

MATHEMATICS

Class-IX

Topic-13

STATISTICS



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CH-13

STATISTICS

A. TABULAR REPRESENTATION OF STATISTICAL DATA

Statistics

Statistics deals with collection of numerical facts i.e., data, their classification & tabulation and their interpretation.

(a) Collection of Data :

On the basis of methods of collection, data can be divided into two categories :

(i) **Primary data** : Data which are collected for the first time by the statistical investigator or with help of his workers is called **primary data**.

(ii) **Secondary data** : These are the data already collected by a person or a society and these may be in published or unpublished form. These are generally obtained from the following two sources.

- Published sources
- Unpublished sources

(b) Classification of Data :

When the data is compiled in the same form and order in which it is collected, it is known as **Raw Data**, It is also called **Crude Data**. For example, the marks obtained by 20 students of class IX in English out of 10 marks are as follows :

7	4	9	5	8	9	6	7	9	2
0	3	7	6	2	1	9	8	3	8

(i) **Variate** : The numerical quantity whose value varies in objective is called a variate, generally a variate is represented by x . There are two types of variate.

→ **Discrete variate** : Its magnitude is fixed. For example, the number of teachers in different branches of a institute are 30, 35, 40 etc.

→ **Continuous variate** : Its magnitude is not fixed. It is expressed in groups like 10 – 20, 20 – 30, ...etc.

(ii) **Range** : The difference of the maximum and the minimum values of the variable x is called range.

(iii) **Class frequency** : In each class the number of times a data is repeated is known as its class frequency.

(iv) **Class interval** = $\frac{\text{Range}}{\text{Number of classes}}$

It is generally denoted by h or i .

(v) **Class limits** : The lowest and the highest value of the class are known as lower and upper limits respectively of that class.

(vi) **Class mark** : The average of the lower and the upper limits of a class is called the mid value or the class mark of that class. It is generally denoted by x .

If x be the mid value and h be the class interval, then the class limits are $\left(x - \frac{h}{2}, x + \frac{h}{2}\right)$.

(c) Frequency distribution

The marks scored by 30 students of IX class, of a school in the first test of Mathematics out of 50 marks are as follows :

6	32	10	17	22	28	0	48	6	22
32	6	36	26	48	10	32	48	28	22
22	22	28	26	17	36	10	22	28	0

The number of times a mark is repeated is called its **frequency**. It is denoted by **f**.

Marks Obtained	Tally mark	Frequency	Marks Obtained	Tally mark	Frequency
0	II	2	26	II	2
6	III	3	28	IIII	4
10	III	3	32	III	3
17	II	2	36	II	2
22	IIII I	6	48	III	3

Above type of frequency distribution is called **ungrouped frequency distribution**. Although this representation of data is shorter than representation of raw data, but from the angle of comparison and analysis it is quite big. So to reduce the frequency distribution, it can be classified into groups in following ways and it is called **grouped frequency distribution**.

Class	Frequency
1–10	8
11–20	2
21–30	12
31–40	5
41–50	3

(i) Kinds of Frequency Distribution :

Statistical methods like comparison, decision taken etc. depend on frequency distribution. Frequency distribution are of three types :

(I) Individual frequency distribution : Here each item or original price of unit is written separately. In this category, frequency of each variable is one. For example : Total marks obtained by 10 students in a class is given as follows :

S. No.	1	2	3	4	5	6	7	8	9	10
Marks obtained	46	18	79	12	97	80	5	27	67	54

(II) Discrete frequency distribution : When number of terms is large and variable are discrete, i.e. variate can accept some particular values only under finite limits and is repeated then it is called **discrete frequency distribution**. For example the wages of employees and their numbers is shown in following table.

Monthly wages	No. of employees
4000	10
6000	8
8000	5
11000	7
20000	2
25000	1

The above table shows ungrouped frequency distribution the same facts can be written in grouped frequency as follows :

Monthly wages	No. of employees
0 – 10,000	23
11,000 – 20,000	9
21,000 – 30,000	1

NOTE : If variable is repeated in individual distribution then it can be converted into discrete frequency distribution.

(III) Continuous frequency distribution : When number of terms is large and variate is continuous. i.e., variate can accept all values under finite limits and they are repeated then it is called **continuous frequency distribution**. For example age of students in a school is shown in the following table :

Age (in year)	Class	No. of students
Less than 5 year	0 – 5	72
From 5 and less than 10 year	5 – 10	103
From 10 and less than 15 year	10 – 15	50
From 15 and less than 20 year	15 – 20	25

(ii) Classes can be made mainly by two methods :

(I) Inclusive series : In this method value of upper and lower limit are both contained in same class. In this method the upper limit of class and lower limit of other class are not same. Some time the value is not a whole number, it is a fraction or in decimals and lies in between the two intervals then in such situation the class interval can be constructed as follows :

A	
Class	Frequency
1 – 10	4
11 – 20	7
21 – 30	6
31 – 40	3
41 – 50	3

(II) Exclusive series : In this method upper limit of the previous class and lower limit of the next class is same. In this method the term of upper limit in a class is not considered in the same class, it is considered in the next class.

Conversion of above inclusive frequency distribution into exclusive frequency distribution is as follows :

A	
Class	Frequency
0.5 – 10.5	4
10.5 – 20.5	7
20.5 – 30.5	6
30.5 – 40.5	3
40.5 – 50.5	3

(d) Cumulative frequency

(i) Discrete frequency distribution : Here we add all previous frequency and get cumulative frequency. It will be more clear from the following table :

Class	Frequency (f)	Cumulative frequency (cf)	Explanation
4000	10	10	10
6000	8	18	$10 + 8 = 18$
8000	5	23	$18 + 5 = 23$
11000	7	30	$23 + 7 = 30$
20000	2	32	$30 + 2 = 32$
25000	1	33	$32 + 1 = 33$

(ii) Continuous frequency distribution :

Monthly income variate (x)	No. of employee frequency (f)
0 – 5	72
5 – 10	103
10 – 15	50
15 – 20	25

Class	Cumulative Frequency	Explanation
Less than 5	72	$72 = 72$
Less than 10	175	$72 + 103 = 175$
Less than 15	225	$175 + 50 = 225$
Less than 20	250	$225 + 25 = 250$

From this table the number of students of age less than the upper limit of a class, i.e. number of student whose age is less than 5, 10, 15, 20 year can determined by merely seeing the table but if we need the number students whose age is more than zero, more than 5, more than 10 or more than 15, then table should be constructed as follows :

Class	Frequency	Age Cumulative frequency	Explanation
0 – 5	72	More than 0	$250 = 250$
5 – 10	103	More than 5	$250 - 72 = 178$
10 – 15	50	More than 10	$178 - 103 = 75$
15 – 20	25	More than 15	$75 - 50 = 25$

Solved Examples

Example. 1

The mid values of a distribution are 54, 64, 74, 84 and 94. Find the class interval and class limits.

Sol. The class interval is the difference of two consecutive class marks, therefore class interval (h) = 64 – 54 = 10.

Here the mid values are given and the class interval is 10.

So class limits are

$$\text{For 1}^{\text{st}} \text{ class } \quad 54 - \frac{10}{2} \quad \text{to } 54 + \frac{10}{2} \text{ or } 49 \text{ to } 59$$

$$\text{For 2}^{\text{nd}} \text{ class } \quad 64 - \frac{10}{2} \quad \text{to } 64 + \frac{10}{2} \text{ or } 59 \text{ to } 69$$

$$\text{For 3}^{\text{rd}} \text{ class } \quad 74 - \frac{10}{2} \quad \text{to } 74 + \frac{10}{2} \text{ or } 69 \text{ to } 79$$

$$\text{For 4}^{\text{th}} \text{ class } \quad 84 - \frac{10}{2} \quad \text{to } 84 + \frac{10}{2} \text{ or } 79 \text{ to } 89$$

$$\text{For 5}^{\text{th}} \text{ class } \quad 94 - \frac{10}{2} \quad \text{to } 94 + \frac{10}{2} \text{ or } 89 \text{ to } 99$$

Therefore class limits are 49 – 59, 59 – 69, 69 – 79, 79 – 89, and 89 – 99.

Example. 2

The blood groups of 30 students of class IX are recorded as follows :

A, B, O, O, AB, O, A, O, B, A, O, B, A, O, O,
A, AB, O, A, A, O, O, AB, B, A, O, B, A, B, O

Represent this data in the form of a frequency distribution table. Find out which is the most common and which is the rarest blood group among these students.

Sol. Frequency distribution table :

Blood Group	Frequency
A	9
B	6
O	12
AB	3

From the frequency table it is clear that most common blood group is O and AB is the rarest blood group among the students.

Example. 3

For the following data of daily wages (in rupees) received by 30 labourers in a certain factory, construct a grouped frequency distribution table by dividing the range into class intervals of equal width, each corresponding to 2 rupees, in such a way that the mid - value of the first class interval corresponds to 12 rupees :

14, 16, 16, 14, 22, 13, 15, 24, 12, 23, 14, 20, 17, 21, 22, 18, 18, 19, 20, 17, 16, 15, 11, 12, 21, 20, 17, 18, 19, 23.

Sol. Minimum daily wage = Rs. 11

Maximum daily wage = Rs. 24

∴ Range = Rs. 24 – Rs. 11 = Rs. 13

Size of class intervals = Rs. 2 [Given]

∴ Number of class intervals = 7 [∴ $\frac{\text{Range}}{\text{Class size}} = \frac{13}{2} = 6.5$]

Since, the mid-value of first class interval is 12 and size of the class interval is Rs. 2

$$\therefore \text{Lower limit of first class interval} = 12 - \frac{2}{2} = 11$$

$$\text{Upper limit of first class interval} = 12 + \frac{2}{2} = 13.$$

\therefore First class intervals is 11 – 13.

Thus, the class intervals are :

11 - 13, 13 - 15, 15 - 17, 17 - 19, 19 - 21, 21 - 23, 23 - 25.

The frequency distribution table is as given under.

Daily wages (in Rs.)	Frequency
11 – 13	3
13 – 15	4
15 – 17	5
17 – 19	6
19 – 21	5
21 – 23	4
23 – 25	3
Total	30

Example. 4

Thirty children were asked about the number of hours they watched T.V. programs in the previous week. The results were found as follows :

1, 6, 2, 3, 5, 12, 5, 8, 4, 8
 10, 3, 4, 12, 2, 8, 15, 1, 17, 6
 3, 2, 8, 5, 9, 6, 8, 7, 14, 12

(i) Make a grouped frequency distribution table for this data, taking class width 5 and one of the class intervals as 5-10.

(ii) How many children watched television for 15 or more hours a week ?

Sol. (i) Frequency distribution table is as follows :

Class intervals	Frequency
0 - 5	10
5 - 10	13
10 - 15	5
15 - 20	2

(ii) Numbers of children that watched 15 or more hours a week = 2 children.

Example.5

The weights in grams of 50 apples picked at random from a consignment are as follows :

131, 113, 82, 75, 204, 81, 84, 118, 104, 110, 80, 107, 111, 141, 136, 123, 90, 78, 90, 115, 110, 98, 106, 99, 107, 84, 76, 186, 82, 100, 109, 128, 115, 107, 115, 119, 93, 187, 139, 129, 130, 68, 195, 123, 125, 111, 92, 86, 70, 126.

Form the grouped frequency table by dividing the variable range into intervals of equal width of 20 g, such that the mid-value of the first class interval is 70 g.

Sol. Size of each class = 20.

Let the lower limit of the first class interval be a.

Then, its upper limit = (a + 20).

Mid-value of the first class interval = 70.

$$\therefore \frac{a + (a + 20)}{2} = 70 \quad \Rightarrow \quad 2a = 120 \quad \Rightarrow \quad a = 60.$$

\therefore The first class interval is 60 – 80.

Frequency distribution table is as follows :

Weight (in grams)	Frequency
60 – 80	5
80 – 100	13
100 – 120	17
120 – 140	10
140 – 160	1
160 – 180	0
180 – 200	3
200 – 220	1
Total	50

Check Your Level

- Find the mid value of the class interval (a – b) .
- Consider the class intervals 1 – 10, 11 – 20, 21 – 30, etc.,... Here what is the class boundary of class interval 11 – 20?
- The following are data on the number of rooms occupied each day in a resort hotel during the month of June:
55, 49, 37, 57, 46, 40, 64, 35, 73, 62, 61, 43, 72, 48, 54, 69, 45, 78, 46, 59, 40, 58, 56, 52, 49, 42, 62, 53, 46, 81.
Organize the data by grouping them into class intervals of size 5. Construct a frequency table.
- Given the following series:
3, 3, 4, 3, 4, 3, 1, 3, 4, 3, 3, 3, 2, 1, 3, 3, 3, 2, 3, 2, 2, 3, 3, 3, 2, 2, 2, 2, 2, 3, 2, 1, 1, 1, 2, 2, 4, 1.
Construct a frequency distribution table for the data and draw the corresponding histogram. Draw also the frequency polygon.
- Construct a cumulative frequency table of both types for the table given below

Class interval	Frequency
110 – 120	6
120 – 130	10
130 – 140	8
140 – 150	10
150 – 160	6
Total frequency	40

Answers

- $\frac{a + b}{2}$
- Upper limit 20 , lower limit 11

B. GRAPHICAL REPRESENTATION OF DATA

(a) Bar Graph :

A bar graph is a pictorial representation of the numerical data by a number of bars (rectangles) of uniform width erected horizontally or vertically with equal spacing between them.

While constructing bar graphs the following points should be kept in mind :

- (i) The width of the bars should be uniform throughout.
- (ii) The gap between one bar and another should be uniform throughout.
- (iii) Bars may be either horizontal or vertical.

(b) Histogram :

Histogram is a rectangular representation of grouped and continuous frequency distribution in which class intervals are taken as base and height of rectangles are proportional to corresponding frequencies. To draw the histogram class intervals are marked along x-axis on a suitable scale. Frequencies are marked along y-axis on a suitable scale, such that the areas of drawn rectangles are proportional to corresponding frequencies.

Construction of histograms are related with four different kinds of frequency distributions.

- (i) When frequency distribution is grouped and continuous and class intervals are also equal.
- (ii) When frequency distribution is grouped and continuous but class interval are not equal.
- (iii) When frequency distribution is grouped but not continuous.
- (iv) When frequency distribution is ungrouped and middle points of the distribution are given.

(c) Difference Between Bar Graph and Histogram

- (i) In histogram there is no gap in between consecutive rectangle as in bar graph.
- (ii) The width of the bar is significant in histogram. In bar graph, width is not important at all.
- (iii) In histogram the areas of rectangles are proportional to the frequency, however if the class size of the frequencies are equal then height of the rectangle are proportional to the frequencies.

(d) Frequency Polygon

A frequency polygon is also a form of graphical representation of frequency distribution. Frequency polygon can be constructed in two ways :

- (i) With the help of histogram
- (ii) Without the help of histogram

Case I : Following procedure is useful to draw a frequency polygon with the help of histogram.

- Construct the histogram for the given frequency distribution.
- Find the middle point of each upper horizontal line of the rectangle.
- Join these middle points of the successive rectangle by straight lines.
- Join the middle point of the initial rectangle with the middle point of the previous expected class interval on the x-axis.

Case II : Following procedure is useful to draw a frequency polygon without the help of histogram.

- Choose the class interval and mark the values on the horizontal axes
- Mark the mid value of each interval on the horizontal axes.
- Mark the frequency of the class on the vertical axes.
- Corresponding to the frequency of each class interval, mark a point at the height in the middle of the class interval.
- Connect these points using line segment.

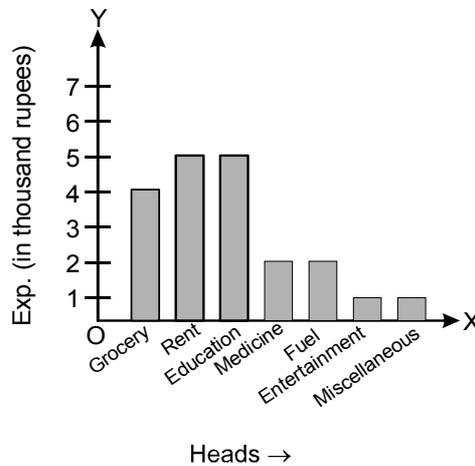
Solved Examples

Example. 6

A family with monthly income of Rs. 20,000 had planned the following expenditure per month under various heads. Draw bar graph for the data given below.

Heads	Expenditure (in Rs. 1000)
Grocery	4
Rent	5
Education of children	5
Medicine	2
Fuel	2
Entertainment	1
Miscellaneous	1

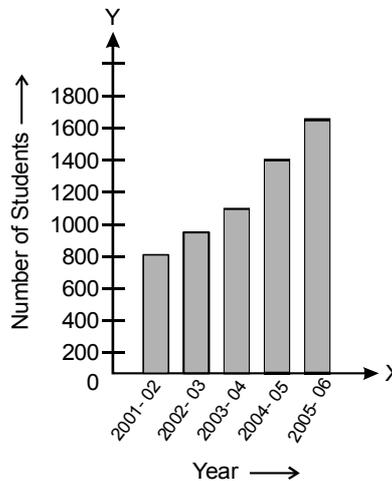
Sol. Take the heads along x-axis and expenditure (in thousand rupees) along y-axis. All the bar should be of the same width and same space should be left between the consecutive bars.


Example. 7

Given below a table which shows the yearwise strength of a school. Represent this data by a bar graph.

Year	2001- 02	2002 - 03	2003 - 04	2004 - 05	2005 - 06
No. of students	800	975	1100	1400	1625

Sol. Take the year along x-axis and number of students along y-axis. All the bar should be of the same width and same space should be left between the consecutive bars.

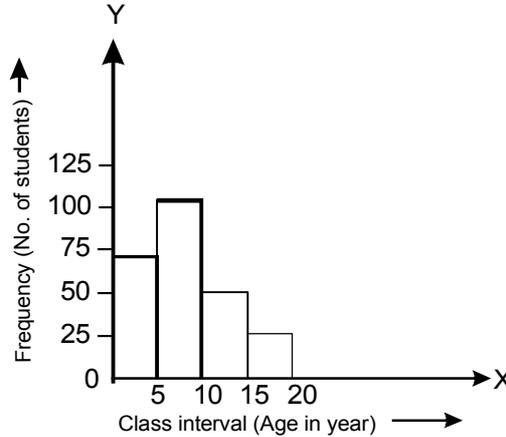


Example. 8

Draw a histogram of the following frequency distribution.

Class (Age in years)	0 – 5	5 – 10	10 – 15	15 – 20
No. of students	72	103	50	25

Sol. Here frequency distribution is grouped and continuous and class intervals are also equal. So mark the class intervals on the x-axis i.e., age in year (scale 1 cm = 5 year). Mark frequency i.e., number of students (scale 1 cm = 25 students) on the y-axis.



Example. 9

The weekly wages of workers of a factory are given in the following table. Draw histogram for it.

Weekly wages	1000 – 2000	2000 – 2500	2500 – 3000	3000 – 5000	5000 – 5500
No. of workers	26	30	20	16	3

Sol. Here frequency distribution is grouped and continuous but class intervals are not same. Under such circumstances the following method is used to find heights of rectangle so that heights are proportional to frequencies.

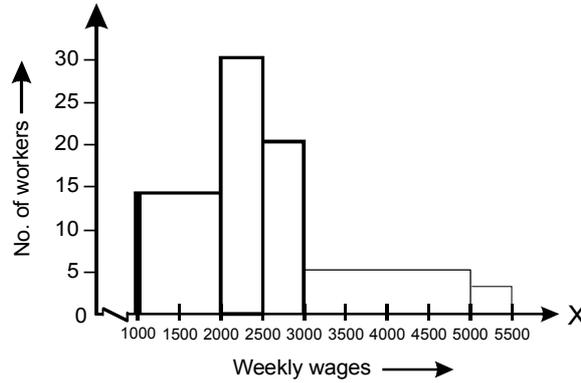
- (i) Write interval (h) of the least interval, here $h = 500$.
- (ii) Redefine the frequencies of classes by the using the following formula.

$$\text{Adjusted frequency of class} = \frac{h}{\text{class interval}} \times \text{frequency of class interval.}$$

So here the redefined frequency table is obtained as follows :

Weekly wages (in Rs.)	No. of workers	Adjusted Frequency
1000 - 2000	26	$\frac{500}{1000} \times 26 = 13$
2000 - 2500	30	$\frac{500}{500} \times 30 = 30$
2500 - 3000	20	$\frac{500}{500} \times 20 = 20$
3000 - 5000	16	$\frac{500}{2000} \times 16 = 4$
5000 - 5500	3	$\frac{500}{500} \times 3 = 3$

Now mark class interval on x-axis (scale 1 cm = 500) and no. of workers on y-axis (scale 1 cm = 5).



This is the required histogram of the given frequency distribution.

Example. 10

The following table shows the number of illiterate persons in the age - group (10 - 58) years in a town :

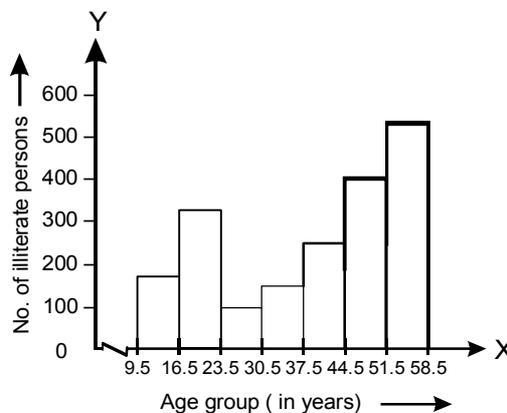
Age group (in years)	10 - 16	17 - 23	24 - 30	31 - 37	38 - 44	45 - 51	52 - 58
Number of illiterate persons	175	325	100	150	250	400	525

Sol. The given frequency distribution is not continuous. So, first convert it into a continuous frequency distribution.

The difference between the lower limit of a class and the upper limit of the preceding class is 1 i.e. $h = 1$. To convert the given frequency distribution into a continuous frequency distribution subtract $\frac{h}{2} = \frac{1}{2} = 0.5$ from each lower limit and add $\frac{h}{2} = \frac{1}{2} = 0.5$ to each upper limit. The distribution so obtained is as given below :

Age group (in years)	9.5 - 16.5	16.5 - 23.5	23.5 - 30.5	30.5 - 37.5	37.5 - 44.5	44.5 - 51.5	51.5 - 58.5
Number of illiterate persons	175	325	100	150	250	400	525

Now mark age group on X-axis (Scale 1 cm = 7yrs) and Number of persons on Y-axis (Scale 1 cm = 100)



Example. 11

Construct a histogram from the following distribution of total marks obtained by 65 students of IX class in the final examination :

Marks (mid-points)	150	160	170	180	190	200
No. of students	8	10	25	12	7	3

Sol. Since the difference between the second and first mid - point is $160 - 150 = 10$.

$$\therefore h = 10 \Rightarrow \frac{h}{2} = 5$$

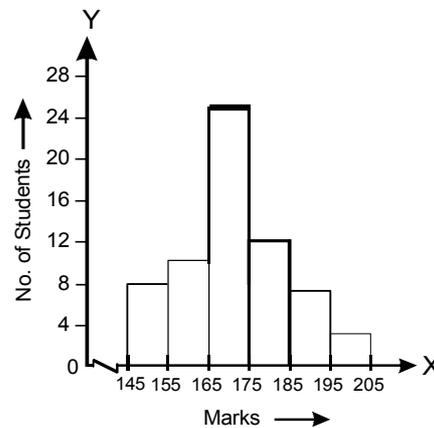
So, lower and upper limits of the first class are $150 - 5$ and $150 + 5$ i.e. 145 and 155 respectively.

\therefore First class interval is 145 - 155.

Using the same procedure, we get the classes of other mid - points as under :

Marks	145 - 155	155 - 165	165 - 175	175 - 185	185 - 195	195 - 205
No. of students	8	10	25	12	7	3

The histogram of the above frequency distribution is as follows :

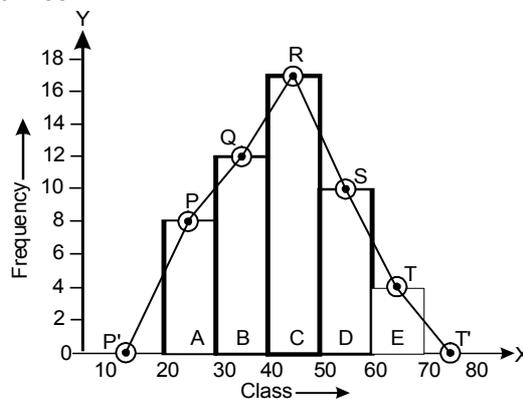


Example. 12

For the following frequency distribution, draw a histogram and construct a frequency polygon with it.

Class	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70
Frequency	8	12	17	9	4

Sol. The given frequency distribution is grouped and continuous, so we construct a histogram by the method given earlier. Join the middle points P, Q, R, S, T of upper horizontal line of each rectangles A, B, C, D, E by straight lines.



Example. 13

Draw a frequency polygon of the following frequency distribution.

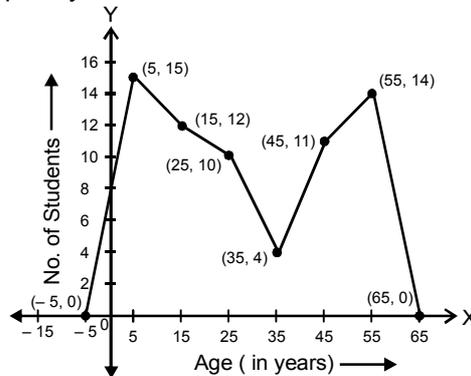
Age (in years)	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60
Frequency	15	12	10	4	11	14

Sol. Here frequency distribution is grouped and continuous so here we obtain following table on the basis of class.

Age (in years)	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60
Class mark	5	15	25	35	45	55
Frequency	15	12	10	4	11	14

Now taking suitable scale on graph mark the points (5, 15), (15, 12), (25, 10), (35, 4), (45, 11), (55, 14).

Since age can not be negative so instead of joining corner (5, 15) with middle point of zero frequency of earlier assumed class, we draw vertical line from the lower limit of this class i.e., 0 and point of half frequency on this line i.e., (0, 7.5) is joined by the end point. Join the last point (55, 14) with the points of zero frequency of the next assumed class i.e., with (65, 0).



Check Your Level

1. The following table gives the population of a village in 1000's in different years:

Year	2008	2009	2010	2011	2012	2013
Population	10	15	16	20	23	25

Draw a bar graph.

2. The following table gives the number of runs scored by a team in the course of a cricket match.

Overs	1-5	5-10	10-15	15-20	20-25	25-30
No. of runs	20	32	45	25	30	15

Represent the data as a histogram.

3. Weights of 65 adults are given by the following table:

Weights	50 – 60	60 – 70	70 – 80	80 – 90	90 – 100	100 – 110	110 – 120
F _i	8	10	16	14	10	5	2

Construct the histogram.

4. Draw the histogram for the data given below.

Age(in yrs)	1–5	5–15	15–30	30–40	40–45	45–50
No. of person	10	14	36	22	12	10

Represent the data as a histogram.

5. Draw a frequency polygon for the following distribution.

Class interval	Frequency
10 – 20	3
20 – 30	6
30 – 40	8
40 – 50	12
50 – 60	9
60 – 70	5

- (i) using histogram
- (ii) without using histogram:

C. MEASURES OF CENTRAL TENDENCY

The commonly used measure of central tendency are

- (a) Mean
- (b) Median
- (c) Mode

(a) **Mean :**

The mean of a number of observation is the sum of the values of all the observations divided by the total number of observations. It is denoted by the symbol \bar{x} , read as **x bar**.

Mean of raw data : If $x_1, x_2, x_3, \dots, x_n$ are the n values (or observations) then, **A.M.** (Arithmetic mean) is

$$\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n} = \frac{\sum_{i=1}^n x_i}{n}$$

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

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

Method for Mean of Ungrouped Data

x_i	f_i	$f_i x_i$
x_1	f_1	$f_1 x_1$
x_2	f_2	$f_2 x_2$
x_3	f_3	$f_3 x_3$
\vdots	\vdots	\vdots
	$\sum f_i =$	$\sum f_i x_i =$

If $x_1, x_2, x_3, \dots, x_n$ are the n values (or observations) and $f_1, f_2, f_3, \dots, f_n$ are corresponding frequencies, then A.M. (Arithmetic mean) is :

$$\bar{x} = \frac{f_1x_1 + f_2x_2 + \dots + f_nx_n}{f_1 + f_2 + f_3 + \dots + f_n} = \frac{\sum_{i=1}^n f_i x_i}{\sum_{i=1}^n f_i}$$

Properties of mean:

- (a) If a constant real number 'a' is added to each of the observation then new mean will be $\bar{x} + a$.
- (b) If a constant real number 'a' is subtracted from each of the observation then new mean will be $\bar{x} - a$.
- (c) If a constant real number 'a' is multiplied with each of the observation then new mean will be $a\bar{x}$.
- (d) If each of the observation is divided by a constant no 'a' then new mean will be $\frac{\bar{x}}{a}$.

Grouped Frequency Distribution

Direct Method : for finding mean

$$\text{Mean, } \bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

Uses of Arithmetic Mean

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

(b) Median :

Median of a distribution is the value of the variable which divides the distribution into two equal parts.

Median of ungrouped data

- Arrange the data in ascending order.
- Count the no. of observations (Let there be 'n' observations)
- If n is odd then median = value of $\left(\frac{n+1}{2}\right)^{\text{th}}$ observation.
- If n is even then median = value of **mean** of $\left(\frac{n}{2}\right)^{\text{th}}$ observation and $\left(\frac{n}{2} + 1\right)^{\text{th}}$ observation or

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

(ii) Uses of Median :

- 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.
- It is used for determining the typical value in problems concerning wages, distribution of wealth etc.

(c) **Mode :**

(i) **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.

(ii) **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.

Empirical Relation between Mode, Median & Mean :

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

Solved Examples

Example. 14

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. 15

If the mean of 6, 4, 7, P and 10 is 8 find P.

Sol. $8 = \frac{6+4+7+P+10}{5} \Rightarrow P = 13.$

Example. 16

If the mean of five observations $x, x + 2, x + 4, x + 6, x + 8$ is 11, find the mean of first three observations.

Sol. $11 = \frac{x+(x+2)+(x+4)+(x+6)+(x+8)}{5}.$

$$55 = 5x + 20$$

$$5x = 35$$

$$x = 7.$$

$$\text{Mean of first three observations} = \frac{x+(x+2)+(x+4)}{3} = \frac{3x+6}{3} = x+2 = 7+2 = 9.$$

Example. 17

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

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

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

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

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

So, the correct mean is 39.7.

Example.18

The mean monthly salary of 10 members of a group is Rs. 1445, one more member whose monthly salary is Rs. 1500 has joined the group. Find the mean monthly salary of 11 members of the group.

Sol. $n = 10, \bar{x} = 1445$

So, total monthly wages of 10 persons = $10 \times 1445 = 14450.$

Monthly salary of one more person who joined the group is Rs. 1500

\therefore Total monthly wages of 11 persons = Rs. 14450 + Rs. 1500 = Rs. 15950

So, average monthly salary of 11 persons = $\frac{15950}{11} = \text{Rs. } 1450.$

Example. 19

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

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

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

Calculation of Mean :

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

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i} \Rightarrow 12.58 = \frac{524 + 7P}{50} \Rightarrow 629 = 524 + 7P$$

$$7P = 105, P = 15.$$

Example. 20

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	$f_i x_i$
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
		$\sum f_i = 40$	$\sum f_i x_i = 1430$

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

Example. 21

Find the median of the following values : 37, 31, 42, 43, 46, 25, 39, 45, 32

Sol. Arranging the data in ascending order, we have

25, 31, 32, 37, 39, 42, 43, 45, 46

Here the number of observations $n = 9$ (odd)

$$\therefore \text{Median} = \text{Value of } \left(\frac{9+1}{2}\right)^{\text{th}} \text{ observation} = \text{Value of } 5^{\text{th}} \text{ observation} = 39.$$

Example. 22

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, 737.

Sol. Arranging the data in ascending order

649, 696, 699, 705, 710, 712, 715, 716, 719, 724, 725, 728, 729, 734, 737, 745

$N = 16$ (Even)

$$\begin{aligned} \text{So, Median} &= \frac{\left(\frac{16}{2}\right)^{\text{th}} \text{ observation} + \left(\frac{16}{2} + 1\right)^{\text{th}} \text{ observation}}{2} \\ &= \frac{8^{\text{th}} \text{ Obs.} + 9^{\text{th}} \text{ Obs.}}{2} = \frac{716 + 719}{2} = 717.5 \end{aligned}$$

Example. 23

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 .

Sol. Here, the number of observations $n = 10$. Since n is even, therefore

$$\begin{aligned} \text{Median} &= \frac{\left(\frac{n}{2}\right)^{\text{th}} \text{ observation} + \left(\frac{n}{2} + 1\right)^{\text{th}} \text{ observation}}{2} \Rightarrow 24 = \frac{5^{\text{th}} \text{ observation} + 6^{\text{th}} \text{ observation}}{2} \\ \Rightarrow 24 &= \frac{(x+2) + (x+4)}{2} \Rightarrow 24 = \frac{2x+6}{2} \Rightarrow 24 = x+3 \Rightarrow x = 21. \end{aligned}$$

Hence, $x = 21$.

Example. 24

Find the mode of the following array of an individual series of scores 7, 7, 10, 12, 12, 12, 11, 13, 13, 17.

Sol. Arranging the data in the form of a frequency table :

Numbers	7	10	11	12	13	17
Frequency	2	1	1	3	2	1

From the above table it is clear that 12 is occurring most number of times.

\therefore Mode is 12.

Solved Examples

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

2. Calculate the mean of the data:

x_i	61	64	67	70	73
f_i	5	18	42	27	8

3. The mean of x_1, x_2, \dots, x_{50} is M , if every x_i ($i = 1, 2, \dots, 50$) is replaced by $\frac{x_i}{50}$, then find new mean.

4. While driving past stores, Tarun counted the number of cars in the parking lots. He counted: 19, 9, 1, 15, 19, 3 and 5. Determine the median and mode of the cars he counted.

5. Mode of some observation is 4 and the median is 3. Then find mean.

Answers

1. 39 2. 67.45 3. $\frac{M}{50}$ 4. Median = 9, Mode = 19
5. 2.5
-

Exercise Board Level

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

1. Find the class-mark of the class 130-150.
2. Find the range of the data :
25, 18, 20, 22, 16, 6, 17, 15, 12, 30, 32, 10, 19, 8, 11, 20.
3. In a frequency distribution, the mid value of a class is 10 and the width of the class is 6. Then find the lower limit of the class.
4. Let m be the mid-point and l be the upper class limit of a class in a continuous frequency distribution. Then find the lower class limit of the class.
5. In the class intervals 10-20, 20-30, then find the number 20 is included in
6. A grouped frequency table with class intervals of equal sizes using 250-270 (270 not included in this interval) as one of the class interval is constructed for the following data :
268, 220, 368, 258, 242, 310, 272, 342, 310, 290, 300, 320, 319, 304, 402, 318, 406, 292, 354, 278, 210, 240, 330, 316, 406, 215, 258, 236.
Then find the frequency of the class 310-330.
7. If \bar{x} represents the mean of n observations x_1, x_2, \dots, x_n , then find the value of $\sum_{i=1}^n (x_i - \bar{x})$.
8. Find the median of the data
78, 56, 22, 34, 45, 54, 39, 68, 54, 84 is
9. Mode of the data
15, 14, 19, 20, 14, 15, 16, 14, 15, 18, 14, 19, 15, 17, 15 is

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

10. Draw a histogram to represent the following frequency distribution :

Class interval	05-10	10-15	15-25	25-45	45-75
Frequency	6	12	10	8	15

11. The mean of five numbers is 30. If one number is excluded, their mean becomes 28. Then find the excluded number is :
12. If the mean of the observations: $x, x+3, x+5, x+7, x+10$ is 9, then find the mean of the last three observations.
13. The mean of 100 observations is 50. If one of the observations which was 50 is replaced by 150, then find the resulting mean.
14. There are 50 numbers. Each number is subtracted from 53 and the mean of the numbers so obtained is found to be -3.5 . Then find the mean of the given numbers
15. The following observations are arranged in ascending order :
26, 29, 42, 53, x , $x + 2$, 70, 75, 82, 93
If the median is 65, find the value of x .

16. Prepare a continuous grouped frequency distribution from the following data:

Mid-point	Frequency
5	4
15	8
25	13
35	12
45	6

17. If the mean of the following data is 20.2, find the value of p:

x	10	15	20	25	30
f	6	8	p	10	6

TYPE (III) : LONG ANSWER TYPE QUESTIONS:

[03 MARK EACH]

18. If \bar{x} is the mean of x_1, x_2, \dots, x_n , then for $a \neq 0$, then prove that the mean of ax_1, ax_2, \dots, ax_n ,

$$\frac{x_1}{a}, \frac{x_2}{a}, \dots, \frac{x_n}{a} \text{ is } \left(a + \frac{1}{a}\right) \frac{\bar{x}}{2}$$

19. Mean of 50 observations was found to be 80.4. But later on, it was discovered that 96 was misread as 69 at one place. Find the correct mean.

20. The points scored by a basket ball team in a series of matches are as follows:
17, 2, 7, 27, 25, 5, 14, 18, 10, 24, 48, 10, 8, 7, 10, 28
Find the median and mode for the data.

21. The lengths of 62 leaves of a plant are measured in millimetres and the data is represented in the following table :

Length (in mm)	Number of leaves
118 - 126	8
127 - 135	10
136 - 144	12
145 - 153	17
154 - 162	7
163 - 171	5
172 - 180	3

22. Following table shows a frequency distribution for the speed of cars passing through at a particular spot on a high way

Class interval (km/h)	Frequency
30 - 40	3
40 - 50	6
50 - 60	25
60 - 70	65
70 - 80	50
80 - 90	28
90 - 100	14

Draw a histogram and frequency polygon representing the data above.

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

23. The marks obtained (out of 100) by a class of 80 students are given below :

Marks	Number of students
Oct-20	6
20 - 30	17
30 - 50	15
50 - 70	16
70 - 100	26

Construct a histogram to represent the data above.

24. Following table gives the distribution of students of sections A and B of a class according to the marks obtained by them.

Section A		Section B	
Marks	Frequency	Marks	Frequency
0 - 15	5	0 - 15	3
15 - 30	12	15 - 30	16
30 - 45	28	30 - 45	25
45 - 60	30	45 - 60	27
60 - 75	35	60 - 75	40
75 - 90	13	75 - 90	10

Represent the marks of the students of both the sections on the same graph by two frequency polygons. What do you observe?

25. The mean of the following distribution is 50.

x	f
10	17
30	$5a + 3$
50	32
70	$7a - 11$
90	19

Find the value of a and hence the frequencies of 30 and 40.

Exercise-1

SUBJECTIVE QUESTIONS

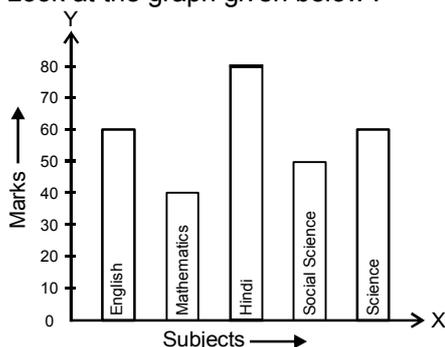
Subjective Easy, only learning value problems

Section (A) : Tabular representation of statistical data

- A-1.** The class marks of a distribution are : 47, 52, 57, 62, 67, 72, 77, 82, 87, 92, 97, 102.
Determine the class size and the class limits.
- A-2.** The weights (in grams) of 40 oranges picked at random from a basket are as follows :
40, 50, 60, 65, 45, 55, 30, 90, 75, 85, 70, 85, 75, 80, 100, 110, 70, 55, 30, 35, 45, 70, 80, 85, 95, 70,
60, 70, 75, 40, 100, 65, 60, 40, 100, 75, 110, 30, 45, 84.
Construct a grouped frequency table by dividing the variable range into class intervals of equal width of 10 g, such that the mid - value of the first class interval is 30 g.
- A-3.** The following are the marks (out of 100) of 60 students in mathematics.
16, 13, 5, 80, 86, 7, 51, 48, 24, 56, 70, 19, 61, 17, 16, 36, 34, 42, 34, 35, 72, 55, 75, 31, 52, 28, 72,
97, 74, 45, 62, 68, 86, 35, 85, 36, 81, 75, 55, 26, 95, 31, 7, 78, 92, 62, 52, 56, 15, 63, 25, 36, 54, 44,
47, 27, 72, 17, 4, 30.
Construct a grouped frequency distribution table with width 10 of each class starting from 0 – 9.
- A-4.** Form a grouped frequency distribution from the following data by inclusive method taking 4 as the magnitude of class intervals.
31, 23, 19, 29, 22, 20, 16, 10, 13, 34, 38, 33, 28, 21, 15, 18, 36, 24, 18, 15, 12, 30, 27, 23, 20, 17,
14, 32, 26, 25, 18, 29, 24, 19, 16, 11, 22, 15, 17, 10.
- A-5.** The relative humidity (in %) of a certain city for a month of 30 days are as follows :
98.1, 98.6, 99.2, 90.3, 86.5, 95.3, 92.9, 96.3, 94.2, 95.1, 89.2, 92.3, 97.1, 93.5, 92.7, 95.1, 97.2,
93.3, 95.2, 97.3, 96.2, 92.1, 84.9, 90.2, 95.7, 98.3, 97.3, 96.1, 92.1, 89.
(i) What is the range of this data ?
(ii) Construct a grouped frequency distribution table with classes 84 - 86, 86 - 88, etc.

Section (B) : Graphical representation of statistical data

- B-1.** Look at the graph given below :



Read it carefully and answer the following questions.

- (i) What information does the bar graph give ?
(ii) In which subject the student scored highest marks ?
(iii) In which subject the student scored lowest marks ?
(iv) What is the average of his marks ?

B-2. Given below is a table which shows the year wise strength of a school. Represent this data by a bar graph.

Year	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
No. of students	800	975	1100	1400	1625	1800

B-3. Draw a histogram to represent the following data :

C.I.	40 - 60	60 - 80	80 - 100	100 - 120	120 - 140	140 - 160	160 - 180	180 - 200
Freq.	20	40	30	50	30	20	10	40

B-4. Draw a histogram for the marks of students given below :

Marks	0 - 10	10 - 30	30 - 45	45 - 50	50 - 60
No. of students	8	32	18	10	6

B-5. Construct a histogram for the following frequency distribution :

C.I.	5 - 12	13 - 20	21 - 28	29 - 36	37 - 44	45 - 52
Frequency	6	15	24	18	4	9

B-6. The ages (in years) of 360 patients treated in a hospital on a particular day are given below :

Age (in years)	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70
Number of patients	90	40	60	20	120	30

Draw a frequency polygon to represent the above data.

B-7. Draw a histogram and frequency polygon on the same graph for the following distribution :

C.I.	1 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60
Frequency	8	3	6	12	2	7

Section (C) : Measure of central tendency

C-1. Find the mean of following data 13, 17, 16, 14, 11, 13, 10, 16, 11, 18, .12, 17.

C-2. Find the median of following data 38, 70, 48, 34, 42, 55, 63, 46, 54, 44.

C-3. Find the mode of following data 2, 2, 6, 5, 4, 3, 4, 5, 7, 9, 4, 5, 3, 1, 10, 4.

C-4. Find the value of p , if the median of following observations is 48.
14, 17, 33, 35, $p - 5$, $p + 7$, 57, 63, 69, 80. The given observation are in ascending order.

C-5. The mean of 16 items was found to be 30. On rechecking, it was found that the two items were wrongly taken as 22 and 18 instead of 32 and 28 respectively. Find the correct mean.

C-6. 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

C-7. Find the mean of the following frequency distribution:

Variable (x_i)	10	30	50	70	89
Frequency (f_i)	7	8	10	15	10

C-8. The weights (in kg) of 16 students are : 31, 35, 27, 29, 32, 43, 37, 41, 34, 28, 36, 44, 45, 42, 30, 48. Find the median. If the weights 44 kg is replaced by 46 kg and 27 kg by 25 kg, find the new median.

C-9. The mean age of a one group of persons is 40. Another group has mean age 48. If the ratio of number of persons in two groups is 5 : 3, then find the mean age of all the persons.

OBJECTIVE QUESTIONS

Single Choice Objective, straight concept/formula oriented

Section (A) : Tabular representation of statistical data

A-1. If the class intervals in a frequency distribution are (72 – 73.9), (74 – 75.9), (76 – 77.9),(78 – 79.9) etc., then the mid-point of the class (74 – 75.9) is :
 (A) 74.50 (B) 74.70 (C) 74.95 (D) 75.00

A-2. In an examination, 10 students scored the following marks in Mathematics 35, 19, 28, 32, 63, 02, 47, 31, 13, 98. Its range is :
 (A) 96 (B) 02 (C) 98 (D) 50

A-3. The difference between the maximum and the minimum value observations in the data is called :
 (A) cumulative frequency (B) class interval
 (C) range (D) frequency

A-4. Frequency of the class interval 4 – 8 is :

Class	0 – 4	4 – 8	8 – 12	12 – 16	16 – 20
Cumulative Frequency (f)	6	15	23	27	30

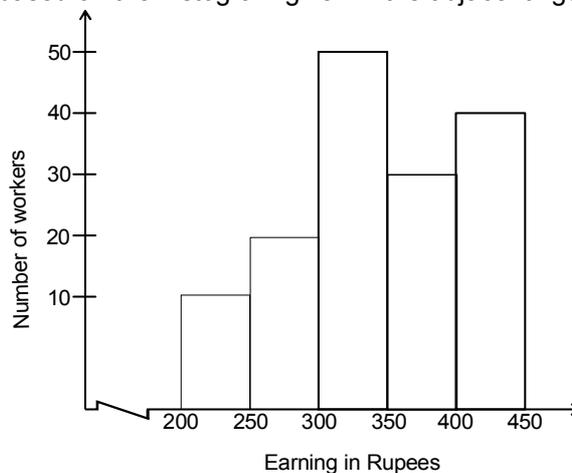
(A) 15 (B) 4 (C) 9 (D) 8

A-5. In the class intervals 0-20 and 20-40, the number 20 is included in :
 (A) 0-20 (B) 20-40 (C) both the intervals (D) None of these

A-6. For the following Class mark 25,30,35,40,45,50 the third class interval is :
 (A) 30 – 35 (B) 25 – 30 (C) 32.5 – 37.5 (D) 27.5 – 32.5

Section (B) : Graphical representation of statistical data

Direction : Each question is based on the histogram given in the adjacent figure.



- B-1.** What is the number of worker earning Rs. 300 to 350 ?
 (A) 50 (B) 40 (C) 45 (D) 130
- B-2.** In which class interval of wages there is the least number of workers ?
 (A) 400-450 (B) 350-400 (C) 250-300 (D) 200-250
- B-3.** What is the upper limit of the class-interval 200-250 :
 (A) 200 (B) 250 (C) 225 (D) None of these

Section (C) : Measure of central tendency

- C-1.** The median of following series 520, 20, 340, 190, 35, 800, 1210, 50, 80 :
 (A) 1210 (B) 520 (C) 190 (D) 35
- C-2.** 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
- C-3.** The mode of the distribution 3, 5, 7, 4, 2, 1, 4, 3, 4 is :
 (A) 7 (B) 4 (C) 3 (D) 1
- C-4.** 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-5.** A student got marks in 5 subjects in a monthly test is given below :
 2, 3, 4, 5, 6, in these obtained marks, 4 is the
 (A) Mean and median (B) Median but no mean
 (C) Mean but no median (D) Mode
- C-6.** What is the mode from the following table :

Marks obtained	3	1	23	33	43
Frequency (f)	7	11	15	8	3

- (A) 13 (B) 43 (C) 33 (D) 23
- C-7.** If the first five elements of a set replaced by $(x_i + 5)$, where $i = 1, 2, 3, \dots, 5$ and the next five elements are replaced by $(x_j - 5)$, where $j = 6, 7, \dots, 10$ then the mean will change by :
 (A) 25 (B) 10 (C) 5 (D) 0
- C-8.** The following numbers are given 61, 62, 63, 61, 63, 64, 64, 60, 65, 63, 64, 65, 66, 64. The difference between their mean and median is (approximately) :
 (A) 0.4 (B) 0.3 (C) 0.2 (D) 0.1
- C-9.** The average of 15 numbers is 18. The average of first 8 is 19 and that last 8 is 17, then the 8th number is :
 (A) 15 (B) 16 (C) 18 (D) 20
- C-10.** The average age of group of eight members is the same as it was 3 years ago, when a young member is substituted for an old member. The incoming member is younger to the outgoing member by :
 (A) 11 years (B) 24 years (C) 28 years (D) 16 years
- C-11.** The average of n numbers $x_1, x_2, x_3, \dots, x_n$ is A. If x_1 is replaced by $(x + a)$, x_2 is replaced by $(x + a)$, x_3, \dots, x_n is replaced by $(x + a)$; then the new average is :
 (A) $\frac{(n+1)A + x_n}{n}$ (B) $\frac{(x-1)A + nx_n}{n}$ (C) $\frac{nA + 1(n+1)x_n}{n}$ (D) $(x + a)A$

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 $x_1, x_2, x_3, \dots, x_n$ is 1, then the arithmetic mean of $\frac{x_1}{k}, \frac{x_2}{k}, \frac{x_3}{k}, \dots, \frac{x_n}{k}$ ($k > 1$) 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 5's, 30 were 6's and the remaining were 7's. 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. 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
16. 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
17. 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
18. 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
19. 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
20. 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 :
 (A) 2000 (B) 3000 (C) 4000 (D) 5000
21. 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 innings is :
 (A) 10 runs (B) 20 runs (C) 11 runs (D) 21 runs
22. The mean of six numbers is 15. If 2 is taken away from every number, the new mean would be :
 (A) 13 (B) 4 (C) 17 (D) 8
23. 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 :
 (A) 34 (B) 33 (C) 32 (D) 31

Exercise-3

NTSE PROBLEMS (PREVIOUS YEARS)

1. From the following table, mode – mean is - **[Rajasthan 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 : **[Rajasthan 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 : **[Rajasthan 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° then temperature on Thursday is :
[Tamilnadu NTSE-Stage-1 2006]
 (A) 24°C (B) 23°C (C) 22°C (D) 20°C
5. Which of these numbers is the average of the remaining three ? **[Bangalore NTSE-Stage-1 2007]**
 (A) 26 (B) 39 (C) 30 (D) 61
6. If the arithmetic mean of the distribution $x, 2x, 2x + 1, 2$ is 7, then the value of x is :
[Rajasthan NTSE Stage-1 2007]
 (A) 5 (B) $\frac{27}{5}$ (C) $\frac{26}{5}$ (D) $\frac{25}{6}$
7. The median of the following distribution
 2, 3, 2, 6, 5, 4, 5, 5 is : **[Rajasthan NTSE Stage-1 2007]**
 (A) 3 (B) 4 (C) 4.5 (D) 6.5
8. 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 _____.
[M.P. NTSE Stage-1 2012]
 (A) 8 (B) 24 (C) 32 (D) 48
9. 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 :
[M.P. NTSE Stage-1 2013]
 (A) $\frac{\bar{X} - 10}{\alpha}$ (B) $\frac{\bar{X} + 10}{\alpha}$ (C) $\frac{\bar{X} + 10\alpha}{\alpha}$ (D) $\frac{\alpha\bar{X} + 10}{\alpha}$
10. The median and mode of a frequency distribution are 525 and 500 then mean of same frequency distribution is :
[Rajasthan NTSE Stage-1 2013]
 (A) 75 (B) 107.5 (C) 527.5 (D) 537.5
11. If the mean of x and $\frac{1}{x}$ is M , then the mean of x^2 and $\frac{1}{x^2}$ is : **[M.P. NTSE Stage-1 2013]**
 (A) M^2 (B) $\frac{M^2}{4}$ (C) $2M^2 - 1$ (D) $2M^2 + 1$
12. Positional mean is : **[M.P. NTSE Stage-1 2013]**
 (A) Arithmetic mean (B) Geometric mean (C) Median (D) Harmonic mean
13. 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
14. The mean of n numbers x_1, x_2, \dots, 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
15. 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
16. 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

17. The median of first 12 prime numbers is **[Rajasthan NTSE Stage-1 2014]**
 (A) 13 (B) 14 (C) 15 (D) 17.
18. 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
19. 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
20. 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 number of tests he appeared is : **[Delhi NTSE Stage-1 2014]**
 (A) 8 (B) 7 (C) 9 (D) 10
21. 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
22. 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
23. 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
24. If \bar{x} is the mean of the terms $x_1, x_2, x_3, \dots, x_n$ and $\sum_{i=1}^n x_i = x_1 + x_2 + x_3 + \dots + x_n$ then, value of $\sum_{i=1}^n x_i - n\bar{x}$ is **[U.P. NTSE Stage-1 2014]**
 (A) 0 (B) 1 (C) n (D) x
25. If mean of 5, 10, 15, P, 20, 35, 40 is 21. Then the value of P will be - **[U.P. NTSE Stage-1 2014]**
 (A) 18 (B) 22 (C) 25 (D) 30
26. The median of first 10 prime numbers will be- **[U.P. NTSE Stage-1 2014]**
 (A) 5 (B) 11 (C) 12 (D) 13
27. If mode of any series is 9 and median is 7 then mean of that series will be- **[U.P. NTSE Stage-1 2014]**
 (A) -6 (B) 6 (C) -5/3 (D) 5/3
28. The mean of the first ten even natural numbers is **[Rajasthan NTSE Stage-1 2015]**
 (A) 10 (B) 11 (C) 12 (D) 13
29. The median of a series is 10. Two additional 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
30. 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

31. 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
32. 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
33. 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..... **[M. P. NTSE Stage-1 2015]**
 (A) 38.8,50 (B) 50,40 (C) 40,35 (D) 35,40
34. 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
35. 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
36. 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- **[U.P. NTSE Stage-1 2017]**
 (A) 14 (B) 7 (C) 15 (D) 20

Answer Key

Exercise Board Level

TYPE (I) :

- | | | | |
|----------|-------|------|-------------|
| 1. 140 | 2. 26 | 3. 7 | 4. $2m - l$ |
| 5. 20-30 | 6. 6 | 7. 0 | 8. 54 |
| | | | 9. 15 |

TYPE (II) :

- | | | | | |
|--------|---------------------|--------|----------|--------|
| 11. 38 | 12. $11\frac{1}{3}$ | 13. 51 | 14. 56.5 | 15. 64 |
| 17. 20 | 19. 80.94 | | | |

TYPE (III) :

20. Median = 12 , Mode = 10

Exercise-1

SUBJECTIVE QUESTIONS

Section (A)

A-2.

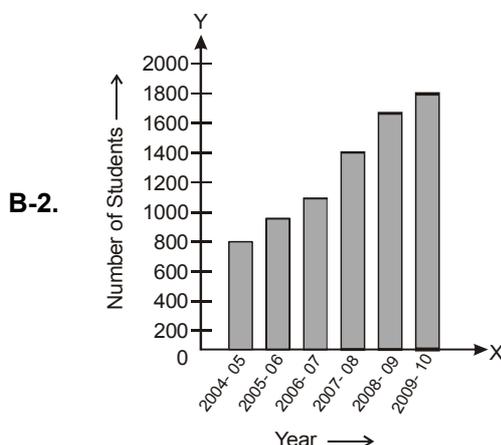
Weight in g	No. of oranges
25 - 35	3
35 - 45	4
45 - 55	4
55 - 65	5
65 - 75	7
75 - 85	7
85 - 95	4
95 - 105	4
105 - 115	2

A-5. (i) 14.3 **(ii)**

Relative humidity (%)	No. of days
84 - 86	1
86 - 88	1
88 - 90	2
90 - 92	2
92 - 94	7
94 - 96	6
96 - 98	7
98 - 100	4

Section (B)

- B-1. (i)** Bar graph gives the information about the marks obtained in different subjects.
(ii) Hindi **(iii)** Mathematics **(iv)** 58



Section (C)

- C-1. 14 C-2. 47 C-3. 4 C-4. 47. C-5. 31.25
 C-6. 20 C-7. 55 C-8. 35.5, 35.5 C-9. 43

OBJECTIVE QUESTIONS

Section (A)

- A-1. (C) A-2. (A) A-3. (C) A-4. (C) A-5. (B)
 A-6. (C)

Section (B)

- B-1. (A) B-2. (D) B-3. (B)

Section (C)

- C-1. (C) C-2. (B) C-3. (B) C-4. (C) C-5. (A)
 C-6. (D) C-7. (D) C-8. (B) C-9. (C) C-10. (B)
 C-11. (D)

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	B	B	A	A	C	A
Ques.	21	22	23																	
Ans.	A	A	D																	

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	B	A	C	C	C	D	C	C	B	A	C	A	C	C	B	A
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36				
Ans.	D	D	D	A	B	C	B	B	D	B	B	B	A	C	A	B				