Numerical Methods for Macroeconomics

Syllabus

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The aim of this course is to provide a basic introduction to the most common numerical methods used by macroeconomists. Many interesting macroeconomics questions require a quantitative answer, for which we need to solve and estimate models that do not have a closed-form solution (i.e. you cannot solve them by hand). As such, we often have to rely on approximate solutions. In this course we will learn how to compute such approximations using numerical methods, either with global and local methods.

Global solutions are accurate enough for many points of the state-space, so that one can study rare events such as deep recessions, and they usually allow for strong non-linearities and discrete choices, such that one can study models with default, entrepreneur choice, etc. The drawback is that they tend to be slow and suffer from the course of dimensionality (so that you need to keep the number of economic variables and shocks low).

In contrast, local methods (such as those implemented by built-in software such as Dynare) deliver accurate solutions around some steady-state of the economy and allow for a large number of economic variables and shocks. Their drawback is that their accuracy is only guaranteed for "normal times", it is hard to allow them to account for discrete choices, and they also have some trouble dealing with risk.

In this course we will explore both ways (global and local methods) using the standard growth model as our work-horse, as it is the ancestor of nearly all current Dynamic-Stochastic Dynamic Equilibrium (DSGE) models used by central banks and other financial institutions. As this is an introductory course, mathematical and economic theory will be kept to a minimum, and all the emphasis will be on the practical side-of-life: on learning the basic computational skills to solve the problem and hand.

Dates: February 10 – 13, 2020.

Time: 09:00 – 10:15, 10:30 – 11:45, 13:00 - 14:15

Prerequisite: Some programming experience in either MATLAB, R, Python, Julia, FORTRAN or C++ is welcomed. However, we will learn coding skills on-the-way, using MATLAB (you can also use Octave as an open-source language that it is mostly compatible with MATLAB, and all what we will do can be quickly adapted to other computing languages).

Intended audience: Policy oriented researchers, and early stage PhD/advanded undergraduate students.

Rules: I will provide all listed materials and slides sequentially. This means that before each lecture, the associated slides will be provided. There are no required assignments for the course. However, I will provide some exercises for people who might be interested in learning more.

Day 1: Introduction to the Standard Growth model, and basic coding skills

We will start with introducing the standard growth model as our work-horse model. First a baby version with only two periods, and then the infinite-time version. We will solve a particular version of the model that has a closed-form solution. Then, we will go over a basic introduction to MATLAB and coding in general.

Day 2: Global Solution Methods

We will introduce the basics of two iteration routines (Value function and Euler equation) to solve with numerical methods the growth model solved by hand the previous day. First we will look at the deterministic version, and then we will introduce uncertainty.

Day 3: Local Solution Methods

We will introduce the basic tools to solve models as an approximation around the steady-state. That way you will understand what software like Dynare is actually doing, and the pros and cons of these techniques, by comparing them with the global methods and the true solution.

Some materials

- Online notes by professor Eric Sims (U. Notredame) on the growth model, Value-function iteration, solving linearized models, and on using Dynare. You can find then at https://www3.nd.edu/˜esims1/grad_macro_17.html.

- Online notes and slides by professor Jesus Fernandez-Villaverde (U. of Pennsylvania). You can find them here: https://www.sas.upenn.edu/˜jesusfv/teaching.html