

Economics 4559: Market Design

University of Virginia, Spring 2021

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“Economists have lately been called upon not only to analyze markets, but to design them. Market design involves a responsibility for detail, a need to deal with all of a market's complications, not just its principle features. Designers therefore cannot work only with the simple conceptual models used for theoretical insights into the general working of markets. Instead, market design calls for an engineering approach.” — Alvin Roth, *Economist as Engineer*

Course description: The course will consider the theory and practice of market design. The goals of the class are to learn to diagnose the problems in markets that render them inefficient, and then develop a toolbox of treatments to remedy failed markets. The course starts with a review of welfare economics (utilitarianism, egalitarianism, the welfare theorems) and the mechanics of market failures (market power, externalities, incomplete information, missing markets). We then study the core tools used in practice to treat failed markets (auctions, deferred acceptance algorithms, top trading cycles, and implementation theory or mechanism design) as well as applied examples (the FCC Spectrum and Incentive Auctions, Google Adwords, the NYC and Boston Public School Matches, the National Resident Matching Program, the Northeastern Kidney Exchange).

Grading:

1. There will be a short homework assignment for each lecture, for a total of 20% of the final grade. Students have 7 days from the class session to turn in the problem set, unless other arrangements are made.
2. There will be three exams, each counting for 20% of the final grade. They will be “traditional” 75 minute exams, but, due to the covid pandemic, they will be “take-home” and open book. Exams will be held during class time.
3. Students in groups of size 1 to 4 will pick a particular market, diagnose its failures, and propose an intervention that addresses its inefficiencies or shortcomings. This can be as specific as “the market for seats at Cavalier basketball games” or as general as “the market for ideas,” but must (1) clearly define the participants in the market, their preferences, their information, and the goals of the market designer, (2) explain why there is a specific market failure that justifies intervention, and (3) propose an intervention which clearly addresses the market failure. The best projects will provide a quantitative equilibrium analysis or empirical analysis of the market or proposed design. Students will summarize their results in a 3–8 page paper, which counts for 20% of the final grade.

How is this semester going to work? I am going to post everything you need to do for the class on Collab. In particular, the lesson videos and problems will be posted for each class session. I am doing my best to keep the video lessons as lean as possible, so that when you are working on the problems, you have a short video to flip through instead of a 75 minute video. In terms of class, I would prefer to use the time as problem solving and “discussion,” where students can either watch the videos in advance or during that time, and ask questions about the videos or problems.

Meeting Times: Tuesday/Thursday, 8:00–9:45 a.m., online asynchronous with synchronous components.

Office Hours: Wednesday 10:00–11:30 a.m. and 3:00–4:30 p.m., and by appointment. Due to the covid pandemic, I will hold office hours online through Zoom for now. At a later date, it might be possible to hold them in person.

Course Materials: Course materials will be available through Collab. There are three units (Welfare and Market Failures, Auctions, and Matching), and each unit is divided into a set of classes, and each class is divided into four to six lessons. Videos for each lesson (about 7 to 14 minutes each) will be made available on Collab. In addition to the content videos, I will post videos that answer common questions and do more examples. Problems and solutions for each class will also be posted on Collab. Practice exams and solutions will be provided in advance of the exams. Regardless of whether you are a “synchronous” or “asynchronous” student, all of the content will always be available on Collab, so the class will be able to proceed as long as you have an Internet connection.

Textbook: There is no required textbook. Slides and handouts will be provided for every class, problems and solutions will be posted online. If you wanted some references, I would recommend any of the following for game theory:

- Harrington, J. *Games, Strategy, and Decision-Making*, Worth Publishers, 2008. This is the friendliest introduction to game theory available. This is best if you find economics challenging or want something a bit easier than the class to fall back on.
- Osborne, M. *An Introduction to Game Theory*, Oxford University Press, 2003. This option is pretty close to how the material will be presented in class. Its biggest advantage is that there are many problems in it, and a publicly available solution manual.
- Gintis, H. *Game Theory Evolving*, Princeton University Press, 2009. This is a quirkier, more intellectual and critical take on game theory and quantitative social science. It is a fun book that puts ideas first. If you think of yourself as more of an intellectual, this might be a fun option.

And for the market design material,

- Haeringer, G. *Market Design: Auctions and Matching*, MIT Press, 2018.

But I will post slides, handouts, and lots of problems, so I do not think it will be necessary to purchase any book.

Prerequisites: Intermediate microeconomics and calculus.

Academic Integrity: (Wording suggested by the administration) "I trust every student in this course to fully comply with all of the provisions of the University's Honor Code. By enrolling in this course, you have agreed to abide by and uphold the Honor System of the University of Virginia. All graded assignments must be pledged, including homework and exams. All suspected violations will be forwarded to the Honor Committee. Please let me know if you have any questions regarding the course Honor policy. If you believe you may have committed an Honor Offense, you may wish to file a Conscientious Retraction by calling the Honor Offices at (434) 924-7602."

Absences, late work, make-up exams, extra credit: If you are unable to turn in homework on time, please contact me in advance to explain the situation. If you, for some reason, are unable to take an exam at the scheduled time, please contact me in advance. There is no extra credit.

Students with Disabilities: If you are entitled to any arrangements, particularly for exams, please get in touch with me as soon as possible.

Class Schedule: There are three units (Welfare Economics and Market Failures; Game Theory and Auctions; and Matching) that each correspond to an exam. Each unit is comprised of classes, and each class is comprised of four to six lessons. Exams cover a single unit and are not cumulative, although later content borrows and builds on the models, results, and language of earlier units.

02/02/21	Rationality, Social Choice, Voting	Rational Choice; Condorcet's Paradox; Arrow's Impossibility Theorem; The Borda Count
02/04/21	Welfare	The Veil of Ignorance, Utilitarianism, and Egalitarianism; Pareto Optimality; Where to Place a Firehouse; How to Cut a Cake; The Trolley Problem
02/09/21	Markets	Demand; Supply; Perfect Competition; The Social Planner; The Welfare

		Theorems; The 1975 Nobel Prize in Economics
02/11/21	Market Power	Monopoly; Oligopoly; Collusion; Anti-Trust Law: ATT and Microsoft and Amazon, Whole Foods, Staples
02/16/21	Externalities	The Externalities Model; Externalities Model 2, and Command and Control; Pigouvian Taxation; Cap-And-Trade; Global Warming, Pandemics, and Bees
02/18/21	Incomplete Information	Information in Economics; The Discontinuous Lemons Model; Market Unraveling; Public Schools, the ACA, and the TARP
02/23/21	Incomplete Information	The Continuous Lemons Model; Signaling and Screening; Insurance; Watermelons; Discrimination
02/25/21	Missing Markets	Aggregation and Welfare; Black Markets; Financial Markets; The Theory of the Second Best
03/02/21	Introduction to Game Theory	Games: Players, Actions, Payoffs, Information; Notation for Games; Best Responses; Dominant Strategies; Examples
03/04/21	Nash Equilibrium	Nash Equilibrium in Strategic Form Games; Examples; Nash Equilibrium in Continuous Games; Examples
03/09/21	BREAK DAY	
03/11/21	EXAM 1	
03/16/21	Bayesian Nash Equilibrium	Beliefs and Best Responses;

		Bayesian Nash Equilibrium; Examples
03/18/21	Introduction to Auctions	Auctions as Markets; Private and Common Values, and Payoffs; Single and Multi-Unit Auctions; The English Auction; The Second Price Auction
03/23/21	The Dutch and First-Price Auction, Revenue Equivalence	The Dutch Auction; The First-Price Auction; Reserve Prices; Efficiency and Revenue Equivalence
03/25/21	The Vickrey Clarke Groves Mechanism	The VCG Model; The VCG Mechanism; Budget Balance; Auctions; Public Goods; Moral Hazard in Teams
03/30/21	Multi-Unit Auctions and Exchanges	Generalized Second Price Auctions; The Uniform Price Auction; The Ausubel Auction; Package and Combinatorial Bidding
04/01/21	Case Studies in Auctions	Experimental Economics; The FCC Spectrum and Incentive Auctions; Google and Facebook; eBay and QuiBids; Italian Procurement Auctions; FAA Slot Auction; Contests to Invent; High Frequency Trading; RGGI
04/06/21	Targeting (Advanced)	Proxy-means testing, subsidized pricing, balanced-budgets and efficiency, machine learning Proxy-Means Testing, Subsidized Pricing, Balanced-budgets and Efficiency
04/08/21	EXAM 2	
04/13/21	Reputations (Advanced)	Repeated Games, The Folk

		Theorem, Reputations
04/15/21	BREAK DAY	
04/20/21	Introduction to Matching	Markets without Money; The University Admissions Problem; The Marriage Market Problem; The Roommates Problem; Stability and the Core; Instability in the Roommates Problem
04/22/21	The Deferred Acceptance Algorithm	Stability in Two-Sided Markets; Unstable Algorithms; The Gale Shapley Algorithm; Examples
04/27/21	Welfare and Incentives in the DA Algorithm	More Examples; The Set of Stable Matches; Polarization in the Core; Private Information and Incentives; Roth's Impossibility Theorem
04/29/21	Case Studies in Matching	National Resident Matching Program; School Choice in NYC and Boston; Sororities and Fraternities
05/04/21	Allocation Problems	Serial Random Dictatorship (no existing property rights); Top Trading Cycles (existing property rights); Examples
05/06/21	Case Studies in Allocation Problems	Kidneys; Livers
05/11/21	Mechanism Design (Advanced)	Implementation and the Revelation Principle; Third-Degree Price Discrimination; The Optimal Auction Problem
05/13/21	Review/Buffer	