

ADVANCED SUBSIDIARY GCE

MEI STATISTICS

Statistics 2 (Z2)

G242

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

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- 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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Candidate forename		Candidate surname	
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Centre number						Candidate number				
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1 (i)	
1 (ii)	

2 (i)	(continued)
2 (ii)	

4 (i)	(continued)
4 (ii)	

5 (i)	
5 (ii)	

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



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