

# Game Theory

# Introduction

- Game theory vs. economic theory
- Elements of a game
- The Prisoners' Dilemma
- Equilibrium
- Social Dilemmas
- Information
- Cooperation

# Basic Concept

- Game theory is the mathematical study of strategic behaviors between two or more discrete players.
- Game theory provides a methodology for studying choices people make in conflict.
- Game theory has important implications for peacemaking and mediation practices

# Game Theory vs. Economic Theory

- Economic Theory
  - Absolute rationality
  - System of markets
  - Not based on individual interaction
  - Outcome based on aggregate actions
- Game Theory
  - Absolute rationality
  - Person to person interaction
  - Outcome based on strategic choices

# Elements of a game

- The players
- The order of play
- The information
- The outcomes

# Solving the game

- Game solution is the best strategy for each player
- Game equilibrium is the constellation of strategies of all players

# The Prisoners' Dilemma

- Bob and Al are caught near a burglary
- In separate rooms, they have to choose whether to confess and implicate the other, or not confess
- If neither confesses, both will receive one year
- If one confesses and the other does not, the one who confesses goes free, while the other receives 20 years
- If both confess, each receives 5 years

# Payoff Matrix

		AL	
		Confess	Do not confess
Bob	Confess	5,5	0,20
	Do not confess	20,0	1,1

# Game Theory Vernacular

		AL	
		Confess	Do not confess
Bob	Confess	Lose, Lose	Lose, Win
	Do not confess	Win, Lose	Win, Win

# Effect of Prisoners' Dilemma

- Acting "rationally" leads to inefficient result
- Demonstrates a common conflict strategy called *minimax*
- Minimax means people minimize the worst harm others can inflict on them
- PD models the reason why people may be uncooperative when cooperation will yield a better result for all parties

# Equilibrium

- Equilibrium is a strategy profile consisting of the best strategies for each player in the game
- Two important types of equilibria:
  - Dominant Strategy
  - Nash Equilibrium

# Dominant Strategy

- A dominant strategy exists when a player chooses a strategy that will provide the maximum payoff no matter what the other player does
- The PD creates a dominant strategy when Bob and Al independently decide to confess.

# Effects of Dominant Strategy

- Based on risk minimization rather than profit maximization
- One party fears that being unilaterally cooperative will cause him/her to be exploited by the other party
- Leads to a strategic choice not to cooperate, even when cooperation leads to a better result

# The Nash Equilibrium

- Developed by mathematician John Nash
- Arises when no dominant strategy exists in a game
- A Nash Equilibrium exists when one party will not deviate from a strategy given that the other players do not deviate

# Payoff Matrix

		Acme	
		Advanced	Proven
Beta	Advanced	20,20	0,0
	Proven	0,0	5,5

# Some Attributes of a Nash Equilibrium

- Multiple Nash Equilibria may exist in a game
- Characterized as strong or weak
- Strong = indifference to other strategies
- Weak = given a choice, preference for one equilibrium over another

# Focal Points

- A focal point is a Nash Equilibrium that is psychologically compelling
- Focal points suggest how players will choose between multiple Nash Equilibriums
- Focal points emerge during settlement negotiations
  - Points of convergence
  - Points of resistance
- Mediators often suggest a focal point when the parties cannot find one for themselves

# Social Dilemmas

- Prisoners' Dilemma
- Chicken
- Deadlock
- Stag Hunt

# Chicken

- Developed from teenage automobile challenge
- Mutual defection is worst outcome
- Unilateral defection by other is best outcome
- Both the PD and Chicken demonstrate how cooperation is subverted by individual rationality

# Deadlock

- Occurs when two parties fail to cooperate because neither wants to cooperate
- Unlike PD, the parties prefer mutual defection over mutual cooperation
- Usually arises because the parties do not see how mutual cooperation will provide a larger payoff than mutual defection
- The peacemaker's solution is to find a way to increase payoff for mutual cooperation

# Deadlock Matrix

	Cooperate	Defect
Cooperate	1,1	0,3
Defect	3,0	2,2

# Stag Hunt

- Stag Hunt illustrates mutual cooperation as a Nash Equilibrium
- The temptation to defect only arises when one player believes the other player has reason to defect
- A Stag Hunt arises when the other party's rationality is in doubt

# Stag Hunt Matrix

	Cooperate	Defect
Cooperate	3,3	0,2
Defect	2,0	1,1

# Comparison of Preferences

DC>DD>CC>CD	Deadlock
DC>CC>DD>CD	Prisoner's Dilemma
DC>CC>CD>DD	Chicken
CC>DC>DD>CD	Stag Hunt

# Relationships of Social Dilemmas

- All derived from Prisoners' Dilemma
- Chicken is a PD with preference for confession and silence reversed
- Stag Hunt is a PD with preference for reward and temptation reversed
- Deadlock is a PD with preference for reward and punishment payoffs switched

# Information

- Common knowledge = all players know information
- Perfect/Imperfect information =
  - Perfect: Every player knows every choice made by every other player
  - Imperfect: At least one player does not know the specific choice made by other players
- Certain/Uncertain information =
  - Certainty: No moves of Nature after the players have moved
  - Uncertainty: Nature moves after the players have moved
- Symmetric/Asymmetric information =
  - Symmetric: At each decision point, players have identical information
  - Asymmetric: One or more players has private information
- Complete/incomplete information
  - Complete: Nature has moved and is observed by all parties
  - Incomplete: Nature has moved, but is not observed by at least one player

# Examples in Litigation

- Case is fully discovered
  - Complete knowledge
- Next witness to be called at trial
  - Imperfect information
- Jury is deliberating
  - Uncertain information (Nature has the last move)
- Defendant's need to settle case
  - Asymmetric information
- Plaintiff's counsel receives tentative ruling, but defense counsel does not know about it
  - Incomplete information

# Information and Efficient Bargaining

- Symmetrical information permits bargaining to be less costly
  - No time wasted in trying to discover if gains exist
- Because of asymmetrical information, parties inflate demands or minimize initial offers
- Suggests that use of caucuses (private sessions in mediation) may overcome asymmetry
- Mediator techniques
  - Break off negotiation if no gain can be achieved
  - Commit parties to split gains made from trade
  - Send “noisy” information to the parties

# Cooperative Bargaining

- Axelrod's work demonstrated robustness of Tit for Tat
- Implications:
  - Mutual cooperation can emerge in a world of egoists
  - Any strategy with traits of niceness, provocability, forgiveness, and transparency will do well in shifting and unpredictable environment
  - Once cooperation is established, it becomes permanent

# Summary

- Game theory as a model of conflict suffers from several limitations
- Nevertheless, game theory offers important insights
  - Demonstrates superiority of cooperation over competition
  - Describes heuristics people use in managing their conflicts
  - Explains why rational decisions often miss opportunities for mutual gain



The End