Mark Scheme 4734
June 2006

1		Add two Poisson distributions	M1		
		With mean 17	A1		
		$P(27)=e^{-17}17^{27}/27!$ or $P(\leq 27)-P(\leq 26)$	M1		Use formula or table
		0.00634 or 0.0063, 0.0064 from tables	A1	**4**	M1A1 0.0052 from N(17,17)
2		H_0: $p_1=p_2=p_3=p_4$,			Indication of equality of proportions
		(H_1: They are not all equal**)**	B1		
		Expected values under H_0=150	B1		
		$X^2= (12^2+23^2+15^2+20^2)/150$	M1		At least one correct term
		=8.653		A1	Accept art 8.65 or 8.66
		Critical value with 3 d.f. = 7.815	B1		
		(X^2 > 7.185 so) reject H_0 and accept that proportions are different.		B1√	**6** ft critical value
3		Assume population of differences has a normal distribution.			
		or sample random	B1		Either assumption.
		H_0: $\mu_B - \mu_A=0$, H_1: $\mu_B - \mu_A > 0$	B1		AEF
		t=(23.43-22.84)/ √(0.548/10)	M1		
		=2.520		A1	
		CV=1.833	B1		Seen
		2.52 > CV so reject H_o	M1		Allow from CV 2.262 (2-tail), 1.812,1.734
		Accept that there is evidence that mean time has reduced.	A1 √	**7**	ft wrong CV
4	(i)	EITHER: $\int_{q_3}^{4} \frac{1}{12}x\,dx=\frac{1}{4}$ or $\int_1^2 \frac{4}{3x^3}dx+\int_2^{q_3}\frac{1}{12}x\,dx=\frac{3}{4}$			M1*
		$[x^2/24]$ OR $[-2/(3x^2)]+[x^2/24]$	A1		Either
		$(16-q_3^2)/24=1/4$ or $1/3 + q_3^2/24 = ¾$	dep *M1		Form equation and attempt to solve
		$q_3=\sqrt{10}$	A1	**4**	Accept to 3 SF
		If they find F(x): M1A1, M1A1			
	(ii)	$E(X^2)=\int_1^2 \frac{4}{3x}dx+\int_2^4 \frac{x^3}{12}dx$			
		$E(X) =\int_1^2 \frac{4}{3x^2}dx+\int_2^4 \frac{x^2}{12}dx$	M1		Either correct
		$\left[\frac{4}{3}\ln x\right]_1^2+\left[\frac{x^4}{48}\right]_2^4$	A1		
		$\left[\frac{-4}{3x}\right]_1^2+\left[\frac{x^3}{36}\right]_2^4$	A1		
		a= E(X^2)/E(X)	M1		
		a=2.6659, 2.67	A1	**5**	Or exact value, (3ln2)/5 + 9/4 or equiv.

5	(i)	(48×72/150) or (48/150)(72/150)×150	M1		Multiply and divide relevant values
			A1	**2**	All correct
	(ii)	No, no expected value less than 5		B1	**1**
	(iii)	H_0:Volume and day are independent			Attributes specified
		(H_1:Volume and day are not independent**)**		B1	
		Critical value for 4 df=13.28	B1		
		Test statistic > 13.28, reject H_0	M1		
		Accept that volume and day are not independent	A1	**4**	
	(iv)	Choose Friday	B1		
		Highest volume		B1	**2** Not reference to E values
$\overline{6}$	(i)	(a) No	B1		Must be with reason
		0.43 belongs to relevant interval		B1	
		(b)Yes			
		0.43 is outside relevant interval	B1	**3**	
	(ii)	H_0:$p_R = p_T$, H_1:$p_R \neq p_T$	B1		Proportions
		Estimate of p = 74/165	B1		
		Variance estimate of difference			
		$=(\frac{74}{165})(\frac{91}{165})(\frac{1}{80}+\frac{1}{85})$	B1		May be implied by later work
		z=(28/80-46/85)/σ_{est}	M1		Standardising
			A1		Completely correct expression
		= -2.468		A1	+ or - , 2.47
		Compare correctly with CV			
		-2.468<-2.326, or 2.468 > 2.326	M1		
		Reject H_0 and accept that the proportions differ on the island.	A1	**8**	Conclusion in context
$\overline{7}$	(i)	T_1~ N(2.2,0.75^2), T_2 ~ N(1.8,0.70^2)			
		Use T_2 - ½ T_1 normal	M1		Or ½T_1 – T_2
		μ=0.7	A1		
		σ^2=0.7^2+ ¼×0.75^2 (0.630625)	A1		
		(0- μ)/σ	M1		From reasonable σ^2 not just sum
		-0.881	A1		+ or -
		Probability 0.189		A1	**6**
(ii)		Use sum of 5 Ts	M1		
		μ=9.4		A1	
		σ^2=2.5225		A1	
		z=(10-μ)/σ		M1	Standardising, must be σ
		Probability 0.6473,0.647		A1	**5**
	(iii)	Calculation of variance	B1	**1**	

8	**(i)**	$s_B^2 = \frac{1}{49}(630.194 - \frac{176.35^2}{50})$	M1		Any equivalent formula
		=0.1675	A1		May be implied by later work
		$H_0: \mu_B - \mu_A = 0$, $H_1: \mu_B - \mu_A > 0$	B1		aef
		z=0.115/√(0.049/40 + 0.1675/50)	M1		Standardising but not from pooled variance estimate
		=1.700	A1		art 1.70
		z > 1.645 , reject H_0	M1		Compare correctly with 1.645
		and accept that $\mu_B > \mu_A$	A1 √	**7**	ft their calculated z
	(ii)	z = 0.09/√(0.004575)	M1		Correct form
		= 1.331	A1		
		H_0 not rejected for $\alpha < 9.16$	M1 A1	**4**	Accept < 9.2, ≤ 9.2 . M1 for correct method for 9.2, A1 for inequality
	(iii)	(a) Not necessary	B1		Ignore any reason
		(b) Not necessary since samples large enough for CLT to be applied (normality of sample means giving normality of difference)	M1		Mention of CLT implied by "sample large"
			A1	**3**	Sample mean (approx) normal. (Do not award if population or sample said to be normal)