Economics 830: Mathematical Economics **gjonesb@gmu.edu**
Fall 2017
Garett Jones

Office Hours:
Th 6pm-6:45pm, and usually T 3-4:30pm, Johnson Center Starbucks, and gladly by appointment.

Review sessions led by GMU Econ graduate assistant John Schuler:
Th 5pm-6pm in Carow Hall, at least for the first few weeks, subject to revision.

Welcome to the course! We'll start off with simple models of economic dynamics and continuous-time economic optimization before turning to the heart of the course, a calculus-heavy meditation on firm and consumer choices without and then with uncertainty.

Skills I take entirely for granted: Elementary differential calculus (univariate and multivariate), elementary integration (univariate), basic matrix/linear algebra (addition, multiplication, a little inversion), univariate unconstrained optimization, and logarithms, logarithms, logarithms. Essentially, the first third or so of Dowling's *Introduction to Mathematical Economics*, as covered in GMU Econ's Math Camp.

Course outline: Subject to revision, particularly later in the semester
A small number of additional assigned readings will be included on Blackboard

Notation
C/W: Chiang and Wainwright's *Fundamental Methods of Mathematical Economics*
S/S: Silberberg and Suen's *Structure of Economics*
Optional readings really are optional.
Parallel are probably very useful if you're new to this, and they may make it into lecture.

Week 1: Logarithmic and exponential functions in economics
C/W Chapter 10

Week 2: Integrals in economics and elements of differential equations
C/W Chapter 14 (14.1-14.5), 15.1-15.2

Online quiz due before week 3 class

Week 3: Nonlinear differential equations and a complete solution to the Solow model
C/W 15.3-15-6

Week 4: Optimal Control Theory
C/W Chapter 20 (20.1-20.4, perhaps 20.5)
Weitzman, Chapter 1 (on Blackboard)
Optional: S/S 20.

Online quiz due before week 5 class

Week 5: Taylor Approximations and Multivariate Optimization
S/S 2.4, 2.5, 4
Parallel: C/W 9.5, 11. (Review 8.1-8.4 on differentials and total derivatives as needed)

Week 6:	Optimization with Equality Constraints (special appearance by homogenous functions) S/S 6 Parallel: C/W 12.
Week 7: 10/12	*Continuous Time and Static Optimization Exam.* *Will include the Greek alphabet.*
Week 8:	The Envelope Theorem and Cost Functions S/S 7, 8 Parallel: C/W 13.5, 13.6
Week 9:	Costs Continued S/S 9
Week 10:	Consumers I S/S 10 Dixit 1, 2 Optional: Varian, Chapters 5-6 *Online quiz due before Week 11 class*
Week 11:	Consumers II SS 11 Optional: Varian, Chapter 7
Week 12:	Intertemporal choice, elements of uncertainty S/S 12
Week 13:	*Thanksgiving Day, no class*
Weeks 14-15:	Making decisions under uncertainty in theory and practice S/S 13 Dixit 9 Optional: Varian, Chapter 11 *Email Final Project by Monday, 12/11, 11pm* **Final Exam: Thursday, 12/14, 7:30pm**

Final Project: You are to write a very short economic paper, about four pages long, based on the imaginary economy of either Mars or Venus, as you choose. You should follow the Caltech Rules format suggested by Stanford's Barry Weingast, a past visitor to GMU and frequent coauthor of Nobelist Douglass North. It is due December 11, a few days before the final. You must submit a PDF. You will get a 20% bonus if your paper appears to be written in LaTeX; I suggest LyX as the easiest way to write in LaTeX, though any method will get you the 20% bonus.

Required Textbooks:

Chiang and Wainwright (C/W), *Fundamental Methods of Mathematical Economics*, 4th edition.
Quite good on optimization theory, and covers a lot of widely-used models along the way. It covers only a few rarely used topics, and I've skipped almost all of them. The new section on continuous time, with which we start the course, is quite good.

Silberberg and Suen (S/S), *The Structure of Economics: A Mathematical Analysis*, 3rd edition.
A graduate-level microeconomics text that does a good job of teaching the required mathematics along the way. The Amazon reviews suggest that this book has been helpful to many new graduate students in economics; that very fact might explain why it isn't assigned more often.

Avinash Dixit, *Optimization in Economic Theory*.
A classic for good reason: It's a thoughtful, idea-driven study of how to set up optimization problems so that you can answer genuinely interesting questions. I only assign a few chapters; consider working through the rest of it over the winter break. I find many good teaching examples here: Dixit's book is just a good idea generator, and it's a tour through the mind of one of the more creative economic theorists of the era.

Optional but excellent:

For the student with more math and micro background:
Varian, *Microeconomic Analysis,* 3rd edition, 1992.
Varian's text is at the intersection of most readable and wisest of the graduate microeconomics textbooks. An emeritus professor at Berkeley, he is now Chief Economist at Google, and coauthored perhaps the first great popular book on the economics of the internet, *Information Rules*. His academic theories were surely derided long ago as unrealistic and irrelevant to the real world. We should all be so irrelevant.

For the student with less of a math and micro background:
Hal Varian, *Intermediate Microeconomics.*
Affectionately known as "Baby Varian," its chapters cover most of the relevant Varian *Analysis* material with algebra instead of calculus, and with more intuitive reasoning. The end of chapter appendices bridge the gap between undergraduate and graduate micro. Baby Varian has helped many a first-year graduate student, myself included. Of course, any edition of Baby Varian will be fine.

Other possibly useful texts:
Dowling, *Schaum's Outline, Introduction to Mathematical Economics*.
Dowling has solutions to many problems and I find that solved problems are extremely helpful when I'm new to a field. The key element that makes Dowling feel pre-modern: His use of numerical solutions rather than parameter-based solutions. In economics it's usually most useful to see what the optimal (or suboptimal) outcome is as a function purely of exogenous parameters, so finding that "optimal profit = 15.3" isn't that helpful: I'd like to know, for example, if profit in a certain market is more responsive to wage changes or to changes in the cost of capital. To do that, you need to solve problems filled with Greek letters, not numbers.

Pemberton and Rau, *Mathematics for Economists: An Introductory Textbook*, Second Edition.

Lots of examples, worth working out. It has a more modern feel than Chiang and Wainwright, but the continuous time chapters weren't as targeted as C/W's.

Ken Binmore, *Mathematical Analysis: A straightforward approach*

Binmore, an important game theorist, writes a quite basic real analysis text. Analysis is more or less the theory underlying calculus, offering proofs of most of the major claims you come across in calculus and its subcomponents (function, the real line, limits, etc.). What makes the book especially valuable is that Binmore is an economic theorist, so his book is structured around tools you'll find yourself using if you find yourself consuming or producing a lot of economic theory. A lot of books cover more analysis, but Binmore's book is quite elegant and fun to read.

Grading: There will be one in-class midterm during week 7 and a final exam given during GMU's scheduled final exam time. There will also be three Blackboard-based quizzes between exams, as noted in the schedule above. The Blackboard quizzes are designed to be just a spur to keeping up with the material and will be on the easier side; the midterm and final will be more challenging.

The final will not cover the first four weeks of material. Do note that questions in C/W, S/S, and Dixit are good practice for the final exam, and for learning to think like an economist.

Semester weighting will be as follows:

Midterm:	30%
Blackboard quizzes (3):	5% each
Final paper:	10%
Final exam:	45%

Students with Disabilities: I am, of course, glad to make accommodations for students with disabilities. GMU's Office of Disability Services is available at ods.gmu.edu.

Again: Final Exam: Thursday, 12/14, 7:30pm. Please plan accordingly.