

(b) Distinguish between the central death rate (m_x), the probability of death p_x and the force of mortality (μ_x) in a life table. Indicate possible inter-relationship among these measures, stating necessary assumptions. 20

(c) In what way do total fertility rate (TFR), gross reproduction rate (GRR) and net reproduction rate (NRR) differ from one another as measures of reproduction ? Does TFR strictly conform to our ideas of a measure of reproduction ? How does NRR indicate the growth of population. 20

10. (a) What do you mean by intelligence quotient (I.Q.) ? Describe the procedure and tests for measuring I.Q. 20

(b) Describe the errors of measurement, estimation substitution and prediction along with their standard deviations in a psychological test. 20

(c) Why is the scaling of raw scores considered necessary ? Describe any two of the commonly used derived scales, mentioning their advantages and disadvantages. 20

Roll No.

Total No. of Pages : 6

1(CCE.M)2
Statistics—II
(23)

Time : Three 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 should select any **three** sections. Attempt any **five** questions from the selected sections, choosing at most **two** questions from each selected section.
- (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 (×) on blank pages of Answer Script.

SECTION-II

3. (a) Explain the usefulness of R-chart. When is s-chart used in place of R-chart ? State the control limits of \bar{x} , R and S charts. Also state how the standard deviation of the process can be estimated from R and s ? 20
- (b) Explain the principles and the procedures of :
- (i) Lot Quality Protection and
 - (ii) Average Quality Protection assured to consumers by sampling inspection plans. Discuss the guidelines for the preparation of a single sampling inspection plan under any one of the two types of protection on the basis of attribute sampling. 20
- (c) What is Average Sample Number (ASN) and Average Total Inspection (ATI) ? Explain clearly how ASN and ATI curves are obtained for a sampling plan by attributes when acceptance rectification scheme is in use. 20
4. (a) Explain the concept of reliability model, survival function, hazard function and cumulative hazard function with suitable examples. Why Gaussian distribution is not suitable in reliability studies ? 20
- (b) Discuss Weibull failure model. Obtain mean time to failure (MTTF) of Weibull failure model. If α is the scale parameter and β is the shape parameter of a Weibull distribution then discuss the behaviour of its failure rate. 20
- (c) Explain the concept of system reliability. Find out probability of failure and hazard function for a system with two components in series. If systems are connected in parallel, what will be the probability of failure ? 20

SECTION-III

5. (a) What is meant by duality in linear programming ? Give the standard canonical primal-dual pair and state its properties. Prove the duality theorem of linear programming. 20
- (b) Solve the given linear programming problem by dual simplex method :
- Minimize $Z = 40x_1 + 200x_2$
 such that $4x_1 + 40x_2 \geq 160$
 $3x_1 + 10x_2 \geq 60$
 $8x_1 + 10x_2 \geq 80$
 $x_1, x_2 \geq 0$ 20
- (c) What is the role of control structure in Fortran programming ? Write down syntax and functioning of different forms of IF construct with the help of examples. 20
6. (a) Define a Markov Chain. Show that a homogeneous Markov Chain is completely specified once the one step transition probabilities and the initial distribution are specified. 20
- (b) Define the method of finding the n-th power of a transition probability matrix through spectral decomposition. Hence find the n-th power of 20
- (c) What is the difference between a subroutine and a function ? When a subroutine is called, how is data passed from the calling program to the subroutine ? 20

(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.

SECTION-I

1. (a) Define simple random sampling. How would you determine the sample size required to estimate the population mean with a given standard error ? 20
- (b) What are the utilities of stratification in survey sampling ? Describe proportional, Neyman and optimum allocation and find the variance of stratified sample mean under these allocations. 20
- (c) Define cluster sampling. If the sizes of the clusters are not same then what are the estimators which you will suggest for estimating population mean, whether any unbiased estimator exists in such case ? If so, then find its variance. 20
2. (a) Define systematic sampling and find the variance of systematic sample mean in terms of intra-class correlation coefficient. Compare the systematic sampling, stratified random sampling and simple random sampling when there is a linear trend in the population. 20
- (b) What is meant by a Randomized block design ? Give the analysis of variance for the design. Obtain the efficiency of this design compared to completely randomised design. 20
- (c) What are factorial experiments ? An experiment was laid out in a randomised block design to compare three varieties of wheat and to study the response of these varieties to four different doses of ammonium sulphate. There were five replications. Describe how you will proceed to analyse the data from the experiment to achieve the objectives. 20

SECTION-IV

7. (a) Explain clearly what is meant by trend of a time series ? Describe the moving average method for determining trend. Explain how the method is related to the method of fitting curves by the principle of least squares. 20
- (b) What do you understand by the seasonal variation in a time series ? Give examples. Explain the link relative method of computing the indices of seasonal variation. 20
- (c) Explain the importance of using appropriate weight in framing index numbers and point out some important systems of weighting. Describe Laspeyre's and Paasche's method of weighting index relatives. 20
8. (a) What is meant by family budget survey ? Explain the method of constructing cost of living index numbers. State their uses. 20
- (b) What are the basic considerations in the determination of demand functions ? Explain the use of 'cross section data' in demand analysis. 20
- (c) Explain the meaning of elasticity of demand with respect to (w.r.t.) price. Given the demand for a commodity and the corresponding price, how will you estimate the elasticity of demand w.r.t. price ? 20

SECTION-V

9. (a) Define a life table, a complete life table, an abridged life table and the radix of a life table. Explain how you would complete a life table given the death rate at each individual age. 20