Centre Number						Candidate Number				
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Other Names										
Candidate Signature										

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

General Certificate of Education
Advanced Level Examination
June 2011

Statistics SS05

Unit Statistics 5

Monday 20 June 2011 9.00 am to 10.30 am

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 the questions in the spaces provided. 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.

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

1 A seaside shop sells bags of *Aunty Mary's Fudge*. Ronnie, the owner, buys pieces of fudge from a factory and packs them into bags. Ronnie wants some variability in weight between the pieces so as to suggest that the fudge may be homemade. However, he is concerned that too much variability would make the packing difficult.

He specifies to the factory that the standard deviation of the weights of the pieces of fudge should be 25 grams. The weights, in grams, of a random sample of 12 pieces from a batch received from the factory are

27 68 54 59 88 38 72 92 39 74 52 60

Test whether this batch meets Ronnie's requirement. Use the 5% significance level and assume that the weights are normally distributed. *(7 marks)*

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2 A recently built office block has suffered a large number of false fire alarms during office hours. Office hours are from 8 am to 5 pm and the times at which these false alarms have occurred are summarised in the table.

Time interval	8 am – 11 am	11 am – 1 pm	1 pm – 3 pm	3 pm – 5 pm
Number of false alarms	19	3	6	7

John, a technician, believes that the false alarms are caused by electrical faults and are equally likely to occur at any time throughout the day.

(a) (i) Using a χ^2 distribution and the 10% significance level, examine whether or not a rectangular distribution provides an adequate model for the data. *(9 marks)*

(ii) Comment on John's belief. *(2 marks)*

(b) When the fire alarm goes off after 4 pm, the office closes for the day. Folake, a manager, believes that some of the false alarms are deliberately caused by office staff wishing to go home early.

(i) Comment on Folake's belief. *(2 marks)*

(ii) Folake argues that, in order to investigate her belief thoroughly, it would be necessary to break the table down into 9 one-hour intervals before applying a χ^2 test.

Explain to Folake why this would not be appropriate. *(2 marks)*

(c) Make one further comment about the distribution of the false alarms. *(1 mark)*

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3 A theatre bar serves drinks during intervals in performances. Currently, the only beer available is *Blandlager*. A theatregoer suggests that bar sales would increase if *Blandlager* were to be replaced by *Crudgiesale*.

Eric, the bar manager, agrees to stock *Crudgiesale* on a trial basis.

A sample of theatregoers who took part in a tasting test on *Crudgiesale* gave it the following scores out of 100.

88 36 74 68 59 76 50 77 18 73 54

(a) Assuming that this is a random sample from a normal distribution, calculate a 95% confidence interval for:

(i) the standard deviation; *(7 marks)*

(ii) the mean. *(4 marks)*

(b) Eric states that, in tasting tests where a large number of theatregoers were asked to score *Blandlager* out of 100, the mean score was 49.7 and the standard deviation was 9.3. He agrees that no one likes or dislikes *Blandlager* very much but it sells well.

However, Eric decides that he will permanently replace *Blandlager* with *Crudgiesale* if:

- the standard deviation for *Crudgiesale* is **no more** than 10 per cent higher than that for *Blandlager*, and
- the mean score for *Crudgiesale* exceeds that for *Blandlager* by **more** than 10 per cent.

Recommend, with explanation, which beer Eric should stock. *(5 marks)*

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4 The time, in minutes, that Michaela waits at a bus stop to catch a bus to work may be modelled by an exponential distribution with parameter $\lambda = 0.22$.

(a) Find the mean and the standard deviation of the time that Michaela waits for a bus. *(2 marks)*

(b) Find the probability that Michaela will have to wait more than 5 minutes for a bus. *(3 marks)*

(c) On Monday morning, Michaela, who has already been waiting at the bus stop for 3 minutes, is joined by a friend, Narinder.

Find the probability that Narinder will have to wait less than 3 minutes for a bus. *(3 marks)*

(d) Michaela records the time that she has to wait on each of 40 consecutive weekday mornings. Using the Central Limit Theorem, find, approximately, the probability that the mean of the times that she records exceeds 3 minutes. *(4 marks)*

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5 A manufacturing firm frequently uses a courier service to transport documents between its factory in Warwickshire and its head office in London.

The firm currently uses *ABC* couriers, but *XYZ* couriers claim that they could deliver the documents in a shorter time.

The firm agrees to give *XYZ* a trial, and to make a permanent change to them if the mean time for *XYZ* can be shown to be less than that for *ABC* by more than 10 minutes.

The last 8 times, in minutes, taken by *ABC* to deliver the documents are shown. The 7 times, in minutes, taken by *XYZ* during their trial are also shown.

***ABC* couriers**	187	212	193	206	188	204	231	220
***XYZ* couriers**	179	198	186	219	164	200	201	

(a) (i) Show that it is plausible to assume that the standard deviations of the times are the same for each courier. Regard the data as random samples from normal distributions and use the 5% significance level. *(8 marks)*

(ii) Examine whether the mean time for *XYZ* is less than that for *ABC* by more than 10 minutes. Use the 10% significance level. *(9 marks)*

(b) It later emerged that the data for *XYZ* were the times from leaving the factory to delivering the documents, whilst the times for *ABC* included the time needed to collect the documents from the factory. It was estimated that, to make a fair comparison, 10 minutes should be added to each of the times recorded for *XYZ*.

Does this additional information affect:

(i) the standard deviation of the times taken by *XYZ*;

(ii) the final decision as to which courier to use?

Explain your answers. *(5 marks)*

(c) Give two reasons, one for each sample, why the assumption that the samples can be treated as random may not be justified. *(2 marks)*

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END OF QUESTIONS

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