Finitely additive strategies, zero-sum games, and decision making

VALORISATION

In general, the Valorization addendum of a PhD thesis seems to be a controversial topic. On one hand, it is valuable to make research more accessible to lay people, both through open access publications and through making research output more understandable. On the other hand, the tendency to marginalize fundamental research is distressing. If the purpose of science is to accumulate knowledge, then fundamental research should also be considered useful. Looking for direct applications is complicated, since the fruit of this type of research can come after a considerable amount of time and moreover, indirectly. This is why there are projects that seemed useless at some point, but are currently considered indispensable. Even at the onset of a research project, one might not know what will be the end result, for example, some famous discoveries were made accidentally.

Specifically, this Valorization addendum creates an opportunity to think about why I spent years of my life being a PhD candidate, and why tax payers supported me in this project. Thinking about usefulness can raise a lot of philosophical questions, for example whether humanity is useful on its own. Assuming that we should keep up the human race, what is useful for it is still an intriguing question which would lead us far away. I will build on a more pragmatic basis.

I start by assuming that education is useful, as it is usually subsidized by the public sector in most European countries. Since I taught a number of courses, I contributed to others' education. Moreover, a PhD is a part of my own personal education. As a PhD candidate, one does not only learn a lot about their own subfield, but through colleagues one can get familiarized with other fields as well.

This thesis is part of fundamental research, so direct applications are meant for researchers. The focus of this thesis is on mixed strategies. Mixed strategies are part of both decision theory and game theory, which means that we assume that decision makers or players can take probabilistic decisions. The

results of this thesis are relevant for models where the time horizon or the action space is infinite.

When you do not know clearly when a game ends, then it can be modeled with an infinite time horizon. For example, discounted models in macroeconomics or bargaining theory can have infinite time horizons. There are numerous models in economics with infinitely many actions. In basic models of industrial organization, firms are assumed to choose from an interval of prices. Similarly, bids and valuations in auction theory are often assumed to be infinite. In spatial economics, for example, in Hotelling's model firms can choose from an infinite set of locations. Consider a stretch of beach with sun bathers and two ice cream vendors. Since the vendors serve the same ice cream at the same price, consumers simply go to the closest vendor. The prediction of this model is that both ice cream vendors will locate in the middle of the stretch of beach, minimizing their product differentiation. Hotelling's model has also been used to analyse many other situations, including radio station programs and political candidates' platforms.

One of the lessons of this thesis is to be careful when modeling games of these types, because they can be very sensitive even to seemingly innocuous changes.

I have argued so far that the results of this thesis can be interesting to researchers in (applied) game theory. As I argued in Chapter 1, game theory has numerous applications to other fields, including economics. Time is well spent on improving economic models, since economists are often part of decision processes that have a vast impact on society. The most famous examples are Nobel-prize winners. For example, Jean Tirole advises the French government, and Alvin Roth advises doctors working on kidney exchange programs and schools on their acceptance procedures. Moreover, some of the above-mentioned theoretical models are tested using actual data, for example by CBS (Centraal Bureau Voor de Statistiek) and CBP (Centraal Planbureau) in the Netherlands.

CURRICULUM VITAE

Anna Zseleva was born on 2 December 1989 in Varna, a city on the Bulgarian Black Sea coast. She seemed to have always been interested in mathematics, and so she specialised in it during high school, and graduated at Berzsenyi Dániel Gimnázium in 2008, in Budapest, Hungary. Not being sure what grown-up mathematicians did, she chose studying economics. However, she carefully chose the economics programme with the most mathematics-related courses. She received her BSc and MSc diplomas in Quantitative Economic Analysis from Corvinus University of Budapest, where she graduated in 2013. She liked her Analysis and Measure Theory courses, which turned out to be useful later on. During her studies she realised that game theorists apply mathematics to many types of human interactions, which fit her interests perfectly. During her graduate studies she won both a university and a national research competition in game theory under the supervision of Miklós Pintér. This naturally led to a desire to pursue a PhD. Between 2013 and 2017 she was a PhD candidate at the Quantitative Economics Department of Maastricht University under the supervision of János Flesch and Dries Vermeulen. During this time many colleagues have mistaken her for a mathematician. In hindsight, it might have been easier if she had studied to be one, instead of having to correct them. The results of her PhD research are presented in this thesis. Anna presented these papers at various international conferences, and one of them is published at an international peer-reviewed journal, Games and Economic Behavior.