Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Thursday 16 January 2025

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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1. A researcher repeats, independently, 100 trials of a task.

The number of successes is X and the probability of success on each trial is 0.05

(a) Find $P(X = 2)$

(2)

(b) Use a suitable Poisson approximation to estimate $P(X = 2)$

(2)

(c) Calculate the percentage error in this approximation.

(2)

(d) State the conditions under which the Poisson distribution may be used as an approximation to the binomial distribution.

(1)

The random variable Y has a Poisson distribution with mean λ such that

$$P(Y = 6) = 0.1601 \text{ and } P(Y = 7) = 0.1418$$

(e) By forming and solving 2 equations, find the value of λ to 2 significant figures. Show your working clearly.

(4)

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Question 1 continued

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Question 1 continued

(Total for Question 1 is 11 marks)

2. (i) Nima wants to investigate the distribution of a discrete random variable X

The unknown mean of the distribution is μ

Nima takes a sample and finds the sample mean, $\bar{x}$

For **each** of the following, state whether or not it is a statistic. Give a reason for your answer in each case.

(a) μ

(b) $\bar{x}$

(2)

(ii) A discrete random variable Y has the sampling distribution given in the table below.

y	2	5	6
$P(Y = y)$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{5}{12}$

Two random independent observations of Y are taken.

Find the probability that the value of the first observation of Y is smaller than the value of the second observation of Y

(3)

(iii) A bag contains three counters, numbered 3, 4 and 5 respectively. Two counters are drawn at random, one after the other without replacement.

(a) List all the possible combinations of the scores on the two counters.

(1)

The random variable T is defined as

T = number on the first counter + (2 × number on the second counter)

(b) List all the possible values of T

(2)

(c) Find the sampling distribution of T

(3)

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Question 2 continued

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Question 2 continued

(Total for Question 2 is 11 marks)

3. The random variable X has a continuous uniform distribution over the interval $[-k, 5k]$ where $k > 0$

(a) Find, in terms of k, the probability density function of X for all values of x

(2)

(b) Sketch the graph of the probability density function of X

(2)

(c) Find the mean of X in terms of k

(1)

(d) Find, in terms of k, the cumulative distribution function of X for all values of x

(4)

The random variable Y is defined by $Y = X^2$

(e) Find $E(Y)$ in terms of k

(3)

(f) Find the exact probability that $Y < 2k^2$
Show your working clearly.

(3)

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Question 3 continued

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Question 3 continued

(Total for Question 3 is 15 marks)

4. (i) The probability density function of a continuous random variable X is given by

$$f(x) = \begin{cases} \frac{x^3}{20} & 1 \leqslant x \leqslant 3 \\ 0 & \text{otherwise} \end{cases}$$

(a) Using algebraic integration find $E(X^2)$
You must show your working.

(3)

Given that $E(X) = 2.42$

(b) find the value of $\text{Var}(X)$ correct to 3 significant figures.

(2)

(ii) A random sample of size 10 is taken from a continuous random variable Y

(a) Find the probability that at least 7 of these values are **smaller** than the upper quartile of Y

(3)

(b) Find the probability that less than or equal to 5 of these values are **larger** than the upper quartile of Y

(2)

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Question 4 continued

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Question 4 continued

(Total for Question 4 is 10 marks)

5. A meteor shower occurs for several weeks every summer. One Monday night during this meteor shower, Chris goes out to look for meteors and sees an average of 15 meteors per hour.

(a) Find the probability that in a random 20-minute period of time on this Monday night Chris sees

(i) at least 6 meteors

(ii) no more than 3 meteors.

(4)

Chris is told by the local astronomy club that there will be more meteors to be seen per hour on the following Friday night than on Monday night.

Chris decides to use data from the Friday night to test, at a 5% significance level, if there is evidence to support the claim of the local astronomy club.

Chris plans to spend 30 minutes looking for meteors on the Friday night.

(b) Write down suitable null and alternative hypotheses that Chris can use.

(1)

(c) Find the critical region for the test and state its associated probability.

(3)

On the Friday night, Chris sees 12 meteors in the 30 minutes.

(d) State the conclusion to the test that can be made using this observation. Give a reason for your answer.

(2)

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Question 5 continued

(Total for Question 5 is 10 marks)

6. The discrete random variable R has the distribution $R \sim \mathrm{B}(n,p)$

The mean of R is 200

(a) State the variance of R in terms of p

(1)

A normal distribution is used as an approximation for R

Using this approximation, $\mathrm{P}(R < 180) = 0.0307$ to 3 significant figures.

(b) Show that $\sqrt{200 - 200p} = 10.96$ to 4 significant figures.

(5)

(c) Hence find the value of p, giving your answer to 2 significant figures.

(2)

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Question 6 continued

(Total for Question 6 is 8 marks)

7. A continuous random variable X has probability density function defined as

$$f(x) = \begin{cases} k(x-3)^2 & 2 \leqslant x \leqslant 6 \\ 0 & \text{otherwise} \end{cases}$$

(a) Sketch the graph of $y = f(x)$

(2)

(b) Hence write down the mode of X

(1)

(c) Using algebraic integration and showing your working clearly

(i) show that $k = \frac{3}{28}$

(4)

(ii) verify that the upper quartile of X lies between 5.71 and 5.72

(3)

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Question 7 continued

Question 7 continued

(Total for Question 7 is 10 marks)

TOTAL FOR PAPER: 75 MARKS

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