12 Statistics

▶ **Statistics:** Science of collection, organisation, presentation, analysis and interpretation of numerical data.

▶ **Data:** Facts or figures that are numeral or otherwise collected with a definite purpose.

▶ **Range of Data:** The difference of the highest and lowest observation in the given data.

▶ **Frequency:** The number of occurrence (or repeated) of an observation.

▶ **Class-size or Class-width:** The difference between the upper and lower class limits.

▶ **Class Mark:** The mid value of class-interval.

▶ **Frequency Distribution:** The table in which the corresponding frequencies are written against each class.

▶ **Inclusive or Discontinuous Frequency Distribution:** A frequency distribution in which the upper limit of one class differs from the lower limit of the succeeding class e.g., in class-interval 0-10, we include both 0 and 10.

▶ **Exclusive or Continuous Frequency Distribution:** A frequency distribution in which the upper limit of one class coincides with the lower limit of the succeeding class e.g., in class-interval 0-10, we include 0 and exclude 10.

▶ **Graphical Representation of Data:** Representing the data through graphs:

  ➤ **Bar Graph:** Pictorial representation of data in which rectangular bars of uniform width are drawn with equal spacing between them on one axis usually the X-axis. The value of the variable is shown on other axis i.e., Y-axis.

The bar graph of the population of following four major cities in India in a particular year is given below:

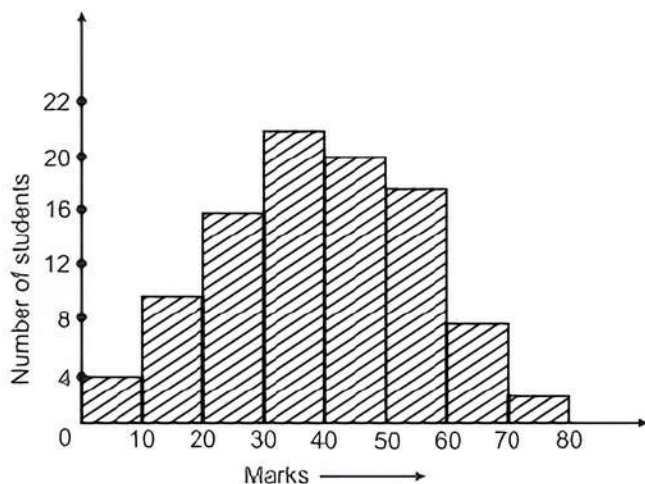| City:	Mumbai	Kolkata	Delhi	Chennai
Population (in Lakh):	120	130	150	80
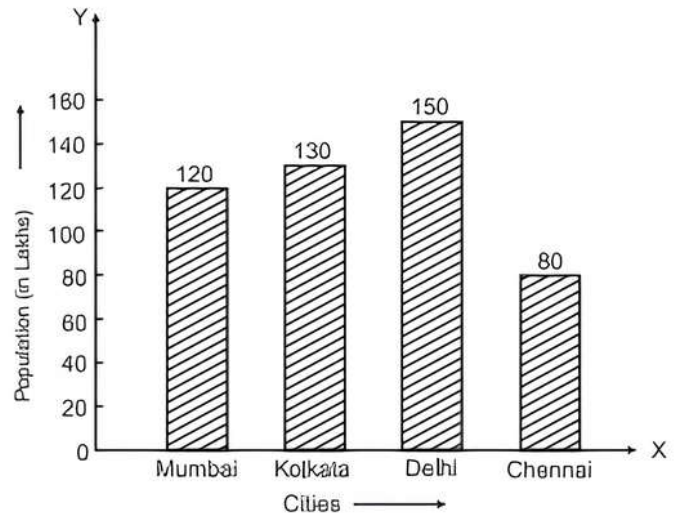
➤ **Histogram:** Graphical representation of frequency distribution of continuous variables in the form of vertical rectangles, where class intervals as bases and frequencies as heights.

In a histogram, when the areas of rectangles are not proportional to frequencies, the adjusted frequency is calculated as,

Adjusted frequency

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

e.g. The histogram of the marks scored by 100 students of the following data is given below:

Marks	Number of Students (Frequency)
0-10	4
10-20	10
20-30	16
30-40	22
40-50	20
50-60	18
60-70	8
70-80	2

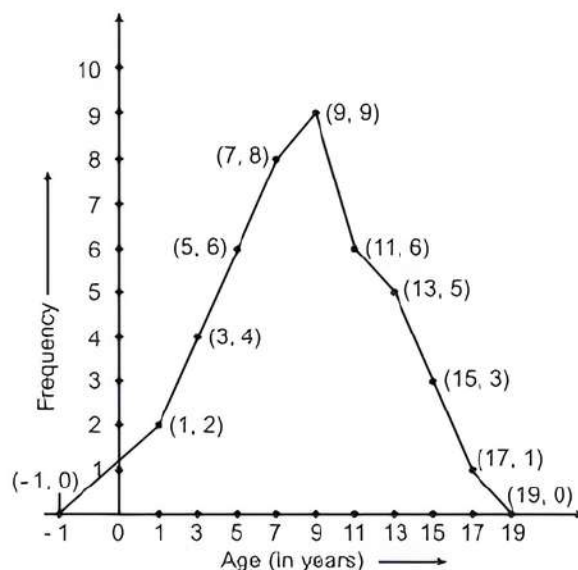| Age (in Years)	Class Mark	Frequency	Points
0-2	1	2	(1, 2)
2-4	3	4	(3, 4)
4-6	5	6	(5, 6)
6-8	7	8	(7, 8)
8-10	9	9	(9, 9)
10-12	11	6	(11, 6)
12-14	13	5	(13, 5)
14-16	15	3	(15, 3)
16-18	17	1	(17, 1)

> **Frequency Polygon**

Method I: Frequency polygon is obtained by joining the mid-points of upper horizontal sides of all the rectangles in the histogram. They can be drawn using class mark of class-intervals.

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

Method II: Frequency polygon is obtained by plotting each class mark with corresponding frequencies and joining these points by the line segment.

e.g. Frequency polygon of different age group of the following data is shown below:

Practice Exercise

Multiple Choice Questions

Q 1. If x be the mid-point and 1 be the upper class limit of a class in a continuous frequency distribution, what is the lower limit of the class?
a. $x - 1$ b. $3x + 8$
c. $2x + 2$ d. $2x - 1$

Q 2. The class marks for a frequency distribution are 15, 20, 25, … . The class corresponding to class mark 20 is :
a. 12.5 - 17.5 b. 17.5 - 22.5
c. 18.5 - 21.5 d. 19.5 - 20.5

Q 3. In a frequency distribution, the mid-value of a class is 12 and the width of the class is 8. The upper limit of the class is:
a. 14 b. 15
c. 16 d. 17

Q 4. The width of each of the four continuous classes in a frequency distribution is 5 and the upper class limit of the upper class is 60. The lower class limit of the lowest class is:
a. 35 b. 40
c. 45 d. 50

Q 5. In a morning walk, I took 30 rounds of a park. During this period I came across person A, person B, person C and person D; 10 times, 8 times, 7 times and 4 times respectively. I want to represent this data graphically. Which of the following is the best representation?
a. Frequency polygon
b. Bar graph
c. Histogram with unequal widths
d. Histogram with equal widths

Q 6. Which one of the following is not the graphical representation of statistical data?
a. Frequency
b. Bar graph
c. Histogram
d. Cumulative Frequency distribution

Q 7. A frequency polygon is constructed by plotting frequency of the class interval and the:
a. upper limit of the class
b. lower limit of the class
c. mid-value of the class
d. any values of the class

Q 8. In a histogram the area of each rectangle is proportional to:

a. the class mark of the corresponding class interval

b. the class size of the corresponding class interval

c. frequency of the corresponding class interval

d. cumulative frequency of the corresponding class interval

Q 9. For drawing a frequency polygon of a continuous frequency distribution, we plot the points whose ordinates are the frequencies of the respective classes and abscissa are respectively, the:

a. class marks of the classes

b. upper limits of the classes

c. lower limits of the classes

d. upper limits of preceding classes

Q 10. In a histogram, each class rectangle is constructed with base as:

a. frequency

b. class-intervals

c. range

d. size of the class

Q 11. In a histogram, the class intervals or the groups are taken along:

a. Y-axis

b. X-axis

c. both X-axis and Y-axis

d. in between X and Y-axes

Q 12. A histogram is a pictorial representation of the grouped data in which class intervals and frequency are respectively taken along:

a. vertical axis and horizontal axis

b. vertical axis only

c. horizontal axis only

d. horizontal axis and vertical axis

Q 13. Consider the following frequency distribution:

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

To draw a histogram to represent the above frequency distribution the adjusted frequency for the class 25-45 is:

a. 6

b. 5

c. 3

d. 2

Assertion & Reason Type Questions ↘

Directions (Q. Nos 14-17): *In the following questions, a statement of Assertion (A) is followed by a statement of a Reason (R). Choose the correct option:*

a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

b. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

c. Assertion (A) is true but Reason (R) is false.

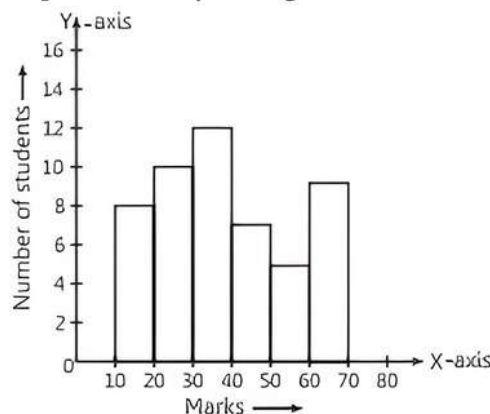d. Assertion (A) is false but Reason (R) is true.

Q 14. Assertion (A): The range of the first 5 multiples of 5 is 10.

Reason (R): Range is equal to the difference of maximum and minimum value.

Q 15. Assertion (A): The following frequency distribution:

Marks	10-20	20-30	30-40	40-50	50-60	60-70
Number of students	8	10	12	7	5	9

is represented by histogram as shown below.

Reason (R): In a histogram there is no gap between any two consecutive rectangles.

Q 16. The marks of different students are given below:

Marks	Number of Students
0-10	8
10-30	12
30-45	15
45-50	10
50-60	5

Assertion (A): The adjusted frequency of class interval 45-50 is 10.

Reason (R): The adjusted frequency of any class can be determined by the formula

Adjusted frequency of a class

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

Q 17. The daily earning of 40 drug stores in the following table:

Daily earning (in ₹)	Number of Stores
200-300	12
300-400	14
400-500	8
500-600	6

Assertion (A): To draw the frequency polygon of the given data, firstly we plot the points (250, 12), (350, 14), (450, 8) and (550, 6) on a graph paper and join these points through a line segment.

Reason (R): Frequency Polygon curve can be constructed only when given data is continuous.

🔋 Fill in the Blanks Type Questions ↘

Q 18. Adjusted frequency of a class
$$= \frac{\text{Minimum class - size}}{\text{Class - size}} \times \text{....................}$$

Q 19. Frequency polygon is obtained by joining .... point of the upper horizontal side of each rectangle.

Q 20. In bar graph/histogram/frequency-polygon, the vertical line of graph always represents .... (frequency/class-interval)

Q 21. In histogram to represents class intervals on the X-axis, it should be .... (continuous/discontinuous)

Q 22. The .... of all bars in histogram should be uniform.

🔋 True/False Type Questions ↘

Q 23. The class marks of a continuous distribution are:
1.04, 1.14, 1.24, 1.34, 1.44, 1.54 and 1.64. The last interval will be 1.55-1.73.

Q 24. In a histogram, the area of each rectangle is proportional to the class size of the corresponding class interval.

Q 25. The space between consecutive bars in bar graph should also be same.

Q 26. A frequency polygon of a given frequency distribution is another method of representing frequency distribution graphically.

Solutions

1. (d) Let l be the lower limit of a class interval.
Then, $\frac{l+1}{2} = x \implies l = 2x - 1$

2. (b) a. $\frac{12.5 + 17.5}{2} = 15 \neq 20$

   b. $\frac{17.5 + 22.5}{2} = \frac{40}{2} = 20$, which is correct.

3. (c) Let x and y be lower and upper limits of the class. Then,
$$\frac{x+y}{2} = 12$$
$\implies \quad x + y = 24$ ...(1)
and $\quad y - x = 8$ ...(2)
Adding eqs. (1) and (2), we get
$\quad 2y = 32 \implies y = 16$
Hence, upper limit of a class is 16.

4. (b) ∵ Width of each class = Upper class limit − Lower class limit
∴ $\quad 5 = 60 -$ Lower class limit
$\implies$ Lower class limit $= 60 - 5 = 55$
∴ The last four continuous classes are 40-45, 45-50, 50-55, 55-60.
Hence, lower class limit of the lowest class is 40.

5. (b) Bar graph is the best representation to show ungrouped frequency distribution graphically.

6. (d) Cumulative frequency distribution is not the graphical representation of statistical data.

7. (c) A frequency polygon is constructed by plotting frequency of the class-interval and the mid-value of the class.

8. (c) In a histogram the area of each rectangle is proportional to frequency of the corresponding class interval.

9. (a) Class marks of the classes.

10. (b) In a histogram, each class rectangle is constructed with base as class-intervals.

11. (b) In a histogram the class-intervals or the groups are taken along X-axis.

12. (d) A histogram is a pictorial representation of the grouped data in which class intervals and frequency are respectively taken along horizontal axis and vertical axis.

13. (d) The minimum width of the given class interval is 5.
Here, width of class interval 25-45 is 20.

∴ Adjusted frequency

$= \dfrac{\text{Minimum class size}}{\text{Class size}} \times \text{Frequency of the class}$

$= \dfrac{5}{20} \times 8 = \dfrac{40}{20} = 2$

14. (d) **Assertion (A):** The first five multiples of 5 are 5, 10, 15, 20, 25

Here minimum value = 5

and maximum value = 25

∴ Range = Maximum value – Minimum value

= 25 – 5 = 20

So, Assertion (A) is false.

Reason (R): It is true to say that range is equal to the difference of maximum and minimum value.

Hence, Assertion (A) is false but Reason (R) is true.

15. (a) Here both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

16. (a) **Assertion (A):** The minimum class size of given class-interval is 5.

Here class size of 45-50 is 5.

∴ Adjusted frequency of a class 45-50 is

$$\dfrac{5}{5} \times 10 = 10$$

So, Assertion (A) is true.

Reason (R): It is also true.

Hence, both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

17. (a) Here both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

18. Frequency of the class

19. mid

20. frequency

21. continuous

22. width

23. Here, 1.64 – 1.54 = 0.1

Now $\dfrac{0.1}{2} = 0.05$

Therefore the last class-interval will be

(1.64 – 0.05)-(1.64 + 0.05)

i.e.,   1.59-1.69

Hence, given statement is false.

24. False,

In a histogram, the area of each rectangle is proportional to its frequency.

25. True

26. True

Case Study Based Questions

Case Study 1

A teacher is a mentor of students who helps in development of skills, knowledge, temperament and attitude. For that, teacher may work with students as a small groups or one to one in a regular intervals. The data collected by the teacher of different age groups are shown below:

On the basis of the above information, solve the following questions:

Q 1. The data collected by the teacher of different age group is:

a. 30   b. 50

c. 55   d. 40

Q 2. The number of students whose age is less than 21 yr is:

a. 18   b. 20

c. 22   d. 24

Q 3. The class mark of the interval in which most of students lie in that interval is:

a. 18   b. 22

c. 23   d. 25

Q 4. The width of the third class interval is:

a. 5   b. 4

c. 4.5   d. 5.5

Q 5. The range of the given data is:

a. 10   b. 14

c. 25   d. 15

1. (c) The data collected by the teacher of different age group is $5 + 15 + 20 + 15$, i.e., 55

   So, option (c) is correct.

2. (b) The number of students whose age is less than 21 yr is $5 + 15$ i.e., 20 students.

   So, option (b) is correct.

3. (c) From the given bar graph, it is clear that most of the students lie in the age group 21-25.

   ∴ The class mark of 21-25 is $\dfrac{21 + 25}{2}$ i.e., 23

   So, option (c) is correct.

4. (b) Third class interval is 21-25.

   ∴ The width of the class interval is $25 - 21 = 4$

   So, option (b) is correct.

5. (d) The minimum and maximum values of given data are 5 and 20.

   ∴ The range of given data

   $\quad$ = Maximum value − Minimum value

   $\quad$ = $20 - 5 = 15$

   So, option (d) is correct.

Case Study 2

India began its vaccination programmed on 16th January 2021. Within one year a massive population above 18 yr vaccinated upto 80% with double dose and 70% of children from age group 15 to 18 by taking Ist dose. This is all possible in short span of time due to combine efforts of governments and the citizens. The data collected by the government of vaccinated population is shown below.

Ages	15-20	20-25	25-30	30-35
Number of peoples (in million)	14	10	12	14
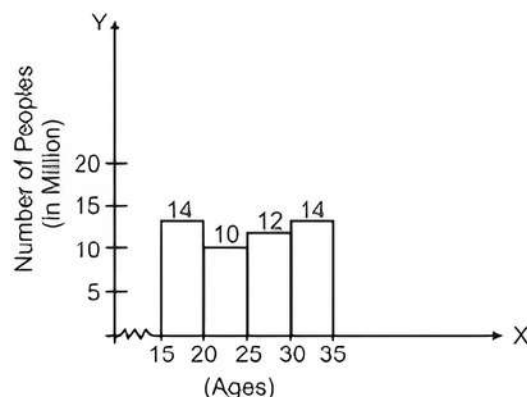
On the basis of the above information, solve the following questions.

Q 1. Upper limit of the fourth class interval is:

$\quad$ a. 30 $\qquad$ b. 35 $\qquad$ c. 35.5 $\qquad$ d. 30.5

Q 2. The class mark of 3rd class interval is:

$\quad$ a. 27 $\qquad$ b. 27.5 $\qquad$ c. 28 $\qquad$ d. 28.5

Q 3. The number of people having ages more than 25 is (in million):

$\quad$ a. 25 $\qquad$ b. 26 $\qquad$ c. 24 $\qquad$ d. 23

Q 4. The number of peoples having maximum ages of 30 is (in million):

$\quad$ a. 36 $\qquad$ b. 34 $\qquad$ c. 33 $\qquad$ d. 38

Q 5. In a histogram, the class intervals on the groups are taken along:

$\quad$ a. X-axis

$\quad$ b. Y-axis

$\quad$ c. Both a. and b.

$\quad$ d. in between X and Y axes

1. (b) In given data, the fourth class-interval is 30-35.

   ∴ The upper limit of fourth class-interval 30-35 is 35.

   So, option (b) is correct.

2. (b) In a given data, the third class is 25-30.

   ∴ The class mark of 25-30 is $\dfrac{25 + 30}{2}$

   $\qquad\qquad\qquad = \dfrac{55}{2} = 27.5$

   So, option (b) is correct.

3. (b) The number of peoples having ages more than

   $\qquad$ 25 is $12 + 14 = 26$ millions

   So, option (b) is correct.

4. (a) The number of peoples having maximum ages of 30 is $14 + 10 + 12$

   $\qquad\qquad\qquad = 36$ million

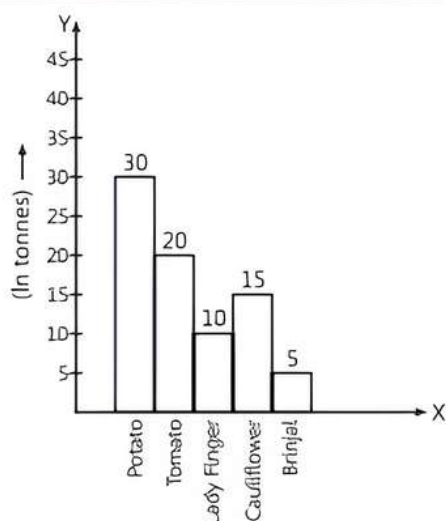   So, option (a) is correct.

5. (a) In a histogram, the class intervals or the groups are taken along X-axis.

Case Study 3

Department of Agriculture, cooperation and farmers welfare conducted an survey to determine the production of a crop in the year 2021 in the city of Amritsar. The data is given below:

Table-7.4
Foodgrains production (In '000 MT)

Crop	2014-15	2015-16	2016-17 Adv. Est.	2017-18 (Target)	2018-19 (Target)
I. Foodgrains					
Rice	127.38	128.88	146.59	132.00	132.00
Maize	735.90	737.88	784.29	740.00	742.00
Ragi	1.91	1.93	2.12	2.20	2.10
Wheat	648.29	687.82	704.21	670.00	690.00
Rice	98.70	34.33	95.82	98.00	98.00
Gram	0.38	0.38	0.40	0.45	0.45
Pulses	69.87	99.17	67.40	61.00	62.50
Foodgrains	1604.48	1630.98	1740.63	1641.85	1688.00
II. Commercial Crops					
Potato	181.30	103.25	195.84	200.00	185.00
Vegetables	1578.45	1608.55	1633.51	1640.00	1650.00
Chill(Green)	18.50	32.33	35.39	32.70	35.00

On the basis of the above information, solve the following questions.

Q 1. Which crop has maximum production?

Q 2. Find the total production of crops.

Q 3. What is the percentage of tomato crop in the given production?

Solutions

1. In the given data, it is clear that the maximum production of crop is potato.

2. The total production of crops
   $$= 30 + 20 + 10 + 15 + 5 = 80 \text{ tonnes}$$

3. ∴ The percentage of tomato crop in given production $= \dfrac{20}{80} \times 100\% = 25\%$

Case Study 4

National Sample Survey Office (NSSO) conducted a survey on the number of people who get infected in a village at time of monsoon and from what disease they got infected. The data has been given below.

Diseases	Number of infected people (in Lakhs)
Malaria	10
Dengue	15
Typhoid	18
Cholera	5
Diarrhoea	7

On the basis of the above information, solve the following questions.

Q 1. Find the range of the infected people.

Q 2. Which diseases, the maximum people is affected?

Q 3. Draw the bar chart from the given data.

Solutions

1. The minimum value of infected people is 5 and the maximum value of infected people is 18.
   ∴ Range of infected people = 18 − 5 = 13 lakhs.

2. In the given data, it is clear that maximum 18 lakhs people affected by typhoid.

3. The bar chart is shown below:
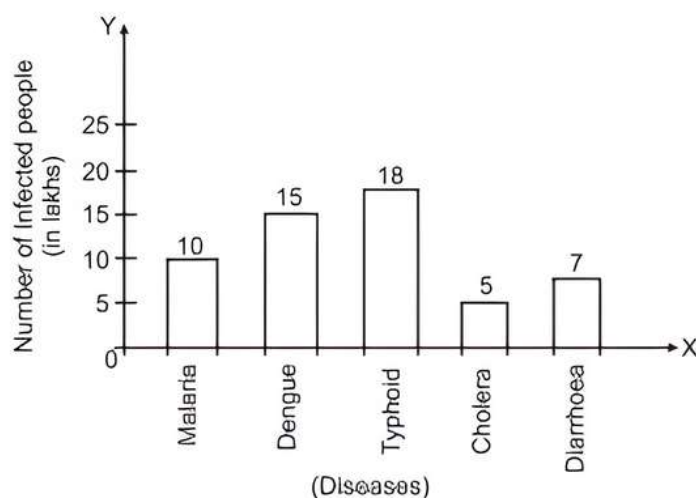
Very Short Answer Type Questions

Q 1. 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 range.

Q 2. In the following class-intervals, find the class width: 0-15, 15-30, 30-45, 45-60.

Q 3. What is the upper class limit of 4th class-interval from the following:

0-10, 10-20, 20-30, 30-40, 40-50, 50-60.

Q 4. In the following class-intervals, find the class mark of fourth class-interval.

0-20, 20-40, 40-60, 60-80, 80-100.

Q 5. The class marks of a frequency distribution are 5, 15, 25, 35,.... Find the class-interval corresponding to the class mark 25.

Q 6. Let m be the mid-value and l be the upper limit of a class in a frequency distribution. Find the lower limit of a class.

Q 7. A bar graph of different modes of transport to go to school as given below:
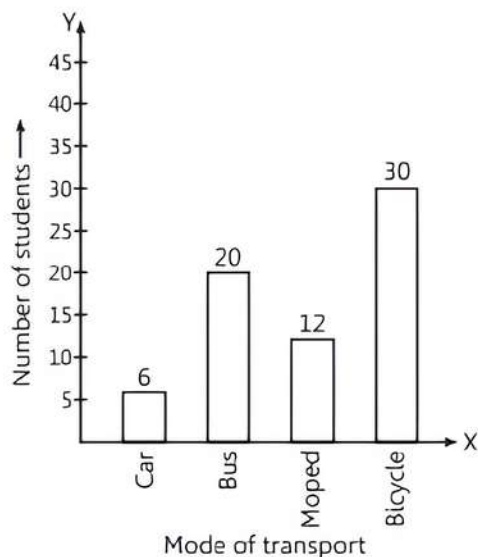
Find the percentage of students, who goes to school by using mode of transport as bus.

Q 8. Is it possible to construct a frequency polygon graph without using Histogram?

Short Answer Type-I Questions ⬎

Q 1. For the following data, make the frequency distribution of adjusting frequency.

Class	2-4	4-6	6-8	8-12	12-20
Frequency	8	10	22	24	16

Q 2. In the figure, there is a histogram depicting daily wages of workers in a factory. Construct the frequency distribution table.

[NCERT Exemplar]
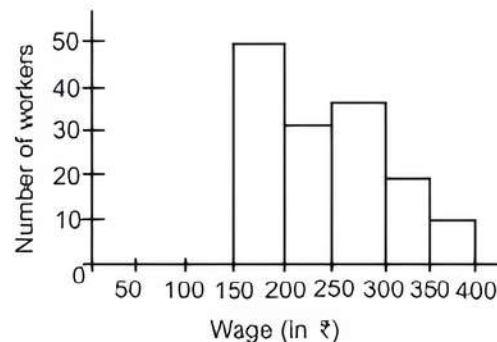
Q 3. Read the bar graph shown in figure and answer the following questions:
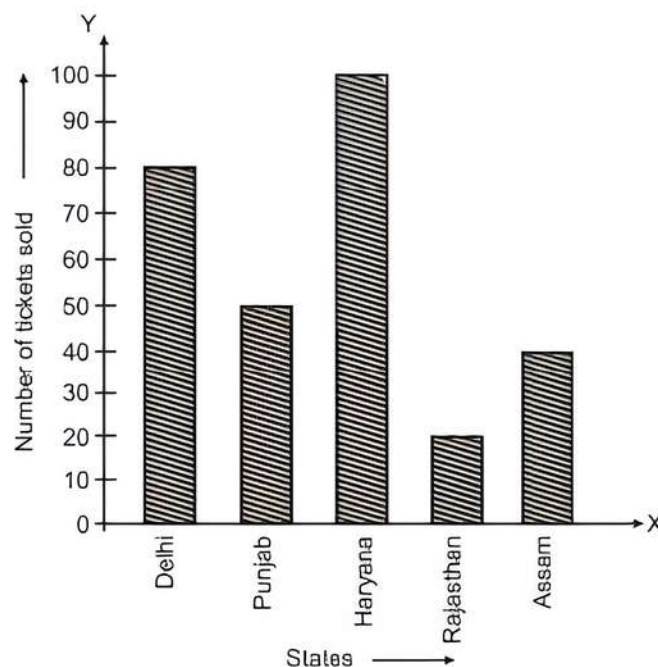
Bar graph of the tickets at different state lotteries sold by an agent on a day

(i) How many tickets of Assam State Lottery were sold by the agent?

(ii) Of which state, were the maximum number of tickets sold?

Q 4. In the figure, there is a histogram depicting daily wages of workers in a factory. Construct the frequency distribution table.
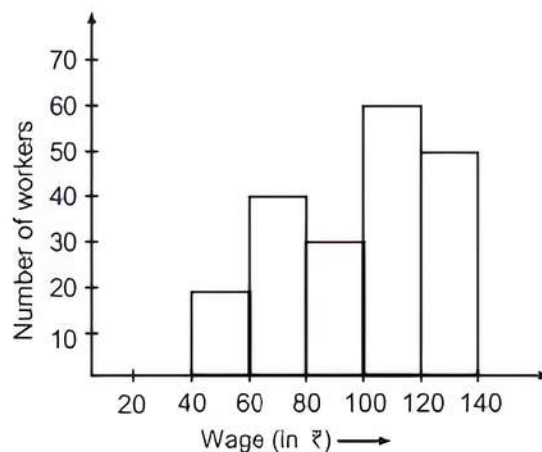
Q 5. In the figure, there is a frequency polygon depicting the speed of cars passing through at a particular spot on a highway. Construct the frequency distribution table:
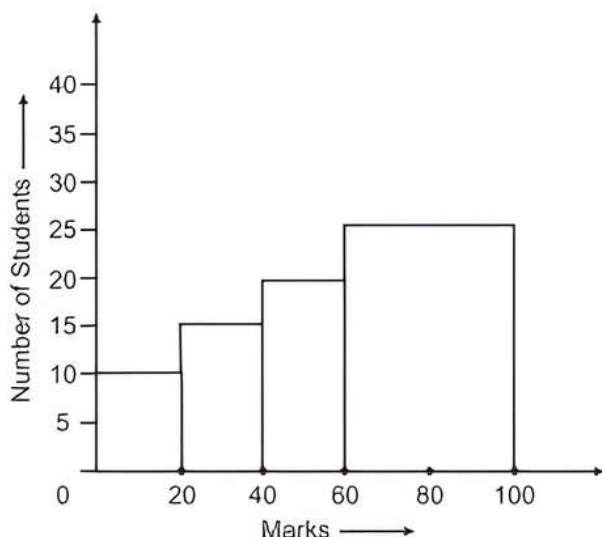
Q 1. The following table shows the favourite sports of 2300 students of a school. Represent this data by a bar graph.

Sports	Cricket	Badminton	Hockey	Football	Tennis
Number of students	800	300	400	500	300

Q 2. The frequency distribution has been represented graphically as follows:

Marks	0-20	20-40	40-60	60-100
Number of students	10	15	20	25

Do you think this representation is correct? If it is not correct, then represent this graph correctly.

Q 3. Look at the following bar graph:
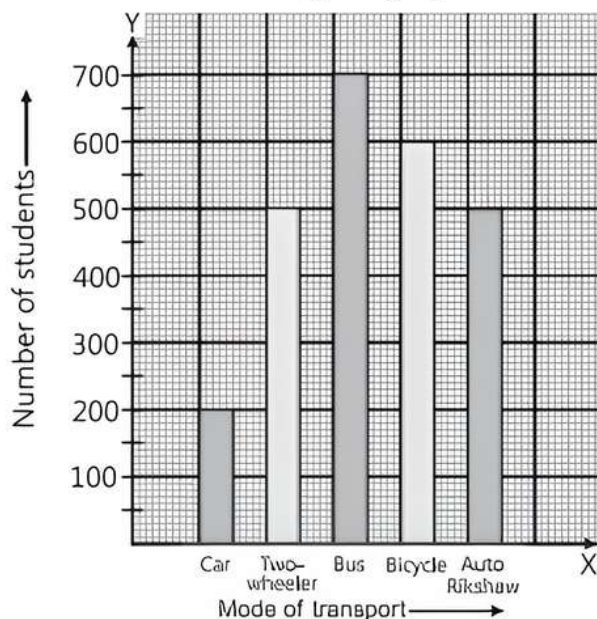
Read it carefully and answer the following questions:

(i) What information does the bar graph give?
(ii) Which is the most popular means of transport?
(iii) Which two means of transport are equally used?
(iv) Find total number of students.

Q 4. Represent the following distribution by a histogram.

Height (in cm)	Number of children
121-130	10
131-140	15
141-150	12
151-160	16
161-170	8
171-180	4

Q 5. Draw the frequency polygon representing the following frequency distribution:

Class-interval	Frequency
10-20	8
20-30	12
30-40	16
40-50	6
50-60	10
60-70	15
70-80	5

Q 6. 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	5
40-50	10
50-60	25

60-70	65
70-80	50
80-90	28
90-100	15

Draw the frequency polygon representing the above data without drawing the histogram.

💡 Long Answer Type Questions ↘

Q 1. The following table gives the lifetime of neon lamps:

Lifetime (in hours)	Number of lamps
300-400	14
400-500	56
500-600	60
600-700	86
700-800	74
800-900	62
900-1000	48

(i) Represent the given information with the help of a histogram.

(ii) How many lamps have a lifetime of more than 700 hours?

Q 2. 100 surnames were randomly picked up from a local telephone directory and a frequency distribution of the number of letters in the English alphabet in the surnames was found as follows:

Number of letters	Number of surnames
1-4	6
4-6	30
6-8	44
8-12	16
12-20	4

(i) Draw a histogram to depict the given information.

(ii) Write the class-interval in which the maximum number of surnames lie.

Q 3. The marks obtained (out of 100) by a class of 80 students are given below:

Marks	Number of students
10-20	6
20-30	17
30-50	15
50-70	16
70-100	26

Draw a histogram to represent the given data.

Q 4. Draw a histogram to represent the following grouped frequency distribution.

Age (in years)	Number of teachers
20-24	10
25-29	28
30-34	32
35-39	48
40-44	50
45-49	35
50-54	12

Q 5. 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.

Q 6. 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.

Q 7. Daily wages (in ₹) of employees of a factory are given below:

Daily wages (in ₹)	Number of employees
200-300	12
300-400	14
400-500	16
500-600	10
600-700	8
700-800	6

Draw a histogram and a frequency polygon on the same graph.

Very Short Answer Type Questions

1. Range = Highest value − Lowest value
   = 27 − 2 = 25

2. Class width = Upper class limit − Lower class limit
   = 15 − 0 = 15

3. 4th class-interval is 30-40. Its upper class limit is 40.

4.

TR!CK

Class mark of class-interval

$$\frac{Upper\ class\ limit + Lower\ class\ limit}{2}$$

Class mark of 60-80

$$= \frac{60+80}{2} = \frac{140}{2} = 70$$

5. Difference between two consecutive class marks is 10, *i.e.*, class-size is 10.
   Class mark is the mid-value of class-interval.
   Hence, class-interval for class mark 25 is 20-30.

6. We know that mid-value

$$= \frac{Upper\ limit + Lower\ limit}{2}$$

$$\therefore \quad m = \frac{l + lower\ limit}{2}$$

$\Rightarrow$ lower limit = $2m - l$
   Hence, lower limit of a class is $2m - L$

7. Total number of students = 6 + 20 + 12 + 30
   = 68

$\therefore$ The percentage of students who goes to school by bus is $\frac{20}{68} \times 100\%$

   = 29.41%

8. Yes, it is possible to construct a frequency polygon without using histogram.

Short Answer Type-I Questions

1.

TR!CK

Adjusted Frequency of a class

$$= \frac{minimum\ class\ size}{class\ size\ of\ the\ class} \times Frequency\ of\ the\ class$$

Here, minimum class size = 4 − 2 = 2
Frequency distribution of adjusting frequency

Class	Frequency	Width of class	Adjusted frequency
2-4	8	2	$\frac{2}{2} \times 8 = 8$
4-6	10	2	$\frac{2}{2} \times 10 = 10$
6-8	22	2	$\frac{2}{2} \times 22 = 22$
8-12	24	4	$\frac{2}{4} \times 24 = 12$
12-20	16	8	$\frac{2}{8} \times 16 = 4$

2. It is clear from the histogram that class interval start from 150-200, 200-250, having width 50. The frequency distribution table is given below:

Wage (₹)	Number of workers
150-200	50
200-250	30
250-300	35
300-350	20
350-400	10
Total	**145**

3. (i) The number of tickets of Assam State Lottery were sold by the agent is 40.
   (ii) The maximum number of tickets sold by Haryana State.

4. It is clear from the histogram that class interval start from 40–60, 60–80, ... having width 20. The frequency distribution table is given below:

| Wage (₹)	Number of workers
40–60	20
60–80	40
80–100	30
100–120	60
120–140	50
Total	**200**

5. It is clear from the histogram that class-interval start from 20-30, 30-40, ..., 80-90. The frequency distribution table is given below:

Class-interval (km/h)	Frequency
20-30	3
30-40	15
40-50	10
50-60	30
60-70	20
70-80	10
80-90	15
Total	**103**

Short Answer Type-II Questions

1. We take name of sports along the X-axis and number of students along the Y-axis by taking suitable scale.

   The required bar graph can be constructed as follows:
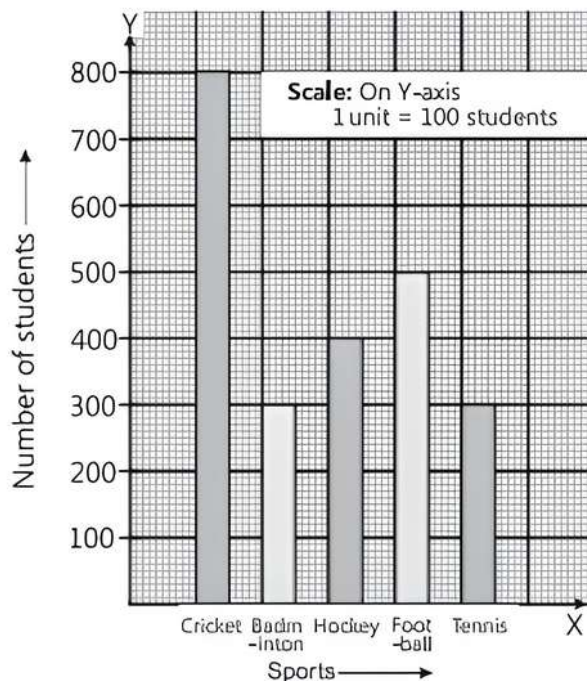
2. No, here the widths of the rectangle are varying, so we need to make certain modifications in the length of the rectangle so that the areas are proportional to the frequencies. We proceed as follows:

   1. Select a class-interval with the minimum class size, here the minimum class size is 20.

   2. The length of the rectangles are modified to be proportionate to the class size 20. Now, we get the following modified table

Marks	Number of Students (frequency)	Width of the class	Length of the rectangle
0-20	10	20	$\frac{10}{20} \times 20 = 10$
20-40	15	20	$\frac{15}{20} \times 20 = 15$
40-60	20	20	$\frac{20}{20} \times 20 = 20$
60-100	25	40	$\frac{25}{40} \times 20 = 12.5$

   So, the correct histogram with varying width is given below:
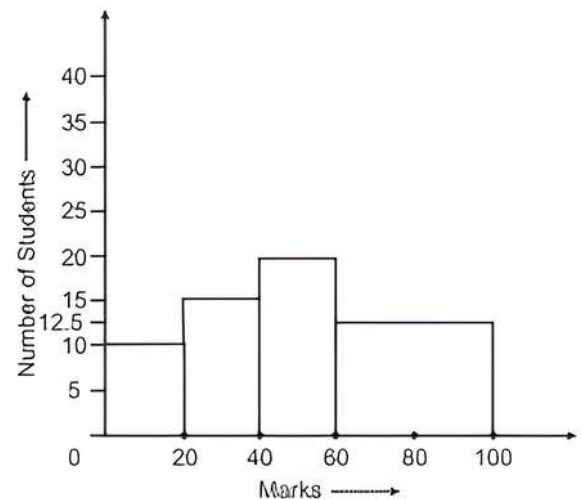
3. (i) The bar graph gives the information about different means of transport used by students.

   (ii) The most popular means of transport is bus because maximum number of students used it.

   (iii) Two-wheeler and auto rickshaw are the two means of transport used equally.

   (iv) Total number of students
   = 200 + 500 + 700 + 600 + 500 = 2500

4. The given frequency distribution is in inclusive form, so first we convert it into exclusive form, as shown below:

Heights (in cm)	Number of Children (Frequency)
120.5-130.5	10
130.5-140.5	15
140.5-150.5	12
150.5-160.5	16
160.5-170.5	8
170.5-180.5	4

   We represent heights along the X-axis and number of children along the Y-axis, using suitable scale. The required histogram can be constructed as follows:
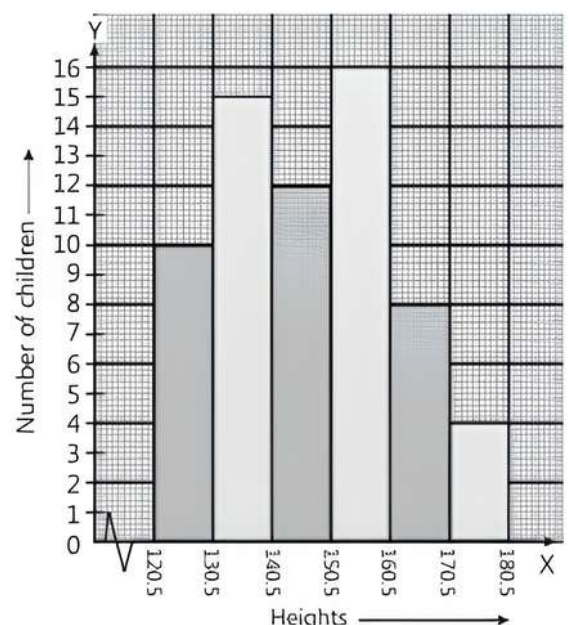
5. First we find the class mark of the given class-intervals.

Class-interval	Class mark	Frequency
10-20	15	8
20-30	25	12
30-40	35	16
40-50	45	6
50-60	55	10
60-70	65	15
70-80	75	5

Now, we mark the class marks 15, 25, 35,... along the X-axis and corresponding frequency along the Y-axis.

Plot the points A(15, 8), B(25, 12), C(35, 16), D(45, 6), E(55, 10), F(65, 15) and G(75, 5) on the graph paper.

Now, we join the line segments AB, BC, CD, DE, EF and FG to obtain the required frequency polygon.
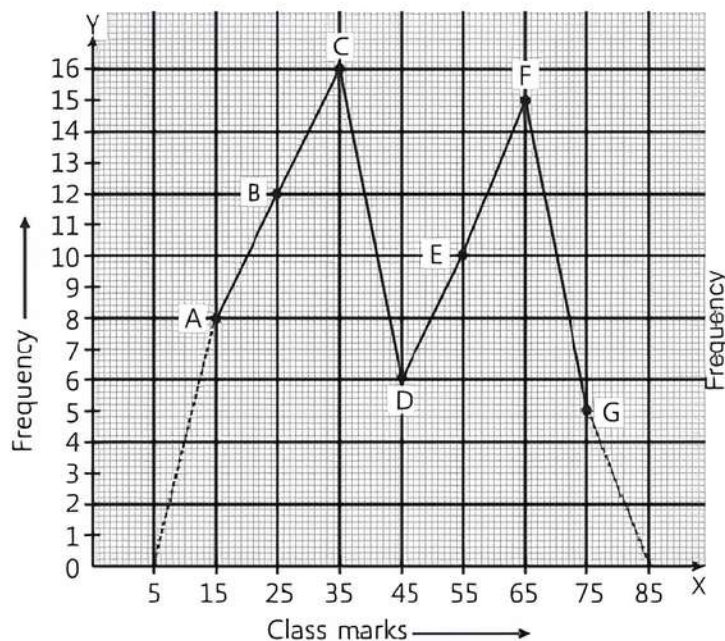
6. We have to draw a frequency polygon without a histogram.

Firstly, we find the class marks of the classes given that is 30–40, 40-50, 50-60, 60-70 ...

$$\therefore \text{ The class mark} = \frac{30+40}{2}$$

$$= \frac{70}{2} = 35$$

Similarly, we can determine the class marks of the other classes.

So, table for class marks is shown below:

Class-interval (km/h)	Class marks	Frequency
30-40	35	5
40-50	45	10
50-60	55	25
60-70	65	65
70-80	75	50
80-90	85	28
90-100	95	15

We can draw a frequency polygon by plotting the class marks along the horizontal axis and the frequency along the vertical axis. Now, plotting all the points B (35, 5), C (45, 10), D (55, 25), E (65, 65), F (75, 50), G (85, 28), H (95, 15), also plot the point corresponding to the considering classes 20-30 and 100-110 each with frequency 0. Join all these point by line segments.
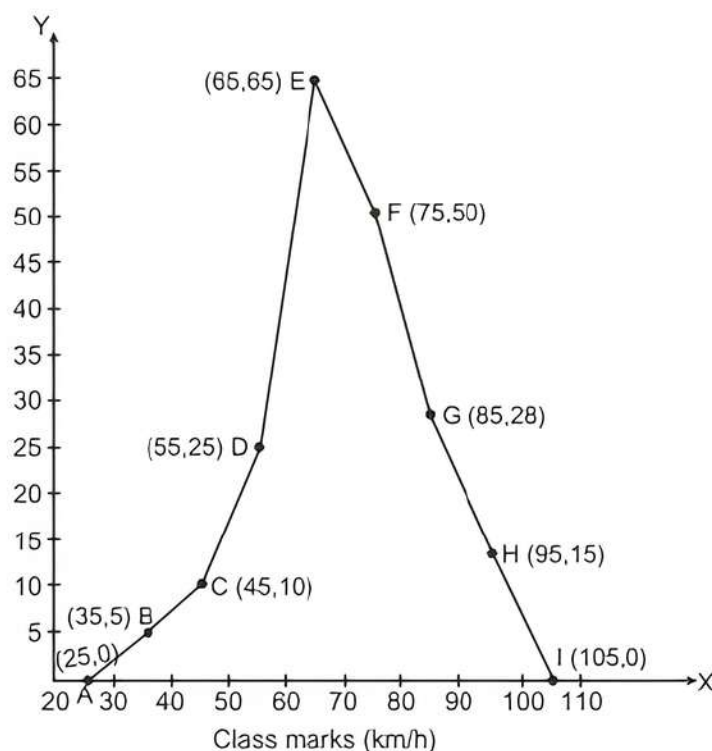
Long Answer Type Questions

1. (i) By taking lifetime (in hours) of neon lamps on X-axis and the number of lamps on Y-axis, the required histogram can be constructed as follows:
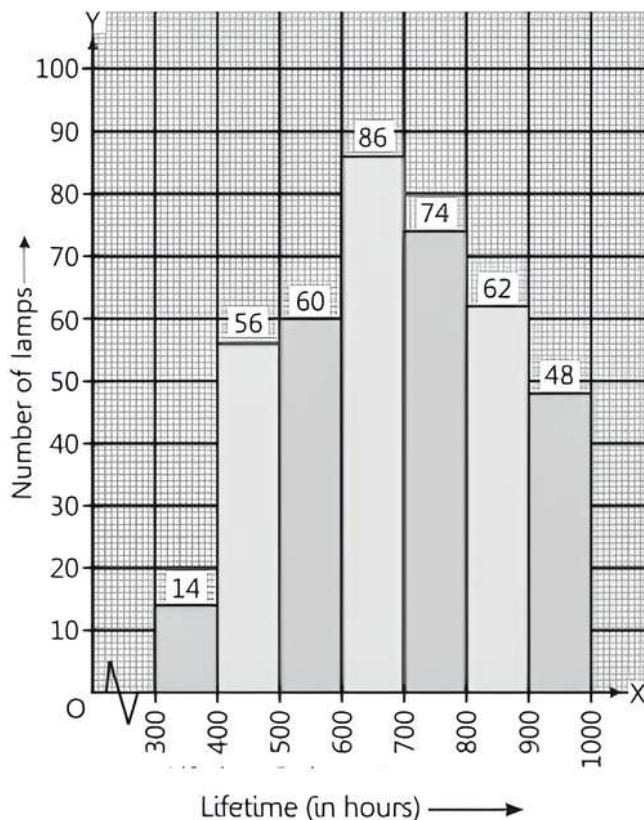
Here, 1 unit on Y-axis represents 10 lamps.

(ii) Therefore, the number of neon lamps having their lifetime more than 700 hours is 184 (i.e., $74 + 62 + 48 = 184$).

2. (i) It can be observed that the data has class-intervals of varying width. The proportion of the number of surnames per 2 letters interval can be calculated as follows:

Number of letters	Frequency (Number of surnames)	Width of class	Length of rectangle
1-4	6	3	$\frac{2}{3} \times 6 = 4$
4-6	30	2	$\frac{2}{2} \times 30 = 30$
6-8	44	2	$\frac{2}{2} \times 44 = 44$
8-12	16	4	$\frac{2}{4} \times 16 = 8$
12-20	4	8	$\frac{2}{8} \times 4 = 1$

By taking the number of letters on X-axis and the proportion of the number of surnames per 2 letters interval on Y-axis and choosing an appropriate scale ($\frac{1}{2}$ unit = 5 students for Y-axis), the required histogram can be constructed as follows:
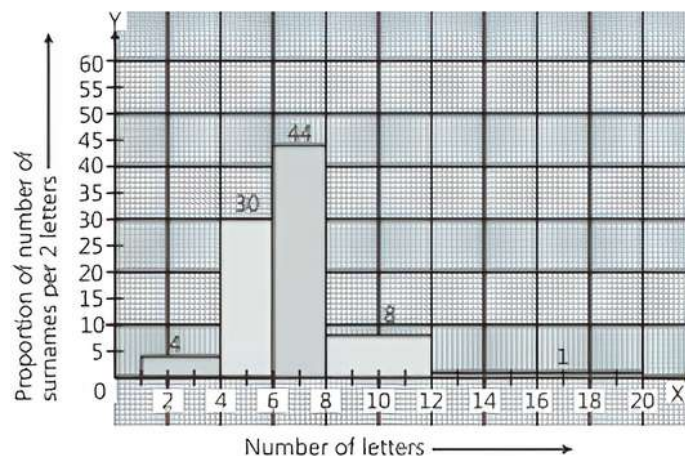
(ii) The class-interval in which the maximum number of surnames lies is 6-8 as it has 44 surnames in it, i.e., the maximum for this data.

3. In the given frequency distribution, class sizes are different. So, we calculate the adjusted frequency for each class.

TR!CK

Adjusted frequency of a class
$$= \frac{\text{Minimum class size}}{\text{Class size of the class}} \times \text{Frequency of the class}$$

Here, minimum size $= 20 - 10 = 10$
We use the formula.
The modification table for frequency distribution is given below:

Marks	Number of students (Frequency)	Adjusted frequency
10-20	6	$\frac{10}{10} \times 6 = 6$
20-30	17	$\frac{10}{10} \times 17 = 17$
30-50	15	$\frac{10}{20} \times 15 = \frac{15}{2} = 7.5$
50-70	16	$\frac{10}{20} \times 16 = \frac{16}{2} = 8$
70-100	26	$\frac{10}{30} \times 26 = \frac{26}{3} = 8.67$

Along the horizontal axis, we represent the class intervals marks on some suitable scale. The corresponding frequencies of number of students are represented along the vertical axis on a suitable scale.

Since, the given intervals start with 10-20. It means that, there is some break (⌇) indicated near the origin to signify the graph is drawn with a scale beginning at 10.

Now, we draw rectangles with class intervals as the bases and the corresponding adjusted frequencies as heights.

A histogram of the given distribution is given below:
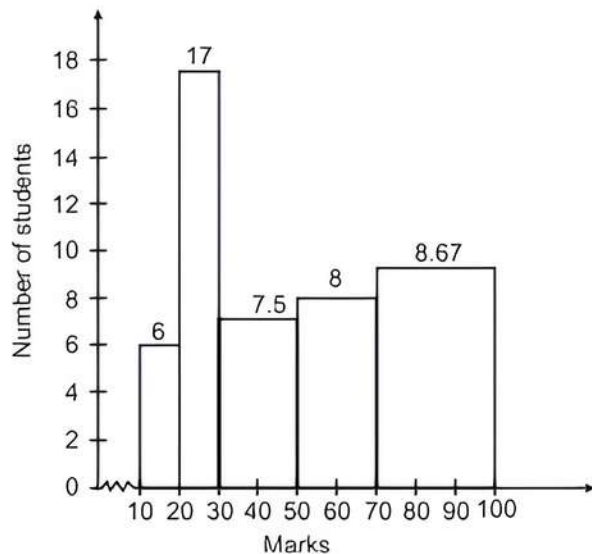
4. The given frequency distribution is in inclusive form. So first, we convert it into exclusive form. Now, consider the class 20-24, 25-29.

Lower limit of 25-29 is 25.

Upper limit of 20-24 is 24.

Thus, the half of the difference is $\dfrac{25-24}{2} = \dfrac{1}{2} = 0.5$

So, we subtract 0.5 from each lower limit and add 0.5 to each upper limit.

The table for continuous grouped frequency distribution is given below:

Age (in years)	Number of teachers
19.5-24.5	10
24.5-29.5	28
29.5-34.5	32
34.5-39.5	48
39.5-44.5	50
44.5-49.5	35
49.5-54.5	12

Thus, the given data becomes in exclusive form.

Along the horizontal axis, we represent the class intervals of ages on some suitable scale. The corresponding frequencies of number of teachers are represented along the vertical axis on a suitable scale.

Since, the given intervals start with 19.5-24.5. It means that, there is some break (〰) indicated near the origin to signify the graph is drawn with a scale beginning at 19.5.

A histogram of the given distribution is given below:
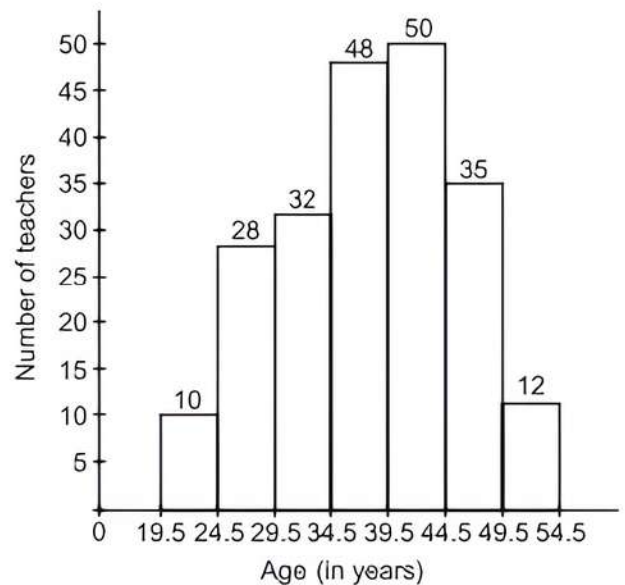
5. Clearly, the given frequency distribution is in exclusive form.

Along the horizontal axis, we represent the class intervals on some suitable scale. The corresponding frequencies are represented along the vertical axis on a suitable scale.

We construct rectangles with class intervals as the bases and the respective frequencies as the heights.

Let us draw a histogram for this data and mark the mid-points of the top of the rectangles as B, C, D, E, F, G and H, respectively. Here, the first class is 30-40 and the last class is 90-100.

Also, consider the imagined classes 20-30 and 100-110 each with frequency 0. The class marks of these classes are 25 and 105 at the points A and I respectively.
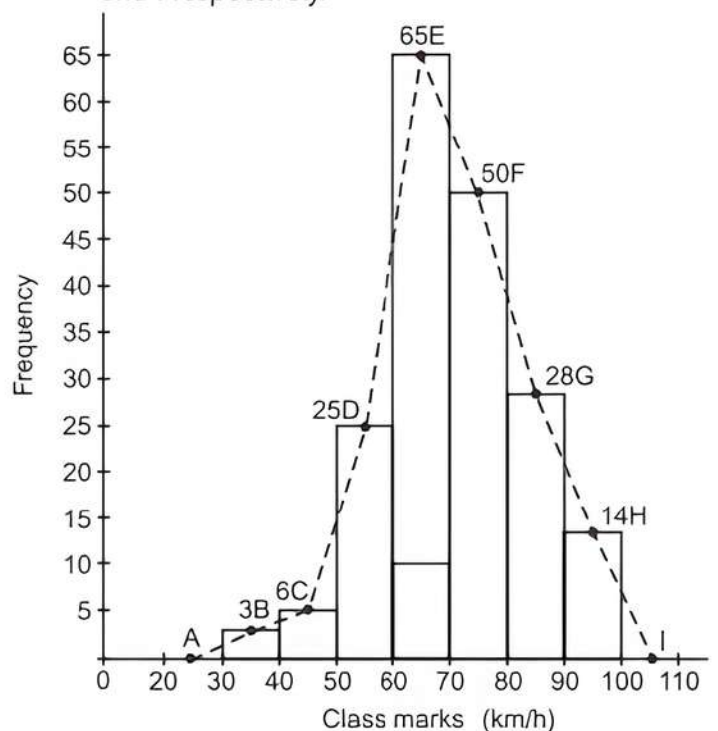
Join all these points by dotted line.

Then, the curve ABCDEFGHI is the required frequency polygon.

6. It can be observed that the class-intervals of the given data are not continuous and there is a gap of 1 in between them. Therefore, $\frac{1}{2} = 0.5$ has to be added to each upper class limits and 0.5 has to be subtracted from each lower class limits 8.

Also, class mark of each interval can be found by using the following formula.

TR!CK

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

Continuous data with class mark of each class-interval can be represented as follows:

Number of balls	Class mark	Team A	Team B
0.5-6.5	3.5	2	5
6.5-12.5	9.5	1	6
12.5-18.5	15.5	8	2
18.5-24.5	21.5	9	10
24.5-30.5	27.5	4	5
30.5-36.5	33.5	5	6
36.5-42.5	39.5	6	3
42.5-48.5	45.5	10	4
48.5-54.5	51.5	6	8
54.5-60.5	57.5	2	10

By taking class marks on X-axis and runs scored on Y-axis, the required frequency polygon can be constructed as follows:
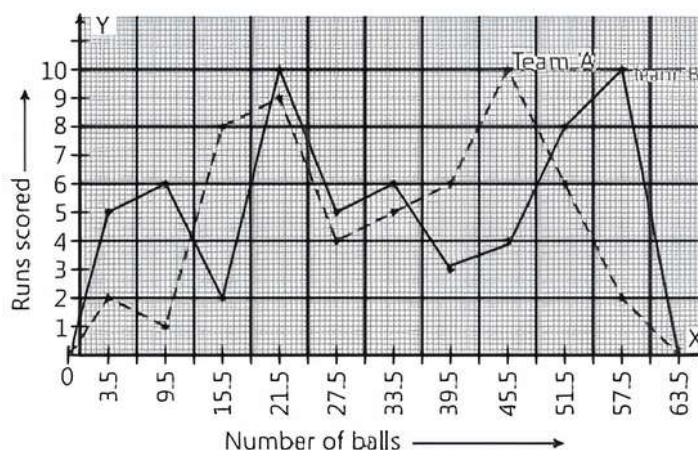
7. We represent the class intervals along the X-axis and the corresponding frequencies along the Y-axis, using a suitable scale.

First we draw a histogram, then we join the mid-points of the tops of adjacent rectangles by line segments to construct a frequency polygon.
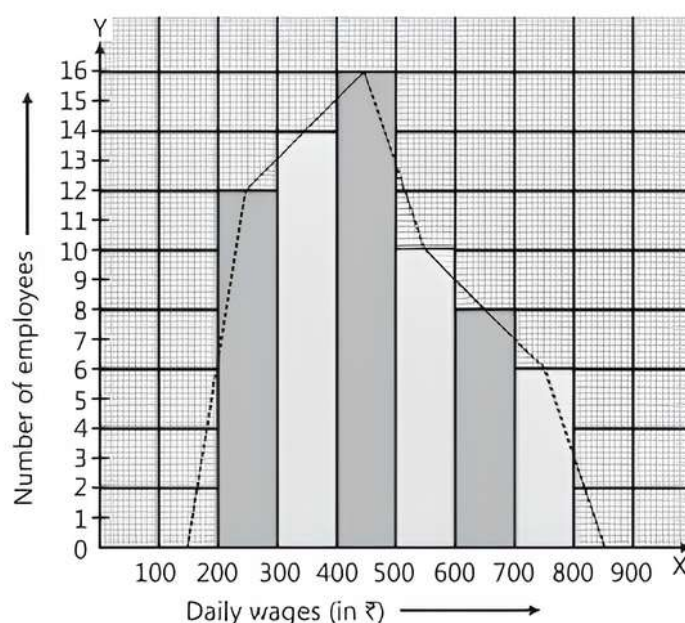
Chapter Test

Multiple Choice Questions

Q 1. The class marks of a frequency distribution are 15, 20, 25, 30, 35, ... The class corresponding to the class mark 30 is:

a. 27-33   b. 27.5-32.5

c. 28-34   d. 30-35

Q 2. In a histogram, the frequencies are taken along:

a. X-axis

b. Y-axis

c. both a. and b.

d. None of the above

Assertion and Reason Type Questions

Directions (Q. Nos. 3-4): *In the following questions, a statement of Assertion (A) is followed by a statement of a Reason (R). Choose the correct option:*

    a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

    b. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

    c. Assertion (A) is true but Reason (R) is false.

    d. Assertion (A) is false but Reason (R) is true.

Q 3. A survey of different ages of workers in a factory are given below:

Age (in Years)	20-30	30-35	35-50	50-55
Number of Workers	15	10	12	18

Assertion (A): The adjusted frequency of class interval 35-50 is 4.

Reason (R): The adjusted frequency of any class can be determined by the formula

Adjusted frequency of a class

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

Q 4. The monthly profits (in ₹) of 100 shops are distributed as follows:

Profit per shop	0-50	50-100	100-150	150-200	200-250	250-300
Number of Shops	12	18	27	20	17	6

Assertion (A): To draw the frequency polygon of the given data, firstly we plot the points (25, 12), (75, 18), (125, 27), (175, 20), (225, 17), (275, 6) on a graph paper and join these points through a line segment.

Reason (R): Frequency polygon curve can be constructed only when given data is continuous.

Fill in the Blanks

Q 5. The range of the data 30, 15, 40, 10, 25, 30, 50, 45, 49, 37 is ....

Q 6. Frequency .... can also be drawn independently without drawing a histogram.

True/False

Q 7. In histogram, their is no space between the consecutive rectangles.

Q 8. Frequency polygon graph is obtained by joining the mid-point of the top horizontal line of each rectangle.

Case Study Based Questions

Q 9. Sundarban forest is a mangrove area in the delta formed by the confluence of the Ganga, Brahmaputra and Meghna Rivers in the Bay of Bengal.

Forest department of India decided to conduct a survey about the number of trees going in Sundarban forest. The data below shows the count of trees.
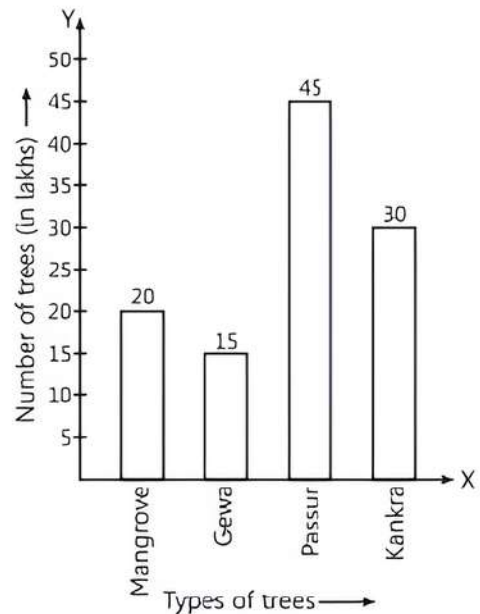
On the basis of the above information, solve the following questions.

(i) Find the range of given data (in lakh).

(ii) What is the total number of trees in Sundarban forest?

OR

Which type of tree has maximum frequency?

(iii) Find the percentage of gewa tree in the Sundarban Forest.

Very Short Answer Type Questions

Q 10. The class marks of a frequency distribution are 4, 14, 24, 34, ... Find the class-interval corresponding to the class mark 24.
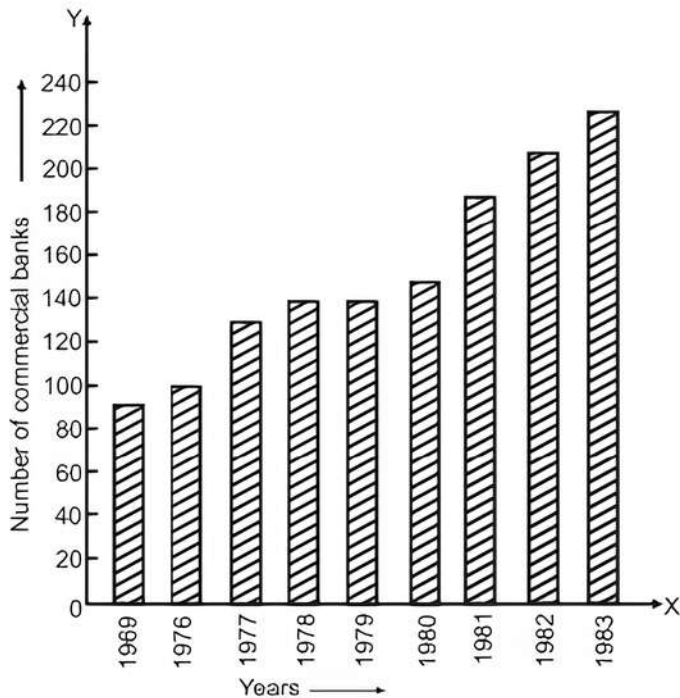
Q 11. A bar graph of different modes of transport to go to school as given below:
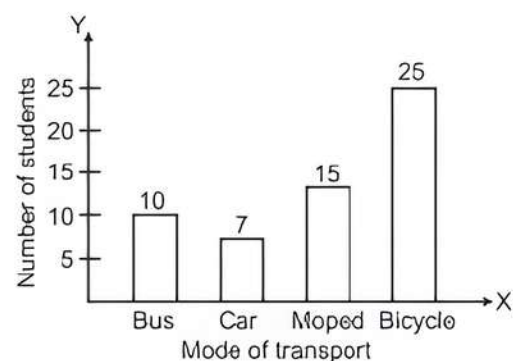
Find the percentage of students, who goes to school by using mode of transport as moped.

Short Answer Type-I Questions

Q 12. Read the bar graph shown in figure and answer the following questions:

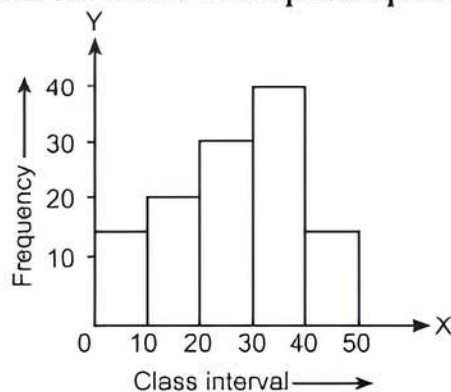Bar graph of the number of commercial bank in India during some years.

(i) What was the number of commercial banks in 1977?

(ii) What is the ratio of the number of commercial banks in 1969 to that in 1980?

Q 13. Using the following figure:

(i) Write the frequency of class (20-30).

(ii) Write the classes with equal frequencies.

Short Answer Type-II Questions

Q 14. The following table gives the marks scored by 65 students in an entrance examination.

Marks	0-10	10-20	20-30	30-40	40-50	50-60
Number of students (Frequency)	10	9	12	8	10	16

Represents this data in the form of a histogram.

Q 15. Construct a frequency polygon for the following data.

Age (in years)	Frequency
0-2	2
2-4	5
4-6	6
6-8	8
8-10	9
10-12	7
12-14	4
14-16	3
16-18	2

Long Answer Type Question

Q 16. The marks scored by 750 students in an examination are given in the form of a frequency distribution table:

Marks	Number of students
600-640	15
640-680	40
680-720	35
720-760	25
760-800	45
800-840	30
840-880	50

Represent this data in the form of a histogram and construct a frequency polygon.