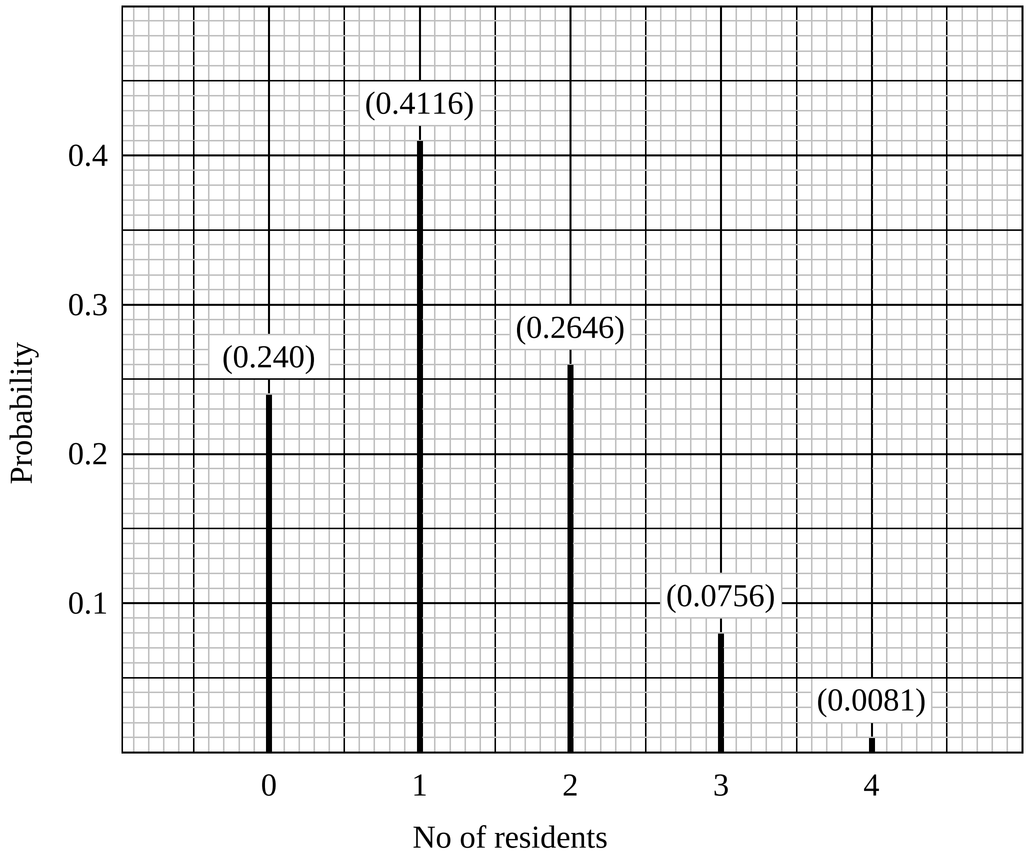
EDEXCEL STATISTICS S2 (6684) – JUNE 2003 PROVISIONAL MARK SCHEME

Question number	Mark scheme	Marks
1. (*a*)	A random variable; that is, a function involving no unknown quantities	B1; B1 (2)
(*b*)	If all possible samples are taken; then their values will form a probability distribution called the sampling distribution	B1; B1 (2)
		(4 marks)
2. (*a*)	λ is large or $\lambda > 10$	B1 (1)
(*b*)	$Y \sim \text{N}(30, 30)$ may be implied	B1
	$\text{P}(Y > 28) = 1 - \text{P}(Y \le 28.5)$	M1 A1
	$= 1 - \text{P}\left(Z \le \frac{28.5 - 30}{\sqrt{30}}\right)$	M1 A1
	$= 1 - \text{P}(Z \le -0.273)$	
	$= 0.607$	A1 (6)
		(7 marks)

(ft = follow through mark; (*) indicates final line is given on the paper)

Question number	Mark scheme	Marks
3. (*a*)	$X \sim B(4, 0.3)$	B1 B1 (2)
(*b*)		
	All probabilities correct	B1
	Scales and labels	B1
	Correct diagram	B1 (3)
(*c*)	1 resident	B1 (1)
(*d*)	$E(X) = np = 1.2$	B1
	$\text{Var}(X) = np(1 - p)$	
	$= 4 \times 0.3 \times 0.7$	M1
	$= 0.84$	A1 (3)
		(9 marks)

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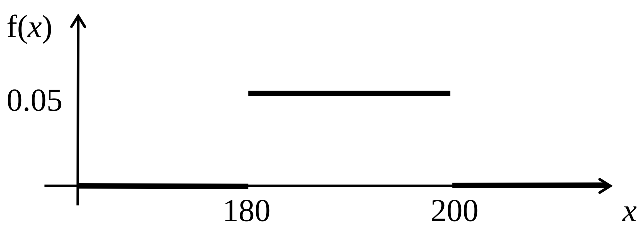
4. (*a*)	*Fixed number* of *independent* trials		B1 B1	
	2 outcomes		B1	
	Probability of success *constant*		B1	(4)
(*b*)	$P(X = 5) = \frac{2}{7}$; $P(X \neq 5) = \frac{5}{7}$	may be implied	B1; B1 ft	
	$P(5 \text{ on sixth throw}) = \left(\frac{5}{7}\right)^2 \times \left(\frac{2}{7}\right)$	$p^n(1-p)$	M1 A1 ft	
	$= 0.0531$		A1	(5)
(*c*)	$P(\text{exactly 3 fives in first eight throws}) = \binom{8}{3}\left(\frac{2}{7}\right)^3\left(\frac{5}{7}\right)^3$	use of ${}^nC_r$ needed	M1 A1 ft	
	$= 0.243$		A1	(3)
				(12 marks)
5. (*a*)	$f(x) = \begin{cases} 0.05 & 180 \le x \le 200 \\ 0 & \text{otherwise} \end{cases}$		B1 B1	
		labels	B1	
		3 parts	B1	(4)
(*b*)(i)	$P(X \le 183) = 3 \times 0.05$		M1	
	$= 0.15$		A1	
(ii)	$P(X = 183) = 0$		B1	(3)
(*c*)	IQR = 10		B1	(1)
(*d*)	$0.05(200 - x)$; $= 0.05(x - 180) \times 2$		M1; A1	
	$200 - x = 2x - 360$			
	$x = 186\frac{2}{3}$		A1	(3)
(*e*)	$\frac{1}{3}$ of all cups of lemonade dispensed contains $186\frac{2}{3}$ ml or less		B1 B1 ft	(2)
	(or $\frac{2}{3}$ of all cups of lemonade dispensed contains $186\frac{2}{3}$ ml or more)			
				(13 marks)

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Question number	Mark scheme	Marks
6. (*a*)	Po(1)	B1 B1
	Each patient seen singly *or* patients with disease seen randomly *or* seen constant rate of once per week *or* each patient assumed independent of the next	B1 (3)
(*b*)	$X \sim \text{Po}(4)$ may be implied	B1
	$P(X > 3) = 1 - P(X \leq 3)$	M1
	$= 1 - 0.4335$	A1
	$= 0.5665$	A1 (4)
(*c*)	$H_0: \lambda = 6$	B1
	$H_1: \lambda < 6$	B1
	$P(X \leq 2) = 0.0620$ $\alpha = 0.05 \Rightarrow$ critical region $X \leq 1$	M1 A1
	$0.0620 > 0.05$ 2 not in critical region	M1
	The number of patients with the disease seen by the doctor has not been reduced	A1 (6)
(*d*)	This does not support the model as the disease will occur in outbreaks; the patients seen by the doctor are unlikely to be independent of each other/don't occur singly	B1; B1 (2)
		(15 marks)

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7. (*a*)	$\int_{-1}^{0} k(x^2+2x+1)\ \ \mathrm{d}x = 1$	limits needed and =1	M1	
	$\left[k\left(\frac{x^3}{3}+x^2+x\right)\right]_{-1}^{0} = 1$	attempt at integration	M1 A1	
	$k = 3$ (*)		A1	(4)
(*b*)	$\mathrm{E}(X) = \int_{-1}^{0} x.\mathrm{f}(x)\ \ \mathrm{d}x$		M1	
	$= \int_{-1}^{0} (3x^3+6x^2+3x)\ \ \mathrm{d}x$	limits needed	A1	
	$= \left[\frac{3x^4}{4}+2x^3+\frac{3x^2}{2}\right]_{-1}^{0}$	integration and substituting limits	M1	
	$= -\frac{1}{4}$		A1	(4)
(*c*)	$\int_{-1}^{x_0} (3x^3+6x^2+3x)\ \ \mathrm{d}x = \left[x^3+3x^2+3x\right]_{-1}^{x_0}$		M1	
	$= x_0 + 3x_0^2 + 3x_0 + 1$		A1	
	$\mathrm{F}(x) = \begin{cases} 0 & x < -1 \\ x^3+3x^2+3x+1 & -1 \le x \le 0 \\ 1 & x > 0 \end{cases}$		B1 B1	(4)
(*d*)	$\mathrm{P}(-0.3 < X < 0.3) = \mathrm{F}(0.3) - \mathrm{F}(-0.3)$		M1	
	$= 1 - 0.343$		A1	
	$= 0.657$		A1	(3)
				(15 marks)

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