PhD & EE
Computational Economics
Module 2, 2021-2022

Course Information

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Office Hour: Tuesday 10:30-11:30, Tuesday 13:30-14:30 or by appointment

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Classes:
Lectures: Day, Time
Venue: PHBS Building, Room

Course Website:
All course related announcements, reading materials, and assignments will be posted at CMS.
http://cms.phbs.pku.edu.cn/claroline/course/index.php?cid=XXX
(Login to CMS and search for "Computational Economics")

1. Course Description

1.1 Context

This course is a PhD-level course in Computational Economics, focusing on the quantitative methods for solving complex macroeconomics models and on the numerical routines for dynamic economic analysis. The first part of the course will cover basic numerical methods of optimization, equation solving, function approximation, numerical dynamic programming, random number generation, simulation of stochastic environment, and the solution of finite-horizon dynamic games and that of the representative-agent dynamic stochastic general equilibrium models. In the second part of the course, we will examine classic and more frontier methodologies for solving heterogeneous-agent general equilibrium models.

Prerequisites: PhD Macroeconomics (I, II), PhD Microeconomics (I, II)

1.2 Textbooks and Reading Materials

This course will be based on a variety of sources, but will heavily draw materials from the following textbooks. Additional supplementary readings may be provided throughout the course when needed.

- Kenneth L. Judd. Numerical Methods in Economics. The MIT Press, 1998. [Judd]
- Mario J. Miranda and Paul L. Fackler. Applied Computational Economics and Finance, the MIT Press, 2002. [MF]

- Jerome Adda and Russell W. Cooper. Dynamic Economics: Quantitative Methods and Applications. The MIT Press, 2003. [AddaCooper]

2. Learning Outcomes

2.1 Intended Learning Outcomes

Learning Goals	**Objectives**	**Assessment (YES with details or NO)**
1. Our graduates will be effective communicators.	1.1. Our students will produce quality business and research-oriented documents.	Yes. Final Project with written report
	1.2. Students are able to professionally present their ideas and also logically explain and defend their argument.	Yes. Presentation and Computational Problem Sets
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.	Yes. In-class discussions
	2.2. Students will be able to apply leadership theories and related skills.	Yes. Final Project with written report
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.	Yes. Problem Sets, Presentation and Final Project
	3.2. Our students will practice ethics in the duration of the program.	Yes. Participation/Final Project/ Problem Sets
4. Our graduates will have a global perspective.	4.1. Students will have an international exposure.	Yes. Global research standard, English readings and writings, and international classroom environment
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.	Yes. Book Chapters and Academic Papers
	5.2. Our students will be prepared to face problems in various business settings and find solutions.	Yes. Presentation and Final Project
	5.3. Our students will demonstrate competency in critical thinking.	Yes. Participation/Final Project/ Problem Sets

2.2 Course specific objectives

We will emphasize practical skills in implementing numerical methods through programming, computation, simulation and analytical applications. After the successful completion of the course, students would be equipped with advanced skills applying the computational skills using one of the popular modern programming language (e.g., C++/Fortran, MATLAB, or Python) and know better about working with detailed micro-level data for disciplining macro models. Ph.D. students are expected to be able to identify and apply the appropriate state-of-the-art quantitative methods for their own research.

2.3 Assessment/Grading Details

- 5% Class participation
- 40% Four Computational Problem Sets
- 10% Presentation
- 45% Final Project

Your overall course grade will be a weighted average of scores of categories above. If at any point during the module you face circumstances which prevent you from attending the lecture, handing in the assignment on time, and/or doing the presentation, please contact me as early as possible to manage the situation. There is little that can be done after an unsatisfactory grade has been assigned.

Computational Problem Sets: each PS requires students to code up their own version of scripts for analytical purposes and generate results to answer multiple questions related to a given paper. Your answer to each question should be logically structured and be related to the materials we covered in class. You will submit a complete package of codes as well as a written document summarizing your finding and responses to questions. The codes should be readily runnable, which means at most a change of directory is needed.

Presentation: Each student is to do a presentation about a given paper from a given list as provided by the instructor. Try focusing on the computational aspect of the paper, though data used, literature standing and contribution, key findings and bigger implications should not be ignored in the presentation. Below are some guidelines

- The presentation will be timed depending on the number of students registered in the class. The completion of your presentation is followed by a Q&A session, and additional comments from the instructor. Be prepared to be interrupted at any time.
- After the presentation, students are responsible to immediately send the slides and a written report summarizing the contents and your critical thinking about that paper.

Final Project: you will be selecting one of the two computational tasks as provided by the instructor and do the complete replication of the paper. That means, you are responsible for re-producing all figures and tables from that paper in a given section or sections highlighted by the instructor. When you submit your final project assignment, please include the codes package and a written document summarizing your finding and responses to questions. The codes should be readily runnable, which means at most a change of directory is needed. Note that in case of failing to precisely replicate the results, don't forget to discuss why in the written document and do provide fair reasons.

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

- **Lecture 1.** Markov Chain Approximation of Continuous Stochastic Process

(a) Rowenhorst Method
(b) Conditional Moments Method
(c) Earlier Methods: Tauchen's method; Quadrature Method

- **Lecture 2.** Equation Solver

(a) Linear Equation Solver
(b) Non-linear Equation Solver

- **Lecture 3.** Representative-agent Neoclassical Growth Models: Functional Approximation

(a) Polynomial Interpolation
(b) Spline Interpolation

- **Lecture 4.** Representative-agent Neoclassical Growth Models: Optimization

(a) One-Dimensional Derivative-free Method: Golden Section Search and Brent's Method
(b) One-Dimensional Quasi-Newton Method
(c) One-Dimensional Newton Method
(d) Multi-Dimensional Method: Sequential Quadratic Programming

- **Lecture 5.** Representative-agent Neoclassical Growth Models: Perturbation

(a) Linear perturbation
(b) Higher-order perturbation and Pruning

- **Lecture 6.** Representative-agent Neoclassical Growth Models: Numerical Integration

(a) Newton-Cotes
(b) Gaussian Quadrature
(c) Monte Carlo Integration

- **Lecture 7.** Representative-agent Neoclassical Growth Models: Simulation

(a) Random Number Generation
(b) Simulation

- **Lecture 8.** Heterogeneous-agent Models with Finitely Lived Households: Life-cycle Consumption-saving Problem

(a) Finite-period dynamic programming
(b) Equilibrium computation

- **Lecture 9.** Application: Finite-horizon Overlapping Generation (OLG) Models: Insights and Solution Methods

- **Lecture 10.** Heterogeneous-agent Models with Infinitely-Lived Households: Stationary Equilibrium and Transition Path

(a) Stationary Distribution
(b) Solving Stationary Equilibrium
(c) Transition path equilibrium

- **Lecture 11.** Heterogeneous-agent Models with Infinitely-Lived Households: Stochastic Equilibrium

(a) Krusell-Smith Method
(b) Evaluate the solution accuracy

- **Lecture 12.** Heterogeneous-agent Models with Infinitely-Lived Households: Stochastic Equilibrium
(a) Other methods
(b) Critical Thinking: the existence of symmetric near-perfect information equilibrium

- **Lecture 13.** Heterogeneous-agent Models: Cross-sectional Data Set and Calibration

- **Lecture 14.** Application: Models with Occasionally Binding Constraints: Insights and Solution Methods

- **Lecture 15.** Application: Heterogeneous Agent New Keynesian Models (HANK Model): Insights and Solution Methods

- **Lecture 16.** Application: Models with News Shocks and Forward Guidance: Insights and Solution Methods

- **Lecture 17 & 18.** Student Presentation of Research Papers

4. Miscellaneous

- As a student, you are responsible for upholding the academic integrity with full commitment to all the ethics, codes, and standards of the PHBS and those of Peking University.

- Show complete courtesy to your classmates and instructor by coming to class on time and switching your cell phones into silence mode during class.

- At any time during the module, please let me know what you think about this class and what can be improved. I appreciate all your feedbacks. Incorporating your suggestions will greatly help me in updating the course for future generations of students.