Example 8. *Calculate the mean deviation about the mean for the following series :*

15, 20, 17, 19, 21, 13, 12, 10, 17, 9, 12.

Solution. Here $n = 11$, and therefore

$$\textbf{Mean} = \frac{15+20+17+19+21+13+12+10+17+9+12}{11} = \frac{165}{11} = \textbf{15} = \textbf{M} \text{ (say)}.$$

Now

x	$d = x - M = (x - 15)$	$\lvert d \rvert$
15	0	0
20	5	5
17	2	2
19	4	4
21	6	6
13	– 2	2
12	– 3	3
10	– 5	5
17	2	2
9	– 6	6
12	– 3	3
		$\Sigma \lvert d \rvert = 38$

$$\therefore \textbf{ Mean deviation} = \frac{\Sigma |d|}{N} = \frac{38}{11} = \textbf{3.455.}$$

Example 9. *The marks obtained by 10 students in an examination were as follows:*

70, 65, 68, 70, 75, 73, 80, 70, 83, 86.

Find the mode, median and mean deviation about the mean.

Solution. Arranging the data in the ascending order we have;

65, 68, 70, 70, 70, 73, 75, 80, 83, 86

Mode = 70. (∵ **70 occurs maximum number of times)**

$$\textbf{Median} = \frac{10+1}{2} \text{ th item} = 5.5\text{th item}$$

$$= \text{Average of 5th and 6th item} = \frac{70+73}{2} = \textbf{71.5}.$$

$$\textbf{Mean} = \frac{\Sigma X}{n} = \frac{65+68+70+70+70+73+75+80+83+86}{10} = \frac{740}{10} = \textbf{74}.$$

$$\textbf{Mean Deviation about mean} = \frac{\Sigma |X - \bar{X}|}{n}$$

$$= \frac{4+9+6+4+1+1+6+4+9+12}{10} = \frac{56}{10} = \textbf{5.6}$$

5.4.2 Mean Deviation for Grouped data

Let $x_1, x_2, x_3, \ldots, x_n$ occur with frequencies $f_1, f_2, f_3, \ldots, f_n$ respectively and let $\Sigma f = n$ and M can be either Mean or Median or Mode, then the mean deviation is given by the formula.

$$\textbf{Mean Deviation} = \frac{\Sigma f |x - M|}{\Sigma f} = \frac{\Sigma f |d|}{n}, \text{ where } d = |x - M| \text{ and } \Sigma f = n.$$

Example 13. *Calculate the mean deviation from the mean for the following data:*

Marks :	*0 – 10*	*10 – 20*	*20 – 30*	*30 – 40*	*40 – 50*	*50 – 60*	*60 – 70*
No. of Students :	*6*	*5*	*8*	*15*	*7*	*6*	*3*

Solution.

Table: Computation of Mean Deviation

Mid-value: (x)	*Frequency:* (f)	$f \times x$	$\lvert x - \bar{x} \rvert$	$f \lvert x - \bar{x} \rvert$
5	6	30	28.4	170.4
15	5	75	18.4	92.0
25	8	200	8.4	67.2
35	15	525	1.6	24.0
45	7	315	11.6	81.2
55	6	330	21.6	129.6
65	3	195	31.6	94.8
	$\Sigma f = 50$	$\Sigma fx = 1670$		$\Sigma f \lvert x - \bar{x} \rvert = 659.2$

Mean: $$\bar{x} = \frac{\Sigma f \times x}{N} = \frac{1670}{50} = 33.4$$

$$\textbf{Mean Deviation} = \frac{\Sigma f \lvert x - \bar{x} \rvert}{\Sigma f} = \frac{659.2}{50} = 13.184.$$

Example 14. *Find the mean deviation from the mean for the following data.*

Class Interval :	*0 – 10*	*10 – 20*	*20 – 30*	*30 – 40*	*40 – 50*	*50 – 60*	*60 – 70*
Frequency :	*8*	*12*	*10*	*8*	*3*	*2*	*7*

WORKING RULE

STEP I Find the mid-values or mid-points of the various classes and denote it by m.

STEP II Take any one of the values of m's as the assumed mean A (Generally, the middle value is taken as A).

STEP III Take the deviations of the mid-points from the assumed mean A and divide it by class interval or common factor i. Denote it by d (or d').

STEP IV Multiply the respective frequencies f with the corresponding deviation d and obtain Σfd.

STEP V Square the deviations d and multiply it with their respective frequencies. Obtain Σfd^2.

STEP VI Substitute the values of Σfd, Σfd^2, i in the formula:

$$\sigma = \sqrt{\frac{\Sigma fd^2}{n} - \left(\frac{\Sigma fd}{n}\right)^2} \times i, \text{ where } n = \Sigma f$$

to get **the desired standard deviation σ.**

Example 21. *Find the standard deviation for the following distribution:*

Marks	*10 – 20*	*20 – 30*	*30 – 40*	*40 – 50*	*50 – 60*	*60 – 70*	*70 – 80*
No. of Students	*5*	*12*	*15*	*20*	*10*	*4*	*2*

Solution. Let us prepare the following table in order to calculate the standard deviation, by assuming $A = 45$.

Table: Computation of Standard Deviation

Marks (Class interval)	*No. of Students (f)*	*Mid-value (m)*	$d = \frac{m-45}{10}$	*fd*	fd^2
10 – 20	5	15	– 3	– 15	45
20 – 30	12	25	– 2	– 24	48
30 – 40	15	35	– 1	– 15	15
40 – 50	20	45	0	0	0
50 – 60	10	55	1	10	10
60 – 70	4	65	2	8	16
70 – 80	2	75	3	6	18
Total	$\Sigma f = n = 68$			$\Sigma fd = -30$	$\Sigma fd^2 = 152$

$$\therefore \sigma = i \times \sqrt{\frac{\Sigma fd^2}{n} - \left(\frac{\Sigma fd}{n}\right)^2} = 10 \times \sqrt{\frac{152}{68} - \left(\frac{-30}{68}\right)^2} = 10 \times \sqrt{(2.2352 - 0.1946)}$$

$$= 10 \times \sqrt{2.0406} = \mathbf{14.3 \text{ Approx.}}$$

Example 22. *Find the standard deviation by the step deviation method for the following data:*

Class-Interval:	*0 – 10*	*10 – 20*	*20 – 30*	*30 – 40*	*40 – 50*	*50 – 60*	*60 – 70*
Frequency:	*6*	*14*	*10*	*8*	*1*	*3*	*8*

Solution. Let the assumed mean $A = 35$