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:

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

*(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)**

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***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 $P(X \geq 8.6)$. **(2 marks)**

*(c)* Find $P(|X - 5| < 2)$. **(2 marks)**

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

*(d)* Show by integration that

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

*(e)* Hence, prove that

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

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

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**END**