

Prisoner's Dilemma with Optional Cooperation and N Participants

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Abstract

This project is designed to simulate the classical Prisoner's Dilemma with the option to cooperate mutually with other prisoners. The purpose of this project is to allow variable parameters so that a variety of situations and settings could be tested. The expected result is a variety of simulations that will show how a specific situation can turn out when given the option to mutually cooperate.

Background

The Prisoner's Dilemma is a non-zero sum game in which two prisoners play against each other for the highest payoff. Each prisoner has only two options, cooperate or defect, and depending on their decisions, they will receive a different payoff. If both were to cooperate, both prisoners can get a higher payoff than if they both defected. However, the temptation to defect yields the highest payoff if the opponent cooperates.

There have been several variations of Prisoner's Dilemma with the most well-known being Iterated Prisoner's Dilemma, or IPD. Research has been done before on the IPD and its variations, resulting in numerous strategies to gain an optimal output, including tit-for-tat. This project looks into cooperation, and how it can affect outcomes.

Results

Tit-for-tat and Suspicious tit-for-tat players always seem to have high rates of defection in comparison to the random players. By the number of turns played, it seems that cooperation only raises the payouts of the specified prisoners by a small number than if they had not cooperated at all. Alongside it, results are much more variable if more prisoners are playing.

	Three Prisoners (Unique Strategies)	Three Prisoners (Non-Unique Strategies)	Four Prisoners
Cooperation Rate (No mutual cooperation)	The TFT and STFT has very low cooperation rates. Random's rate varies.	The TFT and STFT has very low cooperation rates. Random's rate varies.	The results were much more balanced than with three prisoners. The ratio between defection and cooperation were more in proportion.
Defection Rate (No mutual cooperation)	The TFT and STFT prisoners have unusually high defection rates. Random's rate varies.	The TFT and STFT prisoners have unusually high defection rates. Random's rate varies.	The results were much more balanced than with three prisoners. The ratio between defection and cooperation were more in proportion.
Cooperation rate (Random and Random)	The TFT and STFT has very low cooperation rates. Random's rate varies. However, the number of times the TFT and STFT cooperate are relatively higher.	Cooperation rate between the two randoms are pretty similar and quite balanced.	The ratio between cooperation and defection were quite balanced and even.
Defection Rate (Random and Random)	The TFT and STFT prisoners have unusually high defection rates. Random's rate varies. However, the number of times TFT and STFT defect are a little lower.	Defection rate between the two randoms are pretty similar and quite balanced.	The ratio between cooperation and defection were quite balanced and even.
Cooperation Rate (Random and TFT)	N/a	The TFT has a low rate of cooperation in comparison to the random	While Random still had a balanced number as a ratio between cooperation and defection, TFT still had a very low cooperation rate.
Defection Rate (Random and TFT)	N/a	The TFT has a high rate of defection in comparison to the random	While Random still had a balanced number as a ratio between cooperation and

Procedure

The user may specify how many prisoners they would like playing, how many rounds to play, and how many iterations they'd like to run through. The prisoners also have an optional ability to cooperate with one another mutually, in which they will always cooperate with one another. This option can be activated before running the program. At the end of the run, the program collects the data of the number of times each prisoner cooperated, defected, and their final payout.