# 5.4.24

Jnanesh Sathisha Karmar- EE25BTECH11029

**Question:**

Find the inverse of the matrix $\mathbf{A} = \begin{pmatrix} 2 & 1 \\ 4 & 2 \end{pmatrix}$ using the Gauss-Jordan method.

**Solution:** To find the inverse of a matrix $\mathbf{A}$, we use the Gauss-Jordan elimination method. We begin by creating an augmented matrix by placing the identity matrix $\mathbf{I}$ to the right of matrix $\mathbf{A}$, forming $(\mathbf{A}|\mathbf{I})$.

The augmented matrix for $\mathbf{A} = \begin{pmatrix} 2 & 1 \\ 4 & 2 \end{pmatrix}$ is:

$$\left(\mathbf{A} \mid \mathbf{I}\right) = \left(\begin{array}{cc|cc} 2 & 1 & 1 & 0 \\ 4 & 2 & 0 & 1 \end{array}\right) \tag{1}$$

The goal is to use elementary row operations to transform the left side of the augmented matrix into the identity matrix. The right side will then become the inverse, $\mathbf{A}^{-1}$. We perform the operation $R_2 \to R_2 - 2R_1$:

$$\left(\begin{array}{cc|cc} 2 & 1 & 1 & 0 \\ 4-2(2) & 2-2(1) & 0-2(1) & 1-2(0) \end{array}\right) \tag{2}$$

After performing the operation, the matrix becomes:

$$\left(\begin{array}{cc|cc} 2 & 1 & 1 & 0 \\ 0 & 0 & -2 & 1 \end{array}\right) \tag{3}$$

Because a row of zeros has appeared on the left-hand side, it is impossible to continue the process to form the identity matrix. This indicates that the original matrix $\mathbf{A}$ is singular (its determinant is zero). Therefore, the inverse of the matrix does not exist.