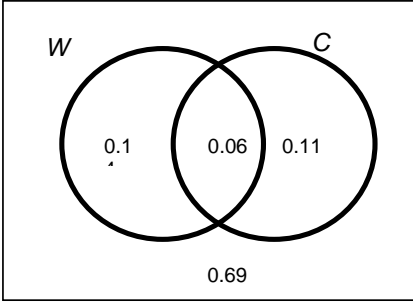


4766 Statistics 1

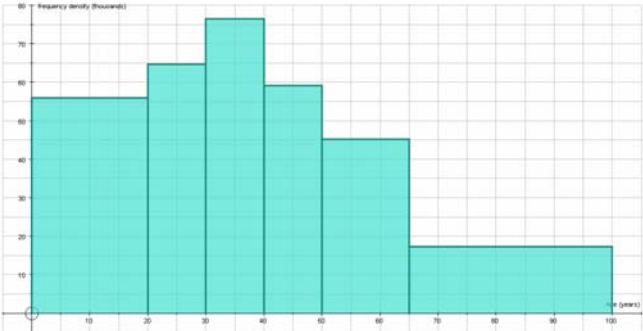
Q1 (i)	Mean = 7.35 (or better) Standard deviation: 3.69 – 3.70 (awfw) Allow $s^2 = 13.62$ to 13.68 Allow $\text{rmsd} = 3.64 - 3.66$ (awfw) After B0, B0 scored then if at least 4 correct mid-points seen or used. {1.5, 4, 6, 8.5, 15} Attempt of their mean = $\frac{\sum fx}{44}$, with $301 \leq fx \leq 346$ and fx strictly from mid-points not class widths or top/lower boundaries.	B2cao $\sum fx = 323.5$ B2cao $\sum fx^2 = 2964.25$ (B1) for variance s.o.i.o (B1) for rmsd (B1) mid-points (B1) $6.84 \leq \text{mean} \leq 7.86$	4
(ii)	Upper limit = $7.35 + 2 \times 3.69 = 14.73$ or 'their sensible mean' + $2 \times$ 'their sensible s.d.' So there could be one or more outliers	M1 (with s.d. < mean) E1dep on B2, B2 earned and comment	2
TOTAL			6
Q2 (i)	$P(W) \times P(C) = 0.20 \times 0.17 = 0.034$ $P(W \cap C) = 0.06$ (given in the question) Not equal so not independent (Allow $0.20 \times 0.17 \neq 0.06$ or $\neq p(W \cap C)$ so not independent).	M1 for multiplying or 0.034 seen A1 (numerical justification needed)	2
(ii)	<div style="text-align: center;">  </div> <p>The last two G marks are independent of the labels</p>	G1 for two overlapping circles labelled G1 for 0.06 and either 0.14 or 0.11 in the correct places G1 for all 4 correct probs in the correct places (including the 0.69) NB No credit for Karnaugh maps here	3
(iii)	$P(W C) = \frac{P(W \cap C)}{P(C)} = \frac{0.06}{0.17} = \frac{6}{17} = 0.353 \text{ (awrt 0.35)}$	M1 for 0.06 / 0.17 A1 cao	2

(iv)	Children are more likely than adults to be able to speak Welsh or 'proportionally more children speak Welsh than adults' Do not accept: 'more Welsh children speak Welsh than adults'	E1FT Once the correct idea is seen, apply ISW	1
		TOTAL	8
Q3			
(i)	(A) $0.5 + 0.35 + p + q = 1$ so $p + q = 0.15$ (B) $0 \times 0.5 + 1 \times 0.35 + 2p + 3q = 0.67$ so $2p + 3q = 0.32$ (C) from above $2p + 2q = 0.30$ so $q = 0.02, p = 0.13$	B1 $p + q$ in a correct equation before they reach $p + q = 0.15$ B1 $2p + 3q$ in a correct equation before they reach $2p + 3q = 0.32$ (B1) for any 1 correct answer B2 for both correct answers	1 1 2
(ii)	$E(X^2) = 0 \times 0.5 + 1 \times 0.35 + 4 \times 0.13 + 9 \times 0.02 = 1.05$ $\text{Var}(X) = \text{'their } 1.05' - 0.67^2 = 0.6011$ (awrt 0.6) (M1, M1 can be earned with their p^+ and q^+ but not A mark)	M1 $\sum x^2 p$ (at least 2 non zero terms correct) M1dep for $(- 0.67^2)$, provided $\text{Var}(X) > 0$ A1 cao (No n or n-1 divisors)	3
		TOTAL	7
Q4			
(i)	$X \sim B(8, 0.05)$ (A) $P(X = 0) = 0.95^8 = 0.6634$ 0.663 or better Or using tables $P(X = 0) = 0.6634$ (B) $P(X = 1) = \binom{8}{1} \times 0.05 \times 0.95^7 = 0.2793$ $P(X > 1) = 1 - (0.6634 + 0.2793) = 0.0573$ Or using tables $P(X > 1) = 1 - 0.9428 = 0.0572$	M1 0.95^8 A1 CAO Or B2 (tables) M1 for $P(X = 1)$ (allow 0.28 or better) M1 for $1 - P(X \leq 1)$ must have both probabilities A1 cao (0.0572 – 0.0573) M1 for $P(X \leq 1) 0.9428$ M1 for $1 - P(X \leq 1)$ A1 cao (must end in...2)	2 3
(ii)	Expected number of days = $250 \times 0.0572 = 14.3$ awrt	M1 for $250 \times \text{prob}(B)$ A1 FT but no rounding at end	2
		TOTAL	7

Q5 (i)	<p>Let p = probability of remembering or naming all items (for population) (whilst listening to music.) $H_0: p = 0.35$ $H_1: p > 0.35$</p> <p>H_1 has this form since the student believes that the probability will be increased/ improved/ got better /gone up.</p>	<p>B1 for definition of p B1 for H_0 B1 for H_1</p> <p>E1dep on $p > 0.35$ in H_0 In words not just because $p > 0.35$</p>	4
(ii)	<p>Let $X \sim B(15, 0.35)$ Either: $P(X \geq 8) = 1 - 0.8868 = 0.1132 > 5\%$ Or $0.8868 < 95\%$</p> <p>So not enough evidence to reject H_0 (Accept H_0)</p> <p>Conclude that there is not enough evidence to indicate that the probability of remembering all of the items is improved / improved/ got better /gone up. (when listening to music.)</p> <p>-----</p> <p>Or:</p> <p>Critical region for the test is {9,10,11,12,13,14,15} 8 does not lie in the critical region.</p> <p>So not enough evidence to reject H_0</p> <p>Conclude that there is not enough evidence to indicate that the probability of remembering all of the items is improved / improved/ got better /gone up. (when listening to music.)</p> <p>-----</p> <p>Or:</p> <p>The smallest critical region that 8 could fall into is {8, 9, 10, 11, 12, 13, 14, and 15}. The size of this region is 0.1132</p> <p>$0.1132 > 5\%$</p> <p>So not enough evidence to reject H_0</p> <p>Conclude that there is not enough evidence to indicate that the probability of remembering all of the items is improved (when listening to music)</p>	<p>Either: M1 for probability (0.1132) M1dep for comparison</p> <p>A1dep</p> <p>E1dep on all previous marks for conclusion in context</p> <p>-----</p> <p>Or:</p> <p>M1 for correct CR (no omissions or additions) M1dep for 8 does not lie in CR A1dep</p> <p>E1dep on all previous marks for conclusion in context</p> <p>-----</p> <p>Or:</p> <p>M1 for CR{8,9,...15} and size = 0.1132 M1 dep for comparison</p> <p>A1dep</p> <p>E1dep on all previous marks for conclusion in context</p>	4
TOTAL			8

Section B			
Q6 (i)	<p>(A) $P(\text{both rest of UK}) = 0.20 \times 0.20$ $= 0.04$</p> <p>(B) Either: All 5 case $P(\text{at least one England}) =$ $(0.79 \times 0.20) + (0.79 \times 0.01) + (0.20 \times 0.79) + (0.01 \times 0.79) +$ (0.79×0.79) $= 0.158 + 0.0079 + 0.158 + 0.0079 + 0.6241 = 0.9559$</p> <p>Or</p> <p>$P(\text{at least one England}) = 1 - P(\text{neither England})$ $= 1 - (0.21 \times 0.21) = 1 - 0.0441 = 0.9559$ or listing all $= 1 - \{ (0.2 \times 0.2) + (0.2 \times 0.01) + (0.01 \times 0.20) + (0.01 \times 0.01) \}$ $= 1 - (**)$ $= 1 - \{ 0.04 + 0.002 + 0.002 + 0.0001 \}$ $= 1 - 0.0441$ $= 0.9559$</p> <p>Or: All 3 case $P(\text{at least one England}) =$ $= 0.79 \times 0.21 + 0.21 \times 0.79 + 0.79^2$ $= 0.1659 + 0.1659 + 0.6241$ $= 0.9559$</p> <hr/> <p>(C) Either $0.79 \times 0.79 + 0.79 \times 0.2 + 0.2 \times 0.79 + 0.2 \times 0.2 = 0.9801$</p> <p>Or $0.99 \times 0.99 = 0.9801$</p> <p>Or $1 - \{ 0.79 \times 0.01 + 0.2 \times 0.01 + 0.01 \times 0.79 + 0.01 \times 0.02 + 0.01^2 \} = 1 - 0.0199$ $= 0.9801$</p>	<p>M1 for multiplying A1cao</p> <p>M1 for any correct term (3case or 5case) M1 for correct sum of all 3 (or of all 5) with no extras A1cao (condone 0.96 www)</p> <p>Or M1 for 0.21×0.21 or for (**) fully enumerated or 0.0441 seen M1 dep for $1 - (1^{\text{st}} \text{ part})$ A1cao</p> <p>See above for 3 case</p> <hr/> <p>M1 for sight of all 4 correct terms summed A1 cao (condone 0.98 www) or M1 for 0.99×0.99 A1cao</p> <p>Or M1 for everything $1 - \{ \dots \}$ A1cao</p>	<p>2</p> <p>3</p> <p>2</p>
(ii)	<p>$P(\text{both the rest of the UK} \mid \text{neither overseas})$ $= \frac{P(\text{the rest of the UK and neither overseas})}{P(\text{neither overseas})}$ $= \frac{0.04}{0.9801} = 0.0408$</p> <p>{Watch for: $\frac{\text{answer}(A)}{\text{answer}(C)}$ as evidence of method ($p < 1$)}</p>	<p>M1 for numerator of 0.04 or 'their answer to (i)(A)'</p> <p>M1 for denominator of 0.9801 or 'their answer to (i) (C)' A1 FT ($0 < p < 1$) 0.041 at least</p>	<p>3</p>

<p>(iii)</p> <p>(A) Probability = $1 - 0.79^5$ $= 1 - 0.3077$ $= 0.6923$ (accept awrt 0.69)</p> <p>see additional notes for alternative solution</p> <p>(B) $1 - 0.79^n > 0.9$</p> <p>EITHER: $1 - 0.79^n > 0.9$ or $0.79^n < 0.1$ (condone = and \geq throughout) but not reverse inequality</p> <p>$n > \frac{\log 0.1}{\log 0.79}$, so $n > 9.768\dots$</p> <p>Minimum $n = 10$ Accept $n \geq 10$</p> <p>-----</p> <p>OR (using trial and improvement): Trial with 0.79^9 or 0.79^{10}</p> <p>$1 - 0.79^9 = 0.8801$ (< 0.9) or $0.79^9 = 0.1198$ (> 0.1)</p> <p>$1 - 0.79^{10} = 0.9053$ (> 0.9) or $0.79^{10} = 0.09468$ (< 0.1)</p> <p>Minimum $n = 10$ Accept $n \geq 10$</p> <p>-----</p> <p>NOTE: $n = 10$ unsupported scores SC1 only</p>	<p>M1 for 0.79^5 or $0.3077\dots$ M1 for $1 - 0.79^5$ dep A1 CAO</p> <p>M1 for equation/inequality in n (accept either statement opposite)</p> <p>M1(indep) for process of using logs i.e. $\frac{\log a}{\log b}$</p> <p>A1 CAO</p> <p>-----</p> <p>M1(indep) for sight of 0.8801 or 0.1198</p> <p>M1(indep) for sight of 0.9053 or 0.09468</p> <p>A1 dep on both M's cao</p> <p>-----</p>	<p>3</p> <p>3</p>	<p>TOTAL</p> <p>16</p>
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Q7			
(i)	Positive	B1	1
(ii)	<p>Number of people = 20×33 (000) + 5×58 (000)</p> <p>= 660 (000) + 290 (000) = 950 000</p>	<p>M1 first term</p> <p>M1(indep) second term</p> <p>A1 cao</p> <p>NB answer of 950 scores M2A0</p>	3
(iii)	<p>(A) $a = 1810 + 340 = 2150$</p> <p>(B) Median = age of 1 385 (000th) person or 1385.5 (000)</p> <p>Age 30, cf = 1 240 (000); age 40, cf = 1 810 (000)</p> <p>Estimate median = $(30) + \frac{145}{570} \times 10$</p> <p>Median = 32.5 years (32.54...) If no working shown then 32.54 or better is needed to gain the M1A1. If 32.5 seen with no previous working allow SC1</p>	<p>M1 for sum</p> <p>A1 cao 2150 or 2150 thousand but not 215000</p> <p>B1 for 1 385 (000) or 1385.5</p> <p>M1 for attempt to interpolate $\frac{145k}{570k} \times 10$</p> <p>(2.54 or better suggests this)</p> <p>A1 cao min 1dp</p>	2 3
(iv)	<p>Frequency densities: 56, 65, 77, 59, 45, 17</p> <p>(accept 45.33 and 17.43 for 45 and 17)</p> 	<p>B1 for any one correct</p> <p>B1 for all correct (soi by listing or from histogram)</p> <p>Note: all G marks below dep on attempt at frequency density, NOT frequency</p> <p>G1 Linear scales on both axes (no inequalities)</p> <p>G1 Heights FT their listed fds or all must be correct. Also widths. All blocks joined</p> <p>G1 Appropriate label for vertical scale eg 'Frequency density (thousands)', 'frequency (thousands) per 10 years', 'thousands of people per 10 years'. (allow key). OR f.d.</p>	5

(v)	<p>Any two suitable comments such as:</p> <p>Outer London has a greater proportion (or %) of people under 20 (or almost equal proportion)</p> <p>The modal group in Inner London is 20-30 but in Outer London it is 30-40</p> <p>Outer London has a greater proportion (14%) of aged 65+</p> <p>All populations in each age group are higher in Outer London</p> <p>Outer London has a more evenly spread distribution or balanced distribution (ages) o.e.</p>	<p>E1</p> <p>E1</p>	2
(vi)	<p>Mean increase ↑ median unchanged (-) midrange increase ↑</p> <p>standard deviation increase ↑ interquartile range unchanged. (-)</p>	<p>Any one correct B1 Any two correct B2 Any three correct B3 All five correct B4</p>	4
		TOTAL	20