EDEXCEL STATISTICS S4 (6686) – JUNE 2003 PROVISIONAL MARK SCHEME

Question number	Scheme		Marks
1. (a)	$H_0 : \sigma_A^2 = \sigma_B^2,\ H_1 : \sigma_A^2 \neq \sigma_B^2$	both	B1
	critical values $F_{24,25} = 1.96$ and $\frac{1}{F_{24,25}} = 0.510$	both	B1
	$\frac{s_B^2}{s_A^2} = 2.10$ or $\frac{s_A^2}{s_B^2} = 0.476$	both	M1A1
	Since 2.10 or 0.476 are in the critical region we reject H_0 and conclude there is evidence that the two variances are different.		A1∫
			(5)
(b)	The populations of pebble lengths are normal.		B1
			(1)
			6
2.	$H_0 : \mu = 5.1,\ H_1 : \mu < 5.1$	both	B1
	$\nu = 9$	9	B1
	Critical Region t<-2.262		B1
	$\overline{x} = 4.91$	4.91	B1
	$s^2 = \frac{241.89 - 10 \times (4.91)^2}{9} = 0.0899$		M1
	$s = 0.300$	0.0899 or 0.300	A1
	$t = \frac{4.91 - 5.1}{\frac{0.3}{\sqrt{10}}} = -2.00$		M1A1
	There is no evidence to suggest that the mean height is less than those grown previously	context	A1∫
			(9)
			9

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Question number	Scheme		Marks	
3 (a)	1-0.8891=0.1109		B1	
				(1)
(b)	1-(P(0)+P(1)+P(2))		M1	
	$=1-((1-p)^{12}+12p(1-p)^{11}+66p^2(1-p)^{10})$		M1A1	
	$=1-(1-p)^{10}((1-p)^2+12p(1-p)+66p^2)$			
	$=1-(1-p)^{10}(1+10p+55p^2)$ ****given****	cso	A1	
				(4)
(c) (i)	1-0.5583=0.442		M1A1	
	1-0.00281=0.997		A1	
				(3)
(ii)	The test is more discriminating for the larger value of p		B1	
				(1)
			9	
4 (a)	$s^2=\dfrac{2962-15\times\left(\dfrac{208}{15}\right)^2}{14}=5.55$ or $(n-1)s^2=2962-\dfrac{208^2}{15}=77.3$	either	M1A1	
	$\dfrac{14\times5.55}{23.685}<\sigma^2<\dfrac{14\times5.55}{6.571}$	23.685,6.571	M1B1,B1	
	$3.28<\sigma^2<11.83$		A1A1	
				(7)
(b)	Since 9 lies in the interval, yes		B1,B1(dep)	
				(2)
			9	

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Question number	Scheme	Marks	
5 (a)(i)	Type I - H_0 rejected when it is true	B1	
(ii)	Type II - H_0 is accepted when it is false	B1	
			(2)
(b)	$H_0 : \lambda = 5,\ H_1 : \lambda > 5$ both	B1	
	$P(X \geq 7 \mid \lambda = 5) = 1 - 0.7622 = 0.2378$ >0.05	M1A1	
	(**OR** $P(X \geq 9) = 0.0681,\ P(X \geq 10) = 0.0318$, CV=10, 7 not in CR. probabs, 10	M1A1)	
	No evidence of an increase in the number of chicks reared per year. context	A1	
			(4)
(c)	$P(X \geq c \mid \lambda = 5) < 0.05$	M1	
	$P(X \geq 9) = 0.0681,\ P(X \geq 10) = 0.0318,\ c=10$ may be seen in (b)	M1	
	P(Type I Error)=0.0318	A1	
			(3)
(d)	$\lambda=8$		
	$P(X \leq 9 \mid \lambda = 8) = 0.7166$	M1A1	
	(OR if *c*=9 in (d), $P(X \leq 8 \mid \lambda = 8) = 0.5925$	M1A1)	
		11	(2)
6 (a)	$E\left(\frac{2}{3}X_1 - \frac{1}{2}X_2 + \frac{5}{6}X_3\right) = \frac{2}{3}\mu - \frac{1}{2}\mu + \frac{5}{6}\mu = \mu$	M1A1	
	$E(Y) = \mu \Rightarrow$ unbiased	B1	
			(3)
(b)	$E(aX_1 + bX_2) = a\mu + b\mu = \mu$	M1	
	$a + b = 1$	A1	
	$\text{Var}(aX_1 + bX_2) = a^2\sigma^2 + b^2\sigma^2$	M1A1	
	$= a^2\sigma^2 + (1-a)^2\sigma^2$	M1	
	$= (2a^2 - 2a + 1)\sigma^2$	A1	
			(6)
(c)	Min value when $(4a-2)\sigma^2 = 0$ $\frac{d}{da}(\text{Var}) = 0$, all correct	M1A1	
	$\Rightarrow 4a - 2 = 0$	A1	
	$a = \frac{1}{2}, b = \frac{1}{2}$.	A1A1∫	
			(5)
		14	

Question number	Scheme		Marks
7 **(a)**	$s_p^2 = \dfrac{7\times 7.84 + 7\times 4}{7+7} = 5.92$		**M1**
	$s_p = 2.433105$	awrt 2.43	**A1**
	$H_0 : \mu_A = \mu_B,\ H_1 : \mu_A \neq \mu_B$	both	**B1**
	$t = \dfrac{26.125 - 25}{2.43\sqrt{\frac{1}{8}+\frac{1}{8}}} = 0.92474$	awrt 0.925	**M1A1**
	$t_{14}(2.5\%) = 2.145$	2.145	**B1**
	Insufficient evidence to reject H_0 that there is no difference in the means.		**A1∫**
			(7)
(b)	d=M1-M2 2,5,-2,1,3,-4,1,3		**M1**
	$\bar{d} = \dfrac{9}{8} = 1.125$	1.125	**B1**
	$s_d^2 = \dfrac{69 - 8\times 1.125^2}{7} = 8.410714$	awrt 8.41	**M1A1**
	$H_0 : \delta = 0,\ H_1 : \delta \neq 0$	both	**B1**
	$t = \dfrac{1.125}{\sqrt{\frac{8.41}{8}}} = 1.0972$	awrt 1.10	**M1A1**
	$t_7(2.5\%) = 2.365$	2.365	**B1**
	There is no significant evidence of a difference between method A and method B.		**A1∫**
			(9)
(c)	Paired sample as they are two measurements on the same orange		**B1**
			(1)
			17