PythonTutorial

September 3, 2021

1 Python Quickstart

This is called a jupyter notebook meant to give a quick introduction to Python. You can execute the code in each cell by clicking in the cell and hitting "Shift-Enter". Restart the notebook using the small square double arrow button above.

[1]:
```python
# Comments start with a hash
```

[2]:
```python
# First thing to do in a new program is import all your libraries
# To install new libraries, just do a "pip install packagename"
#     or "conda install packagename", but
#     anaconda comes with a lot of stuff
#     so you should be good with the base install

import numpy as np                # Numpy is a numerical library.
                                  #   It is built in C which gives it
                                  #   significant performance benefits over
                                  #   pure python code

import pandas as pd               # Pandas is great when you are working
                                  #    with datafiles.

import matplotlib.pyplot as plt # Plotting library

# The "as" command tells python that "np" is short for "numpy"
```

[3]:
```python
# Setting variables

a = 4           # integer
b = 500         # integer
c = 10.1        # float
d = 1.0e6       # float
e = "a string" # string
```

[4]:
```python
# Printing variables

print(a)
print(b)
```

```python
print(a,b)
print("%d %d"%(a,b))     # Here both are formatted as integers
print("%3.2f %e"%(a,b))  # Formatted as float and scientific notation
```

```
4
500
4 500
4 500
4.00 5.000000e+02
```

[5]:
```python
# For loop (notice for loops start with 0, end with n-1)

for n in range(10):
    print("%d^2 = %d"%(n,n**2))
```

```
0^2 = 0
1^2 = 1
2^2 = 4
3^2 = 9
4^2 = 16
5^2 = 25
6^2 = 36
7^2 = 49
8^2 = 64
9^2 = 81
```

[6]:
```python
# While loop (notice we need to increment n manually
#    whereas the for loop does it for you)

n = 0
while n < 10:
    print("%d^2 = %d"%(n,n**2))
    n += 1
```

```
0^2 = 0
1^2 = 1
2^2 = 4
3^2 = 9
4^2 = 16
5^2 = 25
6^2 = 36
7^2 = 49
8^2 = 64
9^2 = 81
```

[7]:
```python
print("-- Python Lists --")
# Python uses lists to store multi-dimensional data
```

```python
a = []                       # Empty list
print(a)
a = [0, 1, 2, 3]             # List with 4 elements
print(a)
a = [n for n in range(10)] # List with a loop in it
print(a[5])                  # Get fifth element in list
print(len(a))                # Get size of lists with len()

print("\n-- Dictionaries --")
# Dictionaries are similar to arrays,
#    but you can set the index to anything you want, like a string
a = {"Mike": 1, "Steve": 2}
print(a)
print(a["Mike"])

print("\n-- Numpy Arrays --")
# An alternative to lists are numpy arrays.
#   Operations with numpy arrays are generally much faster.
#   Use them whenever possible
a = np.array([])             # Empty array
print(a)
a = np.array([0, 1, 2, 3]) # Similar to lists, but better
print(a)
a = np.arange(10)            # Initialize an array [0, 10)
print(a)
a = np.zeros((1000,1000))   # Really big array of all zeros
print(a)
print(a.shape)               # Get size of arrays with shape
```

```
-- Python Lists --
[]
[0, 1, 2, 3]
5
10

-- Dictionaries --
{'Mike': 1, 'Steve': 2}
1

-- Numpy Arrays --
[]
[0 1 2 3]
[0 1 2 3 4 5 6 7 8 9]
[[0. 0. 0. … 0. 0. 0.]
 [0. 0. 0. … 0. 0. 0.]
 [0. 0. 0. … 0. 0. 0.]
 …
```

```
 [0. 0. 0. … 0. 0. 0.]
 [0. 0. 0. … 0. 0. 0.]
 [0. 0. 0. … 0. 0. 0.]]
(1000, 1000)
```

[8]:
```
# Import a year's worth of financial data for apple, amazon, and walmart

aapl = pd.read_csv("data/AAPL.csv") # Read a csv (comma separated value) file
amzn = pd.read_csv("data/AMZN.csv")
wmt = pd.read_csv("data/WMT.csv")

# These are all now pandas dataframes.
# You can take a look at the data by using the head (top five lines)
#    or tail (bottom five lines)
aapl.head()
```

[8]:
```
         Date        Open        High         Low       Close   Adj Close  \
0  2019-06-04  175.440002  179.830002  174.520004  179.639999  177.521378
1  2019-06-05  184.279999  184.990005  181.139999  182.539993  180.387146
2  2019-06-06  183.080002  185.470001  182.149994  185.220001  183.035568
3  2019-06-07  186.509995  191.919998  185.770004  190.149994  187.907410
4  2019-06-10  191.809998  195.369995  191.619995  192.580002  190.308762

     Volume
0  30968000
1  29773400
2  22526300
3  30684400
4  26220900
```

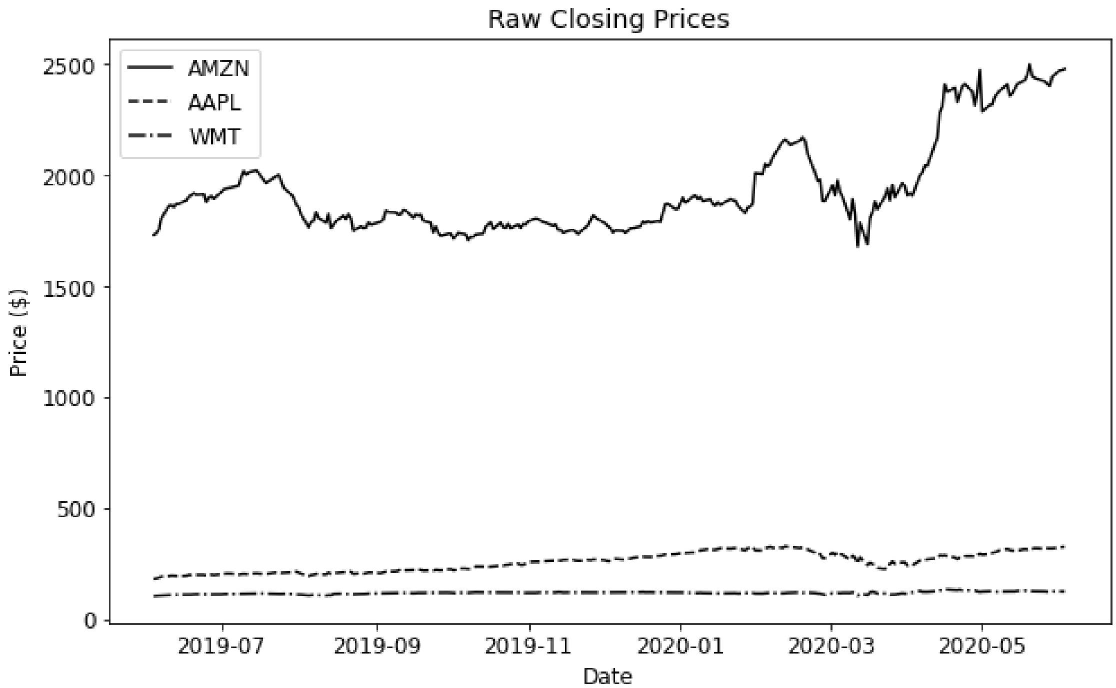
[9]:
```
# You can also get some statistical data using the describe function
aapl.describe()
```

[9]:
```
             Open        High         Low       Close   Adj Close  \
count  253.000000  253.000000  253.000000  253.000000  253.000000
mean   254.951423  258.222055  252.456522  255.601304  254.169563
std     42.722106   43.435319   42.304440   43.076031   43.563057
min    175.440002  179.830002  174.520004  179.639999  177.521378
25%    213.190002  214.419998  211.070007  212.639999  210.752029
50%    257.260010  260.440002  255.380005  259.429993  258.117004
75%    289.929993  297.880005  286.320007  292.649994  291.859924
max    324.739990  327.850006  323.350006  327.200012  326.316681

             Volume
count  2.530000e+02
mean   3.347581e+07
std    1.718790e+07
```

```
min    1.136200e+07
25%    2.184000e+07
50%    2.843260e+07
75%    3.813280e+07
max    1.067212e+08
```

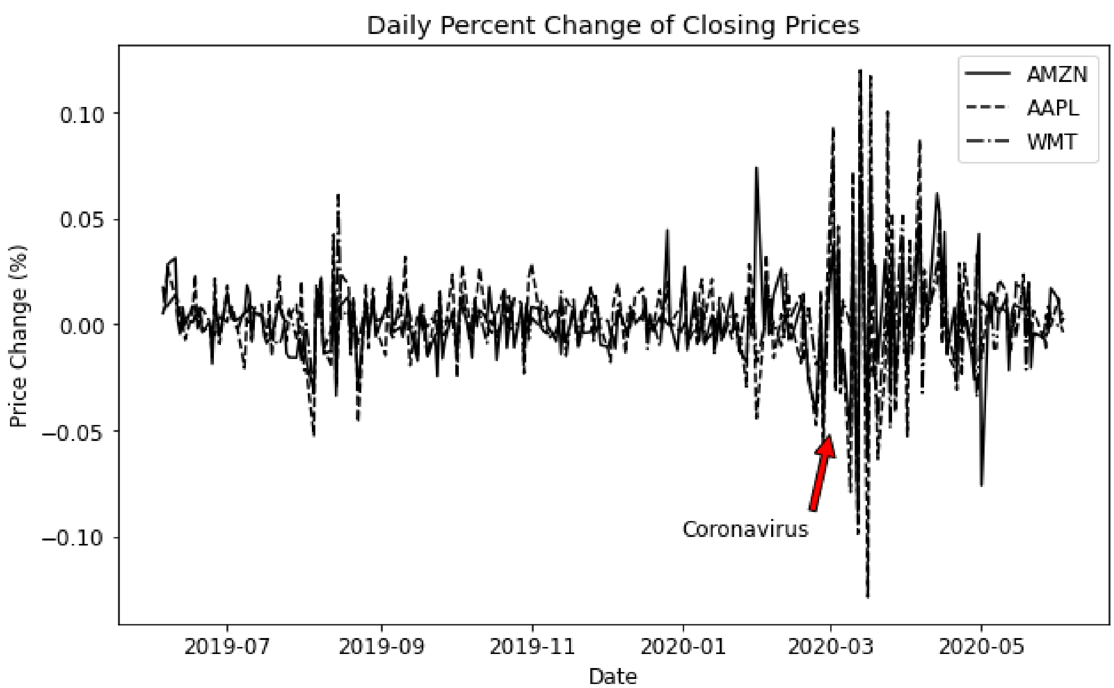
[10]:
```python
# The dataframes all have a "Date" column,
#    but Python doesn't know it's a date yet.
#    You need to define it as a date

amzn["Date"] = pd.to_datetime(amzn["Date"])
aapl["Date"] = pd.to_datetime(aapl["Date"])
wmt["Date"] = pd.to_datetime(wmt["Date"])
```

[11]:
```python
# Plot the raw close prices

plt.figure(figsize=(10,6))    # This sets the size of the plot,
                              #    10 units wide by 6 units high
plt.rcParams['font.size'] = 12
plt.title("Raw Closing Prices")
plt.xlabel("Date")
plt.ylabel("Price ($)")
plt.plot(amzn["Date"], amzn["Close"], 'k-', label="AMZN")
# The arguments here from left to right are x-variable,
#    y-variable, line type (k for black, - for solid line),
#    and line label for the legend
plt.plot(aapl["Date"], aapl["Close"], 'k--', label="AAPL")
plt.plot(wmt["Date"], wmt["Close"], 'k-.', label="WMT")
plt.legend()  # Add a legend
plt.show()
```



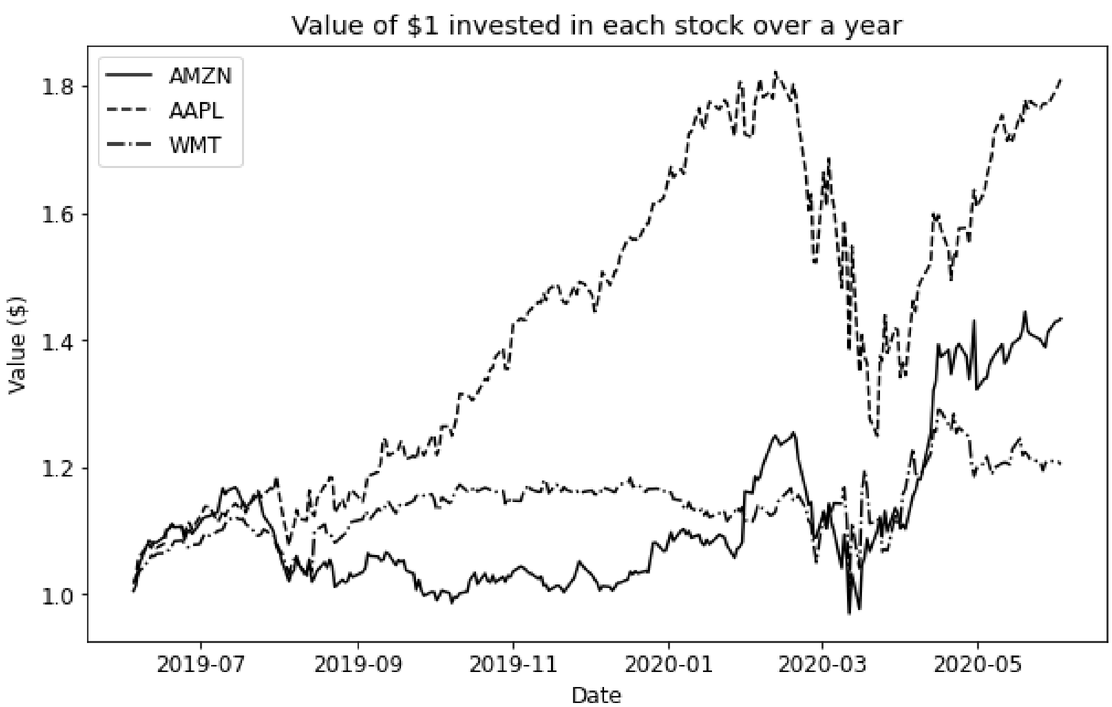
[12]:
```
# That's not a very good plot because amazon
#   is so much higher than the other two
#   Try plotting daily price change instead

amzn_pc = amzn["Close"].pct_change() # Compute daily percent change
aapl_pc = aapl["Close"].pct_change()
wmt_pc = wmt["Close"].pct_change()

amzn["Close_change"] = amzn_pc # Add a column in the dataframe
aapl["Close_change"] = aapl_pc
wmt["Close_change"] = wmt_pc

# Clip off the first entry since the percent change
#    has one less row than the others
amzn = amzn.iloc[1:]
aapl = aapl.iloc[1:]
wmt = wmt.iloc[1:]

plt.figure(figsize=(10,6))
plt.rcParams['font.size'] = 12
plt.title("Daily Percent Change of Closing Prices")
plt.xlabel("Date")
plt.ylabel("Price Change (%)")
plt.plot(amzn["Date"], amzn["Close_change"], 'k-', label="AMZN")
```

```
plt.plot(aapl["Date"], aapl["Close_change"], 'k--', label="AAPL")
plt.plot(wmt["Date"], wmt["Close_change"], 'k-.', label="WMT")
plt.gca().annotate('Coronavirus', xy=(pd.Timestamp(2020,3,1), -0.05),
                    xytext=(pd.Timestamp(2020,1,1), -0.1),
                    arrowprops=dict(facecolor='red', shrink=0.05),
                  )
plt.legend()
plt.show()
```



[13]:
```
# Now assume we invested 1 dollar in each stock a year ago.
#    How much do we have today?

# Add one to each row
amzn_c = amzn_pc + 1
# First row gets $1 investment
amzn_c.iloc[0] = 1.0
# Multiply each row with the row prior and sum
amzn_val = np.cumprod(amzn_c)

aapl_c = aapl_pc + 1
aapl_c.iloc[0] = 1.0
aapl_val = np.cumprod(aapl_c)

wmt_c = wmt_pc + 1
```

```
wmt_c.iloc[0] = 1.0
wmt_val = np.cumprod(wmt_c)

amzn["Value"] = amzn_val
aapl["Value"] = aapl_val
wmt["Value"] = wmt_val

plt.figure(figsize=(10,6))
plt.rcParams['font.size'] = 12
plt.title("Value of $1 invested in each stock over a year")
plt.xlabel("Date")
plt.ylabel("Value ($)")
plt.plot(amzn["Date"], amzn["Value"], 'k-', label="AMZN")
plt.plot(aapl["Date"], aapl["Value"], 'k--', label="AAPL")
plt.plot(wmt["Date"], wmt["Value"], 'k-.', label="WMT")
plt.legend()
plt.show()
```



[14]:
```
# Value of the whole portfolio

port_val = amzn["Value"] + aapl["Value"] + wmt["Value"]

plt.figure(figsize=(10,6))
plt.rcParams['font.size'] = 12
```

```python
plt.title("Value of portfolio over a year")
plt.xlabel("Date")
plt.ylabel("Value ($)")
plt.plot(amzn["Date"], port_val, 'k-')
plt.savefig("portfolio.png")
```