Simulation

IEOR 4404

Fall 2018

Class Time:	MW 5:40-6:55 pm	**Classroom:**	351 CS Building
Recitation Time:	F 2:00-3:00 pm	**Recitation Room:**	To be announced

Instructor: Yi Zhang
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Learning Objectives: The analysis of real-world processes or systems is extremely important both academically and managerially. Simulation is a broad term related to the generalization of real-world systems, modeling real-world systems, and analysis of real-world systems. Decision-makers rely on simulation especially when the real-world system is costly (or even impossible) to implement and analyze. This course will delve deep into different simulation techniques. Especially, we are interested in the conversion of real-world models into a computer coded version and the estimation of various quantities of interest by observing the output of the model when fed with (pseudo-)randomly generated inputs. At the end of this course, you should be able to

1. Use different simulation techniques to generate variables following different distributions.

2. Construct and simulate different systems and analyze the system output.

3. Use variance reduction techniques to make the simulation more efficient

Course website: We will be using Courseworks to post lecture materials, homework assignments, and grades. Please check the updates on the course website periodically.

Textbook: *Simulation* by Sheldon M. Ross (5th edition), Elsevier Academic Press, New York, 2012.
     The course will follow the textbook fairly closely, especially during the beginning of the semester. The electronic version of this textbook is free to download from here. You will need your UNI and password to download the textbook. The physical version of the textbook is also available in the bookstores and through online vendors. You are highly advised to supplement the course materials with reading the textbook chapters.

Software: We will use Python for this course.

Prerequisites: Understanding of basic probability theory and statistics at the level of IEOR 3658, IEOR 4150, or IEOR 4307. Knowledge of stochastic processes (e.g. IEOR 3106 and/or IEOR 4106) is helpful. Previous knowledge of programming is helpful.

Tentative Course Schedule:

- Review of Probability and statistics .... Week 1-2

- Simulation of discrete random variables .....Week 3-4

- Simulation of continuous random variables ..Week 5-6

- Review and mid-term exam .... Week 7

- Simulation and analysis of systems .... Week 8-10

- Variance reduction techniques .... Week 11-13

- MCMC Simulation .... Week 14

- Review .... Week 15

The schedule might be subject to change depending on our course progress and your interest. The final exam schedule will be decided by the Office of the University Registrar. We will make an announcement when the schedule is published.

Grading Policy: Homework(35%), Class Participation (5%), Midterm (25%), Final (30%).
Homework: We will have 9 homework assignments in total. You can collaborate on the homework assignments. However, you must finish the write-up independently. You can find tentative homework assignment post dates and due dates on CourseWorks.
Class Participation: Regular attendance is important and expected. We will have 7 pop-up quizzes. You are required to answer at least 5 of the quizzes. You will get full credit for each quiz as long as enough effort is shown in answering the questions. Your quiz score will count towards your class participation grades. In addition, active learning is one essential part of the class. You are expected to actively participate in class discussions and contribute your ideas. Your class performance will count towards your class participation grades.
Exams: We will have two exams. You are required to finish the questions independently. Communicating with other people during the exam will be considered cheating.
The letter grade will be assigned based on the curve. When assigning the letter grade, we will consider both your standing among your peers and also the class performance as a whole.

Late Policy: The deadlines for all the homework assignments are at midnight. In addition, I will give each person a leeway of 1 hour for each assignment. After the leeway, the submissions will receive a 0. However, the lowest homework grade will be dropped.

Re-grading Policy: If there is any question regarding the grading of homework, please contact the instructor within seven days upon receiving your grades and comments. Since I will be posting solution to each homework assignment, you are expected to compare the solution with your own write-up before sending the request. In your request, you should explain the reasoning for any suspected mistakes in grading.

Discussion Board: We highly encourage you to use Piazza to ask and answer questions. The goal is to make Pizza a collaborative space for learning and communicating. We will also periodically answer questions and manage the content there. Please do not post content directly related to the solution of the assignment questions.

We welcome you to drop by the office hours with any questions you have related to the course. We are also happy to schedule separate meetings outside our office hours.

Also, please always feel free to drop us e-mails. For the e-mails, please expect a reply within 24 hours. If you fail to receive a reply within 48 hours, please send us a reminder.

Important Dates:

Midterm .... October 7, 2018 (in class)
Final Exam .... To be scheduled by the university

Laptop Policy: Please bring your laptop to the classroom. We will be doing some in-class exercise on the laptop. You are also welcome to use the laptop for tasks related to the course materials, such as taking notes and reading the textbook.

Academic Honesty: I highly encourage a collaborative environment. You are encouraged to study with other, help each other, and learn from each other. Students are also highly encouraged to come to the instructor/TA for help. However, your homework assignments should entirely be your own write-up. For the exams and quizzes, you need to finish the questions by yourself. No discussion or collaboration is allowed.

The derivations, estimation results, and descriptions cannot be copied from another person or from any other source. Submissions where these details are identical or nearly identical, either among peers or with another source, will be regarded as cheating. The minimum sanction for copying or other forms of cheating on a homework assignment is the loss of credit equal to two assignments, and sanctions may range up to the termination of your enrollment at Columbia University. All suspected incidents will be recorded with SEAS administration at the same time the student is notified.

Stay Healthy: Studying at Columbia University can be competitive and stressful. We are here to make sure everyone stays healthy physically and mentally. If you have any help with your work or life, please do not hesitate to approach us. We are always here to help. In addition, please do not hesitate to use Columbia Counseling and Psychological Services for anonymous consultation.