Non-Cooperative Games with Uncertainty
Definition, Existence and some properties
of the Extended Equilibrium

József Konczer

konczer.j@gmail.com, konczer.github.io

February 2025

Abstract

This paper introduces a framework for finite non-cooperative games where each player faces a globally uncertain parameter with no common prior. Every player chooses both a mixed strategy and projects a subjective prior to the uncertain parameters. We define an "Extended Equilibrium" by requiring that no player can improve her expected utility via a unilateral change of strategy, and the subjective priors are such that they maximize the expected regret of the players. A fixed-point argument – based on Brouwer's fixed point theorem and mimicking the construction of Nash – ensures existence. Additionally, the "No Fictional Faith" theorem shows that any subjective equilibrium prior must stay non-concentrated if the parameter truly matters to a player. This approach unifies regret-based statistical decision theory and game theory into a unified framework, providing a tool to handle strategic decision-making in the presence of deeply uncertain parameters.