The following examples are not intended to be an exhaustive guide to MATLAB, but may provide some help in using MATLAB to perform common calculations throughout MAE 340 and beyond.

1. **Get help inside of MATLAB**
   To get general help information regarding how to use help:

   $$\texttt{>>}\ \text{help help}$$

   To see the help file for a command called "commandname" :

   $$\texttt{>>}\ \text{help commandname}$$

   To do a keyword search (for instance, if you want to find out about "topicname" but you don't know the names of any related commands), you can try:

   $$\texttt{>>}\ \text{lookfor topicname}$$

2. **Define a polynomial**
   A polynomial is defined in MATLAB by a vector containing the coefficients from highest to lowest order:

Polynomial	MATLAB command
$3s^2 + 5s + 10$	>> p = [3 5 10]
$-7x^4 + x^2 + 4$	>> p = [−7 0 1 0 4]

   Note the zeros in the second example, which must be included to place the nonzero coefficients on the correct powers in the polynomial.

3. **Find roots of a polynomial**
   The roots are the values that make the polynomial equal 0:

Polynomial	MATLAB command for solution:
$3s^2 + 5s + 10 = 0$	>> s=roots([3 5 10])
$-7x^4 + x^2 + 4 = 0$	>> x=roots([−7 0 1 0 4])

   Note that in the first example, s is a vector with 2 elements; in the second example, x is a vector with 4 elements. Roots may be complex, even if all of the polynomial coefficients are real; complex roots are very common in MAE 340 and in mechanical and aerospace practice in general. To isolate the real and/or imaginary parts of a complex vector x:

   $$\texttt{>>}\ \text{xreal} = \text{real(x)}$$

   $$\texttt{>>}\ \text{ximag} = \text{imag(x)}$$

   Note that each of these commands results in a vector with the same number of elements as x. To find the largest (or smallest) element of a vector x, use

   $$\texttt{>>}\ \text{largestx} = \text{max(x)} \qquad \textit{or} \qquad \texttt{>>}\ \text{smallestx} = \text{min(x)}$$

   The following command finds the largest real part among all of the roots (real or complex) of the polynomial defined by $2s^5 + 4s^4 + 3s^2 - 7s + 12$:

   $$\texttt{>>}\ \text{sigma} = \text{max(real(roots([2 5 4 3 -7 12])))}$$

4. **Solve simultaneous algebraic equations**
   Suppose you need to solve for the values of x and y that satisfy the simultaneous equations:

   $$2x + 3y = 7 \quad , \quad 4x - 5y = -12$$

   The following MATLAB commands will calculate the solution, defined here as the vector $\vec{z} = [x\ ;\ y]$:

   $$\texttt{>>}\ \text{A=[2 3 ; 4 -5]}$$

   $$\texttt{>>}\ z = \text{inv(A)*[7 ; -12]}$$

5. **Define a vector of evenly-spaced values**
   The following command defines a vector T (size 1 x 11) containing the values [0 0.1 0.2 ... 1]

   >> T = [0 : 0.1 : 1]

6. **Define a vector that is an element-by-element function of another vector**
   The following command defines vector X = sin(T) , where T is the vector defined above. Thus, X has the same size as T (i.e., 1 x 11), and its elements are [sin(0) sin(0.1) sin(0.2) ... sin(1)]

   >> X = sin(T)

7. **Define a vector that is the element-by-element product of two other vectors**
   Using T defined above, we form X = e^{-T}sin(T) = [e^{0}sin(0) $e^{-0.1}$sin(0.1) $e^{-0.2}$sin(0.2) ... e^{-1}sin(-1)] where, as above, X is size (1 x 11)

   >> X = exp(-T).*sin(T)

   Note that the operator symbol is .* which is called an array multiply (not the same as *)

8. **Plot the vector X vs the vector T**
   The vectors must be the same length (i.e., have the same number of elements):

   >> plot (T, X)

   In this example, the horizontal axis is T and the vertical axis is X

9. **Plot two curves on the same set of axes** Suppose Y and X have both been defined as functions of T. The command

   >> plot(T,X,'b',T,Y,'g')

   plots X vs T as a blue line, and Y vs T as a green line, on the same axes.

   The **plot** command has many more options; use >> **help plot** to see them

10. **Add various labels and enhancements to a plot**
    To label the axes in a plot,

    >> xlabel('This is the name of the horizontal axis')

    >> ylabel('This is the name of the vertical axis')

    To add a title to the plot,

    >> title ('This plot shows X and Y as a function of T')

    To add grid lines to the plot (which enhances the ability to read numerical values)

    >> grid

    To create a legend so that multiple curves are properly identified

    >> legend('X', 'Y')

    Use "help plot" to see the many additional options for customizing your figures, including drawing multiple curves on the same set of axes.