

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 of the following:
 - (a) Explain the construction of $\bar{X}$ and r-charts. Why are both the charts used simultaneously? 12
 - (b) Explain the construction and use of sequential sampling plans for attributes. 12
 - (c) Explain the difference between Reliability, Maintainability, and Availability. Illustrate your answer by suitable examples. 12
 - (d) Describe the M-technique with artificial variables to minimize an objective function in a linear programming problem. What changes will be made in the procedure if the objective function is to be maximized? 12
 - (e) Describe M|G|1 and GI|M|1 queues. Derive the Pollaczek-Khinchin mean value formula for the average number of customers in M|G|1 queue. 12
 - (f) If states i and j of a Markov chain communicate with each other, then show that if state i is recurrent then state j is also recurrent. 12
2.
 - (a) Explain the construction and use of cumulative sum chart. 25
 - (b) Find the reliability function and failure rate function for the lognormal time-to-failure distribution. 20
 - (c) Explain different types of censoring in life testing experiments. When are these used? 15
3.
 - (a) State and prove duality theorem in linear programming. 20
 - (b) Show that, for a Markov chain, if state j is persistent non-null, then as $n \rightarrow \infty$

$$p_{jj}^{(nt)} \rightarrow t/\mu_{jj}$$
 when state j is periodic with period t; &

$$p_{jj}^{(n)} \rightarrow t/\mu_{jj}$$
 when state j is aperiodic. 25
 - (c) Discuss some statistical problems which can be solved by using well known Statistical Software Packages like SPSS and which otherwise are difficult to solve. 15
4.
 - (a) Distinguish between multiple and sequential sampling plans. Derive the OC function and ASN of a double sampling plan under corrective sampling scheme. 15
 - (b) Let $F_i(t)$ denote the failure time distribution of the i^{th} component in a series system consisting of n independent components. Find the system failure time density. 15

- (c) Determine the optimal ordering policy in the case of a single period inventory model with no set up cost, instantaneous stock replenishment and the amount demanded is a continuous random variable. 15
- (d) What is sensitivity analysis? Explain its use with the help of an example. 15

SECTION 'B'

5. Attempt any five sub-parts of the following:
- (a) What are the salient features of the Box-Jenkins approach to time series forecasting? 12
- (b) What are the advantages of a chain index over a fixed base index number? 12
- (c) What are the official agencies responsible for the collection of data on (i) population, (ii) agriculture, (iii) trade, and (iv) prices? 12
- (d) Distinguish between complete and abridged life tables. 12
- (e) Define complete expectation of life (e_x^0) and curtate expectation of life (e_x). Show that $e_x^0 = 1/2 + e_x$. Also comment on the nature of $x + e_x^0$ as a function of x . 12
- (f) What is path analysis? Explain its use in psychometry. 12
6. (a) What are the different methods for determining seasonal variations in a time series? Indicate the seasonal patterns to which these methods are applicable. 20
- (b) Describe the essential steps for the construction of an index number of agriculture production. 20
- (c) Discuss the advantages and limitations of two-stage least squares method of estimation. 20
7. (a) Define Crude Death Rate (CDR) and Standardized Death Rate (STDR). Discuss which one of these two rates can be used to compare the mortality situations of two different places. 20
- (b) Define a logistic curve and examine its suitability as a growth model. Describe Rhodes's Method of fit a logistic curve. 20
- (c) What are morbidity incidence rate and morbidity prevalence rate? How are they computed? Explain their uses. 20
8. (a) Describe the methods of collection of official statistics on agriculture production and prices. What are their limitations and reliability? 15
- (b) Explain the functions of CSO as part of the present statistical system in India. 15
- (c) Define T-scores and percentile scores. Describe why they are used and how these are computed. 15
- (d) What is reliability coefficient of a test? Describe some practical methods of estimating test reliability. 15