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Mark Scheme (Results)
January 2009

GCE

GCE Mathematics (6684/01)

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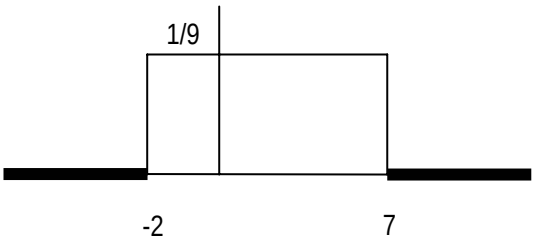
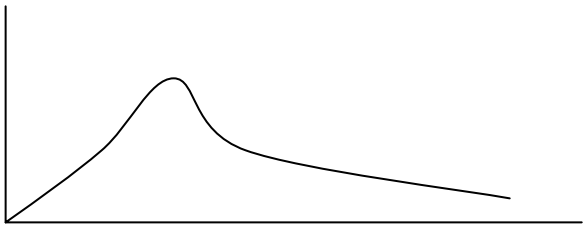
6684 Statistics S2
Mark Scheme

Question Number	Scheme	Marks
1	The random variable X is the number of daisies in a square. Poisson(3)	B1
(a)	$1 - P(X \leq 2) = 1 - 0.4232$ $\quad 1 - e^{-3}(1 + 3 + \frac{3^2}{2!})$ $= 0.5768$	M1 A1 (3)
(b)	$P(X \leq 6) - P(X \leq 4) = 0.9665 - 0.8153$ $\quad e^{-3}\left(\frac{3^5}{5!} + \frac{3^6}{6!}\right)$ $= 0.1512$	M1 A1 (2)
(c)	$\mu = 3.69$ Var $(X) = \frac{1386}{80} - \left(\frac{295}{80}\right)^2$ $= 3.73/3.72/3.71$ accept $s^2 = 3.77$	B1 M1 A1 (3)
(d)	For a Poisson model , Mean = Variance ; For these data $3.69 \approx 3.73$ $\Rightarrow$ Poisson model	B1 (1)
(e)	$\frac{e^{-3.6875}3.6875^4}{4!} = 0.193$ allow their mean or var Awrt 0.193 or 0.194	M1 A1 ft (2)

Question Number		Scheme	Marks
2	(a)	$f(x) = \begin{cases} \frac{1}{9} & -2 \le x \le 7 \\ 0 & otherwise \end{cases}$	B1 B1 (2)
	(b)		B1 B1 (2)
	(c)	E(X) = 2.5 Var (X) = $\frac{1}{12}(7+2)^2$ or 6.75 both	B1
		E (X^2) = Var (X) + E(X)^2	M1
		= 6.75 + 2.5^2 = 13	A1
		alternative	(3)
		$\int_{-2}^{7} x^2 f(x)dx = \left[\frac{x^3}{27}\right]_{-2}^{7}$ $\int$ x^2"f(x)" attempt to integrate and use limits of -2 and 7	B1 M1
		= 13	A1
	(d)	P(-0.2 < X < 0.6) = $\frac{1}{9} \times 0.8$	M1
		= $\frac{4}{45}$ or 0.0889 0r equiv awrt 0.089	A1 (2)

Question Number		Scheme	Marks
3	(a)	$X \sim B(20, 0.3)$	M1
		P $(X \leq 2) = 0.0355$	
		$P(X \geq 11) = 1 - 0.9829 = 0.0171$	
		Critical region is $(X \leq 2) \cup (X \geq 11)$	A1 A1 (3)
	(b)	Significance level = 0.0355 + 0.0171, = 0.0526 or 5.26%	M1 A1 (2)
	(c)	Insufficient evidence to reject H_0 **Or** sufficient evidence to accept H_0 /not significant	B1 ft
		$x = 3$ (or the value) is not in the critical region or 0.1071> 0.025	B1 ft (2)
		Do not allow inconsistent comments	

Question Number		Scheme	Marks
4	(a)	$\int_0^{10} kt\,dt = 1$ or Area of triangle = 1	M1
		$\left[\frac{kt^2}{2}\right]_0^{10} = 1$ or 10 x0.5 x 10k =1 or linear equation in k	M1
		$50k = 1$	
		$k = \frac{1}{50}$ cso	A1
			(3)
	(b)	$\int_6^{10} kt\,dt = \left[\frac{kt^2}{2}\right]_6^{10}$	M1
		$= \frac{16}{25}$	A1
			(2)
	(c)	$E(T) = \int_0^{10} kt^2\,dt = \left[\frac{kt^3}{3}\right]_0^{10}$	M1
		$= 6\frac{2}{3}$	A1
		$\text{Var}(T) = \int_0^{10} kt^3\,dt - \left(6\frac{2}{3}\right)^2 = \left[\frac{kt^4}{4}\right]_0^{10}; -\left(6\frac{2}{3}\right)^2$	M1;M1dep
		$= 50 - \left(6\frac{2}{3}\right)^2$	
		$= 5\frac{5}{9}$	A1
			(5)
	(d)	10	B1
			(1)
	(e)		B1
			(1)

Question Number		Scheme	Marks
5	(a)	X represents the number of defective components.	
		$P(X = 1) = (0.99)^9 (0.01) \times 10 = 0.0914$	M1A1 (2)
	(b)	$P(X \geq 2) = 1 - P(X \leq 1)$ $= 1 - (p)^{10} - (a)$ $= 0.0043$	M1 A1√ A1 (3)
	(c)	$X \sim Po(2.5)$	B1B1
		$P(1 \leq X \leq 4) = P(X \leq 4) - P(X = 0)$ $= 0.8912 - 0.0821$ $= 0.809$	M1 A1 (4)
		Normal distribution used. B1for mean only	
		Special case for parts a and b If they use 0.1 do not treat as misread as it makes it easier. (a) M1 A0 if they have 0.3874 (b) M1 A1ft A0 they will get 0.2639 (c) Could get B1 B0 M1 A0	
		For any other values of p which are in the table do not use misread. Check using the tables. They could get (a) M1 A0 (b) M1 A1ft A0 (c) B1 B0 M1 A0	

Question Number	Scheme	Marks
6 (a)(i)	$H_0 : \lambda = 7$ $H_1 : \lambda > 7$	B1
	X = number of visits. $X \sim$ Po(7)	B1
	P ($X \geq 10$) = 1 - P($X \leq 9$) = 0.1695 1 - P($X \leq 10$) = 0.0985 1 - P($X \leq 9$) = 0.1695 CR $X \geq 11$	M1 A1
	0.1695 > 0.10 , CR $X \geq 11$ Not significant or it is not in the critical region or do not reject H_0 The rate of visits on a Saturday is not greater/ is unchanged	M1 A1 no ft
(ii)	$X = 11$	B1 (7)
(b)	(The visits occur) randomly/ independently or singly or constant rate	B1 (1)
(c)	[$H_0 : \lambda = 7$ $H_1 : \lambda > 7$ (or $H_0 : \lambda = 14$ $H_1 : \lambda > 14$)]	
	$X \sim$N;(14,14)	B1;B1
	P (X $\geq$ 20) = P $\left(z \geq \frac{19.5-14}{\sqrt{14}} \right)$ = P (z $\geq$ 1.47) = 0.0708 or z = 1.2816	+/- 0.5, stand M1 M1 A1dep both M
	0.0708 < 0.10 therefore significant. The rate of visits is greater on a Saturday	A1dep 2nd M (6)

Question Number	Scheme	Marks
7 (a)	$F(x_0) = \int_1^x -\frac{2}{9}x + \frac{8}{9}\,dx = \left[-\frac{1}{9}x^2 + \frac{8}{9}x\right]_1^x$ $= \left[-\frac{1}{9}x^2 + \frac{8}{9}x\right] - \left[-\frac{1}{9} + \frac{8}{9}\right]$ $= -\frac{1}{9}x^2 + \frac{8}{9}x - \frac{7}{9}$	M1A1 A1 (3)
(b)	$F(x) = \begin{cases} 0 & x < 1 \\ -\frac{1}{9}x^2 + \frac{8}{9}x - \frac{7}{9} & 1 \le x \le 4 \\ 1 & x > 4 \end{cases}$	B1B1√ (2)
(c)	$F(x) = 0.75$; or $F(2.5) = -\frac{1}{9}\times 2.5^2 + \frac{8}{9}\times 2.5 - \frac{7}{9}$ $-\frac{1}{9}x^2 + \frac{8}{9}x - \frac{7}{9} = 0.75$ $4x^2 - 32^x + 55 = 0$ $-x^2 + 8x - 13.75 = 0$ $x = 2.5$ $= 0.75$ cso and $F(x) = 0.25$ $-\frac{1}{9}x^2 + \frac{8}{9}x - \frac{7}{9} = 0.25$ $-x^2 + 8x - 7 = 2.25$ $-x^2 + 8x - 9.25 = 0$ quadratic 3 terms =0 $x = \frac{-8 \pm \sqrt{8^2 - 4\times -1 \times -9.25}}{2 \times -1}$ $x = 1.40$	M1; A1 M1 M1 dep M1 dep A1 (6)
(d)	$Q_3 - Q_2 > Q_2 - Q_1$ Or mode = 1 and mode < median Or mean = 2 and median < mode Sketch of pdf here or be referred to if in a different part of the question Box plot with Q_1, Q_2, Q_3 values marked on Positive skew	M1 A1 (2)