

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')

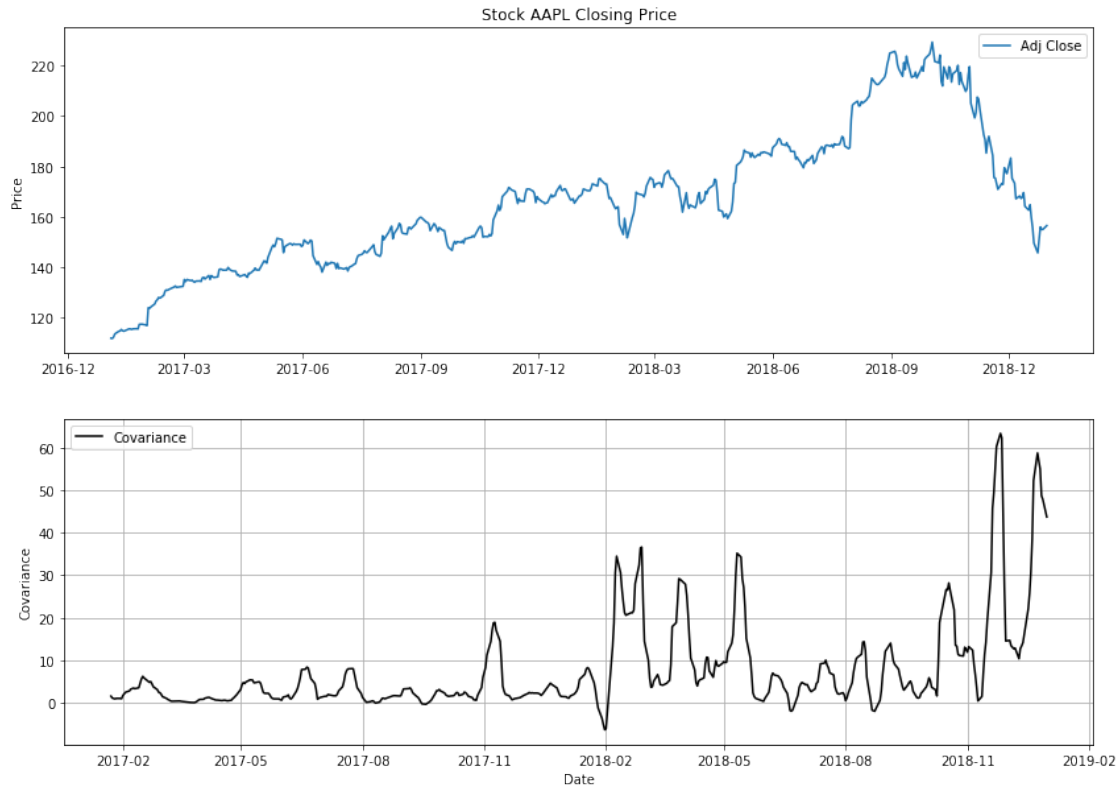
ax2 = plt.subplot(2, 1, 2)
ax2.plot(df['Cov'], label='Covariance', color='black')
```

```

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')
```

