

REVIEW EXERCISE 11

1. Four possible answers are given for the following questions. Choose the correct answer.

- (i) _____ is used to get the cumulative frequencies.
(a) Addition (b) square root (c) multiplication (d) division
- (ii) Second quartile represents:
(a) mean (b) mode (c) median (d) variance
- (iii) First quartile divides the data into _____ equal parts.
(a) Two (b) Three (c) four (d) ten
- (iv) Difference between the highest and the lowest values is called:
(a) mean (b) variance (c) range (d) standard deviation
- (v) Scatter diagram represents a relationship between _____ variables.
(a) five (b) two (c) three (d) four
- (vi) _____ is measure of dispersion:
(a) mean (b) median (c) mode (d) variance
- (vii) Positive square root of variance is called:
(a) mean (b) median (c) standard deviation (d) range
- (viii) _____ is not measure of dispersion.
(a) range (b) arithmetic mean (c) variance (d) standard deviation
- (ix) Variance of the data 8, 8, 8, 8, 8, 8 is:
(a) 0 (b) 16 (c) 8 (d) 48
- (x) Range of first 20 natural numbers is:
(a) 20 (b) 10 (c) 19 (d) 30

2. The following results for the long jump were recorded:

Distance (in cm)	170 – 180	180 – 190	190 – 200	200 – 210	210 – 220	220 – 230
<i>f</i>	2	6	9	12	8	3

Construct the cumulative frequency polygon and locate median, Q_1 , Q_3 , D_7 , P_{90} and interquartile range on it.

3. The summary statistics for a data set is given below. Show it with a box-and-whisker plot.

Min. Value	Max. Value	Q_1	Median	Q_3
5	70	12.6	43	55.6

4. The following table shows the weekly hours spent exercising and resting heart rate (beats per minute) for ten individuals:

Exercise Hours	0	1	2	3	4	5	6	7	8	9
Heart Rate	90	85	83	80	76	74	72	70	68	65

- (i) Plot the data on a scatter diagram and draw a line of best fit.
 (ii) State the type of correlation observed.
 (iii) Predict the heart rate of Sakeena who exercises for 6.5 hours per week.
5. Find the range for the given data, 25, 30, 35, 40, 50, 60, 65, 75
6. Calculate range, variance and standard deviation for the following data set:

Class Interval	0 – 5	5 – 10	10 – 15	15 – 20	20 – 25	25 – 30
f	4	12	20	24	16	4

7. The sum of 5 numbers is 45 and the sum of their squares is 421. Find the mean and standard deviation of the data.
8. The monthly household expenses (rupees in thousands) of two families for 6 months were:
Family A: 45, 47, 46, 48, 46, 47
Family B: 38, 52, 40, 50, 42, 49
 Calculate the mean and standard deviation of the monthly expenses. Which family spends more on average? Which family has more stable expenses?
9. The daily wages of 40 workers in a factory are grouped as follows:

Daily Wages (Rs.)	1000-1200	1200-1400	1400-1600	1600-1800	1800-2000
No. of Workers	6	10	12	8	4

Find the mean, variance and standard deviation of the daily wages.

REVIEW EXERCISE 11 - Complete Solutions

Part 1: Multiple Choice Questions

Question 1(i)

_____ is used to get the cumulative frequencies.

Solution:

Cumulative frequencies are obtained by **adding** frequencies successively.

Answer: (a) Addition

Question 1(ii)

Second quartile represents:

Solution:

The second quartile (Q) represents the **median** of the data.

Answer: (c) median

Question 1(iii)

First quartile divides the data into _____ equal parts.

Solution:

The first quartile (Q) divides the data into **four** equal parts (25% each).

Answer: (c) four

Question 1(iv)

Difference between the highest and the lowest values is called:

Solution:

The difference between the highest and lowest values is called the **range**.

Answer: (c) range

Question 1(v)

Scatter diagram represents a relationship between _____ variables.

Solution:

A scatter diagram shows the relationship between **two** variables.

Answer: (b) two

Question 1(vi)

_____ is measure of dispersion:

Solution:

Variance is a measure of dispersion (spread) of data.

Answer: (d) variance

Question 1(vii)

Positive square root of variance is called:

Solution:

The positive square root of variance is the **standard deviation**.

Answer: (c) standard deviation

Question 1(viii)

_____ is not measure of dispersion.

Solution:

The **arithmetic mean** is a measure of central tendency, not dispersion.

Answer: (b) arithmetic mean

Question 1(ix)

Variance of the data 8, 8, 8, 8, 8 is:

Solution:

All values are equal to 8.

- Mean = 8
- Deviations from mean = 0
- Sum of squared deviations = 0

$$\sigma^2 = \frac{0}{5} = 0$$

Answer: (a) 0

Question 1(x)

Range of first 20 natural numbers is:

Solution:

First 20 natural numbers: 1, 2, 3, ..., 20

- Maximum = 20
- Minimum = 1

$$\text{Range} = 20 - 1 = 19$$

Answer: (c) 19

Question 2: Cumulative Frequency Polygon and Measures

Given Frequency Distribution:

Distance (cm)	170–180	180–190	190–200	200–210	210–220	220–230
f	2	6	9	12	8	3

Step 1: Cumulative Frequency Table

Class	Frequency (f)	Class Boundaries	Cumulative Frequency (cf)
170–180	2	169.5–180.5	2
180–190	6	179.5–190.5	8
190–200	9	189.5–200.5	17
200–210	12	199.5–210.5	29
210–220	8	209.5–220.5	37
220–230	3	219.5–230.5	40

Total Frequency (n) = 40

Step 2: Construct Cumulative Frequency Polygon (Ogive)

Plotting Points:

- (169.5, 0)
- (180.5, 2)
- (190.5, 8)
- (200.5, 17)
- (210.5, 29)

- (220.5, 37)
- (230.5, 40)

text

Cumulative Frequency

^

45 | * (230.5,40)

|

40 | *

| * (220.5,37)

35 |

|

30 | *

| * (210.5,29)

25 |

|

20 | *

| * (200.5,17)

15 |

|

10 | *

| * (190.5,8)

5 | *

|* (180.5,2)

0 +-----+-----+-----+-----+-----+-----+-----+-----+----->

165 170 175 180 185 190 195 200 205 210 215 220 225 230 235

(169.5,0) Distance (cm)

Step 3: Determine Positions for Measures

Measure	Position Formula	Position Value
Median (Q)	$\frac{n}{2} = \frac{40}{2}$	20th value
Lower Quartile (Q)	$\frac{n}{4} = \frac{40}{4}$	10th value
Upper Quartile (Q)	$\frac{3n}{4} = \frac{3(40)}{4}$	30th value
D (7th Decile)	$\frac{7n}{10} = \frac{7(40)}{10}$	28th value
P (90th Percentile)	$\frac{90n}{100} = \frac{90(40)}{100}$	36th value

Step 4: Read Values from Ogive

Measure	Value (from graph)
Median (Q)	202.5 cm
Lower Quartile (Q)	192.5 cm
Upper Quartile (Q)	212.5 cm
D	209.5 cm
P	219.5 cm
Interquartile Range (IQR)	$Q_3 - Q_1 = 212.5 - 192.5 = 20.0$ cm

Step 5: Verification Using Formula Method

Median (Q):

- Median class: 200–210 (cf before = 17, f = 12)

$$Q_2 = L + \frac{\frac{n}{2} - cf}{f} \times h Q_2 = 199.5 + \frac{20 - 17}{12} \times 10 = 199.5 + \frac{3}{12} \times 10 = 199.5 + 2.5 = 202.0$$

Lower Quartile (Q):

- Q class: 190–200 (cf before = 8, f = 9)

$$Q_1 = 189.5 + \frac{10 - 8}{9} \times 10 = 189.5 + \frac{2}{9} \times 10 = 189.5 + 2.22 = 191.72$$

Upper Quartile (Q):

- Q class: 210–220 (cf before = 29, f = 8)

$$Q_3 = 209.5 + \frac{30 - 29}{8} \times 10 = 209.5 + \frac{1}{8} \times 10 = 209.5 + 1.25 = 210.75$$

D :

- D class: 200–210 (cf before = 17, f = 12)

$$D_7 = 199.5 + \frac{28 - 17}{12} \times 10 = 199.5 + \frac{11}{12} \times 10 = 199.5 + 9.17 = 208.67$$

P :

- P class: 220–230 (cf before = 37, f = 3)

$$P_{90} = 219.5 + \frac{36 - 37}{3} \times 10$$

Note: This gives a negative value, so we use the previous class (210–220):

$$P_{90} = 209.5 + \frac{36 - 29}{8} \times 10 = 209.5 + \frac{7}{8} \times 10 = 209.5 + 8.75 = 218.25$$

$$\text{IQR} = Q - Q = 210.75 - 191.72 = 19.03$$

Summary Table

MCQs:

		Option
(i)	Addition	(a)
(ii)	median	(c)
(iii)	four	(c)
(iv)	range	(c)
(v)	two	(b)
(vi)	variance	(d)
(vii)	standard deviation	(c)
(viii)	arithmetic mean	(b)
(ix)	0	(a)
(x)	19	(c)

Question 2 Results:

Measure	Value (Graphical)	Value (Formula)
Median (Q)	202.5	202.0
Q	192.5	191.72
Q	212.5	210.75
D	209.5	208.67
P	219.5	218.25
IQR	20.0	19.03

Key Concepts Summary

Term	Definition
Cumulative Frequency	Running total of frequencies
Ogive	Graph of cumulative frequencies
Median	Middle value (Q)
Quartiles	Divide data into 4 equal parts
Deciles	Divide data into 10 equal parts
Percentiles	Divide data into 100 equal parts
Range	Max – Min
IQR	$Q - Q$

REVIEW EXERCISE 11 (Continued) - Complete Solutions

Question 3: Box-and-Whisker Plot

Given Summary Statistics:

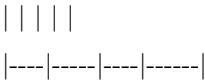
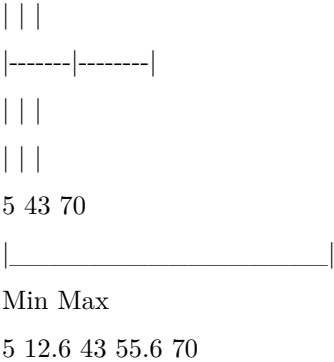
Min. Value	Max. Value	Q	Median	Q
5	70	12.6	43	55.6

Box-and-Whisker Plot:

text

Q Median Q

12.6 43 55.6



Five-Number Summary:

- Minimum = 5
- Q = 12.6
- Median = 43
- Q = 55.6
- Maximum = 70

$IQR = Q - Q = 55.6 - 12.6 = 43$

Question 4: Exercise Hours and Heart Rate

Given Data:

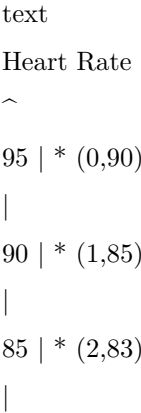
Exercise Hours	0	1	2	3	4	5	6	7	8	9
Heart Rate	90	85	83	80	76	74	72	70	68	65

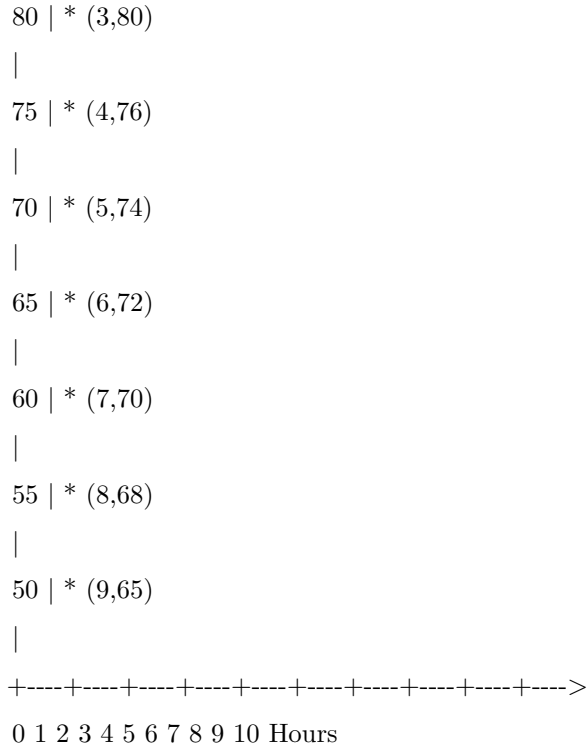
4(i) Scatter Diagram and Line of Best Fit

Step 1: Plot the points:

- (0, 90), (1, 85), (2, 83), (3, 80), (4, 76)
- (5, 74), (6, 72), (7, 70), (8, 68), (9, 65)

Scatter Diagram:





Step 2: Draw the line of best fit (downward sloping).

4(ii) Type of Correlation

Observation: As exercise hours increase, heart rate decreases.

Correlation: Negative Correlation (strong)

4(iii) Predict Heart Rate for 6.5 Hours

Step 1: Locate 6.5 on the x-axis.

Step 2: From 6.5, go vertically up to the line of best fit.

Step 3: From that point, go horizontally left to the y-axis.

Estimation: Approx. **69–70 beats per minute**

Answer: Heart rate **69 beats/min**

Question 5: Find the Range

Data: 25, 30, 35, 40, 50, 60, 65, 75

Solution:

- Maximum Value: 75
- Minimum Value: 25

$$\text{Range} = 75 - 25 = 50$$

Answer: Range = 50

Question 6: Grouped Data - Range, Variance, Standard Deviation

Given:

Class Interval	0–5	5–10	10–15	15–20	20–25	25–30
f	4	12	20	24	16	4

Solution:

Step 1: Find midpoints and calculate mean.

Class	Midpoint (x)	f	fx	x^2	fx^2
0–5	2.5	4	10	6.25	25
5–10	7.5	12	90	56.25	675
10–15	12.5	20	250	156.25	3125
15–20	17.5	24	420	306.25	7350
20–25	22.5	16	360	506.25	8100
25–30	27.5	4	110	756.25	3025

Step 2: Sums:

$$\sum f = 4 + 12 + 20 + 24 + 16 + 4 = 80 \quad \sum fx = 10 + 90 + 250 + 420 + 360 + 110 = 1240 \quad \sum fx^2 = 25 + 675 + 3125 + 7350 + 8100 + 3025 = 22300$$

Step 3: Mean:

$$x = \frac{\sum fx}{\sum f} = \frac{1240}{80} = 15.5$$

Step 4: Range:

- Minimum value 0 (lower boundary of first class)
- Maximum value 30 (upper boundary of last class)

$$\text{Range} = 30 - 0 = 30$$

Step 5: Variance:

$$\sigma^2 = \frac{\sum fx^2}{\sum f} - (x)^2 \sigma^2 = \frac{22300}{80} - (15.5)^2 \sigma^2 = 278.75 - 240.25 = 38.5$$

Step 6: Standard Deviation:

$$\sigma = \sqrt{38.5} = 6.20$$

Answer: Range = 30, Variance = 38.5, Standard Deviation = 6.20

Question 7: Mean and Standard Deviation

Given:

- Sum of 5 numbers = 45 $\rightarrow \sum x = 45$

- Sum of squares = 421 $\rightarrow \sum x^2 = 421$
- $n = 5$

Solution:

Step 1: Mean:

$$\bar{x} = \frac{\sum x}{n} = \frac{45}{5} = 9$$

Step 2: Variance:

$$\sigma^2 = \frac{\sum x^2}{n} - (\bar{x})^2 = \frac{421}{5} - (9)^2 = 84.2 - 81 = 3.2$$

Step 3: Standard Deviation:

$$\sigma = \sqrt{3.2} = 1.79$$

Answer: Mean = 9, Standard Deviation = 1.79

Question 8: Family Expenses Comparison

Family A: 45, 47, 46, 48, 46, 47

Family B: 38, 52, 40, 50, 42, 49

Solution:

Step 1: Calculate means.

Family A:

$$\bar{x}_A = \frac{45 + 47 + 46 + 48 + 46 + 47}{6} = \frac{279}{6} = 46.5$$

Family B:

$$\bar{x}_B = \frac{38 + 52 + 40 + 50 + 42 + 49}{6} = \frac{271}{6} = 45.17$$

Step 2: Calculate standard deviations.

Family A:

x	$x - \bar{x}$	$(x - \bar{x})^2$
45	-1.5	2.25
47	0.5	0.25
46	-0.5	0.25
48	1.5	2.25
46	-0.5	0.25
47	0.5	0.25

$$\text{Sum} = 2.25 + 0.25 + 0.25 + 2.25 + 0.25 + 0.25 = 5.5$$

$$\sigma_A = \sqrt{\frac{5.5}{6}} = \sqrt{0.9167} = 0.957$$

Family B:

x	$x - \bar{x}$	$(x - \bar{x})^2$
38	-7.17	51.36
52	6.83	46.71
40	-5.17	26.69
50	4.83	23.36
42	-3.17	10.03
49	3.83	14.69

$$\text{Sum} = 51.36 + 46.71 + 26.69 + 23.36 + 10.03 + 14.69 = 172.84$$

$$\sigma_B = \sqrt{\frac{172.84}{6}} = \sqrt{28.81} = 5.37$$

Step 3: Compare.

- **Average spending:** Family A spends more ($46.5 > 45.17$)
- **Stability:** Family A is more stable ($0.957 < 5.37$)

Answer: Family A spends more on average and has more stable expenses.

Question 9: Grouped Data - Daily Wages

Daily Wages (Rs.)	1000–1200	1200–1400	1400–1600	1600–1800	1800–2000
No. of Workers	6	10	12	8	4

Solution:

Step 1: Find midpoints and calculate mean.

Class	Midpoint (x)	f	fx	x^2	fx^2
1000–1200	1100	6	6600	1,210,000	7,260,000
1200–1400	1300	10	13000	1,690,000	16,900,000
1400–1600	1500	12	18000	2,250,000	27,000,000
1600–1800	1700	8	13600	2,890,000	23,120,000
1800–2000	1900	4	7600	3,610,000	14,440,000

Step 2: Sums:

$$\sum f = 6 + 10 + 12 + 8 + 4 = 40 \quad \sum fx = 6600 + 13000 + 18000 + 13600 + 7600 = 58800 \quad \sum fx^2 = 7,260,000 + 16,900,000 + \dots$$

Step 3: Mean:

$$x = \frac{\sum fx}{\sum f} = \frac{58800}{40} = 1470$$

Step 4: Variance:

$$\sigma^2 = \frac{\sum fx^2}{\sum f} - (x)^2 \sigma^2 = \frac{88,720,000}{40} - (1470)^2 \sigma^2 = 2,218,000 - 2,160,900 = 57,100$$

Step 5: Standard Deviation:

$$\sigma = \sqrt{57,100} = 238.96$$

Answer: Mean = **Rs. 1470**, Variance = **57,100**, Standard Deviation = **Rs. 238.96**

Summary Table

3	Box plot with Min=5, Q =12.6, Median=43, Q =55.6, Max=70
4(ii)	Negative correlation
4(iii)	Heart rate 69 beats/min
5	Range = 50
6	Range = 30, Variance = 38.5, SD = 6.20
7	Mean = 9, SD = 1.79
8	Family A: Mean=46.5, SD=0.96; Family B: Mean=45.17, SD=5.37; Family A is better
9	Mean = 1470, Variance = 57,100, SD = 238.96

Key Formulas

Measure	Formula
Range	Max – Min
Mean (Grouped)	$x = \frac{\sum fx}{\sum f}$
Variance (Grouped)	$\sigma^2 = \frac{\sum fx^2}{\sum f} - (x)^2$
Standard Deviation	$\sigma = \sqrt{\sigma^2}$