Submitted by: Angelo Luis C. Cu

```
import numpy as np
import pandas as pd

weather = pd.read_csv('data/nyc_weather_2018.csv', parse_dates=['date'])
weather.head()
```

	attributes	datatype	date	station	value
0	,,N,	PRCP	2018-01-01	GHCND:US1CTFR0039	0.0
1	,,N,	PRCP	2018-01-01	GHCND:US1NJBG0015	0.0
2	,,N,	SNOW	2018-01-01	GHCND:US1NJBG0015	0.0
3	,,N,	PRCP	2018-01-01	GHCND:US1NJBG0017	0.0
4	,,N,	SNOW	2018-01-01	GHCND:US1NJBG0017	0.0

Next steps: View recommended plots

```
fb = pd.read_csv('data/fb_2018.csv', index_col='date', parse_dates=True)
fb.head()
```

date	open	high	low	close	volume
2018-01-02	177.68	181.58	177.5500	181.42	18151903
2018-01-03	181.88	184.78	181.3300	184.67	16886563
2018-01-04	184.90	186.21	184.0996	184.33	13880896
2018-01-05	185.59	186.90	184.9300	186.85	13574535
2018-01-08	187.20	188.90	186.3300	188.28	17994726

Next steps: View recommended plots

```
fb.assign(
  abs_z_score_volume=lambda x: x.volume.sub(x.volume.mean()).div(x.volume.std()).abs() # gets the z-score of volume
).query('abs_z_score_volume > 3')
```

date	open	high	low	close	volume	abs_z_score_volume
2018-03-19	177.01	177.17	170.06	172.56	88140060	3.145078
2018-03-20	167.47	170.20	161.95	168.15	129851768	5.315169
2018-03-21	164.80	173.40	163.30	169.39	106598834	4.105413
2018-03-26	160.82	161.10	149.02	160.06	126116634	5.120845
2018-07-26	174.89	180.13	173.75	176.26	169803668	7.393705

```
fb.assign(
  volume_pct_change=fb.volume.pct_change(), # gets the percent change in volume compared to day before
  pct_change_rank=lambda x: x.volume_pct_change.abs().rank( # ranks from highest to lowest change
    ascending=False
  )
).nsmallest(5, 'pct_change_rank') # gets the top 5 highest percent change
```

date	open	high	low	close	volume	volume_pct_change	pct_change_rank
2018-01-12	178.06	181.48	177.40	179.37	77551299	7.087876	1.0
2018-03-19	177.01	177.17	170.06	172.56	88140060	2.611789	2.0
2018-07-26	174.89	180.13	173.75	176.26	169803668	1.628841	3.0

```
# fb announces news feed changes
fb['2018-01-11':'2018-01-12']
# notice that stocks fell from 188.40 on jan. 11 to 179.37 on jan. 12
```

date	open	high	low	close	volume
2018-01-11	188.40	188.40	187.38	187.77	9588587
2018-01-12	178.06	181.48	177.40	179.37	77551299

```
(fb > 215).any() # notice that there weren't any lows above 215
```

```
open       True
high       True
low       False
close      True
```

```
volume     True
dtype: bool
```

```
(fb > 215).all() # there were at least a day where fb's OHLC were less than 215
```

```
open      False
high      False
low       False
close     False
volume     True
dtype: bool
```

```
(fb.volume.value_counts() > 1).sum() # there weren't any days with similar volume
```

```
0
```

```
# separates the volume into 3 "bins" with equal volume
volume_binned = pd.cut(fb.volume, bins=3, labels=['low', 'med', 'high']) # named low, med, high
volume_binned.value_counts()
```

```
low     240
med       8
high      3
Name: volume, dtype: int64
```

```
fb[volume_binned == 'high'].sort_values(
  'volume', ascending=False
)
```

date	open	high	low	close	volume
2018-07-26	174.89	180.13	173.75	176.26	169803668
2018-03-20	167.47	170.20	161.95	168.15	129851768
2018-03-26	160.82	161.10	149.02	160.06	126116634

```
# fb announces slow user growth
fb['2018-07-25':'2018-07-26'] # notice the big drop in stocks from 215.715 to 176.26
```

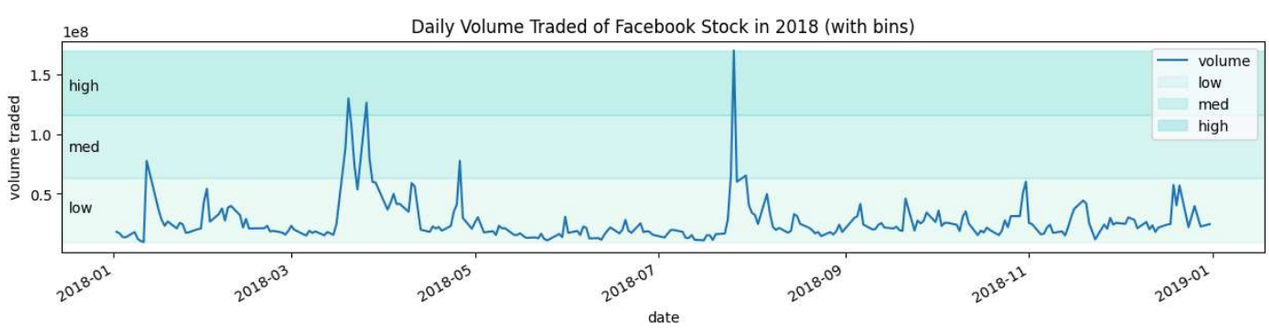
date	open	high	low	close	volume
2018-07-25	215.715	218.62	214.27	217.50	64592585
2018-07-26	174.890	180.13	173.75	176.26	169803668

```
# cambridge analytica scandal
fb['2018-03-16':'2018-03-20'] # another drop in stocks from 184.49 to 168.15
```

date	open	high	low	close	volume
2018-03-16	184.49	185.33	183.41	185.09	24403438
2018-03-19	177.01	177.17	170.06	172.56	88140060
2018-03-20	167.47	170.20	161.95	168.15	129851768

```
import matplotlib.pyplot as plt # plotting using matplotlib
```

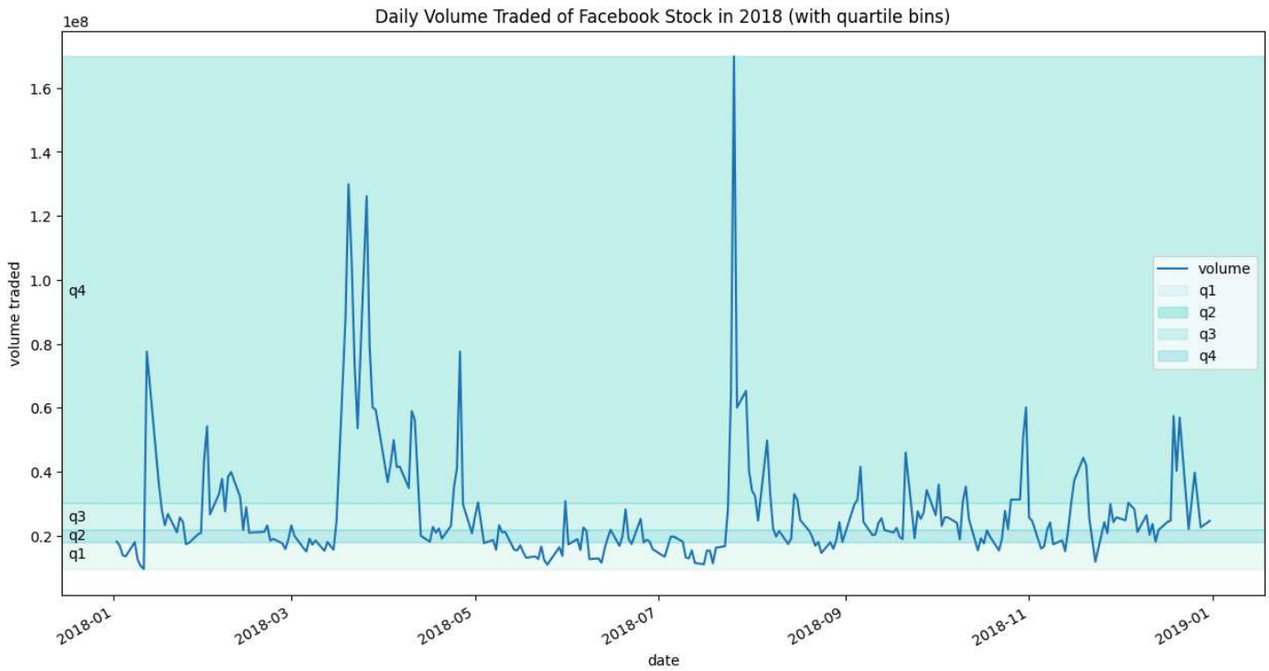
```
fb.plot(y='volume', figsize=(15, 3), title='Daily Volume Traded of Facebook Stock in 2018 (with bins)')

for bin_name, alpha, bounds in zip(
  ['low', 'med', 'high'], [0.1, 0.2, 0.3], pd.cut(fb.volume, bins=3).unique().categories.values
):
  plt.axhspan(bounds.left, bounds.right, alpha=alpha, label=bin_name, color='mediumturquoise')
  plt.annotate(bin_name, xy=('2017-12-17', (bounds.left + bounds.right)/2.1))

plt.ylabel('volume traded')
plt.legend()
plt.show()
```




```
volume_qbinned = pd.qcut(fb.volume, q=4, labels=['q1', 'q2', 'q3', 'q4']) # uses .qcut() method to cut into 4 quartiles
volume_qbinned.value_counts()
```

```
q1    63
q2    63
q4    63
q3    62
Name: volume, dtype: int64
```

```
fb.plot(y='volume', figsize=(15, 8), title='Daily Volume Traded of Facebook Stock in 2018 (with quartile bins)') # plotting with matplotlib
for bin_name, alpha, bounds in zip(
  ['q1', 'q2', 'q3', 'q4'], [0.1, 0.35, 0.2, 0.3], pd.qcut(fb.volume, q=4).unique().categories.values
):
  plt.axhspan(bounds.left, bounds.right, alpha=alpha, label=bin_name, color='mediumturquoise')
  plt.annotate(bin_name, xy=('2017-12-17', (bounds.left + bounds.right)/2.1))
plt.ylabel('volume traded')
plt.legend()
plt.show()
# notice the volume isn't equal anymore with bigger spikes
```




```
central_park_weather = weather.query(
  'station == "GHCND:USW00094728"' # gets weather with central park station
).pivot(index='date', columns='datatype', values='value')
```

```
central_park_weather.SNOW.clip(0, 1).value_counts()
# changes snow column to only have 0 for no snow and 1 for with snow
```

```
0.0    354
1.0     11
Name: SNOW, dtype: int64
```

```
oct_weather_z_scores = central_park_weather.loc[
  '2018-10', ['TMIN', 'TMAX', 'PRCP'] # applies to TMIN, TMAX, and PRCP columns for october
].apply(lambda x: x.sub(x.mean()).div(x.std())) # gets the z score
oct_weather_z_scores.describe().T
```

datatype	count	mean	std	min	25%	50%	75%	max
TMIN	31.0	-1.790682e-16	1.0	-1.339112	-0.751019	-0.474269	1.065152	1.843511
TMAX	31.0	1.951844e-16	1.0	-1.305582	-0.870013	-0.138258	1.011643	1.604016
PRCP	31.0	4.655774e-17	1.0	-0.394438	-0.394438	-0.394438	-0.240253	3.936167

```
oct_weather_z_scores.query('PRCP > 3') # oct. 27 showed higher precipitation
```

date	TMIN	TMAX	PRCP
2018-10-27	-0.751019	-1.201045	3.936167

```
central_park_weather.loc['2018-10', 'PRCP'].describe() # notice the mean is 2.94
```

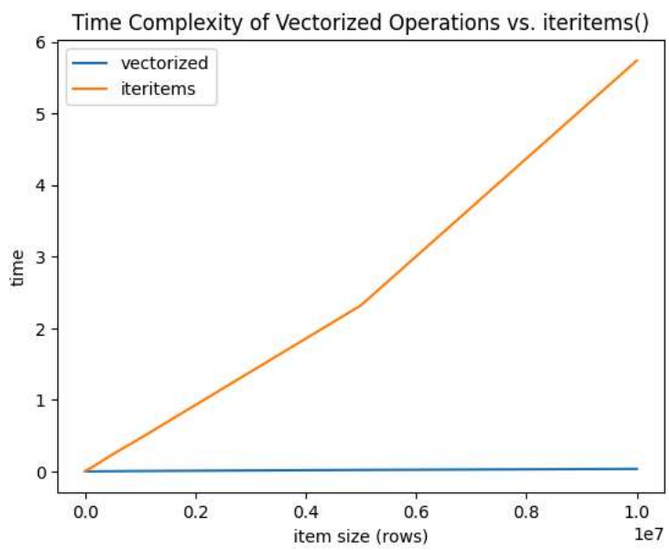
```
count    31.000000
mean      2.941935
std       7.458542
min       0.000000
25%       0.000000
50%       0.000000
75%       1.150000
max      32.300000
Name: PRCP, dtype: float64
```

```
import numpy as np
fb.apply(
  lambda x: np.vectorize(lambda y: len(str(np.ceil(y))))(x) # vectorizes the data
).astype('int64').equals(
  fb.applymap(lambda x: len(str(np.ceil(x)))) # check if it is equal to the length of ceiling
)
```

```
True
```

```
import time
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
np.random.seed(0)
vectorized_results = {}
iteritems_results = {}

for size in [10, 100, 1000, 10000, 100000, 500000, 1000000, 5000000, 10000000]:
  test = pd.Series(np.random.uniform(size=size))

  start = time.time() # uses vector operations
  x = test + 10
  end = time.time()
  vectorized_results[size] = end - start

  start = time.time()
  x = []
  for i, v in test.iteritems(): # uses iteritems
    x.append(v + 10)
  x = pd.Series(x)
  end = time.time()
  iteritems_results[size] = end - start

pd.DataFrame( # plots with matplotlib
  [pd.Series(vectorized_results, name='vectorized'), pd.Series(iteritems_results, name='iteritems')]
).T.plot(title='Time Complexity of Vectorized Operations vs. iteritems()')
plt.xlabel('item size (rows)')
plt.ylabel('time')
plt.show()

# notice that using iteritems is more time intensive
# hence, we should vectorize data whenever possible
```

```
<ipython-input-24-e37844af9fe5>:19: FutureWarning: iteritems is deprecated and will be removed in a future version. Use .items instead.
  for i, v in test.iteritems(): # uses iteritems
```




```
central_park_weather['2018-10'].assign(
  rolling_PRCP=lambda x: x.PRCP.rolling('3D').sum() # performs rolling sum every 3 days
)[['PRCP', 'rolling_PRCP']].head(7).T
```

```
<ipython-input-25-04280828d53d>:1: FutureWarning: Indexing a DataFrame with a datetimelike index using a single string to slice the rows
  central_park_weather['2018-10'].assign(
```

date	2018-10-01	2018-10-02	2018-10-03	2018-10-04	2018-10-05	2018-10-06	2018-10-07
datatype							
PRCP	0.0	17.5	0.0	1.0	0.0	0.0	0.0
rolling_PRCP	0.0	17.5	17.5	18.5	1.0	1.0	0.0

```
central_park_weather['2018-10'].rolling('3D').mean().head(7).iloc[:,:6]
# gets the rolling average every 3 days from october 2018
```

```
<ipython-input-26-2abb37634d3b>:1: FutureWarning: Indexing a DataFrame with a datetimelike index using a single string to slice the rows
  central_park_weather['2018-10'].rolling('3D').mean().head(7).iloc[:,:6]
```

datatype	AWND	PRCP	SNOW	SNWD	TMAX	TMIN
date						
2018-10-01	0.900000	0.000000	0.0	0.0	24.400000	17.200000
2018-10-02	0.900000	8.750000	0.0	0.0	24.700000	17.750000
2018-10-03	0.966667	5.833333	0.0	0.0	24.233333	17.566667
2018-10-04	0.800000	6.166667	0.0	0.0	24.233333	17.200000
2018-10-05	1.033333	0.333333	0.0	0.0	23.133333	16.300000
2018-10-06	0.833333	0.333333	0.0	0.0	22.033333	16.300000
2018-10-07	1.066667	0.000000	0.0	0.0	22.600000	17.400000

```
central_park_weather['2018-10-01':'2018-10-07'].rolling('3D').agg( # performs multiple rolling calculations
  {'TMAX': 'max', 'TMIN': 'min', 'AWND': 'mean', 'PRCP': 'sum'}
).join(
  central_park_weather[['TMAX', 'TMIN', 'AWND', 'PRCP']],
  lsuffix='_rolling' # result is in a column with added _rolling suffix
).sort_index(axis=1) # sorts the result
```

datatype	AWND	AWND_rolling	PRCP	PRCP_rolling	TMAX	TMAX_rolling	TMIN	TMIN_rolling
date								
2018-10-01	0.9	0.900000	0.0	0.0	24.4	24.4	17.2	17.2
2018-10-02	0.9	0.900000	17.5	17.5	25.0	25.0	18.3	17.2
2018-10-03	1.1	0.966667	0.0	17.5	23.3	25.0	17.2	17.2
2018-10-04	0.4	0.800000	1.0	18.5	24.4	25.0	16.1	16.1
2018-10-05	1.6	1.033333	0.0	1.0	21.7	24.4	15.6	15.6
2018-10-06	0.5	0.833333	0.0	1.0	20.0	24.4	17.2	15.6
2018-10-07	1.1	1.066667	0.0	0.0	26.1	26.1	19.4	15.6

```
fb.assign(
  close_ewma=lambda x: x.close.ewm(span=5).mean()
  # .ewm() = exponential weighted moving, .mean() = average
).tail(10)[['close', 'close_ewma']]
```

	close	close_ewma
date		
2018-12-17	140.19	142.235433
2018-12-18	143.66	142.710289
2018-12-19	133.24	139.553526
2018-12-20	133.40	137.502350
2018-12-21	124.95	133.318234
2018-12-24	124.06	130.232156
2018-12-26	134.18	131.548104
2018-12-27	134.52	132.538736
2018-12-28	133.20	132.759157
2018-12-31	131.09	132.202772

```
# using pipes
def get_info(df):
  return '%d rows and %d columns and max closing z-score was %d' % (*df.shape, df.close.max())
# checks if the two statements are the same
# pipe() here is used to also call get_info
fb['2018-Q1'].apply(lambda x: (x - x.mean())/x.std()).pipe(get_info)\
  == get_info(fb['2018-Q1'].apply(lambda x: (x - x.mean())/x.std()))
```

```
<ipython-input-32-62174f0c759c>:6: FutureWarning: Indexing a DataFrame with a datetimelike index using a single string to slice the rows
  fb['2018-Q1'].apply(lambda x: (x - x.mean())/x.std()).pipe(get_info)\
<ipython-input-32-62174f0c759c>:7: FutureWarning: Indexing a DataFrame with a datetimelike index using a single string to slice the rows
  == get_info(fb['2018-Q1'].apply(lambda x: (x - x.mean())/x.std()))
True
```

```
fb.pipe(pd.DataFrame.rolling, '20D').mean().equals(fb.rolling('20D').mean())
# this is more flexible as we can just change the .rolling() to another function
```

```
True
```

```
pd.DataFrame.rolling(fb, '20D').mean().equals(fb.rolling('20D').mean())
# this is the same as the code above
```

```
True
```

```
# for the code to work, window_calc.py should be uploaded to the colab content
from window_calc import window_calc
window_calc??
```

Help ×

```
Signature: window_calc(df, func, agg_dict, *args, **kwargs)
Source:
def window_calc(df, func, agg_dict, *args, **kwargs):
    """
    Run a window calculation of your choice on a DataFrame.

    Parameters:
        - df: The DataFrame to run the calculation on.
        - func: The window calculation method that takes df
                as the first argument.
        - agg_dict: Information to pass to `agg()`, could be a
                    dictionary mapping the columns to the aggregation
                    function to use, a string name for the function,
                    or the function itself.
        - args: Positional arguments to pass to `func`.
        - kwargs: Keyword arguments to pass to `func`.

    Returns:
        - A new DataFrame object.
    """
    return df.pipe(func, *args, **kwargs).agg(agg_dict)
File:      /content/window_calc.py
Type:      function
```

```
window_calc(fb, pd.DataFrame.expanding, np.median).head() # performs expanding median window calculation to fb
```

date	open	high	low	close	volume
2018-01-02	177.68	181.580	177.5500	181.420	18151903.0
2018-01-03	179.78	183.180	179.4400	183.045	17519233.0
2018-01-04	181.88	184.780	181.3300	184.330	16886563.0
2018-01-05	183.39	185.495	182.7148	184.500	15383729.5
2018-01-08	184.90	186.210	184.0996	184.670	16886563.0

```
window_calc(fb, pd.DataFrame.ewm, 'mean', span=3).head() # performs exponential weighted moving mean to fb
```

date	open	high	low	close	volume
2018-01-02	177.680000	181.580000	177.550000	181.420000	1.815190e+07
2018-01-03	180.480000	183.713333	180.070000	183.586667	1.730834e+07
2018-01-04	183.005714	185.140000	182.372629	184.011429	1.534980e+07
2018-01-05	184.384000	186.078667	183.736560	185.525333	1.440299e+07
2018-01-08	185.837419	187.534839	185.075110	186.947097	1.625679e+07

```
window_calc(
central_park_weather['2018-10'], # performs to central_park_weather dataframe
  pd.DataFrame.rolling, # different rolling functions per column
  {'TMAX': 'max', 'TMIN': 'min', 'AWND': 'mean', 'PRCP': 'sum'}, # using .agg() method
  '3D' # for 3 days
).head()
```

```
<ipython-input-39-5c44dd1dd438>:2: FutureWarning: Indexing a DataFrame with a datetimelike index using a single string to slice the rows
  central_park_weather['2018-10'], # performs to central_park_weather dataframe
```

date	datatype	TMAX	TMIN	AWND	PRCP
2018-10-01	24.4	17.2	0.900000	0.0
2018-10-02	25.0	17.2	0.900000	17.5
2018-10-03	25.0	17.2	0.966667	17.5
2018-10-04	25.0	16.1	0.800000	18.5
2018-10-05	24.4	15.6	1.033333	1.0