Syllabus: Computation in Macroeconomics

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Office hours
Monday 11:00am-12:00pm , or by appointment.

Course Description
This course teaches research frontiers in quantitative macroeconomics. More specifically, I focus on computation techniques in heterogeneous agents models (HA) in incomplete markets. I will cover HA models in both discrete time and continuous time. This course will also provide an intuitive introduction to stochastic calculus, stochastic differential equation, and stochastic control. I will cover the following four methods.

	discrete	continuous
deterministic	dynamic programming (DP)	Optimal Control HJB - First order ODE
stochastic	Stochastic DP	Stochastic Control HJB - Second order PDE

HA modeling is now widely used in macroeconomics, labor, international trade, industrial organization, and finance. This type of models can generate endogenous distributions of income, wealth, or firm-size, and hence offers a framework to study inequality, intergeneration mobility, macro-prudential policy, firm size distributions, firm values, and policy issues in industry organization. This course will teach relevant numerical methods in this field.

Prerequisite
Macroeconomics Theory (I), probability theory, familiar with dynamic programming, and familiar with at least one programming language, like Matlab, Python, C/C++.

Course Website
NTU Cool: https://cool.ntu.edu.tw/courses/7174
All course materials and grades will be posted in the website.

Course Outline
Students will learn methodology and relevant techniques to conduct research in this field. Students need to write programming codes every week and submit a research proposal in the middle of December. Hardworking is required.

Grading

- Assignment (70%): there will be 10 assignments, and you need to complete 7 of them (the left 3 are bonus (5% each) or used as the final project). Each assignment is due 11:59 pm Monday. You need to submit your original code and a pdf document (write in English) to my email account. You can form a group of two students to submit one assignment or either by yourself alone. Group discussion is welcome.

Late assignment will have 30% discount in the first week, 50% in the second week, and zero after two weeks of the due date.

- Proposal (15%, due 12/4): In this course, I will also guide you how to start the research. Using techniques learned in class, you need to formulate a research question and find the most relevant paper to replicate. You need to write:
  - Introduction
  - Research Question (challenge)
  - The idea of your answer (theory/model) and one most relevant paper.

  Since many ideas fail, you need to discuss me with your research idea around November. The proposal should use 12pt, 1200 to 2500 words.

- Final project (15%): I will assign you a research paper or one assignment (to replicate). The final project must be done individually, no discussion among students.

Some useful references There is no assigned textbook. I list some useful resources for the course:

- Sargent and Stachurski's website: Quantitative Economics
- Basic knowledge in dynamic programming: Nancy Stokey and R Lucas. 1989. *Recursive Methods in Economic Dynamics.* Harvard University Press. Book.
- Burkhard Heer and Alfred Maussner. 2009. *Dynamic general equilibrium modeling: computational methods and applications.* Springer Science & Business Media. Book.
- Kenneth L Judd. 1998. *Numerical Methods in Economics.* MIT press. Book.