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

General Certificate of Education
Advanced Level Examination
June 2012

Statistics SS05

Unit Statistics 5

Thursday 21 June 2012 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

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.

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 firm installs kitchens in restaurants. In a study aimed at improving the firm's kitchen design, the functional arm reaches, in millimetres, of a sample of 10 chefs were measured. The results were as follows.

712 638 649 720 657 663 684 640 651 648

(a) Calculate an unbiased estimate, s^2, of the variance of the functional arm reaches of chefs. *(1 mark)*

(b) Calculate a 90% confidence interval for the standard deviation of the functional arm reaches of chefs. Assume that the data are a random sample from a normal distribution. *(6 marks)*

(c) Comment on the statement that the design of restaurant kitchens needs to allow for a standard deviation of at least 60 mm in the functional arm reaches of chefs. *(2 marks)*

QUESTION PART REFERENCE

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QUESTION PART REFERENCE

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2 Trains between two major cities run every 30 minutes. Megara and Alan both travel occasionally between these cities.

(a) Megara does not bother to find out the times at which the trains depart and so she arrives at the station at random times. The time, T minutes, that she has to wait for a train to depart may be modelled by a rectangular distribution on $[0, 30]$.

(i) Find the mean and the standard deviation of T. *(3 marks)*

(ii) Find the probability that she has to wait more than 12 minutes for a train to depart. *(2 marks)*

(b) Alan knows the times at which the trains depart. To allow for variations in his journey times to the station, he aims to arrive 10 minutes before a train departs. The time, in minutes, that he has to wait for a train to depart may be modelled by a normal distribution with mean 10.0 and standard deviation 3.1 .

(i) Find the probability that Alan has to wait more than 12 minutes for a train to depart. *(2 marks)*

(ii) Compare the waiting times of Megara and Alan. *(2 marks)*

(c) The train company now increases the frequency of trains to one every 20 minutes. Megara continues to arrive at the station at random times.

Find the mean and the standard deviation of the time that she now has to wait for a train to depart. *(2 marks)*

QUESTION PART REFERENCE

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3 Imran has recently retired and rarely wears a suit. He owns a dark suit which he wears for formal occasions such as weddings. The time, in days, before he next wears the suit may be modelled by an exponential distribution with parameter 0.0045 .

(a) Find:

(i) the mean of this exponential distribution; *(2 marks)*

(ii) the probability that Imran will wear the suit during the next 100 days; *(3 marks)*

(iii) the probability that Imran will not wear the suit for at least a year (365 days). *(2 marks)*

(b) The number of occasions per year on which Imran wears the suit will follow a Poisson distribution. Find the mean of this distribution. *(2 marks)*

(c) Imran also owns a light-coloured suit which he wears for social occasions. The number of occasions per year on which he wears the light-coloured suit may be modelled by a Poisson distribution with mean 1.72 .

State the distribution of the number of occasions per year on which Imran wears either his dark suit or his light-coloured suit. *(2 marks)*

QUESTION PART REFERENCE

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4 A charity shop opened six days a week from Monday to Saturday. Bruno, the manager, decided to open on Sundays on a trial basis starting in November 2011. The Saturday takings, in £, for the 10 weeks before the start of Sunday opening and the Saturday and Sunday takings, in £, for the first 7 weeks of Sunday opening are shown.

Week ending	Saturday takings (£)	Sunday takings (£)
28 August	671	–
4 September	582	–
11 September	611	–
18 September	711	–
25 September	695	–
2 October	648	–
9 October	539	–
16 October	696	–
23 October	723	–
30 October	610	–
6 November	567	234
13 November	589	298
20 November	701	312
27 November	542	342
4 December	591	373
11 December	624	390
18 December	725	421

(a) Bruno is concerned that Sunday opening may cause Saturday takings to drop.

(i) Using **only** the data for Saturday takings, verify that there is no significant evidence, at the 5% level, that the standard deviation of takings on Saturdays up to the end of October 2011 (no Sunday opening) differs from that on Saturdays from the start of November 2011 (Sunday opening). Assume that the data may be treated as random samples from normal distributions. *(7 marks)*

(ii) Using **only** the data for Saturday takings, test, at the 5% significance level, whether the mean Saturday takings have dropped after the end of October 2011. Assume that the Saturday takings up to the end of October 2011 and those from the start of November 2011 may be treated as random samples from normal distributions with equal variances. *(11 marks)*

Question 4 continues on page 14

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QUESTION PART REFERENCE

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4 (b) Bruno estimates that, in order to cover the additional costs incurred by Sunday opening, the mean total takings for Saturday and Sunday of each week from the start of November 2011 would have to exceed the mean Saturday takings up to the end of October 2011 by more than £50. A statistician agrees to carry out an unpaired *t*-test, using the data in the table on page 10, to examine whether there is significant evidence that this has been achieved.

(i) State the null and alternative hypotheses for this test. *(2 marks)*

(ii) The Saturday takings for weeks ending 28 August 2011 to 30 October 2011 constituted one sample for this test. Write down the values of the other sample. *(2 marks)*

(iii) The test statistic for this test is 6.15 . Using the 1% significance level, complete the test and state your conclusions in context. *(3 marks)*

(c) Summarise for Bruno the effects on weekend takings of opening on Sundays. Include in your answer **two** reasons why the conclusions from the hypothesis tests should be treated with caution. *(4 marks)*

QUESTION PART REFERENCE

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QUESTION PART REFERENCE

Answer space for questions 4(b) and 4(c)

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5 A manufacturing firm uses high temperature lubricants. When lubricant is delivered to the firm, tests are carried out to establish the temperature, T °C, to the nearest °C, at which the lubricant becomes ineffective. The supplier of the lubricant claims that the average value of T exceeds 240.

Michael decided to check this claim and produced the following table which summarises 105 test results for this supplier.

T	Frequency
234–236	3
237–239	9
240–242	18
243–245	37
246–248	21
249–251	12
252–254	5

Michael calculated an estimate of the mean to be 244.43 and an estimate of the standard deviation to be 4.09.

He then decided to test whether a normal distribution would provide a suitable model for the data and calculated five expected frequencies as follows.

T	Observed frequency	Expected frequency
234–236	3	
237–239	9	9.21
240–242	18	21.48
243–245	37	29.93
246–248	21	24.89
249–251	12	12.36
252–254	5	

(a) (i) Calculate any additional expected frequencies which are necessary in order to test whether a normal distribution provides a suitable model for the data. Assume that Michael's calculations are correct. *(5 marks)*

(ii) Carry out the test using the 10% significance level. *(8 marks)*

(b) Kabeera wished to carry out a hypothesis test to check whether the mean value of T exceeds 240. She claimed that it would not be necessary to check first that a normal distribution was a suitable model for the data. Comment on her claim. *(2 marks)*

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END OF QUESTIONS

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