



M 15935

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STATISTICS

Paper – 2.2 : Sampling Theory

Time : 3 Hours

Max. Marks: 70

*Instructions : 1) Answer five questions without omitting any Unit.
2) All questions carry equal marks.*

UNIT – 1

- I. a) Show that the sample mean under simple random sampling with replacement is always less precise than sample mean in simple random sampling without replacement.
- b) Explain the terms : 1) Sampling fraction and 2) Finite population correction. Comment on the validity of the statement “Under SRSWOR, the probability of selection of a specified unit in the population at any draw is same as the probability of its selection at the first draw”.
- II. a) Distinguish between probability sampling and non-probability sampling. Discuss their relative advantages and disadvantages.
- b) Obtain the expression for co-variance between any two units in a sample selected by SRSWOR.
- c) A simple random sample of size 3 is drawn from a population of size 5 with replacement. What is the probability that all the units in the sample are distinct.

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UNIT - 2

- III. Explain the different allocations of sample size to different strata in stratified random sampling. With usual notations show that $V_{opt} \leq V_{prop} \leq V_{ran}$.
- IV. a) Show that the relative efficiency of systematic sampling with respect to stratified sampling depends on the values of the within stratum on-circular serial correlation coefficient.
- b) Explain the sampling procedures for populations with linear trend. Also distinguish between fixed population approach and super population approach in survey sampling.

UNIT - 3

- V. a) Obtain the sampling variance of the Horvitz-Thompson estimator of the population mean in PPSWOR sampling. Express the same in Yates-Grundy form.
- b) Distinguish between PPS and PPZ sampling. If a sample of n units is drawn under the PPZ scheme, suggest an unbiased estimator for the population total and evaluate its variance.
- VI. a) Write explanatory note on Midzuno scheme of sampling.
- b) What is the essential difference between an ordered and unordered estimator? Give an example of each and discuss their properties.

UNIT - 4

- VII. a) What is a regression estimator? When is it desirable? Show that the linear regression estimator has a bias of order $\frac{1}{n}$ in simple random sampling.
- b) Define best linear unbiased estimator. Write down the conditions under which the ratio estimator is a best linear unbiased estimator. Under what conditions the regression estimator reduces to the ratio estimator. Also discuss a practical situation in which ratio estimator is appropriate.



- VIII. a) Define ratio estimator of the population ratio R in SRSWOR. Obtain an approximate expression for the MSE of this estimator.
- b) With usual notations, if b is the least square estimate of B and $y_{lr} = \bar{y} + b(\bar{X} - \bar{x})$, obtain the approximate value of $V(y_{lr})$.

UNIT - 5

- IX. a) Suggest an estimator for the population mean under double sampling with stratification. Examine whether the estimator is unbiased and if so obtain the expression for variance.
- b) Distinguish between multistage and multiphase sampling. Also discuss ratio and regression methods in double sampling.
- X. What is cluster sampling? Explain a practical situation in which this sampling design is appropriate. How will you estimate the mean value of the characteristic under study, and the standard error of the estimator of the mean from a cluster sample. Also compare the efficiency of cluster sampling with a simple random sample of the same number of elementary units.