Course Code
Numerical Methods and Analysis
Fourth Module, 2019 - 2020

Course Information

Instructor: Jinhui Bai
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Office Hour: Mon & Thu, 10:30 – 11:30

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Classes:
Lectures: Mon & Thu, 8:30 – 10:20
Venue: Online

Course Website:
If any.

1. Course Description

1.1 Context

Course overview: The goal of the course is to introduce students to advanced quantitative methods and their applications in 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 and simulation, and the solution of dynamic stochastic general equilibrium models. In the second part of the course, we will study econometric estimation methods of nonlinear structural economic models, including Bayesian Estimation, Generalized Method of Moments, Indirect Inference, and Simulated Method of Moments.

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

1.2 Textbooks and Reading Materials

[1] Mario J. Miranda and Paul L. Fackler, 2002. Applied Computational Economics and Finance, MIT Press.

[2] Kenneth L. Judd, 1998. Numerical Methods in Economics, MIT Press.

[3] Press, William H., Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery, 2007. Numerical recipes: The art of scientific computing, 3rd edition, Cambridge University Press.

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.	Research Project
	1.2. Students are able to professionally present their ideas and also logically explain and defend their argument.	Class Presentation
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.	Class Presentation
	2.2. Students will be able to apply leadership theories and related skills.	NO
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.	NO
	3.2. Our students will practice ethics in the duration of the program.	Research Project
4. Our graduates will have a global perspective.	4.1. Students will have an international exposure.	Research Project
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.	Homework
	5.2. Our students will be prepared to face problems in various business settings and find solutions.	Research Project
	5.3. Our students will demonstrate competency in critical thinking.	Research Project

2.2 Course specific objectives

We will emphasize practical skills in implementing numerical methods on computers, including acquiring advanced skills in a popular modern programming language (e.g., C++, MATLAB, or Python) and working with data sets. Several projects will involve computing solutions to canonical dynamic economic models.

After completing the course, successful students should be able to apply state-of-the-art quantitative methods to their dissertation research.

2.3 Assessment/Grading Details

To receive credit, the students need to answer four take-home problem sets, make one presentation of a research article, and a project replicating a research paper. They will count toward the grade as follows.

Problem Sets	Presentation	Project
40	10	50

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. Introduction and Canonical Models

Lecture 2. Discrete State Dynamic Programming

(a) Solution

(b) Invariant Distribution

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

(a) Polynomial Interpolation

(b) Spline Interpolation

(c) Collocation Method

Lecture 4. Representative-agent Neoclassical Growth Models: Optimization

(a) One-Dimensional Derivative-free Method: Grid Search, 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: Equation Solver

(a) Linear Equation Solver

(b) Non-linear Equation Solver

Lecture 6. Representative-agent Neoclassical Growth Models: Perturbation

(a) Linear perturbation

(b) Higher-order perturbation

Lecture 7. Representative-agent Neoclassical Growth Models: Numerical Integration and Markov Chain Approximation

(a) Newton-Cotes

(b) Gaussian Quadrature

(c) Markov Chain Approximation of Continuous Stochastic Process: Rowenhorst Method; Conditional Moments Method; Tauchen’s method; Quadrature Method

Lecture 8. Representative-agent Neoclassical Growth Models: Simulation and Monte Carlo Integration

(a) Random Number Generation

(b) Simulation

(b) Monte Carlo Integration

Lecture 9. Heterogeneous-agent Models with Infinitely-Lived Households: Stationary Equilibrium and Transition Path

(a) Stationary Distribution

(b) Solving Stationary Equilibrium

(c) Transition path equilibrium

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

(a) Krusell-Smith Method

(b) Evaluate the solution accuracy

Lecture 11. Heterogeneous-agent Models with Finitely Lived Households: Life-cycle Consumption-saving Problem

(a) Finite-period dynamic programming

(b) Equilibrium computation

Lecture 12. Econometric Estimation of Structural Models: Indirect Inference and Simulated Method of Moments

(a) Indirect Inference

(b) Simulated Method of Moments

Lecture 13. Representative-agent New Keynesian (RANK) Models: Solution Methods

(a) Perturbation Method

(b) Practicing Dynare

Lecture 14. Representative-agent New Keynesian (RANK) Models: Bayesian Estimation

(a) Bayesian Method

(b) Practicing Dynare

Lecture 15. Heterogeneous-agent New Keynesian (HANK) Models: Solution Methods

Lecture 16. Heterogeneous-agent Models: Cross-sectional Data Set

Lecture 17 - 18. Student Presentation of Research Papers and Project

4. Miscellaneous