Chapter 9: Game Theory

This presentation will be divided into three parts:
1. One time simultaneous games
2. Repeated simultaneous games
3. Sequential games

I will present examples of the important types of games in each part and will explain the important principles that may be concluded from these games.

The tools for analysis will be payoff matrices and game trees. These are shown below:
1. One Time Simultaneous Games
Dominant Strategies

![Game 1](image1)

![Game 2](image2)

![Game 3](image3)
Mixed Strategies

Chicken

\[
\begin{array}{c|cc}
\text{Player 1} & \text{swerve} & \text{don't} \\
\hline
\text{swerve} & 0 & +10 \\
0 & -10 & -100 \\
\text{don't} & +10 & -100 \\
\end{array}
\]

Battle of the Sexes

\[
\begin{array}{c|cc}
\text{Elizabeth} & \text{hockey} & \text{ballet} \\
\hline
\text{hockey} & +1 & 0 \\
+2 & 0 & +2 \\
\text{Allen} & -1 & +1 \\
\text{ballet} & -1 & +1 \\
\end{array}
\]

Penalty Kicks

\[
\begin{array}{c|cc}
\text{Keeper} & \text{right} & \text{left} \\
\hline
\text{right} & 0.9 & 0.3 \\
0.1 & 0.7 & 0.2 \\
\text{Shooter} & 0.2 & 0.8 \\
\text{left} & 0.8 & 0.2 \\
\end{array}
\]
2. Repeated Simultaneous Games
Cartel Game – Punish Cheaters Forever

Payoff Stream from cooperating (Small Q forever):
$15$ $15$ $15$ $15$ …… Present Value = $15 + 15/i$

Payoff Stream from cheating (Large Q forever)
$20$ $5$ $5$ $5$ ……. Present Value = $20 + 5/i$

where $i$ is the interest rate used to discount the future. As long as $i$ is sufficiently small, cooperating is better than cheating.

Put differently, if you will be playing against the same opponent for a long time to come and both of you care enough about the future, you can sustain cooperation.

Cooperation will be harder to sustain if:
1. You play against different people on a regular basis
2. There are infrequent rounds during which the game is played for much larger prizes
3. A player discounts the future very heavily, perhaps because he is facing bankruptcy
4. The prizes shrink over time because the market is in decline
3. Sequential Games
Solving through backward induction
Chapter 9

First Mover Advantage

In general

Chicken

Battle of the Sexes
Second Mover Advantage

In general

![Game Tree](image)

Penalty Kicks

Key Managerial Insights

1. Understand the nature of the game you are playing, what the strategy options are and the relative payoffs to each.
2. Consider how your rival will play the game and respond to your actions. This is just like chess.
3. If there is a first mover advantage, move first. If there is a second mover advantage, move second.
4. Irreversible strategic moves will let you be the first mover, even when the game would otherwise be a simultaneous game. This might mean building a big factory to pre-commit to supplying a large quantity of goods or building a small factory to pre-commit to supplying a small quantity of goods.
5. Repetition makes cooperative outcomes easier to sustain. If you can, you should try to play against the same competitors on a regular basis. It’s difficult and perhaps unwise to trust people that you will be unlikely to see again.
6. Don’t necessarily count on others to play the game correctly or rationally. People make mistakes sometimes, are crazy sometimes, or would like to portray themselves as being crazy.

A Car Racing Example – To Pass or Not To Pass
Imagine that in an automobile race, you are considering passing a slower car near the end of the race. A successful pass would give you the win, not passing would give you second place, and a bad passing attempt in which the leader swerves into you would cause both you and the car in front of you to crash. The payoffs are:

<table>
<thead>
<tr>
<th></th>
<th>Leader swerve</th>
<th>Leader don't</th>
</tr>
</thead>
<tbody>
<tr>
<td>pass</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>You</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>don't</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

The Nash equilibrium is for you to pass and for the leader to not swerve. However, if you believe that the leader is either insane or has poor control of his car and might swerve, even though it doesn’t seem to be in his best interest, you might choose to stay back and finish safely in second place rather than try for first place and risk being taken out. This gives drivers an incentive to portray themselves as either crazy or a little bit out of control.