



NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

QUALIFICATION: Bachelor of science Honours in Applied Statistics	
QUALIFICATION CODE: 08BSSH	LEVEL: 8
COURSE CODE: SAT802S	COURSE NAME: SAMPLING THEORY
SESSION: JANUARY 2020	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

SECOND OPPORTUNITY/SUPPLEMENTARY EXAMINATION QUESTION PAPER	
EXAMINERS	DR. C.R KIKAWA
MODERATOR:	PROF SATHIYA APPUNNI

INSTRUCTIONS
<ol style="list-style-type: none">1. Answer ALL the questions in the booklet provided.2. Show clearly all the steps used in the calculations.3. All written work must be done in blue or black ink and sketches must be done in pencil.

PERMISSIBLE MATERIALS

1. Non-programmable calculator without a cover.

THIS QUESTION PAPER CONSISTS OF 5 PAGES (including this front page)

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SAMPLING THEORY: SAT802S

SECOND/SUPPLEMENTARY EXAMINATION, JANUARY 2020
Time - 3 Hrs. Attempt all Questions. Maximum marks - 100

1. Question (20 marks)
- (a) Discuss the following concepts as used in sampling theory, give relevant examples where applicable:
- i. sample design (2 marks)
 - ii. Sampling errors and non-sampling Errors (2 marks)
 - iii. Sampling plan (2 marks)
- (b) Write short notes on the concept of quota sampling. (5 marks)
- (c) Using the sample we collect, we can construct estimates for the parameter of the population that we are interested in. Usually, there are many ways to construct estimates. Thus, we need some guidelines to determine which estimates are desirable. You are required to discuss three desirable properties of estimators. (9 marks)

2. Question

(20 marks)

The Namibian parliament has made a resolution that physicians in the country should be mandated to visit their respective communities as may be assigned. Suppose the ministry of health is interested in the distribution of the household visits by the physicians in a given community over a specified year. See Table: 1;

(Note: indicate appropriate units on all your answers)

Table 1: Number of Household Visits Made During a Specified year

Physician	No. of Visits	Physician	No. of Visits
1	5	14	4
2	0	15	8
3	1	16	0
4	4	17	7
5	7	18	0
6	0	19	37
7	12	20	0
8	0	21	8
9	0	22	0
10	22	23	0
11	0	24	1
12	5	25	0
13	6	-	-

- (a) Compute the population total. (3 marks)
- (b) Calculate the population mean (3 marks)
- (c) What is the variance of the population distribution? (3 marks)
- (d) Compute the standard deviation (3 marks)
- (e) Define and compute the coefficient of variation of the distribution (5 marks)
- (f) Briefly discuss what the parameter computed in (e) represents. (3 marks)

3. Question

(20 marks)

- (a) Discuss the concept a *simple random sample* in relation to n the sample size and N the population size clearly stating the selection probability of each sample. (5 marks)
- (b) Assume you have a population of N elements and you wish to take a sample of n of these elements. Required to state a well known formula from the theory of permutations and combinations which is used to select, the number T of possible samples of n elements from a population of N elements. (4 marks)
- (c) Given that a population contains 25 elements and one wishes to take a sample of 5 elements. Use the relation stated in (b) to compute the possible samples of 5 elements from the population given. (2 marks)
- (d) Explain, stepwise how to take a Simple Random Sample. (4 marks)
- (e) As a researcher you require to use ratio estimates as an estimation method for your analysis, study Figures 1 and 2 and discuss the suitability of your method. (5 marks)

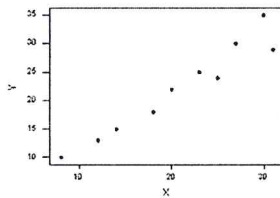


Figure 1: Scatter plot

The regression equation is
 $Y = 1.24 + 1.00 X$

Predictor	Coef	SE Coef	T	P
Constant	1.239	2.007	0.62	0.554
X	1.00253	0.09094	11.03	0.000

Figure 2: Regression output

4. Question

(20 marks)

(a) Discuss the three principal reasons for using stratified random sampling rather than simple random sampling. (6 marks)

(b) The results from a simple random sampling from a stratified population are given in the following table. The columns are the strata sizes, the strata sample sizes, the sample means and the sample variances.

Stratum	N_h	n_h	\bar{y}_h	s_h^2
1	100	20	115.7	57.6
2	300	20	147.2	46.9
3	400	30	133.6	75.3

Figure 3: Table of values

- i. Estimate the population total $\hat{\tau}_{st}$ (5 marks)
- ii. Estimate the stratification mean for the population \bar{y}_{str} (4 marks)
- iii. Estimate the variance of the population mean, $Var(\bar{y}_{st})$ (5 marks)

5. Question (20 marks)

(a) Discuss the concept, *design effect* as used in sampling theory. (3 marks)

(b) Briefly describe (generally) how a systematic sample can be selected from a given population. (5 marks)

(c) Discuss two different scenarios in which cluster sampling is an effective design. (4 marks)

(d) Study the information provided below in relation of cluster sampling and answer the questions that follow.

The primary units selected with probabilities proportional to size:

$$p_i = M_i/M.$$

The Hansen-Hurwitz (p.p.s.) estimator is:

$$\hat{\tau}_p = \frac{M}{n} \sum_{i=1}^n \left(\frac{y_i}{M_i} \right).$$

Given that

$$\bar{y}_i = \frac{y_i}{M_i}$$

$$\hat{V}ar(\hat{\tau}_p) = \frac{M^2}{n(n-1)} \sum_{i=1}^n (\bar{y}_i - \hat{\mu}_p)^2$$

where,

$$\hat{\mu}_p = \frac{\hat{\tau}_p}{M}$$

is unbiased for μ .

From the "Total number of computer help requests", 3 clusters out of 10 clusters are sampled ($n = 3$) with replacement. The data are:

$$y_1 = 420, y_2 = 1785, y_3 = 2198$$

$$M_1 = 650, M_2 = 2840, M_3 = 3200$$

i. Find the Hansen-Hurwitz estimator for the population mean.

(3 marks)

ii. Compute the variance of the estimator.

(5 marks)

END