

Friday 22 June 2012 – Afternoon

A2 GCE MATHEMATICS

4733 Probability & Statistics 2

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

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. 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.
- 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 recycled. Please contact OCR Copyright should you wish to re-use this document.

- 1 In one day's production, a machine produces 1000 CDs. Explain how to take a random sample of 15 CDs chosen from one day's production. [2]
- 2 (i) For the continuous random variable V , it is known that $E(V) = 72.0$. The mean of a random sample of 40 observations of V is denoted by \bar{V} . Given that $P(\bar{V} < 71.2) = 0.35$, estimate the value of $\text{Var}(V)$. [4]
- (ii) Explain why you need to use the Central Limit Theorem in part (i), and why its use is justified. [2]
- 3 It is known that on average one person in three prefers the colour of a certain object to be blue. In a psychological test, 12 randomly chosen people were seated in a room with blue walls, and asked to state independently which colour they preferred for the object. Seven of the 12 people said that they preferred blue. Carry out a significance test, at the 5% level, of whether the statement "on average one person in three prefers the colour of the object to be blue" is true for people who are seated in a room with blue walls. [7]
- 4 In a rock, small crystal formations occur at a constant average rate of 3.2 per cubic metre.
- (i) State a further assumption needed to model the number of crystal formations in a fixed volume of rock by a Poisson distribution. [1]
- In the remainder of the question, you should assume that a Poisson model is appropriate.
- (ii) Calculate the probability that in one cubic metre of rock there are exactly 5 crystal formations. [2]
- (iii) Calculate the probability that in 0.74 cubic metres of rock there are at least 3 crystal formations. [3]
- (iv) Use a suitable approximation to calculate the probability that in 10 cubic metres of rock there are at least 36 crystal formations. [5]
- 5 The acidity A (measured in pH) of soil of a particular type has a normal distribution. The pH values of a random sample of 80 soil samples from a certain region can be summarised as
- $$\Sigma a = 496, \quad \Sigma a^2 = 3126.$$
- Test, at the 10% significance level, whether in this region the mean pH of soil is 6.1. [11]
- 6 At a tourist car park, a survey is made of the regions from which cars come.
- (i) It is given that 40% of cars come from the London region. Use a suitable approximation to find the probability that, in a random sample of 32 cars, more than 17 come from the London region. Justify your approximation. [7]
- (ii) It is given that 1% of cars come from France. Use a suitable approximation to find the probability that, in a random sample of 90 cars, exactly 3 come from France. [4]

- 7 The continuous random variable X has probability density function

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

where a and k are constants.

- (i) Sketch the graph of $y = f(x)$ and explain in non-technical language what this tells you about X . [3]
- (ii) Given that $E(X) = 4.5$, find
- (a) the value of a , [6]
- (b) $\text{Var}(X)$. [3]

- 8 The random variable X has the distribution $N(\mu, 8^2)$. A test is carried out, at the 5% significance level, of $H_0: \mu = 30$ against $H_1: \mu > 30$, based on a random sample of size 18.

- (i) Find the critical region for the test. [4]
- (ii) If $\mu = 30$ and the outcome of the test is that H_0 is rejected, state the type of error that is made. [1]

On a particular day this test is carried out independently a total of 20 times, and for 4 of these tests the outcome is that H_0 is rejected. It is known that the value of μ remains the same throughout these 20 tests.

- (iii) Find the probability that H_0 is rejected at least 4 times if $\mu = 30$. Hence state whether you think that $\mu = 30$, giving a reason. [3]
- (iv) Given that the probability of making an error of the type different from that stated in part (ii) is 0.4, calculate the actual value of μ , giving your answer correct to 4 significant figures. [4]

THERE ARE NO QUESTIONS WRITTEN 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.