

CSM – 69 / 15
Statistics
Paper – II

Time : 3 hours

Full Marks : 300

The figures in the right-hand margin indicate marks.

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

Section – A

1. Answer any **five** of the following :

- (a) Explain product control and control charts for variables. How the 3-sigma control limits for $\bar{X} - \sigma$ is obtained ? 12
- (b) Discuss Hazard function, IFR and DFR with reference to Weibull distribution used in life testing situations. 12

- (c) Explain components of time series and their applications if : 12

time (year)	wt. (production is kg)
1	3
2	5
3	7
4	9

Find production for 3.5 years.

- (d) Discuss Laspeyre's, Paasche's and Fisher Ideal Index Numbers. Discuss Time and Factor reversal test. How Fisher Index is obtained if Laspeyre's and Paasche's is available ? 12
- (e) Express Linear model, least square and generalized least square in method of estimation. For $y = \alpha + \beta x$, find estimates of α and β . If b_{yx} and b_{xy} is available, how r_{xy} (correlation coefficient) can be found ? 12
- (f) Describe official system in agriculture, industry, trade and prices and how the principal publication containing such

statistics is achieved. Discuss various official agencies for data collection in agricultural statistics.

12

2. (a) Describe the methods of construction of np and c charts with Shewhart's method. How and when cumulative sum charts can be applied ?

15

- (b) Explain single and multiple sampling plans for attributes and express their advantages. Also suggest the method for sampling plans for variables.

15

- (c) Express the concepts of producer's and consumer's risk with their applications. Discuss AOQ and ATC curves with their advantages.

15

- (d) (i) Explain LTPD and AOQL with its applications.

- (ii) Dodge-Romig table with their utility. 15

3. (a) In $f(x/\theta) = \frac{1}{\theta} e^{-x/\theta}$, θ is mean life time and an order samples of size n , such that $x_{(1)} < x_{(2)}$

$x_{(r)} < \dots < x_{(n)}$. Here r^{th} order observations are known and $(n - r)$ observations are taken as $x_{(r)}$, obtain the maximum likelihood estimate of θ . Explain truncation situations.

15

(b) Express ARIMA models. How the orders of autoregressive and moving average components can be studied ?

15

(c) Define index number and discuss proportional, time reversal and factor reversal tests with their applications.

15

(d) Define auto-correlation and linear regression models. If $\sum x_i y_i = 100$, $\sum x_i^2 = 50$, $\sum y_i^2 = 250$, $\bar{X} = 50$, $\bar{Y} = 75$, $n = 15$, find the estimate of α and β . Whether these estimates are unbiased ?

15

4. (a) Discuss the problem of multicollinearity. How it can be used in econometric theory ?

15

(b) Express heteroscedasticity of disturbances. How it can be tested ? Give one example of its applications.

15

- (c) Describe official statistics, collection, its reliability and limitations. Suggest the agencies responsible for data collection and its usefulness. 15
- (d) Explain official statistical system in population, agriculture and industrial production. Please express the beginning of these systems in India. 15

Section – B

5. Answer any five of the following :

- (a) Discuss operational research with its different types of models and their applications. 12
- (b) Express simplex procedure and maximize $x_1 + 2x_2 + x_3$ subject to : 12
- $$2x_1 + x_2 - x_3 \leq 2$$
- $$-2x_1 + x_2 - 5x_3 \geq -6$$
- $$4x_1 + x_2 + x_3 \leq 6$$
- $$x_i \geq 0, i = 1, 2, 3$$
- (c) Discuss two-persons zero sum games and express graphical and algebraic solutions of the above. 12

(d) Express Markov chains, finite Markov chains and transient and persistent process with its applications. 12

(e) (i) Life tables and its utility.

(ii) Factor analysis and path analysis.

(iii) z scores and standard scores. 12

(f) Abridged life tables and its constructions.

12

6. Answer any **three** sub-parts of the following :

(a) (i) Express duality theory of linear programming and its economic interpretation. 12

(ii) Describe slack and surplus variables. 8

(b) Describe matrix and transition probability matrix. How is it used in Marketing Problem ? 20

(c) (i) Express $M|M|1$ or $G|M|1$ process and its utilities. 12

(ii) Define accessible state and discuss the properties of states. 8

- (d) (i) $\{X_n\}$ be a Markov chain with state space $\{0, 1, 2\}$ initial probability vector $P^{(0)} = \left\{ \frac{1}{4}, \frac{1}{2}, \frac{1}{4} \right\}$ and one step transition

$$\text{matrix } P = \begin{bmatrix} \frac{1}{4} & \frac{3}{4} & 0 \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ 0 & \frac{1}{4} & \frac{3}{4} \end{bmatrix} \text{ show that } \Pr [x_1 =$$

$$1 \text{ and } x_2 = 1 \mid x_0 = 0] = p_{01} p_{11}. \quad 12$$

- (ii) Express Poisson process. What are the ways of characterising the Poisson process ? 8

7. Answer any **three** of the following :

- (a) (i) Discuss Indian 2011 census and finding. 8

- (ii) N.S.S. and surveys with their limitations and uses. 12

- (b) Express transportation problem and find the condition for existence of feasible solution. Whether North-West corner rule is a basic solution ? 20

- (c) (i) Express vital statistics. Discuss stable and quasi-stable population techniques in estimation of demographic parameters. 10

- (ii) Describe measures of fertility, morbidity rate and standard death rate. Find the relationship between Net-reproduction rate and General reproduction rate. 10
- (d) Describe health surveys in connection with hospital statistics and health statistics. Discuss Arithmetic, Geometric and Harmonic mean and prove that $G^2 = A \cdot H$. 20

8. Answer any **three** of the following :

- (a) Explain periodogram analysis. How it is used for elimination of cyclical component in time series ? 20
- (b) Discuss the steady state difference equations for (∞ /FIFO) and obtain the probability distribution under steady state conditions in the above. 20
- (c) (i) Define a Queue. Briefly explain the important characteristics of a queueing system. 15
- (ii) Describe industrial production. 5
- (d) (i) Describe intelligence quotient and its measurement and uses. 12
- (ii) Validity of test score and its determination. 8

