



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF BIOLOGICAL PHYSICAL MATHEMATICS AND ACTUARIAL  
SCIENCES**

**UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF ACTUARIAL  
SCIENCE WITH IT**

**2<sup>ND</sup> YEAR 1<sup>ST</sup> SEMESTER 2023/2024 ACADEMIC YEAR**

**REGULAR MAIN CAMPUS**

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**COURSE CODE: WAB 2205**

**COURSE TITLE: SAMPLE SURVEY**

**EXAM VENUE:**

**STREAM:**

**DATE:**

**EXAM SESSION:**

**TIME: 2.00 HOURS**

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**Instructions:**

- 1. Answer question one (compulsory) and any other two questions.**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

### **QUESTION ONE (30 MARKS)**

- a) Outline SIX causes of Non – sampling error. (6 Marks)
- b) From the list of 2000 names and addresses, a simple random sample of 250 names is selected without replacement and 50 wrong addresses found.
- Estimate the number of addresses that needs correction from the list. (2 Marks)
  - Calculate the standard error of the above estimate. (2 Marks)
- c) Outline FOUR cases under which sample survey approach may not be recommended for the study of population. (4 Marks)
- d) In a simple random sampling without replacement, show that the sample variance which is unbiased estimator of the adjusted population variance is given by  
$$E(s^2) = \sigma^2$$
 (10 Marks)
- e) A population of 430 units has a mean  $\bar{x} = 19$  and variance  $\bar{x} = 85.6$ . How many units should be selected for estimating  $\bar{x}$  within 10% of  $\bar{x}$  apart from a chance of 1 in 20 (4 Marks)
- f) Give TWO limitations of complete enumeration. (2 Marks)

### **QUESTION TWO (20 MARKS)**

- a) A sample of 40 students is to be drawn from a population consisting of 500 students belonging to colleges A and B. The means and standard deviations are given below

College	Number of students $N_i$	Mean $\bar{Y}_i$	$S_i$
A	300	30	10
B	200	60	40

- Determine the sample sizes that would be drawn using proportional allocation and Neyman allocation. (4 Marks)
  - Find the sample variance of the estimator of the population mean given by Proportional allocation and Neyman allocation (10 Marks)
  - Verify that  $\text{var}(\bar{y}_{st})_{opt} < \text{var}(\bar{y}_{st})_{prop}$  (2 Marks)
- b) Highlight FOUR causes of sampling error. (4 Marks)

### **QUESTION THREE (20 MARKS)**

Consider a population of 6 units whose values are 2, 3, 4, 5, 6, and 7. Write down all possible samples of size 2 without replacement from this population. Hence show that

- $E(\bar{y}) = \bar{Y}$  (5 Marks)
- $E(s^2) = \sigma^2$  (5 Marks)
- $\text{var}(\bar{y}) = \frac{N-n}{Nn} \cdot S^2$  (5 Marks)
- Verify that  $\text{var}(\bar{y})_{SRSWOR} < \text{var}(\bar{y})_{SRSWR}$  (5Marks)

**QUESTION FOUR (20 MARKS)**

- a) Show that in a simple random sampling without replacement, the variance of mean sample is given by  $\text{var}(\bar{y}) = \frac{N-n}{nN} S^2$  (10 Marks)
- b) A simple random sampling of 15 north – south ships were selected from the 386 mile – wide study region so that  $n = 15$  and  $N = 386$ . The number of carbon in the 15 sampled units were 2, 60, 31, 108, 12, 46, 14, 39, 17, 25, 96, 20, 31, 15 and 14.  
Find
- i. The sample mean (2 Marks)
  - ii. The sample variance (2 Marks)
  - iii. The estimated variance of the sample mean (2 Marks)
  - iv. An estimate of the total number of carbon in the study region (2 Marks)
  - v. The estimate of variance of the population total (2 Marks)

**QUESTION FIVE (20 MARKS)**

- a) Show that under proportional allocation, the variance of systematic sampling is given by  $\text{var}(\bar{y}_{st})_{prop} = \left(\frac{1}{n} - \frac{1}{N}\right) \sum_{i=1}^k \omega_i S_i^2$  (5 Marks)
- b) In a farm containing 412 fruit bearing guava trees, 15 clusters each containing 4 trees were selected and yields in Kg were recorded as shown below.

Cluster	1	2	3	4	5	6	7	8	9	10	11
1 <sup>st</sup> tree	5.53	26.11	11.08	12.66	12.87	0.82	54.21	1.94	37.94	56.92	27.59
2 <sup>nd</sup> tree	4.84	10.93	0.65	32.52	3.56	11.68	34.63	35.97	47.69	17.69	37.90
3 <sup>rd</sup> tree	0.69	19.08	4.21	16.92	4.81	40.05	32.55	29.54	16.94	26.24	5.15
4 <sup>th</sup> tree	15.79	11.18	7.56	37.02	57.54	5.15	37.96	28.11	6.77	6.53	9.86

Cluster	12	13	14	15
1 <sup>st</sup> tree	45.98	7.13	14.23	3.58
2 <sup>nd</sup> tree	5.17	34.35	16.89	40.76
3 <sup>rd</sup> tree	24.76	1.17	12.18	28.93
4 <sup>th</sup> tree	25.98	6.77	21.7	1.25

Estimate the average yield in kilogram per tree and population standard error. (15 Marks)