Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

A-level
STATISTICS

Unit Statistics 5

Friday 23 June 2017 Morning Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

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.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- 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 that you do not want to be marked.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

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

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

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.

Answer each question in the space provided for that question.

1 A wood merchant cuts wooden planks into lengths that are advertised as one-metre shelves.

The actual length of a shelf, X cm, may be modelled by the rectangular distribution on the interval $[99, 103]$.

(a) (i) A shelf is chosen at random. Find the probability that its length is greater than 100.5cm.

[2 marks]

(ii) Calculate the mean and the standard deviation of X.

[3 marks]

(b) Samira buys 50 one-metre shelves.

You may assume that these shelves are a random sample.

Calculate an estimate for the probability that the **mean** length of these 50 shelves exceeds 100.75cm.

[3 marks]

QUESTION PART REFERENCE	**Answer space for question 1**

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QUESTION PART REFERENCE	Answer space for question 1

8

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2 Gilbert owns a parcel delivery company. He has recently introduced new delivery scheduling software. The software produces an estimated time for the delivery of each parcel.

Gilbert's aim in introducing the new delivery software is to reduce the variability of the differences between actual and estimated delivery times.

After the new software has been introduced, Gilbert calculates the differences, in minutes, between actual delivery times and estimated delivery times for a random sample of 11 parcels.

$$11 \quad -8 \quad 14 \quad -16 \quad 1 \quad 6 \quad -3 \quad -7 \quad -2 \quad 9 \quad 4$$

(A negative difference indicates that a parcel arrived earlier than estimated.)

You may assume that the differences between actual and estimated delivery times are normally distributed.

(a) The differences between actual and estimated delivery times for the previous delivery scheduling software had a standard deviation of 15.3 minutes.

Investigate, at the 5% level of significance, whether the new software has resulted in a reduction in the standard deviation of the differences between actual and estimated delivery times.

[7 marks]

(b) Has Gilbert achieved his aim? Give a reason for your answer.

[1 mark]

QUESTION PART REFERENCE	**Answer space for question 2**

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QUESTION PART REFERENCE	Answer space for question 2

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3 The lifetime of a Waybriter light bulb, used in indoor security lights, is T **thousand hours**, where T can be modelled by an exponential distribution with parameter $\lambda = 0.0125$

(a) Find the mean lifetime, **in hours**, of a Waybriter light bulb.

[2 marks]

(b) Find the probability that the lifetime of a Waybriter light bulb is:

(i) less than $100\ 000$ hours;

(ii) between $50\ 000$ hours and $150\ 000$ hours.

[5 marks]

(c) The 15 security lights in a new office block are each fitted with a new Waybriter light bulb. These security lights are then permanently switched on.

Find the probability that all of these 15 light bulbs are working 365 days later.

[3 marks]

QUESTION PART REFERENCE	**Answer space for question 3**

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QUESTION PART REFERENCE	Answer space for question 3

10

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4 Mimi is studying wild dogs living in the Canadian wilderness. For these dogs, she has recorded the number of live births per litter, for 120 litters.

Her results are shown in the table.

Number of live births per litter	0	1	2	3	4	5	6	7	8
Number of litters	3	10	13	18	27	25	14	7	3

(a) Using Mimi's records, carry out a χ^2 goodness of fit test, at the 10% level of significance, to investigate whether a Poisson distribution is a suitable model for the number of live births per litter of wild dogs living in the Canadian wilderness.

[12 marks]

(b) Give **two** reasons why the Poisson distribution might **not** be a suitable model for the number of live births per litter of wild dogs.

[2 marks]

QUESTION PART REFERENCE	**Answer space for question 4**

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QUESTION PART REFERENCE	Answer space for question 4

14

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5 Emily, a midwife, is investigating the birth weights of babies. She suspects that children born in the summer months of June, July and August are, on average, heavier than those born at other times of the year.

She records the weights, x kilograms, of a random sample of six babies she delivered in June, July and August and compares them with the weights, y kilograms, of a random sample of nine babies she delivered at other times of the year. Her results are shown in the table.

x	4.27	3.36	3.18	4.74	4.01	3.72			
y	3.63	4.38	2.85	3.92	3.12	2.77	4.04	4.17	2.54

You may assume that x and y are values from independent normal populations.

(a) Confirm, at the 5% significance level, that it can be assumed that the two samples come from populations with the same variance.

[7 marks]

(b) Investigate Emily's suspicion at the 10% level of significance.

[9 marks]

(c) A Type I or a Type II error may have been made in part **(b)**.

(i) Which type of error might have been made?

(ii) Explain, in context, the meaning of the type of error that you have identified in part **(c)(i)**.

[3 marks]

QUESTION PART REFERENCE	**Answer space for question 5**

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QUESTION PART REFERENCE	Answer space for question 5

19

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6 Ronan is the quality control manager of an art supplies company. He is investigating a complaint about the volume of paint in a pot of white acrylic paint.

Ronan takes a random sample of 9 pots of white acrylic paint from his warehouse and records the volumes, in millilitres, as follows:

$$194 \quad 215 \quad 198 \quad 203 \quad 211 \quad 218 \quad 207 \quad 214 \quad 208$$

The volume of paint in a pot may be assumed to be normally distributed.

(a) The company claims that the volume of paint in a pot has a standard deviation of 2.5 ml.

Ronan looks at the data and deduces that the standard deviation of the volume of paint in a pot is greater than 2.5 ml.

(i) Suggest a possible reason for Ronan's deduction.

[2 marks]

(ii) Calculate a 98% confidence interval for the standard deviation of the volume of paint in a pot based on the data from Ronan's sample.

[5 marks]

(iii) State, giving a reason, whether or not your interval in part **(a)(ii)** supports Ronan's deduction.

[2 marks]

(b) (i) Calculate a 90% confidence interval for the mean volume of paint in a pot.

[5 marks]

(ii) The label on each pot of paint states "Contents 200 ml".

Comment on this statement.

[2 marks]

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END OF QUESTIONS

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