

# ISE 347/447: Financial Optimization

Dr. Ted Ralphs

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## 1 Miscellaneous Course Information

Instructor:	Dr. Ted Ralphs
Office:	473 Mohler Lab
Phone:	8-4784
E-mail:	tkr2
Office Hours:	W 1-2, Th 1-2
TA:	Xiaocheng Tang
TA Office:	Mohler 142
TA Office Hours:	M 1-3
Course web page:	<a href="http://www.lehigh.edu/~ted/teaching/ie447/">http://www.lehigh.edu/~ted/teaching/ie447/</a>
Course meeting time:	TR 9:20-10:35

## 2 Description of Course

This course concerns making sound financial decisions in an uncertain world. Increasingly, financial decision-makers are depending on optimization techniques to guide them in their decisions. We will survey the use of such methods in financial decision-making processes. Financial topics to be covered will include asset/liability management, option pricing and hedging, risk management, and portfolio optimization. The optimization techniques to be covered will include linear and nonlinear programming, integer programming, dynamic programming, and stochastic programming. As a supporting theme, the course will also emphasize effective modeling, the use of modeling languages, such as AMPL, and the use of commercial solvers for solving financial optimization problems.

## 3 Course Objectives

The goals of this course are for students to:

1. Cultivate a basic understanding of the optimization methodologies used in financial decision-making.
2. Understand how to formulate financial optimization programs using the tools of mathematical programming.

3. Understand how to select the optimization technique most appropriate for a given financial optimization problem.
4. Understand how to use spreadsheets and modeling languages to interface with optimization software for solving financial optimization problems.

## **4 General Course Requirements**

### **4.1 Prerequisites**

I expect you to have a good undergraduate mathematics background, as well as some previous experience with mathematical modeling and a basic knowledge of probability.

### **4.2 Recommended Primary Text**

Optimization Methods in Finance, by Cornuejols and Tütüncü, Cambridge University Press (2007).

### **4.3 Reading**

There will be required readings associated with each lecture. Most readings will be from the course text, but students are encouraged to seek supplementary material. Links to supplementary reading material can be accessed from the course page.

### **4.4 Lectures**

You are expected to attend and participate in the lectures. Part of the grade will be determined by overall class participation. Lecture materials will be available for reference before the lecture on the course web page.

### **4.5 Assignments**

Assignments will be given according to the course timeline below. There will be nine problem sets and a final project.

### **4.6 Exams**

There will be two quizzes and a final. All exams will be open book and open notes.

## **5 Course Timeline**

The following timelines are subject to change.

## 5.1 Tentative Schedule of Homeworks and Quizzes

<u>Homework/Quiz</u>	<u>Date</u>
Homework #1	January 29
Homework #2	February 12
Midterm #1	February 19
Homework #3	March 5
Homework #4	March 26
Midterm #2	April 2
Homework #5	April 16
Final Project	April 28
Final Exam	??

## 5.2 Tentative Schedule of Topics

<u>Category</u>	<u>Topic</u>	<u>Lectures</u>
Introduction	Introduction	2
Models and Methods	Linear Programming	2
Software	Excel Solver and AMPL	2
Application	Asset/Liability Management and Asset Pricing	2
Models and Methods	Quadratic Programming	2
Software	GAMS and software for nonlinear programming	2
Application	Portfolio Optimization	2
Models and Methods	Integer Programming	2
Application	Constructing an Index Fund	2
Models and Methods	Dynamic Programming	2
Application	Options Pricing	2
Models and Methods	Stochastic Programming	2
Software	Software for Stochastic Programming	2
Application	Portfolio Optimization and Option Pricing	2

## 6 Course Policies and Procedures

### 6.1 Referencing the Work of Others

You should attempt the problem sets on your own before consulting outside references. However, I encourage the use of research materials as a way to supplement your understanding of the course material, as long as you heed the following common-sense ground rules. First, you may not consult my solutions or the problems sets of other students from previous offerings of this course. Second, external sources may be used only to improve your own understanding. You may not quote directly from any source and you should not write down anything that you do not understand. When you write your solutions, you should do it on your own without the direct help of any external sources. If you do use external references in improving your understanding, please cite them! Failure to cite references will be treated as cheating and will not be tolerated. If you are diligent about citing references, you will come out ahead in the end. Please ensure that you understand the spirit and the letter of these rules before beginning any class work.

## 6.2 Respect for Intellectual Property

In both your classwork and your research, it is important that you be aware of and respect the intellectual property rights of others. Unless explicitly stated otherwise, all materials available on the Internet, in libraries, and elsewhere are considered intellectual property and can only be used with the permission of the owner. Please be aware of the license you are being granted when you use these materials and what you are and are not allowed to do with them.

## 6.3 Group Work

You are encouraged to work together on problem sets, especially those designated as group work. However, unless the problem set is specifically designated as group work, you must ultimately demonstrate your understanding of the material by writing up your own solutions without the help of other students or their written work. If you consult with other students (or faculty) on a problem set, this should be considered equivalent to consulting any other reference and should be cited appropriately. This policy will be strictly enforced.

## 6.4 Turning in Assignments

We will try using Google Classroom to manage submissions and see how it goes. Instructions on joining the class on-line will be given out in the first lecture.

## 6.5 Lateness

I will allow a total of 7 days of lateness on assignments throughout the semester. These 7 days can be split up in any way you choose. In other words, you can have one assignment late by 7 days or 7 assignments each late by one day. After that, there is a penalty of 10% off per late-day on each assignment. No assignment will be accepted more than 7 days late. Exceptions to this rule will be made on a case-by-case basis. Please let me know if you will be turning in an assignment late.

## 6.6 Grading

I believe your grade should reflect the actual learning that took place in the course and not be solely the result of a simple formula. The way to maximize your grade in this course is to learn and understand the material. Most formulaic grading systems allow you (even encourage you) to maximize your grade without necessarily maximizing your learning. I want to discourage you from disconnecting these two goals.

Effective learning also involves knowing where to go to get help when you realize that your knowledge or understanding of a topic is incomplete. This could mean asking a classmate some questions, consulting external references, or coming to office hours. It can also mean asking a question in class when you don't understand part of the lecture. Chances are, other people don't understand it either. These are important aspects of class participation.

You will be evaluated on the level of detail and rigor in your homework answers. In general, you should err on the side of giving too much detail in your written work. One common mistake is the assumption that if I assigned the problem, I must know every possible approach to solving it. Many times, however, I will not have thought of the approach you are using and will therefore need some help in understanding your thought process. The more explicit you are, the easier it will be for me

to grade and the more you will demonstrate your understanding. If you spend hours coming up with the answer to a problem, don't short-change yourself by spending only a few minutes writing it down. Take some time to think about how best to present your thoughts. Do not write your problem sets as if you are space constrained.

You will be graded as much as possible according to my overall assessment of your learning in the course and your understanding of the course material. This includes your ability to perform self-assessment, your ability to ask questions to increase your understanding, and your ability to express your ideas in written form rigorously and with an appropriate level of detail. I grade randomly selected problems from each problem set. However, I will distribute detailed solutions to all problems. You are strongly encouraged to evaluate your own work by comparing it to the solutions. For those who would like a formula, the approximate grading scheme is as follows:

20% Homework  
20% Midterm (each)  
20% Final Project  
20% Final Exam

## **6.7 Learning Styles**

There are many different styles of learning. Some people gain better understanding from listening to something being explained orally. Some get better understanding from written material. Some like a combination of both. I do my best to accommodate various styles of learning. However, feel free to let me know what your learning style is so that I can take that into account when determining the future direction of the course.

## **6.8 Office Hours and Appointments**

I very much appreciate and enjoy getting as much feedback from my students as possible, even if it is not all positive. Please don't be afraid to tell me what you think. If you want to just stop by to chat, feel free. My door is usually open, but if you could utilize office hours as much as possible, I would appreciate it. If you would like to make an appointment outside office hours, just call or send an e-mail.