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B. Sc. Examination 2005

MAS 234 Sampling, Surveys and Simulations: Mock

Duration: 1.5 hours

Date and time: Nov 12th 2004, 9.15-10.45am

You should attempt all questions. Marks awarded are shown next to the questions.

Statistical functions provided by the calculator may be used provided that you state clearly where you have used them.

Question 1 Define SRS (Simple Random sampling) of size 2 and find the probability of a particular sample of size 4 from a population size 7. [3]

Question 2 What is *unit non-response*? [2]

Question 3 Write down the sampling distribution (under SRS) of the sample variance s^2 for a sample size 2 from a population size 4 with values 2,5,7,10 (use the shortcut $s^2 = (y_1 - y_2)^2/2$). [10]

Question 4 In the above population, verify that s^2 is unbiased for S^2 , and state a suitable variance estimator for the sample mean \bar{y} . [9]

Question 5 Define the MSE of an estimator e of a population parameter θ . [2]

Question 6 A SRS of size $n = 5$ from a population size $N = 100$ results in $a = 2$ men with responses 3,5 (the rest being women). Estimate the mean response for all men in the population, giving a 95% nominal C.I. [7]

Question 7 Answer the previous question if it is also known that there are exactly 45 men in the population. [6]

Question 8 Using the random string 35037106525577 as economically as possible, draw a SRS of size 3 from a population size 7 by Waterman's algorithm. [9]

Question 9 Find the optimal allocation under StRS for a population with 2 strata as follows (with the usual notation) if the budget is £1000 (no overheads):

h	N_h	S_h	c_h
1	300	30	25
2	500	40	49

Find also the achieved variance. [12]

Question 10 A simple random sample of people results in the following data:

	Mean	S.D.	Number
Men	3.45	2.22	48
Women	1.78	1.46	52

Estimate the population mean (giving a nominal 95% C.I.) if it is known there are 510 men and 540 women. [12]

Question 11 A simple random sample of 6 farms was taken to estimate the population mean number of weeks holiday per employee and the sample data were as follows:

i (farm)	1	2	3	4	5
y_i (total weeks holiday)	12	32	20	23	13
m_i (no. of employees)	3	8	6	4	4

Use a ratio estimate and give a nominal 95% C.I., given there are 600 farms in the region. [14]

Question 12 Draw a PPS sample of size 3 with replacement from a population with cluster sizes 8,4,6,7,5 using the same random string as in Q.8 (starting from the beginning again). Use this sample to estimate the population mean response per element if the total responses for each cluster are 50,24,35,42,29 respectively. Does your nominal 95% C.I. contain the true value? [14]