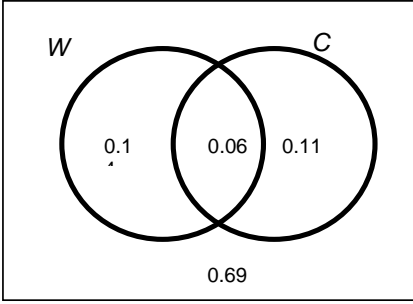


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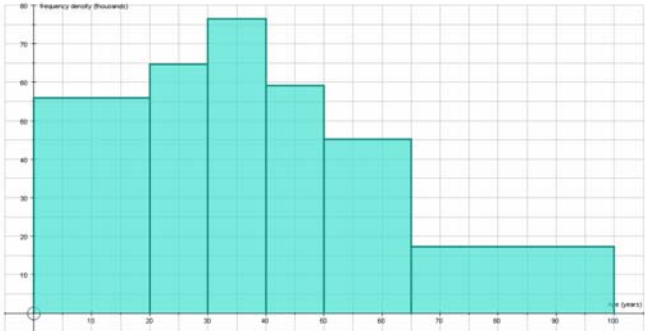
Q1 (i)	<p>Mean = 7.35 (or better)</p> <p>Standard deviation: 3.69 – 3.70 (awfw)</p> <p>Allow $s^2 = 13.62$ to 13.68</p> <p>Allow $\text{rmsd} = 3.64 - 3.66$ (awfw)</p> <p>After B0, B0 scored then if at least 4 correct mid-points seen or used. {1.5, 4, 6, 8.5, 15}</p> <p>Attempt of their mean = $\frac{\sum fx}{44}$, with $301 \leq fx \leq 346$ and fx strictly from mid-points not class widths or top/lower boundaries.</p>	<p>B2cao $\sum fx = 323.5$</p> <p>B2cao $\sum fx^2 = 2964.25$</p> <p>(B1) for variance s.o.i.o</p> <p>(B1) for rmsd</p> <p>(B1) mid-points</p> <p>(B1) $6.84 \leq \text{mean} \leq 7.86$</p>	4
(ii)	<p>Upper limit = $7.35 + 2 \times 3.69 = 14.73$ or 'their sensible mean' + $2 \times$ 'their sensible s.d.'</p> <p>So there could be one or more outliers</p>	<p>M1 (with s.d. < mean)</p> <p>E1dep on B2, B2 earned and comment</p>	2
	TOTAL		6
Q2 (i)	<p>$P(W) \times P(C) = 0.20 \times 0.17 = 0.034$</p> <p>$P(W \cap C) = 0.06$ (given in the question)</p> <p>Not equal so not independent (Allow $0.20 \times 0.17 \neq 0.06$ or $\neq p(W \cap C)$ so not independent).</p>	<p>M1 for multiplying or 0.034 seen</p> <p>A1 (numerical justification needed)</p>	2
(ii)	 <p>The last two G marks are independent of the labels</p>	<p>G1 for two overlapping circles labelled</p> <p>G1 for 0.06 and either 0.14 or 0.11 in the correct places</p> <p>G1 for all 4 correct probs in the correct places (including the 0.69) NB No credit for Karnaugh maps here</p>	3
(iii)	$P(W C) = \frac{P(W \cap C)}{P(C)} = \frac{0.06}{0.17} = \frac{6}{17} = 0.353 \text{ (awrt 0.35)}$	<p>M1 for $0.06 / 0.17$</p> <p>A1 cao</p>	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)	$E(X^2) = 0 \times 0.5 + 1 \times 0.35 + 4 \times 0.13 + 9 \times 0.02 = 1.05$ $\text{Var}(X) = \text{'their } 1.05' - 0.67^2 = 0.6011 \text{ (awrt } 0.6)$ (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 A1cao (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>	<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 M1dep for $1 - (1^{\text{st}} \text{ part})$ A1cao</p> <p>See above for 3 case</p>	<p>2</p> <p>3</p>
	<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 sight of all 4 correct terms summed A1cao (condone 0.98 www) or M1 for 0.99×0.99 A1cao Or M1 for everything $1 - \{ \dots \}$ A1cao</p>	<p>2</p>
	<p>(ii) $P(\text{both the rest of the UK} \mid \text{neither overseas})$ $= \frac{P(\text{the rest of the UK and neither overseas})}{P(\text{neither overseas})}$ $= \frac{0.04}{0.9801} = 0.0408$ {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>

(iii)	<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>
		TOTAL	16

Q7			
(i)	Positive	B1	1
(ii)	Number of people = $20 \times 33 \text{ (000)} + 5 \times 58 \text{ (000)}$ $= 660 \text{ (000)} + 290 \text{ (000)} = 950 \text{ 000}$	M1 first term M1(indep) second term A1 cao NB answer of 950 scores M2A0	3
(iii)	(A) $a = 1810 + 340 = 2150$ (B) Median = age of 1 385 (000 th) person or 1385.5 (000) Age 30, cf = 1 240 (000); age 40, cf = 1 810 (000) Estimate median = $(30) + \frac{145}{570} \times 10$ 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	M1 for sum A1 cao 2150 or 2150 thousand but not 215000 B1 for 1 385 (000) or 1385.5 M1 for attempt to interpolate $\frac{145k}{570k} \times 10$ (2.54 or better suggests this) A1 cao min 1dp	2 3
(iv)	Frequency densities: 56, 65, 77, 59, 45, 17 (accept 45.33 and 17.43 for 45 and 17) 	B1 for any one correct B1 for all correct (soi by listing or from histogram) Note: all G marks below dep on attempt at frequency density, NOT frequency G1 Linear scales on both axes (no inequalities) G1 Heights FT their listed fds or all must be correct. Also widths. All blocks joined 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.	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