School of Mathematics

Course 381 — Mathematical Economics 1998-99
(J.S./S.S. Mathematics, J.S./S.S. TSM)

Lecturer: Dr P Waldron

Requirements/prerequisites: 211 is an essential prerequisite, 221 and 251 are strongly recommended and 212 would be useful, but not essential. Students would also benefit by simultaneously taking Course 412 - Probability.

Duration: Michaelmas, Hilary and Trinity

Number of lectures per week:

Assessment: Problem sets will be assigned regularly throughout the course and will be discussed in tutorials

End-of-year Examination:

Description:
Course 381, first offered in 1993-94, is a course in mathematical economics (including a substantial component on mathematical finance) taught by Dr Patrick Waldron (Economics Department). It is a compulsory mathematics course for Junior Sophister TSM students in mathematics and economics and may also be chosen by the following:

- Sophister students in single honor mathematics
- Senior Sophister TSM students in mathematics whose other subject is not economics
- Senior Sophister TSM students in mathematics and economics who have not already taken course 3.08 (Mathematical economics) as a Junior Sophister economics option.
  (In 1995-96, these courses will be taught separately, although about half of the course material is common to the two courses).

There will be two lectures per week and tutorials will be arranged from week 3 of Michaelmas term. Some tutorials will be based on a collection of Mathematica notebooks accompanying the textbook by Varian.

Objective
The objective of this course is to introduce students of mathematics to a few of the countless applications of mathematics in modern economics and finance. Much of the mathematics will be familiar, and the emphasis will be on applying it in economics.

Course outline
The course will be broken down into the following topics:

1. Introduction to Economics
2. Convexity and Concavity

3. Unconstrained Optimisation
4. Equality Constrained Optimisation and Lagrange Multipliers
5. Inequality Constrained Optimisation and the Kuhn-Tucker Theorem
6. Consumer Choice Theory
7. General Equilibrium Theory
8. The Welfare Theorems
9. Equilibrium with Arrow-Debreu Securities
10. Choice under Uncertainty and the Expected Utility Paradigm
11. The Single-period Portfolio Choice Problem
12. Mathematics of the Portfolio Frontier
13. Market Equilibrium: The Capital Asset Pricing Model
14. Arbitrage and the Pricing of Derivative Securities
15. Multi-period and Continuous Time Investment Problems

Textbooks

[1] Arrow, K.J. & Hahn, F.H. (1971), General Competitive Analysis, Holden-Day, San Francisco.
[2] Debreu, G. (1959), Theory of Value: An Axiomatic Analysis of Economic Equilibrium, Yale University Press, New Haven.
[3] Dixit, A.K. (1990), Optimization in Economic Theory, 2nd edition, Oxford University Press, Oxford.
[4] Hildenbrand, W. & Kirman, A.P. (1988), Equilibrium Analysis: Variations on themes by Edgeworth and Walras, North-Holland, Amsterdam.
[5] Huang, C.-F. & Litzenberger, R.H. (1988), Foundations for Financial Economics, North-Holland.
[6] Kreps, D.M. (1990), A Course in Microeconomic Theory, Harvester Wheatsheaf, New York.
[7] Madden, P. (1986), Concavity and Optimization in Microeconomics, Basil Blackwell, Oxford.
[8] Mendelson, B. (1975), Introduction to Topology, 3rd edition, Allyn and Bacon, Boston.
[8] Merton, R.C. (1972), “An analytic derivation of the efficient portfolio frontier”, Journal of Financial and Quantitative Analysis 7, 1851-1872.
[9] Roberts, A.W. & Varberg, D.E. (1973), Convex Functions, Academic Press, New York.
[10] Rockafellar, R.T. (1970), Convex Analysis, Princeton University Press, Princeton.
[11] Roll, R. (1977), “A critique of the asset pricing theory’s tests - Part I: On past and potential testability of the theory”, Journal of Financial Economics 4, 129-176.

[12] Silberberg, E. (1978), The Structure of Economics: A Mathematical Analysis, McGraw-Hill, New York.
[13] Simon, C.P. & Blume, L. (1994), Mathematics for Economists, Norton, New York.
[14] Takayama, A. (1994), Analytical Methods in Economics, Harvester Wheatsheaf, New York.
[15] Varian, H.R. (1992), Microeconomic Analysis, 3rd edition, Norton, New York.

For the first eight topics, the primary text, insofar as there is one, is Varian. For the last seven topics, it is Huang and Litzenberger. Students should also get the errata for Varian's book. Reference will occasionally be made to particular topics convered in the other sources listed here.

June 10, 1998