



Date: 20-06-2022

Dept. No.

Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

SECTION – A

Answer ALL Questions. Each carries TWO marks.

(10 x 2 = 20 Marks)

1. Distinguish between Population and Sample. What are the assumptions made about population size?
2. Define (i) parameter and (ii) statistic. Give an example for both.
3. Explain the two types of Probability Sampling Designs giving an example for each type.
4. Explain unbiasedness of a statistic under a given sampling design.
5. Explain first order and second order inclusion probabilities.
6. Show that $E_p [s_{xy}] = S_{xy}$, where $P(\cdot)$ is SRSWOR design.
7. Under Balanced Systematic Sampling, prove that the expansion estimator is equal to the population total when linear trend is present in the population.
8. List all possible Modified Systematic Samples when $n = 8$ and $N = 40$.
9. Show that regression estimator \hat{Y}_{LR} is more efficient than ratio estimator \hat{Y}_R for estimating population total unless $\beta = R$.
10. Explain the purpose of using stratified sampling.

SECTION – B

Answer any FIVE Questions. Each carries EIGHT marks.

(5 x 8 = 40 Marks)

11. Describe the unit drawing mechanism under simple random sampling design and establish that this mechanism implements the design.
12. Verify if Lahiri's method of selecting sample is a PPS selection method.
13. Compare the efficiency of \hat{Y}_{LSS} with that of \hat{Y}_{SRS} when the population is linear.
14. In LSS, when the population is linear, obtain Yates's corrected estimator for estimating population total without error.
15. Explain Warner's randomized response technique and obtain the estimate of Π_A .
16. For a sample of size $n = 2$, obtain the true variance of Desraj estimator \hat{Y}_{DR} .
17. In Centered Systematic Sampling, verify that the usual expansion estimator is unbiased for the population total when the population is linear.
18. Show that the ratio estimator \hat{Y}_R is not unbiased for Y and hence obtain its approximate Bias and Mean Square Error.

SECTION – C

Answer any TWO questions. Each carries TWENTY marks.

(2 x 20 = 40 Marks)

19. (a) Suppose from a sample of n units selected using SRS, a subsample of n' units is selected using SRS and added to the original sample. Derive the expected value and approximate sampling variance of $\hat{\frac{Y}{Y}}$, the sample mean based on $(n + n')$ units. For what value of the fraction n'/n , does the efficiency of $\hat{\frac{Y}{Y}}$ compared to that of $\hat{\frac{Y}{Y}}$ attains its maximum value? **(14)**
- (b) State the unit drawing mechanism for Midzuno Sampling Design and show that the mechanism implements the design. **(6)**
20. (a) In Midzuno sampling design, obtain the formula for Π_i and Π_{ij} . **(10)**
- (b) For any sample size n , find an unbiased estimator of the variance of Desraj estimator \hat{Y}_{DR} . **(10)**
21. (a) Describe Two Phase Sampling. Assuming samples are drawn using SRS in both the phases of sampling, suggest \hat{X} , \hat{Y} and \hat{X}_d when (i) the second phase sample is a sub-sample of the first phase sample. (ii) the second phase sample is independent of the first phase sample. Derive $V(\hat{X})$, $V(\hat{Y})$, $V(\hat{X}_d)$, $Cov(\hat{X}, \hat{Y})$, $Cov(\hat{X}, \hat{X}_d)$, and $Cov(\hat{Y}, \hat{X}_d)$ in the second case. **(12)**
- (b) Under Stratified Sampling, explain proportional allocation for a given cost. Deduce $V(\hat{Y}_{st})$ under proportional allocation assuming SRS is used in all the strata. **(8)**
22. Under PPSWR sampling, check that Hansen- Hurwitz estimator \hat{Y}_{HHE} is unbiased for Y . Derive $V(\hat{Y}_{HHE})$ and hence obtain its unbiased estimator. **(20)**

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