![Rotman Commerce University of Toronto logo]

Course Outline

RSM 417H1S
Causal Models for Integrative Strategies
Winter 2015
Course Meets: W 9a-11a, Room WW 120

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Course Scope and Mission

In this course, students develop and extend their real-world analytical abilities by learning causal modeling and data analytics. This is a "methods" course in which the underlying framework is built up from Bayesian network theory. Prospective students are encouraged to google "Bayesian networks" or, better, visit Baysia.us where the people who developed the software used in this course provide some nice overview material. This course is suitable for those with career interests in management consulting, or analytical professions in Finance, Marketing or Strategy.

Causal models are useful for problems that involve variables interconnected by influence relationships. For example, a firm might contemplate launching a new design of an existing product. Such a launch may affect its downstream distribution channels, the differential effectiveness of its various marketing options, and the prices of existing products. Reactions by distributors, such as shifts slotting allowances may, themselves, affect end-user behavior. Additionally, suppliers may adopt new technologies, upstream channels may become more or less competitive. The behavior of upstream agents may affect the behavior of their downstream buyers, some of which may be the firm's direct competitors. And so on. RSM2016 is about framing, analyzing and choosing optimal business decisions with such multilayered influence relationships.

The course covers causal modeling (intervention) and data analytics (inference). Because the approach is based upon Bayesian statistics, the framework has spawned powerful learning algorithms for *data mining* and *pattern recognition*. Thus, the modeler can construct a model based upon expert judgment, calibrate its parameters with data ("big" or otherwise), and then use the calibrated model for decision support and what-if scenario exploration.

Causal modeling is a new, rapidly expanding analytical approach to business decision making. To name just a few organizations that have adopted the approach: Booz Allen management consultants, P&G, Hyatt Hotels, Cancer Care Ontario, the U.S. Environmental Protection Agency, Shell Canada, NASA, Nisan, Bose, UCLA, and many others. The increasing popularity of the approach is due to many factors. Chief among these is: its

ability to integrate both data and theory into a single analytic framework; the existence of powerful commercial software support tools; its flexibility in addressing a wide range of problem categories.

Course Goals
1. Gain an understanding of the important aspects of the underlying causal theory;
2. Learn a specific software support tool (in this case, BayesiaLab);
3. Develop skill in the actual application of this approach, both modeling and data analysis

Course Prerequisites

Prerequisites: ECO220Y1/ECO227Y1/(STA220H1, STA255H1)/(STA257H1, STA261H1).

Required Readings

Textbook: <u>Inference and Intervention: Causal Models for Business Analysis</u>, Ryall and Bramson (2013).

Cases: There is only one case for this class – the Zipcar case. Go to the Coursepack link to get it: https://www.iveycases.com/CoursepackView.aspx?id=5467 You will need to log in or create an account. For technical assistance, contact Ivey Publishing during business hours Monday to Thursday, 8:00am-4:30pm (EST), and Friday, 8:00am-4:00pm (EST) via (e) cases@ivey.ca o. (t) 519-661-3208. Access to your digital coursepack download is for a period of 30 days from date of purchase. **This coursepack is for your personal use only and is not to be shared or distributed in any form**.

Required Software: This course requires the use of a commercial-grade software program called *BayesiaLab*. This software runs on both PC and Mac and will be provided to students under a course license. Further instructions will be provided on how to get the software at the appropriate time. Ideally, students will install the software on a laptop they bring to class. Those who cannot do so should notify me immediately.

Evaluation and Grades
Grades are a measure of the performance of a student in individual courses. Each student shall be judged on the basis of how well he or she has command of the course materials. All assignments will be graded on a 100 point scale and then weighted as follows:

Item		Due Date
Project	35%	See weekly schedule
Midterm Exam	25%	See weekly schedule
Final Exam	35%	Examination period
Participation	05%	See below

Assignment Details

Participation
Attending class, coming prepared, being attentive, participating in the in-class labs, and contributing to class discussions facilitates not only individual learning but also creates positive externalities for the class as a whole. To encourage the creation of these benefits, course participation is factored in to your assessment. Essentially, the 5% weighting means that, if your assessment from other components places you on the margin between two letter grades, your demonstrated level of preparedness, attentiveness, participation, and contribution will determine on which side of the divide your final grade will fall.

Exams
1. *Midterm* The midterm is open-book and covers all preceding lectures.
2. *Final* The final is open-book and comprehensive.

To reward improved performance over the term, final assessment will be computed as the higher of: i) the average of the midterm and the final; or ii) the final. For example, if the midterm grade is 80 and the final is 90, 60% of your grade will be assessed at 90. If the grades are 90 and 80, respectively, then 60% of your grade will be assessed at 85. Note the implication that taking the midterm can only help your final assessment. Failing to take the midterm will result in a midterm grade of zero.

Homework
The midterm and final are problem-oriented. The problems will be similar to those in the book. Therefore, students are encouraged to work all the homework problems in the book. The schedule (below) lists homework problems that are essential. Homework is not collected or graded.

Group Assignment
Overview There is a team project the aim of which is to have students develop proficiency in causal modeling and data analytics, beyond textbook cases. Teams will 3-4 students each and self-organized: please send me an email with the names of your group members before the midterm. If you have less than 4 students in your group, I may add people. THE ASSIGNMENT IS DUE by 5:00pm the day of the last class.

Topic The default topic is the HBS case: Zipcar: Refining the Business Model. I am happy to have teams develop a real-world project based upon their own experience or interests. However, these must be discussed with and approved by me in advance. The following details are for the Zipcar case (an independent project would have similar scope, depth, and deliverables).

Scope There are two components: a BayesiaLab model and a written report. The Bayesia model should include three scenarios. The first scenario should be a "status quo" set of assumptions that recreates Exhibit 3. Then, two additional scenarios should be developed using assumptions that reflect two salient "future worlds" of relevance to the Zipcar project. The report should be no more than 15 pages of discussion, 1.5-spaced, 1" margins, using 12pt font size. Supplemental material may be appended to the report – however, the main body

of the report must stand on its own in terms of describing what was done, detailing the results, and drawing implications.

Information Sources Since cases focus upon the issues facing a real company at a critical juncture in its history, you may know the actions actually taken by the company as well as their consequences. However, we are interested in thinking about how the analytical tools presented in this class might have informed these decisions, not in the decisions per se. You must work from the information contained in the case, augmented by contemporaneous data (i.e., what the decision makers would have known at the time of their decision).

Focus You should answer the case questions with a coherent analysis based upon the content of this course. To emphasize: the primary purpose of the cases is to facilitate learning the material for this class, not to apply concepts learned elsewhere.

Originality Your case analyses are expected to be creative and original. You must not plagiarize others' work. Please review *The University of Toronto's Code of Behaviour on Academic Matters.*

Team vs Individual Grade All group members receive the same grade for their joint assignments. Rotman Commerce has extensive resources in place to support group work. Students should organize the groups up-front, with clarity on division of labor. If, for some reason, issues arise that threaten the smooth performance of assignments, students should proactively seek appropriate support.**

** ** For an appointment with a Rotman Commerce Team Coach, please contact Nikoleta Vlamis at nikoleta@nikoletaandassociates.com or Elaine Zapotoczny at elaine@nikoletaandassociates.com. Nikoleta and Elaine are highly skilled at facilitating team dynamics and collaboration. Note that the Team Coach's role is to provide guidance, support and advice on team matters – not to formally evaluate or assess teamwork for academic purposes.

Weekly Schedule

The following schedule should be considered aspirational – actual material covered may vary depending upon a variety of factors.

#	Date	Topic	Reading	Homework
1	Jan 7	Introduction	Ch. 1	1.1, 1.3-1.6
2	Jan 14	Qualitative causal models	Ch. 2 (pp. 1-31) Ch. 3	2.2, 2.8, 2.9
3	Jan 21	Quantitative causal models	Ch. 4	4.1, 4.2, 4.5-4.7, 4.10
4	Jan 28	Situational assessment (evidence-based reasoning)	Ch. 5	5.1, 5.3-5.6
5	Feb 4	Causal identification	Ch. 2 (pp. 31-39) Ch. 10 (pp. 224-35; through S. 10.2.1)	2.3-2.6 10.1, 10.3, 10.5
6	Feb 11	Unsupervised learning (learning models from data)		
7	Feb 25	MIDTERM		
8	Mar 4	Supervised learning (regression analog)		
9	Mar 11	Cluster analysis (data mining)		
10	Mar 18	Single-agent interventions I	Ch. 7	7.3-7.6, 7.9
11	Mar 25	Single-agent interventions II	Ch. 8	7.1, 7.2, 7.8, 7.11, 7.12
12	Apr 1	Multi-Agent interventions	Ch. 9	9.2, 9.4-9.6
	TBA by FAS	FINAL		

IMPORTANT Given the practical orientation of the course, I teach it in a "semi-flipped" format: most class sessions have a lecture in the first half and a causal modeling "lab" in the second. The lectures will touch upon key points under the assumption that you have read the required material in advance. The labs will mostly feature BayesiaLab exercises.

POLICY AND PROCEDURE

Missed Tests and Assignments (including midterm examinations)
Students who miss a test or assignment for reasons entirely beyond their control (e.g. illness) may submit a request for special consideration. Provided that notification and documentation are provided in a timely manner, and that the request is subsequently approved, no academic penalty will be applied.

In such cases, students must notify Rotman Commerce <u>on the date</u> of the missed test (or due date in the case of course work) and submit supporting documentation (e.g. <u>Verification of Student Illness or Injury form</u>) to the Rotman Commerce Program Office within **48 hours** of the originally scheduled test or due date. Students who do not provide Rotman Commerce or the instructor with appropriate or sufficient supporting documentation will be given a grade of 0 (zero) for the missed test or course deliverable.

Note that the physician's report must establish that the patient was examined and diagnosed at the time of illness, not after the fact. Rotman Commerce will not accept a statement that merely confirms a report of illness made by the student and documented by the physician.

Grade calculations with missed assessments. Assume the student has missed assessments the aggregate weight of which is x%. If 35% + x% is less than or equal to 80%, then the weight of the final will be adjusted to 35% + x%. If 35% + x% is greater than 80%, then the final will be weighted 80% and a make-up exam will be arranged and weighted 35% + x% - 80% (i.e., the difference versus the final's ceiling of 80%).

Late Assignments
Late submissions without special consideration will not be accepted and will be marked zero.

Accessibility Needs
The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible: disability.services@utoronto.ca or http://www.accessibility.utoronto.ca/.

Academic Integrity
Academic Integrity is a fundamental value essential to the pursuit of learning and scholarships at the University of Toronto. Participating honestly, respectively, responsibly, and fairly in this academic community ensures that the UofT degree that you earn will continue to be valued and respected as a true signifier of a student's individual work and academic achievement. As a result, the University treats cases of academic misconduct very seriously.

The University of Toronto's Code of Behaviour on Academic Matters
http://www.governingcouncil.utoronto.ca/policies/behaveac.htm outlines the behaviours that constitute academic misconduct, the process for addressing academic offences, and the penalties that may be imposed. You are expected to be familiar with the contents of this document. Potential offences include, but are not limited to:

In papers and assignments:
- Using someone else's ideas or words without appropriate acknowledgement.
- Submitting your own work in more than one course without the permission of the instructor.
- Making up sources or facts.

- Obtaining or providing unauthorized assistance on any assignment (this includes collaborating with others on assignments that are supposed to be completed individually).

On test and exams:
- Using or possessing any unauthorized aid, including a cell phone.
- Looking at someone else's answers
- Misrepresenting your identity.
- Submitting an altered test for re-grading.

Misrepresentation:
- Falsifying institutional documents or grades.
- Falsifying or altering any documentation required by the University, including (but not limited to), medical notes.

All suspected cases of academic dishonesty will be investigated by the following procedures outlined in the *Code of Behaviour on Academic Matters.* If you have any question about what is or is not permitted in the course, please do not hesitate to contact the course instructor. If you have any questions about appropriate research and citation methods, you are expected to seek out additional information from the instructor or other UofT resources such as College Writing Centres or the Academic Success Centre.

Email
At times, the course instructor may decide to communicate important course information by email. As such, all UofT students are required to have a valid UTmail+ email address. You are responsible for ensuring that your UTmail+ email address is set up AND properly entered on the ROSI system. For more information please visit http://help.ic.utoronto.ca/category/3/utmail.html

Forwarding your utoronto.ca email to a Hotmail, Gmail, Yahoo or other type of email account is not advisable. In some cases, messages from utoronto.ca addresses sent to Hotmail, Gmail or Yahoo accounts are filtered as junk mail, which means that important messages from your course instructor may end up in your spam or junk mail folder.

Blackboard and the Course Page
The online course page for this course is accessed through Blackboard. To access the course page, go to the UofT Portal login at https://portal.utoronto.ca/ and log in using your UTORid and password. Once you have logged in, look for the My Courses module where you'll find the link to all your course websites. If you don't see the course listed here but you are properly registered for the course in ROSI, wait 48 hours. If the course does not appear, go to the Information Commons Help Desk in Robarts Library, 1st floor, for help, or explore the Portal Information and Help at www.portalinfo.utoronto.ca/students and review the Frequently Asked Questions.

Recording Lectures
Lectures and course materials prepared by the instructor are considered by the University to be an instructor's intellectual property covered by the Canadian Copyright Act. Students wishing to record a lecture or other course material in any way are required to ask the instructor's explicit permission, and may not do so unless permission is granted (note: students who have been previously granted permission to record lectures as an accommodation for a disability are, of course, excepted). This includes tape recording, filming, photographing PowerPoint slides, Blackboard materials, etc.

If permission is granted by the instructor (or via Accessibility Services), it is intended for the individual student's own study purposes and does not include permission to "publish" them in anyway. It is absolutely forbidden for a student to publish an instructor's notes to a website or sell them in any other form without formal permission.