OCR
Oxford Cambridge and RSA

Friday 15 June 2018 – 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**. 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 barcodes.
- 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)** A psychology experiment is designed to investigate whether the colour of the paper on which text is printed affects reading speed. Eight randomly selected participants are given two pieces of text to read, one printed on white paper and one printed on pale green paper. The two texts are different, but contain approximately the same number of words and are of equal complexity.

The table shows the length of time, in seconds, that each participant took to read each piece of text. The times have been recorded to the nearest second.

Participant	A	B	C	D	E	F	G	H
White paper	63	55	78	61	48	63	81	57
Green paper	51	61	70	59	45	65	66	50

(i) Explain why a paired test is appropriate in this context. **[1]**

(ii) Carry out a *t* test at the 5% significance level to test whether there is a difference in the population mean times taken to read the two texts. You may assume that the distributional assumptions for the *t* test hold. **[9]**

(b) A psychology textbook claims that the typical capacity for short term memory is seven items. A student believes that among college students it is higher than this. To test his hypothesis, he selects a random sample of ten college students. Each student is shown a list of thirty words and asked to repeat them two minutes later. The number of words each student could remember is given in the table.

Student	A	B	C	D	E	F	G	H	I	J
Number of words	10	15	2	18	13	6	21	3	16	5

(i) Explain why a *t* test would not be appropriate in this situation. **[1]**

(ii) Use a Wilcoxon test with a 5% significance level to test whether, among college students, the average number of words remembered is greater than 7. **[9]**

2 The number of typing errors on a page is often given as an example of a Poisson distribution.

Elaine, who is a typist, wants to investigate whether this is the case for her typing. She picks a random sample of 100 full pages she has typed over the past year and counts the number of typing errors on each page. Her results are recorded in the table.

Number of typing errors on a page	0	1	2	3	4	5	6	$\geqslant 7$
Number of pages	13	15	16	22	22	8	4	0

(i) Use the data in the table to estimate the population mean and variance of the number of typing errors per full page. Comment whether, in the light of these values, a Poisson distribution might be a suitable model for the number of typing errors on a full page of Elaine's typing. **[2]**

(ii) The table in the Answer Book shows some of the expected frequencies and contributions to the test statistic for a χ^2 test for the goodness of fit of a Poisson model for the number of errors on a full page of Elaine's typing. Calculate the missing expected frequencies and hence complete the test using a 5% significance level. **[10]**

(iii) Construct a 95% confidence interval for the mean number of typing errors per full page of Elaine's typing. Explain whether your calculation relies on the Central Limit Theorem. **[5]**

3 The table shows the mean and standard deviation of the number of calories in a single apple, a single banana and a single strawberry. It can be assumed that the number of calories in each type of fruit is Normally distributed.

Fruit	Apple	Banana	Strawberry
Mean (calories)	97.0	112.5	5.5
Standard deviation (calories)	6.3	7.5	1.3

(i) Find the probability that a randomly selected banana contains more than 100 calories. **[2]**

(ii) Write down the probability distribution of the number of calories in half a banana.

Find the probability that one apple contains at least 40 more calories than half a banana. **[6]**

(iii) Vesna makes a smoothie using two apples and seven strawberries. Assuming that the fruits are randomly and independently selected, find the probability that Vesna's smoothie contains more than 250 calories. **[5]**

'Red Ripple' is a smoothie that is sold in bottles. The amount, x millilitres, of drink in 12 randomly selected bottles of 'Red Ripple' smoothie is measured, and the results are summarised as follows:

$$\Sigma x = 2184, \quad \Sigma x^2 = 397\,851.$$

The amount of drink in a bottle is assumed to be Normally distributed.

(iv) (*A*) Construct a 95% confidence interval for the mean amount of drink in a bottle of 'Red Ripple'. **[5]**

(*B*) Explain what is meant by a 95% confidence interval in this context. **[1]**

4 The length of time, in minutes, that I have to wait in the queue for coffee in the college canteen is modelled by the random variable T with cumulative distribution function

$$\mathrm{F}(t) = \begin{cases} 0 & t < 0, \\ \frac{1}{3}t^2 & 0 \leqslant t \leqslant 1, \\ -\frac{1}{6}t^2 + t - \frac{1}{2} & 1 < t \leqslant 3, \\ 1 & t > 3. \end{cases}$$

(i) Use this model to find

(A) the probability that I have to wait for more than 2 minutes, **[2]**

(B) the median waiting time. **[3]**

(ii) Find the probability density function of T. **[3]**

(iii) Show that the expected value of T is $\frac{4}{3}$. **[4]**

You are given that the variance of T is $\frac{7}{18}$.

(iv) I record the time I have to wait in the queue on 30 randomly selected days. Calculate an estimate of the probability that the mean of these 30 waiting times is greater than 1.5 minutes. **[4]**

END OF QUESTION PAPER