4.7.14

EE25btech11028 - J.Navya sri

Question:
Find the distance of the plane 2x - 3y + 4z - 6 = 0 from the origin.

Solution:
We want to find the distance of the plane

$$2x - 3y + 4z - 6 = 0 \quad (1) \tag{1}$$

from the origin using the vector approach

Step 1: Identify the normal vector.
The general equation of a plane is

$$\mathbf{n} \cdot \mathbf{r} = D \quad (2) \tag{2}$$

where

$$\mathbf{n} = \begin{pmatrix} A \\ B \\ C \end{pmatrix} \quad (3) \tag{3}$$

is the normal vector of the plane and D is a constant.
From the given plane ($2x - 3y + 4z = 6$), we have

$$\mathbf{n} = \begin{pmatrix} 2 \\ -3 \\ 4 \end{pmatrix}, \quad D = 6. \quad (4) \tag{4}$$

Step 2: Distance formula.
The distance of a point $\mathbf{r}_0$ from the plane is given by

$$\text{Distance} = \frac{|\mathbf{n} \cdot \mathbf{r}_0 - D|}{\|\mathbf{n}\|} \quad (5). \tag{5}$$

For the origin, $\mathbf{r}_0 = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$, so

$$
\begin{aligned}
\text{Distance} &= \frac{|\mathbf{n} \cdot \mathbf{r}_0 - 6|}{\sqrt{2^2 + (-3)^2 + 4^2}} \\
&= \frac{|(2)(0) + (-3)(0) + (4)(0) - 6|}{\sqrt{4 + 9 + 16}} \\
&= \frac{|-6|}{\sqrt{29}} = \frac{6}{\sqrt{29}} \quad (6).
\end{aligned} \tag{6}
$$

Answer:
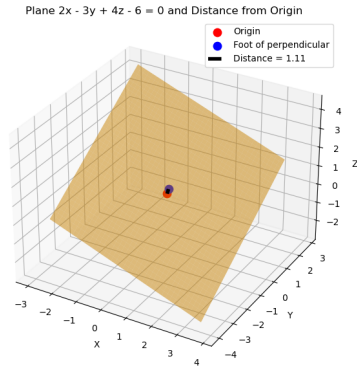
$$\boxed{\dfrac{6}{\sqrt{29}}} \quad (7)$$

(7)

Graph presentation:

Fig. 1