Economics 101A
(Lecture 21)

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Outline

1. Profit Maximization: Monopoly II
2. Price Discrimination
3. Oligopoly?
4. Game Theory
1 Profit Maximization: Monopoly

- Example.

- Linear inverse demand function $p = a - by$

- Linear costs: $C(y) = cy$, with $c > 0$

- Maximization:

$$\max_y (a - by) y - cy$$

- Solution:

$$y^* (a, b, c) = \frac{a - c}{2b}$$

and

$$p^* (a, b, c) = a - b \frac{a - c}{2b} = \frac{a + c}{2}$$

- Figure
• Monopoly profits

• Case 1. High profits

• Case 2. No profits
• Welfare consequences of monopoly
  – Too little production
  – Too high prices

• Graphical analysis
2 Price Discrimination

- Nicholson, Ch. 13, pp. 397–404 [OLD: Ch. 18, pp. 508–515].

- 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).
2.1 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
2.2 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 $100-$
  - 1,000 photocopies for $500-$

• Problem if resale!
2.3 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.
3 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
4 Game Theory

- Nicholson, Ch. 15, pp. 440–449 [OLD: Ch. 10, pp. 246–255].

- 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, ..., 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:

\[
\begin{array}{c|ccc}
1 & 2 & D & ND \\
\hline
D & -4, -4 & -1, -5 \\
ND & -5, -1 & -2, -2 \\
\end{array}
\]
• 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 \( i = 1, \ldots, I \)
- Battle of the Sexes game:

<table>
<thead>
<tr>
<th></th>
<th>She</th>
<th>Ballet</th>
<th>Football</th>
</tr>
</thead>
<tbody>
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<td>2, 1</td>
<td>0, 0</td>
<td>0, 0</td>
</tr>
<tr>
<td>Football</td>
<td>0, 0</td>
<td>1, 2</td>
<td></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 $i = 1, ..., I$
• 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>
</tr>
</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
5 Next lecture

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