Management 57300: Optimization modeling with spreadsheets
Spring 2025

Course Policies

Location/Time: RAWLS 4082, MW 1:10pm - 2:40pm, 01/13/2025 - 03/02/2025
Instructor: Prof. Alex L. Wang
Office: Kran 463
Office Hours: Fridays 11:30-12:30, 1-2:50 in RAWLS 4082
Contact Info: wang5984@purdue.edu

Course Website: Brightspace

Introduction

Companies are nowadays competing using analytical tools and gaining competitive advantage by optimizing business processes. These problems include identifying the optimal customer segment to serve, investing in the optimal mix of projects, identifying inefficiencies in operations, streamlining transportation, and planning ahead for uncertainties in demands and yields. Organizations are acquiring information at a rapid pace and are recognizing it as an asset. They seek better management of data and to use it to inform decisions. The effective use of information requires ability to gather, sort through relevant parts, and to link it to business objectives. It is expected that companies will increase focus on pricing, bundling, reputation management, market selection, logistics management, budgeting, customer segmentation in the next few years and many, if not all, functions depend heavily on optimization abilities. The overarching goal is to realize business objectives faster with more operational efficiency and managed risk.

Course Objectives

The course emphasizes applications of optimization through cases and computer exercises. The applications are chosen to provide insights into business and economics. Areas covered include linear, network, integer, and nonlinear optimization. At the end of the course, you should have

- the ability to model optimization problems
- ability to work with software to solve optimization problems
- relate to optimization theory in a variety of application settings
- develop optimization insights into applications in marketing, finance, and operations

Methods of Instruction

The course is taught using lectures, case analysis, class discussions, interactive problem-solving, and computer exercises/demonstrations. Case analyses provide opportunities for the creative application of optimization techniques to unstructured management problems and serve to illustrate the applications of optimization in managerial decision-making. Computer exercises provide familiarity with optimization software.

Textbook and course materials

Baker, K. R., Optimization Modeling with Spreadsheets, 3rd edition, Wiley 2015, Available electronically at Purdue University Libraries

- Either 2nd or 3rd edition is fine.
- For access outside Purdue, you will need to login through the library.
- Case packet and lecture notes posted on Brightspace.

Software possibilities

- Excel add-on Analytic Solver Basic (Discussions will primarily focus on this environment)
    - Analytic Solver is installed in RAWLS 4082
    - If you prefer to have the software on your machine (only available on Windows), please see the attached installation instructions.
      The course code is: **MGMT57300ALW25SP**
      The book code is: **LABBYOD**
- Alternatives: You may use the following alternatives if you feel comfortable, but there is no official course support for these alternatives.
    - Excel add-in OpenSolver (A free alternative; also compatible with Mac OSX)
    - Excel Solver Default (Comes with Excel, but does not link to robust engines)
    - Python with Gurobi (an advanced alternative that requires significant setup and programming)
    - Julia with Gurobi (an advanced alternative that requires significant setup and programming and provides solver options)

Your role in the course

Preparation. Each student is expected to be prepared for each class, to contribute to class discussions, and to complete all assigned readings and exercises. Lecture material will be posted on the course website. Students are expected to be aware of the announcements, events, and files posted on the course website. The class will be divided into several teams.

All assignments will be handed in as a team. Class and team-work is subject to the following rules:

- if a team member does not contribute, then their name should not appear on the assignments handed in, and they may do the entire assignment and hand it in separately;
- active participation in class discussions and teams is encouraged and is viewed as essential for clarifying difficult concepts. Thus, each team member will evaluate their team members at the end of the course. During classroom lectures in the traditional format, cell phones are not to be used and the use of laptops should be restricted to the course content in discussion. Disruptive use of personal property during class will be penalized by reducing the class participation grade.

Proficiency in optimization modeling can be attained only through extensive practice. It is recommended that students attempt the numerous exercises in the textbook on their own. **Case assignments and homeworks must be turned in by 10:00 am** on the specified due dates using course website.

Courseware: EXCEL files, lecture slides, and lecture recordings will be posted on course website. Students should read the corresponding sections in the book and the slides before and after lecture. It is also helpful to model the classroom exercises using computer software.

Homework: The homework assignment will be posted early (a week in advance) but it will be available for a fixed time once you start.

Course Honor Policy

We expect and encourage students to discuss readings, case materials, and the concepts covered by the course with one another. However, do not falsely represent someone else's work as if it were your own. Students are expected to prepare cases without the assistance or reference to students who have taken the class before, prior semester's class notes and the like. Teams are not allowed to cooperate with each other. In case of violation, the instructor reserves the right to award zero points on the exam/assignment to the individual/team, pursue further action, and/or refer the matter to the university for further action. Further, the use of Internet for finding solutions to cases and problems is prohibited. Specifically, students are expected to follow Purdue regulations governing student conduct (see http://www.purdue.edu/univregs/studentconduct/index.html).

While working individually and with your team members: Each team member is expected to understand, for each homework and case assignment, the reason for choosing a particular

technique, the mechanics of the solution procedure, and the implication(s) of the final solution(s) and recommendation(s).

Grading Policy/Rules

The following table lists the percentage of points allocated to each graded activity.

Case preparation (3) 45%
Class participation 5%
Team participation 10%
Homework 15%
Final examination 25%

Email Availability/Policies

I will be available via email daily, and try to respond as soon as possible (generally within 24-48 hours). When emailing me, please place MGMT 573 and the topic in the subject line. (e.g., MGMT 573 - Case 2 Question). This will help me tremendously in locating and responding to emails quickly.

Course Evaluation

During the last two weeks of the course, you will be provided with an opportunity to evaluate this course and your instructor. Purdue uses an online course evaluation system. You will receive an official email from evaluation administrators with a link to the online evaluation site. You will have up to two weeks to complete this evaluation. Your participation is an integral part of this course, and your feedback is vital to improving education at Purdue University. I strongly urge you to participate in the evaluation system.

Dealing with a Campus Emergency

In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. The changes will be posted on Announcements in Brightspace.

Tentative Course Outline

OMS refers to the textbook Optimization Modeling with Spreadsheets. Topics marked with an asterisk are not covered in OMS (use the PDF slides).

Students are expected to complete the readings listed under Class 0 *prior* to the first day of lecture.

Class	Date	Topic	Reading	Due
0	-	**Linear Programming** • Assumptions in Linear Programming • Feasibility, optimality, production frontier • Level curves • Special cases • Spreadsheet modeling of linear programs • Answer report • Binding/non-binding constraints	OMS § 1 Slides	
1	1/13	**Linear Programming** • Allocation problem • Introduction to Analytic Solver • Three-dimensional geometry • Parameter analysis • Sensitivity to change in unit profits • Sensitivity to right hand side	OMS § 2.1, 2.2, 2.5, 4.2 Slides	
2	1/15	**Linear Programming Duality** • Decreasing marginal utility • Shadow prices, reduced costs • Duality theory*	OMS § 4.4, 4.6.4 Slides	
-	1/20	**No Class: MLK Day**		
3	1/22	**Integer Programming** • Allocation with fixed-cost constraints • Comparison with relaxation	OMS § 6.1, 7.2 Slides	

4	1/27	**Transportation and network flow** • Transportation problem • Solution tree structure* • Integrality property* • Assignment problem • General network flow problem • Perfect matching* • Dual formulation*	OMS § 3, 4.1, 4.3, 4.5, 4.6 Slides	
5	1/29	**Lab session: Using Analytic Solver Platform** • Allocation Problem • Transportation Problem • Assingnment Problem • Perfect matching	Excel handout Slides	
6	2/3	**Matching and sponsored search** • Hall's Theorem and Constricted Sets* • Auction Strategy • Matching Markets • Sponsored Search Markets	Slides	Case 1
7	2/5	**Arbitrage and asset pricing*** • Arbitrage detection • Removing arbitrage • Duality and risk-neutral prices • Fundamental theorem of arbitrage • Asset pricing with binomial market • Asset pricing in incomplete market	Slides	
8	2/10	**Productivity/Efficiency Analysis**	OMS § 5.1-5.6	Case 2

		• Constant returns to scale • Variable returns to scale* • Efficient frontier • Data envelopment analysis • Multiple input/outputs with given relative weights • CRS efficiency and hypothetical comparison unit via LP • VRS efficiency and hypothetical comparison unit via LP*	Slides	
9	2/12	**Productivity planning with multiple sources** • Linearizing objective • Handling separability* • Minimizing piecewise linear convex functions • Alternate formulation*	OMS § 8.5 Slides	
10	2/17	**Stochastic programming** • Stochastic programming • Agricultural planning under weather uncertainty • Expected value of perfect information* • Value of stochastic solution*	OMS § 8.5 Slides	Case 3
11	2/19	**Nonlinear Optimization** • Marketing media selection • Cobb-Douglas functions and elasticity • Optimality conditions • Proportional allocation	OMS § 8.1-8.3 Slides	
12	2/24	**Portfolio Optimization** • Markowitz problem	OMS § 8.4 Slides	

		• Efficient frontier* • Shadow price and tangents* • Zero covariance portfolio and Two fund theorem* • Sharpe Ratio* • Risk-free asset*		
13	2/26	**Multiperiod production planning*** • Network structure • Fixed-cost constraints • Sensitivity to fixed-costs • Sensitivities to capacities	OMS § 6.8 Slides	Case 4 Homework
-	-	**Additional material that we may get to depending on time** • Financial planning: network structure • Node balance equations • Shadow prices, reduced costs, and net present value • Reduced cost and value of borrowing • Shadow price and reduced cost relationship • Tax considerations	OMS § 3.6, 4.6.3 Slides	
-	03/03	**Final exam 6-8pm, RAWLS 3058**		