Mark Scheme (Results)

Summer 2024

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

Question	Scheme	Marks
1 (a)	$k = 3$	B1
		(1)
(b)	$Q_1 = 39$ $Q_3 = 57$	B1 B1
		(2)
(c)	$"57"+1.5\times("57"-"39")$ or $"39"-1.5\times("57"-"39")$	M1
	84 **and** 12 therefore only 1 outlier [85]	A1
		(2)
(d)		M1
		M1
		M1
		A1
		(4)
(e)	A correct difference of the **medians** with supporting figures e.g. On average Birch [trees grow slightly] **taller** as the **median** is larger **48 > 45** oe **or** A correct difference of the **spread** with supporting figures e.g. Maple has a greater spread/variation of **heights** as the **range** is larger **55 > 48** (excluding outlier) oe e.g. Birch has a greater spread/variation of **heights** as the **range** is larger **57 > 55** (with outlier) oe	B1ft
		(1)
(f)	$36 \leqslant a < x$ where $43 \leqslant x \leqslant 45$ **or** $54 \leqslant 2a \leqslant 80$	M1
	$36 \leqslant a \leqslant "43"$ and $54 \leqslant 2a \leqslant 80$	A1ft
	$36 \leqslant a \leqslant 40$	A1
		(3)
	Notes	**Total 13**

(a)	**B1**	Cao
(b)	**B1**	for Q_1 correct
	B1	for Q_3 correct
(c)	**M1**	for either method correct or a correct value (ft their Q_1 and their Q_3)
	A1	Both limits for outliers correct and statement about the outlier or the outlier given.
(d)	**M1**	for a box drawn with only 2 whiskers, only one at each end (condone median line missing)
	M1	for upper whisker ending at 76 (or 84 ft their upper outlier limit) and lower whisker ending at 28
	M1	for Q_1, Q_2 and Q_3 plotted, with $Q_2 = 48$ and ft their Q_1 and Q_3
	A1	for a fully correct box plot with the outlier correctly shown – must be only 1
(e)	**B1ft**	for a correct comment, **referring to heights**, with reference to a **correctly named statistic.** Must **include the figures** compared. Allow 'grow more/bigger' to imply taller Ignore any reference to skew **SC If Q1/Q3 are incorrect then allow a ft comment about spread referring to the difference in IQR if compared to 18**
(f)	**M1**	for either range correct. Allow $72 \leqslant 2a \leqslant 80$ or $27 \leqslant a \leqslant 40$ for $54 \leqslant 2a \leqslant 80$ Condone < rather than $\leqslant$ May be seen as separate inequalities e.g. $2a \leqslant 80$, $2a \geqslant 54$ is allowed for $54 \leqslant 2a \leqslant 80$ A final answer of $36 \leqslant a \leqslant 40$ or $36 < a < 40$ implies M1
	A1ft	for both ranges correct ft their k. Allow $72 \leqslant 2a \leqslant 80$ or $27 \leqslant a \leqslant 40$ for $54 \leqslant 2a \leqslant 80$ Condone < rather than $\leqslant$ May be seen as separate inequalities
	A1	Allow 36 to 40 or 36, 37, 38, 39, 40 **NB** It is possible to get M1A0A1

Question	Scheme	Marks
2 (a)	$\left[P(2X - 3 > 5) = \right] 0.45$	B1
		(1)
(b)	$E(X^2) = 2^2 \times 0.25 + 4^2 \times 0.3 + 5^2 \times 0.2 + 7^2 \times 0.1 + 8^2 \times 0.15 \left[= 25.3 \right]$	M1
	$Var(X) = 2^2 \times 0.25 + 4^2 \times 0.3 + 5^2 \times 0.2 + 7^2 \times 0.1 + 8^2 \times 0.15 - 4.6^2$ or $Var(X) = "25.3" - 4.6^2$	M1
	$= 25.3 - 4.6^2 = 4.14 *$	A1*
		(3)
(c)	$\left[E(Y) = \right] 13.4 = a \times 4.6 - b$	M1
	$\left[Var(Y) = \right] a^2 \times 4.14 = 66.24$	M1
	$a = 4$	A1
	$b = 5$	A1
		(4)
(d)	Sam throws 8 and Alex throws 2, 4 or 5 Sam throws 7 and Alex throws 2 or 4 Sam throws 5 or 4 or 2 and Alex throws 2	M1
	$0.15 \times (0.25 + 0.3 + 0.2)$ or $0.1 \times (0.25 + 0.3)$ or $(0.2 + 0.3 + 0.25) \times 0.25$	M1
	$0.15 \times (0.25 + 0.3 + 0.2) + 0.1 \times (0.25 + 0.3) + (0.2 + 0.3 + 0.25) \times 0.25$	M1
	$= 0.355 \quad \left(= \dfrac{71}{200} \right)$	A1
		(4)
ALT	Alex throws 2 Alex throws 4 and Sam throws 7 or 8 Alex throws 5 and Sam throws 8	M1
	0.25 or $0.3 \times (0.1 + 0.15)$ or 0.2×0.15	M1
	$0.25 + 0.3 \times (0.1 + 0.15) + 0.2 \times 0.15$	M1
	$= 0.355 \quad \left(= \dfrac{71}{200} \right)$	A1
Notes		**Total 12**
(a)	**B1**	0.45 oe
(b)	**M1**	for a correct method to find $E(X^2)$ At least 3 terms correct and added This is not implied by 25.3 on its own
	M1	for use of correct equation ft their $E(X^2)$
	A1*	for a correct expression, with all terms seen, leading to the given answer
(c)	**M1**	for writing or using a correct equation for $E(Y)$
	M1	for writing or using a correct method for $Var(Y)$
	A1	for $a = 4$ may be seen as part of the expression $4X \pm ...$
	A1	for $b = 5$ may be seen as part of the expression $...X - 5$
(d)	**M1**	for recognising all the required combinations – implied by 3 correct probabilities Ignore any repeats but do not ignore any incorrect combinations
	M1	for any one correct calculation from the 3 given
	M1	for any 2 correct calculations from the 3 given
	A1	0.355 oe

Question	Scheme	Marks
3(a)	Width = 1.25 [cm]	B1
	18.75 cm^2 for freq of 20 so $\dfrac{18.75}{20} \times 16 = 15$ cm^2 for a frequency of 16 or $w \times h = 15$ or fd $= 5$	M1
	$[h = 15 \div 1.25$ or $h = 8 \div 5 \times 7.5 =] 12$ (cm)	A1
		(3)
(b)	$Q_2 = [32+]\dfrac{7}{20} \times 4$ or using $n+1$ gives $Q_2 = [32+]\dfrac{7.5}{20} \times 4$	M1
	$= 33.4$ ($n+1$ gives 33.5)	A1
		(2)
(c)	$\bar{y} = \dfrac{104}{50}[= 2.08]$ $\quad$ $\sum(w-20) = 10 \times 104[= 1040]$ or $\sum w = 10 \times 104 + 50 \times 20[= 2040]$	M1
	$\bar{w} = 10 \times "2.08" + 20 = 40.8*$ $\quad\quad$ $\dfrac{"1040"}{50} + 20 = 40.8$ or $\dfrac{"2040"}{50} = 40.8$	A1*
		(2)
(d)	$[$Variance of $y =]\dfrac{233.54}{50} - ("2.08")^2 \left[= \dfrac{861}{2500} = 0.3444 \right]$ or $10 \times$ sd of $y =$ sd of w or $100 \times 233.54 = \sum(w^2) - 40 \times "2040" + 50 \times 400 \left[\Rightarrow \sum(w^2) = 84954 \right]$ oe	M1
	$[$Variance of $w =]"0.3444" \times 100$ or $\dfrac{"84954"}{50} - 40.8^2 \left[= \dfrac{861}{25} = 34.44 \right]$ or sd of $y = \sqrt{"0.3444"} \left[= \dfrac{\sqrt{861}}{50} = 0.5868... \right]$	M1
	sd of $w = \sqrt{"0.3444" \times 100}$ or $\sqrt{"34.44"}$ or $10 \times "\dfrac{\sqrt{861}}{50}"$	M1
	$= 5.868...$ $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ awrt 5.87	A1
(e)(i)	The mean would not change (as 40.8 is the mean)	B1
(ii)	The standard deviation would decrease (as 40.8 is in the middle so data closer together)	B1
	Both correct with a correct reason for why the standard deviation decreases	ddB1
		(3)
	Notes	**Total 14**
(a)	**B1**	for width = 1.25 no need for units
	M1	for sight of 15 or "their w"$\times$"their h"$= 15$ or fd $= 5$ May be implied by $h = 12$
	A1	for height = 12 no need for units
(b)	**M1**	for $\dfrac{7}{20} \times 4$ or $\dfrac{13}{20} \times 4$ or $\dfrac{m-32}{25-18} = \dfrac{4}{20}$ oe or $\dfrac{36-m}{38-25} = \dfrac{4}{20}$ oe (allow 25.5 rather than 25)
	A1	33.4 or if using $(n+1)$ 33.5
(c)	**M1**	for a correct method to find the mean of y or $\sum(w-20)$ or $\sum w$ $(10 \times 104 + k$ where $k \neq 20 \times 50$ is M0)
	A1*	for a correct method to find mean of w which leads to 40.8
(d)	**M1**	for a correct method to find the Variance of y or writing/using $10 \times$sd of $y =$ sd of w or a correct equation to find $\sum w^2$
	M1	for a correct method to find the Variance of w or sd of y ft their Var(y)
	M1	for a correct method to find the sd of w ft their Var(w)
	A1	awrt 5.87 **NB** an exact answer $\dfrac{\sqrt{861}}{5}$ scores A0
(e)(i)	**B1**	for no change (No reason needed) Allow mean = 40.8 to imply no change
(ii)	**B1**	for sd decreases/be smaller/go down (condone Var decreases) (No reason needed)
	ddB1	Both previous B1 awarded. For a correct reason for the sd decreasing Allow $(x - \bar{x}) = 0$ Allow $\sum(x-\bar{x})^2$ doesn't change and n increases. Allow the values would be more concentrated about the mean

Question	Scheme	Marks
4 (a)	$S_{dg} = 141978.84 - \dfrac{1456.8 \times 713.2}{8}$ or $S_{gg} = 72675.98 - \dfrac{713.2^2}{8}$	M1
	$S_{dg} = 12105.12$	A1
	$S_{gg} = 9094.2$	A1
		(3)
(b)	$r = \dfrac{"12105.12"}{\sqrt{16769.78 \times "9094.2"}}$	M1
	$= 0.9802....$ awrt **0.98**	A1
		(2)
(c)	$b = \dfrac{"12105.12"}{16769.78}[= 0.7218...]$	M1
	$a = \dfrac{713.2}{8} - "0.7218..." \times \dfrac{1456.8}{8}[= -42.297....]$	M1
	$g = -42.3 + 0.722d$ *	A1*cso
		(3)
(d)	for each 1 [cm] increase in length/d the girth/g increases by "0.722…"	B1
		(1)
(e)(i)	138.2 awrt **138**	B1
(ii)	[unreliable] as get a negative girth	B1
		(2)
(f)	$0.722x = 17.3$	M1
	$x = 23.96...$ awrt **24**	A1
		(2)
Notes		**Total 13**
(a)	**M1**	for a correct expression for S_{dg} or S_{gg}
	A1	for 12105.12 Allow $\dfrac{302628}{25}$
	A1	for 9094.2 Allow $\dfrac{45471}{5}$
		If exact answers are not seen then SC award M1A0A1 for both awrt 12100 and awrt 9090 if correct methods are seen If exact answers are not seen then SC award M1A0A0 for both awrt 12100 and awrt 9090 if no working seen
(b)	**M1**	for a valid attempt at r with their S_{dg} not equal to 141978.84
	A1	awrt 0.98
(c)	**M1**	for a correct method to find the value of b May be implied by 0.7218 or better
	M1	for a correct method to find a ft their b May be implied by –42.29 or better
	A1*	both method marks must be awarded with sight of 0.7218 or better **or** –42.29 or better
(d)	**B1**	for a suitable contextual comment that mentions 0.722 (or better) If units are stated they must be correct.
(e)(i)	**B1**	awrt 138 Allow 1.38m
(ii)	**B1**	For a correct reason eg sd = 45.8 cm so girth is nearly 3sd below mean so likely outlier Allow substitution of 50 leading to $g = -6.2$ and suitable reason e.g. this is not possible/this is negative Do not allow substitution of 0.5 to imply the girth is negative
(f)	**M1**	for a correct equation. implied by awrt 24
	A1	awrt 24

Question	Scheme	Marks
5 (a)	$P(X < 18) = P\left(Z < \pm\left(\dfrac{18-15}{2}\right)[=\pm1.5]\right)$	M1
	$= 0.9332$ awrt 0.933	A1
		(2)
(b)	$\dfrac{x-15}{2} = 0.2533$	M1B1
	$x = 15.506\ldots$ awrt 15.5	A1
		(3)
(c)	$P(T > \mu - 10) = 0.975$	M1
	$\dfrac{(\mu \pm 10) - \mu}{\sigma} = \pm1.96 \Rightarrow \sigma = \dfrac{10}{1.96}[=5.10\ldots]$	M1
	$P(T > \mu - 5) = P\left(Z > \dfrac{\mu - 5 - \mu}{"5.10\ldots"}[=-0.98]\right)[=0.836\ldots]$	M1
	$P(T > \mu - 5 \mid T > \mu - 10) = \dfrac{"0.836\ldots"}{"0.975"}$	M1
	$= 0.8579\ldots$ awrt 0.858	A1
		(5)
	Notes	**Total 10**
(a)	**M1**	for standardising correctly May be implied by ±1.5
	A1	awrt 0.933 (Do not ISW)
(b)	**M1**	for correct standardisation $=$ to a z value such that $0.25 \,,\, |z| \,,\, 0.26$
	B1	for use of awrt ± 0.2533
	A1	awrt 15.5
(c)	**M1**	for the correct probability of 0.975 – may be seen as the denominator of the fraction. May be implied by use of $|z| = 1.96$ or better
	M1	For $\dfrac{\mu + 10 - \mu}{\sigma} = 1.96$ or $\dfrac{\mu - 10 - \mu}{\sigma} = -1.96$, leading to a value for σ May be implied by ±0.98
	M1	for a correct method to find $P(T > \mu - 5)$ using their value for σ May be implied by -0.98 If $P(T < \mu + 5)$ is calculated then this may be implied by 0.98
	M1	for $\dfrac{p}{0.975}$ where $0.5 < p < 0.975$ (must be a probability not their z value) If the denominator is incorrect only follow through their $P(T > \mu - 10)$ if clearly labelled and > 0.95
	A1	awrt 0.858

Question	Scheme	Marks
6(a)	0.16 oe	B1
		(1)

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<tr><td colspan="3" align="center">Mark parts (b) and (c) together
If values are given in the diagram and the script, then the script takes precedence</td></tr>
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(b)	$[P(C)=]0.04+0.15+0.12+p[=0.31+p]$	$[P(C')=]0.1+0.23+q[=0.33+q]$	
	$[P(S)=]0.1+0.15+0.12+0.23[=0.6]$	$[P(S')=]1-(0.12+0.15+0.1+0.23)[=0.4]$	M1M1
	$[P(S\cap C)=]0.15+0.12[=0.27]$	$[P(S'\cap C')=]q$	
	$("0.31"+p)\times"0.6"="0.27"$ oe	$("0.33"+q)\times"0.4"=q$ oe	M1d
	$p=0.14$ oe	$q=0.22$ oe	A1
			(4)
(c)	$q=1-(0.04+0.12+0.15+0.1+0.23+"p")$	$p=1-(0.04+0.12+0.15+0.1+0.23+"q")$	M1
	$q=0.22$ oe	$p=0.14$ oe	A1ft
			(2)

(d)(i)	$\left[P\big((C\cup S)\cap G'\big)\right]=0.39$ oe	B1
		(1)
(ii)	$P\big(C\,|\,(S\cap G)\big)=\dfrac{0.15}{0.15+0.1}$	M1
	$=0.6$ oe	A1
		(2)
(e)	Number of teenagers $=\dfrac{76}{0.15+"p"}$ oe	M1
	Number who don't play Scrabble $="\left(\dfrac{76}{0.15+p}\right)"\times0.4$ $(=104.8...)$	M1
	$=104.8…$ awrt 105	A1
		(3)

				Total 13
			Notes	

(a)	**B1**	correct probability
(b)	**M1**	for 2 correct probability expressions
	M1	all 3 correct probability expressions Allow P(C) = 0.45
	M1d	dependent on the 1st M1 being awarded for use of $P(C\cap S)=P(C)\times P(S)$ oe or $P(C'\cap S')=P(C')\times P(S')$ ft their probabilities if labelled clearly
	A1	for 0.14 or exact equivalent or 0.22 or exact equivalent
(c)	**M1**	for a correct expression for q ft their value of p or a correct expression for p ft their value of q May be implied by a correct value for q ft their p or a correct value for p ft their q
	A1ft	for 0.22 or exact equivalent ft their value of p or 0.14 or exact equivalent ft their value of q ($p + q = 0.36$ provided p and q are probabilities)
(d)(i)	**B1**	for 0.39 or exact equivalent do not allow 0.04 + 0.12 + 0.23
(ii)	**M1**	for $\dfrac{0.15}{0.15+0.1}$
	A1	for 0.6 or exact equivalent
(e)	**M1**	Relating 76 to their $P(C\cap G)$ May be implied by awrt 262
	M1	for number of teenagers $\times$ 0.4 ft their number of teenagers e.g. 0.4 × "262" provided that the number of teenagers is not 76
	A1	awrt 105 ISW