Computational Methods in Economics (WiSe 2018/19) - Syllabus

Alex Schmitt*

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Mailing list: if you want to receive emails about the course, send an email to **schmitt@ifo.de**

Tentative Schedule

Week	*Wednesday 16-18 c.t., M 101o*	*Friday 10-12 c.t., A 015*
W 01 (17/10)	L1: Introduction (AS)	T1: Version Control (AS, CL)
W 02 (24/10)	T2a: Python Basics I (AS)	T2b: Python Basics II (CL)
W 03 (31/10)	T2c: Numpy/Computer Basics (AS)	NO LECTURE
W 04 (07/11)	T2d$^+$: Pandas (CL)	L3: Systems of Linear Equations (AS)
W 05 (14/11)	L4: Root Finding (AS)	T3: Problem Set (CL)
W 06 (21/11)	T4: Problem Set (CL)	L5a Numerical Optimization (AS)
W 07 (28/11)	L5b: Numerical Optimization (AS)	T2e$^+$: Object-Oriented Programming (AS)
W 08 (05/12)	L6a: Function Approximation (AS)	T5: Problem Set (CL)
W 09 (12/12)	L6b: Function Approximation (AS)	T6a: Problem Set (CL)
W 10 (19/12)	L7: Numerical Integration (AS)	T6b: Problem Set (CL)
W 11 (10/01)	L8a: Dynamic Programming (AS)	T7: Problem Set (CL)
W 12 (17/01)	L8b: Dynamic Programming (AS)	T8a: Problem Set (CL)
W 13 (24/01)	L9: Applied Example 1 (AS)	T8b: Problem Set (CL)
W 14 (31/01)	L10: Applied Example 2 (AS)	Review Session (AS, CL)
W 15 (06/02)	EXAM	-

Note: Sessions marked with a $^+$ are not mandatory for the exam, and their contents are subject to change!

*Ifo Institute, Munich, Germany.

1 Introduction

- About the course: Logistics and Objectives
- What is "Computational Economics"?
- Python: Overview

Literature

- Miranda and Fackler (2004), Ch. 1*
- Judd (1997)
- Judd (1998), Ch. 1

2 Introduction to Version Control and Git

- Using Git for Version Control
- Using Git and Github for Sharing Files

Literature

- Udacity: "Hot Use Git and Github", `https://classroom.udacity.com/courses/ud775` - you need a (free) Udacity account to have access to the course

3 Introduction to Python

- Basics I: Objects and Variables, Types, Loops, Conditional Statements
- Basics II: Functions and Modules
- Scientific Computing: Numpy
- Data Analysis: Pandas$^+$
- Object-Oriented Programming$^+$

Literature

There are countless online resources for learning Python. One that I can recommend is the material on *quantecon.org*: `https://lectures.quantecon.org/py/`

4 Computer Arithmetic

- Representation of numbers
- Numerical errors

Literature

- M&F, Appendix Ch. 2*

5 Solving Systems of Linear Equations

- Review: Linear Algebra
- Systems of Linear Equations
- LU Factorization
- Gaussian Elimination
- Iterative Methods

Literature

- M&F, Ch. 2*

6 Root Finding

- Bisection Method
- Newton and Quasi-Newton Methods
- Numerical Differentiation
- The *Scipy* Package

Literature

- M&F, Ch. 3.1 - 3.6*, Ch. 5.6

7 Numerical Optimization

- Golden Section Search
- Line Search
- Gradient Descent
- Newton and Quasi-Newton Methods
- Application: Solving the deterministic neoclassical growth model

Literature

- M&F, Ch. 4*

8 Function Approximation

- Interpolation vs. regression
- Polynomial basis functions
- Approximating multivariate functions
- *tentative*: B-Splines, Neural Networks

Literature

- M&F, Ch. 6*

9 Numerical Integration

- Newton-Coates methods
- Gaussian Quadrature
- Monte-Carlo integration

Literature

- M&F, Ch. 5*

10 Dynamic Programming

- Finite-horizon DP: backward induction
- Infinite-horizon DP: the Contraction Mapping Theorem
- Numerical implementation
- Application: Solving the stochastic RBC model

Literature

- M&F, Ch. 8*

11 Application 1 (*tentative*): Climate-Economy Modelling

- A deterministic climate-economy model: DICE
- Climate-economy modelling with uncertainty

Literature

- Nordhaus (2011)*
- Jensen and Traeger (2014)

Application 3 (*tentative*): Heterogeneous Agents

- Solving the Aiyagari Model

Literature

- Krusell and Smith (2006), sections 1-3*

References

Jensen, S. and C. P. Traeger (2014). Optimal climate change mitigation under long-term growth uncertainty: Stochastic integrated assessment and analytic findings. European Economic Review 69, 104–125.

Judd, K. L. (1997). Computational economics and economic theory: Substitutes or complements? Journal of Economic Dynamics and Control 21(6), 907–942.

Krusell, P. and A. A. Smith (2006). Quantitative macroeconomic models with heterogeneous agents. Econometric Society Monographs 41, 298.

Miranda, M. J. and P. L. Fackler (2004). Applied computational economics and finance. MIT press.

Nordhaus, W. (2011). Integrated economic and climate modeling. Cowles Foundation Discussion Paper 1839.