2021

STATISTICS

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

1. Answer *any ten* questions: 10×10=100

(a) What is a 'C' chart? When is it used?

(b) Define Fisher's Ideal Index Number. Show that it lies between Laspeyre's and Paasche's Index Numbers.

(c) What is the rationale behind using 3 Sigma Control Limits?

(d) Describe 3 criteria for detecting lack of control in $\bar{x}$ chart.

(e) Define Acceptance Quality Level (AQL) and Lot Tolerance Per cent Defective (LTPD) in the context of a single sampling plan for attributes.

(f) In the context of a single sampling plan for attributes with lot quality p, lot size N and sample size n, derive the expression of Average Amount of Total Inspection (ATI) in terms of the Operating Characteristic (OC) function.

(g) Distinguish between seasonal and cyclical variations in time series data with examples.

(h) For a given data set, describe how the Least Squares Method can be used to fit the exponential curve $u_t = ab^t$.

(i) Describe the method of moving averages for trend determination. How is the period of moving average decided upon?

(j) Define a cost of Living Index Number. How do you compute (a) purchasing power of money and (b) real wages using a cost of Living Index Number?

(k) Define "Crude Death Rate" (CDR) and Specific Death Rate (SDR). Why is SDR preferred over CDR?

(l) If deaths are assumed to be uniformly distributed over the whole year, show that

$$L_x = l_{x+\frac{1}{2}},$$

where the symbols have the usual meaning.

(m) Define Net Reproduction Rate (NRR). What is the significance of NRR = 1?

(n) In the context of a Linear Programming Problem (LPP), define the following:
(a) a feasible solution, (b) a basic feasible solution, (c) an unbounded solution.

(o) Mention in brief the functions of National Sample Survey Organisation.

Group-B

Answer *any five* questions.

2. (a) What is Lorenz Curve in connection with income inequality? Define Gini's measure of concentration (income inequality) and deduce a connection with the area under Lorenz Curve.

(b) What are Specification Limits? (3+3+10)+4=20

3. (a) Define producers' risk and consumer's risk in connection with sampling plan for attributer.

(b) Distinguish between acceptance/rejection sampling plan and acceptance/rectification sampling plan in connection with attribute plans.

(c) For a single sample rectification plan for attributes, if rejected lots are 100% inspected, show that Average Outgoing Quality (AOQ) can be expressed in terms of probability of acceptance (Pa), lot quality (p), lot size (N) and sample size (n). 6+4+10=20

4. (a) Describe a sequential sampling plan for attribute.

(b) Check whether the following index numbers satisfy the Time Reversal Test:

(i) $I_{01} = \frac{\Sigma p_{1i}(q_{0i}\, q_{1i})^{\frac{1}{2}}}{\Sigma p_{0i}(q_{0i}\, q_{1i})^{\frac{1}{2}}}$ (ii) $I_{01} = \frac{\Sigma p_{1i}\, q_{0i}}{\Sigma p_{0i}\, q_{0i}}$ (iii) $I_{01} = \frac{\Sigma p_{1i}\sqrt{q_{0i}}}{\Sigma p_{0i}\sqrt{q_{0i}}}$ 8+(4×3)=20

5. Discuss various problems related to the construction of a Price Index Number. 20

6. (a) Deduce the correlogram of an auto-regressive process of order 1.

(b) Which component of time series is mainly applicable in the following situations?

(i) Fire in a factory

(ii) Decrease in employment in a sugar factory during the off season

(iii) Fall in death rate due to scientific research

Explain the rationale behind your answer in each case. 10+10=20

7. Food *X* contains 6 units of vitamin A and 7 units of vitamin B per gram, and costs Rs. 12·00 per gram. Food *Y* contains 8 units and 12 units of vitamins A and B per gram respectively and costs Rs. 20·00 per gram. The daily requirements of vitamin A and B are at least 100 units and 120 units respectively. Formulate the above as an L.P.P to minimize the cost. Make a graphical representation of the set of constraints and hence find the optimal solution. 10+10=20

8. (a) Show that the following L.P.P has no feasible solution:

Maximize $3x_1 + 5x_2$

Subject to $5x_1 + 5x_2 \leq 25$

$13x_1 + 13x_2 \geq 117,$

$x_1, x_2 \geq 0$

(b) Deduce the following relations:

(i) $q_x = \frac{2m_x}{2+m_x}$ (ii) $\cap p_x = p_x\, p_{x+1} \cdots p_{x+n-1}$

with usual notations. 10+10=20

9. (a) Write a note on estimating National Income.

(b) Describe the role of CSO.

(c) Derive the reliability of an n component parallel system, where each component has reliability p.

10+5+5=20
