# Determinant of a Matrix

Name: _____ Date: _____

The **determinant** of a matrix is a **"special" number** that can be calculated from a **square matrix**. The determinant of a matrix is used in mathematics for many different reasons. Some of the reasons are beyond the scope of this course. We will be using the determinant to help us when finding the inverse of a matrix. For now, we will learn how to do this for a $2 \times 2$ matrix.

## Determinant of a $2 \times 2$ Matrix

In general:

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

The determinant of a matrix is show in two ways:

$$\det(A) \; or \; |A| \;\; or \; \Delta$$

So, the procedure is:

$$\det(A) = |A| = \Delta = ad - bc$$

## Example:

$A = \begin{bmatrix} 3 & 8 \\ 4 & 6 \end{bmatrix}$ =

$D = \begin{bmatrix} 4 & 6 \\ c & 8 \end{bmatrix}$, solve for the value of c if the determinant, $det(D)$ is equal to 14.

## Determinant of a $3 \times 3$ Matrix

In general:

$$A = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$$

Then,

$$\det(A) = a(ei - fh) - b(di - fg) + c(dh - eg)$$

There is a pattern you can follow for this

$$\begin{bmatrix} a & & \\ & \begin{vmatrix} e & f \\ h & i \end{vmatrix} & \end{bmatrix} - \begin{bmatrix} & b & \\ \begin{vmatrix} d & f \\ g & i \end{vmatrix} & & \end{bmatrix} + \begin{bmatrix} & & c \\ & \begin{vmatrix} d & e \\ g & h \end{vmatrix} & \end{bmatrix}$$

or

$$\det(A) = a \cdot \begin{vmatrix} e & f \\ h & i \end{vmatrix} - b \cdot \begin{vmatrix} d & f \\ g & i \end{vmatrix} + c \cdot \begin{vmatrix} d & e \\ g & h \end{vmatrix}$$

## Example:

$$C = \begin{bmatrix} 6 & 1 & 1 \\ 4 & -2 & 5 \\ 2 & 8 & 7 \end{bmatrix}$$

There are similar patterns for $4 \times 4$ and higher order matrices as well. You can use this online calculator to perform these calculations.