Lesson 6
Measures of Central Tendency: Mathematical Averages

Objectives:

To make students able to understand:

- The concept of Statistical Averages and features of a Good Average;
- Properties, Merits, and Demerits of Arithmetic Average;
- Calculations and uses of Arithmetic, Weighted, and Combined Average;
- Calculations and uses of Geometric and Harmonic Average.

INTRODUCTION

Statistical series may be different from each other, in the values of the variable around which most of the items cluster; in the extent to which items are dispersed round the central value, and in the extent of departure from a normal distribution. Because of such a difference between statistical series there are three measures of central tendency. These are:

- Measures of the first order or measures of central tendency or averages;
- Measures of second order or measures of dispersion; and
- Measures of third order or skewness, kurtosis etc.

Measures of Central Tendency can broadly be classified in the following categories:

(A) Mathematical Averages:
- Arithmetic Average
- Geometric Average
- Harmonic Average
- Weighted Average
- Combined Average

(B) Positional Averages:
- Median
- Mode

(C) Partition Values:

- Quartiles
- Deciles
- Percentiles

Meaning of Averages:

It is commonly said that data should be condensed for making them more useful for the investigators. Ratios arid percentages do help in condensing the data but they are not sufficient. As still there may be complexities and confusion as the ratios and percentages may also be larger numbers. The complexities need reduction. They are to be made comparable. For this it is necessary that the various phenomena should be reduced to one figure in each of the case.

A statistical average is a single value which can be used to represent many divergent items for some specific purpose. The concept of averages is so important in the study of statistics that sometimes it is said that. Statistics is the science of averages. It is also said that .an average is a single simple expression in which the net result of a complex group of large numbers is concentrated. Spurr, Kellog and Smith write, "An average is sometimes called a measure of central tendency because individual values of the variable usually cluster around it." Simpson and Kafka state, "A measure of central tendency is a typical value around which other figures congregate."

Uses of Average: An average is a process of condensation. As it is not humanly possible to deal with the large mass of data easily, so this method is used to reduce the figures into a smaller one or in one single result. It considerably reduces the complexities of large numbers. Average is commonly used for the further treatment of statistical derivates and series. It provides is the basis of comparisons with other series or groups of data.

Averages are most suitable way of representation average gives reasonably an assurance of central figures. Ordinarily most of the values of a series cluster in the middle and the number of items on the extreme ends are usually very little. An average satisfactorily represents the whole group of figures from which it is calculated. Ordinarily items with values less than the average cancel the items whose values are more than the average. The average brushes off the irregularities of a series, levels all differences of the individual items and presents complex and unwieldy data by a significant number. It thus, gives a bird's eye-view of an aggregate and can be substituted for individual items in further calculations regarding the series. The average occupies an important place in statistics. Many other techniques of statistical analysis depend upon this measure. This is the reason for Dr. "Bowley defined statistics as “the science of averages”.

Characteristics of a Good Average:

It has been pointed out by some experts of the subject that an average must possess certain qualities. In particular, it must possess the following qualities:

- Simplicity in the process of calculation;
- Defined rigidly of average, otherwise enumerators or the statisticians may use their own discretion in estimation or calculation of the average;
- Average should be based on all the item-values of the distribution;
- Not affected by the fluctuations of sampling as possible;
- The type of the average to be used in different conditions should be base on the nature of enquiry and the degree of accuracy desired.

ARITHMETIC AVERAGE

Amongst all the types of averages, the arithmetic mean is most commonly used due to the simplicity of its calculation and other benefits. It is normally expressed as the sum total of the observations divided by the number of items observed. In the case of a discrete and continuous series, the values of the frequencies are also taken into consideration.

Mathematical Properties of the Arithmetic Average:

- The sum of the deviations of the items from the mean is always equal to zero.

- If a series of an observation consists of two or more component series, the mean of the whole series can be easily expressed in terms of the means of the component series.
- The sum of squared deviations of the items from the mean is less than the sum of squared deviations of items from any other value.
- The means of all the sums and differences of corresponding observations in two series (with equal number of observations) is equal to the sum or difference of the means of the two series.

Merits of Arithmetic Average:

- The greatest merit of the simple mean is its simplicity. It is easy to calculate and easier to follow. Any individual, with a little knowledge can calculate the simple mean and may also put it to use.
- The arithmetic average is calculated taking into consideration all the item values. This removes the difficulty of making any type of selection or to first put the series in an arranged order ascending or descending for mathematical calculations.
- Arithmetic average can be calculated of any type of series symmetrical or asymmetrical.
- The arithmetic average may be computed with the assignment of weights or without weights.
- The arithmetic average is not indefinite.
- The results obtained from the calculation of arithmetic average are easily followed by all and also for further statistical treatment.
- It is open to algebraic and arithmetic treatment.

Demerits of Arithmetic Average:

- As it takes into consideration all the item values, there is always a possibility of its giving a non representative result. It is on account of the inclusion of the heterogeneous items that the result is much affected.

- The arithmetic mean may give a result which is not to be found in the series. Sometimes it creates a lot of confusion to the general reader.
- Sometimes the arithmetic mean may give a result which is not only absurd, but also misleading.
- The simple arithmetic mean can only give a numerical figure and nothing else; it cannot express progress, or retardation or the changes that are occurring in the series over a period of time.
- Arithmetic mean attaches greater importance to bigger items ill the series and lesser importance to smaller items.

Basically there are three methods for calculating mean. These are:

(i) **Direct Method:** In this method, if individual data series is available, we simply divide the sum of the variables by their numbers. However in case of discrete or continuous series, firstly we calculate product of item values and their frequencies, then divide the sum of this product by the total number of the frequency.

(ii) **Short cut Method:** this method is used to simplify the calculations. If data series is individual, firstly we calculate the difference of item values from the assumed mean (called deviations), then divide the sum of deviations by their numbers. However, in case of discrete or continuous series, firstly we calculate product of deviations of item values and their frequencies, then divide the sum of this product by the total number of the frequency.

(iii) **Step Deviation method:** The short cut method discussed above is further simplified or calculations are reduced to a great extent by adopting step deviation from the assumed mean, if possible, it is further divided by a common factor. Scaling down the deviation by a “step” will reduce the calculation to a minimum. In such a case, the frequencies will be multiplied by the step deviations and not by deviations. The decreasement arrived at by scaling down is counterbalanced by multiplying the average of the step deviations by the same amount of step. This is done before adding to the assumed mean.

FORMULAE FOR CALCULATING ARITHMETIC MEAN

Method	Individual Series	Discrete and Continuous Series
Direct Method	$\bar{X} = \frac{\sum X}{N}$	$\bar{X} = \frac{\sum fx}{N}$
Short cut Method (When we take Deviations from Assumed Mean)	$\bar{X} = A + \frac{\sum dx}{N}$	$\bar{X} = A + \frac{\sum fdx}{N}$
Step Deviation Method (When we take Deviations from Assumed Mean, and Deviations are divided by Common Factor (i))	$\bar{X} = A + \frac{\sum dx}{N} X\, i$	$\bar{X} = A + \frac{\sum fdx}{N} X\, i$

Example 1: Calculate mean from the following data:

Roll Nos.	1	2	3	4	5	6	7	8	9	10
Marks	40	50	55	78	58	60	73	35	43	48

Solution:

Roll Nos.	1	2	3	4	5	6	7	8	9	10	N=10
Marks	40	50	55	78	58	60	73	35	43	48	∑X=540

$$\bar{X} = \frac{\sum X}{N} = \frac{540}{10} = 54$$

This question can also be solved by Short Cut Method which is as follows.

Roll Nos.	1	2	3	4	5	6	7	8	9	10	N=10
Marks (X)	40	50	55	78	58	60	73	35	43	48	∑X=540
dx (A = 50)	-10	0	5	28	8	10	23	-15	-7	-2	$\sum dx = 40$

$$\bar{X} = A + \frac{\sum dx}{N} = 50 + \frac{40}{10} = 54$$

Example 2: Calculate mean from the following data:

Value	1	2	3	4	5	6	7	8	9	10
Freq.	21	30	28	40	26	34	40	9	15	57

Solution:

(X)	1	2	3	4	5	6	7	8	9	10	
(F)	21	30	28	40	26	34	40	9	15	57	N = 300
fx	21	60	84	160	130	204	280	72	135	570	$\sum fx = 1716$

$$\overline{X} = \frac{\sum fx}{N} = \frac{1716}{300} = 5.72$$

Above question can also be solved by Short Cut Method which is as follows.

(X)	1	2	3	4	5	6	7	8	9	10	
(F)	21	30	28	40	26	34	40	9	15	57	N=300
Dx(A=5)	-4	-3	-2	-1	0	1	2	3	4	5	$\sum dx = 5$
fdx	-84	-90	-56	-40	0	34	80	27	60	285	$\sum fdx = 216$

$$\overline{X} = A + \frac{\sum fdx}{N} = 5 + \frac{216}{300} = 5.72$$

Example 3: From the following find out the mean profits:

Profit per shop Rs.	Number of shops
100-200	10
200-300	18
300-400	20
400-500	26
500-600	30
600-700	28
700-800	18

Solution:

Calculation of Mean

Profit Rs.	Mid Point (X)	Number of Shops (f)	fx
100-200	150	10	1500
200-300	250	18	4500
300-400	350	20	7000
400-500	450	26	11700
500-600	550	30	16500
600-700	650	28	18200
700-800	750	18	13500
$\sum f = 150$			$\sum fx = 72,900$

$$\bar{X} = \frac{\sum fx}{N} = \frac{72900}{150} = 486$$

Above question can also be solved by using Short Cut Method which is as follows.

Profit Rs.	Mid Point (X)	dx (A= 450)	Number of shops	fdx
100-200	150	-300	10	-3000
200-300	250	-200	18	-3600
300-400	350	-100	20	-2000
400-500	450	0	26	0
500-600	550	100	30	3000
600-700	650	200	28	5600
700-800	750	300	18	5400
			∑f =150	∑fdx= 5400

$$\bar{X} = A + \frac{\sum fdx}{N} = 450 + \frac{5400}{150} = 486$$

If we are using Step Deviation Method, calculation of mean will be as follows.

Profit Rs.	Mid Point (X)	dx (A=450)	dx=(X-450)/100	Number of shops	fdx
100-200	150	-300	-3	10	-30
200-300	250	-200	-2	18	-36
300-400	350	-100	-1	20	-20
400-500	450	0	0	26	0
500-600	550	100	1	30	30
600-700	650	200	2	28	56
700-800	750	300	3	18	54
				∑f =150	∑fdx= 54

Here: ∑f or N=150, ∑fdx= 54, and i=100. Hence, by formula:

$$\bar{X} = A + \frac{\sum dx}{N} X\, i = 450 + \frac{54}{150} X100 = 486$$

WEIGHTED MEAN

In the calculation of simple average each item of the series is considered equally important but there may be cases where all items may not have equal importance, and some of them may be comparatively more important than others. The fundamental purpose of finding out an average is that it shall "fairly" represent, so for as a single figure can, the central tendency of the many varying figures from which it has been calculated. This being so, it is necessary that if some items of a series are more important than others, this fact should not be overlooked altogether in the calculation of an average. If we have to find out the average income of the employees of a certain factory and if we simply add the figures of the income of the manager, an accountant, a clerk, a laborer and a watchman and divide the total by five, the average so obtained cannot be a fair representative of the income of these people. The reason is that in a factory there may be one manager, two accountants, six clerks, one thousand laborers and one dozen watchmen, and if it is so, the relative importance of the figures of their income is not the same. Hence, calculation of weighted mean by assigning proper weights to all the representative groups becomes desirable.

FORMULA FOR CALCULATING WEIGHTED MEAN

Weighted Mean	$\overline{Xw} = \frac{\sum WX}{\sum W}$

Example 4: Comment on the performance of the students of three Universities given below using simple and weighted averages:

University	Bombay		Calcutta		Chennai	
Course of Study	% of Pass	No. of Students('00)	% of Pass	No. of Students('00)	% of Pass	No. of Students('00)
M.A.	71	3	82	2	81	2
M.Com.	83	4	76	3	76	3.5
B.A.	73	5	73	6	74	4.5
B.Com.	74	2	76	7	58	2
B.Sc.	65	3	65	3	70	7
M.Sc.	66	3	60	7	73	2

Solution:

Computation of Simple and Weighted Average

Course of Study	Bombay			Calcutta			Chennai		
	X	W	WX	X	W	WX	X	W	WX
M.A.	71	3	213	82	2	164	81	2	162
M.Com.	83	4	332	76	3	228	76	3.5	266
B.A.	73	5	365	73	6	438	74	4.5	333
B.Com.	74	2	148	76	7	532	58	2	116
B.Sc.	65	3	195	65	3	195	70	7	490
M.Sc.	66	3	198	60	7	420	73	2	146
	∑X= 432	∑W= 20	∑WX= 1451	∑X= 432	∑W= 28	∑WX= 1977	∑X= 432	∑W= 21	∑X= 1513

Here: ∑X and N is the same for all the three universities. So, Sum of ∑X=72.

$$\overline{X} = \frac{\sum X}{N} = \frac{432}{6} = 72$$

But the number of students (Weight) is different. Therefore, we have to calculate the weighted mean. Hence, by formula:

Bombay:

$$\overline{Xw} = \frac{\sum WX}{\sum W} = \frac{1451}{20} = 72.55$$

Calcutta:

$$\overline{Xw} = \frac{\sum WX}{\sum W} = \frac{1977}{28} = 70.60$$

Chennai:

$$\overline{Xw} = \frac{\sum WX}{\sum W} = \frac{1513}{21} = 72.05$$

Hence, Bombay University is the best university because the weighted mean is greater than the other two universities.

COMBINED MEAN

Sometimes data is collected in various small samples from different market segments or localities, the means of different groups or the samples will be different. If we want to know the mean of all the related groups in combined or composite form, we calculate combined or composite mean.

FORMULAE FOR CALCULATING COMBINED MEAN

Combined Mean	$\overline{X_{123}} = \dfrac{\overline{X_1}N_1 + \overline{X_2}N_2 + \overline{X_3}N_3}{N_1 + N_2 + N_3}$

Example 5: A class consists of three sections A, B, and C with 50, 55, and 57 students. The mean marks of students in each of the sections are 48, 52, and 46 respectively. Find the mean marks of the entire class.

Solution: By formula-

$$\overline{X_{123}} = \frac{\overline{X_1}N_1 + \overline{X_2}N_2 + \overline{X_3}N_3}{N_1 + N_2 + N_3}$$

$$\overline{X_{123}} = \frac{50x48 + 55x52 + 57x46}{50 + 55 + 57} = \frac{4882}{162} = 48.65$$

Example 6: The average annual wage of all employees in a factory is Rs. 3000. The average annual wage of male employees is Rs. 3200 and that of female is Rs. 2200. Find the percentage of male and female employees in the factory.

Solution: Let, Male=M, Female= F, and M+F=100.

$$\overline{X_{123}} = \frac{\overline{X_1}N_1 + \overline{X_2}N_2 + \overline{X_3}N_3}{N_1 + N_2 + N_3}$$

$$3000 = \frac{3200xM + 2200xF}{100}$$

Or, 300000 = 3200xM + 2200x (100 - M)

So, 300000 = 3200 M + 220000 - 2200M

Or, (300000 – 220000 = 3200 M - 2200 M) = (80000 = 1000 M)

Hence, M = 80

Thus, percentage of male is 80 and percentage of female employees is 20.

GEOMETRIC MEAN

The geometric mean is the n^{th} root of the product of n numbers. The formula of finding the value of GM in natural numbers is:

$$GM = na_1 + a_2 + a_3 + \ldots.. a_n$$

When a geometric mean of a series of numbers is decided, the computation is best undertaken through the use of logarithms. In that case the value of GM is:

$$GM = \frac{\text{Antilog Log X1} + \text{Log2} + \text{Log3} + \cdots \text{Logn}}{N}$$

Or

$$\text{Log GM} = \frac{\text{Log X1} + \text{Log2} + \text{Log3} + \cdots \text{Logn}}{N}$$

Where: X1, X2, X3, Xn are the item values, and N is the total numbers of items.

Calculation of geometric mean is possible if the number of items are very few the. However, If the number of items is large and their size is big this method of finding out the geometric mean cannot be suitably used. In such a case use of logs is important. This is why it is defined as the antilog of the arithmetic average of the logs of the values of a variable.

FORMULAE FOR CALCULATING GEOMETRIC MEAN

Type of Average	Individual Series	Discrete and Continuous Series
Geometric Mean	$GM = \text{Antilog} \frac{\sum \text{Log X}}{N}$	$GM = \frac{\sum \text{f Log X}}{N}$

Merits of Geometric Mean:

- It is rigidly defined and its value is a precise figure.
- It is based on all the observations of a series.
- It is not much affected by sampling fluctuations.
- It is capable of further algebraic treatment. Weighted geometric mean may also be calculated.
- The product of the items remains unchanged in the geometric mean if each item is replaced by geometric mean.

- Geometric mean lays more stress on the smaller items, thereby neutralizing the effects of extreme variations.
- Geometric mean is a true average and not merely an abstract.

Demerits of Geometric Mean:

- For computing the value of geometric mean of a series, we are required to find the logarithms and finally, the antilogarithms. Not only it entails a lot of time but makes the calculations complicated and technical also.
- In geometric mean, more stress is invariably laid on the smaller items. It may, in some cases, affect the result.
- Geometric mean is difficult to calculate.
- The scope of the use of geometric mean is limited.
- It can neither be calculated nor followed by an average man, who has no specific knowledge of mathematics.

Example 7: Calculate simple geometric mean from: 133, 141, 125, 173, and 182.

Solution: Calculation of the geometric mean.

Size of item	Logarithms
133 141 125 173 182	2.1239 2.1492 2.0969 2.2380 2.2601
n = 5	∑ logs = 10.8681

$$\text{GM} = \text{Antilog}\,\frac{\sum \text{Log X}}{\text{N}}$$

$$\text{GM} = \text{Antilog}\,\frac{10.8681}{5} = \text{Antilog}\,2.1736$$

GM =149 Approx.

Example 8: From the following data calculate the Geometric Mean.

Size of item	6	7	8	9	10	11	12
Frequency	8	12	18	26	16	12	8

Solution:

X	Logarithms	f	(f) × (log X)
6	0.7782	8	6.2256
7	0.8451	12	10.1412
8	0.9031	18	16.2558
9	0.9542	26	24.4092
10	1.0000	16	16.0000
11	1.0414	12	12.4968
12	1.0792	8	8.6336
		N = 100	∑(f) × (log X) = 94.1622

$$\text{GM} = \text{Antilog}\frac{\sum \text{f Log X}}{\text{N}}$$

$$\text{GM} = \text{Antilog}\frac{94.1622}{100} = \text{Antilog } 0.941622$$

GM = 8.742 Approx.

Example 9: Calculate the geometric mean of the following data:

Wages (Rs.)	55-65	65-75	75-85	85-95	95-105	105-115
Frequency	3	4	5	5	7	6

Solution:

Wages	Mid Point	Logarithms (X)	f	(f) × (log X)
55-65	60	1.7782	3	5.3346
65-75	70	1.8451	4	7.3804
75-85	80	1.9031	5	9.5155
85-95	90	1.9542	5	9.7710
95-105	100	2.0000	7	14.0000
105-115	110	2.0414	6	12.2484
			N = 30	∑(f) × (log X) = 58.2499

$$\text{GM} = \text{Antilog}\frac{\sum \text{f Log X}}{\text{N}}$$

$$\text{GM} = \text{Antilog}\frac{58.2499}{30} = \text{Antilog } 1.94166$$

GM = 87.44 Approx.

HARMONIC MEAN

The harmonic mean is the reciprocal of the arithmetic average of the reciprocals of the values. Symbolically,

$$\text{HM} = \frac{\text{N}}{\frac{1}{\text{X1}} + \frac{1}{\text{X2}} + \frac{1}{\text{X3}} + \cdots \frac{1}{\text{Xn}}}$$

Where: X1, X2, X3, Xn = Respective sizes of the items, and

N = Total number of items.

FORMULAE FOR CALCULATING HARMONIC MEAN

Type of Average	Individual Series	Discrete and Continuous Series
Harmonic Mean	$\text{HM} = \frac{\text{N}}{\sum 1/\text{X}}$	$\text{HM} = \frac{\text{N}}{\sum \text{f}.1/\text{X}}$

Merits of the Harmonic Mean:

- It gives a much accurate result than the simple mean.
- It lays maximum weight on the smallest items, thus, removing the effect of the largest items.
- In this case also, we can find the weighted mean.
- It is not so difficult to calculate as the geometric mean.

Demerits of the Harmonic Mean:

- It lays undue emphasis on the smaller, or the smallest items which may yield a somewhat biased result.
- Its calculation is more difficult than that of the simple mean.
- Its coverage is much less than that of the simple mean.
- Normally, the use of reciprocal tables is essential.
- A layman cannot understand the process of calculation and the method of use of the harmonic mean.

Example 10: Calculate the Harmonic mean form the following data:

Size	3	5	7	9	Total
Frequency	20	40	30	10	100

Solution:

Size	1/x	f	f x (1/x)
3 5 7 9	0.3330 0.2000 0.1429 0.1111	20 40 30 10	6.6666 8.0000 4.2870 1.1111
		N = 100	∑(f) × Reciprocal= 20.0647

$$\text{HM} = \frac{\text{N}}{\sum \text{f}.\frac{1}{\text{X}}}$$

$$\text{HM} = \frac{100}{20.0647} = 4.9839$$

Example 11: Calculate of Harmonic Mean of the following series:

Values	2	6	10	14	18
Frequency	4	12	20	9	5

Solution:

Size (X)	f	f x1/x
2	4	$4\times\frac{1}{2}$ = 2.0000
6	12	$12\times\frac{1}{6}$ = 2.0000
10	20	$20\times\frac{1}{10}$ = 2.0000
14	9	$9\times\frac{1}{14}$ = 0.64286
18	5	$5\times\frac{1}{18}$ = 0.2778
	N = 50	$\sum(\frac{f}{x})$ = 6.9207

$$\text{HM} = \frac{\text{N}}{\sum \text{f}.1/\text{X}} = \frac{50}{6.9207} = 7.225$$

Example 12: From the following data calculate Harmonic mean.

Class Interval	10-20	20-30	30-40	40-50	50-60
Frequency	30	75	70	135	220

Solution:

Class Interval	f	Mid Point	f /x
20-Oct	30	15	2.0000
20-30	75	25	3.0000
30-40	70	35	2.0000
40-50	135	45	3.0000
50-60	220	55	4.0000
	N = 530		∑ f /m = 14.0000

$$\text{HM} = \frac{\text{N}}{\sum \text{f}.1/\text{X}} = \frac{530}{14} = 37.86$$

Example 13: From the data given below calculate average output per worker by using Harmonic Mean.

Output	70-74	75-79	80-84	85-89	90-94	95-99	100-104
No. of workers	3	5	15	12	7	6	2

Solution:

Output	Mid Value (m)	No. of workers (f)	f /m
70-74	72	3	0.0416
75-79	77	5	0.0649
80-84	82	15	0.1829
85-89	87	12	0.1379
90-94	92	7	0.0761
95-99	97	6	0.0619
100-104	102	2	0.0196
		N = 50	∑ f /m = 0.5849

$$\text{HM} = \frac{\text{N}}{\sum \text{f}.1/\text{X}} = \frac{50}{0.5849} = 85.4846$$

SUMMARY

In general, averages are said to be a single unit or number, representing a particular result. The average is extracted out of a large mass of varied data through the application of statistical methods. It is a process of condensation very commonly used in the study of almost all the branches of sciences and humanities. Averages are used to simplify the complexities of large mass of unwieldy data.

REVIEW QUESTIONS

- What do you understand by the term average? Point out the properties of a good average. .
- What is meant by measures of central tendency? What are the characteristics of a good measure of central tendency?
- Discuss briefly the merits and demerits of the various statistical averages.
- Discuss the relative merits of the arithmetic, geometric and harmonic mean as measures of central tendency.
- What is harmonic mean? What are its uses and limitations? Also give method of its calculation.
- Following are the marks of students out of 10 in an assignment. Calculate the arithmetic mean

Marks	4	5	6	7	8	9
Frequency	8	10	9	6	4	3

(Ans. 2.1)

- Following figures relates to cost of production of sugarcane in different holdings. Calculate the arithmetic mean

Cost	2-6	6-10	10-14	14-18	18-2	22-26	26-30	30-34
Frequency	1	9	21	47	52	36	19	3

(Ans. 19.21)

- Mean of the following distribution is 47.2. Find the missing frequency.

X	40-43	43-46	46-49	49-52	52-55
Y	31	58	60	?	27

(Ans. 44)

- Following are the marks of students in an examination. Calculate the arithmetic mean

Marks	Below 10	Below 20	Below 30	Below 40	Below 50	Below 60	Below 70	Below 80
Students	15	35	60	84	96	127	198	250

(Ans. 50.4)

- Mean of 20 values is 45. If one of these values is to be taken 64 instead of 46. Find the correct mean. . (Ans. 44.1)
- The mean salary paid to 1,000 workers of an establishment was found to be Rs. 180.40. Later on, after disbursement of salary, it was discovered that the salary of two employees was wrongly entered as Rs. 297 and 165. Their correct salaries were Rs.197 and 185. Find the correct average salary. (Ans. 180.32)
- The average monthly sales for the first eleven months of the year in respect of a certain salesman .were Rs. 12,000 but due to his illness during the last month, the average monthly sales for the whole year came down to Rs. 11,375. What was the value of his sales during the last month? (Ans. Rs. 4,500)
- The average weight of a group of 25 boys was calculated to be 78.4 lb. It was later discovered that one weight was misread as 69 lb. instead of 96 lb. Calculate the correct average. (Ans. 79.48)
- The mean marks of 100 students were found to be 40. Later on it was discovered that a score of 53 was misread as 83. Find the corrected mean corresponding to the corrected score. (Ans. 39.7)
- There are two branches of a company, employing 280 and 320 persons respectively. If the arithmetic mean of the average monthly salary paid to employee in two branches is Rs. 750 and Rs. 937.50 respectively. Find the arithmetic mean of the employees of the company as a whole. (Ans. 850)
- 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 the percentage of percentage of men and women in the group.

(Ans. Men: 6O%, Women: 40%)

- Calculate the geometric mean of: 2574, 475, 5, 0.8, 0.005, and 0.0009.

(Ans. 1.84)

- From the monthly income of ten families given below, calculate the Geometric Mean:

Family	1	2	3	4	5	6	7	8	9	10
Income	145	367	268	73	185	619	280	115	870	315

(Ans. 252.4)

- Calculate the geometric mean and the harmonic mean of: 2000, 35, 400, 15, 40, 1500, 300, 6, 90, 250, and 20. (Ans. GM = 106.7, HM = 30.6)
- A train runs for 30 minutes at a speed of 40 miles an hour and then,. because of repairs of the track 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 hour. What is the average speed? (Ans. 34.33 mph)
- A taxi cab drives from a plain town to a hill station, 60 miles distance, at a mileage rate of 10 miles per gallon of petrol and on the return trip at 15 miles per gallon. Find the harmonic mean, rate of mileage per gallon.

(Ans. 12 miles per gallon)

SUGGESTED READINGS

- Elhance DN: Fundamentals Of Statistics
- Gupta SP: Statistical Methods
- Gupta BN: Statistics
- Nagar KN: Fundamentals of Statistics
- Varshney RD: Fundamentals of Statistics
- Nagar AL: Fundamentals of Statistics