EXERCISE 32.1

1. Calculate the mean deviation about the median of the following observation :
(i) 3011, 2780, 3020, 2354, 3541, 4150, 5000
(ii) 38, 70, 48, 34, 42, 55, 63, 46, 54, 44
(iii) 34, 66, 30, 38, 44, 50, 40, 60, 42, 51
(iv) 22, 24, 30, 27, 29, 31, 25, 28, 41, 42
(v) 38, 70, 48, 34, 63, 42, 55, 44, 53, 47
Solution:
(i) 3011, 2780, 3020, 2354, 3541, 4150, 5000
To calculate the Median (M), let us arrange the numbers in ascending order.
Median is the middle number of all the observation.
2354, 2780, 3011, 3020, 3541, 4150, 5000
So, Median = 3020 and n = 7
By using the formula to calculate Mean Deviation,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

x_i	$\lvert d_i\rvert = \lvert x_i - 3020\rvert$
3011	9
2780	240
3020	0
2354	666
3541	521
4150	1130
5000	1980
Total	4546

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

$= 1/7 \times 4546$
$= 649.42$
∴ The Mean Deviation is 649.42.

(ii) 38, 70, 48, 34, 42, 55, 63, 46, 54, 44
To calculate the Median (M), let us arrange the numbers in ascending order.
Median is the middle number of all the observation.
34, 38, 42, 44, 46, 48, 54, 55, 63, 70
Here the Number of observations are Even then Median = (46+48)/2 = 47

Median = 47 and n = 10
By using the formula to calculate Mean Deviation,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

x_i	$\|d_i\| = \|x_i - 47\|$
38	9
70	23
48	1
34	13
42	5
55	8
63	16
46	1
54	7
44	3
Total	86

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

$= 1/10 \times 86$
$= 8.6$

∴ The Mean Deviation is 8.6.

(iii) 34, 66, 30, 38, 44, 50, 40, 60, 42, 51
To calculate the Median (M), let us arrange the numbers in ascending order.
Median is the middle number of all the observation.
30, 34, 38, 40, 42, 44, 50, 51, 60, 66
Here the Number of observations are Even then Median = (42+44)/2 = 43
Median = 43 and n = 10
By using the formula to calculate Mean Deviation,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

x_i	$\|d_i\| = \|x_i - 43\|$
30	13
34	9
38	5
40	3
42	1

44	1
50	7
51	8
60	17
66	23
Total	87

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 87

= 8.7

∴ The Mean Deviation is 8.7.

(iv) 22, 24, 30, 27, 29, 31, 25, 28, 41, 42

To calculate the Median (M), let us arrange the numbers in ascending order.

Median is the middle number of all the observation.

22, 24, 25, 27, 28, 29, 30, 31, 41, 42

Here the Number of observations are Even then Median = (28+29)/2 = 28.5

Median = 28.5 and n = 10

By using the formula to calculate Mean Deviation,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

x_i	$\lvert d_i\rvert = \lvert x_i - 28.5\rvert$
22	6.5
24	4.5
30	1.5
27	1.5
29	0.5
31	2.5
25	3.5
28	0.5
41	12.5
42	13.5
Total	47

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 47

= 4.7

∴ The Mean Deviation is 4.7.

(v) 38, 70, 48, 34, 63, 42, 55, 44, 53, 47
To calculate the Median (M), let us arrange the numbers in ascending order.
Median is the middle number of all the observation.
34, 38, 43, 44, 47, 48, 53, 55, 63, 70
Here the Number of observations are Even then Median = (47+48)/2 = 47.5
Median = 47.5 and n = 10
By using the formula to calculate Mean Deviation,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

x_i	$\|d_i\| = \|x_i - 47.5\|$
38	9.5
70	22.5
48	0.5
34	13.5
63	15.5
42	5.5
55	7.5
44	3.5
53	5.5
Total	84

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 84
= 8.4
∴ The Mean Deviation is 8.4.

2. Calculate the mean deviation from the mean for the following data :
(i) 4, 7, 8, 9, 10, 12, 13, 17
(ii) 13, 17, 16, 14, 11, 13, 10, 16, 11, 18, 12, 17
(iii) 38, 70, 48, 40, 42, 55, 63, 46, 54, 44
(iv) 36, 72, 46, 42, 60, 45, 53, 46, 51, 49
(v) 57, 64, 43, 67, 49, 59, 44, 47, 61, 59
Solution:
(i) 4, 7, 8, 9, 10, 12, 13, 17

We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - x|$

So, let 'x' be the mean of the given observation.

$x = [4 + 7 + 8 + 9 + 10 + 12 + 13 + 17]/8$

$= 80/8$

$= 10$

Number of observations, 'n' = 8

x_i	$\|d_i\| = \|x_i - 10\|$
4	6
7	3
8	2
9	1
10	0
12	2
13	3
17	7
Total	24

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

$= 1/8 \times 24$

$= 3$

∴ The Mean Deviation is 3.

(ii) 13, 17, 16, 14, 11, 13, 10, 16, 11, 18, 12, 17

We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - x|$

So, let 'x' be the mean of the given observation.

$x = [13 + 17 + 16 + 14 + 11 + 13 + 10 + 16 + 11 + 18 + 12 + 17]/12$

$= 168/12$

$= 14$

Number of observations, 'n' = 12

x_i	$\|d_i\| = \|x_i - 14\|$
13	1
17	3
16	2
14	0
11	3
13	1
10	4
16	2
11	3
18	4
12	2
17	3
Total	28

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

$= 1/12 \times 28$

$= 2.33$

∴ The Mean Deviation is 2.33.

(iii) 38, 70, 48, 40, 42, 55, 63, 46, 54, 44

We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - x|$

So, let 'x' be the mean of the given observation.

$x = [38 + 70 + 48 + 40 + 42 + 55 + 63 + 46 + 54 + 44]/10$

$= 500/10$

$= 50$

Number of observations, 'n' = 10

x_i	$\|d_i\| = \|x_i - 50\|$
38	12
70	20
48	2
40	10
42	8

55	5
63	13
46	4
54	4
44	6
Total	84

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 84
= 8.4
∴ The Mean Deviation is 8.4.

(iv) 36, 72, 46, 42, 60, 45, 53, 46, 51, 49
We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - x|$
So, let 'x' be the mean of the given observation.
x = [36 + 72 + 46 + 42 + 60 + 45 + 53 + 46 + 51 + 49]/10
= 500/10
= 50
Number of observations, 'n' = 10

x_i	$\|d_i\| = \|x_i - 50\|$
36	14
72	22
46	4
42	8
60	10
45	5
53	3
46	4
51	1
49	1
Total	72

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 72

= 7.2

∴ The Mean Deviation is 7.2.

(v) 57, 64, 43, 67, 49, 59, 44, 47, 61, 59

We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - x|$

So, let 'x' be the mean of the given observation.

x = [57 + 64 + 43 + 67 + 49 + 59 + 44 + 47 + 61 + 59]/10

= 550/10

= 55

Number of observations, 'n' = 10

x_i	$\|d_i\| = \|x_i - 55\|$
57	2
64	9
43	12
67	12
49	6
59	4
44	11
47	8
61	6
59	4
Total	74

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 74

= 7.4

∴ The Mean Deviation is 7.4.

3. Calculate the mean deviation of the following income groups of five and seven

members from their medians:

I **Income in ₹**	**II** **Income in ₹**
4000	3800
4200	4000
4400	4200
4600	4400
4800	4600
	4800
	5800

Solution:

Let us calculate the mean deviation for the first data set.

Since the data is arranged in ascending order,

4000, 4200, 4400, 4600, 4800

Median = 4400

Total observations = 5

We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - M|$

x_i	$\lvert d_i\rvert = \lvert x_i - 4400\rvert$
4000	400
4200	200
4400	0
4600	200
4800	400
Total	1200

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

$= 1/5 \times 1200$

$= 240$

Let us calculate the mean deviation for the second data set.

Since the data is arranged in ascending order,

3800, 4000, 4200, 4400, 4600, 4800, 5800

Median = 4400

Total observations = 7
We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - M|$

x_i	$\lvert d_i\rvert = \lvert x_i - 4400\rvert$
3800	600
4000	400
4200	200
4400	0
4600	200
4800	400
5800	1400
Total	3200

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

$= 1/7 \times 3200$
$= 457.14$
∴ The Mean Deviation of set 1 is 240 and set 2 is 457.14

4. The lengths (in cm) of 10 rods in a shop are given below:
40.0, 52.3, 55.2, 72.9, 52.8, 79.0, 32.5, 15.2, 27.9, 30.2
(i) Find the mean deviation from the median.
(ii) Find the mean deviation from the mean also.
Solution:
(i) Find the mean deviation from the median
Let us arrange the data in ascending order,
15.2, 27.9, 30.2, 32.5, 40.0, 52.3, 52.8, 55.2, 72.9, 79.0
We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - M|$
The number of observations are Even then Median = (40+52.3)/2 = 46.15
Median = 46.15
Number of observations, ‘n’ = 10

x_i	$\|d_i\| = \|x_i - 46.15\|$
40.0	6.15
52.3	6.15
55.2	9.05
72.9	26.75
52.8	6.65
79.0	32.85
32.5	13.65
15.2	30.95
27.9	19.25
30.2	15.95
Total	167.4

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

$= 1/10 \times 167.4$

$= 16.74$

∴ The Mean Deviation is 16.74.

(ii) Find the mean deviation from the mean also.

We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - x|$

So, let 'x' be the mean of the given observation.

$x = [40.0 + 52.3 + 55.2 + 72.9 + 52.8 + 79.0 + 32.5 + 15.2 + 27.9 + 30.2]/10$

$= 458/10$

$= 45.8$

Number of observations, 'n' = 10

x_i	$\|d_i\| = \|x_i - 45.8\|$
40.0	5.8
52.3	6.5
55.2	9.4
72.9	27.1
52.8	7
79.0	33.2
32.5	13.3

15.2	30.6
27.9	17.9
30.2	15.6
Total	166.4

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 166.4

= 16.64

∴ The Mean Deviation is 16.64

5. In question 1(iii), (iv), (v) find the number of observations lying between $\overline{X} - \text{M.D.}$ and $\overline{X} + \text{M.D.}$, where M.D. is the mean deviation from the mean.

Solution:

(iii) 34, 66, 30, 38, 44, 50, 40, 60, 42, 51

We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - x|$

So, let 'x' be the mean of the given observation.

x = [34 + 66 + 30 + 38 + 44 + 50 + 40 + 60 + 42 + 51]/10

= 455/10

= 45.5

Number of observations, 'n' = 10

x_i	$\|d_i\| = \|x_i - 45.5\|$
34	11.5
66	20.5
30	15.5
38	7.5
44	1.5
50	4.5
40	5.5
60	14.5
42	3.5
51	5.5
Total	90

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 90

= 9

Now

$\overline{X} - \text{M.D.} = 45.5 - 9 = 36.5$

$\overline{X} + \text{M.D.} = 45.5 + 9 = 54.5$

So, There are total 6 observation between $\overline{X} - \text{M.D.}$ and $\overline{X} + \text{M.D.}$

(iv) 22, 24, 30, 27, 29, 31, 25, 28, 41, 42

We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - x|$

So, let 'x' be the mean of the given observation.

x = [22 + 24 + 30 + 27 + 29 + 31 + 25 + 28 + 41 + 42]/10

= 299/10

= 29.9

Number of observations, 'n' = 10

x_i	$\|d_i\| = \|x_i - 29.9\|$
22	7.9
24	5.9
30	0.1
27	2.9
29	0.9
31	1.1
25	4.9
28	1.9
41	11.1
42	12.1
Total	48.8

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 48.8

= 4.88

Now

$\overline{X} - M.D. = 29.9 - 4.88 = 25.02$

$\overline{X} + M.D. = 29.9 + 4.88 = 34.78$

So, There are total 5 observation between $\overline{X} - M.D.$ and $\overline{X} + M.D.$

(v) 38, 70, 48, 34, 63, 42, 55, 44, 53, 47

We know that,

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

Where, $|d_i| = |x_i - x|$

So, let 'x' be the mean of the given observation.

x = [38 + 70 + 48 + 34 + 63 + 42 + 55 + 44 + 53 + 47]/10

= 494/10

= 49.4

Number of observations, 'n' = 10

x_i	$\|d_i\| = \|x_i - 49.4\|$
38	11.4
70	20.6
48	1.4
34	15.4
63	13.6
42	7.4
55	5.6
44	5.4
53	3.6
47	2.4
Total	86.8

$$MD = \frac{1}{n}\sum_{i=1}^{n}|d_i|$$

= 1/10 × 86.8

= 8.68

Now

$\overline{X} - M.D. = 49.4 - 8.68 = 40.72$

$\overline{X} + M.D. = 49.4 + 8.68 = 58.08$

So, There are total 6 observation between $\overline{X} - M.D.$ and $\overline{X} + M.D.$