ISyE 6644 A,Q – Simulation — Fall 2017

(revised 8/24/17)

Class Times and Place: Tθ 3:00–4:15P, MRDC 2404.

Instructor: Dave Goldsman; Groseclose 433; email `sman@gatech.edu`; website `www.isye.gatech.edu/~sman`; phone 404-894-2365 (office), 404-822-8949 (cell).

Office Hours: Tθ 8:30–9:15A and 12:45–1:30P and by appointment. TV students can call anytime.

Course Website: I'll make announcements and keep grades on T^2, but I'll put all of the notes, HW's, practice tests, etc. on `www.isye.gatech.edu/~sman/courses/6644`.

Teaching Assistant: Jovan Julien; email: `jovan.julien@gatech.edu`

Office Hours: MW 1:30–2:15P and 4:45–5:30P, ISyE Studio (Main 103).

E-mail Communication: Feel free to email us with meaningful questions. But (*unless you're a TV student*), please don't ever, ever send any Arena programs, assignments, or large attachments via email.

Course Objectives: (a) Intro to simulation models and simulation studies; (b) Organization of simulation languages. Modeling with Arena, a comprehensive simulation package with animation capabilities. (c) Statistical aspects including input analysis, random variate generation, output analysis, and variance reduction techniques.

Prerequisites: You *must* know probability and statistics at the level of ISyE 2027 and 2028, and maybe even a little stochastic processes. You should be familiar with some programming language and a spreadsheet package.

Grading:

10%	HW + ??	(incl. surprise quizzes, attendance, professionalism, etc.)
30%	Test #1	Tu Sept. 26
30%	Test #2	Th Nov. 2
30%	Final Exam	Th Dec. 14, 11:30A-1:30P

*Generally speaking, TV students should take any test within about a week of the in-class folks.

Texts:

Law, A. M., *Simulation Modeling and Analysis*, 5th edition, McGraw-Hill Education, New York, 2015.

Kelton, W. D., Sadowski, R. P., and Zupick, N. B., *Simulation with Arena*, 6th edition, McGraw-Hill, New York, 2015.

Feel free to use cheaper, earlier or international editions. Be creative!

Stop the Presses! Averill Law has just written to me that you can now get his book at the deeply discounted price of about $125 at `Amazon.com`.

Course Notes: I provide pretty extensive notes on the website. This doesn't mean that you can simply print out the notes and skip class — the notes should be regarded as supplemental material to what I do in class, and you may miss out on a lot of important material if you don't attend. In addition, don't get too critical if I copy portions of my notes onto the board — after all, they're my notes, eh?

Computer Programming: This course will involve extensive computer programming. We'll cover the basic features of Arena as the semester progresses. I encourage you to study the first four chapters of the Arena text during the first week.

Free Arena software download available at

`https://www.arenasimulation.com/academic/students`.

Note that Arena is a Windows-based application. You can also use ISyE's computer labs to access Arena.

Tests:

- Each exam will be cumulative in that it may include all the topics covered in class since the beginning of the semester up to exam time. You will be allowed x cheat sheets for test $x = 1, 2, 3$, where you can write whatever helpful stuff you want on both sides of the sheets (for $2x$ sides total). You can bring in a calculator, but no other electronic devices. I supply all necessary tables.
- Never, ever cheat. (See the material below on the Honor Code.)
- For your protection, we xerox all tests.

- Look on the front page of the test to see how much time you are allowed.
- If you miss a test, you will need to produce appropriate medical documentation. Your grade in the course will then be based on the remaining two tests (+ HW).
- Sadly, there will be absolutely no makeup exams. None. Zero. Goose egg. Nada. Zip. Zilch.
- I will not exempt anyone from the Final. If this is going to be a problem for you, then you'll need to drop the course. Hurry! Quick! Pronto!

Other Grade-Related Notes:

- Although we're generous graders and nice people, please do not beg for a better grade by saying things like...
  - "I really need an A else I'll lose all HOPE!"
  - "If I don't get an A, I'll have to go to UGA!"
  - "My dog ate my in-class final!"
  - "Since I worked so hard, I think I deserve an A instead of a C!"

  Let's all try to be "winners", not "whiners"!
- Regrading. I'll be happy to correct grading errors. In order to receive a re-grade, you must submit a Grade Grovelling Form within 24 hours of the class in which I hand back the test. The form is available at

  `www.isye.gatech.edu/~sman/courses/gradegrovel.pdf`

  If a test is submitted for regrading, I have the right to regrade the entire test — so it is possible to *lose* additional points. Therefore, it is *strongly recommended* that you do not ask for regrading unless you have substantial reason to believe that I made a mistake when originally grading the test. Also, please do not demean yourself by begging for single points. In order to minimize superfluous regrades, if I find that no additional points should be awarded, then 4 points will be deducted from that exam.

  Again, let's all try to be "winners", not "whiners"!

Homework:

- HW will consist of theoretical problems and computer programming projects.

- You can submit HW's in groups of 2 or 3 people. Feel free to communicate with the other TV students and work together. You only need to submit one assignment per group.
- Problems should be submitted in the order given in the assignment.
- Check your answers. Do your results make sense? If they don't and you can't figure out how to fix the problem, at least stating that you know an error exists will get you more partial credit.
- Things that must be done on all Arena assignments:
  - You absolutely *must* turn in a report that includes all requested statistics (these should preferably be in table form), along with an explanation of the results and any insights or recommendations you have. Your summary should not just reiterate the table results. It should explain these results. Do they make sense? What do they tell you about the system? Do they indicate anything that might be improved? If so, what and how do we improve it? Do we need to collect more information first? If so, what information? If you are comparing systems, tell what system is better and why. Or if that cannot be determined given the information we have, state that and tell what needs to be done in order for a decision to be made.
  - Your Arena modules must have descriptive names that tell anyone unfamiliar with the model what you are doing in those modules. If you want to be more thorough, you can even write out the formulas used for `DECIDE` and `ASSIGN` modules (and maybe other important model parts that may be confusing) to make sure a reader will understand your modeling approach. Furthermore, for anything that does not have a straightforward modeling approach, you need to make it very clear how you chose to model that aspect, either by a few sentences of explanation in your report or by very descriptive modules, or preferably both.
  - Your Arena problem write-ups should be *succinct*. No killing of trees!
    - Use clear, precise English.
    - Only turn in output result pages and Arena screen dumps that are relevant to the problem.
    - Do *not* print results for each of multiple replications of a simulation. If you have a problem for which all the statistics are informative and desired, copy and paste them onto one or two pages rather than printing out a large number of pages.
    - Generally speaking, keep the answer to any Arena problem to ≤ 5 pages.

Project: I'd really like you to do a project that will be (i) helpful to you in your current or future job, and (ii) interesting and fun to do.

Honor Code and Expectations: You are expected to adhere to the Georgia Tech Honor Code. For more information, see

`http://www.policylibrary.gatech.edu/student-affairs/academic-honor-code`

In addition, faculty and students have drawn up a list of mutually beneficial expectations; please see

`http://devpolicylibrary.gatech.edu/student-life/xxii.-student-faculty-expectations`

Cell Phones and Electronics: Turn off your cell phone before you come to class. It is actually OK to use your computer as long as you're following notes or programming with Arena — do not use your computer for anything else.

Course Outline: About 1/4 of the course will focus on the Arena language from KSZ, though I'll also sneak in a thorough probability and statistics review to keep the course self-contained. The rest will concentrate on the theory side of things from Law, though I'll make sure to spread applications throughout. Following is the list of topics to be covered.

1. Introduction
2. Probability and Statistics Review (Law, Chapter 4)
3. Hand Simulations; Spreadsheet Simulations
4. General Modeling Concepts (Law, Chapters 1&2)
5. Arena
   (a) Basics (KSZ, Chapter 4)
   (b) A Generic Call Center in Arena (KSZ, Chapter 5)
   (c) A Manufacturing Center in Arena (KSZ, Chapter 6)
   (d) Entity Transfers in Arena (KSZ, Chapter 7)
   (e) More-Advanced Arena Stuff (KSZ, Chapter 8)
6. Verification and Validation (Law, Chapter 5)

7. Random Number Generation (Law, Chapter 7)
8. Random Variate Generation (Law, Chapter 8) — including single random variables, random processes, and financial models
9. Input Analysis (Law, Chapter 6)
10. Output Analysis (Law, Chapter 9)
11. Comparing Systems (Law, Chapter 10)
12. Variance Reduction (Law, Chapter 11)
13. Other Cool Topics