MARKING SCHEME

MATHEMATICS Compulsory Part · Paper 1

Topic practice: Measures of Dispersion · 2027

This marking scheme has been prepared for markers' reference. It is not a set of model answers. Award method marks where the working is sound. Accept equivalent methods unless the question specifies otherwise.

Question	Solution	Marks	Remarks
SECTION A(1) (16 marks)			
1.	**(a) Range** = 17 **(b) IQR** = 7 (a) Largest value = 20, smallest value = 3. Range = 20 − 3 = 17. (b) There are $n = 11$ data values. The median is the 6th value: 9. Lower half (first 5 values): 3, 5, 5, 6, 8; $Q_1 = 5$. Upper half (last 5 values): 10, 12, 12, 15, 20; $Q_3 = 12$. Interquartile range = $Q_3 - Q_1 = 12 - 5 = 7$.	3	
2.	**(a)** $\sigma \approx 4.73$ **(or exact** $\sqrt{\frac{114}{5}}$**) (b)** $\sigma \approx 4.73$ (a) Mean $\bar{x} = 10$. Deviations from mean: $-6, -3, -1, 2, 8$. Sum of squared deviations = 36 + 9 + 1 + 4 + 64 = 114. Variance = $\frac{114}{5} = 22.8$. Standard deviation = $\sqrt{22.8} \approx 4.73$. (b) Adding a constant to every data value does not change the spread, so the standard deviation remains $\sqrt{22.8} \approx 4.73$.	3	
3.	**(a) Range** = 76**, IQR** = 32 **(b) Positively skewed (skewed to the right).** (a) Range = 88 − 12 = 76. Interquartile range = $Q_3 - Q_1 = 60 - 28 = 32$. (b) The distance from the median to the upper quartile is 60 − 45 = 15, while the distance from the lower quartile to the median is 45 − 28 = 17. The right whisker is much longer than the left whisker (88 − 60 = 28 versus 28 − 12 = 16). The distribution is positively skewed (skewed to the right).	4	
4.	**(a) New mean** = 55**, new standard deviation** = 12 **(b) New mean** = 22**, new standard deviation** = 4.4 (a) If $y = 3x - 5$, then $\bar{y} = 3\bar{x} - 5 = 3(20) - 5 = 55$. The standard deviation is affected only by the multiplication: $\sigma_y = 3\sigma_x = 3(4) = 12$. (b) Increasing by 10% means multiplying by 1.1. New mean = 1.1(20) = 22. New standard deviation = 1.1(4) = 4.4.	6	

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Question	Solution	Marks	Remarks
SECTION A(2) (24 marks)			
5.	**(a) B's median is higher. (b) IQR A** $= 14$**, IQR B** $= 14$**; same. (c) Range A** $= 38$**, range B** $= 30$**; A has larger range. (d) Same spread for middle 50%. (e) The statement is not valid; median is a better measure of typical salary.** (a) Median of A $= 24$, median of B $= 26$. Company B has a higher median salary. (b) IQR of A $= 32 - 18 = 14$; IQR of B $= 34 - 20 = 14$. The interquartile ranges are equal. (c) Range of A $= 50 - 12 = 38$; range of B $= 45 - 15 = 30$. Company A has a larger overall range. (d) The middle 50% of salaries is represented by the box, whose length is the IQR. Since both IQRs are 14, the middle 50% of salaries has the same spread in both companies. (e) The maximum is an extreme value and does not represent the typical salary. The median of B is higher than that of A, so on average (in the sense of the median) Company B pays higher salaries. The statement is not valid.	7	
6.	**(a) IQR** ≈ 4.86 **(b) Range** $= 20$ **(c) Probability** ≈ 0.475 (a) Cumulative frequencies: 6, 16, 30, 37, 40. Q_1 position $=$ 10th value, which lies in the class $4 - 8$. Using linear interpolation within the class: $Q_1 = 4 + \frac{10-6}{10} \times 4 = 4 + 1.6 = 5.6$. Q_3 position $=$ 30th value, which is the upper boundary of the class $8 - 12$; hence $Q_3 = 12$. IQR $= 12 - 5.6 = 6.4$. (b) The smallest possible value is 0 and the largest possible value is 20, so the range is $20 - 0 = 20$. (c) Number of teenagers spending more than 10 hours: In $8 - 12$: assume uniform, proportion above 10 is $\frac{12-10}{4} = \frac{1}{2}$, so $14 \times \frac{1}{2} = 7$. In $12 - 16$: 7. In $16 - 20$: 3. Total $= 7 + 7 + 3 = 17$. Estimated probability $= \frac{17}{40} = 0.425$.	8	
7.	**(a)** 58.5 **(b)** ≈ 7.31 **(c) Mean** $= 63.5$**, SD** ≈ 7.31 (a) Original sum $= 20 \times 60 = 1200$. Correct sum $= 1200 - 80 + 50 = 1170$. Correct mean $= \frac{1170}{20} = 58.5$. (b) Original variance $= 8^2 = 64$. Original sum of squares $= \sum x^2 = n(\sigma^2 + \bar{x}^2) = 20(64 + 60^2) = 20(64 + 3600) = 73280$. Correct sum of squares $= 73280 - 80^2 + 50^2 = 73280 - 6400 + 2500 = 69380$. Correct variance $= \frac{69380}{20} - 58.5^2 = 3469 - 3422.25 = 46.75$. Correct standard deviation $= \sqrt{46.75} \approx 6.84$. (c) Adding 5 to each score increases the mean by 5: new mean $= 58.5 + 5 = 63.5$. The standard deviation is unchanged: ≈ 6.84.	9	

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Question	Solution	Marks	Remarks
SECTION B (10 marks)			
8.	**(a) Range** = 45**, IQR** = 19 **(b) Positively skewed. (c)** 12 **members (d) Median unchanged, IQR unchanged.** (a) Range = 60 − 15 = 45. IQR = $Q_3 - Q_1$ = 41 − 22 = 19. (b) The right whisker (60 − 41 = 19) is longer than the left whisker (22 − 15 = 7), and the distance from the median to Q_3 (41 − 30 = 11) is greater than the distance from Q_1 to the median (30 − 22 = 8). Hence the distribution is positively skewed (skewed to the right). (c) Since Q_3 = 41, about 75% of the members are aged 41 or below. With 24 members, 75% of 24 is 18, so 18 members are aged 41 or below. The number aged between 22 and 41 inclusive is the number from Q_1 to Q_3, which is about 50% of 24, i.e. 12 members. (d) Adding a new member aged 70 increases the total number to 25. The median is the 13th value. The original median was the average of the 12th and 13th values, both equal to 30. The new 13th value is still 30, so the median remains 30. The quartiles are found from the lower and upper halves; the lower quartile remains 22 and the upper quartile remains 41 (the new extreme value does not affect the middle 50%). Hence the interquartile range remains 19.	10	

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