OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MEI STATISTICS

G242

Statistics 2 (Z2)

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
- Printed answer book G242
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Monday 13 June 2011
Morning

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES
These instructions are the same on the printed answer book and the question paper.

- The question paper will be found in the centre of the printed answer book.
- Write your name, centre number and candidate number in the spaces provided on the printed answer book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the printed answer book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES
This information is the same on the printed answer book and the question paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the question paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The printed answer book consists of **12** pages. The question paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this question paper for marking; it should be retained in the centre or destroyed.

1 When making bread, Nancy measures out the flour using a cup. The weight, in grams, of flour in the cup is Normally distributed with mean 144 and standard deviation 2.6.

(i) Find the probability that the weight of flour in the cup is less than 146 grams. **[3]**

(ii) 12% of the time the weight of flour in the cup exceeds k grams. Find the value of k. **[3]**

A recipe for a large loaf of bread requires 4 cups of flour.

(iii) Assuming that the weights of flour per cup are independent, find the probability that the total weight of flour in 4 cups is less than 568 grams. **[4]**

Nancy uses this recipe to make 5 large loaves of bread.

(iv) Find the probability that at least one of the loaves contains less than 568 grams of flour. **[3]**

2 The owner of a large vineyard regularly carries out tests to monitor his grape vines for signs of disease. His vineyard is divided into plots of size $10\,m^2$. One test, carried out in June each year, involves counting the number of 'scorched' leaves per plot, as scorched leaves can be a sign of a potentially destructive disease. From tests carried out in previous years, he has established that the median number of scorched leaves per plot is 25.

He takes steps intended to reduce the number of scorched leaves. The following June he counts the numbers of scorched leaves per plot for a sample of 12 plots. The results are as follows.

24 21 18 23 28 20 31 9 36 13 15 17

(i) Use a Wilcoxon test to examine, at the 5% significance level, whether the vineyard owner has achieved his aim. **[12]**

(ii) What assumption about the sample used is necessary when carrying out this Wilcoxon test? **[1]**

3 Marine scientists have been studying populations of the great scallop, *Pecten maximus*, at a number of sites around the coast of Britain. After over-fishing in the 20th century, the mean size of scallop caught fell below the legal minimum, 110 mm, in so many sites that conservation measures were introduced. At one particular site where the mean size had fallen to 85 mm, scallop fishing was banned for a period of 3 years. Following this 3-year period, a random sample of 15 scallops was obtained at this site and used to produce a 95% confidence interval for the population mean size, in mm, of scallop. The resulting confidence interval, based on the t distribution, was (96.6, 99.4).

(i) Use the confidence interval to show that, at this site, an estimate for the mean of the underlying population is 98.0 mm and obtain an estimate for the population variance. **[5]**

(ii) Explain how the limits of this confidence interval may be used to support the view that the conservation measures are working but the site is not yet ready for the fishing ban to be lifted. **[2]**

Following a further 3-year period, a random sample of 12 scallops is obtained at this site and the size of each scallop recorded. The results, in mm, are as follows.

112 103 115 118 109 107 115 116 111 112 114 113

(iii) Use a t test to examine at the 5% level of significance whether this sample provides evidence that the population mean scallop size now exceeds the legal minimum of 110 mm. **[9]**

4 A student ornithologist is investigating the feeding habits of Eurasian Oystercatchers. She knows that the bill shape of oystercatchers varies between individual birds and suspects that there is an association between bill shape and the location in which birds feed. The bill shapes of 140 oystercatchers, regarded as a random sample, are observed in different feeding locations. The results are summarised in the table below.

		Bill shape	
		Blunt tip	Pointed tip
Feeding location	Shoreline	27	11
	Mudflats	15	37
	Inland field	26	24

(i) A test is to be carried out to examine whether these data provide any evidence of an association between bill shape and feeding location. State the null and alternative hypotheses. The following tables show some of the expected frequencies and contributions to the test statistic. Calculate the remaining expected frequencies and contributions. Complete the test at the 5% level of significance. **[11]**

Expected frequencies		Bill shape	
		Blunt tip	Pointed tip
Feeding location	Shoreline	18.457	19.543
	Mudflats		
	Inland field		

Contributions to the test statistic		Bill shape	
		Blunt tip	Pointed tip
Feeding location	Shoreline	3.9540	3.7344
	Mudflats		
	Inland field		

(ii) With reference to the contributions to the test statistic, comment briefly on how bill shape in each feeding location compares with what would be expected if there were no association. **[3]**

[Question 5 is printed overleaf.]

5 In a bid to increase its number of subscribers, a satellite television company is targeting individual customers who have failed to renew their subscription packages. Individual customers are contacted, by telephone, and offered the chance to purchase a new subscription package at a favourable rate. For every 5 customers called, a record is kept of the number of acceptances of the new package. The results for a random sample of 60 groups of 5 customers are as follows.

Number of acceptances	0	1	2	3	4	5
Observed frequency	17	22	13	6	1	1

(i) Use these data to find the sample mean. **[2]**

A manager at the company proposes to use these data to carry out a test of the goodness of fit of the binomial model B(5, p).

(ii) Show that the manager should use $p = 0.25$. **[2]**

The following table shows the expected frequencies obtained using B(5, 0.25).

Number of acceptances	0	1	2	3	4	5
Expected frequency	14.238	23.730	15.822	5.274	0.876	0.060

(iii) Explain why, in this case, it is appropriate to use 2 degrees of freedom when carrying out the goodness of fit test. **[3]**

(iv) Given that the resulting test statistic is 1.6812, carry out the test at the 10% level of significance. **[3]**

The satellite television company has a customer support service which receives telephone calls at a uniform average rate of 3 calls every 10 seconds.

(v) Use a Poisson model to calculate the probability that

(*A*) exactly 3 calls are received in a 10-second period, **[2]**

(*B*) at least 3 calls are received in a 20-second period. **[3]**

(vi) What additional assumption is needed to justify the use of the Poisson model in part **(v)**? **[1]**

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ADVANCED SUBSIDIARY GCE

MEI STATISTICS

G242

Statistics 2 (Z2)

PRINTED ANSWER BOOK

Candidates answer on this printed answer book.

OCR supplied materials:
- Question paper G242 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Monday 13 June 2011
Morning

Duration: 1 hour 30 minutes

* G 2 4 2 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

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1 (i)	
1 (ii)	

1 (iii)

1 (iv)

2 (i)	

2 (i) **(continued)**

2 (ii)

3 (i)

3 (ii)

3 (iii)

4 (i)

4 (i)	**(continued)**
4 (ii)	

5 (i)

5 (ii)

5 (iii)

5 (iv)

5 (v) (*A*)	
5 (v) (*B*)	
5 (vi)	

OCR
RECOGNISING ACHIEVEMENT

GCE

Statistics (MEI)

Advanced Subsidiary GCE

Unit **G242:** Statistics 2 (Z2)

Mark Scheme for June 2011

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support which keep pace with the changing needs of today's society.

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.

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

Marking instructions for GCE Mathematics (MEI): Statistics strand

1. You are advised to work through the paper yourself first. Ensure you familiarise yourself with the mark scheme before you tackle the practice scripts.

2. You will be required to mark ten practice scripts. This will help you to understand the mark scheme and will not be used to assess the quality of your marking. Mark the scripts yourself first, using the annotations. Turn on the comments box and make sure you understand the comments. You must also look at the definitive marks to check your marking. If you are unsure why the marks for the practice scripts have been awarded in the way they have, please contact your Team Leader.

3. When you are confident with the mark scheme, mark the ten standardisation scripts. Your Team Leader will give you feedback on these scripts and approve you for marking. (If your marking is not of an acceptable standard your Team Leader will give you advice and you will be required to do further work. You will only be approved for marking if your Team Leader is confident that you will be able to mark candidate scripts to an acceptable standard.)

4. Mark strictly to the mark scheme. If in doubt, consult your Team Leader using the messaging system within *scoris*, by email or by telephone. Your Team Leader will be monitoring your marking and giving you feedback throughout the marking period.

   An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

   Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

5. The following types of marks are available.

   M
   A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

6. When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

7. The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

   Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

8. Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.

   Candidates are expected to give numerical answers to an appropriate degree of accuracy. 3 significant figures may often be the norm for this, but this always needs to be considered in the context of the problem in hand. For example, in quoting probabilities from Normal tables, we generally expect *some* evidence of interpolation and so quotation to 4 decimal places will often be appropriate. But even this does not always apply – quotations of the standard critical points for significance tests such as 1.96, 1.645, 2.576 (maybe even 2.58 – but not 2.57) will commonly

suffice, especially if the calculated value of a test statistic is nowhere near any of these values. Sensible discretion *must* be exercised in such cases.

Discretion must also be exercised in the case of small variations in the degree of accuracy to which an answer is given. For example, if 3 significant figures are expected (either because of an explicit instruction or because the general context of a problem demands it) but only 2 are given, loss of an accuracy ("A") mark is likely to be appropriate; but if 4 significant figures are given, this should not normally be penalised. Likewise, answers which are slightly deviant from what is expected in a very minor manner (for example a Normal probability given, after an attempt at interpolation, as 0.6418 whereas 0.6417 was expected) should not be penalised. However, answers which are *grossly* over- or under-specified should normally result in the loss of a mark. This includes cases such as, for example, insistence that the value of a test statistic is (say) 2.128888446667 merely because that is the value that happened to come off the candidate's calculator. Note that this applies to answers that are given as final stages of calculations; intermediate working should usually be carried out, and quoted, to a greater degree of accuracy to avoid the danger of premature approximation.

The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

9. **Rules for crossed out and/or replaced work**

If work is crossed out and not replaced, examiners should mark the crossed out work if it is legible.

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If two or more attempts are made at a question, and just one is not crossed out, examiners should ignore the crossed out work and mark the work that is not crossed out.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

10. Genuine misreading (of numbers or symbols, occasionally even of text) occurs. If this results in the object and/or difficulty of the question being considerably changed, it is likely that all the marks for that question, or section of the question, will be lost. However, misreads are often such that the object and/or difficulty remain substantially unaltered; these cases are considered below.

The simple rule is that *all* method ("M") marks [and of course all independent ("B") marks] remain accessible but at least some accuracy ("A") marks do not. It is difficult to legislate in an overall sense beyond this global statement because misreads, even when the object and/or difficulty remains unchanged, can vary greatly in their effects. For example, a misread of 1.02 as 10.2 (perhaps as a quoted value of a sample mean) may well be catastrophic; whereas a misread of 1.6748 as 1.6746 may have so slight an effect as to be almost unnoticeable in the candidate's work.

A misread should normally attract *some* penalty, though this would often be only 1 mark and should rarely if ever be more than 2. Commonly in sections of questions where there is a numerical answer either at the end of the section or to be obtained and commented on (eg the value of a test statistic), this answer will have an "A" mark that may actually be designated as "cao" [correct answer only]. This should be interpreted *strictly* – if the misread has led to failure to obtain this value, then this "A" mark must be withheld even if all method marks have been earned. It will also often be the case that such a mark is implicitly "cao" even if not explicitly designated as such.

On the other hand, we commonly allow "fresh starts" within a question or part of question. For example, a follow-through of the candidate's value of a test statistic is generally allowed (and often explicitly stated as such within the marking scheme), so that the candidate may exhibit knowledge of how to compare it with a critical value and draw conclusions. Such "fresh starts" are not affected by any earlier misreads.

A misread may be of a symbol rather than a number – for example, an algebraic symbol in a mathematical expression. Such misreads are more likely to bring about a considerable change in the object and/or difficulty of the question; but, if they do not, they should be treated as far as possible in the same way as numerical misreads, *mutatis mutandis*. This also applied to misreads of text, which are fairly rare but can cause major problems in fair marking.

The situation regarding any particular cases that arise while you are marking for which you feel you need detailed guidance should be discussed with your Team Leader.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

11. Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

12. For answers scoring no marks, you must either award NR (no response) or 0, as follows:

Award NR (no response) if:

- Nothing is written at all in the answer space

- There is a comment which does not in any way relate to the question being asked ("can't do", "don't know", etc.)
- There is any sort of mark that is not an attempt at the question (a dash, a question mark, etc.)

The hash key [#] on your keyboard will enter NR.

Award 0 if:
There is an attempt that earns no credit. This could, for example, include the candidate copying all or some of the question, or any working that does not earn any marks, whether crossed out or not.

13. The following abbreviations may be used in this mark scheme.

M1	method mark (M2, etc, is also used)
A1	accuracy mark
B1	independent mark
E1	mark for explaining
U1	mark for correct units
G1	mark for a correct feature on a graph
M1 dep*	method mark dependent on a previous mark, indicated by *
cao	correct answer only
ft	follow through
isw	ignore subsequent working
oe	or equivalent
rot	rounded or truncated
sc	special case
soi	seen or implied
www	without wrong working

14. Annotating scripts. The following annotations are available:

✓and ✖

BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working (after correct answer obtained)
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0,1
SC	Special case

^ Omission sign
MR Misread
Highlighting is also available to highlight any particular points on a script.

15. The comments box will be used by the Principal Examiner to explain his or her marking of the practice scripts for your information. Please refer to these comments when checking your practice scripts.

    Please do not type in the comments box yourself. Any questions or comments you have for your Team Leader should be communicated by the *scoris* messaging system, e-mail or by telephone.

16. Write a brief report on the performance of the candidates. Your Team Leader will tell you when this is required. The Assistant Examiner's Report Form (AERF) can be found on the Cambridge Assessment Support Portal. This should contain notes on particular strengths displayed, as well as common errors or weaknesses. Constructive criticisms of the question paper/mark scheme are also appreciated.

17. Link Additional Objects with work relating to a question to those questions (a chain link appears by the relevant question number) – see scoris assessor Quick Reference Guide page 19-20 for instructions as to how to do this – this guide is on the Cambridge Assessment Support Portal and new users may like to download it with a shortcut on your desktop so you can open it easily! For AOs containing just formulae or rough working not attributed to a question, tick at the top to indicate seen but not linked. When you submit the script, *scoris* asks you to confirm that you have looked at all the additional objects. Please ensure that you have checked all Additional Objects thoroughly.

18. The schedule of dates for the marking of this paper is displayed under 'OCR Subject Specific Details' on the Cambridge Assessment Support Portal. It is vitally important that you meet these requirements. If you experience problems that mean you may not be able to meet the deadline then you must contact your Team Leader without delay.

Q1				
(i)	$P(X<146) = P(Z < \frac{146-144}{2.6}) = P(Z < 0.769\ldots)$ $= \Phi(0.769\ldots)$ $= 0.779$	M1 standardising M1 correct tail A1	**3**	Allow numerator reversed Do not allow 0.7794
(ii)	From tables $\Phi^{-1}(0.88) = 1.1750$ $\frac{k-144}{2.6} = 1.1750$ $k = 144 + 2.6 \times 1.1750 = 147.1$	B1 M1 A1	**3**	Allow -1.175 Equation as seen or equivalent Allow 147.055 and 147
(iii)	Total , $T \sim N(144+144+144+144, 2.6^2+2.6^2+2.6^2+2.6^2)$ i.e. N(576, 27.04) $P(T < 568) = P(Z < -1.538\ldots)$ $= 1 - \Phi(1.538\ldots) = 1 - 0.9380$ $= 0.0620$	B1 mean B1 variance M1 A1	**4**	Sensible attempt at probability with incorrect mean and variance can get M1 A0
(iv)	Let L = the number of large loaves containing less than 568 grams of flour $L \sim B(5, 0.062)$ $P(L \geq 1) = 1 - P(L = 0)$ $= 1 - 0.9380^5$ $= 0.274$	M1 attempt to use $B(5, p)$ SOI M1 A1 FT	**3**	Any p $1 - p^5$ FT p from part (iii)
			13	

Q2				
(i)	H_0: population median = 25 H_1: population median < 25 Actual differences -1 -4 -7 -2 3 -5 6 -16 11 -12 -10 -8 Associated ranks 1 4 7 2 3 5 6 12 10 11 9 8 T^- = 1 + 4 + 7 + 2 + 5 + 12 + 11 + 9 + 8 = 59 T^+ = 3 + 6 + 10 = 19 $\therefore$ T = 19 From n = 12 tables – at the 5% level of significance in a one-tailed Wilcoxon single sample test, the critical value of T is 17 19 > 17 $\therefore$ the result is not significant The evidence does not suggest that there has been a reduction in the average number of scorched leaves – the vineyard owner may not have achieved his aim.	B1 B1 B1 M1 A1 **cao** B1(condone omission if T = 19 used) B1 B1 M1 (use of n = 12) B1 for critical value M1 for a comparison leading to a conclusion A1 conclusion in context	12	B1B0 if 'population' omitted All correct M1 for attempt at **ranking differences** Follow through on the next two B marks only if M1 earned and if $T^+ + T^- = 78$. FT B1 for their T provided that $T^+ + T^- = 78$
(ii)	Sample is assumed to be random	B1	1	Condone 'data' is random
			13	

Q3				
(i)	Estimate for pop^n mean = $\frac{96.6+99.4}{2} = 98$ $98 + 2.145 \times \frac{s}{\sqrt{15}} = 99.4$ $s^2 = 6.391$ ($s = 2.528$)	M1 B1 for 2.145 M1 equation M1 (attempt to solve for s) A1	**5**	If 1.96 is used then allow both M1s but not B1 or final A1 Equation must be fully correct/. Dependent on previous M1
(ii)	The lower bound of this interval is greater than 85, suggesting that the mean scallop size has increased. The upper bound of this interval is still below 110, suggesting that the mean scallop size is still below the legal minimum.	E1 E1	**2**	
(iii)	$H_0 : \mu = 110$ $H_1 : \mu > 110$ Where μ is the population mean scallop size $\bar{x} = 112.0833$ $s_{n-1} = 4.166\ldots$ $t = \frac{112.08\ldots - 110}{s_{n-1}/\sqrt{12}} = 1.732$ (4s.f.) 11 degrees of freedom At 5% level, critical value of t is 1.796 1.732 < 1.796 so the result is not significant. The evidence does not suggest that the mean scallop size exceeds the legal minimum.	B1 B1 B1 (both) M1 A1 FT B1 B1cao M1 A1FT	**9**	Allow B1B0 if 'mean' is used in place of μ FT their estimates FT only if correct cv or 1.782 is used
			16	

<table>
<tr><td>Q4</td><td></td><td></td><td></td><td></td></tr>
<tr><td>(i)</td><td>H_0: there is no association between location and bill shape
H_1: there is an association between location and bill shape

Expected frequencies
<table><tr><th colspan="2" rowspan="2">Expected frequencies</th><th colspan="2">Bill shape</th></tr><tr><th>Blunt</th><th>Pointed</th></tr><tr><td rowspan="3">Location</td><td>Shoreline</td><td>18.457</td><td>19.543</td></tr><tr><td>Mudflats</td><td>25.257</td><td>26.743</td></tr><tr><td>Inland field</td><td>24.286</td><td>25.714</td></tr></table>
Contributions to X^2
<table><tr><th colspan="2" rowspan="2">Contributions</th><th colspan="2">Bill shape</th></tr><tr><th>Blunt</th><th>Pointed</th></tr><tr><td rowspan="3">Location</td><td>Shoreline</td><td>3.9540</td><td>3.7344</td></tr><tr><td>Mudflats</td><td>4.1654</td><td>3.9340</td></tr><tr><td>Inland field</td><td>0.1210</td><td>0.1142</td></tr></table>
$X^2 = 16.023$
2 degrees of freedom
Critical value for 5% significance level is 5.991
As 16.023 > 5.991 the result is significant

There is evidence of an association between location and bill shape.</td><td>B1 (both)

M1
A1

M1
A1cao

A1cao
B1
B1cao
M1
A1FT

A1FT</td><td>11</td><td>Allow M1 for a sensible comparison</td></tr>
</table>

Q4				
(ii)	Shoreline – large contribution indicates a positive association with blunt tips (more blunt tip than expected) Mudflats – Large contribution indicates a negative association with blunt tips (fewer blunt tip than expected) Inland – low contributions indicate observed frequencies were in keeping with what would be expected if there were no association between location and bill shape.	B1 B1 B1	**3**	Some reference to specific contributions is required in order for candidates to earn these marks. If no reference to contributions is made (e.g. reference is only to observed and expected frequency) then award max B1 for a correct statement e.g. more blunt tip than expected at the shoreline
			14	

Q5				
(i)	$\Sigma fx \div \Sigma f = 75 \div 60$ $= 1.25$	M1 A1	**2**	
(ii)	Mean of B(5, p) = $5p$ $5p = 1.25 \Rightarrow p = 1.25 \div 5 = 0.25$ (A.G.)	M1 (using $5p$) A1 (allow $p = 75/300$)	**2**	If no equation in p seen then award SC1 for 1.25/5
(iii)	Need to merge the final three cells due to low expected frequencies. A further restriction results from p being estimated from the sample data.	B1 B1 B1	**3**	
(iv)	Critical value is 4.605 Result is not significant. Do not reject H_0. The evidence suggests that this binomial model is a good fit.	B1 B1 B1	**3**	
(v) *A*	$0.6472 - 0.4232$ $= 0.224$	M1 A1		Finding P($X = 3$)
B	$\lambda = 6$ $1 - P(X \leq 2) = 1 - 0.062$ $= 0.938$	B1 M1 probability structure A1cao	**5**	
(vi)	The calls are likely to arrive randomly and independently of each other	B1	**1**	Must be in context
			16	

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G242 Statistics 2

General Comments

The majority of candidates showed a good understanding of a variety of statistical techniques. There was little evidence of candidates being short of time to complete the paper.

Comments on Individual Questions

Q1 i Well answered.

Q1 ii Well answered. Some candidates used -1.175 (in place of +1.175) and others failed to find a *z*-value at all and were thus heavily penalised.

Q1 iii Poorly answered. Very few candidates knew how to handle this question involving the sum of Normal variables.

Q1 iv Following on from incorrect answers to part (iii) many candidates managed to carry out appropriate calculations with their incorrect values.

Q2 i Well answered. Commonly, candidates failed to include the word 'population' in their hypotheses and some used the symbol 'μ' which was deemed inappropriate. A few candidates failed to rank their 'differences', causing loss of several marks. Generally, conclusions were justified and set out clearly; it should be noted that it is preferable to comment on the suitability of the alternative hypothesis in conclusions to hypothesis tests, than to make an overly-assertive statement about H_0 such as "the evidence shows that the median number of scorched leaves is still 25".

Q2 ii Many candidates provided spurious comments here.

Q3 i Few candidates scored well here; the information that the given confidence interval was based on the *t* distribution was seemingly not noticed by many, as 1.96 was seen regularly. Few candidates realised that the sample mean could be deduced by taking the mid-point of the interval.

Q3 ii Though many candidates seemed to know what was required their answers were often unclear and in many cases incorrect.

Q3 iii Reasonably well answered. Commonly, marks were lost in calculating the sample standard deviation, using incorrect critical values and making incorrect conclusions despite having correct working.

Q4 i Well answered. Occasional errors occurred in calculating contributions to the test statistic and in determining the number of degrees of freedom. A few lost marks for failing to provide context in hypotheses and/or conclusions.

Q4ii Poorly answered. Despite the clear instruction in the question, most candidates failed to make any reference to 'contributions to the test statistic' in their answers.

Q5 i Well answered. A variety of acceptable approaches were seen.

Q5 ii Few candidates provided a convincing justification for using 0.25 as the value of p to use. The instruction 'Show that' was meant to encourage candidates to show some form of justification for the given answer – ideally in the form of an equation involving p.

Q5 iii Poorly answered. Many candidates understood the need to merge cells but did not provide the reason for this being necessary. Very few candidates understood that a further restriction was needed due to the parameter being estimated.

Q5 iv Poorly answered. Conclusions were often incorrect or poorly worded.

Q5 v Poorly answered. Many candidates used an incorrect mean in both parts of the question.

Q5 vi Many answers were not 'in context' and also not very clear in their meaning.

GCE Science (AS only)

			Max Mark	a	b	c	d	e	u
G641/01	Remote Sensing and the Natural Environment	Raw	60	45	40	35	31	27	0
		UMS	90	72	63	54	45	36	0
G642/01	Science and Human Activity	Raw	100	70	62	54	46	38	0
		UMS	150	120	105	90	75	60	0
G643/01	Practical Skills in Science	Raw	40	33	30	27	25	23	0
		UMS	60	48	42	36	30	24	0

GCE Sociology

			Max Mark	a	b	c	d	e	u
G671/01	Exploring Socialisation, Culture and Identity	Raw	100	73	66	59	53	47	0
		UMS	100	80	70	60	50	40	0
G672/01	Topics in Socialisation, Culture and Identity	Raw	100	71	63	55	47	39	0
		UMS	100	80	70	60	50	40	0
G673/01	Power and Control (A2)	Raw	100	70	62	54	47	40	0
		UMS	100	80	70	60	50	40	0
G674/01	Exploring Social Inequality and Difference (A2)	Raw	100	70	62	54	47	40	0
		UMS	100	80	70	60	50	40	0

GCE Spanish

			Max Mark	a	b	c	d	e	u
F721/01	Spanish: Speaking (AS): Externally Marked (OCR Repository)	Raw	60	46	41	36	31	26	0
F721/02	Spanish: Speaking (AS): Externally Marked (CD)	Raw	60	46	41	36	31	26	0
F721/03	Spanish: Speaking (AS): Visiting Examiner	Raw	60	46	41	36	31	26	0
F721	Spanish: Speaking	UMS	60	48	42	36	30	24	0
F722/01	Spanish: Listening, Reading and Writing 1	Raw	140	106	94	82	71	60	0
		UMS	140	112	98	84	70	56	0
F723/01	Spanish: Speaking (A2): Externally Marked (OCR Repository)	Raw	60	47	41	35	30	25	0
F723/02	Spanish: Speaking (A2): Externally Marked (CD)	Raw	60	47	41	35	30	25	0
F723/03	Spanish: Speaking (A2): Visiting Examiner	Raw	60	47	41	35	30	25	0
F723	Spanish: Speaking	UMS	60	48	42	36	30	24	0
F724/01	Spanish: Listening, Reading and Writing 2 (A2)	Raw	140	101	89	77	65	54	0
		UMS	140	112	98	84	70	56	0

GCE Statistics (MEI)

			Max Mark	a	b	c	d	e	u
G241/01	(Z1) Statistics 1	Raw	72	53	45	38	31	24	0
		UMS	100	80	70	60	50	40	0
G242/01	(Z2) Statistics 2	Raw	72	55	48	41	34	27	0
		UMS	100	80	70	60	50	40	0
G243/01	(Z3) Statistics 3	Raw	72	56	48	41	34	27	0
		UMS	100	80	70	60	50	40	0