Questions

This test exercise is of an applied nature and uses data that are available in the data file TestExer3. We consider the so-called Taylor rule for setting the (nominal) interest rate. This model describes the level of the nominal interest rate that the central bank sets as a function of equilibrium real interest rate and inflation, and considers the current level of inflation and production. Taylor (1993) considers the model:

$$i_t = r^* + \pi_t + 0.5(\pi_t - \pi^*) + 0.5g_t$$

with i_t the Federal funds target interest rate at time t, r∗ the equilibrium real federal funds rate, πt a measureof inflation, π∗ the target inflation rate and gt the output gap (how much actual output deviates from potential output). We simplify the Taylor rule in two manners. First, we avoid determining r∗ and π∗ and simply add an intercept to the model to capture these two variables (and any other deviations in the means). Second, we consider production yy rather than the output gap. In this form the Taylor rule is

$$i_t = \beta 1 + \beta 2\pi_t + \beta_3 yt + \varepsilon_t$$

Monthly data are available for the USA over the period 1960 through 2014 for the following variables:

• INTRATE: Federal funds interest rate
• INFL: Inflation
• PROD: Production • UNEMPL: Unemployment
• COMMPRI: Commodity prices
• PCE: Personal consumption expenditure
• PERSINC: Personal income
• HOUST: Housing starts

(a) Use general-to-specific to come to a model. Start by regressing the federal funds rate on the other 7 variables and eliminate 1 variable at a time.

In [1]:

```
%matplotlib inline
import sys
sys.path.append('/Users/CJ/Documents/bitbucket/xforex_v1/xforex_v3')
import pandas as pd
import matplotlib.pyplot as plt
from datetime import datetime
from xforex.BackTesting.econometrics_tools import Econometrics_Tool
import numpy as np

dat = pd.read_csv(
        '/Users/CJ/Documents/bitbucket/xforex_v1/xforex_v3/training/econometric
s/week3-model-specifiction/TestExer3-TaylorRule-round1.txt',
       sep='\t').drop(['Unnamed: 9', 'Unnamed: 10','Unnamed: 11','Unnamed:
12','Unnamed: 13'], axis = 1)
dat.describe()
g2s_model = \
Econometrics_Tool().iter_linear_fit(dat[['PROD', 'INFL','UNEMPL','COMMPRI','PCE',
ERSINC','HOUST']], \
                dat['INTRATE'])
print g2s_model.summary()
```

```
eliminate column: UNEMPL
eliminate column: PROD
                            OLS Regression Results

====================================================================
==========
Dep. Variable:                INTRATE   R-squared:
     0.637
Model:                            OLS   Adj. R-squared:
     0.635
Method:                 Least Squares   F-statistic:
     229.9
Date:                Tue, 13 Sep 2016   Prob (F-statistic):
 2.03e-141
Time:                        15:45:59   Log-Likelihood:
   -1450.2
No. Observations:                 660   AIC:
     2912.
Df Residuals:                     654   BIC:
     2939.
Df Model:                           5

Covariance Type:            nonrobust

====================================================================
==========
                 coef    std err          t      P>|t|      [95.0% C
onf. Int.]
--------------------------------------------------------------------
----------
const         -0.2401      0.230     -1.042      0.298        -0.692
     0.212
INFL           0.7175      0.057     12.555      0.000         0.605
     0.830
COMMPRI       -0.0075      0.003     -2.841      0.005        -0.013
    -0.002
PCE            0.3405      0.059      5.756      0.000         0.224
     0.457
PERSINC        0.2402      0.059      4.048      0.000         0.124
     0.357
HOUST         -0.0205      0.004     -4.678      0.000        -0.029
    -0.012
====================================================================
==========
Omnibus:                       23.848   Durbin-Watson:
     0.100
Prob(Omnibus):                  0.000   Jarque-Bera (JB):
    31.255
Skew:                           0.354   Prob(JB):
  1.63e-07
Kurtosis:                       3.797   Cond. No.
      94.1
====================================================================
==========

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors
 is correctly specified.
```

(b) Use specific-to-general to come to a model. Start by regressing the federal funds rate on only a constant and add 1 variable at a time. Is the model the same as in (a)?

ans: below code shows to add 1 variable at a time and find the best combinations of variables. And the model seems the same as (a)

In [2]:

```
s2g_model = Econometrics_Tool().global_iter_linear_fit_aic(dat[['PROD',
'INFL','UNEMPL','COMMPRI','PCE','PERSINC','HOUST']], \
                dat['INTRATE'])
```

```
****************
Final model:
                            OLS Regression Results                            
====================================================================
==========
Dep. Variable:                INTRATE   R-squared:                
     0.637
Model:                            OLS   Adj. R-squared:           
     0.635
Method:                 Least Squares   F-statistic:              
     229.9
Date:                Tue, 13 Sep 2016   Prob (F-statistic):       
 2.03e-141
Time:                        15:45:59   Log-Likelihood:           
   -1450.2
No. Observations:                 660   AIC:                      
     2912.
Df Residuals:                     654   BIC:                      
     2939.
Df Model:                           5                                         

Covariance Type:            nonrobust                                         

====================================================================
==========
                 coef    std err          t      P>|t|      [95.0% C
onf. Int.]
--------------------------------------------------------------------
----------
const         -0.2401      0.230     -1.042      0.298        -0.692
     0.212
INFL           0.7175      0.057     12.555      0.000         0.605
     0.830
COMMPRI       -0.0075      0.003     -2.841      0.005        -0.013
    -0.002
PCE            0.3405      0.059      5.756      0.000         0.224
     0.457
PERSINC        0.2402      0.059      4.048      0.000         0.124
     0.357
HOUST         -0.0205      0.004     -4.678      0.000        -0.029
    -0.012
====================================================================
==========
Omnibus:                       23.848   Durbin-Watson:            
     0.100
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         
    31.255
Skew:                           0.354   Prob(JB):                 
  1.63e-07
Kurtosis:                       3.797   Cond. No.                 
      94.1
====================================================================
==========

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors
 is correctly specified.
****************
```

In [3]:

```
from tabulate import tabulate
print '|specific to general model:'
print tabulate(pd.DataFrame(s2g_model.params), headers='keys', tablefmt='psql')

print '\n|general to specific model:'
print tabulate(pd.DataFrame(g2s_model.params), headers='keys', tablefmt='psql')
```

```
|specific to general model:
+---------+-------------+
|         |           0 |
|---------+-------------|
| const   | -0.240119   |
| INFL    |  0.717527   |
| COMMPRI | -0.00750067 |
| PCE     |  0.340525   |
| PERSINC |  0.240242   |
| HOUST   | -0.0205297  |
+---------+-------------+

|general to specific model:
+---------+-------------+
|         |           0 |
|---------+-------------|
| const   | -0.240119   |
| INFL    |  0.717527   |
| COMMPRI | -0.00750067 |
| PCE     |  0.340525   |
| PERSINC |  0.240242   |
| HOUST   | -0.0205297  |
+---------+-------------+
```

(c) Compare your model from (a) and the Taylor rule of equation (1). Consider R^2, AIC and BIC. Which of the models do you prefer? **ans:** Taylor rule:

$$federalFundsRate_t = const + b1 * inflation + b2 * production + \varepsilon_t$$

Please change below for the model comparison results. Model from (a) are better when comparing R^2, AIC and BIC

In [4]:

```
taylor_model = Econometrics_Tool().linear_fit(dat[['PROD', 'INFL']], \
                dat['INTRATE'])

df_compare = pd.DataFrame(index=['r-square', 'aic', 'bic'])

df_compare['taylor'] = [taylor_model.rsquared, taylor_model.aic, taylor_model.bi
c]
df_compare['general_to_specific'] = [g2s_model.rsquared,g2s_model.aic, g2s_model.
c]
print tabulate(df_compare, headers='keys', tablefmt='psql')
```

```
+----------+-------------+----------------------+
|          |      taylor |   general_to_specific |
|----------+-------------+----------------------|
| r-square |    0.574701 |             0.637361 |
| aic      | 3011.62     |          2912.42     |
| bic      | 3025.09     |          2939.38     |
+----------+-------------+----------------------+
```

(d) Test the Taylor rule of equation (1) using the RESET test, Chow break and forecast test (with in both tests as break date January 1980) and a Jarque-Bera test. What do you conclude?

ans:

(1)In RESET Test, p value is 0.11. null assumption cannot be rejected at 5% level. (2) In Chow break and forecast test, p value is 7.62693e-74 and 0.0647282, which suggests the possible instability of the taylor. (3) In Jarque-Bera test, p value is 0.00198523, null assuption is rejected at 5% level, which suggests not-normality of error terms

In [5]:

```
# after 1980 model test
from scipy import stats
from statsmodels.stats.outliers_influence import reset_ramsey
from datetime import datetime

dat.index = dat.OBS.map(lambda x: datetime.strptime(x, '%Y:%m'))

df_stat = pd.DataFrame(index=['jarque_bera test', 'RESET', 'Chow-break', 'Chow-f
orcast'])
model =taylor_model


# RESET TEST:  for higher degree dependency
RESET_test = [str(reset_ramsey(model, degree=2)).split(",")[0], \
              str(reset_ramsey(model, degree=2)).split(",")[1].split("=")[1]]

# chow break: stability
# dat.index = dat['Year']
chow_break = Econometrics_Tool().chow_break(dat[['PROD', 'INFL']],
dat['INTRATE'], datetime(1980,1,1))


# chow forcast:

# dat.index = dat['Year']
chow_forcast = Econometrics_Tool().chow_forcast(dat[['PROD', 'INFL']], dat['INTR
ATE'], 0.2)



df_stat['stat'] = [stats.jarque_bera(model.resid)[0], RESET_test[0] , chow_break[
] ,chow_forcast[0]]
df_stat['p-value'] = [stats.jarque_bera(model.resid)[1], RESET_test[1], chow_bre
ak[1] ,chow_forcast[1]]


print tabulate(df_stat, headers='keys', tablefmt='psql')
```

```
                            OLS Regression Results

==============================================================================
Dep. Variable:                INTRATE   R-squared:
     0.856
Model:                            OLS   Adj. R-squared:
     0.856
Method:                 Least Squares   F-statistic:
     1961.
Date:                Tue, 13 Sep 2016   Prob (F-statistic):
 6.08e-278
Time:                        15:45:59   Log-Likelihood:
   -1527.1
No. Observations:                 660   AIC:
     3058.
Df Residuals:                     658   BIC:
     3067.
Df Model:                           2

Covariance Type:            nonrobust

==============================================================================
                 coef    std err          t      P>|t|      [95.0% C
onf. Int.]
------------------------------------------------------------------------------
PROD           0.1596      0.018      8.819      0.000         0.124
     0.195
INFL           1.1583      0.021     55.658      0.000         1.117
     1.199
==============================================================================
Omnibus:                        3.527   Durbin-Watson:
     0.069
Prob(Omnibus):                  0.171   Jarque-Bera (JB):
     3.597
Skew:                           0.165   Prob(JB):
     0.166
Kurtosis:                       2.851   Cond. No.
      1.45
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors
 is correctly specified.
OBS
1980-02-01    14.13
1980-03-01    17.19
1980-04-01    17.61
1980-05-01    10.98
1980-06-01     9.47
Name: INTRATE, dtype: float64
                            OLS Regression Results

==============================================================================
Dep. Variable:                INTRATE   R-squared:
     0.954
```

```
Model:                            OLS   Adj. R-squared:
     0.954
Method:                 Least Squares   F-statistic:
     2504.
Date:                Tue, 13 Sep 2016   Prob (F-statistic):
 5.00e-161
Time:                        15:45:59   Log-Likelihood:
   -412.38
No. Observations:                 241   AIC:
     828.8
Df Residuals:                     239   BIC:
     835.7
Df Model:                           2

Covariance Type:            nonrobust

====================================================================
==========
                 coef    std err          t      P>|t|      [95.0% C
onf. Int.]
--------------------------------------------------------------------
----------
PROD           0.1997      0.014     14.727      0.000         0.173
     0.226
INFL           0.9588      0.016     59.867      0.000         0.927
     0.990
====================================================================
==========
Omnibus:                        4.345   Durbin-Watson:
     0.144
Prob(Omnibus):                  0.114   Jarque-Bera (JB):
     4.179
Skew:                          -0.322   Prob(JB):
     0.124
Kurtosis:                       3.046   Cond. No.
      1.49
====================================================================
==========

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors
 is correctly specified.
                            OLS Regression Results

====================================================================
==========
Dep. Variable:                INTRATE   R-squared:
     0.837
Model:                            OLS   Adj. R-squared:
     0.836
Method:                 Least Squares   F-statistic:
     1069.
Date:                Tue, 13 Sep 2016   Prob (F-statistic):
 6.83e-165
Time:                        15:45:59   Log-Likelihood:
   -1002.7
No. Observations:                 419   AIC:
     2009.
Df Residuals:                     417   BIC:
     2017.
Df Model:                           2
```

```
Covariance Type:            nonrobust

==============================================================================
==========
                 coef    std err          t      P>|t|      [95.0% C
onf. Int.]
------------------------------------------------------------------------------
----------
PROD           0.1239      0.029      4.296      0.000          0.067
     0.181
INFL           1.3650      0.032     42.444      0.000          1.302
     1.428
==============================================================================
==========
Omnibus:                        7.009   Durbin-Watson:
     0.081
Prob(Omnibus):                  0.030   Jarque-Bera (JB):
     7.091
Skew:                          -0.318   Prob(JB):
    0.0289
Kurtosis:                       2.980   Cond. No.
      1.40
==============================================================================
==========

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors
 is correctly specified.
n2: 132
                            OLS Regression Results

==============================================================================
==========
Dep. Variable:                INTRATE   R-squared:
     0.887
Model:                            OLS   Adj. R-squared:
     0.886
Method:                 Least Squares   F-statistic:
     2059.
Date:                Tue, 13 Sep 2016   Prob (F-statistic):
 1.75e-249
Time:                        15:45:59   Log-Likelihood:
   -1210.0
No. Observations:                 528   AIC:
     2424.
Df Residuals:                     526   BIC:
     2432.
Df Model:                           2

Covariance Type:            nonrobust

==============================================================================
==========
                 coef    std err          t      P>|t|      [95.0% C
onf. Int.]
------------------------------------------------------------------------------
----------
PROD           0.2152      0.019     11.105      0.000          0.177
     0.253
INFL           1.1803      0.021     56.269      0.000          1.139
```

```
     1.222
==============================================================================
Omnibus:                        4.033   Durbin-Watson:
     0.074
Prob(Omnibus):                  0.133   Jarque-Bera (JB):
     3.883
Skew:                           0.167   Prob(JB):
     0.143
Kurtosis:                       3.254   Cond. No.
      1.41
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors
 is correctly specified.
                            OLS Regression Results

==============================================================================
Dep. Variable:                INTRATE   R-squared:
     0.545
Model:                            OLS   Adj. R-squared:
     0.538
Method:                 Least Squares   F-statistic:
     77.87
Date:                Tue, 13 Sep 2016   Prob (F-statistic):
  5.87e-23
Time:                        15:45:59   Log-Likelihood:
   -255.11
No. Observations:                 132   AIC:
     514.2
Df Residuals:                     130   BIC:
     520.0
Df Model:                           2

Covariance Type:            nonrobust

==============================================================================
                 coef    std err          t      P>|t|      [95.0% C
onf. Int.]
------------------------------------------------------------------------------
PROD          -0.0411      0.032     -1.294      0.198        -0.104
     0.022
INFL           0.7037      0.060     11.740      0.000         0.585
     0.822
==============================================================================
Omnibus:                       16.983   Durbin-Watson:
     0.052
Prob(Omnibus):                  0.000   Jarque-Bera (JB):
    20.201
Skew:                           0.957   Prob(JB):
  4.11e-05
Kurtosis:                       3.094   Cond. No.
      2.24
==============================================================================
```

```
Warnings:
[1] Standard Errors assume that the covariance matrix of the errors
 is correctly specified.
+------------------+-----------------------------------+------------
-+
|                  | stat                              |     p-value
 |
|------------------+-----------------------------------+------------
-|
| jarque_bera test | 12.4440433084                     | 0.00198523
 |
| RESET            | <F test: F=array([[ 2.53711954]]) | 0.111679
 |
| Chow-break       | 220.016340507                     | 7.62693e-74
 |
| Chow-forcast     | 1.22281217974                     | 0.0647282
 |
+------------------+-----------------------------------+------------
-+
```