

Business Analytics Using Simulation

Instructor: Ping-Han Huang

Course Description:

In many business settings, decisions are made before outcomes are known, and their consequences unfold over time through systems that are only partially understood. This course studies how managerial decisions perform once they meet the realities of markets and operating systems. The course is organized into two modules: marketing and supply chain. In these two contexts, students examine how choices about demand creation, customer response, fulfillment, capacity, timing, and coordination generate outcomes that are often uncertain and delayed. Through case-based simulations, students step into decision-making roles, make choices under incomplete information, observe responses, and diagnose the mechanisms behind performance.

Learning Objectives:

By the end of this course, students will be able to:

- Frame managerial decisions under uncertainty.
- Use simulation and AI-assisted tools as decision-support aids.
- Diagnose performance outcomes.
- Evaluate the robustness of business decisions.
- Communicate recommendations with managerial judgment.

Prerequisites:

This course welcomes students from diverse academic and professional backgrounds. No prior programming experience is required. Familiarity with introductory statistics concepts such as probability, random variables, and basic regression is recommended.

Evaluations:

1. Entry and Exit Quizzes (20%)
2. Midterm Exam (30%)
3. Midterm Project Proposal (20%)
4. Final Project Presentation (30%)

Recommended Textbook:

Module 1:

- *Marketing Management (14th Edition)* by Kotler, P., Keller, K. L., Chernev, A.
- *Principles of Marketing Engineering and Analytics (3rd Edition)* by Lilien, G. L., Rangaswamy, A., De Bruyn, A.

Module 2:

- *Supply Chain Management: Strategy, planning and operation (6th Edition)* by Chopra, S.
- *Simulation modeling and analysis (5th Edition)* by Law, A. M.

Software:

The course will primarily use R for hands-on simulations, but students are welcome to use other programming languages such as Python.

AI Policy:

Students are permitted to use generative AI tools such as ChatGPT and Claude for brainstorming, simulation design, coding support, data interpretation, writing refinement, and presentation preparation. AI should be used strategically and critically, and students are expected to apply their own judgment when evaluating, revising, and integrating AI-generated outputs. When submitting course work, students should briefly specify how generative AI was used.

Tentative Schedule:

Week	Session Title	Core Concepts	Simulations/Case Studies
1	Course Introduction	<ul style="list-style-type: none"> • Course Structure • Simulation-Based Decision-Making • Incomplete Information • Uncertainty 	<ul style="list-style-type: none"> • Random Sampling • Campus Beverage Launch
2	Marketing Response	<ul style="list-style-type: none"> • Marketing Response • Budget Allocation • Diminishing Returns 	<ul style="list-style-type: none"> • Monte Carlo Response Analysis • Coca-Cola Campaign Allocation
3	Customer Lifetime Value	<ul style="list-style-type: none"> • Customer Lifetime Value • Acquisition Cost • Churn and Retention • Short-Term vs Long-Term Profitability 	<ul style="list-style-type: none"> • Customer Retention Modeling • Netflix Membership Acquisition Portfolio
4	Segmentation	<ul style="list-style-type: none"> • Segmentation • Targeting • Strategic Focus • Customer Heterogeneity 	<ul style="list-style-type: none"> • Stratified Market Response Analysis • Nike Digital Campaign Targeting
5	Conjoint Analysis	<ul style="list-style-type: none"> • Product Design • Positioning • Conjoint Analysis • Attribute Trade-Offs 	<ul style="list-style-type: none"> • Choice-Based Market Modeling • Apple Product Design Trade-Off
6	A/B Testing	<ul style="list-style-type: none"> • A/B Testing • Conversion Rate • Test vs Scale Decisions 	<ul style="list-style-type: none"> • A/B Testing • ShopEase Landing Page Experiment
7	Marketing Diagnosis	<ul style="list-style-type: none"> • Marketing Diagnosis • Model Limits • Fragile Assumptions 	<ul style="list-style-type: none"> • Bootstrap Resampling • Uber Eats Promotion Diagnosis
8	Midterm Exam		
9	Supply Chain Flows	<ul style="list-style-type: none"> • Inventory Balance • Stock vs Flow • Cost vs Responsiveness • Supply Chain Drivers 	<ul style="list-style-type: none"> • Inventory Dynamics Modeling • 7-Eleven Fresh Food Replenishment
10	Demand Forecasting	<ul style="list-style-type: none"> • Stochastic Demand • Forecasting Methods • Demand vs Forecast • Replenishment Decisions 	<ul style="list-style-type: none"> • Forecast Error Analysis • PX Mart Holiday Demand Forecasting
11	Inventory Delays	<ul style="list-style-type: none"> • Lead Time • Pipeline Inventory • Backlog and Stockouts • Delayed Feedback 	<ul style="list-style-type: none"> • System Dynamics Modeling • Gogoro Battery Replenishment
12	Sales and Operations Planning	<ul style="list-style-type: none"> • Sales and Operations Planning • Capacity Planning • Inventory Build-Up • Cross-Functional Coordination 	<ul style="list-style-type: none"> • Scenario Analysis • ASUS Gaming Laptop Holiday Launch
13	Supply Chain Resilience	<ul style="list-style-type: none"> • Demand Shocks • Lead Time Variability • Capacity Constraints • Resilience vs Efficiency 	<ul style="list-style-type: none"> • Robustness Analysis • Giant Bicycle Demand Shock
14	Bullwhip Effect	<ul style="list-style-type: none"> • Bullwhip Effect • Demand Amplification • Coordination Failure • System-Wide Instability 	<ul style="list-style-type: none"> • Multi-Stage System Dynamics • Beer Game Simulation
15	Capacity Allocation	<ul style="list-style-type: none"> • Cross-Functional Misalignment • Model Limitations • Managerial Judgment 	<ul style="list-style-type: none"> • Capacity Allocation Optimization • Moon Festival Gift Capacity Allocation
16	Final Project Presentations		