

# **Mark Scheme 4734**

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

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

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