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INTERNATIONAL A LEVEL MATHEMATICS • STATISTICS 1

Statistics 1

Exam Questions by Topic: Mark Scheme

Pearson Edexcel International Advanced Level (WST01/01) • Calculator and Statistical Tables allowed

Every question in the booklet, marked line by line the way an examiner marks it

Chapters (tap a chapter to jump to it)	Qs	Marks	Page	My score
1 Mathematical Modelling Not examined on its own: modelling ideas are tested within Chapters 2 to 7	—	—	Not applicable	
2 Measures of Location and Spread Averages, quartiles, interpolation, standard deviation, coding	10	83	3	
3 Representations of Data Histograms, stem and leaf, box plots, outliers, skewness, comparisons	10	80	own PDF	
4 Probability Venn and tree diagrams, conditional probability, independence	10	80	own PDF	
5 Correlation and Regression PMCC, least squares regression, interpretation, coding	10	84	own PDF	
6 Discrete Random Variables Probability and cumulative distributions, $E(X)$, $\text{Var}(X)$, uniform	10	82	own PDF	
7 The Normal Distribution Standardising, tables, finding μ and σ , conditional problems	10	83	own PDF	

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How to use this mark scheme

The same marking rules Pearson examiners use for WST01.

Mark every line, not just the answer. Method marks are given for a correct method even when the final answer is wrong. If you lost marks, find the *first* line where your working differs from the scheme. That is the thing to fix.

Code	Meaning
M1	Method mark: for knowing a correct method and attempting to apply it. Small slips in the working do not lose this mark.
dM1	Dependent method mark: can only be given if the method mark before it has been given.
A1	Accuracy mark: for a correct answer or line of working. It can only be given if the method mark it depends on has been given.
B1	Independent mark: for a correct result or statement, whatever method was used.
*	The answer is given in the question. Every step must be shown, and the answer must follow from correct working (cso).
cao	Correct answer only.
cso	Correct solution only: no errors anywhere in the working.
ft	Follow through: the mark can be given for correct work using your own earlier (wrong) answer.
oe	Or equivalent: any correct equivalent form is accepted.

“Solutions relying on calculator technology are not acceptable.” When a question says this, a correct final answer with no algebraic working scores **no marks**. The notes under each scheme line say when this applies.



2

Chapter 2: Measures of Location and Spread

Mark scheme. Marks are shown on the right of each line.

Question 1

6 marks

Part	Scheme	Marks
(a)	Cumulative frequencies 7, 19, 29, 35, 38, 40; the 20th and 21st values give $\text{median} = 2$ Q_1: 10th and 11th values = 1; Q_3: 30th and 31st values = 3 $\text{IQR} = 2$	B1 M1 A1 (3)
(b)	$\sum fx = 72$, so $\bar{x} = 1.8$ $\sigma^2 = \frac{204}{40} - 1.8^2 = 1.86$ $\sigma = 1.36$ <i>The common error is to forget to subtract $\bar{x}^2$, or to give the variance instead of the standard deviation.</i>	B1 M1 A1 (3)
Total for Question 1: 6 marks		

Question 2

5 marks

Part	Scheme	Marks
(a)	Boundaries 179.5 and 194.5 , midpoint 187	B1 (1)
(b)	Midpoints 154.5, 164.5, 174.5, 187, 202: $\frac{13905}{80}$ 173.8 cm (173.8125)	M1 A1 (2)
(c)	40th value, in the 170–179 class: $169.5 + \frac{40 - 30}{30} \times 10$ 172.8 cm <i>Using 170 instead of the class boundary 169.5 scores M1 A0. Using $n+1$ (40.5th value) is condoned.</i>	M1 A1 (2)
Total for Question 2: 5 marks		



Question 3

5 marks

Part	Scheme	Marks
(a)	$\bar{x} = 46$	B1
	$\sigma^2 = \frac{53850}{25} - 46^2 = 38$	M1
	$\sigma = 6.16$	A1
		(3)
(b)	Corrected $\sum x = 1150 + 20 = 1170$	M1
	46.8 minutes	A1
		(2)
Total for Question 3: 5 marks		

Question 4

6 marks

Part	Scheme	Marks
(a)	$\bar{y} = \frac{64}{16} = 4$ and $\bar{x} = 5\bar{y} + 200$	M1
	220 g	A1
		(2)
(b)	$\sigma_y^2 = \frac{544}{16} - 4^2 = 18$	M1
	$\sigma_x = 5\sigma_y = 5\sqrt{18}$	M1
	21.2 g	A1
	The “−200” does not affect the spread. Using 5^2 on the standard deviation, or dividing by 5, scores M1 M0 A0.	(3)
(c)	$25 \times 18 = 450$	B1
		(1)
Total for Question 4: 6 marks		



Question 5

5 marks

Part	Scheme	Marks
(a)	Totals $12 \times 64 = 768$ and $8 \times 59 = 472$ 62	M1 A1 (2)
(b)	$\sum x^2 = n(\sigma^2 + \bar{x}^2): 12(25 + 4096) + 8(16 + 3481) = 77\,428$ $\sigma^2 = \frac{77\,428}{20} - 62^2 = 27.4$ 5.23	M1 M1 A1 (3)
Total for Question 5: 5 marks		

Question 6

12 marks

Part	Scheme	Marks
(a)	Median: 30th value, $140 + \frac{30 - 21}{18} \times 10 = 145$ $\text{Median} = 145 \text{ g}$ $Q_1 = 120 + \frac{15 - 6}{15} \times 20 = 132$ and $Q_3 = 150 + \frac{45 - 39}{13} \times 20 = 159.23 \dots$ $\text{IQR} = 27.2 \text{ g}$	M1 A1 M1 A1 (4)
(b)	Midpoints 110, 130, 145, 160, 185: $\sum fx = 8780$ $\bar{x} = 146 \text{ g}$ (146.33...) $\sigma^2 = \frac{1\,311\,150}{60} - 146.33 \dots^2 = 439.05 \dots$ $\sigma = 21.0 \text{ g}$	M1 A1 M1 A1 (4)
(c)	$\frac{170 - 160}{20} \times 13 + 8$ 14.5 (accept 14 or 15)	M1 A1 (2)
(d)	Without replacement: $\frac{18}{60} \times \frac{17}{59}$ 0.0864 $\left(\frac{18}{60}\right)^2 = 0.09$ (with replacement) scores M0 A0: the second potato cannot be the first one again.	M1 A1 (2)
Total for Question 6: 12 marks		



Question 7

11 marks

Part	Scheme	Marks
(a)	$\bar{y} = \frac{58}{40} = 1.45$ $\bar{w} = 4 \times 1.45 + 50 = 55.8$ *	M1 A1* (2)
(b)	$\sigma_y^2 = \frac{262}{40} - 1.45^2 = 4.4475$ $\sigma_w = 4\sigma_y$ 8.44 g	M1 M1 A1 (3)
(c)	$\sum w = 40 \times 55.8 = 2232$ $\sum w^2 = 40(71.16 + 55.8^2)$, using $\sigma_w^2 = 16 \times 4.4475 = 71.16$ $\sum w^2 = 127392$	B1 M1 A1 (3)
(d)	(i) The mean is unchanged, as the new value equals the mean (ii) The standard deviation decreases because $\sum (w - \bar{w})^2$ is unchanged but is now divided by 41 instead of 40 <i>The last B1 needs a reason about the spread (the new value adds no deviation but increases n).</i>	B1 B1 B1 (3)
Total for Question 7: 11 marks		



Question 8

10 marks

Part	Scheme	Marks
(a)	Midpoints 2.5, 7.5, 12.5, 17.5, 25: $\sum fx = 602.5$	M1
	$\bar{t} = 12.05 \text{ min}$	A1
	$\sum fx^2 = 9206.25$, so $\sigma^2 = \frac{9206.25}{50} - 12.05^2 = 38.92 \dots$	M1
	$\sigma = 6.24 \text{ min}$	A1
		(4)
(b)	90th percentile is the 45th value	M1
	Cumulative frequency reaches 45 at the end of the $15 \leq t < 20$ class, so $P_{90} = 20$ minutes	A1
	$20 > 18$: more than 10% wait longer than 18 minutes, so the claim is not supported	A1
		(3)
(c)	$\bar{t} + \sigma = 18.29$ (in the $15 \leq t < 20$ class)	M1
	$\frac{20 - 18.29}{5} \times 9 + 5$	M1
	8 customers (8.08...)	A1
		(3)
Total for Question 8: 10 marks		



Question 9

11 marks

Part	Scheme	Marks
(a)	$\sum fx = 4 + 2p + 30 + 28 + 15 = 77 + 2p$ and $\sum f = 24 + p$ $\frac{77 + 2p}{24 + p} = 3$ $77 + 2p = 72 + 3p$, so $p = 5$ *	M1 M1 A1* (3)
(b)	$n = 29$: median is the 15th value, 3 Q_1 is the 8th value = 2 and Q_3 is the 22nd value = 4 IQR = 2	B1 M1 A1 (3)
(c)	$\sum fx^2 = 4 + 20 + 90 + 112 + 75 = 301$ $\sigma^2 = \frac{301}{29} - 3^2$ 1.17	B1 M1 A1 (3)
(d)	$\frac{87 + k}{30} = 3.1$ k = 6	M1 A1 (2)
Total for Question 9: 11 marks		



Question 10

12 marks

Part	Scheme	Marks
(a)	$\bar{y} = 1.5$, so $\bar{x} = 501.5 \text{ g}$ $\sigma_y^2 = \frac{245}{20} - 1.5^2 = 10$ $\sigma_x = 3.16 \text{ g}$ (the coding $y = x - 500$ does not change the spread)	B1 M1 A1 (3)
(b)	$\frac{30 \times 502 + 20 \times 501.5}{50}$ 501.8 g	M1 A1 (2)
(c)	$\sum x_A^2 = 30(9 + 502^2) = 7\,560\,390$ $\sum x_B^2 = 20(10 + 501.5^2) = 5\,030\,245$ $\sigma^2 = \frac{12\,590\,635}{50} - 501.8^2 = 9.46$ 3.08 g <i>Rounding the means or the sums of squares early spoils the subtraction: keep all figures.</i>	M1 M1 M1 A1 (4)
(d)	$\frac{30 \times 502 - 10}{30} = 501.7 \text{ g}$ $\text{Less than } 3 \text{ g}$ 511 was 9 g above the mean; 501 is close to the new mean, so the total squared deviation is much smaller	B1 B1 B1 (3)
Total for Question 10: 12 marks		

