Course Title

Course title – Intitulé du cours	Quantitative Techniques in Economics
Level / Semester – Niveau /semestre	MRES, / Fall semester
School – Composante	Ecole d'Economie de Toulouse
Teacher – Enseignant responsable	Sumudu Kankanamge & Andreas Schaab
Lecture Hours – Volume Horaire CM	30h
TA Hours – Volume horaire TD	-
TP Hours – Volume horaire TP	-
Course Language – Langue du cours	English
TA and/or TP Language – Langue des TD et/ou TP	-

Teaching staff contacts:

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Course Objectives:

This class is designed to introduce students to standard computational techniques that are now a prerequisite in solving and evaluating modern quantitative economic models. The course will cover global solution techniques. While a number of examples used in this course will be drawn from the field of macroeconomics, many techniques can also be used to solve, simulate and evaluate models from other fields.

Lectures will cover:

1. Incomplete markets/heterogeneous agents models in discrete time:

The first part of the class will explore techniques that explicitly deals with heterogeneity. Starting from a seminal model with idiosyncratic heterogeneity, the techniques seen in the first part of the class will be extended to deal with:

- distribution dynamics,
- transition dynamics,
- models with discrete-continuous choices

- aggregate dynamics.

The class will be computer intensive and students are required to have a laptop or at least a laptop per two students. The computer language will mainly be Julia (no prior knowledge of the language is assumed nor requested). Necessary (free) software will be distributed in class.

2. Incomplete markets/heterogeneous agents models in continuous time. 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

By the end of this course, students should be able to

1. Set up a model,
2. Select and implement the relevant technique to obtain a numerical solution to the model,
3. Simulate the model, and hence generate relevant quantities for the question at stake.

Prerequisites :

Basic computer knowledge. If you have never used Matlab (or another programming language), you should work through some tutorials before the course starts for the second part of the class.

Practical information about the sessions:

Laptops and tablets are accepted.

The class is computer intensive: please have at least a laptop per two students.

Grading system :

TBD. 100% of grade will likely be determined via final research proposal / project.

Bibliography/references :

Part 1:

- Numerical Methods in Economics, by Kenneth L. Judd (Pearson Addison Wesley, 2nd edition, 2008),
- Dynamic General Equilibrium Modeling, by Heer and Maussner (Springer, 2009),
- Recursive macroeconomic theory, by Ljungqvist and Sargent (MIT Press, 2004),
- Computational methods for the study of dynamic economies, by Marimon and Scott (OUP, 2001),
- Dynamic economics, by Adda and Cooper (MIT Press, 2003),
- Recursive methods in economic dynamics, by Stokey and Lucas (Harvard U. Press, 1989)

Part 2:

- No specific textbook.
- Ben Moll's website is an invaluable resource.
- Andreas' own repository (SparseEcon) for heterogeneous-agent macro models will also be used.

Session planning :

TBA

Distance learning *:*

Remote (online) tutorials (classes) are possible.