A level Statistics Paper 5 MARK SCHEME

Question 1

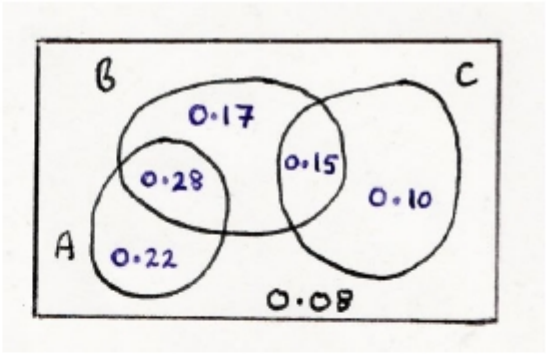
Question Number	Scheme	Marks
(a)	Width (w) = **4** cm	B1
	Areas: 16 cm^2 represents 32 offices (o.e.) or their $h = \frac{6}{\text{their } w}$ (3sf) or $\frac{8}{3.2} \times 0.6$	M1
	So height (h) = **1.5** cm	A1
		(3)
(b)	e.g. $(45) + \frac{20}{25} \times 5$ or $(50) - \frac{5}{25} \times 5$ (o.e.); = (£) **49**	M1; A1
		(2)
(c)	$\frac{\sum fy}{90} = \frac{4420}{90}$, = (£) **49.11** (or better) (Allow $\frac{442}{9}$ or $49\frac{1}{9}$)	M1, A1
		(2)
(d)	$\sqrt{\frac{226687.5}{90} - \bar{x}^2} = \sqrt{106.8487...}$, = 10.3367 = awrt (£) **10.3**	M1, A1
		(2)

	Notes
(a)	M1 for a correct calculation of areas 1 cm^2 = 2 offices (o.e.) A1 for h = 1.5 cm (Correct answer only 2/2)
(b)	M1 for a correct expression without end point. Allow "n + 1" so e.g. $(45) + \frac{20.5}{25} \times 5$ A1 for 49 or, if (n + 1) used, allow 49.1 (Correct answer of 49 only 2/2)
(c)	M1 for an attempt at $\frac{\sum fy}{90}$ with at least 3 correct products of $\sum fy$ or $4000 \leq \sum fy \leq 5000$ A1 for 49.11 (Allow 49.1 from correct working) (Correct answer only 2/2, 49.1 only M1A0)
(d)	M1 for a correct expression including $\sqrt{}$, ft their mean. Allow use of s A1 for awrt 10.3 Allow s = awrt 10.4 if clearly used. [NB use of 49.1 gives 10.389 $\Rightarrow$ A0 (Correct answer of 10.3 with no working is 2/2)

Question 2

Question Number	Scheme	Marks
(a)	$p = \mathrm{P}(B \cap C) = \quad \mathrm{P}(B) \times \mathrm{P}(C) = 0.6 \times 0.25 \quad = \underline{\mathbf{0.15}}$ $q = [\mathrm{P}(C) - p\,] = \underline{\mathbf{0.10}}$	M1 A1 (2)
(b)	$r = 1 - 0.08 - [\mathrm{P}(B) + q] = 1 - 0.08 - 0.6 - 0.1$ (o.e.) or $1 - 0.08 - (0.6 + 0.25 - p)$ $= \underline{\mathbf{0.22}}$	M1 A1cao (2)
(c)	$s = [\mathrm{P}(A) - r\,] = \underline{\mathbf{0.28}}$ $t = [\,\mathrm{P}(B) - p - s$ or use $\mathrm{P}(B \cap C') - s = 0.6 \times 0.75 - "0.28"\,] = \underline{\mathbf{0.17}}$	B1ft B1ft (2)
(d)	$\mathrm{P}(A) \times \mathrm{P}(B) = 0.5 \times 0.6 = 0.3$ which is not equal to s (= 0.28) So A and B are not independent	M1 A1 (2)
(e)	$\dfrac{(s+p) \text{ or } (0.6-t)}{\mathrm{P}(A \cup C) \text{ or } [\mathrm{P}(A) + \mathrm{P}(C)] \text{ or } (r+s+p+q)} = \dfrac{("0.28" + "0.15") \text{ or } (0.6 - "0.17")}{0.5 + 0.25}$ $= \underline{\dfrac{43}{75}}$	M1, A1ft A1 (3) **[11]**

	Notes
(a)	M1 for a correct expression (using independence) for p or 0.15 A1 for $q = 0.10$ (both correct 2/2)
(b)	**Mark (b) & (c) together** M1 for a correct expression for r using $P(B \cup C)$. Can ft their $q \in [0, 0.32]$ A1cao for $r = 0.22$ (correct ans only 2/2)
(c)	1st B1ft for $s = 0.28$ or 0.5 – their "0.22" 2nd B1ft for $t = 0.17$ or 0.6 – their "0.15" – their "0.28"
ALT	**Find t then s then r**
(c)	2nd B1 for $t = 0.17$ [from 1 – 0.08 – P(A) – P(C)]
	1st B1ft for $s = 0.28$ or P(B) – "0.17" – "0.15"
(b)	M1 for $r = P(A) - s$ and the A1 for 0.22
$s = 0.3$	**They assume A and B are independent and get $s = 0.3$ [from P(A)×P(B)]**
(c)	1st B0 for $s = 0.3$ BUT can get 2nd B1ft for either case in the scheme
(b)	M1 for $r = P(A) - s$ BUT then A0cao for $r = 0.2$
(d)	M1 for a correct P(A)×P(B) = 0.5×0.6 or 0.3 **and** a clear comparison with their $s(\neq 0.3)$ Or calculation of $P(A \mid B) = \frac{7}{15}$ or 0.467 or $\frac{\text{their } s}{0.6}$ **and** comparison with P(A) = 0.5 (o.e.) A1 dep. on M1 being earned and clear statement that A and B are not independent
SC $s = 0.3$	dep on 1st B1ft for $s = 0.5 - 0.2$ in (c); for correct calc. and conclusion seen (B1). On epen M0A1
(e)	M1 for a correct ratio expression of probs: num. < den. Allow 1 – (0.08+their "t") on den. Any sight of multiplication on the numerator e.g. 0.6×0.75 is M0 1st A1ft for correct ratio or ft using their values in numerator but correct denominator. 2nd A1 for $\frac{43}{75}$ or accept awrt 0.573



Fully correct Venn diagram will score the first 6 marks

If text and VD disagree use text values

Question 3

Question Number	Scheme		Marks
	Allow any letter instead of X or c for this question		
(a)	$X \sim B(25, 0.2)$	**M1** Writing or using B(25,0.2)or B(25,1/5) [allow Po(5)] May be written in full or implied by a correct CR (allow written as a probability statement)	M1
	$[P(X \geq 9) =] 0.0468$ $[P(X \leq 1) =] 0.0274$	**1st A1** both awrt 0.0468 and awrt 0.0274 seen.	A1
	$X = [0 \leq] \ X \leq 1$	**2nd A1** $X \leq 1$ or $X < 2$ or $0 \leq X \leq 1$ or [0,1] or 0,1 or equivalent statements. $X \leq c$ and $c = 1$	A1
	$9 \leq X \ [\leq 25]$	**3rd A1d** dependent on seeing a probability from the B(25, 0.2) and $X \geq 9$ or $X > 8$ or $9 \leq X \leq 25$ or 9,10,11,12,13,14,15,16,17,18,19,20,21,22, 23,24,25 or [9,25] or equivalent statements. $X \geq c$ and $c = 9$	A1d
	NB These two final 2 A marks must be for statements with "X" only(or list) – not in probability statements SC If a probability from the B(25, 0.2) is seen **and** they either have both CR correct but written as probability statements **or** the CR is written as $1 \geq X \geq 9$ they get A1 A0 for final 2 marks		**(4)**
(b)	$H_0: p = 0.2$ $H_1: p < 0.2$	**B1** both hypotheses with p or π and clear which is H_0 and which is H_1	**B1**
	$P(X \leq 6) = 0.1034$ or CR $X \leq 5$	**1st M1** writing or using B(50, 0.2) and writing or using $P(X \leq 6)$ or $P(X \geq 7)$ on its own. May be implied by a correct CR	**M1**
		1st A1 awrt 0.103. Allow CR $X \leq 5$ or $X < 6$. or if not using CR allow awrt 0.897.	**A1**
	Insufficient evidence to reject H_0, Accept H_0, Not significant. 6 does not lie in the Critical region.	**2nd M1** dependent on previous M being awarded. A correct statement (do not allow if there are contradicting non-contextual statements). ft their Prob/CR compared with 0.05/6/(0.95 if using 0.8979). Do not follow through their hypotheses	**M1d**
	No evidence that increasing the batch size has **reduced** the **percentage** of broken **pots (oe)** **or** evidence that there is **no change** in the **percentage** of broken **pots (oe)**	**2nd A1cso** Conclusion must contain the words **reduced/ no change/not affect oe number/percentage/proportion/ probability oe**, and **pots**. All previous marks must be awarded for this mark to be awarded. Do **not** allow the potters claim /belief is wrong/true **NB** Correct contextual statement on its own scores M1A1	**A1cso** **(5)**
			(Total 9)

Question 4

Question Number	Scheme	Marks
a	Rearranging the equation: $y = -0.2139 + 0.0172x$ $\Rightarrow \log t = -0.2139 + 0.0172P$ $\Rightarrow t = 10^{-0.2139+0.0172P} = 10^{-0.2139} \times 10^{0.0172P}$ $\Rightarrow t = 10^{-0.2139} \times \left(10^{0.0172}\right)^{P}$ Therefore $a = 10^{-0.2139} = 0.611$ (3 s.f.) and $b = 10^{0.0172} = 1.04$ (3 s.f.).	M1 A1 A1
b	Not in the range of data (extrapolation)	A1

Question 5

Q5	Scheme	Marks
a	$H_0 : \rho = 0$ $H_1 : \rho < 0$ From the data, $r = -0.9313$. Since the critical value for $n = 5$ is -0.8783, there is sufficient evidence to reject H_0, i.e. at the 2.5% level of significance, there is sufficient evidence to say that there is negative correlation between the number of miles done by a one-year-old car and its value.	B1 A1 M1 A1
b	If a 1% level of significance was used, then the critical value for $n = 5$ is -0.9343 and so there would not be sufficient evidence to reject H_0.	**A1**
		(5 marks)