3 (Sem–3/CBCS) STA HC 2

2023

STATISTICS

(Honours Core)

Paper : STA–HC–3026

(Survey Sampling and Indian Official Statistics)

Full Marks : 60

Time : Three hours

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

1. Answer the following questions as directed : $1 \times 7 = 7$

(a) The number of possible samples of size n out of N population size in SRSWOR is equal to

(i) ${}^{N}C_{n}$

(ii) N^{n}

(iii) $\frac{(N-n)}{N}$

(iv) n/N

(Choose the correct answer)

(b) A selection procedure of sampling having no involvement of probability is known as _____. *(Fill in the blank)*

(c) Sub sampling is also known as two stage sampling. *(True **or** False)*

(d) The sampling procedure where the probability of selection is proportional to the size of the unit is known as

(i) simple random sampling with replacement

(ii) probability proportional to size sampling

(iii) stratified sampling

(iv) None of the above

(Choose the correct option)

(e) A complete list of units which represents the population to be covered is called the _____. *(Fill in the blank)*

(f) Inverse of sampling fraction is called _____ factor. *(Fill in the blank)*

(g) State the condition under which the regression estimator reduces to the ratio estimator.

2. Answer the following questions briefly : 2×4=8

(a) Name the *three* principles of sampling theory.

(b) Define accuracy and precision.

(c) In what situations the P.P.S sampling is prefered over simple random sampling.

(d) A population of eight households, say a, b, c, d, e, f, g and h, write down all possible samples of size 3 according to the technique of circular systematic sample.

3. Answer ***any three*** from the following questions : 5×3=15

(a) Prove that in stratified random sampling, the $\bar{y}_{st}$ is an unbiased estimate of population mean. Also find its variance.

(b) Explain the concept of linear and circular systematic sampling.

(c) Explain the cumulative total methods and the Lahiri's method of selecting a probability proportional to size (PPS) sample with replacement.

(d) What are the different sources of errors in a sample survey ? How can these errors be controlled ?

(e) Write a note on origin and function of central statistical organisation (CSO) and its publications.

4. Answer ***either*** *(a)* ***or*** *(b)* of the following questions :

(a) In a stratified random sampling with cost function $C = a + \sum_{i=1}^{k} n_i C_i$ where the overhead cost a is a constant and C_i is the average cost of sampling one unit in the ith stratum.

Prove that $n_i = \dfrac{nN_i S_i/\sqrt{C_i}}{\sum_{i=1}^{k}\left(N_i S_i/\sqrt{C_i}\right)}$

From the above relation state the condition under which a larger sample needs to be taken. 7+3=10

(b) Discuss regression method of estimation. Show that simple regression estimate is a biased estimate of population mean $\bar{Y}_N$. Obtain the variance of the simple regression estimate. 10

5. Answer **either** *(a)* **or** *(b)* :

(a) Show that in a simple random sampling without replacement of n clusters containing M elements from a population of N clusters, the sample mean $\bar{y}_n$ is an unbiased estimator of $\bar{Y}$ and its varience is given by

$V(\bar{y}_n) \cong \frac{(1-f)}{nM} S^2[1+(M-1)e]$ for large N where ρ is the intracluster correlation co-efficient. 3+7=10

(b) Find an unbiased estimate of the population mean in systematic sampling.

If the population consists of a linear trend of the form

$Y_i = a + b_i,\ i = 1, 2, ..., N,\ N = nk$

then prove that

$V(\bar{y}_{st}) \leq V(\bar{y}_{sys}) \leq V(\bar{y}_n)_R$

(symbols have their usual meanings) 2+8=10

6. Answer **either** *(a)* **or** *(b)* :

(a) Describe the methods of collection of official statistics in India. In this context discuss the role of Ministry of Statistics and program implementation. 6+4=10

(b) Explain the principal steps involved in the planning and execution of a sample survey. 10