

Entropy-based measures of statistical complexity and unpredictability of strategies in economic games

The inspiration for the project comes from developments in the field of information theory, game theory and their connections to problems arising in social sciences and economics in particular. The main idea is to integrate two independent lines of research made by information theorists and game theorists and apply them in the context of repeated games to measure statistical complexity and unpredictability of strategies. In seminal paper Grassberger and Procaccia introduced complexity measure called excess entropy. It has received large interest and has been applied in many contexts, e.g. to study complexity of time series arising in the financial market, natural languages, complex adaptive systems or protein structure. On the other hand Neyman and Okada introduced to game theory entropy-based measures, which they called strategic entropy and strategic entropy rate. These are measures of uncertainty and average uncertainty of mixed strategies in repeated games. Over the years their work influenced many developments in game theory and has been successfully used to solve problems arising in modeling and studying behavior of agents.

The aim of the project is to define, study and apply in the economic context the analogue of excess entropy (which we call *excess s-entropy*) and, as the project develops, other entropy-based measures of statistical complexity (unpredictability) of the strategy in repeated games. Excess s-entropy will be applied to problems arising in repeated games with bounded recall, reputation models and in the context of coordination games to study Schelling points. The common element which underlies all of research interests lies in strong interactions between information theory and game theory and their mutual impact on complexity and unpredictability of the strategy of an agent in long-term competition and cooperation models widely used in economic theory. Obtained results can be used e.g. to model interactions between central bank (e.g. National Bank of Poland), Monetary Policy Council and financial institutions or firms. For instance, financial institutions may prefer to operate in an investment environment in which the strategy of the central bank is predictable.

To solve the problems described above a whole spectrum of methods coming from information theory, ergodic theory and game theory will be certainly needed. All the results obtained within framework of this project will be submitted to leading journals in the area. An important and positive consequence of the project will be diversifying and intensifying research collaboration with researchers from leading centers in game theory and its applications in economics in Poland and abroad.