GAME THEORY

Game theory is a way to study human behavior. The disciplines most involved in game theory are mathematics and economics, but not exclusively.

Game theory was intended to provide a theory of economic (or strategic) behavior when people interact directly, rather than "through the market." In game theory, "games" have always been a metaphor for more serious interactions in human society. Game theory might be about poker and baseball, but it is not about chess. It may be about such serious interactions as market competition, arms races and environmental pollution, and so Game theory addresses these serious interactions using the metaphor of a game. In these serious interactions, as in games, the individual's choice is essentially a choice of a strategy, and the outcome of the interaction depends on the strategies chosen by each of the participants. So a study of games may indeed tell us something about serious interactions.

In neoclassical economic theory, to choose rationally is to maximize one's rewards. From one point of view, this is a problem in mathematics: choose the activity that maximizes rewards in given circumstances. Thus we may think of rational economic choices as the "solution" to a problem of mathematics. In game theory, the case is more complex, since the outcome depends not only on my own strategies and the "market conditions," but also directly on the strategies chosen by others, but we may still think of the rational choice of strategies as a mathematical problem -- maximize the rewards of a group of interacting decision makers -- and so we again speak of the rational outcome as the "solution" to the game.

Where did Game theory come from? In 1950, while addressing an audience of psychologists at Stanford University, where he was a visiting professor, Mr. A. W. Tucker created the *Prisoners' Dilemma* to illustrate the difficulty of analyzing certain kinds of games. Mr. Tucker's simple explanation has since given rise to a vast body of literature in subjects as diverse as philosophy, ethics, biology, sociology, political science, and of course economics.

The Game

Tucker began with a little story, like this: two burglars, Bob and Al, are captured near the scene of a burglary and are given the "third degree" separately by the police. Each has to choose whether or not to confess and implicate the other. If neither man confesses, then both will serve one year on a charge of carrying a concealed weapon. If each confesses and implicates the other, both will go to prison for 10 years. However, if one burglar confesses and implicates the other, and the other burglar does not confess, the one who has collaborated with the police will go free, while the other burglar will go to prison for 20 years on the maximum charge.

PRISONER'S DILEMMA

The strategies in this case are: confess or don't confess. The payoffs (penalties, actually) are the sentences served. We can express all this compactly in a "payoff table" of a kind that has become pretty standard in game theory. Here is the payoff table for the Prisoners' Dilemma game:

Table

		Al	
		confess	don't
Bob	confess	10,10	0,20
	don't	20,0	1,1

The table is read like this: Each prisoner chooses one of the two strategies. In effect, Al chooses a column and Bob chooses a row. The two numbers in each cell tell the outcomes for the two prisoners when the corresponding pair of strategies is chosen. The number to the left of the comma tells the payoff to the person who chooses the rows (Bob) while the number to the right of the column tells the payoff to the person who chooses the columns (Al). Thus (reading down the first column) if they both confess, each gets 10 years, but if Al confesses and Bob does not, Bob gets 20 and Al goes free.

So: how to solve this game? What strategies are "rational" if both men want to minimize the time they spend in jail? Al might reason as follows: "Two things can happen: Bob can confess or Bob can keep quiet. Suppose Bob confesses. Then I get 20 years if I don't confess, 10 years if I do, so in that case it's best to confess. On the other hand, if Bob doesn't confess, and I don't either, I get a year; but in that case, if I confess I can go free. Either way, it's best if I confess. Therefore, I'll confess."

But Bob can and presumably will reason in the same way -- so that they both confess and go to prison for 10 years each. Yet, if they had acted "irrationally," and kept quiet, they each could have gotten off with one year each.

This remarkable result -- that individually rational action results in both persons being made worse off in terms of their own self-interested purposes -- is what has made the wide impact in modern social science. For there are many interactions in the modern world that seem very much like that, from arms races through road congestion and pollution to the depletion of fisheries and the overexploitation of water resources. These are all quite different interactions in detail, but are interactions in which (we suppose) individually rational action leads to inferior results for each person, and the Prisoners' Dilemma suggests something of what is going on in each of them. That is the source of its power.

For more on Game Theory go to: http://william-king.www.drexel.edu/top/eco/game/game.html