Math Workshop for Entering Ph.D Students
(formerly) Econ 7001
Summer 2008

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Main Texts:

(1) Knut Sydsæter and Peter Hammond. *Essential Mathematics for Economic Analysis*. Prentice Hall, 2006. ISBN: 0-273-68180-X
(2) Knut Sydsæter, Peter Hammond, Atle Seierstad, and Arne Strøm. *Further Mathematics for Economic Analysis*. Prentice Hall, 2005. ISBN: 978-0-273-65576-3
(3) Michael Hoy, John Livernois, Chris McKenna Ray Rees, and Thanasis Stegnos. *Mathematics for Economists*. The MIT Press, 2nd edition, 2001. ISBN: 0-262-08294-2

The mathematical sophistication of the texts (1) and (3) is roughly the same, although the latter is more comprehensive in coverage. The text (2) is meant as a "next step" to the text (1). This tutorial is heavily influenced by the texts (1) and (2), but the student will find most of the topics we cover also covered (but often less thoroughly) in (3).

General Description:

This is a course in the mathematical methods Ph.D students will use during their first-year classes. Everyone will have had at least basic calculus, and also have some familiarity with linear algebra. The material we will cover can be found in chapters 12-16 in (1) along with chapters 1-3 and 13-14 in (2), and in chapters 5-15 in (3). The tentative plan is to cover chapters 12-16 from (1) in week one, and devote the following 2 weeks to chapters 1-3 and 13-14 in (2). Much of what we do in this course is aimed at understanding the concepts (and how to apply them correctly) outlined in the document 'Mathematical Prerequisites for Econ. 7005 "Microeconomic Theory I" and Econ. 7007, "Macroeconomic Theory I".

Exam

The exam for the course will be held on Friday, August 29th at 2:00 P.M. and will be held in BuC 306 (our usual room). The problems found on the exam will be variations on the problems assigned as homework.

(see reverse side for topics)

Topics:

[not necessarily covered in the given order]

- Implicit Differentiation
- Polynomial Approximation and Differentials
  - The Taylor Series
  - Tangent lines, planes, and (more generally) surfaces
  - Rules for differentials
  - Invariance of the differential
  - Differentiating systems of equations
    - Endogenous versus exogenous variables
    - Structural form versus reduced form of equation systems
- The Total Derivative
- Homogeneous and Homothetic Functions.
  - Euler's Theorem
- Multivariable Calculus
  - Gradients and the directional derivative
  - Convex sets
  - Concave and convex functions
  - Quasiconcave and Quasiconvex functions
  - Transformations
- Unconstrained Optimization
  - First order (necessary) conditions and second order (sufficient) conditions
  - The Extreme Value Theorem
  - Envelope Theorems
- Constrained Optimization
- The Direct Method
- The Method of Lagrange Multipliers
  - Necessary conditions (Lagrange's Theorem), and sufficient conditions
  - Interpreting the multipliers
  - Comparative statics
  - The Kuhn-Tucker Conditions
- Matrix Algebra
  - Basic matrix operations and rules
  - Vectors and their geometric interpretation; orthogonality, lines, planes and hyperplanes
  - Determinants and their computation by cofactor expansion
  - Matrix Inverse and the solution of linear systems of equations; Cramer's Rule
  - Basis, span, linear independence, rank
  - Eigenvalues, eigenvectors, diagonalization and the spectral theorem.
  - Quadratic Forms
- Basic Topological Concepts
- Sets, Functions and Correspondences