IE 3553/5553 Simulation, Fall 2023 – Syllabus

Lectures: Mon/Wed, 1:25-3:20pm, Keller Hall 3-230

Instructor: Saumya Sinha (saumya@umn.edu)

Course Description: This course is an introduction to computer simulation. We will cover fundamentals of simulation modeling and analysis: generation of psuedo-random numbers, generation of random variables, input probability distributions, analysis of simulation output, variance reduction techniques, and comparison of system configurations using experimental design. We will also learn how to construct Monte Carlo simulations to answer questions about probability models. For discrete-event simulation models with a time-advance component, we will use Simio, a special-purpose software package to create and analyze simulation models that are commonly encountered in industries such as manufacturing, service operations, healthcare, and transportation. For static Monte Carlo simulations, I will demonstrate techniques using the Python programming language; however, you are free to use R or any other programming language that you prefer.

Prerequisites:
For IE 3553: CSE Upper Division, CSCI 1133 (or equivalent) and IE 3521 (or equivalent)
For IE 5553: Upper division or graduate student; familiarity with probability and statistics

Course Goals and Learning Objectives:
On successful completion of the course, students will have learned to:
- Understand the operation of the simulation clock in discrete event simulation.
- Create discrete-event simulations with a time-advance component using Simio.
- Implement static Monte Carlo simulations in a general-purpose programming language.
- Analyze data to select appropriate input distributions.
- Construct and interpret confidence intervals from simulation output.
- Use proper simulation modeling and design to compare alternative system configurations.
- Utilize variance reduction techniques such as common random numbers.
- Properly design and execute simulation studies using factorial designs.

Textbooks:
1. Simulation, 5th edition, Sheldon M Ross, Academic Press, 2013.
2. Simulation Modeling and Analysis, 5th edition, Averill Law, McGraw Hill, 2015.
3. Simio and Simulation: Modeling, Analysis, Applications, 6th edition, Jeffrey S. Smith and David T. Sturrock, published by Simio LLC, 2022, available at https://textbook.simio.com/SASMAA/.

Workload and Assessment
This class requires reading, working problems by hand, and creating and running models using simulation software. While we will demonstrate the simulation software in class, you will need to investigate and experiment with it on your own. In the end you will gain a marketable skill for Industrial and Systems Engineering professionals.

Assessment will be based on homework, short assignments, two exams, and a group project, and their contributions towards the final grade will be as follows:

Homework   35%
Short assignments   10 %
Exam 1   20%
Exam 2   20%
Project   15%

There will be no "extra credit" assignments. You are encouraged to discuss homework assignments with your classmates; however, *the work you turn in must be your own.*

Tentative Schedule of Topics

Week 1	Introduction to simulation
Week 2	Random number generation
Week 3	Single-server queueing system
Weeks 4-5	Discrete event simulation
Week 6	Simio
Week 7	Midterm exam
Week 8	Simio
Week 9	Input distributions
Weeks 10-11	Output analysis
Week 12	Variance reduction techniques
Week 13	Experimental design
Week 14	Examples and Simio
Week 15	Project Presentations