OCR
Oxford Cambridge and RSA

Wednesday 8 June 2016 – 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.** If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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**.
- 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 recycled. Please contact OCR Copyright should you wish to re-use this document.

1 A biologist is studying a particular species of wading bird. She believes that there may be an association between wing length and the time in the migration season when the birds migrate. She decides to carry out a test. A random sample is collected as birds migrate to their breeding grounds. The results are as follows.

		Time of migration	
		Early	Late
Wing length	length $<$ 108 mm	14	8
	108 mm $\leqslant$ length $\leqslant$ 113 mm	11	16
	length $>$ 113 mm	4	19

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

Expected frequencies		Time of migration	
		Early	Late
Wing length	length $<$ 108 mm		13.139
	108 mm $\leqslant$ length $\leqslant$ 113 mm		16.125
	length $>$ 113 mm	9.264	13.736

Contributions to the test statistic		Time of migration	
		Early	Late
Wing length	length $<$ 108 mm		2.0099
	108 mm $\leqslant$ length $\leqslant$ 113 mm		0.0010
	length $>$ 113 mm	2.9910	2.0172

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

The biologist states that 'birds with longer wings migrate later'.

(ii) With reference to the contributions to the test statistic, discuss the biologist's statement. **[3]**

2 An air charter company uses single-engine aircraft which can transport up to 10 passengers and their luggage. The weight, in kg, of luggage transported on each flight with 10 passengers follows a Normal distribution with mean 280 and variance 400.

(i) Calculate the probability that the weight of luggage is more than 250 kg for a particular flight with 10 passengers. **[3]**

The weight, in kg, of individual passengers is Normally distributed with mean 65 and variance 225. You may assume that weights of passengers are independent.

(ii) Calculate the probability that the total weight of 10 passengers does not exceed 700 kg. **[5]**

To meet safety regulations, the total combined weight, T kg, of the 10 passengers and their luggage must not exceed 1020 kg. You may assume that weights of passengers and weights of luggage are independent.

(iii) Show that $T \sim \text{N}(930, 2650)$. **[2]**

(iv) Calculate $\text{P}(T > 1020)$ and draw a diagram showing the area corresponding to this probability. **[3]**

3 A petrochemical company is carrying out an appraisal of a newly discovered oil reservoir to determine whether it is suitable for development. Test rigs are installed at 12 randomly selected sites. The oil pressure at each site is recorded. The results, in appropriate units, are as follows.

187	232	328	201	198	234
287	165	275	149	258	144

The reservoir is considered to be suitable for development if its average pressure exceeds 200.

(i) Stating any necessary assumption, use a Wilcoxon test to examine, at the 5% significance level, whether these data provide evidence that the reservoir is suitable for development. **[12]**

(ii) What further assumption is necessary in order to carry out a hypothesis test on the mean of the underlying population? State, with a reason, the test that would be used. **[3]**

4 A conservation group is monitoring the numbers of dormice present in a large area of woodland. The woodland is divided into squares of equal area. Fifty of these squares are selected and the number of dormice present in each square is recorded. The results are as follows.

Number of dormice	0	1	2	3	4
Observed frequency	13	18	10	6	3

The sample mean for these data is 1.36.

(i) Calculate the sample standard deviation for these data and explain why an investigation of the goodness of fit of a Poisson model might be appropriate. **[3]**

It is decided to carry out a χ^2 test for the goodness of fit of the Poisson model, using a mean of 1.36 calculated from the data. Some of the expected frequencies are shown in the table below.

Number of dormice	0	1	2	3	$\geqslant 4$
Expected frequency	12.833	17.453	11.868		

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

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

5 Keith works in a factory that produces doors for the building trade. He is expected to assemble doors in an average time of 15 minutes per door. He believes that he is assembling doors at a satisfactory rate. Keith records the times taken to assemble 12 doors. The times, in minutes, are as follows.

15	16	13	15	14	15
14	15	16	17	13	14

(i) Calculate the sample mean and obtain an estimate for the variance of the underlying population. **[2]**

Keith wishes to calculate a confidence interval using these data.

(ii) Explain why Keith should base his confidence interval on the *t* distribution rather than the Normal distribution. State any necessary assumptions. **[4]**

(iii) Obtain a 95% confidence interval for the mean assembly time per door. **[6]**

(iv) With reference to the confidence interval found in part **(iii)**, comment briefly on Keith's belief. **[2]**

END OF QUESTION PAPER