Welcome to **BUSN 20510: Managerial Decision Modeling**!

We learn to model & analyze complex business problems in this course—No words can summarize our final goal better than *Pablo Picasso’s Bull painting (1945)*. Please read the syllabus *carefully* to see why.
Course Overview

Introduction: Modeling and decision making play catalytic roles in the modern business world, as managers are often forced to prioritize among feasible actions in complex situations; in such scenarios, making an informed quantitative decision based on a mathematical model—versus an educated guess by just looking at the complex problem—can drastically change the outcome and have an impact on the business. However, successful quantitative “decision modeling” requires the ability to structure complex problems, to analyze available options in an uncertain world, and to finally make the best decision given the information available.

In this course, we learn basic frameworks, methodologies, and analytical tools required for quantitative managerial decision making in a wide range of business areas. Our goal is learning the foundations and applying these tools to several managerial questions related to resource allocation, revenue management, marketing, risk analysis, and financial assessment. In short, (i) we build models to structure them using spreadsheets, (ii) we then analyze and solve them using the available Excel commands, tools and add-ins, and finally (iii) we study their economic interpretations. On our journey to achieve these goals, we learn how to “structure a decision problem” by identifying objectives, decision alternatives, input parameters, and sources of uncertainty. We then learn how to “build mathematical models to formalize decision problems” by applying analytical tools such as optimization, simulation, and decision trees.

Computer-based Model Building: We mainly use Microsoft Excel as a platform for model building, solution, and analysis. Good working knowledge of basic Excel functions will be assumed so that we can focus on the problem-solving aspects of the course. For example, knowing how to write and copy formulas involving relative and absolute cell addresses, and how to insert and edit charts in Excel will be essential. A typical Excel user may not be familiar with more advanced tools, techniques and add-ins that have significantly increased the power of spreadsheet analysis. This course will introduce and apply these tools, thereby furthering the spreadsheet knowledge base of even an expert Excel user. In addition to standard Excel tools such as Goal Seek and Data Table, we will use Excel’s Solver tool, Solver Table and Open Solver add-ins for decision optimization, Simulation Supplement and @Risk add-ins for Monte Carlo simulation and the Precision Tree add-in for sequential decision analysis.

Style of the Course: The course involves hands-on in-class learning, so it is absolutely essential to attend each class, be on time and use your laptop to actively participate in example problems while in class. We will learn to develop, analyze, and solve spreadsheet models through business cases; these cases are studied during the class and in assigned homeworks, and also appear in simpler forms in our midterm and final exams. One side-goal of this course is to learn how to parse and digest a business case and its goals, and quickly translate them into mathematical objects.

Philosophy of the Course: This course will focus on modeling, analysis and interpretation, rather than the underlying theory or algorithms. This practical approach to problem solving will not only complement the theoretical one, but is also more readily accessible to managers, who find spreadsheets a natural, intuitive and user-friendly platform for organizing information and performing calculations for multiple scenarios. For these reasons, spreadsheets have become an indispensable tool for modern business analysis.
Required Materials

Hardware Requirements: Please ensure you pass/understand both of the requirements before classes start. If you have any questions regarding these requirement, let the instructor know by email.

(I) You must follow along using your Laptop during every class session.

(II) If you are a Mac user, you must find a way to be “Windows compatible” because the DecisionTools Suite will not work on Mac. I recommend either (i) installing a Windows on your Mac using Boot Camp, or (ii) using Windows on a virtual machine such as VMWare Fusion or Parallels Desktop. Please see IT prior to the first class if you need assistance with this requirement.

Software Requirements: These software/add-ins requirements are very important. Please ensure to have a functional version of all of them before classes start. If you have any questions regarding these requirement, let the instructor know by email.

(I) Microsoft Excel 2016 (or later) for Windows, and the Excel Solver.

(II) The Palisade Corporation product Decision Tools Suite. This includes the Excel add- ins: Precision Tree, @RISK, and RiskOptimizer. You can download this from Canvas under Modules→Week 0 (Basic Materials)→Software Requirements→Palisade software.

(III) Excel OpenSolver and Simulation Supplement add-ins, which should be downloaded prior to the first session from the course’s Canvas page under Modules→Week 0 (Basic Materials)→Software Requirements.

(IV) Excel Solver Table add-in, which should be downloaded prior to the first session from Prof. Chris Albright’s website. Link can be found here.

Textbook: The course is actually self-contained and the course packet (slides, business cases, assignments, and supplementary materials)—which can be downloaded from Canvas site—is enough for learning everything. However, I still recommend the following textbook:


For more readings on the subject, students can also use the following optional textbook:


Course Outline (tentative - subject to change)

- Familiarizing Yourself with Excel (0 week - before classes start): please make sure you are familiar with basics of Excel before start attending the course. If you have no experience with Excel, please check the self-study materials and websites on the Canvas site to prepare yourself. This is an easy software to work with and mastering the basics will not take that much time.

- Introduction (1 week): Modeling and analysis of business decision problems using Excel spreadsheets. Review of basic Excel, including Goal Seek, Data Tables and Solver. Applications involving new product introduction, monopoly pricing and buy vs. lease decisions.
• **Optimization Modeling (3.5 weeks):** Constrained optimization models of problems involving best utilization of available resources—equipment, personnel, materials, time, space, capital—to optimize a measure of performance such as profit, cost, sales or return on investment. Model formulation, solution by Solver, sensitivity analysis, and economic interpretation. Applications to optimal product mix, blending, portfolio planning, display advertising, project selection, assignment, budget allocation, asset-liability matching, airline revenue management, workforce scheduling, production planning and portfolio optimization.

• **Simulation Modeling and Uncertainty (3.5 weeks):** Monte Carlo simulation of uncertain environmental variables, using the Rand() function, data tables, Simulation Supplement and @Risk. Applications to performance evaluation, inventory planning, yield management, competitive bidding, project valuation, cash flow analysis, stock option prices, optimal job search and portfolio optimization.

• **Sequential Decision Analysis (1 week):** Modeling and analysis of multiple stage decision problems under uncertainty, using Precision Tree. Applications to valuing real options, oil drilling, process selection and capacity planning.

**Course Requirements and Guidelines**

*(Please read carefully before the start of the quarter)*

**Prerequisite:** Everyone is expected to know the basics of working with Excel spreadsheets. These include developing and copying formulas with relative and absolute cell addresses, as well as drawing and editing charts in Excel.

**Class Work:** Preparation for each class involves reading and preparing the case(s) to be covered in that class. Each case has an Excel data file. Data files related to these cases should be downloaded from the Canvas before (not during) the class. These data files will be used in class to build and analyze models. This problem-solving process seems deceptively simple when watching someone else do it, or reading the solution; however, the only way to learn this important and difficult skill is by practicing it yourself. Everyone is expected to attend all classes on time and actively contribute to the class discussion by sharing ideas, experiences, and insights.

**Grading:** The course grade will be based on group homework assignments (40%), a timed take home midterm (20%), a take-home final (30%) and class participation (10%). For class participation, we divide the grade into three parts:

• **Class attendance (5%):** if a student needs exemption because of an extreme situation caused by living in the pandemic, please contact the instructor early. Otherwise, all students are expected to attend all the sessions of the course in-person.

• **Class activity (5%):** This grade is based on participation in class discussions, questions, and assignments (poll, breakout sessions, etc.).

To incentivize extra class participation, we consider at most 5% grade for extra class activity (completely at the discretion of the instructor and our TA).
Review Sessions: There will be two review sessions held during the quarter by our TA, and two review sessions (in the form of a Q&A) held by the instructor right before the final exam. Exact dates: TBD. The review sessions will be recorded and made available on Canvas.

Assignments: We will have weekly homework assignments—they will be made available by the end of the day on each Wednesday, and due on the Tuesday midnight, before the next section on Wednesday. The homework problems and cases are designed to enhance your understanding of the modeling process and subsequent analysis, which will be covered in class. Some assignments are to be completed individually, while others may be done in groups. Each group consists of five students (we will decide on group assignments during the first week of classes). Grading will be based on demonstrated comprehension of the case, logic of the model and application of concepts, methods and tools learned in class. An ideal homework should include:

- A write-up explaining the problem, model, analysis and results
- A well-organized spreadsheet with clear explanations and documentation including key formulas, gridlines, row and column headings, color coding, shading, etc. For conciseness, do not repeat similar formulas. Add explanations, comments and text boxes to help the reader understand your spreadsheet.

Although many assignments are to be submitted as a group, everyone is expected to work on each assignment individually first, and then combine the individual efforts to produce the best group output. Each group should submit its report, model, analysis and solution online through Canvas.

Honor Code: The honor code requires that you not obtain solutions to the assignments, cases or projects from other students in the past or present classes. In addition, you must not include your name on a group report if you have not contributed substantially to the group work. Students are required to adhere to the standards of conduct in the Booth Honor Code and the Booth Standards of Scholarship. The Booth Honor Code also requires students to sign the following Booth Honor Code pledge, “I pledge my honor that I have not violated the Honor Code during this examination,” on every examination and homework.

Presence: Everyone is expected to attend all classes on time. To minimize delays and disruptions, please come to the class early with programs loaded and updates installed. This will allow class to start on time. We then ask that you stay in your seats until the end of the class, as it only takes a few moments to fall behind and slow down the progress of the entire class. Please be respectful to the class routine, and do not browse the web or use email during class.

Students with Disabilities: The University of Chicago is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements or benefit from the University’s programs or services, please contact Student Disability Services as soon as possible. To receive a reasonable accommodation, you must be appropriately registered with Student Disability Services. Please contact the office at 773-702-6000/TTY 773-795-1186 or disabilities@uchicago.edu, or visit the website at disabilities.uchicago.edu. Student Disability Services is located at 5501 S. Ellis Avenue. If you have an approved accommodation from Student Disability Services that you plan to use in this course, please contact Academic Services (AcademicServices@lists.chicagobooth.edu) as soon as possible. Academic Services will provide support to you and your instructor in order to coordinate the details of your accommodations on your behalf.
Re-grading Policy: If a student wishes to contest a given grade given, they should follow this procedure:

1. Students have up to 5 working days after graded written work has been made available to them to submit it for re-grading. If the work is returned to students at the end of the term, they have 10 days in the next registered term to resubmit the work for re-grading. In contesting a grade, students should be informed that the entire work will be reviewed, not only the sections in question, and the final grade adjusted accordingly.

2. Submissions for re-grading must be done in writing, with the student outlining the specific areas of the work that s/he feels were incorrectly graded. All submissions should be signed and dated by the student.

3. The professor will re-grade the work being contested and provide a response to the student within 20 working days, explaining the results of the review and indicating whether the student’s grade has changed. Oral or written responses may be provided.

4. If a student remains dissatisfied with the grade, s/he has 5 working days after receiving the re-graded work to submit it a second time for re-grading, as outlined in Step 2.

5. The professor will re-grade the work within 20 working days of receiving it, as outlined in Step 3. This concludes the grading appeal process. The professor’s judgments on second submissions of written work will be final. There are no provisions for student appeals to outside parties in resolving grading disputes.

Extra (In-person) Classroom Guidelines
(Please read carefully before the start of the quarter)

Bring Your Laptops: Please always come to the class with a laptop. We will build models in the class using Excel spreadsheets and having your laptop (with a functioning Excel + all required add-ins + data file needed for that week) is required.

Asking Questions: Please raise your hand to ask questions. When asking your question, please state your name prior to asking the question. Ex. “This is John Doe, I would like to ask about this topic.” This is specially important at the beginning of the quarter, so that the instructor knows your name. This is an interactive class and all students are strongly encouraged to ask their questions.

Google Docs and Slides for Discussions: We will also be making use of Google Docs to facilitate class discussion. A google document will be posted for each section, and during class I will ask you to input suggestions and ideas in response to questions I ask. We hope this will emulate our in-person ability for students to suggest multiple ideas quickly. In a similar fashion, we will use Google slides for communal work during breakout sections – each group will have a slide to work on together.

- Google Docs link: TBD
- Google Slides link: TBD

Conversations: Please keep private conversations to a minimum as your conversations may be heard by the rest of your class participants.
Recording: All classes and review sessions will be recorded and they will be made available on Canvas. I also make recorded session of Spring 2021 available on Canvas after each class.

COVID-19 Related University Rules
(Please read carefully before the start of the quarter)

In order to protect the health and well-being of our students, staff and faculty during the COVID-19 pandemic, we are all required to follow a number of safety protocols. Before the start of the quarter, please read carefully and familiarize yourself with the following guidelines and use the available links to get more information.

UChicago Health Pact: All students on campus are required to adhere to the guidelines in the UChicago Health Pact in order to promote a safe environment in the classroom.

- As of March 4, masks will not be required in most non-medical campus office settings, on-campus residence halls, retail stores, and dining spaces. The mask requirement for classrooms and other instructional settings will remain through the end of Winter Quarter on March 19, 2022 to maintain continuity for students and instructors in classroom settings.

- Do not attend an in-person class if you feel unwell or are experiencing COVID-19 related symptoms

The complete text of the UChicago Health Pact along with additional information about COVID-19 protocols can be found here.

Reporting COVID-19 Related Concerns: Any concerns over inappropriate PPE usage, physical distancing, cleaning/disinfection, or other COVID-19 related public health concerns should be directed to UCAIR. If there is an emergency, call 773-702-8181 or dial 123 on any campus phone.

Reporting COVID-19 Exposure or a Confirmed Case: If you were potentially exposed to COVID-19 or your test results come back positive, reach out immediately to C19HealthReport@uchicago.edu.

Attendance: Students who have been exposed to or who are experiencing symptoms of COVID-19 should contact UChicago Student Wellness immediately to be tested, and reach out to their area Dean of Students to request accommodations for classes until:

- At least 10 days have passed since symptoms first appeared and;

- At least 3 days (72 hours) have passed since recovery- defined as resolution of fever without the use of fever-reducing medications and improvement in respiratory symptoms (e.g., cough, shortness of breath).

Recording and Deletion Policies for Academic Year 2021-22: The Recording and Deletion Policies for the current academic year can be found in the Student Manual here:

- Petitions, Audio & Video Recording on Campus.
Schedule of Course Lectures (tentative - subject to change)

Part I: Introduction to Decision Modeling

Session 1 (Wed 03/30/22): Introduction—Excel in Modeling

**Classwork:** Introduction to Decision Modeling; Review of Excel: *Goal Seek* and *Data Tables*

**Assignment 0 (important):** please work on “Assignment 0 — Basics of Excel & Modeling” to check your Excel competency (ideally finish Question 1 before the first class, but definitely until the end of first week); this assignment will be letter-graded to only give you feedback (i.e., is not counted towards the final grade)

**Required & Recommended Readings:**

- Three business cases (required):
  - *New Product Development*
  - *Price Is Right*
  - *Buy vs. Lease*

- Textbook (recommended):
  - “Essential Excel”—Chapters 1 and 2
  - “Principles of Spreadsheet Modeling”— Chapter 7, Section 3

Part II: Optimization Modeling

Session 2 (Wed 04/06/22): Introduction to Linear Optimization

**Classwork:** Resource Allocation; Linear Optimization: *Solver*; Sensitivity Analysis: *Shadow Prices.*

**Homework:** TBD

**Required & Recommended Readings:**

- Two business cases (required):
  - *Producing for Profit*
  - *Picking a Portfolio*

- Textbook (recommended):
  - “Interpreting the Solver Report”— Chapter 3, Sections 1 – 3 and 7 & Chapter 3, Sections 4 – 6 and 9 & Chapter 4, Section 6
Session 3 (Wed 04/13/22): Linear Optimization (cont’d) + Network Optimization Models

Classwork: Optimal Blending; Optimal Bipartite Assignment/Matching; Airline Network Revenue Management

Homework: TBD

Required & Recommended Readings:

- Two business cases (required):
  - *Make Me Wine (and Profit Too)*
  - *Display Ad Auctions*
  - *BlueSky Airlines*
- Textbook (recommended):
  - Chapter 4, Section 5
  - Chapter 5, Section 6

Session 4 (Wed 04/20/22): Integer Programming Models

Classwork: Integer Optimization and Selections; Multi-period Planning

Homework: TBD

Required & Recommended Readings:

- Five business cases (required):
  - *Project Selection*
  - *Managing a Marketing Budget*
  - *Production Planning*
  - *Workforce Planning* (time permitting)
  - *Asset-Liability Matching* (time permitting)
- Textbook (recommended):
  - Chapter 3, Section 8
  - Chapter 4, Sections 2-4, 6, 7

Part III: Simulation Modeling

Session 5 (Wed 04/27/22): Introduction to Risk Analysis

Classwork: Financial Risk Management: *Solver Table*; Introducing Uncertainty: The *Rand()* function

Homework: No Homework. *Timed Take Home Midterm Out (Due May 4)*

Required & Recommended Readings:

- Two business cases (required):
  - *Portfolio Optimization*
  - *Performance Evaluation*
Session 6 (Wed 05/04/22): Probability Models and Simulation
(If time permits, we will have a shorter session—will be decided later)
Classwork: Discrete Probability Models: Binomial and Poisson; Monte-Carlo Simulation; Application: News Vendor Problem
Homework: TBD
Required & Recommended Readings:

- Textbook (recommended):
  - “Nonlinear optimization models”—Chapter 7, Section 7
  - “Review basic probability” —Chapter 11, Sections 1 – 4

Session 7 (Wed 05/11/22): Monte-Carlo Simulation Modeling (cont’d)
Classwork: Wrap up the Previous Session; Continuous Probability Models: Normal and Triangular
Homework: TBD
Required & Recommended Readings:

- Four business cases (required):
  - Revenue Management (from previous week)
  - Bidding To Win
  - Project Valuation
  - Cash Flow Analysis of a Project

- Textbook (recommended):
  - “Review Normal distribution”— Chapter 17, Section 3

Session 8 (Wed 05/18/22): Uncertainty, Time, and Correlation in Simulation Modeling
Classwork: Wrap up the Previous Session; Role of Uncertainty over Time; Correlated Random Variables and Risk Optimizer
Homework: TBD
Required & Recommended Readings:

- Four business cases (required):
  - Cash Flow Analysis of a Project (from previous week)
  - Bonds, Stocks and Options
  - Optimal Job Search
Part IV: Sequential Decision Analysis

Session 9 (Wed 05/25/22): Introduction to Sequential Decision Analysis

Classwork: Precision Tree; Sequential Decisions with Information, Expected Value of Information

Homework: TBD; Take Home Final Out (Due June 4)

Required & Recommended Readings:

- Two business cases (required):
  - Decision Analysis with Information
  - Order Cheap or Order Smart
- Textbook (recommended):
  - Chapter 16

Exam Week Office Hours (by instructor): Course Overview

  Topic: We will review the course in this brief office. Please attend if you have questions before the exam. Bring all of your questions.

  Time/Date: TBD