

# Simulation Analysis

QA 772 (22-QA-772-901)

Spring Quarter 2009, Thursdays 6:00–8:40p.m., 217 Lindner

Web site for the class: <http://blackboard.uc.edu/>

## Syllabus

- **Instructor**

David Kelton, [david.kelton@uc.edu](mailto:david.kelton@uc.edu), <http://www.cba.uc.edu/faculty/keltonwd/>,  
+1-513-556-6834, 525 Lindner.

Office Hours: Before and after each class, by appointment, and pretty much all the time by e-mail.

- **Materials**

- Kelton, Sadowski, and Sturrock, *Simulation With Arena*, 4th edition, McGraw-Hill, 2007.
- Course notes will be distributed either in hardcopy or under Course Documents on Blackboard.
- Optional reference: *Simulation Modeling and Analysis*, either 3rd edition (Law and Kelton, a copy is on reserve in the library) or 4th edition (Law).

- **Objectives**

This is a second course in computer simulation. Study the underlying probabilistic and statistical aspects of computer simulation. Modeling and estimating input processes, random-number generators, variate and process generation, statistical analysis of simulation output, ranking and selection of simulation models, variance-reduction techniques, designing simulation experiments, gradient estimation, and optimization. By the end of the course, students should be able to start reading (and contributing to) the simulation research literature, as well as do a much better job of designing and analyzing simulation experiments. The course will not cover simulation modeling (see the first prerequisite below).

- **Prerequisites**

- A first course in simulation modeling (with a general-purpose language or a simulation language). This must have been an *entire course* devoted to simulation modeling; it is *not* sufficient to have had a brief introduction to simulation as part of an operations-research survey course.
- Probability and statistics (calculus-based).
- Computer and programming skills (FORTRAN, C, C++, etc.).

- **Grading**

- Mid-term Exam (Thursday April 30, 6:00–8:40p.m.) = 30%
- Final Exam (Thursday June 11, 6:00–8:40p.m.) = 40%
- Individual Project/ Presentation/Paper = 30% (more information below)

Both the Mid-term and Final Exams are open-book and open-notes; no other materials permitted. Homework will be assigned but not collected; collaboration on the homework is fine, even encouraged!

- **Computing**

You may use any computer you like, either your own or in a university lab or office, provided that it has the software you'll need. You may obtain the Arena 10 simulation software (academic version), from the instructor (just ask).

- **Topics**

- Introduction and overview of simulation analysis
- Modeling and estimating input processes
- Random-number generation
- Generation of random variates, vectors, and processes
- Statistical analysis of simulation output
- Comparison, ranking, and selection of simulation models
- Variance-reduction techniques
- Designing simulation experiments, gradient estimation, and optimization
- (If time permits) How all this is implemented (or not) and works (or not) in Arena

Specific reading and homework assignments will be made in each class, and will depend on our progress.

- **Individual Project Information**

This will be a simulation application or methodological study of your own choosing. It should be a study with one of the following two approaches:

- Application of appropriate and effective simulation methodology in another field; e.g., manufacturing, health care, logistics, or telecommunications (many others are possible).
- A methodological study about simulation itself; e.g., comparing two different algorithms for ranking and selection on the basis of accuracy or efficiency.

This project is *individual* — it must be done by yourself without consultation with anyone but the instructor. The project must involve some amount of computer work. The "product" is a written paper and a presentation in class on the last class day.

Milestones

- Thursday April 23: Submit a one-"page" (via e-mail to the instructor) proposal of what you plan to do.
- Thursday May 14: Submit a one-"page" (via e-mail) progress report.
- Thursday June 4: Presentation in class.
- *Friday* June 12: Written report due by 6:00p.m. ... earlier is a lot better for you (via e-mail to the instructor).

- **Schedule**

<i>Class Number</i>	<i>Thursdays, 6:00 p.m. – 8:40 p.m., 217 Lindner</i>
1	Thursday April 2
2	Thursday April 9
3	Thursday April 16
4	Thursday April 23 — <i>Project proposal due</i>
5	Thursday April 30 — <i>Mid-Term Exam</i>
6	Thursday May 7
7	Thursday May 14 — <i>Project progress report due</i>
8	Thursday May 21
9	Thursday May 28
10	Thursday June 4 — <i>Project presentations</i>
Finals Week	Thursday June 11 — <i>Final Exam</i>
	<u>Friday</u> June 12, 6:00pm — <i>Written project report due (via e-mail)</i>

- **Links**

- INFORMS Simulation Society -- <http://www.informs-sim.org/>
- Winter Simulation Conference -- <http://www.wintersim.org/>
- Full WSC papers from 1997 - 2008 -- <http://www.informs-sim.org/wscpapers.html>
- EUROSIM, the Federation of European Simulation Societies -- <http://www.eurosim.info/>
- Rockwell Software (formerly Systems Modeling Corporation), the vendor of Arena -- <http://www.arenasimulation.com>
- Simulation of the Buffon Needle Problem (one of many such sites) -- <http://www.angelfire.com/wa/hurben/buff.html>
- The original "bug" and more on Grace Murray Hopper (who coined the term) -- [http://vcencyclopedia.vassar.edu/index.php/Grace\\_Murray\\_Hopper](http://vcencyclopedia.vassar.edu/index.php/Grace_Murray_Hopper)
- Don't even think about daring to go here if you are too young to have used punchcards -- <http://www.facade.com/legacy/punchcard/>