4.11.33

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Question : Find the length of the intercept cut off by the plane $2x + y - z = 5$ on the X axis.
Solution :

Description	Value
Plane	$2x + y - z = 5 \iff \begin{pmatrix} 2 & 1 & -1 \end{pmatrix} \mathbf{x} = 5$

Table : Plane

The equation of plane is

$$\mathbf{n}^\top \mathbf{x} = c \tag{1}$$

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

The X-intercept of the plane is of the form

$$\mathbf{P} = \begin{pmatrix} a \\ 0 \\ 0 \end{pmatrix}. \tag{3}$$

P lies on the plane,

$$\begin{pmatrix} 2 & 1 & -1 \end{pmatrix} \mathbf{P} = 5 \tag{4}$$

$$\begin{pmatrix} 2 & 1 & -1 \end{pmatrix} \begin{pmatrix} a \\ 0 \\ 0 \end{pmatrix} = 5 \tag{5}$$

$$2a + 0 + 0 = 5 \tag{6}$$

$$2a = 5 \tag{7}$$

$$a = \frac{5}{2} \tag{8}$$

Thus, the intercept point is

$$\mathbf{P} = \begin{pmatrix} \frac{5}{2} \\ 0 \\ 0 \end{pmatrix} \tag{9}$$

Answer: The intercept length is $\frac{5}{2}$.

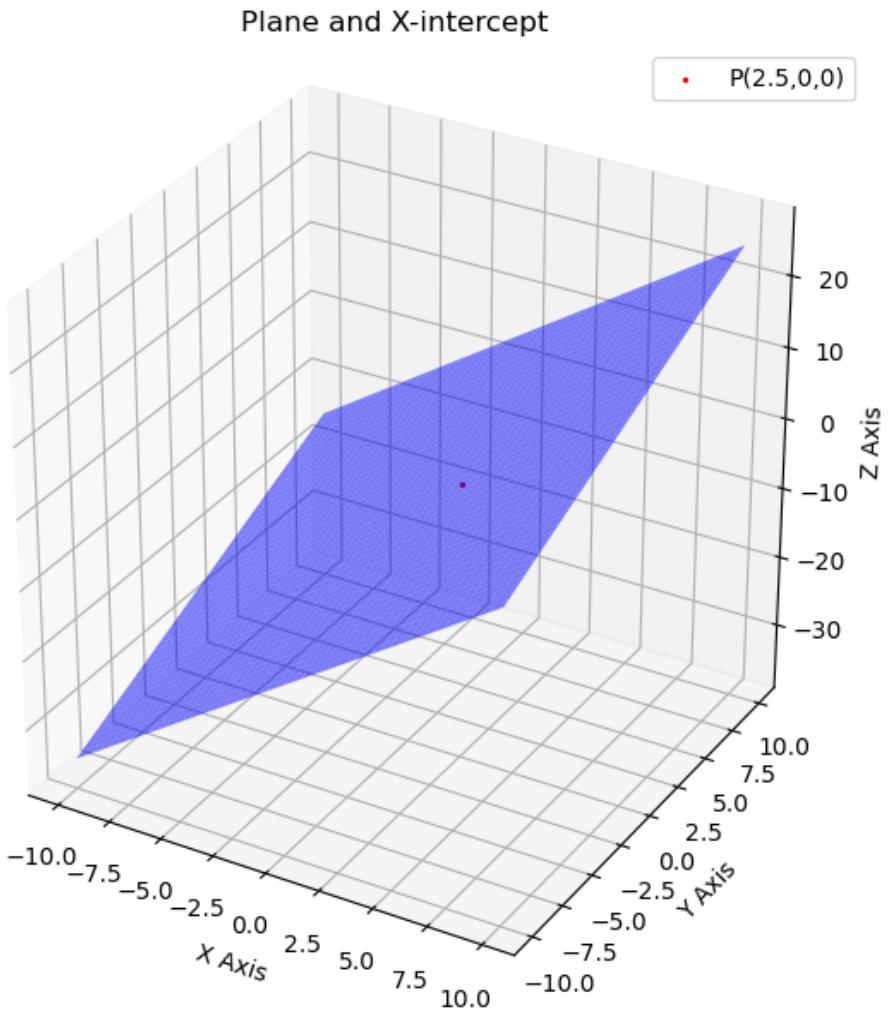
Plane and X-intercept
P(2.5,0,0)
20
10
0
−10
−20
−30
Z Axis
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
Y Axis
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
X Axis

Fig : Plane