



**ADVANCED GCE**  
**MATHEMATICS**  
 Probability & Statistics 2

**4733**

Candidates answer on the Answer Booklet

**OCR Supplied Materials:**

- 8 page Answer Booklet
- List of Formulae (MF1)

**Other Materials Required:**  
 None

**Tuesday 13 January 2009**  
**Morning**

**Duration:** 1 hour 30 minutes



**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.
- You are permitted to use a graphical calculator in this paper.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- This document consists of **4** pages. Any blank pages are indicated.

- 1 A newspaper article consists of 800 words. For each word, the probability that it is misprinted is 0.005, independently of all other words. Use a suitable approximation to find the probability that the total number of misprinted words in the article is no more than 6. Give a reason to justify your approximation. [4]
- 2 The continuous random variable  $Y$  has the distribution  $N(23.0, 5.0^2)$ . The mean of  $n$  observations of  $Y$  is denoted by  $\bar{Y}$ . It is given that  $P(\bar{Y} > 23.625) = 0.0228$ . Find the value of  $n$ . [4]
- 3 The number of incidents of radio interference per hour experienced by a certain listener is modelled by a random variable with distribution  $Po(0.42)$ .
- (i) Find the probability that the number of incidents of interference in one randomly chosen hour is
- (a) 0,  
 (b) exactly 1. [3]
- (ii) Find the probability that the number of incidents in a randomly chosen 5-hour period is greater than 3. [3]
- (iii) One hundred hours of listening are monitored and the numbers of 1-hour periods in which 0, 1, 2, ... incidents of interference are experienced are noted. A bar chart is drawn to represent the results. Without any further calculations, sketch the shape that you would expect for the bar chart. (There is no need to use an exact numerical scale on the frequency axis.) [2]
- 4 A television company believes that the proportion of adults who watched a certain programme is 0.14. Out of a random sample of 22 adults, it is found that 2 watched the programme.
- (i) Carry out a significance test, at the 10% level, to determine, on the basis of this sample, whether the television company is overestimating the proportion of adults who watched the programme. [8]
- (ii) The sample was selected randomly. State what properties of this method of sampling are needed to justify the use of the distribution used in your test. [2]
- 5 The continuous random variables  $S$  and  $T$  have probability density functions as follows.
- $$S : \quad f(x) = \begin{cases} \frac{1}{4} & -2 \leq x \leq 2 \\ 0 & \text{otherwise} \end{cases}$$
- $$T : \quad g(x) = \begin{cases} \frac{5}{64}x^4 & -2 \leq x \leq 2 \\ 0 & \text{otherwise} \end{cases}$$
- (i) Sketch, on the same axes, the graphs of  $f$  and  $g$ . [3]
- (ii) Describe in everyday terms the difference between the distributions of the random variables  $S$  and  $T$ . (Answers that comment only on the shapes of the graphs will receive no credit.) [2]
- (iii) Calculate the variance of  $T$ . [4]

6 The weight of a plastic box manufactured by a company is  $W$  grams, where  $W \sim N(\mu, 20.25)$ . A significance test of the null hypothesis  $H_0 : \mu = 50.0$ , against the alternative hypothesis  $H_1 : \mu \neq 50.0$ , is carried out at the 5% significance level, based on a sample of size  $n$ .

(i) Given that  $n = 81$ ,

(a) find the critical region for the test, in terms of the sample mean  $\bar{W}$ , [5]

(b) find the probability that the test results in a Type II error when  $\mu = 50.2$ . [5]

(ii) State how the probability of this Type II error would change if  $n$  were greater than 81. [1]

7 A motorist records the time taken,  $T$  minutes, to drive a particular stretch of road on each of 64 occasions. Her results are summarised by

$$\Sigma t = 876.8, \quad \Sigma t^2 = 12\,657.28.$$

(i) Test, at the 5% significance level, whether the mean time for the motorist to drive the stretch of road is greater than 13.1 minutes. [11]

(ii) Explain whether it is necessary to use the Central Limit Theorem in your test. [1]

8 A sales office employs 21 representatives. Each day, for each representative, the probability that he or she achieves a sale is 0.7, independently of other representatives. The total number of representatives who achieve a sale on any one day is denoted by  $K$ .

(i) Using a suitable approximation (which should be justified), find  $P(K \geq 16)$ . [7]

(ii) Using a suitable approximation (which should be justified), find the probability that the mean of 36 observations of  $K$  is less than or equal to 14.0. [7]



Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (OCR) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

OCR is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.