AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

A-level
FURTHER MATHEMATICS

Paper 3 Statistics

Thursday 13 June 2019 Afternoon Time allowed: 2 hours

Materials
- You must have the AQA formulae and statistical tables booklet for A-level Mathematics and A-level Further Mathematics.
- You should have a scientific calculator that meets the requirements of the specification. (You may use a graphical calculator.)
- You must ensure you have the other optional Question Paper/Answer Book for which you are entered (**either** Discrete **or** Mechanics). You will have 2 hours to complete **both** papers.

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer each question in the space provided for that question. If you require extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do **not** write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work you do not want to be marked.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 50.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

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Answer **all** questions in the spaces provided.

1 The discrete random variable X has $\text{Var}(X) = 5$

Find $\text{Var}(4X - 3)$

Circle your answer.

[1 mark]

17 20 77 80

2 Amy takes a sample of size 50 from a normal distribution with mean μ and variance 16

She conducts a hypothesis test with hypotheses:

$H_0 : \mu = 52$

$H_1 : \mu > 52$

She rejects the null hypothesis if her sample has a mean greater than 53

The actual population mean is 53.5

Find the probability that Amy makes a Type II error.

Circle your answer.

[1 mark]

0.4% 3.9% 18.9% 45.0%

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3 Alan's journey time to work can be modelled by a normal distribution with standard deviation 6 minutes.

Alan measures the journey time to work for a random sample of 5 journeys. The mean of the 5 journey times is 36 minutes.

3 (a) Construct a 95% confidence interval for Alan's mean journey time to work, giving your values to one decimal place.

[2 marks]

3 (b) Alan claims that his mean journey time to work is 30 minutes.

State, with a reason, whether or not the confidence interval found in part **(a)** supports Alan's claim.

[1 mark]

3 (c) Suppose that the standard deviation is not known but a sample standard deviation is found from Alan's sample and calculated to be 6

Explain how the working in part **(a)** would change.

[1 mark]

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4 A random variable X has a rectangular distribution.

The mean of X is 3 and the variance of X is 3

4 (a) Determine the probability density function of X.

Fully justify your answer.

[5 marks]

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4 (b) A 6 metre clothes line is connected between the point P on one building and the point Q on a second building.

Roy is concerned the clothes line may break. He uses the random variable X to model the distance in metres from P where the clothes line breaks.

4 (b) (i) State a criticism of Roy's model.

[1 mark]

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4 (b) (ii) On the axes below, sketch the probability density function for an alternative model for the clothes line.

[1 mark]



Turn over for the next question

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5 An insurance company models the claims it pays out in pounds (£) with a random variable X which has probability density function

$$f(x) = \begin{cases} \frac{k}{x} & 1 < x < a \\ 0 & \text{otherwise} \end{cases}$$

5 (a) The median claim is £200

Show that $k = \frac{1}{2\ln 200}$

[3 marks]

5 (b) Find $P(X < 2000)$, giving your answer to three significant figures.

[2 marks]

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5 (c) The insurance company finds that the maximum possible claim is £2000 and they decide to refine their probability density function.

Suggest how this could be done.

[2 marks]

Turn over for the next question

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6 During August, 102 candidates took their driving test at centre *A* and 60 passed.

During the same month, 110 candidates took their driving test at centre *B* and 80 passed.

6 (a) Test whether the driving test result is independent of the driving test centre using the 5% level of significance.

[8 marks]

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6 (b) Rebecca claims that if the result of the test in part **(a)** is to reject the null hypothesis then it is easier to pass a driving test at centre *B* than centre *A*.

State, with a reason, whether or not you agree with Rebecca's claim.

[1 mark]

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Turn over for the next question

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7 A shopkeeper sells chocolate bars which are described by the manufacturer as having an average mass of 45 grams.

The shopkeeper claims that the mass of the chocolate bars, X grams, is getting smaller on average.

A random sample of 6 chocolate bars is taken and their masses in grams are measured. The results are

$$\sum x = 246 \qquad \text{and} \qquad \sum x^2 = 10\,198$$

Investigate the shopkeeper's claim using the 5% level of significance.

State any assumptions that you make.

[9 marks]

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Turn over for the next question

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8 The number of telephone calls received by an office can be modelled by a Poisson distribution with mean 3 calls per 10 minutes.

8 (a) Find the probability that:

8 (a) (i) the office receives exactly 2 calls in 10 minutes;

[1 mark]

8 (a) (ii) the office receives more than 30 calls in an hour.

[3 marks]

8 (b) The office manager splits an hour into 6 periods of 10 minutes and records the number of telephone calls received in each of the 10 minute periods.

Find the probability that the office receives exactly 2 calls in a 10 minute period exactly twice within an hour.

[3 marks]

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8 (c) The office has just received a call.

8 (c) (i) Find the probability that the next call is received more than 10 minutes later.

[3 marks]

8 (c) (ii) Mahah arrives at the office 5 minutes after the last call was received.

State the probability that the next call received by the office is received more than 10 minutes later.

Explain your answer.

[2 marks]

END OF QUESTIONS

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