

# 6.2.6

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## Question

Find matrix  $X$  such that

$$X \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix} = \begin{pmatrix} -7 & -8 & -9 \\ 2 & 4 & 6 \end{pmatrix}$$

## Solution

Form the augmented matrix

$$\left( \begin{array}{ccc|ccc} 1 & 4 & & -7 & -8 & -9 \\ 2 & 5 & & 2 & 4 & 6 \\ 3 & 6 & & 0 & 0 & 0 \end{array} \right) \quad (1)$$

(2)

Replace  $R_2 \rightarrow R_2 - 2R_1$  and  $R_3 \rightarrow R_3 - 3R_1$

$$\left( \begin{array}{ccc|ccc} 1 & 4 & & -7 & -8 & -9 \\ 0 & -3 & & 16 & 20 & 27 \\ 0 & -6 & & 21 & 24 & 27 \end{array} \right) \quad (3)$$

Replace  $R_2 \rightarrow \frac{-1}{3}R_2$  and  $R_3 \rightarrow R_3 - 2R_2$

$$\left( \begin{array}{ccc|ccc} 1 & 4 & & -7 & -8 & -9 \\ 0 & 1 & & -16/3 & -20/3 & -9 \\ 0 & 0 & & -11/3 & -16/3 & 9 \end{array} \right) \quad (4)$$

Hence,

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

Pseudoinverse verification

Let,

$$\mathbf{A} = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix} \quad (6)$$

$$\mathbf{B} = \begin{pmatrix} -7 & 2 \\ -8 & 4 \\ -9 & 6 \end{pmatrix} \quad (7)$$

$$\mathbf{A}^+ = \mathbf{A}^\top (\mathbf{A}\mathbf{A}^\top)^{-1} \quad (8)$$

$$= \begin{pmatrix} -17/18 & 4/9 \\ -1/9 & 1/9 \\ 13/18 & -2/9 \end{pmatrix} \quad (9)$$

$$\mathbf{X} = \mathbf{B}\mathbf{A}^+ \quad (10)$$

$$= \begin{pmatrix} -7 & 2 \\ -8 & 4 \\ -9 & 6 \end{pmatrix} \begin{pmatrix} -17/18 & 4/9 \\ -1/9 & 1/9 \\ 13/18 & -2/9 \end{pmatrix} \quad (11)$$

$$= \begin{pmatrix} 1 & 2 \\ -2 & 0 \end{pmatrix} \quad (12)$$

Graph of 3 Planes

