General Certificate of Education
June 2007
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

STATISTICS
Unit Statistics 3

SS03

Thursday 7 June 2007 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 A manufacturer of digital radios seeks the opinions of customers about the performance of its radios before and after introducing a new component.

The manufacturer selects, at random, 10 customers. Each customer is given a radio without the new component and a radio with the new component. Each customer then rates the performance of each radio on a scale from 1 to 20.

The results of the survey are shown in the table.

Customer	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Without new component	16	18	14	18	15	13	16	8	8	13
With new component	12	16	19	18	11	19	19	15	17	12

Carry out a Wilcoxon signed-rank test, at the 5% significance level, to investigate whether customers rated the radio differently after the new component was introduced.

Interpret your conclusion in context. *(9 marks)*

2 An American study investigated the weight gains, x kg, of mothers during pregnancy and the weights, y kg, of their children at 3 years of age.

The table gives the results for a random sample of 10 mothers and their children.

Mother	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
x	18.3	10.8	16.9	8.2	9.8	10.1	12.4	14.6	15.3	18.8
y	19.2	11.5	18.3	10.5	12.4	13.7	14.6	13.5	14.1	20.1

(a) Calculate the value of the product moment correlation coefficient between the weight gains of mothers during pregnancy and the weights of their children at 3 years of age. *(3 marks)*

(b) Carry out a hypothesis test, at the 1% level of significance, to determine whether the value that you calculated in part (a) indicates a positive association between the weight gains of mothers during pregnancy and the weights of their children at 3 years of age.

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

3 A long-term investigation was carried out into disease in childhood.

One part of this investigation considered the height of a child at age one year and the income they achieved at age 50 years. The results are summarised in **Table 1**.

Table 1

Income (£) / Height (cm)	Under 20 500	20 500 and over
Under 75	14	6
75 to under 80	12	18
80 and over	8	22

(a) (i) Use a χ^2 distribution and the 5% level of significance to investigate whether income at age 50 years is associated with height at age one year. *(8 marks)*

(ii) Interpret your result in part (a)(i) in the context of the question. *(2 marks)*

(b) Another part of the investigation considered the effect of a parent travelling with their seriously ill child during the child's transfer by a medical team to a paediatric intensive care unit.

For each of 147 transfers, a record was kept of whether or not the child required emergency medical treatment. The results are summarised in **Table 2**.

Table 2

Parent / Emergency medical treatment	Travelled with child	Did not travel with child
Required	10	8
Not required	92	37

Using a 5% significance level, examine whether the presence of a parent travelling with a child is associated with the occurrence of emergency medical treatment.

Interpret your conclusion in context. *(8 marks)*

4 Scientists carried out research in 2005 to investigate the extent of drug abuse in large Italian towns. Waste water from each of a random sample of nine large Italian towns was analysed. For each town, the estimated cocaine use, measured as the number of 100 g daily doses per 1000 young adults, was calculated.

Results from the research gave the following estimates for cocaine use:

9 26 17 18 21 16 19 13 15

The average estimated cocaine use in large Italian towns during the year 2000 was 14 daily doses per 1000 young adults.

(a) Carry out a sign test, at the 10% level of significance, to investigate the claim that the median cocaine use in large Italian towns has increased since the year 2000.

Interpret your conclusion in context. *(7 marks)*

(b) A random sample of young adults from each of the same nine towns in Italy was asked how difficult they thought it was to buy cocaine in their town. They were asked to respond on a scale of 0 to 10, where 0 represents 'not difficult at all' and 10 represents 'extremely difficult'.

The estimated cocaine use, x, together with the average response, y, of young adults (excluding non-responses) from each town are given in the following table.

Town	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
x	9	26	17	18	21	16	19	13	15
y	8.2	3.1	5.1	4.5	2.6	6.1	4.3	7.3	5.8

(i) Calculate the value of Spearman's rank correlation coefficient between x and y. *(6 marks)*

(ii) Interpret your answer to part (b)(i) in the context of the question. *(1 mark)*

5 Ms Testum wishes to investigate whether students will score differently in a test depending on whether the test is taken in a morning session or an afternoon session.

She selects a group of 19 students of similar ability and randomly assigns some of them to take the test in the morning and the remainder to take the same test in the afternoon.

The students taking the test in the morning are kept apart from the students taking the test in the afternoon until all the students have taken the test.

The ordered scores are given in the table.

Session	Score
morning	44
afternoon	46
afternoon	47
afternoon	51
morning	53
morning	54
morning	56
afternoon	58
afternoon	59
afternoon	61
afternoon	62
morning	63
morning	63
morning	65
afternoon	67
afternoon	68
morning	72
morning	74
morning	81

(a) Carry out a Mann-Whitney *U* test, at the 5% level of significance, to investigate whether there is any difference in the average test score between mornings and afternoons.

Interpret your conclusion in context. *(10 marks)*

(b) A matched-pairs design was suggested for this investigation.

(i) Explain why a matched-pairs design might be preferred when comparing two groups. *(2 marks)*

(ii) Explain how Ms Testum tried to ensure that her test was not biased. *(2 marks)*

Turn over ▶

6 It is believed that a happy marriage can offer increased immunity to infections in those aged over 65.

A sample of 15 males, aged over 65, had their levels of protective antibodies measured one month after their flu jabs. Each male selected his marital category as either 'Happily Married', 'Unhappily Married' or 'Unmarried'.

The results are given in the table.

Happily Married	Unhappily Married	Unmarried
194	185	146
215	192	150
242	210	155
285	236	168
291		195
292		

Carry out a distribution-free test, using the 5% significance level, to investigate whether there is any difference between the average level of protective antibodies found in males aged over 65 for the three marital categories.

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