Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

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General Certificate of Education
Advanced Level Examination
June 2015

Statistics

Unit Statistics 5

SS05

Tuesday 16 June 2015 1.30 pm to 3.00 pm

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

You may use a graphics calculator.

TIME ALLOWED
- **1 hour 30 minutes**

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

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INSTRUCTIONS

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- 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.
- 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.

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.

DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions.

Answer each question in the space provided for that question.

1 The lifetime, X, of a LastLong tyre, measured in tens of thousands of miles, can be modelled by an exponential distribution with probability density function

$$f(x) = \begin{cases} \frac{1}{3}e^{-\frac{x}{3}} & x > 0 \\ 0 & \text{otherwise} \end{cases}$$

(a) For a LastLong tyre, state the value of:

(i) the mean lifetime;

(ii) the standard deviation of the lifetime.

[2 marks]

(b) Find the probability that the lifetime of a randomly selected LastLong tyre is:

(i) less than 10 000 miles;

(ii) between 30 000 and 40 000 miles.

[6 marks]

2 **Brad works as a bird conservationist during the summer months. One of his tasks each summer is to randomly select a number, *n*, of fledgling puffin chicks just before they leave the nesting site and to record the weight, *x* grams, of each selected chick. Brad's summarised results for each of the years 2010 and 2012 are shown in the table.**

	n	$\sum x$	$\sum (x - \bar{x})^2$
2010	**75**	**19 230**	**49 512**
2012	**90**	**23 760**	**49 631**

(a) For EACH year, calculate the mean and the variance of the weights of the chicks selected. [4 marks]

(b) (i) Use a *z*-test to investigate Brad's claim that the mean weight of chicks was greater in 2012 than in 2010. Use the 5% significance level. [6 marks]

(ii) Explain why no distributional assumptions were necessary in carrying out the test in part (b)(i). [2 marks]

(c) State, in the context of this question, the meaning of a Type I error. [2 marks]

3 **Dhiraj currently lives with his parents outside Darlington. He decides to seek his own accommodation either in Darlington or by relocating to London.**

Using an internet site, he selects a number of one-bedroom unfurnished flats in Darlington and records the rental cost per calendar month, £*x*, of each flat selected.

Using the same internet site, he also selects a number of one-bedroom unfurnished flats in the area of London in which he would like to live and records the rental cost per calendar month, £*y*, of each flat selected. His results are shown in the table.

x	y
550	1500
525	1400
525	1384
350	1860
485	1450
450	1575
495	1492
295	1680
500	1820
	1625
	1600
	1595

You may assume that *x* and *y* are values from independent populations with variances σ_x^2 and σ_y^2 respectively.

(a) (i) Investigate, at the 5% significance level, the hypothesis that $\sigma_x^2 = \sigma_y^2$. [7 marks]

(ii) State TWO further assumptions that need to be made for the test in part (a)(i) to be valid. [2 marks]

(b) Dhiraj believes that the rental cost of a one-bedroom unfurnished flat is, on average, more than £1000 per calendar month greater in London than in Darlington. Dhiraj decides to use a hypothesis test to investigate his belief.

(i) Write down suitable null and alternative hypotheses for Dhiraj's test.

(ii) Assuming that all necessary assumptions are satisfied, complete Dhiraj's hypothesis test using the 5% significance level.

[10 marks]

4 **Sandy is a keen cyclist who buys a new racing bicycle to compete in 15-km races. A sample of 14 of Sandy's race times, in minutes, using the new bicycle gave the following results.**

24·2	23·7	26·1	23·8	22·6	24·9	22·7	27·3	25·9
26·4	23·1	25·0	25·2	24·5				

Sandy's coach wishes to use this sample to construct confidence intervals for both the population variance and the population mean of Sandy's 15-km race times.

(a) (i) What assumption, other than that the sample of Sandy's 15-km race times is random, must be made for these confidence intervals to be valid? [1 mark]

(ii) Construct a 95% confidence interval for the population variance of Sandy's 15-km race times. [7 marks]

(iii) Construct a 95% confidence interval for the population mean of Sandy's 15-km race times. [6 marks]

(b) When using an older bicycle, Sandy's 15-km race times, in minutes, had a mean of 26·2 and a variance of 3·39 .

With reference to the confidence intervals you have calculated in parts (a)(ii) and (a)(iii), comment on Sandy's performance in 15-km races when using the new bicycle. [3 marks]

[Turn over]

5 **Alex buys a jewellery-making kit containing beads and threads.**

(a) **There are seven colours of beads: red, yellow, pink, green, orange, purple and blue.**

Each kit contains a random sample of exactly 150 of these beads.

The list of contents included in each kit claims that the beads are produced with colours in the ratios 5:4:3:2:4:2:5 respectively.

Alex opens the kit and counts the number of beads of each of the seven colours. The results are given in the table.

Colour	Red	Yellow	Pink	Green	Orange	Purple	Blue
Number of beads	37	22	11	15	25	9	31

Carry out a χ^2 goodness of fit test at the 1% level of significance to investigate whether the ratios of the colours of beads in the kit bought by Alex provide evidence to support the claim stated in the list of contents. [8 marks]

Answer space for Question 5(a)

[Turn over]

Question 5 continues on next page

5 (b) Each jewellery-making kit contains exactly 10 threads. The lengths, x centimetres, of the threads in a kit may be modelled by a rectangular distribution with probability density function

$$f(x) = \begin{cases} k & 37{\cdot}5 < x < 47{\cdot}5 \\ 0 & \text{otherwise} \end{cases}$$

where k is a constant.

(i) State the value of k. [1 mark]

(ii) Find values for the mean and the standard deviation of X. [3 marks]

(iii) Calculate the probability that a randomly selected thread will have a length within one standard deviation of the mean. [2 marks]

(iv) Alex wishes to make an arrangement of beads for a necklace that requires a thread with a length greater than 45 cm.

Given that the lengths of threads in the kit are independent of each other, calculate the probability that the kit bought by Alex contains at least one such thread. [3 marks]

Answer space for Question 5(b)

[Turn over]

END OF QUESTIONS

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Examiner's Initials	
Question	Mark
1	
2	
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TOTAL	

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