

EDEXCEL FOUNDATION - LONDON EXAMINATIONS

Stewart House 32 Russell Square London WC1B 5DN

June 2001

Advanced Supplementary/Advanced Level

General Certificate of Education

Subject STATISTICS 6684

Paper No. S2

Question number	Scheme	Marks
1. (a)	<p>(i) small village so use <u>census</u> e.g. use electoral <u>register</u> or some other suitable <u>list</u></p> <p>(ii) <u>Sample survey</u> e.g. <u>list</u> of times and days when no. of vehicles travelling through can be counted. (some suitable list of time periods)*</p> <p>(b) e.g. X = no. of vehicles passing through in a 10min period X could have a <u>Poisson</u> distribution</p> <p>* time period must be specified e.g. 10min, 1 hour, 7am-7pm but < 1 day.</p>	<p>BI BI BI BI (4)</p> <p>BI BI (2)</p> <p>(6)</p>
2. (a)	<p>X = no. of accidents in the next month $X \sim P_0(0.9)$ $P(X=0) = e^{-0.9} = 0.4065 \dots = \underline{0.407}$ (3)</p>	<p>BI c.s.o. (1)</p>
(b)	<p>Y = no. of accidents in next 6 months. $Y \sim P_0(5.4)$ $P(Y=2) = \frac{e^{-5.4} \times (5.4)^2}{2} = 0.06585 \dots$ <u>0.066</u> or <u>0.0658/9</u></p>	<p>BI M1, A1 (3)</p>
(c)	<p>M = no. of months with no accidents $M \sim B(4, 0.407)$ $P(M=2) = \binom{4}{2} (0.407)^2 (0.593)^2 = 0.3495$ (0.349 ~ 0.350)</p> <p>Identify correct binomial AWRT</p>	<p>BI (✓ their (a)) M1, A1 (3)</p> <p>(7)</p>

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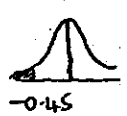
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3.	<p>$H_0: p = \frac{1}{4} ; H_1: p \neq \frac{1}{4}$</p> <p>$X = \text{no. of gold beads in sample of 20. Under } H_0 X \sim B(20, \frac{1}{4})$</p> <table border="0"> <tr> <td style="vertical-align: top;"> <p><u>Critical Region</u></p> <p>$P(X \leq 1) = 0.0243$</p> <p>$P(X \leq 8) = 0.9591$</p> <p>C.R. $X \leq 1$</p> <p>or $X \geq 9$</p> </td><td style="vertical-align: top;"> <p><u>Probability</u></p> <p>$E(X) = 5$</p> <p>$P(X \leq 2) = 0.0913$</p> <p>$P(X \geq 8) = 1 - 0.8982$</p> <p>$= 0.1018$</p> </td><td style="vertical-align: top;"> <p>or</p> <p>$2 \times P(X \leq 2)$</p> <p>$= 2 \times 0.0913$</p> <p>$= 0.1826$</p> </td></tr> </table> <p>Not significant (either $x=2$ not in C.R. or prob. > 10%)</p> <p>Insufficient evidence of a change in proportion of gold beads</p>	<p><u>Critical Region</u></p> <p>$P(X \leq 1) = 0.0243$</p> <p>$P(X \leq 8) = 0.9591$</p> <p>C.R. $X \leq 1$</p> <p>or $X \geq 9$</p>	<p><u>Probability</u></p> <p>$E(X) = 5$</p> <p>$P(X \leq 2) = 0.0913$</p> <p>$P(X \geq 8) = 1 - 0.8982$</p> <p>$= 0.1018$</p>	<p>or</p> <p>$2 \times P(X \leq 2)$</p> <p>$= 2 \times 0.0913$</p> <p>$= 0.1826$</p>	<p>B1; B1</p> <p>M1</p> <p>A1 each value.</p> <p>A1</p> <p>M1</p> <p>A1 ✓</p> <p>(7)</p>
<p><u>Critical Region</u></p> <p>$P(X \leq 1) = 0.0243$</p> <p>$P(X \leq 8) = 0.9591$</p> <p>C.R. $X \leq 1$</p> <p>or $X \geq 9$</p>	<p><u>Probability</u></p> <p>$E(X) = 5$</p> <p>$P(X \leq 2) = 0.0913$</p> <p>$P(X \geq 8) = 1 - 0.8982$</p> <p>$= 0.1018$</p>	<p>or</p> <p>$2 \times P(X \leq 2)$</p> <p>$= 2 \times 0.0913$</p> <p>$= 0.1826$</p>			
4.	<p>$X = \text{no. of letters marked 1st class} \quad X \sim B(10, 0.20)$</p> <p>(a) $P(X \geq 3) = 1 - P(X \leq 2) = 1 - 0.6778 = 0.3222$ or 0.322</p> <p>(b) $P(X < 2) = P(X \leq 1) = 0.3758$ or 0.376</p> <p>(c) $F = \text{no. of 1st class stamps in batch of 70} \quad F \sim B(70, 0.20)$</p> <p>$F \approx N(14, \sqrt{11.2})$</p> <p>$P(F \leq 12) \approx P(Z \leq \frac{12.5 - 14}{\sqrt{11.2}})$</p> <p>$\leftarrow$</p> <p>11 12 13</p> <p>$= P(Z \leq -0.4482 \dots)$</p> <p>$\pm \frac{1}{2}$</p> <p>Standardizing</p> <p>A WRT -0.45</p> <p></p> <p>$= 1 - 0.6736$</p> <p>$= 0.3264$</p> <p>(A WRT $0.326 \sim 0.327$)</p> <p>(d) The 70 letters form a <u>random sample</u> or are <u>representative</u> or letters are <u>independent</u></p>	<p>M1, A1 (2)</p> <p>M1, A1 (2)</p> <p>M1 (Normal approx)</p> <p>A1 μ</p> <p>A1 σ or σ^2</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1 (7)</p> <p>B1 (1)</p> <p>(12)</p>			

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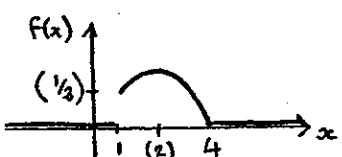
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5.	$X = \text{no. of requests for bulbs in a week. } X \sim P_0(2)$	
(a)	$P(X=4) = \frac{e^{-2} \cdot 2^4}{4!} \quad \text{or} \quad [P(X \leq 4) - P(X \leq 3)]$ $= \underline{0.0902} \quad \text{or} \quad \underline{0.090} \quad \text{or} \quad \underline{0.09}$	M1 A1 (2)
(b)	$P(X > 5) = 1 - P(X \leq 5), = 1 - 0.9834 = \underline{0.0166}$	M1, A1 (2)
(c)	$Y = \text{no. of requests in 3 weeks. } Y \sim P_0(6)$ $P(Y \leq 5), = \underline{0.4457}$	B1 M1, A1 (3)
(d)	$H_0: \lambda = 2 \text{ (or } \mu = 8) ; H_1: \lambda < 2 \text{ (or } \mu < 8)$ $R = \text{no. of requests in 4 weeks. } R \sim P_0(8)$ $P(R \leq 3), = 0.0424 \quad [\text{c.r. } \leq 3 \text{ or prob } < 5\%]$ there is evidence that the rate of requests has decreased	B1; B1 M1, A1 A1 ✓ (5) (12)
6 (a)	$f(x) = \frac{d}{dx} F(x) = \frac{1}{27} (-3x^2 + 12x)$	M1 A2/110 -1 e.e.o.o. (3)
(b)	$\frac{d}{dx} [f(x)] = 0 \Rightarrow -6x + 12 = 0, \Rightarrow x = \underline{2} \text{ is mode}$	M1, A1 (2)
(c)	 <p>$x, f(x)$ axes marked and at least 1, 4</p>	B1 B1 B1 (3)
(d)	$\mu = \int_1^4 \left(\frac{4x^2}{9} - \frac{x^3}{9} \right) dx$ $= \frac{1}{9} \left[\frac{4x^3}{3} - \frac{x^4}{4} \right]_1^4 = \left(\frac{256}{27} - \frac{256}{36} \right) - \left(\frac{4}{27} - \frac{1}{36} \right)$ $= \underline{2.25} \text{ or } \underline{9/4}$	M1 some integration attempted M1 Use of correct limits A1 (3)
(e)	$F(2.25) = \frac{1}{27} (-2.25^3 + 6 \times 2.25^2 - 5) = 0.517 \quad (\text{AWAT } 0.52)$	B1 (1)
(f)	$F(\mu) > 0.5 \Rightarrow \mu > \text{median}$ $F(2) = \frac{1}{27} (-8 + 24 - 5) = \frac{11}{27} = 0.407 \Rightarrow \text{mode} < \text{median}$	B1 ✓ (from (e)) B1 (14) (2)

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7.	<p>(a) $P(T < 0.2) = \underline{0.2}$</p> <p>(b) $\mu = E(T) = \underline{0.5}$</p> <p>(c) $E(T^2) = \int_0^1 t^2 dt = \left[\frac{t^3}{3} \right]_0^1$ $Var(T) = (1/3) - (0) - \mu^2 = \underline{\frac{1}{12}}$</p> <p>(d) $X = \text{no. of children with } T < 0.2 \quad X \sim B(20, 0.2)$ $P(X \leq 4) = \underline{0.6296}$</p> <p>(e) Expect mean to still be close to 0.5 (or <u>no change</u>) Expect variance to be <u>reduced</u></p> <p>(f) $P(T < 0.2) = \int_0^{0.2} 4t dt$ $= \left[4t^2/2 \right]_0^{0.2}$ $= 2 \times (0.2)^2 - 0 = \underline{0.08} \text{ (*)}$</p> <p>(g) $Y = \text{no. of players stopping star in under 2s.}$ $Y \sim B(75, 0.08) \approx P_0(6)$ $P(Y > 7) = 1 - P(Y \leq 7)$ $= 1 - 0.7440$ $= \underline{0.256}$</p>	<p>B1 (1)</p> <p>B1 (1)</p> <p> $\int t^2$ M1 $\left[\right]$ A1 $-\mu^2$ M1 $1/12$ A1 (4) </p> <p>Identify binomial M1 ($\int p$ from (a)) M1, A1 (3)</p> <p>B1 B1 (2)</p> <p>Attempt $\int 4t dt$ between 0, 0.2 M1 A1 c.s.o. (2)</p> <p> P_0 M1 $\lambda = 6$ A1 M1 A1 (4) </p>
(S.C.)	<p><u>Normal Approx</u> $N(6, 5.52)$ $\sqrt{6}, \sqrt{5.52}$ $\rightarrow (0.261 \sim 0.262)$</p>	<p> M1 } is 2/4 only A1 } </p>

(17)