

Application of Game Theory in Decision Making

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Abstract

The range of Operation Research needs to be encompass the complex decision making problems which are meaningful for organizations. This paper is an attempt in this direction. It has been tried to find a methodology which would facilitate the development of expertise in the utilizations of experimental gaming.

Keywords: Mixed-motive games, Prisoner's Dilemma, Maximizing Difference, Chicken game.

1. Introduction

The applications of game theory in the humanities have increased over time in fields like history, philosophy, theology, and linguistics. Game-theoretic models have also been used to examine ethical dilemmas in business and law. However, for humanistic applications of game theory, function has shown to be the most fertile terrain [3].

Undoubtedly, some social conflicts are entered or exacerbated quite deliberately and often for understandable reasons. Equally clearly, nevertheless, the pressures generated in conflicts produce inadvertent decision-making errors even amongst very experienced men. In principle such errors (decisions with which the decision-makers were not satisfied) could have been avoided had suitable assistance been available. Additionally, it is clear that these errors occur across the whole range of social conflicts, including the industrial relations and organizational disputes [5], [8]. We have tried to find a methodology which will produce useful results more rapidly.

2. Mixed-Motive Games

The word conflict is commonly used in two sense; to describe situations in which the parties must decide between alternatives, none of which are wholly acceptable to them all, and for the hostilities that erupt when such situations cannot be contained (a negotiable dispute might be a reasonable label for the first sense in which he uses the term) [7]. The most important real-world conflicts, and those which are most difficult to resolve, derive from different appreciations of the situation by the parties that is, not about how to do something but about what is to be done.

A crucial factor in degeneration of a conflict is surely the feeling of one party that it is unable to obtain a highly valued aim, or an acceptable compromise, because of the actions of another party. A crisis is generally agreed to occur when such a situation arises unexpectedly and there is time pressure on the decision-maker to formulate new plans to deal with the problem. Clearly, by his choice of new aims and policies, the decision-maker may then move away from the conflict or deeper into it.

Human behavior in mixed-motive games has been the subject of many studies [1]. The major reason for this effect is that the combination of co-operative and competitive elements apparently built into the matrix has been assumed to model, on each play, important aspects of conflicts in the real world [4]. But accepting

this premise without much more proof than what is now available seems unrealistic [6]. In particular, it seems unlikely that conflict and crisis-like situations similar to those defined above will necessarily occur on each play in a game simply because of the matrix being used.

We analyze that, in game experiments, account must be taken of the effects of system boundaries. Thus the experimenter cannot assume that his view of the situation corresponds with that of the players. In particular, he cannot assume that the players will necessarily adopt his specification of the aim of the game. In opposition to the game theoretical approach, a number of recent studies have shown that not all players in mixed-motive games attempt to maximize their own monetary winnings.

a) The MD Game

Player II

		X	Y	
		6.6	0.5	A
Player I		5.0	0.0	
				B

b) The CH Game

Player II

		X	Y	
	A	4.4	2.5	
Player I		5.2	1.1	
				B

For Player 1

Join gain (add totals)

A 12 5 8 7

Choose A not B

B 5 0 7 2

Own gain (Own totals)

A 6 0 4 2

Choose A not B

B 5 0 5 1

In repeated plays

Relative gain (difference between totals)

A 0 -5 0 -3

Choose B not A

B +5 0 3 0

(Figure: Mixed motive Games)

As is normal in such games, our players were required to make a choice from two possibilities [6]. These choices are labeled A or B for player 1 and X or Y for player 2, and as the games are symmetrical A is equivalent to X and B is equivalent to Y.

The interactions of the simultaneously and independently made choices on the game matrix determine the payouts to each player, and the participants are then informed of the outcome before making their next decision in a series of related plays.

The participants had no idea who their rival was or how many decisions they would have to make. We take an example of a “Maximizing Difference” (MD) game. The matrix for this game is illustrated in Figure. Clearly, players wishing to maximize their own gains on a play would choose A or X (A, X). This happens because players value the difference between their total and the other player's total rather than the amount of money they receive in absolute terms. It is therefore necessary to understand the player's aims in the game before a reasonable analysis of his behavior can be made. There are four aims (social motives) which might occur frequently in mixed-motive games.

These are maximization of own gain (individualistic), maximization of joint gain (co-operative), maximization of relative gain (competitive), and maximization of other's gain (altruistic).

In the MD the only reason for selecting B, Y would be relative gain.

In the “Prisoner's Dilemma” (PD) game the A, X choice maximizes joint or other's gain and B, Y maximizes own or relative gain.

The “Chicken” (CH) game on first evaluation has the same structure in this respect as the PD [2]. It seems much less likely, however, that a player in CH would choose B, Y repeatedly if he was interested in own gain maximization, because when the other player replied in kind in a series of plays the lowest outcome would be generated for both. Thus the CH approaches the MD with B, Y choices being played mainly for relative gain maximization.

3. The Aims of the players:

Therefore, it would seem possible to construct a straightforward theory of how a CH game would be played by players with different initial goals in order to ascertain if conflicts would arise. The theory used here assumes that after reading their game instructions and making five familiarization (no payment) choices the players select the aims they wish to pursue in the game (that is, over the series of plays). It also assumes that these aims are rather clear-cut and, further, that the players are disposed to play and react in various ways depending on their aims.

Thus we suggest that one group of players decide that their purpose in the game is to make as many points

(as much money) as possible. These are own gain maximizers (OG). Some of this group may also wish to ensure that the other player gains a similar high reward. These are joint gain maximizers (JG). The behavior of both groups will be similar-if they are strongly committed to their aims (OG/JG) they will begin by playing none or very few B, Y choices.

A second group of players decide that their aim is to beat, or at least not to lose of the other player in their game. These are relative gain maximizers (RG) and they will play all or very nearly all B, Y choices even at the start of the game.

A third more heterogeneous group of players will not be strongly committed to either of these aims. They might, for example, like to make a large total but only as long as they do not lose by too much, or they might like to win but only if they do not make too low a total. These will be termed mixed type OG/RG for convenience. It seems unlikely that OG/RG players will be disposed to play extremely high or extremely low percentages of B, Y choices at the start of the game.

Obviously, as the interactions proceed OG/JG players in the same game are likely to lock on to the A, X choices, and no doubt interactions between OG/JG and OG/RG players will, despite some difficulties leading to asymmetric and 1:1 outcomes, end stable compromises. Interactions between two OG/RG players will not be easily predictable; but it must be stressed that when an RG player is involved in a game with any other type the other type will be forced to reconsider his original aims. The RG player can either gain a win or a draw by playing B Y every time.

It would therefore seem to be appropriate to call this a conflict-like situation for the non- RG player. If the theory can be shown to hold, the interest from our point of view is obviously in what the non-RG player does in this situation. This theory based on the players’ aims may be tested against the results of one of our experiments on the CH game.

One would like to assess independently the players’ aims before the game. However, it was sufficient for our purpose to examine the choices in the first five (payment) plays. Any player making 0 or 1 B, Y choice was classified as an own or joint gain maximize (OG/JG).

**Table -1
Conflict Predictions Vs Findings B, Y choices**

Players	Objectives from scores	In five	In total (%)	Conflict predicted	Conflict from statements	Test correct
15	OG/JG	0	0	No	No	Yes
20	OG/JG	0	0			
4	OG/JG	0	44	No	No	Yes
9	OG/JG	0	41			
13	OG/JG	1	37	No	No	Yes
18	OG/JG	0	21	No prediction		
12	OG/RG	3	87			
17	OG/RG	2	75			
5	OG/RG	3	48	Yes	No	No
10	RG	4	48			
14	OG/RG	2	58	Yes	Yes	Yes
19	RG	4	92			

11	RG	5	100			
16	OG/RG	3	58	Yes	Yes	Yes
3	OG/RG	3	54	Yes	Yes	Yes
8	RG	5	100			
1	RG*	4	75	Yes	Yes	Yes
6	RG	5	96			
2	RG	4	82			
7	OG/JG	1	50	Yes	Yes	Yes

Similarly, any player making 4 or 5 B, Y choices in the first five plays was classified as a relative gain maximizer (RG). All other payers are placed in the mixed (OG/RG) group. The predictions of conflict, in the various interactions, may then be compared with the game summary statements written by the players immediately after the end of their games (25-30 plays). The comparisons of predictions and findings are set out in Table 1.

As can be seen from Table 1, this initial test provides good support for the simple aims interaction theory. It is important to note that these predictions relate only to games of up to 30 plays.

We propose that the players caught in an interaction with an RG type would have been prepared to pay larger amounts of money to guarantee the removal of the RG in a subsequent game than would the other non-RG players playing in games without conflicts. Those playing against an RG type would therefore have been detectable in an objective test of the conflict-based on this on this payment measure.

The important point is that games involving an RG player and any other type predictably lead to a conflict-like situation for the non-RG player. Furthermore, it is a simple matter to set up conflict-like situations by taking non-RG players and simulating RG behavior against them.

4. Conflict Games & Players:

The effect of a player’s personality on his behavior in a mixed-motive game is a complex problem. In our games, that would imply that they made more B, Y choices. The evidence is not completely consistent, but the view is justified. The high score plays competitively and the low scorer co-operatively in a mixed-motive game, and that the co-operative person changes his behavior in a mixed interaction.

Whilst we would partially accept these findings, we would have reservations about any assumption that all RG players must be high scorers on the F scale. Contrast, for example, the statements of player 8 and player 19 in Table 1. Whilst player 19 was playing in a defensive manner, player 8 appeared to be gambling lightheartedly.

In the games where RG players were present, the player was clearly dissatisfied with the outcome of the interaction. It appears to be characteristic for these players initially to attempt to alter the RG’s behaviour and only when this fails to look again at their own objectives. The numerical result of the games, showed quite clearly that when the RG player did not respond to efforts to change his behavior, the overwhelming response was then to abandon the original objective and to play in exactly the same way as the P>G player for long series of choices.

5. Conclusion:

We conclude that most non-RG players enter the payment stage of the game with the aim of making a certain amount of money and feeling that they understand how to achieve this. Everything changes if they

are partnered by an RG player. They find the RG player's behavior surprising, as they cannot understand why anyone should not be "sensible" and take the money available.

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