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**Lecture 17: Sequential-Move Games**

1. A Quick Auction
2. The nature of movement
   1. Up until now our players have moved at the same time. Now let us consider games where each player takes turns. These are also known as sequential-move games.
      1. Examples of such games are chess, political races, and market entry.
   2. We show the possibilities with game trees. The first node is for the first mover (or Player One) with different choices extending outward. Each choice ends with either another decision node or a schedule of payoffs (with Player One’s payoffs first) at a terminal node.
      1. For example, Adriana Alpha and Betty Beta are politicians. Alpha is the incumbent and has announced she will be running for re-election. She is wondering if she should run ads or not.
      2. On one hand, ads are expensive and she currently has no challenger. On the other hand, running some ads could deter potential challenger, Betty Beta, from running.
      3. Alpha’s choice is if she should run ads or not. Beta’s choice is if she should enter the race or not.

Alpha

Beta

Beta

1,1

3,3

2,4

4,2

Run

Run

Don’t Run

Ads

Don’t Run

No Ads

1. Playing the game
   1. To play the game, use a technique called *backward induction* (sometimes referred to rollback)—starting at the end of the game and eliminate strategies until you find the outcome.
   2. At the end, there are two decision nodes for Beta.
      1. At the top node, Beta would prefer to Not Run (3 > 1) so we eliminate the Run option.
      2. At the bottom node, Beta would prefer to Run (4 > 2) so we eliminate the Not Run option.
   3. Now we examine Alpha’s node. Since we know what Beta will do based on what Alpha would do, we can consider what Alpha should do.
      1. If Alpha selects Ads, Beta will Not Run so Alpha’s payoff is 3.
      2. If Alpha selects No Ads, Beta will Run so Alpha’s payoff is 2.
      3. Thus Alpha will select Ads (3 > 2).
   4. By “pruning” the rejected strategies, we can see what each player will do and thus determine the *rollback equilibrium*: Ads, Don’t Run.
      1. Note rollback equilibrium is ***not*** the same thing as Nash Equilibrium.
   5. Playing these games is exactly what people do when they think strategically. They ask themselves not just what is best for them, but what is best for other players. By knowing how others will react, they can best prepare of their response.
2. Order advantages
   1. Since we are playing a game with an order of play, sometimes there are advantages to when you play.
   2. Acting earlier is nice because you get to exclude whole parts of the decision tree.
   3. Acting later is nice because you get to act with more information.
   4. *First Mover Advantage*—if your payoffs are higher as a first mover than a second mover. First movers are powerful when excluding options is more important than information.
   5. *Second Mover Advantage*—if your payoffs are higher as a second mover than a first mover. Second movers are powerful when information is more important than excluding options.
   6. To compare, simply change the order of play and then replace the payoffs. ***Remember***: make sure the strategy combinations match the same payoffs.
      1. Note that because the order is reversed, the payoff order is also reversed.

Alpha

Beta

1,1

3,3

2,4

4,2

Run

Don’t Run

Ads

No Ads

Alpha

Ads

No Ads

* + 1. Now the rollback equilibrium is Run, No Ads.
    2. Here, Beta’s payoffs are higher now that she’s the first mover. (4, rather than 3). Thus, there is a first mover advantage.
  1. Second mover advantages also happen:
     1. Undercutting a competitor’s price; you cannot undercut someone unless you know what they are selling at
     2. Forcing a political rival to commit to a plan which can then be attacked (see Herman Cain’s 9-9-9 plan). (Though also note that because of Cain’s flat tax, all Republican candidates are under pressure to come up with their own flat tax plan.)
     3. Advertising: it is sometimes better to respond to a rival’s campaign than risk your own.
  2. Who has the advantage not only depends on the payoffs but the player’s inherent abilities. Some people are better at responding with more information. Others are better at defining the nature of the game.

1. The Centipede Game
   1. Suppose I place a dime on the table in front of two players. One player may either take the dime or pass. Taking the dime ends the game.
   2. If the first player passes, I add another dime and ask the second player to take the dimes or pass. Again, taking the money ends the game.
   3. This continues until either one player takes the money or one dollar in dimes is on the table.

10,0

Take

B

A

A

B

0,20

30,0

0,40

Pass

Pass

Take

Pass

Take

Pass

B

0,100

Pass

Take

Take

…

0,0

* 1. Where’s rollback equilibrium?