FORM 4
CHAPTER 8

Self Test 1

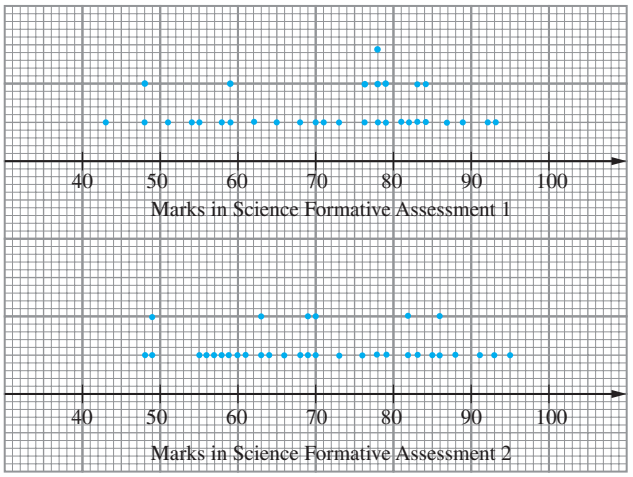
1 (a) Highest average time = 12 minutes
Lowest average time = 2 minutes
(b) Difference = 12 – 2
= 10 minutes

2 Difference in shoes size = 40 – 35
= 5

3 Difference in the total duration of training = 69
86 – Lowest total duration of training = 69
Lowest total duration of training = 86 – 69
= 17
Therefore, $x = 7$

4 Score difference for 4G = Highest mark – Lowest mark
= 99 – 42
= 57
Score difference for 4S = 96 – 40
= 56
Class 4G has a wider spread because the value of range is higher.

5 Difference in marks for Assessment 1 = 93 – 43
= 50
Difference in marks for Assessment 2 = 95 – 48
= 47



The achievement of the students in the Science Formative Assessment 2 is better because the spread is smaller. The highest mark and the lowest mark in the Science Formative Assessment 2 is higher than the Science Formative Assessment 1.

6 (a)

Leaf (Class 4K)	Stem	Leaf (Class 4M)
6 1	3	
9 9 8 3 3 2	4	1 6 6 6 7 8 8 8 9 9
9 8 8 7 4 1 1	5	2 3 3 4 4 6 6 7 8 8 9 9
9 6 5 4 3 3 2 2 2 0	6	0 1 1 1 2 3
8 8 3 1 0	7	2 7

Class 4K: 3 | 1 means 31 litres
Class 4M: 4 | 1 means 41 litres

(b) Difference in the volume of drinking water for class 4K
= 78 – 31
= 47 litres
Difference in the volume of drinking water for class 4M
= 77 – 41
= 36 litres
Generally, the spread in the volume of drinking water for class 4M is smaller as compared to class 4K. The majority of the students in class 4K drink more water because the data focus at the lower part of the stem-and-leaf plot.

Self Test 2

1 (a) 2, (4), 5, (6), 7, (8), 9
Q_1 M Q_3
Range = 9 – 2
= 7
Interquartile range = $Q_3 - Q_1$
= 8 – 4
= 4

(b) 11, 12, | 12, 13, (13), 15, 16, | 16, 18
Q_1 M Q_3
Range = 18 – 11
= 7
$Q_3 - Q_1$ = 16 – 12
= 4

(c) 3.1, 3.4, | 3.4, 3.5, | 4.6, 4.9, | 5.1, 5.4
Q_1 M Q_3
Range = 5.4 – 3.1
= 2.3

$$Q_3 - Q_1 = \frac{4.9 + 5.1}{2} - \frac{3.4 + 3.4}{2}$$
$$= 5 - 3.4$$
$$= 1.6$$

2 Range = 53 – 49
= 4

Mass (kg)	49	50	51	52	53
Number of students	3	5	8	6	2
Cumulative frequency	3	8	16	22	24

$Q_1 = \left(\frac{1}{4} \times 24\right)$th value
= the 6th value
= 50

$Q_3 = \left(\frac{3}{4} \times 24\right)$th value
= the 18th value
= 52

$Q_3 - Q_1$ = 52 – 50
= 2

3 (a) Variance, $\sigma^2 = \frac{3^2 + 3^2 + 5^2 + 6^2 + 11^2 + 12^2}{6} - \left(\frac{3 + 3 + 5 + 6 + 11 + 12}{6}\right)^2$
= 12.89
Standard deviation, $\sigma = 3.59$

(b) Variance, σ^2
$$= \frac{69^2 + 73^2 + 75^2 + 79^2 + 81^2 + 83^2 + 89^2}{7} - \left(\frac{69 + 73 + 75 + 79 + 81 + 83 + 89}{7}\right)^2$$
= 38.53
Standard deviation, $\sigma = 6.207$

(c) Mean, $\bar{x} = \frac{2(0) + 5(1) + 8(2) + 6(3) + 4(4) + 1(5)}{2 + 5 + 8 + 6 + 4 + 1}$
= 2.308

$$\text{Variance } \sigma^2 = \frac{2(0^2) + 5(1^2) + 8(2^2) + 6(3^2) + 4(4^2) + 1(5^2)}{2+5+8+6+4+1} - (2.308)^2$$

$$= 1.596$$

Standard deviation, $\sigma = 1.264$

4 3, 4, ④, 5, 7, | 7, 8, ⑨, 10, 33

Q_1 M Q_3

Range $= 33 - 3$

$= 30$

$Q_3 - Q_1 = 9 - 4$

$= 5$

Interquartile range is more suitable to measure the distribution of the set of data given because there is an outlier or extreme value '33'.

5 **Blue group:**

$$\text{Mean, } \bar{x} = \frac{2(1) + 5(2) + 8(3) + 3(4) + 1(5) + 1(6)}{2+5+8+3+1+1}$$

$= 2.95$

Standard deviation, σ

$$= \sqrt{\frac{2(1^2) + 5(2^2) + 8(3^2) + 3(4^2) + 1(5^2) + 1(6^2)}{2+5+8+3+1+1} - (2.95)^2}$$

$= 1.203$

Red Group:

$$\text{Mean, } \bar{x} = \frac{3(1) + 5(2) + 6(3) + 3(4) + 2(5) + 1(6)}{3+5+6+3+2+1}$$

$= 2.95$

Standard deviation, σ

$$= \sqrt{\frac{3(1^2) + 5(2^2) + 6(3^2) + 3(4^2) + 2(5^2) + 1(6^2)}{3+5+6+3+2+1} - (2.95)^2}$$

$= 1.359$

Standard deviation is more suitable to be used to choose the group with better performance. Blue group and red group have the same mean. Blue group has a smaller standard deviation. Therefore, blue group performs better.

6 (a) **Mass of Participants in Sihat Rimba Programme**

Stem	Leaf
6	7
7	2
8	1 1 3 4 5 6 7 8 8 9 9
9	0 1 2 2 3 3 5 7 7 8 9 9
10	8
11	1 1 3 3 6 9

Key: 6 | 7 means 67 kg

(b) **Heights of Paddy Plants**

Stem	Leaf
3	2 3 3 3 4 4 5 6 7 7 9 9
4	0 3 3 3 4 4 5 5 6 6 7 8 8 8 8 9
5	1 1 2 2

Key: 3 | 2 means 32 cm

7 (a) median = 5.5 kg

(b) first quartile = 4 kg

(c) third quartile = 6.5 kg

(d) interquartile range = (6.5 – 4) kg

= 2.5 kg

(e) minimum value = 2 kg

(f) maximum value = 7.6 kg

(g) range = (7.6 – 2) kg

= 5.6 kg

8 $Q_3 - Q_1 = 5$, standard deviation, $\sigma = 1.23$

New data set = (2 × original data set) + 7

(a) New interquartile range = 2 × 5

= 10

(b) New variance $= 2^2 \times$ Original variance

$= 4 \times 1.23^2$

$= 6.0516$

9 $$\text{Mean, } \bar{x} = \frac{2+3+5+6+8+10}{6}$$

$= 5.667$

$$\text{Standard deviation, } \sigma = \sqrt{\frac{2^2+3^2+5^2+6^2+8^2+10^2}{6} - (5.667)^2}$$

$= 2.748$

When an outlier 43 is added, the standard deviation will increase significantly..

10 Group 1: $n = 12$, mean, $\bar{x}_1 = 28$ years old, variance, $\sigma^2 = 10.33$

Group 2: $n = 25$, mean, $\bar{x}_2 = 32$ years old,

variance, $\sigma^2 = 19.36$

Group 1 + Group 2: $n = 37$

$\Sigma x_1 + \Sigma x_2 = 12(28) + 25(32)$

$= 1\,136$

$$\bar{x}_3 = \frac{1136}{37}$$

$= 30.7$

$$\sigma_1^2,\ 10.33 = \frac{\Sigma x_1^2}{12} - 28^2 \qquad \sigma_2^2,\ 19.36 = \frac{\Sigma x_2^2}{25} - 32^2$$

$\Sigma x_1^2 = (10.33 + 28^2) \times 12$ $\quad \Sigma x_2^2 = (19.36 + 32^2) \times 25$

$= 9\,531.96$ $\quad = 26\,084$

Standard deviation of the combined group

$$= \sqrt{\frac{\Sigma x_1^2 + \Sigma x_2^2}{12+25} - (\bar{x}_3)^2}$$

$$= \sqrt{\frac{9\,531.96 + 26\,084}{37} - 30.7^2}$$

$= 4.484$

SPM PRACTICE

Paper 1

1 **B**

2 **B** 3, 4, | 5, 6, | 7, 9, | 11, 20

Q_1 M Q_3

$$Q_3 - Q_1 = \frac{9+11}{2} - \frac{4+5}{2}$$

$= 10 - 4.5$

$= 5.5$

3 **A**

Total time (minutes)	30	45	60	75	90	105	120	150
Number of students	1	4	5	6	7	5	4	3
Cumulative frequency	1	5	10	16	23	28	32	35

C_1 | $C_2 - C_5$ | $C_6 - C_{10}$ ↑Q_1 | $C_{11} - C_{16}$ | $C_{17} - C_{23}$ | $C_{24} - C_{28}$ ↑Q_3 | $C_{29} - C_{32}$ | $C_{33} - C_{35}$

$$Q_1 = \left(\frac{1}{4} \times 35\right) \text{th value}$$

= the 8.75th value

= 60

$Q_3 = \left(\frac{3}{4} \times 35\right)$th value
$= $ the 26.25th value
$= 105$
$Q_3 - Q_1 = 105 - 60$
$= 45$

4 A Mean, $\bar{x} = \frac{0.6 + 0.76 + 0.8 + 0.8 + 1.3 + 1.5 + 1.9 + 2.1}{8}$
$= 1.22$

Variance, $\sigma^2 = \frac{0.6^2 + 0.76^2 + 0.8^2 + 0.8^2 + 1.3^2 + 1.5^2 + 1.9^2 + 2.1^2}{8} - 1.22^2$
$= 0.2838$

5 A

6 D Standard deviation $B = \frac{\text{Standard deviation } A}{5}$
$= \frac{k}{5}$

Therefore, variance of $B = \frac{k^2}{25}$

Paper 2

Section A

1 (a) 4, 4, | 6, 7, (9), 9, 10, | 13, 15
Q_1 M Q_3

$Q_3 - Q_1 = \frac{10 + 13}{2} - \frac{4 + 6}{2}$
$= 11.5 - 5$
$= 6.5$

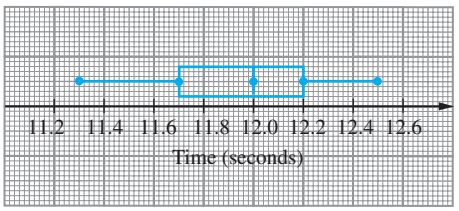
(b) Mean, $\bar{x} = \frac{4 + 4 + 6 + 7 + 9 + 9 + 10 + 13 + 15}{9}$
$= 8.556$

Standard deviation, $\sigma = \sqrt{\frac{4^2 + 4^2 + 6^2 + 7^2 + 9^2 + 9^2 + 10^2 + 13^2 + 15^2}{9} - 8.556^2}$
$= 3.561$

2 11.3, 11.5, (11.7), 11.7, 12, | 12, 12.2, (12.2), 12.2, 12.5
Q_1 M Q_3

Minimum value = 11.3, Maximum value = 12.5
Median = 12, $Q_1 = 11.7$, $Q_3 = 12.2$

Time Record of Ali's 100 m Run



3 Original data
$\sum x = 524$, $\sum x^2 = 45\,956$

Standard deviation, $\sigma = \sqrt{\frac{45\,956}{6} - \left(\frac{524}{6}\right)^2}$
$= 5.676$

New data $= \frac{\text{Original data} - 3}{4}$

New standard deviation $= \frac{\text{Original standard deviation}}{4}$
$= \frac{5.676}{4}$
$= 1.419$

4 (a) Range $= 5 - 0$
$= 5$

(b)

Scores	0	1	2	3	4	5
Number of students	2	4	5	8	6	5
Cumulative frequency	2	6	11	19	25	30

$C_1 - C_2$ $C_3 - C_6$ $C_7 - C_{11}$ $C_{12} - C_{19}$ $C_{20} - C_{25}$ $C_{26} - C_{30}$
Q_1 Q_3

$Q_1 = \left(\frac{1}{4} \times 30\right)$th value $= $ the 7.5th value $= 2$
$Q_3 = \left(\frac{3}{4} \times 30\right)$th value $= $ the 22.5th value $= 4$
$Q_3 - Q_1 = 4 - 2$
$= 2$

(c) Mean, $\bar{x} = \frac{2(0) + 4(1) + 5(2) + 8(3) + 6(4) + 5(5)}{2 + 4 + 5 + 8 + 6 + 5}$
$= 2.9$

Variance, $\sigma^2 = \frac{2(0^2) + 4(1^2) + 5(2^2) + 8(3^2) + 6(4^2) + 5(5^2)}{2 + 4 + 5 + 8 + 6 + 5} - 2.9^2$
$= 2.1567$

5 (a) Minimum value, $m = 9$

(b) Mean, $\bar{x} = \frac{5(0) + 7(2) + 9(4) + 8(6) + 3(8) + 1(10)}{5 + 7 + 9 + 8 + 3 + 1}$
$= 4$

Variance, $\sigma^2 = \frac{5(0^2) + 7(2^2) + 9(4^2) + 8(6^2) + 3(8^2) + 1(10^2)}{5 + 7 + 9 + 8 + 3 + 1} - 4^2$
$= 6.788$
Standard deviation, $\sigma = 2.605$

Section B

6 (a) Mean, $\bar{x} = \frac{(2x - 1) + (x + 3) + 3x + 6 + (4x - 1) + (3x + 2) + (4x + 1) + 5x + (6x - 1) + 11}{10}$
$= \frac{28x + 20}{10}$
$= 2.8x + 2$

(b) $2.8x + 2 = 7.6$
$2.8x = 5.6$
$x = 2$
Data: 3, 5, 6, 6, 7, 8, 9, 10, 11, 11

Variance, $\sigma^2 = \frac{3^2 + 5^2 + 6^2 + 6^2 + 7^2 + 8^2 + 9^2 + 10^2 + 11^2 + 11^2}{10} - 7.6^2$
$= 6.44$
Standard deviation, $\sigma = 2.538$

(c) New set of data $= 4 \times$ (Original data) $+ 5$
New variance $= 4^2 \times$ Original variance
$= 16 \times 6.44$
$= 103.04$

7 (a) Product A:
23, 23, 25, | 25, 29, 30, | 32, 32, 35, | 38, 40, 42
Q_1 M Q_3

Minimum value = 23 Maximum value = 42

$\text{Median} = \frac{30 + 32}{2}$ $Q_1 = \frac{25 + 25}{2}$

$= 31$ $= 25$

$Q_3 = \frac{35 + 38}{2}$

$= 36.5$

Product B:

25, 25, 25, | 26, 27, 28, | 28, 32, 33, | 35, 35, 35

Q_1 M Q_3

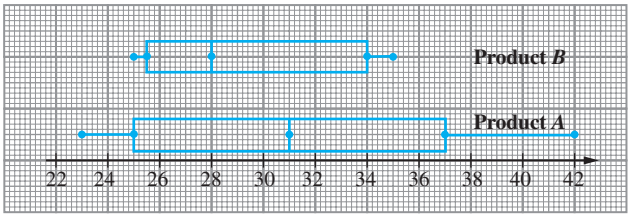
Minimum value = 25 Maximum value = 35

$\text{Median} = \frac{28 + 28}{2}$ $Q_1 = \frac{25 + 26}{2}$

$= 28$ $= 25.5$

$Q_3 = \frac{33 + 35}{2}$

$= 34$



(b) (i) Product B should be chosen to sell in the market because it has smaller value of the range and interquartile range as compared to product A. This shows that product B is more consistent.

(ii) Product A should be chosen to sell in the market. The median of product A is higher, that is 31%. The third quartile of product A, which is 37%, is higher than the maximum value of product B which is only 35%, This means that product A shows higher effect in skin moisture.