

7. In two stage sampling with simple random sampling without replacement(SRSWOR) at both stage, an unbiased estimator of Y is

$$\hat{y} = \frac{N}{n} \sum_{i=1}^n \frac{M_i}{m_i} \sum_{j=1}^{m_i} y_{ij} = \frac{N}{n} \sum_{i=1}^n M_i \bar{Y}_i$$

Also derive the variance of the above estimator.

8. In simple random sampling without replacement (N, n), show that the bias of the ratio estimator $\hat{R}$ is approximately equal to:

$$B(\hat{R}) \sim \frac{1-f}{n \bar{X}^2} (RS_x^2 - \rho S_y S_x) = Rcv(\bar{X})[cv(\bar{X}) - \rho cv(\bar{Y})].$$

9. State the mathematical model with the hypothesis to be tested in a two way ANOVA and prepare ANOVA table.
10. Carry out the statistical analysis if $m \times m$ Latin Square Design (LSD) with one observation per cell.
11. Explain the terms – experimental units, treatments, blocking in design of experiment.
12. Introduce Randomized Complete Block Design (RCBD). Prepare an Analysis of Variance (ANOVA) table for RCBD.
13. The following is partially completed ANOVA table.

Source of Variation	Sum of squares	Degree of freedom	Mean square	F
Treatments	901.9	5		
Blocks	219.43	3		
Error	229.63	-		
Total	1350.25	23		

Complete the ANOVA table and answer the followings.

What design was employed? How many treatments were compared? What about the total number of observations? At 5% level of significance, can we conclude that the treatments have different effects? Are the blocks homogeneous? Explain.