Predictive analytics and decision modeling are two key components of business analytics. They provide business entities and policy makers with the fundamental rationality in evaluating performance, making decisions, designing strategies, and managing risk. In ORF360, we will focus on decision modeling of business analytics and operations management.

The course will emphasize both popular decision models arising from real applications, as well as mathematical decision-making tools and concepts. The first half of the course introduces the basic decision models in revenue management, pricing, and inventory control. The second half of the course consists of a series of business themes, such as finance, energy, healthcare, and games, and focuses on data-driven real-world applications.

Teaching Assistants
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Assignments
Six weekly problem sets (problem solving and/or Matlab programming)

Midterm (TBD)

Final Project (TBD)

Grading
Assignments 35%; Midterm 30%; Final 30%; Misc 5%
ORF 350 - Decision Modeling in Business Analytics

Lecture 1 – Introduction

Lecture 2 – Basics of Revenue Management
  • Overview of revenue management
  • Case study: Airline pricing
  • Demand functions

Lecture 3 – Basic Pricing Model I
  • Solving the basic pricing model, pricing model with capacity constraints
  • Consumer segmentation, consumer surplus, consumer welfare

Lecture 4 – Basic Pricing Model II
  • Two-class pricing model, multiple-class pricing model

Lecture 5 – Exploiting Price Discrimination Against Time
  • Understanding airline fare classes
  • Single resource capacity control problem

Lecture 6 – An Important Tool: Dynamic Programming
  • Dynamic arrival model for customers
  • Introduction to Dynamic Programming

Lecture 7 – Dynamic Pricing Models I
  • Understanding the price trajectory
  • Mark up/down
  • Solving dynamic pricing using dynamic programming

Lecture 8 – Dynamic Pricing Models II

Lecture 9 – Network planning in Airline Management
  • Network capacity control
  • Airline scheduling, smart flight cancellation

Lecture 10 – Network Capacity Control
  • Connection between DP and LP
  • Approximate DP via linear parametric model

Lecture 11 – Consumer Choice Models
  • Effects of reference price

Lecture 12 – Consumer Choice Models and Midterm Review
  • Types of consumers
  • Network effect
------------- Spring Break -------------

Midterm (Tentative)

Lecture 13 – Demand Learning
  •  Parametric vs. Nonparametric

Lecture 14 – Demand Learning and Energy Applications

Lecture 15 – Energy Applications
  •  Nuclear Power Planning by DOE
  •  Risk-averse dynamic programming

Lecture 16 – Workforce Analytics
  •  Talent retention
  •  Prediction of volunteer resign

Lecture 17 – Finance Applications: Automated Trading
  •  Learning from the order book
  •  Markov Chain Estimation

Lecture 18 – Finance Applications: Credit Card and Micro-Loans
  •  Predicting the default rate
  •  Decision with risk concern

Lecture 19 – Healthcare Applications (Tentative)

Lecture 20 – Misc Topics (Tentative)
  •  Google ads problem
  •  Amazon recommendations
  •  Hotel Booking Analytics

Lecture 21 – Mathematics in Games
  •  Nash equilibrium, optimal bluffing frequency in poker
  •  Player analytics and exploitive play
  •  Pokerbots via approximate DP
  •  Risk-free market making in sports betting
  •  Sport modeling

Lecture 22, 23 – Final Presentations and Summary