NCERT Solutions for Class-XI Maths

Chapter-15 Exercise-15.1

NCERT Math Class 11

1. Find the mean deviation about the mean for the data

$$4, 7, 8, 9, 10, 12, 13, 17$$

1. The given data is

$$4, 7, 8, 9, 10, 12, 13, 17$$

Mean of the data, $\bar{x} = \frac{4+7+8+9+10+12+13+17}{8} = \frac{80}{8} = 10$

The deviations of the respective observations from the mean $\bar{x}$, i.e. $x_i - \bar{x}$, are

$$-6, -3, -2, -1, 0, 2, 3, 7$$

The absolute values of the deviations, i.e. $|x_i - \bar{x}|$, are

$$6, 3, 2, 1, 0, 2, 3, 7$$

The required mean deviation about the mean is

M.D. $(\bar{x}) = \frac{\sum_{i=1}^{8}|x_i - \bar{x}|}{8} = \frac{6+3+2+1+0+2+3+7}{8} = \frac{24}{8} = 3$

2. 38, 70, 48, 40, 42, 55, 63, 46, 54, 44

2. We first find the mean ($\bar{x}$) of the data

$$\bar{x} = \frac{1}{10}\sum_{i=1}^{10} x_i = \frac{500}{10} = 50$$

The respective absolute values of the deviations from mean, i.e., $|x_i - \bar{x}|$ are
12, 20, 2, 10, 8, 5, 13, 4, 4, 6

Therefore $\sum_{i=1}^{10}|x_i - \bar{x}| = 84$

And $M.D.(\bar{x}) = \frac{84}{10} = 8.4$

Hence, the mean deviation about the mean for the given data is **8.4**.

3. Find the mean deviation about the median for the data.

$$13,17,16,14,11,13,10,16,11,18,12,17$$

3. The given data is

$$13,17,16,14,11,13,10,16,11,18,12,17$$

Here, the numbers of observations are 12 , which is even.
Arranging the data in ascending order, we obtain

$$10,11,11,12,13,13,14,16,16,17,17,18$$

Median,

$$M=\frac{\left(\frac{12}{2}\right)^{th}\text{ observation}+\left(\frac{12}{2}+1\right)^{th}\text{ observation}}{2}$$

$$=\frac{6^{th}\text{ observation}+7^{th}\text{ observation}}{2}$$

$$=\frac{13+14}{2}=\frac{27}{2}=13.5$$

The deviations of the respective observations from the median, i.e. x_i-M, are

$$-3.5,-2.5,-2.5,-1.5,-0.5,-0.5,0.5,2.5,2.5,3.5,3.5,4.5$$

The absolute values of the deviations, $|x_i-M|$, are

$$3.5,2.5,2.5,1.5,0.5,0.5,0.5,2.5,2.5,3.5,3.5,4.5$$

The required mean deviation about the median is

4. 36, 72, 46, 42, 60, 45, 53, 46, 51, 49

4. Here the number of observations is 10 which is even. Arranging the data into ascending order, we have 36, 42, 45, 46, 46, 49, 51, 53, 60, 72.

Now, Median $=\frac{\left(\frac{10}{2}\right)^{th} observation+\left(\frac{10}{2}+1\right)^{th} observation}{2}=\frac{46+49}{2}=\frac{95}{2}=47.5$

The absolute values of the respective deviations from the median, i.e., $|x_i - M|$ are

11.5, 5.5, 2.5, 1.5, 1.5, 1.5, 3.5, 5.5, 12.5, 24.5

Therefore $\sum_{i=1}^{10}|x_i-M|=70$

And $$M.D.(M)=\frac{1}{10}\sum_{i=1}^{10}|x_i-M|=\frac{1}{10}\times 70=7$$

Hence, the mean deviation about the median for the given data is **7**.

5. Find the mean deviation about the mean for the data.

x_i	5	10	15	20	25
f_i	7	4	6	3	5

5.

x_i	f_i	$f_i x_i$	$\lvert x_i-\bar{x}\rvert$	$f_i\lvert x_i-\bar{x}\rvert$
5	7	35	9	63
10	4	40	4	16
15	6	90	1	6
20	3	60	6	18
25	5	125	11	55

$$\sum_{i=1}^{5}f_i x_i=350$$

$$\therefore \bar{x}=\frac{1}{N}\sum_{i=1}^{5}f_i x_i=\frac{1}{25}\times 350=14$$

$$\therefore MD(\bar{x})=\frac{1}{N}\sum_{i=1}^{5}f_i|x_i-\bar{x}|=\frac{1}{25}\times 158=6.32$$

6.

x_i	10	30	50	70	90
f_i	4	24	28	16	8

6. We make the following table and add other columns after calculations.

x_i	f_i	$f_i x_i$	$\lvert x_i-\bar{x}\rvert$	$f_i\lvert x_i-\bar{x}\rvert$
10	4	40	40	160
30	24	720	20	480
50	28	1400	0	0
70	16	1120	20	320
90	8	720	40	320
	$\sum f_i=80$	$\sum f_i x_i=4000$		$\sum f_i\lvert x_i-\bar{x}\rvert=1280$

$$N = \sum_{i=1}^{5} f_i = 80, \sum_{i=1}^{5} f_i x_i = 4000$$

$$\Rightarrow \bar{x} = \frac{1}{N}\sum_{i=1}^{5} f_i x_i = \frac{1}{80} \times 4000 = 50$$

So, we can calculate the absolute values of the deviations from the mean, i.e., $|x_i - \bar{x}|$, as shown in the table.

Thus, we have $\sum_{i=1}^{5} f_i |x_i - \bar{x}| = 1280$

Therefore $$M.D.(\bar{x}) = \frac{1}{N}\sum_{i=1}^{5} f_i |x_i - \bar{x}| = \frac{1}{80} \times 1280 = 16$$

Hence, the mean deviation about the mean for the given data is **16**.

7. Find the mean deviation about the median for the data.

x_i	5	7	9	10	12	15
f_i	8	6	2	2	2	6

7. The given observations are already in ascending order.
Adding a column corresponding to cumulative frequencies of the given data, we obtain the following table.

x_i	f_i	c.f.
5	8	8
7	6	14
9	2	16
10	2	18
12	2	20
15	6	26

Here, $N = 26$, which is even.
Median is the mean of 13^{th} and 14^{th} observations. Both of these observations lie in the cumulative frequency 14 , for which the corresponding observation is 7 .

$\therefore$ Median $= \dfrac{13^{\text{th}} \text{ observation} + 14^{\text{th}} \text{ observation}}{2} = \dfrac{7+7}{2} = 7$

The absolute values of the deviations from median, i.e. $|x_i - \text{M}|$, are

$\lvert x_i - M \rvert$	2	0	2	3	5	8
f_i	8	6	2	2	2	6
$f_i \lvert x_i - \text{M} \rvert$	16	0	4	6	10	48

$\sum_{i=1}^{6} f_i = 26$ and $\sum_{i=1}^{6} f_i |x_i - \text{M}| = 84$

$\text{M.D.}(\text{M}) = \dfrac{1}{\text{N}} \sum_{i=1}^{6} f_i |x_i - \text{M}| = \dfrac{1}{26} \times 84 = 3.23$

8.

x_i	15	21	27	30	35
f_i	4	5	6	7	8

8.

The given observations are already in ascending order. We make a table for the given data, as shown below, adding other columns after calculations.

x_i	f_i	c.f.	$\lvert x_i$ - M$\rvert$	$f_i \lvert x_i$ - M$\rvert$
15	3	3	13.5	40.5
21	5	8	7.5	37.5
27	6	14	1.5	9
30	7	21	1.5	10.5
35	8	29	6.5	52
	$\sum f_i = 29$			$\sum f_i \lvert x_i - M \rvert = 149.5$

Now, N = 30 which is even.

Median is the mean of 15th and 16th observations. We see that both the 15th as well as the 16th observations lie in the cumulative frequency 21, whose corresponding observation is 30.

Therefore, Median $= \dfrac{15^{th}\, observation + 16^{th}\, observation}{2} = \dfrac{30+30}{2} = 30$

So, we can calculate the absolute values of the deviations from the median, i.e., $|x_i - \text{M}|$, as shown in the table.

Thus, we have $\sum_{i=1}^{5} f_i = 29 \, and \sum_{i=1}^{5} f_i \left| x_i - M \right| = 149.5$

And $$M.D.(M) = \frac{1}{N} \sum_{i=1}^{5} f_i \left| x_i - M \right| = \frac{1}{29} \times 149.5 = 5.1$$

Hence, the mean deviation about the median for the given data is **5.1**.

9. Find the mean deviation about the mean for the data.

Income per day	Number of persons
$0-100$	4
$100-200$	8
$200-300$	9
$300-400$	10
$400-500$	7
$500-600$	5
$600-700$	4
700-800	3

9. The following table is formed.

Income per day	Number of persons f_i	Mid-point x_i	$f_i x_i$	$\lvert x_i - \bar{x} \rvert$	$f_i \lvert x_i - \bar{x} \rvert$
0 – 100	4	50	200	308	1232
100 – 200	8	150	1200	208	1664
200 – 300	9	250	2250	108	972
300 – 400	10	350	3500	8	80
400 – 500	7	450	3150	92	644
500 – 600	5	550	2750	192	960
600 – 700	4	650	2600	292	1168
700 – 800	3	750	2250	392	1176
	50		17900		7896

Here, $N = \sum_{i=1}^{8} f_i = 50, \sum_{i=1}^{8} f_i x_i = 17900$

$$\therefore \bar{x} = \frac{1}{N}\sum_{i=1}^{8} f_i x_i = \frac{1}{50} \times 17900 = 358$$

$$\text{M.D.}\left(\bar{x}\right) = \frac{1}{N}\sum_{i=1}^{8} f_i \left|x_i - \bar{x}\right| = \frac{1}{50} \times 7896 = 157.92$$

10.

Height in cms	95-105	105-115	115-125	125-135	135-145	145-155
Number of boys	9	13	26	30	12	10

10. We make the following table and add other columns after calculations.

Height in cms	Number of boys f_i	Mid-points x_i	$f_i x_i$	$\lvert x_i - \bar{x} \rvert$	$f_i \lvert x_i - \bar{x} \rvert$
95-105	9	100	900	25.3	227.7
105-115	13	110	1430	15.3	198.9
115-125	26	120	3120	5.3	137.8
125-135	30	130	3900	4.7	141
135-145	12	140	1680	14.7	176.4
145-155	10	150	1500	24.7	247
	$\sum f_i = 100$		$\sum f_i x_i = 12530$		$\sum f_i \lvert x_i - \bar{x} \rvert = 1128.$

$$N = \sum_{i=1}^{6} f_i = 100, \sum_{i=1}^{6} f_i x_i = 12530$$

$$\Rightarrow \bar{x} = \frac{1}{N}\sum_{i=1}^{6} f_i x_i = \frac{1}{100} \times 12530 = 125.3$$

So, we can calculate the absolute values of the deviations from the mean, i.e., $|x_i - \bar{x}|$, as shown in the table.

Therefore, we have $\sum_{i=1}^{6} f_i |x_i - \bar{x}| = 1128.8$

And $$M.D.(\bar{x}) = \frac{1}{N}\sum_{i=1}^{6} f_i |x_i - \bar{x}| = \frac{1}{100} \times 1128.8 = 11.28$$

Hence, the mean deviation about the mean for the given data is **11.28**.

11. Find the mean deviation about median for the following data:

Marks	Number of girls
$0-10$	6
$10-20$	8

$20-30$	14
$30-40$	16
$40-50$	4
$50-60$	2

11. The following table is formed.

Marks	Number of boys f_i	Cumulative frequency (c.f.)	Mid-point x_i	$\lvert x_i -$ Med.$\rvert$	$f_i \lvert x_i -$ Med.$\rvert$
0-10	6	6	5	22.85	137.1
10-20	8	14	15	12.85	102.8
20-30	14	28	25	2.85	39.9
30-40	16	44	35	7.15	114.4
40-50	4	48	45	17.15	68.6
50-60	2	50	55	27.15	54.3
	50				517.1

The class interval containing the $\left(\frac{N}{2}\right)^{th}$ or 25^{th} item is $20-30$.

Therefore, $20-30$ is the median class.

It is known that, Median $= l + \frac{\frac{N}{2} - C}{f} \times h$

Here, $I = 20, C = 14, f = 14, h = 10$, and $N = 50$

$\therefore$ Median $= 20 + \frac{25-14}{14} \times 10 = 20 + \frac{110}{14} = 20 + 7.85 = 27.85$

Thus, mean deviation about the median is given by,

M.D. $(M) = \frac{1}{N} \sum_{i=1}^{6} f_i \lvert x_i - M \rvert = \frac{1}{50} \times 517.1 = 10.34$

12. Calculate the mean deviation about median age for the age distribution of 100 persons given below:

Age	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55
Number	5	6	12	14	26	12	16	9

[Hint Convert the given data into continuous frequency distribution by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of each class interval

12. We first convert the given data into continuous frequency distribution by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of each class interval and then form the following table adding the other columns after calculations.

Age	Number f_i	Cumulative frequency $(c.f.)$	Mid-points x_i	$\lvert x_i - Med.\rvert$	$f_i \lvert x_i - Med.\rvert$
15.5-20.5	5	5	18	20	100
20.5-25.5	6	11	23	15	90
25.5-30.5	12	23	28	10	120
30.5-35.5	14	37	33	5	70
35.5-40.5	26	63	38	0	0
40.5-45.5	12	75	43	5	60
45.5-50.5	16	91	48	10	160
50.5-55.5	9	100	53	15	135
	$\sum f_i = 100$				$\sum f_i \lvert x_i - Med.\rvert = 73$

The class interval containing $\frac{N}{2}^{th}$ or 50th item is 35.5-40.5. Therefore, 35.5-40.5 is the median class.

Now, we know that

$$\text{Median} = l + \frac{\frac{N}{2} - C}{f} \times h$$

Here, l = 35.5, C = 37, f = 26, h = 5 and N = 100

Therefore, Median $= 35.5 + \frac{50-37}{26} \times 5 = 35.5 + 2.5 = 38$

So, we can calculate the absolute values of the deviations from the median, i.e., $|x_i - Med.|$, as shown in the table.

Therefore, we have $\sum_{i=1}^{8} f_i |x_i - Med.| = 735$

And $M.D.(M) = \frac{1}{N}\sum_{i=1}^{8} f_i |x_i - Med.| = \frac{1}{100} \times 735 = 7.35$

Hence, the mean deviation about the median for the given data is **7.35**.