Pearson Edexcel International A Level Mathematics

Statistics 2

Past Paper Collection (from 2020)

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Last updated: July 1, 2024

Comments and suggestions to DrYuFromShanghai@QQ.com

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.

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Information

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- There are 6 questions in this question paper. The total mark for this paper is 75.
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Turn over ▶

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)

Leave blank

Question 1 continued

Leave blank

Question 1 continued

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)

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Q2

(Total 15 marks)

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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)

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Q3

(Total 10 marks)

Leave blank

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

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

(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 $\mathrm{F}(t)$ for all values of t.

(5)

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

(2)

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Q4

(Total 15 marks)

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)

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Q5

(Total 13 marks)

Leave blank

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

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

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

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

(4)

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

(4)

Leave blank

Question 6 continued

Leave blank

Question 6 continued

Q6

(Total 8 marks)

TOTAL FOR PAPER: 75 MARKS

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International
Advanced Level

Centre Number | Candidate Number

Wednesday 14 October 2020

Morning (Time: 1 hour 30 minutes) | Paper Reference **WST02/01**

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International Advanced Subsidiary/Advanced Level
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Turn over ▶

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1.

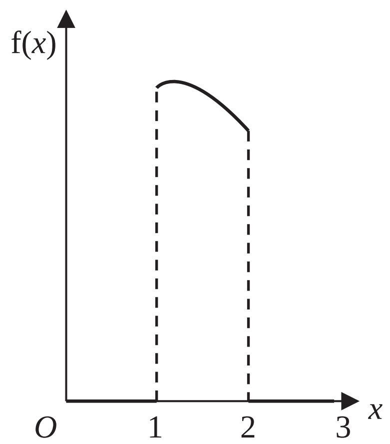


Figure 1

Figure 1 shows a sketch of the probability density function f(x) of the random variable X.

For $1 \leqslant x \leqslant 2$, f($x$) is represented by a curve with equation $f(x) = k\left(\frac{1}{2}x^3 - 3x^2 + ax + 1\right)$ where k and a are constants.

For all other values of x, $f(x) = 0$

(a) Use algebraic integration to show that $k(12a - 33) = 8$

(4)

Given that $a = 5$

(b) calculate the mode of X.

(4)

Leave blank

Question 1 continued

Leave blank

Question 1 continued

Leave blank

Question 1 continued

Q1

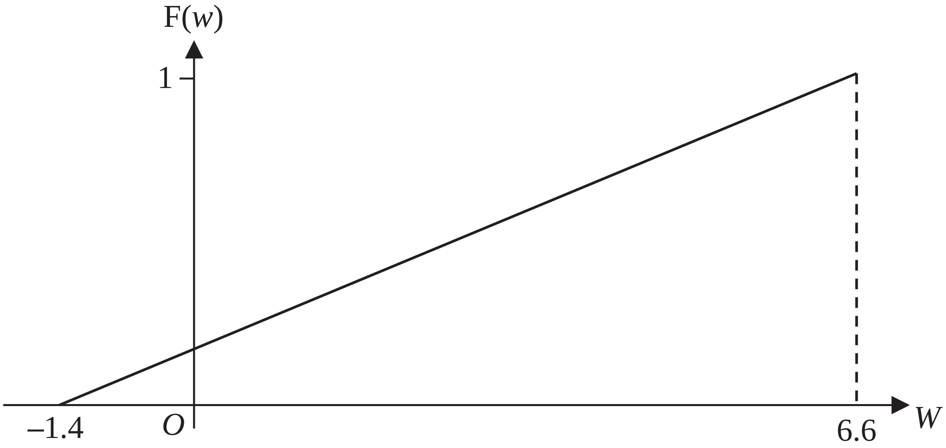
(Total 8 marks)

Leave blank

2. In the summer Kylie catches a local steam train to work each day. The published arrival time for the train is 10 am.

The random variable W is the train's actual arrival time minus the published arrival time, in minutes. When the value of W is positive, the train is late.

The cumulative distribution function F(w) is shown in the sketch below.



(a) Specify fully the probability density function f(w) of W.

(2)

(b) Write down the value of E(W)

(1)

(c) Calculate α such that $P(\alpha \leqslant W \leqslant 1.6) = 0.35$

(2)

A day is selected at random.

(d) Calculate the probability that on this day the train arrives between 1.2 minutes late and 2.4 minutes late.

(2)

Given that on this day the train was between 1.2 minutes late and 2.4 minutes late,

(e) calculate the probability that it was more than 2 minutes late.

(2)

A random sample of 40 days is taken.

(f) Calculate the probability that for at least 10 of these days the train is between 1.2 minutes late and 2.4 minutes late.

(3)

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Q2

(Total 12 marks)

Leave blank

3. A manufacturer produces plates. The proportion of plates that are flawed is 45%, with flawed plates occurring independently.

A random sample of 10 of these plates is selected.

(a) Find the probability that the sample contains

(i) fewer than 2 flawed plates,

(ii) at least 6 flawed plates.

(4)

George believes that the proportion of flawed plates is not 45%. To assess his belief George takes a random sample of 120 plates. The random variable F represents the number of flawed plates found in the sample.

(b) Using a normal approximation, find the maximum number of plates, c, and the minimum number of plates, d, such that

$$P(F \leqslant c) \leqslant 0.05 \text{ and } P(F \geqslant d) \leqslant 0.05$$

where $F \sim B(120, 0.45)$

(7)

The manufacturer claims that, after a change to the production process, the proportion of flawed plates has decreased. A random sample of 30 plates, taken after the change to the production process, contains 8 flawed plates.

(c) Use a suitable hypothesis test, at the 5% level of significance, to assess the manufacturer's claim. State your hypotheses clearly.

(4)

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Q3

(Total 15 marks)

Leave blank

4. In a peat bog, Common Spotted-orchids occur at a mean rate of 4.5 per m^2

(a) Give an assumption, not already stated, that is required for the number of Common Spotted-orchids per m^2 of the peat bog to follow a Poisson distribution.
(1)

Given that the number of Common Spotted-orchids in 1 m^2 of the peat bog can be modelled by a Poisson distribution,

(b) find the probability that in a randomly selected 1 m^2 of the peat bog

(i) there are exactly 6 Common Spotted-orchids,

(ii) there are fewer than 10 but more than 4 Common Spotted-orchids.
(4)

Juan believes that by introducing a new management scheme the number of Common Spotted-orchids in the peat bog will increase. After three years under the new management scheme, a randomly selected 2 m^2 of the peat bog contains 11 Common Spotted-orchids.

(c) Using a 5% significance level assess Juan's belief. State your hypotheses clearly.
(5)

Assuming that in the peat bog, Common Spotted-orchids still occur at a mean rate of 4.5 per m^2

(d) use a normal approximation to find the probability that in a randomly selected 20 m^2 of the peat bog there are fewer than 70 Common Spotted-orchids.
(3)

Following a period of dry weather, the probability that there are fewer than 70 Common Spotted-orchids in a randomly selected 20 m^2 of the peat bog is 0.012

A random sample of 200 non-overlapping 20 m^2 areas of the peat bog is taken.

(e) Using a suitable approximation, calculate the probability that at most 1 of these areas contains fewer than 70 Common Spotted-orchids.
(3)

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Q4

(Total 16 marks)

Leave blank

5. The waiting time, T minutes, of a customer to be served in a local post office has probability density function

$$f(t) = \begin{cases} \frac{1}{50}(18 - 2t) & 0 \leqslant t \leqslant 3 \\ \frac{1}{20} & 3 < t \leqslant 5 \\ 0 & \text{otherwise} \end{cases}$$

Given that the mean number of minutes a customer waits to be served is 1.66

(a) use algebraic integration to find Var(T), giving your answer to 3 significant figures.
(5)

(b) Find the cumulative distribution function F(t) for all values of t.
(4)

(c) Calculate the probability that a randomly chosen customer's waiting time will be more than 2 minutes.
(2)

(d) Calculate $\mathrm{P}\big([\mathrm{E}(T) - 2] < T < [\mathrm{E}(T) + 2]\big)$
(2)

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Q5

(Total 13 marks)

Leave blank

6. (a) Explain what you understand by the sampling distribution of a statistic.

(1)

A factory produces beads in bags for craft shops. A small bag contains 40 beads, a medium bag contains 80 beads and a large bag contains 150 beads. The factory produces small, medium and large bags in the ratio 5:3:2 respectively.

A random sample of 3 bags is taken from the factory.

(b) Find the sampling distribution for the range of the number of beads in the 3 bags in the sample.

(7)

A random sample of n sets of 3 bags is taken. The random variable Y represents the number of these n sets of 3 bags that have a range of 70

(c) Calculate the minimum value of n such that $P(Y = 0) < 0.2$

(3)

Leave blank

Question 6 continued

Leave blank

Question 6 continued

Q6

(Total 11 marks)

TOTAL FOR PAPER: 75 MARKS

END

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Tuesday 19 January 2021

Afternoon (Time: 1 hour 30 minutes) | Paper Reference **WST02/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Statistics S2

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Turn over ▶

Leave blank

1. Jim farms oysters in a particular lake. He knows from past experience that 5% of young oysters do not survive to be harvested.

In a random sample of 30 young oysters, the random variable X represents the number that do not survive to be harvested.

(a) Write down a suitable model for the distribution of X.

(1)

(b) State an assumption that has been made for the model in part (a).

(1)

(c) Find the probability that

(i) exactly 24 young oysters **do survive** to be harvested,

(ii) at least 3 young oysters do not survive to be harvested.

(4)

A second random sample, of 200 young oysters, is taken.
The probability that at least n of these young oysters do not survive to be harvested is more than 0.8

(d) Using a suitable approximation, find the maximum value of n.

(3)

Jim believes that the level of salt in the lake water has changed and it has altered the survival rate of his oysters. He takes a random sample of 25 young oysters and places them in the lake.
When Jim harvests the oysters, he finds that 21 **do survive** to be harvested.

(e) Use a suitable test, at the 5% level of significance, to assess whether or not there is evidence that the proportion of oysters not surviving to be harvested is more than 5%. State your hypotheses clearly.

(5)

Leave blank

Question 1 continued

Leave blank

Question 1 continued

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Question 1 continued

Q1

(Total 14 marks)

Leave blank

2. The distance, in metres, a novice tightrope artist, walking on a wire, walks before falling is modelled by the random variable W with cumulative distribution function

$$F(w) = \begin{cases} 0 & w < 0 \\ \frac{1}{3}\left(w - \frac{w^4}{256}\right) & 0 \leqslant w \leqslant 4 \\ 1 & w > 4 \end{cases}$$

(a) Find the probability that a novice tightrope artist, walking on the wire, walks at least 3.5 metres before falling.

(2)

A random sample of 30 novice tightrope artists is taken.

(b) Find the probability that more than 1 of these novice tightrope artists, walking on the wire, walks at least 3.5 metres before falling.

(3)

Given E(W) = 1.6

(c) use algebraic integration to find Var(W)

(5)

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Q2

(Total 10 marks)

Leave blank

3. The number of water fleas, in 100 ml of pond water, has a Poisson distribution with mean 7

(a) Find the probability that a sample of 100 ml of the pond water does **not** contain exactly 4 water fleas.

(2)

Aja collects 5 separate samples, each of 100 ml, of the pond water.

(b) Find the probability that exactly 1 of these samples contains exactly 4 water fleas.

(3)

Using a normal approximation, the probability that more than 3 water fleas will be found in a random sample of n ml of the pond water is 0.9394 correct to 4 significant figures.

(c) (i) Show that $n - 1.55\sqrt{\dfrac{n}{0.07}} - 50 = 0$

(5)

(ii) Hence find the value of n

(2)

After the pond has been cleaned, the number of water fleas in a 100 ml random sample of the pond water is 15

(d) Using a suitable test, at the 1% level of significance, assess whether or not there is evidence that the number of water fleas per 100 ml of the pond water has increased. State your hypotheses clearly.

(5)

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Q3

(Total 17 marks)

Leave blank

4. A continuous random variable X has probability density function

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

where k and a are constants.

(a) Show that $ka^3 = 3$

(3)

Given that $E(X) = 1.5$

(b) use algebraic integration to show that $a = 6$

(4)

(c) Verify that the median of X is 1.2 to one decimal place.

(3)

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Q4

(Total 10 marks)

Leave blank

5. A piece of wood AB is 3 metres long. The wood is cut at random at a point C and the random variable W represents the length of the piece of wood AC.

(a) Find the probability that the length of the piece of wood AC is more than 1.8 metres.
(2)

The two pieces of wood AC and CB form the two shortest sides of a right-angled triangle. The random variable X represents the length of the longest side of the right-angled triangle.

(b) Show that $X^2 = 2W^2 - 6W + 9$
(2)

[You may assume for random variables S, T and U and for constants a and b that if $S = aT + bU$ then $E(S) = aE(T) + bE(U)$]

(c) Find $E(X^2)$
(6)

(d) Find $P(X^2 > 5)$
(4)

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Q5

(Total 14 marks)

Leave blank

6. The owner of a very large youth club has designed a new method for allocating people to teams. Before introducing the method he decided to find out how the members of the youth club might react.

(a) Explain why the owner decided to take a random sample of the youth club members rather than ask all the youth club members.

(1)

(b) Suggest a suitable sampling frame.

(1)

(c) Identify the sampling units.

(1)

The new method uses a bag containing a large number of balls. Each ball is numbered either 20, 50 or 70
When a ball is selected at random, the random variable X represents the number on the ball where

$$\mathrm{P}(X = 20) = p \qquad \mathrm{P}(X = 50) = q \qquad \mathrm{P}(X = 70) = r$$

A youth club member takes a ball from the bag, records its number and replaces it in the bag.
He then takes a second ball from the bag, records its number and replaces it in the bag.

The random variable M is the mean of the 2 numbers recorded.

Given that

$$\mathrm{P}(M = 20) = \frac{25}{64} \qquad \mathrm{P}(M = 60) = \frac{1}{16} \qquad \text{and} \quad q > r$$

(d) show that $\mathrm{P}(M = 50) = \dfrac{1}{16}$

(7)

Leave blank

Question 6 continued

Leave blank

Question 6 continued

(Total 10 marks)

Q6

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Turn over ▶

1. *Spany* sells seeds and claims that 5% of its pansy seeds do not germinate. A packet of pansy seeds contains 20 seeds. Each seed germinates independently of the other seeds.

(a) Find the probability that in a packet of *Spany*'s pansy seeds

(i) more than 2 but fewer than 5 seeds do not germinate,

(ii) more than 18 seeds germinate.

(5)

Jem buys 5 packets of *Spany*'s pansy seeds.

(b) Calculate the probability that all of these packets contain more than 18 seeds that germinate.

(2)

Jem believes that *Spany*'s claim is incorrect. She believes that the percentage of pansy seeds that do not germinate is greater than 5%

(c) Write down the hypotheses for a suitable test to examine Jem's belief.

(1)

Jem planted all of the 100 seeds she bought from *Spany* and found that 8 did not germinate.

(d) Using a suitable approximation, carry out the test using a 5% level of significance.

(6)

Question 1 continued

Question 1 continued

Question 1 continued

(Total for Question 1 is 14 marks)

2. Luis makes and sells rugs. He knows that faults occur randomly in his rugs at a rate of 3 every $4\,\text{m}^2$

(a) Find the probability of there being exactly 5 faults in one of his rugs that is $4\,\text{m}^2$ in size.

(2)

(b) Find the probability that there are more than 5 faults in one of his rugs that is $6\,\text{m}^2$ in size.

(2)

Luis makes a rug that is $4\,\text{m}^2$ in size and finds it has exactly 5 faults in it.

(c) Write down the probability that the next rug that Luis makes, which is $4\,\text{m}^2$ in size, will have exactly 5 faults. Give a reason for your answer.

(2)

A small rug has dimensions 80 cm by 150 cm. Faults still occur randomly at a rate of 3 every $4\,\text{m}^2$
Luis makes a profit of £80 on each small rug he sells that contains no faults but a profit of £60 on any small rug he sells that contains faults.

Luis sells n small rugs and expects to make a profit of at least £4000

(d) Calculate the minimum value of n

(4)

Luis wishes to increase the productivity of his business and employs Rhiannon. Faults also occur randomly in Rhiannon's rugs and independently to faults made by Luis.
Luis randomly selects 10 small rugs made by Rhiannon and finds 13 faults.

(e) Test, at the 5% level of significance, whether or not there is evidence to support the suggestion that the rate at which faults occur is higher for Rhiannon than for Luis.
State your hypotheses clearly.

(5)

Question 2 continued

Question 2 continued

Question 2 continued

(Total for Question 2 is 15 marks)

3. The continuous random variable Y has the following probability density function

$$f(y) = \begin{cases} \dfrac{6}{25}(y-1) & 1 \leqslant y < 2 \\ \dfrac{3}{50}(4y^2 - y^3) & 2 \leqslant y < 4 \\ 0 & \text{otherwise} \end{cases}$$

(a) Sketch $f(y)$

(2)

(b) Find the mode of Y

(3)

(c) Use algebraic integration to calculate $E(Y^2)$

(4)

Given that $E(Y) = 2.696$

(d) find $Var(Y)$

(2)

(e) Find the value of y for which $P(Y \geqslant y) = 0.9$
Give your answer to 3 significant figures.

(4)

Question 3 continued

Question 3 continued

Question 3 continued

(Total for Question 3 is 15 marks)

4. A bag contains a large number of balls, each with one of the numbers 1, 2 or 5 written on it in the ratio 2 : 3 : 4 respectively.

A random sample of 3 balls is taken from the bag.

The random variable B represents the range of the numbers written on the balls in the sample.

(i) Find $\mathrm{P}(B = 4)$

(ii) Find the sampling distribution of B.

(10)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 10 marks)

5. A game uses two turntables, one red and one yellow. Each turntable has a point marked on the circumference that is lined up with an arrow at the start of the game. Jim spins both turntables and measures the distance, in metres, each point is from the arrow, around the circumference in an anticlockwise direction when the turntables stop spinning.

The continuous random variable Y represents the distance, in metres, the point is from the arrow for the yellow turntable. The cumulative distribution function of Y is given by $\mathrm{F}(y)$ where

$$\mathrm{F}(y) = \begin{cases} 0 & y < 0 \\ 1 - (\alpha + \beta y^2) & 0 \leqslant y \leqslant 5 \\ 1 & y > 5 \end{cases}$$

(a) Explain why (i) $\alpha = 1$

(ii) $\beta = -\frac{1}{25}$

(2)

(b) Find the probability density function of Y

(2)

The continuous random variable R represents the distance, in metres, the point is from the arrow for the red turntable. The distribution of R is modelled by a continuous uniform distribution over the interval $[d, 3d]$

Given that $\mathrm{P}\left(R > \frac{11}{5}\right) = \mathrm{P}\left(Y > \frac{5}{3}\right)$

(c) find the value of d

(3)

In the game each turntable is spun 3 times. The distance between the point and the arrow is determined for each spin. To win a prize, at least 5 of the distances the point is from the arrow when a turntable is spun must be less than $\frac{11}{5}$ m

Jo plays the game once.

(d) Calculate the probability of Jo winning a prize.

(4)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 11 marks)

6. The random variable $Y \sim B(225, p)$

Using a normal approximation, the probability that Y is at least 188 is 0.1056 to 4 decimal places.

(i) Show that p satisfies $145p^2 - 241p + 100 = 0$ when the normal probability tables are used.

(ii) Hence find the value of p, justifying your answer.

(10)

Question 6 continued

Question 6 continued

(Total for Question 6 is 10 marks)

TOTAL FOR PAPER: 75 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

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.

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Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
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Advice

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Turn over

Leave blank

1. A research project into food purchases found that 35% of people who buy eggs do **not** buy free range eggs.

A random sample of 30 people who bought eggs is taken. The random variable F denotes the number of people who do **not** buy free range eggs.

(a) Find $\mathrm{P}(F \geqslant 12)$

(2)

(b) Find $\mathrm{P}(8 \leqslant F < 15)$

(2)

A farm shop gives 3 loyalty points with every purchase of free range eggs. With every purchase of eggs that are **not** free range the farm shop gives 1 loyalty point.
A random sample of 30 customers who buy eggs from the farm shop is taken.

(c) Find the probability that the total number of points given to these customers is less than 70

(3)

The manager of the farm shop believes that the proportion of customers who buy eggs but do **not** buy free range eggs is more than 35%

In a survey of 200 customers who buy eggs, 86 do **not** buy free range eggs.

Using a suitable test and a normal approximation,

(d) determine, at the 5% level of significance, whether there is evidence to support the manager's belief. State your hypotheses clearly.

(7)

Leave blank

Question 1 continued

Leave blank

Question 1 continued

Leave blank

Question 1 continued

Q1

(Total 14 marks)

Leave blank

2. (i) The continuous random variable X is uniformly distributed over the interval $[a, b]$

Given that $P(8 < X < 14) = \frac{1}{5}$ and $E(X) = 11$

(a) write down $P(X > 14)$

(1)

(b) find $P(6X > a + b)$

(4)

(ii) Susie makes a strip of pasta 45 cm long. She then cuts the strip of pasta, at a randomly chosen point, into two pieces. The random variable S is the length of the shortest piece of pasta.

(a) Write down the distribution of S

(1)

(b) Calculate the probability that the shortest piece of pasta is less than 12 cm long.

(2)

Susie makes 20 strips of pasta, all 45 cm long, and separately cuts each strip of pasta, at a randomly chosen point, into two pieces.

(c) Calculate the probability that exactly 6 of the pieces of pasta are less than 12 cm long.

(3)

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Q2

(Total 11 marks)

Leave blank

3. A continuous random variable X has cumulative distribution function

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

where a and b are positive constants.

(a) Show that $b = 4$

(1)

(b) Find the exact value of a

(2)

(c) Find $\mathrm{P}(X > 2.25)$

(2)

(d) Showing your working clearly,

(i) sketch the probability density function of X
(ii) calculate the mode of X

(5)

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Q3

(Total 10 marks)

Leave blank

4. The number of cars entering a safari park per 10-minute period can be modelled by a Poisson distribution with mean 6

(a) Find the probability that in a given 10-minute period exactly 8 cars will enter the safari park.

(2)

(b) Find the smallest value of n such that the probability that at least n cars enter the safari park in 10 minutes is less than 0.05

(2)

The probability that no cars enter the safari park in m minutes, where m is an integer, is less than 0.05

(c) Find the smallest value of m

(2)

A car enters the safari park.

(d) Find the probability that there is less than 5 minutes before the next car enters the safari park.

(3)

Given that exactly 15 cars entered the safari park in a 30-minute period,

(e) find the probability that exactly 1 car entered the safari park in the first 5 minutes of the 30-minute period.

(4)

Aston claims that the mean number of cars entering the safari park per 10-minute period is more than 6

He selects a 15-minute period at random in order to test whether there is evidence to support his claim.

(f) Determine the critical region for the test at the 5% level of significance.

(2)

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Q4

(Total 15 marks)

Leave blank

5. A bag contains a large number of counters.

40% of the counters are numbered 1
35% of the counters are numbered 2
25% of the counters are numbered 3

In a game Alif draws two counters at random from the bag. His score is 4 times the number on the first counter minus 2 times the number on the second counter.

(a) Show that Alif gets a score of 8 with probability 0.0875

(1)

(b) Find the sampling distribution of Alif's score.

(5)

(c) Calculate Alif's expected score.

(2)

Leave blank

Question 5 continued

(Total 8 marks)

Q5

Leave blank

6. The continuous random variable Y has probability density function f(y) given by

$$f(y) = \begin{cases} \frac{1}{14}(y+2) & -1 < y \leqslant 1 \\ \frac{3}{14} & 1 < y \leqslant 3 \\ \frac{1}{14}(6-y) & 3 < y \leqslant 5 \\ 0 & \text{otherwise} \end{cases}$$

(a) Sketch the probability density function f(y)

(2)

Given that $E(Y^2) = \frac{131}{21}$

(b) find $\text{Var}(2Y - 3)$

(4)

The cumulative distribution function of Y is F(y)

(c) Show that $F(y) = \frac{1}{14}\left(\frac{y^2}{2} + 2y + \frac{3}{2}\right)$ for $-1 < y \leqslant 1$

(2)

(d) Find F(y) for all values of y

(5)

(e) Find the exact value of the 30th percentile of Y

(2)

(f) Find $P(4Y \leqslant 5 \mid Y \leqslant 3)$

(2)

Leave blank

Question 6 continued

Leave blank

Question 6 continued

Leave blank

Question 6 continued

Leave blank

Question 6 continued

Q6

(Total 17 marks)

TOTAL FOR PAPER: 75 MARKS

END

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Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

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

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Turn over

Leave blank

1 A local pottery makes cups. The number of faulty cups made by the pottery in a week follows a Poisson distribution with a mean of 6

In a randomly chosen week, the probability that there will be at least x faulty cups made is 0.1528

(a) Find the value of x

(3)

(b) Use a normal approximation to find the probability that in 6 randomly chosen weeks the total number of faulty cups made is fewer than 32

(4)

A week is called a "*poor week*" if at least x faulty cups are made, where x is the value found in part (a).

(c) Find the probability that in 50 randomly chosen weeks, more than 1 is a "*poor week*".

(4)

Leave blank

Question 1 continued

Leave blank

Question 1 continued

Leave blank

Question 1 continued

Q1

(Total 11 marks)

Leave blank

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

$$\mathrm{F}(x) = \begin{cases} 0 & x < -k \\ \dfrac{x+k}{4k} & -k \leqslant x \leqslant 3k \\ 1 & x > 3k \end{cases}$$

where k is a positive constant.

(a) Specify fully, in terms of k, the probability density function of X

(2)

(b) Write down, in terms of k, the value of $\mathrm{E}(X)$

(1)

(c) Show that $\mathrm{Var}(X) = \dfrac{4}{3}k^2$

(2)

(d) Find, in terms of k, the value of $\mathrm{E}(3X^2)$

(3)

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Leave blank

Question 2 continued

Q2

(Total 8 marks)

Leave blank

3 A photocopier in a school is known to break down at random at a mean rate of 8 times per week.

(a) Give a reason why a Poisson distribution could be used to model the number of breakdowns.

(1)

The headteacher of the school replaces the photocopier with a refurbished one and wants to find out if the rate of breakdowns has increased or decreased.

(b) Write down suitable null and alternative hypotheses that the headteacher should use.

(1)

The refurbished photocopier was monitored for the first week after it was installed.

(c) Using a 5% level of significance, find the critical region to test whether the rate of breakdowns has now changed.

(3)

(d) Find the actual significance level of a test based on the critical region from part (c).

(2)

During the first week after it was installed there were 4 breakdowns.

(e) Comment on this finding in the light of the critical region found in part (c).

(2)

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Q3

(Total 9 marks)

Leave blank

4 The continuous random variable X has a probability density function given by

$$f(x) = \begin{cases} \dfrac{1}{2}k(x-1) & 1 \leqslant x \leqslant 3 \\ k & 3 < x \leqslant 6 \\ \dfrac{1}{4}k(10-x) & 6 < x \leqslant 10 \\ 0 & \text{otherwise} \end{cases}$$

where k is a positive constant.

(a) Sketch $f(x)$ for all values of x

(2)

(b) Show that $k = \dfrac{1}{6}$

(2)

(c) Specify fully the cumulative distribution function $F(x)$ of X

(7)

Given that $E(X) = \dfrac{61}{12}$

(d) find $P(X > E(X))$

(2)

(e) Describe the skewness of the distribution, giving a reason for your answer.

(2)

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Leave blank

Question 4 continued

(Total 15 marks)

Q4

Leave blank

5 Applicants for a pilot training programme with a passenger airline are screened for colour blindness. Past records show that the proportion of applicants identified as colour blind is 0.045

(a) Write down a suitable model for the distribution of the number of applicants identified as colour blind from a total of n applicants.

(1)

(b) State one assumption necessary for this distribution to be a suitable model of this situation.

(1)

(c) Using a suitable approximation, find the probability that exactly 5 out of 120 applicants are identified as colour blind.

(3)

(d) Explain why the approximation that you used in part (c) is appropriate.

(2)

Jaymini claims that 75% of all applicants for this training programme go on to become pilots.

From a random sample of 96 applicants for this training programme 67 go on to become pilots.

(e) Using a suitable approximation, test Jaymini's claim at the 5% level of significance. State your hypotheses clearly.

(7)

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Q5

(Total 14 marks)

Leave blank

6 (a) Explain what you understand by the sampling distribution of a statistic.

(1)

At Sam's cafe a standard breakfast consists of 6 breakfast items. Customers can then choose to upgrade to a medium breakfast by adding 1 extra breakfast item or they can upgrade to a large breakfast by adding 2 extra breakfast items. Standard, medium and large breakfasts are sold in the ratio $6:3:2$ respectively.

A random sample of 2 customers is taken from customers who have bought a breakfast from Sam's cafe on a particular day.

(b) Find the sampling distribution for the total number, T, of breakfast items bought by these 2 customers. Show your working clearly.

(7)

(c) Find $\mathrm{E}(T)$

(2)

Leave blank

Question 6 continued

Leave blank

Question 6 continued

Leave blank

Question 6 continued

Q6

(Total 10 marks)

Leave blank

7 The sides of a square are each of length L cm and its area is A cm^2

Given that A is uniformly distributed on the interval [10, 30]

(a) find $\mathrm{P}(L \geqslant 4.5)$

(2)

(b) find $\mathrm{Var}(L)$

(6)

Leave blank

Question 7 continued

Leave blank

Question 7 continued

Q7

(Total 8 marks)

TOTAL FOR PAPER: 75 MARKS

END

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Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

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

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Turn over ▶

1. The independent random variables W and X have the following distributions.

$$W \sim \text{Po}(4) \qquad X \sim \text{B}(3, 0.8)$$

(a) Write down the value of the variance of W

(1)

(b) Determine the mode of X
Show your working clearly.

(2)

One observation from each distribution is recorded as W_1 and X_1 respectively.

(c) Find $\text{P}(W_1 = 2 \text{ and } X_1 = 2)$

(3)

(d) Find $\text{P}(X_1 < W_1)$

(4)

Question 1 continued

Question 1 continued

Question 1 continued

(Total for Question 1 is 10 marks)

2. The time, in minutes, spent waiting for a call to a call centre to be answered is modelled by the random variable T with probability density function

$$f(t) = \begin{cases} \dfrac{1}{192}\left(t^3 - 48t + 128\right) & 0 \leqslant t \leqslant 4 \\ 0 & \text{otherwise} \end{cases}$$

(a) Use algebraic integration to find, in minutes and seconds, the mean waiting time.

(3)

(b) Show that $P(1 < T < 3) = \dfrac{7}{16}$

(3)

A supervisor randomly selects 256 calls to the call centre.

(c) Use a suitable approximation to find the probability that more than 125 of these calls take between 1 and 3 minutes to be answered.

(5)

Question 2 continued

Question 2 continued

Question 2 continued

(Total for Question 2 is 11 marks)

3. A point is to be randomly plotted on the x-axis, where the units are measured in cm.

The random variable R represents the x coordinate of the point on the x-axis and R is uniformly distributed over the interval [–5, 19]

A negative value indicates that the point is to the left of the origin and a positive value indicates that the point is to the right of the origin.

(a) Find the exact probability that the point is plotted to the right of the origin.

(1)

(b) Find the exact probability that the point is plotted more than 3.5 cm away from the origin.

(2)

(c) Sketch the cumulative distribution function of R

(2)

Three independent points with x coordinates R_1, R_2 and R_3 are plotted on the x-axis.

(d) Find the exact probability that

(i) all three points are more than 10 cm from the origin

(3)

(ii) the point furthest from the origin is more than 10 cm from the origin.

(2)

Question 3 continued

Question 3 continued

Question 3 continued

(Total for Question 3 is 10 marks)

4. Past evidence shows that 7% of pears grown by a farmer are unfit for sale.

This season it is believed that the proportion of pears that are unfit for sale has decreased. To test this belief a random sample of n pears is taken. The random variable Y represents the number of pears in the sample that are unfit for sale.

(a) Find the smallest value of n such that $Y = 0$ lies in the critical region for this test at a 5% level of significance.

(3)

In the past, 8% of the pears grown by the farmer weigh more than 180 g. This season the farmer believes the proportion of pears weighing more than 180 g has changed. She takes a random sample of 75 pears and finds that 11 of them weigh more than 180 g.

(b) Test, using a suitable approximation, whether there is evidence of a change in the proportion of pears weighing more than 180 g.
You should use a 5% level of significance and state your hypotheses clearly.

(6)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 9 marks)

5. The number of particles per millilitre in a solution is modelled by a Poisson distribution with mean 0.15

A randomly selected 50 millilitre sample of the solution is taken.

(a) Find the probability that

(i) exactly 10 particles are found,

(ii) between 6 and 11 particles (inclusive) are found.

(4)

Petra takes 12 independent samples of *m* millilitres of the solution.

The probability that at least 2 of these samples contain no particles is 0.1184

(b) Using the Statistical Tables provided, find the value of *m*

(6)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 10 marks)

6. The continuous random variable X has probability density function

$$f(x) = \begin{cases} 0.1x & 0 \leqslant x < 2 \\ kx(8 - x) & 2 \leqslant x < 4 \\ a & 4 \leqslant x < 6 \\ 0 & \text{otherwise} \end{cases}$$

where k and a are constants.

It is known that $P(X < 4) = \dfrac{31}{45}$

(a) Find the exact value of k

(4)

(b) (i) Find the exact value of a

(ii) Find the exact value of $P(0 \leqslant X \leqslant 5.5)$

(3)

(c) Specify fully the cumulative distribution function of X

(6)

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 13 marks)

7. A bag contains 10 counters each with exactly one number written on it.

There are 6 counters with the number 7 on them
There are 3 counters with the number 8 on them
There is 1 counter with the number 9 on it

A random sample of 3 counters is taken from the bag (without replacement).
These counters are then put back in the bag.

This process is then repeated until 20 samples have been taken.

The random variable Y represents the number of these 20 samples that contain the counter with the number 9 on it.

(a) (i) Find the mean of Y

(ii) Find the variance of Y

(5)

A random sample of 3 counters is chosen from the bag (without replacement).

(b) List all possible samples where the median of the numbers on the 3 counters is 7

(2)

(c) Find the sampling distribution of the median of the numbers on the 3 counters.

(5)

Question 7 continued

Question 7 continued

(Total for Question 7 is 12 marks)

TOTAL FOR PAPER: 75 MARKS

END

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Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper reference **WST02/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Statistics S2

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Total Marks

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Turn over

1. A shop sells shoes at a mean rate of 4 pairs of shoes per hour on a weekday.

(a) Suggest a suitable distribution for modelling the number of sales of pairs of shoes made per hour on a weekday.

(1)

(b) State one assumption necessary for this distribution to be a suitable model of this situation.

(1)

(c) Find the probability that on a weekday the shop sells

(i) more than 4 pairs of shoes in a one-hour period,

(ii) more than 4 pairs of shoes in each of 3 consecutive one-hour periods.

(4)

The area manager visits the shop on a weekday, the day after an advert for the shop appears in a local paper.

In a one-hour period during the manager's visit, the shop sells 7 pairs of shoes. This leads the manager to believe that the advert has increased the shop's sales of pairs of shoes.

(d) Stating your hypotheses clearly, test at the 5% level of significance whether or not there is evidence of an increase in sales of pairs of shoes following the appearance of the advert.

(5)

Question 1 continued

(Total for Question 1 is 11 marks)

2. A bag contains a large number of coins. It only contains 20p and 50p coins. A random sample of 3 coins is taken from the bag.

(a) List all the possible combinations of 3 coins that might be taken.

(2)

Let $\overline{X}$ represent the mean value of the 3 coins taken.

Part of the sampling distribution of $\overline{X}$ is given below.

$\overline{x}$	20	a	b	50
$P(\overline{X} = \overline{x})$	$\frac{4913}{8000}$	c	d	$\frac{27}{8000}$

(b) Write down the value of a and the value of b

(1)

The probability of taking a 20p coin at random from the bag is p

The probability of taking a 50p coin at random from the bag is q

(c) Find the value of p and the value of q

(2)

(d) Hence, find the value of c and the value of d

(3)

Let M represent the mode of the 3 coins taken at random from the bag.

(e) Find the sampling distribution of M

(3)

Question 2 continued

Question 2 continued

Question 2 continued

(Total for Question 2 is 11 marks)

3. *Superbounce* is a manufacturer of tennis balls.

It knows from past records that 10% of its tennis balls fail a bounce test.

(a) Find the probability that from a random sample of 10 of these tennis balls

(i) at least 4 fail the bounce test

(ii) more than 1 but fewer than 5 fail the bounce test.

(4)

The managing director makes changes to the production process and claims that these changes will reduce the probability of its tennis balls failing the bounce test.

After the changes were made a random sample of 50 of the tennis balls were tested and it was found that 2 failed the bounce test.

(b) Test, at the 5% significance level, whether or not this result supports the managing director's claim.

(4)

In a second random sample of n tennis balls it was found that none failed the bounce test. As a result of this sample, the managing director's claim is supported at the 1% significance level.

(c) Find the smallest possible value of n

(3)

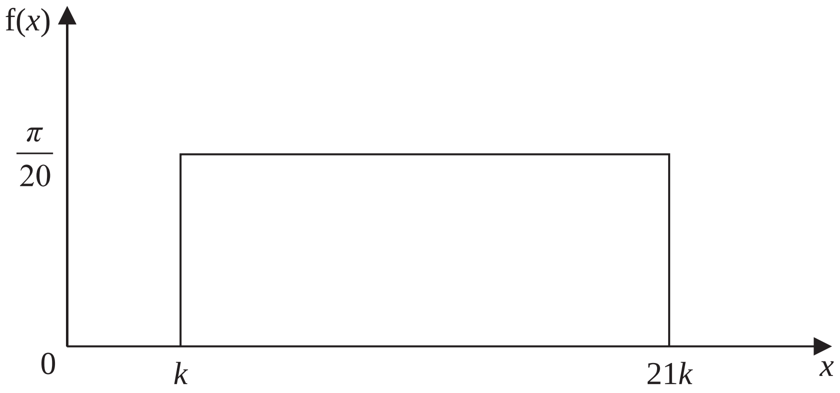
Question 3 continued

Question 3 continued

Question 3 continued

(Total for Question 3 is 11 marks)

4. The continuous random variable X has probability density function f(x), shown in the diagram, where k is a constant.



(a) Find $P(X < 10k)$

(1)

(b) Show that $k = \frac{1}{\pi}$

(2)

(c) Find, in terms of π, the values of

(i) E(X)

(ii) Var(X)

(3)

Circles are drawn with area A, where

$$A = \pi\left(X + \frac{2}{\pi}\right)^2$$

(d) Find E(A)

(4)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 10 marks)

5. A company produces steel cable.

Defects in the steel cable produced by this company occur at random, at a constant rate of 1 defect per 16 metres.

On one day the company produces a piece of steel cable 80 metres long.

(a) Find the probability that there are at most 5 defects in this piece of steel cable.

(2)

The company produces a piece of steel cable 80 metres long on each of the next 4 days.

(b) Find the probability that fewer than 2 of these 4 pieces of steel cable contain at most 5 defects.

(4)

The following week the company produces a piece of steel cable x metres long.

Using a normal approximation, the probability that this piece of steel cable has fewer than 26 defects is 0.5398

(c) Find the value of x

(8)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 14 marks)

6. The continuous random variable X has cumulative distribution function

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

where a, b and k are positive constants.

(a) Show that $ak = 1 - bk^2$

(1)

Using part (a) and given that $\mathrm{E}(X) = \frac{6}{5}$

(b) show that $5bk^3 = 36 - 15k$

(6)

Using part (a) and given that $\mathrm{E}(X) = \frac{6}{5}$ and $\mathrm{Var}(X) = \frac{22}{75}$

(c) show that $5bk^4 = 52 - 10k^2$

(5)

Given that $k < 3$

(d) find the value of k

(4)

(e) Hence find the value of a and the value of b

(2)

Question 6 continued

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 18 marks)

TOTAL FOR PAPER IS 75 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Tuesday 23 May 2023

Morning (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

1. In a large population 40% of adults use online banking.

A random sample of 50 adults is taken.

The random variable X represents the number of adults in the sample that use online banking.

(a) Find

(i) $P(X = 26)$

(2)

(ii) $P(X \geqslant 26)$

(2)

(iii) the smallest value of k such that $P(X \leqslant k) > 0.4$

(1)

A random sample of 600 adults is taken.

(b) (i) Find, using a normal approximation, the probability that no more than 222 of these 600 adults use online banking.

(5)

(ii) Explain why a normal approximation is suitable in part (b)(i)

(1)

Question 1 continued

(Total for Question 1 is 11 marks)

2. (a) State one characteristic of a population that would make a census a practical alternative to sampling.

(1)

A leisure centre has 2500 members.

It asks a sample of 300 members for their opinions on the fees it charges for using the centre.

For the sample,

(b) (i) identify a suitable sampling frame,

(ii) identify a sampling unit.

(2)

The leisure centre has the following pieces of information.

A is the list of the different types of membership that can be paid for by members.

B is the mean of the membership fees paid by **all** 2500 members.

C is the number in the **sample** of 300 members who are satisfied with the fees they pay.

(c) State the piece of information that is a statistic.
Give a reason for your answer.

(1)

Question 2 continued

(Total for Question 2 is 4 marks)

3. The continuous random variable X has probability density function given by

$$f(x) = \begin{cases} \frac{1}{48}\left(x^2 - 8x + c\right) & 2 \leqslant x \leqslant 5 \\ 0 & \text{otherwise} \end{cases}$$

(a) Show that $c = 31$

(3)

(b) Find $P(2 < X < 3)$

(2)

(c) State whether the lower quartile of X is less than 3, equal to 3 or greater than 3
Give a reason for your answer.

(1)

Kei does the following to work out the mode of X

$$f'(x) = \frac{1}{48}(2x - 8)$$

$$0 = \frac{1}{48}(2x - 8)$$

$$x = 4$$

Hence the mode of X is 4

Kei's answer for the mode is incorrect.

(d) Explain why Kei's method does not give the correct value for the mode.

(1)

(e) Find the mode of X
Give a reason for your answer.

(2)

Question 3 continued

Question 3 continued

Question 3 continued

(Total for Question 3 is 9 marks)

4. (a) Given n is large, state a condition for which the binomial distribution $B(n, p)$ can be reasonably approximated by a Poisson distribution.

(1)

A manufacturer produces candles. Those candles that pass a quality inspection are suitable for sale.

It is known that 2% of the candles produced by the manufacturer are not suitable for sale.

A random sample of 125 candles produced by the manufacturer is taken.

(b) Use a suitable approximation to find the probability that no more than 6 of the candles are **not** suitable for sale.

(4)

The manufacturer also produces candle holders.

Charlie believes that 5% of candle holders produced by the factory have minor defects.

The manufacturer claims that the true proportion is less than 5%

To test the manufacturer's claim, a random sample of 30 candle holders is taken and none of them are found to contain minor defects.

(c) (i) Carry out a test of the manufacturer's claim using a 5% level of significance. You should state your hypotheses clearly.

(5)

(ii) Give a reason why this is **not** an appropriate test.

(1)

Ashley suggests changing the sample size to 50

(d) Comment on whether or not this change would make the test appropriate. Give a reason for your answer.

(2)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 13 marks)

5. A continuous random variable Y has cumulative distribution function given by

$$\mathrm{F}(y) = \begin{cases} 0 & y < 3 \\ \frac{1}{16}\left(y^2 - 6y + a\right) & 3 \leqslant y \leqslant 5 \\ \frac{1}{12}\left(y + b\right) & 5 < y \leqslant 9 \\ \frac{1}{12}\left(100y - 5y^2 + c\right) & 9 < y \leqslant 10 \\ 1 & y > 10 \end{cases}$$

where a, b and c are constants.

(a) Find the value of a and the value of c

(4)

(b) Find the value of b

(2)

(c) Find $\mathrm{P}(6 < Y \leqslant 9)$
Show your working clearly.

(3)

(d) Specify the probability density function, $\mathrm{f}(y)$, for $5 < y \leqslant 9$

(1)

Using the information

$$\int_3^5 (6y - 5)\,\mathrm{f}(y)\,\mathrm{d}y + \int_9^{10} (6y - 5)\,\mathrm{f}(y)\,\mathrm{d}y = 26.5$$

(e) find $\mathrm{E}(6Y - 5)$
You should make your method clear.

(4)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 14 marks)

6. Akia selects at random a value from the continuous random variable W, which is uniformly distributed over the interval $[a , b]$

The probability that Akia selects a value greater than 17 is $\frac{1}{5}$

The probability that Akia selects a value less than k is $\frac{53}{60}$

(a) Find the probability that Akia selects a value between 17 and k

(2)

It is known that $\text{Var}(W) = 75$

(b) (i) Find the value of a and the value of b

(4)

(ii) Find the value of k

(2)

(c) Find $\text{P}(-5 < W < 5)$

(2)

(d) Find $\text{E}(W^2)$

(2)

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 12 marks)

7. A bakery sells muffins individually at an average rate of 8 muffins per hour.

(a) Find the probability that, in a randomly selected one-hour period, the bakery sells at least 4 but not more than 8 muffins.

(3)

A sample of 5 non-overlapping **half-hour** periods is selected at random.

(b) Find the probability that the bakery sells fewer than 3 muffins in exactly 2 of these periods.

(5)

Given that 4 muffins were sold in a one-hour period,

(c) find the probability that more muffins were sold in the first 15 minutes than in the last 45 minutes.

(4)

Question 7 continued

Question 7 continued

(Total for Question 7 is 12 marks)

TOTAL FOR PAPER IS 75 MARKS

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 19 October 2023

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

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- 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.
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- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over

1. Sam is a telephone sales representative.

For each call to a customer

- Sam either makes a sale or does not make a sale
- sales are made independently

Past records show that, for each call to a customer, the probability that Sam makes a sale is 0.2

(a) Find the probability that Sam makes

(i) exactly 2 sales in 14 calls,

(ii) more than 3 sales in 25 calls.

(4)

Sam makes n calls each day.

(b) Find the minimum value of n

(i) so that the expected number of sales each day is at least 6

(2)

(ii) so that the probability of at least 1 sale in a randomly selected day exceeds 0.95

(4)

Question 1 continued

(Total for Question 1 is 10 marks)

2. The continuous random variable X has probability density function $\mathrm{f}(x)$ given by

$$\mathrm{f}(x) = \begin{cases} ax^3 & 0 \leqslant x \leqslant 4 \\ bx + c & 4 < x \leqslant d \\ 0 & \text{otherwise} \end{cases}$$

where a, b, c and d are constants such that

- $bx + c = ax^3$ at $x = 4$
- $bx + c$ is a straight line segment with end coordinates $(4, 64a)$ and $(d, 0)$

(a) State the mode of X

(1)

Given that the mode of X is equal to the median of X

(b) use algebraic integration to show that $a = \frac{1}{128}$

(2)

(c) Find the value of d

(2)

(d) Hence find the value of b and the value of c

(3)

Question 2 continued

Question 2 continued

Question 2 continued

(Total for Question 2 is 8 marks)

3. Every morning Navtej travels from home to work. Navtej leaves home at a random time between 08:00 and 08:15

- It always takes Navtej 3 minutes to walk to the bus stop
- Buses run every 15 minutes and Navtej catches the first bus that arrives
- Once Navtej has caught the bus it always takes a further 29 minutes for Navtej to reach work

The total time, T minutes, for Navtej's journey from home to work is modelled by a continuous uniform distribution over the interval $[\alpha, \beta]$

(a) (i) Show that $\alpha = 32$

(ii) Show that $\beta = 47$

(2)

(b) State fully the probability density function for this distribution.

(2)

(c) Find the value of

(i) $\mathrm{E}(T)$

(ii) $\mathrm{Var}(T)$

(3)

(d) Find the probability that the time for Navtej's journey is within 5 minutes of 35 minutes.

(2)

Question 3 continued

(Total for Question 3 is 9 marks)

4. A manufacturer makes t-shirts in 3 sizes, small, medium and large.

20% of the t-shirts made by the manufacturer are small and sell for £10

30% of the t-shirts made by the manufacturer are medium and sell for £12

The rest of the t-shirts made by the manufacturer are large and sell for £15

(a) Find the mean value of the t-shirts made by the manufacturer.

(2)

A random sample of 3 t-shirts made by the manufacturer is taken.

(b) List all the possible combinations of the individual selling prices of these 3 t-shirts.

(2)

(c) Find the sampling distribution of the **median** selling price of these 3 t-shirts.

(6)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 10 marks)

5. A supermarket receives complaints at a mean rate of 6 per week.

(a) State one assumption necessary, in order for a Poisson distribution to be used to model the number of complaints received by the supermarket.

(1)

(b) Find the probability that, in a given week, there are

(i) fewer than 3 complaints received by the supermarket,

(ii) at least 6 complaints received by the supermarket.

(3)

In a randomly selected week, the supermarket received 12 complaints.

(c) Test, at the 5% level of significance, whether or not there is evidence that the mean number of complaints is greater than 6 per week.
State your hypotheses clearly.

(5)

Following changes made by the supermarket, it received 26 complaints over a 6-week period.

(d) Use a suitable approximation to test whether or not there is evidence that, following the changes, the mean number of complaints received is less than 6 per week.
You should state your hypotheses clearly and use a 5% significance level.

(7)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 16 marks)

6. The continuous random variable Y has cumulative distribution function given by

$$\mathrm{F}(y) = \begin{cases} 0 & y < 0 \\ \dfrac{1}{21}y^2 & 0 \leqslant y \leqslant k \\ \dfrac{2}{15}\left(6y - \dfrac{y^2}{2}\right) - \dfrac{7}{5} & k < y \leqslant 6 \\ 1 & y > 6 \end{cases}$$

(a) Find $\mathrm{P}\left(Y < \frac{1}{4}k \mid Y < k\right)$

(2)

(b) Find the value of k

(4)

(c) Use algebraic calculus to find $\mathrm{E}(Y)$

(6)

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 12 marks)

7. The discrete random variable X is given by

$$X \sim B(n, p)$$

The value of n and the value of p are such that X can be approximated by a normal random variable Y where

$$Y \sim N(\mu, \sigma^2)$$

Given that when using a normal approximation

$$P(X < 86) = 0.2266 \quad \text{and} \quad P(X > 97) = 0.1056$$

(a) show that $\sigma = 6$

(7)

(b) Hence find the value of n and the value of p

(3)

Question 7 continued

Question 7 continued

(Total for Question 7 is 10 marks)

TOTAL FOR PAPER IS 75 MARKS

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

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Information

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- 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.
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Turn over

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

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

(a) Sketch the graph of $f(g)$

(2)

(b) Find $P\left((1 \leqslant 2G \leqslant 6) \mid G \leqslant 2\right)$

(4)

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

(c) Find $E\left(2H^2 + 3G + 3\right)$

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 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

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 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.

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)

Question 1 continued

Question 1 continued

Question 1 continued

(Total for Question 1 is 13 marks)

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)

Question 2 continued

Question 2 continued

Question 2 continued

(Total for Question 2 is 9 marks)

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)

Question 3 continued

Question 3 continued

Question 3 continued

(Total for Question 3 is 15 marks)

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 $P(M = 4) = \frac{9}{245}$

(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 $P(T = 0) < 0.15$

(3)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 10 marks)

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 $\mathrm{P}(T > 16)$

(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)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 12 marks)

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)

Question 6 continued

Question 6 continued

(Total for Question 6 is 16 marks)

TOTAL FOR PAPER IS 75 MARKS