IEOR 4404: Simulation

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Meeting time: TBA
Teaching assistants: TBA
Office hours: TBA
Recitations: TBA

Overview. Many real-world systems of interest (such as those found in manufacturing and financial applications) can be faithfully described by stochastic models, which are often too complicated to be analyzed mathematically. However, advances in modern computer technology give us the means to analyze these models by simulation, i.e., by converting them into computer programs and generating many random instances to compute various quantities of interest.

This course introduces the foundation of stochastic simulation. We first explain how to generate (pseudo)random numbers using a computer, and how to utilize these random numbers to generate random variables with arbitrary distributions. Building upon this knowledge, we then show how we can simulate stochastic systems that evolve over time. The last part of the course focuses on understanding the efficiency of general simulation procedures, and introduces various efficiency-improving techniques.

Syllabus and topics.

- **Review of probability** (≈ 2 lectures): probability space, random variables, examples of discrete and continuous random variables, law of large numbers, central limit theorem.

- **Generating random variables** (≈ 6 lectures): random number generation, inverse transform method, acceptance/rejection method, composition method, polar method for generating normal random variables.

- **Simulating stochastic systems** (≈ 7 lectures): homogeneous and inhomogeneous Poisson processes, Markov chains, discrete-event simulation, applications in queueing systems and stock pricing.

- **Output analysis** (≈ 2 lectures): statistical analysis of simulated data.

- **Variance reduction techniques** (≈ 7 lectures): antithetic variates, control variates, conditioning, stratified sampling, importance sampling.

Pre-requisites. Understanding of basic probability theory and statistics at the level of SIEO 3600 or SIEO 4150, and knowledge of a programming language such as C, C++ or Matlab. Knowledge of stochastic processes (e.g. IEOR 3106 and/or IEOR 4106) is also helpful.

Other useful references:


Grading policy (tentative). Weekly homework assignments (10%), midterm (45%) and a final (45%).