Edexcel GCE

Mathematics

Statistics S2 6684

Summer 2005

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Final Mark Scheme

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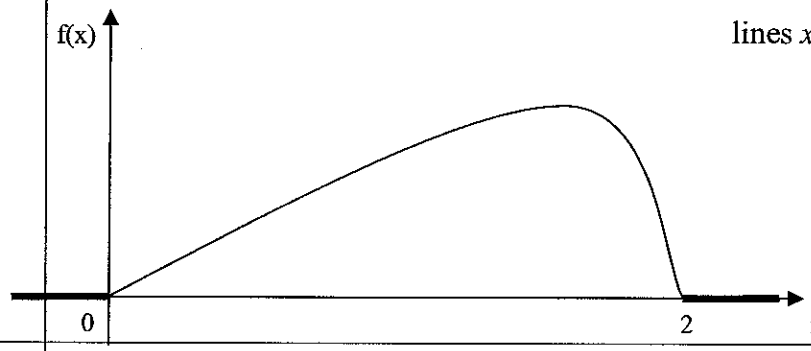
June 2005
6684 Statistics S2
Mark Scheme

Question Number	Scheme		Marks
1(a)	$X \sim B(n, 0.04)$	Implied	B1
	$E(X) = np$		M1
		Use of $np = 5$	
	$5 = 0.04n$		
	$n = 125$	125	A1
			(3)
(b)	$E(X) = 3$		
	$np = 3$	$np = 3$	B1
	$sd = \sqrt{npq} = \sqrt{3(1-0.04)}$	Use of npq	M1
	$= \sqrt{2.88}$	$\sqrt{3(1-0.04)}$	A1
	$= 1.70$	awrt 1.70	A1
			(4)
			Total 7
2(a)	$f(x) = \frac{1}{4}$, $2 \le x \le 6$	$\frac{1}{4}$ and range	B1
	$= 0$, otherwise	0 and range	B1
			(2)
(b)	$E(X) = 4$ by symmetry or formula	4	B1
			(1)
(c)	$Var(X) = \frac{(6-2)^2}{12}$	Use of formula	M1
	$= \frac{4}{3}$	$1.\dot{3}$ or $1\frac{1}{3}$ or $\frac{4}{3}$ or 1.33	A1
			(2)
(d)	$F(x) = \int_2^x \frac{1}{4}\,dt = \left[\frac{1}{4}t\right]_2^x$	Use of $\int f(x)\,dx$	M1
	$= \frac{1}{4}(x-2)$	$\frac{1}{4}(x-2)$ or equiv.	A1
	$F(x) = \frac{1}{4}(x-2)$, $2 \le x \le 6$	$\frac{1}{4}(x-2)$ and range	B1ft
	$= 1$, $x > 6$	ends and ranges	B1
	$= 0$, $x < 2$		
			(4)
(e)	$P(2.3 < X < 3.4) = \frac{1}{4}(3.4-2.3)$	Use of area or F(x)	M1
	$= 0.275$		
		0.275 or $\frac{11}{40}$	A1
			(2)
			Total 11

Question Number	Scheme		Marks
3(a)	Misprints are random / independent, occur singly in space and at a constant rate	Context, any 2	B1, B1 (2)
(b)	$P(X = 0) = e^{-2.5}$ $= 0.08208\ldots\ldots = 0.0821$	Po (2.5) 0.0821	M1 A1 (2)
(c)	$Y \sim Po(5)$ for 2 pages $P(Y > 7) = 1 - P(X \leq 7)$ $= 1 - 0.8666 = 0.1334$	Implied Use of 1 – and correct inequality 0.1334	B1 M1 A1 (3)
(d)	For 20 pages, $Y \sim P_o(50)$ $Y \sim N(50, 50)$ approx	$P_o(50)$ N(50, 50)	B1 B1
	$P(Y < 40) = P(Y \leq 39.5)$ $= P\left(Z \leq \frac{39.5 - 50}{\sqrt{50}}\right)$	cc ± 0.5 standardise above all correct	M1 M1 A1
	$= P(Z \leq -1.4849)$ $= 1 - 0.93 = 0.07$	awrt – 1.48 0.07	A1 A1 (7)
			Total 14
4(a)	Individual member or element of the population or sampling frame		B1 (1)
(b)	A list of all sampling units or all the population		B1 (1)
(c)	All possible samples are chosen from a population; the values of a statistic and the associated probabilities is a sampling distribution		B1 B1 (2)
			Total 4

Question Number	Scheme		Marks
5(a)	$X \sim B(200, 0.02)$ n large, P small so $X \sim Po(np) = Po(4)$	Implied conditions, $P_0(4)$	B1 B1, B1
	$P(X = 5) = \dfrac{e^{-4}4^5}{5!}$ $= 0.1563$	$P(X \le 5) - P(X \le 4)$ 0.1563	M1 A1 (5)
(b)	$P(X < 5) = P(X \le 4)$ $= 0.6288$	$P(X \le 4)$ 0.6288	M1 A1 (2) **Total 7**
6(a)	$\int_0^2 k(4x - x^3)\,dx = 1$	$\int f(x)dx = 1$, all correct	M1 A1
	$k\left[2x^2 - \frac{1}{4}x^4\right]_0^2 = 1$	[*]	A1
	$k(8 - 4) = 1$	cso	A1
	$k = \dfrac{1}{4}$		(4)
(b)	$E(X) = \int_0^2 x.\frac{1}{4}(4x - x^3)\,dx$	$\int xf(x)dx$	M1
	$= \left[\frac{1}{3}x^3 - \frac{1}{20}x^5\right]_0^2$	[*]	A1
	$= \dfrac{16}{15}$	1.07 or $1\frac{1}{15}$ or $\frac{16}{15}$ or $1.0\dot{6}$	A1 (3)
(c)	At mode, $f'(x) = 0$	Implied	M1
	$4 - 3x^2 = 0$	Attempt to differentiate	M1
	$x = \dfrac{2}{\sqrt{3}}$	$\sqrt{\frac{4}{3}}$ or 1.15 or $\frac{2}{\sqrt{3}}$ or $\frac{2\sqrt{3}}{3}$	A1 (3)
(d)	At median, $\int_0^x \frac{1}{4}(4t - t^3)\,dt = \frac{1}{2}$	$F(x) = \frac{1}{2}$ or $\int f(x)dx = \frac{1}{2}$	M1
	$\frac{1}{4}\left(2x^2 - \frac{1}{4}x^4\right) = \frac{1}{2}$	Attempt to integrate	M1
	$x^4 - 8x^2 + 8 = 0$		
	$x^2 = 4 \pm 2\sqrt{2}$	Attempt to solve quadratic	M1
	$x = 1.08$	Awrt 1.08	A1 (4)

(e)	mean (1.07) < median (1.08) < mode (1.15) ⇒ negative skew	any pair cao	M1 A1 (2)
(f)	 	lines $x<0$ and $x>2$, labels, 0 and 2 negative skew between 0 and 2	B1 B1 (2) **Total 18**
7 (a)	X ~ B(10, p)	Binomial (10, 0.75)	B1, B1 (2)
(b)	P(X = 6) = 0.9219 – 0.7759 = 0.1460	P(X≤6) – P(X≤5) 0.1460	M1 A1 (2)
(c)	H_0: $p = 0.75$ (or $p = 0.25$) H_1 : $p < 0.75$ (or $p > 0.25$) Under H_0 , X ~ B(20, 0.75) (or Y ~ B(20,0.25)) P($X \leq 13$) = 1 – 0.7858 = 0.2142 (or P($Y \geq 7$)) Insufficient evidence to reject H_0 as 0.2412 > 0.05 Doctor's belief is not supported by the sample *(OR CR P($X \leq 12$) = 1 – 0.8982 = 0.1018* *(or P($Y \geq 8$))* *P($X \leq 11$) = 1 – 0.9591 = 0.0409* *(or P($Y \geq 9$))* *13 outside critical region* *(or 7))*	Correct H_0 One tailed H_1 Implied P($X \leq 13$) and 1 - , 0.2142 Context *either*	B1 B1 B1 M1, A1 A1 (6) *(M1 A1)*
(d)	P($X \leq$ c) ≤ 0.01 for p=0.75 (or P($Y \geq$ 20-c) ≤ 0.01 for p=0.25) P($X \leq 9$) = 1 – 0.9961 = 0.0039 (or P($Y \geq 11$) P($X \leq 10$) = 1 – 0.9861 = 0.0139 (or P($Y \geq 10$) C. R. is [0,9], so greatest no. of patients is 9.	 0.9961 or 0.9981 9	M1 A1 B1 B1 (4) **Total 14**