MATHEMATICS

Class-X

Topic-11

STATISTICS

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CH-11
STATISTICS

A. INTRODUCTION AND ARITHMETIC MEAN

Statistics is the study of the collection, organisation, analysis, interpretation and presentation of data.

(a) Measures of central tendency

A certain value representative of the whole data and signifying its characteristics is called measure of central tendency or average. Mean, median and mode are the measures of central tendency.

(b) Arithmetic mean

The arithmetic mean (or simple mean) of a set of observations is obtained by dividing the sum of the values of observations by the number of observations.

(i) Mean of raw data

The mean of n observations $\mathbf{x_1, x_2, x_3, \ldots, x_n}$ is

$$\bar{x} = \frac{x_1 + x_1 + \ldots + x_n}{n} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$n\bar{x}$ = sum of observations = $\sum_{i=1}^{n} x_i$

i.e. product of mean & no. of items gives sum of observations.

(ii) Mean for an ungrouped frequency distribution

Let $x_1, x_2, \ldots, x_n$ be n observations with respective frequencies $f_1, f_2, \ldots, f_n$. This means observation x_1 occurs f_1 times, x_2 occurs f_2 times and so on.

Then, sum of the values of all the observations

$= f_1x_1 + f_2x_2 + \ldots + f_nx_n$

$= \sum_{i=1}^{n} f_ix_i$

and number of observations

$= f_1 + f_2 + \ldots + f_n = \sum_{i=1}^{n} f_i$

$$\therefore \quad \text{Mean } (\bar{x}) = \frac{\sum_{i=1}^{n} f_ix_i}{\sum_{i=1}^{n} f_i}$$

It can also be written as

$$(\bar{x}) = \frac{\sum f_ix_i}{\sum f_i}$$

It is understood that i varies from 1 to n.

(iii) Mean of Grouped Data

To calculate the mean of grouped data, we have three methods, which are

(I) Direct method

(II) Assumed mean method

(III) Step deviation method

(I) Direct Method : Firstly, find the class marks of each class interval. These class marks are represent by x_i. In general, for the i^{th} class interval, we have the frequency f_i corresponding to the class marks x_i.

Different steps used in direct method are given below

Step : 1 Find the class mark (mid value), x_i of each class.

$$\text{Class mark of a class} = \frac{\text{Lower limit} + \text{Upper limit}}{2}$$

Step : 2 Calculate $f_i x_i$ for each x_i

Step : 3 Find $\Sigma f_i x_i$ and Σf_i

Step : 4 By using formula, mean, $\left(\bar{x}\right) = \frac{\sum f_i x_i}{\sum f_i}$, calculate the mean

(II) Assumed Mean Method (Shortcut Method) : The cases, in which numerical values of x_i and f_i are large, become tedious and time consuming to find product of x_i and f_i. In these cases, assumed mean method is used. In this method, first of all one among x_i's is chosen as the assumed mean and denoted by a.

We may take 'a' to be that x_i which lies in the centre of $x_1, x_2, ..., x_n$ to reduce our calculation work.

In this method, we subtract an arbitrary constant 'a', called the assumed mean from each value of x_i. The reduced value is $x_i - a$. We denote it by d_i and write

$$d_i = x_i - a.$$

d_i is called the deviation of x_i from the assumed mean a.

Hence, $x_i = a + d_i$

$$\Rightarrow \quad f_i x_i = a f_i + d_i f_i$$

$$\Rightarrow \quad \sum_{i=1}^{n} f_i x_i = \sum_{i=1}^{n} a f_i + \sum_{i=1}^{n} d_i f_i$$

$$\Rightarrow \quad \sum_{i=1}^{n} f_i x_i = a\sum_{i=1}^{n} f_i + \sum_{i=1}^{n} d_i f_i = aN + \sum_{i=1}^{n} d_i f_i \qquad \left[\because \sum_{i=1}^{n} f_i = N\right]$$

$$\Rightarrow \quad \frac{1}{N}\sum_{i=1}^{n} f_i x_i = a + \frac{1}{N}\sum_{i=1}^{n} d_i f_i \qquad \text{[Dividing both sides by N]}$$

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

So, $$\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$$

where, a = Assumed mean

d_i = Deviation from mean $(x_i - a)$

Different steps used in assumed mean method are given below

Step - 1 : for each class interval, calculate the class marks x_i, by using the formula.

$$x_i = \frac{1}{2}\text{ (Lower class limit + Upper class limit)}$$

Step - 2 : Choose a suitable value of x_i in the middle as the assumed mean and denote it by a.

Step - 3 : Calculate the deviation $d_i = (x_i - a)$ for each i.
Step - 4 : Calculate the product $f_i d_i$ for each i.
Step - 5 : Find $N = \Sigma f_i$.
Step - 6 : Calculate the mean $(\bar{x})$, by using the formula

$$\text{Mean } \bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$$

(III) Step-Deviation Method : The main objective of subtracting an arbitrary number from each observation x_i for the calculation of arithmetic mean by short-cut method is to reduce these numbers x_i. In this case, the calculation becomes simpler. We can make these differences still smaller, if these are divisible by a common non-zero number, say h. In this case, the calculation becomes much simpler. We can, therefore, modify the formula of short-cut method as follows:

Let $u_i = \frac{x_i - a}{h}$, i = 1, 2, 3, ..., n.

$\therefore \quad x_i = a + h\,u_i \quad \Rightarrow \quad f_i x_i = a f_i + h\,u_i f_i$

$$\Rightarrow \quad \sum_{i=1}^{n} f_i x_i = a\sum_{i=1}^{n} f_i + h\sum_{i=1}^{n} u_i f_i = aN + h\sum_{i=1}^{n} u_i f_i \quad \Rightarrow \quad \frac{1}{N}\sum_{i=1}^{n} f_i x_i = a + \frac{h}{N}\sum_{i=1}^{n} u_i f_i$$

Divide the above equation by $[\sum_{i=1}^{n} f_i = N]$

$$\Rightarrow \quad \bar{x} = a + \frac{h}{N}\sum u_i f_i$$

Here, h is any arbitrary non-zero constant and a is an assumed mean which is also arbitrary.

So, $$\bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right) h$$

where, a = Assumed mean, $u_i = \frac{x_i - a}{h}$, h = Width of class interval

Different steps used in step deviation method are given below
Step - 1 : For each class interval, calculate the class marks x_i, by using the formula.

$$x_i = \frac{1}{2}\text{ (Lower class limit + Upper class limit)}$$

Step - 2 : Choose a suitable value of x_i in the middle as the assumed mean and denote it by a.
Step - 3 : Calculate the deviation $d_i = (x_i - a)$ for each i.
Step - 4 : Calculate $u_i = \frac{x_i - a}{h}$ for each $d_i = x_i - a$, where h is the class size or common factor of all d_i.
Step - 5 : Find $f_i u_i$ for each u_i.
Step - 6 : Find $\Sigma f_i u_i$ and Σf_i.
Step - 7 : Calculate mean by using formula

$$(\bar{x}) = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right) h$$

(c) Properties of mean

(i) Sum of deviations from mean is zero i.e. $\sum_{i=1}^{n} (x_i - \bar{x}) = 0$.

(ii) If a constant real number 'a' is added to each of the observation than new mean will be $\bar{x} + a$.

(iii) If a constant real number 'a' is subtracted from each of the observation then new mean be $\bar{x} - a$.

(iv) If a constant real number 'a' is multiplied with each of the observation then new mean will be $a\bar{x}$

(v) If each of the observation is divided by a constant no 'a', then new mean will be $\frac{\bar{x}}{a}$.

(d) Merits of arithmetic mean

(i) It is rigidly defined, simple, easy to understand and easy to calculate.
(ii) It is based upon all the observations.
(iii) Its value being unique, we can use it to compare different sets of data.
(iv) It is least affected by sampling fluctuations.
(v) Mathematical analysis of mean is possible. So, It is relatively reliable.

(e) Demerits of arithmetic mean

(i) It can not be determined by inspection nor it can be located graphically.
(ii) Arithmetic mean cannot be used for qualitative characteristics such as intelligence, honesty, beauty etc.
(iii) It cannot be obtained if a single observation is missing.
(iv) It is affected very much by extreme values. In case of extreme items, A.M. gives a distorted picture of the distribution and no longer remains representative of the distribution.
(v) It may lead to wrong conclusions if the details of the data from which it is computed are not given.
(vi) It can not be calculated if the extreme class is open, e.g. below 10 or above 90.
(vii) It cannot be used in the study of ratios, rates etc.

(f) Uses of arithmetic mean

(i) It is used for calculating average marks obtained by a student.
(ii) It is extensively used in practical statistics and to obtain estimates.
(iii) It is used by businessman to find out profit per unit article, output per machine, average monthly income and expenditure etc.

Solved Examples

Example. 1

Find the mean of the factors of 10.

Sol. Factors of 10 are 1, 2, 5 & 10.

$$\bar{x} = \frac{1+2+5+10}{4} = \frac{18}{4} = 4.5$$

Example. 2

The mean of marks scored by 100 students was found to be 40. Later on it was discovered that a score of 53 was misread as 83. Find the correct mean.

Sol. n = 100, $\bar{x}$ = 40

$$\bar{x} = \frac{1}{n}\left(\sum x_i\right) \Rightarrow \quad 40 = \frac{1}{100}\left(\sum x_i\right)$$

$\therefore$ Incorrect value of $\sum x_i = 4000$.

Now, Correct value of $\sum x_i = 4000 - 83 + 53 = 3970$

$\therefore$ Correct mean = $\frac{\text{correct value of } \sum x_i}{n} = \frac{3970}{100} = 39.7$

So, the correct mean is 39.7. **Ans.**

Example. 3

Find the missing value of P for the following distribution whose mean is 12.58

x	5	8	10	12	P	20	25
f	2	5	8	22	7	4	2

Sol. Given $\bar{x}$ = 12.58

Calculation of Mean :

x_i	f_i	f_ix_i
5	2	10
8	5	40
10	8	80
12	22	264
P	7	7P
20	4	80
25	2	50
	$\sum f_i = 50$	$\sum f_ix_i = 524 + 7P$

$$\bar{x} = \frac{\sum f_ix_i}{\sum f_i} \quad \Rightarrow \quad 12.58 = \frac{524 + 7P}{50}$$

629 = 524 + 7P

7P = 105

P = 15.

Example. 4

Find the mean for the following distribution :

Marks	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80
Frequency	6	8	13	7	3	2	1

Sol.

Marks	Mid values x_i	No. of students f_i	f_ix_i
10 - 20	15	6	90
20 - 30	25	8	200
30 - 40	35	13	455
40 - 50	45	7	315
50 - 60	55	3	165
60 - 70	65	2	130
70 - 80	75	1	75
		$\sum f_i = 40$	$\sum f_ix_i = 1430$

$$\bar{x} = \frac{\sum f_ix_i}{\sum f_i} = \frac{1430}{40} = \frac{143}{4} = 35.75 .$$

Example. 5

Find the mean for the following distribution by using deviation method

x_i	15	20	22	24	25	30	33	38
Frequency	5	8	11	20	23	18	13	2

Sol.

x_i	f_i	Let a = 25 $d_i = x_i - 25$	f_id_i
15	5	–10	– 50
20	8	– 5	– 40
22	11	– 3	– 33
24	20	– 1	– 20
25	23	0	0
30	18	5	90
33	13	8	104
38	2	13	26
	$\sum f_i = 100$		$\sum f_id_i = 77$

$$\bar{x} = a + \frac{\sum f_id_i}{\sum f_i} = 25 + \frac{77}{100} = 25.77.$$

Example. 6

Find the mean of following distribution with step-deviation method

Class	10 -15	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40
Frequency	5	6	8	12	6	3

Sol.

Calculation of mean :

Class	x_i	f_i	Let a = 27.5 $u_i = \frac{x_i - 27.5}{5}$	f_iu_i
10 - 15	12.5	5	–3	– 15
15 - 20	17.5	6	– 2	– 12
20 - 25	22.5	8	– 1	– 8
25 - 30	27.5	12	0	0
30 - 35	32.5	6	1	6
35 - 40	37.5	3	2	6
		$\sum f_i = 40$		$\sum f_iu_i = -23$

$$\Rightarrow \quad \bar{x} = a + \left(\frac{\sum f_iu_i}{\sum f_i}\right) h$$

$$\Rightarrow \quad \bar{x} = 27.5 + 5 \times \left(\frac{-23}{40}\right) = 24.625 .$$

Example. 7

The mean of the following frequency distribution is 62.8 and the sum of all frequencies is 50. Compute the missing frequency f_1 and f_2

Class	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100	100 – 120
Frequency	5	f_1	10	f_2	7	8

Sol. Let a = 30, h = 20

Class	x_i	f_i	$u_i = \frac{x_i - a}{h}$	f_iu_i
0 – 20	10	5	–1	– 5
20 – 40	30	f_1	0	0
40 – 60	50	10	+1	10
60 – 80	70	f_2	+ 2	$2f_2$
80 – 100	90	7	+ 3	21
100 –1 20	110	8	+ 4	32
		$\sum f_i = 30 + f_1 + f_2$		$\sum f_iu_i = 58 + 2f_2$

Given: $30 + f_1 + f_2 = 50$

$f_1 + f_2 = 20$ ..... (i)

$$\bar{x} = a + \left(\frac{\sum f_iu_i}{\sum f_i} \times h\right) \Rightarrow 62.8 = 30 + \left(\frac{58 + 2f_2}{50} \times 20\right)$$

$\Rightarrow 32.8 = (58 + 2f_2) \times \frac{2}{5} \Rightarrow 32.8 \times 5 = 116 + 4f_2 \Rightarrow 164 = 116 + 4f_2$

$\Rightarrow 4f_2 = 164 - 116 \Rightarrow 4f_2 = 48 \Rightarrow f_2 = 12$

Now, $f_1 + f_2 = 20$

$f_1 + 12 = 20$

$f_1 = 8$

So, the missing frequencies are $f_1 = 8$ and $f_2 = 12$.

Example. 8

Find the mean marks from the following data

Marks	No. of Students
Below 10	5
Below 20	9
Below 30	17
Below 40	29
Below 50	45
Below 60	60
Below 70	70
Below 80	78
Below 90	83
Below 100	85

Sol. Changing less than type frequency distribution in general frequency distribution.

Marks	x_i	f_i	$a = 45, h = 10$ $u_i = \frac{x_i - a}{h}$	f_iu_i
0 –10	5	5	– 4	– 20
10 – 20	15	4	– 3	– 12
20 – 30	25	8	– 2	– 16
30 –40	35	12	– 1	– 12
40 – 50	45	16	0	0
50 – 60	55	15	+ 1	15
60 –70	65	10	+ 2	20
70 – 80	75	8	+ 3	24
80 – 90	85	5	+ 4	20
90 – 100	95	2	+ 5	10
		$\sum f_i = 85$		$\sum f_iu_i = 29$

According to step deviation formula for mean

$$\bar{x} = a + \left(\frac{\sum f_iu_i}{\sum f_i} \times h\right) \quad \Rightarrow \quad \bar{x} = 45 + \left(\frac{29}{85} \times 10\right)$$

$\Rightarrow \quad \bar{x} = 45 + 3.41 \quad \Rightarrow \quad \bar{x} = 48.41$

So, the mean marks is 48.41.

Check Your Level

1. The mean of the data 16, 20, 26, 40, 50, 60, 70, 30.

2. The weight in kg of 9 members in a school boxing team are 54, 59, x, 53, 73, 49, 50, 58, 45. If the average is 56 then x is

3. The mean of $x_1 + x_2 + .. + x_{10}$ is M. When x_i, i = 1, 2,….10 is replaced by $x_i + 10$, then new mean

4. Find the arithmetic mean age of the below data

Age in years	15	16	17	18	19	20
No. of students	2	5	9	4	3	2

5. The following set of raw data shows the lengths, in millimeters, measured to the nearest mm, of 40 leaves taken from plants of a certain species. This is the table of frequency distribution:

Lengths (mm)	25 – 29	30 – 34	35 – 39	40 – 44	45 – 49	50 – 54	55-59
Frequency	2	4	7	10	8	6	3

Choosing a suitable assumed mean compute the mean by step-deviation method.

Answers

1. 39 **2.** 63 **3.** M + 10 **4.** 17.28 **5.** 43

B MEDIAN

Median is the middle value of the distribution. It is the value of variable such that the number of observations above it is equal to the number of observations below it.

(a) Median of raw data

Step - 1 : Arrange the data in ascending order.
Step - 2 : Count the no. of observation (Let there be 'n' observation)

(i) if n be odd then Median = value of $\left(\frac{n+1}{2}\right)^{th}$ observation.

(ii) if n is even then median is the arithmetic mean of $\left(\frac{n}{2}\right)^{th}$ observation and $\left(\frac{n}{2}+1\right)^{th}$ observation.

(b) Median of discrete frequency distribution

In case of a discrete frequency distribution, we calculate the median by using the following steps.

Step-1 : Find the cumulative frequencies (c.f.).

Step-2 : Find N/2, where N = $\sum_{i=1}^{n} f_i$.

Step-3 : See the cumulative frequency (c.f.) just greater than N/2 and determine the corresponding value of the variable. This value is the required median.

(c) Median of class interval data (grouped)

In a grouped data, we may not find the middle observation by looking at the cumulative freqeuncies, since the middle observation will be some value in a class interval, so it is necessary to find the value inside a class that divides the whole distribution into two halves. For this, we find the cumulative frequencies of all the classes and $\frac{N}{2}$, where N = number of observations. Now, locate the class whose cumulative frequency is greater than (and nearest to) $\frac{N}{2}$. This class is called median class. After finding the median class, use the following formula for calculating the median.

Median = $\ell + \frac{\frac{N}{2} - C}{f} \times h$

ℓ = lower limit of median class,

N = total no of observation
C = cumulative frequency of the class preceding the median class
h = size of the median class
f = frequency of the median class.

(d) Merits of median

(i) It is rigidly defined, easily understood and calculate.

(ii) It is not at all affected by extreme values.

(iii) It can be located graphically, even if the class-intervals are unequal.

(iv) It can be determined even by inspection is some cases.

(e) Demerits of median

(i) In case of even numbers of observations median cannot be determined exactly.
(ii) It is not based on all the observations.
(iii) It is not subject to algebraic treatment.
(iv) It is much affected by fluctuations of sampling.

(f) Uses of median

(i) Median is the only average to be used while dealing with qualitative data which cannot be measured quantitatively but can be arranged in ascending or descending order of magnitude.
(ii) It is used for determining the typical value in problems concerning wages, distribution of wealth etc.

Solved Examples

Example. 9

Following are the lives in hours of 15 pieces of the components of air craft engine.
Find the median : 715, 724, 725, 710, 729, 745, 649, 699, 696, 712, 734, 728, 716, 705, 719

Sol. Arranging the data in ascending order
649, 696, 699, 705, 710, 712, 715, 716, 719, 724, 725, 728, 729, 734, 745
N = 15

So, Median = $\left(\frac{N+1}{2}\right)^{th}$ observation = $\left(\frac{15+1}{2}\right)^{th}$ observation = 8^{th} observation = 716.

Example. 10

The daily wages (in rupees) of 100 workers in a factory are given below

Daily wages (in Rs.)	125	130	135	140	145	150	160	180
No. of workes	6	20	24	28	15	4	2	1

Find the median wage of a worker for the above data.

Sol.

Daily wages (in Rs.)	No. of workes	Cumulative frequency
125	6	6
130	20	26
135	24	50
140	28	78
145	15	93
150	4	97
160	2	99
180	1	100

N = 100 (even)

$$\text{Median} = \frac{\left(\frac{N}{2}\right)^{th} \text{observatio} \quad n + \left(\frac{N}{2}+1\right)^{th} \text{observation}}{2}$$

$$\text{Median} = \frac{50^{th}\text{observation} + 51^{th}\text{observation}}{2} = \frac{135+140}{2} = 137.50$$

$\therefore$ Median wage of a workers in the factory is Rs 137.50.

Example. 11

Calculate the median for the following distribution class

Class	0 -10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60
Frequency	5	10	20	7	8	5

Sol. First we find $\left(\frac{N}{2}\right)^{th}$ value i.e. $\left(\frac{55}{2}\right)^{th} = 27.5^{th}$

which lies in 20-30.

$\therefore$ 20-30 class in median class

Class	f	c.f.
0 - 10	5	5
10 - 20	10	15
20 - 30	20	35
30 - 40	7	42
40 - 50	8	50
50 - 60	5	55

Here : $\ell = 20$, $\frac{N}{2} = 27.5$, C = 15,

f = 20, h = 10

$\therefore$ median = $20 + \frac{27.5 - 15}{20} \times 10$

Median = 26.25.

Example. 12

If the median of the following frequency distribution is 46, find the missing frequencies

Variable	10-20	20-30	30 - 40	40 - 50	50 -60	60 -70	70 -80	Total
Frequency	12	30	f_1	65	f_2	25	18	229

Sol.

Class Interval	Frequency	C.F.	
10 - 20	12	12	
20 - 30	30	42	
30 - 40	f_1	$42 + f_1$	
40 - 50	65	$107 + f_1$	(Median Class)
50 - 60	f_2	$107 + f_1+f_2$	
60 - 70	25	$132 + f_1+f_2$	
70 - 80	18	$150+ f_1+f_2$	

Let the frequency of the class 30 – 40 be f_1 and that of the class 50 – 60 be f_2 .

The total frequency is 229.

$12 + 30 + f_1 + 65 + f_2 + 25 + 18 = 229 \quad \Rightarrow \quad f_1 + f_2 = 79$

It is given that median is 46., clearly, 46 lies in the class 40 – 50. So, 40 – 50 is the median class

$\therefore \quad \ell = 40, h = 10, f = 65$ and $C = 42 + f_1$, $N = 229$

$$\text{Median} = \ell + \frac{\frac{N}{2} - C}{f} \times h \quad \Rightarrow \quad 46 = 40 + \frac{\frac{229}{2} - (42 + f_1)}{65} \times 10$$

$$\Rightarrow \quad 46 = 40 + \frac{145 - 2f_1}{13} \quad \Rightarrow \quad 6 = \frac{145 - 2f_1}{13}$$

$$\Rightarrow \quad 2f_1 = 67 \quad \Rightarrow \quad f_1 = 33.5 \text{ or } 34$$

Since, $f_1 + f_2 = 79$

$\therefore \quad f_2 = 45$

Hence, $f_1 = 34$, and $f_2 = 45$.

Check Your Level

1. Find the median of 9, 5,7, 11, 13, 3.

2. The shirt sizes worn by a group of 200 persons are as follows:

Shirt size	37	38	39	40	41	42	43	44
No. of persons	15	25	39	41	36	17	13	12

Find the median shirt size .

3. The number of words in each of the first eighty sentences of a book were counted. The results are recorded in groups as follows:

No. of words	1 – 4	5 – 8	9 – 12	13 – 16	17 – 20	21 – 24	25 – 28	29 – 32
No. of sentences	2	5	11	23	21	13	4	1

Estimate the median length of sentence correct to one decimal place.

4. The weights of 80 parcels were each measured to the nearest tenth of a kilogram, and the results recorded in groups as follows:

Weight in kg	20 – 24	24 – 28	28 – 32	32 – 36	36 – 40	40 – 44
No of parcels	2	12	17	25	17	7

Calculate the median weight.

Answers

1. 8 **2.** 40 **3.** 16.3 **4.** 33.4

(C) MODE

Mode or modal value of the distribution is that value of variable for which the frequency is maximum.

(a) Mode of ungrouped data (By inspection only)

Arrange the data in an array and then count the frequencies of each variate.
The variate having maximum frequency is the mode.

(b) Mode of continuous frequency distribution

In case of grouped frequency distribution, it is not possible to determine the mode by only looking at the frequencies of observations. In such situation, we can only locate a class having maximum frequency. This class is called 'modal class'.

The mode is obtained by using the value inside the modal class. Mode is calculated by using the formula.

$$\text{Mode} = \ell + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

Where ℓ = lower limit of the modal class

f_1 = frequency of the modal class i.e. the largest frequency.

f_0 = frequency of the class preceding the modal class.

f_2 = frequency of the class succeeding the modal class.

h = width of the modal class

(c) Merits of mode

(i) It can be easily understood and is easy to calculate.
(ii) It is not affected by extreme values and can be found by inspection in some cases.
(iii) It can be measured even if open-end classes and can be represented graphically.

(d) Demerits of mode

(i) It is ill-fined. It is not always possible to find a clearly defined mode.
(ii) It is not based upon all the observation.
(iii) It is not capable of further mathematical treatment. it is after indeterminate.
(iv) It is affected to a greater extent by fluctuations of sampling.

(e) Uses of mode

Mode is the average to be used to find the ideal size, e.g., in business forecasting, in manufacture of ready-made garments, shoes etc.

(f) Empirical Relationship between the three Measures of Central Tendency

The Empirical relationship between mean, median and mode is
Mode = 3 median - 2 mean.
This relationship can be used to find a central tendency when other two central tendencies are given.

Solved Examples

Example. 13

Find the mode of the following data :
25, 16, 19, 48, 19, 20, 34, 15, 19, 20, 21, 24, 19, 16, 22, 16, 18, 20, 16, 19.

Sol. Frequency table for the given data as given below

Value x_i	15	16	18	19	20	21	22	24	25	34	48
Frequency f_i	1	4	1	5	3	1	1	1	1	1	1

19 has the maximum frequency of 5. So, Mode = 19.

Example. 14

The following table shows the age distribution of cases of a certain disease admitted during a year in a particular hospital. Find the modal age.

Age (in Years)	5 - 14	15 - 24	25 - 34	35 - 44	45 - 54	55 - 64
No. of Cases	6	11	21	23	14	5

Sol. Here class intervals are not in inclusive form. So, Converting the above frequency table in inclusive form.

Age (in Years)	4.5 - 14.5	14.5 - 24.5	24.5 - 34.5	34.5 - 44.5	44.5 - 54.5	54.5 - 64.5
No. of Cases	6	11	21	23	14	5

Class 34.5 - 44.5 has maximum frequency. So it is the modal class.

ℓ = 34.5, h = 10, f_0 = 21, f_1 = 23 and f_2 = 14.

$$\therefore \quad \text{Mode} = \ell + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h .$$

$$\text{Mode} = 34.5 + \frac{23-21}{46-21-14} \times 10 = 34.5 + \frac{2}{11} \times 10 = 36.31 .$$

Example. 15

Find the mode of the following distribution

Daily Wages	31 - 36	37 - 42	43 - 48	49 - 54	55 - 60	61 - 66
No. of workers	6	12	20	15	9	4

Sol.

Daily Wages	No. of workers	Daily wages	No of workers
31 - 36	6	30.5 - 36.5	6
37 - 42	12	36.5 - 42.5	12
43 - 48	20	42.5 - 48.5	20
49 - 54	15	48.5 - 54.5	15
55 - 60	9	54.5 - 60.6	9
61 - 66	4	60.5 - 66.5	4
			$\sum f_i = 66$

Modal class frequency is 42.5 – 48.5.

ℓ = 42.5 , f_1 = 20, f_0 = 12, f_2 = 15, h = 6

$$\therefore \quad \text{Mode} = 42.5 + \frac{20-12}{2(20)-12-15} \times 6$$

$$\therefore \quad \text{Mode} = 46.2$$

Example. 16

If the mean and the median of the data is 54 and 51 respectively, then find the mode of the data.

Sol. Mode = 3 median – 2 mean = 3 × 51 – 2 × 54 = 153 – 108 = 45.

Check Your Level

1. Find the mode of 0, 0, 2, 2, 3, 3, 3, 4, 5, 5, 5, 5, 6, 6, 7, 8

2. Write the emprical relation between mean, mode and median.

3. In an examination taken by 400 students, the scores were as shown in the following distribution table:

Marks	1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80	81 – 90	91 – 100
Frequency	8	14	32	56	102	80	54	30	16	8

Find the mode scores.

4 Find the mode of the following distribution.

Below 20	Below 25	Below 30	Below 35	Below 40	Below 45	Below 50	Below 55	Below 60
2	6	24	45	78	89	92	98	100

5. If median and mode are 9.98 and 10.09 respectively, then find mean.

Answers

1. 5 **2.** Mode = 3 Median – 2 Mean **3.** 47.26 **4.** 36.76

5. 9.925

D GRAPHICAL REPRESENTATION OF CUMULATIVE FREQUENCY DISTRIBUTION

The curve obtained by graphically representing cumulative frequency distribution is called a cumulative frequency curve or ogive.

(i) less than type ogives **(ii)** more than type ogives

(a) Less than type ogives

To construct an ogive by less than method, we follow the procedure given below :

Step I : Construct the cumulative frequency table by adding class frequencies.

Step II : Mark upper class limits along *x*-axis as a suitable scale.

Step III : Mark cumulative frequencies along *y*-axis on a suitable scale.

Step IV : Plot the points (x_i, f_i), where x_i is the upper limit of a class and f_i is corresponding cumulative frequency.

Step V : Join the points obtained in step IV by a free hand smooth curve to get the ogive and to get the cumulative frequency polygon join the points obtained in step IV by line segments.

(b) More than type ogives

To construct a cumulative frequency polygon and an ogive by more than method, we follow the procedure given below :

Step I : Construct the cumulative frequency table by subtracting the frequency of each class from the total frequency.

Step II : Mark lower class limits along *x*-axis on a suitable scale.

Step III : Mark cumulative frequencies along *y*-axis on a suitable scale.

Step IV : Plot the points (x_i, f_i), where x_i is the lower limit of a class and f_i is corresponding cumulative frequency.

Step V : Join the points obtained in step IV by a free hand smooth curve to get the ogive and to get the cumulative frequency polygon join the points obtained in step IV by line segments.

Note : When nothing is mentioned, then we generally construct the 'less than type ogive.

(C) Determining the median from the ogive

Ogive can be used to find the median of a frequency distribution.
To find the median, when we have to draw any one of the types of ogives, we follow the procedure given below.

Step I : Draw any one of the two types of ogives on the graph paper.

Step II : Compute N/2 (N = Σfi) and mark the corresponding part on y-axis.

Step III : Draw a line parallel to *x*-axis, from the point marked in step II, meeting the ogive at point A(say).

Step IV : Draw perpendicular AB from A on *x*-axis. The *x*-coordinate of point B gives the median.
To find the median, when we have to draw both the types of ogives on graph paper, we follow the procedure given below.

Step I : Draw less than type and more than type ogives on the graph paper.

Step II : Mark the point of intersection of the two curves drawn in step I. Let this point be- A.

Step III : Draw perpendicular AB from A on the *x*-axis.

The *x*-coordinate of point A gives the median.

Solved Examples

Example. 17

The marks obtained by 400 students in medical entrance exam are given in the following table.

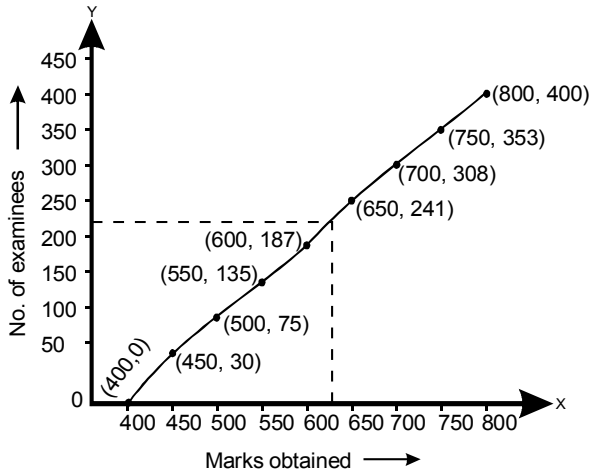
Marks Obtained	400 - 450	450 - 500	500 - 550	550 - 600	600 - 650	650 - 700	700 - 750	750 - 800
No. of Examinees	30	45	60	52	54	67	45	47

(i) Draw Ogive by less than method.
(ii) Draw Ogive by more than method.
(iii) Find the number of examinees, who have obtained the marks less than 625.
(iv) Find the number of examinees, who have obtained 625 and more than marks.

Sol. **(i)** Cumulative frequency table for less than Ogive method is as following

Marks Obtained	No. of Examinees
Less than 450	30
Less than 500	75
Less than 550	135
Less than 600	187
Less than 650	241
Less than 700	308
Less than 750	353
Less than 800	400

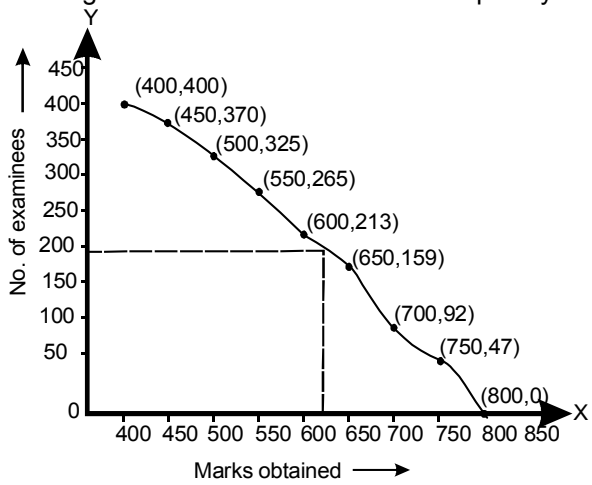
Following are the Ogive for the above cumulative frequency table by applying the given method and the assumed scale.



(ii) Cumulative frequency table for more than Ogive method is as following :

Marks Obtained	No. of Examinees
400 and more	400
450 and more	370
500 and more	325
550 and more	265
600 and more	213
650 and more	159
700 and more	92
750 and more	47

Following are the Ogive for the above cumulative frequency table.



(iii) So, the number of examinees, scoring marks less then 625 are approximately 220.

(iv) So, the number of examinees, scoring marks 625 and more will be approximately 190.

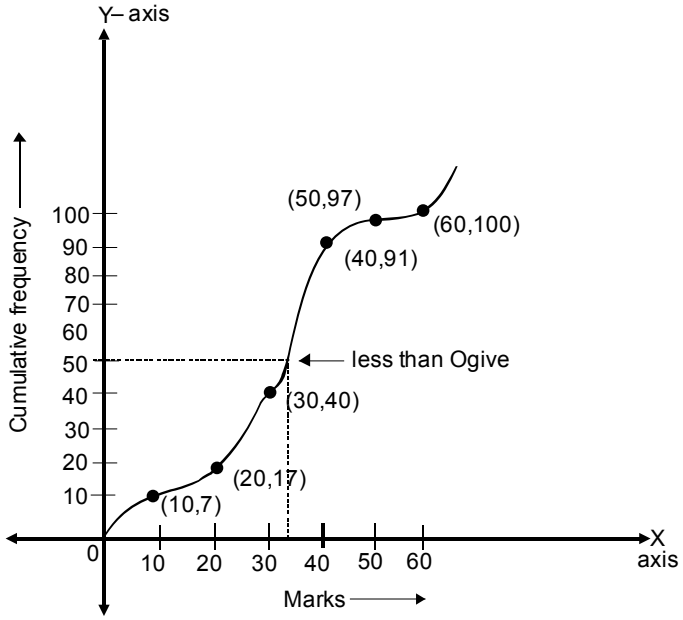
Example. 18

Draw an Ogive for the following frequency distribution by less than method and also find its median from the graph

Marks	0-10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60
Number of students	7	10	23	51	6	3

Sol. Converting the frequency distribution into less than cumulative frequency distribution

Marks	No. of Students
less than 10	7
less than 20	17
less than 30	40
less than 40	91
less than 50	97
less than 60	100



According to graph median = 34 marks.

Check Your Level

1. Which measure of the central tendency is obtained as the x coordinate of the point of intersection of the two ogives for the data?

2. The point of intersection of the ogive is given by (10,20). What is the median

3. The point of intersection of the ogive is given by (12,35), then find the sum of frequency.

4. From a list of names in an office, number of employees and their number of years of service were recorded as follows.

Experience in years	1 – 4	4 – 7	7 – 10	10 – 13	13 – 16	16 – 19
No. of employees	6	30	40	16	4	4

Construct a cumulative frequency distribution table of both the types and sketch the ogives. From the graphs estimate the median of the data. Calculate the median by using the formula and compare the values.

5. Construct a cumulative frequency distribution table for the data given below and draw the ogives of both the types. Find the median value from the graphs.

Class	101 – 150	151 – 200	201 – 250	251 – 300	301 – 350	351 – 400	401 – 450	451 – 500
Frequency	15	18	25	35	32	28	24	20

Answers

1. Median **2.** 10 **3.** 70

Exercise Board Level

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS : [01 MARK EACH]

1. Construction of a cumulative frequency table is useful in determining which measure of central tendency?

2. In the following distribution :

Monthly income range (in Rs)	Number of families
Income more than Rs 10000	100
Income more than Rs 13000	85
Income more than Rs 16000	69
Income more than Rs 19000	50
Income more than Rs 22000	33
Income more than Rs 25000	15

Find the number of families having income range (in Rs) 16000 - 19000

3. If x_i's are the mid points of the class intervals of grouped data, f_i's are the corresponding frequencies and $\bar{x}$ is the mean, then find value of $\sum(f_i x_i - \bar{x})$.

4. In the formula $\bar{x} = a + h\left(\frac{\sum f_i u_i}{\sum f_i}\right)$, for finding the mean of grouped frequency distribution, what is the value of u_i?

5. Name the measure of central tendency given by abscissa of the point of intersection of the less than type and of the more than type cumulative frequency curves of a grouped data

6. For the following distribution :

Class	0-5	5-10	10-15	15-20	20-25
Frequency	10	15	12	20	9

find the sum of lower limits of the median class and modal class

7. Consider the following frequency distribution :

Class	0-5	6-11	12-17	18-23	24-29
Frequency	13	10	15	8	11

Find the upper limit of the median class

8. The times, in seconds, taken by 150 atheletes to run a 110 m hurdle race are tabulated below :

Class	13.8-14	14-14.2	14.2-14.4	14.4-14.6	14.6-14.8	14.8-15
Frequency	2	4	5	71	48	20

Find the number of atheletes who completed the race in less then 14.6 seconds

9. Consider the following distribution :

Marks obtained	Number of students
More than or equal to 0	63
More than or equal to 10	58
More than or equal to 20	55
More than or equal to 30	51
More than or equal to 40	48
More than or equal to 50	42

find the frequency of the class 30-40

TYPE (II) : SHORT ANSWER TYPE QUESTIONS : **[02 MARKS EACH]**

10. Consider the following frequency distribution of the heights of 60 students of a class :

Height (in cm)	Number of students
150-155	15
155-160	13
160-165	10
165-170	8
170-175	9
175-180	5

Find the sum of the lower limit of the modal class and upper limit of the median class

11. For the following distribution :

Marks	Number of students
Below 10	3
Below 20	12
Below 30	27
Below 40	57
Below 50	75
Below 60	80

find the modal class.

12. Consider the data :

Class	65-85	85-105	105-125	125-145	145-165	165-185	185-205
Frequency	4	5	13	20	14	7	4

Find the difference of the upper limit of the median class and the lower limit of the modal class

13. The following table gives the number of pages written by Sarika for completing her own book for 30 days :

Number of pages written per day	16-18	19-21	22-24	25-27	28-30
Number of days	1	3	4	9	13

Find the mean number of pages written per day.

14. The following table shows the cumulative frequency distribution of marks of 800 students in an examination:

Marks	Number of students
Below 10	10
Below 20	50
Below 30	130
Below 40	270
Below 50	440
Below 60	570
Below 70	670
Below 80	740
Below 90	780
Below 100	800

Construct a frequency distribution table for the data above.

15. Form the frequency distribution table from the following data :

Marks (out of 90)	Number of candidates
More than or equal to 80	4
More than or equal to 70	6
More than or equal to 60	11
More than or equal to 50	17
More than or equal to 40	23
More than or equal to 30	27
More than or equal to 20	30
More than or equal to 10	32
More than or equal to 0	34

16. Find the unknown entries a, b, c, d, e, f in the following distribution of heights of students in a class :

Height (in cm)	Frequency	Cumulative frequency
150-155	12	a
155-160	b	25
160-165	10	c
165-170	d	43
170-175	e	48
175-180	2	f
Total	50	

17. The following are the ages of 300 patients getting medical treatment in a hospital on a particular day

Age (in years)	10-20	20-30	30-40	40-50	50-60	60-70
Number of patients	60	42	55	70	53	20

Form:

(i) Less than type cumulative frequency distribution.

(ii) More than type cumulative frequency distribution.

18. Given below is a cumulative frequency distribution showing the marks secured by 50 students of a class :

Marks	Below 20	Below 40	Below 60	Below 80	Below 100
Number of students	17	22	29	37	50

Form the frequency distribution table for the data.

TYPE (III) : LONG ANSWER TYPE QUESTIONS: **[03 MARK EACH]**

19. An aircraft has 120 passenger seats. The number of seats occupied during 100 flights is given in the following table :

Number of seats	100-104	104-108	108-112	112-116	116-120
Frequency	15	20	32	18	15

Determine the mean number of seats occupied over the flights.

20. Weekly income of 600 families is tabulated below :

Weekly income (in Rs)	**Number of families**
0-1000	250
1000-2000	190
2000-3000	100
3000-4000	40
4000-5000	15
5000-6000	5
Total	600

Compute the median income.

21. The weight of coffee in 70 packets are shown in the following table :

Weight (in g)	**Number of packets**
200-201	12
201-202	26
202-203	20
203-204	9
204-205	2
205-206	1

Determine the modal weight.

22. The mean of the following distribution is 18. The frequency f in the class interval 19-21 is missing. Determine f.

Class interval	11-13	13-15	15-17	17-19	19-21	21-23	23-25
Frequency	3	6	9	13	f	5	4

TYPE (IV): VERY LONG ANSWER TYPE QUESTIONS **[05 MARK EACH]**

23. Determine the mean of the following distribution :

Marks	Number of students
Below 10	5
Below 20	9
Below 30	17
Below 40	29
Below 50	45
Below 60	60
Below 70	70
Below 80	78
Below 90	83
Below 100	85

24. The mean of the following frequency distribution is 50, but the frequencies f_1 and f_2 in classes 20-40 and 60-80, respectively are not known. Find these frequencies, if the sum of all the frequencies is 120.

Class	0-20	20-40	40-60	60-80	80-100
Frequency	17	f_1	32	f_2	19

25. The median of the following data is 50. Find the values of p and q, if the sum of all the frequencies is 90.

Marks	**Frequency**
20-30	p
30-40	15
40-50	25
50-60	20
60-70	q
70-80	8
80-90	10

26. The distribution of heights (in cm) of 96 children is given below :

Height (in cm)	**Number of children**
124-128	5
128-132	8
132-136	17
136-140	24
140-144	16
144-148	12
148-152	6
152-156	4
156-160	3
160-164	1

Draw a less than type cumulative frequency curve for this data and use it to compute median height of the children.

27. The annual rainfall record of a city for 66 days is given in the following table.

Rainfall (in cm)	0-10	Oct-20	20-30	30-40	40-50	50-60
Number of days	22	10	8	15	5	6

Calculate the median rainfall using ogives (of more than type and of less than type)

Previous Year Problems

1. The following frequency distribution gives the monthly consumption of electricity of 68 consumers of a locality. **[2 MARKS/CBSE 10TH BOARD: 2013]**

Monthly Consumption (in units)	65-85	85-105	105-125	125-145	145-165	165-185	185-205
Number of consumers	4	5	13	20	14	8	4

Write the above distribution as less than type cumulative frequency distribution.

2. Find the mode of the following data: **[2 MARKS/CBSE 10TH BOARD: 2013]**

Class	0-20	20-40	40-60	60-80
Frequency	15	6	18	10

3. Compute the median for the following cumulative frequency distribution : **[3 MARKS/CBSE 10TH BOARD: 2013]**

Weight	Less than 38	Less than 40	Less than 42	Less than 44	Less than 46	Less than 48	Less than 50	Less than 52
Number of students	0	3	5	9	14	28	32	35

OR

Find the missing frequencies in the following frequency distribution table, if N = 100 and median is 32.

Marks obtained	0-10	10-20	20-30	30-40	40-50	50-60	Total
No. of students	10	?	25	30	?	10	100

4. The mean of the following frequency distribution is 25.2. Find the missing frequency x **[3 MARKS/CBSE 10TH BOARD: 2013]**

C.I.	0-10	10-20	20-30	30-40	40-50
Frequency	8	X	10	11	9

5. Construction of a cumulative frequency table is useful in determining the **[CBSE 10TH BOARD: 2014]**

(A) Mean
(B) Mode
(C) Median
(D) All the above three measures

6. Given below is the distribution of marks obtained by 229 students :

Marks	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80	Total
Number of students	12	30	34	65	45	25	18	229

Write the above distribution as more than type cumulative frequency distribution.

[CBSE 10TH BOARD: 2014]

7. In a retail market, fruit vendor were selling mangoes kept in packing boxes. These boxes contained varying numbers of mangoes. The following was the distribution of mangoes according to the number of boxes. **[CBSE 10TH BOARD: 2014]**

Number of mangoes	**Number of boxes**
50-52	15
53-55	110
56-58	135
59-61	115
62-64	25

Find the mean number of mangoes kept in a packing box, using step-deviation method.

Or

The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is Rs. 18. Find the value of p. **[CBSE 10TH BOARD: 2014]**

Daily pocket allowance In rs	11-13	13-15	15-17	17-19	19-21	21-23	23-25
Number of children	7	6	9	13	p	5	4

8. The following table shows the ages of 100 persons of a locality.

[CBSE 10TH BOARD: 2014]

Age (years)	**Number of person**
0-10	5
Oct-20	15
20-30	20
30-40	23
40-50	17
50-60	11
60-70	9

Draw the less than ogive and find the median.

9. The Median of the following data is 20.75. Find the missing frequencies x and y, if the total frequency is 100 **[CBSE 10TH BOARD: 2014]**

Class interval	Frequency
0 – 5	7
5 – 10	10
10 – 15	x
15 – 20	13
20 – 25	y
25 – 30	10
30 – 35	14
35 – 40	9

10. For a given data with 100 observations the 'less than ogive and the more than ogive' intersect at (525, 50). The median of the data is **[CBSE 10TH BOARD: 2015]**

(A) 520 (B) 525 (C) 500 (D) 225

11. In the given data : **[CBSE 10TH BOARD: 2015]**

Classes	65-85	85-105	105-125	125-145	145-165	165-185	185-205
Frequency	4	5	13	20	14	7	4

The difference between the upper limit of the median class and the lower limit of the modal class is

(A) 0 (B) 20 (C) 10 (D) 30

12. Find the median class and the modal class for the following distribution.

[CBSE 10TH BOARD: 2015]

C.I.	135– 140	140– 145	145– 150	150– 155	155– 160	160– 165
f	4	7	1	1	6	5

13. The mean of the following frequency distribution is 62.8. Find the value p.

[CBSE 10TH BOARD: 2015]

Classes	0 – 20	20 - 40	40 - 60	60 - 80	80 - 100	100 - 120
Frequency	5	8	P	12	7	8

OR

Find the mean of the following frequency distribution, using step-deviation method.

[CBSE 10TH BOARD: 2015]

Classes	25 - 29	30 -34	35 - 39	40 - 44	45 - 49	50 – 54	55 - 59
Frequency	14	22	16	6	5	3	4

14. Find the mode of the following frequency distribution **[CBSE 10TH BOARD: 2015]**

Classes	5-15	15 - 25	25 – 35	35 - 45	45 - 55	55 - 65	65 - 75
Frequency	2	3	5	7	4	2	2

15. Compute the missing frequencies, x and y in the following data if the mean is $166\frac{9}{26}$ and the sum of the observations is 52.

Classes	Frequency
140-150	5
150-160	X
160-170	20
170-180	Y
180-190	6
190-200	2
Total	**52**

Now, also calculate the median.

16. During the medical check-up of 35 students of a class, their weights were recorded as follows :

[CBSE 10TH BOARD: 2015]

Weight	Number of students
Less than 38	0
Less than 40	3
Less than 42	5
Less than 44	9
Less than 46	14
Less than 48	28
Less than 50	32
Less than 52	35

Draw a less than type ogive for the given data. Hence obtain the median weight from the graph and verify the result by using the formula.

17. The length of 42 leaves of a plant are measure correct up to the nearest millimeter and the data is as under : **[CBSE 10TH BOARD: 2016, 2017]**

Length (in m)	118-126	126-134	134-142	142-150	150-158	158-166
Number of leaves	4	5	10	14	4	5

Find the mode length of the leaves.

18. The table below gives the percentage distribution of female teachers in primary schools of rural areas of various states and union territories (U.T.) of India. Find the mean percentage of female teachers by using step-deviation method. **[CBSE 10TH BOARD: 2016]**

Percentage of female teachers	15-25	25-35	35-45	45-55	55-65	65-75	75-85
No. of states/ U.T.	6	11	7	4	4	2	1

19. The following distribution shows the number of runs scored by some top batsman of the world in one-day cricket matches: **[CBSE 10TH BOARD: 2016]**

Runs-scored	Number of batsman
3000-4000	4
4000-5000	18
5000-6000	9
6000-7000	7
7000-8000	6
8000-9000	3
9000-10000	1
10000-11000	1

Find the mode

20. The following frequency distribution gives the monthly consumption of electricity of 68 consumers of a locality. **[CBSE 10TH BOARD: 2017]**

Monthly consumption (in units)	65 – 85	85 – 105	105 – 125	125 – 145	145 – 165	165 – 185	185 – 205
Number of consumers	4	5	13	20	14	8	4

Write the above distribution as less than type cumulative frequency distribution.

21. Find mean of the following frequency distribution using step-deviation method : **[CBSE 10TH BOARD: 2017]**

Class- Interval	0-60	60-120	120-180	180-240	240-300
Frequency	22	35	44	25	24

OR

The mean of the following distribution is 52.5 find the value of p.

Classes	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100
Frequency	15	22	37	p	21

22. A survey regarding the height (in cm) of 51 girls of class X of a school was conducted and the following data was obtained: **[CBSE 10TH BOARD: 2017]**

Height (in cm)	Number of girls
less than 140	4
less than 145	11
less than 150	29
less than 155	40
less than 160	46
less than 165	51

Find the median height.

23. If the median of the distribution given below is 28.5, find the values of x and y, if the total frequency is 60. **[CBSE 10TH BOARD: 2017]**

Class interval	0-10	10-20	20-30	30-40	40-50	50-60	Total
Frequency	5	x	20	15	y	5	60

Exercise-1

SUBJECTIVE QUESTIONS

Subjective Easy, only learning value problems

Section (A) : Introduction and Arithmetic mean

A-1. Find the mean of the first five multiple of 6.

A-2. If the average of 11, 12, 13, 14 and x is 13, then find the value of x.

A-3. The mean of six numbers is 15. If 2 is taken away from every number, then find the new mean.

A-4. If the mean of the following data is 18.75, find the value of p :

x	10	15	p	25	30
f	5	10	7	8	2

A-5. Find the mean of following distribution by step deviation method :

Class interval	50 - 70	70 - 90	90 - 110	110 - 130	130 - 150	150 - 170
No. of workers	18	12	13	27	8	22

A-6. If the mean of following distribution frequency distribution is 188, find the missing frequencies f_1 and f_2.

C.I.	0– 80	80 – 160	160 – 240	240 – 320	320 – 400	Total
Freq.	20	25	f_1	f_2	10	100

Section (B) : Median

B-1. If the mean and median of a set of numbers are 11 and 10 respectively, then find the mode

B-2. Calculate the median from the following data :

Rent (in Rs.)	15 - 25	25 - 35	35 - 45	45 - 55	55 - 65	65 - 75	75 - 85	85 - 95
No. of Houses	8	10	15	25	40	20	15	7

B-3. Find the median class of the following data

Marks obtained	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Frequencey	8	10	12	22	30	18

B-4. Find the missing frequencies and the median for the following distribution if the mean is 1.46 and the sum of all frequencies is 200.

No. of accidents	0	1	2	3	4	5
No. of days	46	f_1	f_2	25	10	5

Section (C) : Mode

C-1. The marks in science of 80 students of class X are given below . Find the mode of the marks obtained by the students in science.

C.I.	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 -70	70 - 80	80 - 90	90 - 100
Freq.	3	5	16	12	13	20	5	4	1	1

C-2. Find the mode of following distribution

C.I.	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 -70	70 - 80
Freq.	5	8	7	12	28	20	10	10

C-3. Find the mean, mode and median of the following data

Classes	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70
Frequencey	5	10	18	30	20	12	5

C-4. If the ratio of mean and mode is 5 : 2 then find the ratio of median : mode.

C-5. The mode of the following distribution is 42. Find the missing frequency x.

Class interval	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70
Frequency	12	20	x	26	6	7

Section (D) : Graphical representation of cumulative frequency distribution

D-1. The following table gives the height of trees

Height	Less than 7	Less than 14	Less than 21	Less than 28	Less than 35	Less than 42	Less than 49	Less than 56
No. of trees	26	57	92	134	216	287	341	360

Draw “less than” ogive and “more than” ogive.

D-2. During the medical check-up of 35 students of a class, their weights were recorded as follows :

Weight (in kg)	Number of students
38 - 40	3
40 - 42	2
42 - 44	4
44 - 46	5
46 - 48	14
48 - 50	4
50 - 52	3

Draw a less than & more than type ogive for the given data. Hence, obtain median weight from the graph.

D-3. Draw 'less than ogive' and 'more than ogive' for the following distribution and hence find its median.

Class	20–30	30–40	40–50	50–60	60–70	70–80	80–90
Frequency	8	12	24	6	10	15	25

D-4 The annual profits earned by 40 shops of a shopping complex in a locality give rise to the following distribution

Profit (in lakh)	Number of shops (frequency)
More than 5	40
More than 10	36
More than 15	22
More than 20	16
More than 25	12
More than 30	6
More than 35	2

Find the median from the graph.

D-5. Following distribution shows the marks obtained by 100 students.

Marks	10–20	20–30	30–40	40–50	50–60	60–70
No. of students	10	15	30	32	8	5

Draw 'less than ogive' for the above data. Find median graphically and verify the result by actual method.

OBJECTIVE QUESTIONS

Single Choice Objective, straight concept/formula oriented

Section (A) : Introduction and Arithmetic mean

A-1. If the arithmetic mean of 5, 7, 9, x is 9 then the value of x is :

(A) 11 (B) 15 (C) 18 (D) 16

A-2. If the first five elements of the set $x_1, x_2, ...x_{10}$ are replaced by $x_i + 5$, i = 1, 2, 3, 4, 5 and next five elements are replaced by $x_j - 5$, j = 6, 7, ... 10, then the mean will change by :

(A) 0 (B) $\frac{n+1}{2}$ (C) 10 (D) 25

A-3 Arun scored 36 marks in English, 44 marks in Hindi, 75 marks in Mathematics and x marks in Science. If he has scored an average of 50 marks, then find the value of x.
(A) 45 (B) 55 (C) 35 (D) 40

A-4. If $u_i = \frac{x_i - 20}{10}$, $\Sigma f_i u_i = 30$ and $\Sigma f_i = 40$, then find the value of $\bar{x}$.
(A) 30 (B) 25 (C) 28.5 (D) 27.5

A-5. The mean of 20 numbers is 13. The new mean if each observation is increased by 5, is
(A) 13 (B) 18 (C) 65 (D) 8

Section (B) : Median

B-1. The median of following series is 520, 20, 340, 190, 35, 800, 1210, 50, 80.
(A) 1210 (B) 520 (C) 190 (D) 35

B-2. The upper limit of the median class of the following distribution is :

Class	0 - 5	6 - 11	12 - 17	18 - 23	24 - 29
Frequency	13	10	15	8	11

(A) 17 (B) 17.5 (C) 18 (D) 18.5

B-3. A data has 25 observations (arranged in descending order). Which observation represents the median ?
(A) 12^{th} (B) 13^{th} (C) 14^{th} (D) 15^{th}

B-4. The median of the observation 11, 12, 14, 18, x + 2, x + 4, 30, 32, 35, 41 arranged in ascending order is 24. Find the value of x.
(A) 20 (B) 21 (C) 22 (D) 23

B-5. If in a data, 10 numbers are arranged in increasing order. If the 7th entry is increased by 4, then the median increases by -
(A) zero (B) 4 (C) 6 (D) 5

Section (C) : Mode

C-1. The mode of the distribution 3, 5, 7, 4, 2, 1, 4, 3, 4 is :
(A) 7 (B) 4 (C) 3 (D) 1

C-2. If the mean and median of a set of numbers are 8.9 and 9 respectively, then the mode will be :
(A) 7.2 (B) 8.2 (C) 9.2 (D) 10.2

C-3. If mode = 80 and mean = 110, then the median is :
(A) 110 (B) 120 (C) 100 (D) 90

C-4. If the mode of the following data is 7, then value of k in 2, 4, 6, 7, 5, 6, 10, 6, 7, 2k + 1, 9, 7, 13 is :
(A) 3 (B) 7 (C) 4 (D) 2

C-5. For a symmetrical distribution, which is correct :
(A) Mean > Mode > Median (B) Mean < Mode < Median
(C) Mode = $\frac{\text{Mean} - \text{Median}}{2}$ (D) Mean = Median = Mode

Section (D) : Graphical representation of cumulative frequency distribution

D-1. Which measure of central tendency is given by the x co-ordinate of the point of intersection of the more than Ogive and less than Ogive.
(A) Mean (B) Median (C) Mode (D) All the above

D-2. For a given data with 50 observations the 'less than ogive' and the 'more than ogive' intersect at (15.5, 20). The median of the data is :
(A) 4.5 (B) 20 (C) 50 (D) 15.5

D-3. The classmark of a class interval is :
(A) Lower limit + Upper limit (B) Upper limit – Lower limit
(C) $\frac{1}{2}$ (Lower limit + Upper limit) (D) $\frac{1}{4}$ (Lower limit + Upper limit)

D-4. Construction of a cumulative frequency table is useful in determining the :
(A) Mean (B) Median
(C) Mode (D) All the above three measures

D-5. Which of the following is not a measure of central tendency :
(A) Mean (B) Median (C) Range (D) Mode

Exercise-2

OBJECTIVE QUESTIONS

1. Range of 14, 12, 17, 18, 16 and x is 20. Find x (x > 0)
(A) 2 (B) 28 (C) 32 (D) Cannot be determined

2. The range of 15, 14, x, 25, 30, 35 is 23. Find the least possible value of x.
(A) 14 (B) 12 (C) 13 (D) 11

3. The width of each of nine classes in a frequency distribution is 2.5 and the lower class boundary of the lowest class is 10.6. Which one of the following is the upper class boundary of the highest class ?
(A) 35.6 (B) 33.1 (C) 30.6 (D) 28.1

4. Let L be the lower class boundary of a class in a frequency distribution and m be the mid point of the class. Which one of the following is the upper class boundary of the class ?
(A) $m + \frac{m+L}{2}$ (B) $L + \frac{m+L}{2}$ (C) 2m – L (D) m – 2L

5. The arithmetic mean of the set of observations 1, 2, 3....n is :
(A) $\frac{n+1}{2}$ (B) $\left(\frac{n}{2}+1\right)$ (C) $\frac{n}{2}$ (D) $\frac{1}{2}$ (n – 1)

6. In a monthly test, the marks obtained in mathematics by 16 students of a class are as follows :
0, 0, 2, 2, 3, 3, 3, 4, 5, 5, 5, 5, 6, 6, 7, 8
The arithmetic mean of the marks obtained is :
(A) 3 (B) 4 (C) 5 (D) 6

7. Mean of a certain number of observation is m. If each observation is divided by x ($x \neq 0$) and increased by y, then the mean of new observation is :

(A) mx + y (B) $\frac{mx+y}{x}$ (C) $\frac{m+xy}{x}$ (D) m + xy

8. The mean of a variable x having 50 observations is 45. If a new variable is defined as U = x + 45, the mean of the new variable is :

(A) 45 (B) 0 (C) 95 (D) 90

9. If the arithmetic mean of the observations x_1, x_2, x_3 ..... x_n is 1, then the arithmetic mean of $\frac{x_1}{k}, \frac{x_2}{k}, \frac{x_3}{k}, ... \frac{x_n}{k}$ (k > 0) is :

(A) greater than 1 (B) less than 1 (C) equal to 1 (D) Both (A) or (B)

10. The mean of a set of observation is a. If each observation is multiplied by b and each product is decreased by c, then the mean of new set of observation is.

(A) $\frac{a}{b}$ + c (B) ab – c (C) $\frac{a}{b}$ – c (D) ab + c

11. The arithmetic mean of 5 numbers is 27. If one of the numbers be excluded, their mean is 25. The excluded number is :

(A) 28 (B) 26 (C) 25 (D) 35

12. The combined mean of three groups is 12 and the combined mean of first two groups is 3. If the first, second and third groups have 2, 3 and 5 times respectively, then mean of third group is :

(A) 10 (B) 21 (C) 12 (D) 13

13. Out of 100 numbers, 20 were 5s, 30 were 6s and the remaining were 7s. The arithmetic mean of the numbers is :

(A) 6.3 (B) 5.4 (C) 6.1 (D) 6.5

14. While dividing each entry in a data by a non-zero number a, the arithmetic mean of the new data :

(A) is multiplied by a (B) does not change (C) is divided by a (D) is diminished by a

15. In order to make the computation of the arithmetic mean of a set of 50 numbers simpler, each observation is subtracted from 53 and the arithmetic mean of the set of differences is found to be – – 3.5 . The arithmetic mean of the set of given numbers is :

(A) 53.07 (B) 52.93 (C) 56.50 (D) 49.50

16. The mean of first n odd natural numbers is $\frac{n^2}{81}$. Find n.

(A) 9 (B) 81 (C) 27 (D) None of these

17. The arithmetic mean of 12 observations is 15. If two observations 20 and 25 are removed, then the arithmetic mean of remaining observations is :

(A) 14.5 (B) 13.5 (C) 12.5 (D) 13

18. Consider the table given below :

Marks	0-10	10-20	20-30	30-40	40-50	50-60
Number of Students	12	18	27	20	17	6

The arithmetic mean of the marks given above, is :

(A) 18 (B) 28 (C) 27 (D) 6

19. The median of 21 observations is 18. If two observations 15 and 24 are included to the observation, then the median of new series is :
(A) 15 (B) 18 (C) 24 (D) 16

20. The median of the following distribution is :

Class interval	35-45	45-55	55-65	65-75
Frequency	8	12	20	10

(A) 56.5 (B) 57.5 (C) 58.7 (D) 59

21. Find the median of the following data.

C.I.	0–10	10–20	20–30	30–40	40–50
f	12	13	25	20	10

(A) 25 (B) 23 (C) 24 (D) 26

22. If the observations 20, 22, 23, 25, (x + 1), (x + 3), 36,38, 39 and 41 have median 30, then the value of x is :
(A) 28 (B) 29 (C) 30 (D) 32

23. If the difference of mode and median of a data is 24, then the difference of median and mean is :
(A) 12 (B) 24 (C) 8 (D) 36

24. The arithmetic mean and mode of a data is 24 and 12 respectively, then the median of the data is .
(A) 25 (B) 18 (C) 20 (D) 22

25. Which of the following does not change for the observation 23, 50, 27, 2x, 48, 59, 72, 89, 5x, 100, 120, when x lies between 15 and 20 ?
(A) Arithmetic mean (B) Range (C) Median (D) Average

Exercise-3

NTSE PROBLEMS (PREVIOUS YEARS)

1. From the following table, mode – mean is - **[Raj NTSE Stage-1 2005]**

x	2	5	7	8
f	2	4	6	3

(A) 0 (B) 1 (C) 6 (D) 7

2. If the arithmetic mean of the marks 3, 4, 8, 5 ,x, 3 ,2, 1 is 4, then the value of x is :
[Raj NTSE Stage-1 2006]
(A) 4 (B) 5 (C) 6 (D) 8

3. If the median of distribution 2, x, 7, 5, 0, 1 is 3, then the value of x is : **[Raj NTSE Stage-1 2006]**
(A) 2 (B) 4 (C) 5 (D) 6

4. Mean temperature of last week of September was 24° C. If mean temperature of Monday, Tuesday, Wednesday and Thursday was 22°C and that of Thursday, Friday, Saturday and Sunday was 25°C then temperature on Thursday is : **(NTSE-Stage-I/Tamilnadu/2006)**
(A) 24°C (B) 23°C (C) 22°C (D) 20°C

5. If the arithmetic mean of the distribution x, 2x, 2x + 1, 2 is 7, then the value of x is : **[Raj NTSE Stage-1 2007]**

(A) $\frac{5}{6}$ (B) $\frac{27}{5}$ (C) $\frac{26}{5}$ (D) $\frac{25}{5}$

6. The median of the following distribution **[Raj NTSE Stage-1 2007]**
2, 3, 2, 6, 5, 4, 5, 5 is :
(A) 3 (B) 4 (C) 4.5 (D) 6.5

7. Which of these numbers is the average of the remaining three ? **(NTSE-Stage-I/Bangalore/2007)**
(A) 26 (B) 39 (C) 30 (D) 61

8. Mean of salary of 10 employees is Rs. 5000. If salary of employees are Rs. 3000. Rs. 4000, Rs. 5000, Rs. 6000, Rs. x, Rs. 7000, Rs. 8000, Rs. 3800, Rs. 2200 and Rs. 9000 then value of x is : **(NTSE Stage - I/Raj. /2008)**
(A) 2000 (B) 3000 (C) 4000 (D) 5000

9. A cricketer has a certain average run for 10 innings. In the 11th inning, he scores 100 runs, and now his average run is increased by 9 runs. Then average of 11 inning is :**(NTSE-Stage-I/MP/2008)**
(A) 10 runs (B) 20 runs (C) 11 runs (D) 21 runs

10. The mean of six numbers is 15. If 2 is taken away from every number, the new mean would be : **(NTSE Stage -I/Bihar/2009)**
(A) 13 (B) 4 (C) 17 (D) 8

11. Out of 50 observations the mean of 25 observation is 30 and mean of rest 25 observation is 32, Then mean of 50 observation is : **(NTSE Stage - I/Raj. /2010)**
(A) 34 (B) 33 (C) 32 (D) 31

12. If the median of $\frac{x}{7},\frac{x}{5},\frac{x}{6},x,\frac{x}{4},\frac{x}{3},\frac{x}{2}$ is 8, then the value of x is _____. **[MP NTSE Stage-1 2012]**

(A) 8 (B) 24 (C) 32 (D) 48

13. The median and mode of a frequency distribution are 525 and 500 then mean of same frequency distribution is : **[Raj. NTSE Stage-1 2013]**
(A) 75 (B) 107.5 (C) 527.5 (D) 537.5

14. If the mean of x and $\frac{1}{x}$ is M, then the mean of x^2 and $\frac{1}{x^2}$ is : **[MP NTSE Stage-1 2013]**

(A) M^2 (B) $\frac{M^2}{4}$ (C) $2M^2 - 1$ (D) $2M^2 + 1$

15. The Arithmetic mean of a set of scores is $\bar{x}$. If each score is first divided by α, $\alpha \neq 0$, and then increased by 10, the mean of the new score is : **[MP NTSE Stage-1 2013]**

(A) $\frac{\bar{X}-10}{\alpha}$ (B) $\frac{\bar{X}+10}{\alpha}$ (C) $\frac{\bar{X}+10\alpha}{\alpha}$ (D) $\frac{\alpha\bar{X}+10}{\alpha}$

16. For the distribution **[Delhi NTSE Stage-1 2013]**

Marks	**Number of students**
Below 5	10
Below 10	25
Below 15	37
Below 20	57
Below 25	66

the sum of the lower limits of the median class and the modal class is :
(A) 15 (B) 25 (C) 30 (D) 35

17. Positional mean is : **[M.P. NTSE Stage-1 2013]**
(A) Arithmetic mean (B) Geometric mean (C) Median (D) Harmonic mean

18. Four times the arithmetic mean of x and 10 is 70, then what is value of x ?
[Maharashtra NTSE Stage-1 2013]
(A) 65 (B) 25 (C) 50 (D) 35

19. The premodal class and postmodal class rectangles have same height. If the modal class is 40-60, then what is mode? **[Maharashtra NTSE Stage-1 2013]**
(A) 40 (B) 60 (C) 100 (D) 50

20. Which of the following is a false statement ? **[Maharashtra NTSE Stage-1 2013]**
(A) Median can be determined graphically (B) Mean can be determined from the graph
(C) Mean cannot be determined by inspection (D) Mode can be determined graphically

21. The mean of n numbers $x_1, x_2, \ldots\ldots x_n$ is M. If x_1 is replaced by 'a', the new mean is :
[Bihar NTSE Stage-1 2014]
(A) $\frac{nM - x_1 + a}{n}$ (B) $\frac{M - x_1 + a}{n}$ (C) $\frac{nM - a + x_1}{n}$ (D) None of these

22. Which of the following is correct for the given data 55, 38, 69, 24, 89 ?
[Bihar NTSE Stage-1 2014]
(A) median = mode (B) mean = mode (C) mean = median (D) None of these

23. The mean of n numbers is M. If 1 is added to the first number, 2 is added to second number, ... n is added to the n^{th} number then the new mean is : **[Bihar NTSE Stage-1 2014]**
(A) M + $\frac{n+1}{2}$ (B) M + $\frac{n}{2}$ (C) M + n (D) None of these

24. Median of 4,5,10,6,7,14,9 and 15 will be : **[Chattisgarh NTSE Stage-1 2014]**
(A) 6 (B) 7 (C) 8 (D) 9

25. If the number 13, 15, 17, 18 and n are arranged in ascending order and their arithmetic mean and median are equal then value of n will be : **[Chattisgarh NTSE Stage-1 2014]**
(A) 27 (B) 22 (C) 28 (D) none of these

26. The average marks scored by Ajay in certain number of tests is 84. He scored 100 marks in his last test. his average score of all these tests is 86, then the total no. of tests he appeared is :
[Delhi NTSE Stage-1 2014]
(A) 8 (B) 7 (C) 9 (D) 10

27. The median of first 12 prime numbers is **[Raj NTSE Stage-1 2014]**
(A) 13 (B) 14 (C) 15 (D) 17.

28. If the arithmetic mean of 9 observations is 100 and that of 6 observations is 80, then the combined mean of all the 15 observations will be : **[Jharkhand NTSE Stage-1 2014]**
(A) 100 (B) 80 (C) 90 (D) 92

29. On 13 consecutive days the number of persons booked for violating speed limit of 40 km/hr. were as follows : **[Jharkhand NTSE Stage-1 2014]**
59, 52,58, 61, 68, 57, 62, 50, 55, 62 53 54, 51
The median number of speed violations per day is :
(A) 61 (B) 52 (C) 55 (D) 57

30. Which of the following is correct for the given data –1, 0, 1, 2, 3, 5, 5, 6, 8, 10, 11 ?
[Jharkhand NTSE Stage-1 2014]

(A) mean = mode = median (B) mean = 5
(C) mean = mode (D) mode = median

31. Find the incorrect formula from the following : **[Maharashtra NTSE Stage-1 2014]**

(A) Median = $L + \left(\frac{N}{2} - c.f.\right)\frac{h}{f}$ (B) Mode = $L + \left(\frac{f_m - f_1}{2f_m - f_1 - f_2}\right)h$

(C) Mean = $\frac{\Sigma f_i x_i}{\Sigma x_i}$ (D) $\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$

32. The median of a series is 10. Two addition observations 7 and 20 are added to the series. The new median will be : **[Bihar NTSE Stage-1 2015]**

(A) 9 (B) 20 (C) 7 (D) 10

33. The mean of the first ten even natural numbers is **[Raj NTSE Stage-1 2015]**

(A) 10 (B) 11 (C) 12 (D) 13

34. The mean of fifteen different natural numbers is 13. The maximum value for the second largest of these numbers is : **(NTSE Stage-2 /2015)**

(A) 46 (B) 51 (C) 52 (D) 53

35. The mean income of 50 persons was calculated as Rs. 169. Later it was found that one figure was wrongly taken as 134 instead of the correct value 143. The correct mean should be
[Bihar NTSE Stage-1 2015]

(A) Rs. 168 (B) Rs. 169.18 (C) Rs. 168.92 (D) Rs. 168.18

36. An additional value 15 is included in a series of 11 values and the mean remains unchanged. The mean of the series was **[Bihar NTSE Stage-1 2015]**

(A) 12 (B) 15 (C) 20 (D) None of these

37. The relation between mean, mode and median is **[Jharkhand NTSE Stage-1 2015]**

(A) Mode = 3 x Mean – 2 x Median (B) Mode = 3 x Median -2 x Mean
(C) Mean = 3 x Median – 2 x Mode (D) Median = 3 x Mean – 2 x Mode

38. The marks of 10 students in certain subject in a class are 20, 19, 50, 48, 50, 36, 35, 50, 40, 40. The mean and mode are respectively as..... **[MP NTSE Stage-1 2015]**

(A) 38.8, 50 (B) 50,40 (C) 40,35 (D) 35,40

39. Find mode from the following grouped frequency distribution table :
[Maharashtra NTSE Stage-1 2015]

Number of Trees Planted	**Number of Students**
0 – 10	30
10 – 20	60
20 – 30	50
30 – 40	70
40 – 50	40

(A) 38 trees (B) 36 trees (C) 35 trees (D) 34 trees

40. In a frequency distribution table, modal value of the wages of 130 workers is Rs. 97.50. L = 94.5, $f_m = x + 15$; $f_1 = x$; $f_2 = x + 5$. Find the upper limit of the modal class.
[Maharashtra NTSE Stage-1 2016]

(A) 96.5 (B) 97.5 (C) 98.5 (D) 99.5

41. The average weight (in kg) of all the students in a class equals the number of students in the class. The increase in the average weight when a teacher to 21 kg is included equals the decrease in average weight when a student of 19 kg is included. The strength of the class is

[Delhi NTSE Stage-1 2016]

(A) 15 (B) 10 (C) 20 (D) 17

42. In a frequency distribution median is $\frac{11}{10}$ times the mean, and mode is 5.2. Find the median.

[Maharashtra NTSE Stage-1 2016]

(A) 4.4 (B) 4.3 (C) 4.1 (D) 4.0

43. In a group of students, 10% students scored marks less than 20, 20% students scored marks between 20 to 40, 35% students scored marks between 40 to 60 and 20% students scored marks between 60 to 80. Remaining 30 students scored marks between 80 to 100. Find the mode of marks. **[Maharashtra NTSE Stage-1 2017]**

(A) 30 (B) 50 (C) 60 (D) 70

44. If number 6,8,2x– 5, 2x – 1 , 15, 17, 20 and 22 are in ascending order and its median is 14 then the value of x will be- **[UP NTSE Stage-1 2017]**

(A) 14 (B) 7 (C) 15 (D) 20

Answer Key

Exercise Board Level

TYPE (I)

1. Median **2.** 19 **3.** 0 **4.** $\frac{x_i - a}{h}$

5. Median **6.** 25 **7.** 17.5 **8.** 82 **9.** 3

TYPE (II)

10. 315 **11.** 30-40 **12.** 20 **13.** 26

16. a = 12, b = 13, c = 35, d = 8, e = 5, f = 50

TYPE (III)

19. 109.92 **20.** Rs 1263.15 **21.** 201.7 g **22.** 8

TYPE (IV)

23. 48.41 **24.** $f_1 = 28$, $f_2 = 24$ **25.** p = 5, q = 7

26. 139 cm **27.** 21.25 cm

Previous Year Problems

2. 52 **3.** 46.5 **OR** 9,16 **4.** X = 12

5. (C) **7.** 57.1875 **OR** P = 20 **8.** 34.34

9. X = 17, Y = 20 **10.** (B) **11.** (B)

12. Modal Class=140-145, Median Class = 150-155

13. P = 10 **OR** 36.357 **14.** 39

15. X=10, Y=9, Median=165.5 **16.** 46.5

17. 144.28 **18.** 39.71 **19.** 4608.695

21. 147.6 **OR** P = 25 **22.** 149.02 **23.** X = 8, Y = 7

Exercise-1

SUBJECTIVE QUESTIONS

Section (A)

A-1. 18 **A-2.** 15 **A-3.** 13 **A-4.** 20 **A-5.** 112.20

A-6. $f_1 = 15$ and $f_2 = 30$.

Section (B)

B-1. 8 **B-2.** 58. **B-3.** 30 – 40 **B-4.** $f_1 = 76$, $f_2 = 38$ and Median = 1

Section (C)

C-1. 53.17 **C-2.** 46.67 **C-3.** Mean = 35.6, Medain = 35.67 and Mode = 35.45

C-4 2 : 1. **C-5** 21

Section (D)

D-2. 46.5 kg **D-3.** 60. **D-4.** 8.75 **D-5.** 38.33

OBJECTIVE QUESTIONS

Section (A)

A-1. (B) **A-2.** (A) **A-3** (A) **A-4.** (D) **A-5.** (B)

Section (B)

B-1. (C) **B-2.** (B) **B-3.** (B) **B-4.** (B) **B-5.** (A)

Section (C)

C-1. (B) **C-2.** (C) **C-3.** (C) **C-4.** (A) **C-5.** (D)

Section (D)

D-1. (B) **D-2.** (D) **D-3.** (C) **D-4.** (B) **D-5.** (C)

Exercise-2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	B	B	C	A	B	C	D	D	B	D	B	A	C	C	B	B	B	B	B
Ques.	21	22	23	24	25															
Ans.	D	A	A	C	B															

Exercise-3

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	B	C	B	D	D	C	B	A	A	A	D	C	D	C	C	B	C	B	D	B
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	A	C	A	C	B	B	C	D	D	D	C	D	B	B	B	B	B	A	D	D
Ques.	41	42	43	44																
Ans.	C	A	B	B																