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KENDRIYAVIDYALAYA SANGATHAN NEW DELHI

अध्ययन सामग्री (प्रश्न बैंक) कक्षा XI के लिए (Study Material (Question Bank) For Class: XI)

सेवाकालीन पाठ्यक्रम : स्नातकोत्तर शिक्षकों (अर्थशास्त्र) हेतु – द्वितीय पाली, 18 से 27 नवम्बर, 2020

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6	Mr.Chandan Kumar Dwivedi	Chero Salempur	Varanasi
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39	Mrs. Seema Devi	Hamirpur	Gurugram
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45	Mrs. Nirmala Devi	Lucknow Cantt	Lucknow
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49	Ms. Kiran Bhatt	OFD Raipur Dehradun	Dehradun
50	Mrs. Rashmi pandey	No 1 , Surat	Ahmedabad

DETAILS OF GROUPS WITH MEMBERS

Group 1

1	AMAR NARAYAN SHUKLA	25
2	Arvind Kumar pareek	26
3	ARCHANA YADAV	27
4	ASAD AHMAD	28

Group 2

5	Bishnu prasad saho	29
6	Chandan Kumar Dwivedi	30
7	Deepak Kumar Bedi	31
8	Dhagala Ram	32

Group 3

9	Dhanpreet Kaur	33
10	DHARAM SINGH BAIRWA	34
11	DUDH NATH PRASAD	35
12	Geeta R	36

Group 4

13	HANS RAJ MEENA	37
14	Hari Mohan Kaushik	38
15	Indrani Sengupta	39
16	J. S. P. Pandey	40

Group 5

17	JAGDISH CHAND YADAV	41
18	JAISHA K J	42
19	Kiran Bhatt	43
20	Krishan Kumar	44
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Group 6

21	MADDILA VENKATESH	
22	MOHAMMAD IKHALAQUE	46
23	Munesh Nagar	47
24	Nandita Maity	48
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Group 7

	NIRMALA DEVI	
	P.L.Sonkar	
	PADAM SINGH	
	Prabhakar Tripathi	

Group 8

	PRAMOD BARIK	
	RAJ KUMAR	
	Rajeev Pathak	
	Rajshree singh	

Group 9

	Rakhi Baisoya	
	Rashmi pandey	
	S. Chandra Sekhar Reddy	
	S C Shukla	

Group 10

	Sanjeev Kumar	
	SANTOSH KUMAR RAI	
	Satish Kumar	
	Seema Devi	

Group 11

	SHAILENDRA KUMARI VERMA	
	Shankar Prasad Sah	
	SHIVALI SHARMA	
	Shubha shukla	
	Subrat Kumar Baliarsingh	

Group 12

	SUNITA MOHANTY	
	SUNNY TA	
	SUSHILA BARA	
	SURESH JANGID	
	UDAY KUMAR SINGH	

Part: 1-“Statistics for Economics”
Chapter-1:- INTRODUCTION

MCQS

1.The word Statics was used first in:

- i) 1749
- ii) 1851
- iii) 1849
- iv) 1790

2. The statistics is concerned with

- i) Aggregate of numerical facts
- ii) Aggregate of disorganised fact
- iii) Aggregate of qualitative fact
- iv) Aggregate of heterogeneous fact

3. Statistics is used by

- i) Government
- ii) Businessman
- iii) Economist
- iv) All of the above

4 .Statistics in singular sense is

- I) Collection of data
- II) organisation of data
- III) presentation of data
- IV) all of the above

5. Statistics is the study of ____ facts

- i) Quantitative
- ii) Qualitative
- iii) Both quantitative and qualitative

iv) Aggregate

6 The term statistics was first used by

i) Gottfried Achenwall

ii) Paul A. samuelson

iii) Lord Robbins

iv) JB say

Answers:

1) A

2) A

3) D

4) D

5) A

6) A

Mark the following statements is true or false

7 Statistics can only deal with quantitative data

8 Statistics solves economic problems

9 statistics is of no use to economics without data

Answers:

7) True

8) True

9) True

Very short answer type questions

10 What is the meaning of scarcity?

11 What is statistics in plural sense?

12 Who produces goods and services for the generation of income?

13 Which activity is the base of all production activities?

14 What do you mean by non-economic activity?

15 Give one limitation of statistics

Answers:

10. In daily life scarcity means acute shortage of a certain commodity but in economics, it means limitation of supply of a commodity in relation to its demand.

11. In plural sense the word statistics refers to numerical facts and figures collected in a systematic manner with a definite purpose in any field of study

12. Producer

13. Consumption

14. Activities which are not concerned with money are called non-economic activities

15. A) It is a study of numerical facts only

b) It is the study of aggregates only

Short answer type questions

- 1) What are your reasons for studying Economics?
- 2) Make a list of activities that constitutes the ordinary business of life. Are these economic activities?
- 3) Discuss the role of statistics in economic planning
- 4) "The government and policy makers use statistical data to formulate suitable policies of economic development." illustrate with two examples

Answers:

- 1) The main reason for studying Economics is making choices in the backdrop of scarcity
- 2) I) buying of goods and services
 - ii) Training services to a company by employees and workers
 - iii) Selling of goods and services
 - iv) Production process carried out by a firm

Yes, the above mentioned activities are regarded as economic activities. This is because, these activities are undertaken for monetary gain and are thus economic activities

- 3) Statistics are used in economic planning for the following purposes
 - (i) Statistical data help us in comparing the rate of development of one country with the rate of development of the other country.
 - (ii) The importance of consumption, production, distribution etc. can be known from the available statistical data.
 - (iii) The success that a plan achieves is measured best by the use of statistical methods.
 - (iv) Statistical data are used for knowing about the progress in the techniques of

production, volume of productions imports, exports, etc.

(v) Planning involves fixation of targets and priorities. Targets which are fixed, have to be achieved within a specific period of time.

- 4) The data on domestic production of oil and demand for oil will help the government in deciding how much it should be imported the data on conjunction of past years and the rate of growth of population would help in determining the demand for future.

Higher Order Thinking Skills

- 1) What are the five main forms of a statistical methods?
- 2) How will you choose the wants to be satisfied?
- 3) Briefly mention the main features of marshall's definition of economics.
- 4) Is economics a positive science or normative science or both?

Answers:

- 1) Statistical methods include the five following form or stages
 - a) Collection of data
 - b) Organisation of data
 - c) Presentation of data
 - d) Analysis of data
 - e) Interpretation of data

- 2) The resources with the producer have a limited and also have alternative uses.

E.g. at any point of time the resources in agriculture like land, labour, water fertilizers etc. are given. all these resources have alternative uses the same resources can be used in production of non-food crops such as rubber, cotton jute etc. we need to recognise the intensity of wants and then use the resources to satisfy them does alternative uses of resources give rise to the problem of choice as to how should our limited resources be spent to satisfy majority of unlimited wants.

- 3) Main features of Marshall Definition of economics are:

i) Economics is a social science and its studies the economic activities of social normal and real man

ii) Wealth is a means while its end is human welfare, i e it is for man and man is not for wealth.

iii) The central point in the study of economic is man's material welfare.

- 4) As positive science answers what is? Or what was. It studies human decision as facts which can be verified with actual data.

A normative science refers to be? What out to have happen? The normative statements, in fact, are the opinions of different persons relating to rightness or wrongness of particular thing or policy.

Thus, economics is both positive and normative science.

Long answer type questions

- 1) Economics is a science as well as an art. Explain?
- 2) Distinguish between quantitative and qualitative data?

Answers:

1) Science refers to a systematic study of certain behaviour. To analyse that behaviour scientists first collect data or facts, then systematically analyse and test to understand the behaviour or pattern of that data set. Finally scientists on the basis of the tested results formulate theories, principles or laws.

If we analyse economics on the above Definition of science then we will find that it is not always true in economics but the thinking of economics always works in the above scientific pattern but outcome or results are not same for each experiment as in natural science. Now the scientific study has been categorized in two branches on the above defined logic

- a) Social Science
- b) natural science.

Economics is a study of social science; therefore it is in category of social science.

In social science there are two types 1: positive and 2: normative science.

Positive science means which are true and testable like laws are testable. MICRO ECONOMICS consist a large part of laws or positive statements; therefore economics is like positive science.

Normative science: opinions regarding the desirability of various actions are called normative statements. MACRO Economics and economic planning which are branches of economics are mostly normative because the answers may turn to be wrong or may be denied.

Hence we can take economics as a science.

Now economics as an art:

Art is concerned with the application of a scientific theory. for example according to the robbins definition, individuals have to choose the best possible alternative that depends on the past experience of the individuals so when we apply a scientific theory then some partial problems may arise, and to tackle them by the learned skills is an art.

Economics is such kind of a subject that has both tests at the same time, a science and an art.

2) The fundamental points of difference between qualitative and quantitative data are discussed below:

- 1) The data type, in which the classification of objects is based on attributes (quality) is called qualitative data. The type of data which can be counted and expressed in numbers and values is called quantitative data.
- 2) The research methodology is exploratory in qualitative data, i.e. to provide insights and understanding. On the other hand, quantitative data is conclusive in nature which aims at testing a specific hypothesis and examine the relationships.
- 3) The approach to inquiry in the case of qualitative data is subjective and holistic whereas quantitative data has an objective and focused approach.

- 4) When the data type is qualitative the analysis is non-statistical. As opposed to quantitative data which uses statistical analysis.
- 5) In qualitative data, there is an unstructured gathering of data. As against this, data collection is structured in quantitative data.
- 6) While qualitative data determines the depth of understanding, quantitative data ascertains the level of occurrence.
- 7) Quantitative data is all about 'How much or how many'. On the contrary, qualitative data asks 'Why?'
- 8) In qualitative data the sample size is small and that too is drawn from non-representative samples. Conversely, the sample size is large in quantitative data drawn from the representative sample.
- 9) Qualitative data develops initial understanding, i.e. it defines the problem. Unlike quantitative data, which recommends the final course of action?

Chapter-2 Collection of Data

Q.1. what is data?

Ans. Data is the information in numerical/number form.

Q.2. Mention two sources of data.

Ans. 1. Primary source, 2. Secondary source.

Q.3. Data originally collected in the process of investigation is known as -----.
(Primary/Secondary)

Ans. Primary

Q.4. Data obtained from published or unpublished sources is known as ----- data.
(Primary/Secondary)

Ans. Secondary

Q.5. Census method is not possible in case of heterogeneous population. (True/False)

Ans. False

Q.6. Primary data involve more time and more expenses. (True/False)

Ans. True

Q.7. a good questionnaire should have:

(A) Minimum questions

(B) Concise

(C) Clear

(D) All the above

Ans. D

Q.8. if the investigator wants to select a sample on the basis of diverse characteristics of the population, which method should he use?

- (a) Convenience sampling method
- (b) Quota sampling method
- (C) Stratified sampling method
- (d) Both (b) and (c)

Ans. (d)

Q.9. for drawing lottery----- sampling is used.

- (a) Random
- (b) Purposive
- (c) Stratified
- (d) Quota

Ans. (a)

Q.10. After every ten years, information regarding population of India is collected through:

- (A) Sample
- (B) Census
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Ans. (B)

Q.11. Match the statements given under A with the correct options given under B.

(A)	(B)
1. Direct personal investigation	1. Local agents are appointed and trained to collect information
(ii) information from correspondents	2. Investigator approach third parties, who are in the possession of information about the subject of enquiry

(iii) Mailed questionnaire method	3.	Investigator collects data by having direct contact with the informant and conducts on-the-spot enquiry
(iv) indirect oral investigation	4.	Investigator makes a questionnaire and send it to the respondents, along with a covering letter

Ans. (i) c; (ii) a; (iii) d; (IV) b.

Q.12. Identify the correct sequence of alternatives given in column II by matching them with respective items in column I:

Column I	Column II
1. Sample method	(a) A short-cut method of random sampling
2. Deliberate sampling method	(b) occurs due to the difference in the scale of measurement
3. Random sampling	(c) only a partial investigation of the universe
4. Systematic sampling method	(d) allows every item an equal probability of being selected in the sample
5. Error of measurement	(e) selection of the sample items is made by choice

Ans. (i) c; (ii) e; (iii) d; (iv) a (v) b.

Q.13. Quota sampling is a ----- sampling. (Random/Non-random)

Ans. Non-random

Q.14. In-----, the entire information is recorded by the respondents themselves. (Questionnaires/schedules)

Ans. Questionnaires

Q.15. Direct personal investigation method suffers from:

(a) Personal Bias (b) Excessive Expenses (c) Time Consuming (d) All the above

Ans. (d)

Q.16 .which of the following errors is more serious and why?

(a) Sampling errors (b) Non-sampling errors

Ans. Non-sampling errors are more serious than sampling errors because a sampling error can be minimised by taking a larger sample. But, non-sampling error cannot be minimised even by taking a large sample.

Q.17. Name any three methods to collect primary data.

Ans. (1) direct personal investigation/interview.

- (2) Indirect oral investigation
- (3) Telephonic interview
- (4) Questionnaire method (any three methods)

Q.18. Mention the three merits and demerits of census method of data collection.

Ans.

Merits	Demerits
Intensive study of population	Expensive
High degree of accuracy and reliability	Needs more time and manpower
Suitable when population is not homogeneous	Inapplicable in case of infinite population

Q. 19. Why is a pilot survey important?

Answer: A pilot survey is essential because

- It helps in assessing the quality and suitability of question
- It evaluates the performance of enumerators
- It helps in designing a set of rules for the investigator
- It estimates the time and cost involved in the final survey

Q.20. Define stratified and mixed sampling?

Answer: In this method, the universe is divided into two groups having different characteristics and the items are selected for each group, so the entire group is represented.

Q.21. what are the qualities of a good questionnaire?

Answer: A good questionnaire should have.

- Less number of question
- Should be clear
- Proper order of question
- Non-controversial
- Question-related to the topic
- Request for return

Q.22. When is a direct personal investigation suitable for primary data collection?

Answer: The direct personal investigation method is suitable for collecting primary data only on the situation when

- The investigation is confined and less
- Authentic and accurate information is required
- The data is to be kept secret
- Direct contact with information is needed

Q.23. In what parameter is statistical information published in the census of India.

Answer: The parameter is statistical information published in the census of India are.

- Population projection
- Sex composition of a population
- Density of population
- Size, growth rate, and distribution of people in India

Q.24. what is Random Sampling? Explain briefly.

In random sampling the individual units from the population are selected at random. In this method, every individual has an equal chance of being selected. That means, whether an individual will get selected in the sample or not, entirely depends on chance. In random sampling all the items of a sample are selected independently of one another.

Random sampling is done in two ways:

- By using lottery method – In lottery method every unit of the population are kept in one place in the form of chits. Then these chits are mixed well and someone is asked to select the required number of chits in a random manner without any bias.
- By using random number table – In this method random number tables are generated to ensure equal probability of selection of every individual unit.

Q.25. Does the lottery method always give you a random sample? Explain.

In random sample, each and every unit of the population has an equal chance of getting selected. Lottery method always gives us a random sample.

In lottery method every unit of the population are kept in one place in the form of chits. Then these chits are mixed well and someone is asked to select the required number of chits in a random manner without any bias. This process leads to collection of random sample from the entire population.

For example, the government wants to determine the impact of rise in petrol price on the household budget of a particular locality. For this a random sample of 30 households has to be taken and studied. The names of all the 300 households are written on pieces of paper and mixed well. Then 30 names are selected by lottery method to generate a random sample.

Chapter: 3- ORGANISATION OF DATA

VERY SHORT QUESTIONS (1 MARK EACH)

Q.1. What do you mean by a discrete series?

Ans. A discrete series that series where individual values differ from each other by definite amount.

Q.2.What do you understand by the term “array”?

Ans. The arrangement of raw data in ascending or descending order of magnitude is known as array.

Q.3.What is meant by the term frequency?

Ans. Frequency refers to the number of items a given value appears in a distribution.

Q.4.Give the meaning of frequency distribution?

Ans. A table in which the frequencies and the associated values of a variable are written side by side, is known as a frequency distribution.

Q.5.What do you understand by individual series?

Ans. Individual series refers to the series in which items are listed singly i.e. each item given a separate vale of measurement.

Q.7.What is meant by geographical classification?

Ans. When the data are classified according to geographical location or region, it is known as geographical classification.

Q.8.What is quantitative classification?

Ans. When data is classified on the basis of the characteristics which can be measured, it is known as quantitative classification.

Q.9.Define qualitative classification?

Ans. When data is classified on the basis of attributes it is known as qualitative classification.

Q.10.What is meant by a statistical series?

The arrangement of classified data in some logical order, like according to the size, according to the time of occurrence or according to some other measurable or non-measurable characteristics, it is known as statistical series.

Q.11.What is meant by variable or variate?

Ans. A variable refers to quantity or attribute whose values varies from one investigation to another.

Q.12.What is meant by class-interval?

Ans. The difference between the upper limit and lower limit of a class is known as class interval. For example: the class interval of the class 10-20 is 10.

Q.13.What are class limit?

Ans. Upper limit and lower limit of the classes are called limits. For example in the class 5-10, 5 is the lower limit and 10 is the upper limit.

Q.14.What does a tally bar signify?

Ans. A tally bar signifies one occurrence of an item corresponding to a particular class-interval.

Q.15.Which series exclude the upper limit of the class interval?

Ans. Exclusive series.

Q.16.A frequency distribution can be:

- | | |
|-------------------|------------------|
| A) Discrete | b) continuous |
| c) Both (a) & (b) | d) none of these |

Ans. c

Q.17. Classes with zero frequencies are called:

- | | |
|--------------|------------------|
| a) Class | b) Empty class |
| c) Nil class | d) none of these |

Ans. b

Q.18.In inclusive class-interval of a frequency distribution:

- | | |
|---|---|
| a) Upper limit of each class-interval is Included | b) lower limit of class interval included |
|---|---|

- | | | |
|-------------------|-------------------|-------|
| c) Both (a) & (b) | d) none of these. | Ans.c |
|-------------------|-------------------|-------|

Q. 19 Classification of literacy rate in percentage of India in terms of years as example

- | | |
|--------------------------------|---------------------------------|
| a) Geographical classification | b) Chronological Classification |
| c) Quantitative Classification | d) Qualitative Classification |

Ans.b

Q. 20 the class mid-point is equal to

- The average of the upper-class limit and lower-class limit
- The product of the upper-class limit and lower-class limit
- The ratio of the upper-class limit and lower-class limit

d) None of the above

Ans. a)

SHORT QUESTIONS (3/4 MARKS)

1. What is frequency distribution? How does it differ from frequency array?

Ans. When observed data are grouped according to class intervals and frequencies of various are shown against them is called frequency distribution.

Frequency distribution shows how the different values of a variable are distributed in different classes along with their corresponding class frequencies. While Frequency Array shows different values of the variables available their corresponding frequencies.

Frequency distribution is a technique of classifying data for a continuous variable whereas frequency array for a discrete series.

2. What is classification of data? Explain chronological data and spatial data.

Ans. It is a technique or process of arranging data in a groups or classes on the basis of certain properties.

Chronological data: When the data is classified on the basis of time.eg. Population of India year wise

Spatial data: When the data is classified on the basis of place like state, country.eg. Production of wheat in different states of India.

3. Distinguish between exclusive and inclusive methods used in classification of data.

Ans.

	Exclusive Series	Inclusive Series												
1.	Upper limit of class interval is the lower limit of succeeding class interval.	Upper limit of class interval is not lower limit of succeeding class interval.												
2.	Upper limit will not be included.	Upper limit will be included.												
3.	Eg. <table border="1" data-bbox="343 1624 766 1832"> <thead> <tr> <th>CI</th> <th>F</th> </tr> </thead> <tbody> <tr> <td>0-10</td> <td>2</td> </tr> <tr> <td>10-20</td> <td>8</td> </tr> </tbody> </table>	CI	F	0-10	2	10-20	8	Eg. <table border="1" data-bbox="909 1624 1369 1832"> <thead> <tr> <th>CI</th> <th>f</th> </tr> </thead> <tbody> <tr> <td>0-9</td> <td>4</td> </tr> <tr> <td>10-19</td> <td>6</td> </tr> </tbody> </table>	CI	f	0-9	4	10-19	6
CI	F													
0-10	2													
10-20	8													
CI	f													
0-9	4													
10-19	6													

4. What is a variable what is a variable? Distinguish between a discrete and a continuous variable.

Answer:

A variable refers to quantity or attribute whose value varies from one investigation to another. The characteristics which is capable of direct quantitative measurement is called a variable or variate. Eg. Height, weight, production, consumption etc. are all variables. A variable is broadly classified into two types:

- i) Discrete Variable: A discrete variable is the one which takes only isolated or discontinuous values. Eg. Fans produced in a factory in a particular year, number of students in a class.
 - ii) Continuous Variable: A continuous variable is the one which can take any value in a specified interval. Eg. Temperature recorded of patients in a hospital, height of all students in class XI.
5. What is loss of information' in classified data?

Classification of data as a frequency distribution summarises the raw data making it concise and comprehensible but it does not show the details that are found in raw data. Once, the data are grouped into classes, an individual observation has no significance in further statistical calculations.

All values in a class interval are assumed to be equal to the middle value of the class interval instead of their actual value which causes considerable loss of information.

Eg. Class 10-20 contains 6 values: 12, 15, and 16,18,14,19. When such data is grouped as a class 10-20 , then individual values have no significance and only frequency , i.e. 6 is recorded not their actual values.

6. Distinguish between unilabiate and bivariate frequency distribution.

Frequency distribution of classified into i) univariate and ii) bivariate frequency distribution. The term “uni” stands for one and thus the frequency distribution of a single variable is called a Univariate Distribution, e.g., the fequency distribution of age of students in a class is univariate as its gives the distribution of a single variable i.e., age of students . On the other hand “bi” means two and a Bivariate Frequency Distribution is the frequency distribution of two variables, e.g., the frequency distribution of two variables, e.g., like height and weight of students is a bivariate distribution.

Calculation based Question

1. Arrange the following raw data in an array and determine range:

40, 47, 19, 29, 8, 50, 13, 59, 36, 24.

Ans. Ascending order: 8, 13, 19, 24, 29,36,40,47, 50, 59.

Descending order: 59, 50, 47, 40, and 36,29,24,19,13,8.

Range=59-8=51

2. Prepare a frequency array of marks obtained by 25 students of a class in Economics test: 20,15,20,30,40,25,25,30,40,20,35,35,50,15,50,25,40,40,20,50,25,30,30,15,45.

Marks	Tally bars	f
15	III	3

20	III	4
25	III	4
30	III	4
35	II	2
40	III	4
45	I	1
50	III	3
		Total= 25

3. Following are the marks obtained by 20 students in an English test:

5,16,17,17,20,21,22,22,25,22,25,26,26,30,31,31,34,35,42,48.

Prepare a frequency distribution taking class interval of 10 using inclusive and exclusive method.

Exclusive Series

C.I.	Tally Bars	f
0-10	I	1
10-20	III	3
20-30	III III	9
30-40	III	5
40-50	II	2
		Total = 20

Inclusive Series

C. I.	Tally bars	f
0-9	I	1
10-19	III	3
20-29	III III	9
30-39	III	5
40-49	II	2
		Total=20

4. From the following frequency distribution , prepare 'less than' and 'more than' cumulative frequency distribution.

Height (cms)	100-110	110-120	120-130	130-140	140-150
No. of students	4	12	20	7	5

Ans. Less than

Height less than	C f
Less than 110	4
Less than 120	16
Less than 130	36
Less than 140	43
Less than 150	48

More than

More than	Cf
More than 100	48
More than 110	44
More than 120	32
More than 130	12
More than 140	5

5. Convert the following into simple frequency distribution. ***

i)

Less than	25	30	35	40	45	50
Cf	8	22	50	85	105	120

ii)

More than	0	10	20	30	40	50
Cf	50	46	40	20	11	4

Ans.

i)

C.I.	f
20-25	8
25-30	14
30-35	28
35-40	35
40-45	20
45-50	15
	Total= 120

ii) A

C.I.	f
0-10	4
10-20	6
20-30	20
30-40	9
40-50	7
50-60	4

6. Change the following into continuous series:

Mid Value	5	15	25	35	45	55
frequency	16	24	30	18	8	4

Ans.

C.I	f
0-10	16
10-20	24
20-30	30

30-40	18
40-50	8
50-60	4

Important Questions – Presentation of Data

Question 1

Define presentation of data.

Answer: The presentation of data is a representation of data in an attractively and transparent manner that everybody understands and analyses.

Question 2

What is tabulation?

Answer: Tabulation means presenting data in tabular form.

Question 3

Define table.

Answer: Table refers to the systematic representation of data with rows and columns.

Question 4

Explain a simple table.

Answer: A simple table only displays one characteristic of the data.

Question 5

What is a complex table?

Answer: It is a table that shows more than one characteristic of the data.

Question 6

Define a derived table.

Answer: A derived data is something where the information is not displayed according to the way it was collected. It is first into ratios or percentages and then presented.

Question 7

What are the two principal parts of a table?

Answer: The two principal parts of a table are (i) Table number and (ii) Title

Question 8

What are the different kinds of a table?

Answer: Tables can be classified into three parts. (i) Purpose (ii) Originality, and (iii) Construction

Question 9

What are the two types of complex table?

Answer: The two types of a complex table are (i) Double or two-way table and (ii) Manifold table

Question 10

What are a different forms of presentation of data?

Answer: The different form of presentation of data are (i) Textual and descriptive presentation (ii) Tabular presentation, and (iii) Diagrammatic presentation

Q.1) Sometime data is given is such that it begins far away from zero then a line is drawn called

- A. False Base Line
- B. Time Line
- C. None
- D. Gap Line

Correct Answer: False Base Line

Q.2) Area diagrams are

- A. Three dimensional
- B. Two dimensional
- C. One dimensional
- D. None

Correct Answer: Two dimensional

Q.3) Type of bar diagram is:

- A. Pie diagram
- B. Pictogram
- C. Sub divided diagram
- D. Line diagrams

Correct Answer: Sub divided diagram

Q.4) One dimensional diagram is:

- A. Rectangles
- B. Line diagram
- C. Squares
- D. Cubes

Correct Answer: Line diagram

Q.5) Two dimensional diagrams used in surface diagrams are:

- A. Squares
- B. Pie diagrams

- C. All the above
- D. Circles

Correct Answer: All the above

Q.6) Following are the forms of presentation of data except

- A. Diagrammatic presentation
- B. Caption presentation
- C. Descriptive presentation
- D. Tabular presentation

Correct Answer: Caption presentation

Q.7) To represents two or more factors simultaneously the following diagram is used

- A. Pie chart
- B. bar diagram
- C. Multiple bar diagram
- D. Histogram

Correct Answer: Multiple bar diagram

Q.8) The sum of frequencies for all classes will always equal

- A. a value between 0 to 1
- B. the number of classes
- C. the number of elements in a data set
- D. 1

Correct Answer: the number of elements in a data set

Q.9) An ideal table should consist of the following main parts except

- A. Captions or column headings
- B. Title of the table
- C. Stubs or row designation
- D. Salutation

Correct Answer: Salutation

Q.10) The numerical information in a statistical table is called the:

- A. Foot note
- B. Body
- C. Table
- D. Source note

Correct Answer: Body

Q.11) A systematic arrangement of data in rows and columns is:

- A. All the above
- B. Table
- C. Body
- D. Tabulation

Correct Answer: Table

Q.12) Pie chart is

- A. None
- B. diagram with no dimension
- C. A circle broken down into component sub-divisions
- D. any form of pictorial representation of data

Correct Answer: A circle broken down into component sub-divisions

Q.13) Time series is the most important format of _____

- A. Pictograms
- B. Pie graph
- C. Histogram
- D. Line graph

Correct Answer: Line graph

Q.14) Sub-divided bar diagram are also called _____ diagram

- A. Component Bar
- B. Ogive
- C. Pie chart
- D. None

Correct Answer: Component Bar

Q.15) Squares are _____ dimensional diagrams

- A. Time
- B. None
- C. Areas
- D. Percentage

Correct Answer: Areas

NCERT Q & A

Question 1.

Bar diagram is a

- (a) one-dimensional diagram
- (b) two-dimensional diagram
- (c) diagram with no dimension
- (d) None of these

Answer:

(a) Bar diagrams are one-dimensional diagrams. Though these are represented on a plane of two axis in form of rectangular bars, the width is of no consequence and only the length depicts the frequency.

Question 2.

Data represented through a histogram can help in finding graphically the

- (a) mean
- (b) mode
- (c) median
- (d) All of these

Answer:

(b) Histogram gives value of mode of the frequency distribution graphically through the highest rectangle.

Question 3.

Ogives can be helpful in locating graphically the

- (a) mode
- (b) mean
- (c) median
- (d) None of these

Answer:

(c) Intersection point of the less than and more than ogives gives the median.

Question 4.

Data represented through arithmetic line graph help in understanding

- (a) long term trend
- (b) cyclicity in data
- (c) seasonality in data
- (d) All of the above

Answer: (a) Arithmetic line graph helps in understanding the trend, periodicity, etc. in a long term time series data.

Question 5.

Width of bars in a bar diagram need not be equal. (True/False)

Answer:

False

Bar diagram comprises a group of equispaced and equiwidth rectangular bars for each class or category of data.

Question 6.

Width of rectangles in a histogram should essentially be equal. (True/False)

Answer:

False

If the class intervals are of equal width, the area of the rectangles are proportional to their respective frequencies and width of rectangles will be equal. However, sometimes it is convenient or necessary to use varying width of class intervals and hence unequal width of rectangles.

Question 7.

Histogram can only be formed with continuous classification of data. (True/False)

Answer:

True

a histogram is never drawn for a discrete variable/data. If the classes are not continuous they are first converted into continuous classes.

Question 8.

Histogram and column diagram are the same method of presentation of data. (True/False)

Answer:

False

Histogram is a two dimensional diagram drawn for continuous data and the rectangles do not have spaces in between while column diagram is one dimensional with space in between every column (bar).

Question 9.

Mode of a frequency distribution can be known graphically with the help of histogram.

(True/False)

Answer:

True

Histogram gives value of mode of the frequency distribution graphically through the highest rectangle.

Question 10.

Median of a frequency distribution cannot be known from the ogives. (True/False)

Answer:

False

Intersection-point of the less than and more than ogives gives the median.

Question 11.

What kind of diagrams are more effective in representing the following?

- (a) Monthly rainfall in a year
- (b) Composition of the population of Delhi by religion
- (c) Components of cost in a factory

Answer:

- (a) The monthly rainfall in a year can be best represented by a bar diagram as only one variable i.e., monthly rainfall is to be presented diagrammatically. The rainfall is plotted on Y-axis in the corresponding month that is plotted on the X-axis.
- (b) Composition of the population of Delhi by religion can be represented by a component bar diagram. A component bar diagram shows the bar and its sub-divisions into two or more components. Thus, the total population can be sub divided in terms of religion and presented through a component bar diagram.
- (c) Different components of cost in a factory can most effectively be depicted through a pie chart. The circle represents the total cost and various components of costs are shown by different portions of the circle drawn according to percentage of total cost each component covers.

Question 12.

Suppose you want to emphasise the increase in the share of urban non-workers and lower level of urbanisation in India as shown in Example 4.2. How would you do it in the tabular form?

Answer:

Share of urban workers and non-workers in India

	Location		
Sex	Worker in urban (in crore)	Non-worker in urban (in crore)	Total
Male	50	70	120
Female	25	50	75
Total	75	120	195

Question 13.

How does the procedure of drawing a histogram differ when class intervals are unequal in comparison to equal class intervals in a frequency table?

Answer:

A histogram is a set of rectangles with bases as the intervals between class boundaries (along X-axis) and with areas proportional to the class frequency. If the class intervals are of equal width, the area of the rectangles are proportional to their respective frequencies.

However, sometimes it is convenient or at times necessary, to use varying width of class intervals. For graphical representation of such data, height for area of a rectangle is the quotient of height i.e., frequency and base i.e., width of the class interval. When intervals are equal, all rectangles have the same base and area can conveniently be represented by the frequency of the interval.

But, when bases vary in their width, the heights of rectangles are to be adjusted to yield comparable measurements by dividing class frequency by width of the class interval instead of absolute frequency. This gives us the frequency density for the purpose of comparison.

Thus Frequency density (Height of rectangle) = Class Frequency / Width of the class interval

Question 14.

The Indian Sugar Mills Association reported that, 'sugar production during the first fortnight of December, 2001 was about 3, 87,000 tonnes, as against 3, 78,000 tonnes during the same fortnight last year (2000). The off-take of sugar from factories during the first fortnight of December, 2001 was 2, 83,000 tonnes for internal consumption and 41,000 tonnes for exports as against 1, 54,000 tonnes for internal consumption and nil for exports during the same fortnight last season.'

(i) Present the data in tabular form.

(ii) Suppose you were to present these data in diagrammatic form which of the diagrams would you use and why?

(iii) Present these data diagrammatically.

Answer:

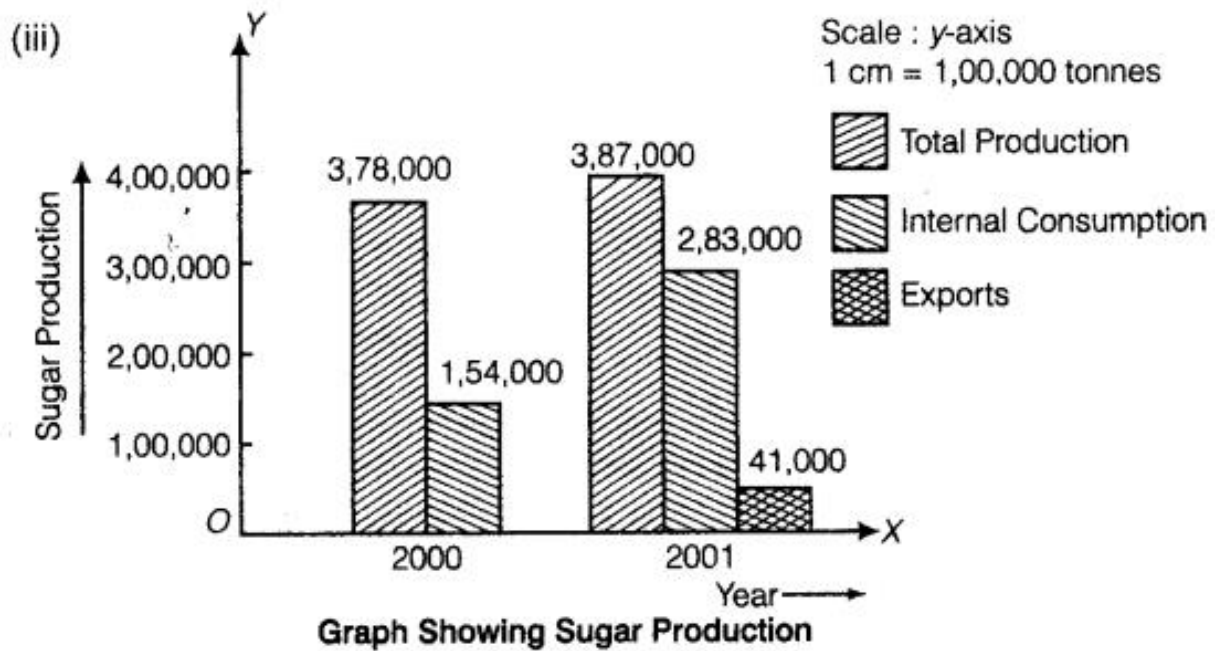
(i) Data in tabular form.

Sugar Production in India

	Total Production (tonnes)	Off-take for Internal Consumption (tonnes)	Off-take for Exports (tonnes)
December 2000	378000	154000	—
December 2001	387000	283000	41000

(ii) The data can effectively be presented diagrammatically using the multiple bar diagram. This is because multiple bar diagrams are used for comparing two or more sets of data for

different years or classes, etc.



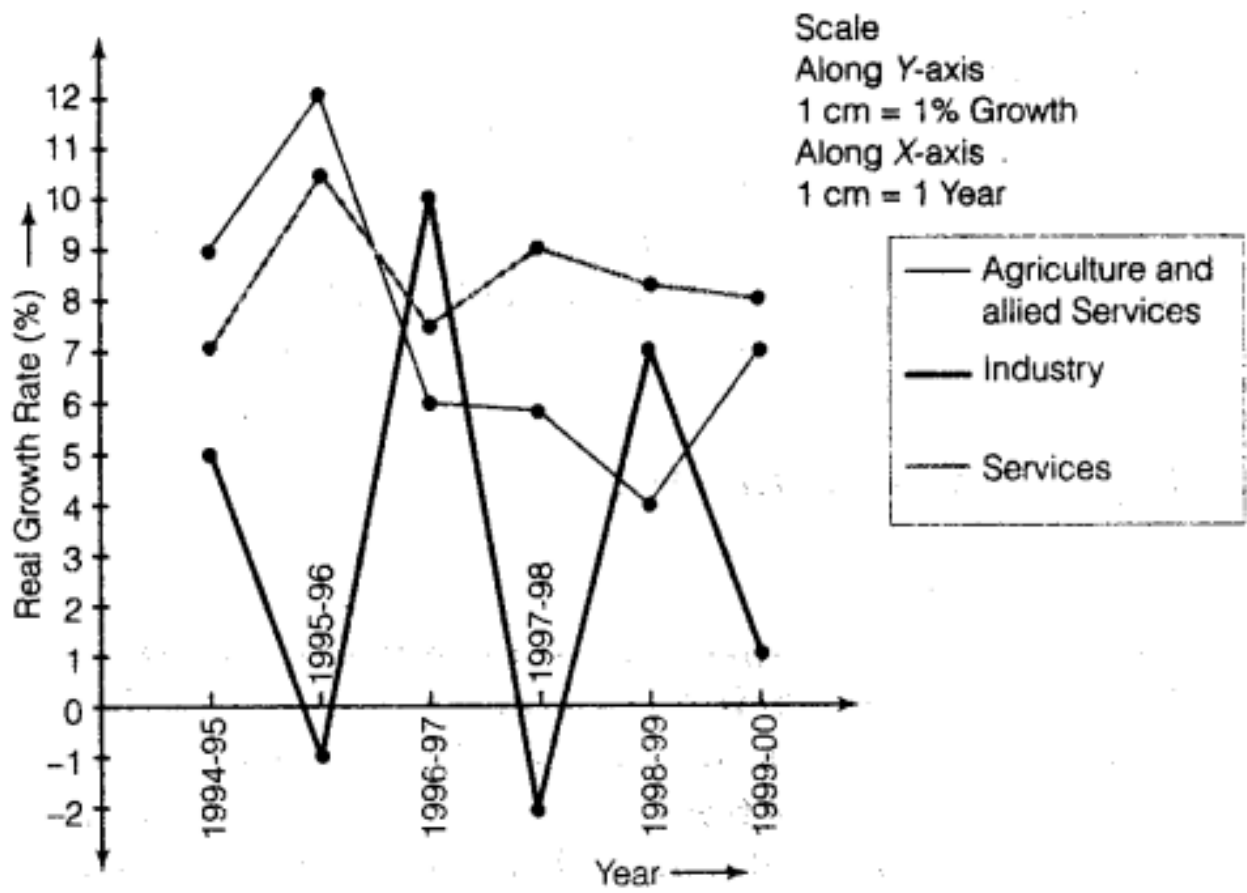
Question 15.

The following table shows the estimated sectorial real growth rates (percentage change over the previous year) in GDP at factor cost.

Year (1)	Agriculture and allied sectors (2)	Industry (3)	Services (4)
1994-95	5.0	9.2	7.0
1995-96	-0.9	11.8	10.3
1996-97	9.6	6.0	7.1
1997-98	-1.9	5.9	9.0
1998-99	7.2	4.0	8.3
1999-2000	0.8	6.9	8.2

Represent the data as multiple time-series graphs.

Answer:



Question

Define tabulation and describe its significance?

Answer:

Tabulation is a systematic and logical presentation of data so that it is easily understandable and comparable.

1. Presentation in Simplified Form:

Tabulation presents the data in a systematic and simplified form so that it is easily understandable to a common man.

2. Trend and Pattern of Data:

Tabulation discloses the trend and pattern of data.

3. Economy in Space and Time:

Tabulation discloses the trend and pattern of data.

4. Comparison:

Tabulation facilitates comparison of data.

5. Statistical Analysis:

Tabulation facilitates statistical analysis by the use of averages, dispersion, correlation etc.

Question

what is a table? Describe the essential parts of a table?

Answer:

A table is a method of presentation of statistical data systematically arranged in rows and columns.

Following are the essential parts of a table:

1. Title:

Every table must have a suitable title at the table so that the reader gets an idea about the contents of the table.

2. Table Number:

Every table should be serially numbered so that it becomes easier for reference in future.

3. Head Notes:

Head note refer to brief statement for explaining any points not included in the heading.

4. Captions and Stubs:

Captions and stubs are heading for the vertical columns and horizontal rows in a table respectively.

5. Body of the Table:

Body of the table contains the numerical information which is presented to the users.

6. Footnotes:

Footnotes clarify heading title, captions, stub etc. Footnote is given at the bottom of a table.

Question

Explain the utility of diagrammatic presentation?

Answer:

The utility of diagrammatic presentation of data will be clear from the following points:

1. The impression created by diagrams, lasts much longer than those presented in a tabular form.
2. Diagrammatic presentation of data saves much time and labour in comparison to other techniques of presentation of data.
3. Diagrams are attractive and have great memorizing effect.

Question

what points should be considered while constructing a diagram?

Answer:

Following points should be considered for constructing a diagram:

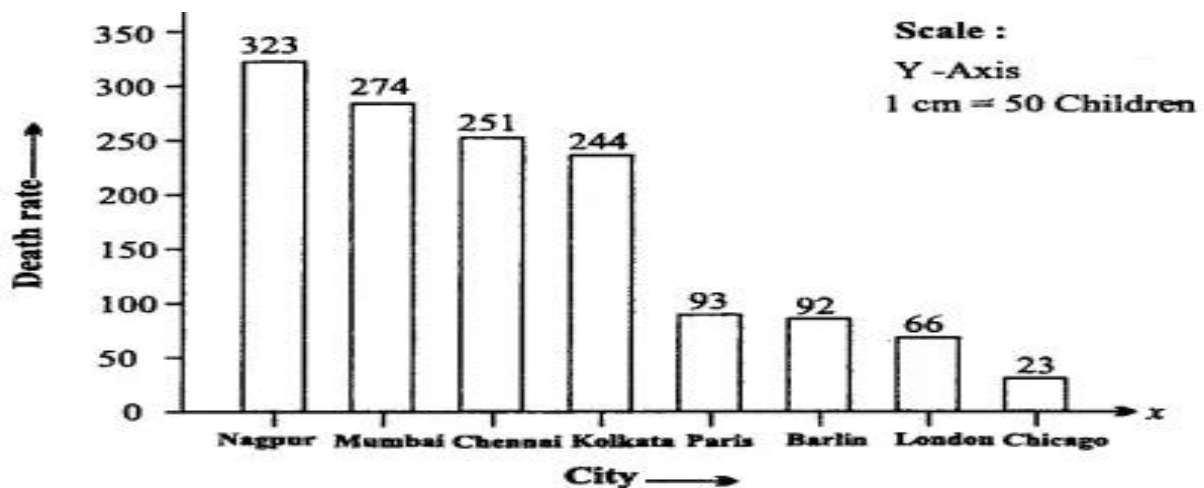
1. The diagram should bear a number and heading.
2. Both X and Y – axis must be clearly labelled.
3. Units of measurements of the variables should be stated at the top right hand corner of the diagram or just below the diagram.
4. The choice of origin should be clear from the diagram.

Question.

On the basis of following data of death rate of various cities prepare a simple bar diagram?

City	Mumbai	Nagpur	Paris	Kolkata	London	Chicago	Chennai	Berlin
Death rate (per 1000)	274	323	93	244	66	23	251	92

Answer:



Question

Construct a pie – diagram to represent the cost of construction of house in Delhi?

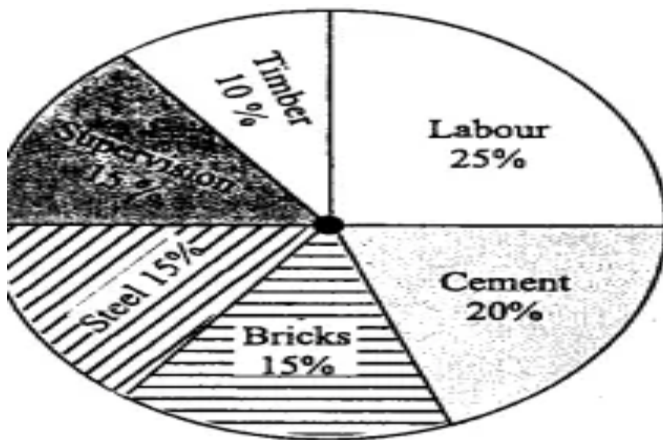
Items	Expenditure %
Labour	25
Bricks	15
Cement	20
Steel	15
Timber	10
Supervision	15

Answer:

For constructing a pie – diagram, it is necessary to percentages into of different degrees:

Items	Expenditure (%)	Expenditure in Degrees
1. Labour	25	$25 \times 3.6 = 90^\circ$
2. Bricks	15	$15 \times 3.6 = 54^\circ$
3. Cement	20	$20 \times 3.6 = 72^\circ$
4. Steel	15	$15 \times 3.6 = 54^\circ$
5. Timber	10	$10 \times 3.6 = 36^\circ$
6. Supervision	15	$15 \times 3.6 = 54^\circ$
Total	100	360°

Cost of Construction of a House in Delhi:



MEDIAN

1. Define median

Ans. Median is a centrally located value of a series such that half of the value of the series are above it and other half below it.

2. Median is that value of a variable which divides the group into.....
Parts. equal/unequal)

Ans. Equal

3.is based on all the items of the distribution (mean/median)

Ans. Mean.

4. The point where 'less than ogive' and 'more than ogive' intersect each other determines median. (True/False)

Ans. True

5. Median is free from the effect of extreme values. (True/False)

Ans. True.

6. Median divides a series into how many parts?

- | | |
|---------|-----------------|
| a) Two | b) Three |
| c) Four | d) All of these |

7. For calculating median, all items of the series are arranged in :

- | | |
|----------------------------------|--------------------|
| a) descending order | b) ascending order |
| c) ascending or descending order | d) none of these |

3-4 mark Questions

Q.1. Define Median. What are its merits and demerits.

Ans. Median is a centrally located value of a series such that half of the value of the series are above it and other half below it.

Merits:

- Simple
- Free from the effect of extreme values
- Certainty

Demerits:

- a) Lack of representative character
- b) Unrealistic
- c) Lack of algebraic treatment

Q.2. Marks of 15 students in their Economics paper are:

6, 9, 10, 12, 18, 19, 23, 23, 24, 28, 37, 48, 49, 53, 60

Find the Median marks

Sol.

Sr.no	Marks in Economics (Ascending order)
1	6
2	9
3	10
4	12
5	18
6	19
7	23
8	23
9	24
10	28
11	37
12	48
13	49
14	53
15	60

$M = \text{Size of } (N+1)/2\text{th item}$

$M = \text{Size of } (15+1)/2\text{th item}$

$M = \text{Size of } 8^{\text{th}} \text{ item}$

Median = 23

Q.3 Find out median of the series of the following data:

Items	3	4	5	6	7	8
Frequency	6	9	11	14	23	10

Sol.

Item	Frequency(f)	Cumulative Frequency
3	6	6
4	9	15
5	11	26
6	14	40
7	23	63
8	10	73
	$\Sigma f = 73$	

Median or $M = \text{Size of } (N+1)/2\text{th item}$

$M = \text{Size of } (73+1)/2\text{th item}$

$M = \text{Size of } 37^{\text{th}} \text{ item}$

$M = 6$

Q.4 Find out median marks of the following marks distribution for 100 student:

Marks	0-10	10-20	20-30	30-40	40-50
No. of Students	8	30	40	12	10

Sol

Marks	No. of Students	Cumulative Frequency
0-10	8	8
10-20	30	38
20-30	40	78
30-40	12	90
40-50	10	100
	$\sum f = 100$	

$M = \text{Size of } N/2\text{th item}$

$M = \text{Size of } 100/2\text{th item}$

$M = \text{Size of } 50^{\text{th}} \text{ item}$

Hence, median lies in the class 20-30

$$M = l + \frac{N/2 - C.F.}{f} \times i$$

$$M = 20 + \frac{50 - 38}{40} \times 10$$

$$M = 23$$

6 mark Questions

Q.1 Find the missing frequency in the following distribution if $N = 100$ and $M = 30$

Marks	0-10	10-20	20-30	30-40	40-50	50-60
No. of Students	10	?	25	30	?	10

Sol.

Marks	Frequency	Cumulative Frequency
0-10	10	10
10-20	f_1	$10 + f_1$
20-30	25	$35 + f_1$
30-40	30	$65 + f_1$

40-50	f2	65 + f1 + f2
50-60	10	75 + f1 + f2
	N or $\sum f = 100$	

1st Equation : from summation of frequencies

$$75 + f1 + f2 = 100$$

$$f1 + f2 = 25 \quad (i)$$

2nd Equation

M = 30, Median class is 30-40

Now $M = l + \frac{N/2 - C.F}{f} \times i$

F

$$30 = 30 + \frac{15 - f1}{3}$$

3

$$0 = \frac{15 - f1}{3}$$

3

f1 = 15 substituting f1 = 15 in equation (i)

$$15 + f2 = 25$$

$$f2 = 10$$

Thus f1 = 15 f2 = 10

Q.2 Find out Median of the following series:

Selling Price	45	46	47	48	49	50	51	52
Frequency	23	20	45	50	41	12	8	4

For self practice

Ans. Median = 48

MODE

Q1. Define mode.

Ans. Mode is the value which occurs most frequently in the series; that is, modal value has highest frequency in the series.

2. Dividing a series into ten equal parts is called:

- a) Decile
- b) Quartile
- c) Percentile
- d) None of these

Ans. a)

3. Mode refers to that value of a series that occurstimes in the series.

- a) zero
- b) infinite
- c) maximum
- d) minimum

Ans. c)

4. What is the relationship between mode, mean and median?

- a) $Z = 3\text{Median} + 2\text{Mean}$
- b) $Z = 3\text{Median} - 2\text{Mean}$
- c) $\text{Mean} = \frac{3M - Z}{2}$
- d) both (b) and (c)

2

Ans. d)

5. Out of the following, by which method mode can be calculated?

- a) inspection method
- b) Grouping method
- c) both (a) and (b)
- d) none of these

Ans. c)

6. The sum of deviations of items from median is zero. (True/False)

Ans. False.

7. An average alone is not enough to compare series. (True/False)

Ans. True.

8. What is mode when mean = 146 and median = 130.

- a) 96
- b) 97
- c) 98
- d) 100

Ans. c)

3-4 mark Question

1. Discuss the merits and demerits of mode.

Ans. Merits:

- 1) Simple and popular
- 2) Least effect of marginal values
- 3) Graphic location
- 4) Best representative value

Demerits:

- 1) Uncertain and vague
- 2) Difficult to identify the modal value when frequencies of all items identical
- 3) Complex procedure of grouping

2. Weight of 50 students is given below. Calculate mode.

Weight	48	49	50	51	52	53
No. of Students	4	10	20	11	3	2

Ans. By inspection of the data, it is quite clear that value 50 occurs the maximum times i.e. by 20 times in the series. Mode(Z) = 50

3. Calculate mode from the following data:

X	0-5	5-10	10-20	20-30	30-40	40-50	50-60
F	2	3	10	20	25	17	7

Sol.

X	f
0-10	5
10-20	10
20-30	20 f ₀
30-40	25 f ₁
40-50	17 f ₂
50-60	7

By inspection we find that mode class is 30-40.

$$Z = L1 + \frac{f1 - f0}{2f1 - f0 - f2} \times i$$

$$L1 = 30, f1 = 25, f0 = 20, f2 = 17, I = 10$$

$$Z = 33.85$$

4. If median and mean of a distribution are 18.8 and 20.2 respectively, what would be its mode?

Ans. $Z = 3\text{Median} - 2\text{Mean}$

$$\text{Mode}(Z) = 3 \times 18.8 - 2 \times 20.2$$

$$\text{Mode} = 56.4 - 40.4$$

$$\text{Mode} = 16$$

5. Median and mean weight of the students of a class are 35.83 and 37.06 respectively. Calculate the mode.

Ans. $Z = 3\text{Median} - 2\text{Mean}$

$$\text{Mode}(Z) = 3 \times 35.83 - 2 \times 37.06$$

$$\text{Mode} = 107.49 - 74.12$$

$$\text{Mode} = 33.28$$

6 Mark Questions

Q.1 Find out mode of the following data with the help of Histogram:

Marks	0-10	10-20	20-30	30-40	40-50	50-60
Frequency	6	8	16	25	12	8

Ans.

Marks	Frequency
0-10	6
10-20	8
20-30	16 f ₀
30-40	25 f ₁
40-50	12 f ₂
50-60	8

By inspection we find that modal class is 30-40.

$$Z = L_1 + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times i$$

$$2f_1 - f_0 - f_2$$

$$L_1 = 30, f_1 = 25, f_0 = 16, f_2 = 12, I = 10$$

$$Z = 30 + \frac{25 - 16}{2(25) - 16 - 12} \times 10$$

$$2(25) - 16 - 12$$

$$Z = 30 + 4.09 = Z = 34.09$$

Q.2 Find out mode, given the following information:

Size	6-10	11-15	16-20	21-25	26-30
Frequency	20	30	50	40	10

Sol.

For the calculation of mode, inclusive series are first to be converted into exclusive series, as under

Class Interval	Excusive class Interval	Frequency
6-10	5.5-10.5	20
11-15	10.5-15.5	30
16-20	15.5-20.5	50
21-25	20.5-25.5	40
26-30	25.5-30.5	10

If we look at the above table we find that 15.5-20.5 is the modal class interval

The actual value of mode is,

$$Z = L1 + \frac{f1 - f0}{2f1 - f0 - f2} \times i$$

$$L1 = 15.5, f1 = 50, f0 = 30, f2 = 40, I = 5$$

$$Z = 15.5 + \frac{50 - 30}{2(50) - 30 - 40} \times 5$$

$$Z = 15.5 + 3.33$$

$$Z = 18.83$$

Q.3 Calculate mode from the following data:

Class Interval	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Frequency	3	4	6	10	6	4	3

For self Practice

$$\text{Mode}(Z) = 65$$

Q.4 Obtain the Mean, Median and Mode of the following data:

Class Interval	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	5	7	15	25	20	15	8	5

Ans. Mean = 40, Median = 39.2, Z = 37.60 (Z=3Median – 2Mean)

ANSWERS (MEAN)

Q N 1. A

Q n 2. d

Q n 3. B

Q n 4. a

Q n 5. b

Q n 6. b

Q n 7. c

Q n 8. A

Q n 9. c

Q n 10. c

Q N11. 30.14 formula $X=A+(Fd'/f) \times i$

Q n 12.35.5 $X= A+ (FD/F)$

Q n 13. 264.12

Qn 14. 61.98 $X= A+ (FD/F)$

Q n 15. 43.6 $x= XW/W$

Q n 16. 62

Ans 17. 27

Ans 18. 36.5 $X=A+(Fd/f)$

Ans 19. 43 formula $X=A+(Fd'/f) \times i$

Ans 20. 29.76 formula $X=A+(Fd'/f) \times i$

Chapter: 5 - MEASURES OF DISPERSION: RANGE AND QUARTILE DEVIATION

Q1 Semi-interquartile range is also known as

- | | |
|-----------------------|-----------------------|
| A) Mean deviation | B) Standard deviation |
| C) Quartile deviation | D) Quartile range |

ANS C

Q2 The range of the following set of observations 2,3,5,9,8,7,6,5,7,4,3 is

- | | |
|--------|-------|
| A) 6 | B) 7 |
| C) 5.5 | D) 11 |

ANS B

Q9 Which measure is based on only the central fifty per cent of the observations?

- | | |
|-----------------------|-----------------------|
| A) Mean deviation | B) Quartile deviation |
| C) Standard deviation | D) All these measures |

ANS B

Q10 When it comes to comparing two or more distributions, we consider

- | | |
|------------------------------------|-----------------------------------|
| A) Relative measures of dispersion | B) Absolute measure of dispersion |
| C) Both (a) and (b) | D) Either (a) or (b) |

ANS A

Q11 Which is the relative measure of dispersion?

- | | |
|--------------------------------------|-------------------|
| A) Range | B) Mean deviation |
| C) Coefficient of standard deviation | D) None of these |

ANS C

Q12 Coefficient of range is

- | | |
|--|-----------------------------------|
| A) $\left(\frac{H+L}{H-L}\right) \times 2$ | B) $\left(\frac{H+L}{2}\right)$ |
| C) $\left(\frac{H+L}{H-L}\right)$ | D) $\left(\frac{H-L}{H+L}\right)$ |

ANS D

Q13 Which of the following formulae is used to find out inter quartile range?

- | | |
|--------------------------|--------------------------|
| A) $\frac{Q_1 - Q_3}{2}$ | B) $\frac{Q_1 + Q_3}{2}$ |
| C) $Q_1 - Q_3$ | D) $Q_1 + Q_3$ |

ANS C

Q14 Quartile deviation is equal to

- | | |
|--------------------------|--------------------------|
| A) $\frac{Q_1 - Q_3}{2}$ | B) $\frac{Q_1 + Q_3}{2}$ |
| C) $\frac{Q_3 - Q_1}{2}$ | D) $\frac{Q_3 + Q_1}{2}$ |

ANS C

Choose appropriate word and fill in the blank

Q15 _____ is the measure of variation of the items
(Dispersion($\sqrt{\quad}$)/Range)

Q16 _____ measure of dispersion is known as coefficient of dispersion
(Absolute/Relative($\sqrt{\quad}$))

Q17 Range is estimated as the _____ of highest and lowest values of the series
(difference($\sqrt{\quad}$)/multiplication)

Q18 Difference between third quartile and first quartile of a series, is called _____
(Quartile Deviation/Inter Quartile Range($\sqrt{\quad}$))

State whether the following statements are true or false

Q19 Dispersion measures the extent to which items tend to disperse away from the central tendency
(true)

Q20 Absolute measure of variation is that in which variability of data is expressed in terms of percentage.
(False)

Q21 Define dispersion

Ans Dispersion is the measure of the extent to which different items tend to disperse away from the central tendency.

Q22 What do you mean by coefficient of dispersion?

Ans The coefficient of dispersion expresses the variability of data in terms of some relative value or percentage. Coefficient of dispersion is known as relative measure of dispersion.

Q23 Define range.

Ans Range is the difference between the highest value and the lowest value in a series thus,

$$\text{Range} = \text{Highest value in the series} - \text{Lowest value in the series}$$

Q24 Define inter quartile range

Ans Difference between third quartile (Q3) and first quartile (Q1) of a series is called inter quartile range

Thus,

$$\text{Inter quartile range} = Q3 - Q1$$

Q25 Define quartile deviation

Ans Quartile deviation is half of inter quartile range. It is also called semi- inter quartile range

Thus,

$$\text{Quartile deviation} = \frac{Q_3 - Q_1}{2}$$

Q26 Give the formula for coefficient of quartile deviation

Ans Coefficient of quartile deviation is calculated using the following formula

Formula:

Coefficient of quartile deviation=

$$\frac{Q_3 - Q_1}{Q_3 + Q_1}$$

Q27 If $Q_1=25$ and $Q_3 = 60$, then the value of coefficient of quartile deviation will be

A)	0.411	B)	0.428
C)	0.380	D)	0.259

ANS A

Short Answers

Q1. State two merits of Range

Ans.

- i) Simple: it is very simple measure of the dispersion of the series. It is simple to calculate as well as understand.
- ii) Widely used: range is widely used in statistical series relating to quality control in production. Control charts are prepared on the basic of range. If the quality of goods produced is within the range prescribed in the charts then the production process is said to be under control. Otherwise not.

Q2. Calculate range and coefficient of range from the given data

600,550,450,350,800,770,900,380,650,850,840,600,680,300

Ans. $R = H-L$

$$=900-300$$

$$=600$$

Coefficient of Range= $(H-L)/(H+L)$

$$=(900-300)/(900+300)$$

$$=600/1200$$

$$=0.50$$

Q3. Calculate range and coefficient of range of the following series

Size	10	11	12	13	14	15	16	18
Frequency	1	13	24	14	15	13	16	20

Solution:

Here, H= 18; L=10

Range(R)= H-L=18-10=8

Coefficient of Range (CR)= H-L/H+L

= 18-10/18+10

=8/28

=0.29

Q4. Calculate the value of range and coefficient of range,

Marks	10-20	20-30	30-40	40-50	50-60	60-70
No of students	10	15	25	30	11	6

Ans:

Range and coefficient of Range

Range= Largest item(L)- smallest Item(S)=70-10=60

Coefficient of range= (L-S)/(L+S) = (70-10)/ (70+10) =60/80=0.75

Range=60 Coefficient of range=0.75

Q5. Calculate range and its coefficient from the following data,

Marks	10	20	30	40	50	60	70	80	90	100
No of students	12	32	62	105	165	205	230	238	244	245

Solution:

In the given we will first calculate the simple class- intervals and convert the series into non-cumulative series, to determine the largest and smallest items.

Marks	No of students
0-10	12
10-20	20
20-30	30
30-40	43
40-50	60
50-60	22
60-70	40
70-80	55
80-90	10
90-100	6

Range = Largest Item- smallest item =100-0= 100 marks

Coefficient of range= $(L-S)/(L+S) = (100-0)/(100+0) =100/100=1$

Q6. Calculate range and its coefficient for the age,

Age (in years)	5-7	8-10	11-13	14-16	17-19
No of students	20	18	10	8	4

Solution:

The inclusive series will be converted into exclusive series to determine the largest and smallest item.

Age in years	No of students
4.5-7.5	20
7.5-10.5	18
10.5-13.5	10
13.5-16.5	8
16.5-19.5	4

Range = Largest Item- smallest item = 19.5-4.5= 15 years

Coefficient of range= $(L-S)/(L+S) = (19.5-4.5)/(19.5+4.5) =15/24=0.625$

Q7. Calculate quartile deviation and its coefficient from the following data:

50,60,70,90,90,110,120,130,145,145,155,170

Ans: the values are already arranged in an ascending order

$Q_1 = \text{Size of } \left[\frac{N+1}{4}\right]\text{th item} = \text{Size of } \left[\frac{12+1}{4}\right]\text{th item} = \text{Size of } 3.25^{\text{th}} \text{ item}$

Size of 3.25th item=size of 3rd item+0.25 times (size of 4th item – size of 3rd item) =
70+0.25(90-70) =70+5

$Q_1 = 75$

$Q_3 = \text{Size of } 3 \left[\frac{N+1}{4}\right]\text{th item} = \text{Size of } 3 \left[\frac{12+1}{4}\right]\text{th item} = \text{Size of } 9.75^{\text{th}} \text{ item}$

Size of 9.75th item=size of 9th item+0.75 times (size of 10th item – size of 9th item) =
145+0.75(145-145)

$Q_3 = 145$

Quartile deviation= $(Q_3-Q_1)/2 = (145-75)/2=35$

Coefficient of quartile deviation= $(Q_3-Q_1)/(Q_3+Q_1) =145-75/145+75=70/220=0.318$

Q8. Calculate lower and upper quartiles, when quartile deviation = 10 and coefficient of quartile deviation=0.5

Ans.

$$\text{Quartile deviation} = (Q_3 - Q_1) / 2 = 10$$

$$Q_3 - Q_1 = 20$$

$$\text{Coefficient of quartile deviation} = (Q_3 - Q_1) / (Q_3 + Q_1) = 0.5$$

$$= 20 / (Q_3 + Q_1) = 0.5$$

$$\text{So } Q_3 + Q_1 = 40$$

$$\text{Or } Q_3 = 40 - Q_1$$

Putting the value of Q_3 in (1) we get

$$(40 - Q_1) - Q_1 = 20$$

$$-2Q_1 = -20$$

$$\text{Or } Q_1 = 10$$

Long answers Questions

Q1. From the following table giving height of students, calculate the interquartile range, quartile deviation and coefficient of quartile deviation

Heights (in cm)	153	155	157	159	161	163	165	167	169
No of students	25	21	28	20	18	24	22	18	23

Ans.

Heights (in cm) (X)	No of students (f)	c.f.
153	25	25
155	21	46
157	28	74
159	20	94
161	18	112
163	24	136
165	22	158
167	18	176
169	23	199

$$Q_1 = \text{Size of } \left[\frac{N+1}{4} \right] \text{th item} = \text{Size of } \left[\frac{199+1}{4} \right] \text{th item} = \text{Size of } 50^{\text{th}} \text{ item}$$

$$Q_1 = 157 \text{ CMS}$$

$$Q_3 = \text{Size of } 3\left[\frac{N+1}{4}\right]\text{th item} = \text{Size of } 3\left[\frac{199+1}{4}\right]\text{th item} = \text{Size of } 150^{\text{th}} \text{ item}$$

$$Q_3 = 165 \text{ CMS}$$

$$\text{Interquartile range} = Q_3 - Q_1 = 165 - 157 = 8$$

$$\text{Quartile deviation} = (Q_3 - Q_1)/2 = (165 - 157)/2 = 4$$

$$\text{Coefficient of Quartile deviation} = (Q_3 - Q_1)/(Q_3 + Q_1) = (165 - 157)/(165 + 157) = 8/322 = 0.025$$

Q2. From the following particulars, calculate the range of marks obtained by middle 50 % of the students. Also calculate quartile deviation

Marks	2	4	6	8	10	12
No of students	3	5	10	12	6	4

Ans.

Marks (X)	No of students (f)	c.f.
2	3	3
4	5	8
6	10	18
8	12	30
10	6	36
12	4	40

To calculate marks of middle of 50 % of students we will have to calculate the difference between marks of 10th student and 30th student i.e. we have to calculate interquartile range

$$Q_1 = \text{Size of } \left[\frac{N+1}{4}\right]\text{th item} = \text{Size of } \left[\frac{40+1}{4}\right]\text{th item} = \text{Size of } 10.25^{\text{th}} \text{ item}$$

$$Q_1 = 6$$

$$Q_3 = \text{Size of } 3\left[\frac{N+1}{4}\right]\text{th item} = \text{Size of } 3\left[\frac{40+1}{4}\right]\text{th item} = \text{Size of } 30.75^{\text{th}} \text{ item}$$

$$Q_3 = 10$$

$$\text{Interquartile range} = Q_3 - Q_1 = 10 - 6 = 4$$

Thus, the range of marks obtained by middle 50% of the students = 4

$$\text{Quartile deviation} = (Q_3 - Q_1)/2 = (10 - 6)/2 = 2$$

Q3. Calculate the interquartile range, quartile deviation and coefficient of quartile deviation from the following figures

Size	0-5	5-10	10-15	15-20	20-25	25-30
Frequency	3	9	15	23	30	20

Ans.

Size (X)	Frequency (f)	c.f.
0-5	3	3
5-10	9	12
10-15	9	12
15-20	23	50
20-25	30	80
25-30	20	100
	N=∑F=100	

$$Q1 = N/4 = 100/4 = 25^{\text{TH}} \text{ item}$$

25th item lies in the group 10-15

$$L1 = 10. \text{ C.F} = 12, F = 15, i = 5$$

$$Q1 = I1 + \frac{\frac{N}{4} - C.F}{f} * i$$

$$= 10 + \frac{25 - 12}{15} * 5 = 14.33$$

$$Q3 = 3N/4 = 3(100)/4 = 75^{\text{th}} \text{ item}$$

75th item lies in the group 20-25

$$L1 = 20. \text{ C.F} = 50, F = 30, i = 5$$

$$Q3 = I1 + \frac{\frac{3N}{4} - C.F}{f} * i$$

$$= 20 + \frac{75 - 50}{30} * 5 = 24.17$$

$$\text{Interquartile range} = Q3 - Q1 = 24.17 - 14.33 = 9.84$$

$$\text{Quartile deviation} = (Q3 - Q1)/2 = (24.17 - 14.33)/2 = 4.92$$

$$\text{Coefficient of quartile deviation} = (Q3 - Q1)/(Q3 + Q1) = (24.17 - 14.33)/(24.17 + 14.33)$$

$$= 9.84/38.50 = 0.25$$

Q4. Calculate the interquartile range, quartile deviation and coefficient of quartile deviation from the following figures

Marks	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55
No of students	10	17	22	31	42	32	26	19	14
Marks (X)	No of students (f)					c.f.			
10.5-15.5	10					10			
15.5-20.5	17					27			
20.5-25.5	22					49			
25.5-30.5	31					80			
30.5-35.5	42					122			
35.5-40.5	32					154			
40.5-45.5	26					180			
45.5-50.5	19					199			
50.5-55.5	14					213			
	N=∑F=213								

$$Q1 = N/4 = 213/4 = 53.25^{\text{TH}} \text{ item}$$

53.25th item lies in the group 25.5-30.5

$$L1 = 25, C.F = 49, F = 31, i = 5$$

$$Q1 = I1 + \frac{\frac{N}{4} - C.F}{f} * i$$

$$= 25.5 + \frac{53.25 - 49}{31} * 5 = 26.18$$

$$Q3 = 3N/4 = 3(213)/4 = 159.75^{\text{th}} \text{ item}$$

159.75th item lies in the group 40.5-45.5

$$L1 = 40, C.F = 154, F = 26, i = 5$$

$$Q3 = I1 + \frac{\frac{3N}{4} - C.F}{f} * i$$

$$= 40.5 + \frac{159.75 - 154}{26} * 5 = 41.6$$

$$\text{Interquartile range} = Q3 - Q1 = 41.6 - 26.18 = 15.42 \text{ MARKS}$$

$$\text{Quartile deviation} = (Q3 - Q1)/2 = (41.6 - 26.18)/2 = 7.71$$

$$\text{Coefficient of quartile deviation} = (Q3 - Q1)/(Q3 + Q1) = (41.6 - 26.18)/(41.6 + 26.18)$$

$$= 15.42/67.78 = 0.22$$

Chapter: 6- MEASURES OF DISPERSION:MEAN DEVIATION & STANDARD DEVIATION**MULTIPLE CHOICE QUESTIONS (MCQs)**

1. The Most commonly used measure of dispersion is:
 - (a) coefficient of variation
 - (b) standard deviation
 - (c) range
 - (d) quartile deviation
2. The standard deviation of a set of 50 observations is 6.5 if value of each observation is increased by 5, then the standard deviation is:
 - (a) 2.5
 - (b) 6.5
 - (c) 3.5
 - (d) none of the above
3. The standard deviation of a set of 50 observations is 8 if each observation is multiplied by 2 then the new value of standard deviation will be:
 - (a) 4
 - (b) 8
 - (c) 16
 - (d) none of the above
4. The standard deviation of 25 numbers is 40 if each of the number is increased by 5, then the new standard deviation will be:
 - (a) 40
 - (b) 45
 - (c) 41.5
 - (d) none of these
5. If all the observations are multiplied by 5, then:
 - (a) new SD would be also multiplied by 5
 - (b) new SD would be half of the previous SD
 - (c) new SD would be increased by 5
 - (d) new SD would be decreased by 5
6. If the values of a set are measured in Cm, the unit of variance will be:
 - (a) Cm
 - (b) Cm²
 - (c) Cm³
 - (d) No unit
7. A set of values is set to be relatively uniform if it has
 - (a) high dispersion
 - (b) zero dispersion
 - (c) little dispersion
 - (d) negative dispersion
8. Which one is difficult to compute?
 - (a) relative measure of dispersion
 - (b) absolute measure of dispersion
 - (c) both (a) & (b)
 - (d) range

9. "Root mean square deviation from mean" is:
- (a) standard deviation
 - (b) quartile deviation
 - (c) both (a) & (b)
 - (d) none of these
10. Which of the following is not a measure of dispersion?
- (a) variance
 - (b) mean deviation
 - (c) standard deviation
 - (d) Mode
11. Which of the following is a relative measure of dispersion?
- (a) standard deviation
 - (b) variance
 - (c) coefficient of variation
 - (d) all of these
12. Which of the following is a unitless measure of dispersion?
- (a) standard deviation
 - (b) mean deviation
 - (c) coefficient of variation
 - (d) range
13. For comparison of two different series, the best measure of dispersion is:
- (a) mean deviation
 - (b) range
 - (c) standard deviation
 - (d) coefficient of variation
14. A measure of relative dispersion is given by the:
- (a) Co-efficient of variance
 - (b) Standard deviation
 - (c) Quartile deviation
 - (d) Variance
15. The heights in cm of a group of first year biology students were recorded. The variance of these heights was subsequently calculated. The unit of measurement for this variance is:
- (a) cm²
 - (b) m
 - (c) m²
 - (d) cm
16. While drawing Lorenz curve zero of X-axis and 100 on Y-axis are joined by a line. This line is known as:
- (a) Line of unemployment
 - (b) Line of income
 - (c) None
 - (d) Line of equal distributions
17. Which information is false regarding Lorenz curve
- (a) The Lorenz curve devised by Dr. Max O. Lorenz is a graphic method of studying dispersion.
 - (b) Used this technique to show employment of a group of people

- (c) The Lorenz curve always lies below the line of equal distribution, unless the distribution is uniform
 - (d) The Area between the line of equal distribution and the plotted curve gives the extent of inequality in the items. The larger the area, more is the inequality
18. The numerical value of the standard deviation can never be
- (a) Negative
 - (b) None
 - (c) Larger than the variance
 - (d) Zero
19. The variance can never be
- (a) Larger than the standard deviation
 - (b) Negative
 - (c) Smaller than the standard deviation
 - (d) Zero
20. Coefficient of variation is:
- (a) Absolute measure
 - (b) relative measure
 - (c) both (a) & (b)
 - (d) None of this
21. Standard Deviation is:
- (e) Absolute measure
 - (f) relative measure
 - (g) both (a) & (b)
 - (h) None of these

Very short answer Type (1 Mark)

1. What is meant by dispersion?
2. What are the two measures of dispersion?
3. What is meant by absolute measure of dispersion?
4. What does the meaning of Mean Deviation?
5. What is meant by Standard Deviation?
6. What is meant by Variance?
7. Which graphical method is used to measure dispersion?

Long answer type question (3-4 marks)

1. Why there is a need for measure of dispersion?
2. state the characteristics of a good measure of dispersion?
3. What is meant by Standard Deviation? Mentioned that different methods to calculate Standard Deviation in case of discrete series?
4. What does mean by combined Standard Deviation? Give the formula for measuring it
5. Distinguish between Mean Deviation and Standard Deviation
6. Mention the merits and demerits of Lorenz Curve

long answer type question (6 marks each)

1. What is the meaning of relative and absolute measure of dispersion?
2. What is meant by Mean Deviation? Give the steps for calculating Mean Deviation in case of individual series
3. Discuss the merits and demerits of Mean Deviation
4. Discuss the step deviation method for calculating Standard Deviation in case of continuous series with the help of an example
5. Write short notes on:
 - (a) Variance
 - (b) Coefficient of Standard Deviation
 - (c) Coefficient of Variation
6. Briefly discuss the properties of Standard Deviation
7. Explain in brief the merits demerits and uses of Standard Deviation
8. What is the meaning of Lorenz Curve? State the steps involved in drawing Lorenz Curve?

Numerical:

Mean Deviation (Individual Series)

1. Calculate the mean deviation from median and its coefficient from the following data

100	150	80	90	160	200	140
-----	-----	----	----	-----	-----	-----

2. Compute Mean Deviation and its coefficient by mean from the data given below:

X	210	220	225	225	235	240	250	270	280
---	-----	-----	-----	-----	-----	-----	-----	-----	-----

3. Compute Mean Deviation and its coefficient by mean from the data given below:

X	5	8	11	12	14
---	---	---	----	----	----

Mean Deviation (Discrete Series)

4. Following are the marks of students. find the mean deviation and the coefficient of mean deviation from mean

Marks	5	10	15	20	25	30	35	40
No of Students	16	32	36	44	28	18	12	14

5. Find out the Mean Deviation from the Median and its coefficient:

Marks	10	11	12	13	14
No of Students	3	12	18	12	3

6. With mean as the base, calculate mean deviation and compare the variability of the two series A and B

Series A	10	12	16	20	25	27	30
Series B	10	20	22	25	27	31	40

(Ans: 0.26) Mean Deviation (Continuous Series)

7. Calculate Mean Deviation from median and its co-efficient

X	0-5	5-10	10-15	15-20	20-25	25-30
f	4	7	8	2	6	3

(Ans: MD from Median- 6.33

Co-efficient of MD – 0.506)

8. Calculate Mean Deviation from mean for the following data:

Classes	20-40	40-80	80-100	100-120	120-140
Frequency	3	6	20	12	9

9. Calculate Mean Deviation from mean and its coefficient for the following data:

Classes	0-10	10-20	20-30	30-40	40-50	50-60
Frequency	3	5	7	2	9	4

(Ans: MD about Mean: 14.33

Co-efficient of MD: 0.32)

Chapter: 7-

CORRELATION

VERY SHORT ANSWERQUESTIONS

1 MARK

1. Give the meaning of correlation.

Ans. The relationship between two or more variables is known as correlation.

2. Where does the correlation between the variables lie?

Ans. Between +1 and -1

3. Does correlation imply causation?

Ans. No it means co-variation

4. What does it mean if the correlation between two variables is +1?

Ans. Perfect positive correlation

5. What is absence of correlation?

Ans. When there is no relationship between the changes in the two variables it is known as absence of correlation.

6. What is scatter diagram?

Ans. Scatter diagram is a kind of diagram wherein data are plotted on a graph paper in the form of dots.

7. Who propounded the Rank Difference Method of correlation?

Ans. Prof. Charles Spearman

8. What is the difference between positive and negative correlation?

Ans. The difference between positive and negative correlation is that in positive correlation variables in the same direction whereas in the negative correlation they move in different directions.

9. When is rank correlation method used?

Ans. Rank correlation method is used when variables are qualitative in nature such as beauty, bravery, wisdom, virtue etc.

Multiple choice questions:

10. _____ correlation relates to the direction of change.

- a) Linear
- b) Positive
- c) Scatter
- d) Limited

11. When we study correlation between only two variables it is called _____

- a) Partial
- b) Simple
- c) Multiple
- d) Double

Ans. Simple

12. The degree of perfect correlation is _____

- a) 0
- b) +1
- c) -1
- d) 0 to 1

Ans. b) +1

13. The range of simple correlation coefficient is _____

- a) 0 to infinity
- b) 0 to -1

- c) -1 to +1
- d) +1 to infinity

Ans. c)

14. The correlation between price of a car and demand of a pen is _____

- a) Positive
- b) Negative
- c) Zero
- d) None of these

Ans. Zero

15. One variable X increases and the other variable Y decreases the correlation is _____

- a) Negative
- b) Positive
- c) Zero
- d) All of these

Ans. Negative

16. Graphic method to measure correlation _____

- a) Bar diagram
- b) Pie diagram
- c) Rank correlation
- d) Scatter diagrams

Ans. Scatter diagrams

17. Mathematical method to measure correlation _____

- a) Karl Pearson's method
- b) Rank correlation method
- c) Both (a) and (b)
- d) Neither (a) and (b)

Ans. C)

18. D denotes the difference between

- a) Ranks of series I and series II
- b) Mean deviation and standard deviation
- c) Positive and negative correlation
- d) Correlation and coefficient of variation.

Ans. a)

Fill in the blanks:

19. Coefficient of correlation in case of perfect negative correlation is _____

Ans. -1

20. The correlation is said to be positive when 2 variables move in the _____ direction

Ans. Same

21. _____ is a graphic presentation of correlation.

Ans. Scatter diagram

22. The Value of correlation co-efficient lies between _____

Ans. 0 and 1

23. Correlation coefficient is _____ of the units of measurement.

Ans. independent

Short answer questions

3 MARKS

1. Why r preferred to covariance as a measure of association?

Ans. r is preferred to covariance due to

- i) Correlation – co-efficient r has no unit.
- ii) Correlation Coefficient is independent of origin as well as scale.

2. Can r lie outside the -1 and +1 range depending on the type of data?

Ans. No, it lies between -1 and +1. If the value of r lies outside these limits it shows there is some error.

3. When rank correlation more precise than simple correlation coefficient?

Ans. Rank method is very useful when data is qualitative in nature and ranks are assigned to different items under consideration. Rank correlation method is also preferred over the

simple correlation co-efficient when extreme values are present in the data. In such a case of simple correlation, correlation- coefficient may be misleading.

4. Does zero correlation mean independence?

Ans. Correlation measures the linear relationship between the two variables. If r is 0, it implies the absence of correlation, i.e. there is no linear relation between them. However, in such cases the variables may be nonlinearly related. So, if two variables are not correlated it does not necessarily follow that they are independent.

5. Can simple correlation co efficient measure any type of relationship?

Ans. The simple correlation coefficient can measure only the direction and magnitude of linear relationship between the two variables it cannot measure nonlinear relationship between the variables.

6. Why does rank correlation coefficient differ from Pearson's correlation co-efficient?

Ans. i) Karl Pearson's method of correlation measures correlation for quantitative data, whereas Spearman's method of rank correlation measures co-efficient of correlation for qualitative data.

Question 1: Find out coefficient of correlation between the age of Husband and Wife, using Karl Pearson's method based on actual mean value of the following series.

Age of Husband	20	23	27	31	35	38	40	42
Age of Wife	18	20	24	30	32	34	36	38

ANSWER:

Age of husband (X)	Deviation $x = X - \bar{X}$	Square of deviation x^2	Age of wife (Y)	Deviation $y = Y - \bar{Y}$	Square of deviation y^2	xy
20	-12	144	18	-11	121	132
23	-9	81	20	-9	81	81
27	-5	25	24	-5	25	25
31	-1	1	30	1	1	-1
35	3	9	32	3	9	9
38	6	36	34	5	25	30
40	8	64	36	7	49	56
42	10	100	38	9	81	90
$\Sigma X = 256$		$\Sigma x^2 = 460$	$\Sigma Y = 232$		$\Sigma y^2 = 392$	$\Sigma xy = 422$

$$X = \Sigma XN = 2568 = 32 \quad Y = \Sigma YN = 2328 = 29 \quad r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} \text{ or } r = \frac{422460}{\sqrt{422460 \times 392}} \text{ or } r = \frac{422180320}{\sqrt{422460 \times 392}} \text{ or } r = +0.994$$

Thus, the coefficient of correlation between husband's age and wife's age is +0.994.

Question 2: Calculate Karl Pearson's coefficient of correlation, between the age and weight of children.

Age (years)	1	2	3	4	5
Weight (kg)	3	4	6	7	10

ANSWER:

Age X	Deviation $x = X - \bar{X}$	Square of deviation x^2	Weight Y	Deviation $y = Y - \bar{Y}$	Square of deviation y^2	xy
1	-2	4	3	-3	9	6
2	-1	1	4	-2	4	2
3	0	0	6	0	0	0
4	1	1	7	1	1	1
5	2	4	10	4	16	8
$\Sigma x = 15$		$\Sigma x^2 = 10$	$\Sigma Y = 30$		$\Sigma y^2 = 30$	$\Sigma xy = 17$

$$X = \Sigma XN = 155 = 3 \quad Y = \Sigma YN = 305 = 6 \quad r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} \text{ or } r = \frac{1710}{\sqrt{10 \times 30}} \text{ or } r = \frac{1710}{\sqrt{300}} \text{ or } r = 1717.32 \Rightarrow r = +0.98$$

Thus, the coefficient of correlation between the age and weight of children is +0.98.

Question 3:

Year	Index of Industrial Production	Number of Unemployed People in thousand
2010	100	11.3
2011	102	12.4
2012	104	14.0
2013	107	11.1
2014	105	12.3
2015	112	12.2
2016	103	19.1
2017	94	26.4

Calculate coefficient of correlation, using Karl Pearson's formula based on actual mean value of the series given below.

Index of Industrial Production n (X)	Deviation $x=X-\bar{X}$ -X	Square of deviation n (x^2)	No. of Unemployed People (Y)	Deviation $y=Y-\bar{Y}$ -Y	Square deviation n (y^2)	xy
100	-3.375	11.39	11.3	-3.55	12.60	+11.98
102	-1.375	1.89	12.4	-2.45	6.00	+3.37
104	0.625	0.39	14.0	-0.85	0.72	-.53
107	3.625	13.14	11.1	-3.75	14.06	-13.59
105	1.625	2.64	12.3	-2.55	6.50	-4.14
112	8.625	74.39	12.2	-2.65	7.02	-22.86
103	-0.375	0.14	19.1	4.25	18.06	-1.59
94	-9.375	87.89	26.4	11.55	133.40	-108.28
$\Sigma x = 827$		$\Sigma x^2 = 191.87$	$\Sigma y = 118.8$		$\Sigma y^2 = 198.36$	$\Sigma xy = -135.64$

ANSWER:

$X = \frac{\Sigma X}{N} = \frac{827}{8} = 103.375$ $Y = \frac{\Sigma Y}{N} = \frac{118.8}{8} = 14.85$ $r = \frac{\Sigma xy}{\Sigma x^2 \times \Sigma y^2}$ or, $r = \frac{-135.64}{191.87 \times 198.36}$
 $\sqrt{\text{or, } r = -135.6438059.33}$ or, $r = -135.64195.09 \Rightarrow r = -0.69$ $X = \frac{\Sigma X}{N} = \frac{827}{8} = 103.375$ $Y = \frac{\Sigma Y}{N} = \frac{118.8}{8} = 14.85$ $r = \frac{\Sigma xy}{\Sigma x^2 \times \Sigma y^2}$ or, $r = \frac{-135.64}{191.87 \times 198.36}$ or, $r = -135.6438059.33$ or, $r = -135.64195.09 \Rightarrow r = -0.69$

Question 4

10 students obtained following ranks in their mathematics and statistics examinations. Find out the extent to which the knowledge of students is correlated in the two subjects.

Rank in Statistics	1	2	3	4	5	6	7	8	9	10
Rank in Mathematics	2	4	1	5	3	9	7	10	6	8

ANSWER:

Rank in statistics (R_1)	Rank in Mathematics (R_2)	$D = R_1 - R_2$	D^2
1	2	-1	1
2	4	-2	4
3	1	2	4
4	5	-1	1
5	3	2	4
6	9	-3	9
7	7	0	0
8	10	-2	4
9	6	3	9
10	8	2	4
$N = 10$			$\Sigma D^2 = 40$

$rk = 1 - 6 \frac{\Sigma D^2}{N^3 - N}$ or, $rk = 1 - 6 \times 40 / (10^3 - 10)$ or, $rk = 1 - 240 / 1000 - 10$ or, $rk = 1 - 240 / 990$ or, $rk = 1 - .24 \Rightarrow rk = +0.76$

Thus, there is a high degree of positive correlation between the marks of the students in statistics and mathematics.

Question 5

Calculate coefficient of rank correlation, given the following data set.

X	20	11	72	65	43	29	50
Y	60	63	26	35	43	51	37

ANSWER:

X	Rank (R_1)	Y	Rank (R_2)	$D = R_1 - R_2$	D^2
20	2	60	6	-4	16
11	1	63	7	-6	36
72	7	26	1	6	36
65	6	35	2	4	16
43	4	43	4	0	0
29	3	51	5	-2	4
50	5	37	3	2	4
$N = 7$					$\Sigma D^2 = 112$

rk = 1 - 6ΣD²N³ - Nor, rk = 1 - 6(112)73 - 7 or, rk = 1 - 672343 - 7 or, rk = 1 - 672336 or, rk = 1 - 2 ⇒ r
 k = -1 rk = 1 - 6ΣD²N³ - Nor, rk = 1 - 611273 - 7 or, rk = 1 - 672343 - 7 or, rk = 1 - 672336 or, rk = 1 -
 2 ⇒ rk = -1

Hence, coefficient of rank correlation = -1

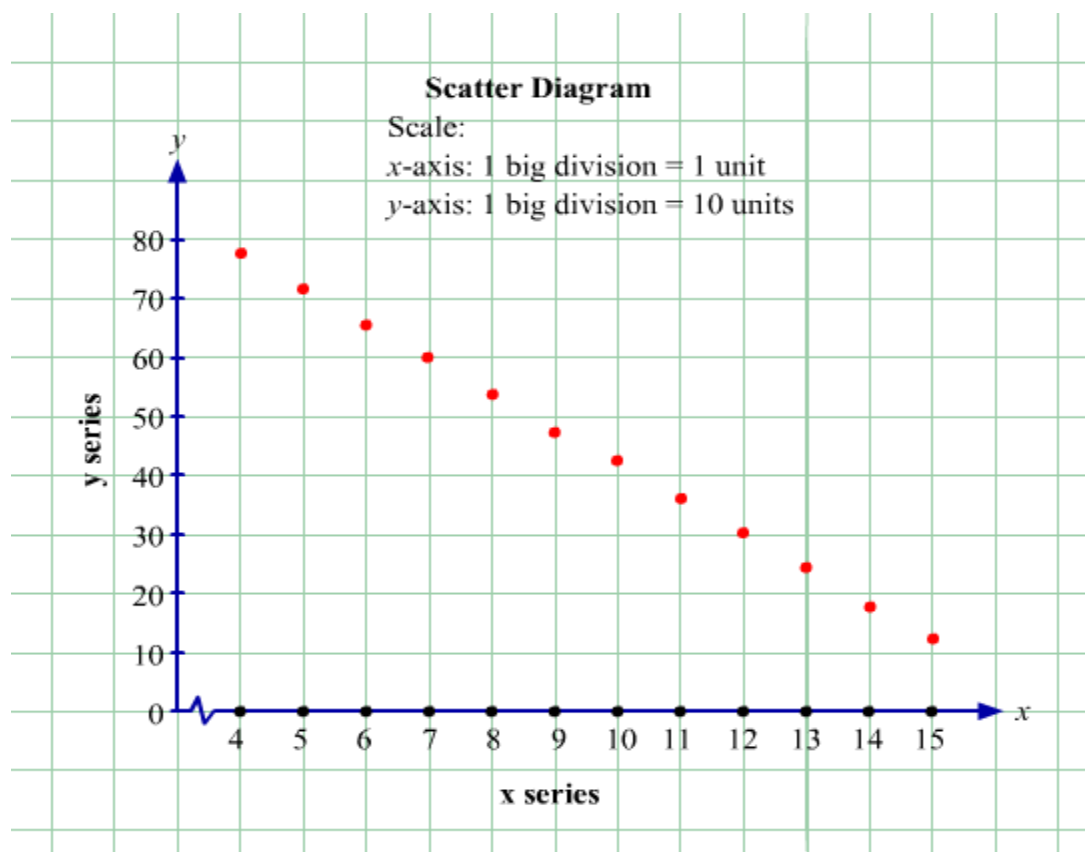
6 MARKS QUESTIONS

Question 1:

Make a scattered diagram of the data given below. Does any relationship exist between the two?

X	4	5	6	7	8	9	10	11	12	13	14	15
Y	78	72	66	60	54	48	42	36	30	24	18	12

ANSWER:



Yes, there exists perfect negative correlation (-1) between X and Y.

Question 2:

Calculate coefficient of correlation of the age of husband and wife using Karl Pearson's method.

Husband (Age)	23	27	28	29	30	31	33	35	36
Wife (Age)	18	20	22	27	29	27	29	28	29

ANSWER:

Husband (h)	$h = H - \bar{H}$	h^2	Wife (w)	$w = W - \bar{W}$	w^2	hw
23	-7.22	52.12	18	-7.44	55.35	53.71
27	-3.22	10.36	20	-5.44	29.59	17.51
28	-2.22	4.92	22	-3.44	11.83	7.63
29	-1.22	1.48	27	1.56	2.43	-1.90
30	-.22	0.04	29	3.56	12.67	-.78
31	.78	0.60	27	1.56	2.43	1.21
33	2.78	7.72	29	3.56	12.67	9.89
35	4.78	22.84	28	2.56	6.55	12.23
36	5.78	33.40	29	3.56	12.67	20.57
$\sum h = 272$		$\sum h^2 = 133.48$	$\sum w = 229$		$\sum w^2 = 146.19$	$\sum hw = 120.07$

Mean age of husbands (\bar{H}) = $\frac{\sum hn}{n} = \frac{2729}{9} = 30.22$ Mean age of wives (\bar{W}) = $\frac{\sum wn}{n} = \frac{2299}{9} = 25.44$
 $r = \frac{\sum hw}{\sqrt{\sum h^2 \times \sum w^2}} = \frac{120.07}{\sqrt{133.48 \times 146.19}} = +0.86$
 Mean age of husbands $\bar{H} = \frac{\sum hn}{n} = \frac{2729}{9} = 30.22$
 Mean age of wives $\bar{W} = \frac{\sum wn}{n} = \frac{2299}{9} = 25.44$
 $r = \frac{\sum hw}{\sqrt{\sum h^2 \times \sum w^2}} = \frac{120.07}{\sqrt{133.48 \times 146.19}} = +0.86$
 Thus, there exists a high positive correlation between age of wife and age of husband.

Question 3:

Calculate correlation of the following data using Karl Pearson's method:

Series A	112	114	108	124	145	150	119	125	147	150
Series B	200	190	214	187	170	170	210	190	180	181

ANSWER:

Series A	$a = A - \bar{A}$	a^2	Series B	$b = B - \bar{B}$	b^2	ab
112	-17.4	302.76	200	10.8	116.64	-187.92
114	-15.4	237.16	190	.8	.64	-12.32
108	-21.4	457.96	214	24.8	615.04	-530.72
124	-5.4	29.16	187	-2.2	4.84	11.88

145	15.6	243.36	170	-19.2	368.64	-299.52
150	20.6	424.36	170	-19.2	368.64	-395.52
119	-10.4	108.16	210	20.8	432.64	-216.32
125	-4.4	19.36	190	.8	.64	-3.52
147	17.6	309.76	180	-9.2	84.64	-161.92
150	20.6	424.36	181	-8.2	67.24	-168.92
$\sum A =$ 1294		$\sum a^2 =$ 2556.4	$\sum B =$ 1892		$\sum b^2 =$ 2059.6	$\sum ab = -$ 1964.8

Mean of Series A (A) = $\frac{\sum A_n}{10} = \frac{1294}{10} = 129.4$ Mean of Series B (B) = $\frac{\sum B_n}{10} = \frac{1892}{10} = 189.2$
 $r = \frac{\sum ab}{\sqrt{\sum a^2 \times \sum b^2}} = \frac{-1964.8}{\sqrt{2556.4 \times 2059.6}} = -0.85$
 Mean of Series A A = $\frac{\sum A_n}{10} = \frac{1294}{10} = 129.4$ Mean of Series B B = $\frac{\sum B_n}{10} = \frac{1892}{10} = 189.2$
 $r = \frac{\sum ab}{\sqrt{\sum a^2 \times \sum b^2}} = \frac{-1964.8}{\sqrt{2556.4 \times 2059.6}} = -0.85$

Question 4:

Using assumed average in Karl Pearson's formula, calculate coefficient of correlation, given the following data:

X	78	89	97	69	59	79	68	61
Y	125	137	156	112	107	106	123	138

ANSWER:

X	$dx = X - A$ $A = 69$	d_x^2	Y	$dy = Y - B$ $B = 125$	d_y^2	$d_x d_y$
78	9	81	125	0	0	0
89	20	400	137	12	144	240
97	28	784	156	31	961	868
69	0	0	112	-13	169	0
59	-10	100	107	-18	324	180
79	10	100	106	-19	361	-190
68	-1	1	123	-2	4	2
61	-8	64	138	13	169	-104
$N = 8$	$\sum d_x = 48$	$\sum d_x^2 = 1530$	$N = 8$	$\sum d_y = 4$	$\sum d_y^2 = 2132$	$\sum d_x d_y = 996$

Suppose the assumed mean is 69 and 125 for series A and series B, respectively.

$$r = \frac{\sum dx dy}{\sqrt{(\sum dx)^2 \times (\sum dy)^2}} = \frac{996}{\sqrt{48^2 \times 4^2}} = \frac{996}{48 \times 4} = \frac{996}{192} = 5.1875$$

$$r = \frac{\sum dx dy}{\sqrt{\sum dx^2 \times \sum dy^2}} = \frac{996}{\sqrt{1530 \times 2132}} = \frac{996}{\sqrt{3262560}} = \frac{996}{1806.25} = 0.551$$

Question 5:

Find out Karl Pearson's coefficient of correlation:

Capital Units (in '000)	10	20	30	40	50	60	70	80	90	100
Profit Receipt	2	4	8	5	10	15	14	20	22	30

ANSWER:

X	$dx = X - A$	d_x^2	Y	$dy = Y - B$	d_y^2	$d_x d_y$
10	-40	1600	2	-13	169	520
20	-30	900	4	-11	121	330
30	-20	400	8	-7	49	140
40	-10	100	5	-10	100	100
50	0	0	10	-5	25	0
60	10	100	15	0	0	0
70	20	400	14	-1	1	-20
80	30	900	20	5	25	150
90	40	1600	22	7	49	280
100	50	2500	30	15	225	750
$N = 10$	$\sum d_x = 50$	$\sum d_x^2 = 8500$	$N = 10$	$\sum d_y = -20$	$\sum d_y^2 = 764$	$\sum d_x d_y = 2250$

$$r = \frac{\sum d_x d_y - (\sum d_x)(\sum d_y)}{N \sqrt{(\sum d_x^2 - (\sum d_x)^2/N)(\sum d_y^2 - (\sum d_y)^2/N)}} = \frac{2250 - 50 \times (-20)}{10 \sqrt{(8500 - (50)^2/10)(764 - (-20)^2/10)}} = \frac{2250 + 1000}{10 \sqrt{(8500 - 250)(764 - 40)}} = \frac{3250}{10 \sqrt{8250 \times 724}} = \frac{3250}{10 \times 2437.4} = \frac{3250}{24374} = 0.1333$$

Question 6:

Seven students of a class secured following marks in Economics and History. Calculate coefficient of correlation with the help of these data.

Economics	66	90	89	55	58	44	42
History	58	76	65	58	53	49	56

ANSWER:

Economics (E)	R_1	History (H)	R_2	$D = R_1 - R_2$	D^2
66	3	58	3.5	-.5	.25
90	1	76	1	0	0
89	2	65	2	0	0
55	5	58	3.5	1.5	2.25
58	4	53	6	-2	4
44	6	49	7	-1	1
42	7	56	5	2	4
$N = 7$					$\sum D^2 = 11.50$

Here, note that for the marks scored in History, two ranks are tied. That is, two students scored 58 marks. Thus, we use the following formula for the calculation of correlation.

$$r_k = 1 - \frac{6[\sum D^2 + 112(M_3 - M_1)]}{N^3 - N}$$

Here, $M_1 = 2$, as two students have scored 58 in History.

$$r_k = 1 - \frac{6[11.50 + 112(8 - 2)]}{343 - 7} = \frac{336 - 72}{336} = +0.79$$

Thus, there exists a positive correlation between marks scored in Economics and marks scored in History.

Question 7:

Find out rank difference correlation of X and Y:

X	80	78	75	75	58	67	60	59
Y	12	13	14	14	14	16	15	17

ANSWER:

X	R_1	Y	R_2	$D = R_1 - R_2$	D^2
80	1	12	8	-7	49
78	2	13	7	-5	25
75	3.5	14	5	-1.5	2.25
75	3.5	14	5	-1.5	2.25
58	8	14	5	3	9
67	5	16	2	3	9
60	6	15	3	3	9
59	7	17	1	6	36
$N = 8$					$\sum D^2 = 141.5$

$r_k = 1 - 6 \frac{[\sum D^2 + 112(M_3 - M_1) + 112(M_3 - M_2)]}{N^3 - N}$ Here, $M_1 = 2$, as the item 75 is appearing twice in X-series. $M_2 = 3$, as the item 14 is appearing thrice in Y-series. or, $r_k = 1 - 6 \frac{[141.50 + 112(23 - 2) + 112(33 - 3)]}{512 - 8}$. $r_k = 504 - 864504 = -0.714$

$r_k = 1 - 6 \frac{[\sum D^2 + 112M_3 - M_1 + 112M_3 - M_2]}{N^3 - N}$ Here, $M_1 = 2$, as the item 75 is appearing twice in X-series. $M_2 = 3$, as the item 14 is appearing thrice in Y-series. or, $r_k = 1 - 6 \frac{141.50 + 112(23 - 2) + 112(33 - 3)}{512 - 8}$. $r_k = 504 - 864504 = -0.714$

Question 8:

Calculate coefficient of correlation of the following data with rank difference and Karl Pearson's methods:

Economics (Marks)	77	54	27	52	14	35	90	25	56	60
Hindi (Marks)	35	58	60	46	50	40	35	56	44	42

ANSWER:

Karl Pearson's Method

Economic s (X)	$d_x = X - A$ $d_x = X - A$	d_x^2	History (Y)	$d_y = Y - B$ $d_y = Y - B$	d_y^2	$d_x d_y$
77	42	1764	35	-15	225	-630
54	19	361	58	8	64	152
27	-8	64	60	10	100	-80
52	17	289	46	-4	16	-68
14	-21	441	50	0	0	0
A=35	0	0	B=5	-10	100	0
5	55	3025	40	-15	225	-825
90	-10	100	35	6	36	-60
25	21	441	56	-6	36	-126
56	25	625	44	-8	64	-200
60			42			
$N = 10$	$\sum d_x = 140$	$\sum d_x^2 = 7110$	$N = 10$	$\sum d_y = -34$	$\sum d_y^2 = 860$	$\sum d_x d_y = -1837$

$r = \frac{\sum d_x d_y}{\sqrt{(\sum d_x^2)(\sum d_y^2)}} = \frac{-1837}{\sqrt{7110 \times 860}} = \frac{-1837}{2451.76} = -0.749$

$r = \frac{\sum d_x d_y}{\sqrt{(\sum d_x^2)(\sum d_y^2)}} = \frac{-1837}{\sqrt{7110 \times 860}} = \frac{-1837}{2451.76} = -0.749$

Rank Difference Method

Economics	R_1	History	R_2	$D = R_1 - R_2$	D^2
77	2	35	9.5	-7.5	56.25
54	5	58	2	3	9
27	8	60	1	7	49
52	6	46	5	1	1
14	10	50	4	6	36
35	7	40	8	-1	1
90	1	35	9.5	-8.5	72.25
25	9	56	3	6	36
56	4	44	6	-2	4
60	3	42	7	-4	16
$N=10$					$\sum D^2=280.5$

$rk = 1 - \frac{6[\sum D^2 + 112(M_3 - M_1)]}{N^3 - N}$ Here, $M_1 = 2$, as two students have scored 35 marks in History. or, $rk = 1 - \frac{6[280.50 + 112(23 - 2)]}{1000 - 10} = -0.703$
 $rk = 1 - \frac{6 \sum D^2 + 112 M_1 (3 - M_1)}{N^3 - N}$ Here, $M_1 = 2$, as two students have scored 35 marks in History. or, $rk = 1 - \frac{6 \times 280.50 + 112(23 - 2)}{1000 - 10} = -0.703$

Question 9: Seven methods of teaching Economics in two universities are shown below. Calculate rank difference correlation.

Teaching Methods	I	II	III	IV	V	VI	VII
Rank of 'A's Students	2	1	5	3	4	7	6
Rank of 'B's Students	1	3	2	4	7	5	6

ANSWER:

Teaching Methods	R_A	R_B	$D = R_A - R_B$	D^2
I	2	1	1	1
II	1	3	-2	4
III	5	2	3	9
IV	3	4	-1	1
V	4	7	-3	9
VI	7	5	2	4
VII	6	6	0	0
$N=7$				$\sum D^2=28$

$rk = 1 - \frac{6 \sum D^2}{N^3 - N}$ - Nor, $rk = 1 - \frac{6 \times 28}{336 - 7} = \frac{336 - 168}{336} = 0.5$ Hence, $rk = 0.5$

Question 10:

Give three examples of perfect correlation. Find out rank difference coefficient of correlation with the help of the following data:

X	48	33	40	9	16	65	26	15	57
Y	13	13	22	6	14	20	9	6	15

ANSWER:

Three examples of perfect correlation are:

1. T.V. viewing and Study hours (-ve correlation). That is, as the hours spent in T.V. viewing increases, the numbers of hours that can be devoted to study decreases and vice-versa.
2. Income used for consumption and amount of saving (-ve correlation). That is, greater the portion of income used for consumption purposes, smaller is the portion of income left for saving purposes and vice-versa.
3. Amount deposited in bank and interest earned (+ve correlation). That is, as the amount deposited in the bank increases, the amount of interest that is earned increases and vice-versa.

X	R ₁	Y	R ₂	D = R ₁ - R ₂	D ²
48	3	13	5.5	-2.5	6.25
33	5	13	5.5	-.5	.25
40	4	22	1	3	9
9	9	6	8.5	.5	.25
16	7	14	4	3	9
65	1	20	2	-1	1
26	6	9	7	-1	1
15	8	6	8.5	-.5	.25
57	2	15	3	.1	1
N = 9					$\sum D^2 = 28$

$rk = 1 - \frac{6[\sum D^2 + 112(M_3 - M_1) + 112(M_3 - M_2)]}{N^3 - N}$ Here, $M_1 = 2$, as the item 13 is appearing twice in Y-series. $M_2 = 2$, as the item 6 is appearing twice in Y-series. or, $rk = 1 - \frac{6[28 + 112(23 - 2) + 112(23 - 2)]}{729 - 9} = \frac{720 - 147}{720} = 0.758$

Here, $M_1 = 2$, as the item 13 is appearing twice in Y-series. $M_2 = 2$, as the item 6 is appearing twice in Y-series. or, $rk = 1 - \frac{6[28 + 112(23 - 2) + 112(23 - 2)]}{729 - 9} = \frac{720 - 147}{720} = 0.758$

Question 11:

Calculate coefficient of correlation of the following data:

X	10	6	9	10	12	13	11	9
Y	9	4	6	9	11	13	8	4

ANSWER:

X	$dx = X - A$ $A = 10$	d_x^2	Y	$dy = Y - B$ $B = 11$	d_y^2	$d_x d_y$
10	0	0	9	-2	4	0
6	-4	16	4	-7	49	28
9	-1	1	6	-5	25	5
10	0	0	9	-2	4	0
12	2	9	11	0	0	0
13	3	4	13	2	4	6
11	1	1	8	-3	9	-3
9	-1	1	4	-7	49	7
$N = 8$	$\sum dx = 0$	$\sum d_x^2 = 32$	$N = 8$	$\sum dy = -24$	$\sum d_y^2 = 144$	$\sum d_x d_y = 43$

$$r = \frac{\sum dx dy - (\sum dx)(\sum dy)/N}{\sqrt{(\sum dx^2 - (\sum dx)^2/N)(\sum dy^2 - (\sum dy)^2/N)}} = \frac{43 - 0 \times (-24)/8}{\sqrt{(32 - (0)^2/8)(144 - (-24)^2/8)}} = \frac{43}{\sqrt{32 \times 72}} = \frac{43}{\sqrt{2304}} = \frac{43}{48} = 0.896$$

Question 12:

Deviation of two series of X and Y are shown. Calculate coefficient of correlation.

X	+5	-4	-2	+20	-10	0	+3	0	-15	-5
Y	+5	-12	-7	+25	-10	-3	0	+2	-9	-15

ANSWER:

d_x	d_x^2	d_y	d_y^2	$d_x d_y$
5	25	5	25	25
-4	16	-12	144	48
-2	4	-7	49	14
20	400	25	625	500
-10	100	-10	100	100
0	0	-3	9	0

3	9	0	0	0
0	0	2	4	0
-15	225	-9	81	135
-5	25	-15	225	75
$\sum d_x = -8$	$\sum d_x^2 = 804$	$\sum d_y = -24$	$\sum d_y^2 = 1262$	$\sum d_x d_y = 897$

$$r = \frac{\sum d_x d_y - (\sum d_x)(\sum d_y)N}{\sqrt{(\sum d_x^2 - (\sum d_x)^2/N)(\sum d_y^2 - (\sum d_y)^2/N)}} \text{ or } r = \frac{897 - (-8)(-24)}{\sqrt{(804 - 64/12)(1262 - 576/12)}} = \frac{897 - 192}{\sqrt{740 \times 104}} = \frac{705}{\sqrt{77040}} = \frac{705}{277.56} = 2.54$$

$$r = \frac{\sum d_x d_y - \sum d_x \sum d_y / N}{\sqrt{(\sum d_x^2 - \sum d_x^2 / N)(\sum d_y^2 - \sum d_y^2 / N)}} \text{ or } r = \frac{897 - (-8)(-24)}{\sqrt{(804 - (-8)^2/12)(1262 - (-24)^2/12)}} = \frac{897 - 192}{\sqrt{(740)(104)}} = \frac{705}{\sqrt{77040}} = \frac{705}{277.56} = 2.54$$

Question 13:

In a baby competition, two judges accorded following to 12 competitors. Find the coefficient of rank correlation.

Entry	A	B	C	D	E	F	G	H	I	J	K	L
Judge X	1	2	3	4	5	6	7	8	9	10	11	12
Judge Y	12	9	6	10	3	5	4	7	8	2	11	1

ANSWER:

Entry	Ranks by Judge X (R_X)	Ranks by Judge Y (R_Y)	$D = R_X - R_Y$	D^2
A	1	12	-11	121
B	2	9	-7	49
C	3	6	-3	9
D	4	10	-6	36
E	5	3	2	4
F	6	5	1	1
G	7	4	3	9
H	8	7	1	1
I	9	8	1	1
J	10	2	8	64
K	11	11	0	0
L	12	1	11	121
$N = 12$				$\sum D^2 = 416$

$$r_k = 1 - \frac{6 \sum D^2}{N^3 - N} \text{ or } r_k = 1 - \frac{6 \times 416}{12^3 - 12} = 1 - \frac{2496}{1716} = -0.455 \text{ Hence, } r_k = -0.455$$

$$r_k = 1 - \frac{6 \sum D^2}{N^3 - N} \text{ or } r_k = 1 - \frac{6 \times 416}{12^3 - 12} = 1 - \frac{2496}{1716} = -0.455 \text{ Hence, } r_k = -0.455$$

Question 14:

In a Fancy-dress competition, two judges accorded the following ranks to eight participants:

Judge X	8	7	6	3	2	1	5	4
Judge Y	7	5	4	1	3	2	6	8

Calculate coefficient of rank correlation.

ANSWER:

R_X	R_Y	$D = R_X - R_Y$	D^2
8	7	1	1
7	5	2	4
6	4	2	4
3	1	2	4
2	3	-1	1
1	2	-1	1
5	6	-1	1
4	8	-4	16
			$\sum D^2 = 32$

$$N = 8$$

$$r_k = 1 - \frac{6 \sum D^2}{N^3 - N} = 1 - \frac{6 \times 32}{8^3 - 8} = 1 - \frac{192}{504} = 0.619$$

Hence, $r_k = 0.619$

Question 15:

In a beauty contest, three judges accorded following ranks to 10 participants:

Judge I	1	6	5	10	3	2	4	9	7	8
Judge II	3	5	8	4	7	10	2	1	6	9
Judge III	6	4	9	8	1	2	3	10	5	7

Find out by Spearman's Rank Difference Method which pair of judges has a common taste in respect of beauty.

ANSWER:

R_1	R_2	R_3	$D_1 = R_1 - R_2$	$D_2 = R_1 - R_3$	$D_3 = R_2 - R_3$	D_1^2	D_2^2	D_3^2
1	3	6	-2	-5	-3	4	25	9

6	5	4	1	2	1	1	4	1
5	8	9	-3	-4	-1	9	16	1
1	4	8	6	2	-4	36	4	16
0	7	1	-4	2	6	16	4	36
3	1	2	-8	0	8	64	0	64
2	0	3	2	1	-1	4	1	1
4	2	1	8	-1	-9	64	1	81
9	1	0	1	2	1	1	4	1
7	6	5	-1	1	8	1	1	64
8	9	7						
						$\sum D_{12}$ =200	$\sum D_{22} =$ 60	$\sum D_{32} =$ $214 \sum D_3$ $2 = 214$

$$N = 10$$

Rank Correlation between Judge 1 and Judge 2 $r_{k1,2} = 1 - \frac{6 \sum D_{12}^2}{N^3 - N} = 1 - \frac{6 \times 200}{1000 - 10} = \frac{990 - 1200}{990} = -0.212$

Rank Correlation between Judge 1 and Judge 3 $r_{k1,3} = 1 - \frac{6 \sum D_{22}^2}{N^3 - N} = 1 - \frac{6 \times 60}{1000 - 10} = \frac{990 - 360}{990} = +0.636$

Rank Correlation between Judge 2 and Judge 3 $r_{k2,3} = 1 - \frac{6 \sum D_{32}^2}{N^3 - N} = 1 - \frac{6 \times 214}{1000 - 10} = \frac{990 - 1284}{990} = -0.296$

Rank Correlation between Judge 1 and Judge 2 $r_{k1,2} = 1 - \frac{6 \sum D_{12}^2}{N^3 - N} = 1 - \frac{6 \times 200}{1000 - 10} = \frac{990 - 1200}{990} = -0.212$

Rank Correlation between Judge 1 and Judge 3 $r_{k1,3} = 1 - \frac{6 \sum D_{22}^2}{N^3 - N} = 1 - \frac{6 \times 60}{1000 - 10} = \frac{990 - 360}{990} = +0.636$

Rank Correlation between Judge 2 and Judge 3 $r_{k2,3} = 1 - \frac{6 \sum D_{32}^2}{N^3 - N} = 1 - \frac{6 \times 214}{1000 - 10} = \frac{990 - 1284}{990} = -0.296$

Observation and Conclusion:

As the rank correlation coefficient between Judge 1 and Judge 3 is highest and positive, so it can be regarded that they have a common taste in respect of beauty.

Question 16:

Following data relates to age group and percentage of regular players. Calculate Karl Pearson's coefficient of correlation.

Age Group	20-25	25-30	30-35	35-40	40-45	45-50
% of Regular Players	40	35	28	20	15	5

ANSWER:

Age Group	Mid Value (X)	% of Regular Players (Y)	$d'X = X - Ah = X - 37.55$ $d'X = X - 37.55$	$d'Y = Y - Bi = Y - 28.5$ $d'Y = Y - 28.5$	(d_x') (d_y')	$(d_x')^2$	$(d_y')^2$
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20-25	22.5	40	-3	2.4	-7.2	9	5.76
25-30	27.5	35	-2	1.4	-2.8	4	1.96
30-35	32.5	28	-1	0	0	1	0
35-40	37.5	20	0	-1.6	0	0	2.56
40-45	42.5	15	1	-2.6	-2.6	1	6.76
45-50	47.5	5	2	-4.6	-9.2	4	21.16
			$\sum dx' = -3$	$\sum dy' = -5$	$\sum(dx' \cdot dy') = -21.8$	$\sum(dx')^2 = 19$	$\sum(dy')^2 = 38.2$

$$r = \frac{\sum d'X d'Y - (\sum d'X)(\sum d'Y)/N}{\sqrt{[\sum d'X^2 - (\sum d'X)^2/N][\sum d'Y^2 - (\sum d'Y)^2/N]}}$$

or, $r = \frac{(-21.8) - (-3)(-5)/6}{\sqrt{[19 - (-3)^2/6][38.2 - (-5)^2/6]}}$ or, $r = \frac{-24.3}{\sqrt{[19 - 96][38.2 - 256]}}$ or, $r = \frac{-24.3}{17.5 \times 34.03} = \frac{-24.3}{595.525} = -24.324/403$ Hence, $r = -0.996$

or, $r = \frac{\sum d'X d'Y - \frac{\sum d'X \sum d'Y}{N}}{\sqrt{[\sum d'X^2 - \frac{(\sum d'X)^2}{N}][\sum d'Y^2 - \frac{(\sum d'Y)^2}{N}]}}$ or, $r = \frac{-21.8 - \frac{-3 \times -5}{6}}{\sqrt{[19 - \frac{(-3)^2}{6}][38.2 - \frac{(-5)^2}{6}]}}$ or, $r = \frac{-24.3}{17.5 \times 34.03} = \frac{-24.3}{595.525} = -24.324/403$ Hence, $r = -0.996$

Question 17:

From the following data, relating to playing habits in various age group of 900 students. Calculate coefficient of correlation between age group and playing habits.

Age Group	15-16	16-17	17-18	18-19	19-20	20-21
Number of Students	250	200	150	120	100	80
Regular Players	200	150	90	48	30	12

ANSWER:

Age Group	Number of People	Number of Players	Percentage of Players (%)
15-16	250	200	$\frac{200}{250} \times 100 = 80\%$
16-17	200	150	$\frac{150}{200} \times 100 = 75\%$
17-18	150	90	$\frac{90}{150} \times 100 = 60\%$
18-19	120	48	$\frac{48}{120} \times 100 = 40\%$

19-20	100	30	$30/100 \times 100 = 30\%$ $30/100 \times 100 = 30\%$
20-21	80	12	$12/80 \times 100 = 15\%$ $12/80 \times 100 = 15\%$

Age Group	Mid Value (X)	Percentage of Players (%) (Y)	$dX = X - A = X - 17.5$ $dX = X - A = X - 17.5$	$dY = Y - B = Y - 40$ $dY = Y - B = Y - 40$	$dXdY$	dX^2	dY^2
15-16	15.5	80	-2	40	-80	4	1600
16-17	16.5	75	-1	35	-35	1	1225
17-18	17.5A	60	0	20	0	0	400
18-19	18.5	40B	1	0	0	1	0
19-20	19.5	30	2	-10	-20	4	100
20-21	20.5	15	3	-25	-75	9	625
	$N = 6$	$N = 6$	$\sum dX = 3$	$\sum dY = 60$	$\sum dXdY = -210$	$\sum dX^2 = 19$	$\sum dY^2 = 3950$

$$r = \frac{\sum dXdY - (\sum dX) \times (\sum dY) / N}{\sqrt{(\sum dX^2 - (\sum dX)^2 / N) \times (\sum dY^2 - (\sum dY)^2 / N)}} \text{ or } r = \frac{-210 - 3 \times (60) / 6}{\sqrt{(19 - (3)^2 / 6) \times (3950 - (60)^2 / 6)}} = \frac{-240.175 \times 3350}{\sqrt{26 \times 3950 - (60)^2 \times 26}} = \frac{-240.18 \times 57.88}{\sqrt{26 \times 3950 - (60)^2 \times 26}} = \frac{-240241.94}{\sqrt{26 \times 3950 - (60)^2 \times 26}} = -0.992 \therefore r = -0.992$$

Hence, the coefficient of correlation between age group and playing habits is -0.992

Question 18:

Following data relates to density of population, number of deaths and population of various cities. Calculate death rate and Karl Pearson coefficient between density of population and

Cities	P	Q	R	S	T	U
Density of Population	200	500	700	500	600	900
Number of Deaths	840	300	312	560	1,140	1,224
Population	42,000	30,000	24,000	40,000	90,000	72,000

death rate.

ANSWER:

Cities	Density	Number of	Population	Death rate
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		Deaths		= Number of Deaths Population $\times 100$ Number of Deaths Population $\times 100$
P	200	840	42000	2
Q	500	300	30000	1
R	700	312	24000	1.3
S	500	560	40000	1.4
T	600	1440	90000	1.6
U	900	1224	72000	1.7

Density (X)	$dx = X - A$ $A = 500$	dx^2	Death Rate (Y)	$dy = Y - B$ $B = 1$	dy^2	$dx dy$
200	-300	90000	2	1	1	-300
500	0	0	1	0	0	0
700	200	40000	1.3	0.3	0.09	60
500	0	0	1.4	0.4	0.16	0
600	100	10000	1.6	0.6	0.36	60
900	400	160000	1.7	0.7	0.49	280
	$\sum dx = 400$	$\sum dx^2 =$ 300000		$\sum dy = 3$	$\sum dy^2 =$ 2.1	$\sum dx dy =$ 100

$r = \frac{\sum dx dy - (\sum dx)(\sum dy)/n}{\sqrt{(\sum dx^2 - (\sum dx)^2/n)(\sum dy^2 - (\sum dy)^2/n)}} = \frac{100 - 400 \times 3 / 6}{\sqrt{(300000 - (400)^2/6)(2.1 - (3)^2/6)}} = \frac{100 - 200}{\sqrt{333333.34 \times 0.6}} = \frac{-100}{522.81 \times 0.77} = -0.248$

Hence, Karl Pearson's Coefficient of Correlation between density of population and death rate is -0.248

$r = \frac{\sum dx dy - \sum dx \sum dy / n}{\sqrt{(\sum dx^2 - \sum dx^2/n)(\sum dy^2 - \sum dy^2/n)}} = \frac{100 - 400 \times 3 / 6}{\sqrt{300000 - 400^2/6 \times 2.1 - 3^2/6}} = \frac{100 - 200}{\sqrt{333333.34 \times 0.6}} = \frac{-100}{522.81 \times 0.77} = -0.248$

Hence, Karl Pearson's Coefficient of Correlation between density of population and death rate is -0.248

Question 19:

From the following data, determine Karl Pearson's coefficient of correlation between X and Y series for 15 pairs:

	X-Series	Y-Series
Mean	80	120
Sum of Squares of deviation from Arithmetic Mean	56	156
Sum of product of deviation of X and Y from their respective Means	92	

ANSWER:

Given: $N = 15$, $X = 80$, $Y = 120$, $\Sigma x^2 = 56$, $\Sigma y^2 = 156$, $\Sigma xy = 92$, $\sigma_x = \frac{\Sigma x^2}{N} = \frac{56}{15} = 3.73$, $\sigma_y = \frac{\Sigma y^2}{N} = \frac{156}{15} = 10.4$, $r = \frac{\Sigma xy}{N \sigma_x \sigma_y} = \frac{92}{15 \times 3.73 \times 10.4} = 0.98$

Hence, Karl Pearson's coefficient of correlation is +0.98

Question 20:

From the following information, determine coefficient of correlation between X and Y series:

	X-Series	Y-Series
Number of Items	15	15
Mean	25	18
SD	3.01	3.03
Sum of Squares of deviation from Mean	136	138
Sum of product of deviation of X and Y from their respective Means	122	

ANSWER:

Given: $N = 15$, $X = 25$, $Y = 18$, $\sigma_x = 3.01$, $\sigma_y = 3.03$, $\Sigma x^2 = 136$, $\Sigma y^2 = 138$, $\Sigma xy = 122$, $r = \frac{\Sigma xy}{N \sigma_x \sigma_y} = \frac{122}{15 \times 3.01 \times 3.03} = 0.89$

$r = \frac{\Sigma xy}{N \sigma_x \sigma_y} = \frac{122}{15 \times 3.01 \times 3.03} = 0.89$

Hence, coefficient of correlation between X and Y series is + 0.89

VERY SHORT ANSWER QUESTIONS**1 MARKS**

24. Give the meaning of correlation.

Ans. The relationship between two or more variables is known as correlation.

25. Where does the correlation between the variables lie?

Ans. Between +1 and -1

26. Does correlation imply causation?

Ans. No it means co-variation

27. What does it mean if the correlation between two variables is +1?

Ans. Perfect positive correlation

28. What is absence of correlation?

Ans. When there is no relationship between the changes in the two variables it is known as absence of correlation.

29. What is scatter diagram?

Ans. Scatter diagram is a kind of diagram wherein data are plotted on a graph paper in the form of dots.

30. Who propounded the Rank Difference Method of correlation?

Ans. Prof. Charles Spearman

31. What is the difference between positive and negative correlation?

Ans. The difference between positive and negative correlation is that in positive correlation variables in the same direction whereas in the negative correlation they move in different directions.

32. When is rank correlation method used?

Ans. Rank correlation method is used when variables are qualitative in nature such as beauty, bravery, wisdom, virtue etc.

Multiple choice questions:

33. _____ correlation relates to the direction of change.

- a) Linear
- b) Positive
- c) Scatter
- d) Limited

34. When we study correlation between only two variables it is called _____

- a) Partial
- b) Simple
- c) Multiple
- d) Double

Ans. Simple

35. The degree of perfect correlation is _____

- a) 0

b) +1

c)-1

d) 0 to 1 Ans. b) +1

36. The range of simple correlation coefficient is _____

a) 0 to infinity

b) 0 to -1

c) -1 to +1

d) +1 to infinity

Ans. c)

37. The correlation between price of a car and demand of a pen is _____

a) Positive

b) Negative

c) Zero

d) None of these

Ans. Zero

38. One variable X increases and the other variable Y decreases the correlation is _____

a) Negative

b) Positive

c) Zero

d) All of these

Ans. Negative

39. Graphic method to measure correlation _____

a) Bar diagram

b) Pie diagram

c) Rank correlation

d) Scatter diagrams

Ans. Scatter diagrams

40. Mathematical method to measure correlation _____

- a) Karl Pearson's method
- b) Rank correlation method
- c) Both (a) and (b)
- d) Neither (a) and (b)

Ans. C)

41. D denotes the difference between

- a) Ranks of series I and series II
- b) Mean deviation and standard deviation
- c) Positive and negative correlation
- d) Correlation and coefficient of variation.

Ans. a)

Fill in the blanks:

42. Coefficient of correlation in case of perfect negative correlation is _____

Ans. -1

43. The correlation is said to be positive when 2 variables move in the _____ direction

Ans. Same

44. _____ is a graphic presentation of correlation.

Ans. Scatter diagram

45. The Value of correlation co-efficient lies between _____

Ans. 0 and 1

46. Correlation coefficient is _____ of the units of measurement.

Ans. independent

Short answer questions

3MARKS

7. Why r preferred to covariance as a measure of association?

Ans. r is preferred to covariance due to

- iii) Correlation – co-efficient r has no unit.
- iv) Correlation Coefficient is independent of origin as well as scale.

8. Can r lie outside the -1 and $+1$ range depending on the type of data?

Ans. No, it lies between -1 and $+1$. If the value of r lies outside these limits it shows there is some error.

9. When rank correlation more precise than simple correlation coefficient?

Ans. Rank method is very useful when data is qualitative in nature and ranks are assigned to different items under consideration.

Rank correlation method is also preferred over the simple correlation coefficient when extreme values are present in the data. In such a case of simple correlation, correlation-coefficient may be misleading.

10. Does zero correlation mean independence?

Ans. Correlation measures the linear relationship between the two variables. If r is 0 , it implies the absence of correlation, i.e. there is no linear relation between them. However, in such cases the variables may be nonlinearly related. So, if two variables are not correlated it does not necessarily follow that they are independent.

11. Can simple correlation coefficient measure any type of relationship?

Ans. The simple correlation coefficient can measure only the direction and magnitude of linear relationship between the two variables it cannot measure nonlinear relationship between the variables.

12. Why does rank correlation coefficient differ from Pearson's correlation coefficient?

Ans. i) Karl Pearson's method of correlation measures correlation for quantitative data, whereas Spearman's method of rank correlation measures coefficient of correlation for qualitative data.

Question 1:

Find out coefficient of correlation between the age of Husband and Wife, using Karl Pearson's method based on actual mean value of the following series.

Age of Husband	20	23	27	31	35	38	40	42
Age of Wife	18	20	24	30	32	34	36	38

ANSWER:

Age of husband (X)	Deviation $x = X - \bar{X}$ $= X - X$	Square of deviation x^2	Age of wife (Y)	Deviation $y = Y - \bar{Y}$ $= Y - Y$	Square of deviation y^2	xy
20	-12	144	18	-11	121	132

23	-9	81	20	-9	81	81
27	-5	25	24	-5	25	25
31	-1	1	30	1	1	-1
35	3	9	32	3	9	9
38	6	36	34	5	25	30
40	8	64	36	7	49	56
42	10	100	38	9	81	90
$\Sigma X =$ 256		$\Sigma x^2 = 460$ $\Sigma x = 256$	$\Sigma Y = 232$ $\Sigma Y = 232$		$\Sigma y^2 = 392$ $\Sigma y = 392$	$\Sigma xy = 422$ $\Sigma x = 256$ $\Sigma y = 392$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}} = \frac{422}{\sqrt{460 \times 392}} = \frac{422}{422.180320} \approx +0.994$$

Thus, the coefficient of correlation between husband's age and wife's age is +0.994.

Question 2:

Calculate Karl Pearson's coefficient of correlation, between the age and weight of children.

Age (years)	1	2	3	4	5
Weight (kg)	3	4	6	7	10

ANSWER:

Age X	Deviation $x = X - \bar{X}$	Square of deviation x^2	Weight Y	Deviation $y = Y - \bar{Y}$	Square of deviation y^2	xy
1	-2	4	3	-3	9	6
2	-1	1	4	-2	4	2
3	0	0	6	0	0	0
4	1	1	7	1	1	1
5	2	4	10	4	16	8
$\Sigma x =$ 15		$\Sigma x^2 = 10$	$\Sigma Y =$ 30		$\Sigma y^2 = 30$	$\Sigma xy =$ 17

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}} = \frac{17}{\sqrt{10 \times 30}} = \frac{17}{17.32} \approx +0.98$$

Thus, the coefficient of correlation between the age and weight of children is +0.98.

Question 3:

Calculate coefficient of correlation, using Karl Pearson's formula based on actual mean value of the series given below.

Year	Index of Industrial Production	Number of Unemployed People in thousand
2010	100	11.3
2011	102	12.4
2012	104	14.0
2013	107	11.1
2014	105	12.3
2015	112	12.2
2016	103	19.1
2017	94	26.4

ANSWER:

Index of Industrial Production (X)	Deviation $x=X-\bar{X}$	Square of deviation (x^2)	No. of Unemployed People (Y)	Deviation $y=Y-\bar{Y}$	Square deviation (y^2)	xy
100	-3.375	11.39	11.3	-3.55	12.60	+11.98
102	-1.375	1.89	12.4	-2.45	6.00	+3.37
104	0.625	0.39	14.0	-0.85	0.72	-.53
107	3.625	13.14	11.1	-3.75	14.06	-13.59
105	1.625	2.64	12.3	-2.55	6.50	-4.14
112	8.625	74.39	12.2	-2.65	7.02	-22.86
103	-0.375	0.14	19.1	4.25	18.06	-1.59
94	-9.375	87.89	26.4	11.55	133.40	-108.28
$\Sigma x = 827$		$\Sigma x^2 = 191.87$	$\Sigma y = 118.8$		$\Sigma y^2 = 198.36$	$\Sigma xy = -135.64$

$$X = \frac{\sum X}{N} = \frac{8278}{10} = 827.8 \quad Y = \frac{\sum Y}{N} = \frac{118.88}{10} = 11.888$$

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}} = \frac{-135.64191.87}{\sqrt{198.36 \times 14.85}} = -0.69$$

$$r = -0.69 \Rightarrow r = -0.69$$

$$r = -0.69$$

Question 4

10 students obtained following ranks in their mathematics and statistics examinations. Find out the extent to which the knowledge of students is correlated in the two subjects.

Rank in Statistics	1	2	3	4	5	6	7	8	9	10
Rank in Mathematics	2	4	1	5	3	9	7	10	6	8

ANSWER:

Rank in statistics (R_1)	Rank in Mathematics (R_2)	$D = R_1 - R_2$	D^2
1	2	-1	1
2	4	-2	4
3	1	2	4
4	5	-1	1
5	3	2	4
6	9	-3	9
7	7	0	0
8	10	-2	4
9	6	3	9
10	8	2	4
$N = 10$			$\sum D^2 = 40$

$$r_k = 1 - \frac{6 \sum D^2}{N^3 - N} = 1 - \frac{6 \times 40}{10^3 - 10} = 1 - \frac{240}{990} = 1 - 0.24 = 0.76$$

Thus, there is a high degree of positive correlation between the marks of the students in statistics and mathematics.

Question 5

Calculate coefficient of rank correlation, given the following data set.

X	20	11	72	65	43	29	50
Y	60	63	26	35	43	51	37

ANSWER:

<i>X</i>	Rank (<i>R</i> ₁)	<i>Y</i>	Rank (<i>R</i> ₂)	D = R₁ - R₂	D²
20	2	60	6	-4	16
11	1	63	7	-6	36
72	7	26	1	6	36
65	6	35	2	4	16
43	4	43	4	0	0
29	3	51	5	-2	4
50	5	37	3	2	4
<i>N</i> = 7					$\Sigma D^2 = 112$

$r_k = 1 - \frac{6 \Sigma D^2}{N^3 - N}$ or, $r_k = 1 - \frac{6(112)}{7^3 - 7}$ or, $r_k = 1 - \frac{672}{343 - 7}$ or, $r_k = 1 - \frac{672}{336}$ or, $r_k = 1 - 2 \Rightarrow r_k = -1$

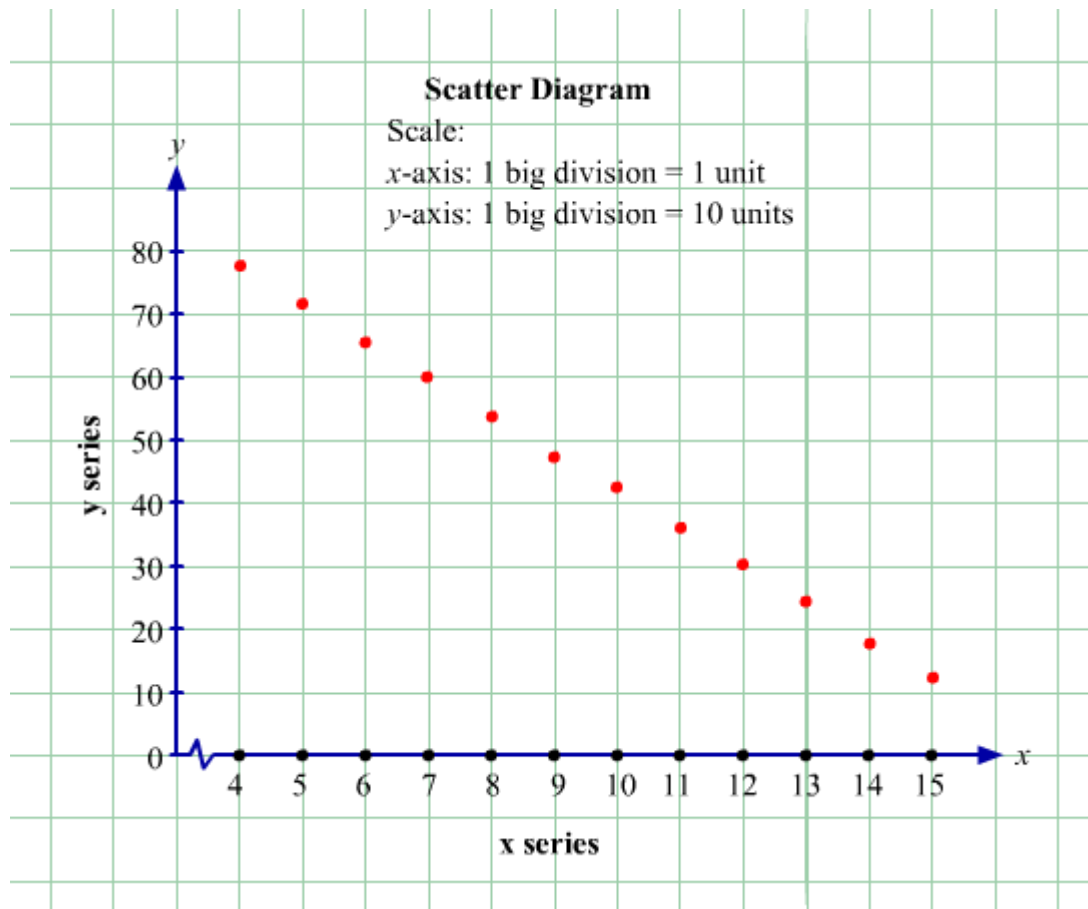
Hence, coefficient of rank correlation = -1

6 MARKS QUESTIONS**Question 1:**

Make a scattered diagram of the data given below. Does any relationship exist between the two?

X	4	5	6	7	8	9	10	11	12	13	14	15
Y	78	72	66	60	54	48	42	36	30	24	18	12

ANSWER:



Yes, there exists perfect negative correlation (-1) between X and Y.

Question 2: Calculate coefficient of correlation of the age of husband and wife using Karl Pearson's method.

Husband (Age)	23	27	28	29	30	31	33	35	36
Wife (Age)	18	20	22	27	29	27	29	28	29

ANSWER:

Husband (h)	$h = H - H_h = H - H$	h^2	Wife (w)	$w = W - W_w = W - W$	w^2	hw
23	-7.22	52.12	18	-7.44	55.35	53.71
27	-3.22	10.36	20	-5.44	29.59	17.51
28	-2.22	4.92	22	-3.44	11.83	7.63
29	-1.22	1.48	27	1.56	2.43	-1.90
30	-.22	0.04	29	3.56	12.67	-.78
31	.78	0.60	27	1.56	2.43	1.21
33	2.78	7.72	29	3.56	12.67	9.89
35	4.78	22.84	28	2.56	6.55	12.23
36	5.78	33.40	29	3.56	12.67	20.57
$\Sigma h = 272$		$\Sigma h^2 = 133.48$	$\Sigma w = 229$		$\Sigma w^2 = 146.19$	$\Sigma hw = 120.07$

Mean age of husbands (H) = $\frac{\sum hn}{n} = \frac{2729}{90} = 30.22$ Mean age of wives (W) = $\frac{\sum wn}{n} = \frac{2299}{90} = 25.44$
 $r = \frac{\sum wh}{\sqrt{\sum h^2 \times \sum w^2}} = \frac{120.17133.48}{\sqrt{146.19 \times 146.19}} = +0.86$
 Mean age of husbands H = $\frac{\sum hn}{n} = \frac{2729}{90} = 30.22$
 Mean age of wives W = $\frac{\sum wn}{n} = \frac{2299}{90} = 25.44$
 $r = \frac{\sum wh}{\sqrt{\sum h^2 \times \sum w^2}} = \frac{120.17133.48}{\sqrt{146.19 \times 146.19}} = +0.86$
 Thus, there exists a high positive correlation between age of wife and age of husband.

Question 3:

Calculate correlation of the following data using Karl Pearson's method:

Series A	112	114	108	124	145	150	119	125	147	150
Series B	200	190	214	187	170	170	210	190	180	181

Series A	$a = A - A$ $a = A - A$	a^2	Series B	$b = B - B$ $b = B - B$	b^2	ab
112	-17.4	302.76	200	10.8	116.64	-187.92
114	-15.4	237.16	190	.8	.64	-12.32
108	-21.4	457.96	214	24.8	615.04	-530.72
124	-5.4	29.16	187	-2.2	4.84	11.88
145	15.6	243.36	170	-19.2	368.64	-299.52
150	20.6	424.36	170	-19.2	368.64	-395.52
119	-10.4	108.16	210	20.8	432.64	-216.32
125	-4.4	19.36	190	.8	.64	-3.52
147	17.6	309.76	180	-9.2	84.64	-161.92
150	20.6	424.36	181	-8.2	67.24	-168.92
$\sum A =$ 1294		$\sum a^2 =$ 2556.4	$\sum B =$ 1892		$\sum b^2 =$ 2059.6	$\sum ab = -$ 1964.8

X	$dx = X - A$ $X - A$	d_x^2	Y	$dy = Y - B$ $Y - B$	d_y^2	$d_x d_y$
78	9	81	B=125 B=1	0	0	0
89	20	400	25	12	144	240
97	28	784	137	31	961	868
A=69 A=	0	0	156	-13	169	0
69	-10	100	112	-18	324	180
59	10	100	107	-19	361	-190
79	-1	1	106	-2	4	2
68	-8	64	123	13	169	-104
61			138			
$N = 8$	$\sum d_x = 48$	$\sum d_x^2 = 1530$	$N = 8$	$\sum d_y = 4$	$\sum d_y^2 = 2132$	$\sum d_x d_y = 996$

ANSWER:

Mean of Series A (A) = $\frac{\sum A_n}{n} = \frac{129410}{10} = 129.4$ Mean of Series B (B) = $\frac{\sum B_n}{n} = \frac{189210}{10} = 189.2$
 $r = \frac{\sum ab}{\sqrt{\sum a^2 \times \sum b^2}} = \frac{-1964.82556.4}{\sqrt{2059.6 \times 2059.6}} = -0.85$
 Mean of Series A A = $\frac{\sum A_n}{n} = \frac{129410}{10} = 129.4$ Mean of Series B B = $\frac{\sum B_n}{n} = \frac{189210}{10} = 189.2$
 $r = \frac{\sum ab}{\sqrt{\sum a^2 \times \sum b^2}} = \frac{-1964.82556.4}{\sqrt{2059.6 \times 2059.6}} = -0.85$

Question 4:

Using assumed average in Karl Pearson's formula, calculate coefficient of correlation, given the following data:

X	78	89	97	69	59	79	68	61
Y	125	137	156	112	107	106	123	138

ANSWER:

Suppose the assumed mean is 69 and 125 for series A and series B, respectively.

$$r = \frac{\sum dx dy - (\sum dx)(\sum dy)/N}{\sqrt{(\sum dx^2 - (\sum dx)^2/N)(\sum dy^2 - (\sum dy)^2/N)}} \text{ or, } r = \frac{996 - 48 \times 48 / 1530 - (48)^2 / 28 \sqrt{2132 - (4)^2 / 28}}{\sqrt{97235.24 \times 46.15}} \therefore r = +0.597$$

$$r = \frac{\sum dx dy - \sum dx \times \sum dy / N}{\sqrt{(\sum dx^2 - \sum dx^2 / N)(\sum dy^2 - \sum dy^2 / N)}} \text{ or, } r = \frac{996 - 48 \times 48 / 1530 - (48)^2 / 28 \sqrt{2132 - (4)^2 / 28}}{\sqrt{97235.24 \times 46.15}} \therefore r = +0.597$$

Question 5:

Find out Karl Pearson's coefficient of correlation:

Capital Units (in '000)	10	20	30	40	50	60	70	80	90	100
Profit Receipt	2	4	8	5	10	15	14	20	22	30

ANSWER:

X	$dx = X - A$ $A = 50$	d_x^2	Y	$dy = Y - B$ $B = 15$	d_y^2	$d_x d_y$
10	-40	1600	2	-13	169	520
20	-30	900	4	-11	121	330
30	-20	400	8	-7	49	140
40	-10	100	5	-10	100	100
50	0	0	10	-5	25	0
60	10	100	5	0	0	0
70	20	400	14	-1	1	-20
80	30	900	20	5	25	150
90	40	1600	22	7	49	280
100	50	2500	30	15	225	750
$N = 10$	$\sum dx = 50$	$\sum d_x^2 = 8500$	$N = 10$	$\sum dy = -20$	$\sum d_y^2 = 764$	$\sum d_x d_y = 2250$

$$r = \frac{\sum dx dy - (\sum dx)(\sum dy)/N}{\sqrt{(\sum dx^2 - (\sum dx)^2/N)(\sum dy^2 - (\sum dy)^2/N)}} \text{ or, } r = \frac{2250 - 50 \times (-20) / 10}{\sqrt{(8500 - (50)^2 / 10)(764 - (-20)^2 / 10)}} = \frac{2350}{\sqrt{90.82 \times 26.90}} \therefore r = +0.961$$

$$r = \frac{\sum dx dy - \sum dx \times \sum dy / N}{\sqrt{(\sum dx^2 - \sum dx^2 / N)(\sum dy^2 - \sum dy^2 / N)}} \text{ or, } r = \frac{2250 - 50 \times (-20) / 10}{\sqrt{(8500 - (50)^2 / 10)(764 - (-20)^2 / 10)}} = \frac{2350}{\sqrt{90.82 \times 26.90}} \therefore r = +0.961$$

Question 6:

Seven students of a class secured following marks in Economics and History. Calculate coefficient of correlation with the help of these data.

Economics	66	90	89	55	58	44	42
History	58	76	65	58	53	49	56

ANSWER:

Economics (E)	R_1	History (H)	R_2	$D = R_1 - R_2$	D^2
66	3	58	3.5	-.5	.25
90	1	76	1	0	0
89	2	65	2	0	0
55	5	58	3.5	1.5	2.25
58	4	53	6	-2	4
44	6	49	7	-1	1
42	7	56	5	2	4
$N = 7$					$\sum D^2 = 11.50$

Here, note that for the marks scored in History, two ranks are tied. That is, two students scored 58 marks. Thus, we use the following formula for the calculation of correlation.

$$r_k = 1 - \frac{6[\sum D^2 + 112(M_3 - M_1)]}{N^3 - N}$$

Here, $M_1 = 2$, as two students have scored 58 in History.
 or, $r_k = 1 - \frac{6[11.50 + 112(8 - 2)]}{343 - 7}$
 $\therefore r_k = \frac{336 - 72}{336} = +0.79$

Thus, there exists a positive correlation between marks scored in Economics and marks scored in History.

Question 7:

Find out rank difference correlation of X and Y:

X	80	78	75	75	58	67	60	59
Y	12	13	14	14	14	16	15	17

ANSWER:

X	R_1	Y	R_2	$D = R_1 - R_2$	D^2
80	1	12	8	-7	49
78	2	13	7	-5	25
75	3.5	14	5	-1.5	2.25
75	3.5	14	5	-1.5	2.25
58	8	14	5	3	9
67	5	16	2	3	9
60	6	15	3	3	9

59	7	17	1	6	36
$N = 8$					$\sum D^2 = 141.5$

$rk = 1 - 6 \frac{[\sum D^2 + 112(M_3 - M_1) + 112(M_3 - M_2)]}{N^3 - N}$ Here, $M_1 = 2$, as the item 75 is appearing twice in X-series. $M_2 = 3$, as the item 14 is appearing thrice in Y-series. or, $rk = 1 - 6 \frac{[141.50 + 112(23 - 2) + 112(33 - 3)]}{512 - 8}$ ∴, $rk = \frac{504 - 864}{504} = -0.714$

$rk = 1 - 6 \frac{[\sum D^2 + 112M_1^3 - M_1 + 112M_2^3 - M_2]}{N^3 - N}$ Here, $M_1 = 2$, as the item 75 is appearing twice in X-series. $M_2 = 3$, as the item 14 is appearing thrice in Y-series. or, $rk = 1 - 6 \frac{[141.50 + 112(23 - 2) + 112(33 - 3)]}{512 - 8}$ ∴, $rk = \frac{504 - 864}{504} = -0.714$

Question 8:

Calculate coefficient of correlation of the following data with rank difference and Karl Pearson's methods:

Economics (Marks)	77	54	27	52	14	35	90	25	56	60
Hindi (Marks)	35	58	60	46	50	40	35	56	44	42

ANSWER:

Karl Pearson's Method

Economic s (X)	$d_x = X - A$	d_x^2	History (Y)	$d_y = Y - B$	d_y^2	$d_x d_y$
77	42	1764	35	-15	225	-630
54	19	361	58	8	64	152
27	-8	64	60	10	100	-80
52	17	289	46	-4	16	-68
14	-21	441	B=50	0	0	0
A=35	0	0	B=5	-10	100	0
5	55	3025	40	-15	225	-825
90	-10	100	35	6	36	-60
25	21	441	56	-6	36	-126
56	25	625	44	-8	64	-200
60			42			
$N = 10$	$\sum d_x = 140$	$\sum d_x^2 = 7110$	$N = 10$	$\sum d_y = -34$	$\sum d_y^2 = 860$	$\sum d_x d_y = -1837$

$r = \frac{\sum d_x d_y - (\sum d_x) \times (\sum d_y)}{N \sqrt{\sum d_x^2 - (\sum d_x)^2 / N} \times \sqrt{\sum d_y^2 - (\sum d_y)^2 / N}}$ or, $r = \frac{-1837 - 140 \times (-34)}{10 \sqrt{7110 - (140)^2 / 10} \times \sqrt{860 - (-34)^2 / 10}} = \frac{-1837 + 4760}{10 \times 210 \times 210} = \frac{2923}{44100} = 0.6628$

$$\frac{\sum dx^2 N \times \sum dy^2 - \sum dy^2 N}{\sqrt{(\sum dx^2 N - \frac{(\sum dx)^2}{N})(\sum dy^2 N - \frac{(\sum dy)^2}{N})}} = \frac{135571.76 \times 27.39 - (140)^2 (10860 - (-34)^2 210)}{135571.76 \times 27.39} = -0.689$$

Rank Difference Method

Economics	R_1	History	R_2	$D = R_1 - R_2$	D^2
77	2	35	9.5	-7.5	56.25
54	5	58	2	3	9
27	8	60	1	7	49
52	6	46	5	1	1
14	10	50	4	6	36
35	7	40	8	-1	1
90	1	35	9.5	-8.5	72.25
25	9	56	3	6	36
56	4	44	6	-2	4
60	3	42	7	-4	16
$N = 10$					$\sum D^2 = 280.5$

$r_k = 1 - 6 \frac{[\sum D^2 + 112(M_3 - M_1)]}{N^3 - N}$ Here, $M_1 = 2$, as two students have scored 35 marks in History. or, $r_k = 1 - 6 \frac{[280.50 + 112(23 - 2)]}{1000 - 10} = -0.703$

$r_k = 1 - 6 \frac{\sum D^2 + 112(M_3 - M_1)}{N^3 - N}$

Here, $M_1 = 2$, as two students have scored 35 marks in History. or, $r_k = 1 - 6 \frac{280.50 + 112(23 - 2)}{1000 - 10} = -0.703$

Question 9:

Seven methods of teaching Economics in two universities are shown below. Calculate rank difference correlation.

Teaching Methods	I	II	III	IV	V	VI	VII
Rank of 'A's Students	2	1	5	3	4	7	6
Rank of 'B's Students	1	3	2	4	7	5	6

ANSWER:

Teaching Methods	R_A	R_B	$D = R_A - R_B$	D^2
I	2	1	1	1
II	1	3	-2	4
III	5	2	3	9
IV	3	4	-1	1
V	4	7	-3	9

VI	7	5	2	4
VII	6	6	0	0
				$\sum D^2=28$

$$N = 7$$

$$rk = 1 - \frac{6 \sum D^2}{N^3 - N} = 1 - \frac{6 \times 28}{343 - 7} = 1 - \frac{168}{336} = 0.5$$

Hence, $rk = 0.5$

Question 10:

Give three examples of perfect correlation. Find out rank difference coefficient of correlation with the help of the following data:

X	48	33	40	9	16	65	26	15	57
Y	13	13	22	6	14	20	9	6	15

ANSWER:

Three examples of perfect correlation are:

1. T.V. viewing and Study hours (-ve correlation). That is, as the hours spent in T.V. viewing increases, the numbers of hours that can be devoted to study decreases and vice-versa.
2. Income used for consumption and amount of saving (-ve correlation). That is, greater the portion of income used for consumption purposes, smaller is the portion of income left for saving purposes and vice-versa.
3. Amount deposited in bank and interest earned (+ve correlation). That is, as the amount deposited in the bank increases, the amount of interest that is earned increases and vice-versa.

X	R ₁	Y	R ₂	D = R ₁ - R ₂	D ²
48	3	13	5.5	-2.5	6.25
33	5	13	5.5	-.5	.25
40	4	22	1	3	9
9	9	6	8.5	.5	.25
16	7	14	4	3	9
65	1	20	2	-1	1
26	6	9	7	-1	1
15	8	6	8.5	-.5	.25
57	2	15	3	.1	1
N = 9					$\sum D^2 = 28$

$$rk = 1 - \frac{6[\sum D^2 + 112(M_3 - M_1) + 112(M_3 - M_2)]}{N^3 - N}$$

Here, $M_1 = 2$, as the item 13 is appearing twice in Y-series. $M_2 = 2$, as the item 6 is appearing twice in Y-series. or, $rk = 1 - \frac{6[28 + 112(23 - 2)]}{729 - 9}$

$-2)+112(23-2)]729-9\therefore, rk=720-147720=0.758rk=1-6\sum D^2+112M_{13}-M_1+112M_{23}-M_2N_3-$
 NHere, $M_1=2$, as the item 13 is appearing twice in Y-series. $M_2=2$, as the item 6 is appearing twice in Y-series. or, $rk=1-628+112(23-2)+112(23-2)729-9\therefore, rk=720-147720=0.758$

Question 11:

Calculate coefficient of correlation of the following data:

X	10	6	9	10	12	13	11	9
Y	9	4	6	9	11	13	8	4

ANSWER:

X	$dx = X - A$ $A = 10$	d_x^2	Y	$dy = Y - B$ $B = 11$	d_y^2	$d_x d_y$
10	0	0	9	-2	4	0
6	-4	16	4	-7	49	28
9	-1	1	6	-5	25	5
10	0	0	9	-2	4	0
12	2	9	11	0	0	0
13	3	9	13	2	4	6
11	1	1	8	-3	9	-3
9	-1	1	4	-7	49	7
$N = 8$	$\sum dx = 0$	$\sum d_x^2 = 32$	$N = 8$	$\sum dy = -24$	$\sum d_y^2 = 144$	$\sum d_x d_y = 43$

$r = \frac{\sum dx dy - (\sum dx) \times (\sum dy) / N}{\sqrt{(\sum dx^2 - (\sum dx)^2 / N) \times (\sum dy^2 - (\sum dy)^2 / N)}} = \frac{43 - 0 \times (-24) / 8}{\sqrt{(32 - 0^2 / 8) \times (144 - (-24)^2 / 8)}} = \frac{43}{\sqrt{32 \times 72}} = \frac{43}{\sqrt{2304}} = \frac{43}{48} = 0.896$

Question 12:

Deviation of two series of X and Y are shown. Calculate coefficient of correlation.

X	+5	-4	-2	+20	-10	0	+3	0	-15	-5
Y	+5	-12	-7	+25	-10	-3	0	+2	-9	-15

ANSWER:

d_x	d_x^2	d_y	d_y^2	$d_x d_y$
5	25	5	25	25
-4	16	-12	144	48

-2	4	-7	49	14
20	400	25	625	500
-10	100	-10	100	100
0	0	-3	9	0
3	9	0	0	0
0	0	2	4	0
-15	225	-9	81	135
-5	25	-15	225	75
$\sum d_x = -8$	$\sum d_x^2 = 804$	$\sum d_y = -24$	$\sum d_y^2 = 1262$	$\sum d_x d_y = 897$

$$r = \frac{\sum d_x d_y - (\sum d_x)(\sum d_y) / N}{\sqrt{(\sum d_x^2 - (\sum d_x)^2 / N)(\sum d_y^2 - (\sum d_y)^2 / N)}} \text{ or } r = \frac{897 - (-8)(-24) / 12}{\sqrt{(804 - (-8)^2 / 12)(1262 - (-24)^2 / 12)}} = \frac{877.828}{24 \times 34.70} = +0.895$$

Question 13:

In a baby competition, two judges accorded following to 12 competitors. Find the coefficient of rank correlation.

Entry	A	B	C	D	E	F	G	H	I	J	K	L
Judge X	1	2	3	4	5	6	7	8	9	10	11	12
Judge Y	12	9	6	10	3	5	4	7	8	2	11	1

ANSWER:

Entry	Ranks by Judge X (R_X)	Ranks by Judge Y (R_Y)	$D = R_X - R_Y$	D^2
A	1	12	-11	121
B	2	9	-7	49
C	3	6	-3	9
D	4	10	-6	36
E	5	3	2	4
F	6	5	1	1
G	7	4	3	9
H	8	7	1	1
I	9	8	1	1
J	10	2	8	64
K	11	11	0	0
L	12	1	11	121

$N = 12$				$\sum D^2 = 416$
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$rk = 1 - \frac{6 \sum D^2}{N^3 - N}$ -Nor, $rk = 1 - \frac{6 \times 416}{12^3 - 12} = 1 - \frac{2496}{1716} = -0.455$ Hence, $rk = -0.455$

Question 14:

In a Fancy-dress competition, two judges accorded the following ranks to eight participants:

Judge X	8	7	6	3	2	1	5	4
Judge Y	7	5	4	1	3	2	6	8

Calculate coefficient of rank correlation.

ANSWER:

R_X	R_Y	$D = R_X - R_Y$	D^2
8	7	1	1
7	5	2	4
6	4	2	4
3	1	2	4
2	3	-1	1
1	2	-1	1
5	6	-1	1
4	8	-4	16
			$\sum D^2 = 32$

$N = 8$

$rk = 1 - \frac{6 \sum D^2}{N^3 - N}$ -Nor, $rk = 1 - \frac{6 \times 32}{8^3 - 8} = \frac{504 - 192}{504} = 0.619$ Hence, $rk = 0.619$

Question 15:

In a beauty contest, three judges accorded following ranks to 10 participants:

Judge I	1	6	5	10	3	2	4	9	7	8
Judge II	3	5	8	4	7	10	2	1	6	9
Judge III	6	4	9	8	1	2	3	10	5	7

Find out by Spearman's Rank Difference Method which pair of judges has a common taste in respect of beauty.

ANSWER:

R_1	R_2	R_3	$D_1 = R_1 - R_2$	$D_2 = R_1 - R_3$	$D_3 = R_2 - R_3$	D_1^2	D_2^2	D_3^2
1	3	6	-2	-5	-3	4	25	9
6	5	4	1	2	1	1	4	1
5	8	9	-3	-4	-1	9	16	1
10	4	8	6	2	-4	36	4	16
3	7	1	-4	2	6	16	4	36
2	1	2	-8	0	8	64	0	64
4	0	3	2	1	-1	4	1	1
9	2	3	2	1	-1	4	1	1
7	1	10	8	-1	-9	64	1	81
8	6	5	1	2	1	1	4	1
8	9	7	-1	1	8	1	1	64
						$\sum D_1^2 = 200$ $\sum D_1 = 200$	$\sum D_2^2 = 60$ $\sum D_2 = 60$	$\sum D_3^2 = 214$ $\sum D_3 = 214$

$$N = 10$$

Rank Correlation between Judge 1 and Judge 2 $r_{k1,2} = 1 - \frac{6 \sum D_1^2}{N^3 - N} = 1 - \frac{6 \times 200}{1000 - 10} = \frac{990 - 1200}{990} = -0.212$

Rank Correlation between Judge 1 and Judge 3 $r_{k1,3} = 1 - \frac{6 \sum D_2^2}{N^3 - N} = 1 - \frac{6 \times 60}{1000 - 10} = \frac{990 - 360}{990} = +0.636$

Rank Correlation between Judge 2 and Judge 3 $r_{k2,3} = 1 - \frac{6 \sum D_3^2}{N^3 - N} = 1 - \frac{6 \times 214}{1000 - 10} = \frac{990 - 1284}{990} = -0.296$

Rank Correlation between Judge 1 and Judge 2 $r_{k1,2} = 1 - \frac{6 \sum D_1^2}{N^3 - N} = 1 - \frac{6 \times 200}{1000 - 10} = \frac{990 - 1200}{990} = -0.212$

Rank Correlation between Judge 1 and Judge 3 $r_{k1,3} = 1 - \frac{6 \sum D_2^2}{N^3 - N} = 1 - \frac{6 \times 60}{1000 - 10} = \frac{990 - 360}{990} = +0.636$

Rank Correlation between Judge 2 and Judge 3 $r_{k2,3} = 1 - \frac{6 \sum D_3^2}{N^3 - N} = 1 - \frac{6 \times 214}{1000 - 10} = \frac{990 - 1284}{990} = -0.296$

Observation and Conclusion:

As the rank correlation coefficient between Judge 1 and Judge 3 is highest and positive, so it can be regarded that they have a common taste in respect of beauty.

Question 16:

Following data relates to age group and percentage of regular players. Calculate Karl Pearson's coefficient of correlation.

Age Group	20-25	25-30	30-35	35-40	40-45	45-50
% of Regular Players	40	35	28	20	15	5

ANSWER:

Age Group	Mid Value (X)	% of Regular Players (Y)	$d'X = X - Ah = X - 37.55$ $d'X = X - 37.55$	$d'Y = Y - Bi = Y - 285$ $d'Y = Y - 285$	(dx') (dy')	$(dx')^2$	$(dy')^2$
20-25	22.5	40	-3	2.4	-7.2	9	5.76
25-30	27.5	35	-2	1.4	-2.8	4	1.96
30-35	32.5	28	-1	0	0	1	0
35-40	37.5	20	0	-1.6	0	0	2.56
40-45	42.5	15	1	-2.6	-2.6	1	6.76
45-50	47.5	5	2	-4.6	-9.2	4	21.16
			$\sum dx' = -3$	$\sum dy' = -5$	$\sum(dx')(dy') = -21.8$	$\sum(dx')^2 = 19$	$\sum(dy')^2 = 38.2$

$$r = \frac{\sum d'X d'Y - (\sum d'X) \times (\sum d'Y) / N}{\sqrt{[\sum d'X^2 - (\sum d'X)^2 / N] \times [\sum d'Y^2 - (\sum d'Y)^2 / N]}}$$

or, $r = \frac{(-21.8) - (-3) \times (-5) / 6}{\sqrt{[19 - (-3)^2 / 6] \times [38.2 - (-5)^2 / 6]}}$

or, $r = \frac{-24.3175}{\sqrt{24.3175 \times 34.03}}$

Hence, $r = -0.996$

Question 17:

From the following data, relating to playing habits in various age group of 900 students. Calculate coefficient of correlation between age group and playing habits.

Age Group	15-16	16-17	17-18	18-19	19-20	20-21
Number of Students	250	200	150	120	100	80
Regular Players	200	150	90	48	30	12

ANSWER:

Age Group	Number of People	Number of Players	Percentage of Players (%)
15-16	250	200	$200/250 \times 100 = 80\%$
16-17	200	150	$150/200 \times 100 = 75\%$

17-18	150	90	$90/150 \times 100 = 60\%$ $90/150 \times 100 = 60\%$
18-19	120	48	$48/120 \times 100 = 40\%$ $48/120 \times 100 = 40\%$
19-20	100	30	$30/100 \times 100 = 30\%$ $30/100 \times 100 = 30\%$
20-21	80	12	$12/80 \times 100 = 15\%$ $12/80 \times 100 = 15\%$

Age Group	Mid Value (X)	Percentage of Players (%) (Y)	$dX = X - A = X - 17.5$	$dY = Y - B = Y - 40$	$dXdY$	dX^2	dY^2
15-16	15.5	80	-2	40	-80	4	1600
16-17	16.5	75	-1	35	-35	1	1225
17-18	17.5	60	0	20	0	0	400
18-19	18.5	40	1	0	0	1	0
19-20	19.5	30	2	-10	-20	4	100
20-21	20.5	15	3	-25	-75	9	625
	$N = 6$	$N = 6$	$\sum dX = 3$	$\sum dY = 60$	$\sum dXdY = -210$	$\sum dX^2 = 19$	$\sum dY^2 = 3950$

$r = \frac{\sum dXdY - (\sum dX)(\sum dY)}{N \sqrt{(\sum dX^2 - (\sum dX)^2/N)(\sum dY^2 - (\sum dY)^2/N)}}$ or, $r = \frac{-210 - 3 \times (60)}{6 \sqrt{(19 - (3^2/6))(3950 - (60^2/6))}}$
 $r = \frac{-240}{6 \sqrt{17.5 \times 3350}}$ or, $r = \frac{-240}{6 \times 57.88} = \frac{-240}{347.28} = -0.92$ ∴ $r = -0.92$
 $r = \frac{\sum dXdY - \sum dX \times \sum dY}{N \sqrt{\sum dX^2 - \sum dX^2/N \times \sum dY^2 - \sum dY^2/N}}$ or, $r = \frac{-210 - 3 \times 60}{6 \sqrt{19 - (3^2/6) \times 3950 - (60^2/6)}}$ = $\frac{-240}{6 \times 57.88} = \frac{-240}{347.28} = -0.92$ ∴ $r = -0.92$

Hence, the coefficient of correlation between age group and playing habits is – 0.992

Question 18:

Following data relates to density of population, number of deaths and population of various cities. Calculate death rate and Karl Pearson coefficient between density of population and death rate.

Cities	P	Q	R	S	T	U
Density of Population	200	500	700	500	600	900

Number of Deaths	840	300	312	560	1,140	1,224
Population	42,000	30,000	24,000	40,000	90,000	72,000

ANSWER:

Cities	Density	Number of Deaths	Population	Death rate = Number of Deaths/Population × 100
P	200	840	42000	2
Q	500	300	30000	1
R	700	312	24000	1.3
S	500	560	40000	1.4
T	600	1440	90000	1.6
U	900	1224	72000	1.7

Density (X)	$dx = X - A$ $A = 500$	dx^2	Death Rate (Y)	$dy = Y - B$ $B = 1$	dy^2	$dx dy$
200	-300	90000	2	1	1	-300
500	0	0	1	0	0	0
700	200	40000	1.3	0.3	0.09	60
500	0	0	1.4	0.4	0.16	0
600	100	10000	1.6	0.6	0.36	60
900	400	160000	1.7	0.7	0.49	280
	$\sum dx = 400$	$\sum dx^2 = 300000$		$\sum dy = 3$	$\sum dy^2 = 2.1$	$\sum dx dy = 100$

$r = \frac{\sum dx dy - (\sum dx)(\sum dy)/n}{\sqrt{(\sum dx^2 - (\sum dx)^2/n)(\sum dy^2 - (\sum dy)^2/n)}} = \frac{100 - 400 \times 3 / 6}{\sqrt{(300000 - (400)^2/6)(2.1 - (3)^2/6)}} = \frac{100 - 200}{\sqrt{333333.34 \times 0.6}} = \frac{-100}{\sqrt{200000}} = -0.248$

Hence, Karl Pearson's Coefficient of Correlation between density of population and death rate is -0.248

Question 19:

From the following data, determine Karl Pearson's coefficient of correlation between X and Y series for 15 paris:

	X-Series	Y-Series
Mean	80	120
Sum of Squares of deviation from Arithmetic Mean	56	156
Sum of product of deviation of X and Y from their respective Means	92	

ANSWER: Given: $N = 15$, $X = 80$, $Y = 120$, $\Sigma x^2 = 56$, $\Sigma y^2 = 156$, $\Sigma xy = 92$
 $\sigma_x = \frac{\Sigma x^2}{N} = \frac{56}{15} = 3.73$, $\sigma_y = \frac{\Sigma y^2}{N} = \frac{156}{15} = 10.4$
 $r = \frac{\Sigma xy}{N \sigma_x \sigma_y} = \frac{92}{15 \times 3.73 \times 10.4} = 0.98$

Hence, Karl Pearson's coefficient of correlation is +0.98

Question 20:

From the following information, determine coefficient of correlation between X and Y series:

	X-Series	Y-Series
Number of Items	15	15
Mean	25	18
SD	3.01	3.03
Sum of Squares of deviation from Mean	136	138
Sum of product of deviation of X and Y from their respective Means	122	

ANSWER

Given: $N = 15$, $X = 25$, $Y = 18$, $\sigma_x = 3.01$, $\sigma_y = 3.03$, $\Sigma x^2 = 136$, $\Sigma y^2 = 138$, $\Sigma xy = 122$
 $r = \frac{\Sigma xy}{N \sigma_x \sigma_y} = \frac{122}{15 \times 3.01 \times 3.03} = 0.89$

Hence, coefficient of correlation between X and Y series is + 0.89

Chapter-9:- INTRODUCTION TO INDEX NUMBERS

Introduction to index number: An index number is a statistical device for measuring changes in the magnitude of a group of related variables.

Features of Index Number

1. Index numbers are expressed in terms of percentages. However, percentage sign (%) is never used.
2. Index numbers are relative measurement of group of data.
3. Index numbers offer a precise measurement of the quantitative change in the concerned variables over time.
4. Index number show changes in terms of averages.
5. They are expressed in numbers.
6. Index number facilitates the comparative study over different time period.

Importance of Index number

1. It serves as a barometer for measuring the value of money.
2. Gives knowledge about change in standard of living.
3. It helps the business community in planning their decision.
4. Helpful to determine the rate of premium.

Limitation of Index Number

1. Limited applicability
2. International comparison is not possible
3. Limited coverage
4. Difficulty in the construction of index number

Types of Index numbers:

- (i) Wholesale price index (WPI)
- (ii) Consumer price index (CPI) or Cost of living index
- (iii) Index of industrial production (IIP)
- (iv) Index of Agricultural production (IAP)
- (v) Sensex

Methods of constructing index numbers:

1. Construction of Simple Index numbers
 - a. Simple Aggregative Method
 - b. Simple Average of Price Relatives Method
2. Construction of weighted Index numbers
 - a. weighted Average of Price Relative Method
 - b. Weighted Aggregative Method

Simple aggregative method:

$$P_{01} = \frac{\sum P_1}{\sum P_0} \times 100$$

Here, P_{01} = Price index of the current year.

ΣP_1 = Sum of the prices of the commodities in the current year

ΣP_0 = Sum of the prices of the commodities in the base year

Current year: Current year is the year for which average change is to be measured or index of index number is to be calculated.

Base year: Base year is the year of reference from which we want measure extent of change in the current year. The index number of base year is generally assumed to be 100.

Simple average of price Relatives method:

$$P_{01} = \frac{\Sigma \left(\frac{P_1}{P_0} \times 100 \right)}{N}$$

Here, P_{01} = Price index of the current year

$\frac{P_1}{P_0} \times 100$ = Price relatives

N = Number of commodities

Weighted average of price relative method:

$$P_{01} = \frac{\Sigma RW}{\Sigma W}$$

Here, P_{01} = Index number for the current year in relation to base year

W = Weight, R = Price relatives i.e. $\frac{P_1}{P_0} \times 100$

Weighted Aggregative method:

(i) Laspeyre's method :- $P_{01} = \frac{P_1 Q_0}{P_0 Q_0} * 100$

(ii) Pasche's method :- $P_{01} = \frac{P_1 Q_1}{P_0 Q_1} * 100$

(iii) Fisher's Method :- $P_{01} = \sqrt{\frac{P_1 q_0}{P_0 q_0} \times \frac{P_1 q_1}{P_0 q_1}} * 100$

Some Important index numbers:

(i) **Consumer price index (CPI):** CPI is also known as the cost of living index, measures the average change in retail prices.

Methods of constructing CPI:

Here,

$$CPI = \frac{\Sigma WR}{\Sigma W}$$

$$R = \frac{P_1}{P_0} \times 100$$

W = Weights

(B) **Aggregative expenditure method:** $P_{01} =$

(ii) **Wholesale price index (WPI):** WPI Indicates the change in the general price level.

(iii) **Index of industrial production (IIP):** IIP is used to measure the relative increase or decrease in the level of industrial production.

IIP=

Here, q_1 = Level of Production in the current year

q_0 = Level of production in the base year

W = Weight

(iv) **Index of agriculture production (IAP)**

IAP is used to study the rise and fall of the yield of principle crops from one period to other period.

(v) **Sensex:** Sensex is the short form of Bombay stock exchange sensitive index with 1978-79 as base. It is the benchmark index for the Indian stock market.

It consists or 30 stocks which represent 13 sectors of the economy and the companies are the leaders in their respective industries.

Problems in construction of index numbers:

- (i) Purpose of index number.
- (ii) Selection of base year.
- (iii) Selection of items.
- (iv) Selection of the prices of items.
- (v) Selection of method of weighting
- (vi) Selection of sources of data
- (vii) Choice of an average.
- (viii) Choice of method.

OBJECTIVE TYPE QUESTIONS (1 MARK)

1. An index number which accounts for the relative importance of the items is known as _____.

- a)weightedindex
- b)simple aggregativeindex
- c)simple average ofrelatives
- d)None ofthese

Ans: (a) weightedindex

2. In most of the weighted index numbers the weight pertains to_____.

- a)baseyear
- b)currentyear
- c)both base and currentyear
- d)None ofthese

Ans (a) base year

3.The impact of change in the price of a commodity with little weight in the index will be_____

- a)small

- b) large
- c) uncertain
- d) None of these

Ans.(a) small

4. A consumer price index measures changes in _____.

- a) retail prices
- b) wholesale prices
- c) producers prices
- d) None of these

Ans.(a) retail prices

5. The item having the highest weight in consumer price index for industrial workers is _____.

- a) Food
- b) Housing
- c) Clothing
- d) None of these

Ans.(a) Food

6. In general, inflation is calculated by using _____.

- a) wholesale price index
- b) consumer price index
- c) producers' price index
- d) None of these

Ans. (a) wholesale price index

7. is a statistical device for measuring relative change in a large number of items.

- a) Measures of Dispersion
- b) Correlation
- c) Both (a) and (b)
- d) Index number

Ans. (d) Index number

8. _____ measure the changes in the physical volume of production, construction or employment.

- a) Price index numbers
- b) Quantity index numbers

- c)Both (a) and(b)
d)Neither (a) nor(b)

Ans.(b)Quantityindexnumbers

9. The value in the base period is given the index number _____.

- a)1
b)0
c) 100
d) None of these

Ans. (c) 100

10.An index number of 150 indicates that the value is _times that of the baseperiod.

- (a) 150
(b) 1.5
c) 50
d) None ofthese

Ans.(b) 1.5

11.The formula for a weighted aggregative price index under Laspeyre'smethodis_____.

$$(a) P_{01} = \frac{\sum p_1}{\sum p_0} \times 100 \quad (b) P_{01} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

$$(c) P_{01} = \frac{\sum p_1 q_1}{\sum p_0 q_0} \times 100$$

$$(d) P_{01} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1}} \times 100$$

$$\text{Ans.(b) } P_{01} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

12. The formula for a weighted aggregative price index under Laspeyre's method is:

$$(a) P_{01} = \frac{\sum p_1}{\sum p_0} \times 100 \quad (b) P_{01} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

$$(c) P_{01} = \frac{\sum p_1 q_1}{\sum p_0 q_0} \times 100 \quad (d) P_{01} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1}} \times 100$$

$$\text{Ans. (b) } \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

13. A weighted aggregative price index using base period quantities as weights, is also known as _____.

- a) Laspeyre's price index
- b) Paasche's price index
- c) Fisher's price index
- d) None of these

Ans. (a) Laspeyre's price index

14. A weighted aggregative price index using current period quantities as weights is also known as _____.

- a) Laspeyre's price index
- b) Paasche's price index
- c) Fisher's price index
- d) None of these

Ans. (b) Paasche's price index

15. In general, the base period weight is preferred to the current period weight. Why?

Ans. It is because calculating the weight every year is inconvenient.

16. Consumer price index (CPI) is also known as the _____.

Ans. cost of living index

17. Consumer price index (CPI) measures the average change in _____.

- a) retail prices
- b) wholesale prices
- c) Average prices
- d) All of these

Ans. (a) retail prices

18. The Reserve Bank of India is using the as the Main measure of how consumer prices are changing.

- a) All-India Rural Consumer Index
- b) Consumer Price Index Numbers for Industrial Workers
- c) All-India Urban Consumer Price Index
- d) All-India Combined Consumer Price Index

Ans: option D) all India combined consumer price index

19. All-India Combined Consumer Price Index is now being prepared with base 2012 = 100 and many improvements have been made in accordance with international standards. The basket of items and weighing diagrams for the revised series has been prepared using the data of the Consumer Expenditure Survey (CES), 2011–12 of the 68th Round of National Sample Survey (NSS). **Fill in the blank.**

Ans. Modified Mixed Reference Period (MMRP)

20. The Consumer Food Price Index (CFPI) is the same as the Consumer Price Index for all 'Food and Beverages'. **True/False? Give reason.**

Ans. False: It does not include alcoholic beverages and prepared meals, snacks, sweets, etc.

21. _____ indicates the change in the general price level.

Ans. The Wholesale price index number

22. What does the statement "WPI with 2011–12 as base is 112.8 in May, 2017" mean?

Ans. It means that the general price level has risen by 12.8 per cent during this period.

23. The 'All Commodities Inflation Rate' is often referred to _____.

Ans. 'Headline Inflation'

24. _____ are used in calculating the purchasing power of money and real wage.

- a) Consumer index number (CPI)

- b) Wholesale price index(WPI)
- c) Index of industrial production(IIP)
- d) All of these

Ans. (a) Consumer index number(CPI)

25. Given the Consumer index number (CPI), how is purchasing power of money calculated?

Ans. Purchasing power of money = $1 / \text{CPI}$

26. Given the money wage and the cost of living index number, how is real wage calculated?

Ans. Real wage = $\text{Money wage} / \text{Cost of living index} * 100$

27. If the CPI (2000=100) is 400 in January 2019, the equivalent of a rupee in January 2019 is

Ans. 25 paise ($100/400 = 0.25$)

28. A series of numerical figures which show the relative position is called _____.

Ans. index number

29. Index number for the base period is always taken as:

(a) 200

b) 50

c) 1

(d) 100

Ans. (d) 100

30. _____ play a very important part in the construction of index numbers.

a) weights

b) classes

c) estimations

d) None of these

Ans. (a) weights

SHORT ANSWER TYPE QUESTION (3/4 MARKS)

Q.1. Why do we need an index number?

Answer: Index number enables us to calculate a single measure of change of a large number of items. The index numbers are needed for the general and specific purpose they are

- Measurement of Change in the Price Level or the Value of ' Money Index number measures the value of money during different periods of time as well as we can use it to know the Impact of the change in the value of money on different sections of society. It can be worked out to correct the inflationary and deflationary gaps in the system.
- Information of Foreign Trade Index of export and import provides useful information regarding foreign trade which helps in formulating the policies of export and import.
- Calculating Real Wages CPI are used in calculating the purchasing power of money and real wage as follows
 - Purchasing power of money = $1/\text{Cost of living index}$
 - Real wage = $(\text{Money wage}/\text{Cost of living index}) \times 100$

Measuring and Comparing Output Index of Industrial Production (IIP) gives us a quantitative figure about the change in production in the industrial sector and thus helps in comparing industrial output in different periods. Similarly, agricultural production index provides us an estimate of the production index provides us an estimate of the production in agricultural sector.

Policy Making of Government With the help of index numbers government determines the monetary and fiscal policy and takes necessary steps to develop the country.

Indicating Stock Prices Sensex and NIFT are index numbers of share prices on BSE and NSE respectively. They serve as a useful guide for investors in the stock market. If the sensex and nifty are rising, investors have positive expectations about the future performance of the economy and it is an appropriate time for investment.

2. What are the desirable properties of the base period?

Answer: Base period should have the following properties

- The base year should be a normal period and periods in which extraordinary events have occurred should not be taken as base periods as they are not appropriate for general comparisons.
- Extreme values should not be selected as base period.
- The period should not be too far in the past as comparison with current period cannot be done with such base year as policies, economic and social conditions change with time.
- Base period should be updated periodically.

3. Why is it essential to have different CPI for different categories of consumers?

Answer:

The Consumer Price Index (CPI) in India is calculated for different categories as under

- CPI for industrial workers.
- CPI for urban non-manual employees.
- CPI for agricultural labourers.

The reason behind calculation of three different CPIs is that the consumption pattern of the three groups (i.e., industrial workers, urban non-manual workers and agricultural labourers) differs significantly from each other. Therefore, to assess the impact of the price change on the cost of living of the three groups, component items included in the index need to be given different weights for each of the group. This necessitates the calculation of different CPI for different categories of consumers.

4. What does a consumer price index for industrial workers measure?

Answer:

Consumer price index for industrial workers measures the average change in retail prices of a basket of commodities which an industrial worker generally consumes. Consumer price index for industrial workers is increasingly being considered the appropriate indicator of general inflation, which shows the most accurate impact of price rise on the cost of living of common people.

The items included in CPI (Consumer Price Index) for industrial workers are food, pan, supari, tobacco, fuel and lighting, housing, colthing, and miscellaneous expenses with food being accorded the highest weight. This implies that the food price changes have a significant impact on the CPI.

5. What is the difference between a price index and a quantity index?

Answer:

The difference between a price index and a quantity index is as follows

- Price index numbers measure and allow for comparison of the prices of certain goods while quantity index number measure the changes in the physical volume of production, construction or employment.
- Price index numbers are more widely used as compared to quantity index numbers.
- Price index is known as unweighted index number while quantity index number is known as weighted index numbers.

6. Is the change in any price reflected in a price index number?

Answer:

No, the change in any price is not reflected in a price index number. Price index numbers measure and permit comparison of the prices of certain goods included in the basket being used to compare prices in the base period with prices in the current period. Moreover, an equal rise in the price of an item with large weight and that of an item with low weight will have different implications for the overall change in the price index.

7. If the salary of a person in the base year is ₹ 4,000 per annum and the current year salary is ₹ 6,000 by how much should his salary rise to maintain the same standard of living if the CPI is 400?

Answer:

Base CPI = ₹ 100

Current CPI = ₹ 400

Base Year Salary = ₹ 4,000

Current Year Salary = ₹ 6,000

When Base CPI is ₹ 100, then the salary is = ₹ 4,000

Current salary equivalent to base year salary = (Base year salary/100) × CPI of current year

When Current CPI is ₹ 400, then the salary should be

= $4,000 \times \frac{400}{100} = ₹ 16,000$

Thus, his salary should be ₹ 16,000 to maintain his purchasing power. Therefore, in the current year his salary should increase by ₹ 16,000 – ₹ 6,000 = ₹ 10,000 so as to maintain the same level of living in the current year as that of the base year.

8. Using Simple Aggregate Method and Price Relatives Method, find out index values for the year 2017 from the following data:

Items	A	B	C	D	E
2004 Price (₹)	15	33	38	25	50
2017 Price (₹)	30	35	57	35	63

ANSWER:

Simple Aggregate Method

Items	2004 Price (P ₀)	2014 Price (P ₁)
A	15	30
B	33	35
C	38	57
D	25	35
E	50	63
	$\Sigma P_0 = 161$	$\Sigma P_1 = 220$

$$P_{01} = \Sigma P_1 / \Sigma P_0 \times 100 \text{ or, } P_{01} = 220/161 \times 100 \Rightarrow P_{01} = 136.64$$

Price Relative Method

Items	2004 Price (P ₀)	2014 Price (P ₁)	Price relative = $P_1/P_0 \times 100$
A	15	30	$= 30/15 \times 100 = 200$
B	33	35	$= 35/33 \times 100 = 106.06$
C	38	57	$= 57/38 \times 100 = 150$
D	25	35	$= 35/25 \times 100 = 140$
E	50	63	$= 63/50 \times 100 = 126$
N = 5			Price Relative = $\Sigma P_1/P_0 \times 100 = 722.06$

$$P_{01} = (\Sigma P_1/P_0 \times 100)/N \text{ or, } P_{01} = 722.06/5 \Rightarrow P_{01} = 144.412$$

9. Find out index value by the Price Relative Method for the year 2017 from the following data:

Items	A	B	C	D	E	F	G
2004 Price (₹)	100	10	5	4	1	2	3
2017 Price (₹)	100	9	4	2	1	2.50	2.25

ANSWER:

Items	2004 Price (P ₀)	2017 Price (P ₁)	Price relative = $P_1/P_0 \times 100$
A	100	100	$=100/100 \times 100 = 100$
B	10	9	$=9/10 \times 100 = 90$
C	5	4	$=4/5 \times 100 = 80$
D	4	2	$=2/4 \times 100 = 50$
E	1	1	$=1/1 \times 100 = 100$
F	2	2.50	$=2.50/2 \times 100 = 125$
G	3	2.25	$=2.25/3 \times 100 = 75$
N = 7			Price Relative = $\Sigma P_1/P_0 \times 100 = 620$

$$P_{01} = (\Sigma P_1/P_0 \times 100)/N \quad P_{01} = 620/7 = 88.57$$

Hence, Price Index = 88.57

10. Taking 2004 as base year, construct the index numbers of the years 2005 and 2009.

Year	2004	2005	2006	2007	2008	2009
Prices (₹)	10	14	16	20	22	24

ANSWER:

Year	Price
2004	10

2005	14
2006	16
2007	20
2008	22
2009	24

Since, base year is given as 2004

$$\therefore P_0 = 10$$

Index number for year 2005

Here, $P_1 = 14$

$$P_{01} = P_1/P_0 \times 100 = 14/10 \times 100 = 140$$

Index number for year 2009

Here, $P_1 = 24$

Substituting the values in the formula

$$P_{01} = 24/10 \times 100 = 240$$

11. Construct index number by Price Relative Method taking 2014 as base year:

Price per Unit in ₹

Year	A	B	C	D
2014	25	18	16	21
2015	20	22	24	22
2016	25	20	25	25
2017	28	24	30	26

ANSWER:

Here, we construct the index number for each of the years from 2012-2014.

Base Year 2014, Current year 2015

	2014 (P_0)	2015 (P_1)	Price Relative = $P_1/P_0 \times 100$
A	25	20	= $20/25 \times 100 = 80$

B	18	22	$=22/18 \times 100 = 122.22$
C	16	24	$=24/16 \times 100 = 150$
D	21	22	$=22/21 \times 100 = 104.76$
			$\sum(P1/P0)/100 = 456.96$

According to the Price Relative Method, price index is calculated using the following formula.

$$P01 = (\sum P1/P0 \times 100) / N$$

Substituting the values in the formula.

$$P01 = 456.98 / 4 = 114.245$$

Base Year 2014, Current year 2016

	2014 (P ₀)	2016 (P ₁)	Price Relative = P ₁ /P ₀ × 100
A	25	25	$=25/25 \times 100 = 100$
B	18	20	$= 20/18 \times 100 = 111.11$
C	16	25	$=25/16 \times 100 = 156.25$
D	21	25	$=25/21 \times 100 = 119.04$
			$\sum(P1/P0)/100 = 486.4$

$$P01 = 486.4 / 4 = 121.60$$

Base Year 2014, Current Year 2017

	2014 (P ₀)	2017 (P ₁)	Price Relative = P ₁ /P ₀ × 100
A	25	28	$=28/25 \times 100 = 112$
B	18	24	$=.24/18 \times 100 = 133.33$
C	16	30	$=.30/16 \times 100 = 187.5$
D	21	26	$=.26/21 \times 100 = 123.80$
			$\sum(P1/P0)/100 = 556.63$

$$P_{01} = 556.63/4 = 139.157$$

LONG TYPE ANSWER QUESTION (6 MARKS)

1. Construct price index number of the following data by using:

(i) Laspeyre's Method, (ii) Paasche's Method, and (iii) Fisher's Method.

Items	Base Year		Current Year	
	Quantity	Price	Quantity	Price
A	3	5	2	8
B	7	4	5	6
C	4	7	3	10
D	6	6	5	7

ANSWER:

Items	q ₀	p ₀	p ₀ q ₀	p ₁	q ₁	p ₁ q ₁	p ₁ q ₀	p ₀ q ₁
A	3	5	15	8	2	16	24	10
B	7	4	28	6	5	30	42	20
C	4	7	28	10	3	30	40	21
D	6	6	36	7	5	35	42	30
			$\Sigma p_0q_0 =$ 107			$\Sigma p_1q_1 =$ 111	$\Sigma p_1q_0 = 148$	$\Sigma p_0q_1 = 81$

(i) Laspeyre's Price index:

$$P_{01} = \frac{\Sigma P_1q_0}{\Sigma P_0q_0} \times 100$$

$$P_{01} = \frac{148}{107} \times 100 = 138.31$$

(ii) Paasche's Price index:

$$P_{01} = \frac{\Sigma P_1q_1}{\Sigma P_0q_1} \times 100$$

$$P_{01} = \frac{111}{81} \times 100 = 137.04$$

(iii) Fisher's Price index:

$$P_{01} = \sqrt{\frac{\Sigma P_1q_0}{\Sigma P_0q_0} \times \frac{\Sigma P_1q_1}{\Sigma P_0q_1}} \times 100$$

$$P_{01} = \sqrt{\frac{148}{107} \times \frac{111}{81}} \times 100 = 137.6$$

1. Given the following data and taking 2004 as the base year, construct index of prices using:
(i) Laspeyre's Method, (ii) Paasche's Method, and (iii) Fisher's Method.

Year	Commodities							
	A		B		C		D	
	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity
2004	24	8	9	3	16	5	10	3
2017	30	10	10	4	20	8	9	4

ANSWER:

	P_0	q_0	P_0q_0	P_1	q_1	P_1q_1	P_1q_0	P_0q_1
A	24	8	192	30	10	300	240	240
B	9	3	27	10	4	40	30	36
C	16	5	80	20	8	160	100	128
D	10	3	30	9	4	36	27	40
			$\sum P_0q_0 = 329$			$\sum P_1q_1 = 536$	$\sum P_1q_0 = 397$	$\sum P_0q_1 = 444$

Laspeyre's Price index

$$P_{01} = \frac{\sum P_1q_0}{\sum P_0q_0} \times 100$$

$$P_{01} = \frac{397}{329} \times 100 = 120.66$$

Paasche's Price index

$$P_{01} = \frac{\sum P_1q_1}{\sum P_0q_1} \times 100$$

$$P_{01} = \frac{536}{444} \times 100 = 120.72$$

Fisher's Price index

$$P_{01} = \sqrt{\frac{\sum P_1q_0}{\sum P_0q_0} \times \frac{\sum P_1q_1}{\sum P_0q_1}} \times 100$$

$$P_{01} = \sqrt{\frac{397}{329} \times \frac{536}{444}} \times 100 = 120.65$$

2. Construct a weighted index number of the following data using price relative method:

Item	A	B	C	D	E
Base Year (Quantity)	24	14	8	4	8
Base Year (Price)	2	4	6	10	5
Current Year (Price)	3	5	9	12	5

ANSWER:

	P_0	q_0	P_1	P_0q_0 (W)	$R=P_1/P_0 \times 100$	RW
A	2	24	3	48	$=3/2 \times 100 = 150$	7200
B	4	14	5	56	$=5/4 \times 100 = 125$	7000
C	6	8	9	48	$=9/6 \times 100 = 150$	7200
D	10	4	12	40	$=12/10 \times 100 = 120$	4800
E	5	8	5	40	$=5/5 \times 100 = 100$	4000
				$\Sigma W = 232$		$\Sigma RW = 30,200$

Weighted index number

$$I_{P01} = \Sigma RW / \Sigma W$$

$$30,200 / 232$$

$$I_{P01} = 130.17$$

3. Find out the index number of the following data with Laspeyre's Method:

Year	2016		2017	
	Price	Quantity	Price	Quantity
A	70	7	80	6
B	62	3	74	2

ANSWER:

	P_0	q_0	P_0q_0	P_1	q_1	P_1q_0
A	70	7	490	80	6	560
B	62	3	186	74	2	222
			$\Sigma P_0q_0 = 676$			$\Sigma P_1q_0 = 782$

Laspeyre's Price index

$$=P_{01} = \frac{\sum P_1 q_0}{\sum P_0 q_0} \times 100$$

$$P_{01} = 782 / 676 \times 100 = 115.68$$

Question 9

Construct Cost of Living Index on the basis of the following data:

Items	Price	Weight
Wheat	241	10
Rice	150	4
Maida	200	2
Pulses	170	2
Oil	125	2

ANSWER:

Items	Price (P)	Weights (W)	PW
Wheat	241	10	2410
Rice	150	4	600
Maida	200	2	400
Pulses	170	2	340
Oil	125	2	250
		$\sum W = 20$	$\sum PW = 4000$

$$\text{Cost of living Index} = \frac{\sum PW}{\sum W} = \frac{4000}{20} = 200$$

5. Construct Consumer Price Index Number with the help of the following data:

Consumer Items	Price	Weight
Food	125	40
Fuel	120	10
Cloth	66.67	25
House Rent	120	15
Miscellaneous	150	10

ANSWER:

Items	Price (P)	Weights (W)	PW
Food	125	40	5000
Fuel	120	10	1200
Cloth	66.67	25	16 66.75
House rent	120	15	1800
Miscellaneous	150	10	1500
		$\Sigma W = \Sigma W = 100$	$\Sigma W = 11166.75$

Consumer price index

$$\frac{\Sigma PW}{\Sigma W} = 11166.75 / 100 = 111.67$$

6. Construct Cost of Living Index Number for the year 2017 from the following statistics:

Commodity	2004 Price	2004 Quantity	2017 Price
A	25	16.0	35
B	36	7.0	48
C	12	3.5	16
D	6	2.5	10
E	28	4.0	28

ANSWER:

	P ₀	q ₀	P ₁	P ₁ q ₀	P ₀ q ₀
A	25	16	35	560	400
B	36	7	48	336	252
C	12	3.5	16	56	42
D	6	2.5	10	25	15
E	28	4	28	112	112
				$\Sigma P_1 q_0 = 821$	$\Sigma P_0 q_0 = 1089$

Cost of Living Index

$$\text{CPI} = \frac{\Sigma P_1 q_0}{\Sigma P_0 q_0} \times 100$$

$$\text{CPI} = \frac{1089}{821} \times 100 = 132.64$$

7. Find the Consumer Price Index from the following data. Using (i) Aggregative Expenditure Method, and (ii) Family Budget Method. Commodity	Quantity Consumed in the year 2004	Unit	Price in 2004 (₹)	Price in 2017 (₹)
Rice	6	Quintal	100	120
Wheat	8	Quintal	80	90
Bajra	1	Quintal	70	70
Arhar	2	Quintal	120	115
Desi Ghee	20	kg	12	15
Sugar	1	Quintal	160	170

ANSWER:

	q_0	P_0	P_1	$W = P_0 q_0$	$P_1 q_0$	$R = \frac{P_1}{P_0} \times 100$	WR
Rice	6	100	120	600	720	$= \frac{120}{100} \times 100 = 120$	72,000
Wheat	8	80	90	640	720	$= \frac{90}{80} \times 100 = 112.5$	72,000
Bajra	1	70	70	70	70	$= \frac{70}{70} \times 100 = 100$	70,000
Arhar	2	120	115	240	230	$= \frac{115}{120} \times 100 = 95.83$	22,999. 2
Ghee	20	12	15	240	300	$= \frac{15}{12} \times 100 = 125$	30,000
Sugar	1	160	170	160	170	$= \frac{170}{160} \times 100 = 106.25$	17,000
				$\Sigma P_0 q_0 = 1950$	$\Sigma P_1 q_0 = 2210$		283999. 2

(i) *Aggregate expenditure method*

$$\text{CPI} = \frac{\sum P_1 q_0}{\sum P_0 q_0}$$

$$\text{CPI} = \frac{2210}{1950} \times 100 = 113.33$$

(ii) *Family Budgeted Method*

$$\text{CPI} = \frac{\sum WR}{\sum W} = \frac{283999.2}{1950} = 145.64$$

8. Construct index number of industrial production in the year 2017 from the following data on the basis of 2005's production:

Industry	Units	2005	2017	Weight
Electrical and Electronics	Mill. Nos.	12	70	36
Metallurgical	Th. Tonnes	22	37	12
Mechanical	Th. Tonnes	72	105	10
Mining	Th. Tonnes	100	123	22
Textiles	Mill. Mtrs.	60	130	8
Miscellaneous	Th. Tonnes	123	270	12

ANSWER:

Industry	q_0	q_1	Weight (W)	$R = q_1/q_0 \times 100$	WR
Electronics	12	70	36	$70/12 \times 100 = 583.33$	20999.88
Metallurgical	22	37	12	$37/22 \times 100 = 168.18$	2018.16
Mechanical	72	105	10	$105/72 \times 100 = 145.83$	1458.3
Mining	100	123	22	$= 123/100 \times 100 = 123$	2706
Textiles	60	130	8	$130/60 \times 100 = 216.67$	1733.36
Misce.	123	270	12	$= .270/123 \times 100 = 219.51$	2634.12
			$\sum W = 100$		$\sum WR = 31549.82$

Index number of Industrial Production

$$\text{IIP} = \frac{\sum WR}{\sum W} \quad \text{IIP} = \frac{31549.82}{100} = 315.50$$

9. Construct index number of industrial production from the following data:

Industry	Number of Items		Weight
	Base Year	Current Year	
Mining and Quarrying	35	107	10
Manufacturing	413	1225	85
Electricity and Electronics	10	27	5

ANSWER:

Industry	Base year (q_0)	Current year (q_1)	Relatives values $R=q_1/q_0 \times 100$	Weight (W)	WR
Mining and quarrying	35	107	305.71	10	3057.1
Manufacturing	413	1225	296.61	85	25211.85
Electricity and electronics	10	27	270	5	1350
				$\sum W = 100$	$\sum RW = 29618.95$

Index number

$$.= \frac{\sum RW}{W} = \frac{29618.95}{100} = 296.19$$

Part-2: INTRODUCTORY MICROECONOMICS**UNIT-1 INTRODUCTION****(4 MARKS)****[VERY SHORT ANSWER QUESTIONS]**

Q1. What is meant by scarcity?

Ans. Limitation of supply in relation to demand for a commodity is known as scarcity.

Q2. What is meant by economizing of resources?

Ans. Optimum use of resources is known as economizing of resources.

Q3. What is meant by economic problem?

Ans. Economic problem is a problem of choice involving satisfaction of unlimited wants out of limited resources having alternative uses.

Q4. Define microeconomics?

Ans. Microeconomics is that part of the economic theory which deals with the individual units of an economy. Example: Demand of a commodity, Price of a commodity etc.

Q5. Define macroeconomics?

Ans. Macroeconomics is that part of the economic theory which studies the behaviour of the aggregates of an economy as a whole. Example: National income, Price level etc.

Q6. Define opportunity cost.

Ans. Opportunity cost is the cost of the next best alternative foregone.

Q7. Define 'Marginal Rate of Transformation'.

Ans. Marginal Rate of Transformation is the ratio of units of one good sacrificed to produce one more unit of the other good.

Q8. Define normative economics?

Ans. Economics as a normative science deals with the situations of value judgements or condition of 'what ought to be'. Example India should expend more on education.

Q9. Define positive economics?

Ans. Positive economics deals with what is or how the economic problems are actually solved. Example: Prices in Indian economy are constantly rising.

Q10. What are the central problems of an economy?

Ans. 1) What to Produce 2) How to Produce 3) For whom to Produce.

Q11. Define production possibility curve?

Ans. Production possibility curve refers to graphical representation of possible combinations of two commodities that can be produced with given resources and technology.

Q12. Why production possibility curve is concave to the origin?

Ans. Production possibility curve is concave to the origin due to increasing marginal rate of transformation or increasing marginal opportunity cost.

[SHORT ANSWER QUESTIONS]

Q13. What does the slope of PPF indicate?

Ans. PPF is a downward sloping concave shaped curve.

(1) Its downward slope indicates that more of one good can be produced only by taking resources away from the production of another good.

(2) Its concave shape indicates that more and more units of one commodity have to be sacrificed to gain an additional unit of another commodity.

Q14. “Economics is about making choices in the presence of scarcity. Defend or refute.

Ans. If there were no scarcity, there would have been no economic problem. In the absence of scarcity the question of unlimited wants does not exist. When resources are not limited and wants are not unlimited, the problem of choice does not exist. Accordingly there should not be economic problem, and thus no economics is required.

Q15. “Massive unemployment shifts the PPC to the left.” Defend or refute.

Ans. Massive strikes or lockouts in industries, fall in demands for the goods, poor weather conditions etc. will not have an impact on the PPC as these do not affect the production capacity of the society produce somewhere below the PPC.

Q16. Explain the properties of PPC?

Ans. 1. The PPC is generally a downward slope curve because if we need to produce more of a good then it has to sacrifice the production of other good.

2. The PPC is generally a concave to the origin. The shape of the PPC is always a concave to the origin which due to the increasing marginal opportunity cost.

Q17. Why does the problem of ‘what to produce’ arise? Explain.

Ans. It arises because resources are scarce and have alternative uses. Since many goods and services can be produced from these resources, the problem is that which of these should be produced.

Q18. Why does the problem of 'how to produce' arise? Explain.

Ans. It arises due to availability of alternative techniques of production. Broadly the choice is between capital intensive techniques and labour intensive techniques. The problem is that which one to employ.

Q19. Why does the problem of 'for whom to produce' arise? Explain.

Ans. "For Whom to produce" is another problem which refers to choice of distribution which needs to be focused for the equal distribution of the resources for the benefits of large many people so as to reduce unequal distribution of the resources and create egalitarian society. The problem is concerned with the personal and functional distribution of resources among the people in the society. The former refers to the distribution of GDP among the different sections of the society while the later refers to the distribution of factor incomes to the factor owners in lieu of their factor services towards the production of national output.

Q20. Differentiate between Micro and Macro economics.

Microeconomics	Macroeconomics
1. Microeconomics is that part of economic theory which studies the behaviour of individual units of an economy.	1. Macroeconomics is that part of economic theory which studies the behaviour of aggregates of the economy as a whole.
2. It aims to determine price of a commodity or factors of production.	2. It aims to determine income and employment level of the economy.
3. The main tools used in the study are demand and supply.	3. The main tools in the study are aggregate demand and aggregate supply.
4. It is also known as 'Price Theory'.	4. It is also known as 'Income and Employment theory'.
5. Example: Individual income, Individual output etc.	5. Example: National income, National output etc.

Q21. Differentiate between Positive economics and Normative economics.

Ans.

Positive Economics	Normative Economics
1. It deals with what is or how the economic problems are actually solved.	1. It deals with what ought to be or how the economic problems should be solved.
2. It can be verified with the actual data.	2. It cannot be verified with the actual data.
3. It aims to make real description of an economic activity.	3. It aims to determine ideals.
4. It is based upon facts, and thus, not suggestive.	4. It is based upon individual opinion and therefore it is suggestive in nature.
5. Example: Prices in Indian economy are constantly rising.	5. Example: India should take steps to control rising prices.

UNIT-2 CONSUMER'S EQUILIBRIUM & DEMAND**(13 MARKS)**[VERY SHORT ANSWER TYPE QUESTIONS]

Q1. What are the two approaches to study consumer's behaviour?

A1.a) Cardinal utility approach

b) Ordinal utility approach

Q2. Write the meaning of utility?

A2. Utility refers to want satisfying power of a commodity. It is the satisfaction, actual, expected derived from the consumption of a commodity.

Q3. How do the classical economist measure utility?

A3. Classical economist measured utility through cardinal measure of utility, it is possible to numerically estimate utility.

Q4. Define total utility?

A4. Total utility refers to the total satisfaction obtained from the consumption of all possible units of a commodity.

$$TU_n = U_1 + U_2 + U_3 + \dots \dots \dots U_n$$

Q5. What do you mean by Marginal utility?

A5. Marginal utility derived from the consumption of one more unit of the given commodity.

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

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

Q6. Define the law of diminishing marginal utility?

A6. The law of diminishing marginal utility states that as we consume more and more units of a commodity, the utility derived from each successive unit goes on decreasing.

Q7. Define consumer's equilibrium?

A7. Consumer's Equilibrium refers to the situation when a consumer is having maximum satisfaction with limited income and has no tendency to change his way of existing expenditure.

Q8. Express MU in units in terms of money?

A8. $MU_m = \text{Marginal utility in units} / \text{Marginal utility of one rupee}(MU_m)$

Q9. Define Law of Equi – Marginal utility?

A9. According to the law of Equi -Marginal a consumer gets maximum satisfaction , when ratio of MU of two commodities and their respective prices are equal and MU falls as consumption increases.

Q10. What are the necessary conditions to attain Consumer's Equilibrium in case of two commodities?

A10. a) The Ratio of Marginal Utility to Price is same in case of both the goods.

b) MU falls as consumption increases .

Q11. What do you mean by indifference curve?

A11. Indifference curve refers to the graphical representation of various alternative combinations of bundles of two goods among which the consumer is indifferent.

Q12. Give the meaning of Monotonic Preferences?

A12. Monotonic preferences means that a rational consumer always prefers more of a commodity as it offers him a higher level of satisfaction.

Q13. What is a budget line?

A13. Budget line is a graphical representation of all possible combinations of two goods which can be purchased with given income and prices , such that the cost of each of these combinations is equal to the money income of the consumer.

Q14. Write the algebraic expression of Budget line?

A14. $M = (PA \times QA) + (PB \times QB)$

Q15. What do you mean by budget set?

A15. Budget set is the set of all possible combination of the two goods which a consumer can afford , given his income and prices in the market.

[SHORT ANSWER TYPE QUESTIONS]

Q1. Explain the various points of relationship between marginal utility and total utility with the of a schedule?

A1. The concept of TU and MU can be understood with help of a schedule.

ICE CREAM CONSUMED	MARGINAL UTILITY MU	TOTAL UTILITY TU
1	20	20
2	16	36
3	10	46
4	4	50
5	0	50
6	-6	44

The above table shows the following relationship

1. TU increases with an increase in consumption of a commodity as long as MU is positive. In this phase, TU increases, but at a diminishing rate as MU from each successive unit tends to diminish.
2. When TU reaches its maximum, MU becomes zero. This is known as point of satiety. TU curve stops rising at this stage.
3. When consumption is increased beyond the point of satiety, TU starts falling as MU becomes negative.

Q2. Why slope of Budget line is represented by Price Ratio?

A2. A point on the budget line indicates a bundle which the consumer can purchase by spending his entire income. So, if the consumer wants to have one more unit of good 1 then he will have to give up some amount of good 2.

Suppose Apple is priced at RS 4(PA) and Guavas at RS 2(PG). It means, to reduce his expenditure on guavas by RS 4, i.e. consumer will have to sacrifice 2 units of guava to gain 1 unit of apple. PA/PG is nothing but the price ratio between apples and guavas. So it is rightly said that Price Ratio indicates the slope of budget line.

[LONG ANSWERS]

Q1. Explain conditions determining how many units of a good consumer will buy at a given price ?

A1. A consumer purchasing a single commodity will be at equilibrium , when he is buying such a quantity of that commodity which gives him maximum satisfaction. The number of units to be consumed of the given commodity by a consumer depends on 2 factors:

1. Price of the given commodity,
2. Expected utility from each successive units.

Let us now determine the consumer's equilibrium of the consumer spends his entire income on single commodity.

UNITS OF X	PRICE (PX) RS	MU (UNITS)	DIFFERENCE Mux and Px	REMARKS
1	10	20	10	MU _x > P _x
2	10	16	6	
3	10	10	0	MU _x = P _x
4	10	4	-6	
5	10	0	-10	MU _x < P _x
6	10	-6	-16	

From the given schedule , it is clear that the consumer will be at equilibrium when he consumes 3 units of of a commodity because at this point MU_x = P_x .

Q2. What are the two necessary conditions to attain Consumer's Equilibrium in case of Two Commodities?

A2. According to the law of Equi Marginal utility a consumer gets maximum satisfaction, when ratios of MU of two commodities and their respective prices are equal and MU falls as consumption increases.

i) The Ratio of Marginal Utility of Price is same in case of both the goods.

$$MU_x / P_x = MU_y / P_y = MU_m$$

Suppose $MU_x / P_x > MU_y / P_y$. In this case the consumer is getting more MU in case of goods X as compared to Y. Therefore , he will buy more of X and less of Y. This will lead to fall in MU_x and rise in MU_y . The consumer will continue to buy more of X till MU_x / P_x

$x = MU_y / P_y$, when $M_x / P_x < MU_y / P_y$, the consumer gets more marginal utility per rupee in case of good Y as compared to X. The consumer will continue to buy more of Y till $MU_x / P_x = MU_y / P_y$.

ii) MU falls as consumption increases. The second condition needed to attain consumer's equilibrium is that MU of a commodity must fall as more of it is consumed. If MU does not fall as consumption increases, the consumer will end up buying only one good.

Finally we can say that a consumer in consumption of two commodities will be at equilibrium when he spends his limited income in such a way that the ratios of marginal utilities of two commodities and their respective prices are equal and MU falls as consumption increases.

(BUDGET LINE & DEMAND)

[VERY SHORT TYPE QUESTIONS]

Q1. Define Budget line?

Ans: Budget line shows the combination of two goods that a consumer can buy with the given income and the prices of two goods.

Q2. Define Indifference map.

Ans: A group of indifference curves is called indifference map.

Q3. What is meant by monotonic preference?

Ans: Monotonic preference refers to that preference of a consumer of a bundle which has at least one commodity more than the other bundle.

Q4. What is Budget set of a consumer?

Ans: A set of two goods that a consumer can buy with given income in his hand and prices of two goods.

Q5. ICs are convex to the origin because of

- a) Increasing MRS b) Diminishing MRS
- c) Law of DMU d) Law of equi-marginal utility

Ans. Diminishing MRS

Q 6. An IC always

- a) Is parallel to the Y axis b) Slopes upward from left to right
- c) Is parallel to the X axis d) Slopes downward from left to right.

Ans. Slopes downward from left to right

ELASTICITY OF DEMAND [VERY SHORT ANSWER TYPE QUESTIONS)

1. Define price elasticity of demand.

Ans. It is a measure of percentage change in quantity demanded due to percentage change in

2. When coefficient of elasticity of demand is 1.25. Is the demand elastic or inelastic and why?

Ans. Elastic because it is greater than one.

3. Write down formula for calculating price elasticity of demand.

Ans. $Ed = \frac{\% \text{ Change in quantity Demanded}}{\% \text{ Change in price.}}$

4. When two demand curves intersect with each other which will be more elastic.

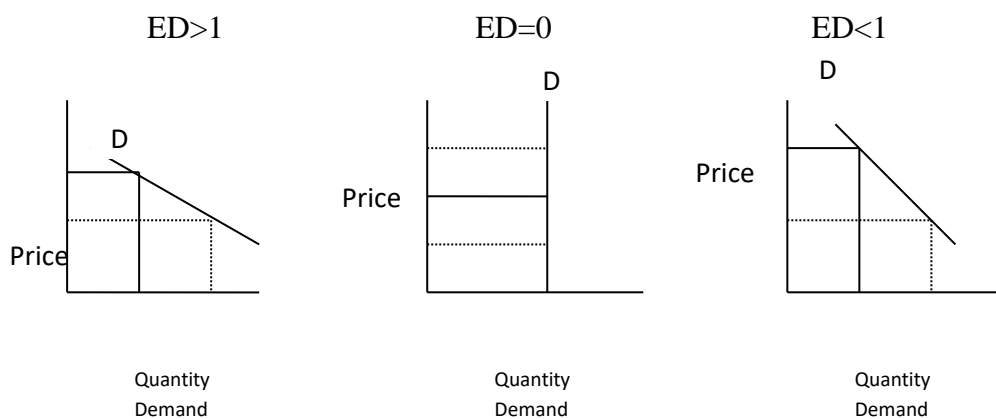
Ans. The demand curve which is more flatter will be more elastic.

5. When is the demand of a commodity said to be inelastic?

Ans. When the percentage change in quantity demanded is less than the percentage change in price.

[SHORT QUESTIONS]

Draw the demand curves to show price elasticity of demand greater than unitary, perfectly inelastic, less than unitary.



The demand curve shows at price P, quantity demanded is Q. but when price rises to P_1 quantity falls to Q_1 and when price falls to P_2 Quantity rises to Q_2 .

1. Price of a commodity falls from Rs. 4 to Rs. 3 per unit. As a result total expenditure on it rises from Rs. 200 to Rs. 300. Find out price elasticity of demand by percentage method.

Price	Total Exp.	Quantity
Rs. 4	Rs. 200	200/4=50
Rs. 3	Rs. 300	300/3=100

$$\text{Ed:- } P / q \times \Delta q / \Delta p$$

$$\text{Ed:- } (-) 4 / 50 \times 100 - 50 / 3-4$$

$$\text{Ed:- } (-) 4 / 50 \times 50 / -1$$

$$\text{Ed:- } 4$$

[LONG ANSWER QUESTIONS]

Q.1 Explain the determinants or factors influence the Price elasticity of demand for a good.

1) *Nature of a good:* The demands for the goods, which are most essential for human survival or to satisfy the basic needs, are inelastic in demand, because the consumers are compelled to buy these goods without getting bothered about the changes in their price.

2) *Proportion of income spent:* The goods on which we spend smaller proportion of our income are inelastic in demand, b'coz the consumers do not bother about the change in their price.

3) *Several uses of the good:* The goods which have several uses like electricity, coal etc. have elastic demand as the rise in their price will compel the consumers to limit the use of these goods.

4) *Future expectation of change in price:* If there is an expectation of change in price, the demand for a good is either less responsive.

5) *Availability of substitutes-* Goods having substitutes are price elastic and vice versa.

6) *Postponment of the use-* Those goods whose use can be postponed for future are of price elastic demand and goods whose use cannot be postponed for future are of less price elastic demand.

7) *Time period-* Demand of commodity is less price elastic in short period and more price elastic in long period.

2. Is the demand for the following elastic ,moderate, highly elastic or completely inelastic? Give reason in support of your answer.

- a) Demand for needles
- b) Demand for petrol
- c) Demand for cars
- d) Demand for textbooks
- e) Demand for fridge

Ans a) Demand for needles is completely inelastic

Reason being that the proportion of income spent on needles is very low

- b) Less elastic demand

Reason as no substitutes are available.

- c) Demand for cars is elastic

Reason being that car is a luxury good for a middle man

- d) Demand for textbooks completely inelastic

Reason being that the text book is necessary goods for students

- e) Demand for fridge is highly elastic

Reason being that consumer can postpone the demand for fridge.

.....

UNIT-3: PRODUCTION FUNCTION

13 MARKS

Very short answer type questions -1 mark each

1. Define production.

Ans: Production refers to combining inputs in order to get the output.

2. What is meant by production function?

Ans: It is the functional relationship between inputs and output in a given state of technology. $Q = f(L, K)$; Q is the output, L: Labour, K: Capital

3. What is meant by product?

Ans: Product refers to volume of goods produced by a firm or an industry during a specific period of time.

4. What is a fixed factor?

Ans: The factor whose quantity remains fixed with the level of output is a fixed factor.

5. What is meant by variable factor?

Ans: Those inputs which change with the level of output.

6. What is meant by inputs?

Ans: Whatever is used in production of goods and services is called as inputs, e.g. land, labour, power, transport, raw material etc.

7. Name any three fixed inputs.

Ans: Machinery, plant, factory building.

8. What is meant by short run?

Ans: A short run refers to the period of time in which a firm can make changes in variable factors and not in fixed factors.

9. What is meant by long run?

Ans: It refers to the time period in which a firm can change all factors of production including machinery, factory building, organization, labour etc.

10. What is meant by total physical product (TPP) or total product (TP) ?

Ans: It refers to the total output at a particular level of variable input when employment of all other inputs are kept fixed.

11. Define marginal product (MP).

Ans: MP is an addition to the TPP when an additional unit of the labour is employed.

12. What is meant by average product (AP)?

Ans: Average product is the TPP per unit employment of variable input i.e. $AP = TP/Q$. Q indicates level of employment of variable input.

13. What is the shape of MP and AP curves?

Ans: Both MP and AP curves are inverse U shaped.

14. Name the law expressing the relationship between the quantities of a variable factor and the quantities of output.

Ans: Law of variable proportions.

15. What is meant by law of variable proportions?

Ans: The law of variable proportions states that, if more and more units of variable factors are employed with fixed factors, MP first increases, then falls but remains positive, becomes zero and finally becomes negative.

Multiple choice questions (MCQs)- 1 mark each

1. When MP is zero, what will happen to TP?

- a-rising b-falling c-maximum d-none of these

2. Identify the phase in which TP increases at an increasing rate and MP also increases.

- a-increasing return to a factor b-diminishing return to a factor c-negative return to a factor d-none of these

3. What happens to AP when MP is more than AP?

- a-AP rises b-AP falls c-AP remains constant d-none of these

4. Which of the following is not a reason for operation of increasing return to a factor?

- a-better utilization of fixed factor b-limitation of fixed factor
c-increase in efficiency of variable factor d-indivisibility of fixed factor

ANSWERS:

1. c-maximum
2. a-increasing return to a factor
3. a-AP rises
4. b-limitation of fixed factor
5. c-MP is maximum
6. a-average product
7. b-TP can never be negative
8. d-All of these
9. b-constant return to a factor
10. b-100 units
11. b-inverse U-shaped
12. b-15
13. c-12
14. a-increasing return to factor
15. c-7.5

True/ False questions

Giving reasons, state whether the following statements are true or false:

1. When there are diminishing returns to a factor, total product always decreases.

Ans: - False. When there is diminishing returns to a factor, TPP increases at a decreasing rate.

2. TPP increases only when MPP increases.

Ans: - False. TPP also increases when MPP decreases but remains positive.

3. Increase in TPP always indicates that there are increasing returns to a factor.

Ans:- False. TPP increases even when there are diminishing returns to a factor.

4. When there are diminishing returns to a factor marginal and total product always fall.

Ans: - False. Only MPP falls, not TPP. In case of diminishing returns to a factor, TPP increase at diminishing rate.

5. .In long run the machineries also change.

Ans: True. As all factors are variable in long run, the machineries also change.

6. AP cannot be zero or negative.

Ans: True. AP is always positive as TP is always positive.

3/4 marks Questions

1. Explain meaning of variable and fixed factors.

Ans: Those inputs which change with the level of output are variable factors.

The factor whose quantity remains fixed with the level of output is a fixed factor.

Capital	Labour	Output
20	1	50

20	2	70
20	3	82
20	4	92
20	5	100

Here units of capital used remain the same for all levels of output. Hence it is the fixed factor. Amount of labour increases as output increases. Hence it is a variable factor.

2. Differentiate between short run and long run.

Basis	Short Run	Long Run
Meaning	Only variable factors are changed	All factors are changed
Price Determination	Demand is active.	Both demand & supply play an important role.
Classification	Factors are classified as fixed & variable.	All factors are variable.

3. Write the relationship between TP and MP.

Ans: a-As long as TP increases at an increasing rate, MP also increases.

b-When TP increases at diminishing rate, MP falls positively.

c-When TP becomes maximum and constant, MP becomes zero.

d-When TP decreases, MP becomes negative.

e- $TP = \sum MP$, $MP_n = TP_n - TP_{n-1}$

4. Write the relationship between AP and MP.

Ans: i-When MP is more than AP, AP rises

ii-When MP is equal to AP, AP is at its maximum.

iii-When MP is less than AP, AP falls.

iv-MP can be positive, zero and negative but AP is always positive as TP is positive always.

5. Complete the following table

Units of labour	Average product(units)	Marginal product(units)
1	4	--
2	---	6
3	6	---
4	---	6
5	---	1
6	4	---

Answer:

Units of labour	Average product(units)	Marginal product(units)	Total product
1	4	4	4
2	5	6	10
3	6	8	18
4	6	6	24
5	5	1	25
6	4	-1	24

6. Complete the following table.

Units of labour	Total product(units)	Average product(units)	Marginal product(units)
1	200	200	200
2	450	225	250
3	750	250	300
4	900	225	150

Answer:

Units of labour	Total product(units)	Average product(units)	Marginal product(units)
1	200	---	----
2	----	---	250
3	----	250	---
4	900	----	---

7. Identify the three phases of the law of variable proportions from the following table.

Units of labour	1	2	3	4	5	6
TPP(units)	10	40	60	70	70	50

ANSWER:

Units of labour	TPP(units)	MPP(units)	Phases
1	10	10	1 st phase (increasing return to factor)
2	40	30	
3	60	20	2 nd phase (diminishing return to factor)
4	70	10	
5	70	0	
6	50	-20	3 rd phase (negative return to factor)

8. From the following table, find out the phases during which there are increasing returns to a factor. Give reasons for your answer.

Units of labour	1	2	3	4	5
APP(units)	20	23	26	22.5	20

Answer:

Units of labour	APP(units)	TPP(units)	MPP(units)	Phases
1	20	20	20	1 st phase of increasing return to factor
2	23	46	26	
3	26	78	32	
4	22.5	90	14	
5	20	100	10	

1st phase-increasing return to factor from 1st to 3rd units of labour. it is because MP is increasing till 3rd unit of labour.

6 marks Questions

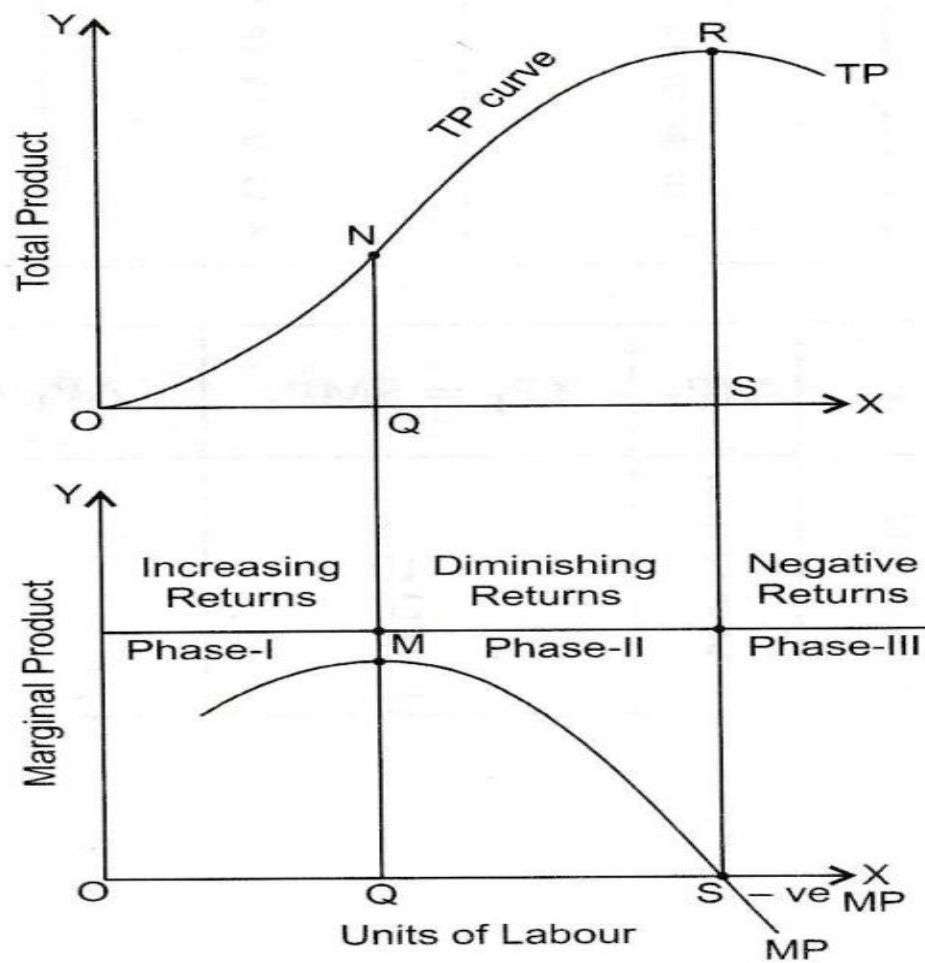
1. Explain the law of variable proportions with the help of a schedule and a diagram

Answer: Statement of law of variable proportion: In short period, when only one variable factor is increased, keeping other factors constant, the total product (TP) initially increases at an increasing rate, then increases at a decreasing rate and finally TP decreases.

MPP initially increase then falls but remains positive then 3rd phase becomes negative. **Schedule of Law of variable proportion**

Fixed factor	Variable factor	Total product	Marginal product	Phase
Land in acres	Labour	Units	Units	
1	0	0	-	I - Increasing returns to a factor
1	1	5	5	
1	2	15	10	
1	3	30	15	
1	4	40	10	II - diminishing returns to a factor
1	5	45	5	
1	6	45	0	
1	7	40	-5	III - Negative returns to a factor

Di



Phase I / Stage I / Increasing returns to a factor.

- TPP increases at an increasing rate
- MPP also increases.

Phase II / Stage II / Diminishing returns to a factor

- TPP increases at decreasing rate
- MPP decreases / falls
- This phase ends when MPP is zero & TPP is maximum

Phase III / Stage III / Negative returns to a factor

- TPP diminishes / decreases

- MPP becomes negative.
2. What are the reasons for
- a) Increasing returns to a factor
 - b) Diminishing returns to a factor
 - c) Negative returns to a factor

Answer

a-Reasons for increasing returns to a factor

- **Better utilization of fixed factor**-In the first phase, the supply of fixed factor is too large and variable factors are very few. When variable factors are increased and combined with fixed factor, then fixed factor is better utilized and output increases at an increasing rate.
- **Increase in efficiency of variable factor**-When variable factors are increased and combined with the fixed factor, then variable factor is utilized in a more efficient manner as there is division of labour.
- **Better co-ordination between factors**-Because of better utilization of fixed factor and efficient utilization of variable factor, then there is better co-ordination between the fixed and variable factor. So, TP increases at increasing rate implying benefits of division of labour.

b-Reasons for diminishing returns to a factor

- **Over-utilization of the fixed factors**-In this stage of the fixed factor gets over utilized and will bring less than proportionate returns as there is pressure on fixed factor.
- **Imperfect substitution of factors**-More and more of one factor cannot be used in place of other as factors are imperfect substitutes.

c-Reasons for negative returns to a factor

- **Limitation of fixed factors**-The quantity of fixed factors cannot be increased.
- **Poor coordination between variable and fixed factor** –The variable factors becomes too excessive in relation to fixed factor. It leads to poor coordination between variable and fixed factors. As a result, total output falls instead of rising.
- **Decrease in efficiency of variable factors**-With continuous increase in variable factor, the advantages of specialization and division of labour start diminishing.

Unit 3: Producer Behaviour and Supply (Contd....)

Topic: Cost

Key Concepts: Cost of production: Expenditure incurred on various inputs to produce goods and services.

Cost function: Functional relationship between cost and output.

Explicit cost: Actual payment made on hired factors of production. For example, wages paid to the hired labourers.

Implicit cost: Imputed value of self - owned factors of production is called implicit cost

For example, interest on owner's capital, rent of own building.

Total Cost: is the total expenditure incurred on the factors and non-factor inputs in the production of goods and services. It is obtained by summing TFC and TVC at various levels of output.

Total Fixed Costs: - It is also called as “overhead cost”, “supplementary cost”, and “unavoidable cost”. which does not change with change in the level of output

(i) Rent of a building (ii) Salary to permanent employees.

Total Variable Cost: TVC are those costs which change with the change in output. These costs are incurred on the variable factors of production. These costs are also called “prime costs”.

Examples

1. Cost of raw material.
2. Expenditure on energy
3. Salary of casual labour etc.

Average cost: It is the “cost per unit” of output produced.

Average Fixed Cost: It is the per unit fixed cost of production. $AFC = TFC / Q$.

Marginal cost: refers to the addition made to total cost when an additional unit of output is produced.

$$MC_n = TC_n - TC_{n-1}$$

(1 Mark Questions)

Question 1: Which of the following is a variable cost? (Choose the correct alternative)

- (a) Salary of permanent staff
- (b) rent of premises
- (c) license fees
- (d) wages

Answer :(d) wages

Question 2: Why does AFC curve not touch the X-axis? (Choose the correct alternative)

- (a) AFC cannot be zero.
- (b) AFC cannot be negative.
- (c) AFC can never be less than 1.
- (d) None of these.

Answer**(a) AFC cannot be zero**

Question 3: In the short run, with the decrease in output, average fixed cost _____ .
(Choose the correct alternative)

- (a) increases
- (b) remains fixed
- (c) decreases
- (d) increases initially, then decreases

Answer :(a) increases

Question 4: Which of the following curve is not a U-shaped curve? (Choose the correct alternative)

- (a) AVC curve
- (b) AFC curve
- (c) AC curve
- (d) MC curve

Answer :(b) AFC curve

Question 5: What is the behaviour of TVC when MC falls? (Choose the correct alternative)

- (a) TVC falls
- (b) TVC rises at decreasing rate
- (c) TVC rises at increasing rate
- (d) TVC rises at a constant rate

Answer**(b) TVC rises at decreasing rate**

Question 6

When output is increased, initially MC falls. It means _____ . (Choose the correct alternative)

- (a) MP of the variable factor increases
- (b) AC falls

- (c) AVC falls
- (d) All of these

Answer :(d) All of these

Question 7:How does AC behave when AVC rises? (Choose the correct alternative)

- (a) AC rises
- (b) AC may fall or rise
- (c) AC falls
- (d) AC is constant

Answer:(b) AC may fall or rise

Question 8:The cost curve, which is inverse S-shaped is: (Choose the correct alternative)

- (a) Average Cost Curve
- (b) Total Fixed Cost Curve
- (c) Total Variable Cost Curve
- (d) Marginal Cost Curve

Answer:(c) Total Variable Cost Curve

Question 9:Area under AVC curve is equal to: (Choose the correct alternative)

- (a) TVC
- (b) AFC
- (c) AVC
- (d) AC

Answer:(a) TVC

Question 10:Minimum point of MC curve comes before the minimum point of: (Choose the correct alternative)

- (a) AC curve
- (b) AVC curve
- (c) Both (a) and (b)
- (d) Neither (a) nor (b)

Answer:(c) Both (a) and (b)

Question 11

AVC can fall even when MC is rising, provided: (Choose the correct alternative)

- (a) $MC < AVC$
- (b) $MC > AVC$
- (c) $MC = AVC$
- (d) None of these

Answer

(a) $MC < AVC$

Question 12

Which of the following cost curves is rectangular hyperbola? (Choose the correct alternative)

- (a) Average cost curve
- (b) Marginal cost curve
- (c) Average variable cost curve
- (d) Average fixed cost curve

Answer

(d) Average fixed cost curve

Question 13

When AC is rising MC is: (Choose the correct alternative)

- (a) Equal to AC
- (b) More than AC
- (c) Less than AC
- (d) Constant

Answer

(b) More than AC

Question 14

Initially, even when there is an increase in AVC, AC may still decline because: (Choose the correct alternative)

- (a) Fall in AFC < Rise in AVC
- (b) Fall in AFC > Rise in AVC
- (c) Fall in AFC = Rise in AVC
- (d) None of these

Answer

(b) Fall in AFC > Rise in AVC

Question 15

If total variable cost and total fixed cost of producing 10 units are 500 and 200, the value of average cost would be? (Choose the correct alternative)

- (a) 50
- (b) 70
- (c) 20
- (d) 80

Answer

(b) 70

Question 16

When the total fixed cost of producing 100 units is 30 and the average variable cost 3, total cost is: (Choose the correct alternative)

- (a) 3
- (b) 30
- (c) 270
- (d) 330

Answer

(d) 330

Question 17

The total cost at 5 units of output is 30. The fixed cost is 5. The average variable cost at 5 units of output is: (Choose the correct alternative)

- (a) 25

(b) 6

(c) 5

(d) 1

Answer

(c) 5

Question 18

A firm's average cost (AFC) is ` 20 at 6 units of output. What will be AFC at 3 units of output? (Choose the correct alternative)

(a) 20

(b) 30

(c) 40

(d) 50

Answer

(c) 40

Question 19

The average fixed cost at 4 units of output is 20. Average variable cost at 5 units of output is 40. Average cost of producing 5 units is: (Choose the correct alternative)

(a) 20

(b) 40

(c) 56

(d) 60

Answer

(c) 56

Question 20

A firm is producing 20 units. At this level of output, ATC and AVC are respectively equal to 40 and 37. What will be the total fixed cost of the firm? (Choose the correct alternative)

(a) 77

(b) 97

(c) 60

(d) 3

Answer

(c) 60

Question 21

Total cost of producing 9 units of output is ` 85. If average total cost of producing 10 units is 10, then what will be the marginal cost of producing 10th unit of output? (Choose the correct alternative)

(a) 15

(b) 75

(c) 95

(d) 10

Answer

(a) 15

Question 22

The AC of producing 5 units is 6 and AC of producing 6 units is 5. What will be the MC of the 6th unit? (Choose the correct alternative)

(a) 6

(b) 5

(c) 11

(d) 0

Answer

(d) 0

(3 & 4 Marks Questions)

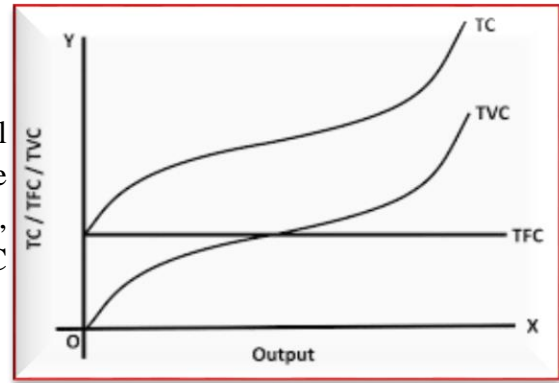
Question 1

What is the shape of TC and TVC curves? Why are TC and TVC curves parallel to each other? Explain. (3 marks)

Answer

TC and TVC curves both are inverse S shaped.

$TC - TVC = TFC$, which remains constant at all levels of output. Therefore, the vertical distance between TC and TVC curve remains the same, being equal to TFC. That is why TC and TVC curves remain parallel to each other.

**Question 2**

Why does the difference between ATC and AVC decrease as output increases?

Answer

$ATC - AVC = AFC$ and $AFC = TFC/Output$. As output increases AFC decreases because TFC remains constant. So, the difference between AC and AVC decreases with increase in output.

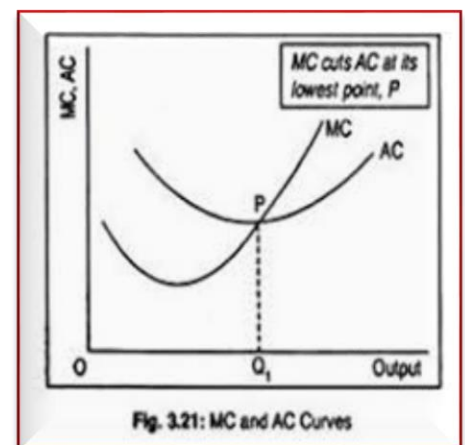
Question 3

Answer the following questions:

- (i) What does the average fixed cost curve look like?
- (ii) What do the short run marginal cost, average variable cost and average cost curves look like?

Answer

- (i) Average fixed cost (AFC) curve looks like a rectangular hyperbola.
- (ii) The short run marginal cost, average variable cost and average cost curves are U-shaped curves.

**Question 4**

Explain the relationship between marginal cost and average cost.(4 Marks)

Answer

- (i) When AC is falling, $AC > MC$.

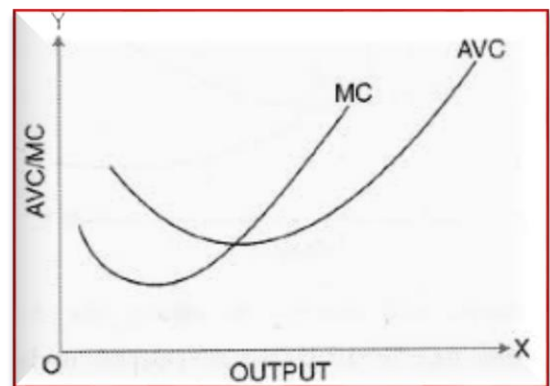
- (ii) When AC is rising, $AC < MC$.
- (iii) When AC is constant, $AC = MC$.
- (iv) MC curve cuts AC curve at its lowest point. Here, $AC = MC$.
- (v) AC can fall even when MC is rising. Both AC and MC curve are U-shaped.

Question 5.

Define cost. State the relation between marginal cost and average variable cost and average variable cost.

Answer

Cost in economics refers to the sum of actual money expenditure on inputs and the imputed expenditure in the form of inputs supplied by the owners including normal profit.



- (i) When AVC is falling, $AVC > MC$.
- (ii) When AVC is rising, $AVC < MC$.
- (iii) When AVC is constant, $AVC = MC$.
- (iv) MC curve cuts AVC curve at its lowest point. Here, $AVC = MC$.
- (v) AVC can fall even when MC is rising. Both AVC and MC curve are U-shaped

Question 6

Why does the minimum point of AC curve fall towards right of minimum point of AVC curve?

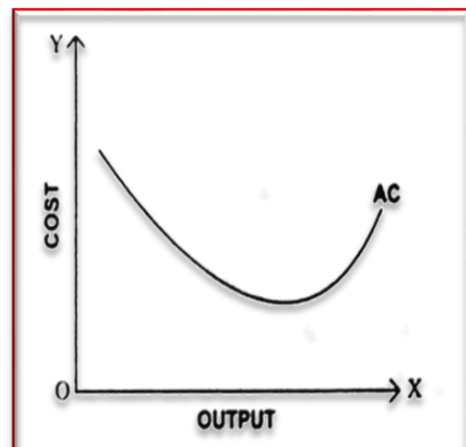
Answer

AC is the sum of AFC and AVC. The minimum point of AC curve fall towards right of minimum point of AVC curve because after a certain level of output AVC starts rising but AC still falls due to decrease in AFC. AC falls because fall in AFC is

greater than the rise in AVC.

Question 7

AVC curve is a U-shaped curve. Why? (3 marks)



Answer

As output increases, initially MC falls. AVC, being the average of all marginal costs, also falls, but falls less than MC. MC falls and reaches its minimum. Then after a certain level of output, MC starts rising. However, AVC continues to fall as long as $MC < AVC$. But when $MC > AVC$, AVC starts rising. Therefore, AVC curve is U-shaped curve.

Question 8

Short run AC curve is U-shaped. Why? (4 marks)

Answer

AC is the sum of AFC and AVC.

Initially both AVC and AFC decrease as output increases. So, AC initially falls.

After a certain level of output production, AVC starts rising, but AFC continues to fall. Now AVC and AFC are moving in opposite direction, i.e., AVC rises and AFC falls. Here, initially the fall in AFC is greater than the rise in AVC. So, AC is still falling.

But, after a point, rise in AVC overrides the fall in AFC. From this point onwards, AC is rising.

Thus, AC curve is U-shaped.

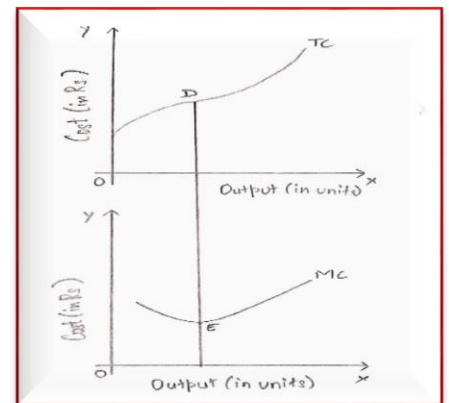
Question 9

Explain the relationship between Total cost and Marginal cost.

Answer

Relationship between Total cost (TC) and Marginal cost (MC):

- (i) When MC falls, TC rises at decreasing rate.
- (ii) When MC rises, TC rises at increasing rate.
- (iii) When MC is constant, TC rises at constant rate.



Question10

Complete the following table

Output	AFC	MC	TC
1	-	-	-
2	-	20	164
3	40	16	-
4	-	-	198
5	24	20	-

Output	TFC	AFC	TVC	AVC	TC	AC	MC
1	120	120	24	24	144	144	24
2	120	60	44	22	164	82	20
3	120	40	60	20	180	60	16
4	120	30	78	19.5	198	49.5	18
5	120	24	98	19.6	218	43.6	20

(6 Marks Questions)**Question 1**

Identify implicit cost and explicit cost in each of the following cases:

- (i) An individual is both the owner and the manager of a shop taken on rent.
- (ii) A producer borrows money and opens a shop. The shop premise is owned by him.
- (iii) A producer invests his own savings in starting a business and employs a manager to look after it.

Answer

- (i) 'Estimated salary of the owner' is the implicit cost as owners would have earned this salary if he had worked with a firm not owned by him. 'Rent paid' is the explicit cost as it is actual money expenditure on input.
- (ii) 'Imputed rent of the shop' is the implicit cost as owners would have earned rent if he had given his shop on rent. 'Interest paid on the borrowed money' is the explicit cost as it is actual money expenditure on input.

(iii) 'Imputed interest on savings' is the implicit cost as producers would have earned interest if he had lent his savings. 'Salary paid to the manager' is the explicit cost as it is actual money expenditure on input.

Question 2

Explain the relation among Total Cost (TC) curve, Total Variable Cost (TVC) curve and Total Fixed Cost (TFC) curve. Use diagrams. (4 marks)

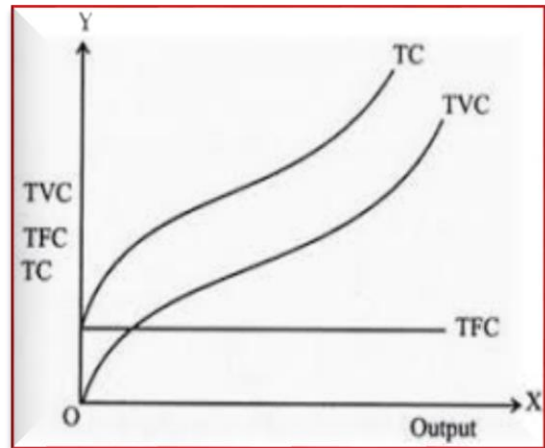
Answer

Relationship between Total Cost (TC) curve, Total Variable Cost (TVC) Curve and Total Fixed cost (TFC) curve.

(i) TC and TVC curves increase with an increase in the level of output. Both are inverted 'S' shaped curves.

(ii) TFC is a straight line parallel to X-axis.

(iii) The vertical gap between TC and TVC is represented by TFC which remains constant with an increase in the level of output.



Question. 3

Calculate TC and AVC at all levels of output.

Output	AFC	MC
1	60	32
2	30	30
3	20	28
4	15	30
5	12	35
6	10	43

Answer:

Output	AFC	TFC	MC	TVC	TC	AVC
1	60	60	32	32	92	32
2	30	60	30	62	122	31
3	20	60	28	90	150	30
4	15	60	30	120	180	30
5	12	60	35	155	215	31
6	10	60	43	198	258	33

Question 4

State giving reasons whether the following statements are true or false.

- (a) With increase in level of output, average fixed cost goes on falling till it reaches zero.
- (b) Marginal cost is not affected by total fixed cost.
- (c) As soon as marginal cost starts rising, average variable cost also starts rising.

Answer

- (a) False: With increase in level of output, average fixed cost (AFC) goes on falling but it can never be zero because $AFC = TFC/\text{output}$ and TFC is positive.
- (b) True: Since total fixed cost does not change with change in output, therefore, marginal cost is independent of total fixed cost and is affected only by change in total variable cost.
- (c) False: When marginal cost (MC) starts rising, AVC can continue to fall as long as MC is less than the AVC.

Question 5

State giving reasons whether the following statements are true or false.

- (a) Total cost can never be constant.
- (b) Average cost falls only when marginal cost falls.
- (c) The difference between average total cost and average variable cost is constant.

Answer :(a) True: Total Cost can be constant only when Marginal Cost is zero, which is not possible.

(b) False: After a certain level of output, MC starts rising but AC continues to fall as long as MC is less than the AC. (c) False: $ATC - AVC = AFC$ and $AFC = TFC/\text{output}$. Therefore, as output increases, AFC falls since TFC is constant at all levels of output.

Concept of Revenue:

Objective type question (1Mark)

Question 1

If the Marginal Revenue curve is parallel to the X-axis, The price of the commodity would be_____.

(Choose the correct alternative)

- (a) Equal to Marginal Revenue
- (b) More than Marginal Revenue
- (c) Zero
- (d) Less than Marginal Revenue

Answer 1

- (a) **Equal to Marginal Revenue.**

Question 2: Under imperfect competition, Average Revenue (AR), Remains _____Marginal Revenue (MR).

(Fill up the blank with correct answer)

Answer 2

Above (higher/greater than/more than)

Question 3

In an imperfectly competitive market, if the Total Revenue is maximum, Marginal Revenue will be_____.

(Fill up the blank with correct answer)

Answer 3

Zero.

Question 4

The MR curve of a firm which can sell more output at the same price, is the same as the_____.

(Choose the correct alternative)

- (a) AR curve

- (b) Demand curve
- (c) Price line
- (d) All of these

Answer 4: (d) All of these

Question 5

The equilibrium condition of a firm is _____.

(Choose the correct alternative)

- (a) $MR = MC$
- (b) $AR = AC$
- (c) $MR = AR$
- (d) $MC = AC$

Answer 5

(a) $MR = MC$

Question 6

A firm can sell more output at the same price ` 10. What will be the marginal revenue by selling 20th unit? (Choose the correct alternative)

- (a) 2
- (b) 200
- (c) 210
- (d) 10

Answer 6

(d) 10

Question 7

When TR rises at decreasing rate, what is the behaviour of MR?

(Choose the correct alternative)

- (a) MR rises
- (b) MR is constant
- (c) MR falls
- (d) MR falls and can become negative

Answer 7

(c) **MR falls**

Question 8

If average revenue curve is a horizontal straight line, then marginal revenue curve will be:

(Choose the correct alternative)

- (a) Downward sloping
- (b) Horizontal straight line
- (c) Upward sloping
- (d) Inverse S-shaped

Answer 8

(b) **Horizontal straight line**

Question 9

When MR remains same, TR increases at: -

(Choose the correct alternative)

- (a) Constant rate
- (b) Decreasing rate
- (c) Increasing rate
- (d) None of these

Answer 9

(a) **Constant rate**

Question 10

When price remains same with rise in output, AR curve is:

(Choose the correct alternative)

- (a) Vertical straight line parallel to Y-axis
- (b) Horizontal straight line parallel to X-axis
- (c) Downward sloping
- (d) Positively sloped

Answer 10**(b) Horizontal straight line parallel to X-axis**

Question 11

When price falls with rise in output, then:

(Choose the correct alternative)

- (a) MR curve is steeper than AR curve
- (b) AR curve is steeper than MR curve
- (c) MR and AR curves coincide in a horizontal straight parallel to the X-axis.
- (d) None of these

Answer 11**(a) MR curve is steeper than AR curve**

Question 12

When total revenue is constant, what will be the effect on average revenue?(Choose the correct alternative)

- (a) AR will fall
- (b) AR will increase
- (c) AR will also be constant
- (d) No effect on AR

Answer 12**(a) AR will fall**

Question 13

If TR curve is a horizontal straight line parallel to X- axis, then MR curve will: (Choose the correct alternative)

- (a) Coincide with X-axis
- (b) Slope downwards
- (c) Slope upwards
- (d) Horizontal straight line parallel to the X-axis

Answer 13**(b) Slope downwards**

Question 14

If a firm's total revenue curve takes the shape of an upward rising straight line which passes through the origin, then: (Choose the correct alternative)

- (a) Price > MR
- (b) Price = MR
- (c) Price < MR
- (d) None of these

Answer 14

- (b) Price = MR**

Question 15

When 5 units of good is sold, total revenue is ₹100. When 6 units are sold, marginal revenue is ₹8. At what price are 6 units sold?(Choose the correct alternative)

- (a) ₹28 per unit
- (b) ₹20 per unit
- (c) ₹18 per unit
- (d) ₹12 per unit

Answer 15

- (c) ₹18 per unit**

Question 16

Suppose total revenue is rising at a constant rate as more and more units of a commodity are sold, marginal revenue would be:

(Choose the correct alternative)

- (a) Greater than Average Revenue
- (b) Equal to Average Revenue
- (c) Less than Average Revenue
- (d) Rising

Answer 16

- (b) Equal to Average Revenue**

Question 17

A firm is able to sell any quantity of a good at a given price. The firm's marginal revenue will be:

(Choose the correct alternative)

- (a) Greater than Average Revenue
- (b) Less than Average Revenue
- (c) Equal to Average Revenue
- (d) Zero

Answer 17

- (c) **Equal to Average Revenue**

Question 18

A firm is able to sell more quantity of a good only by lowering the price. The firm's marginal revenue, as he goes on selling, would be:

(Choose the correct alternative)

- (a) Greater than Average Revenue
- (b) Less than Average Revenue
- (c) Equal to Average Revenue
- (d) Zero

Answer 18

- (b) **Less than Average Revenue**

Question 19

If the Total Revenue of a firm increases by 45000 due to an increase in sale of Good X from 50 units to 65 units, then marginal revenue will be?

Answer 19

3000

Question 20

What is the behaviour of average revenue in a market in which a firm can sell more only by lowering the price?

Answer 20

Since price falls and average revenue means price, therefore, average revenue (AR) falls.

Question 21

What is the behaviour of Marginal Revenue in a market in which a firm can sell any quantity of the output it produces at a given price?

Answer 21

Marginal revenue (MR) remains constant and is equal to the market price.

Question 22

What happens to average revenue when marginal revenue is greater than price?

Answer 22

Since average revenue (AR) means price, therefore, AR increases if $MR > AR$.

Question 23

Why is TR curve a straight line if a firm can sell more quantity of output at the same price?

Answer 23

Since price is constant, TR increases at a constant rate. Therefore, TR curve of the firm is a straight line.

(3 & 4 Marks questions)

Question 1

Explain the relationship between average revenue and marginal revenue when:

- (a) A firm is able to sell more quantity of output at the same price.
- (b) A firm is able to sell more quantity of output by lowering the price.

Answer 1

(i). As price means average revenue (AR), so AR is also constant. When AR is constant, marginal revenue (MR) is equal to AR. Thus, when a firm is able to sell more quantity of output at the same price $MR = AR$.

(ii). Since price falls, it means that AR falls as more quantity is sold. When AR falls, MR is less than AR. Thus, when a firm is able to sell more quantity by lowering the price, $MR < AR$.

Question 2

Under what market condition does Average Revenue always equal Marginal Revenue? Explain.

Answer 2: It is under the perfect competition when a firm can sell more quantity of output at the given price that $AR = MR$ throughout as production is increased by the firm. It is because price, which is same as AR, remains unchanged throughout. By the average-marginal relationship, AR remains unchanged only when $AR = MR$ throughout.

Question 3: What changes will take place in MR when:

- (i) TR increases at increasing rate?
- (ii) TR increases at diminishing rate?
- (iii) TR increases at constant rate?

Answer 3

- (i) MR will increase.
- (ii) MR will decrease, but will remain positive.
- (iii) MR is constant.

Question4

State giving reasons whether the following statements are true or false.

- (a). Total revenue curve always starts from the origin.
- (b). When marginal revenue is zero, average revenue will be constant.
- (c). Marginal revenue is always the price at which the last unit of a commodity is sold.

Answer 4

Relationship between Total revenue (TR) and Marginal revenue (MR):

- (a) True: Total revenue (TR) curve starts from the origin since TR is zero at zero output.
- (b) False: $MR = 0$ is possible when TR is constant and as TR is constant, AR will fall as output is increased.
- (c) False: MR can be less than price (AR) when a firm can sell more units of a commodity only by lowering the price.

Question 5

State giving reasons whether the following statements are true or false.

- (a) When marginal revenue is constant and not equal to zero, then total revenue will also be constant.
- (b) When total revenue is maximum, marginal revenue is also maximum.
- (c) When marginal revenue is positive and constant, average and total revenue will both increase at constant rate.

Answer 5

- (a) False: When marginal revenue (MR) is constant and not equal to zero, then total revenue (TR) will increase at a constant rate.
- (b) False: When total revenue (TR) is maximum, marginal revenue (MR) is zero.
- (c) False: When MR is positive and constant, TR will increase at a constant rate but AR will be constant and will be equal to MR.

Question 6

State giving reasons whether the following statements are true or false.

- (a) When total revenue is constant average revenue will also be constant.
- (b) At the state of producer's equilibrium, marginal cost of the firm should be rising.
- (c) When marginal revenue falls to zero, average revenue becomes maximum.

Answer 6

- (a) False: When TR is constant, $MR = 0$ and AR falls.
- (b) True: If marginal cost (MC) is falling, then it is possible to increase profits by producing more. So, MC should be rising at the state of producer's equilibrium.
- (c) False: When MR falls to zero, AR falls.

(6 Marks Questions)

Question 1

State giving reasons whether the following statements are true or false.

- (a) When MR is falling but positive, TR will also be falling and positive.
- (b) Average revenue and marginal revenue curves slope downwards when more output can be sold by reducing the prices.
- (c) Marginal Revenue can never be negative.

Answer 1

- (a) False: When MR is falling but positive, TR must be rising.
- (b) True: Since price falls, AR falls (as price = AR). Therefore, AR curve is downward sloping. Since AR falls, $MR < AR$. Therefore, MR curve is also downward sloping.
- (c) False: When a firm can sell more output only by lowering the price, it is possible that MR becomes negative when TR falls.

Question 2

State giving reasons whether the following statements are true or false.

- (a) Total Revenue increases with every increase in output.
- (b) When total revenue is constant, average revenue falls.
- (c) Marginal Revenue can never be zero.

Answer 2

- (a) True: Total Cost can be constant only when Marginal Cost is zero, which is not possible.

(b)False: After a certain level of output, MC starts rising but AC continues to fall as long as MC is less than the AC.

(c)False: $ATC - AVC = AFC$ and $AFC = TFC/\text{output}$. Therefore, as output increases AFC falls since TFC is constant at all levels of output.

Question 3

State the relationship between Average Revenue (AR) and Marginal Revenue (MR), using a diagram, under imperfect competition market.

Answer 3

- Both the curves are downward sloping, under imperfect competition.
- MR curves lies half way under the AR curve.
- MR curve can be negative, while AR curve remains positive.

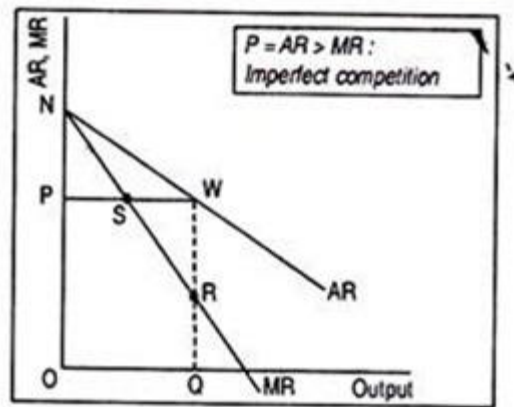


Fig. 3.35: $AR > MR$: Imperfect Competition

Theory of Supply

Multiple Choice Questions:

1. According to law of supply:
 - (a). There is a positive relation between supply and price
 - (b). There is a negative relation between supply and price
 - (c). There is constant relation between supply and price
 - (d). There is no relation between supply and price
 Ans. A
2. Expansion/Extension of supply occurs due to change in:

(a). Goal of the firm	(b). Own price of the commodity
(c). Number of firms	(d). Techniques of production

 Ans. B
3. The law of supply does not apply to:

(a). Agricultural products	(b). Industrial products
----------------------------	--------------------------

- (c). Perishable commodities (d). Both a and c
 Ans. D

4. Supply curve shifts forward due to:

- (A). Decrease in factor price (B). Increase of firms in the market
 (C). High business expectation (D). All of these

Ans. D

5. When supply falls due to factors other than own price of the commodity, it indicates:

- (A). Contraction of supply (B). Decrease in supply
 (C). Extension of supply (D). None of these

Ans.B

6. Imposition of GST,shifts the supply curve:

- (A). To the right (B). To the left
 (C). To the right as well as to the left (D). None of these

Ans. B

7. Subsidy on the production of a commodity causes:

- (A). Increase in supply (B). Decrease in supply
 (C). No change in the supply (D). Both A and B

Ans. A

8. When supply curve is a vertical straight line, it indicates:

- (A). Unitary elastic supply (B). Perfectly elastic supply
 (C). Perfectly inelastic supply (D). Relatively elastic supply

Ans. C

9. When supply curve is parallel to X-axis, elasticity of supply is:

- (A). Zero (B) Infinity
 (C). Unity (D) Negative

Ans. B

10. The supply of durable goods is usually:

- (A). More elastic (B). Less elastic
 (C) Perfectly elastic (D). Perfectly inelastic

Ans.A

11. If 18% fall in the price of a commodity causes 27% decrease in its supply elasticity of supply will be:

- (A). 1.5 (B). 0.5
 (C). 0.67 (D). 2.5

Ans.A

12. When 15% increase in price of the commodity causes 10% increase in the quantity supplied, then elasticity of supply is:

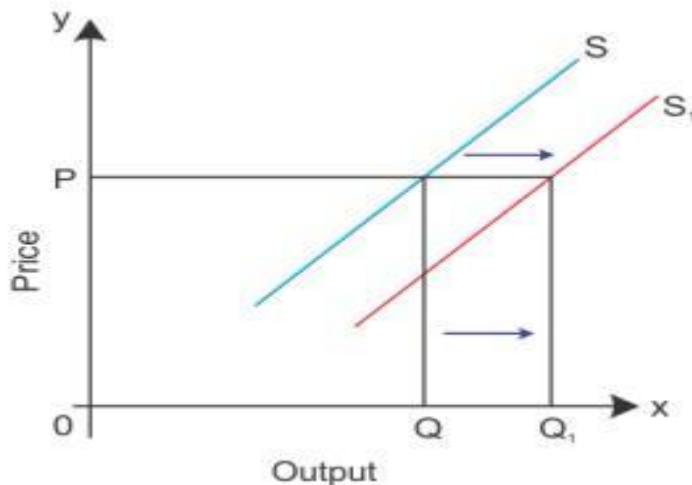
- (A) Elastic (B). Inelastic
 (C). Perfectly elastic (D). Perfectly inelastic

Ans.B

Ans. When supply of a commodity increases without any increase in price of the commodity, it is known as the situation of increase in supply. Increase in supply occurs when quantity supplied increases due to determinants other than own price of the concerned commodity.

3. Introduction of new technology increases marginal product. How would it affect supply curve of a firm?

Ans. Introduction of new technology increases MP. It implies a fall in MC. Accordingly supply curve of a firm shifts to the right, which shows that the producers are now willing to offer more quantity of a commodity at its existing price.



4. Supply is more responsive to price in the long period compared to short period. Comment.

Ans. Yes in the long period all factors are variable factors, while in the short period some factors are fixed and some are variable. Accordingly while in the long period supply can be increased by employing more of all the factors .in short period supply can be increased by employing more of the variable factors only.

Thus, supply can be increased to a much larger extent in the long period compared to short period. Therefore, it is more responsive to price in the long period compared to the short period.

Long Answer Questions

1. Explain the effects of the following on price elasticity of supply of a commodity:
- Nature of commodity
 - Time period

Ans.

- Nature of the commodity produced: the supply of durable goods is elastic. Durable goods can be stored and hence producers can meet their changing market demand by either running down their stocks or by building up

stocks. The supply of perishable goods like milk, vegetables are inelastic, as such goods cannot be stored.

- Time period; It may be difficult to change quantity supplied in few weeks or months in response to price change but easy to do so over a period of year. Therefore, supply tends to be inelastic in the short period and elastic in long period.

2. State giving reasons whether the following statements are true or false.

(a) Contraction of supply occurs due to change in factors other than price of the given commodity.

(b) In case of perfectly inelastic supply, supply curve is a horizontal straight line.

(c) A cost saving technology shifts the supply curve of a commodity towards rights.

Answer

(a) False: Contraction of supply occurs due to fall in price of the given commodity, other factors remaining constant.

(b) False: In case of perfectly inelastic supply, supply curve is a vertical straight line parallel to the Y-axis.

(c) True: A cost saving technology raises productivity and generally lowers per unit cost of production.

Consequently, the probability to earn more profit also increases and hence, the producer is induced to supply more. As a result, supply curve shifts towards right.

3. Examine the effects of the following on the supply curve of a Good X:

(a) Fall in own price of Good X.

(b) Rise in price of factor input producing Good X.

Answer

Effect on supply curve of Good X when there is a:

(i) Fall in own price of Good X: When the price of a commodity falls, it leads to reduced profit margin of the producers, forcing them to sell lesser quantity. It is called as contraction in supply. There will be movement along the same supply curve towards the origin.

(ii) Rise in price of factor input producing Good X: When price of factor input producing Good X rises, profit margin of the producers fall, forcing them to produce less quantity of Good X at the given price. Supply curve will shift leftwards.

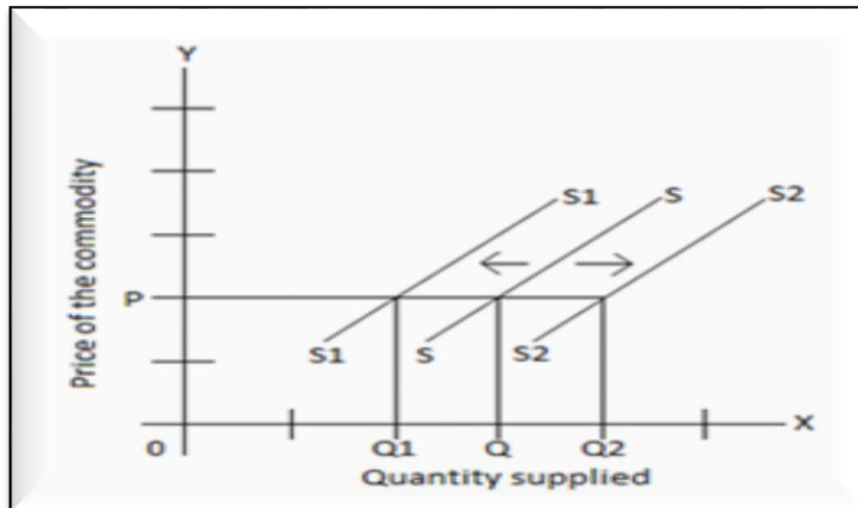
4). Distinguish between change in supply and change in quantity supplied with diagram.

Answer

Change in Supply or Shift of Supply Curve:

Change in Supply refers to increase/decrease in supply due to a change in any factor other than the own price of the good.

Price of the good remaining constant, change in any other factor (e.g., input prices, technique of production, taxes on the good, etc.) leads to a shift in the supply curve. This is also called change in supply.

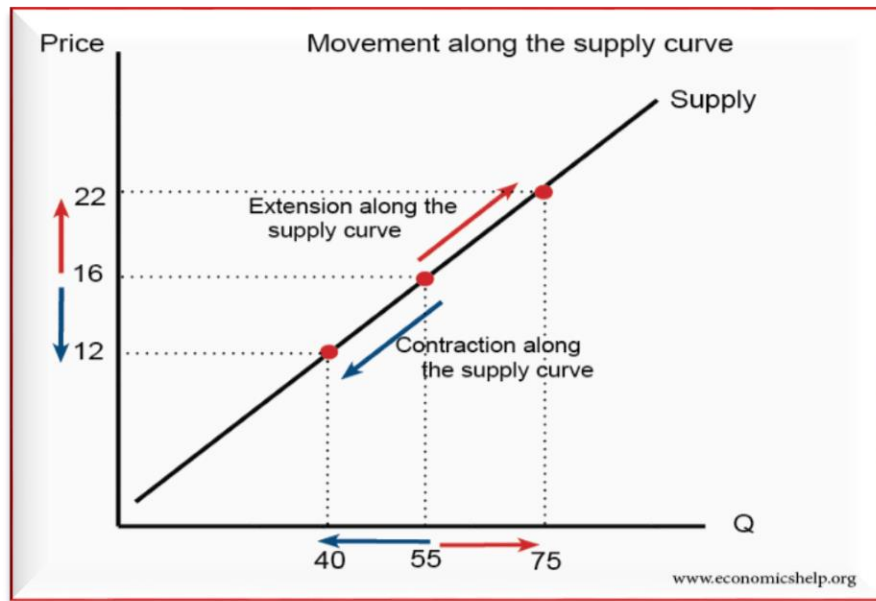


Change in Quantity Supplied

(Movements along the supply curve)

Change in quantity supplied refers to rise/fall in supply due to change in own price of the good, other factors like technology and the prices of factors of production remaining constant.

Other things remaining the same, any change in the price of the good leads to a movement along its supply curve.



By Rajeev Pathak Sir

UNIT: 4-FORMS OF MARKET AND PRICE DETERMINATION

MARKS-10

Q.1.If the influence of an individual seller on the market price is zero,the state of market is---

Ans. Perfect market

Q.2.If both supply and demand increase by the same proportion,

- a. price remains constant
- b. quantity remains constant
- c. quantity increases
- d. both a and c

Ans. d

Q.3.An increase in income results in a higher equilibrium price and quantity when the good is-----

- a. a normal good
- b. an inferior good
- c. a necessity good
- d. all of these

Ans. a

Q.3. which of the following is the effect of price ceiling?

- a. Hoarding
- b. Black marketing
- c. Rationing
- d. All of these

Ans. a

Q.4. Demand curve in case of monopolistic competition is more elastic as compared to demand curve under monopoly due to

- a. huge selling costs
- b. Freedom of entry and exit
- c. Presence of close substitutes
- d. large number of firms

Ans. c

Q.5. Marginal revenue of a firm is constant throughout under

- a. Perfect market
- b. Monopoly
- c. Oligopoly
- d. Monopolistic Competition

Ans. a

Q.6. Demand curve of perfectly competitive market form is a horizontal straight line parallel to x-axis. It happens because--

- a. Selling cost are zero
- b. There is freedom of entry and exit
- c. Firm is a price taker
- d. None of these

Ans. c

Q.7. Under perfect competition the firm earns normal profit in the long run because of ---

- a. large number of buyers and sellers
- b. perfect knowledge about the market
- c. freedom of entry and exit
- d. Homogeneous commodity

Ans. c

Q.8. Firms under oligopoly are independent . True/False

Ans. True

Q.9. An oligopoly firm faces a downward sloping demand curve. True/ false

ans. False

Q.10. Which of these is not a market structure in Economics?

- a. Perfect competition
- b. Monopoly
- c. Monopolistic Competition
- d. Intense competition

Ans. d

Q.11. Which of the following is not a characteristic of a price taker firm--

- a. $TR = P \cdot Q$
- b. $AR = PRICE$

C. Negatively sloped demand curve

- d. $Marginal Revenue = Price$

Ans. C

Q.12. For a non-viable industry, supply curve lies above the demand curve. True/False

Ans. True

Q.13. Change in supply will not change the equilibrium quantity in case of perfectly elastic demand. True/False

Ans. False

Q.14. A simultaneous increase in demand and supply for a given commodity will result in more of the commodity being purchased. True/False

Ans. True

Q.15. Excess supply of a commodity exists when its market price is greater than its equilibrium price. True/False

Ans. True

QUESTION: What happens to market equilibrium when supply decreases? Explain the chain of effects with the help of diagram.

ANS: When supply decreases, equilibrium price rises and equilibrium quantity falls.

To be depicted through the diagram.

Chain of effects:

Decrease in supply leads to excess demand at prevailing market price due to fall in market supply.

Competition among buyers puts an upward pressure on price. Higher price causes contraction of demand and expansion of supply.

This process will continue till demand and supply become equal at new equilibrium price.

QUESTION: Explain Price Ceiling with the help of diagram. What is its implication?

ANS: Price ceiling refers to fixing the maximum price of a commodity at a level lower than the equilibrium price.

Diagram also required.

Implications of price ceiling:

Black marketing:

Controlled price goods are sold illegally at prices higher than the price fixed by the government.

Rationing:

When due to shortage, good is not available at controlled price, government starts system of rationing through fair price shops and distributes good in limited quantities at controlled price.

QUESTION: Market of a good is in equilibrium. If the demand for a good decreases, explain the chain of effect of this change.

ANS: Chain Effect: A decrease in demand leads to leftward shift in demand curve from DD to D'D'. It creates excess supply at old equilibrium price. This leads to competition among sellers, which reduces the price. Decrease in price leads to fall in supply and rise in demand. These changes continue till new equilibrium is established.

QUESTION: Explain the implications of 'freedom of entry and exit' of firms under Perfect competition.

ANS: Freedom of Entry and Exit –It means every seller have the freedom to enter or exit the industry. There are no artificial or natural barriers for entry of new firm and exit of existing firms. **It ensures absence of abnormal profits and abnormal losses in the long run.** A firm can earn abnormal profits or losses in the short run as firms are not in a position to enter or leave the industry. But, in the long run, any abnormal profits, induces new firms to enter the market. It increases the total supply and reduces the market price. This trend continues till profits are reduced to normal. Similarly, abnormal losses lead to exit of existing firms, which reduces the total supply. It leads to rise in price till the losses are wiped out.

QUESTION: Explain the implications of 'large number of buyers and sellers' of firms under perfect competition.

ANS: Very Large number of Buyers and Sellers – In this market the number of sellers is so large that the share of each seller is **insignificant** in total supply. Hence an individual seller cannot influence the market price. Similarly, a single buyer's share in total purchase is so **insignificant** because of their large numbers that an individual buyer **cannot influence the market price.** Under such conditions, price of a commodity is determined by the market forces of demand and supply and each buyer and seller has to accept the same price. As a result uniform price prevails in the market.

QUESTION: Explain the implication of being large number of buyers and sellers in perfect competitive market.

ANS: The feature signifies that no individual buyer and seller can influence the price of the commodity in the market. To an individual producer, the price of the commodity is given and he is price taker.

No individual buyer can influence the market price by his decision to vary the amount that he would like to buy. He is price taker having no bargaining power in the market.

Why demand curve is more elastic under Monopolistic Competitive market than Monopoly? Explain.

Under monopolistic competitive market, demand curve is more elastic than monopoly because there is close substitute available under monopolistic competitive market while under monopoly, there is no close substitute.

QUESTION: Distinguish between monopoly and monopolistic competition.

ANS:

1. Monopoly monopolistic
 - a) Single firm/Many firms
 - b) No close substitute/Many close substitutes

- c) Homogeneous product/Differentiated product
 d) Almost no selling cost/Heavy selling cost

Describe features of Oligopoly.

- Few large firms and large no. of buyers
- No free entry or exit of firms
- Formation of cartel.
- Or any other point.

QUESTION: What are the effects of 'Price Floor' on the market of a good? Explain. OR

QUESTION: Define floor price. Explain the implications of floor price.

ANS: 'Price Floor' is the minimum price fixed by the government below which sellers cannot sell their product.

Since this price is normally set above the equilibrium price, there is excess supply in the market. As the seller may not be able to sell all that he wants to sell, he may illegally attempt to sell the product at a price below the floor price.

Market of a good is in equilibrium. If the demand for a good decrease, explain the chain of effect of this change.

Market of a good is in equilibrium, If the demand for the good decreases this creates an excess supply of the good at the existing price, in the market.

- The excess supply creates competition among sellers, resulting in fall in price, because sellers will not be able to sell all that they want to sell at the existing price.
- Fall in price leads to rise in demand and fall in supply.
- These changes continue till the market reaches new equilibrium.

Q.1. "Crop damaged in Himachal Pradesh sent tomato prices roaring in Delhi"- The Economic Times.

Use an economic theory to analyse the statement.

Ans. When the tomato crop was damaged in Himachal the supply of tomatoes decreases. This means the supply curve will shift leftward. At the prevailing market price, there was an excess demand. In this situation, buyers would have competed to raise the price. This process would have continued till a new equilibrium price was reached where market demand is equal to market supply.

Q.2. Households in Southern India prefer to eat oranges for breakfast as banana plantations in KERALA have been destroyed and price of apples and grapes have also risen. --- The Economics Times

Ans. When the price of apple and grapes rises, consumers will substitute with these fruits with the relatively cheaper oranges. Thus demand for oranges will increase. At the prevailing price, there was an excess demand. In this situation, buyers would have competed to raise the price. This process would have continued till a new equilibrium price was reached where market demand is equal to market supply.

Q.3. Why is the number of firms small in oligopoly? Explain. or

Explain why there are only a few firms in an oligopoly market?

Ans. Oligopoly is a form of market in which there are few firms. However, each firm is so

big that it controls a significant segment of the market. It is so significant that the price and output policy of one firm has a direct bearing on the price and output of the rival firms in the market. That is why, it is not possible to draw any unique demand curve for an oligopoly firm.

Often the oligopoly firms tend to form trusts and cartels with a view to avoid price competition and earn monopoly profits. Only a small number of firm can form trusts and cartels to earn monopoly profits.

Q.4 Why are the firms said to be interdependent in an oligopoly market? Explain. Or Explain why firms are mutually interdependent in an oligopoly market?

Ans. Under oligopoly, there is a high degree of interdependence between the firms. Price and output policy of one firm has a significant impact on the price and output policy of the rival firms in the market as there are only few firms, which are large in size. When one firm lowers its price, the rival firms may also lower the price. And, when one firm raises the price, the rival firms may take its decision accordingly. Note While taking an action on price or output, a firm must take into account the possible reaction of the rival firms in the market.

Q.5 Why is the demand curve of a firm under monopolistic competition more elastic than under monopoly? Explain.

Ans. Demand curve under monopolistic competition are similar to monopoly. But the main difference between monopoly and monopolistic competition is that under monopolistic competition, demand curve is more elastic because the seller has many rivals producing close substitutes in the market, hence consumer can easily substitute away from the good which has become expensive.

Q.6..Distinguish between collusive and non-collusive oligopoly. Explain the following features of oligopoly.

(i) Few firms

(ii) Non-price competition

Ans. Difference between collusive and non-collusive oligopoly

Basis	Collusive oligopoly	Non-collusive oligopoly

Meaning	Under this form, firms might decide to collude together and not to compete with each other.	In this form of oligopoly, firms do not collude but compete with each other.
Firms behave	Under collusive oligopoly, the firms would behave as a single monopoly	Under non-collusive oligopoly, the firms behave Independently.

Q.7 Suppose the price of a good is higher than equilibrium price. Explain the changes that will establish equilibrium price.

Ans. When price prevailing in the market is higher than that of equilibrium price, demand will be less than supply i.e. there is excess supply in the market. Excess supply will force the market price to slide down causing extension of demand and contraction of supply. The process of an extension and contraction would continue till the equilibrium between supply and demand is struck.

Thus, an equilibrium price will be restored through the free play of market forces of demand and supply.

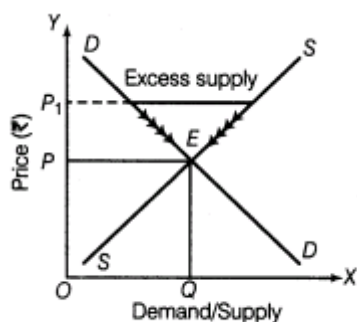


Diagram showing the situation of excess supply

QUESTION: Why is the AR curve of a monopolist less elastic than the AR curve of firm under monopolistic competition?

Ans: Because the monopolistically competitive firm's product is differentiated from other products, the firm will face its own downward-sloping “market” demand curve. This demand curve will be considerably more *elastic* than the demand curve that a monopolist faces because the monopolistically competitive firm has *less* control over the price that it can charge for its output. The firm's control over its price will depend on the degree to which its product is differentiated from competing firms' products. If the firm's product is not differentiated from other products, the firm will face a relatively *elastic* demand curve and will have less control over the price it can charge. If the firm's product is differentiated compared to a competing firm's products, the firm will face a relatively *inelastic* demand curve and will have more control over the price that it can charge.

Price-searching behavior. The monopolistically competitive firm will be a **price-searcher** rather than a price-taker because it faces a downward-sloping demand curve for its product. The firm searches for the price that it will charge in the same way that a monopolist does, by comparing marginal revenue with marginal cost at each possible price along the market demand

QUESTION: Differentiate between Monopoly and Perfect competition

Ans:

Difference among perfect competition, monopoly and monopolistic competition			
Basis ¹	Perfect competition	Monopoly	Monopolistic competition
Number of sellers	There are very large number of sellers and no individual seller has control over market supply.	There is a single seller and the monopolist has full control over the supply.	There are large number of sellers. So, a firm does not have much impact on the market supply.
Nature of product	The product is homogeneous. It is identical in all respect.	There are no close substitutes of the product.	Products are differentiated on the basis of brand, size, colour, shape, etc.
Entry and exit	There is freedom of entry and exit. It leads to absence of abnormal profits and losses in long-run.	There is restriction on entry and exit. So a firm can earn abnormal profit and loss in the long-run.	There is freedom of entry and exit. So, a firm earns only normal profits in the long-run.
Price	Firm is a price-taker as price is determined by the industry.	Monopolist is a price-maker as firm and industry are one and the same thing.	Firm has partial control over price due to product differentiation.
Level of knowledge	Buyers and sellers have perfect knowledge about market condition.	Buyers and sellers do not have perfect knowledge about market condition.	Buyers and sellers do not have perfect knowledge due to product differentiation and selling cost incurred by seller.
Selling cost	No selling costs are incurred.	Selling costs are incurred.	Heavy selling costs are incurred.

QUESTION: Explain the “Interdependence of firms” under oligopoly

ANS: Firms operating under conditions of oligopoly are said to be interdependent, which means they cannot act independently of each other. A firm operating in a market with just a few competitors must take the potential reaction of its closest rivals into account when making its own decisions. In the case of petrol retailing, a seller like **Texaco** may wish to increase its market share by reducing price, but it must take into account the possibility that close rivals, such as Shell and BP, who may also reduce their price in retaliation.

Strategy

Strategy is extremely important to firms that are interdependent. Because firms cannot act independently, they must anticipate the likely response of a rival to any given change in their price, or their non-price activity. In other words, they need to plan, and work out a range of possible options based on how they think rivals might react.

Oligopolists have to make critical strategic decisions, such as:

- Whether to compete with rivals, or collude with them.
- Whether to raise or lower price, or keep price constant.
- Whether to be the first firm to implement a new strategy, or whether to wait and see what rivals do. The advantages of ‘going first’ or ‘going second’ are respectively called 1st and 2nd-mover advantage. Sometimes it pays to go first because a firm can generate *head-start* profits. 2nd mover advantage occurs when it pays to wait and see what new strategies are launched by rivals, and then try to improve on them or find ways to undermine them.

QUESTION: Explain the causes for the emergence of Monopoly.

Ans: Government Licensing

- 1) Patent Rights
- 2) Cartels
- 3) Control of resources

Explanation of the above points

QUESTION: Explain the implications of “Freedom of entry and exit of firms “under perfect competition.

Ans:freedom of Entry signifies that there are no barriers to the entry of new firms into industry. When the existing firms are earning abnormal profits, the new firms, attracted by the prospects of profit, enter the industry. This raises market supply, which in turn, leads to fall in market price and consequently profits. The entry continues till each firm is earning just the normal profits.

'Freedom to exit' signifies that there are no barriers which restrict the existing firms from leaving the industry. The firms try to leave when they are facing losses. As the firms start leaving, market supply falls, leading to rise in market price and consequently reduction in losses. The firms continue to leave till the losses are wiped out and each existing firm is earning just the normal profits.

QUESTION:Explain the 2 features of the Monopolistic competition.

Ans: 1-*Product differentiation*: In monopolistic competition, all brands try to create **product** differentiation to add an element of monopoly over the competing products. This ensures that the product offered by the brand does not have a perfect substitute. Therefore, the

manufacturer can raise the price of the product without having to worry about losing all its customers to other brands. However, in such a market, while all brands are not perfect substitutes, they are close substitutes for each other. Hence, the seller might lose at least some customers to his competitors.

2) *Non-price competition*: In monopolistic competition, sellers compete on factors other than price. These factors include aggressive advertising, product development, better [distribution](#), after sale services, etc. Sellers don't cut the price of their products but incur high costs for the promotion of their goods. If the firms indulge in price-wars, which is the possibility under perfect competition, some firms might get thrown out of the market.

QUESTION: Price Floor is a system to protect the interest of producers.

Ans: The government imposes a lower limit on the price that may be charged for a particular good or service is called price floor. When equilibrium price determined by market forces of demand and supply is considered to be unremunerative for the producer, the government intervenes to protect the interest of producers.

QUESTION: Explain about Price Ceiling.

Ans: What Is a Price Ceiling?

A price ceiling is the mandated maximum amount a seller is allowed to charge for a product or service. Usually set by law, price ceilings are typically applied only to staples such as food and energy products when such goods become unaffordable to regular consumers. Some areas have rent ceilings to protect renters from rapidly climbing rates on residences.

A price ceiling is essentially a type of [price control](#). Price ceilings can be advantageous in allowing essentials to be affordable, at least temporarily. However, economists question how beneficial such ceilings are in the long run.

QUESTION: Difference between cooperative and non cooperative oligopoly.

Ans: Cooperative oligopoly is a form of the market in which there are few firms in the market and all decide to avoid competition through a formal agreement. They collude to form a cartel, and fix for themselves output quota and market price. Non-cooperative oligopoly is a form of the market in which there are few firms in the market and each firm pursues its price

and output policy independent of the rival firms. Each firm tries to increase its market share through competition.

QUESTION: Explain any 2 features of monopoly.

Ans: 1. Single seller and several buyers

The primary feature of a monopoly is a single seller and several buyers. Also, in a monopoly, there is no difference between the firm and the industry.

This is because there is only one producer and/or seller. Therefore, the firm's demand curve is the industry's demand curve. Since there are several buyers, an individual buyer cannot affect the price in a monopoly market.

2-No close substitute

In a monopoly, the product that the monopolist produces has no close substitute. If a close substitute exists, then the monopoly cannot exist.

Remember, a monopoly can only exist when the cross-elasticity of the product that the monopolist produces is zero. Therefore, the monopolist can determine the price of his own choice and refuse to sell below the determined price.

QUESTION: How is equilibrium price determined in perfect competition?

Ans: Equilibrium of the Industry under Perfect Competition

In economic terms, an industry consists of many independent firms. Each firm has a number of factories, farms or mines, as required. Each such firm in industry produces a homogeneous **product**. Equilibrium of the industry happens when the total output of the industry is equal to the total demand. In such a scenario, the prevailing price of a commodity is its equilibrium price.

We know that under competitive conditions, the interaction of **demand** and supply determines the equilibrium price as shown below:

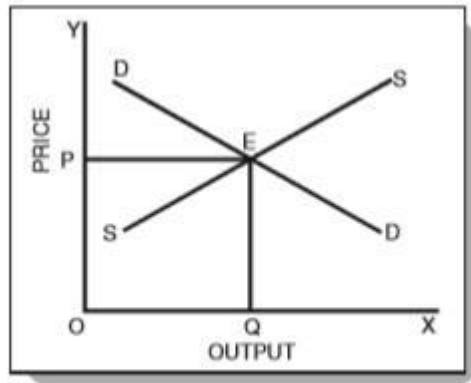


Fig. 1 : Equilibrium of a competitive industry

In Fig. 1 above, OP is the **equilibrium price**. Further, OQ is the equilibrium quantity sold at that price. Now, the equilibrium price is the price at which both the demand and supply are equal. In other words, no buyer, who wanted to buy at that price, goes dissatisfied and no seller, who wanted to sell his goods at that price, goes dissatisfied either.

Note that with the demand remaining the same, if the price is higher or lower than OP, then the market is not in equilibrium. Also, if goods are lesser or higher than the demand, the equilibrium is not attained.

QUESTION: Explain the effect of change in supply of a good on its equilibrium price and equilibrium quantity.

Ans:

Change in Supply

1. A change in supply will cause equilibrium price and output to change in opposite directions.

a. An increase in supply will cause a reduction in the equilibrium price and an increase in the equilibrium quantity of a good.

1. The increase in supply creates an excess supply at the initial price.

a. Excess supply causes the price to fall and quantity demanded to increase.

b. A decrease in supply will cause an increase in the equilibrium price and a decrease in the equilibrium quantity of a good.

1. The decrease in supply creates an excess demand at the initial price.

a. Excess demand causes the price to rise and quantity demanded to decrease.

