OCR
Oxford Cambridge and RSA

Wednesday 3 June 2015 – 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

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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 **8** 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 An engineering company is developing a device to convert tidal energy into electricity. To be viable, the device should produce, on average, 8000 units of electricity per day. The device is tested over a period of several months. The number of units of electricity generated per day on 10 particular days is as follows.

8970 7830 8303 8045 8641 7942 8701 8670 7840 8532

(i) Stating any necessary assumptions, use a Wilcoxon test to examine, at the 5% significance level, whether these data suggest that this device produces more than the required 8000 units of electricity per day on average. **[13]**

Having established Normality of the underlying population, the engineering company decides to carry out a hypothesis test for the population mean.

(ii) State, giving reasons, the test that should be used. **[2]**

2 A food standards officer is investigating the level of salt contained in a particular brand of biscuit. The officer is concerned that, on average, these biscuits contain more than the claimed amount of 0.16 g per biscuit. The officer selects a random sample of 200 biscuits and measures the amount of salt, x g, contained in each biscuit. The results are summarised as follows.

$$\sum x = 34.70 \qquad \sum x^2 = 6.737$$

(i) Calculate the sample mean and show that an estimate for the population variance is 0.00360 correct to 3 significant figures. **[3]**

(ii) Use a test based on the Normal distribution to examine, at the 10% significance level, whether the officer's concern is justified. **[8]**

(iii) Explain why a test based on the Normal distribution is appropriate in this case. **[1]**

(iv) For a test, also carried out at the 10% level, on a different brand of biscuit, the officer summarised a significant result as follows.

This proves that the mean amount of salt exceeds the stated value.

Comment briefly on the wording used in the officer's summary. **[2]**

3 An astronomer is investigating the arrival of photons from a distant astronomical source. The number of photons detected each second during a period of 10 minutes is recorded. The results are shown in the following table.

Number of photons detected each second	0	1	2	3	4	5
Observed frequency	157	220	152	54	15	2

(i) Describe the conditions required for a Poisson distribution to be an appropriate model for the number of photons detected each second. **[2]**

The astronomer decides to use these data to carry out a test of the goodness of fit of the Poisson model, using a mean of 1.26 calculated from the data. Some of the expected frequencies are shown in the table below.

Number of photons detected each second	0	1	2	3	4	$\geqslant 5$
Expected frequency	170.19	214.44	135.10	56.74		

(ii) Calculate the remaining expected frequencies. **[5]**

(iii) Carry out the test using a 5% level of significance. **[8]**

[Questions 4 and 5 are printed overleaf.]

4 A cycle racing team coach is investigating the performance of bicycles with tyres which are inflated to higher than usual pressure. She believes that the performance will be improved on some types of road surface when compared with the average result for tyres inflated to the usual pressure. She decides to carry out a χ^2 test to investigate whether there is an association between bicycle performance and type of road surface. The performance and type of road surface for a random sample of 125 test runs are recorded. The results are as follows.

		Bicycle performance		
		Worse	Same	Improved
Type of road surface	Smooth	3	14	25
	Rough	11	14	10
	Very Rough	19	18	11

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

Expected frequencies		Bicycle performance		
		Worse	Same	Improved
Type of road surface	Smooth	11.088	15.456	15.456
	Rough	9.240		
	Very Rough	12.672		

Contributions to the test statistic		Bicycle performance		
		Worse	Same	Improved
Type of road surface	Smooth	5.8997	0.1372	5.8934
	Rough	0.3352	0.0974	0.6440
	Very Rough	3.1600		

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

(ii) With reference to the contributions to the test statistic, comment briefly on the bicycle performance for each type of road surface. **[3]**

5 Eleanor works in a sugar processing factory. She is responsible for ensuring that the mean weight of sugar per bag does not fall below 1 kg, as labelled. From past experience, she assumes that the weights are Normally distributed.

Eleanor measures the weight, in kg, of sugar in each of a random sample of 8 bags to enable her to calculate a confidence interval for the mean weight of sugar per bag. The results are as follows.

0.998   0.999   0.991   1.005   0.999   0.989   0.998   1.003

(i) Explain why, in this case, it is not appropriate to calculate a confidence interval based on the Normal distribution. **[2]**

(ii) Obtain an appropriate 95% confidence interval for the mean weight of sugar per bag. **[9]**

(iii) Comment briefly on whether Eleanor should be concerned about the weight of sugar per bag. **[3]**

END OF QUESTION PAPER

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