



**ADVANCED GCE  
MATHEMATICS**

Probability & Statistics 2

**4733**

**QUESTION PAPER**

Candidates answer on the printed answer book.

**OCR supplied materials:**

- Printed answer book 4733
- List of Formulae (MF1)

**Other materials required:**

- Scientific or graphical calculator

**Wednesday 22 June 2011  
Morning**

**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.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. 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.
- 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.

**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 reminded of the need for clear presentation in your answers.**
- 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 destroyed.

## 2

- 1 In Fisher Avenue there are 263 houses, numbered 1 to 263. Explain how to obtain a random sample of 20 of these houses. [3]

- 2 The random variable  $Y$  has the distribution  $N(\mu, \sigma^2)$ . It is given that

$$P(Y < 48.0) = P(Y > 57.0) = 0.0668.$$

Find the value  $y_0$  such that  $P(Y > y_0) = 0.05$ . [7]

- 3 The random variable  $X$  has the distribution  $N(\mu, 5^2)$ . A hypothesis test is carried out of  $H_0: \mu = 20.0$  against  $H_1: \mu < 20.0$ , at the 1% level of significance, based on the mean of a sample of size 16. Given that in fact  $\mu = 15.0$ , find the probability that the test results in a Type II error. [7]

- 4 A continuous random variable  $X$  has probability density function

$$f(x) = \begin{cases} \frac{3}{16}(x-2)^2 & 0 \leq x \leq 4, \\ 0 & \text{otherwise.} \end{cases}$$

(i) Sketch the graph of  $y = f(x)$ . [2]

(ii) Calculate the variance of  $X$ . [5]

(iii) A student writes “ $X$  is more likely to occur when  $x$  takes values further away from 2”. Explain whether you agree with this statement. [1]

- 5 A travel company finds from its records that 40% of its customers book with travel agents. The company redesigns its website, and then carries out a survey of 10 randomly chosen customers. The result of the survey is that 1 of these customers booked with a travel agent.

(i) Test at the 5% significance level whether the percentage of customers who book with travel agents has decreased. [7]

(ii) The managing director says that “Our redesigned website has resulted in a decrease in the percentage of our customers who book with travel agents.” Comment on this statement. [1]

- 6 Records show that before the year 1990 the maximum daily temperature  $T^\circ\text{C}$  at a seaside resort in August can be modelled by a distribution with mean 24.3. The maximum temperatures of a random sample of 50 August days since 1990 can be summarised by

$$n = 50, \quad \Sigma t = 1314.0, \quad \Sigma t^2 = 36\,602.17.$$

(i) Test, at the 1% significance level, whether there is evidence of a change in the mean maximum daily temperature in August since 1990. [11]

(ii) Give a reason why it is possible to use the Central Limit Theorem in your test. [1]

## 3

7 The number of customer complaints received by a company per day is denoted by  $X$ . Assume that  $X$  has the distribution  $Po(2.2)$ .

(i) In a week of 5 working days, the probability there are at least  $n$  customer complaints is 0.146 correct to 3 significant figures. Use tables to find the value of  $n$ . [3]

(ii) Use a suitable approximation to find the probability that in a period of 20 working days there are fewer than 38 customer complaints. [5]

A week of 5 working days in which at least  $n$  customer complaints are received, where  $n$  is the value found in part (i), is called a ‘bad’ week.

(iii) Use a suitable approximation to find the probability that, in 40 randomly chosen weeks, more than 7 are bad. [6]

8 (a) A group of students is discussing the conditions that are needed if a Poisson distribution is to be a good model for the number of telephone calls received by a fire brigade on a working day.

(i) Alice says “Events must be independent”. Explain why this condition may not hold in this context. [1]

(ii) State a different condition that is needed. Explain whether it is likely to hold in this context. [2]

(b) The random variables  $R$ ,  $S$  and  $T$  have independent Poisson distributions with means  $\lambda$ ,  $\mu$  and  $\lambda + \mu$  respectively.

(i) In the case  $\lambda = 2.74$ , find  $P(R > 2)$ . [3]

(ii) In the case  $\lambda = 2$  and  $\mu = 3$ , find  $P(R = 0 \text{ and } S = 1) + P(R = 1 \text{ and } S = 0)$ . Give your answer correct to 4 decimal places. [3]

(iii) In the general case, show algebraically that

$$P(R = 0 \text{ and } S = 1) + P(R = 1 \text{ and } S = 0) = P(T = 1). \quad [4]$$

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