

SYLLABUS

Overview

In this class we'll learn how to design mechanisms to allocate scarce resources. Our main tool will be economic theory. In most classes, we'll start with a class of problems and develop a theoretical model that helps us identify what is a "good" solution to the problem, what are the incentive problems that might arise, and whether there are mechanisms that might lead to a good solution. Then we'll consider applications where we think about a particular setting and compare what's done in practice to our solution.

The class divides roughly into two parts: matching and auctions. In the first part, we are going to study matching markets. In particular, we're going to analyze settings where there's no money and no prices. Instead, we have to ask people what they want and try to satisfy their preferences subject to scarcity of resources. Examples include problems such as assigning students to schools in large cities where families can ask to be placed outside their neighborhood school, placing doctors in residency positions, matching people on dating websites, or assigning donated kidneys to transplant patients. We'll study a set of algorithms that have desirable theoretical properties and are often used in practice to solve these problems.

The second part of the class is on auctions. Here we start with the simplest case of a seller who wants to allocate a single item (a house, a company, a painting, or the rights to a natural resource such as oil or timber), and look at how different types of auctions work in theory and practice. Then we'll consider complex allocation problems where a seller wants to allocate goods and bidders may want to buy more than one thing. We will look at the auctions used in financial markets to sell treasury bills and other securities, the auctions used by Google, Microsoft and Facebook to sell advertising, and the auctions used by governments to sell property rights to radio spectrum, and other complex, large-scale assets.

An important goal in this class is to introduce you to areas of economic theory such as game theory and mechanism design, and connect this theory to practical applications. The hope is that once you get familiar with the ideas, you'll be able to read a paper or browse the internet and see lots of examples where this theory is relevant and useful.

By the end of this course students should be able to do the following:

1. Synthesize and integrate the material learned in their previous microeconomics courses;
2. Develop theoretical models of markets;
3. Characterize incentives and identify solutions to these markets; and
4. Be able to distinguish and explain the differences between the theoretical outcomes and actual market behavior.

Prerequisites

The prerequisites for this class are

1. calculus (MATH1100),
2. microeconomic theory (ECON2201 or ECON2203).

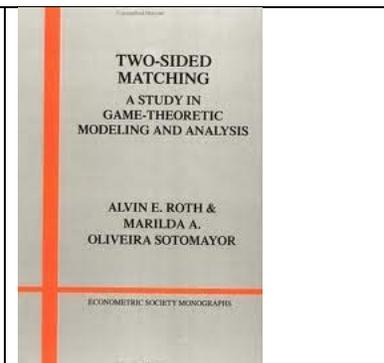
In most of the classes, we are going to study mechanisms that allocate scarce resources and examine whether they satisfy some desirable properties mathematically. Therefore, you should be able to understand and make formal arguments to study the properties of mechanisms.

Logistics

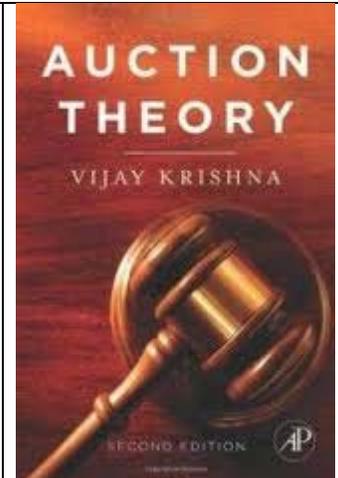
Lecture material, including the power point slides, homework questions, syllabus, etc. will be available at Canvas: <https://bostoncollege.instructure.com/courses/1575377>. The class meets every Tuesday and Thursday 9:00-10:15 at Campion Hall 231.

Textbooks

The text for this class is *Two-Sided Matching: A Study in Game Theoretic Modeling and Analysis*, written by Alvin Roth and Marilda Sotomayor published by Econometric Society. The text is supplemental to the slides covered in class.



For auctions, the recommended textbook is *Auction Theory* written by Vijay Krishna published by Academic Press (Elsevier). This textbook is a graduate level textbook and may be challenging to read. But it is a good reference book.



Assessment

Your grade is based on the following:

1. Two in-class midterm exams (25% each) –The first exam is going to cover matching whereas the second exam is going to cover auctions. Midterm exam dates are **October 10** and **November 21**. No make-up exam will be offered when a student misses an exam. If a student has a legitimate excuse (that can be officially documented) for missing an exam, then the student needs to ask her/his academic advisor to contact me *within two days of the exam* to justify her/his absence and she/he must provide me with official documentation for the excuse. Excused absences include BC-sanctioned activities, serious illness, and family emergencies. They do not include staying up too late studying the night before and sleeping through your alarm. Medical documentation must state that you were medically unable to take the exam and must be dated no later than the day of the exam. If you miss a midterm exam, once I find the excuse acceptable, then I will drop this exam and use the remaining scores for calculating your final grade. If the absence is not excused, the student's score for the exam will be zero.
2. Four problem sets (6% each) – The first two problem sets are on matching, the remaining two are on auctions. Each problem set will be available at least one week before the due date, which depends on how fast we can cover the subjects. You should attempt solving the homework questions alone before discussing with other students. If you work with other students, you should mention the names of individuals that you collaborated with. In any case, the solutions must be written individually using your own words and reasoning. The failure to this rule will be punished by getting no points on the assignment and further as detailed in the academic integrity procedures. Solutions should either be submitted in the beginning of the class. Any late submissions will be discounted by the following formula: $10+t$ where t is the number of hours that you are late (e.g., if you are 10 hours late your maximum grade will be 80 out of 100).

3. Final paper (20%) – The objective of the final paper is to study an existing market or an environment with a potential role for a market, describe the relevant market design questions, and evaluate how the current market design works and/or propose improvements on the current design. Final papers are individual assignments. The final paper is due on **December 8**. *I will not accept any late submissions*. You are also required to submit a proposal/progress report on **November 7**. In addition, you are going to present your paper in class, which is going to be scheduled for the end of the semester (November 28, November 30, December 5, December 7). I will post a document about the final proposal on Canvas in the beginning of the semester but you can check out Al Roth's blog to get ideas: <http://marketdesigner.blogspot.com/>
4. Class Exercises (6%) – Each exercise is one short question on the material covered recently. Most exercises will be in the beginning of the lecture. I will discard the three lowest scores. If you have a legitimate excuse to miss a class, this will count for one of your three lowest scores. No student will be excused for more than three times throughout the semester without any exceptions.

Contact Information

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I prefer to be contacted by e-mail and I will try my best to reply to each e-mail within 24 hours. Please include "ECON3305" in the subject of your e-mail and use your BC e-mail.

Course Administration

- **Academic Integrity:** You are bound by BC's academic integrity rules. If you use sources besides the two textbooks and lecture notes, cite them. Copying work of other people is a university offense, and will be punished by an automatic failure of the course. You can contact me if you need any guidance on how to use material from different resources. Also, see BC's academic integrity policy and procedures: <http://www.bc.edu/offices/stserv/academic/integrity.html>
- **Recording/Taping of classroom activity:** No student may record or tape any classroom activity without my express written consent.
- **Class Demeanor:** The use of laptops, phones and tablets are prohibited. Also, turn off/silence cell phones and be on time to class. Not only are these good practices for the learning environment, but they also show your respect for fellow classmates.

No class

November 23 (Thanksgiving)

Schedule

1. Introduction to Matching Theory

Topics: The “marriage market” and one-to-one matching, stable matches, the Deferred Acceptance algorithm, optimal matches for men and women, incentives.

Reading: David Gale and Lloyd Shapley, "College Admissions and the Stability of Marriage," *American Mathematical Monthly*, 69, 1962, pp. 9-15. [This is the first paper on matching markets and apart from its historic interest it is a *great* paper – a math paper that doesn't have a single equation! Not to be missed.]

2. House Allocation and Kidney Exchange

Topics: The house allocation problem, efficient outcomes and the core, serial dictatorship, the top trading cycles algorithm and variations, kidney exchanges.

Reading: Alvin Roth, Tayfun Sonmez and Utku Unver, "A Kidney Exchange Clearinghouse in New England," *American Economic Review*, 95(2) May 2005, 376-380. [Short article that describes the design of the New England clearinghouse, including the Top Trading Cycles theory used to find matches.]

Short article on National Science Foundation Website: “Kidney Exchange: A Life-Saving Application of Matching Theory,” (Search for “Kidney Exchange NSF”).

3. School Choice

Topics: School choice, the Boston algorithm and its incentive problems, deferred acceptance and top trading cycles as alternatives, problem of ties, Boston & NYC.

Reading: Atila Abdulkadiroğlu and Tayfun Sonmez “School Choice: A mechanism design approach,” *American Economic Review*, 93(3), June 2003, 729-747.
Atila Abdulkadiroğlu, Parag Pathak and Alvin Roth, “The New York City High School Match,” and (with Tayfun Sonmez) “The Boston Public School Match,” *American Economic Review*, 95(2), May 2005, 364-367 and 368-371, [Three articles discussing the design of the New York and Boston school choice systems. These articles are written for professional economists but are at an accessible level.]

Short article on American Mathematical Society website, “School Choice” by Joseph Malkevitch (Search for: “School Choice AMS”).

4. Controlled School Choice

Topics: Controlled school choice, the deferred acceptance algorithm and its incentive problems, quotas.

Reading: Lars Ehlers, Isa Hafalir, M. Bumin Yenmez and M. Ali Yildirim “School Choice with Controlled Choice Constraints: Hard Bounds vs. Soft Bounds” and Federico Echenique and M. Bumin Yenmez “How to Control Controlled School Choice” [Two recent papers that you can access from <https://www2.bc.edu/mehmet-b-yenmez/>]

5. Comparative Statics and Participation

Topics: Comparative statics for the deferred-acceptance algorithm, participation decision in centralized mechanisms.

Reading: Christopher Chambers and M. Bumin Yenmez “Choice and Matching” and Mehmet Ekmekci and M. Bumin Yenmez “Integrating Schools for Centralized Admissions” [Two recent working papers that you can access from <https://www2.bc.edu/mehmet-b-yenmez/>]

6. Matching and Markets

Topics: The assignment model (matching with prices), competitive equilibria and efficiency, ascending auctions, assignment auctions, connection with matching and the deferred acceptance algorithm.

Reading: Overview of Matching Theory handout.

7. Traditional Auction Theory

Topics: The private value model of auctions, ascending auctions, first and second price sealed bid auctions, the revenue equivalence theorem, auction design decisions: encouraging entry, setting reserve prices, subsidizing small bidders.

Reading: National Academy of Sciences Beyond Discovery Report “The Bidding Game,” March 2003. (Search for “bidding game”).

Klemperer, Paul, "What Really Matters in Auction Design," *Journal of Economic Perspectives*, 2002. [Easy to read article that discusses many of the practical economic concerns in designing a large-scale auction.]

8. Sponsored Search Auctions

Topics: The sponsored search market, Google's advertising auction, bidding incentives and equilibria, other ways to run the auction, Facebook's Vickrey auction.

Reading: Edelman, Ben, Michael Ostrovsky and Michael Schwarz, "Internet Advertising and the Generalized Second Price Auction," *American Economic Review*, 2007. [Game theoretic analysis of search engine auctions – challenging.]

9. Common Value Auctions

Topics: The common value model of auctions, the winner's curse, examples and applications, when do prices aggregate information, application to oil lease auctions.

Reading: Hendricks, Ken, and Robert Porter, "An Empirical Study of an Auction with Asymmetric Information," *American Economic Review*, 1988. [Classic study of the winner's curse in bidding for off-shore oil leases. We'll talk about the results in class.]

Richard Thaler, "Anomalies: The Winner's Curse," *Journal of Economic Perspectives*, 2(1), Winter 1988, 191-202. [Accessible article describing experimental and empirical evidence on the winner's curse, by one of the pioneering behavioral economists.]

10. Multi-Unit Auctions and Treasury Auctions

Topics: Sequential auctions, uniform price auctions, discriminatory price auctions, demand reduction, Vickrey pricing and efficient auction design.

Reading: Bikchandani, Sushil and Chi-fu Huang, "The economics of Treasury Securities Markets," *Journal of Economic Perspectives*, 7(3), Summer 1993, 117-134.

11. The FCC and Auctions for Radio Spectrum

Topics: Auctions to award property rights for radio spectrum, design of the FCC auctions, evidence from US and Europe, the Advanced Wireless Service auction.

Readings: Ken Binmore and Paul Klemperer, "The Biggest Auction Ever: The Sale of the British 3G Telecom Licenses," *Economic Journal*, 2002. [Article by leading European auction theorists on the design of the British 3G auction.]

Jeremy Bulow, Jonathan Levin and Paul Milgrom, "Winning Play in Spectrum Auctions," Working Paper, March 2009. [Spectrum auctions from the perspective of the bidders, and some surprising anomalies – most parts should be readable.]

Peter Cramton, "Spectrum Auction Design," Working Paper, June 2009. [New ideas about how to design combinatorial auctions for radio spectrum and other assets.]

Lecture schedule may change or shift slightly during the semester.