Learning Objectives

1. List the three basic elements of a game. Recognize and discuss the effects of dominant strategies and dominated strategies
2. Identify and explain the prisoner's dilemma and how it applies to real-world situations
3. Explain games in which the timing of players' choices matter
4. Discuss strategies that enable players to reap gains through cooperation
Strategies and Payoffs

• Actions have payoffs that depend on:
  – The actions
  – When they are taken
  – The actions of others

• Some markets are characterized by interdependence
  – Apply to monopolistic competition and oligopoly
Game Theory

• **Basic elements of a game:**
  – The players
  – Their available strategies, actions, or decisions
  – The payoff to each player for each possible action

• A **dominant strategy** is one that yields a higher payoff no matter what the other player does
  – A **dominated strategy** is any other strategy available to a player who has a dominant strategy
American and United – Scenario 1

- Players: United and American Airlines supplying service between Chicago and St. Louis
  - No other carriers
- Strategies: Increase advertising by $1,000 or not
- Assumption: all payoffs are known to all parties
- A **payoff matrix** is a table that describes the payoffs in a game for each possible combination of strategies
Payoff Matrix

<table>
<thead>
<tr>
<th>United Airlines Options</th>
<th>American Airlines Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raise Spending</td>
<td>Raise Spending</td>
</tr>
<tr>
<td>United</td>
<td>$5,500</td>
</tr>
<tr>
<td>American</td>
<td>$5,500</td>
</tr>
<tr>
<td>No Raise</td>
<td>$2,000</td>
</tr>
<tr>
<td>United</td>
<td>$8,000</td>
</tr>
<tr>
<td>American</td>
<td>$6,000</td>
</tr>
</tbody>
</table>

- Payoff is symmetric
- Dominant strategy is raise advertising spending
  - Both companies are worse off
Equilibrium in a Game

• A **Nash equilibrium** is any combination of strategies in which each player’s strategy is her or his best choice, given the other player’s strategies
  – Equilibrium occurs when each player follows his dominant strategy, if it exists
  – Equilibrium does not require a dominant strategy
American and United – Scenario 2

- Same situation
  - Different payoffs; non-symmetric

Lower-Left cell is a Nash equilibrium

<table>
<thead>
<tr>
<th>United Airlines Options</th>
<th>American Airlines Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raise Spending</td>
<td>Raise Spending</td>
</tr>
<tr>
<td>United: $3,000</td>
<td>United: $8,000</td>
</tr>
<tr>
<td>American: $4,000</td>
<td>American: $3,000</td>
</tr>
<tr>
<td>No Raise</td>
<td></td>
</tr>
<tr>
<td>United: $4,000</td>
<td>United: $5,000</td>
</tr>
<tr>
<td>American: $5,000</td>
<td>American: $2,000</td>
</tr>
</tbody>
</table>

- American raises spending
  - United anticipates American action; does not raise
Prisoner’s Dilemma

• The advertising example illustrates an important class of games called the prisoner’s dilemma
• The **prisoner’s dilemma** is a game in which each player has a dominant strategy, and when each plays it, the resulting payoffs are smaller than if each had played a dominated strategy
• Consider another example
Prisoner's Dilemma

- Two prisoners are held in separate cells for a serious crime they did commit
- The prosecutor lacks sufficient evidence

<table>
<thead>
<tr>
<th></th>
<th>Confess</th>
<th>Don't Confess</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horace's Options</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confess</td>
<td>Horace: 5 years</td>
<td>Horace: 0 years</td>
</tr>
<tr>
<td></td>
<td>Jasper: 5 years</td>
<td>Jasper: 20 years</td>
</tr>
<tr>
<td>Don't Confess</td>
<td>Horace: 20 years</td>
<td>Horace: 1 year</td>
</tr>
<tr>
<td></td>
<td>Jasper: 0 years</td>
<td>Jasper: 1 year</td>
</tr>
</tbody>
</table>

**Dominant strategy**

**Optimal strategy**
Cartels

- A **cartel** is a coalition of firms that agree to restrict output to increase economic profit
  - Restrict total output
    - Allocate quotas to each player
Cartel in Action

• Two suppliers of bottled water agree to split the market equally
  – Price is set at monopoly level
    • If one party charges less, he gets all of the market
  – Marginal cost is zero
  – Agreement is not legally enforceable
Bottled Water Cartel

- Each party has an incentive to lower the price a little to increase its economic profits
- Successive reductions result in price equal to marginal cost
Bottled Water Cartel

<table>
<thead>
<tr>
<th>Aquapure's Options</th>
<th>Mountain Spring's Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Charge $1</td>
</tr>
<tr>
<td>Charge $1</td>
<td>Aquapure: $500</td>
</tr>
<tr>
<td></td>
<td>Mtn Spring: $500</td>
</tr>
<tr>
<td>Charge $0.90</td>
<td>Aquapure: $990</td>
</tr>
<tr>
<td></td>
<td>Mtn Spring: $0</td>
</tr>
</tbody>
</table>

- If one firm lowers price, they capture the entire market
- Dominant strategy for each firm is lower price to $0.90
- Cartel agreements are unstable
Repeated Prisoner's Dilemma

• In a repeated prisoner’s dilemma the same players repeatedly face the same prisoner’s dilemma

• Both players benefit from collaboration
  – Tit-for-tat strategy limits defections

• A tit-for-tat strategy says my move in this round is whatever your move was in the last round
  – If you defect, I defect

• Tit-for-tat is rarely observed in the market
  – This strategy breaks down with more than two players or potential players
Ban on TV Ads for Cigarettes

- Congressional ban started 1/1/71
  - Advertising spending decreased by $60 million
- Advertising promoted brand switching
  - Legislation moved players to optimal outcome

<table>
<thead>
<tr>
<th>RJR's Options</th>
<th>TV Ads</th>
<th>No TV Ads</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV ads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RJR:</td>
<td>$10 M</td>
<td>RJR:</td>
</tr>
<tr>
<td>Philip Morris:</td>
<td>$10 M</td>
<td>Philip Morris:</td>
</tr>
<tr>
<td>No TV ads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RJR:</td>
<td>$5 M</td>
<td>RJR:</td>
</tr>
<tr>
<td>Philip Morris:</td>
<td>$35 M</td>
<td>Philip Morris:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$20 M</td>
</tr>
</tbody>
</table>
Shouting at Parties

• Party begins with everyone speaking at normal volume
  – More partiers arrive
• Individual incentive to shout
  – Shouting is the dominant strategy
Sometimes Timing Matters

- One party moves first
  - The second can adjust his strategy accordingly
- Viper and Corvette hybrid models
  - When timing does not matter, the payoff matrix shows no dominant strategy
- When timing matters a decision tree is a more useful way of representing payoffs
  - A decision tree describes the possible moves in a game in sequence
  - A decision tree is sometimes called a game tree
## Simultaneous Decisions

<table>
<thead>
<tr>
<th></th>
<th>Hybrid</th>
<th>No Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chevy Corvette's Options</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid</td>
<td>Chevy: $60 M</td>
<td>Chevy: $80 M</td>
</tr>
<tr>
<td></td>
<td>Dodge: $60 M</td>
<td>Dodge: $70 M</td>
</tr>
<tr>
<td>No hybrid</td>
<td>Chevy: $70 M</td>
<td>Chevy: $50 M</td>
</tr>
<tr>
<td></td>
<td>Dodge: $80 M</td>
<td>Dodge: $50 M</td>
</tr>
</tbody>
</table>

- Profits are higher when each company offers a different type of car
Suppose Dodge Moves First

Dodge decides

Chevrolet decides

Final Outcome

A

Offer hybrid

Don’t offer hybrid

B

Offer hybrid

Don’t offer hybrid

C

Offer hybrid

Don’t offer hybrid

D

$60 million for Chevy

$60 million for Dodge

E

$70 million for Chevy

$80 million for Dodge

F

$80 million for Chevy

$70 million for Dodge

G

$50 million for Chevy

$50 million for Dodge
Threats and Promises

• A **credible threat** is a threat to take an action that is in the threatener's best interest to carry out
  – *Analyze This* and Tony Bennett's compensation

• A **credible promise** is a promise to take an action that is in the promiser's best interest to carry out
The Remote Office

- **Players:** Business owner and remote office manager
- **Options:**
  - Business owner can open the office or not
  - Manager can be honest or not
Remote Office Pay-Off

Managerial candidate promises honesty

A ——— B

Open remote office

C

Honest manager
Owner: $1,000
Manager: $1,000

Dishonest Manager
Owner: -$500
Manager: $1,500

Owner: $0
Manager: $500 working elsewhere
Monopolistic Competition and Location

• First mover advantage
  – With Viper and Corvette, firms did better if products were different
  – Tic-tac-toe

• If the differentiator is time or location, the last mover may have the advantage
  – Suppose that customers go to the nearest convenience store
    • Store A locates 1 mile from Freeway
    • Where will Store B locate?
Store B's Location

• A chooses its location
• New business plans to enter the market
  – Location C minimizes customer's travel distance
  – Location B maximizes customers

- Location B
  - 1 mile
  - 1,200 people

- Location C
  - ⅓ mile
  - 800 people

- Location A
  - ⅓ mile
  - 800 people
Other Examples

• There are a number of cases where the last mover gains an advantage
  – Times for flights
  – Movie schedules
  – Cola drink flavors
Commitment

• A **commitment problem** arises from an inability to make credible threats or promises
  – A **commitment device** changes incentives to make threats or promises credible
    • Underworld code, *Omerta*
    • Military-arms-control agreements
    • Tips for waiters

• Various business problems are commitment issues
Restaurant Service

• Restaurant wants to provide superior service
  – Increases pay of wait-staff; monitoring problem
    • If wait-staff are not diligent, restaurant wasted money
  – Restaurant cannot insure good service by paying higher wages

• Repeat customers can ensure good service by tipping
  – A one-time, self-interested diner will not tip
    • Tip is marginal cost
    • Service is completed so marginal benefits are zero
To Tip or Not To Tip?

Waiter

Provide good service

Dinner

Tip

Waiter: $20
Diner: $20

Don't Tip

Waiter: $10
Diner: $5

Provide adequate service

Waiter: − $5
Diner: $30
The Strategic Role of Preferences

- Game theory assumes that the goal of the players is to maximize their outcome
  - In most games, players do not attain the best outcomes
- Altering psychological incentives may also improve the outcome of a game
An honest manager earns more than a dishonest manager

Managerial candidate promises honesty

A ——— B

Open remote office

No remote office

C

Honest Manager
Owner: $1,000
Manager: $1,000

Dishonest Manager
Owner: $500
Manager: – $8,500

Owner: $0
Manager: works elsewhere for $500

An honest manager earns more than a dishonest manager.
Self-Interest Evaluated

• There are exceptions to outcomes based on self-interest
  – Tips at out-of-town restaurants
  – Revenge
  – Passing on "unfair" opportunities
The Role of Preferences

- Preferences are given
  - Affect choices through
    - Sympathy for an adversary
    - Generosity
    - Honesty

- If preferences can be known to the other party, the commitment problem is reduced
  - Trustworthy employee
Character Judgments

• If character were known perfectly, businesses could avoid the costs of dishonesty, shirking, etc.
  – Since people are victimized, make hiring mistakes, and so on, either
    • Character cannot be judged perfectly OR
    • Character information is expensive.
Caveat Emptor

• The payoff of deceit
  – Advantage to seeming honest while being dishonest
    • Greater opportunities
    • Greater exploitation of opportunities
Games and Strategic Behavior

- Prisoner's Dilemma
- Sequential Decisions
- Commitment Problems

- Game Theory
  - Elements
  - Equilibrium
  - Dominant Strategy