FIN515
Numerical Methods and Analysis
Module 1, 2015-2016

Course Information

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Classes:
Lectures: Monday & Thursday 1:30 – 3:20 pm
Venue: PHBS Building, Room 225

Course Website:
http://www.finstab.net/

1. Course Description

1.1 Context

Course overview:
This is an introductory course for students with little or no previous knowledge of the practicalities involved in dynamic modeling. The intention of the course is not to train participants to become specialist model-builders but instead for them to be fully conversant in the main techniques involved in building and using dynamics models in their work. The aim is to make participants 'sophisticated consumers' of dynamic models and to provide a deeper framework and knowledge within which to frame their discussions. Although no prior knowledge is assumed it is a fast paced course and additional reading is provided to help students to consolidate material.

Prerequisites:

Econometrics, Financial Economics, Macroeconomics

1.2 Textbooks and Reading Materials

<u>Textbooks</u>

<u>Readings</u>
Ahn, K., 2015. Numerical Methods and Analysis for Financial Economist. Course Pack, Peking University HSBC Business School.

An, S., Schorfheide, F., 2007. Bayesian Analysis of DSGE Models. Econometric Reviews, 59(4): 1481-1509.
Bansal, R., Yaron, A., 2004. Risks for the Long Run: A Potential Resolution of Asset Pricing Puzzles. Journal of Finance, 59(4): 1481-1509.
Brandimarte, P., 2013. Numerical Methods in Finance and Economics: a MATLAB-Based Introduction. John Wiley & Sons.
Fernández-Villaverde, J., Rubio-Ramírez, J. F., 2006. Solving DSGE Models with Perturbation Methods and A Change of Variables. Journal of Economic Dynamics and Control, 30(12): 2509-2531.
Gali, J., 2005. Lectures on Monetary Policy, Inflation, and the Business Cycle – A Simple Framework for Policy Analysis. Lecture Notes, MIT.
Griffoli, T. M., 2007. Dynare User Guide. Unpublished Manuscript.
Klein, P., 2000. Using the Generalized Schur Form to Solve a Multivariate Linear Rational Expectations Model. Journal of Economic Dynamics and Control, 24(10): 1405-1423.
Ljungqvist, L., Sargent, T. J., 2004. Recursive Macroeconomic Theory. MIT press.
Rachev, S. T., Hsu, J.S.J., Bagasheva, B. S., 2008. Bayesian Methods in Finance. John Wiley & Sons.
Ohanian, L. E., Prescott, E. C., Stokey, N. L., 2009. Introduction to Dynamic General Equilibrium. Journal of Economic Theory, 144(6): 2235-2246.
Torres, J. L., 2013. Introduction to Dynamic Macroeconomic General Equilibrium Models. Vernon Press.
Uhlig, H., 1998. A Toolkit for Analysing Nonlinear Dynamic Stochastic Models Easily. Working Paper, University of Tilburg.

2. Learning Outcomes

2.1 Intended Learning Outcomes

Learning Goals	Objectives	Assessment
1. Our graduates will be effective communicators.	1.1. Our students will produce quality business and research-oriented documents.	O
	1.2. Students are able to professionally present their ideas and also logically explain and defend their argument.	O
2. Our graduates will be skilled in team work and leadership.	2.1. Students will be able to lead and participate in group for projects, discussion, and presentation.	
	2.2. Students will be able to apply leadership theories and related skills.	
3. Our graduates will be trained in ethics.	3.1. In a case setting, students will use appropriate techniques to analyze business problems and identify the ethical aspects, provide a solution and defend it.	
	3.2. Our students will practice ethics in the duration of the program.	
4. Our graduates will have a global perspective.	4.1. Students will have an international exposure.	
5. Our graduates will be skilled in problem-solving and critical thinking.	5.1. Our students will have a good understanding of fundamental theories in their fields.	O
	5.2. Our students will be prepared to face problems in various business settings and find solutions.	
	5.3. Our students will demonstrate competency in critical thinking.	O

2.2 Course specific objectives

By the end of the course students should (i) understand the foundations of dynamic models and how they relate to issues in economics and finance, (ii) be able to write dynamic models in a general form suitable for solution and simulation by computer, (iii) implement basic solution and simulation techniques to analyse dynamic models, showing how the model economies behave and how they respond to different shocks, (iv) be aware of how to extend simple models to answer more complex questions, and (v) feel confident in discussing model-based analysis, evaluating the strength of models used and engaging in conversation with people building economic models.

2.3 Assessment/Grading Details

Assessment task	**Weighting**
Assignment	40%
Quiz	20%
Midterm Exam	10%
Class participation: The weight (no absence: 1, one absence: 0.99, two absences: 0.98, and more than two absences: 0.7) will be used for the final GPA adjustment.	10%
Term paper	20%
Total	100%

Organisation:
The course runs over a series of nine weeks. Each lecture will be a mixture of teaching and practical exercises using MATLAB software to solve and simulate dynamic models. TA sessions are therefore free, allowing students time to reflect and consolidate the understanding. The instructors will be available throughout each evening to answer any questions or queries that arise.

Pre-readings:
Some pre-course readings will be assigned for those students who wish to prepare in advance. The issues involved in the pre-reading will be dealt with in the course so there is no need to understand everything. The pre-reading is as much about getting students to gauge what they do and don't understand as it is to get ideas and issues across.

Problem sets and in-class exercises:
Doing computation by trial and error is the only way to learn computation. The problem sets are designed to get you to apply various numerical methods. You are welcome to work in groups of two or three. More generally, I strongly encourage you to discuss the problem sets with your classmates. Classmates are also a valuable source for tips on programming and general computer advice.
A write-up of your solution (one write-up per group) is due in class on the date indicated on the problem set. The write-up should

- provide a brief and clear verbal description of the methods employed;
- use tables and/or graphs to describe your results;
- contain your computer programs in an appendix.

Just handing in computer programs (m-file) and their output is not acceptable. Please remember to indicate the names of all group members on the write-up.
During class I will call on one or more students to present their solution to the in-class exercises. You will explain your solution to your classmates and illustrate it on the classroom

computer. This means that you will have to bring your computer programs to class on a memory stick or your laptop.

Term paper:
You have considerable freedom to follow your interests in choosing a topic for a term paper (group work). The paper should
• motivate and formulate a research question;
• explain why numerical methods are needed to answer the question;
• present a model;
• discuss a computational strategy for solving the model;
• present the results;
• evaluate the accuracy of the results.
The term paper should be at most 15 double-spaced pages excluding tables, graphs, and appendices (12 point font, 1 inch margins).
I urge you to start thinking of a topic early in the module. The term paper could involve replicating a computational paper. Another way to develop a topic is to think of a theoretical paper that does not compute any (other than perhaps trivial) examples and to compute a small set of interesting examples. Ideally, however, the term paper would ask (and answer) an original research question. Once you have identified a topic, please write a short (at most one page) proposal. Email the proposal to me and make an appointment to discuss the suitability of the topic. I expect all students to have discussed a topic with me before Week 4, 2014 – 2015 Module 4.
You will give a short presentation of your term paper in the last session. The goal is to help you organise your thoughts and obtain feedback from your classmates. The final version of the paper is due Week 8, 2014 – 2015 Module 4.

2.4 Academic Honesty and Plagiarism

It is important for a student's effort and credit to be recognized through class assessment. Credits earned for a student work due to efforts done by others are clearly unfair. Deliberate dishonesty is considered academic misconducts, which include plagiarism; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; or altering, forging, or misusing a University academic record; or fabricating or falsifying of data, research procedures, or data analysis.

All assessments are subject to academic misconduct check. Misconduct check may include reproducing the assessment, providing a copy to another member of faculty, and/or communicate a copy of this assignment to the PHBS Discipline Committee. A suspected plagiarized document/assignment submitted to a plagiarism checking service may be kept in its database for future reference purpose.

Where violation is suspected, penalties will be implemented. The penalties for academic misconduct may include: deduction of honour points, a mark of zero on the assessment, a fail grade for the whole course, and reference of the matter to the Peking University Registrar.

For more information of plagiarism, please refer to *PHBS Student Handbook*.

3. Topics, Teaching and Assessment Schedule

	Date	**Due Date**	**Topic Covered**
1	August 31		Introduction to dynamic modelling

			Course Pack, Gali (2005)
2	September 2	Assignment 1	Computational toolkit **Course Pack**
3	September 7		Taking a model to the computer **Course Pack, Klein (2000)**
4	September 10	Assignment 2	Simulating a Markov switching process **Course Pack**
5	September 14		Solution techniques **Course Pack, Klein (2000)**
6	September 17	Assignment 3	Blanchard-Khan (BK) conditions **Course Pack, Blanchard (1980)**
7	September 21		Simulation techniques **Course Pack**
8	September 24	Assignment 4	BK conditions in RBC model **Course Pack**
9	September 28	Term paper proposal	Midterm Exam **Lectures 1 – 8**
10	October 8	Assignment 5	Advanced dynamic models **Klein (2000)**
11	October 12		FEVD, Multi-shock DSGE model **Course Pack**
12	October 15	Assignment 6	Undetermined coefficient methods **Uhlig (1998)**
13	October 19		Overview (dynamic modelling II) & **Quiz 1 (Lectures 9 – 12)**
14	October 22	Assignment 7	Dynamic programming **Course Pack, Stokey et al. (1989)**
15	October 26		Perturbation methods **Fernandez and Rubio (2005)**
16	October 29	Assignment 8	Markov Chain Monte Carlo (MCMC) **Rachev and Bagasheva (2008)**
17	November 2		Bayesian Estimation of DSGE models **Collard (2009), Griffoli (2008)**
18	November 5	Term paper	Presentation (10 minutes for each group) & **Quiz 2 (Lectures 14 – 17)**

4. Miscellaneous

Software

The default computer language for this course is Matlab. The complete documentation of Matlab and its toolboxes can be freely downloaded at http://www.mathworks.com.

A tutorial to get you started and programming tips are available at http://www.finstab.net. Mario Miranda and Paul Fackler have written a Matlab toolbox called CompEcon. The toolbox includes equation solvers and optimisation routines, a set of routines for function approximation, a set of numerical integration routines, routines for solving ordinary differential equations (both initial and boundary value problems), and routines for solving discrete- and continuous-time dynamic programming problems. The toolbox can be freely downloaded at http://www4.ncsu.edu/~pfackler/compecon/toolbox.html .

There is no point in re-inventing the wheel, and I encourage you to use canned code whenever possible. The web is a valuable resource of ready-made code which is often written by professional programmers and/ or applied mathematicians and has been debugged and optimised over many years. However, part of this course is to acquaint you with different numerical methods and programming a method is the best way to understanding how it works. Using canned code is not. I ask you to rely on your own judgment in making this decision. As a rule of thumb I suggest that in a session on optimisation, say, you do not use an existing optimisation routine but instead code your own.