

## 1

# Linear Equations in Linear Algebra

## 1.1 SOLUTIONS

**Notes:** The key exercises are 7 (or 11 or 12), 19–22, and 25. For brevity, the symbols  $R_1, R_2, \dots$  stand for row 1 (or equation 1), row 2 (or equation 2), and so on. Additional notes are at the end of the section.

$$1. \quad \begin{array}{l} x_1 + 5x_2 = 7 \\ -2x_1 - 7x_2 = -5 \end{array} \quad \begin{bmatrix} 1 & 5 & 7 \\ -2 & -7 & -5 \end{bmatrix}$$

Replace  $R_2$  by  $R_2 + (2)R_1$  and obtain:

$$\begin{array}{l} x_1 + 5x_2 = 7 \\ 3x_2 = 9 \end{array} \quad \begin{bmatrix} 1 & 5 & 7 \\ 0 & 3 & 9 \end{bmatrix}$$

Scale  $R_2$  by  $1/3$ :

$$\begin{array}{l} x_1 + 5x_2 = 7 \\ x_2 = 3 \end{array} \quad \begin{bmatrix} 1 & 5 & 7 \\ 0 & 1 & 3 \end{bmatrix}$$

Replace  $R_1$  by  $R_1 + (-5)R_2$ :

$$\begin{array}{l} x_1 = -8 \\ x_2 = 3 \end{array} \quad \begin{bmatrix} 1 & 0 & -8 \\ 0 & 1 & 3 \end{bmatrix}$$

The solution is  $(x_1, x_2) = (-8, 3)$ , or simply  $(-8, 3)$ .

$$2. \quad \begin{array}{l} 2x_1 + 4x_2 = -4 \\ 5x_1 + 7x_2 = 11 \end{array} \quad \begin{bmatrix} 2 & 4 & -4 \\ 5 & 7 & 11 \end{bmatrix}$$

Scale  $R_1$  by  $1/2$  and obtain:

$$\begin{array}{l} x_1 + 2x_2 = -2 \\ 5x_1 + 7x_2 = 11 \end{array} \quad \begin{bmatrix} 1 & 2 & -2 \\ 5 & 7 & 11 \end{bmatrix}$$

Replace  $R_2$  by  $R_2 + (-5)R_1$ :

$$\begin{array}{l} x_1 + 2x_2 = -2 \\ -3x_2 = 21 \end{array} \quad \begin{bmatrix} 1 & 2 & -2 \\ 0 & -3 & 21 \end{bmatrix}$$

Scale  $R_2$  by  $-1/3$ :

$$\begin{array}{l} x_1 + 2x_2 = -2 \\ x_2 = -7 \end{array} \quad \begin{bmatrix} 1 & 2 & -2 \\ 0 & 1 & -7 \end{bmatrix}$$

Replace  $R_1$  by  $R_1 + (-2)R_2$ :

$$\begin{array}{l} x_1 = 12 \\ x_2 = -7 \end{array} \quad \begin{bmatrix} 1 & 0 & 12 \\ 0 & 1 & -7 \end{bmatrix}$$

The solution is  $(x_1, x_2) = (12, -7)$ , or simply  $(12, -7)$ .

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**W. Keith Nicholson**



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Instructor's Solutions Manual, Linear Algebra with Applications, Second Edition Otto Bretscher, 2001-11-15

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