ISyE 3044 C — Simulation — Fall 2016

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Class Times: MWF 10:05–10:55 p.m., room IC 109.

Office Hours: MWF 3–4 p.m. Please come *prepared* with *specific* questions. Due to large class sizes, I must ask that you honor the above office hours.

Personal Communication: I will reply to brief email messages. Unfortunately, Yanyang and I cannot keep up with lengthy messages or multiple message exchanges related to a single question. Do not send us Simio files because we cannot afford to debug code. We prefer that you stop by during office hours. I will use only the list of the email addresses from the T-Square portal. Announcements, assignments, and other electronic files will be placed on the T-Square portal.

Texts:
- Joines, J. A. and S. D. Roberts, *Simulation Modeling with SIMIO: A Workbook,* 4th edition, Simio, LLC, 2015 **(required)**.
- Banks, J., J. S. Carson, B. L. Nelson, and D. M. Nicol (BCNN), *Discrete-Event System Simulation*, 5th edition. Prentice Hall, New York, 2010 (recommended).

The first book is available at http://www.simio.com/publications/SMSWorkbook/index.php in hard-copy and e-book formats. The hard copy is strongly recommended and can be purchased at a lower price (with grayscale interior). *Earlier editions are not appropriate because they differ substantially from the current (4th) edition.* Keep in mind that Simio is evolving at a rapid pace, so objects have often have new or enhanced properties. The second text is not required, but is a solid source. You can purchase a cheaper version online (the 4th edition is also OK).

Course Objectives:
1. Introduction to simulation models and simulation studies.
2. Modeling with Simio, a state-of-the art simulation package.
3. Statistical aspects including input data analysis, generation of realizations from statistical distributions, output data analysis, and simulation-based optimization.

Prerequisites: (a) Knowledge of probability and statistics at the level of ISyE 2027/2028. Many topics such as generation of realizations from probability distributions and analysis of simulation input/output require a variety of statistical tools. (b) Stochastic processes, in particular queueing theory, at the level of ISyE 3232. The required concepts will be reviewed in an accelerated fashion.

Simulation Language:
- We will model with Simio, a comprehensive discrete-event simulation package with extensive modeling, animation, and statistical analysis capabilities. Simio runs on reasonably new computers running the Microsoft Windows 7/8/8.1/10 operating systems. It also runs on

Macintosh computers *using an emulator* (e.g., Parallels Desktop or VMware Fusion) *on top of* Mac OS X.

- The instruction of Simio will be based on the Simio workbook. Since model building involves a lot of detailed steps, I will often ask you to develop a model up to a point before finishing it up in class.
- Additional Simio resources:
  - o The introductory e-book *Rapid Simulation Solutions: Introduction to Simulation and Simio* is available from the Books menu in the Support ribbon of Simio.
  - o The instructional labs at www.simio.com/resources/videos/learning-simio-lab-series. This site is also accessible from the Videos menu in the Support ribbon.
  - o The site www.simio.com/academics/student-resources.htm.
- Simio's academic edition is available in the ISyE computer labs. The current release is 8.139. We will stick to this release until the end of the semester. Please avoid upgrades unless I give the marching orders. In particular, you should not install major upgrades (with a higher first digit such as 9.xxx) due to backward incompatibilities. Simio is also available on mycloud.gatech.edu both on the *ISYE-SIMIO* virtual desktop and as an *app*. To use the latter, click on Apps and then click on the plus (+) sign on the left-hand side. Then click on *ISyE Apps*, and choose *Simio* as an add-on app. *The virtual desktop is significantly more stable than the app!* Keep in mind that that the total number of concurrent users is limited to 250. *Since virtual applications depend on network connections and some objects may not display properly, I strongly recommend that you use the computer labs, which are among the best on campus.*
- In addition to the full software available in our computer labs, you have the option to also install Simio *on your own Windows computer* at a very low cost. Unlike other similar academic software, the Simio student edition is not a crippled version — it is a full, unlimited model size version equivalent to the $12,000 Simio Design Edition. The $25 cost for one year of use allows access to all the training videos on the Simio web site. *I strongly recommend this option!* To purchase a license, follow the steps below:
  - o Go to the link www.simio.com/student-edition-order.php. If the link does not work, make sure that it contains single hyphenation marks.
  - o Enter your full name, GT email address, academic institution (Georgia Tech), expected graduation year and month, professor's name (Alexopoulos) and course (ISyE 3044).
  - o You should shortly receive a confirmation email. If you do not receive it within 1 hour, please check your junk mail folder as the email sometimes gets intercepted. If you use a different email for PayPal than your student email, check that PayPal email account (and its junk mail folder) as well. If you still cannot find the email, contact customer_service@simio.com. Please ensure that you have followed the above instructions before you contact Simio's customer support.
  - o Download and install the software, and apply the activation code per the instructions in the email.
  - o When prompted, enter the following information to complete the activation.
    - ▪ Pass Phrase: **GATech_2016**
    - ▪ Pass Code: **CCFF2B0C**
- You should *not* contact Simio's technical support regarding modeling issues. There are several Simio forums, where you can post serious questions *after you have spent considerable time with your model*. The forums are listed in www.simio.com/forums.

Excel Add-ins:

- We will use the free tools from www.probabilitymanagement.org/tools.html. The current version 3.0 works with Excel 2010, 2013 and 2016 for Windows and Excel 2016 for Mac OS X. Their download requires registration at the site. (Version 2.0 tools that work with Excel 2011 for Mac OS X are also available, but are not as refined as version 3.0.)
- We may also use software from the site www.bcnn.net, in particular the Simulation Tools. These add-ins work on Windows machines (and maybe with Excel 2011 or 2016 under Mac OS X).

Grading:

15%	Homework	
25%	Test 1	Wednesday, October 5
25%	Test 2	Monday, November 16
35%	Final Exam	Monday, December 12, 11:30–1:00 (notice the shorter time interval)

Homework: Homework will be assigned every 10–14 days. The assignments will contain analytical problems and computer programming problems. We may choose not to grade some questions. *You can collaborate with only one colleague; if you do so, you must submit your own files and list your collaborator.* Violations of the Honor Code will be penalized appropriately. *The assignments must be submitted electronically to the T-Square portal on time. Since connections may be unreliable, you should submit early and often.* Handwritten documents should be scanned and submitted in PDF format (files in JPEG or other image formats will not be graded). *If a homework involves multiple electronic files, you should submit a single archive (e.g., a zip file).* Homework due during the last week of classes will cover material taught earlier.

Computer Programming: This course will involve extensive computer programming in Simio, Microsoft Excel and Matlab/Python. Often the assignments will go beyond class instruction.

Exams: No books or notes are allowed. A sheet containing formulas is available on T-Square; however, you will get a clean sheet with your test paper. The smallest penalty for violations of the honor code during a test is a zero grade in that test. Make-up exams are not allowed without a recommendation from the Office of the Dean of Students. Bathroom visits during exams are at my discretion — I will inform you prior to a test. *Calculators with single-variable statistical capabilities are strongly recommended.* **All other devices with text storage or communication capabilities must be turned off.**

Regrading: If the grader or I have made a mistake in grading a homework or test paper, we will be happy to correct it. If a test is submitted for regrading, I have the right to regrade the entire paper 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 we made a mistake when originally grading the test. *All requests for regrading must be submitted with 7 days from the test date.*

Academic Integrity: The exams will be conducted in strict compliance with the Institute's Honor Code. This code also applies to homework assignments.

Class Rules: The following guidelines are consistent with the recent student-faculty expectations agreement.
- Class attendance is very important. You are not permitted to walk out of class during lectures. If you have an important obligation, you can ask for permission prior to class. You have time to schedule appointments around classes. Late arrivals are disrupting to other students.

- Mobile phones should be turned off. Laptops and tablets should also be turned off unless you can prove that you are using the Simio model currently presented in class. *Anyone caught surfing the internet or using a laptop, tablet or smartphone for tasks that are outside the scope of the class will be asked to leave the room.*
- I may take attendance if and when I sense a drop. Your attendance record will be used when your final score is on the borderline between two adjacent letter grades or when you ask for favors.
- You should not eat food during class. Class time should be solely devoted to learning.

Course Outline: The following topics from the text of BCNN will be covered. The folder *Lecture Materials* under *ISyE 3044-B Resources* contains presentations that cover the topics below in sufficient depth.

Chapter 1–2	Introduction; simulations by hand and spreadsheets
Chapters 3–4	General principles and discrete-event simulation languages
Chapter 5	Statistical models in simulation
Chapter 6	Queueing models
Chapter 7	Random-number generation
Chapter 8	Random-variate generation
Chapter 9	Simulation input modeling
Chapter 10	Verification, calibration, and validation of simulation models
Chapter 11	Output data analysis for a single system
Chapter 12	Comparing alternative system configurations; simulation-based optimization