Homework 4

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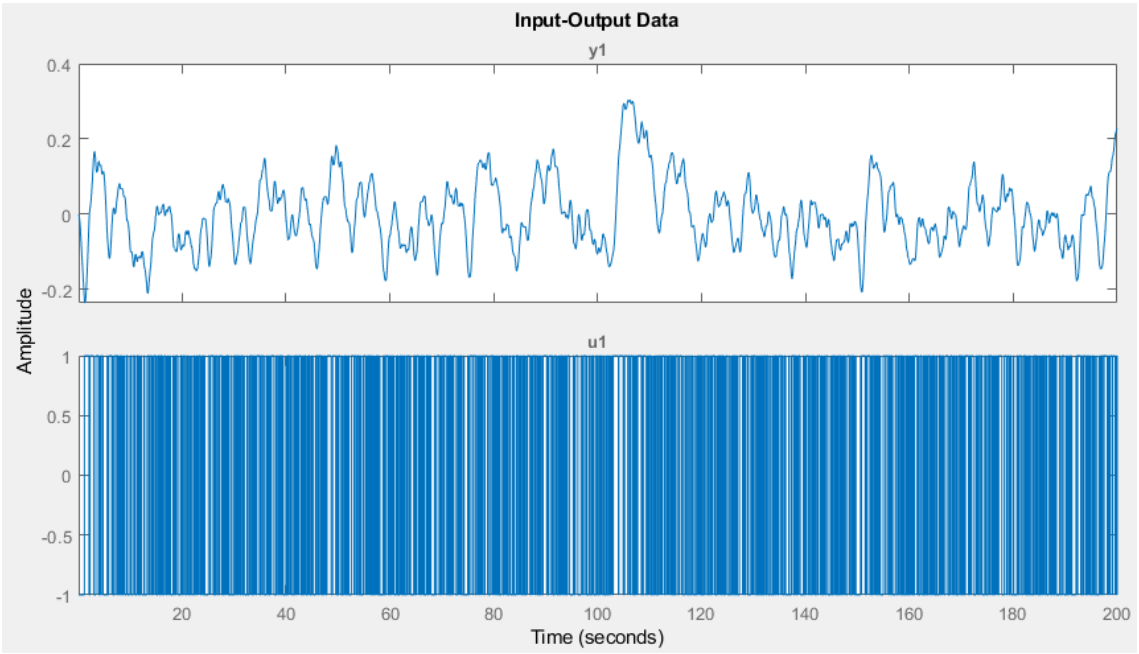
Problem 1)

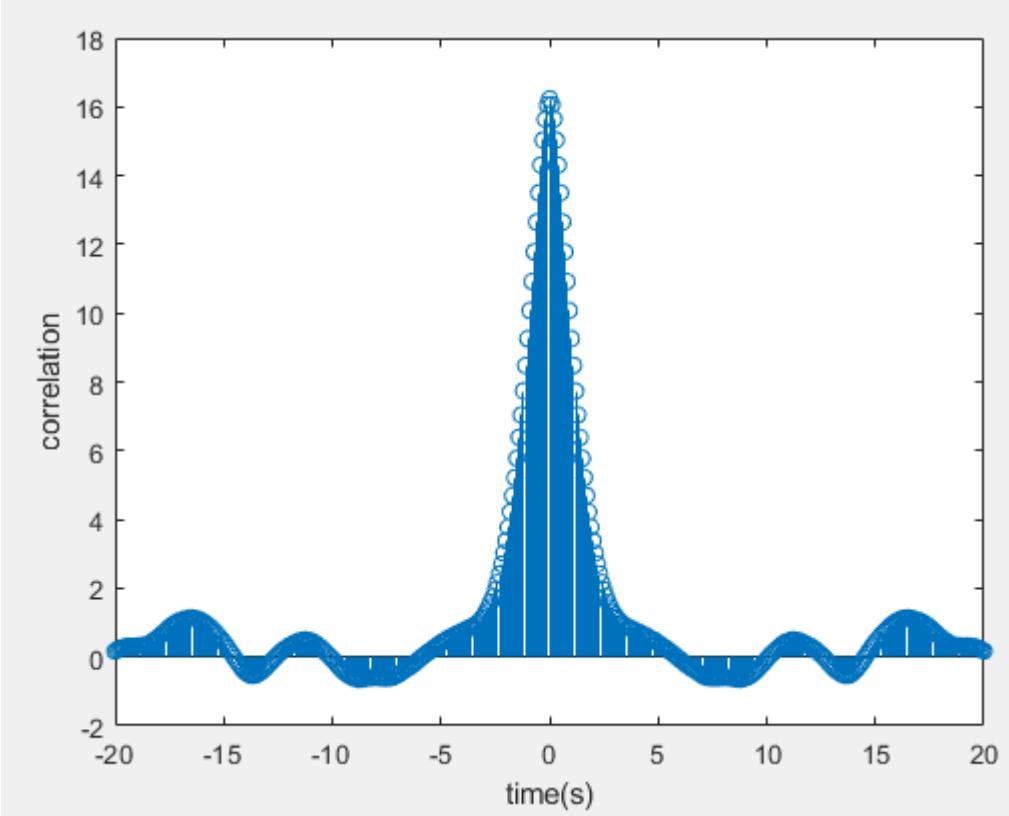
a)



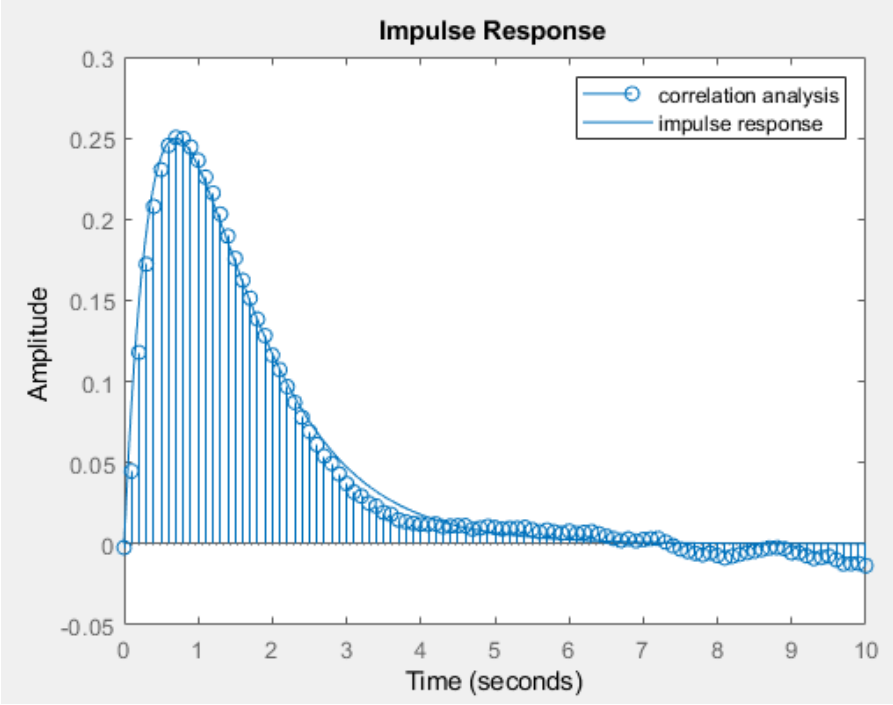

```
%% Homework 4
% Henrik Lucander 724140
clear all
close all
% Problem 1
% a)
%making the transfer function:
num = 1;
den = [1 3 2];
H = tf(num,den);

Ts = 1/10; %sample rate of 10Hz
t = 0:Ts:200; %200s time with sampling time as interval
u = idinput(length(t),'prbs'); %pseudorandom binary signal input
y = lsim(H,u,t); %simulating time response of dynamic system

data = iddata(y,u,Ts); %creating an iddata object from the generated signal
plot(data)
```

b)

```
% b)
tcorr = -20:Ts:20;
autocorr = xcorr(y,200);
figure(2);
stem(tcorr,autocorr);
ylabel('correlation');
xlabel('time(s)');
```

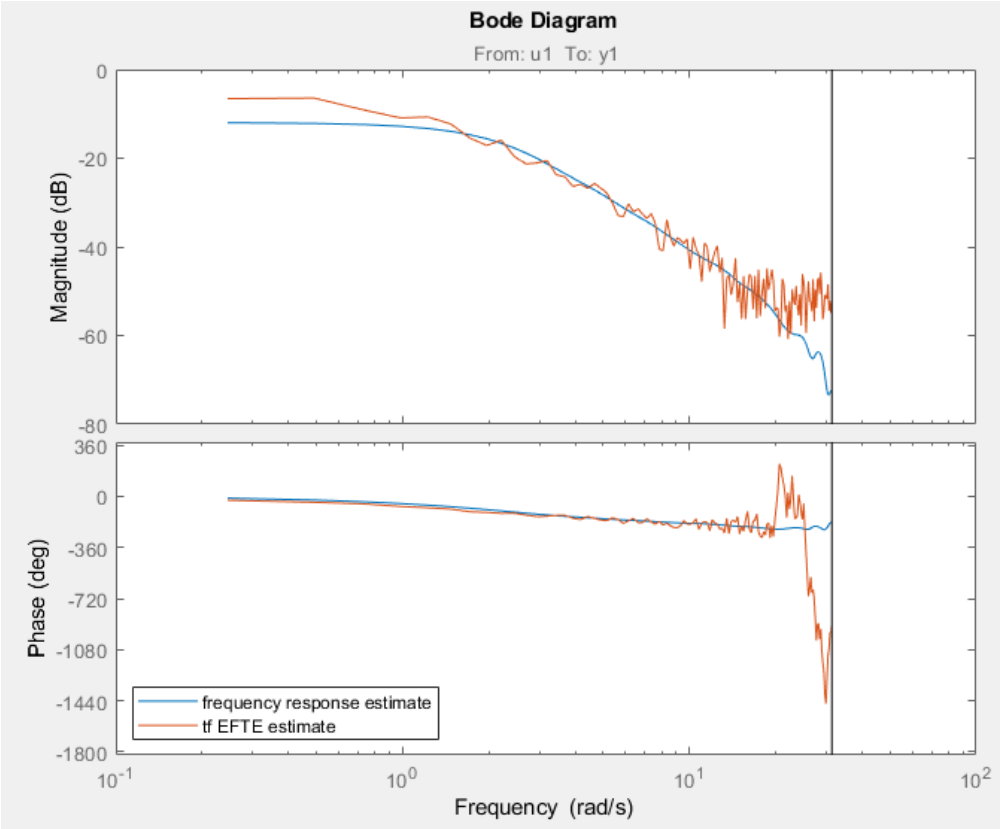


c)




```
28        % c)
29 -      figure(3)
30 -      imp = cra(data,100);
31 -      t2 = 0:Ts:10;
32 -      stem(t2,imp*10);
33 -      hold on
34 -      impulse(H,10);
35 -      legend('correlation analysis','impulse response');
```

d)

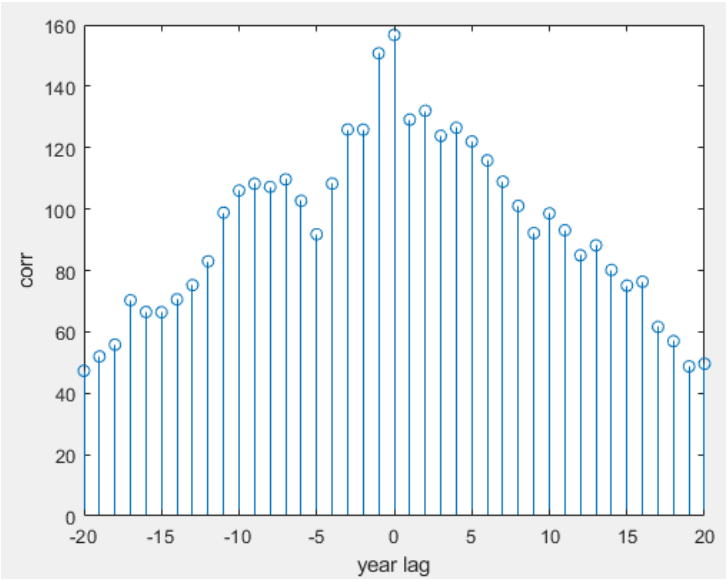



```
38      % d)
39 -    figure(4);
40 -    freq = spa(data);
41 -    estEFTE = etfe(data);
42 -    bode(freq,estEFTE);
43 -    legend({'frequency response estimate','tf EFTE estimate'},'Location','southwest');
```

Problem 2)

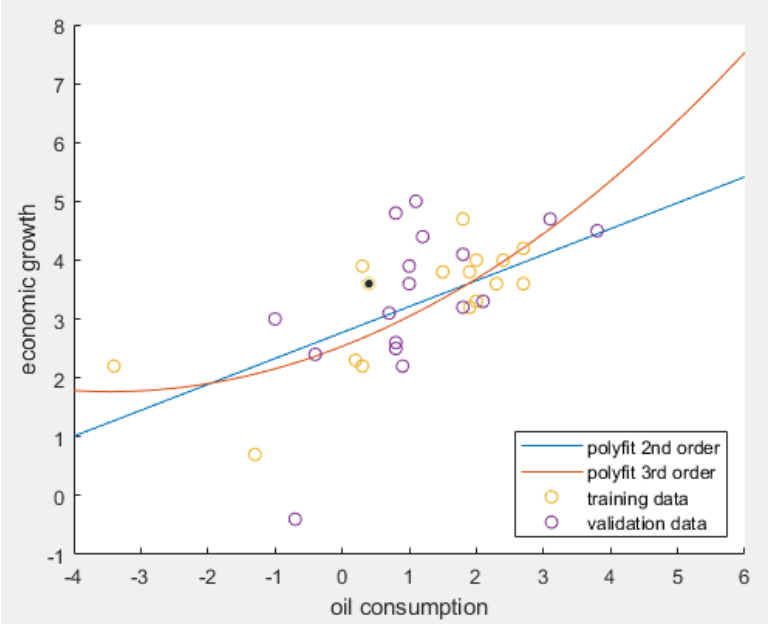
a)

We can analyze the relationship between oil consumption and economic growth by cross correlation.



The variables are correlated, but not very highly. We can see from the plot that the highest correlation is at 0. Therefore, we can say that there is no delay(lag) in the correlation (from year to year).

b)



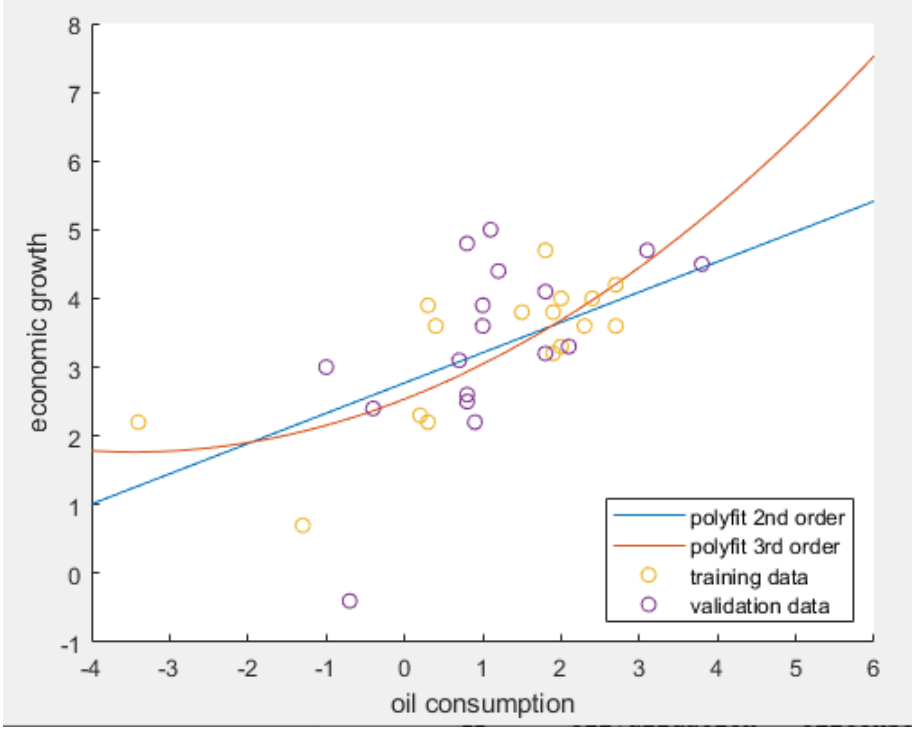
In the plot we can see the estimations for the polynomial model with 2nd order and 3rd order. We can see that the second order fits better.

The m-code used for estimating the polynomial model:

```
19      % b)
20      %splitting the data to training and validation sets:
21 -    oilTraining = oilConsumption(1:end/2);
22 -    oilValidation = oilConsumption(end/2+1:end);
23 -    ecoTraining = economicGrowth(1:end/2);
24 -    ecoValidation = economicGrowth(end/2+1:end);
25 -    pfit1 = polyfit(oilTraining,ecoTraining,1); %second order
26 -    pfit2 = polyfit(oilTraining,ecoTraining,2); %third order
27
28      % c)
29 -    figure(2);
30 -    hold on;
31 -    xaxis = linspace(-4,6,100); %x-axis
32 -    pval1 = polyval(pfit1,xaxis); %second order
33 -    pval2 = polyval(pfit2,xaxis); %third order
34 -    plot(xaxis, pval1);
35 -    plot(xaxis, pval2);
```

c)

The estimation function in part “b” plotted as the blue line.



The prediction for the economic growth in year 2015 if the oil consumption percentage change was -0.5% is: **2.5505%**

```
45 -    oilChange = -0.5;
46 -    ecoGrowthIn2015 = pfit1(1)*oilChange+pfit1(2)
```