105.687 AKVWL Dynamic Macroeconomic Modelling

Dipl.-Ing. Martin Kerndler
martin.kerndler@tuwien.ac.at
Institute of Statistics and Mathematical Methods in Economics
TU Wien

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Course content

This course is aimed at master students from mathematics and business informatics. It provides students with the tools necessary to independently solve modern macroeconomic models using numerical software. To this end, it also covers the necessary economic and methodological background.

Students that successfully passed this course can:

- numerically solve a wide range of determistic and stochastic macroeconomic models (DSGE)

- calibrate a model to empirical data

- quantify the effects of fiscal policy and interpret them economically

- write a master thesis in the field of macroeconomics

Registration

Course registration is via TISS:
    https://tiss.tuwien.ac.at/course/educationDetails.xhtml?courseNr=105687&
                            semester=2020S

Course materials are distributed using TUWEL. Please also sign up for the TUWEL course:
            https://tuwel.tuwien.ac.at/course/view.php?id=21064

Organization and practical information

The course is split into two parts. The first one (before the Easter break) aims at solving deterministic models, the second (after the Easter break) aims at solving stochastic models with aggregate uncertainty. Each part consists of a number of class sessions followed by individual projects. Participation in the classroom sessions is mandatory!

Classroom sessions. The purpose of the classroom sessions is to make you familiar with the economic, methodological, and computational background that is required to carry out the

individual projects. Prior knowledge of dynamic economic models (in particular the Ramsey growth model) is advantageous but not necessary. Since this is an applied course, understanding the economics behind the models and being able to practically solve them is emphasized over mathematical details. Nevertheless, you must be confident with manipulating equations and forming partial derivatives.

You do not need to bring your laptops to the classroom sessions. Any programs written in class will be distributed afterwards. Dates and times of the sessions are indicated in the preliminary schedule below.

Project phase. In the projects you are supposed to independently implement and numerically solve variations of the models discussed in class. You will need to apply both the presented solution methods (to obtain a set of equations that characterized optimal economic behavior) and the computational methods (to numerically solve this set of equations). You will have several weeks to work on each project. Apart from the projects, there are no homeworks, exams etc. During the project phase, there are no scheduled classroom sessions, but we can meet bilaterally to discuss problems that you encounter.

The computational implementation of the projects should be done in MATLAB. If you have never worked with MATLAB before or have not used it for a while, please go through an introductory guide by yourself, such as https://things.maths.cam.ac.uk/catam/MATLAB/manual/booklet.pdf. I recommend to do this before we discuss the computational implementation, such that you can follow the lecture.

The MATLAB software can be used in all computer rooms at TU Wien. Additionally, enrolled students may obtain a private copy for free. For more info see http://www.sss.tuwien.ac.at/sss/mla/.

Grading

Your grade is based on the two projects that you hand in. The grade reflects the correctness of your results, the correctness of your programs, as well as the accuracy of the economic interpretations attached to your results.

Course outline

The course is split into two parts. The first one (before the Easter break) aims at solving deterministic models, the second (after the Easter break) aims at solving stochastic models with aggregate uncertainty. Each part provides the economic foundations, the necessary methodological background, and the computational implementation, followed by independent project work.

Part I: The deterministic neoclassical growth model

- Model description and definition of equilibrium
  - social planner version
  - decentralized version

- Characterizing the model solution using the Lagrangian approach
- Dynamic behavior of the solution paths
  - Linear difference equations
    * homogeneous and inhomogeneous linear difference equations
    * stationary states
    * asymptotic dynamics
  - Nonlinear difference equations
    * linearization around a stationary state and local dynamics
    * stability properties of the deterministic neoclassical growth model
- Numerical solution of the model
  - calibrating to a steady state
  - computing transition paths
  - analyzing anticipated and unanticipated parameter changes
- Project 1: Fiscal policy in the deterministic neoclassical growth model

Part II: The stochastic neoclassical growth model

- Model description and definition of equilibrium
- Characterizing the model solution using dynamic programming
- Dynamic behavior of the solution paths
  - Stochastic linear difference equations
    * deterministic stationary states
    * impulse response functions
    * policy functions
    * moments of the stationary distribution
  - Nonlinear stochastic difference equations
    * linearization around a deterministic stationary state and local dynamics
    * certainty equivalence and higher order approximations
- Numerical solution of the model
  - computing linearized transition paths and moments of the stationary distribution
  - solving DSGE models with Dynare
- Project 2: Policy analysis in a DSGE model using Dynare

Schedule (preliminary)

All class sessions take place in Sem.R. DB gelb 04 in the Freihaus building.

date	time	content
March 2	13:00–13:30	Initial meeting: administrative issues and course details
March 9	12:00–13:30	Model description and definition of equilibrium
March 16	12:00–13:30	Model solution and steady state
March 23	12:00–13:30	Model dynamics and numerical solution
March 30	12:00–14:00	Numerical solution (ctd.)
March 30 to April 19		Project 1
April 20	12:00–13:30	Discussion of Project 1 in class
May 4	12:00–13:30	Model description and review of statistical concepts
May 11	12:00–13:30	Model solution
May 18	12:00–13:30	Approximating the policy functions
May 25	12:00–13:30	Numerical solution by linearization
June 8	12:00–13:30	Numerical solution with Dynare
June 8 to June 28		Project 2
June 29		Discussion of Project 2 in class*

* voluntary participation

References

[1] Martin Brunner and Holger Strulik. Solution of perfect foresight saddlepoint problems: a simple method and applications. *Journal of Economic Dynamics and Control*, 26(5):737–753, 2002.

[2] Lars Ljungqvist and Thomas J. Sargent. *Recursive Methods in Macroeconomic Theory, 4th edition*. MIT Press, 2018.

[3] Gerhard Sorger. *Dynamic Economic Analysis: Deterministic Models in Discrete Time*. Cambridge University Press, 2015.

[4] Klaus Wälde. *Applied Intertemporal Optimization*. Know Thyself – Academic Publishers, Johannes Gutenberg University Mainz, 2012.