26. Statistics: Mean, Median, Ogive, Mode

Let us Work Out 26.1

1. Question

I have written ages of my 40 friends in the table given below.

Age(years)	15	16	17	18	19	20
Number of friends	4	7	10	10	5	4

Let us find average age of my friends by direct method.

Answer

The arithmetic mean is important in statistics. It is also called average or average value, is the quantity obtained by summing two or more numbers or variables and then dividing with the number of numbers or variables.

Direct method of finding the arithmetic mean is the easiest.

We have been given frequency distribution table, let's make it again.

Age (years) _{Xi}	Number of friends (frequency) f:	Xifi
15	4	15 × 4 = 60
16	7	16 × 7 = 112
17	10	$17 \times 10 = 170$
18	10	$18 \times 10 = 180$
19	5	19 × 5 = 95
20	4	20 × 4 = 80
Total	$\Sigma f_i = 40$	$\Sigma f_i x_i = 697$

By direct method, arithmetic mean (AM) is given by

 $AM = \frac{\sum f_i x_i}{\sum f_i}$ $\Rightarrow AM = \frac{697}{40}$ $\Rightarrow AM = 17.425$

Thus, average age of his/her friends is 17.4.

2. Question

I have written member of 50 families of our village in the table given below.

Number of members	2	3	4	5	6	7
Number of families	6	8	14	15	4	3

Let us write the average member of 50 families by the method of assumed mean.

Answer

Since arithmetic mean is also called average or average value, we need to find the average.

No. of	No. of	$d_i = x_i - A$	fidi
members	families	$(d_i = x_i - 4)$	
Xi	fi		
2	6	2 - 4 = -2	6 × -2 = -12
3	8	3 - 4 = -1	8 × -1 = -8
4 ← A	14	4 - 4 = 0	$14 \times 0 = 0$
5	15	5 - 4 = 1	$15 \times 1 = 15$
6	4	6 - 4 = 2	4 × 2 = 8
7	3	7 - 4 = 3	3 × 3 = 9
Total	Σf _i = 50		$\Sigma f_i d_i = 12$

So, we need to create a table showing the frequency.

Observe that, we have taken assumed mean as 4. Assumed mean is a mid-value usually from the $x_i{\,}^\prime s.$

Here, d_i is the deviation from the mean.

Using x_i 's and A, we have found d_i and further have found out $f_i d_i$.

We have the following formula to calculate arithmetic mean using assumedmean method,

$$Mean = A + \frac{\sum f_i d_i}{\sum f_i}$$

Substituting all the values from the table into the formula, we get

$$Mean = 4 + \frac{12}{50}$$
$$\Rightarrow Mean = \frac{200 + 12}{50}$$
$$\Rightarrow Mean = \frac{212}{50}$$

 \Rightarrow Mean = 4.24

Thus, the average members of 50 families is 4.24.

3. Question

If the arithmetic mean of the data given below is 20.6, let us find the value of 'a'

Variable (x _i)	10	15	а	25	35
Frequency (f _i)	3	10	25	7	5

Answer

We have been given the arithmetic mean of the data, that is, 20.6.

 \Rightarrow Mean = 20.6

To find the value of a, we need to simply find mean using direct method.

So, let's make a table showing frequencies and $f_i x_i$.

Variable	Frequency	fixi
Xi	fi	
10	3	$3 \times 10 = 30$
15	10	$10 \times 15 = 150$
а	25	25 × a = 25a
25	7	7 × 25 = 175
35	5	5 × 35 = 175
Total	∑f _i = 50	∑f _i x _i = 530 + 25a

So, we get

 $\sum f_i x_i = 530 + 25a$

$$\sum f_i = 50$$

Using direct method, we have the formula of arithmetic mean as follows:

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow 20.6 = \frac{530+25a}{50} [:: Mean = 20.6, \sum f_i x_i = 530 + 25a \& \sum f_i = 50]$$

$$\Rightarrow 1030 = 530 + 25a$$

$$\Rightarrow 25a = 1030 - 530$$

$$\Rightarrow 25a = 500$$

 $\Rightarrow a = \frac{500}{25}$ $\Rightarrow a = 20$

Thus, a = 20.

4. Question

If the arithmetic mean of the distribution given below is 15, let us find the value of p.

Variable	5	10	15	20	25
Frequency (f)	6	р	6	10	5

Answer

We have been given the arithmetic mean of the data, that is, 15.

 \Rightarrow Mean = 15

To find the value of p, we need to simply find mean using direct method.

So, let's make a table showing frequencies and $f_i \boldsymbol{x}_i.$

Variable	Frequency	fixi
Xi	fi	
5	6	6 × 5 = 30
10	р	p × 10 = 10p
15	6	6 × 15 = 90
20	10	$10 \times 20 = 200$
25	5	5 × 25 = 125
Total	$\Sigma f_i = 27 + p$	$\Sigma f_i x_i = 445 + 10p$

So, we get

 $\sum f_i x_i = 445 + 10p$

$$\sum f_i = 27 + p$$

Using direct method, we have the formula of arithmetic mean as follows:

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow 15 = \frac{445+10p}{27+p} [\because Mean = 15, \sum f_i x_i = 445 + 10p \& \sum f_i = 27 + p]$$

$$\Rightarrow 15 (27 + p) = 445 + 10p$$

$$\Rightarrow 405 + 15p = 445 + 10p$$

 $\Rightarrow 15p - 10p = 445 - 405$ $\Rightarrow 5p = 40$ $\Rightarrow p = \frac{40}{5}$ $\Rightarrow p = 8$

Thus, **p** = 8.

5. Question

Rahamatchacha will go to retail market, for selling mangoes kept in 50 packing boxes. Let us write the number of boxes contained varing number of mangoes in the table given below.

Number of mangoes	50-52	52-54	54-56	56-58	58-60
Number of boxes	6	14	16	9	5

Let us write the mean number of mangoes kept in 50 packing boxes. [using any method]

Answer

Arithmetic mean of grouped frequency distribution is found by taking out midpoints of the class intervals.

Let's create a table showing frequencies and $f_i x_i$.

No. of	No. of boxes	Midpoints	fiXi
mangoes	fi	Xi	
50 - 52	6	51	6 × 51 = 306
52 - 54	14	53	14 × 53 = 742
54 - 56	16	55	16 × 55 = 880
56 - 58	9	57	9 × 57 = 513
58 - 60	5	59	5 × 59 = 295
Total	$\Sigma f_i = 50$		∑f _i x _i = 2736

So, we have

 $\sum f_i x_i = 2736$

$$\sum f_i = 50$$

Using the direct method, we have the formula for arithmetic mean.

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

Using the above values, we get

 $Mean = \frac{2736}{50}$ $\Rightarrow Mean = 54.72$

Thus, mean is 54.72.

6. Question

Mohidul has written ages of 100 patients of village hospital. Let us write by calculating average age of 100 patients. [using any method]

Age(years)	10-20	20-30	30-40	40-50	50-60	60-70
Number of	12	8	22	20	18	20
patients						

Answer

We need to find the average using any method of calculation.

For the data given, the average can be calculated using direct method as the data is small. Using direct method for the given answer will provide us easier and faster calculation.

Let's create a table showing frequencies and $f_i x_i$.

Age	No. of patients	Midpoints	f _i x _i
(years)	fi	Xi	
10 - 20	12	15	12 × 15 = 180
20 - 30	8	25	8 × 25 = 200
30 - 40	22	35	22 × 35 = 770
40 - 50	20	45	20 × 45 = 900
50 - 60	18	55	18 × 55 = 990
60 - 70	20	65	20 × 65 = 1300
Total	$\Sigma f_i = 100$		$\Sigma f_i x_i = 4340$

So, we have

 $\sum f_i x_i = 4340$

 $\sum f_{i} = 100$

Using the direct method, we have the formula for arithmetic mean.

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

Using the above values, we get

 $Mean = \frac{4340}{100}$ $\Rightarrow Mean = 43.4$

Thus, average is 43.4.

7 A. Question

Let us find the mean of the following data by direct method.

Class internal	0-10	10-20	20-30	30-40	40-50
Frequency	4	6	10	6	4

Answer

Arithmetic mean is just the average value of the data or variables given in the data.

To find the mean using direct method, let's create a table showing frequencies and $f_i \boldsymbol{x}_i.$

Class	Frequency	Midpoints	fixi
interval	fi	Xi	
0 - 10	4	5	4 × 5 = 20
10 - 20	6	15	6 × 15 = 90
20 - 30	10	25	10 × 25 = 250
30 - 40	6	35	6 × 35 = 210
40 - 50	4	45	4 × 45 = 180
Total	$\Sigma f_i = 30$		$\Sigma f_i x_i = 750$

So, we have

 $\sum f_i x_i = 750$

$$\sum f_i = 30$$

Using the direct method, we have the formula for arithmetic mean.

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

Using the above values, we get

$$Mean = \frac{750}{30}$$
$$\Rightarrow Mean = 25$$

Thus, mean is 25.

7 B. Question

Let us find the mean of the following data by direct method.

Class	10-	20-	30-	40-	50-	60-
internal	20	30	40	50	60	70
Frequency	10	16	20	30	13	11

Answer

Arithmetic mean is just the average value of the data or variables given in the data.

Let's create a table showing frequencies and $f_i x_i$.

Class	Frequency	Midpoints	fixi
interval	fi	Xi	
10 - 20	10	15	$10 \times 15 = 150$
20 - 30	16	25	$16 \times 25 = 400$
30 - 40	20	35	20 × 35 = 700
40 - 50	30	45	30 × 45 = 1350
50 - 60	13	55	13 × 55 = 715
60 - 70	11	65	11 × 65 = 715
Total	$\Sigma f_i = 100$		∑f _i x _i = 4030

So, we have

 $\sum f_i x_i = 4030$

 $\sum f_i = 100$

Using the direct method, we have the formula for arithmetic mean.

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

Using the above values, we get

$$Mean = \frac{4030}{100}$$

 \Rightarrow Mean = 40.3

Thus, mean is 40.3.

8 A. Question

Let us find the mean of the following data by assumed mean method.

Class interval	0-40	40-80	80-120	120-160	160-200
Frequency	12	20	25	20	13

Answer

We need to find the mean by assumed mean method.

For assumed-mean method, we assume a mean from the midpoints and calculate deviation from that assumed mean.

We can create a table showing frequencies, midpoints and deviations.

Class	Frequency	Midpoints	f _i x _i
interval	fi	Xi	
0 - 40	12	20	12 × 20 = 240
40 - 80	20	60	$20 \times 60 = 1200$
80 - 120	25	100 ← A	$25 \times 100 = 2500$
120 - 160	20	140	20 × 140 = 2800
160 - 200	13	180	13 × 180 = 2340
Total	$\Sigma f_i = 90$		$\Sigma f_i x_i = 9080$

So, we have

 $\sum f_i x_i = 9080$

 $\sum f_i = 90$

Observe that, we have taken assumed mean as 100. Assumed mean is a mid-value usually from the $x_i \dot{\mbox{ s}}.$

Here, d_i is the deviation from the mean.

Using x_i 's and A, we have found d_i and further have found out $f_i d_i$.

We have the following formula to calculate arithmetic mean using assumedmean method,

$$Mean = A + \frac{\sum f_i d_i}{\sum f_i}$$

Substituting all the values from the table into the formula, we get

$$Mean = 100 + \frac{9080}{90}$$
$$\Rightarrow Mean = \frac{9000+9080}{90}$$
$$\Rightarrow Mean = \frac{18080}{90}$$
$$\Rightarrow Mean = 200.89$$

Thus, the mean of the data is 200.89.

8 B. Question

Let us find the mean of the following data by assumed mean method.

Class interval	25-35	35-45	45-55	55-65	65-75
Frequency	4	10	8	12	6

Answer

We need to find the mean by assumed mean method.

For assumed-mean method, we assume a mean from the midpoints and calculate deviation from that assumed mean.

We can create a table showing frequencies, midpoints and deviations.

Class	Frequency	Midpoints	fiXi
interval	fi	Xi	
25 - 35	4	30	4 × 30 = 120
35 - 45	10	40	$10 \times 40 = 400$
45 - 55	8	50 ← A	8 × 50 = 400
55 - 65	12	60	$12 \times 60 = 720$
65 - 75	6	70	6 × 70 = 420
Total	Σf _i = 40		$\Sigma f_i x_i = 2060$

So, we have

 $\sum f_{i}x_{i} = 2060$

$$\sum f_i = 40$$

Observe that, we have taken assumed mean as 50. Assumed mean is a mid-value usually from the x_i 's.

Here, d_i is the deviation from the mean.

Using x_i 's and A, we have found d_i and further have found out $f_i d_i$.

We have the following formula to calculate arithmetic mean using assumedmean method,

$$Mean = A + \frac{\sum f_i d_i}{\sum f_i}$$

Substituting all the values from the table into the formula, we get

$$Mean = 50 + \frac{2060}{40}$$

$$\Rightarrow Mean = \frac{2000+2060}{40}$$
$$\Rightarrow Mean = \frac{4060}{40}$$
$$\Rightarrow Mean = 101.5$$

Thus, the mean of the data is 101.5.

9 A. Question

Let us find the mean of the following data by step deviation method.

Class interval	0-30	30-60	60-90	90-120	120-150
Frequency	12	15	20	25	8

Answer

To find mean using step-deviation method, we need to create a table showing frequencies, midpoints and deviations.

Observe that class size, h = (30 - 0) = (60 - 30) = ... = (150 - 120) = 30

Class interval	Frequency f _i	Midpoint x _i	$u_i = \frac{x_i - A}{h}$	f _i ui
0 - 30	12	15	$\frac{15-75}{30} = \frac{-60}{30} = -2$	12 × -2 = -24
30 - 60	15	45	$\frac{45-75}{30} = -\frac{30}{30} = -1$	15 × -1 = -15
60 - 90	20	75 ← A	$\frac{75 - 75}{30} = 0$	$20 \times 0 = 0$
90 - 120	25	105	$\frac{105 - 75}{30} = \frac{30}{30} = 1$	25 × 1 = 25
120 - 150	8	135	$\frac{135 - 75}{30} = \frac{60}{30} = 2$	8 × 2 = 16
Total	Σf _i = 80			$\Sigma f_i u_i = 2$

We have,

A = 75

 $\sum f_i u_i = 2$

 $\sum f_i = 80$

h = 30

By step deviation method, we can give the formula of mean as:

$$Mean = A + \frac{\sum f_i u_i}{\sum f_i} \times h$$

Using the above values, we have

Mean = $75 + \frac{2}{80} \times 30$ \Rightarrow Mean = $75 + \frac{60}{80}$ \Rightarrow Mean = $75 + \frac{3}{4}$ \Rightarrow Mean = $\frac{300+3}{4}$ \Rightarrow Mean = $\frac{303}{4}$ \Rightarrow Mean = 75.75

Thus, mean is 75.75.

9 B. Question

Let us find the mean of the following data by step deviation method.

Class interval	0-14	14-28	28-42	42-56	56-70
Frequency	7	21	35	11	16

Answer

To find mean using step-deviation method, we need to create a table showing frequencies, midpoints and deviations.

Observe that class size, h = (14 - 0) = (28 - 14) = ... = (70 - 56) = 14

Class interval	Frequency f _i	Midpoint _{Xi}	$u_i = \frac{x_i - A}{h}$	f _i ui
0 - 14	7	7	$\frac{7-35}{14} = \frac{-28}{14} = -2$	7 × -2 = -14
14 - 28	21	21	$\frac{21-35}{14} = \frac{-14}{14} = -1$	21 × -1 = -21
28 - 42	35	35 ←A	$\frac{35 - 35}{14} = 0$	$35 \times 0 = 0$
42 - 56	11	49	$\frac{49-35}{14} = \frac{14}{14} = 1$	11 × 1 = 11
56 - 70	16	63	$\frac{63 - 35}{14} = \frac{28}{14} = 2$	16 × 2 = 32
Total	Σf _i = 90			∑f _i u _i = 8

We have,

A = 35

 $\sum f_i u_i = 8$ $\sum f_i = 90$ h = 14

By step deviation method, we can give the formula of mean as:

$$Mean = A + \frac{\sum f_i u_i}{\sum f_i} \times h$$

Using the above values, we have

Mean = $35 + \frac{8}{90} \times 14$ ⇒ Mean = $35 + \frac{112}{90}$ ⇒ Mean = $\frac{3150+112}{90}$ ⇒ Mean = $\frac{3262}{90}$ ⇒ Mean = 36.24

Thus, mean is 36.24.

10. Question

If the mean of the following frequency distribution table is 24, let us find the value of p.

Class interval (number)	0-10	10-20	20-30	30-40	40-50
Number of students	15	20	35	р	10

Answer

Given that, mean = 24

We need to find the value of p.

To find p, we need to calculate mean by direct method.

Let us make a table showing frequencies, midpoints and $f_i x_i$.

Class interval	No. of	Midpoints	f _i x _i
(number)	students f _i	Xi	
0 - 10	15	5	$15 \times 5 = 75$
10 - 20	20	15	$20 \times 15 = 300$
20 - 30	35	25	35 × 25 = 875
30 - 40	р	35	p × 35 = 35p
40 - 50	10	45	$10 \times 45 = 450$
Total	$\Sigma f_i = 80 + p$		∑f _i x _i = 1700 + 35p

We have

 $\sum f_i x_i = 1700 + 35p$

 $\sum f_i = 80 + p$

By direct method, we have the formula of arithmetic mean:

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow 24 = \frac{1700 + 35p}{80 + p}$$

$$\Rightarrow 24 \times (80 + p) = 1700 + 35p$$

$$\Rightarrow 1920 + 24p = 1700 + 35p$$

$$\Rightarrow 35p - 24p = 1920 - 1700$$

$$\Rightarrow 11p = 220$$

$$\Rightarrow p = \frac{220}{11}$$

$$\Rightarrow p = 20$$

Thus, p = 20.

11. Question

Let us see the ages of the persons present in a metting and determine their average age from the following table :

Age(years)	30-40	35-49	40-44	45-49	50-54	55-59
Number of persons	10	12	15	6	4	3

Answer

The arithmetic mean is also called average or average value, is the sum of the data or variables divided by total number of data or variables.

This is an inclusive type of data, so in order to find the average or arithmetic mean we need to convert it into exclusive type of data.

To convert inclusive type of data into exclusive type, subtract 0.5 from the lower class limit and add 0.5 to upper class limit.

For example, in class limit 30 – 34:

Subtract 0.5 from lower class limit and add 0.5 to upper class limit.

30 - 0.5 = 29.5

34 + 0.5 = 34.5

So, the class interval comes out to be 29.5 – 34.5.

Similarly, we have with other class intervals.

Let's make a table showing exclusive type of data.

Age	No. of persons	Midpoints	f _i x _i
(years)	fi	Xi	
29.5 - 34.5	10	32	$10 \times 32 = 320$
34.5 - 39.5	12	37	12 × 37 = 444
39.5 - 44.5	15	42	15 × 42 = 630
44.5 - 49.5	6	47	6 × 47 = 282
49.5 - 54.5	4	52	4 × 52 = 208
54.5 - 59.5	3	57	3 × 57 = 171
Total	Σf _i = 50		∑f _i x _i = 2055

So, we have

 $\sum f_i x_i = 2055$

$$\sum f_i = 50$$

From direct method, mean is given by

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

Using the above values,

 $Mean = \frac{2055}{50}$

 \Rightarrow Mean = 41.1

Thus, mean is 41.1.

12. Question

Let us find the mean of the following data.

Class interval	5-14	15-24	25-34	35-44	45-54	55-64
Frequency	3	6	18	20	10	3

Answer

The arithmetic mean is also called average or average value, is the sum of the data or variables divided by total number of data or variables.

This is an inclusive type of data, so in order to find the average or arithmetic mean we need to convert it into exclusive type of data.

To convert inclusive type of data into exclusive type, subtract 0.5 from the lower class limit and add 0.5 to upper class limit.

For example, in class limit 5 – 14:

Subtract 0.5 from lower class limit and add 0.5 to upper class limit.

5 - 0.5 = 4.5

14 + 0.5 = 14.5

So, the class interval comes out to be 4.5 – 14.5.

Similarly, we have with other class intervals.

Let's make a table showing exclusive type of data.

Class	Frequency	Midpoints	f _i x _i
interval	fi	Xi	
4.5 - 14.5	3	9.5	3 × 9.5 = 28.5
14.5 - 24.5	6	19.5	6 × 19.5 = 117
24.5 - 34.5	18	29.5	18 × 29.5 = 531
34.5 - 44.5	20	39.5	20 × 39.5 = 790
44.5 - 54.5	10	49.5	10 × 49.5 = 495
54.5 - 64.5	3	59.5	3 × 59.5 = 178.5
Total	$\Sigma f_i = 60$		$\Sigma f_i x_i = 2140$

So, we have

 $\sum f_i x_i = 2140$

$$\sum f_i = 60$$

From direct method, mean is given by

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

Using the above values,

 $Mean = \frac{2140}{60}$

 \Rightarrow Mean = 35.67

Thus, mean is 35.67.

13. Question

Let us find the mean of obtaining marks of girl students if their cumulative frequencies are as follows.

Class interval	Less than				
(marks)	10	20	30	40	50
Number of	5	9	17	29	45
girl students					

Answer

We have been given cumulative frequencies of data as given in question.

We need to convert it into grouped frequency distribution (exclusive type of data).

So, let us create a table showing the frequencies and class intervals.

Class interval (marks)	Class interval (marks)	No. of girl students (frequency) f _i	Midpoints Xi	fixi
Less than 10	0 - 10	5	5	5 × 5 = 25
Less than 20	10 - 20	9	15	9 × 15 = 135
Less than 30	20 - 30	17	25	17 × 25 = 425
Less than 40	30 - 40	29	35	29 × 35 = 1015
Less than 50	40 - 50	45	45	45 × 45 = 2025
Total		Σfi = 105		Σfixi = 3625

So, we have

 $\sum f_i x_i = 3625$

 $\sum f_i = 105$

From direct method, mean is given by

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

Using the above values,

 $Mean = \frac{3625}{105}$ $\Rightarrow Mean = 34.52$

Thus, mean is 34.52.

14. Question

Let us find the mean of the obtaining marks of 60 students from the table given below.

Class interval	1-4	4-9	9-16	16-17
(marks)				
Students	6	12	26	20

Answer

Observe, here the class intervals are unequal but continuous. So, in order to find mean we need to simply find midpoints of the class intervals and further find $f_i x_i$.

We can solve this using three methods,

- Direct method
- Assumed-mean method
- Step Deviation method

We shall calculate the mean using direct method.

Class interval	Frequency	Midpoint	f _i x _i
(marks)	fi	Xi	
1 - 4	6	2.5	6 × 2.5 = 15
4 - 9	12	6.5	12 × 6.5 = 78
9 - 16	26	12.5	26 × 12.5 = 325
16 - 17	20	16.5	$20 \times 16.5 = 330$
Total	$\Sigma f_i = 64$		∑f _i x _i = 748

So, we have

 $\sum f_i x_i = 748$

$$\sum f_i = 64$$

From direct method, mean is given by

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

Using the above values,

 $Mean = \frac{748}{64}$ $\Rightarrow Mean = 11.69$

Thus, mean is 11.69.

Let us Work Out 26.2

1. Question

Per day selling prices (in \gtrless) of Madhu uncle's shop for the last week were 107, 201, 92, 52, 113, 75, 195; let us find the median of the selling prices.

Answer

To find median, it is necessary to arrange the data in either ascending or descending order.

So, let's arrange the data into ascending order. It is,

52, 75, 92, 107, 113, 195, 201

Note that, total number of data, n = 7

Here, n is odd.

When n is odd, median is found out as

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

Putting n = 7, we get

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

$$\Rightarrow$$
 Median = $\left(\frac{8}{2}\right)^{\text{th}}$ term

$$\Rightarrow$$
 Median = 4th term

Note in the ascended order list, 4th term is 107.

$$2^{nd}$$
 term = 75,

 4^{th} term = 107 ß

Thus, median is 107.

2. Question

If ages (in year) of some animals are 6, 10, 5, 4, 9, 11, 20, 18; let us find the median of ages.

Answer

To find median, it is necessary to arrange the data in either ascending or descending order.

So, let's arrange the data into ascending order. It is,

4, 5, 6, 9, 10, 11, 18, 20

Note that, total number of data, n = 8

Here, n is even. When n is even, median is found out as

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

Putting n = 8, we get

$$Median = \frac{\left\{ \left(\frac{8}{2}\right)^{th} term + \left(\frac{8}{2} + 1\right)^{th} term \right\}}{2}$$

$$\Rightarrow Median = \frac{\left\{4^{th} term + 5^{th} term\right\}}{2}$$

$$\Rightarrow Median = \frac{9+10}{2}$$

$$\Rightarrow Median = \frac{19}{2}$$

$$\Rightarrow Median = 9.5$$

Thus, median is 9.5.

3. Question

The marks obtained by 14 students are 42, 51, 56, 45, 62, 59, 50, 52, 55, 64, 45, 54, 58, 60; let us find the median of the obtaining marks.

Answer

To find median, it is necessary to arrange the data in either ascending or descending order.

So, let's arrange the data into ascending order. It is,

42, 45, 45, 50, 51, 52, 54, 55, 56, 58, 59, 60, 62, 64

Note that, total number of data, n = 14

Here, n is even.

When n is even, median is found out as

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

Putting n = 14, we get

$$Median = \frac{\left\{ \left(\frac{14}{2}\right)^{th} term + \left(\frac{14}{2} + 1\right)^{th} term \right\}}{2}$$

$$\Rightarrow Median = \frac{\left\{ 7^{th} term + 8^{th} term \right\}}{2}$$

$$\Rightarrow Median = \frac{54 + 55}{2}$$

$$\Rightarrow Median = \frac{109}{2}$$

$$\Rightarrow Median = 54.5$$

Thus, median is 54.5.

4. Question

Today the scores of our cricket match of ur locality are

7 9 10 11 11 8 7 7 10 6 9 7 9 9 6 6 8 8 9 8 7 8

Let us find the Median of scores in our cricket match.

Answer

To find median, it is necessary to arrange the data in either ascending or descending order.

So, let's arrange the data into ascending order. It is,

6, 6, 6, 7, 7, 7, 7, 7, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 10, 10, 11, 11

Note that, total number of data, n = 22

Here, n is even.

When n is even, median is found out as

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

Putting n = 22, we get

$$Median = \frac{\left\{ \left(\frac{22}{2}\right)^{th} term + \left(\frac{22}{2} + 1\right)^{th} term \right\}}{2}$$

$$\Rightarrow Median = \frac{\left\{ 11^{th} term + 12^{th} term \right\}}{2}$$

$$\Rightarrow Median = \frac{8 + 8}{2}$$

$$\Rightarrow Median = \frac{16}{2}$$

$$\Rightarrow Median = 8$$
Thus, median is 8.

5. Question

Let us find the median of the weight from the following frequency distribution table of 70 students.

Weight (kg)	43	44	45	46	47	48	49	50
Number of students	4	6	8	14	12	10	11	5

Answer

To find out median, we need to calculate cumulative frequency for the given data.

Let us make a table for that.

Weight (kg)	Number of students	Cumulative frequency (less than)
(149)	students	cf
43	4	4
44	6	4 + 6 = 10
45	8	10 + 8 = 18
46	14	18 + 14 = 32
47	12	32 + 12 = 44
48	10	44 + 10 = 54
49	11	54 + 11 = 65
50	5	65 + 5 = 70

Here, n = 70, that is, n = even.

Since, n is even, median can be found out as:

Median = The mean of $\left(\frac{n}{2}\right)^{\text{th}}$ and $\left(\frac{n}{2}+1\right)^{\text{th}}$ observations \Rightarrow Median = The mean of $\left(\frac{70}{2}\right)^{\text{th}}$ and $\left(\frac{70}{2}+1\right)^{\text{th}}$ observations \Rightarrow Median = The mean of 35th and 36th observations

And we know that, 35th observation = 47 [: 35 comes between 32 and 44]

And 36th observation = 47 [:: 36 comes between 32 and 44]

Median = Mean of 47 and 47

 $\Rightarrow \text{Median} = \frac{47+47}{2}$ $\Rightarrow \text{Median} = \frac{94}{2}$ $\Rightarrow \text{Median} = 47$

Thus, median = 47.

6. Question

Let us find the median of length of diameter from the following frequency distribution table of length of diameter of pipe.

Length of diameter (mm)	18	19	20	21	22	23	24	25
Frequency	3	4	10	15	25	13	6	4

Answer

To find out median, we need to calculate cumulative frequency for the given data.

Let us make a table for that.

Length of diameter (mm)	Frequency	Cumulative frequency (less than) cf
18	3	3
19	4	3 + 4 = 7
20	10	7 + 10 = 17
21	15	17 + 15 = 32
22	25	32 + 25 = 57
23	13	57 + 13 = 70
24	6	70 + 6 = 76
25	4	76 + 4 = 80

Here, n = 80, that is, n = even.

Since, n is even, median can be found out as:

 $Median = The mean of \left(\frac{n}{2}\right)^{th} and \ \left(\frac{n}{2} + 1\right)^{th} observations$

⇒ Median = The mean of $\left(\frac{80}{2}\right)^{\text{th}}$ and $\left(\frac{80}{2}+1\right)^{\text{th}}$ observations

 \Rightarrow Median = The mean of 40th and 41th observations

And we know that, 40th observation = 22 [: 40 comes between 33 and 57]

And 41th observation = 22 [:: 41 comes between 33 and 57]

Median = Mean of 22 and 22

 \Rightarrow Median = $\frac{22+22}{2}$

- \Rightarrow Median = $\frac{44}{2}$
- \Rightarrow Median = 22

Thus, median = 22.

7. Question

Let us find the median.

Х	0	1	2	3	4	5	6
f	7	44	35	16	9	4	1

Answer

To find out median, we need to calculate cumulative frequency for the given data.

Let us make a table for that.

х	f	Cumulative frequency (less than) cf
0	7	7
1	44	7 + 44 = 51
2	35	51 + 35 = 86
3	16	86 + 16 = 102
4	9	102 + 9 = 111
5	4	111 + 4 = 115
6	1	115 + 1 = 116

Here, n = 116, that is, n = even.

Since, n is even, median can be found out as:

Median = The mean of
$$\left(\frac{n}{2}\right)^{th}$$
 and $\left(\frac{n}{2}+1\right)^{th}$ observations

 \Rightarrow Median = The mean of $\left(\frac{116}{2}\right)^{\text{th}}$ and $\left(\frac{116}{2}+1\right)^{\text{th}}$ observations

 \Rightarrow Median = The mean of 58th and 59th observations

And we know that, 58^{th} observation = 2 [: 58 comes between 51 and 86]

And 59th observation = 2 [:: 41 comes between 51 and 86]

Median = Mean of 2 and 2

- \Rightarrow Median = $\frac{2+2}{2}$
- \Rightarrow Median = $\frac{4}{2}$
- \Rightarrow Median = 2

Thus, median = 2.

8. Question

The frequency distribution table of expenditures of tiffin allowances of 40 students is given below.

Expenditure for tiffin (in ₹)	35-40	40-45	45-50	50-55	55-60	60-65	65-70
Students	3	5	6	9	7	8	2

Let us find the median of tiffin allowance.

Answer

To find median of tiffin allowance, we need to make a table calculating cumulative frequency.

Expenditure for tiffin (in ₹)	Students (frequency) (f _i)	Cumulative frequency cf
35 - 40	3	3
40 - 45	5	3 + 5 = 8
45 - 50	6	8 + 6 = 14
50 - 55	9	14 + 9 = 23 ←
55 - 60	7	23 + 7 = 30
60 - 65	8	30 + 8 = 38
65 - 70	2	38 + 2 = 40
		N = 40

For median:

We have, total frequency, N = 40

N/2 = 40/2 = 20

Observe, cf = 23 is just greater than 20.

Thus, median class = 50 - 55

Median is given by

$$Median = L + \left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 50

N/2 = 20

cf = cumulative frequency of the class preceding median class = 14

f = frequency of the median class = 9

h = class interval of the median class = 5

Substituting these values in the formula of median, we get

$$Median = 50 + \left[\frac{20 - 14}{9}\right] \times 5$$

$$\Rightarrow$$
 Median = 50 + $\left[\frac{6}{9}\right] \times 5$

$$\Rightarrow$$
 Median = 50 + 3.33

$$\Rightarrow$$
 Median = 53.33

Thus, the median of tiffin allowance is Rs. 53.33.

9. Question

Let us find the median of heights of students from the table below.

Height (cm)	135-	140-	145-	150-	155-	160-	165-
	140	145	150	155	160	165	170
No. of students	6	10	19	22	20	16	7

Answer

To find median of heights of students, we need to make a table calculating cumulative frequency.

Height	Students	Cumulative
(cm)	(frequency)	frequency
	(f _i)	cf
135 - 140	6	6
140 - 145	10	6 + 10 = 16
145 - 150	19	16 + 19 = 35
150 - 155	22	35 + 22 = 57 ←
155 - 160	20	57 + 20 = 77
160 - 165	16	77 + 16 = 93
165 - 170	7	93 + 7 = 100
		N = 100

For median:

We have, total frequency, N = 100

N/2 = 100/2 = 50

Observe, cf = 57 is just greater than 50.

Thus, median class = 150 - 155

Median is given by

$$Median = L + \left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 150

N/2 = 50

cf = cumulative frequency of the class preceding median class = 35

f = frequency of the median class = 22

h = class interval of the median class = 5

Substituting these values in the formula of median, we get

Median =
$$150 + \left[\frac{50 - 35}{22}\right] \times 5$$

⇒ Median = $150 + \left[\frac{15}{22}\right] \times 5$
⇒ Median = $150 + 3.409$

 \Rightarrow Median = 153.409

Thus, the median of heights of students is 153.409 cm.

10. Question

Let us find the median of data from the following frequency distribution table.

Class interval	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	4	7	10	15	10	8	5

Answer

To find median of data, we need to make a table calculating cumulative frequency.

Class	Frequency	Cumulative frequency
interval	(f _i)	Cf
0 - 10	4	4
10 - 20	7	4 + 7 = 11
20 - 30	10	11 + 10 = 21
30 - 40	15	21 + 15 = 36 ←
40 - 50	10	36 + 10 = 46
50 - 60	8	46 + 8 = 54
60 - 70	5	54 + 5 = 59
		N = 59

For median:

We have, total frequency, N = 59

N/2 = 59/2 = 29.5

Observe, cf = 36 is just greater than 29.5.

Thus, median class = 30 - 40

Median is given by

$$Median = L + \left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 30

N/2 = 29.5

cf = cumulative frequency of the class preceding median class = 21

f = frequency of the median class = 15

h = class interval of the median class = 10

Substituting these values in the formula of median, we get

Median =
$$30 + \left[\frac{29.5 - 21}{15}\right] \times 10$$

 \Rightarrow Median = $30 + \left[\frac{8.5}{15}\right] \times 10$
 \Rightarrow Median = $30 + 5.67$

 \Rightarrow Median = 35.67

Thus, the median of data is 35.67.

11. Question

Let us find the median of given data.

Class	5-	10-	15-	20-	25-	30-	35-	40-
interval	10	15	20	25	30	35	40	45
Frequency	5	6	15	10	5	4	3	2

Answer

To find median of data, we need to make a table calculating cumulative frequency.

Class	Frequency	Cumulative frequency
Interval	(fi)	Cf
5 - 10	5	5
10 - 15	6	5 + 6 = 11
15 - 20	15	11 + 15 = 26 ←
20 - 25	10	26 + 10 = 36
25 - 30	5	36 + 5 = 41
30 - 35	4	41 + 4 = 45
35 - 40	3	45 + 3 = 48
40 - 45	2	48 + 2 = 50
		N = 50

For median:

We have, total frequency, N = 50

N/2 = 50/2 = 25

Observe, cf = 26 is just greater than 25.

Thus, median class = 15 - 20

Median is given by

Median = L +
$$\left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 15

N/2 = 25

cf = cumulative frequency of the class preceding median class = 11

f = frequency of the median class = 15

h = class interval of the median class = 5

Substituting these values in the formula of median, we get

- $Median = 15 + \left[\frac{25 11}{15}\right] \times 10$ $\Rightarrow Median = 15 + \left[\frac{14}{15}\right] \times 10$
- \Rightarrow Median = 15 + 9.33
- \Rightarrow Median = 24.33

Thus, the median of data is 24.33.

12. Question

Let us find the median of given data.

Class	1-	6-	11-	16-	21-	26-	31-
interval	5	10	15	20	25	30	35
Frequency	2	3	6	7	5	4	3

Answer

The data given in the question is inclusive type of data, we need to convert it into exclusive type of data.

In order to convert it to exclusive type of data, subtract 0.5 from the lower limit of class interval and add 0.5

To find median of data, we need to make a table calculating cumulative frequency.

Class interval	Frequency (f _i)	Cumulative frequency cf
0.5 - 5.5	2	2
5.5 - 10.5	3	2 + 3 = 5
10.5 - 15.5	6	5 + 6 = 11
15.5 - 20.5	7	11 + 7 = 18 ←
20.5 - 25.5	5	18 + 5 = 23
25.5 - 30.5	4	23 + 4 = 27
30.5 - 35.5	3	27 + 3 = 30
		N = 30

For median:

We have, total frequency, N = 30

N/2 = 30/2 = 15

Observe, cf = 18 is just greater than 15.

Thus, median class = 15.5 - 20.5

Median is given by

Median = L +
$$\left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 15.5

N/2 = 15

cf = cumulative frequency of the class preceding median class = 11

f = frequency of the median class = 7

h = class interval of the median class = 5

Substituting these values in the formula of median, we get

Median =
$$15.5 + \left[\frac{15 - 11}{7}\right] \times 5$$

 \Rightarrow Median = $15.5 + \left[\frac{4}{7}\right] \times 5$

 \Rightarrow Median = 15.5 + 2.857

 \Rightarrow Median = 18.357

Thus, the median of data is 18.357.

13. Question

Let us find the median of given data.

Class	51- 60	61- 70	71- 80	81- 00	91- 100	101-
Froquoney	4	10	15	20	15	4
Frequency	4	10	12	20	15	4

Answer

The data given in the question is inclusive type of data, we need to convert it into exclusive type of data.

In order to convert it to exclusive type of data, subtract 0.5 from the lower limit of class interval and add 0.5

To find median of data, we need to make a table calculating cumulative frequency.

Class interval	Frequency (f _i)	Cumulative frequency cf
50.5 - 60.5	4	4
60.5 - 70.5	10	4 + 10 = 14
70.5 - 80.5	15	14 + 15 = 29
80.5 - 90.5	20	29 + 20 = 49 ←
90.5 - 100.5	15	49 + 15 = 64
100.5 - 110.5	4	64 + 4 = 68
		N = 68

For median:

We have, total frequency, N = 68

N/2 = 68/2 = 34

Observe, cf = 49 is just greater than 34.

Thus, median class = 80.5 – 90.5

Median is given by

Median = L +
$$\left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 80.5

N/2 = 34

cf = cumulative frequency of the class preceding median class = 29

f = frequency of the median class = 20

h = class interval of the median class = 10

Substituting these values in the formula of median, we get

$$Median = 80.5 + \left[\frac{34 - 29}{20}\right] \times 10$$
$$\Rightarrow Median = 80.5 + \left[\frac{5}{20}\right] \times 10$$

- \Rightarrow Median = 80.5 + 2.5
- \Rightarrow Median = 83

Thus, the median of data is 83.

14. Question

Let us find the median of given data.

Marks	Number of Students
Less than 12	12
Less than 22	22
Less than 40	40
Less than 60	60
Less than 72	72
Less than 87	87
Less than 102	102
Less than 111	111
Less than 120	120

Answer

The data given in the question is exclusive type of data.

To find median of data, we need to make a table calculating cumulative frequency.

Marks	No. of	Cumulative
	students	frequency
	f.	of
	li	CI
0 - 10	12	12
10 - 20	22	12 + 22 = 34
20 - 30	40	34 + 40 = 74
30 - 40	60	74 + 60 = 134
40 - 50	72	134 + 72 = 202
50 - 60	87	202 + 87 = 289
60 - 70	102	289 + 102 = 391 ←
70 - 80	111	391 + 111 = 502
80 - 90	120	502 + 120 = 622
		N = 622

For median:

We have, total frequency, N = 622

N/2 = 622/2 = 311

Observe, cf = 391 is just greater than 311.

Thus, median class = 60 - 70

Median is given by

$$Median = L + \left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 60

N/2 = 311

cf = cumulative frequency of the class preceding median class = 289

h = class interval of the median class = 10

Substituting these values in the formula of median, we get

$$Median = 60 + \left[\frac{311 - 289}{102}\right] \times 10$$
$$\Rightarrow Median = 60 + \left[\frac{22}{102}\right] \times 10$$

 \Rightarrow Median = 60 + 2.157

 \Rightarrow Median = 62.157

Thus, the median of data is 62.157.

15. Question

If the median of the following data is 32, let us determine the values of x and y when the sum of the frequencies is 100

Class interral	Frequency
0-10	10
10-20	х
20-30	25
30-40	30
40-50	Y
50-60	10

Answer

Given is, median of the data = 32

Sum of frequency, N = 100

To find: x and y

Let us show cumulative frequency in a table.

Class	Frequency	Cumulative Frequency
interval	fi	cf
0 - 10	10	10
10 - 20	x	10 + x
20 - 30	25	10 + x + 25 = 35 + x
30 - 40	30	35 + x + 30 = 65 + x ←
40 - 50	У	65 + x + y
50 - 60	10	65 + x + y + 10 = 75 + x + y
	N = 75 + x + y	

Here, we have got

N = 75 + x + yBut, N = 100 $\Rightarrow 75 + x + y = 100$

- \Rightarrow x + y = 100 75
- \Rightarrow x + y = 25 ...(i)

For median:

We have, total frequency, N = 100

N/2 = 100/2 = 50

 \therefore median = 32

It lies in the interval 30 – 40.

Thus, median class = 30 - 40

Median is given by

Median = L +
$$\left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 30

N/2 = 50

cf = cumulative frequency of the class preceding median class = 35 + x

f = frequency of the median class = 30

h = class interval of the median class = 10

Substituting these values in the formula of median, we get

Median =
$$30 + \left[\frac{50 - (35 + x)}{30}\right] \times 10$$

 \Rightarrow Median = $30 + \left[\frac{50 - 35 - x}{30}\right] \times 10$
 $\Rightarrow 32 = 30 + \left(\frac{15 - x}{30}\right) \times 10$
 $\Rightarrow 32 = 30 + \left(\frac{15 - x}{3}\right)$
 $\Rightarrow 32 = \frac{90 + 15 - x}{3}$
 $\Rightarrow 96 = 105 - x$
 $\Rightarrow x = 105 - 96$
 $\Rightarrow x = 9$
Substituting x = 9 in equation (i),

x + y = 25

 $\Rightarrow 9 + y = 25$ $\Rightarrow y = 25 - 9$ $\Rightarrow y = 16$

Thus, **x** = 9 and **y** = 16.

Let us Work Out 26.3

1. Question

The following distribution cubic shows the daily profit (in \mathbb{R}) of 100 shops of our village.

Profit of each	0-	5-	100-	150-	200-	250-
shop (in ₹)	50	100	150	200	250	300
Number of	10	16	28	22	18	6
Shops						

Making cumulative frequency (greater than type) distribution table of given data, let us drawn Ogive on graph paper.

Answer

We have been given data of profit of each shop in class interval and data of number of shops.

Let us create greater than type cumulative frequency distribution table.

Profit of each shop (in ₹) x	Cumulative frequency (greater than type) cf
0 or more than 0	10 + 16 + 28 + 22 + 18 + 6 = 100
50 or more than 50	16 + 28 + 22 + 18 + 6 = 90
100 or more than 100	28 + 22 + 18 + 6 = 74
150 or more than 150	22 + 18 + 6 = 46
200 or more than 200	18 + 6 = 24
250 or more than 250	6

Taking Profit of each shop as x-axis and cumulative frequency as y-axis.

Thus plotting the points on a graph, we get

Greater than type Ogive



2. Question

The following data shows the weight of 35 students of class of Nivedita.

Weight (kg.)	Less than 35	Less than 40	Less than 42	Less than 44	Less than 46	Less than 48	Less than 50	Less than 52
Number of students	0	4	6	9	12	28	32	35

Making cumulative frequency (less than type) distribution table, let us draw Ogive on graph paper and hence let us find the median from the graph. Let us find the median by using formula and verify it.

Answer

We have been given data of weight in less than type and data of number of students.

We have

Weight	Number of		
(kg)	students		
X			
Less than 38	0		
Less than 40	4		
Less than 42	6		
Less than 44	9		
Less than 46	12		
Less than 48	28 ←		
Less than 50	32		
Less than 52	35		

Taking weight as x-axis and number of students as y-axis.

Thus plotting the points on a graph, we get



Now we need to plot median in the graph and then verify it using the formula.

So, note that total number of students are 35.

 \Rightarrow N = 35

Find N/2.

$$\frac{N}{2} = \frac{35}{2}$$
$$\Rightarrow \frac{N}{2} = 17.5$$

Draw a line parallel to x axis, passing through 17.2 on y-axis intersecting the less than ogive.

We have graphically,

Less than type Ogive



We can notice from the graph, the line intersecting the ogive touches the y-axis at 46.7.

Now, let us solve theoretically,

Let us make a table showing frequencies and class intervals.

Weight (kg)	Weight (kg) _{Xi}	Number of students	Frequency f _i
Less than 38	36 - 38	0	0
Less than 40	38 - 40	4	4 - 0 = 4
Less than 42	40 - 42	6	6 - 4 = 2
Less than 44	42 - 44	9	9 - 6 = 3
Less than 46	44 - 46	12	12 - 9 = 3
Less than 48	46 - 48	28 ←	28 - 12 = 16
Less than 50	48 - 50	32	32 - 28 = 4
Less than 52	50 - 52	35	35 - 32 = 3

Since, $\frac{N}{2} = 17.5$

Observe, cf = 28 is just greater than 17.5.

Thus, median class = 46 - 48

Median is given by

Median = L +
$$\left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 46

N/2 = 17.5

cf = cumulative frequency of the class preceding median class = 12

f = frequency of the median class = 16

h = class interval of the median class = 2

Substituting these values in the formula of median, we get

$$Median = 46 + \left[\frac{17.5 - 12}{16}\right] \times 2$$
$$\Rightarrow Median = 46 + \left[\frac{5.5}{16}\right] \times 2$$

 \Rightarrow Median = 46 + 0.6875

 \Rightarrow Median = 46.6875

Thus, the median of data is 46.6875 and it is verified.

3. Question

Class	0-5	5-10	10-15	15-20	20-25	25-30
Frequency	4	10	15	8	3	5

Making cumulative frequency (greater than type) distribution table of given data, let us drawn Ogive on graph paper.

Answer

We have been given class intervals and frequency.

Let us create greater than type of cumulative frequency distribution table.

Class	Cumulative frequency
x	(greater than type)
	cf
0 or more than 0	4 + 10 + 15 + 8 + 3 + 5 = 45
5 or more than 5	10 + 15 + 8 + 3 + 5 = 41
10 or more than 10	15 + 8 + 3 + 5 = 31
15 or more than 15	8 + 3 + 5 = 16
20 or more than 20	3 + 5 = 8
25 or more than 25	5

Taking Class as x-axis and cumulative frequency as y-axis.



Thus, this is the more than type Ogive on graph paper.

4. Question

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

Drawing less than type Ogive and greater than type Ogive of given data along same axes, on the graph paper, let us find the median from the graph.

Answer

We have been given class intervals and frequency.

Let us create greater than type as well as less than type of cumulative frequency distribution table.

Class	Cumulative frequency	Class	Cumulative frequency	
x	(greater than type)	х	(less than type)	
	cf		cf	
100 or	12 + 14 + 8 + 6 + 10	Less than 120	12	
more than	= 50			
100				
120 or	14 + 8 + 6 + 10 = 38	Less than 140	12 + 14 = 26 ←	
more than				
120				
140 or	8 + 6 + 10 = 24	Less than 160	26 + 8 = 34	
more than				
140				
160 or	6 + 10 = 16	Less than 180	34 + 6 = 40	
more than				
160				
180 or	10	Less than 200	40 + 10 = 50	
more than				
180				

More than type Ogive

Taking Class as x-axis and cumulative frequency as y-axis separately for greater than type as well as less than type.

Thus plotting the points on a graph, we get



The median is given by intersection point of less-than type and more-than type ogives and is represented on x-axis.

Note here, the arrow points at approximately 139.

Even if we verify by using the formula, we'd get an answer around 139.

Since, $\frac{N}{2} = 25$

Observe in the less than type cumulative frequency, cf = 26 is just greater than 25.

Thus, median class = 120 - 140

Median is given by

$$Median = L + \left[\frac{\frac{N}{2} - cf}{f}\right] \times h$$

Where,

L = Lower class limit of median class = 120

$$N/2 = 25$$

cf = cumulative frequency of the class preceding median class = 12

f = frequency of the median class = 14

h = class interval of the median class = 20

Substituting these values in the formula of median, we get

Median =
$$120 + \left[\frac{25 - 12}{14}\right] \times 20$$

$$\Rightarrow \text{Median} = 120 + \left[\frac{13}{14}\right] \times 20$$

- \Rightarrow Median = 120 + 18.57
- \Rightarrow Median = 138.57 ~ 139

Thus, the median of data is 138.57 and it is verified too.

Let us Work Out 26.4

1. Question

Paid amounts of a day of our 16 friends for going to school and other expenditures are 15, 16, 17, 18, 17, 19, 17, 15, 15, 10, 17, 16, 15, 16, 18, 11

Let us find the mode of paid amounts of a day of our friends.

Answer

Mode is just the set of data value that appears most often.

Let us arrange the data values in ascending order so that observation can be made easily.

10, 11, 15, 15, 15, 15, 16, 16, 16, 17, 17, 17, 17, 18, 18, 19

Note the appearances now,

10 appears \rightarrow 1 time

11 appears \rightarrow 1 time

15 appears \rightarrow 4 times

16 appears \rightarrow 3 times

17 appears \rightarrow 4 times

18 appears \rightarrow 2 times

19 appears \rightarrow 1 time

15 and 17 both appears most times, that is, 4 times.

Thus, mode is 15 and 17.

2. Question

Heights (cm) of some students of our class are given below.

131, 130, 130, 132, 131, 133, 131, 134, 131, 132, 131, 133, 130, 132, 130, 133, 135, 131, 135, 131, 135, 130, 132, 135, 134, 133

Let us find the mode of heights of students.

Answer

Mode is just the set of data values that appears most often.

Let us arrange the data values in ascending order so that observation can be made easily.

Note the appearances now,

130 appears \rightarrow 5 times

131 appears \rightarrow 7 times

132 appears \rightarrow 4 times

133 appears \rightarrow 4 times

134 appears \rightarrow 2 times

135 appears \rightarrow 4 times

 \Rightarrow 131 appears most of the times, that is, 7 times.

Thus, mode is 131.

3. Question

Let us find the mode of data given below :

i. 8, 5, 4, 6, 7, 4, 4, 3, 5, 4, 5, 4, 4, 5, 5, 4, 3, 3, 5, 4, 6, 5, 4, 5, 4, 5, 4, 2, 3, 4

ii. 15, 11, 10, 8, 15, 18, 17, 15, 10, 19, 10, 11, 10, 8, 19, 15, 10, 18, 15, 3, 16, 14, 17, 2

Answer

Since, mode is the set of data values that appears most often in the data.

(i). Arranging the data values in ascending order to make observation easier, we get

2, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 5, 5, 5, 5, 5, 5, 5, 5, 5, 6, 6, 7, 8

Note the appearances now,

1 appears \rightarrow 1 time

3 appears \rightarrow 4 times

4 appears \rightarrow 12 times

5 appears \rightarrow 9 times

6 appears \rightarrow 2 times

7 appears \rightarrow 1 time

8 appears \rightarrow 1 time

 \Rightarrow 4 appears most of the times, that is, 12 times.

Thus, mode is 4.

(ii). Arranging the data values in ascending order to make observation easier, we get

2, 3, 8, 8, 10, 10, 10, 10, 10, 10, 11, 11, 14, 15, 15, 15, 15, 15, 17, 17, 18, 18, 19, 19

Note the appearances now,

2 appears \rightarrow 1 time

3 appears \rightarrow 1 time

8 appears \rightarrow 2 times

10 appears \rightarrow 6 times

11 appears \rightarrow 2 times

14 appears \rightarrow 1 time

15 appears \rightarrow 5 times

17 appears \rightarrow 2 times

18 appears \rightarrow 2 times

19 appears \rightarrow 2 times

 \Rightarrow 10 appears most of the time, that is, 6 times.

Thus, mode is 10.

4. Question

The frequency distribution table shows the selling prices of shoes of a special company of shoe shop of our village.

Size (x _i)	2	3	4	5	6	7	8	9
Frequency (f _i)	3	4	5	3	5	4	3	2

Answer

Since, mode is just the data value/s appearing most often in given set of data values.

We just need to search for the size which has the greatest frequency. Frequency is just the number of occurrence of the data value.

Here,

2 appears \rightarrow 3 times

3 appears \rightarrow 4 times

4 appears \rightarrow 5 times

5 appears \rightarrow 3 times

6 appears \rightarrow 5 times

7 appears \rightarrow 4 times

8 appears \rightarrow 3 times

9 appears \rightarrow 2 times

 \Rightarrow 4 and 5 appears most of the times, that is, 5 times.

Thus, mode is 4 and 5.

5. Question

Let us find the mode from the following frequency distribution table of ages of examinees of an entrance examination.

Age (year)	16-18	18-20	20-22	22-24	24-26
No. of examinees	45	75	38	22	20

Answer

This is a grouped frequency distribution table.

Notice the greatest number of examinees is 75.

$$\Rightarrow$$
 Modal class = 18 - 20

Mode is given by

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

Where,

L = Lower class limit of the modal class = 18

h = class interval of the modal class = 2

 f_1 = frequency of the modal class = 75

 f_0 = frequency of the class preceding the modal class = 45

 f_2 = frequency of the class succeeding the modal class = 38

Substituting values in the formula of mode,

 $Mode = 18 + \frac{75 - 45}{2 \times 75 - 45 - 38} \times 2$ $\Rightarrow Mode = 18 + \frac{30}{67} \times 2$ $\Rightarrow Mode = 18 + \frac{60}{67}$ $\Rightarrow Mode = 18 + 0.896$ $\Rightarrow Mode = 18.896$

Thus, mode is 18.896.

6. Question

Let us see the frequency distribution table of obtaining marks in a periodical examination of 80 students in a class and let us find the mode

Marks	0-	5-	10-	15-	20-	25-	30-	35-
	5	10	15	20	25	30	35	40
No. of students	2	6	10	16	22	11	8	5

Answer

This is a grouped frequency distribution table.

Notice the greatest number of students is 22.

 \Rightarrow Modal class = 20 - 25

Mode is given by

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

Where,

L = Lower class limit of the modal class = 20

h = class interval of the modal class = 5

 f_1 = frequency of the modal class = 22

 f_0 = frequency of the class preceding the modal class = 16

 f_2 = frequency of the class succeeding the modal class = 11 $\,$

Substituting values in the formula of mode,

$$Mode = 20 + \frac{22 - 16}{2 \times 22 - 16 - 11} \times 5$$

$$\Rightarrow Mode = 20 + \frac{6}{17} \times 5$$

$$\Rightarrow Mode = 20 + \frac{30}{17}$$

$$\Rightarrow Mode = 20 + 1.76$$

$$\Rightarrow Mode = 21.76$$

Thus, mode is 21.76.

7. Question

Let us find the mode of frequency distribution table given below :

Class interval	0-5	5-10	10-15	15-20	20-25	25-30	30-35
Frequency	5	12	18	28	17	12	8

Answer

This is a grouped frequency distribution table.

Notice the greatest frequency is 28.

 \Rightarrow Modal class = 15 - 20

Mode is given by

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

Where,

L = Lower class limit of the modal class = 15

h = class interval of the modal class = 5

- f_1 = frequency of the modal class = 28
- f_0 = frequency of the class preceding the modal class = 18

 f_2 = frequency of the class succeeding the modal class = 17

Substituting values in the formula of mode,

 $Mode = 15 + \frac{28 - 18}{2 \times 28 - 18 - 17} \times 5$ $\Rightarrow Mode = 15 + \frac{10}{21} \times 5$ $\Rightarrow Mode = 15 + \frac{50}{21}$ $\Rightarrow Mode = 15 + 2.38$ $\Rightarrow Mode = 17.38$

Thus, mode is 17.38.

8. Question

Let us find the mode of frequency distribution table given below :

Class interval	45-54	55-64	65-74	75-84	85-94	95-104
Frequency	8	13	19	32	12	6

[Hints : In the case of finding mode, we take lower limit of modal class, so we first correct the class limit in inclusive form of class limit.]

Answer

This is a grouped frequency distribution table which is inclusive type.

We need to convert this inclusive type of data into exclusive type of data to find mode of these data values.

To convert to exclusive type of data, subtract 0.5 from the lower class of the interval and add 0.5 to the upper class of the interval.

Class interval	Frequency
	li
44.5 - 54.5	8
54.5 - 64.5	13
64.5 - 74.5	19
74.5 - 84.5	32
84.5 - 94.5	12
94.5 - 104.5	6

Notice the greatest frequency is 32.

 \Rightarrow Modal class = 74.5 - 84.5

Mode is given by

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

Where,

L = Lower class limit of the modal class = 74.5

h = class interval of the modal class = 10

 f_1 = frequency of the modal class = 32

 f_0 = frequency of the class preceding the modal class = 19

 f_2 = frequency of the class succeeding the modal class = 12

Substituting values in the formula of mode,

 $Mode = 74.5 + \frac{32 - 19}{2 \times 32 - 19 - 12} \times 10$ $\Rightarrow Mode = 74.5 + \frac{13}{33} \times 10$ $\Rightarrow Mode = 74.5 + \frac{130}{33}$ $\Rightarrow Mode = 74.5 + 3.94$ $\Rightarrow Mode = 78.44$

Thus, mode is 78.44.

9 A1. Question

The median of a given frequency distribution is found graphically with the help of

- A. Frequency curve
- B. Frequency polygon
- C. Histogram
- D. Ogive

Answer

Frequency curve is a smooth *curve* which corresponds to the limiting case of a histogram computed for a *frequency* distribution of a continuous distribution as the number of data points becomes very large.

Frequency polygons are a graphical device for understanding the shapes of distributions. They serve the same purpose as histograms, but are especially helpful for comparing sets of data.

A *histogram* is an accurate representation of the distribution of numerical data. It is an estimate of the probability distribution of a continuous variable (quantitative variable).

An *ogive*, sometimes called a cumulative frequency polygon, is a type of frequency polygon that shows cumulative frequencies. *Ogives* do look similar to frequency polygons, which we saw earlier. The most important difference between them is that an *ogive* is a plot of cumulative values, whereas a frequency polygon is a plot of the values themselves.

 \Rightarrow Ogives can easily estimate median of a given frequency distribution since they are plots of given class and frequency and median can be estimated on x-axis.

9 A2. Question

If the mean of numbers 6, 7, x, 8, y, 14 is 9, then

Answer

Mean is given by adding the data values or variables and dividing them by the number of data values or variables.

So, Mean =
$$\frac{6+7+x+8+y+14}{6}$$
$$\Rightarrow 9 = \frac{35+x+y}{6}$$
$$\Rightarrow 54 = 35 + x + y$$
$$\Rightarrow 54 - 35 = x + y$$
$$\Rightarrow x + y = 19$$

Thus, option (B) is correct.

9 A3. Question

If 35 is removed from the data 30,34, 35, 36, 37, 38, 39, 40 then the median increases by

A. 2

B. 1.5

C. 1

D. 0.5

Answer

First, let us find out median of the original set of data.

To find its median, arrange the data into ascending order. We get

30, 34, 35, 36, 37, 38, 39, 40

(Since, it was already arranged in ascending order)

Total number of values, n = 8

Since n is even,

Median = The mean of $\left(\frac{n}{2}\right)^{\text{th}}$ term and $\left(\frac{n}{2}+1\right)^{\text{th}}$ term \Rightarrow Median = The mean of $\left(\frac{8}{2}\right)^{\text{th}}$ term and $\left(\frac{8}{2}+1\right)^{\text{th}}$ term

- \Rightarrow Median = The mean of 4th term and 5th term
- \Rightarrow Median = The mean of 36 and 37
- \Rightarrow Median = $\frac{(36+37)}{2}$
- \Rightarrow Median = $\frac{73}{2}$

$$\Rightarrow$$
 Median = 36.5 ...(i)

And if according to the question, 35 is removed then we have the data,

30, 34, 36, 37, 38, 39, 40

Total number of values, n = 7

Since n is odd,

Median =
$$\left(\frac{n+1}{2}\right)^{\text{th}}$$
 term
 \Rightarrow Median = $\left(\frac{7+1}{2}\right)^{\text{th}}$ term
 \Rightarrow Median = $\left(\frac{8}{2}\right)^{\text{th}}$ term
 \Rightarrow Median = 4^{\text{th}} term
 \Rightarrow Median = 37 ...(ii)

Subtracting equations (ii) and (i), we get

Difference = 37 – 36.5

 \Rightarrow Difference = 0.5

Thus, option (D) is correct.

9 A4. Question

If the mode of data 16, 15, 17, 16, 15, x, 19, 17, 14 is 15, then the value of x is

A. 15

- B. 15
- C. 17
- D. 19

Answer

Mode of the data is the value that occurs most of the time in data

Now we can see from data given to us that 16 occurs 2 times and 15 occurs 2 times, rest of the values occur only 1 time

So, for 15 to be the mode of data, 15 should occur three times and this can happen only when x = 15

So, x = 15

9 A5. Question

If the median of arranging the ascending order of data 8, 9, 12, 17, x + 2, x + 4, 30, 31, 34, 39, is 15, then the value of x is

A. 12

B. 21

C. 20

D. 24

Answer

We have arranged data,

8, 9, 12, 17, x + 2, x + 4, 30, 31, 34, 39

Median = 15

Total number of data values, n = 10

Since, n is even, median will be given by

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

⇒ Median = The mean of $\left(\frac{10}{2}\right)^{\text{th}}$ term and $\left(\frac{10}{2}+1\right)^{\text{th}}$ term

- \Rightarrow Median = The mean of 5th term and 6th term
- \Rightarrow Median = The mean of (x + 2) and (x + 4)
- $\Rightarrow \text{Median} = \frac{x+2+x+4}{2}$ $\Rightarrow 15 = \frac{2x+6}{2}$ $\Rightarrow 30 = 2x + 6$ $\Rightarrow 2x = 30 6$ $\Rightarrow 2x = 24$ $\Rightarrow x = \frac{24}{2}$ $\Rightarrow x = 12$

9 B. Question

Let us write true or false of the following statements :

i. Value of mode of data 2, 3, 9, 10, 9, 3, 9 is 10

ii. Median of data 3, 14, 18, 20, 5 is 18

Answer

(i). The statement is false.

To check this, we need to find mode of 2, 3, 9, 10, 9, 3, 9.

Count the data values:

2 appears \rightarrow 1 time

3 appears \rightarrow 2 times

9 appears \rightarrow 3 times

10 appears \rightarrow 1 time

 \Rightarrow 9 appears most of the times, that is, 3 times.

Thus, mode is 9.

Hence, the statement given is **false**.

(ii). The statement is false.

To check this, we need to find median of 3, 14, 18, 20, 5.

Arrange the data into ascending order. We get

3, 5, 14, 18, 20

Total number of values, n = 5

Since n is odd, median is given by

Median =
$$\left(\frac{n+1}{2}\right)^{\text{th}}$$
 term
 \Rightarrow Median = $\left(\frac{5+1}{2}\right)^{\text{th}}$ term
 \Rightarrow Median = $\left(\frac{6}{2}\right)^{\text{th}}$ term

 \Rightarrow Median = 3rd term

Thus, median is 14.

Hence, the statement is false.

9 C. Question

Let us fill in the blanks :

i. Mean, median, mode are measures of _____.

ii. If mean of $x_1, x_2, x_3, \dots, x_n$ is \overline{x} mean of $ax_1, ax_2, ax_3, \dots, ax_n$ is _____.

iii. At the time of finding arithmetic mean, the lengths of all classes are _____.

Answer

(i). Mean, median and mode are measures of **central tendency**.

A central tendency (or measure of central tendency) is a central or typical value for a probability distribution.

Mean gives us the average of given set of values or variables, which is the central value in a set of values.

Median is a value separating higher half from the lower half of the data, which gives us the central measure.

Mode is the value in the data occurring most often, gives an indication of the central value in the data.

(ii). If mean of $x_1, x_2, x_3, \dots, x_n$ is \overline{x} mean of $ax_1, ax_2, ax_3, \dots, ax_n$ is \overline{ax} .

Given that, mean of $x_1, x_2, x_3, ..., x_n$ is $\overline{\mathbf{x}}$.

$$\Rightarrow Mean = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$
$$\Rightarrow \overline{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$
$$\Rightarrow x_1 + x_2 + x_3 + \dots + x_n = n\overline{x} \dots (1)$$

Then, mean of ax_1 , ax_2 , ax_3 , ..., ax_n is given by

$$Mean = \frac{ax_1 + ax_2 + ax_3 + \dots + ax_n}{n}$$
$$\Rightarrow Mean = \frac{a(x_1 + x_2 + x_3 + \dots + x_n)}{n}$$
$$\Rightarrow Mean = \frac{a(n\bar{x})}{n}$$
$$\Rightarrow Mean = a\bar{x}$$

(iii). At the time of finding arithmetic mean, the lengths of all classes are **not necessarily equal.**

It is not necessary for class intervals to be equal but it would be better if class interval size is smaller. But at the time of finding arithmetic mean, equal or unequal class interval can yield result.

10 A. Question

Short answer type question :

Class	65-	85-	105-	125-	145-	165-	185-
	85	105	125	145	165	185	205
frequency	4	15	3	20	14	7	14

Let us find the difference between upper class limit in median class and lower class limit of modal class of the above frequency distribution table.

Answer

Here, we need to find the median class and modal class.

Let us find median class.

Let us create a table.

Class	Frequency	Cumulative Frequency	
	t	cf	
65 - 85	4	4	
85 - 105	15	4 + 15 = 19	
105 - 125	3	19 + 3 = 22	
125 - 145	20	22 + 20 = 42 ←	
145 - 165	14	42 + 14 = 56	
165 - 185	7	56 + 7 = 63	
185 - 205	14	63 + 14 = 77	

Here, total sum of frequency, N = 77

$$\Rightarrow \frac{N}{2} = \frac{77}{2}$$
$$\Rightarrow \frac{N}{2} = 38.5$$

Note in the table that, cf = 42 is just greater than 38.5.

 \Rightarrow Median class = 125 - 145

Now, let us find modal class.

For modal class, just check the greatest frequency.

Here, the greatest frequency = 20

 \Rightarrow Modal class = 125 - 145

Upper class limit of median class = 145

Lower class limit of modal class = 125

Difference = Upper class limit of median class – Lower class limit of modal class

 \Rightarrow Difference = 145 - 125

 \Rightarrow Difference = 20

Thus, answer is 20.

10 B. Question

The following frequency distribution shows the time taken to complete 100 metre hardle race of 150 athletics :

Time	13.8-	14-	14.2-	14.2-	14.6-	14.8-
(seconds)	14	14.2	14.4	14.6	14.8	15
No. of athletics	2	4	5	71	48	20

Let us find the difference between the upper class limit of modal class and lower class limit of modal class.

Answer

To find modal class, find the greatest frequency.

 \Rightarrow Greatest frequency = 71

So, corresponding to this value of frequency, we get class = 14.2 - 14.6

 \Rightarrow Modal class = 14.2 - 14.6

So, upper class limit of modal class = 14.6

Lower class limit of modal class = 14.2

Difference = Upper class limit of modal class – Lower class limit of modal class

 \Rightarrow Difference = 14.6 - 14.2

 \Rightarrow Difference = 0.4

Thus, difference is 0.4.

10 C. Question

The mean of frequency distribution is 8.1, $\sum f_i x_i = 132 + 5k$ and $\sum f_i = 20$, let us find the value of k.

Answer

Given: Mean = 8.1

 $\sum f_i x_i = 132 + 5k$

$$\sum f_i = 20$$

To find k, we need to use the direct method formula of mean.

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow Mean = \frac{132+5k}{20}$$

$$\Rightarrow 8.1 = \frac{132+5k}{20}$$

$$\Rightarrow 162 = 132 + 5k$$

$$\Rightarrow 5k = 162 - 132$$

$$\Rightarrow 5k = 30$$

$$\Rightarrow \mathbf{k} = \frac{30}{5}$$
$$\Rightarrow \mathbf{k} = 6$$

Thus, k = 6.

10 D. Question

If $u_i = \frac{x_i - 25}{10}$, $\sum f_i u_i = 20$ and $\sum f_i = 100$, let us find the value of \overline{x} . Marks Less Less Less Less Less Less than than than than than than 10 20 30 40 50 60 No. of 3

75

80

Let us write the modal class from the above frequency distribution table.

57

Answer

students

Given that, $u_i = \frac{x_i - 25}{10} \dots (i)$

12

27

 $\sum f_i u_i = 20$

 $\sum f_i = 100$

From the step deviation method, we have the relation of deviation (u_i) and assumed mean (A).

$$u_i = \frac{x_i - A}{h}$$

Comparing it with equation (i),

A = 25

h = 10

Using the formula of step deviation method, we have

$$Mean = A + \frac{\sum f_i u_i}{\sum f_i} \times h$$

$$\Rightarrow Mean = 25 + \frac{20}{100} \times 10$$

$$\Rightarrow Mean = 25 + 2$$

$$\Rightarrow Mean = 27$$

To find modal class, we need to find frequencies of the data given.

Marks	No. of students (Less than type)	Class interval	Frequency
Less than 10	3	0 - 10	3
Less than 20	12	10 - 20	12 - 3 = 9
Less than 30	27	20 - 30	27 - 12 = 15
Less than 40	57	30 - 40	57 - 27 = 30
Less than 50	75	40 - 50	75 - 57 = 18
Less than 60	80	50 - 60	80 - 75 = 5

Note the greatest frequency in the data.

So, greatest frequency = 30

Thus, the corresponding class is 30 – 40.

 \Rightarrow Modal class = 30 - 40

Thus, mean is 27 and modal class is 30 – 40.