**2022**

( May/June )

# STATISTICS

( Honours )

**( Survey Sampling and Non-Parametric Inference )**

[ STEH–62 (TH) ]

*Marks* : 56

*Time* : 3 hours

*The figures in the margin indicate full marks for the questions*

Answer **five** questions, selecting **one** from each Unit

## UNIT—I

**1.** *(a)* What is ratio estimation? If variates $y_i$, $x_i$ are measured on each unit of a simple random sample of size $n$, assumed large, then show that the variance of $\hat{R} = \frac{\bar{y}}{\bar{x}}$ is approximately

$$\text{Var}(\hat{R}) = \frac{1-f}{n\bar{X}^2} \frac{\sum_{i=1}^{N}(y_i - Rx_i)^2}{N-1}$$

where $R = \frac{\bar{Y}}{\bar{X}}$ is the ratio of the population mean and $f = \frac{n}{N}$ is the sampling fraction. 2+6=8

*(b)* Mention the advantages and disadvantages of systematic sampling. 4

**2.** *(a)* Write a note on regression method of estimation. 4

*(b)* In SRS, in which $b_0$ is pre-assigned constant, the linear regression estimate

$$\bar{y}_{lr} = \bar{y} + b_0(\bar{X} - \bar{x})$$

is unbiased with variance, prove that

$$\text{Var}(\bar{y}_{lr}) = \frac{1-f}{n} \frac{\Sigma[(y_i - \bar{Y}) - b_0(x_i - \bar{X})]^2}{N-1}$$ 8

UNIT—II

**3.** *(a)* What are the advantages of cluster sampling? 4

*(b)* If $n$ clusters are selected from $N$ clusters by simple random sampling without replacement, then prove that $\bar{y}_c$ is an



( Continued )



unbiased estimator of $\bar{Y}$ with variance

$$V(\bar{y}_c) = \frac{1-f}{n} S_b^2 \approx \frac{1-f}{nM} S^2[1 + (M-1)\rho]$$

where $\rho$ is the intra-class correlation coefficient of observations and $M$ is cluster size. 7

**4.** *(a)* Explain the process of drawing a cluster sample. 4

*(b)* For a single-stage cluster sampling with equal size cluster, under SRSWR, obtain the estimate of total population along with its variance. 7

UNIT—III

**5.** *(a)* What are the advantages of using two-stage sampling? 3

*(b)* In two-stage sampling, if $n$ units are selected from $N$ primary units and from each selected primary unit, if $m$ units are selected from $M$ secondary units by SRSWOR scheme, then show that sample mean $\bar{y}$ is an unbiased estimator of $\bar{Y}$ and the variance of this estimator is

$$V(\bar{y}) = \frac{1-f}{n} S_b^2 + \frac{M-m}{M} \frac{S_w^2}{nm}$$ 8



( Turn Over )

**6.** *(a)* Illustrate briefly the process of drawing a two-stage sample with a suitable example. 4

*(b)* Obtain the unbiased estimator of $V(\overline{y})$ as given in Question no. **5** (b). 7

UNIT—IV

**7.** Obtain the expression for joint p.d.f. of two-order statistics and hence obtain the distribution of range. 11

**8.** *(a)* What do you mean by order statistics? 4

*(b)* Obtain the distribution of $r$ th order statistics from uniform distribution. 7

UNIT—V

**9.** *(a)* Differentiate between parametric and non-parametric approaches to theory of statistical inference. 5

*(b)* Write a note on median test. 6

**10.** *(a)* Write a note on one sample Kolmogorov-Smirnov test. 5

*(b)* Write a note on Mann-Whitney test. 6

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