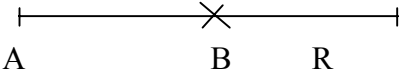
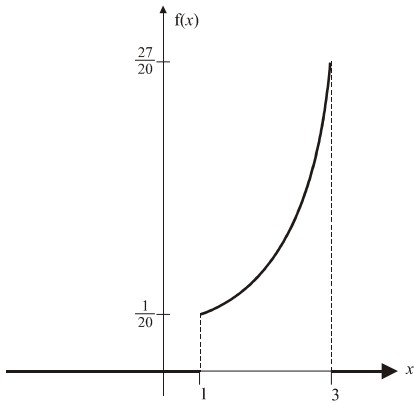


Question Number	Scheme	Marks
<p>1. (a)</p> <p>(b)</p> <p>(c)</p>	<p><u>Advantage</u>: eg quicker/cheaper</p> <p><u>Disadvantage</u>: eg doesn't give the full picture</p> <p>The register of pupils attending</p> <p>The individual pupils</p>	<p>B1</p> <p>B1 (2)</p> <p>B1 (1)</p> <p>B1 (1)</p> <p>(4 marks)</p>
<p>2. (a)</p> <p>(b)</p> <p>(c)</p>	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: right;"> $X \sim U[0,12]$ </div> </div> $P(X \leq x) = \int_0^x \frac{1}{12} dt = \frac{x}{12} \quad \therefore F(x) = \begin{cases} 0, & x < 0 \\ \frac{x}{12}, & 0 \leq x \leq 12 \\ 1 & x > 12 \end{cases}$ $P(X < 4) = \frac{4}{12} = \frac{1}{3}$	<p>B1, B1 (2)</p> <p>M1 A1</p> <p>B1 ft (centre)</p> <p>B1 (ends) (4)</p> <p>B1 ft (1)</p> <p>(7 marks)</p>
<p>3. (a)</p> <p>(b)</p> <p>(c)</p>	<p>$P(SC) = \frac{3}{4}; P(HC) = \frac{1}{4}$</p> <p>Let X represent the number of HC chocolates</p> <p>$\therefore X \sim B(20; 0.25)$</p> <p>$P(X = 10) = 0.9961 - 0.9861 = 0.0100$</p> <p>$P(X < 5) = P(X \leq 4)$</p> <p style="padding-left: 40px;">$= 0.4148$</p> <p>Expected number $= np = 100 \times 0.25 = 25$</p>	<p>either B1</p> <p>can be implied B1</p> <p>awrt 0.010 B1 (3)</p> <p>M1</p> <p>awrt 0.415 A1 (2)</p> <p>M1 A1 (2)</p> <p>(7marks)</p>

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<p>4.</p> <p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	$\bar{x} = \frac{0 \times 37 + 1 \times 65 + 2 \times 60 + \dots + 5 \times 12}{37 + 65 + 60 + \dots + 12} = \frac{500}{250} = 2$ $\text{var} = \frac{\sum x^2}{250} - 2^2 = \frac{1478}{250} - 4 = 1.912 \text{ (or } s^2 = 1.9196\dots)$ <p>For a Poisson distribution the mean must equal the variance; parts (a) and (b) are very close, so a Poisson might be a suitable model.</p> <p>$H_0: \mu = 2; H_1: \mu < 2$</p> <p>$X =$ number of errors over 4 pages. Under H_0 $X \sim P_0(8)$;</p> <p>$P(X \leq 3) = 0.0424$</p> <p>This is less than 5% so a significant result and there is evidence that the secretary has improved.</p>	<p>M1 A1 cso (2)</p> <p>M1 A1 (2)</p> <p>B1 (1)</p> <p>B1 B1</p> <p>M1</p> <p>M1 A1</p> <p>A1 ft (6)</p> <p>(11 marks)</p>
<p>5.</p> <p>(a)</p> <p>(b)</p> <p>(c)</p>	<p>$H_0: p = 0.30$ $H_1: p < 0.30$</p> <p>$X =$ number ordering vegetarian meal $X \sim B(20, 0.30)$ under H_0</p> <p>$P(X \leq 3) = 0.1071 > 5\%$</p> <p>$\therefore$ Not significant i.e. no reason to suspect proportion is lower</p> <p>$H_0: p = 0.10$ $H_1: p \neq 0.10$</p> <p>$Y =$ number ordering vegetarian meal $Y \sim B(100, 0.10) \Rightarrow Y \approx P_0(10)$</p> <p>Need a, b such that $P(Y \leq a) \approx 0.025$ and $P(Y \geq b) \approx 0.025$</p> <p>From tables: $P(Y \leq 4) = 0.0293$ and $P(Y \leq 16) = 0.9730$</p> <p style="text-align: center;">$\Rightarrow P(Y \geq 17) = 0.0270$</p> <p>$\therefore Y \leq 4$ and $Y \geq 17$</p> <p>Significance level is $0.0270 + 0.0293 = \underline{0.0563}$ (5.6%)</p>	<p>B1 B1</p> <p>M1, A1</p> <p>A1 ft (5)</p> <p>B1 B1</p> <p>M1</p> <p>M1 A1</p> <p>A1</p> <p>(6)</p> <p>B1 ft (1)</p> <p>(12 marks)</p>

Question Number	Scheme	Marks
6. (a)	$X = \text{number of sheep per square}$ $X \sim P_0(2.25)$	B1 (1)
(b)	$P(X = 0) = e^{-2.25} = 0.105399 \dots$ awrt <u>0.105</u>	B1 (1)
(c)	$P(X > 2) = 1 - P(X \leq 2) = 1 - e^{-2.25} \left[1 + 2.25 + \frac{(2.25)^2}{2!} \right]$ $1 - 0.60933 \dots = 0.39066$ awrt <u>0.391</u>	M1, M1 A1 A1 (4)
(d)	Sheep would tend to cluster – no longer randomly scattered	B1 (1)
(e)	$Y \sim P_0(20) \Rightarrow \text{normal approx, } \mu = 20, \sigma = \sqrt{20}$ $P(Y < 15) = P(Y \leq 14.5) = P\left(Z \leq \frac{14.5 - 20}{\sqrt{20}}\right)$ $\pm \frac{1}{2}$ $= P(Z \leq -1.2298 \dots)$ $= 1 - 0.8907 = 0.1093$ AWRT <u>0.109</u>	M1, A1 M1, M1 A1 M1 A1 (7) (14 marks)

Question Number	Scheme	Marks
7. (a)	 <p>(b) $E(X) = \int_1^3 \frac{1}{20} x^4 dx = \left[\frac{x^5}{100} \right]_1^3 = \frac{242}{100} = 2.42$</p> <p>(c) $\sigma^2 = \int_1^3 \frac{1}{20} x^5 dx - \mu^2 = \left[\frac{x^6}{120} \right]_1^3 - \mu^2 = \frac{728}{120} - (2.42)^2 = 0.21026$ $\therefore \sigma = 0.459$</p> <p>(d) $P(X \leq x) = \int_1^x \frac{1}{20} t^3 dt = \left[\frac{t^4}{80} \right]_1^x = \frac{x^4}{80} - \frac{1}{80}$</p> $F(x) = \begin{cases} 0 & x \leq 1 \\ \frac{1}{80}(x^4 - 1) & 1 < x < 3 \\ 1 & x \geq 3 \end{cases}$ <p>(e) $F(p) = 0.25 \Rightarrow \frac{1}{80}(p^4 - 1) = \frac{1}{4} \therefore p^4 = 21 \Rightarrow p = 2.14 \dots$ $F(q) = 0.75 \Rightarrow \frac{1}{80}(q^4 - 1) = \frac{3}{4} \therefore q^4 = 61 \Rightarrow q = 2.79 \dots$ IQR = <u>0.65</u></p> <p>(f) $IQR \approx \frac{4}{3} \times 0.459 = \underline{0.612}$, Sensible comment, e.g. reasonable approximation or slight underestimate</p>	<p>B1, B1 B1 (3) $\left(\frac{1}{20}, \frac{27}{20} \right)$</p> <p>M1 [M1] A1 (3)</p> <p>M1 [M1] A1 cso (3)</p> <p>M1 [M1]_i A1 cso</p> <p>B1 ft, centre B1 ends (5)</p> <p>M1 A1</p> <p>A1</p> <p>A1 ft (4)</p> <p>B1</p> <p>B1 (2)</p> <p>(20 marks)</p>