Quiz 02 (Set C)

SIAS, Krea University (AY 2025-26)

Mathematical Methods for Economics (Course Code: **ECON211**)

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Multiple Choice Questions

1. (1 point) Find the roots of the following quadratic equation: $4x^2 - 32x - 80 = 0$.

   A. $(-2, -10)$

   B. $(2, 10)$

   C. No real roots exist

   D. $(-2, 10)$

   Answer: D

Solution:

$$\begin{aligned}
4x^2 - 32x - 80 &= 0 \\
4(x^2 - 8x - 20) &= 0 && \text{(taking 4 as a common factor)} \\
x^2 - 8x - 20 &= 0 && \text{(getting rid of a constant is kosher)} \\
x^2 - 10x + 2x - 20 &= 0 && \text{(since } -8x = -10x + 2x\text{)} \\
x(x-10) + 2(x-10) &= 0 \\
(x-10)(x+2) &= 0 \\
x = 10 \text{ or } x &= -2
\end{aligned}$$

Answer: $\boxed{x = 10, -2}$

2. (1 point) Consider the following statements:

   Statement (i): The set of equations: $\boxed{2x + 3y = 7}$ and $\boxed{4x - 6y = 2}$ has a unique solution.

   Statement (ii): The set of equations: $\boxed{4x - y = 3}$ and $\boxed{-28x + 7y = 21}$ has infinitely many solutions.

   A. Both (i) and (ii) are correct.

   B. Statement (i) is correct but statement (ii) is incorrect.

   C. Statement (ii) is correct but statement (i) is incorrect.

   D. Both (i) and (ii) are incorrect.

   Answer: B

Solution: Consider the first equation from Statement (i).

$$\begin{aligned}
2x + 3y &= 7 \\
\implies 4x + 6y &= 14 && \text{(multiplying the equation by 2)} \\
4x - 6y &= 2 && \text{(writing the second equation as it is)} \\
\implies 8x &= 16 && \text{(adding the two equations)} \\
\implies x &= 2 \\
2(2) + 3y &= 7 && \text{(plugging the value of } x \text{ in the first equation)} \\
\implies 3y &= 3 \\
\implies y &= 1
\end{aligned}$$

There does exist a unique solution. Therefore, the statement is correct.

Consider the second equation from Statement (ii).

$$\begin{aligned}
-28x + 7y &= 21 \\
\implies 4x - y &= -3 && \text{(dividing both sides by -3)}
\end{aligned}$$

This is incompatible with $4x - y = -3$. Therefore, this set doesn't have any solution. So, this assertion is incorrect.

3. (1 point) Identify the element a_{35} in the following matrix:

$$A = \begin{bmatrix} 0 & 1 & 3 & 6 \\ 1 & 2 & 3 & 9 \\ 7 & 5 & 2 & 0 \\ 9 & 4 & 1 & 5 \end{bmatrix}$$

A. 0
B. 1
C. Does not exist
D. 5

Answer: C

Solution: The matrix A is of dimension 4×4. While the third row is very much there, the fifth column doesn't exist. Therefore, the element a_{35} doesn't exist.

Short Answer Questions-I

4. (1 point) There are two matrices A and B such that:

$$A = \begin{bmatrix} x+5 & 0 & 3 \\ 4 & 0.6y & 8 \end{bmatrix}, \quad B = \begin{bmatrix} 6 & 5 & 0.5 \\ 10 & 2 & -10 \end{bmatrix}, \quad 2A + B = \begin{bmatrix} 14 & 5 & 6.5 \\ 18 & 3.2 & 6 \end{bmatrix}$$

Find x and y.

Solution: Using equality of matrices, we can write:

$$\begin{aligned} 2(x+5)+6 &= 14 \\ \implies 2(x+5) &= 8 \\ \implies x+5 &= 4 \\ \implies x &= 4-5 \\ \implies x &= -1 \end{aligned} \qquad \begin{aligned} 2(0.6y)+2 &= 3.2 \\ \implies 1.2y &= 1.2 \\ \implies y &= 1 \end{aligned}$$

Answer: $\boxed{x=-1}$, $\boxed{y=1}$

5. (1 point) Solve for x and y:

$$\begin{aligned} 5x - 6y &= 3 \\ x + 3y &= 2 \end{aligned}$$

Solution:

$$\begin{aligned} 2x + 6y &= 4 && \text{(multiplying the second equation by 2)} \\ 5x - 6y &= 3 && \text{(writing the first equation as it is)} \\ \implies 7x &= 7 && \text{(adding the two equations)} \\ \implies x = 11 + 3y &= 2 && \text{(plugging the value of } x \text{ in the second equation)} \\ \implies 3y &= 1 && \text{(transferring 1 to the RHS)} \\ \implies y &= \frac{1}{3} \end{aligned}$$

Answer: $\boxed{x=1}$, $\boxed{y=\frac{1}{3}}$

6. (1 point) Let $A = \begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 0 \\ 6 & 7 \end{bmatrix}$. Compute AB.

Solution: Let

$$C = AB = \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}$$

$$\begin{aligned} c_{11} &= (2 \times -1) + (1 \times 6) = 4 \\ c_{12} &= (2 \times 0) + (1 \times 7) = 7 \\ c_{21} &= (3 \times -1) + (4 \times 6) = 21 \\ c_{22} &= (3 \times 0) + (4 \times 7) = 28 \end{aligned}$$

Answer:

$$AB = \begin{bmatrix} 4 & 7 \\ 21 & 28 \end{bmatrix}$$

Short Answer Questions-II

7. (2 points) Given the following supply and demand equations:

$$P = 2Q_S^2 + 9Q_S + 10$$
$$P = -Q_D^2 - 3Q_D + 73$$

Calculate the equilibrium price and quantity.

Solution: We know that, at equilibrium, the following is true:

$$\begin{aligned} \text{Supply} &= \text{Demand} \\ Q_S = Q_D &= Q \end{aligned}$$

Therefore,

$$\begin{aligned} 2Q^2 + 9Q + 10 &= -Q^2 - 3Q + 73 \\ \implies 3Q^2 + 12Q - 63 &= 0 && \text{(rerranging terms)} \\ \implies Q^2 + 4Q - 21 &= 0 && \text{(dividing both sides by 3)} \\ \implies Q^2 + 7Q - 3Q - 14 &= 0 && \text{(since } 4Q = 7Q - 3Q\text{)} \\ \implies Q(Q+7) - 3(Q+7) &= 0 \\ \implies (Q+7)(Q-3) &= 0 && \text{(since } a(b+k) - c(b+k) = (a-c)(b+k)\text{)} \\ \implies Q^* &= 3 && \text{(since quantities cannot be negative)} \\ P^* &= 2(Q^*)^2 + 9Q^* + 10 && \text{(using the supply equation)} \\ \implies P^* &= 2(3)^2 + 9 \times 3 + 10 && \text{(since } Q^* = 3\text{)} \\ \implies P^* &= 55 \end{aligned}$$

Answer: $\boxed{Q^* = 3}$, $\boxed{P^* = 55}$

8. (2 points) Use Cramer's rule **OR** matrix inverse method to solve the following set of equations:

$$7x_1 + 5x_2 = 12$$
$$3x_1 - 9x_2 = -6$$

Solution: **Cramer's Rule**

First, write all the matrices you need.

$$A = \begin{bmatrix} 7 & 5 \\ 3 & -9 \end{bmatrix}, \quad B = \begin{bmatrix} 12 \\ -6 \end{bmatrix}, \quad X = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

We also need D_{x_1} and D_{x_2}.

$$D_{x_1} = \begin{vmatrix} 12 & 5 \\ -6 & -9 \end{vmatrix}$$
$$D_{x_2} = \begin{vmatrix} 7 & 12 \\ 3 & -6 \end{vmatrix}$$
$$|A| = \begin{vmatrix} 7 & 5 \\ 3 & -9 \end{vmatrix} = -78$$

Therefore,

$$x_1 = \frac{D_{x_1}}{|A|}$$
$$x_2 = \frac{D_{x_2}}{|A|}$$
$$D_{x_1} = -78$$
$$D_{x_2} = -78$$
$$\implies x_1 = 1, \quad x_2 = 1$$

Matrix Inverse Method

We know that $X = A^{-1}B$ and $A^{-1} = \dfrac{adj(A)}{|A|}$.

$$A^{-1} = \frac{1}{-78}\begin{bmatrix} -9 & -5 \\ -3 & 7 \end{bmatrix} \implies A^{-1}B = \frac{1}{78}\begin{bmatrix} -9 & -5 \\ -3 & 7 \end{bmatrix} \times \begin{bmatrix} 12 \\ -6 \end{bmatrix}$$
$$\implies A^{-1}B = \frac{1}{-78}\begin{bmatrix} (-9 \times 12) + (-5 \times -6) \\ (-3 \times 12) + (7 \times -6) \end{bmatrix}$$
$$\implies A^{-1}B = \frac{1}{-78}\begin{bmatrix} -78 \\ -78 \end{bmatrix}$$
$$\implies A^{-1}B = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$
$$\implies X = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

Answer: $\boxed{x_1 = 1}$, $\boxed{x_2 = 1}$.