Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
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TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
January 2011

Statistics SS03

Unit Statistics 3

Monday 24 January 2011 9.00 am to 10.30 am

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.

Do not write outside the box

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

1 During a particular month, the average number of hours slept per night, x, and the average diastolic blood pressure, y, were recorded for each of a sample of 12 adult males. The results are given in the table.

You may regard the sample as a random sample of all adult males.

Male	x	y
A	10.6	70
B	10.2	74
C	9.8	78
D	9.2	68
E	8.4	72
F	8.0	86
G	7.8	76
H	7.4	80
I	7.4	85
J	7.2	88
K	6.2	92
L	4.1	91

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

(6 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 an association between x and y.

Interpret your conclusion in context. *(4 marks)*

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2 It is claimed that the lengths of prison sentences for burglary crimes in the UK increased over the ten years from 1994 to 2004.

Ten burglars, who were sentenced in 1994, were selected at random.

(a) These burglars were paired with ten burglars sentenced for similar crimes in 2004. The length, in months, of the sentence given to each burglar is given in the table.

Burglar pair / Year	A	B	C	D	E	F	G	H	I	J
1994	10	12	15	23	16	19	10	17	24	9
2004	14	20	14	28	25	12	20	24	30	20

Carry out a Wilcoxon signed-rank test, at the 5% significance level, to investigate the claim.

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

(b) It was suggested that a better design for this research would have been to select the ten burglars sentenced for crimes in 2004 at random.

Explain briefly the advantage of using the original design, rather than this new suggested design, for the investigation in part **(a)**. *(2 marks)*

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3 An organisation kept details of sideswipe accidents involving heavy goods vehicles (HGVs) during 2006.

The type of each sideswipe accident was recorded as 'changing lane to the left', 'changing lane to the right' or 'overtaking moving vehicle'.

The HGV involved was identified as either 'British registered' (right-hand drive) or 'foreign registered' (left-hand drive).

The table summarises details for a random sample of 1100 sideswipe accidents.

	Type of sideswipe accident			
	Changing lane to the left	**Changing lane to the right**	**Overtaking moving vehicle**	**Total**
British registered HGV	293	312	65	670
Foreign registered HGV	10	404	16	430
Total	303	716	81	1100

(a) (i) Investigate, at the 1% significance level, whether the type of sideswipe accident is independent of whether the HGV involved was British registered or foreign registered. *(9 marks)*

(ii) Describe any differences found in the type of sideswipe accident between British registered and foreign registered HGVs. *(2 marks)*

(b) A further random sample of 100 serious HGV accidents was investigated. It was found that 28 of these involved drivers who were 35 years of age or younger. Of these 28 accidents, 8 resulted in prosecution for a driving offence. Of the other accidents, which involved drivers over the age of 35 years, 29 resulted in prosecution for a driving offence.

(i) Form a 2×2 contingency table from this information. *(3 marks)*

(ii) Carry out a χ^2 test, at the 5% significance level, to investigate whether the age of the driver is independent of whether a prosecution for a driving offence resulted.

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

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4 A company is investigating a new method of preparing coffee to package into pods for a coffee-making machine.

Samples of pods are produced using the current method and also the new method. Cups of coffee are then made by the machine from each pod. A coffee taster ranks the cups of coffee, with rank 1 indicating the best tasting coffee.

The results are given in the table.

Cup	Method	Rank
A	Current	10
B	Current	12
C	New	3
D	Current	6
E	New	2
F	New	7
G	New	1
H	Current	8
I	New	4
J	Current	11
K	Current	5
L	New	9

It is claimed by the company that the taste of cups of coffee made from pods produced using the new method is better than that using the current method.

Carry out a Mann–Whitney U test, at the 5% level of significance, to investigate this claim. *(9 marks)*

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5 A brewery carried out an investigation into the acidity levels of five new varieties of beer, A, B, C, D and E. A low acidity level, after a six-month period of storage, is desirable in order to make the beer taste smoother.

Five containers of each variety of beer were stored in exactly the same way for six months and then the acidity level of each variety in each container was measured. The resulting acidity measurements were then ranked, with rank 1 indicating the highest acidity level.

The resultant ranks are given in the table.

Variety				
A	**B**	**C**	**D**	**E**
9	15	1	3	12
13	17	2	4	16
14	19	5	6	20
18	23	8	7	22
21	25	10	11	24

(a) Carry out a Kruskal–Wallis test, using the 1% significance level, to investigate whether there is any difference between the average acidity levels, after storage for six months, for the five different varieties of beer. *(9 marks)*

(b) Interpret your conclusion fully in the context of the question, including advice to the brewery about which variety they should choose in order to obtain the lowest acidity level. *(2 marks)*

(c) Variety E is popular with customers.

Comment on the suggestion that Variety E should be chosen in the light of your answer to part **(b)**. *(2 marks)*

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6 A trial is carried out in which each of a sample of 15 women is asked to taste two granola bars, one of which is made to a new recipe and the other to an existing recipe.

Of these 15 women, 10 preferred the taste of the new recipe granola bar.

(a) The manufacturer of the granola bars wants to draw a conclusion from this trial to use in an advertising campaign.

(i) State null and alternative hypotheses which could be used to test whether women prefer the taste of the new recipe granola bar. *(2 marks)*

(ii) Carry out a suitable hypothesis test at the 5% significance level. You may regard the sample as random. *(5 marks)*

(b) The manufacturer decides to repeat the granola bar trial with a sample of 30 women.

Find the smallest number of women needed, out of these 30, to prefer the taste of the new recipe granola bar in order for the manufacturer to conclude, at the 5% significance level, that women prefer the taste of the new recipe granola bar. *(4 marks)*

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END OF QUESTIONS

There are no questions printed on this page

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