

```
In [30]: %matplotlib inline
import pandas as pd
import numpy as np
```

```
In [31]: data = pd.read_csv("MSFT.csv", index_col = "Date", parse_dates = True)
```

To convert Date column to Date time data type

```
data.Date = pd.to_datetime(data.Date)
```

```
In [32]: data.describe()
```

```
Out[32]:
```

	Open	High	Low	Close	Adj Close	Volume
count	8968.000000	8968.000000	8968.000000	8968.000000	8968.000000	8.968000e+03
mean	37.826968	38.225586	37.425467	37.839524	32.817311	5.908754e+07
std	51.365375	51.844681	50.879880	51.396233	51.608567	3.855465e+07
min	0.088542	0.092014	0.088542	0.090278	0.057099	2.304000e+06
25%	3.935547	3.976563	3.890625	3.937500	2.490378	3.503602e+07
50%	26.718750	26.990000	26.420000	26.705000	18.795607	5.234940e+07
75%	38.155000	38.500314	37.790001	38.152501	28.345474	7.294562e+07
max	305.019989	305.839996	302.000000	305.220001	305.220001	1.031789e+09

```
In [33]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 8968 entries, 1986-03-13 to 2021-10-08
Data columns (total 6 columns):
 #   Column      Non-Null Count  Dtype
---  -
 0   Open        8968 non-null   float64
 1   High        8968 non-null   float64
 2   Low         8968 non-null   float64
 3   Close       8968 non-null   float64
 4   Adj Close   8968 non-null   float64
 5   Volume      8968 non-null   int64
dtypes: float64(5), int64(1)
memory usage: 490.4 KB
```

```
In [34]: data.head()
```

```
Out[34]:
```

	Open	High	Low	Close	Adj Close	Volume
Date						
1986-03-13	0.088542	0.101563	0.088542	0.097222	0.061491	1031788800
1986-03-14	0.097222	0.102431	0.097222	0.100694	0.063687	308160000
1986-03-17	0.100694	0.103299	0.100694	0.102431	0.064785	133171200
1986-03-18	0.102431	0.103299	0.098958	0.099826	0.063138	67766400
1986-03-19	0.099826	0.100694	0.097222	0.098090	0.062040	47894400

```
In [35]: data.tail()
```

Out[35]:

	Open	High	Low	Close	Adj Close	Volume
Date						
2021-10-04	287.399994	287.750000	280.250000	283.109985	283.109985	31350700
2021-10-05	284.049988	290.399994	284.049988	288.760010	288.760010	24993000
2021-10-06	285.779999	293.630005	285.510010	293.109985	293.109985	28002600
2021-10-07	295.179993	296.640015	293.920013	294.850006	294.850006	20430500
2021-10-08	296.220001	296.640015	293.760010	294.850006	294.850006	17680300

In [36]: `data.isnull().sum()`

Out[36]:

Open	0
High	0
Low	0
Close	0
Adj Close	0
Volume	0
dtype:	int64

In [37]: `import matplotlib.pyplot as plt`

`type()` method returns class type of the argument(object) passed as parameter. `type()` function is mostly used for debugging purposes

In [38]: `type(data)`Out[38]: `pandas.core.frame.DataFrame`

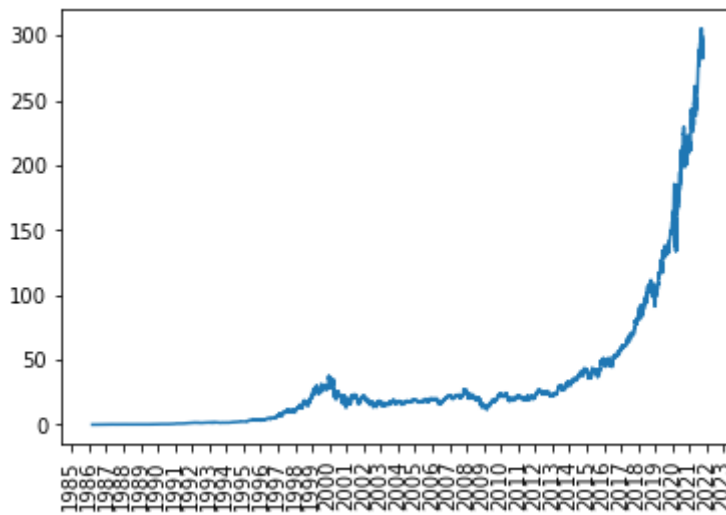
Time series Data

A time series is a sequence of numerical data points taken at successive equally spaced data points in time. In investing a time series tracks movement of stock price, over a specified period of time.

In [39]: `import matplotlib.dates as mdates`

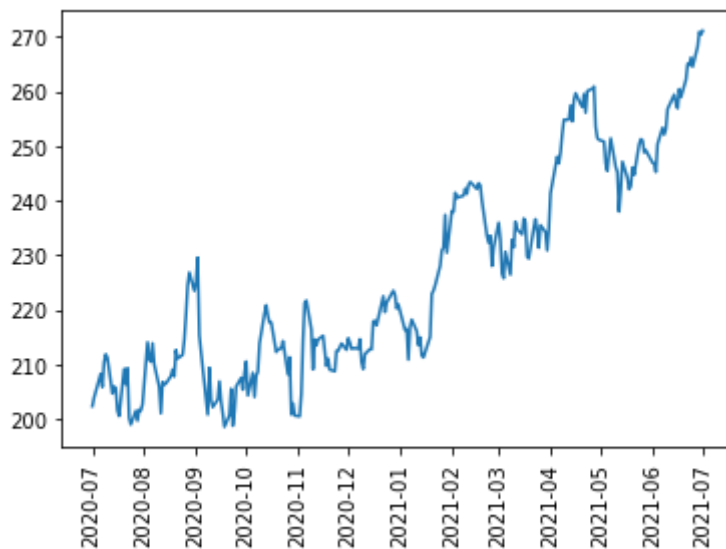
line plot for 1986 to 2021

```
In [40]: plt.plot(data.index, data['Adj Close'])
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter("%Y"))
plt.gca().xaxis.set_major_locator(mdates.YearLocator())
# plt.grid(True)
plt.xticks(rotation = 90)
plt.show()
```

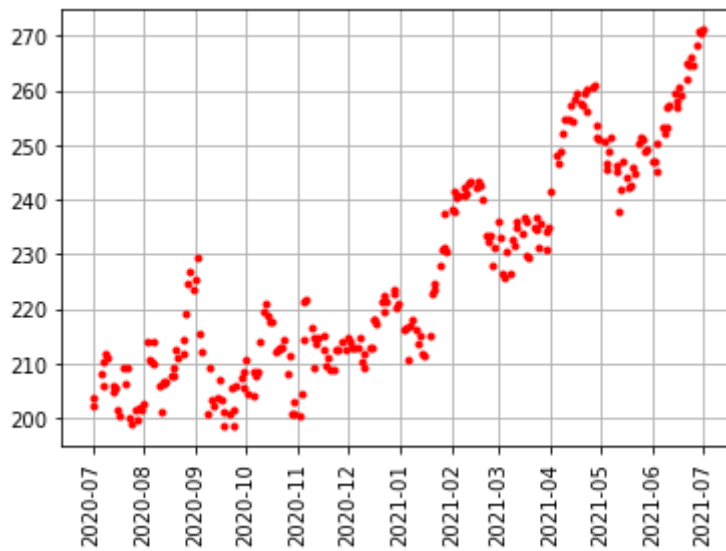


Zooming in

```
In [41]: data_2020_21 = data.loc[pd.Timestamp("2020-07-1"):pd.Timestamp("2021-07-1")]
plt.plot(data_2020_21.index, data_2020_21['Adj Close'])
# plt.grid(True)
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter("%Y-%m"))
plt.gca().xaxis.set_major_locator(mdates.MonthLocator())
plt.xticks(rotation = 90)
plt.show()
```

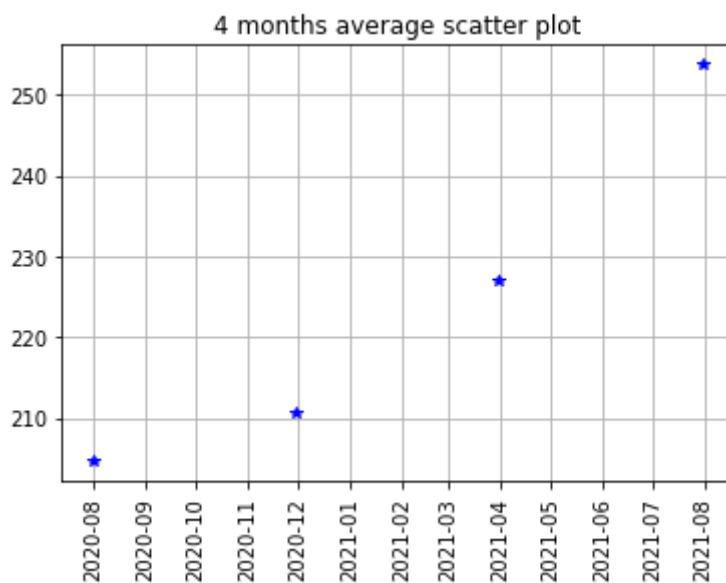


```
In [42]: plt.plot(data_2020_21.index, data_2020_21['Adj Close'], '.', color = 'r')
plt.grid(True)
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter("%Y-%m"))
plt.gca().xaxis.set_major_locator(mdates.MonthLocator())
plt.xticks(rotation = 90)
plt.show()
```



Resampling for 4 months in 2020-21

```
In [43]: data_resample_4M = data_2020_21.resample('4M').mean()
plt.plot(data_resample_4M.index, data_resample_4M['Adj Close'], '*', color = 'b')
plt.grid(True)
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter("%Y-%m"))
plt.gca().xaxis.set_major_locator(mdates.MonthLocator())
plt.xticks(rotation = 90)
plt.title("4 months average scatter plot")
plt.show()
```



```
In [44]: data_resample_W = data.loc[pd.Timestamp('2020-11-01'):pd.Timestamp('2021-08-01')]
```

Resampling weekly

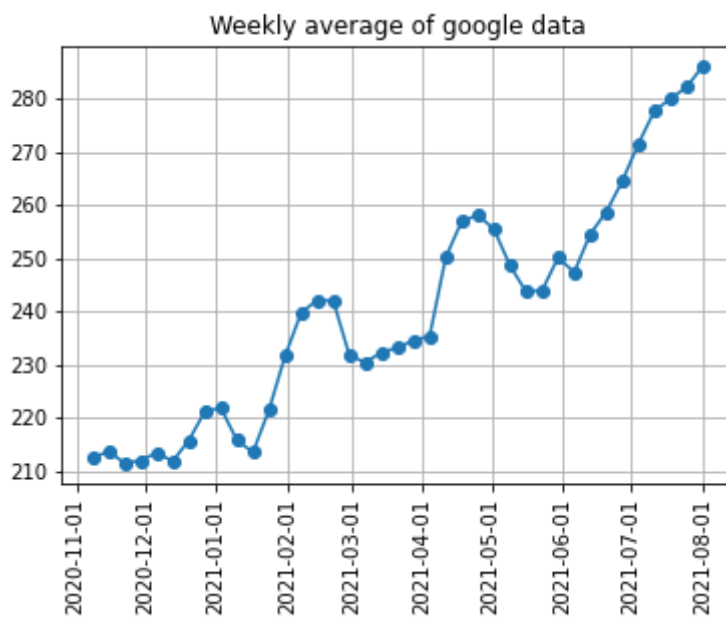
```
In [45]: data_resample_W = data_resample_W.resample('W').mean()
data_resample_W.head()
```

```
Out[45]:
```

Date	Open	High	Low	Close	Adj Close	Volume
2020-11-08	213.299997	216.039999	210.967996	214.431998	212.482257	32395600

	Open	High	Low	Close	Adj Close	Volume
Date						
2020-11-15	216.980002	219.837997	213.684003	215.579999	213.619831	31619180
2020-11-22	213.639999	215.381998	211.891998	213.116000	211.507117	25023200
2020-11-29	212.625000	214.524997	210.880001	213.267498	211.881619	23797075
2020-12-06	214.464002	215.862003	212.763998	214.850003	213.453836	27496140

```
In [46]: plt.plot(data_resample_W.index, data_resample_W['Adj Close'], '-o')
plt.grid(True)
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter("%Y-%m-%d"))
plt.gca().xaxis.set_major_locator(mdates.MonthLocator())
plt.xticks(rotation = 90)
plt.title('Weekly average of google data')
plt.show()
```



Creating a new column namely diff where

diff = open - close

```
In [47]: data['diff'] = data['Open'] - data['Close']
data.head(10)
```

```
Out[47]:
```

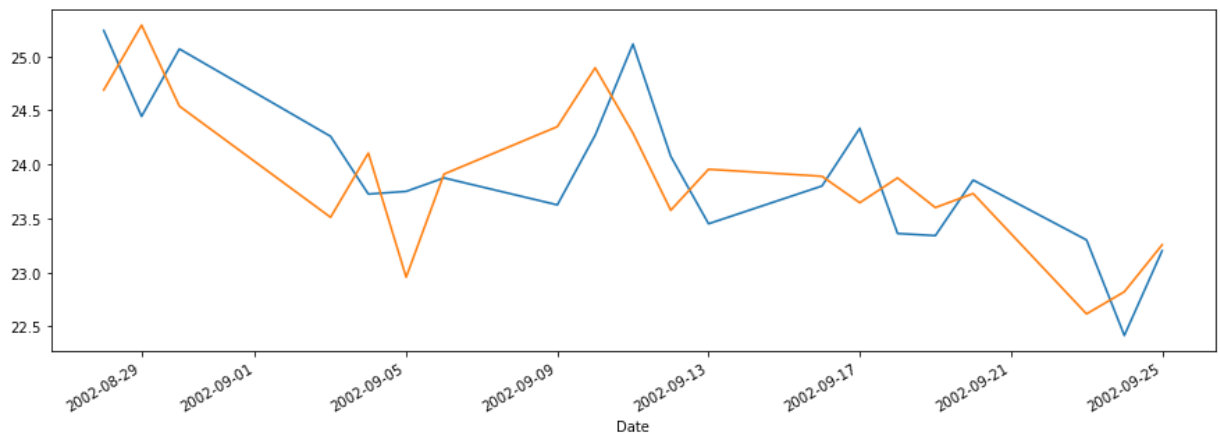
	Open	High	Low	Close	Adj Close	Volume	diff
Date							
1986-03-13	0.088542	0.101563	0.088542	0.097222	0.061491	1031788800	-0.008680
1986-03-14	0.097222	0.102431	0.097222	0.100694	0.063687	308160000	-0.003472
1986-03-17	0.100694	0.103299	0.100694	0.102431	0.064785	133171200	-0.001737
1986-03-18	0.102431	0.103299	0.098958	0.099826	0.063138	67766400	0.002605
1986-03-19	0.099826	0.100694	0.097222	0.098090	0.062040	47894400	0.001736
1986-03-20	0.098090	0.098090	0.094618	0.095486	0.060393	58435200	0.002604
1986-03-21	0.095486	0.097222	0.091146	0.092882	0.058746	59990400	0.002604

	Open	High	Low	Close	Adj Close	Volume	diff
Date							
1986-03-24	0.092882	0.092882	0.089410	0.090278	0.057099	65289600	0.002604
1986-03-25	0.090278	0.092014	0.089410	0.092014	0.058197	32083200	-0.001736
1986-03-26	0.092014	0.095486	0.091146	0.094618	0.059844	22752000	-0.002604

```
In [48]: a = data.iloc[[data['diff'].argmax()]].first_valid_index()
data.index.get_loc(a)
```

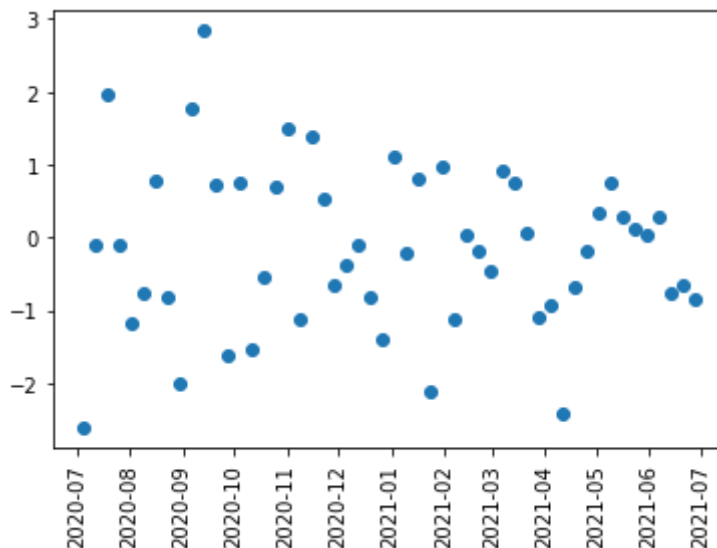
Out[48]: 8691

```
In [49]: data.iloc[4155:4175]['Open'].plot(figsize = (15,5))
data.iloc[4155:4175]['Close'].plot()
plt.show()
```



```
In [50]: data_weekly_mean = data.resample('W').mean()
```

```
In [51]: plt.scatter(data_weekly_mean['2020-07-1':'2021-07-1'].index, data_weekly_mean['2020-
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter("%Y-%m"))
#plt.grid(True)
plt.gca().xaxis.set_major_locator(mdates.MonthLocator())
plt.xticks(rotation = 90)
plt.show()
```



Step 3: Moving Windows

Daily percentages

$$r_t = (p_t / p_{t-1}) - 1$$

```
In [52]: daily_close = data['Adj Close']

# Daily returns
daily_pct_change = daily_close.pct_change()
# daily_pct_change = (data['Close']/data['Close'].shift(1)) - 1

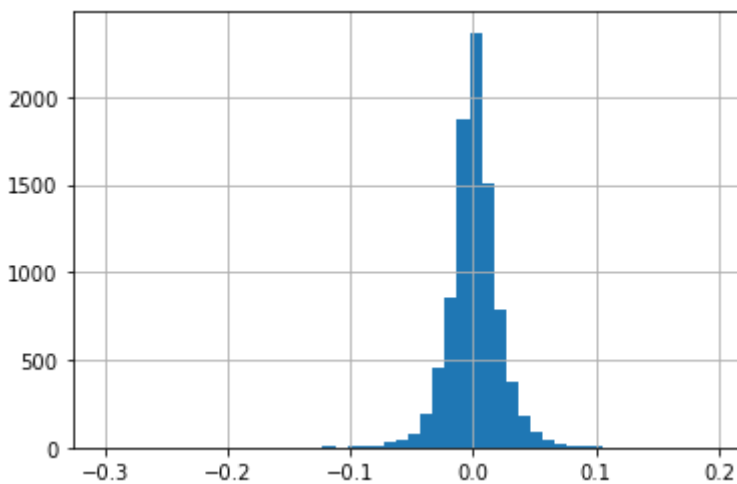
# Replace NA values with 0
daily_pct_change.fillna(0,inplace = True)
daily_pct_change.head()
```

```
Out[52]: Date
1986-03-13    0.000000
1986-03-14    0.035713
1986-03-17    0.017241
1986-03-18   -0.025423
1986-03-19   -0.017390
Name: Adj Close, dtype: float64
```

```
In [53]: daily_pct_change.isnull().sum()
```

```
Out[53]: 0
```

```
In [54]: daily_pct_change.hist(bins = 50)
plt.show()
```



Step 4: Volatility

1. The Volatility of a stock is a measurement of the change in variance in the returns of a stock over a specific period of time.
2. To compare the volatility of a stock with another stock to get a feel for which may have less risk or to a market index to examine the stock's volatility in the overall market.
3. Generally, the higher the volatility, the riskier the investment in that stock.

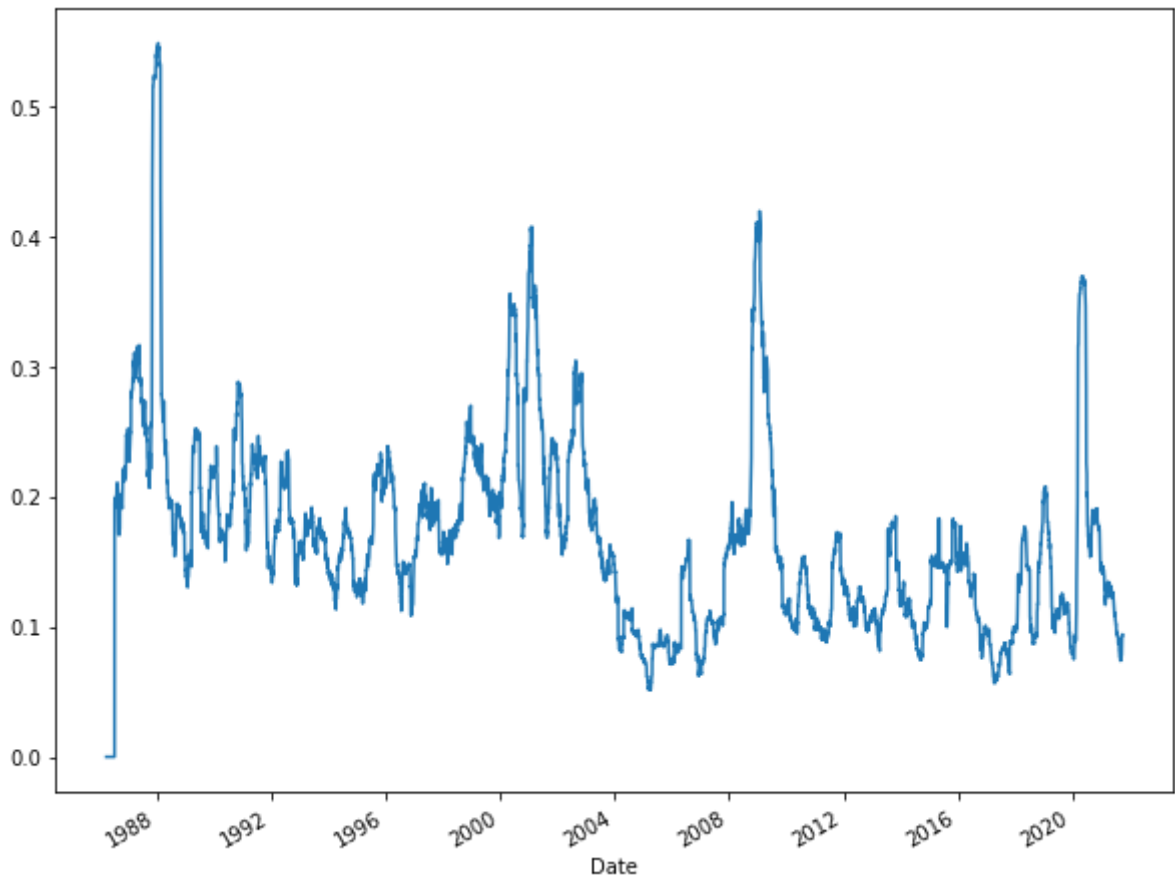
```
In [55]: min_periods = 75
```

```
# Calculate the volatility
vol = daily_pct_change.rolling(min_periods).std() * np.sqrt(min_periods)

vol.fillna(0,inplace = True)
vol.tail()
```

```
Out[55]: Date
2021-10-04    0.092256
2021-10-05    0.093878
2021-10-06    0.094236
2021-10-07    0.093860
2021-10-08    0.093841
Name: Adj Close, dtype: float64
```

```
In [56]: vol.plot(figsize = (10,8))
plt.show()
```



Rolling means (Trends and Seasonality)

```
In [57]: data_adj_close_px = data['Adj Close']

# Short moving window rolling mean
data['50'] = data_adj_close_px.rolling(window = 50).mean()

# Long moving window rolling mean
data['200'] = data_adj_close_px.rolling(window = 200).mean()
```

```
In [58]: data.head()
```

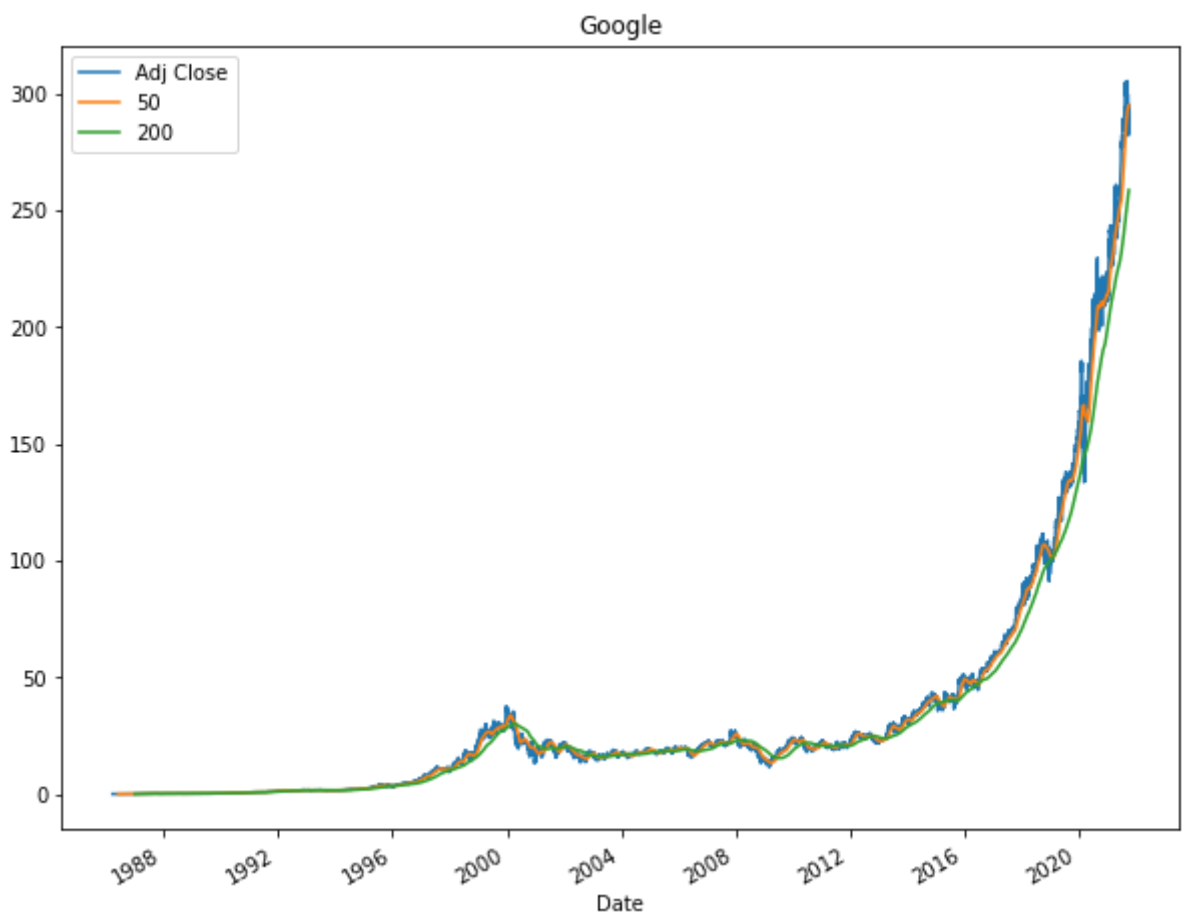
```
Out[58]:
```

	Open	High	Low	Close	Adj Close	Volume	diff	50	200
Date									

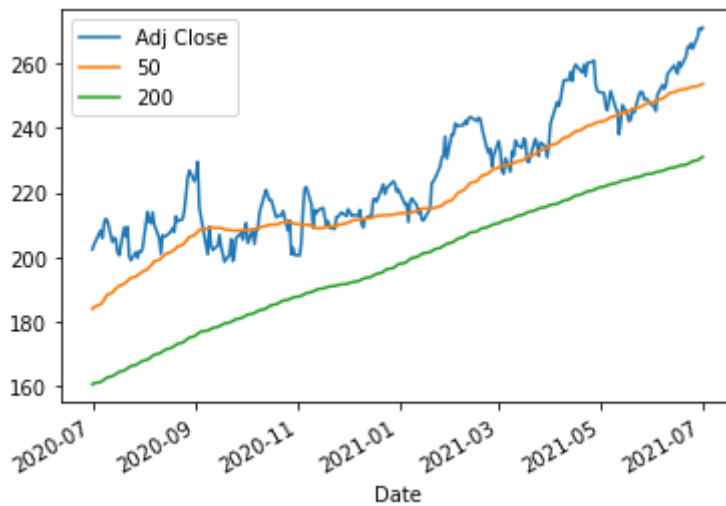
	Open	High	Low	Close	Adj Close	Volume	diff	50	200
Date									
1986-03-13	0.088542	0.101563	0.088542	0.097222	0.061491	1031788800	-0.008680	NaN	NaN
1986-03-14	0.097222	0.102431	0.097222	0.100694	0.063687	308160000	-0.003472	NaN	NaN
1986-03-17	0.100694	0.103299	0.100694	0.102431	0.064785	133171200	-0.001737	NaN	NaN
1986-03-18	0.102431	0.103299	0.098958	0.099826	0.063138	67766400	0.002605	NaN	NaN
1986-03-19	0.099826	0.100694	0.097222	0.098090	0.062040	47894400	0.001736	NaN	NaN

```
In [59]: # Plot the adjusted closing price, the short and long windows of rolling means
data[['Adj Close', '50', '200']].plot(title = "Google", figsize = (10,8))

# Show plot
plt.show()
```



```
In [60]: data.loc['2020-07-01':'2021-07-01'][['Adj Close', '50', '200']].plot();
```



```
In [61]: pip install --upgrade mplfinance
```

Requirement already up-to-date: mplfinance in c:\users\sony\anaconda3\lib\site-packages (0.12.7a17) Note: you may need to restart the kernel to use updated packages.

Requirement already satisfied, skipping upgrade: matplotlib in c:\users\sony\anaconda3\lib\site-packages (from mplfinance) (3.3.2)

Requirement already satisfied, skipping upgrade: pandas in c:\users\sony\anaconda3\lib\site-packages (from mplfinance) (1.1.3)

Requirement already satisfied, skipping upgrade: cycler>=0.10 in c:\users\sony\anaconda3\lib\site-packages (from matplotlib->mplfinance) (0.10.0)

Requirement already satisfied, skipping upgrade: certifi>=2020.06.20 in c:\users\sony\anaconda3\lib\site-packages (from matplotlib->mplfinance) (2020.6.20)

Requirement already satisfied, skipping upgrade: kiwisolver>=1.0.1 in c:\users\sony\anaconda3\lib\site-packages (from matplotlib->mplfinance) (1.3.0)

Requirement already satisfied, skipping upgrade: numpy>=1.15 in c:\users\sony\anaconda3\lib\site-packages (from matplotlib->mplfinance) (1.19.2)

Requirement already satisfied, skipping upgrade: python-dateutil>=2.1 in c:\users\sony\anaconda3\lib\site-packages (from matplotlib->mplfinance) (2.8.1)

Requirement already satisfied, skipping upgrade: pillow>=6.2.0 in c:\users\sony\anaconda3\lib\site-packages (from matplotlib->mplfinance) (8.0.1)

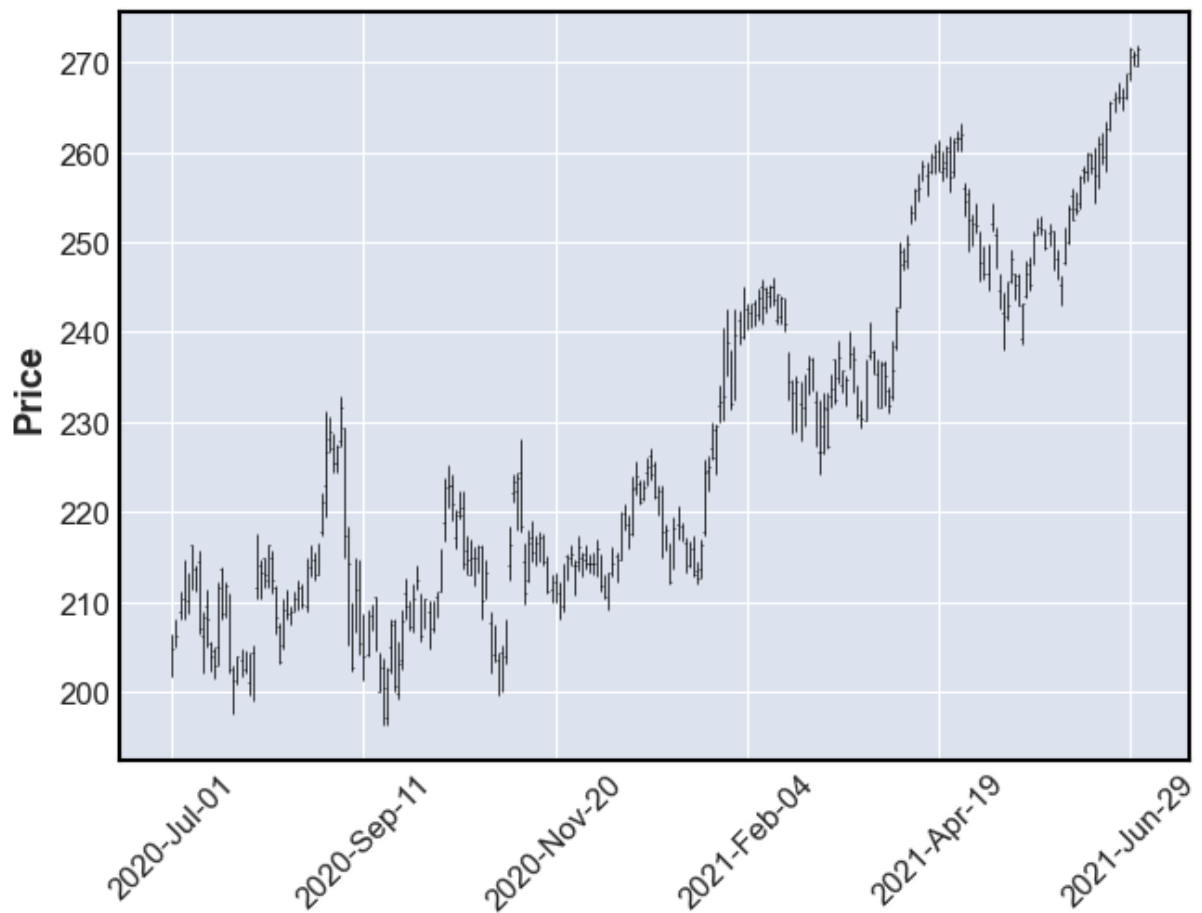
Requirement already satisfied, skipping upgrade: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.3 in c:\users\sony\anaconda3\lib\site-packages (from matplotlib->mplfinance) (2.4.7)

Requirement already satisfied, skipping upgrade: pytz>=2017.2 in c:\users\sony\anaconda3\lib\site-packages (from pandas->mplfinance) (2020.1)

Requirement already satisfied, skipping upgrade: six in c:\users\sony\anaconda3\lib\site-packages (from cycler>=0.10->matplotlib->mplfinance) (1.15.0)

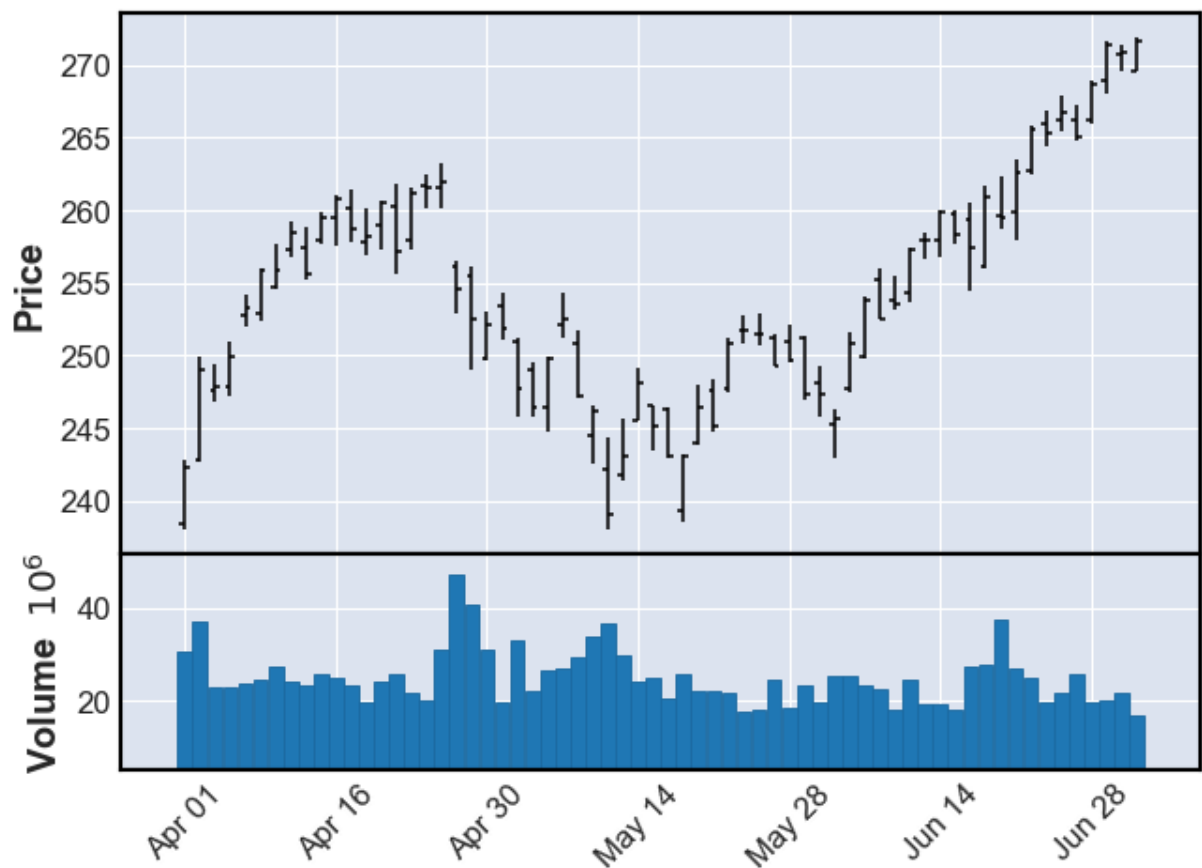
```
In [62]: import mplfinance as mpf
```

```
In [63]: mpf.plot(data_2020_21)
```

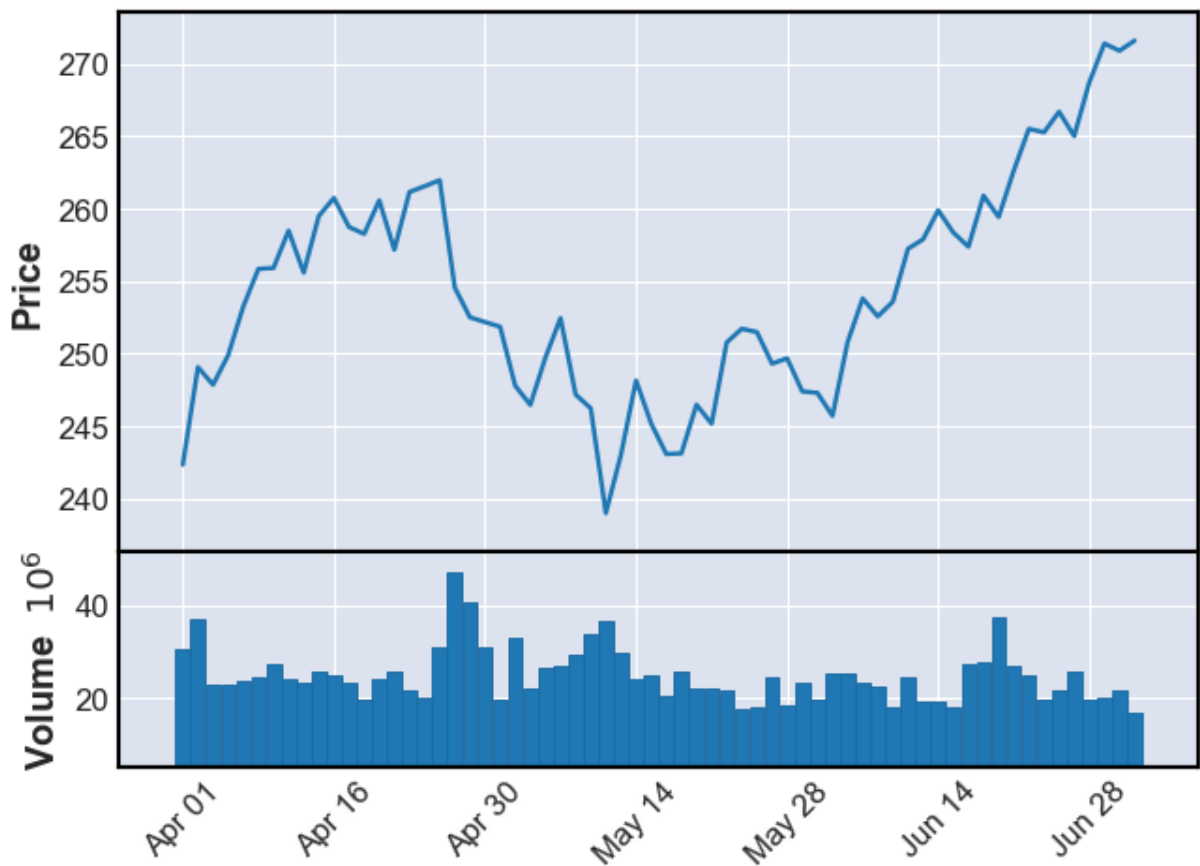


```
In [64]: data_3M = data.loc[pd.Timestamp("2021-04-1"):pd.Timestamp("2021-07-1")]
```

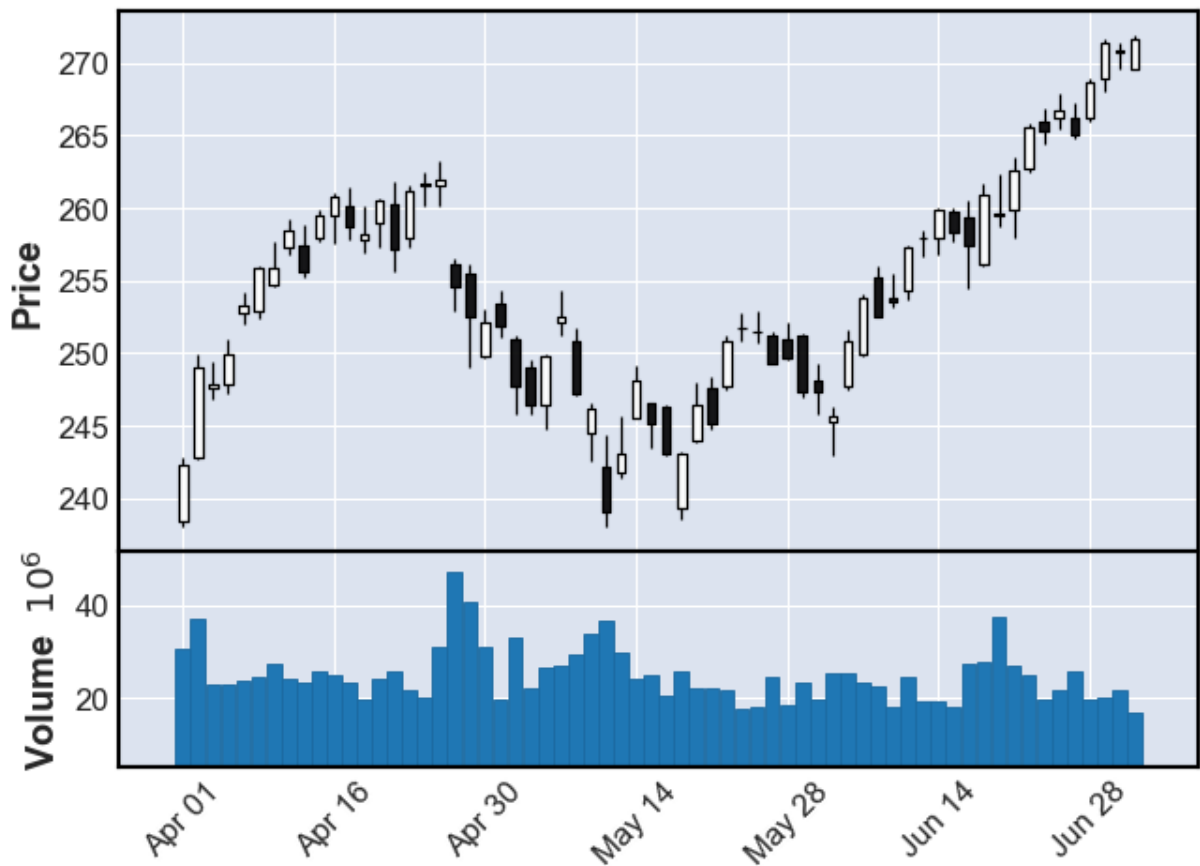
```
In [65]: mpf.plot(data_3M, volume = True)
```



```
In [66]: mpf.plot(data_3M, type = 'line', volume = True)
```



```
In [67]: mpf.plot(data_3M, type = 'candle', volume = True)
```



```
In [68]: mpf.plot(data_3M, type = 'candle', volume = True, style = 'yahoo')
```



```
In [69]: mpf.plot(data_3M, type = 'candle', style = 'yahoo', mav = (7), volume = True)
```



```
In [70]: data_20 = data.loc[pd.Timestamp("2020-01-1"):pd.Timestamp("2020-12-31")]
data_19 = data.loc[pd.Timestamp("2019-01-1"):pd.Timestamp("2019-12-31")]
data_18 = data.loc[pd.Timestamp("2018-01-1"):pd.Timestamp("2018-12-31")]
data_17 = data.loc[pd.Timestamp("2017-01-1"):pd.Timestamp("2017-12-31")]
```

```
data_16 = data.loc[pd.Timestamp("2016-01-1"):pd.Timestamp("2016-12-31")]
data_15 = data.loc[pd.Timestamp("2015-01-1"):pd.Timestamp("2015-12-31")]
```

```
In [71]: f, ax = plt.subplots(3,2,figsize = (10,14))

f.gca().xaxis.set_major_formatter(mdates.DateFormatter("%Y-%m"))
f.gca().xaxis.set_major_locator(mdates.MonthLocator())

ax[0,0].plot(data_15.index,data_15['Adj Close'],color = 'r')
ax[0,0].tick_params(labelrotation = 90)

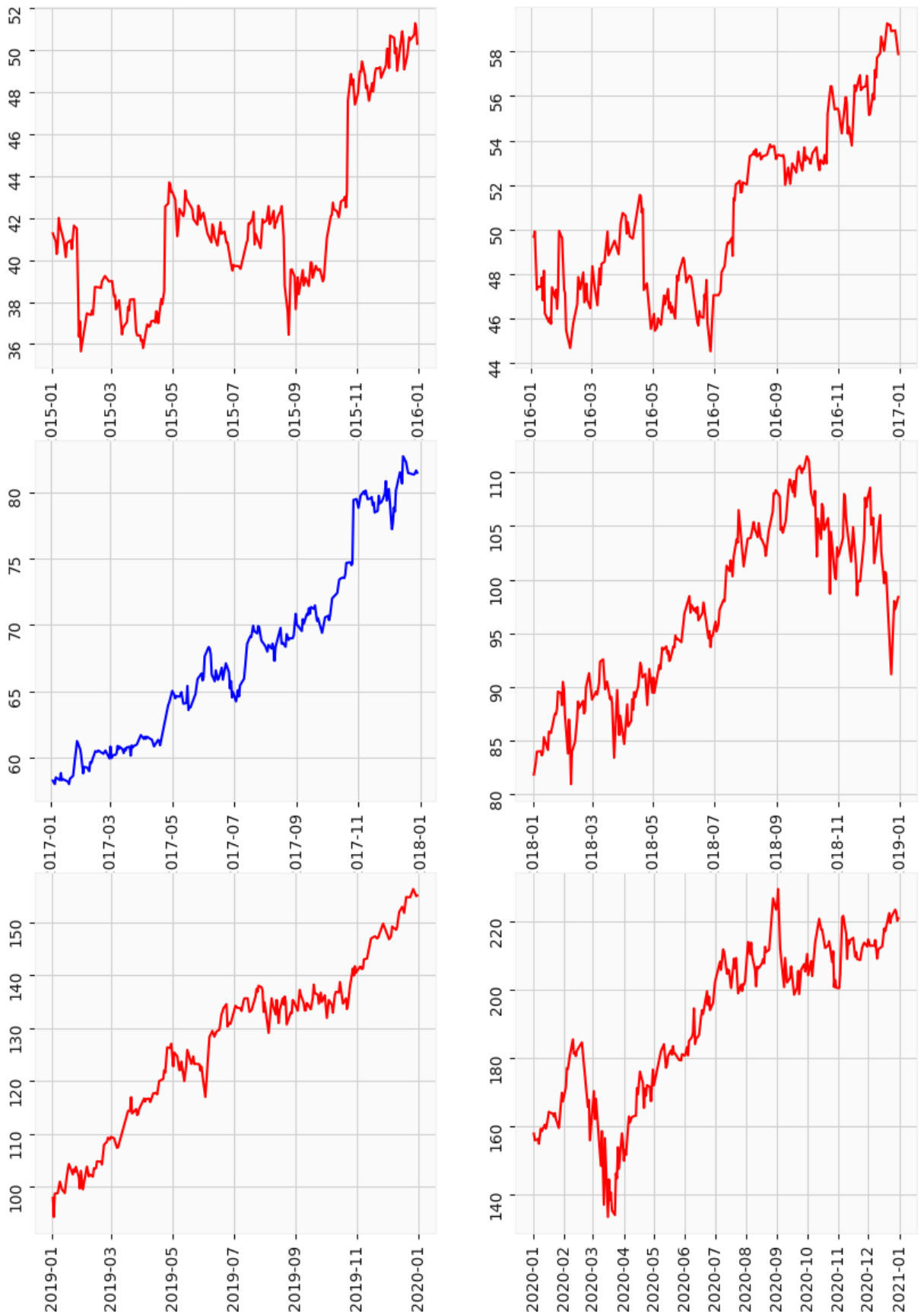
ax[0,1].plot(data_16.index,data_16['Adj Close'],color = 'r')
ax[0,1].tick_params(labelrotation = 90)

ax[1,0].plot(data_17.index,data_17['Adj Close'],color = 'b')
ax[1,0].tick_params(labelrotation = 90)

ax[1,1].plot(data_18.index,data_18['Adj Close'],color = 'r')
ax[1,1].tick_params(labelrotation = 90)

ax[2,0].plot(data_19.index,data_19['Adj Close'],color = 'r')
ax[2,0].tick_params(labelrotation = 90)

ax[2,1].plot(data_20.index,data_20['Adj Close'],color = 'r')
ax[2,1].tick_params(labelrotation = 90)
```



```
In [72]: pip install --upgrade pandas_datareader
```

```
Requirement already up-to-date: pandas_datareader in c:\users\sony\anaconda3\lib\site-packages (0.10.0)
Requirement already satisfied, skipping upgrade: pandas>=0.23 in c:\users\sony\anaconda3\lib\site-packages (from pandas_datareader) (1.1.3)
Requirement already satisfied, skipping upgrade: lxml in c:\users\sony\anaconda3\lib\site-packages (from pandas_datareader) (4.6.1)
Requirement already satisfied, skipping upgrade: requests>=2.19.0 in c:\users\sony\anaconda3\lib\site-packages (from pandas_datareader) (2.24.0)
```

Requirement already satisfied, skipping upgrade: python-dateutil>=2.7.3 in c:\users\sony\anaconda3\lib\site-packages (from pandas>=0.23->pandas_datareader) (2.8.1)
 Requirement already satisfied, skipping upgrade: pytz>=2017.2 in c:\users\sony\anaconda3\lib\site-packages (from pandas>=0.23->pandas_datareader) (2020.1)
 Requirement already satisfied, skipping upgrade: numpy>=1.15.4 in c:\users\sony\anaconda3\lib\site-packages (from pandas>=0.23->pandas_datareader) (1.19.2)
 Requirement already satisfied, skipping upgrade: chardet<4,>=3.0.2 in c:\users\sony\anaconda3\lib\site-packages (from requests>=2.19.0->pandas_datareader) (3.0.4)
 Requirement already satisfied, skipping upgrade: certifi>=2017.4.17 in c:\users\sony\anaconda3\lib\site-packages (from requests>=2.19.0->pandas_datareader) (2020.6.20)
 Requirement already satisfied, skipping upgrade: urllib3!=1.25.0,!1.25.1,<1.26,>=1.21.1 in c:\users\sony\anaconda3\lib\site-packages (from requests>=2.19.0->pandas_datareader) (1.25.11)
 Requirement already satisfied, skipping upgrade: idna<3,>=2.5 in c:\users\sony\anaconda3\lib\site-packages (from requests>=2.19.0->pandas_datareader) (2.10)
 Requirement already satisfied, skipping upgrade: six>=1.5 in c:\users\sony\anaconda3\lib\site-packages (from python-dateutil>=2.7.3->pandas>=0.23->pandas_datareader) (1.15.0)
 Note: you may need to restart the kernel to use updated packages.

```
In [73]: import pandas_datareader.data as web
import datetime
```

```
In [74]: start = datetime.datetime(2021,1,1)
end = datetime.datetime(2021,6,1)
```

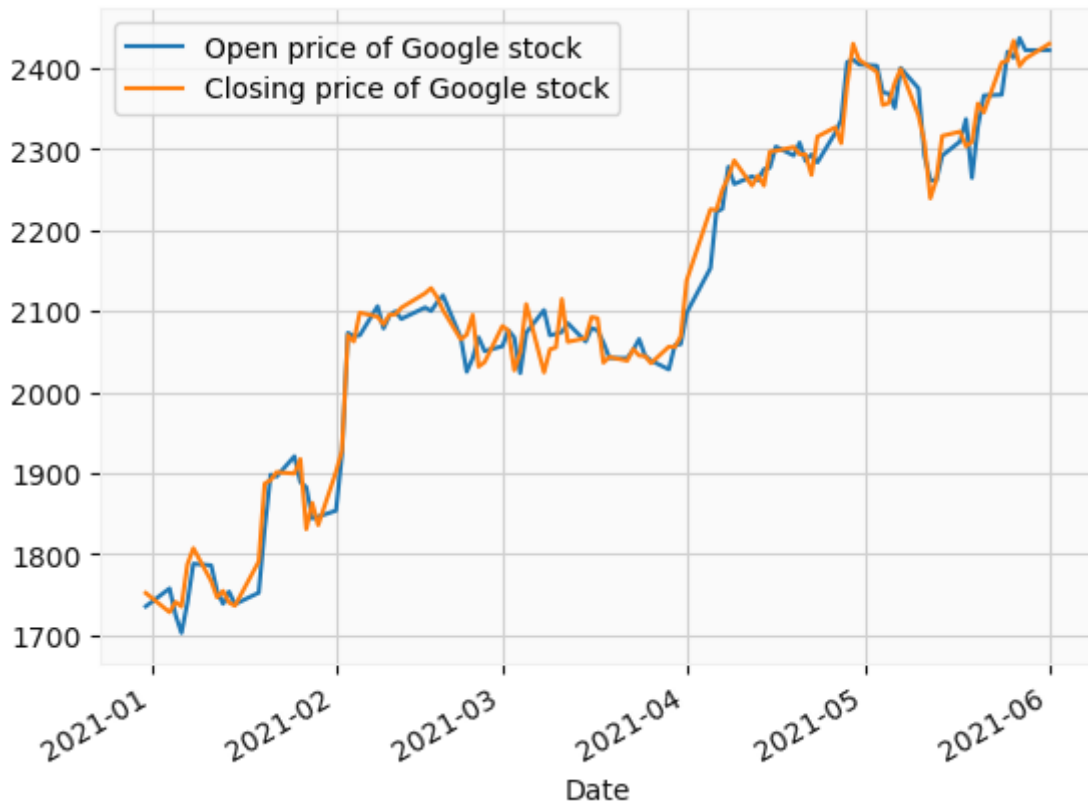
```
In [75]: google = web.DataReader("GOOG", 'yahoo', start, end)
```

```
In [76]: google.head()
```

```
Out[76]:
```

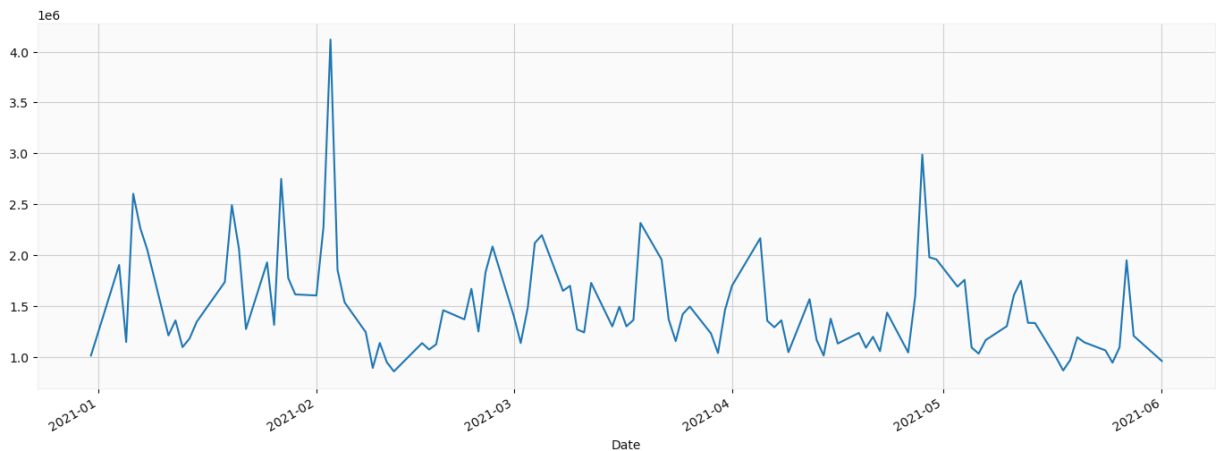
	High	Low	Open	Close	Volume	Adj Close
Date						
2020-12-31	1758.930054	1735.420044	1735.420044	1751.880005	1011900	1751.880005
2021-01-04	1760.650024	1707.849976	1757.540039	1728.239990	1901900	1728.239990
2021-01-05	1747.670044	1718.015015	1725.000000	1740.920044	1145300	1740.920044
2021-01-06	1748.000000	1699.000000	1702.630005	1735.290039	2602100	1735.290039
2021-01-07	1788.400024	1737.050049	1740.060059	1787.250000	2265000	1787.250000

```
In [77]: google.Open.plot(label = 'Open price of Google stock')
google.Close.plot(label = 'Closing price of Google stock')
plt.legend()
plt.show()
```

```
In [78]: google['Volume'].plot(figsize = (17,6))
```

```
Out[78]: <AxesSubplot:xlabel='Date'>
```



```
In [79]: google.to_csv('Goolge_Stock.csv')
```

```
In [80]: %matplotlib inline
```

```
In [81]: a = google.iloc[[google['Volume'].argmax()]].first_valid_index()
```

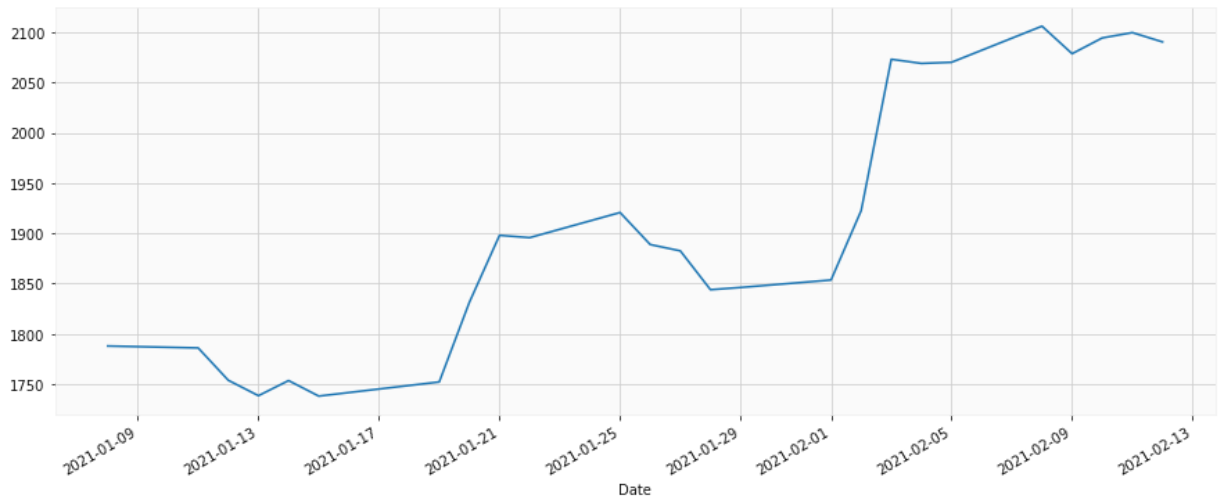
```
In [82]: a
```

```
Out[82]: Timestamp('2021-02-03 00:00:00')
```

```
In [83]: google.index.get_loc(a)
```

```
Out[83]: 22
```

```
In [84]: google.iloc[5:30]['Open'].plot(figsize = (15,6))
plt.show()
```



```
In [85]: google['MA20'] = google['Open'].rolling(20).mean()
google['MA20'].plot(label = '20 days Moving Average')

google['MA60'] = google['Open'].rolling(60).mean()
google['MA60'].plot(label = '60 days Moving Average')

google['Open'].plot(label = 'Open price')
```

```
Out[85]: <AxesSubplot:xlabel='Date'>
```



```
In [87]: start = datetime.datetime(2020,1,1)
end = datetime.datetime(2021,1,1)

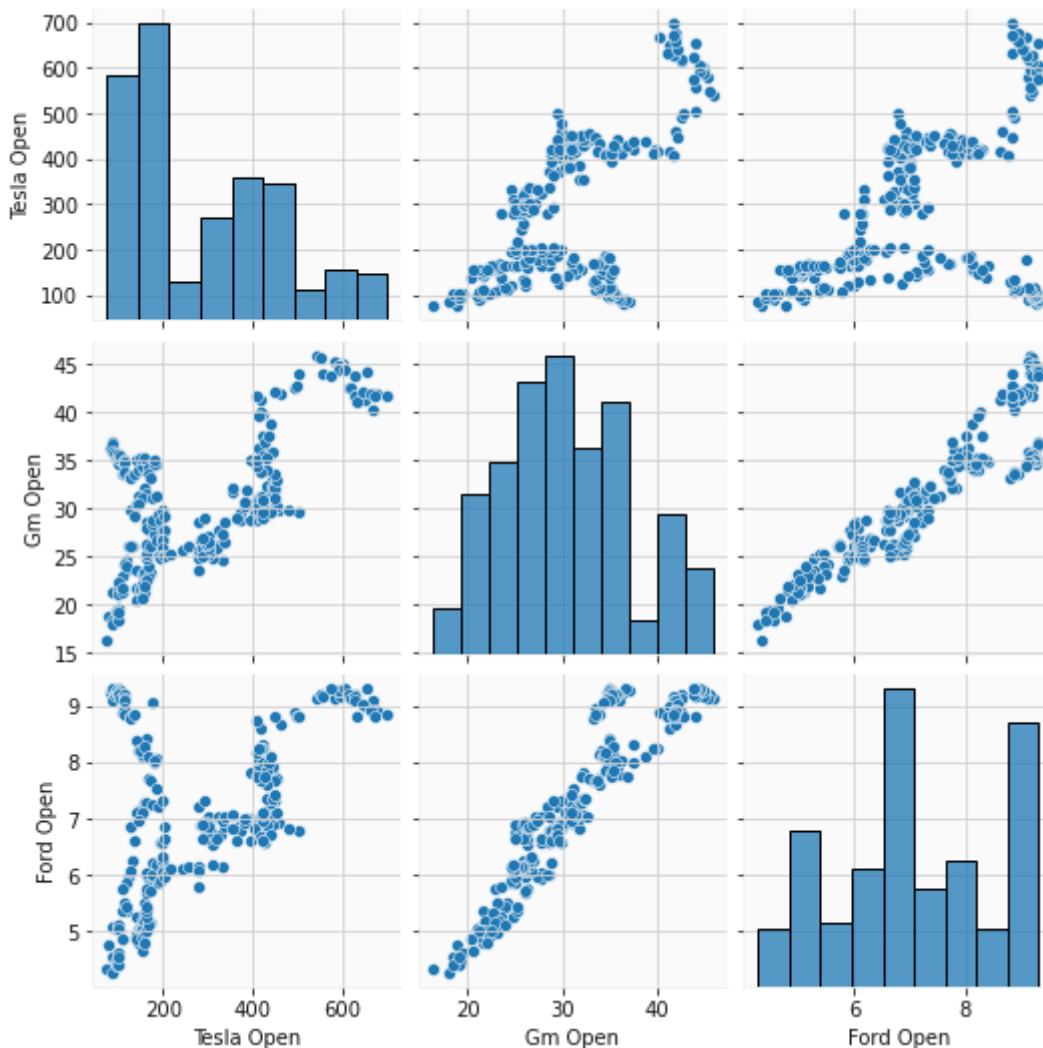
gm = web.DataReader("GM", 'yahoo', start, end)
tesla = web.DataReader("TSLA", 'yahoo', start, end)
ford = web.DataReader("F", 'yahoo', start, end)
```

```
In [88]: car_comp = pd.concat([tesla['Open'], gm['Open'], ford['Open']], axis = 1)
car_comp.columns = ['Tesla Open', 'Gm Open', 'Ford Open']
```

```
In [89]: import seaborn as sns
```

```
In [90]: sns.pairplot(car_comp)
```

```
Out[90]: <seaborn.axisgrid.PairGrid at 0xdb697e8d90>
```



In [91]: `pip install alpha_vantage`

Requirement already satisfied: alpha_vantage in c:\users\sony\anaconda3\lib\site-packages (2.3.1) Note: you may need to restart the kernel to use updated packages.
 Requirement already satisfied: aiohttp in c:\users\sony\anaconda3\lib\site-packages (from alpha_vantage) (3.7.4.post0)
 Requirement already satisfied: requests in c:\users\sony\anaconda3\lib\site-packages (from alpha_vantage) (2.24.0)
 Requirement already satisfied: multidict<7.0,>=4.5 in c:\users\sony\anaconda3\lib\site-packages (from aiohttp->alpha_vantage) (5.2.0)
 Requirement already satisfied: typing-extensions>=3.6.5 in c:\users\sony\anaconda3\lib\site-packages (from aiohttp->alpha_vantage) (3.7.4.3)

Requirement already satisfied: attrs>=17.3.0 in c:\users\sony\anaconda3\lib\site-packages (from aiohttp->alpha_vantage) (20.3.0)
 Requirement already satisfied: async-timeout<4.0,>=3.0 in c:\users\sony\anaconda3\lib\site-packages (from aiohttp->alpha_vantage) (3.0.1)
 Requirement already satisfied: chardet<5.0,>=2.0 in c:\users\sony\anaconda3\lib\site-packages (from aiohttp->alpha_vantage) (3.0.4)
 Requirement already satisfied: yarl<2.0,>=1.0 in c:\users\sony\anaconda3\lib\site-packages (from aiohttp->alpha_vantage) (1.6.3)
 Requirement already satisfied: certifi>=2017.4.17 in c:\users\sony\anaconda3\lib\site-packages (from requests->alpha_vantage) (2020.6.20)
 Requirement already satisfied: urllib3!=1.25.0,!1.25.1,<1.26,>=1.21.1 in c:\users\sony\anaconda3\lib\site-packages (from requests->alpha_vantage) (1.25.11)
 Requirement already satisfied: idna<3,>=2.5 in c:\users\sony\anaconda3\lib\site-packages (from requests->alpha_vantage) (2.10)

In [92]: `from alpha_vantage.timeseries import TimeSeries`

In [93]: `API_key = "KIH8MY12P2QGKGPW"`

```
In [94]: ts = TimeSeries(key = API_key, output_format = 'pandas')
```

```
In [95]: data = ts.get_monthly_adjusted('MSFT')
data
```

```
Out[95]: (
           1. open  2. high  3. low  4. close  5. adjusted close \
date
2021-10-08  282.1217  296.6409  280.25   294.85         294.8500
2021-09-30  302.8650  305.3200  281.62   281.92         281.9200
2021-08-31  286.3600  305.8400  283.74   301.88         301.8800
2021-07-30  269.6100  290.1500  269.60   284.91         284.3623
2021-06-30  251.2300  271.6500  243.00   270.90         270.3792
...
2000-04-28   94.4400   96.5000   65.00    69.75          22.1056
2000-03-31   89.6200  115.0000   88.94   106.25          33.6734
2000-02-29   98.5000  110.0000   88.12    89.37          28.3237
2000-01-31  117.3700  118.6200   94.87    97.87          31.0176
1999-12-31   91.0600  119.9400   90.87   116.75          37.0012

           6. volume  7. dividend amount
date
2021-10-08  1.525488e+08             0.00
2021-09-30  5.029312e+08             0.00
2021-08-31  4.403603e+08             0.56
2021-07-30  5.223030e+08             0.00
2021-06-30  5.083889e+08             0.00
...
2000-04-28  1.129073e+09             0.00
2000-03-31  1.014094e+09             0.00
2000-02-29  6.672438e+08             0.00
2000-01-31  6.374376e+08             0.00
1999-12-31  6.304889e+08             0.00

[263 rows x 7 columns],
{'1. Information': 'Monthly Adjusted Prices and Volumes',
 '2. Symbol': 'MSFT',
 '3. Last Refreshed': '2021-10-08',
 '4. Time Zone': 'US/Eastern'})
```

```
In [96]: data[0]
```

```
Out[96]:
```

	1. open	2. high	3. low	4. close	5. adjusted close	6. volume	7. dividend amount
date							
2021-10-08	282.1217	296.6409	280.25	294.85	294.8500	1.525488e+08	0.00
2021-09-30	302.8650	305.3200	281.62	281.92	281.9200	5.029312e+08	0.00
2021-08-31	286.3600	305.8400	283.74	301.88	301.8800	4.403603e+08	0.56
2021-07-30	269.6100	290.1500	269.60	284.91	284.3623	5.223030e+08	0.00
2021-06-30	251.2300	271.6500	243.00	270.90	270.3792	5.083889e+08	0.00
...
2000-04-28	94.4400	96.5000	65.00	69.75	22.1056	1.129073e+09	0.00
2000-03-31	89.6200	115.0000	88.94	106.25	33.6734	1.014094e+09	0.00

	1. open	2. high	3. low	4. close	5. adjusted close	6. volume	7. dividend amount
date							
2000-02-29	98.5000	110.0000	88.12	89.37	28.3237	6.672438e+08	0.00
2000-01-31	117.3700	118.6200	94.87	97.87	31.0176	6.374376e+08	0.00
1999-12-31	91.0600	119.9400	90.87	116.75	37.0012	6.304889e+08	0.00

263 rows × 7 columns

In [97]: data[1]

Out[97]: {'1. Information': 'Monthly Adjusted Prices and Volumes',
 '2. Symbol': 'MSFT',
 '3. Last Refreshed': '2021-10-08',
 '4. Time Zone': 'US/Eastern'}

In [98]: data[0].head()

Out[98]:

	1. open	2. high	3. low	4. close	5. adjusted close	6. volume	7. dividend amount
date							
2021-10-08	282.1217	296.6409	280.25	294.85	294.8500	152548781.0	0.00
2021-09-30	302.8650	305.3200	281.62	281.92	281.9200	502931199.0	0.00
2021-08-31	286.3600	305.8400	283.74	301.88	301.8800	440360333.0	0.56
2021-07-30	269.6100	290.1500	269.60	284.91	284.3623	522303043.0	0.00
2021-06-30	251.2300	271.6500	243.00	270.90	270.3792	508388858.0	0.00

In [99]: ts = TimeSeries(key = API_key, output_format = 'JSON')
 data = ts.get_monthly_adjusted('MSFT')
 data

Out[99]: ({'2021-10-08': {'1. open': '282.1217',
 '2. high': '296.6409',
 '3. low': '280.2500',
 '4. close': '294.8500',
 '5. adjusted close': '294.8500',
 '6. volume': '152548781',
 '7. dividend amount': '0.0000'},
 '2021-09-30': {'1. open': '302.8650',
 '2. high': '305.3200',
 '3. low': '281.6200',
 '4. close': '281.9200',
 '5. adjusted close': '281.9200',
 '6. volume': '502931199',
 '7. dividend amount': '0.0000'},
 '2021-08-31': {'1. open': '286.3600',

```
'2. high': '305.8400',
'3. low': '283.7400',
'4. close': '301.8800',
'5. adjusted close': '301.8800',
'6. volume': '440360333',
'7. dividend amount': '0.5600'},
'2021-07-30': {'1. open': '269.6100',
'2. high': '290.1500',
'3. low': '269.6000',
'4. close': '284.9100',
'5. adjusted close': '284.3623',
'6. volume': '522303043',
'7. dividend amount': '0.0000'},
'2021-06-30': {'1. open': '251.2300',
'2. high': '271.6500',
'3. low': '243.0000',
'4. close': '270.9000',
'5. adjusted close': '270.3792',
'6. volume': '508388858',
'7. dividend amount': '0.0000'},
'2021-05-28': {'1. open': '253.4000',
'2. high': '254.3500',
'3. low': '238.0700',
'4. close': '249.6800',
'5. adjusted close': '249.2000',
'6. volume': '495089530',
'7. dividend amount': '0.5600'},
'2021-04-30': {'1. open': '238.4700',
'2. high': '263.1900',
'3. low': '238.0501',
'4. close': '252.1800',
'5. adjusted close': '251.1168',
'6. volume': '568698272',
'7. dividend amount': '0.0000'},
'2021-03-31': {'1. open': '235.9000',
'2. high': '241.0500',
'3. low': '224.2600',
'4. close': '235.7700',
'5. adjusted close': '234.7760',
'6. volume': '724981506',
'7. dividend amount': '0.0000'},
'2021-02-26': {'1. open': '235.0600',
'2. high': '246.1300',
'3. low': '227.8800',
'4. close': '232.3800',
'5. adjusted close': '231.4002',
'6. volume': '489396912',
'7. dividend amount': '0.5600'},
'2021-01-29': {'1. open': '222.5300',
'2. high': '242.6400',
'3. low': '211.9400',
'4. close': '231.9600',
'5. adjusted close': '230.4535',
'6. volume': '647897096',
'7. dividend amount': '0.0000'},
'2020-12-31': {'1. open': '214.5100',
'2. high': '227.1800',
'3. low': '209.1100',
'4. close': '222.4200',
'5. adjusted close': '220.9755',
'6. volume': '593966967',
'7. dividend amount': '0.0000'},
'2020-11-30': {'1. open': '204.2900',
'2. high': '228.1200',
'3. low': '200.1200',
'4. close': '214.0700',
'5. adjusted close': '212.6797',
'6. volume': '573325190',
'7. dividend amount': '0.5600'},
```

```
'2020-10-30': {'1. open': '213.4900',
'2. high': '225.2100',
'3. low': '199.6200',
'4. close': '202.4700',
'5. adjusted close': '200.6228',
'6. volume': '631674298',
'7. dividend amount': '0.0000'},
'2020-09-30': {'1. open': '225.5100',
'2. high': '232.8600',
'3. low': '196.2500',
'4. close': '210.3300',
'5. adjusted close': '208.4111',
'6. volume': '768528897',
'7. dividend amount': '0.0000'},
'2020-08-31': {'1. open': '211.5200',
'2. high': '231.1500',
'3. low': '203.1400',
'4. close': '225.5300',
'5. adjusted close': '223.4724',
'6. volume': '692382980',
'7. dividend amount': '0.5100'},
'2020-07-31': {'1. open': '203.1400',
'2. high': '216.3800',
'3. low': '197.5100',
'4. close': '205.0100',
'5. adjusted close': '202.6468',
'6. volume': '769842002',
'7. dividend amount': '0.0000'},
'2020-06-30': {'1. open': '182.5400',
'2. high': '204.4000',
'3. low': '181.3500',
'4. close': '203.5100',
'5. adjusted close': '201.1641',
'6. volume': '765012029',
'7. dividend amount': '0.0000'},
'2020-05-29': {'1. open': '175.8000',
'2. high': '187.5100',
'3. low': '173.8000',
'4. close': '183.2500',
'5. adjusted close': '181.1376',
'6. volume': '688873081',
'7. dividend amount': '0.5100'},
'2020-04-30': {'1. open': '153.0000',
'2. high': '180.4000',
'3. low': '150.3600',
'4. close': '179.2100',
'5. adjusted close': '176.6589',
'6. volume': '984810925',
'7. dividend amount': '0.0000'},
'2020-03-31': {'1. open': '165.3100',
'2. high': '175.0000',
'3. low': '132.5200',
'4. close': '157.7100',
'5. adjusted close': '155.4650',
'6. volume': '1612954386',
'7. dividend amount': '0.0000'},
'2020-02-28': {'1. open': '170.4300',
'2. high': '190.7000',
'3. low': '152.0000',
'4. close': '162.0100',
'5. adjusted close': '159.7038',
'6. volume': '887894931',
'7. dividend amount': '0.5100'},
'2020-01-31': {'1. open': '158.7800',
'2. high': '174.0500',
'3. low': '156.5100',
'4. close': '170.2300',
'5. adjusted close': '167.3510',
'6. volume': '555989763',
```

```
'7. dividend amount': '0.0000'},
'2019-12-31': {'1. open': '151.8100',
'2. high': '159.5500',
'3. low': '146.6500',
'4. close': '157.7000',
'5. adjusted close': '155.0329',
'6. volume': '452664147',
'7. dividend amount': '0.0000'},
'2019-11-29': {'1. open': '144.2600',
'2. high': '152.5000',
'3. low': '142.9700',
'4. close': '151.3800',
'5. adjusted close': '148.8198',
'6. volume': '393028043',
'7. dividend amount': '0.5100'},
'2019-10-31': {'1. open': '139.6600',
'2. high': '145.6700',
'3. low': '133.2200',
'4. close': '143.3700',
'5. adjusted close': '140.4665',
'6. volume': '560654410',
'7. dividend amount': '0.0000'},
'2019-09-30': {'1. open': '136.6100',
'2. high': '142.3700',
'3. low': '134.5100',
'4. close': '139.0300',
'5. adjusted close': '136.2144',
'6. volume': '477645820',
'7. dividend amount': '0.0000'},
'2019-08-30': {'1. open': '137.0000',
'2. high': '140.9400',
'3. low': '130.7800',
'4. close': '137.8600',
'5. adjusted close': '135.0681',
'6. volume': '585509525',
'7. dividend amount': '0.4600'},
'2019-07-31': {'1. open': '136.6300',
'2. high': '141.6800',
'3. low': '134.6700',
'4. close': '136.2700',
'5. adjusted close': '133.0535',
'6. volume': '484553299',
'7. dividend amount': '0.0000'},
'2019-06-28': {'1. open': '123.8500',
'2. high': '138.4000',
'3. low': '119.0100',
'4. close': '133.9600',
'5. adjusted close': '130.7980',
'6. volume': '508324437',
'7. dividend amount': '0.0000'},
'2019-05-31': {'1. open': '130.5300',
'2. high': '130.6500',
'3. low': '123.0400',
'4. close': '123.6800',
'5. adjusted close': '120.7606',
'6. volume': '547218448',
'7. dividend amount': '0.4600'},
'2019-04-30': {'1. open': '118.9500',
'2. high': '131.3700',
'3. low': '118.1000',
'4. close': '130.6000',
'5. adjusted close': '127.0535',
'6. volume': '433157868',
'7. dividend amount': '0.0000'},
'2019-03-29': {'1. open': '112.8900',
'2. high': '120.8200',
'3. low': '108.8000',
'4. close': '117.9400',
'5. adjusted close': '114.7373',
```



```
'6. volume': '589045341',
'7. dividend amount': '0.0000'},
'2019-02-28': {'1. open': '103.7800',
'2. high': '113.2400',
'3. low': '102.3500',
'4. close': '112.0300',
'5. adjusted close': '108.9878',
'6. volume': '469095970',
'7. dividend amount': '0.4600'},
'2019-01-31': {'1. open': '99.5500',
'2. high': '107.9000',
'3. low': '97.2000',
'4. close': '104.4300',
'5. adjusted close': '101.1599',
'6. volume': '714204787',
'7. dividend amount': '0.0000'},
'2018-12-31': {'1. open': '113.0000',
'2. high': '113.4200',
'3. low': '93.9600',
'4. close': '101.5700',
'5. adjusted close': '98.3894',
'6. volume': '944287635',
'7. dividend amount': '0.0000'},
'2018-11-30': {'1. open': '107.0500',
'2. high': '112.2400',
'3. low': '99.3500',
'4. close': '110.8900',
'5. adjusted close': '107.4176',
'6. volume': '720228643',
'7. dividend amount': '0.4600'},
'2018-10-31': {'1. open': '114.7500',
'2. high': '116.1800',
'3. low': '100.1100',
'4. close': '106.8100',
'5. adjusted close': '103.0139',
'6. volume': '927547942',
'7. dividend amount': '0.0000'},
'2018-09-28': {'1. open': '110.8500',
'2. high': '115.2900',
'3. low': '107.2300',
'4. close': '114.3700',
'5. adjusted close': '110.3052',
'6. volume': '480255674',
'7. dividend amount': '0.0000'},
'2018-08-31': {'1. open': '106.0300',
'2. high': '112.7800',
'3. low': '104.8400',
'4. close': '112.3300',
'5. adjusted close': '108.3378',
'6. volume': '456630721',
'7. dividend amount': '0.4200'},
'2018-07-31': {'1. open': '98.1000',
'2. high': '111.1500',
'3. low': '98.0000',
'4. close': '106.0800',
'5. adjusted close': '101.9123',
'6. volume': '569501573',
'7. dividend amount': '0.0000'},
'2018-06-29': {'1. open': '99.2800',
'2. high': '102.6900',
'3. low': '97.2600',
'4. close': '98.6100',
'5. adjusted close': '94.7358',
'6. volume': '602585341',
'7. dividend amount': '0.0000'},
'2018-05-31': {'1. open': '93.2100',
'2. high': '99.9900',
'3. low': '92.4500',
'4. close': '98.8400',
```

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'5. adjusted close': '94.9567',
'6. volume': '509418119',
'7. dividend amount': '0.4200'},
'2018-04-30': {'1. open': '90.4700',
'2. high': '97.9000',
'3. low': '87.5100',
'4. close': '93.5200',
'5. adjusted close': '89.4590',
'6. volume': '668258570',
'7. dividend amount': '0.0000'},
'2018-03-29': {'1. open': '93.9900',
'2. high': '97.2400',
'3. low': '87.0800',
'4. close': '91.2700',
'5. adjusted close': '87.3067',
'6. volume': '732866406',
'7. dividend amount': '0.0000'},
'2018-02-28': {'1. open': '94.7900',
'2. high': '96.0700',
'3. low': '83.8300',
'4. close': '93.7700',
'5. adjusted close': '89.6982',
'6. volume': '690287596',
'7. dividend amount': '0.4200'},
'2018-01-31': {'1. open': '86.1300',
'2. high': '95.4500',
'3. low': '85.5000',
'4. close': '95.0100',
'5. adjusted close': '90.4659',
'6. volume': '543377322',
'7. dividend amount': '0.0000'},
'2017-12-29': {'1. open': '83.6000',
'2. high': '87.4999',
'3. low': '80.7000',
'4. close': '85.5400',
'5. adjusted close': '81.4488',
'6. volume': '447828256',
'7. dividend amount': '0.0000'},
'2017-11-30': {'1. open': '83.6800',
'2. high': '85.0600',
'3. low': '82.2400',
'4. close': '84.1700',
'5. adjusted close': '80.1444',
'6. volume': '415711970',
'7. dividend amount': '0.4200'},
'2017-10-31': {'1. open': '74.7100',
'2. high': '86.2000',
'3. low': '73.7100',
'4. close': '83.1800',
'5. adjusted close': '78.8028',
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