INDE 572 – Stochastic Processes and Simulation
Syllabus, Spring 2022

Instructor: Saumya Sinha, Ph.D. (saumya.sinha@rice.edu)
Class Meetings: TR, 9:25-10:40am

Course Description: This course aims to enable students to build and analyze mathematical models of real-life applications where uncertainty is present. Applications are drawn from a variety of domains, such as inventory, reliability, telecommunications, and healthcare systems. The following topics will be covered: Discrete & continuous time Markov chains, Poisson processes, queueing systems, Markov decision processes, Monte Carlo & discrete-event simulation. Basic knowledge of probability (random variables, probability distribution functions, moments of random variables, expectations, conditional probability) will be assumed.

Prerequisites:
- INDE 571
- Familiarity with a scientific programming language, e.g., Matlab, Python, R
- Familiarity with multivariable calculus and elementary matrix manipulations (matrix addition and multiplication, Gaussian elimination)

Learning Outcomes: By the end of this course, students will be able to
- describe fundamental modeling tools for situations where uncertainty exists,
- develop discrete- and continuous-time Markov models of systems,
- understand basic principles of renewal theory and use them for performance calculations,
- model production and service systems using queueing models, and calculate long-run average performance measures,
- construct models for sequential decision making under uncertainty and determine optimal decisions for design and operations of various systems.

Textbooks:
There is no prescribed textbook for the class. Lecture notes will be available through Canvas, and the following books will be used as references. You are not expected to purchase these books, but if you would like to purchase one, I recommend the first one.
- S.M. Ross, Introduction to Probability Models, Academic Press, 12th Edition, 2019.
- V.G. Kulkarni, Modeling and Analysis of Stochastic Systems, Chapman & Hall/CRC Texts in Statistical Science, 3rd Edition, 2016.
- E. Cinlar, Introduction to Stochastic Processes, Dover Books on Mathematics, 2013.
- F. Hillier and G. Lieberman, Introduction to Operations Research, McGraw Hill, 10th Edition, 2014.

Work and assessment:
Students will complete weekly homework assignments, a class project in 1-2 member teams, a midterm exam, and a final exam for this class. The grade will be distributed as follows:
- Homework -- 40% (weekly)
- Project -- 10%
- Midterm exam -- 25%
- Final exam -- 25%