# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – STATISTICS

THIRD SEMESTER – NOVEMBER 2007

**ST 3502 - BASIC SAMPLING THEORY**

**BB 21**

Date : 31/10/2007 Dept. No. Max. : 100 Marks

Time : 9:00 - 12:00

## PART – A

**Answer ALL the Questions:** **(10 x 2 = 20)**

1. Justify the need for sampling.
2. Distinguish between variance and mean square error.
3. Show that $s^2$ is an unbiased estimate of $S^2$.
4. Show that in SRSWOR, the probability of drawing a specified unit in r-th draw is equal to the probability of drawing in at the first draw.
5. Describe a simple procedure of selecting a sample with varying probability.
6. In PPS with replacement, show that the estimator of the population means is unbiased.
7. What are the advantages of stratified sampling scheme?
8. How would you decide on the choice of sample size for different strata?
9. Define systematic sampling.
10. Illustrate the practical utility of systematic sampling.

## PART - B

**Answer any FIVE Questions:** **(5 x 8 = 40)**

11. Explain the role and importance of sampling frame and sampling design in sampling methodology.
12. In a bank there are 10000 deposit accounts. A simple random sample of 36 accounts was drawn without replacement. If Y denotes the amount in a deposit account, with the following sample information: $\sum y_i = 900$ and $\sum y_i^2 = 25{,}335$, find an unbiased estimate of the average amount in a deposit account and its estimated percentage coefficient of variation.
13. Derive the variance of Hansen-Hurwitz estimator for population total.
14. Compare stratified sampling with simple random sampling without replacement in terms of precision.
15. Estimate the gain in precision due to stratification.
16. Show that sample mean in the case of systematic sample is an unbiased estimator and obtain its variance.
17. Explain circular systematic sampling. Illustrate the scheme for a given N and n.
18. Define balanced systematic sampling. Compare and contrast with the other schemes of systematic sampling.

## PART - C

**Answer any TWO Questions:** **(2 x 20 = 20)**

19. a) Describe Lahiri's method of selection and its merits over cumulative method.
    b) Define the concept of inclusion probability and suggest an estimator and obtain its variance.

20. a) Obtain the sample size under Neyman's allocation and optimal allocation under fixed cost and fixed variance.
    b) Show that $V(\bar{y})_{opt} \leq V(\bar{y})_N \leq (\bar{y})_p$, under fixed cost.

21. a) Compare the variances of the sample mean under systematic sample with stratified and simple random sampling assuming linear trend.
    b) Obtain the relative efficiency of systematic sample as compared to simple random sampling without replacement.

22. a) Show that in SRSWOR the probability of selecting n samples from N is $1/ {}^{N}C_{n}$.
    b) In CSS assuming linear trend prove that the sample mean coincides with population mean when k is odd and is unbiased for population mean when k is even.

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