

Roll No. ....

Total Pages : 03

**CMDQ/D-23**

**6521**

**SAMPLING THEORY**

**ST-301**

Time : Three Hours]

[Maximum Marks : 75

**Note :** Attempt *Five* questions in all, selecting at least *one* question from each Unit. Q. No. **1** is compulsory. All questions carry equal marks.

**Compulsory Question**

1. Answer the following :
  - (a) Differentiate between simple random sampling with replacement and without replacement. **2**
  - (b) What is finite population correction and sampling fraction ? **2**
  - (c) Write a short note on proportional allocation in stratified sampling. **2**
  - (d) Differentiate between difference estimator and regression estimator. **2**
  - (e) In what situations the cluster sampling be preferred ? **2**
  - (f) Give the idea of sampling with probability proportional to size. **2**

- (g) Describe double sampling for ratio estimate in nutshell. **3**

### Unit I

2. Derive the unbiased estimates of the population mean and its variance based on simple random sampling (i) without replacement (ii) with replacement from a finite population.
3. Explain stratified random sampling with proportional allocation and optimum allocations and obtain their variances. Show that under certain conditions,  $V_{\text{opt}} \leq V_{\text{prop}} \leq V_{\text{ran}}$ .

### Unit II

4. Explain separate and combined ratio estimates of population total and obtain their variances. Also compare their variances.
5. Find  $\text{Var}(\bar{y}_{lr})$  when  $b$  is the least squares estimate of  $B$  and  $\bar{y}_{lr} = \bar{y} + b(\bar{X} - \bar{x})$ . Also compare  $\text{Var}(\bar{y}_{lr})$  with ratio estimate and mean per unit.

### Unit III

6. (a) What is systematic sampling ? Show that in systematic sampling, positive correlation between units in the samples inflates the variance of the mean of a systematic sample.

- (b) Prove that the mean of systematic sample is more precise than the mean of a simple random sample taken without replacement if and only if  $S_{w, sy}^2 > S^2$ .

7. (a) Describe Jessen's cost function.  
(b) Derive the unbiased estimate of the population mean and its variance based on double sampling for stratification.

### Unit IV

8. (a) Derive the Horwitz-Thompson unbiased estimator of population total and its variance.  
(b) If a sample of  $n$  units is drawn with probability proportional to  $z_i$  with replacement, derive an unbiased sample estimate of  $V(\hat{Y}_{ppz})$  for any  $n > 1$ .
9. Discuss in detail the following :  
(i) Two-stage sampling  
(ii) Repetitive surveys.