

General Certificate of Education
June 2008
Advanced Subsidiary Examination



STATISTICS
Unit Statistics 3

SS03

Friday 6 June 2008 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 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 an electrical appliance wants to adjust one of the components used in the appliance. The effect that the adjustment would have on the resistance of the component is investigated.

The manufacturer selects, at random, 8 components. Each component has its resistance, in ohms, measured before and after the adjustment.

The results of the investigation are shown in the table.

Component	A	B	C	D	E	F	G	H
Before	38	42	44	35	44	36	44	42
After	41	49	42	40	43	40	46	50

- (a) Carry out a Wilcoxon signed-rank test, at the 5% significance level, to investigate whether or not the average resistance of the component is changed by the adjustment.

Interpret your conclusion in context.

(9 marks)

- (b) (i) Give **one** reason why a Wilcoxon signed-rank test might be preferred to a sign test in carrying out an investigation similar to the one carried out in part (a).
(1 mark)
- (ii) Describe **one** situation in which it would **not** be possible to carry out a Wilcoxon signed-rank test but it would be possible to carry out a sign test.
(2 marks)

- 2 A road safety organisation obtained the annual number of road deaths, x per 100 000 of the population, and the number of motor vehicles, y per 1000 of the population, for countries in the EU.

The table gives the results for a random sample of 10 countries in the EU.

Country	A	B	C	D	E	F	G	H	I	J
x	5.9	6.1	6.3	8.0	8.4	10.2	10.5	12.8	14.8	19.3
y	559	528	518	650	487	607	754	597	496	480

- (a) Calculate the value of Spearman's rank correlation coefficient between x and y .
(6 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 the annual number of road deaths per 100 000 of the population and the number of motor vehicles per 1000 of the population for countries in the EU.
(5 marks)

- 3 (a) A long-term trial was carried out into the effectiveness of giving accident victims with serious head traumas a steroid drug in addition to other treatments. In the trial, 1061 victims were randomly assigned to be given the steroid drug and the remainder were given a drug with no active ingredient (a placebo). The victims either died as a result of their injuries or survived.

The results of the trial are summarised in **Table 1**.

Table 1

	Additional treatment given		Total
	Steroid drug	Placebo	
Died	396	422	818
Survived	665	665	1330

Carry out a test, using the 5% level of significance, to investigate whether the survival of accident victims with serious head traumas is independent of the additional treatment given. (10 marks)

- (b) A trial was carried out into the effectiveness of a new anaesthetic drug. A sample of 500 patients undergoing a minor operation volunteered for the trial. Of these patients, 250 were randomly assigned to be given the standard anaesthetic drug and the remaining 250 were given the new anaesthetic drug.

The level of consciousness of each patient, 30 minutes after the operation was completed, was recorded as unconscious, semi-conscious or fully conscious. The **percentages** of patients in these levels of consciousness, for those given the standard anaesthetic drug and for those given the new anaesthetic drug, are shown in **Table 2**.

Table 2

	Anaesthetic drug given	
	Standard (percentage)	New (percentage)
Unconscious	52	36
Semi-conscious	36	46
Fully conscious	12	18

- (i) Using the 1% level of significance, carry out a χ^2 test for association between the drug given and the level of consciousness 30 minutes after the operation was completed. (10 marks)
- (ii) Interpret your conclusion in part (b)(i) in the context of the question. (2 marks)

- 4 The nicotine content, in milligrams, is measured for a random sample of 16 king-size cigarettes, each from a different brand. The brands are categorised as ‘Very Low Tar’, ‘Low Tar’ or those for which no claim is made about tar content.

The results are given in the table.

Very Low Tar	Low Tar	No Claim Made
0.40	0.69	0.86
0.67	0.96	1.06
0.76	1.03	1.12
0.82	1.04	1.26
1.01	1.08	2.03
1.02		

Carry out a distribution-free test, using the 5% significance level, to investigate whether there is any difference in the average nicotine content for cigarette brands categorised as ‘Very Low Tar’, ‘Low Tar’ or those for which no claim is made about tar content.

Interpret your conclusion in context.

(13 marks)

- 5 The LDL cholesterol level was measured for each of 16 males living in the USA in 2006. Of these, 8 had been randomly selected from males aged under 30 years and 8 had been randomly selected from males aged over 50 years.

The age and the LDL cholesterol level, in mg/dl, for each male are given in the table.

Male	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Age	29	18	29	28	23	19	21	27	56	54	51	52	71	65	54	76
LDL	121	137	140	159	177	189	191	201	181	196	225	228	234	249	259	339

- (a) Carry out a Mann-Whitney U test, at the 5% level of significance, to investigate whether, in the USA, males aged under 30 years have, on average, a lower LDL cholesterol level than those aged over 50 years. (10 marks)
- (b) The median LDL cholesterol level, for males aged between 35 years and 64 years living in the USA, is known to be 223 mg/dl.

A random sample of 9 males, aged between 35 years and 64 years, living in China, each had their LDL level, in mg/dl, measured with the following results:

158 225 164 178 182 184 191 195 231

Carry out a sign test, at the 10% level of significance, to investigate the claim that the median LDL cholesterol level for males aged between 35 years and 64 years is greater for those living in the USA than for those living in China.

Interpret your conclusion in context.

(7 marks)

END OF QUESTIONS

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