

Place and

Time HOD-D-336 T/Th 4:00-5:15

Professor: [Professor Roger D. Congleton](#)

Office: 4131 Reynolds Hall

Office Hours *Wednesday and Thursday 2:30-3:30 and most other times in the afternoon by appointment*.E-Mail roger.congleton@mail.wvu.edu

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Required Text: (None, the web notes on the class website, homework assignments on Ecampus, and the lectures are sufficient)

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Course Overview

Mathematical Economics is a lecture-based course that uses algebra and calculus to analyze economic decision making and market equilibria when consumers and firms are rational in the sense that they have clear consistent goals that can be represented as net benefits or utility levels. Although the main focus of the course is theory, applications to a wide range of choice and policy settings are used to illustrate the relevance of the tools developed in class.

There are several types of economic results that are most easily derived and demonstrated using algebra and calculus; these are the main focus of the course. Part I uses calculus on exponential utility and production functions to characterize consumer and firm choices, and equilibria in perfectly competitive and less than perfectly competitive markets. Part II uses algebra and calculus to model choices under uncertainty and inter-temporal choices (choices that affect the future). Part III uses calculus and algebra to model settings where outcomes are jointly determined by the decisions of a small number of decision makers acting more or less independently of one another (game theory), again using concrete functional forms. Part IV (if we have time) will show how abstract functional forms can be used to generalize the results from Parts I, II, and III.

The goal of the course is to provide the student with an understanding of the mathematical models that ground contemporary micro-economics. It is a challenging course, and is most useful for students who are good at math and thinking about advanced degrees in economics or economic-related subjects.

Dates	Topic
18-Aug-22	1. Introduction to Mathematical Economics Model building and methodological Individualism: Optimization as a model of rational decision making by consumers and firms. Methodological Individualism. Microeconomics as an implication of purposeful behavior. Models of rational choice using Geometry, Algebra, and Calculus as modelling tools (1 lecture)

I. Optimization and Neoclassical Economics

23-Aug-22	2. Optimization and the Shapes of Functions The geometry of three types of concavity. Usefulness of assumption of strict concavity. The notation of derivatives. Derivatives as a method for determining concavity. Example: Consumer Choice using net benefit maximization with explicit functional forms.. (1 lecture)
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25-Aug-22	3. Optimization and Some Core Insights from Neoclassical Economics Use of calculus to characterize marginal cost and marginal benefit curves for consumers and firms. Deriving consumer and firm level demand and supply curves from the net-benefit maximizing model. Constrained and unconstrained optimization (2 lectures) Homework-1 (Due Aug 31)
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1-Sept-22	4. Constrained Optimization and Some Core Insights of Neoclassical Economics Characterizing consumer demand using exponential utility functions and budget constraints. Advantages over the net benefit maximizing approach. Exponential Production functions and Market Supply. A more sophisticated grounding for competitive equilibrium and comparative statics. (3 lectures) Homework 2 (due Sept 14)
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13-Sept-22	5. Optimization by Firms Facing Downward Sloping Demand Curves . Price taking and price making firms. Cost functions and market structure. Simultaneously determining output and prices. (1 lecture)
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**STUDY
GUIDE
I**

20-Sept-22 Review for First Exam

22-Sept-22 First Exam

27-Sept-22 Review of First Exam

II. Choice Under Uncertainty and Intertemporal Choice

29-Sept-22	5. Optimization and Uncertainty: Expected Utility Maximizing Choices Expected values with discrete and continuous probability functions. Maximizing expected utility. Individual demand curves when product quality is uncertain. Supply curves when market prices are uncertain. lottery games (2 lectures) Homework-3 (due Oct 5)
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6-Oct-22	6. Optimization and Time: Intertemporal Choice Present discounted values with finite and infinite time periods. Importance of time discount rates for intertemporal calculations. Combining
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intertemporal choice and choice under uncertainty. (3 lectures) **Homework-4 (Due Oct 17)**

III. An Introduction to Non-Cooperative Game Theory

18-Oct-22 5. Introduction to Non-Cooperative Game Theory: Game Matrices and the Concepts of a Nash Equilibrium and Best Reply Function (in games with 2 players with countable numbers of strategies). (1 lecture) **Homework-5 (Due Oct 19)**

20-Oct-22 6. Games with Infinite (Continuous) Numbers of Strategies: Illustration: Lotteries with 2 and N players. Lotteries as contests, Contests as lotteries, Dissipation Rates. Application to politics, etc. **Homework-6 (Due Oct 26)** (2 lectures)

27-Oct-22 7. Imperfect Competition as Games Between Small Numbers of Firms
Cournot and Stackelberg Duopoly, the Effect of Entry in Cournot Markets (1 lecture) **Homework-7 (Due Oct 26)**

1-Nov-22 **Review for Second Exam**

3-Nov-2022 Second Exam Exam to be proctored, tentative Travel Day (PPE society) for Prof Congleton

8-Nov-22 **Review of Second Exam**

IV. Optimization: Generalizing with Abstract Functional

10-18 Nov 2022 **Forms** (Tentative Travel Week for the Japanese Public Policy Association, Nov 14-19) / (2 Prerecorded Lectures online unless Covid etc causes the conference in Japan to be online via zoom or something similar)

10-Nov-22 8. Microeconomics with Abstract (but shaped) Functions

Generalized Concave Utility Functions and Demand. Generalized Cost Functions and Supply. The Mathematics of downward sloping demand curves and upward sloping supply curves. Abstract Representations of Contests, Comparative Statics using the Implicit Function Differentiation Theorem (5 lectures, continues after Thanksgiving break). **Homework-8 (Due Dec 7)**

19-27 Nov 22 **Thanksgiving-Fall Recess / No Class**

8-Dec-22 10. Overview of the course and Paper Workshop

Final Papers on an Economic or a Political Topic Using Mathematical Tools from this Course.

Due by Email at Midnight on the Scheduled Exam Day

**STUDY
GUIDE
II**

**Ideas for
Paper
Topics**

Grades:

Eight Homeworks	24.00%
Bonus for Class Participation	4.00%
Two Exams	54.00%
Final Paper (AOL)	22.00%

Marginal extra credit for extra-helpful class participation (up to 2-3% bonus)