

January 2026 Executive Electives

Prescriptive AI: the edge of optimization

Instructor

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Office hours: by appointment

Meeting times.

8:30-11:30 am and 1:00-4:00 pm on Wednesday-Thursday, January 7-8, 2026.

Faculty bio.

Alexandre Jacquillat is the Maurice F. Strong Career Development Associate Professor and an Associate Professor of Operations Research and Statistics at the MIT Sloan School of Management. His research develops scalable prescriptive algorithms for large-scale optimization, discrete optimization, optimization under uncertainty and machine learning. He has worked extensively in air transportation, urban mobility, middle-mile logistics, responsible supply chains, and other social good operations. Alexandre is the recipient of over ten research awards including, most recently, the INFORMS-wide Donald P. Gaver, Jr. Early Career Award for Excellence in Operations Research. He also received several teaching awards, including the MIT Jamieson Prize for Excellence in Teaching—the most prestigious teaching award at the Sloan School of Management. Prior to joining the MIT Faculty, he received a Master of Science in Applied Mathematics from the Ecole Polytechnique and PhD in Engineering from MIT, and taught at Carnegie Mellon University.

Course contents.

Modern organizations increasingly rely on prescriptive AI—the decision-making layer in AI that turns data into actionable recommendations and measurable impact. At the heart of prescriptive AI, optimization methods provide the mathematical and computational engine for intelligent decision-making. Thanks to recent breakthroughs in optimization algorithms and computing power, large-scale problems can now be routinely solved in practice. These advances have powered decision support systems that have transformed industries from manufacturing and logistics to pricing, energy, finance, healthcare, and sports.

This course offers a hands-on introduction to optimization technologies that drive today's advanced analytics, AI systems and business decision-making. Through real-world case studies, this course will develop optimization solutions to complex, large-scale, and often ill-defined decision-making problems arising in business and policy. Emphasis will be placed on modeling decisions correctly and effectively, understanding the technical distinction between “easy” and “hard” problems, and building the right model to maximize organizational impact. Discussions will also examine how to define model boundaries, evaluate trade-offs, and foster effective collaboration between data science teams and business leaders.

This course prepares participants to lead or participate in prescriptive-AI initiatives. It will build the fluency to communicate with technical teams on optimization projects, interpret and communicate optimization outputs in managerial contexts, and identify high-impact optimization opportunities within organizations. Specifically, the learning objectives are:

- *Modeling*: Translate complex, real-world decision problems into well-structured, data-driven optimization formulations.
- *Methods*: Understand the capabilities and limitations of modern optimization solvers, distinguishing between easily solvable and computationally challenging problems.
- *Implementation*: Run computational code using state-of-the-art solvers to see optimization technologies in action with large-scale datasets.
- *Analysis*: Evaluate the edge of optimization against benchmarks, and assess the sensitivities and trade-offs inherent in quantitative decision models.
- *Communication*: Present optimization insights effectively across business and technical audiences, bridging analytical depth with managerial relevance.

Course at a glance.

Lec.	Date	Module	Case study
1	09/04	Introduction	Decarbonization in production planning
2	09/09	Linear optimization	Network revenue management in airline operations
3	09/11	Linear optimization	The analytics of digital platforms
4	09/16	Linear optimization	Humanitarian logistics operations
5	09/18	Integer optimization	Planning a vaccination campaign
6	09/23	Integer optimization	Public school buses: design and operations
7	09/25	Optimization under uncertainty	Power systems planning
8	09/30	Optimization under uncertainty	Data center operations

Readings.

These case studies will be based on real-world examples. Readings will be made available ahead of time to familiarize yourselves with the context and the methods for some of them. For each reading, attention should be placed on the problem description, the quantitative approach, the results, and the impact. Mathematical details, if any, can easily be skipped for the purpose of this course. Specific readings will include the following references. They will be made available on Canvas ahead of time and will be discussed in class.

Lectures 3 and 8: Azagirre, X., Balwally, A., Candeli, G., Chamandy, N., Han, B., King, A., Lee, H., Loncaric, M., Martin, S., Narasiman, V., et al. (2024). A better match for drivers and riders: Reinforcement learning at Lyft. *INFORMS Journal on Applied Analytics*, 54(1):71–83

Lecture 4: Peters, K., Silva, S., Gonçalves, R., Kavelj, M., Fleuren, H., Den Hertog, D., Ergun, O., and Freeman, M. (2021). The nutritious supply chain: optimizing humanitarian food assistance. *INFORMS Journal on Optimization*, 3(2):200–226

Lecture 5: Bertsimas, D., Digalakis Jr, V., Jacquillat, A., Li, M. L., and Previero, A. (2022). Where to locate COVID-19 mass vaccination facilities? *Naval Research Logistics (NRL)*, 69(2):179–200

Lecture 6: Holland, C., Levis, J., Nuggehalli, R., Santilli, B., and Winters, J. (2017). UPS optimizes delivery routes. *Interfaces*, 47(1):8–23

Lecture 6: Bertsimas, D., Delarue, A., Eger, W., Hanlon, J., and Martin, S. (2020). Bus routing optimization helps Boston public schools design better policies. *INFORMS Journal on Applied Analytics*, 50(1):37–49

Prerequisites.

Data, Models and Decisions, or a similar course in data science that introduces the key methodologies to turn data into decisions. This course will place optimization methodologies within the broader data science landscape, so basic knowledge of statistics and machine learning will be useful. The focus of the course will be on strategic understanding of optimization methodologies rather than on their mathematical formalism. Basic competency in algebra and computational programming will be helpful but is not required; we will also leverage Large Language Models to support the more technical components of the course. If you are concerned about your background, please contact the instructor.

Related subjects.

The Analytics Edge, which covers predictive AI applications based on machine learning. This course, in contrast, covers prescriptive AI applications using optimization.

Class participation and conduct.

This course will be structured around lecture materials and in-class discussions. You are expected to take an active learning role in this course by addressing the questions raised by case studies, interpreting and critiquing optimization solutions, and bringing examples from your domains of expertise. In-class time will alternate between lectures and dialogues among participants. There is often no single right way to formulate an optimization model, and the course will benefit from all participants' willingness to take risks in bringing ideas to the table and building upon others' contributions.

The course will follow the Sloan policies and norms, posted on Canvas.

Deliverables.

- Due on Tuesday, January 6: Warm-up exercise. We will introduce the first case using a small-scale spreadsheet example. You will be given instructions to solve it, evaluate its solution, interpret its solution, and derive insights from sensitivity analyses.
- Due on Wednesday, January 7: One-page proposal. You will identify a complex decision-making challenge within an organization that you are familiar with, and propose how you might address this challenge. The deliverable should be directed to the organization's leadership, and should be framed accordingly. It should describe the problem, propose a data-driven methodological approach, convey expected results and outcomes, and outline an engagement plan including personnel and time commitment.
- Due on Thursday, January 22: final project. In the project, you will apply optimization methods either to a problem faced by an organization that you are familiar with, or to a problem that will be provided. You will work in self-formed teams. If you choose to work on your own problem, your team will be responsible for defining the problem, gathering relevant data, formulating an optimization problem, implementing it to derive a solution, reporting computational results, evaluating the benefits of optimization, and communicating recommendations to a decision-maker. Similar steps will be followed for the problem that will be provided. This project aims to reinforce technical skills (e.g., modeling, data-driven implementation) and managerial skills (e.g., teamwork, technical communication of technical results). Details will be given in class.

Use of generative AI technologies

In this course, we will leverage two AI tools:

- An AI assistant that can answer questions about the course contents.
- An AI tutor that can provide problem-solving guidance.

In addition, we will learn how to leverage off-the-shelf large language models to formulate and implement optimization models, which can be used in the project and beyond this course.

You are encouraged to use them throughout the semester and to provide feedback. We also encourage you to think critically about their answers and to definitely not trust them blindly. It is your responsibility to assess the quality of your deliverables.

Special needs

I encourage you to let me know about any concern or any need that you may have during the course. I will be happy to discuss your specific needs privately and to work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability, I encourage you to contact the Student Disability Services at sds-all@mit.edu.