Mount Kenya University

UNIVERSITY EXAMINATION 2024/2025

SCHOOL OF PURE AND APPLIED SCIENCES
DEPARTMENT OF NATURAL SCIENCES

BED (SCIENCE)/BED (ARTS) BSNE AND ENH
REGULAR

UNIT CODE: BMA4203 **UNIT TITLE: DESIGN AND ANALYSIS OF SAMPLE SURVEYS**

DATE: MON 9TH DEC, 2024 8.00AM MAIN EXAM TIME: 2 HOURS

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO

QUESTION ONE

a) Differentiate between
   i) Sampling and census. (2 Marks)
   ii) Sampling unit and Sampling frame. (2 Marks)
   iii) Ratio estimation and Regression estimation. (2 Marks)

b) Out of a population of 100 medical records, 40 are randomly sampled and then audited. 10 out of the 40 audits reveal fraud. From this information, give an estimate,
   i) Standard error of the proportions (4 Marks)
   ii) 95% confidence interval for the proportion of audits in the population with fraud. (4 Marks)

c) The population of 196 cities in the year 1920 was 22919 million, established through census while a sample of 49 cities had a total of 5054millions. In 1930, survey of the 149 cities gave a total of 6262million people showing that majority of the cities had a 20% increase. Use
   i) Ratio estimation to obtain the population total in 1930. (4 Marks)
   ii) Sample mean to estimate the population total 1930. (4 Marks)

d) i) Define the term first order inclusion probability. (2 Marks)

ii) Show that the sample mean $\bar{y}$ is unbiased estimator of the population mean μ using first order inclusion probability. (5 Marks)

SECTION B

QUESTION TWO

A small village had the following six households

household	a	b	c	d	e	f
Household size	6	8	3	5	7	4

a) Write down all possible samples of size four. (2 Marks)

b) State the probability of selecting any one of these samples. (1 Mark)

c) Let Y be the house hold size, obtain

i) The population mean (μ_Y) and the variance. σ_Y^2 (4 Marks)

ii) Samples means ($\bar{y}$) and variances s_Y^2 for all possible samples size 4 (6 Marks)

d) Determine the value of $E(\bar{y})$ and $var(\bar{y})$. (7Marks)

QUESTION THREE

a) i) Define an indicator variable. (2 Marks)

ii) Determine the first order inclusion probability. (3 Marks)

b) Define the term stratified proportionate random sample. (4 Marks)

c) Select a sample size 20 using stratified proportionate random sampling give the information below. (11 Marks)

age	< 15	15-25	> 25
males	20	15	5
females	10	40	10

QUESTION FOUR

A simple random sample of 30 households was drawn from a city comprising of 14,848 households. The number of persons per household was as follows:

5,6,3,3,2,3,3,3,4,4,3,2,7,4,3
5,4,4,3,3,4,3,3,1,2,4,3,4,2,4

a) Estimate the total number of the people in the area. (10 Marks)

b) Compute the probability that this estimate is within $\pm 5\%$ of the true value. (10 Marks)

QUESTION FIVE

A survey of 40 households was conducted to establish TV viewership hours in three different neighborhoods in a city as given below.

A	B	C
35 28 26 41	27 4 49 10	8 15 21 7
43 29 32 37	15 41 25 30	14 30 20 11
36 25 29 31		12 32 34 24
39 38 40 45		
28 27 35 34		

Estimate the average television viewing time and give a 95% confidence interval in hours per week for

i) All households in the city. (13 Marks)
ii) All households in neighborhood A. (7 Marks)