AI for Investment Analysis
Python Pandas 量化投資分析
(Quantitative Investing with Pandas in Python)

1082AIIA07
MBA, IMTKU (M2399) (8409) (Spring 2020)
Wed 3, 4 (10:10-12:00) (B206)

Min-Yuh Day
Associate Professor
Dept. of Information Management, Tamkang University

http://mail.tku.edu.tw/myday/
2020-04-22
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<th>日期 (Date)</th>
<th>內容 (Subject/Topics)</th>
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<td>人工智慧投資分析課程介紹 (Course Orientation on AI for Investment Analysis)</td>
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<td>TensorFlow 深度學習投資分析 II (Deep Learning for Investment Analysis with TensorFlow II)</td>
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課程大綱 (Syllabus)

週次 (Week) 日期 (Date) 內容 (Subject/Topics)
13 2020/05/27 人工智慧投資分析個案研究 II
   (Case Study on Artificial Intelligence for Investment Analysis II)
14 2020/06/03 TensorFlow 深度學習投資分析 III
   (Deep Learning for Investment Analysis with TensorFlow III)
15 2020/06/10 投資組合最佳化與程式交易
   (Portfolio Optimization and Algorithmic Trading)
16 2020/06/17 期末報告 I (Final Project Presentation I)
17 2020/06/24 期末報告 II (Final Project Presentation II)
18 2020/07/01 教師彈性補充教學
Quantitative Investing with Pandas in Python
Outline

• Quantitative Investing with Pandas in Python
  – Numpy
    • Scientific computing
  – Pandas
    • Data structures and data analysis tools
The Quant Finance PyData Stack

Quantopian

PyTables

StatsModels

NetworkX

scikits-image

matplotlib

NumPy

SciPy

sympy

Python

ipython

jupyter

PyThalesians

Zipline

DX Analytics

PyAlgoTrade

QuantLib

Source: http://nbviewer.jupyter.org/format/slides/github/quantopian/pyfolio/blob/master/pyfolio/examples/overview_slides.ipynb#5
```python
import pandas as pd
import pandas_datareader.data as web
import matplotlib.pyplot as plt
import seaborn as sns
import datetime as dt
import matplotlib inline

# Read Stock Data from Yahoo Finance
end = dt.datetime.now()
start = dt.datetime(2017, 1, 1)
df = web.DataReader('AAPL', 'yahoo', start, end)
df.to_csv('AAPL.csv')
print(df.tail())
df2 = pd.read_csv('AAPL.csv')
print(df2.tail())

df['Adj Close'].plot(legend=True, figsize=(12, 8), title='AAPL', label='Adj Close')
plt.figure(figsize=(12, 9))
top = plt.subplot2grid((12,9), (0, 0), rowspan=10, colspan=9)
bottom = plt.subplot2grid((12,9), (10,0), rowspan=2, colspan=9)
top.plot(df.index, df['Adj Close'], color='blue')
bottom.bar(df.index, df['Volume'])

def MA05 = df['Adj Close'].rolling(5).mean() # 5 days
MA20 = df['Adj Close'].rolling(20).mean() # 20 days
MA60 = df['Adj Close'].rolling(60).mean() # 60 days

df2 = pd.DataFrame({'Adj Close': df['Adj Close'], 'MA05': df['MA05'], 'MA20': df['MA20'], 'MA60': df['MA60']})
df2.plot(figsize=(12, 9), legend=True, title='AAPL')
df2.to_csv('AAPL_MA.csv')
fig = plt.gcf()
fig.set_size_inches(12, 9)
fig.savefig('AAPL_plot.png', dpi=300)
```

https://tinyurl.com/imtkupython101
Numpy

NumPy

Base

N-dimensional array package
NumPy is the fundamental package for scientific computing with Python.
NumPy

- NumPy provides a \textbf{multidimensional array} object to store homogenous or heterogeneous data; it also provides \textbf{optimized functions/methods} to operate on this array object.

Source: Yves Hilpisch (2014), Python for Finance: Analyze Big Financial Data, O'Reilly
NumPy

NumPy is the fundamental package for scientific computing with Python. It contains among other things:

- a powerful N-dimensional array object
- sophisticated (broadcasting) functions
- tools for integrating C/C++ and Fortran code
- useful linear algebra, Fourier transform, and random number capabilities

Besides its obvious scientific uses, NumPy can also be used as an efficient multi-dimensional container of generic data. Arbitrary data-types can be defined. This allows NumPy to seamlessly and speedily integrate with a wide variety of databases.

NumPy is licensed under the BSD license, enabling reuse with few restrictions.

Getting Started

- Getting NumPy
- Installing the SciPy Stack
- NumPy and SciPy documentation page
- NumPy Tutorial
- NumPy for MATLAB© Users
- NumPy functions by category
- NumPy Mailing List

For more information on the SciPy Stack (for which NumPy provides the fundamental array data structure), see scipy.org.

http://www.numpy.org/
NumPy ndarray

### One-dimensional Array (1-D Array)

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### Two-dimensional Array (2-D Array)

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</tr>
</tbody>
</table>
v = list(range(1, 6))
v
2 * v

import numpy as np
v = np.arange(1, 6)
v
2 * v

Source: Yves Hilpisch (2014), Python for Finance: Analyze Big Financial Data, O'Reilly
```python
1 v = list(range(1, 6))
2 v

[1, 2, 3, 4, 5]

1 2 * v

[1, 2, 3, 4, 5, 1, 2, 3, 4, 5]

1 import numpy as np
2 v = np.arange(1, 6)
3 v

array([[1, 2, 3, 4, 5]])

1 2 * v

array([[ 2,  4,  6,  8, 10]])
```
```python
import numpy as np
a = np.array([1, 2, 3])
b = np.array([4, 5, 6])
c = a * b
print(c)
```

Source: Yves Hilpisch (2014), Python for Finance: Analyze Big Financial Data, O'Reilly
```python
import numpy as np

a = np.zeros((2, 2))  # Create an array of all zeros
print(a)  # Prints "[[ 0.  0.]
      #     [ 0.  0.]]"

b = np.ones((1, 2))  # Create an array of all ones
print(b)  # Prints "[[ 1.  1.]]"

c = np.full((2, 2), 7)  # Create a constant array
print(c)  # Prints "[[ 7.  7.]
      #     [ 7.  7.]]"

d = np.eye(2)  # Create a 2x2 identity matrix
print(d)  # Prints "[[ 1.  0.]
      #     [ 0.  1.]]"

e = np.random.random((2, 2))  # Create an array filled with random values
print(e)  # Might print "[[ 0.91940167 0.08143941]
      #     [ 0.68744134 0.87236687]]"
```

```
[[ 0.  0.]
 [ 0.  0.]]
[[ 1.  1.]]
[[ 7  7]
 [ 7  7]]
[[ 1.  0.]
 [ 0.  1.]]
[[0.66258211 0.65552598]
 [0.00429934 0.21695824]]
```
Quickstart tutorial

Prerequisites

Before reading this tutorial you should know a bit of Python. If you would like to refresh your memory, take a look at the Python tutorial.

If you wish to work the examples in this tutorial, you must also have some software installed on your computer. Please see http://scipy.org/install.html for instructions.

The Basics

NumPy’s main object is the homogeneous multidimensional array. It is a table of elements (usually numbers), all of the same type, indexed by a tuple of positive integers. In NumPy dimensions are called axes. The number of axes is rank.

For example, the coordinates of a point in 3D space [1, 2, 1] is an array of rank 1, because it has one axis. That axis has a length of 3. In the example pictured below, the array has rank 2 (it is 2-dimensional). The first dimension (axis) has a length of 2, the second dimension has a length of 3.

```python
[[ 1., 0., 0.],
 [ 0., 1., 2.]]
```

NumPy’s array class is called ndarray. It is also known by the alias array. Note that numpy.array is not the same as the Standard Python Library class array.array, which only handles one-dimensional arrays and offers less functionality. The more important attributes of an ndarray object are:

```python
ndarray.ndim
```

the number of axes (dimensions) of the array. In the Python world, the number of dimensions is referred to as rank.

```python
ndarray.shape
```
```python
import numpy as np
a = np.arange(15).reshape(3, 5)
a.shape
a.ndim
a.dtype.name
```

```
array([[ 0,  1,  2,  3,  4],
       [ 5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14]])
```

```
print(a.shape)
(3, 5)
```

```
a.ndim
2
```

```
a.dtype.name
'int64'
```
### Matrix

An **$m$-by-$n$ matrix** is a rectangular array of numbers, symbols, or expressions, arranged in rows and columns. Each entry in the matrix is denoted by $a_{i,j}$, where $i$ represents the row and $j$ represents the column.

- **Rows** (denoted by $m$) change as we move downward through the matrix.
- **Columns** (denoted by $n$) change as we move rightward through the matrix.
- **Entries** change as we move from left to right within each row.

The general form of an $m$-by-$n$ matrix is:

\[
\begin{bmatrix}
  a_{1,1} & a_{1,2} & a_{1,3} & \cdots \\
  a_{2,1} & a_{2,2} & a_{2,3} & \cdots \\
  a_{3,1} & a_{3,2} & a_{3,3} & \cdots \\
  \vdots & \vdots & \vdots & \ddots \\
\end{bmatrix}
\]

Source: https://simple.wikipedia.org/wiki/Matrix_(mathematics)
NumPy ndarray: Multidimensional Array Object
NumPy ndarray

One-dimensional Array (1-D Array)

<table>
<thead>
<tr>
<th></th>
<th>0</th>
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<td>m-1</td>
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<td>18</td>
<td>19</td>
<td>20</td>
</tr>
</tbody>
</table>

Two-dimensional Array (2-D Array)
```python
import numpy as np
a = np.array([1, 2, 3, 4, 5])
```

One-dimensional Array (1-D Array)

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

```python
a
array([1, 2, 3, 4, 5])
```
Two-dimensional Array (2-D Array)

\[
a = \text{np.array}\left([\begin{array}{ccccc}
1 & 2 & 3 & 4 & 5 \\
6 & 7 & 8 & 9 & 10 \\
11 & 12 & 13 & 14 & 15 \\
16 & 17 & 18 & 19 & 20 \\
\end{array}\right]\right)
\]
import numpy as np

a = np.array([[0, 1, 2, 3],
              [10, 11, 12, 13],
              [20, 21, 22, 23]])

a
```python
a = np.array([[0, 1, 2, 3], [10, 11, 12, 13], [20, 21, 22, 23]])
```

```
a = np.array([[0, 1, 2, 3], [10, 11, 12, 13], [20, 21, 22, 23]])
a
```

```
array([[ 0,  1,  2,  3],
       [10, 11, 12, 13],
       [20, 21, 22, 23]])
```

```
print(a.ndim)
2
```

```
print(a.shape)
(3, 4)
```
NumPy Basics: Arrays and Vectorized Computation

## NumPy Array

<table>
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<tr>
<th></th>
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<td><strong>0</strong></td>
<td>0,0</td>
<td>0,1</td>
<td>0,2</td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>1,0</td>
<td>1,1</td>
<td>1,2</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>2,0</td>
<td>2,1</td>
<td>2,2</td>
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# Numpy Array

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<th>Shape</th>
</tr>
</thead>
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<td>arr[:2, 1:]</td>
<td>(2, 2)</td>
</tr>
<tr>
<td>arr[2]</td>
<td>(3,)</td>
</tr>
<tr>
<td>arr[2, :]</td>
<td>(3,)</td>
</tr>
<tr>
<td>arr[2:, :]</td>
<td>(1, 3)</td>
</tr>
<tr>
<td>arr[ :, :2]</td>
<td>(3, 2)</td>
</tr>
<tr>
<td>arr[1, :2]</td>
<td>(2,)</td>
</tr>
<tr>
<td>arr[1:2, :2]</td>
<td>(1, 2)</td>
</tr>
</tbody>
</table>


Materials and IPython notebooks for "Python for Data Analysis" by Wes McKinney, published by O'Reilly Media

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<th>Description</th>
<th>Date</th>
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</tr>
<tr>
<td>examples</td>
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<td>4 months ago</td>
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<tr>
<td>ch10.ipynb</td>
<td>Make more cells markdown instead of raw</td>
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</table>

NumPy Basics: Arrays and

```
In [ ]: import numpy as np
np.random.seed(12345)
import matplotlib.pyplot as plt
plt.rc('figure', figsize=(10, 5))
np.set_printoptions(precision=4, suppress=True)
```

```
In [ ]: import numpy as np
my_arr = np.arange(1000000)
my_list = list(range(1000000))
```

```
In [ ]: %time for _ in range(10): my_arr2 = my_arr * 2
%time for _ in range(10): my_list2 = [x * 2 for x in my_list]
```

The NumPy ndarray: A Multidimensional Array Object

```
In [ ]: import numpy as np
# Generate some random data
data = np.random.randn(2, 3)
data
```
Python
Pandas
Pandas is an open source, BSD-licensed library providing high-performance, easy-to-use data structures and data analysis tools for the Python programming language.

Pandas is a NUMFOCUS sponsored project. This will help ensure the success of development of pandas as a world-class open-source project.

A Fiscally Sponsored Project of

NUMFOCUS
OPEN CODE = BETTER SCIENCE

0.19.2 Final (December 24, 2016)

This is a minor bug-fix release in the 0.19.x series and includes some small regression fixes, bug fixes and performance improvements.

Highlights include:

- Compatibility with Python 3.6

http://pandas.pydata.org/
pandas

Python Data Analysis Library

providing high-performance, easy-to-use data structures and data analysis tools for the Python programming language.

Source: http://pandas.pydata.org/
pandas Ecosystem

- **Statistics and Machine Learning**
  - Statsmodels
  - sklearn-pandas

- **Visualization**
  - Bokeh
  - yhat/ggplot
  - Seaborn
  - Vincent
  - IPython Vega
  - Plotly
  - Pandas-Qt

- **IDE**
  - IPython
  - quantopian/qgrid
  - Spyder

- **API**
  - pandas-datareader
  - quandl/Python
  - pydatastream
  - pandaSDMX
  - fredapi

- **Domain Specific**
  - Geopandas
  - xarray

- **Out-of-core**
  - Dask
  - Blaze
  - Odo

pandas-datareader

Up to date remote data access for pandas, works for multiple versions of pandas.

⚠️ Warning

As of v0.6.0 Yahoo!, Google Options, Google Quotes and EDGAR have been immediately deprecated due to large changes in their API and no stable replacement.

⚠️ Note

As of v0.6.0 Google finance is still functioning for historical price data, although there are frequent reports of failures. Failure is frequently encountered when bulk downloading historical price data.

Usage

Starting in 0.19.0, pandas no longer supports pandas.io.data or pandas.io.wb, so you must replace your imports from pandas.io with those from pandas_datareader:

```python
from pandas.io import data, wb # becomes
from pandas_datareader import data, wb
```

Many functions from the data module have been included in the top level API.

Get Financial Data Directly into Python

Get millions of financial and economic datasets from hundreds of publishers directly into Python.

Load Quandl Data Directly Into Python

All the Data You Want
Quandl unifies financial and economic datasets from hundreds of publishers on a single user-friendly platform.

Directly Into Python

https://www.quandl.com/tools/python
PyDatastream

Project description

PyDatastream is a Python interface to the Thomson Dataworks Enterprise (DWE) SOAP API (non free), with some convenience functions for retrieving Datastream data specifically. This package requires valid credentials for this API.

For the documentation please refer to README.md inside the package or on the GitHub (https://github.com/vfilimonov/pydatastream/blob/master/README.md).

https://pypi.org/project/PyDatastream/
pandaSDMX: Statistical Data and Metadata eXchange in Python

pandaSDMX is an Apache 2.0-licensed Python client to retrieve and acquire statistical data and metadata disseminated in SDMX 2.1, an ISO-standard widely used by institutions such as statistics offices, central banks, and international organisations. pandaSDMX exposes datasets and related structural metadata including dataflows, codelists, and datastructure definitions as pandas Series or multi-indexed DataFrames. Many other output formats and storage backends are available thanks to Odo.

Supported data providers

pandaSDMX ships with built-in support for the following agencies (others may be configured by the user):

- Australian Bureau of Statistics (ABS)
- European Central Bank (ECB)
- Eurostat
- French National Institute for Statistics (INSEE)
- Instituto Nacional de la Estadistica y Geografia - INEGI (Mexico)
- International Monetary Fund (IMF) - SDMX Central only
- International Labour Organization (ILO)
- Italian statistics Office (ISTAT)
- Norges Bank (Norway)
- Organisation for Economic Cooperation and Development (OECD)
- United Nations Statistics Division (UNSD)
- UNESCO (free registration required)
- World Bank - World Integrated Trade Solution (WITS)

https://pandasdmx.readthedocs.io/en/latest/
Fred API

FRED® API

General Documentation | API | Toolkits

The FRED® API is a web service that allows developers to write programs and build applications that retrieve economic data from the FRED® and ALFRED® websites hosted by the Economic Research Division of the Federal Reserve Bank of St. Louis. Requests can be customized according to data source, release, category, series, and other preferences.

General Documentation

- Overview
- What is FRED®?
- What is ALFRED®?
- FRED® versus ALFRED®
- Real-Time Periods
- Errors

API

Categories

- fred/category – Get a category.
- fred/category/children – Get the child categories for a specified parent category.
- fred/category/related – Get the related categories for a category.
- fred/category/series – Get the series in a category.
- fred/category/tags – Get the tags for a category.
- fred/category/related_tags – Get the related tags for a category.

https://research.stlouisfed.org/docs/api/fred/
pandas is a Python package providing fast, flexible, and expressive data structures designed to make working with “relational” or “labeled” data both easy and intuitive. It aims to be the fundamental high-level building block for doing practical, real-world data analysis in Python. Additionally, it has the broader goal of becoming the most powerful and flexible open source data analysis / manipulation tool available in any language. It is already well on its way toward this goal.

pandas is well suited for many different kinds of data:

- Tabular data with heterogeneously-typed columns, as in an SQL table or Excel spreadsheet
- Ordered and unordered (not necessarily fixed-frequency) time series data.
- Arbitrary matrix data (homogeneously typed or heterogeneous) with row and column labels
- Any other form of observational / statistical data sets. The data actually need not be labeled at all to be placed into a pandas data structure

The two primary data structures of pandas, Series (1-dimensional) and DataFrame (2-dimensional), handle the vast majority of typical use cases in finance, statistics, social science, and many areas of engineering. For R users, DataFrame provides everything that R's data.frame provides and much more. pandas is built on top of NumPy and is

pandas: powerful Python data analysis toolkit

• Tabular data with heterogeneously-typed columns, as in an SQL table or Excel spreadsheet
• Ordered and unordered (not necessarily fixed-frequency) time series data.
• Arbitrary matrix data (homogeneously typed or heterogeneous) with row and column labels
• Any other form of observational / statistical data sets. The data actually need not be labeled at all to be placed into a pandas data structure

Source: http://pandas.pydata.org/pandas-docs/stable/
Series

DataFrame

• Primary data structures of pandas
  – Series (1-dimensional)
  – DataFrame (2-dimensional)

• Handle the vast majority of typical use cases in finance, statistics, social science, and many areas of engineering.

Source: http://pandas.pydata.org/pandas-docs/stable/
pandas DataFrame

• **DataFrame** provides everything that R’s `data.frame` provides and much more.

• pandas is built on top of **NumPy** and is intended to integrate well within a scientific computing environment with many other 3rd party libraries.
## Comparison with SAS

<table>
<thead>
<tr>
<th>pandas</th>
<th>SAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DataFrame</td>
<td>data set</td>
</tr>
<tr>
<td>column</td>
<td>variable</td>
</tr>
<tr>
<td>row</td>
<td>observation</td>
</tr>
<tr>
<td>groupby</td>
<td>BY-group</td>
</tr>
<tr>
<td>NaN</td>
<td>.</td>
</tr>
</tbody>
</table>

Python Pandas Cheat Sheet

Data Wrangling with pandas Cheat Sheet

Syntax – Creating DataFrames

Tidy Data – A foundation for wrangling in pandas

Reshaping Data – Change the layout of a data set

Subset Observations (Rows)

Subset Variables (Columns)

Logic in Python (and pandas)

Method Chaining

Most pandas methods return a DataFrame so that another pandas method can be applied to the result. This improves readability of code.

df = pd.DataFrame(
    {'a': [4,5,6],
     'b': [7,8,9],
     'c': [10,11,12]},
    index=[1,2,3])

cols = ['a', 'b', 'c']

Create DataFrame with a MultiIndex

http://pandas.pydata.org


Written by Evgeni Lushchik, Prinington Consultants
Creating `pd.DataFrame`

```python
import pandas as pd

df = pd.DataFrame({
    "a": [4, 5, 6],
    "b": [7, 8, 9],
    "c": [10, 11, 12],
},
    index = [1, 2, 3])
```

Pandas DataFrame

```
    type(df)
```

```
    type(df)

    pandas.core.frame.DataFrame
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
print('pandas imported')

s = pd.Series([1, 3, 5, np.nan, 6, 8])
s

dates = pd.date_range('20181001', periods=6)
dates

Source: http://pandas.pydata.org/pandas-docs/stable/10min.html
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
print('pandas imported')

s = pd.Series([1, 3, 5, np.nan, 6, 8])

s

0    1.0
1    3.0
2    5.0
3   NaN
4    6.0
5    8.0
dtype: float64

dates = pd.date_range('20181001', periods=6)
dates

DatetimeIndex(['2018-10-01', '2018-10-02', '2018-10-03', '2018-10-04',
               '2018-10-05', '2018-10-06'],
              dtype='datetime64[ns]', freq='D')
```
```python
df = pd.DataFrame(np.random.randn(6,4), index=dates, columns=list('ABCD'))
df
```

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018-10-01</td>
<td>-0.336188</td>
<td>0.584621</td>
<td>-1.061433</td>
<td>-0.036278</td>
</tr>
<tr>
<td>2018-10-02</td>
<td>0.903683</td>
<td>-0.839723</td>
<td>-0.270219</td>
<td>-1.099606</td>
</tr>
<tr>
<td>2018-10-03</td>
<td>0.920208</td>
<td>-0.240353</td>
<td>-0.818598</td>
<td>-1.105489</td>
</tr>
<tr>
<td>2018-10-04</td>
<td>0.221045</td>
<td>-0.314589</td>
<td>0.042071</td>
<td>-1.447280</td>
</tr>
<tr>
<td>2018-10-05</td>
<td>0.946862</td>
<td>-1.570305</td>
<td>-1.009180</td>
<td>-0.375659</td>
</tr>
<tr>
<td>2018-10-06</td>
<td>-0.225148</td>
<td>0.510691</td>
<td>2.002372</td>
<td>-0.335005</td>
</tr>
</tbody>
</table>
```python
df = pd.DataFrame(np.random.randn(3,5),
                  index=['student1','student2','student3'],
                  columns=list('ABCDE'))
df
```

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>student1</td>
<td>-0.346884</td>
<td>-1.232934</td>
<td>-0.302072</td>
<td>-1.345084</td>
<td>-0.723880</td>
</tr>
<tr>
<td>student2</td>
<td>1.090955</td>
<td>-0.010483</td>
<td>1.280072</td>
<td>-0.253958</td>
<td>-0.030604</td>
</tr>
<tr>
<td>student3</td>
<td>0.325660</td>
<td>0.808956</td>
<td>-0.395820</td>
<td>-1.498926</td>
<td>1.603471</td>
</tr>
</tbody>
</table>
df2 = pd.DataFrame({ 'A' : 1.,
'B' : pd.Timestamp('20181001'),
'C' : pd.Series(2.5,index=list(range(4)),dtype='float32'),
'D' : np.array([3] * 4,dtype='int32'),
'E' : pd.Categorical(["test", "train", "test", "train"]),
'F' : 'foo' })

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.0</td>
<td>2018-10-01</td>
<td>2.5</td>
<td>3</td>
<td>test</td>
<td>foo</td>
</tr>
<tr>
<td>1</td>
<td>1.0</td>
<td>2018-10-01</td>
<td>2.5</td>
<td>3</td>
<td>train</td>
<td>foo</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
<td>2018-10-01</td>
<td>2.5</td>
<td>3</td>
<td>test</td>
<td>foo</td>
</tr>
<tr>
<td>3</td>
<td>1.0</td>
<td>2018-10-01</td>
<td>2.5</td>
<td>3</td>
<td>train</td>
<td>foo</td>
</tr>
</tbody>
</table>
df2.dtypes

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>float64</td>
</tr>
<tr>
<td>B</td>
<td>datetime64[ns]</td>
</tr>
<tr>
<td>C</td>
<td>float32</td>
</tr>
<tr>
<td>D</td>
<td>int32</td>
</tr>
<tr>
<td>E</td>
<td>category</td>
</tr>
<tr>
<td>F</td>
<td>object</td>
</tr>
</tbody>
</table>

dtype: object
Python Pandas for Finance

Source: https://mapattack.wordpress.com/2017/02/12/using-python-for-stocks-1/
Yves Hilpisch (2018),
Python for Finance: Mastering Data-Driven Finance, O'Reilly

https://github.com/yhilpisch/py4fi2nd

Source: https://www.amazon.com/Python-Finance-Mastering-Data-Driven/dp/1492024333
! pip install pandas_datareader

Collecting pandas_datareader
  Downloading https://files.pythonhosted.org/packages/cc/5c/ea5b6dcfd0f55c5f81e37fb45335ec01ccec1a99b8a79339137f5ed269e0/pandas_datareader-58.tar.gz (112kB)
    100% |elasbf| 112kB 2.7MB/s

Collecting lxml (from pandas_datareader)
  Downloading https://files.pythonhosted.org/packages/03/a4/9e8a8035fc7c7670e5eab97f34ff2ef0edd78a491bf96df5accedb0e63f5/1xml-4.2.5-cp38-cp38.tar.gz (5.8MB)
    100% |elasbf| 5.8MB 7.5MB/s

Requirement already satisfied: pandas>=0.19.2 in /usr/local/lib/python3.6/dist-packages (from pandas_datareader) (0.22.0)
Requirement already satisfied: requests>=2.3.0 in /usr/local/lib/python3.6/dist-packages (from pandas_datareader) (2.18.4)
Requirement already satisfied: wrapt in /usr/local/lib/python3.6/dist-packages (from pandas_datareader) (1.10.11)
Requirement already satisfied: python-dateutil>=2 in /usr/local/lib/python3.6/dist-packages (from pandas-datareader)=0.19.2--pandas_datareader) (2)
Requirement already satisfied: numpy>=1.9.0 in /usr/local/lib/python3.6/dist-packages (from pandas-datareader>=0.19.2--pandas_datareader) (1.14.6)
Requirement already satisfied: pytz>=2011k in /usr/local/lib/python3.6/dist-packages (from pandas-datareader>=0.19.2--pandas_datareader) (2018.5)
Requirement already satisfied: idna<2.7,>=2.5 in /usr/local/lib/python3.6/dist-packages (from requests>=2.3.0--pandas_datareader) (2.6)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.6/dist-packages (from requests>=2.3.0--pandas_datareader) (4)
Requirement already satisfied: urllib3<=1.23,>=1.21.1 in /usr/local/lib/python3.6/dist-packages (from requests>=2.3.0--pandas_datareader) (1.23)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.6/dist-packages (from python-dateutil>=2--pandas-datareader=0.19.2--pandas_datareader)

Installing collected packages: lxml, pandas-datareader
Successfully installed lxml-4.2.5 pandas-datareader-0.7.0
conda install pandas-datareader

```
[iMyday-MacBook-Pro:~ imyday$ conda install pandas-datareader
Fetching package metadata ...........
Solving package specifications:  .

Package plan for installation in environment /Users/imyday/anaconda:

The following NEW packages will be INSTALLED:

    pandas-datareader: 0.2.1-py36_0
    requests-file: 1.4.1-py36_0

Proceed ([y]/n)? y

requests-file- 100% |###################################| Time: 0:00:00  1.55 MB/s
pandas-datareader 100% |###################################| Time: 0:00:00  409.66 kB/s

[iMyday-MacBook-Pro:~ imyday$ conda list
# packages in environment at /Users/imyday/anaconda:
#
  _license           1.1            py36_1
  alabaster          0.7.9         py36_0
  anaconda           4.3.1          np111py36_0
  anaconda-client    1.6.0          py36_0
  anaconda-navigator 1.5.0          py36_0
  anaconda-project   0.4.1          py36_0
```
# !pip install pandas_datareader
import pandas_datareader.data as web
import datetime as dt

# Read Stock Data from Yahoo Finance
end = dt.datetime(2017, 12, 31)
start = dt.datetime(2016, 1, 1)
df = web.DataReader("AAPL", 'yahoo', start, end)
df.to_csv('AAPL.csv')
df.from_csv('AAPL.csv')
df.tail()
# !pip install pandas_datareader
import pandas as pd
import pandas_datareader.data as web
import matplotlib.pyplot as plt
import seaborn as sns
import datetime as dt
%matplotlib inline

#Read Stock Data from Yahoo Finance
end = dt.datetime.now()
#start = dt.datetime(end.year-2, end.month, end.day)
start = dt.datetime(2016, 1, 1)
df = web.DataReader("AAPL", 'yahoo', start, end)
df.to_csv('AAPL.csv')
df.from_csv('AAPL.csv')
df.tail()
df['Adj Close'].plot(legend=True, figsize=(12, 8), title='AAPL', label='Adj Close')
plt.figure(figsize=(12,9))
top = plt.subplot2grid((12,9), (0, 0), rowspan=10, colspan=9)
bottom = plt.subplot2grid((12,9), (10,0), rowspan=2, colspan=9)
top.plot(df.index, df['Adj Close'], color='blue')  # df.index gives the dates
bottom.bar(df.index, df['Volume'])
# set the labels
top.axes.get_xaxis().set_visible(False)
top.set_title('AAPL')
top.set_ylabel('Adj Close')
bottom.set_ylabel('Volume')

plt.figure(figsize=(12,9))
sns.distplot(df['Adj Close'].dropna(), bins=50, color='purple')
# simple moving averages

df['MA05'] = df['Adj Close'].rolling(5).mean()  # 5 days

df['MA20'] = df['Adj Close'].rolling(20).mean()  # 20 days

df['MA60'] = df['Adj Close'].rolling(60).mean()  # 60 days

df2 = pd.DataFrame({'Adj Close': df['Adj Close'], 'MA05': df['MA05'], 'MA20': df['MA20'], 'MA60': df['MA60']})

df2.plot(figsize=(12, 9), legend=True, title='AAPL')

df2.to_csv('AAPL_MA.csv')

fig = plt.gcf()  
fig.set_size_inches(12, 9)

fig.savefig('AAPL_plot.png', dpi=300)

plt.show()
# !pip install pandas_datareader
import pandas as pd
import pandas_datareader.data as web
import matplotlib.pyplot as plt
import seaborn as sns
import datetime as dt
%matplotlib inline

#Read Stock Data from Yahoo Finance
end = dt.datetime.now()
start = dt.datetime(end.year-2, end.month, end.day)
df = web.DataReader("AAPL", 'yahoo', start, end)
df.to_csv('AAPL.csv')
df.from_csv('AAPL.csv')
df.tail()

df["Adj Close"].plot(legend=True, figsize=(12, 8), title='AAPL', label='Adj Close')
plt.figure(figsize=(12,9))
top = plt.subplot2grid((12,9), (0, 0), rowspan=10, colspan=9)
bottom = plt.subplot2grid((12,9), (10,0), rowspan=2, colspan=9)
top.plot(df.index, df["Adj Close"], color='blue') #df.index gives the dates
bottom.bar(df.index, df["Volume"])

# set the labels
top.axes.get_xaxis().set_visible(False)
top.set_title('AAPL')
top.set_ylabel('Adj Close')
bottom.set_ylabel('Volume')

plt.figure(figsize=(12,9))
sns.distplot(df["Adj Close"].dropna(), bins=50, color='purple')

# simple moving averages
df["MA05"] = df["Adj Close"].rolling(5).mean() #5 days
df["MA20"] = df["Adj Close"].rolling(20).mean() #20 days
df["MA60"] = df["Adj Close"].rolling(60).mean() #60 days
df2 = pd.DataFrame({"Adj Close": df["Adj Close"], 'MA05': df["MA05"], 'MA20': df["MA20"], 'MA60': df["MA60"]})
df2.plot(figsize=(12, 9), legend=True, title='AAPL')
df2.to_csv('AAPL_MA.csv')
fig = plt.gcf()
fig.set_size_inches(12, 9)
fig.savefig('AAPL_plot.png', dpi=300)
plt.show()
```python
# !pip install pandas_datareader
import pandas as pd
import pandas_datareader.data as web
import matplotlib.pyplot as plt
import seaborn as sns
import datetime as dt
%matplotlib inline

# Read Stock Data from Yahoo Finance
end = dt.datetime.now()
start = dt.datetime(2018, 1, 1)
df = web.DataReader('AAPL', 'yahoo', start, end)
df.to_csv('AAPL.csv')
df.from_csv('AAPL.csv')
df.tail()

df['Adj Close'].plot(legend=True, figsize=(12, 8), title='AAPL', label='Adj Close')
plt.figure(figsize=(12,9))
top = plt.subplot2grid((12,9), (0, 0), rowspan=10, colspan=9)
bottom = plt.subplot2grid((12,9), (10,0), rowspan=2, colspan=9)
top.plot(df.index, df['Adj Close'], color='blue') # df.index gives the dates
bottom.bar(df.index, df['Volume'])

# set the labels
top.axes.get_xaxis().set_visible(False)
top.set_title('AAPL')
top.set_ylabel('Adj Close')
bottom.set_ylabel('Volume')

plt.figure(figsize=(12,9))
sns.distplot(df['Adj Close'].dropna(), bins=50, color='purple')

# simple moving averages
df['MA05'] = df['Adj Close'].rolling(5).mean() #5 days
df['MA20'] = df['Adj Close'].rolling(20).mean() #20 days
df['MA60'] = df['Adj Close'].rolling(60).mean() #60 days
df2 = pd.DataFrame({'Adj Close': df['Adj Close'], 'MA05': df['MA05'], 'MA20': df['MA20'], 'MA60': df['MA60']})
df2.plot(figsize=(12, 9), legend=True, title='AAPL')
df2.to_csv('AAPL_MA.csv')
fig = plt.gcf()
fig.set_size_inches(12, 9)
fig.savefig('AAPL_plot.png', dpi=300)
plt.show()
```
Finance Data from Quandl

```python
# ! pip install quandl
import quandl

# quandl.ApiConfig.api_key = "YOURAPIKEY"
df = quandl.get("WIKI/AAPL", start_date="2016-01-01", end_date="2017-12-31")
df.to_csv('AAPL.csv')
df.from_csv('AAPL.csv')
df.tail()
```

```
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>2017-12-22</td>
<td>174.68</td>
<td>175.424</td>
<td>174.500</td>
<td>175.01</td>
<td>16052615.0</td>
<td>0.0</td>
<td>1.0</td>
<td>174.68</td>
<td>175.424</td>
<td>174.500</td>
<td>175.01</td>
<td>16052615.0</td>
</tr>
<tr>
<td>2017-12-26</td>
<td>170.80</td>
<td>171.470</td>
<td>169.679</td>
<td>170.57</td>
<td>32968167.0</td>
<td>0.0</td>
<td>1.0</td>
<td>170.80</td>
<td>171.470</td>
<td>169.679</td>
<td>170.57</td>
<td>32968167.0</td>
</tr>
<tr>
<td>2017-12-27</td>
<td>170.30</td>
<td>170.780</td>
<td>169.710</td>
<td>170.60</td>
<td>21672062.0</td>
<td>0.0</td>
<td>1.0</td>
<td>170.30</td>
<td>170.780</td>
<td>169.710</td>
<td>170.60</td>
<td>21672062.0</td>
</tr>
<tr>
<td>2017-12-28</td>
<td>171.00</td>
<td>171.850</td>
<td>170.480</td>
<td>171.08</td>
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<td>0.0</td>
<td>1.0</td>
<td>171.00</td>
<td>171.850</td>
<td>170.480</td>
<td>171.08</td>
<td>15997739.0</td>
</tr>
<tr>
<td>2017-12-29</td>
<td>170.52</td>
<td>170.590</td>
<td>169.220</td>
<td>169.23</td>
<td>25643711.0</td>
<td>0.0</td>
<td>1.0</td>
<td>170.52</td>
<td>170.590</td>
<td>169.220</td>
<td>169.23</td>
<td>25643711.0</td>
</tr>
</tbody>
</table>
```

Source: [https://www.quandl.com/tools/python](https://www.quandl.com/tools/python)
Yahoo Finance Symbols: AAPL Apple Inc. (AAPL)

Symbols similar to 'aapl'

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Company Name</th>
<th>Last Price</th>
<th>Industry / Category</th>
<th>Type</th>
<th>Exchange</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAPL</td>
<td>Apple Inc.</td>
<td>139.84</td>
<td>Electronic Equipment</td>
<td>Stocks</td>
<td>NMS</td>
</tr>
<tr>
<td>AAPL.SW</td>
<td>Apple Inc.</td>
<td>140.70</td>
<td>N/A</td>
<td>Stocks</td>
<td>EBS</td>
</tr>
<tr>
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http://finance.yahoo.com/q?s=AAPL
Apple Inc. (AAPL) - NasdaqGS

139.84  -1.62 (-1.15%)  139.35  -0.49 (-0.35%)

At close: 4:00PM EDT  
After hours: 7:59PM EDT

Summary

<table>
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<tr>
<th>Players</th>
<th>Conversations</th>
<th>Statistics</th>
<th>Profile</th>
<th>Financials</th>
<th>Options</th>
<th>Holders</th>
<th>Historical Data</th>
<th>Analysts</th>
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Previous Close  141.46

Open  142.11

Bid  139.31 x 100

Ask  139.40 x 1300

Day's Range  139.73 - 142.80

52 Week Range  89.47 - 142.80

Volume  39,529,912

Avg. Volume  26,889,183

Market Cap  733.68B

Beta  1.45

PE Ratio  (TTM)  16.79

EPS (TTM)  8.33

Earnings Date  Apr 24, 2017 - Apr 28, 2017

Dividend & Yield  2.28 (1.63%)

Ex-Dividend Date  N/A

1y Target Est  143.29

Interactive chart


Trade prices are not sourced from all markets
Yahoo Finance Charts: Apple Inc. (AAPL)

Apple Inc. (AAPL) 139.84  -1.62 (-1.15%)  As of 4:00PM EDT. Market closed.

Open  142.11  Close  139.84  Low  139.73  High  142.80  Vol  39.53M  % Chg  63.27%

http://finance.yahoo.com/chart/AAPL
Apple Inc. (AAPL) Historical Data

http://finance.yahoo.com/q/hp?s=AAPL+Historical+Prices

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<td>142.11</td>
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<td>139.73</td>
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<td>139.84</td>
<td>39.116,800</td>
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### Yahoo Finance Historical Prices

**Apple Inc. (AAPL)**

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<th>Close</th>
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http://finance.yahoo.com/quote/AAPL/history?period1=345398400&period2=1490112000(interval=1d&filter=history&frequency=1d)
### Yahoo Finance Historical Prices

**Apple Inc. (AAPL)**

**Time Period:** Dec 12, 1980 - Mar 22, 2017

**Currency in USD**

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[Link to Yahoo Finance Historical Prices](http://finance.yahoo.com/quote/AAPL/history?period1=345398400&period2=1490112000&interval=1d&filter=history&frequency=1d)
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</table>
Yahoo Finance Charts
Alphabet Inc. (GOOG)

Alphabet Inc. (GOOG) 830.46 -17.94 (-2.11%)  As of 4:00PM EDT. Market closed.

Open 851.40
Close 830.46
Low 829.10
High 853.50
Vol 2.29M
% Chg 159.99%
Dow Jones Industrial Average
(^DJI)

http://finance.yahoo.com/chart/^DJI
TSEC weighted index (^TWII) - Taiwan

http://finance.yahoo.com/chart/^TWII
Taiwan Semiconductor Manufacturing Company Limited (2330.TW)

**Summary**

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<th>Metric</th>
<th>Value</th>
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<tbody>
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<td>Ask</td>
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<td>Day's Range</td>
<td>191.50 - 193.00</td>
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<td>52 Week Range</td>
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<td>Ex-Dividend Date</td>
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**As of 9:52AM CST. Market open.**

**Price:** 192.50 **Change:** -2.50 **Change %:** -1.28%

**Add to watchlist**

Yahoo Finance Charts
TSMC (2330.TW)

Taiwan Semiconductor Manufacturing Company Limited (2330.TW) 192.00 -3.00 (-1.54%)
As of 10:29AM CST. Taiwan Delayed Price. Market open.

Opening price: 192.50
Closing price: 192.00
Lowest price: 191.50
Highest price: 193.00
Volume: 9.33M
Percentage change: 301.44%

http://finance.yahoo.com/chart/2330.TW
Yahoo Finance Charts
USD/TWD (USDTWD=X)

30.4100  -0.0200 (-0.0657%)
As of 3:04PM GMT. Market open.

https://finance.yahoo.com/quote/USDTWD%3DX/chart?p=USDTWD%3DX

PV
# US Dollar/USDX - Index - Cash (DX-Y.NYB)

```python
# pip install pandas_datareader
import pandas as pd
import pandas_datareader.data as web
import matplotlib.pyplot as plt
import seaborn as sns
import datetime as dt

#matplotlib inline

# Read Stock Data from Yahoo Finance
end = dt.datetime.now()
#start = dt.datetime(end.year-2, end.month, end.day)
start = dt.datetime(2017, 1, 1)
df = web.DataReader("DX-Y.NYB", 'yahoo', start, end)
df.to_csv('DX-Y.NYB.csv')
print(df.tail())

df2 = pd.read_csv('DX-Y.NYB.csv')
```
US Dollar/USDX - Index - Cash (DX-Y.NYB)
import pandas as pd
import pandas_datareader.data as web

df = web.DataReader('AAPL', data_source='yahoo', start='1/1/2010', end='3/21/2017')
df.to_csv('AAPL.csv')
df.tail()
df = web.DataReader('GOOG',
data_source='yahoo', start='1/1/1980',
end='3/21/2017')
df.head(10)
```python
df.tail(10)
```

<table>
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df.count()

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dtype: int64
df.ix['2015-12-31']

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Name: 2015-12-31 00:00:00, dtype: float64
```python
import pandas as pd

df.to_csv('2330.TW.Yahoo.Finance.Data.csv')
```

**2330.TW.Yahoo.Finance.Data.csv**

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<th>Close</th>
<th>Volume</th>
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```
import fix_yahoo_finance as yf

data = yf.download("^TWII", start="2017-07-01", end="2017-11-15")
data.to_csv('TWII_201707_201711.csv')
data.tail()
```
df.loc[start:end]

def = df.loc[ '2017-10-01' : '2017-11-15' ]
```python
import matplotlib.pyplot as plt
%matplotlib inline
import fix_yahoo_finance as yf

df = yf.download("^TWII", start="2000-01-01", end="2017-11-15")
df.to_csv('YF_TWII_2000_2017.csv')
print(df.head())

fig = plt.figure(figsize=(16,9))
df['Adj Close'].plot()
fig.show()
```
import matplotlib.pyplot as plt
from matplotlibfinance import candlestick_ohlc
import matplotlib.pyplot as plt
from matplotlib.finance import candlestick_ohlc
# Convert Daily Data to Weekly Data

def daily_to_weekly(df):
    # dfWeekly = daily_to_weekly(df)
    # df.sort_index(axis=0, level=None, ascending=True, inplace=True)
    Open = df.Open.resample('W-Fri').first()  # W  W-MON  W-Fri
    High = df.High.resample('W-Fri').max()
    Low = df.Low.resample('W-Fri').min()
    Close = df.Close.resample('W-Fri').last()
    Volume = df.Volume.resample('W-Fri').sum()
    Adj_Close = df["Adj Close"].resample('W-Fri').last()
    dfWeekly = pd.concat([Open, High, Low, Close, Volume, Adj_Close], axis=1)
    dfWeekly = dfWeekly[pd.notnull(dfWeekly["Adj Close"])]
    return dfWeekly
#Convert Daily Data to Monthly Data

def daily_to_monthly(df):
    #dfMonthly = daily_to_monthly(df)
    Open = df.Open.resample('M').first()
    High = df.High.resample('M').max()
    Low = df.Low.resample('M').min()
    Close = df.Close.resample('M').last()
    Volume = df.Volume.resample('M').sum()
    Adj_Close = df['Adj Close'].resample('M').last()
    dfMonthly = pd.concat([Open, High, Low, Close, Volume, Adj_Close], axis=1)
    dfMonthly = dfMonthly[pd.notnull(dfMonthly['Adj Close'])]
    return dfMonthly
Multi-Platform Tools for Market Analysis ...
TA-Lib is widely used by trading software developers requiring to perform technical analysis of financial market data.

- Includes 200 indicators such as ADX, MACD, RSI, Stochastic, Bollinger Bands etc... (more info)
- Candlestick pattern recognition
- Open-source API for C/C++, Java, Perl, Python and 100% Managed .NET

Free Open-Source Library
TA-Lib is available under a BSD License allowing it to be integrated in your own open-source or commercial application. (more info)

Commercial Application
TA-Lib is also available as an easy to install Excel Add-Ins. Try it for free!

http://ta-lib.org/
#Stochastic oscillator %D

def KDJ(df, n, m1, m2):
    #KDJ(df, 9, 3, 3)
    KDJ_n = n
    KDJ_m1 = m1
    KDJ_m2 = m2

    df['Low_n'] = pd.rolling_min(df['Low'], KDJ_n)
    df['Low_n'].fillna(value=pd.expanding_min(df['Low']), inplace=True)
    df['High_n'] = pd.rolling_max(df['High'], KDJ_n)
    df['High_n'].fillna(value=pd.expanding_max(df['High']), inplace=True)

    df['RSV'] = (df['Close'] - df['Low_n']) / (df['High_n'] - df['Low_n']) * 100

    df['KDJ_K'] = pd.ewma(df['RSV'], KDJ_m1)
    df['KDJ_D'] = pd.ewma(df['KDJ_K'], KDJ_m2)
    df['KDJ_J'] = 3 * df['KDJ_K'] - 2 * df['KDJ_D']

    return df

Source: https://www.quantopian.com/posts/technical-analysis-indicators-without-talib-code
# Bollinger Bands

def BBANDS20(df, n):
    MA = pd.Series(pd.rolling_mean(df['Close'], n))
    MSD = pd.Series(pd.rolling_std(df['Close'], n))
    b1 = 4 * MSD / MA
    B1 = pd.Series(b1, name = 'BollingerB_' + str(n))
    df = df.join(B1)
    b2 = (df['Close'] - MA + 2 * MSD) / (4 * MSD)
    B2 = pd.Series(b2, name = 'Bollinger%b_' + str(n))
    df = df.join(B2)
    return df

Bollinger Bands

#Bollinger Bands BB_20

def BB_20(df):
    df['BB_MA20'] = pd.stats.moments.rolling_mean(df['Adj Close'], 20)
    df['BB_SD20'] = pd.stats.moments.rolling_std(df['Adj Close'], 20)
    df['BB_UpperBand'] = df['BB_MA20'] + (df['BB_SD20']*2)  # Default 2*SD
    df['BB_LowerBand'] = df['BB_MA20'] - (df['BB_SD20']*2)
    df['BB_PB'] = (df['Adj Close'] - df['BB_LowerBand']) / (df['BB_UpperBand'] - df['BB_LowerBand'])
    df['BB_BW'] = (df['BB_UpperBand'] - df['BB_LowerBand']) / df['BB_MA20']
    df['BB_UpperBand_1SD'] = df['BB_MA20'] + (df['BB_SD20'])
    df['BB_LowerBand_1SD'] = df['BB_MA20'] - (df['BB_SD20'])
    #BB_PB: Bollinger Band Percent b (PB)
    #BB_BW: Bollinger Band Band Width (BW)
    return df

Source: https://www.quantopian.com/posts/technical-analysis-indicators-without-talib-code
The Quant Finance PyData Stack

- PyThalesians
- Zipline
- DX Analytics
- PyAlgoTrade
- QuantLib
- StatsModels
- PyTables
- NetworkX
- scikit-image
- matplotlib
- pandas
- PyMC
- SciPy
- NumPy
- SymPy
- Ipython
- Python

Source: http://nbviewer.jupyter.org/format/slides/github/quantopian/pyfolio/blob/master/pyfolio/examples/overview_slides.ipynb#5
Leveling Wall Street's Playing Field

Quantopian inspires talented people everywhere to write investment algorithms. Select authors may license their algorithms to us and get paid based on performance.

Start Coding

https://www.quantopian.com/
Summary

• Quantitative Investing with Pandas in Python
  – Numpy
    • Scientific computing
  – Pandas
    • Data structures and data analysis tools
References

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