BUSI 3308B
SIMULATION METHODS IN BUSINESS
WINTER 2015

A. PERSONAL INFORMATION

Instructor: Iman Niroomand, PhD,
                 Office: 919-1 Ext 3248
                 Email: iman.niroomand@carleton.ca
                 Office hours: Fridays, 4:00pm - 5:30pm or by appointment

Timetable: Wednesdays: 2:35 pm – 5:25 pm (LECTURE)
                 Thursdays: 9:35 am – 11:25 am (TUTORIAL 1)

Locations: CB 3101 , 1728DT (E-lab)

B. PREREQUISITE STATEMENT

Third-year standing; BUSI 2301 with a grade of C or higher and one of ECON 2202 or STAT 2607 with a grade of C- or higher.

C. COURSE MATERIAL

1. W. David Kelton, Randall P. Sadowski and Nancy B. Zupick, Simulation with Arena, McGraw-Hill, 2015, sixth edition (hereafter KS). The book comes with a free installation of the Arena software for academic purposes on student computers running on Windows 95 or higher: Go to the following website to download and install the academic software: https://www.arenasimulation.com/simulation-software-download
   Computer labs located in the Dunton Tower, rooms 705, 1723 and 1728 (E-lab) have ARENA installed on the appropriate machines.

2. Averill M. Law, W. David Kenton, Simulation Modeling Analysis, McGraw-Hill, 2007, fourth edition (hereafter LK). The library reserve keeps a copy of this book.

3. Andrew F.Seila, Vlatko Ceric and Pandu Tadikamalla, Applied simulation modeling, Thomson, 2003. (hereafter SC)

3. Class Notes: Copies of lecture notes will be available on the course website.

D. COURSE OBJECTIVES

This course is designed to introduce basic concepts of system modeling and computer simulation through case studies, worked examples and hands-on project experience. The process and methodology of using simulation for problem solving and decision-making are emphasized through static simulations with spreadsheets and discrete-event simulations with specialized software. Simulation language Arena will be used as a tool for model building. Students will be learned generation of random variables, input modeling, model design, analysis of output, and experimental design through the entire course. Also, They will be required to apply the modeling techniques to a real

world (or fictitious) problem through a term project. They will come out of the class being able to:
   o identify situations where simulation can be applied;
   o conduct successfully a simulation study;
   o communicate with specialists or managers who use simulation to perform what-if analysis.

The following topics will be covered:

   o Fundamental of simulation concepts
   o Statistic and Probability in simulation
   o Selecting input distributions
   o Random-number generation
   o Generating random variates
   o Simulation output analysis
   o Building valid, credible, and appropriately detailed simulation model
   o Model building with Arena
   o Model building with Spreadsheet

E. COURSE EVALUATION

Assignments (2):	15%
Two quizzes	7%
Simulation project:	30%
Computer lab simulation mi-term examination:	8%
Final examination (including a take-home simulation question):	40%
TOTAL	100%

1. *Examination:*

   There are two exams (including the final) and two quizzes. The mid-term exam will consist of a computer lab question on simulation with spreadsheet. This exam, scheduled on **March 12, 2015**, is opened book and opened-notes. The in-class final exam will be closed book, closed-notes. The test questions will come from the text, homework assignments, lecture notes and class discussions and may consist of multiple-choice and/or essay questions or problems. The instructor will make available a formula sheet, which should not contain any other material except formulas. University will establish and announce the date for the final exam. This exam will be cumulative. For the final exam, the instructor will also distribute a take home question to answer using Arena software. The question will be distributed **on April 01, 2015** at 5:00 p.m. and the due-date is **on April 02, 2015 before midnight (Max 31 hours).** No makeup will be given for exams except for documented and acceptable emergencies (as defined by university standard). Students are advised that exam papers (mid-term or final) will not be returned back to them after being marked. They will only be available for consultation at the instructor's office.

2. *Quizzes:*

   Regarding the quizzes, the first quiz is about the data collection and input data analyzer. The second quiz is about the output data analyzer and system comparisons.

3. *Homework:*

Homework assignments will be posted on the course web site at the dates to be announced on the course news page. They are due at the start of the class on the date specified. The penalty for late homework is 20% per day. Assignments that are not professionally presented, i.e., cannot be read without undue effort, will loss marks. The instructor will not be responsible for a homework submitted through email. Students should make arrangements to have a hard copy of their homework submitted in time if they are not able to make it to class on the day the homework is due. Unless otherwise stated, no collaboration is allowed for homework, although discussions are encouraged.

4. Simulation Project using ARENA

The purpose of the group project is to integrate the material learned in the course. In conducting the project, students should obtain practical knowledge about the steps in performing a simulation study, from data collection and input analysis, experimental design, model development and debugging, model validation and verification, output analysis and written presentation.

4.1   Guidelines

o   Students should form a team of up to 4 or 5 people. Each group must submit names of the group members by e-mail to the instructor before **January 28, 2015**.
o   It is the group's responsibility to find a problem suitable for system modeling and simulation (real word or fictitious problem). Students' imagination and creativity are the only limits. However, the project should be carefully selected to demonstrate the meaningful use of simulation and to be completed in a reasonable amount of time. You also need to have sufficient information about the problem in order to develop the simulation model. **Each project must be approved by the instructor**.
o   The final project will be presented in class as scheduled.

4.2   Project Proposal

o   Each group must submit their project proposal by e-mail to the instructor before **February 11, 2015**. The proposal report should include the project title, names of team members, the organization involved, and the brief description of the decision problem under study and the objective of the simulation. The proposal should be typed with no more than three pages. Handwriting is not acceptable.

4.3 Project Report

The project report should include at least the following sections:

o   Introduction. Background of the organization involved or description of the problem they want to simulate. Decision problems under study. The justification of using simulation for solving the problem.
o   Problem formulation. Variables and constraints. System performance measures and objective functions.
o   The interrelationship between variables.

o   Data collection and analysis (if required). Methods of data collection. Data analysis.
o   Model construction and validation. Simulation model written using Arena. Model verification and validation.
o   Model experimentation and output analysis.
o   Conclusion and recommendation. The interpretation of simulation results. Recommendations to solve the problem.
o   Limitations and further improvement. The limitation of current study. Suggested improvement in the future.

The final report should be typed with no more than 30 pages (1.5 line spacing), including the appendices. A listing/printout of your program and a soft copy of the Arena model (ready to run!) must be submitted with your report. Flow charts/networks diagrams are optional but highly recommended, especially for other than extremely simple models.

4.4 Project peer evaluation

In an effort to promote fairness, a peer evaluation form will be required at the time of project final report submission on which the contributions made by each of the group members are evaluated. Group members who receive unsatisfactory peer evaluations from the rest of their group will have their project grade lowered accordingly.

Tentative Schedule

Week	Date	Topic/Information	Reading(s)
1	01/7	o Course introduction	
		o Introduction to modeling and simulation	o KS, chapter 1 o LK chapter 1 (1.1-1.2,1.7,1.9) o KS, chapter 2 (2.8) o KS, chapter 13
		o Fundamental of simulation concepts – Static and Dynamic Simulation with Spreadsheet	o KSS chapter 2 (section 2.7)
2	01/14	o Monte Carlo simulation modeling using Excel	o SC chapter 2
		o Dynamic Simulation – Hand simulation	o KSS chapter 2(sections 2.1-2.6) o LK chapter 1 (1.4.1, 1.4.2)
		o Data Collection (introduction)	o KSS chapter 4(4.6.2-4.6.3) o Case study - electronic assembly and testing system (see course website)
3	01/21	o Statistics in Simulation	o LK chapter 4 (4.4-4.5) o KSS App B (B.2-B.6) o LK chapter 9 (9.4)
		o Probability in simulation	o LK chapter 4 (4.2) KSS App B (B.1-B.2)
4	01/28	o Probability in simulation (cont'd)	
		o A Guided tour through arena	o KS Chapter 3
5	02/04	o Model building with Arena Software I	KSS chapter 4 (4.1-4.3)
		o Selecting input probability distributions	o LK chapter 6 (6.1-6.2,6.4.1-6.4.2,6.5, 6.6.2, 6.11) o KSS App C
6	02/11	o Input modeling with Arena	o KSS chapter 4 (4.6.4)
		o Generating random variates	o KSS chapter 12 (12.1 – 12.2) o LK chapter 7 (7.1, 7.2)
7	**02/18**	o **No Class (Winter Break)**	
8	02/25	o Quiz 1: Data collection and input data analyzer	
		o **Modeling Detailed Operations in arena**	o LK chapter 5

Week	Date	Topic/Information	Reading(s)
9	03/04	o Building valid, credible, and appropriately detailed simulation model	o LK chapter 5
	03/05	o **Assignment # 1 (due at the end of the tutorial)**	
10	03/11	o Simulation output analysis o Output Analysis with Arena	o KSS chapter 6 (6.1-6.4) o KSS chapter 7 (7.2) o LK chapter 9 (9.1,9.3, 9.4.1, 9.4.3, 9.5.1-9.5.2) o LK chapter 10 (10.1-10.3) o KSS chapter 6 (6.4) o KSS chapter 7 (7.4)
	03/12	**Mid-Term (computer lab -1728DT)**	
11	03/18	o Simulation output analysis (Cont'd) o Output Analysis with Arena (Cont'd)	
12	03/25	o Quiz 2: output data analyzer and system comparisons o Advanced modeling in arena simulation o Applications of simulation o **Assignment # 2 due**	
13	04/01	o **Project final presentation and report due** o **Arena final exam take-home question (due 04/09 by midnight using the assignment drop box available on CULearn)**	
14	04/08	o **No Class**	

Tentative Schedule (Tutorial)

Week	Date	Scheduled topic
3	01/15	○ Simulation with Spreadsheet
4	01/22	○ Simulation with Spreadsheet
5	01/29	○ Introduction to Arena Software
6	02/05	○ Simulation with Arena Software
7	02/12	○ Simulation with Arena Software
8	02/19	○ No Class (Winter Break)
9	02/26	○ Simulation with Arena Software
10	03/05	○ Simulation with Arena Software (midterm review)
11	**03/12**	○ **Mid-Term (lab question)**
12	03/19	○ Simulation output analysis with Arena Output Analyzer
13	03/26	○ Term project consulting (Arena)
14	04/02	○ No Class

IMPORTANT ADDITIONAL INFORMATION

Required calculator in BUSI course examinations
If you are purchasing a calculator, we recommend any one of the following options: Texas Instruments BA II Plus (including Pro Model), Hewlett Packard HP 12C (including Platinum model), Staples Financial Calculator, Sharp EL-738C & Hewlett Packard HP 10bII.

Group work
The Sprott School of Business encourages group assignments in the school for several reasons. They provide you with opportunities to develop and enhance interpersonal, communication, leadership, follower-ship and other group skills. Group assignments are also good for learning integrative skills for putting together a complex task. Your professor may assign one or more group tasks/assignments/projects in this course. Before embarking on a specific problem as a group, it is your responsibility to ensure that the problem is meant to be a group assignment and not an individual one.

Medical certificate
Please note that in all occasions that call for a medical certificate you must use or furnish the information demanded in the standard university form.
http://www1.carleton.ca/registrar/forms/

In accordance with the Carleton University Undergraduate Calendar (p 34), the letter grades assigned in this course will have the following percentage equivalents:

A+ = 90-100   B+ = 77-79   C+ = 67-69   D+ = 57-59
A   = 85-89   B   = 73-76   C   = 63-66   D   = 53-56
A - = 80-84   B - = 70-72   C - = 60-62   D - = 50-52
F   = Below 50   WDN = Withdrawn from the course
ABS = Student absent from final exam
DEF = Deferred (See above)
FND = (Failed, no Deferred) = Student could not pass the course even with 100% on final exam

FND:
To reduce instances of miscommunication, Carleton introduced a grade FND (Failure with No Deferral) to be assigned to students who fail to meet the minimum in-term performance standards explicitly set out in the outline and applied consistently (i.e., there is no other hidden criteria).

Academic Regulations, Accommodations, Plagiarism, Etc.
University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:
http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/

Academic Accommodations for Students with Disabilities
The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your

Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (*if applicable*). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (*if applicable*).
- The deadlines for contacting the Paul Menton Centre regarding accommodation for final exams for the April 2015 exam period is November 8, 2013 and for the April 2014 exam period is March 6, 2015.

> *For Religious Obligations:*

Students requesting academic accommodation on the basis of religious obligation should make a formal, written request to their instructors for alternate dates and/or means of satisfying academic requirements. Such requests should be made during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist, but no later than two weeks before the compulsory event.
Accommodation is to be worked out directly and on an individual basis between the student and the instructor(s) involved. Instructors will make accommodations in a way that avoids academic disadvantage to the student.
Students or instructors who have questions or want to confirm accommodation eligibility of a religious event or practice may refer to the Equity Services website for a list of holy days and Carleton's Academic Accommodation policies, or may contact an Equity Services Advisor in the Equity Services Department for assistance.

For Pregnancy:
Pregnant students requiring academic accommodations are encouraged to contact an Equity Advisor in Equity Services to complete a letter of accommodation. The student must then make an appointment to discuss her needs with the instructor at least two weeks prior to the first academic event in which it is anticipated the accommodation will be required.

Academic Integrity
Violations of academic integrity are a serious academic offence. Violations of academic integrity – presenting another's ideas, arguments, words or images as your own, using unauthorized material, misrepresentation, fabricating or misrepresenting research data, unauthorized co-operation or collaboration or completing work for another student – weaken the quality of the degree and will not be tolerated. Penalties may include expulsion; suspension from all studies at Carleton; suspension from full-time studies; a refusal of permission to continue or to register in a specific degree program; academic probation; and a grade of Failure in the course, amongst others. Students are expected to familiarize themselves with and follow the Carleton University Student Academic Integrity Policy which is available, along with resources for compliance a thttp://www2.carleton.ca/sasc/advisingcentre/academic-integrity/.

Assistance for Students:
Student Academic Success Centre (SASC): www.carleton.ca/sasc
Writing Tutorial Services: http://www1.carleton.ca/sasc/writing-tutorial-service/
Peer Assisted Study Sessions (PASS): www.carleton.ca/sasc/peer-assisted-study-sessions

Important Information:
- Students must always retain a hard copy of all work that is submitted.

- All final grades are subject to the Dean's approval.
- Please note that you will be able to link your CONNECT (MyCarleton) account to other non-CONNECT accounts and receive emails from us. However, for us to respond to your emails, we need to see your full name, CU ID, and the email must be written from your valid CONNECT address. Therefore, it would be easier to respond to your inquiries if you would send all email from your connect account. If you do not have or have yet to activate this account, you may wish to do so by visiting https://portal.carleton.ca/

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Winter Term 2015

January 5, 2015

- Winter-term classes begin.

January 16, 2015

- Last day for registration for winter term courses.
- Last day to change courses or sections for winter term courses.

January 31, 2015

- Last day for withdrawal from winter term and winter portion of fall/winter courses with full fee adjustment.
- Last day for receipt of applications for review of final grades in fall-term courses.

February 13, 2015

- April examination schedule available online.

February 13-21 (may include evenings and Saturdays), 2015

- Fall-term deferred examinations will be written.

February 16, 2015

- Statutory holiday. University closed.

February 16-20, 2015

- Winter Break, classes suspended.

March 1, 2015

- Last day for receipt of applications from potential Spring (June) graduates.

March 6, 2015

- Last day to submit, to the Paul Menton Centre for Students with Disabilities, Formal Examination Accommodation Forms for April examinations.

April 3, 2015

- Statutory holiday, University closed.

April 8, 2015

- Last day of fall/winter and winter-term classes.
- Last day for academic withdrawal from fall/winter and winter-term courses.
- Last day for handing in term work and the last day that can be specified by a course instructor as a due date for term work for fall/winter and winter-term courses.

April 9-10, 2015

- No classes or examinations take place

April 11-23, 2015

- Final examinations in winter term and fall/winter courses may be held. Examinations are normally held all 7 days of the week.