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Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Friday 7 June 2024

Afternoon (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 6 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 A garage sells tyres. The number of customers arriving at the garage to buy tyres in a 10-minute period is modelled by a Poisson distribution with mean 2

(a) Find the probability that

(i) fewer than 4 customers arrive to buy tyres in the next 10 minutes,

(ii) more than 5 customers arrive to buy tyres in the next 10 minutes.

(3)

The manager randomly selects 20 non-overlapping, 30-minute periods.

(b) Find the probability that there are between 4 and 7 (inclusive) customers arriving to buy tyres in exactly 15 of these 30-minute periods.

(4)

The manager believes that placing an advert in the local paper will lead to a significant increase in the number of customers arriving at the garage.
A week after the advert is placed, the manager randomly selects a 25-minute period and finds that 10 customers arrive at the garage to buy tyres.

(c) Test, at the 5% level of significance, whether or not there is evidence to support the manager's belief.
State your hypotheses clearly.

(5)

(d) Explain why the Poisson distribution is unlikely to be valid for the number of tyres sold during a 10-minute period.

(1)

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Question 1 continued

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Question 1 continued

(Total for Question 1 is 13 marks)

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2 The continuous random variable H has cumulative distribution function given by

$$\mathrm{F}(h) = \begin{cases} 0 & h \leqslant 0 \\ \dfrac{h^2}{48} & 0 < h \leqslant 4 \\ \dfrac{h}{6} - \dfrac{1}{3} & 4 < h \leqslant 5 \\ \dfrac{3}{10}h - \dfrac{h^2}{75} - \dfrac{2}{3} & 5 < h \leqslant d \\ 1 & h > d \end{cases}$$

where d is a constant.

(a) Show that $2d^2 - 45d + 250 = 0$

(2)

(b) Find $\mathrm{P}(H < 1.5 \mid 1 < H < 4.5)$

(4)

(c) Find the probability density function $\mathrm{f}(h)$
You may leave the limits of h in terms of d where necessary.

(3)

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Question 2 continued

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Question 2 continued

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Question 2 continued

(Total for Question 2 is 9 marks)

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3 Jian owns a large group of shops. She decides to visit a random sample of the shops to check if the stocktaking system is being used incorrectly.

(a) Suggest a suitable sampling frame for Jian to use.

(1)

(b) Identify the sampling units.

(1)

(c) Give one advantage and one disadvantage of taking a sample rather than a census.

(2)

Jian believes that the stocktaking system is being used incorrectly in 40% of the shops.

To investigate her belief, a random sample of 30 of the shops is taken.

(d) Using a 5% level of significance, find the critical region for a two-tailed test of Jian's belief.
You should state the probability in each tail, which should each be as close as possible to 2.5%

(3)

The total number of shops, in the sample of 30, where the stocktaking system is being used incorrectly is 20

(e) Using the critical region from part (d), state what this suggests about Jian's belief. Give a reason for your answer.

(1)

Jian introduces a new, simpler, stocktaking system to all the shops.

She takes a random sample of 150 shops and finds that in 47 of these shops the new stocktaking system is being used incorrectly.

(f) Using a suitable approximation, test, at the 5% level of significance, whether or not there is evidence that the proportion of shops where the stocktaking system is being used incorrectly is now **less than** 0.4
You should state your hypotheses and show your working clearly.

(7)

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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 15 marks)

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4 A bag contains 50 counters, each with one of the numbers 4, 7 or 10 written on it in the ratio 2 : 3 : 5 respectively.

A random sample of 2 counters is taken from the bag. The numbers on the 2 counters are recorded as D_1 and D_2

The random variable M represents the mean of D_1 and D_2

(a) Show that $\mathrm{P}(M = 4) = \dfrac{9}{245}$

(1)

(b) Find the sampling distribution of M

(6)

A random sample of n sets of 2 counters is taken. The random variable T represents the number of these n sets of 2 counters that have a mean of 4

Given that each set of 2 counters is replaced after it is drawn,

(c) calculate the minimum value of n such that $\mathrm{P}(T = 0) < 0.15$

(3)

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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 10 marks)

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5 A receptionist receives incoming telephone calls and should connect them to the appropriate department. The probability of them being connected to the wrong department on the first attempt is 0.05

A random sample of 8 calls is taken.

(a) Find the probability that at least 2 of these calls are connected to the wrong department on the first attempt.

(3)

The receptionist receives 1000 calls each day.

(b) Use a Poisson approximation to find the probability that exactly 45 callers are connected to the wrong department on the first attempt in a day.

(3)

The total time, T seconds, taken for a call to be answered by a department has a continuous uniform distribution over the interval [10, 50]

(c) Find $P(T > 16)$

(2)

The number of calls the receptionist receives in a one-minute interval is modelled by a Poisson distribution with mean 6
The receptionist receives a call from Jia and tries to connect it to the right department.

(d) Find the probability that in the next 40 seconds Jia's call is answered by the right department on the first attempt and the receptionist has received no other calls.

(4)

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Question 5 continued

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Question 5 continued

(Total for Question 5 is 12 marks)

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6 **In this question solutions relying entirely on calculator technology are not acceptable.**

The continuous random variable X has the following probability density function

$$f(x) = \begin{cases} a + bx & -1 \leqslant x \leqslant 3 \\ 0 & \text{otherwise} \end{cases}$$

where a and b are constants.

(a) Show that $4a + 4b = 1$

(3)

Given that $E(X^2) = \frac{17}{5}$

(b) (i) find an equation in terms of a only

(5)

(ii) hence show that $b = 0.1$

(2)

(c) Sketch the probability density function $f(x)$ of X

(2)

(d) Find the value of k for which $P(X \geqslant k) = 0.8$

(4)

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 16 marks)

TOTAL FOR PAPER IS 75 MARKS

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