# 32. Statistics

### Exercise 32.1

#### 1 A. Question

Calculate the mean deviation about the median of the following observation :

3011, 2780, 3020, 2354, 3541, 4150, 5000

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation.

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Here, Observations 3011, 2780, 3020, 2354, 3541, 4150, 5000 are Given.

Since, Median is the middle number of all the observation,

So, To Find the Median, Arrange the numbers in Ascending order, we get

2354, 2780, 3011, 3020, 3541, 4150, 5000

Therefore, The Median = 3020

Deviation |d| = |x-Median|

Now, The Mean Deviation is

Xi	d <sub>i</sub>  = x <sub>i</sub> -3020
3011	9
2780	240
3020	0
2354	666
3541	521
4150	1130
5000	1980
Total	4546

Mean Deviation =  $\frac{4546}{7}$ 

## Hence, The Mean Deviation is 649.42

## 1 B. Question

Calculate the mean deviation about the median of the following observation :

38, 70, 48, 34, 42, 55, 63, 46, 54, 44

#### **Answer**

**Given,** Numbers of observations are given.

To Find: Calculate the Mean Deviation.

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Here, Observations 38, 70, 48, 34, 42, 55, 63, 46, 54, 44 are Given.

Since, Median is the middle number of all the observation,

So, To Find the Median, Arrange the numbers in Ascending order, we get

34, 38, 42, 44, 46, 48, 54, 55, 63, 70

Here the Number of observations are Even then Median =  $\frac{46+48}{2}$ 







Therefore, The Median = 47

Deviation |d| = |x-Median|

And, The number of observations is 10.

Now, The Mean Deviation is

Xi	$ 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 ∑di	86

Mean Deviation =  $\frac{86}{10}$ 

# Hence, The Mean Deviation is 8.6

## 1 C. Question

Calculate the mean deviation about the median of the following observation :

34, 66, 30, 38, 44, 50, 40, 60, 42, 51

### **Answer**

Given, Numbers of observations are given.

**To Find:** Calculate the Mean Deviation.

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Here, Observations 34, 66, 30, 38, 44, 50, 40, 60, 42, 51 are Given.

Since, Median is the middle number of all the observation,

So, To Find the Median, Arrange the numbers in Ascending order, we get

30, 34, 38, 40, 42, 44, 50,51, 60, 66

Here the Number of observations are Even then the middle terms are 42 and 44

Therefore, The Median =  $\frac{42+44}{2}$  = 43

Deviation |d| = |x-Median|

And, The number of observations is 10.

Now, The Mean Deviation is



Xi	$ 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 ∑ di	87
60 66	17 23

Mean Deviation = 
$$\frac{87}{10}$$
 = 8.7

# Hence, The Mean Deviation is 8.7

## 1 D. Question

Calculate the mean deviation about the median of the following observation :

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation.

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Here, Observations 22, 24, 30, 27, 29, 31, 25, 28, 41, 42are Given.

Since, Median is the middle number of all the observation,

So, To Find the Median, Arrange the numbers in Ascending order, we get

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

Here the Number of observations are Even then the middle terms are 28 and 29

Therefore, The Median = 
$$\frac{28+29}{2}$$
 = 28.5

Deviation |d| = |x-Median|

And, The number of observations is 10.

Now, The Mean Deviation is

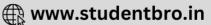
Xi	d <sub>i</sub>  = x <sub>i</sub> -28.5
22	6.5
24	4.5
30	1.5
27	1.5
29	0.5
31	2.5
25	3.5
28	0.5
41	12.5
42	13.5
Total ∑ di	47

Mean Deviation = 
$$\frac{47}{10}$$
 = 4.7

Hence, The Mean Deviation is 8.7







## 1 E. Question

Calculate the mean deviation about the median of the following observation:

38, 70, 48, 34, 63, 42, 55, 44, 53, 47

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation.

Formula Used: Mean Deviation =  $\frac{\sum d_i}{}$ 

**Explanation:** Here, Observations 38, 70, 48, 34, 63, 42, 55, 44, 53, 47 are Given.

Since, Median is the middle number of all the observation,

So, To Find the Median, Arrange the numbers in Ascending order, we get

34, 38, 43, 44, 47, 48, 53, 55, 63, 70

Here the Number of observations are Even then the middle terms are 47 and 48.

Therefore, The Median =  $\frac{47+48}{2}$  = 47.5

Deviation |d| = |x-Median|

And, The number of observations are 10.

Now, The Mean Deviation is

Xi	$ 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
47	0.5
Total ∑ di	84

Mean Deviation =  $\frac{84}{10}$  = 8.4

#### Hence, The Mean Deviation is 8.4

# 2 A. Question

Calculate the mean deviation from the mean for the following data:

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

#### **Answer**

Given, Numbers of observations are given.

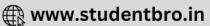
To Find: Calculate the Mean Deviation from mean.

Formula Used:

**Explanation:** Here, Observations 4, 7, 8, 9, 10, 12, 13, 17 are Given.

Deviation |d| = |x-Mean|





Mean = 
$$\sum \frac{|\mathbf{x}_1|}{n}$$

Mean of the Given Observations =  $\frac{4+7+8+9+10+12+13+17}{8} = \frac{80}{8}$ 

And, The number of observations is 8.

Now, The Mean Deviation is

$\mathbf{X}_{\mathrm{i}}$	d <sub>i</sub>  = x <sub>i</sub> -10
4	6
7	3
8	2
9	1
10	0
12	2
13	3
17	7
Total ∑xi =80	24

Mean Deviation = 
$$\frac{\sum d_i}{n}$$

Mean Deviation of the given Observations =  $\frac{24}{8}$  = 3

# Hence, The Mean Deviation is 3

# 2 B. Question

Calculate the mean deviation from the mean for the following data:

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation from Mean.

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Here, Observations 13, 17, 16, 14, 11, 13, 10, 16, 11, 18, 12, 17 are Given.

Deviation |d| = |x-Mean|

Mean = 
$$\sum \frac{|\mathbf{x}_1|}{n}$$

Mean of the Given Observations =  $\frac{13+17+16+14+11+13+10+16+11+18+12+17}{12} = \frac{168}{12}$ 

And, The number of observations is 12.

Now, The Mean Deviation is



$\mathbf{X}_{i}$	d <sub>i</sub>  = x <sub>i</sub> -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 $x_i = 168$	28
16 11 18 12 17	2 3 4 2 3

Mean Deviation = 
$$\frac{\sum d_i}{n}$$

Mean Deviation of the given Observations =  $\frac{28}{12}$  = 2.33

# Hence, The Mean Deviation is 2.33

## 2 C. Question

Calculate the mean deviation from the mean for the following data :

## **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation.

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Here, Observations 38, 70, 48, 40, 42, 55, 63, 46, 54, 44 are Given.

Deviation |d| = |x-Mean|

Mean = 
$$\sum \frac{|\mathbf{x}_1|}{n}$$

Mean of the Given Observations = 
$$\frac{38+70+48+40+42+55+63+46+54+44}{10} = \frac{500}{10}$$

And, The number of observations is 10.

Now, The Mean Deviation is

$\mathbf{X}_{\mathrm{i}}$	$ 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 $\sum x_i = 500$	84

Mean Deviation = 
$$\frac{\sum d_i}{n}$$



Mean Deviation of the given Observations =  $\frac{84}{10}$  = 8.4

# Hence, The Mean Deviation is 8.4

## 2 D. Question

Calculate the mean deviation from the mean for the following data:

#### Answer

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation.

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Here, Observations 36, 72, 46, 42, 60, 45, 53, 46, 51, 49 are Given.

Deviation |d| = |x-Mean|

Mean = 
$$\sum \frac{|\mathbf{x}_1|}{\mathbf{n}}$$

Mean of the Given Observations = 
$$\frac{36+72+46+42+60+45+53+46+51+49}{10} = \frac{500}{10}$$

And, The number of observations is 10

Now, The Mean Deviation is

Xi	$ 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 $\sum x_i = 500$	84

Mean Deviation = 
$$\frac{\sum d_i}{n}$$

Mean Deviation of the given Observations =  $\frac{84}{10}$  = 8.4

#### Hence, The Mean Deviation is 7.4

## 2 E. Question

Calculate the mean deviation from the mean for the following data :

57, 64, 43, 67, 49, 59, 44, 47, 61, 59

# Answer

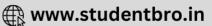
Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation.

**Formula Used:** Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Here, Observations 57, 64, 43, 67, 49, 59, 44, 47, 61, 59 are Given.





Deviation |d| = |x-Mean|

$$Mean = \sum \frac{|\mathbf{x}_1|}{n}$$

Mean of the Given Observations =  $\frac{57+64+43+67+49+59+44+47+61+59}{10} = \frac{550}{10}$ 

And, The number of observations is 10

Now, The Mean Deviation is

Xi	$ d_i  =  x_i - 55 $
43	12
44	11
47	8
49	6
57	2
59	4
59	4
61	6
64	9
67	12
Total $\sum x_i = 500$	74

Mean Deviation =  $\frac{\sum d_i}{n}$ 

Mean Deviation of the given Observations =  $\frac{74}{10}$  = 7.4

# Hence, The Mean Deviation is 7.4

## 3. Question

Calculate the mean deviation of the following income groups of five and seven members from their medians:

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

#### **Answer**

**Given,** Numbers of observations are given in two groups.

**To Find:** Calculate the Mean Deviation from their Median.

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

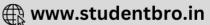
For Group 1: Since, Median is the middle number of all the observation,

So, To Find the Median, Arrange the Income of Group 1 in Ascending order, we get

4000, 4200, 4400, 4600, 4800

Therefore, The Median = 4400





Deviation |d| = |x-Median|

Now, The Mean Deviation is

Xi	$ \mathbf{d}_{i}  =  \mathbf{x}_{i} $
	4400
4000	400
4200	200
4400	0
4600	200
4800	400
Total	1200

Mean Deviation = 
$$\frac{\sum d_i}{n}$$

Mean Deviation Of Group  $1 = \frac{1200}{5} = 240$ 

For Group 2: Since, Median is the middle number of all the observation,

So, To Find the Median, Arrange the Income of Group 2 in Ascending order, we get

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

Therefore, The Median = 4400

Deviation |d| = |x-Median|

Now, The Mean Deviation is

Xi	d <sub>i</sub>  = x <sub>i</sub> -4400
3800	600
4000	400
4200	200
4400	0
4600	200
4800	400
5800	1400
Total	3200

$$\text{Mean Deviation} = \frac{\sum d_i}{n}$$

Mean Deviation Of Group 2 = 
$$\frac{3200}{7}$$
 = 457.14

# Hence, The Mean Deviation of Group 1 is 240 and Group 2 is 457.14

#### 4. Question

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.

# **Answer**

(i) **Given,** Numbers of observations are given .

To Find: Calculate the Mean Deviation from their Median.

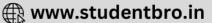
**Formula Used:** Mean Deviation =  $\frac{\sum d_i}{n}$ 

Explanation: Since, Median is the middle number of all the observation,

So, To Find the Median, Arrange the given length of shops in Ascending order, we get

15.2, 27.9, 30.2, 32.5, 40.0, 52.3, 52.8, 55.2, 72.9, 79.0





Here the Number of observations are Even then Median =  $\frac{40.0+52.3}{2}$ 

Therefore, The Median = 46.15

Deviation |d| = |x-Median|

Now, The Mean Deviation is

Xi	$ 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	$\sum d_{i}$ 167.4			

Mean Deviation = 
$$\frac{\sum d_i}{n}$$

Mean Deviation From Median =  $\frac{167.4}{10}$  = 16.74

## Hence, The Mean Deviation is 16.74

(ii) Here, Observations 15.2, 27.9, 30.2, 32.5, 40.0, 52.3, 52.8, 55.2, 72.9, 79.0 are Given.

Deviation |d| = |x-Mean|

$$\mathsf{Mean} = \sum \frac{|\mathbf{x}_1|}{\mathbf{n}}$$

Mean of the Given Observations =  $\frac{15.2 + 27.9 + 30.2 + 32.5 + 40.0 + 52.3 + 52.8 + 55.2 + 72.9 + 79.0}{10} = \frac{458}{10}$ 

And, The number of observations is 10

Now, The Mean Deviation is

Xi	d <sub>i</sub>  = x <sub>i</sub> -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

Mean Deviation = 
$$\frac{\sum d_i}{n}$$

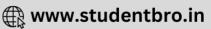
Mean Deviation of the given Observations =  $\frac{166.4}{10}$  = 16.64

# Hence, The Mean Deviation is 16.64

#### 5. Question

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





M.D. is the mean deviation from the mean.

## **Answer**

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

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation from Mean

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Here, Observations 34, 66, 30, 38, 44, 50, 40, 60, 42, 51 are Given.

$$Mean = \frac{Sum of all observation}{Total No. of observation}$$

Mean for given data 
$$\overline{X} = \frac{34+66+30+38+44+50+40+60+42+51}{10} = \frac{455}{10}$$

Deviation |d| = |x-Mean|

And, The number of observations is 10.

Now, The Mean Deviation is

X <sub>i</sub>	$ d_i  =  x_i - 45.5 $
	[di] [Xi 15.5]
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	$\sum di = 90$

Mean Deviation M.D=  $\frac{90}{10}$  = 9

Now,

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

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

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

(iv) Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation from Mean

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Numbers of observations are 22,24,30,27,29,31,25,28,41,42.

$$Mean = \frac{Sum of all observation}{Total No. of observation}$$

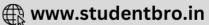
Mean for given data 
$$\overline{X} = \frac{(22+24+30+27+29+31+25+28+41+42)}{10} = \frac{299}{10}$$

Deviation |d| = |x-Mean|

And, The number of observations is 10.

Now, The Mean Deviation is





$\mathbf{X}_{i}$	$ 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	$\sum di = 48.8$

Mean Deviation M.D=  $\frac{48.8}{10}$  = 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 6 observation between  $\overline{\mathbf{X}}$ - M.D and  $\overline{\mathbf{X}}$ + M.D

(V) Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation from Mean

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

**Explanation:** Numbers of observations are 38,70,48,34,63,42,55,44,53,47.

$$\mathsf{Mean} = \frac{\mathsf{Sum} \, \mathsf{of} \, \mathsf{all} \, \mathsf{observation}}{\mathsf{Total} \, \mathsf{No}.\mathsf{of} \, \mathsf{observation}}$$

Mean for given data 
$$\overline{X} = \frac{(38+70+48+34+63+42+55+44+53+47)}{10} = \frac{494}{10}$$

Deviation |d| = |x-Mean|

And, The number of observations is 10.

Now, The Mean Deviation is

Xi	$ 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	$\sum di = 86.8$			

Mean Deviation M.D=  $\frac{86.8}{10}$  = 8.68

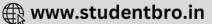
Now,

$$\overline{X}$$
- 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





## Exercise 32.2

#### 1. Question

Calculate the mean deviation from the median of the following frequency distribution :

Heights in inches	58	59	60	61	62	63	64	65	66
No. of students	15	20	32	35	35	22	10	8	

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum d_i}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from the median. So,

We know, Median is the Middle term,

Therefore, Median = 61

Let  $x_i$  =Heights in inches

And,  $f_i$  = Number of students

Xi	fi	Cumulative	d <sub>i</sub>  = x <sub>i</sub> -61	F <sub>i</sub>  d <sub>i</sub>
		Frequency		
58	15	15	3	45
59	20	35	2	40
60	32	67	1	32
61	35	102	0	0
62	35	137	1	35
63	22	159	2	44
64	20	179	3	60
65	10	189	4	40
66	8	197	5	40
	N=197			Total=336

N = 197

Mean deviation=
$$\frac{336}{197}$$
 = 1.70

## Hence, The mean deviation is 1.70.

#### 2. Question

The number of telephone calls received at an exchange in 245 successive on 2-minute intervals is shown in the following frequency distribution :

Number of calls	0	1	2	3	4	5	6	7
Frequency	14	21	25	43	51	40	39	12

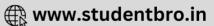
Compute the mean deviation about the median.

# Answer

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation





**Formula Used:** Mean Deviation =  $\frac{\sum f[d_{ij}]}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from the median. So,

We know, Median in the even terms  $\frac{3+5}{2}$ ,

Therefore, Median = 4

Let  $x_i$  =Number of calls

And,  $f_i$  = Frequency

Xi	fi	Cumulative	$ d_i  =  x_i $	Fi di
		Frequency	4	
0	14	14	4	56
1	21	35	3	63
2	25	60	2	50
3	43	103	1	43
4	51	154	0	0
5	40	194	1	40
6	39	233	2	78
7	12	245	3	36
				Total=366
	Total=245			

$$N = 245$$

Mean Deviation = 
$$\frac{\sum f|d_{ij}|}{N}$$

Mean deviation for given data 
$$=\frac{336}{245} = 1.49$$

# Hence, The mean deviation is 1.49

### 3. Question

Calculate the mean deviation about the median of the following frequency distribution :

Xi	5	7	9	11	13	15	17
fi	2	4	6	8	10	12	8

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f|d_{ij}|}{n}$ 

## **Explanation.**

Here we have to calculate the mean deviation from the median. So,

Here, N = 50

Then, N/2 = 
$$\frac{50}{2}$$
 = 25

SO, The median Corresponding to 25 is 13



Xi	fi	Cumulative	d <sub>i</sub>  = x <sub>i</sub> -13	F <sub>i</sub>  d <sub>i</sub>
		Frequency		
5	2	2	8	16
7	4	6	6	24
9	6	12	4	24
11	8	20	2	16
13	10	30	0	0
15	12	42	2	24
17	8	50	4	32
	Total=50			Total= 136

$$N = 50$$

Mean Deviation = 
$$\frac{\sum f[d_{ij}]}{N}$$

Mean deviation for given data  $=\frac{136}{50} = 2.72$ 

# Hence, The mean Deviation is 2.72.

# 4 A. Question

Find the mean deviation from the mean for the following data:

Xi	5	7	9	10	12	15
fi	8	6	2	2	2	6

#### **Answer**

Given, Numbers of observations are given.

**To Find:** Calculate the Mean Deviation from the mean.

Formula Used: Mean Deviation =  $\frac{\sum f[d_{ij}]}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from Mean So,

$$\mathsf{Mean} = \frac{\sum f_i x_i}{f_i}$$

Xi	fi	Cumulative	d <sub>i</sub>  = x <sub>i</sub> -	F <sub>i</sub>  d <sub>i</sub>
		Frequency	Mean	
		$(x_if_i)$		
5	8	40	4	32
7	6	42	2	12
9	2	18	0	0
10	2	20	1	2
12	2	24	3	6
15	6	90	6	36
	Total =26	Total=234		Total = 88

Mean = 
$$\frac{234}{26}$$
 = 9

$$\text{Mean Deviation} = \frac{\sum f |d_{ij}|}{N}$$

Mean deviation for given data  $=\frac{88}{26} = 3.3$ 

# Hence, The mean Deviation is 3.3.

## 4 B. Question

Find the mean deviation from the mean for the following data:



Xi	5	10	15	20	25
fi	7	4	6	3	5

#### **Answer**

Given, Numbers of observations are given.

**To Find:** Calculate the Mean Deviation from the mean.

Formula Used: Mean Deviation =  $\frac{\sum f |d_{ij}|}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from Mean So,

$$\mathsf{Mean} = \frac{\sum f_i x_i}{f_i}$$

Xi	fi	Cumulative	$ d_i  =  x_i $	$F_i d_i $
		Frequency	Mean	
		$(x_if_i)$		
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	Total=350		Total=158

Mean = 
$$\frac{350}{25}$$
 = 14

Mean Deviation = 
$$\frac{\sum f[d_{ij}]}{N}$$

Mean deviation for given data  $=\frac{158}{25} = 6.32$ 

# Hence, The mean Deviation is 6.32.

## 4 C. Question

Find the mean deviation from the mean for the following data:

Xi	10	30	50	70	90
fi	4	24	28	16	8

#### **Answer**

Given, Numbers of observations are given.

**To Find:** Calculate the Mean Deviation from the mean.

Formula Used: Mean Deviation =  $\frac{\sum f[d_{ij}]}{n}$ 

#### **Explanation.**

Here we have to calculate the mean deviation from Mean So,

$$\text{Mean} = \frac{\sum f_i x_i}{f_i}$$





Xi	fi	Cumulative Frequency (x <sub>i</sub> f <sub>i</sub> )	d <sub>i</sub>  = x <sub>i</sub> -Mean	F <sub>i</sub>  d <sub>i</sub>
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	Total=350		Total=158

Mean = 
$$\frac{350}{25}$$
 = 14

$$\text{Mean Deviation} = \frac{\sum f[d_{ij}]}{N}$$

Mean deviation for given data  $=\frac{158}{25} = 6.32$ 

## Hence, The mean Deviation is 6.32.

## 4 D. Question

Find the mean deviation from the mean for the following data:

Size:	20	21	22	23	24
Frequency:	6	4	5	1	4

#### **Answer**

Given, Numbers of observations are given.

**To Find:** Calculate the Mean Deviation from the mean.

Formula Used: Mean Deviation =  $\frac{\sum f[d_{ij}]}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from Mean So,

$$\text{Mean} = \frac{\sum f_i x_i}{f_i}$$

Mean of given Data = 
$$\frac{4000}{80}$$
 = 50

Xi	fi	Cumulative Frequency (x <sub>i</sub> f <sub>i</sub> )	d <sub>i</sub>  = x <sub>i</sub> - Mean	F <sub>i</sub>  d <sub>i</sub>
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
	Total=80	Total=4000		Total=1280

$$Mean = \frac{4000}{80} = 50$$

Mean Deviation = 
$$\frac{\sum f|d_{ij}|}{N}$$

Mean deviation for given data  $=\frac{1280}{80} = 16$ 

# Hence, The mean Deviation is 16

## 4 E. Question





Find the mean deviation from the mean for the following data:

Size:	1	3	5	7	9	11	13	15
Frequency:	3	3	4	14	7	4	3	4

#### **Answer**

Given, Numbers of observations are given.

**To Find:** Calculate the Mean Deviation from the mean.

Formula Used: Mean Deviation =  $\frac{\sum f[d_{ij}]}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from Mean So,

$$Mean = \frac{\sum f_i x_i}{f_i}$$

Mean of the given data is  $\frac{433}{20} = 21.65$ 

Xi	fi	Cumulative Frequency (x <sub>i</sub> f <sub>i</sub> )	d <sub>i</sub>  = x <sub>i</sub> - Mean	F <sub>i</sub>  d <sub>i</sub>
20	6	120	1.65	9.9
21	4	84	0.65	2.6
22	5	110	0.35	1.75
23	1	23	1.35	1.35
24	4	96	2.35	9.40
	Total =20	Total = 433		Total=25

Mean Deviation = 
$$\frac{\sum f|d_{ij}|}{N}$$

Mean deviation for given data is  $\frac{25}{20} = 1.25$ 

# Hence, The mean Deviation is 1.25.

## 5 A. Question

Find the mean deviation from the median for the following data:

Xi	15	21	27	30
fi	3	5	6	7

# Answer

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f |d_{ij}|}{n}$ 

#### **Explanation.**

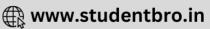
Here we have to calculate the mean deviation from the median. So,

$$N = 21$$

$$\frac{N}{2} = 10.5$$

SO, The median Corresponding to 10.5 is 27





Xi	fi	Cumulative Frequency	d <sub>i</sub>  = x <sub>i</sub> -Med	F <sub>i</sub>  d <sub>i</sub>
15	3	3	15	45
21	5	8	9	45
27	6	14	0	0
30	7	21	3	21
	N=21	Total=46		Total =101

$$\text{Mean Deviation} = \frac{\sum f[d_{ij}]}{N}$$

Mean deviation for given data 
$$=\frac{101}{21} = 4.80$$

# Hence, The Mean Deviation is 4.80.

## 5 B. Question

Find the mean deviation from the median for the following data:

>	C <sub>i</sub>	74	89	42	54	91	94	35
f	i	20	12	2	4	5	3	4

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation = 
$$\frac{\sum f[d_{ij}]}{n}$$

# **Explanation.**

Here we have to calculate the mean deviation from the median. So,

$$N = 50$$

$$\frac{N}{2} = 25$$

## SO, The median Corresponding to 12.5 is 74

Xi	fi	Cumulative Frequency	d <sub>i</sub>  = x <sub>i</sub> -Med	$F_i d_i $
35	4	4	39	156
42	2	6	32	64
54	4	10	20	80
74	20	30	0	0
89	12	42	15	180
91	5	47	17	85
94	3	50	20	60
	Total=50			Total = 625

Mean Deviation = 
$$\frac{\sum f|d_{ij}|}{N}$$

Mean deviation for given data 
$$=\frac{625}{50} = 12.5$$

# Hence, The Mean Deviation is 12.5.

## 5 C. Question

Find the mean deviation from the median for the following data:

Mark obtained	10	11	12	14	15
No. of students	2	3	8	3	4





#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f|d_{ij}|}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from the median. So,

$$N = 20$$

$$\frac{N}{2} = 10$$

SO, The median Corresponding to 10 is 12

Xi	fi	Cumulative	$ d_i  =  x_i - Med $	$F_i d_i $
		Frequency		
10	2	2	2	4
11	3	5	1	3
12	8	13	0	0
14	3	16	2	6
15	4	20	3	12
	Total=20			Total =25

Mean Deviation = 
$$\frac{\sum f|d_{ij}|}{N}$$

Mean deviation for given data  $\frac{25}{20} = 1.25$ 

Hence, The Mean Deviation is 1.25.

## Exercise 32.3

## 1. Question

Compute the mean deviation from the median of the following distribution:

Class	0-10	10-20	20-30	30-40	40-50
Frequency	5	10	20	5	10

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f[d_{ij}]}{n}$ 

# **Explanation.**

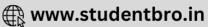
Here we have to calculate the mean deviation from the median. So,

Median is the middle term of the X<sub>i</sub>,

Here, The middle term is 25

Therefore, Median = 25





Class Interval	Xi	Fi	Cumulative	d <sub>i</sub> =(x-	$F_id_i$
			Frequency	median)	
0-10	5	5	5	20	100
10-20	15	10	15	10	100
20-30	25	20	35	0	0
30-40	35	5	91	10	50
40-50	45	10	101	20	200
		Total=50			Total=450

$$\text{Mean Deviation} = \frac{\sum f |d_{ij}|}{N}$$

Mean deviation for given data  $\frac{450}{50} = 9$ 

# Hence, The Mean Deviation is 9

#### 2 A. Question

Find the mean deviation from the mean for the following data:

Classes	0-100	100-200	200-300	300-400	400-500	500-600	600-700	700-800
Frequencies	4	8	9	10	7	5	4	3

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f |d_{ij}|}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from the mean. So,

$$\text{Mean} = \sum \frac{f_i x_i}{n}$$

Here, Mean = 
$$\frac{17900}{50}$$

Therefore, Mean = 358

Class	Xi	Fi	$F_iX_i$	d <sub>i</sub> =(x-mean)	$F_id_i$
Interval					
0-100	50	4	200	308	1232
100-200	150	8	1200	208	1664
200-300	250	9	2250	108	972
300-400	350	10	3500	8	80
400-500	450	7	3150	92	644
500-600	550	5	2750	192	960
600-700	650	4	2600	292	1168
700-800	750	3	2250	392	1176
		Total=50	Total=17900		Total=7896

Mean Deviation = 
$$\frac{\sum f|d_{ij}|}{N}$$

Mean deviation for given data  $\frac{7896}{50} = 157.92$ 

# Hence, The Mean Deviation is 157.92

# 2 B. Question

Find the mean deviation from the mean for the following data:

Classes	95-105	105-115	115-125	125-135	135-145	145-155
Frequencies	9	13	16	26	30	12







#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f|d_{ij}|}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from the mean. So,

$$Mean = \sum \frac{f_i x_i}{n}$$

Here, Mean =  $\frac{13630}{106}$  = 128.6

Therefore, Mean = 49

Class Interval	Xi	Fi	F <sub>i</sub> X <sub>i</sub>	d <sub>i</sub> =(x-mean)	Fi  di
95 - 105	100	9	900	-28.6	257.4
105 - 115	110	13	1430	-18.6	241.8
115 - 125	120	16	1920	-8.6	137.6
125 - 135	130	26	3380	1.4	36.4
135 - 145	140	30	4200	12.4	372
145 - 155	150	12	1800	22.4	268.8
		N=106	Total = 13630		Total=1314

$$\text{Mean Deviation} = \frac{\sum f |d_{ij}|}{N}$$

Mean deviation for given data =  $\frac{1314}{106}$  = 12.39

# 2 C. Question

Find the mean deviation from the mean for the following data:

Classes	0-10	10-20	20-30	30-40	40-50	50-60
Frequency	6	8	14	16	4	2

## **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f|d_{ij}|}{n}$ 

## **Explanation.**

Here we have to calculate the mean deviation from the mean. So,

$$\mathsf{Mean} = \sum \frac{f_i x_i}{n}$$

Here, Mean = 
$$\frac{1350}{50}$$

Therefore, Mean = 27



Class Interval	Xi	Fi	$F_iX_i$	d <sub>i</sub> =(x-mean)	$F_i d_i$
0-10	5	6	30	22	132
10-20	15	8	120	12	96
20-30	25	14	350	2	28
30-40	35	16	560	8	128
40-50	45	4	180	18	72
50-60	55	2	110	28	56
		Total=50	Total=1350		Total=512

$$\text{Mean Deviation} = \frac{\sum f |d_{ij}|}{N}$$

Mean deviation for given data  $\frac{512}{50} = 10.24$ 

# Hence, The Mean Deviation is 10.24

#### 3. Question

Compute mean deviation from mean of the following distribution:

Marks	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
No. of students	8	10	15	25	20	18	9	5

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f |d_{ij}|}{n}$ 

## **Explanation.**

Here we have to calculate the mean deviation from the mean. So,

$$\mathsf{Mean} = \sum \frac{f_i x_i}{n}$$

Here, Mean = 
$$\frac{5390}{110}$$

Therefore, Mean = 49

Class Interval	Xi	Fi	$F_iX_i$	d <sub>i</sub> =(x-mean)	$F_id_i$
10-20	15	8	120	34	272
20-30	25	10	250	24	240
30-40	35	15	525	14	210
40-50	45	25	1125	4	100
50-60	55	20	1100	6	120
60-70	65	18	1170	16	288
70-80	75	9	675	26	234
80-90	85	5	425	36	180
		N=110	Total=5390		Total=1644

$$\text{Mean Deviation} = \frac{\sum f |d_{ij}|}{N}$$

Mean deviation for given data  $\frac{1644}{110} = 14.95$ 

## Hence, The Mean Deviation is 14.95

## 4. Question

The age distribution of 100 life-insurance policy holders is as follows:



Age (on nearest birth day)	17-19.5	20-25.5	26-35.5	36-40.5	41-50.5	51-55.5	56-60.5	61-70.5
No. of persons	5	16	12	26	14	12	6	5

Calculate the mean deviation from the median age.

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f |d_{ij}|}{n}$ 

## **Explanation.**

Here we have to calculate the mean deviation from the median. So,

N = 96

$$\frac{N}{2} = 48$$

SO, The cumulative frequency just greater than 48 is 59, and the corresponding value of x is 38.25

Median = 38.25

Class	Xi	Fi	Cumulative	d <sub>i</sub> =(x-	Fidi
Interval			Frequency	median)	
17-19.5	18.25	5	5	20	100
20-25.5	22.75	16	21	15.5	248
26-35.5	30.75	12	33	7.5	90
36-40.5	38.25	26	59	0	0
41-50.5	45.75	14	73	7.5	105
51-55.5	53.25	12	85	15	180
56-60.5	58.25	6	91	20	120
61-70.5	65.75	5	96	27.5	137.5
		Total=96			Total=980.5

Mean Deviation = 
$$\frac{\sum f|d_{ij}|}{N}$$

Mean deviation for given data  $\frac{980.5}{96} = 10.21$ 

# Hence, The Mean Deviation is 10.21.

### 5. Question

Find the mean deviation from the mean and from a median of the following distribution :

Marks	0-10	10-20	20-30	30-40	40-50
No. of students	5	8	15	16	6

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

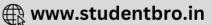
Formula Used: Mean Deviation =  $\frac{\sum f[d_{ij}]}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from the median. So,

N = 50





$$\frac{N}{2} = 25$$

SO, The cumulative frequency just greater than 25 is 58, and the corresponding value of x is 28

Median = 28

Now, Mean = 
$$\sum \frac{f_i x_i}{N}$$

$$\frac{1350}{50} = 27$$

Mean = 27

Class Interval	Xi	Fi	Cumulative Frequency	d <sub>i</sub> =(x- median)	Fidi	F <sub>i</sub> X <sub>i</sub>	x <sub>i</sub> - mean	F <sub>i</sub>  x <sub>i</sub> - mean
0-10	5	5	5	23	115	25	22	110
10-20	15	8	13	13	104	120	12	96
20-30	25	15	28	3	45	375	2	30
30-40	35	16	44	7	112	560	8	128
40-50	45	6	50	17	102	270	18	108
	4 -	N=50			Total=478	Total=1350		Total=472

Mean deviation from Median  $\frac{478}{50} = 9.56$ 

And, Mean deviation from Median  $\frac{472}{50} = 9.44$ 

Hence, The Mean Deviation from the median is 9.56 and from mean is 9.44.

# 6. Question

Calculate 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 persons	of	5	6	12	14	26	12	16	9

## **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f |d_{ij}|}{n}$ 

**Explanation.** Here, The Given class interval does not continue, So, we subtract 0.5 from a lower limit of the class and add 0.5 to the upper limit of the class,By this Class interval remain same while the function becomes continues.

	_		1		1
Class	Xi	Fi	Cumulative	d <sub>i</sub> =(x-	$F_i d_i$
Interval			Frequency	median)	
15.5-20.5	18	5	5	20	100
20.5-25.5	23	6	11	15	90
25.5-30.5	28	12	23	10	120
30.5-35.5	33	14	37	5	70
35.5-40.5	38	26	63	0	0
40.5-45.5	43	12	75	5	60
45.5-50.5	48	16	91	10	160
50.5-55.5	53	9	100	15	135
		N = 100			$\sum fd = 735$

Here we have to calculate the mean deviation from the median. So,

$$N = 100$$

$$\frac{N}{2} = 50$$





Thus, the cumulative frequency slightly greater than 50 is 63 and lie under class 35.5-40.5.

$$Median = 1 + \frac{\frac{N}{2} - F}{f} \times h$$

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

Median = 38

Mean Deviation = 
$$\frac{\sum f|d_{ij}|}{N}$$

Mean deviation for given data  $\frac{735}{100} = 73.5$ 

# Hence, The Mean Deviation is 73.5

## 7. Question

Calculate the mean deviation about mean for the following frequency distribution :

Class interval :	0-4	4-8	8-12	12-16	16-20
Frequency:	4	6	8	5	2

#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f |d_i|}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from the mean. So,

$$Mean = \sum \frac{f_i x_i}{n}$$

Here, Mean = 
$$\frac{230}{25}$$

Therefore, Mean = 9.2

Class Interval	Xi	Fi	$F_iX_i$	d <sub>i</sub> =(x-mean)	$F_i d_i$
0-4	2	4	8	7.2	28.8
4-8	6	6	36	3.2	19.2
8-12	10	8	80	0.8	6.4
12-16	14	5	70	4.8	24
16-20	18	2	36	8.8	17.6
		Total=25	Total=230		Total=96

$$\text{Mean Deviation} = \frac{\sum f |d_{ij}|}{N}$$

Mean deviation for given data  $\frac{96}{25} = 3.84$ 

# Hence, The Mean Deviation is 3.84

# 8. Question

Calculate mean deviation from the median of the following data:

Class interval	0-6	6-12	12-18	18-24	24-30
Frequency:	4	5	3	6	2





#### **Answer**

Given, Numbers of observations are given.

To Find: Calculate the Mean Deviation

Formula Used: Mean Deviation =  $\frac{\sum f|d_i|}{n}$ 

# **Explanation.**

Here we have to calculate the mean deviation from the median. So,

$$N = 20$$

$$\frac{N}{2} = 10$$

So, the cumulative frequency just greater than 10 is 12, and the corresponding value of x is 15

Median = 15

Now, Mean = 
$$\sum \frac{f_i x_i}{N}$$

$$\frac{282}{20} = 14.1$$

Mean = 14.1

Class	Xi	Fi	Cumulative	di=(x-	Fidi	FiXi	Xi-	Fi xi-mean
Interval			Frequency	median)			mean	
0 - 6	3	4	4	12	48	12	11.1	44.4
6 - 12	9	5	9	6	30	45	5.1	25.5
12 - 18	15	3	12	0	0	45	0.9	2.7
18 - 24	21	6	18	6	36	126	6.9	41.4
24 - 30	27	2	20	12	24	54	12.9	25.8
						·		
		N=20			Total=138	Total=282		Total=139.8

Mean deviation from Median =  $\frac{138}{20}$  = 6.9

And, Mean deviation from Median  $\frac{139.8}{20} = 96.99$ 

Hence, The Mean Deviation from the median is 6.9 and from mean is 6.99.

# **Exercise 32.4**

# 1 A. Question

Find the mean, variance and standard deviation for the following data:

2, 4, 5, 6, 8, 17

# **Answer**

**Explanation:** Here, Mean  $\overline{X} = \frac{2+4+5+6+8+17}{6}$ 

$$\Rightarrow \overline{X} = \frac{42}{6} = 7$$

Xi	$(x_i-X) = (x_i-7)$	(x <sub>i</sub> -7) <sup>2</sup>
2	-3	25
4	-3	9
5	-2	4
6	-1	1
8	1	1
17	10	100
		$\sum_{i=1}^{6} (x_i - \bar{X})^2 = 140$

And, n=6







Variance (X) =  $\frac{1}{n} \sum_{i=1}^{6} (x_i - \overline{X})$ 

$$\frac{140}{6} = 23.33$$

Variance = 23.33

Standard deviation =  $\sqrt{\text{Var}(X)}$ 

$$\sigma = \sqrt{23.33}$$

Standard deviation = 4.83

## 1 B. Question

Find the mean, variance and standard deviation for the following data:

## **Answer**

**Explanation:** Here, Mean  $\overline{X} = \frac{6+7+10+12+13+4+8+12}{8}$ 

$$\Rightarrow \overline{X} = \frac{72}{8} = 9$$

Xi	$(x_i-X)=(x_i-7)$	(x <sub>i</sub> -7) <sup>2</sup>
6	-3	9
7	-2	4
10	1	1
12	3	9
13	4	16
4	-5	25
12	3	9
		$\sum_{1}^{8} (x_i - \bar{X})^2 = 74$

And, n=8

Variance (X) = 
$$\frac{1}{n} \sum_{i=1}^{8} (x_i - \overline{X})$$

$$\frac{74}{9}$$

Variance = 9.25

Standard deviation =  $\sqrt{\text{Var}(X)}$ 

$$\sigma = \sqrt{9.25}$$

Standard deviation = 3.04

#### 1 C. Question

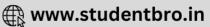
Find the mean, variance and standard deviation for the following data:

## **Answer**

**Explanation:** Here, Mean  $\overline{X} = \frac{227 + 235 + 255 + 269 + 292 + 312 + 321 + 333 + 348}{10}$ 

$$\Rightarrow \overline{X} = \frac{2891}{10} = 289.1$$





Xi	$(x_i-X)=(x_i-7)$	$(x_i-7)^2$
227	-62.1	3856.41
235	-54.1	2926.81
255	-34.1	1162.81
269	-20.1	404.01
292	2.9	8.41
299	9.9	98.01
312	22.9	524.41
321	31.9	1017
333	43.9	1927.21
348	58.9	3469.21
		$\sum_{1}^{10} (x_i - \bar{X})^2 = 15394.9$

And, n=10

Variance (X) = 
$$\frac{1}{n} \sum_{i=1}^{10} (x_i - \overline{X})$$

Variance = 15394.9

Standard deviation =  $\sqrt{\text{Var}(X)}$ 

$$\sigma = \sqrt{1539.49}$$

Standard deviation = 39.24

# 1 D. Question

Find the mean, variance and standard deviation for the following data:

# Answer

**Explanation:** Here, Mean 
$$\overline{X} = \frac{15+22+27+11+9+21+14+9}{8}$$

$$\Rightarrow \overline{X} = \frac{128}{8} = 16$$

Xi	$(x_i-X)=(x_i-7)$	(x <sub>i</sub> -7) <sup>2</sup>
15	-1	1
22	6	36
27	11	121
11	5	25
9	-7	49
21	5	25
14	-2	4
9	-7	49
		$\sum_{1}^{8} (x_i - \bar{X})^2 = 310$

And, n=8

Variance (X) = 
$$\frac{1}{n} \sum_{i=1}^{8} (x_i - \overline{X})$$

$$\frac{310}{8}$$

Variance = 38.75





Standard deviation =  $\sqrt{\text{Var}(X)}$ 

$$\sigma = \sqrt{38.75}$$

Standard deviation = 6.22

## 2. Question

The variance of 20 observations is 4. If each observation is multiplied by 2, find the variance of the resulting observations.

#### **Answer**

Given, The variance of 20 observations is 4.

**To Find:** Find the variance of resulting observations.

**Explanation:** Let Assume,  $x_1, x_2, x_3, ..., x_{20}$  be the given observations.

So, Variance (X) = 5 (Given)

$$X = \frac{1}{n} \times \sum (x_i - \overline{X})^2$$

Now, Let  $u_1, u_2, \dots u_{20}$  be the new observation,

When we multiply the new observation by 2, then

$$U_i=2x_i$$
 (for  $i=1,2,3...,20$ ) ---(i)

Now,

$$\mathsf{Mean} = \overline{\mathsf{U}} = \frac{\sum_{i=0}^{20} \mathsf{U}_{i}}{\mathsf{n}}$$

$$\frac{\sum_{i=1}^{20} 2x_i}{20}$$

$$Mean = 2\overline{X}$$

Since, 
$$u_i - \overline{U} = 2x_i - 2\overline{X}$$

$$2(x_i - \overline{X})$$

Now, 
$$(u_i - \overline{U})^2 = (2(x_i - \overline{X}))^2$$

$$4(x_i - \overline{X})^2$$

Comparing Both the observations,

$$\frac{\sum_{20}^{i=1}(u_i-\overline{U})^2}{20} = \frac{\sum_{20}^{i=1}4(x_i-\overline{X})^2}{20}$$

$$4 \times \frac{\sum_{20}^{i=1} (x_i - \overline{X})^2}{20}$$

Variance (U)  $=4 \times Variance$  (X)

4×5

20

Hence, The variance of new observations is 20.

# 3. Question

The variance of 15 observations is 4. If each observation is increased by 9, find the variance of the resulting observations.



#### **Answer**

Given, The variance of 20 observations is 4.

To Find: Find the variance of resulting observations.

**Explanation:** Let Assume,  $x_1, x_2, x_3, ..., x_{15}$  be the given observations.

So, Variance (X) = 4 (Given)

$$X = \frac{1}{n} \times \sum (x_i - \overline{X})^2$$

Now, Let  $u_1, u_2, \dots u_{20}$  be the new observation,

When new observation increase by 9, then

$$U_i = x_i + 9 (for i = 1, 2, 3..., 20) ---(i)$$

Now,

$$\overline{U} = \frac{1}{n} \sum_{i=1}^{15} u_i$$

$$\frac{1}{15}\sum_{i=1}^{15}(x_i+9)$$

$$\frac{1}{15} \sum_{i=1}^{15} x_i + \frac{9 \times 15}{15}$$

$$\overline{U} = 9 + \overline{X}$$

$$\mathbf{u_i} - \overline{\mathbf{U}} = (\mathbf{x_i} + 9) - (9 + \overline{\mathbf{X}})$$

$$u_i - \overline{U} = x_i - \overline{X}$$

$$\frac{\sum_{i=1}^{15}(u_i-\overline{U})^2}{15} = \frac{\sum_{i=1}^{15}4(x_i-\overline{X})^2}{15}$$

$$\frac{\sum_{i=1}^{15} (u_i - \overline{U})^2}{15} = 4$$

Variance (U) = 60

Hence, The variance of new observations is 60.

#### 4. Question

The mean of 5 observations is 4.4 and their variance is 8.24. If three of the observations are 1, 2 and 6, find the other two observations.

#### **Answer**

**Given,** Mean of 5 observation is 4.4 and variance is 8.24.

To Find: Find the other two observation

**Assumption:** Let x and y be the other two observation. And Mean is 4.4

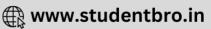
Here, Mean = 
$$\frac{1+2+6+x+y}{5}$$
 = 4.4

$$9+x+y=22$$

$$X+y=13$$
 .....(1)

Now, Let Variance (X) be the variance of this observation which is to be 8.24





If  $\overline{X}$  is the mean than we get,

$$8.24 = \frac{1}{5}(1^2 + 2^2 + 6^2 + x^2 + y^2) - (\overline{x})^2$$

$$8.24 = \frac{1}{5}(1^2 + 2^2 + 6^2 + x^2 + y^2) - (4.4)^2$$

$$8.24 = \frac{1}{5}(41 + x^2 + y^2) - 19.36$$

$$X^2+y^2=97$$
 .....(2)

$$(x+y)^2+(x-y)^2=2(x^2+y^2)$$

By Subsititute the value we get,

$$13^2+(x-y)^2=2\times97$$

$$(x-y)^2=194-169$$

$$(x-y)^2=25$$

$$x-y = \pm 5 \dots (3)$$

On solving equations (1) and (3) we get,

$$2x = 18$$

$$X = 9$$

And, 
$$y = 4$$

## Hence, The other two observations are 9 and 4.

## 5. Question

The mean and standard deviation of 6 observations are 8 and 4 respectively. If each observation is multiplied by 3, find the new mean and new standard deviation of the resulting observations.

### **Answer**

Given, The mean is 8 and SD is 4 for 6 observation

**To Find:** Find a new mean and new standard Deviation.

**Formula Used:** Standard Deviation ( $\sigma^2 = Variance$ )

# **Explanation:**

Let Assume,  $x_1, x_2, x_3, ..., x_6$  be the given observations.

So, Variance (X) = 8 (Given)

n=6

and  $\sigma = 4$  (SD)

$$X = \frac{1}{n} \times \sum X_i$$

$$8 = \frac{1}{6} \times \sum_{i=1}^{6} x_i$$

Now, Let  $u_1, u_2, \dots u_{20}$  be the new observation,

When we multiply the new observation by 3, then

$$U_i=3x_i$$
 (for  $i=1,2,3...,6$ ) .....(i)

Now,





$$\overline{U} = \frac{1}{n} \sum_{i=1}^{15} u_i$$

$$\frac{1}{6}\sum_{i=1}^{6}(3x_i)$$

$$3 \times \frac{1}{6} \sum_{i=1}^{6} (x_i)$$

$$\overline{U} = 3\overline{X}$$

$$3 \times 8 = 25$$

$$U = 24$$

Therefore, The Mean of new observation is 24

Now.

Standard Deviation  $\sigma_x = 4$ 

$$\sigma_x^2 = Variance X$$

Since, Variance (X) = 16

Variance (U) = 
$$\frac{1}{6}\sum_{i=1}^{6}(3x_i - 3X)$$

$$3^2 \times \frac{1}{6} \times \sum (x_i - X)^2$$

9×16

$$\sigma_{\rm u}^2 = \text{Variance (U)}$$

$$\sigma_n^2 = 144$$

$$\sigma = 12$$

Hence, The mean of new observation is 24 and Standard deviation of new data is 12.

### 6. Question

The mean and variance of 8 observations are 9 and 9.25 respectively. If six of the observations are 6, 7, 10, 12, 12 and 13, find the remaining two observations.

# **Answer**

Given, Mean of 8 observation is 9 and variance is 9.25.

**To Find:** Find the other two observation

**Assumption:** Let x and y be the other two observation. And Mean is 9

Here, Mean = 
$$\frac{6+7+10+12+12+13+x+y}{8} = 9$$

$$60+x+y=72$$

$$X+y=12$$
 .....(1)

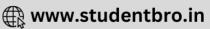
Now, Let Variance (X) be the variance of this observation which is to be 9.25

If  $\overline{X}$  is the mean than we get,

$$9.25 = \frac{1}{8}(6^2 + 7^2 + 10^2 + 12^2 + 12^2 + 13^2 + x^2 + y^2) - (\overline{x})^2$$







$$9.25 = \frac{1}{8}(6^2 + 7^2 + 10^2 + 12^2 + 12^2 + 13^2 + x^2 + y^2) - (9)^2$$

$$642+x^2+y^2=722$$

$$X^2+y^2=80$$
 ---(2)

$$(x+y)^2+(x-y)^2=2(x^2+y^2)$$

By Subsititute the value we get,

$$12^2+(x-y)^2=2\times80$$

$$(x-y)^2=160-144$$

$$(x-y)^2=14$$

$$x-y = \pm 4$$
 .....(3)

On solving equations (1) and (3) we get,

X = 8, 4

And y = 4.8

Hence, The other two observations are 8 and 4.

## 7. Question

For a group of 200 candidates, the mean and the standard deviations of scores were found to be 40 and 15 respectively. Later on, it was discovered that the scores of 43 and 35 were misread as 34 and 53 respectively. Find the correct mean and standard deviation.

#### **Answer**

To Find: Find the correct mean and standard deviation.

**Explanation:** Here,  $n=200, \overline{X}=40, \sigma=15$ 

$$X = \frac{1}{n} \times \sum X_i$$

$$40 = \frac{1}{200} \times \sum_{i=1}^{200} x_i$$

$$\sum x_i = 40 \times 200$$

Since, the score was incorrect,

Now, The sum is incorrect

Corrected 
$$\sum x_i = 8000 - 34 - 53 + 43 + 35$$

8000-7

The correct score is 7993

So, The mean of correct score =  $\frac{\sum x}{n}$ 

7993

200

Mean = 39.95

Now, Standard variance  $\sigma = 15$ 

Since, Variance =  $\sigma^2$ 







Variance = 255

$$X = \frac{1}{n} \times \sum (x_i - \overline{X})^2$$

$$255 = \frac{1}{200} \times \sum (x_i)^2 - (40)^2$$

$$255 = \frac{1}{200} \times \sum (x_i)^2 - 1600$$

$$\sum (x_i)^2 = 200 \times 1825$$

$$\sum (x_i)^2 = 365000$$

Now, the correct  $\sum (x_i)^2 = 365000 - 34^2 - 53^2 + 43^2 + 35^2$ 

365000-1156-2809+1849+1225

$$\sum (x_i)^2 = 364109$$

Corrected Variance =  $\left(\frac{1}{n} \times \text{corrected } \sum x_i\right)$  - (Corrected mean)<sup>2</sup>

$$\left(\frac{1}{200} \times 364109\right) - (39.95)^2$$

1820.54-1596.40

Corrected variance = 224.14

Now, Corrected Standard Deviation =  $\sqrt{\text{Corrected variance}}$ 

$$\sigma = \sqrt{224.14}$$

Correct Deviation is 14.97

# 8. Question

The mean and standard deviation of 100 observations were calculated as 40 and 5.1 respectively by a student who took by mistake 50 instead of 40 for one observation. What are the correct mean and standard deviation?

#### **Answer**

To Find: Find the correct mean and standard deviation.

**Explanation:** Here,  $n=100, \overline{X}=40, \sigma=5.1$ 

$$X = \frac{1}{n} \times \sum X_i$$

$$40 = \frac{1}{100} \times \sum_{i=1}^{100} x_i$$

$$\sum x_i = 40 \times 100$$

Now,

Corrected  $\sum x_i = 4000 - 50 + 40$ 

3990

So, The mean of correct score =  $\frac{\text{Corrected Sum}}{n}$ 





Mean = 39.9

Now, Standard variance  $\sigma = 5.1$ 

Since. Variance =  $\sigma^2$ 

Variance = 26.01

$$X = \frac{1}{n} \times \sum (x_i - \overline{X})^2$$

$$26.01 = \frac{1}{100} \times \sum (x_i)^2 - (40)^2$$

$$26.01 = \frac{1}{100} \times \sum (x_i)^2 - 1600$$

$$\sum (x_i)^2 = 162601$$

Corrected  $\sum (x_i)^2 = 162601-50+40$ 

Corrected  $\sum (x_i)^2 = 162591$ 

Corrected Variance =  $\left(\frac{1}{n} \times \text{corrected } \sum x_i\right)$  - (Corrected mean)<sup>2</sup>

$$\left(\frac{1}{100} \times 162591\right) - (39.9)^2$$

1625.91-1592.01

Corrected variance =34 (Approx)

Now, Corrected Standard Deviation =  $\sqrt{\text{Corrected variance}}$ 

$$\sigma = \sqrt{34}$$

Correct Deviation is 5.83

# Hence, The correct Mean is 39.9 and Correct SD is 5.83

#### 9. Question

The mean and standard deviation of 20 observations are found to be 10 and 2 respectively. On rechecking it was found that an observation 8 was incorrect. Calculate the correct mean and standard deviation in each of the following cases:

- (i) If wrong item is omitted
- (ii) if it is replaced by 12.

## **Answer**

Given: Mean = 10

And, standard deviation = 2

We know that,

$$\frac{\sum x_i}{n} = Mean$$

$$\sum x_i = 10 \times 20 = 200$$

When wrong item is omitted,  $\sum x_i = 200 - 8 = 192$ 





Corrected mean = 
$$\frac{192}{19}$$
 = 10.10

When it is replaced by 12,  $\sum x_i = 192 + 12 = 204$ 

Corrected mean=
$$\frac{204}{20}$$
= 10.73

Now, for standard deviation,

$$Variance = (2)^2 = 4$$

And we know that,

$$\frac{\sum x_i^2}{n} - \left(\frac{\sum x_i}{n}\right)^2 = 4$$

$$\frac{\sum x_i^2}{n} - 100 = 4$$

$$\sum x_i^2 = 104 \times 20 = 2080$$

Now, omitting the wrong observation, we get,

$$\sum x_i^2 = 2080 - (8)^2 = 2016$$

Corrected Deviation = 
$$\sqrt{\left(\frac{2016}{19}\right) - \left(\frac{192}{19}\right)} = \frac{1}{19}\sqrt{38304 - 36864} = 1.99$$

Now, replacing the observation

$$\sum x_i^2 = 2016 + (12)^2 = 2160$$

Corrected Deviation = 
$$\sqrt{\frac{2160}{20} - (\frac{204}{20})} = \sqrt{108 - 10.2} = 9.88$$

### 10. Question

The mean and standard deviation of a group of 100 observations were found to be 20 and 3 respectively. Later on, it was found that three observations were incorrect, which were recorded as 21, 21 and 18. Find the mean and standard deviation if the incorrect observations were omitted.

# **Answer**

To Find: Find the correct mean and standard deviation.

**Explanation:** Here,  $n=100, \overline{X}=20, \sigma=3$ 

$$X = \frac{1}{n} \times \sum X_i$$

$$20 = \frac{1}{100} \times \sum_{i=1}^{100} x_i$$

$$\sum x_i = 20 \times 100$$

So, Corrected 
$$\sum x_i = 2000 - 21 - 21 - 18$$

Corrected 
$$\sum x_i = 1940$$

Now, Standard variance  $\sigma = 3$ 

Since, Variance =  $\sigma^2$ 







Variance = 9

$$X = \frac{1}{n} \times \sum (x_i - \overline{X})^2$$

$$9 = \frac{1}{100} \times \sum (x_i)^2 - (20)^2$$

$$9 = \frac{1}{100} \times \sum (x_i)^2 - 400$$

$$\sum (x_i)^2 = 40900$$

Corrected 
$$\sum (x_i)^2 = 40900 - 21^2 - 21^2 - 18^2$$

Corrected  $\sum (x_i)^2 = 39694$ 

Correct mean = 
$$\frac{1940}{97}$$
 = 20

Corrected Variance =  $\left(\frac{1}{n} \times \text{corrected } \sum x_i\right)$  - (Corrected mean)<sup>2</sup>

$$\left(\frac{1}{97} \times 39694\right) - (20)^2$$

409.22-400

Corrected variance =9.22

Now, Corrected Standard Deviation =  $\sqrt{\text{Corrected variance}}$ 

$$\sigma = \sqrt{9.22}$$

Correct Deviation is 3.04

# Hence, The correct Mean is 20 and Correct SD is 3.04

# 11. Question

Show that the two formula for the standard deviation of ungrouped data

$$\sigma = \sqrt{\frac{1}{n}\sum \left(x_i - \overline{X}\right)^2} \text{ and } \sigma' = \sqrt{\frac{1}{n}\sum x_i^2 - \overline{X}^2} \ \text{ are equivalent, where } \overline{X} = \frac{1}{n}\sum x_i \ .$$

# Answer

We know,  $\sigma = \sqrt{\text{Variance}(X)}$ 

$$\sum (x_i - \overline{x})^2 = \sum (x_i^2 - 2x_i \overline{X} + \overline{X}^2)$$

$$\sum (x_i - \overline{x})^2 = \sum (x_i^2) - 2\overline{X} \sum x_i + \overline{X}^2 \sum 1$$

$$\sum (x_i - \overline{x})^2 = \sum (x_i^2) - 2\overline{X}(\overline{X}) + \overline{X}^2$$

$$\sum (x_i - \overline{x})^2 = \sum (x_i^2) - (\overline{X}^2)$$

On Diving both sides by  $\frac{1}{n}$ , we get

$$\frac{1}{n}\sum(x_i-\overline{x})^2=\frac{1}{n}\sum(x_i^2)-(\overline{X}^2)$$

Taking square root both side







$$\sqrt{\frac{1}{n}\sum (x_i - \overline{x})^2} = \sqrt{\frac{1}{n}\sum (x_i^2) - (\overline{X}^2)}$$

Hence, Proved

# **Exercise 32.5**

# 1. Question

Find the standard deviation for the following distribution:

x:	4.5	14.5	24.5	34.5	44.5	54.5	64.5
f:	1	5	12	22	17	9	4

### **Answer**

Given, The data is given in table/

To Find: Find the standard deviation

The formula used: SD =  $\sqrt{\text{Var}(X)}$ 

**Explanation:** Here, Mean =  $\sum \frac{f_i x_i}{f_i}$ 

$$Mean = \frac{4.5+14.5+24+34.5+44.4+54.5+64.5}{7} = 34.4$$

Xi	Fi	d <sub>i</sub> =(x <sub>i</sub> - mean)	$u_i = \frac{x_i - mean}{10}$	f <sub>i</sub> u <sub>i</sub>	U <sub>i</sub> <sup>2</sup>	f <sub>i</sub> u <sub>i</sub> ²
4.5	1	-30	-3	-3	9	9
14.5	5	-20	-2	-10	4	20
24	12	-10	-1	-12	1	12
34.5	22	0	0	0	0	0
44.5	17	10	1	17	1	17
54.5	9	20	2	18	4	36
64.5	4	30	3	12	9	36
	$\sum f_i = 70$			$\sum u_i f_i = 22$		$\sum_{i=1}^{n_i^2 f_i} u_i^2 f_i$

Now, N=70, 
$$\sum u_i f_i = 22$$
,  $\sum u_i^2 f_i = 130$ 

$$Var(X) = h^2 \left[ \frac{1}{N} \sum_{i=1}^{n} f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^{n} u_i f_i \right)^2 \right]$$

$$Var(X) = 10^2 \left[ \frac{1}{70} \times 130 - \left( \frac{1}{70} \times 22 \right)^2 \right]$$

$$100 \left[ \frac{130}{70} - \left( \frac{22}{70} \right)^2 \right]$$

$$100\left[\frac{13}{7} - \frac{121}{1225}\right]$$

100[1.857-0.0987]

100[1.7583]

$$Var(X) = 175.83$$

Standard Deviation  $\sigma = \sqrt{Var(X)}$ 

 $\sqrt{175.83}$ 



# Hence, The standard deviation is 13.26

### 2. Question

Table below shows the frequency f with which 'x' alpha particles were radiated from a diskette

x:	0	1	2	3	4	5	6	7	8	9	10	11	12
f:	51	203	383	525	532	408	273	139	43	27	10	4	2

Calculate the mean and variance.

#### **Answer**

Given, The data is given in table

To Find: Find the mean and variance

**Explanation:** Mean =  $\sum \frac{f_i x_i}{x_i}$ 

 $Mean = \frac{10078}{2600} = 3.88$ 

Xi	Fi	F <sub>i</sub> X <sub>i</sub>	(X <sub>i</sub> -X)	(X <sub>i</sub> -X) <sup>2</sup>	F <sub>i</sub> (X <sub>i</sub> -X) <sup>2</sup>
0	51	0	-3.88	15.05	767.55
1	203	203	-2.88	8.29	1682.87
2	383	766	-1.88	3.53	1351.99
3	525	1575	-0.88	0.77	404.25
4	532	2128	0.12	0.014	7.448
5	408	2040	1.12	1.25	510
6	273	1638	2.12	4.49	1225.77
7	139	973	3.12	9.73	1352.47
8	42	344	4.12	16.97	729.71
9	27	243	5.12	26.21	707.67
10	10	100	6.12	37.45	374.5
11	4	44	7.12	50.69	202.76
12	2	24	8.12	65.93	131.86
	N=2600	$\sum f_i x_i = 10078$			$\sum f_i(x_i - \bar{X})^2 = 9448.848$

Now, N=70

$$\text{Variance}(\textbf{X}) = \frac{\sum f_i (\textbf{x}_i - \overline{\textbf{X}})^2}{N}$$

$$\sigma^2 = \frac{9448.848}{2600} = 3.63$$

# Hence, The mean is 3.88 and variance is 3.63

# 3 A. Question

Find the mean, and standard deviation for the following data:

Year ren	der:	10	20	30	40	50	60
No.	of	15	32	51	78	97	109
persons (cumula	tivo).						

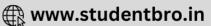
# **Answer**

Given, The data is given in table/

To Find: Find the standard deviation

The formula used:  $SD = \sqrt{Var(X)}$ 





# **Explanation:**

Xi	Fi	fi		f <sub>i</sub> u <sub>i</sub>	Ui2	f <sub>i</sub> u <sub>i</sub> ²
			$u_i = \frac{x_i - mean}{10}$			
10	15	15	-2.5	-37.5	6.25	93.75
20	32	17	-1.5	-25.5	2.25	38.25
30	51	19	-0.5	-9.5	0.25	4.75
40	78	27	0.5	13.5	0.25	6.75
50	97	19	1.5	28.5	2.25	42.75
60	109	12	2.5	30	6.25	75
		$\sum f_i = 109$		$\sum u_i f_i = -0.5$		$\sum u_i^2 f_i = 261.2$

Now, N=109, 
$$\sum u_i f_i = -0.5$$
,  $\sum u_i^2 f_i = 261.2$ 

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 35 + 10 \left( \frac{-0.5}{109} \right)$$

$$\overline{X} = 34.96$$

$$Var(X) = h^{2} \left[ \frac{1}{N} \sum_{i=1}^{n} f_{i} u_{i}^{2} - \left( \frac{1}{N} \sum_{i=1}^{n} u_{i} f_{i} \right)^{2} \right]$$

$$Var(X) = 100 \left[ \frac{261.25}{109} - \frac{0.25}{11881} \right]$$

100×2.396

Variance = 239.6

Standard Deviation  $\sigma = \sqrt{239.6}$ 

SD = 15.47 years

# Hence, The standard deviation is 15.47

# 3 B. Question

Find the mean, and standard deviation for the following data:

Marks:	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Frequency:	1	6	6	8	8	2	2	3	0	2	1	0	0	0	1

# Answer

Given, The data is given in table/

To Find: Find the standard deviation

The formula used: SD =  $\sqrt{Var(X)}$ 

**Explanation:** 



Xi	fi	f <sub>i</sub> x <sub>i</sub>	f <sub>i</sub> x <sub>i</sub> <sup>2</sup>
2	1	2	4
3	6	18	54
4	6	24	96
5	8	40	200
6	8	48	288
7	2	14	98
8	2	16	128
9	3	27	243
10	0	0	0
11	2	22	242
12	1	12	144
13	0	0	0
14	0	0	0
15	0	0	0
16	1	16	256
	N=40	Total=239	Total=1753

Now, N=40,  $\sum x_i f_i = 239$ ,  $\sum x_i^2 f_i = 1753$ 

Mean 
$$\overline{X} = \left(\frac{\sum x_i f_i}{N}\right)$$

$$\overline{X} = \frac{239}{40}$$

$$\bar{X} = 5.975$$

$$Var(X) = \frac{1753}{40} - (5.97)^2$$

Variance = 8.12

Standard Deviation  $\sigma = \sqrt{8.12}$ 

SD = 2.85 years

# Hence, The standard deviation is 2.85

# 4 A. Question

Find the standard deviation for the following data:

x:	3	8	13	18	23
f:	7	10	15	10	6

### **Answer**

Given, The data is given in table/

To Find: Find the standard deviation

The formula used: SD =  $\sqrt{var(x)}$ 

# **Explanation:**

Xi	Fi	F <sub>i</sub> x <sub>i</sub>			
			$(x_i - \bar{X})$	$(x_i - \bar{X})^2$	$(x_i - \bar{X})^2 f$
3	7	21	-9.79	95.84	670.88
8	10	80	-4.79	22.94	229.4
13	15	195	0.21	0.04	0.6
18	10	180	5.21	27.14	271.4
23	6	138	10.21	104.24	625.44
	$\sum f_i = 48$	$\sum f_i x_i = 614$			$\sum (x_i - \bar{X})^2 f = 1797.32$

$$Var(X) = \frac{\sum (x_i - \overline{X})^2 f}{\sum f_i}$$





$$Var(X) = \frac{1797.32}{48}$$

Variance = 37.44

Standard Deviation  $\sigma = \sqrt{37.44}$ 

$$SD = 6.12$$

# Hence, The standard deviation is 6.12

# 4 B. Question

Find the standard deviation for the following data:

x:	2	3	4	5	6	7
f:	4	9	16	14	11	6

#### **Answer**

Given, The data is given in table/

To Find: Find the standard deviation

The formula used:  $SD = \sqrt{Var(X)}$ 

# **Explanation:**

Xi	fi	$f_i x_i$	f <sub>i</sub> x <sub>i</sub> <sup>2</sup>
2	4	8	16
3	9	27	81
4	16	64	256
5	14	70	350
6	11	66	396
7	6	42	294
	N=60	Total =	Total=1393
		277	

Now, N=60, 
$$\sum x_i f_i =$$
 277,  $\sum x_i^2 f_i =$  1393

Mean 
$$\overline{X} = \left(\frac{\sum x_i f_i}{N}\right)$$

$$\overline{X} = \frac{277}{60}$$

$$\overline{X} = 4.62$$

$$Var(X) = \frac{1393}{60} - (4.62)^2$$

Variance = 1.88

Standard Deviation  $\sigma = \sqrt{1.88}$ 

SD = 1.37

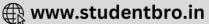
Hence, The standard deviation is 1.37

# Exercise 32.6

# 1. Question

Calculate the mean and S.D. for the following data:





Expenditure (in ₹):	0-10	10-20	20-30	30-40	40-50
Frequency:	14	13	27	21	15

### **Answer**

**Given,** The data is given in table/

To Find: Find the standard deviation

The formula used:  $SD = \sqrt{Var(X)}$ 

# **Explanation:**

Expenditure	Mid Point(X <sub>i</sub> )	F <sub>i</sub>	F <sub>i</sub> X <sub>i</sub>	$(x_i - \bar{X})$	$(x_i - \bar{X})^2$	$(x_i-\tilde{X})^2 f$
0-10	5	14	70	-21.1	445.21	6233.94
10-20	15	13	195	-11.1	123.21	1601.1
20-30	25	27	675	-1.1	1.21	34.67
30-40	35	21	735	8.9	79.21	1663.41
40-50	45	15	675	18.9	357.21	53.58
10001100		$\sum_{i=90}^{6} f_i$	$\sum_{i=2350} f_i x_i$			$\sum_{i=1797.32} (x_i - \bar{X})^2 f$

Mean 
$$\overline{X} = \sum rac{f_i x_i}{f_i}$$

$$\overline{X} = \frac{2350}{90}$$

Mean = 26.11

$$Var(X) = \frac{14891.9}{90}$$

Variance = 165.47

Standard Deviation  $\sigma = \sqrt{165.47}$ 

SD = 12.86

# Hence, The standard deviation is 12.86

# 2. Question

Calculate the standard deviation for the following data:

Class:	0-30	30-60	60-90	90-120	120-150	150-180	180-210
Frequency:	9	17	43	82	81	44	24

### **Answer**

**Given,** The data is given in table/

To Find: Find the standard deviation

The formula used: SD =  $\sqrt{var(x)}$ 

**Explanation:** 





Class	Fi	Xi	$u_i = \frac{x_i - mean}{30}$	f <sub>i</sub> u <sub>i</sub>	Ui <sup>2</sup>	f <sub>i</sub> u <sub>i</sub> ²
0-30	9	15	-3	-27	9	81
30-60	17	45	-2	-34	4	68
60-90	43	75	-1	-43	1	43
90-120	82	105	0	0	0	0
120-150	81	135	1	81	1	81
150-180	44	165	2	88	4	176
180-210	24	195	3	72	9	216
		$\sum f_i = 300$		$\sum u_i f_i = 137$		$\sum u_i^2 f_i = 665$

Now, N=300, 
$$\sum u_i f_i = 137$$
,  $\sum u_i^2 f_i = 665$ 

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 105 + 30 \left(\frac{137}{300}\right)$$

$$\bar{X} = 118.7$$

$$Var(X) = h^2 \left[ \frac{1}{N} \sum_{i=1}^{n} f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^{n} u_i f_i \right)^2 \right]$$

$$Var(X) = \frac{900}{90000} [300 \times 665 - 18769]$$

$$\frac{1}{100}[199500 - 18769]$$

Variance = 1807.31

Standard Deviation  $\sigma = \sqrt{1807.31}$ 

SD = 42.51

# Hence, The standard deviation is 42.51

# 3. Question

Calculate the A.M. and S.D. for the following distribution:

Class:	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency:	18	16	15	12	10	5	2	1

### **Answer**

**Given,** The data is given in table/

To Find: Find the standard deviation

The formula used:  $SD = \sqrt{Var(X)}$ 

**Explanation:** 



Class	Fi	Xi	$u_i = \frac{x_i - mean}{10}$	f <sub>i</sub> u <sub>i</sub>	f <sub>i</sub> u <sub>i</sub> ²
0-10	18	5	-3	-54	162
10-20	16	15	-2	-32	64
20-30	15	25	-1	-15	15
30-40	12	35	0	0	0
40-50	10	45	1	10	10
50-60	5	55	2	10	20
60-70	2	65	3	6	18
70-80	1	75	4	4	16
	$\sum f_i = 79$			$\sum u_i f_i = -71$	$\sum u_i^2 f_i = 305$

Now, N=79, 
$$\sum u_i f_i = -71$$
,  $\sum u_i^2 f_i = 305$ 

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 35 + 10\left(\frac{-71}{79}\right)$$

$$\bar{X} = 26.01$$

$$\text{Var}(\textbf{X}) = h^2 \left[ \frac{1}{N} \sum_{i=1}^n f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^n u_i f_i \right)^2 \right]$$

$$Var(X) = 100 \left[ \frac{305}{79} - \frac{5041}{6241} \right]$$

Variance = 305.20

Standard Deviation  $\sigma = \sqrt{305.20}$ 

SD = 17.47

# Hence, The standard deviation is 17.47

### 4. Question

A student obtained the mean and standard deviation of 100 observations as 40 and 5.1 respectively. It was later found that one observation was wrongly copied as 50, the correct figure is 40. Find the correct mean and S.D.

# **Answer**

**Given,** Uncorrected mean is 40 and corrected SD is 5.1 and N = 100

To Find: Find the correct mean and SD

Explanation: Here,  $\bar{x}=40$ ,  $\sigma=5.1$  and n=100

Then,  $\sum x_o = 4000$ 

The corrected sum of observation  $\sum x_n = 4000 - 50 + 40$ 

$$\sum x_n = 3990$$

So, 
$$\overline{\mathbf{x}_{\mathbf{n}}} = \frac{\sum \mathbf{x}_{\mathbf{n}}}{\mathbf{n}}$$

$$\overline{x_n} = \frac{3990}{100}$$

$$\overline{x_n} = 39.90$$

Now, Given Incorrect SD = 5.1





$$\sigma = 5.1$$

$$\sum (x_i - \overline{x_o})^2 = 2601$$

$$\sum (x_i - \overline{x_o})^2 = 2601 - 100 + 0.01 = 2501.1$$

Corrected 
$$\sigma_n = \sqrt{\frac{\sum (x_i - \overline{x_0})^2}{n}}$$

$$\sigma_n=\sqrt{\frac{2501.01}{100}}$$

Correct SD is 5

# Hence, Correct mean is 39.90 and correct SD is 5

# 5. Question

Calculate the mean, median and standard deviation of the following distribution

C	lass-	31-	36-	41-45	46-50	51-55	56-60	61-65	66 -70
in	terval:	35	40						
Fr	equency:	2	3	8	12	16	5	2	3

#### **Answer**

Given, The data is given in table/

To Find: Find the standard deviation

The formula used:  $SD = \sqrt{Var(X)}$ 

# **Explanation:**

Class	Fi	Xi	$u_i = \frac{x_i - mean}{4}$	f <sub>i</sub> u <sub>i</sub>	f <sub>i</sub> u <sub>i</sub> ²
31-35	2	33	-4	-8	32
36-40	3	38	-3	-9	27
41-45	8	43	-2	-16	32
46-50	12	48	-1	-12	12
51-55	16	53	0	0	0
56-60	5	58	1	5	5
61-65	2	63	2	4	8
66-70	2	68	3	6	18
	$\sum f_i = 50$			$\sum u_i f_i = -30$	$\sum u_i^2 f_i = 134$

Now, N=50, 
$$\sum u_i f_i = -30$$
,  $\sum u_i^2 f_i = 134$ 

Mean 
$$\overline{X} = A + h\left(\frac{\sum u_i f_i}{N}\right)$$

$$\overline{X} = 53 + 5\left(-\frac{30}{50}\right)$$

$$\overline{X} = 50$$

$$Var(X) = h^{2} \left[ \frac{1}{N} \sum_{i=1}^{n} f_{i} u_{i}^{2} - \left( \frac{1}{N} \sum_{i=1}^{n} u_{i} f_{i} \right)^{2} \right]$$

$$Var(X) = 25 \left[ \frac{134}{50} - \frac{9}{25} \right]$$

Variance = 58



Standard Deviation  $\sigma = \sqrt{58}$ 

SD = 7.62

### Hence, The standard deviation is 7.62

### 6. Question

Find the mean and variance of frequency distribution given below:

Xi	:	1 ≤ x < 3	3 ≤ x < 5	5 ≤ x < 7	7 ≤ x < 10
$f_1$	:	6	4	5	1

#### **Answer**

Given, The data is given in table

To Find: Find the mean and, the variance of the frequency

**Explanation:** Here, the class interval is not continues frequency distribution, So we have to convert into continues frequency distribution by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit then we get,

Class	Fi	Xi	$u_i = \frac{x_i - mean}{1}$	f <sub>i</sub> u <sub>i</sub>	f <sub>i</sub> u <sub>i</sub> ²
1-2	6	1.5	-4	-24	96
3-4	4	3.5	-2	-8	16
5-6	5	5.5	0	0	0
7-8	1	7.5	2	2	4
	$\sum f_i = 16$			$\sum u_i f_i = -30$	$\sum u_i^2 f_i = 116$

Now, N=16, 
$$\sum u_i f_i = 30$$
,  $\sum u_i^2 f_i = 116$ 

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 5.5 + 1 \left( \frac{1}{16} \times (-30) \right)$$

$$\bar{X} = 3.625$$

$$Var(X) = h^2 \left[ \frac{1}{N} \sum_{i=1}^{n} f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^{n} u_i f_i \right)^2 \right]$$

$$Var(X) = 1 \left[ \left( \frac{1}{16} \times 116 \right) - \left( \frac{1}{16} \times (-30) \right)^2 \right]$$

Variance = 3.74

# Hence, The variance is 3.74

# 7. Question

The weight of coffee in 70 jars is shown in the following table:

Weight	(in	200-	201-	202-	203-	204-	205-
grams):		201	202	203	204	205	206
Frequency:		13	27	18	10	1	1

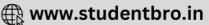
Determine the variance and standard deviation of the above distribution.

# **Answer**

Given, The data is given in table







To Find: Find the mean and, the variance of the frequency

**Explanation:** Here, the class interval in not continues frequency distribution, So we have to convert into continues frequency distribution by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit then we get,

Clas	s	Fi	Xi	$u_i = \frac{x_i - mean}{1}$	f <sub>i</sub> u <sub>i</sub>	f <sub>i</sub> u <sub>i</sub> <sup>2</sup>
200-2	01	13	200.5	-1.5	-19.5	29.25
201-2	02	27	201.5	-1	-27	27
202-2	03	18	202.5	-0.5	-9	4.5
203-2	04	10	203.5	0	0	0
204-2	05	1	204.5	0.5	0.5	0.25
205-2	06	1	205.5	1	1	1
		$\sum f_i = 70$			$\sum u_i f_i = -54$	$\sum u_i^2 f_i = 62$

Now, N=70, -54,  $\sum u_i^2 f_i = 62$ 

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 203.5 + 2\left(-\frac{54}{70}\right)$$

$$\bar{X} = 201.9$$

$$Var(X) = h^2 \left[ \frac{1}{N} \sum_{i=1}^{n} f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^{n} u_i f_i \right)^2 \right]$$

$$Var(X) = 4\left[\left(\frac{62}{70}\right) - \left(-\frac{54}{70}\right)^2\right]$$

Variance = 0.98

Standard Deviation  $\sigma = \sqrt{0.98}$ 

SD = 0.99

# Hence, The standard deviation is 0.99

### 8. Question

Mean, and standard deviation of 100 observations was found to be 40 and 10 respectively. If at the time of calculation two observations were wrongly taken as 30 and 70 in place of 3 and 27 respectively, find the correct standard deviation.

### **Answer**

**Given,** Uncorrected mean is 40 and corrected SD is 10 and N = 100

To Find: Find the correct mean and SD

Explanation: Here,  $\bar{x} = 40$ ,  $\sigma = 10$  and n = 100

Then,  $\sum x_o = 4000$ 

The corrected sum of observation  $\sum x_n = 4000 - 30 - 70 + 3 + 27$ 

$$\sum x_n = 3930$$

So, 
$$\overline{\mathbf{x}_n} = \frac{\sum \mathbf{x}_n}{n}$$

$$\overline{x_n} = \frac{3930}{100}$$





$$\overline{x_n} = 39.30$$

Variance =100

$$100 = \frac{\sum x_i^2}{100} - (40)^2$$

10000+160000

Incorrect  $\sum x_i^2 = 170000$ 

Correct 
$$\sum x_i^2 = 170000 - (900 + 4900) + (9 + 729)$$

Correct  $\sum x_i^2 = 164938$ 

Correct SD, 
$$\sigma = \sqrt{\frac{\text{Correct}\sum x^2}{n} - (\text{Correct Mean})^2}$$

Correct SD, 
$$\sigma = \sqrt{\frac{164938}{100} - (39.3)^2}$$

Hence, SD = 10.24

### 9. Question

While calculating the mean and variance of 10 readings, a student wrongly used the reading of 52 for the correct reading 25. He obtained the mean and variance as 45 and 16 respectively. Find the correct mean and the variance.

### **Answer**

**Given,** Uncorrected mean is 40 and corrected SD is 10 and N = 100

To Find: Find the correct mean and SD

**Explanation:** Here,  $\bar{x} = 45$ , Var = 16 and n = 10

Then, 
$$\sum x_{\alpha} = 450$$

The corrected sum of observation  $\sum x_n = 450 - 52 + 25$ 

$$\sum x_n = 423$$

So, 
$$\overline{\mathbf{x}_n} = \frac{\sum \mathbf{x}_n}{\mathbf{n}}$$

$$\overline{x_n} = \frac{423}{10}$$

$$\overline{x_n} = 42.3$$

Variance =16

$$16 = \frac{\sum x_i^2}{10} - (45)^2$$

Incorrect  $\sum x_i^2 = 20410$ 

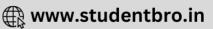
Correct 
$$\sum x_i^2 = 20410 - 2704 + 625$$

Correct 
$$\sum x_i^2 = 18331$$

Correct SD, 
$$\sigma = \sqrt{\frac{\text{Correct}\sum x^2}{n} - (\text{Correct Mean})^2}$$







Correct SD, 
$$\sigma = \sqrt{\frac{18331}{10} - (42.3)^2}$$

SD = 6.62

Variance =  $6.62 \times 6.62$ 

**Hence,** Variance = 43.82

# 10. Question

Calculate the mean, variance and standard deviation of the following frequency distribution:

	Class:	1-10	10-20	20-30	30-40	40-50	50-60
Γ	Frequency:	11	29	18	4	5	3

#### **Answer**

Given, The data is given in table

To Find: Find the standard deviation of the frequency

### **Explanation:**

Class	Fi	Xi	$u_i = \frac{x_i - mean}{10}$	f <sub>i</sub> u <sub>i</sub>	f <sub>i</sub> u <sub>i</sub> ²
0-10	11	5	-3	-33	99
10-20	29	15	-2	-58	116
20-30	18	25	-1	-18	18
30-40	4	35	0	0	0
40-50	5	45	1	5	5
50-60	3	55	2	6	12
	$\sum f_i = 70$	·		$\sum u_i f_i = -98$	$\sum u_i^2 f_i = 250$

Now, N=70, 
$$-98$$
,  $\sum u_i^2 f_i = 250$ 

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 35 + 10\left(-\frac{98}{70}\right)$$

$$\overline{X} = -21$$

$$Var(X) = h^{2} \left[ \frac{1}{N} \sum_{i=1}^{n} f_{i} u_{i}^{2} - \left( \frac{1}{N} \sum_{i=1}^{n} u_{i} f_{i} \right)^{2} \right]$$

$$Var(X) = 100 \left[ \left( \frac{1}{70} \times 250 \right) - \left( \frac{1}{70} \times (-98) \right)^2 \right]$$

Variance = 100(3.57-1.96)

Variance = 161

Standard Deviation  $\sigma = \sqrt{161}$ 

SD = 12.7

Hence, The standard deviation is 12.7

### Exercise 32.7

# 1. Question

Two plants A and B of a factory show the following results about the number of workers and the wages paid to them





	Plant A	Plant B
No. of	5000	6000
workers		
Average	₹2500	₹2500
monthly		
wages		
The	81	100
variance of		
distribution		
of wages		

In which plant A or B is there greater variability in individual wages?

### **Answer**

Variation of the distribution of wages in plant A( $\sigma^2$ =18)

So, Standard deviation of the distribution  $A(\sigma - 9)$ 

Similarly, the Variation of the distribution of wages in plant  $B(\sigma^2=100)$ 

So, Standard deviation of the distribution  $B(\sigma - 10)$ 

And, Average monthly wages in both the plants is 2500,

Since The plant with a greater value of SD will have more variability in salary.

# Hence, Plant B has more variability in individual wages than plant A

# 2. Question

The means and standard deviations of heights and weights of 50 students in a class are as follows:

	Weights	Heights
Mean	63.2 kg	63.2 inch
Standard	5.6 kg	11.5 inch
deviation		

Which shows more variability, heights or weights?

# **Answer**

**Given,** The mean and SD is given of 50 students.

**To Find:** which shows more variability, height and weight.

The formula used: Coefficient of variations =  $\frac{SD}{Mean} \times 100$ 

# **Explanation:**

The coefficient of variations in weights =  $\frac{SD}{Mean} \times 100$ 

$$\Rightarrow \frac{5.6}{63.2} \times 100 = 8.86$$

The coefficient of variations in weights =  $\frac{SD}{Mean} \times 100$ 

$$\Rightarrow \frac{11.5}{63.2} \times 100 = 18.19$$

As results clearly show that Cv heights is greater than Cv in weights.

# Hence, Heights will show more variability than weights

# 3. Question

The coefficient of variation of two distribution are 60% and 70%, and their standard deviations are 21 and 16 respectively. What is their arithmetic means?

# **Answer**





Here, the Coefficient of variation for the first distribution is 60

And, Coefficient of variation for the first distribution is 70

$$SD(\sigma_1) = 21$$
 and  $SD(\sigma_2) = 16$ 

We know that, Coefficients variation  $=\frac{\text{SD}}{\text{Mean}} \times 100$ 

So, Mean 
$$\overline{X} = \frac{SD}{CV} \times 100$$

For first distribution

$$\overline{X} = \frac{21}{60} \times 100$$

Mean = 35

For the second distribution

$$\overline{X} = \frac{16}{70} \times 100$$

Mean = 22.86

Hence, Means are 35 and 22.86.

# 4. Question

Calculate coefficient of variation from the following data:

Income (in ₹):	1000-1700	1700-2400	2400-3100	3100-3800	3800-4500	4500-5200
No. of families:	12	18	20	25	35	10

### **Answer**

Given, The data is given in table

To Find: Find the standard deviation of the frequency

# **Explanation:**

Class	Fi	Xi	$u_i = \frac{x_i - mean}{700}$	f <sub>i</sub> u <sub>i</sub>	f <sub>i</sub> u <sub>i</sub> ²
1000-1700	12	1350	-2	-24	48
1700-2400	18	2050	-1	-18	18
2400-3100	20	2750	0	0	0
3100-3800	25	3450	1	25	25
3800-4500	35	4150	2	70	140
4500-5200	10	4850	3	30	90
	$\sum f_i = 120$			$\sum u_i f_i = 83$	$\sum u_i^2 f_i = 321$

Now, N=120, 
$$\sum u_i^2 f_i = 321$$

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 2750 + 700 \left( \frac{83}{120} \right)$$

$$\overline{X} = 3234.17$$

$$Var(X) = h^2 \left[ \frac{1}{N} \sum_{i=1}^{n} f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^{n} u_i f_i \right)^2 \right]$$



$$Var(X) = 490000 \left[ \left( \frac{321}{120} \right) - \left( \frac{83}{120} \right)^2 \right]$$

Variance = 1076332.64

Standard Deviation  $\sigma = \sqrt{1076332.64}$ 

$$SD = 1037.47$$

Coefficients variation = 
$$\frac{1037.46}{3234.17} \times 100$$

Cv = 32.08

# Hence, The coefficient variation is 332.08

### 5. Question

An analysis of the weekly wages paid to workers in two firms A and B, belonging to the same industry gives the following results:

	Firm A	Firm B
No. of	586	648
wage		
earners		
Average weekly	₹52.5	₹47.5
wages		
The	100	121
variance of		
the		
distribution		
of wages		

- (i) Which firm A or B pays out the larger amount as weekly wages?
- (ii) Which firm A or B has greater variability in individual wages?

# **Answer**

(i) Average weekly wages = 
$$\frac{\text{Total weekly wages}}{\text{No.of workers}}$$

Total weekly wages =  $(Avg weekly wages) \times (No. of workers)$ 

Total weekly wages of Firm A =  $52.5 \times 586$  = Rs 30765

Total weekly wages of Firm B =  $47.5 \times 648$  = Rs 30780

Firm B pays a larger amount as Firm A

(ii) Here SD(firm A) 10 and SD (Firm B) = 11

Coefficient variance (Firm A) =  $\frac{10}{52.5} \times 100$ 

Cv (Firm A) = 19.04

Coefficient variance (Firm B) =  $\frac{11}{47.5} \times 100$ 

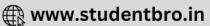
Cv (Firm B) = 23.15

Hence, Cv of firm B is greater that that of firm A, Firm B has greater variability in individual wages.

### 6. Question

The following are some particulars of the distribution of weights of boys and girls in a class:





	Boys	Girls
Number	100	50
Mean	60 kg	45 kg
weight		_
Variance	9	4

Which of the distributions is more variable?

#### **Answer**

Here SD(Boys) is 3 and SD(girls) = 2

Coefficient variability =  $\frac{SD}{Mean} \times 100$ 

Coefficient variance (Boys) =  $\frac{3}{60} \times 100$ 

Cv (Boys) = 5

Coefficient variance (Girls) =  $\frac{2}{45} \times 100$ 

Cv (Girls) = 4.4

# Hence, Cv Boys is greater than Cv girls, then the distribution of weights of boys is more variable than that of girls

# 7. Question

The mean and standard deviation of marks obtained by 50 students of a class in three subjects, mathematics, physics and chemistry are given below:

Subject	Mathematics	Physics	Chemistry
Mean	42	32	40.9
Standard	12	15	20
deviation			

Which of the three subjects shows the highest variability in marks and which shows the lowest?

#### **Answer**

$$\sigma_m=12$$
 ,  $\sigma_p=15$  ,  $\sigma_m=20$  and  $\overline{X_m}=42$  ,  $\overline{X_p}=32$  ,  $\overline{X_c}=40.9$ 

Coefficient variability =  $\frac{\sigma}{\bar{x}} \times 100$ 

Cv (Maths) = 
$$\frac{12}{42} \times 100$$

$$Cv (Maths) = 28.57$$

Cv (physics) = 
$$\frac{15}{32} \times 100$$

So, 
$$Cv$$
 (physics) =  $46.87$ 

Cv (chemistry) = 
$$\frac{20}{40.9} \times 100$$

So, 
$$Cv$$
 (chemistry) =  $48.89$ 

Hence, Cv of chemistry is greatest, the variability of marks in chemistry is highest and that of Mathematics is lowest.

# 8. Question

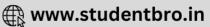
From the data given below state which group is more variable  $G_1$  or  $G_2$ ?

Marks	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Group G <sub>1</sub>	9	17	32	33	40	10	9
Group G₂	10	20	30	25	43	15	7

### **Answer**







Given, The data is given in the table.

To find: Check which group is more variable G1 and G2

Explanation: Let's find the coefficient of the variable for group G1

Class Interval	F	х	U=(X- A)/h	Fu	U²	Fu²
10-20	9	15	-3	-27	9	81
20-30	17	25	-2	-34	4	68
30-40	32	35	-1	-32	1	32
40-50	33	45	0	0	0	0
50-60	40	55	1	40	1	40
60-70	10	65	2	20	4	40
70-80	9	75	3	27	9	81
	Total= 150			Total=-6		Total=342

Here, n=150 a= 45

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 45 + 10 \left( \frac{-6}{150} \right)$$

$$\bar{X} = 44.6$$

$$Var(X) = h^{2} \left[ \frac{1}{N} \sum_{i=1}^{n} f_{i} u_{i}^{2} - \left( \frac{1}{N} \sum_{i=1}^{n} u_{i} f_{i} \right)^{2} \right]$$

$$Var(X) = 100 \left[ \left( \frac{342}{150} \right) - \left( \frac{-6}{150} \right)^2 \right]$$

Variance = 227.84

Standard Deviation  $\sigma = \sqrt{227.84}$ 

Standard Deviation  $\sigma = 15.09$ 

The coefficient of variation =  $\frac{\text{SD}}{\overline{x}} \times 100$ 

So, Coefficient of variation =  $\frac{15.09}{44.6} \times 100$ 

Cv = 33.83

Now find the coefficient of variable for group G2

Class	F	Х	U=(X-	Fu	U <sup>2</sup>	Fu <sup>2</sup>
Interval			A)/h			
10-20	10	15	-3	-30	9	90
20-30	20	25	-2	-40	4	80
30-40	30	35	-1	-30	1	30
40-50	25	45	0	0	0	0
50-60	43	55	1	43	1	43
60-70	15	65	2	30	4	60
70-80	7	75	3	21	9	62
	Total=			Total=-6		Total=366
	150					

Here, n=150 a= 45

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 45 + 10 \left( \frac{-6}{150} \right)$$





 $\overline{X} = 44.6$ 

$$Var(X) = h^2 \left[ \frac{1}{N} \sum_{i=1}^n f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^n u_i f_i \right)^2 \right]$$

$$Var(X) = 100 \left[ \left( \frac{366}{150} \right) - \left( \frac{-6}{150} \right)^2 \right]$$

Variance = 243.84

Standard Deviation  $\sigma = \sqrt{243.84}$ 

Standard Deviation  $\sigma = 15.62$ 

The coefficient of variation =  $\frac{SD}{\overline{x}} \times 100$ 

So, Coefficient of variation =  $\frac{15.62}{44.6} \times 100$ 

Cv = 35.02

Since, G2 has a high coefficient of variance,

Hence, Group G2 is more variable.

# 9. Question

Find the coefficient of variation for the following data:

Size (in cms):	10-15	15-20	20-25	25-30	30-35	35-40
No. of items:	2	8	20	35	20	15

# **Answer**

Given, The data is given in table

To Find: Find the coefficient variation.

# **Explanation:**

Class	Fi	Xi	$u_i {=} \frac{x_i {-} mean}{5}$	f <sub>i</sub> u <sub>i</sub>	f <sub>i</sub> u <sub>i</sub> ²
10-15	2	12.5	-2	-4	8
15-20	8	17.5	-1	-8	8
20-25	20	22.5	0	0	0
25-30	35	27.5	1	35	35
30-35	20	32.5	2	40	80
35-40	15	37.5	3	45	135
	$\sum f_i = 100$			$\sum u_i f_i = 108$	$\sum u_i^2 f_i = 266$

Now, N=100, 
$$\sum u_i^2 f_i = 266$$

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X}=22.5+5\left(\frac{108}{100}\right)$$

$$\bar{X} = 27.90$$

$$Var(X) = h^2 \left[ \frac{1}{N} \sum_{i=1}^{n} f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^{n} u_i f_i \right)^2 \right]$$



$$Var(X) = 25 \left[ \left( \frac{266}{100} \right) - \left( \frac{108}{100} \right)^2 \right]$$

Variance = 37.34

Standard Deviation  $\sigma = \sqrt{37.34}$ 

$$SD = 6.11$$

Coefficients variation 
$$=\frac{6.11}{27.90} \times 100$$

Cv = 21.9

# Hence, The coefficient variation is 21.9

# 10. Question

From the prices of shares X and Y given below: Find out which is more stable in value:

х:	35	54	52	53	56	58	52	50	51	49
Y:	108	107	105	105	106	107	104	103	104	101

#### **Answer**

Given, Data is given in the form of two table

To Find: Find out which one is more stable in value

Explanation: Let's Find for Value X

х	d=(x-Mean)	d²
35	-13	169
24	-24	576
52	4	16
53	5	25
56	8	64
58	10	100
52	4	16
50	2	4
51	3	9
49	1	1
Total=480		Total=980

Now, N=70

$$\overline{X} = \frac{1}{n} \sum X_i$$

$$\overline{X} = \frac{1}{10} [480] = 48$$

$$Variance(X) = \frac{\sum (x_i - \overline{X})^2}{N}$$

$$Variance(X) = \frac{980}{10} = 98$$

SD (X)=
$$\sqrt{\text{Var}(X)}$$

SD (X)=
$$\sqrt{98}$$
=9.9

Coefficient of variation = 
$$\frac{SD}{\bar{x}} \times 100$$

Coefficient of variation = 
$$\frac{9.9}{48} \times 100 = 20.6$$

# Let's Find for Value Y





х	d=(x-Mean)	d²
108	3	9
107	2	4
105	0	0
105	0	0
106	1	1
107	2	4
104	-1	1
103	-2	4
104	-1	1
101	-4	16
Total=1050		Total=40

Now, N=10

$$\overline{Y} = \frac{1}{n} \sum x_i$$

$$\overline{Y} = \frac{1}{10}[1050] = 105$$

$$Variance(Y) = \frac{\sum (x_i - \overline{X})^2}{N}$$

$$Variance(Y) = \frac{40}{10} = 4$$

SD (Y)=
$$\sqrt{\text{Var}(Y)}$$

SD (Y)=
$$\sqrt{4}$$
=2

Coefficient of variation =  $\frac{\text{SD}}{\overline{\overline{Y}}} \times 100$ 

The coefficient of variation =  $\frac{2}{105} \times 100 = 1.90$ 

# Hence, Cv for Y is smaller that Cv of X, So X is more stable that y.

# 11. Question

Life of bulbs produced by two factories A and B are given below:

Length of life (in hours):	550-650	650-750	750-850	850-950	950-1050
Factory A (No. of bulbs):	10	22	52	20	16
Factory B (No. of bulbs):	8	60	24	16	12

The bulbs of which factory are more consistent from the point of view of the length of life?

# **Answer**

# For Factory A

Length of line	Mid Value Xi	Fi	$u_i = \frac{x_i - 800}{100}$	F <sub>i</sub> u <sub>i</sub>	F <sub>i</sub> u <sub>i</sub> <sup>2</sup>
550-650	600	10	-2	-20	40
650-750	700	22	-1	-22	22
750-850	800	52	0	0	0
850-950	900	20	1	20	20
950-1050	1000	16	2	32	64
		$\sum_{i=120}^{\infty} f_i$		$\sum u_i f_i = 10$	$\sum u_i^2 f_i = 146$





Now, N=120, 
$$\sum u_i^2 f_i = 146$$

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 800 + 100 \left( \frac{10}{120} \right)$$

$$\overline{X} = 808.33$$

$$Var(X) = h^2 \left[ \frac{1}{N} \sum_{i=1}^n f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^n u_i f_i \right)^2 \right]$$

$$Var(X) = 10000 \left[ \left( \frac{1}{120} \times 146 \right) - \left( \frac{1}{120} \times 10 \right)^2 \right]$$

Variance = 12097

Standard Deviation  $\sigma = \sqrt{12097}$ 

$$SD = 109.98$$

Coefficients variation = 
$$\frac{109.98}{808.33} \times 100$$

# For Factory B

Length of line	Mid Value Xi	Fi	$= \frac{u_i}{100}$	F <sub>i</sub> u <sub>i</sub>	F <sub>i</sub> u <sub>i</sub> <sup>2</sup>
550-650	600	8	-2	-16	32
650-750	700	60	-1	-60	60
750-850	800	24	0	0	0
850-950	900	16	1	16	16
950-1050	1000	12	2	12	48
		$\sum_{i=120}^{\infty} f_i$		$\sum_{i=-48} u_i f_i$	$\sum u_i^2 f_i = 156$

Now, N=120, 
$$\sum u_i^2 f_i = 156$$

Mean 
$$\overline{X} = A + h \left( \frac{\sum u_i f_i}{N} \right)$$

$$\overline{X} = 800 + 100 \left( -\frac{48}{120} \right)$$

$$\bar{X} = 760$$

$$Var(X) = h^2 \left[ \frac{1}{N} \sum_{i=1}^n f_i u_i^2 - \left( \frac{1}{N} \sum_{i=1}^n u_i f_i \right)^2 \right]$$

$$Var(X) = 10000 \left[ \left( \frac{1}{120} \times 156 \right) - \left( \frac{1}{120} \times (-48) \right)^2 \right]$$

Variance = 11400

Standard Deviation  $\sigma = \sqrt{11400}$ 

$$SD = 106.77$$

Coefficients variation  $=\frac{110}{770} \times 100$ 







Since, the coefficient of variation of factory B is greater than the coefficient of variation of factory A,

Hence, This means bulbs of factory A are more consistent from the point of view of the length of life.

# 12. Question

Following are the marks obtained, out of 100, by two students Ravi and Hashina in 10 tests:

								48		
Hashina:	10	70	50	20	95	55	42	60	48	80

Who is more intelligent and who is more consistent?

### **Answer**

Given, Marks obtained by two students in 10 tests are given in Table.

To Find: Who is more intelligent and who is more consistent?

Explanation: Marks obtained by Ravi

Mean, 
$$\overline{X} = A + \frac{\sum d_i}{n}$$

$$\overline{X} = 45 + \frac{-9}{10} = 44.1$$

SD 
$$(\sigma) = \sqrt{\left(\frac{\sum d_i^2}{n} - \left(\frac{\sum d}{n}\right)^2\right)}$$

SD 
$$(\sigma) = \sqrt{\left(\frac{1699}{10} - \left(\frac{-9}{10}\right)^2\right)}$$

SD 
$$(\sigma) = \sqrt{169.09}$$

SD 
$$(\sigma) = 13.003$$

Coefficient of variation = 
$$\frac{SD}{Mean}$$

$$Cv = \frac{13.003}{44.1} \times 100 = 29.49$$

# For Hashima

Mean, 
$$\overline{X} = A + \frac{\sum d_i}{n}$$

$$\overline{X} = 55 + \frac{-20}{10} = 53$$

SD 
$$(\sigma) = \sqrt{\left(\frac{\sum d_i^2}{n} - \left(\frac{\sum d}{n}\right)^2\right)}$$

SD 
$$(\sigma) = \sqrt{\left(\frac{6368}{10} - \left(\frac{-20}{10}\right)^2\right)}$$

SD 
$$(\sigma) = \sqrt{632.8}$$

SD 
$$(\sigma) = 25.16$$

Coefficient of variation = 
$$\frac{SD}{Mean}$$

$$Cv = \frac{25.16}{53} \times 100 = 47.47$$





Since, The coefficient of variation in mark obtained by Hashima is greater than the coefficient of Variation in mark obtained by Ravi,

# Hence, Hasima is more consistent and intelligent

# **Very Short Answer**

### 1. Question

Write the variance of first n natural numbers.

#### Answer

Let the numbers be 1,2,3,...,n

Sum of First n natural numbers is  $\frac{n(n+1)}{2}$ 

$$\text{Mean } \overline{X} = \frac{\text{Sum of all observation}}{\text{Total number of observation}}$$

$$\Rightarrow \overline{X} = \frac{\frac{n(n+1)}{2}}{n} = \frac{n+1}{2}$$

$$\Rightarrow \sigma^2 = \frac{\sum (x_i - \overline{X})}{n}$$

$$\Rightarrow \sigma^2 = \frac{\sum \left(x_i - \frac{n+1}{2}\right)^2}{n}$$

$$\Rightarrow \sigma^2 = \frac{1}{n} \left[ \sum x_i^2 - x_1(n+1) + \left(\frac{n+1}{2}\right)^2 \right]$$

$$\Rightarrow \sigma^2 = \frac{n(n+1)(2n+1)}{6n} - \left[\frac{n(n+1)}{2}\right] \left(\frac{n+1}{n}\right) + \frac{(n+1)^2}{4n} \times n$$

$$\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6} - \left[\frac{n(n+1)}{2}\right] \left(\frac{n+1}{n}\right) + \frac{(n+1)^2}{4}$$

$$\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6} - \left[\frac{(n+1)^2}{2}\right] + \frac{(n+1)^2}{4}$$

$$\Rightarrow \sigma^2 = \frac{(n+1)(n-1)}{12}$$

Hence, 
$$\sigma^2 = \frac{(n+1)(n-1)}{12}$$

# 2. Question

If the sum of the squares of deviations for 10 observations taken from their mean is 2.5, then write the value of standard deviation.

# **Answer**

Given, The sum of the squares of derivations for 10 observation, and mean is 2.5.

To Find: Find the standard derivation

**Explanation:** Here, N=10 and mean = 2.5

The square of each division =  $\frac{2.5}{10}$  = 0.25

Standard deviation  $\sigma = \sqrt{0.25}$ 







# Hence, standard deviation is 0.5

# 3. Question

If  $x_1$ ,  $x_2$ , .....,  $x_n$  are n values of a variable X and  $y_1$ ,  $y_2$ , .....,  $y_n$  are n values of variable Y such that  $y_i = ax_i + b$ , i = 1, 2, ...., n, then write Var(Y) in terms of Var(X).

# **Answer**

$$Var(X) = \frac{\Sigma(x_i - \overline{X})^2}{n}$$

$$Var(Y) = \frac{\sum (y_i - \overline{Y})^2}{n}$$

And, 
$$y_i = ax_1 + b$$

$$\overline{y} = \frac{\sum y_i}{n}$$

$$\overline{y} = \frac{a\sum ax_i + nb}{n}$$

$$\overline{y} = a\overline{X} + b$$

$$Var(Y) = \frac{\sum (ax_i + b - a\overline{X} - b)^2}{n}$$

$$Var(Y) = \frac{\sum (ax_i - a\overline{X})^2}{n}$$

$$Var(Y) = a^2 \frac{\sum (x_i - \overline{X})^2}{n}$$

$$Var(Y) = a^2 Var(X)$$

# Hence, proved

# 4. Question

If X and Y are two variates connected by the relation  $Y=\frac{aX+b}{c}$  and  $Var(X)=\sigma^2$ , then write the expression for the standard deviation of Y.

### **Answer**

Given, 
$$Y = \frac{aX+b}{c}$$
,  $Var(X) = \sigma^2$ 

**To Find:** Write the expression for the standard deviation of Y.

**Explanation:** We have  $Y = \frac{aX+b}{c}$ 

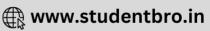
$$Mean (y) = \frac{\sum y_i}{n}$$

We can write as Mean (y) = 
$$\frac{\left(\frac{a\sum x + nb}{c}\right)}{c}$$

Mean (y) = 
$$\frac{a\sum \overline{X}}{nc} + \frac{nb}{nc}$$

$$Var(X) = \sum_{n=1}^{\infty} \frac{(x_i - \overline{X})^2}{n}$$





But,  $Var(X) = \sigma^2$ 

Then, 
$$Var(Y) = \sum \frac{(y_i - \overline{Y})^2}{n}$$

Now, Substitute the value of yiand Y, then we get

$$Var(Y) = \frac{\sum \left(\frac{aX}{c} + \frac{b}{c} - \frac{a}{c}\overline{X} - \frac{b}{c}\right)^2}{n}$$

$$Var(Y) = \frac{\sum \left(\frac{aX}{c} - \frac{a}{c}\overline{X}\right)^2}{n}$$

$$\text{Var}(\textbf{Y}) = \Big(\!\frac{\textbf{a}}{\textbf{c}}\!\Big)^2 \frac{\sum (\textbf{x}_i - \overline{\textbf{X}})^2}{n}$$

$$Var(Y) = \left(\frac{a}{c}\right)^2 \sigma^2$$

SD 
$$(\sigma) = \sqrt{\left(\frac{a}{c}\right)^2 \sigma^2}$$

$$(Y\sigma) = \left|\frac{a}{c}\right| \sigma$$

# Hence, Proved

# 5. Question

In a series of 20 observations, 10 observations are each equal t k, and each of the remaining halves is equal to -k. If the standard deviation of the observation is 2, then write the value of k.

# **Answer**

Given, n=20,  $d_i=x_i-a$ 

$$d_i = x_i - a$$

Where 
$$\mathbf{a} = \frac{\sum \mathbf{x_i}}{\mathbf{n}}$$

$$d_i = x_i - \frac{\sum x_i}{20}$$

$$\mathbf{d_i} = \mathbf{x_i} - \mathbf{0}$$

$$d_i = x_i$$

$$\sum d_i = \sum x_i = 0$$

$$\sum d_i^2 = \sum 20k^2$$

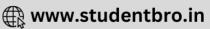
$$\sigma^2 = \frac{\sum d_i^2}{n} - \left(\frac{\sum d_i}{n}\right)^2$$

$$\sigma^2=\frac{20k^2}{20}-0$$

$$\sigma^2 = k^2\,$$

$$\sigma=2=\sqrt{k^2}$$





# 6. Question

If each observation of a raw data whose standard deviation is  $\sigma$  is multiplied by a, then write the S.D. of the new set of observations.

#### Answer

We know,

Standard deviation 
$$\sigma = \sqrt{\frac{\sum (x_i - \overline{X})^2}{n}}$$

And, mean 
$$\overline{X} = \frac{1}{n} \sum x_i$$

Now, multiply by a in  $x_i$ 

$$\overline{x_{new}} = \frac{1}{n} \sum ax_i$$

$$\overline{x_{new}} = a \times \frac{1}{n} \sum x_i$$

$$\overline{x_{\text{new}}} = a\overline{x_{\text{old}}}$$

New standard deviation, 
$$\sigma_{new} = \sqrt{\frac{\sum (ax_i - \overline{X})^2}{n}}$$

$$\sigma_{\rm new} = \sqrt{\frac{\sum (a^2 x_i - \overline{X})^2}{n}}$$

$$\sigma_{\rm new} = |a| \sqrt{\frac{\sum (x_i - \overline{X})^2}{n}}$$

$$\sigma_{new} = |a|\sigma_{old}$$

# Hence, Proved

### 7. Question

If a variable X takes values 0, 1, 2, ...., n with frequencies  ${}^{n}C_{0}$ ,  ${}^{n}C_{1}$ ,  ${}^{n}C_{2}$ , ..... ${}^{n}C_{n}$ , then write variance X.

# **Answer**

we know, mean 
$$x = \frac{\sum x_i f_i}{\sum f_i}$$

$$\overline{x} = \frac{\sum x_i f_i}{\sum f_i}$$

$$\overline{x} = \frac{0 \times {^n_0}C + 1 \times {^n_1}C + \dots + n \times {^n_n}C}{{^n_0}C + {^n_1}C + \dots {^n_n}C}$$

$$\overline{x} = \frac{n \times 2^{n-1}}{\frac{2^n}{n+1}}$$

Hence, 
$$\overline{x} = \frac{n(n+1)}{2}$$

# **MCQ**

# 1. Question





For a frequency distribution mean deviation from mean is computed by

A. M.D. = 
$$\frac{\sum f}{\sum f \mid d \mid}$$

$$\text{B. M.D.} = \frac{\sum d}{\sum f}$$

C. M.D. = 
$$\frac{\sum fd}{\sum f}$$

D. M.D. = 
$$\frac{\sum f \mid d \mid}{\sum f}$$

### **Answer**

The general formula of Mean is  $\overline{x} = \frac{\sum x_i f_i}{\sum f_i}$ 

For mean deviation, d = (x-mean)

$$M.\mathbf{D} = \frac{\sum fd}{\sum f}$$

### 2. Question

For a frequency distribution standard deviation is computed by applying the formula

$$A \cdot \sigma = \sqrt{\frac{\sum f d^2}{\sum f} - \left(\frac{\sum f d}{\sum f}\right)^2}$$

$$\textbf{B} \cdot \ \sigma = \sqrt{\left(\frac{\sum fd}{\sum f}\right)^2 - \frac{\sum fd^2}{\sum f}}$$

$$\text{C. } \sigma = \sqrt{\frac{\sum f \vec{d}^2}{\sum f} - \frac{\sum f \vec{d}}{\sum f}}$$

$$\text{D. } \sigma = \sqrt{\left(\frac{\sum fd}{\sum f}\right)^2 - \frac{\sum fd^2}{\sum f}}$$

### **Answer**

We know,

$$M.\mathbf{D} = \frac{\sum fd}{\sum f}$$

Variance = 
$$\left(\frac{\sum f d^2}{\sum f} - \left(\frac{\sum f d}{\sum f}\right)^2\right)$$

SD, 
$$\sigma = \sqrt{Variance}$$

Hence, 
$$\sigma = \sqrt{\left(\frac{\Sigma f d^2}{\Sigma f} - \left(\frac{\Sigma f d}{\Sigma f}\right)^2\right)}$$

# 3. Question



If v is the variance and  $\sigma$  is the standard deviation, then

A. 
$$v = \frac{1}{\sigma^2}$$

B. 
$$v = \frac{1}{\sigma}$$

C. 
$$v = \sigma^2$$

D. 
$$v^2 = \sigma$$

# **Answer**

If v is the variance and  $\sigma$  is the standard deviation, then

We know that the formula of standard variance is

$$\sigma = \sqrt{Variance}$$

So, variacne = 
$$\sigma^2$$

### 4. Question

The mean deviation from the median is

A. equal to that measured from another value

B. Maximum if all observation are positive

C. greater than that measured from any other value.

D. less than that measured from any other value.

# Answer

# equal to that measured from the another value

### 5. Question

If n = 10,  $\overline{X}$  =12 and  $\sum x_i^2$  =1530, then the coefficient of variation is

- A. 36%
- B. 41%
- C. 25%
- D. none of these

# **Answer**

Given, n=10,  $\overline{X} = 12$  and  $\sum x_i^2 = 1530$ 

We know, Variance =  $\left(\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2\right)$ 

Variance =  $\left(\frac{1530}{10} - (12)^2\right)$ 

Variance = (153-144)

 $\sigma = \sqrt{Variance}$ 

$$\sigma = \sqrt{9}$$

$$SD = 3$$



Coefficient of variance =  $\frac{SD}{Mean} \times 100$ 

Coefficient of variance =  $\frac{3}{12} \times 100$ 

Cv = 25

Hence, Cv = 15

### 6. Question

The standard deviation of the data:

x:	1	а	a <sup>2</sup>	 a <sup>n</sup>
f:	<sup>n</sup> C <sub>0</sub>	nC <sub>1</sub>	nC <sub>2</sub>	 <sup>n</sup> C <sub>n</sub>

ls

A. 
$$\left(\frac{1+a^2}{2}\right)^n - \left(\frac{1+a}{2}\right)^n$$

$$B. \left(\frac{1+a^2}{2}\right)^{2n} - \left(\frac{1+a}{2}\right)^n$$

$$C \cdot \left(\frac{1+a}{2}\right)^{2n} - \left(\frac{1+a^2}{2}\right)^n$$

D. none of these

### **Answer**

Let us calculate the mean first,

$$\mathsf{Mean} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\overline{x} = \frac{1 \times {^n_0C} + a \times {^n_1C} + \cdots + a^n \times {^n_nC}}{{^n_0C} + {^n_1C} + \dots {^n_nC}}$$

$$\overline{x} = n \left( \frac{1 + a^2}{2} \right)^{2n}$$

Standard deviation = 
$$\left(\frac{1+a^2}{2}\right)^{2n} - \left(\frac{1+a}{2}\right)^n$$

# 7. Question

The mean deviation of the series a, a+d, a+2d, ....., a+2n from its mean is

A. 
$$\frac{(n+1)d}{2n+1}$$

B. 
$$\frac{nd}{2n+1}$$

C. 
$$\frac{n(n+1)d}{2n+1}$$

D. 
$$\frac{(2n+1)d}{n(n+1)}$$



### **Answer**

Given, Series is a, a+d, a+2d,...,+a+2n

Mean (X) = 
$$\frac{a+a+d+a+2d+\cdots+a+2nd}{2n+1}$$

$$\overline{X} = \frac{a+a+d+a+2d+\cdots + a + 2nd}{2n+1}$$

$$\overline{X} = \frac{a(2n+1) + (d+2d+\cdots + 2nd)}{2n+1}$$

$$\overline{X} = \frac{a(2n+1) + d(1+2+3...+2n)}{2n+1}$$

$$\overline{X}=\frac{a(2n+1)+d\frac{2n(2n+1)}{2}}{2n+1}$$

$$\overline{X} = \frac{a(2n+1) + dn(2n+1)}{2n+1}$$

$$\overline{X} = \frac{(2n+1)(a+nd)}{2n+1}$$

$$\overline{X} = a + nd$$

Now, deviation from mean is  $x_i$ -X

$$M.D = \frac{nd+(n-1)d+(n-2)d+\dots+0+d+2d+\dots+(n-1)d+(n-2)d+nd}{2n+1}$$

$$\mathsf{M.D} = \frac{2d(1+2+3+\cdots(n-1)+(n-2)+n)}{2n+1}$$

$$\mathsf{M.D} = \frac{2\left(\frac{n(n+1)}{2}\right)d}{2n+1}$$

Hence, M.D = 
$$\frac{n(n+1)d}{2n+1}$$

### 8. Question

A batsman scores runs in 10 innings as 38, 70, 48, 34, 42, 55, 63, 46, 54 and 44. The mean deviation about mean is

- A. 8.6
- B. 6.4
- C. 10.6
- D. 7.6

#### **Answer**

Mean (X)=
$$\frac{38+70+48+34+42+55+63+46+54+44}{10}$$

$$(\overline{X}) = \frac{494}{10}$$

Xi	d=(x <sub>i</sub> -Mean)
38	-11.4
70	20.6
48	-1.4
34	-15.4
42	-7.4
55	5.6
63	13.6
46	-3.4
54	4.6
44	-5.4
	$\sum d_i = 0$

Here,  $N = 10 \sum d = 0$ 

Mean deviation =  $\left(\frac{\sum d_i}{N}\right)$ 

$$M.D = \left(\frac{0}{10}\right)$$

# Hence, MD is 0

# 9. Question

The mean deviation of the numbers 3, 4, 5, 6, 7 from the mean is

- A. 25
- B. 5
- C. 1.2
- D. 0

# **Answer**

The mean deviation of the numbers 3, 4, 5, 6, 7

$$\text{Mean } \overline{X} = \frac{3+4+5+6+7}{5}$$

$$\overline{X} = \frac{25}{5}$$

$$\overline{\mathbf{X}} = 5$$

Xi	(x <sub>i</sub> -mean)
3	-2
4	-1
5	0
6	1
7	2
$\sum x_i = 25$	$\sum d_i = 0$

$$\text{Mean deviation} = \frac{\sum d_i}{\sum x_i}$$

Mean deviation = 
$$\frac{0}{25}$$

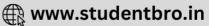
# Hence, Mean deviation is 0

# 10. Question

The sum of the squares deviations for 10 observations for 10 observations taken from their mean 50 is 250. The coefficient of variation is

A. 10%





B. 40%

C. 50%

D. none of these

#### **Answer**

Given, n=10 mean 250

SD, 
$$\sigma = \sqrt{\left(\frac{250}{10}\right)}$$

$$\sigma = \sqrt{25}$$

$$SD = 5$$

Now, Coefficient of variance =  $\frac{SD}{Mean} \times 100$ 

$$Cv = \frac{5}{50} \times 100$$

$$Cv = 50$$

# Hence, Coefficient of Variation is 10

### 11. Question

Let  $x_1, x_2, \ldots, x_n$  be values taken by a variable X and  $y_1, y_2, \ldots, y_n$  be the values taken by a variable Y such that  $y_i = ax_i + b$ ,  $i = 1,2, \ldots, n$ . Then,

A. 
$$Var(Y) = a^2 Var(X)$$

B. 
$$Var(X) = a^2 Var(Y)$$

C. 
$$Var(X) = Var(X) + b$$

D. none of these

# **Answer**

we have given,  $y_i = ax_i + b$ 

Mean (Y) = 
$$\frac{\sum f_i}{n}$$

$$\overline{Y} = \frac{a\sum x_n + bn}{n}$$

Mean (y) = 
$$\frac{a\sum \overline{X}}{n} + \frac{nb}{n}$$

Then, 
$$Var(Y) = \sum_{n} \frac{(y_i - \overline{Y})^2}{n}$$

And, 
$$Var(X) = \sum_{n=1}^{\infty} \frac{(x_i - \overline{X})^2}{n}$$

$$Var(Y) = \frac{\sum (aX + b - a\overline{X} - b)^2}{n}$$

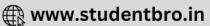
$$Var(Y) = \frac{\sum (a - a\overline{X})^2}{n}$$

$$Var(Y) = a^2 \frac{\sum (x_i - \overline{X})^2}{n}$$

$$Var(Y) = a^2 Var(X)$$







# Hence, $Var(Y) = a^2 Var(X)$

# 12. Question

If the standard deviation of a variable X is  $\sigma$ , then the standard deviation of the variable  $\frac{aX+b}{c}$  is

- A. a  $\sigma$
- B.  $\frac{a}{c}\sigma$
- C.  $\left| \frac{a}{c} \right| \sigma$
- D.  $\frac{a\sigma + b}{c}$

#### **Answer**

We have 
$$X = \frac{aX+b}{c}$$

Mean (X) = 
$$\frac{\sum y_i}{n}$$

We can write as: Mean (X) = 
$$\frac{\left(\frac{a\sum X + nb}{c}\right)}{n}$$

Mean (X) = 
$$\frac{a\sum \overline{X}}{nc} + \frac{nb}{nc}$$

$$Var(X) = \sum \frac{(x_i - \overline{X})^2}{n}$$

Now, Substitute the value of  $y_i$  and Y, then we get

$$Var(X) = \frac{\sum \left(\frac{aX}{c} + \frac{b}{c} - \frac{a}{c}\overline{X} - \frac{b}{c}\right)^{2}}{n}$$

$$Var(X) = \frac{\sum \left(\frac{aX}{c} - \frac{a}{c}\overline{X}\right)^2}{n}$$

$$\text{Var}(\textbf{X}) = \Big(\!\frac{\textbf{a}}{\textbf{c}}\!\Big)^2 \frac{\sum (\textbf{x}_i - \overline{\textbf{X}})^2}{\textbf{n}}$$

$$Var(X) = \left(\frac{a}{c}\right)^2 \sigma^2$$

SD 
$$(\sigma) = \sqrt{\left(\frac{a}{c}\right)^2 \sigma^2}$$

$$(X\sigma) = \left| \frac{a}{c} \right| \sigma$$

# Hence, Proved

# 13. Question

If the S.D. of a set of observations is 8 and if each observation is divided by -2, the S.D. of the new set of observations will be

A. -4





B. -8

C. 8

D. 4

#### **Answer**

Let take two observation 16 and 32

Now,

Xi	X <sub>i</sub> <sup>2</sup>
16	256
32	1024
$\sum x_i = 48$	$\sum x_i^2 = 1280$

$$Variance = \left(\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2\right)$$

$$\sigma = \sqrt{\left(\frac{1280}{2} - \left(\frac{48}{2}\right)^2\right)}$$

$$\sigma = \sqrt{640 - 576}$$

$$\sigma = \sqrt{64}$$

$$SD = 8$$

Now, If we divide each observation then SD is

Xi	X <sub>i</sub> <sup>2</sup>
8	64
16	256
$\sum x_i = 24$	$\sum x_i^2 = 320$

Variance = 
$$\left(\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2\right)$$

$$\sigma = \sqrt{\left(\frac{320}{2}\right) - \left(\frac{24}{2}\right)^2}$$

$$\sigma = \sqrt{160 - 144}$$

$$\sigma = \sqrt{16}$$

$$SD = 4$$

Hence, SD will also be half.

# 14. Question

If two variates X and Y are connected by the relation  $Y = \frac{aX + b}{c}$ , where a, b, c are constants such that ac < o, then

A. 
$$\sigma Y = \frac{a}{c} \sigma X$$



B. 
$$\sigma Y = -\frac{a}{c} \sigma X$$

C. 
$$\sigma Y = \frac{a}{c} \sigma X + b$$

D. none of these

**Answer** 

Given, 
$$Y = \frac{aX+b}{c}$$

**To Find:** Write the expression for the standard deviation of Y.

**Explanation:** We have  $Y = \frac{aX+b}{c}$ 

Mean (y) = 
$$\frac{\sum y_i}{n}$$

We can write as: Mean (y) = 
$$\frac{\left(\frac{a\sum x + nb}{c}\right)}{n}$$

Mean (y) = 
$$\frac{a\sum \overline{X}}{nc} + \frac{nb}{nc}$$

$$Var(X) = \sum \frac{(x_i - \overline{X})^2}{n}$$

Then, 
$$Var(Y) = \sum_{n=1}^{\infty} \frac{(y_i - \overline{Y})^2}{n}$$

Now, Substitute the value of yiand Y, then we get

$$Var(Y) = \frac{\sum \left(\frac{aX}{c} + \frac{b}{c} - \frac{a}{c}\overline{X} - \frac{b}{c}\right)^2}{n}$$

$$Var(Y) = \frac{\sum \left(\frac{aX}{c} - \frac{a}{c}\overline{X}\right)^2}{n}$$

$$\text{Var}(\textbf{Y}) = \Big(\!\frac{\textbf{a}}{\textbf{c}}\!\Big)^2 \frac{\sum (\textbf{x}_i - \overline{\textbf{X}})^2}{n}$$

$$Var(Y) = \left(\frac{a}{c}\right)^2 \sigma^2$$

SD 
$$(\sigma) = \sqrt{\left(\frac{a}{c}\right)^2 \sigma^2}$$

$$(Y\sigma) = \left| \frac{a}{c} \right| \sigma$$

### 15. Question

If for a sample of size 60, we have the following information  $\sum x_i^2 = 18000$  and  $\sum x_i = 960$ , then the variance is

- A. 6.63
- B. 16
- C. 22
- D. 44



Answer

Given, N=60, $\sum x_i = 55$ ,  $\sum x_i^2 = 385$ 

$$Variance = \left(\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2\right)$$

Variance = 
$$\left(\frac{18000}{60} - \left(\frac{960}{60}\right)^2\right)$$

Variance = (300 - 256)

Variance = 44

Hence, variance = 44

# 16. Question

Let a, b, c, d, e be the observations with mean m and standard deviation s. The standard deviation of the observations a + k, b + k, c + k, d + k, e + k is

- A. s
- B. ks

C.s + k

D. 
$$\frac{s}{k}$$

#### **Answer**

Let a, b, c,d,e be the observation and mean is m

$$m = \frac{a+b+c+d+e}{5}$$

Let suppose new mean be  $m_1$ 

$$m_{\textbf{1}} = \frac{a+k+b+k+c+k+d+k+e+k}{5}$$

$$m_1 = \frac{5k}{5} + \frac{a+b+c+d+e}{5}$$

$$M_1 = m + k$$

Now, The standard deviation

$$S = \sqrt{\frac{(a-m)^2 + (b-m)^2 + (c-m)^2 + (e-m)^2}{5}}$$

So, The standard deviation for new observation

$$s_1 = \sqrt{\frac{(a+k-n)^2 + (b+k-n)^2 + (c+k-n)^2 + (e+k-n)^2 + (d+k-n)^2}{5}}$$

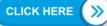
Now, we can compare both observation

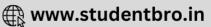
$$a+k-n=a+k-(m+k)$$

$$a+k-n = a+k-m-k$$

$$a+k-n=a-m$$







Similary

b+k-n=b-m

c+k-n=c-m

d+k-n=d-m

e+k-n=e-m

when we substitute the values, we get,

 $S_1 = S$ 

# Hence, The Sd is S

# 17. Question

The standard deviation of first 10 natural numbers is

A. 5.5

B. 3.87

C. 2.97

D. 2.87

### **Answer**

First 10 natural numbers are 1,2,3,4,5,6,7,8,9,10

So, 
$$N = 10$$

Xi	Xi <sup>2</sup>
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100
$\sum x_i = 55$	$\sum x_i^2 = 385$

$$Variance = \left(\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2\right)$$

$$\sigma = \sqrt{\left(\frac{385}{10} - \left(\frac{55}{10}\right)^2\right)}$$

$$\sigma = \sqrt{38.5 - 30.25}$$

$$\sigma = \sqrt{8.25}$$

# Hence, SD is 2.87

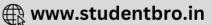
# 18. Question

Consider the first 10 positive integers. If we multiply each numbers by -1 and then add 1 to each number, the variance of the numbers so obtained is

A. 8.25

B. 6.5





C. 3.87

D. 2.87

### **Answer**

Consider 10 positive integer

Let Assume, 1,2,3,4,5,6,7,8,9,10

Now, If we multiply by -1 in each number we get,

And then we add 1 in each number

Now,

$\mathbf{X}_{i}$	X <sub>i</sub> <sup>2</sup>
0	0
-1	1
-2	4
-3	9
-4	16
-5	25
-6	36
-7	49
-8	64
-9	81
$\sum x_i = -45$	$\sum x_i^2 = 285$

Standard deviation Variance  $= \left(\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2\right)$ 

$$Var = \left(\frac{285}{10} - \left(\frac{-45}{10}\right)^2\right)$$

$$Var = (28.5 - 20.25)$$

Var = 8.25

# Hence, variance is 8.25

# 19. Question

Consider the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. It is added to each number, the variance of the numbers so obtained is

A. 6.5

B. 2.87

C. 3.87

D. 8.25

# **Answer**

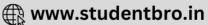
Consider numbers are 1,2,3,4,5,6,7,8,9,10

If one is added to each number then, numbers will be

Let say  $x_i = 2,3,4,5,6,7,8,9,10,11$ 

So, N= 10





Xi	Xi²
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100
11	121
$\sum x_i = 65$	$\sum x_i^2 = 505$

Standard deviation Variance = 
$$\left(\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2\right)$$

$$Var = \left(\frac{505}{10} - \left(\frac{65}{10}\right)^2\right)$$

$$Var = 8.25$$

# Hence, the variance is 8.25

# 20. Question

The mean of 100 observations is 50, and their standard deviations is 5. The sum of all squares of all the observations is

- A. 50,000
- B. 250,000
- C. 252500
- D. 255000

### **Answer**

Given, 
$$\bar{x}=50$$
,  $n=100$  and  $\sigma=5$ 

$$\sigma = \frac{\sum x_i}{N}$$

$$\sum x_i = 50 \times 100$$

$$\sum x_i = 5000$$

Now, 
$$\sigma^2 = \frac{\sum x_i^2}{N} - (\overline{x})^2$$

$$25 = \frac{\sum x_i^2}{100} - (50)^2$$

$$\sum x_i^2 = 252500$$

# 21. Question

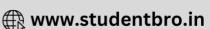
Let  $x_1, x_2, \ldots, x_n$ , be n observations. Let  $y_i = ax_i + b$  for  $I = 1, 2, \ldots, n$ , where a and b are constant. If the mean of  $x_i^{'s}$  is 48 and their standard deviation is 12, the mean of  $y_i^{'s}$  is 55 and standard deviation of  $y_i^{'s}$  is 15, the values of a and b are

A. 
$$a = 1.25$$
,  $b = -5$ 

B. 
$$a = -1.25$$
,  $b = 5$ 







C. 
$$a = 2.5$$
,  $b = -5$ 

D. 
$$a = 2.5, b = 5$$

# **Answer**

Mean(y) = a.mean(x) + b

Therefore,

$$55 = a.48 + b$$

We can see that only first option satisfies this equation. Therefore, a is the correct answer.

# 22. Question

The mean deviation of the data 3, 10, 10, 4, 7, 10, 5 from the mean is

- A. 2
- B. 2.57
- C. 3
- D. 3.57

# **Answer**

**Explanation:** Mean 
$$\overline{X} = \frac{3+10+10+4+7+10+5}{7}$$

$$\overline{X} = \frac{49}{7}$$

$$\overline{\mathbf{X}} = \mathbf{7}$$

X <sub>i</sub>	$D_i =  x_i - x $
3	4
10	3
10	3
4	3
7	0
10	3
5	2
Total	18

Mean Deviation = 
$$\frac{\sum d_i}{N}$$

Mean Deviation = 
$$\frac{18}{7}$$

# Hence, The MD is 2.57

# 23. Question

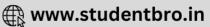
The mean deviation for n observations  $x_1,\,x_2,\,....,\,x_n$  from their mean  $\overline{\chi}$  is given by

A. 
$$\sum_{i=1}^{n} (x_i - \overline{X})$$

$$\text{B. } \frac{1}{n} \underset{i=1}{\overset{n}{\sum}} (x_i - \overline{X})$$

$$\mathsf{C.}\ \sum_{i=1}^n \left( x_i - \overline{X} \right)^2$$





D. 
$$\frac{1}{n} \sum_{i=1}^{n} (x_i - \overline{X})^2$$

#### **Answer**

Let  $x_1, x_2, ... x_n$  be n observation

And X is the aithemetic mean then,

We know, Standard deviation  $\sigma = \sqrt{\left(\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2\right)}$ 

So, 
$$\sigma = \frac{1}{n} \sqrt{(\sum x_i^2 - \overline{X})^2}$$

# 24. Question

Let  $x_1, x_2, \ldots, x_n$  be n observations and  $\overline{X}$  be their arithmetic mean. The standard deviation is given by

A. 
$$\sum_{i=1}^{n} (x_i - \overline{X})^2$$

B. 
$$\frac{1}{n} \sum_{i=1}^{n} (x_i - \overline{X})^2$$

$$\mathsf{C.}\ \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(x_{i}-\overline{X}\right)^{2}}$$

D. 
$$\sqrt{\frac{1}{n}\sum_{i=1}^n x_i^2 - \overline{X}^2}$$

### **Answer**

Let  $x_1, x_2, ... x_n$  be n observation

And X is the arithmetic mean then,

We know, Standard deviation  $\sigma = \sqrt{\left(\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2\right)}$ 

So, 
$$\sigma = \frac{1}{n} \sqrt{(\sum x_i^2 - \overline{X})^2}$$

# 25. Question

The standard deviation of the observations 6, 5, 9, 13, 12, 8, 10 is

- A. 6
- B.  $\sqrt{6}$
- c.  $\frac{52}{7}$
- D.  $\sqrt{\frac{52}{7}}$

# **Answer**

The standard deviation of the observations 6, 5, 9, 13, 12, 8, 10 is



X <sub>i</sub>	X <sub>i</sub> <sup>2</sup>
6	36
5	25
9	81
13	169
12	144
8	64
10	100
$\sum x_i = 63$	$\sum x_i = 619$

And, N=7

Standard deviation 
$$\sigma = \sqrt{\left(\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2\right)}$$

$$\sigma = \sqrt{\left(\frac{619}{7} - \left(\frac{63}{7}\right)^2\right)}$$

$$\sigma = \sqrt{\left(\frac{7\times619\times3969}{49}\right)}$$

$$\sigma = \sqrt{\frac{396}{49}}$$

$$\sigma = \sqrt{\frac{52}{7}}$$

