

Syllabus

Python for Finance

- **Instructors:** Marton Sebok
Tibor Hari
Illes Farkas
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Robert Kabai
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- **Credits:** 0 (0 ECTS)
- **Term:** Spring 2017-2018
- **Course level:** MA/MSc/MBA
- **Prerequisites:** Good knowledge of Python, or completion of online courses stated below.

Course description

The aim of the course is to provide a broad understanding of the principles and techniques of Python coding for finance applications mainly through the use of Jupyter notebook with intuitively visualized output. The learning objectives will be achieved through discussing theory and solving tasks together.

Following the introductory class, the course is divided into three main sections. We will begin with the fundamentals of *data reduction and clustering* applied specifically to financial data with Python libraries (classes 2,3,4). Next, we will introduce techniques for *derivative pricing*, both with a discretized and a continuous approach (classes 5,6). Last, we will discuss two specific examples of speeding up financial calculations by applying *advanced numerical techniques* (classes 7,8). The course ends with an exam.

Understanding the problems covered in the course will be important to all students seeking a career in a rapidly expanding technology-intensive field of finance. Please see "Further reading" below.

Learning outcomes

Core Learning Area	Learning Outcome
Interpersonal Communication Skills	Participate in class discussions and problem solving exercises. Present arguments and findings. Objectively critique findings of fellow students.
Technology Skills	Use of Python with Jupyter notebook in problem solving. Tools needed from Linear algebra and Stochastic calculus are introduced during course.
Cultural Sensitivity and Diversity	Harness international and professional diversity of students in viewing issues and problems from different perspectives.
Quantitative Reasoning	Apply financial models and formulae.
Critical Thinking	Exercise the powers of inquiry, logical thinking and critical analysis. Interpret and evaluate theoretical arguments and empirical evidence.
Ethics and Social Responsibility	Evaluate and discuss challenges related to efficient coding, mathematical modeling and professional behavior.
Management Knowledge and Skills	Attain a broad understanding of the principles of quantitative evidence based financial decision making.

Prerequisites for Python

- (1) If Python will be your first coding language:
 - Learn Python the Hard Way, <https://learnpythonthehardway.org> → Login, top right corner of page
- (2) If you have coded before:
 - HackerRank Python, <https://www.hackerrank.com/domains/python>
 - 10 minutes to Pandas, <https://pandas.pydata.org/pandas-docs/stable/10min.html>

Further reading

Louie Woodall, *Quants head for the shop floor*, Risk.net, 15 Jun 2017.
Newsletters: importpython.com, pythonweekly.com, news.efinancialcareers.com

Assessment

Grading will be based on the total score out of 100, in line with CEU's standard grading guidelines.

Course schedule and materials for each session

1. Introduction - Marton Sebok (Mon 16 April 1800-1940)
Investment banks. Citi. MQA. Students. Python tools. Jupyter notebooks.
2. PCA from scratch with numpy – Robert Kabai / Tibor Hari (Mon 23 Apr 1800-1940)
PCA Intro. Basic PCA implementation. Visualization with matplotlib. Matching result with sklearn.decomposition.PCA.
3. Pandas data cleaning – Robert Kabai / Illes Farkas (Wed 2 May 1800-1940)
Working with loans and learning about Asset Backed Securities. Exploratory data analysis, data cleaning.
4. Scikit-learn prediction – Robert Kabai / Robert Sipos (Thu 3 May 1800-1940)
Prediction of Loan Default based on historical performance data using Scikit-learn.
5. European call option, binomial tree pricer – Illes Farkas / Marton Sebok (Mon 7 May 1800-1940)
European call option. Risk-neutral pricing with small binomial trees. Normalized n-step binomial tree.
6. Wiener & Itô processes, Black-Scholes equation - Illes Farkas / Marton Sebok (Thu 10 May 1800-1940)
Wiener process, generalized Wiener. Itô process. Black-Scholes equation. Risk-neutral pricing of a European call option with the Black-Scholes-Merton formula.
7. Monte Carlo simulations – Robert Sipos / Tibor Hari (Thu May 17 1800-1940)
Comparing to analytic solution, introducing path dependent products. Using variance reduction techniques to speed up the convergence.
8. Trade compression – Robert Sipos / Tibor Hari (Thu 24 May 1800-1940)
Introducing the concept and its motivations. Unilateral case as a linear programming problem.
9. Final Exam (Thu 31 May 1800-1940)

Brief bios of the instructors

The course instructors are members of Citi's Markets Quantitative Analysis (MQA) group. The MQA group develops and supports the financial models used for the pricing of securities for the Trading desks and for the risk management of Citi's positions globally within the Markets Division of the Institutional Clients Group (ICG). MQA has teams of quantitative analysts vertically aligned to each business by asset class, covering Equities & Hybrids, G10 Rates and Local Markets, FX, Credit, Commodities and Mortgages/Securitized Markets. There are also teams that are horizontally aligned and whose work span multiple businesses to address cross-asset requirements in areas such as Algorithmic Trading, Risk Management, Investment Strategy Modelling and Index Publication, Decision Support Tools, CVA and Regulatory work (Dodd-Frank, Basel II / III). MQA's key business partners within the Institutional Client Group are the Trading, Structuring and Sales Desks, the Risk Organization (including the Model Validation Group), Valuation and Control, and the Technology Risk teams.

Marton Sebok is Quantitative Developer VP and Team Leader.

Marton joined Citi in 2014. Since then he has been working on C++ and Python infrastructure related tasks around the analytical libraries. Prior to Citi, Marton had a 10-year career working as a C++ developer and team lead at various places.

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Tibor Hari is Quantitative Developer Officer.

Tibor joined Citi in 2016, and is working as a Python developer. Most of his tasks are related to the infrastructure around the analytical libraries. Prior to Citi, Tibor was working as a C++ developer for 2 years, and studied computer science MSC.

Illes Farkas is Quantitative Analysis AVP.

Illes joined Citi in 2017. From 1998 to 2017 he worked at the Hungarian Academy of Sciences and Eotvos University on computational statistical physics, with research visits to Germany, the US and China. Illes received his D.Sc. in 2016 and his habilitation degree in 2017. Earlier he worked mainly on complex networks and collective motion. At Citi he works currently on CVA and FVA with C++.

LinkedIn: <http://linkedin.com/in/illesfarkas>

Robert Sipos is a Quantitative Analyst.

Robert joined the Quant team in 2015 and mainly works on CVA related models. Robert has completed his PhD from the Budapest University of Technology and Economics in 2016. His previous academic experience includes working at Alfréd Rényi Institute of Mathematics, Hungarian Academy of Sciences; and teaching BSc/MSc level courses for 8 years. He was awarded with the Pro Scientia Gold Medal in 2011.

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Robert Kabai is a Quantitative Analyst.

Robert joined Citi in 2015. Prior to that he worked for 1 year on classification algorithms in a big data environment and for 1 year as a developer in business intelligence. Robert received his MSC at the Budapest University of Technology and Economics in 2014 in the field of analytical business intelligence.

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