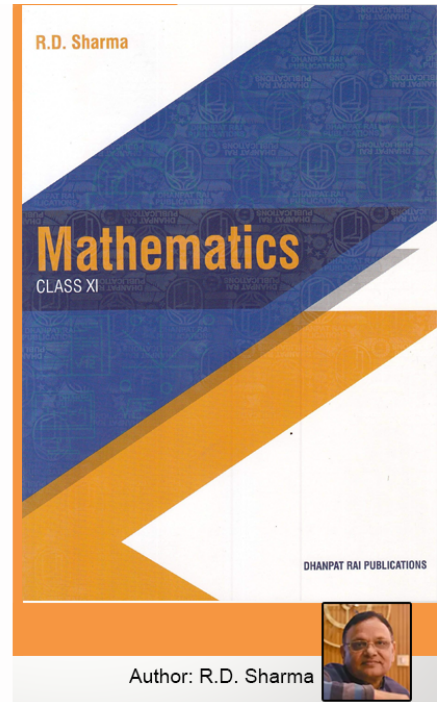


Class 11 - Chapter 32 Statistics



RD Sharma Solutions for Class 11 Maths Chapter 32–Statistics

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RD Sharma Solutions for Class 11 Maths Chapter 32–Statistics

RD Sharma 11th Maths Chapter 32, Class 11 Maths Chapter 32 solutions

EXERCISE 32.1 PAGE NO: 32.6

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

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(i) 3011, 2780, 3020, 2354, 3541, 4150, 5000

(ii) 38, 70, 48, 34, 42, 55, 63, 46, 54, 44

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

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

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

Solution:

(i) 3011, 2780, 3020, 2354, 3541, 4150, 5000

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

Median is the middle number of all the observation.

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

So, Median = 3020 and $n = 7$

By using the formula to calculate Mean Deviation, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

$$|d_i| = |x_i - 3020|$$

3011	9
2780	240
3020	0
2354	666
3541	521
4150	1130
5000	1980
Total	4546

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

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$$= 1/7 \times 4546$$

$$= 649.42$$

∴ The Mean Deviation is 649.42.

(ii) 38, 70, 48, 34, 42, 55, 63, 46, 54, 44

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

Median is the middle number of all the observation.

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

Here the Number of observations are Even then Median = $(46+48)/2 = 47$

Median = 47 and $n = 10$

By using the formula to calculate Mean Deviation, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

$$x_i \quad |d_i| = |x_i - 47|$$

38	9
70	23
48	1
34	13
42	5
55	8
63	16
46	1
54	7
44	3
Total	86

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

$$= \frac{1}{10} \times 86$$

$$= 8.6$$

∴ The Mean Deviation is 8.6.

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

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

Median is the middle number of all the observation.

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

Here the Number of observations are Even then Median = $(42+44)/2 = 43$

Median = 43 and n = 10

By using the formula to calculate Mean Deviation, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

$$|d_i| = |x_i - 43|$$

x_i

30 13

34 9

38 5

40 3

42 1

44 1

50 7

51 8

60 17

66 23

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Total 87

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

$$= \frac{1}{10} \times 87$$

$$= 8.7$$

∴ The Mean Deviation is 8.7.

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

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

Median is the middle number of all the observation.

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

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

Median = 28.5 and n = 10

By using the formula to calculate Mean Deviation, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

$$|d_i| = |x_i - 28.5|$$

x_i

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

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42	13.5
----	------

Total	47
-------	----

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

$$= \frac{1}{10} \times 47$$

$$= 4.7$$

∴ The Mean Deviation is 4.7.

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

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

Median is the middle number of all the observation.

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

Here the Number of observations are Even then Median = $(47+48)/2 = 47.5$

Median = 47.5 and n = 10

By using the formula to calculate Mean Deviation, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

x_i	$ d_i = x_i - 47.5 $
-------	------------------------

38	9.5
----	-----

70	22.5
----	------

48	0.5
----	-----

34	13.5
----	------

63	15.5
----	------

42	5.5
----	-----

55	7.5
----	-----

44	3.5
----	-----

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53 5.5

47 0.5

Total 84

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

$$= \frac{1}{10} \times 84$$

$$= 8.4$$

∴ The Mean Deviation is 8.4.

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

(i) 4, 7, 8, 9, 10, 12, 13, 17

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

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

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

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

Solution:

(i) 4, 7, 8, 9, 10, 12, 13, 17

$$\text{We know that, } MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$\text{Where, } |d_i| = |x_i - x|$$

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

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

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

$$= 10$$

Number of observations, 'n' = 8

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$$x_i \quad |d_i| = |x_i - 10|$$

4	6
7	3
8	2
9	1
10	0
12	2
13	3
17	7
Total	24

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

$$= \frac{1}{8} \times 24$$

$$= 3$$

∴ The Mean Deviation is 3.

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

$$\text{We know that, } MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$\text{Where, } |d_i| = |x_i - x|$$

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

$$x = \frac{13 + 17 + 16 + 14 + 11 + 13 + 10 + 16 + 11 + 18 + 12 + 17}{12}$$

$$= \frac{168}{12}$$

$$= 14$$

Number of observations, 'n' = 12

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$$x_i \quad |d_i| = |x_i - 14|$$

13	1
17	3
16	2
14	0
11	3
13	1
10	4
16	2
11	3
18	4
12	2
17	3
Total	28

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

$$= \frac{1}{12} \times 28$$

$$= 2.33$$

∴ The Mean Deviation is 2.33.

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

We know that, $MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

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

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

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

$$= 500/10$$

$$= 50$$

Number of observations, 'n' = 10

$$|d_i| = |x_i - 50|$$

x_i

38 12

70 20

48 2

40 10

42 8

55 5

63 13

46 4

54 4

44 6

Total 84

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

$$= \frac{1}{10} \times 84$$

$$= 8.4$$

∴ The Mean Deviation is 8.4.

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

We know that, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

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

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

$$x = [36 + 72 + 46 + 42 + 60 + 45 + 53 + 46 + 51 + 49]/10$$

$$= 500/10$$

$$= 50$$

Number of observations, 'n' = 10

$$|d_i| = |x_i - 50|$$

x_i

36 14

72 22

46 4

42 8

60 10

45 5

53 3

46 4

51 1

49 1

Total 72

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

$$= \frac{1}{10} \times 72$$

$$= 7.2$$

∴ The Mean Deviation is 7.2.

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

We know that, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

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

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

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

$$= 550/10$$

$$= 55$$

Number of observations, 'n' = 10

$$|d_i| = |x_i - 55|$$

x_i

57 2

64 9

43 12

67 12

49 6

59 4

44 11

47 8

61 6

59 4

Total 74

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

$$= 1/10 \times 74$$

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$$= 7.4$$

∴ The Mean Deviation is 7.4.

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

IIncome in ₹	IIIncome in ₹
4000	3800
4200	4000
4400	4200
4600	4400
4800	4600
	4800
	5800

Solution:

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

Since the data is arranged in ascending order,

4000, 4200, 4400, 4600, 4800

Median = 4400

Total observations = 5

We know that, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

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

$$|d_i| = |x_i - 4400|$$

x_i

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4000	400
4200	200
4400	0
4600	200
4800	400
Total	1200

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

$$= \frac{1}{5} \times 1200$$

$$= 240$$

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

Since the data is arranged in ascending order,

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

Median = 4400

Total observations = 7

We know that, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

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

$$|d_i| = |x_i - 4400|$$

x_i

3800	600
4000	400
4200	200
4400	0
4600	200

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4800 400

5800 1400

Total 3200

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

$$= \frac{1}{7} \times 3200$$

$$= 457.14$$

∴ The Mean Deviation of set 1 is 240 and set 2 is 457.14

4. The lengths (in cm) of 10 rods in a shop are given below:

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

(i) Find the mean deviation from the median.

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

Solution:

(i) Find the mean deviation from the median

Let us arrange the data in ascending order,

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

We know that, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

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

The number of observations are Even then Median = $(40+52.3)/2 = 46.15$

Median = 46.15

Number of observations, 'n' = 10

$$|d_i| = |x_i - 46.15|$$

x_i

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40.0	6.15
52.3	6.15
55.2	9.05
72.9	26.75
52.8	6.65
79.0	32.85
32.5	13.65
15.2	30.95
27.9	19.25
30.2	15.95
Total	167.4

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

$$= \frac{1}{10} \times 167.4$$

$$= 16.74$$

∴ The Mean Deviation is 16.74.

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

$$\text{We know that, } MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$\text{Where, } |d_i| = |x_i - x|$$

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

$$x = \frac{[40.0 + 52.3 + 55.2 + 72.9 + 52.8 + 79.0 + 32.5 + 15.2 + 27.9 + 30.2]}{10}$$

$$= 458/10$$

$$= 45.8$$

Number of observations, 'n' = 10

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$$|d_i| = |x_i - 45.8|$$

x_i	
40.0	5.8
52.3	6.5
55.2	9.4
72.9	27.1
52.8	7
79.0	33.2
32.5	13.3
15.2	30.6
27.9	17.9
30.2	15.6
Total	166.4

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

$$= \frac{1}{10} \times 166.4$$

$$= 16.64$$

∴ The Mean Deviation is 16.64

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

Solution:

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

We know that, $MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

Where, $|d_i| = |x_i - \bar{x}|$

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

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

$$= 455/10$$

$$= 45.5$$

Number of observations, 'n' = 10

$$|d_i| = |x_i - 45.5|$$

x_i

$$34 \quad 11.5$$

$$66 \quad 20.5$$

$$30 \quad 15.5$$

$$38 \quad 7.5$$

$$44 \quad 1.5$$

$$50 \quad 4.5$$

$$40 \quad 5.5$$

$$60 \quad 14.5$$

$$42 \quad 3.5$$

$$51 \quad 5.5$$

$$\text{Total} \quad 90$$

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

$$= 1/10 \times 90$$

$$= 9$$

$$\text{Now } \overline{X - M.D} = \overline{X - M.D} - M.D = 45.5 - 9 = 36.5 \quad \overline{X + M.D} = \overline{X + M.D} + M.D = 45.5 + 9 = 54.5$$

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

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

We know that, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

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

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

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

$$= 299/10$$

$$= 29.9$$

Number of observations, 'n' = 10

$$|d_i| = |x_i - 29.9|$$

x_i

22 7.9

24 5.9

30 0.1

27 2.9

29 0.9

31 1.1

25 4.9

28 1.9

41 11.1

42 12.1

Total 48.8

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

$$= 1/10 \times 48.8$$

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$$= 4.88$$

Now

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

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

So, There are total 5 observation between

and

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

We know that, $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$ $MD = \frac{1}{n} \sum_{i=1}^n |d_i|$

Where, $|d_i| = |x_i - \bar{x}|$

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

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

$$= 494/10$$

$$= 49.4$$

Number of observations, 'n' = 10

$$|d_i| = |x_i - 49.4|$$

x_i

38 11.4

70 20.6

48 1.4

34 15.4

63 13.6

42 7.4

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55	5.6
44	5.4
53	3.6
47	2.4
Total	86.8

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

$$= \frac{1}{10} \times 86.8$$

$$= 8.68$$

Now

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

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

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

EXERCISE 32.2 PAGE NO: 32.11

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

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

Solution:

To find the mean deviation from the median, firstly let us calculate the median.

We know, Median is the Middle term,

So, Median = 61

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Let x_i = Heights in inches

nd, f_i = Number of students

x_i	f_i	Cumulative Frequency	$ d_i = x_i - M = x_i - 61 $	$f_i d_i $
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

$$N=197 \text{ MD} = \frac{1}{n} \sum_{i=1}^n |d_i| \text{ MD} = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$= \frac{1}{197} \times 336$$

$$= 1.70$$

∴ The mean deviation is 1.70.

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

	0	1	2	3	4	5	6	7
Number of calls								

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Frequency 14 21 25 43 51 40 39 12

Compute the mean deviation about the median.

Solution:

To find the mean deviation from the median, firstly let us calculate the median.

We know, Median is the even term, $(3+5)/2 = 4$

So, Median = 8

Let x_i = Number of calls

And, f_i = Frequency

x_i	f_i	Cumulative Frequency	$ d_i = x_i - M = x_i - 61 $	$f_i d_i $
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

$$N = 245 \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$= \frac{1}{245} \times 366$$

$$= 1.49$$

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∴ The mean deviation is 1.49.

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

x_i	5	7	9	11	13	15	17
f_i	2	4	6	8	10	12	8

Solution:

To find the mean deviation from the median, firstly let us calculate the median.

We know, $N = 50$

Median = $(50)/2 = 25$

So, the median Corresponding to 25 is 13

x_i	f_i	Cumulative Frequency	$ d_i = x_i - M = x_i - 13 $	$f_i d_i $
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

$$N = 50 \quad MD = \frac{1}{N} \sum_{i=1}^n f_i |d_i| \quad MD = \frac{1}{50} \sum_{i=1}^n f_i |d_i|$$

$$= \frac{1}{50} \times 136$$

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$$= 2.72$$

∴ The mean deviation is 2.72.

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

(i)

x_i 5 7 9 10 12 15

f_i 8 6 2 2 2 6

Solution:

To find the mean deviation from the mean, firstly let us calculate the mean.

By using the formula,

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

x_i	f_i	Cumulative Frequency ($\sum f_i$)	$ d_i = x_i - \text{Mean} $	$f_i d_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

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

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$$= 234/26$$

$$= 9$$

$$\text{Mean deviation} = \frac{\sum f_i |d_i|}{f_i}$$

$$= 88/26$$

$$= 3.3$$

∴ The mean deviation is 3.3

(ii)

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

Solution:

To find the mean deviation from the mean, firstly let us calculate the mean.

By using the formula,

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

x_i	f_i	Cumulative Frequency ($\sum f_i$)	$ d_i = x_i - \text{Mean} $	$f_i d_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

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Total = 25 Total = 350

Total = 158

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

$$= 350/25$$

$$= 14$$

$$\text{Mean deviation} = \frac{\sum f_i |d_i|}{f_i}$$

$$= 158/25$$

$$= 6.32$$

∴ The mean deviation is 6.32

(iii)

x_i 10 30 50 70 90

f_i 4 24 28 16 8

Solution:

To find the mean deviation from the mean, firstly let us calculate the mean.

By using the formula,

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

x_i f_i Cumulative Frequency ($x_i f_i$) $|d_i| = |x_i - \text{Mean}|$ $f_i |d_i|$

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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

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

$$= 4000/80$$

$$= 50$$

$$\text{Mean deviation} = \frac{\sum f_i |d_i|}{f_i}$$

$$= 1280/80$$

$$= 16$$

∴ The mean deviation is 16

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

(i)

x_i 15 21 27 30

f_i 3 5 6 7

Solution:

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To find the mean deviation from the median, firstly let us calculate the median.

We know, $N = 21$

Median = $(21)/2 = 10.5$

So, the median Corresponding to 10.5 is 27

x_i	f_i	Cumulative Frequency	$ d_i = x_i - M $	$f_i d_i $
15	3	3	15	45
21	5	8	9	45
27	6	14	3	18
30	7	21	0	0
Total = 21		Total = 46		Total = 108

$$N = 21 \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$= \frac{1}{21} \times 108$$

$$= 5.14$$

$\therefore$ The mean deviation is 5.14

(ii)

x_i	74	89	42	54	91	94	35
f_i	20	12	2	4	5	3	4

Solution:

To find the mean deviation from the median, firstly let us calculate the median.

We know, $N = 50$

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$$\text{Median} = (50)/2 = 25$$

So, the median Corresponding to 25 is 74

x_i	f_i	Cumulative Frequency	$ d_i = x_i - M $	$f_i d_i $
74	20	4	39	156
89	12	6	32	64
42	2	10	20	80
54	4	30	0	0
91	5	42	15	180
94	3	47	17	85
35	4	50	20	60
Total = 50		Total = 189		Total = 625

$$N = 50 \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$= \frac{1}{50} \times 625$$

$$= 12.5$$

$\therefore$ The mean deviation is 12.5

(iii)

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

Solution:

To find the mean deviation from the median, firstly let us calculate the median.

We know, $N = 20$

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$$\text{Median} = (20)/2 = 10$$

So, the median Corresponding to 10 is 12

x_i	f_i	Cumulative Frequency	$ d_i = x_i - M $	$f_i d_i $
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	

$$N = 20 \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$= \frac{1}{20} \times 25$$

$$= 1.25$$

∴ The mean deviation is 1.25

EXERCISE 32.3 PAGE NO: 32.16

1. 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

Solution:

To find the mean deviation from the median, firstly let us calculate the median.

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Median is the middle term of the X_i ,

Here, the middle term is 25

So, Median = 25

Class Interval	x_i	f_i	Cumulative Frequency	$ d_i = x_i - M $	$f_i d_i $
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

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

$$= \frac{1}{50} \times 450$$

$$= 9$$

$\therefore$ The mean deviation is 9

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

(i)

Classes	0-10	100-20	200-30	300-40	400-50	500-60	600-70	700-80
	0	0	0	0	0	0	0	0
Frequencies	4	8	9	10	7	5	4	3

Solution:

To find the mean deviation from the mean, firstly let us calculate the mean.

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By using the formula,

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

$$= 17900/50$$

$$= 358$$

Class Interval	x_i	f_i	Cumulative Frequency	$ d_i = x_i - M $	$f_i d_i $
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

$$N = 50 \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$= 1/50 \times 7896$$

$$= 157.92$$

∴ The mean deviation is 157.92

(ii)

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

Solution:

To find the mean deviation from the mean, firstly let us calculate the mean.

By using the formula,

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

$$= 13630/106$$

$$= 128.58$$

Class Interval	x_i	f_i	Cumulative Frequency	$ d_i = x_i - M $	$f_i d_i $
95-105	100	9	900	28.58	257.22
105-115	110	13	1430	18.58	241.54
115-125	120	16	1920	8.58	137.28
125-135	130	26	3380	1.42	36.92
135-145	140	30	4200	11.42	342.6
145-155	150	12	1800	21.42	257.04
N = 106			Total = 13630		Total = 1272.6

$$N = 106 \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$= \frac{1}{106} \times 1272.6$$

$$= 12.005$$

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∴ The mean deviation is 12.005

3. 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

Solution:

To find the mean deviation from the mean, firstly let us calculate the mean.

By using the formula,

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

$$= 5390/110$$

$$= 49$$

Class Interval	x_i	f_i	Cumulative Frequency	$ d_i = x_i - M $	$f_i d_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

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$$N = 110 \quad \text{Total} = 5390$$

$$\text{Total} = 1644$$

$$N = 110 \quad MD = \frac{1}{N} \sum_{i=1}^n n_i |d_i| \quad MD = \frac{1}{N} \sum_{i=1}^n n_i |d_i|$$

$$= \frac{1}{110} \times 1644$$

$$= 14.94$$

∴ The mean deviation is 14.94

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

Age (on nearest birthday)	17-19.	20-25.	26-35.	36-40.	41-50.	51-55.	56-60.	61-70.
	5	5	5	5	5	5	5	5
No. of persons	5	16	12	26	14	12	6	5

Calculate the mean deviation from the median age.

Solution:

To find the mean deviation from the median, firstly let us calculate the median.

$$N = 96$$

$$\text{So, } N/2 = 96/2 = 48$$

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

$$\text{So, Median} = 38.25$$

Class Interval	x_i	f_i	Cumulative Frequency	$ d_i = x_i - M $	$f_i d_i $
17-19.5	18.25	5	5	20	100
20-25.5	22.75	16	21	15.5	248
36-35.5	30.75	12	33	7.5	90

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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	

$$N = 96 \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i| \quad MD = \frac{1}{n} \sum_{i=1}^n |d_i|$$

$$= \frac{1}{96} \times 980.5$$

$$= 10.21$$

∴ The mean deviation is 10.21

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

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

Solution:

To find the mean deviation from the median, firstly let us calculate the median.

$$N = 50$$

$$\text{So, } N/2 = 50/2 = 25$$

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

$$\text{So, Median} = 28$$

By using the formula to calculate Mean,

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

$$= 1350/50$$

$$= 27$$

Class Interval	x_i	f_i	Cumulative Frequency	$ d_i = x_i - \text{Median} $	$f_i d_i $	$F_i X_i$	$ X_i - \text{Mean} $	$F_i X_i - \text{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
		N = 50			Total = 478	Total = 1350		Total = 472

Mean deviation from Median = $478/50 = 9.56$

And, Mean deviation from Median = $472/50 = 9.44$

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

EXERCISE 32.4 PAGE NO: 32.28

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

(i) 2, 4, 5, 6, 8, 17

Let Mean be,

$$\bar{X} = \frac{2+4+5+6+8+17}{6}$$

$$\bar{X} = \frac{42}{6} = 7$$

X_i	$(x_i - \bar{X}) = (x_i - 7)$	$(x_i - 7)^2$
2	-3	25
4	-3	9
5	-2	4
6	-1	1
8	1	1
17	10	100
		$\sum_{i=1}^6 (x_i - \bar{X})^2 = 140$

$$N = 6$$

$$\begin{aligned} \text{Variance (X)} &= \frac{1}{n} \sum_{i=1}^6 (x_i - \bar{X})^2 \\ &= 140/6 \\ &= 23.33 \end{aligned}$$

$$\text{Variance} = 23.33$$

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

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

$$\text{Standard deviation} = 4.83$$

(ii) 6, 7, 10, 12, 13, 4, 8, 12

X_i	$(x_i - \bar{X}) = (x_i - 7)$	$(x_i - 7)^2$
6	-3	9
7	-2	4
10	1	1
12	3	9
13	4	16
4	-5	25
12	3	9
		$\sum_{i=1}^8 (x_i - \bar{X})^2 = 74$

$$N = 8$$

$$\begin{aligned} \text{Variance (X)} &= \frac{1}{n} \sum_{i=1}^8 (x_i - \bar{X})^2 \\ &= 74/8 \\ &= 9.25 \end{aligned}$$

Let Mean be,

$$\bar{X} = \frac{6+7+10+12+13+4+8+12}{8}$$

$$\bar{X} = \frac{72}{8} = 9$$

$$\text{Variance} = 9.25$$

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

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

$$\text{Standard deviation} = 3.04$$

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

Solution:

Let Assume, $x_1, x_2, x_3, \dots, x_{20}$ be the given observations.

Given: Variance (X) = 5

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

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

When we multiply the new observation by 2, then

$$U_i = 2x_i \text{ (for } i=1, 2, 3, \dots, 20) \dots (i)$$

Now,

Mean:

$$\begin{aligned}\bar{U} &= \frac{\sum_{i=1}^{20} u_i}{n} \\ &= \frac{\sum_{i=1}^{20} 2x_i}{20}\end{aligned}$$

$$\text{Mean} = 2\bar{X}$$

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

$$= 2(x_i - \bar{X})$$

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

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

Comparing both the observations

$$\begin{aligned}\frac{\sum_{i=1}^{20} (u_i - \bar{U})^2}{20} &= \frac{\sum_{i=1}^{20} 4(x_i - \bar{X})^2}{20} \\ &= 4 \times \frac{\sum_{i=1}^{20} (x_i - \bar{X})^2}{20}\end{aligned}$$

$$\text{Variance (U)} = 4 \times \text{Variance (X)}$$

$$= 4 \times 5$$

$$= 20$$

$\therefore$ The variance of new observations is 20.

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

Solution:

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Let Assume, $x_1, x_2, x_3, \dots, x_{15}$ be the given observations.

Given: Variance (X) = 4

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

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

When new observation increase by 9, then

$$U_i = x_i + 9 \text{ (for } i=1, 2, 3, \dots, 20) \dots (i)$$

Now,

$$\begin{aligned}\bar{U} &= \frac{1}{n} \sum_{i=1}^{15} u_i \\ &= \frac{1}{15} \sum_{i=1}^{15} (x_i + 9) \\ &= \frac{1}{15} \sum_{i=1}^{15} x_i + \frac{9 \times 15}{15}\end{aligned}$$

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

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

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

$$\begin{aligned}\frac{\sum_{i=1}^{15} (u_i - \bar{U})^2}{15} &= \frac{\sum_{i=1}^{15} 4(x_i - \bar{X})^2}{15} \\ &= \frac{\sum_{i=1}^{15} (u_i - \bar{U})^2}{15} = 4\end{aligned}$$

$$\text{Variance (U)} = 4$$

$\therefore$ The variance of new observations is 4.

4. 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.

Solution:

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

$$\text{Let Mean} = \frac{1+2+6+x+y}{5} = 4.4$$

$$\Rightarrow 9 + x + y = 22$$

$$x + y = 13 \dots\dots (1)$$

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

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

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

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

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

$$x^2 + y^2 = 97 \dots\dots (2)$$

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

By substituting the value we get,

$$13^2 + (x - y)^2 = 2 \times 97$$

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

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

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

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

$$2x = 18$$

$$x = 9 \text{ and } y = 4$$

$\therefore$ The other two observations are 9 and 4.

5. 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.

Solution:

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

Given: Variance (X) = 8

$N = 6$ and $\sigma = 4$ (SD)

$$\bar{X} = \frac{1}{n} \times \sum x_i$$

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

Now, Let $u_1, u_2, \dots, u_6$ be the new observation,

When we multiply the new observation by 3, then

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

Now,

$$\begin{aligned}\bar{U} &= \frac{1}{n} \sum_{i=1}^6 u_i \\ &= \frac{1}{6} \sum_{i=1}^6 (3x_i) \\ &= 3 \times \frac{1}{6} \sum_{i=1}^6 (x_i)\end{aligned}$$

$$\begin{aligned}\bar{U} &= 3\bar{X} \\ &= 3 \times 8 = 24\end{aligned}$$

$$U = 24$$

So, the Mean of new observation is 24

Now,

Standard Deviation $\sigma_x = 4$

$\sigma_x^2 = \text{Variance } X$

Since, Variance (X) = 16

$$\begin{aligned}\text{Variance (U)} &= \frac{1}{6} \sum_{i=1}^6 (3x_i - 3X)^2 \\ &= 3^2 \times \frac{1}{6} \times \sum (x_i - X)^2 \\ &= 9 \times 16\end{aligned}$$

$\sigma_u^2 = \text{Variance (U)}$

$\sigma_u^2 = 144$

$\sigma = 12$

$\therefore$ The mean of new observation is 24 and Standard deviation of new observation is 12.

6. 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.

Solution:

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

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

$$\Rightarrow 60 + x + y = 72$$

$$x + y = 12 \dots\dots (1)$$

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

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

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

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

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

$$x^2 + y^2 = 80 \dots\dots (2)$$

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

By substituting the value we get,

$$12^2 + (x - y)^2 = 2 \times 80$$

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

$$(x - y)^2 = 16$$

$$X - y = \pm 4 \dots\dots (3)$$

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

$$x = 8, 4 \text{ and } y = 4, 8$$

$\therefore$ The other two observations are 8 and 4.

EXERCISE 32.5 PAGE NO: 32.37

1. 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

Solution:

By using the formula for standard deviation:

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

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

So,

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

X_i	F_i	$d_i = (x_i - \text{mean})$	$u_i = \frac{x_i - \text{mean}}{10}$	$f_i u_i$	U_i^2	$f_i u_i^2$
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
	$\sum f_i = 70$			$\sum u_i f_i = 22$		$\sum u_i^2 f_i = 130$

Now,

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

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

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

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

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

$$= 100 [1.857 - 0.0987]$$

$$= 100 [1.7583]$$

$$\text{Var}(X) = 175.83$$

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$$\begin{aligned}\text{Standard Deviation, } \sigma &= \sqrt{\text{Var}(X)} \\ &= \sqrt{175.83} \\ &= 13.26\end{aligned}$$

$\therefore$ The standard deviation is 13.26

2. 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.

Solution:

By using the formula to find mean,

$$\text{Mean} = \frac{\sum f_i x_i}{N} = \frac{10078}{2600} = 3.88$$

X_i	F_i	$F_i X_i$	$(X_i - \bar{X})$	$(X_i - \bar{X})^2$	$F_i (X_i - \bar{X})^2$
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,
 $N = 70$

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

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

∴ The mean is 3.88 and variance is 3.63

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

(i)

	10	20	30	40	50	60
Year render:						
No. of persons (cumulative)	15	32	51	78	97	109

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Solution:

By using the formula to find standard deviation:

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

X_i	F_i	f_i	$u_i = \frac{x_i - \text{mean}}{10}$	$f_i u_i$	U_i^2	$f_i u_i^2$
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,

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

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

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

$$\bar{X} = 34.96$$

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

$$\begin{aligned} \text{Var}(X) &= 100 \left[\frac{261.25}{109} - \frac{0.25}{11881} \right] \\ &= 100 \times 2.396 \end{aligned}$$

$$\text{Variance} = 239.6$$

$$\begin{aligned} \text{Standard Deviation, } \sigma &= \sqrt{239.6} \\ &= 15.47 \text{ years} \end{aligned}$$

$\therefore$ The standard deviation is 15.47

(ii)

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Marks:

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Frequency: 1 6 6 8 8 2 2 3 0 2 1 0 0 0 1

Solution:

By using the formula to find standard deviation:

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

x_i	f_i	$f_i x_i$	$f_i x_i^2$
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,

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

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

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

$$= 5.975$$

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

$$\text{Variance} = 8.12$$

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

$$= 2.85 \text{ years}$$

$\therefore$ The standard deviation is 2.85

4. Find the standard deviation for the following data:

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(i)

x: 3 8 13 18 23

f: 7 10 15 10 6

Solution:

By using the formula to find standard deviation:

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

X_i	F_i	$F_i X_i$	$(x_i - \bar{X})$	$(x_i - \bar{X})^2$	$(x_i - \bar{X})^2 f$
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
	$\sum f_i = 48$	$\sum f_i x_i = 614$			$\sum (x_i - \bar{X})^2 f = 1797.32$

Now, $N = 48$

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

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

Variance = 37.44

$$\text{Standard Deviation, } \sigma = \sqrt{37.44} \\ = 6.12$$

$\therefore$ The standard deviation is 6.12

(ii)

x: 2 3 4 5 6 7

f: 4 9 16 14 11 6

Solution:

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By using the formula to find standard deviation:

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

x_i	f_i	$f_i x_i$	$f_i x_i^2$
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 = 277	Total=1393

Now,

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

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

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

$$= 4.62$$

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

$$\text{Variance} = 1.88$$

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

$$= 1.37$$

$\therefore$ The standard deviation is 1.37

EXERCISE 32.6 PAGE NO: 32.41

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

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

Solution:

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By using the formula to find standard deviation:

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

Expenditure	Mid Point(X_i)	F_i	$F_i X_i$	$(x_i - \bar{X})$	$(x_i - \bar{X})^2$	$(x_i - \bar{X})^2 f$
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
		$\sum f_i$ = 90	$\sum f_i x_i$ = 2350			$\sum (x_i - \bar{X})^2 f$ = 1797.32

Now,

$$\text{Mean, } \bar{X} = \frac{\sum f_i x_i}{\sum f_i}$$

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

$$= 26.11$$

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

$$\text{Variance} = 165.47$$

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

$$= 12.86$$

$\therefore$ The standard deviation is 12.86

2. 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

Solution:

By using the formula to find standard deviation:

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

Class	F_i	x_i	$u_i = \frac{x_i - \text{mean}}{30}$	$f_i u_i$	U_i^2	$f_i u_i^2$
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,

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

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

$$\begin{aligned} \bar{X} &= 105 + 30 \left(\frac{137}{300} \right) \\ &= 118.7 \end{aligned}$$

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

$$\begin{aligned} \text{Var}(X) &= \frac{900}{90000} [300 \times 665 - 18769] \\ &= \frac{1}{100} [199500 - 18769] \end{aligned}$$

$$\text{Variance} = 1807.31$$

$$\begin{aligned} \text{Standard Deviation, } \sigma &= \sqrt{1807.31} \\ &= 42.51 \end{aligned}$$

$\therefore$ The standard deviation is 42.51

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

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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

Solution:

By using the formula to find standard deviation:

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

Class	F_i	x_i	$u_i = \frac{x_i - \text{mean}}{10}$	$f_i u_i$	$f_i u_i^2$
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,

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

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

$$\begin{aligned} \bar{X} &= 35 + 10 \left(\frac{-71}{79} \right) \\ &= 26.01 \end{aligned}$$

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

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

$$\text{Variance} = 305.20$$

$$\begin{aligned} \text{Standard Deviation, } \sigma &= \sqrt{305.20} \\ &= 17.47 \end{aligned}$$

$\therefore$ The standard deviation is 17.47

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4. 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.

Solution:

Given: Uncorrected mean is 40 and corrected SD is 5.1 and $N = 100$

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,

$$\begin{aligned}\bar{x}_n &= \frac{\sum x_n}{n} \\ &= 3990/100 \\ &= 39.90\end{aligned}$$

Now,

Given Incorrect SD = 5.1

$\sigma = 5.1$

$$\sum (x_i - \bar{x}_o)^2 = 2601$$

$$\sum (x_i - \bar{x}_o)^2 = 2601 - 100 + 0.01 = 2501.1$$

$$\text{Corrected SD, } \sigma_n = \sqrt{\frac{\sum (x_i - \bar{x}_o)^2}{n}}$$

$$\begin{aligned}\sigma_n &= \sqrt{\frac{2501.01}{100}} \\ &= 5\end{aligned}$$

$\therefore$ Correct mean is 39.9 and correct SD is 5

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

	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
Class-interval								
Frequency:	2	3	8	12	16	5	2	3

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Solution:

By using the formula to find standard deviation:

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

Class	F_i	x_i	$u_i = \frac{x_i - \text{mean}}{4}$	$f_i u_i$	$f_i u_i^2$
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,

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

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

$$\begin{aligned} \bar{X} &= 53 + 5 \left(-\frac{30}{50} \right) \\ &= 50 \end{aligned}$$

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

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

$$\text{Variance} = 58$$

$$\begin{aligned} \text{Standard Deviation, } \sigma &= \sqrt{58} \\ &= 7.62 \end{aligned}$$

$\therefore$ The standard deviation is 7.62

EXERCISE 32.7 PAGE NO: 32.47

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

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

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

Solution:

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.

$\therefore$ Plant B has more variability in individual wages than plant A

2. 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 deviation	5.6 kg	11.5 inch

Which shows more variability, heights or weights?

Solution:

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Given: The mean and SD is given of 50 students.

Let us find which shows more variability, height and weight.

By using the formulas,

$$\text{Coefficient of variations} = \frac{\text{SD}}{\text{Mean}} \times 100$$

$$\text{Coefficient of variations in weights} = \frac{\text{SD}}{\text{Mean}} \times 100$$

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

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

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

As results clearly show that coefficient of variations in heights is greater than coefficient of variations in weights.

∴ Heights will show more variability than weights

3. 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?

Solution:

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 of variation $= \frac{SD}{Mean} \times 100$

So,

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

For first distribution

$$\begin{aligned}\bar{X} &= \frac{21}{60} \times 100 \\ &= 35\end{aligned}$$

For the second distribution

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

$$= 22.86$$

$\therefore$ Means are 35 and 22.86

4. Calculate coefficient of variation from the following data:

	1000-170	1700-240	2400-310	3100-380	3800-450	4500-520
Income (in ₹):	0	0	0	0	0	0
No. of families:	12	18	20	25	35	10

Solution:

Let us find the standard deviation of the frequency:

Class	F_i	x_i	$u_i = \frac{x_i - \text{mean}}{700}$	$f_i u_i$	$f_i u_i^2$
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,

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

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

$$\begin{aligned} \bar{X} &= 2750 + 700 \left(\frac{83}{120} \right) \\ &= 3234.17 \end{aligned}$$

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

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

$$\text{Variance} = 1076332.64$$

$$\begin{aligned} \text{Standard Deviation, } \sigma &= \sqrt{1076332.64} \\ &= 1037.47 \end{aligned}$$

$$\begin{aligned} \text{Coefficients of variation} &= \frac{1037.46}{3234.17} \times 100 \\ &= 32.08 \end{aligned}$$

$\therefore$ The coefficient variation is 32.08

5. 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

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

(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?

Solution:

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

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

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

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

Firm B pays a larger amount as Firm A

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

$$\begin{aligned}\text{Coefficient variance (Firm A)} &= \frac{10}{52.5} \times 100 \\ &= 19.04\end{aligned}$$

$$\begin{aligned}\text{Coefficient variance (Firm B)} &= \frac{11}{47.5} \times 100 \\ &= 23.15\end{aligned}$$

∴ Coefficient variance of firm B is greater than that of firm A, Firm B has greater variability in individual wages.

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

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

Which of the distributions is more variable?

Solution:

Given: SD (Boys) is 3 and SD (girls) = 2

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

$$\begin{aligned}\text{Coefficient variance (Boys)} &= \frac{3}{60} \times 100 \\ &= 5\end{aligned}$$

$$\begin{aligned}\text{Coefficient variance (Girls)} &= \frac{2}{45} \times 100 \\ &= 4.4\end{aligned}$$

∴ Coefficient variance of Boys is greater than Coefficient variance of girls, and then the distribution of weights of boys is more variable than that of girls.



Chapterwise RD Sharma Solutions for Class 11 Maths :

- Chapter 1–Sets
- Chapter 2–Relations
- Chapter 3–Functions
- Chapter 4–Measurement of Angles
- Chapter 5–Trigonometric Functions
- Chapter 6–Graphs of Trigonometric Functions
- Chapter 7–Values of Trigonometric Functions at Sum or Difference of Angles
- Chapter 8–Transformation Formulae
- Chapter 9–Values of Trigonometric Functions at Multiples and Submultiples of an Angle
- Chapter 10–Sine and Cosine Formulae and their Applications
- Chapter 11–Trigonometric Equations
- Chapter 12–Mathematical Induction
- Chapter 13–Complex Numbers
- Chapter 14–Quadratic Equations
- Chapter 15–Linear Inequations
- Chapter 16–Permutations
- Chapter 17–Combinations
- Chapter 18–Binomial Theorem
- Chapter 19–Arithmetic Progressions
- Chapter 20–Geometric Progressions

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- Chapter 21–Some Special Series
- Chapter 22–Brief review of Cartesian System of Rectangular Coordinates
- Chapter 23–The Straight Lines
- Chapter 24–The Circle
- Chapter 25–Parabola
- Chapter 26–Ellipse
- Chapter 27–Hyperbola
- Chapter 28–Introduction to Three Dimensional Coordinate Geometry
- Chapter 29–Limits
- Chapter 30–Derivatives
- Chapter 31–Mathematical Reasoning
- Chapter 32–Statistics
- Chapter 33–Probability

About RD Sharma

RD Sharma isn't the kind of author you'd bump into at lit fests. But his bestselling books have helped many CBSE students lose their dread of maths. Sunday Times profiles the tutor turned internet star

He dreams of algorithms that would give most people nightmares. And, spends every waking hour thinking of ways to explain concepts like 'series solution of linear differential equations'. Meet Dr Ravi Dutt Sharma — mathematics teacher and author of 25 reference books — whose name evokes as much awe as the subject he teaches. And though students have used his thick tomes for the last 31 years to ace the dreaded maths exam, it's only recently that a spoof video turned the tutor into a YouTube star.

R D Sharma had a good laugh but said he shared little with his on-screen persona except for the love for maths. "I like to spend all my time thinking and writing about maths problems. I find it relaxing," he says. When he is not writing books explaining mathematical concepts for classes 6 to 12 and engineering students, Sharma is busy dispensing his duty as vice-principal and head of department of science and humanities at Delhi government's Guru Nanak Dev Institute of Technology.

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