



# Mark Scheme (Results)

January 2024

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

Question Number	Scheme		Marks
1 (a)	$2 \times 36 = 72 \quad 8 \times 4 = 32$		M1 A1 (2)
(b)	$[13] + \frac{(204-184)}{120} \times 2$	$[13] + \frac{(204.5-184)}{120} \times 2$	M1
	$= \frac{40}{3} = \text{awrt } 13.3$		A1 (2)
(c)	Symmetrically distributed/No skew as the mean $\approx$ median		B1 (1)
(d)	$\frac{32}{4} + 152 + \frac{120}{2} [= 220]$		M1
	$\frac{'220'}{408} \times \frac{'219'}{407}$		M1
	$\frac{365}{1258}$ or 0.2901... awrt 0.29		A1 (3)
<b>Notes</b>			<b>Total 8</b>
(a)	<b>M1</b>	For any equivalent method to find either frequency Maybe implied by either correct frequency Also maybe implied by two frequencies which add to 104 Also maybe implied by a correct scale on the fd axis , at least 3 labels	
	<b>A1</b>	For 72 and 32	
(b)	<b>M1</b>	For any equivalent method to find the median e.g. $\frac{Q_2 - 13}{15 - 13} = \frac{204 - 184}{304 - 184}$ or $\frac{15 - Q_2}{Q_2 - 13} = \frac{304 - 204}{204 - 184}$ allow working downwards $[15] - \frac{(304 - 204)}{120} \times 2$	
	<b>A1</b>	awrt 13.3	
(c)	<b>B1</b>	For a correct identification of skew [which must either be symmetric/no skew or (slight) negative skew] with a correct supporting reason. Condone mean < median so negative skew Allow use of 'their median' in the comparison provided 'their median' ... 13.2 Allow $Q_1 = \text{awrt } 10.8$ or $\text{awrt } 10.9$ <b>and</b> $Q_3 = \text{awrt } 15.1$ <b>and</b> $Q_2 - Q_1 > Q_3 - Q_2$ so negative skew. Comments referring only to the diagram (being symmetrical therefore no skew) send to review	
(d)	<b>M1</b>	For a correct method to find the number of plants between 8cm and 14cm (may be implied by sight of 220)	
	<b>M1</b>	For $\frac{n}{408} \times \frac{n-1}{407}$ or $\left(\frac{n}{408}\right)^2$ with 210 ,, n ,, 230	
	<b>A1</b>	awrt 0.29 may see $\frac{3025}{10404}$ from $\left(\frac{220}{408}\right)^2$	

Question Number	Scheme		Marks
2 (a)(i)	Mean = 71.83...	awrt 71.8	B1
(ii)	Standard deviation = $\sqrt{\frac{62802}{12} - \left(\frac{862}{12}\right)^2}$ or variance = $\frac{62802}{12} - \left(\frac{862}{12}\right)^2$		M1
	$\sqrt{73.47...} = 8.571...$	8.57 * (to 3s.f.)	A1*
			(3)
(b)	$S_{xx} = 62802 - \frac{862^2}{12} [= \frac{2645}{3} = 881.66...]$		M1
	$r = \frac{512.67}{\sqrt{413.67 \times '881.66...'}}$		M1
	= 0.8489...	awrt 0.849	A1
			(3)
(c)	Mean = $\frac{5}{9} \times ('71.8' - 32)$		M1
	= 22.11...	awrt 22.1	A1ft
	Standard deviation = $\frac{5}{9} \times 8.57...$		M1
	= 4.76...	awrt 4.76	A1
			(4)
(d)	$r = '0.8489...' / \text{same (as for } x \text{ and } y)$		M1
	$r$ not affected by (linear) coding oe		A1
			(2)
<b>Notes</b>			<b>Total 12</b>
(a)(i)	<b>B1</b>	awrt 71.8 Allow $\frac{431}{6}$ oe	
(ii)	<b>M1</b>	A correct method to find the standard deviation or the variance ft their mean for M1 only Also allow s.d. = $\sqrt{\frac{S_{xx}}{n}}$	
	<b>A1*</b>	Must see at least one simplification of working <b>and</b> the given answer 8.57. e.g. $\sqrt{73.47...}$ or 8.572 or 8.571... or $\frac{23\sqrt{5}}{6}$ or $\sqrt{\frac{2645}{36}}$ therefore s.d. = 8.57* (to 3s.f.) $\sqrt{\frac{62802}{12} - 71.8^2}$ scores M1A0 (use of 71.8 or 71.83 always scores M1A0). To get required accuracy must see at least 71.833 used i.e. $\sqrt{\frac{62802}{12} - 71.833^2}$	
(b)	<b>M1</b>	A correct method to find $S_{xx}$ (implied by awrt 882)	
	<b>M1</b>	A correct method to find PMCC using their value of $S_{xx}$	
	<b>A1</b>	awrt 0.849	
(c)	<b>M1</b>	A correct method to find the mean ft their mean in part (a)	
	<b>A1ft</b>	awrt 22.1 ft their mean in part (a)	
	<b>M1</b>	A correct method to find the standard deviation (do not isw if any further calculation is done after multiplying by $\frac{5}{9}$ )	
	<b>A1</b>	awrt 4.76	
(d)	<b>M1</b>	$r =$ their part (b) provided $-1$ ,, their part (b) ,, $1$ allow 2 s.f. on the ft	
	<b>A1</b>	Any correct reasoning but M1 must be scored. Allow e.g. 'addition/subtraction <b>and</b> multiplication/division does not affect $r$ ' ,	

Question Number	Scheme		Marks
3 (a)	$1 - p, \frac{7}{8}$ and $\frac{9}{10}$ in the correct place on tree diagram		B1 (1)
(b)	$\frac{1}{8}p + \frac{1}{10}(1 - p) = 0.11$		M1 A1ft
	$p = \frac{2}{5}$		A1 (3)
(c)	$\frac{2}{5} \times \frac{1}{8} = \frac{1}{20}$		M1 A1ft (2)
(d)	$P(Y12   R) = \frac{\frac{2}{5} \times \frac{7}{8}}{1 - 0.11}$ or $P(Y12   R) = \frac{\frac{2}{5} \times \frac{7}{8}}{\frac{2}{5} \times \frac{7}{8} + \frac{3}{5} \times \frac{9}{10}}$		M1
	$= \frac{35}{89}$		A1 (2)
<b>Notes</b>			<b>Total 8</b>
(a)	<b>B1</b>	For a fully correct tree diagram with all 3 correct labels. Allow if $1 - p$ is seen and crossed out/replaced with a numerical probability.	
(b)	<b>M1</b>	For $\frac{1}{8}p$ or $\frac{1}{10}(1 - p)$ 'seen in an equation for $p$	
	<b>A1ft</b>	For a fully correct equation in $p$ or correct ft equation based on their tree diagram	
	<b>A1</b>	oe correct answer scores 3 out of 3	
(c)	<b>M1</b>	For $p \times \frac{1}{8}$ ft their $p$ , provided $p$ is a probability	
	<b>A1ft</b>	For a correct answer ft their $p$ , provided $p$ is a probability. Correct answer scores 2 out of 2	
(d)	<b>M1</b>	For a correct ratio of probabilities. Can ft their $p$ , provided $p$ is a probability	
	<b>A1</b>	For $\frac{35}{89}$ (Allow awrt 0.393)	

Question Number	Scheme		Marks
4 (a)	LQ = 28 or UQ = 48		B1
	'48'+1.5('48'-'28')[= 78]		M1
	90 > 78 so, 90 is an outlier*		A1*
			(3)
(b)	$b = \frac{1735.6}{1667.6} [= 1.04\dots]$		M1
	$a = 38.2 - 'b'(42.2)[= -5.72\dots]$		M1
	$s = -5.72 + 1.04f$ *		A1*
			(3)
(c)	For every <b>extra mark</b> (oe) in <b>French/f</b> , <b>Spanish/s goes up</b> (oe) by [on average] <b>1.04 marks</b>		B1
			(1)
(d) (i)	$s = -5.72 + 1.04 \times 55 = 51.48$	awrt 51.5	M1 A1
	(ii) $s = -5.72 + 1.04 \times 18 = 13$		A1
			(3)
(e)	<ul style="list-style-type: none"> <li>The first estimate is an interpolation/The second estimate is an extrapolation</li> <li>55 is within the range of data/18 is not within the range of data</li> <li>55 is closer to the mean/18 is further away from the mean</li> </ul> <p>.....so 51.5 is the more reliable estimate</p>		M1
			A1
			(2)
<b>Notes</b>			<b>Total 12</b>
(a)	<b>B1</b>	For either LQ or UQ correct (may be seen in calculation for M1)	
	<b>M1</b>	Correct use of $Q_3 + 1.5 \times (Q_3 - Q_1)$ fit their LQ and their UQ provided their UQ > their LQ	
	<b>A1*</b>	For both LQ and UQ correct and identifying 90>78 or 90 is an outlier Answer is given so no incorrect working can be seen	
(b)	<b>M1</b>	For a correct method to find the gradient	
	<b>M1</b>	For a correct method to find the intercept (division by 11 is M0)	
	<b>A1*</b>	Cao (dep on both M marks) must see printed answer $s = -5.72 + 1.04f$	
(c)	<b>B1</b>	For a correct numerical interpretation of the gradient in context which must include <u>marks</u> at least once	
(d) (i)	<b>M1</b>	For a correct substitution into the regression equation. May be seen in (i) or (ii) or implied by one correct answer	
	<b>A1</b>	awrt 51.5 Allow 51 or 52	
(ii)	<b>A1</b>	13 or awrt 13.0	
(e)	<b>M1</b>	For any equivalent correct reason Ignore extraneous non-contradictory comments For the second bullet point <b>must</b> be clear that they are referring to French marks (24,, f,, 68). Do <b>not</b> allow comments that refer to the range of Spanish marks e.g. ‘51.5’ is within the range of data/‘13’ is not within the range of data’ Do <b>not</b> allow ‘55 is closer to the median (than 18)’	
	<b>A1</b>	For clearly identifying the estimate from part (d)(i): 51.5 or 55 or (i) or ‘the first estimate’, etc.	

Question Number	Scheme		Marks
5 (a)	$P(X < 38.8) = P\left(Z < \frac{38.8 - 40}{4}\right) [= P((Z < -0.3))]$		M1
	$= 1 - 0.6179 = 0.3821^*$		A1*
			(2)
(b)	$P(\text{Qualify}) = 1 - (0.3821)^3$ or $1 - 0.3821 + 0.3821 \times (1 - 0.3821) + 0.3821^2 \times (1 - 0.3821)$		M1
	$[= 0.9442]$		
	$P(X > 44) = P\left(Z > \frac{44 - 40}{4}\right) [= P((Z > 1))]$		M1
	$[= 1 - 0.8413] = 0.1587$		A1
	$P(X > 44 \text{ on 2nd attempt}   \text{Qualify}) = \frac{0.3821 \times '0.1587'}{'0.9442'}$		M1
	$0.06422\dots$ awrt 0.0642		A1
			(5)
<b>Notes</b>			<b>Total 7</b>
(a)	<b>M1</b>	For standardising using 38.8, 40 and 4 (allow $\pm$ )	
	<b>A1*</b>	Must see $1 - 0.6179$ or we must see 0.38209 or 0.38208... or better Answer is given so no incorrect working can be seen (but condone poor probability notation)	
(b)	<b>M1</b>	For a correct method to find the probability of qualifying	
	<b>M1</b>	For standardising using 44, 40 and 4 (implied by $1 - 0.8413$ or awrt 0.1587)	
	<b>A1</b>	awrt 0.16	
	<b>M1</b>	For a correct ratio of probabilities ft their 0.1587 and their 0.9442. Use of 0.6179 in the denominator is M0	
	<b>A1</b>	awrt 0.0642	

Question Number	Scheme		Marks
6 (a)	$P(B A) = \frac{P(B \cap A)}{P(A)}$		
	$0.3 = \frac{P(B \cap A)}{x} \Rightarrow P(B \cap A) = 0.3x$		M1
	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$		M1
	$0.65 = x + y - 0.3x \Rightarrow 0.65 = 0.7x + y$		
	$14x + 20y = 13^*$		A1*
			(3)
(b)(i)	$P(B \cup C) = P(B) + P(C)$ or $P(B \cap C) = 0$		M1
	$0.85 = \frac{1}{2}x + 2y$		A1
(ii)	Attempt to solve the 2 equations simultaneously		M1
	$x = 0.5$ $y = 0.3$		A1
			(4)
(c)	$P(B A) = 0.3$ <b>and</b> $P(B) = '0.3'$	$P(A) \times P(B) = '0.5' \times '0.3'$ <b>and</b> $P(A \cap B) = 0.3 \times '0.5'$ or $P(A \cap B) = '0.5' + '0.3' - 0.65$	M1
	So, A and B are statistically independent		A1ft
			(2)
<b>Notes</b>			<b>Total 9</b>
(a)	<b>M1</b>	Use of $P(B A) = \frac{P(B \cap A)}{P(A)}$ assuming independence is M0 e.g. $P(B \cap A) = P(B) \times P(A) [= xy]$ May be implied by $P(B \cap A) = 0.3x$ (may be seen on a Venn diagram)	
	<b>M1</b>	Use of $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ with substitution of $P(A \cup B)$ , $P(A)$ and $P(B)$ (the equation may be seen in a Venn diagram) $0.65 = x + y - 0.3x$ implies M1M1	
	<b>A1*</b>	Answer is given so no incorrect working can be seen	
(b)(i)	<b>M1</b>	Use of $P(B \cup C) = P(B) + P(C)$ or sight of $P(B \cap C) = 0$	
	<b>A1</b>	Any correct second equation in x and y which need not be simplified.	
(ii)	<b>M1</b>	Attempt to solve the 2 equations simultaneously. Either a correct substitution seen or a correct method to eliminate x or y	
	<b>A1</b>	For $x = 0.5$ and $y = 0.3$	
(c)	<b>M1</b>	For finding all of the probabilities needed for a test for independence (probabilities must be labelled) ft their values of x and y $P(B A)$ <b>and</b> $P(B)$ or $P(A)$ , $P(B)$ <b>and</b> $P(A \cap B)$ For $P(A \cap B)$ we <b>must</b> see working shown	
	<b>A1ft</b>	For a correct ft conclusion for their values of x and y (must have scored M1)	

Question Number	Scheme					Marks										
7 (a)	$\frac{k+4}{8} = 1$ [ $k = 4$ * ]					B1*										
						(1)										
(b)	<b>x</b>	1	2	3	4	M1 M1 A1										
	<b>P(X = x)</b>	$\frac{1}{13}$	$\frac{7}{26} - \frac{1}{13} = \frac{5}{26}$	$\frac{15}{26} - \frac{7}{26} = \frac{4}{13}$	$1 - \frac{15}{26} = \frac{11}{26}$											
						(3)										
(c)	4					B1ft										
						(1)										
(d)	$E(X) = 1 \times \frac{1}{13} + 2 \times \frac{5}{26} + 3 \times \frac{4}{13} + 4 \times \frac{11}{26} \left[ = \frac{40}{13} \right]$	<table border="1"> <tr> <td><b>Y</b></td> <td>7</td> <td>20</td> <td>33</td> <td>46</td> </tr> <tr> <td><b>P(Y = y)</b></td> <td><math>\frac{1}{13}</math></td> <td><math>\frac{5}{26}</math></td> <td><math>\frac{4}{13}</math></td> <td><math>\frac{11}{26}</math></td> </tr> </table>				<b>Y</b>	7	20	33	46	<b>P(Y = y)</b>	$\frac{1}{13}$	$\frac{5}{26}$	$\frac{4}{13}$	$\frac{11}{26}$	M1
	<b>Y</b>	7	20	33	46											
	<b>P(Y = y)</b>	$\frac{1}{13}$	$\frac{5}{26}$	$\frac{4}{13}$	$\frac{11}{26}$											
	$E(X^2) = 1^2 \times \frac{1}{13} + 2^2 \times \frac{5}{26} + 3^2 \times \frac{4}{13} + 4^2 \times \frac{11}{26} \left[ = \frac{135}{13} \right]$	$E(Y) = 7 \times \frac{1}{13} + 20 \times \frac{5}{26} + 33 \times \frac{4}{13} + 46 \times \frac{11}{26} \left[ = 34 \right]$				M1										
	$\text{Var}(X) = \frac{135}{13} - \left( \frac{40}{13} \right)^2 \left[ = \frac{155}{169} \right]$	$E(Y^2) = 7^2 \times \frac{1}{13} + 20^2 \times \frac{5}{26} + 33^2 \times \frac{4}{13} + 46^2 \times \frac{11}{26} \left[ = 1311 \right]$				M1										
$\text{Var}(13X - 6) = 13^2 \times \frac{155}{169}$	$\text{Var}(13X - 6) = '1311' - '34'^2$				M1											
	$= 155$					A1										
						(5)										
<b>Notes</b>						<b>Total 10</b>										
(a)	<b>B1*</b>	$\frac{k+4}{8} = 1$ oe Allow verification method $\frac{4+4}{8} = 1$ provided they conclude $k = 4$														
(b)	<b>M1</b>	For a correct method to find one probability from $x = 2, x = 3$ or $x = 4$ (implied by any one correct probability from $x = 2, x = 3$ or $x = 4$ )														
	<b>M1</b>	For a correct method to find a second probability from $x = 2, x = 3$ or $x = 4$ (implied by any two correct probabilities from $x = 2, x = 3$ or $x = 4$ )														
	<b>A1</b>	For a fully correct probability distribution. Need not be in a table, but 1, 2, 3 and 4 must be associated with correct probability														
(c)	<b>B1ft</b>	Must be consistent with the highest probability in their distribution in part (b). If no distribution is found, then the answer must be 4														
(d)	<b>M1</b>	For a correct method to find $E(X)$ (implied by awrt 3.08) ft their table use of $\sum xF(x)$ is M0 or for a correct probability distribution for $13X - 6$ ft their probabilities in (b)														
	<b>M1</b>	For a correct method to find $E(X^2)$ (implied by awrt 10.4) ft their table use of $\sum x^2F(x)$ is M0 or for a correct method to find $E(Y)$ ft their table														
	<b>M1</b>	Use of $E(X^2) - E(X)^2$ ft their $E(X^2)$ and their $E(X)$ or for a correct method to find $E(Y^2)$ ft their table														
	<b>M1</b>	Use of $13^2 \text{Var}(X)$ ft their $\text{Var}(X)$ or use of $E(Y^2) - E(Y)^2$ ft their $E(Y^2)$ and their $E(Y)$														
	<b>A1</b>	Cao														

Question Number	Scheme		Marks	
8 (a)	$P(X > \mu + 2k) = 0.2$ or $P(X < \mu + 2k) = 0.8$	or or	$P(X < \mu - 2k) = 0.2$ $P(X > \mu - 2k) = 0.8$	M1
	$\frac{\mu + 2k - \mu}{6} = 0.8416$	or	$\frac{\mu - 2k - \mu}{6} = -0.8416$	M1 A1
	$k = 2.5248\dots$		awrt 2.52	A1
			(4)	
(b)	$P\left(Y > \frac{3}{2}\mu\right) \Rightarrow P\left(Z > \frac{\frac{3}{2}\mu - \mu}{\sigma}\right) \Rightarrow P\left(Z > \frac{\frac{1}{2}\mu}{\sigma}\right)$		M1	
	$\mu = \frac{3}{2}\sigma^2 \Rightarrow P\left(Z > \frac{\frac{1}{2}\left(\frac{3}{2}\sigma^2\right)}{\sigma}\right) \left[ = P\left(Z > \frac{3}{4}\sigma\right) \right]$		M1	
	or $\sigma = \sqrt{\frac{2\mu}{3}} \Rightarrow P\left(Z > \frac{\frac{1}{2}\mu}{\sqrt{\frac{2\mu}{3}}}\right) = \left[ P\left(Z > \frac{1}{2}\sqrt{\frac{3\mu}{2}}\right) \right]$			
	or $\frac{1}{2}\frac{\mu}{\sigma} = k$ and $2\mu = 3\sigma^2$		M1	
	$\frac{3}{4}\sigma = 1.5$ or $\frac{1}{2}\sqrt{\frac{3\mu}{2}} = 1.5$ or $3\sigma^2 = 6\sigma$			
$\mu = 6$ only, $\sigma = 2$ only		A1 A1		
		(5)		
<b>Notes</b>			<b>Total 9</b>	
(a)	<b>M1</b>	For any of the given tail probability statements which may be seen on a diagram Also may be implied by awrt $\pm 0.84$ seen		
	<b>M1</b>	For standardising using $\mu$ and 6 and setting = to z value, where $0.8 <  z  < 0.9$ Implied by $(\pm)\frac{k}{3} = (\pm)0.84$ or better		
	<b>A1</b>	For a fully correct standardisation with a compatible z value. $ z $ must be 0.8416 or better		
	<b>A1</b>	awrt 2.52 (Allow 2.525) Answer only 2.52 is M1M1A0A1 Answer only 2.5248 is M1M1A1A1		
(b)	<b>M1</b>	For standardising using $\frac{3}{2}\mu$ , $\mu$ and $\sigma$		
	<b>M1</b>	For substitution of $\mu = \frac{3}{2}\sigma^2$ into their standardisation <b>or</b> setting up two equations in $\mu$ and $\sigma$		
	<b>M1</b>	For their expression for $\sigma$ only or $\mu$ only used with $\pm 1.5$		
	<b>A1</b>	$\mu = 6$ or $\sigma = 2$		
	<b>A1</b>	$\mu = 6$ and $\sigma = 2$ must reject any other values if found		