

5.4.40

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Question:

Using elementary transformations, find the inverse of the following matrix.

$$\begin{pmatrix} 1 & 0 & 0 \\ 3 & 3 & 0 \\ 5 & 2 & 1 \end{pmatrix}$$

Solution:

$$\mathbf{A} = \begin{pmatrix} 1 & 0 & 0 \\ 3 & 3 & 0 \\ 5 & 2 & 1 \end{pmatrix} \quad (1)$$

$$\begin{pmatrix} 1 & 0 & 0 & | & 1 & 0 & 0 \\ 3 & 3 & 0 & | & 0 & 1 & 0 \\ 5 & 2 & 1 & | & 0 & 0 & 1 \end{pmatrix} \xrightarrow[\text{R}_3 \rightarrow \text{R}_3 - 5\text{R}_1]{\text{R}_2 \rightarrow \text{R}_2 - 3\text{R}_1} \begin{pmatrix} 1 & 0 & 0 & | & 1 & 0 & 0 \\ 0 & 3 & 0 & | & -3 & 1 & 0 \\ 0 & 2 & 1 & | & -5 & 0 & 1 \end{pmatrix} \quad (2)$$

$$\xrightarrow{\text{R}_2 \rightarrow \frac{1}{3}\text{R}_2} \begin{pmatrix} 1 & 0 & 0 & | & 1 & 0 & 0 \\ 0 & 1 & 0 & | & -1 & \frac{1}{3} & 0 \\ 0 & 2 & 1 & | & -5 & 0 & 1 \end{pmatrix} \xrightarrow{\text{R}_3 \rightarrow \text{R}_3 - 2\text{R}_2} \begin{pmatrix} 1 & 0 & 0 & | & 1 & 0 & 0 \\ 0 & 1 & 0 & | & -1 & \frac{1}{3} & 0 \\ 0 & 0 & 1 & | & -3 & -\frac{2}{3} & 1 \end{pmatrix} \quad (3)$$

$$\mathbf{A}^{-1} = \begin{pmatrix} 1 & 0 & 0 \\ -1 & \frac{1}{3} & 0 \\ -3 & -\frac{2}{3} & 1 \end{pmatrix} \quad (4)$$