

ISQS 7339: Optimization and Simulation (Prescriptive Analytics)

Syllabus - Online Section

Instructor

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Description and Background of Course

The relatively new area of prescriptive analytics enables users to "prescribe" various possible actions to and guide them towards a solution for different business problems. In summary, these analytics are all about giving practical advice. Prescriptive analytics often takes advantage of optimization and simulation methods while attempting to measure the consequence of future decisions to recommend possible outcomes before the execution of potential scenarios. In an ideal situation, prescriptive analytics predicts not only what will occur, but also why it will occur to accommodate recommendations regarding actions that will take advantage of the predictions.

Prerequisite

Basic knowledge about R, Python, Algebra, Probability, and Statistics.

Learning Outcomes

After taking this course, students will be able to:

1. Develop optimization decision models for business problems, using Python
 - Assessed by Homework 1 and Quiz 1
2. Develop Monte-Carlo simulation for risk analysis, using R
 - Assessed by Homework 2 and Quiz 2
3. Develop discrete-event simulation models for queuing systems, using R
 - Assessed by Homework 3 and Quiz 3

Textbook

There is no required textbook for this course. All assigned readings will be available online. For students who wish to do further reading, the following offer relevant materials to this course:

- Hillier, F. S. Lieberman G. J. Introduction to Operations Research (10th ed.). Mc Graw Hill Education (ISBN: 978-0-07-352345-3)
- Ragsdale, C. T. (2015). Spreadsheet modeling & decision analysis: A practical introduction to business analytics (7th ed.). Stamford, CT: Cengage Learning. (ISBN-10: 1-285-41868-9; ISBN-13: 978-1-285-41868-1)
- Templ, M. Simulation for Data Science with R, Packt (Open Source)

Course Structure

Module 1- Linear Optimization

Linear optimization is an area of mathematics that deals with determining optimal values or solutions that can be formulated with linear equations and inequalities. This process involves finding the minimal or maximal values, given some conditions, or constraints. In this class, we cover the following contents:

- Introduction to linear programming (LP)
- Solving LP by Simplex method
- Sensitivity analysis in LP
- Introduction to integer programming (IP): The branch and bound method
- BIP, IP, and MIP Application

Module 2- Monte Carlo Simulation

Monte Carlo simulation is the process of generating random values for uncertain inputs in a model, computing the output variables of interest, and repeating this process for many trials to understand the distribution of the output results. In this class, we cover the following contents:

- Introduction to Monte-Carlo simulation
- Random number generation and input analysis
- The business application of Monte-Carlo simulation
- Resampling methods (bootstrapping)
- Markov Chain Monte-Carlo

Module 3- Discrete Event Simulation

Discrete event simulation (DES) is a method of simulating the behavior and performance of a real-life process, facility, or system, including servers and queues. In this class, we cover the following contents:

- Introduction to discrete event simulation
- Introduction to simulation in R Simmer
- Modeling service operations
- Analyzing simulation outputs

Assessment and Grading

Assignment	Percentage
Homework	40%
Quiz	45%
Group Application	15%

Grades are calculated based on the following. [97%, 100%] A+, [93%, 97%) A, [90%, 93%) A-, [87%, 90%) B+, [83%, 87%) B, [80%, 83%) B-, [70%, 80%) C, [60%, 70%) D, and [00%, 60%) F. Please do NOT count on rounding to move you from a lower grade category to a higher one!

Academic Misconduct in ISQS-7339

Academic misconduct is defined pervasively as including, but not limited to, cheating on examinations or assignments; plagiarizing, which means misleading as your work any part of work performed by another person; working with another student on an assignment in which that assignment is designated as an individual assignment; interfering with another student's work, and any other misrepresentation of your work.

Plagiarism, cheating, etc. include any misrepresentation of your work. You are expected to provide your own responses from your own brain for all class assignments. If you copy material from the internet and misrepresent it as your own, that is plagiarism. If you copy answers to homework or exams from the internet or another student or an article or a textbook, that is cheating. All answers from all students on written work are submitted to iThenticate. iThenticate identifies about 99% of plagiarized and copied material. Please do your own work.

Please note that academic misconduct is a serious offense and will be handled by the appropriate authorities in the department, the college, and the university. If a student is determined to be guilty of cheating or plagiarism, the final letter-grade for that student might be reduced to F.

Homework

There will be three large homework assignments throughout the semester. Homeworks provide students an opportunity to practice the skills and techniques covered in lectures and to demonstrate their grasp of related concepts and terminology. Late homework can receive only partial credit, and never a higher score than anyone who submitted on time. Students are not allowed to share their write-up with other students. Any evidence of academic misconduct will be reported to the Office of Student Conduct, and if a student is determined to be guilty of cheating or plagiarism, the final letter-grade for that student might be reduced to F.

Quiz

There will be three quizzes throughout the semester. These quizzes contain short answer or multiple-choice questions and focus mainly on the concepts, definitions, coding notations, and the interpretation of outputs. Students are not allowed to share questions and answers with other students. Any evidence of academic misconduct will be reported to the Office of Student Conduct, and if a student is

determined to be guilty of cheating or plagiarism, the final letter-grade for that student might be reduced to F.

Group Application

Students have an opportunity to work on a set of problems as a group. The students' attempts will be graded based on their participation in the discussion and the quality and correctness of the final submission. Groups are not allowed to share their solution with other groups. Any evidence of academic misconduct will be reported to the Office of Student Conduct, and if a student (or group) is determined to be guilty of cheating or plagiarism, the final letter-grade for the student or group might be reduced to F.

How to Succeed in this Course

If you want to be a successful student:

- Be self-motivated and self-disciplined.
- Be willing to "ask questions" if problems arise. The discussion board will be a great platform to ask your questions like you are sitting in the class. I will actively check the discussion board and respond to your concerns.
- Be willing and able to commit to 8 to 24 hours per week for this course.
- Take notes while watching videos.
- Be curious to understand all coding syntaxes. The best place to ask questions is the discussion board.
- Be able to write codes and apply analysis after watching demonstration videos or reading independently.
- Be able to communicate through writing.
- Accept critical thinking and decision making as part of the learning process.

In contrast, here are some common behaviors that lead to failing the course.

- Don't watch videos before starting to work on assignments.
- Wait until the last day to begin assignments.
- Forget about deadlines.
- Ignore blackboard announcements, emails from the instructor and/or your peers regarding course activities.
- Ignore discussion board posts.
- Don't get familiar with the grade book and syllabus.

Netiquette

Your instructor and fellow students wish to foster a safe online learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea, but you are not to attack an individual. Our differences, some of which are outlined in the university's nondiscrimination statement below, will add richness to this learning experience. Please consider that

sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a pleasant and respectful course ambiance. Please read the Netiquette rules for this course:

- Do not dominate any discussion. Allow other students to join in the discussion.
- Do not use offensive language.
- Present ideas appropriately.
- Be cautious in using the Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language. This could lead to misinterpretation.
- Keep an "open-mind" and be willing to express even your minority opinion.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.

Grade and Course Communication: Blackboard

Course announcements, syllabus, handouts, supplemental readings, handouts, and grades are made available through Blackboard and via TTU email. All students are required to regularly check the class Blackboard space for announcements. Blackboard is also used to submit classwork.

Academic Integrity / Dishonesty (Operating Procedure 34. 12)

Operating Procedure 34.12 states: Academic integrity is taking responsibility for one's own class and/or course work, being individually accountable, and demonstrating intellectual honesty and ethical behavior. Academic integrity is a personal choice to abide by the standards of intellectual honesty and responsibility. Because education is a shared effort to achieve learning through the exchange of ideas, students, faculty, and staff have the collective responsibility to build mutual trust and respect. Ethical behavior and independent thought are essential for the highest level of academic achievement, which then must be measured. Academic achievement includes scholarship, teaching, and learning, all of which are shared endeavors. Grades are a device used to quantify the successful accumulation of knowledge through learning. Adhering to the standards of academic integrity ensures grades are earned honestly. Academic integrity is the foundation upon which students, faculty, and staff build their educational and professional careers. Please also see [*Student Handbook and the Code of Student Conduct*](#). [Texas Tech University ("University") Quality Enhancement Plan, Academic Integrity Task Force, 2010].

The Master of Science in Data Science Program (MS-DS) at Texas Tech is committed to educating critical thinkers that are free of academic or professional dishonesty. All MS-DS students are upheld to the standard of having integrity in the work they produce. The standard rule is for all MSDS students to be responsible in an ethical and honest manner. Any instance of academic integrity violations as listed in the [*MS-DS Program Academic Integrity Policy*](#), including, but not limited to, cheating on examinations or assignments, plagiarism, collusion, and

misrepresenting facts will be taken seriously. All acts of academic misconduct will be reported and adjudicated as prescribed by the [MS-DS Program Academic Integrity Policy](#).

Students with Disabilities Policy (Operating Procedure 34.22)

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services in West Hall or call 806-742-2405.

Student Absence for Observance of Religious Holy Day Policy (Operating Procedure 34.19)

"Religious holy day" means a holy day observed by a religion whose places of worship are exempt from property taxation under Texas Tax Code §11.20.2. A student who intends to observe a religious holy day 4 should make that intention known in writing to the instructor prior to the absence. A student who is unable to submit assignments or complete scheduled quizzes due to the observance of a religious holy day shall be allowed to complete those within a reasonable time after the absence.

Disclaimer

This syllabus is subject to change.