YLE13 Introduction to Matlab

Start Matlab

Matlab automatically creates a folder where to save your files

Take a look at the video from Matlab help à Demos à Getting started with Matlab

<u>Structure of Matlab</u>

- help window, demos, help desk
- A: command window
- B: M-files

<u>A. Command Window</u>:

Call m-files by writing the name of the m-file

USEFUL COMMANDS	
whos	variables you are using
what	files in your folder
save/load tulos	save/load variables and results as .mat file
clear	clear variables from the session (values of vectors and matrices are saved until changed or cleared)
arrow up	previous command in the command history
Ctrl+C	interrupts computing

<u>Parameters</u>

- **a=1, b=2** shown in command window (use for important results). Not shown in command window (typically better in programming): **a=1; b=2;**

COMPUTATIONS	
a+b	sum of scalars, vectors and matrices
a-b	
a*b	
a/b	
a^b	a to the power of b
a^.5	
a=[1 2]	vector
A=[1 2; 3 4]	matrix

Try: a(1) = 1, A(2,1) = ?

A(:,1), A(:,1:2), A(1:end,2) ?

FUNCTIONS	
max(a)/min(a)	
mean(a)	
var(a)	
abs(a)	
exp	
log	
factorial(n)	
randn	
roots([1 2 3])	$x^2 + 2x + 3 = 0$
length(a)	vector length
size(A)	matrix size
sum	summing values of a vector

Write in the command window help function to get more info on each function!

B. M-files:
Programming editor

1.1 Simulation loops
for – end

Example

firm.m

```
%Producing 1 or two units of good with price of 1.5 euros
p=1.5;
for y=1:2
   P(y)=p*y-y^2     %profits
end
```

1.2 Hotelling model
-basic Hotelling model price path comparison, competitive market vs monopoly

hotelling.m

```
clear
%x0 = 7600,
pb=118;
r=0.05;
beta=0.5;

for x=1:90
 t=x-1;

 y(x)=pb*exp(r*(t-50));
ym(x)=pb*exp(r*(t-83))/2+pb/2;

 end

hold on
plot(0:50,y(1:51))
plot(0:83,ym(1:84))
xlabel('t')
ylabel('p')
```

Price and exhaustion time of oil

Assume solar energy is the only backstop –technology for oil and it can produce the same energy as a barrel of oil with the price of 200 dollars. Assume further that the oil stock is 2000 billion (10^9) barrels, discount rate is 4% and demand parameter $b=1*10^{-9}$.

oljy.m

```
clear
x0=2000*1E9;
pb=200;
r=0.04;
beta=1E-9;

for T=1:90

  C(T)=pb*T-pb/r+(pb*exp(-r*T))/r-beta*x0;          %When C=0,
                                                    %T is the exhaustion time

  [Y I1]=min(abs(C));

  end

   Tc=I1

   t=0:Tc;
   p=pb*exp(r*(t-Tc));

   plot(0:Tc,p)
```

Alternative way of solving the time of exhaustion T:

ehtymisfkt.m

```
function C=ehtymisfkt(T)
pb=130;r=.02;beta=.4;x0=4000;
C=pb*T-pb/r+(pb*exp(-r*T))/r-beta*x0;
```

ehthetki.m

```
Tc=fzero('ehtymisfkt',[8])
```

After writing the function in an m-file this could be written in command window or inserted to another m-file

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Comparative dynamics

Assume the price of solar energy decreases to 150 dollars. How does this change affect the exhaustion time of oil? How does the price of oil change in time?

oljy2.m

```
clear
x0=2000*1E9;
pb=200;
r=0.04;
beta=1E-9;

for T=1:90

  C(T)=pb*T-pb/r+(pb*exp(-r*T))/r-beta*x0;


  [Y I1]=min(abs(C));

  end

   Tc=I1

   t=0:Tc;
   p=pb*exp(r*(t-Tc));

 %--------------------new code (compared to the previous example) starts here
  pb=150;
  for T2=1:90

  C2(T2)=pb*T2-pb/r+(pb*exp(-r*T2))/r-beta*x0;

  [Y2 I2]=min(abs(C2));

  end

   Tc2=I2
   t=0:Tc2;
   p2=pb*exp(r*(t-Tc2));

   hold on
   plot(0:Tc,p,'linewidth',3)
   plot(0:Tc2,p2,'r','linewidth',3)
```

Comparative dynamics of the extraction rate

oljy3.m

```
clear
x0=2000*1E9;
pb=200;
r=0.04;
beta=1E-9;

for T=1:90

  C(T)=pb*T-pb/r+(pb*exp(-r*T))/r-beta*x0;

  [Y I1]=min(abs(C));

  end

   Tc=I1

   t=0:Tc;
   q=(pb/beta)*(1-exp(r*(t-Tc)));    %This is new here

 %--------------------
  pb=150;
  for T2=1:90

  C2(T2)=pb*T2-pb/r+(pb*exp(-r*T2))/r-beta*x0;

  [Y2 I2]=min(abs(C2));

  end

   Tc2=I2

   t=0:Tc2;
   q2=(pb/beta)*(1-exp(r*(t-Tc2)));

   hold on
   plot(0:Tc,q,'linewidth',3)
   plot(0:Tc2,q2,'r','linewidth',3)
```

Exercise

1. Compute, illustrate and explain the comparative dynamics for price and extraction rate paths when
   a) oil stock decreases to 1500 billion barrels.
   b) discount rate increases to 10%.
   c) demand increases: beta = $0.2*10^{-9}$.