THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

SEPTEMBER –DECEMBER 2021

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

REGULAR PROGRAMME

MAT 364: DESIGN AND ANALYSIS OF SAMPLE SURVEY

Date: DECEMBER 2021	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any TWO Questions	

Q1.

a) Define the following terms **(3 Marks)**

   i) Sample survey
   ii) Estimator
   iii) Bias

b) State and explain the properties of a BEST estimator. **(7 Marks)**

c) State and describe the four types of non-sampling error. **(8 Marks)**

d) From a population of size 5, calculate the number of samples of size 2 that can be drawn using

   i) SRSWR.
   ii) SRSWOR. **(2 Marks)**

e) The depth Y of the roots of plants in a field is uniformly distributed between 5cm and 8cm with the probability density function $f(y)=\frac{1}{3}, \forall 7<y<10.$ Estimate the average length of roots of the plants with an accuracy of relative standard error of 2%. What is the required minimum with replacement sample size n? **(4 Marks)**

f) Suppose a population consists of $N=4$ units. The variable Y_i takes values $1,2,3,4$. Calculate:

i) The populations mean square error. **(3 Marks)**

ii) population variance **(3 Marks)**

Q2. The following data shows daily yield of two types of cows in litres per day.

S.No	Type	Yield
1	*A*	43
2	*B*	49
3	*A*	47
4	*A*	42
5	*B*	52
6	*A*	49
7	*A*	44
8	*B*	54
9	*A*	48
10	*A*	45
11	*A*	47
12	*A*	52
13	*B*	50
14	*A*	49
15	*B*	63
16	*A*	44
17	*A*	46
18	*B*	56
19	*A*	50
20	*A*	48
21	*B*	50

a) If we select a $SRSWOR$ sample of 4 units, find the variance of the estimator of population mean. **(8 Marks)**

b) If we stratify the population on the basis of type, and then select 2 units from each type, find the variance of the estimator of mean in stratified sampling. (Let type B take stratum 1 and type A take stratum2). **(12 Marks)**

Q3. Consider a population consisting of the following six units.

Unit	A	B	C	D	E	F
Value	718	912	1014	1113	1110	615

Consider the following sampling plan.

Sample number	samples	Probability
1	ACE	1/9
2	ACF	1/9
3	ADE	1/9
4	ADF	1/9
5	BCE	1/9
6	BCF	1/9
7	BDE	1/9
8	BDF	1/9
9	CDF	1/9

Use the above tables to compute the following.

a) $E(\overline{y}_t)$ **(16 Marks)**

b) $B(\overline{y}_t)$ **(2 Marks)**

c) $MSE(\overline{y}_t)$ **(2 Marks)**

Q4. An experienced farmer makes an eye estimate of the weight of peaches x_i on each tree in an orchard of $N=200$ trees with population mean $\overline{X}=58$. The peaches are picked and weighed on a simple random sample of 10 trees, with the following results:

Tree	1	2	3	4	5	6	7	8	9	10	Total
Actual wt, y_i	61	42	50	58	67	45	39	57	71	53	543
Est. wt, x_i	59	47	52	60	67	48	44	58	76	58	569

Apply the ratio method of estimation to estimate:

a) The average actual weight.` **(4 Marks)**

b) An estimator of the mean square error of the ratio estimator. **(13 Marks)**

c) Hence deduce the 95% confidence interval. **(3 Marks)**

Q5. A company selected a SRSWOR sample of six varieties of a product out of 70 varieties available in the market as shown below.

Variety	*A*	*B*	*C*	*D*	*E*	*F*
No. of items	855	940	90	46	20	16

a) Estimate the average number of items in each variety. **(3 Marks)**

b) Construct a 95% confidence interval for the average number of items in each variety. **(12 Marks)**

c) Estimate the total number of items in the market. **(2 Marks)**

d) Construct a 95% confidence interval for the total number of items in the market. **(3 Marks)**

END