WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 3rd Semester Examination, 2021-22

STSACOR07T-STATISTICS (CC7)

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Answer any *four* questions from Question Nos. 1 to 6 and any *two* questions from Question Nos. 7 to 9

1. Discuss with examples the differences among the sampling schemes namely stratified sampling, cluster sampling and two stage sampling. 5

2. Explain why the variance of the sample mean, obtained from a single systematic sample, cannot be estimated unbiasedly. How can you overcome this problem? 3+2=5

3. Find the optimum allocation (i.e. the value of n_h) when we try to minimize $\text{Var}_{\text{WR}}(\bar{y}_{st})$ subject to the constraint $c = c_0 + \sum c_h n_h^3$, when the population units are drawn by SRSWR scheme, independently from each stratum. The symbols have their usual meanings and c_0 and c_h are known constants. 5

4. Discuss with an example under what conditions, ratio and regression estimators used to estimate the population mean. Find the approximate expressions of MSE of ratio estimator. 2+3=5

5. Find the mean and variance of the sample mean for two stage sample if the first stage units are drawn by SRSWR and second stage units are drawn by SRSWOR method. 5

6. Describe how do you determine the sample size for SRSWOR if you have an estimate of population variance along with given
   (a) Standard error $2\frac{1}{2}$
   (b) Coefficient of variation of sample mean. $2\frac{1}{2}$

7. Suppose $Y_i = Y(U_i) = 2 - 3i$ for all $i = 1, 2, ... , N$, with N is an exact multiple of the sample size n. Then prove that $\text{Var}_{\text{WOR}}(\bar{y}_{st}) : \text{Var}(\bar{y}_{sys}) : \text{Var}_{\text{WOR}}(\bar{y}) \approx 1 : n : n^2$, where the symbols have their usual meanings. 10

8. If there are two strata, φ is the ratio of the actual $\frac{n_1}{n_2}$ to the optimum $\frac{n_1}{n_2}$ for fixed sample size, show that, irrespective of the values of N_1, N_2, S_1 and S_2, the relative precision of the actual allocation to the optimum allocation is never less than $\frac{4\varphi}{(1+\varphi)^2}$. 10

9. Suppose the values of the study variable are all zero for qN of the population units $(0 < q < 1)$. Sometimes with the expenditure of effort, these units can be found, so that they need not be sampled. If σ^2 is the overall population variance and σ_0^2 the variance when all zero units are excluded, show that $p^2\sigma_0^2 = p\sigma^2 - q\bar{Y}^2$, where $\bar{Y}$ is the population mean and $p = 1 - q$. Further, if the population total is estimated by SRSWR of size n, then show that with the exclusion of the zero units, the fractional reduction in the variance of the estimator is $\frac{q(V^2+1)}{V^2}$ where $V = \frac{\sigma}{\bar{Y}}$ is the coefficient of variation in the original population. 7+3=10

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within* 1 *hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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