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Name.....

Reg. No.....

FIRST SEMESTER M.A. DEGREE EXAMINATION, DECEMBER 2016

(CCSS)

Economics

ECO 1C 03—MATHEMATICS FOR ECONOMICS

(2013 Admissions)

Time : Three Hours

Maximum : 80 Marks

Part A

*Answer all questions.
Each question carries 1 mark.*

1. For the Cobb-Douglas production function of the form $Q = AL^\alpha K^\beta$, the marginal product of capital $\left(\frac{\partial Q}{\partial K}\right)$ is derived as :
 - (a) $\alpha AL^\alpha K^{\beta-1}$.
 - (b) $\alpha AL^{\alpha-1} K^\beta$.
 - (c) $\beta AL^\alpha K^{\beta-1}$.
 - (d) $\beta AL^\alpha K^{1-\beta}$.
2. The total Revenue function of a monopolist with the marginal revenue function $MR = 10 - 4Q$ is
 - (a) $10Q - 2Q^2 + C$.
 - (b) $5Q^2 - 2Q^2 + C$.
 - (c) $\frac{1}{10}Q - \frac{1}{2}Q^2 + C$.
 - (d) $\frac{1}{5}Q^2 - \frac{1}{2}Q^2 + C$.
3. A matrix is said to be singular if :
 - (a) We can find its inverse matrix.
 - (b) It has a non-zero determinant.
 - (c) The value of its determinant is zero.
 - (d) None of the above.
4. An equation that relates consecutive terms of a sequence of numbers is known as :
 - (a) Difference equation.
 - (b) Differential equation.
 - (c) Simultaneous equation.
 - (d) None of the above.

Turn over

5. Which of the following is an identity matrix ?

(a) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$.

(b) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.

(c) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$.

(d) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 0 \end{bmatrix}$.

$$\frac{5}{8} \times \frac{3}{5} = \frac{15}{40} = \frac{3}{8}$$

6. Box A contains 5 red marbles and 3 blue marbles, and Box B contains 3 red and 2 blue marbles. A marble is drawn at random from each box. What is the probability that both marbles are red ?

(a) $\frac{5}{8}$.

(c) $\frac{3}{8}$.

(b) $\frac{49}{40}$.

(d) $\frac{8}{13}$.

$$\frac{1}{2} \times \frac{5}{8} + \frac{3}{5} \times \frac{1}{2}$$

7. Let X be a random variable with mean μ and standard deviation $\sigma > 0$. Then the standardized random variable Z is defined by :

(a) $X = \frac{z - \mu}{\sigma}$.

(b) $Z = \frac{x - \mu}{\sigma}$.

(c) $X = \frac{\mu - z}{\sigma}$.

(d) $Z = \frac{\sigma - \mu}{x}$.

$$\frac{5}{16} + \frac{3}{10}$$

$$\frac{25 + 24}{80} = \frac{49}{80}$$

8. In a normal curve, the ordinate is highest at :

(a) Mean.

(b) Variance.

(c) Standard deviation.

(d) Q_1 .

$$\frac{49}{80}$$

9. If the slope of the regression line is calculated to be 2.5 and the intercept 16 then the value of dependent variable Y when independent variable X is 4 is :

(a) 66.5.

(b) 26.

(c) 16.

(d) 2.5.

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10. The method of least squares dictates that we choose a regression line where the sum of the square of deviations of the points from the line is :

(a) Maximum.

(b) Minimum.

(c) Zero.

(d) Positive.

Part B

Answer any **eight** questions.
Each question carries 5 marks.

11. Explain the important properties of a determinant in matrix algebra.
12. Find the characteristic roots and determine the sign definiteness of matrix $A = \begin{bmatrix} 6 & 2 \\ 2 & 2 \end{bmatrix}$.
13. A monopolist has inverse demand function $P = 150 - 2x$. His total cost is $C = 1.1x^3 - 3x^2 + 5x + 100$. What is the profit maximizing price and output ?
14. Determine the elasticity of demand when the price falls from 136 to 119, given the demand function $P = 200 - Q^2$.
15. A firm's short-run production function is given by $Q = 300L^2 - L^4$, where L denotes the number of workers. Find the size of the workforce that maximizes the average product of labour (AP_L).
16. Given $MC = \frac{dTC}{dQ} = 32 + 18Q - 12Q^2$, and fixed cost is 43. Find the total cost function.
17. For the matrix $A = \begin{bmatrix} 5 & 0 & 2 \\ 3 & 4 & 5 \\ 2 & 1 & 2 \end{bmatrix}$ derive the adjoint matrix.
18. Given the set of simultaneous equations :

$$3x_1 + 4x_2 + 9x_3 = 45$$

$$5x_2 + 2x_3 = 32$$

$$4x_1 + 2x_2 + 4x_3 = 32.$$

Use Cramer's rule to find the value of x_2 only.

19. The equilibrium prices P_1 and P_2 for two goods satisfy the equations :

$$9P_1 + P_2 = 43$$

$$2P_1 + 7P_2 = 57.$$

Express this system in matrix form and hence find the values of P_1 and P_2 .

20. Solve the differential equation $\frac{dy}{dt} = -2y + 100$ in the case when the initial condition is $y(0) = 10$.

Turn over

21. A player tosses two fair coins. The player wins Rs. 2 if 2 heads occur, and Re. 1 if 1 head occurs. On the other hand, the player loses Rs. 3 if no heads occur. Find the expected value of the game.
22. Let X be a random variable with distribution :

X	1	2	3
$P(X = x)$	0.3	0.5	0.2

Find the Mean, Variance and Standard Deviation of X .

(8 × 5 = 40 marks)

Part C

Answer any **two** questions.
Each question carries 15 marks.

23. The probability that A hits a target is $\frac{1}{3}$ and the probability that B hits a target is $\frac{1}{5}$. They both fire at the target. Find the probability that :
- A does not hit the target.
 - Both hit the target.
 - One of them hits the target.
 - Neither hits the target.
24. For a firm, each unit of capital and labour cost Rs. 10 and Rs. 20 respectively. The total input costs are fixed at Rs. 1,600. If the firm faces a production function given by $Q = 4LK + L^2$, find the levels of K and L when the firm maximizes its output. Also find the maximum output.
25. Use Lagrange multipliers to find expressions for K and L which maximize output given by a Cobb-Douglas production function $Q = AL^\alpha K^\beta$ (A, α and β are positive constants), subject to a cost constraint $P_K K + P_L L = M$ (P_K price of capital, P_L price of labour and M is the total budget for the producer).
26. Use matrix inversion to solve for the unknowns in the system of linear equations given below :

$$5x_1 - 2x_2 + 3x_3 = 16$$

$$2x_1 + 3x_2 - 5x_3 = 2$$

$$4x_1 - 5x_2 + 6x_3 = 7.$$

(2 × 15 = 30 marks)