EDEXCEL STATISTICS S2 (6684) – JUNE 2004

PROVISIONAL MARK SCHEME

| Qn no. | Scheme Ma | rks | |
|--------|--|---------------------|-------------|
| 1(a) | A <u>list of</u> (all) the members of the <u>population</u> | B1 | |
| (b) | A random variable that is a <u>function</u> of a random <u>sample</u> that contains <u>no unknown parameters</u> | B1 B1 | (1) |
| | C | Fotal 3 mai | (2) rks) |
| 2(a) | $P(X < 2.7) = \frac{3.7}{5} = 0.74 \tag{0.74}$ | B 1 | , |
| (b) | | | (1) |
| (0) | $E(X) = \frac{4-1}{2} = 1.5$ Require minus or complete attempt at integration, 1.5 | M1A1 | |
| (c) | Var(X) = $\frac{1}{12}(4+1)^2 = \frac{25}{12} = 2.08\dot{3}$ Require plus, $\frac{25}{12}or2\frac{1}{12}or2.08\dot{3}or2.08$ | M1A1 | (2) |
| | | - | (2) |
| 3 | $H_0: p = 0.25, H_1: p > 0.25$ 1 tailed | Fotal 5 mai B1B1 | rks) |
| | Under H_0 , $X \square$ Bin(25,0.25) Implied by probability | B1 | |
| | $P(X \ge 10) = 1 - P(X \le 9) = 0.0713 > 0.05$ Correct inequality, 0.0713 | M1A1 | |
| | Do not reject H_0 , there is insufficient evidence to support Brad's claim. DNR, context | A1A1 | |
| 4(a) | (' Fixed no of trials/ independent trials/ success & failure/ Probab of success is constant any 2 | Fotal 7 mai B1B1 | |
| (b) | X is rv 'no of defective components $X \square Bin(20,0.1)$ Bin(20,0.1) | B1 | (2) |
| | | DI | (1) |
| (c) | P(X = 0) = 0.1216 = 0, 0.1216 M1A1 | | |
| (d) | $P(X > 6) = 1 - P(X \le 6) = 1 - 0.9976 = 0.0024$ Strict inequality & 1- with 6s, 0.0024 | M1A1 | (2) |
| (e) | E(X)=20x0.1=2 2 | B1 | (2) |
| | Var(X) = 20x0.1x0.9 = 1.8 1.8 | B1 | |
| (f) | $X \square$ Bin(100,0.1) Implied by approx used | B1 | (2) |
| | $X \square P(10)$ | B1 | |
| | $P(X > 15) = 1 - P(X \le 15) = 1 - 0.9513 = 0.0487$ Strict inequality and 1- with 15, 0.0487 | M1A1 | |
| | (OR $X \square$ N(10,9), $P(X > 15.5) = 1 - P(Z < 1.83) = 0.0336 (0.0334)$ with 15.5 | <i>B1M1A1</i>) | |
| | (OR $X \square$ N(10,10), $P(X > 15.5) = 1 - P(Z < 1.74) = 0.0409 (0.0410)$ with 15.5 | <i>B1M1A1</i>) | (4) |
| | (T | otal 13 mai | |

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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> | atistic B1B1 | | |
| (b) | P(X < 2) = P(X = 0) + P(X=1) | both | M1 | (2) |
| | $=e^{-\frac{1}{7}}+\frac{e^{-\frac{1}{7}}}{7}$ | both | A1 | |
| | =0.990717599 =0.9907 to 4 sf | awrt 0.991 | A1 | (3) |
| (c) | $X \square P(14 \times \frac{1}{7}) = P(2)$ | | B1 | |
| | $P(X \le 4) = 0.9473$ C | orrect inequality, 0.9473 | M1A1 | (3) |
| (d) | $H_0: \lambda = 4, H_1: \lambda < 4$ Accept μ & | $\mathbf{H}_0: \boldsymbol{\lambda} = \frac{1}{7}, \ \mathbf{H}_1: \boldsymbol{\lambda} < \frac{1}{7}$ | B1B1 | (3) |
| | $X \square \mathbf{P}(4)$ | Implied | B1 | |
| | $P(X \le 1) = 0.0916 > 0.05,$ | Inequality 0.0916 | M1A1 | |
| | So insufficient evidence to reject null hypothesis Number of breakdowns has not significantly decreased | | A1 A1 | |
| | | () | Cotal 15 ma | (7) rks) |
| 6 (a) | No of defects in carpet area a sq m is distributed $Po(0.05a)$ | Poisson, 0.05a | | |
| | Defects occur at a constant rate, independent, singly, randomly | Any 1 | B1 | |
| (b) | $X \square P(30 \times 0.05) = P(1.5)$ | P(1.5) | B1 | (3) |
| | $P(X=2) = \frac{e^{-1.5} \times 1.5^2}{2} = 0.2510$ | Tables or calc 0.251(0) | M1A1 | |
| (c) | $P(X > 5) = 1 - P(X \le 5) = 1 - 0.9955 = 0.0045$ Strict ind | equality, 1-0.9955, 0.0045 | M1M1A1 | (3) |
| (d) | $\mathbf{V} \square \mathbf{D}(17.75)$ | T 11 1 | D 4 | (3) |
| | $X \square P(17.75)$ | - | B1 | |
| | X 🗆 N(17.75,17.75) | Normal, 17.75 | B1 | |
| | $P(X \ge 22) = P\left(Z > \frac{21.5 - 17.75}{\sqrt{17.75}}\right)$ Stand | lardise, accept 22 or ± 0.5 | M1M1 | |
| | =P(Z > 0.89) | awrt 0.89 | A1 | |
| | =0.1867 | 0.1867, | A1 | |
| | | Γ) | Total 15 mai | (6) rks) |

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| $ \begin{aligned} & F(\mathbf{x}) = \int_{0}^{1} \frac{1}{3} xd x + \int_{1}^{2} \frac{8 x^{4}}{4s} d x & \int xf(x) d x, 2 \text{ terms added MIMI} \\ & = \left[\frac{1}{6} x^{2} \right]_{0}^{1} + \left[\frac{8 x^{3}}{225} \right]_{1}^{2} & \text{Expressions, limits A1A1} \\ & = 1.268 = 1.27 \text{ to } 3 \text{ sf } \text{ or } \frac{571}{450} \text{ or } 1\frac{121}{450} & \text{awrt1.27 A1} \\ & (5) \end{aligned} $ $ \begin{aligned} & (b) & F(x_{0}) = \int_{0}^{v_{0}} \frac{1}{3} d x = \frac{1}{3} x_{0} \text{ for } 0 \le x < 1 & \text{variable upper limit on } \int f(x) d x, \frac{1}{3} x_{0} \text{ MIA1} \\ & F(x_{0}) = \frac{1}{3} + \int_{1}^{v_{0}} \frac{8 x^{3}}{4s} d x \text{ for } 1 \le x \le 2 & \text{their fraction } + v.u.l \text{ on } \int f(x) d x \And d c \text{ terms } MI \\ & = \frac{1}{3} + \left[\frac{8 x^{4}}{180} \right]_{1}^{v} & \frac{8 x^{4}}{180} & A1 \\ & = \frac{1}{4s} (2x_{0}^{4} + 13) & A1 \\ & 0 & x < 0 \\ & F(x) = & \frac{1}{3} x & 0 \le x < 1 \\ & 1 & x > 2 \\ & 1 & x > 2 \end{aligned} $ $ \end{aligned} $ $ \begin{aligned} & (c) & F(m) = 0.5 \\ & F(m) = 0.5 \\ & H(a) = \frac{1}{2} \\ & m^{4} = 4.75 \\ & m = 1.48 \text{ to } 3sf & avrt1.4\mathsf{8 \ A1 \\ & m^{4} = A.75 \\ & m = 1.48 \text{ to } 3sf & avrt1.4\mathsf{8 \ A1 \\ & man \\ & M \end{aligned} $ | Qn no. | | Scheme | | Ма | rks | |
|--|--------|---|--|-------------------|---|------------|-----|
| (b) (b) $F(x_{0}) = \int_{0}^{x_{0}} \frac{1}{3} dx = \frac{1}{3} x_{0} \text{ for } 0 \le x < 1 \qquad \text{variable upper limit on} \qquad \int f(x) dx, \ \frac{1}{3} x_{0} \text{ MIA1} \qquad (5)$ $F(x_{0}) = \int_{0}^{x_{0}} \frac{1}{3} dx = \frac{1}{3} x_{0} \text{ for } 0 \le x < 1 \qquad \text{variable upper limit on} \qquad \int f(x) dx, \ \frac{1}{3} x_{0} \text{ MIA1} \qquad (5)$ $F(x_{0}) = \int_{0}^{x_{0}} \frac{1}{3} dx = \frac{1}{3} x_{0} \text{ for } 0 \le x < 1 \qquad \text{variable upper limit on} \qquad \int f(x) dx, \ \frac{1}{3} x_{0} \text{ MIA1} \qquad (5)$ $F(x_{0}) = \int_{0}^{x_{0}} \frac{1}{3} dx = \frac{1}{3} x_{0} \text{ for } 1 \le x \le 2 \qquad \text{their fraction + v.u.l on} \qquad \int f(x) dx \& 2 \text{ terms } \text{M1} \qquad = \frac{1}{4} + \int_{1}^{x_{0}} \frac{8x^{4}}{180} dx \text{for } 1 \le x \le 2 \qquad \text{their fraction + v.u.l on} \qquad \int f(x) dx \& 2 \text{ terms } \text{M1} \qquad = \frac{1}{4} + \int_{1}^{x_{0}} \frac{8x^{4}}{180} dx \text{for } 1 \le x \le 2 \qquad \text{their fraction + v.u.l on} \qquad \int f(x) dx \& 2 \text{ terms } \text{M1} \qquad = \frac{1}{4} + \int_{1}^{x_{0}} \frac{8x^{4}}{180} dx \text{for } 1 \le x \le 2 \qquad \text{their fraction + v.u.l on} \qquad \int f(x) dx \& 2 \text{ terms } \text{M1} \qquad = \frac{1}{4} + \int_{1}^{x_{0}} (2x^{4} + 13) \qquad \text{for } 1 \le x \le 2 \qquad \text{middle pair, ends } \text{B1,B1} \qquad = \frac{1}{45} (2x^{4} + 13) \qquad 1 \le x \le 2 \qquad \text{their function=0.5 } \text{M1A1ft} \qquad m^{4} = 4.75 \qquad \text{modelian } \text{B1} \qquad \text{for } 1.48 \text{ to } 3 \text{ sf} \qquad \text{awrt1.48 } \text{A1} \qquad \text{(3)}$ | 7(a) | $E(X) = \int_0^1 \frac{1}{3} x dx + \int_1^2 \frac{8x^4}{45} dx$ | | $\int x f(x)$ | (x)dx, 2 terms added | M1M1 | |
| (b) $F(x_{0}) = \int_{0}^{x_{0}} \frac{1}{3} dx = \frac{1}{3} x_{0} \text{ for } 0 \le x < 1 \qquad \text{variable upper limit on} \qquad \int f(x) dx, \frac{1}{3} x_{0} \text{ M1A1}$ $F(x_{0}) = \frac{1}{3} + \int_{1}^{x_{0}} \frac{8x^{3}}{45} dx \text{for } 1 \le x \le 2 \qquad \text{their fraction + v.u.l on} \qquad \int f(x) dx \& 2 \text{ terms} \text{M1}$ $= \frac{1}{3} + \left[\frac{8x^{4}}{180}\right]_{1}^{x_{0}} \qquad \text{A1}$ $= \frac{1}{45} \left(2x_{0}^{4} + 13\right) \qquad \text{A1}$ $\frac{0 \qquad x < 0}{F(x) = \qquad \frac{1}{3}x \qquad 0 \le x < 1} \qquad \text{middle pair, ends} \text{B1,B1}$ $= \frac{1}{45} \left(2x^{4} + 13\right) = \frac{1}{2} \qquad \text{Their function=0.5} \text{M1A1ft}$ $m^{4} = 4.75 \qquad \text{middle pair, ends} \text{A1}$ $(d) \qquad \text{mean < median} \qquad \text{B1}$ (5) | | $= \left[\frac{1}{6}x^{2}\right]_{0}^{1} + \left[\frac{8x^{5}}{225}\right]_{1}^{2}$ | | | Expressions, limits | A1A1 | |
| (b) $F(x_{0}) = \int_{0}^{x_{0}} \frac{1}{3} dx = \frac{1}{3} x_{0} \text{ for } 0 \le x < 1 \qquad \text{variable upper limit on} \qquad \int f(x) dx, \frac{1}{3} x_{0} \text{ M1A1}$ $F(x_{0}) = \frac{1}{3} + \int_{1}^{x_{0}} \frac{8x^{3}}{45} dx \text{for } 1 \le x \le 2 \qquad \text{their fraction + v.u.l on} \qquad \int f(x) dx \& 2 \text{ terms} \text{M1}$ $= \frac{1}{3} + \left[\frac{8x^{4}}{180}\right]_{1}^{x_{0}} \qquad $ | | $= 1.26\dot{8} = 1.27$ to 3 sf | or $\frac{571}{450}$ or $1\frac{121}{450}$ | | awrt1.27 | A1 | |
| (c) $ \begin{array}{ccccccccccccccccccccccccccccccccccc$ | (b) | $F(x_0) = \int_0^{x_0} \frac{1}{3} dx = \frac{1}{3} x_0 \text{ for } 0 \le$ | x < 1 variab | ole upper limit o | $\int f(x) dx, \frac{1}{3}x_0$ | M1A1 | (5) |
| (c) $F(x) = \frac{1}{45} (2x^{4} + 13)$ $0 	 x < 0$ $F(x) = \frac{1}{3} x 	 0 \le x < 1$ $\frac{1}{45} (2x^{4} + 13) 	 1 \le x \le 2$ $1 	 x > 2$ (7) $F(m) = 0.5$ $\frac{1}{45} (2x^{4} + 13) = \frac{1}{2}$ $m^{4} = 4.75$ $m = 1.48 	 to 3 	 sf$ $mean (3)$ | | $F(x_0) = \frac{1}{3} + \int_1^{x_0} \frac{8x^3}{45} dx \text{ for } 1 \le$ | $x \le 2$ their fraction | on + v.u.l on | $\int f(x) dx \& 2 \text{ terms}$ | M1 | |
| (c) $F(x) = \begin{pmatrix} 0 & x < 0 \\ F(x) = \frac{1}{3}x & 0 \le x < 1 \\ \frac{1}{45}(2x^4 + 13) & 1 \le x \le 2 \\ 1 & x > 2 \end{pmatrix}$ middle pair, ends B1,B1 (c) $F(m) = 0.5$ $\frac{1}{45}(2x^4 + 13) = \frac{1}{2}$ $m^4 = 4.75$ m = 1.48 to 3 sf (d) mean < median B1 (3) | | $=\frac{1}{3}+\left[\frac{8x^4}{180}\right]_{1}^{x_0}$ | | | $\frac{8x^4}{180}$ | A1 | |
| (c) $F(x) = \frac{1}{3}x \qquad 0 \le x < 1$ $\frac{1}{45}(2x^{4} + 13) \qquad 1 \le x \le 2$ $1 \qquad x > 2$ (7) F(m) = 0.5 $\frac{1}{45}(2x^{4} + 13) = \frac{1}{2}$ $m^{4} = 4.75$ m = 1.48 to 3 sf (d) mean <median $F(x) = \frac{1}{3}x \qquad 0 \le x < 1$ $1 \le x \le 2$ Their function=0.5 M1A1ft awrt1.48 A1 (3)</median | | $=\frac{1}{45}(2x_0^4+13)$ | | | | A1 | |
| (c) $F(m) = 0.5$ $\frac{1}{45}(2x^{4} + 13)$ $1 \le x \le 2$ (7) $F(m) = 0.5$ $\frac{1}{45}(2x^{4} + 13) = \frac{1}{2}$ $m^{4} = 4.75$ $m = 1.48 \text{ to } 3 \text{ sf}$ (d) mean <median <math="" display="block">B1 (3)</median> | | | | <i>x</i> < 0 | | | |
| (c) $\frac{1}{45}(2x^{4}+13) \qquad 1 \le x \le 2$ $1 \qquad x > 2$ (7) $F(m) = 0.5$ $\frac{1}{45}(2x^{4}+13) = \frac{1}{2}$ $m^{4} = 4.75$ $m = 1.48 \text{ to } 3 \text{ sf}$ (d) mean <median (3)="" (f)="" (f)<="" td=""><td></td><td>$\mathbf{F}(x) =$</td><td>$\frac{1}{3}x$</td><td>$0 \le x < 1$</td><td>middle pair, ends</td><td>B1,B1</td><td></td></median> | | $\mathbf{F}(x) =$ | $\frac{1}{3}x$ | $0 \le x < 1$ | middle pair, ends | B1,B1 | |
| (c) $F(m) = 0.5$ $\frac{1}{45}(2x^4 + 13) = \frac{1}{2}$ $m^4 = 4.75$ m = 1.48 to 3 sf (d) mean <median (7) Their function=0.5 M1A1ft awrt1.48 A1 (3) B1</median | | | $\frac{1}{45}(2x^4+13)$ | $1 \le x \le 2$ | The second se | , | |
| F(m) = 0.5 $\frac{1}{45}(2x^{4}+13) = \frac{1}{2}$ Their function=0.5 M1A1ft $m^{4} = 4.75$ m = 1.48 to 3 sf awrt1.48 A1 (3) B1 | (c) | | 1 | <i>x</i> > 2 | | | (7) |
| $m = 1.48 \text{ to } 3 \text{ sf} \qquad \text{awrt } 1.48 \text{ A1} $ (3) (d) mean <median b1<="" td=""><td></td><td>$\frac{1}{45} (2x^4 + 13) = \frac{1}{2}$</td><td></td><td></td><td>Their function=0.5</td><td>M1A1ft</td><td></td></median> | | $\frac{1}{45} (2x^4 + 13) = \frac{1}{2}$ | | | Their function=0.5 | M1A1ft | |
| (d) mean <median b1<="" td=""><td></td><td></td><td></td><td></td><td>awrt1.48</td><td>A1</td><td>(3)</td></median> | | | | | awrt1.48 | A1 | (3) |
| Negative Skew dep B1 | (d) | mean <median Negative Skew</median | | | dep | | |
| (2) (Total 17 marks) | | | | | Γ) | otal 17 ma | |