KISII UNIVERSITY

UNIVERSITY EXAMINATIONS

SPECIAL EXAMINATION

THIRD YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE MATHEMATICS /BACHELOR OF SCIENCE APPLIED STATISTICS

FIRST SEMESTER 2021/2022

(JULY, 2022)

STAT 341: SAMPLING METHODS 1

STREAM: Y3 S1 **TIME: 2 HOURS**

DAY: FRIDAY, 11.30 AM – 1.30 PM **DATE: 29/07/2022**

INSTRUCTIONS:

1. Do not write anything on this question paper.

2. Answer Question ONE (Compulsory) and any other TWO Questions.

1 a)

i) Give three major states of a survey design.

ii) Give four data collection methods

b)Let $\bar{x}$be the mean of a simple random sample of size and drawn without replacement from a population of size$n$. Show that:

i) $V(\bar{x}) = \frac{N-n}{N}\frac{S^2}{n}$, Where

$S^2 = \sum_{i=1}^{N}\frac{(X_i-\bar{X})^2}{N-1}$

ii) $E(s^2)$ $=S^2$ where $s^2 = \sum_{i=1}^{n}\frac{(x_i-x)^2}{n-1}$ (15marks)

c) For a certain characteristics X for individuals in a population of size N=5, the values are 4,3,6,8 and 9

i) Calculate$(\bar{X})$, the population mean .

ii) Calculate S^2 , the population variance

iii) For all possible samples of sixe n=2 calculate $\bar{x}$(Hint: there are 10 such samples)

iv)Calculate the variance of the values obtained in (iii) and calculate the quantity

$\frac{N-n}{N}\frac{S^2}{n}$ (8marks)

2. a) Give reasons why stratification may be suitable in surveys (4marks)

b) Obtainn_h for Neyman allocation, where $n_h$is the size of the sample from the h[th] stratum. (5marks)

c) A population has three strata with sizes means and variances as given below

	N_h	$\bar{X}_h$	S_h
Stratum 1	18000	5.2	2.8
Stratum 2	30000	4.8	3.0
Stratum 3	72000	6.9	2.5

i) Obtain the population mean and variance

ii) Obtain the proportional and Neyman allocation if a stratified sample of size 10000 was to be drawn in a survey. (11marks)

3.a) Give two advantages of systematic sampling over sample random sampling. (2marks)

b) The data in the table below are for a small artificial population that exhibits a fairly steady rising trend. N=40, K=10 and N=4 each column represent a systematic sample and rows are the strata.

Strata	1	2	3	4	5	6	7	8	9	10
i	0	1	1	2	5	9	7	7	8	6
ii	6	8	9	10	13	12	15	16	16	17
iii	18	19	20	20	24	23	25	28	29	27
iv	26	30	31	31	33	32	35	37	38	38

Calculate

i) V_{ran}

ii) V_{st}

iii) Prepare ANOVA table (18marks)

4a) In a population with N=6, the values of y are 8,3,1,11,4 and 7. If a random sample of size 2 are drawn with replacement from this population . Show by findings all possible samples that

$V(\bar{y})$ satisfies the equation ; (11marks)

$$V(\bar{y})=\frac{\delta^2}{n}=\frac{S^2}{n}\frac{(N-1)}{N}$$

b) In a study of plant disease the plants were grown in 160 small plots containing nine plants each , A random sample of 40 plots was chosen and three random plants in each sampled plots were examined for the presence of diseases . It was found that 22 had no diseased plants (out of three),11 had one , 4 had two and 3 had three estimate;

i) The proportion of diseased plant

ii) Its standard error

5 a) Consider a population of size N in which the number of units possessing a certain characteristics is A, let the number of units possessing the characteristic in a simple random sample of size n be a.

i) Prove that $P=\frac{a}{N}$ is an Unbiased estimator of P= A/N

ii) Show that $V(P) = \frac{N-n}{N-1}\frac{PQ}{n}$

Where Q = 1-P

iii) Give an estimate of V(p)

b) In a simple random sample of size 65 units were found to possess a certain characteristic under investigation. Obtain the 99% confidence bounds for the population proportion possessing the characteristic. The population size is 7000

(9marks)