COURSE INFORMATION

Course title:	Managerial Decision Modeling and Analytics		
Course code:	BAMS 523	Credits:	1.5
Session, term, period:	2022W1, Period 6	Class location:	David Lam 125
Section(s):	001	Class times:	Tu/Th 10am – 12 pm
Course duration:	Sept 6 - Oct 7, 2022	Pre-requisites:	n/a
Division:	Operations and Logistics	Co-requisites:	n/a
Program:	FT MBA		

Course websites: For assignments, quizzes, announcements, files:
https://canvas.ubc.ca
For offline discussion/Q&A:
https://piazza.com/class/l6ek68ohc6q6ve
(Piazza can also be accessed from the left panel of the Canvas course site)

INSTRUCTOR INFORMATION

Instructor:	Steven Shechter		
Phone:	604-822-8340	Office location:	HA 477
Email:	steven.shechter@sauder.ubc.ca	Office hours:	By appointment, via Zoom

Teaching assistant:	Ziqian (Zack) Zhu
Office hours:	TBD
Email:	ziqian.zhu@sauder.ubc.ca

COURSE DESCRIPTION

The success of many organizations, across a variety of industries, hinges on the ability to combine available data with advanced analytical techniques to improve decision-making. The term "analytics" is rather broad in its scope and spans three main categories: descriptive, predictive, and prescriptive analytics. This course primarily focuses on the last item: prescriptive analytics, which involves learning how to formulate and solve challenging decision problems, using specialized software. This course does not cover the topics of predictive analytics, such as machine learning, artificial intelligence, and regression. It assumes that any descriptive and predictive modeling has already been completed, and now an organization wants to use these analyses as inputs to prescriptive models, which seek to determine optimal, or near optimal, decisions. For example, organizations may want to know the best way to schedule their employees or the best way to manage their inventory. This course explores examples across a wide range of industries and functional areas of business.

COURSE FORMAT

The course will consist of live lectures, discussions, games, and other in-class exercises.

LEARNING OBJECTIVES

- To introduce students to the basic concepts of optimization and Monte Carlo simulation.
- To enable students to develop and solve models that arise in practice.
- To develop skills in conveying the results of decision models to managerial audiences.

By the end of the course, students will be able to:

- Recognize different problems types and be able to formulate an appropriate decision model for solving them.
- Implement and solve optimization models with Python and Gurobi.
- Implement and analyze Monte Carlo simulation models with Python.
- Gain insight into solutions obtained from decision models.
- Understand how changes in different inputs might affect models' outputs ("sensitivity analysis").
- Provide several examples of companies and organizations successfully applying these modeling techniques.

ASSESSMENTS

Summary

Component	Weight
Optimization Group Assignment	20%
Simulation Group Assignment	20%
Group Project	50%
Class participation/Professionalism	10%
Total	100%

Details of Assessments

Assignments

There will be two group assignments during this course, performed by teams consisting of 3-4 students each. You will be *randomly assigned* to groups for each homework set. I realize that random matchings of students for assignments may create some discomfort for some people. However, there is important real-world experience gained with this approach. Most of us do not end up with professional colleagues of our choosing, and so this is meant to simulate the need to successfully complete various jobs with random co-workers. That being said, you will get to choose your own group for the course project; after all, maybe you will create a start-up with classmates you know well.

Unless otherwise noted, each assignment should be a self-contained Jupyter notebook, using Python. For the optimization assignment, you should also use Gurobi as the optimization software. Your notebooks should be well-documented (e.g., clear labeling of variables, markdown text and comments clarifying steps of the code), so that someone who has not developed the model can easily understand it and replicate your results and findings.

Group Project:
See end of this document for details.

Participation/Professionalism:

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

There are a number of ways to actively participate in the course. These include: asking and answering questions during lecture as well as outside of class via the Piazza discussion forum, sharing thoughts/ideas/news stories/etc. that promote peer-to-peer learning, participating in office hours.

Also, you will be expected to participate in various activities throughout the course. These include in-class games, exercises, "Fake-Quiz Thursdays," and "Ask-Me-Anything Fridays."

> *Fake-Quiz Thursdays:* A short quiz will take place at the start of class each Thursday in weeks 2-5. These quizzes are fake in the sense that your quiz grade *will not* count towards your overall course mark. The purpose of these quizzes is to check your understanding of course materials, as well as to motivate discussion afterwards (we will go over the answers afterwards).

> *Ask-Me-Anything Fridays*: Each Friday of weeks 1-4, I want each of you to submit one question to me via Canvas. It can be about anything related to the course. Examples may include questions related to:
> - Clarifying materials on the course slides
> - Following up on in-class quizzes, problems, or discussions
> - Bigger-picture questions around real-world applications/implementations (but not something you would find the answer to within 5 minutes of "googling around"!)
> My TA and I will select some of your questions to post answers to each week.

Marking Policy

All assessments in the course (assignments, project, participation/professionalism) will be marked on a "CheckPlus/Check/CheckMinus" scale. These will then be converted into a number. By default, a "Check" means "good" and will receive 80%. CheckPlus means "very good" and will receive 85%, and "CheckMinus" means "below average" and maps to 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 numerical marks, but this will be the exception. For example, while most CheckMinus solutions may receive 75%, a really poor job submission may receive a lower mark. Also, while most CheckPlus solutions will receive 85%, an especially outstanding solution may receive a higher mark.

For assignment and the project, a "CheckPlus" means that the work was thorough and thoughtful, the model development was entirely (or nearly entirely) correct, and that

recommendations were clearly justified. "Check" means that the work was reasonable but with some room for improvement, due to modeling or analysis mistakes and/or due to recommendations that were not as compelling as they could be. "CheckMinus" means that the work 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.

LEARNING MATERIALS

Requirements:

- 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* class.

Suggested Reading Materials:

While you can certainly do well in the course without purchasing a book, there are several good textbooks on decision modeling for further reference. These include:

- *Managerial Decision Modeling with Spreadsheets*, second Canadian edition, by Render, Stair, Balakrishnan, Smith
  - This is available for temporary loan through course reserves; you can ask for it at the front desk of the David Lam library.
- *Management Science: The Art of Modeling with Spreadsheets*, by Powell and Baker.
  - Note: this book is also available online, via the UBC library: http://gw2jh3xr2c.search.serialssolutions.com/?sid=sersol&SS_jc=TC0001980413&title=Management%20science%20%3A%20the%20art%20of%20modeling%20with%20spreadsheets

Technology Requirements:
- Jupyter, Python, and Gurobi software installed (see installation notes on the course website).

COURSE-SPECIFIC POLICIES AND RESOURCES

Prerequisites
This is a quantitative course. Students should have a basic familiarity with statistics and probability. This course also requires some comfort with coding in Python. Most of you (except for perhaps any exchange students) have taken BA 515 with Professor Gene Lee, which introduces MBA students to Python. If you have not taken this, then you should go through the "Introduction to Data Science in Python" course on DataCamp prior to beginning this course (and for those who did take Prof. Lee's course, I recommend that you review the basics of Python there).

Missed or late assignments/projects
Late submissions will not be accepted and will receive a grade of zero (this is standard for RHL courses).

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. If an academic concession is granted during the course, the student will be provided options by RHL, or by the instructor in consultation with RHL, per UBC's policy on Academic Concession.

Code Plagiarism

Code plagiarism falls under the UBC policy for Academic Misconduct. Students must correctly cite any code 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 and a full citation of the original source code that has been reused.

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

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 later than 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 be required 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 survivors of 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 others and 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 all students 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 cheating may 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.

COPYRIGHT

All materials of this course (course handouts, lecture slides, assessments, course readings, etc.) are the intellectual 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. In no 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. Students may not share class Zoom links or invite others who are not registered to view sessions.

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, and traditions from one generation to the next on this site.

COURSE SCHEDULE

Class#	CLASS TOPICS	ASSIGNMENTS / DELIVERABLES
Week 1 (Sept 6, 8)	• Introduction to Optimization and Linear Programming • Sept 8: Burrito Optimization Game	Before Sept 8: Install Python/Jupyter/Gurobi. Gurobi registration is needed for the Burrito Optimization Game on Sept 8. Sept 8: HW1 assigned Sept 9: Ask-Me-Anything Friday
Week 2 (Sept 13, 15)	• Linear programming Sensitivity Analysis • Network optimization • Introduction to Integer Programming	Sept 16: Project Proposal due Sept 16: Ask-Me-Anything Friday
Week 3 (Sept 20, 22)	• Integer Programming examples • Introduction to Decision Making under Uncertainty and the "Flaw of Averages"	Sept 22: HW 1 due Sept 23: HW2 assigned Sept 23: Ask-Me-Anything Friday
Week 4 (Sept 27, 29)	• Introduction to Monte Carlo Simulation • Monte Carlo (MC) Simulation in Python	Sept 30: Ask-Me-Anything Friday
Week 5 (Oct 4, 6)	• Examples of Monte Carlo simulation across several industries • Simulation optimization	Oct 7: HW 2 due
Week 6 (Oct 10-14)	Final Project	TBD

Project Details

Overview
The purpose of the course project is to gain optimization or simulation modeling, analysis, and "Storytelling with Analytics" experience. Groups of 3-5 students should propose an optimization or simulation project that interests them and that I approve after reviewing the proposal. You may form your own groups, or let me know if you need help finding a group.

The project may be something that groups come up with on their own, or it may be based on a case study that requires optimization or simulation modeling (and which does not have a publicly available solution). One source of such case studies is the journal: *INFORMS Transactions on Education*. You can access this via the UBC Library here:
https://gw2jh3xr2c.search.serialssolutions.com/?sid=sersol&SS_jc=TRANONED&title=Transactions%20on%20education

Examples of past projects include:
- Staffing optimization at a clothing store
- Beer production planning
- Assigning pharmaceutical sales representatives to different regions of Turkey
- Airline revenue management

Deliverables and Deadlines

Project component	Due
Proposal	Sept 16 (11:59 PM)
Final Deliverables	TBD (during exam week)

Proposal
In 1-2 paragraphs, briefly describe your project proposal. If you plan to pursue your own project idea, describe the problem and the questions you plan to investigate. If you are planning to work on a published case study, provide the link or pdf to the case and the questions you plan to answer around it. I will give you feedback on your proposal within 24 hours of your submitting it (you can submit it prior to Sept 16).

Final Deliverables
The final deliverable should be a self-contained Jupyter Notebook using Python. 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 a single notebook. If your project involves optimization modeling, you should use Gurobi to solve the optimization problem(s).

In creating your notebooks, consider two types of readers that may focus on different parts of the file: 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 the code.

For the write-up/reporting portions of the notebook (i.e., the html markdown portions), include the following:

1. An Executive Summary
2. Introduction
3. Model formulations
4. Model results
5. Discussion/Recommendations/Conclusion

For the code sections of the notebook, follow good coding conventions (e.g., clear variable names, liberal use of comments, etc.). A good question to ask yourself is "can someone else looking at my notebook understand what it is doing, how it works, and reproduce the results without me being there to answer questions?"