## 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) :  $1\times7=7$

   *(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 sumpling.

( *Turn Over* )

(e) The ratio estimators of the population ratio $R_N = Y/X$, the total $Y$ and the mean $\overline{Y}_N$ are respectively defined as $R_n = \overline{y}_n / \overline{x}_n$, $\hat{Y}_R = R_n X$ and $\overline{Y}_R = R_n \overline{X}_N$.

(f) Sub-sampling is also known as two-stage sampling.

(g) Sampling fraction is

(i) $\dfrac{n}{N}$

(ii) $1 - \dfrac{n}{N}$

(iii) $1 + \dfrac{n}{N}$

2. Answer the following questions in brief :

$$2 \times 4 = 8$$

(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?

( Continued )

(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 :

$$5 \times 3 = 15$$

(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.

( Turn Over )

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

   (a) Find the unbiased estimate of the population mean in linear systematic sampling. If $\rho$ 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 $\rho$ ?
   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
   $$\text{var}(\bar{y}_n)_R \geq \text{var}(\bar{y}_{st})_{\text{prop}} \geq \text{var}(\bar{y}_{st})_{\text{Ney}}$$
   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

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

(Symbols have their usual meanings.)

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

★ ★ ★