San Francisco State University
ECON 702

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# Matlab Basics

1. Matlab interface
   (a) Command window
   (b) Workspace window
   (c) Choosing current directory
   (d) Matlab Toolboxes
   (e) Matlab Editor
   (f) Matlab Help
2. Basic operations with numbers
3. Creating grids and arrays
   (a) `x = 1:2:10` (creates a vector of numbers [1,3,5,7,9])
   (b) `x = [3, 12, 0; 7, 11, 13; 6, 6, 6]` (creates a matrix)
   (c) `x = linspace(a,b,n)'` (n equally spaced numbers between a and b)
   (d) `;` suppressing display
   (e) Plotting vectors:

```
x = -10:10;
y = x.^2; plot(x,y)
title('Quadratic function f(x) = x^2');
xlabel('x');
ylabel('y')
```

4. Matrices
   (a) Creating special martrices: `zeros, ones, rand, randn, eye`
   (b) Subscripting
   `A(i,j)` is the element in row `i` column `j` of matrix `A`
   `A(i,end)` is the last element in row `i` of matrix `A`
   `A(end,j)` is the last in column `j` of matrix `A`
   (c) Vectorizing `":"`, the colon operation
   (d) Deleting rows or columns
   `A(3,:) = []` (Deletes the 3rd row of matrix `A`)
   `A(:,5) = []` (Deletes the 5th column of matrix `A`)

(e) Matrix arithmetics: transpose, multiplication by constant, matrix multiplication (matrices must conform)., inv, element-by-element multiplication (matrices must be of identical size)

`A', A*B, A.*B, inv(A)`

(f) Important functions for data: `min, max, mean, sum, cumsum, cumprod`.

5. M-files (programming in Matlab)

(a) **Scripts.** A script is a program, a series of matlab commands. Here is an example of a program that simulates productivity shocks. The total factor productivity, $A_t$ is assumed to be generated by the following probability model:

$$\begin{aligned} A_{t+1} &= (1+\gamma)^t A_1 e^{z_t} \\ \text{where } z_{t+1} &= \rho z_t + \varepsilon_t, \quad \varepsilon_t \sim N(0, \sigma) \end{aligned}$$

Thus, $z_t$ is an $AR(1)$ process. Notice that

$$\ln(A_{t+1}) = \ln(A_1) + t\ln(1+\gamma) + z_t$$

Therefore, this model of TFP is consistent with the data, in that it exhibits a constant growth rate of $\gamma$ on average, and fluctuates around the trend. For practice, write this program into a matlab file and make sure you understand how it works.

Editor - C:\Documents and Settings\mbar\Desktop\ECON700spring2008\Matlab\Exercises\Example1.m

File Edit Text Go Cell Tools Debug Desktop Window Help

```
% Example1.m is a script (program written in Matlab language). This program
% simulates a time series of productivity shocks, A, that can be used in
% business cycle models. Notice that Matlab does not read the comments that
% follow after the % symbol. These comments are for clarity. Use as much of
% these explanatory comments as possible
clear all; %Clearing everything from the memory
close all; %Closing all the figures
%*************************************************
%               Step 1 - Initial values           *
%*************************************************
A(1,1) = 1; %Initial value of the productivity shock
g = 0.02; %Average growth rate of productivity
rho = 0.95; %AR(1) coefficient of productivity shock
z(1,1) = 0; %Initial value of productivity shock
%*************************************************
% Step 2 - Simulating time series of productivity *
%*************************************************
for t = 1:1:70 %Simulating productivity shocks for 70 year
    eps(t,1) = 0.02*randn(1,1); %Error term in productivity shock
    z(t+1,1) = rho*z(t,1) + eps(t,1); %Productivity shock: AR(1) process
    A(t+1,1) = A(1,1)*(1+g)^t*exp(z(t+1,1)); %Deterministic + stochastic component
end %Ending the "for" loop

%*************************************************
%           Step 3 - Protting the figures         *
%*************************************************
years = (1930:1:2000)';
figure(1)
plot(years, A)
title('Simulated Productivity Shocks')
xlabel('Years')
ylabel('Total Factor Productivity')

figure(2)
plot(years, log(A))
title('ln(Simulated Productivity Shocks)')
xlabel('Years')
ylabel('ln(Total Factor Productivity)')
```

Experiment with different simulations when you change the values of $\rho$ and $\sigma$.

(b) **Functions.** A function is an m-file that can be used and reused as an intrinsic Matlab function. For example, the next function computes the roots of a quadratic polynomial of the form

$$ax^2 + bx + c = 0$$

We know from math that in general there are two roots (solutions) to this function:

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$
$$x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

The general structure of a function is

$$[\text{outputs}] = \text{functionname}\,(\text{inputs})$$

In the next example, the inputs are $(a, b, c)$, i.e. 3 numbers, and the output is $[x_1, x_2]$, the roots of the quadratic. For practice, write this function and compute the roots of

$$x^2 - 1577x + 606726 = 0$$

Type in the command window: `[x1, x2] = quadraticmichael(1,-1577,606726)`. It is important that you understand the structure of functions and how they are used.