MRES: Quantitative Methods in Macroeconomics (Part II)

**Instructor**: Andreas Schaab ([schaab.aj@gmail.com](mailto:schaab.aj@gmail.com))

**Language**: We will mainly use Matlab.

**GitHub**: We will use a GitHub organization account for the class. You should open an account and familiarize yourself with git.

https://github.com/schaab-teaching/NumericalMethods

**Prerequisites**: If you have never used Matlab (or another programming language), you should work through some tutorials before the course starts.

**Textbooks**: None.

* Ben Moll’s website is an invaluable resource.
* We will also use my own repository (SparseEcon) for heterogeneous-agent macro models.

**Grading and Homework**: TBD. 100% of grade will likely be determined via final research proposal / project.

**Objectives**: My part of the course will exclusively focus on continuous-time methods. You will learn about:

* Basic numerical methods (solving ordinal / partial / stochastic differential equations, finite-difference methods, non-linear equations, …)
* Partial differential equations and their application in heterogeneous-agent models
* Continuous-time dynamic programming
* Hamilton-Jacobi-Bellman equations
* Kolmogorov forward equations
* Stochastic analysis: stochastic processes, SDEs, basic measure theory, stochastic calculus
* How to solve dynamic general equilibrium models
* How to solve heterogeneous-agent models in continuous time
* How to simulate models
* Sequence-space methods for heterogeneous-agent models
* Continuous-time dynamic programming with adaptive sparse grids

**Lecture 1**:

* Ordinary differential equations
* Finite-difference methods
* The stochastic neoclassical growth model in continuous time
* Heterogeneous-agent economies (Huggett) in continuous time: HJBs, KFs, generators, …

**Lecture 2**:

* Dynamic programming in continuous time with adaptive sparse grids
* Introduction to SparseEcon dynamic programming repository

**Lecture 3**:

* One-asset HANK models
* Sequence space methods
* One-asset HANK code
* Two-asset HANK models + code

**Lecture 4**:

* TBD… maybe Krusell-Smith

**Lecture 5**:

* Welfare assessments with heterogeneous agents
* Computing aggregate welfare assessments in continuous-time, heterogeneous-agent economies