( Old Course )

Full Marks : 50
Pass Marks : 20

Time : 2 hours

1. Choose the correct answer of each question from given alternatives :  1×5=5

(a) The number of possible samples of size $n$ from a population of $N$ units with replacement is

(i) $N!$

(ii) $\binom{N}{n}$

(iii) $N^n$

(iv) $n^2$

(b) Sampling fraction is considered to be negligible, if it is

(i) $\leq 10\%$

(ii) $\leq 5\%$

(iii) $> 5\%$

(iv) $> 10\%$

(c) Regarding the number of strata, which statement is true?

(i) Lesser the number of strata, better it is.

(ii) More the number of strata, worse it is.

(iii) More the number of strata, better it is.

(iv) None of the above

(d) Which of the following advantages of systematic sampling do you approve?

(i) Easy selection of sample

(ii) Economical

(iii) Spread of sample over the whole population

(iv) All of the above

(e) Under proportional allocation, the size of the sample from each stratum depends on

(i) total sample size

(ii) size of the stratum

(iii) population size

(iv) All of the above

2. Answer the following questions in brief :  2×5=10

(a) What are non-sampling errors?

(b) What do you mean by sampling frame?

(c) What is the key feature of simple random sampling?

(d) Explain circular systematic sampling.

(e) What is the role of NSO in India? Explain briefly.

3. (a) Discuss briefly the main steps involved in a sample survey. Enumerate the advantages of a sample survey over complete enumeration. 5+5=10

*Or*

(b) What are the different sources of errors in sample survey? Describe the measures to be taken in controlling these errors. Elucidate judgement sampling and probability sampling. 3+4+3=10

4. (a) (i) What do you mean by simple random sampling with replacement and without replacement from a finite population?

(ii) Show that in SRSWOR, the sample mean is an unbiased estimator of the population mean, i.e., $E(\bar{y}_n) = \bar{Y}_N$.

(iii) Show that in SRSWOR, the variance of the sample mean is given by

$$\text{var}(\bar{y}_n) = \frac{S^2}{n}\frac{N-n}{N} \qquad 4+3+3=10$$

*Or*

(b) (i) What do you mean by simple random sampling of attributes?

(ii) In a population of $N$ units, the number of units possessing a certain characteristic is $A$, and in a simple random sample of size $n$ from it, the number of units possessing that characteristic is $a$.

*( Continued )*

If $P = \dfrac{A}{N}$, $p = \dfrac{a}{n}$, $Q = 1 - P$ and $q = 1 - p$, then show that $p$ is an unbiased estimator of population proportion $P$ and $\text{var}(p) = \dfrac{N-n}{N-1}\dfrac{PQ}{n}$. 3+3+4=10

*Or*

(c) Describe the procedure of stratified random sampling. Under what conditions is stratified random sampling preferred over simple random sampling and why? Prove that $\text{var}(\bar{y}_{st})$ is minimum for fixed total size of the sample $(n)$ if $n_i \propto N_i S_i$. 2+3+5=10

5. (a) What do you mean by ratio estimator? Obtain the bias of the ratio estimator $\hat{R}$ in simple random sampling. Show that the fixed approximation to the relative bias of the ratio estimator in simple random sampling without replacement is given by

$$\frac{B(\hat{R})}{R} \equiv \frac{(1-f)}{n}(C_x^2 - \rho C_x C_y)$$

where $C_x = \dfrac{S_x}{\bar{X}}$ and $C_y = \dfrac{S_y}{\bar{Y}}$ are the coefficients of variation of $x$ and $y$ respectively. 2+2+5=9

*( Turn Over )*

*Or*

(b) What is cluster sampling? In what situation is the cluster sampling preferred? Show that in simple random sampling without replacement of $n$ clusters each containing $M$ elements from a population of $N$ clusters, the sample mean $\bar{y}_n$ is an unbiased estimator of $\bar{y}$ and its variance is given by

$$\text{var}(\bar{y}_n) \cong \left(\frac{1-f}{n}\right) S_M^2 \{1 + (M-1)\rho\}$$

where $\rho$ is the intracluster correlation coefficient. 2+2+5=9

6. (a) Discuss the role and importance of official statistics in India, highlighting their use in economic planning and policy-making. Mention two examples of official statistics collected in India. 6

*Or*

(b) Describe in brief the functions of the Central Statistical Organization and name at least five of its publications. 6

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