

# BUSINESS STATISTICS

## Courses of Studies:

### UNIT - I

#### Statistical Data and Descriptive Statistics (With the use of Excel and Other Statistical Software)

**Nature and Classification of data:** Univariate, Bivariate and Multivariate data; time-series and cross-sectional data.

#### Measure of Central Tendency:

1. Mathematical averages including Arithmetic mean, Geometric mean and Harmonic mean, Properties and applications.
2. Positional Averages  
More and Median and other partition values including Quartiles, Deciles and Percentiles.

### UNIT - II

#### Measures of Variation (With the use of Excel and Other Statistical Software)

Absolute and relative, Range, Quartile Deviation, Mean Deviation, Standard Deviation, and their coefficients, Properties of Standard Deviation/Variance

**Skewness:** Meaning, Measurement using Karl Pearson and Bowley's measures; Concept of Kurtosis.

### UNIT - III

#### Simple Correlation and Regression Analysis (With the use of Excel and Other Latest Software)

**Correlation Analysis:** Meaning of Correlation: Simple, multiple and partial; linear and non-linear correlation and Causation; Scatter diagram, Peasons's coefficient of Correlation, calculation and properties (proofs not required) Correlation and Probable error, Rank Correlation.

**Regression Analysis:** Principle of least square and Regression lines, Regression equations and estimation, Properties of regression coefficients, Relationship between Correlation and Regression coefficient, Standard error of estimate.

### UNIT - IV

#### Index Numbers (With use of Excel and Other Latest Software)

Meaning and uses of index number. Construction of index numbers: fixed and chain base; univariate and composite, Aggregative and average of relatives – simple and weighted.

Test of adequacy of index numbers. Base shifting, splicing and deflating, Problems in the construction of index numbers.

Construction of consumer price indices, important share price indices.

#### Time Series Analysis (With use of Excel and Other Latest Software)

Components of time series, Additive and multiplicative models, Trend analysis. Fitting of trend line using the principle of least squares - linear, second degree parabola and exponential. Conversion of annual linear trend equation to quarterly/monthly basis and vice-versa. Moving averages, Seasonal variation – Calculation of Seasonal Indices using Simple averages, Ratio-to-trend, and Ratio-to-moving average methods. Uses of seasonal indices.

**LONG QUESTIONS OF 7 Marks each**

**Questions of 7 Marks each:**

1. What do you mean by Statistics? Discuss the essential characteristics of Statistics.
2. Discuss the importance and limitations of Statistics.
3. Explain with illustrations the uses of statistics in economics and planning.
4. What do you mean by Primary Date? Discuss the important method of collections of Primary Date.
5. Distinguish between Primary Data and Secondary Data.
6. What do you mean by Secondary Data? What are the various sources of collecting the secondary data?
7. What do you mean by editing of data? What are the factors to be taken into account of edition of Primary data?
8. State and prove the relationship between A. M., G. M. and H. M.
9. What do you mean by Average? Discuss the characteristics of an ideal average.
10. What do you mean by Arithmetic Mean? How is it calculated? Discuss the advantages and disadvantages of Arithmetic Mean.
11. Define Harmonic Mean and discuss its merits and demerits. Under what situations would you recommend its use?
12. Briefly explain the role of grouping and analysis table in calculation of mode.

**PRACTICAL PROBLEMS:**

**UNIT - I**

**EXERCISE - A (Mean)**

1. The following are the daily salaries in rupee of 30 employees of a firm:  
91, 139, 126, 119, 100, 87, 65, 77, 99, 95, 108, 127, 86, 148, 116,  
76, 69, 88, 112, 118, 89, 116, 97, 105, 95, 80, 86, 106, 93, 135,

The firm gave bonus of Rs 10, 15, 20, 25, 30, 35, 40, 45 and 50 to employees in the respective salary group exceeding Rs 60 but not exceeding 70, exceeding Rs 70 but not exceeding 80 and so on up to exceeding 140 but not exceeding 150. Construct a frequency distribution and find out the total daily bonus paid per employee.

**Ans: Average daily bonus = Rs 27.50**

2. The management of a college decides to give scholarship to the students who have scored marks 70 and above 70 in Business Statistics. The following are the marks scored by 20 B. Com. Students:

71    73    74    85    86    88    91    94    96    99  
74    74    76    93    91    94    96    98    88    94

The scholarship payable is given below:

Marks	70 - 75	75 - 80	80 - 85	85 - 90	90 - 95	95 - 100
Scholarship amount (Rs)	100	200	300	400	500	600

Estimate the total scholarship payable and the average scholarship payable.

3. Certain number of salesmen were appointed in different territories and the following data were compiled from their sales reports:

Sales('000 Rs)	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	32 - 36	36 - 40
No. of salesmen	11	13	16	14	----	9	17	6	4

If the average sales is believed to be Rs 19,920, find the missing information.

**Ans: Missing Frequency = 10**

4. The mean of the following frequency distribution is 50. But the frequencies  $f_1$  and  $f_2$  in classes 20 – 40 and 60 – 80 are missing. Find the missing frequencies:

Class :	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100	
Frequency:	17	$f_1$	32	$f_2$	19	Total 120

**Ans:  $f_1 = 28, f_2 = 24$**

5. 100 students appeared for an examination. The result of those who failed are given below:

Marks	5	10	15	20	25	30	Total
No. of students	4	6	8	7	3	2	30

If the average marks of all students were 68.6, find out average marks of those who passed.

**Ans: 91.21**

6. Out of 50 examinees, those passing the examination are shown below. If the average mark of all the examinees is 5.16, what would be the average marks of examinees having failed in it?

Marks obtained	4	5	6	7	8	9
No. of students passing the Exam.	8	10	9	6	4	3

**Ans: 2.1**

7. Define a 'weighted mean'. Under what circumstances would you prefer it to an un-weighted mean?

Calculate the weighted mean price of a table from the following data, assuming that weights are proportional to the number of tables sold:

Price per table (Rs)	3,600	4,000	4,400	4,800
No. of tables sold	14	11	9	6

**Ans: Rs 4,070**

8. 26. Compute the weighted arithmetic mean of the index number from the data below:

	Group				
	Food	Clothing	Fuel and Light	House Rent	Miscellaneous
Index No.	125	133	141	173	182
Weights	7	5	4	1	3

**Ans: 141.15**

9. The following table gives the distribution of 100 accidents during seven days of the week of a given month. During the particular month there are 5 Mondays, Tuesday s and Wednesday s and only four each of the other days. Calculate the average number of accidents per day:

Days	No. of Accidents	Days	No. of Accidents
Sunday	26	Thursday	8
Monday	16	Friday	10
Tuesday	12	Saturday	18
Wednesday	10		

**Ans: 14.13 = 14**

10. To produce a scooter of a certain make, labour of different kinds is required in quantities as follows:

Skilled labour	:	50 hours
Semi-skilled labour	:	100 hours
Unskilled labour	:	300 hours

If hourly wage rates for these three kinds of labour are Rs 100, Rs 70 and Rs 20 respectively, what is the average labour cost per hour in producing the scooter?

**Hints: Use weighted arithmetic mean**

**Ans: Rs 40 per hour**

11. A candidate obtained the following percentage of marks in different subjects in the Half-Yearly Examination:

English	Statistics	Cost Accountancy	Economics	Income Tax
46%	67%	72%	58%	53%

It is agreed to give double weights to marks in English and Statistics as compared to other subjects. What is the simple and weighted arithmetic mean?

**Ans: Simple A.M. = 59.2%; Weighted A.M. = 58.43%**

12. Calculate simple and weighted arithmetic averages from the following data and comment on them:

Designation	Daily salary (in Rs)	Strength of the cadre
Class I Officer	1,500	10
Class II Officer	800	20
Subordinate staff	500	70
Clerical staff	250	100
Lower staff	100	150

**Ans: Simple A.M. = Rs 630; Weighted A.M. = Rs 302.86**

13. Comment on the performance of the students of three Universities given below using an appropriate average:

University	A		B		C	
	% of Pass	No. of students in hundred	% of Pass	No. of students in hundred	% of Pass	No. of students in hundred
M.A.	81	2	82	2	71	3
M. Com.	76	3.5	76	3	83	4
M.Sc.	73	2	60	7	66	3
B. Com.	58	2	76	7	74	2
B. Sc.	70	7	65	3	65	3
B.A.	74	4.5	73	6	73	5

**Ans: Simple average (A.M.) of pass percentage is 72% in each case, we are unable to distinguish between performance of students in the three universities.**

**However, on the basis of weighted average of pass percentage, University C (72.55%) is the best followed by University A (72.05%) and University B (70.61%)**

14. From the results of two colleges A and B given below, state which of them is better and why?

Name of Examination	College A		College B	
M.A	60	50	200	160
M. Com.	100	90	240	190
B.A.	400	300	200	140
B. Com.	240	150	160	100
Total	800	590	800	590

**Hints and Ans: Find the weighted average of percentage of passed students (X), the corresponding weights (W) being the number of students appeared. Both the colleges have the same average i.e. 73.75%.**

15. A travelling salesman made five trips in two months. The record of sales is given below:

The sales manager criticized the salesman's performance as not very good since his mean daily sales were only Rs 54,000 (2,70,000/5). The salesman called this an unfair statement for his daily mean sales were as high as Rs 55,200 (13,80,000/25). What does each average mean here? Which average seems to be more appropriate?

Trip	No. of days	Value of sales(in'00 Rs)	Sales per day (in'00 Rs)
1	5	3,000	600
2	4	1,600	400
3	3	1,500	500
4	7	3,500	500
5	6	4,200	700
	25	13,800	2,700

**Ans: The Manager obtained the simple arithmetic mean of the sales per day, while the salesman obtained the weighted arithmetic mean. The latter (weighted average) seems to be more appropriate.**

**Exercise B (Partition Values)**

1. Find the median of the following two series:

(i) 38    34    39    35    32    31    37    30    41

(ii) 30    31    36    33    29    28    35    36

**Ans: (i) 35 (ii) 32**

2. Following are the marks obtained by a batch of 10 students in a certain class test in Statistics (X) and Accountancy (Y).

Roll No.	1	2	3	4	5	6	7	8	9	10
X	63	64	62	32	30	60	47	46	35	28
Y	68	66	35	42	26	85	44	80	33	72

In which subject is the level of knowledge of the students is higher?

**Ans: Med (X) = 46.5; Med (Y) = 55. Level of knowledge of students is higher in Accountancy.**

3. Find mean and median from the data given below:

Marks obtained	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60
No. of students	12	18	27	20	17	6

**Ans: Mean = 28; Median = 27.41**

4. Calculate arithmetic mean and median from the following series:

Income (Rs)	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30
Frequency	5	7	10	8	6	4

**[C.S. (Foundation) Dec. 2000]**

**Ans: Arithmetic mean = 14.375; Median = 14**

5. From the data given below, find the missing frequency, if the Arithmetic Mean is Rs 33.

Also find the median of the series:

Loss per shop (Rs)	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60
No. of shops	10	15	30	-----	25	20

**[C.A. (Foundation) Nov. 2000]**

**Ans: Missing frequency = 25; Median = 33**

6. Given below is the distribution of marks obtained by 140 students in an examination:

Marks	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
No. of students	7	15	18	25	30	20	16	7	2

Find the median of the distribution.

7. Compute the median from the following data:

Mid-value	115	125	135	145	155	165	175	185	195
frequency	6	25	48	72	116	60	38	22	3

Hints: The class intervals are: 110 - 120, 120 - 130, ----- 190 - 200.

Ans: Median = 153.79

8. You are given below a certain statistical distribution:

Value	Less than 100	100 - 200	200 - 300	300 - 400	400 and above	Total
Frequency	40	89	148	64	39	380

Calculate the most suitable average giving reasons for your choice.

Ans: Md. = 241.22

9. The following table gives the distribution of marks secured by some students in a certain examination:

Marks	:	0 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80
No. of Students:		42	38	120	84	48	36	31

Find (i) Median marks

(ii) The percentage of failure if minimum for a pass is 35 marks

Ans: (i) Md. = 40.46 (ii) 31.58%

10. Calculate the median from the following data:

Weight (in gms.) :	410 - 419	420 - 429	430 - 439	440 - 449	450 - 459	460 - 469	470 - 479
No. of Apples :	14	20	42	54	45	18	7

Ans: Median = 443.94 gms.

11. Given below is the distribution of 140 candidates obtaining marks X or higher in a certain examination (all marks are given in whole number):

Marks (More than)	10	20	30	40	50	60	70	80	90	100
Frequency	140	133	118	100	75	45	25	9	2	0

Calculate the mean and median marks obtained by the candidates.

Ans: Mean = 50.714, Median = 51.167

12. The following table gives the weekly wages in rupees in a certain commercial organisation:

Weekly wages ('00 Rs)	30 -	32 -	34 -	36 -	38 -	40 -	42 -	44 -	46 -	48 - 50
Frequency	3	8	24	31	5	61	38	21	12	2

Find: (i) the median and the first quartile, (ii) the number wage earners receiving between Rs 3,700 and Rs 4,700 per week.

Ans: (i) Md. = Rs 4029.51, Q<sub>1</sub> = Rs 3777.42 (ii) 191

13. Define a percentile. Find the 45<sup>th</sup> and 57<sup>th</sup> percentiles for the following data on marks obtained by 100 students:

Marks	20 - 25	25 - 30	30 - 35	35 - 40	40 - 45	45 - 50
No. of Students	10	20	20	15	15	20

Ans: P<sub>45</sub> = 33.75; P<sub>57</sub> = 37.33

14. Find:

(a) the 2<sup>nd</sup> decile, (b) the 4<sup>th</sup> decile (c) the 90<sup>th</sup> percentile, and (d) the 68<sup>th</sup> percentile for the data given below, interpreting clearly the significance of each:

Age of Head of Family (years)	Number (in million)	Age of Head of Family (years)	Number (in million)
Under 25	2.22	55 - 64	6.63
25 - 29	4.05	65 - 74	4.16

30 - 34	5.08	75 and over	<u>1.66</u>
35 - 44	10.45		Total <u>43.72</u>
45 - 54	9.47		

**Ans:  $D_2 = 31.94$  years  $D_4 = 40.38$  years,  $P_{90} = 67.98$  years  $P_{68} = 52.87$  years**

15. Find the (i) Lower quartile (ii) Upper quartile (iii) 7<sup>th</sup> decile, and (iv) 60<sup>th</sup> percentile, for the following frequency distribution:

Wages (Rs)	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80 - 90	90 - 100
No. of Persons	1	3	11	21	43	32	9

**Ans: (i) Rs 67.14 (ii) Rs 83.44 (iii) Rs 81.56 (iv) Rs 78.37**

16. 20. Draw an ogive for the data given below and show how can the value of median be read off from this graph. Verify your result.

Class Interval :	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30
Frequency :	5	10	15	8	7	5

**Ans: Median = 13.5 (approx.); By formula,  $M_d = 13.33$**

17. Draw a 'less than ogive' from the following data and hence find out the value of lower quartile:

Class Interval :	0 - 5	5 - 10	10 - 20	20 - 30	30 - 40	40 - 50
Frequency :	5	10	15	20	8	5

**Ans:  $Q_1 = 12$**

18. The frequency distribution of heights of 100 college students is as follows:

Height (cms.) :	141 - 150	151 - 160	161 - 170	171 - 180	181 - 190	Total
Frequency :	5	16	56	19	4	100

Draw an ogive (less than or more than type) of this distribution and from the ogive find:

(i) the first quartile (ii) the median (iii) the third quartile, and (iv) Inter-quartile range

**Ans:  $Q_1 = 161.2$  cms.  $Q_3 = 170.1$  cms Median = 165.7 cms I.Q. Range = 8.9 cms.**

19. The monthly salary distribution of 250 families in a certain locality in Agra is given below:

Monthly Salary (Rs)	No. of Families	Monthly Salary (Rs)	No. of Families
More than 0	250	More than 2,000	55
More than 500	200	More than 2,500	30
More than 1,000	120	More than 3,000	15
More than 1,500	80	More than 3,500	5

Draw a 'less than ogive' from the data given above and hence find out:

(i) Limits of the income of middle 50% of the families; and

(ii) If income-tax is to be levied on families whose income exceeds Rs 1,800 p.m.; calculate the percentage of families, which will be paying income-tax.

**Ans: (i)  $Q_1 = Rs 578$  (approx);  $Q_3 = Rs 1850$**

**(ii)  $\frac{25}{(2000-150)} \times (2000 - 1800) + 25 + 15 + 10 + 5 = 65$**

**Percentage of families paying income tax =  $\frac{65}{200} \times 100 = 26\%$**

20. Draw a 'less than' and 'more than' ogive curve for the following data and find the median:

No. of Children	0	1	2	3	4	5	6
No. of Families	150	72	50	28	12	8	5

**Hints: Since the number of children is a discrete random variable which take on positive integer values, the given frequency distribution can be expressed as grouped frequency distribution with exclusive type classes as given below:**

Variable	0 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7
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<b>Frequency</b>	<b>150</b>	<b>72</b>	<b>50</b>	<b>28</b>	<b>12</b>	<b>8</b>	<b>5</b>
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**Ans; Median from ogive = 1.1 (aprox.)**

21. With the help of given data, find:

- (i) Value of middle 50% of items; (ii) Value of exactly 50% item; (iii) The value of  $P_{40}$  and  $D_6$ ; (iv) Graphically with the help of ogive curve, the values of  $Q_1$ ,  $Q_3$ , median,  $P_{40}$  and  $D_6$ :

Class Interval	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	Total
Frequencies	5	10	15	20	10	5	65

**Ans: (i)  $Q_3 - Q_1 = 29.19 - 19.92 = 9.27$ ; (ii) Md. =  $Q_2 = 25.13$  (iii)  $P_{40} = 23.17$ ,  $D_6 = 26.75$**

22. One hundred and twenty students appeared for a certain test and the following marks distribution was obtained:

Marks :	0 - 20	20 - 40	40 - 60	60 - 80	80 - 100
Students :	10	30	36	30	14

Find: (i) The limits of marks of middle 30% of the students.

(ii) The percentage of students getting marks more than 75.

(iii) The number of students who fail, if 35 marks are required for passing.

**Ans: (i)  $P_{35} = 41.1$ ;  $P_{65} = 61.3$  (ii)  $\frac{100}{120} \left[ \left( \frac{30}{20} \times 5 \right) + 14 \right] = 17.9\%$  (iii)  $10 + \frac{15}{20} \times 30 = 32.5 = 33$**

23. The expenditure of 1,000 families is given as under:

Expenditure (in Rs)	40 - 59	60 - 79	80 - 99	100 - 119	120 - 139
No. of families	50	?	500	?	50

The median for the distribution is Rs 87. Calculate the missing frequencies.

**Ans: 262.5, 137.5 = 263, 137**

24. An incomplete frequency distribution is given as follows:

Variable	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	Total
Frequency	12	30	?	65	?	25	19	230

You are given that median value is 46.

(a) Using the median formula, fill up the missing frequencies.

(b) Calculate the Arithmetic Mean of the completed table.

**Ans: (a) 64, 45 (b) 45.96**

25. An incomplete distribution is given below:

Variable :	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70
Frequency :	10	20	?	40	?	25	15

(i) You are given that the median value is 35. Find out missing frequency (given the total frequency = 170)

(ii) Calculate the arithmetic mean of the completed table.

**Ans: (i) 35, 25 (ii) 35.88**

26.

The data in the adjoining table represent travel expenses (other than transportation) for 7 trips made during November by a salesman for a small firm:

An auditor criticized these expenses as excessive, asserting that the average expense per day is Rs 10 (Rs 70 divided by 7). The salesman replied that the average is only Rs 4.20 (Rs 105 divided by 25) and that in any

Trip	Days	Expenses (Rs)	Expenses per day (Rs)
1	0.5	13.50	27
2	2.0	12.00	6
3	3.5	17.50	5
4	1.0	9.00	9
5	9.0	27.00	3



event the median is the appropriate measure and is only Rs 3. The auditor rejoined that the arithmetic mean is the appropriate measure, but that the median is Rs 6.

6	0.5	9.00	18
7	8.5	17.00	2
Total	25.0	105.00	70

You are required to:

- (i) Explain the proper interpretation of each of the four averages mentioned.
- (ii) What average seems appropriate to you?

27. For a certain class of workers, numbering 700, hourly wages vary between Rs 30 and Rs 75. 12% of the workers are earning less than Rs 35 while 13% are getting equal to or more than Rs 60, out of which 6% are earning between Rs 70 and Rs 75. The first quartile and median wages are, respectively, Rs 40 and Rs 47. The 40<sup>th</sup> and 65<sup>th</sup> percentiles are Rs 43 and Rs 53 respectively. You are required to put the above information in the form of a frequency distribution and estimate the mean wages of the workers.

**Ans:**

<b>Hourly wages (Rs)</b>	<b>30 - 35</b>	<b>35 - 40</b>	<b>40 - 43</b>	<b>43 - 47</b>	<b>47 - 53</b>	<b>53 - 60</b>	<b>60 - 75</b>
<b>No. of workers</b>	<b>84</b>	<b>91</b>	<b>105</b>	<b>70</b>	<b>105</b>	<b>91</b>	<b>49</b>

$\bar{X} = \text{Rs } 48.33$

28. For a certain group of saree weavers of Varanasi, the median and quartile earning per hour are Rs 44.3 and Rs 43.0 and 45.9 respectively. The earnings for the group ranges between 40 and Rs 50. Ten per cent of the group earn under Rs 42; 13% earn Rs 47 and over, and 6% Rs 48 and over. Put these data in the form of a frequency distribution and obtain the value of the mean wage.

**Ans:**

<b>Hourly wages (Rs)</b>	<b>40 - 42</b>	<b>42 - 43</b>	<b>43 - 44.3</b>	<b>44.3 - 45.9</b>	<b>45.9 - 47</b>	<b>47 - 48</b>	<b>48 - 50</b>
<b>No. of workers</b>	<b>10</b>	<b>15</b>	<b>25</b>	<b>25</b>	<b>12</b>	<b>7</b>	<b>6</b>

### Exercise C (Mode)

1. The Bharat Ball Bearing Ltd. has collected the following data:  
12, 19, 21, 30, 13, 19, 22, 31, 17, 20, 24, 31, 18, 21, 27, 31  
 (i) Compute the arithmetic mean, the median and the mode using the sixteen observations given.  
 (ii) Why is mode said to be an erratic measure of central tendency?  
 (iii) Why is median called a position average?

**Ans: A.M. = 22.25, Md. = 21, Mo = 31**

2. Calculate mean, median and mode from the following data of the heights in inches of a group of students:

61, 62, 63, 61, 63, 64, 64, 60, 65, 63, 64, 65, 66, 64

Now suppose that a group of students whose heights are 60, 66, 59, 68, 67 and 70 inches, is added to the original group. Find the mean, median and mode of the combined group.

**Ans:**

<b>First group</b>	<b>M = 63.2</b>	<b>Md. = 63.5</b>	<b>Mo. = 64</b>
<b>Combine group</b>	<b>M = 63.75</b>	<b>Md. = 64</b>	<b>Mo. = 64</b>

3. Atul gets a pocket money allowance of Rs 12 per day. Thinking that this was rather less, he asked his friends about their allowances and obtained the following data which includes his allowance also – (amounts in Rs):

12, 18, 10, 5, 25, 20, 20, 22, 15, 10, 10, 15, 13, 20, 18  
10, 15, 10, 18, 15, 12, 15, 10, 5, 10, 12, 18, 20, 5, 8.

He presented these data to his father and asked for an increase in his allowance as he was getting less than average amount. His father, a statistician, countered pointing out that Atul's allowance was actually more than the average account.

Reconcile these statements.

**Ans: Atul computed A.M. and his father computed Mode.**

4. The number of fully formed apples on 100 plants were counted with following results:

No. of apples	0	1	2	3	4	5	6	7	8	9	10
No. of plants	2	5	7	11	18	24	12	8	6	4	3

(i) How many apples were there in all?

(ii) What was the average of number of apples per plant?

(iii) What was the modal number of apples?

**Ans: (i) 486 (ii)  $\bar{X} = 4.86$  (iii) Mo = 5**

5. Given below is the frequency distribution of marks obtained by 90 students. Compute the arithmetic mean, median and mode:

Marks	No. of students	Marks	No. of students
15 - 19	6	45 - 49	9
20 - 24	14	50 - 54	10
25 - 29	12	55 - 59	5
30 - 34	10	60 - 64	4
35 - 39	10	65 - 69	1
40 - 44	9		

**Ans: Mean = 37.17; Md. = 36; mo. = 23.5**

6. Find out the median and mode from the following table:

No. of days absent	No. of students	No. of days absent	No. of students
Less than 5	29	Less than 30	644
Less than 10	224	Less than 35	650
Less than 15	465	Less than 40	653
Less than 20	582	Less than 45	655
Less than 25	634		

**Ans: Md. = 12.75; Mo. = 23.5**

7. Find out the Mean, Median and the Mode in the following series:

Size (below)	5	10	15	20	25	30	35
Frequency	1	3	13	17	27	36	38

**Ans: Md. = 12.75; Mo. = 11.35**

8. In 500 small scale industrial units, the return on investment ranged from 0 to 30%, no unit sustaining any loss. 5% of industrial units had returns exceeding 0% but not exceeding 5%, 15% of units had returns exceeding 5% but not exceeding 10%. Median and upper quartiles ate of return was 15% and 20% respectively. The uppermost layer of return exceeding 25% but not exceeding 30% was earned by 25%. Present the information in the form of frequency table with intervals as follows:

Exceeding 0% but not exceeding 5%	Exceeding 5% but not exceeding 10%
Exceeding 10% but not exceeding 15%	Exceeding 15% but not exceeding 20%
Exceeding 20% but not exceeding 25%	Exceeding 25% but not exceeding 30%

Use  $N/4$ ,  $2N/4$ ,  $3N/4$  as ranks of lower, middle and upper quartiles respectively. Find the rate of return around which there is maximum concentration of units.

**Ans:**

Return in %	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30
No. of units	25	75	150	125	0	125

**Mode = 13.75, Rate of return around which there is maximum concentration of units is 13.75%.**

9. Calculate the arithmetic mean and the median of the frequency distribution given below. Hence calculate the mode using the empirical relation between the three.

Class limits :	130 - 134	135 - 139	140 - 144	145 - 149	150 - 154	155 - 159	160 - 164
Frequency :	5	15	28	24	17	10	1

**Ans: M = 145.35; Md. = 144.92; Mo. = 144.06**

10. (a) Briefly explain the role of grouping and analysis table in calculation of mode.  
 (b) From the following data of weight of 122 persons, determine the modal weight by the method of grouping:

Weight (in lbs.)	100 - 110	110 - 120	120 - 130	130 - 140	140 - 150	150 - 160	160 - 170	170 - 180
No. of persons	4	6	20	32	33	17	8	2

**Hints: Method of grouping gives two modal classes 130 - 140 and 140 - 150 i.e. the distribution is bimodal. Locate the value of mode by using the empirical relation  $Mo = 3Md - 2M$ .**

**Ans: Mean (M) = 139.51; Median (Md.) = 139.69; Mode (Mo.) = 140.05**

11. Calculate the Mode, Median and Arithmetic average from the following data:

Class	f	Class	f
0 - 2	8	25 - 30	45
2 - 4	12	30 - 40	60
4 - 10	20	40 - 50	20
10 - 15	10	50 - 60	13
15 - 20	16	60 - 80	15
20 - 25	25	80 - 100	4

**Hints: Rewrite the frequency distribution with classes of equal magnitude 10.**

**Ans: Mo. = 28.15; Md. = 28.29; Mean = 30.08**

12. In the following data, two class frequencies are missing:

Class	Frequency	Class	Frequency
100 - 110	4	150 - 160	?
110 - 120	7	160 - 170	16
120 - 130	15	170 - 180	10
130 - 140	?	180 - 190	6
140 - 150	40	190 - 200	3

However, it was possible to ascertain that the total number of frequencies was 150 and that the median has been correctly found to be 146.25

You are required to find out with the help of the information given:

- (i) Two missing frequencies.  
 (ii) Having found the missing frequencies, calculate the arithmetic mean.  
 (iii) Without using the direct formula, find the value of mode.

**Ans: (i) 24, 25 (ii)  $\bar{X} = 147.33$  (iii) Mode = 144.08**

13. The median and mode of the following hourly wage distribution are known to be Rs 33.5 and Rs 34 respectively. Three frequency values from the table, however, missing. You are required to find out those values.

Wages in Rs	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	Total
No. of persons	4	16	?	?	?	6	4	230

**Ans: 60, 100, 40.**

14. You are given the following incomplete frequency distribution. It is known that the total frequency is 1000 and that the median is 413.11. Estimate by calculation the missing frequencies and find the value of the mode.

Value (X)	Frequency (f)	Value (X)	Frequency (f)
300 – 325	5	400 – 425	326
325 – 350	17	425 – 450	?
350 – 375	80	450 – 475	88
375 – 400	?	475 – 500	9

**Ans: Missing frequencies are 227 and 248 respectively. Mo. = 413.98**

15. “Hari put the jar of water and the packet of sweets on the ground and sat down in the shade of the tree and waited”.

Prepare a frequency distribution for the words in the above sentence taking the number of letters in words as the variable. Calculate the mean, median and mode.

**Ans: Mean = 3.56, Median = Mode = 3**

16. Treating the number of letters in each word in the following passage as the variable X, prepare the frequency distribution table and obtain its mean, median, mode.

“The reliability of data must always be examined before any attempt is made to base conclusion upon them. This is true of all data, but particularly so of numerical data, which do not carry their quality written large on them. It is a waste of time to apply the refined theoretical methods of Statistics to data which are suspect from the beginning.”

**Ans: Mean = 4.565 Median = 4 Mode = 3**

17. The frequency distribution of marks obtained by 60 students of a class in a college is given below:

Marks	:	30 – 34	35 – 39	40 – 44	45 – 49	50 – 54	55 – 59	60 – 64
No. of Students	:	3	5	12	18	14	6	2

(i) Draw a Histogram for this distribution and find the modal value.

(ii) Draw a cumulative frequency curve and find the marks limits of the middle 50% students.

**Ans: (i) Mode = 47.5 marks (ii)  $Q_1 = 42.5$  marks  $Q_3 = 52$  marks**

18. Determine the value of Median and Mode of the following distribution graphically. Verify the results by actual calculations. After verifying, calculate the value of Mean and sketch a curve indicating the general shape of the distribution and comment.

Size	10 – 19	20 – 29	30 – 39	40 – 49	50 – 59	60 – 69	70 – 79	80 – 89	90 – 99
Frequency	11	19	21	16	10	8	6	3	1

**Hint: Change classes into class boundaries for Md. and Mode. Use Ogive for Md. And Histogram for Mode graphically.**

**Use Formula:  $Md. = 37.83, Mo. = 32.35, Mean = [(3Md. - Mo.) / 2] = 40.57$**

**$M > Md. > Mo. \Rightarrow$  Distribution is positively skewed.**

### Exercise D (Geometric Mean and Harmonic Mean)

1. Compute the geometric mean of the following data:

35657	6754	431	32.5	4.17	0.897	0.05403	0.00678
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Ans: 16.14

2. Compute the geometric mean of the following data:

0.7894	0.0563	0.0041	0.6465	0.0003	0.0975	0.0854
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Ans: 0.04349

3. Compute the geometric mean of the following data:

100	150	360	200	500	450	750	800	900	5000
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Ans: 480.5

4. From the following data, calculate the weighted geometric mean

Head of Expenditure	Index Numbers	weight
Food	150	6
Shelter	130	3
Clothing	120	4
Education	110	5
Medicine	90	2

Ans: 123.4

5. Compute the geometric mean of the following series:

Marks	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
No. of Students	8	15	25	6	7	4

Ans: 21.03

6. Compute the Geometric Mean from the following distribution:

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

7. Compute the Geometric Mean from the following distribution:

Marks	0 – 9	10 – 19	20 – 29	30 – 39	40 – 49	50 – 59
No. of students	8	32	22	58	124	84

Ans: 36.5

8. Find the missing frequency of the following series, if its geometric mean is 17.15:

Value	10	15	25	12	20
Frequency	2	3	5	2	?

Ans: 2.03 or 2

9. Find the combined Geometric Mean of the following:

Sections	A	B	C
No. of items	8	7	5
Geometric Mean	8.52	10.12	7.75

Ans: 8.84

10. Determine the Geometric Mean of the following stock prices:

Stock Price (in Rs)	60 – 79.9	80 – 99.9	100 – 119.9	120 – 139.9	140 – 159.9
Frequency	7	6	8	32	20

Ans: 121.31

11. Calculate the Harmonic Mean from the following series:

X:	1	10	100	.1	0.1	0..1	1.5	5.15	230	.5	.03	.095	.007	1275
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Ans: 0.0108

12. Compute the Weighted Harmonic Mean from the following data:

Values	1	0.4	1.5	45	174	0.01	3	12.5
Weights	8	15	2	15	10	20	10	5

Ans: 0.0414

13. Find the Harmonic Mean for the following data:

Marks	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
No. of Students	7	11	16	17	25	30

Ans: 24.33

14. From the data given below, calculate the Harmonic Mean:

Output	10 – 14	15 – 19	20 – 24	25 – 29	30 – 34	35 – 39	40 – 44
No. of workers	2	6	7	12	15	5	3

Ans: 25.56

15. Find the missing frequency of the following series, if its harmonic mean is 20.08:

Marks	10	20	30	40	50
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F:	20	30	?	15	5
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Ans: 29.63 or 30

16. The following table gives marks obtained by a group of students in a test.

Calculate the harmonic mean of the series:

Marks obtained:	20	21	22	23	24	25
No. of students:	4	2	7	1	3	1

[Ans: 21.9]

17. Calculate the H. M. for the following:

Marks obtained:	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50
No. of students:	4	7	28	12	9

[Ans: 20.48]

18. Calculate arithmetic mean and geometric mean of the following distribution:

X	:	2	3	4	5	6	7	8
F	:	2	4	6	2	3	2	1

Ans: A.M. = 4.5; G.M. = 4.192

19. Find the geometric and harmonic mean from the following data.

Items	1	2	3	4	5	6	7	8	9	10
Value	15	250	15.7	157	1.57	105.7	105	1.06	25.7	0.257

Ans: G.M. = 16.04; H.M. = 1.7637

20. Compute the geometric mean of the following data:

35657	6754	431	32.5	4.17	0.897	0.05403	0.00678
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Ans: 16.14

21. Compute the geometric mean of the following data:

0.7894	0.0563	0.0041	0.6465	0.0003	0.0975	0.0854
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Ans: 0.04349

22. Compute the geometric mean of the following data:

100	150	360	200	500	450	750	800	900	5000
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Ans: 480.5

23. From the following data, calculate the weighted geometric mean

Head of Expenditure	Index Numbers	weight
Food	150	6
Shelter	130	3
Clothing	120	4
Education	110	5
Medicine	90	2

Ans: 123.4

24. Compute the geometric mean of the following series:

Marks	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
No. of Students	8	15	25	6	7	4

Ans: 21.03

25. Compute the Geometric Mean from the following distribution:

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

Ans:

26. Compute the Geometric Mean from the following distribution:

Marks	0 – 9	10 – 19	20 – 29	30 – 39	40 – 49	50 – 59
No. of students	8	32	22	58	124	84

Ans: 36.5

27. Find the missing frequency of the following series, if its geometric mean is 17.15:

Value	10	15	25	12	20
Frequency	2	3	5	2	?

Ans: 2.03 or 2

28. Find the combined Geometric Mean of the following:

Sections	A	B	C
No. of items	8	7	5
Geometric Mean	8.52	10.12	7.75

Ans: 8.84

29. Determine the Geometric Mean of the following stock prices:

Stock Price (in Rs)	60 – 79.9	80 – 99.9	100 – 119.9	120 – 139.9	140 – 159.9
Frequency	7	6	8	32	20

Ans: 121.31

30. Calculate the Harmonic Mean from the following series:

X:	1	10	100	.1	0.1	0..1	1.5	5.15	230	.5	.03	.095	.007	1275
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Ans: 0.0108

31. Compute the Weighted Harmonic Mean from the following data:

Values	1	0.4	1.5	45	174	0.01	3	12.5
Weights	8	15	2	15	10	20	10	5

Ans: 0.0414

32. Find the Harmonic Mean for the following data:

Marks	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
No. of Students	7	11	16	17	25	30

Ans: 24.33

33. From the data given below, calculate the Harmonic Mean:

Output	10 – 14	15 – 19	20 – 24	25 – 29	30 – 34	35 – 39	40 – 44
No. of workers	2	6	7	12	15	5	3

Ans: 25.56

34. Find the missing frequency of the following series, if its harmonic mean is 20.08:

Marks	10	20	30	40	50
F:	20	30	?	15	5

Ans: 29.63 or 30

## UNIT - II

### Long Questions of 7 Marks each: (Theory Questions)

1. What is measure of dispersion? Discuss the characteristics of a good measure of dispersion.
2. What do you mean by Standard Deviation? Distinguish between Mean Deviation and Standard Deviation.
3. Discuss different properties of Standard Deviation with suitable examples.
4. Why is standard deviation considered to be the best measure of dispersion? Illustrate with examples.

### PRACTICAL PROBLEMS:

#### EXERCISE - A (Range and IQR)

1. From the monthly income of 10 families given below, calculate:  
(a) the median (b) the geometric mean (c) the coefficient of range

S. No.	1	2	3	4	5	6	7	8	9	10
Income in Rs	145	367	268	73	185	619	280	115	870	315

**Ans: (a) Md = Rs 274 (b) G = Rs 252.4 (c) Coefficient of Range = 0.84**

2. The index number of prices of cotton shares ( $I_1$ ) and coal shares ( $I_2$ ) in a given year are as under:

Months:	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
$I_1$	188	178	173	164	172	183	184	185	211	217	232	240
$I_2$	131	130	130	129	129	120	127	127	130	137	140	142

Calculate range for each share. Hence, discuss which share do you consider more variable in price.

**Ans: Range ( $I_1$ ) = 76, Coefficient of Range ( $I_1$ ) = 0.19; Range ( $I_2$ ) = 22, Coefficient of Range ( $I_2$ ) = 0.084; Hence cotton shares are more variable in prices.**

3. Age distribution of 200 employees of a firm is given below: Construct a less than ogive curve and hence or otherwise calculate semi-inter quartile range  $\frac{Q_3 - Q_1}{2}$  of the distribution:

Age in years (less than)	25	30	35	40	45	50	55
No. of employees	10	25	75	130	170	189	200

**Ans:  $Q_1 = 33.5$  years       $Q_3 = 43$  years       $\frac{Q_3 - Q_1}{2} = 4.75$  years**

4. Find the mode, median, lower quartile ( $Q_1$ ) and upper quartile ( $Q_3$ ) and Coeff. of Q. D. from the following data:

Wages:	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
No. of workers:	22	38	46	35	20

**Ans: Mode = 24.21; Median = 24.46  $Q_1 = 14.803$   $Q_3 = 24.21$  Coeff. of Q. D. = 0.396**

5. Calculate the Coefficient of Quartile Deviation of the following data:

Size	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	32 - 36	36 - 40
Frequency	6	10	18	30	15	12	10	6	2

**Ans:  $Q_1 = 14.5$   $Q_3 = 24.92$  Coefficient of Q.D. = 0.2643**

6. Find (i) Inter-quartile range (ii) Semi-inter-quartile range, and (iii) Coefficient of quartile deviation from the following frequency distribution:

Marks	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80 - 90
No. of Students	60	45	120	25	90	80	120	60

**Ans: (i) 38.75 (ii) 19.375 (iii) 0.3647**

7. From the following data,

(i) Calculate the percentage of workers getting wages (a) more than Rs 44 (b) between Rs 22 and Rs 58

(ii) Find the quartile deviation

Wages (Rs)	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80
No. of workers	20	45	85	160	70	55	35	30

**Ans: (i) (a) 32.4% (b) 68.4% (ii)  $Q_1 = 27.06$   $Q_3 = 49.29$  Q.D. = 11.115**

8. Calculate the appropriate measure of dispersion from the following data:

Wage in Rs per week	Less than 35	35 - 37	38 - 40	41 - 43	Over 43
No. of wage earners	14	62	99	18	7

**Ans: Coefficient of Q.D. = 0.046**

9. Find out the range of middle 50%, middle 80% and coefficient of Q.D. from the following table:



Size of items	2	4	6	8	10	12
Frequency	3	5	10	12	6	4

**Ans: Quartile range = 4; Percentile Range = 8; Coefficient of Q.D. = 0.25**

### EXERCISE B (Mean Deviation & Standard Deviation)

1. Calculate the mean deviation about A.M. from the following:

Value (X)	10	11	12	13
Frequency (f)	3	12	18	12

**Ans: A.M. = 11.87; M. D. = 0.7**

2. Calculate the mean deviation about median of the series:

X	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5
f	2	3	5	6	6	4	6	4	14

**Ans: M.D. (about median) = 2.22**

3. Compute the quartile deviation and mean deviation from median for the following data:

Height in inches	No. of students	Height in inches	No. of students
58	15	63	22
59	20	64	22
60	32	65	10
61	35	66	8
62	33	---	---

**Ans: Q.D. = 1.5; M.D. (about median) = 1.73**

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

Series A:	3484	4572	4124	3682	5624	4388	3680	4308
Series B:	487	508	620	382	408	266	186	218

**Ans: Series A: Md. = 4216 ; M.D. = 490.25; Coefficient of M.D. = 0.116**

**Series B: Md. = 395 ; M.D. = 121.38; Coefficient of M.D. = 0.307.**

**Series B is more variable.**

5. Compare the dispersion of the following series by using the co-efficient of mean deviation.

Age (years) :	16	17	18	19	20	21	22	23	24	Total
No. of boys :	4	5	7	12	20	13	5	0	4	70
No. of girls :	2	0	4	8	15	10	6	3	2	50

**Ans: Coefficient of M.D. about median (boys) = 0.0685; Coefficient of M.D. about median (girls) = 0.0630**

6. Calculate the mean deviation from mean for the following data:

Marks:	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70
No. of Students	6	5	8	15	7	6	3

**Ans: Mean = 33.4; M.D. about mean = 13.184**

**[C.A. Foundation, May 1999]**

7. Find out mean deviation and its coefficient from median from the following series:

Size of items:	4	6	8	10	12	14	16
Frequency:	2	1	3	6	4	3	1

**Ans: 2.4; 0.24**

8. Calculate the mean deviation about the mean for the following data:

X	5	15	25	35	45	55	65
F	8	12	10	8	3	2	7

Also find the M.D. about median and comment on the results obtained in (a) and (b)

**Ans: Mean = 29; M.D. about mean = 16; Median = 22; M.D. about median = 15.8**

9. Calculate mean deviation from median from the following data:

Class interval	Frequency	Class interval	Frequency
20 - 25	6	50 - 55	10
25 - 30	12	55 - 60	8
30 - 40	17	60 - 70	5
40 - 45	30	70 - 80	5
45 - 50	10		

Also calculate the coefficient of mean deviation

**Ans: 8.75; 0.206**

10. The following distribution gives the difference in age between husband and wife in a particulars community:

Difference in years	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40
Frequency	449	705	507	281	109	52	16	4

Calculate the mean deviation about median from these data. What light does it throw on the social conditions of a community?

**Ans: M.D. about median = 5.24**

11. Find the median and mean deviation of the following data:

Size	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70
Frequency	7	12	18	25	16	14	8

**Ans: Median = 35.2; M.D. = 13.148**

12. Calculate the value of coefficient of mean deviation (from median) of the following data:

Marks	No. of Students	Marks	No. of Students
10 - 20	2	50 - 60	25
20 - 30	6	60 - 70	20
30 - 40	12	70 - 80	10
40 - 50	18	80 - 90	7

**Ans: Median = 54.8; M.D about median = 12.95; Coefficient of M.D. = 0.236**

13. Compute the mean deviation from median and from mean for the following distribution of the scores of college students:

Scores	140 - 150	150 - 160	160 - 170	170 - 180	180 - 190	190 - 200
Frequency	4	6	10	10	9	3

**Ans: 10.24; 10.56**

14. Calculate the Mean Deviation from Median from the following data:

Wages in Rs (Mid value)	125	175	225	275	325
No. of persons	3	8	21	8	2

**Ans: Median = 221.43; M.D. (Median) = 31.607**

15. Calculate standard deviation of the following marks obtained by 5 students in a tutorial group:

Marks obtained: 8, 12, 13, 15, 22

**Ans: 4.6**

16. Compute the standard deviation of the following series;

Daily wages of Workers (in Rs)	No. of Workers	Daily wages of Workers (in Rs)	No. of Workers	Daily wages of Workers (in Rs)	No. of Workers
100 - 105	200	120 - 125	350	140 - 145	280
105 - 110	210	125 - 130	520	145 - 150	210
110 - 115	230	130 - 135	410	150 - 155	160
115 - 120	320	135 - 140	320	155 - 160	90

**Ans: S.D. = 14.244**

17. Find the mean and standard deviation of the following data:

Age under (years)	10	20	30	40	50	60	70	80
No. of persons dying	15	30	53	7	100	110	115	125

**Ans: Mean = 35.16; S.D. = 19.76 years**

18. In the following data, two class frequencies are missing:

Class Interval	Frequency	Class Interval	Frequency
100 – 110	4	150 – 160	?
110 – 120	7	160 – 170	16
120 – 130	15	170 – 180	10
130 – 140	?	180 – 190	6
140 – 150	40	190 – 200	3

However, it was possible to ascertain that the total number of frequencies was 150 and that the median has been correctly found out as 146.25. you are required to find with the help of information given:

- (i) The two missing frequencies;
- (ii) Having found the missing frequencies, calculate the Arithmetic Mean and Standard Deviation
- (iii) Without using the direct formula, find the value of mode.

**Ans: (i) 24, 25 (ii) A.M. = 147.33; S.D. = 19.2 (iii) Mode = 144.09**

19. The following table gives the distribution of income of household based on hypothetical data:

Income (Rs)	Percentage of households	Income (Rs)	Percentage of households
Under 100	7.2	500 – 599	14.9
100 – 199	11.7	600 – 699	10.4
200 – 299	12.1	700 – 999	9.0
300 – 399	14.8	1,000 and above	4.0
400 – 499	15.9		

- (i) What are the problems involved computing standard deviation from the above data?
- (ii) Compute a suitable measure of dispersion

**Ans: (ii) Compute Quartile Deviation; Q. D. = 169.425; Co-efficient of Q.D. = 0.404**

### EXERCISE C (Skewness)

1. From the following distribution of marks, find the Karl Pearson's skewness and its coefficient:

Roll No.	1001	1002	1003	1004	1005	1006
Marks	4	6	20	10	7	3

**Ans: SK(p) = 5.49; Coefficient of SK(p) = 0.97**

2. From the following frequency distribution, find out Karl Pearson's skewness and its coefficient:

Wages in Rs	10	20	30	40	50	60
No. of workers	3	7	10	20	6	4

**Ans: SK(p) = - 3.8; Coefficient of SK(p) = - 0.30**

3. From the following distribution, find out Karl Pearson's coefficient of skewness:

Group	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45
F:	5	10	12	14	30	18	9	2

**Ans: SK(p) = - 0.32**

4. From the following data, find Bowley's skewness and its coefficient

Size	1	5	12	22	17	9	4
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Also compare the result with those of Karl Pearson.

**Ans: SK(B) = 3; Coefficient of SK(B) = 0.23; Ans: SK(p) = 3; Coefficient of SK(p) = 0.43**

5. From the following frequency distribution, find Bowley's skewness and its coefficient:

X:	70	80	90	100	110	120	130	140
F:	8	20	35	40	32	25	18	22

**SK(B) = 10; Coefficient of SK(B) = 0.33**

6. From the following distribution of marks secured by a class of students, find the skewness, and its coefficient by the method given by Bowley:

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70	above 70
No. of Students	8	20	35	40	32	25	18	22

**Ans: SK(B) = - 1.53; Coefficient of SK(B) = - 0.07**

7. From the following data, find Kelly's skewness and its coefficient. Also compare them with those of Bowley:

X:	3	10	30	40	47	50	55	60	70	75
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**SK(K) = - 18.8; Coefficient of SK(B) = - 0.27; SK(B) = - 9.5; Coefficient of SK(B) = - 0.25**

8. Find out Kelley's skewness, and its coefficient from the following distribution:

X	4	6	10	20	7	3
F:	3	10	0	40	47	50

**SK(K) = 9; Coefficient of SK(B) = 0.50;**

9. From the following series, find out the value of Median, P90, P10 and Kelly's coefficient of skewness:

Wages	Below 20	20-25	25-30	30-35	35-40	40 and above
No. of workers	1	2	15	22	7	3

**SK(K) = 1.06; Coefficient of SK(B) = 0.08;**

### UNIT - III

1. What do you mean by correlation? Explain different types of correlation.
2. Discuss different methods of measuring the correlation of two variables.
3. Discuss the various properties of correlations coefficient with suitable examples.
4. What do you mean by Regression Analysis? Discuss the essential features and assumptions of regression analysis.
5. Distinguish between correlation analysis and regression analysis.

#### Practical Problems:

### CORRELATION ANALYSIS

#### EXERCISE - A

1. The production manager of a company maintains that the flow time in days (Y), depends on the number of operations (X) to be performed. The following data give the necessary information:

X:	2	2	3	4	4	5	6	6	7	7
Y:	8	13	14	11	20	10	22	26	22	25

Calculate the value of the Karl Pearson's Correlation Coefficient.

**Ans: r (x, y) = 0.78**

2. Making use of the data given below, calculate the coefficient of correlation  $r_{12}$

Case:	A	B	C	D	E	F	G	H
-------	---	---	---	---	---	---	---	---

$X_1$	10	6	9	10	12	13	11	9
$X_2$	9	4	6	9	11	13	8	4

3. Ans:  $r(1,2) = 0.8958$

4. Calculate Karl Pearson's coefficient of correlation from the following data, using 20 as the working mean for price and 70 as the working mean for demand:

Price	14	16	17	18	19	20	21	22	23
Demand	84	78	70	75	66	67	62	58	60

5. Ans:  $r = -0.954$

6. Calculate the Karl Pearson's coefficient of correlation from the following data:

No.	Subject	Percentage of Marks		No.	Subject	Percentage of Marks	
		First Term	Second Term			First Term	Second Term
1.	Hindi	75	62	5.	Commerce	77	69
2.	English	81	68	6.	Mathematics	81	72
3.	Economics	70	65	7.	Statistics	84	76
4.	Accounts	76	60	8.	Costing	75	72

Ans:  $r = 0.623$

7. Calculate the Karl Pearson's coefficient of correlation for the following ages of husbands and wives at the time of their marriage:

Age of husband (in years)	23	27	28	28	28	30	30	33	35	38
Age of wife (in years)	18	20	22	27	21	29	27	29	28	28

Ans:  $r = 0.8013$

8. Calculate Pearson's coefficient of correlation from the following data using 44 and 26 respectively as the origin of X and Y:

X:	43	44	46	40	44	42	45	42	38	40	42	57
Y:	29	31	19	18	19	27	27	29	41	30	26	10

Ans:  $r_{xy} = -0.7326$

9. The following table gives the distribution of total population and those who are totally or partially blind among them. Find out if there is any relation between age and blindness:

Age	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80
No. of persons ('000)	100	60	40	36	24	11	6	3
Blind	55	40	40	40	36	22	18	15

Hints: Here we shall find the correlation coefficient between age (X) and no. of blinds per lakh (Y) as given in the following table

X	5	15	25	35	45	55	65	75
Y	55	67	100	111	150	200	300	500

Ans:  $r = 0.8982$

10. With the following data in 6 cities, calculate the coefficient of correlation by Pearson's method between the density of population and the death rate:

Cities	Area in square miles	Population (in '000)	No. of deaths
A	150	30	300
B	180	90	1440
C	100	40	560
D	60	42	840
E	120	72	1224
F	80	24	312

Hint: Find  $r$  between,  $Density = \frac{Population}{Area}$ ; and  $Death Rate = \frac{No. of Deaths}{Population} \times 1000$

Ans:  $r = 0.9876$

11. Calculate the correlation coefficient from the following data:

X	12	9	8	10	11	13	7
Y	14	8	6	9	11	12	3

12. Let now each value of X be multiplied by 2 and then 6 be added to it. Similarly multiply each value of Y by 3 and subtract 2 from it. What will be the correlation coefficient between the new series of X and Y?

[C. A. Foundation, May 1997]

Ans:  $r(X, Y) = 0.9485$

13. 18. Given:  $\sum X = 125$ ,  $\sum Y = 100$ ,  $\sum X^2 = 650$ ,  $\sum Y^2 = 436$ ,  $\sum XY = 520$  and  $n = 25$ , obtain the value of Karl Pearson's correlation coefficient  $r(X, Y)$

Ans: 0.67

14. You are given the following information relating to a frequency distribution comprising of 10 observations:

$$\bar{X} = 5.5, \bar{Y} = 4.0, \sum X^2 = 385, \sum Y^2 = 192, \sum (X + Y)^2 = 947$$

Find  $r_{xy}$

Ans:  $r(X, Y) = 0.681$

15. A computer while calculating the correlation coefficient between the variables X and Y obtained the following results:

$$n = 30, \sum X = 120, \sum X^2 = 600, \sum Y = 90, \sum Y^2 = 250, \sum XY = 356$$

It was, however, later discovered at the time of checking that it had copied down two pairs of observations as:

X	Y
8	10
12	7

While the correct values were,

X	Y
8	12
10	8

Obtain the correct value of the correlation coefficient between X and Y.

Ans:  $r = 0.0504$

[I.C.W.A. December, 2003]

16. Coefficient of correlation between X and Y for 20 items is 0.3; mean of X is 15 and that of Y is 20, standard deviations are 4 and 5 respectively. At the time of calculations one pair (X = 27, Y = 30) was wrongly taken as (X = 17, Y = 35). Find the correct coefficient of correlation.

Ans: Correct value of correlation coefficient = 0.5153

17. In order to find the correlation coefficient between variables X and Y from 12 pairs of observations, the following calculations were made:

$$\sum X = 30, \sum Y = 5, \sum X^2 = 670, \sum Y^2 = 285, \sum XY = 334$$

On subsequent verification, it was found that the pair (X = 11, Y = 4) was copied wrongly, the correct value being (X = 10, Y = 14). Find the correct value of correlation coefficient.

Ans: 0.78

18. Calculate the coefficient of correlation and find its probable error from the following data:

X:	7	6	5	4	3	2	1
Y	18	16	14	12	10	6	8

Ans:  $r_{xy} = 0.9643$ ; P.E. (r) = 0.0179

19. Find Karl Pearson's correlation coefficient between age and playing habits of the following students:

Age (Years)	15	16	17	18	19	20
No. of students	250	200	150	120	100	80
No. of Regular players	200	150	90	48	30	12

Hint: Find  $r$  between age (X) and percentage of regular players (Y).

Ans:  $r_{xy} = -0.9912$

20. Calculate Karl Pearson's coefficient of correlation for the following series:

Price (in Rs)	110 – 111	111 – 112	112 – 113	113 – 114	114 - 115
Demand (in Kg.)	600	640	640	680	700
Price (in Rs)	116 – 117	117 – 118	118 – 119		
Demand (in Kg.)	830	900	1,000		

Also calculate the probable error of the correlation coefficient. From your result can you assert that the demand is correlated with price?

**Ans:  $r = 0.9651$ ; P.E. ( $r$ ) = 0.0154**

21. The deviations from the respective means of X and Y series are given below:

x	-4	-3	-2	-1	0	1	2	3	4
y	3	-3	-4	0	4	1	2	-2	-1

Calculate Karl Pearson's coefficient of correlation from the above data.

**Ans:  $r_{(X,Y)} = 0$**

22. Calculate the coefficient of correlation between X and Y series from the following data:

	X Series	Y Series
No. of observations	15	15
Arithmetic mean	25	18
Standard deviation	5	5

$$\sum(X - 25)(Y - 18) = 125$$

**Ans:  $r_{xy} = 0.33$**

23. Given  $n = 10$ ,  $\sum X = 100$ ,  $\sum(X - 10)^2 = 600$ ,  $\sum Y = 150$ ,  $\sum(Y - 15)^2 = 25$ ,  $\sum(X - 10)(Y - 15) = 60$

**Ans:  $r = 2\sqrt{5} = 0.8944$**

24. The following results are obtained between two series. Compute the coefficient of correlation:

	X Series	Y Series
Number of items	7	7
Arithmetic mean	4	8
Sum of squares of deviations from arithmetic mean	28	76
Summation of products of deviations of X and Y series from their respective means =	46	

**Ans: 0.997**

### Exercise - B (Rank Correlation)

1. Ranking of 10 trainees at the beginning (X) and at the end (Y) of a certain course are given below:

Trainees	A	B	C	D	E	F	G	H	I	J
X:	1	6	3	9	5	2	7	10	8	4
Y:	6	8	3	7	2	1	5	9	4	10

Calculate Spearman's rank correlation coefficient. [I.C.W.A. Inter, June 1995]

**Ans:  $R = 0.394$**

2. The rank of same 16 students in Mathematics and Physics are as follows. Two number within brackets denote the ranks of the students in Mathematics and Physics.

(1, 1) (2, 10) (3, 3) (4, 4) (5, 5) (6, 7) (7, 2) (8, 6) (9, 8) (10, 11) (11, 15) (12, 9) (13, 14) (14, 12) (15, 16) (16, 13)

Calculate the rank correlation coefficient for proficiencies of this group in Mathematics and Physics.

**Ans:  $R = 0.8$**

3. Two judges in a beauty competition rank the 12 entries as follows:

X:	1	2	3	4	5	6	7	8	9	10	11	12
Y:	12	9	6	10	3	5	4	7	8	2	11	1

What degree of agreement is there between the two judges.

**Ans:  $R = -0.454$**

4. Ten competitors in a beauty contest are ranked by three judges in the following order:

1 <sup>st</sup> Judge	1	5	4	8	9	6	10	7	3	2
2 <sup>nd</sup> Judge	4	8	7	6	5	9	10	3	2	1
3 <sup>rd</sup> Judge	6	7	8	1	5	10	9	2	3	4

Use rank correlation coefficient to discuss which pair of judges has the nearest approach to beauty.

**Ans:  $R_{12} = 0.5515, R_{13} = 0.0545, R_{23} = 0.7333$**

**The pair of 2<sup>nd</sup> and 3<sup>rd</sup> judges has the nearest approach to common tastes in beauty.**

5. For the following data, calculate the Coefficient of Rank Correlation:

X:	80	91	99	71	61	81	70	59
Y:	123	135	154	110	105	134	121	106

**R = 0.9524**

6. The following are the marks obtained by a group of students in two papers. Calculate the rank coefficient of correlation:

Economics:	78	36	98	25	75	82	92	62	65	39
Statistics:	84	51	91	69	68	62	86	58	35	49

**Ans: R = 0.6121**

7. Calculate Spearman's coefficient of rank correlation for the following data of scores in psychology (X) and arithmetical ability (Y) of 10 children:

Child	A	B	C	D	E	F	G	H	I	J
X:	105	104	102	101	100	99	98	96	93	92
Y:	101	103	100	98	95	96	104	92	97	94

**R = 0.6**

8. Compute the Coefficient of Rank Correlation between X and Y from the data given below:

X:	8	10	7	15	3	20	21	5	10	14	8	16	22	19	6
Y:	3	12	8	13	20	9	14	11	4	16	15	10	18	23	25

**Ans: R = 0.0357**

9. Given the following aptitude and I. Q. scores for a group of students. Find the coefficient of rank correlation:

Aptitude Score	57	58	59	59	60	61	60	64
I.Q. Score	97	108	95	106	120	126	113	110

**Ans: R = 0.7024**

10. The following data relate to the marks obtained by 10 students of a class in Statistics and Costing:

Marks in Statistics	30	38	28	27	28	23	30	33	28	35
Marks in Costing	29	27	22	29	20	29	18	21	27	22

Obtain the rank correlation coefficient.

**Ans: R = 0.3515**

11. Find the coefficient of rank correlation between the marks obtained in Mathematics (X) and those in Statistics (Y) by 10 students of a certain class out of a total marks of 50 in each subject:

Student No.:	1	2	3	4	5	6	7	8	9	10
X:	12	18	32	18	25	24	25	40	38	22
Y:	16	15	28	16	24	22	28	36	34	19

**Ans: R = 0.95**

12. From the following data, calculate the coefficient of rank correlation between X and Y:

X:	32	35	49	60	43	37	43	49	10	20
Y:	40	30	70	20	30	50	72	60	45	25

**Ans: R = - 0.0758**

### EXERCISE C (REGRESSION ANALYSIS)

1. Given the following values of X and Y:

X:	3	5	6	8	9	11
Y:	2	3	4	6	5	8

Find the equation of regression of:

- (i) Y on X and (ii) X on Y



Interpret the results

**Ans:  $Y = 0.7143X - 0.3334$ ;  $X = 1.2857Y + 1.0001$**

2. Obtain the equations of the two lines of regression for the data given below:

X:	1	2	3	4	5	6	7	8	9
Y:	9	8	10	12	11	13	14	16	15

**Ans:  $Y = 0.95X + 7.25$ ;  $X = 0.95Y + 7.25$**

3. From the following data of the age of husband and the age of wife, form two regression lines and calculate the husband's age when the wife's age is 16:

Husband's age:	36	23	27	28	28	29	30	31	33	35
Wife's age:	29	18	20	22	27	21	29	27	29	28

**Ans: Husband's age:  $X$  : Wife's age:  $Y$   
 $Y = 0.95X - 3.5$ ,  $X = 0.8Y + 10$  ( $X$ ) <sub>$Y=16$</sub>  = 22.8**

4. Find the regression equation Y on X where Y and x are the marks obtained by 10 students as given below:

Y:	20	60	55	45	75	35	25	90	10	50
X:	20	45	65	40	55	35	15	80	25	50

**Ans:  $b_{xy} = 1.105$ ;  $Y = 1.105X - 1.015$  [C.A. (Foundation) May, 2002]**

5. The following data give the experience of machine operators and their performance ratings as given by number of good parts turned out per pieces:

Operator	1	2	3	4	5	6	7	8
Experience (in years) (X)	16	12	18	4	3	10	5	12
Performance Ratings (Y)	87	88	89	68	78	80	75	83

Calculate the regression line of performance ratings on experience and estimate the probable performance if an operator has 7 years' experience.

**Ans:  $Y = 69.97 + 1.133X$ ; 77.601**

6. You are given the data relating to purchases and sales. Obtain the two regression equations by the method of least squares and estimate the likely sales when the purchases equal 100:

Purchases:	62	72	98	76	81	56	76	92	88	49
Sales:	112	124	131	117	132	96	120	136	97	85

**Ans: Purchases X; Sales Y;  $X = 0.6515Y + 0.0775$ ;  $Y = 0.7825X + 56.3125$ ; 134.5625**

7. The height of fathers and sons is given in the following table. Find the two lines of regression and estimate the expected average height of the son when the height of the father is 67.5 inches:

Height of father (in inches)	65	66	67	67	68	69	71	73
Height of sons (in inches)	67	68	64	68	72	70	69	70

**Ans:  $Y = 0.4242X + 39.5484$ ;  $X = 0.525Y + 32.2875$ ; 68.18 inches**

8. The following table gives the ages and blood pressure of 10 women:

Age (Y)	56	42	36	47	49	42	60	72	63	55
Blood Pressure (Y)	147	125	118	128	145	140	155	160	149	150

- (i) Find the correlation coefficient between X and Y.  
 (ii) Determine the least square regression equation Y on X.  
 (iii) Estimate the blood pressure of a woman whose age is 45 years.

**Ans: (i)  $r = 0.89$  (ii)  $Y = 83.758 + 1.11X$  (iii) When  $X = 45$ ,  $Y = 134$**

9. A panel of two judges P and Q graded seven dramatic performances independently by awarding marks as follows:

Performance:	1	2	3	4	5	6	7
Marks of P:	46	42	44	40	43	41	45
Marks of Q:	40	38	36	35	39	37	41

The eighth performance, which Judge Q could not attend, was awarded 37 marks by Judge P. If Judge Q has also been present, how many marks would be expected to have been awarded by him to the eighth performance?

**Ans:  $33.5 = 34$**

10. The following table gives the normal weight of baby during the first six months of life:

Age in months	0	2	3	5	9
Weight in lbs.	5	7	8	10	12

Estimate the weight of a baby at the age of 4 months.

**Ans: 9.2982 lbs**

11. You are given the following data:

	X	Y
Arithmetic Mean	36	85
Standard Deviation	11	8

Correlation coefficient between X and Y = 0.66

- (i) Find two regression equations (ii) Estimate the value of X when Y = 75

**Ans: (i)  $Y = 0.48X + 67.72$ ;  $X = 0.9075Y - 41.1375$ ; (ii) 26.925**

12. 34. A survey was conducted to study the relationship between expenditure on accommodation (X) and expenditure on food and entertainment (Y) and the following results were obtained:

	Mean	S. D.
Expenditure on accommodation	Rs 173	63.15
Expenditure on food and entertainment	Rs 47.8	22.98
Coefficient of correlation = + 0.57		

Write down the equation of regression of X on Y and estimate the expenditure on food and entertainment, if the expenditure on accommodation is Rs 200.

**Ans:  $Y = 0.207X + 11.99$ ,  $Y_{X=200} = \text{Rs } 53.29$**

13. Find out the regression coefficients Y on X and X on Y on the basis of the following data:

$\sum X = 50$ ,  $\bar{X} = 5$ ,  $\sum Y = 60$ ,  $\bar{Y} = 6$ ,  $\sum XY = 350$ , Variance of X = 4, Variance of Y = 9

**Ans:  $b_{yx} = 1.25$ ,  $b_{xy} = 0.56$**

14. In order to find the correlation coefficient between two variables X and Y from 12 pairs of observations, the following calculations were made:

$\sum X = 30$ ,  $\sum X^2 = 670$ ,  $\sum Y = 5$ ,  $\sum Y^2 = 285$ ,  $\sum XY = 344$ ,

On subsequent verification, it was discovered that the pair (X = 11, Y = 4) was copied wrongly, the correct values being (X = 10, Y = 14). After making necessary correction, find:

- (a) the two regression coefficients; (b) the two regression equations;  
(c) the correlation coefficient.

**Ans: (a)  $b_{yx} = 0.694$ ;  $b_{xy} = 0.898$  (b) : Y on X:  $Y = 0.694X - 0.427$ ; X on Y:  $X = 0.898Y + 1.294$  (c)  $r_{(x,y)} = 0.7894 = 0.79$**

## UNIT - IV

- Define an index number. Discuss the essential characteristics of an index number.
- What are the index numbers? Discuss the different problems that we faced in the construction of an index number.
- Discuss the importance and limitations of index numbers.
- What do you mean by cost of living index numbers? Discuss the methods for construction of such index numbers.
- What is a fixed based index number? Differentiate it from chain base index numbers. Discuss the merits and demerits of both the index numbers.
- What is Fisher's ideal index number? What is it so called? Show that it satisfies to both the time reversal test and factor reversal test.
- 'Index numbers are called the economic barometer of a country'. Comment on the statement and also bring out the limitations of the index numbers.
- What are different methods of measuring trend? Explain the methods of eliminating trend in a time series. Which one do you consider better?
- Explain briefly the various methods of determining the trend in a time series.
- Explain 'ratio to trend' method of measuring seasonal variations and discuss its relative merits and demerits.

## Practical Problems.

### Index Numbers:

### EXERCISE A (General Price Index)

1. On the basis of figures of production of generators given below, construct:

(a) Quantity index; and (b) Price index (using 1990 as base)

Year	1990	1991	1992	1993	1994
Units Produced (in thousands)	24	30	32	38	44
Value of Output (in Rs Million)	192	255	272	361	451

Ans:

<b>Year</b>	<b>1990</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>
<b>Price Index</b>	<b>100</b>	<b>106.25</b>	<b>106.25</b>	<b>118.75</b>	<b>128.12</b>
<b>Quantity Index</b>	<b>100</b>	<b>125</b>	<b>133.33</b>	<b>158.33</b>	<b>183.33</b>

2. What is the difference between Laspeyre's and Paasche's system of weights in compiling a price index? Calculate both Laspeyre's and Paasche's aggregative price indices for the year 2000 from the following data:

Commodities	Quantity		Price Per Unit (Rs)	
	1999	2000	1999	2000
A	3	5	20	25
B	4	6	25	30
C	2	3	30	25
D	1	2	10	7.50

Ans: 109.78; 109.72

3. From the data given below compute Laspeyr's and Paasche's index numbers:

Commodities	Price		Quantity	
	1995	2001	1995	2001
A	4	10	50	40
B	3	9	10	2
C	2	4	5	2

(Price and Quantity figures are in appropriate units)

Ans: 254.16; 250.58

4. The geometric mean of index number of Laspeyre and Paasche is 229.5648 while the sum of Laspeyre's and Paasche's index number is 480. Find out Laspeyre's and Paasche's indices.

Ans: 310; 170

5. Using Paasche's formula, compute the quantity index and the price index number of 2000 with 1996 as base year:

Commodities	Quantity Units		Value in (Rs)	
	1999	2000	1999	2000
A	100	150	500	900
B	80	100	320	500
C	60	72	150	360
D	30	33	360	297

(b) For the above problem also compute price index by

(i) Marshall Edgeworth formula; (ii) Fisher's formula (iii) Dorbish-Bowley formula; (iv) Walsch formula

Ans: (a)  $P_{01} = 119.2$ ;  $Q_{01} = 131.09$  (b) (i) 118.68 (ii) 118.62 (iii) 118.6225 (iv) 118.64

6. "Marshall-Edgeworth index number is a good approximation to the Fisher's Ideal Index Number" – Verify the truth of this statement from the following data:

Year	Rice		Wheat		Jowar	
	Price	Quantity	Price	Quantity	Price	Quantity
1970	9.3	100	6.4	11	5.1	5
1977	4.5	90	3.7	10	2.7	3

**Ans: 49.135 : 49.134**

7. A company spent Rs 50, Rs 48, Rs 18 and Rs 42 during 1998. The company increased the expenditure to Rs 100, Rs 98, Rs 60 and Rs 102 respectively on four commodities. If the units of four commodities purchased during 1998 and 1999 are identical i.e. 5, 2, 6 and 17, compute the price index for 1999 by the most suitable method.

**Ans: Simple Aggregative method 227.85**

8. From the data given below construct an index number of the group of four commodities using:

(i) Simple Aggregative Method and (ii) Fisher's Ideal Formula.

Commodities	Base Year (1996)		Current Year (1997)	
	Price per unit	Expenditure (Rs)	Price per unit	Expenditure (Rs)
1	2	40	5	75
2	4	16	8	40
3	1	10	2	24
4	5	25	10	60

**Ans: (i) 208.33 (ii) 219.13**

9. Using Fisher's Ideal Formula, compute price and quantity index numbers for 1984 with 1982 as base year, given the following information:

Year	Commodity A		Commodity B		Commodity C	
	Price (Rs)	Quantity(kg)	Price (Rs)	Quantity(kg)	Price (Rs)	Quantity(kg)
1982	5	10	8	6	6	3
1984	4	12	7	7	3	4

**Ans:  $P_{01} = 83.59$ ;  $Q_{01} = 120.6$**

10. On the basis of the following information, calculate the Fisher's Ideal Index Number:

Commodities	Base Year		Current Year	
	Price	Quantity	Price	Quantity
A	2	40	6	50
B	4	50	8	40
C	6	20	9	30
D	8	10	6	20
E	10	10	5	20

**Ans:  $P_{01} = 149.15$**

11. Calculate Fisher's Ideal Index from the following data:

Commodities	Base Year		Current Year	
	Quantity	Price	Quantity	Price
A	15	4	10	6
B	20	3	25	4
C	10	6	20	5
D	30	5	25	5

**Ans:  $P_{01} = 149.15$**

12. Find Laspeyre's, Paasche's and Fisher's price and quantity index numbers from the following data:

Commodities	Base Year		Current Year	
	Price (Rs)	Quantity (kg)	Price (Rs)	Quantity (kg)
A	5	25	6	30
B	10	5	15	4
C	3	40	2	50
D	6	30	8	35

[C.A. Foundation, May 2007]

Ans:  $P_{01} = 1117.74; 112.73; 113.73; Q_{01} = 115.79; 113.76; 114.77$

13. Given that  $\sum p_1q_1 = 250$ ,  $\sum p_0q_0 = 150$ . Paasche's Index Number = 150 and Dorbish-Bowley's Index Number = 145, find out (i) Fisher's Ideal Index Number; and (ii) Marshall-Edgeworth's Index Number.

Ans: 144.9, 145.26

14. From the following data, construct a price index number of the group of four commodities by using Fisher's Ideal Formula:

Commodities	Base Year		Current Year	
	Price per unit	Expenditure Rs	Price per unit	Expenditure Rs
A	2	40	5	75
B	4	16	8	40
C	1	10	2	24
D	5	25	10	60

Ans:  $P_{01} = 219.1$

15. From the information given below, find the price index for the Year II with Year I as base by using Fisher's ideal index number formula:

Commodities	Price (Rs)/unit		Total Value (Rs)	
	Year I	Year II	Year I	Year II
A	35	36	700	756
B	31	40	465	480
C	30	32	240	320
D	20	22	40	44

[I.C.W.A (Inter) June 2001]

Ans:  $P_{01} = 111.34$

16. From the following data, construct Quantity Index Number by:

(i) Fisher's Method, and (ii) Marshall-Edgeworth's Method

Commodities	Base Year		Current Year	
	Price (Rs)	Quantity (kgs)	Expenditure (Rs)	Quantity (kgs)
A	25	40	2,000	50
B	22	18	1,200	30
C	54	16	1,320	44
D	20	40	1,350	45
E	18	30	630	15

Ans: (i) 136.85 (ii) 134.94

17. From the data given below, calculate quantity index number for the year 2000 by using:

(i) Laspeyre's (ii) Paasche's and (iii) Fisher's formulae

Commodities	Year 1999		Year 2,000	
	Price	Value	Price	Value
A	10	70	11	115.5
B	5	45	10	45
C	6	30	5	45

[C.S. Foundation Dec. 2000]

**Ans: (i) 125.17 (ii) 107.03 (iii) 115.75**

18. Calculate the index number by using geometric mean:

Commodity	Base Year Price	Current Year Price
A	2	7
B	4	5

**Ans: 209.17**

19. The following are the prices of commodities in 1998 and 1999. Calculate a price index based on price-relatives, using geometric mean:

Year	commodity					
	A	B	C	D	E	F
1998	45	60	20	50	85	120
1999	60	70	30	75	90	130

**Ans: 126**

20. The price quotations for four different commodities for 1990 and 1995 are given below. Calculate the index number for 1995 with 1990 as base by using (i) simple average of price-relatives, (ii) weighted average of price-relatives

Commodities	Weights	Price in Rupees	
		1995	1990
A	5	4.50	2.00
B	7	3.20	2.50
C	6	4.50	3.00
D	2	1.80	1.00

**Ans: (i) 170.75 (ii) 164.05**

21. Calculate price index of the following data by taking Base 1995 = 100, by weighted average of relative method:

Commodities	1995 Price (Rs)	Quantity	1996 Price (Rs)
A	20	2	25
B	10	3	12
C	12	5	18
D	16	4	16
E	5	7	4

**Ans: 110.48**

22. Calculate the index number for 1998 with 1990 as base using the Weighted Average or Price Relatives Method for the following data:

Commodities	Weights	Price in Rupees	
		1995	1990
A	2	12	24
B	8	8	12
C	4	15	27
D	5	6	18
E	1	10	12

**Ans: 197**

23. Compute the Weighted Index Numbers for 1997 and 1999 (Based on 1996) by relative method from the following data. Also interpret the computed index numbers.

Years		Commodities			
		A	B	C	D
1996	Price	6	8	9	12
	Weight	5	3	1	1

1997	Price	9	10	6	10
1998	Price	12	12	9	15
1999	Price	15	14	12	20

**Ans: Base 1996 = 100; Price I No. for 1997 = 127.50; Price I No. for 1999 = 207.50**

24. The price relatives and weights of a set of commodities are given in the following table:

Commodity	A	B	C	D
Price Relatives	125	120	127	119
Weights	$W_1$	$2W_1$	$W_2$	$W_2 + 3$

If the sum of the weights is 40 and the index for the set is 122, find the values of  $W_1$  and  $W_2$

**Ans:  $W_1 = 7$  and  $W_2 = 8$**

25. Given below are the prices and weights of given commodities for the year 1990, 1991 and 1992:

Commodity	Weights	Price in Rupees		
		1990	1991	1992
A	20	12.00	18.00	24.00
B	15	3.00	6.00	15.00
C	10	12.50	18.75	25.00
D	40	10.00	30.00	50.00
E	15	4.50	9.00	13.50

Using either aggregative method or relative method, calculate the weighted price index numbers for 1991 and 1992, taking 1990 as base year.

**Ans: Price indices based on Price Relatives are: for 1991 225, for 1992 380**

### Exercise B (Test of Index Number Formulae)

1. From the following data find the index numbers for the current year and the base year based on each other and show that the Geometric Mean makes it reversible but the Arithmetic Mean does not.

Commodity	Prices	
	Base Year	Current Year
A	25	55
B	30	45

**Ans:  $P_{01}$  (AM) = 185  $P_{01}$ (GM) = 181.66;  $P_{10}$  (AM) = 56.06;  $P_{10}$  (GM) = 55.05**

**$P_{01} \times P_{10}$  (AM)  $\neq 1$ ;  $P_{01} \times P_{10}$ (GM) = 1**

2. Compute Fisher's index number on the basis of the following data:

Commodity	Base Year		Current Year	
	Price (in'00 Rs)	Expenditure(in'00 Rs)	Price (in'00 Rs)	Expenditure(in'00 Rs)
A	3	25	10	60
B	1	10	2	24
C	4	16	8	40
D	2	40	5	75

Also apply Factor Reversal Test to the above index number.

**Ans:  $P_{01} = 219.12$**

3. Using the following data, show whether the time reversal test is satisfied by Fisher's price index

Commodity	$p_0$	$q_0$	$p_1$	$q_1$
A	12	30	14	20
B	10	20	15	16

**Ans: Yes**

4. Using the following data, show that the Fisher's ideal index satisfies both the time reversal test and factor reversal test:

Commodity	Base Year		Current Year	
	Price	Quantity	Price	Quantity
A	6	50	10	60
B	2	100	2	120
C	4	60	6	60

**Ans:  $P_{01} = 143.05$**

5. Following are the values:

$$\sum p_0q_0 = 425$$

$$\sum p_1q_0 = 505$$

$$\sum p_1q_1 = 530$$

$$\sum p_0q_1 = 470$$

Show that Fisher's method, Paasche's and Marshall method either satisfy time reversal test or do not satisfy both or one of them.

**Hint: Fisher's index satisfies both the tests; Marshall-Edgeworth method satisfies Time Reversal Test only and Paasche's index satisfies none of these tests.**

### Exercise C (Fixed Base and Chain Base)

1. From the fixed base index number given below, find out chain base index numbers:

Year	1996	1997	1998	1999	2000	2001
Index No.	200	220	240	250	280	300

**Ans: 200; 220; 240; 250; 280; 300**

2. 4. Convert the following series of index numbers to chain base indices:

Year :	1990	1991	1992	1993	1994	1995	1996	1997
Index No.	100	110	125	133	149	139	150	165

**Ans: 100 110 125 133 149 139 150 165**

3. Convert the following link relatives into price relatives, taking 1995 as the base:

Year	1995	1996	1997	1998	1999	2000
Link Relatives	120	150	180	225	270	324

4. From the fixed base index numbers given below, obtain chain base index numbers:

Year	1993	1994	1995	1996	1997	1998
Index Number	150	180	120	120	80	96

**Ans: 150 180 120 120 80 96**

5. From the chain base index numbers given below, prepare fixed base index numbers:

Year	1994	1995	1996	1997	1998
Index No.	90	110	115	120	130

**Ans: 90, 99, 113.85, 136.62, 177.6**

6. From the chain base index numbers given below, prepare the fixed base index numbers:

Year	1991	1992	1993	1994	1995
Index No.	110	160	140	100	150

**Ans: 110, 176, 246.4, 492.8, 739.2**

7. Prepare fixed base index numbers from the chain base index numbers given below:

Year	1991	1992	1993	1994	1995	1996
Index Number	92	102	104	98	103	101

**Ans: 92, 93.84, 97.59, 95.64, 98.51 99.50**

8. From the following annual average prices of three commodities given in rupees per unit, find chain index number based on 1997:

Commodities	1997	1998	1999	2000	2001
X	8	10	12	15	12
Y	10	12	15	18	20
Z	6	9	12	15	18

**Ans: 100, 131.67, 166.05, 204.79 212.36**

9. Assuming that all the goods can be assigned equal weights, calculate the chain base index numbers for the year 1996 to 2000 on the basis of the following price relatives:



$$\left[ \text{Price Relative} = \frac{\text{Current Year's Price}}{\text{Last Year's Price}} \times 100 \right]$$

	Goods A	Goods B	Goods C	Goods D	Goods E
1996	100	100	100	100	100
1997	90	125	134	118	133
1998	89	61	60	115	125
1999	112	200	80	93	140
2000	122	66	150	86	86

**Ans: 100, 120, 108, 135, 137.8**

10. The price index of crude oil was 120 in 1997 with 1995 as base year and 130 in 1998 with 1997 as base. The price of crude further increased by 20% in 1999 over 1998 and decreased by 10% in 2000 over 1999. It further decreased by 10% in 2001 over 2000. Obtain the chain base indices of crude prices of 2001 over 1995.

*Hints: Chain Indices – Chained to Base 1995*

Year	1955	1997	1998	1999	2000	2001
Chain Index. Chained to Base 1995 = 100	100	120	$\frac{130}{100} \times 120$ =156	$\frac{100+20}{1000} \times 156$ =187.20	$\frac{100-10}{100} \times$ 187.20 = 168.48	$\frac{100-10}{100} \times 168.48$ = 151.63

11. 1 Calculate the Chain Base index numbers from the data given below:

Commodity	Price of Commodities (in Rs)				
	1991	1992	1993	1994	1995
A	2	3	4	2	7
B	3	6	9	4	3
C	4	12	20	8	16
D	5	7	18	11	22

**Ans: 100, 197.50, 349.16, 170.70, 352.07**

12. Calculate the chain base index numbers from the data given below:

year	Price of Commodities (in Rs)				
	A	B	C	D	E
1996	10	20	12	40	100
1997	12	22	14	45	110
1998	11	25	18	49	106
1999	14	28	10	43	102
2000	15	23	9	42	101

**Ans: 100, 113.82, 122.74, 117.54, 111.88**

### Exercise D (Base Shifting)

1. The following are price index numbers (Base 1985 = 100)

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Index No.	100	120	122	116	120	120	137	136	149	156	137

Shift the base to 1990 and recast the index numbers.

**Ans: 83.33, 100, 101.67, 96.67, 100, 100, 114.17, 113.33, 124.17, 130.00, 114.17**

2. The followings are the index number of wholesale prices of a certain commodity based on 1992:

Year	2012	2013	2014	2015	2016
Index No.	100	108	120	150	210

Shift the base to 2014 and obtain new index numbers.

**Ans: 93.33, 90, 100, 125, 175**

3. In the following series of index numbers, shift the base from 2010 to 2013:

Year	2010	2011	2012	2013	2014	2015	2016	2017
Index No.	100	105	110	125	135	180	195	205

**Ans: 80, 84, 88, 100, 108, 144, 156, 164**

4. The following are the index number of price based on 2007. Shift the base from 2007 to 2011:

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
Index No.	100	140	260	340	400	450	500	260	240

**Ans: (Base 2011 = 100) 25, 35, 65, 85, 100, 112.50, 125, 65, 60**

5. Given below are two sets of indices one with 1995 as base and the other with 2002 as base:

(a) Year	Index No.	(b) Year	Index No.
1995	100	2002	100
1996	115	2003	105
1997	122	2004	118
1998	150	2005	98
1999	200	2006	102
2000	220	2007	105
2001	240	2008	120
2002	250	2009	125

The index number (a) with 1995 base was discontinued in 2002. It is desired to splice the second index number (b) with 2002 base to the first index number for the sake of continuity. How will it be done so that the combined series has a common base of 1995?

**Ans: 1995 1996 ----- 2002 2003 2004 2005 2006 2007 2008 2009**  
**100 115 ----- 250 262.5 295 245 255 262.5 300 312.5**

6. Given below are two sets of indices. For the purpose of continuity of records, you are required to construct a combining series with the year 2013 as the base:

Year	I set – Price Relatives	II set – Link Relatives
2010	100	
2011	120	
2012	125	
2013	150	
2014		110
2015		120
2016		95
2017		105

**Ans: I No.'s from 2010 to 2017 (Base 2013 = 100) are: 66.7, 80, 83.3, 100, 110, 120, 95, 105.**

7. Combine the two series of index numbers given below to obtain a new series with:  
 (i) 2013 = 100; (ii) 2010 = 100

#### WHOLESALE PRICE INDEX

Year	Old Series 2008 = 100	Revised Series 2013 = 100
2010	111	
2011	113	
2012	115	
2013	119	100
2014	134	112
2015		122

State the assumptions underlying your calculations.

**Ans: (i) 93.27, 94.25, 96.63, 100, 112, 122**

**(ii) 100, 101.80, 103.60, 107.21, 120.72, 131.50\* [(\*) :  $\frac{134 \times 122}{112} \times \frac{100}{111} = 131.50$ ]**

8. Given below are two index number series. Splice them on the base 2014 = 100.

Year	2010	2011	2012	2013	2014	2015
Old Price Index for Steel (Base 2005 = 100)	141.5	163.7	158.2	156.8	157.1	
New Price Index				99.8	100.0	102.3

(Base 2014 = 100)

Ans:	Year	2010	2011	2012	2013	2014	2015
	I. No.	90.06	104.20	100.69	99.80	100	102.3

9. (a) A firm in a certain industry has an index of material prices based on movements in the prices of selected materials weighted by the quantities consumed in the base year.

The price index series based on 2000 = 100, for the year 2010 – 2015 was as follows:

Year	2010	2011	2012	2013	2014	2015
Index	120.3	122.1	126.4	125.2	127.0	131.6

In 2015, the index was completely revised to take into account a change in the type of materials used. The new index, based on 2015 = 100, showed the following values:

Year	2015	2016	2017
Index	100	106.3	109.4

- (b) (i) Splice the new index to the old, i.e. splice 'forward;' (ii) Splice the old index to the new, i.e. splice 'backward'.

Ans: (i)	2016	2017	(ii)	2010	2011	2012	2013	2014
	139.9	144		91.4	92.8	96.0	95.1	96.5

10. What are the uses of 'base shifting' on an Index Number series? Prepare a spliced series of index numbers with 2013 as base from the following series:

Years	2008	2009	2010	2011	2012	2013	2014
Index A	100	120	135				
Index B			100	115	125	145	
Index C						100	110

Ans: Year	2008	2009	2010	2011	2012	2013	2014
Splicing Indices A and B to C (Base 2013)	51.08	61.30	68.97	79.31	86.21	100	110

11. Given the following data:

Year	2015	2016	2017	2018	2019	2020	2021
Monthly Pay (Rs)	10,500	11,000	11,500	12,500	13,500	14,000	14,500
Price Index	115	120	130	138	144	150	160

(i) Calculate the real monthly pay for each year.

(ii) In which year die the employees have the highest purchasing power?

(iii) What percentage of increase in the monthly pay for the year 2021 is required (if any) to compensate him with the purchasing power in the year of this highest real pay?

Ans: (i)

Year	2015	2016	2017	2018	2019	2020	2021
Real Monthly pay (Rs)	9130.43	9166.67	8846.15	9057.97	9375.00	9333.33	9062.50

(ii) Highest purchasing power corresponds to the year 2019, which is the year of highest real wages (Rs 9,375.00)

(iii) Required monthly increase in pay in 2021 =  $\left(\frac{9375.00 - 9062.50}{9062.50}\right) \times 100 = 3.448\%$

12. Mean monthly wages (X) and cost of living index numbers (Y) for the years 2010 to 2015 are given below:

Year	2010	2011	2012	2013	2014	2015
Rs X:	360	400	480	520	550	590
Y:	100	104	115	160	210	260

In which year the real income was (i) the highest (ii) the lowest?

Ans: (i) 2012 (ii) 2015

13. The table below shows the average wages in rupees per day of a group of industrial workers during the years 2010 – 2021. The consumer price indices for these years with Base (2000 = 100) are also shown.

14. (a) Determine the Real Wages of the workers during the year 2010-2021 as compared with their wages in 2010.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Average wage of workers	1.19	1.33	1.44	1.57	1.75	1.84	1.89	1.94	1.97	2.13	2.28	2.45
Consumer price index	100	107.6	106.6	107.6	116.2	118.8	119.8	120.2	119.9	121.7	125.9	129.3

(b) Determine the purchasing power of the Rupee for 2021 as compared to the year 2010. What is the significance of this result?

**Ans: (a) Real wages (in Rs) for 2010 to 2021:**

**1.19, 1.24, 1.35, 1.46, 1.51, 1.55, 1.58, 1.61, 1.64, 1.75, 1.81, 1.89**

**(b) Re 0.77**

15. The following data relate to the average weekly income of workers and the price index:

Years	2015	2016	2017	2018	2019	2020
Weekly Income (Rs)	800	819	825	876	920	924
Price Index (2015 = 100)	100	105	110	120	125	135

Calculate the real income of workers during the year 2015 to 2020

**Ans: Real Income (Rs): 800, 780, 750, 730, 736, 684.**

16. The following data relate to the income of the people and General Index of Prices of a certain region. Calculate : (i) Real Income (Rs) and (ii) Index Number of Real Income with 2013 as base

Year	2013	2014	2015	2016	2017	2018	2019
Income (in '00 Rs.)	800	819	825	876	920	938	924
General Price Index Number	100	105	110	120	125	140	140

**Ans:**

Year	2013	2014	2015	2016	2017	2018	2019
Real Wages (in '00 Rs.)	800	780	750	730	736	670	660
Index Number of Real Wages	100	97.5	93.75	91.25	92	83.75	82.5

17. Given the following data:

Year	2010	2011	2012	2013
Monthly Pay (Rs)	22,500	23,500	24,000	24,500
Price Index	142	148	155	162

(i) Calculate the real monthly income for each year,

(ii) Calculate the index of rear wages for each year with 2010 as base year.

**Ans: (i) Real Wages (in Rs) : 15,845 15,878 15,484 5,123**

**(ii) Indices of Real wages (2010 = 10): 100.0 100.21 97.92 95.44**

18. The employees of an American Company have presented the following data in support of their contention that they are entitled to a wage adjustment. Dollar amounts shown represent the average weekly take-home pay of the group:

Year	2013	2014	2015	2016
Pay	240	250	260	280
Index	120	150	160	200

(i) Compute the real wages.

(ii) Compute the amount of pay needed in 2016 to provide so that the buying power equal to that enjoyed in 2013:

<b>Ans: (i) Year</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
<b>Real Wages (Dollars)</b>	<b>200</b>	<b>166.67</b>	<b>462.50</b>	<b>140</b>

(ii)  $\frac{240}{120} \times 200 = 400$  Dollars

19. The following data gives the average monthly income of a teacher and general index of price during 2010-17. Prepare the index number to show that change in the real income of the teacher and comment on price increase.

Year	:	2010	2011	2012	2013	2014	2015	2016	2017
Income	:	4,000	4,400	4,800	5,200	5,600	6,000	6,400	6,800
Index	:	100	130	160	220	270	330	400	490

**Ans: Real Income Indices (Base 2010 = 100):**

**100.00, 84.62, 75.00, 59.09, 51.85, 45.45, 40.00, 34.69**

### Exercise E (Cost of Living Index)

1. Find the cost of living index for the following data:

Group	Food	Clothing	Rent	Fuel and lighting	Miscellaneous
Group Index	180	150	100	110	80
Weights	140	42	49	56	63

**Ans: 136**

2. In the construction of a certain Cost of Living Index Number, the following group index numbers were found. Calculate the Cost of Living Index Number by using:

(i) The weighted arithmetic mean; and (ii) The weighted geometric mean

Group	Food	Fuel and lighting	Clothing	House Rent	Miscellaneous
Index Number	352	200	230	160	190
Weights	140	10	8	12	15

**Ans: (i) 274.26 (ii) 261.1**

3. A worker earned Rs 900 per month in 2010. The cost of living index increased by 70% between 2010 and 2013. How much extra income should the worker have earned in 2013 so that he could buy the same quantities as in 2010?

**Ans: Rs 12 ×  $\left[ \left( \frac{170}{100} \times 900 \right) - 900 \right] = \text{Rs } 7,560$**

4. During a certain period the cost of living index number goes up from 110 to 200 and the salary of the worker is also increased from Rs 325 to Rs 550. Does the worker really gain, and if so, by how much in real terms?

**Ans: Loss of Rs 90.90**

5. 13. Following information relating to workers in an industrial town is given.

Items of consumption	Consumer Price Index in 2020 (2010 = 100)	Proportion of expenditure on the items
(i) Food, drinks and tobacco	225	52%
(ii) Clothing	175	8%
(iii) Fuel and Lighting	155	10%
(iv) Housing	250	14%
(v) Miscellaneous	150	16%

Average wage per month in 2010 was Rs 2,000. What should be the average wage per worker per month in 2020 in that town so that the standard of living of the workers does not fall below the 2010 level?

**Ans: Rs 4,110.**

6.

The adjoining table gives the cost of living index numbers for different groups with their

Group	Cost of living index	Weight
-------	----------------------	--------

respective weights for the year 2012 (Base Year: 2002). Calculate the overall Cost of Living Index Number.

Mr. Bose got a salary of Rs 550 in 2002. Determine how much he should have to receive as salary in 2012 to maintain his standard of living as in 2002.

Food	525	40
Clothing	325	16
Lighting & Fuel	240	15
Rent	180	20
Others	200	9

[I.C.W.A (Intermediate) Dec. 1996]

**Ans: 352; Rs 1,936**

7.

The adjoining information relating to workers in an industrial town is given.

Average wage per month in 2010 is Rs 2,000. What should be dearness allowance expressed as % of wages? What should be the average wage per worker per month in 2015 in that town so that the standard of living of workers does not fall below the 2010 level?

Items of Consumption	Consumer price index	Proportion of Expenditure on them
Food	132	40
Clothing	154	16
Fuel & Lighting	147	15
Housing	178	20
Miscellaneous	158	9

**Ans: CPI in 2015 = 141.76; The pay of worker in 2015 should be:  $\left(\frac{2,000 \times 141.76}{100}\right) = \text{Rs } 2,835.20$**

**D.A. expressed as % of wages =  $\frac{2,835.20 - 2,000}{2,000} \times 100 = 41.76\%$**

8. Incomplete information obtained from a partially destroyed record on cost of living analysis is given below:

Group	Group Index	Percent (%) of Total Expenditure
Food	268	60*
Clothing	280	Not available
Housing	210	20*
Fuel and Electricity	240	5
Miscellaneous	260	Not available

The cost of living index with percent of total expenditure as weight was found to be 255.8. Estimate the missing weights.

**Ans: Clothing: 10; Miscellaneous: 5**

9. The monthly income of a person is Rs 10,500. It is given that the cost of living index for a particular month is 136. Find out the amount spent by that person:

(i) On food; and (ii) On clothing

Item	Food	Rent	Clothing	Fuel and Power	Miscellaneous
Expenditure (Rs)	?	1470	?	1680	1890
Index	180	100	150	110	80

**Ans: Food: 4,200; Clothing: 1,260.**

10. A textile worker in the city of Ahmedabad earns Rs 750 p.m. The cost of living index for January, 2016, is given as 180. Using the following data, find out the amount he spends on (i) Food and (ii) Rent

Group	Expenditure (Rs)	Group Index
(i) Food	?	190
(ii) Clothing	125	181
(iii) Rent	?	140
(iv) Fuel and Lighting	100	118
(v) Miscellaneous	75	101

**Ans: (i) Rs 300 (ii) Rs 150**

11. In calculating the cost of living index the following weights were used: Food  $8\frac{1}{2}$ ; Rent 2; Clothing  $2\frac{1}{2}$ ; Fuel and Light 1; Miscellaneous 11. Calculate the index number for a data when the percentage increase in prices of the various items over prices of July, 2018 = 100 were 31, 57, 90, 75 and 88 respectively.

**Ans: 152.2**

12. In calculating a certain cost of living index number, the following weights were used. Food 15, Clothing 3, Rent 4, Fuel and Light 2, Miscellaneous 11. Calculate the index for a date when the average percentage increases in price of item in the various groups of the base period were 32, 54, 47, 78 and 58 respectively.

Suppose a business executive was earning Rs 2,050 in the base period. What should be his salary in the current period if his standard of living is to remain the same?

**Ans: 141.76; Rs 2,906.08**

13. The cost of living index uses the following weights:

Food 40, Rent 15, Clothing 10, Fuel 10, Miscellaneous 15. During the period 2010 – 15, the cost of living index raised from 100 to 205.83. Over the same period the percentage rise in prices were:

Rent 60, Clothing 180, Fuel 75 and Miscellaneous 165. What is the percentage of change in the price of food?

**Ans: 90**

14. The relative importance of the following eight groups of family expenditure we found to be – Food 348, Rent 88, Clothing 97, Fuel and Light 65, House durable goods 71, Miscellaneous goods 35, Services 79, Drink and tobacco 217. The corresponding % increase in price for Oct. 2015 gave the following values – 25, 1, 22, 18, 14, 13, ? and 4. Calculate the percentage increase in group – services, if the percentage increase for whole group is 15.278.

**Ans: 11**

15. From some given data, the retail price index based on five items, viz. Food, Rent and Rates, Fuel and Light, Clothing and Miscellaneous was calculated as 205. Percentage increases in prices over the base period are given below:

Rent and Rates 60, Clothing 210, Fuel and Light 120, Miscellaneous 130

Calculate the percentage increase in the Food Group, given that the weights of different items are as follows:

Food 60, Rent and Rates 16, Fuel and Light 8, Clothing 12, Miscellaneous 4, All items 100.

**Ans: 92.3% increase in food group**

16. Calculate the cost of living index number form the following data:

Group/Commodities	Weights	Group/Commodity Index Number
	W	
Food	71	370
Clothing	3	423
Fuel, etc.	9	469
House Rent	7	110
Miscellaneous	10	279

**[C.A. (Foundation), Nov. 2001]**

**Ans: 353.20**

17. The subgroup indices of the consumer price index number of workers of an industrial town for the year 2013 (with base 2008) were:

Food	Cloth	Fuel and Light	House Rent	Miscellaneous
180	140	125	200	150

18. The weights of the various subgroups are 50, 9, 6, 15 and 20 respectively. It is proposed to fix industrial dearness allowance such that the employees are compensated fully for the rise in prices of food and house rent but only to the extent of 50% of increase in the prices of the rest of the sub-groups. What should be the dearness allowance expressed as percentage of wages?

**Hint: Since the employees are compensated fully for the rise in price of food and house rent but only to the extent of 50% of increased in the prices of the rest of the subgroups, for clouting the C.O.L. Index (for giving compensation) were will take the index of cloth, fuel and light, and miscellaneous items as:**

$$100 + \frac{40}{2} = 120, 100 + \frac{25}{2} = 112.5 \text{ and } 100 + \frac{50}{2} = 125, \text{ respectively. C.O.L. Index} = 162.5$$

**Hence, the dearness allowance to be given to employees should be 62.55% of their wages in 2008.**

19. The group indices and the corresponding weights for the working class cost of living index numbers in an industrial city for the years 2016 and 2020 are given below:

Group	Weight	Group Index	
		2016	2020
Food	71	370	380
Clothing	3	423	504
Fuel, etc.	9	469	336
House Rent	7	110	116
Miscellaneous	10	279	283

(a) Compute the cost of living indices for the two year 2016 and 2020.

(b) If a worker was getting Rs 3,000 per month in 2016, do you think that he should be given some extra allowance so that he can maintain his 2016 standard of living? If so, what should be the minimum amount of this extra allowance?

**Ans: (a) 353.20; 351.58 (b) No extra allowance should be given**

20. Labour and capital are used in two different proportions to products A and B, but the price of each input is equal for both products. On the basis of the information given in the attached table, prepare, for the year 2020 separate price indices for labour and capital:

	Product A	Product B
Weight for labour	60	70
Weight for capital	40	30
Cost of Production Index for 2020 (Base Year 2010 = 100)	340	330

**Ans: P<sub>01</sub> (Labour) = 300; P<sub>01</sub> (Capital) = 400**

21. An enquiry into the budgets of the middle class families in a certain city in India gave the following information:

Expenses on	Food	Fuel	Clothing	Rent	Misc.
	35%	10%	20%	15%	20%
Price in 2015 (Rs)	150	25	75	30	40
Price in 2016 (Rs)	145	23	65	30	45

What is the cost of living index number of 2016 as compared with that of 2015?

**Ans: 102.86**

22. Using the formula  $I_x = \frac{\sum q_0 p_1}{\sum q_0 p_0} \times 100$ , and find the consumer price index for 2020 with 2009 as base with the help of the following data. Interpret the Index Number so obtained.

Item No.	Quantity consumed in 2009 (q <sub>0</sub> )	Price per unit in 2009 (p <sub>0</sub> )	Price per unit in 2009 (p <sub>1</sub> )



1	75	3.4	9.6
2	16	2.5	8.5
3	15	7.6	12.6
4	22	4.5	7.5
5	13	7.0	11.0
6	3	2.0	4.0

**Ans: 225.61**

23. Construct the consumer price index numbers for 2019 and 2020 from the indices given below:

Year	Food	Rent	Clothing	Fuel	Misc.
2018	100	100	100	100	100
2019	102	100	103	100	97
2020	106	102	105	101	98

Assume the following weights for different groups:

Food	Rent	Clothing	Fuel	Misc.
60	16	12	8	4

**Ans: For 2016: 101.44; For 2020: 104.52**

24. Index of Industrial Production covers three groups of industries. The index increased from 106.4 to 150.2 from one point of time to another. The index number of individual three groups of industries, over the same period, changed as follows: Mining and Quarrying from 102.0 to 144.1; Manufacturing from 106.5 to 146.6; Electricity from 110.4 to 189.9

Determine the weights for the individual groups of industries.

**Ans: (9.9, 81.2, 8.9) = (10, 81, 9)**

25. If the Consumer Price Index (for the same class of people and with same base year) is higher for Delhi than that for Mumbai, does it necessarily mean that Delhi is more expensive (for this class of people) than Mumbai. Give reasons in support of your answer.
26. Owing to change in prices, the consumer price index of the working class in a certain area rises in a month by one quarter of what it was before, to 225. The index of food became 252 from 198, that of clothing from 185 to 2015, that of fuel and lighting from 175 to 195, and that of miscellaneous from 138 to 212. The index of rent, however, remained unchanged at 15. It was known that weight of clothing, rent, and fuel and lighting were the same. Find out the exact weight weights of all the groups.

**Hints: Let  $I_1$  and  $I_2$  be the index number in the beginning of the month and at the end of the month respectively.**

$$\text{So } I_2 = 225 \text{ and } I_1 = \left(1 + \frac{1}{4}\right) I_1 = \frac{5}{4} I_1 \Rightarrow I_1 = \frac{4}{5} \times 225 = 180$$

**By forming and solving the two equations i.e. one at the beginning and one at the end, the following weights will be found:**

**Food: 54, Clothing: 10, Fuel and Lighting: 10, Rent: 10, Miscellaneous: 16**

27. In a working class consumer price index number of a particular town the weights corresponding to different groups of items were as follows:

Food – 55, Fuel – 15, Clothing – 10, Rent – 8 and Miscellaneous – 12

In Oct. 2020, the DA was fixed by a mill of that town at 182 per cent for the workers which fully compensated for the rise in prices of food and rent but did not compensate for anything else. Another mill of the same town paid D.A. of 46.5 per cent which compensated for the rise in fuel and miscellaneous groups. It is known that rise in food is double than that of fuel and the rise in miscellaneous group is double than that of rent.

Find the rise in food, fuel, rent and miscellaneous groups.

**Ans: Percentage increase is:**

**Food: 317.14; Fuel: 158.57; Rent: 94.64; Miscellaneous: 189.28**

28. The estimated per capita income for India in 1931-32 was Rs 65. The estimated for 1972-73 was Rs 650. In 1972-73, every Indian was, therefore, 10times more prosperous than in 1931-32. Comment.

### Time Series Analysis

#### Exercise F

1. Discuss the relative merits and demerits of 'free-hand curve' method of studying trend. What point will you keep in mind in drawing such a trend curve?

With the help of graph paper, obtain the trend curve:

Year :	1992	1993	1994	1995	1996	1997	1998
Value :	64	82	97	71	78	112	115
Year :	1999	2000	2001	2002	2003	2004	
Value :	131	88	100	146	150	120	

2. Compute the values by the method of semi-averages from the data given below:

Year :	2012	2013	2014	2015	2016	2017	2018	2019
No. of sheep (in lakhs) :	56	55	51	47	42	38	35	32

**Ans: Trend values (in lakhs) for the year 2012 to 2019 are: 59, 56, 50.5, 46.5, 41.5, 37, 35, 32**

3. The sales of a commodity in tones varied from January 2009 to December 2009 in the following manner:

280	300	280	280	270	240
230	230	220	200	210	200

Find a trend by the method of semi-average.

4. Fit a trend line from the following data by using semi-average method:

Year :	2013	2014	2015	2016	2017	2018
Profit (in '000 lakhs) :	100	120	140	150	130	200

**Ans: By joining the points (2014, 120) and (2017, 160), we get the trend line.**

5. Fit a straight line trend to the following data using the method of least squares and calculate the production for the year 2021:

Year :	2016	2017	2018	2019	2020
Production ('000 tons) :	83	92	74	90	166

**Ans:  $Y = 101 + 16.4X$ ; (X - Origin = 1998); Estimated production for 2021 is 150.2 ('000 tones)**

6. Fit a straight line trend to the following data by Least Square Method:

Year :	2011	2013	2015	2017	2019
Production :	18	21	23	27	16

Specify the year of origin. Estimate production for the year 2018 and 2020.

**Ans:  $Y = 21 + 0.1X$  [Origin X : 2015];  $(Y)_{2018} = 21.3$ ;  $(Y)_{2020} = 21.5$**

7. Fit a straight line trend to the following data and estimate the value of output for the year 2017:

Year :	2007	2008	2009	2010	2011	2012	2013
Production of steel: (in million tons)	60	72	75	65	80	85	95

**Ans:  $Y_c = 76 + 4.86X$  (Origin 2010); Y = million tons:  $(Y)_{2017} = 110.02$  (million tons)**

8. Below are given the figures of production (in thousand quintals) of a sugar factory:

Year :	2013	2014	2015	2016	2017	2018	2019
Production (in '000 quintals):	80	90	92	83	94	99	92

(i) Fit a straight line trend to these figures by the method of least squares.

(ii) Show the given data and the trend line on the graph paper;

- (iii) Estimate the production for 2022;  
 (iv) Find the slope of the straight line trend;  
 (v) Do the figures show a rising trend or a falling trend?  
 (vi) What does the different between the given figures and trend values indicate?

**Ans: (i)  $Y_c = 90 + 2X$ : Origin: 2016 (1<sup>st</sup> July)**

**Trend values ('000 quintals): 84, 86, 88, 90, 92, 94, 96**

**(iii)  $(Y)_{2022} = 102$  ('000 quintals); (iv) Slope = 2 ('000 quintals) (v) Rising trend: since slope is positive**

9. Fit a straight line trend to the time series data given below by 'least squares method' and predict the sales for the year 2020:

Year (t) :	2013	2014	2015	2016	2017	2018	2019
Sales (in lakh Rs) (Y) :	25	30	38	50	62	80	95

**Ans: Straight line trend:  $Y = 54.29 + 11.93X$ ; ( $X = t - 1996$ )**

**Estimated sales for 2020 are:  $Y = [54.29 + 11.93 (2020 - 1996)] = \text{Rs } 102.01$  lakhs.**

10. Fit a straight line trend to the following data by least squares method taking 2009 as the year of origin and estimate exports for the 2015:

Year :	2006	2007	2008	2009	2010	2011	2012
Export (in tonnes) :	47	50	53	65	62	64	72

**Ans: Straight line trend:  $Y = 59 + 4x$ ; ( $X = t - 1999$ )**

**Estimated exports for 2015:  $Y = 59 + 4 \times 6 = 83$  tonnes.**

11. Using the method of least squares, fit a straight line to the following data and find the trend values and short term fluctuations.

Year :	2010	2011	2012	2013	2014	2015	2016	2017	2018
Values :	232	226	220	180	190	168	162	152	144

**Ans: Trend Values ( $Y_c$ ): 234, 222, 210, 198, 186, 174, 162, 150, 138**

**Short-term fluctuations: ( $Y - Y_c$ ): - 2, 4, 6, - 18, 4, - 6, 0, 2, 6 (Assuming additive model)**

12. You are given the exports of electronics goods from 2010 to 2019. Fit a linear trend to the exports data and estimated the expected exports for the year 2025;

Year :	2010	2011	2012	2013	2014	2015
Exports (crores Rs.) :	11	16	13	18	22	20

**Ans:  $Y = 11.529 + 1.063X$ ; (Origin 1990):  $Y_{2025} = 27.474$  (crores Rs.)**

13. The following table shows the consumption of butter in a district in different years. Obtain the trend values by the method of least squares.

Year :	2009	2010	2011	2012	2013	2014
Consumption ('000 kgs.) :	60	80	90	120	145	170

(b) Also obtain the monthly increase in consumption of butter.

**Ans: (a)  $Y_c = 110.83 + 11.07X$ ;  $X = 2(t - 2011.5)$**

**Trend Values (in '000 kgs.): 55.48, 77.62, 99.76, 121.90, 144.04, 166.18**

**(b) Monthly increase in consumption of butter = 1.8450 ('000 kgs.) = 1845 kgs.**

14. Fit a straight line trend equation by the method of least squares and estimate the value for 2019:

Year :	2010	2011	2012	2013	2014	2015	2016	2017
Value :	380	400	650	720	690	600	870	930

**Ans:  $Y_c = 655 + 35.83X$ ;  $X = 2(t - 2013.5)$**

**Trend Values: 404.19, 175.85, 547.51, 619.17, 690.83, 762.49, 834.15, 905.81;**

**$Y_{2019} = 1049.13$**

15. The following data relate to the number of passenger cars (in millions) produced from 2013 to 2020:

Year	2013	2014	2015	2016	2017	2018	2019	2020
------	------	------	------	------	------	------	------	------

Number	6.7	5.3	4.3	6.1	5.6	7.9	5.8	6.1
--------	-----	-----	-----	-----	-----	-----	-----	-----

Fit a straight line trend by the method of least squares to the above time series data. Use your result to estimate the production in 2020 and compare it with actual production.

**Ans:  $Y = 5.975 + 0.0512X$ ;  $X = 2(t - 2016.5)$ ;  $Y_{2020} = 6.3337$  millions.**

16. In a study of its sales, a motor company obtained the following least square trend equations:

$Y = 1,600 + 200X$  (origin 2010, X units = 1 year; Y = total number of units sold annually)

The company has physical facilities to produce only 3,600 units a year and it believes that it is reasonable to assume that at least for the next decade the trend will continue as before.

(a) What is the average annual increase in the number of units sold?

(b) By what year will the company's expected sales have equaled its present physical capacity?

(c) Estimate the annual sales for 2015.

How much in excess of company's present physical capacity is this estimated value?

**Ans: (a) 200 units (b) In 2020 (c) 4,600 units: Excess = 4,600 - 3,600 = 1,000 units**

17. Convert the following annual trend equation for total sales of a company to a monthly trend equation:

$Y = 162 + 15.8X$  (Origin: 2015; Scale: 1 units of X = 1 year)

Forecast the sales for June, 2018 by the two equations. Compare your results.

**Ans:  $Y = 13.5 + 0.1097X$ ; (Origin: 2015, X unit = 1 month: Y unit = monthly sales)**

18. The trend of the annual sales of Bharat Aluminum Company is described by the following equation:

$Y_c = 12 + 0.7X$ : (Origin: 2010; X unit = 1 year and Y unit = Annual production)

Step the equation down to a month to month basis and shift the origin to 1<sup>st</sup> January 2010.

**Ans:  $Y_c = 1 + \frac{0.7}{144} X$ ; (Origin: 1<sup>st</sup> July 2010; X unit = 1 month);**

**$Y_c = 0.9712 + 0.0048X$  (Origin: 1<sup>st</sup> January, 2010)**

19. The trend equation for certain production is given by :  $Y = 3,600 + 288t$ ; where

Y = Annual production in thousand tons: t: Time with origin, the year 2010 and unit = 1 year

Estimate the trend value of the production for September, 2014.

**[I.C.W.A (Intermediate) June, 2000]**

Hints: Monthly trend equation is given by:

20.  $Y = \frac{3,600}{12} + \frac{288}{144} t = 300 + 2t$ : Origin: 1<sup>st</sup> July, 2010; t: Unit 1 month; Y: Monthly production

For September 2014 i.e. 15<sup>th</sup> September, 2014:  $t = 4 \times 12 + 2.5 = 50.5$

Estimated production for 2014 =  $300 + 2 \times 50.5 = 401$  thousand tons.

### Exercise G

1. Using three-year moving averages, determine the trend and short-term fluctuations. Plot the original and trend values on the same graph paper:

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production (in '000 tonnes)	21	22	23	25	24	22	25	26	27	26

**Ans: Trend (3 yearly M.A.): 22 23.3 24 23.7 23.7 24.3 26 26.3**

**Using additive model, short-term fluctuations are: 0, -0.3, 1.0, 0.3, -1.7, 0.7, 0, 0.7**

2. Assuming an additive model, apply 3 year moving average to obtain the trend-free series for years 2 to 6:

Year	1	2	3	4	5	6	7	8
Exports (Rs lakhs)	126	130	137	141	145	155	159	

<b>Ans: Year</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>M.A. Values</b>	----	<b>131</b>	<b>136</b>	<b>141</b>	<b>147</b>	<b>153</b>	----	
<b>Trend free Values</b>	----	<b>- 1</b>	<b>1</b>	<b>0</b>	<b>- 2</b>	<b>2</b>	----	

3. From the following data, calculate the trend values using four-yearly moving average:

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Values	506	620	1036	673	588	696	1116	738	663

**Ans: M.A. Values for 2011 to 2015 respectively are: 719, 738.75, 758.25, 776.375, 793.875**

4. Assuming a four-year cycle, calculate the trend by the method of moving average from the following data relating to production of tea in a certain tea estate:

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Production (Kg.)	464	515	518	467	502	540	557	571	586	612

**[I.C.W.A (Intermediate) Dec' 1999]**

**Ans: 4-yearly M.A.'s for 2013 to 2018 respectively are:**

**495.70, 503.60, 511.60, 529.50, 553.00, 572.50**

5. From the given data, compute 'trend' and 'short-term fluctuations' by the Moving Average Method, assuming a four-yearly cycle and multiplicative model:

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Sales	75	60	55	60	65	70	70	75	85	100	70

<b>Ans: Years:</b>		<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<b>M.A. Values</b>		<b>61.2</b>	<b>61.2</b>	<b>64.37</b>	<b>68.12</b>	<b>72.5</b>	<b>78.7</b>	<b>82.50</b>
		<b>5</b>	<b>5</b>			<b>0</b>	<b>5</b>	
<b>Trend values</b>	<b>eliminated</b>	<b>89.8</b>	<b>97.9</b>	<b>100.98</b>	<b>102.76</b>	<b>96.5</b>	<b>95.2</b>	<b>103.03</b>
		<b>0</b>	<b>6</b>			<b>5</b>	<b>4</b>	

6. Eliminate trend by moving average method and comment:

Year	1 <sup>st</sup> Quarter	2 <sup>nd</sup> Quarter	3 <sup>rd</sup> Quarter	4 <sup>th</sup> Quarter
2015	40	35	38	40
2016	42	37	39	38
2017	41	35	38	42

**Ans: M.A. Values (M.A.V.) and Trend Eliminated Values (T.A.V.) (Assuming multiplicative model) for 3<sup>rd</sup> Quarter of 2015 to 2<sup>nd</sup> Quarter of 2017, respective are:**

**M. A. V. 38.5 39.0 39.375 39.25 38.875 38.5 38.125 38.5**

**T. E. V. 98.70 102.56 106.67 94.27 100.32 98.70 107.54 90.91**

7. What is trend in a time series? The following table gives the annual sales (un Rs 1,000) of a commodity:

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Sales	710	705	680	687	757	629	644	783	781	805	873

Determine the trend by calculating the 5 yearly moving averages.

**8. [I.C.W.A. (Intermediate) June, 1995]**

**Ans: 5 yearly M.A. (Trend) for 2012 to 2018 are respectively: (Rs 1,000)**

**707.80, 691.60, 679.40, 700.00, 718.80, 728.40, 777.00**

9. Find the trend for the following series using a three-year weighted moving average with weights 1, 2, 1.

Year	1	2	3	4	5	6	7
Value	2	4	5	7	8	10	13

**Ans: 3.75, 5.25, 6.75, 8.25, 10.25**

10. For the following series of observations, verify that the 2-year centred moving average is equivalent to 3-year weighted moving average with weights 1, 2, 1 respectively.

Year	2014	2015	2016	2017	2018	2019	2020
Value	2	4	5	7	8	10	13

**[I.C.W.A. (Intermediate) June, 2002]**

**Ans: M.A. Values for 2015 to 2019 are respectively: 3.75, 5.25, 6.75, 8.25, 10.25**

11. For the following data, verify that the 5-yearly moving weighted moving average trend values with weights 1, 2, 2, 2, 1 respectively are equivalent to 4-yearly centred moving average trend values.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Sales (Rs lakhs)	5	3	7	6	4	8	9	10	8	9	9

Ans: M.A.'s for 2007 to 2013 are: 5.125, 5.625, 6.500, 7.250, 8.250, 8.875, 9.000

### Exercise 9.3

1. Compute the seasonal averages, and seasonal indices for the following time-series:

Month	2014	2015	2016	Month	2014	2015	2016
Jan.	15	23	25	July	20	22	30
Feb.	16	22	25	Aug.	28	28	34
March	18	28	35	Sept.	29	32	38
April	18	27	36	Oct.	33	37	47
May	23	31	36	Nov.	33	34	41
June	23	28	30	Dec.	38	44	53

[Hints: Use Method of Simple Average]

Ans: 70, 70, 90, 90, 100, 90, 80, 100, 110, 130, 120, 150.

2. Assuming no trend in the series, calculate seasonal indices for the following data:

Year	Quarter (in units)			
	I	II	III	IV
2014	78	66	84	80
2015	76	74	82	78
2016	72	68	80	70
2017	74	70	84	74
2018	76	74	86	82

[C.A. (Foundation) May, 1999]

Hints: Use the method of simple averages

Ans: Seasonal indices for the four quarters are: 98.43; 92.15; 108.90; 100.52

3. Find seasonal variations by the ratio-to-trend method from the data given below:

Year	1 <sup>st</sup> Quarter	2 <sup>nd</sup> Quarter	3 <sup>rd</sup> Quarter	4 <sup>th</sup> Quarter
2013	30	40	36	34
2014	34	52	50	44
2015	40	58	54	48
2016	54	76	68	62
2017	80	92	86	82

Ans: Straight line trend equation is given by:  $Y = 56 + 12X$

Origin: 1995 (1<sup>st</sup> July): X units = 1 year : Y units : Average quarterly values.

Seasonal Indices: 92.0, 117.4, 102.1, 88.5

4. Find the seasonal variations by the ratio to trend method from the data given below:

Year	Quarter			
	I	II	III	IV
2011	60	80	72	68
2012	68	104	100	88
2013	80	116	108	96
2014	108	152	136	124
2015	160	172	172	164

Ans:

Quarter	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub>
S.I. (Adjusted)	92.05	117.36	102.13	88.46

- 5.

11. From the given ratios of observed values to trend values (%), calculate seasonal indices. If sales for 2021 are expected to be Rs 2,000

Years	Quarters			
	I	II	III	IV
2017	80	95	80	110

lakhs, what are the likely sales for individual quarters?

2018	101	104	90	110
2019	100	95	90	100
2020	115	110	100	120

Out of additive and multiplicative models in time series analysis, which is better and why?

**Ans: S.I.: 99, 101, 90, 110**

6. 12. Calculate the seasonal indices from the following data:

Year	Ratio to Moving Averages (%)			
	Quarters			
	I	II	III	IV
2017	-----	-----	85.21	90.25
2018	128.12	91.71	96.10	10.90
2019	112.33	100.35	78.13	97.88
2020	105.20	103.50	-----	-----

**Ans: 115.93, 99.12, 87.01, 97.93**

7. Calculate the seasonal indices from the following ratio-to-moving average values expressed in percentage:

Year	Season → Summer	Rain	Winter
2019	----	101.75	107.14
2020	96.18	92.30	114.00
2021	92.45	95.20	118.18

**[C.A. (Foundation) May, 2002]**

**Ans: (Summer) 93.127; (Rain) 95.202; (Winter) 111.683**

8. The following are the figures of quarterly production, for which some quarterly centered moving averages have been calculated:

Year	Quarter	Production	Moving average
2012	1	216	-----
	2	281	-----
	3	209	227.00
	4	200	226.13
2013	1	220	229.88
	2	270	237.50
	3	250	243.75
	4	220	252.50
2014	1	250	
	2	310	
	3	280	
	4	246	

Calculate the remaining values of moving averages. Treating the moving averages as trend values, compute the seasonal indices

**Ans: M.A. values for I and II Quarter of 2014 are 261.25, 268.25**

**Assuming multiplicative model of time series, Seasonal Indices are: 96.65, 115.77, 98.29, 88.67**

9. Given the following quarterly sales figures in thousands of rupees for the year 2016-2019, find the specific seasonal by the method of moving averages.

	I	II	III	IV
2016	290	280	285	310
2017	320	305	310	330
2018	340	321	320	340
2019	270	360	362	380

**Ans: 104.25, 97.94, 96.52, 101.29**

10. Obtain the seasonal indices by the link relative method, for the following data:

**AVERAGE QUARTERLY PRICE OF A COMMODITY**

Quarter	Years				
	2016	2017	2018	2019	2020
I	30	35	31	31	34
II	26	28	29	31	36
III	22	22	28	25	26
IV	31	36	32	35	33

**Ans: 108.02, 99.75, 81.21, 111.0**



## UNIT - I

### Fill in the blanks:

#### Chapter - 1 (Collection of data)

1. There are \_\_\_\_\_ methods of collecting primary data.
2. There are \_\_\_\_\_ method of collecting secondary data.
3. Data are classified into \_\_\_\_\_ and \_\_\_\_\_.
4. \_\_\_\_\_ is a suitable method of collecting data when the informants are literates and spread over a vast area.
5. Data originally collected by an investigator are known as \_\_\_\_\_.
6. Before a questionnaire is finalized, it should be \_\_\_\_\_.
7. Process of assembling the primary data is called \_\_\_\_\_ of statistics.
8. Questionnaire method cannot be used when the informants are \_\_\_\_\_.
9. Most of the statistical analysis rest on \_\_\_\_\_ data.
10. The data which is more reliable is known as \_\_\_\_\_ data.
11. The data which are collected from outside are known as \_\_\_\_\_ data.
12. The data which are collected from inside are known as \_\_\_\_\_ data.
13. The data which are collected from the source of origin are known as \_\_\_\_\_ data.
14. The data which are collected from published and unpublished sources are known as \_\_\_\_\_ data.
15. Person who conducts the statistical enquire is known as -----.
16. The person who helps the investigator in collecting the information is known as \_\_\_\_\_.
17. The persons from whom the statistical data are collected are known as \_\_\_\_\_.
18. The investigation method in which the investigator himself personally goes to the sources of data is known as \_\_\_\_\_ method.
19. The \_\_\_\_\_ investigation method adopted when the original informants are either not found or found to be reluctant to provide information in writing.
20. The method of collecting data adopted by the New Paper or periodical agencies is known as \_\_\_\_\_.
21. When a list of questions relating to the subject matter of the problem is sent to the informants then it is known as ----- method.
22. When the questionnaire contains only two types of answer i.e. Yes or No then it is known as \_\_\_\_\_.
23. The questionnaire which contains three types of answers i.e. Yes or No or Don't know then it is known as \_\_\_\_\_.
24. The questionnaire which contains more than three alternatives answers is known as \_\_\_\_\_.
25. The strategy to test the questionnaire using a smaller sample compared to plan size is known as \_\_\_\_\_.
26. That data which includes one piece of information is known as \_\_\_\_\_.
27. The set of data which includes information on two characteristics is known as \_\_\_\_\_.
28. The set of data which comprises of three or more characteristics is known as \_\_\_\_\_.
29. The data which are recorded in chronological order is known as \_\_\_\_\_.
30. The data which not recorded in time sequence is known as \_\_\_\_\_.

#### Answers:

1.	5	2.	3
3.	Primary , Secondary	4.	Mailed Questionnaire
5.	Primary Date	6.	Pretested
7.	Collection	8.	Illiterates
9.	Secondary data	10.	Primary data
11.	External data	12.	Internal data
13.	Primary data	14.	Secondary data
15.	Investigator	16.	Enumerator

17.	Respondent	18.	Direct Personal Investigation
19.	Indirect oral investigation	20.	Local correspondent
21.	Questionnaire	22.	Dictonomous
23.	Tricotomons	24.	Multiple questions
25.	Pilot survey	26.	Univariate data
27.	Bivariate data	28.	Multi-variate data
29.	Time series data	30.	Cross sectional data

## Chapter - 2 (Classification and Tabulation of data)

- Classification is the \_\_\_\_\_ step in tabulation.
- In classification and tabulation \_\_\_\_\_ is the chief requisite and \_\_\_\_\_ is the chief teacher.
- When data are observed \_\_\_\_\_, the type of classification is known as chronological classification.
- The number of observations corresponding to particular class is known as the \_\_\_\_\_ of that class.
- \_\_\_\_\_ classification is done according to some characteristics that can be measured.
- Classification, Seriation and Tabulation are \_\_\_\_\_ to each other.
- Classification and tabulation facilitate further \_\_\_\_\_.
- Statistical errors can be \_\_\_\_\_ through classification and tabulation.
- A discrete variable can be presented in a \_\_\_\_\_ series.
- When a series in which different value of a variable are shown in a discontinuous manner along with respective frequency is known as \_\_\_\_\_ series.
- Arrangement of data into various groups or categories of homogeneous character is known as \_\_\_\_\_.
- When the data are classified on the basis of area or place then it is known as \_\_\_\_\_ classification.
- A characteristic which varies in amount of magnitude under different time and place is known as \_\_\_\_\_.
- The variable which always takes an integral value viz. 10, 15, 20, 12, etc. is known as \_\_\_\_\_.
- The difference between the largest value and smallest value of a variable is known as \_\_\_\_\_.
- The form of classification made by excluding the upper boundary of a class viz. (0 - 10), 10 will be excluded is known as \_\_\_\_\_.
- The form of classification made by including the upper boundary of a class viz. (0 - 10) both 0 and 10 will be included is known as \_\_\_\_\_.
- The number of items coming within or shown against a particular class is known as \_\_\_\_\_.
- The small lines put usually vertically as the representative of an item against a particular value e.g. *IIII* is known as \_\_\_\_\_.
- The frequency per unit of class interval or magnitude of a class is known as \_\_\_\_\_.
- Number of observations with similar or closely related values are put in separate bunches or groups and each group are in order of magnitude in a class is known as \_\_\_\_\_.
- The arrangement of the different values of a variable in a successive manner is known as \_\_\_\_\_.
- An individual series arranged in order i.e. Ascending or Descending is known as \_\_\_\_\_.
- The row heading of a table is known as \_\_\_\_\_.

Answers:

1.	First	2.	Commonsense, Experience
3.	Over a period of time	4.	Frequency
5.	Quantitative	6.	Complementary
7.	Analysis of data	8.	Minimised
9.	Continuous	10.	Discrete
11.	Classification	12.	Geographical/Areal/spatial
13.	Variable	14.	Discrete variable
15.	Range	16.	Exclusive form
17.	Inclusive form	18.	Class frequency

19.	Tally Bar	20.	Frequency density
21.	Frequency distribution	22.	Seriation
23.	Array	24.	Stub

## Chapter – 4 (Measures of Central Value)

- \_\_\_\_\_ is more suitable measure of central tendency as it is least affected by sampling fluctuation.
- Harmonic Mean gives \_\_\_\_\_ weightage to smaller values.
- Simple Arithmetic Mean gives \_\_\_\_\_ weightage to values of the variables.
- Mean is affected by presence of \_\_\_\_\_ values in the series.
- Reciprocal of the \_\_\_\_\_ of a number is the number itself.
- If Mean and number of items of different series are given, the \_\_\_\_\_ Mean can be obtained.
- If all the items of a series are divided by  $p$ , the value of Mean is also \_\_\_\_\_ by  $p$ .
- Harmonic Mean cannot be computed when any of the values in the series is \_\_\_\_\_.
- When all the values of a series are equal then the A.M., G.M. and H.M. of the series are \_\_\_\_\_.
- If any value in a series is zero, the value of Geometric Mean becomes \_\_\_\_\_.
- Median is a \_\_\_\_\_ average.
- Mode is the value that has the greatest \_\_\_\_\_.
- Percentiles divide the series into \_\_\_\_\_ equal parts.
- In a moderately skewed distribution, if the values of Mean and Median are 8 and 9, the value of Mode will be \_\_\_\_\_.
- \_\_\_\_\_ is the most ill defined average.
- When Mean, Median and Mode of a series are equal the series is called \_\_\_\_\_ series.
- In a positively skewed distribution Mode is \_\_\_\_\_ than Mean.
- Median is more suitable for \_\_\_\_\_ classification.
- A series having 2 modal values is called \_\_\_\_\_ series.
- Second quartile and \_\_\_\_\_ decile of a series are equal.
- Mode = 3 Median - \_\_\_\_\_.
- Median is better suitable in case of \_\_\_\_\_ series.
- Mode is better suited to \_\_\_\_\_ series.
- \_\_\_\_\_ average is better suited to qualitative phenomenon.
- The reciprocal of reciprocal of arithmetic mean is known as \_\_\_\_\_.
- The  $n^{\text{th}}$  root of the products of  $n$  items of a series is known as \_\_\_\_\_.
- The value of mean median and mode are equal in case of \_\_\_\_\_ distribution.
- The variable having the highest frequency is known as \_\_\_\_\_.
- \_\_\_\_\_ can be calculated from a frequency distribution with open end classes.
- In the calculation of \_\_\_\_\_, all the observations are taken into consideration.
- \_\_\_\_\_ is not affected by extreme observations.
- Average rainfall of a city from Monday to Saturday is 0.3 inch. Due to heavy rainfall on Sunday, the average rainfall for the week increases to 0.5 inch. The rainfall of Sunday was \_\_\_\_\_.
- The sum of squared deviations is minimum when taken from \_\_\_\_\_.
- The sum of absolute deviations is minimum when taken from \_\_\_\_\_.
- Median = \_\_\_\_\_ Quartile.
- Mean is \_\_\_\_\_ by extreme observations.
- Median is the average suited for \_\_\_\_\_ classes.
- For studying phenomenon like intelligence and honesty \_\_\_\_\_ is a better average to be used while for phenomenon like size of shoes or readymade garments the average to be preferred is \_\_\_\_\_.
- Typist A can type a sheet in 5 minutes, typist B in 6 minutes and typist C in 8 minutes. The average number of sheets types per hour per typist is \_\_\_\_\_.

40. The mean of 10 observations is 20 and median is 15. If 5 is added to each observation, the new mean is \_\_\_\_\_ and median is \_\_\_\_\_.
41. A distribution with two modes is called \_\_\_\_\_ and with more than two modes is called \_\_\_\_\_
42. Average suited for qualitative phenomenon is \_\_\_\_\_
43. If 25% of the observations lie above 80, 40% of the observations are less than 50 and 70% are greater than 40, then \_\_\_\_\_ = 80; \_\_\_\_\_ = 50; \_\_\_\_\_ = 40.
44. Relationship between Median,  $Q_1$ ,  $Q_2$  and  $Q_3$  is \_\_\_\_\_
45.  $D_5$ ,  $P_{80}$ , Median,  $D_7$  and  $P_{50}$  are related by \_\_\_\_\_
46. Relationship between  $D_4$ ,  $Q_2$ ,  $P_{60}$ ,  $P_{75}$  and  $Q_3$  is \_\_\_\_\_
47. The empirical relationship between mean, median and mode for a moderately asymmetrical distribution is \_\_\_\_\_
48. If the maximum frequency is repeated then mode is located by the method of \_\_\_\_\_
49. The distance covered is fixed but speeds are varying and an average speed is to be calculated by using \_\_\_\_\_ mean
50. When depreciation is charged by diminishing balance method and an average rate of depreciation is to be calculated by using \_\_\_\_\_ mean.
51. If the A.M. of  $X$  is 25, then A.M. of  $X + 2$  will be \_\_\_\_\_.
52. If the A.M. of  $X$  is 18, then A.M. of  $X - 2$  will be \_\_\_\_\_.
53. If the A.M. of  $X$  is 62, then A.M. of  $2X + 2$  will be \_\_\_\_\_.
54. If the A.M. of  $X$  is 28, then A.M. of  $3X - 2$  will be \_\_\_\_\_.
55. If the A.M. of  $X$  is 26, then A.M. of  $\frac{X}{2} + 5$  will be \_\_\_\_\_.
56. The A.M. of 50 items is calculated to be 12. If all the observations are increased by 3, then the new A.M. will be \_\_\_\_\_

**Answers:**

1.	Mean	2.	More
3.	No	4.	Extreme
5.	Reciprocal	6.	Combined
7.	Divided	8.	Zero
9.	Equal	10.	Zero
11.	Positional	12.	Frequency
13.	100	14.	11
15.	Mode	16.	Symmetrical
17.	Smaller	18.	Positional
19.	Bi-modal	20.	5 <sup>th</sup>
21.	2 Mean	22.	Open-end
23.	Equal class interval	24.	Median
25.	Harmonic Mean	26.	Geometric Mean
27.	Symmetrical	28.	Mode
29.	Median Or Mode	30.	Mean
31.	Median or Mode	32.	1.7"
33.	Mean	34.	Median
35.	Second	36.	Very much affect
37.	Open-end	38.	Median, Mode
39.	9.47	40.	25, 20
41.	Bi-modal, Multi-modal	42.	Median
43.	$Q_3 = 80, P_{40} = D_4 = 50, P_{30} = 40$	44.	$Q_1 < Q_2 = Md. \leq Q_3$
45.	$D_5 = P_{50} = Md. \leq D_7 \leq P_{80}$	46.	$D_4 < Q_2 < P_{60} < P_{75} = Q_3$
47.	$Mo. = 3Md. - 2M$	48.	Grouping
49.	Harmonic	50.	Geometric

51.	27	52.	16
53.	126	54.	82
55.	18	56.	15

## UNIT - II

- Q. D. is ----- of S. D.
- When  $Q_1 = 30$ ,  $Q_3 = 50$ , the coefficient of Q. D. is -----.
- If C. V. is 20,  $\bar{X}$  is 50,  $\sigma$  is -----
- If Variance is 81 and Mean is 50, CV is -----.
- $\sigma$  is known as the second ----- of dispersion and other measures of dispersion are known as ---  
----- of the order.
- Sum of the deviations from median is -----.
- Sum of the squares of deviations from ----- is the minimum.
- The dispersion of two distributions can't be compared properly without knowing their -----  
measure of dispersion.
- The relative measures of dispersion are ----- from units employed.
- The difference between two extreme values of a series is known as -----.
- The measure of dispersion which is used in quality control, weather forecast, price changes etc. is  
known as -----.
- The formula of standard deviation of first 'n' natural numbers is -----.

### Answers:

1.	2/3	2.	20	3.	25%	4.	18
5.	Order, none	6.	Minimum	7.	Mean	8.	Relative
9.	Exempted	10.	Range	11.	Range	12.	$\sqrt{\frac{1}{12}(n^2 - 1)}$

- is the simplest measure of dispersion.
- Coefficient of range is called coefficient of -----.
- Range, I.Q.R. and Q.D. are ----- measures of dispersion.
- Positional dispersion are ----- of positional average.
- Mathematical dispersion is ----- of further mathematical analysis.
- Range ----- be used in open-end distributions.
- Range is ----- by fluctuations of sampling.
- Median lies half-way on the same scale from  $Q_1$  to  $Q_3$  in ----- series.
- $Q_1 + QD \neq Q_3 - QD$  in ----- series of distribution.
- QD includes at least ----- percent in asymmetrical series.

### Answers:

1.	Range	2.	Scatter	3.	Positional	4.	counterparts
5.	capable	6.	cannot	7.	affected	8.	symmetrical
9.	asymmetrical	10.	fifty				

- Mean deviation is ----- defined.
- Mean deviation ----- affected by extreme items.
- Mean deviation is useful in ----- business cycle.
- Mean deviation is ----- capable of further algebraic treatment.
- Mean deviation is difficult to compute if Mean, Median and Mode are in -----.
- It is ----- to ignore ' $\pm$ ' signs in computing Mean Deviation.
- Mean Deviation is meaningful in studying ----- samples.
- Mean Deviation is rarely used in ----- studies/surveys.
- is based on all the observations of the series.
- Mean deviation is the ----- mean of deviations taken from a central value.
- Mean deviation is also known as mean ----- deviation.
- Mean deviation is also known as first ----- of dispersion.

### Answers:

1.	Rigidly	2.	Less	3.	Forecasting	4.	Not
5.	Fractions	6.	Illogical	7.	Small	8.	Socio-logical

9.	Mean deviation	10.	Arithmetic	11.	Absolute	12.	Moment
----	----------------	-----	------------	-----	----------	-----	--------

- is the best measure of dispersion.
- Standard Deviation is ----- of the change of origin.
- S.D. is ----- upon change in scale.
- Coefficient of variation is the ----- of coefficient of Standard Deviation.
- The Standard Deviation of first 'n' natural numbers is -----.
- Standard Deviation can only be calculated from -----.
- S.D. is free from any defects suffered by ----- measure of dispersion.
- S.D. is capable of ----- algebraic treatment.
- When mean is 12, Variance is 9, the coefficient of variation is -----.
- If in a series the coefficient of variation is 55.42% and Mean is 46, the Standard Deviation shall be -----.
- If the coefficient of variation of a series is 48.86 and its Standard Deviation is 24.43, the Arithmetic Mean shall be -----.
- The higher the degree of variability, the ----- is the consistency in the value of variables.

Answers:

1.	Standard Deviation	2.	independent	3.	dependent	4.	percentage
5.	$\sqrt{\frac{n^2-1}{12}}$	6.	Mean	7.	Other	8.	Further
9.	25%	10.	25.495	11.	50	12.	Lesser

- The sum of the squares of deviations of 10 observations taken from Mean 50 is 250. The C.V. of the series will be \_\_\_\_\_.
- The Mean and S.D. of a series are 30 and 60 respectively. By adding 2 to each variable, the new Mean = \_\_\_\_\_ and new S.D. = \_\_\_\_\_.
- If both the Mean and the Variance of a series are 25, the coefficient of S.D. = \_\_\_\_\_ and C.V. = \_\_\_\_\_.
- If 25% of the items are less than 10 and 25% are more than 40, the coefficient of Q.D. will be \_\_\_\_\_.
- The median and standard deviation are 20 and 4 respectively. If each item is increased by 2, the median will be \_\_\_\_\_ and the S.D. will be \_\_\_\_\_.
- Q. D. is an \_\_\_\_\_ measure of dispersion.
- The \_\_\_\_\_ the Lorenz Curve is from the line of the equal distribution, the greater is the variability in the series.
- Variance is equal to square of \_\_\_\_\_.
- Mean deviation is normally calculated by taking deviations from \_\_\_\_\_.
- Sum of the deviations is least when taken from \_\_\_\_\_.
- Standard deviation is calculated by taking deviations from \_\_\_\_\_.
- If each item is added by 5 then the value of S. D. will be \_\_\_\_\_.
- If each item is multiplied by 3, the value of S. D. will be \_\_\_\_\_.
- If each item is multiplied by 2, the value of Variance will be \_\_\_\_\_.
- The measure of dispersion which is most affected by the values of extreme items is \_\_\_\_\_.
- The measure of dispersion which takes the middle 50% of the items is \_\_\_\_\_.
- The half of Inter Quartile Range is known as \_\_\_\_\_.
- The formula of coefficient of variation is \_\_\_\_\_.

Answers:

1.	10	2.	32	3.	20, 20%
4.	60%	5.	22, 4	6.	Absolute
7.	Farther	8.	Standard deviation	9.	Median
10.	Median	11.	Arithmetic Mean	12.	Unchanged
13.	Multiplied by 3	14.	Multiplied by 4	15.	Range
16.	Inter Quartile Range	17.	Quartile Deviation	18.	$\frac{S.D.}{Mean} \times 100$

UNIT - III

Correlation Analysis:

- 1) The value of correlation coefficient must lie in between \_\_\_\_\_.
- 2) When the value of correlation coefficient is + 1 then it is known as \_\_\_\_\_.
- 3) When the value of correlation coefficient is - 1 then it is known as \_\_\_\_\_.
- 4) When the value of correlation coefficient is 0 then it is known as \_\_\_\_\_.
- 5) If all the variables are added with a constant then the value of correlation coefficient will be \_\_\_\_\_.
- 6) If all the variables are deducted with a constant then the value of correlation coefficient will be \_\_\_\_\_.
- 7) If all the variables are multiplied with a constant then the value of correlation coefficient will be \_\_\_\_\_.
- 8) If all the variables are divided with a constant then the value of correlation coefficient will be \_\_\_\_\_.
- 9) The value of correlation coefficient is \_\_\_\_\_ of change of scale.
- 10) The value of correlation coefficient is \_\_\_\_\_ of change of origin.
- 11) The value of correlation coefficient is independent of change of \_\_\_\_\_ and \_\_\_\_\_.
- 12) Correlation coefficient of rank is calculated by \_\_\_\_\_ method.
- 13) In ranks are not repeated then the result of Spearman's method will be \_\_\_\_\_ to Karl Pearson's method.
- 14) Coefficient of correlation is significant when  $r$  is more than \_\_\_\_\_ times of probable error.
- 15) The 'r' of population lies between \_\_\_\_\_ of the sample.
- 16) The probable error of coefficient of correlation is calculated by \_\_\_\_\_.
- 17) The standard error of coefficient of correlation is given by \_\_\_\_\_.
- 18) The coefficient of determination is given by \_\_\_\_\_.
- 19) The relationship between two or more variables is studied by \_\_\_\_\_.
- 20) The cause and effect relationship between two or more variables is known as \_\_\_\_\_.
- 21) When the relationship between two variables is studied at a time then it is known as \_\_\_\_\_ correlation.
- 22) When the relationship between three or more variables is studied at a time then it is known as \_\_\_\_\_ correlation.
- 23) When the value of the two variables move in the same direction then it is known as \_\_\_\_\_ correlation.
- 24) When the value of two variables move in the opposite direction then it is known as \_\_\_\_\_ correlation.
- 25) When the value of correlation coefficient is + 1 then it is known as \_\_\_\_\_ correlation.
- 26) When the value of correlation coefficient is - 1 then it is known as \_\_\_\_\_ correlation.
- 27) When the value of correlation coefficient is + 0.86 then it is known as \_\_\_\_\_ correlation.
- 28) When the value of correlation coefficient is - 0.84 then it is known as \_\_\_\_\_ correlation.
- 29) When the value of correlation coefficient is + 0.35 then it is known as \_\_\_\_\_ correlation.
- 30) When the value of correlation coefficient is - 0.39 then it is known as \_\_\_\_\_ correlation.

- 31) When the two variables are plotted on a graph and it produces a straight line then the correlation is said to be \_\_\_\_\_.
- 32) When the two variables are plotted on a graph and it produces a straight line moving upward from left to right then it is \_\_\_\_\_ correlation.
- 33) When the two variables are plotted on a graph and it produces a straight line moving downward from left to right then it is \_\_\_\_\_ correlation.
- 34) When the graph of two variables gives a curve line then it is known as \_\_\_\_\_ correlation.

**Answer:**

1.	$\pm 1$	2.	Perfect positive
3.	Perfect negative	4.	No correlation
5.	Unchanged	6.	Unchanged
7.	Unchanged	8.	Unchanged
9.	Independent	10.	Independent
11.	Origin, Scale	12.	Spearman's
13.	Equal	14.	6
15.	$r \pm PE_r$	16.	$PE_r = 0.6745 \times \frac{1-r^2}{\sqrt{n}}$
17.	$SEr = \frac{1-r^2}{\sqrt{n}}$	18.	$r^2$
19.	Correlation	20.	Conisation
21.	Simple	22.	Multiple
23.	Positive	24.	Negative
25.	Perfect positive	26.	Perfect negative
27.	High degree positive	28.	High degree negative
29.	Low degree positive	30.	Low degree negative
31.	Linear or Perfect	32.	Perfect Positive
33.	Perfect Negative	34.	Non-liner or imperfect

### Regression Analysis:

- 1) The Pearson's coefficient of correlation is the square root of the two \_\_\_\_\_.
- 2) If  $b_{xy}$  is positive then  $b_{yx}$  will be \_\_\_\_\_.
- 3) If both  $b_{xy}$  and  $b_{yx}$  are positive then correlation coefficient will be \_\_\_\_\_.
- 4) The regression analysis measures \_\_\_\_\_ relations between X and Y.
- 5) The purpose of regression analysis is to study \_\_\_\_\_ between variables.
- 6) Lines of regression are \_\_\_\_\_ if  $r = 0$  and they are \_\_\_\_\_ if  $r = \pm 1$ .
- 7) The farther the two regression lines cut each other the \_\_\_\_\_ be the degree of correlation.
- 8) If the regression coefficient of X on Y and Y on X are  $-0.4$  and  $-0.9$  respectively then the value of correlation coefficient is \_\_\_\_\_.
- 9) If one regression coefficient is more than unity then the other must be \_\_\_\_\_ than unity.
- 10) The statistical tool with the help of which we estimate the value of \_\_\_\_\_ variable from the value of another \_\_\_\_\_ variable, is known as \_\_\_\_\_.
- 11) The product of two regression coefficients must be \_\_\_\_\_ than 1.
- 12) The name of the variable whose value will be estimated is \_\_\_\_\_.
- 13) The geometric mean of two regression coefficients is known as \_\_\_\_\_.
- 14) If  $b_{xy} = 0.5$ ,  $r = 0.8$  and  $V_y = 16$ , then  $\sigma_x =$  \_\_\_\_\_.
- 15) If  $b_{xy} = 4$  then the value of  $b_{yx}$  will be less than or equal to \_\_\_\_\_.
- 16) If  $b_{xy} = 0.5$  then  $b_{yx}$  will be less than or equal to \_\_\_\_\_.



Answer:

1.	Regression coefficients	2.	Positive
3.	Positive	4.	Average
5.	Dependence	6.	Perpendicular, Same
7.	Lesser	8.	- 0.6
9.	Less	10.	Unknown, Known, Regression
11.	Less than or equal to	12.	Dependent
13.	Correlation coefficient	14.	2.5
15.	$\frac{1}{4}$ or 0.25	16.	2

UNIT - IV

Index Numbers:

1. To measure changes in the price level for a group of people \_\_\_\_\_ index number is prepared.
2. Index numbers are called \_\_\_\_\_ of economic changes.
3. \_\_\_\_\_ test is satisfied by both Fisher's and Kelly's formulae.
4. The base period should be a \_\_\_\_\_ period.
5. Fisher's index is \_\_\_\_\_ mean of Laspeyre's and Paasche's index numbers.
6. Quantity index number reflects \_\_\_\_\_ changes from one period to another.
7. \_\_\_\_\_ is the most suitable average for constructing index numbers.
8. Kelly's index number \_\_\_\_\_ the circular test.

Answers:

1.	Cost of living	2.	Barometer	3.	Factor reversal
4.	Normal	5.	Geometric	6.	Quantity
7.	Geometric mean	8.	Satisfies		

1. Statistical device which is used to indicate the relative movement of data is \_\_\_\_\_.
2. A year in relations to which the data of any other year is compared to known the percentage of increase and decrease in changes is \_\_\_\_\_ year.
3. The method in which quantities consumed in the base year are taken as weight is \_\_\_\_\_ method.
4. The method in which quantities consumed in the current year are taken as weight is \_\_\_\_\_ method.
5. The method of index number which is the arithmetic mean of Laspeyre's method and Paasche's method is \_\_\_\_\_ method.
6. The method of index number which is the geometric mean of Laspeyre's method and Paasche's method is \_\_\_\_\_ method.
7. The method of index number in which the average quantities consumed in base year and current year are taken as weight is \_\_\_\_\_ method.
8. The index number in which quantities consumed are ignored is known as \_\_\_\_\_ index number.
9. The index number which is constructed to show the change in quantities is known as \_\_\_\_\_ index number.
10. The series of index numbers in which the base year is always the same are known as \_\_\_\_\_ index numbers.
11. The index numbers in which the base year is never fixed but changes from year to year is known as \_\_\_\_\_ index numbers.
12. When two series of index numbers having different base years are joined together to form a new series of index numbers then it is called \_\_\_\_\_.

13. The percentage of money wage with respect to price index is known as \_\_\_\_\_.
14. The base of BSE Sensex is \_\_\_\_\_.
15. When the index number of constructed for a particular group of persons living in the society is known as \_\_\_\_\_ index.

Answers:

1.	Index Numbers	2.	Base	3.	Laspeyre's
4.	Paasche's	5.	Dorbish-Bowley	6.	Fisher's
7.	Marshall-Edgeworth	8.	Un-weighted or simple	9.	Quantity
10.	Fixed Base	11.	Chain Base	12.	Splicing
13.	Real wage	14.	1978-79	15.	Cost of living

**Time Series Analysis:**

1. The one that is very useful in forecasting in the short-term is \_\_\_\_\_ component.
2. The cyclical movements are due to \_\_\_\_\_.
3. An overall tendency of rise or fall in a time series is called \_\_\_\_\_.
4. Of the four components of a time series, the one that has primary uses for long term forecasting is \_\_\_\_\_ component.
5. The line obtained by the method of least square is known as the line of \_\_\_\_\_.
6. A time series consists of the data arranged in \_\_\_\_\_ order.
7. The equation of Gompertz Curve is of the form \_\_\_\_\_.
8. In trend equation  $Y = A + bX$ , a is the \_\_\_\_\_ and b is the \_\_\_\_\_.
9. Comparable monthly data may be obtained by multiplying each of the values by \_\_\_\_\_ and in a leap year by \_\_\_\_\_.
10. A polynomial equation in the form of  $Y = a + bX + cX^2 + dX^3$  is called a \_\_\_\_\_.
11. The additive model of a time series is expressed as \_\_\_\_\_.
12. When the difference between successive observations of a time series are constant or nearly so, the \_\_\_\_\_ may be an appropriate representation of trend equation.
13. Link relative method is one of the methods of determining \_\_\_\_\_ of a time series.
14. The tool which used to understand the underlying structure and function that produces the observation is known as \_\_\_\_\_.
15. The trend that gives the general tendency of the data for a long period is known as \_\_\_\_\_.
16. Component of a time series which is defined as the repetitive and predictable movement around the trend line in one year or less is known as \_\_\_\_\_.
17. The variation in a time series that usually lasts for two or more years is known as \_\_\_\_\_.

Answers:

1.	Seasonal	2.	Trade cycle	3.	Secular tend
4.	Trend	5.	Best fit	6.	Chronological
7.	$Y = a^{bX}$	8.	Y-intercept, Slope of trend	9.	30.4167, 30.5
10.	Second degree parabola	11.	$Y = T = S + C + I$	12.	Straight line
13.	Seasonal variation	14.	Time Series Analysis	15.	Secular trend
16.	Seasonal variation	17.	Cyclical variation		

## COMMERCE DSE – I (BUSINESS STATISTICS)

### UNIT – I

#### Questions of 2 Marks and 3 Marks each

**Two Marks Questions will be answered within 3 sentences each and Three Marks Questions will be answered within six sentences each**

1. Explain the meaning of Descriptive Statistics.
2. Explain Statistics as Date and as Method.
3. What are the limitations of Statistics?
4. Explain the use of statistics in Commerce.
5. Explain the characteristics of Statistics.
6. What are the functions of Statistics?
7. What are the qualities of a Statistician?
8. Who is an investigator?
9. Who is an Enumerator?
10. What is primary data?
11. What is secondary data?
12. What do you mean by Pilot Survey?
13. What is time series data?
14. What do you mean by Cross Sectional Data?
15. What is Range?
16. What do you mean by class interval?
17. What is meant by class boundaries?
18. What is Tally Bar?
19. What do you mean by frequency density?
20. What do you mean by Relative Frequency?
21. What is open-end series?
22. Give the difference between Exclusive series and Inclusive series.
23. Give the differences between 'More than' and 'Less then' frequency distribution.
24. Distinguish between Univariate and Bi-variate series.
25. What do you mean by central value?
26. Give three features of a good average.
27. What is Arithmetic Mean?
28. What is simple Arithmetic Mean?
29. What do you mean by Weighted Arithmetic Mean?
30. What is combined Arithmetic Mean?
31. Write three properties of Arithmetic Mean.
32. Write two advantages of Arithmetic Mean.
33. Write two advantages of Arithmetic Mean.
34. What is Geometric Mean?
35. What is combined Geometric Mean?
36. Give three advantages of G.M.
37. Write two disadvantages of Geometric Mean.
38. For what purpose G.M. is used?
39. What is Harmonic Mean?
40. Give the uses of Harmonic Mean.
41. Give two advantages of Harmonic Mean.
42. Give three limitations of H.M.
43. What are the relationship between A.M., G.M. and H.M.?
44. What is median?
45. Write three advantages of Median.
46. Write three limitations of Median.

47. What do you mean by Quartiles?
48. What is Decile?
49. What is percentile?
50. What is Mode?
51. Give three advantages of Mode.
52. Give three disadvantages of Mode.
53. What is the relationship between Mean, Median and Mode?
54. What do you mean by Emperical Mode?

**PRACTICAL PROBLEMS:**

1. Calculate average bonus paid per member from the following data:

Bonus (in Rs)	50	60	70	80	90	100	110
No. of persons	1	3	5	7	6	2	1

**Ans: Rs 79.60**

2. Peter travelled by car for 4 days. He drove 10 hours each day. He drove: first day at the rate of 45 km per hour; second day at the rate of 40km per hour; third day at the rate of 38 km per hour and fourth day at the rate of 37 km per hour. What was his average speed?

**Ans: 40 km p. h.**

3. Typist A can type a letter in 5 minutes, typist B in 10 minutes and typist C in 15 minutes. What is the average number of letters types per hour per typist?

**Ans: Required average =  $(12 + 6 + 4)/3 = 7.33$**

4. A taxi ride in a city costs one rupee for first kilometre and sixty paise for each additional kilometre. The cost of each kilometer is incurred at the beginning of the kilometre, so that the rider pays for a whole kilometer. What is the average cost for  $2\frac{3}{4}$  kilometre?

**Ans: Average cost for  $2\frac{3}{4}$  kilometre =  $(100 + 60 + 60) \times \frac{4}{11}$  paise = 80 paise**

5. The mean weight of student in a group of 6 students is 119 lbs. The individual weights of five of them are 115, 109, 129, 117 and 114 lbs. What is the weight of the sixth student?

**Ans: 130 lbs.**

6. Average marks in Statistics of 10 students of a class was 68. A new student took admission with 72 marks, whereas two existing students left the college. If the marks of these students were 40 and 39, find the average marks of the remaining students.

**Ans: 75.78 (approx.)**

7. Shri Narendra Kumar has invested his capital in three securities, namely RELIANCE Ltd.. TISCO and SATYAM: Rs 40,000, Rs 50,000 and Rs 80,000 respectively. If he collects dividends of Rs 10,000 from each company, compute his average return from three securities.

**Ans: 17.5%**

8. Twelve persons gambled on a certain night. Seven of them lost at an average rate of Rs 10.50 while five gained at an average of Rs 13.00. Is the information given above correct? If not, why?

**Ans: Information is incorrect.**

9. Goals scored by a hockey team in successive matches are 5, 7, 4, 2, 4, 0, 5 and 3. What is the number of goals, the team must score in 10<sup>th</sup> match in order that the average comes to 4 goals per match.

**Ans: 5**

10. The sum of deviations of a certain number of observations measured from 4 is 72 and the sum of the deviations of the same value form 7 is - 3. Find the number of observations and their mean.

**Ans: n = 25 and  $\bar{X} = 6.88$**

11. The daily average sales of a store were Rs 2,750 for the month of Feb. 1996. During the month, the highest and the lowest sales were Rs 8,950 and Rs 580 respectively. Find the average daily sales if the highest and the lowest sales are not taken into account.

**Ans: Rs 2,600.74**

12. Two variables X and Y are related by:  $Y = (X - 5)/10$  and each of them has 5 observations. If the mean of X is 45, find mean of Y.

**Ans: 4**

13. The average salary of 49 out of 50 employees in a firm is Rs 100. The salary of 50<sup>th</sup> employee is Rs 97.50 more than the average salary of all the 50 workers. Find the mean salary of all the employees of the firm.

14. The mean of 99 items is 55. The value of 100<sup>th</sup> item is 99 more than the mean of 100 items. What is the value of 100<sup>th</sup> item?

15. The mean of 200 items was 50. Later on it was discovered that two items were wrongly read as 92 and 8 instead of 192 and 88. Find out the correct mean.

16. The average daily income for a group of 50 persons working in a factory was calculated to be 169. It was later discovered that one figure was mis-read as 134 instead of the correct value 143. Calculate the correct average income.

17. The average marks of 80 students were found to be 40. Later, it was discovered that a score of 4 was misread as 84. Find the correct mean of 80 students.

18. The mean age of a combined group of men and women is 30 years. If the mean age of the group of men is 32 and that of the group of women is 27, find out the percentage of men and women in the group.

19. The mean annual salary of all employees in a company is Rs 25,000. The mean salary of male and female employees is Rs 27,000 and Rs 17,000 respectively. Find the percentage of males and females employed by the company.

20. If the means of two groups of m and n observations are 40 and 50 respectively, and the combined mean of two groups is 42, find the ratio m : n.

21. The mean marks obtained by 300 students in the subject of Statistics are 45. The mean of the top 100 of them was found to be 70 and the mean of the last 100 was known to be 20. What is the mean of the remaining 100 students?

22. The mean hourly wage of 100 labourers working in a factory, running two shifts of 60 and 40 workers respectively, is Rs 38. The mean hourly wage of 60 labourers working in a morning shift is Rs 40. Find the mean hourly wage of 40 labourers working in the evening shift.

23. There are three sections of B. Com. 1<sup>st</sup> year in a certain college. The number of students in each section and the average marks obtained by them in the Statistics paper in the annual examination are as follows:

Section	Average marks in Statistics	No. of Students
A	75	50
B	60	60
C	55	50

Find the average marks obtained by the students of all the sections taken together.

24. B. Com. (Pass) III year has three Sections A, B and C with 50, 40 and 60 students respectively. The mean marks for the three sections were determined as 85, 60 and 65 respectively. However, marks of a student of section A were wrongly recorded as 50 instead of zero. Determine the mean marks of all the three sections put together.

25. The mean monthly salary paid to 77 employees in a company was Rs 78. The mean salary of 32 of them was Rs 75 and that of other 25 was 82. What was the mean salary of the remaining?

26. Define the weighted arithmetic mean of a set of numbers. Show that it is unaffected if all the weights are multiplied by some common factor.
27. A contractor employs three types of workers male, female and children. To a male worker he pays Rs 16 per hour, to a female worker Rs 13 per hour and to a child worker Rs 10 per hour. What is the average wage per hour paid by the contractor if the number of male, female and children is 20, 15 and 5 respectively?
28. Find the harmonic mean of the numbers:  $\frac{1}{5}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, 1$

[I.C.W.A. (Foundation) Jun 2004, Dec; 2002]

Ans:  $\frac{1}{3}$

29. If each of 3, 48 and 96 occurs once and 6 occur thrice, verify that geometric mean is greater than harmonic mean.

Ans: G.M. = 12; H.M. = 6.94; G.M. > H.M.

30. Show the weighted harmonic mean of the first n natural numbers, where the weights are equal to the corresponding numbers, is given by  $(n + 1)/2$ .

31. An aeroplane flies around a square the sides of which measuring 100 km. each. The aeroplane covers at a speed of 100 km. per hour first side, at 200km. per hour the second side, at 300 km. per hour the third side and at 400 km. per hour the fourth side. Use the correct mean to find the average speed around the square.

Ans: 192 km. p.h.

32. Four factories emit a kilogram of pollutant each in 4, 5, 8 and 12 days respectively. What is the average rate of pollutant discharge? Use you answer to calculate the total pollutant discharged by the four factories in one week.

Hint: Find H.M. of 4, 5, 8, 12

Ans: 1kg. pollutant in 480/79 days per factory.

Total pollutant discharged by four factories per week =  $\frac{79}{480} \times 4 \times 7 = 4.608$  kg.

33. A railway train runs for 30 minutes at a speed of 40 miles an hour and the, because of repairs of the tract runs for 10 minutes at a speed of 8 miles an hour, after which it resumes its previous speed and runs for 20 minutes except for a period of 2 minutes when it had to run over a bridge with a speed of 30 miles per hours. What is the average speed?

Hints: Average speed = Total Distance covered ÷ Total time taken

$$= \left[ \left( \frac{40}{60} \times 30 + \frac{8}{60} \times 10 + \frac{40}{60} \times 18 + \frac{30}{60} \times 2 \right) \div (30 + 10 + 20) \right] \text{m. p. h}$$

Ans: 34.33 m.p.h.

34. A cyclist covers his first three kilometres at an average speed of 8 km. per hour, another 2 kms. at 9 km. per hour and the last 2 kms. at 4 km. per hour. Find the average speed for the entire journey.

Ans: 6.38 kms. Per hour

35. If X travels 8 kms. at 4 km. per hour; 6 kms. at 3 km. per hour and 4 kms. at 2km. per hour, what would be the average rate per hour at which he travelled?

Ans: Weighted H.M. = 3 km. p.h.

36. A man travelled by car for 3 days. He covered 480 km. each day. On the first day he drove for 10 hours at 48 km. an hour; on the second day he drove for 12 hours at 40 km. an hour and on the last day he drove for 15 hours at 32 km. an hour. What was his average speed?

Ans: 38.919 km. p. h.

37. Kishore travels 900 kms. by train at an average speed of 60 km. per hour; 3,000 km. by steamship at an average of 25 km. per hour; 400 kms. by aeroplane at 350 km. per hour; and finally 15 kms. by bus at 25 km. per hour. Calculate his average speed for the entire journey.

Ans: 31.556 km. p. h.

38. 32. A man travels from Agra to Dehradun covering 204 miles at a mileage rate of 10 miles per gallon of petrol and via Ghaziabad with an additional journey of 40 miles at the rate of 15 miles per gallon. Find the average mileage per gallon.

**Ans: 10.58 miles per gallon.**

39. The consumption of petrol by a motor was a gallon for 20 miles while going up from plains to hill station and a gallon for 24 miles while coming down. What particular average would you consider appropriate for finding the average consumption in miles per gallon for up and down journey, and why?

**Ans: Harmonic Mean = 21.82 miles per gallon.**

40. A man having to drive 90 kilometres wishes to achieve an average speed of 30 kilometres per hour. For the first half of the journey he averages only 20 km. p. h. What must be his average for the second half of the journey if his overall average is to be 30 km. p. h.

**Ans: 60 km. p.h.**

41. An aeroplane travels distances of  $d_1$ ,  $d_2$  and  $d_3$  kms. at speed  $V_1$ ,  $V_2$  and  $V_3$  km. per hour respectively. Show that the average speed ( $V$ ) is given by:

$$\frac{d_1+d_2+d_3}{V} = \frac{d_1}{V_1} + \frac{d_2}{V_2} + \frac{d_3}{V_3}$$

42. A person purchases one kilogram of cabbage from each of the four places at the rate of 20 kg., 16 kg., 12kg. and 10kg. per 100 rupee respectively. On the average how many kg. of cabbage has he purchased per 100 rupee?

43. If you spend Rs 100 per week on apples and the price of apples for three weeks is Rs 25, Rs 20 and Rs 10 per kilogram, what is the average price of apples for you?

**Ans: Rs 15.79**

44. In a certain office a letter is typed by A in 4 minutes. The same letter is typed by B, C and D in 5, 6, 10 minutes respectively. What is the average time taken in completing one letter? How many letters do you expect to be typed in one day comprising of 8 working hours.

**Ans: H.M. = 5.58 minutes per letter; Letters type in 8 hours (480 minutes) =  $\frac{480}{5.58} = 86$**

45. A scooterist purchased petrol at the rate of Rs 24, Rs 29.50 and Rs 36.85 per litre during three successive years. Calculate the average price of petrol:

(i) If he purchased 150, 180 and 195 litres in the respective years; and

(ii) If spent Rs 3,850, Rs 4,675 and Rs 5,825 in three years

Give support to your answer.

**Hints: Average price of petrol/litre =  $\frac{\text{Total money spent on petrol}}{\text{Total petrol consumed in litres}}$**

**(i) Weighted A.M. of prices the weights being the quantities of petrol purchased.**

**(ii) Weighted H.M. of prices, the weights being money spent on petrol.**

**Ans: (i) Rs 30.65/ litre (ii) Rs 30/litre (approx.)**

46. Define Arithmetic Mean, Harmonic Mean and Geometric Mean for a set of  $n$  observations and state the relationship between them.

**Ans:  $A \geq G \geq H$ ; the sign of equality holds if and only if all the observations are equal.**

Show the relationship between arithmetic mean and harmonic mean for the variable  $X$ , which can take the values  $a$  and  $b$  such that  $a, b$  are non-negative integers.

$$\text{Ans: } A \times H = \left(\frac{a+b}{2}\right) \left(\frac{2ab}{a+b}\right) = ab = G^2$$

47. If for two numbers, the arithmetic mean is 25 and the harmonic mean is 9, what is the geometric mean of the series.

**Ans: G.M. = 15**

48. If A.M. of two numbers is 17 and G.M. is 15, find the H.M. of these numbers.

**Ans: 13.24**

49. Comment on the following: "The G.M. and A.M. of a distribution are 27 and 30. Then H.M. is 26."

**Ans: Since  $A.M. \geq G.M. \geq H.M.$ , the statement is correct.**

50. State giving reasons which average will be more appropriate in the following cases:

(i) The distribution has open-end classes.

**Ans: (i) Md. or Mo.**

(ii) The distribution has wide range of variations.

**Ans: G.M.**

51. Find the G.M. of 1, 2, 3,  $\frac{1}{2}$ ,  $\frac{1}{3}$ . What will be the geometric mean if '0' is added to this set of values?

**[I.C.W.A (Foundation) June 2003]**

**Ans: 1 and 0**

52. Find the geometric mean of: 1, 7, 29, 18, 65, 91 and 103.

**Ans: 20.62**

53. Calculate the geometric mean of the data: 1, 7, 29, 92, 115 and 375

**Ans: 30.50**

54. If population of a city doubled itself in twenty years, is it correct to say that the rate of growth has been 5% per annum?

**Ans: No,  $r = 3.5\%$**

55. The population of a city was 1,00,000 in 2005 and 1,44,000 a decade later. Estimate the population at the middle of the decade.

**Ans: 1,20,000**

56. The population of India in 2011 and 2021 were 361 and 439 million respectively.

a. What was the average percentage increase per year during the period?

b. If the average rate of increase from 2011 to 2021 remains the same, what would be the population in 2031?

**Ans: (i) 2% (ii) 533.85 million**

57. The population of a country increased by 20 per cent in the first decade and by 30 per cent in the second decade and by 45 per cent in the third decade. Determine the average decennial growth rate of population.

**Ans: 31.3%**

58. A machine depreciates by 40% in the first year, by 25% in the second year and by 10% per annum for the next three years, each percentage being calculated on the diminishing value. What is the average percentage of depreciation for the entire period.

**Ans: 20%**

59. An income tax assessee depreciated the machinery of his factory by 20 per cent in each of the first two years and 40 per cent in the third year. How much average depreciation relief should he claim from the taxation department?

**Ans: 27.32%**

60. (b) A businessman depreciated the machinery of his factory by 20% in the first two years and 40% in the third year. What is the average depreciation for the three years?

**Ans: G.M. = 27.32%**

61. An economy grows at the rate of 2% in the first year, 2.5% in the second year, 3% in the third year, 4% in the fourth .....and 10% in the tenth year. What is the average rate of growth on the economy?

**Ans: 5.6% p.a.**

62. The annual rates of growth achieved by a nation for 5 years are 5%, 7.5%, 2.5%, 5% and 10% respectively. What is the compound rate of growth for the 5 year period?

**Ans: 5.9%**



63. The number of divorces per 1,000 marriage in a big city in India increased from 96 in 2010 to 120 in 2020. Find the annual rate of increase of the divorce rate for the period 2010 to 2020.  
**Ans:  $r = 2.26\%$**
64. If arithmetic mean and geometric mean of two values are 10 and 8 respectively, find the values.  
**Ans: 16, 4**
65. 18. A man gets three successive annual raises in salary of 20%, 30% and 25% respectively, each percentage being reckoned in his salary at the end of the previous year. How much better or worse would he have been if he had been given three annual raises of 25% each, reckoned in the same way.  
**Ans: The man would be better in the second case by 0.31% of his starting salary in the 1<sup>st</sup> year.**
66. The geometric mean of 4 items is 100 and of another 8 items is 3.162. Find the geometric mean of the 12 items.  
**Ans: 10**
67. Geometric mean of  $n$  observations is found to be  $G$ . How will you find the correct value of the Geometric Mean if some of the values used in its calculation are found to be wrong and should be replaced by correct values?
68. Geometric mean of 2 numbers is 15. If by mistake one figure is taken as 5, instead of 3, find the correct geometric mean.  
**Ans: 11.62**
69. The geometric mean of four values was calculated as 16. It was later discovered that one of the values was recorded as 32 when, in fact, it was 162. Calculate the correct geometric mean.  
**Ans: 24**
70. Define simple and weighted geometric mean of a given distribution.
71. The weighted geometric mean of three numbers 229, 275 and 125 is 203. The weights for 1<sup>st</sup> and 2<sup>nd</sup> numbers are 2 and 4 respectively. Find the weight of the third.  
**Ans: 3**
72. The weighted geometric mean of the four numbers 9, 25, 17 and 30 is 15.3. If the weights of the first three numbers are 5, 3 and 4 respectively, find the weights of the fourth number.  
**Ans: 2 (approx.)**
73. Define Harmonic Mean and discuss its merits and demerits. Under what situations would you recommend its use.
74. In a moderately skewed distribution:  
Arithmetic mean = 24.6 and the mode = 26.1. Find the value of the median and explain the reason for the method employed.  
**Ans: Median = 25.1**
75. In a moderately asymmetrical distribution the value of median is 42.8 and the value of mode is 40. Find the mean.  
**Ans: Mean = 44.2**
76. In a moderately asymmetrical distribution the value of mean is 75 and the value of mode is 60. Find the median.  
**Ans: Median = 70**
77. In a moderately skewed distribution Arithmetic mean = 24.6 and the mode = 26.1. Find the value of the median and explain the reason for the method employed.  
**Ans: Median = 25.1**
78. In a moderately asymmetrical distribution the value of median is 42.8 and the value of mode is 40. Find the mean.  
**Ans: Mean = 44.2**

79. In a moderately asymmetrical distribution the value of mean is 75 and the value of mode is 60. Find the median.

**Ans: Median = 70**

80. Find the G.M. of 1, 2, 3,  $\frac{1}{2}$ ,  $\frac{1}{3}$ . What will be the geometric mean if '0' is added to this set of values?

**[I.C.W.A (Foundation) June 2003]**

**Ans: 1 and 0**

81. Find the geometric mean of: 1, 7, 29, 18, 65, 91 and 103.

**Ans: 20.62**

82. Calculate the geometric mean of the data: 1, 7, 29, 92, 115 and 375

**Ans: 30.50**

83. If population of a city doubled itself in twenty years, is it correct to say that the rate of growth has been 5% per annum?

**Ans: No, r = 3.5%**

84. The population of a city was 1,00,000 in 2005 and 1,44,000 a decade later. Estimate the population at the middle of the decade.

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86. The population of a country increased by 20 per cent in the first decade and by 30 per cent in the second decade and by 45 per cent in the third decade. Determine the average decennial growth rate of population.

**Ans: 31.3%**

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**Ans: 27.32%**

(b) A businessman depreciated the machinery of his factory by 20% in the first two years and 40% in the third year. What is the average depreciation for the three years?

**Ans: G.M. = 27.32%**

89. (a) An economy grows at the rate of 2% in the first year, 2.5% in the second year, 3% in the third year, 4% in the fourth .....and 10% in the tenth year. What is the average rate of growth on the economy?

**Ans: 5.6% p.a.**

(b) The annual rates of growth achieved by a nation for 5 years are 5%, 7.5%, 2.5%, 5% and 10% respectively. What is the compound rate of growth for the 5 year period?

**Ans: 5.9%**

90. The number of divorces per 1,000 marriage in a big city in India increased from 96 in 2010 to 120 in 2020. Find the annual rate of increase of the divorce rate for the period 2010 to 2020.

**Ans: r = 2.26%**

91. If arithmetic mean and geometric mean of two values are 10 and 8 respectively, find the values.

**Ans: 16, 4**

92. A man gets three successive annual raises in salary of 20%, 30% and 25% respectively, each percentage being reckoned in his salary at the end of the previous year. How much better or worse would he have been if he had been given three annual raises of 25% each, reckoned in the same way.

**Ans: The man would be better in the second case by 0.31% of his starting salary in the 1<sup>st</sup> year.**

93. The geometric mean of 4 items is 100 and of another 8 items is 3.162. Find the geometric mean of the 12 items.

**Ans: 10**

94. (a) Geometric mean of  $n$  observations is found to be  $G$ . How will you find the correct value of the Geometric Mean if some of the values used in its calculation are found to be wrong and should be replaced by correct values?

(b) Geometric mean of 2 numbers is 15. If by mistake one figure is taken as 5, instead of 3, find the correct geometric mean.

**Ans: 11.62**

(c) The geometric mean of four values was calculated as 16. It was later discovered that one of the values was recorded as 32 when, in fact, it was 162. Calculate the correct geometric mean.

**Ans: 24**

95. Define simple and weighted geometric mean of a given distribution.

The weighted geometric mean of three numbers 229, 275 and 125 is 203. The weights for 1<sup>st</sup> and 2<sup>nd</sup> numbers are 2 and 4 respectively. Find the weight of the third.

**Ans: 3**

96. The weighted geometric mean of the four numbers 9, 25, 17 and 30 is 15.3. If the weights of the first three numbers are 5, 3 and 4 respectively, find the weights of the fourth number.

**Ans: 2 (approx.)**

97. Find the harmonic mean of the numbers:  $\frac{1}{5}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, 1$

**[I.C.W.A. (Foundation) Jun 2004, Dec; 2002]**

**Ans:  $\frac{1}{3}$**

98. If each of 3, 48 and 96 occurs once and 6 occur thrice, verify that geometric mean is greater than harmonic mean.

**Ans: G.M. = 12; H.M. = 6.94; G.M. > H.M.**

99. Show the weighted harmonic mean of the first  $n$  natural numbers, where the weights are equal to the corresponding numbers, is given by  $(n + 1)/2$ .

100. An aeroplane flies around a square the sides of which measuring 100 km. each. The aeroplane covers at a speed of 100 km. per hour first side, at 200km. per hour the second side, at 300 km. per hour the third side and at 400 km. per hour the fourth side. Use the correct mean to find the average speed around the square.

**Ans: 192 km. p.h.**

101. Four factories emit a kilogram of pollutant each in 4, 5, 8 and 12 days respectively. What is the average rate of pollutant discharge? Use your answer to calculate the total pollutant discharged by the four factories in one week.

**Hint: Find H.M. of 4, 5, 8, 12**

**Ans: 1kg. pollutant in 480/79 days per factory.**

**Total pollutant discharged by four factories per week =  $\frac{79}{480} \times 4 \times 7 = 4.608$  kg.**

102. A railway train runs for 30 minutes at a speed of 40 miles an hour and the, because of repairs of the tract runs for 10 minutes at a speed of 8 miles an hour, after which it resumes its previous speed and runs for 20 minutes except for a period of 2 minutes when it had to run over a bridge with a speed of 30 miles per hours. What is the average speed?

**Hints: Average speed = Total Distance covered ÷ Total time taken**  

$$= \left[ \left( \frac{40}{60} \times 30 + \frac{8}{60} \times 10 + \frac{40}{60} \times 18 + \frac{30}{60} \times 2 \right) \div (30 + 10 + 20) \right] \text{ m. p. h}$$

**Ans: 34.33 m.p.h.**

103. A cyclist covers his first three kilometres at an average speed of 8 km. per hour, another 2 kms. at 9 km. per hour and the last 2 kms. at 4 km. per hour. Find the average speed for the entire journey.

**Ans: 6.38 kms. Per hour**

104. If X travels 8 kms. at 4 km. per hour; 6 kms. at 3 km. per hour and 4 kms. at 2km. per hour, what would be the average rate per hour at which he travelled?

**Ans: Weighted H.M. = 3 km. p.h.**

105. A man travelled by car for 3 days. He covered 480 km. each day. On the first day he drove for 10 hours at 48 km. an hour; on the second day he drove for 12 hours at 40 km. an hour and on the last day he drove for 15 hours at 32 km. an hour. What was his average speed?

**Ans: 38.919 km. p. h.**

106. Kishore travels 900 kms. by train at an average speed of 60 km. per hour; 3,000 km. by steamship at an average of 25 km. per hour; 400 kms. by aeroplane at 350 km. per hour; and finally 15 kms. by bus at 25 km. per hour. Calculate his average speed for the entire journey.

**Ans: 31.556 km. p. h.**

107. A man travels from Agra to Dehradun covering 204 miles at a mileage rate of 10 miles per gallon of petrol and via Ghaziabad with an additional journey of 40 miles at the rate of 15 miles per gallon. Find the average mileage per gallon.

**Ans: 10.58 miles per gallon.**

108. The consumption of petrol by a motor was a gallon for 20 miles while going up from plains to hill station and a gallon for 24 miles while coming down. What particular average would you consider appropriate for finding the average consumption in miles per gallon for up and down journey, and why?

**Ans: Harmonic Mean = 21.82 miles per gallon.**

109. A man having to drive 90 kilometres wishes to achieve an average speed of 30 kilometres per hour. For the first half of the journey he averages only 20 km. p. h. What must be his average for the second half of the journey if his overall average is to be 30 km. p. h.

**Ans: 60 km. p.h.**

110. 35. An aeroplane travels distances of  $d_1$ ,  $d_2$  and  $d_3$  kms. at speed  $V_1$ ,  $V_2$  and  $V_3$  km. per hour respectively. Show that the average speed ( $V$ ) is given by:

$$\frac{d_1+d_2+d_3}{V} = \frac{d_1}{V_1} + \frac{d_2}{V_2} + \frac{d_3}{V_3}$$

111. A person purchases one kilogram of cabbage from each of the four places at the rate of 20 kg., 16 kg., 12kg. and 10kg. per 100 rupee respectively. On the average how many kg.of cabbage has he purchased per 100 rupee?

112. If you spend Rs 100 per week on apples and the price of apples for three weeks is Rs 25, Rs 20 and Rs 10 per kilogram, what is the average price of apples for you?

**Ans: Rs 15.79**

113. In a certain office a letter is types by A in 4 minutes. The same letter is types by B, C and D in 5, 6, 10 minutes respectively. What is the average time taken in completing one letter? How many letter do you expect to be typed in one day comprising of 8 working hours.

**Ans: H.M. = 5.58 minutes per letter; Letters type in 8 hours (480 minutes) =  $\frac{480}{5.58} = 86$**

114. A scooterist purchased petrol at the rate of Rs 24, Rs 29.50 and Rs 36.85 per litre during three successive years. Calculate the average price of petrol:

(i) If he purchased 150, 180 and 195 litres in the respective years; and

(ii) If spent Rs 3,850, Rs 4,675 and Rs 5,825 in three years

Give support to your answer.

$$\text{Hints: Average price of petrol/litre} = \frac{\text{Total money spent on petrol}}{\text{Total petrol consumed in litres}}$$

**(i) Weighted A.M. of prices the weights being the quantities of petrol purchased.**

**(ii) Weighted H.M. of prices, the weights being money spent on petrol.**

**Ans: (i) Rs 30.65/ litre (ii) Rs 30/litre (approx.)**

115. Define Arithmetic Mean, Harmonic Mean and Geometric Mean for a set of n observations and state the relationship between them.

**Ans:  $A \geq G \geq H$ ; the sign of equality holds if and only if all the observations are equal.**

116. Show the relationship between arithmetic mean and harmonic mean for the variable X, which can take the values a and b such that a, b are non-negative integers.

$$\text{Ans: } A \times H = \left(\frac{a+b}{2}\right) \left(\frac{2ab}{a+b}\right) = ab = G^2$$

117. If for two numbers, the arithmetic mean is 25 and the harmonic mean is 9, what is the geometric mean of the series.

**Ans: G.M. = 15**

118. If A.M. of two numbers is 17 and G.M. is 15, find the H.M. of these numbers.

**Ans: 13.24**

119. Comment on the following: "The G.M. and A.M. of a distribution are 27 and 30. Then H.M. is 26."

**Ans: Since  $A.M. \geq G.M. \geq H.M.$ ; the statement is correct.  $G.M. = \sqrt{A.M. \times H.M.} = \sqrt{30 \times 26} \neq 27$ . So the statement is false from another angle.**

## UNIT - II

1. What do you mean by Range?
2. Give three different fields where range is used.
3. Give two advantages of Range.
4. Give three disadvantages of Range.
5. Give three essential features of a good measure of dispersion.
6. What do you mean by absolute measure of dispersion?
7. What do you mean by Relative measure of dispersion?
8. Distinguish between absolute and relative measure of dispersion.
9. What is the Inter Quartile Range?
10. What is Quartile Deviation?
11. Give three advantages of IQR.
12. Give three disadvantages of IQR.
13. Compare IQR with QD as measures of dispersion.
14. What is mean deviation?
15. Give three advantages of Mean Deviation.
16. Give three disadvantages of Mean Deviation.
17. What is Standard Deviation?
18. Give three advantages of Standard Deviation.
19. Give three disadvantages of Standard Deviation.
20. Compare mean deviation with standard deviation.
21. Taking three imaginary items prove that S.D. is independent of change of origin.
22. Taking three imaginary items prove that S.D. is dependent of change of scale.

23. Write three essential properties of Standard Deviation.

**PRACTICAL PROBLEMS:**

1. Find the range and the coefficient of range for the following observations:

65, 70, 82, 59, 81, 76, 57, 60, 55 and 50

**Ans: 32; 0.2424**

2. Find the value of third quartile if the values of first quartile and quartile deviation are 104 and 18 respectively.

**Ans:  $Q_1 = 140$**

3. Why is standard deviation considered to be the best measure of dispersion? Find the variance if  $\sum x^2 = 150$  and  $N = 6$ . Deviations are taken from actual mean.

**Ans: 25**

4. From the following information, find the standard deviation for X and Y variables:

$$\sum X = 235 \quad \sum Y = 250 \quad \sum X^2 = 6,750 \quad \sum Y^2 = 6,840 \quad N = 10$$

**Ans:  $\sigma_x = 11.08$  ;  $\sigma_y = 7.68$**

5. You are given the following raw sums in a statistical survey of two variables X and Y:

$$\sum X = 240 \quad \sum Y = 250 \quad \sum X^2 = 6,400 \quad \text{and} \quad \sum Y^2 = 7,060$$

Ten items are included in each survey. Compute Standard Deviation of X and Y variable.

**Ans:  $\sigma_x = 8$  ;  $\sigma_y = 9$**

6. State the formula for computing standard deviation of  $n$  natural numbers 1, 2, .....n.

$$\text{Ans: } \sigma = \sqrt{\frac{1}{12}(n^2 - 1)}$$

7. Show that the standard deviation of the natural numbers 1, 2, 3, 4 and 5 is  $\sqrt{2}$

8. Mean of 10 items is 50 and S.D. is 14. Find the sum of the squares of all the items.

**Ans:  $\sum X^2 = 26,960$**

9. The standard deviation calculated from a set of 32 observations is 5. If the sum of the observations is 80, what is the sum of the square of these observations?

**Ans:  $\sum X^2 = 1,000$**

10. The mean of 200 items is 48 and their standard deviation is 3. Find the sum and sum of squares of all the items.

**Ans: 9,600; 4,62,600**

11. Given: No. of observations ( $N$ ) = 100, Arithmetic Average ( $\bar{X}$ ) = 2, Standard deviation ( $s_x$ ) = 4, find  $\sum X$  and  $\sum X^2$

**Ans:  $\sum X = 200$ ;  $\sum X^2 = 2,000$**

12. The mean of 5 observations is 3 and variance is 2. If three of the five observations are 1, 3, 5, find the other two.

**Ans: 2, 4**

**UNIT - III**

1. What is positive correlation?
2. What is negative correlation?
3. What do you mean by simple correlation?
4. What do you mean by multiple correlation?
5. What is perfect correlation?
6. What is imperfect correlation?
7. What is perfect positive correlation?
8. What is perfect negative correlation?
9. What is partial correlation?
10. What is linear correlation?

11. What is non-linear correlation?
12. What is absence of correlation?
13. What do you mean by Standard Error in correlation?
14. What do you mean by Probable Error in correlation?
15. What do you mean by regression?
16. What is the meaning of regression lines?
17. What do you mean by regression coefficient?
18. What is standard error of estimate?
19. What is Scatter diagram?
20. What is the method of Least Square in Regression Analysis?

**Short problems:**

1. In a bivariate sample, the sum of the squares of differences between the ranks of observed values of two variables is 231 and the correlation coefficient between them is  $-0.4$ . Find the number of pairs.  
**Ans:  $n = 10$**

2. The coefficient of rank correlation of the marks obtained by 10 students in biology and chemistry was found to be  $0.8$ . It was later discovered that the difference in ranks in two subjects obtained by one of the students was wrongly taken as  $7$  instead of  $9$ . Find the correct coefficient of rank correlation.  
**Ans: Correct value of  $R = 0.6061$ .**

3. The coefficient of rank correlation of the marks obtained by 10 students in Statistics and Accountancy was found to be  $0.2$ . It was later discovered that the difference in ranks in two subjects obtained by one of the students was wrongly taken as  $9$  instead of  $7$ . Find the correct coefficient of rank correlation.  
**Ans: Correct value of  $R = 0.3939$ .**

4. The coefficient of rank correlation of the marks obtained by 12 students in biology and chemistry was found to be  $0.6$ . It was later discovered that the difference in ranks in two subjects obtained by one of the students was wrongly taken as  $8$  instead of  $3$ . Find the correct coefficient of rank correlation.  
**Ans: Correct value of  $R = 0.7924$ .**

5. Given the information: Sum of  $X = 5$ ; Sum of  $Y = 4$   
Sum of squares of deviation from the mean of  $X = 40$ ; Sum of squares of deviation from the mean of  $Y = 50$ ; Sum of the products of deviations from the mean of  $X$  and  $Y = 32$ . Number of pairs of observations =  $10$

Calculate:

- (i) Regression coefficient of  $Y$  on  $X$ ; (ii) Regression coefficient of  $X$  on  $Y$
- (iii) Karl Pearson's coefficient of correlation

**Ans:  $b_{xy} = 0.80$ ;  $b_{yx} = 0.64$   $r_{(X,Y)} = 0.7156$**

6. For some bivariate data, the following results were obtained:  
Mean value of variable  $X = 53.2$  and  $Y = 39.5$   
Regression Coefficient of  $Y$  on  $X = -1.5$  and of  $X$  on  $Y = -0.38$   
What should be the most likely value of  $X$  when  $Y = 50$ ?  
Also find the coefficient of correlation between two variables.

**Ans:  $X = 53.2 + (-1.5)(50 - 39.5) = 49.21$ ;  $r = -\sqrt{(-1.5)(-0.38)} = -\sqrt{0.57} = -0.7549$**

7. For a particular product, the sales ( $Y$ ) and advertisement expenditure ( $X$ ) for 10 years, provide the results:

$$\sum X = 15, \sum Y = 110, \sum X^2 = 250, \sum Y^2 = 3200, \sum XY = 400$$

Find the regression line of  $Y$  on  $X$  and the estimated value of  $Y$  for  $X = 10$

**[ICWA Inter]**

**Ans:  $Y = 1.033X + 9.4505, 19.78$**

8. Calculate the correlation coefficient from the following results:

$N = 10, \sum X = 350, \sum Y = 310, \sum (X - 35)^2 = 162, \sum (Y - 31)^2 = 22,$   
 $\sum (X - 35)(Y - 31) = 92$

Also find the regression line of Y on X.

9. For bivariate data, you are given the following:

$\sum (X - 58) = 46, \sum (Y - 58) = 9, \sum (X - 58)^2 = 3086, \sum (Y - 58)^2 = 483, \sum (X - 58)(Y - 58) = 1095.$  No. of pairs of observations is 7. You are required to determine the two regression equation and the coefficient of correlation between X and Y.

**Ans: Regression Equations:**

**Y on X:  $Y = 0.372X + 35.266$ ; X on Y:  $X = 2.197Y - 65.680$ ;  $r(X,Y) = 0.904$**

If the two regression line corresponding to two variables X and Y meet at a point (2,30)  $V_{(X)} = 4, V_{(Y)} = 1$  and correlation coefficient between X and Y is  $\frac{1}{2}$ , the estimated value of Y for X = 6 is:

10. Let the two variables X and Y have the covariance and correlation coefficient between them as 2 and 0.5 respectively and  $V(X) = 2V(Y)$ , then the regression coefficient of X on Y is:

11. For bivariate data the mean value of X is 20 and the mean value of Y is 45. The regression coefficient of Y on X is 4 and that of X on Y is 1/9. Find:

- (i) The coefficient of correlation.
- (ii) The standard deviation of X if the standard deviation of Y is 12.
- (iii) Also write down the equation of regression lines.

**Ans: (i) 0.67 (ii)  $\sigma_x = 2$  (iii) Regression equations of Y on X and X on Y are respectively:  $Y = 4X - 35; 9X = Y + 135$**

12. 31. From the following results, obtaine the two regression equations and estimate the yield when the rainfall is 22cms. and the rainfall when the yield is 600 kgs.

	Yield in kgs. (X)	Rainfall in cms. (Y)
Mean	508.4	26.7
S.D.	36.8	4.6

Coefficient of correlation between yield and rainfall is 0.52.

**[C.A. (Foundation), Nov. 2001]**

**Ans:  $Y = 4.16X + 397.328; X = 0.065Y - 6.346; 488.85 \text{ kgs.}; 32.654 \text{ cms.}$**

13. The following table shows the mean and standard deviation of the prices of two shares in a stock exchange:

Shares	Mean (in Rs)	Standard deviation (in Rs)
A Ltd.	39.5	10.8
B Ltd.	47.5	16

If the coefficient of correlation between the prices of two shares is 0.42, find the most likely price of share. A corresponding to a price of Rs 55 observed in the case of share B.

**Ans:  $X = 0.27Y + 26.675; \text{Rs } 41.52$**

14. Given the following information:

	X	Y
Mean	6	8
Standard Deviation	5	13
Coefficient of Determination	= 0.64	

Find: (i)  $b_{yx}$  and  $b_{xy}$  and (ii) Value of Y when X = 100

**Ans: (i)  $r^2 = 0.64 \Rightarrow r = \pm 0.8 ; b_{yx} = 2.08 \text{ or } - 2.08$  and  $b_{xy} = 0.31 \text{ or } - 0.31$  (ii) 203.52**

### Regression Analysis:

1. What do you mean by regression?



2. What is regression coefficient?
3. What is regression line?
4. What is coefficient of determination?
5. What is scatter diagram?
6. Explain the method of least square in regression.

### Practical problems:

1. If the two regression line corresponding to two variables X and Y meet at a point (2, 30)  $V_{(X)} = 4$ ,  $V_{(Y)} = 1$  and correlation coefficient between X and Y is  $\frac{1}{2}$ , find the estimated value of Y for X = 6
2. Let the two variables X and Y have the covariance and correlation coefficient between them as 2 and 0.5 respectively and  $V_{(X)} = 2V_{(Y)}$ , then find the regression coefficient of X on Y.
3. For bivariate data the mean value of X is 20 and the mean value of Y is 45. The regression coefficient of Y on X is 4 and that of X on Y is  $\frac{1}{9}$ . Find the coefficient of correlation.
4. For bivariate data the mean value of X is 20 and the mean value of Y is 45. The regression coefficient of Y on X is 4 and that of X on Y is  $\frac{1}{9}$ . Find the standard deviation of X if the standard deviation of Y is 12.
5. For bivariate data the mean value of X is 20 and the mean value of Y is 45. The regression coefficient of Y on X is 4 and that of X on Y is  $\frac{1}{9}$ . Write down the equation of regression lines.

## UNIT - IV

### Index Numbers:

1. What do you mean by index numbers?
2. Give the purposes for which index number is constructed.
3. What is Price Index Number?
4. What is Quantity Index Number?
5. What is Value Index Number?
6. What do you mean by change of base of index numbers?
7. What do you mean by splicing of index numbers?
8. What is deflating of index numbers?
9. What is cost of living index number?
10. What is a base year?
11. What is Time Reversal Test?
12. What do you mean by Factor Reversal Test?
13. What is Circular Test?
14. What do you mean by Unit Test?
15. Explain unweighted index numbers.
16. When is weighted index number used?
17. Explain Laspeyre's method of index number.
18. Explain Paasche's method of index number.
19. Why is Fisher's method called Ideal Index number?

### Practical Problems:

1. The geometric mean of index number of Laspeyre and Paasche is 229.5648 while the sum of Laspeyre's and Paasche's index number is 480. Find out Laspeyre's and Paasche's indices.

**Ans: 310; 170**

2. A company spent Rs 50, Rs 48, Rs 18 and Rs 42 during 1998. The company increased the expenditure to Rs 100, Rs 98, Rs 60 and Rs 102 respectively on four commodities. If the units of four commodities purchased during 1998 and 1999 are identical i.e. 5, 2, 6 and 17, compute the price index for 1999 by the most suitable method.

**Ans: Simple Aggregative method 227.85**

3. Given that  $\sum p_1q_1 = 250$ ,  $\sum p_0q_0 = 150$ . Paasche's Index Number = 150 and Dorbish-Bowley's Index Number = 145, find out (i) Fisher's Ideal Index Number; and (ii) Marshall-Edgeworth's Index Number.

**Ans: 144.9, 145.26**

4. A worker earned Rs 900 per month in 2010. The cost of living index increased by 70% between 2010 and 2013. How much extra income should the worker have earned in 2013 so that he could buy the same quantities as in 2010?

**Ans: Rs 12 ×  $\left[\left(\frac{170}{100} \times 900\right) - 900\right] = \text{Rs } 7,560$**

5. During a certain period the cost of living index number goes up from 110 to 200 and the salary of the worker is also increased from Rs 325 to Rs 550. Does the worker really gain, and if so, by how much in real terms?

**Ans: Loss of Rs 90.90**

6. In calculating the cost of living index the following weights were used: Food  $8\frac{1}{2}$ ; Rent 2; Clothing  $2\frac{1}{2}$ ; Fuel and Light 1; Miscellaneous 11. Calculate the index number for a data when the percentage increase in prices of the various items over prices of July, 2018 = 100 were 31, 57, 90, 75 and 88 respectively.

**Ans: 152.2**

7. In calculating a certain cost of living index number, the following weights were used. Food 15, Clothing 3, Rent 4, Fuel and Light 2, Miscellaneous 11. Calculate the index for a date when the average percentage increases in price of item in the various groups of the base period were 32, 54, 47, 78 and 58 respectively.

Suppose a business executive was earning Rs 2,050 in the base period. What should be his salary in the current period if his standard of living is to remain the same?

**Ans: 141.76; Rs 2,906.08**

8. The cost of living index uses the following weights:

Food 40, Rent 15, Clothing 10, Fuel 10, Miscellaneous 15. During the period 2010 – 15, the cost of living index raised from 100 to 205.83. Over the same period the percentage rise in prices were:

Rent 60, Clothing 180, Fuel 75 and Miscellaneous 165. What is the percentage of change in the price of food?

**Ans: 90**

9. The relative importance of the following eight groups of family expenditure we found to be – Food 348, Rent 88, Clothing 97, Fuel and Light 65, House durable goods 71, Miscellaneous goods 35, Services 79, Drink and tobacco 217. The corresponding % increase in price for Oct. 2015 gave the following values – 25, 1, 22, 18, 14, 13, ? and 4. Calculate the percentage increase in group – services, if the percentage increase for whole group is 15.278.

**Ans: 11**

10. From some given data, the retail price index based on five items, viz. Food, Rent and Rates, Fuel and Light, Clothing and Miscellaneous was calculated as 205. Percentage increases in prices over the base period are given below:

Rent and Rates 60, Clothing 210, Fuel and Light 120, Miscellaneous 130

Calculate the percentage increase in the Food Group, given that the weights of different items are as follows:

Food 60, Rent and Rates 16, Fuel and Light 8, Clothing 12, Miscellaneous 4, All items 100.

**Ans: 92.3% increase in food group**

### Time Series Analysis:

1. What do you mean by residual method?
2. What is meant by Direct Percentage method?
3. What is Harmonic analysis method?
4. What is meant by reference cycle analysis method?
5. Explain the meaning of secular trend?
6. Write short note on seasonal variation.
7. What do you mean by cyclical variation?
8. What is erratic variation?

### Practical Problems:

1. In a study of its sales, a motor company obtained the following least square trend equations:  
 $Y = 1,600 + 200X$  (origin 2010, X units = 1 year; Y = total number of units sold annually)  
The company has physical facilities to produce only 3,600 units a year and it believes that it is reasonable to assume that at least for the next decade the trend will continue as before.  
(a) What is the average annual increase in the number of units sold?  
(b) By what year will the company's expected sales have equaled its present physical capacity?  
(c) Estimate the annual sales for 2015.

How much in excess of company's present physical capacity is this estimated value?

**Ans: (a) 200 units (b) In 2020 (c) 4,600 units: Excess = 4,600 – 3,600 = 1,000 units**

2. Convert the following annual trend equation for total sales of a company to a monthly trend equation:

$$Y = 162 + 15.8X \text{ (Origin: 2015; Scale: 1 units of } X = 1 \text{ year)}$$

Forecast the sales for June, 2018 by the two equations. Compare your results.

**Ans:  $Y = 13.5 + 0.1097X$ ; (Origin: 2015, X unit = 1 month; Y unit = monthly sales)**

3. The trend of the annual sales of Bharat Aluminum Company is described by the following equation:

$$Y_c = 12 + 0.7X \text{ (Origin: 2010; X unit = 1 year and Y unit = Annual production)}$$

Step the equation down to a month to month basis and shift the origin to 1<sup>st</sup> January 2010.

$$\text{Ans: } Y_c = 1 + \frac{0.7}{144} X; \text{ (Origin: 1}^{\text{st}} \text{ July 2010; X unit = 1 month);}$$

$$Y_c = 0.9712 + 0.0048X \text{ (Origin: 1}^{\text{st}} \text{ January, 2010)}$$

4. The trend equation for certain production is given by :  $Y = 3,600 + 288t$ ; where  
Y = Annual production in thousand tons; t: Time with origin, the year 2010 and unit = 1 year

Estimate the trend value of the production for September, 2014.

**[I.C.W.A (Intermediate) June, 2000]**

Hints: Monthly trend equation is given by:

5.  $Y = \frac{3,600}{12} + \frac{288}{144} t = 300 + 2t$ ; Origin: 1<sup>st</sup> July, 2010; t: Unit 1 month; Y: Monthly production

For September 2014 i.e. 15<sup>th</sup> September, 2014:  $t = 4 \times 12 + 2.5 = 50.5$

Estimated production for 2014 =  $300 + 2 \times 50.5 = 401$  thousand tons.