



# Syllabus

## DECISION MODELS & ANALYTICS

### Fall 2019

### Undergraduate Program

**INSTRUCTOR** Professor Jiawei Zhang  
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Office Hours: TBD

**TEACHING FELLOW** TBD

### TEXTBOOKS

The following books are very good references for this course. NYU students have free online access to these books.

- **Optimization Modeling with Spreadsheets**, Second Edition, by Kenneth R. Baker

<https://onlinelibrary.wiley.com/doi/book/10.1002/9780470949108>

- **Financial Modeling with Crystal Ball and Excel**, 2<sup>nd</sup> Edition, by John Charnes

<https://ebookcentral.proquest.com/lib/nyulibrary-ebooks/detail.action?docID=827132>

### COURSE OBJECTIVE

This course introduces the basic principles and techniques of applied mathematical modeling for managerial decision-making. You will learn to use some important analytic methods (optimization, Monte Carlo simulation, and spreadsheet modeling), to recognize their assumptions and limitations, and to employ them in decision-making.

Students will:

- Develop mathematical models that can be used to improve decision making within an organization.
- Sharpen their ability to structure problems and to perform logical analyses.
- Practice translating descriptions of decision problems into formal models, and investigate those models in an organized fashion.
- Identify settings in which models can be used effectively and apply modeling concepts in practical situations.

- Strengthen their computer skills, focusing on how to use the computer to support decision-making.

The emphasis will be on model formulation and interpretation of results, not on mathematical theory. The emphasis is on models that are widely used in diverse industries and functional areas, including finance, operations, and marketing.

## **COURSE CONTENTS**

### **Deterministic Models:**

**Linear Programming** – formulating optimization problems, spreadsheet modeling, using Solver, sensitivity analysis, multi-period modeling.

- Product mix
- Capital Budgeting
- Personnel scheduling
- Marketing research
- Purchasing TV ads
- Investment strategy
- Online advertising
- Airline revenue management capacity allocation
- Production planning and scheduling
- Cash matching: Managing pension fund

**Integer Programming** – Integer and binary variables, logical relationships

- Scheduling professors
- Online dating
- Supply chain design
- Project selection
- Supplier selection

**Network Optimization** – Minimum cost flow, shortest path, maximum flow

- Transportation problem
- Currency exchange

**Non-linear Optimization** – Local vs. global optimality, evolutionary algorithm, linear reformulation

- Mean-variance portfolio optimization
- Pricing and demand estimation
- Pricing bundles

## **Probabilistic Models:**

**Simulation** – Basic concepts, Crystal Ball software

- NPV estimation
- Return of a portfolio
- Project valuation
- Option pricing
- Insurance claims
- Market share
- Pay per click online advertising
- Customer loyalty

## **Simulation and Optimization**

- Overbooking and revenue management
- Competitive bidding
- Liquidity optimization
- Project management
- Retirement planning

## **PRE-REQUISITES**

Although there are no specific pre-requisites for this class, prior knowledge of **basic probability concepts (probability distributions, percentiles, expected value, standard deviation, variance and covariance)** would be helpful.

## **WEBSITE/COURSE MATERIALS**

NYU Classes will be used as the main communication tool, and materials will be posted in the system. This includes the homework assignments, the problems studied and the completed models. To log in, you will need your Stern email account and the associated password.

## **GRADING**

At NYU Stern we seek to teach challenging courses that allow students to demonstrate differential mastery of the subject matter. Assigning grades that reward excellence and reflect differences in performance is important to ensuring the integrity of our curriculum.

In general, students in this elective course can expect a grading distribution where about 50% of students will receive A's for excellent work and the remainder will receive B's for good or very good work. In the event that a student performs only adequately or below, he or she can expect to receive a C or lower. The actual distribution for this course and your own grade will depend upon how well each of you actually performs in this course. The grades for this course will be based on homework assignments (35%), midterm exam (25%), final exam (25%) and class participation (15%).

## RE-GRADING

In line with the grading guidelines for NYU Stern, the process of assigning of grades is intended be one of unbiased evaluation. This means that students are encouraged to respect the integrity and authority of the professor's grading system and discouraged from pursuing arbitrary challenges to it.

If a student feels that an inadvertent error has been made in the grading of an individual assignment or in assessing an overall course grade, a request to have that the grade be re-evaluated may be submitted. Students should submit such requests in writing to the professor within 7 days of receiving the grade, including a brief written statement of why he or she believes that an error in grading has occurred.

## CLASS PARTICIPATION

The professor will judge class participation on the extent to which you appear prepared, the relevance and depth of your comments, the degree to which you listen carefully and respond to your peers, and your willingness to take chances in order to further the educational experiences of others. You will lose participation points if you miss classes and/or arrive late and/or leave early multiple times.

## HOMEWORK

There are five homework assignments in total. All assignments will be posted on Blackboard. You should submit both a **printout** (in class) and an electronic copy (via e-mail to the [sterndmazhang@gmail.com](mailto:sterndmazhang@gmail.com) with subject line “**Undergraduate Decision Models Homework #X**”, before class). Keep a copy of all homework submitted.

Late assignments will not be accepted unless due to documented serious illness or family emergency. Professor will make exceptions for religious observance or civic obligation only when the assignment cannot reasonably be completed prior to the due date and the student makes arrangements for late submission with the professor in advance. **You can collaborate with a single colleague in solving the homework questions, but you must acknowledge that in your submission. The assignments must be submitted individually in order to receive credit.**

## ELECTRONIC DEVICES

Cell phones and other electronic devices are a disturbance to both students and professors. All electronic devices (except laptops) must be turned off prior to the start of each lecture.

You are expected to bring a laptop to each class, unless otherwise instructed. The laptop should be able to run Microsoft Excel, including the Solver package. The laptop will not be used throughout the entire class, and we ask you to close your laptop until you are asked to use it.

## **ACADEMIC INTEGRITY**

Integrity is critical to the learning process and to all that we do here at NYU Stern. All students are expected to abide by the NYU Stern Student Code of Conduct. A student's responsibilities include, but are not limited to:

- A duty to acknowledge the work and efforts of others when submitting work as one's own. Ideas, data, direct quotations, paraphrasing, creative expression, or any other incorporation of the work of others must be clearly referenced.
- A duty to exercise the utmost integrity when preparing for and completing examinations, including an obligation to report any observed violations.

Please see [www.stern.nyu.edu/uc/codeofconduct](http://www.stern.nyu.edu/uc/codeofconduct) for more information.

## **STUDENTS WITH DISABILITIES**

Students whose class performance may be affected due to a disability should notify the professor early in the semester so that arrangements can be made, in consultation with the Henry and Lucy Moses Center for Students with Disabilities, to accommodate their need.

## **IMPORTANT DATES (TBD)**

- Assignment 1 is due
- Assignment 2 is due
- Assignment 3 is due
- Midterm exam
- Assignment 4 is due
- Assignment 5 is due
- Final exam