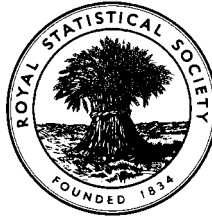


EXAMINATIONS OF THE ROYAL STATISTICAL SOCIETY
(formerly the Examinations of the Institute of Statisticians)



ORDINARY CERTIFICATE IN STATISTICS, 2000

Paper I

Time Allowed: Three Hours

There is no restriction on the number of questions that a candidate may attempt, nor on the order in which they are attempted. Candidates are not required to answer all the questions: they should answer as many as they can.

The number of marks allotted to each question or part-question is shown in brackets. The total for the whole paper is 100. A pass may be obtained by scoring at least 50 marks.

Graph paper and Official tables are provided.

Candidates may use silent, cordless, non-programmable electronic calculators.

*Where a calculator is used the **method** of calculation should be stated in full.*

This examination paper consists of 7 printed pages followed by 1 blank page (page 8). This front cover is page 1. The reverse of the front cover is intentionally left blank and is page 2. Question 1 starts on page 3.

There are 8 questions altogether in the paper.

1. In a monthly Government survey designed to study the characteristics of personal travel within the country, a number of households are sampled. All members of the chosen household are given an interview-led questionnaire (i.e. the questionnaire is completed by the interviewer) and are also asked to keep diaries of all the journeys they undertake during a seven day period.

(i) Suggest three general questions about personal circumstances which have a bearing on the amount of travel undertaken that might usefully be asked during the interview. (3)

(ii) Write down two advantages and two disadvantages of interview-led questionnaires. (4)

(iii) The sample design is multi-stage. A simple random sample of 20 primary units is selected each month and a simple random sample of 21 addresses is selected from each primary unit. The questionnaire is given to all adult members of households at those addresses.

Explain clearly how you would set up such a sample design. Why is it appropriate to use a multi-stage sample in this case? Why is it necessary to sample each month? (4)

(iv) In 1996 it was found that 623 addresses were ineligible (i.e. contained no households). Of the eligible addresses, 58 contained two households and the remainder contained exactly one household.

Calculate the total number of households at eligible addresses and explain how the ineligible category might arise. (3)

(v) After the survey the households were divided into four categories, two categories of response, A and B, and two of non-response, C and D. In 1996 the numbers of households in categories A, B and C were 3214, 300 and 827 respectively.

Calculate the percentage of households in each category in 1996. (3)

2. A medical centre is run by four doctors. It has 10,000 patients, each of whom is registered with just one of the doctors as follows:

	<i>Dr Angus</i>	<i>Dr Brown</i>	<i>Dr Craig</i>	<i>Dr Dyson</i>
<i>Number of patients</i>	2,500	3,000	1,500	3,000

The doctors want to carry out a survey to see whether patients are satisfied with the service given by the centre and to seek suggestions as to how facilities may be improved.

- (i) Give instructions to the doctors as to how to proceed in selecting a stratified sample of 200 patients, stratifying by doctor, so that the samples are representative of the numbers of patients registered with each doctor.

(6)

- (ii) One of the doctors suggests using a quota sample of 200 patients instead. Explain how this would differ from the stratified random sample.

(4)

- (iii) Give one advantage and one disadvantage of using

- (a) a stratified random sample,
(b) a quota sample

in this specific situation.

(4)

3. (a) A simple random sample of 8 children is to be selected from a class of 32.

Write down the probabilities that one particular child

- (i) is in the sample,
(ii) is not in the sample. (2)

Assuming that the class register has children numbered from 1 to 32, obtain such a sample, using pairs of digits from the *last* column of Table IV in your statistical tables. You should start with the first pair of digits in the column (96) and use the digits in order as they appear. Explain carefully how the sample was obtained and note any pairs of digits which you discard in the process.

(6)

- (b) A library contains 1000 fiction books which are of five types. The numbers of books of each type are:

Type of book	<i>General</i>	<i>Crime</i>	<i>Romance</i>	<i>Horror</i>	<i>Western</i>
Number of books	432	311	112	89	56

Explain how you would obtain a random sample of 8 books and find their type using just this information and triples of random digits.

(3)

Find such a sample and note the type of each member of your sample using the *bottom* row of Table IV. You should start with the first three digits in the row (856) and use the digits in order as they appear.

(4)

4. Surveys concerned with changes in personal opinion over time are often conducted by randomly selecting a panel of respondents initially and then re-interviewing the same panel on subsequent occasions.

Give three advantages and three disadvantages that the panel method has over the alternative of choosing new samples on each occasion.

(6)

5. ABC airlines issues a questionnaire to people on their international flights. The questionnaire, which is in English, includes questions on such topics as frequency of travel and purpose of travel as well as on the experiences of catering, service etc on the particular flight. Questionnaires are given to passengers in randomly pre-selected seats on the aircraft and are issued and collected by one of the cabin crew.

- (i) Explain three problems with this method of carrying out such a survey and suggest one way of avoiding each of these problems.

(8)

Three questions on the questionnaire are as follows:

(1) *Was your flight a day flight, departure time 07.00 hours to 22.00 hours, or a night flight, departure time 22.00 hours to 07.00 hours?*

(2) *Regarding the cleanliness of the toilets on the flight, would you say that:*

(a) *the toilets were kept clean and tidy throughout the flight,*

(b) *the toilets were clean and tidy at the beginning of the flight but deteriorated throughout the flight,*

(c) *the toilets were not clean and tidy at the beginning nor throughout the flight?*

(3) *Are you likely to fly with ABC airlines again during the next six months ? Yes/No.*

- (ii) Outline a problem with each of these questions and suggest how each could be modified to avoid the problem.

(8)

6. A university, established ten years ago, is setting up a database to record current details of all those former students who have obtained first degrees at the university. The university authorities are particularly keen to know what further qualifications and education the graduates have acquired and when and where these were obtained. Details of all employment since leaving the university are also required.

(i) Design a form to be mailed to former students to collect the desired data. (12)

(ii) Give details of any difficulties the university is likely to face in attempting to collect the desired data by mail and suggest how these difficulties might be tackled. (6)

7. "Time and motion" studies of employees are often used in industry to determine the processes involved in carrying out repetitive tasks and the times needed to complete each of these processes.

Explain the advantages of using an observational method rather than interviewing employees in such circumstances. State any advantages of interviewing employees before finalising a standard description of the process.

(6)

8. A database named STOCK is being designed to store records describing retail sales items. Typical records are shown below:

<u>Stock-keeping unit (SKU)</u>	<u>Item</u>	<u>Cost</u>	<u>Selling price</u>	<u>Quantity in stock</u>
A431-03	Sack truck	99.50	176.00	35
A364-01	Watering can	14.20	26.65	65
B139-01	Refuse sacks	2.20	5.60	1,220
C210-10	Digging fork	6.75	13.70	120

Give details of a design for this database, in which you should list the fields, giving appropriate field names, together with the field types and suitable widths. Where appropriate, indicate the number of decimal places allowed.

(8)

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