Mathematical Economics

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Suggested Textbook:

- Simon and Blume, Mathematics for Economists, 1994. (S & B)
- Leonard and van Long, Optimal Control Theory and Static Optimization in Economics, 1992. (L & vL)

Other Texts Useful but NOT Required for this Course:

- Takayama, Mathematical Economics, Cambridge University Press: Cambridge, UK, 1985.
- Rudin, Principles of Mathematical Analysis, McGraw-Hill: New York, 1976.
- Stokey, Lucas, and Prescott, Recursive Methods In Economic Dynamics, HU Press, 1989.
- Ok, Real Analysis with Economic Applications, Princeton University Press, 2007.
- Sundaram, A First Course in Optimization Theory, 1996.

Brief Description and Aim:

This course is concerned with developing the basic mathematical tools needed for advanced study in economics. It will also improve your understanding of economic theory; make your other economics courses much easier.

Do we have to study math in order to do economics? Yeah. You got to have a quantitative mind. It might even be fun. We should consider "math" as a language which is a way of representing and conveying information. You might not like to learn another language but you have to if you want to communicate with others. Now I am guiding you to learn and love (if possible) a different language, math. Math helps us to understand much more complicated material.

In this course, we will not only solve problems but also prove things, and that is a significant conceptual part of this course. This will require you to take a more formal approach to mathematics. Not only will you need to know these, but you will have to understand them, and be able (through the use of them) to demonstrate that you understand them. Simply learning the definitions without understanding what they mean is not going to be adequate.

I highly recommend you to study for this course on a daily basis to produce the best outcome. Doing assigned exercises is essential for your success. Since each topic is built on preceding topics, make sure that you understand the core of the material before we move to the next topic. Do not hesitate to contact me and/or your TA for your questions.

	Tentative Schedule	
# 1	**Introduction & Basics**	Elements of Set Theory and Logic How to do “proofs”?
# 2	**Mappings**	Relations, Functions, Sequences, Correspondences, Vectors, Matrices
# 3	**Analysis in** R	Sequences in R, Lim Inf and Lim Sup, Limits Sequences in R,
# 4		Functions in R, Continuity, Differentiation and Integral,
# 5	**Metric Spaces**	Definition and Examples, Open and Close Sets
# 6		Compact Sets, Completeness,
# 7	**Linear Spaces**	Introduction, Linear Subspaces, The Span of A Set of Vectors, Linear Independence and Basis,
# 8		Hyperplanes, Orthogonal Projections,
# 9		Subsets of Linear Spaces, Affine Sets, Convex Sets and Convex Hulls, Simplex and Convex Cone, Eigenvalues and Eigenvectors,

#10	**Optimization**	Existence Unconstrained Optimization First Order Conditions Second Order Conditions
#11	**Constrained Optimization**	Equality Constraints The Theorem of Lagrange Constraint Qualifications
#12		Inequality Constraints The Kuhn-Tucker Theorem Mixed Constraints
#13	**Parametric Maximization**	The Maximum Theorem Fixed Point Theorem
If time allows..... #14	**Differential Equations**	Linear differential equations Nonlinear differential equation Systems of differential equations
#15	**Optimal Control**	The Hamiltonian and the maximum principle the transversalty condition When are necessary conditions also sufficient Infinite planning horizons
#16	**Difference Equations**	Deterministic difference equations Rational expectations and uncertainty Nonlinear difference equations
#17	**Dynamic Programming**	Deterministic finite-horizon problems Deterministic infinite-horizon problems Dynamic programming and optimal control Stochastic dynamic programming