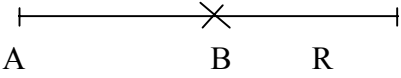
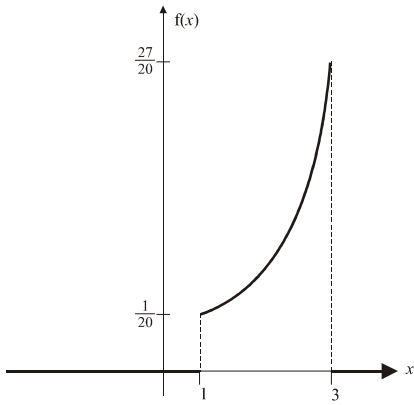


Question Number	Scheme	Marks
1.	<p>(a) <u>Advantage</u>: eg quicker/cheaper  <u>Disadvantage</u>: eg doesn't give the full picture</p> <p>(b) The register of pupils attending</p> <p>(c) The individual pupils</p>	<p>B1  B1 (2)  B1 (1)  B1 (1)  <b>(4 marks)</b></p>
2.	<p>(a)  <math>X \sim U[0,12]</math></p> <p>(b) <math>P(X \leq x) = \int_0^x \frac{1}{12} dt = \frac{x}{12}</math> <math>\therefore F(x) = \begin{cases} 0, &amp; x &lt; 0 \\ \frac{x}{12}, &amp; 0 \leq x \leq 12 \\ 1 &amp; x &gt; 12 \end{cases}</math></p> <p>(c) <math>P(X &lt; 4) = \frac{4}{12} = \frac{1}{3}</math></p>	<p>B1, B1 (2)  M1 A1  B1 ft (centre)  B1 (ends) (4)  B1 ft (1)  <b>(7 marks)</b></p>
3.	<p>(a) <math>P(SC) = \frac{3}{4}</math>; <math>P(HC) = \frac{1}{4}</math> either</p> <p>Let <math>X</math> represent the number of HC chocolates  <math>\therefore X \sim B(20; 0.25)</math> can be implied</p> <p><math>P(X = 10) = 0.9961 - 0.9861 = 0.0100</math> awrt 0.010</p> <p>(b) <math>P(X &lt; 5) = P(X \leq 4)</math>  <math>= 0.4148</math> awrt 0.415</p> <p>(c) Expected number = <math>np = 100 \times 0.25 = 25</math></p>	<p>B1  B1  B1 (3)  M1  A1 (2)  M1 A1 (2)  <b>(7marks)</b></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><math>H_0: \mu = 2; H_1: \mu &lt; 2</math></p> <p><math>X =</math> number of errors over 4 pages. Under <math>H_0</math> <math>X \sim P_0(8)</math>;</p> <p><math>P(X \leq 3) = 0.0424</math></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><b>(11 marks)</b></p>
<p>5.</p> <p>(a)</p> <p>(b)</p> <p>(c)</p>	<p><math>H_0: p = 0.30</math> <span style="float: right;"><math>H_1: p &lt; 0.30</math></span></p> <p><math>X =</math> number ordering vegetarian meal <span style="float: right;"><math>X \sim B(20, 0.30)</math> under <math>H_0</math></span></p> <p><math>P(X \leq 3) = 0.1071 &gt; 5\%</math></p> <p><math>\therefore</math> Not significant i.e. no reason to suspect proportion is lower</p> <p><math>H_0: p = 0.10</math> <span style="float: right;"><math>H_1: p \neq 0.10</math></span></p> <p><math>Y =</math> number ordering vegetarian meal <span style="float: right;"><math>Y \sim B(100, 0.10) \Rightarrow Y \approx P_0(10)</math></span></p> <p>Need <math>a, b</math> such that <math>P(Y \leq a) \approx 0.025</math> and <math>P(Y \geq b) \approx 0.025</math></p> <p>From tables: <math>P(Y \leq 4) = 0.0293</math> and <math>P(Y \leq 16) = 0.9730</math></p> <p style="text-align: center;"><math>\Rightarrow P(Y \geq 17) = 0.0270</math></p> <p><math>\therefore Y \leq 4</math> and <math>Y \geq 17</math></p> <p>Significance level is <math>0.0270 + 0.0293 = \underline{0.0563}</math> (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><b>(12 marks)</b></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)	$P(X > 2) = 1 - P(X \leq 2) = 1 - e^{-2.25} \left[ 1 + 2.25 + \frac{(2.25)^2}{2!} \right]$ $1 - 0.60933 \dots = 0.39066$	M1, M1 A1 awrt <u>0.391</u> A1 (4)
(d)	Sheep would tend to cluster – no longer randomly scattered	B1 (1)
(e)	$Y \sim P_0(20) \Rightarrow \text{normal approx, } \mu = 20, \sigma = \sqrt{20}$ $P(Y < 15) = P(Y \leq 14.5) = P\left(Z \leq \frac{14.5 - 20}{\sqrt{20}}\right)$ $= P(Z \leq -1.2298 \dots)$ $= 1 - 0.8907 = 0.1093$	M1, A1 $\pm \frac{1}{2}$ M1, M1 A1 AWRT <u>0.109</u> M1 A1 (7) <b>(14 marks)</b>

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