GCE Examinations

Statistics
Module S2

Advanced Subsidiary / Advanced Level

Paper B

Time: 1 hour 30 minutes

Instructions and Information

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

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)**

Turn over

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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)

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

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

(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

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