OCR
RECOGNISING ACHIEVEMENT

GCE

Statistics (MEI)

Advanced Subsidiary GCE **G242**

Statistics 2 (Z2)

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

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<table>
<tr><td>Q1</td><td></td><td></td><td></td></tr>
<tr><td>(i)</td><td>H_0: there is no association between warbler and tree
H_1: there is an association between warbler and tree

Expected frequencies
<table><tr><td></td><td>Willow</td><td>Birch</td><td>Oak</td></tr><tr><td>Chiffchaff</td><td>15.695</td><td>16.340</td><td>10.965</td></tr><tr><td>Willow Warbler</td><td>34.310</td><td>35.720</td><td>23.970</td></tr><tr><td>Whitethroat</td><td>22.995</td><td>23.940</td><td>16.065</td></tr></table>
Contributions to X^2
<table><tr><td></td><td>Willow</td><td>Birch</td><td>Oak</td></tr><tr><td>Chiffchaff</td><td>2.0665</td><td>0.6827</td><td>7.4447</td></tr><tr><td>Willow Warbler</td><td>0.6411</td><td>1.4837</td><td>5.9775</td></tr><tr><td>Whitethroat</td><td>0.0439</td><td>0.6484</td><td>0.5362</td></tr></table>
$X^2 = 19.525$

4 degrees of freedom
Critical value for 5% significance level is 9.488
As 19.525 > 9.488 the result is significant

There is evidence of an association between the warbler and tree.</td><td>B1

M1
A1

M1
A1

A1

B1
B1
M1
A1

A1</td><td>11</td></tr>
<tr><td>(ii)</td><td>Chiffchaffs occurred more frequently than expected in Oak trees.
Willow Warblers occurred less frequently than expected in Oak trees.
Whitethroat occurred more or less as expected.</td><td>E1

E1

E1</td><td>3</td></tr>
<tr><td>(iii)</td><td>P(Birch|Whitethroat) = 20/63</td><td>M1
A1</td><td>2</td></tr>
<tr><td></td><td></td><td></td><td>16</td></tr>
</table>

Q2			
(i)	This is a small sample The variance is unknown We must assume birth weights are Normally distributed	B1 B1 B1	**3**
(ii)	Estimate for population mean = 2965 g Estimate for population standard deviation $= \sqrt{\dfrac{106593000 - \dfrac{35580^2}{12}}{11}}$ = 315.983… = 316 to 3 sf	B1 M1 A1 CAO	**3**
(iii)	$H_0 : \mu = 2800$ & $H_1 : \mu > 2800$ Where μ represents the population mean birth weight of babies born after the introduction of the prenatal care programme. $t = \dfrac{2965 - 2800}{SD/\sqrt{12}}$ = 1.809 (using SD = 316) 11 degrees of freedom At 5% level, critical value of t is 1.796 1.809 > 1.796 so the result is significant. Evidence suggests the mean birth weight has increased.	B1 B1 B1 M1 A1 CAO B1 B1 M1A1 A1	**10**
			16

Q3			
(i)*A*	$\sum fx \div \sum f = 360 \div 150$ (= 2.4 A.G.)	M1 A1	**2**
B	Variance = $1.734^2 = 3.0067\ldots$, which seems close to the mean value of 2.4. A Poisson model may be appropriate.	B1 E1(compare mean with variance – allow arguments either way, with relevant conclusion)	**2**
(ii)	H_0: The Poisson model is suitable		
	$P(X = 1) = 0.2177$ & $P(X \geq 6) = 0.0357$	B1 (both probabilities)	
	Missing expected frequencies are 32.655 ($x = 1$), and 5.355 ($x \geq 6$)	M1 A1 (expected freq)	**3**
	Missing contributions are 4.4421 ($x = 2$) and 1.7232 ($x = 3$)	M1 A1	
	$X^2 = 13.7441$	A1	**3**
	There are 7 – 1 – 1 = 5 degrees of freedom.	B1	
	At the 5% significance level the critical value is 11.07	B1	
	The result is significant	B1	
	Evidence suggests that the Poisson model is inappropriate.	B1	**4**
			14

Q4			
	H_0: population median = 210 H_1: population median ≠ 210	B1 B1	**2**
	Actual differences 33 41 8 17 -5 22 -12 14 -23 54	B1	
	Associated ranks 8 9 2 5 1 6 3 4 7 10	M1 A1	
	T^- = 1 + 3 + 7 = 11	B1	
	T^+ = 8 + 9 + 2 + 5 + 6 + 4 + 10 = 44	B1	
	$\therefore T$ = 11	B1	**6**
	From n = 10 tables – at the 5% level of significance in a two-tailed Wilcoxon single sample test, the critical value of T is 8	M1 (use of n = 10 in tables) A1	
	11 > 8 ∴the result is not significant	M1 A1	
	The evidence does not suggest that there is a difference between the median dive duration of adolescent seals and the seal population as a whole.	E1	**5**
			13

Q5			
(i)	$P(X < 500) = P(Z < \frac{500-502}{1.29}) = P(Z < -1.550)$ $1 - \Phi(1.550) = 1 - 0.9394 = 0.0606$(awrt 0.061)	M1 standardising M1 correct tail A1	**3**
(ii)	From tables $\Phi^{-1}(0.99) = 2.326$ $\frac{500-\mu}{1.29} = -2.326$ $\mu = 500 + 2.326 \times 1.29 = 503$	B1 for 2.326 seen M1 for equation in μ and negative z-value A1	**3**
(iii)	$9.05 \pm 1.96 \times \frac{0.06}{\sqrt{40}}$ (9.03, 9.07)	B1 centred on 9.05 B1 for 1.96 M1 structure A1 A1	**5**
(iv)	As the lower limit of the interval in part (iii) is more than 9 gallons, this does not suggest that the mean volume is below 9 gallons for this month. Allow sensible alternatives	E1 E1	**2**
			13

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

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