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Ergodicity of Replicator Equation with Historic Behavior Perturbation

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Abstract

Stable and historical behaviours are common in dynamical systems studied within evolutionary game theory. This motivates the analysis of replicator equations obtained as convex combinations of two equations that display contrasting dynamical regimes. A canonical example is the evolutionary dynamics of the Rock-Paper-Scissors (RPS) game, whose payoff matrix generates a well-known replicator flow. Previous research has demonstrated that, depending on the parameter λ is an element of $[0,1]$, a convex combination of a regular replicator operator and a non-ergodic operator may inherit either regularity or non-ergodicity. The current study creates a simplified model that incorporates higher-order interaction components and a unique subclass of replicator equations. We demonstrate that the resulting system is strictly non-ergodic at $\lambda=1$, yet displays an increasing propensity toward ergodicity as λ approaches 1 from below. Although the framework is presently restricted to a specialised family of models, it establishes a tractable setting for future investigations into the interplay between higher-order effects and ergodicity in evolutionary game dynamics.

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