

Math 7 Elementary Linear Algebra
INTRODUCTION TO MATLAB
2. GRAPHING LINEAR EQUATIONS

Commands learned:

- How to define a row matrix of evenly spaced values
- How to enter a functional expression, stored as a row matrix
- The plot command

Every object in MatLab is a matrix and this includes mathematical expressions. The data needed to generate a graph is stored in matrices that contain the x and y coordinates of the points on the graph; literally, MatLab constructs a graph by plotting points. You have to tell it what points to plot.

Suppose we want to graph the linear equation $3x - 4y = 5$ in MatLab. To do this we will have to

1. Define a domain for the graph. The domain is a matrix of x values.
2. Express y as a function of x . The functional expression will be evaluated by MatLab over the domain specified and that numerical data stored as a matrix of y values.

Defining the Domain of the Graph. To define the domain, we construct a matrix of x values.

Suppose we want to graph the line over the x -interval $[-2, 3]$. Enter the following, without a semicolon at the end of the input:

$$x = [-2 : 0.5 : 3]$$

You have defined a matrix of x values starting at -2 and ending at 3 with an increment of 0.5. That is, the syntax of this input tells MatLab to construct a matrix of values by starting at -2 and successively incrementing (adding) 0.5 until the value of 3 is reached.

NOTE 1: In general, it is usually best to terminate the line of input with a semicolon, in order to suppress the output, as the matrix of x values may have a large number of entries in it.

NOTE 2: For higher degree polynomials it is best to use a smaller increment.

Defining the Functional Expression and Matrix of y Values. Begin by manually

solving the linear equation for y : $y = \frac{3x-5}{4}$. It is not necessary to simplify the

expression further and it is a good practice to leave the expression in rational form, which may be more exact than decimal form.

The syntax for entering the functional expression into MatLab is similar to that used in your calculator. Type in the following without a semicolon:

$$y = (3 * x - 5) / 4$$

Entering the expression automatically generates a matrix of y values; the entries in the matrix are obtained by evaluating the expression you entered using the x values from the

defined domain. Corresponding entries in the x and y matrices constitute an ordered pair of points on the graph of the line.

NOTE 3: $y = (3 * x - 5) / 4$ is not a symbolic expression, and the software does not treat it as such. The expression tells MatLab to carry out these operations on each entry in the matrix x in order to produce a matrix of corresponding y values.

NOTE 4: Here, too, in general it is usually best to type a semicolon at the end of the input line, in order to suppress the output, as the matrix of y values could be quite large.

Graphing the Line. A simple plot command is used to obtain the graph, which will open in a separate window.

$$\text{plot}(x, y)$$

Multiple functions can be graphed in the same plot window. There are several ways to do accomplish this. Here is one way to do it.

Suppose you have defined a domain $x1$ for a function $y1$ and a domain $x2$ for a function $y2$. Then

$$\text{plot}(x1, y1, x2, y2)$$

Plots both lines together. MatLab automatically chooses different colors for the two lines.

Exercise: plot the two linear equations $3x - 4y = 5$ and $4x + 4y = 5$ over the interval $[-3, 4]$. Print your plot and hand it in with your name and MatLab2 written on it.