THE UNIVERSITY OF MICHIGAN - DEARBORN
COLLEGE OF BUSINESS

- Course: DS 632, Section 201
- Title of Course: System Simulation
- Instructor: Edward Williams
- Term: Summer II 2016
- Office Hours: Tuesdays & Thursdays 3:30pm 5:50pm in 131D FCS, and by appointment.
- Class Places/Times: Tuesdays and Thursdays, 6:00-8:45pm 191 FCS
- Telephone: 131D, my office 313-583-6553
- Departmental Office: 313-583-5336
- Fax: 313-271-9836
- E-Mail Address: williame@umich.edu

Questions explicitly pertinent to the course material and hence of likely interest to the entire class (e.g., how to solve a particular exercise in optimization, model-building, or analysis) should be posted on the Canvas website. In this regard, I urgently commend to your attention the use of Discussion Threads which I have installed on the Canvas website. More individual questions or issues (e.g., notifying me of a problem such as illness, business travel, or bereavement) should be handled via electronic mail or a message to my daytime telephone number. The preferred method of contact is email to Canvas (or to my campus address (the first of the two addresses above)); I intend to check that address daily except when away or ill.

Accommodations for Students with Disabilities:

The University will make reasonable accommodations for persons with documented disabilities. Students need to register with Disability Resource Services every semester they are taking classes. DRS is located in Counseling and Support Services, 2157 University Center. To be assured of having services when they are needed, students should be registered. <signed Nancy Lehnert, M.A., Disability Resource Services Assistant, 313-593-5430>.

The University of Michigan-Dearborn maintains an "Inclement Weather Campus Closure Information Line" at 313-436-9157. You may wish to call this number in case of severe storms, power outages, insurrection, epidemic, or other unpleasant (understatement!) events to see if the campus is open.

Course Description:

In the course students will learn how to design, model, verify, validate, and implement discrete-event computer simulation models of real or conceptual systems. Simulation studies will be conducted using the contemporary, powerful, interactive, drag-&-drop software Simio® (version 8). Students will learn random number generation, application of distribution sampling, selection of probability distributions based on goodness-of-fit tests, and conducting of output analysis.

Course Objectives:
Specific course objectives are to develop comprehensive understandings of:
1. The meaning of simulation and its importance in business.
2. The common applications of discrete-event system simulation, e.g., in manufacturing, service industries, health care delivery, transportation, and logistics (examples).
3. Ability to build, verify, and validate a simulation model using appropriate software (this course will use the Simio® software, with mention of others).
4. Basic results of queuing theory.
5. Basic techniques of input and output analysis.
6. Visualization of a system simulation animation.

Required Text:

W. David Kelton, Jeffrey Smith, and David Sturrock. 2013. *Simio and Simulation: Modeling, Analysis, Applications*, 3rd edition. Learning Solutions. ISBN-13: 978-1-493616-20-6 (pertains to "Economy Edition," which has grayscale illustrations).

Recommended Reference:

Joines, Jeffrey A. and Stephen D. Roberts. 2015. *Simulation Modeling with Simio: A Workbook*, 4th edition. Simio® LLC. ISBN-13: 978-1-519142-20-7.

For availability of these and other materials at the campus bookstore, see their web site.

Student Evaluation:

First examination 26 July 2016 (in-class part; see below)	25%
Second examination 18 August 2016 (in-class; see below)	25%
Term Project (team) Presentations 16 August 2016	25%
Homework team assignments throughout	20%
Class participation throughout	5%

Grading Scale:

94-100 = A	90-93 = A-	
87-89 = B+	84-86 = B	80-83 = B-
77-79 = C+	74-76 = C	70-73 = C-
67-69 = D+	64-66 = D	60-63 = D-

Grades will be computed to a scale of 1000. For example, suppose the first examination contains questions totaling 100 points. Its percentage weight of 1000 is 25, so your score would be multiplied by 2.5. If the first examination contains questions totaling 80 points, your score on it would be multiplied by 3.125.

For the term project, your team has 3 options; choose one:

1. Simple Restaurant, pages 365-367 of the textbook.
2. Small Branch Bank, pages 367-371 of the textbook.
3. A project of your team's choice, simulating and analyzing a manufacturing, service, health-care, or any other process with which your team is or becomes familiar. If your team is interested in this option, please speak with me informally and *early in the course*.

If your team chooses option 3 and performs very well, I may expand the team's work into a paper to be published in a conference proceedings – students would then be "published authors."

As an enticement, the 2 citations below had exactly this origin from previously taught sections of this course:

Gruber, Jared W., Renée Smiddy, Jeffrey M. Watson, and Edward J. Williams. 2015. Simulation Helps Local Grocery Store Compete Effectively Against Large Chains. In *Fifth International Conference on Industrial Engineering and Operations Management* (ISBN 978-0-9855497-2-5, pages 2421-2424).

Sivaramakrishnan, Sapthagirishwaran Thennal, Shanmugasundaram Chandrasekaran, Jennifer Dhanapal, Paul Ajaydivyan Jeya Sekar, and Edward J. Williams. 2016. Simulation Improves Operations at a Specialized Takeout Restaurant. In *Proceedings of the 30th European Conference on Modelling and Simulation*, eds. Thorsten Claus, Frank Herrmann, Michael Manitz, and Oliver Rose, 59-65.

Deliverables for the term project:

1. A Simio® model built to solve a business problem at a company. The model must be statistically valid and have ample internal documentation. These two requirements are *vastly* more important than a lovely, flashy animation.
2. A written report (MS Word® please) documenting your project. Suggested outline:
    A. Brief background of enterprise on whose behalf the modeling was undertaken.
    B. Description of the business problem (e.g., low throughput, inappropriate resource utilizations, long queues (# of entities in queue and/or long waiting times), excessive costs, etc.
    C. Commentaries on how you collected and analyzed input data.
    D. Commentaries on how you built, verified, and validated the Simio® model.
    E. Analysis of your output results (e.g., performance metrics of current system and of the system as you would recommend be modified, based on your simulation results); these should include commentaries on # of replications run, length of replications, whether the model is terminating or steady-state (and length of warm-up if steady-state), and confidence levels (usually 90%, 95%, or 99%) for the predicted performance metrics).
    F. Suggestions on how your work might be extended in the future.
3. A MS PowerPoint® file highlighting key items from the written report – this is the file you might present to corporate management in the Executive Conference Room.
4. An oral presentation based upon the MS PowerPoint® file and the Simio® model.

Students are *strongly* encouraged to form teams (ideal size 3 or 4) to work on all course and homework assignments. The two examinations will be individual efforts. The first examination will have two parts: a closed-book, closed-notes portion written in class and comprising conceptual short-answer essay questions, and an open-book, open-notes part, due several days afterward and

involving the building of a simulation model. The second examination will have a closed-book part only (the term project will "substitute" for an open-book part). Early in the course, one person on a team (you will self-select the teams) should email me the team roster. I will define those teams in Canvas for convenience of submitting assignments, including the Term Project deliverables.

The 25% weight of the first examination includes both parts. The closed-book, closed-notes, computer-off portion of each examination will entail writing short paragraph answers to questions testing your understanding of fundamental concepts. These questions will *not* require you to formulate problems, undertake computations, or memorize formulas (that's what computers are for!). The open-book, open-notes, computer-on portion of the first examination will be done on a "take-home test" basis; you will solve a problem like the homework problems (individually, not in your teams) and upload your results to Canvas.

Notes and Comments:
Violations of academic standards of ethics will result in a grade of zero for the assignment in question.
Late work will be penalized proportionate to the length of delay (documented extenuating circumstances excepted).
If the in-class part of the first examination is canceled for any reason, assume it will be given the next scheduled class period.

Course Schedule:
Text Topic

Expected course schedule:

Textbook	Topic
Chapter 1	Introduction to Simulation
Chapter 2	System Dynamics, Basics of Queueing Theory
Chapter 3	Types of Simulation
Chapter 4	Getting Started with Simio®
Chapter 5	Additional Powers of Simio®
Chapter 6	Analysis of Input Data
Chapter 7	Convenient Model Representation of Input Data
Chapter 8	Animation (cursory); Entity Movement
Chapter 9	Advanced Simio® Modeling Techniques
Chapter 10	Quick Look at Customization
Chapter 11	Modeling Manufacturing Systems
Chapter 11	Modeling Service Systems