S1 Measures of Location and Spread: exam questions

10 questions · 29 marks · full mark schemes

Name _____ Date _____ Score / 29

- Mean, median, mode, quartiles and percentiles (incl. interpolation), variance and standard deviation; coding.
- Try every question before you look at the mark schemes. They start after the questions: M marks for method, A marks for accuracy, B marks for a correct result on its own.
- Online, with more practice: alevelmathrevision.com/alevel-frontend/units/s1/measures-location-spread-questions

1. **2 marks · warm-up**

A dataset has a variance of 40. If every value in the dataset is multiplied by 3, what is the variance of the new dataset?

2. **2 marks · warm-up**

A list of test scores has a range of 40 and an interquartile range (IQR) of 15. If every student receives 5 bonus marks, write down the new range and the new IQR.

3. **3 marks · standard**

Calculate an estimate for the standard deviation of the parcel weights ($0 \leq w < 10$: 5, $10 \leq w < 20$: 12, $20 \leq w < 30$: 3). You may use the estimated mean of 14 kg.

4. 3 marks · standard

A set of temperature readings, t, are coded using the formula $y = \frac{t-20}{2}$. Given that the mean of the coded data $\bar{y} = 8.5$, find the mean of the original temperatures, $\bar{t}$.

5. 3 marks · standard

The mean of 9 numbers is 12. A 10th number is added to the set, and the new mean becomes 13. Find the value of the 10th number.

6. 3 marks · standard

A cumulative frequency table shows that 40 students took a test. The 90th percentile, P_{90}, falls in the class $60 \leq x < 70$. The cumulative frequency before this class is 30, and the frequency of this class is 8. Use linear interpolation to estimate P_{90}.

7. 3 marks · standard

A dataset has a lower quartile of 20 and an upper quartile of 45. An outlier is defined as any value that is greater than $Q_3 + 1.5 \times IQR$ or less than $Q_1 - 1.5 \times IQR$. Find the boundaries for outliers in this dataset.

8. 3 marks · standard

A frequency table lists values $x = 10, 15, 20$ with corresponding frequencies $f = 5, k, 2$. Given that the mean of x is 14, find the value of the missing frequency k.

9. 3 marks · standard

The times taken, t minutes, for 30 people to complete a task are summarised by $\Sigma t = 1050$ and $\Sigma t^2 = 38000$. Find the mean and standard deviation of the times taken.

10. 4 marks · harder

In a histogram representing continuous data, the bar for the class $20 \leq t < 30$ has a frequency of 15 and is represented by an area of 30 square units. Another class $30 \leq t < 50$ has a frequency of 40. Find the area of the bar representing this second class.

Answers and worked solutions

Question 1

2 marks

1. M1 for recognising that multiplying data by b multiplies the variance by b^2.
2. A1 for calculating $3^2 \times 40 = 9 \times 40 = 360$.

Question 2

2 marks

1. M1 for recognising that adding a constant shifts the entire distribution without affecting measures of spread.
2. A1 for stating the new Range is 40 and the new IQR is 15.

Question 3

3 marks

1. M1 for calculating $\Sigma fx^2 = 5(5^2) + 12(15^2) + 3(25^2) = 125 + 2700 + 1875 = 4700$.
2. M1 for using the standard deviation formula: $\sigma = \sqrt{\frac{\Sigma fx^2}{n} - \bar{x}^2} = \sqrt{\frac{4700}{20} - 14^2}$.
3. A1 for evaluating $\sqrt{235 - 196} = \sqrt{39} \approx 6.24$ kg.

Question 4

3 marks

1. M1 for setting up the equation $\bar{y} = \frac{\bar{t} - 20}{2}$.
2. M1 for substituting $\bar{y} = 8.5$ to get $8.5 = \frac{\bar{t} - 20}{2}$.
3. A1 for solving to find $\bar{t} = 17 + 20 = 37$.

Question 5

3 marks

1. M1 for finding the sum of the original 9 numbers: $9 \times 12 = 108$.
2. M1 for finding the sum of the 10 numbers: $10 \times 13 = 130$.
3. A1 for finding the 10th number by subtraction: $130 - 108 = 22$.

Question 6

3 marks

1. M1 for identifying the required value is the 90% of $40 =$ 36th value.
2. M1 for setting up the interpolation: $60 + \frac{36 - 30}{8} \times 10$.
3. A1 for evaluating to get $60 + \frac{6}{8} \times 10 = 60 + 7.5 = 67.5$.

Question 7

3 marks

1. M1 for calculating the Interquartile Range (IQR): $45 - 20 = 25$.
2. M1 for setting up the boundary calculations: $20 - 1.5(25)$ and $45 + 1.5(25)$.
3. A1 for finding the boundaries: Lower $= -17.5$ and Upper $= 82.5$.

Question 8

3 marks

1. M1 for writing the expression for the total sum: $\Sigma fx = 50 + 15k + 40 = 90 + 15k$ and total frequency $\Sigma f = 7 + k$.
2. M1 for setting up the mean equation: $\frac{90 + 15k}{7 + k} = 14$.
3. A1 for solving to get $90 + 15k = 98 + 14k \implies k = 8$.

Question 9

3 marks

1. B1 for calculating the mean: $\bar{t} = \frac{1050}{30} = 35$ minutes.
2. M1 for applying the formula $\sigma = \sqrt{\frac{\Sigma t^2}{n} - \bar{t}^2} = \sqrt{\frac{38000}{30} - 35^2}$.
3. A1 for calculating $\sigma = \sqrt{1266.67 - 1225} = \sqrt{41.67} \approx 6.45$ minutes.

Question 10

4 marks

1. M1 for relating frequency to area: Area $\propto$ Frequency.
2. M1 for establishing the scaling factor: $30 \text{ units}^2 = 15 \text{ freq} \implies 1 \text{ freq} = 2 \text{ units}^2$.
3. M1 for calculating the target area: 40×2.
4. A1 for stating the area is 80 square units.

More measures of location and spread practice with instant feedback: alevelmathrevision.com/alevel-frontend/units/s1/measures-location-spread-questions

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