

MA MATHEMATICAL METHODS REVIEW

Fall 2009

Instructor: Prof. Ronan Congar
ronan.congar@univ-rouen.fr

This course reviews basic mathematical methods required for graduate courses in economics. Topics to be covered include elementary analysis and matrix algebra, differentiation, derivatives and integration, optimization (both static and dynamic). The emphasis is placed on problem solving and lecture elements of the course are kept at a minimum.

The following references are appendix chapters in textbooks that correspond to both the coverage and the format of the course and may be valuable as notes for this course: Jehle and Reny [2] (Mathematical Appendix: Chapter A1 Sets and Mappings and Chapter A2 Calculus and Optimization) and Wooldridge [5] (Appendix D: Summary of Matrix Algebra).

A much more complete treatment of the topics to be covered can be found in standard textbooks in mathematics: Sydsæter and Hammond [3], Sydsæter and al. [4] and Chiang [1].

1 Schedule

Tuesday, Sept. 8:	9:00 am-11:00 am and 1:00 pm-3:00 pm	DMS 10161
Wednesday, Sept. 9:	5:30 pm-8:30 pm	DMS 3105
Friday, Sept. 11:	2:30 pm-4:00 pm	DMS 1120
Saturday, Sept. 12:	9:00 am-11:00 am and 1:00 pm-3:00 pm	TBT 070
Monday, Sept. 14:	5:30 pm-8:30 pm	DMS 3105
Wednesday, Sept. 16:	5:30 pm-8:30 pm	DMS 3105
Friday, Sept. 18:	2:30 pm-4:00 pm	DMS 1120
Saturday, Sept. 19:	9:00 am-11:00 am and 1:00 pm-3:00 pm	TBT 070

2 Course outline

Topics to be covered include:

2.1 Sets and Functions

Basic Concepts and Definitions (Sets, Convex Sets, Binary Relations and Functions), *Continuous Functions and Compact Sets* (Open and Closed Sets, Bounded and Compact Sets, Continuity, Properties of Continuous Functions), *Concave and Quasiconcave Functions* (Concave Functions, Quasiconcave Functions).

2.2 Elements of Matrix and Vector Algebra

Matrices and Vectors (Equality, Addition of Two Matrices, Scalar Multiplication, Matrix Multiplication, Identity Matrix, Scalar Matrix, Diagonal Matrix, Transposition), *Determinants* (Determinants, Properties of Determinants, Singular Matrices, The Inverse Matrix, Properties of Inverse Matrices) *Linear Dependence and Rank* (Linear Independence, Rank of a Matrix, Solving Linear Systems), *Quadratic Forms* (Quadratic Forms, Definite Matrices).

2.3 Differentiation and Derivatives

Functions of a Single Variable (Derivatives. The Differential of a Function. Higher-order Derivatives. Taylor's Theorem. Concavity and First and Second Derivatives, Integration), *Functions of a Several Variables* (Derivatives. The Differential of a Function. Higher-order Derivatives. Taylor's Theorem. Concavity and First and Second Derivatives. Homogeneous Functions and Euler's Theorem).

2.4 Unconstrained Optimization

Single Variable Optimization (First- and Second-order Conditions. Concavity and Convexity. The Envelope Theorem. Comparative Statics). *Multivariate Optimization* (First- and Second-order Conditions. Concavity and Convexity. The Envelope Theorem. Comparative Statics and the Implicit Function Theorem).

2.5 Constrained Optimization

Optimization with Equality Constraints (Solution by direct substitution. Lagrange's Method. Interpretation of the Lagrange multipliers. The Case of Several Constraints. Second-Order Conditions), *Optimization with Inequality Constraint* (Kuhn-Tucker Theorem), *Dynamic Optimization* (Introduction).

References

- [1] Chiang A.C., *Fundamental Methods of Mathematical Economics* (McGraw-Hill, third edition: 1984).
- [2] Jehle G.A. and P.J. Reny, *Advanced Microeconomic Theory* (Addison-Wesley, second edition: 2001).
- [3] Sydsæter K. and P. Hammond, *Essential Mathematics for Economic Analysis* (Prentice Hall, third edition: 2008).
- [4] Sydsæter K., P. Hammond, A. Seierstad and A. Strøm *Further Mathematics for Economic Analysis* (Prentice Hall, second edition: 2008).

- [5] Wooldridge J.M., *Introductory Econometrics* (South-Western, second edition, 2002).