General Certificate of Education
June 2006
Advanced Subsidiary Examination

STATISTICS
Unit Statistics 3

SS03

Thursday 8 June 2006 9.00 am to 10.30 am

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 SS03.
- 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 An environmental organisation gathers information from a variety of countries.

The municipal waste per capita, x kg, and the CO_2 emissions per capita, y tonnes, for one year are given in the table for each of ten randomly selected countries.

x	y
305	4.8
400	7.2
555	7.4
330	7.5
340	7.6
390	8.8
430	10.1
405	11.9
320	12.0
490	17.1

(a) Calculate the value of Spearman's rank correlation coefficient between x and y.

(5 marks)

(b) Carry out a hypothesis test, at the 10% level of significance, to determine whether the value that you calculated in part (a) indicates an association between x and y.

Interpret your conclusion in context. *(5 marks)*

2 A survey recorded the ages and home location of mothers who gave birth to their first baby in the UK during 2003. The results reported for a random sample of 100 mothers are summarised in the table.

Age (years) / Location	Under 20	20–29	30–39	40 and over
North	9	18	18	2
South	3	12	28	10

(a) Test, at the 5% level of significance, whether the age of the mother is independent of her home location. *(9 marks)*

(b) Interpret your conclusion in part (a) by comparing the data for women aged under 20 with those for women aged 40 and over. *(2 marks)*

(c) A researcher discovered later that the results were actually based on a random sample of 200 mothers but had been recorded in the table as percentages.

For the test in part (a), state **with reasons** the effect, if any, that this information would have on:

(i) the null and alternative hypotheses;

(ii) the critical value;

(iii) the value of the test statistic;

(iv) the conclusion to the test. *(6 marks)*

Turn over for the next question

3 A trade union believes that the median weekly wage for full-time workers in company cafeterias has increased after it launched a campaign to raise awareness of low pay in the sector.

After the campaign, a random sample of ten trade union members, all of whom worked full-time in company cafeterias, was asked how much they earned last week. The results, in £, were as follows:

157.45 146.65 152.30 151.60 157.10 152.15 145.40 147.60 164.75 158.60

Before the campaign, the median weekly wage for full-time workers in company cafeterias was £148.50.

(a) Carry out a Wilcoxon signed-rank test to determine whether there appears to have been an increase in the median wage after the campaign. Use the 5% level of significance. *(10 marks)*

(b) Interpret your conclusion in part (a) in the context of this question. *(1 mark)*

(c) (i) Give a reason why the Wilcoxon signed-rank test might be preferred to the sign test in carrying out a test similar to the one carried out in part (a). *(1 mark)*

(ii) Describe a situation in which it would **not** be possible to carry out the Wilcoxon signed-rank test but it would be possible to carry out the sign test. *(2 marks)*

4 An investigation is carried out into the yield from alfalfa plants when four different methods of irrigation, A, B, C and D, are used. The table gives the **rank values** for the yields of each of 22 alfalfa plants and the method of irrigation used. A rank value of 1 indicates the lowest yield.

Method of Irrigation			
A	**B**	**C**	**D**
4	6	16	20
11	15	18	14
8	12	19	21
2	5	17	9
3	10	22	13
1	7		

(a) Carry out a test, using the 1% significance level, to investigate whether there is any difference between the average yield obtained from alfalfa plants for the four different methods of irrigation.

Interpret your conclusion in context. *(12 marks)*

(b) Identify, with reasons, which of the four different methods of irrigation you would recommend to be used in order to obtain the greatest yield from alfalfa plants. *(3 marks)*

Turn over for the next question

5 Nine adult patients, who suffer from asthma, agreed to take part in a clinical trial for the effectiveness of two aerosols, A and B, in the relief of asthma symptoms. Each patient was given aerosol A on one occasion and aerosol B on a different occasion; the order of administration being decided by a random procedure.

Each patient's forced expiratory volume (FEV) was measured before and after treatment and the percentage increase in FEV for each patient with each aerosol is given in the table. A higher percentage increase in FEV indicates a more effective aerosol.

Patient	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Aerosol A	28	22	10	40	18	52	49	40	34
Aerosol B	24	16	5	17	23	57	30	16	14

(a) Carry out a sign test, at the 10% significance level, to investigate whether there is any difference in the average effectiveness of the two aerosols. *(6 marks)*

(b) Interpret your conclusion in the context of this question. *(1 mark)*

6 Plants of the same species grow on opposite sides of a valley. Nine randomly selected plants from each side were weighed and the results, in grams, are given in the table.

East Side	27.1	40.3	15.7	36.4	16.3	15.3	32.0	15.7	27.5
West Side	11.7	14.7	19.1	22.0	6.7	14.1	20.1	24.4	15.4

Carry out a Mann–Whitney U test, at the 5% level of significance, to investigate whether there is any difference in the average weights of the plants from the two sides.

Interpret your conclusion in context. *(12 marks)*

END OF QUESTIONS

There are no questions printed on this page

There are no questions printed on this page