

Quantitative Economics with Python

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1 Course description

This course aims to teach quantitative economics and the computer language python. We use python to teach economics and economics to teach python. For our purposes, python has many advantages.

1. It is free.
2. It is well documented and has many scientific and numerical packages that are very useful for economic and financial calculations.
3. Its object oriented structure conforms naturally with the way in which we like to teach economics, namely, in terms of classes of objects with common mathematical structures having affiliated ‘methods’ that we can easily access.
4. It is fun.
5. It is widely used in science, finance, and industry. A working knowledge of it gives students a big advantage in terms of landing summer jobs, internships, and research assistant jobs.

The course will use an online text being written by John Stachurski and Thomas Sargent, as well as additional materials that we will supply in class. Every economic topic will have a python counterpart. This will discipline our economics and our computer programming.

Among the economic topics that we shall cover are:

1. Data analysis and manipulation using python.
2. Networks.
3. The classical growth model.
4. Fiscal policy in the growth model.
5. Milton Friedman’s model of permanent income.

6. Robert Barro's model of tax smoothing (virtually the same as Milton Friedman's model).
7. The celebrated McCall search model for prices and wages.
8. A "lake model" of unemployment and employment stocks and flows.
9. Introduction to linear time series models.
10. Markov processes and the powerful properties of ergodicity and stationarity.
11. Hidden Markov models and filtering.

You may go to QuantEcon and look at the following lectures to preview the course content:

- Getting Started with Python
- Linear Algebra
- Linear State Space Models
- Lake Model
- Permanent Income

2 Course Schedule

This course will start with the foundations of Python programming making use of some simple economic examples, and then move into the exploration of more advanced economic topics.

2.1 Topic Breakdown

Weeks 1 to 3 Python: Programming Fundamentals

Weeks 4 to 8 Python: Linear Algebra, Linear State Space Models, Discrete Markov Chain, and the Lake Model

Week 9 Python: Object Oriented Programming

Week 10 McCall Search Model

Week 11 Python: Data Analysis and Manipulation

Week 12 Permanent Income Model

Week 13 to 14 Extension Topic (Asset Pricing, Kalman Filters)

2.2 Weekly Breakdown

Week	Content
Week 1 26th Jan 28th Jan	<ul style="list-style-type: none"> • Introduction to Python Programming. Installing Python, Setting up a programming environment, and Jupyter. • Reading: <ol style="list-style-type: none"> 1. About Python, 2. Getting started, 3. Python by example • Assignments: <ol style="list-style-type: none"> 1. Installing the Anaconda Python Distribution 2. Programming Assignment #1 • Instructor: Matthew McKay
Week 2 02nd Feb 04th Feb	<ul style="list-style-type: none"> • Python Essentials: Data Structures and Conditional Logic • Python Functions • Reading: <ol style="list-style-type: none"> 1. Python essentials 2. Python foundations • Programming Assignment #2 • Instructor: Matthew McKay
Week 3 09th Feb 11th Feb	<ul style="list-style-type: none"> • Python Packages • Linear Algebra with Python • Reading: <ol style="list-style-type: none"> 1. Numpy 2. Scipy 3. Matplotlib 4. Linear Algebra • Programming Assignment #3 • Instructor: Matthew McKay
Week 4 16th Feb 18th Feb	<ul style="list-style-type: none"> • Linear State Space Models • Reading: Linear State Space Models • Assignment #4 • Instructor: Zhen Huo

Week 5 23rd Feb 25th Feb	<ul style="list-style-type: none"> • Linear State Space Models • Reading: Linear State Space Models • Assignment #5 • Instructor: Zhen Huo
Week 6 01st Mar 03rd Mar	<ul style="list-style-type: none"> • Discrete Markov Chains - Theory • Discrete Markov Chains - Applications • Reading: Discrete Markov Chains • Assignment #6 • Instructor: Zhen Huo
Week 7 08th Mar 10th Mar	<ul style="list-style-type: none"> • Lake Model of Employment and Unemployment • Reading: Lake Model • Assignment #7 • Instructor: Zhen Huo

Spring Break 14th March to 20th March

Week	Content
Week 8 22nd Mar 24th Mar	<ul style="list-style-type: none"> • Midterm Exam • Object Oriented Python: Classes • Reading: Object Oriented Python • Programming Assignment #8 • Instructor: Matthew McKay
Week 9 29th Mar 31st Mar	<ul style="list-style-type: none"> • Object Oriented Python • Lake Model of Employment and Unemployment • Reading: Lake Model • Assignment #9 • Instructor: Matthew McKay and Zhen Huo
Week 10 05th Apr 07th Apr	<ul style="list-style-type: none"> • McCall Search Model (Extension to Lake Model) • Reading: McCall Search Model • Assignment #10 • Instructor: Zhen Huo

Week 11 12th Apr 14th Apr	<ul style="list-style-type: none"> • Data analysis and manipulation using python (Pandas, NetworkX, Statsmodels) • Reading: <ol style="list-style-type: none"> 1. Pandas 2. NetworkX 3. Statsmodels • Programming Assignment #11 • Instructor: Matthew McKay
Week 12 19th Apr 21st Apr	<ul style="list-style-type: none"> • Permanent Income Model • Reading: Permanent Income Model • Assignment: TBD • Instructor: Zhen Huo / Tom Sargent
Week 13 26th Apr 28th Apr	<ul style="list-style-type: none"> • Extension Topic #1 (Asset Pricing in the Markov Model) • Reading: TBD • Assignment: TBD • Instructor: Zhen Huo / Tom Sargent
Week 14 03rd May 05th May	<ul style="list-style-type: none"> • Review • Reading: TBD • Instructor: Zhen Huo, Matthew McKay, and Tom Sargent