Math Camp 2017 - MatLab Primer

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1. **Functions**.
   When working in MatLab for 241 A (or for your own research), you'll typically be writing functions. Writing functions is preferable to working exclusively in the editor for many reasons, including saving time. You'll be required to write MatLab functions for 241 A.

2. **Example Function**.
   Here is an example of code for a simple function that calculates the coefficients and standard errors for a linear regression:

```
function[b, S2] = OLS(X, Y)
        [n, k] = size(X);
        b = (X.'*X)^(-1)*(X.'*Y);
        e = Y-X*b;
        s2 = (e.'*e)/(n-k);
        S2 = diag(s2*(X.'*X)^(-1));
end
```

   Remember to end lines in semi-colons! In MatLab, save this file as "OLS.m" to call the function later. Breaking it down line-by-line:

   - `function[b, S2] = OLS (X, Y)`
     - `function[b, S2]` tells MatLab we're starting a funtion that returns *outputs* `b` and `S2`.
     - `OLS(X, Y)` names the function "OLS," which takes *inputs* `X` and `Y`.
   - `[n, k] = size (X);` produces a vector with two entries; `size(X)` assigns to `n` the number of rows and to `k` the number of columns of `X`.
   - `b = (X.'*X)^(-1)*(X.'*Y);` is the usual formula for OLS; note that `.'` is used to take the transpose of a matrix and `^(-1)` is used to take the inverse.
   - `e = Y-X*b;` is the usual formula for the error terms
   - `s2 = (e.'*e)/(n-k);` calculates the estimated variance
   - `S2 = diag(s2*(X.'*X)^(-1));` calculates the variance of each of our estimates. The `diag()` function pulls out the main diagonal of a matrix (here it's pulling the variances out of the variance-covariance matrix).
   - `end` tells MatLab that the function is complete.

3. **Example Script**
   Scripts are where you specify the parameters that will serve as inputs for your function. Save a file called "Example.m" in the same directory as your "OLS.m" file with code that looks something like:

```
clear all;
clc;

X = [1 5 3 ; 1 1 4 ; 1 5 7 ; 1 3 10];
Y = [2; 3 ; 2 ; 1];

[b,S2] = OLS(X,Y);
```

   Again, thinkin about the code line-by-line:

   - `clear all;` clears any saved data/parameters/etc. from MatLab.
   - `clc;` clears the command window.
   - `X` has been defined as a 4-by-3 matrix; spaces separate values within a row, semi-colons indicate the start of a new row
   - `Y` is the "outcome" vector
   - `[b,S2] = OLS(X,Y);` calls the function we defined above, taking `b` and `S2` as the outputs

   So long as your script and your function are saved in the same directory, MatLab will automatically call your function.