Serial No. | 1801 | C–HLR–K–TC

# STATISTICS—III

Time Allowed : Three Hours | Maximum Marks : 200

## INSTRUCTIONS

*Candidates should attempt FIVE questions in ALL including Question Nos. 1 and 5 which are compulsory. The remaining THREE questions should be answered by choosing at least ONE question each from Section A and Section B.*

*The number of marks carried by each question is indicated against each.*

*Answers must be written only in ENGLISH.*

*(Symbols and abbreviations are as usual.)*

*If any data value is to be assumed for answering a question, the same must be mentioned clearly.*

## SECTION—A

1. Attempt any FIVE parts :—                8×5=40

    (a)  What precautions would you take in planning for a sample survey ?

[1]                                    (Contd.)

(b)  Explain the concepts of linear and circular systematic sampling giving suitable illustrations. Further show that for linear systematic sampling, sample mean is an unbiased estimator for population mean.

(c)  What is cluster sampling ? In the case of cluster sampling for proportions, obtain an unbiased estimator of population proportion. Also compute variance of your estimator.

(d)  Define SBIBD. Show that for SBIBD, if the number of treatments is even then $(r-\lambda)$ is a perfect square.

(e)  Discuss the procedure for carrying out the analysis and testing procedure by means of ANOVA table for two way classification.

(f)  4 treatments N, P, K and S are administered in 4 blocks through 4 columns. The layout of design is as shown below :

Columns

| N | P | K | S |
|---|---|---|---|
| P | K | S | N |
| K | S | N | P* |
| S | N | P | K |

Blocks

Identify the above design.

If the observation (*) in third row and fourth column is missing, how would you estimate the missing yield ?

[2]                                    (Contd.)

2. (a) Explain the concept of stratification in stratified Random sampling. What is proportional and optimum allocation in stratified simple Random sampling ?

With usual notations show that :

$$V(\overline{y}_{st})_{opt} < V(\overline{y}_{st})_{prop} < V(\overline{y})_{ran} .$$

(b) How would you determine the sample size n the case of SRSWR and SRSWOR when RSE is fixed ?

(c) What is PPS Sampling ? Explain why such type of sampling is needed ? Describe Lahiri's method for PPS selection of sample.

(d) What are ratio and regression estimates ? How would you obtain bias of these estimators ?

$$10 \times 4 = 40$$

3. (a) Write a critical note on the method of Double Sampling.

(b) A hypothetical population has the population units in linear trend given by $Y_i = a + bi$ $(i = 1, 2, ... N)$. Show that :

$$V(\overline{y}_{WR}) = \frac{b^2}{12^n}(N+1)(N-1)$$

(Contd.)

$$V(\bar{y}_{WOR}) = \frac{b^2}{12}(k-1)(N+1) \text{ where } N = nk$$

$$\text{and } V(\bar{y}_{SY}) = \frac{b^2}{12}(k^2-1).$$

Hence deduce that :

$$V(\bar{y}_{SY}) : V(\bar{y}_{WOR}) : V(\bar{y}_{WR}) = \frac{1}{n} : 1 : 1.$$

(c) What is intrablock and interblock analysis ? Discuss how would you carry out interblock analysis for BIBD.

(d) Show that for BIBD :

    (i)   bk = rv

    (ii)   r(k − 1) = λ(v − 1).

Further show that for resolvable BIBD :

    b ≥ v + r − 1.

Name the design when equality holds good.

<div align="right">10×4=40</div>

4. (a) Discuss the layout for $2^3$ factorial experiment with suitable illustration. How would you carry out the analysis of such a design ?

   (b) Describe under which situations a Latin square design can be preferred to completely randomised design and randomised block design. What are the merits and demerits of LSD ?

(c) What is confounding in a factorial experiment ? Explain why it is necessary.

Enumerate the advantages and disadvantages for confounding.

(d) What do you understand by PBIBD ? What restrictions are imposed upon the parameter of first type of PBIBD ? $10×4=40$

## SECTION—B

5. Attempt any **FIVE** parts :— $8×5=40$

(a) What are the three tests of index numbers ? Verify whether the following index number satisfies any of these tests :

$$I = \frac{1}{2}(L + P)$$

where L = Laspeyaye's Price Index Number

P = Plasche's Price Index Number.

(b) Discuss in detail the variate difference method to obtain trend component in a time series.

(c) Examine whether the following semi-log function represents a demand function or not ?

$$\log_e P = A - BX \quad (P > 0, X > 0, A > 0, B > 0,$$
$$A > B)$$

where P = Price, X = Demand.

If yes, compute the elasticity of demand when A = 30 and B = 0·4.

[5] (Contd.)

(d) State clearly the basic assumptions underlying classical general linear model. Explain briefly the situation when the basic assumption about the rank of datamatrix is violated.

(e) What is the problem of identification in simultaneous linear equations system model ?

(f) Discuss the ratio to trend method for separating the seasonal component in a time series

6. (a) What is the problem of heteroscedasticity in linear models ?

Discuss how would you tackle this problem ?

(b) What is multiple coefficient of determination $R^2$ for K variate general linear model ?

Express $\bar{R}^2$ in terms of $R^2$ and interpret your result. How would you make a choice for a suitable linear model on the basis of $\bar{R}^2$ ?

(c) Discuss briefly the steps involved in the construction of cost of living index number.

(d) What is C.S.O. ?

Describe briefly the role and importance of C.S.O. for execution of Indian statistical data.

10×4=40

7. (a) For Leontief's static input-output open system model, explain the following terms :

    (i)   Transactions Matrix

    (ii)  Technology Matrix

    (iii) Input-output Coefficients

    (iv) Gross Output Vector

    (v)  Bill of Goods.

  (b) Write a critical note on the methods of estimating national income of India.

  (c) Discuss Slutsky-Yule effect when moving average procedure is carried out on the random component of a given time series.

  (d) What are the errors of measurement in the case of linear models ?

    What are the consequences for these errors and briefly explain how would you deal with such situation.            $10 \times 4 = 40$

8. (a) What is the problem of Autocorrelation in linear models ?

    Discuss about its effect and state briefly how would you tackle the problem of autocorrelation.

  (b) What are order and rank conditions for identification in simultaneous linear equations system model ?

[7]                    (Contd.)

(c) Write a critical note on Pareto's income distribution with specific reference to Indian data.

(d) Explain clearly about the following :

    (i) Generalised least squares method

    (ii) Weighted least squares method

    (iii) Eigenvalue approach for dealing with multicollinearity in linear models

$10 \times 4 = 40$