General Certificate of Education
June 2007
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

STATISTICS
Unit Statistics 5

SS05

Wednesday 20 June 2007 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 blue or black ink or 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.

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Answer **all** questions.

1 A furnishing company stocks rolls of fabric for making curtains. When there is less than 2 metres of fabric left on a roll, the roll is discarded. The length of fabric left on a discarded roll is X metres, where X has a rectangular distribution over the interval [0, 2].

(a) Find the probability that the length of fabric left on a discarded roll is:

(i) between 0.8 metres and 1.2 metres; *(2 marks)*

(ii) exactly 1 metre. *(1 mark)*

(b) When the length of fabric left on a discarded roll is less than 0.6 metres, the fabric is thrown away; otherwise it is sold as a remnant.

(i) One day, three rolls are discarded. Assuming that the amounts of fabric left on the rolls are independent, find the probability that remnants can be sold from all three rolls. *(3 marks)*

(ii) The fabric left on a particular roll is long enough to be sold as a remnant. Find the probability that this remnant is less than 1 metre long. *(2 marks)*

2 Damien has agreed to raise money for charity. He displays a cake and charges entrants to guess its weight. The weights, x grams, guessed by a random sample of 10 entrants are summarised as follows:

$$\bar{x} = 446.9 \qquad s = 13.9$$

(a) Assuming that the weights guessed by all entrants are normally distributed, construct a 95% confidence interval for:

(i) the mean weight guessed; *(5 marks)*

(ii) the standard deviation of weights guessed. *(5 marks)*

(b) Damien states that, on average, people underestimate the weight of the cake. Its actual weight is 460 grams. Use the appropriate result from part (a) to comment on Damien's statement. *(2 marks)*

(c) Damien suspects that he made a mistake when he wrote down one guess as 350 grams. Use results from **both** the confidence intervals constructed in part (a) to explain why his suspicion is plausible. *(3 marks)*

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3 Sandeep is training for a marathon. Each weekday he runs the same route from his home in the morning and again in the evening. He records his time for each run. For random samples of 8 morning runs and 10 evening runs, his times, in minutes, are as follows:

Morning:	64.1	69.2	62.1	70.2	65.9	71.8	63.7	64.9		
Evening:	62.8	60.9	65.8	77.6	66.3	75.2	72.7	74.2	65.3	63.5

(a) Sandeep believes that his running times are more variable in the evening than in the morning. Carry out an F-test, at the 5% level of significance, to investigate his belief. Assume that Sandeep's running times for both morning and evening are normally distributed. *(9 marks)*

(b) On Saturdays, Sandeep trains at an athletics stadium. He completes a set number of laps on the running track in the morning and the same number of laps in the afternoon. His running times for both morning and afternoon are normally distributed, each with a standard deviation of 2.1 minutes.

For a random sample of 12 morning runs, Sandeep's mean running time is 61.7 minutes.

For a random sample of 9 afternoon runs, his mean running time is 58.9 minutes.

Sandeep's trainer claims that, on average, Sandeep completes the run **more than one minute** faster in the afternoon than in the morning. Carry out a hypothesis test, at the 5% significance level, to determine whether the evidence supports this claim. *(7 marks)*

4 Adrian is a skilful badminton player. When he serves low, the height, in centimetres, at which the shuttle crosses over the top of the net may be modelled by an exponential distribution with parameter $\lambda = 0.4$.

(a) For one of Adrian's low serves, find the probability that the height at which the shuttle crosses over the top of the net is:

(i) less than 2 cm; *(2 marks)*

(ii) between 2 cm and 5 cm. *(2 marks)*

(b) Verify that, for Adrian's low serves, the median height at which the shuttle crosses over the top of the net is between 1.7 cm and 1.8 cm. *(4 marks)*

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5 (a) The continuous random variable X has a normal distribution with mean 310 and standard deviation 4. The following table shows probabilities for ranges of values of X.

Range of values	Probability
$X < 304$	a
$304 \leqslant X < 306$	b
$306 \leqslant X < 308$	0.1499
$308 \leqslant X < 310$	0.1915
$310 \leqslant X < 312$	0.1915
$312 \leqslant X < 314$	0.1499
$314 \leqslant X < 316$	c
$X \geqslant 316$	d

Calculate the values of a, b, c and d, giving your answers to four decimal places.

(4 marks)

(b) Mollie sells raspberries in small punnets. She weighs the contents of each of 100 punnets and obtains the following results.

Weight of raspberries (grams)	**Number of punnets**
Less than 304	5
304 –	13
306 –	10
308 –	18
310 –	25
312 –	20
314 –	5
316 or more	4

Mollie plans to model the weight, in grams, of raspberries per punnet by a normal distribution with mean 310 and standard deviation 4. Carry out a goodness of fit test, at the 10% significance level, to investigate whether her proposed model is suitable.

(8 marks)

(c) Mollie considers three possibilities for labelling a punnet of raspberries:

1 Average contents 310 grams

2 Minimum contents 300 grams

3 Minimum contents 305 grams

Assuming that the model proposed in part (b) is suitable, comment on **each** of these three possibilities. You should refer to both the given data and the proposed model where appropriate.

(4 marks)

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6 Amy and Ben have part-time jobs making sandwiches, which are then packaged for sale to local businesses. When making cheese sandwiches, they have to judge by eye the amount of grated cheese to put in a sandwich. During an informal assessment, their supervisor concluded that the mean amounts of grated cheese put into sandwiches by Amy and Ben were about the same.

Later, as part of a formal assessment, the supervisor weighs the amount of grated cheese, x grams, selected by Amy for a sandwich on each of 11 randomly chosen occasions, and the amount of grated cheese, y grams, selected by Ben on each of 9 randomly chosen occasions. She then calculates the means, $\bar{x}$ and $\bar{y}$, and the standard deviations, s_x and s_y, for the two samples of weights.

	Mean	**Standard deviation**
Amy	$\bar{x} = 41.6$	$s_x = 3.24$
Ben	$\bar{y} = 38.4$	$s_y = 2.71$

Stating **two** necessary assumptions, carry out a hypothesis test, at the 1% level of significance, to investigate whether the supervisor's earlier assessment was correct.

(12 marks)

END OF QUESTIONS

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