EDEXCEL STATISTICS S2 **JANUARY 2003 PROVISIONAL MARK SCHEME**

Question Number		Scheme	Marks
1.	(*a*)	Continuous uniform (Rectangular) U(–0.5, 0.5)	B1 B1 (2)
	(*b*)	P(error within 0. 2 cm) = $2 \times 0.2 = 0.4$	M1 A1 (2)
	(*c*)	P(both within 2 cm) = $0.4^2 = 0.16$	M1 A1 (2)
			(6 marks)
2.	(*a*)	$X \sim$ Po(7)	B1
		P($X \leq 2$) = 0.0296	B1
		P($X \geq 13$) = 1 – 0.9370 = 0.0270	M1 A1
		Critical region is ($X \leq 2$) $\cup$ ($X \geq 13$)	A1 (5)
	(*b*)	Significance level = 0.0296 + 0.0270 = 0.0566	B1 (1)
	(*c*)	$x = 5$ is not the critical region $\Rightarrow$ insufficient evidence to reject H_0	M1 A1 (2)
			(8 marks)
3.	(*a*)	Weeds grow independently, singly, randomly and at a constant rate (weeds/m^2) any 2	B1 B1 (2)
	(*b*)	Let X represent the number of weeds/m^2	
		$X \sim$ Po(0.7), so in 4 m^2, $\lambda = 4 \times 0.7 = 2.8$	B1
		P($Y < 3$) = P($Y = 0$) + P($Y = 1$) + P($Y = 2$)	M1
		$= e^{-2.8}\left(1 + 2.8 + \frac{2.8^2}{2}\right)$	A1
		= 0.46945	A1 (4)
	(*c*)	Let X represent the number of weeds per 100 m^2	
		$X \sim$ Po($100 \times 0.7 = 70$)	B1
		P($X > 66$) $\approx$ P($Y > 66.5$) where $Y \sim$ N(70, 70)	M1 M1 A1
		$\approx P\left(Z > \frac{66.5 - 70}{\sqrt{70}}\right)$	M1
		$\approx$ P($Z > –0.41833\ldots$) = 0.6628	A1 (6)
			(12 marks)

Question Number		Scheme	Marks
4.	(*a*)	$P(X > 0.7) = 1 - F(0.7) = 0.4267$	M1 A1 (2)
	(*b*)	$f(x) = \frac{d}{dx}F(x) = \frac{4}{3} \times 2x - \frac{4x^2}{3}$	M1
		$= \frac{4x}{3}(2 - x^2)$ for $0 \le x \le 1$	A1 (2)
	(*c*)	$E(X) = \int_0^1 \frac{4}{3}(2x^2 - x^4)\,dx = \left[\frac{4}{3}\left(\frac{2x^3}{3} - \frac{x^5}{5}\right)\right]_0^1$	M1 A1
		$= \frac{28}{45} = 0.622$	A1
		$\text{Var}(X) = \int_0^1 \frac{4}{3}(2x^3 - x^5)\,dx - \left(\frac{28}{45}\right)^2$	M1
		$= \left[\frac{4}{3}\left(\frac{2x^4}{4} - \frac{x^6}{6}\right)\right]_0^1 - \left(\frac{28}{45}\right)^2$	A1
		$= \frac{116}{2025} = 0.05728$	A1 (6)
	(*d*)	$f(x) = \frac{4}{3}(2 - 3x^2) = 0$	M1
		$\Rightarrow \text{mode} = \sqrt{\frac{2}{3}} = 0.816496$	A1
		$\text{skewness} = \frac{\frac{28}{45} - \sqrt{\frac{2}{3}}}{\sqrt{\frac{116}{2025}}} = -0.81170$	M1 A1 (4)
			(14 marks)

Question Number	Scheme	Marks
5. (*a*)	Let X represent the number of double yolks in a box of eggs	B1
	$\therefore X \sim \text{B}(12, 0.05)$	B1
	$\text{P}(X = 1) = \text{P}(X \leq 1) - \text{P}(X \leq 0) = 0.8816 - 0.5404 = 0.3412$	M1 A1 (3)
(*b*)	$\text{P}(X > 3) = 1 - \text{P}(X \leq 3) = 1 - 0.9978 = 0.0022$	M1 A1 (2)
(*c*)	$\text{P}(\text{only } 2) = \text{C}_2^3 (0.3412)^2(0.6588)^2$	M1 A1
	$= 0.230087$	A1 (3)
(*d*)	Let X represent the number of double yolks in 10 dozen eggs	
	$\therefore X \sim \text{B}(120, 0.05) \Rightarrow X = \text{Po}(6)$	B1
	$\text{P}(X \geq 9) = 1 - \text{P}(X \leq 8) = 1 - 0.8472$	M1 A1
	$= 0.1528$	A1
(*e*)	Let X represent the weight of an egg $\therefore W \sim \text{N}(65, 2.4^2)$	M1
	$\text{P}(X > 68) = \text{P}\left(Z > \frac{68-65}{2.4}\right)$	A1
	$= \text{P}(Z > 1.25)$	A1
	$= 0.1056$	A1 (3)
		(15 marks)

Question Number	Scheme	Marks
6. (*a*)	All subscribers to the magazine	B1 (1)
(*b*)	A list of all members that had paid their subscriptions	B1 (1)
(*c*)	Members who have paid	B1 (1)
(*d*)	Advantage: total accuracy	B1
	Disadvantage: time consyming to obtain data and analyse it	B1 (2)
(*e*)	Let X represent the number agreeing to change the name	
	$\therefore X \sim \text{B}(25, 0.4)$	B1
	$\text{P}(X = 10) = \text{P}(X \le 10) - \text{P}(X \le 9) = 0.1612$	M1 A1 (3)
(*f*)	$\text{H}_0: p = 0.40$, $\text{H}_1: p < 0.40$	B1, B1
	$\text{P}(X \le 6) = 0.0736 > 0.05 \Rightarrow$ not significant	M1 A1
	No reason to reject H_0 and conclude % is less than the editor believes	A1 (5)
(*g*)	Let X represent the number agreeing to change the name $\therefore X \sim \text{B}(200, 0.4)$	
	$\text{P}(71 \le X < 83) \approx \text{P}(70.5 \le Y < 82.5)$ where $Y \sim \text{N}(80, 48)$	B1 B1
	$\approx \text{P}\left(\frac{70.5-80}{\sqrt{48}} \le X < \frac{82.5-80}{\sqrt{48}}\right)$	M1 M1
	$\approx \text{P}(-1.37 \le X < 0.36)$	A1 A1
	$= 0.5533$	A1 (7)
		(20 marks)