COURSE INFORMATION

Course title:	Simulation Modeling I: Data Processing and Monte Carlo Simulation		
Course code:	BAMS 503	Credits:	1.5
Session, term, period:	2021 W2, Period 4	Class location:	HA 132
Section(s):	BA1	Class times:	Tues/Thurs 10 am – 12 pm
Course duration:	Feb 28 – March 31, 2022	Pre-requisites:	N/A
Division:	Operations and Logistics	Co-requisites:	N/A
Program:	MBAN		

Course website: https://canvas.ubc.ca

INSTRUCTOR INFORMATION

Instructor:	Steven Shechter		
Phone:	604-822-8340	Office location:	Henry Angus 477 or by Zoom
Email:	steven.shechter@sauder.ubc.ca	Office hours:	TBD (also, by appointment)

Teaching assistant: TBD
Office hours: TBD
Email: TBD

COURSE DESCRIPTION

Simulation is a widely used methodology in both industry and academia because it is a vital tool for decision making under uncertainty. A simulation model allows the user to test a variety of "what-if" scenarios on a computer and evaluate a variety of outcomes from complex processes before considering implementing any changes to the real system. Areas of application include health care, finance, risk analysis, manufacturing, logistics, call centers, sports, and military.

This course introduces students to the foundations of Monte Carlo simulation. The course also covers how to analyze and process raw data, with the goal of creating useful inputs to a simulation model.

COURSE FORMAT

The course will consist of lectures, exposing the relevant material, in-class discussions, in-class hands-on work, out-of-class discussions on Piazza, and out-of-class practice problems.

The lectures will be self-contained and no textbook is required for this course. Copies of the slides used in class will be available on the course website after the lecture. You should supplement the slides with your own notes taken during the lectures.

LEARNING OBJECTIVES

- To learn the benefits of Monte Carlo simulation through several examples
- To learn how to develop Monte Carlo simulations in Excel, Python, and R
- To learn how to analyze and process available data for use in a simulation model
- To develop critical thinking skills when making decisions under uncertainty
- To develop the ability to translating technical content into managerial insights

ASSESSMENTS

Summary

Component	Weight
Three individual quizzes (10% each)	30%
Final group project:	60%
Participation/Professionalism	10%
Total	100%

Details of Assessments

Quizzes:

There will be three quizzes on Canvas, one in each of weeks 2-4 (no quiz in week 1 or week 5). Quizzes will be based on material covered in class through that week (and may include material from previous weeks).

The quizzes will be released Saturday, 12:01 AM Vancouver time and close on Sunday, 11:59 PM Vancouver time. Once you begin the quiz, you will have 2 hours to complete it from that start time (it does not allow you to take breaks and pause the 2-hour timer). The quizzes will be based on material covered in class through that week (and may include material from previous weeks). Quizzes are to be done individually; academic honesty requires that students do not discuss anything about the quiz with each other during the two days the quiz is released.

Participation/Professionalism:

There are a number of ways to actively participate in the course. These include: asking and answering questions during lecture, sharing thoughts/ideas/news stories/etc. that promote peer-to-peer learningin class and/or via the Piazza discussion forum, participating in office hours, contributing to practice problems (e.g., by solving them and/or proposing new ones), and others.

The professionalism component includes being on time to class, avoiding distractions (e.g., cell phoneusage), and treating others with respect. More aspects of professionalism are covered below in the "Robert H. Lee Graduate School" and "University" policies sections.

Final Project:

See end of this document for details.

LEARNING MATERIALS

Technology requirements:

- In-class examples will primarily be shown in Python. However, for many models discussed, I will post both Python and R versions.
- The project should be done in Python or R; your choice.

Suggested Reading Materials:

An excellent simulation textbook used for graduate courses at many universities is: "Simulation Modeling and Analysis" by Law and Kelton (there are several updated editions of this, and I think the

most recent editions just have the single author "Law"). This book is a good reference for both BAMS 503 and BAMS 504. The book is by no means required for the course; it's just a good textbook to have on your bookshelf if you see yourself doing simulation modeling in the future.

COURSE-SPECIFIC POLICIES AND RESOURCES

Prerequisites

Simulation modeling requires a solid understanding of other analytics methodologies; namely statistics and probability. It also requires comfort with coding, as simulation is coding-intensive (the coding you did already in the program with Python and R will be enough coding background for this course).

Missed or late quizzes

Late submissions will not be accepted and will receive a grade of zero.

Academic Concessions

If extenuating circumstances arise, please contact the RHL Graduate School program office as early as reasonably possible, and submit an Academic Concession Request & Declaration Form https://webforms.sauder.ubc.ca/academic-concession-rhlee. If an academic concession is granted during the course, the student will be provided options by RHL, or by the instructor in consultation withRHL, per UBC's policy on Academic Concession.

Code Plagiarism

Code plagiarism falls under the UBC policy for Academic Misconduct. Students must correctly cite anycode that has been authored by someone else or by the student themselves for other assignments.

Cases of "reuse" may include, but are not limited to:

- the reproduction (copying and pasting) of code with none or minimal reformatting (e.g.,changing the name of the variables)
- the translation of an algorithm or a script from a language to another
- the generation of code by automatic code-generations software

An "adequate acknowledgement" requires a detailed identification of the (parts of the) code reused anda full citation of the original source code that has been reused.

Students are responsible for ensuring that any work submitted does not constitute plagiarism. Studentswho are in any doubt as to what constitutes plagiarism should consult their instructor before handing inany assignments.

POLICIES APPLICABLE TO COURSES IN THE ROBERT H. LEE GRADUATE SCHOOL

Attendance

Excepting extenuating circumstances, students are expected to attend 100% of their scheduled class hours. Absent students limit their own academic potential, and that of their classmates, and cause unnecessary disruption to the learning environment. Students missing more than 20% of the total scheduled class hours for a course (including classes held during the add/drop period) without havingreceived an academic concession will be withdrawn from that course. Withdrawals, depending on timing, could result in a "W" or an "F" standing on the transcript.

COVID-19 POLICIES FOR ATTENDANCE & ACADEMIC CONCESSIONS:

If a student feels unwell, they should stay home and send a courtesy email to each impacted instructor and cc their program manager. The student should also submit an Academic Concession Request & Declaration Form.

If a student suspects possible Covid-19 infection, they should use the BC Ministry of Health's self-assessment tool, to help determine whether further assessment or testing for COVID-19 is recommended.

If a student is required to self-isolate (e.g., while waiting for test results), they should follow the steps above (stay home, email instructor(s) and program manager, submit an Academic Concession Request & Declaration Form, and follow BC Health Guidance.

Students who are required to quarantine, should get in touch with their Program Manager to discuss the possibility of academic concessions for each impacted course. The Program Manager will work closely with your instructors to explore options for you to make up the missed learning.

COVID-19 SAFETY IN THE CLASSROOM:

Masks: Masks are **required** for all indoor classes, as per the BC Public Health Officer orders. For our in-person meetings in this class, it is important that all of us feel as comfortable as possible engaging in class activities while sharing an indoor space. For the purposes of this order, the term "masks" refers to medical and non-medical masks that cover our noses and mouths. Masks are a primary tool to make it harder for Covid-19 to find a new host. You will need to wear a medical or non-medical mask for the duration of our class meetings, for your own protection, and the safety and comfort of everyone else in the class. You may be asked to remove your mask briefly for an ID check for an exam, but otherwise, your mask should cover your nose and mouth. Please do not eat in class. If you need to drink water/coffee/tea/etc, please keep your mask on between sips. Students who need special accommodation are asked to discuss this with the program office.

Seating in class: To reduce the risk of Covid transmission, please sit in a consistent area of the classroom each day. This will minimize your contacts and will still allow for the pedagogical methods planned for this class to help your learning.

Visit the following website for the most recent updates regarding Covid-19 protocol on campus:https://students.ubc.ca/campus-life/returning-to-campus

Punctuality

Students are expected to arrive for classes and activities on time and fully prepared to engage. Late arrivals may be refused entry at the discretion of the instructor or activity lead. Students arriving laterthan halfway through a scheduled class will be treated as absent for that class.

Electronic Devices

Devices such as laptops, tablets, and cell phones are not permitted to be used in class unless directed by the instructor for in-class activities. Students who do not follow the School's policy in this regard may berequired to leave the room for the remainder of the class, so that they do not distract others. Research shows that students' use of laptops in class has negative implications for the learning environment, including reducing their own grades and the grades of those sitting around them.

Citation Style

Please use the American Psychological Association (APA) reference style to cite your sources.

Details of the above policies and other RHL Policies are available at:
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,199,506,1625

UNIVERSITY POLICIES AND RESOURCES

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivorsof sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by othersand to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available on the UBC Senate website at https://senate.ubc.ca/policies-resources-support-student-success.

Respect for Equity, Diversity, and Inclusion

The UBC Sauder School of Business strives to promote an intellectual community that is enhanced by diversity along various dimensions including status as a First Nation, Metis, Inuit, or Indigenous person, race, ethnicity, gender identity, sexual orientation, religion, political beliefs, social class, and/or disability. It is critical that students from diverse backgrounds and perspectives be valued in and well- served by their courses. Furthermore, the diversity that students bring to the classroom should be viewed as a resource, benefit, and source of strength for your learning experience. It is expected that allstudents and members of our community conduct themselves with empathy and respect for others.

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheatingmay result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

Academic Freedom and Students Studying from Outside Canada

During this pandemic, the shift to online learning has greatly altered teaching and studying at UBC, including changes to health and safety considerations. Keep in mind that some UBC courses might cover topics that are censored or considered illegal by non-Canadian governments. This may include, but is notlimited to, human rights, representative government, defamation, obscenity, gender or sexuality, and historical or current geopolitical controversies.

If you are a student living abroad, you will be subject to the laws of your local jurisdiction, and your local authorities might limit your access to course material or take punitive action against you. UBC is strongly committed to academic freedom, but has no control over foreign authorities (please visit http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,33,86,0 for an articulation of the values of the University conveyed in the Senate Statement on Academic Freedom). Thus, we recognize that students will have legitimate reason to exercise caution in studying certain subjects. If you have concerns regarding your personal situation, consider postponing taking a course with manifest risks, until you are back on campus or reach out to your academic advisor to find substitute courses. For further information and support, please visit: http://academic.ubc.ca/support- resources/freedom-expression

COPYRIGHT

All materials of this course (course handouts, lecture slides, assessments, course readings, etc.) are theintellectual property of the instructor or licensed to be used in this course by the copyright owner.
Redistribution of these materials by any means without permission of the copyright holder(s) constitutes a breach of copyright and may lead to academic discipline and could be subject to legal action. Any lecture recordings are for the sole use of the instructor and students enrolled in the class. Inno case may the lecture recording or part of the recording be used by students for any other purpose, either personal or commercial. Further, audio or video recording of classes are not permitted without the prior consent of the instructor.

ACKNOWLEDGEMENT

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people, who for millennia have passed on their culture, history, andtraditions from one generation to the next on this site.

ONLINE TEACHING TOOL & REQUIREMENTS

The default for office hours will be to hold them via Zoom. If you don't have a Zoom account yet, please set one up. Links to office hours will be provided once the class begins.

COURSE SCHEDULE

(Subject to change with class consultation)

Week	Topic	Assessments due
1	• Introduction to Simulation • The "Flaw of Averages" • Example models: Project management Newsvendor problem	
2	• Random number and random variable generation • Example models: Revenue management Warranty analysis	Quiz 1 Released Saturday, March 12 at 12:01 AM
3	• Input modeling • Distribution fitting • Example models: Surgical scheduling Production planning	Quiz 2 Released Saturday, March 19, 12:01 AM
4	• Output Analysis • Comparing Multiple Systems • Variance Reduction Techniques • Example model: Contract bidding	Quiz 3 Released Saturday, March 26, 12:01 AM
5	• Simulation Optimization • Example model: Inventory planning	
6	Exam week	Final project deliverables Due: TBD

PROJECT DETAILS

Overview

The purpose of the course project is to gain simulation modeling, analysis, and report-writing experience. Groups of 3-5 students may choose any topic that interests them. Feel free to run your project ideas by me in advance (no formal proposal submission is required). You may form your own groups, or let me know if you need help finding a group.

Project Deliverables

The final deliverable can either be a Jupyter Notebook or an R Markdown file. That is, instead of submitting a final report and your code separately, I want you to integrate all of your storytelling and code/analysis in one of these two popular environments for analytics-based reporting.

This is an opportunity to hone your "storytelling with analytics" skills. In creating your report, consider two types of readers that may focus on different parts of the report: 1) a manager without a technical background who wants to understand clearly the key managerial insights and how they are supported by the analysis, and 2) an analytics professional who wants to understand the technical details and view the code. Therefore, make sure you implement good coding conventions (e.g., clear variable names, liberal use of comments, etc. so that someone who knows Python or R can clearly understand what you did and reproduce it).

Marking of Final Projects

Projects will be marked on a "CheckPlus/Check/CheckMinus" scale. These will then be converted into a number. Usually, a "Check" means an "average" solution and will receive approximately 80%. CheckPlus will receive more than this (typically 85%) and CheckMinus will receive less (typically 75%). The category assigned will depend on the quality of the solutions, where quality involves a combination of good modeling and derivation of results, as well as good presentation and discussion of the solution. The modal mark will generally be a "Check." CheckPlus/Check/CheckMinus marks need not always map exactly to 85%/80%/75% marks. Some differences in quality may be accommodated by assigning different percentage marks. For example, while most CheckMinus solutions may receive 75%, a really poor job may receive a lower mark. Also, while most CheckPlus solutions may receive 85%, an especially outstanding solution may receive a higher mark.

In general, a "CheckPlus" means that the report was thorough and thoughtful, the model development was entirely (or nearly entirely) correct, and that recommendations were clearly justified. "Check" means that the solution was satisfactory but with room for improvement, due to modeling or analysis mistakes and/or due to recommendations that were not as compelling as they could be. Finally, "CheckMinus" means that the solution was unsatisfactory with significant room for improvement. For example, model development contained several errors and/or recommendations and explanations were unclear or unsupported by the evidence.