

2019

STATISTICS

(Major)

Paper : 5.2

(Sample Survey)

Full Marks : 60

Time : 3 hours

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

1. Fill in the blanks/Write true or false/Choose the correct option (No reasoning is necessary) : 1×7=7
- (a) A relative measure of bias is ____.
- (b) Precision of an estimator is inversely proportional to its ____.
- (c) A complete list of sampling units which represents the population to be covered is called the ____.
- (d) The sample mean square is not an unbiased estimator of the population mean square in simple random sampling.

- (e) The ratio estimators of the population ratio $R_N = Y/X$, the total Y and the mean \bar{Y}_N are respectively defined as $R_n = \bar{y}_n / \bar{x}_n$, $\hat{Y}_R = R_n X$ and $\bar{Y}_R = R_n \bar{X}_N$.
- (f) Sub-sampling is also known as two-stage sampling.
- (g) Sampling fraction is
- $\frac{n}{N}$
 - $1 - \frac{n}{N}$
 - $1 + \frac{n}{N}$

2. Answer the following questions in brief : 2×4=8

- (a) Mention the important random sampling number series along with the different tests for randomness generally applied to these series.
- (b) What is the basic difference between simple random sampling and p.p.s. sampling procedures?

- (c) Distinguish between two-stage sampling and stratified random sampling.
- (d) Suppose in a population $N=11$; sample size is $n=4$. Taking $k=3$, write all possible samples using a systematic sampling procedure.

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

- (a) Write a note on sampling and non-sampling errors in a sample survey.
- (b) Give at least two different forms of definitions of simple random sampling without replacement.
- (c) Describe a systematic sampling procedure when the population size (N) is an integral multiple of the sample size (n).
- (d) What are the methods of selecting a p.p.s. sample with replacement? Explain them clearly.

(4)

(e) Discuss cluster sampling procedure with example.

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

(a) (i) What are the advantages of sample survey over complete census?

5

Or

Obtain the best linear unbiased estimator of population mean in simple random sampling.

(ii) Prove that in stratified random sampling for fixed total size of the sample (n), $\text{var}(\bar{y}_{st})$ is minimum if

$$n_i \propto N_i S_i$$

(Symbols have their usual meanings.)

5

(b) Describe the two-stage sampling procedure. For a two-stage sampling, where first-stage units are of equal size, obtain the variance of the estimator of the population mean.

4+6=10

(5)

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

(a) Find the unbiased estimate of the population mean in linear systematic sampling. If ρ is the intraclass correlation coefficient between the units of the same systematic sample, show that

$$\text{var}(\bar{y}_{sys}) = \frac{nk-1}{nk} \{1 + (n-1)\rho\} \frac{S^2}{n}$$

What is the minimum value of ρ ?

$$4+5+1=10$$

(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.

$$2+4+4=10$$

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

(a) Discuss stratified random sampling procedure. Show that

$$\text{var}(\bar{y}_n)_R \geq \text{var}(\bar{y}_{st})_{prop} \geq \text{var}(\bar{y}_{st})_{Ney}$$

$$4+6=10$$

(b) In simple random sampling without replacement of n clusters each containing M number of elements from a population of N clusters, show that the sample mean \bar{y}_{no} is an unbiased estimate of population mean \bar{y}_{oo} and its variance is

$$\text{var}(\bar{y}_{no}) = \frac{1-f}{n} S_b^2$$

(Symbols have their usual meanings.)

Also compare the efficiency of cluster sampling with that of simple random sampling without replacement. 5+5=10
