

Location and Office Hours

We will meet in room 315 in Baxter Hall during weekdays, September 7th-24th, from 10am to noon. I'll stay around after class if you want to discuss anything.

My office number is 136, phone extension x8772. If you have any questions, stop by. I might ask you to come back another time, but I will do my best to provide assistance. My email is gpf@hss.caltech.edu.

Objectives

The objective of the course is to present to you some mathematical tools and results that will be used throughout the first year. We will emphasize the intuition behind the results, and how to write good proofs. The material we will cover consists of those parts of real analysis, optimization and linear algebra that are most useful for microeconomic theory and econometrics. Unfortunately, we will not have much time to study probability.

There will be daily problem sets, and these are the heart of the course. In order to learn the material, you should do as many problems as you can. Contact me if you are having difficulty with a problem. Please, put some effort in writing well. Keep in mind you will be required to write many proofs in your first year, so if you have no experience with that, you should start practicing as early as possible.

I did not program anything for the last three days of the course in case we cannot cover one lecture per day. If we do cover one lecture per day, we will spend those last three days solving problems and I will try to answer any questions you might have about the material.

References

Here is a list of some books at the level of the course. The book that best approximates the content we will cover is de la Fuente's book. Kim Border has notes on his website about almost all the topics we will cover.

- Stephen Abbott, *Understanding Analysis*, (Springer, 2002).
- Robert B. Ash, *Basic Probability Theory*, (Dover Publications, 2008).
- Sheldon Axler, *Linear Algebra Done Right*, 2nd ed. (Springer, 2004).
- Robert G. Bartle, *The Elements of Real Analysis*, 2nd ed. (Wiley, 1976).

- Robert G. Bartle and Donald R. Sherbert, *Introduction to Real Analysis*, 3rd Edition, 3rd ed. (Wiley, 1999).
- Stephen Boyd and Lieven Vandenberghe, *Convex Optimization* (Cambridge University Press, 2004).
- Angel de la Fuente, *Mathematical Methods and Models for Economists*, (Cambridge University Press, 2000).
- William Feller, *An Introduction to Probability Theory and Its Applications*, Vol. 1, 3rd ed. (Wiley, 1968).
- P.R. Halmos, *Finite-Dimensional Vector Spaces* (Springer, 1993).
- Serge Lang, *Linear Algebra*, 3rd ed. (Springer, 2004).
- David G. Luenberger and Yinyu Ye, *Linear and Nonlinear Programming*, 3rd ed. (Springer, 2008).
- Charles Chapman Pugh, *Real Mathematical Analysis* (Springer, 2003).
- Sheldon M. Ross, *Introduction to Probability Models*, Ninth Edition, 9th ed. (Academic Press, 2006).
- Walter Rudin, *Principles of Mathematical Analysis*, Third Edition, (McGraw-Hill, 1976).
- Georgi E. Shilov, *Linear Algebra* (Dover Publications, 1977).
- Georgi E. Shilov, *Elementary Real and Complex Analysis*, Revised. (Dover Publications, 1996).
- Carl P. Simon and Lawrence E. Blume, *Mathematics for Economists*, 1st ed. (W.W. Norton & Co., 1994).
- Gilbert Strang, *Introduction to Linear Algebra*, Fourth Edition, 4th ed. (Wellesley Cambridge Press, 2009).
- Gilbert Strang, *Linear Algebra and Its Applications*, 4th ed. (Brooks Cole, 2005).
- Kenneth M. Hoffman and Ray Kunze, *Linear Algebra*, 2th ed. (Prentice Hall, 1971).
- Sundaram Rangaraj K., *A First Course in Optimization Theory*, (Cambridge University Press 1996).
- Robert B. Ash, *Basic Probability Theory*, (Dover, 2008).
- Robert B. Ash, *Real Variables with Basic Metric Space Topology*, (Dover, 2009).
- A. N. Kolmogorov and S. V. Fomin, *Introductory Real Analysis*, 1st ed. (Dover, 1975).

Let me know if you are interested in other topics, more advanced references, etc.

Daily Plan

Week 1

- Lecture 1:** *Sets, Numbers, and Relations*
- Lecture 2:** *Topology of \mathbb{R}^n*
- Lecture 3:** *Linearity and Convexity*
- Lecture 4:** *Separation and Tangency (Separating Hyperplanes and Derivatives)*

Week 2

- Lecture 5:** *Unconstrained Optimization*
- Lecture 6:** *Projections*
- Lecture 7:** *Least-Squares*
- Lecture 8:** *Optimization with Equality Constraints*
- Lecture 9:** *Optimization with Inequality Constraints*

Week 3

- Lecture 10:** *Probability*
- Lecture 11:** *Systems of Equations (Fixed Points and Implicit/Inverse Function Theorem)*
- Lecture 12:** *Undetermined*
- Lecture 13:** *Undetermined*
- Lecture 14:** *Undetermined*