LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **STATISTICS**

FIRST SEMESTER – **APRIL 2023**

PST1MC04 – SAMPLING THEORY

Date: 04-05-2023 Dept. No. Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

	SECTION A		
	Answer ALL the questions		
1	**Define the following:**	**(5 x 1 = 5)**	
a)	Probability sampling design for LSS.	K1	CO1
b)	Midzuno Sampling Design.	K1	CO1
c)	Desraj ordered estimator $\hat{Y}_{DR}$.	K1	CO1
d)	Inclusion Indicator.	K1	CO1
e)	Ratio estimator $\hat{Y}_{R}$.	K1	CO1
2	**Fill in the blanks.**	**(5 x 1 = 5)**	
a)	The Modified Systematic Sample of size n = 8 from a population of size N = 40 when r = 1 is _____.	K2	CO1
b)	The probability of selecting a linear systematic sample consisting of 3^{rd} and 4^{th} population units, when a sample of size n = 4 is taken from a population of size N = 12 is _____.	K2	CO1
c)	If 'T' is unbiased for 'θ', then Mean Square Error of 'T' reduces to _____.	K2	CO1
d)	For any sampling design P(·) , $E_P[n(s)]$ = _____	K2	CO1
e)	Warner's Randomized Response Technique was proposed in the year _____.	K2	CO1
	SECTION B		
	Answer any THREE of the following questions.	**(3 x 10 = 30)**	
3	Write the unit drawing mechanism for SRSWOR design. Show that this mechanism satisfies the SRSWOR design.	K3	CO2
4	Compare the efficiency of $\hat{Y}_{LSS}$ with that of $\hat{Y}_{SRS}$ when the population is linear.	K3	CO2
5	Why do we discard Hurwitz – Thompson estimator under PPSWOR scheme? Check whether or not Desraj ordered estimator is unbiased for population total.	K3	CO2
6	Illustrate that unbiasedness of a statistic depends on the design.	K3	CO2
7	Deduct the formula for $\hat{Y}_{HT}$ and V ($\hat{Y}_{HT}$) under SRSWOR Design.	K3	CO2
	SECTION C		
	Answer any TWO of the following questions.	**(2 x 12.5 = 25)**	
8	Deduct the formula for $\hat{Y}_{St}$, V ($\hat{Y}_{St}$) and v ($\hat{Y}_{St}$) under (i) SRSWOR and (ii) PPSWR designs.	K4	CO3
9	A simple random sample of size $n = n_1 + n_2$ with mean $\hat{\bar{Y}}$ is drawn from a finite population of size 'N' and a simple random subsample of size 'n_1' is drawn from it with mean $\hat{\bar{Y}}_1$. Obtain V ($\hat{\bar{Y}}_1$ - $\hat{\bar{Y}}_2$), where $\hat{\bar{Y}}_2$ is the mean of the remaining 'n_2' units in the sample.	K4	CO3

10	Prove that v ($\hat{Y}_{HT}$) ≥ 0 for all 's' receiving positive probabilities under Midzuno Sampling Design.	K4	CO3
11	In LSS, when the population is linear, derive Yates's corrected estimator for estimating population total without error.	K4	CO3
	SECTION D		
	Answer any ONE of the following question. **(1 x 15 = 15)**		
12	Describe in detail Simmons' unrelated randomized response technique for estimating population proportion $\prod_A$ when $\prod_Y$ is known.	K5	CO4
13	Describe the procedure of regression estimation and obtain the approximate bias and mean square error of $\hat{Y}_{LR}$.	K5	CO4
	SECTION E		
	Answer any ONE of the following question. **(1 x 20 = 20)**		
14	Derive the approximate bias and mean square error of the ratio estimator $\hat{Y}_R$ and deduct their expressions under (i) SRSWOR , (ii) PPSWR , and (iii) Midzuno Sampling designs.	K6	CO5
15	Derive the variance of (i) Hansen – Hurwitz estimator in double sampling (10) (ii) Estimator $\hat{Y}_{TS}$ in Two – Stage Sampling. (10)	K6	CO5

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