Leo Simon

ARE201a
Fall 2015

Production, Industrial Organization and Regulation:
Part a: Mathematical Foundations
Syllabus

SB refers to Mathematics for Economists, by Carl Simon and Larry Blume (SB). F refers to Mathematical Methods and Models for Economists, by Angel De La Fuente MWG refers to Mathematical Appendix to Microeconomic Theory, by Mas-Colell, Whinston and Green (MWG). The texts are only peripherally related to the course material. The chapter guides are approximate.

(1) **Linear Algebra** SB(6-11,16,23,26,27), F(3), MWG(M.D)
- (a) Linear Combinations, Linear Independence, Linear Dependence and Cones.
- (b) Vector Spaces
- (c) Spanning, Dimension, Basis
- (d) Matrices and Rank
- (e) Linear Functions
- (f) The "graph" of a linear function from $\mathbb{R}^2$ to $\mathbb{R}^2$
- (g) Determinants, Rank and volume
- (h) Solving linear equation systems and Cramer's Rule
- (i) Eigenvalues and eigenvectors

(2) **Calculus** SB(2-4,14,30), F(4)
- (a) The fundamental notion: linear approximations to nonlinear functions.
- (b) Partial Derivative, Cross Partial and Total Derivatives
- (c) The differential in Multivariate Calculus: real-valued functions
- (d) The differential in Multivariate Calculus: vector-valued functions
- (e) Taylor's Theorem
- (f) Application of Taylor's theorem: 2nd order conditions for an unconstrained maximum

(3) **Constrained Optimization** SB(18,19), F(7), MWG(M.K)
- (a) Existence and Uniqueness
- (b) Necessary and sufficient conditions for a solution to an NPP
- (c) Demonstration of why the KT conditions are really necessary
- (d) Interpretation of the Lagrange Multiplier
- (e) KT conditions and the Lagrangian approach
- (f) Computing a solution to a NPP: a worked example
- (g) Second Order conditions for a Constrained Maximum

(4) **Comparative Statics** SB(15,19.2), F(5.2), MWG(M.E, M.L)
- (a) The envelope theorem (unconstrained version).
- (b) The envelope theorem (constrained version).
- (c) Implicit function theorem
- (d) The implicit function theorem and comparative statics.