MAT188 LAB 1

In Lab 1, we will use MATLAB to generate vectors, and will learn how to plot simple two dimensional graphs. We assume you already done your prelab worksheet, and your PCE0. that is you have finished the first three modules of onramp, and you have MATLAB installed. If you work on this worksheet from a lab on-campus, or if you are remotely connected to a computer lab on campus through ECF, you don't need to have MATLAB on your personal computer.

EXERCISE 1 (Defining Vectors). *In our textbook, you learned that a column vector of size n is an $n \times 1$ matrix, and a row vector is a $1 \times n$ matrix. Vectors are closely connected to what we call an array in MATLAB. An array is a group of values or a sequence of numbers. A vector can be seen as an array with one column or one row .*

(1) *Start by defining a simple vector. Try*

```
>> x=[2 3 4 5 6]
```

Alternatively, you can use commas instead of spaces to separate numbers:

```
>> x=[2,3,4,5,6]
```

(2) *You can also define a vector using the colon operator* `:`*, which creates numbers in an interval separated by a "step" value. For example, try:*

```
>> x2=1:2:9
```

(3) *The* `linspace` *(linearly spaced vector) command creates a vector of evenly spaced numbers (points) in a given interval. The difference between consecutive numbers depends on the number of points. Try the following command end explain in clear words what it does*

```
>> x3=linspace(2,5,7)
```

(4) *Vector operations: try the commands below on your vectors $\vec{x}$, $\vec{x}_2$ and $\vec{x}_3$ and explain which mathematical vector operations they perform:*

```
>> y=3*x
>> y2=x+x2
>> y3=x-4*x2
```

(5) *What happens if you try the line below. Why?*

```
>> z=x3+x2
```

(6) *Other than operations that you see in linear algebra, MATLAB allows us to do some other arithmetic on arrays that don't correspond to any vector operations, but are useful in other areas, for example when we use arrays to plot functions. For instance, try the following commands and explain what they do.*

```
>> y4=x.*x2
>> y5=x./x2
>> y6=x.^2
```

EXERCISE 2. *(Discretization and Plotting)*

Discretization is the process of approximating a continuous function with a discrete number of points so we can store and use this function in digital calculations. No matter whether we use 5 points or 5,000,000 points, this discrete version is an approximation of the continuous function. All results found through numeric computation are approximations to the solutions that might be found through analytic means.

We will now use MATLAB to define and plot the function $y = e^{-x}\sin(4\pi x)$*. For comparison, we will first plot the decaying exponential function and the sinusoidal function on their own, then combine them to plot the final function, resulting in a figure with three functions.*

(1) *Create a discrete collection of values of the independent variable x. Use* `linspace` *to create a vector that starts at* 0*, ends at* 5*, and has* 101 *points.*[1]

```
>> x=linspace(0,5,101)
```

(2) *You can use MATLAB's built-in functions to operate on vectors. Applying a function to a vector applies it to each individual component of the vector, creating a new vector of the same size. Try*

```
>> y1=exp(-x);
>> y2=sin(4*pi*x);
```

(3) *What happens if we don't put semicolons?*

(4) *Now combine the output to get the vector of the complete function*

```
>> y=y1.*y2;
```

(5) *Plot the approximation of the final function on its own:*

```
>> plot(x,y);
```

(6) *ow, plot all three functions on the same figure to understand how the two separate functions combine to form the decaying sinusoidal function.*

```
>> plot(x,y1,x,y2,x,y);
```

(7) *Use this process to define and plot the vectors* y_1*,* y_2*, and* y *using* 11 *points instead of* 101*. Do this again for* $5,000,001$ *points. What do you observe about both exercises? Hint: You should start with the clear all command, and the up arrow should be helpful.*

It is important to always consider the results from MATLAB with skepticism. Using your own understanding of the underlying concepts, you should always have a general idea of the expected results before using MATLAB. Always ask yourself, "Do these results from my numeric computations make sense?"

EXERCISE 3. *Finish MATLAB onramp on your own. Your TA may ask you to show your progress during your next LAB. You don't need to submit anything for this lab.*

[1]Note that we use 101 points here to get 100 intervals (differences between pairs of consecutive numbers). Using 100 points would have given 99 intervals, which is valid but more likely to have small rounding errors in the approximation. In most cases, 101 points is a good number to plot a function.