

A Characterization of Nash Equilibrium in Behavioral Strategies through Local Sequential Rationality

The concept of Nash equilibrium in behavioral strategies (NEBS) was formulated for an extensive-form game by invoking dynamic programming. To compute a NEBS in an extensive-form game, the traditional approach invokes a transformation to its associated normal-form representation. However, the associated normal-form game is often exponentially large in the size of the game tree and essentially independent of the structure of game trees and players' beliefs. To address these limitations, this paper develops a characterization of NEBS by introducing an auxiliary behavioral strategy profile and a self-independent belief system. The characterization just requires local sequential rationality defined by linear payoff functions at every information set, ensuring global rationality. The characterization enables us to analytically determine all Nash equilibria for small extensive-form games and establish the existence of Nash equilibrium without relying on the associated normal-form games. Building upon this characterization, we derive a polynomial system that serves as a necessary and sufficient condition for Nash equilibrium. Moreover, as a byproduct, we secure a differentiable path-following method for computing a Nash equilibrium from the characterization. Comprehensive numerical experiments further confirm the effectiveness and efficiency of the method.



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