

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 SIXTEEN questions divided in four Sections.

Candidate has to attempt FIVE questions in all.

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'

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| 1. (a) | What is meant by statistical quality control? What does it aim to achieve? Does a statistically controlled process always meet specifications? Explain. | 30 |
| (b) | Describe the common control charts in use. How do you measure the efficiency of a control chart? | 30 |
| 2. (a) | Discuss the relative advantages of double sampling plans over single sampling plans. | 20 |
| (b) | Explain the concepts of producer's and consumer's risks, AOQL and LTPD. | 20 |
| (c) | Describe the construction and use of Dodge-Romig tables. | 20 |
| 3. (a) | Distinguish between (i) Reliability and Availability (ii) Series and Parallel Systems | 20 |
| (b) | Explain how the reliability of a system can be increased by utilizing the concept of redundancy. | 20 |
| (c) | A system consists of four identical components connected in parallel. What must be the reliability of each component, if the overall reliability of the system is R? | 20 |
| 4. (a) | Define a renewal process and a renewal function. Also give an example of a renewal process and obtain the associated renewal function. | 20 |
| (b) | Examine Weibull distribution as a failure model. Derive its hazard function, | 20 |
| (c) | Explain the meaning of censored and truncated samples. When are these used? | 20 |

SECTION 'B'

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| 5. (a) | What are the different types of models used in Operational Research? Explain their general methods of solution. | 20 |
| (b) | For a linear programming problem, explain the following terms (i) Convex cone (ii) Feasible solution (iii) Extreme point (iv) Optimal basic feasible solution (v) Artificial variables | 20 |
| (c) | For a given linear programming problem, state its dual and show that the dual of the dual is the primal. Also, state the relationship between the nature of the solutions of the primal and the dual problems. | 20 |
| 6. (a) | Explain the differences between a transportation problem and an assignment problem. Show how the latter can be regarded as a special case of a linear programming problem. | 25 |
| (b) | Explain what you understand by sensitivity analysis in linear programming. | 15 |
| (c) | State the minimax theorem for the theory of games. What are optimal strategies? | 20 |

7. (a) What is the main problem in inventory management? Discuss the various costs involved in an inventory problem. 20
- (b) In a certain manufacturing situation the production is instantaneous and the demand per year is R. Show that the optimal order quantity q per run which minimizes the total cost is given by

$$q = \sqrt{((2RC_3(C_1 + C_2))/C_1C_2)}$$

Where C_1 = storage cost per unit per year, C_2 = shortage cost per unit per year, C_3 = set up cost per run. 20

- (c) The following mortality rates have been observed for a certain type of light bulbs:

During week no.	1	2	3	4	5
Proportion of bulbs failing	0.10	0.15	0.25	0.30	0.20

Decide on the best replacement policy, it being given that Re. 1.00 and Re. 0.25 are the costs of individual and group replacement per bulb respectively. 20

8. (a) For an M/M/1 queue, determine in steady state (i) the probability that, at any time, there are n units in the system, and (ii) the expected number of units in the system. 20
- (b) For the case of k channels, Poisson arrivals with mean arrival rate λ and exponential service time with mean service rate μ , determine in steady state: (i) the probability that all the channels are empty, and (ii) the probability that an arrival has to wait. 20
- (c) Write notes on any three of the following (i) Discrete-time Markov Chains (ii) Transition Probability Matrix. (iii) G/M/1 and M/G/1 queues. (iv) Uses of SPSS. 20

SECTION 'C'

9. (a) What is meant by a time series? Explain the difference between the seasonal and cyclical variations in a time series. 20
- (b) Explain the use of ARIMA models in forecasting. 20
- (c) State the Laspeyre's formula for a price index number and examine whether it satisfies the time and the factor reversal tests. 20
10. (a) Discuss the tests to be satisfied by an ideal index number. Illustrate these with respect to Fishers index number. 20
- (b) What is a chain-base index number? Discuss its advantages and disadvantages over a fixed-base index number. 20
- (c) Describe the essential steps for the construction of a cost of living index number. 20
11. (a) Specify the general linear model. Show that under certain conditions (to be stated), the least squares and the maximum likelihood methods produce identical estimators of the coefficients in the model. 20
- (b) Explain the problem of multicollinearity. Interpret it algebraically and geometrically. Suggest methods to overcome the problem. 20
- (c) State the problem of autocorrelation and its effect on the least squares estimator, Describe the Durbin-Watson procedure for testing autocorrelation. 20
12. (a) Explain the method of generalized least squares for estimating the parameters of a linear model, stating the assumptions underlying it. 20
- (b) State the problem of identification in simultaneous equations model. Derive a necessary and sufficient condition for the identifiability of an equation. 20
- (c) Describe the methods of collection of official statistics in India and name the principal publications containing such statistics. 20

SECTION 'D'

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| 13. | (a) | Discuss the sources, uses and limitations of demographic data in India. | 20 |
| | (b) | Define the following rates and explain their uses: (i) Infant mortality rate (ii) Crude death rate (iii) Standardized death rate | 20 |
| | (c) | Explain the construction of net reproduction rate. Interpret its value when it is less than, equal to or greater than unity. | 20 |
| 14. | (a) | Explain a method of constructing a life-table. What are the uses of a life-table? | 20 |
| | (b) | Explain the use of stable population technique in the estimation of demographic parameters. | 20 |
| | (c) | Examine Gompertz curve as a growth model. | 20 |
| 15. | (a) | Define a T-score. Explain the method of computing T-scores from raw test scores. | 20 |
| | (b) | Illustrate the need for scaling of test scores. Define (i) a standard score, and (ii) a percentile score | 20 |
| | (c) | Explain the concept of validity of test scores. How is it determined? | 20 |
| 16. | | Write explanatory notes on the following | |
| | (a) | Intelligence Quotient Tests | 20 |
| | (b) | Morbidity and its Measurement | 20 |
| | (c) | Use of factor analysis in psychometry | 20 |