

CLASS XI MATHEMATICS NOTES

Key Notes and Important Questions with Answers

CHAPTER - 15

STATISTICS

KEY POINTS

- Range of Ungrouped Data and Discrete Frequency Distribution = Largest observation – smallest observation.
- Range of Continuous Frequency Distribution = Upper Limit of Highest Class — Lower Limit of Lowest Class
- Mean deviation for ungrouped data or raw data

$$M.D.(\bar{x}) = \frac{\sum |x_i - \bar{x}|}{n}$$

$$M.D.(M) = \frac{\sum |x_i - M|}{n}, \text{ where } M = \text{Median}$$

- Mean deviation for grouped data (Discrete frequency distribution and Continuous frequency distribution).

$$M.D.(\bar{x}) = \frac{\sum f_i |x_i - \bar{x}|}{N}, \text{ where } N = \sum f_i$$

$$M.D.(M) = \frac{\sum f_i |x_i - M|}{N}, \text{ where } N = \sum f_i$$

- Variance is defined as the mean of the squares of the deviations from mean.
- Standard deviation 'σ' is positive square root of variance.

$$\sigma = \sqrt{\text{variance}}$$

- variance σ^2 and standard deviation (SD) σ for ungrouped data

$$\sigma^2 = \frac{1}{n} \sum (x_i - \bar{x})^2$$

$$SD = \sigma = \sqrt{\frac{1}{n} \sum (x_i - \bar{x})^2}$$

- Standard deviation of a discrete frequency distribution

$$\sigma = \sqrt{\frac{1}{N} \sum f_i (x_i - \bar{x})^2} = \frac{1}{N} \sqrt{N \sum f_i x_i^2 - (\sum f x_i)^2}$$

- Standard deviation of a continuous frequency distribution

$$\sigma = \sqrt{\frac{1}{N} \sum f_i (x_i - \bar{x})^2} = \frac{1}{N} \sqrt{N \sum f_i x_i^2 - (\sum f x_i)^2}$$

where x_i are the midpoints of the classes.

- Short cut method to find variance and standard deviation

$$\sigma^2 = \frac{h^2}{N^2} \left[N \sum f_i y_i^2 - (\sum f_i y_i)^2 \right]$$

$$\sigma = \frac{h}{N} \sqrt{N \sum f_i y_i^2 - (\sum f_i y_i)^2}$$

Where $y_i = \frac{x_i - A}{h}$

- Coefficient of variation (C.V) = $\frac{\sigma}{\bar{x}} \times 100$, $\bar{x} \neq 0$
- If each observation is multiplied by a positive constant k then variance of the resulting observations become k^2 times of the original value and standard deviation becomes k times of the original value.
- If each observation is increased by k, where k is positive or negative, the variance and standard deviation remains same.
- Standard deviation is independent of choice of origin but depends on the scale of measurement.
- The series having higher coefficient of variation is called more variable than the other. While the series having lesser coefficient of variation is called more consistent or more stable. For series with equal means the series with lesser standard deviation is more stable.
- The mean and standard deviation of a set of n_1 observations are $\bar{x}_1$ and s_1 respectively while the mean and standard deviation of another set of n_2 observations are $\bar{x}_2$ and s_2 respectively then the standard deviation of the combined set of $(n_1 + n_2)$ observations is given by

$$S.D = \sqrt{\frac{n_1(s_1)^2 + n_2(s_2)^2}{n_1 + n_2} + \frac{n_1 n_2 (\bar{x}_1 - \bar{x}_2)^2}{(n_1 + n_2)^2}}$$

Important Questions with Solutions

Section-A

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. The sum of the squares of deviation for 10 observations taken from their mean 50 is 250. Find the coefficient of variation.
2. If the standard deviation of a variable X is σ , then find the standard deviation of variable $\frac{ax+b}{c}$.
3. If the variance of 14, 18, 22, 26, 30, is 32, then find the variance of 28, 36, 44, 52, 60.
4. Find range of the following data.

Class	10-19	20-29	30-39	40-49	50-59
Frequency	5	4	5	3	2

5. The variance of 10 observations is 16 and their mean is 12. If each observation is multiplied by 4, what are the new mean and the new variance?
6. The standard deviation of 25 observations is 4 and their mean is 25. If each observation is increased by 10, what are the new mean and the new standard deviation?

Section-B

SHORT ANSWER TYPE QUESTIONS (4 MARKS)

7. In a series of $2n$ observations, half of them equal 'a' and remaining half equal $-a$. If the standard deviation of the observations is 2, then find the value of $|a|$.
8. The frequency distribution

x	A	2A	3A	4A	5A	6A
f	2	1	1	1	1	1

Where A is positive integer, has a variance of 160. Determine the value of A.

9. Find the mean deviation from the mean of A.P:
a, a+d, a+2d, ..., a+2nd.
10. Consider the first 10 positive integers. If we multiply each number by -1 and then add 1 to each number, find the variance of the numbers so obtained.
11. Coefficients of variation of two distributions are 60 and 80 and their standard deviations are 21 and 36. What are their means?
12. Life of bulbs produced by two factors A and B given below

<i>Length of Life</i>	<i>Factory A</i>	<i>Factory B</i>
<i>in (Hours)</i>	<i>(Number of bulbs)</i>	<i>(Number of bulbs)</i>
550-650	10	8
650-750	22	60
750-850	52	24
850-950	20	16
950-1050	16	12

The bulb of which factory are more consistent from point of view of length.

13. The mean of 5 observations is 4.4 and their variance is 8.24. If three of the observations are 1, 2 and 6. Find the other two observations.

14. Calculate the possible values of x if standard deviation of the numbers 2, 3, $2x$ and 11 is 3.5.
15. Mean and standard deviation of the data having 18 observations were found to be 7 and 4 respectively. Later it was found that 12 was miscopied as 21 in calculation. Find the correct mean and the correct standard deviation.
16. Find the standard deviation of
 $a, a+d, a+2d, \dots, a+2nd$
17. Suppose a population A has 100 observations 101, 102, ..., 200. Another population B has 100 observations 151, 152, ..., 250. If V_A and V_B represent the variances of the two populations respectively then find the ratio of V_A and V_B .

Section-C

LONG ANSWER TYPE QUESTIONS (6 MARKS)

18.

Calculate the mean	Size	2	4	6	8	10	12	14	16
deviation about mean	Frequency	2	2	4	5	3	2	1	1

deviation about mean for the following data.

19. Calculate the mean deviation about median for the following data:

20.

T_x	10	15	20	25	30	35	40	45
h								
ef	7	3	8	5	6	8	4	4

There are 60 students in a class. The following is the frequency distribution of the marks obtained by the students in a test :

x_i	0	1	2	3	4	5
f_i	$x-2$	X	x^2	$(x+1)^2$	$2x$	$2x+1$

where x is positive integer. Determine the mean and standard deviation of the marks.

21. Find the mean and variance of the frequency distribution given below

X	$1 \leq x < 3$	$3 \leq x < 5$	$5 \leq x < 7$	$7 \leq x < 10$
f	6	4	5	1

22. Calculate the mean deviation about mean (Q. No. 22 & 23)

Classes	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	2	3	8	14	8	3	2

- 23.

Marks	0-10	10-20	20-30	30-40	40-50
Number of Students	5	8	15	16	6

24. Find the mean deviation about the median

Weight (in kg.)	30-40	40-50	50-60	60-70	70-80	80-90
Number of Persons	8	10	10	16	4	2

25. The mean and standard deviation of some data taken for the time to complete a test are calculated with following results:

Number of observations = 25, mean = 18.2

Standard deviation = 3.25 seconds

Further another set of 15 observations $x_1, x_2, \dots, x_{15}$ also in

$$\sum_{i=1}^{15} x_i^2 = 5524.$$

Calculate the standard deviation based on all 40 observations.

26. Find the coefficient of variation of the following data

Classes	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Frequency	5	12	15	20	18	10	6	4

27. Which group of students is more stable- Group A or Group B?

Classes	5-15	15-25	25-35	35-45	45-55	55-65	65-73
Number in Group A	4	12	22	30	23	5	4
Number in Group B	5	15	20	33	15	10	2

28. Mean and standard deviation of 100 observations were found to be 40 and 10 respectively. If at the time of calculation two observations were wrongly taken as 30 and 70 in place of 3 and 27 respectively. Find correct standard deviation.

29. For a distribution $\sum (x_i - 5) = 3$, $\sum (x_i - 5)^2 = 43$ and total number of items is 18. Find the mean and standard deviation.
30. The following is the record of goals scored by team A in a football session:

Number in Goals scored	0	1	2	3	4
Number of Matches	1	9	7	5	3

For the team B, mean number of goals scored per match was 2 with standard deviation 1.25 goals. Find which of the two teams is more consistent in their performance.

ANSWERS

1. 10
2. $\left| \frac{a}{c} \right| \sigma$
3. 128
4. 50
5. 48,256
6. 35, 4
7. 2
8. $A = 7$
9. $\frac{n(n+1)}{2n+1}d$
10. 8.25
11. 35, 45
12. Factory A
13. 4, 9
14. 3, $7/3$

- | | | | |
|-----|---------------------------------------|-----|----------------------------|
| 15. | 6.5, 2.5 | 16. | $\sqrt{\frac{n(n+1)}{3}}d$ |
| 17. | 1 | 18. | 2.8 |
| 19. | 10.1 | | |
| 20. | Mean = 2.8, Standard deviation = 1.12 | | |
| 21. | 4.16, 3.96 | 22. | 10 |
| 23. | 9.44 | 24. | 11.44 |
| 25. | 3.87 | 26. | 31.24 |
| 27. | Group A | 28. | 10.24 |
| 29. | 5.17, 1.53 | 30. | Team A |