G. BRINT RYAN
COLLEGE OF BUSINESS
Department of Information
Technology & Decision Sciences

ADAR 4020: Process Optimization and Prescriptive Analysis Syllabus

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Fall, 2026

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Office Hours: by appointment
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Class Hours: Tue-Thu 3:30 - 4:50 pm
Class Room: FRLD 458

Course Description

Introduction to prescriptive analysis and optimization techniques. As the corolary of the data analysis processes, prescriptive analytics provides the tools to support and recommend the best course of action available when addressing complex problems by using operations and project data.
Topics may include simulation techniques, sensitivity analysis, deterministic and stochastic modeling for operations research, linear programming, production frontiers and theory of constraints.

Prerequisites

Prerequisite(s): Statistics knowledge and data management, Inferential and Predictive analysis

Course Learning Outcomes

At the end of the course, you should:

1. Develop and apply prescriptive analysis to support decision-making by providing the best alternatives available that improve business or process outcomes.
2. Understand the robustness of an assessment using sensitivity analysis by determining how results are affected by changes in methods, models or assumptions.
3. Perform risk analysis techniques by generating simulations.
4. Understand what optimization and linear programming is.
5. Formulate and solve maximization linear programming problems.
6. Formulate and solve minimization linear programming problems.
7. Apply optimization techniques to solve non-linear programming models.

Required Courseware & Materials

In order to promote accessibility and affordability, all the textbooks referred here are not required to purchase. We will be using curated content and the following are an excellent source for studying.

- **Business Analytics: Communicating with Data** (with McGraw-Hill Connect) by S. Jaggia, A. Kelly, K. Lertwachara, and L. Chen. Published by McGraw-Hill.
- **Principles of Risk Analysis : Decision Making under Uncertainty** by Charles Yoe. Publisher: Taylor & Francis group.
- **Canvas** (https://unt.instructure.com/login/ldap): The lecture notes, quizzes, all of the exams and other material will be posted on Canvas so please make sure you keep up and check Canvas often.
- **Microsoft Excel**, installed in computer labs and available to download (Office 365) at https://aits.unt.edu/support/office365apps.
  IF YOU ARE LESS FAMILIAR WITH EXCEL:
  Any Excel Primer – Any Excel reference that covers basic excel functions material. Also, check Linkedin Learning (you have an account as a UNT student) for short courses on excel. Any youtube video about spreadsheet basics should work as well.
- **R Studio** a graphical user interface (GUI) for R. It can be downloaded at https://www.rstudio.com/products/rstudio/download/#download

Course General Guidelines

Brief notes about this course:

- This is an upper-level course. You will need to use software that allows you run different analytical models. Programming and spreadsheet modeling are key features of this course. I encourage you to practice and learn how to use programming languages such as R or VBA.
- This course will include challenging material; however, the tests and assignments are designed so that any of you who is willing to put in the time to attend class consistently, work extensively outside of class, use or develop good study strategies, and contact me when you are struggling, can develop a thorough understanding of the course material and ultimately succeed in the course.
- It is important to understand the different types of information we use to run simulations or linear programming models. Relationships among different pieces of information allow to organize and group lesson topics in meaningful and efficient ways.
- As for prescriptive analysis, it is key to understand the context of problem and the goals to be achieved. Simple models are frequently enough to run simulations or optimization problems but sometimes cannot reflect the whole story, and additional variables should be considered.

Guidelines

- I encourage you to **study** all the posted material in the course. You are strongly encouraged to try and solve the problems included in the lecture slides individually or in group. Replicate all the steps to solve the problems, not simply verify that the provided solutions "make sense".
- You should **work** independently or in groups on the assignments and case studies. The case studies are intended to assist you in better structuring the learning time you spend on mastering the course material. Exam questions will mostly refer to class lectures and assignments. The best way to prepare for exams is to go over the exercises seen in class or in homework/assignments.
- Therefore, **doing the assignments is essential for success in this course**. In fact, the assignments constitute a large portion of your grade in this course. You are encouraged to keep up with the homework and meet the submission deadlines.

Assessment

To demonstrate your ability and performance in Process Optimization & Prescriptive Analysis, you will be evaluated on a number of homework assignments, case studies, and exam questions. Rather than being purely numerical, assignments, case problems and exams will require interpretation and thorough analysis of the problems presented showing a clear understanding of the

topics and relationship with real-world applications.

You will be provided with varied material to assess four main learning areas:

- Reflective: based on videos, articles, books/chapters, or guest testimonials students should respond based on a set of either provoking questions or reflections with supporting statements.
- Case analysis: a real world examples of the issues or concepts seen in class, students are asked to analyze problems and research, test and present potential solutions preferably coming from Semester projects.
- Examination: standard formal tests
- Discussions: exchange of ideas on every class meeting will take place, discussion forums are opened electronically and brought to class discussion.

Grading Structure

1 Midterm	160 pts
1 Final exam (cumulative)	160 pts
8 Assignments	480 pts (60 points each)
2 Case Studies	200 pts (100 points each)
TOTAL	**1,000 points**
attendance	Required to be eligible for passing grade: maximum 3 absences allowed 20 pts for perfect attendance
extra-credit	2.5 pts for assignment completed on time 5 pts for completing syllabus quiz *tbd* pts for SPOT evaluation

- **Exams**: The midterm and the final exams will be available on Canvas. For each exam you will be given the full class time to respond it. Both exams are in-class. You should be ready to take the timed exam at class time. The Final Exam is comprehensive.
- **Assignments**: There are 8 assignments that need to be completed throughout the course. Assignments will be posted on Canvas. The due dates for the problem sets are listed on this syllabus. These form a significant part of the course grade and must be completed by the due date to receive full credit as well as bonus points (2.5 extra credit points per assignment). Late submissions still receive full credit, provided they are completed by the end of day on December 11th, 2026; however, no bonus points are earned. No credit is awarded for any assignment completed after this date.
- **Case Study**: The purpose of the case studies is to introduce a real issue, analyze it and work on possible solutions and make recommendations using prescriptive analytics. In the

first case, you will be required to find a real-world issue, preferably from your semester project, analyze it with the tools seen in the course and develop a report according to industry standards by communicating insights gained from a non-technical standpoint. In the second case, you will be required to make a short presentation of your findings and support your recommendations. The initial dates for submitting reports (Case 1) and make the presentation (Case 2) are posted in this syllabus. These are an important part of the course grade. The due dates can change throughout the course, please check regularly Canvas for any changes in date submissions.

- **Letter Grades**: If you achieve the following thresholds, you are guaranteed to receive the letter grade listed next to them:

$$\geq 900 \rightarrow \text{A}$$
$$\geq 800 \rightarrow \text{B}$$
$$\geq 700 \rightarrow \text{C}$$
$$\geq 600 \rightarrow \text{D}$$
$$< 600 \rightarrow \text{F}$$

- **Extra Credit**: There are some opportunities for you to earn extra credit to push your grade to the next grade letter:

  Attendance.- If you attend all sessions during the semester you will be entitled up to 20 points on top of your final grade. However, if you have more than three absences without justification you will not have access to your final grade and will have a non-passing grade.

  Assignment submission.- Each assignment that you finish on time (according to the due dates posted in this syllabus) earns you 2.5 extra credit points. That means a student who finishes all problem sets on time will receive 20 points in addition to the 480 points for the assignments.

  Syllabus quiz.- Since this is the main document this course is using to pursue the learning outcomes, it is critical that you read it thoroughly and understand each item on it. You can respond a quiz related to the content of this syllabus and earn 5 extra-credit points. The due date is posted in the syllabus as well, but it has to be completed on the first week of the course.

  SPOT evaluation.- I will give ec points for those who respond the course evaluation at the end of the semester. You will have to send me proof of your submission to get access to this extra-credit points.

  These extra credit points are added to your total but the maximum score is still out of 1,000 points.

University and School Policies and my course learning mindset

- DIVERSITY & INCLUSION: As members of the UNT community, we have all made a commitment to be part of an institution that respects and values the identities of the students and employees with whom we interact. UNT does not tolerate identity-based discrimination, harassment, and retaliation so we will work as a class to collaborate in ways that encourage inclusivity. Although disagreements and debates are encouraged, personal attacks are unacceptable. Together, we can ensure a safe and welcoming classroom for all.

- CAREGIVER RESPONSIBILITIES: I have great respect for students who are balancing their pursuit of education with the responsibilities of caring for children or other family members. If you run into challenges that require you to miss a class, or if your caregiving responsibilities are interfering with your ability to engage in learning, please contact me. There may be some instances of flexibility we can offer to support your learning.

- STAY INFORMED: Access regularly the course material posted on Canvas. If you feel that you are struggling with the material, please contact me.

- COMPLAINTS: I value the many perspectives students bring to our classroom. Please work with me to create a classroom culture of open communication, mutual respect, and inclusion. All discussions should be respectful and civil. If you ever feel like this is not the case, please stop by my office and let me know. We are all learning together.If you wish to register a complaint, you should first discuss your complaint with me. If you wish to carry it further, contact the program director and then other instances in the College, but only after first discussing it with your instructor.

- EXAMS: Even though exams are stressing, you are perfectly capable of solve them successfully. If you are under extenuating circumstances please reach out to me as soon as possible to receive support. I normally require written requests to fulfill UNT regulations. We can then discuss alternative arrangements.

- LEARNING SUPPORT: I'm here for you. My aim is to facilitate your learning process. Please do not hesitate to ask questions to me, (the professor, Dr. Palao). I will answer to your questions as quick as possible if you email me. Sometimes, similar questions may be raised by some of you, so in those cases I will post an announcement in Canvas to make sure everyone has the information. So, when you ask a generic question, others can benefit from your question. Since we do meet in person in-class questions are critical, because questions are automatically available to everyone in the classroom.

- WITHDRAWING / DROPPING THE COURSE: Keep in mind that if you are considering to withdraw the class, make sure you received all the possible support before. If you still feel necessary to do so, please check the academic calendar for properly withdraw before the scheduled last drop day. If you stop attending class, you should execute the drop procedure since failure to do so will result in a grade of "F" which cannot be changed.

- ACADEMIC INTEGRITY: This course adheres to the UNT policy on academic integrity. The policy can be found at https://vpaa.unt.edu/fs/resources/academic/integrity. Remember that if you engage in academic dishonesty you will receive a failing grade on the

test or assignment, or a failing grade in the course. In addition, the case may be reported to the UNT Dean of Students/Academic Integrity Office, which maintains a database of related violations.
Students are expected to read https://policy.unt.edu/policy/06-003 UNT's Student Standards of Academic Integrity with defines academic dishonesty and sets out the consequences of unethical behavior.

- STUDENTS WITH DISABILITIES: The New College complies with the Americans with Disabilities Act (ADA) in making reasonable accommodations for qualified students with disability. If you have an established disability you should register with the Office for Disability Accommodation (ODA) and receive further instructions. Please see contact me as soon as possible if you have any questions.
- DEADLINES: Dates of drop deadlines, final exams, etc., are published in the university catalog and the schedule of classes. Please be sure you keep informed about these dates.
- SPOT: The Student Perceptions of Teaching (SPOT) is a requirement for all organized classes at UNT. This short Web-based survey will be made available to you at the end of the semester/session, providing you a chance to comment on how this class is taught. I am very interested in the feedback I get from students, as I work to continually improve my teaching. I consider SPOT to be an important part of your participation in this class.
- INCOMPLETE GRADE (I): The grade of "I" is not given except for rare and very unusual emergencies, as per University guidelines. An "I" grade cannot be used to substitute your poor performance in class. Do not let that happen and contact me as soon as possible!
- CAMPUS CLOSING: In the event of an official campus closing, please check your UNT e-mail for instructions on how to turn in assignments, how the due dates are modified, etc.

Schedule and weekly learning goals

The description and timelines contained in the syllabus are subject to change at Professor's discretion based on the group learning's pace or other events that may impact the current schedule.

It is meant to be a guide and several items are subject to change. Exams may be moved in time & will be announced. I STRONGLY recommend that you adhere to the schedule below. This way, you should progress at a reasonable, sustainable pace. You will also be able to keep up with the Homework deadlines and Quiz and Exam dates.

Schedule and weekly learning goals

Main Topic	Week	Dates	Sub Topics	Dues Assignments, Cases, & Exams
Predictive Analytics	Week 1	18 Aug	Course Intro-Syllabus **L.0** LPM and Logistic Regression	Read thoroughly the syllabus
		20 Aug	**L.0** Odds and Accuracy Rate	**Syllabus quiz** **Assignment 1** Part 1 (23 Aug)
Course Overview	Week 2	25 Aug	**L.1** What is Prescriptive Analytics?	**Assignment 1** Part 2 (27 Aug)
		27 Aug	**L.2** Risk Analysis Principles Core Subjects, Types of Risk Analysis	**Assignment 1** Part 3 (30 Aug)
Risk Analysis & Simulation	Week 3	1 Sept	**L.3** Qualitative Risk Analysis: Qualitative Risk Assessment QRA Methodologies	**Assignment 2** (3 Sept)
		3 Sept	**L.3** Qualitative Risk Analysis: L.3.1 - Brainstorming	**Assignment 3** (Part I) (6 Sept)
	Week 4	8 Sept	**L.3** Qualitative Risk Analysis: L.3.2 - Cause & Effect Analysis	Case Study 1 Instructions out!
		10 Sept	**L.3** Qualitative Risk Analysis: L.3.3 Bow-Tie Analysis	**Assignment 3** (Part II) (13 Sept)
	Week 5	15 Sept	**L.3** Qualitative Risk Analysis: L.3.4 Risk Matrix	
		17 Sept	**L.4** Quantitative Risk Analysis: L.4.1 Empirical Probability Distributions	**Assignment 3** (Part III) (20 Sept)

Schedule and weekly learning goals *(cont.)*

Main Topic	Week	Dates	Topics & Sub Topics	Dues Assignments & Cases
Risk Analysis & Simulation	Week 6	22 Sept	**L.4** Quantitative Risk Analysis: L.4.2 Triangular Distribution Random Variables - Uncertainty	
		24 Sept	**L.4** Quantitative Risk Analysis: L.4.3 Observations generation Continuous/Discrete Cases	**Assignment 4** (27 Sept)
	Week 7	29 Sept	**L.5** Montecarlo Simulation L.5.1 Model formulation & random number generation	
		1 Oct	**L.5** Montecarlo Simulation L.5.2 Performing analysis Result interpretation	**Assignment 5** (4 Oct)
	Week 8	6 Oct	Review Class	**Case 1 Report** (6 Oct))
		8 Oct	**MIDTERM** (In person during class time)	
Optimization & Linear Programming	Week 9	13 Oct	**L.6** Optimization & Linear Programming Overview	
		15 Oct	**L.6** Optimization & LP L.6.1 What is optimization?	
	Week 10	20 Oct	**L.6** Optimization & LP L.6.2 Linear programming principles	
		22 Oct	**L.7** Maximization in LP L.7.1 Solving Maximization problem	Case Study 2 Instructions out!
	Week 11	27 Oct	**L.7** Maximization in LP L.7.2 Slack, Surplus, Binding & Non-binding constraints	
		29 Oct	**L.7** Maximization in LP L.7.3 Sensitivity in LP solutions	**Assignment 6** (1 Nov)

Schedule and weekly learning goals *(cont.)*

Main Topic	Week	Dates	Topics & Sub Topics	Dues Assignments & Cases
Optimization & Linear Programming	Week 12	3 Nov	Practice	
		5 Nov	**L.8** Minimization in LP L.8.1 Solving Minimization Problem	
	Week 13	10 Nov	**L.8** Minimization in LP L.8.2 Sensitivity in minimization	
		12 Nov	Practice	**Assignment 7** (15 Nov)
	Week 14	17 Nov	**L.9** Special Cases in LP L.9.1 Multiple optimal solutions	
		19 Nov	**L.9** Special Cases in LP L.9.2 Infeasibility & Unboundedness	**Assignment 8** (22 Nov)
Wrapping Up	Week 15	**NO CLASS!** Happy Thanksgiving! *(prepare your final project presentation!)*		
	Week 16	1 Dec	**Case 2 Presentations**	
		3 Dec	**Case 2 Presentations**	**Case 2 Report** (6 Dec)
	Week 17	8 Dec	**FINAL EXAM** (During class time)	