Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

A-level
STATISTICS

Unit Statistics 5

Friday 22 June 2018 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 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.

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.

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

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Answer **all** questions.

Answer each question in the space provided for that question.

1 Kelly works with the large apes in a zoo. She uses a set of scales to weigh their meals. The scales round the measurements to the nearest 0.1 kilogram.

The rounding error X kilograms, can be modelled by the distribution

$$f(x) = \begin{cases} 10 & -0.05 < x < 0.05 \\ 0 & \text{otherwise} \end{cases}$$

(a) State the mean and calculate the standard deviation of X.

[3 marks]

(b) (i) Find the probability that the scales have overestimated the weight of a meal by exactly 25 grams.

[1 mark]

(ii) Given that the scales have underestimated the weight of a meal by at least 10 grams, what is the probability that the rounding error is more than 35 grams?

[4 marks]

(c) Kelly weighs 46 meals each day.

Estimate the probability that the **size** of the **mean** rounding error, $\bar{X}$, on a particular day is less than 0.01 kilogram.

[4 marks]

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

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QUESTION PART REFERENCE	Answer space for Question 1

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2 Julio is a biologist studying a stable population of platypuses that live in burrows in the banks of a long river in eastern Australia.

Julio is modelling the distance in kilometres between platypus burrows with an exponential distribution with parameter $\lambda = 0.36$.

(a) Using this model, find:

(i) the mean distance, in kilometres, between platypus burrows along this river;

[1 mark]

(ii) the probability that Julio has to explore less than 3 km of this river before finding a platypus burrow.

[2 marks]

(b) Julio has already explored 5 km of this river without finding a platypus burrow.

What is the probability that he will have to explore at least a further 2 km before finding a platypus burrow?

[2 marks]

(c) Give one reason, in context, why the exponential model might not be a suitable model for the distance between platypus burrows along the river.

[2 marks]

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

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3 Two brands of baking parchment, Brand A and Brand B, are sold in rolls that have a nominal length of 30 metres.

The lengths, in metres, of a random sample of 10 rolls of **Brand A** baking parchment were:

31.6 29.6 30.3 28.9 29.7 30.5 31.1 28.7 29.1 30.5

Lengths of baking parchment on rolls may be assumed to be normally distributed.

A sample of 12 rolls of **Brand B** baking parchment yielded a mean length of 30.9 metres and a standard deviation of 1.21 metres.

(a) (i) Calculate a 95% confidence interval for the standard deviation of the length of rolls of **Brand A** baking parchment.

[6 marks]

(ii) Calculate a 95% confidence interval for the standard deviation of the length of rolls of **Brand B** baking parchment.

[3 marks]

(iii) Using the confidence intervals calculated in parts **(a)(i)** and **(a)(ii)**, comment on whether the lengths of rolls of Brand A baking parchment are more variable than the lengths of rolls of Brand B.

[2 marks]

(b) (i) Show that the value of the pooled estimate of the population variance for the length in metres of rolls of baking parchment is 1.22 , correct to three significant figures.

[2 marks]

(ii) Test at the 10% level of significance, whether rolls of baking parchment of Brand B are, on average, more than 20 **centimetres** longer than those of Brand A.

[8 marks]

(c) Recommend whether Brand A or Brand B rolls of baking parchment should be bought. You should consider your answers to both part **(a)** and part **(b)** together with any other relevant factors.

[4 marks]

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4 Prudence works for the Highways Agency. Her department has received many complaints about the amount of debris from lorries on the verges along a particular stretch of motorway.

To investigate the distribution of debris, Prudence had high resolution aerial photographs of the verges taken by a drone. Her team counted the number of items of debris visible on the photographs.

The table summarises, for each pair of successive junctions, the distances between them and the number of items of debris counted.

Junction interval	**6 to 7**	**7 to 8**	**8 to 9**	**9 to 10**	**10 to 11**	**11 to 12**	**Total**
Distance between junctions (km)	3.2	3.8	5.1	4.7	4.8	3.4	**25**
Number of items of debris	71	84	110	142	102	91	**600**

(a) Using a χ^2 distribution and the 10% significance level, test whether a rectangular distribution provides an adequate model for the number of items of debris per kilometre.

[9 marks]

(b) The Highways Agency can take action against the companies who are responsible for such debris.

Use your calculations, together with your conclusion in part **(a)**, to advise Prudence on which junction interval(s) she should concentrate her investigation on in order to identify the companies responsible.

[2 marks]

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5 At a particular doctors' surgery, patients who want to stop smoking are sent to a clinic where they receive advice and support.

Patients can choose one of two therapies: nicotine patches or nicotine gum.

After one week on their chosen therapy, the 15 patients who claimed they had been successful at stopping smoking had their blood nicotine levels measured in nanograms per millilitre, ng/ml.

The results are shown in the table.

Nicotine patch therapy	495	378	224	646	176	334	318	
Nicotine gum therapy	517	325	414	468	446	507	619	522

(a) Syed, a nurse working at the clinic, suspected that the blood nicotine levels of patients are more variable when using nicotine patches than when using nicotine gum.

Making any necessary assumptions, investigate, at the 5% significance level, whether Syed's suspicion is justified.

[8 marks]

(b) The manufacturer of the **nicotine gum** claims that for users taking the recommended dosage, their blood nicotine levels, in ng/ml , will have a variance of no more than 7100.

Making any necessary assumptions, test, at the 5% significance level, whether the manufacturer's claim is reasonable.

[7 marks]

(c) State the assumptions about the samples and the populations that were necessary for the tests in part **(a)** and part **(b)** to be valid.

Comment, in context, on the likely validity of these assumptions.

[5 marks]

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