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

Qn no.	Scheme	Marks
1(a)	A list of (all) the members of the population	**B1**
		(1)
(b)	A random variable that is a function of a random sample	**B1**
	that contains no unknown parameters	**B1**
		(2)
		(Total 3 marks)
2(a)	$P(X < 2.7) = \frac{3.7}{5} = 0.74$ 0.74	**B1**
		(1)
(b)	$E(X) = \frac{4-1}{2} = 1.5$ Require minus or complete attempt at integration, 1.5	**M1A1**
		(2)
(c)	$Var(X) = \frac{1}{12}(4+1)^2 = \frac{25}{12} = 2.08\dot{3}$ Require plus, $\frac{25}{12}$ *or* $2\frac{1}{12}$ *or* $2.08\dot{3}$ *or* 2.08	**M1A1**
		(2)
		(Total 5 marks)
3	$H_0 : p = 0.25,\ H_1 : p > 0.25$ 1 tailed	**B1B1**
	Under H_0, $X \sim$ Bin(25,0.25) Implied by probability	**B1**
	$P(X \geq 10) = 1 - P(X \leq 9) = 0.0713 > 0.05$ Correct inequality, 0.0713	**M1A1**
	Do not reject 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 $X \sim$ Bin(20,0.1) Bin(20,0.1)	**B1**
		(1)
(c)	P(X = 0)=0.1216 =0, 0.1216	**M1A1**
		(2)
(d)	$P(X > 6) = 1 - P(X \leq 6) = 1 - 0.9976 = 0.0024$ Strict inequality & 1- with 6s, 0.0024	**M1A1**
		(2)
(e)	E(X)=20x0.1=2 2	**B1**
	Var(X)=20x0.1x0.9=1.8 1.8	**B1**
		(2)
(f)	$X \sim$ Bin(100,0.1) Implied by approx used	**B1**
	$X \sim$ P(10)	**B1**
	$P(X > 15) = 1\text{-}P(X \leq 15) = 1\text{-}0.9513 = 0.0487$ Strict inequality and 1- with 15, 0.0487	**M1A1**
	(OR $X \sim N(10,9)$, *P(X > 15.5) = 1-P(Z<1.83)=0.0336 (0.0334) with 15.5*	***B1M1A1*****)**
	(OR $X \sim N(10,10)$, *P(X > 15.5) = 1-P(Z<1.74)=0.0409 (0.0410) with 15.5*	***B1M1A1*****)**
		(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**
	$= e^{-\frac{1}{7}} + \frac{e^{-\frac{1}{7}}}{7}$	both **A1**
	$=0.990717599\ldots = 0.9907$ to 4 sf	awrt 0.991 **A1** **(3)**
(c)	$X \sim P(14\times\frac{1}{7}) = P(2)$	**B1**
	$P(X \le 4) = 0.9473$	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**
	$P(X \le 1) = 0.0916 > 0.05,$	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 $\text{Po}(0.05a)$	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**
	$P(X = 2) = \frac{e^{-1.5}\times 1.5^2}{2} = 0.2510$	Tables or calc 0.251(0) **M1A1** **(3)**
(c)	$P(X > 5) = 1 - P(X \le 5) = 1 - 0.9955 = 0.0045$	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**
	$P(X \ge 22) = P\left(Z > \frac{21.5 - 17.75}{\sqrt{17.75}}\right)$	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)	$E(X)=\int_0^1 \frac{1}{3}x\,dx+\int_1^2 \frac{8x^4}{45}dx$	$\int xf(x)dx$, 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)	$F(x_0)=\int_0^{x_0}\frac{1}{3}dx=\frac{1}{3}x_0$ for $0\le x<1$	variable upper limit on $\int f(x)dx$, $\frac{1}{3}x_0$ **M1A1**
	$F(x_0)=\frac{1}{3}+\int_1^{x_0}\frac{8x^3}{45}dx$ for $1\le x\le 2$	their fraction + v.u.l on $\int f(x)dx$ &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**
	$F(x)=\begin{cases}0 & x<0\\ \frac{1}{3}x & 0\le x<1\\ \frac{1}{45}\left(2x^4+13\right) & 1\le x\le 2\\ 1 & x>2\end{cases}$	middle pair, ends **B1,B1**
		(7)
(c)	$F(m)=0.5$	
	$\frac{1}{45}\left(2x^4+13\right)=\frac{1}{2}$	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)