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Study Guide

Modeling Real-World Data with Matrices

A **matrix** is a rectangular array of terms called **elements.**
A matrix with m rows and n columns is an $\boldsymbol{m \times n}$ **matrix.**
The dimensions of the matrix are m and n.

Example 1 **Find the values of x and y for which $\begin{bmatrix} 3x+5 \\ y \end{bmatrix} = \begin{bmatrix} y-9 \\ -4x \end{bmatrix}$ is true.**

Since the corresponding elements must be equal, we can express the equal matrices as two equations.

$$3x + 5 = y - 9$$
$$y = -4x$$

Solve the system of equations by using substitution.

$$3x + 5 = y - 9$$
$$3x + 5 = (-4x) - 9 \quad \textit{Substitute } -4x \textit{ for } y.$$
$$x = -2$$

$$y = -4x$$
$$y = -4(-2) \quad \textit{Substitute } -2 \textit{ for } x.$$
$$y = 8$$

The matrices are equal if $x = -2$ and $y = 8$.

To add or subtract matrices, the dimensions of the matrices must be the same.

Example 2 **Find $C - D$ if $C = \begin{bmatrix} 3 & 6 \\ -2 & 4 \end{bmatrix}$ and $D = \begin{bmatrix} 1 & 5 \\ -7 & 8 \end{bmatrix}$.**

$$\begin{aligned} C - D &= C + (-D) \\ &= \begin{bmatrix} 3 & 6 \\ -2 & 4 \end{bmatrix} + \begin{bmatrix} -1 & -5 \\ 7 & -8 \end{bmatrix} \\ &= \begin{bmatrix} 3 + (-1) & 6 + (-5) \\ -2 + 7 & 4 + (-8) \end{bmatrix} \\ &= \begin{bmatrix} 2 & 1 \\ 5 & -4 \end{bmatrix} \end{aligned}$$

To multiply two matrices, the number of columns in the first matrix must be equal to the number of rows in the second matrix. The product of two matrices is found by multiplying columns and rows.

Example 3 **Find each product if $X = \begin{bmatrix} 4 & 3 \\ 5 & 2 \end{bmatrix}$ and $Y = \begin{bmatrix} 8 & 0 \\ 9 & -6 \end{bmatrix}$.**

a. XY

$$XY = \begin{bmatrix} 4(8) + 3(9) & 4(0) + 3(-6) \\ 5(8) + 2(9) & 5(0) + 2(-6) \end{bmatrix} \text{ or } \begin{bmatrix} 59 & -18 \\ 58 & -12 \end{bmatrix}$$

b. YX

$$YX = \begin{bmatrix} 8(4) + 0(5) & 8(3) + 0(2) \\ 9(4) + (-6)(5) & 9(3) + (-6)(2) \end{bmatrix} \text{ or } \begin{bmatrix} 32 & 24 \\ 6 & 15 \end{bmatrix}$$