

ARITHMETIC-MEAN, MODE AND MEDIAN

36.1 REVIEW

1. Arithmetic Mean (or mean)

The Arithmetic mean in statistics has the same meaning as average in Arithmetic.

2. Arithmetic Mean of Raw Data

Add the given data and divide the sum by the number of data.

Example 1 :

Find the arithmetic mean of : 7, 10, 15, 11 and 9.

Solution :

$$\text{Sum of given data} = 7 + 10 + 15 + 11 + 9 = 52$$

$$\text{No. of given data} = 5$$

$$\therefore \text{Arithmetic mean of given data} = \frac{52}{5} = 10.4 \quad (\text{Ans.})$$

Thus, the mean of n numbers $x_1, x_2, x_3, x_4, \dots, x_n$

$$= \frac{x_1 + x_2 + x_3 + x_4 + \dots + x_n}{n} = \frac{\Sigma x}{n}$$

The Greek letter Σ (called sigma) represents the sum of numbers (the given statistical data). In example 1, given above :

$$\Sigma x = 7 + 10 + 15 + 11 + 9 = 52 \text{ and } n = 5$$

$$\therefore \text{Arithmetic mean} = \frac{\Sigma x}{n} = \frac{52}{5} = 10.4 \quad (\text{Ans.})$$

3. Arithmetic Mean of Tabulated Data

Let the frequencies of the numbers $x_1, x_2, x_3, \dots, x_n$ be $f_1, f_2, f_3, \dots, f_n$ respectively.

$$\begin{aligned} \text{Then, the Arithmetic mean} &= \frac{f_1 \cdot x_1 + f_2 \cdot x_2 + \dots + f_n \cdot x_n}{f_1 + f_2 + f_3 + \dots + f_n} \\ &= \frac{\Sigma f \cdot x}{\Sigma f} \quad [\Sigma f = \text{total number of observations} = n] \end{aligned}$$

Example 2 :

Find the mean (arithmetic mean) of :

x	10	15	20	25	30
f	3	4	2	5	6

Solution :

$$\begin{aligned} \Sigma f \cdot x &= f_1 \cdot x_1 + f_2 \cdot x_2 + f_3 \cdot x_3 + \dots + f_n \cdot x_n \\ &= 3 \times 10 + 4 \times 15 + 2 \times 20 + 5 \times 25 + 6 \times 30 = 435 \end{aligned}$$

$$\Sigma f = 3 + 4 + 2 + 5 + 6 = 20$$

$$\therefore \text{Mean} = \frac{\Sigma f \cdot x}{\Sigma f} = \frac{435}{20} = 21.75 \quad (\text{Ans.})$$

4. Arithmetic Mean of Grouped Data

Example 3 :

Find the mean of :

Class-intervals	20-30	30-40	40-50	50-60	60-70
Frequency	8	12	15	9	6

Solution :

Steps :

1. Find the mean-value (class-mark) of each class-interval.
2. Represent the mean value by x .
3. Find the mean using the same method as in example 2 (given above).

Class Intervals	Frequency (f)	Mean Mark (x)	f × x
20-30	8	$\frac{20+30}{2} = 25$	200
30-40	12	= 35	420
40-50	15	= 45	675
50-60	9	= 55	495
60-70	6	= 65	390
	$\Sigma f = 50$		$\Sigma fx = 2180$

$$\begin{aligned} \therefore \text{Required Mean} &= \frac{\Sigma fx}{\Sigma f} \\ &= \frac{2180}{50} = 43.6 \end{aligned}$$

(Ans.)

Let the mean of some given numbers is m . If each of these numbers is :

- (i) **increased by x** , mean of resulting numbers = $m + x$
- (ii) **decreased by x** , mean of resulting numbers = $m - x$
- (iii) **multiplied by x** , mean of resulting numbers = $m \times x$, or
- (iv) **divided by x** , mean of resulting numbers = $m \div x$.

Example 4 :

The mean of some numbers is 20. Find the mean of resulting numbers when each number is :

- (i) increased by 5
- (ii) decreased by 8
- (iii) multiplied by 2
- (iv) divided by 4

Solution :

- (i) **The resulting mean** = $20 + 5 = 25$ (Ans.)
- (ii) **The resulting mean** = $20 - 8 = 12$ (Ans.)
- (iii) **The resulting mean** = $20 \times 2 = 40$ (Ans.)
- (iv) **The resulting mean** = $\frac{20}{4} = 5$ (Ans.)

36.2 MODE

The number which appears maximum times in the given statistical data is called **mode**. In other words, mode is the number whose frequency is maximum.

Example 4 :

Find the mode of following data : 15, 20, 15, 30, 20, 20, 30, 15, 20, 20.

Solution :

Since, in the given data, the number 20 appears maximum times. \therefore **Mode = 20 (Ans.)**

Example 5 :

Find the mode from the following frequency distribution :

Numbers	10	11	12	13	14	15	16	17	18
Frequency	7	15	20	25	30	9	8	12	24

Solution :

Since, the frequency of number 14 is maximum. \therefore **Mode = 14 (Ans.)**

36.3 MEDIAN

If the given statistical data be arranged in ascending or descending order of their magnitudes (values); then the value of the middle term is called **median**.

If the number of given data is odd, there will be only one middle term, which is the median of given data. But if, the number of given data is even, there will be two middle terms and the median will be the average of these two terms.

Example 6 :

Find the median of the following data :

- (i) 15, 12, 10, 9, 8, 13, 17
 (ii) 3, 5, 9, 10, 11, 4, 5, 8, 12, 15.

Solution :

- (i) On arranging the given data in ascending order of their magnitudes, we get :
 8, 9, 10, 12, 13, 15, 17

Since, the number of terms is odd (seven) :

Median = middle term = 12 (Ans.)

Whether the given data be arranged in ascending or descending order, the value of their median is unique.

- (ii) On arranging the given data in descending order of their magnitudes, we get :
 15, 12, 11, 10, 9, 8, 5, 5, 4, 3

As the number of terms is even, the two middle terms are 9 and 8.

\therefore **Median = $\frac{9+8}{2} = 8.5$ (Ans.)**

TEST YOURSELF

- Mean of $x + 2$, $3 - 2x$ and $x + 1 = \dots = \dots$
- The mean of a certain set of data = 16. If each number in this data is first increased by 4 and then divided by 5; the new mean of the resulting numbers = $\dots = \dots$
- For 10, 15, 10, 20, 15, 10, 10, 15 and 20 mode = \dots
 If each given number is :
 (a) increased by 3; the mode of resulting numbers = \dots
 (b) divided by 5, the mode of resulting numbers = \dots

4. The median of 8, 3, 4, 7 and 6 =
- If each given number is :
- (a) decreased by 2, the median of the resulting numbers =
- (b) multiplied by 2, the median of the resulting numbers =
5. For 20, 25, 30, 25 and 25,
- (a) mean = =
- (b) mode =
- (c) median =

EXERCISE 36

1. Find the mean of :
- (i) 9, 11, 12, 4 and 7
- (ii) 3, 5, 3, 4, 2, 0, 7 and 10
- (iii) 6.2, 5.6, 4.8, 11.2, 12.5, 7.4 and 6.3
- (iv) $3\frac{2}{3}$, $6\frac{1}{3}$, $7\frac{2}{3}$, $10\frac{1}{3}$ and 11
2. (i) Find the mean of first 8 whole numbers.
- (ii) Find the arithmetic mean of integers from - 5 to 5.
- (iii) Find the mean of integers from - 4 to 5.
3. (i) The mean of 8, 7, 9, 10, 12, x and 14 is 12, find the value of x.
- (ii) The mean of 3, a + 2, 8, 12, 2a - 1 and 6 is 7, find the value of a.
4. For some given numbers their mean is 36. Find the mean of resulting numbers obtained when each number is :
- (i) increased by 6.
- (ii) decreased by 10.
- (iii) divided by 9.
- (iv) multiplied by 3.
5. Find the mean of : 10, 12, 14, 18 and 21. Also, find the resulting mean when each of these numbers is first multiplied by 3 then decreased by 10.
6. Find the mean of the following frequency distribution :

Age (in years)	18	19	20	21	22
No. of boys	14	10	20	24	12

7. The weights of 40 students of class VIII are given below :

Weight (kg)	38	40	41	43	45	48
No. of students	3	8	9	7	6	7

Find the mean weight.

8. Find the arithmetic mean for the following grouped frequency distribution :

(i)

Class-intervals	0-10	10-20	20-30	30-40	40-50
Frequency	12	11	14	10	13

(ii)

Class-intervals	6-10	10-14	14-18	18-22	22-26	26-30
Frequency	4	6	9	12	7	2

9. The following table gives the per day income of 50 pupils. Find the arithmetic mean of their per day income.

Income/day (₹)	70-74	74-78	78-82	82-86	86-90
No. of people	8	10	11	17	4

10. Find the mode of :

(i) 5, 6, 9, 13, 6, 5, 6, 7, 6, 6, 3

(ii) 7, 7, 8, 10, 10, 11, 10, 13, 14

11. Find the mode of :

(i)	x	15	16	17	18	19	20	21	22	23
	f	6	7	9	13	10	12	8	0	4

(ii)	Height (cm)	37	38	39	40	41
	Number of plants	46	89	93	90	153

12. Find the medians of the following data :

(i) 5, 7, 9, 11, 15, 17, 2, 23 and 19

(ii) 9, 3, 20, 13, 0, 7 and 10

(iii) 18, 19, 20, 23, 22, 20, 17, 19, 25 and 21

(iv) 3.6, 9.4, 3.8, 5.6, 6.5, 8.9, 2.7, 10.8, 15.6, 1.9 and 7.6.

13. Find the mean and the mode for the following data :

Term	18	22	26	30	34	38
Frequency	3	5	10	2	8	2

14. The heights (in cm) of 8 girls of a class are 140, 142, 135, 133, 137, 150, 148 and 138 respectively. Find the mean height of these girls and their median height.

15. Find the mean, the median and the mode of :

(i) 12, 24, 24, 12, 30 and 12

(ii) 21, 24, 21, 6, 15, 18, 21, 45, 9, 6, 27 and 15.

ANSWERS

TEST YOURSELF

1. $\frac{x+2+3-2x+x+1}{3} = 2$ 2. $\frac{16+4}{5} = 4$ 3. 10 (a) 13 (b) 2 4. 6 (a) 4 (b) 12

5. (a) $\frac{20+25+30+25+25}{5} = 25$ (b) 25 (c) 25

EXERCISE 36

1. (i) 8.6 (ii) 4.25 (iii) $7\frac{5}{7}$ (iv) 7.8 2. (i) 3.5 (ii) 0 (iii) 0.5 3. (i) 24 (ii) 4 4. (i) 42 (ii) 26 (iii) 4 (iv) 108

5. 15; 35 6. 20.125 years 7. 42.75 kg 8. (i) $25\frac{1}{6}$ (ii) 17.8 9. 79.92 10. (i) 6 (ii) 10 11. (i) 18 (ii) 41

12. (i) 11 (ii) 9 (iii) 20 (iv) 6.5 13. Mean = 27.73 and mode = 26 (the term with greatest frequency)

14. Mean = 140.375 cm and median = 139 cm 15. (i) 19, 15 and 12 (ii) 19, 19.5 and 21