ECON 510: Mathematics Review

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University of Science and Technology
Hong Kong, Autumn 2009

Venue: 1505.

Time: Mon/Wed 09:00-10:20.

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Office Hours: by appointment.

Course Objectives: The course reviews some of the analytical tools most frequently used in economics and econometrics. It thereby enables students to follow and construct rigorous mathematical arguments within the context of economic, econometric and statistical analysis.

Intended Learning Outcomes:

- Understand formal mathematical arguments in the areas of calculus, real analysis and probability theory, linear algebra, optimization.
- Construct rigorous mathematical arguments in these areas.
- Prepare students for applications of the mathematical tools in economic theory and econometrics.

Teaching Approach: The lectures will be self-contained and constitute the primary resource for students taking this course. The formal presentation in lectures is intended to be interactive in order to make relatively abstract and theoretical material easily accessible. It is complemented by regular homework assignments in order to deepen students' understanding and enable them to actively master the material.

Resources: There is no mandatory textbook for the course. The main recommended accompanying textbooks for the course are

Adda, J. and R. Cooper (2003): *Dynamic Economics*, Cambridge MA: MIT press

Chiang, A.C. (1984): *Fundamental Methods if Mathematical Economics*, 3rd ed., New York: McGraw-Hill

Simon,, C. and L. Blume (1994): *Mathematics for Economists*, New York: Norton

For the probability theoretic part of the course, the appendix on probability theory of classical econometric textbooks are a useful starting point. Alternatives are:

Stone, C.J. (1996): *A Course in probability and Statistics*, Belmont: Duxbury Press

and more advanced treatments, such as:

Billingsley, P. (1995): *Probability and Measure*, 3rd ed., New York: Wiley

Durrett, R. (1996): *Probability: Theory and Examples*, 2nd ed., Belmont: Duxbury Press

Course Requirements: midterm examination (30 per cent) and final examination (70 per cent).

Grading Policy: Grading will focus on the degree to which students can demonstrate that they can use the mathematical tools presented throughout the course in order to construct formal and rigorous arguments. As a general matter, this course, as any other course at the University, enforces highest standards of academic integrity. Cheating and plagiarism will be reported to the university and the course grade will appear on students' records with an X, to show that the grade resulted from cheating. This X grade stays on the academic record until graduation. Repeated cheating, resulting in further X grades, triggers disciplinary procedures that can lead to expulsion from the University.

Tentative Course Outline:

1. **Single Variable Calculus**

   Single variable functions, limits, continuity, derivatives, composite functions, inverse functions, concavity and convexity, minima, maxima, Taylor series expansions.

2. **Integral Calculus**

   Indefinite integral, definite integral, fundamental theorems of calculus, integration rules, differentiation of integrals.

3. **Linear Algebra**

   Matrices and vectors, determinant, rank, inverse matrix, matrix operations, eigenvalue and diagonalization, matrix spectrum, trace, idempotent matrices, algebra of square matrices.

4. **Multivariate Calculus**

   Multivariate functions, continuity, derivatives, implicit functions.

5. **Optimization**

   Critical points, extrema, saddle points, unconstrained optimization, optimization with equality constraints, optimization with inequality constraints, envelope theorem.

6. **Dynamic Optimization**

   Discrete-time stochastic programming, continuous-time deterministic programming, applications.

7. **Differential Equations**

   Linear first-order differential equations with constant and variable coefficients, separable equations, nonlinear first-order differential equations, systems of linear differential equations.

8. **Probability Theory**

   Probabilities, conditional probability, independence, univariate and multivariate random variables, marginal, conditional, joint distribution, moments, law of iterated expectations