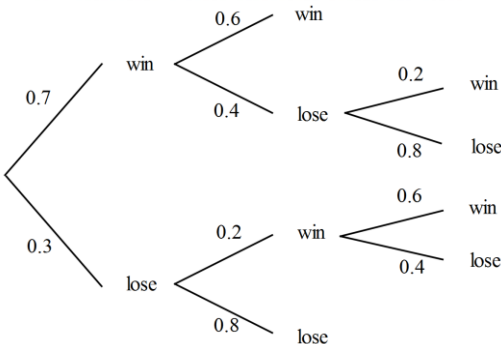




# Mark Scheme (Results)

October 2023

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

Question Number	Scheme		Marks
1 (a)			B1 B1 B1
(b)	$0.7 \times 0.6 = 0.42$ oe		(3) M1 A1
(c)	'0.42' + $(0.7 \times '0.4' \times '0.2') + ('0.3' \times '0.2' \times '0.6')$ = 0.512 oe		(2) M1 A1
(d)	$\frac{'0.42'}{'0.512'} = 0.8203\dots$ oe awrt 0.820		(2) M1 A1ft
(e)	$\frac{'0.42' + (0.7 \times '0.4' \times '0.2')}{0.7} = 0.68$ oe or $0.6 + '0.4' \times '0.2' = 0.68$ oe		(2) M1 A1
			(2)
	<b>Notes</b>		<b>Total 11</b>
(a)	<b>B1</b>	For 0.3 in the correct place on the first branch and 0.4 in the correct place on the second branch	
	<b>B1</b>	For 0.2 and 0.8 in the correct place in the second branch	
	<b>B1</b>	For 0.2, 0.8, 0.6 and 0.4 in the correct place in the third branch	
		<b>NB</b> ISW any extra branches drawn on the tree diagram	
(b)	<b>M1</b>	For $0.7 \times 0.6$	
	<b>A1</b>	Cao	
(c)	<b>M1</b>	For $'0.42' + (0.7 \times '0.4' \times '0.2') + ('0.3' \times '0.2' \times '0.6')$ Follow through part (b) and their tree diagram	
	<b>A1</b>	Cao	
(d)	<b>M1</b>	For $\frac{\text{part (b)}}{\text{part (c)}}$ provided the answer is a probability or ft their tree diagram	
	<b>A1ft</b>	awrt 0.820 or ft part (b) and part (c) provided the answer is a probability or ft their tree diagram. Allow 0.82 If ft and a decimal answer is given then this must be at least 3sf	
(e)	<b>M1</b>	For a correct ratio of probabilities. Follow through their part (b) and their tree diagram or $0.6 + '0.4' \times '0.2'$ ft their tree diagram	
	<b>A1</b>	Cao Allow 0.680	

Question Number	Scheme		Marks
2 (a)(i)	$Q_2 = 57$		B1
(ii)	$Q_1 = 45 \quad Q_3 = 63$		B1 B1
			(3)
(b)	'63'+1.5('63'-'45')[= 90] or '45'-1.5('63'-'45')[= 18]		M1
	= 90 or = 18		A1ft
	16 and 94 [are outliers]*		A1*
			(3)
(c)	A boxplot drawn with 2 whiskers		M1
	$Q_1$ , $Q_2$ and $Q_3$ plotted correctly		A1ft
	Whiskers drawn correctly		A1ft
	Outliers marked at 16 and 94		A1
			(4)
(d)	The <b>median</b> / $Q_2$ for February is less/lower than the <b>median</b> / $Q_2$ for December oe		B1ft
	The <b>IQR</b> / <b>range</b> for February is less/lower than December (allow similar) oe		B1ft
	For a correct interpretation of either average or spread e.g.		B1ft
	<ul style="list-style-type: none"><li>on average February weigh less than December oe</li><li>the weights of February are less varied/little change in variability than the weights of December oe</li><li>They weighed more later in the year oe</li><li>Most of the distribution has shifted right, implying that most kangaroos have gained weight but some appear to have lost weight.</li></ul>		
			(3)
	<b>Notes</b>		<b>Total 13</b>
(a)(i)	<b>B1</b>	Cao	
(ii)	<b>B1</b>	Cao	
	<b>B1</b>	Cao	
(b)	<b>M1</b>	For use of either $Q_3 + 1.5(Q_3 - Q_1)$ or $Q_1 - 1.5(Q_3 - Q_1)$ ft part (a)	
	<b>A1ft</b>	For either 90 or 18 ft part (a)	
	<b>A1*</b>	For identifying both outliers with no incorrect/missing working (This can ft part (a))	
(c)	<b>M1</b>	A boxplot drawn with 2 whiskers	
	<b>A1ft</b>	For $Q_1$ , $Q_2$ and $Q_3$ plotted correctly ft part (a)	
	<b>A1ft</b>	Whiskers drawn at 18 and 90 ft part (b) <b>or</b> 23 and 86	
	<b>A1</b>	Outliers marked at 16 and 94	
(d)	<b>B1ft</b>	A correct comparison of medians ft their boxplot drawn or part (a) (No figures are required but if quoted then they need to be correct ft) Must mention the word median/ $Q_2$	
	<b>B1ft</b>	A correct comparison of range/IQR ft their boxplot drawn or part (a) (No figures are required but if quoted then they need to be correct ft) Must mention either IQR or range	
	<b>B1ft</b>	A correct interpretation of either the average or the spread ft their boxplot drawn or part (a)	
		<b>NB</b> Ignore any reference to skew or outliers	

Question Number	Scheme		Marks
3 (i) (a)	$w = 0.15$		B1
	$x = 0.7 - 0.15 = 0.55$		B1
	$y = 0.65 - 0.55 = 0.1$		B1
	$z = 1 - 0.15 - 0.55 - 0.1 = 0.2$		B1
			(4)
(b)	'0.15' + '0.1' = '0.25'		B1ft
			(1)
(c)	$[P(C) \times P(O)] = '0.65' \times '0.7' \neq '0.55' [= P(C \cap O)]$ or $[P(C O) =] \frac{'0.55'}{'0.7'} \neq '0.65' [= P(C)]$ oe		M1
	'0.455' $\neq$ '0.55' or '0.7857'... $\neq$ '0.65' [So not independent]*		A1*
			(2)
3 (ii) (a)	$\left[ P(F \cup H) = \frac{2}{7} + \frac{1}{4} = \right] \frac{15}{28}$		B1
			(1)
(b)	$\frac{5}{8} = \frac{2}{7} + P(G) - \frac{2}{7}P(G)$		M1
	$P(G) = \frac{\frac{5}{8} - \frac{2}{7}}{1 - \frac{2}{7}} = \frac{19}{56} \div \frac{5}{7}$		dM1
	$P(G) = \frac{19}{40}$		A1
			(3)
(c)	$\left[ P(F \cap G) = \frac{2}{7} \times \frac{19}{40} = \right] \frac{19}{140}$		B1ft
			(1)
	<b>Notes</b>		<b>Total 12</b>
(i)(a)	<b>B1</b>	$w = 0.15$ If answer is given in the script and the Venn diagram, then mark the script	
	<b>B1</b>	$x = 0.55$ If answer is given in the script and the Venn diagram, then mark the script	
	<b>B1</b>	$y = 0.1$ If answer is given in the script and the Venn diagram, then mark the script	
	<b>B1</b>	$z = 0.2$ If answer is given in the script and the Venn diagram, then mark the script	
(b)	<b>B1ft</b>	For $w + y = '0.25'$ follow through their $w$ and their $y$ (You will need to check for their values) provided this is a probability	
(c)	<b>M1</b>	For ' $(x + y) \times (w + x)$ ' $\neq$ ' $x$ ' or $\frac{'x'}{'w + x'} \neq 'x + y'$ ft their $w, x$ and $y$	
	<b>A1*</b>	A fully correct solution with values evaluated and no errors ft their $w, x$ and $y$	
(ii) (a)	<b>B1</b>	For $\frac{15}{28}$ oe Allow awrt 0.536	
(b)	<b>M1</b>	For use of $P(F \cup G) = P(F) + P(G) - P(F) \times P(G)$	
	<b>dM1</b>	Dependent on M1. For a correct rearrangement to find $P(G)$ e.g. $\left(\frac{5}{8} - \frac{2}{7}\right) \div \left(1 - \frac{2}{7}\right)$ Allow $\frac{19}{56} = \frac{5}{7}P(G)$ May be implied by $\frac{19}{40}$	
	<b>A1</b>	For $\frac{19}{40}$ oe	
(c)	<b>B1ft</b>	For $\frac{19}{140}$ oe or $\frac{2}{7} \times P(G)$ evaluated correctly and where $P(G)$ is a probability	

Question Number	Scheme		Marks
4 (a)	$E\left(\frac{1}{X}\right) = 1 \times \frac{1}{10} + \frac{1}{2} \times \frac{1}{5} + \frac{1}{3} \times \frac{3}{10} + \frac{1}{4} \times \frac{2}{5} = \frac{2}{5}^*$		B1*
			(1)
(b)	$E\left(\left(\frac{1}{X}\right)^2\right) = 1^2 \times \frac{1}{10} + \left(\frac{1}{2}\right)^2 \times \frac{1}{5} + \left(\frac{1}{3}\right)^2 \times \frac{3}{10} + \left(\frac{1}{4}\right)^2 \times \frac{2}{5} \left[ = \frac{5}{24} \right]$		M1
	$\text{Var}\left(\frac{1}{X}\right) = \frac{5}{24} - \left(\frac{2}{5}\right)^2 = \frac{29}{600}$		M1 A1
			(3)
(c) (i)	$[E(Y) =] 12$		B1
(ii)	$[Var(Y) =] 30^2 \text{Var}\left(\frac{1}{X}\right) = \frac{87}{2}$ or If $y : 30 \ 15 \ 10 \ 7.5$ then $[Var(Y) =] \frac{375}{2} - 12^2 = \frac{87}{2}$		M1 A1
			(3)
(d)	$[Y < 20 \Rightarrow] \frac{30}{X} < 20 \Rightarrow X > 1.5 \quad \text{or } y : 30 \ 15 \ 10 \ 7.5$		M1
	$P(Y < 20) = P(X > 1.5) = \frac{9}{10}$		A1
	$[P(X < 3   Y < 20) =] \frac{P(X = 2)}{P(X > 1.5)} = \frac{\frac{1}{5}}{\left(\frac{9}{10}\right)} = \frac{2}{9}$ or $[P(X < 3   Y < 20) =] \frac{P(Y = 15)}{P(Y < 20)} = \frac{\frac{1}{5}}{\left(\frac{9}{10}\right)} = \frac{2}{9}$		dM1 A1 A1
			(5)
	Notes		Total 12
(a)	B1*	Value given, so must see sight of a correct expression, with no incorrect working seen. (Allow equivalent expressions.)	
(b)	M1	For attempt at an expression for $E\left(\left(\frac{1}{X}\right)^2\right)$ with at least 3 correct terms (Allow equivalent expressions.) May be embedded in a correct expression for $\text{Var}(X)$	
	M1	For a correct expression for $\text{Var}\left(\frac{1}{X}\right)$ (Need not be simplified) ft a stated value of $E\left(\left(\frac{1}{X}\right)^2\right)$	
	A1	Cao Allow awrt 0.0483	
(c) (i)	B1	For $[E(Y)] = 12$	
(ii)	M1	For correct use of $30^2 \text{Var}\left(\frac{1}{X}\right)$ ft their $\text{Var}\left(\frac{1}{X}\right)$ or $\frac{375}{2} - 12^2$ (May be implied by $\frac{87}{2}$ oe)	
	A1	For $[Var(Y) =] \frac{87}{2}$ oe	
(d)	M1	For a correct inequality for $Y < 20$ or all 4 values of $Y$ found (these may be seen in part (c))	
	A1	For $P(Y < 20) = \frac{9}{10}$ (May be seen as the denominator (e.g 0.2 + 0.3 + 0.4 oe) in a ratio of probabilities and scores M1A1)	
	dM1	Dependant on 1 <sup>st</sup> M1 For $\frac{P(X = 2)}{P(X > 1.5)}$ or $\frac{P(Y = 15)}{P(Y < 20)}$ Allow $\frac{P(1.5 < X < 3)}{P(X > 1.5)}$ or a correct ratio of probabilities ft $P(Y < 20)$	
	A1	For a correct numerator	
	A1	For $\frac{2}{9}$ oe (Allow a decimal answer that is 3sf or better e.g. 0.222)	

Question Number	Scheme		Marks
5 (a)	$X \sim N(210, 25^2)$		
	$P(X < 240) = P\left(Z < \frac{240 - 210}{25}\right) [= P(Z < 1.2)]$		M1
	$= 0.8849^*$		A1*
			(2)
(b)	$P(190 < X < 240) = 0.8849 - P\left(Z < \frac{190 - 210}{25}\right) [= 0.8849 - P(Z < -0.8)]$		M1
	$0.8849 - 0.2119 = 0.673$		awrt
	0.673		A1
			(2)
(c)	$\frac{210 + k - 210}{25} = 1.96$ or $\frac{210 - k - 210}{25} = -1.96$		M1 B1
	$k = 49$		awrt 49
			A1
			(3)
(d)	$P(X < S) = 0.15 \Rightarrow \frac{S - 210}{25} = -1.0364$		M1 B1
	$S = 184.09$		awrt 184
			A1
			(3)
(e)	$Y \sim N(\mu, \sigma^2)$		
	$P(Y < 152) = 0.05 \Rightarrow \frac{152 - \mu}{\sigma} = -1.6449$		M1 A1
	$P(Y > 180) = 0.40 \Rightarrow \frac{180 - \mu}{\sigma} = 0.2533$		A1
	$28 = 1.8982\sigma$		dM1
	$\sigma = 14.75...$ and $\mu = 176.26...$		A1
			(5)
	<b>Notes</b>		<b>Total 15</b>
(a)	<b>M1</b>	For standardising using 240, 210 and 25	
	<b>A1*</b>	Cao As the answer is given then no incorrect working should be seen	
(b)	<b>M1</b>	For standardising using 190/230, 210 and 25 and subtracting from 0.8849 May be implied by $\Phi(1.2) + \Phi(0.8) - 1$ or $0.8849 + 0.7881 - 1$	
	<b>A1</b>	awrt 0.673	
(c)	<b>M1</b>	For standardising and setting equal to a $z$ value, where $1.9 <  z  < 2$	
	<b>B1</b>	For $ z  = 1.96$ or better	
	<b>A1</b>	awrt 49	
(d)	<b>M1</b>	For standardising using $S$ (allow any letter) and setting equal to a $z$ value, where $1 <  z  < 1.1$	
	<b>B1</b>	For $z = -1.0364$	
	<b>A1</b>	awrt 184	
(e)	<b>M1</b>	For a correct method to form an equation in $\mu$ and $\sigma$ set equal to a $z$ value, where $-1.6 < z < -1.7$ or $0.2 < z < 0.3$ (Signs must be compatible)	
	<b>A1</b>	For a correct equation for $P(Y < 152)$	
	<b>A1</b>	For a correct equation for $P(Y > 180)$	
	<b>dM1</b>	Dependent on previous M mark. For solving the 2 equations simultaneously. If answers are incorrect then working must be shown. May be implied by $\sigma =$ awrt 14.8 and $\mu =$ awrt 176	
	<b>A1</b>	For $\sigma =$ awrt 14.8 and $\mu =$ awrt 176	

Question Number	Scheme			Marks
6 (a)(i)	$x = 1.2 + 0.2(1.4x + 1.5)$ o.e or $y = 1.4(1.2 + 0.2y) + 1.5$ o.e			M1
	$x = \frac{25}{12}$ $y = \frac{53}{12}$			A1A1
	$[\sum x =] \frac{25}{12} \times 12 [= 25]$			A1*
				(4)
(b)	$[\sum y =] \left(\frac{53}{12}\right)' \times 12 = 53$			M1A1ft
	$S_{xy} = \frac{6961}{60} - \frac{(25 \times '53')}{12} = 5.6$			M1 A1
				(4)
(c)	$\frac{'5.6'}{S_{xx}} = 1.4$ and $\frac{'5.6'}{S_{yy}} = 0.2$	$\frac{'5.6'}{\sqrt{\frac{'5.6'}{1.4} \times \frac{'5.6'}{0.2}}}$	$\frac{S_{xy}}{S_{xx}} = 1.4$ and $\frac{S_{xy}}{S_{yy}} = 0.2$	M1
	$S_{xx} = 4$ and $S_{yy} = 28$	$\frac{5.6}{\sqrt{1.4 \times 0.2}}$	$r^2 = 1.4 \times 0.2$	A1
	$r = \frac{'5.6'}{\sqrt{4 \times '28'}} = 0.5291...$	$\sqrt{1.4 \times 0.2} = 0.5291$		M1 dA1
	awrt 0.529			(4)
	<b>Notes</b>			<b>Total 12</b>
(a)(i)	<b>M1</b>	For either of the two equations o.e or an attempt to solve the two equations simultaneously. May be implied by $x = \frac{25}{12} / 2.08$ or better or $y = \frac{53}{12} / 4.42$ or better		
	<b>A1</b>	For either $x = \frac{25}{12} / 2.08$ or better or $y = \frac{53}{12} / 4.42$ or better		
	<b>A1</b>	For both $x = \frac{25}{12} / 2.08$ or better and $y = \frac{53}{12} / 4.42$ or better (May be written as a coordinate) <b>NB This is M1 on EPEN</b>		
(ii)	<b>A1*</b>	For $\frac{25}{12} \times 12$ Allow use of $\sum x$ rather than $\bar{x}$ e.g. $\sum x = 14.4 + 0.2(1.4 \sum x + 18)$ oe As the answer is given no incorrect working must be seen. <b>NB Working must be shown</b>		
(b)	<b>M1</b>	For $\left(\frac{53}{12}\right)' \times 12$ ft their y coordinate. Allow use of $\sum y$ rather than $\bar{y}$ e.g. $\sum y = 1.4(14.4 + 0.2 \sum y) + 18$ oe		
	<b>A1ft</b>	For $\sum y = 53$ or ft their y coordinate $\times 12$ (An answer of exactly 5.6 implies M1A1)		
	<b>M1</b>	Use of $S_{xy} = \frac{6961}{60} - \frac{25 \times \sum y'}{12}$ ft their $\sum y$ If $\sum y$ is not stated then M0 is awarded		
	<b>A1</b>	5.6 (Allow awrt 5.6)		

(c)	<b>M1</b>	<p>For use of the gradient to find <math>S_{xx}</math> and <math>S_{yy}</math> ft their <math>S_{xy}</math> or use of <math>\frac{S_{xy}}{\sqrt{S_{xy} \times \frac{S_{xy}}{1.4 \times 0.2}}}</math></p> <p>or setting both <math>\frac{S_{xy}}{S_{xx}}</math> and <math>\frac{S_{xy}}{S_{yy}}</math> equal to their respective gradients</p>
	<b>A1</b>	$S_{xx} = 4 \text{ and } S_{yy} = 28 \text{ or } \frac{S_{xy}}{\frac{S_{xy}}{\sqrt{1.4 \times 0.2}}} \text{ or } \frac{(S_{xy})^2}{S_{xx} \times S_{yy}} = 1.4 \times 0.2$
	<b>M1</b>	<p>For a correct expression for <math>r</math> ft their <math>S_{xy}</math>, <math>S_{xx}</math> and <math>S_{yy}</math> or <math>\sqrt{1.4 \times 0.2}</math> If answer is incorrect then you must see their stated values substituted into a correct expression for <math>r</math>. An answer of <math>\frac{\sqrt{7}}{5}</math> implies M1A1M1 only</p>
	<b>dA1</b>	<p>Dependant on all previous marks being awarded. awrt 0.529</p>