EDEXCEL FOUNDATION

Stewart House 32 Russell Square London WC1B 5DN

January 2004

Advanced Subsidiary/Advanced Level

General Certificate of Education

Subject **STATISTICS 6684** Paper No. **S2**

Question number	Scheme	Marks
1.		
(a)	List of patients registered with the practice. Require 'list' or 'register' or database or similar	**B1** **(1)**
(b)	The patient(s)	**B1** **(1)**
(c)	Adv: Quicker, cheaper, easier, used when testing results in destruction of item, quality of info about each sampling unit is often better. Any one Disadv: Uncertainty due to natural variation, uncertainty due to bias, possible bias as sampling frame incomplete, bias due to subjective choice of sample, bias due to non-response . Any one	**B1** **B1** **(2)**
(d)	Non-response due to patients registered with the practice but who have left the area	**B1** **(1)** **(Total 5 Marks)**
2(a)	$P(R \geq 4) = 1 - P(R \leq 3) = 0.6533$ Require 1 minus and correct inequality	**M1A1** **(2)**
(b)	$P(S \leq 1) = P(S=0) + P(S=1), = e^{-2.71} + 2.71e^{-2.71}, = 0.2469$ awrt 0.247	**M1,A1,A1** **(3)**
(c)	$P(T \leq 18) = P(Z \leq \frac{18-25}{5}), = P(Z \leq -1.4) = 0.0808$ 4 dp, cc no marks	**M1,A1** **(2)** **(Total 7 Marks)**
3(a)	$p = \frac{1}{2}$	**B1** **(1)**
(b)	Binomial distribution is symmetrical	**B1** **(1)**
(c)	Since n is large and $p \approx 0.5$ then use normal approximation, Can be implied below $np = 96$ and $npq = 49.92$ $P(90 \leq X < 105) \approx P(89.5 \leq Y \leq 104.5)$ where $Y \sim N(96, 49.92)$ ±0.5 cc on both $\approx P\left(\frac{89.5-96}{\sqrt{49.92}} \leq Z \leq \frac{104.5-96}{\sqrt{49.92}}\right)$ Standardisation of both $\approx P(-0.92 \leq Z \leq 1.20)$ awrt -0.92 & 1.20 $\approx 0.7055\text{-}0.7070$ 4dp in range	**M1** **A1A1** **M1,** **M1** **A1** **A1** **(7)** **(Total 9 Marks)**

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4		
(a)	*n* large, *p* small	**B1,B1** **(2)**
(b)	Let X represent the number of people catching the virus, $X \sim \mathrm{B}\left(12, \frac{1}{150}\right)$ Implied	**B1**
	$\mathrm{P}(X=2) = \mathrm{C}_2^{12}\left(\frac{1}{150}\right)^2\left(\frac{149}{150}\right)^{10}, = 0.0027$ Use of Bin including C_2^{12}, 0.0027(4) only	**M1A1,A1** **(4)**
(c)	$X \sim \mathrm{Po}(np) = \mathrm{Po}(8)$ Poisson, 8	**B1,B1**
	$\mathrm{P}(X<7) = \mathrm{P}(X \le 6) = 0.3134$ $X \le 6$ for method, 0.3134	**M1A1** **(4)** **(Total 10 Marks)**
5(a)	Vehicles pass at random / one at a time / independently / at a constant rate Any 2&context	**B1B1**dep **(2)**
(b)	X is the number of vehicles passing in a 10 minute interval,	
	$X \sim \mathrm{Po}\left(\frac{51}{60}\times 10\right) = \mathrm{Po}(8.5)$ Implied Po(8.5)	**B1**
	$\mathrm{P}(X=6) = \frac{8.5^6 \mathrm{e}^{-8.5}}{6!}, = 0.1066$ (or 0.2562-0.1496=0.1066) Clear attempt using 6, 4dp	**M1A1** **(3)**
(c)	$\mathrm{P}(X \ge 9) = 1 - \mathrm{P}(X \le 8) = 0.4769$ Require 1 minus and correct inequality	**M1A1** **(2)**
(d)	$\mathrm{H}_0 : \lambda = 8.5,\ \mathrm{H}_1 : \lambda < 8.5$ One tailed test only for alt hyp	**B1∫,B1∫**
	$\mathrm{P}(X \le 4 \mid \lambda = 8.5) = 0.0744, > 0.05$ $X \le 4$ for method, 0.0744	**M1,A1**
	(Or $\mathrm{P}(X \le 3 \mid \lambda = 8.5) = 0.0301, < 0.05$ so CR $X \le 3$ correct CR	**M1,A1)**
	Insufficient evidence to reject H_0, 'Accept'	**M1**
	so no evidence to suggest number of vehicles has decreased. Context	**A1∫** **(6)** **(Total 13 Marks)**

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6		
(a)	Let X represent the number of plant pots with defects, $X \sim \mathrm{B}(25,0.20)$ Implied	**B1**
	$\mathrm{P}(X \le 1) = 0.0274, \mathrm{P}(X \ge 10) = 0.0173$ Clear attempt at both tails required, 4dp	**M1A1A1**
	Critical region is $X \le 1, X \ge 10$	**A1**
		(5)
(b)	Significance level = 0.0274+0.0173=0.0447 Accept % 4dp	**B1** cao
		(1)
(c)	$\mathrm{H}_0 : \lambda = 10,\ \mathrm{H}_1 : \lambda > 10$ (or $\mathrm{H}_0 : \lambda = 60,\ \mathrm{H}_1 : \lambda > 60$)	**B1B1**
	Let Y represent the number sold in 6 weeks, under H_0, $Y \sim \mathrm{Po}(60)$	
	$\mathrm{P}(Y \ge 74) \approx \mathrm{P}(W > 73.5)$ where $W \sim \mathrm{N}(60,60)$ ± 0.5 for cc ,73.5	**M1A1**
	$\approx \mathrm{P}(\mathrm{Z} \ge \frac{73.5-60}{\sqrt{60}}) = \mathrm{P}(\mathrm{Z} > 1.74) =, 0.0407 - 0.0409 < 0.05$ Standardise using $60\sqrt{60}$	**M1,A1**
	Evidence that rate of sales per week has increased.	**A1∫**
		(7)
		(Total 13 Marks)

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7		
(a)	$\int_0^4 kx(5-x)\mathrm{d}x = 1$ Limits required	**M1**
	$k\left[\frac{5x^2}{2} - \frac{x^3}{3}\right]_0^4 = 1$ $\left[\frac{5x^2}{2} - \frac{x^3}{3}\right]$	**A1**
	Sub in limits and solve to give **** $k = \frac{3}{56}$ **** Correct solution	**A1**
		(3)
(b)	$\mathrm{F}(x) = \int_0^{x_0} \mathrm{f}(x)\mathrm{d}x = \int_0^{x_0} \frac{3}{56}x(5-x)\,\mathrm{d}x = \frac{3}{56}\left[\frac{5x^2}{2} - \frac{x^3}{3}\right]_0^{x_0}$ Variable upper limit required	**M1**
	$= \frac{x_0^2}{112}(15-2x_0)$	**A1**
	$\mathrm{F}(x) = \begin{cases} 0 & x<0 \\ \frac{x^2}{112}(15-2x) & 0\le x\le 4 \\ 1 & x>4 \end{cases}$ Ends, middle.	**B1,B1∫**
		(4)
(c)	$\mathrm{E}(x) = \int_0^4 \frac{3}{56}x^2(5-x)\,\mathrm{d}x = \frac{3}{56}\left[\frac{5x^3}{3} - \frac{x^4}{4}\right]_0^4 = 2.29$ $\int x\mathrm{f}(x)\mathrm{d}x$, $\left[\frac{5x^3}{3} - \frac{x^4}{4}\right]$, 3sf $(2\frac{2}{7})$	**M1A1A1**
		(3)
(d)	$\mathrm{f}'(x) = \frac{3}{56}(5-2x) = 0 \Rightarrow$ Mode=2.5 Attempt $\mathrm{f}'(x)$, $(5-2x)=0$, 2.5	**M1A1A1**
	(Or Sketch M1, x=0&5 A1, Mode=2.5 A1)	
		(3)
(e)	F(2.3)=0.491, F(2.5)=0.558 Their F, awrt 0.491 & 0.558 or 0.984 & -6.5	**M1,A1**
	F(m)=0.5 $\Rightarrow$ m lies between 2.3 and 2.5 cso	**A1**
		(3)
(f)	Mean (2.29)<Median (2.3-2.5)<Mode (2.5)	**B1**
	Negative skew	**B1** dep
		(2)
		(Total 18 Marks)