Math Camp
Static Optimization: July 25 - August 7, 2012
Dynamic Optimization: August 20 - August 24, 2012

Jonathan Kreamer  
Office: Tydings 4118B  
Email: kreamer@econ.umd.edu  
Office Hours: M-F 8:30 - 9:00am

Brian Quistorff  
Office: Tydings 4118L  
Email: quistorff@econ.umd.edu  
Office Hours: M-F 3:00 - 3:30pm

Lecture: M-F 9:00am - 12:00pm  
Discussion: M-F 1:00pm - 3:00pm  
Room: Tydings 2110

Mathematical Economics Outline

The purpose of this course is to develop mathematical tools and intuition that will be valuable in analyzing a wide variety of economic problems. Through 8 lectures, we will cover static optimization problems and related topics. Following an 8 day course on Probability and Statistics, we will continue with 5 lectures on dynamic economic analysis.

The course textbooks are Simon, C. and L. Blume: Mathematics for Economists. Norton and Co. New York. 1994 (referred to in the readings as (SB)) and De La Fuente, A. (2000): Mathematical methods and models for economists, Cambridge: Cambridge University Press (referred to as (DLF)). Most of the topics covered in the course are treated in these books though we will deviate from the treatment of the texts in the lectures. Other useful resources are:

Static Optimization:

*Dynamic Optimization:*

There will be one test worth 100% of the grade. Problem sets along with solutions in PDF will be provided at [www.econ.umd.edu/vincent](http://www.econ.umd.edu/vincent). You are strongly recommended to try these problems (in groups, if so desired) before the review sessions and before looking at the solutions. Note, however, the suggested solutions do not come with a guarantee! We also offer some lecture notes at the same site. There may well be typos on them and you use them at your own risk!

The order of material in lectures may vary slightly from the list below.

*Static Optimization*

**I) Preliminary Concepts**
  i) Some Examples.
  ii) Continuity and Linearity. (*SB 13; DLF 1.5.b, 2.1-2.8*)
  iii) Vector Geometry. (*SB 10.1-10.4*)
  iv) Hyperplanes – Definition. Supporting and separating hyperplanes. (*DLF 6.1.c-6.1.d*)
  v) Derivatives and Gradients. (*SB 14.4, 14.6, 14.8; DLF 4.1-4.2*)
  vi) Homogeneous and Homothetic Functions (*SB 20.1, 20.4; DLF 4.5*)
  vii) Some More Geometry of Vectors in $R^q$

**II) Concepts and Problems in Unconstrained Optimization**
  i) Convexity, concavity and quasi-concavity. (*SB 16, 21.1-21.3; DLF 6.1.a, 6.2-6.3*)
  ii) Necessary conditions for an Optimum. (*SB 17.1-17.4; R 23, 25, 27*)
  iii) Sufficient conditions for an Optimum. (*SB 17.1-17.4*)
  iv) Minimizing versus maximizing.
III) Constrained Optimization I – Representing Constraint Sets
   i) Some Examples.
   ii) Functional Representation of Constraint Sets.
   iii) Open, Closed, Bounded Sets. (*SB* 12; *DLF* 2.4)
   iv) Convex sets.

IV) Constrained Optimization II – Kuhn Tucker Theory
   i) Examples.
   ii) Lagrange’s Theorem (*SB* 18.2; *DLF* 7.1.b)
   iii) Kuhn-Tucker Theorem and Differentiability (Necessary Conditions) (*SB* 18.3, 18.6; *DLF* 7.1.c)
   iv) The Constraint Qualification.
   v) Complementary Slackness.

V) Applications and Examples
   ii) Cost Functions and Shephard’s Lemma

VI) Comparative Statics
   i) Implicit function theorem. (*SB* 15.1 - 15.3.)
   ii) The Theorem of the Maximum. (S 9.2)
   iii) The Envelope Theorem (*SB* 19.1, 19.2)
   iv) Correspondences and Fixed Point Theorems (S 9.1, 9.4)
   v) Monotone Comparative Statics. Readings: *MWG* *MK*, *ML*, *ES*, *MS*.

Dynamic Optimization

VII) Discrete Time Intertemporal Optimization
   i) Alternative Methods of Discrete Time Intertemporal Optimization
   ii) The Maximum Principle
   iii) Dynamic Programming (*DLF*, 12.1)

- *DLF*, Chapter 13

VIII) Difference Equations
   i) Basic Concepts for Univariate equations (*DLF*, 9.1, 9.2, 9.4, 9.5)
   ii) Linear Systems (*DLF*, 10.1, 10.2)
   iii) Elements of Nonlinear Systems (*DLF*, 10.3)
• DLF, Chapter 11

VIII) Differential Equations (If time allows)
   i) Basic Concepts for Univariate equations (*DLF, 9.1, 9.2, 9.3, 9.5* )
   ii) Linear Systems (*DLF, 10.1, 10.2*)
   iii) Elements of Nonlinear Systems (*DLF, 10.3*)

• DLF, Chapter 11

X) Continuous Time Intertemporal Optimization (Not Covered)
   i) The Maximum Principle (*DLF, 12.2*)
   ii) Dynamic programming

• DLF, Chapter 13

XI) Extensions to Stochastic Setting (Not covered)
   i) Stochastic Difference Equations
   ii) Stochastic Discrete Time Intertemporal Optimization
   iii) Stochastic Differential Equations
   iv) Stochastic Continuous Time Intertemporal Optimization