



UNIVERSITY EXAMINATIONS

SECOND SEMESTER 2023/2024 ACADEMIC YEAR

**THIRD YEAR EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE (ECONOMICS AND
STATISTICS)**

STAT 321: SAMPLE SURVEY

STREAM: R

TIME: 2 HRS

DAY: WEDNESDAY[8.30 A.M – 10.30 A.M] DATE: 10/04/2024

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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INSTRUCTIONS**Instructions****Answer question ONE and any other Two questions****QUESTION ONE (30 MARKS)**

- a) What is the difference between the Sample and population? **(2 Marks)**
- b) State two characteristics of sampling frame. **(2 Marks)**
- c) From a list of 6000 names and addresses, a simple random sample of 300 names showed on investigation 50 names had wrong addresses. Find the total number of addresses needing correction in the list and its 95% confidence interval. **(5 Marks)**
- d) Describe the stratified random sampling. **(3 Marks)**
- e) A wholesale food distributor in a large city wants to know whether demand is great enough to justify adding a new product to his stock. To aid in making his decision, he plans to add this product to a sample of the stores he services in order to estimate average monthly sales. He only services four large chains in the city. Hence, for administrative convenience, he decides to use stratified random sampling with each chain as a stratum. There are 24 stores in stratum I, 36 in stratum 2, 30 in stratum 3, and 30 in stratum 4. The distributor has enough time and money to obtain data on monthly sales in 16 stores. Because he has no prior information on the stratum variances and because the cost of sampling is the same in each stratum, he decides to use proportional allocation to determine the sample in each stratum. Find the sample allocation in each stratum. **(3 Marks)**
- f) The new product is introduced in three stores chosen at random from chain I, five stores from chain 2, and four stores each from chains 3 and 4. The sales figures after a month show the results given in the accompanying table.

	Stratum I	Stratum II	Stratum III	Stratum IV
1	94	105	108	92
2	90	111	96	110
3	102	101	100	94
4		93	93	91
5		120		



Find the

- i) mean (\bar{x}_{st}) sales figures. (4 Marks)
- ii) sample variance of each stratum. (5 Marks)
- iii) stratified random sampling variance $Var(\bar{x}_{st})$. (3 Marks)
- iv) 95% confidence interval for the total. (3 Marks)

QUESTION TWO (20 MARKS)

a) A company want to estimate the total number of palm trees on 100 islands. The area of each island is known and it is reasonable to think that the number of trees on each island is proportional to size of the island. Four islands are selected proportional to their sizes. The probability of selecting the four islands and the number of trees in the islands is given below.

i	size	p_i	y_i
1	1	0.01	14
29	5	0.05	50
29	5	0.05	50
36	2	0.02	25

- i) Estimate the total numbers of trees in the islands using Horvitz-Thompson estimator. (5 Marks)
- ii) Estimate the mean numbers of trees in the islands using Hansen-Hurwitz estimator. (4 Marks)
- iii) Construct the 95% confidence interval for the mean and the total using Hansen-Hurwitz estimator.

QUESTION THREE (20 MARKS)

a) A simple random sample of $n = 11$ hospital records is drawn to estimate the average amount of money due on $N = 500$ open accounts. The sample values in Dollars for these eleven records are listed below.

9, 10, 9, 11, 9, 15, 6, 4, 10, 8, 8

Calculate the.

- i) sample mean. (2 Marks)
- ii) total (2 Marks)
- iii) sample variance. (3 Marks)
- iv) variance of the mean (2 Marks)



- v) Standard error of the mean. (2 Marks)
- vi) 95% Confidence interval for the mean. (2 Marks)
- b) State two use of standard error in sample survey. (2 Marks)
- c) Let x_1, x_2, \dots, x_n be a sample from population with n units selected at random without replacement and \bar{x} is the sample mean. Prove that the sample mean is unbiased. (5 Marks)

QUESTION FOUR (20 MARKS)

- a) The following data shows the stratification of all the farm in the county by farm size and the average acres of maize per farm in each stratum. For a sample of 100 farms compute the sample sizes in each stratum under;
 - i) Proportional to size (3 Marks)
 - ii) Optimum allocation (Neyman allocation) (3 Marks)

Farm Size (acres)	Number of Farms N_h	Average Corn Acres \bar{Y}_h	Standard Deviation S_h
0-40	394	5.4	8.3
41-80	461	16.3	13.3
81-120	391	24.3	15.1
121-160	334	34.5	19.8
161-200	169	42.1	24.5
201-240	113	50.1	26.0
241-	148	63.8	35.2
Total or mean	2010	26.3	

- b) In stratified random sampling with a linear function $cost = C = c_o + \sum c_h n_h$, the variance of the estimated mean \bar{y}_{st} is a minimum for a specified cost C, and the cost is a minimum for a specified variance $V(\bar{y}_{st})$, when n_h is proportional to $\frac{W_h S_h}{\sqrt{c_h}}$. For a fixed n, the minimum

variance is given by, $V_{\min}(\bar{y}_{st}) = \frac{\sum (W_h S_h)^2}{n}$. Prove this result. (7 Marks)

- c) In simple random sampling the variance of the sample mean is given by,

$$V(\bar{y}) = \left(\frac{N-n}{Nn} \right) S^2.$$

Prove this result. (7 Marks)



QUESTION FIVE (20 MARKS)

- a) What is Non-probability sampling? Give an example. **(3 Marks)**
- b) A production manager would like to estimate the mean time required for workers to complete a task on an assembly line. Assume that she knows that σ is 80 seconds. How large a sample should she draw to estimate μ to within 5 seconds with 95% confidence? **(3 Marks)**
- c) The data below shows the weekly family income and the weekly expenditure on food in a sample random sample of 5 low-income families.

Weekly family income	64	62	87	58	92
Weekly expenditure on food	14.3	20.8	22.7	41.2	28.2

Calculate the percentage of the income that is spent on food and its standard error. **(6 Marks)**

- d) From a list of 468 small 2-year colleges a simple random sample of 100 colleges was drawn. The sample contained 54 public and 46 private colleges. Data for number of student (y) and number of teachers (x) are shown below.

	n	$\Sigma(y)$	$\Sigma(x)$
Public	54	31,281	2,024
Private	46	13,707	1,075
	$\Sigma(y^2)$	$\Sigma(yx)$	$\Sigma(x^2)$
Public	29,881,219	1,729,349	111,090
Private	6,366,785	431,041	33,119

- i) Calculate the ratio (number of students) / (number of teachers) for public school. **(2 Marks)**
- ii) Compute the 95% confidence interval of the estimates in (i) above. **(6 Marks)**

