POLI 150: Strategic Interaction & Game Theory

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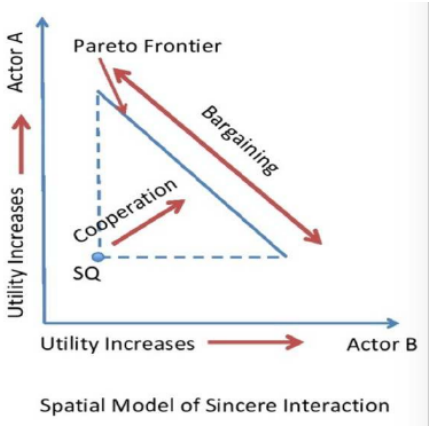
Today's Class

- Review of Bargaining & Cooperation
- Elements of Game Theory
- Prisoner's Dilemma

Cooperation & Bargaining Overview

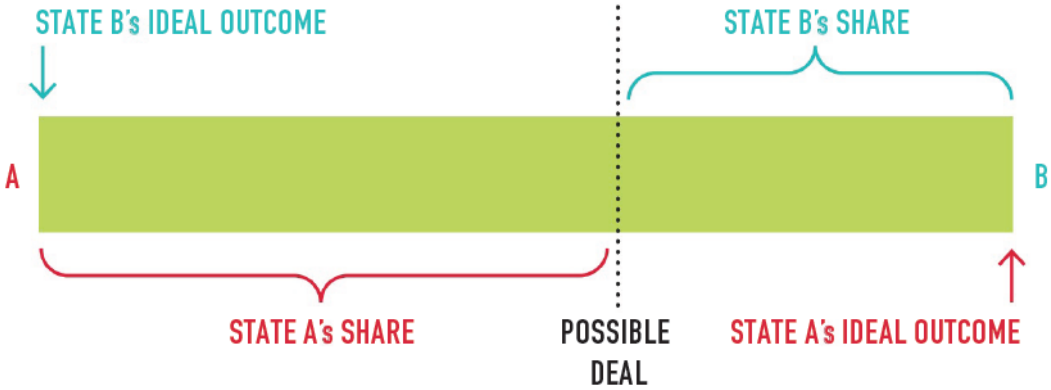
- Cooperation involves improving at least one actor's position while not making any worse off (positive-sum)
- Bargaining divides a fixed sum of goods between two or more actors (zero-sum)
- Almost all international interactions fall into one of these categories

Spatial Model



Spatial Model of Sincere Interaction

Bargaining Model



Bargaining Power

- Bargaining power is the ability to get another actor to do something that it would not do otherwise
- The reversion outcome plays a role in determining bargaining power
- Coercion is a straightforward way to gain bargaining power, but it carries costs
- Outside options can improve a bargaining position as well

Coordination

- The easiest type of cooperative interaction is coordination: all actors agree to make the same choices
- Actors have no incentive not to comply
- Driving on the same side of the road, speaking the same language in important contexts, etc.

Collaboration

- Collaboration requires actors to contribute for joint gains, but actors have incentives to deviate
- Leads to the classical collective action problem
- Actors want to derive benefits from public goods (i.e. clean air), but have incentives to free-ride

Split or Steal

Encouraging Cooperation

- Why didn't the actors cooperate in the golden balls game?
- How can we encourage cooperation between actors?
  1. Iteration
  2. Linkage
  3. Information

Strategic Interaction

- When multiple actors' choices matter for the outcome, interactions are fundamentally important
- This encompasses most (all?) international actions of interest
- What one actor expects others to do shapes his or her decision
- This is the essence of *strategic interaction*

Game Theory

- We can use game theory to analyze strategic interactions
- Here, we model the decision-making process of two or more actors
- Outcomes result from combination of decisions
- We find the stable outcomes that result from these interactions

Prisoner's Dilemma

Prisoner's Dilemma Parameters

- Actors 1 and 2 decide whether to stay silent (cooperate) or rat out their accomplice (defect)
- No chance for communication, and decisions are made simultaneously
- The punishment is decided based upon the combined choices

Prisoner's Dilemma Outcomes

- $\{C,C\} \rightarrow$ each person goes to prison for one year
- $\{D,D\} \rightarrow$ each person goes to prison for five years
- $\{C,D\} \rightarrow$ 1 goes to prison for ten years, 2 goes free
- $\{D,C\} \rightarrow$ 1 goes free, 2 goes to prison for ten years

Game Theory

- We will use game theory to analyze these sorts of interactions
- Our goal is to find stable outcomes called *equilibria*
- To do so, we must find each actor's *best response*
- Reminder: actors are rational and have complete information

Components of Games

1. Actors: the units making decisions; can be generic or specific
2. Actions: the set of decisions available to each actor
3. Payoffs: what the actors get for each possible outcome
4. Preferences: actors have preferences over payoffs; we assume that actors can rank-order their possible payoffs
5. Strategies: actors' plans of action for every possible choice by an opponent; their best response

Dominant Strategies

- Sometimes, actors will always choose the same action regardless of what their opponent will do
- We say that this actor has a *dominant strategy*
- In other cases, an actor's strategy or best response depends upon what the other actors are doing

Solving a Game

- We solve a game by considering the best responses of each actor
- Any outcome that is a mutual best response is called an equilibrium
- The actors cannot improve their payoff by unilaterally deviating
- If even one actor has a profitable deviation, the outcome is not an equilibrium

Prisoner's Dilemma

		Actor 2	
		C	D
Actor 1	C	$-1, -1$	$-10, 0$
	D	$0, -10$	$-5, -5$

Prisoner's Dilemma

- Suppose Actor 2 is going to cooperate
- Which action yields the best payoff for Actor 1?

Prisoner's Dilemma

		Actor 2	
		C	D
Actor 1	C	$-1, -1$	$-10, 0$
	D	$0, -10$	$-5, -5$

Prisoner's Dilemma

		Actor 2	
		C	D
Actor 1	C	$-1, -1$	$-10, 0$
	D	$0, -10$	$-5, -5$

Prisoner's Dilemma

- Suppose Actor 2 is going to defect
- Which action yields the best payoff for Actor 1?

Prisoner's Dilemma

		Actor 2	
		C	D
Actor 1	C	$-1, -1$	$-10, 0$
	D	$0, -10$	$-5, -5$

Prisoner's Dilemma

		Actor 2	
		C	D
Actor 1	C	$-1, -1$	$-10, 0$
	D	$0, -10$	$-5, -5$

Prisoner's Dilemma

- We would say that defect is the dominant strategy for Actor 1
- Suppose Actor 1 is going to cooperate.
- Which action yields the best payoff for Actor 2?

Prisoner's Dilemma

		Actor 2	
		C	D
Actor 1	C	$-1, -1$	$-10, 0$
	D	$0, -10$	$-5, -5$

Prisoner's Dilemma

		Actor 2	
		C	D
Actor 1	C	$-1, -1$	$-10, 0$
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Prisoner's Dilemma

- Suppose Actor 1 is going to defect.
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Prisoner's Dilemma

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Prisoner's Dilemma

		Actor 2	
		C	D
Actor 1	C	$-1, -1$	$-10, 0$
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Prisoner's Dilemma

- Thus, each actor's dominant strategy is to defect
- What is the equilibrium of this game?

Prisoner's Dilemma

		Actor 2	
		C	D
Actor 1	C	$-1, -1$	$-10, 0$
	D	$0, -10$	$-5, -5$

Prisoner's Dilemma Equilibrium

- There is a unique equilibrium: both actors will defect
- We know this because there's no unilateral deviation that is profitable
- Why can't the actors agree to cooperate given that each would be better off?
- Each has an incentive to defect!

Returning to Split or Steal

- Split or Steal!

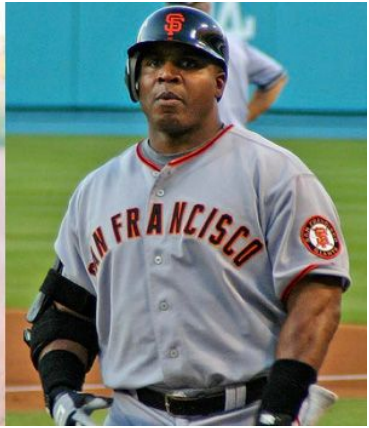
Split or Steal as a PD

		Actor 2	
		Split	*Steal*
Actor 1	*Split*	$33, 33$	$0, 66$
	Steal	$66, 0$	$0, 0$

Prisoner's Dilemma in Real Life

- Here we have the possibility of cooperation, but it fails
- This simple model helps explain why cooperation is so hard
- Applications of the prisoner's dilemma extend to all sorts of things, from advertising to doping in professional sports

Prisoner's Dilemma in Real Life



Prisoner's Dilemma in Real Life

Prisoner's Dilemma in Real Life

Prisoner's Dilemma & Baseball

		Canseco	
		No Steroids	*Steroids*
Bonds	*No Steroids*	$1, 1$	$-5, 5$
	Steroids	$5, -5$	$-2, -2$

An Aside About Advertising...

Reminders

- We assume that the actors are rational $\rightarrow$ can rank their preferred outcomes and make purposive decisions
- We assume complete information about the structure of the game
- The actual value of the payoffs does not matter, but the ranking does
- Prisoner's can't cooperate because they always have a profitable deviation when the other side cooperates

Changing the Prisoner's Dilemma

- One method for trying to encourage cooperation is by iterating this game
- What sorts of strategies could you imagine for an iterated prisoner's dilemma?
- Two that have gained a lot of popularity are tit-for-tat and grim trigger