



RAN-2403081203033001

M.Sc. (Sem.-III) Examination October - 2025

Statistics : Sampling Theory-II (303)

Time: 3 Hours]

[Total Marks: 70

સૂચના : / Instructions

- (1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the above details on your answer book
- (2) Attempt all questions.
- (3) Each question carries 14 marks.
- (4) Answer any two out of the three bits given in each question.
- (5) Draw the figure and give example wherever necessary.

Seat No.:

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Student's Signature

- Q.1.** i. Discuss merits and demerits of different sampling techniques you have studied.
ii. In usual notations, show that the mean of a systematic sample is more efficient than the mean of a simple random sample if $S_w^2 > S^2$. State the main drawback of this sampling scheme.
iii. Discuss a comparison of systematic sampling with SRS and stratified random sampling under linear trend.
- Q.2.** i. Explain the rationale behind the use of auxiliary variable X, highly negatively correlated to the character under study Y. Construct the product estimator for population total based on a SRSWOR sample. Obtain its bias and variance of the proposed estimator.
ii. Define regression estimator with pre-assigned b_0 for finite population mean. Compare its efficiency with that of mean per unit estimator, after obtaining required expressions.
iii. Discuss the unbiased ratio estimator in detail.
- Q.3.** i. Why do we need two stage sampling? Explain the process to get a two stage sample with real life applications. Discuss estimation of the population mean under two stage sampling with unequal sized PSUs.
ii. Considering the simple cost function in two stage sampling with equal sized first stage units of equal size, obtain the optimum values of the first and second stage sample sizes.
iii. Discuss double sampling for ratio estimator in detail.
- Q.4.** i. Discuss the planning of a survey on “Evaluating Awareness of Climate Change Among Farmers of south Gujarat”.
ii. Discuss the planning of a survey on “Estimating Tourist Satisfaction in Heritage Site”.
iii. Discuss the planning of a survey on “Studying the Adoption of Solar Energy in Rural Households”.
- Q.5.** i. Discuss the justification for using varying probability of selection estimator for finite population total in surveys. Prove or give a counter example that if there is perfect correlation between Y and X then $V(\hat{Y}_P)_{PPSWR}$ will always be smaller than $V(\hat{Y})_{SRSWR}$.

- ii. If π_i and π_{ij} denote the inclusion probabilities when a sample of size n is selected with varying probabilities and without replacement from a population of size N , prove the following:

i.
$$\sum_{i=1}^N \pi_i = n$$

ii.
$$\sum_{i(\neq j)=1}^N \pi_{ij} = (n-1)\pi_j$$

iii.
$$\sum_{i(\neq j)=1}^N \sum_{j=1}^N \pi_{ij} = n(n-1)$$

- iii. Define Horvitz-Thompson (H-T). Obtain the expression of variance H-T estimator. State the unbiased estimator of this variance suggested by Horvitz-Thompson and discuss their limitations.
