Counteracting Erratic Behaviour
A Game-Theoretical Analysis of Parametrised Strategies
(Feinkonzept)

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Contents

(The last three sections depend on the obtained findings and are therefore not elaborated in this concept paper. They only demonstrate the structure of my ”Maturaarbeit” (MA).)

1 Introduction

In many fields of our society, it seems as if many believe to get the maximum output by acting unpredictable in order to exploit the other (e.g. Trump's tariff policies). This MA aims at investigating if such strategies hold their justification or if the population profits more from foreseeable interactions. Game Theory offers a mathematical framework for simulating and studying this problem, especially in its variant of the Iterated Continuous Prisoner's Dilemma.

2 Theoretical Foundations

In order to comprehend the key concepts of my MA, the underlying principles that underpin my analysis need to be reviewed. These include:

Game Theory: Game Theory is a mathematical study that examines interactions between strategies.

Prisoner's Dilemma: In the Prisoner's Dilemma, two strategies play against each other. They can either cooperate or defect. They get points from the pay-off matrix based on the decision they have made.

	C	D
C	3, 3	0, 5
D	5, 0	1, 1

The dilemma's core arises from the following: It is most logical to pick defection because the pay-off 5 or 1 point is better than 3 or 0 points. But this in fact is a loss of points for both since they could have got 3 points with mutual cooperation instead of only 1 point.

Iterated Prisoner's Dilemma: This variant of the Prisoner's Dilemma consists of two strategies and a number of rounds where in each round the two strategies play the single Prisoner's Dilemma and gain points that are added up until the end.

Iterated Continuous Prisoner's Dilemma The Iterated Continuous Prisoner's Dilemma is a variant where pay-offs are given based on non-binary decisions of the strategies. Meaning, strategies can submit any number between zero and one.

Advanced Variants: Also the evolutionary model of the Prisoner's Dilemma can be examined where a group of strategies play against each other. Survival of one strategy is determined by whether they won or lost against another. Reproduction is guaranteed by a win. A certain stable state of a percentage of all initial strategies in that group will eventually establish.

Current Findings: Studies have repeatedly shown that the strategy named Tit-For-Tat is the most successful one in the Iterated Prisoner's Dilemma. This strategy follows the idea of equivalent retaliation i.e. it will cooperate or defect likewise as the opponent did the last round. Four criteria were identified to be important to get a high-scoring output of the tournament: niceness, willingness to retaliate, being forgiving and not being envious. The continuous variant, on the other hand, has only been used in context with the evolutionary aspect. As you will read later, my MA does not concern the evolutionary variant and is thus a completely new idea.

3 Methods and Implementation

Simulation: The main idea of this MA is that strategies hold a parameter which determines their behaviour. It influences how they calculate their decision. This parameter ranges from zero to ten. I will implement five strategies in total and let every strategy play against each other strategy, including itself. Two of these strategies can be categorised as random. And the rest of them being either responsive or rigid. One game consists of multiple Iterated Continuous Prisoner's Dilemma's. In one interaction of two strategies, I will let every parameter play against every other parameter. I will plot surfaces with the generated data and analyse these surfaces considering their hills and valleys.

Programming Language: The simulation of these parameter-based strategies playing the Iterated Continuous Prisoner's Dilemma will be implemented in Python. Data generation and plotting the surfaces is automatically done by the simulation. The most successful strategies will be described in depth.

4 Results

5 Discussion and Limitations

6 Conclusion