

# GCE Examinations

## Statistics

### Module S2

Advanced Subsidiary / Advanced Level

Paper B

Time: 1 hour 30 minutes

#### *Instructions and Information*

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Candidates may use any calculator except those with a facility for symbolic algebra and/or calculus.

Full marks may be obtained for answers to ALL questions.

Mathematical and statistical formulae and tables are available.

This paper has 6 questions.

#### *Advice to Candidates*

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You must show sufficient working to make your methods clear to an examiner. Answers without working will gain no credit.



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1. (a) Explain what you understand by the term sampling frame when conducting a sample survey. **(1 mark)**
- (b) Suggest a suitable sampling frame and identify the sampling units when using a sample survey to study
- (i) the frequency with which cars break down in the first 3 months after being serviced at a particular garage,
  - (ii) the weight loss of people involved in trials of a new dieting programme.
- (4 marks)**
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2. An ornithologist believes that on average 4.2 different species of bird will visit a bird table in a rural garden when 50 g of breadcrumbs are spread on it.
- (a) Suggest a suitable distribution for modelling the number of species that visit a bird table meeting these criteria. **(1 mark)**
- (b) Explain why the parameter used with this model may need to be changed if
- (i) 50 g of nuts are used instead of breadcrumbs,
  - (ii) 100g of breadcrumbs are used. **(2 marks)**

A bird table in a rural garden has 50 g of breadcrumbs spread on it.

Find the probability that

- (c) exactly 6 different species visit the table, **(2 marks)**
- (d) more than 2 different species visit the table. **(4 marks)**
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3. In a test studying reaction times, white dots appear at random on a black rectangular screen. The continuous random variable  $X$  represents the distance, in centimetres, of the dot from the left-hand edge of the screen. The distribution of  $X$  is rectangular over the interval  $[0, 20]$ .

(a) Find  $P(2 < X < 3.6)$ . **(2 marks)**

(b) Find the mean and variance of  $X$ . **(3 marks)**

The continuous random variable  $Y$  represents the distance, in centimetres, of the dot from the bottom edge of the screen. The distribution of  $Y$  is rectangular over the interval  $[0, 16]$ .

Find the probability that a dot appears

(c) in a square of side 4 cm at the centre of the screen, **(4 marks)**

(d) within 2 cm of the edge of the screen. **(4 marks)**

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4. It is believed that the number of sets of traffic lights that fail per hour in a particular large city follows a Poisson distribution with a mean of 3.

Find the probability that

(a) there will be no failures in a one-hour period, **(1 mark)**

(b) there will be more than 4 failures in a 30-minute period. **(3 marks)**

Using a suitable approximation, find the probability that in a 24-hour period there will be

(c) less than 60 failures, **(5 marks)**

(d) exactly 72 failures. **(4 marks)**

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*Turn over*

5. Six standard dice with faces numbered 1 to 6 are thrown together.

Assuming that the dice are fair, find the probability that

- (a) none of the dice show a score of 6, **(3 marks)**
- (b) more than one of the dice shows a score of 6, **(4 marks)**
- (c) there are equal numbers of odd and even scores showing on the dice. **(3 marks)**

One of the dice is suspected of being biased such that it shows a score of 6 more often than the other numbers. This die is thrown eight times and gives a score of 6 three times.

- (d) Stating your hypotheses clearly, test at the 5% level of significance whether or not this die is biased towards scoring a 6. **(7 marks)**

6. The continuous random variable  $X$  has the following probability density function:

$$f(x) = \begin{cases} \frac{1}{6}x, & 0 \leq x \leq 2, \\ \frac{1}{12}(6-x), & 2 \leq x \leq 6, \\ 0, & \text{otherwise.} \end{cases}$$

- (a) Sketch  $f(x)$  for all values of  $x$ . **(4 marks)**
- (b) State the mode of  $X$ . **(1 mark)**
- (c) Define fully the cumulative distribution function  $F(x)$  of  $X$ . **(9 marks)**
- (d) Show that the median of  $X$  is 2.536, correct to 4 significant figures. **(4 marks)**

**END**