MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR
THIRD YEAR SECOND SEMESTER

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES
BACHELOR OF SCIENCE APPLIED STATISTICS WITH COMPUTING

COURSE CODE: STA 3227-1
COURSE TITLE: SAMPLING THEORY & METHODS I

DATE: 04/6/24   **TIME: 1100-1300HRS**

INSTRUCTIONS TO CANDIDATES

1. Answer **Question ONE** and any other **Two** questions.

2. Show all the workings clearly

3. Do not write on the question paper

4. All Examination Rules Apply.

Question One (20 Marks)

a) Briefly discuss how to draw a stratified random sample from a population.
(4 Marks)

b) A school desires to estimate the average score that may be obtained on a reading comprehension exam for students in the sixth grade. The school's students are grouped into three tracks, with the fast learners in track I and slow learners III. The school decides to stratify on tracks since this method should reduce variability of test scores. The sixth grade contains 55 students in track I, 80 in track II and 65 in track III. A stratified random sample of 50 students is proportionally allocated and yields simple random samples of $n_1 = 14, n_2 = 20 \; and \; n_3 = 16$ from tracks I, II and III. The test is administered to the sample of students, with the results as shown in the table below

Track I		Track II		Track III	
80	92	85	82	42	32
68	85	48	75	36	31
72	87	53	73	65	29
85	91	65	78	43	19
90	81	49	69	53	14
62	79	72	81	61	31
61	83	53	59	42	30
		68	52	39	32
		71	61		
		59	42		

Determine the sizes of samples from the strata for

    i)   Neyman allocation   **(5 Marks)**

    ii)   Proportional Allocation   **(4 Marks)**

c) A large construction firm has 120 houses in various stages of completion. For estimation of the total amount of construction in the process, a simple random sample of 12 houses is selected and the accumulated costs determined on each. The following costs were obtained.

35.5	30.2	28.9	36.4	29.8	34.1
32.6	26.4	38.0	38.2	32.2	27.5

    i) Calculate the sample mean and variance   **(4 Marks)**

    ii) Estimate the total number of houses in the area and its approximate 99% Confidence Interval   **(3 Marks)**

Question Two (15 Marks)

A forester wants to estimate the total number of farm acres planted in trees for a state. Since the number of acres of trees varies considerably with the size of the farm, he decides to stratify on a farm sizes. The 240 farms in the state are placed in one of four categories according to size. A stratified random sample of 40 farms, selected by using proportional allocation, yields the results the results shown in the accompanying table on the number of acres planted in trees.

Stratum I 0−200 Acres		Stratum II 200−400 Acres		Stratum III 400−600 Acres		Stratum IV Over 600 Acres	
$N_1 = 86$		$N_2 = 72$		$N_3 = 52$		$N_4 = 30$	
$n_1 = 14$		$n_2 = 12$		$n_3 = 9$		$n_4 = 5$	
97	67	125	155	142	256	167	655
42	125	67	96	310	440	220	540
25	92	256	47	495	510	780	
105	86	310	236	320	396		
27	43	220	352	196			
45	59	142	190				
53	21						

a) Calculate $\bar{y}_{st}$ *and* $V(\bar{y}_{st})$ **(12 Marks)**

b) Estimate the total number of acres of trees on farms in the estate and place a bound on the error of estimation. **(3 Marks)**

Question Three (15 Marks)

(a) The quality control section of an industrial firm uses systematic sampling to estimate the average amount of fill in 12-litre cans coming off an assembly line. From a day's production of 1,800, every 50th systematic sample gave the following measurements.

12.00	11.97	12.01	12.03	12.01
11.91	11.98	12.03	11.98	12.00
11.87	12.01	11.98	11.87	11.90
12.05	11.87	11.91	11.93	11.94
11.72	11.93	11.95	11.97	11.93
11.85	11.98	11.87	12.05	12.02
11.80	11.83	11.88	11.89	12.05

i) Estimate μ and place a bound on the error of estimation. **(6 Marks)**

ii) Find the 95% confidence interval for the total number of a day's production. **(4 Marks)**

a) A dentist is interested in the effectiveness of a new toothpaste. A group of 1000 school children participated in the study. The pre-study records showed that there was an average of 2.2 cavities every six months. After three months of the study, the dentist sampled 10 children to determine how they were progressing on the new toothpaste. The following results were obtained.

Child	1	2	3	4	5	6	7	8	9	10
No. of cavities	0	4	2	3	2	0	3	4	1	1

i) Calculate $\bar{y}$, $V(\bar{y})$ and estimate the total number of cavities in the whole group **(5 Marks)**

Question Four (20 Marks)

a) A sociological study conducted in a small town calls for an estimation of the proportion of households that contains at least one member who is over 65 years of age. The city has 621 households according to the most recent census. A simple random sample of 60 was selected from the list. Out of the 60 sampled, 11 had at list one member over 65 years of age. Estimate the true population proportion and place a bound on the error of estimation **(5 Marks)**

b) A market research firm conducted a survey in a city for the purpose of estimating the total monthly household expenditure on Compact Discs (CDs) and the total number of households owning a Compact Disc Player (CDP). The city was divided into four areas and a random sample of households was selected from each area. The results of the survey are shown below.

Area	N_i	n_i	Sample Average Monthly expenditure	Sample proportion owning CDP
1	20,000	100	10.40	0.150
2	10,000	100	6.10	0.083
3	35,000	100	4.05	0.042
4	15,000	100	8.24	0.075

i) Estimate the average monthly household expenditure on CDs in the city and the proportion of households in the city that owns CDP. **(5 Marks)**

ii) Calculate the total monthly expenditure on CDs and the total number of households owning a CDP in the city. **(5 Marks)** **END//**