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Sr. No. of Question Paper : 1149

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Your Roll No.....

Unique Paper Code : 237303

Name of the Paper : Survey Sampling (STHT-304)

Name of the Course : B.Sc. (H) Statistics

Semester : III

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt five questions in all, selecting three from Section A and two from Section B.

SECTION A

1. (a) Discuss the basic principles of sample survey. What are the main steps involved in a sample survey? What are the advantages of sample survey over census? Discuss briefly.

(b) A simple random sample of size $n = n_1 + n_2$ with mean \bar{y}_n is drawn from a finite population and a simple random subsample of size n_1 with mean \bar{y}_{n_1} is drawn from it. Show that :

$$(i) V(\bar{y}_{n_1} - \bar{y}_{n_2}) = \left(\frac{1}{n_1} + \frac{1}{n_2} \right) S^2$$

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$$(ii) \quad V(\bar{y}_{n_1} - \bar{y}_n) = \left(\frac{1}{n_1} + \frac{1}{n} \right) S^2$$

$$(iii) \quad \text{Cov}(\bar{y}_n, \bar{y}_{n_1} - \bar{y}_n) = 0$$

where \bar{y}_{n_2} is the mean of remaining n_2 units in the sample and S^2 is the population mean square. (8,7)

2. (a) Justify the statement :

“The efficiency of stratified sampling relative to simple random sampling without replacement depends on the allocation of the sample to the various strata.”

- (b) Explain the concept of post stratification. Prove that post stratification with large sample is almost as precise as stratified sampling with proportional allocation. (8,7)

3. (a) What is the guiding principle for the construction of strata ? Stating assumptions, obtain the optimal points of stratification with Neyman and proportional allocation.

- (b) The uniform distribution

$$f(y) = 1; 0 < y < 1$$

is divided into two strata at the point ‘a’. Find p_1 , p_2 , S_1^2 and S_2^2 where p_i is proportion and S_i^2 is the variance of the i^{th} stratum. (8,7)

4. (a) Define linear systematic and circular systematic sampling.

Show that a systematic sample has the same precision as the corresponding stratified sample with one unit per stratum if $\rho_{\text{wst}} = 0$, where ρ_{wst} is the correlation between the deviations from the stratum means of the pair of items that are in the same systematic sample.

- (b) What is meant by non-response in sample surveys? What are the effects of non-response on the estimates? Prove the statement "the estimates obtained from incomplete samples may be reasonable if response and non-response classes are alike". (8,7)

SECTION B

5. (a) Define Difference estimator and derive the linear regression estimator from it. Also obtain, to the first approximation, the bias and the standard error of linear regression estimator.
- (b) Define super-population and model unbiasedness. Stating clearly the underlying assumptions, show that for a super population model the ratio estimator is BLUE. Also derive the expression for minimum variance. (7,8)
6. (a) Determine the optimum size of cluster which will provide maximum precision for a given cost. Also show that the optimum size of cluster will be smaller if:
- (i) the cost of enumeration of an element increases,
 - (ii) the cost of travel between units decreases,
 - (iii) the cost of the survey is sufficiently large.
- (b) In two-stage sampling with equal first stage units, prove that sample mean is an unbiased estimator of population mean and obtain the estimated variance of sample mean. (8,7)
7. (a) In usual notations, prove that the mean of cluster means $\bar{\bar{y}}$ is an unbiased estimator of population mean with variance given as

$$V(\bar{\bar{y}}) = \frac{N-n}{N-1} \cdot \frac{\sigma^2}{nM} [1 + (M-1)\rho]$$

- (b) If y and x are unbiased estimators of the population totals Y and X respectively, then show that, if the correlation coefficient between $\frac{y}{x}$ and x is negligible then variance of the ratio estimator $\frac{y}{x}$ can be approximated by $C_y^2 - C_x^2$, where C_y and C_x are the coefficients of variation of y and x respectively. (9,6)