Syllabus: Dynamic Programming, Spring 2023

- **Instructor:** Cheng-Hung Wu
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  - **Office Hour:** Monday 11:00 or by appointment
  - **TA:** TBA
  - **TA Office Hour:** Guo Ching Building 112, Friday 13:30 - 15:00 or by appointment
- **Lectures**
  - **Time:** Monday 13:20 - 16:10,
  - **Location:** Guo Ching Building 101
- **Course web page:** *TBA*
- **Course description:** This course emphasizes on the use of stochastic dynamic optimization methods in theory and practice. General knowledge of probability theory and stochastic processes is assumed. Applications considered include revenue management, queueing systems and supply chain systems. The topics discussed also have wide applications to financial, economic, and engineering systems.
- **Course Objectives and Contents:**

  Solve problems in which sequential decision making is an issue

  Understand the Principle of Optimality

  Know how to include randomness in sequential decision-making processes

  Construct and Solve infinite horizon Markov decision problems

  Show the existence of optimal policy structure for a wide variety of dynamic optimization problems

  Introduction to Stochastic Programming (another stochastic optimization tool based on mathematical programming)
- **Required background:** Background in college level mathematical analysis, probability theory, and stochastic processes is required. In addition, homework and term project will include developing computer codes for algorithms presented in class. These computer codes could be applied to solve stochastic dynamic decision problems in practice.
- **Readings:** There will be no required textbook for this course; required reading materials will be distributed either in class or through the course web page.

  There are many good textbooks on dynamic programming, however, most of them are much more extensive than what we could cover in this semester. These textbooks differ slightly in their emphasis and presentation; I am providing references to some of them for you to use as reference materials in this course:

- E. V. Denardo, Dynamic Programming: Models and Applications, 1982 (out of print)
- M. L. Puterman, Markov Decision Processes, Wiley, 1994
- L. I. Sennott, Stochastic Dynamic Programming and the Control of Queueing Systems, Wiley, 1999
- J. R. Birge and F. Louveaux, Introduction to Stochastic Programming, Springer, 1997
- S. G. Nash and A. Sofer, Linear and Nonlinear Programming, McGraw-Hill, 1996
- D. P. Bertsekas, Dynamic Programming and Optimal Control, 2nd edition, Athena Scientific, 2001
- V. G. Kulkarni, Modeling and Analysis of Stochastic Systems, Chapman & Hall,1995
- S. M. Ross, Introduction to Probability Models, 8th edition, Academic Press, 2002 S. M. Ross, Stochastic Processes, 2nd edition, Wiley, 1995
- S. Resnick, Adventure in Stochastic Processes, 1st edition, Birkhauser, 1992
- S. Karlin and H. E. Taylor, A First Course in Stochastic Processes, 2nd edition, Academic Presses, 1975

If you find one of these books (or sections in several books) particularly useful to you in mastering the course material, I would appreciate your comments.

- **Grading:** Course grades are determined from performance on homework assignments, projects, paper presentation and in-class discussion, midterm, and final exam. Grading is based on:

  1st Midterm Exam. 30%, 2nd Midterm Exam. 30%,
  Quizzes/Homework 20%, Projects/ Discussion/ Reports 20%.

- **Homeworks**: Homework assignments will be posted on the course website a week before the due date. All homework assignments are **due at the beginning of the class next week**. No late homework will be accepted. (Homework solutions will be posted on the course website, and your submitted homework may not be returned.)

- **Course Policies** Notify me ASAP if you are unable to take an exam or meet a deadline for any reasons. I must hear from you (either in person, by email, or by voice mail) prior to the exam or the due date. Any excuses will need to be appropriately documented. In each instance, we will discuss how you will make up for the missed work.

- **Individual work policies and Honor Code:** You are allowed (indeed, encouraged) to consult with other students enrolled in the class during the conceptualization of a problem, or ask for technical support in accessing necessary software. However, all submitted homework assignments (including computer codes and outputs, if relevant) should represent your own efforts.

  In particular, you are not allowed to obtain, look at, use, or in anyway attempt to derive advantage from existing solutions for this or other classes, including solutions produced by former students, previous or current instructors, or textbook publishers.

  You must observe the university Honor Code with respect to examinations and all other aspects of this course. If any of the above policies, or other aspects of the Honor Code are unclear to you, please ask me to clarify them as soon as the issue arises.