

# EDEXCEL FOUNDATION

Stewart House 32 Russell Square London WC1B 5DN

June 2004

Advanced Subsidiary/Advanced Level

General Certificate of Education

Subject **STATISTICS 6684**

Paper No. **S2**

Qn no.	Scheme	Marks
1(a)	A <u>list of</u> (all) the members of the <u>population</u>	<b>B1</b> (1)
(b)	A random variable that is a <u>function</u> of a random <u>sample</u> that contains <u>no unknown parameters</u>	<b>B1</b> <b>B1</b> (2) (Total 3 marks)
2(a)	$P(X < 2.7) = \frac{3.7}{5} = 0.74$	0.74 <b>B1</b> (1)
(b)	$E(X) = \frac{4-1}{2} = 1.5$	Require minus or complete attempt at integration, 1.5 <b>M1A1</b> (2)
(c)	$Var(X) = \frac{1}{12}(4+1)^2 = \frac{25}{12} = 2.08\bar{3}$	Require plus, $\frac{25}{12}$ or $2\frac{1}{12}$ or $2.08\bar{3}$ or $2.08$ <b>M1A1</b> (2) (Total 5 marks)
3	$H_0 : p = 0.25, H_1 : p > 0.25$ Under $H_0, X \sim \text{Bin}(25, 0.25)$ $P(X \geq 10) = 1 - P(X \leq 9) = 0.0713 > 0.05$ Do not reject $H_0$ , there is insufficient evidence to support Brad's claim.	1 tailed <b>B1B1</b> Implied by probability <b>B1</b> Correct inequality, 0.0713 <b>M1A1</b> DNR, context <b>A1A1</b> (7) (Total 7 marks)
4(a)	Fixed no of trials/ independent trials/ success & failure/ Probab of success is constant any 2	<b>B1B1</b> (2)
(b)	$X$ is rv 'no of defective components $X \sim \text{Bin}(20, 0.1)$	$\text{Bin}(20, 0.1)$ <b>B1</b> (1)
(c)	$P(X = 0) = 0.1216$	$= 0, 0.1216$ <b>M1A1</b> (2)
(d)	$P(X > 6) = 1 - P(X \leq 6) = 1 - 0.9976 = 0.0024$	Strict inequality & 1- with 6s, 0.0024 <b>M1A1</b> (2)
(e)	$E(X) = 20 \times 0.1 = 2$ $Var(X) = 20 \times 0.1 \times 0.9 = 1.8$	2 <b>B1</b> 1.8 <b>B1</b> (2)
(f)	$X \sim \text{Bin}(100, 0.1)$ $X \sim P(10)$ $P(X > 15) = 1 - P(X \leq 15) = 1 - 0.9513 = 0.0487$ (OR $X \sim N(10, 9), P(X > 15.5) = 1 - P(Z < 1.83) = 0.0336$ (0.0334) with 15.5 (OR $X \sim N(10, 10), P(X > 15.5) = 1 - P(Z < 1.74) = 0.0409$ (0.0410) with 15.5	Implied by approx used <b>B1</b> <b>B1</b> Strict inequality and 1- with 15, 0.0487 <b>M1A1</b> <b>B1M1A1</b> <b>B1M1A1</b> (4) (Total 13 marks)

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5 (a)	<u>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).</u>	<b>B1B1</b>
(b)	$P(X < 2) = P(X=0) + P(X=1)$ $= e^{-\frac{1}{7}} + \frac{e^{-\frac{1}{7}}}{7}$ $= 0.990717599... = 0.9907 \text{ to 4 sf}$	<b>both M1</b> <b>both A1</b> <b>awrt 0.991 A1</b>
(c)	$X \sim P(14 \times \frac{1}{7}) = P(2)$ $P(X \leq 4) = 0.9473$	<b>B1</b> <b>Correct inequality, 0.9473 M1A1</b>
(d)	$H_0 : \lambda = 4, H_1 : \lambda < 4$ $X \sim P(4)$ $P(X \leq 1) = 0.0916 > 0.05,$ So insufficient evidence to reject null hypothesis Number of breakdowns has not significantly decreased	<b>Accept <math>\mu</math> &amp; <math>H_0 : \lambda = \frac{1}{7}, H_1 : \lambda &lt; \frac{1}{7}</math> B1B1</b> <b>Implied B1</b> <b>Inequality 0.0916 M1A1</b> <b>A1</b> <b>A1</b>
		<b>(7)</b>
		<b>(Total 15 marks)</b>
6 (a)	No of defects in carpet area $a$ sq m is distributed $Po(0.05a)$ Defects occur at a constant rate, independent, singly, randomly	<b>Poisson, 0.05a B1B1</b> <b>Any 1 B1</b>
(b)	$X \sim P(30 \times 0.05) = P(1.5)$ $P(X = 2) = \frac{e^{-1.5} \times 1.5^2}{2} = 0.2510$	<b>P(1.5) B1</b> <b>Tables or calc 0.251(0) M1A1</b>
(c)	$P(X > 5) = 1 - P(X \leq 5) = 1 - 0.9955 = 0.0045$	<b>Strict inequality, 1-0.9955, 0.0045 M1M1A1</b>
(d)	$X \sim P(17.75)$ $X \sim N(17.75, 17.75)$ $P(X \geq 22) = P\left(Z > \frac{21.5 - 17.75}{\sqrt{17.75}}\right)$ $= P(Z > 0.89)$ $= 0.1867$	<b>Implied B1</b> <b>Normal, 17.75 B1</b> <b>Standardise, accept 22 or <math>\pm 0.5</math> M1M1</b> <b>awrt 0.89 A1</b> <b>0.1867, A1</b>
		<b>(6)</b>
		<b>(Total 15 marks)</b>

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7(a)	$E(X) = \int_0^1 \frac{1}{3}x dx + \int_1^2 \frac{8x^4}{45} dx$ $= \left[ \frac{1}{6}x^2 \right]_0^1 + \left[ \frac{8x^5}{225} \right]_1^2$ $= 1.26\dot{8} = 1.27 \text{ to 3 sf} \quad \text{or } \frac{571}{450} \text{ or } 1\frac{121}{450}$	$\int xf(x)dx$ , 2 terms added <b>M1M1</b> Expressions, limits <b>A1A1</b> awrt 1.27 <b>A1</b>
(b)	$F(x_0) = \int_0^{x_0} \frac{1}{3} dx = \frac{1}{3}x_0 \text{ for } 0 \leq x < 1$ $F(x_0) = \frac{1}{3} + \int_1^{x_0} \frac{8x^3}{45} dx \text{ for } 1 \leq x \leq 2$ $= \frac{1}{3} + \left[ \frac{8x^4}{180} \right]_1^{x_0}$ $= \frac{1}{45}(2x_0^4 + 13)$ $F(x) = \begin{matrix} 0 & x < 0 \\ \frac{1}{3}x & 0 \leq x < 1 \\ \frac{1}{45}(2x^4 + 13) & 1 \leq x \leq 2 \\ 1 & x > 2 \end{matrix}$	variable upper limit on $\int f(x)dx$ , $\frac{1}{3}x_0$ <b>M1A1</b> their fraction + v.u.l on $\int f(x)dx$ & 2 terms <b>M1</b> $\frac{8x^4}{180}$ <b>B1</b> <b>A1</b> middle pair, ends <b>B1,B1</b>
(c)	$F(m) = 0.5$ $\frac{1}{45}(2m^4 + 13) = \frac{1}{2}$ $m^4 = 4.75$ $m = 1.48 \text{ to 3 sf}$	Their function = 0.5 <b>M1A1ft</b> awrt 1.48 <b>A1</b>
(d)	mean < median Negative Skew	<b>B1</b> dep <b>B1</b>
		<b>(Total 17 marks)</b>