



Statistics (MEI)

Advanced Subsidiary GCE AS H132

Mark Scheme for the Units

June 2007

H132/MS/R/07

Oxford Cambridge and RSA Examinations

OCR (Oxford, Cambridge and RSA Examinations) is a unitary awarding body, established by the University of Cambridge Local Examinations Syndicate and the RSA Examinations Board in January 1998. OCR provides a full range of GCSE, A level, GNVQ, Key Skills and other qualifications for schools and colleges in the United Kingdom, including those previously provided by MEG and OCEAC. It is also responsible for developing new syllabuses to meet national requirements and the needs of students and teachers.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

© OCR 2007

Any enquiries about publications should be addressed to:

OCR Publications PO Box 5050 Annesley NOTTINGHAM NG15 0DL

 Telephone:
 0870 870 6622

 Facsimile:
 0870 870 6621

 E-mail:
 publications@ocr.org.uk

CONTENTS

Advanced Subsidiary GCE Statistics (H132)

MARK SCHEMES FOR THE UNITS

Unit	Content	Page
G241	Statistics 1	1
G242	Statistics 2	7
G243	Statistics 3	11
*	Grade Thresholds	16

Mark Scheme G241 June 2007

Q1 (i)	$\binom{8}{4}$ ways to select = 70	M1 for $\begin{pmatrix} 8\\4 \end{pmatrix}$	2
		ATCAU	
(ii)	4! = 24	B1 CAO	1
		TOTAL	3
Q2 (i)	Amount0- <20	B1 for amounts B1 for frequencies	2
(ii)	Total ≈ $10 \times 800 + 35 \times 480 + 75 \times 400 + 150 \times 200 = \text{\pounds}84800$	M1 for their midpoints × their frequencies A1 CAO	2
		TOTAL	4
Q3 (i)	Mean = $\frac{3026}{56}$ = 54.0	B1 for mean	
	$S_{xx} = 178890 - \frac{15378}{56} = 15378$ $s = \sqrt{\frac{15378}{56}} = 16.7$	M1 for attempt at S_{xx}	3
	V 55	A1 CAO	
(ii)	\overline{x} + 2s = 54.0 + 2×16.7 = 87.4 So 93 is an outlier	M1 for their \overline{x} + 2×their s A1 FT for 87.4 and comment	2
(iii)	New mean = $1.2 \times 54.0 - 10 = 54.8$ New <i>s</i> = $1.2 \times 16.7 = 20.1$	B1 FT M1A1 FT	3
		TOTAL	8
Q4 (i)	(A) P(at least one) $=\frac{36}{50} = \frac{18}{25} = 0.72$ (B) P(exactly one) $=\frac{9+6+5}{50} = \frac{20}{50} = \frac{2}{5} = 0.4$	B1 aef M1 for (9+6+5)/50 A1 aef	3
(ii)	P(not paper aluminium) = $\frac{13}{24}$	M1 for denominator 24 or 24/50 or 0.48 A1 CAO	2
(iii)	P(one kitchen waste) = $2 \times \frac{18}{50} \times \frac{32}{49} = \frac{576}{1225} = 0.470$	M1 for both fractions M1 for $2 \times$ product of both, or sum of 2 pairs A1	3
		TOTAL	8

Q5	11 th value is 4,12 th value is 4 so median is 4	B1	
(i)	Interguartile range = $5 - 2 = 3$	M1 for either quartile	
		A1 CAO	3
(ii)	 No, not valid any two valid reasons such as : the sample is only for two years, which may not be representative the data only refer to the local area, not the whole of Britain even if decreasing it may have nothing to do with global warming more days with rain does not imply more total rainfall a five year timescale may not be enough to show a long term trend 	B1 E1 E1	3
		ΤΟΤΔΙ	6
Q6 (i)	Either P(all 4 correct) = $\frac{4}{7} \times \frac{3}{6} \times \frac{2}{5} \times \frac{1}{4} = \frac{1}{35}$ or P(all 4 correct) = $\frac{1}{{}^{7}C_{4}} = \frac{1}{35}$	M1 for fractions, or ⁷ C ₄ seen A1 NB answer given	2
(ii)	$E(X) = 1 \times \frac{4}{35} + 2 \times \frac{18}{35} + 3 \times \frac{12}{35} + 4 \times \frac{1}{35} = \frac{80}{35} = 2\frac{2}{7} = 2.29$ $E(X^{2}) = 1 \times \frac{4}{35} + 4 \times \frac{18}{35} + 9 \times \frac{12}{35} + 16 \times \frac{1}{35} = \frac{200}{35} = 5.714$ $Var(X) = \frac{200}{35} - \left(\frac{80}{35}\right)^{2} = \frac{24}{49} = 0.490 \text{ (to 3 s.f.)}$	M1 for p (at least 3 terms correct) A1 CAO M1 for x^2p (at least 3 terms correct) M1 <i>dep</i> for – their E(X) ² A1 FT their E(X) provided Var(X) > 0	5
		TOTAL	7

Q7 (i)Q7 (i)G1 probabilities of result0.03Positive result0.95 0.05 ClearG1 probabilities of disease G1 probabilities of disease0.030.06Doubtful result0.10 0.90 ClearHas the disease G1 probabilities of clear(ii)P(negative and clear) = 0.91×0.99 = 0.9009 M1 for their 0.91×0.99 A1 CAOM1 for their 0.91×0.99 A1 CAO(iii)P(negative and clear) = 0.91×0.99 = 0.9009 M1 for their 0.91×0.99 A1 CAOM1 three products M1 dep sum of three products A1 FT their treeM1 for their 0.91×0.99 A1 FT their treeM1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 indep for their 0.0436 as don 0.0436 as diseaseM1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 indep for their 0.0436 as don 0.0436 as diseaseM1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 indep for their 0.0436 as don 0.0436 as diseaseM1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 indep for their 0.0436 as don 0.0436 as diseaseM1 for their 0.01×0.91 or 0.0436 as disease will test negative.M1 for their 0.01×0.91 or 0.0436 as disease will test negative.M1 for their 0.01×0.91 or 0.0436 as disease will test negative.M1 for their 0.01×0.91 or 0.0436 as disease will test negative.M1 for their 0.01×0.91 or 0.0436 as disease will test negative.M1 for their 0.01×0.91 or 0.0436 as disease will test negative.M1 for their 0.01×0.91 or 0.0436 as disease will test negative.M1 for their 0.91×0.91 <th></th> <th>Section B</th> <th></th> <th></th>		Section B		
(ii) $P(negative and clear) = 0.91 \times 0.99$ M1 for their 0.91×0.99 2(iii) $P(has disease) = 0.03 \times 0.95 + 0.06 \times 0.10 + 0.91 \times 0.01$ M1 three productsM1 three products 0.91×0.01 $= 0.0285 + 0.006 + 0.0091$ M1 for their 0.01×0.91 3(iv) $P(negative has disease)$ $= 0.0436$ M1 for their 0.01×0.91 3(iv) $P(negative has disease)$ $= \frac{P(negative and has disease)}{P(has disease)} = \frac{0.0091}{0.0436} = 0.2087$ M1 for their 0.01×0.91 3(v)Thus the test result is not very reliable.E1 FT for idea of 'not reliable' or 'could be improved', etcE1 FT for idea of 'not reliable' or 'could be improved', etcF1 FT(v)Thus the test negativeF1 FTF1 FT7	Q7 (i)	0.03 0.03 0.06 0.06 0.06 0.06 0.06 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.00 Clear 0.99 Clear 0.99 Clear	G1 probabilities of result G1 probabilities of disease G1 probabilities of clear G1 labels	4
(iii)P(has disease)= $0.03 \times 0.95 + 0.06 \times 0.10 +$ 0.91×0.01 M1 three products M1dep sum of three products A1 FT their tree3(iv)P(negative has disease) $= \frac{P(negative and has disease)}{P(has disease)} = \frac{0.0091}{0.0436} = 0.2087$ M1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 indep for their 0.0436 as denominator A1 FT their tree3(v)Thus the test result is not very reliable. A relatively large proportion of people who have the disease will test negativeE1 FT for idea of 'not reliable' or 'could be improved', etc2	(ii)	P(negative and clear) = 0.91 × 0.99 = 0.9009	M1 for their 0.91 \times 0.99 A1 CAO	2
(iv)P(negative has disease)M1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 <i>indep</i> for their 0.0436 as denominator A 1 FT their tree3(v)Thus the test result is not very reliable.E1 FT for idea of 'not reliable' or 'could be improved', etcE1 FT FT FT2	(iii)	P(has disease) = $0.03 \times 0.95 + 0.06 \times 0.10 +$ 0.91×0.01 = $0.0285 + 0.006 + 0.0091$ = 0.0436	M1 three products M1 <i>dep</i> sum of three products A1 FT their tree	3
 (v) Thus the test result is not very reliable. A relatively large proportion of people who have the disease will test negative. E1 FT for idea of 'not reliable' or 'could be improved', etc E1 FT for idea of 'not reliable' or 'could be improved', etc 	(iv)	P(negative has disease) = $\frac{P(negative and has disease)}{P(has disease)} = \frac{0.0091}{0.0436} = 0.2087$	M1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 <i>indep</i> for their 0.0436 as denominator A1 FT their tree	3
	(v)	Thus the test result is not very reliable. A relatively large proportion of people who have the disease will test negative.	E1 FT for idea of 'not reliable' or 'could be improved', etc E1 FT	2
	(vi)	P(negative or doubtful and declared clear) = $0.91 + 0.06 \times 0.10 \times 0.02 + 0.06 \times 0.90 \times 1$ = $0.91 + 0.00012 + 0.054 = 0.96412$	M1 for their 0.91 + M1 for either triplet M1 for second triplet A1 CAO TOTAL	4

Q8	X ~ B(17, 0.2)		
(i)	$P(X \ge 4) = 1 - P(X \le 3)$	B1 for 0.5489	
	= 1 – 0.5489 = 0.4511	M1 for 1 – their 0.5489	3
		A1 CAO	
(ii)	$E(X) = np = 17 \times 0.2 = 3.4$	M1 for product	2
		A1 CAO	
(iii)	P(X = 2) = 0.3096 - 0.1182 = 0.1914		
	P(X = 3) = 0.5489 - 0.3096 = 0.2393	B1 for 0.2393	
	P(X = 4) = 0.7582 - 0.5489 = 0.2093	B1 for 0.2093	3
	So 3 applicants is most likely	A1 CAO dep on both	
		B1s	
(iv)	(A) Let p = probability of a randomly selected maths	B1 for definition of <i>p</i> in	
	graduate applicant being successful (for population)	context	
	$H_0: p = 0.2$		
	$H_1: p > 0.2$	B1 for H ₀	
	(B) H_1 has this form as the suggestion is that		4
	mathematics graduates are <u>more</u> likely to be successful.	El	
(v)	Let X ~ B(17, 0.2)	B1 for 0.1057	
. ,	$P(X \ge 6) = 1 - P(X \le 5) = 1 - 0.8943 = 0.1057 > 5\%$	B1 for 0.0377	
	$P(X \ge 7) = 1 - P(X \le 6) = 1 - 0.9623 = 0.0377 < 5\%$	M1 for at least one	
		comparison with 5%	4
	So critical region is {7,8,9,10,11,12,13,14,15,16,17}	A1 CAO for critical	
		region <i>dep</i> on M1 and	
		at least one B1	
(vi)	Because $P(X \ge 6) = 0.1057 > 10\%$	E1	
	Either: comment that 6 is still outside the critical region		2
	Or comparison $P(X \ge 7) = 0.0377 < 10\%$	E1	
		TOTAL	18

Mark Scheme G242 June 2007

I				
	1(i)	$P(X < 30) = P(Z < \frac{30 - 26}{2})$	N/1	
		2.4		
		= P(Z < 1.666)	A1	
		= 0.952 (3sf)		3
	1 <i>(</i> ii)	$(h^{-1}(0.99)) = 2.326$	B1	
	'('')	ψ (0.99) - 2.020 r - 26	ы	
		$\frac{x^2}{24} = 2.326$ (Equation in positive z)	M1	
		2.4		
		x = 31.58 (CAO)	A1	
		must leave at 06 28 (dependent on M1)	A1 FT	4
	1(iii)	C.I. centred on 67.4	M1	
		67.4 ± 1.96×2.45÷√30 (B1 for 1.96)	B1 M1	
		(66.5.69.2)		
		(00.3, 00.3)	AI (FI sensible z)	4
	1(iv)	The CI does not contain the scheduled journey time of 65	E1(65 not in)	
	()	minutes.		
		This suggests that the scheduled time is not accurate.	E1(suggests)	
		The mean journey time could be greater than 65 minutes.	E1(mean	•
	1())	Valid commont on comple size	greater)	3
	1(v)	Valid comment on randomness	E1	2
	2(i)	H_0 : population median = 280	B1	-
	()	H_1 : population median > 280	B1	
		Actual differences	N / /	
		-89 -30 -2 20 1 -63 132 210 130 153 80 90 85 10 -102 Associated ranks		
		9 5 2 4 1 6 13 15 12 14 7 10 8 3 11	M1 A1	
		T = 9 + 5 + 2 + 6 + 11 = 33	B1	
		<i>T</i> ⁺ = 4 + 1 + 13 + 15 + 12 + 14 + 7 + 10 + 8 + 3 = 87	D1	
		· <i>T</i> = 33	B1FT	
			5111	
		From tables – at the 5% level of significance in a one-tailed		
		Wilcoxon signed rank test, the critical value of T is 30	B1	
		33 > 30 ∴the result is not significant	Μ1 Δ1	
		The evidence does not suggest an increase in the numbers of		
		Manx Shearwaters flying past the observatory at this time of	E1	
		year.		
				12
	2(ii)	Variable - symmetry about median	E1	
		Sample - random	E1	2
				_

standard deviation = 4.65B123(ii) $H_0: \mu = 50 & H_1: \mu < 50$ B1Where μ represents the mean fungicide level in the underlying population.E1 $t = \frac{45.9 - 50}{5D/\sqrt{10}} = -2.79$ (3s.f.)M1 A19 degrees of freedom At 5% level, critical value of $t = 1.833$ $-2.79 < -1.833$ so the result is significantM1 A1Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.93(iii)The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1dep(pop ^B)4(ii)Eateria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate)4(iii) $\Sigma fx+\Sigma f$ $= 580+200 = 2.9$ (A.G.)M1 $= 2$ 4(iii) $P(X = 0) = 0.055$ $P(X = 1) = 0.1596$ $P(X = 1) = 0.15$	3(i)	mean = 45.9	B1	
3(ii) $H_0: \mu = 50$ & $H_1: \mu < 50$ B123(ii) $H_0: \mu = 50$ & $H_1: \mu < 50$ B1E1 $Vhere \mu$ represents the mean fungicide level in the underlying population.E1S1 $t = \frac{45.9 - 50}{5D} = -2.79$ (3s.f.)M1A19 degrees of freedomAt 5% level, critical value of $t = 1.833$ M1 A1-2.79 < -1.833 so the result is significantA1B1Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.93(iii)The amount of fungicide in the underlying population follows a Normal distributionE1(Normal)4(i)Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) $= 580+200 = 2.9$ (A.G.)A124(iii)Variance = $1.762^2 = 3.1046$ mean π variance so does not give reason to doubt suitability of the Poisson modelB1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 <br< th=""><th></th><th>standard deviation = 4.65</th><th>B1</th><th></th></br<>		standard deviation = 4.65	B1	
3(ii) $H_0: \mu = 50$ $H_1: \mu < 50$ B1Where μ represents the mean fungicide level in the underlying population.E1 $t = \frac{45.9 - 50}{SD/\sqrt{10}} = -2.79$ (3s.f.) $\sqrt{10}$ M1 A19 degrees of freedom At 5% level, critical value of $t = 1.833$ $-2.79 < -1.833$ so the result is significantM1 A1 A1Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.93(iii)The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1(app(pop ^B)) 24(i)Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate)4(ii)A $\Sigma fx + \Sigma f$ $= 580 + 200 = 2.9$ (A.G.)M1 A14(iii)BVariance $= 1.762^2 = 3.1046$ mean \approx variance so does not give reason to doubt suitability of the Poisson modelB1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 <b< th=""><th></th><th></th><th></th><th>2</th></b<>				2
Where μ represents the mean fungicide level in the underlying population.E1 $t = \frac{45.9 - 50}{SD/\sqrt{10}} = -2.79 (3s.f.)$ M1 A19 degrees of freedom At 5% level, critical value of $t = 1.833$ $-2.79 < -1.833$ so the result is significantB1 B1 B1 A1Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.93(iii)The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1dep(pop ²) 24(i)Bacteria occur randomly with a uniform mean rate of occurrenceM1 A1 E1(random) E1(uniform mean rate)4(ii) $\Sigma fx + \Sigma f$ $= 580 + 200 = 2.9 (A.G.)$ M1 A1 E1dep4(iii) $Vx = 0 = 0.055$ $P(X = 1) = 0.1596$ $P(X = 8) = 0.0059$ $11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)$ B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 	3(ii)	$H_0: \mu = 50 \& H_1: \mu < 50$	B1	
Where µ represents the mean fungicide level in the underlying population.E1 $t = \frac{45.9 - 50}{SD/\sqrt{10}} = -2.79 (3s.f.)$ M1 A19 degrees of freedom At 5% level, critical value of $t = 1.833$ -2.79 < -1.833 so the result is significantM1 A1 A1Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.M1 A1 A1 3(iii) The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1dep(pop ⁿ) 4(ii) Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate) 4(iii) $\Sigma fx + \Sigma f$ = 580 + 200 = 2.9 (A.G.)M1 A1 4(iii) Variance = 1.762 ² = 3.1046 mean \approx variance so does not give reason to doubt suitability of the Poisson modelB1 E1dep E1dep B1 B1 E1dep 4(iii) P(X = 0) = 0.055 P(X = 1) = 0.1596 P(X = 1) = 0.1596 P(X = 1) = 0.31.92 (X = 1), 1.98 (X \ge 8)B1 M1 (x 200) 4(iv) 6 degrees of freedom (8 - 1 - 1) Critical value at 5% level is $X^2 = 12.59$ 9.032 < 12.59 so not significant The Poisson model seems a good fit.M1 A1 M1 A1 (F.T.			⊏1	
underlying population.M1 A1 $t = \frac{45.9 - 50}{SD/\sqrt{10}} = -2.79 (3s.f.)$ M1 A19 degrees of freedom At 5% level, critical value of $t = 1.833$ $-2.79 < -1.833$ so the result is significantB1 B1 M1 A1 A1Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.93(iii)The amount of fungicide in the underlying population follows a Normal distribution $E1(Normal)$ $E1dep(pop^2)$ 4(i)Bacteria occur randomly with a uniform mean rate of occurrence $E1(random)$ $E1(uniformmean rate)4(ii)B\Sigma fx+\Sigma f= 580+200 = 2.9 (A.G.)B1E1 depA14(ii)BVariance = 1.762^2 = 3.1046mean \approx variance so does not give reason to doubt suitability ofthe Poisson modelB1E1 depA14(iii)P(X = 0) = 0.055P(X \ge 8) 0.009911 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)B1A14(iv)6 degrees of freedom (8 - 1 - 1)Critical value at 5% level is X^2 = 12.599.032 < 12.59 so not significantThe Poisson model seems a good fit.A1A1(F.T.$		Where μ represents the mean fungicide level in the		
$t = \frac{45.9 - 50}{SD/\sqrt{10}} = -2.79 (3s.f.)$ 9 degrees of freedom At 5% level, critical value of t = 1.833 -2.79 < -1.833 so the result is significant Evidence suggests the mean level of fungicide in the crop is below the agreed safe level. 3 (iii) The amount of fungicide in the underlying population follows a Normal distribution 4 (i) Bacteria occur randomly with a uniform mean rate of occurrence 4 (ii) Extract f = 580+200 = 2.9 (A.G.) 4 (iii) Variance = 1.762 ² = 3.1046 mean ~ variance so does not give reason to doubt suitability of the Poisson model 4 (iii) P(X = 0) = 0.055 P(X = 1) = 0.1596 P(X = 2) = 0		underlying population.		
$t = \frac{45.9 - 50}{SD} = -2.79 (3s.f.)$ $y = \frac{1}{\sqrt{10}} = -2.79 (3s.f.)$ $z = \frac{1}{\sqrt{10}} = -2.81 (1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 $			M1	
SD $\sqrt{10}$ Bart (com)B1 B1 B1 M1 A1 A1B1 B1 M1 A1 A1At 5% level, critical value of $t = 1.833$ -2.79 < -1.833 so the result is significantA1Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.9 3(iii) The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1dep(pop ⁰) 4(i) Bacteria occur randomly with a uniform mean rate of occurrenceE1(nandom) E1(uniform mean rate) 4(ii) $\Sigma fx \div \Sigma f$ = 580+200 = 2.9 (A.G.)M1 A1 4(iii) $Variance = 1.762^2 = 3.1046$ mean \approx variance so does not give reason to doubt suitability of the Poisson modelB1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B		$t = \frac{45.9 - 50}{50} = -2.79$ (3s.f.)	A1	
4^{10} B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 M1 A1 A1 4^{10} 9^{10} 3(iii) The amount of fungicide in the underlying population follows a Normal distribution $E1(Normal)$ E1dep(pop ^D) 2 4(i) Bacteria occur randomly with a uniform mean rate of occurrenceM1 E1(random) E1(uniform E1(uniform ean rate) 4(ii) $\Sigma fx+\Sigma f$ = 580+200 = 2.9 (A.G.)M1 A1 4(iii) $Variance = 1.762^2 = 3.1046$ mean \approx variance so does not give reason to doubt suitability of the Poisson modelB1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 		SD/10		
9 degrees of freedom At 5% level, critical value of $t = 1.833$ $-2.79 < -1.833$ so the result is significantB1 M1 A1 A1Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.93(iii)The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1dep(pop ^B)4(i)Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate)4(ii)A $\Sigma f_{X+\Sigma} f$ $= 580+200 = 2.9 (A.G.)$ M1 A14(ii)BVariance = 1.762^2 = 3.1046 mean ≈ variance so does not give reason to doubt suitability of the Poisson modelB1 E1dep4(iii)P $P(X = 0) = 0.055$ $P(X = 1) = 0.1596$ $P(X \ge 8) 0.0099$ $11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)$ B1 M1 (×200) A14(iv)6 degrees of freedom (8 – 1 – 1) Critical value at 5% level is $X^2 = 12.59$ $9.032 < 12.59$ so not significant The Poisson model seems a good fit.M1 (for 8-1- A1 M1		$/\sqrt{10}$	B1	
At 5% level, critical value of $t = 1.833$ -2.79 < -1.833 so the result is significant		9 degrees of freedom	B1	
-2.79 < -1.833 so the result is significant		At 5% level, critical value of $t = 1.833$	M1 A1	
A1A1Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.A193(iii)The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1dep(pop ⁿ)24(i)Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate)24(ii)A $\Sigma fx \div \Sigma f$ = 580+200 = 2.9 (A.G.)M1 A124(ii)BVariance = 1.762 ² = 3.1046 mean ≈ variance so does not give reason to doubt suitability of the Poisson modelB1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 <b< th=""><th></th><th>-2.79 < -1.833 so the result is significant</th><th></th><th></th></b<>		-2.79 < -1.833 so the result is significant		
Evidence suggests the mean level of fungicide in the crop is below the agreed safe level.93(iii)The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1dep(pop ⁿ)4(i)Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate)4(ii)A $\Sigma f_{X} \div \Sigma f$ $= 580 \div 200 = 2.9$ (A.G.)M1 A14(ii)BVariance = 1.762² = 3.1046 mean ≈ variance so does not give reason to doubt suitability of the Poisson modelB1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B			A1	
below the agreed safe level.E3(iii)The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1dep(pop ⁰)4(i)Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate)4(ii)A $\Sigma f x + \Sigma f$ = 580 + 200 = 2.9 (A.G.)M1 A14(ii)BVariance = 1.762 ² = 3.1046 mean ~ variance so does not give reason to doubt suitability of the Poisson modelB1 E1dep4(iii) $P(X = 0) = 0.055$ $P(X = 1) = 0.1596$ $P(X = 8) 0.0099$ $11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)$ B1 M1 (x200) A14(iv)6 degrees of freedom $(8 - 1 - 1)$ Critical value at 5% level is $X^2 = 12.59$ $9.032 < 12.59$ so not significant The Poisson model seems a good fit.M1 M1 M14		Evidence suggests the mean level of fungicide in the crop is		0
3(iii) The amount of fungicide in the underlying population follows a Normal distributionE1(Normal) E1dep(pop ^D)2 4(i) Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate)2 4(ii) $\Sigma fx + \Sigma f$ = 580+200 = 2.9 (A.G.)M1 A12 4(ii)B $\nabla fx + \Sigma f$ = 580+200 = 2.9 (A.G.)M1 A12 4(ii)B Variance = 1.762 ² = 3.1046 mean \approx variance so does not give reason to doubt suitability of the Poisson modelB1 E1dep 4(iii) $P(X = 0) = 0.055$ $P(X = 1) = 0.1596$ $P(X \ge 8) 0.0099$ $11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)$ B1 M1 (×200) A1 4(iv) 6 degrees of freedom $(8 - 1 - 1)$ Critical value at 5% level is $X^2 = 12.59$ $9.032 < 12.59$ so not significant The Poisson model seems a good fit.M1 A1 A1 4		below the agreed safe level.		9
3(iii)The amount of rungicide in the underlying population follows a Normal distribution $E1(Normal)$ $E1dep(popn)$ 4(i)Bacteria occur randomly with a uniform mean rate of occurrence $E1(random)$ $E1(uniformmean rate)4(ii)A\Sigma fx + \Sigma f= 580 + 200 = 2.9 (A.G.)M1A14(ii)BVariance = 1.762^2 = 3.1046mean \approx variance so does not give reason to doubt suitability ofthe Poisson modelB1E1dep4(iii)P(X = 0) = 0.055P(X = 1) = 0.1596P(X \ge 8) 0.009911 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)A1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1B1$		The event of function is the uncleaking a coulotion		
3(iii) Follows a Normal distributionEndep(pop)2 4(i) Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate)2 4(ii)A $\Sigma f x \div \Sigma f$ 	2(111)	I ne amount of fungicide in the underlying population	E I (NOIMAI) E1don(non ⁿ)	
4(i)Bacteria occur randomly with a uniform mean rate of occurrenceE1(random) E1(uniform mean rate)24(ii)A $\Sigma fx \div \Sigma f$ 	3(III)	tollows a Normal distribution	Eldeh(hob)	2
(i)Description of occurrenceEntertain of mean rate4(ii)A $\Sigma fx \div \Sigma f$ E1 (uniform mean rate)24(ii)A $\Sigma fx \div \Sigma f$ M1 $= 580 \div 200 = 2.9$ (A.G.)A124(ii)BVariance = 1.762² = 3.1046 mean \approx variance so does not give reason to doubt suitability of the Poisson modelB14(iii) $P(X = 0) = 0.055$ $P(X = 1) = 0.1596$ $P(X \ge 8) 0.0099$ B111 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)M1 (×200) A14(iv)6 degrees of freedom (8 - 1 - 1) Critical value at 5% level is $X^2 = 12.59$ $9.032 < 12.59$ so not significant The Poisson model seems a good fit.M14(iv)6 degrees a good fit.M1	4(i)	Bacteria occur randomly	E1(random)	-
4(ii)A $\Sigma f_X \div \Sigma f$ M1 $= 580 \div 200 = 2.9 (A.G.)$ A124(ii)BVariance = 1.762² = 3.1046 mean ≈ variance so does not give reason to doubt suitability of the Poisson modelB14(iii) $P(X = 0) = 0.055$ $P(X = 1) = 0.1596$ $P(X \ge 8) 0.0099$ B111 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)M1 (×200) A14(iv)6 degrees of freedom (8 - 1 - 1) Critical value at 5% level is $X^2 = 12.59$ $9.032 < 12.59$ so not significant The Poisson model seems a good fit.M1 (for 8-1- A1	,	with a uniform mean rate of occurrence	E1(uniform	2
4(ii)A $\Sigma f_{X} \div \Sigma f$ M1 A1 2 4(ii)B Variance = 1.762 ² = 3.1046 B1 B1 E1dep 2 4(ii)B Variance so does not give reason to doubt suitability of the Poisson model B1 E1dep 2 4(iii) P(X = 0) = 0.055 B1 E1dep 2 P(X = 1) = 0.1596 B1 B1 2 P(X ≥ 8) 0.0099 B1 B1 2 11 (X = 0), 31.92 (X = 1), 1.98 (X ≥ 8) M1 (×200) 5 A1 A1 A1 A1 4(iv) 6 degrees of freedom (8 – 1 – 1) M1 (for 8-1-1) M1 (for 8-1-1) Critical value at 5% level is $X^2 = 12.59$ A1 A1 A1 9.032 < 12.59 so not significant			mean rate)	
= $580 \div 200 = 2.9 (A.G.)$ A1 2 4(ii)B Variance = $1.762^2 = 3.1046$ mean \approx variance so does not give reason to doubt suitability of the Poisson model B1 2 4(iii) $P(X = 0) = 0.055$ P(X = 1) = 0.1596 $P(X \ge 8) 0.0099$ $11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)$ B1 B1 B1 B1 B1 4 4(iv) 6 degrees of freedom $(8 - 1 - 1)$ Critical value at 5% level is $X^2 = 12.59$ 9.032 < 12.59 so not significant The Poisson model seems a good fit. M1 (for 8-1- 1) A1 A1 4	4(ii)A	$\Sigma f \mathbf{x} \div \Sigma f$	M1	
4(ii)BVariance = $1.762^2 = 3.1046$ mean \approx variance so does not give reason to doubt suitability of the Poisson modelB1 E1dep4(iii) $P(X = 0) = 0.055$ $P(X = 1) = 0.1596$ $P(X \ge 8) 0.0099$ $11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)$ B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 		= 580÷200 = 2.9 (A.G.)	A1	2
mean \approx variance so does not give reason to doubt suitability of the Poisson modelE1dep4(iii) $P(X = 0) = 0.055$ $P(X = 1) = 0.1596$ $P(X \ge 8) 0.0099$ $11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)$ B1 B1 B1 B1 M1 (×200) A14(iv)6 degrees of freedom $(8 - 1 - 1)$ Critical value at 5% level is $X^2 = 12.59$ $9.032 < 12.59$ so not significant The Poisson model seems a good fit.M1 (for 8-1- A1 M1 (for 7.1)	4(ii)B	Variance = 1.762 ² = 3.1046	B1	
the Poisson model 2 4(iii) $P(X = 0) = 0.055$ B1 $P(X = 1) = 0.1596$ B1 B1 $P(X \ge 8) \ 0.0099$ B1 B1 11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8) M1 (×200) 5 4(iv) 6 degrees of freedom (8 - 1 - 1) M1 (for 8-1- Critical value at 5% level is $X^2 = 12.59$ 1) A1 9.032 < 12.59 so not significant		mean \approx variance so does not give reason to doubt suitability of	E1dep	
4(iii) $P(X = 0) = 0.055$ $P(X = 1) = 0.1596$ $P(X \ge 8) 0.0099$ B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1		the Poisson model		2
$P(X = 1) = 0.1596$ $P(X \ge 8) 0.0099$ $11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)$ B1 B1 M1 (×200) A14(iv)6 degrees of freedom $(8 - 1 - 1)$ Critical value at 5% level is $X^2 = 12.59$ $9.032 < 12.59$ so not significant The Poisson model seems a good fit.M1 (for 8-1- 1) A14 (iv)6 degrees of freedom $(8 - 1 - 1)$ Critical value at 5% level is $X^2 = 12.59$ $A1$ M1 (for 8-1- 4 A1	4(iii)	P(X = 0) = 0.055	B1	
$P(X \ge 8) \ 0.0099$ B1 $11 \ (X = 0), \ 31.92 \ (X = 1), \ 1.98 \ (X \ge 8)$ M1 (×200) A1 4(iv) 6 degrees of freedom $(8 - 1 - 1)$ Critical value at 5% level is $X^2 = 12.59$ 1) 9.032 < 12.59 so not significant A1 The Poisson model seems a good fit. M1 (F.T.		P(X = 1) = 0.1596	B1	
If $(X = 0)$, 31.92 ($X = 1$), 1.98 ($X \ge 8$) M1 ($\times 200$) 5 A1 A1 4(iv) 6 degrees of freedom $(8 - 1 - 1)$ M1 (for 8-1-1) Critical value at 5% level is $X^2 = 12.59$ 1) 9.032 < 12.59 so not significant		$P(X \ge 8) = 0.0099$	B1	-
4(iv)6 degrees of freedom $(8 - 1 - 1)$ M1 (for 8-1-Critical value at 5% level is $X^2 = 12.59$ 1)9.032 < 12.59 so not significantA1The Poisson model seems a good fit.M1 (F.T.		$11 (X = 0), 31.92 (X = 1), 1.98 (X \ge 8)$	MT (×200)	Э
Critical value at 5% level is $X^2 = 12.59$ 1)9.032 < 12.59 so not significantA1The Poisson model seems a good fit.M14	4(iv)	6 degrees of freedom $(8 - 1 - 1)$	M1 (for 8-1-	
9.032 < 12.59 so not significantA1The Poisson model seems a good fit.M14	-(,,)	Critical value at 5% level is $X^2 = 12.59$	1)	
The Poisson model seems a good fit. A1 (F.T.		9.032 < 12.59 so not significant	A1	
		The Poisson model seems a good fit	M1	4
			A1 (F.T.	-
sensible c.v.)			sensible c.v.)	

5(i)	H_0 : there is no association between sex and viewing preference H_1 : there is an association between sex and viewing preference			B1			
	Expecte	d frequencies					
				Female	Male		
		Programme	Film	24.288	21.712		
		Туре	Drama	19.008	16.992		
			News	20.592	18.408		
			Sport	33.264	29.736		
			Music	16.368	14.632	M1	
			Wildlife	18.48	16.52	A1	
					1		
	Contribu	tion to X^2					
				Female	Male		
		Programme	Film	0.12067	0.13499		
		Туре	Drama	1.31103	1.46658		
			News	3.43310	3.84042		
			Sport	2.58002	2.88612	N/4	
			Music	0.34258	0.38323		
			Wildlife	0.65532	0.73308		
	$X^2 = 17.8$ 5 degree Critical v As 17.88 There is	88715 es of freedom value at 5% leve 3715 > 11.07 th s evidence of	el is 11.07 e result is sigr an associat	nificant tion between s	ex and viewing	A1 B1 B1 M1A1 A1	
	preferen	ce.			J. J		11
5(ii)	The larg sport pro	est contribution ogrammes. The	to the test s value 3.4331	tatistic come fron 0 shows a positiv	n news and ve association	E1	
	between shows a	females and n negative asso	ews programr ciation betwee	nes whereas the n males and new	value 3.84042 /s programmes.	E1	
	With spo	ort, the preferer	ices are revers	sed.		E1	
	The sma	allest contribution	ons to the test	statistic were for	film		
	program	mes showing s	imilarities betw	veen male and fe	emale.		3

Mark Scheme G243 June 2007

Q1				
(i)	There may be differences in 'fertility' in			
	different parts of the field – any such			
	differences should affect the pairs equally.	E2	(2, 1, 0)	2
(ii)	Population of differences in ratings is			
	Normally distributed.	B1		
	H ₀ : $\mu_D = 0$ (or $\mu_A = \mu_B$ etc)	B1	Do NOT allow \overline{D} or similar	
	H ₁ : $\mu_{r} \neq 0$ (or $\mu_{r} \neq \mu_{r}$ etc)		unless it is clearly and explicitly	
	$\mu_D = \mu_D + O(O(\mu_A + \mu_B O(O)))$	B1	stated to be a <u>population</u> mean.	
			Hypotheses in words only must	
			include "population".	
	Where μ_D is the population mean for	B1	For adequate verbal definition.	
	differences		Allow absence of "population"	
			here if correct notation μ has	
			been used.	
	MUST be paired comparison t test.			
	Use of differences.	M1		
	Differences are:			
	3.7, 1.4, -2.6, -0.6, 0.4, -1.0, 0.2, 2.1, -			
	0.1, 0.7	A1	For both. [s _n = 1.647 <u>NOT</u>	
	$\overline{d} = 0.42$ $s_{n-1} = 1.736$		allowed.]	
	0.42 - 0			
	Test statistic is $\frac{1}{1.726 \times \sqrt{10}} = 0.765$	M1		
	1./36/√10	A1	A1 is c.a.o. but FT from here if	
			M1 awarded (but no marks from	
			here on if not paired <i>t</i> test).	
			Use of $0 - \overline{d}$ scores M1 A0.	
			but FT.	
			Allow c's \overline{d} and/or s_{n-1} .	
			Allow alternatives:	
			$0 + (c'_{2}, 1.833) \times \frac{1.736}{(-1.006)}$	
			$\frac{1}{\sqrt{10}}$ (- 1.000)	
			for subsequent comparison with	
			\overline{d} .	
			1.736	
			<u>UR</u> $d = (c's 1.833) \times \frac{2.100}{\sqrt{10}}$	
			$(=\overline{d} - 1.006)$ for subsequent	
			comparison with 0.	
	Refer to t ₉	M1	No FT if wrong.	
	Double-tailed 10% critical value is 1.833	A1	No FT if wrong.	
	Not significant	E1		
	Seems mean ratings may be assumed	E1		
	equal.			
	Wilcoxon signed rank test for paired	B1		13
	samples.			

Q2				
(i)	35 • 30 • 25 • •	G1	Axes, including labels. "x" and "y" suffice as they are defined in the question.	
	20 Y 15 10	G1	Clear "break" in the x-axis.	
	5 0 1900 2100 2300 2500 2700 2900 3100 X	G1	All points correct (allow one error).	
	Looks strongly linear.	B1	Comments re bivariate Normality may be rewarded in part (iii).	4
(ii)	r = 0.9774	M1 A1	Regard as implicit from correct answer.	2
	If used: $\sum x = 33361 \sum x^2 = 75604869 S_{xx} = 1407780.9$			
	$\sum y = 205.9 \sum y^2 = 3870.63 \qquad S_{yy} = 1044.3093$ $\sum xy = 495410.1 \qquad S_{xy} = 37474.773$			
(iii)	Bivariate Normality.	M1		
(5.4)	Yes – (long thin !) "cigar" shape.	E1		2
(1V)	where ρ is the correlation coefficient for the underlying bivariate population. From tables, upper 1% point for <i>n</i> =15 is	B1 A1	No FT if wrong.	
	0.5923			
	Significant.	E1		
	between traffic flow and air pollution.	E1		5
(v)	 For any sensible comments, <u>such as</u>: correlation does not necessarily imply causation. there could be another confounding 	E1, E1		
	factor – this might be a "false positive".			2

Q3 (i)	 H₀: the medians of the two populations are the same. H₁: the medians of the two populations are different. [Or more formal statements.] Wilcoxon rank sum test (or Mann-Whitney form thereof). Ranks are: A 5 15 6 3 18 10 7 1 4 11 B 8 2 22 13 9 20 14 19 17 16 21 12 Rank sum for smaller sample is 80. Refer to (10, 12) table. Two-tail 5% critical value is 84 [or 29 for M-W]. Significant. Seems median heights are different. 	B1 B1 M1 A1 B1 A1 E1 E1	Allow 1 for "medians", but require "population" for second mark. Combined ranking. All ranks correct (FT if M1 earned). [Or M-W statistic = 1+6+1+1+8+3+1+0+1+3=25] No FT from here if wrong. No FT from here if wrong.	10
(ii)	 A No, seems to need "pairing". B Not clear-cut, perhaps no strong reason for "pairing", but large-scale weather systems affecting whole country might be important. 	E1 E1 E1 E1 E1	Or other sensible comments.	5

 (i) Need to define the region geographically. Age and/or sex sub-classifications? E1 May be problems of people who go out of/come into the region to buy goods. E1 Frequency of purchase sub-classifications? E1 (ii) Elect a (simple) random sample of schools/colleges. Select sample (or complete enumeration) in each selected school/college. E1 (iii) Comments to effect of administrative E1 convenience, less cost
Age and/or sex sub-classifications?E1May be problems of people who go out of/come into the region to buy goods.E1Frequency of purchase sub-classifications?E1(ii)Elect a (simple) random sample of schools/colleges.E1Select sample (or complete enumeration) in each selected school/college.E1(iii)Comments to effect of administrative convenience, less costE1
May be problems of people who go out of/come into the region to buy goods.E1Frequency of purchase sub-classifications?E1(ii)Elect a (simple) random sample of schools/colleges.E1Select sample (or complete enumeration) in each selected school/college.E1(iii)Comments to effect of administrative convenience, less costE1
of/come into the region to buy goods. E1 Frequency of purchase sub-classifications? E1 (ii) Elect a (simple) random sample of schools/colleges. Select sample (or complete enumeration) in each selected school/college. E1 (iii) Comments to effect of administrative convenience, Less cost E1
Frequency of purchase sub-classifications? E1 Or other sensible comments 4 (ii) Elect a (simple) random sample of schools/colleges. E1 2 Select sample (or complete enumeration) in each selected school/college. E1 2 (iii) Comments to effect of administrative convenience, E1 2 less cost E1 2
(ii) Elect a (simple) random sample of schools/colleges. E1 2 Select sample (or complete enumeration) in each selected school/college. E1 2 (iii) Comments to effect of administrative convenience, less cost E1 2
(iii) Comments to effect of administrative convenience, E1 2 (iii) Comments to effect of administrative convenience, E1 2
Select sample (or complete enumeration) in each selected school/college. E1 2 (iii) Comments to effect of administrative convenience, less cost E1 2
each selected school/college. E1 (iii) Comments to effect of administrative convenience, E1 less cost E1
(iii)Comments to effect of administrative convenience,E1 E12
convenience, E1 2
(i.e.) Each churten chauld be nonnecentative of
(IV) Each cluster should be representative of
only a sub-population.
Stratified sampling. B1 3
(v) Pooled s ⁻ is M1 For any reasonable attempt at
$\frac{(6 \times 9.28) + (9 \times 12.16)}{1000} - \frac{165.12}{1000} - \frac{11008}{1000}$
15 15 A1
If correct
Test statistic is $68.6-64.2$ (-0) M1 For numerator
M1 For $\sqrt{11.008}$ (or candidate's
$\sqrt{11.008}\sqrt{7+10}$ value)
$ \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad$
$=\frac{4.4}{1.625} = 2.691$
$A1 = \frac{1.035}{1.010}$
FT HOIT HERE IT AIL WI HIARS
editieu.
Allow alternatives as in question
Defende f
Refer to t_{15} .
Double-tailed 5% point is 2.131.
Significant. E1
Seems that population mean ratings are E1
different.
Must assume population variances are the B1 11
same.
(vi) (From e.g. college roll) select one of the
first 60 at random.
and then every 60 ^m . M1
Equivalent to simple random sampling, with
some reason consistent within candidate's M1
answer.
Discussion E2 E0,1 or 2.
Allow E1 for comment re each
student has equal chance of
selection.
Allow E2 for comment re no 5
cycles in list of names.

Advanced Subsidiary GCE (MEI Statistics) (H132) June 2007 Assessment Session

Unit Threshold Marks

Unit		Maximum Mark	а	b	С	d	е	u
G241	Raw	72	55	48	41	35	29	0
	UMS	100	80	70	60	50	40	0
G242	Raw	72	58	50	43	36	29	0
	UMS	100	80	70	60	50	40	0
G243	Raw	72	58	50	43	36	29	0
	UMS	100	80	70	60	50	40	0

Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

	Maximum Mark	Α	В	С	D	E	U
H132	300	240	210	180	150	120	0

The cumulative percentage of candidates awarded each grade was as follows:

	Α	В	С	D	E	U	Total Number of Candidates
H132	14.3	42.9	71.4	85.7	100	100	7

For a description of how UMS marks are calculated see; <u>www.ocr.org.uk/OCR/WebSite/docroot/understand/ums.jsp</u>

Statistics are correct at the time of publication

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

OCR Customer Contact Centre

(General Qualifications)

Telephone: 01223 553998 Facsimile: 01223 552627 Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored



Oxford Cambridge and RSA Examinations is a Company Limited by Guarantee Registered in England Registered Office; 1 Hills Road, Cambridge, CB1 2EU Registered Company Number: 3484466 OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations) Head office Telephone: 01223 552552 Facsimile: 01223 552553

© OCR 2007