settingARIMA

February 25, 2018

#

In [1]:
```
import warnings
warnings.filterwarnings("ignore")
```

In [2]:
```
import pandas as pd
from statsmodels.tsa.seasonal import seasonal_decompose
```

In [3]:
```
import matplotlib.pyplot as plt
```

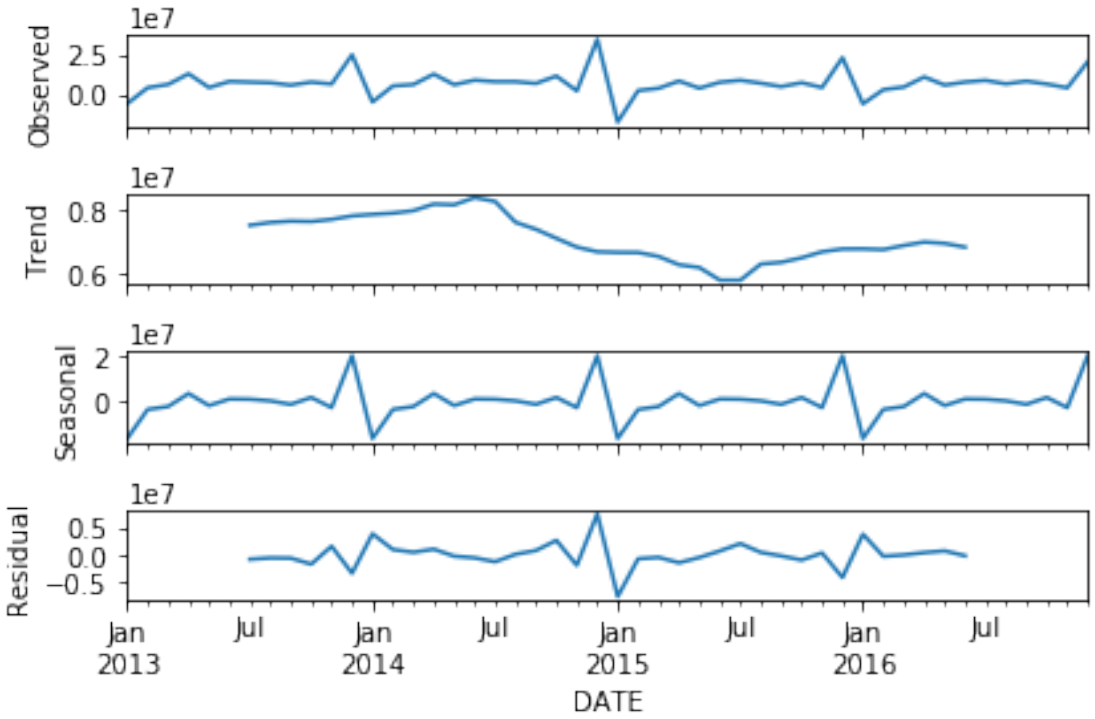
In [4]:
```
df_xl = pd.read_excel('test.xls', sheetname="Data" ,dtype={ '_5000': float})
df_xl = df_xl.drop(['_10','_50','_100','_500','_1000'], axis=1)
```

In [5]:
```
df_xl.reset_index(inplace=True)
df_xl['Date'] = pd.to_datetime(df_xl['DATE'])
df_xl = df_xl.set_index('DATE')
```

In [6]:
```
decomposition = seasonal_decompose(df_xl._5000, freq=12) # decomposition of initial da
```

In [7]:
```
decomposition.plot()
```

Out[7]:



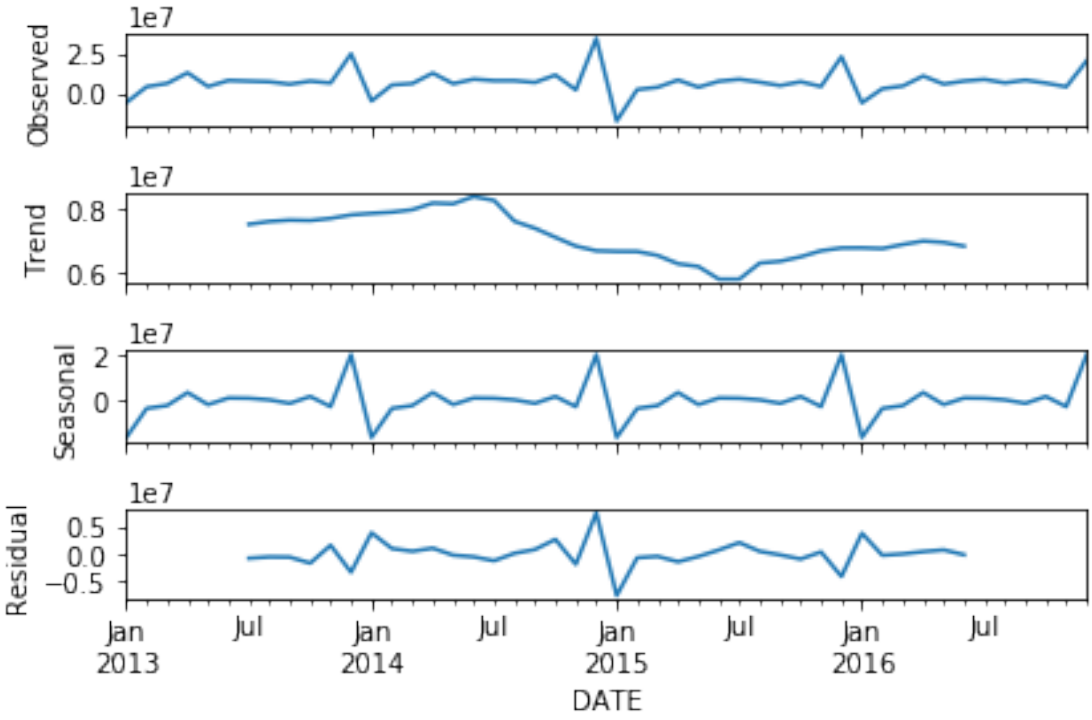
#

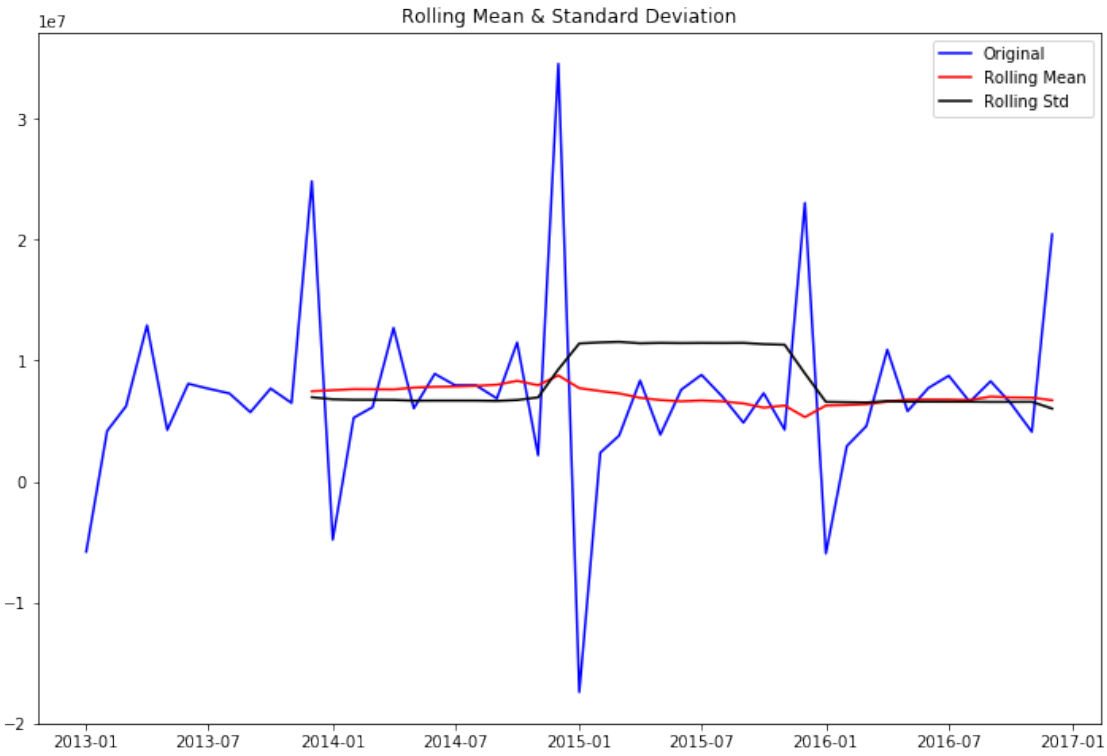
In [8]:
```
from statsmodels.tsa.stattools import adfuller
```

In [9]:
```
def test_stationarity(timeseries):

    #Determing rolling statistics
    rolmean = pd.rolling_mean(timeseries, window=12)
    rolstd = pd.rolling_std(timeseries, window=12)

    #Plot rolling statistics:
    fig = plt.figure(figsize=(12, 8))
    plt.plot(timeseries, color='blue',label='Original')
    plt.plot(rolmean, color='red', label='Rolling Mean')
    plt.plot(rolstd, color='black', label = 'Rolling Std')
    plt.legend(loc='best')
    plt.title('Rolling Mean & Standard Deviation')
    plt.show()

    #Perform Dickey-Fuller test:
    print('Results of Dickey-Fuller Test:')
    dftest = adfuller(timeseries, autolag='AIC')
    dfoutput = pd.Series(dftest[0:4], index=['Test Statistic','p-value','#Lags Used','
    for key,value in dftest[4].items():
```

```
            dfoutput['Critical Value (%s)'%key] = value
        print(dfoutput)
```

```
In [10]: test_stationarity(df_xl._5000)
```





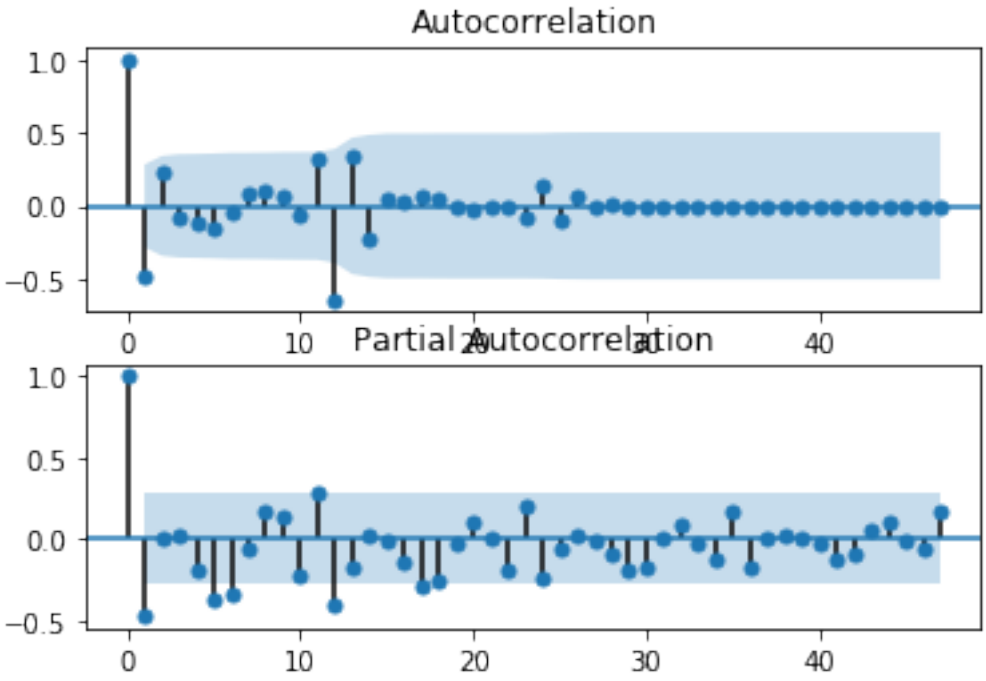

```
Results of Dickey-Fuller Test:
Test Statistic                  -3.835828
p-value                          0.002561
#Lags Used                      10.000000
Number of Observations Used     37.000000
Critical Value (1%)             -3.620918
Critical Value (5%)             -2.943539
Critical Value (10%)            -2.610400
dtype: float64
```

0.0.1 ..,

#
PACF/ACF

```
In [11]: from statsmodels.graphics.tsaplots import plot_acf
         from statsmodels.graphics.tsaplots import plot_pacf

In [12]: decomposition.resid = decomposition.resid.fillna(0.0)

In [32]: plt.subplot(211)
         plot_acf(decomposition.resid, ax=plt.gca())
         plt.subplot(212)
```

```
plot_pacf(decomposition.resid, ax=plt.gca())
plt.show()
```



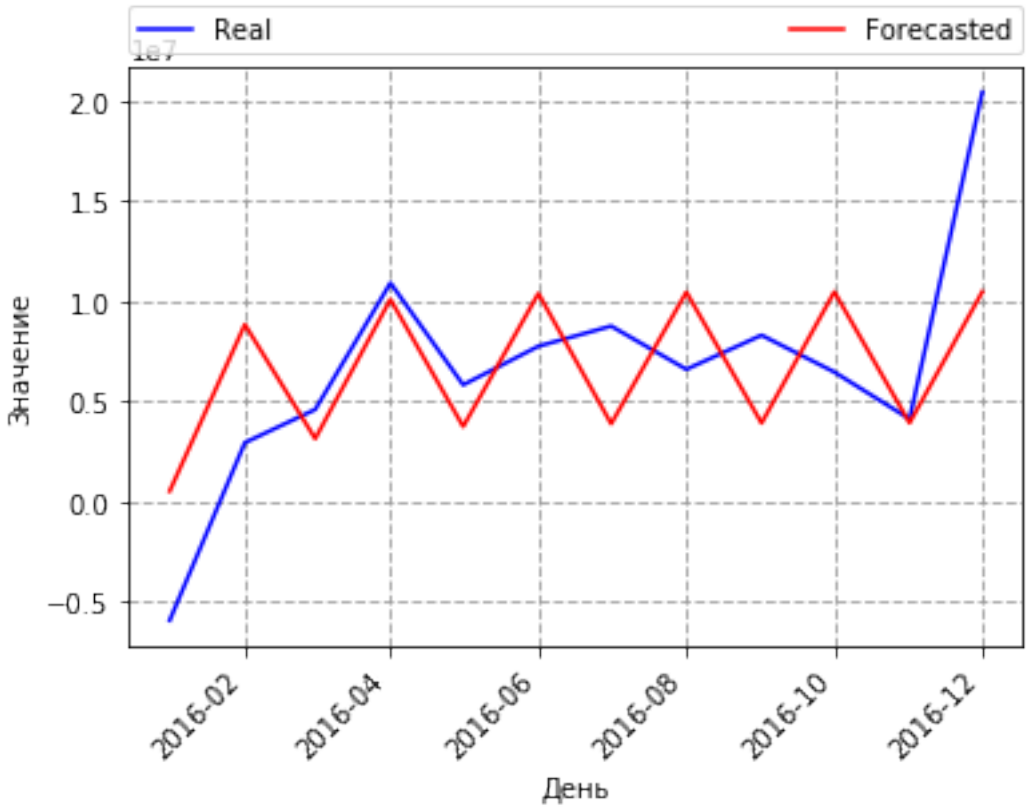
ARIMA1

ACF/PACF

```
In [14]: from statsmodels.tsa.arima_model import ARIMA

In [17]: model = ARIMA(df_xl._5000[:-12], order=(2,0,2))
         model_fit = model.fit(disp=0)

In [24]: output_ARIMA1 = model_fit.forecast(steps=12)[0]

In [21]: from sklearn.metrics import mean_squared_error as mse

In [27]: for i in range(len(output_ARIMA1)):
             print('Predicted: '+str(output_ARIMA1[i])+'; Expected: '+str(df_xl._5000[i-12]))
         print('MSE is: '+str(mse(output_ARIMA1,df_xl._5000[-12:])))

Predicted: 506012.346432; Expected: -5956345.0
Predicted: 8835085.07903; Expected: 2928645.0
Predicted: 3128964.82344; Expected: 4588335.0
Predicted: 10095830.8727; Expected: 10914205.0
Predicted: 3734961.51681; Expected: 5819945.0
```

```
Predicted: 10387104.5824; Expected: 7750460.0
Predicted: 3874970.74079; Expected: 8758015.0
Predicted: 10454396.266; Expected: 6595085.0
Predicted: 3907320.52899; Expected: 8303250.0
Predicted: 10469940.2523; Expected: 6459850.0
Predicted: 3914797.21465; Expected: 4115055.0
Predicted: 10473528.7069; Expected: 20452525.0
MSE is: 2.20425449844e+13
```

```
In [30]: plt.plot(df_xl.index[-12:],df_xl._5000[-12:], color='b', label='Real')
         plt.plot(df_xl.index[-12:],output_ARIMA1, color='r', label='Forecasted')
         plt.grid(color='#999999', linestyle='dashed', linewidth=1, alpha=0.8)
         plt.legend(bbox_to_anchor=(0., 1.02, 1., .102), loc=3, ncol=2, mode="expand", bordera
         plt.xlabel('')
         plt.xticks(rotation=45, ha='right')
         plt.ylabel('')
         plt.show()
```



###

```
In [75]: model = ARIMA(df_xl._5000[:-12], order=(4,0,5))
         model_fit = model.fit(disp=0)
```

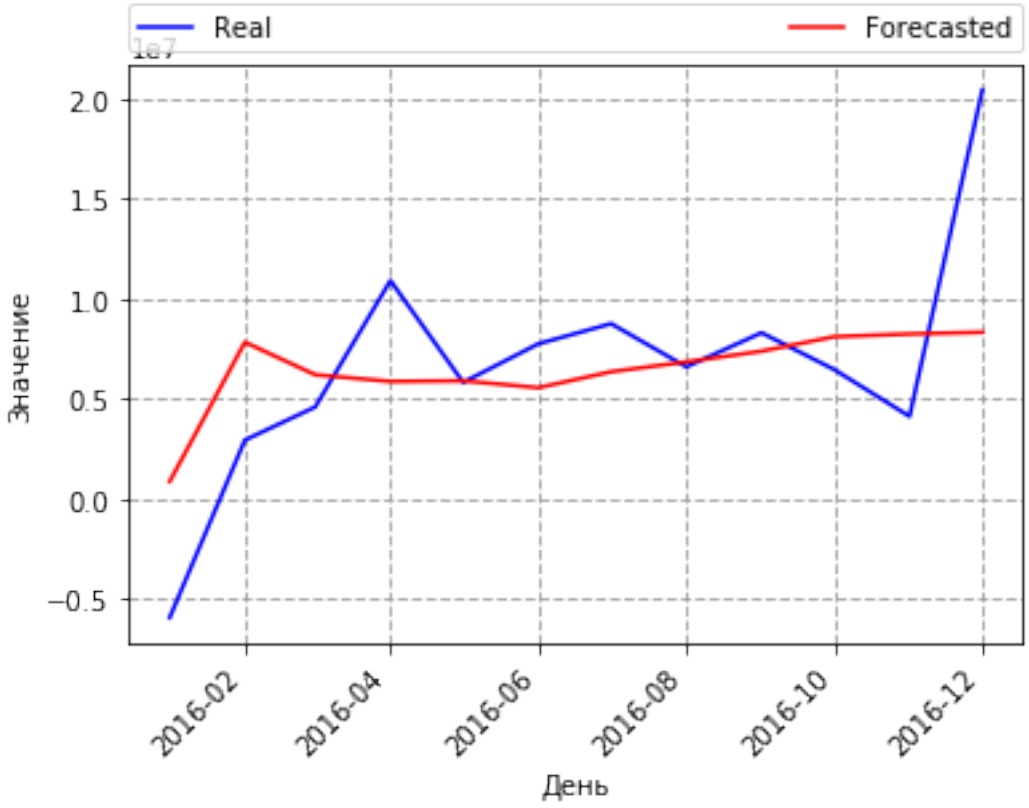
```
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\base\model.py:496: ConvergenceWarning: M
  "Check mle_retvals", ConvergenceWarning)
```

```
In [76]: output_ARIMA1 = model_fit.forecast(steps=12)[0]
```

```
In [77]: for i in range(len(output_ARIMA1)):
             print('Predicted: '+str(output_ARIMA1[i])+'; Expected: '+str(df_xl._5000[i-12]))
         print('MSE is: '+str(mse(output_ARIMA1,df_xl._5000[-12:])))
```

```
Predicted: 856073.36483; Expected: -5956345.0
Predicted: 7831364.53413; Expected: 2928645.0
Predicted: 6201015.90643; Expected: 4588335.0
Predicted: 5866002.90846; Expected: 10914205.0
Predicted: 5898535.55956; Expected: 5819945.0
Predicted: 5552503.67654; Expected: 7750460.0
Predicted: 6352362.22793; Expected: 8758015.0
Predicted: 6844052.69611; Expected: 6595085.0
Predicted: 7379907.84236; Expected: 8303250.0
Predicted: 8106799.67276; Expected: 6459850.0
Predicted: 8242105.34289; Expected: 4115055.0
Predicted: 8328516.15635; Expected: 20452525.0
MSE is: 2.30671887049e+13
```

```
In [78]: plt.plot(df_xl.index[-12:],df_xl._5000[-12:], color='b', label='Real')
         plt.plot(df_xl.index[-12:],output_ARIMA1, color='r', label='Forecasted')
         plt.grid(color='#999999', linestyle='dashed', linewidth=1, alpha=0.8)
         plt.legend(bbox_to_anchor=(0., 1.02, 1., .102), loc=3, ncol=2, mode="expand", bordera
         plt.xlabel('')
         plt.xticks(rotation=45, ha='right')
         plt.ylabel('')
         plt.show()
```



- (3,1,2) - , ;
- (2,0,3) - , ;
- (1,0,1) - , ;
- (2,0,1) - , ;
- (1,1,2) - , ;
- (5,0,4) - , , ;
- (4,0,2) - , ;
- (4,0,5) - , ;

0.0.2 , ARIMA, , ACF/PACF

#
ARIMA2

```
In [81]: train_data = df_xl[:-12]
         test_data = df_xl[-12:]
```

3

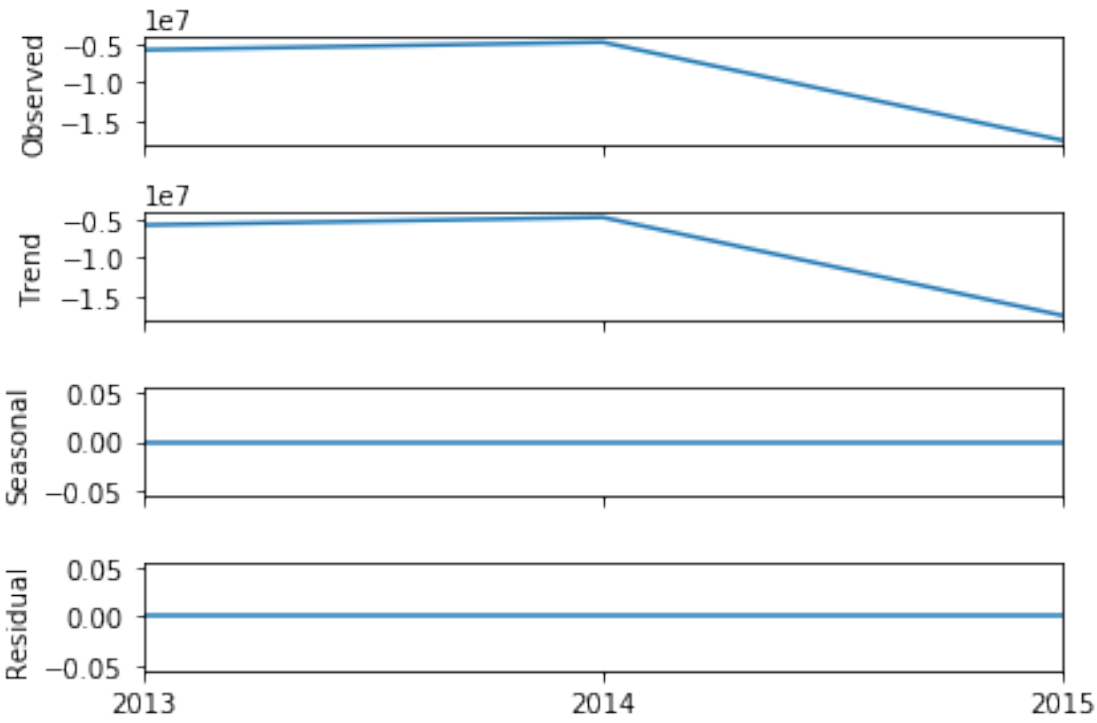
```
In [90]: amount_of_train_years = 3
```

In [110]:
```
# generating test data for second ARIMA
train_jan = pd.DataFrame()
train_feb = pd.DataFrame()
train_mar = pd.DataFrame()
train_apr = pd.DataFrame()
train_may = pd.DataFrame()
train_jun = pd.DataFrame()
train_jul = pd.DataFrame()
train_aug = pd.DataFrame()
train_sep = pd.DataFrame()
train_oct = pd.DataFrame()
train_nov = pd.DataFrame()
train_dec = pd.DataFrame()

for i in range(amount_of_train_years):
    train_jan = train_jan.append(df_xl.ix[0+i*12])
    train_feb = train_feb.append(df_xl.ix[1+i*12])
    train_mar = train_mar.append(df_xl.ix[2+i*12])
    train_apr = train_apr.append(df_xl.ix[3+i*12])
    train_may = train_may.append(df_xl.ix[4+i*12])
    train_jun = train_jun.append(df_xl.ix[5+i*12])
    train_jul = train_jul.append(df_xl.ix[6+i*12])
    train_aug = train_aug.append(df_xl.ix[7+i*12])
    train_sep = train_sep.append(df_xl.ix[8+i*12])
    train_oct = train_oct.append(df_xl.ix[9+i*12])
    train_nov = train_nov.append(df_xl.ix[10+i*12])
    train_dec = train_dec.append(df_xl.ix[11+i*12])
```

In [111]:
```
decomposition = seasonal_decompose(train_jan._5000, freq=1)
```

In [112]:
```
decomposition.plot()
```

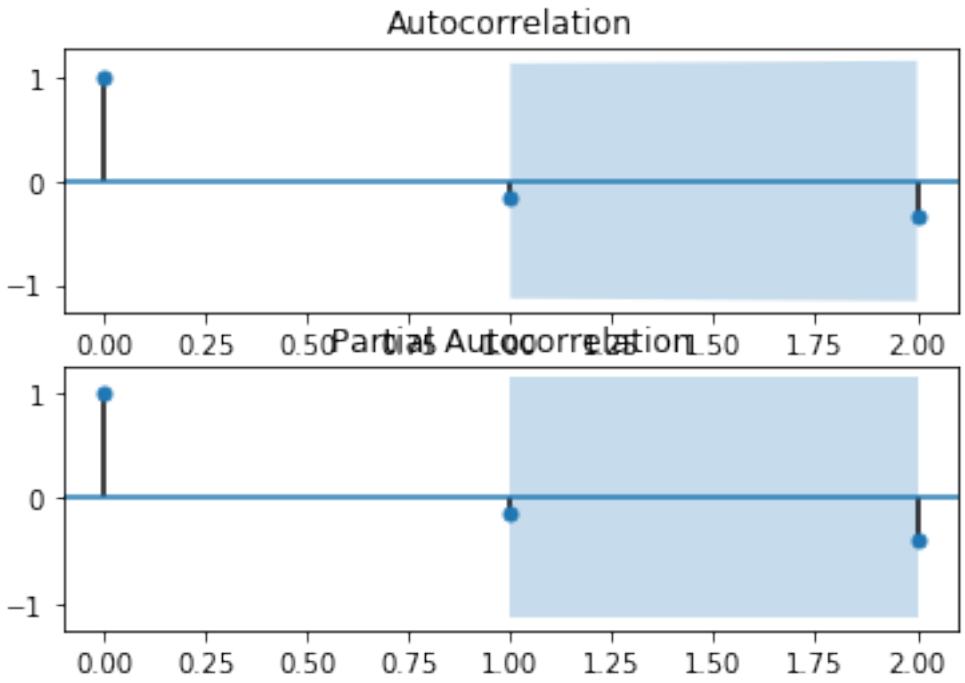
Out[112]:




```
In [113]: decomposition.resid = decomposition.resid.fillna(0.0)
```

, :

```
In [116]: plt.subplot(211)
          plot_acf(train_mar._5000, ax=plt.gca())
          plt.subplot(212)
          plot_pacf(train_mar._5000, ax=plt.gca())
          plt.show()
```




```
In [118]: import numpy as np

In [195]: arima2_result = np.array([])

In [166]: arima2_train_data = [[train_jan],
                               [train_feb],
                               [train_mar],
                               [train_apr],
                               [train_may],
                               [train_jun],
                               [train_jul],
                               [train_aug],
                               [train_sep],
                               [train_oct],
                               [train_nov],
                               [train_dec]
                              ]

In [196]: for i in range(12):
              model2 = ARIMA(arima2_train_data[i][0]._5000, order=(1,0,0))
              model_fit2 = model2.fit(disp=0)
              arima2_month_forecast = model_fit2.forecast(steps=1)[0]
              arima2_result = np.append(arima2_result,arima2_month_forecast)
```

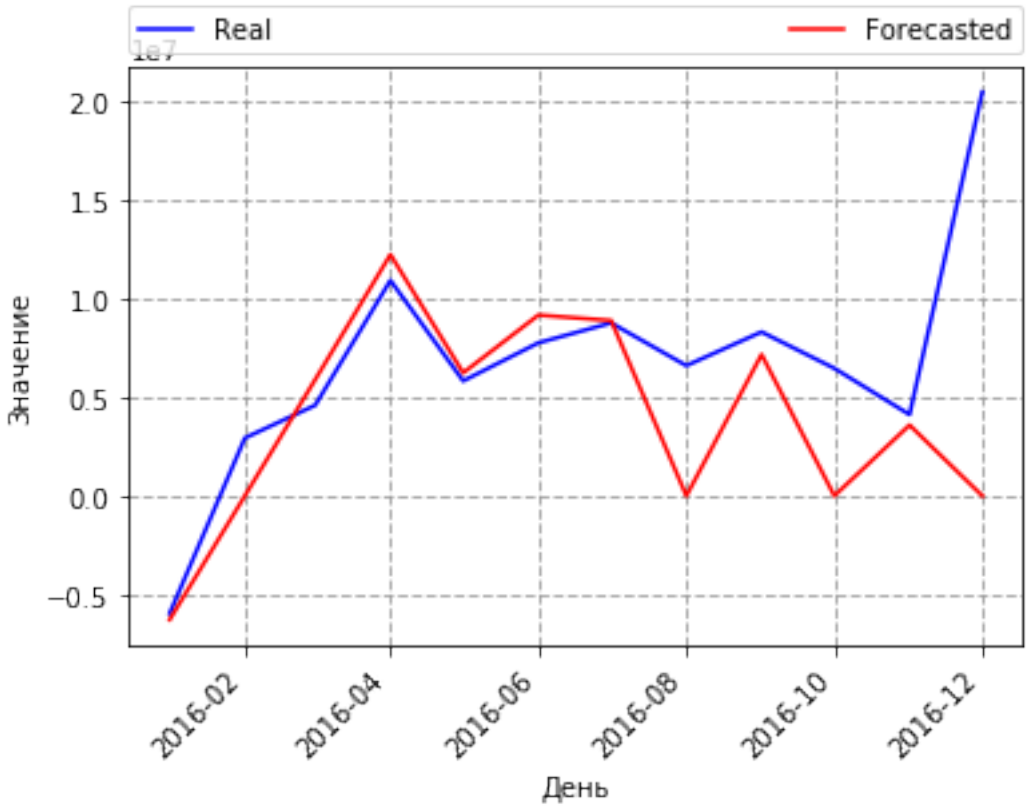
```
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\base\model.py:496: ConvergenceWarning: M
  "Check mle_retvals", ConvergenceWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\base\model.py:496: ConvergenceWarning: M
  "Check mle_retvals", ConvergenceWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\base\model.py:496: ConvergenceWarning: M
  "Check mle_retvals", ConvergenceWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\base\model.py:496: ConvergenceWarning: M
  "Check mle_retvals", ConvergenceWarning)
```

```
In [197]: arima2_result = np.nan_to_num(arima2_result)
```

```
In [198]: for i in range(len(arima2_result)):
              print('Predicted: '+str(arima2_result[i])+'; Expected: '+str(df_xl._5000[i-12]))
          print('MSE is: '+str(mse(arima2_result,df_xl._5000[-12:])))
```

```
Predicted: -6270341.61581; Expected: -5956345.0
Predicted: 0.0; Expected: 2928645.0
Predicted: 5889515.0706; Expected: 4588335.0
Predicted: 12220548.9851; Expected: 10914205.0
Predicted: 6229636.75087; Expected: 5819945.0
Predicted: 9156483.28738; Expected: 7750460.0
Predicted: 8878415.60285; Expected: 8758015.0
Predicted: 0.0; Expected: 6595085.0
Predicted: 7156937.3076; Expected: 8303250.0
Predicted: 0.0; Expected: 6459850.0
Predicted: 3584022.29246; Expected: 4115055.0
Predicted: 0.0; Expected: 20452525.0
MSE is: 4.32800850246e+13
```

```
In [199]: plt.plot(df_xl.index[-12:],df_xl._5000[-12:], color='b', label='Real')
          plt.plot(df_xl.index[-12:],arima2_result, color='r', label='Forecasted')
          plt.grid(color='#999999', linestyle='dashed', linewidth=1, alpha=0.8)
          plt.legend(bbox_to_anchor=(0., 1.02, 1., .102), loc=3, ncol=2, mode="expand", bordera
          plt.xlabel('')
          plt.xticks(rotation=45, ha='right')
          plt.ylabel('')
          plt.show()
```

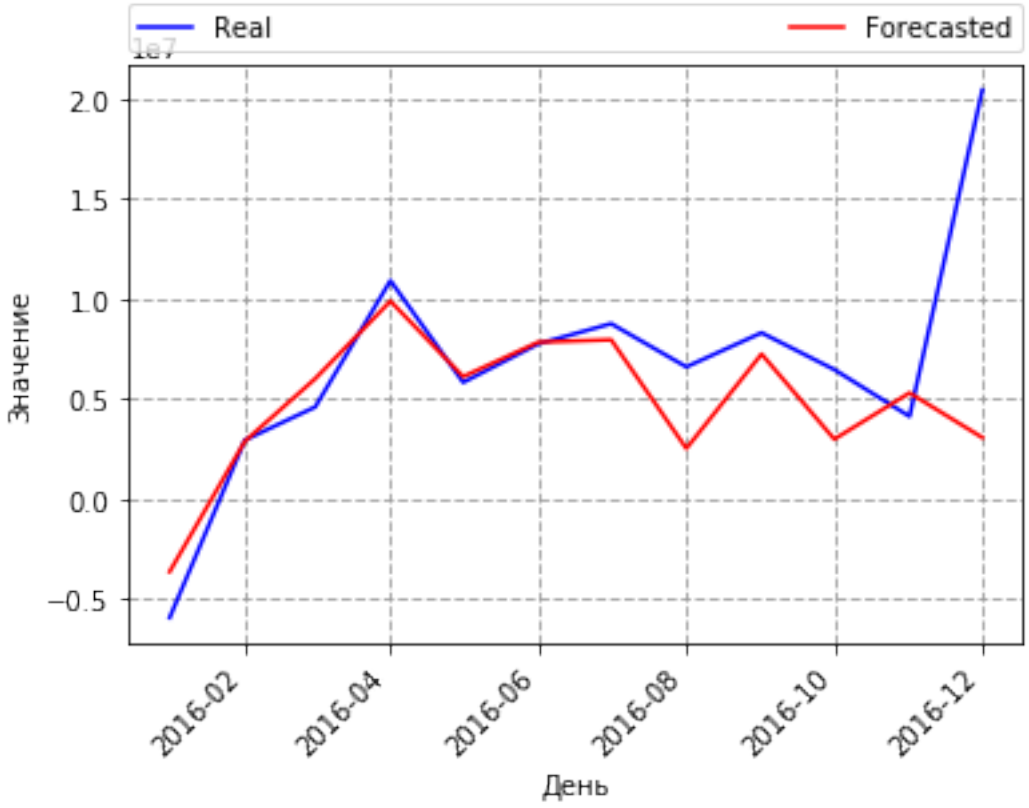


#

$$\begin{cases} Z = \alpha * ARIMA1 + \beta * ARIMA2; \\ \alpha + \beta = 1; \\ \alpha \geqslant 0, \beta \geqslant 0. \end{cases} \qquad \Longrightarrow \alpha = \frac{Z - ARIMA2}{ARIMA1 - ARIMA2};$$

```
In [200]: z = df_xl._5000[-12:]
          arima1 = output_ARIMA1
          arima2 = arima2_result

In [207]: alpha_12 = np.array([])

In [208]: for i in range(12):
              alpha_12 = np.append(alpha_12,np.array([(z[i]-arima2[i])/(arima1[i]-arima2[i])]))


In [210]: alpha_12 = alpha_12[(alpha_12 <= 1.0) & (alpha_12 >= 0.0)]

In [216]: alpha = np.mean(alpha_12)
```

```
In [218]: beta = 1. - alpha

In [219]: print('Alpha and beta is: '+str(alpha)+'; '+str(beta))

Alpha and beta is: 0.366982960408; 0.633017039592



In [220]: final_forecast = np.array([])

In [221]: for i in range(12):
              final_forecast = np.append(final_forecast, alpha*arima1[i]+beta*arima2[i])

In [222]: for i in range(len(final_forecast)):
              print('Predicted: '+str(final_forecast[i])+'; Expected: '+str(df_xl._5000[i-12]))
          print('MSE is: '+str(mse(final_forecast,df_xl._5000[-12:])))

Predicted: -3655068.74912; Expected: -5956345.0
Predicted: 2873977.34077; Expected: 2928645.0
Predicted: 6003830.56951; Expected: 4588335.0
Predicted: 9888538.85386; Expected: 10914205.0
Predicted: 6108128.25548; Expected: 5819945.0
Predicted: 7833884.18055; Expected: 7750460.0
Predicted: 7951397.05717; Expected: 8758015.0
Predicted: 2511650.71961; Expected: 6595085.0
Predicted: 7238763.69453; Expected: 8303250.0
Predicted: 2975057.34334; Expected: 6459850.0
Predicted: 5293459.40013; Expected: 4115055.0
Predicted: 3056423.51486; Expected: 20452525.0
MSE is: 2.85882876386e+13


In [223]: plt.plot(df_xl.index[-12:],df_xl._5000[-12:], color='b', label='Real')
          plt.plot(df_xl.index[-12:],final_forecast, color='r', label='Forecasted')
          plt.grid(color='#999999', linestyle='dashed', linewidth=1, alpha=0.8)
          plt.legend(bbox_to_anchor=(0., 1.02, 1., .102), loc=3, ncol=2, mode="expand", bordera
          plt.xlabel('')
          plt.xticks(rotation=45, ha='right')
          plt.ylabel('')
          plt.show()
```


Real
Forecasted
1e7
2.0
1.5
1.0
0.5
0.0
−0.5
Значение
2016-02
2016-04
2016-06
2016-08
2016-10
2016-12
День