Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Friday 12 January 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 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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Pearson

1. The manager of a supermarket is investigating the number of complaints per day received from customers.

A random sample of 180 days is taken and the results are shown in the table below.

Number of complaints per day	0	1	2	3	4	5	6	$\geqslant 7$
Frequency	12	28	37	38	29	17	19	0

(a) Calculate the mean and the variance of these data.

(3)

(b) Explain why the results in part (a) suggest that a Poisson distribution may be a suitable model for the number of complaints per day.

(1)

The manager uses a Poisson distribution with mean 3 to model the number of complaints per day.

(c) For a randomly selected day find, using the manager's model, the probability that there are

(i) at least 3 complaints,

(ii) more than 4 complaints but less than 8 complaints.

(4)

A week consists of 7 consecutive days.

(d) Using the manager's model and a suitable approximation, show that the probability that there are less than 19 complaints in a randomly selected week is 0.29 to 2 decimal places.
Show your working clearly.
(*Solutions relying on calculator technology are not acceptable.*)

(5)

A period of 13 weeks is selected at random.

(e) Find the probability that in this period there are exactly 5 weeks that have less than 19 complaints.
Show your working clearly.

(3)

Question 1 continued

Question 1 continued

Question 1 continued

(Total for Question 1 is 16 marks)

2. The length of pregnancy for a randomly selected pregnant sheep is D days where

$$D \sim \mathrm{N}(112.4, \sigma^2)$$

Given that 5% of pregnant sheep have a length of pregnancy of less than 108 days,

(a) find the value of σ

(3)

Qiang selects 25 pregnant sheep at random from a large flock.

(b) Find the probability that more than 3 of these pregnant sheep have a length of pregnancy of less than 108 days.

(2)

Charlie takes 200 random samples of 25 pregnant sheep.

(c) Use a Poisson approximation to estimate the probability that at least 2 of the samples have more than 3 pregnant sheep with a length of pregnancy of less than 108 days.

(3)

Question 2 continued

(Total for Question 2 is 8 marks)

3. Rowan believes that 35% of type *A* vacuum tubes shatter when exposed to alternating high and low temperatures.

Rowan takes a random sample of 15 of these type *A* vacuum tubes and uses a two-tailed test, at the 5% level of significance, to test his belief.

(a) Give **two** assumptions, in context, that Rowan needs to make for a binomial distribution to be a suitable model for the number of these type *A* vacuum tubes that shatter when exposed to alternating high and low temperatures.

(2)

(b) Using a binomial distribution, find the critical region for the test.
You should state the probability of rejection in each tail, which should be as close as possible to 0.025

(3)

(c) Find the actual level of significance of the test based on your critical region from part (b)

(1)

Rowan records that in the latest batch of 15 type *A* vacuum tubes exposed to alternating high and low temperatures, 4 of them shattered.

(d) With reference to part (b), comment on Rowan's belief. Give a reason for your answer.

(1)

Rowan changes to type *B* vacuum tubes. He takes a random sample of 40 type *B* vacuum tubes and finds that 8 of them shatter when exposed to alternating high and low temperatures.

(e) Test, at the 5% level of significance, whether or not there is evidence that the proportion of type *B* vacuum tubes that shatter when exposed to alternating high and low temperatures is lower than 35%
You should state your hypotheses clearly.

(5)

Question 3 continued

Question 3 continued

Question 3 continued

(Total for Question 3 is 12 marks)

4. The continuous random variable G has probability density function f(g) given by

$$\text{f}(g) = \begin{cases} \frac{1}{15}(g+3) & -1 < g \leqslant 2 \\ \frac{3}{20} & 2 < g \leqslant 4 \\ 0 & \text{otherwise} \end{cases}$$

(a) Sketch the graph of f(g)

(2)

(b) Find $\text{P}\left(\left(1 \leqslant 2G \leqslant 6\right) \middle| G \leqslant 2\right)$

(4)

The continuous random variable H is such that E(H) = 12 and Var(H) = 2.4

(c) Find $\text{E}\left(2H^2 + 3G + 3\right)$
Show your working clearly.
(*Solutions relying on calculator technology are not acceptable.*)

(6)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 12 marks)

5. The random variable W has a continuous uniform distribution over the interval $[-6, a]$ where a is a constant.

Given that $\text{Var}(W) = 27$

(a) show that $a = 12$

(2)

Given that $\text{P}(W > b) = \frac{3}{5}$

(b) (i) find the value of b

(2)

(ii) find $\text{P}\left(-12 < W < \frac{b}{2}\right)$

(2)

A piece of wood AB has length 160 cm. The wood is cut at random into 2 pieces. Each of the pieces is then cut in half. The four pieces are used to form the sides of a rectangle.

(c) Calculate the probability that the area of the rectangle is greater than $975\,\text{cm}^2$

(4)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 10 marks)

6. A bag contains a large number of counters with an odd number or an even number written on each.

Odd and even numbered counters occur in the ratio 4 : 1

In a game a player takes a random sample of 4 counters from the bag.

The player scores

5 points for each counter taken that has an even number written on it

2 points for each counter taken that has an odd number written on it

The random variable X represents the total score, in points, from the 4 counters.

(a) Find the sampling distribution of X

(6)

A random sample of n sets of 4 counters is taken. The random variable Y represents the number of these n sets that have a total score of exactly 14

(b) Calculate the minimum value of n such that $P(Y \geqslant 1) > 0.95$

(3)

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 9 marks)

7. A continuous random variable X has cumulative distribution function $F(x)$ given by

$$F(x) = \begin{cases} 0 & x < 1 \\ k(ax + bx^3 - x^4 - 4) & 1 \leqslant x \leqslant 2 \\ 1 & x > 2 \end{cases}$$

where a, b and k are non-zero constants.

Given that the mode of X is 1.5

(a) show that $b = 3$

(3)

(b) Hence show that $a = 2$

(1)

(c) Show that the median of X lies between 1.4 and 1.5

(4)

Question 7 continued

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 8 marks)

TOTAL FOR PAPER IS 75 MARKS