

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) Distinguish between Process Control and Product Control. How do we achieve them? 12
 - (b) Obtain the OC function of $\bar{x}$ control chart. Explain its use. 12
 - (c) Define failure rate function and obtain it for the Weibull time-to-failure distribution. 12
 - (d) Define irreducible Markov chain. Show that in an irreducible Markov chain, all states are of the same type. 12
 - (e) What is an M/M/c queue? Show that the expected number of busy servers in an M/M/c queue in steady state is $c\rho = \lambda/\mu$ and that the expected number of idle servers is $c(1-\rho)$ 12
 - (f) Explain the Simplex Algorithm for solving a linear programming problem. 12
2. (a) Explain the construction and use of c-chart. 25
 - (b) Define system failure rate. Show that in a series system consisting of n independent components, failure rate is equal to the sum of the failure rates of its components, and it is not true for parallel system. 20
 - (c) Obtain the maximum likelihood estimate of the mean for the exponential model based on a censored sample. 15
3. (a) Solve the following LP problem graphically: Maximise $Z = 3x_1 + 2x_2$ subject to

$$[x_1 + 2x_2 \leq 6; 2x_1 + x_2 \leq 8; -x_1 + x_2 \leq 1; x_2 \leq 2; x_1, x_2 \geq 0]$$
 25
 - (b) Explain the assignment problem. Show that an assignment problem can be solved by the transportation technique. 20
 - (c) Define renewal density and renewal function. Show that the renewal function $H_0(t)$ for an ordinary renewal process is given by $H_0(t) = t/\mu + (\sigma^2 - \mu^2)/2\mu^2$ 15
4. (a) Explain the construction and use of sampling plans for stipulated producer's and consumer's risks. How do we choose the best sampling plan? 15
 - (b) What is redundancy? Is redundancy at the component level more effective than redundancy at the system level? Justify your answer. 15
 - (c) What is an inventory system? Classify and discuss the different types of costs involved in an inventory system. 15
 - (d) Let $X_1, X_2, \dots, X_n$ be a random sample from an $N(\mu, \sigma^2)$ distribution (μ, σ^2 known). Let $T = \sum_{i=1}^n X_i^{5/2} e^{n-2x_i^{1/2}}$ [?] be a statistic. Explain how the well-known statistical software 15

packages like SPSS can be used to find the distribution of T.

SECTION 'B'

5. Attempt any five sub-parts of the following:
 - (a) Describe the method of link relatives for isolating seasonal variations in a time series. 12
 - (b) What are the different tests a good index number should satisfy? How many of them are satisfied by the Fisher's ideal index number? 12
 - (c) What are the principal publications which provide data on (i) agriculture, (ii) industrial production, (iii) trade and (iv) prices? 12
 - (d) Explain and interpret the following: (i) Vital rates and ratios (ii) Fertility rate (iii) Morbidity rate 12
 - (e) How are population projections made? 12
 - (f) Explain the use of factor analysis in psychometry. 12
6. (a) What is stationary time series? What are the different schemes or models which may account for oscillatory movements in a stationary time series? 20
 - (b) Discuss briefly the various steps for constructing a wholesale price index number. 20
 - (c) Explain briefly the problem of multicollinearity in general linear models, its consequences and solutions. 20
7. (a) Derive Makeham's law stating clearly the underlying assumptions. Also explain how the constants in the Makeham's law can be ascertained from four equidistant values of l_x . 20
 - (b) What are the uses of stable and quasi-stable population techniques in estimation of demographic parameters? 20
 - (c) Define general fertility rate (GFR) and age specific fertility rate (ASFR). Describe the methods for calculating these fertility rates. Also indicate why ASFR is considered as an improvement over GFR. 20
8. (a) What are the methods of collection of official statistics on industrial production and trade? What are their limitations and reliability? 15
 - (b) Explain the functions of NSSO as a part of the present statistical system in India. 15
 - (c) Explain the different methods of combining and comparing scores in several tests, stating clearly the assumptions made in each case. 15
 - (d) What are intelligence tests and how are they used in measuring intelligence? 15