Total No. of Printed Pages-5 Roll No. _____

1(CCE-M)6

STATISTICS-II

[23]

Time Allowed -03 Hours *Maximum Marks-300*

INSTRUCTIONS

i) Answers must be written in English.

ii) The number of marks carried by each question is indicated at the end of the question.

iii) The answer to each question or part thereof should begin on a fresh page.

iv) Your answer should be precise and coherent.

v) The part/parts of the same question must be answered together and should not be interposed between answers to other questions.

*vi) Candidates will select any **THREE** sections and attempt any **FIVE** Questions from selective sections,choosing atmost **TWO** Questions from each selective sections.*

vii) If you encounter any typographical error, please read it as it appears in the text book.

viii) Candidates are in their own interest advised to go through the General Instructions on the back side of the title page of the Answer Script for strict adherence.

ix) No Continuation sheets shall be provided to any candidate under any circumstances.

x) Candidates shall put a cross (x) on blank pages of answer Script.

xi) No blank page be left in between answer to various questions.

xii) No programmable Calculator is allowed.

xiii) No stencil (with different markings) is allowed.

xiv) In no circumstances help of scribe will be allowed.

SECTION-I

1. a) What is 'probability proportional to size'(PPS)sampling? In what situations is PPS sampling recommended? Also explain a method of selecting a PPS sample without replacement.Further obtain an unbiased estimator of the population mean and the variance of this estimator using a PPS sample.

b) Obtain an estimate of the gain in precision due to stratification under pro portional allocation relative to simple random sampling for estimating the population mean $\bar{Y}_N$. **(30,30)**

2. a) Discuss ratio and regression methods of estimation and compare them.

b) Describe two-stage sampling.How would you estimate the population mean and obtain its variance,using a two-stage sample if all primary units have equal number of secondary units. **(30,30)**

3. a) For a 2^4 factorial experiment with 3 replications,each containing 4 blocks,obtain a design such that no main effect is confounded and any interaction is confounded not more than once.Also obtain the variance of the estimate of a main effect and that of a confounded interaction.Further,explain how will you calculate the sum of squares due to a confounded interaction.

b) Give the layout of a randomized block design considering 6 treatments into 5 blocks.Is this a balanced design?Give the complete analysis of variance of randomized block design with k treatments and r blocks. **(30,30)**

4. a) Define a simple lattice design and derive its complete analysis.

b) What is missing plot technique?Explain its importance.In a randomized block design one observation is missing.Estimate the missing value and indicate how you will carry out the exact analysis. **(30,30)**

SECTION-II

5. a) Describe the common control charts in use. How do you measure the efficiency of a control chart?

b) Explain the concepts of producer's and consumer's risks,AQL and LTPD. **(40,20)**

6. a) Explain the justification for using the three sigma limits in the control charts irrespective of the actual probability distribution of the quality characteristic.

b) Show that the probability that at least one of the two points X and R goes outside the control limits is

$$1-\left[\Phi\left(\sqrt{n}T+3\rho\right)-\Phi\left(\sqrt{n}T-3\rho\right)\right]\left[\mathrm{P}\left(\frac{R}{\sigma}\le D_{2\rho}\right)-\mathrm{P}\left(\frac{R}{\sigma}\le D_{1\rho}\right)\right]$$

Where $\rho=\frac{\sigma'}{\sigma}, \mathrm{T}=\frac{\mu'-\mu}{\sigma}$ *and* $1-\Phi(x)=\int_x^{\infty}\frac{1}{\sqrt{2\pi}}e^{\frac{-z^2}{2}}dz$, assuming that the control charts are based on μ^1 as population mean and σ^1 as population standard deviation,where the actual values of these parameters are μ and σ respectively. **(30,30)**

7. a) Distinguish between (i) reliability and availability, (ii) series and parallel systems.

b) A system consists of four identical components connected in parallel. What must be the reliability of each component, if the overall reliability of the system is R?

c) In a life testing experiment n identical units are put on test, where the failure time follows an exponential distribution. The life-time of the first r failures is noted.

Obtain the ML estimators of (i) mean life-time, and (ii) reliability function.

(20,20,20)

8. a) Explain the main features of a bath tub model failure curve and its suitability in describing real life situations. Illustrate by a suitable example.

b) What are type I and type II censored life testing experiments? If the life time distribution is exponential, explain how will you estimate the parameter of the distribution under type II censoring.

SECTION-III

9. a) What is Operations research? Account for the growing importance of OR in business decisions.

b) The initial cost of an item is Rs.15,000 and maintenance or running costs(in Rs.)for different years are given below:

Year	1	2	3	4	5	6	7
Running costs(in Rs.)	2,500	3,000	4,000	5,000	6,500	8,000	10,000

What is the replacement policy to be adopted, if the capital is worth 11% and there is no salvage value? **(25,35)**

10. a) If $X_n=\max\{Y_1,Y_2,.....Y_n\}$, where Y_j denotes the number on the face turning up in the i-th toss of a die with faces 1,2,3,4,5,6. Show that $\{X_n\}$ is a Markov chain. Obtain its transition matrix.

b) Consider a communication system which transmit the two digits 0 and 1 through several stages. Let $X_n(n\geq 1)$ be the digit leaving the n^{th} stage of the system and X_0, the digit entering the first stage leaving the 0^{th} stage. At each stage there is a constant probability q that the digit which enters will be transmitted unchanged, and probability p=1-q otherwise. Find the n-step transition matrix of the two-state Markov chain and the steady state probabilities, if there is any. Also find the probability that the digit entering the first stage is 0, given that digit leaving the m^{th} stage is 0 when the initial distribution is given by $Pr[X_0=0]=a=1-Pr[X_0=1]$. **(30,30)**

11. a) Describe the (M/M/C) : (∞/FIFO) queuing model.Derive the expressions for:

i) The steady state equations,

ii) Probability that a customer on arrival will have to wait,

iii) Expected number of customers in the queue.

b) Explain briefly the general methods for solving OR models.

c) Discuss various classification schemes of models in OR. **(30,15,15)**

12. a) Solve the following problem by Simplex method:

$x_1+x_2 \leq 10$

$2x_1+3x_2 \leq 25$

$x_1+5x_2 \leq 35$

$x_1, x_2 \geq 0.$

b) Develop a subprogram to calculate the trace of elements in the k-th sub diagonal with k= -(n-1),...,-1,0,1,..,(n-1). Here,k=0 for the diagonal and k<0 (or > 0) for lower (or upper) diagonal. Hence demonstrate its use in a calling program using the following matrix and all values of k **(30,30)**

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \\ 3 & 4 & 1 & 2 \\ 4 & 1 & 2 & 3 \end{pmatrix}$$

SECTION-IV

13. a) Specify the time and factor reversal tests for a price index number.Illustrate by a standard price index number which satisfies both these tests,proving your claim.

b) Define a time series.Explain briefly the various components of a time series.Also explain the additive and multiplicative models.

c) State the different methods for determining the seasonal variations in a time series.Describe the Link Relative method. **(15,25,20)**

14. a) Describe the essential steps for the construction of a cost of living index number.

b) Define price elasticity of demand and income elasticity of demand. Point out their uses in economic anlysis. **(30,30)**

15. a) How does one detect heteroscedasticity in linear models?What are the implications of heteroscedasticity in estimating the regression coefficients?

b) State the problem of identification in simultaneous equations model.Derive a necessary and sufficient condition for the identifiability of an equation.

(30,30)

16. a) State the problem of autocorrelation and its effects on the least squares estimator. Describe the Durbin-Watson procedure for testing autocorrelation.

b) Explain the method of generalized least squares for estimating the parameters of a linear model,stating the assumptions underlying it. **(25,35)**

SECTION-V

17. a) What are the sources of demographic data in India?Explain and compare the population register and population census as sources of demographic data.

b) Define and compare infant death rate and infant mortality rate (IMR). Also explain how IMR is determined from death statistics.

c) Project the Logistic curve as a model of human population growth and discuss its limitations. **(20,20,20)**

18. Write explanatory notes on any **THREE** of the following:

a) Morbidity and its measures.

b) Health surveys.

c) Force of mortality and its evaluation.

d) Uses of life tables. **(20,20,20)**

19. a) In what way do Total Fertility Rate(TFR) ,Gross Reproduction Rate (GRP) and Net Reproduction Rate (NRR) differ from one another as measures of reproduction?Does TFR strictly conform to our ideas of a measure a reproduction? How does NRR indicate the growth of population?

b) What do you understand by stable and quasi-stable populations?Derive Lotka's equation linking the intrinsic rate of growth with the age structure of a stable population.Hence show that under neutral change in mortality by age,the age distribution of a stable population does not change. **(30,30)**

20. a) Why is it considered desirable to convert raw scores to some standard scores? Define 'standardized scores', normalized scores' and describe how they are derived.

b) Define reliability of a test? Explain any one method of determining the reliablility of tests in detail.

c) Explain the term Intelligence Quotient(IQ).Describe the procedure and tests for measuring IQ. **(20,20,20)**
