

## CBSE-IX

Embark on a comprehensive exploration of Statistics with our specialized study module designed for CBSE Class IX- Mathematics. This resource is meticulously crafted to provide a solid foundation in statistical concepts, ensuring proficiency in this fundamental aspect of mathematics.

# STATISTICS

## STUDY MODULE



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STUDY MODULE  
CBSE-MATHEMATICS

# STATISTICS

**Introduction to Statistics:**

- Begin your journey into Statistics with a clear and concise introduction, laying the groundwork for understanding the importance of statistical analysis in real-world scenarios.

**Data Collection and Representation:**

- Explore the methods of data collection and representation, understanding how to organize and present data effectively using tables, graphs, and charts.

**Measures of Central Tendency:**

- Delve into measures of central tendency, including mean, median, and mode. Understand their calculation methods and their significance in analyzing data.

**Application in Real-world Scenarios:**

- Connect theoretical knowledge to practical applications. Explore the diverse applications of Statistics in real-world scenarios, from analyzing survey data to making informed decisions.

**Problem-Solving Practice:**

- Hone your problem-solving skills with targeted practice questions. The module includes questions of varying difficulty levels, ensuring a comprehensive preparation for the CBSE Class 9 Mathematics examination.

**Application of Similar Triangles:**

- Connect theoretical knowledge to practical applications. Explore the diverse applications of similar triangles in real-world scenarios, from surveying to indirect measurement.

**Visual Learning Aids:**

- Enhance your comprehension with visual aids, diagrams, and illustrations. Visual representations make abstract statistical concepts visually tangible, aiding in better understanding and retention.

**Time-Efficient Study:**

- Optimize your study time with a focused and condensed exploration of Statistics. The module is designed for efficient learning, allowing you to reinforce your knowledge in a short span.

**Accessible Anytime, Anywhere:**

- Access the study module online at your convenience. The digital platform offers flexibility for efficient and personalized study, allowing you to tailor your learning schedule for optimal results.



### Syllabus Reference

#### ❖ STATISTICS

It is a branch of mathematics dealing with the collection of data, organising, summarising, presenting and analysing data and drawing valid conclusions and thereafter making reasonable decisions on the basis of such analysis.

#### ❖ LIMITATIONS OF STATISTICS

- Statistics laws are not exact. They are true on averages only.
- Statistics does not study individual but it deals with group.
- Statistics is not suited to the study of qualitative phenomenon, as beauty, honesty, poverty.
- Statistics is liable to be misused. Data collected for certain purpose, may not be suitable for another purpose.

#### ❖ STATISTICAL DATA

The first thing in every statistical investigation is the collection of data, but these data in their original form are so huge and complex that they do not give a clear and correct picture of the whole data. Statistical methods are applied to arrange the data in a proper form.

There are two types of statistical data:

- Primary Data:** The data which is collected for the first time by the collector for his own purpose is called **Primary Data**.
- Secondary Data:** The data which are collected by someone else and used by the collector for his own purpose is called **Secondary Data**.

#### ❖ PRESENTATION OF DATA

After collection of data, the collector has to find ways to condense them in tabular form in order to study their salient features. Such an arrangement is called **Presentation of Data**.

Raw data can be arranged as follows:

- Serial order
- Ascending order
- Descending order

If the raw data is arranged in ascending or descending order of magnitude, it is called **an array**.

And the raw data arranged in serial order or ascending or descending order are called **arranged data**.

#### ❖ FREQUENCY DISTRIBUTION

Frequency distribution are of two types:

- Discrete frequency distribution
  - Continuous or grouped frequency distribution
- (a) Discrete frequency distribution:** The process of preparing this type of distribution is very simple. It is done by the use of tally marks. In the first column of the frequency table, we write all possible values of the variable from the lowest to the highest.
- (b) Continuous or grouped frequency distribution:** If the number of observations are large and the difference between the greatest and the smallest observations is large, then we condense the data into classes or groups.
- There are two methods of classifying the data according to the class-intervals:
- Exclusive method
  - Inclusive method



- (i) When the class-intervals are so fixed that the upper limit of one class is the lower limit of the next class, it is called Exclusive method of classification.
- (ii) In Inclusive method, the classes are so formed that the upper limit of a class is included in that class.

❖ **CONVERSION OF INCLUSIVE SERIES INTO EXCLUSIVE SERIES**

It is always advisable to convert inclusive series into exclusive series to get correct results.

∴ Conversion factor = 'd'

$$= \frac{\left( \text{Value of the lower limit of the class} \right) - \left( \text{Value of the upper limit of preceding class} \right)}{2}$$

Now, subtract this conversion factor from the lower limit of each class and add to the upper limit of each class.

❖ **CUMULATIVE FREQUENCY DISTRIBUTION**

If the frequency of the first class is added to the second class and this sum is added to the third and so on, then the frequencies so obtained are known as cumulative frequencies (c.f.). The table showing cumulative frequencies is called **cumulative frequency table**.

❖ **TRUE UPPER AND LOWER LIMITS**

- (i) In an Exclusive form, the upper and lower limits of a class are called true upper limit and true lower limit.
- (ii) In an Inclusive form, the true limit of a class is obtained by subtracting 0.5 from the lower limit of the class and true upper limit of the class is obtained by adding 0.5 to the upper limit.

❖ **CLASS SIZE OR SIZE OF CLASS-INTERVAL**

The difference between the true upper limit and true lower limit of a class is known as its class size or size of class-interval.

❖ **CLASS MARK OR MID-VALUE OF A CLASS**

The class mark is defined as follows:

$$\begin{aligned} \text{Class Mark} &= \frac{\text{Upper limit} + \text{Lower limit}}{2} \\ &= \frac{\text{True upper limit} + \text{True lower limit}}{2} \end{aligned}$$

❖ **RANGE**

The difference between the minimum and maximum values of the data, is called **range of the data**.

$$\text{Range} = \text{Maximum Value} - \text{Minimum Value}$$

❖ **FORMATION OF CLASSES**

The following points must be noted while formation of classes from a given data in the raw form:

- (i) Classes should be non-overlapping.
- (ii) There should be no gaps between the classes.
- (iii) The classes should be of the same size.
- (iv) Upper and lower limits should be clearly defined.

❖ **GRAPHICAL REPRESENTATION OF DATA**

As we know, picture gives better understanding than the data. The pictorial representations are eye-catching and leave a deeper and more lasting impression on the mind of the observer. Here, we'll study the following graphical representations:

- (A) Bar graphs
- (B) Histograms
- (C) Frequency polygon

**(A) Bar graphs:** It is a graphical representation of data when the frequency distribution is ungrouped or the classes are non-continuous for grouped frequency distribution. In this case, bars are rectangles of uniform width drawn with equal space in between them on X-axis. Along Y-axis, scale of height of the rectangles is shown.

**(B) Histograms:** It is a graphical representation of frequency distribution of a continuous variables. In this case, class-intervals of continuous data is taken on X-axis and

rectangles of appropriate height is equal to the frequency of that class-interval are erected over them.

∴ Height of rectangle = Frequency

**(C) Frequency polygon:** It is obtained by joining the mid-points of the respective top of the rectangles in a histogram. To complete the polygon, the mid-points at each end are joined to the immediately lower or higher mid-points at zero frequency.

❖ **CONSTRUCTION OF A FREQUENCY POLYGON WITHOUT USING A HISTOGRAM**

(i) If only frequency polygon is to be drawn, first represent the class marks on the X-axis and corresponding frequencies on Y-axis. Plot the corresponding points and join them by the line segments.

(ii) While drawing a graph, is to put kink denoted by  $\swarrow \searrow$  on that axis on which markings do not begin with zero and are started from some other desired point.

❖ **CUMULATIVE FREQUENCY CURVE OR OGIVE**

Cumulative frequency curve or an ogive is the graphical representation of a cumulative frequency distribution.

There are two methods of constructing an ogive:

- (i) Less than method
- (ii) More than method

**(i) Less than method:**

**Step 1.** If the frequency is in inclusive form then convert it into exclusive form.

**Step 2.** Construct a cumulative frequency table.

**Step 3.** Mark upper class limits along X-axis.

**Step 4.** Mark the corresponding cumulative frequency along Y-axis.

**Step 5.** Plot the points and join them by a free hand curve.

**Step 6.** The lower limit of the first class-interval becomes the upper limit of the imagined class with '0' frequency.

Join the imagined point (lower limit of first '0') with the first point of the curve and so on.

∴ The required curve is an ogive.

**(ii) More than method:**

**Step 1.** Convert the frequency distribution into more than type cumulative frequency distribution by subtracting the frequency of each class from total frequency.

**Step 2.** Mark the lower class limits on X-axis.

**Step 3.** After this mark, the corresponding cumulative frequency on Y-axis.

**Step 4.** Plot the points and join them by a free hand curve.

❖ **MEASURES OF CENTRAL TENDENCY**

The following are the three measure of central tendencies:

- (i) Mean (ii) Median (iii) Mode

**(i) Mean:** If  $x_1, x_2, \dots, x_n$  are  $n$ -observations, then the arithmetic mean of  $n$ -observations is given by

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

**(ii) Median:** Median is the value of the variable which divides the data into two equal parts.

**If  $n$  is odd:**

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

**If  $n$  is even:** Median = Mean of the values of

$$\left[\left(\frac{n}{2}\right)^{\text{th}} \text{ item}\right] \text{ and } \left[\left(\frac{n}{2} + 1\right)^{\text{th}} \text{ item}\right]$$

**(iii) Mode:** It is observation which occurs most frequently in the data. Mode is the value of that variate for which frequency is the maximum.



**NCERT & BOARD QUESTIONS CORNER**  
 (Remembering & Understanding Based Questions)

**Very Short Answer Type Questions**

1. **The points scored by a basketball team in a series of matches are follows: 17, 7, 10, 25, 5, 10, 18, 10 and 24. Find the range.**

**Sol.** Here, maximum points = 25 and  
 minimum points = 5  
 Range = Maximum value  
 - Minimum value  
 = 25 - 5 = 20

2. **If  $\bar{x}$  is the mean of  $n$  observations  $x_1, x_2, x_3, \dots, x_n$ , then find  $\sum_{i=1}^n (x_i - \bar{x})$ .**

**Sol.**  $\sum_{i=1}^n (x_i - \bar{x}) = (x_1 - \bar{x}) + \dots + (x_n - \bar{x})$   
 $= \frac{x_1 + x_2 + \dots + x_n}{n} \cdot n - \bar{x} \cdot n$   
 $= \bar{x} \cdot n - \bar{x} \cdot n = 0$

3. **Find the mean of first six natural numbers.**

**Sol.** First six natural numbers are 1, 2, 3, 4, 5 and 6  
 Mean =  $\frac{1+2+3+4+5+6}{6} = \frac{21}{6} = 3.5$

4. **The median of the data 26, 56, 32, 33, 60, 17, 34, 29, 45 is 33. If 26 is replaced by 62, then find the new median.**

**Sol.** Here, the given data in ascending order is 17, 29, 32, 33, 34, 45, 56, 60, 62

Now, median is  $\left(\frac{9+1}{2}\right)^{\text{th}}$  term i.e., 5<sup>th</sup> term.

Hence, new median is 34.

5. **The points scored by a basketball team in a series of matches are as follows: 17, 2, 7, 27, 25, 5, 14, 18, 10. Find the median.**

**Sol.** Here, points scored in ascending order are 2, 5, 7, 10, 14, 17, 18, 25, 27, we have  $n = 9$  terms

$$\therefore \text{Median} = \left(\frac{n+1}{2}\right)^{\text{th}} \text{ term} = \left(\frac{9+1}{2}\right)^{\text{th}} \text{ term}$$

$$= 5^{\text{th}} \text{ term} = 14$$

6. **The blood group of 20 students of class 9 of a school are recorded as:**

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

**Find the most common (mode) blood group among these students.**

**Sol.** Here, A occurs 6 times, B occurs 4 times, O occurs 8 times and AB occurs 2 times.

$\therefore$  Most common blood group is O.

7. **The scores of an English test (out of 100) of 20 students are given below:**

**75, 69, 88, 55, 95, 88, 73, 64, 75, 98, 88, 95, 90, 95, 88, 44, 59, 67, 88, 99.**

**Find the median and mode of the data.**

**Sol.** The scores of an english test (out of 100) in ascending order are:

44, 55, 59, 64, 67, 69, 73, 75, 75, 88, 88, 88, 88, 88, 90, 95, 95, 95, 98, 99

Here,  $n = 20$

$$\therefore \text{Median} = \text{Mean of } \left(\frac{n}{2}\right)^{\text{th}} \text{ term and } \left(\frac{n}{2} + 1\right)^{\text{th}} \text{ term}$$

$$= \text{Mean of } 10^{\text{th}} \text{ and } 11^{\text{th}} \text{ term}$$

$$\text{Median} = \text{Mean of } 88 \text{ and } 88 = 88$$

$$\text{Mode} = 88$$

[ $\because$  88 occurred max. no. of times i.e., 5 times]

8. **If the mean of five observations  $x + 2, x + 4, x + 5, x + 6$  and  $x + 8$  is 20, then find the observations.**

**Sol.** Here, mean of given five observations is 20.

$$\therefore \frac{(x+2) + (x+4) + (x+5) + (x+6) + (x+8)}{5} = 20$$

$$\Rightarrow 5x + 25 = 100$$

$$\Rightarrow 5x = 75$$

$$\Rightarrow x = 15$$

Hence, the five observations are 17, 19, 20, 21 and 23.

**Short Answer Type - I Questions**

9. The heights of 50 students, measured to the nearest centimetres have been found to be as follows:

161 150 154 165 168 161 154  
 162 150 151 162 164 171 165  
 158 154 156 172 160 170 153  
 159 161 170 162 165 166 168  
 165 164 154 152 153 156 158  
 162 160 161 173 166 161 159  
 162 167 168 159 158 153 154  
 159

(i) Represent the data given above by a grouped frequency distribution table, taking the class-intervals as 160-165, 165-170 etc.

(ii) What can you conclude about their heights from the table?

Sol. (i) Frequency distribution table: Minimum height = 150 cm, Maximum height = 173 cm

Heights (in cm)	Tally Marks	Number of Students (Frequency)
150 - 155		12
155 - 160		9
160 - 165		14
165 - 170		10
170 - 175		5
Total		50

(ii) Conclusion: More than 50% students are shorter than 165 cm.

10. Three coins were tossed 30 times simultaneously. Each time the number of heads occurring was noted down as follows:

0 1 2 2 1 2 3  
 1 3 0 1 3 1 1  
 2 2 0 1 2 1 3  
 0 0 1 1 2 3 2  
 2 0

Prepare a frequency distribution for the data given above.

Sol. Frequency distribution table:

No. of Heads	Tally Marks	Frequency
0		6
1		10
2		9
3		5
Total		30

11. Thirty children were asked about the number of hours they watched TV programmes 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 frequency distribution table for this data, taking class width 5 and one of the class as 5-10.

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

Sol. (i) Frequency distribution table:

No. of Hours (in a week)	Tally Marks	Frequency
0 - 5		10
5 - 10		13
10 - 15		5
15 - 20		2
Total		30

(ii) From the above frequency distribution table, we observe that number of children in the class-interval 15 - 20 is 2.

So, 2 children view television for 15 hours or more than 15 hours a week.



- 12.** The mean weight per student in a group of 7 students is 55 kg. The individual weights of 6 of them in kg are 52, 54, 55, 53, 56, 54. Find the weight of the seventh student.

**Sol.**

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

$$\Rightarrow 55 = \frac{x_1 + x_2 + \dots + x_7}{7}$$

$$\Rightarrow x_1 + x_2 + \dots + x_7 = 55 \times 7 = 385$$

$$x_1 + x_2 + \dots + x_6 = 52 + 54 + 55 + 53 + 56 + 54 = 324$$

$$\therefore x_7 = 385 - 324 = 61 \text{ kg}$$

- 13.** The mean of the first 8 observations is 18 and last 8 observations is 20. If the mean of all 15 observations is 19, find the 8th observation.

**Sol.** Sum of first 8 observations =  $8 \times 18 = 144$   
 Sum of last 8 observations =  $8 \times 20 = 160$   
 Sum of 15 observations =  $15 \times 19 = 285$   
 $\therefore$  8th observation =  $(144 + 160) - 285$   
 $= 304 - 285 = 19$

- 14.** Find the mode of 14, 25, 14, 28, 18, 17, 18, 14, 23, 22, 14, 18.

**Sol.** First of all arrange the given data in ascending order:  
 14, 14, 14, 14, 17, 18, 18, 18, 22, 23, 25, 28  
 Here, 14 occurs maximum times i.e., 4 times.  
 $\therefore$  Mode = 14

- 15.** Give one example of a situation in which:  
 (i) the mean is an appropriate measure of central tendency.  
 (ii) the mean is not an appropriate measure of central tendency but the median is an appropriate measure of central tendency.

**Sol.** (i) The mean is an appropriate measure of central tendency because of its unique value and can be used to compare different groups of data.  
 (ii) For the measurement of qualitative characteristics.  
 e.g., beauty, honesty, intelligence etc. mean cannot be used.

### Short Answer Type - II Questions

- 16.** The weights (in gms) of 50 mangoes picked at random from a consignment are as follows:

141	123	92	85	214	91	94
128	114	120	90	117	121	151
146	133	100	88	100	125	120
108	116	109	117	94	86	196
92	110	119	138	125	117	125
129	103	197	149	139	140	78
205	133	135	121	102	96	80
136						

Form the grouped frequency table by dividing the variable range into intervals of equal width of 20 gms such that the mid-value of the first interval is 80 gms.

**Sol.** It is given that the 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 = 80

$$\therefore \frac{a + (a + 20)}{2} = 80$$

$$\Rightarrow 2a + 20 = 160$$

$$\Rightarrow 2a = 140$$

$$\Rightarrow a = \frac{140}{2} = 70$$

$\therefore$  The first class-interval is 70 – 90 and the other class-intervals are 90 – 110, 110 – 130, 130 – 150, 150 – 170, 170 – 190, 190 – 210, 210 – 230.



So, the frequency distribution is as under:

Weight (in gms)	Tally Marks	Frequency
70 - 90		5
90 - 110		13
110 - 130		17
130 - 150		10
150 - 170		1
170 - 190	-	0
190 - 210		3
210 - 230		1
Total		50

17. Find the unknown entries (a, b, c, d, e, f, g) in the following frequency (distribution) table of heights of 50 students in a class:

Classes (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
	g	

Sol. Cumulative frequency distribution table:

Classes (Height in cm)	Frequency	Cumulative Frequency
Less than 155	12	12 = a
Less than 160	b	12 + b = 25
Less than 165	10	12 + b + 10 = c
Less than 170	d	12 + b + 10 + d = 43
Less than 175	e	12 + b + 10 + d + e = 48
Less than 180	2	12 + b + 10 + d + e + 2 = f
	g	50

$$\begin{aligned} \Rightarrow a &= 12 \\ 12 + b &= 25 \\ \Rightarrow b &= 25 - 12 = 13 \\ 12 + b + 10 &= c \\ \Rightarrow 12 + 13 + 10 &= c \\ \Rightarrow c &= 35 \\ 12 + b + 10 + d &= 43 \\ \Rightarrow 12 + 13 + 10 + d &= 43 \\ \Rightarrow d &= 8 \\ 12 + b + 10 + d + e &= 48 \\ \Rightarrow 12 + 13 + 10 + 8 + e &= 48 \\ \Rightarrow e &= 5 \\ 12 + b + 10 + d + e + 2 &= f \\ \Rightarrow 12 + 13 + 10 + 8 + 5 + 2 &= f \\ \Rightarrow f &= 50 \\ g &= 50 \\ \therefore a &= 12, b = 13, c = 35, d = 8, \\ e &= 5, f = 50, g = 50 \end{aligned}$$

18. Draw a histogram of the weekly pocket expenses of 125 students of a school given below:

Weekly pocket expenses (in ₹)	Number of Students
0 - 10	10
10 - 20	20
20 - 30	10
30 - 40	15
40 - 70	30
80 - 100	40

Sol. Here, the class sizes are different, so calculate the adjusted frequency for each class by using the formula.

Frequency density or adjusted frequency for a

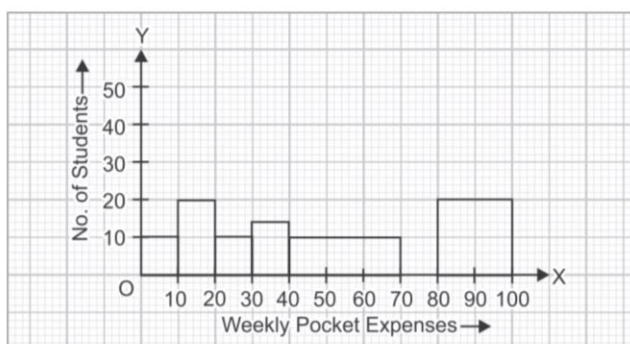
$$\text{class} = \frac{\text{Minimum class size}}{\text{Class size of this class}} \times \text{Frequency}$$

Here, the minimum class size = 10 - 0 = 10

Weekly Pocket Expenses (in ₹)	No. of Students ( $f_i$ )	Adjusted Frequency
0 - 10	10	$\frac{10}{10} \times 10 = 10$
10 - 20	20	$\frac{10}{10} \times 20 = 20$
20 - 30	10	$\frac{10}{10} \times 10 = 10$

30 – 40	15	$\frac{10}{10} \times 15 = 15$
40 – 70	30	$\frac{10}{30} \times 30 = 10$
80 – 100	40	$\frac{10}{20} \times 40 = 20$

Let us represent weekly pocket money along x-axis and corresponding adjusted frequencies along y-axis on a suitable scale, the required histogram is as given below:



19. Draw a histogram for the following data:

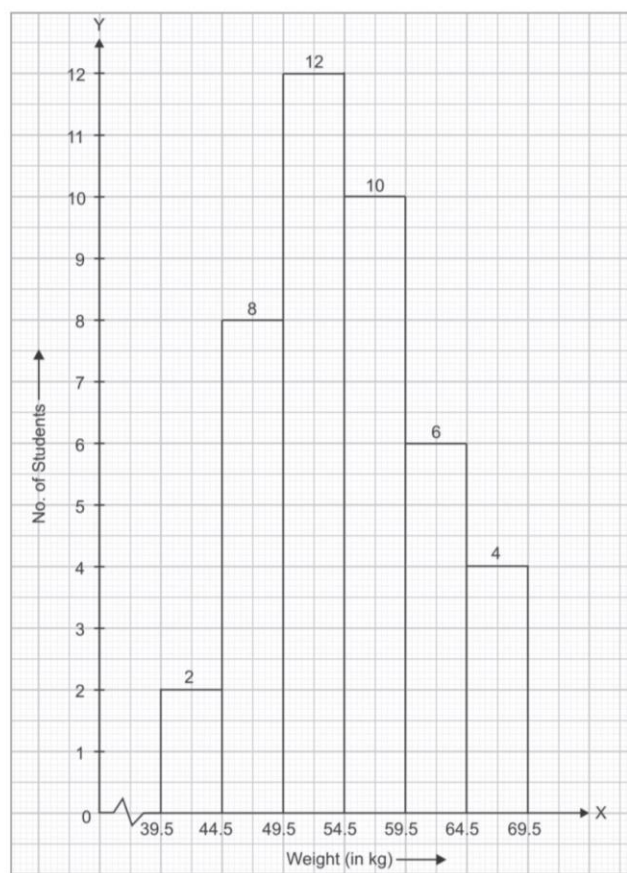
Weight (in kg)	No. of Students
40 – 44	2
45 – 49	8
50 – 54	12
55 – 59	10
60 – 64	6
65 – 69	4

Sol.  $\therefore$  Class-intervals are Exclusive.

Here,  $h = 45 - 44 = 1$

$\therefore$  Subtract 0.5 from each lower limit and add 0.5 to each upper limit to convert it into continuous distribution.

Weight (in kg)	No. of Students
39.5 – 44.5	2
44.5 – 49.5	8
49.5 – 54.5	12
54.5 – 59.5	10
59.5 – 64.5	6
64.5 – 69.5	4



20. The weight in grams of 35 mangoes 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

From the grouped frequency table by dividing the variable range into interval of equal width of 20 grams, such that the mid-value of the first class interval is 70 g. Also, draw histogram.

Sol. It is given that the size of each class interval = 20 and the mid-value of the first class interval is 70. Let the lower limit of the first class interval be  $a$ , then its upper limit =  $a + 20$ .

$$\therefore \frac{a + (a + 20)}{2} = 70$$

$$\Rightarrow a = 70 - 10 = 60$$

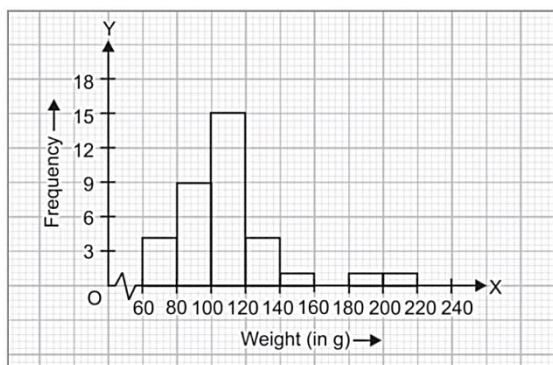


Thus, the first class interval is 60 – 80 and the other class-intervals are 80 – 100, 100 – 120, 120 – 140, 140 – 160, 160 – 180, 180 – 200 and 200 – 220.

So, the grouped frequency table is as under:

Weight (in g)	Tally Marks	Frequency
60 – 80		4
80 – 100	 /	9
100 – 120	 / / / / /	15
120 – 140		4
140 – 160		1
160 – 180	-	0
180 – 200		1
200 – 220		1
Total	35	35

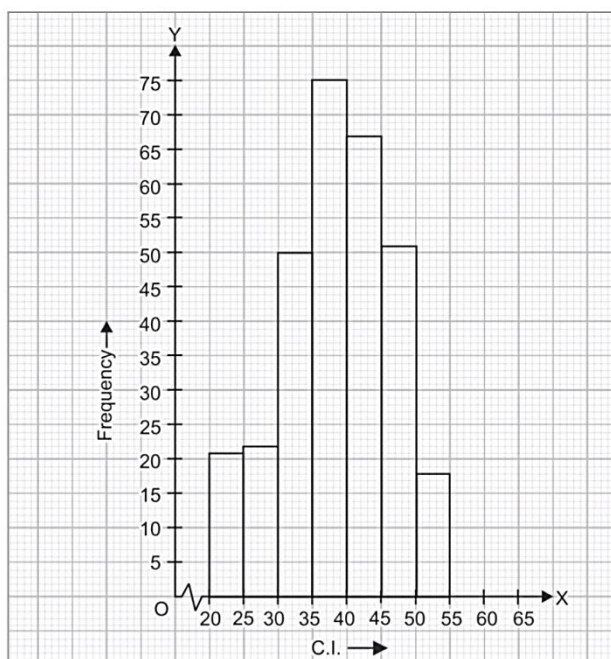
Let us represent weight (in g) along x-axis and corresponding frequencies along y-axis on a suitable scale, the required histogram is as under:



**21. Draw a histogram for the given data:**

Class-Interval	Frequency
20 – 25	21
25 – 30	22
30 – 35	50
35 – 40	75
40 – 45	67
45 – 50	51
50 – 55	18

**Sol.** Let us represent class-intervals along x-axis and corresponding frequencies along y-axis on a suitable scale, the required histogram is as under:



**22. The mean of 5 numbers is 18. If one number is excluded, their mean is 16. Find the excluded number.**

**Sol.** As  $n = 5$ ,  $\bar{X} = 18$

$$\therefore \bar{X} = \frac{\sum x_i}{n}$$

$$\Rightarrow \sum x_i = n\bar{X}$$

$$\Rightarrow \sum x_i = 5 \times 18 = 90$$

So, the total of 5 numbers = 90

Let us assume that 'a' is the excluded number.

$\therefore$  The total of 4 numbers is  $(90 - a)$

$$\therefore \text{Mean of 4 numbers} = \frac{90 - a}{4}$$

$$\Rightarrow 16 = \frac{90 - a}{4}$$

$$\Rightarrow 64 = 90 - a$$

$$\Rightarrow a = 90 - 64$$

$$\Rightarrow a = 26$$

$\therefore$  The excluded number is 26.

**23. Find the median of following data: 17, 23, 57, 46, 33, 29, 28, 30, 34. If observation 23 is removed from data, then find the new median.**

**Sol.** 17, 23, 57, 46, 33, 29, 28, 30, 34

Ascending order: 17, 23, 28, 29, 30, 33, 34, 46, 57

$$n = 9 \text{ (odd)}$$

$$\therefore \text{Median} = \left(\frac{n+1}{2}\right)^{\text{th}} \text{ term} = \left(\frac{9+1}{2}\right) = \left(\frac{10}{2}\right) = 5^{\text{th}} \text{ term} = 30$$

Thus, the required median is 30.

When 23 is removed,  $n = 8$

Median = Average of 4<sup>th</sup> and 5<sup>th</sup> terms

$$= \frac{30+33}{2} = \frac{63}{2} = 31.5$$

Thus, new median is 31.5.

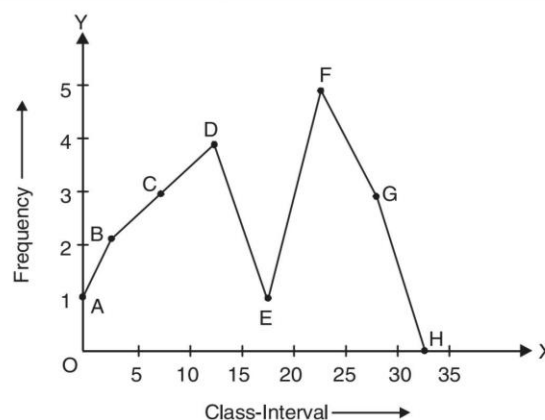
**24.**

Class-Interval	Frequency
0 - 5	2
5 - 10	3
10 - 15	4
15 - 20	1
20 - 25	5
25 - 30	3

Make a frequency polygon for above given frequency table.

**Sol.**

Class-Interval	Class Marks	f
0 - 5	2.5	2
5 - 10	7.5	3
10 - 15	12.5	4
15 - 20	17.5	1
20 - 25	22.5	5
25 - 30	27.5	3



OABCDEFGH is the required polygon.

### Long Answer Type Questions

- 25.** The length of 40 leaves of a plant are measured correct to one millimetre, and the obtained data is represented in the following table:

Length (in mm)	Number of Leaves
118 - 126	3
127 - 135	5
136 - 144	9
145 - 153	12
154 - 162	5
163 - 171	4
172 - 180	2

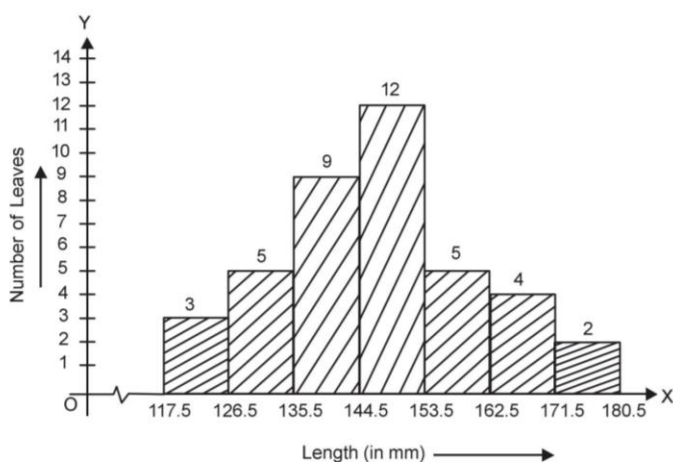
- Draw a histogram to represent the given data.
- Is there any other suitable graphical representation for the same data?
- Is it correct to conclude that the maximum number of leaves are 153 mm long? Why?

- Sol.** (i) Here, the frequency distribution is not continuous. So, convert it into continuous frequency distribution. The difference between the lower limit of a class and the upper limit of the preceding class is 1, i.e.,  $h = 1$ . Subtract  $\frac{h}{2} = \frac{1}{2} = 0.5$  from each lower limit and add 0.5 to each upper limit to convert it into continuous distribution.

Length (in mm)	Number of Leaves
117.5 - 126.5	3
126.5 - 135.5	5
135.5 - 144.5	9
144.5 - 153.5	12
153.5 - 162.5	5
162.5 - 171.5	4
171.5 - 180.5	2



The histogram of the frequency distribution is as follows:



(ii) Yes, we can make frequency polygon to represent given data.

(iii) No, the number of leaves naming 153 mm or less than 153 mm are 29 (3 + 5 + 9 + 12) and the number of leaves having the length more than 153 mm are 11 (5 + 4 + 2).

We do not know about the number of leaves having length 153 mm.

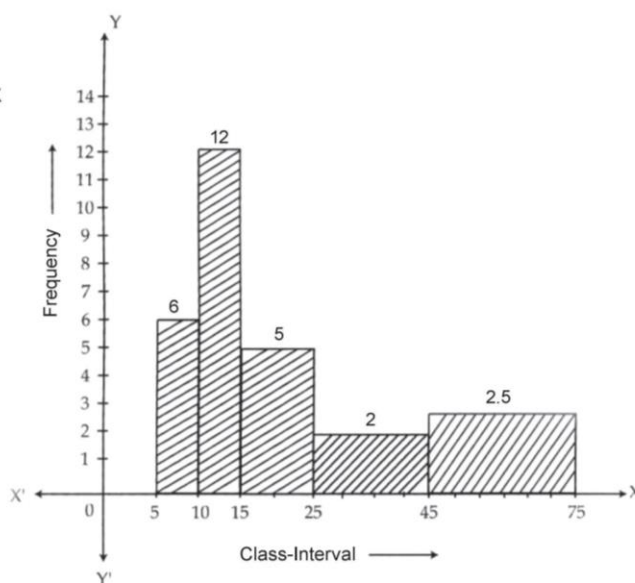
**26. Draw histogram to represent the following distribution:**

Class-Interval	Frequency
5 - 10	6
10 - 15	12
15 - 25	10
25 - 45	8
45 - 75	15

**Sol.**

C.I.	f	Width of the class	Adjusted frequency
5 - 10	6	5	$\frac{6}{5} \times 5 = 6$
10 - 15	12	5	$\frac{12}{5} \times 5 = 12$

C.I.	f	Width of the class	Adjusted frequency
15 - 25	10	10	$\frac{10}{10} \times 5 = 5$
25 - 45	8	20	$\frac{8}{20} \times 5 = 2$
45 - 75	15	30	$\frac{15}{30} \times 5 = 2.5$

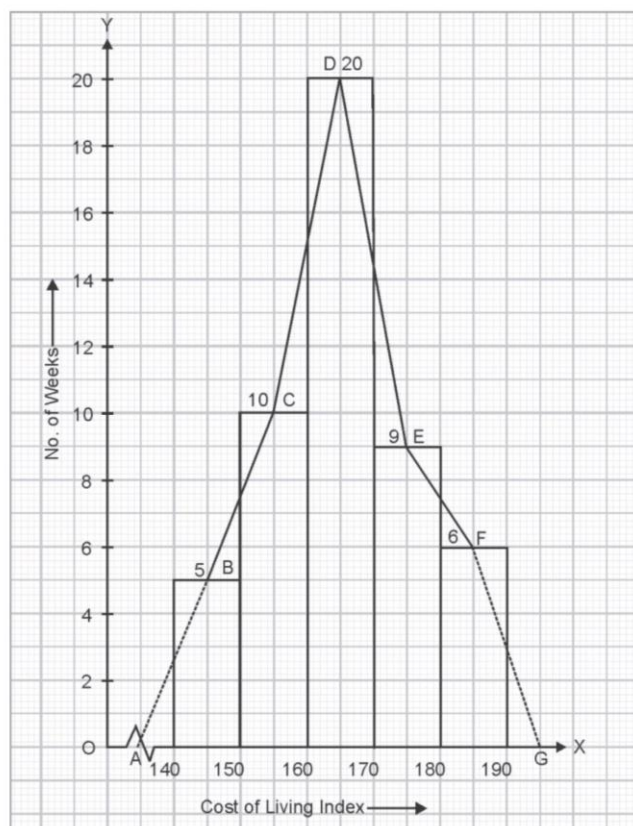


**27.**

Cost of Living Index	Number of Weeks
140 - 150	5
150 - 160	10
160 - 170	20
170 - 180	9
180 - 190	6
<b>Total</b>	<b>50</b>

**Draw histogram and frequency polygon for the above data.**

**Sol.**



ABCDEFGH is the required frequency polygon.

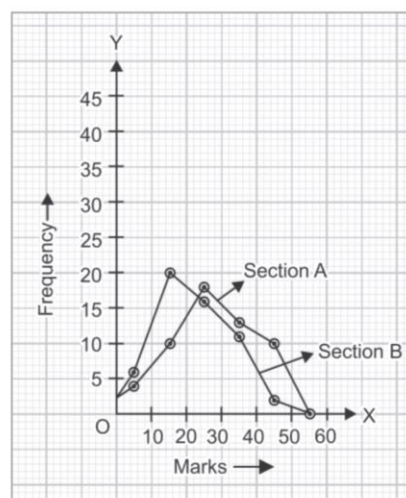
- 28.** The following two tables give the distribution of students of two sections according to the marks obtained by them:

Section A		Section B	
Marks	Frequency	Marks	Frequency
0 - 10	4	0 - 10	6
10 - 20	10	10 - 20	20
20 - 30	18	20 - 30	16
30 - 40	13	30 - 40	11
40 - 50	10	40 - 50	2

Represent the marks of the students of both the sections on the same graph by two frequency polygons.

**Sol.** For the class marks, we have

Marks	Class Marks	Section A	Section B
0 - 10	5	4	6
10 - 20	15	10	20
20 - 30	25	18	16
30 - 40	35	13	11
40 - 50	45	10	2



- 29.** Find mean, mode and median for the following data:

41, 39, 48, 52, 46, 62, 54, 40, 96, 52, 98, 40, 42, 52, 60

**Sol.** Mean

$$\bar{x} = \frac{41 + 39 + 48 + 52 + 46 + 62 + 54 + 40 + 96 + 52 + 98 + 40 + 42 + 52 + 60}{15} = \frac{822}{15}$$

$$\bar{x} = 54.8$$

Frequency of 52 is 3 which is maximum

$$\therefore \text{Mode} = 52$$

Arrange the data in ascending order: 39, 40, 40, 41, 42, 46, 48, 52, 52, 52, 54, 60, 62, 96, 98

Here,  $n = 15$  (an odd number)



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

$$= \left(\frac{15+1}{2}\right)^{\text{th}} \text{ value}$$

$$= 8^{\text{th}} \text{ value}$$

$$= 52$$

30. Find the mean salary of 60 workers of a factory from the following table:

Salary (in ₹)	Number of Workers
3000	16
4000	12
5000	10
6000	8
7000	6
8000	4
9000	3
10000	1
<b>Total</b>	<b>60</b>

Sol.

Salary (in ₹) ( $x_i$ )	Number of Workers ( $f_i$ )	$f_i x_i$
3000	16	48000
4000	12	48000
5000	10	50000
6000	8	48000
7000	6	42000
8000	4	32000
9000	3	27000
10000	1	10000
Total	$\Sigma f_i = N = 60$	$\Sigma f_i x_i = 305000$

$$\therefore \text{Mean} = \bar{x} = \frac{\sum_{i=1}^n f_i x_i}{\sum_{i=1}^n f_i}$$

$$\Rightarrow \bar{x} = \frac{305000}{60} \Rightarrow \bar{x} = 5083.33$$

Hence, mean salary of 60 workers is ₹ 5083.33.

31. The runs scored by two teams A and B on the first 60 balls in a cricket match are given below:

Number of Balls	Team A	Team B
1 - 6	2	5
7 - 12	1	6
13 - 18	8	2
19 - 24	9	10
25 - 30	4	5
31 - 36	5	6
37 - 42	6	3
43 - 48	10	4
49 - 54	6	8
55 - 60	2	10

Represent the data of both the teams on the same graph by frequency polygons.

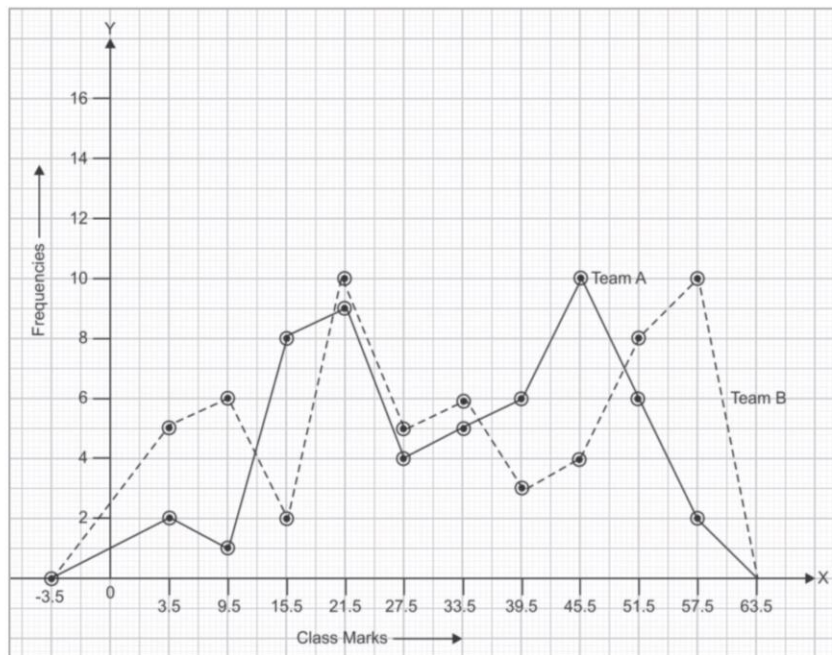
Sol. For the class marks, we have

Number of Balls	Class Marks	Team A	Team B
1 - 6	3.5	2	5
7 - 12	9.5	1	6
13 - 18	15.5	8	2
19 - 24	21.5	9	10
25 - 30	27.5	4	5
31 - 36	33.5	5	6
37 - 42	39.5	6	3
43 - 48	45.5	10	4
49 - 54	51.5	6	8
55 - 60	57.5	2	10

Let us represent class marks on X-axis and frequencies on Y-axis on a suitable scale.

To get the frequency polygon of team A, plot the points (3.5,2), (9.5,1), (15.5,8), (21.5,9), (27.5,4), (33.5,5), (39.5,6), (45.5,10), (51.5,6) and (57.5,2) and join the points by the line segments.

To get the frequency polygon of team B, plot the points (3.5,5), (9.5,6), (15.5,2), (21.5,10), (27.5,5), (33.5,6), (39.5,3), (45.5,4), (51.5,8) and (57.5,10) and join the points by dotted line segments.



**APPLICATION BASED QUESTIONS (Solved)**

1. The class-marks of a distribution are: 11, 15, 19, 23, 27, 31 and 35. Find the class size and the class boundaries.

**Sol.** Here, the class marks are uniformly spaced. So, the class size is the difference between any two consecutive class marks.

$$\therefore \text{Class size} = 15 - 11 = 4$$

We know that, if  $a$  is the class mark of a class and  $h$  is its class size, then the lower and upper limits of the class interval are  $a - \frac{h}{2}$  and  $a + \frac{h}{2}$  respectively.

$$\text{Thus, lower limit of first class} = 11 - \frac{4}{2} = 9$$

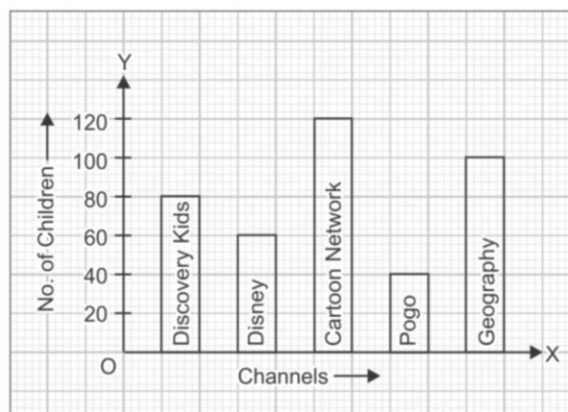
$$\text{And, upper limit of first class} = 11 + \frac{4}{2} = 13$$

So, first class interval is 9 – 13

Hence, the class boundaries are:

9 – 13, 13 – 17, 17 – 21, 21 – 25, 25 – 29, 29 – 33 and 33 – 37.

2. Different types of cartoon channels preferred by children among the age group 6 – 10 years are depicted in the following bar graph:



**Find the ratio of the least watched channel to the highest watched channel.**

**Sol.** As per given bar graph, the highest bar is of cartoon network while lowest bar is of Pogo channel.

Hence, the required ratio = 40 : 120 = 1 : 3



3. The mean of seven numbers is 35. If out of these seven numbers, the mean of first four numbers is 33 and the mean of last four numbers is 36, then find the fourth number.

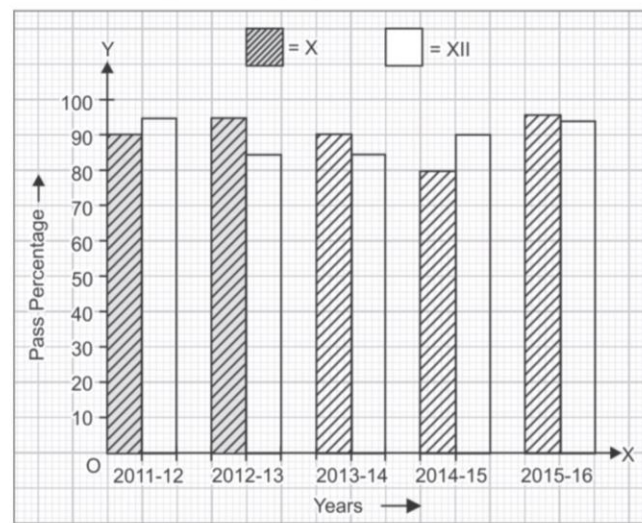
**Sol.** Here, Mean of 7 numbers = 35  
 $\therefore$  Sum total of 7 numbers =  $35 \times 7 = 245$   
 Mean of first four numbers = 33  
 $\therefore$  Sum total of first four numbers =  $33 \times 4 = 132$   
 Mean of last four numbers = 36  
 $\therefore$  Sum total of last four numbers =  $36 \times 4 = 144$   
 Thus, sum total of eight numbers =  $132 + 144 = 276$   
 Since fourth number has been included in both the sums.  
 Hence, the fourth number =  $276 - 245 = 31$

4. The results of pass percentage of classes X and XII in CBSE Examinations for 5 years are given in the following table:

Year	X	XII
2011 - 12	90	95
2012 - 13	95	85
2013 - 14	90	85
2014 - 15	80	90
2015 - 16	98	97

Draw bar graph to represent the data.

**Sol.** The required bar graphs is drawn as shown below:



**ANALYZING, EVALUATING & CREATING TYPE QUESTIONS (Solved)**

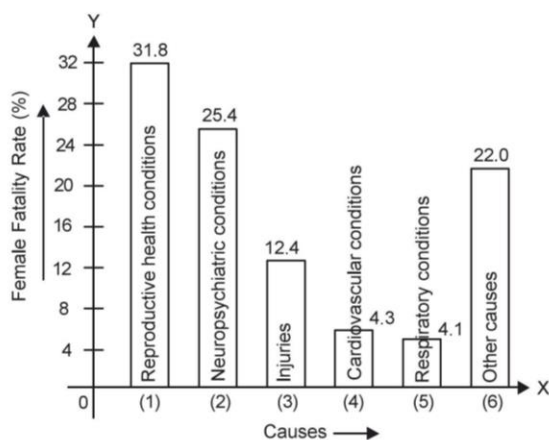
1. Highlighting the need for having better health facility specially for women health care awareness among senior citizens of the country, regarding the welfare of the women. A survey was conducted by a NGO for the cause of illness and death among the women between the age group 15 to 44 (in years). The data obtained and presented as:

S.No.	Causes	Female Fatality Rate (%)
1.	Reproductive health conditions	31.8
2.	Neuropsychiatric conditions	25.4

3.	Injuries	12.4
4.	Cardiovascular conditions	4.3
5.	Respiratory conditions	4.1
6.	Other causes	22.0

- (i) Represent the information given above graphically.  
 (ii) Which condition is the major cause of women's ill health and death worldwide?  
 (iii) Try to find out, with the help of your teacher, any two factors which play a major role in the cause in (ii) above being the major cause.

**Sol.** (i) The bar graph of the data is as given below:



In the graph, drawn causes of illness and death among women between the ages 15-44 (in years) worldwide is denoted on X-axis and female fatality rate (%) is denoted on the Y-axis.

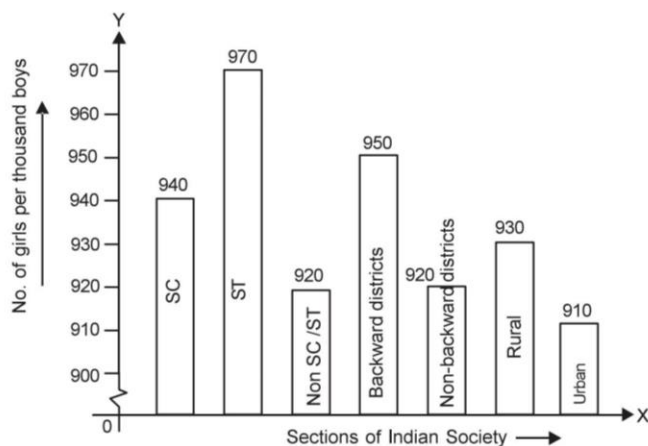
- (ii) The major cause of women's ill health and death worldwide is reproductive health condition.
- (iii) Two other factors which play a major role in the cause in (ii) above are neuropsychiatric conditions and other causes.

**2. The following data on the number of girls (to the nearest ten) per thousand boys in different sections of the Indian society is given below:**

Sections of Indian Society	No. of Girls per thousand Boys
Scheduled Caste (SC)	940
Scheduled Tribe (ST)	970
Non-SC/ST	920
Backward districts	950
Non-backward districts	920
Rural	930
Urban	910

- (i) Represent the information above by a bar graph.
- (ii) In the classroom, discuss what conclusions can be arrived at from the graph.

**Sol.** (i) The required graph is given below:



In the graph, different sections of the society is taken on X-axis and number of girls per thousand boys is taken on the Y-axis.

[Scale: 1 cm = 10 girls.]

- (ii) From the graph, the number of girls to the nearest ten per thousand boys are maximum in scheduled tribes whereas they are minimum in urban.

**3. Shimpi, a class IX student received cash award of ₹ 10000 (Ten thousand) in the singing competition. Her father advised her to make a budget plan for spending this amount. She made the following plan:**

S. No.	Head	Amount
1.	Donation in temple	200
2.	Tuition fee to needy child	100
3.	Welfare of senior citizens	500
4.	Welfare of street children	800
5.	Saving in bank	4000
6.	Books for family library	2000
7.	Picnic for family	1000
8.	Gift to grand parents	1100
9.	Tea party to friends	300
	<b>Total</b>	<b>10000</b>

Make a bar graph for the above data.

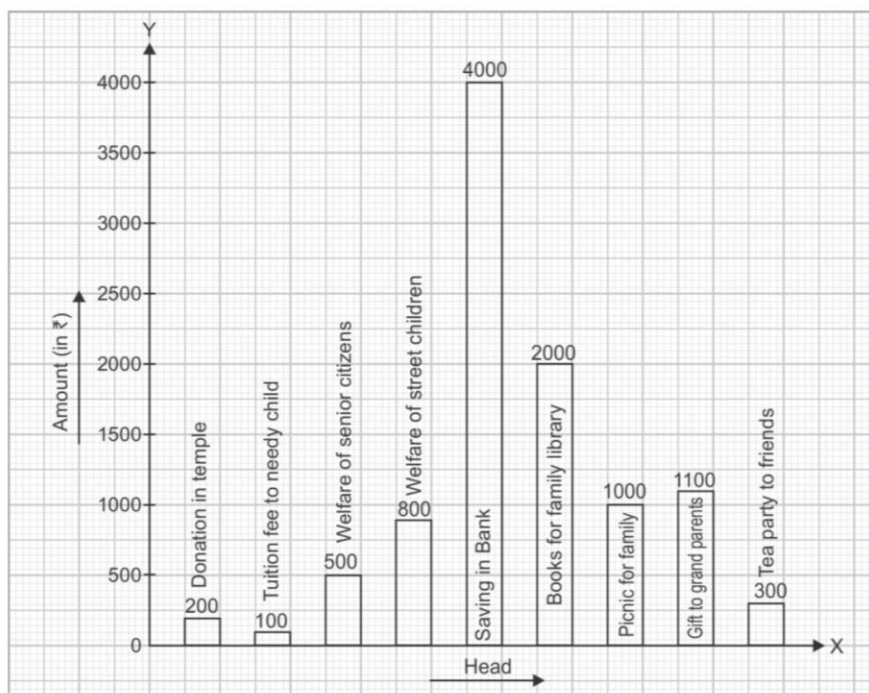
From above answer the following question:  
 Which mathematical concepts have been covered in this?



**Sol.** The bar graph of given data is given alongside:

In the graph, head is taken on X-axis and amount is taken on Y-axis.

Representation of data using bar graph.



4. In a class average score of girls in an examination is 80 and that of boys is 70. The average score of the whole class is 74. Find the percentage of girls and boys in the class.

**Sol.** Let the number of girls be  $x$  and number of boys be  $y$ .

Average score of the whole class = 74

$$\therefore \frac{80x + 70y}{x + y} = 74$$

$$\Rightarrow 80x + 70y = 74x + 74y$$

$$\Rightarrow 6x = 4y$$

$$\Rightarrow 3x = 2y$$

$$\Rightarrow y = \frac{3}{2}x$$

Thus, percentage of girls in the class =  $\frac{x}{x+y} \times 100$

$$= \frac{x}{x + \frac{3}{2}x} \times 100$$

$$= \frac{2}{5} \times 100 = 40\%$$

And, percentage of boys in the class =  $(100 - 40)$

$$= 60\%$$

5. If the mean of 7 observations 28,  $x$ , 32, 43,  $x + 2$ ,  $x + 5$  and 45 is 38, find  $x$ . Hence, find the median.

**Sol.** Here, mean of given 7 observations is 38

$$\therefore \frac{28 + x + 32 + 43 + x + 2 + x + 5 + 45}{7} = 38$$

$$\Rightarrow 155 + 3x = 266$$

$$\Rightarrow 3x = 111$$

$$\Rightarrow x = \frac{111}{3}$$

$$\Rightarrow x = 37$$

Thus, the seven observations are: 28, 37, 32, 43, 39, 42 and 45

Writing in ascending order, the observations are:

28, 32, 37, 39, 42, 43, 45

Number of observations ( $n$ ) = 7, which is odd

$$\therefore \text{Median} = \left(\frac{7+1}{2}\right)^{\text{th}} \text{ term}$$

$$= 4^{\text{th}} \text{ term}$$

$$= 39$$

6. The monthly income of a family is ₹13000. Proportionate expenditures on different items are given below:

Item	Food	Rent	Clothing	Education	Miscellaneous
Ratio	9	6	4	3	4

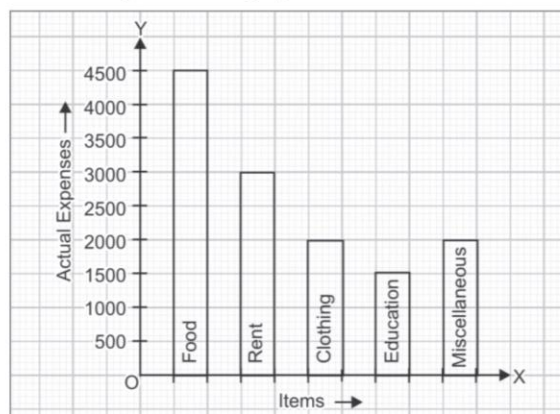
Prepare a table to show the actual expenses in each item and hence draw a bar graph.

**Sol.** Table of the actual expenses on each item is shown below as sum of the ratios is 26 and total income is ₹ 13000.

Item	Ratio	Actual Expenses (in ₹)
Food	9	$\frac{9}{26} \times 13000 = 4500$
Rent	6	$\frac{6}{26} \times 13000 = 3000$

Clothing	4	$\frac{4}{26} \times 13000 = 2000$
Education	3	$\frac{3}{26} \times 13000 = 1500$
Miscellaneous	4	$\frac{4}{26} \times 13000 = 2000$

The required bar graph is drawn as:





**ASSIGNMENT**

- Q.1.** The marks obtained by 11 students in a class in a Mathematics exam are: 20, 8, 13, 32, 28, 18, 17, 8, 20, 31, 30. The given data is:  
 (a) Grouped data (b) Ungrouped data  
 (c) Arrayed data (d) None of these
- Q.2.** Find the range of the data 12, 25, 15, 18, 17, 20, 22, 6, 16, 11, 8, 19, 10, 30, 20, 32.  
 (a) 26 (b) 32  
 (c) 18 (d) 20
- Q.3.** In a given data, some variables are given with particular values. We want to represent these graphically, then we can represent these using:  
 (a) Frequency polygon (b) Histogram  
 (c) Bar graph (d) None of these
- Q.4.** Find the class mark of the class 130 – 150.  
 (a) 120 (b) 70  
 (c) 150 (d) 140
- Q.5.** Find the median of the numbers 84, 78, 54, 56, 68, 22, 34, 45, 39, 54.  
 (a) 38 (b) 54  
 (c) 42 (d) 24
- Q.6.** Find the mean of the first six prime numbers.  
 (a) 6.83 (b) 5.40  
 (c) 4.42 (d) 7.22
- Q.7.** The mean of the following data is 8.

$x$	3	5	7	9	11	13
$f$	6	8	15	$p$	8	4

Find the value of  $p$ .

- (a) 23 (b) 24  
 (c) 25 (d) 21
- Q.8.** Find mode of the data 15, 17, 15, 19, 14, 18, 15, 14, 16, 15, 14, 20, 19, 14, 15.  
 (a) 14 (b) 15  
 (c) 16 (d) 17
- Q.9.** The mean of five numbers is 30. If one number is excluded, their mean becomes 28. The excluded number is:  
 (a) 42 (b) 38  
 (c) 24 (d) 76
- Q.10.** The class marks of a frequency distribution are: 47, 52, 57, 62, 67, 72, 77, 82, 87, 92, 97, 102. Find the class size, class limits and true class limits.
- Q.11.** A cricketer has a mean score of 58 runs in nine innings. Find out how many runs are to be scored by him in the tenth innings to raise the mean score to 61.
- Q.12.** If the mean of the following data is 18.75, find the value of  $p$ .

$x_i$	10	15	$p$	25	30
$f_i$	5	10	7	8	2

**Q.13.** There are 840 creatures in a zoo as per list given below:

Beast animals	Other land animals	Birds	Water animals	Reptiles
120	345	165	135	75

Represent the above data by a bar chart.

**Q.14.** Draw the frequency polygon representing the following frequency distribution.

Class-interval	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59
Frequency	12	16	20	8	10	4

**Q.15.** Draw a histogram to represent the following frequency distribution.

Class-interval	10 - 15	15 - 20	20 - 30	30 - 50	50 - 80
Frequency	6	10	10	8	18