TM241743Y

Reg. No :.....

Name :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, NOVEMBER 2024

2024 ADMISSIONS REGULAR

SEMESTER I - CORE COURSE Applied Statistics and Data Analytics

ST1C04TM - Sampling Theory

Time : 3 Hours **Maximum Weight : 30**

Part A

I. Answer any Eight questions. Each question carries 1 weight **(8x1=8)**

1. Distinguish between sampling and non-sampling errors.
2. Distinguish between random sampling and non-random sampling errors.
3. Show that sample proportion p is an unbiased and consistent estimate of population proportion in SRSWOR(N, n) scheme.
4. Define a population with a linear trend. How do you select a Systematic sample from such a population?
5. Explain the method for finding confidence interval for population mean and population total in stratified sampling.
6. Show that the ratio estimators are biased. Derive the expression for its bias term.
7. Distinguish between multistage and multiphase sampling.
8. Explain any method of selecting a PPS with replacement sample.
9. Explain Lahiri's method under PPS.
10. Explain Ordered Estimators.

Part B

II. Answer any Six questions. Each question carries 2 weight **(6x2=12)**

11. From a SRS of n units selected without replacement from a population of N units, Construct an unbiased estimate of the population proportion P of the units possessing certain characteristics. Derive the sample variance and the unbiased estimate of the variance of the estimate.
12. Distinguish between SRSWR and SRSWOR. Obtain an unbiased estimate of the sampling variance when the population mean is estimated based on SRSWR.
13. Determination of the sample size n when the population mean is estimated based on a stratified sample, where the sample is selected using neyman allocation.
14. Compare SRS and Systematic sampling.
15. Suggest a mean estimator $\bar{y}_{cl}'$ in the case of single stage cluster sampling with unequal cluster size. Find the variance of the mean estimator.
16. Show that in equal size cluster sampling the cluster sample mean is an unbiased and consistent estimator of the population mean.
17. Show that an unbiased estimate of $$V(\hat{Y}_{PPS}) = \frac{1}{n(n-1))}\sum_{i=1}^{n}\left(\frac{y_i}{p_i} - \hat{Y}_{PPS}\right)^2$$
18. The following table give the number of houses and the area under paddy in 12 villages in West Bengal. Draw a PPS with replacement sample of 4 villages using the number of houses as sizes.

Village No.	1	2	3	4	5	6	7	8	9	10	11	12
No. of houses	15	21	109	51	42	7	11	23	12	21	28	32

Part C

III. Answer any Two questions. Each question carries 5 weight **(2x5=10)**

19. (a) Explain estimating confidence interval for population mean and population total for SRS. (b) Explain the method of determining the sample size n for sampling proportion under SRSWOR(N, n) scheme.

20. What is the method of Stratification? Give some reasons and advantages of stratification. Discuss the problem of optimum allocation with respect to stratified random sampling.

21. Explain Cluster sampling. Show that $\bar{y}_{cl}$ is an unbiased estimate of population mean and

$$V(\bar{y}_{cl}) = \left(\frac{N-n}{Nn}\right)\frac{S^2}{M}\left[1+(M-1)\rho_c\right]$$

22. (a) Explain Harwitz- Thompson estimator, when it is used and its drawbacks.

(b) Show that in PPSWOR, $\hat{Y}_{H-T}$ is an unbiased estimate of the population total Y and its sampling variance is given by,

$$V\left(\hat{Y}_{H-T}\right) = \sum_{i=1}^{N}\left(\frac{1-\pi_i}{\pi_i}\right)y_i^2 + \sum_{i=1}^{N}\sum_{j=1 i\neq j}^{N}\left(\frac{\pi_{ij}-\pi_i\pi_j}{\pi_i\pi_j}\right)y_i y_j.$$