

STATISTICS

Paper-II

Time Allowed : Three Hours

Full Marks : 300

Candidates should attempt Question No. 1 from Section-A and Question No. 5 from Section-B which are compulsory, and any three of the remaining questions, selecting at least one from each Section.

All questions carry equal marks.

SECTION—A

1. Attempt any FIVE parts of the following :—

(a) Explain the Shewhart Control Chart Technique. 12

(b) What is the CUSUM control chart ? How is it better than the ordinary control charts ? 12

(c) What is heteroscedasticity ? Explain a plotting technique to detect heteroscedasticity. 12

(d) Explain in short how cyclical and seasonal components can be estimated in a time series. 12

(e) Explain the various steps for scientific forecasting. 12

- (f) Write a note on the Indian statistical system. 12
2. (a) What is maintainability? Derive an expression of MTTF in terms of reliability under preventive maintenance. 20
- (b) For a single sampling plan, obtain the expressions for the OC and the ASN functions. Draw the two curves establishing their values at certain specific points. 20
- (c) Explain the effects of moving averages on cyclical and random components of a time series. 20
3. (a) Discuss the different steps that have to be taken in the construction of Wholesale Price Index Number in India. Show that Laspeyres's and Paasche's index numbers may be looked upon as weighted average of price relatives. 25
- (b) Find the variance of the time to 'failure' for two identical units, each with a failure rate λ , placed in *standby* parallel configuration. Compare the result of the same two units placed in *active* parallel configuration ignoring switching failures and failures in standby mode. 20
- (c) Write brief notes on the different statistical organizations of India, under the Central Government. 15

4. (a) State the Gauss-Markov assumptions for the ordinary least squares estimation. Show that the ordinary least squares estimator for the regression coefficient is the best linear unbiased estimator. 15
- (b) What is multicollinearity ? What are its consequences ? How does it differ from exact multicollinearity ? 15
- (c) Fatigue wear out of a component has a lognormal distribution with $t_M = 5000$ hours and $\beta = 0.20$, (symbols having their usual meanings) :
- (i) Compute M.T.T.F. and S.D.
- (ii) Find the reliability of the component at 3000 hours. 15
- (d) Explain the statistical reasoning for the use of 3σ control limits in the development of control charts for normal and non-normal observations. 15

SECTION—B

5. Attempt any FIVE sub-parts of the following :—
- (a) (i) What do you mean by a Linear Programming Problem (LPP) ?
- (ii) Define slack variables and explain its use in LPP.
- (iii) Distinguish between basic solution and basic feasible solution in LPP.
- (iv) Explain optimum solution of an LPP. 12

- (b) Explain the problem and outline the method of obtaining the solution of a two-person zero-sum game with mixed strategies. 12
 - (c) Define M/G/1 queue. What is Embedded Markov chain? How the Embedded Markov chain technique is used to analyse the M/G/1 queue? 12
 - (d) Distinguish between complete and abridged life tables. Explain the King's method of constructing abridged life tables. 12
 - (e) What do you mean by "Validity of a test?" Explain the following types of validity:
 - (i) Content validity
 - (ii) Criterion-based validity and
 - (iii) Predictive validity. 12
 - (f) Define Markov chain. State and prove the Ergodic theorem and explain its applications in the analysis of Markov chains. 12
6. (a) Explain the iterative process of a simplex algorithm for solving a LPP. 20
- (b) Describe a transportation problem and give the flow chart of any one algorithm used for obtaining the solution of this problem. 20
- (c) Explain the method of obtaining the solution of a Game problem by Linear Programming. 20

7. (a) Define periodicity of a Markov chain. If i and j are communicating states, show that the periods of i and j are identically equal. 15

(b) When do you say that a Markov chain is irreducible? Give an example of a Markov chain which is irreducible. 15

(c) Consider an inventory problem in which R units at a constant rate are to be supplied over a period of time T with shortages permitted. S is the inventory at the beginning of each time interval t s. Suppose q is the run size. Let the inventory of S units are utilized for t_1 time units and for another t_2 time units there is shortage. Given C_s is the setup cost per production run, C_h is the average holding cost for holding one unit in the inventory for a unit of time and C_p is the shortage cost per one unit for a unit of time.

Then determine the optimum size of q and derive the total expected cost at the optimum chosen level of q . 15

(d) Define M/M/1 queue. For this queue derive the expected waiting time of a customer in the queue under steady state conditions. 15

8. (a) Define :

(i) Neonatal mortality rate.

(ii) Foetal death rate and

(iii) Perinatal mortality rate.

Explain how these constants are helpful in the study of health care problems of a population. 15

(b) Explain how Gompertz's law is useful to study the mortality behaviour of a population. Illustrate a method of fitting this model for a given data. 15

(c) Define intelligence quotient. Explain any one method of measuring intelligence quotient. 15

(d) What are direct and indirect effects in a path analysis ? Explain how path analysis is applied in Psychometry ? 15