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About Game Theory And Types Of Games

Akmal I. Sotvoldiyev, Dilshod I. Ostonaqulov
E-mail: akmal.sotvoldiyev@mail.ru
Tashkent Institute of Finance, Tashkent, Uzbekistan

Annotation. This article presents the basic concepts of game theory, types of games and their differences

Keywords: game, conflict situations, game winning, optimality, strategy, Nash equilibrium, zero sum game

Introduction

The branch of mathematics that studies conflict situations, i.e. situations where the interests of the participants (players) are opposite or incompatible, is called “Game theory”.

Game theory is a mathematical theory that allows each “player”participating in a conflict state to determine the best (optimal) of the actions to be taken to achieve the greatest achievement (or smallest loss), to give a pass.

Many economic processes can also be viewed from the point of view of Game theory. For example, the participants in the game are enterprises, suppliers and consumers who produce the same type of product, and the achievement of the game can be the effectiveness of production funds, income funds, price or cost of the product.

The creation of Game theory is associated with the name of John von Neumann, one of the great mathematicians of the 20th century. His monograph “Economic Processes and Game Theory”, published in 1944 in collaboration with Morgenshtern, became a fundamental foundation in the development of Game theory.

Despite the fact that game theory considers economic models, until the 50s of the 20th century it was only a mathematical theory. After World War II, as a result of the sharp jump in the US economy and the resulting increased funding of science, attempts began to apply the theory of games in practice in economics, biology, cybernetics, technology and other fields. During and immediately after World War II, the military took a serious interest in Game theory, which they saw as a powerful apparatus for researching strategic decisions. In the early 1950s, John Nash developed methods of analysis in which all participants would win or fail. Such cases are called “Nash equilibria”. According to his theory, parties must use an optimal strategy that leads to the creation of a stable balance. It is beneficial for players to maintain this balance, as any change will worsen their condition. Nesh's work contributed significantly to the development of Game theory. The mathematical tools of economic modeling have been revised. John Nash shows that A.Smith’s classical approach to competition is not optimal when everyone is for themselves. There are more optimal strategies when each person tries to work better for himself, to do good for others. In the past 20-30 years, the importance and interest of Game Theory has increased significantly, some areas of modern economic theory cannot be explained without applying game theory. A major contribution to the practical application of Game theory was the work of Thomas Schelling. He was a 2005 Nobel Prize laureate in economics (“conflict strategy”).

It should be noted that the methods and conclusions of Game theory are used in relation to conflict situations that are repeated many times.

In practice, when researching conflict states using mathematical methods, a simpler model of states is constructed by discarding non-essential facts. Such a model is called a game. In the game, the conflict situation develops according to a certain rule. The essence of the game is that each participant (player) tries to choose a solution that gives him the best result.

Main Part

In explaining the meaning of game theory, let’s consider the following simple game:

Prisoner’s dilemma

	B criminal’s strategy “silence”	**B criminal strategy “betrayal”**
A criminal’s strategy	Half a year for every one	10 years to A criminal,

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"silence"		B criminal liberty
A criminal's strategy "betrayal"	10 years to criminal B, A criminal liberty	Every two years for one

Now let's imagine the situation from the point of view of A criminal. If the B criminal is silent, it is better to betray him and get free. If he betrays, then A criminal is also better to betray and take two years instead of ten.

Thus, if each player chooses the best strategy for himself, both betray each other and take two years. This is not the optimal situation for both. If both think about the common good, then it will take only half a year.

Games are separated into different looks and cases, depending on the nature:

1. ***Cooperative / non-cooperative game***

Cooperative play is a conflict in which players can interact with each other and join groups to achieve the best possible outcome. An example of a cooperative game is the bridge card game, in which each player's points are counted separately, but the couple with the most wins. Games without cooperation from two types of games describe situations in detail and give more accurate results. Cooperatives treat the gameplay as a whole. Despite the fact that these two types are opposed to each other, strategies can be combined, which can bring more benefits than both.

2. ***Zero sum and nonzero sum***

A zero-sum game is a game in which the income of one player is equal to the loss of another. For example, a simple dispute: if you won the amount N, someone lost the same amount N. In a game with a non-zero sum, the total cost of the game can vary, which can benefit one player without removing its price from another. As an example, chess is perfect here: by turning a piece into a queen, player A increases the total amount of its grains, while not removing anything from player B.

The interests of two or more participants in the game may clash. Accordingly, such games can be two and multiplayer. According to the nature of achievements, games are divided into zero-sum and non-zero-sum games. In a zero-sum game, the total capital of the players does not change, but is redistributed only during the game, and thus the sum of winnings is zero, i.e. $\nu_1 + \nu_2 + ... + \nu_n = 0,$ where ν_j is j-player's achievement.

In non-zero sum games, however, the sum of the players' winnings is nonzero. For example, in the game lotoreia, part of the contribution collected from the players is given to lotoreia organizations. Therefore, it becomes $\nu_1 + \nu_2 + ... + \nu_n < 0$.

3. ***Parallel and sequential***

A Parallel game is a game in which players perform simultaneous actions, or where one player's action is unknown to the other until the end of the general cycle.

In a consecutive game, each player has information about their opponent's previous move before making their choice. And it is not at all necessary for the information that leads to the next type to be complete.

4. ***Practical problems***

Of course, it should also be noted that there are certain limits to the application of analytical tools of Game Theory. In the following cases, it can only be used provided that additional information is obtained:

First, it is when players have different ideas about the game in which they participate, or when they do not have enough knowledge of each other's capabilities. For example, there may be vague information about the competitor's fees (cost structure). If less complex information is not characterized by completeness, a similar case experiment can be applied, taking into account certain differences.

Secondly, game theory is difficult to apply in many balanced situations. This problem can arise even during simple games with simultaneous selection of strategic decisions.

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Thirdly, if the strategic decision-making situation is very difficult, players often cannot choose the best options for themselves. For example, several businesses may enter the market at different times, or the reaction of businesses operating there may be more difficult than aggressive or friendly.

It has been experimentally proven that when a game is expanded to ten or more stages, players cannot use the appropriate algorithms and continue the game with equilibrium strategies.

Unfortunately, real situations are often very complex and change so quickly that it is impossible to accurately predict how competitors will react to changing tactics. Nevertheless, game theory is useful when it is necessary to identify what is most important in the context of competitive decision-making and that requires consideration of factors. This information is important because it allows you to take into account additional variables or factors that have the ability to influence the situation and thus increase the effectiveness of the solution.

Conclusion

In conclusion, it should be noted that game theory is a very complex field of knowledge. When referring to it, it is necessary to clearly know the limits of observing and applying a certain precaution. Very simple interpretations are fraught with hidden danger. Due to its complexity, game theory analysis and advice are only recommended for important problem areas. Experience has shown that it is preferable to use the appropriate tools when carrying out a one-time, strategically important planning.

From the above we can conclude that:

1. From studying the economic process, it is necessary to correctly understand the goal and the essence of the problem in it, making sure that one of the above 3 groups is suitable for the problem we are studying and for our goal.

2. It is necessary to adapt one of the models belonging to the selected group to the problem under study.

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