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Mark Scheme (Results)

October 2022

Pearson Edexcel International Advanced Level In Statistics S1 (WST01) Paper 01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

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PEARSON EDEXCEL IAL MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

'M' marks
These are marks given for a correct method or an attempt at a correct method. In Mechanics they are usually awarded for the application of some mechanical principle to produce an equation.
e.g. resolving in a particular direction, taking moments about a point, applying a suvat equation, applying the conservation of momentum principle etc.
The following criteria are usually applied to the equation.

To earn the M mark, the equation
(i) should have the correct number of terms
(ii) be dimensionally correct i.e. all the terms need to be dimensionally correct
e.g. in a moments equation, every term must be a 'force x distance' term or 'mass x distance', if we allow them to cancel 'g' s.
For a resolution, all terms that need to be resolved (multiplied by sin or cos) must be resolved to earn the M mark.

M marks are sometimes dependent (DM) on previous M marks having been earned.
e.g. when two simultaneous equations have been set up by, for example, resolving in two directions and there is then an M mark for solving the equations to find a particular quantity – this M mark is often dependent on the two previous M marks having been earned.

'A' marks
These are dependent accuracy (or sometimes answer) marks and can only be awarded if the previous M mark has been earned. E.g. M0 A1 is impossible.

'B' marks
These are independent accuracy marks where there is no method (e.g. often given for a comment or for a graph)

A few of the A and B marks may be f.t. – follow through – marks.

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3. General Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes.

- bod – benefit of doubt
- ft – follow through
- the symbol $\surd$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- * The answer is printed on the paper
- ⌊ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:

If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

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Special notes for marking Statistics exams (for AAs only)

- Any correct method should gain credit. If you cannot see how to apply the mark scheme but believe the method to be correct then please send to review.
- For method marks, we generally allow or condone a slip or transcription error if these are seen in an expression. We do not, however, condone or allow these errors in accuracy marks.

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Question Number	Scheme	Marks
1. (a)	[Area = k × frequency $\rightarrow$ 16.5 = k × 12 $\rightarrow$] Area = $\frac{16.5}{12}\times 18$ oe	M1
	= **<u>24.75</u>** (cm^2)	A1 (2)
(b)	fd method $\frac{24}{58-55}[=8]$ **and** $\frac{35}{55-50}[=7]$ **or**	
	Area method $\frac{16.5}{12}\times 24[=33]$ **and** $\frac{16.5}{12}\times 35[=48.125]$ **or**	M1
	$\frac{16.5}{12}\times\frac{24}{3}[=11]$ **and** $\frac{16.5}{12}\times\frac{35}{5}[=9.625]$	
	Let h = height of the 2nd tallest bar	
	$[h=]\frac{10}{'8'}\times'7'$ **or** $[h=]\frac{"48.125"\times 10\times 3}{5\times"33"}$ **or** $[h=]"9.625"\times\frac{10}{"11"}$	dM1
	= **<u>8.75</u>** (cm)	A1 (3)
(c)(i)	$[Q_2=]50+\frac{7}{35}\times 5$ or $[Q_2=]55-\frac{28}{35}\times 5$	M1
	= **<u>51</u>** (cm)	A1
(ii)	$[Q_3=]55+\frac{2}{24}\times 3$ or $[Q_3=]58-\frac{22}{24}\times 3$ **and** $"55.25"-45$	M1
	= **<u>10.25</u>** (cm)	A1 (4)
(d)	$\frac{"55.25"-2("51")+45}{"55.25"-45}$	M1
	[= –0.17073… < 0] negative [skew].	A1ft (2)
	Notes	**[11]**

(a)
M1 allow equivalent eg $16.5\times\frac{3}{2}$
A1 for 24.75 allow 24.8

(b)
M1 correct method for finding the frequency density or area for the highest **and** 2nd highest bars
Allow if 8 and 7 seen or 33 and 48.125 seen or 9.625 rather than 48.125 and/or 11 seen rather than 33
dM1 dep on previous M mark awarded. A fully correct expression for h or a fully correct equation to enable h to be found eg $\frac{"33"}{10\times 3}=\frac{"48.125"}{5h}$
A1 8.75 oe **NB** answer of 8.75 seen as final answer 3/3

(c)(i)
M1 for $50+\frac{7}{35}\times k$ **or** $55-\frac{28}{35}\times k$ **or** $\frac{Q_2-50}{k}=\frac{60-53}{88-53}$ **or** $\frac{55-Q_2}{k}=\frac{88-60}{88-53}$ where 4,, k,, 6 oe
(condone use of n + 1 ie 7.5 rather than 7, 27.5 rather than 28 or 60.5 rather than 60)
A1 51 (condone for use of n + 1 awrt 51.1)

(ii)
M1 $55+\frac{2}{24}\times t$ **or** $58-\frac{22}{24}\times t$ **or** $\frac{Q_3-55}{t}=\frac{90-88}{112-88}$ **or** $\frac{58-Q_3}{t}=\frac{112-90}{112-88}$ oe where 2,, t,, 4
and using $"\text{their } Q_3"-45$
(condone use of n + 1 ie 2.5 or 2.75 rather than 2, 21.5 or 21.25 rather than 22 or 90.5 or 90.75 rather than 90)
A1 10.25 oe eg 41/4 allow 10.3 from correct working

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(d)	M1 substitution of their values from (c) seen **or** awrt –0.17 or –7/41 A1ft dependent on M1 being scored. Correct description of skewness consistent with their values from part (c) ignore the final answer if working shown. Only allow no skew or symmetrical if their value should be 0 Ignore correlation.

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Question Number	Scheme	Marks
2. (a)	$[S_{tt} =]82\,873 - \frac{1361^2}{40}$ $[S_{ct} =]83\,634 - \frac{1634\times1361}{40}$ $[S_{tt} =]36\,564.975$ $[S_{ct} =]28\,037.15$	M1 A1 A1 (3)
(b)	$[r =]\frac{'28\,037.15'}{\sqrt{28\,732.1\times'36\,564.975'}} = 0.865...$ awrt **0.865**	M1 A1 (2)
(c)	In general, films with higher **cost** have higher ticket **sales**.	B1ft (1)
(d)	$[b =]\frac{'28\,037.15'}{28\,732.1}[= 0.9758\ldots]$ $[a =]\frac{1361}{40} - 'b'\times\frac{1634}{40}$ **or** $34.025 - "b"\times 40.85$ $t = -5.8369\ldots + 0.9758\ldots c$ * $t =$ awrt $-5.84 +$ awrt $0.976c$*	M1 M1 A1cso* (3)
(e)	$t = -5.84 + 0.976\times90$ $t =$ £82 million awrt **£82 million**	M1 A1 (2)
(f)	$-5.84 + 0.976c < 0.8c \rightarrow 0.176c < 5.84$ $c < 33.1818$ $c <$ awrt (£) **33.2**	M1 A1 (2)
	Notes	**Total 13**
(a)	Mark part (a) and (b) together M1 either correct expression A1 36 564.975 or exact equivalent A1 28037.15 or exact equivalent **SC** M1A1 A0 for awrt 36565 and awrt 28037	
(b)	M1 valid attempt at r with their $S_{cc} \neq 28732.1$ and their $S_{ct} \neq 83634$ A1 awrt 0.865	
(c)	B1ft only ft if $\lvert r\rvert<1$ For a correct comment in context. Must include words underlined (Allow use of c for cost and t for sales) and be compatible with their value in (b). Must have that as one increases/decreases the other increases/decreases. Allow other words eg goes up Do not accept t and c are similar.	
(d)	M1 correct numerical expression for b ft their $S_{ct} \neq 83634$ Implied by awrt 0.9758 or better M1 attempt at a with their value of b substituted. Implied by awrt 5.837 or better A1*cso answer given so both method marks must be awarded and no incorrect working seen. Either $b = 0.9758$ (or better) **or** $a = 5.837$ (or better) must be seen somewhere along with the correct equation in t and c (do not allow fractions).	
(e)	M1 for substituting $c = 90$ into $t =$ awrt $-5.84 +$ awrt $0.976c$ Implied by awrt 82 A1 £82 million (must include units. Allow 82 million pounds). Allow awrt £82 million	
(f)	M1 forming inequality (allow > or < or = or „ or …) with $0.8c$ A1 correct inequality in c (allow any letter) with awrt 33.2 (units not required). Do not allow as a fraction. Ignore any lower limit. Condone awrt 33200000 or awrt 33.2 million	

Question Number	Scheme	Marks
3. (a)	$[\bar{x}=]\frac{-1.2}{8}$ [= −0.15] $\sum b = 21\times 8 + 2\times(-1.2)$ [= 165.6]	M1
	"−0.15" $= \frac{\bar{b}-21}{2}$ oe $[\bar{b}=]\frac{165.6}{8}$	M1
	= **20.7** (cm)	A1
		(3)
(b)	$\sigma_x = \sqrt{\frac{5.1}{8}-\left(\frac{-1.2}{8}\right)^2}$ [$=\sqrt{0.615}=0.784...$]	M1
	$\sigma_b = 2\times$'0.784...'	M1
	= awrt **1.57** (cm)	A1
		(3)
(c)(i)	$x_9 = 1.2 \rightarrow b_9 = 1.2\times 2 + 21$ oe **or** $9\times 21 - 8\times$'20.7'[= 354.6]	M1
	= **23.4** (cm)	A1
		(2)
(ii)	$\sum x^2 = 5.1 + 1.2^2$ [= 6.54] $\left[\Rightarrow \sigma_x = \sqrt{\frac{5.1+1.2^2}{9}-0^2}\right]$	M1
	= awrt **0.852** (cm)	A1
		(2)
	Notes	**Total 10**
(a)	1st M1 for correct expression for $\bar{x}$ ignore letter 2nd M1 Using equation. "$\bar{x}$" $= \frac{\bar{b}-21}{2}$ where $-1.2 <$ '$\bar{x}$' < 1.2 Condone b rather than $\bar{b}$ A1 20.7 oe 1st M1 for correct expression for $\sum b$ 2nd M1 use of "$\sum b$" $\div n$ where '$\sum b$' >18	
(b)	1st M1 correct method for σ_x **or** σ_x^2 **or** $5.1 = \frac{\sum b^2 - 42\times"168.6"+8\times 441}{4}$ **or** $\sum b^2 = 3447.6$ 2nd M1 for use of 2 × their σ_x (or 4 × their σ_x^2) (adding 21 is M0) **or** $\frac{"3447.6"}{8}-\left(\frac{"165.6"}{8}\right)^2$ or $\sqrt{\frac{"3447.6"}{8}-\left(\frac{"165.6"}{8}\right)^2}$ A1 awrt 1.57 Allow $\frac{\sqrt{246}}{10}$ (allow s_b = awrt 1.68 or $\frac{4\sqrt{246}}{35}$ from an n – 1 method)	
(c)(i)	M1 for a correct equation using $x_9 = 1.2$ to enable b_9 to be found eg $1.2 = \frac{b-21}{2}$ **or** a correct method to find $\sum x$ for the 9 squirrels. ft their 20.7 A1 23.4 oe	
(ii)	M1 for $5.1+"(\pm 1.2)"^2$ [= 6.54] seen ft their x_9 Condone $5.1+(\pm 9.6)^2$ [= 97.26] A1 awrt 0.852 Allow $\frac{\sqrt{654}}{30}$ (allow s_x = awrt 0.904 from an n – 1 method)	

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Question Number	Scheme	Marks
4.	$\left[\mathrm{F}(6)=\right]\frac{45}{77}$ **and** $\left[\mathrm{F}(7)=\right]\frac{60}{77}$	M1
	$\left[\mathrm{P}(W=7)=\mathrm{F}(7)-\mathrm{F}(6)=\right]"\frac{60}{77}"-"\frac{45}{77}"\left[=\frac{15}{77}\right]$ **and**	
	$\left[\mathrm{P}(W=8)=\mathrm{F}(8)-\mathrm{F}(7)=\right]1-"\frac{60}{77}"\left[=\frac{17}{77}\right]$	M1
	$\mathrm{E}(W)=6\times"\frac{45}{77}"+7\times"\frac{15}{77}"+8\times"\frac{17}{77}"$	M1
	$\left[=6\times0.5844+7\times0.1948\ +\ 8\times0.22077\right]$	
	$=\ \underline{\mathbf{\frac{73}{11}}}$ **or awrt** $\underline{\mathbf{6.64}}$	A1
	Notes	**[4]**
	1st M1 for $\frac{45}{77}$ **and** $\frac{60}{77}$ seen Allow awrt 0.58 **and** awrt 0.78. may be seen unsimplified Implied by 2nd M1 or by seeing $\frac{15}{77}$ 2nd M1 for $"\frac{60}{77}"-"\frac{45}{77}"$ **and** $1-"\frac{60}{77}"$ allow awrt 0.195 or 0.20 **and** awrt 0.22 ft their F(6) and F(7) if working shown 3rd M1 for an attempt to calculate E(W) with P(W = 6) correct and the correct method or value for at least one of P(W = 7) or P(W = 8) A1 $\frac{73}{11}$ oe or awrt 6.64	

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Question Number	Scheme	Marks
5. (a)	$P(W > 70) = P\left(Z > \frac{70-80}{8}[=-1.25]\right)$	M1
	$= P(Z > -1.25)$ or $P(Z < 1.25)$	A1
	$= 0.8944$ awrt **0.894**	A1
		(3)
(b)	$P(W < k) = 0.85$ or $P(W > k) = 0.15$	B1
	$\pm\left(\frac{k-80}{8}\right) =$ **1.0364**	M1 B1
	$k = 88.29\ldots$ awrt **88.3**	A1
		(4)
(c)	$P(W < 66) = P\left(Z < \frac{66-80}{8}[=-1.75]\right)[= 0.0401$ (calc 0.040059…)]	M1
	$0.25 \times P(Z < -1.75)\left[= 0.010025\ (\text{calc}\, 0.0100147...)\right]$ or $0.25 \times (1 - P(Z < 1.75))$	dM1
	$\frac{y-80}{8} =$ **–2.32**(63)	M1 A1
	$y = 61.389\ldots$ awrt **61.4**	A1
		(5)
	Notes	**Total 12**

(a)
M1 for standardising with 70, 80 and 8 (allow $\pm$)
1st A1 $z = \pm 1.25$
2nd A1 awrt 0.894 (calc 0.894350…) **NB** do not ISW so an answer of 0.1056 is A0

(b)
1st B1 for either correct probability statement. Allow „ for < and …for >
(may be implied by z = awrt 1.04)
M1 standardising with 80, 8 and equating to z, where $1 < |z| < 2$
2nd B1 $z = \pm 1.0364$ or better (calc 1.036432…)
A1 awrt 88.3 (calc 88.291459…)
NB awrt 88.3 implies 1st B1 and M1 but not the 2nd B1 they could get B1M1B0A1
(Answer only 88.291 to 88.292 scored 4 out of 4)

(c)
1st M1 standardising with 66, 80 and 8 (allow $\pm$) or seeing awrt 0.0401 in working
2nd dM1 (dep on 1st M1) $0.25 \times$"their $P(Z < -1.75)$" or 0.0401 – 0.030075 or seeing
$\left[0.75 \times 0.0401 + 0.9599 =\right]$ 0.9899…
3rd M1 for standardising and equating to z, where $|z| > 2$
1st A1 correct standardisation equation with compatible signs and 2.32 „ $|z|$ „ 2.34
2nd A1 awrt 61.4 (allow awrt 61.3)

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Question Number	Scheme	Marks
6. (a)(i)	[P(A) =] **0.25**	B1
(ii)	$[\mathrm{P}(A \mid B) =]$ **1**	B1
(iii)	$[\mathrm{P}(A \mid C) =]$ **0**	B1
		(3)
(b)	$\frac{q}{q+r} = \frac{3}{5}$	M1
	$0.13 + p + s = \frac{7}{10}$	M1
	$p + q + r + s + 0.12 + 0.13 = 1$	M1
	Solving simultaneously to get	
	$\frac{q}{0.3-0.12} = \frac{3}{5}$ **or** $0.3 = 0.12 + 1.5r + r$ **or** $0.3 = 0.12 + q + \frac{2}{3}q$ oe	dM1
	q = **0.108**	A1
	r = **0.072**	A1
		(6)
(c)	$\frac{5}{8} = 0.13 + 0.12 + \text{'0.072'} + s$ oe	M1
	s = **0.303**	A1
		(2)
	Notes	**Total 11**

(a)(i) B1 0.25 oe

(ii) B1 1 cao

(iii) B1 0 cao

(b) 1st M1 correct expression for $\mathrm{P}(C \mid D) = \frac{3}{5}$. Allow P($D$) for $q + r$

2nd M1 correct expression for $\mathrm{P}(B' \cap D') = \frac{7}{10}$

3rd M1 A correct equation or use of sum of probabilities = 1 **must** imply correct equation eg may ft their

$\mathrm{P}(B' \cap D') = \frac{7}{10}$ Implied by $q + r = 0.18$

or P(D) = 0.18

NB $\frac{3}{10} = 0.12 + q + r$ is 2ndM1 3rdM1

4th dM1 (dep on all 3 previous M1 being awarded) solving to obtain a correct equation in a single variable. Implied by a correct value for q or r

1st A1 q = 0.108 or $\frac{27}{250}$ oe

2nd A1 r = 0.072 or $\frac{9}{125}$ oe

(c) M1 correct expression for $\mathrm{P}(B \cup C') = \frac{5}{8}$ ft their value for r. Allow use of the letter r

eg $\frac{5}{8} = 0.13 + 0.12 + r + s$ oe We will condone values of r outside the range $0 < r < 1$

A1 s = 0.303 oe

Question Number	Scheme	Marks
7. (a)	$\left[\frac{0.1}{0.8}\right] = \underline{\mathbf{\frac{1}{8}}}$	B1 (1)
(b)	$[0^2 \times 0.1 +]\, 5^2 \times 0.2 + 10^2 \times 0.7 = 75$*	B1*cso (1)
(c)	$\mathrm{E}(X) = [0 \times 0.1 +]\, 5 \times 0.2 + 10 \times 0.7\, [= 8]$ $\mathrm{Var}(X) = 75 - ('8')^2$ $\mathrm{Var}(X) = \underline{\mathbf{11}}$	M1 M1 A1 (3)
(d)	$\mathrm{Var}(4 - 3X) = 3^2 \times \mathrm{Var}(X) [= 3^2 \times "11"]$ $= \underline{\mathbf{99}}$	M1 A1ft (2)
(e)	P((0, 5), (0, 10), (5, 10)) $= 0.1 \times 0.2 + 0.1 \times 0.7 + 0.2 \times 0.7$ $[= 0.02 + 0.07 + 0.14]$ $= \underline{\mathbf{0.23}}$ P((0, 0), (5, 5), (10, 10) $= 1 - (0.1^2 + 0.2^2 + 0.7^2)$ $[= 0.5(1 - (0.01 + 0.04 + 0.49))]$ $= \underline{\mathbf{0.23}}$	M1M1 A1 (3)
(f)	Products: 0, 25, 50, 100 $\mathrm{P}(D = 0) = 0.1 + 0.1 - 0.1 \times 0.1 [= 0.19]$ $\quad \mathrm{P}(D = 25) = 0.2^2$ $\mathrm{P}(D = 50) = 2 \times 0.2 \times 0.7$ $\quad \mathrm{P}(D = 100) = 0.7^2$ D: **0**, **25**, **50**, **100** P(D = d): **0.19**, **0.04**, **0.28**, **0.49**	B1 M1 M1 A1 (4)
	Notes	**Total 14**

(a) B1 $\frac{1}{8}$ oe Allow 0.125 Do not ISW

(b) B1*cso correct expression and 75 with no errors seen. Allow $5^2 \times 0.2 + 10^2 \times 0.7 = 75$

(c) M1 correct method to find mean. If no method seen award if 8 is seen
M1 attempt at expression for variance ie 75 –(their E(X))^2
A1 11 cao

(d) M1 Use of $(-3)^2 \times \mathrm{Var}(X)$ (condone 3 rather than –3 and missing bracket if final answer is correct) or $4^2 \times 0.1 + (-11)^2 \times 0.2 + (-26)^2 \times 0.7 - (-20)^2$ condone 11, 26 and 20
A1ft 99 or ft 9 × 'their (c)'

(e) 1st M1 for at least one correct product. **NB** may be combined eg 0.3×0.7 but not in the numerator or denominator of a fraction
2nd M1 a fully correct expression oe e.g. $0.1 \times 0.2 + 0.3 \times 0.7$
A1 0.23 oe

(f) B1 all 4 correct products with no incorrect extras unless they have a probability of 0 associated with them
1st M1 A correct method to find 1 of the 4 probabilities. Does not need to be associated with the correct product
ALT $\mathrm{P}(D = 0) = 0.1 \times 0.1 + 2 \times 0.1 \times 0.2 + 2 \times 0.1 \times 0.7\, [= 0.19]$
2nd M1 A correct method to find 3 of the 4 probabilities or 2 of the 4 probabilities if the total of the 4 probabilities is 1 Must be associated with the correct product
A1 all four correct probabilities (oe) associated with the correct products

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