



CFDS® – Chartered Financial Data Scientist Introduction to Python

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0 Getting started

0.1 Introduction

Introduction

This mini-course will help you learn to:

- navigate in a Jupyter Notebook
- be able to code simple Python code (variables + lists, conditions, flow control)
- know how to find help in the Python universe / zoo
- basics of `numpy` and `scipy`
- basics of `pandas`
- basics of plotting

I will also create a set of videos for self-learning on "Statistics with Python" to build on the material from your first session.

A great reference is **Python for Finance (2nd edition)** by Yves Hilpisch. (It uses Python version 3.7.)

Background

- Python is an open-source programming language that can be downloaded and used for free.
- Python was created by Guido van Rossum and first published in 1991.
- Today the language is largely developed by the Python Software Foundation, a nonprofit organization.
- It is named after the British comedy group "Monty Python".

In []:

```
import this
```

Many examples and extended information can be found on the following websites:

- [Beginners' Guide \(https://wiki.python.org/moin/BeginnersGuide\)](https://wiki.python.org/moin/BeginnersGuide)
- [Python.org \(https://docs.python.org/3/tutorial/\)](https://docs.python.org/3/tutorial/)
- [Scipy Lectures \(http://scipy-lectures.org/downloads/ScipyLectures-simple.pdf\)](http://scipy-lectures.org/downloads/ScipyLectures-simple.pdf)
- [The Hitchhiker's Guide to Python \(https://docs.python-guide.org\)](https://docs.python-guide.org)

Pros

- **Universal:** Python runs on any operating system.
- **Easy to learn:** Although Python is highly versatile (e.g. can be used for scientific computing), it is relatively easy to learn.
- **Readable code:** Python is a high-level programming language, making it easy to read and work with.
- **General purpose:** The language can be applied to solve different problems at hand.
- **Open source and free.**
- **Cross-platform**
- **Indentation aware:** indentation is used instead of braces to mark code blocks.

Cons

- **Speed:** While Python is not slow, it cannot keep up with compiled languages such as C, C++, Fortran, COBOL, etc.

0.2 Installing Python and Jupyter Notebook

Setting up Python for this class

- The book uses **Python 3.7**. The code here has been updated to use **Python 3.11**, which is the current version.
- Easiest method to get started:
 - Install [Anaconda \(https://www.anaconda.com\)](https://www.anaconda.com); this will setup up **Python** as well as the **Jupyter Notebook** environment that we are going to use in class.

Jupyter Notebook

- **Jupyter Notebook** is a browser-based application used for creating and sharing documents, containing live code, visualizations, equations, plain text, and many other features.

- Launch Jupyter Notebook:
 - from Anaconda or
 - from the command line (`Terminal` in MacOS or `cmd` in Windows) using the command

```
jupyter notebook
```

- Jupyter notebooks run in a local webserver.

Jupyter Notebook

- Before launching Jupyter Notebook from the command line you may wish to navigate to the directory where the notebooks are stored or where you want to store them.
- To open a new notebook click on "New" and "Python 3" in the Jupyter Notebook main window.
- To learn to use Jupyter Notebook before, click on "Help" and "User Interface Tour".

Using Colab

- If you don't have Jupyter Notebook installed yet, you can use the online service <https://colab.research.google.com> (<https://colab.research.google.com>).
- However, I strongly recommend to install you own version at some point.

Other ways to run Python

- The Python **shell**: call `python` from a shell or start an online version at [online shell](https://www.python.org/shell/) (<https://www.python.org/shell/>).

```
Python 3.7.0 (default, Aug 22 2018, 20:50:05)
[GCC 5.4.0 20160609] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import math
>>> math.log(1)
0.0
>>> █
```

Online console from [PythonAnywhere](#)

Other ways to run Python

- Run Python scripts (suffix `.py`) from a command line using the `python` command, e.g. `python file.py`.
- Python's **IDLE** (Integrated Development and Learning Environment) is another basic shell to run Python commands.
- An **IDE** (Integrated Development Environment) is an application that integrates programming, running code, debugging, etc.
- **IPython**: Interactive Python shell.

The Python Ecosystem

- Aside from the programming language, there is a large number of packages, modules and other tools available to support specific tasks.
- For example, various plotting libraries are available and can be readily used using `import`.

Popular packages ("The scientific stack")

- `NumPy` [_](http://www.numpy.org)(<http://www.numpy.org>): multidimensional array objects
- `SciPy` [_](http://www.scipy.org)(<http://www.scipy.org>): functionality often needed in science or finance
- `matplotlib` [_](http://www.matplotlib.org)(<http://www.matplotlib.org>): plotting
- `pandas` [_](http://pandas.pydata.org)(<http://pandas.pydata.org>): times series and tabular data
- `scikit-learn` [_](http://scikit-learn.org)(<http://scikit-learn.org>): machine learning package
- `PyTables` [_](http://www.pytables.org)(<http://www.pytables.org>): data storage package

Navigating Jupyter Notebook

- Cells in Jupyter Notebook are either "text cells", where you can write Markdown code, or they are "code cells" containing... well, code.
- Markdown cheat sheet: <https://www.markdownguide.org/cheat-sheet/>
(<https://www.markdownguide.org/cheat-sheet/>)
- To type in a cell, click on it until the bar on the left turns green.
- To exit typing mode, hit the ESC button (the bar turns blue).
- To run a cell (text or code), type: SHIFT-RETURN.

How code is run:

- A Python interpreter ("the kernel") is running in the background waiting for work.
- Whenever you hit SHIFT-RETURN, the Python interpreter will run the code in the cell.
- It will also update its internal state, for example if you load packages, introduce variables or assign values to variables.
- Closing the kernel erases the internal state of the session. (Note how this is different from saving the file.)

Navigating Jupyter Notebook

- Spend a moment to make yourself familiar with the functionality in a Jupyter Notebook.
- The little keyboard icon below the menu opens a dialog box with all possible Notebook commands.
- You can type to narrow down the commands.
- It also shows keyboard shortcuts associated with commands.
- A couple of commands are used so often (e.g. opening a new cell below the current one), that it pays off to memorise their shortcuts.
- Aside from the usual "File", "Edit", "View" entries, the menu lets you operate the kernel.

Navigating Jupyter Notebook

In []:

```
import numpy as np
import math
import matplotlib.pyplot as plt
x = np.linspace(0, 6, 100);
y = np.sin(x);
plt.plot(x, y);
```

0.3 A first example

Example loading and plotting financial data

- The following code imports the packages that will be used and sets up the plotting library.

In []:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

Example loading and plotting financial data

- The following code imports a time series of S&P 500 index data from a `csv` file (`csv` =comma separated values).
- It also shows information about the time series.

In []:

```
# If using colab, then uncomment the line below and comment the line after that
#data = pd.read_csv('https://raw.githubusercontent.com/packham/Python_CFDS/main/data')
data = pd.read_csv('data/tr_eikon_eod_data.csv', index_col=0, parse_dates=True)
data = pd.DataFrame(data[['SPX']])
data.dropna(inplace=True)
data.info()
```

Example loading and plotting financial data

- Transform the index level data to log-returns, estimate volatility (=standard deviation of returns) and produce plots of index and volatility.

In []:

```
data['rets'] = np.log(data / data.shift(1))
data['vola'] = data['rets'].rolling(252).std() * np.sqrt(252)
data[['SPX', 'vola']].plot(subplots=True, figsize=(10, 6));
```

