

## Section 9.5 Applications of Matrices and Determinants

**Objective:** In this lesson you learned how to use Cramer's Rule to solve systems of linear equations.

Course Number

Instructor

Date

**Important Vocabulary** Define each term or concept.

**Uncoded row matrices**

**Coded row matrices**

### I. Area of a Triangle (Page 677)

The area of a triangle with vertices  $(x_1, y_1)$ ,  $(x_2, y_2)$ , and  $(x_3, y_3)$  is

$$\text{Area} = \pm \frac{1}{2} \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

where the symbol  $\pm$  indicates that the appropriate sign should be chosen to yield a positive area.

**Example 1:** Find the area of a triangle whose vertices are  $(-3, 1)$ ,  $(2, 4)$ , and  $(5, -3)$ .

#### *What you should learn*

How to use determinants to find areas of triangles

### II. Collinear Points (Page 678)

**Collinear points** are . . .

Three points  $(x_1, y_1)$ ,  $(x_2, y_2)$ , and  $(x_3, y_3)$  are collinear if and only if

$$\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = 0.$$

**Example 2:** Determine whether the points  $(-2, 4)$ ,  $(0, 3)$ , and  $(8, -1)$  are collinear.

#### *What you should learn*

How to use determinants to decide whether points are collinear

**III. Cramer's Rule** (Pages 679–681)

**Cramer's Rule** states that if a system of  $n$  linear equations in  $n$  variables has a coefficient matrix  $A$  with a nonzero determinant  $|A|$ , the solution of the system is

$$x_1 = \frac{|A_1|}{|A|}, \quad x_2 = \frac{|A_2|}{|A|}, \dots, x_n = \frac{|A_n|}{|A|}$$

where the  $i$ th column of  $A_i$  is \_\_\_\_\_  
\_\_\_\_\_.

Cramer's Rule does not apply if the determinant of the coefficient matrix is \_\_\_\_\_, in which case the system has either no solution or \_\_\_\_\_.

**Example 3:** Use Cramer's Rule to solve the system of linear equations.

$$\begin{cases} 2x + y + z = 6 \\ -x - y + 3z = 1 \\ y - 2z = -3 \end{cases}$$

**IV. Cryptography** (Pages 682–684)

A cryptogram is . . .

To use matrix multiplication to encode and decode messages, . . .

**What you should learn**

How to use Cramer's Rule to solve systems of linear equations

**What you should learn**

How to use matrices to code and decode messages

**Homework Assignment**

Page(s)

Exercises