

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 ?

- (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
Blocks		K	S	N	P*
		S	N	P	K

Identify the above design.

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

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 :

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

- (b) How would you determine the sample size in 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  $Y_i = a + bi$  ( $i = 1, 2, \dots, N$ ).

Show that :

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

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

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

Hence deduce that :

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

(c) What is intrablock and interblock analysis ?

Discuss how would you carry out interblock analysis for BIBD.

(d) Show that for BIBD :

$$(i) \quad bk = rv$$

$$(ii) \quad r(k-1) = \lambda(v-1).$$

Further show that for resolvable BIBD :

$$b \geq v + r - 1.$$

Name the design when equality holds good.

$$10 \times 4 = 40$$

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 parameters 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 = Lasperaye's Price Index Number

P = Paasche'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.

- (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. 10×4=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 ?

- (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.

10×4=40