

STATISTICS (Paper II)

Time Allowed : Three Hours

Maximum Marks : 300

QUESTION PAPER SPECIFIC INSTRUCTIONS

(Please read each of the following instructions carefully before attempting questions)

There are EIGHT questions divided in two Sections.

Candidate has to attempt FIVE questions in all.

Question Nos. 1 and 5 are compulsory and out of the remaining, any THREE are to be attempted choosing at least ONE question from each Section.

The number of marks carried by a question/part is indicated against it.

Wherever any assumptions are made for answering a question, they must be clearly indicated.

Word limit in questions, wherever specified, should be adhered to.

SECTION 'A'

1. Attempt any five sub-parts:
 - (a) Explain the concept of rational sub grouping for control chart purpose. Describe two schemes based on order of production in this context. 12
 - (b) Derive an unknown sigma variable sampling plan when there is only an upper specification limit on the quality characteristic in acceptance sampling. 12
 - (c) Describe Type I, Type II and random censoring of samples. 12
 - (d) Formulate a general linear programming problem (LPP). Define slack and surplus variables and explain their role in this context. 12
 - (e) Outline two different types of replacement models. 12
 - (f) Describe a queueing system. State the measures of performance of the single server exponential queue. 12
2.
 - (a) Explain the statistical basis of a p-chart. Describe its construction when the subgroup size n is (i) fixed and (ii) varying. 20
 - (b) Describe the double sampling attributes plan for lot disposition. Derive its OC and ASN functions. What is curtailed inspection? 20
 - (c) Project Weibull distribution as a failure model. Derive its hazard function. What is a bath-tub curve? 20
3.
 - (a) Obtain a necessary and sufficient condition for a basic feasible solution of a LPP to be an optimal solution. 20
 - (b) Derive the formula for EOQ when (i) demand is deterministic and continuous (ii) shortages are allowed, and (iii) production is deterministic and continuous. State the assumptions made. 20
 - (c) The purchase cost of an equipment is C and $f(x)$, ($x \geq 0$) denotes the maintenance cost function, where x is the age of the equipment. Assuming the salvage value to be zero, obtain an optimal replacement policy. Also determine the optimal replacement time when $C=50$ and $f(x)=3x^2+5$, $x \geq 0$. 20
4.
 - (a) What is a CUSUM control chart? How are the parameters of the V-mask for such a chart determined? 15
 - (b) Explain the concepts of AOQ and ATI for rectifying inspection by attributes. What is AOQL? 15

- (c) Define a Markov chain. How are the states of a Markov chain classified? In a finite Markov chain, can all the states be transient? Justify. 15
- (d) Write briefly on the software package SPSS. 15

SECTION 'B'

5. Attempt any five sub-parts:
- (a) Define a time series and its main components. Explain the terms (i) stationarity and (ii) invertibility in time series. 12
- (b) Describe a general linear model (GLM) in K independent variables. Justify the inclusion of a random error term in this model. 12
- (c) Explain Durbin-Watson test for auto correlation in a GLM. 12
- (d) Define net reproduction rate. How is this rate constructed and interpreted? 12
- (e) Examine the use of stable population concept in estimation of demographic parameters. 12
- (f) What is test reliability? Describe a method of measuring reliability of a test. 12
6. (a) Briefly discuss the following in time series analysis: (i) Determination of trend (ii) Forecasting 20
- (b) Explain identification problem in a simultaneous equation model. State, without proof, the rank and order conditions of identifiability. Also outline the two-stage least squares method of estimation. 20
- (c) 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. 20
7. (a) Project the logistic curve as a model of human population growth and discuss its limitations. 20
- (b) Explain the basic assumptions while constructing a life table. In usual notations, prove
- $$q_x = 2m_x / (2 + m_x)$$
- What are the uses of a life table? 20
- (c) Compute the crude and standardized death rates for Population 'A', given the following information.
- | Age group (years) | Standard population | No. of deaths | Population 'A' | No. of deaths |
|-------------------|---------------------|---------------|----------------|---------------|
| 0 - 10 | 600 | 9 | 400 | 12 |
| 10 - 20 | 1000 | 5 | 1500 | 6 |
| 20 - 60 | 3000 | 24 | 2400 | 20 |
| Above 60 | 400 | 20 | 700 | 25 |
- Interpret the results. 20
8. (a) Outline an application of factor analysis. 15
- (b) Write briefly on: (i) methods of collection of official statistics in India (ii) their reliability and limitations. 20
- (c) What is intelligence quotient and how is it constructed? 15
- (d) Write a brief note on Central Statistical Organization. 10