MATHEMATICS

CLASS NOTES FOR CBSE

Chapter 14. Stastics

01. Mean Deviation

I. Mean Deviation For Ungrouped Data or Individual Observations

If x_1, x_2, ..., x_n are n values of a variable X, then the mean deviation from an average. A (median or Arithmetic Mean*) is given by*

$$M.D. = \frac{1}{n}\sum_{i=1}^{n}|x_1 - A| = \frac{1}{n}\Sigma|d_i|, \text{where } d_i = x_i - A$$

We may use the following algorithm to find mean deviation of individual observations:

Algorithm

Step I *Compute the central value or average 'A' about which mean deviation is to be calculated.*

Step II *Take deviations of the observations about the central value 'A' obtained in Step I ignoring ± sings and denote these deviations by $|d_i|$.*

Step III *Obtain the total of these deviations i.e.* $\sum_{i=1}^{n}|d_i|$.

Step IV *Divide the total obtained in step III by the number of observations.*

Example 1 Find the mean deviation from the mean for the following data :
6, 7, 10, 12, 13, 4, 8, 20

Solution Let $\overline{X}$ be the mean of the given data. Then,

$$\overline{X} = \frac{6+7+10+12+13+4+8+20}{8} = 10$$

Compounds of Mean Deviation

x_i	$\lvert d_i\rvert = \lvert x_i - \overline{X}\rvert = \lvert x_i - 10\rvert$
6	4
7	3
10	0
12	2
13	3
4	6
8	2
20	10
Total	$\sum d_i = 30$

We have, $\sum|d_i| = 30$ and $n = 8$

$$\therefore \quad M.D. = \frac{1}{n}\sum|d_i| = \frac{30}{8} = 3.75$$

Example 2 Calcualte the mean deviation about median from the following data : 340, 150, 210, 240, 300, 310, 320.

Solution Arranging the observations in ascending order of magnitude, we have 150, 210, 240, 300, 310, 320, 340.

Clearly, the middle observation is 300. So, medina = 300.

Calculation of Mean Deviation

x_i	$\|d_i\| = \|x_i - 300\|$
340	40
150	150
210	90
240	60
300	0
310	10
320	20
Total	$d_i = \sum \|x_i - 300\| = 370$

$$\therefore \quad M.D. = \frac{1}{n} \sum |d_i| = \frac{1}{7} \sum |x_i - 300| = \frac{370}{7} = 52.8$$

II. Mean Deviation of A Discrete Frequency Distribution

If x_i/f_i ; $i = 1, 2, ..., n$ is the frequency distribution, then mean deviation from an average A (median or Arithmetic Mean) is given by

$$M.D. = \frac{1}{N}\sum_{i=1}^{n} f_i \left|x_1 - A\right|, \text{ where } \sum_{i=1}^{n} f_i = N$$

We may use the following algorithm to find the mean deviation of a discrete frequency distribution.

Algorithm

Step I *Calculate the central value or average 'A' of the given frequency distribution about which mean deviation is to be calculated.*

Step II *Take deviations of the observations from the central value in step I ignoring sings and denote them by* $|d_i|$.

Step III *Multiply these deviations by respective frequencies and obtain the total* $\sum_{i=1}^{n} f_i |d_i|$.

Step IV *Divide the total obtained in step III by the number of observations i.e.* $N = \sum_{i=1}^{n} f_i$ *to obtain the mean deviation.*

Example 1 Calculate the mean deviation about mean from the following data :

x_i :	3	9	17	23	27
f_i :	8	10	12	9	5

Solution Calculation of mean deviation about mean.

x_i	f_i	$f_i x_i$	$\lvert x_i - 15\rvert$	$f_i \lvert x_i - 15\rvert$
3	8	24	12	96
9	10	90	6	60
17	12	204	2	24
23	9	207	8	72
27	5	135	12	60
	$N = \sum f_i = 44$	$N = \sum f_i x_i = 660$		$\sum f_i \lvert x_i - 15\rvert = 312$

$$\text{Mean} = \overline{X} = \frac{1}{N}\left(\sum f_i x_i\right) = \frac{660}{44} = 15$$

$$\text{Mean deviation} = M.D. = \frac{1}{N}\sum f_i \lvert x_i - 15\rvert = \frac{312}{44} = 7.09$$

Example 2 Calculate the mean deviation from the median for the following distribution:

x_i :	10	15	20	25	30	35	40	45
f_i :	7	3	8	5	6	8	4	9

Solution We have to calcualte mean deviation about median. So, first we calculate median.

x_i	f_i	*Cumulative frequency*	$\lvert d_i\rvert = \lvert x_i - 30\rvert$	$f_i \lvert d_i\rvert$
10	7	7	20	140
15	3	10	15	45
20	8	18	10	80
25	5	23	5	25
30	6	29	0	0
35	8	37	5	40
40	4	41	10	40
45	9	50	15	135
	$N = \sum f_i = 50$			$\sum f_i \lvert d_i\rvert = 505$

We have, $N = 50 \Rightarrow N/2 = 25$.

The cumulative frequency just greater than $N/2$ is 29 and the corresponding value of x is 30. Hence, median = 30.

Now, $$\text{Mean deviation} = \frac{1}{N}\sum f_i \lvert d_i\rvert = \frac{505}{50} = 10.1$$

III. Mean Deviation of A Grouped or Continuous Frequency Distribution

For calculating mean deviation of a continuous frequency distribution the procedure is same as for a discrete frequency distribution. The only difference is that here we have to obtain the mid-points of the various classes and take the deviations of the these mid-points from the given central value (median or mean).