Lista 3 - Geometria Analítica

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Filipe Carvalho

1. Considere a matriz $A=(a_{ij})_{3\times3}$, tal que

$$a_{ij}=\begin{cases} i+j, & i<j \\ 2i-j, & i=j \\ j-i, & i>j \end{cases}$$

Determine X na equação matricial $AX=B$, onde $B=\begin{bmatrix}-1\\2\\-3\end{bmatrix}$

$$A=\begin{bmatrix}a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{bmatrix}=\begin{bmatrix}1 & 3 & 4\\ -1 & 2 & 5\\ -2 & -1 & 3\end{bmatrix}$$

$$\det(A)=\left|\begin{matrix}1 & 3 & 4\\ -1 & 2 & 5\\ -2 & -1 & 3\end{matrix}\right|\begin{matrix}1 & 3\\ -1 & 2\\ -2 & -1\end{matrix} = 6-30+4+9+5+16$$

10, 19, 24, 40

$$= 10$$

$\det(A_1)$

$$\left|\begin{matrix}-1 & 3 & 4\\ 2 & 2 & 5\\ -3 & -1 & 3\end{matrix}\right|\begin{matrix}-1 & 3\\ 2 & 2\\ -3 & -1\end{matrix} = \cancel{-6}-45-8-\cancel{18}-5+\cancel{24}$$

-24

-53

$\boxed{-58}$

$$\boxed{x_1=\frac{-58}{10}}$$

$\det(A_2)$

$$\left|\begin{matrix}1 & -1 & 4\\ -1 & 2 & 5\\ -2 & -3 & 3\end{matrix}\right|\begin{matrix}1 & -1\\ -1 & 2\\ -2 & -3\end{matrix} = 6+10+12-3+15+16$$

22 22 30 -6

37 34

40 56

$$\boxed{x_2=\frac{56}{10}}$$

$\det(A_3)$

$$\left|\begin{matrix}1 & 3 & -1\\ -1 & 2 & 2\\ -2 & -1 & -3\end{matrix}\right|\begin{matrix}1 & 3\\ -1 & 2\\ -2 & -1\end{matrix} = -6-12-1-9+2-4$$

-18 -19 -28 -26 -30

$$\boxed{x_3=\frac{-30}{10}=-3}$$

$$X=\begin{bmatrix}\frac{-58}{10}\\ \frac{-56}{10}\\ -3\end{bmatrix}$$

2. Resolva as equações matriciais usando inversão de matrizes.

a) $\begin{bmatrix}1 & 4\\ 2 & 3\end{bmatrix} X = \begin{bmatrix}-1\\ -1\end{bmatrix}$ $X = \begin{bmatrix}3 & -4\\ -2 & 1\end{bmatrix} \cdot \frac{1}{-5} \cdot \begin{bmatrix}-1\\ -1\end{bmatrix}$ $\begin{bmatrix}-\frac{3}{5} & \frac{4}{5}\\ \frac{2}{5} & -\frac{1}{5}\end{bmatrix} \cdot \begin{bmatrix}-1\\ -1\end{bmatrix} = \begin{bmatrix}(\frac{3}{5} - \frac{4}{5})\\ (-\frac{2}{5} + \frac{1}{5})\end{bmatrix} = \begin{bmatrix}-\frac{1}{5}\\ -\frac{1}{5}\end{bmatrix}$

b) $A + BY = C \rightarrow BY = C - A \quad Y = B^{-1} \cdot (C - A)$

$B^{-1} = \frac{1}{-1}\begin{bmatrix}5 & -3\\ -2 & 1\end{bmatrix} = \begin{bmatrix}-5 & 3\\ 2 & -1\end{bmatrix}$

$Y = \begin{bmatrix}-5 & 3\\ 2 & -1\end{bmatrix} \cdot \left(\begin{bmatrix}1 & 7\\ 2 & 7\end{bmatrix} - \begin{bmatrix}2 & 3\\ 5 & 5\end{bmatrix}\right) = \begin{bmatrix}-5 & 3\\ 2 & -1\end{bmatrix} \cdot \begin{bmatrix}-1 & 4\\ -3 & 2\end{bmatrix} = \begin{bmatrix}-4 & -16\\ 1 & 6\end{bmatrix}$

c) $\underset{A}{\begin{bmatrix}1 & 0 & 0\\ 2 & 1 & 0\\ 2 & 3 & 1\end{bmatrix}} W = \underset{B}{\begin{bmatrix}5\\ 7\\ 2\end{bmatrix}}$ $W = A^{-1} \cdot B$

$\det(A) = 1 \cdot 1 \cdot 1 = 1$

$\text{cof}(A) = \begin{bmatrix}\tilde{a}_{11} & \tilde{a}_{12} & \tilde{a}_{13}\\ \tilde{a}_{21} & \tilde{a}_{22} & \tilde{a}_{23}\\ \tilde{a}_{31} & \tilde{a}_{32} & \tilde{a}_{33}\end{bmatrix}$

$\tilde{a}_{11} = (-1)^2 \cdot \begin{vmatrix}1 & 0\\ 3 & 1\end{vmatrix} = 1$ $\quad \tilde{a}_{21} = (-1)^3 \cdot \begin{vmatrix}0 & 0\\ 3 & 1\end{vmatrix} = 0$

$\tilde{a}_{12} = (-1)^3 \cdot \begin{vmatrix}2 & 0\\ 2 & 1\end{vmatrix} = -2$ $\quad \tilde{a}_{22} = (-1)^4 \cdot \begin{vmatrix}1 & 0\\ 2 & 1\end{vmatrix} = 1$

$\tilde{a}_{13} = (-1)^4 \cdot \begin{vmatrix}2 & 1\\ 2 & 3\end{vmatrix} = 4$ $\quad \tilde{a}_{23} = (-1)^5 \cdot \begin{vmatrix}1 & 0\\ 2 & 3\end{vmatrix} = -3$

$\tilde{a}_{31} = (-1)^4 \cdot \begin{vmatrix}0 & 0\\ 1 & 0\end{vmatrix} = 0$ $\quad \tilde{a}_{32} = (-1)^5 \cdot \begin{vmatrix}1 & 0\\ 2 & 0\end{vmatrix} = 0$ $\quad \tilde{a}_{33} = (-1)^6 \cdot \begin{vmatrix}1 & 0\\ 2 & 1\end{vmatrix} = 1$

$\text{cof}(A) = \begin{bmatrix}1 & -2 & 4\\ 0 & 1 & -3\\ 0 & 0 & 1\end{bmatrix}^t = \begin{bmatrix}1 & 0 & 0\\ -2 & 1 & 0\\ 4 & -3 & 1\end{bmatrix}$

$W = \begin{bmatrix}1 & 0 & 0\\ -2 & 1 & 0\\ 4 & -3 & 1\end{bmatrix} \cdot \begin{bmatrix}5\\ 7\\ 2\end{bmatrix} = \begin{bmatrix}5\\ -3\\ 1\end{bmatrix}$

3. Sejam A, B e C matrizes inversíveis de mesma ordem, resolva as equações em X.

a) $AXB = C \rightarrow (AB)X = C \quad X = (AB)^{-1} \cdot C \quad X = A^{-1} \cdot B^{-1} \cdot C$

b) $A(B+X) = A \rightarrow B+X = A \cdot A^{-1} \rightarrow X = -B$

c) $ACXB = C \rightarrow (ABC)X = C \quad X = (ABC)^{-1} \cdot C \rightarrow X = A^{-1} \cdot B^{-1} \cdot \underbrace{\cancel{C^{-1}} \cancel{C}}_{0}$

d) $\underbrace{(AB)^{-1} \cdot (AX)} = \underbrace{CC^{-1}}_{0} \rightarrow \underbrace{(A^{-1} \cdot A)}_{0} (B^{-1} \cdot X) = 0 \quad X = B$

e) $AB^{t}XB^{-1} = A^{t}$

$B^{t}XB^{-1} = A^{t}A^{-1}$

$B^{t}X = A^{t}A^{-1} \cdot B \quad X = A^{t}A^{-1}B[B^{t}]^{-1}$

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4. Resolva os sistemas lineares usando a regra de Cramer.

a) $\begin{cases} 3x - 4y = 1 \\ x + 3y = 9 \end{cases} \quad \overset{A}{\begin{bmatrix} 3 & -4 \\ 1 & 3 \end{bmatrix}} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \overset{B}{\begin{bmatrix} 1 \\ 9 \end{bmatrix}}$

$\det(A) = 13$

$\det(A_x) = \begin{vmatrix} 1 & -4 \\ 9 & 3 \end{vmatrix} = 39 \quad x = \frac{39}{13} = 3$

$\det(A_y) = \begin{vmatrix} 3 & 1 \\ 1 & 9 \end{vmatrix} = 26 \quad y = \frac{26}{13} = 2$

b) $\begin{cases} 5x + 8y = 34 \\ 10x + 16y = 50 \end{cases}$ $\quad det(A) = 80 - 80 = 0$

$$\begin{array}{r} 34 \\ 16 \\ \hline 204 \\ 340 \\ \hline 544 \end{array}$$

$\begin{bmatrix} 5 & 8 \\ 10 & 16 \end{bmatrix} \quad \begin{bmatrix} 34 \\ 50 \end{bmatrix}$ $\quad det(Ax) = \begin{vmatrix} 34 & 8 \\ 50 & 16 \end{vmatrix} = 544 - 400 = 144$

Sistema Impossível (SI)

c) $\begin{cases} x + 2y = 5 \\ 2x - 3y = -4 \end{cases}$ $\quad A = \begin{bmatrix} 1 & 2 \\ 2 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 5 \\ -4 \end{bmatrix}$

$det(A) = -7$

$det(Ax) = \begin{vmatrix} 5 & 2 \\ -4 & -3 \end{vmatrix} = -15 + 8 = -7 \qquad x = \frac{-7}{-7} = 1$ //

$det(Ay = \begin{vmatrix} 1 & 5 \\ 2 & -4 \end{vmatrix} = -4 - 10 = -14 \qquad y = \frac{-14}{-7} = 2$ //

d) $3x + 2y - 5z = 8$

$2x - 4y - 2z = -4$

$x - 2y - 3z = -4$

$A = \begin{bmatrix} 3 & 2 & -5 \\ 2 & -4 & -2 \\ 1 & -2 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 8 \\ -4 \\ -4 \end{bmatrix}$

$det(A) \begin{vmatrix} 3 & 2 & -5 & 3 & 2 \\ 2 & -4 & -2 & 2 & -4 \\ 1 & -2 & -3 & 1 & -2 \end{vmatrix} = 36 - 4 + \cancel{20} + \cancel{12} - \cancel{12} - \cancel{20} = 32$

$det(Ax) = \begin{vmatrix} 8 & 2 & -5 & 8 & 2 \\ -4 & -4 & -2 & -4 & -4 \\ -4 & -2 & -3 & -4 & -2 \end{vmatrix}$

112 $\qquad$ 192

$96 + 16 - 40 - 24 - 32 + 80$

$-64 \qquad -96$

$192 - 96 = 96$

$x: \frac{96}{32} = \boxed{3}$

$$\det(A_y) = \left|\begin{array}{ccc|cc} 3 & 8 & -5 & 3 & 8 \\ 2 & -4 & -2 & 2 & -4 \\ 1 & -4 & -3 & 1 & -4 \end{array}\right|$$

$$36 - 16 + 40 + 48 - 24 - 20$$

20   $\cancel{8}4$ 24   4   24

$$y = \frac{64}{32} = \boxed{2}$$

$$\det(A_z) = \left|\begin{array}{ccc|cc} 3 & 2 & 8 & 3 & 2 \\ 2 & -4 & -4 & 2 & -4 \\ 1 & -2 & -4 & 1 & -2 \end{array}\right| = 48 - 8 - 32 + 16 - 24 + 32 = 32$$

40   8   24   0

$$z = \frac{32}{32} = 1$$

e)
$$\begin{cases} x + 2y - z = 2 \\ 2x - y + 3z = 9 \\ 3x + 3y - 2z = 3 \end{cases}$$

$$A = \begin{bmatrix} 1 & 2 & -1 \\ 2 & -1 & 3 \\ 3 & 3 & -2 \end{bmatrix} \qquad B = \begin{bmatrix} 2 \\ 9 \\ 3 \end{bmatrix}$$

$$\det(A) = \left|\begin{array}{ccc|cc} 1 & 2 & -1 & 1 & 2 \\ 2 & -1 & 3 & 2 & -1 \\ 3 & 3 & -2 & 3 & 3 \end{array}\right|$$

20   14   22   13   10

$$2 + 18 - 6 + 8 - 9 - 3 = 10$$

$$\det(A_x) = \left|\begin{array}{ccc|cc} 2 & 2 & -1 & 2 & 2 \\ 9 & -1 & 3 & 9 & -1 \\ 3 & 3 & -2 & 3 & 3 \end{array}\right|$$

13   +9   10

$$4 + \cancel{18} - 27 + 36 - \cancel{18} - 3 = 10 \qquad x = \frac{10}{10} = 1$$

$$\det(A_y) = \left|\begin{array}{ccc|cc} 1 & 2 & -1 & 1 & 2 \\ 2 & 9 & 3 & 2 & 9 \\ 3 & 3 & -2 & 3 & 3 \end{array}\right|$$

2   -7   20

$$\cancel{-18} + \cancel{18} - 6 + 8 - 9 + 27 = 20 \qquad y = \frac{20}{10} = 2$$

24   27   30

$$\det(A_z) = \left|\begin{array}{ccc|cc} 1 & 2 & 2 & 1 & 2 \\ 2 & -1 & 9 & 2 & -1 \\ 3 & 3 & 3 & 3 & 3 \end{array}\right|$$

$$-3 + 54 + \cancel{12} - \cancel{12} - 27 + 6 = 30 \qquad z = \frac{30}{10} = 3$$

f)
$$\begin{cases} x + 3z = -8 \\ 2x - 4y = -4 \\ 3x - 2y - 5z = 26 \end{cases}$$

$$A = \begin{bmatrix} 1 & 0 & 3 \\ 2 & -4 & 0 \\ 3 & -2 & -5 \end{bmatrix} \qquad B = \begin{bmatrix} -8 \\ -4 \\ 26 \end{bmatrix}$$

24

$$\det(A) = \left|\begin{array}{ccc|cc} 1 & 0 & 3 & 1 & 0 \\ 2 & -4 & 0 & 2 & -4 \\ 3 & -2 & -5 & 3 & -2 \end{array}\right| = 20 + 0 - 12 + 0 + 0 + 36 = 44$$

$\det(A_x) = \begin{vmatrix} -8 & 0 & 3 \\ -4 & -4 & 0 \\ 26 & -2 & -5 \end{vmatrix}\begin{matrix} -8 & 0 \\ -4 & -4 \\ 26 & -2 \end{matrix} = -160 + 0 + 24 - 0 - 0 + 312 = 176$

260
52
312

-136

$\det(A_y) = \begin{vmatrix} 1 & -8 & 3 \\ 2 & -4 & 0 \\ 3 & 26 & -5 \end{vmatrix}\begin{matrix} 1 & -8 \\ 2 & -4 \\ 3 & 26 \end{matrix} = 20 - 0 + 156 - 80 - 0 + 36 = 132$

132 192 112 212 - 36 200 - 24 176

$x = \frac{176}{44} = 4$

$y = \frac{132}{44} = 3$

$\det(A_z) = \begin{vmatrix} 1 & 0 & -8 \\ 2 & 4 & -4 \\ 3 & -2 & 26 \end{vmatrix}\begin{matrix} 1 & 0 \\ 2 & 4 \\ 3 & 2 \end{matrix} = 104 + 0 + 32 - 0 - 8 + 96$

146 138 234

$z = \frac{234}{44}$

$\boxed{\text{conferir}}$

g) $\begin{cases} x + 2y + 3z = 10 \\ 3x + 4y + 6z = 23 \\ 3x + 2y + 3z = 10 \end{cases}$ $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 6 \\ 3 & 2 & 3 \end{bmatrix}$ $B = \begin{bmatrix} 10 \\ 23 \\ 10 \end{bmatrix}$

$\det(A) = \begin{vmatrix} 1 & 2 & 3 \\ 3 & 4 & 6 \\ 3 & 2 & 3 \end{vmatrix}\begin{matrix} 1 & 2 \\ 3 & 4 \\ 3 & 2 \end{matrix} = \cancel{12} + \cancel{36} + \cancel{18} - \cancel{18} - \cancel{12} - \cancel{36} = 0$ $\boxed{\text{SPI ou SI}}$

$\det(A_x) \begin{bmatrix} 10 & 2 & 3 \\ 23 & 4 & 6 \\ 10 & 2 & 3 \end{bmatrix}\begin{matrix} 10 & 2 \\ 23 & 4 \\ 10 & 2 \end{matrix}$ $\cancel{120} + \cancel{120} + \cancel{138} - \cancel{138} - \cancel{120} - \cancel{120} = 0$

$\det(A_y) \begin{vmatrix} 1 & 10 & 3 \\ 3 & 23 & 6 \\ 3 & 10 & 3 \end{vmatrix}\begin{matrix} 1 & 10 \\ 3 & 23 \\ 3 & 10 \end{matrix} = 69 + 180 + \cancel{90} - \cancel{90} - 60 - 207 =$

$249 - 267 = -18$ $\boxed{\text{SI}}$ não tem resposta

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5. Classifique, quanto ao número de soluções, os seguintes sistemas homogêneos.

a) $\begin{cases} 3x_1 - 4x_2 = 0 \\ -6x_1 + 8x_2 = 0 \end{cases}$ $A = \begin{bmatrix} 3 & -4 \\ -6 & 8 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

$\det(A) = 24 - 24 = 0$

$\det(A_{x_1}) = \begin{vmatrix} 0 & -4 \\ 0 & 8 \end{vmatrix} = 0$

$\det(A_{x_2}) = \begin{vmatrix} 3 & 0 \\ -6 & 0 \end{vmatrix} = 0$

Sistema Possível Indeterminado (SPI), infinitas soluções.

b) $\begin{cases} x + y + z = 0 \\ 2x + 2y + 4z = 0 \\ x + y + 3z = 0 \end{cases}$ $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 4 \\ 1 & 1 & 3 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

$\det(A) = \begin{vmatrix} 1 & 1 & 1 & 1 & 1 \\ 2 & 2 & 4 & 2 & 2 \\ 1 & 1 & 3 & 1 & 1 \end{vmatrix} = 6 + 4 + 2 - 6 - 4 - 2 = 0$

$\boxed{SPI}$

$\det(A_x) = 0$ $\det(A_y) = 0$ $\det(A_z) = 0$

c) $\begin{cases} x + y + 2z = 0 \\ x - y - 3z = 0 \\ x + 4y = 0 \end{cases}$ $A = \begin{bmatrix} 1 & 1 & 2 \\ 1 & -1 & -3 \\ 1 & 4 & 0 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

$\det(A) = \begin{vmatrix} 1 & 1 & 2 & 1 & 1 \\ 1 & -1 & -3 & 1 & -1 \\ 1 & 4 & 0 & 1 & 4 \end{vmatrix} = 0 - 3 + 8 - 0 + 12 + 2$

20 22

19

$\boxed{SPD}$

$x = 0$ $y = 0$ $z = 0$

6. Verifique se existem valores de m para os quais os sistemas abaixo são possíveis e determinados.

a) $\begin{cases} 3x + my = 2 \\ x - y = 1 \end{cases}$ $A = \begin{bmatrix} 3 & m \\ 1 & -1 \end{bmatrix}$ $B = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$

$\det(A) = \cancel{x} -3 - m$ $\boxed{\text{SPD se } m \neq -3}$

$\det(A_x) = \begin{vmatrix} 2 & m \\ 1 & -1 \end{vmatrix} = -2 - m$

$\det(A_y) = \begin{vmatrix} 3 & 2 \\ 1 & 1 \end{vmatrix} = 1$

b) $3x + 2(m-1)y = 1$ $m \neq 0$

$mx - 4y = 0$ $m \neq 3$ $\boxed{m \neq -3}$

$A = \begin{bmatrix} 3 & (2m-2) \\ m & -4 \end{bmatrix}$ $B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ $m \neq 3$

b)

$-12 - (m \cdot (2m-2))$ $-12 - (2m^2 - 2m)$

$-12 - 2m^2 + 2m$

$\downarrow$

$-m^2 + m - 6$ $a=1$ $b=1$ $c=-6$

$\frac{-1 \pm \sqrt{1^2 - 4 \cdot 1 \cdot -6}}{2 \cdot 1}$ $\frac{-1 \pm \sqrt{1-24}}{2}$ não possui raízes reais $m \mid m \in \mathbb{R}$ $\nexists$ p/ SPD

c) $\begin{cases} x - y = 2 \\ x + my = -z \\ -x + y - z = 4 \end{cases}$ $\rightarrow x + my + z = 0$

$A = \begin{bmatrix} 1 & -1 & 0 \\ 1 & m & 1 \\ -1 & 1 & -1 \end{bmatrix}$ $B = \begin{bmatrix} 2 \\ 0 \\ 4 \end{bmatrix}$

$\det(A) = \left|\begin{matrix} 1 & -1 & 0 \\ 1 & m & 1 \\ -1 & 1 & -1 \end{matrix}\right|\begin{matrix} 1 & -1 \\ 1 & m \\ -1 & 1 \end{matrix}$ $-m + \cancel{1} + 0 - \cancel{1} - 1 + 0$

$-m - 1 \neq 0$

$-m \neq 1$ $\boxed{m \neq -1}$ SPD se $m \neq -1$

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7.

6 por peça produzida corretamente $\rightarrow x$

-2 por peça com defeito $\rightarrow y$

225 peças no total

750 reais

$$\begin{cases} x + y = 225 \\ 6x - 2y = 750 \end{cases}$$

$\boxed{x = 150}$

$$\begin{array}{r} 2x + 2y = 450 \\ + \quad 6x - 2y = 750 \\ \hline 8x = 1200 \end{array}$$

$x = \frac{1200}{8} = 150$

8.

- 540 km por mês
- 60 c. / km no automóvel
- 20 c. / km na motocicleta
- custo mensal 300 reais

$0{,}6x + 0{,}2y = 300$

$x + y = 540$

$$\begin{array}{r} 3x + y = 1500 \\ - \quad x + y = 540 \\ \hline 2x = 960 \end{array}$$

$$\boxed{\begin{array}{l} x = 480 \\ y = 60 \end{array}}$$

9.

total 500 reais

cédulas de $\underbrace{2, 5 \text{ e } 10}_{x}$ ($5 \rightarrow y$)

total de cédulas 92

qta. de 2 e 10 igual

20 de 2
20 de 10
52 de 5

$2x + y = 92$

$2x + 10x + 5y = 500$

$12x + 5y = 500$

$\ominus \; 10x + 5y = 460$

$2x = 40$

$$\boxed{\begin{array}{l} x = 20 \\ y = 52 \end{array}}$$

10.

$$x + y = 109$$
$$x + z = 142$$
$$z + y = 97$$

$$\begin{array}{rl} & x + y = 109 \\ - & x + z = 142 \\ \hline & y - z = -33 \\ + & z + y = 97 \\ & 2y = 64 \quad y = 32 \end{array}$$

$x + 32 = 109 \qquad x = 109 - 32 = 77$

$77 + z = 142 \qquad z = 142 - 77 = 65$

$$\begin{cases} x = 77 \\ y = 32 \\ z = 65 \end{cases}$$

6.

d)
$$mx + y - z = 4$$
$$x + my + z = 0$$
$$x - y = 2$$

$$A = \begin{bmatrix} m & 1 & -1 \\ 1 & m & 1 \\ 1 & -1 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 4 \\ 0 \\ 2 \end{bmatrix}$$

$$\det(A) = \left| \begin{array}{ccc|cc} m & 1 & -1 & m & 1 \\ 1 & m & 1 & 1 & m \\ 1 & -1 & 0 & 1 & -1 \end{array} \right|$$

$0 + 1 + 1 - 0 + m + m \neq 0$

$2m + 2 \neq 0$

$2m \neq -2$

$\boxed{m \neq -1}$