## 5 SEM TDC STS M 3 (N/O)

## 2 0 1 9

( November )

## STATISTICS

( Major )

Course : 503

### ( Sample Survey )

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

( New Course )

Full Marks : 80
Pass Marks : 24

*Time* : 3 hours

1. Select the correct one out of the given
   alternatives :  1×8=8

   (a) A selection procedure of a sample
   having no involvement of probability is
   known as

   (i) purposive sampling

   (ii) judgement sampling

   (iii) subjective sampling

   (iv) All of the above

*( Turn Over )*

(b) The errors in a survey other than sampling errors are called

   (i) formula errors

   (ii) planning errors

   (iii) non-sampling errors

   (iv) None of the above

(c) The number of possible samples of size $n$ out of $N$ population units without replacement is

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

   (ii) $n^2$

   (iii) $(N)_n$

   (iv) $n!$

(d) The standard error of the sample mean from a random sampling with replacement is

   (i) $\left( \sqrt{\dfrac{N-n}{N-1}} \cdot \dfrac{\sigma}{\sqrt{n}} \right)$

   (ii) $\dfrac{\sigma}{\sqrt{2n}}$

   (iii) $\dfrac{\sigma}{\sqrt{n}}$

   (iv) None of the above

(e) Under proportional allocation in stratified sampling, the sample from each stratum is

   (i) proportional to stratum size

   (ii) of same size from each stratum

   (iii) in proportion to the per unit cost of survey of the stratum

   (iv) All of the above

(f) Which of the following statements does not hold good in case of stratified sampling?

   (i) Stratified sampling is convenient

   (ii) It reduces error for fixed cost

   (iii) Stratified sampling is always good

   (iv) It enables to gather information about different stratum separately

(g) If the number of population units $N$ is an integral multiple of sample size $n$, the systematic sampling is called

   (i) linear systematic sampling

   (ii) circular systematic sampling

   (iii) random systematic sampling

   (iv) All of the above

          *( Turn Over )*

(h) What sampling design is most appropriate for cluster sampling?

    (i) Simple random sampling with replacement

    (ii) Simple random sampling without replacement

    (iii) Stratified random sampling

    (iv) Quota sampling

2. Answer the following questions in brief :

$$2 \times 8 = 16$$

(a) Mention two disadvantages of sampling over complete enumeration.

(b) What are non-sampling errors?

(c) How are random number tables adopted for drawing sample in simple random sampling?

(d) Show that in simple random sampling without replacement, the sample mean is an unbiased estimate of the population mean.

(e) What are the advantages of stratified random sampling over simple random sampling?

(f) What is proportional allocation in stratified random sampling?

(g) Is systematic sampling a probability sampling? Justify.

(h) In what situations the cluster sampling be preferred?

3. (a) What is a sample survey? What are the limitations of sampling? What are the different sources of errors in a sample survey? Describe the measures to be taken in controlling these errors. Elucidate judgement sampling and probability sampling. 2+2+2+4+4=14

*Or*

(b) Write explanatory notes on the following : 4+4+6=14

(i) NSSO and its function

(ii) CSO and its function

(iii) Population census of India and its functions

4. (a) Define simple random sampling. From a random sample of size $n$ from a population of size $N$, how do you estimate the population mean and population total?

( *Turn Over* )

Show that the probability of selection of a specified unit at the first of any subsequent draw is the same in case of simple random sampling.

Prove that in simple random sampling without replacement, sample mean square is an unbiased estimate of the population mean square. 2+4+3+5=14

*Or*

(b) What is finite population correction and sampling fraction? Explain briefly the ratio and regression methods of estimation. Derive the expressions for variance in case of ratio and regression methods of estimation for simple random sampling. 4+4+6=14

5. (a) Explain the purpose of stratification. Mention its advantages and disadvantages. What are the allocation procedures in stratified sampling? Describe the methods of proportional allocation and optimum allocation. Deduce Neyman's formula for optimum allocation in stratified random sampling. 2+2+2+4+4=14

*( Continued )*

*Or*

(b) What is stratified random sampling? Prove that for stratified random sampling

$$\bar{y}_{st} = \frac{1}{N} \sum_{i=1}^{K} N_i \bar{y}_i$$

is an unbiased estimator of the population mean $\bar{Y}$ and its variance is

$$\text{Var}(\bar{y}_{st}) = \sum_{i=1}^{K} (1 - f_i) W_i^2 \frac{S_i^2}{n_i}$$

where $W_i = N_i / N$, $f_i = n_i / N_i$ and $S_i^2 =$ stratum variance and show that

$$\text{Var}(\bar{y}_{st})_{\text{opt}} \leq \text{Var}(\bar{y}_{st})_{\text{prop}} \leq \text{Var}(\bar{y})_{\text{SRS}}$$

2+5+7=14

6. (a) Explain the method of systematic sampling. Obtain an unbiased estimate of the population mean and compare its efficiency with that of a simple random sampling estimate. Also compare and contrast systematic sampling with stratified random sampling. 3+3+4+4=14

*Or*

(b) Describe cluster sampling. Explain the difference between systematic sampling and cluster sampling. Write a note on population with linear trend. 3+5+6=14

( *Turn Over* )

20P/**303**

( Old Course )

Full Marks : 80
Pass Marks : 32

Time : 3 hours

1. Fill in the blanks :                                    1×8=8

   (a) The list of all the items of a population is known as _____.

   (b) The discrepancy between a parameter and its estimate due to sampling process is known as _____.

   (c) The quantity $\frac{N-n}{N}$ in usual notation is called _____.

   (d) Under simple random sampling with replacement, the same item can occur _____ in the sample.

   (e) Stratified sampling is not preferred when the population is _____.

   (f) If the sample size for each stratum is in proportion to stratum size, it is called _____.

*(g)* Systematic sample can be said to give ____ reliable results as compared to a simple random sample.

*(h)* Efficiency of cluster sampling ____ as the cluster size decreases.

**2.** Answer the following questions in brief :

2×8=16

*(a)* What is meant by sampling frame?

*(b)* What do you mean by judgement sampling?

*(c)* What are the merits of simple random sampling?

*(d)* Discuss standard error of an estimator.

*(e)* What is optimum allocation in stratified random sampling?

*(f)* What are the main differences between cluster sampling and stratified random sampling?

*(g)* Define linear and circular systematic sampling.

*(h)* How would you know that a population is in linear trend?

**3.** *(a)* Distinguish between sample survey and complete enumeration. Discuss in brief the principal steps involved in sample survey. What are the demerits of sample survey?

$$3+8+3=14$$

*Or*

*(b)* Explain probability sampling and non-probability sampling. Distinguish between sampling and non-sampling errors. Discuss different sources of these errors.

$$4+4+6=14$$

**4.** *(a)* What do you mean by simple random sampling with replacement and without replacement from a finite population? Explain the various methods of drawing a random sample. Prove that in simple random sampling without replacement, sample mean square is an unbiased estimate of the population mean square.

$$4+5+5=14$$

*Or*

*(b)* What do you mean by simple random sampling of attributes? Prove that in simple random sampling without replacement, the variance of the sample proportion is given by

$$\text{Var}(p) = \frac{N-n}{N-1}\frac{PQ}{n}$$

Show that sample proportion $p$ is an unbiased estimator of the population proportion $P$.         3+7+4=14

5. Answer any *two* of the following :    14×2=28

(a) Describe the procedure of stratified random sampling. Mention two commonly used stratifying factors. Under what conditions is stratified random sampling preferred to simple random sampling? Prove that for stratified random sampling

$$\bar{y}_{st} = \frac{1}{N}\sum_{i=1}^{K} N_i \bar{y}_{ni}$$

is an unbiased estimator of the population mean $\bar{Y}_N$. Work out Neyman's optimum allocation principle of units in stratified random sampling.
        2+2+3+3+4=14

(b) Explain the method of systematic sampling. What are the advantages and disadvantages of systematic sampling?

If $\bar{y}_{sys}$ is the mean of the systematic sample, show that its variance is given by

$$\text{Var}(\bar{y}_{sys}) = \frac{N-1}{N}S^2 - \frac{(n-1)K}{N}S_{wsy}^2$$

        ( *Turn Over* )

where

$$S_{wsy}^2 = \frac{1}{K(n-1)} \sum_{i=1}^{K} \sum_{j=1}^{n} (y_{ij} - \bar{y}_i)^2$$

is the mean square among units which lie within the same systematic sample.

4+4+6=14

*(c)* What do you mean by cluster sampling? Give the formulae for estimating the mean of the characteristic $X$ under single stage cluster sampling. Explain the efficiency of cluster sampling as compared to simple random sampling without replacement. 3+7+4=14

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