

Game Theory
Berkeley MBA for Executives Program
Summer 2014

Course Outline

I. Contact information

Instructor: Shachar Kariv

- Office: 505 Evans Hall (Department of Economics)
- E-mail: kariv@berkeley.edu
- Phone: 510-250-2529
- Skype: shachar_kariv
- Web page: <http://emlab.berkeley.edu/~kariv/>

GSI: Matthew Leister

- E-mail: leister@berkeley.edu

II. General information

The course presents some of the main topics in game theory. Game theory is about what happens when decision makers (spouses, workers, managers, presidents) interact. In the past fifty years, game theory has gradually become a standard language in economics. The power of game theory is its generality and (mathematical) precision, and because game theory is rich and crisp, it is applicable to many business situations.

Nevertheless, the spread of game theory outside of economics has suffered because of the misconception that it requires a lot of fancy math. A typical question is what is game theory good for, or more precisely, is game theory meant to predict what decision makers do, to give them advice, or what?! The answer is that (only) the tools of analytical game theory can be used to predict, postdict (explain), and prescribe, taking into account that even if game theory is not always accurate, descriptive failure is prescriptive opportunity.

As Robert J. Aumann (2005 Nobel Economics Laureate “for having enhanced our understanding of conflict and cooperation through game-theory analysis”) said “... game theory is a sort of umbrella or ‘unified field’ theory for the rational side of social science, where ‘social’ is interpreted broadly, to include human as well as non-human players (computers, animals, plants).” We will show that game theory is not just a normative theory (how people ought to choose), but also as a descriptive theory (how people actually choose) and even as a prescriptive theory (as a practical aid to choice).

III. Reading material

The class will rely on handouts that will be given for each class and also be available for downloading in PDF format from the course web page. The notes will contain all the material for the course. The following textbook is very useful:

- Avinash Dixit and Barry Nalebuff, **The Art of Strategy**. WW Norton.

Also recommended for lighter reading on business and games is:

- Adam Branderburger and Barry Nalebuff, **Co-opetition**. Currency Doubleday.

IV. Problem sets

The course will rely heavily on problem sets. Each segment a problem set will be assigned and will generally be due the following segment. The problem sets are meant to be learning tools and thus will be not counted for the course grade. All questions in the problem sets are a required material. Please work on the problem sets with each other. Answer keys will be distributed but will not available for downloading from the course web page.

V. Grading

The requirements for a grade in the class is a final take-home exam. The exam will test your basic knowledge in the course material and the ability to apply this material to new problems. Further details will be given later in the semester.

VI. Office hours

Online by appointment. Further details will be given in the first lecture. When you are on campus, feel free to drop by my office (505 Evans Hall) to ask questions, or even just to introduce yourself and to chat. You can e-mail us any question, and we will try to respond promptly. In case you have any trouble, there are plenty opportunities for help. We would also be happy to discuss with you any issues beyond the course work, not necessarily of game-theoretic substance.

VII. Outline

The course is divided to (i) strategic and extensive games with perfect information, and (ii) strategic and extensive games with imperfect information. The dimension on which the division of the course is based is as follows.

- Under perfect information, players are assumed to be able to observe all the decisions that have previously been made (they have perfect information about the entire history of actions that have been taken before them). Under imperfect information, by contrast, players may observe the actions of *some* other players in the game but they do not observe the actions of *all* the other players.

- A strategic game is a model in which each player chooses his plan of action once and for all, and these choices are made simultaneously. An extensive game, by contrast, is a model in which there is a specified an order of events and each player can consider her plan of action whenever it is her turn to make a decision. For example, a so-called sealed-bid auction is a strategic game, whereas an English auction and a Dutch auction are extensive games (more below).

Auctions – an illustration

We will cover many topics, including bargaining, arm/advertisement/R&D races, elections, mergers, mechanism design (2012 Nobel Economics Prize), and more. To illustrate, let’s talk about auctions. From Babylonia (women at marriageable age) to Athens, Rome, and medieval Europe (rights to collect taxes, dispose of confiscated property, lease of land and mines, and more), and to eBay, auctioning has a very long history.

The word “auction” comes from the Latin *augere*, meaning “to increase.” The earliest use of the English word “auction” given by the Oxford English Dictionary dates from 1595 and concerns an auction “when will be sold Slaves, household goods, etc.” In this era, the auctioneer lit a short candle and bids were valid only if made before the flame went out (Samuel Pepys, 1633-1703).

Auctions, broadly defined, are used to allocate significant economics resources. Examples include works of art, government bonds, offshore tracts for oil exploration, radio spectrum, and more. Auctions also take many forms so a game-theoretic framework is needed to understand the consequences of various auction designs. Game theory can also suggest the design likely to be most effective, and the one likely to raise the most revenues. There are many types of auctions which we will organize according to three criteria as follows:

- **Sequential / simultaneous.** Bids may be called out sequentially or may be submitted simultaneously in sealed envelopes. In an English (or oral) auction the seller actively solicits progressively higher bids and the item is soled to the highest bidder. In a Dutch auction the seller begins by offering units at a “high” price and reduces it until all units are soled. These are extensive games. A sealed-bid auction, by contrast, is a strategic game where all bids are made simultaneously, and the item is sold to the highest bidder.
- **First-price / second-price.** The price paid may be the highest bid or some other price. In a first-price auction, the bidder who submits the highest bid wins and pay a price equal to her bid. In a second-price auction, the bidder who submits the highest bid wins and pay a price equal to the second highest bid. Variants include all-pay auctions, discriminatory, uniform, Vickrey (William Vickrey, 1996 Nobel Economics Laureate), and more.
- **Private-value / common-value.** Bidders can be certain or uncertain about each other’s valuation. In private-value auctions, valuations differ among bidders, and each bidder is certain of her own valuation and can be certain or uncertain of every

other bidder's valuation. In common-value auctions, all bidders have the same valuation, but bidders do not know this value precisely and their estimates of it vary. Can you think of examples of private-value and common-value auctions?