

Assignments in Mathematics Class X (Term I)

14. STATISTICS

IMPORTANT TERMS, DEFINITIONS AND RESULTS

- The mean \bar{x} of n values $x_1, x_2, x_3, \dots, x_n$ is given by

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$

- **Mean of grouped data (without class-intervals)**

- (i) **Direct Method** : If the frequencies of n observations $x_1, x_2, x_3, \dots, x_n$ be $f_1, f_2, f_3, \dots, f_n$ respectively, then the mean \bar{x} is given by

$$\bar{x} = \frac{x_1 f_1 + x_2 f_2 + x_3 f_3 + \dots + x_n f_n}{f_1 + f_2 + f_3 + \dots + f_n} = \frac{\sum f_i x_i}{\sum f_i}$$

- (ii) **Deviation Method or Assumed Mean Method**

In this case, the mean \bar{x} is given by $\bar{x} = a + \frac{\sum f_i (x_i - a)}{\sum f_i} = a + \frac{\sum f_i d_i}{\sum f_i}$,

Where, a = assumed mean, $\sum f_i$ = total frequency, $d_i = x_i - a$

$\sum f_i (x_i - a)$ = sum of the products of deviations and corresponding frequencies.

- **Mean of grouped data (with class-intervals)**

In this case the class marks are treated as x_i .

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

- (i) **Direct Method**

If the frequencies corresponding to the class marks $x_1, x_2, x_3, \dots, x_n$ be $f_1, f_2, f_3, \dots, f_n$ respectively, then

mean \bar{x} is given by $\bar{x} = \frac{f_1 x_1 + f_2 x_2 + f_3 x_3 + \dots + f_n x_n}{f_1 + f_2 + f_3 + \dots + f_n} = \frac{\sum f_i x_i}{\sum f_i}$

- (ii) **Deviation or Assumed Mean Method**

In this case the mean \bar{x} is given by $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$,

Where, a = assumed mean, $\sum f_i$ = total frequency and $d_i = x_i - a$

- (iii) **Step Deviation Method**

In this case we use the following formula.

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

Where, a = assumed mean, $\sum f_i$ = total frequency, h = class-size

and $u_i = \frac{x_i - a}{h}$

- Mode is that value among the observations which occurs most often i.e., the value of the observation having the maximum frequency.
- If in a data more than one value have the same maximum frequency, then the data is said to be multi-modal.
- In a grouped frequency distribution, the class which has the maximum frequency is called the modal class.

- We use the following formula to find the mode of a grouped frequency distribution.

$$\text{Mode } (M_0) = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h, \text{ where}$$

l = lower limit of modal class, h = size of the class-interval,
 f_1 = frequency of the modal class, f_0 = frequency of the class preceding the modal class,
 f_2 = frequency of the class succeeding the modal class.

- Median is the value of the middle most item when the data are arranged in ascending or descending order of magnitude.

- **Median of ungrouped data**

- (i) If the number of items n in the data is odd, then

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

- (ii) If the total number of items n in the data is even, then

$$\text{Median} = \frac{1}{2} \left[\text{value of } \frac{n}{2} \text{th item} + \text{value of } \left(\frac{n}{2} + 1 \right) \text{th item} \right]$$

- Cumulative frequency of a particular value of the variable (or class) is the sum total of all the frequencies up to that value (or the class).
- There are two types of cumulative frequency distributions.
 - (i) cumulative frequency distribution of less than type.
 - (ii) cumulative frequency distribution of more than type.

- **Median of grouped data with class-intervals**

In this case, we first find the half of the total frequencies, *i.e.*, $\frac{n}{2}$. The class in which $\frac{n}{2}$ lies is called the median class and the median lies in this class.

We use the following formula for finding the median.

$$\text{Median } (M_e) = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h,$$

Where, l = lower limit of the median class, n = number of observations,
 cf = cumulative frequency of the class preceding the median class,
 f = frequency of the median class, h = class size.

- The three measures mean, mode and median are connected by the following relations.

$$\text{Mode} = 3 \text{ median} - 2 \text{ mean}$$

$$\text{or median} = \frac{\text{mode}}{3} + \frac{2 \text{ mean}}{3} \quad \text{or mean} = \frac{3 \text{ median}}{2} - \frac{\text{mode}}{2}$$

- The graphical representation of a cumulative frequency distribution is called an ogive or cumulative frequency curve.
- We can draw two types of ogives for a frequency distribution. These are less than ogive and more than ogive.
- For less than ogive, we plot the points corresponding to the ordered pairs given by (upper limit, corresponding less than cumulative frequency). After joining these points by a free hand curve, we get an ogive of less than type.
- For more than ogive, we plot the points corresponding to the ordered pairs given by (lower limit, corresponding more than cumulative frequency). After joining these points by a free hand curve, we get an ogive of more than type.

- Ogive can be used to estimate the median of data. There are two methods to do so.

First method : Mark a point corresponding to $\frac{n}{2}$, where n is the total frequency, on cumulative frequency axis (y -axis). From this point, draw a line parallel to x -axis to cut the ogive at a point. From this point, draw a line perpendicular to the x -axis to get another point. The abscissa of this point gives median.

Second method : Draw both the ogives (less than ogive and more than ogive) on the same graph paper which cut each other at a point. From this point, draw a line perpendicular to the x -axis, to get another point. The abscissa of this point gives median.

SUMMATIVE ASSESSMENT

MULTIPLE CHOICE QUESTIONS

[1 Mark]

A. Important Questions

- If 35 is the upper limit of the class-interval of class-size 10, then the lower limit of the class-interval is :
 (a) 20 (b) 25 (c) 30 (d) none of these
- In the assumed mean method, if A is the assumed mean, then deviation d_i is :
 (a) $x_i + A$ (b) $x_i - A$ (c) $A - x_i$ (d) none of these
- Mode is :
 (a) middle most value (b) least frequent value (c) most frequent value (d) none of these
- The correct formula for finding the mode of a grouped frequency distribution is :
 (a) $\text{Mode} = h + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times l$ (b) $\text{Mode} = f_1 + \left(\frac{f_1 - f_0}{2h - f_0 - f_2} \right) \times l$
 (c) $\text{Mode} = l - \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$ (d) $\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$
- For finding mean of a data, if we use $\bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$, then it is called :
 (a) the direct method (b) the step deviation method (c) the assumed mean method (d) none of these
- In the formula $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$, for finding the mean of a grouped data, d_i 's are deviation from :
 (a) lower limits of the classes (b) upper limits of the classes
 (c) mid-points of the classes (d) frequencies of the class-marks
- While computing mean of grouped data, we assume that the frequencies are :
 (a) evenly distributed over all the classes (b) centred at the class-marks of the classes
 (c) centred at the upper limits of the classes (d) centred at the lower limits of the classes
- If x_i 's are the mid-points of the class-intervals of a grouped data, f_i 's are the corresponding frequencies and \bar{x} is the mean, then $\sum (f_i x_i - \bar{x})$ is equal to :
 (a) 0 (b) -1 (c) 1 (d) 2
- In the formula $\bar{x} = a + h \left(\frac{\sum f_i u_i}{\sum f_i} \right)$, for finding the mean of a grouped frequency distribution, u_i is equal to :
 (a) $\frac{x_i + a}{h}$ (b) $h(x_i - a)$ (c) $\frac{x_i - a}{h}$ (d) $\frac{a - x_i}{h}$
- The formula for median of a grouped data is :
 (a) $\text{Median} = l + \left(\frac{n - cf}{f} \right) \times h$ (b) $\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$

(c) Median = $2l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$ (d) none of these

11. In the formula, median = $l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$, h is :
 (a) class-mark (b) class-size (c) height (d) none of these
12. The curve drawn by taking upper limits along x -axis and cumulative frequency along y -axis is :
 (a) frequency polygon (b) more than ogive (c) less than ogive (d) none of these
13. For 'more than ogive' the x -axis represents :
 (a) upper limits of class-intervals (b) mid-values of class-intervals
 (c) lower limits of class-intervals (d) frequency
14. Ogive is the graph of :
 (a) lower limits and frequency (b) upper limits and frequency
 (c) lower/upper limits and cumulative frequency (d) none of these
15. The curve 'less than ogive' is always :
 (a) ascending (b) descending
 (c) sometimes ascending and sometimes descending
 (d) none of these

B. Questions From CBSE Examination Papers

1. In the figure the value of the median of the data using the graph of less than ogive and more than ogive is :
 [2010 (T-I)]

- (a) 5
 (b) 40
 (c) 80
 (d) 15

2. If mode = 80 and mean = 110, then the median is :
 [2010 (T-I)]

- (a) 110
 (b) 120
 (c) 100
 (d) 90

3. The lower limit of the modal class of the following data is :
 [2010 (T-I)]

C.I.	0-10	10-20	20-30	30-40	40-50
Frequency	5	8	13	7	6

- (a) 10 (b) 30 (c) 20 (d) 50

4. The mean of the following data is : 45, 35, 20, 30, 15, 25, 40 : [2010 (T-I)]

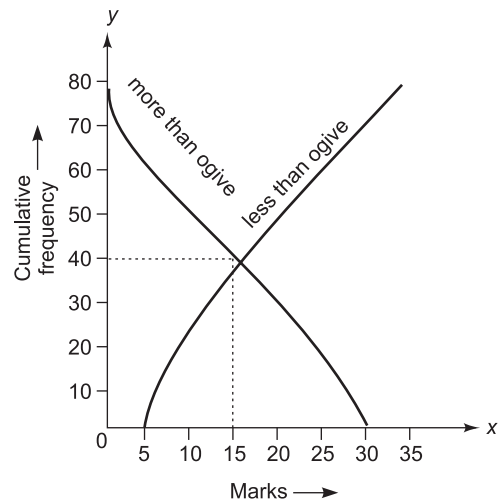
- (a) 15 (b) 25 (c) 35 (d) 30

5. The mean and median of a data are 14 and 15 respectively. The value of mode is : [2010 (T-I)]

- (a) 16 (b) 17 (c) 13 (d) 18

6. For a given data with 50 observations the 'less than ogive' and the 'more then ogive' intersect at (15.5, 20). The median of the data is : [2010 (T-I)]

- (a) 4.5 (b) 20 (c) 50 (d) 15.5



7. The empirical relationship among the Median, Mode and Mean of a data is : [2010 (T-I)]
 (a) mode = 3 median + 2 mean (b) mode = 3 median – 2 mean
 (c) mode = 3 mean – 2 median (d) mode = 3 mean + 2 median
8. For a symmetrical distribution, which is correct? [2010 (T-I)]
 (a) Mean > Mode > Median (b) Mean < Mode < Median
 (c) Mode = $\frac{\text{Mean} + \text{Median}}{2}$ (d) Mean = Median = Mode
9. Which of the following is not a measure of central tendency ? [2010 (T-I)]
 (a) Mean (b) Median (c) Range (d) Mode
10. The class mark of a class interval is : [2010 (T-I)]
 (a) Lower limit + Upper limit (b) Upper limit – Lower limit
 (c) $\frac{1}{2}$ (Lower limit + Upper limit) (d) $\frac{1}{4}$ (Lower limit + Upper limit)
11. If mode of a data is 45, mean is 27, then median is : [2010 (T-I)]
 (a) 30 (b) 27 (c) 23 (d) None of these
12. For the following distribution : [2010 (T-I)]

Marks	Below 10	Below 20	Below 30	Below 40	Below 50	Below 60
No. of students	3	12	27	57	75	80

- The modal class is :
 (a) 10–20 (b) 20–30 (c) 30–40 (d) 50–60
13. For a given data with 60 observations the ‘less than ogive’ and ‘more than ogive’ intersect at (66.5, 30). The median of the data is : [2010 (T-I)]
 (a) 66.5 (b) 30 (c) 60 (d) 36.5
14. The abscissa of the point of intersection of the less than type and of the more than type cumulative frequency curves of a grouped data gives its : [2010 (T-I)]
 (a) mean (b) median (c) mode (d) all the three above
15. A data has 25 observations (arranged in descending order). Which observation represents the median ? [2010 (T-I)]
 (a) 12th (b) 13th (c) 14th (d) 15th
16. If mode of the following data is 7, then value of k in 2, 4, 6, 7, 5, 6, 10, 6, 7, $2k + 1$, 9, 7, 13 is : [2010 (T-I)]
 (a) 3 (b) 7 (c) 4 (d) 2
17. The mean and median of a data are 14 and 16 respectively. The value of mode is : [2010 (T-I)]
 (a) 13 (b) 16 (c) 18 (d) 20
18. The upper limit of the median class of the following distribution is : [2010 (T-I)]

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

- (a) 17 (b) 17.5 (c) 18 (d) 18.5
19. The measures of central tendency which can't be found graphically is : [2010 (T-I)]
 (a) mean (b) median (c) mode (d) none of these
20. The measure of central tendency which takes into account all data items is : [2010 (T-I)]
 (a) mode (b) mean (c) median (d) none of these

SHORT ANSWER TYPE QUESTIONS

[2 Marks]

A. Important Questions

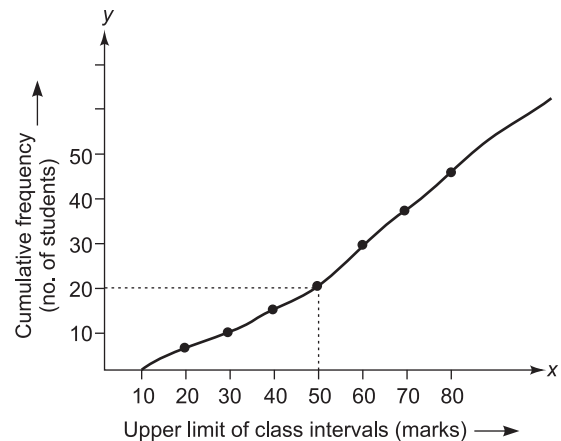
- The following are the marks of 9 students in a class. Find the median marks :
21, 24, 27, 30, 32, 34, 35, 38, 48.
- Find the median of the daily wages of ten workers from the following data :

8, 9, 11, 14, 15, 17, 18, 20, 22, 25.

- Find the mode of the given data : 120, 110, 130, 110, 120, 140, 130, 120, 140, 120.
- Find the mode of the following data :
25, 16, 19, 48, 19, 20, 34, 15, 19, 20, 21, 24, 19, 16, 22, 16, 18, 20, 16, 19.
- Find the value of x , if the mode of the following data is 25.
15, 20, 25, 18, 14, 15, 25, 15, 18, 16, 20, 25, 20, x , 18.
- Calculate the mean for the following distribution :

$x :$	5	6	7	8	9
$f :$	4	8	14	11	3

- Find the mode of the following data :
15, 8, 26, 24, 15, 18, 20, 15, 24, 19, 15.
- Is it correct to say that an ogive is a graphical representation of a frequency distribution ? Give reason.
- Is it true to say that mean, median and mode of a grouped data will always be different. Justify your answer.
- Will the median class and modal class of a grouped data always be different ? Justify your answer.
- A student draws a cumulative frequency curve for the marks obtained by 40 students of a class as shown. Find the median marks obtained by the students of the class.
- The mean of ungrouped data and the mean calculated when the same data is grouped are always the same. Do you agree with the statement ? Give reason.



- What is the lower limit of the modal class of the following frequency distribution ?

Age (in years)	0–10	10–20	20–30	30–40	40–50	50–60
No. of patients	16	13	6	11	27	18

- Find the sum of the deviations of the variate values 3, 4, 6, 7, 8, 14 from their mean.
- If the mean of the following distribution is 6, find the value of p :

x	2	4	6	10	$p + 5$
y	3	2	3	1	2

- If \bar{x} is the mean of ten natural numbers x_1, x_2, \dots, x_{10} , show that :
 $(x_1 - \bar{x}) + (x_2 - \bar{x}) + (x_3 - \bar{x}) + \dots + (x_{10} - \bar{x}) = 0$.

- For a particular year, the following is the distribution of the ages (in yrs.) of primary school teachers in a state :

Age (in yrs)	16–20	21–25	26–30	31–35	36–40	41–45	46–50
No. of teachers	11	32	51	49	27	6	4

Find how many teachers are of age less than 31 years.

- If $\sum f_i = 11, \sum f_i x_i = 2p + 52$ and the mean of the distribution is 6, find the value of p .

- A class teacher has the following absentee record of 40 students of a class for the whole term. Find the mean number of days a student was absent.

No. of days :	0–6	6–10	10–14	14–20	20–28	28–38	38–40
No. of students	11	10	7	4	4	3	1

- The table given below shows the frequency distribution of the scores obtained by 200 candidates in an MBA examination.

Score	200–250	250–300	300–350	350–400	400–450	450–500	500–550	550–600
No. of Candidates	30	15	45	20	25	40	10	15

Draw a cumulative frequency curve by using less than series.

21. The shirt sizes worn by a group of 200 persons, who bought the shirt from a store are as follows :

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

Find the modal shirt size worn by the group.

22. Find the median wage of a worker engaged at a construction site whose data are given below :

Wages (in Rs.)	3500	3800	4100	4500	5500	6500	7000
No. of workers	12	13	25	17	15	12	6

23. Find the median for the following data :

Marks (out of 20)	5	9	10	12	13	16	18	20
No. of students	4	5	6	42	11	6	4	2

24. Find f and F .

Marks	0–10	10–30	30–60	60–80	80–90	
No. of students (frequency)	5	15	f	8	2	$N = 60$
c.f.	5	F	50	58	60	$N = \sum f_i = 60$

B. Questions From CBSE Examination Papers

1. Convert the following data into more than type distribution. [2010 (T-I)]

Class Intervals	50–55	55–60	60–65	65–70	70–75	75–80
Frequency	2	8	12	24	38	16

2. Find the mean of the following data. [2010 (T-I)]

Class Intervals	1–3	3–5	5–7	7–9	9–11
Frequency	7	8	2	2	1

3. Find the modal class and the median class for the following distribution. [2010 (T-I)]

C.I.	0–10	10–20	20–30	30–40	40–50
Frequency	6	10	12	8	7

4. Find the modal class and the median class for the following distribution : [2010 (T-I)]

Class Intervals	135–140	140–145	145–150	150–155	155–160	160–165
Frequency	4	7	18	11	6	5

5. The mean of the following data is 7.5. Find the value of P . [2010 (T-I)]

x_i	3	5	7	9	11	13
f_i	6	8	15	P	8	4

6. Find the mean of the following frequency distribution table. [2010 (T-I)]

C.I.	0–10	10–20	20–30	30–40	40–50
Frequency	5	12	10	14	9

7. The median class of a frequency distribution is 125–145. The frequency and cumulative frequency of the

class preceding to the median class are 20 and 22 respectively. Find the sum of the frequencies, if the median is 137. **[2010 (T-I)]**

8. A survey conducted on 20 households in a locality by a group of students resulted in the following frequency table for the number of family members in a household. **[2010 (T-I)]**

Family size :	1-3	3-5	5-7	7-9	9-11
No. of families :	7	8	2	2	1

Find the mode for the data above :

9. Find the mode of given distribution : **[2010 (T-I)]**

C.I.	0-10	10-20	20-30	30-40	40-50
Frequency	2	12	22	8	6

10. Write the frequency distribution table for the following data : **[2010 (T-I)]**

Marks	Below 10	Below 20	Below 30	Below 40	Below 50	Below 60
No. of students	0	12	20	28	33	40

11. The marks obtained by 60 students, out of 50 in a Mathematics examination, are given below :

[2010 (T-I)]

Marks	0-10	10-20	20-30	30-40	40-50
No. of students	5	13	12	20	10

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

12. Find the mode of the given data : **[2010 (T-I)]**

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

13. Find the median of the following given data : **[2010 (T-I)]**

x	6	7	5	2	10	9	3
f	9	12	8	13	11	14	7

14. Write the frequency distribution table for the following data : **[2010 (T-I)]**

Marks	Above 0	Above 10	Above 20	Above 30	Above 40	Above 50
No. of students	30	28	21	15	10	0

15. Construct the frequency distribution table for the given data : **[2010 (T-I)]**

Marks Obtained	Less than 10	Less than 20	Less than 30	Less than 40	Less than 50	Less than 60
No. of students	14	22	37	58	67	75

16. Find the mode of the given data : **[2010 (T-I)]**

Class Intervals	3-6	6-9	9-12	12-15	15-18	18-21	21-24
Frequency	2	5	10	23	21	12	3

17. Find the mean of the following frequency distribution : **[2003, 2007]**

Class	0-10	10-20	20-30	30-40	40-50
Frequency	8	12	10	11	9

18. The wickets taken by a bowler in 10 cricket matches are as follows : **[2010 (T-I)]**

2 6 4 5 0 2 1 3 2 3

Find the mode of the data.

19. Find the median for the following frequency distribution : **[2010 (T-I)]**

Class Intervals	10-19	20-29	30-39	40-49	50-59	60-69	70-79
Frequency	2	4	8	9	4	2	1

20. Find the median of the following data. **[2010 (T-I)]**

Marks	0–10	10–30	30–60	60–80	80–100
Frequency	5	15	30	8	2

21. Convert the given cumulative frequency table into frequency distribution table : [2010 (T-I)]

Marks	Number of students
0 and above	120
20 and above	108
40 and above	90
60 and above	75
80 and above	50
100 and above	24
120 and above	9
140 and above	0

22. For the data given below draw more than ogive graph and find the value of median. [2010 (T-I)]

Production (in tons)	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	Total
No. of labourers	8	18	23	37	47	26	16	7	182

23. If the mean of the following data is 18.75, find the value of p . [2005]

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

24. The mean of the following frequency distribution is 62.8. Find the missing frequency x . [2007]

Class	0–20	20–40	40–60	60–80	80–100	100–120
Frequency	5	8	x	12	7	8

25. What is the lower limit of the modal class of the following frequency distribution ? [2009]

Age (in yrs)	0–10	10–20	20–30	30–40	40–50	50–60
No. of patients	6	13	6	11	27	18

26. Find the median class of the following data : [2008]

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

SHORT ANSWER TYPE QUESTIONS

[3 Marks]

A. Important Questions

1. Using short-cut method (Deviation method), calculate the mean of the following frequency distribution.

Daily earnings (in Rs.)	950	1000	1050	1100	1250	1500	1600
No. of shopkeepers	24	18	13	15	20	11	9

2. The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is Rs. 18. Find the missing frequency f .

Daily pocket allowance (in Rs.)	11–13	13–15	15–17	17–19	19–21	21–23	23–25
No. of children	7	6	9	13	f	5	4

3. Find the value of p if the mean of following distribution is 20. [V. Imp.]

x	15	17	19	$20 + p$	23
f	2	3	4	$5p$	6

4. The following data gives the information of the observed lifetimes (in hours) of 225 electrical components : [Imp.]

Lifetime (in hours)	0–20	20–40	40–60	60–80	80–100	100–120
Frequency	10	35	52	61	38	29

Determine the modal lifetimes of components.

5. A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarised it in the table given below. Find the mode of the data :

No. of cars	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80
Frequency	7	14	13	12	20	11	15	8

6. If the mode of the following distribution is 57.5, find the value of x .

x	30–40	40–50	50–60	60–70	70–80	80–90	90–100
f	6	10	16	x	10	5	2

7. The distribution below gives the weights of 30 students of a class. Find the median weight of the students.

Weight (in kg)	40–45	45–50	50–55	55–60	60–65	65–70	70–75
Number of students	2	3	8	6	6	3	2

8. Using assumed mean method, find the mean of the following data :

x	240	250	260	270	280	290	300
f	15	25	32	47	15	12	4

9. Find the value of p , if the value of the following distribution is 55.

x	$p + 3$	30	50	70	89
f	p	8	10	15	10

10. Compute the mode of the following data :

Class-interval	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50
Frequency	3	8	13	18	28	20	13	8	6	4

11. Calculate the missing frequency from the following distribution, it is given that the median of the distribution is 24.

Class-interval	0–10	10–20	20–30	30–40	40–50
Frequency	5	25	?	18	7

12. Find the median wages for the following frequency distribution.

Wage per day (in Rs.)	61–70	71–80	81–90	91–100	101–110	111–120
No. of workers	5	15	20	30	20	8

B. Questions From CBSE Examination Papers

1. Find the mean of the following data : [2010 (T-I)]

Classes	25–30	30–35	35–40	40–45	45–50	50–55	55–60
Frequency	14	22	16	6	5	3	4

2. Find the median of the following data : [2010 (T-I)]

Marks	Number of Students
0 and above	80
10 and above	77
20 and above	72
30 and above	65

40 and above	55
50 and above	43
60 and above	28
70 and above	16
80 and above	10
90 and above	8
100 and above	0

3. Find the mean of the following data. [2010 (T-I)]

Classes-interval	30–40	40–50	50–60	60–70	70–80	80–90	90–100
Frequency	2	3	8	6	6	3	2

4. Find the median daily expenses from the following data. [2010 (T-I)]

Daily Expenses (in Rs.)	No. of families
20–40	6
40–60	9
60–80	11
80–100	14
100–120	20
120–140	15
140–160	10
160–180	8
180–200	7
Total	100

5. The mean of the following distribution is 62.8 and the sum of all frequencies is 50. Compute the missing frequencies f_1 and f_2 . [2010 (T-I)]

Classes	0–20	20–40	40–60	60–80	80–100	100–120	Total
Frequency	5	f_1	10	f_2	7	8	50

6. Find unknown entries a, b, c, d, e, f in the following distribution of heights of students in a class and the total number of students in the class in 50. [2010 (T-I)]

Height in c.m.	150–155	155–160	160–165	165–170	170–175	175–180
Frequency	12	b	10	d	e	2
Cumulative frequency	a	25	c	43	48	f

7. Find the mean marks from the following data : [2010 (T-I)]

Marks	Below 10	Below 20	Below 30	Below 40	Below 50	Below 60
Number of students	4	10	18	28	40	70

8. Find the median of the following data [2010 (T-I)]

C.I.	0–10	10–20	20–30	30–40	40–50	Total
Frequency	8	16	36	34	6	100

9. Draw a less than ogive for the following frequency distribution : [2010 (T-I)]

Classes	150–155	155–160	160–165	165–170	170–175	175–180
Frequency	6	10	22	34	16	12

10. The given distribution shows the number of runs scored by some top batsmen of the world in one-day international cricket matches. Find the mode of the data. [2010 (T-I)]

Runs Scored	3000–4000	4000–5000	5000–6000	6000–7000
No. of batsmen	4	18	9	7
Runs Scored	7000–8000	8000–9000	9000–10000	10000–11000
No. of batsmen	6	3	1	1

11. During the medical check up of 35 students of a class, their weights were recorded as follows. Draw a less than type ogive for the given data. Hence obtain median weight from the graph. [2010 (T-I)]

Weight (in kg)	Number of Students
less than 38	0
less than 40	3
less than 42	5
less than 44	9
less than 46	14
less than 48	28
less than 50	32
less than 52	35

12. Find mean of the following frequency distribution using step deviation method. [2010 (T-I)]

Classes	0–10	10–20	20–30	30–40	40–50
Frequency	7	10	15	8	10

13. Find the missing frequency for the given frequency distribution table, if the mean of the distribution is 18. [2010 (T-I)]

Classes	11–13	13–15	15–17	17–19	19–21	21–23	23–25
Frequency	3	6	9	13	f	5	4

14. Find the mode of the following frequency distribution : [2010 (T-I)]

Marks	10–20	20–30	30–40	40–50	50–60	60–70	70–80
No. of students	4	8	10	12	10	4	2

15. Find the median of the following data. [2010 (T-I)]

Classes	500–600	600–700	700–800	800–900	900–1000
Frequency	40	28	35	22	25

16. Find the missing frequencies f_1 and f_2 if mean of 50 observations is 38.2. [2010 (T-I)]

Classes Interval	0–10	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	4	4	f_1	10	f_2	8	5

17. The median of the distribution given below is 35. Find the value of x and y , if the sum all frequencies is 170. [2010 (T-I)]

Variable	0–10	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	10	20	x	40	y	25	15

18. The mean of the following data is 53, find the missing frequencies. [2010 (T-I)]

Age in years	0–20	20–40	40–60	60–80	80–100	Total
No. of people	15	f_1	21	f_2	17	100

19. The daily expenditure of 100 families are given below. Calculate f_1 and f_2 , if the mean daily expenditure is Rs. 188. [2010 (T-I)]

Expenditure	140–160	160–180	180–200	200–220	220–240
No. of families	5	25	f_1	f_2	5

20. Compute the median for the following data : [2010 (T-I)]

Class interval	Less than 20	Less than 30	Less than 40	Less than 50	Less than 60	Less than 70	Less than 80	Less than 90	Less than 100
Cumulative frequency	0	4	16	30	46	66	82	92	100

21. Find the missing frequencies in the following frequency distribution table, if $N = 100$ and median is 32. [2010 (T-I)]

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

22. Find the median of the following data [2010 (T-I)]

Class Interval	40–45	45–50	50–55	55–60	60–65	65–70	70–75
Frequency	2	3	8	6	6	3	2

23. Find the mean of the following data using step deviation method. [2010 (T-I)]

Class Interval	0–10	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	4	4	7	10	12	8	5

24. Find the mode of following frequency distribution : [2010 (T-I)]

Class Interval	0–10	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	5	8	15	20	14	8	5

25. Find the median of the following data : [2010 (T-I)]

Height (in cm)	Less than 120	Less than 140	Less than 160	Less than 180	Less than 200
Number of students	12	26	34	40	50

26. Find mode of the given data : [2010 (T-I)]

C.I.	0–10	10–20	20–30	30–40	40–50	50–60
Frequency	16	13	6	11	27	18

27. The mean of the following frequency distribution is 57.6 and the sum of observations is 50. Find the missing frequencies f_1 and f_2 . [2004]

Class	0–20	20–40	40–60	60–80	80–100	100–120	Total
Frequency	7	f_1	12	f_2	8	5	50

28. Find the mode from the following frequency distribution : [2004]

Class interval	25–50	50–75	75–100	100–125	125–150	150–175	175–200
Frequency	12	17	20	30	25	19	11

29. Find the modal marks from the following table : [2004]

Marks	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80
No. of students	5	18	30	45	40	15	10	6

30. Find the mode from the following data : [2005]

Height (in cm)	80–90	90–100	100–110	110–120	120–130
No. of students	7	11	5	4	10

A. Important Questions

1. Find the missing frequencies f_1 and f_2 in the following frequency distribution, if it is known that the mean of the distribution is 50 and the total frequency is 150. [HOTS]

x	10	30	50	70	90
f	17	f_1	32	f_2	19

2. A life insurance agent found the following data for distribution of ages of 100 policy holders. Calculate the median age, if policies are given only to persons having age 18 years onwards but less than 60 years.

Age (in years)	Number of policy holders
Below 20	2
Below 25	6
Below 30	24
Below 35	45
Below 40	78
Below 45	89
Below 50	92
Below 55	98
Below 60	100

3. Find the mean marks of the students from the following frequency distribution.

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

4. Calculate the mode from the following data :

Monthly salary (in Rs)	No. of employees
less than 5000	90
less than 10000	240
less than 15000	340
less than 20000	420
less than 25000	490
less than 30000	500

5. Compute the median for the following data :

Marks (more than or equal to)	No. of students
80	150
90	141
100	124
110	105
120	60
130	27
140	12
150	0

6. The median value for the following frequency distribution is 35 and the sum of all the frequencies is 170. Find the values of x and y .

C.I.	0–10	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	10	20	x	40	y	25	15

7. Find the mode of the marks obtained by 80 students in a class test in mathematics as given below :

Marks	No. of students
less than 10	3
less than 20	8
less than 30	24
less than 40	36
less than 50	49
less than 60	69
less than 70	75
less than 80	80

8. The following table shows the ages of the patients admitted in a hospital during a year.

Age (in years) (more than or equal to)	5	15	25	35	45	55
No. of patients	80	74	63	42	19	5

Find the mode and mean of the data given above. Compare and interpret the two measures of central tendency.

9. The mode of the following distribution is 65.625 hours. Find the value of p .

Lifetime (in hours)	0–20	20–40	40–60	60–80	80–100	100–120
Frequency	10	35	52	61	p	29

10. Find the median for the following data :

Marks	Below 10	Below 20	Below 30	Below 40	Below 50	Below 60	Below 70	Below 80
Number of students	12	32	57	80	92	116	164	200

11. A survey regarding the height (in cm) of 51 girls of class X of a school was conducted and the following data was obtained.

Height in cm	Number of girls
Less than 140	4
Less than 145	11
Less than 150	29

Less than 155	40
Less than 160	46
Less than 165	51

Find the median height.

12. The following table gives the distribution of the lifetime of neon lamps. [Imp.]

Lifetime (in hours) (more than or equal to)	1500	2000	2500	3000	3500	4000	4500	5000
No. of lamps	400	386	330	270	184	110	48	0

Find the median lifetime of a lamp.

13. The annual profits earned by 38 shops in a market is represented in following table. [Imp.]

Profit (in lakhs of Rs) (more than or equal to)	5	10	15	20	25	30	35
No. of shops	38	28	16	14	10	7	3

Draw both the ogives for the above data and hence obtain the median.

14. From the following data, draw the two types of cumulative frequency curves and determine the median.

Height (in cm)	Frequency
140–144	3
144–148	9
148–152	24
152–156	31
156–160	42
160–164	64
164–168	75
168–172	82
172–176	86
176–180	34

B. Questions From CBSE Examination Papers

1. Convert the following data to a less than type distribution and draw its ogive. Also find the median from the graph. [2010 (T-I)]

Class Interval	100–120	120–140	140–160	160–180	180–200
Frequency	12	14	8	6	10

2. Convert the following data into a more than type distribution and draw its ogive. Also find the median of the data from the graph. [2010 (T-I)]

Class Interval	100–120	120–140	140–160	160–180	180–200
Frequency	12	14	8	6	10

3. Draw 'more than ogive' for the following frequency distribution and hence obtain the median.

[2010 (T-I)]

Class Interval	5–10	10–15	15–20	20–25	25–30	30–35	35–40
Frequency	2	12	2	4	3	4	3

4. Draw 'less than ogive' for the following frequency distribution and hence obtain the median.

[2010 (T-I)]

Marks obtained	10–20	20–30	30–40	40–50	50–60	60–70	70–80
No. of students	3	4	3	3	4	7	9

5. If the median of the following data is 525. Find the values of x and y if the sum of the frequencies is 100. [2010 (T-I)]

Class Interval	0–100	100–200	200–300	300–400	400–500
Frequency	2	5	x	12	17

Class Interval	500–600	600–700	700–800	800–900	900–1000
Frequency	20	y	9	7	4

6. Calculate the mode of the following frequency distribution table. [2010 (T-I)]

Marks	Above 25	Above 35	Above 45	Above 55	Above 65	Above 75	Above 85
Number of students	52	47	37	17	8	2	0

7. During medical check up of 35 students of a class, their weights were recorded. [2010 (T-I)]

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

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

8. Change the following data into less than type distribution and draw its ogive. Hence find the median of the data. [2010 (T-I)]

Marks obtained	30–39	40–49	50–59	60–69	70–79	80–89	90–99
No. of students	5	7	8	10	5	8	7

9. Draw less than and more than ogive for the following distribution and hence obtain the median.

[2010 (T-I)]

Marks	30–40	40–50	50–60	60–70	70–80	80–90	90–100
No. of students	14	6	10	20	30	8	12

10. The following distribution gives the annual profit earned by 30 shops of a shopping complex.

[2010 (T-I)]

Profit (in Lakh Rs.)	0–5	5–10	10–15	15–20	20–25
No. of shops	3	14	5	6	2

Change the above distribution to more than type distribution and draw its ogive.

11. Following distribution shows the marks obtained by the class of 100 students.

[2010 (T-I)]

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

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

12. Find the median by drawing both ogives. [2010 (T-I)]

Class Interval	50–60	60–70	70–80	80–90	90–100
Frequency	3	5	9	12	6

13. If the median of the distribution given below is 28.5, find the values of x and y . [2010 (T-I)]

Class Intervals	0–10	10–20	20–30	30–40	40–50	50–60	Total
Frequency	5	x	20	15	y	5	60

14. The mean of the following data is 50. Find the missing frequencies f_1 and f_2 . [2010 (T-I)]

C.I.	0–20	20–40	40–60	60–80	80–100	Total
No. of students	17	f_1	32	f_2	19	120

15. Draw a less than ogive for the following data : [2010 (T-I)]

Marks	Number of students
Less than 20	0
Less than 30	4
Less than 40	16
Less than 50	30
Less than 60	46
Less than 70	66
Less than 80	82
Less than 90	92
Less than 100	100

Find the median of the data from the graph and verify the result using the formula.

16. The following table gives the distribution of expenditures of different families on education. Find the mean expenditure on education of a family. [2004]

Expenditure (in Rs.)	Number of families
1000–1500	24
1500–2000	40
2000–2500	33
2500–3000	28
3000–3500	30
3500–4000	22
4000–4500	16
4500–5000	7

17. 100 surnames were randomly picked up from a local telephone directory and the frequency distribution of the number of letters in the English alphabet in the surnames was obtained as follows : [2008]

Number of letters	1–4	4–7	7–10	10–13	13–16	16–19
Number of surnames	6	30	40	16	4	4

Determine the median number of letters in the surnames. Find the mean number of letters in the surnames. Also, find the modal size of the surnames.

18. Find the mean, mode and median of the following data : [2008]

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

19. The following table gives the daily income of 50 workers of a factory : [2008]

Daily income (in Rs.)	100–120	120–140	140–160	160–180	180–200
No. of workers	12	14	8	6	10

Find the mean, median and mode of the above data.

20. The median of the following data is 52.5. Find the values of x and y if the total frequency is 100. [2009]

Class Interval	Frequency
0–10	2
10–20	5
20–30	x
30–40	12
40–50	17
50–60	20
60–70	y
70–80	9
80–90	7
90–100	4

21. Find the mode, median and mean for the following data : [2009]

Marks obtained	25–35	35–45	45–55	55–65	65–75	75–85
No. of students	7	31	33	17	11	1

FORMATIVE ASSESSMENT

Activity 1

Objective : To find median graphically.

Materials Required : Graph paper and geometry box.

Preparation for the Activity :

We shall learn the process with the help of an illustration. Let us compute the median of the following data.

Marks	15 – 20	20 – 25	0 – 5	30 – 35	25 – 30	5 – 10	35 – 40	10 – 15
No. of students	10	18	4	22	25	6	7	8

We shall learn two methods to find out median. Before that let us put the data in a proper form and complete the requisites.

1. Arrange the data in ascending order, i.e., put the intervals in proper sequence 0 – 5, 5 – 10, 10 – 15, 35 – 40 along with their respective frequencies.
2. Compute frequencies for ‘Marks less than’, the upper limits of each class interval.
3. Compute frequencies for ‘Marks more than’, the lower limits of each class interval.

Original given data

Marks	No. of students
15 – 20	10
20 – 25	18
0 – 5	4
30 – 35	22
25 – 30	25
5 – 10	6
35 – 40	7
10 – 15	8

Marks	No. of students
Less than 5	4
Less than 10	$4 + 6 = 10$
Less than 15	$10 + 8 = 18$
Less than 20	$18 + 10 = 28$
Less than 25	$28 + 18 = 46$
Less than 30	$46 + 25 = 71$
Less than 35	$71 + 22 = 93$
Less than 40	$93 + 7 = 100$

Arranged in Ascending order of marks

Marks	No. of students
0 – 5	4
5 – 10	6
10 – 15	8
15 – 20	10
20 – 25	18
25 – 30	25
30 – 35	22
35 – 40	7

Marks	No. of students
More than 0	$100 - 0 = 100$
More than 5	$100 - 4 = 96$
More than 10	$96 - 6 = 90$
More than 15	$90 - 8 = 82$
More than 20	$82 - 10 = 72$
More than 25	$72 - 18 = 54$
More than 30	$54 - 25 = 29$
More than 35	$29 - 22 = 7$
More than 40	$7 - 7 = 0$

Method 1. Using less than ogive only

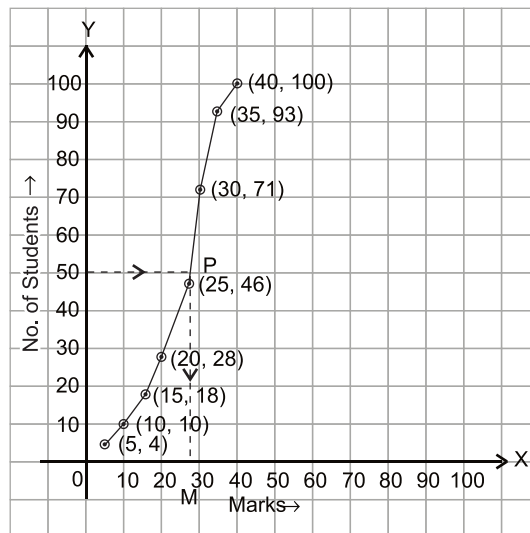


Figure 1

1. Mark the upper limits along X-axis on a suitable scale.
2. Mark the corresponding (less than) frequencies along Y-axis choosing a suitable scale.
3. Plot the points (5, 4); (10, 10); (15, 18); (20, 28); (25, 46); (30, 71); (35, 93); (40, 100)
4. Join the points (with free hand) to get a curve as shown in figure 1.

5. Compute $\frac{N}{2}$, i.e., $\frac{100}{2} = 50$ and mark the corresponding point on Y -axis as shown in figure 1.
6. Draw a line parallel to X -axis, from the point marked in the above step, meeting the curve at P(say) as shown in figure 1.
7. Draw perpendicular PM from P on the X -axis as shown in figure 1. The abscissa of M gives the median value.
 \therefore Median (M_e) = 26.

Method 2. Using less than ogive and more than ogive (both).

1. Draw both 'less than' and 'more than' ogives on the same graph paper as shown in figure 2.
2. Mark the point of intersection of these two ogives as P(say) as shown in figure 2

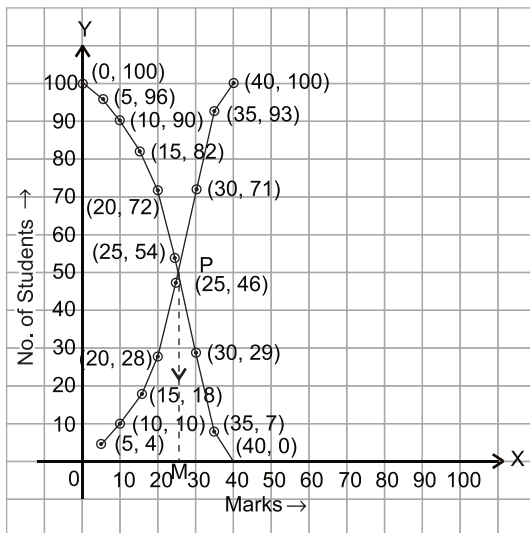


Figure 2

3. Draw perpendicular PM from P on the X -axis as shown in figure 2.
 The x -coordinate of point M gives the median value.
 \therefore Median (M_e) = 26.
 You can verify this algebraically. The value obtained graphically will be the same as obtained algebraically except for errors in plotting and reading the scale.

Activity 2

Objective : To find mode graphically.

Materials Required : Graph paper and geometry box.

Preparation for the Activity : We shall take some data, as in the previous activity, to understand the process of finding mode graphically.

Let us compute the mode of the following data :

Marks	0 – 5	5 – 10	10 – 15	15 – 20	20 – 25	25 – 30	30 – 35	35 – 40
No. of students	4	6	8	10	18	25	22	7

1. Draw a histogram from the given data, taking marks along X -axis and frequencies along Y -axis shown in figure 1.
2. Decide the bar of the corresponding modal class.

3. Join the left upper corner point A of the modal bar with left upper corner C of the bar of the succeeding class interval to get AC as shown in figure 1.
4. Similarly, join the upper right corner point B of the bar of the modal class with the upper right corner point D of the bar of the preceding class interval to get BD as shown in figure 1.
5. AC and BD intersect at a point P(say) as shown in figure 1.
6. From the point P, draw a perpendicular PM on X-axis as shown in figure 1.
7. The x -coordinate of the point M will give the modal value.

\therefore Mode (M_0) = 28.5.

You can verify this algebraically. The value obtained graphically will be the same as obtained algebraically except for errors in plotting and reading the scale.

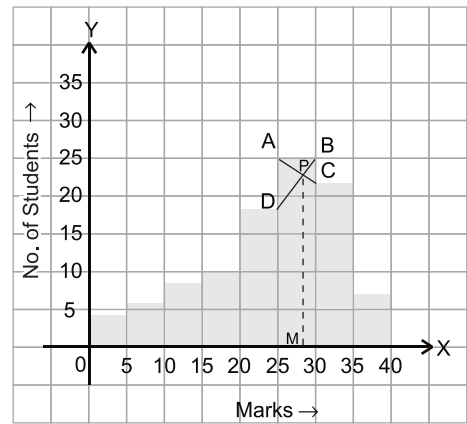


Figure 1

**Exercise 14.1****Question 1:**

A survey was conducted by a group of students as a part of their environment awareness programme, in which they collected the following data regarding the number of plants in 20 houses in a locality. Find the mean number of plants per house.

Number of plants	0 – 2	2 – 4	4 – 6	6 – 8	8 – 10	10 – 12	12 – 14
Number of houses	1	2	1	5	6	2	3

Which method did you use for finding the mean, and why?

Answer:

To find the class mark (x_i) for each interval, the following relation is used.

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

Class mark (x_i) =

2

x_i and $f_i x_i$ can be calculated as follows.

Number of plants	Number of houses (f_i)	x_i	$f_i x_i$
0 – 2	1	1	$1 \times 1 = 1$
2 – 4	2	3	$2 \times 3 = 6$
4 – 6	1	5	$1 \times 5 = 5$
6 – 8	5	7	$5 \times 7 = 35$
8 – 10	6	9	$6 \times 9 = 54$
10 – 12	2	11	$2 \times 11 = 22$
12 – 14	3	13	$3 \times 13 = 39$



Total	20		162
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From the table, it can be observed that

$$\sum f_i = 20$$

$$\sum f_i x_i = 162$$

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

Mean,

$$= \frac{162}{20} = 8.1$$

Therefore, mean number of plants per house is 8.1.

Here, direct method has been used as the values of class marks (x_i) and f_i are small.

Question 2:

Consider the following distribution of daily wages of 50 worker of a factory.

Daily wages (in Rs)	100 – 120	120 – 140	140 – 160	160 – 180	180 – 200
Number of workers	12	14	8	6	10

Find the mean daily wages of the workers of the factory by using an appropriate method.

Answer:

To find the class mark for each interval, the following relation is used.

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

Class size (h) of this data = 20

Taking 150 as assured mean (a), d_i , u_i , and $f_i u_i$ can be calculated as follows.



Daily wages (in Rs)	Number of workers (f_i)	x_i	$d_i = x_i - 150$	$u_i = \frac{d_i}{20}$	$f_i u_i$
100 – 120	12	110	– 40	– 2	– 24
120 – 140	14	130	– 20	– 1	– 14
140 – 160	8	150	0	0	0
160 – 180	6	170	20	1	6
180 – 200	10	190	40	2	20
Total	50				– 12

From the table, it can be observed that

$$\sum f_i = 50$$

$$\sum f_i u_i = -12$$

$$\begin{aligned}\text{Mean } \bar{x} &= a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h \\ &= 150 + \left(\frac{-12}{50} \right) 20 \\ &= 150 - \frac{24}{5} \\ &= 150 - 4.8 \\ &= 145.2\end{aligned}$$

Therefore, the mean daily wage of the workers of the factory is Rs 145.20.

Question 3:

The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is Rs.18. Find the missing frequency f .



Daily pocket allowance (in Rs)	11 – 13	13 – 15	15 – 17	17 – 19	19 – 21	21 – 23	23 – 25
Number of workers	7	6	9	13	f	5	4

Answer:

To find the class mark (x_i) for each interval, the following relation is used.

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

Given that, mean pocket allowance, $\bar{x} = \text{Rs } 18$

Taking 18 as assured mean (a), d_i and $f_i d_i$ are calculated as follows.

Daily pocket allowance (in Rs)	Number of children f_i	Class mark x_i	$d_i = x_i - 18$	$f_i d_i$
11 – 13	7	12	– 6	– 42
13 – 15	6	14	– 4	– 24
15 – 17	9	16	– 2	– 18
17 – 19	13	18	0	0
19 – 21	f	20	2	$2f$
21 – 23	5	22	4	20
23 – 25	4	24	6	24
Total	$\sum f_i = 44 + f$			$2f - 40$

From the table, we obtain



$$\sum f_i = 44 + f$$

$$\sum f_i u_i = 2f - 40$$

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

$$18 = 18 + \left(\frac{2f - 40}{44 + f} \right)$$

$$0 = \left(\frac{2f - 40}{44 + f} \right)$$

$$2f - 40 = 0$$

$$2f = 40$$

$$f = 20$$

Hence, the missing frequency, f , is 20.

Question 4:

Thirty women were examined in a hospital by a doctor and the number of heart beats per minute were recorded and summarized as follows. Find the mean heart beats per minute for these women, choosing a suitable method.

Number of heart beats per minute	65 – 68	68 – 71	71 – 74	74 – 77	77 – 80	80 – 83	83 – 86
Number of women	2	4	3	8	7	4	2

Answer:

To find the class mark of each interval (x_i), the following relation is used.

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

Class size, h , of this data = 3

Taking 75.5 as assumed mean (a), d_i , u_i , $f_i u_i$ are calculated as follows.



Number of heart beats per minute	Number of women f_i	x_i	$d_i = x_i - 75.5$	$u_i = \frac{d_i}{3}$	$f_i u_i$
65 – 68	2	66.5	– 9	– 3	– 6
68 – 71	4	69.5	– 6	– 2	– 8
71 – 74	3	72.5	– 3	– 1	– 3
74 – 77	8	75.5	0	0	0
77 – 80	7	78.5	3	1	7
80 – 83	4	81.5	6	2	8
83 – 86	2	84.5	9	3	6
Total	30				4

From the table, we obtain

$$\sum f_i = 30$$

$$\sum f_i u_i = 4$$

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

$$= 75.5 + \left(\frac{4}{30} \right) \times 3$$

$$= 75.5 + 0.4 = 75.9$$

Therefore, mean hear beats per minute for these women are 75.9 beats per minute.

**Question 5:**

In a retail market, fruit vendors were selling mangoes kept in packing boxes. These boxes contained varying number of mangoes. The following was the distribution of mangoes according to the number of boxes.

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

Find the mean number of mangoes kept in a packing box. Which method of finding the mean did you choose?

Answer:

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

It can be observed that class intervals are not continuous. There is a gap of 1

between two class intervals. Therefore, $\frac{1}{2}$ has to be added to the upper class limit

and $\frac{1}{2}$ has to be subtracted from the lower class limit of each interval.

Class mark (x_i) can be obtained by using the following relation.



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

Class size (h) of this data = 3

Taking 57 as assumed mean (a), d_i , u_i , $f_i u_i$ are calculated as follows.

Class interval	f_i	x_i	$d_i = x_i - 57$	$u_i = \frac{d_i}{3}$	$f_i u_i$
49.5 – 52.5	15	51	- 6	- 2	- 30
52.5 – 55.5	110	54	- 3	- 1	- 110
55.5 – 58.5	135	57	0	0	0
58.5 – 61.5	115	60	3	1	115
61.5 – 64.5	25	63	6	2	50
Total	400				25

It can be observed that

$$\sum f_i = 400$$

$$\sum f_i u_i = 25$$

$$\begin{aligned}\text{Mean, } \bar{x} &= a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h \\ &= 57 + \left(\frac{25}{400} \right) \times 3 \\ &= 57 + \frac{3}{16} = 57 + 0.1875 \\ &= 57.1875 \\ &= 57.19\end{aligned}$$

Mean number of mangoes kept in a packing box is 57.19.



Step deviation method is used here as the values of f_i, d_i are big and also, there is a common multiple between all d_i .

Question 6:

The table below shows the daily expenditure on food of 25 households in a locality.

Daily expenditure (in Rs)	100 – 150	150 – 200	200 – 250	250 – 300	300 – 350
Number of households	4	5	12	2	2

Find the mean daily expenditure on food by a suitable method.

Answer:

To find the class mark (x_i) for each interval, the following relation is used.

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

Class size = 50

Taking 225 as assumed mean (a), $d_i, u_i, f_i u_i$ are calculated as follows.

Daily expenditure (in Rs)	f_i	x_i	$d_i = x_i - 225$	$u_i = \frac{d_i}{50}$	$f_i u_i$
100 – 150	4	125	– 100	– 2	– 8
150 – 200	5	175	– 50	– 1	– 5
200 – 250	12	225	0	0	0
250 – 300	2	275	50	1	2
300 – 350	2	325	100	2	4
Total	25				– 7

From the table, we obtain



$$\sum f_i = 25$$

$$\sum f_i u_i = -7$$

$$\begin{aligned}\text{Mean, } \bar{x} &= a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h \\ &= 225 + \left(\frac{-7}{25} \right) \times (50) \\ &= 225 - 14 \\ &= 211\end{aligned}$$

Therefore, mean daily expenditure on food is Rs 211.

Question 7:

To find out the concentration of SO_2 in the air (in parts per million, i.e., ppm), the data was collected for 30 localities in a certain city and is presented below:

concentration of SO_2 (in ppm)	Frequency
0.00 – 0.04	4
0.04 – 0.08	9
0.08 – 0.12	9
0.12 – 0.16	2
0.16 – 0.20	4
0.20 – 0.24	2

Find the mean concentration of SO_2 in the air.

Answer:

To find the class marks for each interval, the following relation is used.



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

Class size of this data = 0.04

Taking 0.14 as assumed mean (a), d_i , u_i , $f_i u_i$ are calculated as follows.

Concentration of SO ₂ (in ppm)	Frequency f_i	Class mark x_i	$d_i = x_i - 0.14$	$u_i = \frac{d_i}{0.04}$	$f_i u_i$
0.00 – 0.04	4	0.02	– 0.12	– 3	– 12
0.04 – 0.08	9	0.06	– 0.08	– 2	– 18
0.08 – 0.12	9	0.10	– 0.04	– 1	– 9
0.12 – 0.16	2	0.14	0	0	0
0.16 – 0.20	4	0.18	0.04	1	4
0.20 – 0.24	2	0.22	0.08	2	4
Total	30				– 31

From the table, we obtain

$$\sum f_i = 30$$

$$\sum f_i u_i = -31$$

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



$$\begin{aligned}
 &= 0.14 + \left(\frac{-31}{30}\right)(0.04) \\
 &= 0.14 - 0.04133 \\
 &= 0.09867 \\
 &\approx 0.099 \text{ ppm}
 \end{aligned}$$

Therefore, mean concentration of SO₂ in the air is 0.099 ppm.

Question 8:

A class teacher has the following absentee record of 40 students of a class for the whole term. Find the mean number of days a student was absent.

Number of days	0 – 6	6 – 10	10 – 14	14 – 20	20 – 28	28 – 38	38 – 40
Number of students	11	10	7	4	4	3	1

Answer:

To find the class mark of each interval, the following relation is used.

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

Taking 17 as assumed mean (a), d_i and $f_i d_i$ are calculated as follows.

Number of days	Number of students f_i	x_i	$d_i = x_i - 17$	$f_i d_i$
0 – 6	11	3	– 14	– 154
6 – 10	10	8	– 9	– 90
10 – 14	7	12	– 5	– 35



14 – 20	4	17	0	0
20 – 28	4	24	7	28
28 – 38	3	33	16	48
38 – 40	1	39	22	22
Total	40			- 181

From the table, we obtain

$$\sum f_i = 40$$

$$\sum f_i d_i = -181$$

$$\text{Mean, } \bar{x} = a + \left(\frac{\sum f_i d_i}{\sum f_i} \right)$$

$$= 17 + \left(\frac{-181}{40} \right)$$

$$= 17 - 4.525$$

$$= 12.475$$

$$\approx 12.48$$

Therefore, the mean number of days is 12.48 days for which a student was absent.

Question 9:

The following table gives the literacy rate (in percentage) of 35 cities. Find the mean literacy rate.

Literacy rate (in %)	45 – 55	55 – 65	65 – 75	75 – 85	85 – 95
Number of cities	3	10	11	8	3

Answer:

To find the class marks, the following relation is used.



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

Class size (h) for this data = 10

Taking 70 as assumed mean (a), d_i , u_i , and $f_i u_i$ are calculated as follows.

Literacy rate (in %)	Number of cities f_i	x_i	$d_i = x_i - 70$	$u_i = \frac{d_i}{10}$	$f_i u_i$
45 – 55	3	50	– 20	– 2	– 6
55 – 65	10	60	– 10	– 1	– 10
65 – 75	11	70	0	0	0
75 – 85	8	80	10	1	8
85 – 95	3	90	20	2	6
Total	35				– 2

From the table, we obtain

$$\sum f_i = 35$$

$$\sum f_i u_i = -2$$

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

$$= 70 + \left(\frac{-2}{35} \right) \times (10)$$

$$= 70 - \frac{20}{35}$$

$$= 70 - \frac{4}{7}$$

$$= 70 - 0.57$$

$$= 69.43$$

Therefore, mean literacy rate is 69.43%.

**Exercise 14.2****Question 1:**

The following table shows the ages of the patients admitted in a hospital during a year:

age (in years)	5 – 15	15 – 25	25 – 35	35 – 45	45 – 55	55 – 65
Number of patients	6	11	21	23	14	5

Find the mode and the mean of the data given above. Compare and interpret the two measures of central tendency.

Answer:

To find the class marks (x_i), the following relation is used.

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

Taking 30 as assumed mean (a), d_i and $f_i d_i$ are calculated as follows.

Age (in years)	Number of patients f_i	Class mark x_i	$d_i = x_i - 30$	$f_i d_i$
5 – 15	6	10	– 20	– 120
15 – 25	11	20	– 10	– 110
25 – 35	21	30	0	0
35 – 45	23	40	10	230
45 – 55	14	50	20	280
55 – 65	5	60	30	150
Total	80			430

From the table, we obtain



$$\sum f_i = 80$$

$$\sum f_i d_i = 430$$

$$\begin{aligned}\text{Mean, } \bar{x} &= a + \frac{\sum f_i d_i}{\sum f_i} \\ &= 30 + \left(\frac{430}{80} \right) \\ &= 30 + 5.375 \\ &= 35.375 \\ &\approx 35.38\end{aligned}$$

Mean of this data is 35.38. It represents that on an average, the age of a patient admitted to hospital was 35.38 years.

It can be observed that the maximum class frequency is 23 belonging to class interval 35 – 45.

Modal class = 35 – 45

Lower limit (l) of modal class = 35

Frequency (f_1) of modal class = 23

Class size (h) = 10

Frequency (f_0) of class preceding the modal class = 21

Frequency (f_2) of class succeeding the modal class = 14

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\ &= 35 + \left(\frac{23 - 21}{2(23) - 21 - 14} \right) \times 10 \\ &= 35 + \left[\frac{2}{46 - 35} \right] \times 10 \\ &= 35 + \frac{20}{11} \\ &= 35 + 1.81 \\ &= 36.8\end{aligned}$$



Mode is 36.8. It represents that the age of maximum number of patients admitted in hospital was 36.8 years.

Question 2:

The following data gives the information on the observed lifetimes (in hours) of 225 electrical components:

Lifetimes (in hours)	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100	100 – 120
Frequency	10	35	52	61	38	29

Determine the modal lifetimes of the components.

Answer:

From the data given above, it can be observed that the maximum class frequency is 61, belonging to class interval 60 – 80.

Therefore, modal class = 60 – 80

Lower class limit (l) of modal class = 60

Frequency (f_1) of modal class = 61

Frequency (f_0) of class preceding the modal class = 52

Frequency (f_2) of class succeeding the modal class = 38

Class size (h) = 20

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\ &= 60 + \left(\frac{61 - 52}{2(61) - 52 - 38} \right) (20)\end{aligned}$$



$$\begin{aligned} &= 60 + \left(\frac{9}{122 - 90} \right) (20) \\ &= 60 + \left(\frac{9 \times 20}{32} \right) \\ &= 60 + \frac{90}{16} = 60 + 5.625 \\ &= 65.625 \end{aligned}$$

Therefore, modal lifetime of electrical components is 65.625 hours.

Question 3:

The following data gives the distribution of total monthly household expenditure of 200 families of a village. Find the modal monthly expenditure of the families. Also, find the mean monthly expenditure.

Expenditure (in Rs)	Number of families
1000 – 1500	24
1500 – 2000	40
2000 – 2500	33
2500 – 3000	28
3000 – 3500	30
3500 – 4000	22
4000 – 4500	16
4500 – 5000	7



Answer:

It can be observed from the given data that the maximum class frequency is 40, belonging to 1500 – 2000 intervals.

Therefore, modal class = 1500 – 2000

Lower limit (l) of modal class = 1500

Frequency (f_1) of modal class = 40

Frequency (f_0) of class preceding modal class = 24

Frequency (f_2) of class succeeding modal class = 33

Class size (h) = 500

$$\begin{aligned}
 \text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\
 &= 1500 + \left(\frac{40 - 24}{2(40) - 24 - 33} \right) \times 500 \\
 &= 1500 + \left(\frac{16}{80 - 57} \right) \times 500 \\
 &= 1500 + \frac{8000}{23} \\
 &= 1500 + 347.826 \\
 &= 1847.826 \approx 1847.83
 \end{aligned}$$

Therefore, modal monthly expenditure was Rs 1847.83.

To find the class mark, the following relation is used.

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

Class size (h) of the given data = 500

Taking 2750 as assumed mean (a), d_i , u_i , and $f_i u_i$ are calculated as follows.

Expenditure (in Rs)	Number of families f_i	x_i	$d_i = x_i - 2750$	$u_i = \frac{d_i}{500}$	$f_i u_i$
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1000 – 1500	24	1250	– 1500	– 3	– 72
1500 – 2000	40	1750	– 1000	– 2	– 80
2000 – 2500	33	2250	– 500	– 1	– 33
2500 – 3000	28	2750	0	0	0
3000 – 3500	30	3250	500	1	30
3500 – 4000	22	3750	1000	2	44
4000 – 4500	16	4250	1500	3	48
4500 – 5000	7	4750	2000	4	28
Total	200				– 35

From the table, we obtain

$$\sum f_i = 200$$

$$\sum f_i u_i = -35$$

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

$$\bar{x} = 2750 + \left(\frac{-35}{200} \right) \times 500$$

$$= 2750 - 87.5$$

$$= 2662.5$$

Therefore, mean monthly expenditure was Rs 2662.50.

**Question 4:**

The following distribution gives the state-wise teacher-student ratio in higher secondary schools of India. Find the mode and mean of this data. Interpret the two measures.

Number of students per teacher	Number of states/U.T
15 – 20	3
20 – 25	8
25 – 30	9
30 – 35	10
35 – 40	3
40 – 45	0
45 – 50	0
50 – 55	2

Answer:

It can be observed from the given data that the maximum class frequency is 10 belonging to class interval 30 – 35.

Therefore, modal class = 30 – 35

Class size (h) = 5

Lower limit (l) of modal class = 30

Frequency (f_1) of modal class = 10

Frequency (f_0) of class preceding modal class = 9

Frequency (f_2) of class succeeding modal class = 3



$$\begin{aligned}
 \text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\
 &= 30 + \left(\frac{10 - 9}{2(10) - 9 - 3} \right) \times (5) \\
 &= 30 + \left(\frac{1}{20 - 12} \right) 5 \\
 &= 30 + \frac{5}{8} = 30.625
 \end{aligned}$$

$$\text{Mode} = 30.6$$

It represents that most of the states/U.T have a teacher-student ratio as 30.6.

To find the class marks, the following relation is used.

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

Taking 32.5 as assumed mean (a), d_i , u_i , and $f_i u_i$ are calculated as follows.

Number of students per teacher	Number of states/U.T (f_i)	x_i	$d_i = x_i - 32.5$	$u_i = \frac{d_i}{5}$	$f_i u_i$
15 – 20	3	17.5	– 15	– 3	– 9
20 – 25	8	22.5	– 10	– 2	– 16
25 – 30	9	27.5	– 5	– 1	– 9
30 – 35	10	32.5	0	0	0
35 – 40	3	37.5	5	1	3
40 – 45	0	42.5	10	2	0



45 – 50	0	47.5	15	3	0
50 – 55	2	52.5	20	4	8
Total	35				– 23

$$\begin{aligned}\text{Mean, } \bar{x} &= a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h \\ &= 32.5 + \left(\frac{-23}{35} \right) \times 5 \\ &= 32.5 - \frac{23}{7} = 32.5 - 3.28 \\ &= 29.22\end{aligned}$$

Therefore, mean of the data is 29.2.

It represents that on an average, teacher–student ratio was 29.2.

Question 5:

The given distribution shows the number of runs scored by some top batsmen of the world in one-day international cricket matches.

Runs scored	Number of batsmen
3000 – 4000	4
4000 – 5000	18
5000 – 6000	9
6000 – 7000	7



7000 – 8000	6
8000 – 9000	3
9000 – 10000	1
10000 – 11000	1

Find the mode of the data.

Answer:

From the given data, it can be observed that the maximum class frequency is 18, belonging to class interval 4000 – 5000.

Therefore, modal class = 4000 – 5000

Lower limit (l) of modal class = 4000

Frequency (f_1) of modal class = 18

Frequency (f_0) of class preceding modal class = 4

Frequency (f_2) of class succeeding modal class = 9

Class size (h) = 1000

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\ &= 4000 + \left(\frac{18 - 4}{2(18) - 4 - 9} \right) \times 1000 \\ &= 4000 + \left(\frac{14000}{23} \right) \\ &= 4000 + 608.695 \\ &= 4608.695\end{aligned}$$

Therefore, mode of the given data is 4608.7 runs

Question 6:

A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarised it in the table given below. Find the mode of the data:



Number of cars	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Frequency	7	14	13	12	20	11	15	8

Answer:

From the given data, it can be observed that the maximum class frequency is 20, belonging to 40 – 50 class intervals.

Therefore, modal class = 40 – 50

Lower limit (l) of modal class = 40

Frequency (f_1) of modal class = 20

Frequency (f_0) of class preceding modal class = 12

Frequency (f_2) of class succeeding modal class = 11

Class size = 10

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\ &= 40 + \left[\frac{20 - 12}{2(20) - 12 - 11} \right] \times 10 \\ &= 40 + \left(\frac{80}{40 - 23} \right) \\ &= 40 + \frac{80}{17} \\ &= 40 + 4.7 \\ &= 44.7\end{aligned}$$

Therefore, mode of this data is 44.7 cars.

**Exercise 14.3****Question 1:**

The following frequency distribution gives the monthly consumption of electricity of 68 consumers of a locality. Find the median, mean and mode of the data and compare them.

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

Answer:

To find the class marks, the following relation is used.

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

Taking 135 as assumed mean (a), d_i , u_i , $f_i u_i$ are calculated according to step deviation method as follows.

Monthly consumption (in units)	Number of consumers (f_i)	x_i class mark	$d_i = x_i - 135$	$u_i = \frac{d_i}{20}$	$f_i u_i$
65 – 85	4	75	– 60	– 3	–



					12
85 – 105	5	95	– 40	– 2	– 10
105 – 125	13	115	– 20	– 1	– 13
125 – 145	20	135	0	0	0
145 – 165	14	155	20	1	14
165 – 185	8	175	40	2	16
185 – 205	4	195	60	3	12
Total	68				7

From the table, we obtain

$$\sum f_i u_i = 7$$

$$\sum f_i = 68$$

$$\text{Class size } (h) = 20$$

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

$$= 135 + \frac{7}{68} \times 20$$

$$= 135 + \frac{140}{68}$$

$$= 137.058$$

From the table, it can be observed that the maximum class frequency is 20, belonging to class interval 125 – 145.

Modal class = 125 – 145



Lower limit (l) of modal class = 125

Class size (h) = 20

Frequency (f_1) of modal class = 20

Frequency (f_0) of class preceding modal class = 13

Frequency (f_2) of class succeeding the modal class = 14

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\ &= 125 + \left[\frac{20 - 13}{2(20) - 13 - 14} \right] \times 20 \\ &= 125 + \frac{7}{13} \times 20 \\ &= 125 + \frac{140}{13} = 135.76\end{aligned}$$

To find the median of the given data, cumulative frequency is calculated as follows.

Monthly consumption (in units)	Number of consumers	Cumulative frequency
65 – 85	4	4
85 – 105	5	4 + 5 = 9
105 – 125	13	9 + 13 = 22
125 – 145	20	22 + 20 = 42
145 – 165	14	42 + 14 = 56
165 – 185	8	56 + 8 = 64
185 – 205	4	64 + 4 = 68

From the table, we obtain



$$n = 68$$

Cumulative frequency (cf) just greater than $\frac{n}{2}$ (i.e., $\frac{68}{2} = 34$) is 42, belonging to interval 125 – 145.

Therefore, median class = 125 – 145

Lower limit (l) of median class = 125

Class size (h) = 20

Frequency (f) of median class = 20

Cumulative frequency (cf) of class preceding median class = 22

$$\begin{aligned}\text{Median} &= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h \\ &= 125 + \left(\frac{34 - 22}{20} \right) \times 20 \\ &= 125 + 12 \\ &= 137\end{aligned}$$

Therefore, median, mode, mean of the given data is 137, 135.76, and 137.05 respectively.

The three measures are approximately the same in this case.

Question 2:

If the median of the distribution is given below is 28.5, find the values of x and y .

Class interval	Frequency
0 – 10	5
10 – 20	x
20 – 30	20



30 – 40	15
40 – 50	y
50 – 60	5
Total	60

Answer:

The cumulative frequency for the given data is calculated as follows.

Class interval	Frequency	Cumulative frequency
0 – 10	5	5
10 – 20	x	$5 + x$
20 – 30	20	$25 + x$
30 – 40	15	$40 + x$
40 – 50	y	$40 + x + y$
50 – 60	5	$45 + x + y$
Total (n)	60	

From the table, it can be observed that $n = 60$

$$45 + x + y = 60$$

$$x + y = 15 \quad (1)$$

Median of the data is given as 28.5 which lies in interval 20 – 30.

Therefore, median class = 20 – 30

Lower limit (l) of median class = 20

Cumulative frequency (cf) of class preceding the median class = $5 + x$

Frequency (f) of median class = 20



Class size (h) = 10

$$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

$$28.5 = 20 + \left[\frac{\frac{60}{2} - (5+x)}{20} \right] \times 10$$

$$8.5 = \left(\frac{25-x}{2} \right)$$

$$17 = 25 - x$$

$$x = 8$$

From equation (1),

$$8 + y = 15$$

$$y = 7$$

Hence, the values of x and y are 8 and 7 respectively

Question 3:

A life insurance agent found the following data for distribution of ages of 100 policy holders. Calculate the median age, if policies are given only to persons having age 18 years onwards but less than 60 year.

Age (in years)	Number of policy holders
Below 20	2
Below 25	6
Below 30	24
Below 35	45



Below 40	78
Below 45	89
Below 50	92
Below 55	98
Below 60	100

Answer:

Here, class width is not the same. There is no requirement of adjusting the frequencies according to class intervals. The given frequency table is of less than type represented with upper class limits. The policies were given only to persons with age 18 years onwards but less than 60 years. Therefore, class intervals with their respective cumulative frequency can be defined as below.

Age (in years)	Number of policy holders (f_i)	Cumulative frequency (cf)
18 – 20	2	2
20 – 25	$6 - 2 = 4$	6
25 – 30	$24 - 6 = 18$	24
30 – 35	$45 - 24 = 21$	45
35 – 40	$78 - 45 = 33$	78
40 – 45	$89 - 78 = 11$	89
45 – 50	$92 - 89 = 3$	92
50 – 55	$98 - 92 = 6$	98



55 – 60	$100 - 98 = 2$	100
Total (n)		

From the table, it can be observed that $n = 100$.

Cumulative frequency (cf) just greater than $\frac{n}{2}$ (i.e., $\frac{100}{2} = 50$) is 78, belonging to interval 35 – 40.

Therefore, median class = 35 – 40

Lower limit (l) of median class = 35

Class size (h) = 5

Frequency (f) of median class = 33

Cumulative frequency (cf) of class preceding median class = 45

$$\begin{aligned}\text{Median} &= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h \\ &= 35 + \left(\frac{50 - 45}{33} \right) \times 5 \\ &= 35 + \frac{25}{33} \\ &= 35.76\end{aligned}$$

Therefore, median age is 35.76 years.

Question 4:

The lengths of 40 leaves of a plant are measured correct to the nearest millimeter, and the data obtained is represented in the following table:

Length (in mm)	Number of leaves f_i
118 – 126	3



127 – 135	5
136 – 144	9
145 – 153	12
154 – 162	5
163 – 171	4
172 – 180	2

Find the median length of the leaves.

(**Hint:** The data needs to be converted to continuous classes for finding the median, since the formula assumes continuous classes. The classes then change to 117.5 – 126.5, 126.5 – 135.5... 171.5 – 180.5)

Answer:

The given data does not have continuous class intervals. It can be observed that the

difference between two class intervals is 1. Therefore, $\frac{1}{2} = 0.5$ has to be added and subtracted to upper class limits and lower class limits respectively.

Continuous class intervals with respective cumulative frequencies can be represented as follows.

Length (in mm)	Number or leaves f_i	Cumulative frequency
117.5 – 126.5	3	3
126.5 – 135.5	5	$3 + 5 = 8$
135.5 – 144.5	9	$8 + 9 = 17$
144.5 – 153.5	12	$17 + 12 = 29$



153.5 – 162.5	5	$29 + 5 = 34$
162.5 – 171.5	4	$34 + 4 = 38$
171.5 – 180.5	2	$38 + 2 = 40$

From the table, it can be observed that the cumulative frequency just greater than

$\frac{n}{2}$ (i.e., $\frac{40}{2} = 20$) is 29, belonging to class interval 144.5 – 153.5.

Median class = 144.5 – 153.5

Lower limit (l) of median class = 144.5

Class size (h) = 9

Frequency (f) of median class = 12

Cumulative frequency (cf) of class preceding median class = 17

$$= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Median

$$\begin{aligned} &= 144.5 + \left(\frac{20 - 17}{12} \right) \times 9 \\ &= 144.5 + \frac{9}{4} = 146.75 \end{aligned}$$

Therefore, median length of leaves is 146.75 mm.

Question 5:

Find the following table gives the distribution of the life time of 400 neon lamps:

Life time (in hours)	Number of lamps
1500 – 2000	14



2000 – 2500	56
2500 – 3000	60
3000 – 3500	86
3500 – 4000	74
4000 – 4500	62
4500 – 5000	48

Find the median life time of a lamp.

Answer:

The cumulative frequencies with their respective class intervals are as follows.

Life time	Number of lamps (f_i)	Cumulative frequency
1500 – 2000	14	14
2000 – 2500	56	$14 + 56 = 70$
2500 – 3000	60	$70 + 60 = 130$
3000 – 3500	86	$130 + 86 = 216$
3500 – 4000	74	$216 + 74 = 290$
4000 – 4500	62	$290 + 62 = 352$
4500 – 5000	48	$352 + 48 = 400$
Total (n)	400	



It can be observed that the cumulative frequency just greater than

$\frac{n}{2}$ (i.e., $\frac{400}{2} = 200$) is 216, belonging to class interval 3000 – 3500.

Median class = 3000 – 3500

Lower limit (l) of median class = 3000

Frequency (f) of median class = 86

Cumulative frequency (cf) of class preceding median class = 130

Class size (h) = 500

$$= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Median

$$= 3000 + \left(\frac{200 - 130}{86} \right) \times 500$$

$$= 3000 + \frac{70 \times 500}{86}$$

$$= 3406.976$$

Therefore, median life time of lamps is 3406.98 hours.

Question 6:

100 surnames were randomly picked up from a local telephone directory and the frequency distribution of the number of letters in the English alphabets in the surnames was obtained as follows:

Number of letters	1 – 4	4 – 7	7 – 10	10 – 13	13 – 16	16 – 19
Number of surnames	6	30	40	6	4	4

Determine the median number of letters in the surnames. Find the mean number of letters in the surnames? Also, find the modal size of the surnames.

Answer:



The cumulative frequencies with their respective class intervals are as follows.

Number of letters	Frequency (f_i)	Cumulative frequency
1 – 4	6	6
4 – 7	30	$30 + 6 = 36$
7 – 10	40	$36 + 40 = 76$
10 – 13	16	$76 + 16 = 92$
13 – 16	4	$92 + 4 = 96$
16 – 19	4	$96 + 4 = 100$
Total (n)	100	

It can be observed that the cumulative frequency just greater than is 76, belonging to class interval 7 – 10.

Median class = 7 – 10

Lower limit (l) of median class = 7

Cumulative frequency (cf) of class preceding median class = 36

Frequency (f) of median class = 40

Class size (h) = 3

$$= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Median

$$\frac{n}{2} \left(\text{i.e., } \frac{100}{2} = 50 \right)$$



$$= 7 + \left(\frac{50 - 36}{40} \right) \times 3$$

$$= 7 + \frac{14 \times 3}{40}$$

$$= 8.05$$

To find the class marks of the given class intervals, the following relation is used.

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

Taking 11.5 as assumed mean (a), d_i , u_i , and $f_i u_i$ are calculated according to step deviation method as follows.

Number of letters	Number of surnames f_i	x_i	$d_i = x_i - 11.5$	$u_i = \frac{d_i}{3}$	$f_i u_i$
1 – 4	6	2.5	– 9	– 3	– 18
4 – 7	30	5.5	– 6	– 2	– 60
7 – 10	40	8.5	– 3	– 1	– 40
10 – 13	16	11.5	0	0	0
13 – 16	4	14.5	3	1	4
16 – 19	4	17.5	6	2	8
Total	100				– 106

From the table, we obtain

$$\sum f_i u_i = -106$$

$$\sum f_i = 100$$



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

Mean,

$$= 11.5 + \left(\frac{-106}{100} \right) \times 3$$

$$= 11.5 - 3.18 = 8.32$$

The data in the given table can be written as

Number of letters	Frequency (f_i)
1 – 4	6
4 – 7	30
7 – 10	40
10 – 13	16
13 – 16	4
16 – 19	4
Total (n)	100

From the table, it can be observed that the maximum class frequency is 40 belonging to class interval 7 – 10.

Modal class = 7 – 10

Lower limit (l) of modal class = 7

Class size (h) = 3

Frequency (f_1) of modal class = 40

Frequency (f_0) of class preceding the modal class = 30

Frequency (f_2) of class succeeding the modal class = 16



$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\ &= 7 + \left[\frac{40 - 30}{2(40) - 30 - 16} \right] \times 3 \\ &= 7 + \frac{10}{34} \times 3 \\ &= 7 + \frac{30}{34} = 7.88\end{aligned}$$

Therefore, median number and mean number of letters in surnames is 8.05 and 8.32 respectively while modal size of surnames is 7.88.

Question 7:

The distribution below gives the weights of 30 students of a class. Find the median weight of the students.

Weight (in kg)	40 – 45	45 – 50	50 – 55	55 – 60	60 – 65	65 – 70	70 – 75
Number of students	2	3	8	6	6	3	2

Answer:

The cumulative frequencies with their respective class intervals are as follows.

Weight (in kg)	Frequency (<i>fi</i>)	Cumulative frequency
40 – 45	2	2
45 – 50	3	2 + 3 = 5
50 – 55	8	5 + 8 = 13
55 – 60	6	13 + 6 = 19



60 – 65	6	$19 + 6 = 25$
65 – 70	3	$25 + 3 = 28$
70 – 75	2	$28 + 2 = 30$
Total (n)	30	

Cumulative frequency just greater than $\frac{n}{2}$ (i.e., $\frac{30}{2} = 15$) is 19, belonging to class interval 55 – 60.

Median class = 55 – 60

Lower limit (l) of median class = 55

Frequency (f) of median class = 6

Cumulative frequency (cf) of median class = 13

Class size (h) = 5

$$= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Median

$$= 55 + \left(\frac{15 - 13}{6} \right) \times 5$$

$$= 55 + \frac{10}{6}$$

$$= 56.67$$

Therefore, median weight is 56.67 kg.



Exercise 14.4

Question 1:

The following distribution gives the daily income of 50 workers of a factory.

Daily income (in Rs)	100 – 120	120 – 140	140 – 160	160 – 180	180 – 200
Number of workers	12	14	8	6	10

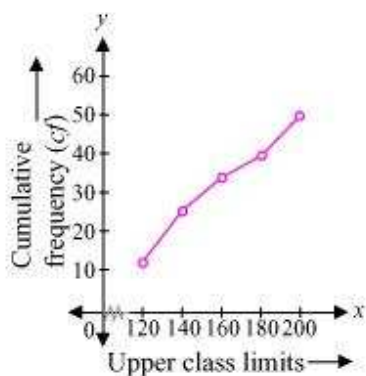
Convert the distribution above to a less than type cumulative frequency distribution, and draw its ogive.

Answer:

The frequency distribution table of less than type is as follows.

Daily income (in Rs) (upper class limits)	Cumulative frequency
Less than 120	12
Less than 140	$12 + 14 = 26$
Less than 160	$26 + 8 = 34$
Less than 180	$34 + 6 = 40$
Less than 200	$40 + 10 = 50$

Taking upper class limits of class intervals on x-axis and their respective frequencies on y-axis, its ogive can be drawn as follows.

**Question 2:**

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

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

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

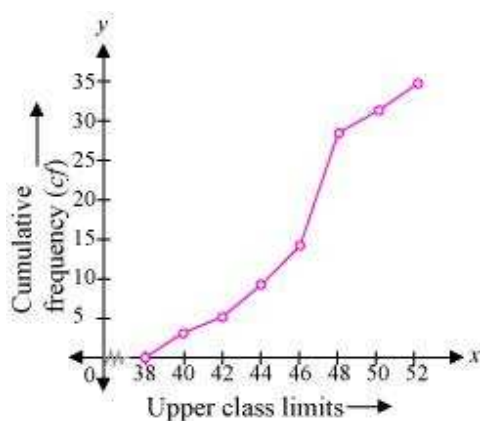


Answer:

The given cumulative frequency distributions of less than type are

Weight (in kg) upper class limits	Number of students (cumulative frequency)
Less than 38	0
Less than 40	3
Less than 42	5
Less than 44	9
Less than 46	14
Less than 48	28
Less than 50	32
Less than 52	35

Taking upper class limits on x-axis and their respective cumulative frequencies on y-axis, its ogive can be drawn as follows.

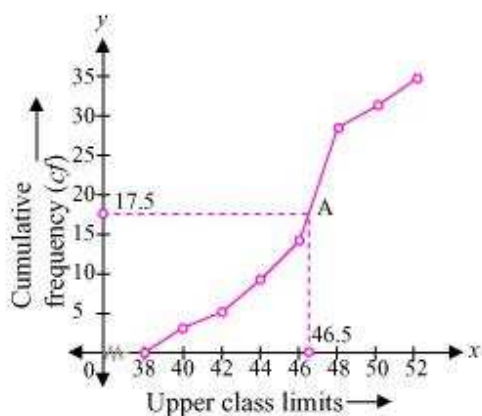


Here, $n = 35$



So, $\frac{n}{2} = 17.5$

Mark the point A whose ordinate is 17.5 and its x-coordinate is 46.5. Therefore, median of this data is 46.5.



It can be observed that the difference between two consecutive upper class limits is 2. The class marks with their respective frequencies are obtained as below.

Weight (in kg)	Frequency (f)	Cumulative frequency
Less than 38	0	0
38 – 40	$3 - 0 = 3$	3
40 – 42	$5 - 3 = 2$	5
42 – 44	$9 - 5 = 4$	9
44 – 46	$14 - 9 = 5$	14
46 – 48	$28 - 14 = 14$	28
48 – 50	$32 - 28 = 4$	32



50 – 52	35 – 32 = 3	35
Total (n)	35	

The cumulative frequency just greater than $\frac{n}{2}$ (i.e., $\frac{35}{2} = 17.5$) is 28, belonging to class interval 46 – 48.

Median class = 46 – 48

Lower class limit (l) of median class = 46

Frequency (f) of median class = 14

Cumulative frequency (cf) of class preceding median class = 14

Class size (h) = 2

$$\begin{aligned}\text{Median} &= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h \\ &= 46 + \left(\frac{17.5 - 14}{14} \right) \times 2 \\ &= 46 + \frac{3.5}{7} \\ &= 46.5\end{aligned}$$

Therefore, median of this data is 46.5.

Hence, the value of median is verified.

Question 3:

The following table gives production yield per hectare of wheat of 100 farms of a village.

Production yield (in kg/ha)	50 – 55	55 – 60	60 – 65	65 – 70	70 – 75	75 – 80
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Number of farms	2	8	12	24	38	16
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Change the distribution to a more than type distribution and draw ogive.

Answer:

The cumulative frequency distribution of more than type can be obtained as follows.

Production yield (lower class limits)	Cumulative frequency
more than or equal to 50	100
more than or equal to 55	$100 - 2 = 98$
more than or equal to 60	$98 - 8 = 90$
more than or equal to 65	$90 - 12 = 78$
more than or equal to 70	$78 - 24 = 54$
more than or equal to 75	$54 - 38 = 16$

Taking the lower class limits on x-axis and their respective cumulative frequencies on y-axis, its ogive can be obtained as follows.

