

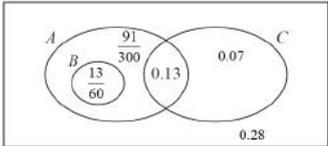


Mark Scheme (Results)

Summer 2021

Pearson Edexcel International Advanced Level
In Statistics S1 Paper WST01/01

Question Number	Scheme	Marks
<p>1. (a)</p> <p>(b)</p>	<div style="text-align: center;"> <p><u>First Counter</u> <u>Second Counter</u></p> </div> <p>(2)</p> <p> $P(Y) = \frac{7}{12} \times \frac{2}{11} + \frac{3}{12} \times \frac{2}{11} + \frac{2}{12} = \left\{ \frac{42}{132} \text{ or } \frac{7}{22} \right\} \quad \underline{\text{or}}$ $P(\text{Yellow and two counters}) = \frac{7}{12} \times \frac{2}{11} + \frac{3}{12} \times \frac{2}{11} = \left\{ \frac{20}{132} \text{ or } \frac{5}{33} \right\}$ $\frac{P([Y \cap R] \cup [Y \cap B])}{P(Y)} = \frac{\frac{20}{132}}{\frac{42}{132}}$ $= \frac{20}{42} \quad \underline{\text{or}} \quad \frac{10}{21} \quad \text{oe}$ </p> <p>(3)</p> <p>[5 marks]</p>	<p>B1 B1</p> <p>M1</p> <p>M1</p> <p>A1</p>
Notes		
<p>(a)</p> <p>(b)</p>	<p>1st B1 for the remaining probs on first set of branches and at least one on 2nd set</p> <p>2nd B1 for a fully correct tree diagram with all the correct probabilities</p> <p>1st M1 for a correct ft expression for P(Y) or P(Yellow and two counters)ft their tree diagram</p> <p>eg $1 - \frac{7}{12} \times \frac{6+3}{11} - \frac{3}{12} \times \frac{7+2}{11}$</p> <p>NB: The method is implied by the numbers in curly brackets but we do not need to see them to award the mark.</p> <p>2nd M1 for a correct ratio formula (symbols or words) <u>and</u> at least one correct ft prob or fully correct ft ratio. Do not follow through probabilities > 1 or < 0</p> <p>A1 for $\frac{10}{21}$ or exact equivalent. (Allow 0.476190)</p> <p>NB if an exact correct fraction is not given and an awrt 0.476.... is given it would get M1M1A0 if from correct working</p> <p>Generally if the answer is correct then award full marks (unless from obvious incorrect working) or notes indicate otherwise</p>	

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<p>2. (a)</p> <p>(b)</p> <p>(c)</p>	<p>B and C</p> <p>A and C independent gives: $P(C) \times 0.65 = 0.13$ or $0.65 \times (r + 0.13) = 0.13$ or $0.65 \times (0.48 - s) = 0.13$ $P(C) = 0.2$ or $r + 0.13 = 0.2$ or $0.48 - s = 0.2$ $r \{= 0.2 - 0.13\} = \underline{0.07}$ or $s \{= 0.48 - 0.2\} = \underline{0.28}$ $P(A) + r + s = 1$ or $0.65 + "0.07" + s = 1$ or $0.65 + "0.28" + r = 1$ $s \{= 1 - 0.72\} = \underline{0.28}$ and $r \{= 1 - 0.93\} = \underline{0.07}$</p> <p>$P[(B \cup C)] = "0.2" + q$ or $0.13 + "0.07" + q$ $P(A \cap C') = p + q \quad \{= 0.52\}$ $\{P[(A \cap C') \cap (B \cup C)] = q \Rightarrow\} \quad "(p + q) \times (0.2 + q) = q$ or $"(p + q) \times (0.13 + "0.07" + q) = q$ or $"(p + q) \times (1 - s - p) = 0.52 - p$ [Using $p + q = 0.52$] $0.52 \times (0.2 + q) = q$ or $0.52(0.72 - p) = 0.52 - p$ $q = \frac{13}{60}$ $p = \frac{91}{300}$</p>	<p>B1 (1)</p> <p>M1 A1 A1 M1 A1 (5)</p> <p>B1ft B1 M1 M1 A1 A1 (6)</p>
	Notes	[12 marks]
<p>(a)</p> <p>(b)</p> <p>(c)</p>	<p>B1 B and C seen. If they include A then B0</p> <p>1st M1 for a correct equation for $P(C)$ using independence. 1st A1 for $P(C) = 0.2$ correct linear equation for r or s 2nd A1 for either $r = 0.07$ or $s = 0.28$ 2nd M1 for using $\sum p = 1$ Allow letter r and s or their values for r and s provided they are probabilities. 3rd A1 for both $s = 0.28$ and $r = 0.07$</p> <p>NB: The quotations around the 0.07 ("0.07") imply that we ft their value</p> <p>1st B1ft for an expression (in q) for $P(B \cup C)$ ft their value of r or their "0.2" eg $0.13 + "their r" + q$ Implied by 1st or 2nd M1 below. 2nd B1 for a correct expression for $P(A \cap C')$ in terms of p and q or 0.52 Implied by 1st or 2nd M1 below 1st M1 for a correct use of independence (ft their probabilities), values or letters. Implied by 2nd M1 2nd M1 using $p + q = 0.52$ to gain a linear equation in one variable 1st A1 for a correct fraction for q 2nd A1 for a correct fraction for p SC: If both p and q are given as equivalent recurring decimals award A0A1 eg $0.21\dot{6}$ and $0.30\dot{3}$</p>	

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<p>3 (a)</p> <p>(b)</p> <p>(c)(i)</p> <p>(ii)</p> <p>(d)</p> <p>(e)</p>	<p>Width = <u>2.5 (cm)</u> 1.5 cm^2 for freq of 5 so $6 \times 1.5 = 9 \text{ cm}^2$ for freq of 30 <u>or</u> $fd = \frac{5}{3} w \times h = 9$ So $h = 9 \div 2.5$ or $6 \div \frac{5}{3} = \mathbf{3.6 \text{ (cm)}}$</p> <p>$Q_2 = [12] + \frac{16}{25} \times 3$ allow use of $(n + 1)$ giving $[12] + \frac{16.5}{25} \times 3$ $= 13.92 = \text{awrt } \mathbf{13.9}$</p> <p>$\sum fx = 5 \times 6.5 + 13 \times 9 + 16 \times 11 + 25 \times 13.5 + 30 \times 17.5 + 11 \times 24 = 1452$ $\bar{x} = 14.52 = \text{awrt } \mathbf{14.5}$</p> <p>$\sum fx^2 = 6.5^2 \times 5 + 9^2 \times 13 + 11^2 \times 16 + 13.5^2 \times 25 + 17.5^2 \times 30 + 24^2 \times 11 = 23\,280$ $\sigma_x = \sqrt{\frac{23\,280}{100} - ("14.52")^2}$ <u>or</u> $\sqrt{21.9696}$ $\sigma_x = 4.687... = \text{awrt } \mathbf{4.69}$</p> <p>$\frac{1}{2} \times 13 + 16 + 25 + 30 + \frac{1}{4} \times 11$ So proportion is 80.25 % or 0.8025 awrt <u>0.803</u></p> <p>Profit = $2.2 \times "0.8025" + 0.8 \times \frac{0.75 \times 11}{100} - 1.2 \times \left(1 - \left[0.8025 + \frac{0.75 \times 11}{100} \right] \right)$ $= 1.6935$ awrt <u>1.7 (p)</u></p>	<p>B1 M1 A1 (3)</p> <p>M1 A1 (2)</p> <p>M1 A1 (2)</p> <p>M1 M1 A1 (3)</p> <p>M1 A1 (2)</p> <p>M1 A1 (2)</p>
Notes		[14 marks]
<p>(a)</p> <p>(b)</p> <p>(c)(i)</p> <p>(ii)</p> <p>(d)</p> <p>(e)</p>	<p>B1 for width = 2.5 (cm) M1 for sight of 9 cm^2 or $w \times h = 9$ or $fd = \frac{5}{3}$ (o.e.) A1 for height = 3.6 (cm)</p> <p>M1 for $\frac{16}{25} \times 3$ or $\frac{9}{25} \times 3$ or $\frac{m-12}{15-m} = \frac{16}{9}$ For any correct equation leading to Q_2 or correct fraction as part of Q_2</p> <p>A1 for awrt 13.9 (use of $(n + 1)$ giving 13.98 = awrt 14.0)</p> <p>M1 for attempt at $\sum fx$ with at least 3 correct terms <u>or</u> $900 < \sum fx < 1800$ for info $\sum fx = 32.5 + 117 + 176 + 337.5 + 525 + 264$</p> <p>A1 for awrt 14.5 (correct answer only 2/2)</p> <p>1st M1 for attempt at $\sum fx^2$ with at least 3 correct terms <u>or</u> $20\,000 < \sum fx^2 < 26\,000$ for info $\sum fx^2 = 211.25 + 1053 + 1936 + 4556.25 + 9187.5 + 6336$</p> <p>2nd M1 for a correct expression including $\sqrt{\quad}$ (ft their $\sum fx^2$ if clear it is $\sum fx^2$) Do not allow $(\sum fx)^2$ for $\sum fx^2$</p> <p>A1 for awrt 4.69 (allow $s = 4.7107... \text{ awrt } 4.71$) (correct answer only 3/3)</p> <p>M1 for attempt at a correct expression (allow 1 error or omission) eg $100 - \left(5 + \frac{13}{2} \right) - \frac{33}{4}$</p> <p>A1 for awrt 80.3% or 0.803</p> <p>M1 for a correct expression ft their 0.8025 o.e. eg $\left[2.2 \times (100 - 11.5 - 8.25) + 0.8 \times 8.25 - 1.2 \times 11.5 \right] \div 100$ Condone $\left[2.2 \times "80" + 0.8 \times (8) - 1.2 \times (12) \right] \div 100$</p> <p>A1 for awrt 1.7 Allow £0.017 (this must have units)</p>	

Question Number	Scheme	Marks
4. (a)	$P(W < 120) = P\left(Z < \frac{120-165}{35}\right)$ $= P(Z < -1.2857\dots) = 1 - 0.9015 \text{ or } 1 - 0.9007285\dots$ $= 0.09927\dots = \text{awrt } \underline{\underline{0.0985\sim0.0994}}$	M1 M1 A1 (3)
(b)	e.g. $P(W > x) = \frac{1}{3}$ gives $\frac{x-165}{35} = \pm 0.43$ (calculator 0.430727...) Limits 149.9245... to 180.0754... awrt <u>150</u> to <u>180</u>	M1B1 A1, A1 (4)
(c)	$P(W < 200 \mid W > "180")$ or $\frac{P("180" < W < 200)}{P(W > "180") \text{ or } \frac{1}{3}}$ $= \frac{0.8413(44739\dots) - \frac{2}{3}}{\frac{1}{3}}$ $= 0.52403\dots \underline{\underline{(0.523\sim0.5264)}}$	M1 A1 (num) A1 (3)
(d)	$\frac{1}{3} \times \frac{1}{3} \times \frac{1}{3}; \times 3!$ $= \underline{\underline{\frac{2}{9}}}$	M1;M1 A1 (3)
Notes		
(a)	1 st M1 for standardising with 120 (allow 210), 165 and 35. Accept \pm 2 nd M1 for attempting $1 - p$ [where $0.85 < p < 0.95$] A1 for awrt 0.0985~0.0994 (Correct ans only 3/3)	
(b)	M1 for standardising with x (o.e.) 165 and 35 and setting equal to a z value, $0.4 < z < 0.5$ (Accept $\frac{165-x}{35} = \pm z$ where $0.4 < z < 0.5$) B1 for use of $z = 0.43$ or better We must see 0.43 or better. 1 st A1 for lower limit of awrt 150 2 nd A1 for upper limit of awrt 180 SC A0A1 for two limits symmetrically placed about 165 provided M1 scored NB: correct answers with no working can score M1B0A1A1	
(c)	M1 for a correct probability statement (either form) ft their 180 or a correct ratio 1 st A1 for a correct numerator (awrt 0.175) 2 nd A1 for an answer in the range awrt 0.523~0.5264 (use of 180 gives 0.5263869...)	
(d)	1 st M1 for $\left(\frac{1}{3}\right)^3$ (or equivalent) 2 nd M1 for $p \times 3!$ (or equivalent) where $0 < p < \frac{1}{6}$ A1 for $\frac{2}{9}$ or any exact equivalent	

[13 marks]

Question Number	Scheme	Marks
5. (a)	$\{E(X) = \} -2a - b + 0 \times c + b + 4a$ <u>or</u> $2a$ $\{ 2a = 0.5 \text{ so } \} \underline{a = 0.25}$	M1 A1 (2)
(b)	$\{E(X^2) = \} (-2)^2 \times a + (-1)^2 \times b + 0 + 1^2 \times b + 4^2 \times a$ <u>or</u> $20a + 2b$ (o.e.) $\{\text{Var}(X) = \} "20a + 2b" - 0.5^2$ $20a + 2b - 0.25 = 5.01$ (o.e.) e.g. "4.75" + $2b = 5.01$ $\{ 2b = 0.26 \text{ so } \} \underline{b = 0.13}$ $\{\text{Use of sum of probs} = 1 \text{ to calculate a 2}^{\text{nd}} \text{ value}\} \underline{c = 0.24}$	M1 M1 A1 A1 A1ft (5)
(c)(i)	$\{E(Y) = 5 - 8 \times 0.5 \} = \underline{1}$	B1
(ii)	$\{\text{Var}(Y) = \} (-8)^2 \times 5.01$ $= 320.64$ awrt <u>321</u>	M1 A1 (3)
(d)	$4X^2 > 5 - 8X$ $(2X - 1)(2X + 5) > 0 \Rightarrow X > 0.5$ So need $X = 1$ or 4 <u>or</u> probability of $a + b$ $= \underline{0.38}$	M1 M1A1 M1 A1 (5) [15 marks]
Notes		
(a)	M1 for any correct expression for $E(X)$ in terms of a (or a, b, c) A1 for $a = 0.25$	
(b)	1 st M1 for attempt at an expression for $E(X^2)$ with at least 3 correct non-zero terms 2 nd M1 for a correct expression for $\text{Var}(X)$ eg " $18a - c + 1" - 0.5^2$ Allow with their value of a substituted 1 st A1 for a correct equation for b (or possibly c) eg " $18a - c + 1" - 0.5^2 = 5.01$ Allow with their value of a substituted 2 nd A1 for either $b = 0.13$ or $c = 0.24$ 3 rd A1ft for using $c = 1 - 2 \times "0.25" - 2 \times "0.13"$ or $b = (1 - 2 \times "0.25" - "0.24") \div 2$ to gain the correct ft answer for their 2 nd value	
(c)	B1 for $\{E(Y) = \} 1$ M1 for correct use of $\text{Var}(aX + b) = a^2 \text{Var}(X)$ A1 for awrt 321	
(d)	1 st M1 for correct quadratic inequality (may be inside prob statement) or table of values 2 nd M1 for an attempt to solve or identifying correct X values 1 st A1 for $X > 0.5$ [may also have $X < -2.5$] 3 rd M1 for realising need $X = 1$ and 4 only or answer of their $(a + b)$ 2 nd A1 for 0.38 (or exact equivalent) only (correct ans only 5/5)	

Question Number	Scheme	Marks
<p>6. (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p> <p>(f)</p> <p>(g)</p>	$\{S_{yy} = \} 42.63 - \frac{23.7^2}{16} = [7.524375]$ <p>Use of $\bar{y} = 3.684 - 0.3242\bar{x}$; so $\sum x = 16 \times \left(\frac{3.684 - \frac{23.7}{16}}{0.3242} \right) = 108.71067..$</p> $\{S_{xx} = \} 756.81 - \frac{("108.71..")^2}{16} ; = 18.18435... \text{ awrt } \underline{18.2}$ $b = \frac{S_{xy}}{S_{xx}} \Rightarrow S_{xy} = "18.1843.." \times (-0.3242) [= -5.8953..]; r = \frac{"-5.89536.."}{\sqrt{"18.184.." \times 7.524375}}$ $= -0.50399... = \underline{-0.49 \sim -0.51}$ <p>Sub $x = 2$ in the regression line gives $y = 3.0356$</p> $\text{St.dev} = \sqrt{\frac{S_{xx}}{n}} = \sqrt{\frac{"18.184..."}{16}} = 1.066...$ <p>So limits are: $\frac{"108.71..."}{16} \pm 3 \times "1.066..." = 3.5965... \sim 9.9929... = \text{awrt } \underline{3.6 \sim 10}$</p> <p>The probability of $x = 2$ being in the range is very small; so Behrouz's estimate is <u>unreliable</u></p> <p>Should use regression of x on y to estimate unemployment or equivalent So Andi's suggestion is not suitable <u>or</u> not to be recommended</p>	<p>B1</p> <p>(1)</p> <p>M1; A1</p> <p>M1; A1</p> <p>(4)</p> <p>M1; M1</p> <p>A1</p> <p>(3)</p> <p>B1</p> <p>(1)</p> <p>M1</p> <p>M1, A1</p> <p>(3)</p> <p>B1ft; dB1ft</p> <p>(2)</p> <p>B1 dB1</p> <p>(2)</p> <p>[16 marks]</p>
Notes		
<p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p> <p>(f)</p> <p>(g)</p>	<p>B1 Value given so must see sight of a correct expression – allow 561.69 for 23.7^2</p> <p>1st M1 for clear use of regression line with \bar{y} <u>or</u> $\sum y$</p> <p>1st A1 for $\sum x = \text{awrt } 109$</p> <p>2nd M1 for a correct expression for S_{xx} ft their $\sum x$</p> <p>2nd A1 for awrt 18.2</p> <p>1st M1 for use of gradient to find S_{xy}</p> <p>2nd M1 for a correct expression for r ft their S_{xy} and S_{xx}</p> <p>A1 for an answer in the range $-0.49 \sim -0.51$</p> <p>B1 for sight of $y = 3.03... \text{ or better. Allow } 3.04$</p> <p>1st M1 for a correct attempt at st. dev. ft their S_{xx} or $\sqrt{\frac{756.81}{16} - \left(\frac{"108.71..."}{16}\right)^2}$ ft their $\sum x$</p> <p>2nd M1 for one correct calc...ft their values</p> <p>A1 for a range awrt 3.6~10</p> <p>1st B1ft for a correct reason ft their range in part (e) eg $x = 2$ is <u>outside</u> the range. Allow extrapolation</p> <p>2nd dB1ft dep on 1st B1 for stating a correct conclusion for their range</p> <p>1st B1 for a suitable reason based on reg line, eg regression line (y on x) can only be used to estimate wages. Allow x instead of unemployment and y instead of wages</p> <p>2nd dB1 dep on 1st B1 for suggesting not suitable (or equivalent)</p>	