Outline

1. Price Discrimination

2. Oligopoly?

3. Game Theory
1 Price Discrimination

- Nicholson, Ch. 14, pp. 513-519

- Restriction of contract space:
  - So far, one price for all consumers. But:
  - Can sell at different prices to differing consumers (first degree or perfect price discrimination).

- Self-selection: Prices as function of quantity purchased, equal across people (second degree price discrimination).

- Segmented markets: equal per-unit prices across units (third degree price discrimination).
1.1 Perfect price discrimination

- Monopolist decides price and quantity consumer-by-consumer

- What does it charge? Graphically,

- Welfare:
  - gain in efficiency;
  - all the surplus goes to firm
1.2 Self-selection

• Perfect price discrimination not legal

• Cannot charge different prices for same quantity to A and B

• Partial Solution:
  – offer different quantities of goods at different prices;
  – allow consumers to choose quantity desired
• Examples (very important!):
  
  – bundling of goods (xeroxing machines and toner);

  – quantity discounts

  – two-part tariffs (cell phones)
Example:

- Consumer A has value $1 for up to 100 photocopies per month
- Consumer B has value $.50 for up to 1,000 photocopies per month

Firm maximizes profits by selling (for $ small):

- 100 photocopies for $100-ε
- 1,000 photocopies for $500-ε

Problem if resale!
1.3 Segmented markets

- Firm now separates markets

- Within market, charges constant per-unit price

- Example:
  - cost function $TC(y) = cy$.
  - Market A: inverse demand function $p_A(y)$ or
  - Market B: inverse function $p_B(y)$
• Profit maximization problem:

$$\max_{y_A, y_B} p_A (y_A) y_A + p_B (y_B) y_B - c (y_A + y_B)$$

• First order conditions:

• Elasticity interpretation

• Firm charges more to markets with lower elasticity
• Examples:

  – student discounts

  – prices of goods across countries:
    * airlines (US and Europe)
    * books (US and UK)
    * cars (Europe)
    * drugs (US vs. Canada vs. Africa)

• As markets integrate (Internet), less possible to do the latter.
2 Oligopoly?

- Extremes:
  - Perfect competition
  - Monopoly

- Oligopoly if there are $n$ (two, five...) firms

- Examples:
  - soft drinks: Coke, Pepsi;
  - cellular phones: Sprint, AT&T, Cingular,...
  - car dealers
Firm $i$ maximizes:

$$\max_{y_i} p (y_i + y_{-i}) y_i - c (y_i)$$

where $y_{-i} = \sum_{j \neq i} y_j$.

First order condition with respect to $y_i$:

$$p'_{Y} (y_i + y_{-i}) y_i + p - c'_y (y_i) = 0.$$  

Problem: what is the value of $y_{-i}$?

- simultaneous determination?

- can firms $-i$ observe $y_i$?

Need to study strategic interaction
3 Game Theory

- Nicholson, Ch. 8, pp. 251-268

- Unfortunate name

- Game theory: study of decisions when payoff of player $i$ depends on actions of player $j$.

- Brief history:
  
  - von Neuman and Morgenstern, Theory of Games and Economic Behavior (1944)
  
  - Nash, Non-cooperative Games (1951)
  
  - ...

  - Nobel Prize to Nash, Harsanyi (Berkeley), Selten (1994)
• Definitions:

- Players: $1, \ldots, I$

- Strategy $s_i \in S_i$

- Payoffs: $U_i (s_i, s_{-i})$
Example: Prisoner’s Dilemma

- $I = 2$

- $s_i = \{D, ND\}$

- Payoffs matrix:

\[
\begin{array}{c|cc}
1 & D & ND \\
\hline
D & -4, -4 & -1, -5 \\
ND & -5, -1 & -2, -2 \\
\end{array}
\]
• What prediction?

• Maximize sum of payoffs?

• Choose dominant strategies

• **Equilibrium in dominant strategies**

• Strategies \( s^* = (s_i^*, s_{-i}^*) \) are an Equilibrium in dominant strategies if

\[
U_i(s_i^*, s_{-i}) \geq U_i(s_i, s_{-i})
\]

for all \( s_i \in S_i \), for all \( s_{-i} \in S_{-i} \) and all \( i = 1, ..., I \)
• Battle of the Sexes game:

<table>
<thead>
<tr>
<th></th>
<th>Ballet</th>
<th>Football</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballet</td>
<td>2, 1</td>
<td>0, 0</td>
</tr>
<tr>
<td>Football</td>
<td>0, 0</td>
<td>1, 2</td>
</tr>
</tbody>
</table>

• Choose dominant strategies? Do not exist

• Nash Equilibrium.

• Strategies \( s^* = (s^*_i, s^*_{-i}) \) are a Nash Equilibrium if

\[
U_i(s^*_i, s^*_{-i}) \geq U_i(s_i, s^*_i)
\]

for all \( s_i \in S_i \) and \( i = 1, \ldots, I \)
• Is Nash Equilibrium unique?

• Does it always exist?

• Penalty kick in soccer (matching pennies)

<table>
<thead>
<tr>
<th>Kicker \ Goalie</th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>0,1</td>
<td>1,0</td>
</tr>
<tr>
<td>R</td>
<td>1,0</td>
<td>0,1</td>
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</tbody>
</table>

• Equilibrium always exists in mixed strategies $\sigma$
• Mixed strategy: allow for probability distribution.

• Back to penalty kick:
  
  – Kicker kicks left with probability \( k \)
  
  – Goalie kicks left with probability \( g \)

  – utility for kicker of playing \( L \) :
    \[
    U_K (L, \sigma) = gU_K(L, L) + (1 - g)U_K(L, R) = (1 - g)
    \]

  – utility for kicker of playing \( R \) :
    \[
    U_K (R, \sigma) = gU_K(R, L) + (1 - g)U_K(R, R) = g
    \]
• Optimum?
  
  - $L \succ R$ if $1 - g > g$ or $g < 1/2$
  
  - $R \succ L$ if $1 - g < g$ or $g > 1/2$
  
  - $L \sim R$ if $1 - g = g$ or $g = 1/2$

• Plot best response for kicker

• Plot best response for goalie
• Nash Equilibrium is:
  – fixed point of best response correspondence
  – crossing of best response correspondences
4 Next lecture

- Oligopoly: Cournot
- Oligopoly: Bertrand
- Dynamic games
- Stackelberg duopoly
- Auctions