



K24N 0003

Reg. No. : .....

Name : .....

II Semester M.Sc. Degree (CBSS – Regular) Examination, April 2023  
(2022 Admission)

STATISTICS WITH DATA ANALYTICS  
MST2C07 : Sampling and Design of Experiments

Time : 3 Hours

Max. Marks : 80

PART – A

Answer **all** questions, **each** question carries **2** marks.

(8×2=16)

1. Distinguish between probability sampling and non-probability sampling.
2. What is simple random sampling with replacement ?
3. What is ratio method ?
4. Define multistage sampling.
5. Explain the procedure of constructing an LSD.
6. What is a standard Gauss Markoff set up ?
7. Define incidence matrix.
8. What is an PBIBD ?

PART – B

Answer **any four** questions. **Each** question carries **4** marks.

(4×4=16)

9. Show that in simple random sampling the probability of a specified unit being drawn at any draw is equal to the probability of drawing it at the first draw.
10. How are clusters to be formed for single stage cluster sampling ? Explain.
11. Distinguish between design with random effects model and fixed effects model.

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12. Write down the step involved in Yates procedure.
13. Distinguish between sampling design and sampling strategy.
14. Prove that for a BIBD with parameters  $v, b, k, r, \lambda$ ,  $vr = bk$ .

PART – C

Answer **any four** questions. **Each** question carries **12** marks.

**(4×12=48)**

15. a) Explain stratified random sampling. Under what conditions will stratified random sampling more efficient than SRS ? Briefly discuss the different allocations of sample size to different strata.  
b) For cluster sampling with equal size clusters obtain its efficiency with respect to SRSWOR using intra-class correlation coefficient. Discuss the situations when you would prefer cluster sampling to SRSWOR.
  16. a) Derive the approximate bias and MSE of ratio estimator. How do you make an ratio estimator unbiased.  
b) What is a difference estimator ? Find its mean and variance.
  17. a) Obtain the least square estimate of the vector parameters in the linear model.  
b) For the linear model  $y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$ ,  $i = 1, 2, 3$ ,  $j = 1, 2, 3, 4, 5$ . Examine whether  $\alpha_1 + \alpha_2 - 2\alpha_3$  is estimable.
  18. a) What is an BIBD ? Prove that a resolvable BIBD with parameters  $v, b, k, r, \lambda$  holds  $b \geq v + r - k$ .  
b) When a BIBD becomes resolvable ? Prove that a resolvable BIBD with parameters  $v, b, k, r, \lambda$  holds  $b \geq v + r - 1$ .
  19. a) Derive the MSE for ratio estimator and regression estimator and compare these estimators.  
b) Derive the variance of unbiased estimator of population mean under SRSWOR and prove that sample mean square is an unbiased estimator of population mean square.
  20. a) Explain random effects one-way model by stating the assumptions. Estimate the variance of the treatment error.  
b) Use the analysis of covariance technique in an RBD to estimate a missing value of an RBD.
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