

**NATIONAL UNIVERSITY OF SCIENCE AND
TECHNOLOGY**

DEPARTMENT OF APPLIED MATHEMATICS

SMA 2205 SURVEY METHODS

MAY 2003

Time: 3 hours

Answer **ALL** questions in Section A and **ANY THREE** questions from section B

SECTION A [40 marks] Answer **ALL** questions from this section

A1. Briefly explain, using examples, the meaning of each of the following terms

- (a) target population.
- (b) sampling units.
- (c) Sample.
- (d) sampling frame.
- (e) Element.

[10 marks]

A2. With the aid of examples distinguish between the terms:

- (a) probability sampling and non probability sampling.
- (b) Sampling errors and non sampling errors
- (c) Overcoverage and undercoverage in the sampling frame

[10 marks]

A3. With reference to a survey on students social life at a certain university, criticize the following question proposed for inclusion in a questionnaire.
Where did you sleep last week?

- (i) on campus residence
- (ii) off campus residence

[2 marks]

A4. The table below contains raw data collected in a survey conducted on NUST students. The research objectives included an investigation into the percentage of students who are satisfied with their degree programme. Summarize the information provided in the table below in a form suitable for presentation in a report and comment on your findings.

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	MALES			FEMALES		
	Satisfied with Programme			Satisfied with Programme		
	Yes	No	Total	Yes	No	Total
Part I	130	50	180	80	40	120
Part II	100	60	160	90	20	110
Part III	80	60	140	60	20	80
Part IV	90	30	120	70	20	90
Total	400	200	600	300	100	400

[10marks]

A5. A survey was conducted to gather information concerning food supplies for undergraduate students at the University of Zimbabwe. Resources are available for selecting a sample of 1000 students. Suggest and describe how to implement a suitable sampling method for this survey.

[8 marks]

SECTION B [60marks]

Candidates may attempt any **THREE** questions from this section

- B6.** (a) What is a cluster sample? Under what circumstances are cluster samples advantageous?
- (b) The safety department of a certain bus company wants to estimate the proportion of unsafe tyres on their 200 buses (assume that there are six tyres per bus and only one spare tyre). Treating each bus as a cluster, a random sample of 20 buses gave the following number of unsafe tyres per bus.
- 1,2,4,3,1,1,0,0,1,1,2,3,4,0,1,2,3,2,0,0
- (i) Estimate the proportion of unsafe tyres being used on the company's buses and place a bound on the error of estimation.
- (ii) Estimate the total number of unsafe tyres and place a bound on the error of estimation. [20 marks]
- B7.** (a) Define stratified random sampling. Under what circumstances are stratified random samples advantageous?
- (b) A company wishes to estimate the total number of over time hours among all employees during a certain month. Since different types of work will result in different over time hours, stratified random sampling is used with each group of employees forming a separate stratum.
- (i) Data from previous years suggest the variances shown in the table below for the number of over time hours for the three groups of employees. Use Neyman allocation to calculate the strata sample sizes for $n = 100$.

	Stratum I	Stratum II	Stratum III
σ^2_i	18	10	5
N_i	500	360	140

- (ii) The company selects a sample of 18 Labourers (L), 10 Technicians (T) and 2 Administrators (A) and collects the required information, as shown in the table below.

	L		T		A
8	24	0	4	5	1
0	16	32	0	24	8
6	0	16	8	12	
7	4	4	3	2	
9	5	8	1	8	
18	2	0			

Estimate the proportion of employees who had more than 10 hours of overtime of work during the month. Place a bound on the error of estimation. [20 marks]

- B8.** (a) With reference to systematic sampling, explain what is meant by each of the following terms:
- random population.
 - ordered population.
 - Periodic population.
- (b) Outline a procedure for selecting a repeated systematic random sample.
- (c) In a survey, a 1-in-20 systematic sample is drawn from an alphabetic list of NUST students. It is found that 64.2% of the students in the sample are satisfied with their degree programme. Estimate T , the total number of students who are satisfied with their degree programme and give a 95% confidence interval for T . The total number of students is 2000. [20 marks]
- B9.** (a) Suppose y_1, \dots, y_n denotes a simple random sample from a population of size N with mean μ and variance σ^2 . Show that the sample size required to estimate T , the population total with a bound on the error, d , is
- $$n = \frac{N\sigma^2}{\frac{d^2}{z^2 N^2} (N-1) + \sigma^2}$$
- (b) An investigator is interested in estimating the total cost of water consumed, in a particular month, in a certain town of $N = 1500$ houses. A simple random sample

of $n = 100$ houses was selected. The sample average cost for the n houses was $\bar{y} = \$400.00$ with a sample variance of $s^2 = 50$.

- (i) Estimate the total (T) cost of water in the town.
- (ii) Place a bound on the error of estimation using 2% level of significance.
- (iii) Determine the sample size required to estimate, T , the total cost of water consumed in the town, with a bound on the error of estimation of $d = 200$ and 10% level of significance. [20 marks]

END OF EXAMINATION

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