

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) With reference to control charts, distinguish between (i) warning limits and action limits, and (ii) Type I and Type II errors. 12
 - (b) Explain the construction and use of $\bar{X}$ and R charts. 12
 - (c) Explain the concepts of 'availability' and 'maintainability'. 12
 - (d) Describe the different models used in Operations Research and state the general methods for solving them. 12
 - (e) What is queuing process? Obtain the probability generating function for the queue length of M/M/1 queueing model and obtain the mean queue size. 12
 - (f) Consider the Markov chain $\{X_n, n \geq 0\}$ with the states (0, 1, 2) and with transition probability matrix $\begin{bmatrix} 3/4 & 1/4 & 0 \\ 1/4 & 1/2 & 1/4 \\ 0 & 3/4 & 1/3 \end{bmatrix}$ and the initial distribution $P\{X_0=i\}=1/3; i=0,1,2$. Obtain the value of: $P\{X_0=1, X_2=2, X_1=1, X_0=2\}$ 12
2.
 - (a) Explain the statistical basis and construction of p and np charts. 25
 - (b) Explain with examples series and parallel systems. A series system of n components is such that each component has a failure distribution given by $F(x)=1-e^{-(x/\alpha)^\beta}; x \geq 0$ [?]. Find the failure distribution of the system assuming that the components operate independently and n is large. What will be this distribution under parallel connection? 20
 - (c) Explain the meaning of censored and truncated samples. When are these used? 15
3.
 - (a) Solve by Big-M method the following LP problem: Maximize $Z=3x_1-x_2$ subject to $[2x_1+x_2 \geq 2; x_1+3x_2 \leq 3; x_2 \leq 4; x_1, x_2 \geq 0]$ 25
 - (b) What are replacement problems? Discuss such a problem in which items deteriorate with time and the value of money remains the same as per passage of time. 15
 - (c) What do you understand by 'recurrent' and 'transient' states of a discrete parameter Markov chain? Show that a state j is recurrent if and only if $\sum_{n=0}^{\infty} p_{jj}^{(n)} = \infty$ & if a state j is transient, then $p_{ij}^{(n)} \rightarrow 0$ for all i. 20
4.
 - (a) What do you understand by sampling inspection plan for variables? Explain how it differs from the sampling inspection plan for attributes. State the use of Dodge-Romig tables. 15
 - (b) What is redundancy? Explain the use of redundancy in reliability improvement. 15

- (c) Describe a Poisson process. Obtain the distribution of interarrival times in a Poisson process. 15
- (d) What are SPSS packages? Explain their uses. 15

SECTION 'B'

5. Attempt any five sub-parts of the following:
 - (a) Describe the method of moving averages for determining the trend component of a time series. How is trend eliminated? 12
 - (b) Define Fisher's ideal index number. Why is it called ideal? 12
 - (c) What are the principal publications which provide data on (i) industrial production, (ii) foreign exchange and (iii) mining activity? 12
 - (d) Define and interpret the following measures: (i) Infant mortality rate (ii) Expectation of life (iii) Density of population 12
 - (e) Define a logistic curve and examine its suitability as a growth model. 12
 - (f) What is the 'validity' of a test? How is it measured? 12
6.
 - (a) What are the different methods for determining the cyclical component of a time series? Describe 'periodogram analyses'. 20
 - (b) Describe the essential steps for the construction of an index number of industrial production. 20
 - (c) Obtain the generalized least squares technique for estimating the coefficients of a linear model. Compare this with ordinary least squares estimation. 20
7.
 - (a) Define crude and standardized death rates. Describe the direct and indirect methods for calculating standardized death rates. 20
 - (b) Explain the various columns of a life table giving the relationship between them. What is an abridged life table? 20
 - (c) Write a note on health surveys and hospital statistics. 20
8.
 - (a) What are the various official agencies responsible for data collection? Discuss their roles. 15
 - (b) Describe the present official statistical system in India dealing with collection of agricultural statistics. 15
 - (c) Why is it considered desirable to convert given raw scores into some standard scores? Define 'standardized scores' and 'normalized scores', and describe how these are derived. 15
 - (d) Describe any two methods commonly used for computing the 'reliability' coefficient of a test. What is the effect of lengthening of a test on its reliability? 15