Syllabus ECON0114 *2019-2020*

Computational Methods for Economists

Content

ECON0114 Computational Methods for Economists is a course that is different from many of the courses that you have had before. So it is important you read this syllabus with some care before choosing this module in your 2nd or final year.

Aims:
The aim of the course is to train you in several important **skills** such as:

- the skill to engage with *structured computing*, i.e. the ability to break large problems down into basic computational steps that, when executed sequentially yield a solution to the problem;
- the skill to assess *validity and robustness of approximate solutions* to *computationally intensive* problems, i.e. the ability to deal with problems requiring a quantity of calculations that goes beyond what you can do by hand, that requires automation but also approximation and repetition under alternative assumptions to assess validity and robustness;
- the skill to *independently generate* interesting modelling questions and *explore* their answers, i.e. the ability to creatively vary upon questions in problem sets or lecture material, or to make task-choice within broader tasks set in a problem-set or exam and to explore paths of solution that you formulate yourself and that deviate significantly from 'model'-solutions or lecture notes examples;

The course also aims to convey additional knowledge that will augment and add to the **knowledge** you will have required in year-1 Mathematics for Economists or equivalent courses. This involves

- Tensor-products, projectors and basis-transformations;
- Eigenvalue problems for non-symmetric matrices;
- Dynamical optimization problems & future-discounting;
- Cyclical processes and an introduction to Fourier Analysis;
- Network theory: applications in Economics & Political Sciences;
- Network theory: notions of network centrality;
- Network theory: clustering, communities and classification;

- Network theory: Optimising and evolving networks;

Question:
Are these skills and knowledge that you would enjoy acquiring?

Mathematica & Coding:
This is not a ‘coding class’ although by the end you will have a working familiarity with the typical strucures of coding such as Do-, For- and While- loops, variable-checks and calling sub-routines based upon the outcomes of variable-checks.

The lecturer will exclusively use Mathematica, however any of the coding done could equally well be done in MatLab or programming languages such as Python or C++. Although these alternatives will not be taught in the course, students are welcome to use them in solving problem sets and exam problems.

Assessment

This module has formative assessment and summative assessment in the following way:

- 5 *formative* problem sets will be set that are optional to submit or not, those who submit get feedback on their solutions and a grade-estimate ranging from A-D,F (i.e. Ist-IIIrd or fail);
- 5 *summative* problem sets will be set where submission is expected and whose average contributes 40% to the final mark;
- 1 *Take-Home Exam* will be issued in the last week of the course, to be submitted roughly 1 or 2 weeks before the start of the next term, the mark of that exam counts 60% towards the final mark;

Marking will happen in such a way that an acceptable distribution of marks will be the result (i.e. no unusual numbers of fails or firsts).

Aims:
The assessment form is chosen in such a way that students will practice the skills and apply the knowledge they have acquired in each problem set. The take-home exam takes *the same form* as the problem sets. The formative problem sets take the same form as the summative problem sets!
The marking scheme of the problem sets involves:
- Assess the skills listed above under the aims;
- Assess the knowledge acquired and the ability to use that knowledge;

Question:
This way of assessing students comes with an additional work-load *during* term but with the pay-off of having no revision for this module afterwards. The work on the problem-sets will be

quite intense and require you to develop *a routine* in regularly working on such problems throughout the term. Is that something you would enjoy?

Who marks:
The lecturer will mark all summative problem sets as well as the exam. That marking is then checked by a second marker from the Department and an external marker.

Classes

This course comes without tutorials but instead has 4 contacts hours, 2 classes of 2-hours each, every week. The distinction between the 2 classes is roughly:
- **Lectures**: here new material is introduced and discussed and there is Q&A about lecture materials;
- **Practicals**: here we go through examples, practice problems and problem sets;
All classes are lecturecast!

Aims:
The lectures focus on the knowledge aims of the course. The practicals focus on the skills aims of the course. You get the most from the practicals by having looked at past practice problems and examples prior to attending the class and formulating questions about them.

Question:
Student questions are an important part especially of the practicals. As a result this module will work best for you if you enjoy asking questions. Do you think you fit, or would like to try and fit, that profile?

Office hours:
The lecturer will have *two* office hours weekly.

Practice Problems

Every week there will be a series of practice problems available for you to work and practice with. They each tend to be shorter than the problem set problems but there are more of them. Last year's problem set problems are typically dressed down into additional practice problems for a subsequent year.

Aims:
Practice problems are there for you to practice and train some of the skills you will need in the problem sets and exam. Typically they contains problems where 'solutions by hand' are possible, or where simplified versions of the Mathematica commands are used. There is no submission and no feedback in these problems, but questions about them can be asked during practicals and full-solutions will be provided at the end of each week.

Question:
Practice problems are another example of how in this module you will be expected to have a routine of working, on your own as well as with fellow students, regularly on the problems. Ideally you guide your absorption of the lecture material not by reading or re-watching lectures but by parsing through the practice problems and problem-sets. Is this a way of learning that appeals to you?

How did students to last year?

The distribution of marks in this module does not deviate in any particular way from most 2nd and 3rd year optional modules. That means that between 20%-25% of students will be expected to achieve a 1st class result while the number of failing candidates will typically be expected to land between 0%-7%.

What is this course good for?

You can find applications of the material covered in this course in many branches of economics and quantitative political sciences, such as:
- Finance and financial-modelling;
- Econometrics;
- The study of market- and international trade models;
- Models for the diffusion of knowledge and opinions in communities of agents;
- Agent-based economic modelling;
- Environmental Economics, Economics of Science, Citation Analysis & Scientometrics;

Connections to other fields:
There are numerous connections to fields such as:
- Statistics & Social Network Analysis;
- Collective decision-making and Social Learning models;
- Neural networks;
- Machine learning;
- Big data;
- Computer Science;
- COmplex systems;
- Statistical Physics;