Lecture 13(ii)

Announcements

- Platform Debate 3 this week on intellectual property. (Also a worksheet.)
- Final Exam is **cumulative**. See OneStop page (at the very bottom of Moodle at Week 15. Has links to practice midterms all in one place.

Lecture on Game Theory

1. More on IP and R&D
Policy Proposal 4: Finance pharmaceutical research through government research (example of human genome project

2. The Prisoner's Dilemma

3. The Simple Version of the Battle of the Sexes

4. The Battle of the Sexes with Some Strategic Moves

5. Mutually-Assured Destruction.

IP and R&D

Policy Proposal 4

Finance creative activity through government research grants (or prizes) and put the results in the public domain to be freely used.

We do this to some extent, maybe we should do more?

- Public radio
- Health R&D through National Institute of Health
- Music (grants, Mozart sponsored by various princes

An example of some interesting research by Heidi Williams, brand new Ph.D. now at MIT

For summary go here:
http://www.sciencenews.org/view/generic/id/61941/title/Gene_licensing_stifles_R%2Bamp;D
For technical paper go here:
http://www.nber.org/papers/w16213

"Intellectual Property Rights and Innovation: Evidence from the Human Genome"

- Public effort to sequence human genome
  - started 1990, finished in 2003.
  - Put all results in public domain.
- Private Effort, Craig Ventor (Celera)
  - started 1998 to finish in 2001
  - licensed its findings to drug companies (but entered public domain when the public effort got it)
  - Williams finds out that drugs discovered first by Celera encountered delays in subsequent research (Point 3 from Lec13(i))

- Interesting because Celera had a relatively weak from of IP protection (not a patent)
- One big additional point: the competition between the private sector and the public sector might have spurred the public sector to move faster.

Game Theory

We have worked through Monopoly and Perfect Competition. What happens in between?

Oligopoly

With a few sellers, how do they interact?

Take OPEC (the cartel of oil producing nations).

Gains for the group to for each to hold back oil production to keep up the price. So each county in cartel gets a production quota.

Gain for the individual decision marker to deviate from the agreement and secretly sell more than the quota amount at the high price.

How does it all work out?

Game Theory is a useful tool

Prisoner's Dilemma

Scenario: Robinson and Friday have been caught trying to steal widgets from S4. Have been brought in for questioning. They are being kept in separate rooms.

Each chooses between two actions: Confess or Remain Silent.

The outcome depends upon what they both do.

Let's look at the Payoff Matrix

Payoff Matrix (minus)
How Years in Jail Depend Upon Both Actions

Robinson

Friday	**Confess**	**Stay Silent**
Confess	**R gets 8** **F gets 8**	**R gets 20** **F gets 0**
Stay Silent	**R gets 0** **F gets 20**	**R gets 1** **F gets 1**

Strategy: a rule for how a player in the game behaves.

Look at incentives for Friday.

Suppose he thinks Robinson is staying silent....

Suppose he thinks Robinson is going to confess....

Nash Equilibrium
Player 1's strategy is optimal for him or her taking as given how Player 2 is behaves.

Likewise for Player 2's strategy.

Nash Equilibrium of this game:

This equilibrium is particularly compelling because it is special. Each choice made is a Dominant Strategy

Optimal regardless of what they other person does

Let's look at the efficiency of the equilibrium outcome from the perspective of the two players of the game.

Equilibrium Outcome:
Both confess and each gets 8 years in jail.

If instead neither confess, each gets only 1 year in jail.

If they could cooperate, (somehow commit to not confessing), both parties would be better off.

Let's look at another famous game...

The Battle of the Sexes

Female

	Watch Football	Watch Gossip Girl
Male Watch Football	F gets 1 M gets 3	F gets 0 M gets 0
Male Watch Gossip Girl	F gets 0 M gets 0	F gets 3 M gets 1

Suppose the two players simultaneously make their choice. Let's figure out the optimal strategy for each player

Look at incentives for the male player:

Suppose he thinks girl is going to watch football....

Suppose he thinks the girl is going to watch Gossip Girl...

Look at incentives for the female player:

Suppose she thinks guy is going to watch football....

Suppose she thinks the guy is going to watch Gossip Girl...

What are the Nash Equilibria of this simultaneous-move game?

Let's change the game so that the action is sequential.

Girl moves first. Sends text message to guy about her decision. Then guy moves. What is the equilibrium outcome now if the guy rationally optimizes given the girl's choice?

First Mover Advantage

Lets change it one more time. Like above, girl picks show before guy, and sends text message to guy, after picking her show..

But before the girl picks her show, the guy makes a deal with all his friends that if any of them hears that he watched Gossip Girl, they all will defriend him on Facebook. Suppose the guy really likes having facebook friends, and if he is defriended by all the guys he suffers a **loss of 10**.

After this move, the payoffs look like:

The Battle of the Sexes
If guy is defriended from when he watches Gossip Girl.

Female

Watch Football | **Watch Gossip Girl**

Watch Football

Male

Watch Gossip Girl

	F gets 1 M gets 3	F gets 0 M gets 0
	F gets 0 M gets 0 −10 = −10	F gets 3 M gets 1 − 10 = − 9

Now work out the equilibrium when each player is forward-looking and assumes the other player will play rationally, given the choices already made by the other player. To solve this, need to work backwards and look at the endgame.

Suppose guy strikes the deal with his friends to defriend him if he watches Gossip Girl.

Then regardless girl's choice, in the endgame, guy will choose

_____

Anticipating guy's behavior, girl will choose _____

Anticipating how girl will respond to pact with friends, guy will make the pack.

This move on the guy's part is something like the famous example of Cortez burning his ships after landing in Mexico in 1519. He was playing a game with his soldiers. Fighting the Aztec Indians then became a better option for the soldiers than retreating back to the ships.

This is a taste of game theory.
More than being fun and interesting, it is a powerful tool for social scientists to study important strategic interactions.
(Mention this because this is a Social Science Core Class)

Example in Political Science: The Cold War and Mutually-Assured Destruction.

Potential Prisoner's Dilemma Situation for a first strike nuclear Attack.

		Soviet Union: First Strike	Soviet Union: Don't Attack
U.S.	First Strike	USSR gets −100 U.S. gets - 100	USSR. gets−1000 US. gets 200
	Don't Attack	USSR gets 200 U.S. gets −1000	USSR gets 0 U.S. gets 0

The unique Nash equilibrium is_____
(Prisoner's dilemma again.)

Suppose instead, each party can **credibly** commit to launch a massive retaliatory attack on warning. So if one party launches a first strike, nuclear winter results. The payoffs now look like: (where $-\infty$ means "minus infinity")

		Soviet Union: First Strike	Soviet Union: Don't Attack
U.S.	First Strike	USSR gets $-\infty$ U.S. gets $-\infty$	USSR gets $-\infty$ US. gets $-\infty$
	Don't Attack	USSR gets $-\infty$ U.S. gets $-\infty$	USSR gets 0 U.S. gets 0

The unique Nash equilibrium is now

_____

This is the concept of mutually-assured destruction, (MAD) which results in a kind of stability.

- Requires both to keep up in an arms race (if one is more powerful than the other then MAD can break down).
- Requires rationality on both parts.

A useful theory for thinking about Soviet/U.S. Cold War interactions.

Not a useful theory for thinking about North Korea and Iran....