Unit 11 · Statistics

ANSWER KEY · FOR TEACHERS

Full marks 28

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. dispersion
2. quartile deviation
3. mean deviation
4. standard deviation
5. variance
6. coefficient of variation

K · 3

Each carries 0.5 mark.

2 Multiple choice

i. **a.** 8 — K · 1

$\frac{40-24}{2} = 8$. 16 is the interquartile range, 32 the mean of the quartiles, and 0.25 the coefficient.

ii. **b.** 0.25 — U · 1

$\frac{40-24}{40+24} = \frac{16}{64} = 0.25$. 0.6 is $\frac{24}{40}$.

iii. **b.** it does not change — U · 1

Every value moves the same way, so the mean moves by 5 too and every distance from the mean stays the same. The spread is unchanged; this is why the assumed-mean method works.

iv. **c.** 15% — A · 1

$\frac{6}{40} \times 100\% = 15\%$. 6.67% divides the mean by σ, $\frac{40}{6} \approx 6.67$, the wrong way up; 0.15% is the coefficient of standard deviation, without the 100.

v. **a.** 1.5 — A · 1

$\sigma = \sqrt{2.25} = 1.5$. 1.125 halves the variance; 5.0625 squares it.

3 Very short answers

a. MARKING SCHEME — K · 1

✓ The formula, with the square root and $\left(\frac{\Sigma fm}{N}\right)^2$.

b. MARKING SCHEME — U · 1

✓ The 18% group, as its C.V. is smaller.

4 Short answers

a. MARKING SCHEME — U · 2

✓ The mean, $\frac{\Sigma fm}{N} = 20$, must be squared.

✓ $\sigma = 5$.

b. MARKING SCHEME — A · 2

✓ $\sigma = 9$.

✓ Variance $= 81$.

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c. MARKING SCHEME A · 2

- ✓ The ages in order, smallest 9 and largest 25, median 15.
- ✓ $Q_1 = 11.5$ and $Q_3 = 19$.

d. MARKING SCHEME A · 2

- ✓ $Q_1 = 16.43$ and $Q_3 = 30.83$.
- ✓ Q.D. $= 7.20$ and coefficient ≈ 0.30.

5 Long answers

a. ANSWER A · 4

Take $A = 700$, $h = 200$: $d' = -2, -1, 0, 1, 2$; $fd' = -12, -10, 0, 11, 10$, so $\Sigma fd' = -1$; $fd'^2 = 24, 10, 0, 11, 20$, so $\Sigma fd'^2 = 65$.

a. $\overline{X} = 700 + \dfrac{-1}{50} \times 200 =$ **Rs 696**.

b. $\sigma = \sqrt{\dfrac{65}{50} - \left(\dfrac{-1}{50}\right)^2} \times 200 = \sqrt{1.2996} \times 200 = 1.14 \times 200 =$ **Rs 228**.

c. C.V. $= \dfrac{228}{696} \times 100\% \approx$ **32.76%**.

d. The other group's C.V. $= \dfrac{250}{900} \times 100\% \approx 27.78\%$, smaller, so **the other group's earnings are more uniform**, though its standard deviation is larger.

MARKING SCHEME

- ✓ The table of d', fd', fd'^2, and $\overline{X} = 696$.
- ✓ $\sigma = 228$.
- ✓ C.V. $\approx 32.76\%$.
- ✓ The other group's C.V. 27.78%, so it is more uniform.

b. ANSWER A · 4

a. A: **51 kg**; B: **52 kg**.

b. A: $52 - 50 =$ **2 kg**; B: $64 - 41 =$ **23 kg**.

c. A: $\dfrac{52 - 50}{52 + 50} = \dfrac{2}{102} \approx$ **0.02**; B: $\dfrac{64 - 41}{64 + 41} = \dfrac{23}{105} \approx$ **0.22**.

d. **Fertilizer A**: its coefficient of quartile deviation is about a tenth of B's, and its yields stay between 48 and 54 kg, while B's fell as low as 30 kg. The medians are almost equal, so B gives no more in a typical year.

MARKING SCHEME

- ✓ Medians 51 kg and 52 kg.
- ✓ Interquartile ranges 2 kg and 23 kg.
- ✓ Coefficients 0.02 and 0.22.
- ✓ A, with a reason from the coefficients or the boxes.

6 Think

ANSWER HA · 2

No. Every value and the mean lie between the smallest and the largest value, so no value is farther from the mean than the range. The squared distances are each at most the range squared, so their mean is too, and σ is at most the range (equal only when the range is 0, every value the same). (In fact σ is never more than half the range.)

MARKING SCHEME

- ✓ No.
- ✓ A reason: every distance from the mean is at most the range.

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7 Activity: Hand spans

(not marked)

WHAT STUDENTS SHOULD FIND

Your own numbers. The column $x - \overline{X}$ adds up to 0 (check it). σ comes out a little bigger than the mean deviation, often about 1.2 or 1.3 times it.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	5	5	16	2	**28**

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