

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS
A2 GCE
4733/01
MATHEMATICS
Probability & Statistics 2
QUESTION PAPER
FRIDAY 5 JUNE 2015: Morning
DURATION: 1 hour 30 minutes
plus your additional time allowance
MODIFIED ENLARGED 24pt**

Candidates answer on the Printed Answer Book or any suitable paper provided by the centre. The Printed Answer Book may be enlarged by the centre.

**OCR SUPPLIED MATERIALS:
Printed Answer Book 4733/01
List of Formulae (MF1)**

**OTHER MATERIALS REQUIRED:
Scientific or graphical calculator
READ INSTRUCTIONS OVERLEAF**

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book or on the paper provided by the centre. Please write clearly and in capital letters.

IF YOU USE THE PRINTED ANSWER BOOK WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED.

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.

Answer ALL the questions.

Read each question carefully. Make sure you know what you have to do before starting your answer.

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

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.

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.

BLANK PAGE

BLANK PAGE

- 1 The random variable Y is normally distributed with mean μ and variance σ^2 . It is found that $P(Y > 150.0) = 0.0228$ and $P(Y > 143.0) = 0.9332$. Find the values of μ and σ . [6]**
- 2 A class investigated the number of dead rabbits found along a particular stretch of road.**
 - (i) The class agrees that dead rabbits occur randomly along the road. Explain what this statement means. [1]**
 - (ii) State, in this context, an assumption needed for the number of dead rabbits in a fixed length of road to be modelled by a Poisson distribution, and explain what your statement means. [2]**

Assume now that the number of dead rabbits in a fixed length of road can be well modelled by a Poisson distribution with mean 1 per 600 m of road.

- (iii) Use an appropriate formula, showing your working, to find the probability that in a road of length 1650 m there are exactly 3 dead rabbits. [3]**

- 3 A continuous random variable X has probability density function**

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

where a is a constant.

- (i) It is given that $P(-3 \leq X \leq 3) = 0.125$. Find the value of a in this case. [4]
- (ii) It is given instead that $\text{Var}(X) = 1.35$. Find the value of a in this case. [5]
- (iii) Explain the relationship between x and X in this question. [1]

- 4 A continuous random variable is normally distributed with mean μ . A significance test for μ is carried out, at the 5% significance level, on 90 independent occasions.**

- (i) Given that the null hypothesis is correct on all 90 occasions, use a suitable approximation to find the probability that on 6 or fewer occasions the test results in a Type I error. Justify your approximation. [5]
- (ii) Given instead that on all 90 occasions the probability of a Type II error is 0.35, use a suitable approximation to find the probability that on fewer than 29 occasions the test results in a Type II error. [5]

- 5 (i) State an advantage of using random numbers in selecting samples. [1]
- (ii) It is known that in analysing the digits in large sets of financial records, the probability that the leading digit is 1 is 0.25. A random sample of 18 leading digits from a certain large set of financial records is obtained and it is found that 8 of the leading digits are 1s. Test, at the 5% significance level, whether the probability that the leading digit is 1 in this set of records is greater than 0.25. [7]
- 6 Records for a doctors' surgery over a long period suggest that the time taken for a consultation, T minutes, has a mean of 11.0. Following the introduction of new regulations, a doctor believes that the average time has changed. She finds that, with new regulations, the consultation times for a random sample of 120 patients can be summarised as
- $$n = 120, \sum t = 1411.20, \sum t^2 = 18\,737.712.$$
- (i) Test, at the 10% significance level, whether the doctor's belief is correct. [11]
- (ii) Explain whether, in answering part (i), it was necessary to assume that the consultation times were normally distributed. [1]

- 7 A large railway network suffers points failures at an average rate of 1 every 3 days. Assume that the number of points failures can be modelled by a Poisson distribution. The network employs a new firm of engineers. After the new engineers have become established, it is found that in a randomly chosen period of 15 days there are 2 instances of points failures.**
- (i) Test, at the 5% significance level, whether there is evidence that the mean number of points failures has been reduced. [7]**
- (ii) A new test is carried out over a period of 150 days. Use a suitable approximation to find the greatest number of points failures there could be in 150 days that would lead to a 5% significance test concluding that the average number of points failures had been reduced. [6]**
- 8 The random variable S has the distribution $B(14, p)$. A significance test is carried out of the null hypothesis $H_0: p = 0.3$ against the alternative hypothesis $H_1: p > 0.3$. The critical region for the test is $S \geq 8$.**
- (i) Find the significance level of the test, correct to 3 significant figures. [2]**
- (ii) It is given that, on each occasion that the test is carried out, the true value of p is equally likely to be 0.3, 0.5 or 0.7, independently of any other test. Four independent tests are carried out. Find the probability that at least one of the tests results in a Type II error. [5]**

END OF QUESTION PAPER

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.

