LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – STATISTICS

THIRD SEMESTER – November 2009

ST 3504/ST 3502/ST 4500 - BASIC SAMPLING THEORY

Date & Time: 06/11/2009 / 9:00 - 12:00 Dept. No. | Max. : 100 Marks

PART - A

Answer ALL the Questions. (10 x 2 =20 marks)

1. **Define the term "*Unbiasedness*" of an estimator with respect to a sampling design.**
2. **Distinguish between "Statistic" and "Parameter" in the theory of finite population sampling.**
3. **Give the distribution of the random variable r_i which denotes the number of times the i^{th} population unit occurs when a simple random sample of size n is drawn from a population consisting of N units.**
4. **Find $V(y_i), i = 1,2,..,n$, where y_i is the value of the i^{th} drawn unit when a simple random sample of size n is drawn from a population consisting of N units.**
5. **Compute the probability of drawing 3rd population unit in a draw when a PPSWR sample is drawn from a population consisting of 5 units having sizes 3,5,1,3 and 5.**
6. **Examine the validity of the statement : "Sample mean is always unbiased for population mean in PPSWR"**
7. **What is meant by *Proportional allocation*?**
8. **Under what condition *Neyman allocation* reduces to *Equal allocation*?**
9. **Mention any two limitations of Linear Systematic Sampling.**
10. **Write down a sampling-estimating strategy in which population mean coincides with the sample mean in the presence of linear trend.**

PART - B

Answer any FIVE Questions. (5 x 8 =40 marks)

11. **Define: Mean Square Error of an estimator. Show that the variance of an estimator under a given sampling design never takes a value less than its mean square error.**
12. **Let $S = \{1,2,3\}$ Compute the expected values of the estimator $\hat{T} = \frac{N}{n(s)} \sum_{i \in s} Y_i$ under the sampling design**

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

and offer your comments.

13. **Derive $V(\bar{y})$ under simple random sampling with replacement.**
14. **Suggest an unbiased estimator for the population total under PPSWR and derive its variance.**
15. **Explain Cumulative total method of PPS selection and show that it is a *PPS* selection method.**

16. **Derive the formula for *Neyman allocation* in stratified random sampling and offer your comments on the derived formula**
17. **Explain Modified systematic sampling and derive the $V(\bar{y})$ under MSS assuming the population values possess linear trend**
18. **Derive the variance of sample mean under LSS in terms of S^2_{wsy}**

PART - C

Answer any TWO Questions. (2 x 20 =40 marks)

19. **Derive $V(\bar{y})$ under simple random sampling without replacement and obtain an unbiased estimator for the same.**

20. **With two strata, a sample would like to have $n_1 = n_2$ for administrative convenience instead of using the values given by the Neyman allocation. If V and V_{opt} denote the variances given by the $n_1 = n_2$ and the Neyman allocation then show that the fractional increase in variance, $\frac{V - V_{opt}}{V_{opt}} = \left[\frac{r-1}{r+1}\right]^2$ where $r = \frac{n_1}{n_2}$ as given by the Neyman allocation. Assume the strata sizes are large.**

21. **Show that for populations possessing linear trend, under the usual notations $V(\bar{y}_{st}) \leq V(\bar{y}_{sys}) \leq V(\bar{y}_{srs})$**

22. **Write short notes on the following**

(a) **Lahiri's method of PPS selection**

(b) **Centered Systematic Sampling**

(c) **Limitations of Census**

(d) **Optimum allocation**

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