LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SECOND SEMESTER – **APRIL 2019**

16/17/18PST2MC03– SAMPLING THEORY

Date: 09-04-2019 Dept. No. Max. : 100 Marks

Time: 01:00-04:00

SECTION – A

Answer ALL questions. Each carries TWO marks. (10 x 2 = 20 marks)

1. What are the two types of Sampling Designs? Give an example for each type.
2. Compute $E[I_i(s)]$ and $E[I_i(s)I_j(s)]$; $i, j = 1, 2, \ldots, N$; $i \neq j$.for any sampling design $P(.)$.
3. Derive $\prod_i$ and $\prod_{ij}$ for Simple Random Sampling Design.
4. Define the Linear Systematic Sampling Design and explain its sampling scheme.
5. Explain Random Group Method of Sampling. Give the estimator for population total under this method.
6. Describe cumulative total method and show that it is a PPS selection method.
7. Show that the ratio estimator is a particular case of the regression estimator.
8. In Double Sampling, derive the approximate bias of the Ratio Estimator.
9. In Modified Systematic Sampling, write all possible samples of size 6 from a population of size 30.
10. Explain Multistage Sampling.

SECTION – B

Answer any FIVE questions. Each carries EIGHT marks. (5 x 8 = 40 marks)

11. Explain the unit drawing mechanism in Simple Random Sampling Design, and prove that this mechanism implements the design.
12. Establish the following for any fixed size sampling design:

(i) $\sum_{j=1}^{N} ®_{ij} = (n-1)\pi_i; \quad j \neq i$

and (ii) $\sum_{j=1}^{N} (®_i ®_j - ®_{ij}) = \pi_i(1-\pi_i); \quad i = 1,2,\ldots,N; \; j \neq i$.

13. Verify if $\hat{Y}_{LSS}$ is more efficient than $\hat{Y}_{SRS}$, when the population is linear.
14. In PPSWOR sampling scheme, give the reason for using Desraj ordered estimator instead ofHurwitz – Thompson estimator. Verify if Desraj ordered estimator is unbiased for populationtotal.

15. Prove that $v(\hat{Y}_{HT}) \geq 0$ for all 's' for which P(s) >0, under Midzuno Sampling Design.

16. In LSS, obtain Yates's corrected estimator for estimating population total without error when the population is linear.

17. Derive $v(\hat{Y}_{DR})$ for sample of any size "n".

18. Discuss in detail about Warner's randomized response technique for estimating the population proportion.

SECTION – C

Answer any TWO questions. Each carries TWENTY marks. (2 x 20 = 40 marks)

19 (a) Prove that unbiasedness of an estimator depends on the sampling design. **(10)**

(b) Define $\hat{Y}_{HT}$ under SRS Design and hence find V ($\hat{Y}_{HT}$). **(10)**

20 (a) Explain the regression estimation procedure and find the approximate bias and mean square error of $\hat{Y}_{LR}$. **(10)**

(b) Obtain the formula for $\hat{Y}_{St}$, V ($\hat{Y}_{St}$) and v ($\hat{Y}_{St}$) under the design (i) SRSWOR and (ii) PPSWR . **(10)**

21. Derive the approximate bias and mean square error of the ratio estimator $\hat{Y}_R$ andhence deduce their expressions under (i) SRSWOR , (ii) PPSWR , and (iii) Midzuno Sampling. **(20)**

22 (a) A simple random sample of size $n = n_1 + n_2$ with mean $\frac{\wedge}{Y}$ is drawn from a finite population of size N and a simple random subsample of size n_1 is drawn from it with mean $\frac{\wedge}{Y_1}$. Obtain V ($\frac{\wedge}{Y_1}$ - $\frac{\wedge}{Y_2}$) , where $\frac{\wedge}{Y_2}$ is the mean of the remaining n_2 units in the sample. **(10)** .

(b) Derive the variance of the following estimators:

(i) Hansen – Hurwitz estimator in double sampling,

(ii) Estimator $\hat{Y}_{TS}$ in Two – Stage Sampling. **(10)**

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