COURSE TOPICS

1. **Introduction to Simulation**
   - key issues in simulation
   - system state definitions
   - specification of performance measures
   - discrete-event stochastic systems
   - Monte Carlo methods

2. **Probability Models for Discrete-Event Stochastic Systems**
   - discrete-time Markov chains (DTMC’s)
   - continuous-time Markov chains (CTMC’s)
   - semi-Markov processes
   - generalized semi-Markov processes (GSMP’s)
   - selecting input distributions

3. **Sample-Path Generation**
   - time-advance mechanisms
   - uniform and non-uniform random number generation
   - specialized generation methods for CTMC’s and other processes
   - event-list data structures

4. **Statistical Inference for Simulations**
   - laws of large numbers, central limit theorems, and confidence intervals
   - multiple replications for simple performance measures
   - complicated performance measures: Taylor series, sectioning and jackknifing
   - steady-state simulation: regenerative and batch-means methods
   - estimation of delay characteristics
   - efficiency-improvement techniques
   - computational issues

5. **Making Decisions using Simulation**
   - selecting the best system
   - stochastic optimization

Methodology will be illustrated via examples chosen from computer, telecommunication, manufacturing, workflow, financial, and transportation systems.

During the first week or so of the course, there will be two optional review seasons, one for computer programming basics and one for probability and statistics.
GOALS OF THE COURSE

• Understand the basic principles and methods underlying elementary Monte Carlo methods and computer simulation of discrete-event stochastic systems

• Gain familiarity with the most commonly used stochastic models for discrete-event systems

• Become skilled at developing probabilistic models of a wide variety of real-world systems.

• Become adept at designing, running, and analyzing simulations

• Appreciate the power and wide applicability of simulation techniques

• Be able to critique someone else’s simulation results

• Become educated consumers of simulation software---know which questions you should be asking about what goes on “under the hood.” We won’t focus on specific simulation packages, but rather on skills that can be transferred to any such package.