

CHUKA



UNIVERSITY

**UNIVERSITY EXAMINATION
RESIT/SUPPLEMENTARY / SPECIAL EXAMINATIONS
EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF EDUCATION
SCIENCE, BACHELOR OF SCIENCE MATHEMATICS, BACHELOR OF ARTS
ECONOMICS MATHEMATICS, BACHELOR OF SCIENCE ECONOMICS
STATISTICS**

MATH 341: SAMPLING METHODS I

STREAMS: BED SC, BSC MATH, BA ECON MATH, BSC ECON STAT

TIME: 2 HOURS

DAY/DATE: TUESDAY 10/08/2021

8.30 A.M - 10.30 A.M.

INSTRUCTIONS:

Question 1 (30 Marks)

- a) State 4 sources of errors in sample surveys. (4 marks)
- b) State 3 principles of sampling theory and explain what is meant by each principle. (6 marks)
- c) A population is found to have 12 observations. If samples of size 5 were taken from the population, state the number of samples that can be found if
 - i) Sampling is done without replacement. (1 mark)
 - ii) Sampling is done with replacement. (1 mark)
 - iii) If the standard errors for the sample means in I and ii were computed, state one which would be more precise as an estimator of the standard deviation. Support your answer. (3 marks)
- d) Consider a random sample of size n which has to be drawn from a finite population of size N . if simple random sampling method is used where sampling is done without replacement. Show that the probability of selecting a unit in the second draw is equal to selecting it in any other draw. (5 marks)

e) The following data was extracted from a demographic journal.

stratum	1	2	3	4	5
Stratum size	90	30	60	120	100
Stratum mean	6	10	12	8	
Stratum variance	2.25	3.24	3.61	2.89	1.96

- i) If the entire population mean is 9.8, determine the missing stratum mean and hence the population standard deviation. (5 marks)
- ii) For a stratified random sample of 162 elements, determine the sample size of the 4th stratum under Neyman allocation. (3 marks)
- f) Explain clearly how sampling is carried out using systematic sampling procedure. (2 marks)

Question 2 (20 Marks)

- a) A population consists of $N=nM$ units. Explain how you would obtain a systematic sample of size n from this population. (5 marks)
- b) Under what conditions would you prefer systematic sampling to simple random sampling (2 marks)
- c) Consider the following items in a population 15,17, 14, 18, 15,16. Suppose a sample of size 5 is selected by simple random sampling without replacement. By enumerating all the possible samples , show that;
 - i) The sample means is an unbiased estimator of the population mean. (5 marks)
 - ii) The sample variance is an unbiased estimator of the population variance. (4 marks)
 - iii) In simple random sampling the variance of sample means satisfies the formula

$$\text{Var}(\bar{y}) = \frac{N-n}{N} \frac{S^2}{n} \quad (4 \text{ marks})$$

Question 3 (20 Marks)

- a) Show that the stratified sample mean (\bar{y}_{str}) is an unbiased estimator of the population mean. (5marks)
- b) A stratified population was found to have 5 strata. The stratum sizes, means and variances were displayed as shown.

Stratum	size	Mean	Variance
A	41	9.1	1.96
B	74	11.2	1.13
C	117	7.3	1.31
D	45	9.6	1.74
E	98	6.9	2.03

- i) Calculate the overall population mean and the population variance. (10 marks)
- ii) For a stratified random sample of size 80, determine the appropriate stratum sample sizes under proportional allocation. (5 marks)
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