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INTERNATIONAL A LEVEL MATHEMATICS • STATISTICS 1 (WST01)

Statistics 1 Practice Paper 2

Mark Scheme

AIMING FOR A

Written in the style of the Pearson Edexcel International Advanced Level paper (WST01/01) • 75 marks

Every question marked line by line the way an examiner marks it, with notes on the common errors

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 depends on the method mark before it.
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 / cso	Correct answer only / correct solution only, with no errors anywhere in the working.
ft / oe	Follow through from your own earlier answer / or any correct equivalent form.
awrt	Answers which round to the value given, so $-0.9637\ldots$ earns “awrt -0.964”.

Normal distribution: show the standardisation. Write $z = (x - \mu)/\sigma$ with the numbers in, then use the tables: probabilities to 4 decimal places, and percentage points such as 1.6449 and 2.3263 to 4 decimal places. A calculator answer with no standardisation shown can lose the method marks.

Rough grade guide (out of 75): A **58** • B **49** • C **40**

Based on recent WST01 grade boundaries. Real boundaries change every series, so treat this as a guide, not a grade.

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What to revise next

Write in your score for each question. Where you dropped marks, tap the chapter to practise ten more exam questions on it.

Q	What it tested	Marks	Practise it	Score
1	A distribution built from a sample space; E(X), Var(X) and a linear function	10	Ch 6 Discrete Random Variables Ch 4 Probability	
2	Combining and correcting summary statistics; comparing box plots; scaling	11	Ch 2 Location and Spread Ch 3 Representations of Data	
3	Coded summary statistics, correlation and a regression line in the original units	11	Ch 5 Correlation and Regression Ch 2 Location and Spread	
4	Normal parameters from two percentages; a conditional probability	10	Ch 7 The Normal Distribution Ch 4 Probability	
5	A survey Venn diagram with independent and mutually exclusive events	11	Ch 4 Probability	
6	A histogram drawn to scale; interpolated quartiles; fitting a normal model	11	Ch 3 Representations of Data Ch 7 The Normal Distribution	
7	Unknown probabilities from E(X); two independent observations	11	Ch 6 Discrete Random Variables Ch 4 Probability	
	Total	**75**		

Where did the marks go? If you lost the first marks of a question, the method needs work: go back to that chapter's key skills page. If you lost the final marks, the method is fine and the gap is a link between topics, such as carrying coding back to the original units or using a probability from one part in the next. Paper 3 gives no route at all and hides a trap in every question.

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Question 1

10 marks

Part	Scheme	Marks
(a)	25 equally likely pairs; $P(X = x) = P(\text{both} \leqslant x) - P(\text{both} \leqslant x-1) = \dfrac{x^2-(x-1)^2}{25}$, or a sample-space diagram	M1
	At least three probabilities correct	A1
	$\begin{array}{c\|ccccc} x & 1 & 2 & 3 & 4 & 5 \\ \hline P(X=x) & \frac{1}{25} & \frac{3}{25} & \frac{5}{25} & \frac{7}{25} & \frac{9}{25} \end{array}$	A1
	Treating X as uniform (each $\frac{1}{5}$) scores M0. The larger score is more likely to be large.	(3)
(b)	$E(X) = \dfrac{1+6+15+28+45}{25} = \dfrac{95}{25}$	M1
	$\boxed{3.8}$	A1
		(2)
(c)	$E(X^2) = \dfrac{1+12+45+112+225}{25}$	M1
	$= 15.8$	A1
	$\text{Var}(X) = 15.8 - 3.8^2 = \boxed{1.36}$	A1
		(3)
(d)	$E(W) = 3 \times 3.8 - 8 = 3.4$, and $3X - 8 > 3.4$ when $X > 3.8$	M1
	$P(X = 4) + P(X = 5) = \boxed{\dfrac{16}{25}}$ $(= 0.64)$	A1
		(2)
		Total for Question 1: 10 marks

Question 2

11 marks

Part	Scheme	Marks
(a)	$\sum = 1240 + 1680 = 2920$ and $\sum x^2 = 78\,160 + 97\,080 = 175\,240$	**M1**
	Mean $= \dfrac{2920}{50} = \boxed{58.4}$	**A1**
	$\sigma = \sqrt{\dfrac{175\,240}{50} - 58.4^2} = \sqrt{94.24}$	**M1**
	$\boxed{9.71}$ (awrt)	**A1**
		(4)
(b)	$\sum = 2920 + 30 = 2950$ and $\sum x^2 = 175\,240 - 48^2 + 78^2 = 179\,020$	**M1**
	Mean $\boxed{59}$	**A1**
	$\sigma = \sqrt{3580.4 - 59^2} = \sqrt{99.4} = \boxed{9.97}$ (awrt)	**A1**
	Both totals change: $\sum x$ by +30 and $\sum x^2$ by $78^2 - 48^2$. Adding 30^2 to $\sum x^2$ scores M0.	**(3)**
(c)	The median for class A (63) is higher than for class B (56), so class A generally scored higher	**B1**
	Class B is more spread out: IQR 14 against 11 (or range 44 against 34)	**B1**
	Each comparison must use the values from the box plots and be in context.	**(2)**
(d)	Mean $= 1.5 \times 59 - 10$, or s.d. $= 1.5 \times 9.97\ldots$	**M1**
	Mean $\boxed{78.5}$, s.d. $\boxed{15.0}$ (awrt 14.95 or 15.0)	**A1**
	The -10 moves every mark by the same amount, so it does not change the standard deviation.	**(2)**
		Total for Question 2: 11 marks

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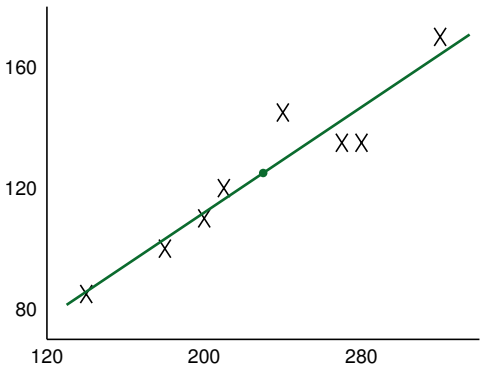
Question 3

11 marks

Part	Scheme	Marks
(a)	$S_{uu} = 314 - \dfrac{24^2}{8}$	M1
	Two of $S_{uu} = 242$, $S_{vv} = 204$, $S_{uv} = 211$	A1
	All three correct	A1
		(3)
(b)	$r = \dfrac{211}{\sqrt{242 \times 204}}$	M1
	0.950 (awrt), because coding by subtracting and dividing by positive numbers does not change r	A1
		(2)
(c)	$b_v = \dfrac{211}{242} = 0.8719\ldots$	M1
	$\bar{u} = 3$, $\bar{v} = 5$: $v = 2.384\ldots + 0.8719\ldots u$	M1
	$\dfrac{y - 100}{5} = 2.384 + 0.8719\left(\dfrac{x - 200}{10}\right)$	M1
	$y = 24.7 + 0.436x$	A1
	The gradient is multiplied by $\frac{5}{10}$, not left as 0.872. Check: the line must pass through $(\bar{x}, \bar{y}) = (230, 125)$.	
		(4)
(d)		B1
	A straight line through (230, 125) and, for example, (150, 90.1) and (300, 155.5)	
		(1)
(e)	Each extra 1 mm of length adds about 0.436 g to the mass (oe, e.g. 10 mm adds 4.36 g)	B1
		(1)
		Total for Question 3: 11 marks

Question 4

10 marks

Part	Scheme	Marks
(a)	$z = -1.2816$ for the lower 10%	**B1**
	$z = 0.8416$ for the upper 20%	**B1**
	$\frac{48.8-\mu}{\sigma} = -1.2816$ and $\frac{54.1-\mu}{\sigma} = 0.8416$	**M1**
	Subtracting: $5.3 = 2.1232\sigma$	**M1**
	$\boxed{\sigma = 2.50}$, $\boxed{\mu = 52.0}$ (awrt)	**A1**
		(5)
(b)	$P(L > 55) = P(Z > 1.20) = 1 - 0.8849 = 0.1151$	**M1**
	$\frac{P(L>55)}{P(L>52)} = \frac{0.1151}{0.5}$	**M1**
	$\boxed{0.230}$ (awrt)	**A1**
	The event "longer than 55" is inside "longer than 52", so the numerator is just $P(L > 55)$*, and 52 is the mean.*	
		(3)
(c)	$3 \times 0.1151 \times 0.8849^2$	**M1**
	$\boxed{0.270}$ (awrt)	**A1**
		(2)
		Total for Question 4: 10 marks

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Question 5

11 marks

Part	Scheme	Marks
(a)	Total: $p+q+25+r+18+27=120$, so $p+q+r=50$	M1
	Basketball: $q+25+r=45$, so $q+r=20$	M1
	$\boxed{p=30}$	A1
	Independence: $\frac{q}{120}=\frac{p+q}{120}\times\frac{45}{120}$, so $q=\frac{3}{8}(30+q)$	M1
	$\boxed{q=18}$, $\boxed{r=2}$	A1
		(5)
(b)	$\frac{r}{45}$	M1
	$\boxed{\frac{2}{45}}$	A1
		(2)
(c)	Not cricket: $120-20=100$ students, of whom $30+18=48$ play football	M1
	$\boxed{0.48}$	A1
	All 48 footballers are outside C, because F and C are mutually exclusive.	
		(2)
(d)	$\mathrm{P}(B\cap C)=\frac{2}{120}=\frac{1}{60}$ and $\mathrm{P}(B)\times\mathrm{P}(C)=\frac{45}{120}\times\frac{20}{120}=\frac{1}{16}$	M1
	$\frac{1}{60}\neq\frac{1}{16}$, so B and C are not independent	A1
		(2)
	Total for Question 5: 11 marks	

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Question 6

11 marks

Part	Scheme	Marks
(a)	Width: the class is half as wide, so $\boxed{1.5\,\text{cm}}$	B1
	Area $3 \times 1.4 = 4.2\,\text{cm}^2$ for 28 tomatoes, so $0.15\,\text{cm}^2$ each; 52 tomatoes need $7.8\,\text{cm}^2$	M1
	Height $= \dfrac{7.8}{1.5} = \boxed{5.2\,\text{cm}}$	A1
		(3)
(b)	Q_1: 50th value, $80 + \dfrac{50-34}{40} \times 5$	M1
	$\boxed{Q_1 = 82}$	A1
	Q_3: 150th value, $90 + \dfrac{150-126}{60} \times 10 = \boxed{94}$	A1
		(3)
(c)	$z = 0.6745$ for the upper quartile	B1
	$(87.5 + 0.6745\sigma) - (87.5 - 0.6745\sigma) = 94 - 82$, so $1.349\sigma = 12$	M1
	$\boxed{\sigma = 8.90}$ (awrt)	A1
		(3)
(d)	$\text{P}(M > 100) = \text{P}\left(Z > \dfrac{12.5}{8.90}\right) = \text{P}(Z > 1.41) = 0.0793;\ 200 \times 0.0793 = 15.9$	M1
	About 16, close to the 14 in the table, so the model is reasonable here (oe)	A1
		(2)
		Total for Question 6: 11 marks

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Question 7

11 marks

Part	Scheme	Marks
(a)	$0.2+a+0.25+b+0.1=1$, so $a+b=0.45$	**M1**
	$0.2+2a+0.75+4b+0.5=2.85$, so $2a+4b=1.4$	**M1**
	$\boxed{a=0.2}$, $\boxed{b=0.25}$	**A1**
		(3)
(b)	$\mathrm{E}(X^2)=0.2+0.8+2.25+4+2.5=9.75$	**M1**
	$\mathrm{Var}(X)=9.75-2.85^2=1.6275$, and $\mathrm{Var}(5-3X)=9\,\mathrm{Var}(X)$	**M1**
	$\boxed{14.6}$ (awrt 14.6 or 14.65)	**A1**
		(3)
(c)	Pairs $(1,3)$, $(3,1)$ and $(2,2)$	**M1**
	$2\times0.2\times0.25+0.2\times0.2$	**M1**
	$\boxed{0.14}$	**A1**
	The pairs $(1,3)$ *and* $(3,1)$ *are different outcomes, so their product is doubled;* $(2,2)$ *is counted once.*	
		(3)
(d)	$\mathrm{P}(X_1=X_2)=0.2^2+0.2^2+0.25^2+0.25^2+0.1^2=0.215$, and by symmetry	
	$\mathrm{P}(X_1>X_2)=\dfrac{1-0.215}{2}$ (or a full listing)	**M1**
	$\boxed{0.3925}$	**A1**
		(2)
		Total for Question 7: 11 marks

TOTAL FOR PAPER: 75 MARKS