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A STUDY OF GAME THEORY AND ITS APPLICATION IN ECONOMICS

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ABSTRACT

In this research article, we introduce Game theory has been used as a potent analytical tool by numerous areas since its inception. The major ideas of game theory are summarized in this paper, as well as their application in microeconomics. This research article also gives an overview and definition of relevant terminologies related to this theory like a game, Nash equilibrium, and dominance which form the basis of the theory con- cept. Finally, in the last section, it also focuses on extensive games, mixed strategies, with both perfect and imperfect information, and their relevant practical application of the concept as applied in the field of economics.

Keywords: Game Theory, Nash Equilibrium, Cournot Model, Bertrand Model, Zero-sum game, Economics.

1. Introduction and Preliminaries

Game theory is a branch of the applied mathematics, contributes insight into economics, sociology, and many other disciplines. Game theory has out- standing effects on the theory of economics, and the literature on applying game theoretical and related approaches to economics is growing rapidly, and yet many theoretical and empirical challenges remain in this field.

Game theory is commonly used in economics, psychology, biology, and political science. Its application is majorly in studies of competitive scenes. As such, the stated problems are referred to as games while the participants are referred to as the players. A player may be defined as a person, or a group of persons that are involved in the decision-making process.

Game theory was initially developed to solve economic problems. Morgenstern and Neumann argued that existing mathematical models did not fully understand the workings of physical sciences. As such, they developed what they assumed to be a better model for economics.

According to the theorists, economics operates like a game, which necessitated a new mathematical approach to understand how players relate to each other. Essentially, game theory focuses on the strategic elements of decision-making. In other words, it analyzes the aspects controlled by the players instead of pure chance. In retrospect, game theory is viewed as a supplement to the classical theory of probability. A key difference between game theory and

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other strategic business decisions is that there is a direct connection between the optimal decision and the outcome, while other factors influence the latter. The next section explores how game theory applies in economics. This theory has been of great importance in various fields, especially those of social sciences dating back to more than fifty years ago. It first looked into zero-sum games where one per- son's gains are equal to the losses of the other player [1]. Game theory may be defined as a decision-making process in formal studies where various players make choices that directly or indirectly affect the other players' interests.

2. The basic content of game theory

In this segment, we present a content of game theory. What is Game Theory? Social situations are characterized by competing players. Game theory helps us perceive and understand these social situations among the competitors. So what is game theory? Game theory was developed in the mid-20th century by economist Oskar Morgenstern and mathematician John von Neumann. The mathematical model seeks to determine the best option for an individual player when the other participant's unknown choice affects the overall outcome. This theoretical framework is more of a scientific strategy that yields optimal decision-making. In the real world, game theory is applied when analyzing scenarios such as pricing competition and product development among competing firms.

The game theory definition describes the concept as a model for under- standing interactive situations among competing players. As such, the theory assumes that the strategy implemented by one player shapes the other player's payoff. Indeed, its proponents argue that the outcome of social interactions is influenced by different identities, strategies, and preferences of competing players. Nonetheless, different game theory models impose additional assumptions and requirements. Game theory can determine likely results in situations involving multiple players with known outcomes and quantifiable payouts. This payout can be in the form of utility or financial payoff. Game theory provides a mathematical approach for analyzing situations that involve parties who make interdependent decisions. As already stated, the outcome of social interactions (game) depends on the optimal decisions of the interacting parties (players). It is important to note that the players may have identical, contradictory, or diverse interests.

In economics, game theory attempts to determine equilibrium solutions subject to the rational behavior of market players. These participants are bound by conceivable situations which establish the rules of behavior in any situation. In this case, the underlying notion is that all market participants are confronted by economic situations whose outcome depends not only on their strategies but also on their opponents' decisions. An economy or a market operates as a game because there is a set of procedures and rules that participants must comply with. Each player applies the rules depending on their unique strategy. Each participant's strategies and

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decisions influence outcomes in the market. The result of each approach is the player's payoff. The saddle point is the equilibrium point. Economies may involve either a constant or a non-constant sum in this context. Participants in a constant sum game gain or lose at the expense of each other. In this case, profits will remain the same. On the other hand, a non-constant sum game allows each player to accrue different profits. The players may also choose to collaborate to grow their profits. The game theory assumes a duopolistic market comprises two firms seeking to maximize profits. The model also postulates that where one company gains, the other loses. In this market situation, the interests of competing firms remain opposed, and individual players will attempt to counter the strategies of their competitors to protect themselves from possible losses. Therefore, a payoff matrix can be constructed for the participants.

3. Application of Game Theory

This section manages with some applications of our presented study. The first application of the game theory was during the study duopoly by Cournt back in the year 1838. Other scholars like Camerer highlight the application of game theory in 1713 through a letter from James Waldegrave. John Neumann [8], through his study of the theory of polar games, puts to the spotlight the application of this theory in the 20th century. Neumann, together with other neo-classical economists, brought with them a fresh way of looking into the theory as a competitive process with economic players applying strategic interactions. The first published material on game theory was authored by John Forbes Nash in his thesis in 1949. The thesis was entitled 'Non-Cooperative Games,' where he introduced the widely used phenomenon of Nash Equilibrium or equilibrium point [1], [2]. Nash Equilibrium is noted to be a concept based on the principle where strategy combinations the players are most likely to choose represents one that none of the other players could do better if they chose other different strategy keeping in mind the strategy choice of the others. Economists use 'Game Theory' as a tool to analyze economic competition, economic phenomena such as bargaining, mechanism design, auctions, voting theory; experimental economics, political economy, behavioral economics etc. Game theory is applied for determining different strategies in the business world. The major application lies in oligopolistic competition and hence the major concern in this research paper. Oligopoly market may simply be defined as the scenario where a small group of huge companies in unison acquires control of a large market share well informed on the effects of their nature of correlation on the profits and market shares. Due to this oligopolistic structure, decision-making in this case heavily relies on game theory.

As previously said, game theory is useful in analyzing economic issues. As a result, game theory may be used to investigate how corporations' strategies affect the payoffs of individual participants in various markets. An industry with two enterprises is known as a duopoly.

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4. Concluding remarks

It is evident from this paper that game theory goes beyond mathematical representations to the description of the real world events where decisions made by other players affect other players' interests. Game theory may not be very efficient in the prediction of behavior like in the case of sciences thoughin some unique cases.

In the future, based on Nash equilibrium, we can investigate the equilibrium, taking into account more realistic aspects in order to improve the accuracy of the final analysis result. Game theory can be used in conjunction with stakeholder theory and behavioral economics in microeconomics.

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