

STATISTICS

Paper II

Time Allowed : Three Hours

Maximum Marks : 200

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

There are **EIGHT** questions in all, out of which **FIVE** are to be attempted.

Question Nos. **1** and **5** are compulsory. Out of the remaining **SIX** questions, **THREE** are to be attempted selecting at least **ONE** question from each of the two **Sections A** and **B**.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Question-cum-Answer Booklet must be clearly struck off.

All questions carry equal marks. The number of marks carried by a question/part is indicated against it.

Answers must be written in **ENGLISH** only.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if necessary and indicate the same clearly.

SECTION 'A'

1. Answer all of the following : 8×5=40
- 1.(a) Distinguish between tolerance limits and specification limits. Interpret the situation when tolerance limits are not included within the specification limits. 8
- 1.(b) Describe the different types of redundancy and their uses in reliability improvement. 8
- 1.(c) Explain the following terms :
(i) OC function (ii) ATI (iii) AOQL (iv) LTPD 8
- 1.(d) Consider the Markov chain with the following transition probability matrix :

$$P = \frac{1}{2} \begin{pmatrix} 0 & 1 & 2 \\ 0 & 1 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} \\ 0 & 1 & 0 \end{pmatrix}$$

- (i) Is the chain irreducible ?
- (ii) Check whether the states of the chain are periodic, persistent and non-null. 8
- 1.(e) What is a linear programming problem (LPP) ? Differentiate between the simplex method and two-phase simplex method for solving LPP. 8

- 2.(a) Develop the OC function of a double sampling plan for attributes. 10
- 2.(b) Distinguish between process control and product control. What are the statistical techniques to achieve these ? 15
- 2.(c) The following data is on minutes to breakdown for an insulating fluid. There were 11 tests at 30 kV. After 100 minutes, there were 7 breakdowns at the following times in minutes :

7.74, 17.05, 20.46, 21.02, 22.66, 43.40, 47.30.

The other 4 units had not failed.

Assuming the failure time distribution is exponential calculate the MLE for the Reliability Function at time $t = 25$ minutes. 15

- 3.(a) Use duality to solve the LPP :

$$\begin{aligned} \text{Minimize } & z = 3x_1 + x_2 \\ \text{Subject to } & 2x_1 + 3x_2 \geq 2 \\ & x_1 + x_2 \geq 1 \\ & x_1, x_2 \geq 0. \end{aligned}$$

20

3.(b) Solve the following transportation problem :

20

	D_1	D_2	D_3	D_4	a_i
O_1	10	7	3	6	3
O_2	1	6	8	3	5
O_3	7	4	5	3	7
b_j	3	2	6	4	

4.(a) In a game of matching coins with two players, suppose A wins one unit of value when there are two heads, wins nothing when there are two tails and loses $\frac{1}{2}$ unit of value when there is one head and one tail. Determine the pay off matrix and the optimal strategies for both the players. 20

4.(b) Solve the following LPP :

$$\begin{aligned} \text{Maximize } z &= 2x_1 + 3x_2 + x_3 \\ \text{Subject to } -3x_1 + 2x_2 + 3x_3 &= 8 \\ -3x_1 + 4x_2 + 2x_3 &= 7 \\ x_1, x_2, x_3 &\geq 0. \end{aligned}$$

20

SECTION 'B'

5. Answer all of the following :

8×5=40

5.(a) What is homogeneity error in connection with index number ? What steps will you take to reduce this error ? 8

5.(b) Discuss the rationale behind the moving average method in determining trend. 8

5.(c) What do you mean by parallel tests ? Obtain the effect of test length on the reliability of a test. 8

5.(d) What are the different components of a time series ? Why a multiplicative model is often preferred for explaining a time series on economic and business data ? 8

5.(e) Define and compare the crude birth rate, gross and net reproduction rates as measures of fertility. How do you determine the rate of growth of a population ? 8

6.(a) Write down the usefulness of cost of living index number. Can we have a single cost of living index number for India ? Give reasons in favour of your answer. 20

- 6.(b) The following table gives (with no missing values) the overall and groupwise cost of living indices (with the year 2000 as base) with six different expenditure groups and their respective weights, for the urban middle class people of a particular city, in 2004 and 2005 :

Group	Weight	Group Index (2004)	Group Index (2005)
Food	350	117	120
Clothing and Footwear	156	113	118
Housing	187	118	—
Transport and Vehicles	108	112	117
Durable household goods	76	102	111
Other items	123	121	125
Total	1000	—	119.5

- (i) Compute the overall cost of living index for 2004.
 (ii) Hence, determine the group index for housing in the year 2005. 20

- 7.(a) In a music competition there are m participants who are to be evaluated by n judges who want to judge the participants by ordering their performances. Discuss in detail how can you combine the verdicts of the judges to come to a final conclusion. Clearly mention the assumptions, if any. 20

- 7.(b) Given the following table for l_x , the number of rabbits living at age x , complete the life table for rabbits :

x	0	1	2	3	4	5	6
l_x	100	90	80	75	60	30	0

If A, B, C are three rabbits of age 1, 2 and 3 years respectively, find the probability that

- (i) at least one of them will be alive for one year more.
 (ii) A, B, C will be alive for two years of time.
 (iii) Exactly one of the three is alive in two years of time.
 (iv) All will be dead in two years time. 20

- 8.(a) (i) Which scale is mainly used to measure a Psychological trait ?
 (ii) Suppose you have two score distributions given by

$$f(x) = \frac{1}{l_1}; \quad 0 \leq x \leq l_1 \text{ and}$$

$$g(y) = \frac{1}{l_2}; \quad 0 \leq y \leq l_2$$

for scores x and y respectively. Find the equivalence curve relating x and y and mention its utility.

- (iii) Describe in brief, a practical method for obtaining equivalent scores from the score distributions for x and y without going into the process of graduation. 20

- 8.(b) Explain multicollinearity with an example. Discuss the different methods of detection of multicollinearity. 20