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S. No. of Question Paper : 1858

Unique Paper Code : 237202

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Name of the Paper : STHT-204/Applied Statistics I

Name of the Course : B.Sc. (H) Statistics

Semester : II

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt six questions in all. Question No. 1 is compulsory.

Select two questions from Section A and three from Section B.

Use of simple calculators and finance tables is allowed.

1. (i) Explain the concept of indifference curves clearly stating the properties.
- (ii) Show that if price relatives are constant, then the weighting system index numbers is irrelevant.
- (iii) If η_1 and η_2 be the price elasticities of supply laws :

$$p = e^x \text{ and } p = \frac{e^x}{x}$$

show that :

$$\eta_1 \eta_2 = \eta_1 - \eta_2$$

- (iv) If MR is Rs. 26 and elasticity of demand with respect to price is 3, find AR.

P.T.O.

- (v) If p_t be the price, x_t the per capita quantity, y_t the per capita disposal income at time t and the demand function is :

$$\log p_t = 0.618 - 2.27 \log x_t + 1.31 \log y_t.$$

then compute the price elasticity and income elasticity of demand.

- (vi) Define wholesale price index number and give the formula to calculate it.
- (vii) Find the time required for Rs. 2500 to yield Rs. 300 in simple interest at 8%. 2,2,2,2,2,2,3

Section A

2. (a) Let $X_j =$ price relatives $= \frac{p_{ij}}{p_{oj}}$, $Y_j =$ quantity relatives $= \frac{q_{ij}}{q_{oj}}$, $V_{oi} =$ value index

$$\text{number} = \frac{\sum p_{ij} q_{ij}}{\sum p_{oj} q_{oj}}, \text{ and } w_j = \text{weight of } X_j \text{ and } Y_j = p_{oj} q_{oj} \quad (j = 1, 2, \dots, n).$$

Show that :

$$\frac{P_{oi}^L}{P_{oi}^P} = 1 - \frac{r_{XY} \sigma_X \sigma_Y}{V_{oi}},$$

where r_{XY} is the weighted correlation coefficient between X and Y and σ_X and σ_Y are the weighted standard deviations of X and Y respectively. Deduce the conditions under which Laspeyre's price index is greater than, equal to or less than Paasche's price index.

- (b) Outline the mathematical tests for an ideal index number. Illustrate these tests with respect to Fisher's ideal index number.

3. (a) Describe the problems in the construction of index numbers with special reference to :
- (i) Selection of commodities; and
 - (ii) Selection of base period.
- (b) Define Pareto's law of distribution of income and obtain its Lorenz curve. What is the concentration ratio for $r = 1.5$? Give its physical interpretation. 6,6
4. (a) Define the price elasticity of demand and income elasticity of demand. Point out their uses in economics and statistical analysis. The demand function for a commodity X is given by :

$$x = 300 - 0.5 p_x^2 + 0.02 p_0 + 0.05 y$$

where x is the quantity demanded of X, p_x is the price of X, p_0 the price of a related commodity and y is the constant income. Compute :

- (i) The price elasticity of demand for X
 - (ii) The income elasticity of demand for X when $p_x = 12$, $p_0 = 10$ and $y = 200$.
- (b) Demand function for a commodity X is given by :

$$D(x) = 300 - \frac{p_x^2}{2} + \frac{p_y}{50} + \frac{y}{20},$$

where p_x is the price of the commodity, p_y is the price of related commodity and y is the income of the consumer. Find the cross elasticity of demand for X when $p_x = 10$, $p_y = 15$ and $y = 300$. 6,6

P.T.O.

Section B

5. (a) Given the production function $q = f(L, K)$, where L and K are the variable inputs and the cost function $C = wL + rK + b$, where w = wage rate of labour, r = price of capital, b = cost. Derive the first order and second order conditions for maximum profit, when the firm sells in a perfectly competitive market.
- (b) Find the ratio of the marginal utility for two goods x_1 and x_2 when the utility function :

$$U = ax_1 + bx_2 + c\sqrt{x_1 x_2}.$$

Verify that the same result is obtained when the utility function is :

$$U = \log (ax_1 + bx_2 + c\sqrt{x_1 x_2}) \quad | \quad 6,6$$

6. (a) A production function is given by :

$$q = 4 L^{2/3} K^{1/3},$$

where L is labour and K is capital :

- (i) Find the behaviour of the marginal product of each factor.
- (ii) What is the nature of returns to scale ?
- (iii) What is the reward of labour and capital if each factor is paid a price equal to its marginal product ?
- (b) The demand and supply functions for a commodity are given by $p = 24 e^{-x}$ and $p = 3 e^{x/2}$ respectively. Determine the consumer's and producer's surplus. 8,4

7. (a) An individual's utility function for two goods is given below :

$$U = (x + 2) (y + 1)$$

It is given that $p_x = \text{Rs. } 4$, $p_y = \text{Rs. } 6$ and the individual fixed income is Rs. 130.

Using Lagrange multiplier's method, find the optimal levels of purchase of two commodities.

Is the second order condition for maximum utility satisfied ?

- (b) After producing 35 units, a company determines that its production facility is following a learning curve of the form $f(x) = 300 - 900e^{-2x}$, where $f(x)$ is the rate of labour hours required to produce the x th unit. How many total labour hours would be required to produce an additional 25 units. 8,4

8. (a) According to the will of a man, his life insurance of Rs. 40,000 should be deposited soon after his death. The bank has to pay Rs. 5,000 annually to his heir and if the interest is 5% per annum compounded continuously, how many annual payments could be made ?

- (b) Mr. X secured two loans from the bank, one for Rs. 8,000 due in 3 years and one for Rs. 15,000 due in 6 years, both at an interest of 10% per annum compounded semiannually. The bank has agreed to allow the two loans to be consolidated into one loan payable in 5 years at the same interest. What amount will Mr. X be required to pay the bank at the end of 5 years ? 6,6