

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Education
Advanced Level Examination
June 2010

Statistics

SS05

Unit Statistics 5

Friday 18 June 2010 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 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.

For Examiner's Use	
Examiner's Initials	
Question	Mark
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TOTAL	



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

- 1 Rowena's sewing machine occasionally misses a stitch. When Rowena sews a seam, the distance, X metres, to the first missed stitch may be modelled by an exponential distribution with mean 0.8.
- (a) Show that the parameter, λ , of this distribution is 1.25. (1 mark)
- (b) Find the probability that the machine misses a stitch before Rowena has sewn 0.5 metres of a seam. (3 marks)
- (c) Rowena has to sew a seam of length 1.4 metres.
- (i) Find the probability that no stitches have been missed when she has sewn half of this seam. (3 marks)
- (ii) Assuming that no stitches were missed in the first half of the seam, find the probability that there is at least one missed stitch in the completed seam. (2 marks)

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QUESTION
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Turn over ►



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2 Simon is investigating two models, A and B, of vacuum flask of the same capacity to decide which is better at keeping liquid hot. To test a flask, he pours freshly boiled water into it and seals the top. Five hours later, he measures the temperature of the water.

- (a)** Simon carries out this procedure on 7 occasions using flask A and on 8 occasions using flask B. He records the water temperature, $x^{\circ}\text{C}$ for flask A and $y^{\circ}\text{C}$ for flask B, after each test, with the following results.

x :	72.5	76.5	79.5	79.0	78.0	78.5	74.5	
y :	72.0	75.0	74.5	72.0	71.5	73.5	69.5	76.5

Carry out a hypothesis test, at the 1% significance level, to investigate whether there is a difference in the mean water temperature after five hours between flasks A and B. Assume that the given data are random samples from normal distributions with equal variances. (12 marks)

- (b)** Simon carried out his tests at home, using kitchen equipment, over a period of 15 days. He used flask A on the first 7 days and flask B on the last 8 days.

Suggest **two** reasons why his results may **not** be reliable. (2 marks)

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3 A pizza restaurant serves a standard size of tomato and mozzarella cheese pizza called a Tommo.

(a) The salt content, x grams, is measured for each of nine Tommos, with the following results.

2.3 2.8 2.1 2.0 2.5 2.4 2.6 2.2 2.7

These data, which may be regarded as a random sample from a normally distributed population, may be summarised by

$$\bar{x} = 2.4 \quad s = 0.2739$$

(i) Identify the population from which the sample has been taken. (1 mark)

(ii) Assuming that any necessary conditions are satisfied, construct a 99% confidence interval for:

(A) the mean salt content of Tommos; (5 marks)

(B) the standard deviation of the salt content of Tommos. (5 marks)

(iii) The recommended daily allowance (RDA) of salt for an adult is 6 grams.

The pizza restaurant had previously been criticised because an adult could consume more than half the RDA of salt by eating one Tommo. The restaurant manager claims that this criticism is no longer valid.

Use the given data and your two confidence intervals to comment on this claim.

(3 marks)

(b) Two chefs work in the restaurant. The times, y minutes, taken by Mario to prepare a Tommo are recorded on 10 occasions. The times, w minutes, taken by Emilio to prepare a Tommo are recorded on 8 occasions. The results are summarised to give the following standard deviations.

$$s_Y = 0.3795 \quad s_W = 0.2403$$

Assuming that any necessary conditions are satisfied, carry out a hypothesis test, at the 5% significance level, to investigate whether Mario's preparation times are more variable than those of Emilio. (7 marks)

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(a) The numbers of recorded incidents per week during a period of 95 weeks are obtained from the firm's records. These data are summarised in the following frequency table.

Number of incidents during week	0	1	2	3	4	5
Number of weeks	26	28	17	11	8	5

Carry out a goodness of fit test, at the 5% significance level, to determine whether a Poisson distribution is an appropriate model for the number of incidents per week which cause damage to the firm's vehicles. (13 marks)

(b) Make **two** statements about the variable considered in this question which support the conclusion that you reached in part **(a)**. In each case, you should identify a necessary condition for a Poisson model to be appropriate, and give an explanation or an example to suggest why this condition is or is not likely to be satisfied. *(4 marks)*

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5 The normally distributed random variables V and W have standard deviations $\sigma_V = 2.7$ and $\sigma_W = 3.6$ respectively. A test is to be carried out to determine whether the mean value of V exceeds that of W by more than 2.

(a) Write down null and alternative hypotheses for this test. (2 marks)

(b) Random samples of 20 values of V and 20 values of W are chosen and the sample means are found to be

$$\bar{v} = 15.43 \quad \bar{w} = 11.16$$

Write down a numerical expression for a test statistic for the test. (2 marks)

(c) The critical value for the test is 1.6449.

State the significance level of the test. (1 mark)

QUESTION
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- 6** Details are obtained of all school children in years 5 to 7 in a particular county for the 2010 to 2011 school year. The ages, in years, of these children on 1 September 2010 are modelled by a continuous rectangular distribution on the interval $[9, 12]$.
- (a) Find the probability that a child, chosen at random from years 5 to 7 in this county, is more than $11\frac{1}{2}$ years old on 1 September 2010. (2 marks)
- (b) Three children from years 5 to 7 in this county are to be chosen at random to attend an important county event. The names of the children will be chosen on 1 September 2010 and the event will take place half a year later.
- Find the probability that:
- (i) all three children are under 10 years old on the day their names are chosen; (2 marks)
- (ii) at least one of the three children will be under 10 years old on the day the event takes place. (4 marks)
- (c) State **one** assumption which must be made for the model used in this question to be appropriate. (1 mark)

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