TOM MBOYA UNIVERSITY

UNIVERSITY EXAMINATIONS

2023/2024 ACADEMIC YEAR,

SECOND YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF

BACHELOR OF SCIENCE IN APPLIED STATISTICS AND ACTURIAL SCIENCE

COURSE CODE: MAS 201

COURSE TITLE: DESIGN AND ANALYSIS SAMPLE SURVEY

(MAIN EXAM, 2023)

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INSTRUCTION TO CANDIDATES

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

All questions in section B carry Equal Marks

Duration of the examination: 3 hours

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SECTION A (30 marks):

QUESTION ONE

a) Distinguish between:
   i. Population and sample (2mks)
   ii. Stratified and systematic random sampling techniques (2mks)
   iii. Clusters and two-stage sampling methods. (2mks)

b) Enumerate and explain four advantages of taking a sample as compared to census (4mks)

c) State and explain clearly why stratified random sampling methods is widely used in practice (4mks)

d) Describe briefly the simple random sampling (2mks)

e) Write and explain the advantages of simple random sampling method. (2mks)

f) What are the advantages of systematic sampling method? But why is this method not widely used? (3mks)

g) Explain briefly the main sources of error in sampling surveys. What precautions should one take in order to get the required precision of estimates? (4mks)

h) Consider a simple random sample of size n consisting observations $y_1, y_2, ..., y_i, ...y_n$ drawn from a finite population of size n.
Let the sample mean,

$\overline{y} = \sum_{i=1}^{n} y_i / n$ and population mean, $\overline{Y} = \sum_{i=1}^{N} y_i / N$.

Show that $\overline{y}$ is an unbiased estimator of $\overline{Y}$ i.e $E(\overline{y}) = \overline{Y}$. (5mks)

SECTION B ANSWER ANY TWO QUESTION

QUESTION TWO 20 MKS

a) Let $y_1, y_2, ..., y_i, ...y_n$ be a simple random sample drawn from a finite population of size N.Further let

$$s^2 = \sum_{i=1}^{n} (yi - \overline{\overline{y}})^2 / n-1$$ and $$S^2 = \sum_{i=1}^{N} (y_i - \overline{\overline{y}})^2 / N-1$$ be the sample and population variances respectively.

i. Show that s^2 is an unbiased estimator of S^2 (6mks)

ii. If $\overline{y} = \sum_{i=1}^{n} y_i / n$ .Is this the sample mean, show that $V(\overline{y}) = \frac{N-n}{N} \frac{S^2}{n}$ (6mks)

b) Sample proportion p is an unbiased estimator of population proportion P, show that E(p)= P (3mks)

c) The variance of sample proportion V(p) is unbiased estimate of the variance such as

$$V(np) = nPQ \frac{N-n}{N-1}.$$ (5mks)

QUESTION THREE 20MKS

a) What circumstances stratified random sampling is used. (3mks)
b) What is the objective of stratification. (3mks)
c) What are the merits and limitations of stratified random sampling (4mks)
d) A sample of 30 students is to be drawn from population of 300 students belonging to two colleges A and B. The means and standard deviation of marks are given below

College	total no. of students	$\overline{Y}_i$	S_i
A	200	30	10
B	100	60	40

i. How will you draw the sample using proportional allocation (3mks)
ii. How will you draw the sample using Neyman allocation technique (3mks)

iii. Verify that Neyman's allocation is more efficient than proportional allocation (4mks)

QUESTION FOUR 20MKS

a) What are probability and non-probability sampling? (2mks)

b) Distinguish between:

iv. Target population and sample population (2mks)

v. Lottery method and random number method of simple random sampling (2mks)

c) Using the following dataset 1,2,3,4

i) Draw all possible sample of size n=2 without replacement (2mks)

ii) Verify that the sample mean $\bar{x}$ is unbiased estimator of the population mean μ (4mks)

iii) Prove that the sample variance s^2 is unbiased estimator of the population variance δ^2 (4mks)

iv) Show that var($\bar{x}$)=$\frac{N-n}{Nn}s^2$ (4mks)

QUESTION FIVE 20 MKS

a) Consider a finite population of size 6, consisting of elements 3, 8, 2,5,10 and 12. If a simple random sample of size 2 was collected.

i. Write all possible samples (3mks)

ii. Compute the means of samples in (i) (3mks)

iii. Verify that $(\bar{y}) = \bar{Y}$ (4mks)

iv. Verify that sample variance is equal to the population variance (4 mks)

b) State and prove the three properties of simple random sampling (6mks)