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Activity title

Oligopoly

Keywords

Oligopoly, game theory, Nash equilibrium

Overview of activity (1-2 brief paragraphs)

Stylized version of the 1990’s decision by Airbus and Boeing, when both companies were researching the feasibility of a very large passenger aircraft. Uses game theory (strategies, stylized payoffs, Nash equilibria).

Short description of activity (1-2 sentences)

Investment decisions by two duopolists. Create payoff matrix with stylized payoffs and strategies, followed by finding Nash equlibria.

Expected student learning outcomes

* Contrast collusion and competition
* Analyze oligopoly situations using game theory
* Identify players, strategies, and payoffs in a strategic economic situation
* Calculate the Nash equilibria in a one-shot game

Context for use

* Is the activity appropriate for principles courses, intermediate courses, or selective elective courses?
  + Principles
* What prior student knowledge is required?
  + Oligopoly, payoff matrix, strategies, Nash equilibrium
* Are there class size limitations?
  + No
* How much time is needed for the activity? Does it extend across more than one class period?
  + About 50 minutes
* Is this activity connected to another TBL activity? If so, please provide a link to that activity. For example, is this activity part of a group of activities within a single TBL module?
  + This activity can be used on its own, though it is part of a series of activities in the same module.

Teaching notes

The purpose of this application is to introduce students to analyzing a type of strategic interaction between firms (duopolists) using game theory for the first time. Before tackling this application, students have read the chapters on oligopoly and game theory. In the OpenStax textbook, game theory is not explored in depth, so before this application students have only seen a 2-player, 2-strategy payoff matrix, discussing the Nash equilibrium only in a prisoner-dilemma-like setting. This application is the first that allows them to practice those concepts and tools.

Part 1 does not cause any problem. Before students create the payoff matrix, it is useful to tell them what player goes in the rows, and remind them of the convention about the order of payoffs, so all teams create a similar payoff matrix (as opposed to having the payoffs or players switched). Comparing answers across teams at this point allows everyone to start from a common payoff matrix.

Part 2 usually is pretty straightforward, and you may want to consider having teams solving parts 2 and 3.

Part 3 is where the fun begins. This is the first time teams are trying to find a Nash equilibrium. Common mistakes include expressing the equilibrium in terms of payoffs, instead of strategies, or insisting that if both firms would be better off by colluding, then they would both switch, without realizing that the Nash equilibrium requires each player to consider her strategies and payoffs while keeping the other player’s strategy constant.

Part 4 encourages students to transform the payoff matrix in such a way that both firms would find themselves colluding in the new Nash equillibrium. The discussion question aims at having students think outside of the mini-universe of the two firms, and what would be the impact on consumers and others. This is a good time to talk about antitrust legislation and its purpose (for example, the contract proposed in part 4 would be illegal in the U.S.).

The game was presented as a one-shot simultaneous game. After parts 3 and 4, it would be useful to talk about what would happen in a repeated game, when Boeing and Airbus keep meeting each other, and whether the players might be able to sustain a collusive equilibrium, even in the absence of an explicit contract (that is, without modifying the initial payoff matrix).

Note that in my class each team has a small whiteboard (sometimes called a huddleboard) to respond to most questions, and they share their results by raising their whiteboards simultaneously (the whiteboards/huddleboards are small and light enough that they can be raised by one person, and they are big enough that everyone can observe the results of all other teams).

Assessment of student learning outcomes

Observation and discussion of student answers. Module ends in a capstone test. Final exam also tests these learning outcomes.

Additional resources

Additional information about this activity submission

Information given to student groups for this application exercise

**Module 2**

**Application #2: Oligopoly**

The competition between [Airbus](https://en.wikipedia.org/wiki/Airbus) and [Boeing](https://en.wikipedia.org/wiki/Boeing_Commercial_Airplanes) has been characterized as a [duopoly](https://en.wikipedia.org/wiki/Duopoly) in the large [jet airliner](https://en.wikipedia.org/wiki/Jet_airliner) market since the 1990s. During the 1990s both companies began researching the feasibility of a passenger aircraft larger than the [Boeing 747](https://en.wikipedia.org/wiki/Boeing_747), which was then the largest airliner in operation. They both came to similar conclusions:

* If neither company took costly investments to build a superjumbo jet, Boeing would earn $10 billion in profits while Airbus would earn $8 billion in profits.
* If only Airbus decided to invest in the A380 at an R&D cost of $1 billion, it would earn an additional $2 billion while Boeing would lose $2 billion but have no R&D cost.
* If only Boeing decided to invest in the 787 Dreamliner at an R&D cost of $1 billion, it would earn an additional $2 billion while Airbus would lose $2 billion but have no R&D cost.
* If both companies invested in their respective superjumbos, they would have the same revenue as if they had not invested, but would each have to pay $1billion in R&D costs.
* Airbus and Boeing make their decisions simultaneously and independently.

1. **On your whiteboard, write down the corresponding payoff matrix.** Remember that each airliner company has the choice to invest or not to invest in their superjumbo jets, and that the payoffs should be written as ("Airbus Payoff","Boeing Payoff").
2. Suppose both companies were able to collude with one another. This means they are aiming to maximize their joint profits. What would they choose? **Use your whiteboard to mark, in the table of the previous part, the preferred cell from the point of view of the companies**.
3. **Indicate in the payoffs matrix which is the Nash Equilibrium of this game**.
4. Now suppose Boeing and Airbus decided to collude with punishment. If either invests in their own superjumbo they must pay the other $3 billion. *Note that such an agreement whether explicit or implicit is illegal.* This payment occurs over and above the increases/decrease in revenue and investment costs. **Indicate in the payoffs matrix which is the new Nash equilibrium of this game.**

**Discussion:** Airbus and Boeing are deciding based on their own profits alone. What if they collude, would consumers lose?