Date: 22-04-2016   Dept. No.   Max. : 100 Marks
Time: 01:00-04:00

SECTION - A

Answer all the questions.   **(10 X 2 = 20)**

1. Define Probability Sampling Design and what are the types of Sampling Designs?
2. Define Inclusion Indicator and find its mean.
3. Write the procedure to select a sample of size n in PPSWR using Cumulative Total Method.
4. Define Desraj Ordered Estimator.
5. Write an unbiased estimator for the population total Y under LSS. Verify whether it is unbiased.
6. Given the sample size n=8 and the population size N=40.   Write all possible samples under modified systematic sampling scheme.
7. Explain Ratio Estimation.
8. Describe the term Auxiliary Information.
9. What is meant by Non Response? Mention the types of Non-Response techniques.

10. Show that Ratio Estimator is a particular case of Regression Estimator if $\dfrac{s_{xy}}{s^2_x} = \dfrac{\hat{\overline{Y}}}{\hat{\overline{X}}}$

SECTION- B

Answer any five questions.   **(5 X 8 = 40)**

11. Show that under SRS,

$$v\left(\hat{\overline{Y}} SRS\right) = N^2 \frac{N-n}{Nn} \ \frac{1}{n-1}\sum_{i \in s}\left(Y_i - \hat{\overline{Y}}\right)^2 \text{ where } \hat{\overline{Y}} = \frac{1}{n}\sum_{i \in s}Y_i$$

12. Establish that Cumulative Total method and Lahiri's methods of sample selection are PPS selection methods.

13. Given $Y_1=4$, $Y_2=3$, $Y_3=5$, $Y_4=2$, $Y_5=7$, $\pi_1=\dfrac{1}{7}$, $\pi_2=\dfrac{4}{7}$, $\pi_3=\dfrac{6}{7}$, $\pi_4=\dfrac{6}{7}$, $\pi_5=\dfrac{3}{7}$

   Verify that $\hat{Y}_{HT}$ is unbiased for Y using
   i) the definition of Expectation
   ii) an expression involving Inclusion Indicator under the design

$$P(s) = \begin{cases} \frac{1}{7} & if \ s = \{1,3\} \\ \frac{3}{7} & if \ s = \{2,3,4\} \\ \frac{3}{7} & if \ s = \{3,4,5\} \end{cases}$$

14. Explain Random Group Method and Show that $\hat{Y}_{RG}$ is an Unbiased Estimator of Y.

15. Derive the formula for n_h under Proportional Allocation and obtain variance of $\hat{\bar{Y}}_{st}$ under proportional allocation.
16. Show that the sample mean in unbiased for population mean in Modified Systematic Sampling for linear population and show that its variance is zero.
17. Derive Hartley Ross Unbiased Ratio Type Estimator.

18. Explain in detail Warner's Model and find the estimated variance of $\hat{\pi}_A$

SECTION- C

Answer any two questions. $(2 \times 20 = 40)$

19 a) Derive the variance of Hurwitz Thompson Estimator and also write it in Yates Grundy form. **(12)**

19 b) Under a given sampling design, show that one can find more than one unbiased estimator for a given parameter. **(8)**

20. Find the first order and second order inclusion probability under Midzuno sampling Design and hence show that $V(\hat{\bar{Y}}_{HT})$ is nonnegative for all s receiving positive probability.

21a) For populations possessing linear trend, Prove that $V\left(\hat{\bar{Y}}_{LSS}\right) < V\left(\hat{\bar{Y}}_{SRS}\right)$ where $\hat{\bar{Y}}_{LSS}$ and

$\hat{\bar{Y}}_{SRS}$ are the conventional expansion estimators under LSS and SRS respectively. **(12)**

21 b) Find the approximate Bias and Mean Square Error of Regression Estimate of population total. **(8)**

22 a) Discuss about Double Sampling and find the Bias and Mean Square Error of $\hat{\bar{Y}}_{RD}$. **(10)**

22 b) Explain multistage sampling and find the variance of $\hat{\bar{Y}}_{Ts}$. **(10)**

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