Chapter II
Game Theory as a Tool in Mobile Technologies and Applications

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ABSTRACT

Game theory is a tool used in the context of conflict interest among interacting decision makers. Game theory may be considered as a generalization of the decision theory that includes multiple players or decision makers. This chapter provides an introduction and overview of the game theory and demonstrates its potential applications in mobile business & technologies. Thus, the chapter provides a global outlook of game and economic theory and provides a comprehensive introduction to the more general subject of mathematical economics again in the context of mobile business. The reason for the importance of game theory in the context of mobile business & technologies is the fact that game theory deals primarily with distributed optimization. This distribution and optimization is individual user trade-users who are involved in making their own decisions in their own time and space. The chapter covers the role of game theory in different aspects of mobile applications, technologies and business.

INTRODUCTION

In the world of mobile business there are conflicting interests between two or more providers. To better understand the phenomenon, let A and B be two service providers in mobile communication field. There will be conflict of interest regarding business issues such as spectrum, tariff, region etc. In mathematical modeling A and B are called players and business is a game. The game should have minimum of two players and as the number of players increases the modeling complexity increases.

Sequential and simultaneous are two fundamental type of games. There are alternative moves in sequential gaming, which follow the rule "Look ahead and reason back". Where as in simultaneous game there is not necessarily any last move. One has to consider all possible combination and search for dominant strategy.

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Game Theory can be classified into two categories (i) cooperative game theory (ii) non co-operative game theory. The non co-operative game can be zero sum game or non zero sum game. In zero sum game the gain of one player is equal to the loss of other player. In non-zero sum game the gain of one player is not equal to the loss of other player. The non-zero sum game was first introduce by John Nash .It is also called Nash equilibrium. Nash equilibrium is the universally used solution concept. However, co-operative game theory is totally different from non co-operative game theory. Co operative game theory is applied to solve different problem as this theory deals with the solution that are equitable. Further, the game can be modeled/played using certain strategies taken by a player in terms of pure or mixed strategies. In general if A takes m pure strategy and B takes n pure strategy than the game is called two person game or mxn rectangular game. A matrix is generated in terms of gain/loss (payoff matrix) if the player payoff functions are common to the players, a game is treated as game of complete information. Where as in the game of incomplete information at least to one player the payoff function is not known. To find the value of game $m \times n$ maxmin minmax principle is applied. The analytical condition of pure strategy of two-person sum game can be expressed as

$$\max_{x \varepsilon A} \min_{y \varepsilon B} f(x,y) \leq \min_{y \varepsilon B} \max_{x \varepsilon A} f(x,y)$$

In case of mixed strategies the analytical conclusion is given as

$$E(p,q) = \sum_{i=1}^{m} \sum_{j=1}^{n} a_{ij} p_i q_j;$$

where p and q are the mixed strategies of A and B respectively $[a_{ij}]$, payoff matrix of order $m \times n$. The game can further be classified in terms of static or dynamic game. In the formal game the players do not have any information about the move/choices of other players i.e. the players have their own choices(bidding). In the later case the games have multiple move/stages (in case of chess, bargaining). To conclude the role of game theory which is " the study of multi person decision problem" can be used in different areas of study such as business, Engineering, Intelligence, biology, Social beliefs, Trade and so many other related areas.

The chapter is organized in five sections. In section 1 we provide the basic introduction of game theory, followed by the role of game theory in business, the application of game theoretic approach in different mobile technologies in section 2 and 3. The other aspect related to social perspective is discussed in section 4. We conclude the chapter in the last section.

ROLE OF GAME THEORY IN BUSINESS

Due to advances in information technology and e-commerce the decision and its consequences in business are affected by the interactions.(with customers, suppliers other business partners …) . Any business decision or action taken by a group or organization has multiple impacts due to the interacting group/member inside or outside the firm. In such scenario where the outcome of one depends on other and there is interactive decision making in such condition the role of game theory is interesting. The obvious question one can ask is the why to use game theory than other tools?. However, any approach such as decision tree or optimization infers/optimizes results from the perspective of one player only. It could not incorporate the strategic behaviour of other players. In previous section it was clearly established that game theory is a collection of tools for predicting outcomes of a players/group, which interacts, and an action of individual affects the payoff of other players/group in the game.

In Market Power

In business the companies often compete on prices and are involved in price war in order to control of the market share. In such cases the behaviour of the company can well be understood or analyzed using the game theory framework, which generally referred to as "Prisoner Dilemma". Assuming the business as a long time process the concept of repetition of interaction are captured for which organizations used different strategical move with the person/group/organization involved in the chain/interactions giving two widely used approaches based on vertical integration and virtual integration. In the initial phases the vertical integration was used and later due to globalization and information advancement concept of virtual integration came into existence. Game theory is being widely used in business and economic field due to

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