COURSE INFORMATION

Course title:	Optimal Decision Making II		
Course code:	BAMS 508	Credits:	1.5
Session, term, period:	2021W1, Period 2	Class location:	HA 133
Section(s):	BA1	Class times:	Tues/Thurs 2pm-4pm
Course duration:	Oct 25 – Nov 26, 2021	Pre-requisites:	BAMS 506
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:	HA 477
Email:	steven.shechter@sauder.ubc.ca	Office hours:	By appointment

Teaching assistant: Sally Kim
Office hours: TBD
Email: sally.kim@ubc.ca

COURSE DESCRIPTION

Optimization problems arise whenever one seeks to use activities in the best possible way, to maximize profits, to minimize costs, or more generally to find a "best" solution to a complex problem. Discrete Optimization models are those optimization models that involve a discrete structure, such as when activity levels are restricted to integer values, when modeling complex logical relationships using binary logic, or when optimizing over a graph or network. Discrete optimization applies to many functional fields of management, such as production and operations, supply chain, transportation and logistics, project planning, health care, marketing, as well as capital budgeting and investment planning involving discrete activities. It also applies to several disciplines in science, such as computer science, mathematics, physics and biology, and to many fields in engineering.

The course will present fundamental models and methods in discrete optimization. The emphasis will be placed on useful modeling methodologies and their applications. The course will present guidelines for choosing among alternate formulations, as well as among alternate solution approaches.

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 introduce students to the basic concepts and models of discrete optimization.
- To enable students to develop and use discrete optimization models arising in a variety of industries.

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

1. Formulate a discrete optimization model for a decision problem, solve it using appropriate tools, interpret the results, and derive managerial insights relevant to the intended application.
2. Compare alternate formulations and choose one that is most appropriate for a given situation.
3. Understand the main solution approaches used in practice, and appreciate their strengths and weaknesses in view of their practical applications.
4. Solve optimization problems using Excel Solver and OpenSolver.

ASSESSMENTS

Summary

Component	Weight
Four quizzes	40%
Final group project	50%
Participation/Professionalism	10%
Total	100%

Details of Assessments

Quizzes:

There will be four quizzes on Canvas, one in each of weeks 2-5 (no quiz in week one). The quizzes will be released Saturday, 9 AM, and to be completed by Sunday, 11:59 PM. Once you begin the quiz, you will have 2 hours to complete it. The quizzes will be based on material covered in class through that week (and may include material from previous weeks).

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

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. You should supplement them withyour own notes taken during the lectures.

Technology requirements:

- A computer with Windows installed. If you own an Apple laptop, you are responsible for configuring Windows on your Mac. A free copy of Microsoft Windows 10 Education is availablefor all eligible active UBC Students here: https://it.ubc.ca/services/desktop-print- services/software-licensing/windows-10-education. Apple provides instructions on how to install Windows 10 here: https://support.apple.com/en-ca/HT201468. You will need enough space on your computer to handle both macOS and Windows 10.
- Excel Solver, the optimization tool embedded in Excel spreadsheets. For students using a Maccomputer, you should use the Excel Solver in the Windows environment. The Mac version of Excel Solver is buggy.
- You may also want to install the OpenSolver add-in for Excel, available here: https://opensolver.org/
    - This allows you to solver large models than can be handled by standard Solver. For example, the pediatrician case study problem we will discuss in class is too large for standard Solver.

Suggested Reading Materials:

- Hillier, Frederick S. and Lieberman, Gerald J. (2014). Introduction to Operations Research, 10th Edition. McGraw Hill.
    - Relevant sections in the 10th edition are indicated in the Course Schedule below (marked with "HL" in the readings column).

This text is an excellent resource, but not required for the course.

COURSE-SPECIFIC POLICIES AND RESOURCES

Prerequisites

This course builds on the foundation established in BAMS 506, so a good understanding of that material is necessary for doing well in BAMS 508.

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

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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

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	Readings or Activities	Assessments due
1	• Introduction to Discrete Optimization • Introduction to Computational Complexity • Network optimization: Transportation and Assignment problems	HL 9.1, 9.3	
2	• Network optimization: Trees and Paths Min Cost Network Flows	HL 10.1-10.6, 10.8	Project Proposal due: Nov 5, 11:59 PM Quiz 1
3	• Integer programming (IP) formulations • IP "tricks" • Covering, Packing, and Partitioning	HL 12.1-12.5	Quiz 2
4	• Case study: Pediatrician Scheduling at BC Women's Hospital	BCWH Case Study	Quiz 3
5	• IP solution methods ○ Branch-and-Bound ○ Cutting planes ○ Heuristics	HL 12.5-12.8 Ch. 14	Quiz 4
6	Final Project deliverables		Due date/time: TBD

PROJECT DETAILS

Overview

The purpose of the course project is to gain optimization modeling, analysis, and report-writing experience. Groups of 3-4 students should propose an optimization 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 based on a case study that requires optimization 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://pubsonline-informs-org.ezproxy.library.ubc.ca/journal/ited

Examples of past projects include:

- Staffing optimization at a clothing store
- Beer production optimization
- Assigning pharmaceutical sales representatives to different regions
- Airline revenue management

Note: Most projects require more decision variables and constraints than Excel Solver can handle. In such cases, you may use the free Excel add-in OpenSolver (available at opensolver.org), or call an optimization package from within Python or R (e.g. Gurobi, CPLEX, PULP, etc.).

Deliverables and Deadlines

Project component	Due
Proposal	Nov 5 (11:59 PM)
Final report and Optimization Models	TBD (during exam week)

Proposal

In at most 2 pages (single-spaced), provide a brief background of your project topic and the questions you plan to investigate. I will give you feedback on your proposal within 48 hours of your submitting it (you can submit it prior to Nov 5).

Final report

Your report should be a very clear, well-written Word document that includes the following sections:

1. A one-page Executive Summary
2. Introduction
3. Model formulations
4. Model results
5. Discussion/Conclusion

If you are doing a case study, your report should include solutions and discussions to any questions specifically asked in the case. These may be incorporated into your write-up of parts 3-5. Note that this

does not mean that the questions asked in the case are the *only* aspects of the case to evaluate, discuss, and comment on. I'd like to see you consider 2-3 other interesting questions you come with on your own and for which you provide managerial insights and recommendations through proper analysis.

When writing up your reports, consider two perspectives: 1) a student showing me you know the technical details of what is going on, and 2) a consultant explaining to management what is going on. With regard to the latter, be sure you don't just provide numerical results, but explain things clearly and concisely. Provide insight and justify your recommendations.

The average length of the document (before any appendices) should be approximately 10-15 pages single-spaced.

Optimization models

Besides being logically correct and clean (i.e., if there are many ways to go about the same thing, you chose a simpler approach), your models should be easy to read and understand. A good question to ask yourself is "can someone else looking at my model understand what it is doing and how it works, without me being there to explain it and answer any questions?" If you find it easier, you may include a "readme.doc" with your submission which explains aspects of your model.

Marking of Final Projects

You project marks will be based on both your write-up and your model. 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.