GCE Examinations

Statistics
Module S2

Advanced Subsidiary / Advanced Level

Sample Paper from Solomon Press

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 7 questions.

Advice to Candidates

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

1. *(a)* State two reasons for using a sample survey rather than a census in statistical work.

    (2 marks)

   (b) Suggest a suitable sampling frame and identify the sampling units when using a sample survey to study the circulation figures of local newspapers in Britain.

    (2 marks)

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2. A company with a banner advert at an internet chatroom believes that 1 in 40 new visitors to the chatroom will visit its site.

   (a) Find the probability that of 30 new visitors to the chatroom, at most one will visit the advertiser's site.

    (4 marks)

   During one day there are 200 new visitors to the chatroom.

   (b) Using a suitable approximation, find the probability that more than 10 of these will visit the advertiser's site.

    (4 marks)

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3. A circular coin is rolled over a flat surface covered with parallel lines 4 cm apart. The coin falls flat and the random variable X represents the minimum distance of the centre of the coin from the nearest line.

   (a) Suggest a suitable distribution for modelling the random variable X. **(1 mark)**

   (b) Write down the probability density function f(x) of X. **(2 marks)**

   Given that the coin has a diameter of 2.6 cm,

   (c) find the probability that when the coin falls flat it is not covering any part of a line.

    (2 marks)

   The surface is changed so that the gaps between the parallel lines alternate between 3 cm and 5 cm. The random variable Y represents the minimum distance of the centre of the coin from the nearest line when this new surface is used.

   (d) (i) Sketch the probability density function f(y) for all values of y.

       (ii) Define fully the probability density function f(y) of Y. **(5 marks)**

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4. An average of eight emails per day are received at one address.

(a) Explain why a Poisson distribution may be suitable for modelling the number of emails received each day.

(3 marks)

(b) Find the probability that at least six emails are received in one day. **(3 marks)**

(c) Using a suitable approximation, find the probability that more than 50 emails are received in a 5-day period.

(5 marks)

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5. An art gallery sells postcards of all the paintings in its current exhibition.

The gallery sells an average of 1.5 postcards per hour of a particular painting. Find the probability that the gallery will sell

(a) no postcards of the painting in a one-hour period, **(2 marks)**

(b) more than two postcards of the painting in a half-hour period. **(5 marks)**

The morning after a programme about the painting's artist is shown on television the gallery sells 7 postcards of the painting in a two-hour period.

(c) Stating your hypotheses clearly, test at the 5% level of significance whether or not there has been an increase in the rate at which the postcard sells.

(5 marks)

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

$$f(t) = \begin{cases} k(2 + t - t^2), & 0 \le t \le 2, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Show that $k = \frac{3}{10}$. **(4 marks)**

(b) Sketch f(t) for all values of t. **(3 marks)**

(c) Find the mode of T. **(2 marks)**

(d) Show that $E(T) = \frac{4}{5}$. **(4 marks)**

Turn over

7. Past records show that a particular basketball player scores from 70% of her free shots.

In practise the player takes sets of 10 free shots.

(a) Comment on the suitability of the binomial distribution for modelling the number of times she will score from a set of 10 free shots.

(2 marks)

Assuming that a binomial distribution is appropriate,

(b) find the probability that she will score less than 6 times in a set of 10 free shots.

(4 marks)

One day in practise the player takes 5 sets each of 10 free shots.

(c) Find the probability that she scores less than 6 times in at most one set of 10 free shots.

(4 marks)

The player changes the position of her feet and takes 50 free shots. She wishes to use the total number of times she scores in the 50 shots to test if the proportion of shots on which she scores has changed.

(d) Stating clearly the hypotheses that she should use, find the critical region for this test such that the probability for each tail of the region is as close as possible to 5%.

(6 marks)

(e) State the significance level of this test. **(1 mark)**

END