data_challenge

August 6, 2021

[ ]:

```
```

0.1 *PART 1*

Bank of America (BAC), Goldman Sachs (GS), JpMorgan Chase(JPM), Morgan Stanley(MS), Wells Fargo(WFC) since 2000 to date.

2. Install and load API

[ ]:

```
!pip install yfinance
import yfinance as yf
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns
from IPython.display import display
```

```
Requirement already satisfied: yfinance in /usr/local/lib/python3.7/dist-
packages (0.1.63)
Requirement already satisfied: requests>=2.20 in /usr/local/lib/python3.7/dist-
packages (from yfinance) (2.23.0)
Requirement already satisfied: lxml>=4.5.1 in /usr/local/lib/python3.7/dist-
packages (from yfinance) (4.6.3)
Requirement already satisfied: multitasking>=0.0.7 in /usr/local/lib/python3.7
/dist-packages (from yfinance) (0.0.9)
Requirement already satisfied: pandas>=0.24 in /usr/local/lib/python3.7/dist-
packages (from yfinance) (1.1.5)
Requirement already satisfied: numpy>=1.15 in /usr/local/lib/python3.7/dist-
packages (from yfinance) (1.19.5)
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/dist-
packages (from pandas>=0.24->yfinance) (2018.9)
Requirement already satisfied: python-dateutil>=2.7.3 in
/usr/local/lib/python3.7/dist-packages (from pandas>=0.24->yfinance) (2.8.1)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/dist-
packages (from python-dateutil>=2.7.3->pandas>=0.24->yfinance) (1.15.0)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7
/dist-packages (from requests>=2.20->yfinance) (2021.5.30)
```

```
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in
/usr/local/lib/python3.7/dist-packages (from requests>=2.20->yfinance) (1.24.3)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-
packages (from requests>=2.20->yfinance) (2.10)
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7
/dist-packages (from requests>=2.20->yfinance) (3.0.4)
```

3. Create a dataframe for all banks and load them.

[ ]:

```
tickers = ["BAC", "GS", "JPM", "MS", "WFC"]
stockDF = yf.download(tickers, start="2000-01-01")
stockDF
```

```
[*********************100%***********************]  5 of 5 completed
```

[ ]:

```
            Adj Close                                ...     Volume                      
                  BAC         GS         JPM        ...        JPM       MS        WFC
Date                                                 ...                                 
2000-01-03  13.893577   68.596458   25.715622  ...   12019200  5309000   9037000
2000-01-04  13.068926   64.275795   25.151373  ...   11723400  6234400  15237200
2000-01-05  13.212340   61.265915   24.996122  ...    8714550  7744200   8228200
2000-01-06  14.341758   63.887451   25.351000  ...    8369250  6586000   8326800
2000-01-07  13.965284   64.130188   25.816750  ...    6571950  6324800   7711200
...               ...         ...         ...  ...        ...      ...       ...
2021-07-30  38.360001  374.880005  151.779999  ...    9804600  8320200  25792500
2021-08-02  37.959999  378.190002  151.169998  ...   10203200  9409600  23960700
2021-08-03  38.549999  380.359985  152.889999  ...   10386600  7042600  24041400
2021-08-04  38.270000  377.859985  151.240005  ...   10154000  7137500  22175500
2021-08-05  38.904999  382.709412  153.005005  ...    4188720  2525780  13613478

[5433 rows x 30 columns]
```

[ ]:

```
## Bank of Amercia stock info
BAC = stockDF.xs('BAC', level=1, axis=1)

##  Goldman Sachs stock info
GS =  stockDF.xs('GS', level=1, axis=1)

## JpMorgan Chase
JPM = stockDF.xs('JPM', level=1, axis=1)

## Morgan Stanley
MS = stockDF.xs('MS', level=1, axis=1)

## Wells Fargo
WFC = stockDF.xs('WFC', level=1, axis=1)
```

[ ]:

```
WFC
```

```
[ ]:              Adj Close      Close       High        Low       Open    Volume
     Date
     2000-01-03  10.768756  19.562500  20.187500  19.000000  20.156250   9037000
     2000-01-04  10.235478  18.593750  18.843750  18.000000  18.625000  15237200
     2000-01-05  10.132262  18.406250  18.875000  18.031250  18.500000   8228200
     2000-01-06  10.579529  19.218750  19.500000  18.468750  18.531250   8326800
     2000-01-07  10.768756  19.562500  19.843750  19.281250  19.625000   7711200
     ...               ...        ...        ...        ...        ...       ...
     2021-07-30  45.939999  45.939999  46.849998  45.730000  46.259998  25792500
     2021-08-02  45.790001  45.790001  46.810001  45.570000  46.040001  23960700
     2021-08-03  46.830002  46.830002  46.939999  45.110001  45.980000  24041400
     2021-08-04  46.150002  46.150002  46.970001  46.040001  46.270000  22175500
     2021-08-05  46.650002  46.650002  46.904999  46.009998  46.049999  13613478

     [5433 rows x 6 columns]
```

```
[ ]: closeDF = pd.DataFrame(BAC['Close'])
     closeDF['GS'] =  pd.DataFrame(GS['Close'])
     closeDF['JPM'] =  pd.DataFrame(JPM['Close'])
     closeDF['MS'] =  pd.DataFrame(MS['Close'])
     closeDF['WFC'] =  pd.DataFrame(WFC['Close'])
     closeDF.columns = tickers
     closeDF
```

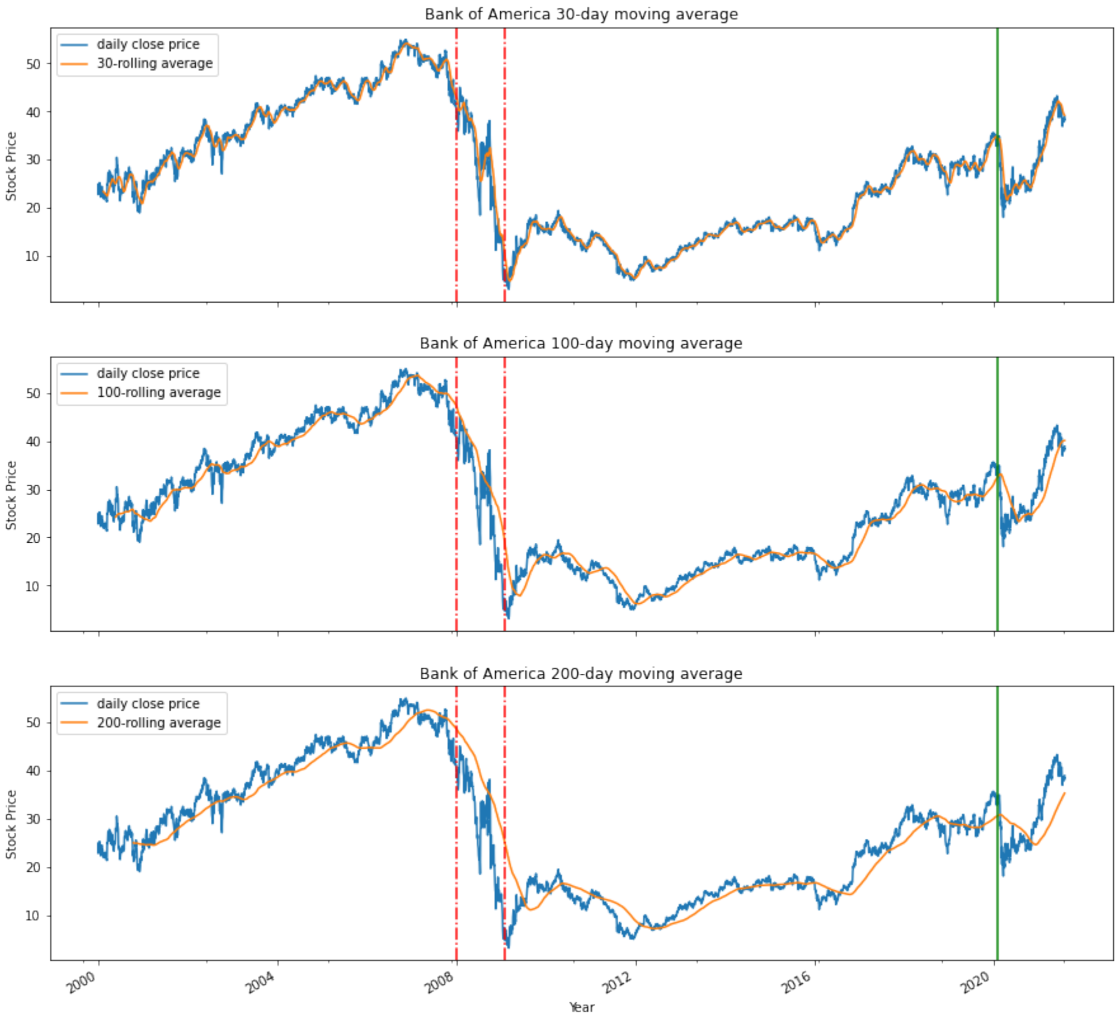
```
[ ]:                    BAC          GS         JPM         MS        WFC
     Date
     2000-01-03  24.218750   88.312500   48.583332  67.500000  19.562500
     2000-01-04  22.781250   82.750000   47.250000  62.500000  18.593750
     2000-01-05  23.031250   78.875000   46.958332  60.218750  18.406250
     2000-01-06  25.000000   82.250000   47.625000  61.375000  19.218750
     2000-01-07  24.343750   82.562500   48.500000  63.281250  19.562500
     ...               ...         ...         ...        ...        ...
     2021-07-30  38.360001  374.880005  151.779999  95.980003  45.939999
     2021-08-02  37.959999  378.190002  151.169998  96.230003  45.790001
     2021-08-03  38.549999  380.359985  152.889999  96.599998  46.830002
     2021-08-04  38.270000  377.859985  151.240005  96.290001  46.150002
     2021-08-05  38.904999  382.709412  153.005005  97.504997  46.650002

     [5433 rows x 5 columns]
```

0.2 *Part 2*

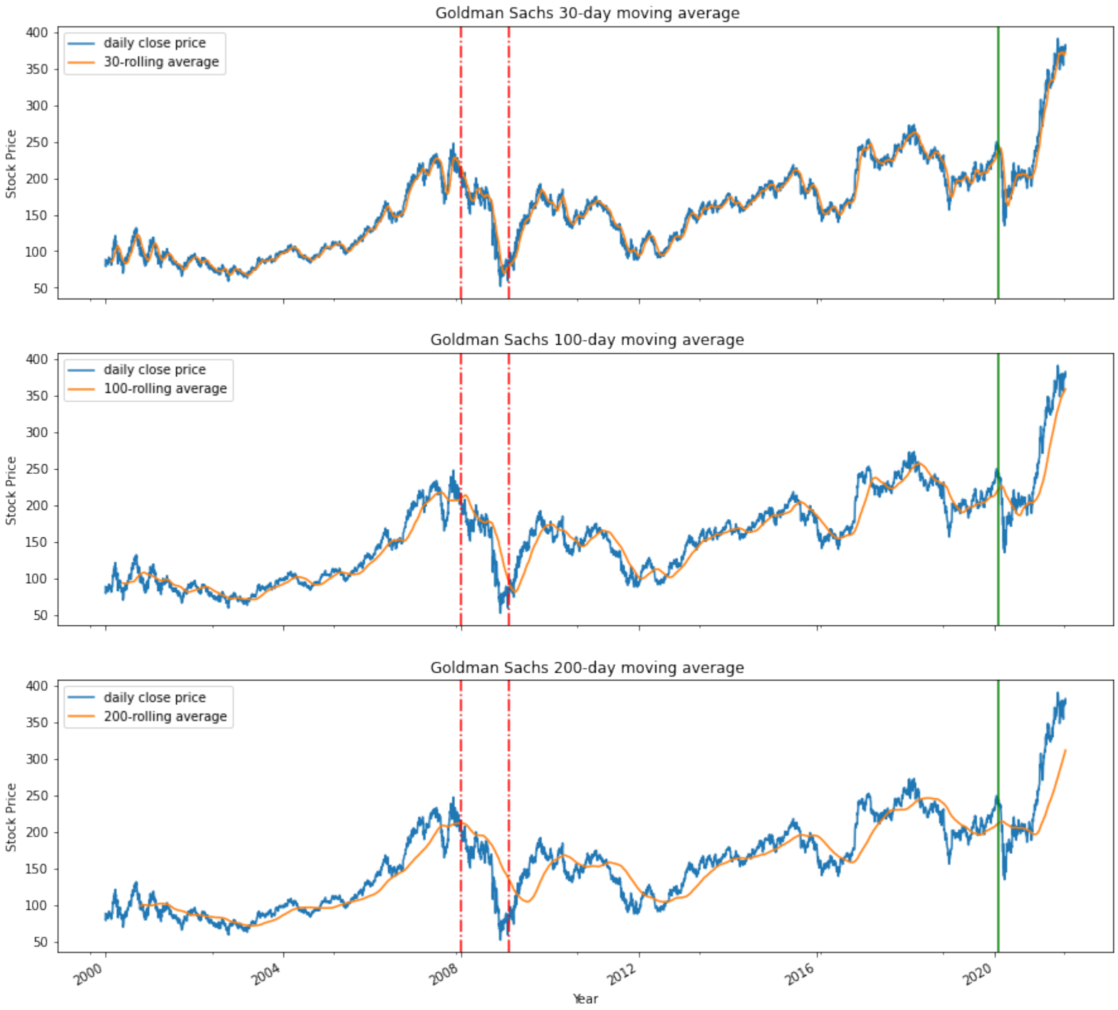
4. Plot moving average (30 day, 100 day, and 200 day) and daily close price for each bank.

```
[ ]: dayList = [30, 100, 200]


     fig, ax = plt.subplots(3, 1, figsize=(15,15),
                            sharex=True)
```

```python

for index, day in enumerate(dayList):
  BAC['Close'].plot(ax=ax[index])
  BAC['Close'].rolling(day).mean().plot(ax=ax[index])
  ax[index].set_title(f'Bank of America {day}-day moving average')
  ax[index].axvline( '2008-01-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2009-02-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2020-02-01', color="green", linestyle ="-",)
  ax[index].set_xlabel("Year")
  ax[index].set_ylabel("Stock Price")
  ax[index].legend(['daily close price', f'{day}-rolling average'])
```

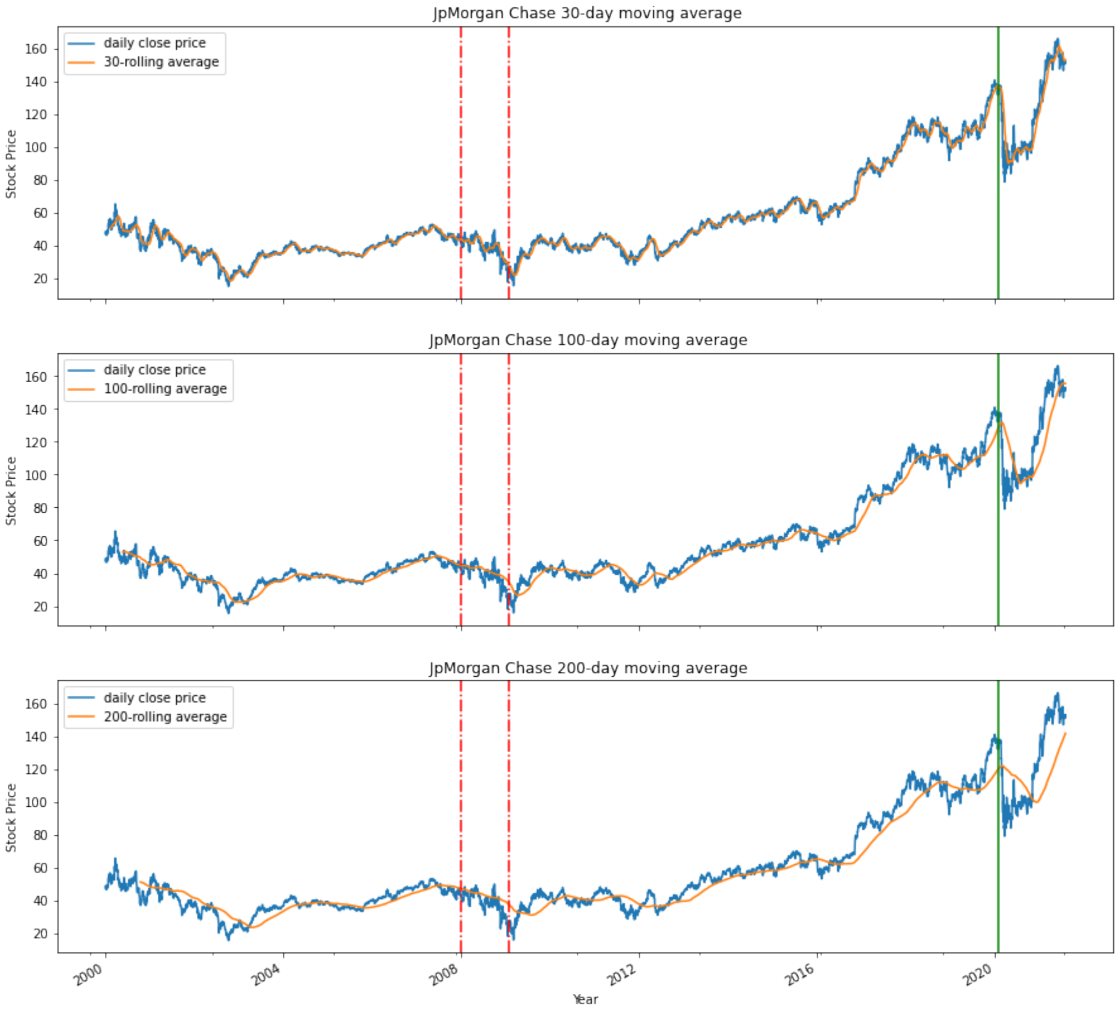


[ ]:
```python
fig, ax = plt.subplots(3, 1, figsize=(15,15),
                         sharex=True)

for index, day in enumerate(dayList):
  GS['Close'].plot(ax=ax[index])
  GS['Close'].rolling(day).mean().plot(ax=ax[index])
  ax[index].set_title(f' Goldman Sachs {day}-day moving average')
  ax[index].axvline( '2008-01-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2009-02-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2020-02-01', color="green", linestyle ="-",)
  ax[index].set_xlabel("Year")
  ax[index].set_ylabel("Stock Price")
  ax[index].legend(['daily close price', f'{day}-rolling average'])
```

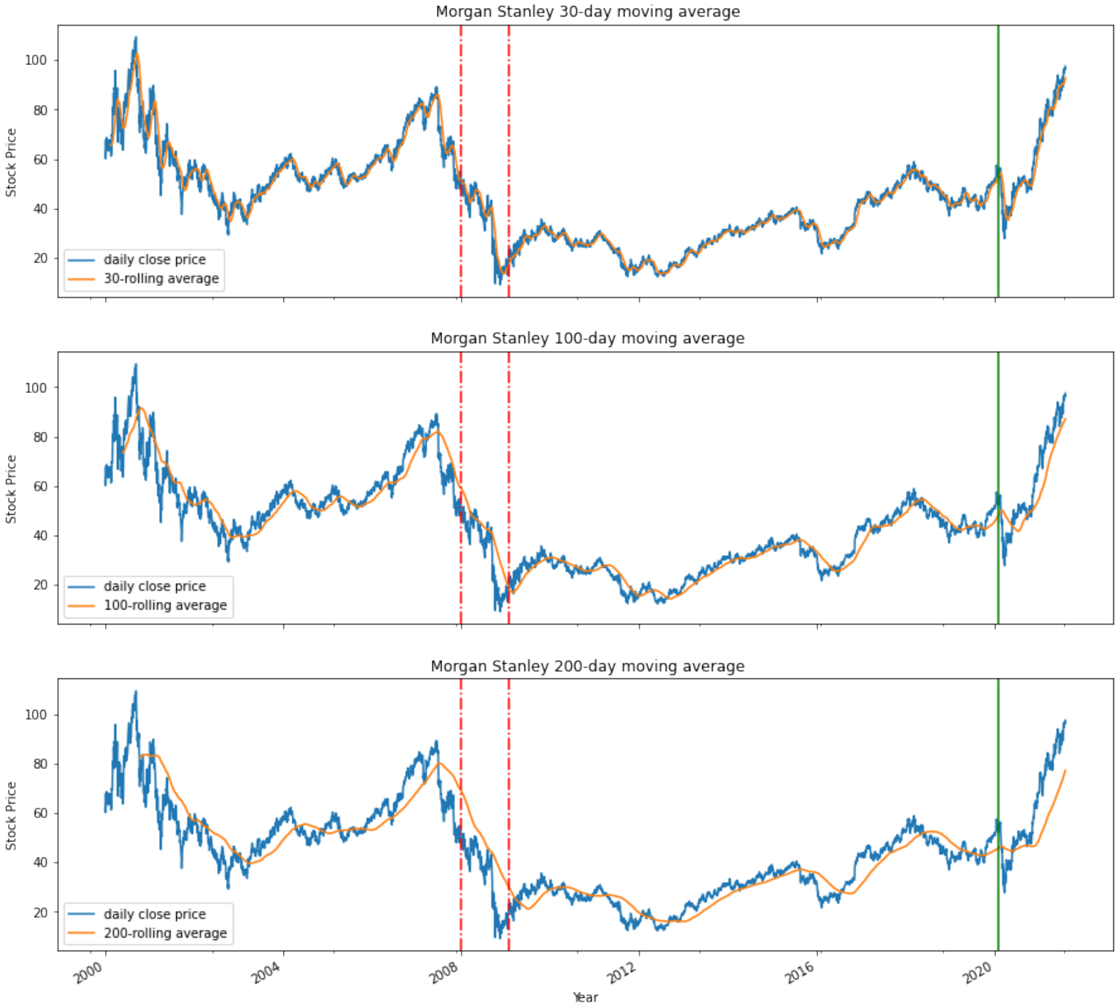


[ ]:

```
fig, ax = plt.subplots(3, 1, figsize=(15,15),
                       sharex=True)

for index, day in enumerate(dayList):
  JPM['Close'].plot(ax=ax[index])
  JPM['Close'].rolling(day).mean().plot(ax=ax[index])
  ax[index].set_title(f' JpMorgan Chase {day}-day moving average')
  ax[index].axvline( '2008-01-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2009-02-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2020-02-01', color="green", linestyle ="-",)
  ax[index].set_xlabel("Year")
  ax[index].set_ylabel("Stock Price")
  ax[index].legend(['daily close price', f'{day}-rolling average'])
```



[ ]:
```
fig, ax = plt.subplots(3, 1, figsize=(15,15),
                       sharex=True)

for index, day in enumerate(dayList):
  MS['Close'].plot(ax=ax[index])
  MS['Close'].rolling(day).mean().plot(ax=ax[index])
  ax[index].set_title(f' Morgan Stanley {day}-day moving average')
  ax[index].axvline( '2008-01-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2009-02-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2020-02-01', color="green", linestyle ="-",)
  ax[index].set_xlabel("Year")
  ax[index].set_ylabel("Stock Price")
  ax[index].legend(['daily close price', f'{day}-rolling average'])
```


Morgan Stanley 30-day moving average

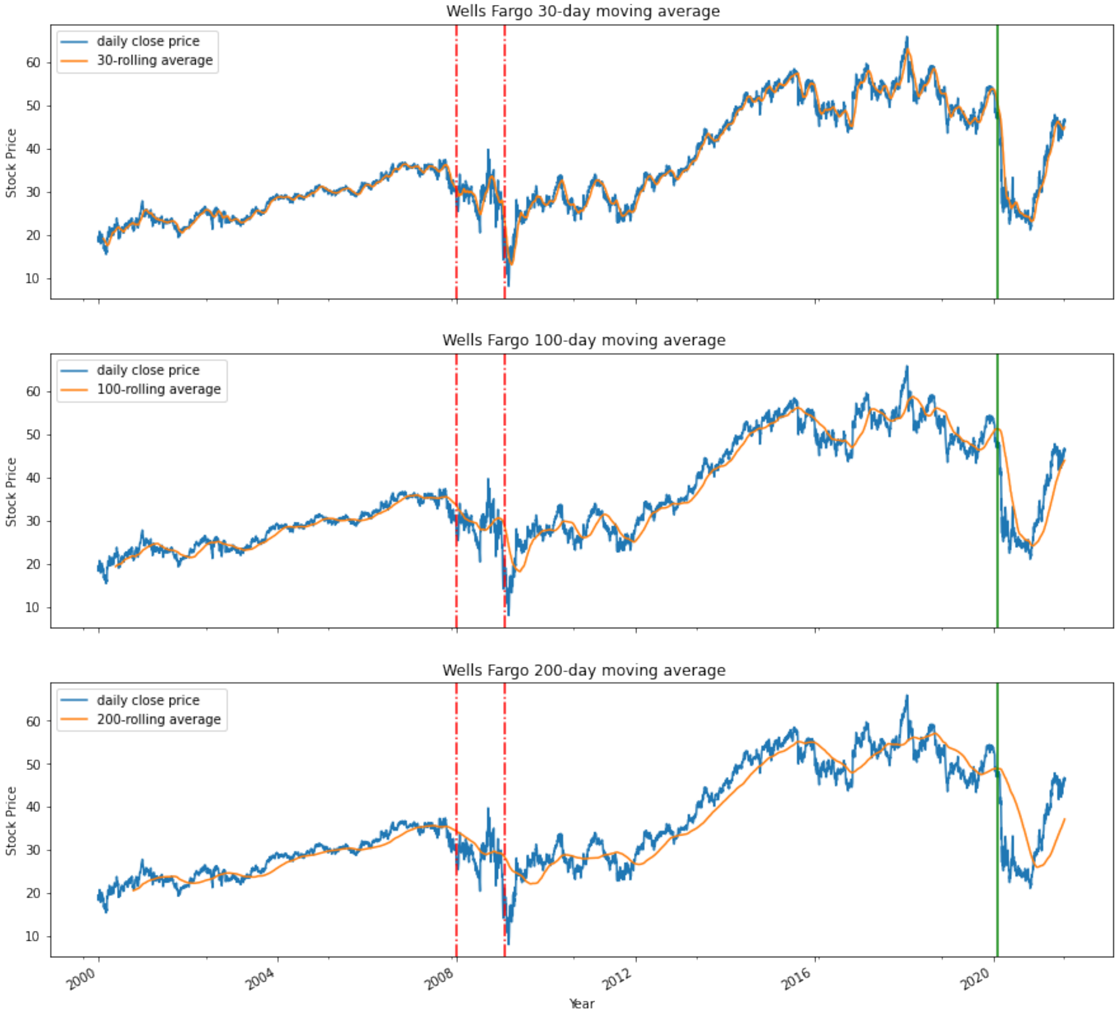
Morgan Stanley 100-day moving average

Morgan Stanley 200-day moving average

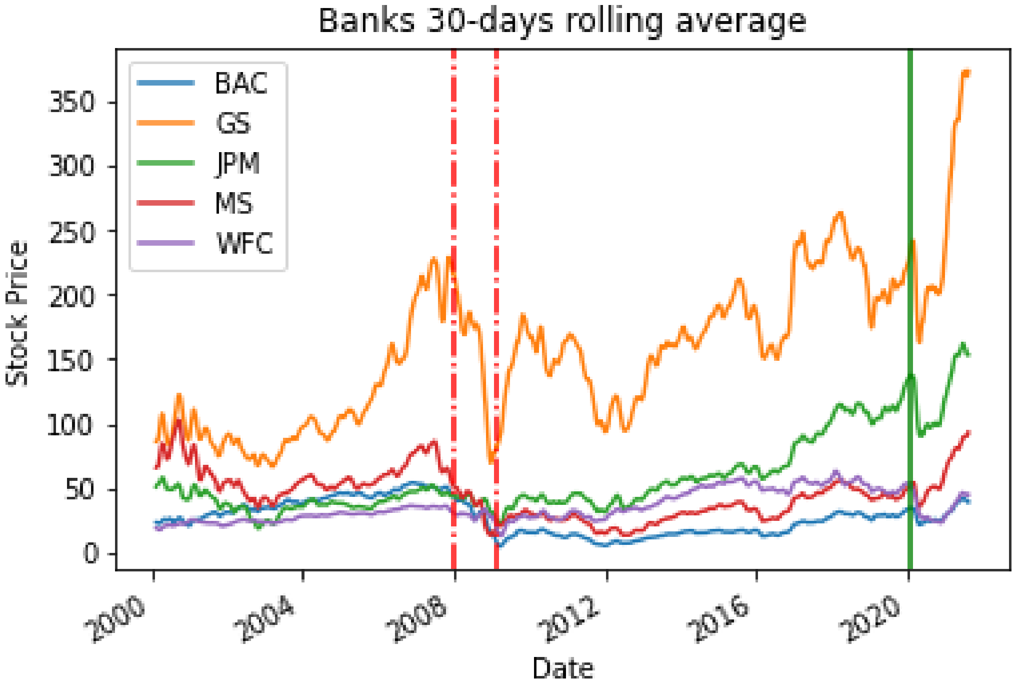
[ ]:

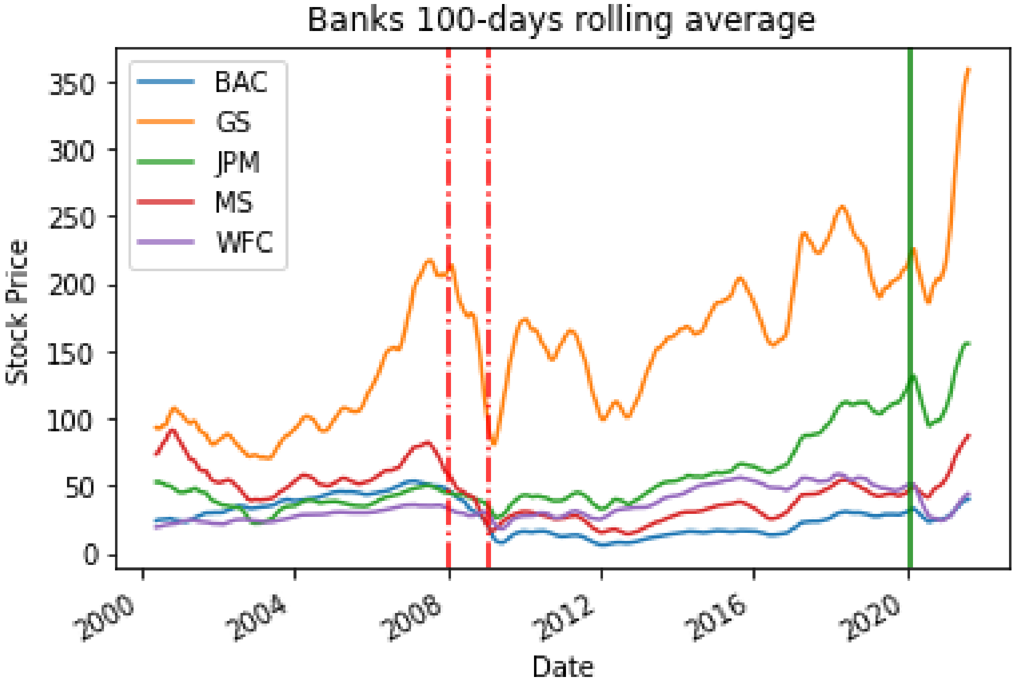
```
fig, ax = plt.subplots(3, 1, figsize=(15,15),
                       sharex=True)

for index, day in enumerate(dayList):
  WFC['Close'].plot(ax=ax[index])
  WFC['Close'].rolling(day).mean().plot(ax=ax[index])
  ax[index].set_title(f' Wells Fargo {day}-day moving average')
  ax[index].axvline( '2008-01-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2009-02-01', color="red", linestyle ="-.",)
  ax[index].axvline( '2020-02-01', color="green", linestyle ="-",)
```

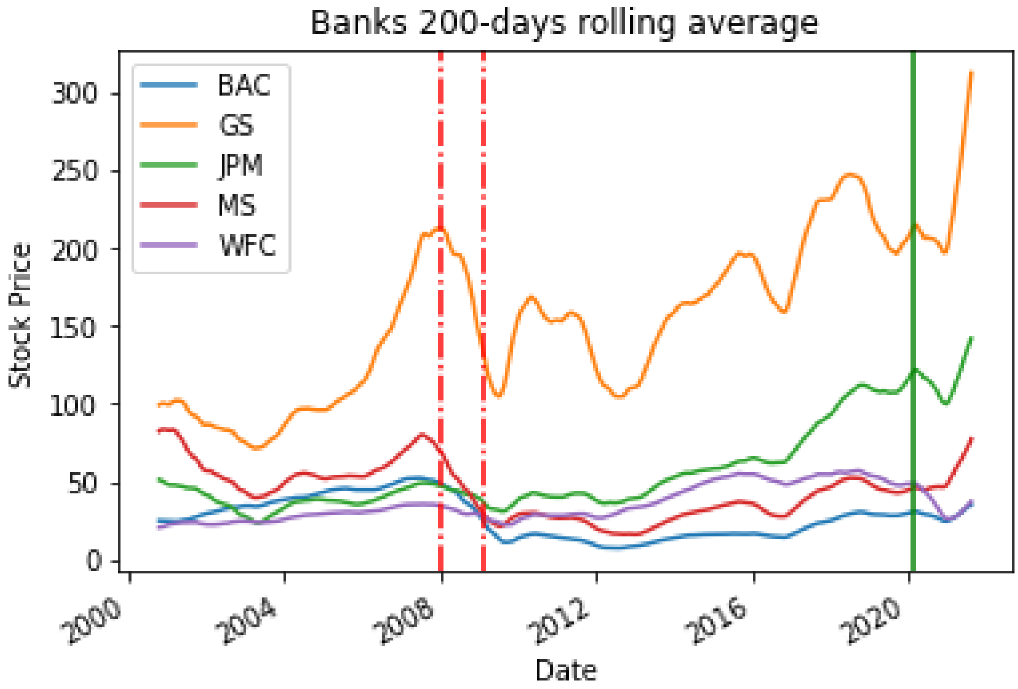
```
    ax[index].set_xlabel("Year")
    ax[index].set_ylabel("Stock Price")
    ax[index].legend(['daily close price', f'{day}-rolling average'])
```



```
[ ]: for index, day in enumerate(dayList):
         closeDF.rolling(day).mean().plot()
         plt.axvline( '2008-01-01', color="red", linestyle ="-.",)
         plt.axvline( '2009-02-01', color="red", linestyle ="-.",)
         plt.axvline( '2020-02-01', color="green", linestyle ="-",)
         plt.ylabel("Stock Price")
         plt.title(f"Banks {day}-days rolling average")
```


Banks 30-days rolling average
BAC
GS
JPM
MS
WFC
Stock Price
350
300
250
200
150
100
50
0
2000
2004
2008
2012
2016
2020
Date


Banks 100-days rolling average
BAC
GS
JPM
MS
WFC
Stock Price
350
300
250
200
150
100
50
0
2000
2004
2008
2012
2016
2020
Date



5. Calculate daily rate of change, find ROC for all banks

[ ]:

```
rocDF = pd.DataFrame(BAC['Close'].pct_change())
rocDF['GS'] =  pd.DataFrame(GS['Close'].pct_change())
rocDF['JPM'] =  pd.DataFrame(JPM['Close'].pct_change())
rocDF['MS'] =  pd.DataFrame(MS['Close'].pct_change())
rocDF['WFC'] =  pd.DataFrame(WFC['Close'].pct_change())
rocDF.columns = tickers
rocDF
```

[ ]:

```
                 BAC        GS       JPM        MS       WFC
Date
2000-01-03       NaN       NaN       NaN       NaN       NaN
2000-01-04 -0.059355 -0.062987 -0.027444 -0.074074 -0.049521
2000-01-05  0.010974 -0.046828 -0.006173 -0.036500 -0.010084
2000-01-06  0.085482  0.042789  0.014197  0.019201  0.044143
2000-01-07 -0.026250  0.003799  0.018373  0.031059  0.017886
...              ...       ...       ...       ...       ...
2021-07-30 -0.008273 -0.007072 -0.007974 -0.003116 -0.012043
2021-08-02 -0.010428  0.008829 -0.004019  0.002605 -0.003265
2021-08-03  0.015543  0.005738  0.011378  0.003845  0.022712
2021-08-04 -0.007263 -0.006573 -0.010792 -0.003209 -0.014521
2021-08-05  0.016593  0.012834  0.011670  0.012618  0.010834

[5433 rows x 5 columns]
```

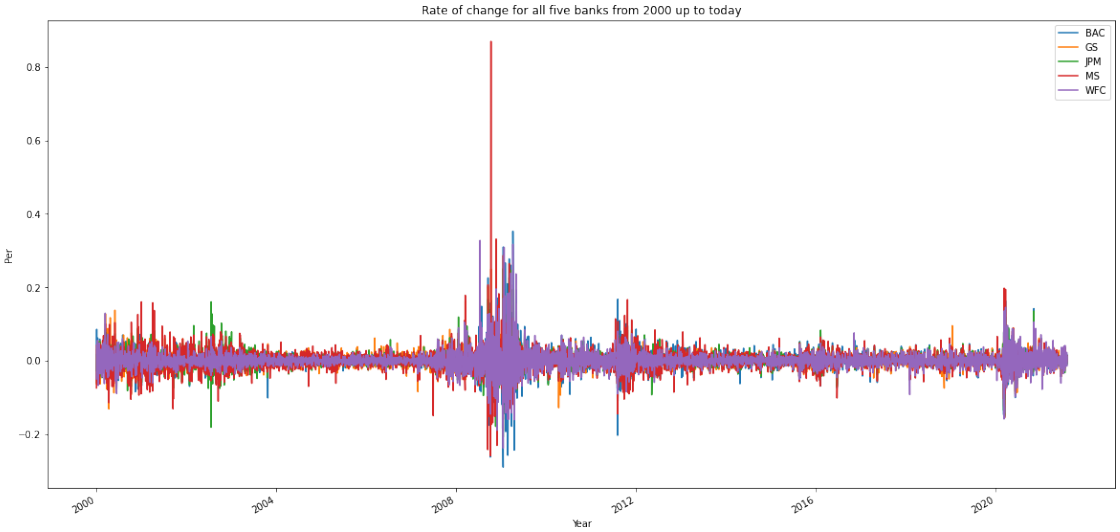
6. Show ROC for all banks on the same Plot

[ ]:

```
rocDF.plot(figsize=(20,10))
plt.title("Rate of change for all five banks from 2000 up to today")
plt.xlabel("Year")
plt.ylabel("Per")
```

[ ]:

```
Text(0, 0.5, 'Per')
```



0.3 *Part 4*

7. Explore days with highest change (idxmax and idxmin)

[ ]:

```
# # rocDF['GS'].idxmax().date()
# rocDF.loc[(rocDF['GS'].idxmax(),"GS")]



def bankIDX(name,df):
  lowDate = df[name].idxmin()
  lowValue = df.loc[(lowDate,name)]
  highDate = df[name].idxmax()
  highValue = df.loc[(highDate,name)]
  dict = {'' : ['Highest', 'Lowest'],
          'Days' : [highDate, lowDate],
          'Values' : [highValue, lowValue]}
  df = pd.DataFrame(dict)
  display(df)
```

7.1 Bank of America

[ ]:

```
bankIDX("BAC",rocDF)
```

```
                Days    Values
0  Highest 2009-04-09  0.352691
1   Lowest 2009-01-20 -0.289694
```

7.2 Goldman Sachs

[ ]:

```
bankIDX("GS",rocDF)
```

```
                Days    Values
0  Highest 2008-11-24  0.264678
1   Lowest 2009-01-20 -0.189596
```

7.3 JPMorgan Chase

[ ]:

```
bankIDX("JPM",rocDF)
```

```
                Days    Values
0  Highest 2009-01-21  0.250967
1   Lowest 2009-01-20 -0.207274
```

7.4 Morgan Stanley

[ ]:

```
bankIDX("MS",rocDF)
```

```
                Days    Values
0  Highest 2008-10-13  0.869835
1   Lowest 2008-10-09 -0.258929
```

7.5 Wells Fargo

[ ]:

```
bankIDX("WFC",rocDF)
```

```
                Days    Values
0  Highest 2008-07-16  0.327645
1   Lowest 2009-01-20 -0.238223
```

8. Tell a story => Financial crisis

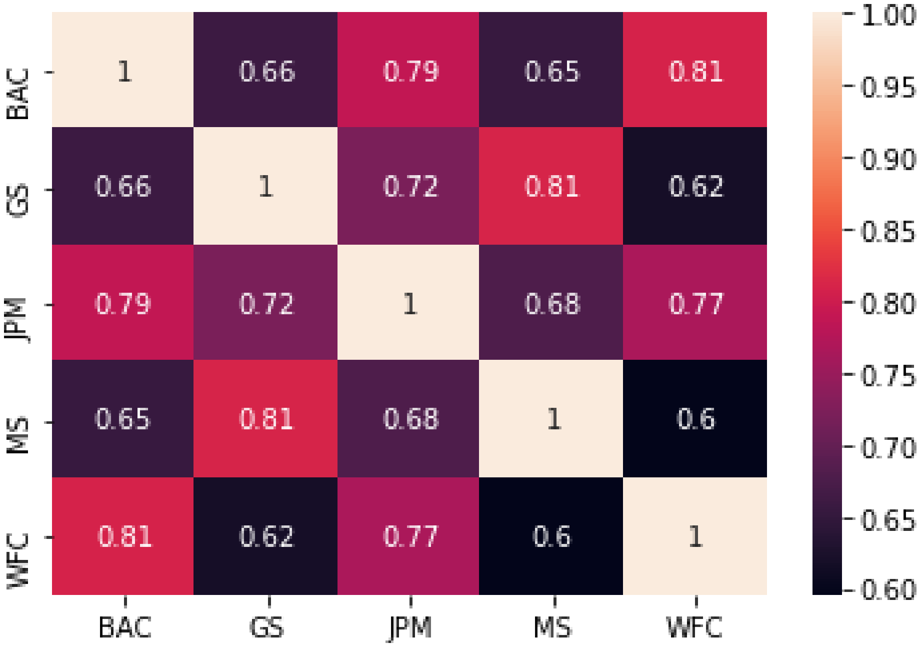
9. Correlation between stocks

[ ]:

```
sns.heatmap(rocDF.corr(), annot=True)
```

[ ]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f4c3b589390>
```



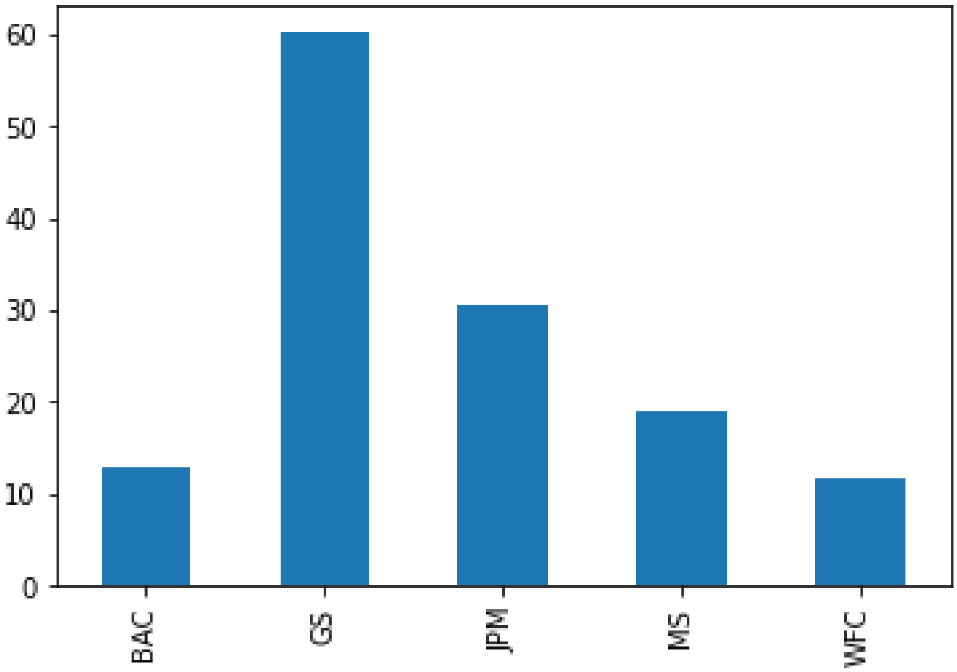
10. Explore volatility of bank stocks

[ ]:

```
closeDF.std().plot(kind="bar")
# ref: https://www.buyupside.com/alphavantagelive/volatilitycalculatorcomputeav.
 ↪php?symbol=BAC&numberyears=21.7&submit=Calculate+Volatility
# https://www.buyupside.com/alphavantagelive/volatilitycalculatorcomputeav.php?
 ↪symbol=GS&numberyears=21.7&submit=Calculate+Volatility
# https://www.buyupside.com/alphavantagelive/volatilitycalculatorcomputeav.php?
 ↪symbol=JPM&numberyears=21.7&submit=Calculate+Volatility
# https://www.buyupside.com/alphavantagelive/volatilitycalculatorcomputeav.php?
 ↪symbol=MS&numberyears=21.7&submit=Calculate+Volatility
# https://www.buyupside.com/alphavantagelive/volatilitycalculatorcomputeav.php?
 ↪symbol=WFC&numberyears=21.7&submit=Calculate+Volatility
```

[ ]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f4c3cc17f90>
```


60
50
40
30
20
10
0
BAC
GS
JPM
MS
WFC