

CHAPTER 20

Game Theory, Strategic Decision Making, and Behavioral Economics

Chapter Goals

- Explain what game theory is and give an example of a game and a solution to a game.
- Discuss how strategic reasoning and backward induction are used in solving games.
- Distinguish informal game theory from formal game theory.
- Describe how the results of game theory experiments challenge some standard economic assumptions.

Game Theory and the Economic Way of Thinking

Game theory is formal economic reasoning applied to situations in which decisions are interdependent.

- Game theory is a very flexible tool that allows us to develop more precise models of situations that involve strategic interactions.
- Game theory models are more flexible than the standard economic models.
- Game theory is a framework to use in understanding real-world events.

The Game Theory Framework

Four “A” students partied the night before an exam and slept through the exam.

They tell the professor that the reason they missed the exam was that they were all in a car that had a flat tire.

The professor lets them make up the exam.

The exam had two questions, an essay relating to the material and a screening question... which tire?

A **screening question** is a question structured in such a way as to reveal strategic information about the person who answers

The Prisoner's Dilemma

The **prisoner's dilemma** is a well-known two-person game that demonstrates the difficulty of cooperative behavior in certain circumstances.

There is a **payoff matrix** which is a table that shows the outcome of every choice by every player, given the possible choices of all other players.

The payoff matrix has three elements:

1. Players
2. Strategies
3. Payoffs

Application: The Prisoner's Dilemma

Payoff Matrix:

Players are A and B.

Strategies are to confess or not.

Payoffs are jail time or not.

		B CONFESS	B DOES NOT CONFESS
A CONFESS	5 years for A 5 years for B	A goes free 10 years for B	
A DOES NOT CONFESS	10 years for A B goes free	6 months for A 6 months for B	

Application: The Prisoner's Dilemma

What is the best strategy for each player given the other player's choice? What is the outcome?

		B CONFESS	B DOES NOT CONFESS
A CONFESS	5 years for A 5 years for B	A goes free 10 years for B	
A DOES NOT CONFESS	10 years for A B goes free	6 months for A 6 months for B	

Dominant Strategies and Nash Equilibrium

- A **dominant strategy** is a strategy that is preferred by a player regardless of the opponent's move.
- A **Nash equilibrium** is a set of strategies for each player in the game in which no player can improve his or her payoff by changing strategy unilaterally.

A Nash equilibrium doesn't have to be the solution that is jointly best for all players.

An Overview of Game Theory as a Tool in Studying Strategic Interaction

A **non-cooperative game** is a game in which each player is out for him- or herself and agreements are either not possible or not enforceable.

Cooperative games are games in which players can form coalitions and can enforce the will of the coalition on its members.

Sequential games are games where players make decisions one after another so one player responds to the known decisions of other players.

Simultaneous move games are games where players make their decisions at the same time as other players without knowing what choices other players have made.

An Overview of Game Theory as a Tool in Studying Strategic Interaction

In the game, cheap talk is possible.

Cheap talk is communication that occurs before the game is played that carries no cost and is backed up only by trust, and not any enforceable agreement.

Cheap talk does not influence the results.

An Overview of Game Theory as a Tool in Studying Strategic Interaction

Formal game theory assumptions:

- Players are fully forward looking.
- Players always behave in a manner that gives them the highest payoff.
- Players expect all other players to behave in the same manner.

Strategies of Players

In **backward induction**, you begin with a desired outcome and then determine the decisions that could have led you to that outcome.

A **dominant strategy** is a strategy that is preferred by a player regardless of the opponent's move; prisoner's dilemma, for example.

- Nash Equilibrium – *a set of strategies for each player in the game in which no player can improve his or her payoff by changing strategy unilaterally.*

A **mixed strategy** is a strategy of choosing randomly among moves; for example, rock, paper, scissors.

An Example of Strategy: The Two-Thirds Game

Each player chooses a number between 0 and 100, and the person who chooses $\frac{2}{3}$ of the average chosen by the class wins.

If people choose randomly, the average would be 50, $\frac{2}{3}$ of which is 33, so the person choosing 33 would win. If other people reason the same way, and choose 33, then the winning number is 22, $\frac{2}{3}$ of 33.

If the rollback reasoning continues, the winning number gets smaller and smaller, and the Nash equilibrium is zero. (*In experiments, people don't choose zero.*)

Informal Game Theory and Modern Behavioral Economics

Informal game theory is often called behavioral game theory because it relies on empirical observation, not deductive logic alone, to determine the likely choices of individuals

Informal game theory examines how people actually think and behave and is, therefore, empirically based.

To apply game theory to real-world problems, game theory must be accompanied by a combination of reasoning, intuition, and empirical study about how people actually behave.

Survivor Challenge

Three players (Rudy, Kelly, and Richard) have to stand on a pole and touch the immunity idol for as long as possible.

Possible outcomes from Richard's perspective:

- Rudy wins and picks Richard to continue, but Rudy would win in the final.
- Kelly wins and picks Richard to continue, but it is unclear who wins in the final.
- Richard wins and picks Rudy, but Richard loses in the final *or* he picks Kelly and breaks the alliance with Rudy and loses in the final.

Result was Kelly won, chose Richard to continue, and Richard won the final million dollar prize.

Auction Markets

- **Standard sealed bid auction** is where the person who bids the highest gets the good.
- **Vickrey auctions** are a sealed bid auction where the highest bidder wins but pays the price bid by the next highest bidder.

Vickrey auctions result in higher bids because people are more likely to bid their willingness to pay.

Game Theory and the Challenge to Standard Economic Assumptions

- Modern behavioral economists use an approach that builds on traditional economics.
- Behavioral economics uses informal game theory to explore rationality and the nature of individuals' utility functions.
- Behavioral economists use experiments in which people actually play formal games.
- The trust game is used to explain altruistic behavior

Fairness: The Trust Game

- In the trust game the first player is given \$10 and the choice of keeping it all for himself or investing some portion of it, which will be tripled and given to the other player
- The other player, the trustee, can keep the tripled amount or return some to the first player.
- Acting purely in self-interest, the Nash equilibrium is for the first player to keep the entire \$10.
- However, experimental evidence shows that on average, individuals invest about \$5 and, on average, the trustees returns a little less than the investment.

The results suggest that people want to trust and reward trust.

Endowment and Framing Effects

Endowment effect is the tendency of people to value an item that they possess more than they would value that item if they did not possess it.

Framing effects are the tendency of people to base their choices on how the choice is presented.

- An early-bird special is a better advertisement than a surcharge for peak-time meals
- Would you choose option A of saving 200 of 600 lives or option B that will end lives of 400 of 600?

The Importance of the Traditional Model

Even though people don't always act as the traditional economic model predicts, the traditional model and its assumptions are still relevant.

Whenever “money is left on the table,” we can expect firms and people who understand the economic model to develop businesses and schemes to take that money off the table – to transfer money from those who act “irrationally” to those who are acting “rationally.”

Chapter Summary (1 of 3)

Game theory is a highly flexible modeling approach that can be used to study a variety of situations in which decisions are interdependent.

In the prisoner's dilemma game both players have a dominant strategy that leads to a jointly undesirable outcome.

A payoff matrix provides a summary of each player's strategies and how the outcomes of their choices depend on the actions of the other players.

A Nash equilibrium is an equilibrium of a game that results from a noncooperative game when each player plays his or her best strategy.

Chapter Summary (2 of 3)

A dominant strategy is one that is preferred regardless of one's opponent's move. A mixed strategy is choosing randomly.

The strategies of players are different in simultaneous and sequential games.

Sometimes people follow a mixed-strategy of choosing randomly among moves.

Behavioral economics examines deviations between formal game theoretical predictions and actual outcomes of games.

Chapter Summary (3 of 3)

Insights from behavioral economics can be applied to real-world decision making such as in auctions.

Endowment and framing effects are examples of findings in behavioral economics that challenge the traditional model's predictions.

The traditional model remains relevant because it only takes a few people to realize that money has been left on the table for the results of the standard model to hold.