

# Computational Economics Problem Set I

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## 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

$$\underbrace{\begin{pmatrix} 1 & b \\ 1 & -d \end{pmatrix}}_A \underbrace{\begin{pmatrix} p \\ q \end{pmatrix}}_x = \underbrace{\begin{pmatrix} a \\ c \end{pmatrix}}_y$$

Breaking matrix A into LU:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \left| \begin{pmatrix} 1 & b \\ 1 & -d \end{pmatrix} \right. \xrightarrow{r2-r1} \underbrace{\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}}_L \left| \underbrace{\begin{pmatrix} 1 & b \\ 0 & -d-b \end{pmatrix}}_U \right.$$

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

$$\underbrace{\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}}_L \underbrace{\begin{pmatrix} z_1 \\ z_2 \end{pmatrix}}_z = \underbrace{\begin{pmatrix} a \\ c \end{pmatrix}}_y$$

This will create a new system of linear equation:

$$z_1 = a \quad (5)$$

$$-z_1 + z_2 = c \rightarrow z_2 = c - a \quad (6)$$

And from  $Ux = z$

$$\underbrace{\begin{pmatrix} 1 & b \\ 0 & -d-b \end{pmatrix}}_U \underbrace{\begin{pmatrix} p \\ q \end{pmatrix}}_x = \underbrace{\begin{pmatrix} a \\ c-a \end{pmatrix}}_z$$

Solving for x:

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

$$p + bq = a$$

$$p = a - bq \quad (8)$$

$$p = a - b \frac{a-c}{b+d}$$

**4**

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

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

**5**

Matlab code for Gauss - Seidel Method

```
1 clear all
2 clc
3
4 %% Using Gauss - Seidel Method to solve system of lin. equation
5 A=[1,0.5;1,-1];
6 y=[3,1]';
7
8 %Choosing Q for Gauss Seidel
```

```

9
10 Q=triu(A);
11 Qinv = inv(Q);
12
13 tol=10e-6;
14 maxit=1000;
15 p=0.1;
16 q=0.1
17
18 for i=1:maxit
19     p(i+1) = 3 - 0.5*q(i);
20     q(i+1) = p(i+1) - 1;
21     dp = p(i+1) - p(i);
22     if norm(dp,1)<tol break
23     end
24 end
25
26 disp(['The equilibrium price is ', num2str(p(end)), ' and the ...
       equilibrium quantity is ', num2str(q(end))])
27 disp(['The number of iteration is ', num2str(i)])
28 disp(' ')

```

## 6

### Matlab Code for Iteration using Succesive Over Relaxation

```

1 lambda=0.1:0.1:0.9;
2 l=size(lambda,2);
3 maxit1=100000;
4
5 for j=1:l
6     x1=[0,0]';
7     for ii = 1:maxit1
8         dx1 = Qinv*(y - A*x1);
9         x1 = x1 + lambda(j)*dx1;
10        if norm(dx1,1) < tol break
11        end
12        if ii>=maxit1
13            disp('No Convergence')
14        end
15    end
16    disp(['For lambda ', num2str(lambda(j)), ' ', ...
17        ', price is ', num2str(x1(1)), ', quantity is ', ...
18        num2str(x1(2)), ...
19        ', iteration is ', num2str(ii)])
19 end

```

$\lambda = 0.8$  gives the fastest value of convergence.

## Problem 2

### 1 - 5

```
1 clear all
2 clc
3
4 %Load the quarterly GDP data from Germany and Greece
5 data=xlsread("OECD-Germany-Greece-GDP")';
6 %Log of the data
7 log_data = log(data);
8
9 %Separating between countries' data: Ger for German and Gre for ...
   Greece
10 Ger = log_data(:,1);
11 Gre = log_data(:,2);
12
13 %Calculating the trend from log GDP of Germany and Greece using ...
   lambda =
14 %1600
15 T_Ger = hpfilter(Ger,1600);
16 T_Gre = hpfilter(Gre,1600);
17
18 %Calculating the trend using OLS:
19 %Calculating the coefficient regressor:
20
21 %For Germany
22 X_Ger = [ones(length(Ger),1),(1:1:length(Ger))'];
23 beta_Ger = inv(X_Ger'*X_Ger)*X_Ger'*Ger;
24
25 %For Greece
26 X_Gre = [ones(length(Gre),1),(1:1:length(Gre))'];
27 beta_Gre = inv(X_Gre'*X_Gre)*X_Gre'*Gre;
28
29 %The linear trend for Germany from OLS
30 Y_Ger_hat = X_Ger*beta_Ger;
31
32 %The linear trend for Gre from OLS
33 Y_Gre_hat = X_Gre*beta_Gre;
34
35 %Calculating The Output Gap
36
37 %Germany
```

```

38 %Output Gap From HP Filter
39 Real_T_Ger = exp(T_Ger);
40 G_Ger_hp = (exp(Ger) - Real_T_Ger)./Real_T_Ger;
41 %Output Gap From OLS
42 Real_OLS_Ger = exp(Y_Ger_hat);
43 G_Ger_OLS = (exp(Ger) - Real_OLS_Ger)./Real_OLS_Ger;
44
45 %Greece
46 %Output Gap From HP Filter
47 Real_T_Gre = exp(T_Gre);
48 G_Gre_hp = (exp(Gre) - Real_T_Gre)./Real_T_Gre;
49 %Output Gap From OLS
50 Real_OLS_Gre = exp(Y_Gre_hat);
51 G_Gre_OLS = (exp(Gre) - Real_OLS_Gre)./Real_OLS_Gre;
52
53 %Plot log GDP with Hp Filter and OLS Trend
54 %Germany
55 figure('name','Log GDP versus Trends')
56 subplot(2,1,1)
57 plot(Ger)
58 hold on
59 plot(T_Ger)
60 plot(Y_Ger_hat,'green')
61 hold off
62 legend('Log GDP' , 'HP Filter', 'OLS','Location','southeast')
63 ylabel('Log GDP')
64 xlabel('Number of Quarters Starting from Q1 1995')
65 title('Log GDP, HP Filter and OLS Trend of Germany')
66
67 %Greece
68 subplot(2,1,2)
69 plot(Gre)
70 hold on
71 plot(T_Gre)
72 plot(Y_Gre_hat,'green')
73 hold off
74 legend('Log GDP' , 'HP Filter', 'OLS','Location','northwest')
75 ylabel('Log GDP')
76 xlabel('Number of Quarters Starting from Q1 1995')
77 title('Log GDP, HP Filter and OLS Trend of Greece')
78
79 %Plotting The Output Gaps from HP Filter and OLS
80 %Germany
81 figure('name','Output Gap')
82 subplot(2,1,1)
83 plot(G_Ger_hp)
84 hold on
85 plot(G_Ger_OLS)
86 yline(0)

```

```

87 hold off
88 legend('HP Filter' , 'OLS', 'Location', 'southeast')
89 ylabel('Output Gap')
90 xlabel('Number of Quarters Starting from Q1 1995')
91 title('Output Gap from HP Filter and OLS Trend of Germany')
92
93 %Greece
94 subplot(2,1,2)
95 plot(G_Gre_hp)
96 hold on
97 plot(G_Gre_OLS)
98 yline(0)
99 hold off
100 legend('HP Filter' , 'OLS', 'Location', 'southeast')
101 ylabel('Output Gap')
102 xlabel('Number of Quarters Starting from Q1 1995')
103 title('Output Gap from HP Filter and OLS Trend of Greece')

```

## Graph for Section 2.5 (Code is at the above)

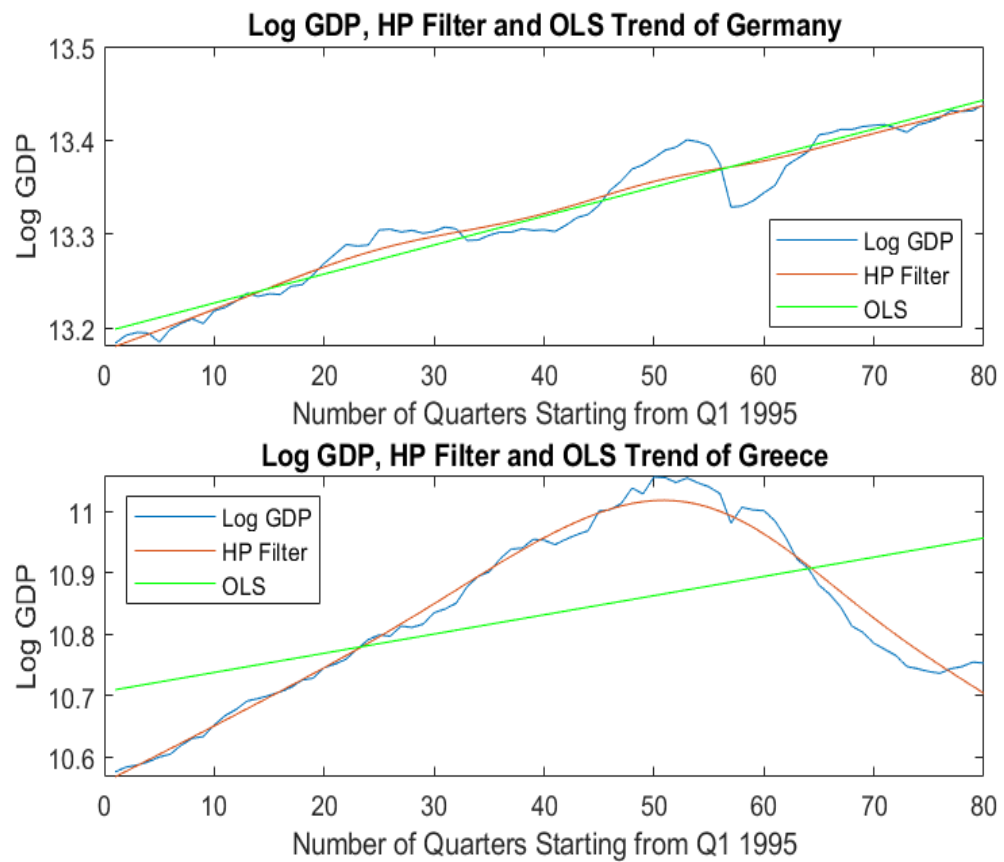


Figure 1: Log GDP Versus Trend

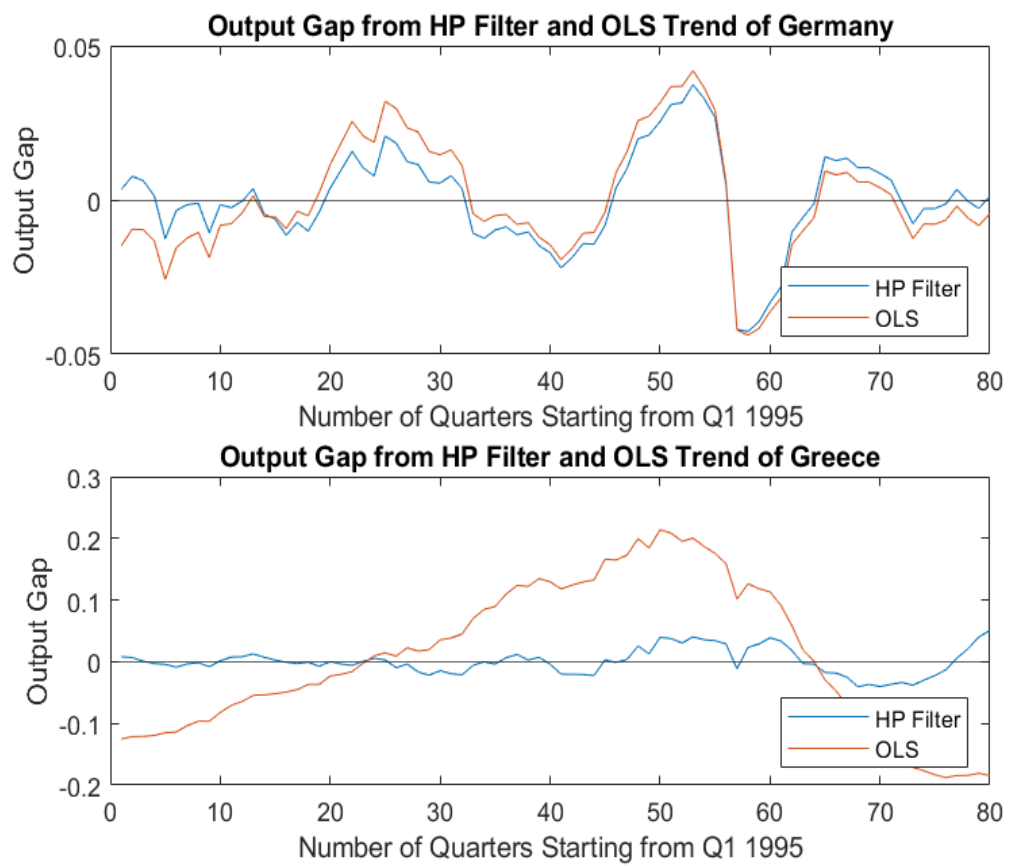


Figure 2: Output Gap