Mathematical Methods for PhD and MACRM Students
September 2019
Syllabus

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TA Session: Daily 1-2pm

Description
The goal of the Mathematical Methods course is to review the majority of the mathematics that will be used during the core courses of the PhD and MACRM programs. The treatment of topics will be semi-rigorous: in coursework, students will prove the simpler results but not the more advanced results. Students will not receive an official grade for this course but will be assigned problem sets and take graded quizzes throughout the course.

We will begin by introducing sets, functions and metric spaces. The second week will be devoted to the linear algebra topics (necessary for applied econometrics) and differential calculus. The third week will wrap up with convex analysis, optimization, and monotone comparative statics. Throughout, but particularly in the latter half of the course, we will use Sage (https://cocalc.com/?utm_source=sagemath.org&utm_medium=landingpage) to help with plotting and visualization. Applications are taken from economics and political economy.

A lot of material will be covered in three weeks. Students may not be able to master it all in this short time. Instead, I recommend devoting yourself to learning as much of the terms, concepts and processes as you are able. Many of terms and concepts will appear again in economic context when your coursework begins. The exercise of proving and the logic of writing proofs will serve as a foundation for all of the core courses. The best way to master the material is to practice (and a lot of practice is necessary). To that end, there will be daily problem sets, group problems in class, and quizzes. Most of the TA sessions will be recitation, where Lucas will review solutions to practice problems.

Course materials and more detail will be available on the Canvas course site.

Class Meeting Schedule

Week 1: Tuesday - Friday, 9am-12 noon, Thursday 1-2:30 pm (no TA session on Thursday)

Week 2: Monday - Thursday, 9am-12 noon, Tuesday 1-2:30 pm (no TA session on Tuesday; Friday TA session 9am - 11am)

Week 3: Monday - Friday, 9am-12 noon.

Textbooks and References
The main textbook for the course will be Cinlar, Erhan and Robert Vanderbei, *Real and Convex Analysis*, Springer, 2012. The eBook is available through the university library, http://link.springer.com/978-1-4614-5257-7.

We will also use material from the mathematical appendices of two canonical textbooks.

- Mas-Colell, Andreu, Michael Dennis Whinston, and Jerry R. Green. *Microeconomic Theory.* Oxford, 1995.
- Greene, William H. *Econometric Analysis.* Pearson, 2008. (Recent appendices are available on Prof. Greene's website: http://people.stern.nyu.edu/wgreene/Text/econometricanalysis.htm)

Other Recommended Texts

- Sally, Paul J. *Tools of the Trade: An Introduction to Advanced Mathematics.* American Mathematical Society, 2008.
- Jehle, Geoffrey and Philip Reny. *Advanced Microeconomic Theory.* Addison Wesley Longman, 2nd ed. 2001.
- Ok, Efe. *Real Analysis with Economic Application.* Princeton, 2007.
- Vohra, Rakesh. *Advanced Mathematical Economics.* Routledge, 2005.
- Corbae, Dean, Maxwell Stinchcombe and Juraj Zeman. *An Introduction to Mathematical Analysis for Economic Theory and Econometrics.* Princeton, 2009.