

22:544:636 Simulation modeling and analysis

Fall 2023

1WP Room 502

Mondays 4-6:50pm

Dr Thomas Lidbetter

1WP Room 1076

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Many complex processes and systems cannot be readily understood and analyzed using existing analytical models. Decision makers rely on simulation to understand such systems and to find optimal policies. This course will introduce some basic techniques for modeling and simulating complex systems in the presence of uncertainty. Using the framework of stochastic discrete event simulation, we shall build simulation models and analyze those models by performing computational experiments. We will focus on building and analyzing appropriate models for a range of applications in manufacturing, finance and logistics.

Course delivery mode: Hybrid. Some classes will be in person and some will be online (see course schedule below). You are expected to attend all in-person classes. Participation will be required. All classes will be recorded.

Learning Management System: Canvas

Hardware and software requirements: Students should have a desktop or laptop with webcam.

COURSE MATERIALS

- B. Nelson, *Foundations and Methods of Stochastic Simulation*, 2nd edition, Springer, 2021
- A. Law, *Simulation Modeling and Analysis*, 5th edition, McGraw-Hill, 2014

LEARNING GOALS AND OBJECTIVES

- This course is designed to help students develop skills and knowledge in the following areas:

- *Modeling and simulating complex systems in the presence of uncertainty*
- *Computer models of complex systems*
- *Simulation experiments and their output*
- *Application of simulation modeling and analysis in manufacturing, finance and logistics.*

- Students who complete this course will demonstrate the following:

- *Ability to model complex systems using stochastic discrete event simulation*
- *Ability to implement a simulation model using an appropriate programming language*
- *Ability to analyze the output from simulations*

- Students develop these skills and knowledge through the following course activities and assignments:

- *Regular homework assignments*
 - *An exam*
 - *A group modeling project*
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PREREQUISITES

A basic knowledge of probability and statistics and experience of programming in Python.

ACADEMIC INTEGRITY

I do NOT tolerate cheating. Students are responsible for understanding the RU Academic Integrity Policy (http://academicintegrity.rutgers.edu/files/documents/AI_Policy_2013.pdf). I will strongly enforce this Policy and pursue *all* violations. On all examinations, students must sign the RU Honor Pledge, which states, "On my honor, I have neither received nor given any unauthorized assistance on this examination or assignment." Don't let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

ATTENDANCE AND PREPARATION POLICY

- Expect me to attend all class sessions. I expect the same of you. If I am to be absent, my department chair or I will send you notice via email and Blackboard as far in advance as possible. If you are to be absent, report your absence in advance at <https://sims.rutgers.edu/ssra/>. If your absence is due to religious observance, a Rutgers-approved activity, illness, or family emergency/death and you seek makeup work, also send me an email with full details and supporting documentation within 3 days of your first absence.

- For weather emergencies, consult the campus home page. If the campus is open, class will be held.

- Expect me to arrive on time for each class session. I expect the same of you.

- Expect me to remain for the entirety of each class session. I expect the same of you.

- Expect me to prepare properly for each class session. I expect the same of you. Complete all background reading and assignments. You cannot learn if you are not prepared. The minimum expectation is that for each class, you have prepared by studying for at least twice as many hours.

- Expect me to participate fully in each class session. I expect the same of you. Stay focused and involved. You cannot learn if you are not paying attention.

CLASSROOM CONDUCT

- Do not call out in class. If you have a question, raise your hand.
- No food or drink in class.
- No side conversations or use of cell phones in class.
- Use the bathroom before class to avoid the necessity of bathroom breaks.

EXAM DATES AND POLICIES

There will be an exam roughly two-thirds of the way through the class.

During the exam, the following rules apply:

- If you have a disability that influences testing procedures, provide me an official letter from the Office of Disability Services **at the start of the semester**.
- No cell phones or other electronics are allowed during the exam.

Make-up exam policy:

- **Allowances for make-up exams** “Make-up” exams are allowed only for those students whose absence on a class exam date was due to a legitimate illness or emergency (i.e., circumstances beyond their control). MSIS Department Coordinator Office ultimately determines what does or does not constitute a “legitimate” illness/emergency.
- **Procedures for obtaining authorization to take a make-up exam:** If your absence is due to illness, the MSIS Department Coordinator Office will require you to provide them with a document from your doctor indicating that you were indeed sick that day. If you do not provide the MSIS Department Coordinator Office with a doctor's note, they cannot in turn provide me with the proper authorization to allow a make-up exam.

GRADING POLICY

Course grades are determined as follows:

2% participation
28% Homework assignments
30% Group projects
40% Exam

Your final grade is not subject to negotiation. If you feel I have made an error, submit your written argument to me within one week of receiving your final grade. Clarify the precise error I made and provide all due supporting documentation. If I have made an error, I will gladly correct it. But I will adjust grades only if I have made an error. I cannot and will not adjust grades based on consequences, such as hurt pride, lost scholarships, lost tuition reimbursement, lost job opportunities, or dismissals. Do not ask me to do so. It is dishonest to attempt to influence faculty in an effort to obtain a grade that you did not earn, and it will not work.

COURSE SCHEDULE

<u>Date</u>	<u>Format</u>	<u>Topic</u>
Sep 11 th	In person	Intro to stochastic discrete event simulation, examples
Sep 18 th	Online	Review of probability and statistics
Sep 25 th	In person	Generating random variates and random numbers
Oct 2 nd	Online	Background on Poisson processes and queuing theory
Oct 9 th	In person	Simulation of queuing systems and other examples, including time series analysis and financial modeling
Oct 16 th	Online	Introduction to simulation using Python
Oct 23 rd	Online	Simulation using Python: examples
Oct 30 th	In person	Simulation of inventory and job shop models
Nov 6 th	Online	Simulation of Markov decision processes
Nov 13 th	In person	Exam
Nov 20 th	Online	Agent based simulation and Monte Carlo simulation
Nov 27 th	In person	Analysis of output: risk and error, input/output uncertainty
Dec 4 th	Online	Experiment design and analysis, variance reduction techniques
Dec 11 th	In person	Presentation of group projects

SUPPORT SERVICES

If you need accommodation for a *disability*, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey, provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law Against Discrimination. <https://ods.rutgers.edu>

If you are a military *veteran* or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. <http://veterans.rutgers.edu/>

If you are in need of *mental health* services, please use our readily available services.

Rutgers University-Newark Counseling Center: <http://counseling.newark.rutgers.edu/>

If you are in need of *physical health* services, please use our readily available services.

Rutgers Health Services – Newark: <http://health.newark.rutgers.edu/>

If you are in need of *legal* services, please use our readily available services: <http://rusls.rutgers.edu/>

If you are in need of additional *academic assistance*, please use our readily available services.

Rutgers University-Newark Learning Center: <http://www.ncas.rutgers.edu/rlc>

Rutgers University-Newark Writing Center: <http://www.ncas.rutgers.edu/writingcenter>