ISYE 3044 SIMULATION ANALYSIS AND DESIGN

Prepared Prof. Christos Alexopoulos, Fall 2013

Credit: 3-0-3

Prerequisite(s): ISyE 2028 and ISyE 3232

Catalog Description:
Discrete event simulation methodology emphasizing the statistical basis for simulation modeling and analysis. Overview of computer languages and simulation design applied to various industrial situations.

Texts:
Banks, J., Carson, J. S., Nelson, B. L., and Nikol, D. M. *Discrete-Event System Simulation*, 4th edition, Prentice-Hall, 2010.
Pegden, C. D., and Sturrock, D. T. *Rapid Modeling Solutions: Introduction to Simulation and Simio*, Simio LLC (included with software).
Joines, J. A. and S. D. Roberts, *Simulation Modeling with SIMIO: A Workbook*. Available online at www.simio.com/academics/workbook/index.html (optional).

Objectives
(1) Introduction to simulation models and simulation studies; (2) Organization of simulation languages; (3) Modeling with a state-of-the art simulation package with 3-D, true-to-scale animation capabilities such as Simio; (4) Statistical aspects including input data analysis, generation of realizations from statistical distributions, output data analysis, and simulation-based optimization.

Topical Outline
The topics and approximate number of weeks of coverage are in the table below.

Topics	Weeks
General principles and simulation languages	1
Statistical models in simulation	0.5
Queueing models	0.5
Random number generation	1
Random variate generation	1.5
Input modeling	1
Verification and validation	0.5
Output analysis for a single model	1
Comparison and evaluation of alternative system designs	1
Introduction to Simio	1
Serial Manufacturing Systems	1
Animation in Simio	0.5
Entity Routing	1

Advanced Modeling Techniques: Simio Processes	1.5
Modeling with Tables and External Data	1
Simulation of Systems with Vehicles and Conveyors	1

Outcomes

At the end of this course, students will be able to:

1. Evaluate the effects ofrandomness on system behavior and performance.
2. Develop credible and valid simulation models.
3. Fit statistical distributions to input data.
4. Analyze output data from simulations.
5. Compare alternative system designs using simulation.

Course outcome \ Program Outcomes	**a. apply math**	**b. Design, conduct experiment, analyze interpret data**	**c. Design system**	**d. team**	**e. problem solving**	**f. prof/ and ethical responsibilities**	**g. communication**	**h. global, eco, envi and soc context**	**i. Life-long learning**	**j. Contemporary issues**	**k. use tools for eng. practice**
1. Evaluate the effects of randomness on system behavior and performance	High	High			High						
2. Develop credible and valid simulation models			High								
3. Fit statistical distributions to input data	High	High									High
4. Analyze output data from simulations	High	High									High
5. Compare alternative system designs using simulation					High		Med			High	High

Evaluation of important outcomes

Modeling exercises are given in several homework assignments. The modeling exercises cover various systems including manufacturing and inventory systems, and warehousing systems containing vehicles and conveyors. The students are asked to write reports describing the outcomes of the simulation experiments and containing appropriate recommendations. The nature of a modeling exercise does not permit testing in midterm or final examinations.

Three or more important outcomes will be evaluated from direct questions in the final examination:

1. Test the goodness-of-fit of a statistical distribution to a data set.

2. Compute confidence intervals for system performance measures.
3. Compute a sample size necessary for computing estimates with e required precision.
4. Compare systems based on outputs of simulations.

ISyE ABET Student Outcomes a - k

a) An ability to apply knowledge of mathematics, science, and engineering
b) An ability to design and conduct experiments, as well as to analyze and interpret data
c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) An ability to function on multidisciplinary teams
e) An ability to identify, formulate, and solve engineering problems
f) An understanding of professional and ethical responsibility
g) An ability to communicate effectively
h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) A recognition of the need for, and an ability to engage in life-long learning
j) A knowledge of contemporary issues
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.