Cooperative behavior and perception evolution in pandemic response: A norm compliance dilemma analysis

During a pandemic outbreak, the community witnesses a divergence in the adoption of containment measures, which are critical in curbing disease transmission. These measures are perceived as a communal benefit but come at a cost that is individually and heterogeneously perceived. Within this context, the actions and decisions made can be likened to a Prisoner's Dilemma scenario, whereby the perceived benefits and costs shape the cooperative dynamics of the population.

This research project ventures to explore the coevolution of cooperative behavior and individual perception through the prism of evolutionary game theory. This investigation casts the adoption of disease containment measures as cooperative acts, thereby introducing a game-theoretical framework termed the "Norm Compliance Dilemma". In this framework, the evolution of agents' behaviors is intricately linked to their unique and evolving perceptions over time.

The initial phase of the project is grounded in the analysis of a simplified model representing a well-mixed, infinite population characterized by homogeneous perceptions. Through this approach, the project aims to analytically decipher a system of ordinary differential equations to foresee the potential game equilibria. This analytic solution provides a theoretical baseline to understand the underlying dynamics of cooperation and compliance during a pandemic.

The subsequent stage involves comparing the theoretical outcomes derived from the initial analysis with empirical data derived from finite populations. These populations exhibit heterogeneous individual perceptions and are organized in network structures, thereby adding layers of complexity to the analysis. This comparative study aims to shed light on the nuances that govern cooperative behavior in real-world scenarios, offering a more rounded view of the dynamics at play.

By delving into this Norm Compliance Dilemma, the project aspires to unravel the intricacies of cooperative behavior and perception evolution during pandemic outbreaks, potentially guiding more effective response strategies in future health crises.

Required skills

- **Proficient programming skills**: Applicants should possess proficiency in a suitable programming language. Familiarity with Python or Java is highly preferred.
- **Understanding of game theory**: A solid foundational understanding of game-theoretical setups will be advantageous. This knowledge will aid in comprehending and potentially expanding the scope of the project to include other frameworks such as coordination, conflict, or coalition games.
- **Numerical simulation experience**: Prior experience in conducting numerical simulations is desirable. Experience in modeling complex systems through simulations will be a valuable asset.

Supervisor: Alberto Antonioni, Carlos III University of Madrid, Spain

E-mail: alberto.antonioni@uc3m.es