OCR

Friday 6 June 2014 – Afternoon

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 inside 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**.
- 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 dietician is investigating a claim that the dietary supplement 'red-yeast rice' can reduce cholesterol levels by 15 units on average. The dietician believes that the reduction will be greater than this. A group of volunteers is given the supplement for a period of eight weeks. The reduction in cholesterol levels of a sample of 10 of these volunteers is measured. The results are as follows.

16	24	27	22	11	13	26	21	18	20

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

(ii) What further assumption is necessary for a test based on the t distribution to be appropriate? **[1]**

2 A medical researcher is investigating alternative methods for determining glucose levels in diabetes patients' blood. The most common method involves taking a small sample of blood; this is accurate but may be stressful for some patients. One alternative method involves measuring the glucose level in tear fluid. To assess the accuracy of this alternative method, the researcher records the difference in values given by the two methods for each of a random sample of 15 patients. The results, in suitable units, are as follows.

0.3	0.5	–0.2	0.8	0.3	–0.1	0.1	–0.2	0.4	–0.1	0.5	0.3	0.4	0.1	–0.7

(i) Given that the sample standard deviation is 0.374, use the t distribution to test, at the 5% significance level, the null hypothesis $\mathrm{H}_0: \mu = 0$ against the alternative hypothesis $\mathrm{H}_1: \mu \neq 0$, where μ represents the mean of the underlying population of differences. **[8]**

Another alternative method for determining blood glucose levels involves a test using ultrasound. The researcher records the difference between the value given by an ultrasound test and the value given by a blood test for a random sample of 12 patients.

(ii) Given that the sample mean is 0.19 and the sample standard deviation is 0.281, calculate a 95% confidence interval based on the t distribution for the mean difference in level given by these two methods. **[5]**

(iii) Given that underlying Normality holds, why is the t distribution required in parts **(i)** and **(ii)**? **[1]**

3 A sports equipment manufacturer produces 'yellow dot' and 'red dot' squash balls. The weights of each type of ball may be assumed to be Normally distributed. The manufacturer carries out regular checks of the production process. The weights, in grams, for a random sample of 10 yellow dot balls are as follows.

23.7 24.2 24.6 24.1 24.3 24.4 23.9 23.8 24.0 24.2

(i) Calculate the sample mean. **[1]**

The weight of a yellow dot ball should be 24 grams.

(ii) Given that the population standard deviation is 0.3 grams, use a test based on the Normal distribution, at the 5% significance level, to examine whether this sample provides evidence that the mean weight of yellow dot balls is not 24 grams. **[9]**

The weights of red dot balls are Normally distributed with mean 24.7 grams and standard deviation 0.4 grams. Red dot balls are sold in packs of 6. Balls in a pack may be regarded as a random sample.

(iii) Find the probability that the total weight of the 6 balls in a pack exceeds 150 grams. **[4]**

4 A seismologist is monitoring the global occurrence of earthquakes. Each week, she records the number of 'moderate strength' earthquakes that occur around the world. The following table summarises the results for a random sample of 200 weeks.

Number of earthquakes	0	1	2	3	4	5	6	$\geqslant 7$
Observed frequency	7	47	49	46	25	19	7	0

(i) The sample mean is 2.6. Calculate the sample standard deviation. Hence comment briefly on whether or not the Poisson distribution may provide a suitable model for these data. **[3]**

The seismologist decides to test the goodness of fit of a Poisson model. She uses the sample mean as an estimate for the mean of the underlying population to produce the following expected frequencies.

Number of earthquakes	0	1	2	3	4	5	6	$\geqslant 7$
Expected frequency	14.86	38.62	50.21	43.52	28.28	14.71	6.37	3.43

(ii) Show how the expected frequency of 28.28 for the number of weeks in which 4 earthquakes occur is calculated. **[3]**

(iii) Carry out the test of the goodness of fit of the Poisson model at the 5% level of significance. **[10]**

Question 5 begins on page 4

5 A car manufacturer decides to investigate whether there is an association between the age of customers and their 'brand loyalty' (ie whether they are returning customers or first time customers). A random sample of 150 customers is selected and classified as follows.

		Brand loyalty	
		Returning customer	First time customer
Age (in years)	Under 35	25	12
	35 to 50	38	35
	Over 50	31	9

The following tables show some of the expected frequencies and contributions to the test statistic for use in part **(i)**.

Expected frequencies		Brand loyalty	
		Returning customer	First time customer
Age (in years)	Under 35	23.187	13.813
	35 to 50	45.747	
	Over 50		14.933

Contributions to the test statistic		Brand loyalty	
		Returning customer	First time customer
Age (in years)	Under 35	0.142	0.238
	35 to 50	1.312	
	Over 50		2.357

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

(ii) With reference to the contributions to the test statistic, comment briefly on brand loyalty in the different age groups. **[3]**

END OF QUESTION PAPER