

[This question paper contains 4 printed pages.]

1425

Your Roll No. ....

**B.Sc. (Hons.) / II**

**A**

**STATISTICS – Paper XV**

**(Sampling Theory and Methods)**

**(Admissions of 1999 and onwards)**

*Time : 2 Hours*

*Maximum Marks : 38*

*(Write your Roll No. on the top immediately  
on receipt of this question paper.)*

*Attempt **Four** questions in all,  
selecting **two** questions from each Section.*

**SECTION I**

1. (a) Discuss briefly principal steps in planning of sample surveys.
- (b) In a population of  $N$  units, the number of units possessing a certain attribute is  $A$  and, in a simple random sample of size  $n$  from it, the number of units possessing that attribute is  $a$ . If  $P = \frac{A}{N}$  and  $p = \frac{a}{n}$ , show that

$$V(p) = \frac{N-n}{N-1} \frac{P(1-P)}{n}$$

P.T.O.

and an unbiased estimator of  $V(p)$  is

$$\frac{N-n}{n-1} \frac{p(1-p)}{N}$$

- (c) Obtain an unbiased estimator of population mean along with its sampling variance for pps sampling with replacement. (3,3½,3)
2. What is the guiding principle for the construction of strata? Obtain the optimal points of stratification with Neyman and proportional allocations assuming that the characteristic under study has a continuous distribution. Also present the  $\text{Cum} \sqrt{f}$  rule given by Dalenius and Hodges to obtain these optimal points. (9½)
3. (a) Explain the concept of non-response. Describe Hansen and Hurwitz technique to deal with the problem of incomplete samples in mail surveys. Obtain the variance of the estimator of the population mean for it.
- (b) State the practical difficulties in adopting the Neyman method of allocation of a sample to different strata. How much would be the increase in the variance, on the average, if the allocation is based on the estimates of strata mean squares? (4½,5)

## SECTION II

4. (a) Describe systematic and circular systematic sampling procedures. Prove that the systematic sampling is more efficient than srswor if the variability within a particular systematic sample is more than the variability in the population.
- (b) Compare regression estimator with ratio estimator and simple random sample mean. (5½,4)
5. (a) If  $y$  and  $x$  are unbiased estimates of the population totals of  $Y$  and  $X$ , show that the variance of the ratio estimate  $y/x$  can be approximated by  $c_y^2 - c_x^2$ , where  $c_x$  and  $c_y$  are the coefficients of variation of  $x$  and  $y$  respectively. (The correlation coefficient between  $y/x$  and  $x$  is assumed to be negligible.)
- (b) Define double-sampling. If  $\bar{y}_{erd}$  denotes the regression estimator of population mean in double sampling then obtain  $E(\bar{y}_{erd})$  and  $V(\bar{y}_{erd})$ . Also, show that

$$V(\bar{y}_{er}) \leq V(\bar{y}_{erd}) \leq V(\bar{y}_n)$$

where  $\bar{y}_{er}$  is the regression estimator of population mean and  $\bar{y}_n$  is sample mean in srswor.

(3,6½)

P.T.O.

6. (a) Show that :

- (i) Efficiency of cluster sampling increases as mean square within clusters increases.
- (ii) If the clusters are formed of random samples of elements of population, they will on an average, be as efficient as the individual elements themselves.

(b) Obtain the optimum allocation of the sample in two-stage sampling when the cost function is defined as :

$$C = c_1n + c_2nm$$

the notations have their usual meaning. (6,3½)