



**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

**Friday 14 January 2011
Afternoon**

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 **16** 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.

- 1 A random sample of nine observations of a random variable is obtained. The results are summarised as

$$\Sigma x = 468, \quad \Sigma x^2 = 24\,820.$$

Calculate unbiased estimates of the population mean and variance. [4]

- 2 The random variable H has the distribution $N(\mu, 5^2)$. The mean of a sample of n observations of H is denoted by \bar{H} . It is given that $P(\bar{H} > 53.28) = 0.0250$ and $P(\bar{H} < 51.65) = 0.0968$, both correct to 4 decimal places. Find the values of μ and n . [6]

- 3 The probability that a randomly chosen PPhone has a faulty casing is 0.0228. A random sample of 200 PPhones is obtained. Use a suitable approximation to find the probability that the number of PPhones in the sample with a faulty casing is 2 or fewer. Justify your approximation. [6]

- 4 The continuous random variable X has mean μ and standard deviation 45. A significance test is to be carried out of the null hypothesis $H_0: \mu = 230$ against the alternative hypothesis $H_1: \mu \neq 230$, at the 1% significance level. A random sample of size 50 is obtained, and the sample mean is found to be 213.4.

(i) Carry out the test. [5]

(ii) Explain whether it is necessary to use the Central Limit Theorem in your test. [2]

- 5 A temporary job is advertised annually. The number of applicants for the job is a random variable which is known from many years' experience to have a distribution $Po(12)$. In 2010 there were 19 applicants for the job. Test, at the 10% significance level, whether there is evidence of an increase in the mean number of applicants for the job. [7]

- 6 The number of randomly occurring events in a given time interval is denoted by R . In order that R is well modelled by a Poisson distribution, it is necessary that events occur independently.

(i) Let R represent the number of customers dining at a restaurant on a randomly chosen weekday lunchtime. Explain what the condition 'events occur independently' means in this context, and give a reason why it would probably not hold in this context. [2]

Let D represent the number of tables booked at the restaurant on a randomly chosen day. Assume that D can be well modelled by the distribution $Po(7)$.

(ii) Find $P(D < 5)$. [2]

(iii) Use a suitable approximation to find the probability that, in five randomly chosen days, the total number of tables booked is greater than 40. [6]

- 7 Two continuous random variables S and T have probability density functions f_S and f_T given respectively by

$$f_S(x) = \begin{cases} \frac{a}{x^2} & 1 \leq x \leq 3, \\ 0 & \text{otherwise,} \end{cases}$$
$$f_T(x) = \begin{cases} b & 1 \leq x \leq 3, \\ 0 & \text{otherwise,} \end{cases}$$

where a and b are constants.

- (i) Sketch on the same axes the graphs of $y = f_S(x)$ and $y = f_T(x)$. [3]
- (ii) Find the value of a . [3]
- (iii) Find $E(S)$. [3]
- (iv) A student gave the following description of the distribution of T : "The probability that T occurs is constant". Give an improved description, in everyday terms. [1]
- 8 A company has 3600 employees, of whom 22.5% live more than 30 miles from their workplace. A random sample of 40 employees is obtained.
- (i) Use a suitable approximation, which should be justified, to find the probability that more than 5 of the employees in the sample live more than 30 miles from their workplace. [8]
- (ii) Describe how to use random numbers to select a sample of 40 from a population of 3600 employees. [3]
- 9 A pharmaceutical company is developing a new drug to treat a certain disease. The company will continue to develop the drug if the proportion p of those who have the disease and show a substantial improvement after treatment is greater than 0.7. The company carries out a test, at the 5% significance level, on a random sample of 14 patients who suffer from the disease.
- (i) Find the critical region for the test. [3]
- (ii) Given that 12 of the 14 patients in the sample show a substantial improvement, carry out the test. [5]
- (iii) Find the probability that the test results in a Type II error if in fact $p = 0.8$. [3]

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

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.



**ADVANCED GCE
MATHEMATICS**

Probability & Statistics 2

4733

PRINTED ANSWER BOOK

Candidates answer on this printed answer book.

OCR supplied materials:

- Question paper 4733 (inserted)
- List of Formulae (MF1)

Other materials required:

- Scientific or graphical calculator

**Friday 14 January 2011
Afternoon**

Duration: 1 hour 30 minutes



Candidate forename		Candidate surname	
-----------------------	--	----------------------	--

Centre number						Candidate number				
---------------	--	--	--	--	--	------------------	--	--	--	--

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 **16** pages. The question paper consists of **4** pages. Any blank pages are indicated.

PLEASE DO NOT WRITE ON THIS PAGE

7 (iii)	
7 (iv)	

8 (i)	(continued)
8 (ii)	

PLEASE DO NOT WRITE ON THIS PAGE



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

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.