ECONOMICS MATH CAMP – August 2013

GENERAL DESCRIPTION

Math Camp is intended to support 1st-year graduate students in Economics, Agricultural & Resource Economics, and related disciplines, in being ready to successfully pursue ECON 501 (Quantitative Methods for Economists) and other mathematically oriented graduate courses.

Math Camp is very strongly recommended for all entering students with the exception of individuals who have especially strong recent math training. Math Camp is required for all students funded by the Department of Agricultural and Resource Economics.

SCHEDULE (subject to change):

Monday, August 19, 1-3pm in Clark A204
Wednesday, August 21, 1-3pm in Clark A204
Thursday, August 22, 1-3pm in Clark A204
Friday, August 23, 9-11am in Clark C238 and 1-3pm in Clark A204

INSTRUCTOR: Liesel Hans, Economics Ph.D. Candidate

MY EMAIL: Liesel.Hans@Colostate.edu

TEXT: Simon & Blume, *Mathematics for Economists* (Norton, 1994), Chapters 1-6
…This is the text required for ECON 501, where coverage will begin with Chapter 7.

Recommended as an additional resource: Dowling, *Schaum's Outline Introduction to Mathematical Economics,* 3rd edition (McGraw-Hill, 2001).

A. INTRODUCTION

1. PURPOSE OF THE COURSE

Despite uniform requirements of one semester of undergraduate calculus, which is usually limited to single variable calculus and associated optimization methods; many of you come to graduate school with a variety of math background experiences. It is for this reason that we hold this Math Camp to get your brains working and ensure that you all have time to practice the mathematical skills needed to succeed in ECON 501 and the remainder of your graduate school experience.

2. MOTIVATIONS FOR THE USE OF MATH IN ECONOMICS

In many ways, the primary difference between a graduate and undergraduate-level understanding of economic theory is simply a difference in the *language* we use to help us tell economic stories. Most likely, your undergraduate training resulted in a familiarity with both graphical and verbal analysis. For example, you likely used indifference curves to represent preferences in a two-good model, then added a budget constraint, and showed that the optimal bundle of consumption occurred where the marginal rate of substitution equaled the price ratio of the two goods. You could then change prices and trace out a demand curve, and put it together with a supply curve to determine market outcomes.

In graduate school, we use all of the same economic concepts….marginal rates of substitution, budget constraints, supply and demand, etc… However, in order to tell more complicated stories, we need to move beyond simple two-dimensional cases which we can graph. Enter mathematics, especially the tools of calculus. Think about it…we're always going on about marginal this and marginal that in economics, right? Well, marginal means incremental, and the partial derivative of a differentiable function gives us the incremental change in a function if one of its arguments changes. Although this is just the tip of the iceberg, it illustrates the potential power of the mathematical language to allow economics to represent and tell stories about all sorts of economic behavior. In essence, it is what WE do as ECONOMISTS!

3. DESIGN OF THE COURSE

Throughout this week, we will have five 2-hour class sessions including both lecture and working through practice problems together. Homework assignments will be given in order to give you some time to practice the material, and will only be graded so that you can get a sense of the level of your understanding.

Sample Outline:

B. SINGLE VARIABLE CALCULUS: REVIEW
1. The vocabulary of functions
    a. Real numbers and the real line, $\mathbf{R}_1$; intervals in $\mathbf{R}_1$
    b. Functions; increasing, decreasing, constant; linear
    c. Examples in economics
2. Derivatives
    a. Slopes of linear functions reviewed
    b. Slope of a non-linear function: limit of the slope of a series of secants, defintion of derivative
    c. Rules for computing derivatives
    d. Economic applications: marginal cost, elasticity, sellers' revenue effects
    e. Inverse functions: demand as an example, the Inverse Function Theorem
    f. Higher level derivatives: 2_{nd} derivatives and their meaning
    g. Characterizing functions using derivatives: increasing, decreasing, concave, convex
3. Maxima and minima
    a. Local vs global optima; interior and boundary solutions
    b. First order necessary condition for an interior solution
    c. Second order sufficient condition for a max or min
    d. First order conditions when boundary solutions are possible: case of x bounded below at zero
    e. Economic application: profit-max
4. e and ln
    a. What is e? The interest compounding process as a motivation; definition
    b. Future values and present values
    c. The natural logarithm ln: review of logs; definition of ln; review of logarithm operation
    d. Economic applications: elasticity (demand), rates of change over time (environmental impact)

C. SYSTEMS OF LINEAR EQUATIONS
1. Some simple economics examples
    a. Supply and demand equations; solution as equilibrium
    b. IS-LM model; solution as equilibrium
    c. OLS estimation; solution as optimal estimators
    d. Why linear equation systems are important in economics
2. The standard form of linear systems
    a. The 1-equation 1-unknown case: simple issues of existence and uniqueness of a solution

b. 2 equations and 2 unknowns; m equations and n unknowns; what if $m \neq n$?

D. ADDITIONAL TOPICS AS TIME ALLOWS
   1. Matrix Calculus
   2. Integral Calculus (Appendix A4 in Simon & Blume)
   3. Probability (Appendix A5 in Simon & Blume)