Quiz 02 (Set B)

SIAS, Krea University (AY 2025-26)

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

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Multiple Choice Questions

1. (1 point) Consider the following statements:

Statement (i): The set of equations: $\boxed{2x + 3y = 5 \text{ and } 4x - 6y = -2}$ has a unique solution.

Statement (ii): The set of equations: $\boxed{4x - y = 3 \text{ and } -28x + 7y = 21}$ does not have any solution.

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 statements are incorrect.

Answer: A

Solution: Consider the first set of equations.

$$
\begin{aligned}
2x + 3y &= 5 \\
\implies 4x + 6y &= 10 && \text{(multiplying the equation by 2)} \\
4x - 6y &= -2 && \text{(equation two as it is)} \\
8x &= 8 && \text{(adding the previous two equations)} \\
x &= 1 \\
y &= 1 && \text{(using equation one)}
\end{aligned}
$$

The set of equations, indeed, has a solution and, therefore, the assertion 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 also correct.

2. (1 point) Identify the element a_{43} in the following matrix A

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

A. 0
B. 1
C. 2
D. 3

Answer: B

Solution: $a_{43} = 1$.

$$
A = \begin{bmatrix} a_{11} = 0 & a_{12} = 1 & a_{13} = 3 & a_{14} = 6 \\ a_{21} = 1 & a_{22} = 2 & a_{23} = 3 & a_{24} = 9 \\ a_{31} = 7 & a_{32} = 5 & a_{33} = 2 & a_{34} = 0 \\ a_{41} = 9 & a_{42} = 4 & \boxed{a_{43} = 1} & a_{44} = 5 \end{bmatrix}
$$

3. (1 point) Find the roots of the following quadratic equation: $2x^2 + 32x + 128 = 0$.

A. $(-16, 4)$
B. $(-8, 8)$

C. (-8)

D. $(4, -16)$

Answer: C

Solution:

$$
\begin{aligned}
2x^2 + 32x + 128 &= 0 \\
\implies 2(x^2 + 16x + 64) &= 0 && \text{(taking 2 as a common factor)} \\
\implies x^2 + 16x + 64 &= 0 && \text{(getting rid of a constant is kosher)} \\
\implies x^2 + 2(8x) + (8)^2 &= 0 \\
\implies (x+8)^2 &= 0 && \text{(since } (a^2 + 2ab + b^2) = (a+b)^2\text{)} \\
\implies (x+8) &= 0 \\
\implies x &= -8
\end{aligned}
$$

Answer : $\boxed{x = -8}$.

Short Answer Questions-I

4. (1 point) Solve for x and y:

$$
\begin{aligned}
3x - 4y &= -2 \\
6x + 2y &= 6
\end{aligned}
$$

Solution:

$$
\begin{aligned}
12x + 4y &= 12 && \text{(multiplying the second equation by 2)} \\
3x - 4y &= -2 && \text{(writing the first equation as it is)} \\
\implies 15x &= 10 && \text{(adding the two equations we just wrote)} \\
\implies x &= \frac{2}{3} \\
3 \times \frac{2}{3} - 4y &= -2 && \text{(plugging the value of } x \text{ back into the first equation)} \\
\implies 2 - 4y &= -2 \\
\implies -4y &= -4 \\
\implies y &= 1
\end{aligned}
$$

Answer: $\boxed{x = \frac{2}{3}}$, $\boxed{y = 1}$.

5. (1 point) Let $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & -1 \\ 6 & 7 \end{bmatrix}$. Compute BA.

Solution: Let

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

$$
\begin{aligned}
c_{11} &= (0 \times 1) + (-1 \times 3) = -3 \\
c_{12} &= (0 \times 2) + (-1 \times 4) = -4 \\
c_{21} &= (6 \times 1) + (7 \times 3) = 27 \\
c_{22} &= (6 \times 2) + (7 \times 4) = 40
\end{aligned}
$$

Answer:

$$BA = \begin{bmatrix} -3 & -4 \\ 27 & 40 \end{bmatrix}$$

6. (1 point) There are two matrices A and B such that:

$$A = \begin{bmatrix} x+5 & 0 & 3 \\ 4 & 0.6y & 8 \end{bmatrix}, \quad B = \begin{bmatrix} 6 & 5 & 0.5 \\ 10 & 2 & -10 \end{bmatrix}, \quad 2A + B = \begin{bmatrix} 16 & 5 & 6.5 \\ 18 & 5 & 6 \end{bmatrix}$$

Compute x and y.

Solution: Using equality of matrices, we can write:

$$\begin{aligned} 2(x+5)+6 &= 16 \\ \implies 2(x+5) &= 10 \\ \implies x+5 &= 5 \\ \implies x &= 5-5 \\ \implies x &= 0 \end{aligned} \qquad \begin{aligned} 2(0.6y)+2 &= 5 \\ \implies \frac{6}{5}y &= 3 \\ \implies 6y &= 15 \\ \implies y &= \frac{5}{2} \end{aligned}$$

Answer: $\boxed{x = 0}$, $\boxed{y = \frac{5}{2}}$

Short Answer Questions-II

7. (2 points) Use Cramer's rule **OR** matrix inverse method to solve the following set of equations:

$$\begin{aligned} 9x_1 + 7x_2 &= 16 \\ 4x_1 - 5x_2 &= -1 \end{aligned}$$

Solution: Cramer's Rule

First, write all the matrices you need.

$$A = \begin{bmatrix} 9 & 7 \\ 4 & -5 \end{bmatrix}, \quad B = \begin{bmatrix} 16 \\ -1 \end{bmatrix}, \quad X = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

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

$$\begin{aligned} D_{x_1} &= \begin{vmatrix} 16 & 7 \\ -1 & -5 \end{vmatrix} \\ D_{x_2} &= \begin{vmatrix} 9 & 16 \\ 4 & -1 \end{vmatrix} \\ |A| &= \begin{vmatrix} 9 & 7 \\ 4 & -5 \end{vmatrix} = -73 \end{aligned}$$

Therefore,

$$\begin{aligned} x_1 &= \frac{D_{x_1}}{|A|} \\ x_2 &= \frac{D_{x_2}}{|A|} \\ D_{x_1} &= -73 \\ D_{x_2} &= -73 \\ \implies x_1 &= 1, \quad x_2 = 1 \end{aligned}$$

Matrix Inverse Method

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

$$
\begin{aligned}
A^{-1} &= \frac{1}{-73}\begin{bmatrix}-5 & -7\\ -4 & 9\end{bmatrix} \implies A^{-1}B = \frac{1}{-73}\begin{bmatrix}-5 & -7\\ -4 & 9\end{bmatrix} \times \begin{bmatrix}16\\ -1\end{bmatrix}\\
\implies A^{-1}B &= \frac{1}{-73}\begin{bmatrix}(-5\times 16)+(-7\times -1)\\ (-4\times 16)+(9\times -1)\end{bmatrix}\\
\implies A^{-1}B &= \frac{1}{-73}\begin{bmatrix}-73\\ -73\end{bmatrix}\\
\implies A^{-1}B &= \begin{bmatrix}1\\ 1\end{bmatrix}\\
\implies X &= \begin{bmatrix}1\\ 1\end{bmatrix}
\end{aligned}
$$

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

8. (2 points) Given the following supply and demand equations:

$$
\begin{aligned}
\text{Supply: } P &= 2Q_S^2 + 11Q_S + 9\\
\text{Demand: } P &= -Q_D^2 - 7Q_D + 57
\end{aligned}
$$

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,

$$
\begin{aligned}
2Q^2 + 11Q + 9 &= -Q^2 - 7Q + 57\\
\implies 3Q^2 + 18Q - 48 &= 0 && \text{(rerranging terms)}\\
\implies Q^2 + 6Q - 16 &= 0 && \text{(dividing both sides by 3)}\\
\implies Q^2 + 8Q - 2Q - 16 &= 0 && \text{(since } 6Q = 8Q - 2Q\text{)}\\
\implies Q(Q+8) - 2(Q+8) &= 0\\
\implies (Q+8)(Q-2) &= 0 && \text{(since } a(b+k) - c(b+k) = (a-c)(b+k)\text{)}\\
\implies Q^* &= 2 && \text{(since quantities cannot be negative)}\\
P^* &= 2(Q^*)^2 + 10Q^* + 10 && \text{(using the supply equation)}\\
\implies P^* &= 2(2)^2 + 11\times 2 + 9 && \text{(since } Q^* = 2\text{)}\\
\implies P^* &= 39
\end{aligned}
$$

Answer: $\boxed{Q^* = 2}$, $\boxed{P^* = 39}$