Assignment 1

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1 Question No.33

Find the distance of the point $\begin{pmatrix} 1 \\ -1 \end{pmatrix}$ from the line $\begin{pmatrix} 12 & -5 \end{pmatrix}\mathbf{x} = -82$

2 Explanation

First we find the normal vector to the given line and then using the normal vector we can find out the line which is perpendicular to the given line and passes through the point $\begin{pmatrix} 1 & -1 \end{pmatrix}$.The distance from the point to the line is the distance between point of intersection of two lines and the given point

The equation of the line perpendicular to the given line is and passing through the given point is

$$\mathbf{x} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} + K\begin{pmatrix} -12 \\ 5 \end{pmatrix} \qquad (2.0.1)$$

By rewriting the above equation we get

$$\mathbf{x} - \begin{pmatrix} 1 \\ -1 \end{pmatrix} = K\begin{pmatrix} -12 \\ 5 \end{pmatrix} \qquad (2.0.2)$$

$$\left\lVert \mathbf{x} - \begin{pmatrix} 1 \\ -1 \end{pmatrix} \right\rVert = K\left\lVert \begin{pmatrix} -12 \\ 5 \end{pmatrix} \right\rVert \qquad (2.0.3)$$

Since the two lines intersect,X will be same for both equations. Therefore we can write the given line equation by substituting X from equation (2.0.2)

$$\begin{pmatrix} 12 & -5 \end{pmatrix}\left(\begin{pmatrix} 1 \\ -1 \end{pmatrix} + K\begin{pmatrix} -12 \\ 5 \end{pmatrix} \right) = -82 \qquad (2.0.4)$$

By simplifying above line equation we get the value of K

$$K = 99/169 \qquad (2.0.5)$$

Therefore, by subtituting K in equation (2.0.4) we can get the distance between the point and the given line

$$Distance = (99/169) * \left\lVert \begin{pmatrix} -12 \\ 5 \end{pmatrix} \right\rVert \qquad (2.0.6)$$

$$Distance = 7.615 \qquad (2.0.7)$$

The distance between the line and point is 7.615