Road Map

1. Backward Induction
2. Examples
3. Application: Stackelberg Duopoly
4. [Next Application: Negotiation]
Definitions

**Perfect-Information game** is a game in which all the information sets are singleton.

**Sequential Rationality:** A player is sequentially rational iff, at each node he is to move, he maximizes his expected utility conditional on that he is at the node – even if this node is precluded by his own strategy.

**Backward Induction:** Apply sequential rationality and the “common knowledge” of it as much as possible (in finite games of perfect information).
A game

\[
\begin{array}{cccc}
1 & A & 2 & 1 \\
D & \delta & d & (1,-5) \\
(4,4) & (5,2) & (3,3) \\
\end{array}
\]
Backward Induction

1. Take any pen-terminal node
2. Pick one of the payoff vectors (moves) that gives ‘the mover’ at the node the highest payoff
3. Assign this payoff to the node at the hand;
4. Eliminate all the moves and the terminal nodes following the node
5. If yes, go to any non-terminal node; if no, the picked moves
Battle of The Sexes with perfect information

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>F</th>
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<tbody>
<tr>
<td>O</td>
<td>(2,1)</td>
<td></td>
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| F | (0,0)| (0,0)| (1,2)
Note

- Backward Induction always yields a Nash Equilibrium.
- There are Nash equilibria that are different from the Backward Induction outcome.
- Sequential rationality is stronger than rationality.
Matching Pennies (wpi)

1

Head

2

head tail

(-1,1) (1,-1)

Tail

2

head tail

(1,-1) (-1,1)
A game with multiple solutions
Stackelberg Duopoly

**Game:**

\[ N = \{1,2\} \quad c = 0; \]

1. Firm 1 produces \( q_1 \) units
2. Observing \( q_1 \), Firm 2 produces \( q_2 \) units
3. Each sells the good at price

\[
P = \max\{0,1-(q_1+q_2)\}.
\]

\[
\pi_i(q_1, q_2) = q_i[1-(q_1+q_2)] \text{ if } q_1 + q_2 < 1, \\
0 \quad \text{otherwise}.
\]
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