General Certificate of Education
June 2009
Advanced Level Examination

STATISTICS SS05
Unit Statistics 5

Monday 15 June 2009 1.30 pm to 3.00 pm

For this paper you must have:
- an 8-page answer book
- 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.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is SS05.
- Answer **all** questions.
- Show all necessary working; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information
- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.

Answer **all** questions.

1 Sadia arranges to meet Arlene at a coffee bar on Saturday evenings at 8.00 pm. Past experience suggests that Arlene will arrive at the coffee bar X minutes after 8.00 pm, where X may be modelled by an exponential distribution with parameter 0.05 .

(a) Find the mean and standard deviation of the number of minutes after 8.00 pm that Arlene will arrive at the coffee bar. *(2 marks)*

(b) If Sadia arrives at 8.20 pm, find the probability that Arlene will already have arrived. *(3 marks)*

(c) Sadia arrives at 8.20 pm and finds that Arlene has not yet arrived. Find the probability that Arlene will arrive after 8.30 pm. *(3 marks)*

2 Helen sells machines for filling jars and claims that the weights of the contents of jars will be distributed with a standard deviation of 1.4 grams. One of her machines was used to fill jars with mustard.

The weights, in grams, of the contents of the first eight jars filled were

212 227 216 224 217 216 218 220

Leonidas, a statistician, glanced at the data and stated that he thought the standard deviation of the weights of the contents of jars was greater than 1.4 grams.

(a) Suggest a possible reason for Leonidas's statement. *(2 marks)*

(b) Assuming that the data may be regarded as a random sample from a normal distribution, calculate a 90% confidence interval for the standard deviation of the weights of the contents of jars. *(7 marks)*

(c) State, giving a reason, whether or not your calculation in part (b) supports Leonidas's statement. *(2 marks)*

(d) Using a method which is appropriate in the light of your conclusion in part (c), calculate a 95% confidence interval for the mean weight of the contents of jars. *(5 marks)*

(e) The target was for each jar to contain 212 grams of mustard. Helen stated that the confidence interval calculated in part (d) indicated that the mean could be reduced and all jars would still contain at least 212 grams of mustard. Comment on this statement. *(3 marks)*

3 Each new employee joining a construction company is issued with a safety helmet. The helmets come in five sizes: 1, 2, 3, 4 and 5.

The data below represent the sizes of the helmets issued to the 40 most recent new employees.

3	3	1	2	5	4	4	2	2	3	5	4	5	4	3	4	4	3	4	3
3	2	4	5	2	5	3	5	5	4	3	3	5	4	5	4	4	5	1	5

(a) Form the data into a frequency distribution. *(2 marks)*

(b) Olan, who is in charge of ordering the helmets, believes that the distribution of helmet sizes required by new employees may be modelled by the following probability distribution.

Helmet size	Probability
1	0.15
2	0.20
3	0.30
4	0.20
5	0.15

Using the 5% significance level, examine whether this distribution adequately models the helmet sizes required by new employees. Assume that the 40 most recent new employees may be regarded as a random sample of all new employees. *(7 marks)*

(c) Olan is about to order 1000 new helmets with the proportion of each size as indicated by the probability distribution.

Advise Olan as to whether he should modify the proportions of the sizes in the order. If you advise him to modify the order, state, in general terms, how you believe the proportions should be changed. *(2 marks)*

4 Sopphira spends the summer in a large European city. She frequently catches an underground train to and from the centre of the city. The trains run every six minutes and her arrivals at the station are independent of when a train is due. The length of time, in minutes, that she has to wait for a train may be modelled by a rectangular distribution on the interval (0, 6).

(a) Calculate the probability that when she goes to catch a train she has to wait for between 2.9 and 3.1 minutes. *(2 marks)*

(b) Find the mean and standard deviation of the length of time that she has to wait for a train. *(3 marks)*

(c) During her holiday, Sopphira catches the train on 46 occasions. Find, approximately, the probability that the mean length of time that she has to wait for a train is between 2.9 and 3.1 minutes. *(5 marks)*

Turn over for the next question

5 Fidel owns a shop selling fishing tackle. He obtains fishing line from Raoul, a manufacturer. Raoul states that his standard fishing line has a mean breaking strength of 15.3 kg with a standard deviation of 0.65 kg.

Fidel would also like to stock stronger fishing line which he could sell at a higher price. Raoul states that he is able to supply premium fishing line with a mean breaking strength at least 5 kg greater than the standard fishing line. However, the standard deviation would also be increased to 0.95 kg.

Fidel decides to measure the breaking strengths of samples of each type of fishing line with the following results, in kg.

Standard fishing line	15.9	16.4	14.8	15.2	14.3	14.9	15.0
Premium fishing line	18.8	20.4	22.1	19.1	19.3	18.7	

(a) By carrying out tests at the 5% significance level, verify that it is reasonable to assume that the standard deviation of the breaking strength of:

(i) the standard fishing line is 0.65 kg;

(ii) the premium fishing line is 0.95 kg.

Regard each sample as a random sample from a normal distribution. *(11 marks)*

(b) Assuming that the standard deviations of the breaking strengths of the two types of fishing line are as stated by Raoul, test whether the data are consistent with the mean breaking strength of the premium fishing line being at least 5 kg greater than the mean breaking strength of the standard fishing line. Use the 10% significance level. *(7 marks)*

(c) By using the data above and the 5% significance level, verify that the hypothesis that the standard deviations of the breaking strengths of the two types of fishing line are equal is accepted. *(6 marks)*

(d) Compare the results of part (a) with those of part (c) and comment. *(3 marks)*

END OF QUESTIONS