



**WEST BENGAL STATE UNIVERSITY**  
B.Sc. Honours 3rd Semester Examination, 2020, held in 2021

**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 No. 1 to 6 and any two questions from Question No. 7 to 9**

1. Discuss with examples the differences among the sampling schemes namely stratified sampling, cluster sampling and two stage sampling. 5
2. (a) Why do you need circular systematic sampling? 1+4  
(b) From a population of 8 units, draw all the possible samples of size 3 using circular systematic sampling method.
3. Find the optimum allocation (i.e., the value of  $n_h$ ) when we try to minimize  $Var_{WOR}(\bar{y}_{st})$  subject to the constraint  $c = c_0 + \sum c_h n_h^{1/3}$ , when the population units are drawn by SRSWOR scheme, independently from each stratum. The symbols have their usual meanings and  $c_0$  and  $c_h$  are known constants. 5
4. (a) Find the probability that the population unit  $U_4$  will occur but the two population units  $U_1$  and  $U_8$  will not occur in a sample of size 5 when the sample is drawn by SRSWOR from a population of size 50.  $2\frac{1}{2} + 2\frac{1}{2}$   
(b) Find the probability that the three population units  $U_1$ ,  $U_4$  and  $U_8$  will be included in a sample of size 5 when a sample is drawn by SRSWR from a population of size 50.
5. Find the mean and variance of the sample mean for two stage sample if the first stage units are drawn by SRSWOR and second stage units are drawn by SRSWR method. 5
6. For a stratified random sampling in which samples from different strata are drawn independently by SRSWR sampling scheme. Obtain an unbiased estimator of the overall population proportion  $P$  of an attribute  $A$  and also obtain an expression for the sampling variance of the proposed estimator. 5

7. Suppose  $Y_i = Y(U_i) = \alpha + \beta i$  for all  $i = 1, 2, \dots, N$ , with  $N$  is an exact multiple of the sample size  $n$ . Then prove that  $Var_{WOR}(\bar{y}_{st}) \leq Var(\bar{y}_{sys}) \leq Var_{WOR}(\bar{y})$ , where the symbols have their usual meanings. 10
8. A simple random sample of size  $n = n_1 + n_2$  is drawn without replacement from a finite population of size  $N$  with population variance  $\frac{(N-1)S^2}{N}$ . Further a second simple random sample of size  $n_1$  is drawn without replacement from the first sample. Let  $\bar{y}_1$  be the sample mean of the second sample and  $\bar{y}_2$  be the mean of the remaining  $n_2$  units in the first sample. Show that  $Cov(\bar{y}_1, \bar{y}_2) = -\frac{S^2}{N}$ . 10
9. (a) Discuss with an example under what conditions is a ratio estimator used to estimate the population mean. 3+5+2  
 (b) Find the bias of the ratio estimator relative to its standard error.  
 (c) Give an upper bound of the expression obtained in (b).

**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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