LOM 5354 – Simulation for Managerial Decision Making
Winter/Spring Semester 2009
Professor L. Douglas Smith

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Office hours: I am generally in my office and available by appointment during the day M-F. You may call or drop in at any time. I am happy to discuss concepts and to offer help over the telephone. Do not hesitate to call me at home, even late in the evening. You may also contact me via e-mail. Even when traveling, I check e-mail daily where practicable.

Prerequisite: LOM 5300 and LOM 5350 or LOM 5320.


Provided with the textbook is the academic version of the Arena simulation software.

Course Objectives

The purpose of this course is to give students (1) knowledge of the power and limitations of discrete event simulation models for the analysis of managerial problems with stochastic features (i.e., probabilistic elements that extend through time), (2) an understanding of the practical and theoretical issues that are confronted in the construction and use of computerized simulation models, (3) experience in constructing simulation models and verifying their applicability, and (4) experience in using models to investigate the effects of altering features of the simulated systems.

Course Methodology

After an overview of different types of simulation models and the contexts in which they are used, the class sessions will concentrate on constructing simulation models to address case studies provided by the instructor, in preparation for a major simulation project to be undertaken by students individually (or in teams, where warranted). Students will be assigned a series of readings from published articles dealing with simulation applications. They will also discuss situations from the popular press and their business experience where simulation is or could be used to shed light on important issues.

Students will prepare a proposal for their term project using the guidelines in this syllabus. They will define the problem to be investigated, construct the simulation model, validate its applicability, and draw conclusions from their analysis. They will present their results in a formal written report and orally to the class at the end of the semester.

Approximate Grading Scheme

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Midterm Exam</td>
<td>35%</td>
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<tr>
<td>Periodic exercises and leadership of class discussion</td>
<td>10%</td>
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<tr>
<td>Major project</td>
<td>45%</td>
</tr>
<tr>
<td>Project presentation</td>
<td>10%</td>
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Topical Outline

1. Overview of simulation processes and applications (KSS Chapter 1)
   - types of simulation models
   - discrete versus continuous simulation
   - autonomous versus nonautonomous models
   - uses of simulation for managerial problems
   - simulation software

2. Basic simulation concepts and building blocks for models (KSS Chapter 2)
   - generation of random events using pseudorandom number generators
   - identifying and representing systems using discrete states and events
   - review of the basics of queueing theory
   - time-based versus event-based statistics (accumulate versus tally in generating averages)
   - selecting an experimental frame
   - defining performance measures
   - steady-state versus terminating systems
   - simplification to focus on critical components
   - lumping system components for efficiency
   - timing of events (scheduling events and activities)
   - object-oriented simulation software
   - simulation entities and attributes
     - resources
     - queues
     - global variables

3. Introduction to the Arena simulation software (KSS Chapter 3)
   - construction of basic queueing model for a simple service system
     - creation of simulation modules
     - creation of simulation entities
     - defining processes and specifying probability distributions for related times
     - defining resources and capacities
     - connecting modules and producing animation
     - setting termination criteria
     - generating reports

4. Modeling basic production operations (KSS Chapter 4)
   - allowing for probabilistic branching
   - incorporating random failures for resources
   - allowing preemption of resources for high priority items
   - defining work stations and transfer mechanisms
   - fitting data to theoretical distributions

5. Refining models to exert control and to accommodate complexities using advanced process panels (KSS Chapter 5)
   - use of sets to define status of entities and special characteristics
   - definition of mathematical expressions for user-defined variables
   - handling nonstationary arrival processes
   - creation of submodels within a hierarchical structure
   - splitting (duplicating) model entities
   - holding and signaling modules
   - hierarchical models
   - model verification and debugging
6. Experimental replications and statistical analysis (KSS Chapter 6)
   - start-up processes, initializing (resetting) statistics and approaching steady state
   - replications of terminating simulations
   - setting scenarios and saving results for statistical analysis using the process analyzer
   - searching for optimal configurations
7. Intermediate modeling, experimental designs (KSS Chapter 7)
   - allowing for entity-dependent path sequences
   - testing for serial correlation in sequential performance statistics
   - warm-up periods for steady-state analyses
   - antithetic random numbers for variance reduction
8. Creating and animating resources for transportation of entities among modules (KSS Chapter 8)
   - mobile transporters with stated capacities
   - nonaccumulating conveyors (like belts)
   - accumulating conveyors (like roads)
9. Adding complexity for queueing dynamics (KSS Chapter 9)
   - reneging behavior
   - finite station buffers
   - overlapping resource utilization
   - use of detached queues (sets) for generating special statistics and controlling entity behavior
10. Model integration and customization (KSS Chapter 10)
    - reading and writing external data with Access and Excel files
    - interacting with the user to control processing
Outline of a Proposal for the Term Project

Problem to be investigated
- two or three sentence summary of the managerial problem

Purpose of the simulation exercise
- what the simulation is to achieve
- how the simulation results might potentially be employed
  - understanding what affects system performance?
  - predicting improvements from changes to the system?

Description of the System
- elements of the system
- performance measures
- uncontrollable factors
- controllable factors
- experimental factors

Environmental considerations
- perspectives of different stakeholders
Sample Outline for Report on Major Project

A. Executive Summary

A brief report (perhaps two or three typewritten pages) summarizing the purpose of the study, what was done, how it was done, and what was found.

B. Detailed Report of the Simulation Study

I. Description of the General Problem (or System)
   - what is to be learned from the study
   - how the findings might be used

II. Summary of Similar Studies Reported in the Literature
   - brief statement of work done by others
   - significant methodological features of other studies that affected the design of this study

III. Overview of Simulation Model
   - description of aspects of the system captured by the model
   - illustrative diagrams or system flow charts
   - narrative of processes
   - parameters used in the model
   - statistics to be generated

IV. Experimental Design
   - experimental factors
   - distributions used
   - alternative configurations of model and values of parameters

V. Experimental Findings
   - tables of simulation results
   - inference drawn from simulation results

VI. Conclusion
   - brief summary of the significance of the findings
   - insights obtained and new questions that were raised
   - potential value of the findings in improving the system studied

C. Appendices
1. documentation for the simulation model
2. sample listings of model results
3. sample data
4. machine-readable version of the model on a CD.
Applications of Discrete-Event Simulation Modeling
(available on ABI/INFORM)

(For comparative features of simulation packages, see OR MS Today October 2007 Survey of Discrete-Event Simulation Software.)


