June 2006
6684 Statistics S2
Mark Scheme

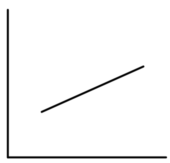
Question Number	Scheme	Marks
1. (a)	Saves time / cheaper / easier any one or A census/asking all members takes a long time or is expensive or difficult to carry out	B1 (1)
(b)	List, register or database of all club members/golfers or Full membership list	B1 (1)
(c)	Club member(s)	B1 (1)
		Total 3 marks
2. (a)	$\text{P(L < -2.6)} = 1.4\times\frac{1}{8} = \frac{7}{40}$ or 0.175 or equivalent	B1 (1)
(b)	$\text{P (L < – 3.0 or L > 3.0)} = 2\times\left(1\times\frac{1}{8}\right) = \frac{1}{4}$ M1 for 1/8 seen	M1;A1 (2)
(c)	$\text{P (within 3mm)} = 1-\frac{1}{4} = 0.75$ B(20,0.75) recognises binomial	B1
	Using B(20,p)	M1
	Let X represent number of rods within 3mm	
	$\text{P}(X \le 9 / \text{p} = 0.25)$ or $1 - \text{P}(X \le 10 / p = 0.75)$	M1
	$= 0.9861$ awrt 0.9861	A1 (4)
		Total 7 marks

Question Number	Scheme	Marks
3. (a)	Let X represent the number of properties sold in a week	
	$\therefore X \sim P_o(7)$ must be in part a	B1
	Sales occur independently/randomly, singly, at a constant rate context needed once	B1 B1 (3)
(b)	$P(X=5) = P(X \le 5) - P(X \le 4)$ or $\frac{7^5 e^{-7}}{5!}$	M1
	$= 0.3007 - 0.1730$	
	$= 0.1277$ awrt 0.128	A1 (2)
(c)	$P(X > 181) \approx P(Y \ge 181.5)$ where $Y \sim N(168, 168)$ N (168, 168)	B1
	$= P\left(z \ge \frac{181.5 - 168}{\sqrt{168}}\right)$ ± 0.5 stand with μ and σ	M1 M1
	Give A1 for 1.04 or correct expression	A1
	$= P(z \ge 1.04)$	
	$= 1 - 0.8508$ attempt correct area $1-p$ where $p > 0.5$	M1
	$= 0.1492$ awrt 0.149	A1 (6)
		Total 11 marks

Question Number	Scheme	Marks
4. (a)	Let X represent the number of breakdowns in a week.	
	$X \sim \mathrm{P_o}\,(1.25)$ implied	B1
	$\mathrm{P}\,(X < 3) = \mathrm{P}\,(0) + \mathrm{P}(1) + \mathrm{P}(2)$ or $\mathrm{P}\,(X \le 2)$	M1
	$= \mathrm{e}^{-1.25}\left(1 + 1.25 + \frac{(1.25)^2}{2!}\right)$	A1
	$= 0.868467\ldots\ldots$ awrt 0.868 or 0.8685	A1 (4)
(b)	$\mathrm{H}_0 : \lambda = 1.25$; $\mathrm{H}_1 : \lambda \neq 1.25$ (or $\mathrm{H}_0 : \lambda = 5$; $\mathrm{H}_1 : \lambda \neq 5$) λ or μ	B1 B1
	Let Y represent the number of breakdowns in 4 weeks	
	Under H_0, $Y \sim \mathrm{P}_0(5)$ may be implied	B1
	$\mathrm{P}\,(Y \ge 11) = 1 - \mathrm{P}(Y \le 10)$ or $\mathrm{P}(X \ge 11) = 0.0137$ One needed for M $\mathrm{P}(X \ge 10) = 0.0318$	M1
	$= 0.0137$ CR $X \ge 11$	A1
	0.0137 < 0.025, 0.0274 < 0.05, 0.9863 > 0.975, 0.9726>0.95 or $11 \ge 11$ any .allow %	M1
	√ from H_1 Evidence that the rate of breakdowns has changed /decreased context From their p	B1√ (7)
		Total 11 marks

Question Number	Scheme	Marks
5. (a)	Binomial	B1 (1)
	Let X represent the number of green mugs in a sample	
(b)	$X \sim B(10, 0.06)$ may be implied or seen in part a	B1
	$P(X = 3) = {}^{10}C_3(0.06)^3(0.94)^7$ ${}^{10}C_3(p)^3(1-p)^7$	M1
	$= 0.016808\ldots$ awrt 0.0168	A1 (3)
(c) (i)	Let X represent number of green mugs in a sample of size 125	
	$X \sim P_0(125 \times 0.06 = 7.5)$ may be implied	B1
	$P(10 \le X \le 13) = P(X \le 13) - P(X \le 9)$	M1
	$= 0.9784 - 0.7764$	
	$= 0.2020$ awrt 0.202	A1 (3)
(ii)	$P(10 \le X \le 13) \approx P(9.5 \le Y \le 13.5)$ where $Y \sim N(7.5, 7.05)$ 7.05	B1
	9.5, 13.5	B1
	$= P\left(\frac{9.5-7.5}{\sqrt{7.05}} \le z \le \frac{13.5-7.5}{\sqrt{7.05}}\right)$ ± 0.5 stand.	M1 M1
	both values or both correct expressions. $= P(0.75 \le z \le 2.26)$ awrt 0.75 and 2.26	A1
	$= 0.2147$ awrt 0.214or 0.215	A1 (6)
		Total 13 marks

Question Number	Scheme		Marks	
6 (a)	$\int_1^4 \frac{1+x}{k}dx = 1$	$\int f(x)=1$ Area = 1	M1	
	$\therefore \left[\frac{x}{k}+\frac{x^2}{2k}\right]_1^4 = 1$	correct integral/correct expression	A1	
	$k = \frac{21}{2}$ *	cso	A1	(3)
(b)	$\mathrm{P}(X \le x_0) = \int_1^{x_0} \frac{2}{21}(1+x)$	$\int f(x)$ variable limit or +C	M1	
	$= \left[\frac{2x}{21}+\frac{x^2}{21}\right]_1^{x_0}$	correct integral + limit of 1 May have k in	A1	
	$= \frac{2x_0 + x_0{}^2 - 3}{21}$ or $\frac{(3+x)(x-1)}{21}$		A1	
	$\mathrm{F}(x) = \begin{cases} 0, & x < 1 \\ \frac{x^2+2x-3}{21} & 1 \le x < 4 \\ 1 & x \ge 4 \end{cases}$	middle; ends	B1√; B1	(5)
(c)	$\mathrm{E}(X) = \int_1^4 \frac{2x}{21}(1+x)dx$	valid attempt $\int x\mathrm{f}(x)$	M1	
	$= \left[\frac{x^2}{21}+\frac{2x^3}{63}\right]_1^4$	x^2 and x^3 correct integration	A1	
	$= \frac{171}{63} = 2\frac{5}{7} = \frac{19}{7} = 2.7142....$	awrt 2.71	A1	(3)

Question Number	Scheme	Marks
(d)	$F(m) = 0.5 \Rightarrow \frac{x^2+2x-3}{21} = \frac{1}{2}$ putting their $F(x) = 0.5$	M1
	$\therefore 2x^2 + 4x\text{-}27 = 0$ or equiv	
	$\therefore x = \frac{-4 \pm \sqrt{16 - 4.2(-27)}}{4}$ attempt their 3 term quadratic	M1
	$\therefore x = -1 \pm 3.8078...$	
	i.e. $x = 2.8078\ldots$ awrt 2.81	A1 (3)
(e)	Mode = 4	B1 (1)
(f)	<u>Mean < median < mode</u> ($\Rightarrow$ negative skew) allow numbers in place of words	B1 (1)
	Or	
	<u>Mean < median</u>	
	 w diagram but line must not cross y axis	
		Total 16 marks

Question Number	Scheme	Marks
7. (a)	Let X represent the number of bowls with minor defects.	
	$\therefore X \sim \mathrm{B};(25, 0.20)$ may be implied	B1; B1
	$\mathrm{P}\left(X \le 1\right) = 0.0274$ or $\mathrm{P}(X = 0) = 0.0038$ need to see at least one. prob for $X \le$ no For M1	M1A1
	$\mathrm{P}\left(X \le 9\right) = 0.9827; \Rightarrow \mathrm{P}\left(X \ge 10\right) = 0.0173$ either	A1
	$\therefore \text{CR is } \left\{X \le 1 \cup X \ge 10\right\}$	A1 (6)
b)	Significance level = 0.0274 + 0.0173	
	= 0.0447 or 4.477% awrt 0.0447	B1 (1)
c)	$\mathrm{H}_0 : p = 0.20$; $\mathrm{H}_1 : p < 0.20$;	B1 B1
	Let Y represent number of bowls with minor defects	
	Under H_0 $Y \sim \mathrm{B}\ (20, 0.20)$ may be implied	B1
	$\mathrm{P}\ (Y \le 2)$ or $\mathrm{P}(Y \le 2) = 0.2061$ either $\mathrm{P}(Y \le 1) = 0.0692$	M1
	= 0.2061 CR $Y \le 1$	A1
	$0.2061 > 0.10$ or $0.7939 < 0.9$ or $2 > 1$ their p	M1
	Insufficient evidence to suggest that the proportion of defective bowls has decreased.	B1√ (7)