Mark Scheme (Results)

Summer 2022

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

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Summer 2022
Question Paper Log number P71200A
Publications Code WST01_01_2206_MS

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.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

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.

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 √ 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.

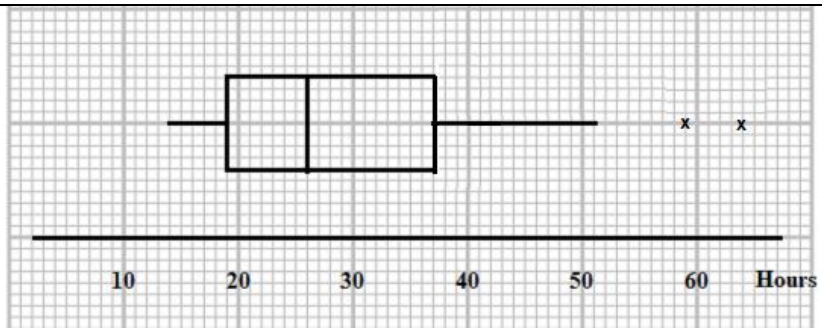
5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

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.

Special notes for marking Statistics exams (for AAs only)

- If a method leads to “probabilities” which are greater than 1 or less than 0 then M0 should be awarded unless the mark scheme specifies otherwise.
- 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.

Question Number	Scheme	Marks
1(a)	$w = 8$	B1
	$x = 19$	B1
	$y = 37$	B1
		(3)
(b)	$"37"+1\times("37"-"19")$ [= 55]	M1
	59 and 64	A1ft
		(2)
(c)		M1 A1ft A1ft
		(3)
(d)	$\dfrac{("37"-26)-(26-"19")}{("37"-"19")}$	M1
	= 0.22 (to 2 sf)	A1
		(2)
(e)	E.g. 'The mean uses all the data'	B1
		(1)
		Total 11

		Notes
(a)	**B1B1B1**	Cao May be seen in table before part (a). $w = 28$ is first B0.
(b)	**M1**	Calculation for the outliers using their lower quartile and upper quartile. Allow "their upper quartile" + "their IQR" for this mark i.e. 37 + 18
	A1ft	For identifying 59 and 64 as outliers from correct working. Ft the identification of outlier(s) (if any) from "their 55" from their shown calculation. Answer only is M0A0.
(c)	**M1**	For a box with at least one whisker drawn
	A1ft	14 for lowest whisker, 26 for median, "19" and "37" plotted for quartiles ft their values for quartiles
	A1ft	Upper whisker at 51 or "their 51" **plus** "their outliers" plotted but there must be at least one outlier for this mark. Condone upper whisker at "their 55". NB award A0 if there is more than one whisker at either end
(d)	**M1**	For substituting their values into the formula
	A1	Allow awrt 0.22 (allow $\frac{2}{9}$ or $0.\dot{2}$)
(e)	**B1**	A correct reason which supports *Landacre*'s use of the mean or rejects their use of the median. Allow comment relating to (slight) positive skew so mean > median so *Landacre* will know the larger average they will have to pay. Comments about skewness/symmetry on their own score B0. Mean includes the outliers is B1. Condone Median is not affected by the outliers for B1. Mean is more accurate is B0.

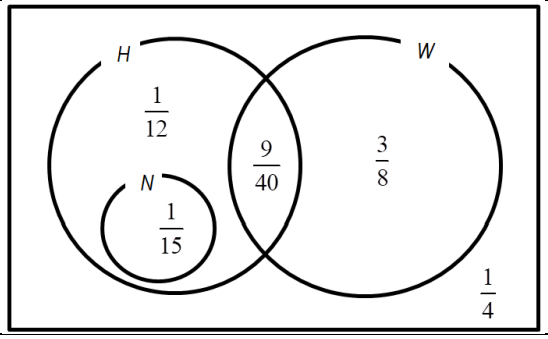
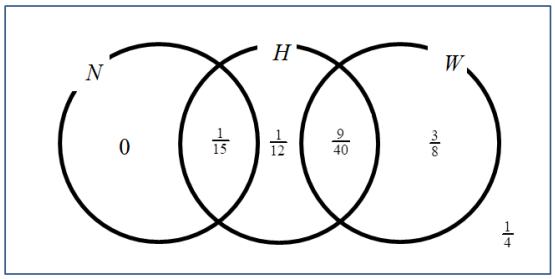
Question Number	Scheme	Marks
2(a)	$S_{gg} = 3624.41 - \frac{144.84^2}{9} \left[= 1293.4516\right]$	M1
	$r = \frac{40.25}{\sqrt{"1293.4516" \times 1.29}}$	M1
	= 0.985…. awrt 0.985	A1
		(3)
(b)	As the population/t increases, GDP/g increases oe	B1
		(1)
(c)	$b = \frac{40.25}{1.29} \left[= 31.20155...\right]$	M1
	$a = \frac{144.84}{9} - "31.20155..." \times \frac{7.87}{9} \left[= -11.19068....\right]$	M1
	$g = ...31.20155...t$	A1
	$g = -11.2 + 31.2t$	A1
		(4)
(d)	The **GDP/*g*** increases by (an average of) **"31.2" billion [**dollars] when the **population/*t*** increases by **one million**.	B1
		(1)
(e)(i)	$"-11.2" + "31.2" \times 7$	M1
	= 207.2… awrt 207	A1
		(2)
(ii)	Unreliable as 7 000 000 is much greater than the mean population/ $\bar{t}$ for the 9 years.	B1
		(1)
(f)	$0.1 = "31.2" x$	M1
	$x = 0.003205...$ million people awrt 0.0032	A1
		(2)
	Notes	**Total 14**

(a)	**M1**	Correct method for finding S_{gg} (implied by awrt 1290 to 3sf)
	M1	Correct method for finding r using their S_{gg} If S_{gg} = 3624.41 is used here, then M0.
	A1	awrt 0.985 (correct answer only scores M1M1A1)
(b)	**B1**	A correct interpreted contextual statement including population (or t) and GDP (or g). 'Strong positive correlation between population and GDP' on its own is B0.
(c)	**M1**	Correct method for finding b
	M1	Correct method for finding a using their b $a = 16.0... - "31.20155..." \times 0.874... \left[= -11.19068....\right]$
	A1	Only dep on 1st M1 awrt 31.2 in a regression equation (allow any variables in the equation).
	A1	Correct equation $g = \text{awrt} -11.2 + \text{awrt } 31.2t$ (must be g and t) Do not allow fractions.
(d)	**B1**	Idea that the GDP increases by "Their b" billion dollars for every 1 million increase in population
(e)(i)	**M1**	Correct method. Allow substitution of 7 000 000 instead of 7
	A1	awrt 207 (billion) (isw after an answer of 207 is seen)
(ii)	**B1**	Unreliable with a correct supporting comment which must reference t or $\bar{t}$ [=0.874] or population 'Extrapolation so unreliable' on its own is B0. Reference to g out of range is also B0.
(f)	**M1**	Equating 0.1 with "their b" × x Or substituting two values for g with a difference of 0.1 in their equation leading to a value of x
	A1	awrt 0.0032 (million) Allow awrt 3200 (to 2sf) Do not allow fractions.

Qu. No.	Scheme	Marks
3(a)	Width = 2.5 (cm)	B1
	Height = $\left(\frac{35}{15}\times 6\right)\div "2.5"$ or $\frac{4}{5}\times 7$ or $6cm^2 = 15$ (logs) or $14cm^2 = 35$ (logs) oe	M1
	= 5.6 (cm)	A1
		(3)
(b)	Median $= [20] + \frac{25}{35}\times 5$ allow $[20] + \frac{25.5}{35}\times 5$	M1
	= 23.57… allow 23.64…. awrt 23.6	A1
		(2)
(c)	19 + 35 + 8 (= 62*) **or** 88 – 3 – 15 – 8 (= 62*)	B1cso*
		(1)
(d)	P(4 logs fit) = $\left(\frac{62}{88}\right)\times\left(\frac{61}{87}\right)\times\left(\frac{60}{86}\right)\times\left(\frac{59}{85}\right)$	M1
	= 0.23922…. awrt 0.239	A1
		(2)
(e)(i)	mean of $y = \frac{924}{88}[=10.5]$	M1
	mean of $w = ("10.5" + 255)\times 2$	M1
	= 531	A1
		(3)
(ii)	variance of $y = \frac{12862}{88} - ("10.5")^2 [= 35.909...]$	M1
	variance of $w = "35.909"\times 4$ or $"35.909"\div 0.5^2$	M1
	= 143.636… awrt 144	A1
		(3)

Notes — **Total 14**

(a)	**B1**	2.5 oe
	M1	Correct method to relate area to number of logs (may be implied by "their *w*" × "their *h*" = 14)
	A1	5.6 oe
(b)	**M1**	For a correct fraction multiplied by 5. Allow working downwards e.g. $[25] - \frac{10}{35}\times 5$
	A1	Correct answer from correct working. Allow exact fraction.
(c)	**B1**	A correct calculation seen. Allow $\frac{1}{2}(16)$ for 8. Allow equivalent methods $\frac{x-54}{70-54} = \frac{26-25}{27-25}$ Minimum working required 54 + 8 or 70 – 8 or $\frac{54+70}{2}$ NB: 26 + *x* = 88 → *x* = 62 is B0.
(d)	**M1**	For $\left(\frac{n}{88}\right)\times\left(\frac{n-1}{87}\right)\times\left(\frac{n-2}{86}\right)\times\left(\frac{n-3}{85}\right)$ (allow any $n < 88$)
	A1	awrt 0.239
	SC	With replacement awrt 0.246 scores M1A0
(e)(i)	**M1**	Correct method for finding mean of *y* (implied by 10.5) or for equation $0.5\sum w - 88\times 255 = 924$
	M1	Correct method for finding mean of *w* or $\sum w = 46728$ and $\frac{46728}{88}$
	A1	Cao
(ii)	**M1**	Correct method for finding variance of *y* (implied by awrt 35.9) or $0.25\sum w^2 + 255^2\times 88 - 255\sum w = 12862$
	M1	Correct method for finding variance of *w* or $\sum w^2 = 24825208$ and $\frac{24825208}{88} - "531"^2$

	A1	awrt 144	
Question Number	Scheme		Marks
4(a)	$P(H \cup W) = P(H) + P(W) - P(H \cap W)$	$P(H' \cap W) = P(H \cup W) - P(H)$	M1
	$P(H \cap W) = \frac{3}{8} \times P(W)$	$P(H' \cap W) = P(H') \times P(W)$	M1
	$\frac{3}{4} = \frac{3}{8} + P(W) - \frac{3}{8}P(W)$	$\frac{3}{8} = \frac{5}{8}P(W)$	A1
	$P(W) = \frac{3}{5}$*	$P(W) = \frac{3}{5}$*	A1cso*
			(4)
(b)	$P(N' \mid H) = \frac{\frac{3}{8} - \frac{1}{15}}{\frac{3}{8}}$ or $\frac{\frac{9}{40} + \frac{1}{12}}{\frac{3}{8}}$ or $1 - \frac{\frac{1}{15}}{\frac{3}{8}}$		M1
	$= \frac{37}{45}$ = awrt 0.822		A1
			(2)
(c)	 		B1 M1 M1 M1 A1 **(5)**
	Notes		**Total 11**
(a)	**M1**	for use of $P(H \cup W) = P(H) + P(W) - P(H \cap W)$ (with at least one value correctly substituted) or use of $P(H' \cap W) = P(H \cup W) - P(H)$ (with at least one value correctly substituted)	
	M1	for use of $P(H \cap W) = P(H) \times P(W)$ or use of $P(H' \cap W) = P(H') \times P(W)$	
	A1	a correct equation in P(W) (allow W or x here)	
	A1cso*	Correct solution ending with P(W)= $\frac{3}{5}$ with no wrong working seen. Dep. on all previous marks.	
	NB	A method which uses $\frac{3}{5}$ or $\frac{3}{5} \times \frac{3}{8}\left[= \frac{9}{40}\right]$ can score maximum M1M1A0A0.	
(b)	**M1**	For $\frac{p}{\frac{3}{8}}$ where $0 < p < \frac{3}{8}$ use of independence is M0 e.g. $\frac{x \times \frac{3}{8}}{\frac{3}{8}}$	
	A1	awrt 0.822	
(c)	**B1**	3 circles labelled. Either N inside H or allow as intersecting circles with $P(N \cap H') = 0$, but do not allow blank space to be considered 0. Condone missing box for this mark. Allow all 3 circles overlapping with all zeros correctly labelled.	
	M1	For $P(H \cap W) = \frac{3}{8} \times \frac{3}{5}\left[= \frac{9}{40}\right]$ seen or correctly placed in Venn diagram.	
	M1	For their $\frac{3}{5} - "\frac{9}{40}" = "\frac{3}{8}"$ (may be implied by the regions in their P(W) adding to 0.6)	
	M1	For their $\frac{3}{8} - "\frac{9}{40}" - \frac{1}{15} = "\frac{1}{12}"$	
	A1	Fully correct diagram with ¼ and box and correct probabilities (allow exact decimal equivalents)	

Question Number	Scheme	Marks
5(a)	$\left[\mathrm{E}\left(R^2\right)=\right]2^2\times0.25+3^2\times0.3+4^2\times0.15+5^2\times0.1+6^2\times0.2$ (= 15.8*)	B1cso*
		(1)
(b)	$\left[\mathrm{sd}\ (R)=\right]\sqrt{15.8-3.7^2}$	M1
	$=\sqrt{2.11}$	
	Standard deviation = 1.4525…. awrt 1.45	A1
		(2)
(c)	$d=1$	B1
		(1)
(d)	$0.1+0.2+0.1+a+b=1$ oe	M1
	$2\times0.1+3\times0.2+4\times0.1+5a+6b=4.55$ oe	M1
	$5(0.6-b)+6b=3.35$ **or** $5a+6(0.6-a)=3.35\ \Rightarrow a=0.25$ **or** $b=0.35$	M1
	$c=0.4+"0.25"$ **or** $c=1-"0.35"$	M1
	$c=0.65$ oe	A1
		(5)
(e)	$0.9\times0.75\times0.1$	M1
	= 0.0675	A1
		(2)
(f)	For identifying that if Jessie scores 2, Pabel has no spin oe may be implied	M1
	$[0.10\times0+]0.2\times0.3+0.1\times0.15+"0.25"\times0.1+"0.35"\times0.2$	M1
	= 0.17	A1
		(3)
Notes		**Total 14**

(a)	**B1**	Correct calculation with all products seen (allow 1 + 2.7 + 2.4 + 2.5 + 7.2) Figures may be seen in table before part (a). Condone missing addition signs if products seen in table.
(b)	**M1**	Use of formula including the square root
	A1	awrt 1.45 (correct answer with no working scores M1A1)
(c)	**B1**	For 1
(d)	**M1**	Allow equivalents eg $a+b=0.6$
	M1	Allow equivalents eg $5a+6b=3.35$
	M1	Correct method to eliminate *a* or *b* (implied by a correct value for *a* or *b*) This mark can still be scored even if the method leads to a value of *a* or *b* which is not a probability. May see $a = c - 0.4$ to eliminate *a* or $b = 1 - c$ used to eliminate *b*
	M1	A complete method for finding the value of *c* (condone using any value of *a* and *b* for this mark)
	A1	0.65 oe
(e)	**M1**	For the product of 3 probabilities
	A1	0.0675 or exact equivalent fraction eg $\frac{27}{400}$
(f)	**M1**	Identifying that if Jessie scores 2, there is only one spin or the 4 correct possibilities only
	M1	At least 3 correct non-zero probability products ft their *a* and *b* (an answer of 0.195 scores M0M1A0)
	A1	0.17

Question Number	Scheme	Marks
6(a)	$\mathrm{P}(V>104.9)=\mathrm{P}\left(Z>\dfrac{104.9-100}{2.5}\right)$	M1
	$=1-0.975$	M1
	$=0.0250$ 0.025 or awrt 0.0250	A1
		(3)
(b)	Expected number $=150\times"0.025"$	M1
	$=3.75$ awrt 3.75	A1
		(2)
(c)	$\left[\mathrm{P}(V>v\,\|\,V<104.9)=\right]\dfrac{[\mathrm{P}(v<V<104.9)]}{\mathrm{P}(V<104.9)}=0.2801$	M1
	$\mathrm{P}(v<V<104.9)=(1-"0.025")-\mathrm{P}(V<v)$	M1
	$\mathrm{P}(V<v)=(1-"0.025")\ -\ (1-"0.025")\times 0.2801$ [=0.7019] oe	dM1
	$\dfrac{v-100}{2.5}=0.53$	M1A1
	v = 101.325 awrt 101.32 or awrt 101.33	A1
		(6)

Notes		**Total 11**
(a)	**M1**	Standardising with 104.9, 100 and 2.5 (allow ±) implied by 1.96 seen
	M1	For use of $1-p$ with $0.9<p<1$ condone answer of 0.0249 for this mark
	A1	Allow 0.025 or awrt 0.0250 (NB calculator answer is 0.02499….) (answer only scores M1M1A1)
(b)	**M1**	For $150\times"$their part $(a)"$
	A1	awrt 3.75 isw after answer of 3.75 seen. If 3.75 not seen, allow 4 if the method mark is awarded.
(c)	**M1**	For writing or using a ratio of probabilities with denominator $\mathrm{P}(V<104.9)$ oe and equating to 0.2801 $\dfrac{p}{\mathrm{P}(V<104.9)}=0.2801$ implied by awrt 0.273 Use of independence is M0 e.g. $\dfrac{x\times\mathrm{P}(V<104.9)}{\mathrm{P}(V<104.9)}=0.2801$
	M1	For writing or using $\mathrm{P}(V>v\cap V<104.9)=\mathrm{P}(V<104.9)-\mathrm{P}(V<v)[=(1-"0.025")-\mathrm{P}(V<v)]$
	ALT	**For first two M marks** $\dfrac{\mathrm{P}(V<v)}{\mathrm{P}(V<104.9)}=1-0.2801$ scores M1M1, then follow scheme.
	dM1	(dep M1) Dependent on previous M1 for rearranging to find $\mathrm{P}(V<v)$ Allow equivalent oe $(1-"\text{their}(a)")(1\ -\ 0.2801)$ NB: [P($V<v$) =] awrt 0.702 implies M1M1M1 or [P($V>v$) =] awrt 0.298 implies M1M1M1
	M1	Standardising with 100, 2.5 and equating to a z-value, $\dfrac{v-100}{2.5}=z$ $0.4<\lvert z\rvert<0.6$ Watch out for $\dfrac{v-100}{2.5}=$probability which is M0
	A1	Correct equation with compatible signs
	A1	awrt 101.33 (allow awrt 101.32 from use of calculator)

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