Centre Number						Candidate Number				
Surname										
Other Names										
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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 2013

Statistics SS05

Unit Statistics 5

Thursday 13 June 2013 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 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.

Answer **all** questions.

Answer each question in the space provided for that question.

1 New A-level Maths students arrived at a sixth-form college in September to start their course. Alan, the head of department, allocated the students at random into classes of size 15. After the first three weeks of the course, he set all the students the same test. Alan chose a class at random and the marks achieved by the 15 students in the class were as follows:

74 53 77 64 74 61 85 62 71 45 48 56 67 64 70

(a) Assuming that the marks achieved in the test can be modelled by a normal distribution, calculate a 90% confidence interval for the standard deviation of marks achieved. *(7 marks)*

(b) Alan aimed to have a standard deviation of 18 for the marks achieved in this test across all classes.

Did Alan achieve his aim? Your answer should refer to your confidence interval in part **(a)**. *(2 marks)*

QUESTION PART REFERENCE

Answer space for question 1

QUESTION PART REFERENCE

Answer space for question 1

2 Nasreen owns a small supermarket. She sells boxes of six free-range eggs from each of two local suppliers, Alaric and Belinda.

Nasreen weighs each box in a random sample of boxes of eggs from each supplier. Her results, in grams, are as follows:

Alaric 473 485 474 471 470 463

Belinda 423 426 432 449 447 438 445 446

The weight of a box of eggs from Alaric may be modelled by a normal distribution with a standard deviation of 7 grams. The weight of a box of eggs from Belinda may be modelled by a normal distribution with a standard deviation of 10 grams.

Investigate, at the 5% level of significance, Nasreen's belief that the mean weight of a box of eggs from Alaric is more than 24 grams greater than the mean weight of a box of eggs from Belinda. *(9 marks)*

QUESTION PART REFERENCE

Answer space for question 2

QUESTION PART REFERENCE

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3 Thomas grows cherry tomatoes in his greenhouse. A new brand of fertiliser, *Moretom*, has recently come on to the market. Thomas decides to compare its effectiveness for growing cherry tomatoes with *Tomsplus*, the brand that he has used previously. He grows two sets of plants of the same variety of cherry tomato under the same conditions in his greenhouse, fertilising one set with *Moretom* and the other set with *Tomsplus*.

The yield, in grams, from each plant is shown in the table.

Fertiliser										
	Moretom	1383	1397	1373	1404	1369	1357	1343	1375	1392	1381
	Tomsplus	1375	1345	1315	1350	1348	1334	1327	1343		

It may be assumed that, for each fertiliser, the yields are normally distributed.

(a) Show, using the 5% significance level, that there is no difference in variability between the yields from plants grown using *Moretom* and the yields from plants grown using *Tomsplus*. *(8 marks)*

(b) Investigate, at the 1% significance level, the claim that the mean yield from plants grown using *Moretom* is greater than that from plants grown using *Tomsplus*. *(10 marks)*

(c) The total cost of *Moretom* for Thomas's 10 plants was £15 whereas the total cost of *Tomsplus* for his 8 plants was £10. Thomas sells all his cherry tomatoes at £3 per kilogram.

Use this information, together with your findings in part **(b)**, to advise Thomas on which of the two brands of fertiliser he should use next season in order to maximise his profit per plant. *(3 marks)*

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4 Gill, an optometrist, visits primary schools and tests the eyes of children in Year 6 prior to their transfers to secondary school. Gill knows that the probability that a teenager is short-sighted is 0.3. She suspects that this probability may be the same for younger children.

Gill has collected data from visits that she has made to 80 local primary schools. She selects a random sample of 15 children, whose eyes she has tested, from each school.

The data are tabulated below.

Number of short-sighted children (x)	0	1	2	3	4	5	6	7	$\geqslant 8$	**Total**
Number of schools (f)	1	6	10	21	16	13	9	4	0	**80**

(a) Carry out a χ^2 goodness of fit test, at the 5% significance level, to determine whether the binomial distribution B(15, 0.3) is an appropriate model for the number of short-sighted children in a random sample of 15 children in Year 6. *(11 marks)*

(b) Gill calculates correctly, from the data above, that the proportion of short-sighted children in her sample is 0.25. Her table of correct observed and expected frequencies using the binomial distribution B(15, 0.25) is given below.

Number of short-sighted children (x)	$\leqslant 1$	2	3	4	5	$\geqslant 6$
Observed frequency	7	10	21	16	13	13
Expected frequency	6.41	12.47	18.02	18.02	13.21	11.87

Gill calculates correctly that the test statistic for the above data is 1.37, correct to three significant figures.

Carry out a χ^2 goodness of fit test, at the 5% significance level, to determine whether the number of short-sighted children in a random sample of 15 children in Year 6 follows a binomial distribution. *(5 marks)*

(c) Comment on your conclusions in parts **(a)** and **(b)**. *(2 marks)*

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5 Margaret, the manager of a health centre, is investigating the duration of consultations between patients and doctors.

(a) She initially models the duration, in minutes, of a consultation as a rectangular distribution on the interval $[0, 8]$.

(i) Using this model, calculate the probability that the duration of a consultation will be between 1 minute and 7 minutes. *(2 marks)*

(ii) Find values for the mean and the standard deviation of the duration of a consultation. *(3 marks)*

(iii) Give one reason why the above model may not be appropriate. *(1 mark)*

(b) Margaret then decides to model the duration, in minutes, of a consultation as an exponential distribution with a parameter of 0.25.

Using this model, calculate the probability that the duration of a consultation will be:

(i) between 1 minute and 7 minutes; *(3 marks)*

(ii) exactly 8 minutes; *(1 mark)*

(iii) more than 8 minutes; *(2 marks)*

(iv) more than 10 minutes, given that it has already been 8 minutes. *(3 marks)*

(c) At the health centre, the appointments given to patients to see a doctor are made at 10-minute intervals. Margaret wishes to reduce this interval to 8 minutes to allow more patients to be seen. The health centre's doctors feel that the current 10-minute time interval is not sufficient and do not want any reduction in the allocated time for a consultation.

Making reference to your answers in part **(b)**, comment on the wishes of **either** Margaret **or** the doctors. *(3 marks)*

QUESTION PART REFERENCE

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