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Proposed Title: Non-Zero-Sum Stackelberg Game in Large Population

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Abstract:

We consider an N-player interacting strategic game in the presence of a (endogenous) dominating player, who gives direct influence on individual agents, through its impact on their control in the sense of Stackelberg game, and then on the whole community. Each individual agent is subject to a delay effect on collecting information, specifically at a delay time, from the dominating player. The size of his delay is completely known by the agent; while to others, including the dominating player, his delay plays as an hidden random variable coming from a common fixed distribution. By invoking a non-canonical fixed point property, we show that, for a general class of finite N-player games, each of them converges to the mean field counterpart which may possess an optimal solution that can serve as an ϵ-Nash equilibrium for the corresponding finite N-player game. Secondly, we provide, with explicit solutions, a comprehensive study on the corresponding linear quadratic mean field games of small agents with delay from a dominating player. Due to the non-Brownian nature of the filtration, for the representative agent, being information flow obtained from both the dominating player and the whole community via the mean field term, we propose to utilize Backward Stochastic Dynamics (instead of the common approach through BSDEs) for the construction of adjoint process for the resolution of his optimal control. A simple sufficient condition for the unique existence of mean field equilibrium is provided by tackling a class of non-symmetric Riccati equations. Finally, via a study of a class of forward backward stochastic functional differential equations, the optimal control of the dominating player is granted given the unique existence of the mentioned mean field equilibrium for small players.