



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

Wednesday 17 June 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.

2

- 1 The random variable H has the distribution $N(\mu, \sigma^2)$. It is given that $P(H < 105.0) = 0.2420$ and $P(H > 110.0) = 0.6915$. Find the values of μ and σ , giving your answers to a suitable degree of accuracy. [6]
- 2 The random variable D has the distribution $Po(20)$. Using an appropriate approximation, which should be justified, calculate $P(D \geq 25)$. [6]
- 3 An electronics company is developing a new sound system. The company claims that 60% of potential buyers think that the system would be good value for money. In a random sample of 12 potential buyers, 4 thought that it would be good value for money. Test, at the 5% significance level, whether the proportion claimed by the company is too high. [7]
- 4 A survey is to be carried out to draw conclusions about the proportion p of residents of a town who support the building of a new supermarket. It is proposed to carry out the survey by interviewing a large number of people in the high street of the town, which attracts a large number of tourists.
- (i) Give two different reasons why this proposed method is inappropriate. [2]
- (ii) Suggest a good method of carrying out the survey. [3]
- (iii) State two statistical properties of your survey method that would enable reliable conclusions about p to be drawn. [2]
- 5 In a large region of derelict land, bricks are found scattered in the earth.
- (i) State two conditions needed for the number of bricks per cubic metre to be modelled by a Poisson distribution. [2]
- Assume now that the number of bricks in 1 cubic metre of earth can be modelled by the distribution $Po(3)$.
- (ii) Find the probability that the number of bricks in 4 cubic metres of earth is between 8 and 14 inclusive. [3]
- (iii) Find the size of the largest volume of earth for which the probability that no bricks are found is at least 0.4. [4]
- 6 The continuous random variable R has the distribution $N(\mu, \sigma^2)$. The results of 100 observations of R are summarised by
- $$\Sigma r = 3360.0, \quad \Sigma r^2 = 115\,782.84.$$
- (i) Calculate an unbiased estimate of μ and an unbiased estimate of σ^2 . [4]
- (ii) The mean of 9 observations of R is denoted by \bar{R} . Calculate an estimate of $P(\bar{R} > 32.0)$. [4]
- (iii) Explain whether you need to use the Central Limit Theorem in your answer to part (ii). [2]

3

7 The continuous random variable X has probability density function given by

$$f(x) = \begin{cases} \frac{2}{9}x(3-x) & 0 \leq x \leq 3, \\ 0 & \text{otherwise.} \end{cases}$$

(i) Find the variance of X . [5]

(ii) Show that the probability that a single observation of X lies between 0.0 and 0.5 is $\frac{2}{27}$. [2]

(iii) 108 observations of X are obtained. Using a suitable approximation, find the probability that at least 10 of the observations lie between 0.0 and 0.5. [6]

(iv) The mean of 108 observations of X is denoted by \bar{X} . Write down the approximate distribution of \bar{X} , giving the value(s) of any parameter(s). [3]

8 In a large company the time taken for an employee to carry out a certain task is a normally distributed random variable with mean 78.0 s and unknown variance. A new training scheme is introduced and after its introduction the times taken by a random sample of 120 employees are recorded. The mean time for the sample is 76.4 s and an unbiased estimate of the population variance is 68.9 s^2 .

(i) Test, at the 1% significance level, whether the mean time taken for the task has changed. [7]

(ii) It is required to redesign the test so that the probability of making a Type I error is less than 0.01 when the sample mean is 77.0 s. Calculate an estimate of the smallest sample size needed, and explain why your answer is only an estimate. [4]

**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, is given to all schools that receive assessment material 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 1PB.

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.