MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2018/2019 ACADEMIC YEAR

4TH YEAR **2ND** SEMESTER EXAMINATION

AMS 417 – METHODS

DURATION: 2 HOURS

DATE: 25th April 2019

TIME: 2-4pm

Instructions to candidates:

1. Answer question One and Any Other Two questions
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a) State and explain four reasons of sampling 4marks

b) Give four advantages of stratified sampling 4marks

c) Define the following terms as used in sample surveys

i. Purposive sampling 1mark
ii. Convenience sampling 1mark
iii. Quota sampling 1mark

d) A sample of 30 students is to be drawn from a population of 300 students belonging to two colleges A and B. The means and standard deviations of their marks are given below.

	Total number of students	$\bar{y}_i$	s_i
College A	200	30	10
College B	100	60	40

Use this information to confirm that Neyman allocation scheme is more efficient than proportional allocation.

e) Suppose that we have a population of size N = 5 whose population units are 1, 2, 3, 4, 5 and that we require a sample size of n=3 form the population. Assuming we use simple random sampling without replacement (SRWOR). Find

i. Specify the samples 2marks
ii. Show that the sample mean is unbiased for population using this data. 4marks

f) Suppose the following summarized information is made available

$$n = 25, N = 275, \bar{x} = 9.2, \bar{y} = 2.6, \sum_{i=1}^{25} x_i^2 = 2200, \sum_{i=1}^{25} x_i y_i = 500, \sum_{i=1}^{25} y_i^2 = 170$$

i. Estimate R and var (R). 4marks
ii. Find the confidence interval R. 2marks

g) A production line makes 10,000 units a day. How can the quality control department take a systematic sample of 5% of these? 2marks

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a) A stratified population has 5 strata. The stratum size N_i and means $\bar{Y}_i$ and S_i^2 of some variable Y are as follows.

Stratum	N_i	$\bar{Y}_i$	S_i^2
1	117	7.3	1.31
2	98	6.9	2.03
3	74	11.2	1.13
4	41	9.1	1.96
5	45	9.6	1.74

i. Calculate the overall population mean. 2marks

ii. For a stratified simple random sample of size 80, determine the appropriate stratum sample sizes under proportional allocation and Neyman allocation. 10marks

b) A local TV station conducts a survey of food costs by taking a simple random sample of 48 basic food stuffs purchased in a supermarket. Prices in dollars for these items are recorded in two separate occasions. Three months apart, the earlier ones being denoted x_i and the latter y_i. The sample ratio r gives an indication of change of these basic food prices over three months period in the form of an estimate of the population R of the mean prices of food. The following results were obtained.

$\bar{x} = 11.41, \bar{y} = 12.07, \sum_{i=1}^{48} x_i^2 = 8431.7, \sum_{i=1}^{48} x_i y_i = 8564.1, \sum_{i=1}^{48} y_i^2 = 9270.6$

i. Obtain the value of r. 2marks

ii. Estimate variance of r. 2marks

iii. Obtain the 95% confidence interval for the population ratio R. 3marks

QUESTION THREE (20 MARKS)

a) Let Y_i be the value of the characteristic under study for i^{th} unit of the population and Xi be the value of the population. Show that the ratio estimator $(\bar{y}_R)$ is a biased estimate of the population mean $\bar{Y}$ 6marks.

b) In studying lung function in a group of 560 workers in a coal mine, an estimate was required of mean value of some relevant measure Y. A simple random sample of 10 workers was taken and their value, y_i, determined by an appropriate test. A note of their heights x_i was also made. The results were:

y_i	3.0	3.5	3.3	3.1	4.1	3.2	3.7	2.9	3.9	3.4
x_i (cm)	173	183	170	175	160	157	168	180	178	163

Form routine medical records, the average height for the group of 560 workers is known to be ---

i. Estimate $\bar{Y}$ from the data. 4marks

ii. Calculate the approximate standard error of your estimate. 5marks

c) A simple random sample of 10 households was selected from a population of 100 households. The respective number of people in the sample are:

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

Estimate the number of people per household and hence the variance of the estimate 5 marks

QUESTION FOUR (20 MARKS)

a) Let N=100 and n = 10. Assume the random start r is selected, say, r=5. Find a systematic sample composition. 3marks

b) In a particular sector, a survey is conducted to investigate the extent of absenteeism from duty which is not connected to illness or official holidays. A random sample of 1000 employees out of the total workforce of 36000 were asked to indicate the number of days they had failed to report to work for the periods of 6 months. The following were the results.

No. of days	0	1	2	3	4	5	6	7	8	9
No. of employees	451	162	187	112	49	21	5	11	2	0

i. Determine the average number of days that were lost by the sector. 2marks

ii. Determine an estimate of population variance $S^{2.}$ 2marks

iii. Find the 95% confidence interval for the population mean $\bar{Y}$ 2marks

iv. Find the variance of the sample mean 2marks

c) A videotape hire company has shops in each of the five regions. Three regions have 12 shops, the others have 8. The sales manager phones 12 shops chosen by picking 3 regions at random then making a choice of 3, 5 and 4 shops from the chosen regions. The results were as follows:

First region: 260, 296, 182 - 12 shops

Second region: 156, 261, 130, 302, 241 - 8 shops

Third region: 196, 356, 268, 284 -12 shops

Estimate the total number Y of video films hired from the company in a particular week 5marks

d) In a private library, the books are kept on 130 shelves of similar sizes. The number of books on 15 shelves picked at random were found to be:

28, 23, 25, 33, 31, 18, 22, 29, 30, 22, 26, 20, 21, 28, 25

Estimate the total number of books in the library. 4marks