Algebra 2
Lesson 4-5/4-6: Determinants: 2x2 and 3x3 Matrices
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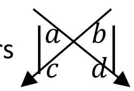
Data transferred over the internet is encoded or encrypted so that someone attempting to illegally access the data will find something that is unintelligible. One way to encrypt messages and data uses matrices and their inverses. We will be looking at matrix inverses during the next lesson. Today, we are looking at **determinants** which are used in calculating inverses.

The determinant, abbreviated **det** and symbolized with | **|,** it is a nonzero quantity (when the det=0 we have another situation that we will look at in the next lesson). For a 2×2 matrix, its determinant is found by subtracting the products of its diagonals:

Given a matrix A=$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$, where a, b, c, and d are real numbers 

det A = $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$

Example: Compute the determinant of A=$\begin{bmatrix} -3 & 4 \\ 2 & -5 \end{bmatrix}$

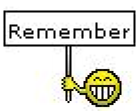
det A = det $\begin{vmatrix} -3 & 4 \\ 2 & -5 \end{vmatrix}$

= $(-3)(-5) - (4)(2)$

$= 15 - 8$

$=$ **7**

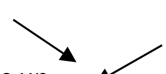
One can also compute a determinant using a graphing calculator:



YOU MUST BE ABLE TO CALCULATE DETERMINANTS WITH OUT THE AID OF A CALCULATOR!!!!

- Press **MATRIX** > > to **EDIT**. Down to **1:[A]. ENTER**
- Enter the matrix dimensions: # rows **ENTER** # columns **ENTER.** Enter the data for the 2x2 matrix in the matrix.
- Press **2nd MODE (QUIT)**
- Press **MATRIX** again. Go right once to **MATH.** Down to **1:det**.
- Press **MATRIX** again. Down to **1:[A]. ENTER**. Answer is displayed.

The computations for 3×3 determinants are messier than for 2×2's. Various methods can be used, but the simplest method is probably the following:

1) Write down the determinant
2) Expand the determinant by rewriting the first two columns of numbers
3) Multiply along the down-to-the-right-diagonals, and then add them up.
4) Multiply along the down-to-the-left-diagonals and then add these values up. 
5) Lastly subtract the down-right-diagonal total from the down to the left diagonal total.

Example:

A= $\begin{bmatrix} 4 & -2 & 0 \\ -3 & 10 & 1 \\ 2 & 6 & -1 \end{bmatrix}$ det A= $\begin{vmatrix} 4 & -2 & 0 \\ -3 & 10 & 1 \\ 2 & 6 & -1 \end{vmatrix}$ expand: $\begin{matrix} 4 & -2 & 0 & 4 & -2 \\ -3 & 10 & 1 & -3 & 10 \\ 2 & 6 & -1 & 2 & 6 \end{matrix}$

down to the right minus down to the left

$(4)(10)(-1) + (-2)(1)(2) + (0)(-3)(6) \quad - \quad (0)(10)(2) + (4)(1)(6) + (-2)(-3)(-1)$

$(-40 - 4 + 0\ ) \quad - \quad (0 + 24 - 6)$

$-44 - 18 = -\mathbf{62}$

Answer format: $\underline{\boldsymbol{det\ A = -62}}$

A 3x3 determinant may be calculated on a calculator using the same steps as those for a 2x2

UNDERSTAND THAT YOU MUST BE ABLE TO SOLVE A 3X3 DETERMINANT USING THE LONGHAND METHOD!

FIND THE DETERMINANT FOR THE FOLLOWING MATRICES:

$\begin{bmatrix} 7 & 2 \\ 0 & -3 \end{bmatrix}$
$\begin{bmatrix} 1 & 2 & 5 \\ 3 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix}$