Economics 414
Game Theory

Professor Peter Cramton
Spring 2005

Outline

- Introduction
- Syllabus
- Web demonstration
- Examples

About Me: Peter Cramton

- B.S. Engineering, Cornell University
- Ph.D. Business & Economics, Stanford University
- Associate Professor, Yale University, 1984-93
- National Fellow, Hoover Institution, Stanford University, 1992-93
- Professor of Economics, University of Maryland, since 1993
- Chairman, Market Design Inc., since 1995
- Chairman, Spectrum Exchange, since 1999
- President, Criterion Auctions, since 2000

Course Objectives

- To understand the importance of competitive and cooperative factors in a variety of decision problems
- To learn how to structure and analyze these problems from a quantitative perspective

Course Outline

- Strategic-Form Games
- Extensive-Form Games
- Repeated Games
- Bayesian Games and Bayesian Equilibrium
- Dynamic Games of Incomplete Information
- Bargaining Theory
- Auction Theory (and Practice)

Logistics

- Meet Tuesday and Thursday, 9:30 – 10:45
- Problem Sets (about 6) and Web Exercises [20% of grade]
  - Must be own work; don’t look at past solutions
  - Small discussion groups fine
- Midterm Exam [30% of grade]
- Final Exam [50% of grad]
  - Tuesday, May 17, 8-10 am
- Office Hours Tues 7:30 to 9:30 am
  - Tydings 4101a
  - 301.405.6987 or cramton@umd.edu

Did you get my email?

- Email sent to econ414-0101-spr05@coursemail.umd.edu
- If you did not get it, then either:
  - University has wrong email address for you
  - You are not registered for this class (e.g. you are on the waitlist)
  - Your mail quota is exceeded

Web exercises

- Register at http://gametheory.tau.ac.il/ (student's registration in upper right)
- Your login name will be:
  - CR479U<student e-mail> where <student e-mail> is your full email.
- The class password is:
  - **e139288Zt**
- I will send an email with assignments

Readings

- Martin J. Osborne, *An Introduction to Game Theory*, Oxford University Press (2004) [Required]
- Web site: www.cramton.umd.edu

Introduction and Examples

Definition

Game theory is the study of mathematical models of conflict and cooperation between *intelligent and rational* decision makers.

- *Rational:* each individual maximizes her expected utility
- *Intelligent:* individual understands situation, including fact that others are intelligent rational decision makers

Game 1

- Each of three players simultaneously picks a number from [0,1]
- A dollar goes to the player whose number is closest to the average of the three numbers
- In case of ties, the dollar is split equally

Game 1 in Normal Form (Strategic Form)

- player $i \in N = \{1,\ldots,n\}$
- strategy $s_i \in S_i$
- strategy vector (profile)
  $s = (s_1,\ldots,s_n) \in S = S_1 \times \ldots \times S_n$
- payoff function $u_i(s): S \rightarrow \Re$, which maps strategies into real numbers
- game in normal form $\Gamma = \{S_1,\ldots,S_n;u_1,\ldots,u_n\}$

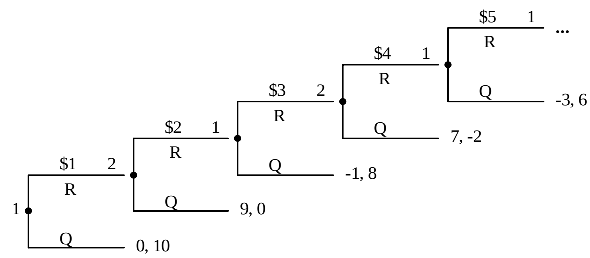
Game 2: Both Pay Auction

- $10 is auctioned to highest of two bidders
- Players alternate bidding
- At each stage, bidding player must decide either to raise bid by $1 or to quit
- Game ends when one of the two bidders quits in which case the other bidder gets the $10, and *both* bidders pay the auctioneer their bids

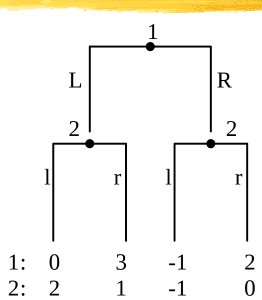
Game in Extensive Form

- Who plays when?
- What can they do?
- What do they know?
- What are the payoffs?

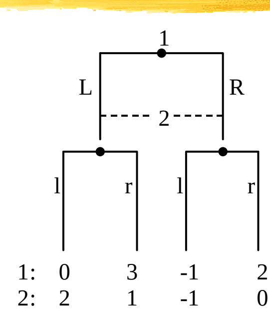
Game 2 in Extensive Form (Game Tree)



Game 3



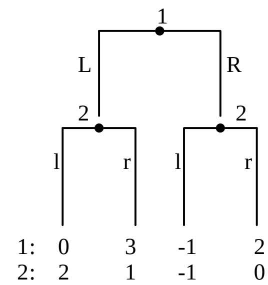
Game 4



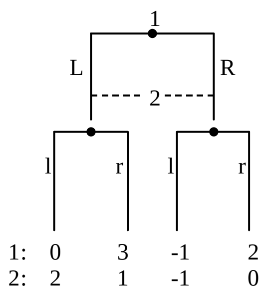
Definitions

- *Strategy*: a complete plan of action (what to do in *every* contingency)
- *Information Set*: for player i is a collection of decision nodes satisfying two conditions: player i has the move at every node in the collection, and i doesn't know which node in the collection has been reached

Game 3: How many info sets?



Game 4: How many info sets?



More Definitions

- *Perfect Information*: each information set is a single node (Chess, checkers, go, ...)
- Finite games of perfect information can be "solved" by backward induction in the extensive form or elimination of weakly dominated strategies in the normal form
- *Imperfect Information*: at some point in the tree some player is not sure of the complete history of the game so far

Game 3: Backward Induction

Looking ahead and reasoning back