

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel
Level 3 GCE**

Centre Number

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Candidate Number

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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 5 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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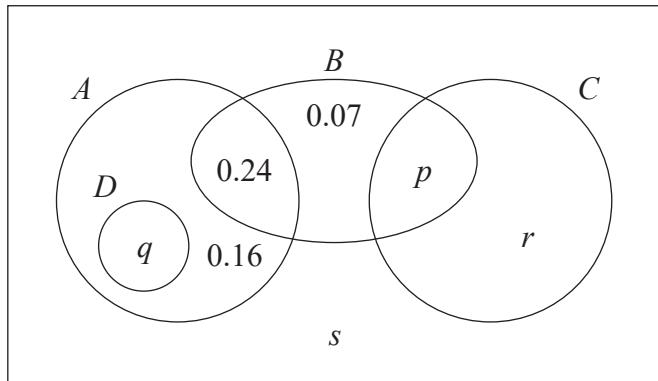
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1. The Venn diagram shows the probabilities associated with four events, A , B , C and D



- (a) Write down any pair of mutually exclusive events from A , B , C and D

(1)

Given that $P(B) = 0.4$

- (b) find the value of p

(1)

Given also that A and B are independent

- (c) find the value of q

(2)

Given further that $P(B' | C) = 0.64$

- (d) find

(i) the value of r

(ii) the value of s

(4)



Question 1 continued

(Total for Question 1 is 8 marks)



2. A random sample of 15 days is taken from the large data set for Perth in June and July 1987.

The scatter diagram in Figure 1 displays the values of two of the variables for these 15 days.

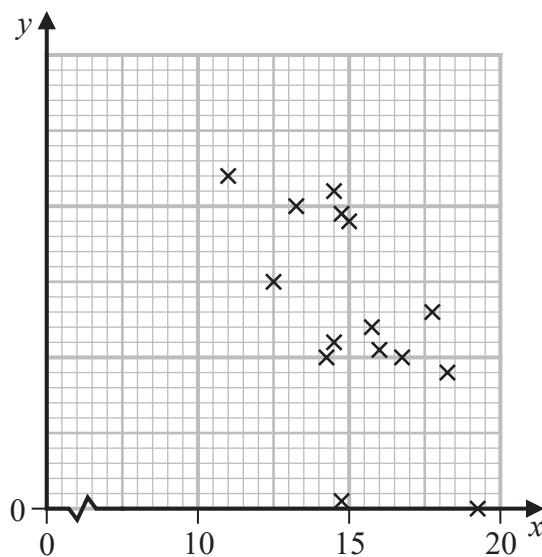


Figure 1

- (a) Describe the correlation.

(1)

The variable on the x -axis is Daily Mean Temperature measured in $^{\circ}\text{C}$.

- (b) Using your knowledge of the large data set,

(i) suggest which variable is on the y -axis,

(ii) state the units that are used in the large data set for this variable.

(2)

Stav believes that there is a correlation between Daily Total Sunshine and Daily Maximum Relative Humidity at Heathrow.

He calculates the product moment correlation coefficient between these two variables for a random sample of 30 days and obtains $r = -0.377$

- (c) Carry out a suitable test to investigate Stav's belief at a 5% level of significance.
State clearly

- your hypotheses
- your critical value

(3)

On a random day at Heathrow the Daily Maximum Relative Humidity was 97%

- (d) Comment on the number of hours of sunshine you would expect on that day, giving a reason for your answer.

(1)



Question 2 continued



Question 2 continued

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Question 2 continued

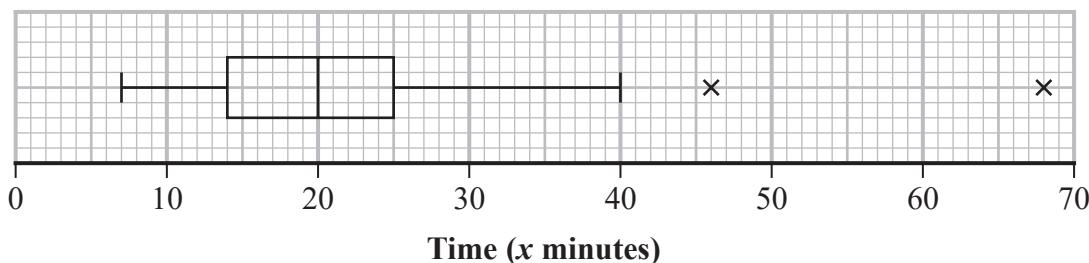
(Total for Question 2 is 7 marks)



3. Each member of a group of 27 people was timed when completing a puzzle.

The time taken, x minutes, for each member of the group was recorded.

These times are summarised in the following box and whisker plot.



- (a) Find the range of the times.

(1)

- (b) Find the interquartile range of the times.

(1)

For these 27 people $\sum x = 607.5$ and $\sum x^2 = 17623.25$

- (c) calculate the mean time taken to complete the puzzle,

(1)

- (d) calculate the standard deviation of the times taken to complete the puzzle.

(2)

Taruni defines an outlier as a value more than 3 standard deviations above the mean.

- (e) State how many outliers Taruni would say there are in these data, giving a reason for your answer.

(1)

Adam and Beth also completed the puzzle in a minutes and b minutes respectively, where $a > b$.

When their times are included with the data of the other 27 people

- the median time increases
- the mean time does not change

- (f) Suggest a possible value for a and a possible value for b , explaining how your values satisfy the above conditions.

(3)

- (g) Without carrying out any further calculations, explain why the standard deviation of all 29 times will be lower than your answer to part (d).

(1)



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Question 3 continued



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Question 3 continued



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Question 3 continued

(Total for Question 3 is 10 marks)



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4. The discrete random variable D has the following probability distribution

d	10	20	30	40	50
$P(D = d)$	$\frac{k}{10}$	$\frac{k}{20}$	$\frac{k}{30}$	$\frac{k}{40}$	$\frac{k}{50}$

where k is a constant.

- (a) Show that the value of k is $\frac{600}{137}$ (2)

The random variables D_1 and D_2 are independent and each have the same distribution as D .

- (b) Find $P(D_1 + D_2 = 80)$
Give your answer to 3 significant figures. (3)

A single observation of D is made.

The value obtained, d , is the common difference of an arithmetic sequence.

The first 4 terms of this arithmetic sequence are the angles, measured in degrees, of quadrilateral Q

- (c) Find the exact probability that the smallest angle of Q is more than 50° (5)



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Question 4 continued



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Question 4 continued



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Question 4 continued

(Total for Question 4 is 10 marks)



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5. A health centre claims that the time a doctor spends with a patient can be modelled by a normal distribution with a mean of 10 minutes and a standard deviation of 4 minutes.

- (a) Using this model, find the probability that the time spent with a randomly selected patient is more than 15 minutes.

(1)

Some patients complain that the mean time the doctor spends with a patient is more than 10 minutes.

The receptionist takes a random sample of 20 patients and finds that the mean time the doctor spends with a patient is 11.5 minutes.

- (b) Stating your hypotheses clearly and using a 5% significance level, test whether or not there is evidence to support the patients' complaint.

(4)

The health centre also claims that the time a dentist spends with a patient during a routine appointment, T minutes, can be modelled by the normal distribution where $T \sim N(5, 3.5^2)$

- (c) Using this model,

- (i) find the probability that a routine appointment with the dentist takes less than 2 minutes

(1)

- (ii) find $P(T < 2 \mid T > 0)$

(3)

- (iii) hence explain why this normal distribution may not be a good model for T .

(1)

The dentist believes that she cannot complete a routine appointment in less than 2 minutes.

She suggests that the health centre should use a refined model only including values of $T > 2$

- (d) Find the median time for a routine appointment using this new model, giving your answer correct to one decimal place.

(5)



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Question 5 continued



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Question 5 continued



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Question 5 continued



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Question 5 continued

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(Total for Question 5 is 15 marks)

TOTAL FOR STATISTICS IS 50 MARKS

