ECO 392M.8
Mathematics for Economists
Fall 2013

Instructor: Maxwell B. Stinchcombe,

Time and Location: M, W 12:30-1:50pm, BRB 1.120

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Office Hours: T, Th 9:30-11:00am, BRB 2.102A

Overview and Objectives

We are going to cover enough real analysis and convex analysis, all with optimization applications, to (hopefully) make the material in microeconomics, macroeconomics, and prob/stats more comprehensible.

Requirements

A good calculus class and some matrix algebra, plus some mathematical maturity.

Administrative Issues

I will hand out hard copy of, e-mail, and post (on my webpage) the weekly assignments. I encourage you to work together on the assignments. However, you should be sure to write up your own solutions.

There will be two take-home exams. On both of them, you must work alone, you may consult any inanimate source, but you must cite any sources you use.

The mid-term will come after we have finished the continuity topics in the real analysis part of the course, mid-October, depending on timing.

On Tuesday, December 10, I will give out a take home final exam. It will be due Thursday, December 12, 2013 at 12:00 noon.

Required Texts

- Corbae, D., Stinchcombe, M. B., and Zeman, J. (2009). *An introduction to mathematical analysis for economic theory and econometrics*. Princeton University Press, Princeton, NJ
- Mas-Collel, A., Whinston, M. D., and Green, J. (1995). *Microeconomic theory*. Oxford University Press, Oxford
- Casella, G. and Berger, R. L. (1990). *Statistical inference*. The Wadsworth & Brooks/Cole Statistics/Probability Series. Wadsworth & Brooks/Cole Advanced Books & Software, Pacific Grove, CA

Course Outline

We will spend time developing the real line, $\mathbb{R}$, and its metric space properties, especially completeness. After this we will turn to $\mathbb{R}^\ell$, again viewing it as a metric space. By the end of this material, we will be working with correspondences, aiming at the main result, the Theorem of the Maximum. We will then turn to convex analysis to finish off the semester.

1. The Real Line, $\mathbb{R}$ (Weeks 1-3)

There are two ways that textbooks develop the model of quantities that we use, an axiomatic approach featuring "cuts," and an approximation approach that "completes the rationals." We will do it in this second fashion.

A. Rationals, distance, convergence, Cauchy sequences (CSZ 3.1-3, Aug 28)
B. Completeness (CSZ 3.4-5, Sept 4, 6)
C. Supremum, infimum, summability (CSZ 3.7-9, Sept 9, 11)

2. The Metric Space $\mathbb{R}^\ell$ (Weeks 4-10)

During this part of the course, we will cover much of the material contained in a good undergradatue real analysis class. This is a lot of material. We will do it in a fashion emphasizing the optimization and equilibrium applications. We will, mostly, cover proofs that work in all metric spaces, not just the metric space $\mathbb{R}^\ell$. The times below will be adjusted as needed.

A. Metrics and the discrete metric space (CSZ 4.1-2, Sept 16)
B. Norms and completeness (CSZ 4.3-4, Sept 18)
C. Closure, convergence, and completeness (CSZ 4.5, Sept 23, 25)
D. Separability and compactness (CSZ 4.3-4, Sept 30, Oct. 2)
E. Continuity I (CSZ 4.8, Oct 7)
F. Continuity II (CSZ 4.8-9, Oct 9)
G. Lipschitz and uniform continuity (CSZ 4.9, Oct 14)
H. Hemi-continuity and continuity of correspondences (CSZ 4.10, Oct 16, 21)
I. Theorem of the Maximum (CSZ 4.10, Oct 23, 28)
J. Contraction mappings (CSZ 4.11, Oct 30)

3. Convex Analysis (Weeks 11-14)

A. Separation (CSZ 5.1-3, Nov 4)
B. Separation and duality (CSZ 5.4, Nov 6)
C. Boundary issues, concave and convex functions (CSZ 5.5-6, Nov 11, 13)
D. Kuhn-Tucker and Langrange multipliers (CSZ 5.8-9, Nov 18, 20, 25)
E. Differentiability and concavity (CSZ 5.10, Dec 2)
F. A quick intro to fixed point theorems (CSZ 5.11-12, Dec 6)