BOSTON UNIVERSITY
Department of Mechanical Engineering

Simulation (ME514/EC514)
Fall 2010

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Office hour: Thursdays 1-2 pm

Course objectives:

- To introduce the principles of Monte Carlo simulation and its application in diverse areas of science and engineering.
- To go over some of the decision processes in planning and operation of systems.
- To describe how simulation can be used as a decision support system in planning and operation of systems.
- To introduce how to develop models for analyzing real-world systems.
- To introduce principles of discrete event simulation and a simulation language (ARENA).
- To discuss what are the "best" ways to design and perform simulation experiments.
- To introduce how data from simulation should be interpreted to help make sound decisions (statistical data analysis).

Text: *Simulation with Arena,* **(4th edition)** W. D. Kelton, R. P. Sadowski, D. A. Sadowski, McGraw-Hill, 2004

Simulation language: We will introduce a simulation language, ARENA. In the beginning of the course we will use EXCEL for some examples.

Evaluation: Homework: 25%, midterm exam 30%, Project 35%, class participation 10%.

Tentative Date for midterm: Thursday November 11 (2-4 pm)
Tentative due date for class project: Thursday, December 16.

AD account (very important): Some class material will be placed in a folder on AD server. In addition electronic copies of the homework need to be submitted via AD. **To access the material and to submit your homework you need to have an Active Directory (AD) account. To request such an account, go to the link http://www.bu.edu/computing/accounts/ad/eng and follow directions.**

Complementary Texts:

1. *Simulation Modeling and Analysis*, by A. Law & D. Kelton, Mc Graw Hill , 4th ed., 1999.
2. *Simulation*, Sheldon Ross, Academic Press, 3rd ed., 2002.

SYLLABUS

1. *Introduction to simulation & Monte Carlo simulation*; simulation for the analysis of systems: systems, models; application examples. (Th Sept 2, Tu Sept 7)

2. *Modeling randomness*: Random variables; probability distributions; random vectors & joint distributions; random processes. (Th Sept 9, Tu Sept 14)

3. *Simulating random phenomena*; random variate generation; uniform and non-uniform random number generation; Inverse transform & Acceptance Rejection algorithms. (Tu Sept 14, Th Sept 16)

4. *Output Analysis I*: statistical estimation: Law of Large Numbers & Central Limit Theorem; confidence intervals; Monte Carlo examples; comparing systems. (Tu Sept 21, Th Sept 23)

5. *Discrete-Event Systems & Simulation*: Event driven systems; states & events; Discrete Event (DES) models; event scheduling simulation; data structures. (Tu Sept 28, Th Sept 30, Tu Oct 5)

6. *Introduction to ARENA*: Process modeling perspective; model development; output processor. (Tu Oct 5, Th Oct 7)

7. *Output analysis II & Performance improvement & optimization*: finite horizon & long term (steady state) performance criteria; terminating & steady state simulation; sensitivity estimation; comparing multiple systems; system optimization. (Tu Oct 19, Th Oct 21, Tu Oct 26)

8. *Design of Experiments*: Factor screening; design matrix; analysis of variance (ANOVA); response surface optimization. (Th Oct 18, Tu Nov 1, Th Nov 4)

9. *Review & Exam*. (Tu Nov 9, Th Nov 11)

10. *Input modeling*: Using data for input modeling; fitting theoretical distributions; goodness of fit tests. (Tu Nov 16, Th Nov 18)

11. *Variance Reduction Techniques*: Importance sampling, control variate, stratification, common random numbers. (Tu Nov 30, Th Dec 2)

12. *Project discussion and review:* (Th Dec 9)