EDEXCEL STATISTICS S2 (6684) – JUNE 2004 PROVISIONAL MARK SCHEME

Qn no.	Scheme		Marks
1(a)	A <u>list of</u> (all) the members of the <u>population</u>		**B1**
			(1)
(b)	A random variable that is a <u>function</u> of a random <u>sample</u>		**B1**
	that contains <u>no unknown parameters</u>		**B1**
			(2)
			(Total 3 marks)
2(a)	$\mathrm{P}(X < 2.7) = \frac{3.7}{5} = 0.74$	0.74	**B1**
			(1)
(b)	$\mathrm{E}(X) = \frac{4-1}{2} = 1.5$	Require minus or complete attempt at integration, 1.5	**M1A1**
			(2)
(c)	$\mathrm{Var}(X) = \frac{1}{12}(4+1)^2 = \frac{25}{12} = 2.08\dot{3}$	Require plus, $\frac{25}{12}$ or $2\frac{1}{12}$ or $2.08\dot{3}$ or 2.08	**M1A1**
			(2)
			(Total 5 marks)
3	$\mathrm{H_0} : p = 0.25,\ \mathrm{H_1} : p > 0.25$	1 tailed	**B1B1**
	Under $\mathrm{H_0}$, $X \sim \mathrm{Bin}(25, 0.25)$	Implied by probability	**B1**
	$\mathrm{P}(X \geq 10) = 1 - \mathrm{P}(X \leq 9) = 0.0713 > 0.05$	Correct inequality, 0.0713	**M1A1**
	Do not reject $\mathrm{H_0}$, there is insufficient evidence to support Brad's claim.	DNR, context	**A1A1**
			(7)
			(Total 7 marks)
4(a)	Fixed no of trials/ independent trials/ success & failure/ Probab of success is constant any 2		**B1B1**
			(2)
(b)	X is rv 'no of defective components $X \sim \mathrm{Bin}(20, 0.1)$	$\mathrm{Bin}(20, 0.1)$	**B1**
			(1)
(c)	$\mathrm{P}(X = 0) = 0.1216$	=0, 0.1216	**M1A1**
			(2)
(d)	$\mathrm{P}(X > 6) = 1 - \mathrm{P}(X \leq 6) = 1 - 0.9976 = 0.0024$	Strict inequality & 1- with 6s, 0.0024	**M1A1**
			(2)
(e)	$\mathrm{E}(X) = 20 \times 0.1 = 2$	2	**B1**
	$\mathrm{Var}(X) = 20 \times 0.1 \times 0.9 = 1.8$	1.8	**B1**
			(2)
(f)	$X \sim \mathrm{Bin}(100, 0.1)$	Implied by approx used	**B1**
	$X \sim \mathrm{P}(10)$		**B1**
	$\mathrm{P}(X > 15) = 1 - \mathrm{P}(X \leq 15) = 1 - 0.9513 = 0.0487$	Strict inequality and 1- with 15, 0.0487	**M1A1**
	(OR $X \sim \mathrm{N}(10, 9)$, *P(X > 15.5) = 1-P(Z<1.83)=0.0336 (0.0334)*	*with 15.5*	*B1**M1A1***)
	(OR $X \sim \mathrm{N}(10, 10)$, *P(X > 15.5) = 1-P(Z<1.74)=0.0409 (0.0410)*	*with 15.5*	*B1**M1A1***)
			(4)
			(Total 13 marks)

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5 (a)	A range of values of a test statistic such that if a value of the test statistic obtained from a particular sample lies in the critical region, then the null hypothesis is rejected (or equivalent).		**B1B1**
			(2)
(b)	$P(X < 2) = P(X=0) + P(X=1)$	both	**M1**
	$= e^{-\frac{1}{7}} + \dfrac{e^{-\frac{1}{7}}}{7}$	both	**A1**
	=0.990717599… =0.9907 to 4 sf	awrt 0.991	**A1**
			(3)
(c)	$X \sim P(14 \times \frac{1}{7}) = P(2)$		**B1**
	$P(X \leq 4) = 0.9473$	Correct inequality, 0.9473	**M1A1**
			(3)
(d)	$H_0 : \lambda = 4,\ H_1 : \lambda < 4$	Accept μ & $H_0 : \lambda = \frac{1}{7},\ H_1 : \lambda < \frac{1}{7}$	**B1B1**
	$X \sim P(4)$	Implied	**B1**
	$P(X \leq 1) = 0.0916 > 0.05$,	Inequality 0.0916	**M1A1**
	So insufficient evidence to reject null hypothesis		**A1**
	Number of breakdowns has not significantly decreased		**A1**
			(7)
			(Total 15 marks)
6 (a)	No of defects in carpet area a sq m is distributed $Po(0.05a)$	Poisson, 0.05a	**B1B1**
	Defects occur at a constant rate, independent, singly, randomly	Any 1	**B1**
			(3)
(b)	$X \sim P(30 \times 0.05) = P(1.5)$	P(1.5)	**B1**
	$P(X = 2) = \dfrac{e^{-1.5} \times 1.5^2}{2} = 0.2510$	Tables or calc 0.251(0)	**M1A1**
			(3)
(c)	$P(X > 5) = 1 - P(X \leq 5) = 1 - 0.9955 = 0.0045$	Strict inequality, 1-0.9955, 0.0045	**M1M1A1**
			(3)
(d)	$X \sim P(17.75)$	Implied	**B1**
	$X \sim N(17.75, 17.75)$	Normal, 17.75	**B1**
	$P(X \geq 22) = P\left(Z > \dfrac{21.5 - 17.75}{\sqrt{17.75}}\right)$	Standardise, accept 22 or ± 0.5	**M1M1**
	$= P(Z > 0.89)$	awrt 0.89	**A1**
	=0.1867	0.1867,	**A1**
			(6)
			(Total 15 marks)

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Qn no.	Scheme		Marks
7(a)	$\mathrm{E}(X) = \int_0^1 \frac{1}{3}x\,\mathrm{d}x + \int_1^2 \frac{8x^4}{45}\mathrm{d}x$	$\int x\mathrm{f}(x)\mathrm{d}x$, 2 terms added	**M1M1**
	$= \left[\frac{1}{6}x^2\right]_0^1 + \left[\frac{8x^5}{225}\right]_1^2$	Expressions, limits	**A1A1**
	$= 1.26\dot{8} = 1.27$ to 3 sf or $\frac{571}{450}$ or $1\frac{121}{450}$	awrt1.27	**A1**
			(5)
(b)	$\mathrm{F}(x_0) = \int_0^{x_0} \frac{1}{3}\mathrm{d}x = \frac{1}{3}x_0$ for $0 \le x < 1$	variable upper limit on $\int \mathrm{f}(x)\mathrm{d}x$, $\frac{1}{3}x_0$	**M1A1**
	$\mathrm{F}(x_0) = \frac{1}{3} + \int_1^{x_0} \frac{8x^3}{45}\mathrm{d}x$ for $1 \le x \le 2$	their fraction + v.u.l on $\int \mathrm{f}(x)\mathrm{d}x$ &2 terms	**M1**
	$= \frac{1}{3} + \left[\frac{8x^4}{180}\right]_1^{x_0}$	$\frac{8x^4}{180}$	**A1**
	$= \frac{1}{45}\left(2x_0^4 + 13\right)$		**A1**
	$\mathrm{F}(x) = \begin{cases} 0 & x < 0 \\ \frac{1}{3}x & 0 \le x < 1 \\ \frac{1}{45}\left(2x^4 + 13\right) & 1 \le x \le 2 \\ 1 & x > 2 \end{cases}$	middle pair, ends	**B1,B1**
			(7)
(c)	$\mathrm{F}(m) = 0.5$ $\frac{1}{45}\left(2x^4 + 13\right) = \frac{1}{2}$	Their function=0.5	**M1A1ft**
	$m^4 = 4.75$ $m = 1.48$ to 3 sf	awrt1.48	**A1**
			(3)
(d)	mean<median		**B1**
	Negative Skew	dep	**B1**
			(2)
			(Total 17 marks)