ASSIGNMENT 1

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1 PROBLEM

Find the equation of the plane which contains the line intersection of the planes

$$\begin{pmatrix}1 & 2 & 3\end{pmatrix}\mathbf{x} = 4 \tag{1.0.1}$$

$$\begin{pmatrix}2 & 1 & -1\end{pmatrix}\mathbf{x} = -5 \tag{1.0.2}$$

and which is perpendicular to the plane

$$\begin{pmatrix}5 & 3 & -6\end{pmatrix}\mathbf{x} = -8 \tag{1.0.3}$$

2 SOLUTION

the direction vectors are m_1 and m_2 respectively

$$\mathrm{m}_1 = \begin{pmatrix}1\\2\\3\end{pmatrix} \tag{2.0.1}$$

$$\mathrm{m}_2 = \begin{pmatrix}2\\1\\-1\end{pmatrix} \tag{2.0.2}$$

The euation of the plane through intersection of the given two planes is

$$(\ \mathrm{m}_1 + \lambda\mathbf{m_2})\mathbf{x} = 4 - 5\lambda \tag{2.0.3}$$

$$\mathrm{mx} = 4\text{-}5\lambda \tag{2.0.4}$$

Direction vector of plane of intersection

$$\mathrm{m} = \mathrm{m}_1 + \lambda\mathbf{m_2} \tag{2.0.5}$$

$$= \begin{pmatrix}1\\2\\3\end{pmatrix} + \lambda\begin{pmatrix}2\\1\\-1\end{pmatrix} \tag{2.0.6}$$

$$= \begin{pmatrix}1+2\lambda\\2+\lambda\\3-\lambda\end{pmatrix} \tag{2.0.7}$$

This is perpendicular to

$$\mathrm{n} = \begin{pmatrix}5\\3\\-6\end{pmatrix} \tag{2.0.8}$$

Then $\mathbf{m^T n} = 0$

$$\begin{pmatrix}1+2\lambda & 2+\lambda & 3-\lambda\end{pmatrix}\begin{pmatrix}5\\3\\-6\end{pmatrix} = 0$$

$5 + 10\lambda + 6 + 3\lambda - 18 + 6\lambda = 0$
$13 + 6\lambda = 7$
$19\lambda = 7$
$\lambda = \frac{7}{19}$

substitute the λ value in the equation(2.0.7) then

$$\mathrm{m}= \begin{pmatrix}1+2(\frac{7}{19})\\2+(\frac{7}{19})\\3-(\frac{7}{19})\end{pmatrix} \tag{2.0.9}$$

$$\mathrm{m} = \begin{pmatrix}1.736\\2.368\\2.631\end{pmatrix} \tag{2.0.10}$$

substitute $\mathbf{m}$ and λ value in the equation(2.0.4) then

$$\mathrm{mx} = 4\text{- }5(7/19) \tag{2.0.11}$$

$$\begin{pmatrix} 1.736 & 2.368 & 2.631 \end{pmatrix} x = 2.157 \quad (2.0.12)$$

3 ANSWER

the equation of the plane which contains the line intersection of given planes is

$$\begin{pmatrix} 1.736 & 2.368 & 2.631 \end{pmatrix} x = 2.157 \quad (3.0.1)$$