



*(Knowledge for Development)*

**KIBABII UNIVERSITY**  
**UNIVERSITY EXAMINATIONS**  
**2017/2018 ACADEMIC YEAR**  
**SECOND YEAR FIRST SEMESTER**  
**SPECIAL/ SUPPLEMENTARY EXAMINATION**  
**FOR THE DEGREE OF BACHELOR OF SCIENCE**

**MATHEMATICS**

**COURSE CODE: STA 243**

**COURSE TITLE: SAMPLE SURVEYS I**

**DATE: 03/10/18**

**TIME: 3 PM -5 PM**

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**INSTRUCTIONS TO CANDIDATES**

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 4 Printed Pages. Please Turn Over.

**Question 1 Compulsory (30 marks)**

- a) State and explain five uses of sample surveys. (5 marks)
- b) Briefly describe systematic sampling. (3 marks)
- c) State the difference between target population and sample population. (4 marks)
- d) The following Observations are assumed to be from a normal population:  
35, 14, 53, 68, 64, 26, 19, 34, 36 and 58
- i) Estimate the population mean (2 marks)
- ii) Determine the 95% confidence bounds for the population mean (4 marks)
- e) Give three advantages and three disadvantages of probability sampling methods. (6 marks)
- f) Briefly describe how the stratified sampling is done (3 marks)
- g) State three physical layout of a questionnaire (3 marks)

**Question 2 (20 marks)**

- a) A population has size  $N=6$  where the values of characteristic  $X$  are 1, 8, 3, 11, 4 and 7. A sample of size  $n=2$  is to be selected for estimating the population mean  $\bar{Y}$ .
- (i). List the possible samples with their corresponding means. (3 marks)
- (ii). Verify that the sample mean  $\bar{y}$  is unbiased estimator of the population mean  $\bar{Y}$  and that its variance is given by
- $$\frac{s^2(N-n)}{nN}$$
- b) State and explain three situations under which optimum allocation can be applied in stratified random sampling. (3 marks)

c) A population has 4 strata with corresponding sizes, means and variances as given below;

|           | $N_i$  |    | $S_i^2$ |
|-----------|--------|----|---------|
| Stratum 1 | 2000   | 12 | 16      |
| Stratum 2 | 1000   | 8  | 9       |
| Stratum 3 | 500    | 6  | 4       |
| Stratum 4 | 10,000 | 22 | 25      |

(i). Obtain the population mean and variance. (9 marks)

(ii). Find the proportional and Neyman allocation if a stratified sample of size 1,000 is to be drawn to estimate the population mean. (8 marks)

### Question 3 (20 marks)

a) Let  $A$  be the number of units possessing a certain characteristic under investigation in a population of size  $N$ . Suppose the number possessing the characteristic in a simple random sample of size  $n$  is  $a$ , let  $p = a/n$ .

(i). Prove that  $p$  is an unbiased estimator of  $P = A/N$  (5 marks)

(ii). Show that  $Var(p) = \frac{N-n}{N-1} \frac{P(1-P)}{n}$  (7 marks)

b) In a simple random sample of size  $n=350$ , there were 93 individuals with a disease under investigation. If the population size is  $N=2984$ . Obtain the 95% confidence bounds for the proportion with the disease in the population.

(8 marks)

### Question 4 (20 marks)

a) Briefly describe systematic sampling. (2 marks)

b) Distinguish between cluster sampling and stratified sampling. (2 marks)

c) Define the term ratio estimation and give the rationale of using it. (2 marks)

d) A sample of branches of equatorial Bank was randomly selected and the number of employees with post graduate qualifications was recorded. Also recorded was the total number of employees in the selected branch. The record is as below;

|                         | Branch 1 | Branch 2 | Branch 3 | Branch 4 | Branch 5 |
|-------------------------|----------|----------|----------|----------|----------|
| Number of postgraduates | 12       | 8        | 16       | 10       | 4        |
| Number of employees     | 45       | 32       | 75       | 47       | 11       |

(i). Estimate the number of employees with post graduate qualifications per branch using the ratio estimator if the bank has a total of 63 branches with 3,200 employees.

- (ii). Compare the estimate in (i) with the one obtained without using the ratio estimator. (6 marks)
- (iii). Estimate the variance of the estimate. (4 marks)

**Question 5 (20 marks)**

- a) State the meanings of the following;
- (i). Sampling errors
  - (ii). Non sampling errors

(4 marks)

b. Show that  $s^2 = \sum_{i=1}^n \frac{(y_i - \bar{y})^2}{n-1}$  is unbiased estimate of  $S^2 = \sum_{i=1}^N \frac{(y_i - \bar{y})^2}{N-1}$  (8 marks)

- c) A survey is to be made of the prevalence of common diseases in a large population. For any disease that affects at least 1% of the individuals in the population, it is desired to estimate the total number of cases with a coefficient of variation of not more than 20%. What size of simple random sample is needed assuming that the presence of the disease can be recognized without mistakes?

(8 marks)