GCE Examinations

Statistics
Module S3

Advanced Subsidiary / Advanced Level

Paper B

Time: 1 hour 30 minutes

Instructions and Information

Candidates may use any calculator except those with a facility for symbolic algebra and / or calculus.

Full marks may be obtained for answers to ALL questions.

Mathematical and statistical formulae and tables are available.

This paper has 7 questions.

Advice to Candidates

You must show sufficient working to make your methods clear to an examiner. Answers without working will gain no credit.

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1. *(a)* Explain briefly the method of quota sampling. **(3 marks)**

(b) Give one disadvantage of quota sampling compared with stratified sampling. **(1 mark)**

(c) Describe a situation in which you would choose to use quota sampling rather than stratified sampling and explain why. **(2 marks)**

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2. Commentators on a game of cricket say that a certain batsman is "playing shots all round the ground". A sports statistician wishes to analyse this claim and records the direction of shots played by the batsman during the course of his innings. She divides the 360° around the batsman into six sectors, measuring the angle of each shot clockwise from the line between the wickets, and obtains the following results:

Sector	0° –	45° –	90° –	180° –	270° –	315° – 360°
No. of Shots	18	19	15	20	9	15

Stating your hypotheses clearly and using a 5% level of significance test whether or not these data can be modelled by a continuous uniform distribution. **(9 marks)**

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3. A film-buff is interested in how long it takes for the credits to roll at the end of a movie. She takes a random sample of 20 movies from those that she has bought on DVD and finds that the credits on these films last for a total of 46 minutes and 15 seconds

(a) Assuming that the time for the credits to roll follows a Normal distribution with a standard deviation of 23 seconds, use her data to calculate a 90% confidence interval for the mean time taken for the credits to roll. **(5 marks)**

(b) Find the minimum number of movies she would need to have included in her sample for her confidence interval to have a width of less than 10 seconds. **(5 marks)**

(c) Explain why her sample might not be representative of all movies. **(1 mark)**

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4. A hospital administrator is assessing staffing needs for its Accident and Emergency Department at different times of day. The administrator already has data on the number of admissions at different times of day but needs to know if the proportion of the cases that are serious remains constant.

Staff are asked to assess whether each person arriving at Accident and Emergency has a "minor" or "serious" problem and the results for three different time periods are shown below.

	Minor	Serious
8 a.m. – 6 p.m.	45	11
6 p.m. – 2 a.m.	49	22
2 a.m. – 8 a.m.	14	7

Stating your hypotheses clearly, test at the 5% level of significance whether or not there is evidence of the proportion of serious injuries being different at different times of day.

(11 marks)

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5. In a competition, a wine-enthusiast has to rank ten bottles of wine, *A* to *J*, in order starting with the one he thinks is the most expensive. The table below shows his rankings and the actual order according to price.

Rank	1	2	3	4	5	6	7	8	9	10
Enthusiast	*D*	*C*	*J*	*A*	*G*	*F*	*B*	*E*	*I*	*H*
Price	*A*	*C*	*D*	*H*	*J*	*B*	*F*	*I*	*G*	*E*

(a) Calculate Spearman's rank correlation coefficient for these data. **(6 marks)**

(b) Stating your hypotheses clearly, test at the 5% level of significance whether or not there is evidence of positive correlation.

(4 marks)

(c) Explain briefly how you would have been able to carry out the test if bottles *B* and *F* had the same price.

(2 marks)

Turn over

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6. A researcher collects data on the height of boys aged between nine and nine and-a-half years and their diet.

The data on the height, V cm, of the 80 boys who had always eaten a vegetarian diet is summarised by

$$\Sigma V = 10\,367, \qquad \Sigma V^2 = 1\,350\,314.$$

(a) Calculate unbiased estimates of the mean and variance of V. **(5 marks)**

The researcher calculates unbiased estimates of the mean and variance of the height of boys whose diet has included meat from a sample of size 280, giving values of 130.5 cm and 96.24 cm^2 respectively.

(b) Stating your hypotheses clearly, test at the 1% level whether or not there is a significant difference in the heights of boys of this age according to whether or not they have a vegetarian diet.

(8 marks)

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7. An examiner believes that once she has marked the first 20 papers the time it takes her to mark one paper for a particular exam follows a Normal distribution. Having already marked more than 20 papers for each of the *P1*, *M1* and *S1* modules set one summer, the mean and standard deviation, in seconds, of the time it takes her to mark a paper for each module are as shown in the table below.

	Mean	Standard Deviation
P1	252	17
M1	314	42
S1	284	29

(a) Find the probability that the difference in the time it takes her to mark two randomly chosen *P1* papers is less than 5 seconds.

(6 marks)

(b) Find the probability that it takes her less than 10 hours to mark 45 *M1* and 80 *S1* papers.

(7 marks)

END

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