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INTERNATIONAL A LEVEL MATHEMATICS • STATISTICS 1 (WST01)

Statistics 1 Practice Paper 1

Mark Scheme

AIMING FOR B

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 **63** • B **54** • C **45**

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 discrete random variable: probability function, F(x), E(X) and Var(X)	10	Ch 6 Discrete Random Variables	
2	Quartiles from a stem and leaf diagram, outliers, a box plot and skewness	10	Ch 3 Representations of Data Ch 2 Location and Spread	
3	S values, correlation, a regression line, interpolation and extrapolation	11	Ch 5 Correlation and Regression	
4	A Venn diagram with independence; conditional probability	9	Ch 4 Probability	
5	A histogram, interpolation, mean and standard deviation of grouped data	12	Ch 3 Representations of Data Ch 2 Location and Spread	
6	Standardising, symmetry, the inverse normal and “exactly two of three”	11	Ch 7 The Normal Distribution Ch 4 Probability	
7	A tree diagram without replacement, conditional probability and a quadratic	12	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 accuracy, a missing reason or an answer not put in context. In Statistics 1 many marks are for one sentence of interpretation, so practise writing it with the numbers and the context.

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Question 1

10 marks

Part	Scheme	Marks
(a)	$k(1+2+3)+k(3+2+1)=1$, so $12k=1$ $k=\frac{1}{12}$	M1 A1* (2)
(b)	$F(2.5)=P(X\leqslant 2)=P(X=1)+P(X=2)=\frac{1}{12}+\frac{2}{12}$ $\boxed{\frac{1}{4}}$ *X only takes whole-number values, so $F(2.5)$ is the same as $F(2)$. Using $P(X\leqslant 3)$ scores M0.*	M1 A1 (2)
(c)	$\boxed{E(X)=3.5}$, because the distribution is symmetrical about 3.5	B1 (1)
(d)	$E(X^2)=\frac{1\times 1+4\times 2+9\times 3+16\times 3+25\times 2+36\times 1}{12}$ $=\frac{170}{12}=\frac{85}{6}$ $\text{Var}(X)=\frac{85}{6}-3.5^2=\frac{23}{12}$	M1 A1 A1* (3)
(e)	$\text{Var}(5-3X)=(-3)^2\,\text{Var}(X)=9\times\frac{23}{12}$ $\boxed{\frac{69}{4}=17.25}$ *The 5 does not change the spread, and the -3 is squared. Using $-3\times\frac{23}{12}$ or $5-3\times\frac{23}{12}$ scores M0.*	M1 A1 (2)
		Total for Question 1: 10 marks

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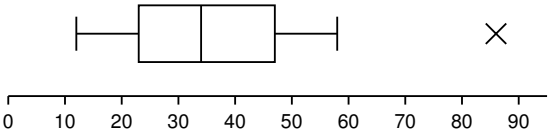
Question 2

10 marks

Part	Scheme	Marks
(a)	Median: the 14th value, $\boxed{Q_2 = 34}$	B1
	$\frac{27}{4} = 6.75$, so the 7th value: $\boxed{Q_1 = 23}$	B1
	$\frac{3\times 27}{4} = 20.25$, so the 21st value: $\boxed{Q_3 = 47}$	B1
		(3)
(b)	$Q_3 - Q_1 = 24$: $47 + 1.5 \times 24 = 83$ and $23 - 1.5 \times 24 = -13$	M1
	$86 > 83$, so 86 is an outlier. The next largest value is $58 < 83$ and the smallest is $12 > -13$, so there are no other outliers	A1
		(2)
(c)		B1
	Box from 23 to 47 with the median at 34	
	Whiskers to 12 and to 58 (not to 86)	B1
	The outlier 86 marked separately with a cross	B1
		(3)
(d)	$\boxed{\text{Positive skew}}$	B1
	$Q_3 - Q_2 = 13 > Q_2 - Q_1 = 11$	B1
	The second B1 needs the two values (or a correct comparison of them), not just "the upper whisker is longer".	
		(2)
	Total for Question 2: 10 marks	

Question 3

11 marks

Part	Scheme	Marks
(a)	$S_{td} = 7829 - \dfrac{112 \times 770}{10}$ $= 7829 - 8624 = -795$	M1 A1* (2)
(b)	$r = \dfrac{-795}{\sqrt{215.6 \times 3156}}$ $\boxed{-0.964}$ awrt	M1 A1 (2)
(c)	Strong negative correlation: on warmer days the café sells fewer hot drinks *The comment must be in context (temperature and hot drinks). "Strong negative correlation" alone scores B0.*	B1 (1)
(d)	$b = \dfrac{-795}{215.6} = -3.687\ldots$ $a = 77 - b \times 11.2 = 118.29\ldots$ $\boxed{d = 118 - 3.69t}$	M1 M1 A1 (3)
(e)	$118 - 3.69 \times 12 = 73.7$: $\boxed{74}$ hot drinks (awrt 74)	B1 (1)
(f)	30 °C is outside the range of the data (4 °C to 19 °C), so this would be extrapolation	B1 (1)
(g)	A model simplifies the real world: other factors, such as the day of the week or rain, also affect sales	B1 (1)
		Total for Question 3: 11 marks

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Question 4

9 marks

Part	Scheme	Marks
(a)	$0.12+p+0.20+q+0.15+0.33=1$, so $p+q=0.2$	**M1**
	Independence: $\mathrm{P}(A\cap B)=\mathrm{P}(A)\mathrm{P}(B)$, so $p=(0.12+p)(p+0.20+q)=(0.12+p)\times 0.4$	**M1**
	$\boxed{p=0.08}$	**A1**
	$\boxed{q=0.12}$	**A1**
	Using $p+q=0.2$ inside $\mathrm{P}(B)$ is the key step: it makes $\mathrm{P}(B)=0.4$, so the equation is linear in p	**(4)**
(b)	$\mathrm{P}(A\cup C)=0.12+0.08+0.12+0.15=0.47$	**M1**
	$\mathrm{P}(B\cap(A\cup C))=0.08+0.12=0.2$	**M1**
	$\frac{0.2}{0.47}=\boxed{\frac{20}{47}}$ (awrt 0.426)	**A1**
		(3)
(c)	$\mathrm{P}(B)\times\mathrm{P}(C)=0.4\times 0.27=0.108$	**M1**
	$\mathrm{P}(B\cap C)=0.12\neq 0.108$, so B and C are $\boxed{\text{not independent}}$	**A1**
	All three values must be seen, with a conclusion. Writing only "not independent" scores M0 A0.	**(2)**
		Total for Question 4: 9 marks

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Question 5

12 marks

Part	Scheme	Marks
(a)	Area = frequency: $5 \times 2 + 5 \times 4.4$ $\boxed{32}$	M1 A1 (2)
(b)	$3 \times 4.4 + 5 \times 6 + 5 \times 2.4$ $(= 13.2 + 30 + 12)$ $\boxed{55}$ (accept 55.2)	M1 A1 (2)
(c)	50th value: 32 people below 15, so $15 + \dfrac{50 - 32}{30} \times 5$ $\boxed{18}$ minutes (accept 18.1 from using $n+1$)	M1 A1 (2)
(d)	Midpoints 7.5, 12.5, 17.5, 25, 35, 50: $\bar{t} = \dfrac{2025}{100}$ $\sigma = \sqrt{\dfrac{50437.5}{100} - 20.25^2}$ $\boxed{\text{mean } 20.25}$, $\boxed{\text{s.d. } 9.71}$ (awrt) *The frequency comes from the area of each bar: 10, 22, 30, 24, 10, 4. Using the frequency densities as frequencies scores M0.*	M1 M1 A1 (3)
(e)	$\boxed{\text{Positive skew}}$ Mean (20.25) $>$ median (18)	B1 B1 (2)
(f)	The times are skewed, but a normal distribution is symmetrical	B1 (1)
		Total for Question 5: 12 marks

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Question 6

11 marks

Part	Scheme	Marks
(a)	$P(X < 1000) = P\left(Z < \frac{1000-1010}{8}\right) = P(Z < -1.25)$ $= 1 - 0.8944 =$ $\boxed{0.1056}$ (awrt 0.106)	**M1** **A1** **(2)**
(b)	1020 is as far above the mean as 1000 is below it: $\boxed{0.1056}$	**B1** **(1)**
(c)	$z = 1.6449$ $\frac{w-1010}{8} = 1.6449$ $\boxed{w = 1023}$ (awrt 1023)	**B1** **M1** **A1** **(3)**
(d)	$3 \times 0.1056^2 \times 0.8944$ (three orders: LLH, LHL, HLL) $\boxed{0.0299}$ (awrt) *Without the factor 3 the answer is 0.00997, the probability of one particular order only.*	**M1** **A1** **(2)**
(e)	$P(X < 1000) = 0.01$, so $z = -2.3263$ $\frac{1000-\mu}{8} = -2.3263$ $\mu = 1000 + 18.61 = 1018.6\ldots = 1019$ grams to the nearest gram *The new mean must be above 1000, so the z-value is negative. Using +2.3263 gives $\mu = 981.4$, which should be rejected.*	**B1** **M1** **A1*** **(3)**
		Total for Question 6: 11 marks

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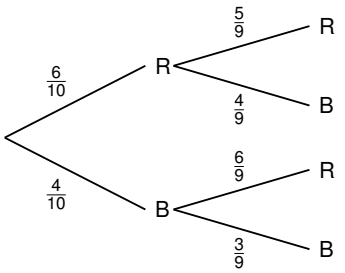
Question 7

12 marks

Part	Scheme	Marks
(a)	 After a red: $\frac{5}{9}$ (red) and $\frac{4}{9}$ (blue) After a blue: $\frac{6}{9}$ (red) and $\frac{3}{9}$ (blue)	B1 B1 (2)
(b)	$\frac{6}{10} \times \frac{5}{9} + \frac{4}{10} \times \frac{3}{9}$ $\boxed{\frac{7}{15}}$	M1 A1 (2)
(c)	$1 - \frac{6}{10} \times \frac{5}{9}$ (or the sum of the three products with a blue) $\boxed{\frac{2}{3}}$	M1 A1 (2)
(d)	P(red then blue) = $\frac{6}{10} \times \frac{4}{9} = \frac{4}{15}$ $\frac{4/15}{2/3}$ $\boxed{\frac{2}{5}}$ *The numerator is only the outcomes that are in both events: red first* and *at least one blue.*	M1 M1 A1 (3)
(e)	$\frac{6}{10+k} \times \frac{5}{9+k} = \frac{1}{7}$ $(10+k)(9+k) = 210$, so $k^2 + 19k + 90 = 210$ and $k^2 + 19k - 120 = 0$ $(k-5)(k+24) = 0$: $\boxed{k = 5}$ ($k = -24$ rejected)	M1 A1* A1 (3)
		Total for Question 7: 12 marks

TOTAL FOR PAPER: 75 MARKS

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