University of Pennsylvania – The Wharton School

OIDD 912: Mini-Course on Optimization

Fall 2016

When: Wednesdays, 3:30-6:30pm
Where: JMHH 540 (OIDD conference room)
Instructor: Sergei Savin
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Course Description

This mini-course constitutes the second part of a two-part sequence and serves as a continuation of the summer math camp. Mathematical optimization provides a unifying framework for studying issues of rational decision-making, optimal design, effective resource allocation and economic efficiency. It is a central methodology of many business-related disciplines, including operations research, marketing, accounting, economics, game theory and finance. In many of these disciplines, a solid background in optimization theory is essential for doing research.

The course provides a rigorous introduction to the fundamental theory of optimization. It examines optimization theory in two primary settings: static optimization and optimization over time (dynamic programming). Applications from problem areas in which optimization plays a key role are also introduced. The goal of the course is to provide students with a foundation sufficient to use basic optimization in their own research work and/or to pursue more specialized studies involving optimization theory.

The course is designed for entering doctoral students. The prerequisites are calculus, linear algebra and some familiarity with real analysis, as covered in the summer math camp. Other concepts are developed as needed throughout the course.

Outline of the Course

Week	Topics Covered
1	Constrained Optimization: Theorem of Lagrange, KKT conditions
2	Convexity and Optimization: Convex Sets and Convex Functions, Implications for Unconstrained and Constrained Optimization
3	Quasiconvexity: Implications and Use in Optimization
4	Supermodularity and Parametric Monotonicity
5	NLP Duality, Lagrange Multipliers, Weak and Strong Duality
6	Finite-Horizon Dynamic Programming: Markov Strategies, Existence of Optimal Strategy
7	Stationary Discounted Dynamic Programming: Bellman Equation, Value Iteration, Policy Iteration

Textbook

Sundaram, R.K. *A First Course in Optimization Theory*, Cambridge University Press, 1996.

Other References

Bazaraa, M., Sherali, H., and Shetty, C. *Nonlinear Programming: Theory and Algorithms*, Third Edition, John Wiley & Sons, 2006.

Bertsekas, D. *Dynamic Programming and Optimal Control*, Third Edition, Athena Scientific Publishing, 2007.

Course Work and Grading

6 weekly homework assignments will be given out during the course. There will also be an open-book/open-notes final exam. The course grade will be the weighted average of homework (60%) and final (40%) grades.