An Introduction to Game Theory

Game theory is the study of strategic decision making. More formally, it is "the study of mathematical models of conflict and cooperation between intelligent rational decision-makers who are seeking their self interest". An alternative term suggested "as a more descriptive name for the discipline" is **interactive decision theory.**

We will use Game Theory in this class to supplement the material found in the district curriculum. Although Game Theory is an extension of the district curriculum, it can be aptly applied to economics, politics, and social situations. This makes game theory one of the "bridges" between the different concepts found in the course.

We will study game theory conceptually and not so much mathematically. The goal for unit 1 is to learn the basic models and stories. After unit 1 we will apply the basic models to more concrete ideas of the course. Although we will learn additional games after unit 1, the foundation of our most important games will be established.

Historically, the most advanced students in this course have not only applied game theory to the topics found in all units but also to their core topics and their final exam essay.

Make no mistake about it game theory is a real subject, studied at every university, utilized by the CIA, businesses leaders, economic advisors, and political parties. Scholars have earn the Nobel Laureate in economics (the highest award in the profession) for their use of game theory.

The Basics

Players, Strategies, and Pay-offs

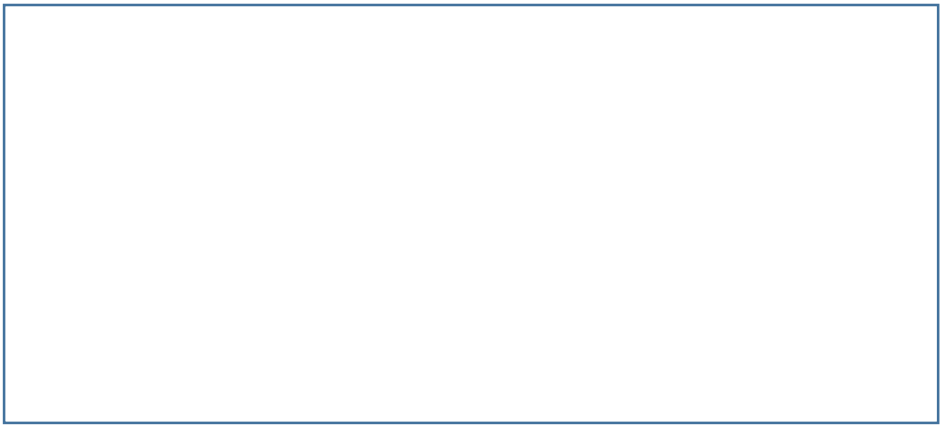
For most games we will develop matrices to help use understand the game.

We will learn the basics of game theory by playing one of the most children's game, Rock-Scissors-Paper.

First it is a 2 player game. Player 1 and Player 2.

Player 2

Player 1



Next each player has 3 strategies. They can play a Rock, Scissors, or a Paper.

		Player 2		
		Rock	Scissors	Paper
Player 1	Rock			
	Scissors			
	Paper			

We need to make a couple assumption.

1st- Both players are trying to win and therefor will make rational decisions to achieve this priority

2nd- Both players know the rules

3rd – Neither player knows what the other is going to do.

4th- Both players know the pay-offs and are trying to maximize their utility

Pay-offs

In Game theory, payoffs may be explained in specific detail, by assigning a numbers, money, years, or even happy and sad faces. The important thing is that each player knows the impact of their decisions.

In, the game Rock-Scissors-Paper, both players understand the following:

Rock beats Scissors (+1 for Rock, - 1 for Scissors)

Scissors beats Paper (+1 for Scissors, -1 for Paper)

Paper beats Rock (+1 for Paper, -1 for Rock)

All ties result in zero for both players

By filling in the matrix with the pay-offs it can give you a visual of the basics of this game.

		Player 2		
		Rock	Scissors	Paper
Player 1	Rock	0, 0	+1, -1	-1, +1
	Scissors	-1, +1	0, 0	+1, -1
	Paper	+1, -1	-1, +1	0, 0

As a class we will play Rock-Scissors-Paper. Your goal is to earn as much money as possible.

When playing games students should always think about the following items:

1. Play dominate strategies that best maximize your payoffs. Is there a dominate strategy?

2. Make rational choice based on your information. What information do you know about the game? The other player? The pay-off?

3. Know your self interest. What do you want?

4. Put yourself in other's shoes. What do they want?

5. Eliminate weaker options so that you are left with the Best Response. Is there a dominated strategy?

6. Think strategically- anticipate (look forward and reason backward)

7. Cooperation must be enforced. You're competing

After we play the game please answer the questions below.

1. Was there a specific strategy that always won (no matter what the other player did) or in other words was there a strictly dominate strategy?

2. Was there a specific strategy that always lost (no matter what the other player did) or in other words was there a strictly dominated strategy?

3. What was the best approach to take with this game?

4. For each box what was the sum of each payoff?

5. In life have you ever heard anything referred to as a zero-sum game?

We will now play a different game. This game is even simpler and relates to this class even more than Rock-Scissors-Paper.

The game is called Rock-Scissors and below is the completed matrix.

		Player 2	
		Rock	Scissors
Player 1	Rock	0, 0	+1, -1
	Scissors	-1, +1	0, 0

Now turn to person next to you and play the game three times. After you play the game answer the questions below.

1. Was there a specific strategy that always won (no matter what the other player did) or in other words was there a strictly dominate strategy?

2. Was there a specific strategy that always lost (no matter what the other player did) or in other words was there a strictly dominated strategy?

3. What was the best approach to take with this game?

4. If you know that your opponent will play rock what should you play?

5. If you know that your opponent will play paper what should you play?

6. Do you think your opponent is thinking the same thing?

7. Acting as player 1 circle the payoff for playing the correct strategy if player 2 plays rock, repeat if player 2 plays paper.

8. Acting as player 2 circle the payoff for playing the correct strategy if player 1 plays rock, repeat if player 1 plays paper.

9. Is there a box where both payoffs are circled? If so that is a Nash Equilibirum.

		Player 2	
		Rock	Scissors
Player 1	Rock	0, 0	+1, -1
	Scissors	-1, +1	0, 0

Nash Equilibrium

A concept of game theory where the optimal outcome of a game is one where no player has an incentive to deviate from his or her chosen strategy after considering an opponent's choice. Overall, an individual can receive no incremental benefit from changing actions, assuming other players remain constant in their strategies. A game may have multiple Nash equilibria or none at all.

Put in another way, if you knew that your opponent was playing Rock, you would still play Rock and vice verse. If you knew your opponent was playing scissors you would still play Rock and vice verse.

It is in both player's self-interest to play Rock. But what if for some reason it was in the best interest of society for everyone to play scissors?

What if it was in society's best interest for each player to agree to play their dominated strategy?

This is one of the big questions of the course and fundamental part of government.

Consider this scenerio. . .

Two drivers, driving on streets that are perpendicular to each other, approach the same intersection at the same time.

This intersection has no stop signs, no traffic lights, and no traffic cop to wave cars through and to tell others to stop.

Consider both drivers have an incentive to get to their destination on time and don't want to be bothered to stop but at the same time neither wants to crash?

Predict what will happen assuming they have perfect information (they see each other) and that they are acting rational.

Do we really need lights? signs? or laws?

How do we change incentive?

Brainstorm other situations that people interact in predictable manners in the absence of law.

Why do we need laws?