Computational Economics Problem Set I

By:

Problem 1

1

The market equilibrium is characterized by Supply = Demand. Therefore:

$$\begin{aligned} S &= D \\ a - bq &= c + dq \\ 0 &= c + dq - a + bq \\ 0 &= bq + dq - (a - c) \end{aligned} \tag{1}$$

2

From (1):

$$q = \frac{a-c}{b+d} \tag{2}$$

Plug (2) into the demand function:

$$\begin{aligned} p &= a - bq \\ p &= a - b\frac{a-c}{b+d} \\ p &= a - \frac{ab - bc}{b+d} \end{aligned} \tag{3}$$

Plug (2) into the supply function:

$$\begin{aligned} p &= c + dq \\ p &= c + d\frac{a-c}{b+d} \\ p &= c + \frac{ad - cd}{b+d} \end{aligned} \tag{4}$$

3

$$\underbrace{\begin{pmatrix} 1 & b \\ 1 & -d \end{pmatrix}}_{\text{A}} \underbrace{\begin{pmatrix} p \\ q \end{pmatrix}}_{\text{x}} = \underbrace{\begin{pmatrix} a \\ c \end{pmatrix}}_{\text{y}}$$

Breaking matrix A into LU:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \Bigg| \begin{pmatrix} 1 & b \\ 1 & -d \end{pmatrix} \xrightarrow{r2-r1} \underbrace{\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}}_{\text{L}} \Bigg| \underbrace{\begin{pmatrix} 1 & b \\ 0 & -d-b \end{pmatrix}}_{\text{U}}$$

Therefore we can describe this as LUx = y. Let us assume Ux = z, therefore Lz = y.

$$\underbrace{\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}}_{\text{L}} \underbrace{\begin{pmatrix} z_1 \\ z_2 \end{pmatrix}}_{\text{z}} = \underbrace{\begin{pmatrix} a \\ c \end{pmatrix}}_{\text{y}}$$

This will create a new system of linear equation:

$$z_1 = a \tag{5}$$

$$-z_1 + z_2 = c \rightarrow z_2 = c - a \tag{6}$$

And from Ux = z

$$\underbrace{\begin{pmatrix} 1 & b \\ 0 & -d-b \end{pmatrix}}_{\text{U}} \underbrace{\begin{pmatrix} p \\ q \end{pmatrix}}_{\text{x}} = \underbrace{\begin{pmatrix} a \\ c-a \end{pmatrix}}_{\text{z}}$$

Solving for x:

$$(-d-b)q = c - a \rightarrow q = \frac{a-c}{b+d} \tag{7}$$

$$\begin{aligned} p + bq &= a \\ p &= a - bq \\ p &= a - b\frac{a-c}{b+d} \end{aligned} \tag{8}$$

4

$$q = \frac{a-c}{b+d} = \frac{3-1}{0.5+1} = \frac{4}{3} \tag{9}$$

$$p = a - b\frac{a-c}{b+d} = 3 - \frac{1}{2}\left(\frac{3-1}{0.5+1}\right) = \frac{7}{3} \tag{10}$$

5

Matlab code for Gauss - Seidel Method

```
clear all
clc

%% Using Gauss - Seidel Method to solve system of lin. equation
A=[1,0.5;1,-1];
y=[3,1]';

%Choosing Q for Gauss Seidel
```

```
Q=triu(A);
Qinv = inv(Q);

tol=10e-6;
maxit=1000;
p=0.1;
q=0.1

for i=1:maxit
    p(i+1) = 3 - 0.5*q(i);
    q(i+1) = p(i+1) - 1;
    dp = p(i+1) - p(i);
    if norm(dp,1)<tol break
    end
end

disp(['The equilibrium price is ', num2str(p(end)), ' and the ...
    equilibrium quantity is ', num2str(q(end))])
disp(['The number of iteration is ', num2str(i)])
disp(' ')
```

6

Matlab Code for Iteration using Succesive Over Relaxation

```
lambda=0.1:0.1:0.9;
l=size(lambda,2);
maxit1=100000;

for j=1:l
    x1=[0,0]';
    for ii = 1:maxit1
            dx1 = Qinv*(y - A*x1);
            x1 = x1 + lambda(j)*dx1;
            if norm(dx1,1) < tol break
            end
            if ii≥maxit1
                disp('No Convergence')
            end
    end
    disp(['For lambda ', num2str(lambda(j)), ' ', ...
        ', price is ', num2str(x1(1)),', quantity is ', ...
            num2str(x1(2)),...
        ', iteration is ', num2str(ii)])
end
```

Problem 2

```
clear all
clc

%Load the quarterly GDP data from Germany and Greece
data=xlsread("OECD-Germany_Greece_GDP")';
%Log of the data
log_data = log(data);

%Separating between countries' data: Ger for German and Gre for ...
    Greece
Ger = log_data(:,1);
Gre = log_data(:,2);

%Calculating the trend from log GDP of Germany and Greece using ...
    lambda =
%1600
T_Ger = hpfilter(Ger,1600);
T_Gre = hpfilter(Gre,1600);

%Calculating the trend using OLS:
%Calculating the coefficient regressor:

%For Germany
X_Ger = [ones(length(Ger),1),(1:1:length(Ger))'];
beta_Ger = inv(X_Ger'*X_Ger)*X_Ger'*Ger;

%For Greece
X_Gre = [ones(length(Gre),1),(1:1:length(Gre))'];
beta_Gre = inv(X_Gre'*X_Gre)*X_Gre'*Gre;

%The linear trend for Germany from OLS
Y_Ger_hat = X_Ger*beta_Ger;

%The linear trend for Gre from OLS
Y_Gre_hat = X_Gre*beta_Gre;

%Calculating The Output Gap

%Germany
%Output Gap From HP Filter
Real_T_Ger = exp(T_Ger);
G_Ger_hp = (exp(Ger) - Real_T_Ger)./Real_T_Ger;
%Output Gap From OLS
Real_OLS_Ger = exp(Y_Ger_hat);
```

```
G_Ger_OLS = (exp(Ger) - Real_OLS_Ger)./Real_OLS_Ger;

%Greece
%Output Gap From HP Filter
Real_T_Gre = exp(T_Gre);
G_Gre_hp = (exp(Gre) - Real_T_Gre)./Real_T_Gre;
%Output Gap From OLS
Real_OLS_Gre = exp(Y_Gre_hat);
G_Gre_OLS = (exp(Gre) - Real_OLS_Gre)./Real_OLS_Gre;

%Plot log GDP with Hp Filter and OLS Trend
%Germany
figure('name','Log GDP versus Trends')
subplot(2,1,1)
plot(Ger)
hold on
plot(T_Ger)
plot(Y_Ger_hat,'green')
hold off
legend('Log GDP' ,'HP Filter', 'OLS','Location','southeast')
ylabel('Log GDP')
xlabel('Number of Quarters Starting from Q1 1995')
title('Log GDP, HP Filter and OLS Trend of Germany')

%Greece
subplot(2,1,2)
plot(Gre)
hold on
plot(T_Gre)
plot(Y_Gre_hat,'green')
hold off
legend('Log GDP' ,'HP Filter', 'OLS','Location','northwest')
ylabel('Log GDP')
xlabel('Number of Quarters Starting from Q1 1995')
title('Log GDP, HP Filter and OLS Trend of Greece')

%Plotting The Output Gaps from HP Filter and OLS
%Germany
figure('name','Output Gap')
subplot(2,1,1)
plot(G_Ger_hp)
hold on
plot(G_Ger_OLS)
yline(0)
hold off
legend('HP Filter' ,'OLS','Location','southeast')
ylabel('Output Gap')
xlabel('Number of Quarters Starting from Q1 1995')
title('Output Gap from HP Filter and OLS Trend of Germany')
```

```

%Greece
subplot(2,1,2)
plot(G_Gre_hp)
hold on
plot(G_Gre_OLS)
yline(0)
hold off
legend('HP Filter' ,'OLS','Location','southeast')
ylabel('Output Gap')
xlabel('Number of Quarters Starting from Q1 1995')
title('Output Gap from HP Filter and OLS Trend of Greece')
```