Playing Games with Game Theory
or
Hop off, you Frogs?

Diplomacy is in essence an elaborate game. How should Britain and France try to resolve the current breakdown in their relationship? Should their next moves be friendly or hostile, collaborative or conflicting?. In the jargon of game theory, should they co-operate or defect?

Game theory - a branch of maths used widely in economics - tries to work out what the best strategies are for each player. It was used as early as the 1950s as a strategic tool by the Americans to try to fathom out a global nuclear strategy. More recently, it has become fashionable through the film *Beautiful Mind*, about the bizarre genius John Nash.

One game in particular occurs so often in different disguises that it has got its own name - the Prisoner's Dilemma - and thousands of articles devoted to more complicated variants. It seems highly relevant to the present political *impasse* with France.

Imagine that you and an accomplice have pulled off a sophisticated robbery. You are under arrest, but there is no hard evidence against you. Here's the deal you are offered: if you confess and your partner doesn't, you walk free and he gets 10 years. If you don't and your partner confesses, it is you who goes down for 10 years. If you both confess, the prosecutor cuts a deal and you get 3 years apiece. But if neither of you own up, you get a year each for stealing the getaway car. What do you do?

We can summarise the outcomes of the two strategies in a simple table. Co-operating here means keeping silent. To confess means to defect. The pair of numbers in each cell – an appropriate but technically correct phrase in this context – shows the length of sentence received by each player under all four potential outcomes.

	Player B			
Player A	Co-operate		Defect	
	A	B	A	B
Co-operate	1	1	10	0
Defect	0	10	3	3

If both co-operate, they get one year each, if A co-operates but B defects, A gets 10 years and B gets off, and so on.

The Prisoner's Dilemma contains a paradox. We can show quite easily that the best strategy for each player will lead to defection, to the (3,3) outcome [*See below*] But, transparently, a better outcome for both is available, namely the co-operation of (1,1).

Sadly, in real life, the temptation to defect is always strong. As Thomas a'Becket declaimed in *Murder in the Cathedral*, 'The last temptation is the greatest treason'. So does this means that we should just tell the Frogs to hop off, whilst they could presumably desecrate a few more war graves?

In a one-off situation, the answer is clear. And we can prove that it remains the same when the game has a large and fixed number of moves.

Fortunately, reality is more complicated than this. Usually, whether it is international diplomacy, the dealings between two companies, or a personal relationship, we do not know how many moves or plays there are going to be. This apparently small change to the rules makes an enormous difference to the complexity of the game[1].

Robert Axelrod at the University of Michigan has contributed a tremendous amount to our understanding of the game. He devised a strategy which did very well for a number of years in elaborate tournaments, competing against other strategies. Called

[1] a web search on Google gives 35,000 sites. A very good but technical one is the Stanford *Encyclopedia of Philosophy* site at http://plato.stanford.edu/entries/prisoner-dilemma/

Tit for Tat (TFT), it should gladden the hearts of liberals everywhere. TFT says: start by co-operating, and then imitate the other player's last move. It is nice, in the sense that it is never the first to defect. It is forgiving and will co-operate with defectors if they are willing to change behaviour. And it is clear, so the other side finds it easy to learn how you play. But it also has the threat of retaliation, in that it copies the action of a defector. A perfect Blairite mix.

So, if the French make a friendly gesture, we reciprocate and harmony prevails. Alas, game theory does not permit such a simple conclusion. All the above is based on the assumption that the players have a tremendous amount of accurate information. They know for certain the pairs of values in the pay-off table. They execute their own strategies without error. And they always interpret correctly a move by the other side.

Once these imperfections are allowed into the game, the best strategy, or even one which is good in lots of situations, remains unknown. There is even a suggestion that strategies involving lots of defection moves might turn out to be best after all, which might help to account for American strategy on Kyoto, the United Nations and much else.

So, like much of economics, game theory can be very useful, but only in very limited sets of circumstances. And international diplomacy does not seem to be one of them.

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The Paradox of the Prisoner's Dilemma:

Suppose I am player A. I do not know what my accomplice will do. But if player B keeps silent ('co-operating' with me), I get a token year in jail for co-operating as well, but nothing if I confess ('defect'). So my best strategy is to defect. If, on the other hand, he confesses ('defects'), I get 10 years for co-operating, and only 3 if I defect as well. So again my best strategy is to defect. A similar logic applies to player B. So both will defect and get 3 years each. But there is a better outcome for both, namely to keep silent and co-operate and serve just 1 year.