Applied Numerical Methods for Economics and Finance

Summer Semester 2012

Lecturer: Sigrid Röhrs
Time:
Location:
Course Credits: 6CP, 3SWS (Semesterwochenstunden)
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Office hours: Thursday 8:30-10 am and by appointment

General Information

This course is open for Master students from the Master in Money and Finance (MMF), International Economics and Economic Policy (IEEP) and Quantitative Economics (MSQE). The objective of the course is to acquire a good basic understanding and overview of numerical techniques typically used for economics and finance. This knowledge should enable you to use numerical methods for your own research projects.

Content of the Course and Grading

In the first part of the course we will look at the basic numerical tools that are mostly used to solve numerical problems in economics and finance (solving equations systems, optimization methods, numerical integration and differentiation, function approximation, solving systems of functional equations). In the second part of the course we will look at typical applications where numerical techniques are necessary. For this part you are free to propose a topic that interests you particularly.
During the course we will use the software Matlab/Octave to implement the solution techniques. (If you do not want to purchase the Matlab program for yourself, you can use Octave, a free software.) Whenever possible we will use the CompEcon Toolbox of the book by Miranda and Fackler to minimize the programming effort. However for some applications we will have to write programming code in Matlab/Octave ourselves.
The idea of the course is that you can use the methods for your own research projects. Therefore 50% of the grade will consist in a problem set to be solved at home and the other 50% consists of a presentation of your own project/application.

Pre-requisites for the course

The course will be based mainly on the book by Miranda and Fackler. To be able to follow the course you should understand basic concepts and terminology of matrix algebra and real analysis (Appendix A of Miranda and Fackler is a good introduction). Ideally you should also be acquainted with the software Matlab/Octave. I will give a short introduction to Matlab/Octave, but if you never worked with the program I suggest nevertheless to read Appendix B “A Matlab Primer” of Miranda and Fackler.

Outline

PART I: NUMERICAL METHODS

1. Introduction
    - Computer Arithmetic and Data Storage
    - Rounding Error
    - Ill Conditioning
    - Stopping Criteria

2. Solving Linear Equations
    - L-U Factorization
    - Gaussian Elimination
3. Solving Nonlinear Equations
    - Bisection Method
    - Function Iteration
    - Newton's Method
    - Other Methods
4. Optimization methods
    - Derivative-Free Methods
    - Newton-Raphson Method
    - Line Search Methods
    - Constrained Optimization
5. Numerical Integration and Differentiation
    - Gaussian Quadrature
    - Monte Carlo Integration
6. Function Approximation
    - Polynomial interpolation
    - Piecewise Polynomial Splines
    - Collocation Method

PART II: APPLICATIONS

7. Finance Applications
8. Macroeconomic Models
9. Other Applications (depending on composition of the course and desires of students)

References

- Mario J. Miranda and Paul L. Fackler "Applied Computational Economics and Finance", MIT Press, 2004
- Kenneth L. Judd "Numerical Methods in Economics", MIT Press, 1998
- Burkhard Heer and Alfred Maussner "Dynamic General Equilibrium Modelling", Springer Verlag, 2004