MATLAB: Session 1

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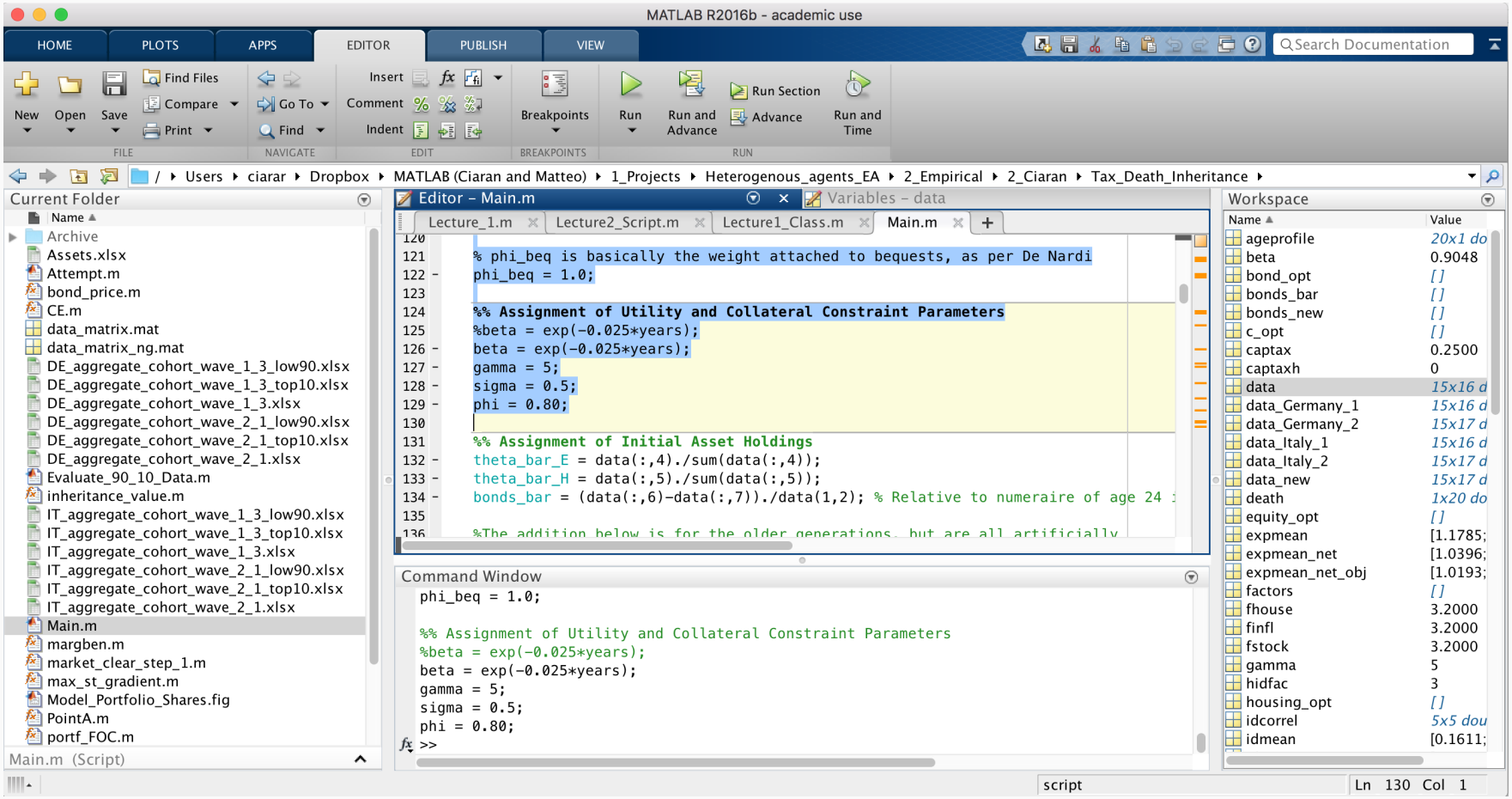
Why MATLAB?

1. Easy to use scripting language for linear algebra
2. Built-in Numerical Computation
    - Matrix decompositions
    - Numerical integration
    - Optimization etc.
3. Plotting in tractable and appealing way

MATLAB Interface



Getting Help

If you don't know, Google it! (someone very likely to have had same problem)

Help!

$>>$ *help* $<$ *command* $>$
$>>$ *doc* $<$ *command* $>$

$>>$ *lookfor* (somewhat inferior to google)

Demos and examples

Basic Syntax (1)

- **Semicolon**

$$>> 4 + 5;$$

- **% for comments**

$$>> 4 * 5\% - 6$$

- **Assignment**

$$>> y = 4/5$$

- **Matrix Assignment**

$$>> y = [1, 2; 3, 4]$$

- **Single Element Assignment**

$$>> y(2, 2) = 4/10$$

Basic Syntax (2)

- **Transpose**

$$>> y = y'$$

- **Logical**

$$>> y = (y == 0)$$

- **Colon Operator**

$$>> x = -pi : 0.1 : pi;$$

- **Linspace Command**

$$>> z = \text{linspace}(-pi, pi, 100)$$

- **Call Functions**

$$>> y = sin(x)$$

- **Using Logical Statements**

$$>> y(y > 0.5) = 0.5$$

Basic Syntax (3)

- **Matrix Multiplication**

$$>> x * x$$
$$>> x. * x$$

- **Strings**

$$>> a = [\text{'two' 'words'}]$$
$$a(2)$$

- **Size**

$$>> \text{size}(x)$$
$$>> \text{size}(x, 2)$$

- **Zeros**

$$>> \text{zeros}(5, 3)$$
$$>> \text{zeros}(\text{size}(x))$$

- **Clear Command/Variables/Figures**

clc; clear all; close all

Basic MATLAB Usage

Stopping Code Running

ctrl + c

Running the Script

- **"Run" Tab** - Found in Editor tab - runs full script
- **"Run Section" Tab** - Found in Editor tab - runs section
- **Cmd+Enter** - Runs whatever is highlighted

Basic Plotting

Create a figure

$$>> figure;$$

Line plot

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

title;xlabel;ylabel;

$$>> title('myplot'); xlabel('x'); ylabel('y');$$

Scatter plot

$$>> holdon; scatter(x, y);$$

Saving and Loading Data

Saving Data

$$save('filename','var1','var2','var3')$$

Loading Data

- MATLAB files

$$load('filename')$$

- Excel Files

$$[\text{data textdata}] = \text{xlsread('Random.xlsx')}$$

- Add paths to other files

$$\text{addpath}(< \text{pathname} >)$$

Example: TripAdvisor Dataset

Load the data

$$[\text{data textdata}] = \text{xlsread('TripAdvisor.xlsx','Raw')}$$

Use *unique* to identify set of possible prices

$$\text{Prices} = \text{unique(textdata(2:end,5))}$$

Then, use *strcmp* to generate logicals from strings

$$\begin{aligned}\text{PriceLow} &= \text{strcmp(textdata(2:end,5),Prices(1))}\\ \text{PriceMed} &= \text{strcmp(textdata(2:end,5),Prices(1))}\\ \text{PriceHig} &= \text{strcmp(textdata(2:end,5),Prices(1))}\end{aligned}$$

Clean data by removing:

- Observations where there is no Price indication
- Observations where merge was unsuccessful

Regressions (1)

Assignment of Variable Names

placeId = datamatrix(:,1);

Generate X variable

X = [ones(size(userRating)) Height];

Run regression

b = X over Y

Generate t-statistics

Regressions (2)

Run Regression with More Dummies

X = [ones(size(userRating)) isGreat isFresh isOk PriceHig PriceMed];

EXERCISE: What is the effect of price on ratings?

- Start with basic single-variable
- Add variables you think are relevant
- Evaluate t-statistics to examine significance

MATLAB Functions

Generation of functions

function $<$ outputvars $>=<$ function-name $>$ $(<$ inputvars $>)$

Functions saved as m. files under the function-name.

Example $y = min(x, 2)$

Control Flow

"for" Loops

for $i = 1 : 10$
    statements
end

"If" Statements

if $x == 0$
    statements
else   statements
end

"while" Statements

while $d > 0.01$
    statements
end

Note: If you can, write in matrix form, not loops

Example 1: Fibonacci

$$f(1) = 1; f(2) = 1$$
$$f(n) = f(n-1) + f(n-2)$$

Write code that returns the nth element

1. Recursion
2. Loop
3. Practice
   - Write code that returns first n elements (in loop and recursion)
   - Use tic/toc to time recursion and loop functions; plot the differences up to n=30
   - Question: Why is one faster than the other?

Example 2: Numerical Integration/Pareto Distribution

$$F_X(x) = \begin{bmatrix} 1 - \frac{x_m}{x}^{\alpha} & if \quad x \geq x_m \\ 0 & ifx < x_m \end{bmatrix}$$

$$f_X(x) = \begin{bmatrix} \frac{\alpha x_m^{\alpha}}{x^{\alpha+1}} & if \quad x \geq x_m \\ 0 & ifx < x_m \end{bmatrix}$$

PRACTICE 1

1. Write a function for the Pareto PDF ($\alpha = 2$; $x_m = 1$)
2. Write a function for the Pareto CDF

PRACTICE 2: Derive Probability of Drawing

1. Define a grid x that covers (3,4), with step size d
2. Evaluate Pareto density on x, store as fx
3. Find the sum of fx times the step size

Function Handles and Expected Values

- Convenient alternative to writing an alternative function .m file
  - particularly useful if function is simple
  - funcname = @$(x)(f(x))$

Examples

- Example 1: addone = @$(x)(x+1)$
- Example 2: addition = @$(x,y)(x+y)$
- Example 3: multiply = @$(x,y)(x*y)$

EXERCISE: Expected Values Using Function Handles