Math 408R: UT Worksheet 3: Functions, continued September 9, 2014

Here we explore further features of MATLAB. To begin, please open up MATLAB.
Please note: For each exercise below, enter the requested code into a *new* line in the Command Window; of course, its fine to *copy* code from one cell to the next, modify as necessary, and then execute the new code, in the new cell.
This tutorial concerns the function $y = t^2$, and various ways of graphing and studying this function using MATLAB.

1. In the Command Window, input the line

   ```
   t = linspace(-2,2,40)
   ```

   what happened?

2. In general, the command

   ```
   t = linspace(a,b,N)
   ```

   generates N linearly spaced numbers from a to b and places them in the array t (it actually generates a row vector t containing N points spaced equally between a and b). In the previous worksheet, we worked with the MATLAB command:

   ```
   ezplot(f,[a,b])
   ```

   While this command had the advantage of being simple, it doesn't have the flexibility of using the Matlab "plot" command option. Now enter the following command:

   ```
   y = t^2
   ```

   What was returned?

3. What went wrong in the previous exercise is this: MATLAB views t as a vector (or a list of numbers) and doesn't know how to square a list of numbers. Fortunately, there are a number of ways around this. Here's one easy way. In MATLAB, if we place a "dot" after the t, Matlab will then square each element in our vector. Now enter the command:

   ```
   y = t.^2
   ```

   What was returned?

4. Let's try the above exercises again, but now use a semi-colon after each of the commands. That is, now enter:

```
t = linspace(-2,2,40);
```

and then enter

```
y = t.^2;
```

What was returned? (Note that the use of a semi colon in MATLAB suppresses the output from appearing on the screen).

5. In the previous exercises, you have created two vectors, t and y, each with the same number of elements (40). We will now use the "plot" command to create a graph of $y = t^2$ on the interval $[-2, 2]$. Now enter the following:

```
plot(t,y)
```

What happened?

6. Next, we will add labeling to our plot. When using the plot command we have many options available (as compared to ezplot where the options are limited). Suppose we want to label the axes and title the plot. We could do this using the following sequence of commands:

```
plot(t,y)
hold on
title('Time vs Distance'), xlable('Seconds'), ylabel('Meters')
```

What was returned (the command `hold on` tells MATLAB to use the previous figure for all subsequent commands)?

7. Now suppose that, instead of simply putting a t on the horizontal axis and an y on the vertical axis, we want to write "t (seconds)" on the vertical axis, and "y (meters)" on the horizontal axis. By cutting, pasting, and modifying your code from the previous problem, enter and execute code that will do exactly this. What code did you enter?

8. If s' denotes the rate of change of s with respect to time t, in exercise 7 above, what are the units of s'?

9. We are now going to zoom in on the graph of $y = t^2$, near the t-value $t = 1$. To do this, change your t and the corresponding y vector to now operate on the interval $[0.9999, 1.0001]$ (hint: now make a new `linspace` command and execute your other code accordingly). How would you describe the basic shape of the graph you now see?

10. We'd like to figure out the *slope* of the "line" you graphed in the previous exercise. (It's not *really* a line – more on this apparent linearity later in the semester – but let's pretend.) Use the graph you produced to estimate the slope.

11. Now use MATLAB to compute the slope of the “line” you’ve graphed. You can do this by entering

    ```
    (y(40)-y(1))/(t(40)-t(1))
    ```

    in the Command Window. Here $t(1)$ is the beginning (leftmost) t value shown on your graph, $t(40)$ is the ending (rightmost) t value (remember, your t and y vectors have 40 elements), and $y(1)$ and $y(40)$ are the corresponding y values. Go ahead and do this. What is your slope?

12. Using everything you’ve learned above, now plot the function $P = D^2 - 2D$, with the axes labeled appropriately; with D in dollars and P in pickles (why not?); on a domain from -1.002 to -0.998. Then use MATLAB to compute the slope of the “line” you see.

13. Finally, we want to make sure we know how to save graphical output from MATLAB, so that we can send it to ourselves, send it to a printer, insert it into an electronic file in which we’re doing our homework, etc. Go back to your most recent graph, and under file select “Save". At this point you will be available to save your figure under the format that is most appropriate to your application. To access your figure again in MATLAB, you would want to save it under the default “.fig” format. However, MATLAB has several other options (for example, .jpg or .eps). Do it, so that your image is saved. Then make sure you can find that image, so you can use it when you need it.