OCR
RECOGNISING ACHIEVEMENT

Thursday 6 June 2013 – Morning

AS GCE MEI STATISTICS

G242/01 Statistics 2 (Z2)

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book G242/01
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

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. HB 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**.
- This 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 recycled. Please contact OCR Copyright should you wish to re-use this document.

1 A health care inspector is monitoring the occurrence of the 'superbug' MRSA in a large hospital. Each day, he checks for the presence of MRSA in different areas of the hospital and records the number of areas where MRSA is detected. The following table summarises the results for a random sample of 300 days.

Number of areas where MRSA is detected	0	1	2	3	4
Observed frequency	86	108	74	24	8

(i) Show that the sample mean is 1.2. Given also that the sample standard deviation is 1.03, explain why the Poisson distribution may provide a suitable model for these data. **[3]**

The inspector wishes to test the goodness of fit of a Poisson model. The mean calculated from the data is used as an estimate for the mean of the underlying population to produce the following expected frequencies.

Number of areas where MRSA is detected	0	1	2	3	$\geqslant 4$
Expected frequency	90.36	108.43	65.06	26.02	10.13

(ii) Show how the expected frequency of 90.36 for 0 areas containing MRSA is calculated. **[3]**

(iii) Carry out the test of the goodness of fit of the Poisson model at the 5% level of significance. **[9]**

2 A gas boiler manufacturer is working to improve its domestic hot water boilers. It wishes to ensure that the boilers heat water as quickly as possible. New boilers are tested in controlled conditions by measuring the temperature of the water after 15 seconds of heating. The resulting temperatures, in degrees Celsius, for a random sample of 8 observations are as follows.

51.0 50.7 49.8 50.4 50.6 50.8 49.3 50.6

It is required to produce a confidence interval for the population mean temperature using these data.

(i) Stating a necessary assumption, explain why a confidence interval based on the *t* distribution is more appropriate, in this case, than a confidence interval based on the Normal distribution. **[4]**

(ii) Obtain a 95% confidence interval, based on the *t* distribution, for the population mean temperature. **[7]**

The manufacturer aims to produce a boiler that, in 15 seconds, heats water to 50 degrees Celsius on average.

(iii) With reference to the confidence interval found in part **(ii)**, comment on whether the manufacturer has been successful in its aim. **[2]**

3 A musical instrument manufacturer is developing a new range of violin strings made from a synthetic material. Part of the development process involves testing breaking strength. The breaking strengths of a random sample of 12 strings are measured. The results, in suitable units, are as follows.

347 345 349 348 350 349 349 344 354 347 351 350

(i) Explain, with reference to the sample, whether or not you think that these data could have an underlying Normal distribution. **[2]**

It is required that the mean breaking strength of synthetic strings should not be below 350.

(ii) Given that the sample standard deviation is 2.678, use a t test to examine, at the 5% significance level, whether this sample provides evidence that the mean breaking strength of these synthetic strings is below the minimum requirement. **[11]**

4 'Cool Milk Dairy' offers a delivery service for its milk. Milk is delivered each day in glass bottles. Empty bottles are collected so that they can be washed and used again. The dairy manager is monitoring the return of bottles to ensure there are enough bottles in stock to cover future demand. Over a long period of time she has established that, on average, 13 fewer bottles are collected each day than are delivered. For the past six months the dairy has been replacing lost stock with bottles from a different supplier and the dairy manager suspects that the average of 13 might have changed. A daily record of the difference between the number of bottles delivered, x, and the number of empty bottles collected, y, is kept. The differences, $x - y$, for ten consecutive days are as follows.

25 3 4 17 18 11 19 14 20 24

(i) Stating any necessary assumptions, use a Wilcoxon test to examine, at the 5% significance level, whether these data support the dairy manager's suspicions. **[13]**

(ii) Comment on the validity of any assumptions made in part **(i)**. **[2]**

[Question 5 is printed overleaf.]

5 A sea ferry operator is working to improve punctuality on one of its sailing routes. It decides to test for an association between the sea condition at the time of sailing and punctuality. The punctuality and sea condition of a random sample of 200 ferry crossings are recorded. The results are as follows.

		Punctuality	
		Not late	Late
Sea condition	Rough	36	12
	Moderate	91	12
	Slight	44	5

The following tables show some of the expected frequencies and contributions to the test statistic.

Expected frequencies		Punctuality	
		Not late	Late
Sea condition	Rough	41.040	6.960
	Moderate	88.065	
	Slight	41.895	

Contributions to the test statistic		Punctuality	
		Not late	Late
Sea condition	Rough	0.6189	3.6497
	Moderate	0.0978	
	Slight	0.1058	

(i) Calculate the remaining expected frequencies and contributions. Carry out the test using a 5% level of significance. **[11]**

The journey times for this particular route may be modelled using a Normal distribution with mean 160 minutes and standard deviation 5.5 minutes.

(ii) Given that the ferry departs at 08:30 and is scheduled to arrive at 11:15, find the probability that it is not late. **[5]**

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RECOGNISING ACHIEVEMENT

Thursday 6 June 2013 – Morning

AS GCE MEI STATISTICS

G242/01 Statistics 2 (Z2)

PRINTED ANSWER BOOK

G21600061 3

Candidates answer on this Printed Answer Book.

OCR supplied materials:
- Question Paper G242/01 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

G 2 4 2 0 1

Candidate forename		Candidate surname	

Centre number						Candidate number				

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1 (i)	
1 (ii)	

1 (iii)	

2 (i)

2 (ii)

(answer space continued on next page)

2 (ii)	**(continued)**
2 (iii)	

3 (i)

3 (ii)

(answer space continued on next page)

3 (ii)	**(continued)**

4 (i)	
	(answer space continued on next page)

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

5 (i)

Expected frequencies		Punctuality	
		Not late	Late
Sea condition	Rough	41.040	6.960
	Moderate	88.065	
	Slight	41.895	

Contributions to the test statistic		Punctuality	
		Not late	Late
Sea condition	Rough	0.6189	3.6497
	Moderate	0.0978	
	Slight	0.1058	

(answer space continued on next page)

5 (i)	**(continued)**
5 (ii)	

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RECOGNISING ACHIEVEMENT

GCE

Statistics (MEI)

Advanced Subsidiary GCE

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

Mark Scheme for June 2013

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, 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.

Annotations and abbreviations

Annotation in scoris	Meaning
 and 	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
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	

Other abbreviations in mark scheme	Meaning
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
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working

Subject-specific Marking Instructions for GCE Mathematics (MEI) Statistics strand

a. 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.

b. 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.

c. 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.

d. 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.

e. 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.

f. 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.

g. Rules for replaced work

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 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.

h. 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.

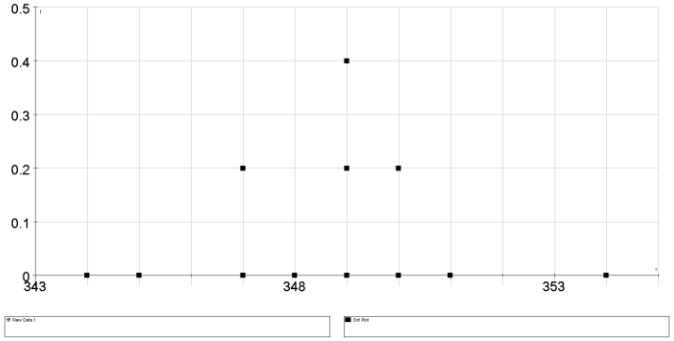
A misread may be of a symbol rather than a number – for example, an algebraic symbol in a mathematical expression. Such misreads are more likely to bring about a considerable change in the object and/or difficulty of the question; but, if they do not, they should be treated as far as possible in the 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.

Question			Answer	Marks	Guidance	
1	(i)		$\Sigma fx \div \Sigma f = 360 \div 300$	M1	(=1.2 answer given)	Allow if calculation shown in full
				A1		
			Variance = $1.03^2 = 1.0609$			
			Mean is approximately equal to variance	E1	NB clear comparison with variance	
				[3]		
1	(ii)		Using $X \sim$ Poisson(1.2)	M1	for attempt at P(X = 0) using Poisson pdf or tables	
			$P(X = 0) = e^{-1.2}$			
			= 0.3012	A1		
			0.3012×300 (= 90.36 A.G.)	B1		Do not allow 300 - Σothers
				[3]		
1	(iii)		H_0: The Poisson model is suitable	B1		Allow "the Poisson distribution is suitable"
			H_1: The Poisson model is not suitable			
				M1	Attempt at $(f_o - f_e)^2 \div f_e$	
				A1	Contributions (approx): 0.2102 0.0017 1.2291 0.1573 0.4481	
			Test statistic = 2.0464	A1	Test statistic in range 2.04 – 2.05	
			Number of degrees of freedom = 3	B1	5 – 1 – 1	
			Critical value = 7.815	B1	No further marks if critical value incorrect	
			2.0464 < 7.815	M1		
			Result is not significant.	A1		
			The evidence does not suggest that this Poisson model is not a good fit to these data	E1		
				[9]		

Question			Answer	Marks	Guidance	
2	(i)		Sample too small to base CI on Normal distribution Variance unknown Assume Normality … … of underlying population	 E1 E1 E1* E1dep* **[4]**		 Condone underlying Normal distribution Do not allow "… of the data"
2	(ii)		Sample mean = 50.4 Sample standard deviation = 0.568 (3 s.f.) $50.4 \pm 2.365 \times \frac{0.5682..}{\sqrt{8}}$ (49.92, 50.88)	B1 B1 M1 B1 M1 A1 A1 **[7]**	 Centred on 50.4 2.2365 Structure Max 3 d.p.	 Including value from *t* tables.
2	(iii)		As the CI contains 50, it appears that the manufacturer may have been successful in its aim.	E1* E1dep* **[2]**	Allow other sensible comments	

Question			Answer	Marks	Guidance	
3	(i)		Sensible comment with justification. e.g. Data symmetrically distributed (may use a diagram such as a dot plot) and so there may be an underlying Normal distribution.  	E1 E1 **[2]**	Allow "most points are in the middle with a few large and small points". For judgement regarding Normality.	Condone "the majority of points are around the mean"
3	(ii)		H_0: $\mu = 350$ H_1: $\mu < 350$ Where μ represents the population mean breaking strength of these synthetic strings. Sample mean = $4183/12$ (348.583…) $t = \dfrac{4183/12 - 350}{2.678/\sqrt{12}}$ = - 1.833 11 degrees of freedom At 5% level, critical value of t is 1.796 - 1.833 < - 1.796 so the result is significant Evidence suggests the mean breaking strength is below the minimum requirement	B1 B1 B1 B1 M1 A1 B1 B1 M1 A1 A1 **[11]**	Hypotheses in words must refer to population CAO Allow -1.83 No further marks if cv incorrect	Allow -1.84 from use of 348.58

Question			Answer	Marks	Guidance	
4	(i)		Assume that the underlying population [of differences] is distributed symmetrically …	B1		
			… and the sample is random.	B1		
			H_0: population median = 13	B1		
			H_1: population median ≠ 13	B1	If "population" not stated then B0B1.	
			Actual differences 12 -10 -9 4 5 -2 6 1 7 11	B1		
			Associated ranks 10 8 7 3 4 2 5 1 6 9	M1 A1	M1 for valid attempt at ranking	
			$T^- = 8 + 7 + 2 = 17$	M1	M1 for finding sum of ranks	$T^+ = 10 + 3 + 4 + 5 + 1 + 6 + 9 = 38$
			$\therefore T = 17$	A1		
			From $n = 10$ tables – at the 5% level of significance in a two-tailed Wilcoxon single sample test, …	M1	Use of $n = 10$	
			… the critical value of T is 8	A1	No further marks if cv incorrect.	
			$17 > 8 \therefore$ the result is not significant	M1		
			The evidence does not suggest that there has been a change in the average of the difference between the number of bottles delivered and the number of bottles collected each day.	A1 **[13]**	Non-assertive conclusion, in context.	Condone "suggests that the population median is 13 "
4	(ii)		e.g. there are not enough data to see whether the underlying distribution could be symmetrical.	E1	Sensible comment relating to shape of distribution.	
			e.g. sample not random as all observations were made on consecutive days.	E1 **[2]**	Sensible comment relating to the randomness of the sample.	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th colspan="2">Guidance</th></tr>
<tr><td>5</td><td>(i)</td><td></td><td>H_0: No association between sea condition and punctuality.
H_1: There is an association between sea condition and punctuality.

<table><tr><th colspan="2" rowspan="2">Expected frequencies</th><th colspan="2">Punctuality</th></tr><tr><th>Not late</th><th>Late</th></tr><tr><td rowspan="3">Sea condition</td><td>Rough</td><td>41.040</td><td>6.960</td></tr><tr><td>Moderate</td><td>88.065</td><td>14.935</td></tr><tr><td>Slight</td><td>41.895</td><td>7.105</td></tr></table>
<table><tr><th colspan="2" rowspan="2">Contributions to the test statistic</th><th colspan="2">Punctuality</th></tr><tr><th>Not late</th><th>Late</th></tr><tr><td rowspan="3">Sea condition</td><td>Rough</td><td>0.6189</td><td>3.6497</td></tr><tr><td>Moderate</td><td>0.0978</td><td>0.5768</td></tr><tr><td>Slight</td><td>0.1058</td><td>0.6236</td></tr></table>
$X^2 = 5.673$

2 degrees of freedom
Critical value for 5% significance level is 5.991

As 5.673 < 5.991 the result is not significant

There is no evidence to suggest an association between sea condition and punctuality.</td><td>B1

M1 A1

M1
A1

A1

B1
B1

M1 A1

A1

[11]</td><td>No FT from here if incorrect.

Condone “the evidence suggests that there is no association between sea condition and punctuality”.</td><td></td></tr>
<tr><td>5</td><td>(ii)</td><td></td><td>Attempt to find P(sailing time < 165)
P(sailing time < 165) = $P(Z < \frac{165-160}{5.5})$
= P(Z < 0.9091)
= Φ(0.9091)
= 0.8182</td><td>B1
M1*

A1
M1dep*
A1
[5]</td><td>Standardising

For 0.9091
Correct use of Normal tables
Allow 0.8184 and 0.8183</td><td></td></tr>
</table>

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OCR
RECOGNISING ACHIEVEMENT

GCE

Statistics (MEI)

Advanced Subsidiary GCE **AS H132**

OCR Report to Centres

June 2013

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, 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 report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

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

G242 Statistics 2

General Comments

Many candidates appeared to be well-prepared for this paper and managed to complete all questions, satisfactorily, in the time available. A small number of candidates made little or no attempt at any of the questions. Though there was evidence of uncertainty about underlying distributional assumptions and the key differences between the types of test used, most candidates coped well and could manage to carry out the different techniques required. The overall quality of the entry for this module has improved.

Comments on Individual Questions

1)(i) Generally well-answered. The most common mistake was to compare mean with standard deviation in order to justify the use of a Poisson model.

1)(ii) Many fully correct answers were provided. Some candidates failed to make a start on this question or tried to adopt a Chi-squared test approach. As the intention was for candidates to use the Poisson pdf, or tables, in their working, those using 300 – Σ(other expected frequencies) were not given credit.

1)(iii) Most candidates provided correct hypotheses though some got them the wrong way round. Many candidates accurately calculated the test statistic. In conclusions, many suitable, non-assertive comments were seen; some candidates reached the wrong conclusion (i.e. rejected the null hypothesis). A significant number of candidates failed to take account of the estimated parameter when working out the number of degrees of freedom.

2)(i) Most candidates gained some credit on this question though answers were not always complete. Candidates were familiar with the small sample/unknown population variance conditions for using the *t* distribution though the assumption, “Normality of the underlying population”, was often not stated.

2)(ii) Fully correct answers were seen, though many used percentage points from the Standard Normal distribution rather than the *t* distribution as requested and were, consequently, penalised. In general, candidates managed to obtain the sample mean and centre their confidence interval on it. Most also managed to calculate the sample standard deviation correctly.

2)(iii) Overall, candidates did not answer this well. Many realised that they were expected to see if the confidence interval contained the required population mean, 50, and interpret the outcome, though some commented that the interval contained the “sample” mean.

3)(i) Though several good responses were seen, many struggled to understand what was required or found it difficult to explain their ideas clearly.

3)(ii) Most candidates picked up a lot of marks here. Marks were commonly lost in stating hypotheses; in particular when hypotheses were stated in words rather than symbols, as the key word “population” was usually omitted. The sample mean and test statistic were found correctly by most. Of those using 11 degrees of freedom, most found the correct critical value though not all managed to complete the test correctly, with inappropriate comparisons made and incorrect conclusions drawn.

4)(i) Again, many high marks were seen in this part. Common errors included incorrect or omitted assumptions. Many realised the need for the sample to be random but then went on to say that the data in the sample must be assumed to be Normally distributed rather than referring to the underlying population. In stating hypotheses, "population" was frequently omitted. Those candidates who obtained the differences between the sample values and 13 generally managed to score most of the remaining marks. Though correct test statistic and critical value were obtained, some candidates thought that 17 > 8 meant that the result was significant. Candidates should be aware that tied ranks should not occur in this paper (and so look for errors on their part when this happens).

4)(ii) As many candidates did not state correct assumptions in part (i) they could not pick up the marks here. Those that did state correct assumptions in part (i) still found this difficult. Of the two marks, the mark for commenting on the randomness of the sample was more frequently given.

5)(i) This was well-answered. Most candidates picked up marks for calculating the remaining expected frequencies and contributions. Most candidates correctly identified that there were 2 degrees of freedom, though some failed to state this. Some candidates switched the hypotheses round though most got these correct. Again, in a few cases, there was some uncertainty over whether to accept or reject the null hypothesis using the values obtained.

5)(ii) Many candidates did not manage to work out that there are 165 minutes between 08:30 and 11:15. Of those that did, many obtained all 5 marks. Others managed to attempt to use the Normal distribution, usually obtaining a Z-value of 0.9091. Of these, some calculated $P(Z > 0.9091)$ rather than $P(Z < 0.9091)$ and others used inappropriate rounding and lost accuracy.

For a description of how UMS marks are calculated see:
www.ocr.org.uk/learners/ums_results.html

Unit level raw mark and UMS grade boundaries June 2013 series
AS GCE / Advanced GCE / AS GCE Double Award / Advanced GCE Double Award

GCE Mathematics (MEI)

			Max Mark	a	b	c	d	e	u
4751/01	(C1) MEI Introduction to Advanced Mathematics	Raw	72	62	56	51	46	41	0
		UMS	100	80	70	60	50	40	0
4752/01	(C2) MEI Concepts for Advanced Mathematics	Raw	72	54	48	43	38	33	0
		UMS	100	80	70	60	50	40	0
4753/01	(C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	58	52	46	40	33	0
4753/02	(C3) MEI Methods for Advanced Mathematics with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4753/82	(C3) MEI Methods for Advanced Mathematics with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
4753	(C3) MEI Methods for Advanced Mathematics with Coursework	UMS	100	80	70	60	50	40	0
4754/01	(C4) MEI Applications of Advanced Mathematics	Raw	90	66	59	53	47	41	0
		UMS	100	80	70	60	50	40	0
4755/01	(FP1) MEI Further Concepts for Advanced Mathematics	Raw	72	63	57	51	45	40	0
		UMS	100	80	70	60	50	40	0
4756/01	(FP2) MEI Further Methods for Advanced Mathematics	Raw	72	61	54	48	42	36	0
		UMS	100	80	70	60	50	40	0
4757/01	(FP3) MEI Further Applications of Advanced Mathematics	Raw	72	60	52	44	36	28	0
		UMS	100	80	70	60	50	40	0
4758/01	(DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	62	56	51	46	40	0
4758/02	(DE) MEI Differential Equations with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4758/82	(DE) MEI Differential Equations with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
4758	(DE) MEI Differential Equations with Coursework	UMS	100	80	70	60	50	40	0
4761/01	(M1) MEI Mechanics 1	Raw	72	57	49	41	33	25	0
		UMS	100	80	70	60	50	40	0
4762/01	(M2) MEI Mechanics 2	Raw	72	50	43	36	29	22	0
		UMS	100	80	70	60	50	40	0
4763/01	(M3) MEI Mechanics 3	Raw	72	64	56	48	41	34	0
		UMS	100	80	70	60	50	40	0
4764/01	(M4) MEI Mechanics 4	Raw	72	56	49	42	35	29	0
		UMS	100	80	70	60	50	40	0
4766/01	(S1) MEI Statistics 1	Raw	72	55	48	41	35	29	0
		UMS	100	80	70	60	50	40	0
4767/01	(S2) MEI Statistics 2	Raw	72	58	52	46	41	36	0
		UMS	100	80	70	60	50	40	0
4768/01	(S3) MEI Statistics 3	Raw	72	61	55	49	44	39	0
		UMS	100	80	70	60	50	40	0
4769/01	(S4) MEI Statistics 4	Raw	72	56	49	42	35	28	0
		UMS	100	80	70	60	50	40	0
4771/01	(D1) MEI Decision Mathematics 1	Raw	72	58	52	46	40	35	0
		UMS	100	80	70	60	50	40	0
4772/01	(D2) MEI Decision Mathematics 2	Raw	72	58	52	46	41	36	0
		UMS	100	80	70	60	50	40	0
4773/01	(DC) MEI Decision Mathematics Computation	Raw	72	46	40	34	29	24	0
		UMS	100	80	70	60	50	40	0
4776/01	(NM) MEI Numerical Methods with Coursework: Written Paper	Raw	72	56	50	44	38	31	0
4776/02	(NM) MEI Numerical Methods with Coursework: Coursework	Raw	18	14	12	10	8	7	0
4776/82	(NM) MEI Numerical Methods with Coursework: Carried Forward Coursework Mark	Raw	18	14	12	10	8	7	0
4776	(NM) MEI Numerical Methods with Coursework	UMS	100	80	70	60	50	40	0
4777/01	(NC) MEI Numerical Computation	Raw	72	55	47	39	32	25	0
		UMS	100	80	70	60	50	40	0
4798/01	(FPT) Further Pure Mathematics with Technology	Raw	72	57	49	41	33	26	0
		UMS	100	80	70	60	50	40	0

GCE Statistics (MEI)

			Max Mark	a	b	c	d	e	u
G241/01	(Z1) Statistics 1	Raw	72	55	48	41	35	29	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