Pandas - Applications in Finance

In [1]:

```python
import numpy as np
import pandas as pd
import datetime, calendar

import matplotlib.pyplot as plt
from mpl_finance import candlestick_ohlc

import matplotlib.dates as mdates

np.set_printoptions(suppress=True)
```

In [2]:

```python
datafile = 'http://people.bu.edu/kalathur/datasets/AAPL.csv'

df = pd.read_csv(datafile, index_col='Date', parse_dates=True)
df = df.round(2)
df
```

Out[2]:

	Open	High	Low	Close	Adj Close	Volume
Date						
2019-01-02	154.89	158.85	154.23	157.92	156.05	37039700
2019-01-03	143.98	145.72	142.00	142.19	140.51	91312200
2019-01-04	144.53	148.55	143.80	148.26	146.50	58607100
2019-01-07	148.70	148.83	145.90	147.93	146.18	54777800
2019-01-08	149.56	151.82	148.52	150.75	148.96	41025300
...	...	...	...	...	...	...
2019-09-10	213.86	216.78	211.71	216.70	216.70	31777900
2019-09-11	218.07	223.71	217.73	223.59	223.59	44289600
2019-09-12	224.80	226.42	222.86	223.09	223.09	32226700
2019-09-13	220.00	220.79	217.02	218.75	218.75	39763300
2019-09-16	217.73	220.13	217.56	219.90	219.90	20750000

178 rows × 6 columns

In [3]:

```
df.mean().round(2)
```

Out[3]:

```
Open                 189.65
High                 191.59
Low                  188.10
Close                189.94
Adj Close            188.90
Volume          28910325.84
dtype: float64
```

Volume Weighted Average Price (VWAP)

In [4]:

```
vwap = np.average(df['Adj Close'], weights=df['Volume'])
print("VWAP =", vwap)
```

```
VWAP = 187.04154812148687
```

Averages by Day of Week

In [5]:

```
for freq in ['W-MON', 'W-TUE', 'W-WED', 'W-THU', 'W-FRI']:
    print(freq, "Average", df.resample(freq).asfreq().dropna()['Adj Close'].mean().round(2))
```

```
W-MON Average 190.02
W-TUE Average 188.58
W-WED Average 189.2
W-THU Average 188.45
W-FRI Average 188.31
```

In [6]:

```
result = df.groupby(df.index.dayofweek)['Adj Close'].mean().round(2)
result
```

Out[6]:

```
Date
0    190.02
1    188.58
2    189.20
3    188.45
4    188.31
Name: Adj Close, dtype: float64
```

In [7]:

```
result.index = [calendar.day_name[index] for index in result.index]
result
```

Out[7]:

```
Monday       190.02
Tuesday      188.58
Wednesday    189.20
Thursday     188.45
Friday       188.31
Name: Adj Close, dtype: float64
```

In [ ]:

Interpreting Moving Averages

https://www.tradingview.com/wiki/Moving_Average (https://www.tradingview.com/wiki/Moving_Average)

Simple Moving Average (SMA)

- For analyzing time-series data
- Moving window of N periods
- Mean of values inside the window
- an unweighted moving average

In [8]:

```
# 20-day moving window

N = 20
```

In [9]:

```
newDF = df.copy()
```

In [10]:

```
newDF['SMA'] = df['Adj Close'].rolling(window=N).mean().round(2)
newDF
```

Out[10]:

	Open	High	Low	Close	Adj Close	Volume	SMA
Date							
2019-01-02	154.89	158.85	154.23	157.92	156.05	37039700	NaN
2019-01-03	143.98	145.72	142.00	142.19	140.51	91312200	NaN
2019-01-04	144.53	148.55	143.80	148.26	146.50	58607100	NaN
2019-01-07	148.70	148.83	145.90	147.93	146.18	54777800	NaN
2019-01-08	149.56	151.82	148.52	150.75	148.96	41025300	NaN
...	...	...	...	...	...	...	...
2019-09-10	213.86	216.78	211.71	216.70	216.70	31777900	208.73
2019-09-11	218.07	223.71	217.73	223.59	223.59	44289600	209.46
2019-09-12	224.80	226.42	222.86	223.09	223.09	32226700	210.48
2019-09-13	220.00	220.79	217.02	218.75	218.75	39763300	211.33
2019-09-16	217.73	220.13	217.56	219.90	219.90	20750000	212.00

178 rows × 7 columns

In [11]:
```
newDF['mDate'] = mdates.date2num(df.index)
newDF
```

Out[11]:

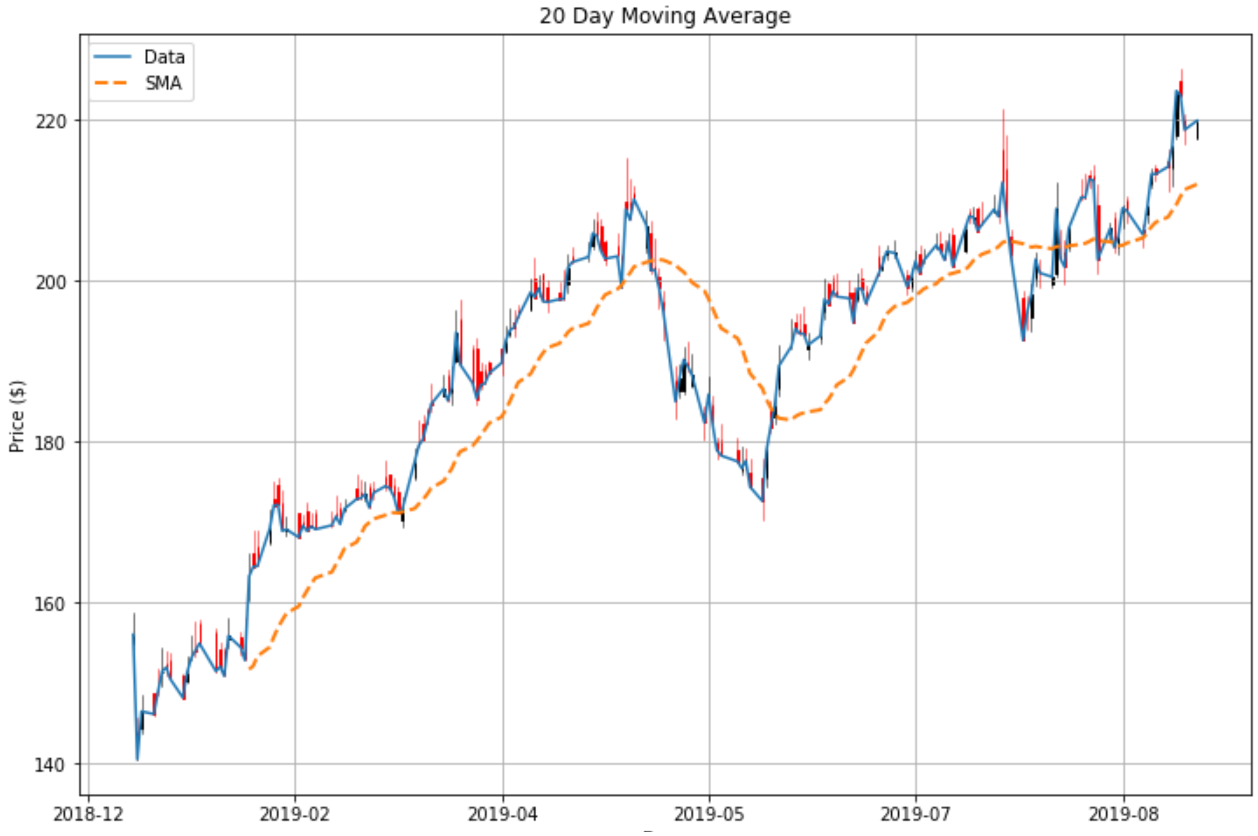
	Open	High	Low	Close	Adj Close	Volume	SMA	mDate
Date								
2019-01-02	154.89	158.85	154.23	157.92	156.05	37039700	NaN	737061.0
2019-01-03	143.98	145.72	142.00	142.19	140.51	91312200	NaN	737062.0
2019-01-04	144.53	148.55	143.80	148.26	146.50	58607100	NaN	737063.0
2019-01-07	148.70	148.83	145.90	147.93	146.18	54777800	NaN	737066.0
2019-01-08	149.56	151.82	148.52	150.75	148.96	41025300	NaN	737067.0
...	...	...	...	...	...	...	...	...
2019-09-10	213.86	216.78	211.71	216.70	216.70	31777900	208.73	737312.0
2019-09-11	218.07	223.71	217.73	223.59	223.59	44289600	209.46	737313.0
2019-09-12	224.80	226.42	222.86	223.09	223.09	32226700	210.48	737314.0
2019-09-13	220.00	220.79	217.02	218.75	218.75	39763300	211.33	737315.0
2019-09-16	217.73	220.13	217.56	219.90	219.90	20750000	212.00	737318.0

178 rows × 8 columns

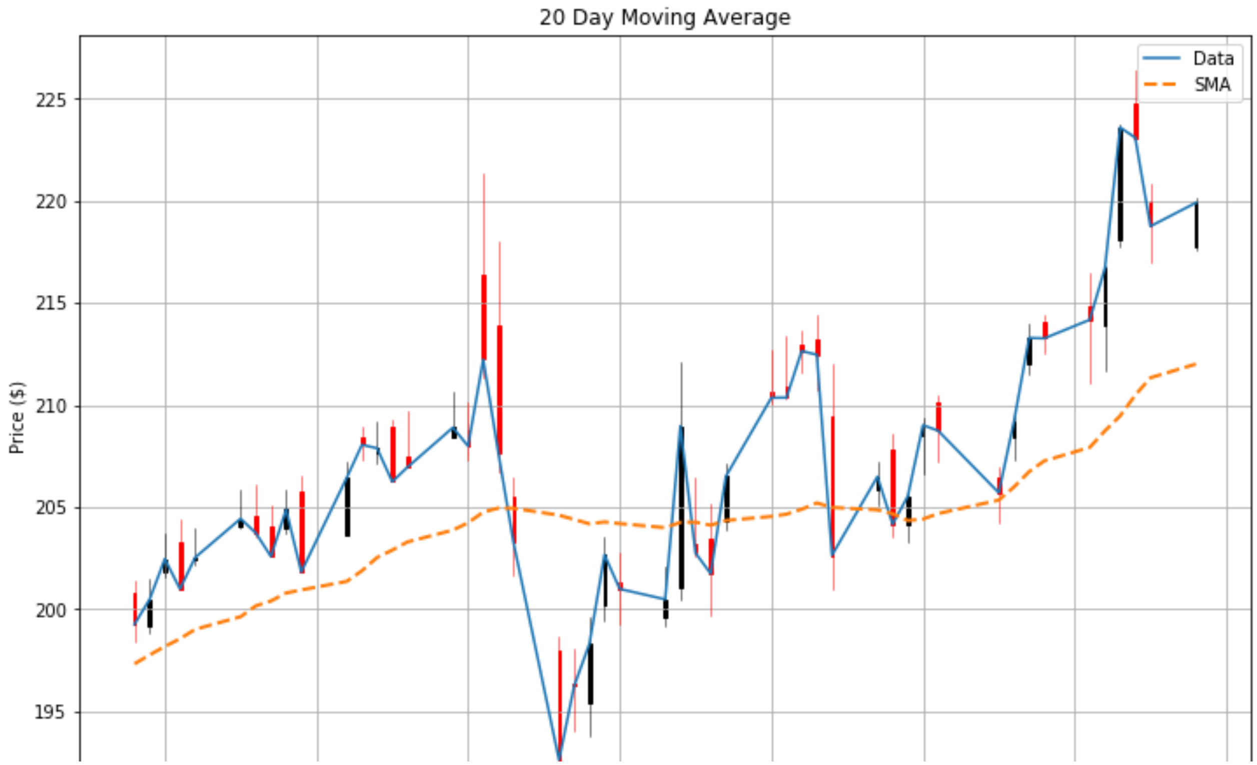
In [12]:
```
olhc = newDF[['mDate', 'Open', 'High', 'Low', 'Adj Close']].copy().values
olhc[:5]
```

Out[12]:
```
array([[737061.  ,    154.89,    158.85,    154.23,    156.05],
       [737062.  ,    143.98,    145.72,    142.  ,    140.51],
       [737063.  ,    144.53,    148.55,    143.8 ,    146.5 ],
       [737066.  ,    148.7 ,    148.83,    145.9 ,    146.18],
       [737067.  ,    149.56,    151.82,    148.52,    148.96]])
```

In [13]:
```
fig, ax = plt.subplots(1, figsize=(12,8))

candlestick_ohlc(ax, olhc)

plt.plot(newDF['mDate'], newDF['Adj Close'], label='Data')
plt.plot(newDF['mDate'], newDF['SMA'], '--', lw=2.0, label='SMA')

ax.xaxis.set_major_formatter(mdates.DateFormatter('%Y-%m'))

plt.title("20 Day Moving Average")
plt.xlabel("Days")
plt.ylabel("Price ($)")
plt.grid()
plt.legend()
plt.show()
```



In [14]:
```
# Show plot for lastN values only

lastN = 50

fig, ax = plt.subplots(1, figsize=(12,8))

candlestick_ohlc(ax, olhc[-lastN:])

plt.plot(newDF['mDate'][-lastN:], newDF['Adj Close'][-lastN:], label='Data')
plt.plot(newDF['mDate'][-lastN:], newDF['SMA'][-lastN:], '--', lw=2.0, label='SMA')

ax.xaxis.set_major_formatter(mdates.DateFormatter('%Y-%m'))

plt.title("20 Day Moving Average")
plt.xlabel("Days")
plt.ylabel("Price ($)")
plt.grid()
plt.legend()
plt.show()
```



Weighted Moving Average (WMA)

In [15]:

```
# 20-day moving window

N = 20
```

In [16]:

```
weights = np.arange(1, N+1)
print(weights)
```

```
[ 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20]
```

In [17]:

```
# Return closure function to be applied on each group

def f(w):
    def g(x):
        return np.sum(x*w)/sum(w)
    return g
```

In [ ]:

In [18]:

```
newDF['WMA'] = df[['Adj Close']].rolling(window=N).apply(f(weights))
newDF
```

```
/Library/Frameworks/Python.framework/Versions/3.7/lib/python3.7/site-packages/ipykernel_launcher.py:1: FutureWa
rning: Currently, 'apply' passes the values as ndarrays to the applied function. In the future, this will chang
e to passing it as Series objects. You need to specify 'raw=True' to keep the current behaviour, and you can pa
ss 'raw=False' to silence this warning
  """Entry point for launching an IPython kernel.
```

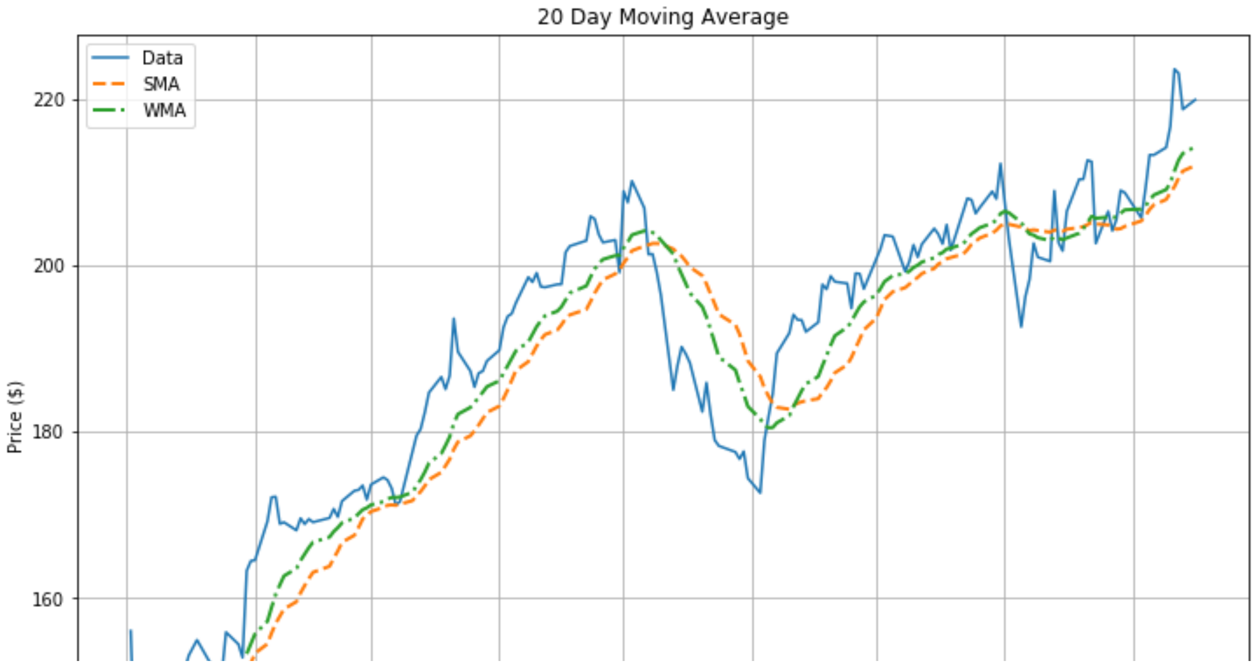
Out[18]:

	Open	High	Low	Close	Adj Close	Volume	SMA	mDate	WMA
Date									
2019-01-02	154.89	158.85	154.23	157.92	156.05	37039700	NaN	737061.0	NaN
2019-01-03	143.98	145.72	142.00	142.19	140.51	91312200	NaN	737062.0	NaN
2019-01-04	144.53	148.55	143.80	148.26	146.50	58607100	NaN	737063.0	NaN
2019-01-07	148.70	148.83	145.90	147.93	146.18	54777800	NaN	737066.0	NaN
2019-01-08	149.56	151.82	148.52	150.75	148.96	41025300	NaN	737067.0	NaN
...	...	...	...	...	...	...	...	...	...
2019-09-10	213.86	216.78	211.71	216.70	216.70	31777900	208.73	737312.0	209.944000
2019-09-11	218.07	223.71	217.73	223.59	223.59	44289600	209.46	737313.0	211.359048
2019-09-12	224.80	226.42	222.86	223.09	223.09	32226700	210.48	737314.0	212.656857
2019-09-13	220.00	220.79	217.02	218.75	218.75	39763300	211.33	737315.0	213.444476
2019-09-16	217.73	220.13	217.56	219.90	219.90	20750000	212.00	737318.0	214.260619

178 rows × 9 columns

```
In [19]: fig, ax = plt.subplots(1, figsize=(12,8))

         plt.plot(newDF.index, newDF['Adj Close'], label='Data')
         plt.plot(newDF.index, newDF['SMA'], '--', lw=2.0, label='SMA')
         plt.plot(newDF.index, newDF['WMA'], '-.', lw=2.0, label='WMA')

         plt.title("20 Day Moving Average")
         plt.xlabel("Days")
         plt.ylabel("Price ($)")
         plt.grid()
         plt.legend()
         plt.show()
```

```
/Library/Frameworks/Python.framework/Versions/3.7/lib/python3.7/site-packages/pandas/plotting/_matplotlib/conve
rter.py:103: FutureWarning: Using an implicitly registered datetime converter for a matplotlib plotting method.
The converter was registered by pandas on import. Future versions of pandas will require you to explicitly regi
ster matplotlib converters.

To register the converters:
        >>> from pandas.plotting import register_matplotlib_converters
        >>> register_matplotlib_converters()
  warnings.warn(msg, FutureWarning)
```



```
In [ ]:
```

Exponential Moving Average (EMA)

- For analyzing time-series data
- Alternative to SMA
- Moving window of N periods
- Uses exponentially decreasing weights
- Gives higher weights to recent prices
- weighted averages are calculated using weights $(1 - alpha) * *(n - 1), (1 - alpha) * *(n - 2), \ldots, 1 - alpha, 1$

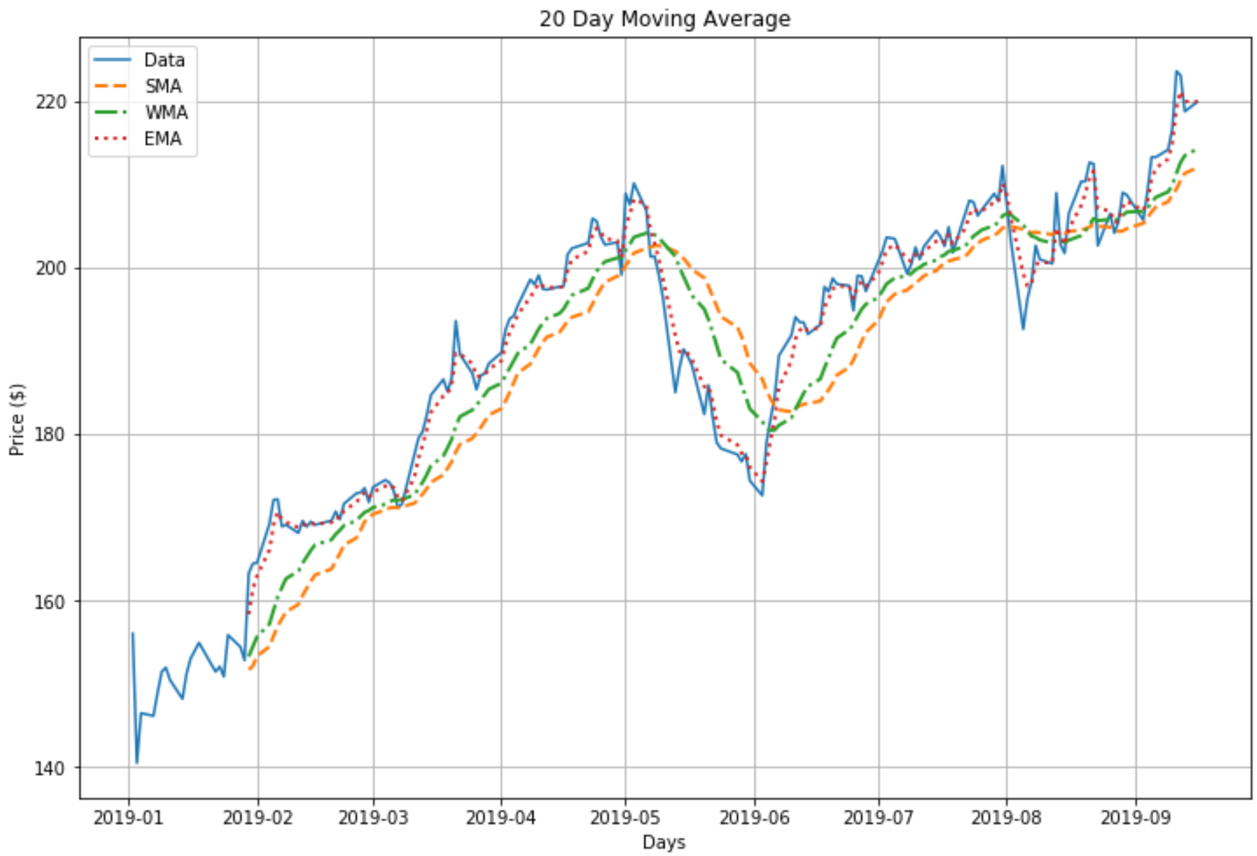
```
In [20]: newDF['EMA'] = df[['Adj Close']].ewm(alpha=0.5, min_periods=N).mean()
         newDF
```

Out[20]:

	Open	High	Low	Close	Adj Close	Volume	SMA	mDate	WMA	EMA
Date										
2019-01-02	154.89	158.85	154.23	157.92	156.05	37039700	NaN	737061.0	NaN	NaN
2019-01-03	143.98	145.72	142.00	142.19	140.51	91312200	NaN	737062.0	NaN	NaN
2019-01-04	144.53	148.55	143.80	148.26	146.50	58607100	NaN	737063.0	NaN	NaN
2019-01-07	148.70	148.83	145.90	147.93	146.18	54777800	NaN	737066.0	NaN	NaN
2019-01-08	149.56	151.82	148.52	150.75	148.96	41025300	NaN	737067.0	NaN	NaN
...	...	...	...	...	...	...	...	...	...	...
2019-09-10	213.86	216.78	211.71	216.70	216.70	31777900	208.73	737312.0	209.944000	214.881240
2019-09-11	218.07	223.71	217.73	223.59	223.59	44289600	209.46	737313.0	211.359048	219.235620
2019-09-12	224.80	226.42	222.86	223.09	223.09	32226700	210.48	737314.0	212.656857	221.162810
2019-09-13	220.00	220.79	217.02	218.75	218.75	39763300	211.33	737315.0	213.444476	219.956405
2019-09-16	217.73	220.13	217.56	219.90	219.90	20750000	212.00	737318.0	214.260619	219.928203

178 rows × 10 columns

In [21]:
```
fig, ax = plt.subplots(1, figsize=(12,8))

plt.plot(newDF.index, newDF['Adj Close'], label='Data')
plt.plot(newDF.index, newDF['SMA'], '--', lw=2.0, label='SMA')
plt.plot(newDF.index, newDF['WMA'], '-.', lw=2.0, label='WMA')
plt.plot(newDF.index, newDF['EMA'], ':',  lw=2.0, label="EMA")


plt.title("20 Day Moving Average")
plt.xlabel("Days")
plt.ylabel("Price ($)")
plt.grid()
plt.legend()
plt.show()
```



```
In [ ]:
```