



Mark Scheme (Results)

January 2019

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

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

January 2019
Publications Code WST01_01_1901_MS
All the material in this publication is copyright
© Pearson Education Ltd 2019

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.

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: Method marks are awarded for 'knowing a method and attempting to apply it', unless
 otherwise indicated.
- A marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

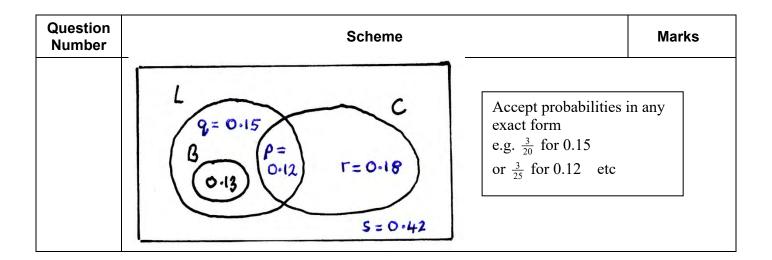
These are some of the traditional marking abbreviations that will appear in the mark schemes.

- bod benefit of doubt
- ft follow through
- the symbol $\sqrt{}$ 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)
- d... or dep dependent
- indep independent
- dp decimal places
- sf significant figures
- ▶ ★ The answer is printed on the paper or ag- answer given
- 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.	or misreading which does not alter the character of a question or materially simplify it, deduct two rom any A or B marks gained, in that part of the question affected.		
6.	Ignore wrong working or incorrect statements following a correct answer.		

January 2019 WST01 STATISTICS 1 Mark Scheme

Question Number	Scheme	Marks	
1.(a)	B and C or "band" and "choir" but NOT $P(B)$ and $P(C)$	B1 (1)	
(b)	[L and C independent implies] $P(L \cap C) = P(L) \times P(C) = 0.4 \times 0.3$ $p = \underline{0.12}$	M1 A1	
(c)	$q = 0.4 - 0.13 - \text{their } p = \underline{0.15}$ $r = 0.3 - \text{their } p = \underline{0.18}$ $s = 1 - (0.4 + 0.3 - \text{their } p) \text{ or } 1 - (0.4 + \text{their } r) = \underline{0.42}$	(2) B1ft B1ft B1ft	
(d)	$P(L \mid B \cup C) \text{ or } \frac{P(L \cap [B \cup C])}{P(B \cup C)} = ; \frac{0.13 + "0.12"}{0.13 + 0.3}$	(3) M1; A1ft	
	$=\frac{25}{43}$	A1 (3) [9 marks]	
	Notes	[9 marks]	
(a)	B1 for B and C indicated. Allow other non-trivial pairs e.g. B and $L \cap C$ bu	t not L and L'	
(b)	Correct answers only to parts (b), (c) or (d) score all the relevant marks.		
(c)	2^{nd} B1ft for 0.18 or a correct r allowing ft of their p concerned to be p	The ft requires all values concerned to be probabilities. (Labelled or on Venn diagram)	
(d)	M1 for a correct probability expression (letters and symbols) <u>and</u> any ratio of probabilities (num < denom). May be implied by a correct (or correct ft) probability ratio. 1 st A1ft for a correct (or correct ft) probability ratio (num < denom) 2 nd A1 for $\frac{25}{43}$ or exact equivalent		
	NB completed Venn diagram. (If answers conflict the script takes preference	over diagram)	



Question Number	Scheme	Marks	
2.(a)	$[E(X) =] (-2 \times 0.15) + (-1 \times a) + 0 + (1 \times a) + (3 \times 0.4) \text{ or } -0.3 - a + a + 1.2$	M1	
	= <u>0.9</u>	A1	
		(2)	
(b)	$ [E(X^2) =]\{(-2)^2 \times 0.15\} + \{(-1)^2 \times a\} + \{1^2 \times a\} + \{3^2 \times 0.4\} $	M1	
	<u>or</u> $0.6 + 2a + 3.6$		
	So $4.2 + 2a = 4.54$	dM1	
	$a = \underline{0.17}$ Use of sum of probabilities = 1 e.g. $0.15 + 0.34 + 0.4 + b = 1$	A1 M1	
	b = 0.11	A1	
		(5)	
(c)	$[Var(X) =] 4.54 - (their 0.9)^2 = 3.73]$	M1	
	$Var(Y) = (-2)^2 Var(X)$	M1	
	= 14.92 (accept 14.9)	A1	
		(3)	
		[10 marks]	
	Notes Correct answers with no working can score all the relevant ma	rks	
(a)	M1 for an attempt at $E(X)$ i.e. at least 3 non-zero correct products seen	ii KS.	
	A1 for 0.9 or any exact equivalent		
<i>a</i> >		1 ()	
(b)	1 st M1 for an attempt at an expression in a for $E(X^2)$ (at least 3 non-zero co	- '	
	2^{nd} dM1 dependent on 1^{st} M1 for using their E(X^2) and 4.54 to form a linear e 1^{st} A1 for $a = 0.17$ or exact equivalent	equation in a	
	3^{rd} M1 for use of sum of probabilities = 1 to form a linear equation for b (ft their $a \in [0,1]$)		
	or for the equation $0.15 + 2a + b + 0.4 = 1$ or $2a + b = 0.45$		
	2^{nd} A1 for $b = 0.11$ or exact equivalent		
(c)	1^{st} M1 for a correct expression for $Var(X)$ (ft their 0.9 for $E(X)$)		
	Allow expression based on working out $E(X^2)$ and ft their $E(X)$, their $a \in [0,1]$, their $b \in [0,1]$	
	2^{nd} M1 for $(-2)^2 \times (\text{their Var}(X))$ condone e.g. $-2^2 \text{Var}(X)$ if it later becomes	$\operatorname{es} \operatorname{4Var}(X)$	
	This can be awarded for the formula with $Var(X)$ not necessarily a variation $Var(X)$ and $Var(X)$ is the formula with $Var(X)$ is the formula with $Var(X)$ and $Var(X)$ is the formula with $Var(X)$ is the formula with $Var(X)$ and $Var(X)$ is the formula with $Var(X)$ is the form		
	If they state $Var(X) = E(X^2)$ or 4.54 then M0M1 is possible.		
	A1 for 14.92 (accept 14.9)		
	Dist of V		
ALT	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\frac{-3}{0.4}$	
	1st M1 for E(Y) = 6 "a" + 3 "b" - 0.15 or 1.2 and E(Y²) = 26 "a" + 9 "b" +		
	2^{nd} M1 for Var(Y) = "16.36" – ["1.2"] ² allow ft of their E(Y) \neq their (a) and I		
		but $E(Y^2) > 0$	
i			

Question Number	Scheme	Marks
3. (a)	$[W \sim N(64, 8^2)] \qquad P(W < 51) = P\left(Z < \frac{51 - 64}{8}\right) \text{ or } P(Z < -1.625)$ $= 1 - 0.9484 \text{(calc. } 1 - 0.9479187299\text{)}$	M1
	= $1 - 0.9484$ (calc. $1 - 0.9479187299$) = awrt <u>0.052</u>	M1 A1
(b)	Require: $P(W > 49 \mid W < 51)$ $= \frac{P(49 < W < 51)}{P(W < 51)} \underline{\text{or}} \frac{P(-1.875 < Z < -1.625)}{P(Z < -1.625)}$	(3) M1 M1
	$= \frac{P(W < 51)}{0.021684}$ $= \frac{0.021684}{(a)}$	A1ft
	= 0.4163 awrt <u>0.42</u>	A1 (4)
(c)	$\left[P(W > H) = 0.10 \Longrightarrow\right] \frac{H - 64}{8} = 1.2816$	M1B1
	H = 74.2528 awrt <u>74.3</u>	A1 (3)
		[10 marks]
(a)	Notes 1 st M1 for standardising with 51(or 77), 64 and 8 (allow \pm) Implied by $z = a^{-1}$	$\frac{1}{1}$
	2 nd M1 for $1-p$ where $0.9 A1 for awrt 0.052 (NB If they use z = (\pm) 1.62 from correct standardisin NB Calculator gives 0.0520812 [ans only of awrt 0.052 is 3/3]$	
(b)	1 st M1 for a correctly stated conditional probability. May be implied by correct M1 for a correct ratio of probabilities in their W or Z (either version from $\frac{(a) - P(W < 49)}{(a)} \underline{\text{or}} 1 - \frac{P(W < 49)}{(a)} \text{will score M1M1}$ 1 st A1ft for a correct ratio of probabilities with their (a) on denominator and the range [0.0215, 0.0210]. Name > Denominator	scheme)
	the range [0.0215, 0.0219]. Num > Denom is A0 2^{nd} A1 for a final answer of awrt 0.42 (dep on at least one other mark) Final answer of $\frac{5}{12}$ will lose the final A1 unless awrt 0.42 is seen as we	ell
Ans only	For an answer of 0.416 or better award 4/4	
(c)	M1 for standardising with H , 64 and 8 and setting equal to a z value where B1 for using $z = \pm 1.2816$ (or better e.g. calc: 1.2815515) can be with 8^2	instead of 8 etc
NB z = 1.28 Ans only Ans only	P($Z > \frac{H-64}{8}$)=1.2816 can score M1B0 unless a correct answer implies 3/3 A1 for awrt 74.3 (calc gives 74.25241253) award M1B0A1 for an answer of 74.24 or awrt 74.2 if B0 scored for $z = 1.28$ for an answer only of awrt 74.3 (can come from $z = 1.282$ etc) award M1B0A1 for an answer for H in the range $74.252 \le H \le 74.253$ award M1B1A1	

Question Number	Scheme	Marks
4.(a)	Width: 15 minutes is 0.5 cm so 60 mins will be $4 \times 0.5 = 2$ (cm)	B1
	Height: freq of 25 represented by $6 \times 0.5 = 3$ (cm ²) so freq of 24 is $\frac{24}{25} \times 3$	M1
	So height = $\frac{1}{"2"} \times \frac{24}{25} \times 3 = \underline{1.44}$ (cm)	A1
(b)	$[Q_2 =] \{30\} + \frac{(50 - [25 + 17])}{28} \times 30 \text{or e.g.} \frac{60 - 30}{70 - 42} = \frac{m - \{30\}}{50 - 42}$ $= 38.571 \text{awrt } \underline{38.6}$	(3) M1 A1
(c)	Use of midpoints to get $\sum fx = 5070$ (allow 5000 to 1 sf)	(2) M1
(c)	$[\overline{t} \text{ or } \overline{x}] = \underline{50.7}$	A1
	455 510 5	(2)
(d)	$[\sigma] = \sqrt{\frac{455512.5}{100} - "50.7"^2} \text{ or } \sqrt{1984.635}$	M1
	= 44.5492 awrt <u>44.5</u>	A1 (2)
(e)	\overline{t} or $\overline{x} > Q_2$ [allow "50.7" > "38.6" or formula] so <u>positive</u> (skew)	B1
(f)(i)	Median: no change	(1)
	Since e.g. all 18 values or all changes are still below the median	B2/1/0
(ii)	Mean: will be smaller Since e.g. changes will reduce total of x (7×7.5 not 25×7.5 in 1 st class)	B1
(iii)	Standard deviation: will be greater	
	Since e.g. (18 zeros means) data more spread out	(3) [13 marks]
	Notes	
(a)	(a) B1 for a width of 2 (cm) M1 for some calc' linking area and frequency for both groups or their $w \times \text{their } h = 2.88$ A1 for 1.44 (or exact equivalent e.g. $\frac{36}{25}$)	
(b)	M1 for $+\frac{8}{28} \times 30$ (o.e.) May work down e.g. $\{60\} - \frac{20}{28} \times 30$ or if using $(n+1)$ for $\frac{8.5}{28} \times 30$	
	A1 for awrt 38.6 (accept $\frac{270}{7}$) or (if using $(n + 1)$ for 39.107 or awrt 39.1)	
(c)		
	A1 for 50.7 or exact equivalent e.g. $\frac{5070}{100}$	
(d)	M1 for a correct expression including square root (ft their mean) A1 for awrt 44.5 (or 44.55) (allow use of $s = 44.77367$ or awrt 44.8)	
(e)	B1 for positive skew <u>plus</u> a suitable correct reason [allow use of values provided Allow correct use of quartiles but must see $Q_1 = 15$ and $Q_3 = 72.5$	$\operatorname{led}\left(c\right) \geq\left(b\right)]$
(f)(i)~(iii)	B2 for all 3 correct statements B1 for only 2 correct statements (B1B0) 3^{rd} B1 dep on B2 for at least one suitable reason. (Allow calculation of \overline{x} or Do not accept comments like "median not affected by extreme values" With 18 zeros $\Sigma fx = 4935$, $\overline{x} = 49.35$, $\Sigma fx^2 = 454500$, $\sigma = 45.930$, $s = 46.161$.	

Question Number	Scheme	Marks
5.(a)	$\left[\overline{x} = \frac{96}{80} = \right] \ \underline{1.2}$	B1
(b)	$P(S=2) = 3 \times 0.4^2 \times 0.6$ = <u>0.288</u>	(1) M1 A1
(c)	$P(S = 0) = 1 - (0.496 + "0.288")$ or $0.6^3 = \underline{0.216}$	B1ft (2)
(d)(i)	$p_1 = 0.25$ and $p_2 = 0.4$ and $p_3 = 0.55$	M1
400	$P(T=3) = p_1 \times p_2 \times p_3 = 0.25 \times 0.4 \times 0.55 = \underline{0.055} (*)$	Alcso
(ii)	$P(T=1) = \underbrace{0.25 \times 0.6 \times 0.45}_{0.075} + \underbrace{0.75 \times 0.4 \times 0.45}_{0.125} + \underbrace{0.75 \times 0.6 \times 0.55}_{0.2475}$	M1A1
	$\underline{\text{or}} = 0.0675 + 0.135 + 0.2475 = 0.45 (*)$	A1 cso
	<u></u>	(5)
(e)	$P(T=0) = 0.75 \times 0.6 \times 0.45$ (or equivalent expression for P(T=2))	M1
	$= \underline{0.2025} \qquad \qquad (\text{Allow } \frac{81}{400})$	A1
	$P(T=2) = 1 - (0.505 + "0.2025") = \underline{0.2925}$ (Allow $\frac{117}{400}$)	Alft
		(3)
(f)	Estimate probs from the data: $\begin{array}{c ccccccccccccccccccccccccccccccccccc$	M1
	(or frequencies for S and T) $f/80$ 0.2 0.45 0.3 0.05 $P(S=x)$ 0.216 0.432 0.288 0.064	A 1
	P(T=x) = 0.2025 = 0.45 = 0.2925 = 0.055	A1
	Ting's model is always closer f 16 36 24 4	A1
	So choose Ting's model S(f) 17.28 34.56 23.04 5.12	(3)
	T(f) 16.2 36 23.4 4.4	[15 marks]
(a)	Notes B1 for 1.2 or any exact equivalent	
(4)	Mark (b) and (c) together (M1 is for a full method for $P(S = 2)$))
(b)	M1 for $k \times 0.4^2 \times 0.6$ (including $k = 1$) where $k \in \mathbb{Z}^+$ or $3 \times p^2 \times (1 - p)$ for som	ne $p \in (0, 1)$
	A1 for 0.288 or an exact equivalent e.g. $\frac{36}{125}$	
	Correct answers in table can score all marks in (b) and (c). Table takes p	
(c)	B1ft for $P(S = 0)$ based on sum of probabilities = 1 i.e. $0.216 \text{ or } 1 - (0.496 + \text{their } 0)$	0.288) <u>or</u> 0.6 ³
(d)	1^{st} M1 for a correct attempt to find all 3 p_i values. Implied by the correct pro-	oduct expr'
	1 st A1 for a correct numerical product and no incorrect working seen for P(7)	T=3)
	2^{nd} M1 for at least 1 correct product in $P(T=1)$ (ft their p_i probabilities) B	
	2 nd A1 for at least 2 correct products seen 3 rd A1cso for all 3 correct products seen and no incorrect working seen is	$(-p_3) = 0.45$ s $2^{\text{nd}} M0$
	Correct answers in table can score all marks in (e). Table takes prefe	
(e)	M1 for a correct product for $P(T=0)$ or all 3 correct products for $P(T=2)$	
	1st A1 for either correct probability (correctly labelled or placed in the table)	
	2^{nd} A1ft for a correct 4 th probability or a 4 th probability that makes the sum = 1	
(f)	M1 for attempt at calculating probs from the data or freqs $S(f)$ and $T(f)$ (at le	east 3 correct)
	1 st A1 for all figs correct(2sf) and comparison of probs (or frequencies) for the	
	2 nd A1 for clearly choosing Ting's model (dependent on M1A1 scored) e.g. "Ting's is best because probabilities (or frequencies) are always closer" scored.	rec AlAl
SC (A0A0)		
- ()	<u> </u>	

Question Number	Scheme	Marks
6.(a)	Mean, median, average, marks, results score: on P2 (y) is lower than P1 (x) o.e. Spread, dispersion, range, st. dev, var(iance): on P2 is more than P1 o.e	B1 B1
(b)(i) (ii)	e.g. (38, 0) doesn't follow the pattern/trend <u>or</u> out of range of other points <u>or</u> far from (best fit) line / other points (o.e.) The student was absent when paper 2 was taken (o.e.)	(2) B1 B1 (2)
(c)	New $\overline{x} = \frac{35.75 \times 16 - 38}{15}$ or $\frac{534}{15}$, $= 35.6$	M1, A1
	New $\overline{y} = \frac{25.75 \times 16}{15} = 27.4\dot{6}$ awrt $\frac{27.5}{15}$ (allow $\frac{412}{15}$)	B1 (3)
(d)(i)	New $\sum xy = 15837 - 38 \times 0$ so no change	B1
(ii)	$S_{xy} = 15837 - \frac{(35.75 \times 16 - 38) \times (25.75 \times 16)}{15} \underline{\text{or}} -\frac{"534" \times "412"}{15} \underline{\text{or}} -\frac{220008}{15}$	M1
	$= \underline{1169.8} (*)$	A1cso (3)
(e)	$r = \frac{1169.8}{\sqrt{965.6 \times 1561.7}}$, = 0.9526079 awrt 0.953	M1, A1
(f)	$b = \frac{1169.8}{965.6}$ [= 1.21147], $a = "27.5" - "b" \times "35.6"$ [= -15.6618]	(2) M1, M1
	y = -15.6/7 + 1.2x $b = awrt 1.2$, $a = awrt -15.6 or -15.7$	A1, A1 (4)
(g)	(Value of r increased from 0.746 to 0.953) so points lie closer to a st. line	B1 (1)
(h)	$y = "1.21" \times 38 - "15.66"$ or awrt <u>30</u>	B1ft (1) [18 marks]
	Notes	
(a)	for a correct comment on 1 st B1: mean etc 2 nd B1: spread etc, one of these 5 te	rms seen
(b)	1 st B1 for a suitable explanation (saying an "extreme point" is B0) 2 nd B1 for a suitable comment e.g. teacher didn't mark it, wrongly recorded/plot	ted (o.e.)
(c)	M1 for a correct method to find \overline{x} (a list requires $\Sigma x = 534$ and ÷15 or correct ans) A1 for 35.6 or e.g. $35\frac{3}{5}$ B1 for awrt 27.5	
(d)(i) (ii)	B1 for explanation with sight of "38×0" (o.e.) e.g. for (38, 0) or omitted po M1 for a correct expression (can ft their 534 and their 412 if they are stated in A1cso dependent on M1 with no incorrect working seen. [May be seen in (e)]	
(e)	M1 for a correct method (implied by ans = awrt 0.95) A1 for awrt 0.953	
(f)	1^{st} M1 for a correct expression for $b = 2^{\text{nd}}$ M1 for a correct expr' seen for a (ft is $a = 1^{\text{st}}$ A1 for $a = 1^{\text$	
(g)	B1 for a suitable comment e.g. <u>linear</u> relationship <u>stronger</u> or <u>stronger linear</u> co	orrelation
(h)	B1ft for awrt 30 or ft expression using $x = 38$ in their equation (need not be eval	uated)

