

**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.

- 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  $\mu$  and  $\sigma$ , 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  $\mu$  and an unbiased estimate of  $\sigma^2$ . [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]

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  $68.9 \text{ s}^2$ .

(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]

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