```
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

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

	open	high	low	close	volume
date					
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

```
fb.assign(
    abs_z_score_volume = lambda x: x.volume.sub(x.volume.mean()).div(x.volume.std()).abs()
).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(),
    pct_change_rank = lambda x: x.volume_pct_change.abs().rank(
        ascending = False
    )
).nsmallest(5, 'pct_change_rank')
```

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
2018-09-21	166.64	167.25	162.81	162.93	45994800	1.428956	4.0
2018-03-26	160.82	161.10	149.02	160.06	126116634	1.352496	5.0

```
fb['2018-01-11':'2018-01-12']
```

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()
```

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

```
volume     True
dtype: bool
```

```
(fb > 215).all()
```

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

```
(fb.volume.value_counts() > 1).sum()
```

```
0
```

```
volume_binned = pd.cut(fb.volume, bins=3, labels=['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
)
```

	open	high	low	close	volume
date					
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

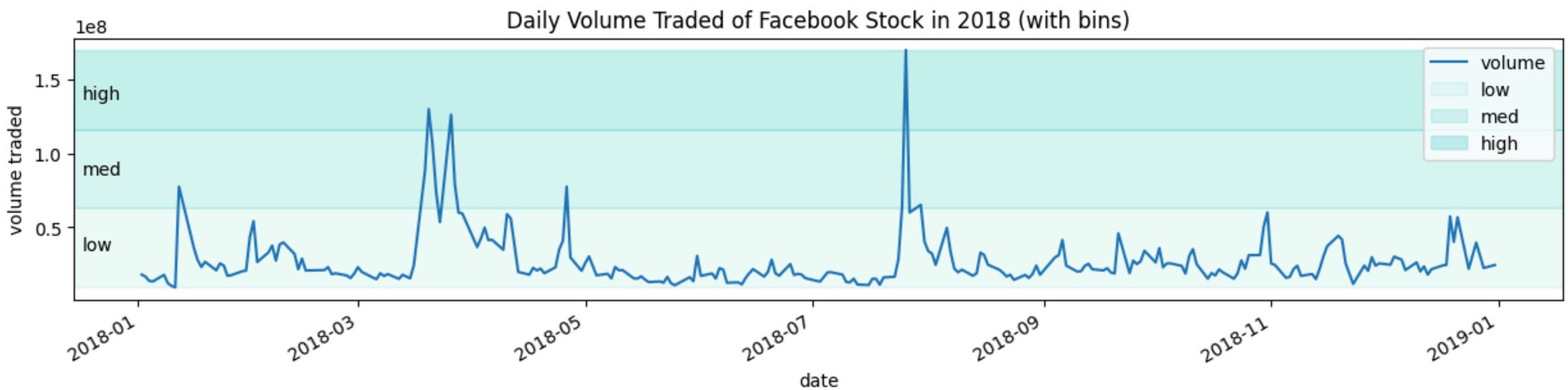
```
fb['2018-07-25':'2018-07-26']
```

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

```
fb['2018-03-16': '2018-03-20']
```

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


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()
```

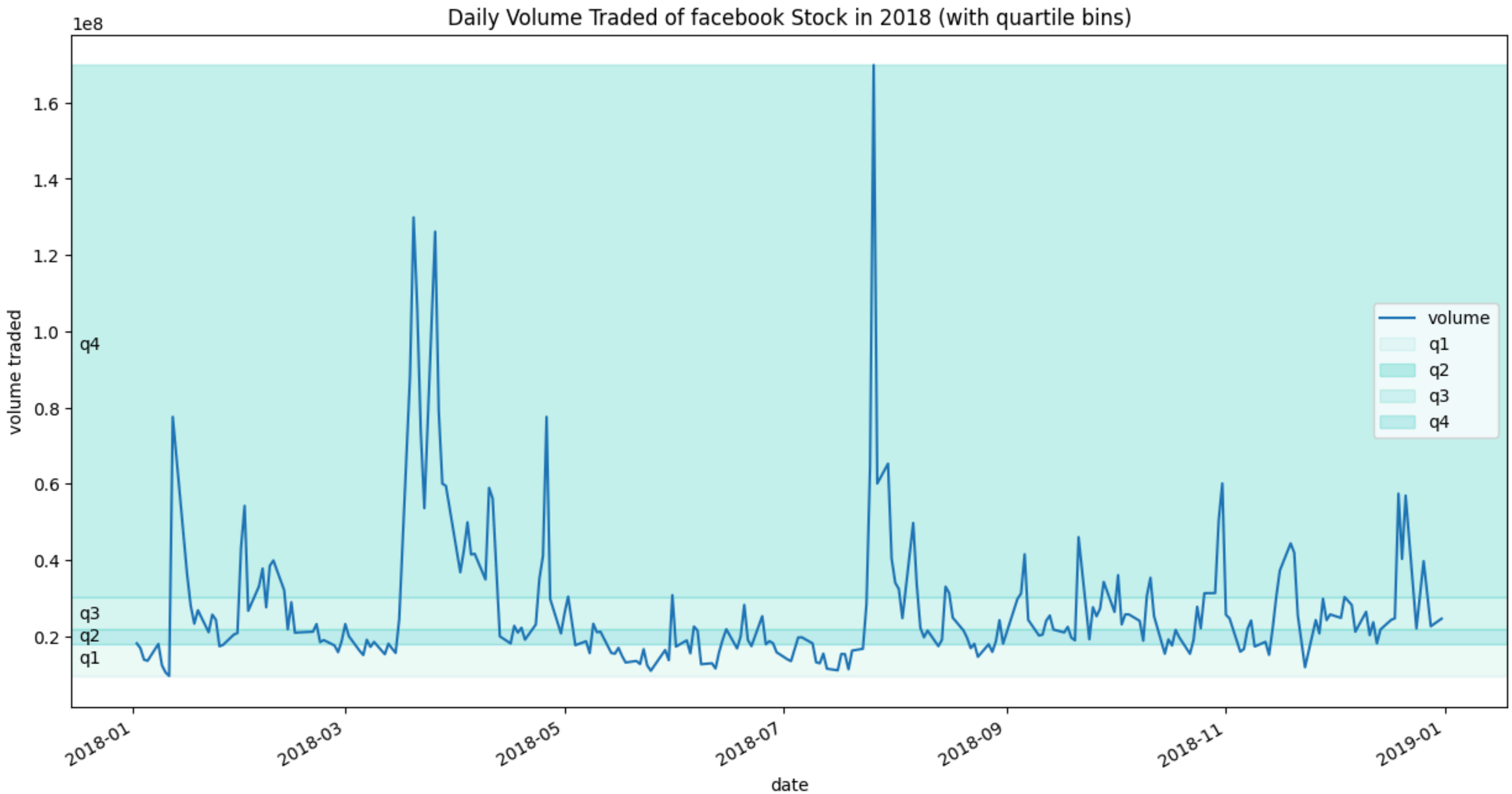



```
volume_qbinned = pd.qcut(fb.volume, q =4, labels=['q1', 'q2', 'q3', 'q4'])
volume_qbinned.value_counts()
```

```
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)')

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()
```




```
central_park_weather = weather.query('station == "GHCND:USW00094728"'
).pivot(index='date', columns='datatype', values='value')
central_park_weather.head()
```

datatype date	AWND	PRCP	SNOW	SNWD	TMAX	TMIN	WDF2	WDF5	WSF2	WSF5	WT01	WT02	WT03	WT06	WT08
2018-01-01	3.5	0.0	0.0	0.0	-7.1	-13.8	300.0	300.0	6.7	11.2	NaN	NaN	NaN	NaN	NaN
2018-01-02	3.6	0.0	0.0	0.0	-3.2	-10.5	260.0	250.0	7.2	12.5	NaN	NaN	NaN	NaN	NaN
2018-01-03	1.4	0.0	0.0	0.0	-1.0	-8.8	260.0	270.0	6.3	9.8	NaN	NaN	NaN	NaN	NaN
2018-01-04	5.6	19.3	249.0	30.0	-1.6	-7.1	310.0	310.0	10.7	19.2	1.0	1.0	NaN	NaN	1.0
2018-01-05	5.8	0.0	0.0	180.0	-7.1	-12.7	280.0	280.0	9.4	15.7	NaN	NaN	NaN	NaN	NaN

```
central_park_weather.SNOW.clip(0,1).value_counts()
```

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

Applying Functions

```
oct_weather_z_scores = central_park_weather.loc[
    '2018-10', ['TMIN', 'TMAX', 'PRCP']
].apply(lambda x: x.sub(x.mean()).div(x.std()))
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')
```

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

```
central_park_weather.loc['2018-10', 'PRCP'].describe()
```

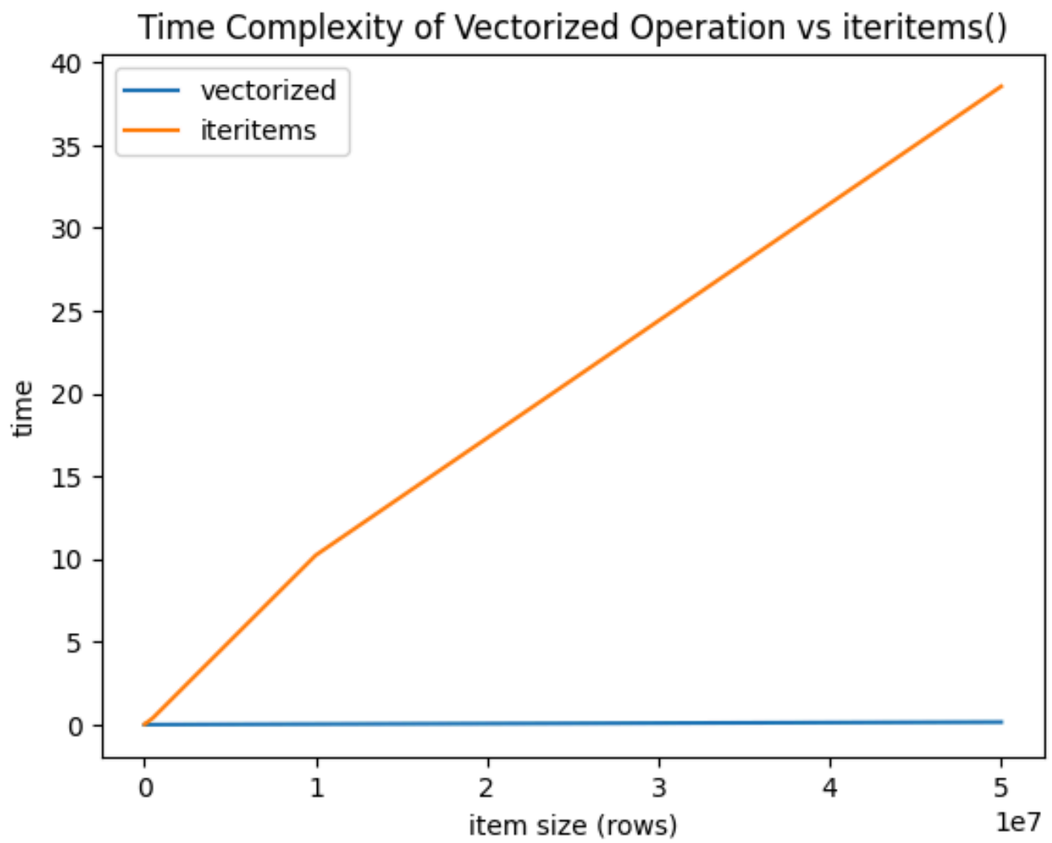
```
count    31.000000
mean      2.941935
std       7.458542
min       0.000000
25%       0.000000
50%       0.000000
75%       1.150000
max      32.300000
Name: PRCP, dtype: float64
```

```
import numpy as np

fb.apply(
    lambda x: np.vectorize(lambda y: len (str(np.ceil(y))))(x)
).astype('int64').equals(
    fb.applymap(lambda x: len(str(np.ceil(x))))
)
```

```
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, 10000000, 50000000, 10000000]:
  test = pd.Series(np.random.uniform(size=size))

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

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

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

```
<ipython-input-38-977627aa05a0>:22: FutureWarning: iteritems is deprecated and will be removed in a future version. Use .items instead.
  for i, v in test.iteritems():
```



Window Calculations

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

```
<ipython-input-40-7153c5f9a0f1>:1: FutureWarning: Indexing a DataFrame with a datetimelike index using a single string to slice the rows, like `frame[string]`, is depr
  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]
```

```
<ipython-input-41-2abb37634d3b>:1: FutureWarning: Indexing a DataFrame with a datetimelike index using a single string to slice the rows, like `frame[string]`, is depr
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': '2018-10-17'].rolling('3D').agg(
    {'TMAX': 'max', 'TMIN': 'min', 'AWND':'mean', 'PRCP' : 'sum'}
).join(
    central_park_weather[['TMAX', 'TMIN', 'AWND', 'PRCP']],
    lsuffix='_rolling'
).sort_index(axis=1)
```

datatype date	AWND	AWND_rolling	PRCP	PRCP_rolling	TMAX	TMAX_rolling	TMIN	TMIN_rolling
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
2018-10-08	1.8	1.133333	0.0	0.0	23.3	26.1	17.8	17.2
2018-10-09	0.3	1.066667	0.0	0.0	25.0	26.1	18.9	17.8
2018-10-10	1.2	1.100000	0.0	0.0	26.7	26.7	21.7	17.8
2018-10-11	0.6	0.700000	21.3	21.3	25.0	26.7	20.6	18.9
2018-10-12	2.6	1.466667	10.9	32.2	20.0	26.7	10.6	10.6
2018-10-13	NaN	1.600000	2.5	34.7	12.8	25.0	7.8	7.8
2018-10-14	NaN	2.600000	0.0	13.4	14.4	20.0	8.3	7.8
2018-10-15	NaN	NaN	1.3	3.8	20.0	20.0	11.1	7.8
2018-10-16	NaN	NaN	0.3	1.6	15.6	20.0	8.3	8.3
2018-10-17	NaN	NaN	0.0	1.6	16.1	20.0	7.8	7.8

```
central_park_weather.PRCP.expanding().sum().equals(central_park_weather.PRCP.cumsum())
```

```
False
```

```
central_park_weather['2018-10-01':'2018-10-07'].expanding().agg(
    {'TMAX': np.max, 'TMIN': np.min, 'AWND' : np.mean, 'PRCP':np.sum}
).join(
    central_park_weather[['TMAX', 'TMIN', 'AWND', 'PRCP']],
    lsuffix = '_expanding'
).sort_index(axis=1)
```

datatype	AWND	AWND_expanding	PRCP	PRCP_expanding	TMAX	TMAX_expanding	TMIN	TMIN_expanding
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	0.825000	1.0	18.5	24.4	25.0	16.1	16.1

```
fb.assign(
    close_ewma=lambda x: x.close.ewm(span=5).mean()
).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