The rank of student C is 3, the rank of E is 4, and the rank of D is 5.

Step 5: Calculate the difference of ranks of each student (column 6).

Step 6: Check the sum of the differences recorded in column 6. It is always zero.

Step 7: Each difference of ranks of column 6 is squared and recorded in column 7. Get the sum $\sum D^2$.

Step 8: Put the value of N and $2D^2$ in the formula of Spearman's co-efficient of correlation.

2. Calculating from Ranked Data:

Example 2:

In a speech contest Prof. Mehrotra and Prof. Shukla, judged 10 pupils. Their judgements were in ranks, which are presented below. Determine the extent to which their judgements were in agreement.

Table 5.9 Computation of ρ (Rho)

Pupil	Prof. Mehrotra's Ranks (R_1)	Prof. Shukla's Ranks (R_2)	Difference $D = (R_1 - R_2)$	D_2
A	1	1	0	0
B	3	2	1	1
C	4	5	–1	1
D	7	9	–2	4
E	6	6	0	0
F	9	8	1	1
G	8	10	–2	4
H	10	7	3	9
1	2	4	–2	4
J	5	3	2	4
N=10			$\Sigma D = 0$	$\Sigma D^2 = 28$

$$\rho = 1 - \frac{6 \times \Sigma D^2}{N(N^2 - 1)} = 1 - \frac{6 \times 28}{10(10^2 - 1)} = 1 - \frac{6 \times 28}{990} = 1 - .17 = + .83$$

The value of co-efficient of correlation is + .83. This shows a high degree of agreement between the two judges.

3. Calculating ρ (Rho) for tied Ranks:

Example 3:

The following data give the scores of 10 students on two trials of test with a gap of 2 weeks in Trial I and Trial II.

Compute the correlation between the scores of two trials by rank difference method:

Table 5.10 Computation of ρ (Rho)

Student	Trial-1 (X)	Trial-2 (Y)	Rank on Trial I R_1	Rank on Trial II R_2	Diff. D	D^2
A	10	16	6.5	5.5	1.0	1.00
B	15	16	3	5.5	–2.5	6.25
C	11	24	5	1.5	3.5	12.25
D	14	18	4	4	0	0
E	16	22	2	3	–1.0	1.00
F	20	24	1	1.5	– 0.5	0.25
G	10	14	6.5	7.5	–1.0	1.00
H	8	10	9	10	– 1.0	1.00
I	7	12	10	9	1.0	1.00
J	9	14	8	7.5	0.5	0.25
N=10					ΣD =00	ΣD^2 =24.00

$$\rho = 1 - \frac{6 \times \Sigma D^2}{N(N^2 - 1)} = 1 - \frac{6 \times 24}{10(10^2 - 1)} = 1 - \frac{6 \times 24}{10 \times 99} = 1 - .145$$

$\rho = + .855$.

The correlation between Trial I and II is positive and very high. Look carefully at the scores obtained by the 10 students on Trial I and II of the test.

Do you find any special feature in the scores obtained by the 10 students? Probably, your answer will be "yes".

In the above table in column 2 and 3 you will find that more than one student are getting the same scores. In column 2 students A and G are getting the same score viz. 10. In column 3, the students A and B, C and F and G and J are also getting the same scores, which are 16, 24 and 14 respectively.

Definitely these pairs will have the same ranks; known as Tied Ranks. The procedure of assigning the ranks to the repeated scores is somewhat different from the non-repeated scores.

Look at column 4. Student A and G have similar scores of 10 each and they possess 6th and 7th rank in the group. Instead of assigning the 6th and 7th rank, the average of the two rank i.e., 6.5 (6 + 7/2 = 13/2) has been assigned to each of them.

The same procedure has been followed in respect of scores on Trial II. In this case, ties occur at three places. Students C and F have the same score and hence obtain the average rank of (1 + 2/2 = 1.5). Student A and B have rank position 5 and 6; hence are assigned 5.5 (5 + 6/2) rank each. Similarly, student G and J have been assigned 7.5 (7 + 8/2) rank each.

If the values are repeated more than twice, the same procedure can be followed to assign the ranks:

For example:

if three students get a score of 10, at 5th, 6th and 7th ranks, each one of them will be assigned a rank of 5 + 6 + 7/3= 6.

The rest of the steps of procedure followed for calculation of ρ ~~(rho)~~ are the same as explained earlier.

Interpretation:

The value of ρ can also be interpreted in the same way as Karl Pearson's Coefficient of Correlation. It varies between -1 and + 1. The value + 1 stands for a perfect positive agreement or relationship between two sets of ranks while ρ = – 1 implies a perfect negative relationship. In case of no relationship or agreement between ranks, the value of ρ = 0.

Advantages of Rank Difference Method:

1. The Spearman's Rank Order Coefficient of Correlation computation is quicker and easier than (r) computed by the Pearson's Product Moment Method.

2. It is an acceptable method if data are available only in ordinal form or number of paired variables is more than 5 and not greater than 30 with minimum or a few ties in ranks.
3. It is quite easy to interpret p.

Limitations:

1. When the interval data are converted into rank-ordered data the information about the size of the score differences is lost; e.g., in the Table 5.10, if D in Trial II gets scores from 18 up to 21, his rank remains only 4.
2. If the number of cases is more, giving ranks to them becomes a tedious job.

SUMMARY OF THE CHAPTER

Correlation is a statistical technique that can show whether and how strongly pairs of variables are related. For example, height and weight are related; taller people tend to be heavier than shorter people. The relationship isn't perfect. People of the same height vary in weight, and you can easily think of two people you know where the shorter one is heavier than the taller one. Nonetheless, the average weight of people 5'5" is less than the average weight of people 5'6", and their average weight is less than that of people 5'7", etc. Correlation can tell you just how much of the variation in peoples' weights is related to their heights.

Although this correlation is fairly obvious your data may contain unsuspected correlations. You may also suspect there are correlations, but don't know which are the strongest. An intelligent correlation analysis can lead to a greater understanding of your data.

EXERCISE

Multiple Choice Questions

1. The covariance is:
   A. All of these.
   B. A measure of the strength of relationship between two variables.
   C. Dependent on the units of measurement of the variables.
   D. An unstandardized version of the correlation coefficient.

Answer: All of these

2. How much variance has been explained by a correlation of .9?
   A. 18%
   B. 9%
   C. 81%
   D. None of these

Answer: 81%

3. A correlation of .7 was found between time spent studying and percentage on an exam. What is the proportion of variance in exam scores that can be explained by time spent studying?

   A. .70 B. .49

   C. .30 D. .7

Answer: .49

4. Rank the score of 5 in the following set of scores:

   9, 3, 5, 10, 8, 5, 9, 7, 3, 4

   A. 4.5 B. 4

   C. 3 D. 6

Answer: 4.5

5. If Pearson's correlation coefficient between stress level and workload is .8, how much variance in stress level is not accounted for by workload?

   A. 20% B. 2%

   C. 8% D. 36%

Answer: 36%

Review Questions

1. Define correlation.
2. Define partial correlation.
3. Define the line of best fit..
4. Explain the principal methods for calculating the coefficient of correlation.
5. What is the difference between negative and positive correlation?
6. What is the nature of correlation of two variables, when they move in the same direction?
7. Coefficient of correlation is between -1 and +. How would you express it arithmetically?

Space for Work

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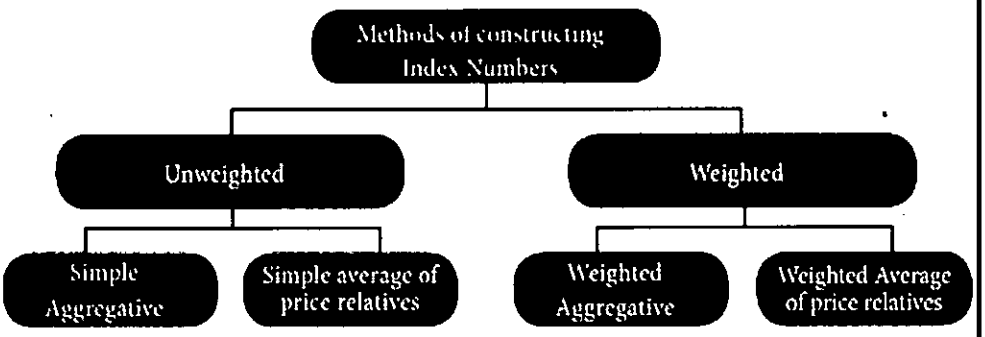
12 METHODS OF CONSTRUCTING INDEX NUMBERS

METHODS OF CONSTRUCTING INDEX NUMBERS

Different types of index number (price/quantity/value) can be classified as follows.



Unweighted Index Numbers

An unweighted price Index Number measures the percentage change in price of a single item or a group of items between two periods of time. In unweighted index numbers, all the values taken for study are of equal importance. There are two methods in this category.

(i) Simple aggregative method:

Under this method the prices of different items of current year are added and the total is divided by the sum of prices of the base year items and multiplied by 100.

$$P_{01} = \frac{\sum p_1}{\sum p_0} \times 100$$

p_1 = Current year prices for various commodities

p_0 = Base year prices for various commodities

P_{01} = Price Index number

Limitations of the simple aggregative method

(i) Relative importance of the commodities is not taken into account.

(ii) Highly priced items influence the index number

Example

Construct the Price Index Number for the year 1997, from the following information taking 1996 as base year.

Commodities	Price in 1996 (₹)	Price in 1997 (₹)
Rice	130	115
Wheat	80	65
Sugar	75	70
Ragi	95	90
Oil	105	105
Dal	35	20

Solution:

Construction of Price Index:

Commodities	Price in 1996 (₹) (p_0)	Price in 1997 (₹) (p_1)
Rice	130	115
Wheat	80	65
Sugar	75	70
Ragi	95	90
Oil	105	105
Dal	35	20
	$\sum p_0 = 520$	$\sum p_1 = 465$

$$P_{01} = \frac{\sum p_1}{\sum p_0} \times 100$$

$$= \frac{465}{520} \times 100 = 89.42$$

Price Index in 1997, when compared to 1996 has fallen by 10.58%

Example

Calculate Price Index Number for 2016 from the following data by simple aggregate method, taking 2016 as base year.

Commodities	Price per kg	
	2015	2016
Apple	100	140
Orange	30	40
Pomegranate	120	130
Guava	40	50

Solution:

Commodities	2015 (p_0)	2016 (p_1)
Apple	100	140
Orange	30	40
Pomegranate	120	130
Guava	40	50
Total	290	360

$$\text{Price index: } P_{01} = \frac{\Sigma p_1}{\Sigma p_0} \times 100$$

$$= \frac{360}{290} \times 100$$

$= 3600/29$

$P_{01} = 124.13\%$

Price index for the year 2016 when compared to 2015 has been increased by 24.13%.

2. Simple average of price relative method

Under this method, first of all price relatives are obtained for the various items and then average of these relatives is obtained by using either arithmetic mean or geometric mean. Price relative is the price of the current year expressed as the percentage of the price of the base year. The formula for computing Index Number under this method on using Arithmetic mean and Geometric mean are given below.

If N is the member of items, p_1 is the price of the commodity with current year and p_0 is the price of the commodity in the base year then, the average Price Index Number is

$$\text{(i) } P_{01} = \frac{\sum \frac{p_1}{p_0} \times 100}{N} \text{ (using Arithmetic mean)}$$

$$\text{(ii) } P_{01} = \text{antilog} \frac{\sum \log\left(\frac{p_1}{p_0} \times 100\right)}{N} \text{ (using Geometric mean)}$$

Advantages of Average Price Index

1. It is not influenced by the extreme prices of items as equal importance is given to all items.
2. Price relatives are pure numbers; therefore, the value of the average price relative index is not affected by the units of measurement of commodities included in the calculation of index numbers.

Limitations

1. Equal weights are assigned to every commodity included in the index. Each price relatives is given equal importance, but in actual practice, it is not true.
2. Arithmetic mean is very often used to calculate the average price relatives, but it has a few disadvantages. The use of geometric mean is difficult to calculate.

Example

Compute price index number by simple average of price relatives method using arithmetic mean and geometric mean.

Item	Price in 2001 (₹)	Price in 2002 (₹)
A	6	10
B	2	2
C	4	6
D	10	12
E	8	12

Solution:

Calculation of price index number by simple average of price relatives:

Item	Price in 2001 (₹) p_0	Price in 2002 (₹) p_1	$p = \frac{p_1}{p_0} \times 100$	$\log p$
A	6	10	166.7	2.2201
B	2	2	100.0	2.0000
C	4	6	150.0	2.1761
D	10	12	120.0	2.0792
E	8	12	150.0	2.1761
			$\Sigma p = 686.7$	$\Sigma \log p = 10.6515$

(i) Price relative index number based on arithmetic mean:

$$P_{01} = \frac{\sum \frac{p_1}{p_0} \times 100}{N} = \frac{\sum p}{N} = \frac{686.7}{5} = 137.34$$

(ii) Price relative index number based on geometric mean:

$$P_{01} = \text{antilog}\left(\frac{\sum \log p}{N}\right) = \text{antilog}\left(\frac{10.6515}{5}\right)$$

= antilog (2.13303)

= 134.9

Hence, the price index number based on arithmetic mean and geometric mean for the year 2002 are 137.34 and 134.9 respectively.

Example

Construct simple average price relative index number using arithmetic mean for the year 2012 for the following data showing the profit from various categories sold out in departmental stores.

Profit (per week)	2010	2012
Groceries	150600	170800
Cosmetics	70000	82000
Stationery items	12000	10800
Utensils	20000	18600

Solution:

Index number uning Arithmertic Mean of price relatives

	Profit in 2010 (p_0)	Profit in 2012 (p_1)	p_1/p_0 x 100
Groceries	150600	170800	$\frac{170800}{150600}\times 100 = 11341$
Cosmetics	70000	82000	$\frac{82000}{70000}\times 100 = 117.14$
Stationery items	12000	10800	$\frac{10800}{12000}\times 100 = 90.00$
Utensils	20000	18600	$\frac{18600}{20000}\times 100 = 93.00$
		Total	413.55

Simple average price relatives using A.M =

$$= P_{01} = \frac{\sum \frac{p_1}{p_0}\times 100}{N}$$

$$= \frac{413.55}{4}$$

$$= 103.3875$$

=103.3875

P_{01} = 103.39

The average price relative index number using arithmetic mean for the year 2012 is 103.39

Example

Construct simple average price relative index number using geometric mean for the year 2015 for the data showing the expenditure in education of the children taking different courses.

Expenditure per year	2014	2015
B.Sc	24000	26000
B.Com	20000	22000
B.E	108000	12000
M.B.B.S	150000	168000

Solution:

Expenditure	Year 2014 (p_0)	Year 2015 (p_1)	$P = (p_1/p_0) \times 100$	log P
B.Sc	24000	26000	$\frac{26000}{24000} \times 100 = 108.33$	2.0346
B.Com	20000	22000	$\frac{22000}{20000} \times 100 = 110.00$	2.0414
B.E	108000	12000	$\frac{120000}{108000} \times 100 = 111.11$	2.0457
M.B.B.S	150000	168000	$\frac{168000}{150000} \times 100 = 112.00$	2.0492
				$\sum \log P = 8.1709$

P_{01} = antilog ($\sum$ log P / N)

= antilog (8.1709 / 4)

= antilog (2.04275)

= antilog (2.0428)

= 110.4

The average price relative index number using geometric mean for the year 2015 is 110.4

WEIGHTED INDEX NUMBERS

In computing weighted Index Numbers, the weights are assigned to the items to bring out their economic importance. Generally, quantise consumed or value are used as weights.

Weighted index numbers are also of two types

(i) Weighted aggregative

(ii) Weighted average of price relatives

1. Weighted aggregate Index Numbers

In this method price of each commodity is weighted by the quantity sale either in the base year or in the current year. There are various methods of assigning weights and thus there are many methods of constructing index numbers. Some of the important formulae used under these methods are

(a) Laspeyre's Index (P_{01}^{L})

(b) Paasche's Index (P_{01}^{P})

(c) Dorbish and Bowley's Index (P_{01}^{DB})

(d) Fisher's Ideal Index (P_{01}^{F})

(e) Marshall-Edgeworth Index (P_{01}^{Em})

(f) Kelly's Index (P_{01}^{K})

(a) Laspeyre's method

The base period quantities are taken as weights. The Index is

$$P_{01}^{L} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

(b) Paasche's method

The current year quantities are taken as a weight. In this method, we use continuously revised weights and thus this method is not frequently used when the number of commodities is large. The Index is

$$P_{01}^{P} = \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$$

(c) Dorbish and Bowley's method

In order in take into account the impact of both the base and current year, we make use of simple arithmetic mean of Laspeyre's and Paasche's formula

The Index is

$$P_{01}^{DB} = \frac{P_{01}^{L} + P_{01}^{P}}{2}$$

$$= \frac{\frac{\sum p_1 q_0}{\sum p_0 q_0} + \frac{\sum p_1 q_1}{\sum p_0 q_1}}{2} \times 100$$

(d) Fisher's Ideal Index

It is the geometric mean of Laspeyre's Index and Paasche's Index, given by:

$$P_{01}^{F} = \sqrt{P_{01}^{L} \times P_{01}^{P}}$$

$$= \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1}} \times 100$$

(e) Marshall-Edgeworth method

In this method also both the current year as well as base year prices and quantities are considered.

The Index is

$$P_{01}^{ME} = \frac{\sum p_1 (q_0 + q_1)}{\sum p_0 (q_0 + q_1)} \times 100$$

$$= \frac{\sum p_1 q_0 + \sum p_1 q_1}{\sum p_0 q_0 + \sum p_0 q_1} \times 100$$

(f) Kelly's method

The Kelly's Index is

$$P_{01}^{K} = \frac{\sum p_1 q}{\sum p_0 q} \times 100, \qquad q = \frac{q_0 + q_1}{2}$$

where q refers to quantity of some period, not necessarily of the mean of the base year and current year. It is also possible to use average quantity of two or more years as weights. This method is known as fixed weight aggregative index.

Example

Construct weighted aggregate index numbers of price from the following data by applying

1. Laspeyre's method
2. Paasche's method
3. Dorbish and Bowley's method
4. Fisher's ideal method
5. Marshall-Edgeworth method

Commodity	2016		2017	
	Price	Quantity	Price	Quantity
A	2	8	4	6
B	5	10	6	5
C	4	14	5	10
D	2	19	2	13

Solution:

Calculation of various indices

Commodity	2016		2017		p_1q_0	p_0q_0	p_1q_1	p_0q_1
	Price p_0	Quantity q_0	Price p_1	Quantity q_1				
A	2	8	4	6	32	16	24	12
B	5	10	6	5	60	50	30	25
C	4	14	5	10	70	56	50	40
D	2	19	2	13	38	38	26	26
					$\sum p_1q_0 = 200$	$\sum p_0q_0 = 160$	$\sum p_1q_1 = 130$	$\sum p_0q_1 = 103$

(1) Laspeyre's Index:

$$P_{01}^{L} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

$$= \frac{200}{160} \times 100 = 125$$

(2) Paasche's Index

$$P_{01}^{P} = \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$$

= 130 / 103 ×100 = 126.21

(3) Dorbish and Bowley's Index

$$P_{01}^{DB} = \frac{P_{01}^{L} + P_{01}^{P}}{2} = \frac{125 + 126.21}{2}$$

= 125.6

(4) Fisher's Ideal Index

$$P_{01}^{F} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1}} \times 100$$

$$= \sqrt{\frac{200}{160} \times \frac{130}{103}} \times 100$$

$$= \sqrt{1.578} \times 100 = 1.2561 \times 100$$

= 125.61

(5) Marshall-Edgeworth method

$$P_{01}^{ME} = \frac{\sum p_1 q_0 + \sum p_1 q_1}{\sum p_0 q_0 + \sum p_0 q_1} \times 100$$

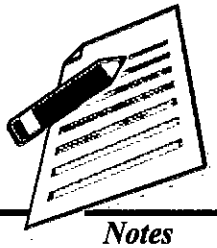
$$= \frac{200 + 130}{160 + 103} \times 100 = \frac{330}{263} \times 100$$

$$= 125.48$$

= 125.48

Summary of the Unit

The value of money does not remain constant over time. It rises or falls and is inversely related to the changes in the price level. A rise in the price level means a fall in the value of money and a fall in the price level means a rise in the value of money. Thus, changes in the value of money are reflected by the changes in the general level of prices over a period of time. Changes in the general level of prices can be measured by a statistical device known as 'index number.'



Index number is a technique of measuring changes in a variable or group of variables with respect to time, geographical location or other characteristics. There can be various types of index numbers, but, in the present context, we are concerned with price index numbers, which measures changes in the general price level (or in the value of money) over a period of time.

Price index number indicates the average of changes in the prices of representative commodities at one time in comparison with that at some other time taken as the base period. According to L.V. Lester, "An index number of prices is a figure showing the height of average prices at one time relative to their height at some other time which is taken as the base period."

EXERCISE

Multiple Choice Questions

1. Index number for base year is always considered as------
   a. 100 b. 101
   c. 201 d. 1000
2. Index number is a special type of ----------
   a. Average b. dispersion
   c. correlation d. None of the above
3. Index number is always expressed in ----------
   a. Percentage b. ratio
   c. proportion d. None of the above
4. Index number is also called as----------
   a. Economic barometer b. Parameter
   c. Constant d. None of the above
5. Which index number is called as ideal index numbr.
   a. Lasperys b. Paasches
   c. Fisher d. None of the above
6. In Lasperys price index number weight is considered as---------
   a. quantity in base year b. quantity during current year
   c. prices in base year d. prices in current year.
7. In Paasches price index number weight is considered as---------
   a. quantity in base year b. quantity in current year
   c. prices in base year d. prices in current year.
8. Fishers price index number is the -------
   a. A.M. of Lasperys and Paasches I.N.
   b. G.M. of Lasperys and Paasches I.N.
   c. Difference between Lasperys and Paasches I.N
   d. None of the above.
9. A period for which index number is determined is called as ------
   a. current period. b. base period
   c. Normal period. d. None of the above

13 MODULE-V : INTRODUCTION TO ECONOMICS

Module Content

Meaning of Economics, Meaning of Microeconomics and Macroeconomics, relationship and distinction between the two, positive and normative economics. Meaning of economic problem, why Economic Problem arises, Central Problems, what to produce, how to produce and for Whom to produce; Concept of production possibility frontier, Opportunity Cost and marginal opportunity cost.

Objective of the module

The main objective of this module is to make student understand about the basics of Economics and its branches as well. Central Problems, what to produce, how to produce and for Whom to produce has also been discussed in this module.

Introduction

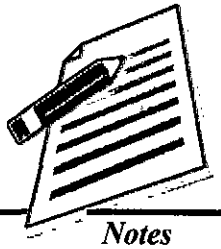
What Economics is All About?

The science of economics was born with the publication of Adam Smith's An Inquiry into the Nature and Causes of Wealth of Nations in the year 1776. Adam Smith is known as the father of Economics. At its birth, the name of economics was 'Political Economy'. Towards the end of the 19th century there was a definite change from use of word 'Political Economy' to 'Economics'.

The word 'Economics' was derived from two Greek words oikou (a house) and nomos (to manage). Thus, the word economics was used to mean home management with limited funds available in the most economical manner possible.

Lionel Robbins defines economics as a science of scarcity. Prof. Robbins in his book Nature and Significance of Economic Science states, "Economics is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses".

Paul A. Samuelson defines economics as "the study of how men and society choose, with or without the use of money, to employ scarce productive resources which could have alternative uses, to produce various commodities over time and distribute them for consumption now and in future among various people and groups of society."



This definition emphasises growth over time. It is modern and wider in scope. The definition takes into account consumption, production, distribution and exchange of goods. Hence, it is most satisfactory definition of economics. This definition has been accepted universally.

Microeconomics Meaning and Subject-matter of Microeconomics

The word 'Micro' is derived from the Greek word mikros meaning small. Microeconomics deals with small segments of the society.

Microeconomics is defined as the study of behaviour of individual decision-making units, such as consumers, resource owners and firms. It is also known as Price Theory since its major subject-matter deals with the determination of price of commodities and factors. Microeconomics has both theoretical and practical importance. It solves the three central problems of an economy, i.e., what, how and for whom to produce.

Macroeconomics Meaning and Subject-matter of Macroeconomics

The word 'Macro' is derived from the Greek word makros meaning large. Macroeconomics deals with aggregative economics.

Macroeconomics is defined as the study of overall economic phenomena, such as problem of full employment, GNP, savings, investment, aggregate consumption, aggregate investment, economic growth, etc. It is also known as Theory of Income and Employment since its major subject-matter deals with the determination of income and employment. The study of macroeconomics is used to solve many problems of an economy like, monetary problems, economic fluctuations, general unemployment, inflation, disequilibrium in the balance of payment position, etc

Positive or a normative science

Economics as a Positive Science

Positive economics deals with what is or how an economics problem facing a society is actually solved.

Robbins held that economics was purely a positive science. According to him, economics should be neutral or silent between ends, i.e., there should be no desire to learn about ethics of economic decisions. In other words, in positive economics we study human decisions as facts which can be verified with actual data. Examples of positive economics are:

(a) India is an overpopulated country.

(b) A fall in the price of a good leads to a rise in its quantity demanded.

(c) Prices have been rising in India.

(d) Minimum Wage Law increases unemployment.

(e) A profit maximising firm will set its price where marginal revenue is equal to marginal cost.

(f) Air is a mixture of gases.

(g) Increase in real per capita income increases the standard of living of people.

Economics as a Normative Science

Normative economics deals with what ought to be or how an economic problem should be solved. Alfred Marshall and Pigou have considered the normative aspect of economics. They maintain that economics is a normative science as it prescribes that course of action which is desirable and necessary to achieve social goals.

In other words, in normative economics there is no reservation on passing value judgement on moral rightness or wrongness of things. Normative economics gives prescriptive statements. Examples of normative economics are:

(a) Government should guarantee a minimum wage for every worker.

(b) Government should stop Minimum Support Price to the farmers.

(c) India should not take loans from foreign countries.

(d) India should spend more money on defence.

(e) Rich people should be taxed more.

(f) Free education should be given to the poor

Interdependence of Positive and Normative Science

In reality, economics has developed along both positive and normative lines. Both these aspects have grown inseparably. The role of an economist is not only to explain and explore (i.e., positive aspect) but also to admire and condemn (i.e., negative aspect.) This role of an economist is essential for a healthy and rapid growth of an economy. Examples of statements which contain both positive and normative economics are:

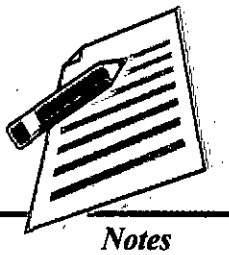
(a) A rise in the price of a good leads to a fall in its quantity demanded; therefore, Government should check rise in prices.

(b) Rent Control Act provides accommodation to the needy people; therefore, the Act should be honestly implemented.

(c) Indian economy is a developing economy; the Government should make it developed through correct planning. In the above three examples, the first part of the statement is positive giving facts and the second part is normative based on value judgements.

Meaning of Economic Problems

Economic problem is the problem of choice. The problem of choice has to be faced by every economy of the world, whether developed or developing. Human beings have wants which are unlimited. When these wants get satisfied, new wants crop up. Human wants multiply at a fast rate. The economic resources to satisfy these unlimited wants are limited. In other words, resources or factors of



production (they are defined as goods and services needed to carry out production i.e., land, labour, capital and entrepreneurship) are scarce. They are available in limited quantities in relation to the demand. Resources are not only scarce but they also have alternative uses. All this necessitates a choice between which goods and services to produce first.

The economy comprising of individuals, business firms, and societies must make this choice. According to Prof. Robbins, "the economic problem is the problem of choice or the problem of economising, i.e., it is the problem of fuller and efficient utilisation of the limited resources to satisfy maximum number of wants.

The scarcity of resources creates this situation." If an economy employs more resources to produce good X, then it will have to forego the production of good Y. Hence, economy has to choose which of the two goods X or Y will give more satisfaction. An economy can produce both wheat and rice on the same plot of land. The decision to produce wheat is an outcome of choice.

Causes of Economic Problems

1. **Human Wants are Unlimited**. Human beings have wants which are unlimited. Human want to consume more of better goods and services has always been increasing. For example, the housing need has risen from a small house to a luxury house, the need for means of transportation has gone up from scooters to cars, etc. Human wants are endless. They keep on increasing with rise in people's ability to satisfy them. They are attributed to
   (i) people's desire to raise their standard of living, comforts and efficiency;
   (ii) human tendency to accumulate things beyond their present need,
   (iii) multiplicative nature of some wants e.g., buying a car creates want for many other things - petrol, driver, car parking place, safety locks, spare parts, insurance, etc.
   (iv) basic needs for food, water and clothing,
   (v) influence of advertisements in modern times create new kinds of wants and demonstration effect. Due to these reasons human wants continue to increase endlessly. While some wants have to be satisfied as and when they arise such as food, clothes, shelter, water, etc., some can be postponed e.g., purchase of a luxury car. The priority of wants varies from person to person and from time to time for the same person.

   Therefore, the question arises as to 'which want to satisfy first' and 'which the last'. Thus, consumers have to make the choice as to 'what to consume' and 'how much to consume'.
2. **Resources are Limited**. Scarcity of resources is the root cause of all economic problems. All resources that are available to the people at any

point of time for satisfying their wants are scarce and limited. Conceptually, anything which is available and can be used to satisfy human wants and desire is a resource. In economics, however, resources that are available to individuals, households, firms and society at any point of time are traditionally natural resources (land). Human resources (labour), capital resources (like machine, building, etc.) and entrepreneurship are scarce. Resource scarcity is a relative term. It implies that resources are scarce in relation to the demand for resources. The scarcity of resources is the mother of all economic problems. It forces people to make choices.

3. **Resources have Alternative Uses.** Resources are not only scarce in supply but they have alternative uses. Same resources cannot be used for more than one purpose at a time. For example, ₹ 100 can be put in various alternative purposes such as buying petrol, notebook, ice-cream, burger, cold drink, etc. Similarly, an area of land can be used for farming or as a playground or for constructing school, college or hospital building or for constructing residential building, etc. But return on the area of a land or utility of putting ₹ 100 in various uses varies according to the use of the concerned resources.

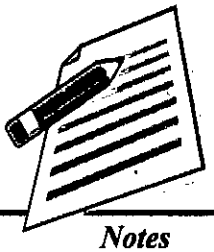
   Thus, people have to make choice between alternating uses of the resources. If the area of land is put to a particular use, the landlord has to forgo the return expected from its other alternative uses. This is termed as opportunity cost. Economics as a social science analyses how people (individuals and the whole society or economy) make their choices between economic goals they want to achieve, between goods and services they want to produce and between alternative uses of their resources which will maximise their gains.

Economic Problems of an Economy

Economic problems are reflected in the form of Central or Basic Problems of an economy. Any economy—whether market, centrally planned, or mixed—has to face these problems. According to Samuelson, there are three fundamental and interdependent problems in an economic organisation—what, how and for whom—which are grouped under allocation of resources. Allocation of resources means how much of each resource is devoted to the production of goods and services.

1. **Allocation of Resources**

   (a) **What Goods to Produce and How Much to Produce?** Due to limited resources, every economy has to decide what goods to produce and in what quantities. If the means were unlimited, then it would lead to a stage of salvation. But the means are limited and the economy must decide the efficient allocation of scarce resources so that both output and output-mix are optimum. An economy has to make a choice of the wants which are important for the economy



as a whole. For example, if the economy decides to produce more cloth, it is bound to reduce the production of food. The reason is that resources used to produce food and cloth are limited and given. An economy cannot produce more of both food and cloth. Thus, an economy has to decide what goods it would produce on the basis of availability of technology, cost of production, cost of supplying and demand for the commodity.

(b) How to Produce? It is the question of choice of technique of production. Since resources are scarce, an inefficient technique of production, which would lead to wastage and high cost, cannot be applied. A technique of production which would maximise output or minimise cost should be used. We generally consider two types of techniques of production: labour-intensive and capital-intensive techniques. In labour-intensive technique, more labour and less capital is used. In capital-intensive technique, more capital and less labour is used. For example, it is always technically possible to produce a given amount of wheat or rice with more of labour and less of capital (i.e. with labour intensive technology) or with more of capital and less of labour (i.e. with capital intensive technology). The same is true for most commodities. In the case of some commodities however, choices are limited. For example, production of woollen carpets and other items of handicrafts is by nature labour intensive, while production of cars, TV sets, computers, aircrafts, etc., is capital intensive. In most commodities, however, alternative technology may be available. Alternative techniques of production involve varying costs. Therefore, the problem of choice of technology arises. The guiding principle of this problem is to adopt such technique of production which has least cost to produce per unit of the commodity. At macro level the most efficient technique is the one which uses least quantity of scarce resources. Hence, producers must always produce efficiently by using the most efficient technology. Thus, every economy has to choose the most efficient technique of producing a commodity.

(c) For Whom to Produce? This is the question of how to distribute the product among the various sections of the society. National product is the total output generated by the firms. Goods and services are produced in the economy for those who have the ability (i.e. capacity) to buy them Ability or capacity or purchasing power of people depends on their income. More income means more capacity to buy. The total output ultimately flows to the households in the form of income, i.e., their wages, rent, profits or interest. There are millions of people in a society. Each one cannot get sufficient income to satisfy all his wants. This raises the problem of distribution of national product among different households. Who should get how

much is thus the problem? Thus, guiding principle of this problem is output of the economy be distributed among different sections of the society in such a way that all of them get a minimum level of consumption.

Production Possibility Frontier

A production possibility frontier (PPF) shows the maximum possible output combinations of two goods or services an economy can achieve when all resources are fully and efficiently employed

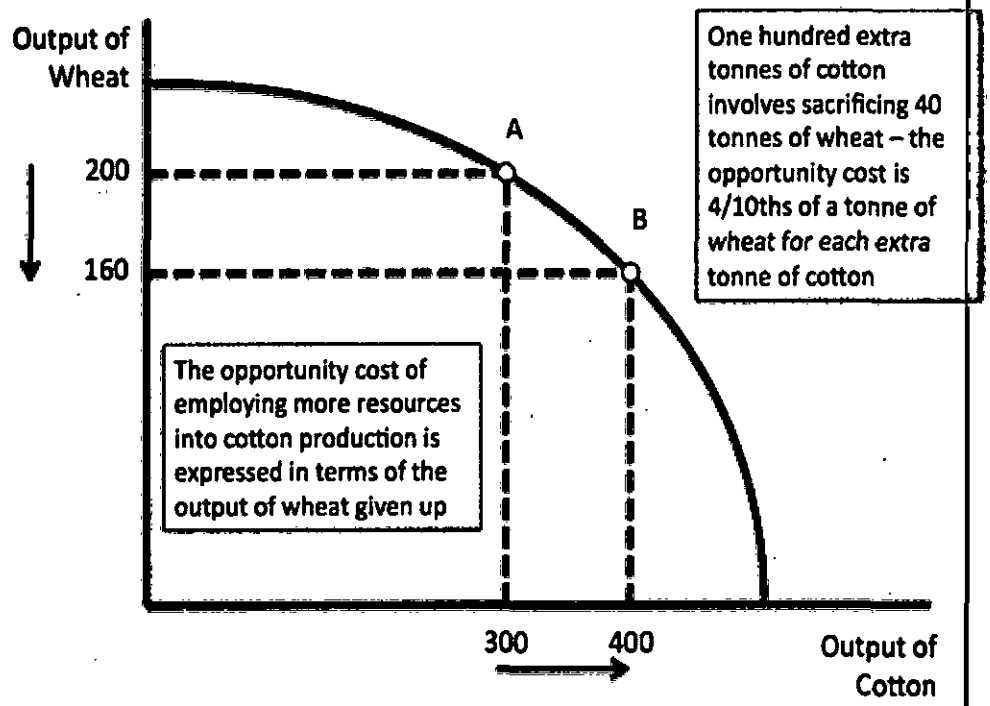
Opportunity Cost and the PPF

Reallocating scarce resources from one product to another involves an opportunity cost

If we increase our output of consumer goods (i.e. moving along the PPF from point A to point B) then fewer resources are available to produce capital goods

If the law of diminishing returns holds true then the opportunity cost of expanding output of X measured in terms of lost units of Y is increasing.

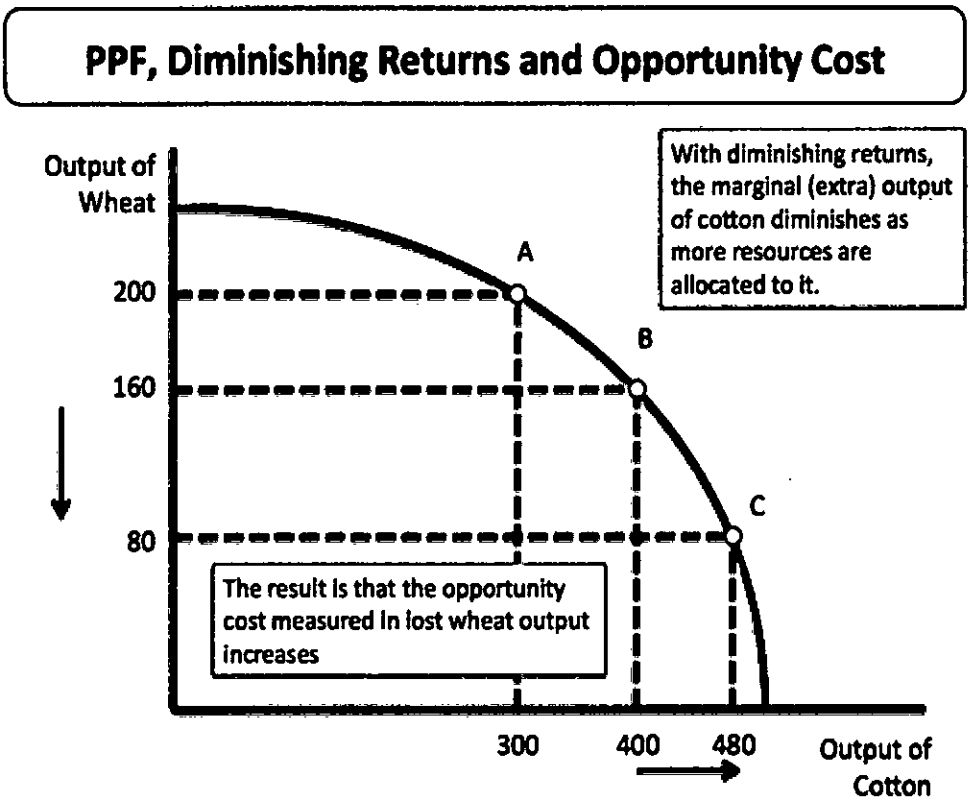
Production Possibility Frontier (PPF)



PPF and opportunity cost

We normally draw a PPF on a diagram as concave to the origin i.e. as we move down the PPF, as more resources are allocated towards Good Y the extra output gets smaller – so more of Good X has to be given up in order to produce Good Y

This is an explanation of the law ofdiminishing returns and it occurs because not all factor inputs are equally suited to producing items



PPF and diminishing returns

PPF and Economic Efficiency

Production Possibilities

A production possibility frontier is used to illustrate the concepts of opportunity cost, trade-offs and also show the effects of economic growth.

Points within the curve show when a country's resources are not being fully utilised

Combinations of the output of consumer and capital goods lying inside the PPF happen when there are unemployed resources or when resources are used inefficiently. We could increase total output by moving towards the PPF

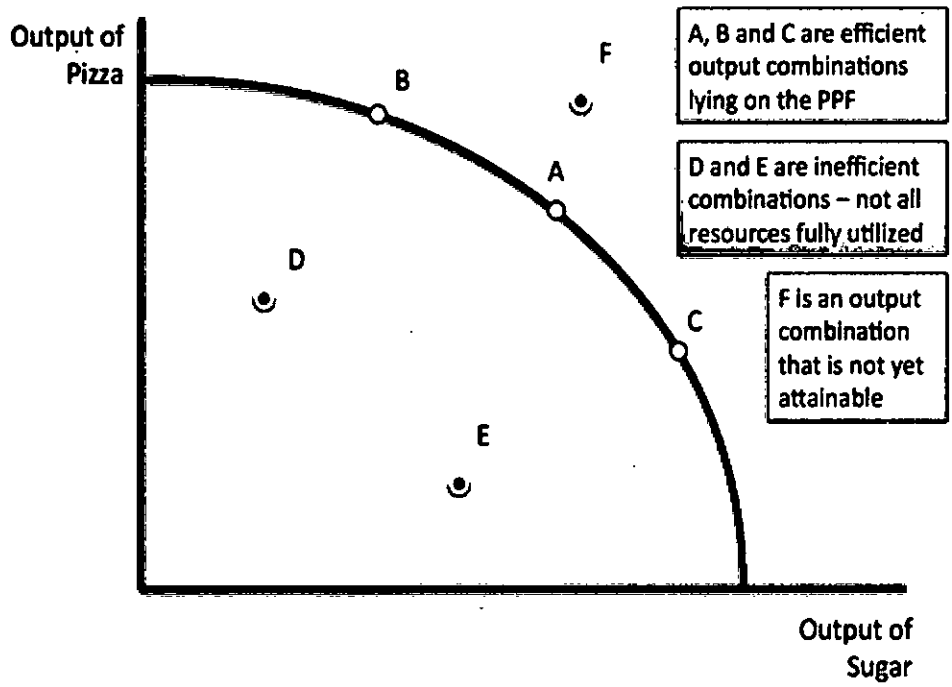
Combinations that lie beyond the PPF are unattainable at the moment

A country would require an increase in factor resources, an increase in the productivity or an improvement in technology to reach this combination.

Trade between countries allows nations to consume beyond their own PPF.

Producing more of both goods would represent an improvement in welfare and a gain in what is called allocative efficiency.

Production Possibility Frontier (PPF)



PPF and economic efficiency

Opportunity Cost

Opportunity cost in economics can be defined as benefits or value missed out by business owners, small businesses, organization, investors, or an individual because they choose to accomplish or achieve anything else. It helps organizations in better decision-making by showing the lost opportunity because of investing over an alternative which can be anything like shares, stock market, real estate, land, services, etc. Generally, the financial report does not show the opportunity cost because it is not only about money or monetary cost. It is also associated with the lost time invested somewhere else which is providing utility. In simple terms, it is a concept in microeconomics that tells you about the output and potential opportunities foregone.

It shows the relation between choice and scarcity. In this article, we will learn more about examples, formula, explicit cost, implicit cost, and concept of opportunity cost in managerial economics.

Definition of Opportunity Cost in Economics

In modern economic analysis, the factors of production are scarce as compared to the wants. Therefore, when society uses a certain factor in the production of a specific commodity, then it forgoes other commodities for which it could use the same factor. This led to the idea of an opportunity cost (OC).

Let's say that a certain kind of steel is needed to manufacture weapons for war. Therefore, society has to give up the number of utensils that it could produce using the same amount of steel.

Hence, the opportunity cost of producing weapons for war is the number of utensils forgone.

OPPORTUNITY COST

In other words, opportunity costs are the costs of the next best alternative forgone. Therefore, we can deduce two important aspects:

1. The opportunity costs of a product are only the best alternative forgone and not any other alternative.
2. These costs are viewed as the next-best alternative goods that we can produce with the same value of factors which are more or less the same.

How to Calculate Opportunity Cost

Formula of Opportunity cost = Return of Investment from the best option available – Return of investment from the chosen option.

Examples of Opportunity Cost

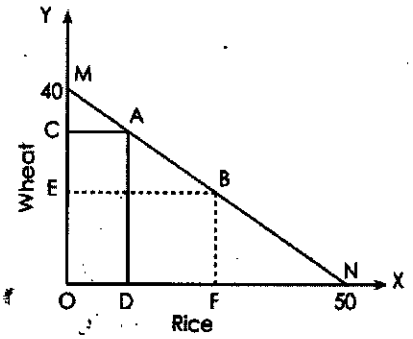
Let's understand these costs with the help of an illustration.

Let's say that a farmer has a piece of land on which he can grow wheat or rice.

Therefore, if he chooses to grow wheat, then he cannot grow rice and vice-versa.

Hence, the opportunity cost for rice is the wheat crop that he forgoes. The following diagram explains this:

Opportunity Cost Graph –



Let's assume that the farmer can produce either 50 quintals of rice (ON) or 40 quintals of wheat (OM) using this land. Now, if he produces rice, then he cannot produce wheat.

Therefore, the OC of 50 quintals of rice (ON) is 40 quintals of wheat (OM).

Further, the farmer can choose to produce any combination of the two crops along the curve MN (production possibility curve). Let's say that he chooses the point A as shown above.

Therefore, he produces OD amount of rice and OC amount of wheat. Subsequently, he decides to shift to point B. Now, he has to reduce the production of wheat from OC to OE in order to increase the production of rice from OD to OF.

Therefore, the OC of DF amount of rice is CE amount of wheat.

Applications of Opportunity Cost

- Determining factor prices
- Determining economic rent
- Consumption pattern decisions
- Determining factor prices
- Product plan decisions
- Decisions about national priorities

Determining factor prices

The factors for production need a price equal to or greater than what they command for alternative uses. If the factor price is less than the factor's opportunity cost, then the said factor moves to the better-paying alternative.

Determining economic rent

Many modern economists use this concept for determining economic rent. As per them, economic rent = The factor's actual earning – Its opportunity cost or transfer earning

Consumption pattern decisions

According to this concept, if with a given amount of money a consumer chooses to have more of one thing, then he needs to have less of the other.

Further, he cannot increase the consumption of all the goods at the same time. Therefore, he decides his consumption pattern using the concept of opportunity cost.

Product plan decisions

Let's say that a producer has fixed resources and technology. If he wants to produce a greater amount of one commodity, then he must sacrifice the quantity of another commodity.
Therefore, he uses this concept to make decisions about his production plan.

Decisions about national priorities

Every country has certain resources at its command and needs to plan the production of a wide range of commodities. This decision depends on the national priorities which are based on opportunity costs.

For example, if a country is at war, then it will use its resources to produce more war-related goods as compared to civilian goods. This concept helps the country in making these decisions.

Summary of the Chapter

The basic economic activities of life are production, distribution and disposition of goods and services. A society will be facing scarcity of resources during the time of fulfillment of these activities.

As such scarcity is evident, due to the availability of limited resources, and human needs having no limit. Therefore, this variation between the supply and demand leads to the formation of central problems of an economy.

The central problems of an economy revolve around these factors.

1. What to produce?
2. How to produce?
3. For whom to produce?

EXERCISE

Multiple Choice Questions

1. The law of scarcity
- (a) States that the want of a consumer will never be satisfied completely
- (b) Indicates that the want of consumer will be satisfied in a socialistic system
- (c) Is only for underdeveloped countries
- (d) Is not for rich and developed countries

Answer A

2. To make a rational decision a person needs
- (a) Choices that don't have trade-offs
- (b) Choices that never change
- (c) Choices that are consistent with a similar goal every time
- (d) Logical choices without error.

Answer C

3. The central problem of an economy is
- (a) Assigning limited resources in a way that unlimited desires and needs of the society are satisfied
- (b) Ensuring a minimum income for each citizen.
- (c) Assuring that production happens in the most effective way.
- (d) Analyzing the demand with market economies.

Answer A

4. An economy succeeds in producing resources efficiently when
   (a) Goods and services are produced without resources being wasted.
   (b) The total number of goods manufactured is high.
   (c) The resources employe are the best
   (d) The resources employed for highly valued uses.

Answer A

5. Which option is a disadvantage for allocating resources utilizing a market system?
   (a) Profits will be less
   (b) Impossible to stop the wastage of scarce resources
   (c) Notable unemployment may take place
   (d) Uneven distribution of income

Answer D

6. Which branch of economic theory is associated with the difficulty of resources allocation
   (a) Econometrics.
   (b) Micro-economic theory
   (c) Macro-economic theory
   (d) None of the above

Answer B

7. The creation of choice is done by
   (a) Scarcity of resources
   (b) Less choice option
   (c) The urgency of needs
   (d) Abundance of resources

Answer A

Review Questions

Q1. What are the Central problems of an economy
Q2. What do you mean by the production possibilities of an economy?
Q3. What is the difference between microeconomics and macroeconomics?
Q4. What is normative economics?
Q5. What is positive economics?

Space for Work

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14 FEATURES OF INDIAN ECONOMY

Module Content

Meaning of Utility, Marginal and Total utility, Law of Diminishing Marginal Utility, Consumer's Equilibrium based on utility analysis. Meaning of Indifference curve and budget line, consumer's equilibrium using in difference curve and budget line. Meaning, factors affecting demand, law of demand, Individual and market demand, demand schedule and demand curve movement along the demand curve and shift in demand curve. Meaning, Factors affecting price elasticity of demand. Methods of Calculating price elasticity of demand

(a) Percentage method

(b) Total expenditure method

(c) Geometric method Simple numerical problems based on each method

Objective of the module

The main objective of this module is to make student understand about the basics of Demand and utility including utility types and laws. Apart from that Methods of Calculating price elasticity of demand has also been discussed in this module.

Introduction

Meaning of Consumer Equilibrium:

It is a situation in which a costumer is getting maximum satisfaction and he has no tendency to change his pattern of consumption.

Condition: - MUX = PX

MEANING OF UTILITY: -

"Utility may be defined as wants satisfying power of a commodity. It is a relative concept with respect to person, place and time". According to Marshall- "The utility of a thing to a person at a time is measured by the extent to which it satisfies his wants"

Types of Utility

Total, marginal, and average utility and gives an example of how to find each of them given an initial table.

Quantity Consumed	Total Utility (sum of utility from consumption)	Marginal Utility (change in total utility divided by change in quantity consumed)	Average Utility (total utility divided by total quantity consumed)
1	50	50	50
2	90	40	45
3	120	30	40
4	140	20	35
5	150	10	30
6	155	5	25.83
10	160	1.25	16

The difference between total utility, marginal utility and average utility is pretty intuitive but it takes some practice to learn.

Most problems in economics will give you a table showing the quantity consumed/purchased, and an associated column showing total utility from these purchases. Total utility shows the total amount of utility (satisfaction or happiness) achieved from the consumption of ALL of the goods or services consumed.

Using the above table as an example, the total amount of happiness you get from consuming 1 good is 50, but if you consume 2 goods you will have a total utility of 90. If you happen to consume 10 goods, your total utility from the consumption of these 10 goods will be 160.

Marginal utility is calculated by taking the difference in total utilities, and dividing by the change in quantity consumed. Most of the time the change in quantity consumed will be 1, but this is not always the case. Using the table above as an example, calculating the marginal utility is done by taking the difference between total utility (and dividing by 1, which gives the same number). However, when we move from consuming 6 units to 10 units, we have to divide the change in total utility (5) by the change in quantity (4) to get 1.25, which means that each good provides 1.25 utility.

To get average utility, we take total utility and divide it by the number of goods being consumed. Using the table above as an example, you can see that each row in the average utility column can be confirmed by taking the amount in the total utility column and dividing by the amount in the quantity column.

The relation among marginal utility, total utility and average utility

It can be understood by a careful study of Table and Fig. It is clear from this table and figure that initially the total utility curve slopes upwards to the right.

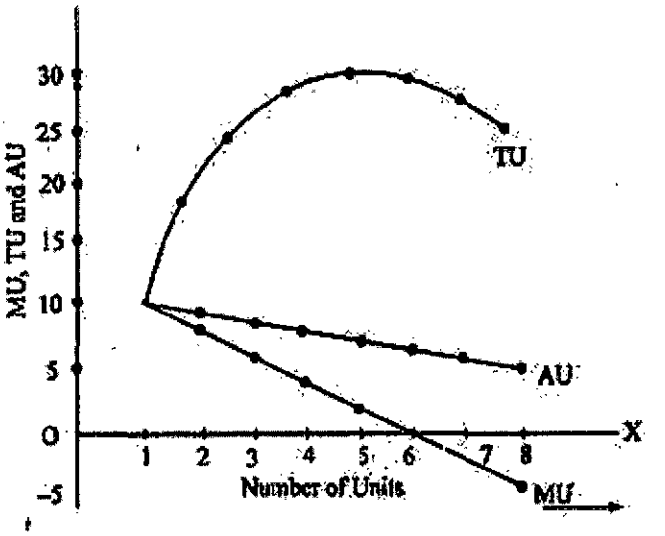
This indicates that the total utility will rise with consumption of additional units of the commodity. However, the increase in total utility is not constant, but falls

steadily. In other words, the total utility rises at a falling rate. This is shown by corresponding downward or negative slope of the marginal utility curve. In the present example, this happens upto 6 units of the commodity.

Table 4.1: Relationship among Total Utility, Marginal Utility and Average Utility (in Rupees)

Number of Units	Total Utility (TU)	Marginal Utility (MU)	Average Utility (AU)
1	10	10	10
2	18	8	9
3	24	6	8
4	28	4	7
5	30	2	6
6	30	0	5
7	28	-2	4
8	24	-4	3

When the total utility reaches its maximum value, marginal utility becomes zero. Before this point, though marginal utility falls, it always remains positive. In our example, this happens, when the consumer consumes sixth unit of the commodity. It is called the point of satiety. The total utility stops rising at this stage. When consumption is expanded beyond the point of satiety, the total utility starts falling because marginal utility turns negative. In the present example, the consumer gets negative marginal utilities of Rs. 2 and Rs. 4, when he decides to consume seventh and eighth units of the commodity respectively.



Relation among MU, TU and AU

The relationship between total utility and marginal utility can also be verified mathematically by using the concept of slope. We know that the slope of the

total utility curve at each point indicates the marginal utility derived from the corresponding level of consumption. This has been shown in Fig. 4.2.

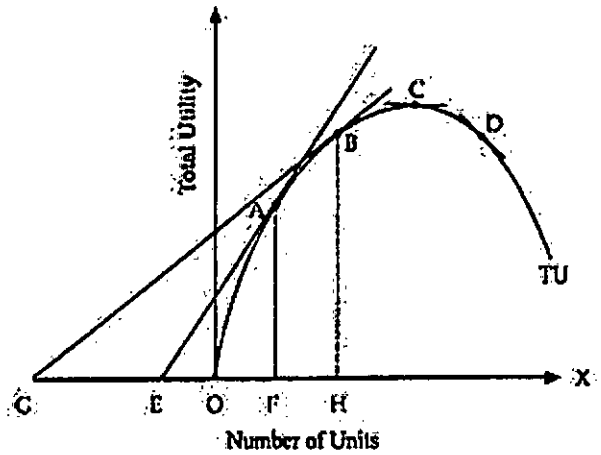


Fig. Marginal Utility though Slope of Total Utility

In Fig. 4.2, four points 'A', 'B' 'C' and 'D' are considered on the total utility curve. The slopes at these points are measured by the slopes of the tangents drawn at these points. The slope of the total utility curve at point 'A' is AF/EF, while the slope of the total utility curve at point 'B' is BH/GH. Since AF/EF > BH/GH, marginal utility for the unit corresponding to point 'A' is greater than for the unit corresponding to point 'B'.

Thus, initially, marginal utility falls, as total utility rises at diminishing rate. Further, at maximum point 'C' on the total utility curve, the tangent is parallel to X-axis. So, its slope is zero. Therefore, marginal utility is zero, when total utility is maximum. Again, slope of the tangent after point 'C' becomes negative (e.g., point 'D' in the figure). This shows that marginal utility turns negative, after total utility reaches its maximum point.

Unlike marginal utility, average utility is always positive, since it is a ratio of two non- negative values. So, the graph of average utility always remains above X-axis. When average utility attains maximum value, it is equal to marginal utility. Like marginal utility curve, average utility curve is also downward sloping.

Measurement of utility

- Cardinal utility
- Ordinal utility

Cardinal utility

Cardinal utility means satisfaction that can be measured in numbers such as 1, 2, and 3. While ordinal utility refers to satisfaction, it cannot be measured in numbers.

Ordinal utility emphasizes ordering/rank of bundles of goods.

Cardinal utility emphasizes the size of the difference between two bundles of goods.

ASSUMPTIONS OF CARDINAL UTILITY ANALYSIS:

The main assumption or premises on which the cardinal utility analysis rests are as under.

(i) **Rationality**. The consumer is rational. He seeks to maximize satisfaction from the limited income which is at his disposal.

(ii) **Utility is cardinally measurable**. The utility can be measured in cardinal numbers such as 1, 3, 10, 15, etc. The utility is expressed in imaginary cardinal numbers tells us a great deal about the preference of the consumer for a good.

(iii) **Marginal utility of money remains constant.** Another important premise of cardinal utility of money spent on the purchase of a good or service should remain constant.

(iv) **Diminishing marginal utility.** It is also assumed that the marginal utility obtained from the consumption of a good diminishes continuously as its consumption is increased.

(v) **Independent utilities.** According to the Cardinalist school, the utility which is derived from the consumption of a good is a function of the quantity of that good alone. If does not depend at all upon the quantity consumed of other goods. The goods, we can say, possess independent **utilities and are additive.**

(vi) **Introspection method**. The Cardinalist school assumes that the behaviour of marginal utility in the mind of another person can be judged with the help of self-observation. For example, I know that as I purchase more and more of a good, the less utility I derived from the additional units of it. By applying the same principle, I can read other people mind and say with confidence that marginal utility of a good diminishes as they have more units of it.

CRITICISM:

Pareto, an Italian Economist, severely criticized the concept of cardinal utility. He stated that utility is neither quantifiable nor addible. It can, however be compared. He suggested that the concept of utility should be replaced by the scale of preference. Hicks and Allen, following the footsteps of Pareto, introduced the technique of indifference curves. The cardinal utility approach is thus replaced by ordinal utility function

Law of Diminishing Marginal Utility:

Definition and Statement of the Law:

The ***law of diminishing marginal utility*** describes a familiar and fundamental tendency of human behaviour. The law of diminishing marginal utility ***states that***:

"As a consumer consumes more and more units of a specific commodity, the utility from the successive units goes on diminishing".

Mr. H. Gossen, a German economist, was first to explain this law in 1854. **Alfred Marshal** later on restated this law in the following words:

"The additional benefit which a person derives from an increase of his stock of a thing diminishes with every increase in the stock that already has".

Law is Based Upon Three Facts:

The law of diminishing marginal utility is based upon three facts. **First**, total wants of a man are unlimited but each single want can be satisfied. As a man gets more and more units of a commodity, the desire of his for that good goes on falling. A point is reached when the consumer no longer wants any more units of that good. **Secondly**, different goods are not perfect substitutes for each other in the satisfaction of various particular wants. As such the marginal utility will decline as the consumer gets additional units of a specific good. **Thirdly**, the marginal utility of money is constant given the consumer's wealth.

The basis of this law is a fundamental feature of wants. It states that when people go to the market for the purchase of commodities, they do not attach equal importance to all the commodities which they buy. In case of some of commodities, they are willing to pay more and in some less. There are two main reasons for this difference in demand. (1) the linking of the consumer for the commodity and (2) the quantity of the commodity which the consumer has with himself. The more one has of a thing, the less he wants the additional units of it. In other words, the marginal utility of a commodity diminishing as the consumer gets larger quantities of it. This, in brief, is the axiom of law of diminishing marginal utility.

Explanation and Example of Law of Diminishing Marginal Utility:

This law can be explained by taking a very simple example. Suppose, a man is very thirsty. He goes to the market and buys one glass of sweet water. The glass of water gives him immense pleasure or we say the first glass of water has great utility for him. If he takes second glass of water after that, the utility will be less than that of the first one. It is because the edge of his thirst has been blunted to a great extent. If he drinks third glass of water, the utility of the third glass will be less than that of second and so on.

The utility goes on diminishing with the consumption of every successive glass water till it drops down to zero. This is the point of satiety. It is the position of consumer's equilibrium or maximum satisfaction. If the consumer is forced further to take a glass of water, it leads to disutility causing total utility to decline. The marginal utility will become negative. A rational consumer will stop taking water at the point at which marginal utility becomes negative even if the good is free. In short, the more we have of a thing, ceteris paribus, the less we want still more of that, or to be more precise.

"In given span of time, the more of a specific product a consumer obtains, the less anxious he is to get more units of that product" or we can say that as

more units of a good are consumed, additional units will provide less additional satisfaction than previous units. The following table and graph will make the law of diminishing marginal utility clearer.

Schedule of Law of Diminishing Marginal Utility:

Units	Total Utility	Marginal Utility
1st glass	20	20
2nd glass	32	12
3rd glass	40	8
4th glass	42	2
5th glass	42	0
6th glass	39	-3

From the above table, it is clear that in a given span of time, the first glass of water to a thirsty man gives 20 units of utility. When he takes second glass of water, the marginal utility goes on down to 12 units; When he consumes fifth glass of water, the marginal utility drops down to zero and if the consumption of water is forced further from this point, the utility changes into disutility (-3).

Here it may be noted that the utility of then successive units consumed diminishes not because they are not of inferior in quality than that of others. We assume that all the units of a commodity consumed are exactly alike. The utility of the successive units falls simply because they happen to be consumed afterwards.

Curve/Diagram of Law of Diminishing Marginal Utility:

The law of diminishing marginal utility can also be represented by a diagram.

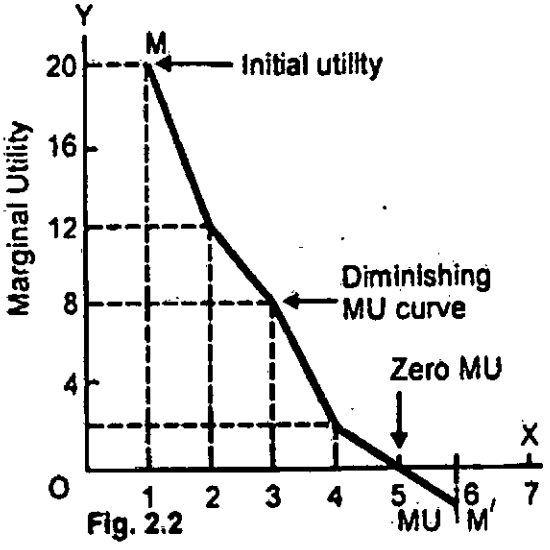


Fig. 2.2

In the figure (2.2), along OX we measure units of a commodity consumed and along OY is shown the marginal utility derived from them. The marginal utility of the first glass of water is called initial utility. It is equal to 20 units. The MU of the 5th glass of water is zero. It is called satiety point. The MU of the 6th

glass of water is negative (-3). The MU curve here lies below the OX axis. The utility curve MM' falls left from left down to the right showing that the marginal utility of the success units of glasses of water is falling.

Assumptions of Law of Diminishing Marginal Utility:

The law of diminishing marginal utility is true under certain assumptions. These assumptions are as under:

(i) **Rationality:** In the cardinal utility analysis, it is assumed that the consumer is rational. He aims at maximization of utility subject to availability of his income.

(ii) **Constant marginal utility of money:** It is assumed in the theory that the marginal utility of money based for purchasing goods remains constant. If the marginal utility of money changes with the increase or decrease in income, it then cannot yield correct measurement of the marginal utility of the good.

(iii) **Diminishing marginal utility:** Another important assumption of utility analysis is that the utility gained from the successive units of a commodity diminishes in a given time period.

(iv) **Utility is additive:** In the early versions of the theory of consumer behavior, it was assumed that the utilities of different commodities are independent. The total utility of each commodity is additive.

$U = U^1 (X^1) + U^2 (X^2) + U^3 (X^3) \ldots\ldots\ldots U^n (X^n)$

(v) **Consumption to be continuous:** It is assumed in this law that the consumption of a commodity should be continuous. If there is interval between the consumption of the same units of the commodity, the law may not hold good. For instance, if you take one glass of water in the morning and the 2nd at noon, the marginal utility of the 2nd glass of water may increase.

(vi) **Suitable quantity:** It is also assumed that the commodity consumed is taken in suitable and reasonable units. If the units are too small, then the marginal utility instead of falling may increase up to a few units.

(vii) **Character of the consumer does not change:** The law holds true if there is no change in the character of the consumer. For example, if a consumer develops a taste for wine, the additional units of wine may increase the marginal utility to a drunkard.

(viii) **No change to fashion:** Customs and tastes: If there is a sudden change in fashion or customs or taste of a consumer, it can than make the law inoperative.

(ix) **No change in the price of the commodity:** there should be any change in the price of that commodity as more units are consumed.

Limitations/Exceptions of Law of Diminishing Marginal Utility:

There are some exceptions or limitations to the law of diminishing utility.

(i) **Case of intoxicants:** Consumption of liquor defies the low for a short period. The more a person drinks, the more likes it. However, this is truer only initially. A stage comes when a drunkard too starts taking less and less liquor and eventually stops it.

(ii) **Rare collection:** If there are only two diamonds in the world, the possession of 2nd diamond will push up the marginal utility.

(iii) **Application to money:** The law equally holds good for money. It is true that more money the man has, the greedier he is to get additional units of it. However, the truth is that the marginal utility of money declines with richness but never falls to zero.

Practical Importance of Law of Diminishing Marginal Utility:

The law of diminishing utility has great practical importance in economics. The law of demand, the theory of consumer's surplus, and the equilibrium in the distribution of expenditure are derived from the law of diminishing marginal utility.

(i) **Basis of the law of demand:** The law of marginal diminishing utility and the law of demand are very closely related to each other. In fact, they law of diminishing marginal utility, the more we have of a thing, and the less we want additional increment of it. In other words, we can say that as a person gets more and more of a particular commodity, the marginal utility of the successive units begins to diminish. So, every consumer while buying a particular commodity compares the marginal utility of the commodity and the price of the commodity which he has to pay.

If the marginal utility of the commodity is higher than that of price, he purchases that commodity. As he buys more and more, the marginal utility of the successive units begins to diminish. Then he pays fewer amounts for the successive units. He tries to equate at every step the marginal utility and the price of the commodity, he must lower its price so that the consumers are induced to buy large quantities and this is what is explained in the law of demand. From this, we conclude that the law of demand and the law of diminishing are very closely inter-related.

(ii) **Consumer's surplus concept:** The theory of consumer's surplus is also based on the law of diminishing marginal utility. A consumer while purchasing the commodity compares the utility of the commodity with that of the price which he has to pay. In most of the cases, he is willing to pay more than what he actually pays. The excess of the price which he would be willing to pay rather than to go without the thing over that which he actually does pay is the economic measure of this surplus

satisfaction. It is in fact difference between the total utility and the actually money spent.

(iii) **Importance to the consumer:** A consumer in order to get the maximum satisfaction from his relatively scarce resources distributes his income on commodities and services in such a way that the marginal utility from all the uses are the same. Here again the concept of marginal utility helps the consumer in arranging his scale of preference for the commodities and services.

(iv) **Importance to finance minister:** Sometimes it is pointed out that the law of diminishing marginal utility does not apply on money. As a person collects money, the desires to accumulate more money increases. This view is superficial. It is true that wealth is acquired for the procurement of goods and services and man is always anxious in getting more and more of money. But what about the utility of money to him? Is it not a fact that as a person gets more and more wealth, its utility progressively decreases, though it does not reach to zero?

For example, a person who earns $90,000 per month attaches less importance to $10. But a man who gets $1000 per month, the value of $10 to him is very high. A finance minister knowing this fact that the utility of money to a rich man is high and to poor man low bases the system of taxation in such a way that the rich persons are taxed at a progressive rate. The system of modern taxation is therefore, based on the law of diminishing marginal utility.

Law of Equi-Marginal Utility:

(Equilibrium of the Consumer Through the Law of Equi-Marginal Utility):

Other Names of this Law:

Law of Substitution OR Law of Maximum Satisfaction OR Law of Indifference OR

Proportion Rule OR Gossen's Second Law.

In the cardinal utility analysis, the principle of equal marginal utility occupies an important place.

Definition and Statement of Law of Equi-Marginal Utility:

The ***law of equi-marginal utility*** is simply an extension of law of diminishing marginal utility to two or more than two commodities. The law of equilibrium utility is known, by various names. It is named as the Law of Substitution, the Law of Maximum Satisfaction, the Law of Indifference, the Proportionate Rule and the Gossen's Second Law.

n cardinal utility analysis, this **law is stated by Lipsey** in the following words:

"The household maximizing the utility will so allocate the expenditure between commodities that the utility of the last penny spent on each item is equal".

As we know, every consumer has unlimited wants. However, the income this disposal at any time is limited. The consumer is, therefore, faced with a choice among many commodities that he can and would like to pay. He, therefore, consciously or unconsciously compress the satisfaction which he obtains from the purchase of the commodity and the price which he pays for it. If he thinks the utility of the commodity is greater or at-least equal to the loss of utility of money price, he buys that commodity.

As he buys more and more of that commodity, the utility of the successive units begins to diminish. He stops further purchase of the commodity at a point where the marginal utility of the commodity and its price are just equal. If he pushes the purchase further from his point of equilibrium, then the marginal utility of the commodity will be less than that of price and the household will be loser. A consumer will be in equilibrium with a single commodity symbolically:

$$MU^x = P^x$$

A prudent consumer in order to get the maximum satisfaction from his limited means compares not only the utility of a particular commodity and the price but also the utility of the other commodities which he can buy with his scarce resources. If he finds that a particular expenditure in one use is yielding less utility than that of other, he will tie to transfer a unit of expenditure from the commodity yielding less marginal utility. The consumer will reach his equilibrium position when it will not be possible for him to increase the total utility by uses. The position of equilibrium will be reached when the marginal utility of each good is in proportion to its price and the ratio of the prices of all goods is equal to the ratio of their marginal utilities.

The consumer will maximize total utility from his income when the utility from the last rupee spent on each good is the same. Algebraically, this is:

$$MU_a / P_a = MU_b / P_b = MU_c = P_c = MU_n = P_n$$

Here: (a), (b), (c).... (n) are various goods consumed.

Assumptions of Law of Equi-Marginal Utility:

The main assumptions of the law of equi-marginal utility are as under.

(i) **Independent utilities.** The marginal utilities of different commodities are independent of each other and diminish with more and more purchases.

(ii) **Constant marginal utility of money.** The marginal utility of money remains constant to the consumer as he spends more and more of it on the purchase of goods.

(iii) **Utility is cardinally measurable.**

(iv) **Every consumer is rational in the purchase of goods.**

Example and Explanation of Law of Equi-Marginal Utility:

The doctrine of equi-marginal utility can be explained by taking an example. Suppose a person has $5 with him whom he wishes to spend on two commodities, tea and cigarettes. The marginal utility derived from both these commodities is as under:

Schedule:

Units of Money	MU of Tea	MU of Cigarettes
1	10	12
2	8	10
3	6	8
4	4	6
5	2	3
$5	**Total Utility = 30**	**Total Utility = 30**

A rational consumer would like to get maximum satisfaction from $5.00. He can spend money in three ways:

(i) $5 may be spent on tea only.

(ii) $5 may be utilized for the purchase of cigarettes only.

(iii) Some rupees may be spent on the purchase of tea and some on the purchase of cigarettes.

If the prudent consumer spends $5 on the purchase of tea, he gets 30 utility. If he spends $5 on the purchase of cigarettes, the total utility derived is 39 which are higher than tea. In order to make the best of the limited resources, he adjusts his expenditure.

(i) By spending $4 on tea and $1 on cigarettes, he gets 40 utility (10+8+6+4+12 = 40).

(ii) By spending $3 on tea and $2 on cigarettes, he derives 46 utility (10+8+6+12+10 = 46).

(iii) By spending $2 on tea and $3 on cigarettes, he gets 48 utility (10+8+12+10+8 = 48).

(iv) By spending $1 on tea and $4 on cigarettes, he gets 46 utility (10+12+10+8+6 = 46).

The sensible consumer will spend $2 on tea and $3 on cigarettes and will get maximum satisfaction. When he spends $2 on tea and $3 on cigarette, the marginal utilities derived from both these commodities is equal to 8. When the marginal utilities of the two commodities are equalizes, the total utility is then maximum, i.e., 48 as is clear from the schedule given above.

Curve/Diagram of Law of Equi-Marginal Utility:

The law of equi-marginal utility can be explained with the help of diagrams.

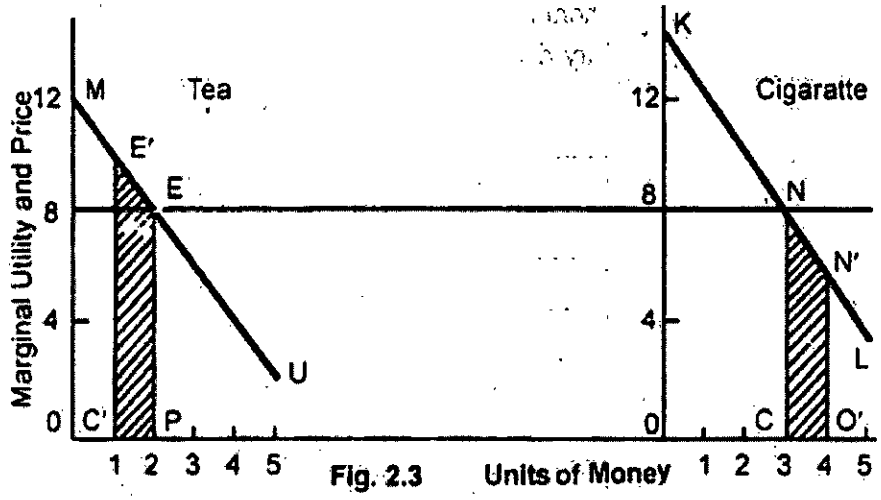


Fig. 2.3

In the figure 2.3 MU is the marginal utility curve for tea and KL of cigarettes. When a consumer spends OP amount ($2) on tea and OC ($3) on cigarettes, the marginal utility derived from the consumption of both the items (Tea and Cigarettes) is equal to 8 units (EP = NC). The consumer gets the maximum utility when he spends $2 on tea and $3 on cigarettes and by no other alternation in the expenditure.

We now assume that the consumer spends $1 on tea (OC′ amount) and $4 (OQ′) on cigarettes. If CQ′ more amounts are spent cigarettes, the added utility is equal to the area CQ′ N′N. On the other hand, the expenditure on tea falls from OP amount ($2) to OC′ amount ($1). There is a toss of utility equal to the area C′PEE. The loss is utility (tea) is greater than that The loss in utility (tea) is maximum satisfaction except the combination of expenditure of $2 on tea and $3 on cigarettes.

This law is known as the ***Law of maximum Satisfaction*** because a consumer tries to get the maximum satisfaction from his limited resources by so planning his expenditure that the marginal utility of a rupee spent in one use is the same as the marginal utility of a rupee spent on another use.

It is known as the ***Law of Substitution*** because consumer continuous substituting one good for another till, he gets the maximum satisfaction.

It is called the ***Law of Indifference*** because the maximum satisfaction has been achieved by equating the marginal utility in all the uses. The consumer than becomes indifferent to readjust his expenditure unless some change fakes place in his income or the prices of the commodities, etc.

Limitations/Exceptions of Law of Equi-Marginal Utility:

(i) **Effect on fashions and customs:** The law of equi-marginal utility may become inoperative if people forced by fashions and customs spend money on the purchase of those commodities which they clearly knows

yield less utility but they cannot transfer the unit of money from the less advantageous uses to the more advantageous uses because they are forced by the customs of the country.

(ii) **Ignorance or carelessness:** Sometimes people due to their ignorance of price or carelessness to weigh the utility of the purchased commodity do not obtain the maximum advantage by equating the marginal utility in all the uses.

(iii) **Indivisible units:** If the unit of expenditure is not divisible, then again the law may become inoperative.

(iv) **Freedom of choice:** If there is no perfect freedom between various alternatives, the operation of law may be impeded.

Importance of Law of Equi-Marginal Utility:

The law of equi-marginal utility is of great practical importance. The application of the principle of substitution extends over almost every field of economic enquiry. Every consumer consciously trying to get the maximum satisfaction from his limited resources acts upon this principle of substitution. Same is the case with the producer. In the field of exchange and in theory of distribution too, this law plays a vital role. In short, despite its limitation, the law of maximum satisfaction is meaningful general statement of how consumers behave.

In addition to its application to consumption, it applies equally to the theory of production and theory of distribution. In the theory of production, it is applied on the substitution of various factors of production to the point where marginal return from all the factors are equal. The government can also use this analysis for evaluation of its different economic prices.

The equal marginal rule also guides an individual in the spending of his saving on different types of assets. The law of equal marginal utility also guides an individual in the allocation of his time between work and leisure. In short, despite limitations the law of substitution is applied to all problems of allocation of scarce resources.

Derivation of the Demand Curve in Terms of Utility Analysis:

Dr. Alfred Marshal was of the view that the law of demand and so the demand curve can be derived with the help of utility analysis.

He **explained the derivation of law of demand:**

(i) In the case of a single commodity and

(ii) in the case of two or more than two commodities. In the utility analysis of demand, the following assumptions are made:

Assumptions:

(i) Utility is cardinally measurable.

(ii) Utilities of different commodities are independent.

(iii) The marginal utility of money to the consumer remains constant.

(iv) Utility gained from the successive units of a commodity diminishes.

(1) Derivation of Demand Curve in the Case of a Single Commodity (Law of Diminishing Marginal Utility):

Dr. Alfred Marshall derived the demand curve with the aid of law of diminishing marginal utility. The law of diminishing marginal utility states that as the consumer purchases more and more units of a commodity, he gets less and less utility from the successive units of the expenditure. At the same time, as the consumer purchases more and more units of one commodity, then lesser and lesser amount of money is left with him to buy other goods and services.

A rational consumer, before, while purchasing a commodity compares the price of the commodity which he has to pay with the utility of a commodity he receives from it. So long as the marginal utility of a commodity is higher than its price ($MU_x > P_x$), the consumer would demand more and more units of it till its marginal utility is equal to its price $MU_x = P_x$ or the equilibrium condition is established.

To put it differently, as the consumer consumes more and more units of a commodity, its marginal utility goes on diminishing. So it is only at a diminishing price at which the consumer would like to demand more and more units of a commodity.

Diagram/Curve:

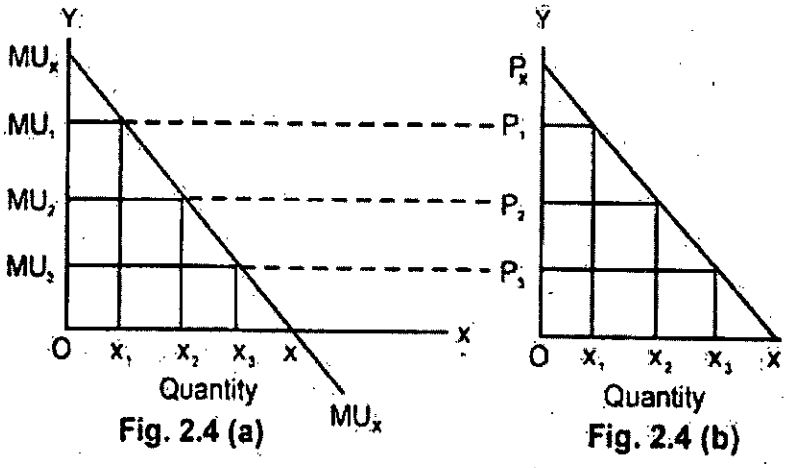


Fig. 2.4 (a) Fig. 2.4 (b)

In fig. 2.4

(a) the MU_x is negatively slopped. It shows that as the consumer acquires larger quantities of good x, its marginal utility diminishes. Consequently, at diminishing price, the quantity demanded of the good x increases as is shown in fig. 2.4 (b).

At X^1, quantity the marginal utility of a good is MU^1. This is equal to P^1 by definition. The consumer here demands OX^1 quantity of the commodity at P^1 price. In the same way X^2 quantity of the good is equal to P^2. Here at P^2 price, the consumer will buy OX^2 quantity of commodity. At X^3

quantity the marginal utility is MU^3, which is equal to P^3. At P^3, the consumer will buy OX^3 quantity and so on.

We conclude from above, that as the purchase of the units of commodity X are increased, its marginal utility diminishes. So at diminishing price, the quantity demanded of good X increases as is evident from fig. 2.4 (b). The rational supports the notion of down slopping demand curve that when price falls, other things remaining the same, the quantity demanded of a good increase and vice versa. (The negative section of the MU curve does not form part of the demand curve, since negative quantities do not make sense in economics).

(2) Derivation of the Demand Curve in the Case of Two or More than Two

Commodities (Law of Equi-Marginal Utility):

The law of diminishing marginal utility can also be applied in case of two or more than two goods. When a consumer has to spend a certain given income on a number of goods, he attains maximum satisfaction when the marginal utilities of the goods are proportional to their prices as stated below.

$$MU^x / P^x = MU^y / P^y = \ldots\ldots\ldots\ldots MU^n / P^n$$

Derivation of Demand Curve:

In the fig. 2.5 (a), (b) and (c) given the money income, the price of X commodity (P_x) and the price of Y commodity (P_y) and constant marginal utility of money (MU_m), the demand curve derived is illustrated. The consumer allocates his money income between X and Y commodities to get OQ^1 units of good X and OY unit of good Y commodities because the combination correspondence to:

$$MU_x / P_x = MU_y / P_y = MU_m$$

At the OM level (constant).

Diagram/Curve:

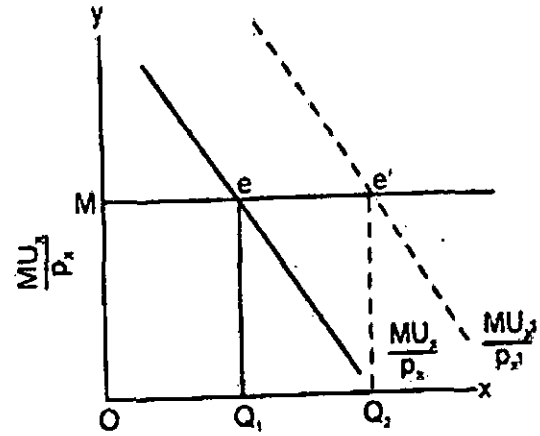


Fig. 2.5 (a) (Units of X Commodity)

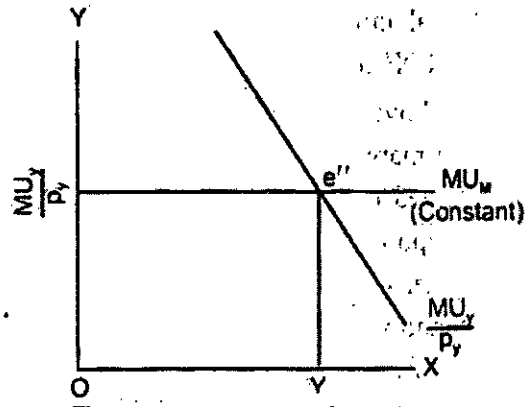


Fig. 2.5 (b) (Units of Y Commodity)

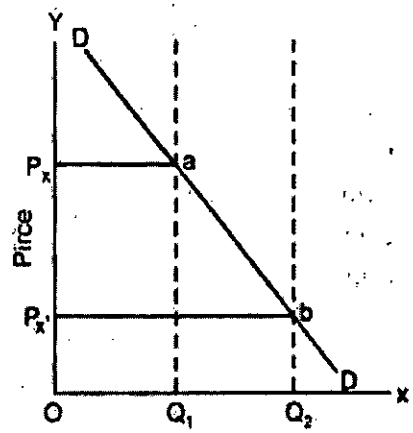


Fig. 2.5 (c) Quantity Demanded

Let us assume that money income and price of Y commodity remain constant but the price of X commodity decreases. As a result of this money expenditure on commodity X rises resulting MU_x / P_x curve to shift towards right. The consumer now allocates his income to OQ_2 quantity of X commodity and O_y quantity of Y commodity because the combinations correspondence to

$$\mathbf{MU_x / P_x = MU_y / P_y = MU_m}$$

(constant) at OM level.

Thus, in response to decrease in the price from Px to Px^1, the quantity demanded of a good X increases from OQ_1 to OQ_2. The DD is a negatively sloped demand curve.

Indifference curves OR Ordinal utility

Indifference Curve

A popular alternative to the marginal utility analysis of demand is the Indifference Curve Analysis. This is based on consumer preference and believes that we cannot quantitatively measure human satisfaction in monetary terms. This approach assigns an order to consumer preferences rather than measure them in terms of money. Let us take a look.

What is an Indifference Curve?

It is a curve that represents all the combinations of goods that give the same satisfaction to the consumer. Since all the combinations give the same amount of satisfaction, the consumer prefers them equally. Hence the name Indifference Curve.

Here is an example to understand the indifference curve better. Peter has 1 unit of food and 12 units of clothing. Now, we ask Peter how many units of clothing is he willing to give up in exchange for an additional unit of food so that his level of satisfaction remains unchanged.

Peter agrees to give up 6 units of clothing for an additional unit of food. Hence, we have two combinations of food and clothing giving equal satisfaction to Peter as follows:

1. 1 unit of food and 12 units of clothing
2. 2 units of food and 6 units of clothing

Combination	Food	Clothing
A	1	12
B	2	6
C	3	4
D	4	3

By asking him similar questions, we get various combinations as follows:

Graphical Representation:

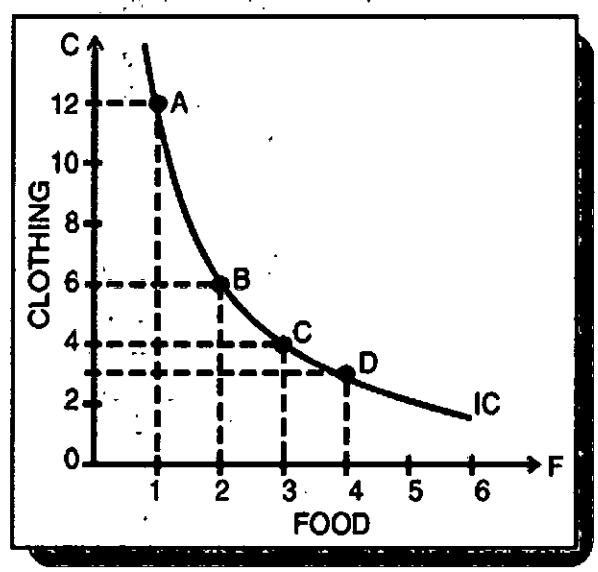


Fig. 1 : A Consumer's Indifference Curve

The diagram shows an Indifference curve (IC). Any combination lying on this curve gives the same level of consumer satisfaction. It is also known as Iso-Utility Curve.

Indifference Map

An Indifference Map is a set of Indifference Curves. It depicts the complete picture of a consumer's preferences. The following diagram showing an indifference map consisting of three curves:

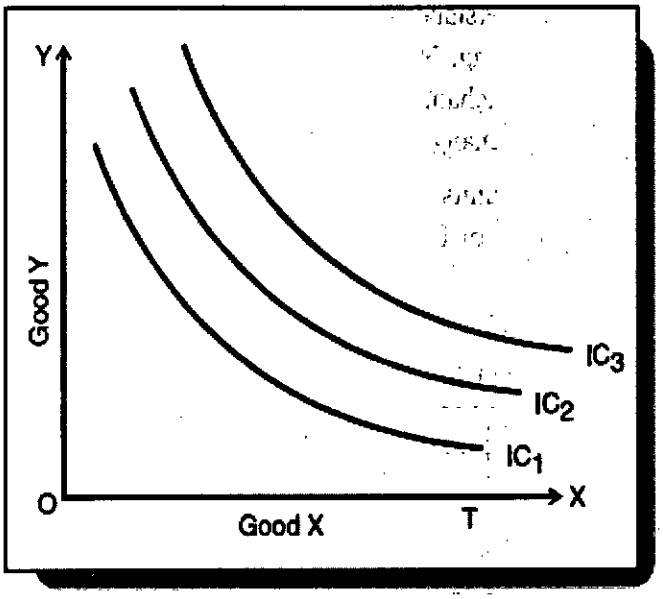


Fig. 2 : Indifference Map

We know that a consumer is indifferent among the combinations lying on the same indifference curve. However, it is important to note that he prefers the combinations on the higher indifference curves to those on the lower ones.

This is because a higher indifference curve implies a higher level of satisfaction. Therefore, all combinations on IC1 offer the same satisfaction, but all combinations on IC2 give greater satisfaction than those on IC1.

Marginal Rate of Substitution

This is the rate at which a consumer is prepared to exchange a good X for Y. If we go back to Peter's example above, we have the following table:

Combination	Food	Clothing	MRS
A	1	12	–
B	2	6	6
C	3	4	2
D	4	3	1

In this example, Peter initially gives up 6 units of clothing to get an extra unit of food. Hence, the MRS is 6. Similarly, for subsequent exchanges, the MRS is 2 and 1 respectively. Therefore, MRS of X for Y is the amount of Y whose loss can be compensated by a unit gain of X, keeping the satisfaction the same.

Interestingly, as Peter accumulates more units of food, the MRS starts falling –

meaning he is prepared to give up fewer units of clothing for food. There are two reasons for this:

1. As Peter gets more units of food, his intensity of desire for additional units of food decreases.
2. Most of the goods are imperfect substitutes for one another. If they could substitute one another perfectly, then MRS would remain constant.

Properties of an Indifference Curve or IC

Here are the properties of an indifference curve:

An IC slopes downwards to the right

This slope signifies that when the quantity of one commodity in combination is increased, the amount of the other commodity reduces. This is essential for the level of satisfaction to remain the same on an indifference curve.

An IC is always convex to the origin

From our discussion above, we understand that as Peter substitutes clothing for food, he is willing to part with less and less of clothing. This is the diminishing marginal rate of substitution. The rate gives a convex shape to the indifference curve. However, there are two extreme scenarios:

1. Two commodities are perfect substitutes for each other – In this case, the indifference curve is a straight line, where MRS is constant.
2. Two goods are perfect complementary goods – An example of such goods would be gasoline and water in a car. In such cases, the IC will be L-shaped and convex to the origin.

Indifference curves never intersect each other

Two ICs will never intersect each other. Also, they need not be parallel to each other either. Look at the following diagram:

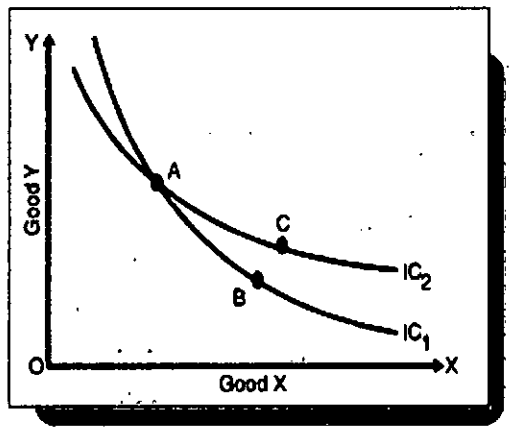


Fig. 3 : Intersecting Indifference Curves

Fig 3 shows tow ICs intersecting each other at point A. Since A and B lie on IC1, the give the same satisfaction level. Similarly, A and C give the same satisfaction level, as they lie on IC2. Therefore, we can imply that B and C offer the same level of satisfaction, which is logically absurd. Hence, no tow ICs can touch or intersect each other.

A higher IC indicates a higher level of satisfaction as compared to a lower IC

A higher IC means that a consumer prefers more goods than not.

An IC does not touch the axis

This is not possible because of our assumption that a consumer considers different combinations of two commodities and wants both of them. If the curve touches either of the axes, then it means that he is satisfied with only one commodity and does not want the other, which is contrary to our assumption.

Budget Line

Since a higher indifference curve represents a higher level of satisfaction, a consumer will try to reach the highest possible IC to maximize his satisfaction. In order to do so, he has to buy more goods and has to work under the following two constraints:

1. He has to pay the price for the goods and
2. He income is limited, restricting the availability of money for purchasing these goods

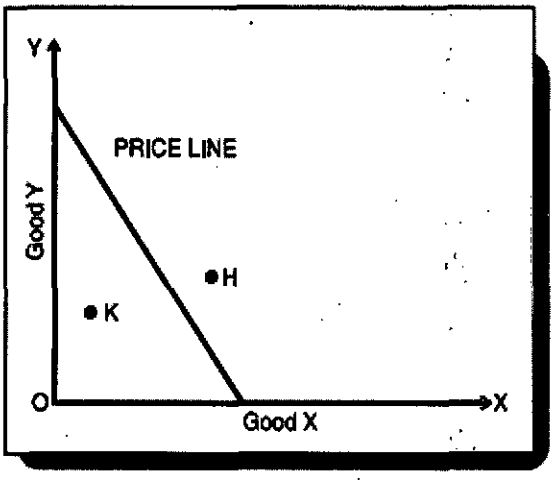


Fig. 4 : Price Line

As can be seen above, a budget line shows all possible combinations of two goods that a consumer can buy within the funds available to him at the given prices of the goods. All combinations that are within his reach lie on the budget line.

A point outside the line (point H) represents a combination beyond the financial reach of the consumer. On the other hand, a point inside the line (point K) represents under-spending by the consumer.

SUMMARY OF THE CHAPTER

A customer is the one who normally determines his demand for goods on the basis of satisfaction (utility) that he procures from it. So, what is a utility?

The utility of goods is its want-satisfying capability. The more the stronger the aspiration to have it, the more is the utility procured from the goods. The utility is instinctive. Distinct people can get different degrees of utility from the same goods. For instance, someone who likes sweets will get much higher utility from a sweet than someone who doesn't sweets. The utility that an individual obtains from the goods can differ with the change in location and time. For instance, utility from the use of an Air conditioner certainly relies upon whether the person is in Srinagar or Jaipur(location) or whether it is winter or summer (season).

Approaches that elucidate consumer behaviour

- **Cardinal Utility Analysis** – Cardinal utility is defined as – 'the perspective is put forward by the economists, who presume that utility is quantifiable and the consumer can convey his or her contentment in fundamental or measurable numbers, such as 2,3,4 and so on.

Measures of Utility:

- **Total Utility** – Total utility of a determined quantity of goods or commodity (TU) is the total contentment procured from utilizing the given amount of some goods 'p'.
- **Marginal Utility** – MU is the difference in total utility due to the utilization of one extra unit of goods or commodity.
- **Ordinal Utility Analysis** – The customer does not quantify utility in numerals. All the theory of customer decision-making under constraints of certitude can be and mostly is, conveyed in the terms of ordinal utility.

EXERCISE

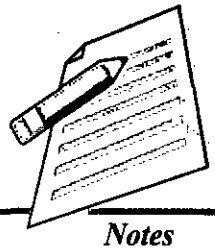
Multiple Choice Questions

1. Which of the following statements regarding utility is not true?
   A. It is a satisfying power of a commodity.
   B. It is purely a subjective entity.
   C. Utility is always measurable.
   D. It helps consumers to make choices.

Answer: Utility is always measurable.

2. Which of the following utility approach is based on the theory of Alfred Marshall?
   A. Ordinal utility approach
   B. None of these
   C. *Cardinal utility approach*
   D. Independent variable approach

Answer: Cardinal utility approach



3. _____ is the addition to total utility by the consumption of one additional unit of the commodity?
   A. Total utility
   B. Ordinal utility
   C. Average utility
   D. Marginal utility

Answer: Marginal utility

4. Which of the following utility approach suggests that utility is a measurable and quantifiable entity?
   A. None of these
   B. Ordinal approach
   C. Cardinal approach
   D. Both cardinal & ordinal

Answer: Cardinal approach

5. _____ shows various combinations of two goods that give same amount of satisfaction to the consumer?
   A. Isoquant
   B. Indifference curve
   C. Isocost curve
   D. Marginal utility curve

Answer: Indifference curve

6. Indifference curve slopes_____?
   A. Downward to the right
   B. Downward to the left
   C. Upward to the left
   D. Upward to the right

Answer: Downward to the right

7. _____ is defined as the difference between what the consumer is willing to pay for a product and what he actually pays?
   A. Consumer surplus
   B. Consumer burden
   C. Optimum price
   D. Price gap

Answer: Consumer surplus

8. According to the law of diminishing marginal utility, _____?
   A. Additional consumption always yields extra utility
   B. Additional consumption leads to lower average total utility
   C. Additional consumption always yields negative utility
   D. After a point any addition in the consumption causes a reduction in total utility.

Answer: After a point any addition in the consumption causes a reduction in total utility.

9. The want satisfying power of a commodity is known as:
   A. Supply
   B. Consumption
   C. Utility
   D. Demand

Answer: Utility

10. What is called point of satiety?
   A. The point where marginal utility becomes less than zero
   B. The point where marginal utility becomes greater than zero
   C. The point where marginal utility becomes zero.
   D. None of above

Answer: The point where marginal utility becomes zero.

11. The total utility divided by the number of units consumed is known as?
   A. Total utility
   B. Average utility
   C. Marginal utility
   D. None of above

Answer: Average utility

12. Utility is measured in terms of?
    A. Utils
    B. Centimeter
    C. Gram
    D. Seconds

Answer. Utils

13. The concept of marginal utility was developed by?
    A. Alfred Marshall
    B. Robbins
    C. Hicks & Allen
    D. Paul Samuelson

Answer: Alfred Marshall

14. Indifference curve represents?
    A. More than two commodities
    B. Four commodities
    C. Only two commodities
    D. Less than two commodities

Answer: Only two commodities

15. Consumer's surplus is also known as?
    A. Differential surplus
    B. Elasticity of demand
    C. Buyer's surplus
    D. Indifference surplus

Answer: Buyer's surplus

Review Questions

1. What do you understand by the term Utility?
2. Discuss the basic types of Utility
3. Discuss the major concepts underlying the theory of Utility
4. Draw the relationship existing among the Total Utility, Average Utility and Marginal Utility
5. Discuss extensively about the Cardinal approach to the study of Utility
6. Discuss extensively about the Ordinal approach to the study of Utility
7. Highlight the major distinctions between the Cardinal and Ordinal approaches to the study of Utility
8. What is law of diminishing marginal utility DMU?
9. What is consumer equilibrium? Demonstrate it graphically and algebraically.

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15 DEMAND

Definition of demand

The amount of a particular economic good or service that a consumer or group of consumers will want to purchase at a given price.

The demand curve is usually downward sloping, since consumers will want to buy more as price decreases. Demand for a good or service is determined by many different factors other than price, such as the price of substitute goods and complementary goods. In extreme cases, demand may be completely unrelated to price, or nearly infinite at a given price.

Along with supply, demand is one of the two key determinants of the market price.

Meaning of Demand

Demand: The term 'demand' is defined as the desire for a commodity which is backed by willingness to buy and ability to pay for it.

TYPES OF DEMAND

1. **Direct and indirect demand:**

   Producers' goods and consumers' goods: demand for goods that are directly used for consumption by the ultimate consumer is known as direct demand (example: Demand for T shirts). On the other hand, demand for goods that are used by producers for producing goods and services. (example: Demand for cotton by a textile mill)

2. **Derived demand and autonomous demand:**

   When a produce derives its usage from the use of some primary product it is known as derived demand. (example: demand for tyres derived from demand for car) Autonomous demand is the demand for a product that can be independently used. (example: demand for a washing machine)

3. **Durable and non-durable goods demand:**

   Durable goods are those that can be used more than once, over a period of time (example: Microwave oven) Non-durable goods can be used only once (example: Band-aid)

4. **Firm and industry demand:**

   Firm demand is the demand for the product of a particular firm. (example:

Dove soap) The demand for the product of a particular industry is industry demand (example: demand for steel in India)

5. **Total market and market segment demand:**

A particular segment of the markets demand is called as segment demand (example: demand for 21 laptops by engineering students) the sum total of the demand for laptops by various segments in India is the total market demand. (example: demand for laptops in India)

6. **Short run and long run demand:**

Short run demand refers to demand with its immediate reaction to price changes and income fluctuations. Long run demand is that which will ultimately exist as a result of the changes in pricing, promotion or product *improvement aftermarket adjustment with sufficient time.*

7. **Joint demand and Composite demand:**

When two goods are demanded in conjunction with one another at the same time to satisfy a single want, it is called as joint or complementary demand. (example: demand for petrol and two wheelers) A composite demand is one in which a good is wanted for several different uses. (example: demand for iron rods for various purposes)

8. **Price demand, income demand and cross demand:**

Demand for commodities by the consumers at alternative prices are called as price demand. Quantity demanded by the consumers at alternative levels of income is income demand. Cross demand refers to the quantity demanded of commodity 'X' at a price of a related commodity 'Y' which may be a substitute or complementary to X.

DETERMINANTS OF DEMAND

i. **General factors**

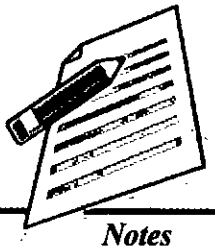
- Change in the number of buyers
- Change in consumer incomes Change in consumer tastes
- Change in the prices of complementary and substitute goods Additional factors related to luxury goods and durables
- Change in consumer expectations in future income
- Change in consumer expectations of future
- prices Additional factors related to market demand

1. **Price of the commodity**

The consumer will buy more of a commodity when its price declines and vice versa,because it increases his purchasing power. He can therefore buy more of it.Price and the Demand vary inversely.

2. **Income of the consumer**

The consumer will buy more of a commodity when his income increases and viceVersa. Both demand and income of the consumer move in the



same direction.It may be reverse for inferior goods here demand will increase with decrease in the income and vice-versa.

3. **Price of the related goods**

   When a change in the price of one commodity influences the demand of the other commodity and so the commodities are interrelated. These related commodities are of two types: substitutes and complements.

   When the price of one commodity and the quantity demanded of other commodity are move is same direction, it is called as substitutes

   When the price of one commodity and the quantity demanded of other commodity are move is opposite direction, it is called as complementary

4. **Taste and preferences**

   If the consumer taste and preferences are favour of a commodity results in greater demand, and if it against the commodity it results in smaller demand for the commodity.

5. Additional factors such as expectation in income and prices

   In case the consumer expects a higher income in future, he spends more at present and thereby the demand for the good increases and vice versa.

   Similarly, if the consumer expects future prices of the good to increase, he would rather like to buy the commodity now more than on later, this will increase the demand for the commodity.

DEMAND FUNCTION:

Demand function -- a behavioural relationship between quantity consumed and a person's maximum willingness to pay for incremental increases in quantity. It is usually an inverse relationship where at higher (lower) prices, less (more) quantity is consumed. Other factors which influence willingness-to-pay are income, tastes and preferences, and price of substitutes

Individual Demand function

Qdx = f(Px, Y, P1.....Pn-1, T, A ,Ey, Ep, u)

Where

Qdx= qty demanded for the product X

Px = price of the product

Y = level of household income

P1.... Pn-1 = price of all the other related products

T = tastes of the consumer

A = advertising

Ey = consumer 's expected future income

Ep= consumer 's expected future price

U= all those determinants that are not covered in the list determinants

Market Demand function

Qdx = f(Px, Y, P1.....Pn-1, T, A ,Ey, Ep, P, D, u)

Qdx, Px,Y,P1...Pn-1,T,A, Ey,Ep,U are the same as the individual demand function

P = population

D = distribution of consumers in various categories such as income, age, sex etc.

Law of Demand

Demand is essential for the creation, survival and profitability of a firm. "*Demand in economics is the desire to possess something and the willingness and the ability to pay a certain price in order to possess it*". **-J. Harvey**

"*Demand in economics means desire backed up by enough money to pay for the good demanded*"

1. Characteristics of Demand

Price: Demand is always related to price.

Time: Demand always means demand per unit of time, per day, per week, per month or per year.

Market: Demand is always related to the market, buyer and sellers.

Amount: Demand is always a specific quantity which a consumer is willing to purchase.

Law of Demand

The Law of Demand was first stated by Augustin Cournot in 1838. Later it was refined and elaborated by Alfred Marshall.

Definitions

The Law of Demand says as "the quantity demanded increases with a fall in price and diminishes with a rise in price".

-Marshall

"The Law of Demand states that people will buy more at lower price and buy less at higher prices, other things remaining the same".

-Samuelson

Assumptions of Law of Demand

- The income of the consumer remains constant.
- The taste, habit and preference of the consumer remain the same.
- The prices of other related goods should not change.
- There should be no substitutes for the commodity in study.
- The demand for the commodity must be continuous.
- There should not be any change in the quality of the commodity.

Given these assumptions, the law of demand operates. If there is change even in one of these assumptions, the law will not operate.

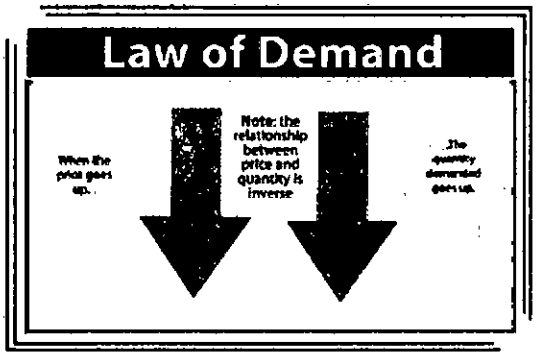
Demand Schedule

Table 2.4 Demand Schedule

Price	Quantity Demanded
5	1
4	2
3	3
2	4
1	5

Explanation

The law of demand explains the relationship between the price of a commodity and the quantity demanded of it.



This law states that quantity demanded of a commodity expands with a fall in price and contracts with a rise in price. In other words, a rise in price of a commodity is followed by a contraction demand and a fall in price is followed by extension in demand. Therefore, the law of demand states that there is an inverse relationship between the price and the quantity demanded of a commodity.

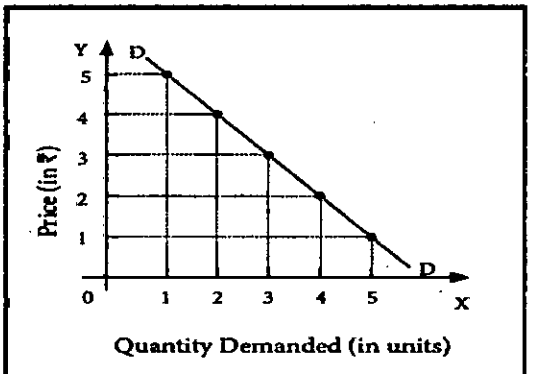


Diagram 2.4

In the diagram 2.4, X axis represents the quantity demanded and Y axis represents the price of the commodity.

is the demand curve, which has a negative slope i.e., slope downward from left

to right which indicates that when price falls, the demand expands and when price rises, the demand contracts.

Market Demand for a Commodity

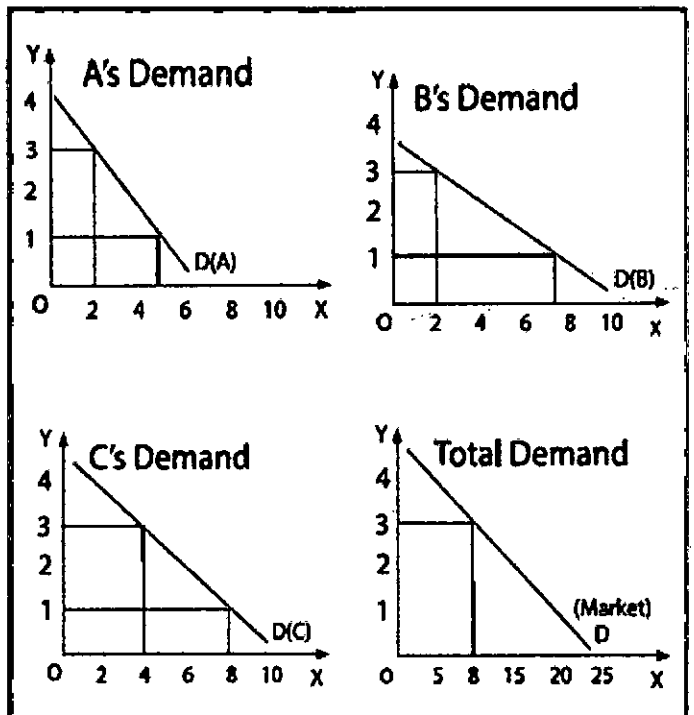


Diagram 2.5

The market demand curve for a commodity is derived by adding the quantum demanded of the commodity by all the individuals constituting the market. In the diagram given above, the final market demand curve represents the addition of the demand curve of the individuals A, B and C at the same price.

When Price is Rs.3, the Market demand is 2+2+4 = 8 When Price is Rs.1, the Market demand is 6+8+8 = 22

As in the case of individual demand schedule, the Market Demand Curve is at a price, at a place and at a time.

Determinants of Demand

- ***Changes in Tastes and Fashions***: The demand for some goods and services is very susceptible to changes in tastes and fashions
- ***Changes in Weather***: An unusually dry summer results in a increase in the demand for cool drinks.
- ***Taxation and Subsidy:*** If fresh taxes are levied or the existing rates of taxation on commodities are increased their prices go up. The subsidies will bring down the prices. Therefore, taxes reduce demand and subsidies raise demand.

- ***Changes in Expectations:*** Expectations also bring about a change in demand. Expectation of rise in price in future results in increase in demand.
- ***Changes in Savings:*** Savings and demand are inversely related.
- ***State of Trade Activity***: During the periods of boom and prosperity, the demand for all commodities tends to increase. On the contrary, during times of depression there is a general slackening of demand.
- ***Advertisement:*** In advanced capitalistic countries advertising is a powerful instrument increasing the demand in the market.
- ***Changes in Income:*** An increase in family income may increase the demand for durables like video recorders and refrigerators. Equal distribution of income enables poor to get more income. As a result consumption level increases.
- ***Change in Population:*** The demand for goods depends on the size of population. An increase in population tends to increase the demand for goods and a decrease in population tends to decrease the demand (if other things remain constant)

Exceptions to the law of demand

Normally, the demand curve slopes downwards from left to right. But there are some unusual demand curves which do not obey the law and the reverse occurs. A fall in price brings about a contraction of demand and a rise in price results in an extension of demand. Therefore the demand curve slopes upwards from left to right. It is known as exceptional demand curve.

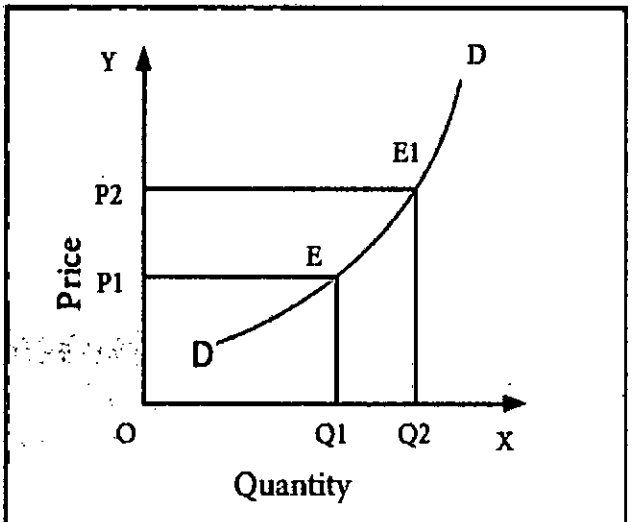


Diagram 2.6

In the diagram 2.6, DD is the demand curve which slopes upwards from left to right. It shows that when price is OP_1, OQ_1 is the demand and when the price rises to OP_2, demand also extends to OQ_2.

Reasons for Exceptional Demand Curve

- **Giffen Paradox:** The Giffen good or inferior good is an exception to the law of demand. When the price of an inferior good falls, the poor will buy less and vice versa.
- **Veblen or Demonstration effect:** Veblen has explained the exceptional demand curve through his doctrine of conspicuous consumption. Rich people buy certain goods because it gives social distinction or prestige. For example, diamonds.
- **Ignorance**: Sometimes, the quality of the commodity is judged by it's price. Consumers think that the product is superior if the price is high. As such they buy more at a higher price.
- **Speculative effect:** If the price of the commodity is increasing then the consumers will buy more of it because of the expectation that it will increase still further. Eg stock markets.
- **Fear of shortage:** During times of emergency or war, people may expect shortage of a commodity and so buy more.

Extension and Contraction of Demand

The changes in the quantity demanded for a commodity due to the change in its price alone are called "Extension and Contraction of Demand". In other words, buying more at a lower price and less at a higher price is known as "Extension and Contraction of Demand".

Movement along Demand Curve

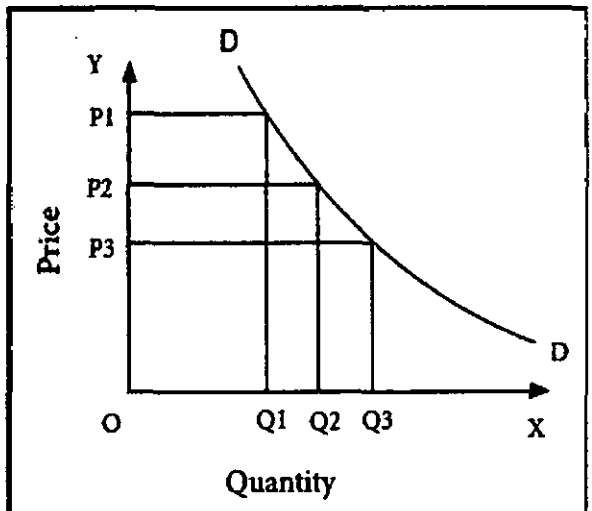


Diagram 2.7

In the diagram 2.7, at point A, the price OP_2 and quantity demanded is OQ_2. When price falls to OP_3 (movement along the demand curve A to C) the quantity demanded increases to OQ_3. If price rises to OP1 (movement from A to B) quantity demanded decreases to OQ_1.

9. Shift in the Demand Curve

A shift in the demand curve occurs with a change in the value of a variable other than its price in the general demand function. An increase or decrease in demand due to changes in conditions of demand is shown by way of shifts in the demand curve.

On the left-hand side of the diagram 2.8, the original demand curve is d^1d^1, the price is OP_1 and the quantity demanded is OQ_1. Due to change in the conditions of demand (change in income, taste or change in prices of substitutes and /or complements) the quantity demanded decreases from OQ_1 to OQ_2. This is shown in the demand curve to the left. The new demand curve is d^1d^1. This is called decrease in demand.

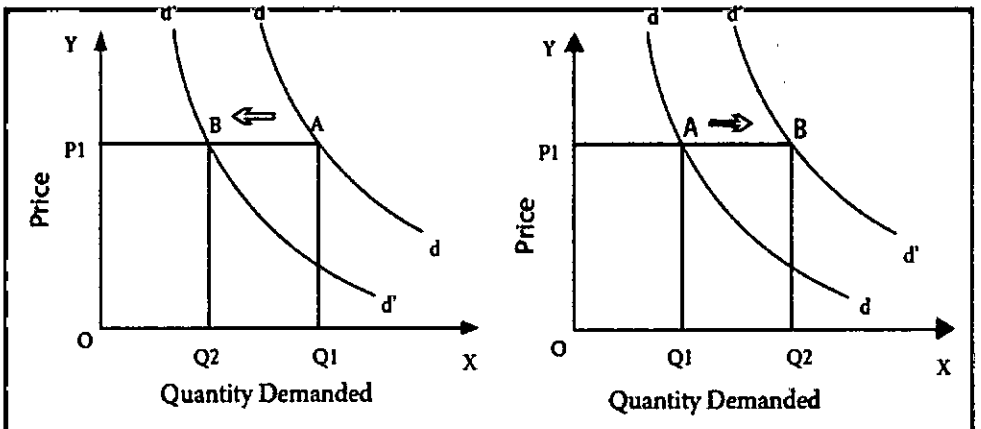


Diagram 2.8

On the right hand side of the diagram 2.8, the original price is OP_1 and the quantity demanded is OQ_1 . Due to changes in other conditions, the quantity purchased has increased to OQ_2 . Thus the demand curve shifts to the right d^1d^1. This is called increase in demand.

'Extension' and 'Contraction' of demand follow a change in price. Increases and decreases in demand take place when price remains the same and the other factors bring about demand changes.

Different types of Elasticity of Demand

After knowing what is demand and what is law of demand, we can now come to elasticity of demand. Law of demand will tell you the direction i.e. it tells you which way the demand goes when the price changes. But the elasticity of demand tells you how much the demand will change with the change in price to demand to the change in any factor.

Different types of Elasticity of Demand:

1. Price Elasticity of Demand
2. Income Elasticity of Demand
3. Cross Elasticity of Demand
4. Advertisement Elasticity of Demand

Price Elasticity of Demand:

We will discuss how sensitive the change in demand is to the change in price. The measurement of this sensitivity in terms of percentage is called price Elasticity of Demand. According to Marshall, Price Elasticity of Demand is the degree of responsiveness of demand to the change in price of that commodity.

Types of Price Elasticity of Demand

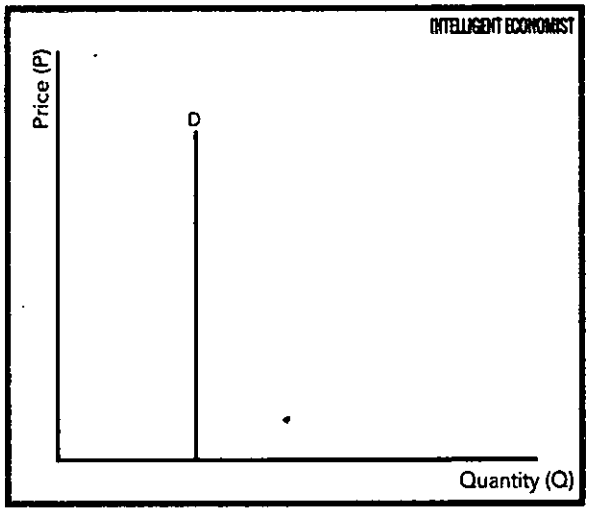
1. **Perfectly Inelastic Demand, (PED = 0)**

   With a perfectly inelastic demand, there is no change in the demand for a product with a change in its price. This means that the demand remains constant for any value of price. The demand curve is represented as a straight vertical line.

   It is practically impossible to find a product that has perfectly inelastic demand. The closest thing could be essentials like water or certain food products.

   This is the effect on total revenue with a change in price:

   - Price ↑ → Total Revenue ↑
   - Price ↓ → Total Revenue ↓



2. **Relatively Inelastic Demand, (PED = 0 < x < 1)**

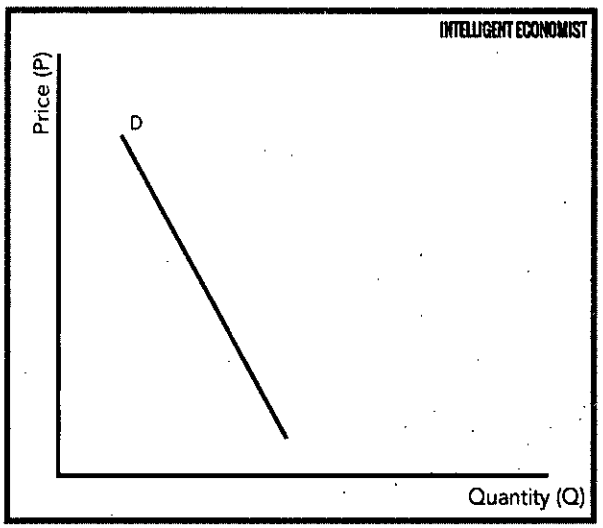
   Relatively inelastic demand occurs when the percentage change in demand is less than the percentage change in the price of a product.

   For example, if the price of a product increases by 15% and the demand for the product decreases only by 7%, then the demand would be called relatively inelastic.

   The demand curve of relatively inelastic demand is rapidly sloping.

   This is the effect on total revenue with a change in price:

   - Price ↑ → Total Revenue ↑
   - Price ↓ → Total Revenue ↓

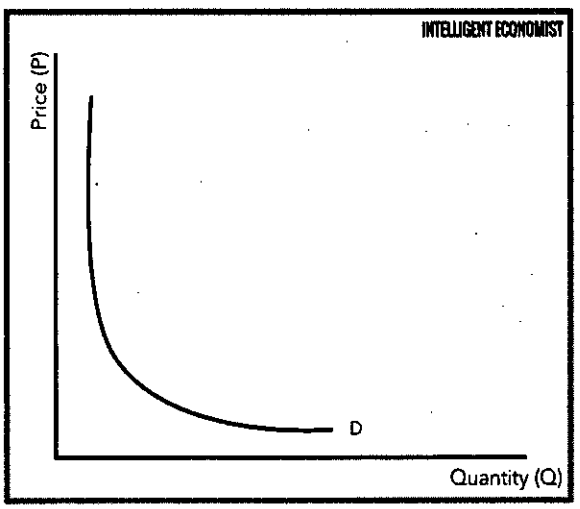


3. Unit Elastic Demand, (PED = 1)

Demand is said to be unit elastic when the proportionate change in demand produces the same change in the price. The quantity demanded changes by the same percentage as the change in price.

This is the effect on total revenue with a change in price:

- Price ↑ → No Change in Total Revenue
- Price ↓ → No Change in Total Revenue



4. Relatively Elastic Demand, (PED = 1 < x < ∞)

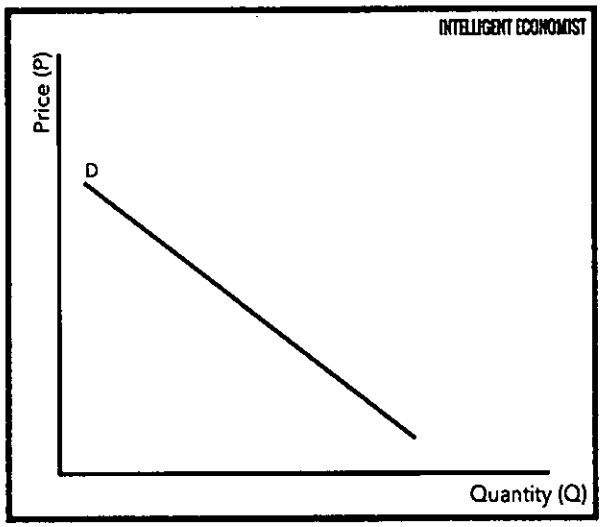
Relatively elastic demand is defined as the proportionate change produced in demand is greater than the proportionate change in the price of a product. The quantity demanded changes by a larger percentage than the change in price.

For example, if the price of a product increases by 10% and then the demand for the product decreases by 15%, then the demand would be relatively elastic.

The demand curve of relatively elastic demand is gradually sloping. It is less steep than relatively inelastic demand.

This is the effect on total revenue with a change in price:

- Price ↑ → Total Revenue ↓
- Price ↓ → Total Revenue ↑



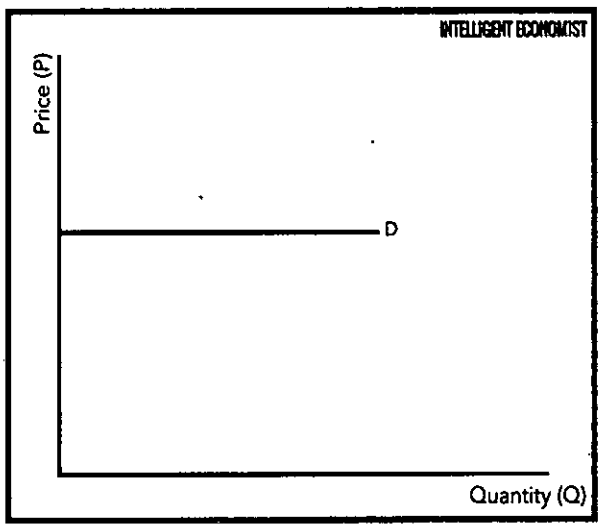
5. **Perfectly Elastic Demand, (PED = ∞)**

In Perfectly Elastic Demand, a small rise in price will result in a fall in demand to zero, while a small fall in price will result in the demand to become infinite. Consumers will buy all available at some price, but none at any other price. This is a theoretical concept because it requires perfect competition where the slightest price increase results in zero demand.

In a perfectly elastic demand, the demand curve is represented as a horizontal straight line.

This is the effect on total revenue with a change in price:

- Price ↑ → 0 Total Revenue
- Price ↓ → 0 Total Revenue



Factors influencing Price Elasticity of Demand:

- Availability of Substitutes

- Nature of Commodity
- Number of Uses
- Durability of commodity
- Consumer's income

Practical significance of Price Elasticity of Demand:

(a) Importance to the business

(b) Important to Government

2.4 Income elasticity of demand:

In economics, the income elasticity of demand measures the responsiveness of the quantity demanded of a good to the change in the income of the people demanding the good. It is calculated as the ratio of the percent change in quantity demanded to the percent change in income. For example, if, in response to a 10% increase in income, the quantity of a good demanded increased by 20%, the income elasticity of demand would be 20%/10% = 2.

2.5 Cross elasticity of demand:

In economics, the cross elasticity of demand and cross price elasticity of demand measures the responsiveness of the quantity demand of a good to a change in the price of another good.

It is measured as the percentage change in quantity demanded for the first good that occurs in response to a percentage change in price of the second good. For example, if, in response to a 10% increase in the price of fuel, the quantity of new cars that are fuel inefficient demanded decreased by 20%, the cross elasticity of demand would be -20%/10% = -2.

2.6 Advertisement Elasticity of Demand:

The degree of responsiveness of quantity demanded to the change in the advertisement expense ,of expenditure. Ea= Change in quantity demanded x original advertisement expenses Change in advertisement expenses original quantity demanded

Important factors influencing Advertisement:

- Promotional elasticity of demand will be affected, depending on whether it is a new product or the product with a growing market.
- The amount a competitor reacts to the firm's advertisement.
- The time interval between the advertisement expensed or expenditure and the unresponsiveness of the sales
- The influence of non-advertisement determinants of demands such as trends, price, income etc

Uses of Advertisement Elasticity of Demands:

- It helps the manager to decide the advertisement expense. If the advertisement is more than one, which means incremental revenue exceeds incremental expenses, then increased expenditure on advertisement can be justified.
- The fire should observe the saturation point, where advertisement pays nothing or does not help in increasing sales revenue.

MEASUREMENT OF PRICE ELASTICITY OF DEMAND

There are three methods of measuring price elasticity of demand. They are:

- Total Outlay Method
- Point Method
- Arc Method

Total Outlay Method

The measure of price elasticity of demand measuring the total expenditure made on the consumption of goods & services before & after the change in the price is called toral outlay method. When the price of goods changes, total expenditure made on the goods & services may increase or decreases or remains same.

According to Alfred Marshall, "Elasticity of demand can be measured by considering the change in price and the subsequent change in the total quantity of goods purchased and the total amount of money spent on it".

Price elasticity of demand can be measured on the following three bases: -

1. **Elasticity of Demand Greater than Unitary (Ep>1)**

   If the total expenditure increases due to a small fall in price & total expenditure decrease due to rise in price then elasticity of demand will be greater than unity. Thus, there is negative relationship between price of the commodity & total expenditure. Hence, the total expenditure and price of a commodity are inversely related to each other.

2. **Elasticity of Demand Equal to Unitary (Ep=1)**

   If the total expenditure made by the **consumer** on a commodity doesn't change with any rise or fall in price of the commodity then elasticity of demand will be equal to unity

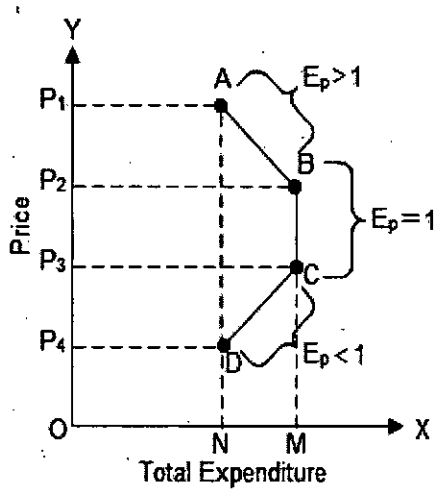
3. **Elasticity of Demand Less then Unitary (Ep<1)**

   If the total expenditure of a commodity falls due to the fall in price, then the price elasticity of demand is said to be less than one in this state. Hence, both total expenditure and price move in the same direction.

The above cases are prescribed with the table below:

Price (in Rs.)	Quantity demanded (in kg.)	Total Expenditure (in Rs.)	Elasticity
10	1	10	Ep>1
8	2	16	
6	4	24	Ep=1
4	6	24	
2	8	16	Ep<1
1	10	10	

In the given table, quantity demanded of a commodity is increasing serially 1, 2, 4, 6, 8 and 10 as the price of a commodity is decreasing 10. 8. 6. 4. 2 and 1 respectively. In the column of total expenditure, it is rising at first and remains constant at certain then later it is decreasing. It shows all three cases based on the price elasticity of demand. These conditions are also mentioned with the help of a diagram.



In the above graph, total expenditure is measured along X-axis and price is measured along Y-axis respectively. The points A and B show the inverse relation between price and total expenditure, where the price increases and total expenditure falls and vice versa. Next point B and C seems to be parallel to price, where there is no change in total expenditure even there is a change in price. Point C and D show the positive relation between price and total expenditure. When the price increases the total expenditure also increases and when the price decreases the total expenditure also decreases.

Point Method

In the point methrod. the price elasticity can be measured at the different point of linear & non-linear demand curve. It is also known as geometrical method. Elasticity at any point is the ratio of lower segment of straight line to the upper segment.

A linear demand curve AB is given & it is required to measure elasticity at point C on linear demand curve; i.e.

The straight-line demand curve AB is given & it is required to measure elasticity at point C on the demand curve. In given figure, corresponding to point C on the demand curve AB, price is OP_1 & quantity demand is OQ_2, quantity demanded rises from OQ_1 to OQ_2.

We can get following conclusions from the above figure:

1. Price elasticity of demand at point C is always equal to one (Ep = 1)
2. Price elasticity of demand lying between C & A is less than one (Ep < 1)
3. Price elasticity of demand at point A is equal to zero (Ep = 0)
4. Price elasticity of demand at points lying between C & B is greater than one (Ep > 1)
5. Price elasticity of demand at point A is equals to infinitive (Ep = ∞)

Summary of the Unit

Supply and demand illustrate the working of a market and the interaction between suppliers and consumers. Supply and demand curves determine the price and quantity of goods and services. Any changes in supply and demand will have an effect on the equilibrium price and quantity of the good sold. It will also affect the incentives for producers and consumers

- Supply is the amount of the good that is being sold onto the market by producers. At higher prices, it is more profitable for firms to increase supply, so supply curve slopes upward.
- Demand is the quantity of the good that consumers wish to buy at different prices. At higher prices, less will be demanded. As prices fall, more will be demanded.

Keywords: demand, Elasticity, uncertainty

EXERCISE

Multiple Choice Questions

1. Normally a demand curve will have the shape:
   (A) Horizontal (B) Vertical
   (C) Downward sloping (D) Upward sloping

Answer: Downward sloping

2. Which one is the assumption of law of demand?
   (A) Price of the commodity should not change
   (B) Quantity demanded should not change
   (C) Prices of substitutes should not change
   (D) Demand curve must be linear

Answer: Prices of substitutes should not change

3. The elasticity of demand of durable goods is:
   (A) Less than unity (B) Greater than unity
   (C) Equal to unity (D) Zero

Answer: Greater than unity

4. Which among the following statement is INCORRECT?
   (A) On a linear demand curve, all the five forms of elasticity can be depicted'
   (B) If two demand curves are linear and intersecting each other then coefficient of elasticity would be same on different demand curves at the point of intersection.
   (C) If two demand curves are linear, and parallel to each other then at a particular price the coefficient of elasticity would be different on different demand curves
   (D) The price elasticity of demand is expressed in terms of relative not absolute, changes in Price and quantity demanded'

Answer: If two demand curves are linear and intersecting each other then coefficient of elasticity would be same on different demand curves at the point of intersection.

5. The horizontal demand curve parallel to x-axis implies that the elasticity of demand is:
   (A) Zero (B) Infinite
   (C) Equal to one (D) Greater than zero but less than infinity

Answer: Infinite

6. In the short run, when the output of a firm increases, its average fixed cost:
   (A) Remains constant (B) Decreases
   (C) Increases (D) First decreases and then rises

Answer: Decreases

7. What is meant by Autarky in international trade?
   (A) Monopoly in international trade
   (B) Imposition of restrictions in international trade
   (C) Removal of all restrictions from international trade
   (D) The idea of self-sufficiency and no international trade by a country

Answer: The idea of self-sufficiency and no international trade by a country

8. Cost push inflation occurs because of:
   (A) Wage push (B) Profit push
   (C) Both A and B (D) Ineffective policies of the government

Answer: Both A and B

9. When demand is perfectly inelastic, an increase in price will result in:
   (A) A decrease in total revenue (B) An increase in total revenue
   (C) No change in total revenue (D) A decrease in quantity demanded

Answer: An increase in total revenue

10. Other things equal, if a good has more substitutes, its price elasticity of demand is:
   (A) Larger (B) Smaller
   (C) Zero (D) Unity

Answer: Larger

11. If elasticity of demand is very low it shows that the commodity is:
    (A) A necessity (B) A luxury
    (C) Has little importance in total budget (D) (a) and (c) above

Answer: A necessity

12. If demand is unitary elastic, a 25% increases in price will result in:
    (A) 25% change in total revenue
    (B) No change in quantity demanded
    (C) 1% decrease in quantity demanded
    (D) 25% decrease in quantity demanded

Answer: 25% decrease in quantity demanded

13. Demand for a commodity refers to:
    (A) Need for the commodity
    (B) Desire for the commodity
    (C) Amount of the commodity demanded at a particular price and at a particular time
    (D) Quantity demanded of that commodity

Answer: Amount of the commodity demanded at a particular price and at a particular time

14. If the demand for a good is inelastic, an increase in its price will cause the total expenditure of the consumers of the good to:
    (A) Increase (B) Decrease
    (C) Remain the same (D) Become zero

Answer: Increase

15. An individual demand curve slopes downward to the right because of the:
    (A) Working of the law of diminishing marginal utility
    (B) substitution effect of decrease in price
    (C) income effect of fall in Price
    (D) All of the above

Answer: All of the above

Review Questions:

1. Define demand.
2. State the law of demand.
3. Prepare a demand schedule for an apple i-pad in the Indian market.
4. Distinguish between shift in demand and a movement along a demand curve.
5. List out the factors which determine market demand for a commodity of your choice.
6. Categorize the types of demand with proper examples.
7. What is meant by industry demand and company demand?
8. Explain perfectly elastic demand and perfectly in elastic demand with a suitable example. 9. Explain the concept of cross elasticity of demand with an example.
10. Explain the concept of income elasticity of demand and discuss the importance of income elasticity of demand for a business firm.
11. What are the different types of price elasticity of demand?
12. Explain the slope of income demand curve for a superior and inferior good.
13. Discuss the cross elasticity of demand with an example.
14. List out the significance of elasticity of demand in managerial decision making.

16 MODULE-VII PRODUCER'S BEHAVIOUR

Module Content

Meaning of production function, Production function in the Short Run, Law of Variable Proportion. Meaning of Cost, Fixed and Variable cost, Explicit and Implicit cost, Monetary cost, Real cost, Private and Social costs, Short-run costs. Meaning, determinants of supply, law of supply, individual and market supply, supply schedule and supply curve, movement along the supply curve and shift in supply curve. Meaning, measurement of price elasticity of supply by

(a) Percentage method

(b) Geometric method Factors affecting price elasticity of supply

Objective of the module

The main objective of this module is to make student understand about the basics of production function and its short term and long-term laws. Cost and its types and basics of supply including its methods has also been discussed in this module.

Introduction

Production is a process of using various material and immaterial inputs in order to make output for consumption. Production process creates economic well-being. The satisfaction of needs originates from the output. Production is the result of cooperation of four factors of production (land, labour, capital and organisation). In Economics, production refers to the creation or addition of value. It simply transforms the inputs into output.

Production may be at varying levels. The scale of production influences the cost of production. All manufacturers are aware that when production of a commodity takes place on a larger scale, the average cost of its production is low. This is the reason why the entrepreneurs are interested in enlarging the scale of production of their commodities. They stand to benefit from the resulting economies of scale. There is also the possibility of making their products available in the market at lower prices.

Features of the Factors of Production

Factors of production means resources used in the process of production of

commodities. There are of four types viz., land, labour, capital and organization or enterprise. Here, land represents natural resources (such as soil, mineral deposits, seas, rivers, natural forests, fisheries etc). Labour represents human resources. Together, these two factors are called the *'primary factors of production'*.

These two factors produce some units of goods for the purpose of consumption. And as consumption of these goods takes place, there is the possibility of some of these goods getting left over. Thus, saving is production minus consumption. This saved amount is called as capital, which serves as investment in the production process. Also, organisation or enterprise is a special form of labour. The third and the fourth factors are called *'secondary factors of production'*.

These four factors depend on each other. They have a coordinated impact on production of goods and services.

1. **Land**

   In ordinary sense 'land' refers to the soil or the surface of the earth or ground. But, in Economics, land means all gifts of Nature owned and controlled by human beings which yield an income. Land is the original source of all material wealth. The economic prosperity of a country depends on the richness of her natural resources. The quality and quantity of agricultural wealth are determined by the nature of soil, climate and rainfall.

   The agricultural products are the basis of trade and industry. Industry survives on the availability of coal-mines or waterfall for electricity production. Hence, all aspects of economic life like agriculture, trade and industry are generally influenced by natural resources which are called as "Land" in economics.

   Characteristics of Land

   - Land is a primary factor of production.
   - Land is a *passive* factor of production.
   - Land is the free gift of Nature.
   - Land has no cost of production.
   - Land is fixed in supply. It is inelastic in supply.

- Land is permanent.
- Land is immovable.
- Land is heterogeneous as it differs in fertility.
- Land has alternative uses.
- Land is subject to Law of Diminishing Returns.

2. Labour

Labour is the active factor of production. In common parlance, labour means manual labour or unskilled work. But in Economics the term 'labour' has a wider meaning.

It refers to any work undertaken for securing an income or reward. Such work may be manual or intellectual. For example, the work done by an agricultural worker or a cook or rickshaw puller or a mason is manual. The work of a doctor or teacher or an engineer is intellectual. In short, labour in economics refers to any type of work performed by a labourer for earning an income

According to Marshall, labour represents services provided by the factor labour, which helps in yielding an income to the owner of the labour-power.

Characteristics of Labour

- Labour is the animate factor of production.
- Labour is an *active* factor of production.
- Labour implies several types: it may be manual (farmer) or intellectual (teacher, lawyer etc).
- Labour is inseparable from the Labourer.
- Labour is less mobile between places and occupations.
- Labour is a means as well as an end. It is both the cause of production and consumer of the product.
- Labour units are heterogeneous.
- Labour differs in ability.
- Labour has weak bargaining power.

3. Capital

Marshall says *"capital consists of all kinds of wealth other than free giftsofnature, which yield income"*. Bohm-Bawerk defines it as 'a produced means of production'. As said earlier, capital is a secondary means of production. It refers to that part of production which represents 'saving used as investment' in the further production process. For example, the entire mango is not eaten; a part of that (its nut) is used to produce more mangoes.

Bohm-Bawerk

It is a stock concept. All capital is wealth but all wealth is not capital. For example, tractor is a capital asset which can be used in cultivation (production) of farm, but due to some reason the same is kept unused (idle) for some period. It cannot be termed as capital for that period. It is only wealth

Characteristics of Capital

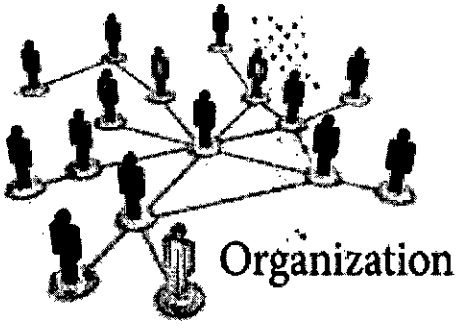
- Capital is a man-made factor.
- Capital is mobile between places and persons.
- Capital is a passive factor of production.
- Capital's supply is elastic.
- Capital's demand is a derived demand.
- Capital is durable.

Capital may be tangible or intangible. For example, buildings, plants and machinery, factories, inventories of inputs, warehouses, roads, highways etc are tangible capital. The examples for intangible capital are investment on advertisement, expenses on training programme etc.

Financial Capital means the assets needed by a firm to provide goods and services measured in term of money value. It is normally raised through debt and equity issues. The prime aim of it is to a mass wealth in terms of profit.

4. ***Organization***

The man behind organizing the business is called as 'Organizer' or 'Entrepreneur'. An organiser is the most important factor of production. He represents a special type of labour. Joseph Schumpeter says that an entrepreneur innovates, coordinates other factors of production, plans and runs a business. He not only runs the business, but bears the risk of business. His reward is residual. This residual is either positive (profit) or negative (loss) or zero.




Joseph Schumpeter

Production Function

Production function refers to the relationship among units of the factors of production (inputs) and the resultant quantity of a good produced (output).

According to George J. Stigler, *"Production function is the relationship between inputs of productive services per unit of time and outputs of product per unit of time."*


George J.Stigler

Production function may be expressed as: Q = f (N, L, K, T) Where, Q = Quantity of output, N = Land; L = Labour; K = Capital; and T = Technology. Depending on the efficiency of the producer, this production function varies.

The function implies that the level of output (Q) depends on the quantities of different inputs (N, L, K, T) available to the firm.

Short-run Production and Long run Production

In Micro economics, the distinction between long run and short run is made on the basis of fixed inputs that inhibit the production.

The short-run is the period where some inputs are variable, while others are fixed. Another feature is that firms do not enter into the industry and existing firms may not leave the industry.

Long run, on the other hand, is the period featured by the entry of new firms to the industry and the exit of existing firms from the industry.

In general, Production function may be classified into two

- Short-run Production Function as illustrated by the Law of Variable Proportions.
- Long-run Production Function as explained by the Laws of Returns to Scale.

Total Product (TP)

It refers to the total amount of commodity produced by the combination of all inputs in a given period of time.

Summation of marginal products, i.e.

$TP = \sum MP$

where, TP= Total Product, MP= Marginal Product

Average Product (AP)

It is the result of the total product divided by the total units of the input employed. In other words, it refers to the output per unit of the input.

Mathematically, $AP = TP/N$

Where,

AP= Average Product

TP= Total Product

N= Total units of inputs employed

Marginal Product (MP)

It is the addition or the increment made to the total product when one more unit of the variable input is employed. In other words, it is the ratio of the change in the total product to the change in the units of the input. It is expressed as

$MP = \Delta TP/\Delta N$

where,

MP = Marginal Product

ΔTP = Change in total product

ΔN = Change in units of input It is also expressed as

MP = TP (n) – TP (n-1)

Where,

MP = Marginal Product

TP(n) = Total product of employing nth unit of a factor

TP(n-1) = Total product of employing the previous unit of a factor, that is, (n-1) th unit of a factor.

Relationship among Total, Average and Marginal Products

Stages	Total Product	Marginal Product	Average Product
Stage I	Initially it increases at an increasing rate and then increases at a deceasing rate	At the beginning it increases, then reaches a maximum and starts to decrease	At the first instant it increases, then attains maximum
Stage II	It continues to increase at a diminishing rate and reaches maximum.	It continues to diminish and becomes equal to zero	It is equal to MP and then begins to diminish
Stage III	It diminishes	It becomes negative	It continues to diminish but always greater than zero (positive)

Law of Variable Proportions

Meaning:

Law of variable proportions occupies an important place in economic theory. This law examines the production function with one factor variable, keeping the quantities of other factors fixed. In other words, it refers to the input-output relation when output is increased by varying the quantity of one input.

When the quantity of one factor is varied, keeping the quantity of other factors constant, the proportion between the variable factor and the fixed factor is altered; the ratio of employment of the variable factor to that of the fixed factor goes on increasing as the quantity of the variable factor is increased.

Since under this law we study the effects on output of variation in factor proportions, this is also known as the law of variable proportions. Thus, law of variable proportions is the new name for the famous" Law of Diminishing Returns" of classical economics. This law has played a vital role in the history of economic

thought and occupies an equally important place in modern economic theory. This law has been supported by the empirical evidence about the real world.

The law of variable proportions or diminishing returns has been stated by various economists in the following manner:

As equal increments of one input are added; the inputs of other productive services being held constant, beyond a certain point the resulting increments of product will decrease, i.e., the marginal products will diminish," (G. Stigler)

"As the proportion of one factor in a combination of factors is increased, after a point, first the marginal and then the average product of that factor will diminish." (F. Benham)

"An increase in some inputs relative to other fixed inputs will, in a given state of technology, cause output to increase; but after a point the extra output resulting from the same addition of extra inputs will become less." (Paul A. Samuelson)

Marshall discussed the law of diminishing returns in relation to agriculture. He defines the law as follows: "An increase in the capital and labour applied in the cultivation of land causes in general a less than proportionate increase in the amount of product raised unless it happens to coincide with an improvement in the arts of agriculture."

It is obvious from the above definitions of the law of variable proportions (or the law of diminishing returns) that it refers to the behaviour of output as the quantity of one factor is increased, keeping the quantity of other factors fixed and further it states that the marginal product and average product will eventually decline.

Assumptions of the Law:

The law of variable proportions or diminishing returns, as stated above, holds good under the following conditions:

1. First, the state of technology is assumed to be given and unchanged. If there is improvement in the technology, then marginal and average products may rise instead of diminishing.
2. Secondly, there must be some inputs whose quantity is kept fixed. This is one of the ways by which we can alter the factor proportions and know its effect on output. This law does not apply in case all factors are proportionately varied. Behaviour of output as a result of the variation in all inputs is discussed under "returns to scale".
3. Thirdly the law is based upon the possibility of varying the proportions in which the various factors can be combined to produce a product. The law does not apply to those cases where the factors must be used in fixed proportions to yield a product.

When the various factors are required to be used in rigidly fixed proportions, then the increase in one factor would not lead to any increase in output, that is,

the marginal product of the factor will then be zero and not diminishing. It may, however, be pointed out that products requiring fixed proportions of factors are quiet uncommon. Thus, the law of variable proportion applies to most of the cases of production in the real world.

The law of variable proportions is illustrated in Table 16.1.and Fig. 16.3. We shall first explain it by considering Table 16.1. Assume that there is a given fixed amount of land, with which more units of the variable factor labour, is used to produce agricultural output.

Table 16.1: Returns to Labour

Units of Labour	*Total Product (Quintals)*	*Marginal Product (Quintals)*	*Average Product (Quintals)*
L	Q	$\frac{\Delta Q}{\Delta L}$	$\frac{Q}{L}$
1	80	80	80
2	170	90	85
3	270	100	90
4	368	98	92
5	430	62	86
6	480	50	80
7	504	24	72
8	504	0	63
9	495	–9	55
10	480	–15	48

With a given fixed quantity of land, as a farmer raises employment of labour from one unit to 7 units, the total product increases from 80 quintals to 504 quintals of wheat. Beyond the employment of 8 units of labour, total product diminishes. It is worth noting that up to the use of 3 units of labour, total product increases at an increasing rate.

This fact is clearly revealed from column 3 which shows successive marginal products of labour as extra units of labour are used. Marginal product of labour, it may be recalled, is the increment in total output due to the use of an extra unit of labour.

It will be seen from Col. 3 of Table 16.1, that the marginal product of labour initially rises and beyond the use of three units of labour, it starts diminishing. Thus when 3 units of labour are employed, marginal product of labour is 100 and with the use of 4th and 5th units of labour marginal product of labour falls to 98 and 62 respectively.

Beyond the use of eight units of labour, total product diminishes and therefore marginal product of labour becomes negative. As regards average product of labour, it rises upto the use of fourth unit of labour and beyond that it is falling throughout.

Three Stages of the Law of Variable Proportions:

The behaviour of output when the varying quantity of one factor is combined with a fixed quantity of the other can be divided into three distinct stages. In order to understand these three stages, it is better to graphically illustrate the production function with one factor variable.

This has been done in Fig. 16.3. In this figure, on the X-axis the quantity of the variable factor is measured and, on the F,-axis the total product, average product and marginal product are measured. How the total product, average product and marginal product a variable factor change as a result of the increase in its quantity, that is, by increasing the quantity of one factor to a fixed quantity of the others will be seen from Fig. 16.3.

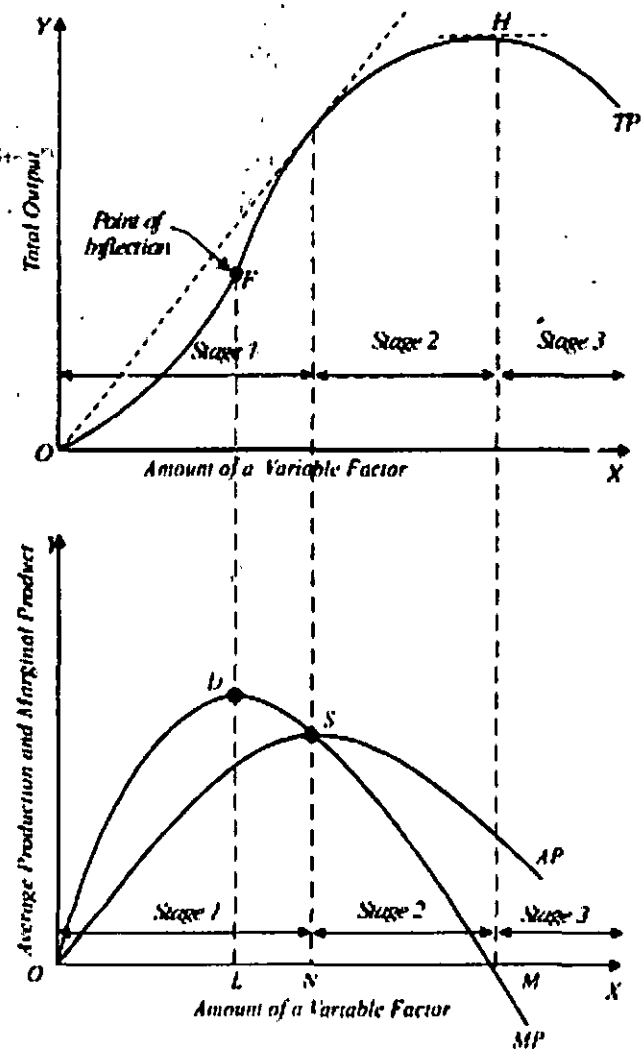


Fig. 16.3. *Three Stages of the Law of Variable Proportions*

In the top Danel of this figure, the total product curve TP of variable factor goes on increasing to a point and alter that it starts declining. In the bottom pane- average and marginal product curves of labour also rise and then decline; marginal product curve starts declining earlier than the average product curve.

The behaviour of these total, average and marginal products of the variable factor as a result of the increase in its amount is generally divided into three stages which are explained below:

Stage 1:

In this stage, total product curve TP increases at an increasing rate up to a point. In Fig. 16.3. from the origin to the point F, slope of the total product curve TP is increasing, that is, up to the point F, the total product increases at an increasing rate (the total product curve TP is concave upward upto the point F), which means that the marginal product MP of the variable factor is rising.

From the point F onwards during the stage 1, the total product curve goes on rising but its slope is declining which means that from point F onwards the total product increases at a diminishing rate (total product curve TP is concave downward), i.e., marginal product falls but is positive.

The point F where the total product stops increasing at an increasing rate and starts increasing at the diminishing rate is called the point of inflection. Vertically corresponding to this point of inflection marginal product is maximum, after which it starts diminishing.

Thus, marginal product of the variable factor starts diminishing beyond OL amount of the variable factor. That is, law of diminishing returns starts operating in stage 1 from point D on the MP curve or from OL amount of the variable factor used.

This first stage ends where the average product curve AP reaches its highest point, that is, point S on AP curve or CW amount of the variable factor used. During stage 1, when marginal product of the variable factor is falling it still exceeds its average product and so continues to cause the average product curve to rise.

Thus, during stage 1, whereas marginal product curve of a variable factor rises in a part and then falls, the average product curve rises throughout. In the first stage, the quantity of the fixed factor is too much relative to the quantity of the variable factor so that if some of the fixed factor is withdrawn, the total product will increase. Thus, in the first stage marginal product of the fixed factor is negative.

Stage 2:

In stage 2, the total product continues to increase at a diminishing rate until it reaches its maximum point H where the second stage ends. In this stage both the marginal product and the average product of the variable factor are diminishing but remain positive.

At the end of the second stage, that is, at point M marginal product of the variable factor is zero (corresponding to the highest point H of the total product curve TP). Stage 2 is very crucial and important because as will be explained below the firm will seek to produce in its range.

Stage 3: Stage of Negative Returns:

In stage 3 with the increase in the variable factor the total product declines and therefore the total product curve TP slopes downward. As a result, marginal product of the variable factor is negative and the marginal product curve MP goes below the X-axis. In this stage the variable factor is too much relative to the fixed factor. This stage is called the stage of negative returns, since the marginal product of the variable factor is negative during this stage.

It may be noted that stage 1 and stage 3 are completely symmetrical. In stage 1 the fixed factor is too much relative to the variable factor. Therefore, in stage 1, marginal product of the fixed factor is negative. On the other hand, in stage 3 the variable factor is too much relative to the fixed factor. Therefore, in stage 3, the marginal product of the variable factor is negative.

The Stage of Operation:

Now, an important question is in which stage a rational producer will seek to produce. A rational producer will never choose to produce in stage 3 where marginal product of the variable factor is negative. Marginal product of the variable factor being negative in stage 3, a producer can always increase his output by reducing the amount of the variable factor.

It is thus clear that a rational producer will never be producing in stage 3. Even if the variable factor is free, the rational producer will stop at the end of the second stage where the marginal product of the variable factor is zero.

At the end point M of the second stage where the marginal product of the variable factor is zero, the producer will be maximising the total product and will thus be making maximum use of the variable factor. A rational producer will also not choose to produce in stage 1 where the marginal product of the fixed factor is negative.

A producer producing in stage 1 means that he will not be making the best use of the fixed factor and further that he will not be utilising fully the opportunities of increasing production by increasing quantity of the variable factor whose average product continues to rise throughout the stage 1. Thus, a rational entrepreneur will not stop in stage 1 but will expand further.

Even if the fixed factor is free (i.e., costs nothing), the rational entrepreneur will stop only at the end of stage 1 (i.e., at point N) where the average product of the variable factor is maximum. At the end point N of stage 1, the producer they will be making maximum use of the fixed factor.

It is thus clear from above that the rational producer will never be found producing in stage 1 and stage 3. Stage 1 and 3 may, therefore, be called stages of economic absurdity or economic non-sense. The stages 1 and 3 represent non-economic regions in production function.

A rational producer will always seek to produce in stage 2 where both the marginal product and average product of the variable factor are diminishing. At which particular point in this stage, the producer will decide to produce depends upon the prices of factors. The stage 2 represents the range of rational production decisions.

We have seen above how output varies as the factor proportions are altered at any given moment. We have also noticed that this input-output relation can be divided into three stages. Now, the question arises as to what causes increasing marginal returns to the variable factor in the beginning, diminishing marginal returns later and negative marginal returns to the variable factor ultimately.

Causes of Initial Increasing marginal Returns to a Factor:

In the beginning, the quantity of the fixed factor is abundant relative to the quantity of the variable factor. Therefore, when more and more units of a variable factor are added to the constant quantity of the fixed factor, the fixed factor is more intensively and effectively utilised.

This causes the production to increase at a rapid rate. When, in the beginning the variable factor is relatively smaller in quantity, some amount of the fixed factor may remain unutilised and therefore when the varisble factor is increased fuller utilisation of the fixed factor becomes possible with the resul[illegible] increasing returns are obtained.

The question arises as to why the fixed factor is not initially taken [illegible] appropriate quantity which suits the available quantity of the variable factor[illegible]wer to this question is provided by the fact that generally those factor[illegible] as fixed which are indivisible. Indivisibility of a factor means th[illegible]e t[illegible]ological requirements a minimum amount of that factor must be e[illegible]oye[illegible]er the level of output.

Thus, as more units of variable factor are employed [illegible]th a[illegible]le fixed factor, output greatly increases in the beginning[illegible]ulle[illegible] effective utilisation of the latter. Thus, we see that indi[illegible]bility of some factors which causes increasing returns to the va[illegible] beginning.

The second reason why we get increasing returns t[illegible]ctor in the initial stage is that as more units of the variable factor[illegible]efficiency of the variable factor itself increases. This is becauseufficient quantity of the variable factor, it becomes possible tdivision or division of labour which results in higher productivition or of the variable factor, the greater the scope especiallantity will be the level of its productivity or effic[illegible]ater

The Laws of Returns to Scale: Production Function with two Variable Inputs!

The laws of returns to scale can also be explained in terms of the isoquant approach. The laws of returns to scale refer to the effects of a change in the scale of factors (inputs) upon output in the long run when the combinations of factors are changed in the same proportion.

If by increasing two factors, say labour and capital, in the same proportion, output increases in exactly the same proportion, there are constant returns to scale. If in order to secure equal increases in output, both factors are increased in larger proportionate units, there are decreasing returns to scale. If in order to get equal increases in output, both factors are increased in smaller proportionate units, there are increasing returns to scale.

The returns to scale can be shown diagrammatically on an expansion path "by the distance between successive 'multiple-level-of-output" isoquants, that is, isoquants that show levels of output which are multiples of some base level of output, e.g., 100, 200, 300, etc."

Increasing Returns to Scale:

Figure 8 shows the case of increasing returns to scale where to get equal increases in output, lesser proportionate increases in both factors, labour and capital, are required.

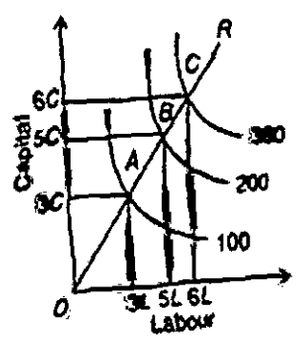


Fig. 8

e figure:

It follow require 3C ÷ 3L

100 u require 5C ÷ 5L

200 require 6C ÷ 6L

xpansion path OR, OA > AB > BC. In this case, the production eneous of degree greater than one. The increasing returns to scale he existence of indivisibilities in machines, management, labour, e items of equipment or some activities have a minimum size and d into smaller units. When a business unit expands, the returns to ecause the indivisible factors are employed to their full capacity.

Increasing returns to scale also result from specialisation and division of labour. When the scale of the firm expands there is wide scope for specialisation and division of labour. Work can be divided into small tasks and workers can be concentrated to narrower range of processes. For this, specialized equipment can be installed.

Thus with specialization efficiency increases and increasing returns to scale follow:

Further, as the firm expands, it enjoys internal economies of production. It may be able to install better machines, sell its products more easily, borrow money cheaply, procure the services of more efficient manager and workers, etc. All these economies help in increasing the returns to scale more than proportionately.

Not only this, a firm also enjoys increasing returns to scale due to external economies. When the industry itself expands to meet the increased long-run demand for its product, external economies appear which are shared by all the firms in the industry. When a large number of firms are concentrated at one place, skilled labour, credit and transport facilities are easily available.

Subsidiary industries crop up to help the main industry. Trade journals, research and training centres appear which help in increasing the productive efficiency of the firms. Thus these external economies are also the cause of increasing returns to scale.

Decreasing Returns to Scale:

Figure 9 shows the case of decreasing returns where to get equal increases in output, larger proportionate increases in both labour and capital are required.

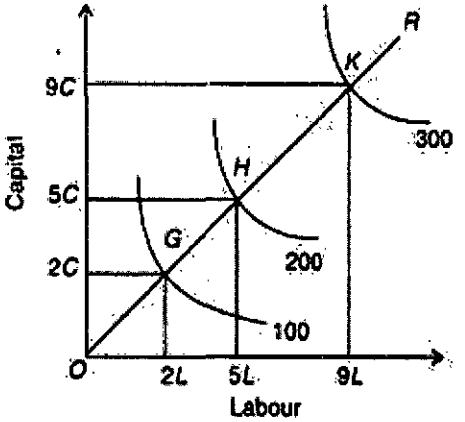


Fig. 9

It follows that:

100 units of output require 2C + 2L

200 units of output require 5C + 5L

300 units of output require 9C + 9L

So that along the expansion path OR, OG < GH < HK.

In this case, the production function is homogeneous of degree less than one. Returns to scale may start diminishing due to the following factors. Indivisible factors may become inefficient and less productive. Business may become unwieldy and produce problems of supervision and coordination.

Large management creates difficulties of control and rigidities. To these internal diseconomies are added external diseconomies of scale. These arise from higher factor prices or from diminishing productivities of the factors. As the industry continues to expand the demand for skilled labour, land, capital, etc. rises.

There being perfect competition, intensive bidding raises wages, rent and interest. Prices of raw materials also go up. Transport and marketing difficulties emerge. All these factors tend to raise costs and the expansion of the firms leads to diminishing returns to scale so that doubling the scale would not lead to doubling the output.

Constant Returns to Scale:

Figure 10 shows the case of constant returns to scale. Where the distance between the isoquants 100, 200 and 300 along the expansion path OR is the same, i.e., OD = DE = EF. It means that if units of both factors, labour and capital, are doubled, the output is doubled. To treble the output, units of both factors are trebled.

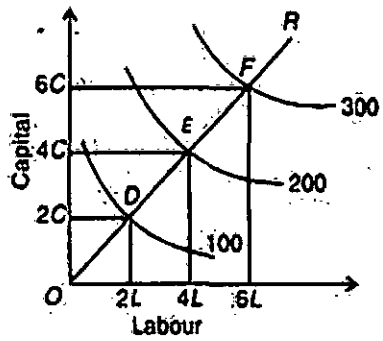


Fig. 10

It follows that:

100 units of output require

1 (2C + 2L) = 2C + 2L

200 units of output require

2 (2C + 2L) = 4C + 4L

300 units of output require

3 (2C + 2L) = 6C + 6L

The returns to scale are constant when internal economies enjoyed by a firm are neutralised by internal diseconomies so that output increases in the same proportion. Another reason is the balancing of external economies and external diseconomies.

Constant returns to scale also result when factors of production are perfectly divisible, substitutable, homogeneous and their supplies are perfectly elastic at

given prices. That is why, in the case of constant returns to scale, the production function is homogeneous of degree one.

Alternative Method:

We have explained above the three laws of returns to scale separately on the assumption that there are three processes and each process shows the same returns over all ranges of output. "However, the technological conditions of production may be such that returns to scale may vary over different ranges of output. Over some range, we may have constant returns to scale, while over another range we may have increasing or decreasing returns to scale."

To explain it we draw an expansion path OR from the origin in Fig. 11 This are divided into segments by the successive isoquants representing equal increments in output, i.e., 100, 200, 300 and so on. As we move along the expansion path, the distance between the successive isoquants diminishes, it is a case of increasing returns to scale.

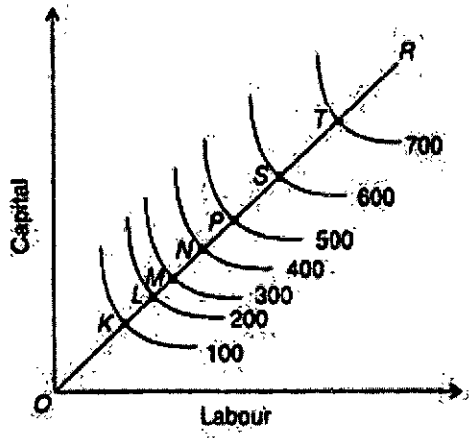


Fig. 11

This stage is shown in the figure from K to M. The distance between KL and Z.M becomes smaller LM<KL. The firm, therefore, requires smaller increases in the quantities of labour and capital to produce equal increments of output.

If the segments between two isoquants are of equal length, there are constant returns to scale. If labour and capital are doubled, the output would also be doubled. Thus, when output increases from 300 to 400 and to 500 units, the isoquants representing these output levels mark off equal distances along the scale line, up to point P, i.e., MN = NP.

If these are decreasing returns to scale, the distance between a pair of isoquants would become longer on the expansion path. ST is longer than PS. It shows that to increase output larger increases in quantities of labour and capital are required. Thus, on the same expansion path from K to M, there are increasing returns to scale, from M to P, there are constant returns to scale and from P to T, and there are diminishing returns to scale.

Summary of the Unit

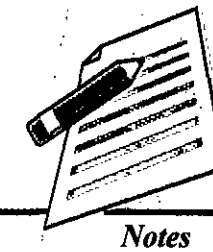
In economics, a production function relates physical output of a production process to physical inputs or factors of production. It is a mathematical function that relates the maximum amount of output that can be obtained from a given number of inputs – generally capital and labor. The production function, therefore, describes a boundary or frontier representing the limit of output obtainable from each feasible combination of inputs.

Firms use the production function to determine how much output they should produce given the price of a good, and what combination of inputs they should use to produce given the price of capital and labor. When firms are deciding how much to produce they typically find that at high levels of production, their marginal costs begin increasing. This is also known as diminishing returns to scale – increasing the quantity of inputs creates a less-than-proportional increase in the quantity of output. If it weren't for diminishing returns to scale, supply could expand without limits without increasing the price of a good.

EXERCISE

Multiple Choice Questions

1. _____ shows the overall output generated at a given level of input:
   (a) Cost function
   (b) Production function
   (c) Iso cost
   (d) Marginal rate of technical substitution
2. If LAC curve falls as output expands, this is due to _____:
   (a) *Law of diminishing retains* (b) *Economics of scale*
   (c) Law of variable proportion (d) Diseconomics of scale
3. Isoquants are equal to:
   (a) Product Lines (b) Total utility lines
   (c) Cost lines (d) Revenue lines
4. The marginal product curve is above the average product curve when the average product is :
   (a) Increasing (b) Decreasing
   (c) Constant (d) None
5. Increasing returns to scale can be explained in terms of:
   (a) External and internal economies
   (b) External and internal diseconomies
   (c) External economics and internal diseconomies
   (d) All of these
6. An isoquant is _____ to an iso cost line at equilibrium point:
   (a) Convex (b) Concave
   (c) Tangent (d) Perpendicular



7. At the point of inflexion, the marginal product is:
   (a) Increasing
   (b) Decreasing
   (c) Maximum
   (d) Negative
8. Diminishing marginal returns implies:
   (a) Decreasing average variable costs
   (b) Decreasing marginal costs
   (c) Increasing marginal costs
   (d) Decreasing average fixed costs
9. If the marginal product of labour is below the average product of labour. It must be true that:
   (a) Marginal product of labour is negative
   (b) Marginal product of labour is zero
   (c) Average product of labour is falling
   (d) Average product of labour is negative
10. Law of variable proportion is valid when:
   (a) Only one input is fixed and all other inputs are kept variable
   (b) All factors are kept constant
   (c) All inputs are varied in the same proportion
   (d) None of these

ANSWERS

1. (b) Production function
2. (b) Economics of scale
3. (a) Product Lines
4. (a) Increasing
5. (a) External and internal economies
6. (c) Tangent
7. (c) Maximum
8. (c) Increasing marginal costs
9. (c) Average product of labour is falling
10. (a) Only one input is fixed and all other inputs are kept variable

Review Questions

1. List out the major factors of production (input factors used) in a cement factory.
2. Define production function and Cobb-Douglas production function.
3. Write short notes on Marginal Product and Average product.
4. Briefly discuss the concept Returns to scale, increasing and decreasing returns to scale.
5. Explain the Law of variable proportions.
6. Discuss the managerial uses of production function.

17 CONCEPT OF COST

Concept of Cost:

Short run Cost Curves

1. **Total Fixed Cost (TFC)**

Table 4.1 Total Fixed Cost

Output (in unit)	Total Fixed Cost (in ₹)
0	1000
1	1000
2	1000
3	1000
4	1000
5	1000

All payments for the fixed factors of production are known as Total Fixed Cost. A hypothetical TFC is shown in table 4.1 and diagram 4.1

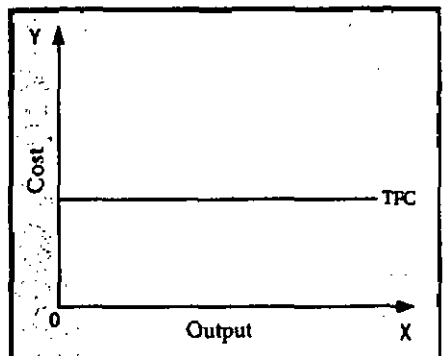


Diagram 4.1

For instance, if TC = Q3 –18Q2 + 91Q +12, the fixed cost here is 12. That means, if Q is zero, the Total cost will be 12, hence fixed cost.

It could be observed that TFC does not change with output. Even when the output is zero, the fixed cost is Rs.1000. TFC is a horizontal straight line, parallel to X axis.

2. **Total Variable Cost (TVC)**

All payments to the variable factors of production is called as Total Variable Cost. Hypothetical TVC is shown in table-4.2 and Diagram 4.2

Table 4.2 Total Variable Cost

Output (in unit)	Total Variable Cost (in ₹)
0	0
1	200
2	300
3	400
4	600
5	900

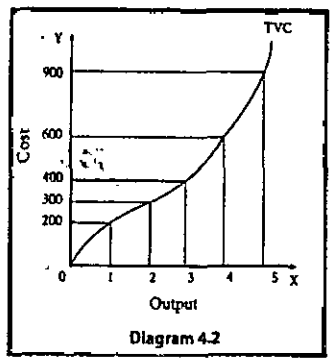


Diagram 4.2

In the diagram the TVC is zero when nothing is produced. As output increases TVC also increases. TVC curve slopes upward from left to right. For instance, in TC = $Q^3 - 18Q^2 + 91Q + 12$, variable cost, TVC = $Q^3 - 18Q^2 + 91Q$

3. Total Cost Curves

Total Cost means the sum total of all payments made in the production. It is also called as Total Cost of Production. Total cost is the summation of Total Fixed Cost (TFC) and Total Variable Cost (TVC). It is written symbolically as

TC = TFC + TVC. For example, when the total fixed cost is Rs. 1000 and the total variable cost is Rs. 200 then the Total cost is = Rs. 1200 (Rs. 1000 + Rs. 200).

If TFC = 12 and

TVC = $Q^3 - 18Q^2 + 91Q$

TC = $12 + Q^3 - 18Q^2 + 91Q$

Table 4.3 Total Cost Curves

Output (in unit)	Total Fixed Cost (TFC) (in ₹)	Total Variable Cost (TVC) (in ₹)	Total Cost (TC) TFC+TVC (in ₹)
0	1000	0	1000
1	1000	200	1200
2	1000	300	1300
3	1000	400	1400
4	1000	600	1600
5	1000	900	1900

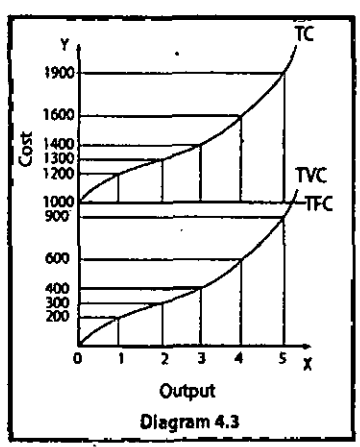


Diagram 4.3

It is to be noted that

- The TC curve is obtained by adding TFC and TVC curves vertically.
- TFC curve remains parallel to x axis, indicating a straight line.
- TVC starts from the origin and moves upwards, as no variable cost is incurred at zero output.
- When TFC and TVC are added, TC starts from TFC and moves upwards.
- TVC and TC curves are the same shapes but beginning point is different.

4. Average Fixed Cost (AFC)

It refers to the fixed cost per unit of output. It is obtained by dividing the total fixed cost by the quantity of output. AFC = TFC / Q where, AFC denotes average fixed cost, TFC denotes total fixed cost and Q denotes quantity of output. For example, if TFC is 1000 and the quantity of output is 10, the AFC is Rs. 100, obtained by dividing Rs. 1000 by 10. TVC is shown in table 4.4 and Diagram 4.4.

Table 4.4 Average Fixed Cost

Q (in unit)	TFC (in ₹)	AFC TFC/Q (in ₹)
0	1000	1000/0 = ∞
1	1000	1000/1 = 1000
2	1000	1000/2 = 500
3	1000	1000/3 = 333
4	1000	1000/4 = 250
5	1000	1000/5 = 200

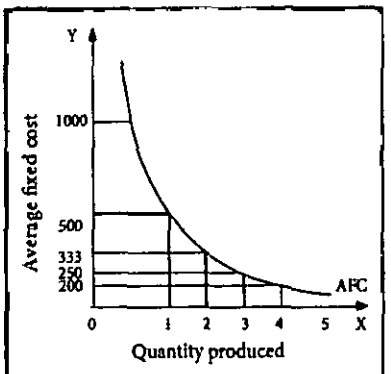


Diagram 4.4

It is to be noted that

- AFC declines as output increases, as fixed cost remains constant
- AFC curve is a downward sloping throughout its length, never touching X and Y axis. It is asymptotic to both the axes.
- The shape of the AFC curve is a rectangular hyperbola.

5. Average Variable Cost (AVC)

It refers to the total variable cost per unit of output. It is obtained by dividing total variable cost (TVC) by the quantity of output (Q). ***AVC = TVC / Q*** where, AVC denotes Average Variable cost, TVC denotes total variable cost and Q denotes quantity of output. For example, When the TVC is Rs. 300 and the quantity produced is 2, the AVC is Rs. 150, (AVC = 300/2 = 150) AVC is shown in table 4.5 and Diagram 4.5. If TVC = $Q^3 - 18Q^2 + 91Q$

AVC = $Q^2 - 18Q + 91$

Table 4.5 Average Variable Cost

Q (in unit)	TVC (in ₹)	AVC TVC/Q (in ₹)
0	0	0/0 = 0
1	200	200/1 = 200
2	300	300/2 = 150
3	400	400/3 = 133
4	600	600/4 = 150
5	900	900/5 = 180

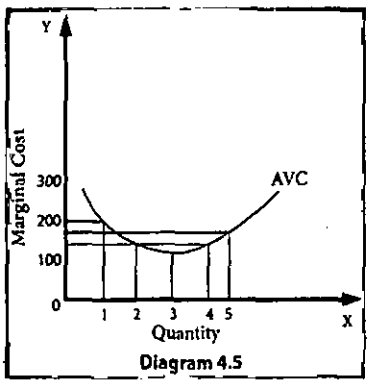


Diagram 4.5

It is to be noted that

- AVC declines initially and then increases with the increase of output.
- AVC declines up to a point and moves upwards steeply, due to the law of returns.
- AVC curve is a U-shaped curve.

6. *Average Total Cost (ATC) or Average Cost (AC)*

It refers to the total cost per unit of output.

It can be obtained in two ways.

1. By dividing the firm's total cost (TC) by the quantity of output (Q). ***ATC = TC / Q***. For example, if TC is Rs. 1600 and quantity of output is Q=4, the Average Total Cost is Rs. 400.

   (ATC = 1600/4 = 400) If ATC is $Q^3 - 18Q^2 + 91Q + 12$, then AC $= Q^2 - 18Q + 91\ 12/Q$

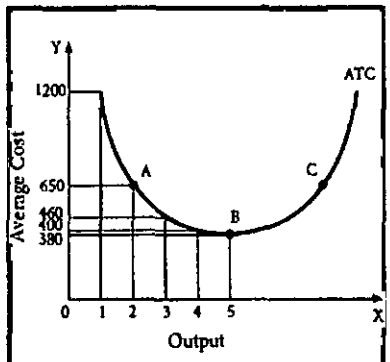


Diagram 4.6

Table 4.6 Average Total Costv or Average Cost

Q (in unit)	TFC (in ₹)	TVC (in ₹)	TC (in ₹) TFC +TVC	ATC (TC/Q) (in ₹)	AFC (in ₹)	AVC (in ₹)	ATC (AFC +AVC) (in ₹)
0	1000	0	1000	1000 /0= ∞	0	0	0 + 0 = 0
1	1000	200	1200	1200 /1= 1200	1000	200	1000+200 =1200
2	1000	300	1300	1300 /2= 650	500	150	500 + 150= 650
3	1000	400	1400	1400 /3= 466	333	133	333 + 133= 466
4	1000	600	1600	1600 /4= 400	250	150	250 + 150= 400
5	1000	900	1900	1900 /5= 380	200	180	200 + 180= 380

2. ByATC is derived by adding together Average Fixed Cost (AFC) and Average Variable Cost (AVC) at each level of output. ***ATC = AFC + AVC***. For example, when Q= 2, TFC = 1000, TVC=300; AFC=500; AVC=150;ATC=650. ATC or AC is shown in table 4.6 and Diagram 4.6

It should be noted that

- ATC curve is also a 'U' shaped curve.

- Initially the ATC declines, reaches a minimum when the plant is operated optimally, and rises beyond the optimum output.
- The 'U' shape of the AC reflects the law of the variable proportions

7. Marginal Cost (MC)

It is the cost of the last single unit produced. It is defined as the change in total costs resulting from producing one extra unit of output. In other words, it is the addition made to the total cost by producing one extra unit of output.

Table 4.7 Marginal Cost

Q (in unit)	TC (in ₹)	MC (in ₹)
0	1000	--
1	1200	1200 - 1000 = 200
2	1300	1300 - 1200 = 100
3	1400	1400 - 1300 = 100
4	1600	1600 - 1400 = 200
5	1900	1900- 1600 = 300

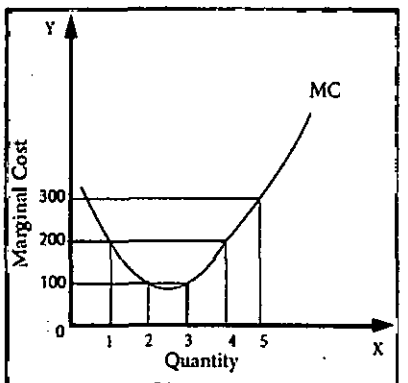


Diagram 4.7

Marginal cost is important for deciding whether any additional output can be produced or not. MC = ΔTC / ΔQ where MC denotes Marginal Cost, ΔTC denotes change in total cost and ΔQ denotes change in total quantity. For example, a firm produces 4 units of output and the Total cost is Rs. 1600. When the firm produces one more unit (4 +1 = 5 units) of output at the total cost of Rs. 1900, the marginal cost is Rs. 300.

MC = 1900 – 1600 = Rs. 300.

The other method of estimating MC is :

$MC = TC_n - TC_{n-1}$ or $TC_{n+1} - TC_n$

where, 'MC' denotes Marginal Cost, 'TC_n' denotes Total cost of 'n'th item, TC_{n-1} denotes Total Cost of 'n-1' th item, TC_{n+1} denotes Total Cost of n+1 th item. For example,

when TC4 = Rs.1600, TC(4-1)=Rs.1400 and then MC= Rs.200, (MC=1600-1400)

when TC4 = Rs.1600, TC(4+1)=1900 and then MC= 300.

MC schedule is shown in Table 4.7 and MC Curve is shown in diagram 4.7. It is to be noted that

- MC falls at first due to more efficient use of variable factors.
- MC curve increases after the lowest point and it slopes upward.
- MC cure is a U-shaped curve.
- The slope of TC is MC.

If $TC = Q^3 - 18Q^2 + 91Q + 12$

$MC = 3Q^2 - 36Q + 91$

8. **The relationship between Average Cost and Marginal cost**

There is a unique relationship between the AC and MC curves as shown in diagram 4.8.

- When AC is falling, MC lies below AC.
- When AC becomes constant, MC also becomes equal to it.
- When AC starts increasing, MC lies above the AC.
- MC curve always cuts AC at its minimum point from below.

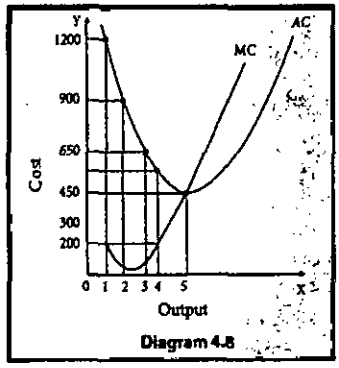


Diagram 4.8

Long Run Cost Curve:

In the long run all factors of production become variable. The existing size of the firm can be increased in the case of long run. There are neither fixed inputs nor fixed costs in the long run.

LAC is given in diagram 4.9.

LAC is given in diagram 4.9.

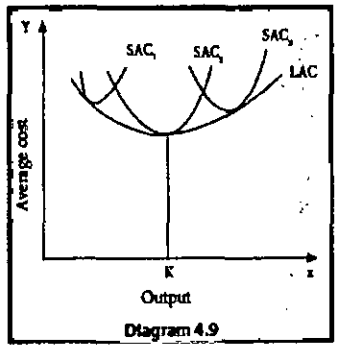


Diagram 4.9

Long run average cost (LAC) is equal to long run total costs divided by the level of output.

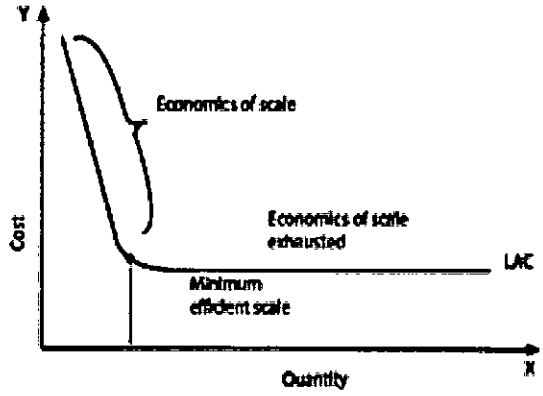
LAC = LTC/Q

- where, LAC denotes Long-Run Average Cost,
- LTC denotes Long-run Total Cost and
- Q denotes the quantity of output.

The LAC curve is derived from short-run average cost curves. It is the locus of points denoting the least cost curve of producing the corresponding output.

The LAC curve is called as 'Plant Curve' or 'Boat shape Curve' or 'Planning Curve' or 'Envelop Curve'.

A significant recent development in cost theory is that the long-run average cost curve is L- shaped rather than U-shaped. The L-shape of the long-run average cost curve implies that in the beginning when output is expanded through increase in plant size and associated variable factors, cost per unit falls rapidly due to economies of scale.



Supply

Definition

The Law of Supply can be stated as:

"*Other things remaining the same, if the price of a commodity increases its quantity supplied increases and if the price of a commodity decreases, quantity supplied also decreases*".

Supply Function

The supply of a commodity depends on the factors such as price of commodity, price of labour, price of capital, the state of technology, number of firms, prices of related goods, and future price expectations and so on. Mathematically the supply function is

$Q_s = f(P_x, P_r, P_f, T, O, E)$

Where Q_s = Quantity supplied of x commodity

P_x = Price of x Commodity

P_r = Price of related goods

P_f = Price of factors of production

T = Technology

O = Objective of the producer

E = Expected Price of the commodity.

Assumptions

- Law of Supply is based on the following assumptions.
- There is no change in the prices of factors of production
- There is no change in price of capital goods
- Natural resources and their availability remain the same
- Prices of substitutes are constant
- There is no change in technology
- Climate remains unchanged
- Political situations remain unchanged
- There is no change in tax policy

Explanation

Suppose that the supply function is

$Q_s = f(P)$ or $Q = 20P$

P is an independent variable. When its value changes, new values of Q_s can be calculated.

Supply Schedule

A supply schedule shows the different quantities of supply at different prices. This information is given in the supply schedule given below.

Price and Supply

Table 3.4 Price and Supply

Price (P)	Supply (Q_s)
1	20
2	40
3	60
4	80
5	100

Qs = 20P

2. **Supply Curve**

A supply curve represents the data given in the supply schedule. As the price of the commodity increases, the quantum supplied of the commodity also increases. Thus the supply curve has a positive slope from left to right. (see diagram 3.12.)

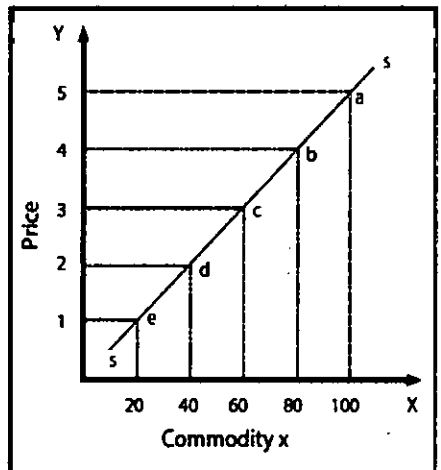


Diagram 3.12

The quantum supplied of commodity x is represented on X axis. And the price of the commodity is represented on the Y axis. The points such as e, d, c, b and a on the supply curve SS', represent various quantities at different prices.

Factors determining supply

Price of the commodity

Higher the price larger the supply. Price is the incentive for the producers and sellers to supply more.

Price of other commodities

The supply of a commodity depends not only upon its price but also price of other commodities. For instance, if the price of commercial crops like cotton rise, this may result in reduction in cultivation of food crops like paddy and so its supply

Price of factors

When the input prices go up, this results in rise in cost and so supply will be affected.

Price expectations

The expectation over future prices determines present supply. If a rise in price is anticipated in future, sellers tend to retain their produce for future sale and so supply in present market is reduced.

Technology

With advancement in technology, production level improves, average cost **declines and as a result supply level increase.**

Natural factors

In agriculture, natural factors like monsoon, climate etc. play a vital role in determining production level.

Discovery of new raw materials

The discovery of new raw materials which are cheaper and of high quality tends to increase supply of the product.

Taxes and subsidies

Subsidies for inputs, credit, power etc. encourage the producers to produce more. Withdrawal of such incentives will hamper production. Taxes both direct and indirect kill the ability and willingness to produce more.

Objective of the firm

When the goal of the firm is sales maximisation or improving market share, the supply of the product is likely to be higher.

Elasticity of Supply

Elasticity of supply may be defined as *the degree of responsiveness of change in supply to change in price on the part of sellers.*

It is mathematically expressed as:

Elasticity of supply = proportionate change in supply / proportionate change in price

$e_s = (\Delta Q_s / Q_s) / (\Delta P / P)$;

$e_s = \Delta Q_s / \Delta P \times P / Q_s$

Where Q_s represents the supply, P represents price, Δ denotes a change.

Types of Elasticity of Supply

There are five types of elasticity of supply.

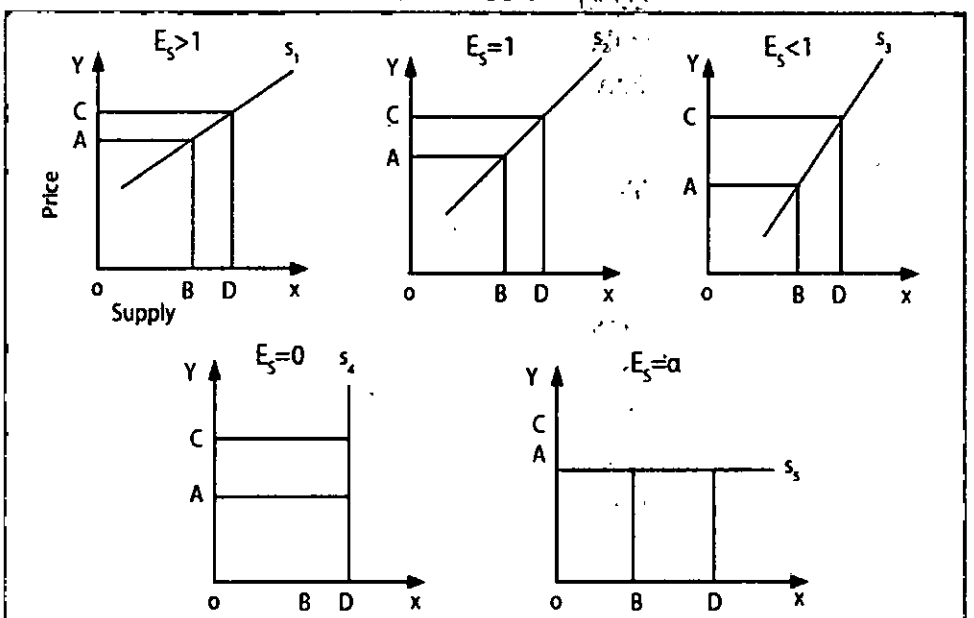


Diagram 3.13

1. **Relatively elastic supply (see Diagram 3.13)**

   The co-efficient of elastic supply is greater than 1(Es > 1). One percent change in the price of a commodity causes more than one per cent change in the quantity supplied of the commodity.

2. **Unitary elastic supply (see Diagram 3.13)**

   The coefficient of elastic supply is equal to 1 (Es = 1). One percent change in the price of a commodity causes an equal (one per cent) change in the quantity supplied of the commodity.

3. **Relatively inelastic supply (see Diagram 3.13**

   The coefficient of elasticity is less than one (Es < 1). One percent change in the price of a commodity causes a less than one per cent change in the quantity supplied of the commodity.

4. **Perfectly inelastic supply (see Diagram 3.13)**

   The coefficient of elasticity is equal to zero (Es = 0). One percent change in the price of a commodity causes no change in the quantity supplied of the commodity.

5. **Perfectly elastic supply (see Diagram 3.13)**

   The coefficient of elasticity of supply is infinity. (Es = α). One percent change in the price of a commodity causes an infinite change in the quantity supplied of the commodity.

Factors governing elasticity of supply

1. ***Nature of the commodity***

   Durable goods can be stored for a long time. So, the producers can wait until they get a high price. Once they get higher price, larger supply is possible. The elasticity of supply of durable goods is high. But perishables are to be sold immediately. So perishables have low elasticity of supply.

2. **Cost of production**

   When production is subject to either constant or increasing returns, additional production and therefore increased supply is possible. So elasticity of supply is greater. Under diminishing returns, increase in output leads to high cost. So elasticity of supply is less.

3. **Technical condition**

   In large scale production with huge capital investment, supply cannot be adjusted easily. So elasticity of supply is lesser. Where capital equipment is less and technology simple, the supply is more elastic.

4. **Time factor**

   During very short period when supply cannot be adjusted, elasticity of demand is very low. In short period, variable factors can be added and so supply can be adjusted to some extent. So elasticity of supply is more. In long period, even the fixed factors can be added and hence supply is highly elastic.

SUMMARY OF THE CHAPTER

Costs are very important in business decision-making. Cost of production provides the floor to pricing. It helps managers to take correct decisions, such as what price to quote, whether to place a particular order for inputs or not whether to abandon or add a product to the existing product line and so on.

Ordinarily, costs refer to the money expenses incurred by a firm in the production process. But in economics, cost is used in a broader sense. Here, costs include imputed value of the entrepreneur's own resources and services, as well as the salary of the owner-manager.

There are various concepts of cost that a firm considers relevant under various circumstances. To make a better business decision, it is essential to know the fundamental differences and uses of the main concepts of cost.

EXERCISE

Multiple Choice Questions

1. Opportunity cost is:
   (a) Direct cost
   (b) Total cost
   (c) Accounting cost
   (d) Cost of foregone opportunity
2. As output increases, average fixed cost:
   (a) Remains constant (b) Starts falling
   (c) Start rising (d) None
3. Average fixed cost can be obtained through:
   (a) AFC=TFC/TS (b) AFC=EC/TU
   (c) AFC=TC/PC (d) AFC=TFC/TU
4. AFC curve is:
   (a) Convex & downward sloping
   (b) Concave & downward sloping
   (c) Convex & upward sloping
   (d) Concave & upward rising
5. A firm's average fixed cost is Rs 20 at 6 units of output what will it be at 4 units of output?
   (a) Rs 60 (b) Rs 30
   (c) Rs 40 (d) Rs 20
6. U-shaped average cost curve is based on:
   (a) Law of increasing cost
   (b) Law of decreasing cost
   (c) Law of constant returns to scale
   (d) Law of variable proportions
7. When shape of average cost curve is upwards, marginal cost:
   (a) Must be decreasing
   (b) Must be constant
   (c) Must be rising
   (d) Any of these
8. If total cost at 10 units is Rs 600 and Rs 640 for 11th unit. The marginal cost of 11th unit is:
   (a) Rs 20 (b) Rs 30
   (c) Rs 40 (d) Rs 50
9. Economic cost excludes:
   (a) Accounting cost + explicit cost
   (b) Accounting cost + implicit cost
   (c) Explicit cost + Implicit cost
   (d) Accounting cost + opportunity cost

10. Which of the following cost curves is never 'U' shaped?
    (a) Average cost curve
    (b) Marginal cost curve
    (c) Total cost curve
    (d) Fixed cost curve

ANSWERS

1. (d) Cost of foregone opportunity
2. (b) Starts falling
3. (d) AFC=TFC/TU
4. (a) Convex & downward sloping
5. (b) Rs 30
6. (d) Law of variable proportions
7. (c) Must be rising
8. (c) Rs 40
9. (a) Accounting cost + explicit cost
10 (d) Fixed cost curve

Review Questions

Q.1. What is an opportunity cost?

Q.2. What are the fixed costs of a firm? Give examples.

Q.3. Explain why fixed cost does not enter into marginal cost of production.

Q.4. What are the variable costs of a firm? Give examples.

Q.5. Explain why does the minimum point of MC curve occur to the left of the minimum point of AC curve?

Q.6. Is AFC curve U-shaped? If not, what is the possible shape of AFC curve? What is the shape of the average fixed cost curve of a firm?

Q.7. Will AC rise or fall when MC exceeds AC? If MC = AC, how will AC behave?

Q.8. If all inputs are increased simultaneously will AC increase due to the law of diminishing marginal productivity?

Q.9. All costs are variable costs in the long run. Explain.

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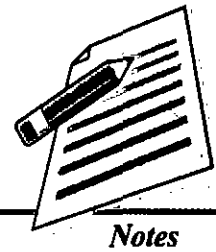


18 MODULE-VIII MARKET AND PRICE DETERMINATION

Module Content

Meaning of market, Different forms of market – Perfect competition, monopoly, monopolistic competition and oligopoly- their meaning and features Meaning of equilibrium price, Determination of equilibrium price, excess demand and excess supply; Effect of changes in demand and supply on equilibrium price and quantity; Simple applications of demand and supply analysis – ceiling price, floor price. Concept of revenue – Total Revenue, Average Revenue Marginal Revenue. Various concepts of profit; profit; Maximization of a competitive firm Total revenue and total cost approach, Marginal revenue and Marginal cost approach

Objective of the module

After reading this unit the reader will understand that the economist meaning of market is something different from the common understanding of the market. In economics, the market is the study about the demand for and supply of a particular commodity and its consequent fixing of prices for instance the market may be a bullion market, stock market, or even food grains market. The market is broadly divided into two categories like perfect market and imperfect market. The perfect market is further divided into pure market (which is a myth) and perfect market. The imperfect market is divided into monopoly market, monopolistic market, oligopoly market and duopoly market. Based on the nature of competition and on the number of buyers and sellers operating in the market, the price for the commodity may be settled at the point where the demand forces and supply forces agree upon.

Introduction

Market Structure is defined as the number of firms producing identical products which are homogeneous. In other words, it is the factors that influence the interaction of buyers and sellers in a market, and also determines changes in price by how different levels of production and selling processes interact together.

For defining market structure, we first need to understand what market is? Market is a place where buyers and sellers meet and exchange goods or services. And now if we extend this concept a little more, there are certain conditions which create the structure of a market. Such conditions can be condensed in the following –

- Number of Buyers
- Number of sellers
- Buyer Entry Barriers
- Seller Entry Barriers
- Size of the firm
- Product Differentiation/ Homogeneous Product
- Market Share
- Competition

Market structures are important both to firms and consumers alike, because it influences how they (firms and consumers operating within the market or industry) behave in terms of pricing, supply, entry & exit, competition and efficiency. Currently, there are four types of market structures practiced in the world. These are:

- Perfect Competition
- Imperfect or Monopolistic Competition
- Monopoly
- Oligopoly

These market structures are as a result of the different degrees of competition within the industry. Each structure is differentiated by freedom of entry and exit, number of buyers and sellers, product differentiation, etc.

However, each market structure has got its advantages and disadvantages. Below are some of the advantages and disadvantages of each market structure.

The structure of a particular market plays an important role in defining the determinants that affect these market structures. Determinants like price, product differentiation etc. are affected by the competitive structure of the market. The classification of markets in terms of their basic characteristics helps identify a limited number of market structures that can be used to analyse decision-making.

The four characteristics used to classify market structures are:

(i) Number and size distribution of sellers,

(ii) Number and size distribution of buyers,

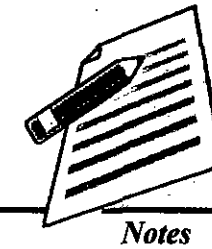
(iii) Product differentiation and

(iv) Condition of entry and exit.

(i) Number and size distribution of sellers

The firm's ability to affect the price and the quantity of a product supplied to the market is related to the number of firms offering the same product. If there are a large number of sellers, the influence of any one firm is likely to be less.

Consider the number of firms selling fruits and vegetables in your locality. It is unlikely that any one of them will exercise a great influence over price. On the contrary, if there are only few sellers in the market, an



individual firm can exercise greater control over price and total supply of the product. Considering this fact the number of firms can be classified into large, few, two and one.

(ii) Number and size distribution of buyers

Markets can also be characterized by the number and size distribution of buyers, where there are many small buyers of a product and all are likely to pay about the same price. Consider a big firm in a city. For example, TISCO in Jamshedpur is a large and perhaps the only firm in the area.

TISCO will thus be able to exercise considerable influence on the price at which it buys inputs from suppliers in the area. Similarly, Maruti Udyog Limited (MUL) in Gurgaon is one of the large automobile manufacturers and has considerable influence over the price at which it buys inputs such as glass, radiator caps and accessories from other suppliers located in the region. Both MUL and TISCO are firms that are said to have 'monopsony' power in their buying decisions. However, if there are a large number of buyers, they will be unable to demand lower prices from sellers. One reason why large firm are able to negotiate lower prices is because of large volume purchases.

(iii) Product Differentiation

If the products competing in the market are not identical or homogeneous, they are said to be differentiated and hence 'product differentiation' exists in the market. Product differentiation is a fact of life and there is some amount of differentiation for almost all products that we buy in markets.

For example, ingredients in different soaps could be different as can be the packaging, advertising etc. Even seemingly homogeneous goods such as apples and bananas are at present differentiated on the basis of the orchards where they have been grown and the way these are marketed. Wheat is a good example of a product that can be considered undifferentiated.

The degree of substitutability or product differentiation is measured by cross-elasticity of demand between two competing products. This feature was explained in unit 5. Products can be classified into perfect substitutes or homogeneous products, close substitutes like soaps of different brands, remote substitutes like radio and television and no substitutes like cereals and soaps.

Further, perfect substitutes for one consumer may not be so for another. For example, Rahul may feel that Coke and Pepsi are perfect substitutes while Sachin may have a strong brand preference for Pepsi. Product differentiation is a basis for a lot of advertising that is seen in the media where the focus is to create a strong brand preference for the product being advertised.

(iv) **Conditions of Entry and Exit**

Entry or exit of firms to an industry refers to the difficulty or ease with which a new firm can enter or exit a market. In short run, where the capital of firms is fixed, entry and exit does not make much difference. Ease of entry and exit is however a crucial determinant of the nature of a market in the long run.

When it is difficult for firms to enter the market, existing firms will have much greater freedom in pricing and output decisions than if they had to worry about new entrants. Consider a firm such as Ranbaxy that has a patent on a particular drug.

A patent is an exclusive right to market the product for a given period of time, say 12 years. If there are no close substitutes to that drug, the firm will be free from competition for the duration of the patent.

Thus, the barriers to entry in the market for this drug are high. Similarly, since Indian Railways, is a public monopoly no new entrant can enter the market. Microsoft too has been able to create substantial entry barriers in the market making it difficult for new firms to enter in the market. On the other hand, retail outlets and the restaurant business witness several new firms entering the market periodically, implying that entry barriers are relatively low

Basic Market Structure				
Market structure	Seller Entry barriers	Seller Number	Buyer Entry Barriers	Buyer Number
Perfect competition	No	Many	No	Many
Monopolistic Competition	No	Many	No	Many
Oligopoly	Yes	Few	No	Many
Monopoly	Yes	One	No	Many

Markets in detail

Perfect competition

Characteristics of Perfect Competition

1. Many firms, each is selling an identical product. Each firm's output is a perfect substitute for the output of the other firms, so the demand for each firm's output is perfectly elastic.

2. Large number of buyers who are indifferent from whom to buy
3. No barriers (restrictions) to entry or exit; it is relatively easy to get into the business
4. Each firm produces a very small share of the total output so that no individual firm has the market power to influence the market price of the good it produces. A perfectly competitive firm is a price taker; it takes the market price as given.
5. Firms already in the industry have no advantage over new entrants
6. Complete information is available to buyers and sellers are about price, demand, and supply in the market
7. Perfectly competitive firms earn zero economic profit in the long run (only normal profit)

Assumptions of the model

Perfect competition is considered as the ideal or the standard against which everything is judged. **Perfect competition** is characterised as having:

- **Many buyers and sellers**. Nobody has power over the market.
- **Perfect knowledge** by all parties. Customers are aware of all the products on offer and their prices.
- Firms can sell as much as they want, but only at the price ruling. Thus sellers have no control over market price. They are **price takers,** not price makers.
- All firms produce the **same product**, and all products are **perfect substitutes** for each other, i.e. goods produced are **homogenous**.
- There is **no advertising**.
- There is **freedom of entry and exit** from the market. Sunk costs are few, if any. Firms can, and will come and go as they wish.
- Companies in perfect competition in the long-run are both **productively and allocatively efficient**.

Equilibrium under perfect competition

In perfect competition, the market is the sum of all of the individual firms. The market is modelled by the standard market diagram (demand and supply) and the firm is modelled by the cost model (standard average and marginal cost curves). The firm as a price taker simply 'takes' and charges the market price (P* in Figure 1 below). This price represents their average and marginal revenue curve. Onto this we superimpose the marginal and average cost curves and this gives us the equilibrium of the firm.

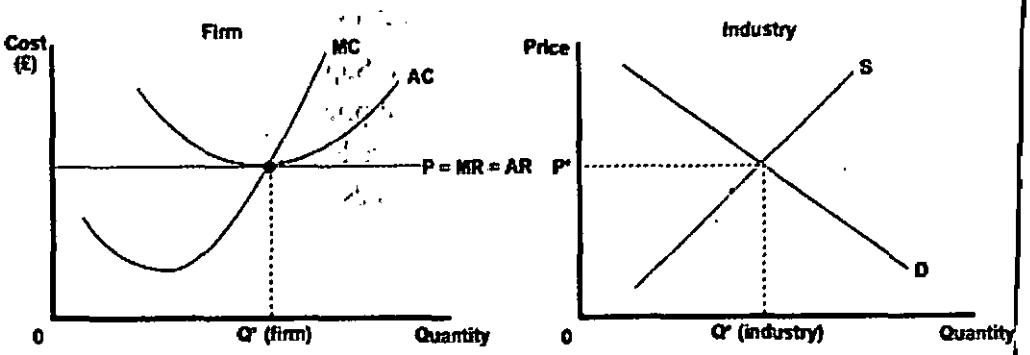


Figure Equilibrium of the firm and industry in perfect competition

Firms in equilibrium in perfect competition will make just normal profit. This level of profit is just enough to keep them in the industry and since profits are adequate they have no incentive to leave.

Normal profits

Normal profit is the level of profit that is required for a firm to keep the resources they are using in their current use. In other words it is enough profit to keep them in the industry. Anything in excess of normal profits is called abnormal or supernormal profits.

Any profit above normal profit is a 'bonus' for the firms, as it is more than they need to keep them in the industry. We call this **supernormal** (or abnormal) profit. However, this supernormal profit will be a signal to other firms and will attract more firms into the industry. If firms are making consistently below normal profits then they will choose to leave the industry.

What does this mean for prices and competition?

Consider the following case.

A firm enters a perfectly competitive market with a product. It sells Q1 units of its product at price P1. It is able to make supernormal profits at this stage. It sells at P1 but has a cost of only C. It makes SNP's of P1 to C per unit sold. This is shown below.

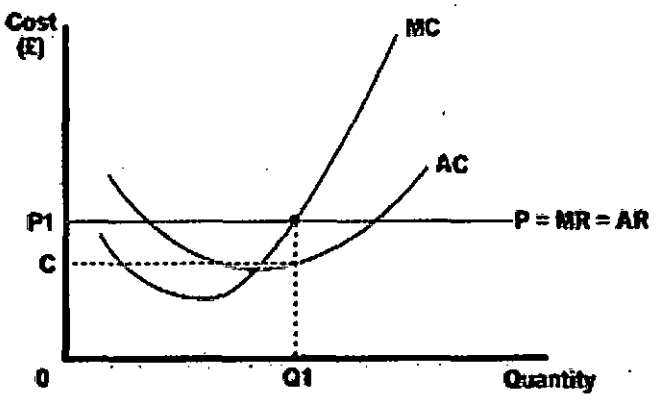


Figure Firm in perfect competition making supernormal profit

Competition is perfect. New firms enter the market. Supply increases (the supply curve shifts to the right - S2 in Figure 3 below) and prices fall. The original firm has to lower its price or it will sell nothing. It charges P2 (the same as the market price) and so now sells Q2. The market size expands from Q1 to Q2. Look at the modified diagram below.

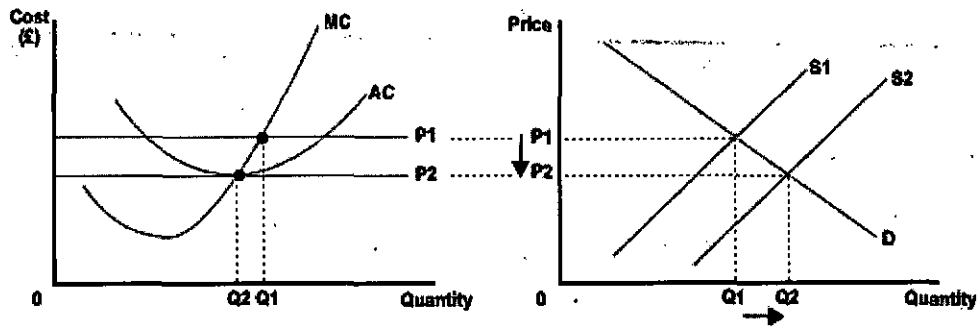


Figure The impact on a market of supernormal profit

The presence of SNP's has attracted more firms to the market and this has led to the price falling. The supernormal profits were competed away and equilibrium was reached where only normal profit was earned. Each of the firms will now be in long run equilibrium earning only normal profit. The long run equilibrium is where MC = MR = AC = AR. This can be seen in Figure 4 below.

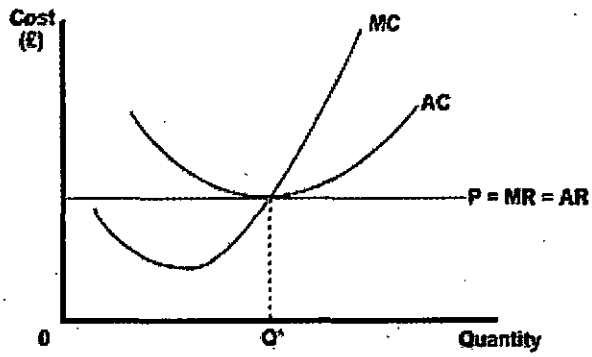


Figure Long run equilibrium in perfect competition

The falling prices put pressure on the less efficient firms. They may be forced to close and transfer their assets elsewhere.

Short-run losses

A firm with high costs may face a short-term loss-making situation. It is not at risk in the short-run provided price at least covers its variable cost, i.e. its day-to-day running costs, so that a contribution is made towards the fixed costs. This is shown below. The price, P*, covers variable costs and some fixed costs. A loss of C - P* is made.

2. Under which of the following forms of market structure does a firm has no control over the price of its product:
   (a) Monopoly (b) Oligopoly
   (c) Monopolistic competition (d) Perfect competition
3. Given the relation $MR = P(1 - \frac{1}{e})$ if e > 1, then :
   (a) MR > 0 (b) MR < 0
   (c) MR = 0 (d) None
4. Profits of the firm will be more at:
   (a) MR = MC
   (b) Additional revenue from extra unit equals its additional cost
   (c) Both of above
   (d) None
5. What should firm do when Marginal revenue is greater than marginal cost?
   (a) Firm should expand output
   (b) Effect should be made to make them equal
   (c) Prices should be covered down
   (d) All of these
6. Under monopoly price discrimination depends upon:
   (a) Elasticity of demand for commodity
   (b) Elasticity of supply for commodity
   (c) Size of market
   (d) All of above
7. Firms in a monopolistic market are price _____:
   (a) Takers (b) Givers
   (c) Makers (d) Acceptors
8. Market which have two firms are known as:
   (a) Oligopoly (b) Duopoly
   (c) Monopsony (d) Oligopsony
9. Monopolist can determine:
   (a) Price (b) Output
   (c) Either price or output (d) None
10. MR of nth unit is given by:
   (a) TR_n/TR_{n-1} (b) $TR_n + TR_{n-1}$
   (c) $TR_n - TR_{n-1}$ (d) All of these

ANSWERS

1. (d) Absence of transport cost
2. (d) Perfect competition
3. (a) MR > 0
4. (c) Both of above
5. (a) Firm should expand output
6. (a) Elasticity of demand for commodity
7. (c) Makers
8. (b) Duopoly

9. (c) Either price or output
10 (c) $TR_n - TR_{n-1}$

Review Questions:

1. Define monopolistic competition.
2. What is the difference between monopoly and monopolistic competition?
3. How does the monopolistic competitor incur loss in the business? Explain with a suitable graph.
4. What do you mean by oligopoly market? What are its characteristic features? Give a suitable example for the same.
5. Distinguish between oligopoly and duopoly market.
6. Describe the kinked demand curve with a graph.
7. What is price discrimination? What are its objectives?
8. Discuss briefly the major types of price discriminations with suitable examples.
9. Explain the major degrees of price discrimination.
10. What are the managerial uses of understanding the market structure?

Space for Work

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19 REVENUE ANALYSIS

Revenue Analysis

The amount of money that a producer receives in exchange for the sale of goods is known as revenue. In short, revenue means sales revenue. It is the amount received by a firm from the sale of a given quantity of a commodity at the prevailing price in the market. For example, if a firm sells 10 books at the price of Rs.100 each, the total revenue will be Rs. 1000.

1. **Revenue Concepts**

   The three basic revenue concepts are: Total Revenue, Average Revenue and Marginal Revenue.

   (a) **Total Revenue:**

   Total revenue is the amount of income received by the firm from the sale of its products. It is obtained by multiplying the price of the commodity by the number of units sold.

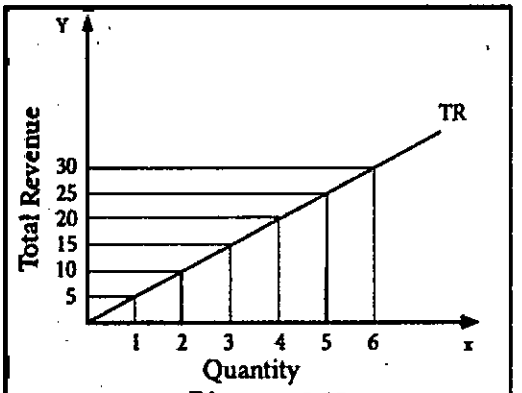


Diagram 4.10

Table 4.8
Total Revenue - Constant Price

Quantity sold (Q)	Price (P)	Total Revenue (TR)
1	5	5
2	5	10
3	5	15
4	5	20
5	5	2
6	5	30

TR=P × Q

where,

TR denotes Total Revenue,

P denotes Price and

Q denotes Quantity sold.

For example, a cell-phone company sold 100 cell-phones at the price of Rs. 500 each.

TR is Rs. 50,000. (TR= 500 × 100 = 50,000).

When price is constant, the behaviour of TR is shown in table 4.8 and diagram 4.10, assuming P=5. When P = 5; TR = PQ

When price is declining increase in quantity sold. (Eg. Imperfect Competition on the supply market) the behaviour of TR is shown in table 11-9 and diagram 4.11. TR can be obtained from Demand function: If Q

When P

Table

Total Revenue

Output	Total Revenue
8	24
7	28
6	30
5	30
4	28
3	24
2	18
1	10

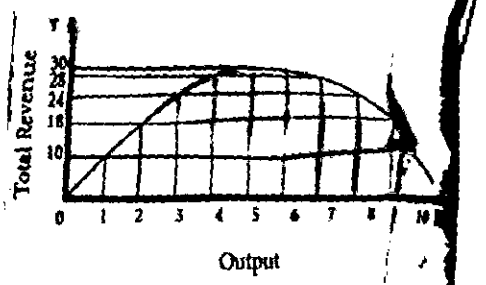


Diagram 4.11

TR = PQ = 1 × 10 = 10

When P = 3, Q = 8, TR = 24

When P = 0, Q = 1, TR = 10

(b) **Average Revenue**

Average revenue is the revenue per unit of the commodity sold. It is calculated by dividing the Total Revenue (TR) by the number of units sold (Q)

AR = TR /Q; if TR = PQ, AR = PQ/Q = P

AR denotes Average Revenue; TR denotes Total Revenue; Q denotes Quantity of unit sold.

For example, if the Total Revenue from the sale of 30, the Average Revenue is Rs.6. **(AR= 30/5 =6)** It is that AR is equal to Price.

AR=TR/Q = PQ/Q=P

(c) **Marginal Revenue**

Marginal revenue (MR) is the addition to the total revenue by the sale of an additional unit of a commodity. It is calculated by dividing change in total revenue by the change in quantity sold out. MR = ΔTR / ΔQ where MR denotes Marginal Revenue, ΔTR denotes change in Total Revenue and ΔQ denotes change in Total quantity.

The other method of estimating MR is

$MR=TR_n-TR_{n-1}$ (or) $TR_{n+1}-TR_n$

where, MR denotes Marginal Revenue, TR_n denotes total revenue of nth item, TR_{n-1} denotes Total Revenue of $n-1th$ item and TR_{n-1} denotes Total Revenue of n item.

If TR = PQ MR = dTR dQ = which is equal to AR

2. **Relationship between AR and MR**

If a firm is able to sell additional units at the same price, AR will be constant and equal. If the firm is able to sell additional units by reducing the price, then both AR and MR will fall and

Constant AR and MR (at Fixed Price)

When price remains constant or fixed, the MR will also constant and coincide with AR. Under perfect competition as the price is uniform and fixed, it is equal to MR and their shape will be a straight line horizontal to X axis. The AR and MR Schedule under constant price is given in Table 4.10 and in the diagram 4.12.

Table 4.10
TR, AR - Constant price

Quantity Sold	Total Revenue	Average Revenue (AR)	Marginal Revenue (MR)
1	5	5	5
2	10	5	5
3	[illegible]	5	5
4	[illegible]	5	5
5	[illegible]	5	5
6	[illegible]	5	5

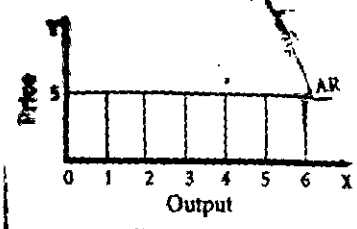


Diagram 4.12

Declining (at Declining Price)

When a firm sells quantities at lower prices both AR and MR will fall but the fall in MR will be steeper than the fall in the AR. It is to be noted that MR will be lower than AR. Both AR and MR will be sloping downwards straight from left to right. The MR curve divides the distance between AR Curve and Y axis into two parts. The decline in AR need not be a straight line or linear. If the price falls with the increase in quantity sold, the AR can be non-linear, taking the shape of a concave or convex to the origin.

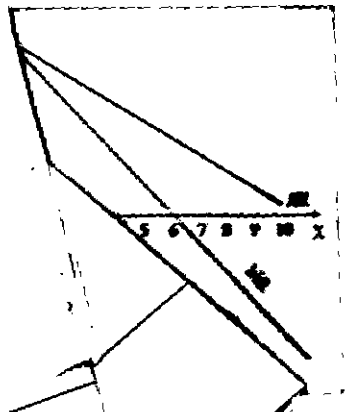


Table 4.11
AR, TR, MR at declining price

Quantity Sold (Q)	Price (P)/ Average Revenue (AR) ₹	Total Revenue (TR) ₹	Marginal Revenue (MR) ₹
1	10	10	-
2	9	18	8
3	8	24	6
4	7	28	4
5	6	30	2
6	5	30	0
7	4	28	-2
8	3	24	-4
9	2	18	-6
10	1	10	-8

3. **Relationship among TR, AR and MR Curves:**

When marginal revenue is positive, total revenue rises, when MR is zero the total revenue becomes maximum. When marginal revenue becomes negative total revenue starts falling. When AR and MR both are falling, then MR falls at a faster rate than AR.

4. **TR, AR, MR and Elasticity of Demand**

The relationship among AR, MR and elasticity of demand (e) is stated as follows.

MR = AR (e-1/e)

The relationship between the AR curve and MR curve depends upon the elasticity of AR curve (AR = DD = Price).

(a) When price elasticity of demand is greater than one, MR is positive and TR is increasing.

(b) When price elasticity of demand is less than one, MR is negative and TR is decreasing.

(c) When price elasticity of demand is equal to one, MR is equal to zero and TR is maximum and constant.

It is to be noted that, the output range of 1 to 5 units, the price elasticity of demand is greater than one according to total outlay method. Hence, TR is increasing and MR is positive.

Table 4.12 TR, AR, MR & Elasticity

Quantity (Q)	Price (P)	TR	AR	MR	Elasticity
0	11	0	11	-	
1	10	10	10	10	
2	9	18	9	8	
3	8	24	8	6	e > 1
4	7	28	7	4	
5	6	30	6	2	
6	5	30	5	0	e = 1
7	4	28	4	-2	
8	3	24	3	-4	
9	2	18	2	-6	e < 1
10	1	10	1	-8	
11	0	0	0	-10	

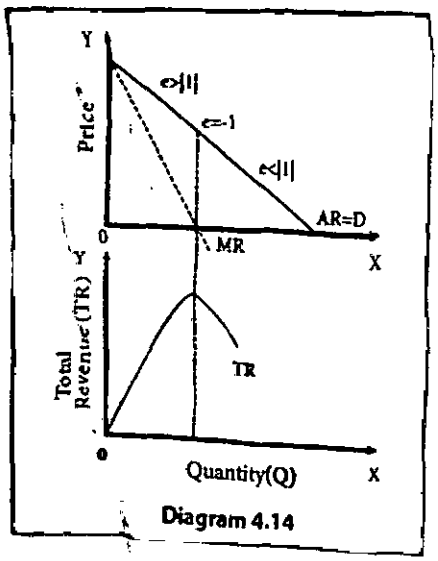


Diagram 4.14

At the output range of 5 to 6 units, the price elasticity of demand is equal to one. Hence, TR is maximum and MR equals to zero.

At the output range of 6 units to 10 units, the price elasticity of demand is less than unity. Hence, TR is decreasing and MR is negative.

EXERCISE

Multiple Choice Questions

1. If all units are sold at same price how will it affect AR and MR?
   (a) B. AR > MR (b) A. AR = MR
   (c) D. AR + MR = 0 (d) C. AR < MR

Answer: (b) A. AR = MR

2. What is price line
   (a) The demand curve (b) The AR curve
   (c) The MR curve (d) The TR curve

Answer: (c) The MR curve

3. Can TR be a horizontal Straight line?
   (a) May be (b) Can't say
   (c) Yes (d) No

Answer: (d) No

4. The revenue of a firm per unit sold is its
   (a) MR (b) AR
   (c) TR (d) TC

Answer: (b) AR

5. The product of AR and price at every unit sold is the firm's
   (a) TR (b) TVC
   (c) MR (d) AR

Answer: (a) TR

20 MODULE-IX : NATIONAL INCOME ACCOUNTING

Module Content

Meaning of income, four factors of production, factor incomes and nonfactor incomes, final goods and intermediate goods, basic economic activities, closed and open economy, stock and flow, circular flow of income, concept of domestic territory and normal residents, value of output and value added, market price vs factor cost, domestic income vs national income, real & nominal GDP concept of depreciation. Concepts of GDP, NDP GNP & NNP (at market price and factor cost) Methods of calculating national income-value added or product method, income method and expenditure method, private income, personal income and personal disposable income, national disposable income (gross and net), GDP and economic welfare

Objective of the module

The main objective of this module is to make student understand about the basics of national income and its related concepts like GDP, NDP GNP & NNP. Methods of calculating national income has also been explained in this module.

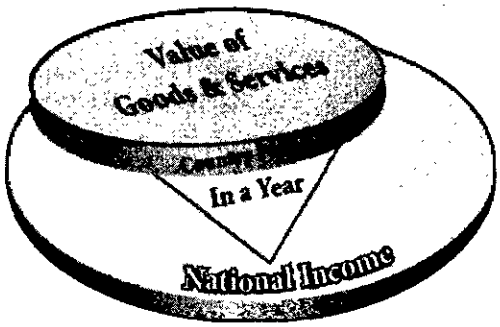
roduction

ional Income provides a comprehensive measure of the economic activities of tion. It denotes the country's purchasing power. The growth of an economy is sured by the rate at which its real national income grows over time. National ne thus serves as an instrument of economic planning. Further, national income of the most significant macroeconomic variables. Thus, a clear understanding meaning, concepts, measurement and uses of national income is essential.

laureate Simon Kuznets first introduced the concept of national income.

ng of National Income

mon parlance, National means the total money ll final goods and services in a country during a period of time (one year).



Definitions

"The labour and capital of a country acting on its natural resources pro annually a certain net aggregate of commodities, material and immaterial incl services of all kinds. This is the true net annual income or revenue of the co or national dividend".

-Alfred Mar

GDP and its detractors.

The welfare of a nation can scarcely be inferred from a measurement of nat income as defined by the GDP... goals for more growth should specify of and for what.

Simon Kuznets, (Creator of GDP) 1932

Simon Kuznets, (Creator of GDP) 1932

"The net output of the commodities and services flowing during the yea the country's productive system into the hands of the ultimate consumers net addition to the country's stock of capital goods".

- Simon

Basic concepts of national income

The following are some of the concepts used in measuring national inco

1. GDP
2. GNP
3. NNP
4. NNP at factor cost
5. Personal Income
6. Disposable Income
7. Per capita Income
8. Real Income
9. GDP deflator

1. Gross Domestic Product (GDP)

GDP is the total market value of final goods and services produc the country during a year. This is calculated at market prices and as GDP at market prices.

GDP by expenditure method at market prices $= C + I + G +$

Where C – consumption goods; I – Investment goods;

G – Government purchases;

X – Exports; M – Imports

(X – M) is net export which can be positive or negative.

(a) Net Domestic Product (NDP)

NDP is the value of net output of the economy during the year. Some of the country's capital equipment wears out or becomes outdated each year during the production process.

Net Domestic Product = GDP - Depreciation.

2. Gross National Product (GNP)

GNP is the total measure of the flow of final goods and services at market value resulting from current production in a country during a year, including net income from abroad. GNP includes five types of final goods and services:

(1) value of final consumer goods and services produced in a year to satisfy the immediate wants of the people which is referred to as consumption (C);

(2) gross private domestic investment in capital goods consisting of fixed capital formation, residential construction and inventories of finished and unfinished goods which is called as gross investment (I) ;

(3) goods and services produced or purchased by the government which is denoted by (G) ; and

(4) net exports of goods and services, i.e., the difference between value of exports and imports of goods and services, known as (X-M) ; Net factor incomes from abroad which refers to the difference between factor incomes (wage, interest, profits) received from abroad by normal residents of India and factor incomes paid to the foreign residents for factor services rendered by them in the domestic territory in India (R-P);

(5) GNP at market prices means the gross value of final goods and services produced annually in a country plus net factor income from abroad (C + I + G + (X-M) + (R-P)).

GNP at Market Prices = GDP at Market Prices + Net Factor income from Abroad.

3. Net National Product (NNP) (at Market price)

Net National Product refers to the value of the net output of the economy during the year. NNP is obtained by deducting the value of depreciation, or replacement allowance of the capital assets from the GNP. It is expressed as,

NNP = GNP – depreciation allowance.

(depreciation is also called as Capital Consumption Allowance)

4. NNP at Factor cost

NNP refers to the market value of output. Whereas NNP at factor cost is

the total of income payment made to factors of production. Thus, from the money value of NNP at market price, we deduct the amount of indirect taxes and add subsidies to arrive at the net national income at factor cost.

NNP at factor cost = NNP at Market prices – Indirect taxes + Subsidies.

5. **Personal Income**

Personal income is the total income received by the individuals of a country from all sources before payment of direct taxes in a year. Personal income is never equal to the national income, because the former includes the transfer payments whereas they are not included in national income. Personal income is derived from national income by deducting undistributed corporate profit, and employees' contributions to social security schemes and adding transfer payment.

Personal Income = National Income – (Social Security Contribution and undistributed corporate profits) + Transfer payment

6. **Disposable Income**

Disposable Income is also known as Disposable personal income. It is the individual's income after the payment of income tax. This is the amount available for households for consumption.

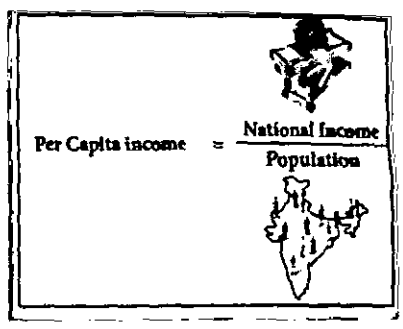
Disposable Income = Personal income – Direct Tax.

As the entire disposable income is not spent on consumption,

Disposal income = consumption + saving.

7. **Per Capita Income**

The average income of a person of a country in a particular year is called Per Capita Income. Per capita income is obtained by dividing national income by population.



8. **Real Income**

Nominal income is national income expressed in terms of a gene price level of a particular year in other words, real income is the buy power of nominal income. National income is the final value of go and services produced and expressed in terms of money at current pri But it does not indicate the real state of the economy. The real INCO is derived as follows:

National Income at constant price = National Income at current price ÷ P_1 / P_0

9. **GDP deflator**

GDP deflator is an index of price changes of goods and services included in GDP. It is a price index which is calculated by dividing the nominal GDP in a given year by the real GDP for the same year and multiplying it by 100.

GDP deflator = [Nominal GDP/Real GDP] x100

Methods of Measuring National Income

All goods and services produced in the country must be counted and converted against money value during a year. Thus, whatever is produced is either used for consumption or for saving. Thus, national output can be computed at any of three levels, viz., production, income and expenditure. Accordingly, there are three methods that are used to measure national income:

1. Production or value-added method
2. Income method or factor earning method
3. Expenditure method

And if these methods are done correctly, the following equation must hold

Output = Income = Expenditure

$$\text{GDP deflator} = \frac{\textit{Nominal GDP}}{\textit{Real GDP}} \times 100$$

GDP - By Sum of Spending, Factor Incomes or Output

GDP (Expenditure)	GDP (Factor Incomes)	GDP (Value of Output)

• Consumption
• Government spending
• Investment spending
• Change in value of stocks
• Exports
• –Imports
• = GDP (known as aggregate demand)
	• Income from people in jobs and in self employment (e.g. wages and salaries)
	• Profit private sector business
	• Rent income from the ownership of land
		• Value added from each of the main economic sectors
		• These sectors are
		  • Primary
		  • Secondary
		  • Manufacturing
		  • Quaternary

This is because the three methods are circular in nature. It begins as production, through recruitments of factors of production, generating income and going as incomes to factors of production.

1. Product Method

Product method measures the output of the country. It is also called inventory method. Under this method, the gross value of output from different sectors like agriculture, industry, trade and commerce, etc., is obtained for the entire economy during a year. The value obtained is actually the GNP at market prices. Care must be taken to avoid double counting.

The value of the final product is derived by the summation of all the values added in the productive process. To avoid double counting, either the value of the final output should be taken into the estimate of GNP or the sum of values added should be taken.

In India, the gross value of the farm output is obtained as follows:

(i) Total production of 64 agriculture commodities is estimated. The output of each crop is measured by multiplying the area sown by the average yield per hectare.

(ii) The total output of each commodity is valued at market prices.

(iii) The aggregate value of total output of these 64 commodities is taken to measure the gross value of agricultural output.

(iv) The net value of the agricultural output is measured by making deductions for the cost of seed, manures and fertilisers, market charges, repairs and depreciation from the gross value.

Similarly, the gross values of the output of animal husbandry, forestry, fishery, mining and factory establishments are obtained by multiplying their estimates of total production with market prices. Net value of the output in these sectors is derived by making deductions for cost of materials used in the process of production and depreciation allowances, etc. from gross value of output.

Net value of each sector measured in this way indicates the net contribution of the sector to the national income.

Precautions

The product method is followed in underdeveloped countries, but it is less reliable because the margin error in this method is large. In India, this method is applied to agriculture, mining and manufacturing, including handicrafts.

1. Double counting is to be avoided under value added method. Any commodity which is either raw material or intermediate good for the final production should not be counted. For example, value of cotton enters value of yarn as cost, and of yarn in cloth and that of cloth in garments. At every stage value added only should be calculated.
2. The value of output used for self consumption should be counted while measuring national income.

3. In the case of durable goods, sale and purchase of second-hand goods (for example pre owned cars) should not be included.

2. Income Method (Factor Earning Method)

This method approaches national income from the distribution side. Under this method, national income is calculated by adding up all the incomes generated in the course of producing national product.

Steps involved

1. The enterprises are classified into various industrial groups.
2. Factor incomes are grouped under labour income, capital income and mixed income.
   (a) Labour income - Wages and salaries, fringe benefits, employer's contribution to social security.
   (b) Capital income – Profit, interest, dividend and royalty
   (c) Mixed income – Farming, sole proprietorship and other professions.
3. National income is calculated as domestic factor income plus net factor incomes from abroad. In short,
   $\mathbf{Y = w + r + i + \pi + (R\text{-}P)}$
   w = wages, r = rent, i = interest, π = profits,
   R = Exports and P = Imports

This method is adopted for estimating the contributions of the remaining sectors, viz., small enterprises, banking and insurance, commerce and transport, professions, liberal arts and domestic service, public authorities, house property and foreign sector transaction.

Data on income from abroad (the rest of the world sector or foreign sector) are obtained from the account of the balance of payments of the country.

Precautions

While estimating national income through income method, the following precautions should be taken.

Items not to be included

1. Transfer payments are not to be included in estimation of national income as these payments are not received for any services provided in the current year such as pension, social insurance etc.
2. The receipts from the sale of second-hand goods should not be treated as part of national income as they do not create new flow of goods or services in the current year.
3. Windfall gains such as lotteries are also not to be included as they do not represent receipts from any current productive activity.
4. Corporate profit tax should not be separately included as it has been already included as a part of company profit.

Items to be included

1. Imputed value of rent for self-occupied houses or offices is to be included.
2. Imputed value of services provided by owners of production units (family labour) is to be included.

3. **The Expenditure Method (Outlay method)**

Under this method, the total expenditure incurred by the society in a particular year is added together. To calculate the expenditure of a society, it includes personal consumption expenditure, net domestic investment, government expenditure on consumption as well as capital goods and net exports. Symbolically,

GNP = C + I + G + (X-M)

C - Private consumption expenditure

I - Private Investment Expenditure

G - Government expenditure

X-M = Net exports

Precautions

1. **Second hand goods:** The expenditure made on second hand goods should not be included.
2. **Purchase of shares and bonds:** Expenditures on purchase of old shares and bonds in the secondary market should not be included.
3. **Transfer payments:** Expenditures towards payment incurred by the government like old age pension should not be included.
4. **Expenditure on intermediate goods:** Expenditure on seeds and fertilizers by farmers, cotton and yarn by textile industries are not to be included to avoid double counting. That is only expenditure on final products are to be included

National Income (NNP_{FC}) = Gross Value Added by all the production Enterprises within the Domestic Territory of the Country – Depreciation – Net Indirect Taxes + Net Factor Income from Abroad

[Where, Net Indirect Taxes = Indirect tax – Subsidies]

[Gross Value Added = Value of Output – Intermediate Consumption] Value of Output = Sales + Change in Stock

Where, Change in Stock = Closing Stock – Opening Stock

Note: If entire output is sold within the year, then value of output will be equal to sales itself.

or

Value of Output = Price x Quantity Sold

GDP_{MP} = Private Final Consumption + Government Final Consumption Expenditure + Gross Domestic Capital Formation + Net Exports (Exports – Imports)

Circular Flow of Income

The circular flow of income is a model of an economy showing connections between different sectors of an economy. It shows flows of income, goods and services and factors of production between economic agents such as firms, households, government and nations. The circular flow analysis is the basis of national accounts and macroeconomics.

There are three models of circular flow of income, representing the major economic systems.

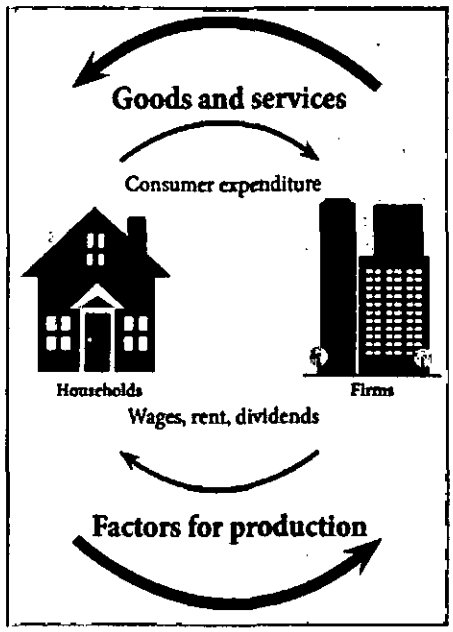
1. **Two Sector Model:** It is for a simple economy with households and firms.
2. **Three Sector Model:** It is for a mixed and closed economy with households, firms and government.
3. **Four Sector Model:** It is for an open economy with households, firms, government and rest of the world (External sector).

1. **Circular Flow of Income in a Two-Sector Economy:**

   There are only two sectors namely, household sector and firm sector.

   (i) **Household Sector:** The household sector is the sole buyer of goods and services, and the sole supplier of factors of production, i.e., land, labour, capital and organisation. It spends its entire income on the purchase of goods and services produced by the business sector. The household sector receives income from firm sector by providing the factors of production owned by it.

   (ii) **Firms:** The firm sector generates its revenue by selling goods and services to the household sector. It hires the factors of production, i.e., land, labour, capital and organisation, owned by the household sector. The firm sector sells the entire output to households.



In a two- sector economy, production and sales are equal and there will be a circular flow of income and goods. The outer circle represents real flow (factors and goods) and the inner circle represents the monetary flow (factor prices and commodity prices). Real flow indicates the factor services flow from household sector to the business sector, and goods and services flow from business sector to the household. The basic identities of the two-sector economy are as under:

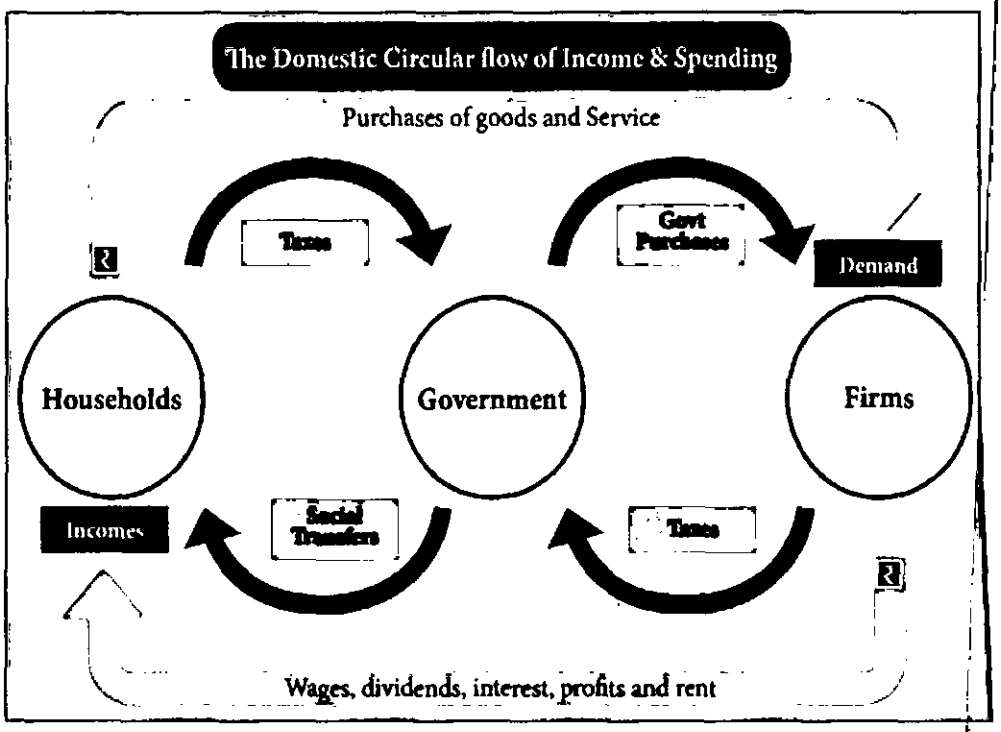
Y= C+I

Where

Y is Income; C is Consumption; I is investment

2. **Circular Flow of Income in a Three-Sector Economy:**

In addition to household and firms, inclusion of the government sector makes this model a three-sector model. The government levies taxes on households and firms, purchases goods and services from firms, and receive factors of production from household sector. On the other hand, the government also makes social transfers such as pension, relief, subsidies to the households. Similarly, Government pays the firms for the purchases of goods and services.



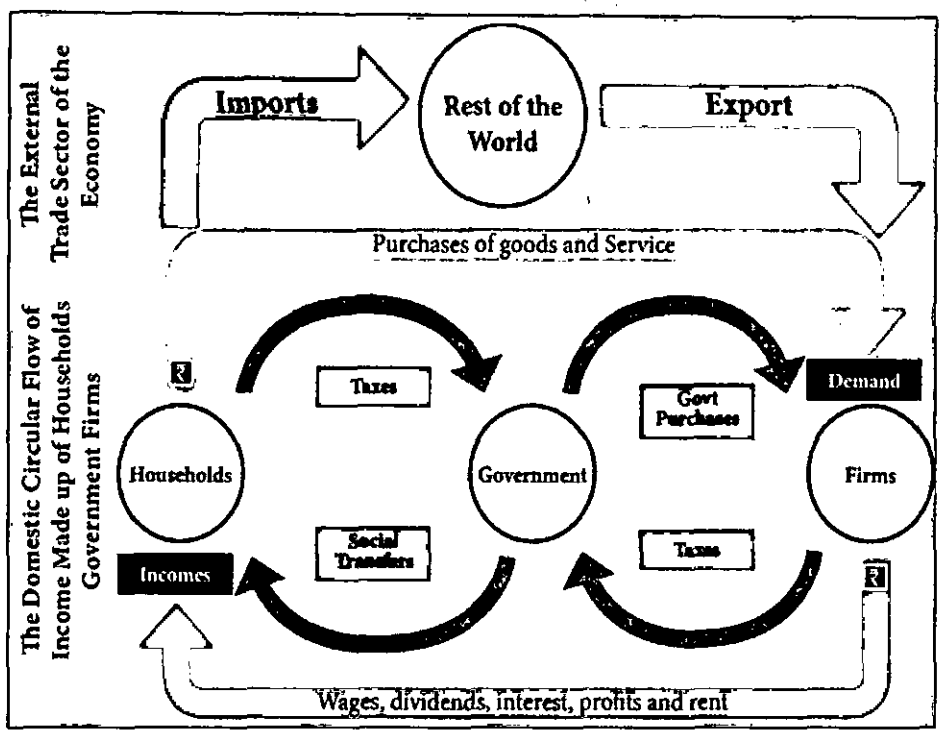
The Flow Chart illustrates three-sector economy model:

Under three sector model, national income (Y) is obtained by adding Consumption expenditure (C), Investment expenditure (I) and Government expenditure (G).

Therefore:

Y= C+I+G

3. Circular Flow of Income in a Four-Sector Economy:



In a Four- sector economy, in addition to household, firms and government, a fourth sector namely, external sector is included. In real life, only four-sector economy exists. This model is composed of four sectors namely, (i) Households, (ii) Firms, (iii) Government, (iv) External sector

The external sector comprises exports and imports. It is illustrated in the Flow Chart.

In four-sector economy, expenditure for the entire economy include domestic expenditure (C+I+G) and net exports (X– M). Therefore,

$$Y = C + I + G + (X - M)$$

SUMMARY OF THE CHAPTER

National income means the value of goods and services produced by a country during a financial year. Thus, it is the net result of all economic activities of any country during a period of one year and is valued in terms of money. National income is an uncertain term and is often used interchangeably with the national dividend, national output, and national expenditure. We can understand this concept by understanding the national income definition.

There are various methods for measuring National Income:

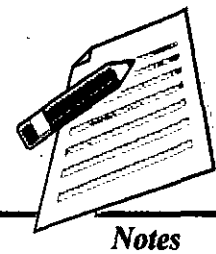
1. Gross Domestic Product (GDP)
2. Gross National Product (GNP)
3. Net National Product (NNP)
4. Net Domestic Product (NDP)

5. National Income at Factor Cost (NIFC)
6. Transfer Payments
7. Personal Income
8. Disposable Personal Income

EXERCISE

Multiple Choice Questions

1. Output means. .....unless stated otherwise
   (a) Gross output at MP (b) Net output at MP
   (c) Gross output at FC (d) None
   Ans: A
2. Which of the following is not a component of domestic income?
   (a) Operating surplus (b) Compensation of employees
   (c) Net factor income from abroad (d) Mixed income
   Ans: C
3. A growing country is one whose
   (a) GNP is rising at current prices
   (b) GNP is constant at constant prices
   (c) GNP is rising at constant prices
   (d) None of these
   Ans: C
4. If factor cost is greater than marker price, it means that
   (a) Indirect taxes < subsidies (b) Indirect taxes > subsidies
   (c) I.T = subsidies (d) None
   Ans: A
5. An Indian farmer produces wheat without incurring cost of inputs alll sells for Rs. 1,000 to a miller who grinds wheat into flour and sells for Rs 1,200 to baker. The baker sells bread to consumers for Rs. 1,600. Total v: added is Rs.
   (a) 1,600 (b) 2,200
   (c) 1,000 (d) 1,400
   Ans: A
6. Which of the following is not true about final goods ?
   (a) Final gods satisfy wants of ultimate consumers and producers.
   (b) Final goods have direct demand as they satisfy the wants directly.
   (c) Final goods are subject to further transformation in the process of production.
   (d) Final goods are neither used up as raw-material nor for resale in the same year.
   Ans: C
7. Following is an example of final good:
   (a) Flour used by a banker in making biscuits
   (b) Unsold stock of goods lying with the sellers
   (c) Tyres purchased by a transport company
   (d) Mobile sets purchased by a mobile dealer
   Ana: B



Review Question

1. Define the concept of Value-Added method?
2. Distinguish between intermediate consumption and final consumption?
3. Whether the following items will be included in national income? Give reasons for your answer.
   i. Bonus to employees
   ii. Purchase of books by a student
   iii. Bus fare paid by a passenger
   iv. Wages received by an Indian working in British embassy.
   v. Free meals to beggars
4. Are the following a part of a country's net domestic product at market price? Explain
   i. Net indirect taxes
   ii. Net exports
   iii. Net factor income from capital

Space for Work

21 MODULE-X : THEORY OF INCOME AND EMPLOYMENT

Module Content

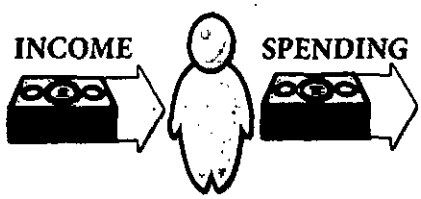
Consumption function, saving function and investment function propensity to consume and save Concept of aggregate demand, Determination of Equilibrium level of Income, Increase in income Through Multiplier Process; Excess demand and Deficiency in demand.

Objective of the module

The main objective of this module is to make student understand about the basics of Consumption function and saving functions. The concept of multiplier has also been discussed in this module.

Consumption Function

1. Meaning of Consumption Function



CONSUMPTION FUNCTION

The consumption function or propensity to consume refers to income consumption relationship. It is a "functional relationship between two aggregates viz., total consumption and gross national income."

Symbolically, the relationship is represented as

C= f (Y)

Where,

C = Consumption

Y = Income

f = Function

Thus the consumption function indicates a functional relationship between C and Y, where C is the dependent variable and Y is the independent variable, i.e., C is

determined by Y. This relationship is based on the ceteris paribus (other things being same) assumption, as only income consumption relationship is considered and all possible influences on consumption are held constant.

In fact, consumption function is a schedule of the various amounts of consumption expenditure corresponding to different levels of income. A hypothetical consumption schedule is given in Table 1.

Table : 1 Income - Consumption Schedule (₹Crores)

Income Y	Consumption C	Savings S
0	20	-20
60	70	-10
120	120	0
180	170	10
240	220	20
300	270	30
360	320	40

If we take C = 100 + 0.8y, then MPC = 0.8

Here, if Y = 0, C = 100; if Y = 100, C = 180;

if Y = 200, C = 260;

if Y = 300, C = 340 (MPC = $\frac{\Delta c}{\Delta y}$ =0.8)

In mathematical terms

C= a + b Y or C = 20 + 0.8Y

Where a>0 and b<1

C= Consumption

a= constant or intercept = 20

Y= income

b= MPC (Marginal prosperity to consume) = 0.8 = $\frac{\Delta c}{\Delta y}$

The above table shows that consumption is an increasing function of income because consumption expenditure increases with increase in income. Here it is shown that when income is zero, people spend out of their past savings on consumption because they must eat in order to live (Autonomous Consumption).

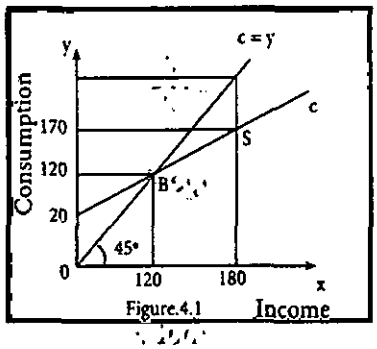


Figure.4.1

Here, when y = 120, C = 120 (Point B is the diagram)

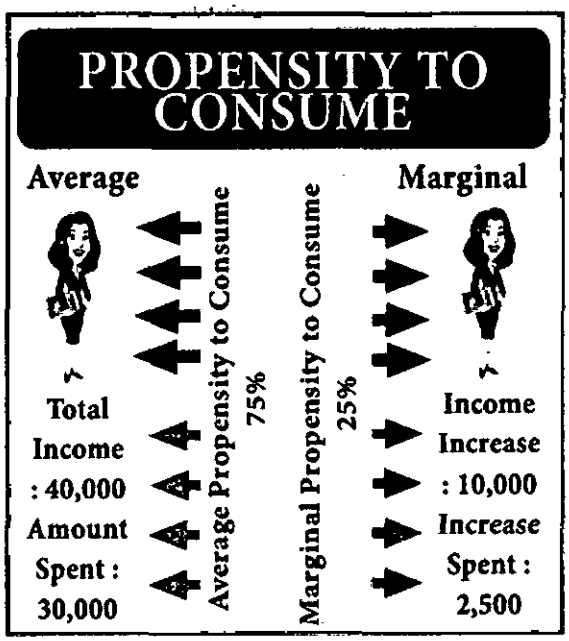
When y = 180, C = 170, S = 10 (Point S is the diagram)

If Y increases to 360, C = 320, S = 40

In the diagram, income is measured horizontally and consumption is measured vertically. In 45 line at all levels, income and consumption are equal. It is a linear consumption function based on the assumption that consumption changes by the same amount as does income.

Thus the consumption function measures not only the amount spent on consumption but also the amount saved. This is because the propensity to save is merely the propensity not to consume. The 45° line may therefore be regarded as a zero-saving line, and the shape and position of the C curve indicate the division of income between consumption and saving.

2. Technical Attributes of the Consumption Function



(i) The Average Propensity to Consume $= \frac{c}{y}$

(ii) The Marginal Propensity to Consume $= \frac{\Delta c}{\Delta y}$

(iii) The Average Propensity to Save $= \frac{s}{y}$

(iv) The Marginal Propensity to Save $= \frac{\Delta s}{\Delta y}$

(1) The Average Propensity to Consume:

The average propensity to consume is the ratio of consumption expenditure to any particular level of income." Algebraically it may be expressed as under:

APC = C/Y

$$APC = \frac{C}{Y}$$

C= Consumption

Y = Income

(2) The Marginal Propensity to Consume:

The marginal propensity to consume may be defined as the ratio of the change in the consumption to the change in income. Algebraically it may be expressed as under:

MPC = ΔC/ΔY

$$MPC = \frac{\Delta C}{\Delta Y}$$

Where

ΔC= Change in Consumption

ΔY = Change in Income

MPC is positive but less than unity

0 < ΔC/ΔY < 1

$$0 < \frac{\Delta C}{\Delta Y} < 1$$

(3) The Average Propensity to Save (APS) :

The average propensity to save is the ratio of saving to income.

APS is the quotient obtained by dividing the total saving by the total income. In other words, it is the ratio of total savings to total income. It can be expressed algebraically in the form of equation as under

APS = S/Y

$$APS = \frac{S}{Y}$$

Where

S= Saving

Y=Income

(4) The Marginal Propensity to Save (MPS) :

Marginal Propensity to Save is the ratio of change in saving to a change in income.

MPS is obtained by dividing change in savings by change in income. It can be expressed algebraically as

$$MPS = \frac{\Delta S}{\Delta Y}$$

MPS = ΔS/ΔY

ΔS = Change in Saving

ΔY= Change in Income

Since MPC+MPS=1

MPS=1-MPC and MPC = 1 - MPS

Generally the average ie APC is expressed in percentage and the MPC in fraction.

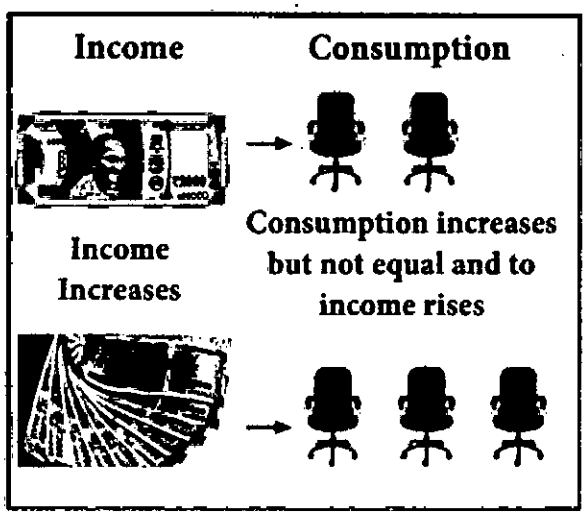
Table: 2 Calculation of APC, MPC, APS and MPS

Income Y	Consumption C	APC % C/Y	APS % S/Y	MPC ΔC/ΔY	MPS ΔS/ΔY
120	120	(120/120)100 = 100	(0/120)0	-	-
180	170	(170/180)100 = 94	(10/180)100	50/60 = 0.83	0.17

3. Keynes's Psychological Law of Consumption:

Keynes propounded the fundamental Psychological Law of Consumption which forms the basis of the consumption function. He stated that "The fundamental psychological law upon which we are entitled to depend with great confidence both prior from our knowledge of human nature and from the detailed facts of

experience, is that men are disposed as a rule and on the average to increase their consumption as their income increases but not by as much as the increase in their income." The law implies that there is a tendency on the part of the people to spend on consumption less than the full increment of income.



Assumptions:

Keynes's Law is based on the following assumptions:

1. **Ceteris paribus (constant extraneous variables):**
   The other variables such as income distribution, tastes, habits, social customs, price movements, population growth, etc. do not change and consumption depends on income alone.
2. **Existence of Normal Conditions:**
   The law holds good under normal conditions. If, however, the economy is faced with abnormal and extraordinary circumstances like war, revolution or hyperinflation, the law will not operate. People may spend the whole of increased income on consumption.
3. **Existence of a Laissez-faire Capitalist Economy:**
   The law operates in a rich capitalist economy where there is no government intervention. People should be free to spend increased income. In the case of regulation of private enterprise and consumption expenditures by the State, the law breaks down.

Propositions of the Law:

This law has three propositions:

(1) **When income increases, consumption expenditure also increases but by a smaller amount.** The reason is that as income increases, our wants are satisfied side by side, so that the need to spend more on consumer goods diminishes. So, the consumption expenditure increases with increase in income but less than proportionately.

(2) **The increased income will be divided in some proportion between consumption expenditure and saving.** This follows from the first proposition because when the whole of increased income is not spent on consumption, the remaining is saved. In this way, consumption and saving move together.

(3) **Increase in income always leads to an increase in both consumption and saving.** This means that increased income is unlikely to lead to fall in either consumption or saving. Thus with increased income both consumption and saving increase.

Table 3. The three propositions of the law

120	120	0
180	170	10
240	220	20

Proposition (1): Income increases by ₹ 60 crores and the increase in consumption is by ₹ 50 crores.

Proposition (2): The increased income of ₹ 60 crores in each case is divided in some proportion between consumption and saving respectively. (i.e., ₹ 50crores and ₹ 10 crores).

Proposition (3): As income increases consumption as well as saving increase. Neither consumption nor saving has fallen.

Diagrammatically, the three propositions are explained in Figure 4.2. Here, income is measured horizontally and consumption and saving are measured on the vertical axis. C is the consumption function curve and 45° line represents income consumption equality.

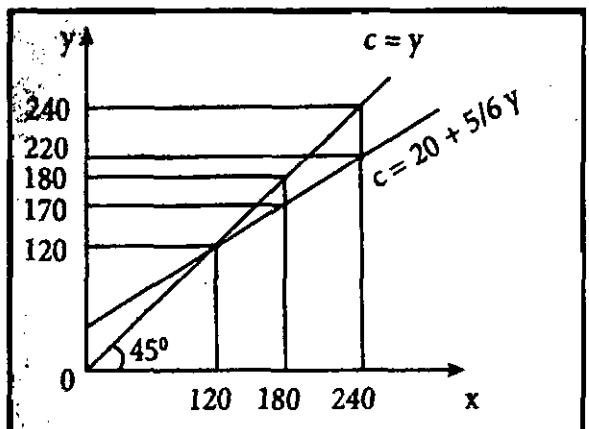


Figure.4.2

Proposition (1): When income increases from 120 to 180 consumption also increases from 120 to 170 but the increase in consumption is less than the increase in income, 10 is saved.

Proposition (2): When income increases to 180 and 240 it is divided in some proportion between consumption by 170 and 220 and saving by 10 and 20 respectively.

Proposition (3): Increases in income to 180 and 240 lead to increased consumption 170 and 220 and increased saving 20 and 10 than before. It is clear from the widening area below the C curve and the saving gap between 45° line and C curve.

4. Determinants of Consumption function: Subjective and Objective Factors

J.M Keynes has divided factors influencing the consumption function into two namely: Subjective factors and Objective factors

(a) Subjective Factors

Subjective factors are the internal factors related to psychological feelings. Major subjective factors influencing consumption function are given below.

Keynes lists eight motives which lead *individuals* to refrain from spending, they are:

1. **The motive of precaution:** To build up a reserve against unforeseen contingencies. Eg. Accidents, sickness
2. **The motive of foresight:** The desire to provide for anticipated future needs. Eg. Old age
3. **The motive of calculation:** The desire to enjoy interest and appreciation.
4. **The motive of improvement:** The desire to enjoy for improving standard of living.
5. **The motive of financial independence.**
6. **The motive of enterprise** (desire to do forward trading).
7. **The motive of pride.**(desire to bequeath a fortune)
8. **The motive of avarice.**(purely miserly instinct)

Keynes sums up the motives as Precaution, Foresight, Calculation, Improvement, Independence, Enterprise, Pride and Avarice.

The *Government, institutions* and *business corporations* and *firms* may also consume mainly because of the following four motives:

1. **The motive of enterprise:** The desire to obtain resources to carry out further capital investment without incurring debt.
2. **The motive of liquidity:** The desire to secure liquid resources to meet emergencies, and difficulties.
3. **The motive of improvement:** The desire to secure a rising income and to demonstrate successful management.

4. The motive of financial prudence:

The desire to ensure adequate financial provision against depreciation and obsolescence and to discharge debt.

According to Keynes, the subjective factors do not change in the short run and hence consumption function remains stable in the short period.

(b) Objective Factors

Objective factors are the external factors which are real and measurable. These factors can be easily changed in the long run. Major objective factors influencing consumption function are:

1) Income Distribution

If there is large disparity between rich and poor, the consumption is low because the rich people have low propensity to consume and high propensity to save. The community with more equal distribution of income tends to have high propensity to consume. This view has been corroborated by V.K.R.V. Rao.

2) Price level

Price level plays an important role in determining the consumption function. When the price falls, real income goes up; people will consume more and propensity to save of the society increases.

3) Wage level

Wage level plays an important role in determining the consumption function and there is positive relationship between wage and consumption. Consumption expenditure increases with the rise in wages. Similar is the effect with regard to windfall gains.

4) Interest rate

Rate of interest plays an important role in determining the consumption function. Higher rate of interest will encourage people to save more money and reduces consumption.

5) Fiscal Policy

When government reduces the tax the disposable income rises and the propensity to consume of community increases. The progressive tax system increases the propensity to consume of the people by altering the income distribution in favour of poor.

6) Consumer credit

The availability of consumer credit at easy installments will encourage households to buy consumer durables like automobiles, fridge, computer. This pushes up consumption.

7) Demographic factors

Ceteris paribus, the larger the size of the family, the grater is the consumption. Besides size of family, stage in family life cycle, place of residence and occupation affect the consumption function. Families with

C = 100 + 0.8 y; I = 100

I = 10

Y = C + I

= 100 + 0.8y + 100

0.2y = 200

Y = 1000

Here, C = 100 + 0.8y = 100 + (1000) = 900;

S = 100 = I

After I is raised by 10, now I = 110,

Y = 100 + 0.8y + 110

0.2y = 210

Y = 210/0.2 = 1050

Here C = 100=0.8(1050) = 940; S = 110 = I

Diagrammatic Explanation.

At 45° line y = C+ S

It implies the variables in axis and axis are equal.

The MPC is assumed to be at 0.8 (C = 100 + 0.8y)

The aggregate demand (C+I) curve intersects 45° line at point E.

The original national income is 500.

(C = 100 + 0.8y = 100 + 0.8(500) = 500)

When I is 100, y = 1000, C = 900;

S = 100 = I

The new aggregate demand curve is C+I' = 100 + 0.8y + 100 +10

Y = 210/0.2 = 1050

C = 940; S = 110 =

3. **Working of Multiplier**

   Suppose the Government undertakes investment expenditure equal to ₹100 crore on some public works, by way of wages, price of materials etc. Thus, income of labourers and suppliers of materials increases by ₹100 crore. Suppose the MPC is 0.8 that is 80 %. A sum of ₹80 crores is spent on consumption (A sum of ₹ 20 Crores is saved). As a result, suppliers of goods get an income of ₹80 crores. They inturn spend ₹64 crores (80% of ₹80 cr). In this manner consumption expenditure and increase in income act in a chain like manner.

Positive Multiplier and Negative Multiplier Effects	
Positive Multiplier	**Negative Multiplier**
When an intial increases in an injection (or a decrease in a leakage) leads to a greater final increase in real GDP.	When an intial increases in an injection (or an increase in a leakage) leads to a greater final decrease in real GDP.

The final result isΔY = 100+100×4/5+100 ×[4/5]2+100×[4/5]3 or,

ΔY = 100 + 100 x 0.8 + 100 x (0.8)2 + 100

x (0.8)3

=100 + 80 + 64 + 51.2...

=500

that is 100×1/1-4/5

100×1/1/5

100×5 = ₹500 crores

For instance, if C = 100 + 0.8Y, I = 100, Then Y = 100 + 0.8Y + 100

0.2Y = 200

Y = 200/0.2 = 1000→Point B If I is increased to 110, then

0.2Y =210

Y = 210/0.2 = 1050→Point D

For ₹10 increase in I, Y has increased by ₹50.

This is due to multiplier effect.

At point A, Y = C = 500

C = 100 + 0.8 (500) = 500; S=0

At point B, Y = 1000

C = 100 + 0.8 (1000) = 900; S = 100 = I

At point D, Y = 1050

C = 100 + 0.8 (1050) = 940; S = 110 = I

When I is increased by 10, Y increases by 50.

This is multiplier effect (K = 5)

K = 1/0.2= 5

4. Classification of Multiplier: Static and dynamic multiplier

1. Static and dynamic multiplier

   i. **Static multiplier** is otherwise known as simultaneous multiplier, timeless multiplier, and logical multiplier.

   Under static multiplier the change in investment and the resulting change in income are simultaneous. There is no time lag. There is also no change in MPC as the economy moves from one equilibrium position to another.

   ii. **Dynamic multiplier** is also known as 'sequence multiplier'. In real life, income level does not increase instantly with investment. In fact, there is a time lag between increase in income and consumption expenditure.

5. **Leakages of multiplier**

The multiplier assumes that those who earn income are likely to spend a proportion of their additional income on consumption. But in practice, people tend to spend their additional income on other items. Such expenses are known as leakages.

Payment towards past debts.

If a portion of the additional income is used for repayment of old loan, the MPC is reduced and as a result the value of multiplier is cut.

Purchase of existing wealth

If income is used in purchase of existing wealth such as land, building and shares money is circulated among people and never enters into the consumption stream. As a result the value of multiplier is affected.

Import of goods and services

Income spent on imports of goods or services flows out of the country and has little chance to return to income stream in the country. Thus imports reduce the value of multiplier.

Non availability of consumer goods

The multiplier theory assumes instantaneous supply of consumer goods following demand. But there is often a time lag. During this gap (D>S) inflation is likely to rise. This reduces the consumption expenditure and thereby multiplier value.

Full employment situation

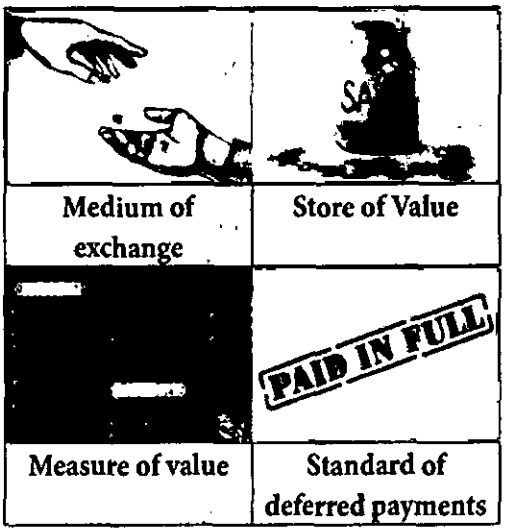
Under conditions of full employment, resources are almost fully employed. So, additional investment will lead to inflation only, rather than generation of additional real income.

6. **Uses of multiplier**

   1. Multiplier highlights the importance of investment in income and employment theory.

i) **Money as a medium of exchange:** This is considered as the basic function of money. Money has the quality of general acceptability, and all exchanges take place in terms of money. On account of the use of money, the transaction has now come to be divided into two parts. First, money is obtained through sale of goods or services. This is known as sale. Later, money is obtained to buy goods and services. This is known as purchase. Thus, in the modern exchange system money acts as the intermediary in sales and purchases.

ii) **Money as a measure of value:** The second important function of money is that it measures the value of goods and services. In other words, the prices of all goods and services are expressed in terms of money. Money is thus looked upon as a collective measure of value. Since all the values are expressed in terms of money, it is easier to determine the rate of exchange between various types of goods in the community.



2. **Secondary Functions**

(i) **Money as a Store of value:** Savings done in terms of commodities were not permanent. But, with the invention of money, this difficulty has now disappeared and savings are now done in terms of money. Money also serves as an excellent store of wealth, as it can be easily converted into other marketable assets, such as, land, machinery, plant etc.

ii) **Money as a Standard of Deferred Payments:** Borrowing and lending were difficult problems under the barter system. In the absence of money, the borrowed amount could be returned only in terms of goods and services. But the modern money-economy has greatly facilitated the borrowing and lending processes. In other words, money now acts as the standard of deferred payments.

iii) **Money as a Means of Transferring Purchasing Power:** The field of exchange also went on extending with growing economic development. The exchange of goods is now extended to distant lands. It is therefore, felt necessary to transfer purchasing power from one place to another.

3. **Contingent Functions**

i) **Basis of the Credit System:** Money is the basis of the Credit System. Business transactions are either in cash or on credit. For example, a depositor can make use of cheques only when there are sufficient funds in his account. The commercial bankscreate credit on the basis of adequate cash reserves. But, money is at the back of all credit.

ii) **Money facilitates distribution of National Income:** The task of distribution of national income was exceedingly complex under the barter system. But the invention of money has now facilitated the distribution of income as rent, wage, interest and profit.

iii) **Money helps to Equalize Marginal Utilities and Marginal Productivities:** Consumer can obtain maximum utility only if he incurs expenditure on various commodities in such a manner as to equalize marginal utilities accruing from them. Now in equalizing these marginal utilities, money plays an important role, because the prices of all commodities are expressed in money. Money also helps to equalize marginal productivities of various factors of production.

iv) **Money Increases Productivity of Capital:** Money is the most liquid form of capital. In other words, capital in the form of money can be put to any use. It is on account of this liquidity of money that capital can be transferred from the less productive to the more productive uses.

Supply of Money

Money supply means the total amount of money in an economy. It refers to the amount of money which is in circulation in an economy at any given time. Money supply plays a crucial role in the determination of price level and interest rates. Money supply viewed at a given point of time is a stock and over a period of time it is a flow.

Meaning of Money Supply

In India, currency notes are issued by the Reserve Bank of India (RBI) and coins are issued by the Ministry of Finance, Government of India (GOI) . Besides these, the balance is savings, or current account deposits, held by the public in commercial banks is also considered money. The currency notes are also called fiat money and legal tenders.

Money supply is a stock variable. RBI publishes information for four alternative measures of Money supply, namely M_1,M_2,M_3 and M_4.

M_1 = Currency, coins and demand deposits

M_2 = M_1 + Savings deposits with post office savings banks

$M_3 = M_2$ + Time deposits of all commercial and cooperative banks

$M_4 = M_3$ + Total deposits with Post offices.

M_1 and M_2 are known as narrow money

M_3 and M_4 are known as broad money

The gradations are in decreasing order of liquidity.

Currency Symbol ₹

The new symbol designed by D.Udaya Kumar, a post graduate of IIT Bombay was finally selected by the Union cabinet on 15th July, 2010. The new symbol is an amalgamation of Devanagri 'Ra' and the Roman 'R' without the stem. The symbol of India rupee came into use on 15thJuly,2010. After America, Britain, Japan, Europe Union. India is the 5th country to accept a unique currency symbol.

Determinants of Money Supply

1. Currency Deposit Ratio (CDR); It is the ratio of money held by the public in currency to that they hold in bank deposits.
2. Reserve deposit Ratio (RDR); Reserve Money consists of two things
   (a) vault cash in banks and
   (b) deposits of commercial banks with RBI.
3. Cash Reserve Ratio (CRR); It is the fraction of the deposits the banks must keep with RBI.
4. Statutory Liquidity Ratio (SLR); It is the fraction of the total demand and time deposits of the commercial banks in the form of specified liquid assests.

Central Bank

A central bank, reserve bank, or monetary authority is an institution that manages a state's currency, money supply, and interest rates. Central banks also usually oversee the commercial banking system of their respective countries.

1. Functions of Central Bank (Reserve Bank of India)

The Reserve Bank of India (RBI) is India's central banking institution, which controls the monetary policy of the Indian rupee. It commenced its operations on 1 April 1935 in accordance with the Reserve Bank of India Act, 1934. The original share capital was divided into shares of ₹100 each fully paid, which were initially owned entirely by private shareholders. Following India's independence on 15 August 1947, the RBI was nationalised on 1 January 1949.

1. **Monetary Authority:** It controls the supply of money in the economy to stabilize exchange rate, maintain healthy balance of payment, attain financial stability, control inflation, strengthen banking system.

2. **The issuer of currency:** The objective is to maintain the currency and credit system of the country. It is the sole authority to issue currency. It also takes action to control the circulation of fake currency.
3. **The issuer of Banking License:** As per Sec 22 of Banking Regulation Act, every bank has to obtain a banking license from RBI to conduct banking business in India.
4. **Banker to the Government:** It acts as banker both to the central and the state governments. It provides short-term credit. It manages all new issues of government loans, servicing the government debt outstanding and nurturing the market for government securities. It advises the government on banking and financial subjects.
5. **Banker's Bank:** RBI is the bank of all banks in India as it provides loan to banks, accept the deposit of banks, and rediscount the bills of banks.
6. **Lender of last resort:** The banks can borrow from the RBI by keeping eligible securities as collateral at the time of need or crisis, when there is no other source.
7. **Act as clearing house:** For settlement of banking transactions, RBI manages 14 clearing houses. It facilitates the exchange of instruments and processing of payment instructions.
8. **Custodian of foreign exchange reserves:** It acts as a custodian of FOREX. It administers and enforces the provision of Foreign Exchange Management Act (FEMA), 1999. RBI buys and sells foreign currency to maintain the exchange rate of Indian rupee v/s foreign currencies.
9. **Regulator of Economy:** It controls the money supply in the system, monitors different key indicators like GDP, Inflation, etc.
10. **Managing Government securities:** RBI administers investments in institutions when they invest specified minimum proportions of their total assets/liabilities in government securities.
11. **Regulator and Supervisor of Payment and Settlement Systems:** The Payment and Settlement Systems Act of 2007 (PSS Act) gives RBI oversight authority for the payment and settlement systems in the country. RBI focuses on the development and functioning of safe, secure and efficient payment and settlement mechanisms.
12. **Developmental Role:** This role includes the development of the quality banking system in India and ensuring that credit is available to the productive sectors of the economy. It provides a wide range of promotional functions to support national objectives. It also includes establishing institutions designed to build the country's financial infrastructure. It also helps in expanding access to affordable financial services and promoting financial education and literacy.
13. **Publisher of monetary data and other data:** RBI maintains and provides all essential banking and other economic data, formulating and critically evaluating the economic policies in India. RBI collects, collates and publishes data regularly.
14. **Exchange manager and controller:** RBI represents India as a member of the International Monetary Fund [IMF]. Most of the commercial banks are authorized dealers of RBI.

15. **Banking Ombudsman Scheme:** RBI introduced the Banking Ombudsman Scheme in 1995. Under this scheme, the complainants can file their complaints in any form, including online and can also appeal to the Ombudsman against the awards and the other decisions of the Banks.
16. **Banking Codes and Standards Board of India:** To measure the performance of banks against Codes and standards based on established global practices, the RBI has set up the Banking Codes and Standards Board of India (BCSBI).

2. **Credit Control Measures**

Credit control is the primary mechanism available to the Central banks to realize the objectives of monetary management. The RBI is much better placed than many of credit control. The statutory basis for the control of the credit system by the Reserve Bank is embodied in the Reserve Bank of India Act, 1934 and the Banking Regulation Act, 1949.

Credit Control Measures

General (Quantitative)	Selective (Qualitative)
1. Bank Rate	1. Rationing of Credit
2. Open Market Operations	2. Direct Action
3. Variable Cash Reserve Ratio	3. Moral suasion
	4. Publicity
	5. Regulation of Consumer' Credit
	6. Marginal Requirements

3. **Methods of Credit Control**

I. Quantitative or General Methods:

1. **Bank Rate Policy:**

The bank rate is the rate at which the Central Bank of a country is prepared to re-discount the first class securities. It means the bank is prepared to advance loans on approved securities to its member banks. As the Central Bank is only the lender of the last resort the bank rate is normally higher than the market rate. For example: If the Central Bank wants to control credit, it will raise the bank rate. As a result, the deposit rate and other lending rates in the money-market will go up. Borrowing will be discouraged, and will lead to contraction of credit and vice versa.

2. **Open Market Operations:**

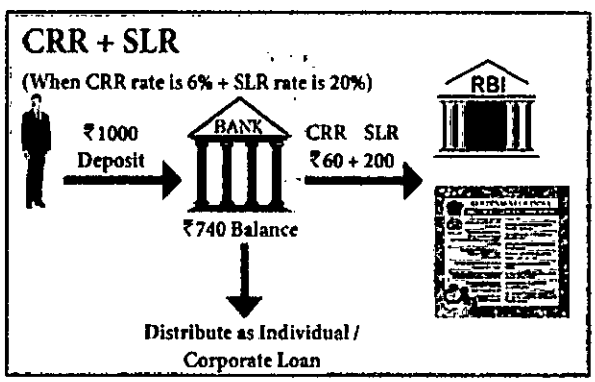
In narrow sense, the Central Bank starts the purchase and sale of Government securities in the money market.

In Broad Sense, the Central Bank purchases and sells not only Government securities but also other proper eligible securities like bills and securities of private concerns. When the banks and the private individuals purchase these securities they have to make payments for these securities to the Central Bank.

3. **Variable Reserve Ratio:**

   (a) **Cash Reserves Ratio:**

   Under this system the Central Bank controls credit by changing the Cash Reserves Ratio. For example, if the Commercial Banks have excessive cash reserves on the basis of which they are creating too much of credit,this will be harmful for the larger interest of the economy. So it will raise the cash reserve ratio which the Commercial Banks are required to maintain with the Central Bank.



   Similarly, when the Central Bank desires that the Commercial Banks should increase the volume of credit in order to bring about an economic revival in the economy. The central Bank will lower down the Cash Reserve Ratio with a view to expand the lending capacity of the Commercial Banks.

   Variable Cash Reserve Ratio as an objective of monetary policy was first suggested by J.M. Keynes. It was first followed by Federal Reserve System in United States of America. The commercial banks as per the statute has to maintain reserves based on their demand deposit and fixed deposit with central bank is called as Cash Reserve Ratio.

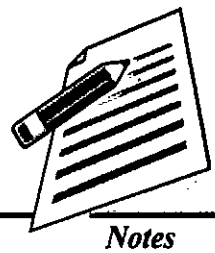
   If the CRR is high, the commercial bank's capacity to create credit will be less and if the CRR is low, the commercial bank's capacity to create credit will be high.

   (b) **Statutory Liquidity Ratio:**

   Statutory Liquidity Ratio (SLR) is the amount which a bank has to maintain in the form of cash, gold or approved securities. The quantum is specified as some percentage of the total demand and time liabilities (i.e., the liabilities of the bank which are payable on demand anytime, and those liabilities which are accruing in one month's time due to maturity) of a bank.

II. Qualitative or Selective Method of Credit Control:

The qualitative or the selective methods are directed towards the diversion of credit into particular uses or channels in the economy. Their objective is mainly to control and regulate the flow of credit into particular industries or businesses. The following are the frequent methods of credit control under selective method:



1. Rationing of Credit
2. Direct Action
3. Moral Persuasion
4. Method of Publicity
5. Regulation of Consumer's Credit
6. Regulating the Marginal Requirements on Security Loans

1. Rationing of Credit

This is the oldest method of credit control. Rationing of credit as an instrument of credit control was first used by the Bank of England by the end of the 18th Century. It aims to control and regulate the purposes for which credit is granted by commercial banks. It is generally of two types.

(a) **The variable portfolio ceiling:** It refers to the system by which the central bank fixes ceiling or maximum amount of loans and advances for every commercial bank.

(b) **The variable capital asset ratio:** It refers to the system by which the central bank fixes the ratio which the capital of the commercial bank should have to the total assets of the bank.

2. Direct Action

Direct action against the erring banks can take the following forms.

(a) The central bank may refuse to altogether grant discounting facilities to such banks.

(b) The central bank may refuse to sanction further financial accommodation to a bank whose existing borrowing are found to be in excess of its capital and reserves.

(c) The central bank may start charging penal rate of interest on money borrowed by a bank beyond the prescribed limit.

3. Moral Suasion

This method is frequently adopted by the Central Bank to exercise control over the Commercial Banks. Under this method Central Bank gives advice, then requests. and persuades the Commercial Banks to co-operate with the Central Bank in implementing its credit policies.

4. Publicity

Central Bank in order to make their policies successful, take the course of the medium of publicity. A policy can be effectively successful only when an effective public opinion is created in its favour.

5. Regulation of Consumer's Credit:

The down payment is raised and the number of installments reduced for the credit sale.

6. Changes in the Marginal Requirements on Security Loans:

This system is mostly followed in U.S.A. Under this system, the Board of Governors of the Federal Reserve System has been given the power to prescribe margin requirements for the purpose of preventing an excessive use of credit for stock exchange speculation.

This system is specially intended to help the Central Bank in controlling the volume of credit used for speculation in securities under the Securities Exchange Act, 1934.

The Repo Rate and the Reverse Repo Rate are the frequently used tools with which the RBI can control the availability and the supply of money in the economy. RR is always greater than RRR in India

Repo Rate: (RR)

The rate at which the RBI is willing to lend to commercial banks is called Repo Rate. Whenever banks have any shortage of funds they can borrow from the RBI, against securities. If the RBI increases the Repo Rate, it makes borrowing expensive for banks and vice versa. As a tool to control inflation, RBI increases the Repo Rate, making it more expensive for the banks to borrow from the RBI. Similarly, the RBI will do the exact opposite in a deflationary environment.

Reverse Repo Rate: (RRR)

The rate at which the RBI is willing to borrow from the commercial banks is called reverse repo rate. If the RBI increases the reverse repo rate, it means that the RBI is willing to offer lucrative interest rate to banks to park their money with the RBI. This results in a decrease in the amount of money available for banks customers as banks prefer to park their money with the RBI as it involves higher safety. This naturally leads to a higher rate of interest which the banks will demand from their customers for lending money to them.

4. **Reserve Bank of India and Rural Credit**

   In a developing economy like India, the Central bank of the country cannot confine itself to the monetary regulation only, and it is expected that it should take part in development function in all sectors especially in the agriculture and industry.

5. **Role of RBI in agricultural credit**

   RBI has been playing a very vital role in the provision of agricultural finance in the country. The Bank's responsibility in this field had been increased due to the predominance of agriculture in the Indian economy and the inadequacy of the formal agencies to cater to the huge requirements of the sector. In order to fulfill this important role effectively, the RBI set up a separate *Agriculture Credit Department.* However, the volume of informal loans has not declined sufficiently.

6. **Functions of Agriculture Credit Department:**

   (a) To maintain an expert staff to study all questions on agricultural credit;

   (b) To provide expert advice to Central and State Government, State Co-operative Banks and other banking activities.

   (c) To finance the rural sector through eligible institutions engaged in the business of agricultural credit and to co-ordinate their activities.

The duties of the RBI in agricultural credit were much restricted as it had to function only in an ex -officio capacity being the Central Bank of the country. It could not lend directly to the farmers, but the supply of rural credit was done

through the mechanism of refinance with institutions specializing in rural credit. Primary societies may borrow from Central Co-operative Bank, and the latter may borrow from the apex or the State Co-operative Bank, which in its turn might get accommodation facilities from the RBI.

The RBI was providing medium-term loans also for a period exceeding 15 months to 5 years for reclamation of land, construction of irrigation works, purchase of machinery, etc.

The Reserve Bank of India was also providing long-term loans to fiancé permanent changes in land and also for the redemption of old debts.

With the establishment of *National Bank for Agriculture and Rural Development* (NABARD), all the functions of the RBIrelating to agricultural credit had been taken over and looked after by NABARD since 1982. Since then, all activities relating to rural credit are entirely looked after by NABARD

Monetary Policy

Monetary Policy is the macroeconomic policy being laid down by the Central Bank towards the management of money supply and interest rate. It is the demand side economic policy used by the government of a country to achieve macroeconomic objectives like inflation, consumption, growth and liquidity. The monetary policy gained its significance after the World War II, thanks to the initiation made by Milton Friedman, who is associated with the doctrine of "monetarism" and who received Nobel Prize in 1976. He boldly announced in his book "Monetary History of the UnitedStates, 1867 – 1960" that the Great Depression of the 1930's was largely the outcome of the bungling monetary policies of the Federal Reserve System.

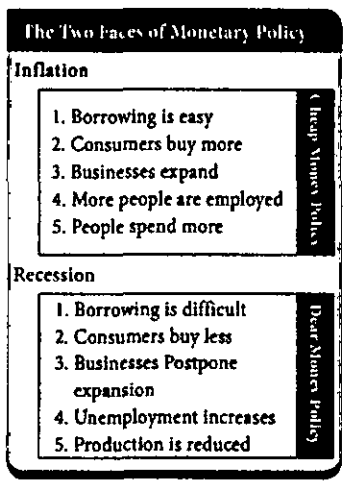

Milton Friedman

1. **Monetary Policy: Expansionary Vs. Contractionary**

   Expansionary policy is cheap money policy when a monetary authority uses its tools to stimulate the economy. An expansionary policy maintains short-term interest rates at a lower than usual rate or increases the total supply of money in the economy more rapidly than usual. It is traditionally used to try to combat unemployment by lowering interest rates in the hope that less expensive credit will entice businesses into expanding. This increases aggregate demand (the overall demand for all goods and services in an economy), which boosts short-term growth as measured by gross domestic product (GDP) growth.

   The Contractionary monetary policy is dear money policy, which maintains short-term interest rates higher than usual or which slows the rate of growth in the money supply or even shrinks it. This slows short-term economic

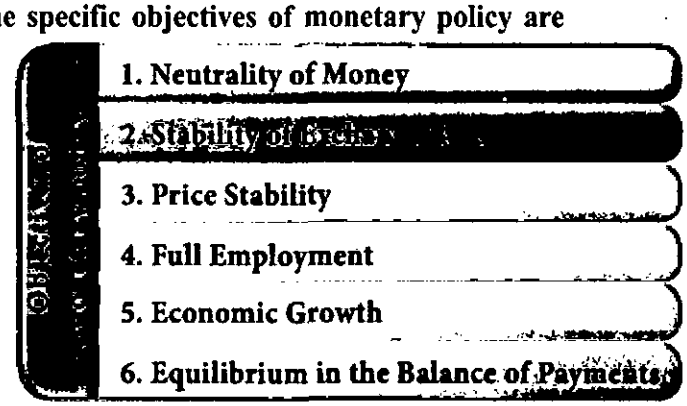
growth and lessens inflation. Contractionary monetary policy can lead to increased unemployment and depressed borrowing and spending by consumers and businesses, which can eventually result in an economic recession if implemented too vigorously.



2. Objectives of Monetary Policy

The monetary policy in developed economies has to serve the function of stabilization and maintaining proper equilibrium in the economic system. But in case of underdeveloped countries, the monetary policy has to be more dynamic so as to meet the requirements of an expanding economy by creating suitable conditions for economic progress. It is now widely recognized that monetary policy can be a powerful tool of economic transformation.

3. The specific objectives of monetary policy are



1. Neutrality of Money

Economists like Wicksteed, Hayek and Robertson are the chief exponents of neutral money. They hold the view that monetary authority should aim at neutrality of money in the economy. Monetary changes could be the root cause of all economic fluctuations. According to neutralists, the monetary change causes distortion and disturbances in the proper operation of the economic system of the country.

2. Exchange Rate Stability

Exchange rate stability was the traditional objective of monetary authority. This was the main objective under Gold Standard among different

countries. When there was disequilibrium in the balance of payments of the country, it was automatically corrected by movements. It was popularly known as "Expand Currency and Credit when gold is coming in; contract currency and credit when gold is going out." This system will correct the disequilibrium in the balance of payments and exchange rate stability will be maintained.

It must be noted that if there is instability in the exchange rates, it would result in outflow or inflow of gold resulting in unfavorable balance of payments. Therefore, stable exchange rates are advocated.

3. **Price Stability**

Economists like Crustave Cassel and Keynes suggested price stabilization as a main objective of monetary policy. Price stability is considered the most genuine objective of monetary policy. Stable prices repose public confidence. It promotes business activity and ensures equitable distribution of income and wealth. As a consequence, there is general wave of prosperity and welfare in the community.

But it is admitted that price stability does not mean 'price rigidity' or price stagnation'. A mild increase in the price level provides a tonic for economic growth. It keeps all virtues of a stable price.

4. **Full Employment**

During world depression, the problem of unemployment had increased rapidly. It was regarded as socially dangerous, economically wasteful and morally deplorable. Thus, full employment was considered as the main goal of monetary policy. With the publication of Keynes' General Theory of Employment, Interest and Money in 1936, the objective of full employment gained full support as the chief objective of monetary policy.

5. **Economic Growth**

Economic growth is the process whereby the real per capita income of a country increases over a long period of time. It implies an increase in the total physical or real output, production of goods for the satisfaction of human wants.

Therefore, monetary policy should promote sustained and continuous economic growth by maintaining equilibrium between the total demand for money and total production capacity and further creating favourable conditions for saving and investment. For bringing equality between demand and supply, flexible monetary policy is the best course.

6. **Equilibrium in the Balance of Payments**

Equilibrium in the balance of payments is another objective of monetary policy which emerged significant in the post war years. This is simply due to the problem of international liquidity on account of the growth of world trade at a faster speed than the world liquidity.

It was felt that increasing of deficit in the balance of payments reduces the ability of an economy to achieve other objectives. As a result, many less developed countries have to curtail their imports which adversely affects development activities. Therefore, monetary authority makes efforts to maintain equilibrium in the balance of payments.

Government Budget

Government Budget It is a statement of expected/estimated receipts and expenditure of the government over the period of a financial year, i.e. 1st April to 31st March.

Types of Budget

(i) Balanced budget, i.e. estimated receipts = estimated expenditure
(ii) Surplus budget, i.e. estimated receipts > estimated expenditure
(iii) Deficit budget, i.e. estimated receipts < estimated expenditure

Objectives of Government Budget

(i) Re-distribution of income and wealth
(ii) Re-allocation of resources
(iii) Economic growth
(iv) Management of public enterprises
(v) Economic stability
(vi) Generation of employment
(vii) Reducing regional disparities

Impacts of Budget

(i) Brings aggregate fiscal discipline level.
(ii) Promotes better allocation of resources.
(iii) Can effectively and efficiently implement programme.

Components of Budget

(i) Revenue budget It is the statement of estimated revenue receipts and estimated revenue expenditure during a fiscal year.

(ii) Capital budget It is an account of the assets as well as the liabilities of the Central Government, which takes into consideration changes in capital during a fiscal year.

Revenue Receipts The receipts which neither create any corresponding liability for the government nor does it lead to any reduction in assets is termed as revenue receipts, e.g. tax receipts of the government.

Classification of Revenue Receipts

(i) Tax revenue It consists of the proceeds of taxes and other duties levied by the Central Government. It comprises of

(a) Direct tax These are the taxes for which the incidence and impact of tax falls on the same person, i.e. actual burden of the taxes cannot be shifted, e.g. income tax, corporation tax, etc.

(b) Indirect tax These are the taxes for which the incidence and impact fall on separate persons, i.e. burden of these taxes can be shifted to others, e.g. service tax, entertainment tax, etc.

(ii) Non-tax revenue It mainly consists of interest receipts on account of loans by the Central Government, dividends and profits on investment made by the government, fees and other receipts for services rendered by the government.

Revenue Expenditures Those expenditures of the government, which neither cause any increase in government assets nor cause any reduction in government liabilities are termed as revenue expenditures, e.g. expenditure on old age pensions, salaries, etc.

Classification of Revenue Expenditure

(i) **Administrative expenses** These are incurred on normal running of the government, e.g. salaries and pension of government employees.

(ii) **Social welfare expenses** These are incurred to promote social well being of the citizens, e.g. expenditure on rural development, education and health services, and subsidies.

Note Interest payments by government on loans taken is also an example of revenue expenditure.

Capital Receipts The receipts which create corresponding liability for the government or which lead to reduction in assets of the government are termed as capital receipts, e.g. loans taken by the government, disinvestment of any PSUs, etc. Classification of capital receipts are :

(i) **Borrowings** These are funds raised by the government to meet its expenses. Government may borrow from :

(a) Public

(b) RBI

(c) Foreign Governments

(d) International Financial Institutions like IMF, World Bank Etc.

(ii) **Recovery of loans** It refers to that inflow of cash which the government has disbursed previously.

(iii) **Other receipts** It includes

(a) Proceeds from disinvestment.

(b) Mobilisation of savings through NSC, KVP, etc.

Capital Expenditures Those expenditures of the government, which lead to increase in government assets or lead to reduction in government liabilities is termed as capital expenditure, e.g. expenses on the construction of national highways, payment of loan by the government, etc.

Classification of capital expenditure are :

(i) Loans to states and union territories result in outflow of funds, but also create assets in the form of debtors.

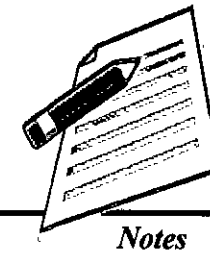
(ii) Expenditure of building infrastructure like roads, metro rail network, etc.

Public Expenditure These expenses are incurred by the government for developing infrastructure and promoting social welfare.

Summary of the Unit

The components of the money supply are as follows:

Paper Money and Coins – The Central Bank or Government issues these as Currency. Further, they have a 100% acceptance as a means of payment. The



acceptance is based on a 'promise to pay the bearer' gold and/or foreign exchange in return.

Demand Deposit – A bank has a legal obligation to pay money on demand. The money-ness is highest in currency and demand deposits.

Near Money or Money Substitute – A commonly used Near Money is a bank cheque. many people accept it as a means of payment. However, there is no legal compulsion behind their acceptance.

Term deposit – This is less liquid than a demand deposit as the individual cannot use it before a fixed period of time.

Other Financial Assets – Many non-banking financial intermediaries issue these assets.

Features of Budget

1. It is an estimate of the economic activities of an entity which related to a specified future period.
2. It must be written and approved by the appropriate authority.
3. It should be modified or corrected, whenever, there is a change in circumstances.
4. It plays the role of a business barometer that helps in measuring the performance of the business by comparing actual and budgeted results.
5. It is prepared on the basis of past experiences and trends in the business.
6. It is a business practice, which is used to forecast the operating activities and financial position of the business.

EXERCISE

Multiple Choice Questions

1. "Money is what money does" – who said?
   (a) Crowther (b) Robertson
   (c) Walker (d) Marshall
2. Direct exchange of goods against goods is called:
   (a) Charter (b) Money
   (c) Barter (d) None of these
3. What possess general acceptability?
   (a) Bank draft (b) Money
   (c) Bill of exchange (d) None of these
4. Which type of deposits gives highest rate of interest?
   (a) Current deposit (b) Fixed deposit
   (c) Recurring deposit (d) None of these
5. Which bank deals with short-term credit?
   (a) Agricultural bank (b) Commercial bank
   (c) Industrial bank (d) None of these

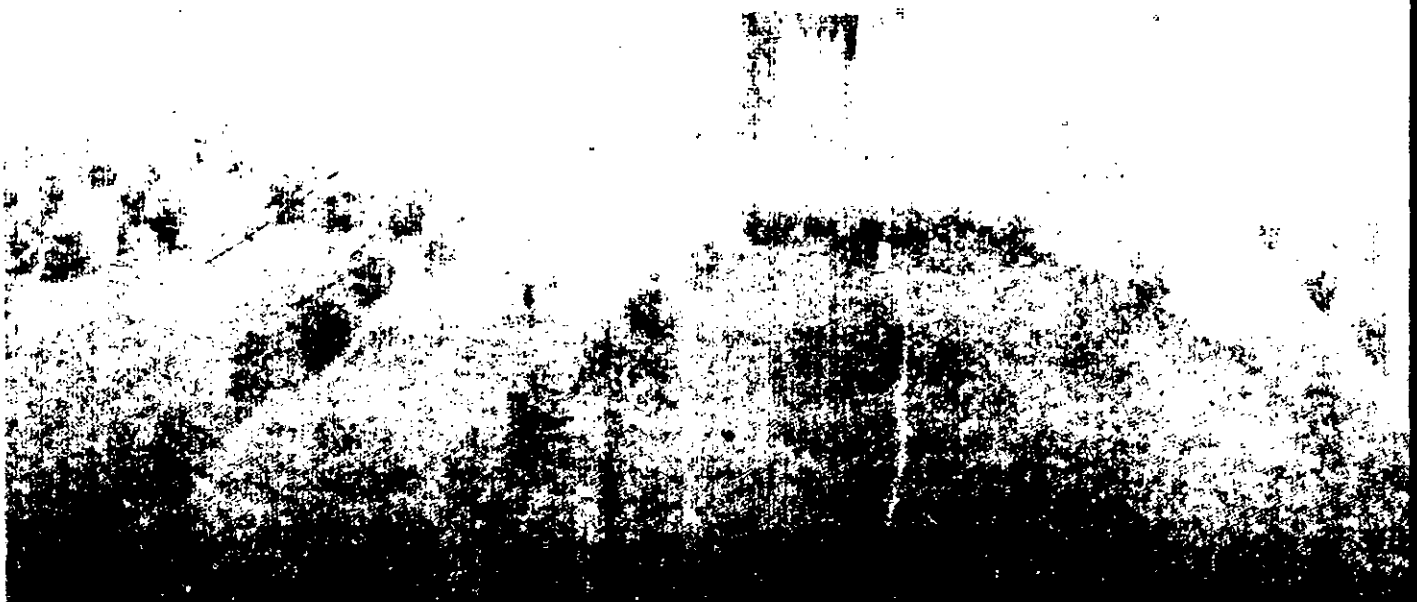
6. Which of the following is not the function of the commercial bank?
   (a) Issue of paper notes. (b) Acceptance of deposits
   (c) Advancing loans (d) Credit control
7. Which of the following is not near money?
   (a) Paper notes (b) Treasury bill
   (c) Bond (d) Bill of exchange
8. Which bank is called lender of last resort?
   (a) Commercial bank (b) Agricultural bank
   (c) Industrial bank (d) Central bank
9. In which year the Reserve Bank of the India was established?
   (a) 1945 (b) 1947
   (c) 1935 (d) 1953
10. Which bank enjoys monopoly power of Note issue?
   (a) NABARD (b) Commercial Bank
   (c) Central Bank (d) None of these
11. For which function, money is accepted as unit of account?
   (a) Measure of value, (b) Medium of exchange
   (c) Standard of deferred payment (d) Store of value
12. Which is considered as the mother of all Central Banks?
   (a) Bank of England (b) Risks Bank of Sweden
   (c) Federal Reserve Bank (d) Reserve Bank of India
13. Which of the following is an example of direct tax?
   (a) Sales tax (b) Commodity tax
   (c) Income tax (d) None of these
14. Who deals with income and expenditure of public authorities?
   (a) Public finance (b) Private finance
   (c) Local Govt. (d) None of these

Answer:

1. Walker,
2. Barter,
3. Money,
4. Fixed deposit,
5. Commercial bank,
6. issue of paper notes,
7. paper notes,
8. Central bank,
9. 1935,
10. Central bank,
11. Measure of value,
12. Bank of England,
13. Income tax,
14. Public finance.

Review Questions

1. Define government budget.
2. Give two examples of indirect taxes.
3. What is a direct tax?
4. Give two examples of non-tax revenue receipts.
5. Define tax
6. what are the functions of a central bank?
7. What are the components of money supply.



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