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Candidate surname

Other names

Centre Number

Candidate Number

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Pearson Edexcel Level 3 GCE

Tuesday 20 June 2023

Afternoon

Paper
reference

9MA0/31

Mathematics

Advanced

PAPER 31: Statistics

You must have:

Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

Candidates may use any calculator allowed 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 statistical tables should be quoted in full. If a calculator is used instead of 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.
- The total mark for this part of the examination is 50. There are 6 questions.
- 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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5. Tisam is playing a game.
She uses a ball, a cup and a spinner.

The random variable X represents the number the spinner lands on when it is spun.
The probability distribution of X is given in the following table

x	20	50	80	100
$P(X = x)$	a	b	c	d

where a , b , c and d are probabilities.

To play the game

- the spinner is spun to obtain a value of x
- Tisam then stands x cm from the cup and tries to throw the ball into the cup

The event S represents the event that Tisam successfully throws the ball into the cup.

To model this game Tisam assumes that

- $P(S | \{X = x\}) = \frac{k}{x}$ where k is a constant
- $P(S \cap \{X = x\})$ should be the same whatever value of x is obtained from the spinner

Using Tisam's model,

(a) show that $c = \frac{8}{5}b$ (2)

(b) find the probability distribution of X (5)

Nav tries, a large number of times, to throw the ball into the cup from a distance of 100 cm.

He successfully gets the ball in the cup 30% of the time.

(c) State, giving a reason, why Tisam's model of this game is not suitable to describe Nav playing the game for all values of X (1)



6. A medical researcher is studying the number of hours, T , a patient stays in hospital following a particular operation.

The histogram on the page opposite summarises the results for a random sample of 90 patients.

- (a) Use the histogram to estimate $P(10 < T < 30)$ (2)

For these 90 patients the time spent in hospital following the operation had

- a mean of 14.9 hours
- a standard deviation of 9.3 hours

Tomas suggests that T can be modelled by $N(14.9, 9.3^2)$

- (b) With reference to the histogram, state, giving a reason, whether or not Tomas' model could be suitable. (1)

Xiang suggests that the frequency polygon based on this histogram could be modelled by a curve with equation

$$y = kxe^{-x} \quad 0 \leq x \leq 4$$

where

- x is measured in **tens of hours**
- k is a constant

- (c) Use algebraic integration to show that

$$\int_0^n xe^{-x} dx = 1 - (n + 1)e^{-n} \quad (4)$$

- (d) Show that, for Xiang's model, $k = 99$ to the nearest integer. (3)

- (e) Estimate $P(10 < T < 30)$ using
 (i) Tomas' model of $T \sim N(14.9, 9.3^2)$ (1)

- (ii) Xiang's curve with equation $y = 99xe^{-x}$ and the answer to part (c) (2)

The researcher decides to use Xiang's curve to model $P(a < T < b)$

- (f) State one limitation of Xiang's model. (1)



