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Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Tuesday 23 May 2023

Morning (Time: 1 hour 30 minutes)

Paper reference **WST02/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Statistics S2

You must have:
Mathematical Formulae and Statistical Tables (Yellow), calculator

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Values from the statistical tables should be quoted in full. If a calculator is used instead of the tables, the value should be given to an equivalent degree of accuracy.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 75.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ▶

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1. In a large population 40% of adults use online banking.

A random sample of 50 adults is taken.

The random variable X represents the number of adults in the sample that use online banking.

(a) Find

(i) $P(X = 26)$

(2)

(ii) $P(X \geqslant 26)$

(2)

(iii) the smallest value of k such that $P(X \leqslant k) > 0.4$

(1)

A random sample of 600 adults is taken.

(b) (i) Find, using a normal approximation, the probability that no more than 222 of these 600 adults use online banking.

(5)

(ii) Explain why a normal approximation is suitable in part (b)(i)

(1)

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Question 1 continued

(Total for Question 1 is 11 marks)

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2. (a) State one characteristic of a population that would make a census a practical alternative to sampling.

(1)

A leisure centre has 2500 members.

It asks a sample of 300 members for their opinions on the fees it charges for using the centre.

For the sample,

(b) (i) identify a suitable sampling frame,

(ii) identify a sampling unit.

(2)

The leisure centre has the following pieces of information.

A is the list of the different types of membership that can be paid for by members.

B is the mean of the membership fees paid by **all** 2500 members.

C is the number in the **sample** of 300 members who are satisfied with the fees they pay.

(c) State the piece of information that is a statistic.
Give a reason for your answer.

(1)

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Question 2 continued

(Total for Question 2 is 4 marks)

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3. The continuous random variable X has probability density function given by

$$f(x) = \begin{cases} \frac{1}{48}\left(x^2 - 8x + c\right) & 2 \leqslant x \leqslant 5 \\ 0 & \text{otherwise} \end{cases}$$

(a) Show that $c = 31$

(3)

(b) Find $P(2 < X < 3)$

(2)

(c) State whether the lower quartile of X is less than 3, equal to 3 or greater than 3
Give a reason for your answer.

(1)

Kei does the following to work out the mode of X

$$f'(x) = \frac{1}{48}(2x - 8)$$

$$0 = \frac{1}{48}(2x - 8)$$

$$x = 4$$

Hence the mode of X is 4

Kei's answer for the mode is incorrect.

(d) Explain why Kei's method does not give the correct value for the mode.

(1)

(e) Find the mode of X
Give a reason for your answer.

(2)

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Question 3 continued

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Question 3 continued

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Question 3 continued

(Total for Question 3 is 9 marks)

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4. (a) Given n is large, state a condition for which the binomial distribution B(n, p) can be reasonably approximated by a Poisson distribution.

(1)

A manufacturer produces candles. Those candles that pass a quality inspection are suitable for sale.

It is known that 2% of the candles produced by the manufacturer are not suitable for sale.

A random sample of 125 candles produced by the manufacturer is taken.

(b) Use a suitable approximation to find the probability that no more than 6 of the candles are **not** suitable for sale.

(4)

The manufacturer also produces candle holders.

Charlie believes that 5% of candle holders produced by the factory have minor defects.

The manufacturer claims that the true proportion is less than 5%

To test the manufacturer's claim, a random sample of 30 candle holders is taken and none of them are found to contain minor defects.

(c) (i) Carry out a test of the manufacturer's claim using a 5% level of significance. You should state your hypotheses clearly.

(5)

(ii) Give a reason why this is **not** an appropriate test.

(1)

Ashley suggests changing the sample size to 50

(d) Comment on whether or not this change would make the test appropriate. Give a reason for your answer.

(2)

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Question 4 continued

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Question 4 continued

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Question 4 continued

(Total for Question 4 is 13 marks)

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5. A continuous random variable Y has cumulative distribution function given by

$$\mathrm{F}(y) = \begin{cases} 0 & y < 3 \\ \frac{1}{16}\left(y^2 - 6y + a\right) & 3 \leqslant y \leqslant 5 \\ \frac{1}{12}\left(y + b\right) & 5 < y \leqslant 9 \\ \frac{1}{12}\left(100y - 5y^2 + c\right) & 9 < y \leqslant 10 \\ 1 & y > 10 \end{cases}$$

where a, b and c are constants.

(a) Find the value of a and the value of c

(4)

(b) Find the value of b

(2)

(c) Find $\mathrm{P}(6 < Y \leqslant 9)$
Show your working clearly.

(3)

(d) Specify the probability density function, $\mathrm{f}(y)$, for $5 < y \leqslant 9$

(1)

Using the information

$$\int_3^5 (6y - 5)\,\mathrm{f}(y)\,\mathrm{d}y + \int_9^{10} (6y - 5)\,\mathrm{f}(y)\,\mathrm{d}y = 26.5$$

(e) find $\mathrm{E}(6Y - 5)$
You should make your method clear.

(4)

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Question 5 continued

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Question 5 continued

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Question 5 continued

(Total for Question 5 is 14 marks)

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6. Akia selects at random a value from the continuous random variable W, which is uniformly distributed over the interval $[a\ ,\ b]$

The probability that Akia selects a value greater than 17 is $\frac{1}{5}$

The probability that Akia selects a value less than k is $\frac{53}{60}$

(a) Find the probability that Akia selects a value between 17 and k

(2)

It is known that $\text{Var}(W) = 75$

(b) (i) Find the value of a and the value of b

(4)

(ii) Find the value of k

(2)

(c) Find $\text{P}(-5 < W < 5)$

(2)

(d) Find $\text{E}(W^2)$

(2)

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Question 6 continued

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 12 marks)

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7. A bakery sells muffins individually at an average rate of 8 muffins per hour.

(a) Find the probability that, in a randomly selected one-hour period, the bakery sells at least 4 but not more than 8 muffins.

(3)

A sample of 5 non-overlapping **half-hour** periods is selected at random.

(b) Find the probability that the bakery sells fewer than 3 muffins in exactly 2 of these periods.

(5)

Given that 4 muffins were sold in a one-hour period,

(c) find the probability that more muffins were sold in the first 15 minutes than in the last 45 minutes.

(4)

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Question 7 continued

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Question 7 continued

(Total for Question 7 is 12 marks)

TOTAL FOR PAPER IS 75 MARKS

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