OCR
Oxford Cambridge and RSA

Friday 17 June 2016 – Afternoon

A2 GCE MATHEMATICS (MEI)

4768/01 Statistics 3

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4768/01
- 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 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**. If additional space is required, you should use the lined page(s) at the end of the Printed Answer Book. 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 game consists of 20 rounds. Each round is denoted as either a starter, middle or final round. The times taken for each round are independently and Normally distributed with the following parameters (given in seconds).

Type of round	Mean	Standard deviation
Starter	200	15
Middle	220	25
Final	250	20

The game consists of 4 starter, 12 middle and 4 final rounds. Find the probability that

(i) the mean time per round for the 4 final rounds will exceed 260 seconds, **[3]**

(ii) all 20 rounds will be completed in a total time of 75 minutes or less, **[5]**

(iii) the 12 middle rounds will take at least 3.5 times as long in total as the 4 starter rounds, **[5]**

(iv) the mean time per round for the 12 middle rounds will be at least 25 seconds less than the mean time per round for the 4 final rounds. **[5]**

2 **(a)** A genetic model involving body colour and eye colour of fruit flies predicts that offspring will consist of four phenotypes in the ratio 9 : 3 : 3 : 1.

A random sample of 200 such offspring is taken. Their phenotypes are found to be as follows.

Phenotype	Brown body Red eye	Brown body Brown eye	Black body Red eye	Black body Brown eye
Frequency	125	37	32	6
Relative proportion from model	9	3	3	1

Carry out a test, using a 2.5% level of significance, of the goodness of fit of the genetic model to these data. **[9]**

(b) The median length of European fruit flies is 2.5 mm. South American fruit flies are believed to be larger than European fruit flies. A random sample of 12 South American fruit flies is taken. The flies are found to have the following lengths (in mm).

1.7 1.4 3.1 3.5 3.8 4.2 2.2 2.9 4.4 2.6 3.9 3.2

Carry out a Wilcoxon signed rank test, using a 5% level of significance, to test this belief. **[9]**

3 The random variable X has the following probability density function:

$$f(x) = \begin{cases} k(1-x^2) & -1 \leqslant x \leqslant 1 \\ 0 & \text{elsewhere,} \end{cases}$$

where k is a positive constant.

(i) Calculate the value of k. **[3]**

(ii) Sketch the probability density function. **[3]**

(iii) Calculate Var(X). **[3]**

(iv) Find a cubic equation satisfied by the upper quartile q, and hence verify that $q = 0.35$ to 2 decimal places. **[5]**

(v) A random sample of 40 values of X is taken. Using a suitable approximating distribution, calculate the probability that the mean of these values is greater than 0.125. Justify your choice of distribution. **[4]**

4 An insurance company is investigating a new system designed to reduce the average time taken to process claim forms. The company has decided to use 10 experienced employees to process claims using the old system and the new system.

Two procedures for comparing the systems are proposed.

Procedure A There are two sets of claim forms, set 1 and set 2. Each contains the same number of forms. Each employee processes set 1 on the old system and set 2 on the new system. The times taken are compared.

Procedure B There is just one set of claim forms which each employee processes firstly on the old system and then on the new system. The times taken are compared.

(i) State one weakness of each of these procedures. **[2]**

In fact a third procedure which avoids these two weaknesses is adopted. In this procedure each employee is given a randomly selected set of claim forms. Each set contains the same number of forms. The employees each process their set of claim forms on both systems. The times taken, in minutes, are shown in the table.

Employee	1	2	3	4	5	6	7	8	9	10
Old system	40.5	42.9	52.8	51.7	77.2	66.7	65.2	49.2	55.6	58.3
New system	39.2	40.7	50.6	50.7	71.4	70.5	71.1	47.7	52.1	55.5

(ii) Carry out a paired t test at the 5% level of significance to investigate whether the mean length of time taken to process a set of forms has reduced using the new system. **[10]**

(iii) State fully the usual conditions for a paired t test. **[3]**

(iv) Construct a 99% confidence interval for the mean reduction in time taken to process a set of forms using the new system. **[3]**

END OF QUESTION PAPER