Q1. Find the mean deviation about the mean for the data in Exercises 1 and 2.
4, 7, 8, 9, 10, 12, 13, 17

A.1. Mean of the given observation is.

$$\bar{x} = \frac{4+7+8+9+10+12+13+17}{8}$$

$$= \frac{80}{8} = 10.$$

Deviation of the respective observation about the mean $\bar{x}$ *i.e.*, $x_i - \bar{x}$ are 4–10,7–10,8–10,9–10,10–10,12–10,13–10,17–10

=–6,–3,–2,–1,0,2,3,7

The absolute value of the deviation *i.e.*, $|x_i - \bar{x}|$ are 6,3,2,1,0,2,3,7.

Therefore, the required mean deviation about the mean is

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

$$= \frac{24}{8}$$

= 3.

Q2. 38, 70, 48, 40, 42, 55, 63, 46, 54, 44

A.2. Mean of the given observation is.

$$\bar{x} = \frac{38+70+48+40+42+55+63+46+54+44}{10}$$

$$= \frac{500}{10} = 50.$$

So,

x_i	38	10	48	40	42	55	63	46	54	44
$\lvert x_i - 50 \rvert$	12	20	2	10	8	5	13	4	4	6

Therefore, the required mean deviation about the mean is

$$\text{M.D. } (\bar{x}) = \frac{1}{n}\sum_{i=1}^{n}|x_i - \bar{x}|$$

$$= \frac{12+20+2+10+8+5+13+4+4+6}{10}$$

$$= \frac{84}{10}$$

= 8.4

Q3. Find the mean deviation about the median for the data in Exercises 3 and 4.
13, 17, 16, 14, 11, 13, 10, 16, 11, 18, 12, 17

A.3. Arranging the data in ascending order we get,

10,11,1112,13,13,14,16,16,17,17,18

As *n*=12, even

So, median is the mean of $\left(\dfrac{M}{2}\right)^{\text{th}}$ and $\left(\dfrac{M}{2}+1\right)^{\text{th}}$ observation.

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

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

So, deviation of respective observation about the median. $M, |x_i - M|$ are

x_i	10	11	11	12	13	13	14	16	16	17	17	18
$\lvert x_i - M\rvert$	3.5	2.5	2.5	1.5	0.5	0.5	0.5	2.5	2.5	3.5	3.5	4.5

Therefore the mean deviation about the mean is

$$\text{M.D.}(M) = \frac{1}{n} \times \sum_{i=1}^{n} |x_i - M|$$

$$= \frac{1}{12} \times (3.5+2.5+2.5+1.5+0.5+0.5+0.5+2.5+2.5+3.5+3.5+4.5)$$

$$= \frac{28}{12} = 2.33.$$

Q4. 36, 72, 46, 42, 60, 45, 53, 46, 51, 49

A.4. Arranging the given data in ascending order we get,

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

As $n = 10$ (even)

$$\text{Median} = \frac{\left(n/2\right)^{\text{th}} \text{ observation } + \left(n/2 + 1\right)^{\text{th}} \text{ observation}}{2}$$

$$\Rightarrow \;= \frac{5^{\text{th}} \text{ observation} + 6^{\text{th}} \text{ observation}}{2}$$

$$= \frac{46+49}{2}$$

$$= \frac{95}{2}$$

= 47.5

x_i	36	42	45	46	46	49	51	53	60	72
$\lvert x_i - M\rvert$	11.5	5.5	2.5	1.5	1.5	1.5	3.5	5.5	12.5	24.5

$$\therefore \text{M.D. (M)} = \frac{1}{n} \times \sum_{i=1}^{n} |x_i - M|$$

$$= \frac{1}{10} \times \left(11.5+5.5+2.5+1.5+1.5+1.5+3.5+5.5+12.5+24.5\right)$$

$$= \frac{70}{10} = 7.$$

Q5. Find the mean deviation about the mean for the data in Exercises 5 and 6.

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

A.5. From the given data we have,

x_i	f_i	$x_i\ f_i$	$\lvert x_i - 14\rvert$	$f_i\lvert x_i - 14\rvert$
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
Total –	25	350		158

We have, $\mathrm{N} = \sum_{i=1}^{n} f_i = 7+4+6+3+5 = 25$.

And mean $(\bar{x}) = \frac{1}{\mathrm{N}}\sum_{i=1}^{n} f_i x_i = \frac{1}{25} \times 350 = 14$.

Therefor mean deviation about mean $= \frac{1}{\mathrm{N}} \times \sum_{i=1}^{n} f_i \lvert x_i - \bar{x}\rvert$.

$= \frac{1}{25} \times 158.$

= 6.32.

Q6. x_i	**10**	**30**	**50**	**70**	**90**
f_i	**4**	**24**	**28**	**16**	**8**

A.6. From the given data we tabulate the following.

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

We have,

$\mathrm{N} = \sum_{i=1}^{n} f_i = 4+24+28+16+8 = 80$

So, mean, $\bar{x} = \frac{1}{\mathrm{N}} \times \sum_{i=1}^{\mathrm{M}} f_i x_i = \frac{1}{80} \times 4000 = 50.$

Therefore, $\mathrm{M{\cdot}D{\cdot}}\,(\bar{x}) = \frac{1}{\mathrm{N}} \times \sum_{i=1}^{n} f_i \lvert x_i - \bar{x}\rvert = \frac{1}{80} \times 1280 = 16$

Q7. Find the mean deviation about the median for the data in Exercises 7 and 8.

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

A.7. From the given data we cantabulate the following.

x_i	f_i	Cumulative frequency C.f.	$\lvert x_i - M\rvert$	$f_i\lvert x_i - M\rvert$
5	8	8	2	16
7	6	14	0	0
9	2	16	2	4
10	2	18	3	6
12	2	20	5	10
15.	6	26	8	48
Total	26			84

Now, N=26 which is even.
So, Median is the mean of 13th and 14th observation. Both of these observations lie in the cumulative frequency 14 for which corresponding observation is 7.

So, Median, $M = \dfrac{13^{n} \text{ observation } + 14^{th} \text{ obs}^{n}.}{2.}.$

$= \dfrac{7+7}{2} = 7$

Therefore, $\text{M.D}(\text{M}) = \dfrac{1}{N}\sum_{i=1}^{n} f_i \lvert x_i - M\rvert.$

$= \dfrac{1}{26}\times 84$

= 3. 230.

Q8. x_i 15 21 27 30 35
f_i 3 5 6 7 8

A.8. From the given data we can tabulate the following.

x_i	f_i	$c.f.$	$\lvert x_i - M\rvert$	$f_i\lvert x_i - M\rvert$
15	3	3	15	45
21	5	8	9	45
27	6	14	3	18
30	7	21	0	0
35	8	29	5	40
Total	29			148

Here N = 29 which is odd.

So, median $= \left(\dfrac{29+1}{2}\right)^{th}$ observation =15th observation which lie in the cumulative frequency 21 for which the corresponding observation is30.
i.e, median, M = 30.

Therefore. $\text{M.D(M)} = \dfrac{1}{N}\times\sum_{i=1}^{n} f_i\lvert x_i - M\rvert$

$= \frac{1}{29} \times 148$

= 5. 10

Q9. Find the mean deviation about the mean for the data in Exercises 9 and 10.

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

A.9. From the given data we cantabulate the following.

Income per day in `	Number of person f_i	Mid points x_i	$f_i\, x_i$	$\lvert x_i - \bar{x} \rvert$	$f_i \lvert x_i - \bar{x} \rvert$
01-00	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
Total	50		17900		7896

We have. $\bar{x} = \frac{1}{\text{N}} \sum_{i=1}^{n} f_i x_i = \frac{1}{50} \times 17900 = 358.$

Therefore, $\text{M.D}(\bar{x}) = \frac{1}{\text{N}} \times \sum_{i=1}^{M} f_i \lvert x_i - \bar{x} \rvert$

$= \frac{1}{50} \times 7896 = 157.92$

Q10.

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

A.10. From the given data we can insulate the following.
Take the assumed mean$a$=120 and h=10

Heigts in cm.	No. of boys f_i	Mid-pointsx_i	$d_i = \frac{x_i - a}{h}$	$f_i d_i$	$\lvert x_i - \bar{x} \rvert$	$f_i \lvert x_i - \bar{x} \rvert$
95-105	9	100	-2	-18	25.3	227.7
105–115	13	110	-1	-13	15.3	198.9
115-125	26	120	0	0	5.3	137.8
125-135	30	130	1	30	4.7	141
135-145	12	140	2	24	14.7	176.4

145-155	10	150	3	30	24.7	247
Total	100			53		1128.8

So, $\overline{x} = a + \dfrac{\sum_{i=1}^{n} f_i d_i}{\text{N}} \times h$

$= 120 + \dfrac{53}{100} \times 10$

= 120 + 5.3
125.3

Therefore, $\text{M}\cdot\text{D}\cdot(\overline{x}) = \dfrac{1}{\text{N}} \times \sum_{i=1}^{n} f_i \left| x_i - \overline{x} \right|.$

$= \dfrac{1}{100} \times 1128.8$

= 11. 288.

Q11.Find the mean deviation about median for the following data :

Marks	**0-10**	**10-20**	**20-30**	**30-40**	**40-50**	**50-60**
Number of girls	**6**	**8**	**14**	**16**	**4**	**2**

A.11. From the given data we can tabulate the following.

Marks	No. of girls (f_i)	*c.f.*	mid-pointsx_i	$\left\| x_i - M \right\|$	$f_i \left\| x_i - M \right\|$
0-10	6	6	5	22.85	137.1
10-20	8	14	15	12.85	102.8
20-30	14	28	35	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
Total	50				517.1

The class interval containing $\dfrac{\text{N}^{th}}{2}$ or25th term is 20-30. So 20-30 is the median class.

We know that,

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

$\Rightarrow \text{M} = 20 + \dfrac{25 - 14}{14} \times 10.$

= 20 + 7.85

27.85.

Therefore, $\text{M.D}(\text{M}) = \frac{1}{\text{N}} \times \sum_{i=1}^{n} f_i \left| x_i - \text{M} \right| = \frac{1}{50} \times 517.1 = 10.34..$

Q12.Calculate the mean deviation about median age for the age distribution of 100 persons given below:

Age (in years)	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]

A.12. The given data is made'continuous by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of each class. So, we cam tabulate as.

Age	number f_i	c.f.	mid-point x_i	$\left\| x_i - \text{M} \right\|$	$f_i \left\| x_i - \text{M} \right\|$
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
Total	100				735

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

And median, $\text{M} = l + \frac{\text{N}/2 - C}{f} \times h$

$= 35.5 + \frac{50 - 37}{26} \times 5$

$= 35.5 + 2.5$

$= 38.$

Therefore, $\text{M.D}(\text{M}) = \frac{1}{\text{N}} \times \sum_{i=1}^{n} f_i \left| x_i - \text{M} \right|$

$= \frac{1}{100} \times 735$

= 7. 35