ENMG 622 Simulation
Spring 2010, CRN 20014, M: 7:00 - 10:00 PM, Bechtel 407

Instructor
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Course Description and Objectives
Simulation is concerned with developing computer models that mimic the behavior of real systems. This is done through the generation of “random variates” that replicate the statistical properties of a system. Simulation falls under the umbrella of Operations Research. The objective of simulation (like other OR models) is to gain insight into the real system with the ultimate goal of enhancing performance. Simulation is generally used when analytical methods are not sufficient (i.e., the model cannot be developed with closed-form mathematical expressions). It is also used for validating analytical models. As such, simulation is one of the most popular decision making tools used by analysts in OR and related disciplines. The objective of this course is to introduce the student to the main ingredients of a successful simulation study. Students will learn how to (i) process input data for a simulation model; (ii) develop a simulation model on a computer; and (iii) analyze the output of the simulation. Simulation models will be developed using Arena and basic spreadsheets. Financial, services and manufacturing applications will be presented.

Textbooks

Additional References
Tentative Schedule
Topics will be covered according to the following schedule.

- Week 1: Course introduction, OR modeling approach, simulation overview (Chapter 1 in Law and KSS books)
- Week 3: Introduction to discrete event and process oriented simulation. Hand simulation of a queueing and an inventory system (Chapter 1 in Law, Chapter 2 in KSS). Introduction to Arena (Chapter 3 in KSS).
- Week 4: Random number generators, linear congruential generators, mixed and multiplicative (Chapter 7 Law). Modeling basic systems with Arena (Chapter 4 KSS).
- Week 5: Other random number generators (more general congruential, composite), tests for random numbers (Chapter 7 Law). Modeling detailed operations in Arena (Chapter 5 KSS).
- Week 6: Generating nonuniform random variates, inverse transform method, composition method, acceptance-rejection method (Chapter 8 Law). Modeling detailed operations with Arena (Chapter 5 KSS).
- Week 7: Generating nonuniform random variates, application to well-known continuous and discrete distributions (Chapter 8 Law).
- Week 8: Midterm Exam
- Week 9: More on generating random variates, generating from Normal, gamma and arrival processes. Modeling detailed operations with Arena (Chapter 5 KSS).
- Week 10: Collecting input probability distributions, estimation of parameters, MLE estimators goodness of fit tests, Chi-Square, Kolmogorov-Smirnov. (Chapter 6 Law).
- Input Analysis in Arena (Chapter 4 KSS). Financial application: Simulating stock prices.
- Week 11: Output analysis, statistical estimation, confidence intervals, termination rules (Chapter 9 Law). Output analysis in Arena (Chapter 6 KSS).
- Week 13: Class presentation of student projects.
- Week 14: Final Exam (Comprehensive)
Grading
Midterm Exam 25%
Final Exam 25%
Project 25%
Homework 25%

Homework
Homework will be assigned frequently. It will involve conceptual problems from Law book and Arena applications from KSS book. All students are encouraged to solve the homework problems, and to discuss them with each other and the instructor. However, every student must write and submit the homework assignment individually. Homework problems should not be typed unless they are the output of Arena or Excel spreadsheets. Make sure you staple the homework. Certain assignments require emailing Arena files. Doing the homework is the best way to excel in this course.

Project
The project involves either (i) simulating a real system with complete input analysis, model development in Arena and output analysis with suggestions for improvement; or (ii) simulating a really challenging theoretical problem and drawing useful insights. You can work in groups of two. Possible ideas for (i) include simulating traffic, parking systems, port and airport operations, computer and communications networks, call centers, banks operations, supermarket check-out lines, hospitals, diseases spread, emergency rooms, emergency response, construction operations, manufacturing systems, games, or any interesting system you find. For (ii), I recommend looking at pricing complex financial derivatives using simulation. Your ideas are also welcomed if you happen to face a challenging research problem. You should work in groups of two. A one-page proposal for the project is due on Monday 03/22/2010. In this proposal, you briefly describe the system you want to simulate and the objective of the simulation study. Upon reading your proposals, I will either accept your proposal or ask you to look for another idea. On the last day of classes, You are required to do a 15-minute presentation of your project. You must also submit a written report not exceeding 15 pages, double-spaced, font 12, ample margins, and containing an abstract, an introduction and a conclusion section.

Attendance Policy and Class Management
Attendance will be noted. A student is allowed two unexcused absences at most.

Course Website

http://staff.aub.edu.lb/~bm05/ENMG622/

Look for assignments and slides presented in class there.

Students are advised to review all relevant university rules and regulations including those related to attendance, cheating, plagiarism, misconduct, and academic integrity, among many others. It shall be expected that strict enforcement of these rules and regulations will be exercised.