GradeMax

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | Candidate Number

Thursday 23 January 2020

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 (Blue), 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 ▶

P60573A

©2020 Pearson Education Ltd.

1/1/1/1/

P 6 0 5 7 3 A 0 1 2 4

Pearson

Leave blank

1. *Flogcar* is a car hire company that only allows cars to be hired for single days. The numbers of cars hired on different days are statistically independent. The number of cars hired on a randomly selected day from *Flogcar* is modelled by a Poisson distribution with mean 4

(a) Calculate the probability that exactly 6 cars are hired from *Flogcar* on a randomly selected day.

(2)

(b) Calculate the probability that on 2 randomly selected days, the total number of cars hired from *Flogcar* is between 3 and 7 inclusive.

(3)

(c) Use a suitable approximation to find the probability that on 7 randomly selected days, the total number of cars hired from *Flogcar* is more than 30

(5)

The probability that a car hired from *Flogcar* is returned in good condition is 0.97

In a randomly chosen period, *Flogcar* hires out 100 cars.

(d) (i) Explain why the distribution of the number of cars returned in good condition would not be well approximated by the Poisson distribution.

(1)

(ii) By considering the number of cars hired out that are **not** returned in good condition, use a Poisson approximation to estimate the probability that more than 95 of the cars hired out in this period are returned in good condition. Show your working clearly.

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 1 continued

Leave blank

Question 1 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 1 continued

Q1

(Total 14 marks)

Leave blank

2. Duck eggs are classed as large or small.

Kiyoshi knows that 35% of the eggs laid by his ducks are classed as large and the rest are classed as small. The eggs are randomly allocated to boxes each containing 6 eggs.

A box is selected at random.

Calculate the probability that this box contains

(a) (i) exactly 2 large eggs,

(ii) more large eggs than small eggs.

(5)

Kiyoshi believes that the proportion of large eggs produced by the ducks will increase if he adds a supplement to the ducks' food. To check his belief he takes a random sample of 50 eggs after the supplement has been added to the ducks' food and finds that 25 of them are large eggs.

(b) Use a suitable test, at the 5% level of significance, to determine whether or not there is evidence to support Kiyoshi's belief. State your hypotheses clearly.

(5)

Kiyoshi sells boxes that contain more large eggs than small eggs for a profit of £1.20 and the rest of the boxes for a profit of £0.60

The proportion of large eggs produced by Kiyoshi's ducks has increased to 45% and the cost of the supplement is £0.10 per box of eggs. Given that the eggs are still randomly allocated to boxes,

(c) explain whether or not Kiyoshi should continue to add the supplement to the ducks' food in order to make a greater profit.

(5)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 2 continued

Leave blank

Question 2 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 2 continued

(Total 15 marks)

Q2

Leave blank

3. A task was designed to take a person 25 minutes to complete. The random variable T represents the time, in minutes, it takes to complete the task and is uniformly distributed over the interval $[25 - k, 25 + 3k]$ where $k > 0$

(a) Find $P(25 - 0.5k < T < 25 + 2.5k)$

(1)

Given that $E(T^2) = 918.76$

(b) find the value of k.

(6)

The task is to be completed by 50 people. Assuming that people complete the task independently,

(c) calculate the probability that at least 20 of these people complete the task in less than 25 minutes.

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 3 continued

Leave blank

Question 3 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 3 continued

(Total 10 marks)

Q3

Leave blank

4. The random variable T has probability density function $f(t)$ where

$$f(t) = \begin{cases} \frac{1}{3} & 1 \leqslant t < 2 \\ k(4t^2 - t^3) & 2 \leqslant t \leqslant 4 \\ 0 & \text{otherwise} \end{cases}$$

(a) Show that $k = \frac{1}{22}$

(3)

(b) Sketch the probability density function.

(2)

(c) Find the mode of T.

(3)

(d) Find the cumulative distribution function $F(t)$ for all values of t.

(5)

(e) Find the probability that T is greater than 3

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 4 continued

Leave blank

Question 4 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 4 continued

(Total 15 marks)

Q4

Leave blank

5. Chris runs boat trips between two islands during the summer. During her trips, Chris claims that whales are seen randomly at a mean rate of 2 in every 9 trips.

To investigate Chris's claim, a random sample of 18 boat trips run by Chris was taken.

(a) Using a 5% level of significance, find the critical region, for a two-tailed test, to enable Chris to test her claim.

(3)

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

(1)

The total number of whales seen in the 18 boat trips was 6

(c) State what this suggests about Chris's claim. Give a reason for your answer.

(1)

The following summer, Chris decides to run n trips so that the probability of her seeing at least one whale is more than 0.9

(d) Assuming Chris's claim is true, find the minimum value of n.

(4)

Chris believes that she sees fewer whales during the winter. A random sample of 45 trips run in the winter was taken and the total number of whales seen was 5

(e) Test, at the 5% level of significance, whether or not the mean rate of whales seen in winter is less than 2 in every 9 trips. State your hypotheses clearly.

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 5 continued

Leave blank

Question 5 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 5 continued

(Total 13 marks)

Q5

Leave blank

6. The random variable X has probability density function $f(x)$ where

$$f(x) = \begin{cases} \frac{1}{8}(x^2 + 2x + 1) & -1 \leqslant x < 1 \\ \frac{1}{4} & 1 \leqslant x \leqslant \frac{11}{3} \\ 0 & \text{otherwise} \end{cases}$$

Given that $E(X) = \frac{31}{18}$

(a) use algebraic integration to find $\text{Var}(X)$

(4)

(b) Calculate $P\left(X < -\frac{1}{2}\right) + P\left(X > \frac{1}{2}\right)$

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Leave blank

Question 6 continued

Leave blank

Question 6 continued

Q6

(Total 8 marks)

TOTAL FOR PAPER: 75 MARKS

END

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA