# Section 2.2

Systems of Linear Equations

## Recall from College Algebra:

To solve a linear system of equations using matrices, the first thing we do, is set up a corresponding augmented matrix.

$$\begin{aligned}2x+3y&=5\\3x-5y&=-2\end{aligned} \Rightarrow \left[\begin{array}{cc|c}2 & 3 & 5\\ 3 & -5 & -2\end{array}\right]$$

Notice: You must line up the variables vertically so you have a column for each variable. Also, the vertical line represents the = in the equations

## To solve these systems we tried to get them into what we called Reduced Row Echelon Form

What did this mean? We tried to get a 1 in the 1st row, 1st column, and zeros above and below, then we got a 1 in the 2nd row, 2nd column with zeros above and below (for all the columns to the left of the vertical line.

$$\left[\begin{array}{cc|c}1 & 0 & 31/19\\ 0 & 1 & 11/19\end{array}\right]$$

from this form, we can simply read off the solution to the system.

## Matrix Operations

1) You can replace any row with the product of that row and a nonzero constant. (this is how I get the leading 1's)
2) You can switch any two rows.
3) You can replace a row with the sum of itself and a constant multiple of another row (this is how I get the zeros above and/or below the leading 1's)

## Example:

Use matrices to solve: x+3y=8
2x-y = 4

First, form the corresponding matrix.

$$\left[\begin{array}{cc|c}1 & 3 & 8\\ 2 & -1 & 4\end{array}\right]$$

Now, I work column by column. First I get a 1 in the 1st row, 1st column and then I get zeros above and/or below it. Then I start on the 2nd column, etc.

## Solve #17 in section 2.2

$$\left[\begin{array}{cc|c}1 & 3 & 8\\ 2 & -1 & 4\end{array}\right] \underset{-2R_1+R_2\to R_2}{\Rightarrow} \left[\begin{array}{cc|c}1 & 3 & 8\\ 0 & -7 & -12\end{array}\right] \underset{-\frac{1}{7}R_2\to R_2}{\Rightarrow} \left[\begin{array}{cc|c}1 & 3 & 8\\ 0 & 1 & 12/7\end{array}\right]$$

$$\underset{-3R_2+R_1\to R_1}{\Rightarrow} \left[\begin{array}{cc|c}1 & 0 & 20/7\\ 0 & 1 & 12/7\end{array}\right]$$

Now, we simply read off the solution to the system.

X = 20/7
Y = 12/7

## To use Rowops

1) Push MRTX button on  your calculator
2) Arrow over and highlight EDIT
3) Hit Enter (make sure that matrix A is highlighted)
4) Enter the order of the matrix (remember, the number of rows is first, then the number of columns
5) Enter the matrix entry by entry

## Now what?

1) Hit PRGM
2) Find Rowops and highlight it and hit ENTER
3) The matrix that you entered should appear
4) Hit enter again to see the options
5) Use the appropriate operation to get a 1 in row 1 column 1 (I use multiply)
6) To get the zeros, use the pivot option.  You will pivot on the row and column where you just got a 1.