

Statistical Mechanics of Games — Evolutionary Game Theory

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Abstract

This paper formulates evolutionary game theory with a new concept using statistical mechanics. This study analyzes the following situations: each player on the lattice plays a game with its nearest neighbor or with a randomly matched player. These situations are formulated using an analogy with the Ising model and the Sherrington-Kirkpatrick model, the simplest models in statistical mechanics. As a result, theoretical calculations agree with classical evolutionary game theory in terms of the parameter (γ) size¹.

This study analyzes the action's probability of distribution on the lattice with percolation in details. If γ is sufficiently small, then we know the kind of patterns the distribution of actions makes on the lattice. These patterns are either a concentric circle or a chess pattern. If γ meets certain conditions, then infinite (*)-clusters coexist in a chess pattern. In particular, this study shows that bifurcations occur in a quenched system with externalities, hence, this system has multiple equilibria.

This study discusses the simplified Cont and Bouchaud model through our models. We can understand the player's behavior in Cont and Bouchaud model.

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¹ The limit behavior, as γ approaches infinity, is closely connected to the modeling of game theory with rational player. When $\gamma=0$, behavior is essentially random, as all strategies are played with equal probability.