

Covariance

September 29, 2021

1 Covariance

<https://www.investopedia.com/articles/financial-theory/11/calculating-covariance.asp>

```
[1]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

import warnings
warnings.filterwarnings("ignore")

# fix_yahoo_finance is used to fetch data
import fix_yahoo_finance as yf
yf.pdr_override()
```

```
[2]: # input
symbol1 = 'AAPL'
symbol2 = 'QQQ'
start = '2017-01-01'
end = '2019-01-01'

# Read data
df1 = yf.download(symbol1,start,end)
df2 = yf.download(symbol2,start,end)

# View Columns
df1.head()
```

```
[*****100%*****] 1 of 1 downloaded
```

```
[*****100%*****] 1 of 1 downloaded
```

```
[2]:
```

	Open	High	Low	Close	Adj Close	\
Date						
2017-01-03	115.800003	116.330002	114.760002	116.150002	111.709831	
2017-01-04	115.849998	116.510002	115.750000	116.019997	111.584778	
2017-01-05	115.919998	116.860001	115.809998	116.610001	112.152229	
2017-01-06	116.779999	118.160004	116.470001	117.910004	113.402542	
2017-01-09	117.949997	119.430000	117.940002	118.989998	114.441246	

	Volume
Date	
2017-01-03	28781900
2017-01-04	21118100
2017-01-05	22193600
2017-01-06	31751900
2017-01-09	33561900

```
[3]: df2.head()
```

```
[3]:
```

	Open	High	Low	Close	Adj Close \
Date					
2017-01-03	119.269997	119.989998	118.889999	119.540001	117.254288
2017-01-04	119.669998	120.410004	119.660004	120.190002	117.891861
2017-01-05	120.099998	120.949997	120.099998	120.870003	118.558853
2017-01-06	121.000000	122.250000	120.690002	121.930000	119.598587
2017-01-09	122.029999	122.550003	121.949997	122.330002	119.990944

	Volume
Date	
2017-01-03	22307600
2017-01-04	19749100
2017-01-05	20644300
2017-01-06	24074300
2017-01-09	18748000

```
[4]: c = df1['Adj Close'].cov(df2['Adj Close'])
```

```
[5]: c
```

```
[5]: 457.62891396091828
```

```
[6]: df = pd.concat([df1['Adj Close'], df2['Adj Close']],axis=1)
```

```
[7]: df.head()
```

```
[7]:
```

	Adj Close	Adj Close
Date		
2017-01-03	111.709831	117.254288
2017-01-04	111.584778	117.891861
2017-01-05	112.152229	118.558853
2017-01-06	113.402542	119.598587
2017-01-09	114.441246	119.990944

```
[8]: # Rename columns
df.columns = [symbol1,symbol2]
```

```
[9]: df.head()
```

```
[9]:
```

	AAPL	QQQ
Date		
2017-01-03	111.709831	117.254288
2017-01-04	111.584778	117.891861
2017-01-05	112.152229	118.558853
2017-01-06	113.402542	119.598587
2017-01-09	114.441246	119.990944

```
[10]: n = 14
df['Cov'] = df['AAPL'].rolling(n).cov(df['QQQ'])
```

```
[11]: df.head(20)
```

```
[11]:
```

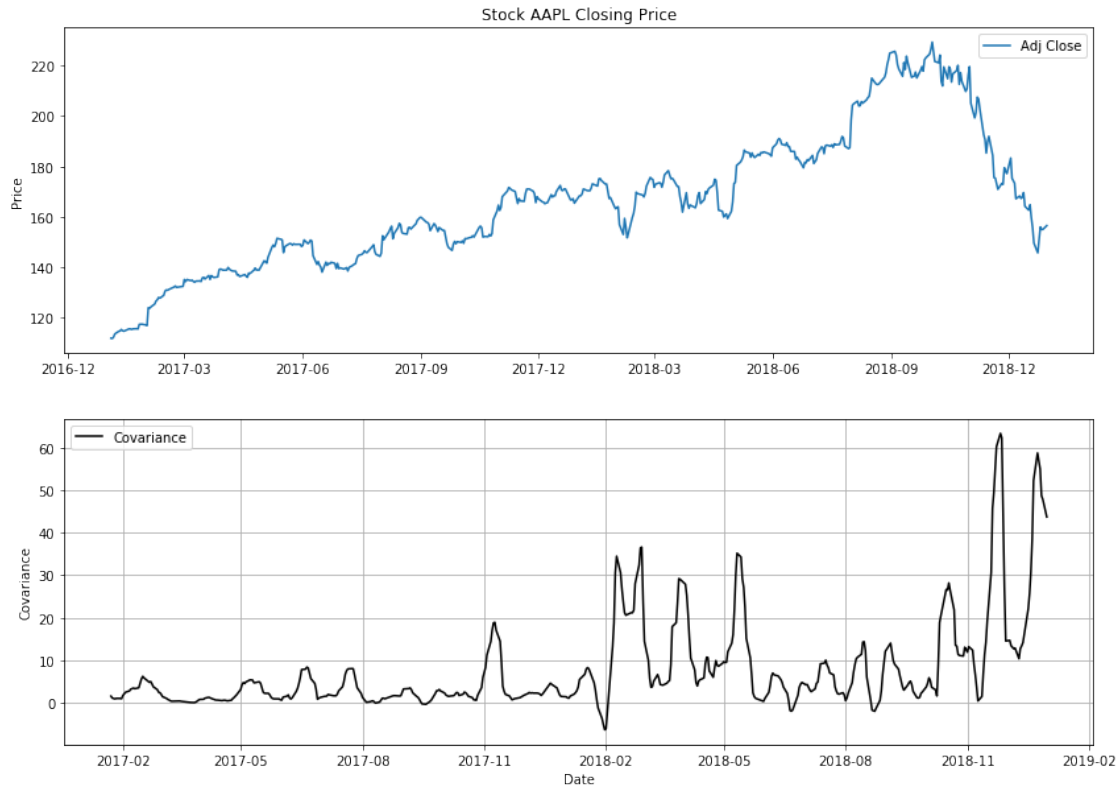
	AAPL	QQQ	Cov
Date			
2017-01-03	111.709831	117.254288	NaN
2017-01-04	111.584778	117.891861	NaN
2017-01-05	112.152229	118.558853	NaN
2017-01-06	113.402542	119.598587	NaN
2017-01-09	114.441246	119.990944	NaN
2017-01-10	114.556656	120.255775	NaN
2017-01-11	115.172195	120.579460	NaN
2017-01-12	114.691307	120.393089	NaN
2017-01-13	114.489334	120.805077	NaN
2017-01-17	115.412643	120.442139	NaN
2017-01-18	115.403008	120.687355	NaN
2017-01-19	115.201050	120.628510	NaN
2017-01-20	115.412643	120.893341	NaN
2017-01-23	115.489578	120.991440	1.621366
2017-01-24	115.383789	121.805565	1.180761
2017-01-25	117.220779	123.031662	1.080130
2017-01-26	117.278488	123.159172	0.984301
2017-01-27	117.288101	123.394600	1.094121
2017-01-30	116.980324	122.433334	1.092502
2017-01-31	116.711029	122.188110	1.029555

```
[12]: fig = plt.figure(figsize=(14,10))
ax1 = plt.subplot(2, 1, 1)
ax1.plot(df1['Adj Close'])
ax1.set_title('Stock ' + symbol1 + ' Closing Price')
ax1.set_ylabel('Price')
ax1.legend(loc='best')

ax2 = plt.subplot(2, 1, 2)
ax2.plot(df['Cov'], label='Covariance', color='black')
```

```
ax2.grid()
ax2.legend(loc='best')
ax2.set_ylabel('Covariance')
ax2.set_xlabel('Date')
```

[12]: Text(0.5,0,'Date')



1.1 Candlestick with Covariance

```
[13]: from matplotlib import dates as mdates
import datetime as dt

dfc = df1.copy()
dfc['VolumePositive'] = dfc['Open'] < dfc['Adj Close']
#dfc = dfc.dropna()
dfc = dfc.reset_index()
dfc['Date'] = mdates.date2num(dfc['Date'].astype(dt.date))
dfc.head()
```

```
[13]:      Date      Open      High      Low      Close  Adj Close  \
0  736332.0  115.80003  116.33002  114.76002  116.15002  111.709831
1  736333.0  115.84998  116.51002  115.75000  116.01997  111.584778
```

2	736334.0	115.919998	116.860001	115.809998	116.610001	112.152229
3	736335.0	116.779999	118.160004	116.470001	117.910004	113.402542
4	736338.0	117.949997	119.430000	117.940002	118.989998	114.441246

	Volume	VolumePositive
0	28781900	False
1	21118100	False
2	22193600	False
3	31751900	False
4	33561900	False

```
[14]: from mpl_finance import candlestick_ohlc

fig = plt.figure(figsize=(14,10))
ax1 = plt.subplot(2, 1, 1)
candlestick_ohlc(ax1,dfc.values, width=0.5, colorup='g', colordown='r', alpha=1.
    ↪0)
ax1.xaxis_date()
ax1.xaxis.set_major_formatter(mdates.DateFormatter('%d-%m-%Y'))
ax1.grid(True, which='both')
ax1.minorticks_on()
ax1v = ax1.twinx()
colors = dfc.VolumePositive.map({True: 'g', False: 'r'})
ax1v.bar(dfc.Date, dfc['Volume'], color=colors, alpha=0.4)
ax1v.axes.yaxis.set_ticklabels([])
ax1v.set_ylim(0, 3*df1.Volume.max())
ax1.set_title('Stock ' + symbol1 + ' Closing Price')
ax1.set_ylabel('Price')

ax2 = plt.subplot(2, 1, 2)
ax2.plot(df['Cov'], label='Covariance', color='black')
ax2.grid()
ax2.legend(loc='best')
ax2.set_ylabel('Covariance')
ax2.set_xlabel('Date')
```

```
[14]: Text(0.5,0,'Date')
```

