Python_Project_Finalized

June 11, 2018

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pylab as plt
%matplotlib inline
from matplotlib.pylab import rcParams
rcParams['figure.figsize'] = 15, 6
```

In [2]:
```
df = pd.read_csv('AAPL.csv', index_col='Date', parse_dates=True)
df = df.reindex(pd.date_range(df.index[0],df.index[-1], freq='B'))
print(df.index.freq)
print(df.index)
df.head(10)
```

```
<BusinessDay>
DatetimeIndex(['2012-11-16', '2012-11-19', '2012-11-20', '2012-11-21',
               '2012-11-22', '2012-11-23', '2012-11-26', '2012-11-27',
               '2012-11-28', '2012-11-29',
               ...
               '2017-11-02', '2017-11-03', '2017-11-06', '2017-11-07',
               '2017-11-08', '2017-11-09', '2017-11-10', '2017-11-13',
               '2017-11-14', '2017-11-15'],
              dtype='datetime64[ns]', length=1304, freq='B')
```

Out[2]:

	Open	High	Low	Close	Adj Close	Volume
2012-11-16	75.028572	75.714287	72.250000	75.382858	68.175804	316723400.0
2012-11-19	77.244286	81.071426	77.125717	80.818573	73.091835	205829400.0
2012-11-20	81.701431	81.707146	79.225716	80.129997	72.469093	160688500.0
2012-11-21	80.607140	81.052856	79.514282	80.242859	72.571182	93250500.0
2012-11-22	NaN	NaN	NaN	NaN	NaN	NaN
2012-11-23	81.024284	81.714287	80.371429	81.642860	73.837326	68206600.0
2012-11-26	82.271431	84.285713	81.958572	84.218575	76.166786	157644900.0
2012-11-27	84.221428	84.345711	82.871429	83.540001	75.553101	133332500.0
2012-11-28	82.467140	83.685715	81.751427	83.277145	75.315369	130216100.0
2012-11-29	84.317146	84.892860	83.607140	84.194283	76.144821	128674700.0

In [3]:
```
import warnings
warnings.filterwarnings("ignore")
```

```
        import statsmodels.tsa.api as smt
        import statsmodels.api as sm
        import scipy.stats as scs
        import matplotlib.pyplot as pylt
        def tsplot(y, lags=None, figsize=(10, 8), style='bmh'):
            if not isinstance(y, pd.Series):
                y = pd.Series(y)
            with pylt.style.context(style):
                fig = pylt.figure(figsize=figsize)

                layout = (3, 2)
                ts_ax = pylt.subplot2grid(layout, (0, 0), colspan=2)
                acf_ax = pylt.subplot2grid(layout, (1, 0))
                pacf_ax = pylt.subplot2grid(layout, (1, 1))
                qq_ax = pylt.subplot2grid(layout, (2, 0))
                pp_ax = pylt.subplot2grid(layout, (2, 1))

                y.plot(ax=ts_ax)
                ts_ax.set_title('Time Series Analysis Plots')
                smt.graphics.plot_acf(y, lags=lags, ax=acf_ax, alpha=0.5)
                smt.graphics.plot_pacf(y, lags=lags, ax=pacf_ax, alpha=0.5)
                sm.qqplot(y, line='s', ax=qq_ax)
                qq_ax.set_title('QQ Plot')
                scs.probplot(y, sparams=(y.mean(), y.std()), plot=pp_ax)

                pylt.tight_layout()
            return
```

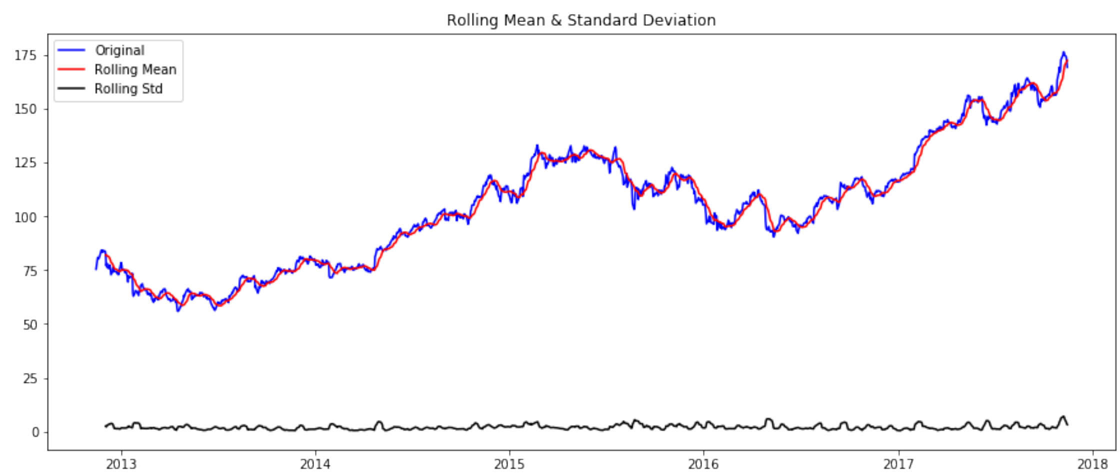
```
In [4]: from statsmodels.tsa.stattools import adfuller
        def test_stationarity(timeseries):

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

            #Plot rolling statistics:
            orig = plt.plot(timeseries, color='blue',label='Original')
            mean = plt.plot(rolmean, color='red', label='Rolling Mean')
            std = plt.plot(rolstd, color='black', label = 'Rolling Std')
            plt.legend(loc='best')
            plt.title('Rolling Mean & Standard Deviation')
            plt.show(block=False)

            #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 [5]:
```
ts = df['Close'].dropna()
ts.head(10)
```

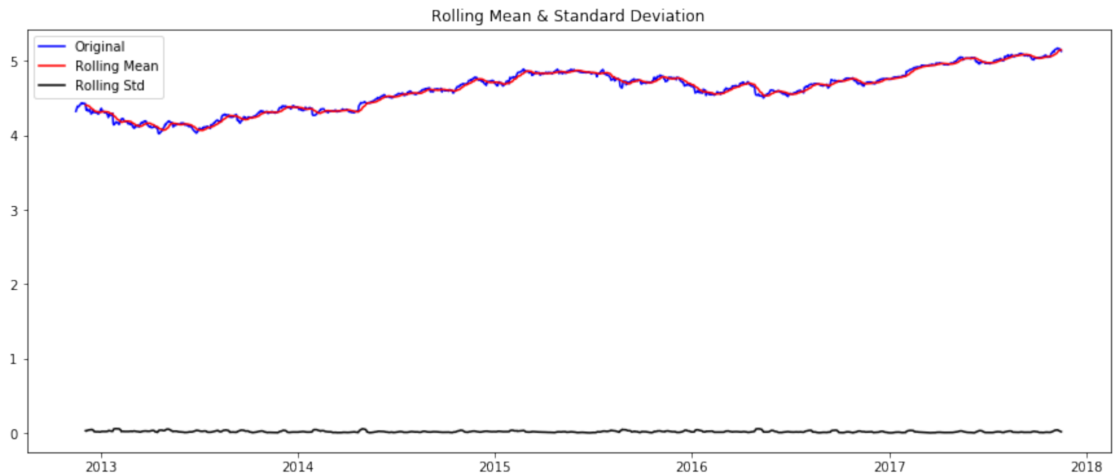
Out[5]:
```
2012-11-16    75.382858
2012-11-19    80.818573
2012-11-20    80.129997
2012-11-21    80.242859
2012-11-23    81.642860
2012-11-26    84.218575
2012-11-27    83.540001
2012-11-28    83.277145
2012-11-29    84.194283
2012-11-30    83.611427
Name: Close, dtype: float64
```

In [6]:
```
test_stationarity(ts)
```



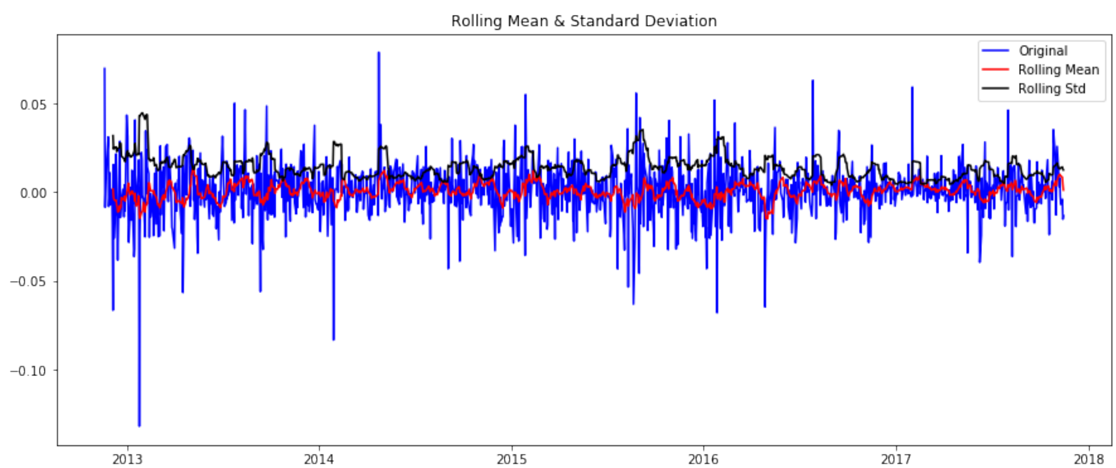

```
Results of Dickey-Fuller Test:
Test Statistic                    0.078719
p-value                           0.964578
#Lags Used                        0.000000
Number of Observations Used    1258.000000
Critical Value (1%)              -3.435559
Critical Value (5%)              -2.863840
Critical Value (10%)             -2.567995
dtype: float64
```

In [7]:
```
ts_log = np.log(ts)
test_stationarity(ts_log)
```



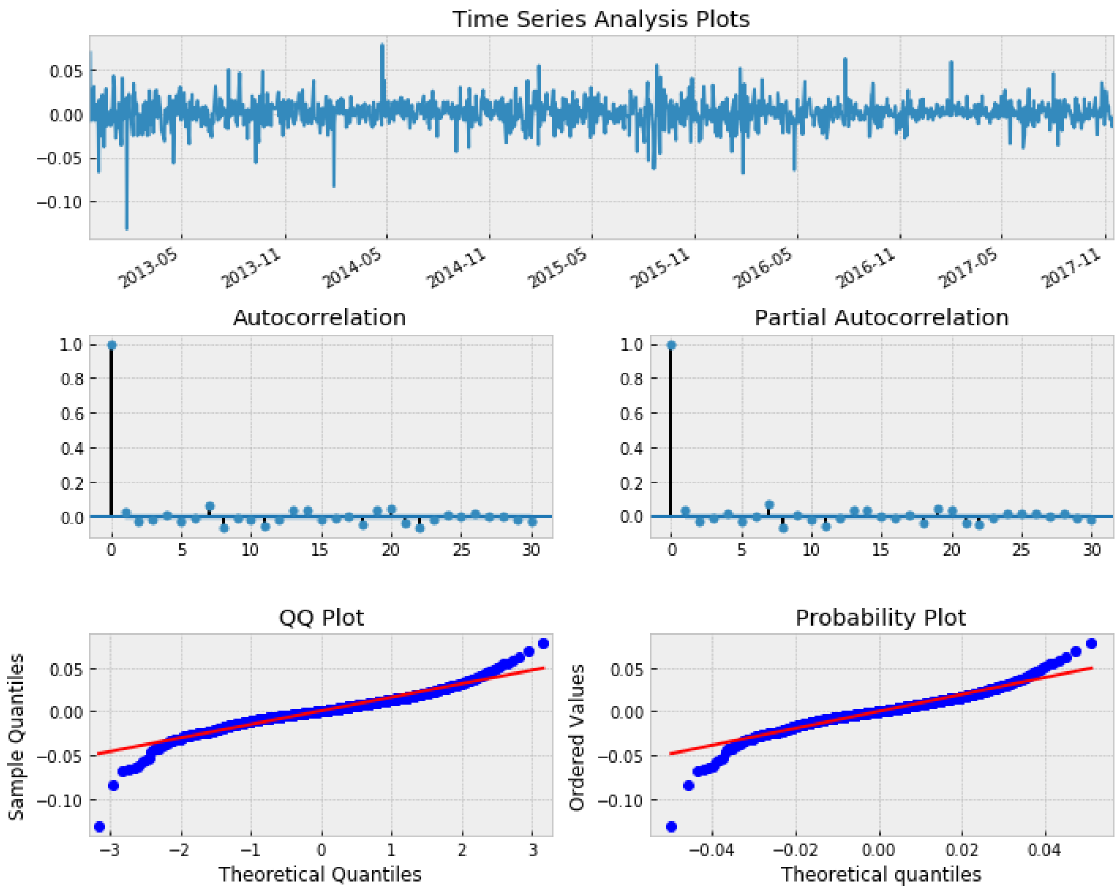

```
Results of Dickey-Fuller Test:
Test Statistic                    -0.165314
p-value                            0.942532
#Lags Used                         8.000000
Number of Observations Used     1250.000000
Critical Value (1%)               -3.435592
Critical Value (5%)               -2.863855
Critical Value (10%)              -2.568003
dtype: float64
```

```
In [8]: ts_log_diff = ts_log - ts_log.shift()
        ts_log_diff.dropna(inplace=True)
        test_stationarity(ts_log_diff)
```



```
Results of Dickey-Fuller Test:
Test Statistic                 -1.285132e+01
p-value                         5.345185e-24
#Lags Used                      7.000000e+00
Number of Observations Used     1.250000e+03
Critical Value (1%)            -3.435592e+00
Critical Value (5%)            -2.863855e+00
Critical Value (10%)           -2.568003e+00
dtype: float64
```

```
In [9]: tsplot(ts_log_diff, lags=30)
```




```
In [16]: import warnings
         import itertools
         warnings.filterwarnings("ignore") # specify to ignore warning messages
         # Define the p, d and q parameters to take any value between 0 and 2 and s between 0
         p = d = q = range(0, 2)
         s = range(0,13)
```

```python
# Generate all different combinations of p, q and q triplets
pdq = list(itertools.product(p, d, q))

# Generate all different combinations of seasonal p, q and q triplets
seasonal_pdqs = [(x[0], x[1], x[2], x[3]) for x in list(itertools.product(p, d, q, s))

for param in pdq:
    for param_seasonal in seasonal_pdqs:
        try:
            mod = sm.tsa.statespace.SARIMAX(df['Close'],
                                            order=param,
                                            seasonal_order=param_seasonal,
                                            enforce_stationarity=False,
                                            enforce_invertibility=False)

            results = mod.fit()

            print('ARIMA{}x{} - AIC:{}'.format(param, param_seasonal, results.aic))
        except:
            continue
```

```
ARIMA(0, 0, 0)x(0, 0, 1, 0) - AIC:13796.656921351896
ARIMA(0, 0, 0)x(0, 0, 1, 1) - AIC:13796.656921351896
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ARIMA(0, 0, 0)x(0, 0, 1, 5) - AIC:13766.78843724716
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ARIMA(1, 1, 0)x(1, 0, 1, 11) - AIC:4654.157728413423
ARIMA(1, 1, 0)x(1, 0, 1, 12) - AIC:4640.475199594942
ARIMA(1, 1, 0)x(1, 1, 0, 1) - AIC:5158.341833498458
ARIMA(1, 1, 0)x(1, 1, 0, 2) - AIC:5164.75783578661
ARIMA(1, 1, 0)x(1, 1, 0, 3) - AIC:5230.943858862401
ARIMA(1, 1, 0)x(1, 1, 0, 4) - AIC:5161.056708977281
ARIMA(1, 1, 0)x(1, 1, 0, 5) - AIC:5170.537710474774
ARIMA(1, 1, 0)x(1, 1, 0, 6) - AIC:5208.557744114149
ARIMA(1, 1, 0)x(1, 1, 0, 7) - AIC:5065.493923881606
ARIMA(1, 1, 0)x(1, 1, 0, 8) - AIC:5166.511438960819
ARIMA(1, 1, 0)x(1, 1, 0, 9) - AIC:5091.692403854289
ARIMA(1, 1, 0)x(1, 1, 0, 10) - AIC:5067.879644917075
ARIMA(1, 1, 0)x(1, 1, 0, 11) - AIC:5126.905798297606
ARIMA(1, 1, 0)x(1, 1, 0, 12) - AIC:5128.444716630571
ARIMA(1, 1, 0)x(1, 1, 1, 1) - AIC:4688.202200134627
ARIMA(1, 1, 0)x(1, 1, 1, 2) - AIC:4689.844254229141
ARIMA(1, 1, 0)x(1, 1, 1, 3) - AIC:4688.271250582346
ARIMA(1, 1, 0)x(1, 1, 1, 4) - AIC:4684.450267980999
ARIMA(1, 1, 0)x(1, 1, 1, 5) - AIC:4670.171454355295
ARIMA(1, 1, 0)x(1, 1, 1, 6) - AIC:4667.821393421067
ARIMA(1, 1, 0)x(1, 1, 1, 7) - AIC:4660.368250403815
ARIMA(1, 1, 0)x(1, 1, 1, 8) - AIC:4660.92687100424
ARIMA(1, 1, 0)x(1, 1, 1, 9) - AIC:4670.2007062115545
ARIMA(1, 1, 0)x(1, 1, 1, 10) - AIC:4644.651426902787
ARIMA(1, 1, 0)x(1, 1, 1, 11) - AIC:4660.723420490964
ARIMA(1, 1, 0)x(1, 1, 1, 12) - AIC:4652.8382464585775
```

```
ARIMA(1, 1, 1)x(0, 0, 0, 0) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 1) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 2) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 3) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 4) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 5) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 6) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 7) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 8) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 9) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 10) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 11) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 0, 12) - AIC:4684.609230353709
ARIMA(1, 1, 1)x(0, 0, 1, 0) - AIC:4682.943240930395
ARIMA(1, 1, 1)x(0, 0, 1, 1) - AIC:4682.943240930395
ARIMA(1, 1, 1)x(0, 0, 1, 2) - AIC:4683.288488676853
ARIMA(1, 1, 1)x(0, 0, 1, 3) - AIC:4676.669711975719
ARIMA(1, 1, 1)x(0, 0, 1, 4) - AIC:4672.806057700229
ARIMA(1, 1, 1)x(0, 0, 1, 5) - AIC:4671.652396971278
ARIMA(1, 1, 1)x(0, 0, 1, 6) - AIC:4667.610337552883
ARIMA(1, 1, 1)x(0, 0, 1, 7) - AIC:4664.180973067823
ARIMA(1, 1, 1)x(0, 0, 1, 8) - AIC:4663.000764514236
ARIMA(1, 1, 1)x(0, 0, 1, 9) - AIC:4657.965440531312
ARIMA(1, 1, 1)x(0, 0, 1, 10) - AIC:4656.731934089834
ARIMA(1, 1, 1)x(0, 0, 1, 11) - AIC:4639.593312451755
ARIMA(1, 1, 1)x(0, 0, 1, 12) - AIC:4636.165279037487
ARIMA(1, 1, 1)x(0, 1, 0, 1) - AIC:4686.2243617547865
ARIMA(1, 1, 1)x(0, 1, 0, 2) - AIC:5220.229483149878
ARIMA(1, 1, 1)x(0, 1, 0, 3) - AIC:5600.808382280467
ARIMA(1, 1, 1)x(0, 1, 0, 4) - AIC:5491.747957222929
ARIMA(1, 1, 1)x(0, 1, 0, 5) - AIC:5548.891071688372
ARIMA(1, 1, 1)x(0, 1, 0, 6) - AIC:5593.18562084906
ARIMA(1, 1, 1)x(0, 1, 0, 7) - AIC:5497.0088738588565
ARIMA(1, 1, 1)x(0, 1, 0, 8) - AIC:5476.0377228794005
ARIMA(1, 1, 1)x(0, 1, 0, 9) - AIC:5482.373296853171
ARIMA(1, 1, 1)x(0, 1, 0, 10) - AIC:5527.381960753216
ARIMA(1, 1, 1)x(0, 1, 0, 11) - AIC:5571.8926603509
ARIMA(1, 1, 1)x(0, 1, 0, 12) - AIC:5568.271195745585
ARIMA(1, 1, 1)x(0, 1, 1, 1) - AIC:4687.766275988726
ARIMA(1, 1, 1)x(0, 1, 1, 2) - AIC:4684.134053074693
ARIMA(1, 1, 1)x(0, 1, 1, 3) - AIC:4683.391748201327
ARIMA(1, 1, 1)x(0, 1, 1, 4) - AIC:4677.917662084422
ARIMA(1, 1, 1)x(0, 1, 1, 5) - AIC:4666.091194581175
ARIMA(1, 1, 1)x(0, 1, 1, 6) - AIC:4669.088143488641
ARIMA(1, 1, 1)x(0, 1, 1, 7) - AIC:4657.060867917937
ARIMA(1, 1, 1)x(0, 1, 1, 8) - AIC:4658.771708668768
ARIMA(1, 1, 1)x(0, 1, 1, 9) - AIC:4659.192991444055
ARIMA(1, 1, 1)x(0, 1, 1, 10) - AIC:4638.458224557011
```

```
ARIMA(1, 1, 1)x(0, 1, 1, 11) - AIC:4641.163272871736
ARIMA(1, 1, 1)x(0, 1, 1, 12) - AIC:4643.196748709523
ARIMA(1, 1, 1)x(1, 0, 0, 0) - AIC:4685.813632758201
ARIMA(1, 1, 1)x(1, 0, 0, 1) - AIC:4685.813632758201
ARIMA(1, 1, 1)x(1, 0, 0, 2) - AIC:4683.226143720506
ARIMA(1, 1, 1)x(1, 0, 0, 3) - AIC:4682.3309566402295
ARIMA(1, 1, 1)x(1, 0, 0, 4) - AIC:4678.003389498277
ARIMA(1, 1, 1)x(1, 0, 0, 5) - AIC:4674.17756257409
ARIMA(1, 1, 1)x(1, 0, 0, 6) - AIC:4671.703377724532
ARIMA(1, 1, 1)x(1, 0, 0, 7) - AIC:4668.963142368178
ARIMA(1, 1, 1)x(1, 0, 0, 8) - AIC:4664.823007046083
ARIMA(1, 1, 1)x(1, 0, 0, 9) - AIC:4656.579052989559
ARIMA(1, 1, 1)x(1, 0, 0, 10) - AIC:4659.776710215937
ARIMA(1, 1, 1)x(1, 0, 0, 11) - AIC:4656.7299245732465
ARIMA(1, 1, 1)x(1, 0, 0, 12) - AIC:4641.960643054459
ARIMA(1, 1, 1)x(1, 0, 1, 0) - AIC:4685.311046710811
ARIMA(1, 1, 1)x(1, 0, 1, 1) - AIC:4685.311046710811
ARIMA(1, 1, 1)x(1, 0, 1, 2) - AIC:4684.385804321919
ARIMA(1, 1, 1)x(1, 0, 1, 3) - AIC:4678.442273327409
ARIMA(1, 1, 1)x(1, 0, 1, 4) - AIC:4674.230689018553
ARIMA(1, 1, 1)x(1, 0, 1, 5) - AIC:4673.652402082708
ARIMA(1, 1, 1)x(1, 0, 1, 6) - AIC:4669.610340756629
ARIMA(1, 1, 1)x(1, 0, 1, 7) - AIC:4666.180959378511
ARIMA(1, 1, 1)x(1, 0, 1, 8) - AIC:4663.935193438301
ARIMA(1, 1, 1)x(1, 0, 1, 9) - AIC:4653.4926429333855
ARIMA(1, 1, 1)x(1, 0, 1, 10) - AIC:4658.179933594265
ARIMA(1, 1, 1)x(1, 0, 1, 11) - AIC:4641.593317876756
ARIMA(1, 1, 1)x(1, 0, 1, 12) - AIC:4639.020113813534
ARIMA(1, 1, 1)x(1, 1, 0, 1) - AIC:4688.202200275361
ARIMA(1, 1, 1)x(1, 1, 0, 2) - AIC:4977.625464068044
ARIMA(1, 1, 1)x(1, 1, 0, 3) - AIC:5233.078200851445
ARIMA(1, 1, 1)x(1, 1, 0, 4) - AIC:5162.961376175286
ARIMA(1, 1, 1)x(1, 1, 0, 5) - AIC:5172.498047188062
ARIMA(1, 1, 1)x(1, 1, 0, 6) - AIC:5211.213762292229
ARIMA(1, 1, 1)x(1, 1, 0, 7) - AIC:5067.4084986378075
ARIMA(1, 1, 1)x(1, 1, 0, 8) - AIC:5167.232163194971
ARIMA(1, 1, 1)x(1, 1, 0, 9) - AIC:5093.386197731833
ARIMA(1, 1, 1)x(1, 1, 0, 10) - AIC:5069.641695255636
ARIMA(1, 1, 1)x(1, 1, 0, 11) - AIC:5127.793695703502
ARIMA(1, 1, 1)x(1, 1, 0, 12) - AIC:5130.1848899429115
ARIMA(1, 1, 1)x(1, 1, 1, 1) - AIC:4744.880681946693
ARIMA(1, 1, 1)x(1, 1, 1, 2) - AIC:4687.543841716303
ARIMA(1, 1, 1)x(1, 1, 1, 3) - AIC:4685.7222439127945
ARIMA(1, 1, 1)x(1, 1, 1, 4) - AIC:4680.649379246129
ARIMA(1, 1, 1)x(1, 1, 1, 5) - AIC:4668.091056332199
ARIMA(1, 1, 1)x(1, 1, 1, 6) - AIC:4675.076886702416
ARIMA(1, 1, 1)x(1, 1, 1, 7) - AIC:4659.059436293449
ARIMA(1, 1, 1)x(1, 1, 1, 8) - AIC:4661.102723785732
```

```
ARIMA(1, 1, 1)x(1, 1, 1, 9) - AIC:4666.586686180261
ARIMA(1, 1, 1)x(1, 1, 1, 10) - AIC:4640.456542628248
ARIMA(1, 1, 1)x(1, 1, 1, 11) - AIC:4654.930551012263
ARIMA(1, 1, 1)x(1, 1, 1, 12) - AIC:4651.131052062675
```

In [17]:
```
#ARIMA(0, 1, 1)x(0, 0, 1, 12) - AIC:4634.909942938197
```

In [10]:
```
model = sm.tsa.statespace.SARIMAX(df['Close'], order=(0,1,1), seasonal_order=(0,0,1,2
results_season = model.fit(disp=-1)
```

In [11]:
```
df['forecast'] = results_season.predict(start = 1, end = 1304)
df.tail(10)
```

Out[11]:
```
                  Open        High         Low       Close   Adj Close  \
2017-11-02  166.600006  168.500000  165.279999  168.110001  167.507828
2017-11-03  174.000000  174.259995  171.119995  172.500000  171.882111
2017-11-06  172.369995  174.990005  171.720001  174.250000  173.625839
2017-11-07  173.910004  175.250000  173.600006  174.809998  174.183823
2017-11-08  174.660004  176.240005  174.330002  176.240005  175.608719
2017-11-09  175.110001  176.100006  173.139999  175.880005  175.250000
2017-11-10  175.110001  175.380005  174.270004  174.669998  174.669998
2017-11-13  173.500000  174.500000  173.399994  173.970001  173.970001
2017-11-14  173.039993  173.479996  171.179993  171.339996  171.339996
2017-11-15  169.970001  170.320007  168.380005  169.080002  169.080002

                Volume    forecast
2017-11-02  41393400.0  166.778332
2017-11-03  59398600.0  168.192761
2017-11-06  35026300.0  172.574190
2017-11-07  24361500.0  174.185273
2017-11-08  24409500.0  174.781889
2017-11-09  29482600.0  176.259457
2017-11-10  25145500.0  175.834829
2017-11-13  16982100.0  174.649877
2017-11-14  24782500.0  173.981972
2017-11-15  28773400.0  171.292622
```

In [12]:
```
df_temp = df[[ 'Close','forecast']].dropna()
plt.plot(df['Close'], label='Original')
plt.plot(df['forecast'], label='Model')
plt.legend(loc='best')
plt.title('RMSE: %.4f'% np.sqrt(sum((df_temp['forecast'] - df_temp['Close'])**2)/len(c
```

Out[12]:
```
<matplotlib.text.Text at 0x29c22c44b00>
```


```
In [13]: from pandas.tseries.offsets import DateOffset

In [14]: future_dates =[df.index[-1] + DateOffset(days=x) for x in range(1,20)]

In [15]: future_dates

Out[15]: [Timestamp('2017-11-16 00:00:00'),
          Timestamp('2017-11-17 00:00:00'),
          Timestamp('2017-11-18 00:00:00'),
          Timestamp('2017-11-19 00:00:00'),
          Timestamp('2017-11-20 00:00:00'),
          Timestamp('2017-11-21 00:00:00'),
          Timestamp('2017-11-22 00:00:00'),
          Timestamp('2017-11-23 00:00:00'),
          Timestamp('2017-11-24 00:00:00'),
          Timestamp('2017-11-25 00:00:00'),
          Timestamp('2017-11-26 00:00:00'),
          Timestamp('2017-11-27 00:00:00'),
          Timestamp('2017-11-28 00:00:00'),
          Timestamp('2017-11-29 00:00:00'),
          Timestamp('2017-11-30 00:00:00'),
          Timestamp('2017-12-01 00:00:00'),
          Timestamp('2017-12-02 00:00:00'),
          Timestamp('2017-12-03 00:00:00'),
          Timestamp('2017-12-04 00:00:00')]

In [16]: future_df = pd.DataFrame(index=future_dates, columns=df.columns)

In [17]: final_df = pd.concat([df, future_df])
         final_df.tail(10)
```

Out[17]:

	Open	High	Low	Close	Adj Close	Volume	forecast
2017-11-25	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-11-26	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-11-27	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-11-28	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-11-29	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-11-30	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-12-01	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-12-02	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-12-03	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2017-12-04	NaN	NaN	NaN	NaN	NaN	NaN	NaN

In [18]:

```
final_df['forecast'] = results_season.predict(start = 1, end = 1320)
final_df.tail(20)
```

Out[18]:

	Open	High	Low	Close	Adj Close \
2017-11-15	169.970001	170.320007	168.380005	169.080002	169.080002
2017-11-16	NaN	NaN	NaN	NaN	NaN
2017-11-17	NaN	NaN	NaN	NaN	NaN
2017-11-18	NaN	NaN	NaN	NaN	NaN
2017-11-19	NaN	NaN	NaN	NaN	NaN
2017-11-20	NaN	NaN	NaN	NaN	NaN
2017-11-21	NaN	NaN	NaN	NaN	NaN
2017-11-22	NaN	NaN	NaN	NaN	NaN
2017-11-23	NaN	NaN	NaN	NaN	NaN
2017-11-24	NaN	NaN	NaN	NaN	NaN
2017-11-25	NaN	NaN	NaN	NaN	NaN
2017-11-26	NaN	NaN	NaN	NaN	NaN
2017-11-27	NaN	NaN	NaN	NaN	NaN
2017-11-28	NaN	NaN	NaN	NaN	NaN
2017-11-29	NaN	NaN	NaN	NaN	NaN
2017-11-30	NaN	NaN	NaN	NaN	NaN
2017-12-01	NaN	NaN	NaN	NaN	NaN
2017-12-02	NaN	NaN	NaN	NaN	NaN
2017-12-03	NaN	NaN	NaN	NaN	NaN
2017-12-04	NaN	NaN	NaN	NaN	NaN

	Volume	forecast
2017-11-15	28773400.0	171.292622
2017-11-16	NaN	169.090641
2017-11-17	NaN	169.146117
2017-11-18	NaN	NaN
2017-11-19	NaN	NaN
2017-11-20	NaN	169.147436
2017-11-21	NaN	169.147436
2017-11-22	NaN	169.147436
2017-11-23	NaN	169.147436
2017-11-24	NaN	169.147436

```
2017-11-25          NaN         NaN
2017-11-26          NaN         NaN
2017-11-27          NaN  169.147436
2017-11-28          NaN  169.147436
2017-11-29          NaN  169.147436
2017-11-30          NaN  169.147436
2017-12-01          NaN  169.147436
2017-12-02          NaN         NaN
2017-12-03          NaN         NaN
2017-12-04          NaN  169.147436
```

In [19]:
```
plt.plot(final_df['Close'].tail(70), label='Original')
plt.plot(final_df['forecast'].tail(60), label='Model')
plt.title('Forecasting')
plt.legend(loc='best')
```

Out[19]: `<matplotlib.legend.Legend at 0x29c23a0f978>`