Write your name here

Surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number	Candidate Number

Statistics S2

Advanced/Advanced Subsidiary

Monday 25 June 2018 – Morning
Time: 1 hour 30 minutes

Paper Reference
WST02/01

You must have:
Mathematical Formulae and Statistical Tables (Blue)

Total Marks

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. 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). Coloured pencils and highlighter pens must not be used.
- **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. When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- 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.

Turn over

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1. A salesman sells insurance to people. Each day he chooses a number of people to contact. The probability that the salesman sells insurance to a person he contacts is 0.05

On Monday he chooses to contact 10 people.

(a) Find the probability that on Monday the salesman sells insurance to
(i) exactly 1 person,
(ii) at least 3 people.

(3)

(b) Find the number of people he should contact each day in order to sell insurance, on average, to 3 people per day.

(2)

(c) Calculate the least number of people he must choose to contact on Friday, so that the probability of selling insurance to at least 1 person on Friday exceeds 0.99

(4)

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Question 1 continued

Q1

(Total 9 marks)

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2. John weaves cloth by hand. Emma believes that faults are randomly distributed in John's cloth at a rate of more than 4 per 50 metres of cloth. To check her belief, Emma takes a random sample of 100 metres of the cloth and finds that it contains 14 faults.

(a) Stating your hypotheses clearly, test, at the 5% level of significance, Emma's belief.

(5)

Armani also weaves cloth by hand. He knows that faults are randomly distributed in his cloth at a rate of 4 per 50 metres of cloth. Emma decides to buy a large amount of Armani's cloth to sell in pieces of length l metres. She chooses l so that the probability of no faults in a piece is exactly 0.9

(b) Show that $l = 1.3$ to 2 significant figures.

(4)

Emma sells 5000 of these pieces of cloth of length 1.3 metres. She makes a profit of £2.50 on each piece of cloth that does not contain any faults but a loss of £0.50 on any piece that contains at least one fault.

(c) Find Emma's expected profit.

(3)

Question 2 continued

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Question 2 continued

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Question 2 continued

(Total 12 marks)

Q2

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3. A machine pours oil into bottles. It is electronically controlled to cut off the flow of oil randomly between 100 ml and k ml, where $k > 100$. It is equally likely to cut off the flow at any point in this range. The random variable X is the volume of oil poured into a bottle.

Given that $\mathrm{P}(102 \leqslant X \leqslant k) = \dfrac{2}{3}$

(a) show that $k = 106$

(3)

(b) Find the probability that the volume of oil poured into a bottle is

(i) less than 105 ml,

(ii) exactly 105 ml.

(2)

(c) Write down the value of $\mathrm{E}(X)$

(1)

(d) Find the 15th percentile of this distribution.

(2)

(e) Determine the value of x such that $3\mathrm{P}(X \leqslant x - 1.5) = \mathrm{P}(X \geqslant x + 1.5)$

(3)

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Question 3 continued

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Question 3 continued

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Question 3 continued

Q3

(Total 11 marks)

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4. The volume of milk, M litres, in cartons produced by a dairy, has distribution $\mathrm{N}(\mu, \sigma^2)$, where μ and σ are unknown. A random sample of 12 cartons is taken and the volume of milk in each carton is measured $(M_1, M_2, \ldots, M_{12})$. A statistic X is based on this sample.

(a) Explain what is meant by "a random sample" in this case.
(1)

(b) State the population in this case.
(1)

(c) Write down the distribution of $\dfrac{M_{12} - \mu}{\sigma}$
(1)

(d) Explain what you understand by the sampling distribution of X.
(1)

(e) State, giving a reason, which of the following is not a statistic based on this sample.

(I) $3M_1 + \dfrac{2M_{11}}{6}$ (II) $\displaystyle\sum_{i=1}^{12}\left(\frac{M_i - \mu}{\sigma}\right)^2$ (III) $\displaystyle\sum_{i=1}^{12}(2M_i - 3)$
(2)

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Question 4 continued

Q4

(Total 6 marks)

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5. Cars stop at a service station randomly at a rate of 3 every 5 minutes.

(a) Calculate the probability that in a randomly selected 10 minute period,

(i) exactly 7 cars will stop at the service station,

(ii) more than 7 cars will stop at the service station.

(4)

Using a normal approximation, the probability that more than 40 cars will stop at the service station during a randomly selected n minute period is 0.2266 correct to 4 significant figures.

(b) Find the value of n.

(9)

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Question 5 continued

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Question 5 continued

Question 5 continued

(Total 13 marks)

Q5

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6. A random variable X has probability density function given by

$$f(x) = \begin{cases} \dfrac{1}{4} & 0 \leqslant x < 1 \\ \dfrac{x^3}{5} & 1 \leqslant x \leqslant 2 \\ 0 & \text{otherwise} \end{cases}$$

(a) Use algebraic integration to find $E(X)$

(3)

(b) Use algebraic integration to find $\text{Var}(X)$

(3)

(c) Define the cumulative distribution function $F(x)$ for all values of x.

(4)

(d) Find the median of X, giving your answer to 3 significant figures.

(2)

(e) Comment on the skewness of the distribution, justifying your answer.

(2)

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Question 6 continued

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Question 6 continued

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Question 6 continued

Q6

(Total 14 marks)

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7. A manufacturer produces packets of sweets. Each packet contains 25 sweets. The manufacturer claims that, on average, 40% of the sweets in each packet are red.

A packet is selected at random.

(a) Using a 1% level of significance, find the critical region for a two-tailed test that the proportion of red sweets is 0.40

You should state the probability in each tail, which should be as close as possible to 0.005

(5)

(b) Find the actual significance level of this test.

(1)

The manufacturer changes the production process to try to reduce the number of red sweets. She chooses 2 packets at random and finds that 8 of the sweets are red.

(c) Test, at the 1% level of significance, whether or not there is evidence that the manufacturer's changes to the production process have been successful. State your hypotheses clearly.

(4)

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Question 7 continued

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Question 7 continued

Q7

(Total 10 marks)

TOTAL FOR PAPER: 75 MARKS

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