

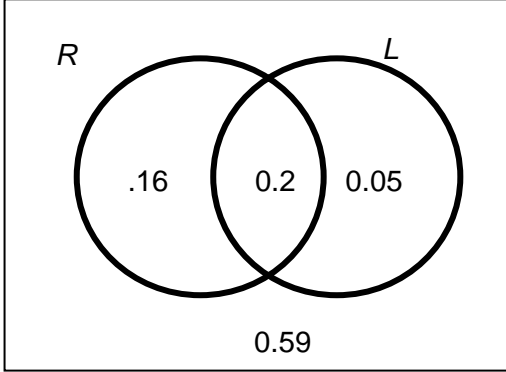
4766 Statistics 1

Section A

Q1 (i)	<p>(With $\sum fx = 7500$ and $\sum f = 10000$ then arriving at the mean)</p> <p>(i) £0.75 scores (B1, B1)</p> <p>(ii) 75p scores (B1, B1)</p> <p>(iii) 0.75p scores (B1, B0) (incorrect units)</p> <p>(iv) £75 scores (B1, B0) (incorrect units)</p> <p>After B0, B0 then sight of $\frac{7500}{10000}$ scores SC1. SC1 or an answer in the range £0.74 - £0.76 or 74p – 76p (both inclusive) scores SC1 (units essential to gain this mark)</p> <p><u>Standard Deviation: (CARE NEEDED here with close proximity of answers)</u></p> <ul style="list-style-type: none"> 50.2(0) using divisor 9999 scores B2 (50.20148921) 50.198 (= 50.2) using divisor 10000 scores B1(<i>rmsd</i>) If divisor is <u>not</u> shown (or calc used) and only an answer of 50.2 (i.e. <u>not</u> coming from 50.198) is seen then award B2 on b.o.d. (default) <p>After B0 scored then an attempt at S_{xx} as evident by either</p> $S_{xx} = (5000 + 200000 + 250000000) - \frac{7500^2}{10000} \quad (= 25199375)$ <p style="text-align: center;">or</p> $S_{xx} = (5000 + 200000 + 250000000) - 10000(0.75)^2$ <p style="text-align: center;">scores (M1) or M1ft ‘their 7500²’ or ‘their 0.75²’</p> <p>NB The <u>structure</u> must be correct in both above cases with a max of <u>1 slip only after applying the f.t.</u></p>	<p>B1 for numerical mean (0.75 or 75 seen) B1dep for correct units attached</p> <p>B2 correct s.d. (B1) correct rmsd</p> <p>(B2) default</p> <p>$\sum fx^2 = 25,205,000$</p> <p>Beware $\sum x^2 = 25,010,100$</p> <p>After B0 scored then (M1) or M1f.t. for attempt at S_{xx}</p> <p><i>NB full marks for correct results from recommended method which is use of calculator functions</i></p>	4
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(ii)	<p>P(Two £10 or two £100)</p> $= \frac{50}{10000} \times \frac{49}{9999} + \frac{20}{10000} \times \frac{19}{9999}$ $= 0.0000245 + 0.0000038 = (0.00002450245 + 0.00000380038)$ $= 0.000028(3) \text{ o.e.} = (0.00002830283)$ <p>After M0, M0 then $\frac{50}{10000} \times \frac{50}{10000} + \frac{20}{10000} \times \frac{20}{10000} \text{ o.e.}$</p> <p>Scores SC1 (ignore final answer but SC1 may be implied by sight of $2.9 \times 10^{-5} \text{ o.e.}$)</p> <p>Similarly, $\frac{50}{10000} \times \frac{49}{10000} + \frac{20}{10000} \times \frac{19}{10000} \text{ scores SC1}$</p>	<p>M1 for either correct product seen (ignore any multipliers)</p> <p>M1 sum of both correct (ignore any multipliers)</p> <p>A1 CAO (as opposite with no rounding)</p> <p>(SC1 case #1)</p> <p>(SC1 case #2) CARE answer is also 2.83×10^{-5}</p>	3
		TOTAL	7
Q2 (i)	<p>Either $P(\text{all correct}) = \frac{1}{6} \times \frac{1}{5} \times \frac{1}{4} \times \frac{1}{3} \times \frac{1}{2} \times \frac{1}{1} = \frac{1}{720}$</p> <p>or $P(\text{all correct}) = \frac{1}{6!} = \frac{1}{720} = 0.00139$</p>	<p>M1 for 6! Or 720 (sioc) or product of fractions</p> <p>A1 CAO (accept 0.0014)</p>	2
(ii)	<p>Either $P(\text{picks T, O, M}) = \frac{3}{6} \times \frac{2}{5} \times \frac{1}{4} = \frac{1}{20}$</p> <p>or $P(\text{picks T, O, M}) = \frac{1}{6} \times \frac{1}{5} \times \frac{1}{4} \times 3! = \frac{1}{20}$</p> <p>or $P(\text{picks T, O, M}) = \frac{1}{\binom{6}{3}} = \frac{1}{20}$</p>	<p>M1 for denominators</p> <p>M1 for numerators or 3!</p> <p>A1 CAO</p> <p>Or M1 for $\binom{6}{3}$ or 20 <u>sioc</u></p> <p>M1 for $1/\binom{6}{3}$</p> <p>A1 CAO</p>	3
		TOTAL	5
Q3 (i)	$p = 0.55$	B1 cao	1
(ii)	<p>$E(X) =$ $0 \times 0.55 + 1 \times 0.1 + 2 \times 0.05 + 3 \times 0.05 + 4 \times 0.25 = 1.35$</p> <p>$E(X^2) = 0 \times 0.55 + 1 \times 0.1 + 4 \times 0.05 + 9 \times 0.05 + 16 \times 0.25$ $= 0 + 0.1 + 0.2 + 0.45 + 4$ $= (4.75)$</p> <p>$\text{Var}(X) = \text{'their'} 4.75 - 1.35^2 = 2.9275 \text{ awfw } (2.9275 - 2.93)$</p>	<p>M1 for $\sum rp$ (at least 3 non zero terms correct)</p> <p>A1 CAO(no 'n' or 'n-1' divisors)</p> <p>M1 for $\sum r^2 p$ (at least 3 non zero terms correct)</p> <p>M1dep for – their $E(X)^2$ provided $\text{Var}(X) > 0$</p> <p>A1 cao (no 'n' or 'n-1' divisors)</p>	5
(iii)	$P(\text{At least 2 both times}) = (0.05+0.05+0.25)^2 = 0.1225 \text{ o.e.}$	<p>M1 for $(0.05+0.05+0.25)^2$ or 0.35^2 seen</p> <p>A1cao: awfw $(0.1225 - 0.123)$ or $49/400$</p>	2

		TOTAL	8
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Q4 (i)	<p>$X \sim B(50, 0.03)$</p> <p>(A) $P(X = 1) = \binom{50}{1} \times 0.03 \times 0.97^{49} = 0.3372$</p> <p>(B) $P(X = 0) = 0.97^{50} = 0.2181$ $P(X > 1) = 1 - 0.2181 - 0.3372 = 0.4447$</p>	<p>M1 0.03×0.97^{49} or $0.0067(4)....$ M1 $\binom{50}{1} \times pq^{49}$ (p+q =1) A1 CAO (awfw 0.337 to 0.3372) or 0.34(2s.f.) or 0.34(2d.p.) but not just 0.34</p> <p>B1 for 0.97^{50} or 0.2181 (awfw 0.218 to 0.2181) M1 for $1 - ('their' p(X = 0) + 'their' p(X = 1))$ must have both probabilities A1 CAO (awfw 0.4447 to 0.445)</p>	<p>3</p> <p>3</p>
(ii)	<p>Expected number = $np = 240 \times 0.3372 = 80.88 - 80.93 = (81)$ <i>Condone $240 \times 0.34 = 81.6 = (82)$ but for M1 A1f.t.</i></p>	<p>M1 for $240 \times \text{prob (A)}$ A1FT</p>	2
		TOTAL	8
Q5 (i)	<p>$P(R) \times P(L) = 0.36 \times 0.25 = 0.09 \neq P(R \cap L)$ Not equal so not independent. (Allow $0.36 \times 0.25 \neq 0.2$ or $0.09 \neq 0.2$ or $\neq p(R \cap L)$ so not independent)</p>	<p>M1 for 0.36×0.25 or 0.09 seen A1 (numerical justification needed)</p>	2
(ii)		<p>G1 for two overlapping circles labelled</p> <p>G1 for 0.2 and either 0.16 or 0.05 in the correct places</p> <p>G1 for all 4 correct probs in the correct places (including the 0.59)</p> <p>The last two G marks are independent of the labels</p>	3
(iii)	<p>$P(L R) = \frac{P(L \cap R)}{P(R)} = \frac{0.2}{0.36} = \frac{5}{9} = 0.556$ (awrt 0.56)</p> <p>This is the probability that Anna is late given that it is raining. (must be in context) Condone 'if' or 'when' or 'on a rainy day' for 'given that' but not the words 'and' or 'because' or 'due to'</p>	<p>M1 for $0.2/0.36$ o.e. A1 cao</p> <p>E1 (indep of M1A1) Order/structure must be correct i.e. no reverse statement</p>	3
		TOTAL	8

Section B

Q6 (i)	Median = 4.06 – 4.075 (inclusive) $Q_1 = 3.8$ $Q_3 = 4.3$ Inter-quartile range = $4.3 - 3.8 = 0.5$	B1cao B1 for Q_1 (cao) B1 for Q_3 (cao) B1 ft for IQR must be using t-values not locations to earn this mark	4
(ii)	Lower limit ‘their 3.8’ – $1.5 \times$ ‘their 0.5’ = (3.05) Upper limit ‘their 4.3’ + $1.5 \times$ ‘their 0.5’ = (5.05) Very few if any temperatures <u>below 3.05 (but not zero)</u> None <u>above 5.05</u> ‘So few, if any outliers’ scores SC1	B1ft: must have -1.5 B1ft: must have +1.5 E1ft dep on -1.5 and Q_1 E1ft dep on +1.5 and Q_3 Again, must be using t-values NOT locations to earn these 4 marks	4
(iii)	Valid argument such as ‘Probably not, because there is nothing to suggest that they are not genuine data items; (they do not appear to form a separate pool of data.)’ Accept: exclude outlier – ‘measuring equipment was wrong’ or ‘there was a power cut’ or ref to hot / cold day [Allow suitable valid alternative arguments]	E1	1
(iv)	Missing frequencies 25, 125, 50	B1, B1, B1 (all cao)	3
(v)	Mean = $(3.2 \times 25 + 3.6 \times 125 + 4.0 \times 243 + 4.4 \times 157 + 4.8 \times 50) / 600$ $= 2432.8 / 600 = 4.05(47)$	M1 for at least 4 midpoints correct and being used in attempt to find $\sum ft$ A1cao: awfw (4.05 – 4.055) ISW or rounding	2
(vi)	New mean = $1.8 \times$ ‘their 4.05(47)’ + 32 = 39.29(84) to 39.3 New s = 1.8×0.379 $= 0.682$	B1 FT M1 for 1.8×0.379 A1 CAO awfw (0.68 – 0.6822)	3
		TOTAL	17

<p>Q7 (i)</p>	<p>$X \sim B(10, 0.8)$</p> <p>(A) <i>Either</i> $P(X = 8) = \binom{10}{8} \times 0.8^8 \times 0.2^2 = 0.3020$ (awrt)</p> <p><i>or</i> $P(X = 8) = P(X \leq 8) - P(X \leq 7)$ $= 0.6242 - 0.3222 = 0.3020$</p> <p>(B) <i>Either</i> $P(X \geq 8) = 1 - P(X \leq 7)$ $= 1 - 0.3222 = 0.6778$</p> <p><i>or</i> $P(X \geq 8) = P(X = 8) + P(X = 9) + P(X = 10)$ $= 0.3020 + 0.2684 + 0.1074 = 0.6778$</p>	<p>M1 $0.8^8 \times 0.2^2$ or $0.00671\dots$</p> <p>M1 $\binom{10}{8} \times p^8 q^2$; ($p+q=1$) Or $45 \times p^8 q^2$; ($p+q=1$) A1 CAO (0.302) not 0.3</p> <p>OR: M2 for $0.6242 - 0.3222$ A1 CAO</p> <p>M1 for $1 - 0.3222$ (s.o.i.) A1 CAO awfw $0.677 - 0.678$ or M1 for sum of 'their' $p(X=8)$ plus correct expressions for $p(X=9)$ and $p(X=10)$</p> <p>A1 CAO awfw $0.677 - 0.678$</p>	<p>3</p> <p>2</p>
<p>(ii)</p>	<p>Let $X \sim B(18, p)$ Let p = probability of delivery (within 24 hours) (for population)</p> <p>$H_0: p = 0.8$ $H_1: p < 0.8$</p> <p>$P(X \leq 12) = 0.1329 > 5\%$ ref: [pp =0.0816]</p> <p>So not enough evidence to reject H_0</p> <p>Conclude that there is not enough evidence to indicate that less than 80% of orders will be delivered within 24 hours</p> <p>Note: use of critical region method scores M1 for region $\{0,1,2,\dots,9, 10\}$ M1dep for 12 does not lie in critical region then A1dep E1dep as per scheme</p>	<p>B1 for definition of p</p> <p>B1 for H_0 B1 for H_1</p> <p>M1 for probability 0.1329</p> <p>M1dep strictly for comparison of 0.1329 with 5% (seen or clearly implied)</p> <p>A1dep on both M's</p> <p>E1dep on M1,M1,A1 for conclusion in context</p>	<p>7</p>

(iii)	<p>Let $X \sim B(18, 0.8)$ $H_1: p \neq 0.8$ LOWER TAIL $P(X \leq 10) = 0.0163 < 2.5\%$ $P(X \leq 11) = 0.0513 > 2.5\%$</p> <p>UPPER TAIL $P(X \geq 17) = 1 - P(X \leq 16) = 1 - 0.9009 = 0.0991 > 2.5\%$ $P(X \geq 18) = 1 - P(X \leq 17) = 1 - 0.9820 = 0.0180 < 2.5\%$</p> <p>So critical region is $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 18\}$ o.e. Condone $X \leq 10$ and $X \geq 18$ or $X = 18$ but not $p(X \leq 10)$ and $p(X \geq 18)$ Correct CR without supportive working scores SC2 max after the 1st B1 (SC1 for each fully correct tail of CR)</p>	<p>B1 for H_1</p> <p>B1 for 0.0163 or 0.0513 seen</p> <p>M1dep for either correct comparison with 2.5% (not 5%) (seen or clearly implied)</p> <p>A1dep for correct lower tail CR (must have zero)</p> <p>B1 for 0.0991 or 0.0180 seen</p> <p>M1dep for either correct comparison with 2.5% (not 5%) (seen or clearly implied)</p> <p>A1dep for correct upper tail CR</p>	<p>7</p>
		TOTAL	19