GCE Examinations

Statistics
Module S2

Advanced Subsidiary / Advanced Level

Paper C

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.

Written by Shaun Armstrong & Chris Huffer

1. *(a)* Explain briefly what you understand by the terms

(i) population,

(ii) sample. **(2 marks)**

(b) Giving a reason for each of your answers, state whether you would use a census or a sample survey to investigate

(i) the dietary requirements of people attending a 4-day residential course,

(ii) the lifetime of a particular type of battery. **(4 marks)**

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2. The manager of a supermarket receives an average of 6 complaints per day from customers.

Find the probability that on one day she receives

(a) 3 complaints, **(3 marks)**

(b) 10 or more complaints. **(2 marks)**

The supermarket is open on six days each week.

(c) Find the probability that the manager receives 10 or more complaints on no more than one day in a week.
(4 marks)

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3. The sales staff at an insurance company make house calls to prospective clients. Past records show that 30% of the people visited will take out a new policy with the company.

On a particular day, one salesperson visits 8 people. Find the probability that, of these,

(a) exactly 2 take out new policies, **(3 marks)**

(b) more than 4 take out new policies. **(2 marks)**

The company awards a bonus to any salesperson who sells more than 50 policies in a month.

(c) Using a suitable approximation, find the probability that a salesperson gets a bonus in a month in which he visits 150 prospective clients.
(5 marks)

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4. A rugby player scores an average of 0.4 tries per match in which he plays.

(a) Find the probability that he scores 2 or more tries in a match. **(5 marks)**

The team's coach moves the player to a different position in the team believing he will then score more frequently. In the next five matches he scores 6 tries.

(b) Stating your hypotheses clearly, test at the 5% level of significance whether or not there is evidence of an increase in the number of tries the player scores per match as a result of playing in a different position.

(5 marks)

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5. The continuous random variable X has the following cumulative distribution function:

$$\mathrm{F}(x) = \begin{cases} 0, & x < 0, \\ \frac{1}{432}x^2(x^2 - 16x + 72), & 0 \le x \le 6, \\ 1, & x > 6. \end{cases}$$

(a) Find $\mathrm{P}(X < 2)$. **(2 marks)**

(b) Find and specify fully the probability density function $\mathrm{f}(x)$ of X. **(4 marks)**

(c) Show that the mode of X is 2. **(6 marks)**

(d) State, with a reason, whether the median of X is higher or lower than the mode of X.

(1 mark)

Turn over

6. A shop receives weekly deliveries of 120 eggs from a local farm. The proportion of eggs received from the farm that are broken is 0.008

(a) Explain why it is reasonable to use the binomial distribution to model the number of eggs that are broken in each delivery.
(3 marks)

(b) Use the binomial distribution to calculate the probability that at most one egg in a delivery will be broken.
(4 marks)

(c) State the conditions under which the binomial distribution can be approximated by the Poisson distribution.
(1 mark)

(d) Using the Poisson approximation to the binomial, find the probability that at most one egg in a delivery will be broken. Comment on your answer.
(5 marks)

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7. The random variable X follows a continuous uniform distribution over the interval [2, 11].

(a) Write down the mean of X. **(1 mark)**

(b) Find $\mathrm{P}(X \geq 8.6)$. **(2 marks)**

(c) Find $\mathrm{P}(|X - 5| < 2)$. **(2 marks)**

The random variable Y follows a continuous uniform distribution over the interval $[a, b]$.

(d) Show by integration that

$$\mathrm{E}(Y^2) = \tfrac{1}{3}(b^2 + ab + a^2).$$ **(5 marks)**

(e) Hence, prove that

$$\mathrm{Var}(Y) = \tfrac{1}{12}(b - a)^2.$$

You may assume that $\mathrm{E}(Y) = \tfrac{1}{2}(a + b)$. **(4 marks)**

END