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2 SEM TDC ECOH (CBCS) C 4

2023

(May/June)

ECONOMICS

(Core)

Paper : C–4

(Mathematical Methods in Economics—II)

Full Marks : 80

Pass Marks : 32

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer/Answer the following : 1×8=8

(a) The time path of price is convergent when

(i) slope of supply curve is steeper than the demand curve

(ii) slope of demand curve is greater than the slope of supply curve

(iii) slope of demand curve is equal to slope of supply curve

(iv) None of the above

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(b) Select the correct statement.

(i) The value of a determinant changes if the rows and columns are interchanged.

(ii) If two rows of a determinant are identical, the value of the determinant will be non-zero.

(iii) If any two rows are interchanged, the sign of the determinant will alter, but numerical value will remain same.

(iv) All of the above

(c) If $|A| \neq 0$, then A is

(i) zero matrix

(ii) singular matrix

(iii) non-singular matrix

(iv) diagonal matrix

(d) If the total cost function is

$$C = 2Q^3 - 15Q^2 + 30Q + 16$$

then the AVC will be

(i) $6Q^2 - 30Q + 30$

(ii) $2Q^2 - 15Q + 30 + \frac{16}{Q}$

(iii) $2Q^2 - 15Q + 30$

(iv) 16

(e) The profit maximization in multi-product firm, producing two products, requires that

(i) $|H_1| > 0$ and $|H_2| < 0$

(ii) $|H_1| > 0$ and $|H_2| > 0$

(iii) $|H_1| < 0$ and $|H_2| = 0$

(iv) $|H_1| < 0$ and $|H_2| > 0$

(f) Define homogeneous production function.

(g) The cross elasticity of demand in case of complementary goods is

(i) positive

(ii) negative

(iii) independent

(iv) zero

(h) The least cost combination of inputs requires

(i) slope of indifference curve = slope of budget line

(ii) slope of isoquant = slope of isocost curve

(iii) the isoquant is convex to the origin

(iv) Both (ii) and (iii)

2. Answer any *four* of the following : 4×4=16

(a) Write a note on economic application of first-order difference equation.

(b) Explain briefly the inverse of a matrix and its properties.

(c) Prove that for any scalar λ,

$$\lambda(A+B) = \lambda A + \lambda B$$

(d) What is meant by Constant Elasticity of Substitution (CES) production function? Prove that CES production function is a linear homogeneous function.

(e) The marginal revenue and marginal cost functions of a firm are given as

$$MR = 25 - \frac{1}{2}Q$$

$$MC = 0 \cdot 2Q^2 - \frac{1}{3}Q + 2$$

and total fixed cost is 10. Find out total profit when the firm produces and sells 10 units of output.

3. *(a)* *(i)* Solve the difference equation $Y_{t+1} - Y_t = 10$ and $Y_0 = 5$. 4

(ii) In a Cobweb model

$$Q_{dt} = a - bP_t \quad (a, b > 0)$$
$$Q_{st} = -c + dP_{t-1} \quad (c, d > 0)$$
$$Q_{dt} = Q_{st}$$

Obtain the time path P_t and analyze the condition for its convergence. 7

Or

(b) *(i)* Given, slope of demand curve $|\alpha| = 3$ and slope of supply curve $|\beta| = 4$. Determine whether equilibrium is stable. 1

(ii) Given the demand and supply function as

$$3X_{dt} = 20 - P_t$$
$$3X_{st} = -20 + 7P_{t-1}$$

Find the equilibrium price, the time path and determine, whether or not the equilibrium is stable. 7

(iii) Solve the following difference equation by iterative method : 3

$$Y_{t+1} - Y_t = 5 \text{ and } Y_0 = 10$$

4. *(a)* *(i)* Define rank of a matrix. 1

(ii) Evaluate the following determinant : 3

$$\begin{vmatrix} 1 & 1 & 3 \\ 2 & -2 & 1 \\ 1 & 0 & -2 \end{vmatrix}$$

(iii) Solve the following national income model using Crammer's rule : 6

$$Y = C + I_0 + G_0$$
$$C = \alpha + \beta(Y - T) \quad (\alpha > 0,\ 0 < \beta < 1)$$
$$T = \gamma + \delta Y \quad (\gamma > 0;\ 0 < \delta < 1)$$

Or

(b) *(i)* Find the inverse of the following matrix A : 4

$$A = \begin{bmatrix} 2 & 0 & -5 \\ 4 & 1 & 2 \\ -3 & 0 & 1 \end{bmatrix}$$

(ii) Solve the following system of simultaneous equations by matrix inversion : 6

$$4x_1 + 2x_2 - x_3 = 40$$
$$2x_1 + 3x_2 = 43$$
$$x_1 + 3x_3 = 38$$

5. *(a)* *(i)* Distinguish between Cobb-Douglas production function and CES production function. State and prove the properties of Cobb-Douglas production function. 2+10=12

(ii) Mention two important reasons as to why CES production function is superior to Cobb-Douglas production function. 2

Or

(b) *(i)* Given $z = \dfrac{(3x - y)}{(x^3 + 3y)}$. Find $\dfrac{\delta z}{\delta x}$ and $\dfrac{\delta z}{\delta y}$. 4

(ii) If the total cost of a function is given by $TC = 100 - 2q + 0 \cdot 5q^2$, show that the slope of average cost curve is negative when output is less than 10. 6

(iii) A consumer has a utility function

$$u = u(Q) = \alpha Q^{\beta}, \quad \alpha > 0; \; 0 < \beta < 1$$

Does the utility function display diminishing marginal utility? 4

6. *(a)* A monopolist produces two products Q_1 and Q_2 jointly. His cost function is

$$TC = Q_1^2 + \frac{1}{4} Q_2^2 + 20 Q_1 Q_2 + 10$$

$$AR_1 = 32 - 3Q_1$$
$$AR_2 = 16 - 4Q_2$$

Find profit maximizing output and maximum profit. 7+3=10

Or

(b) A monopolist has the following total revenue (R) and total cost (C) functions :

$$R = 30q - q^2$$
$$C = q^3 - 15q^2 + 10q + 100$$

Find *(i)* profit maximizing output, *(ii)* maximum profit and *(iii)* point elasticity of demand at equilibrium level of output. 4+3+3=10

7. *(a)* *(i)* Using Lagrange multiplication method, find the extreme value of the function

$$Y = x_1^2 + x_1 x_2 + \frac{3}{2} x_2^2$$

subject to $x_1 + 2x_2 = 14$. 5

(ii) A consumer has a utility function $u = xy$, where x and y are the goods purchased and his budget constraint is given by $B = xP_x + yP_y$. Find out demand functions for x and y. 6

Or

(b) Cost and production function of a firm that wants to produce 64 units at minimum cost are respectively $C = 2L + 4K$ and $Q = 8L^{1/4}K^{1/2}$. Find the quantity of K and L. 11

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