INTERVENING IN A SOCIALLY NETWORKED PROBLEM: A SIMULATION-BASED APPROACH

Doctoral Candidate

Saikat Das, FP/09/17
Management Information Systems
Indian Institute of Management Calcutta

Thesis Advisory Committee

Prof. Uttam Kumar Sarkar (Chairperson)
Prof. Saibal Chattopadhyay
Prof. Indranil Bose

Abstract

We can refer to society as a group of individuals living together in a community with interactions between interconnected parts. It is complex in structure, behaviour and has problems like

implement the proposed network-based approach and presented a novel framework in this dissertation.

Overall, this study makes several relevant contributions to the existing body of literature. Among the academic contributions, first, it introduces a novel framework to study a societal problem such as the spread of infection using a network-based approach. Earlier models, in general, lack flexibility in analysing different network-centric situations by changing the underlying network structure. We designed an algorithm in this study to model the situation in a new way. We then developed a computer program to allow the user to create any desired network structure and conduct analysis based on that. Second, while most existing research on modelling the spread of infection in a society focussed on modelling factors concerning population and infection, they may have neglected individual-level parameters. Such studies overlooked the differences between individuals in a population and treated society as a homogenous collection of individuals. We contributed by modelling heterogeneity between individuals in their ability to withstand an infection which may vary due to several underlying factors. Third, taking COVID-19 as a specific example, we simulated the spread of infection using the proposed network-based approach to model epidemics under different scenarios and compared their outcomes to empirical data corresponding to eight countries from different regions. Fourth, we introduced eight measures to compare the outcome of simulated scenarios and empirical data; some of these sophisticated measures have never been used in earlier epidemiological model studies. Although we have highlighted the contributions to modelling epidemics in this study, the novel framework using the network-based approach discussed here; can be customized to solve a broader range of network-centric problems.

Apart from the above academic contributions regarding building a novel framework and its application under different situations, the findings of this study have practical implications for policymakers. The proposed approach can be used to explore the outcome of different intervention strategies under hypothetical conditions. Policymakers can apply the simulation-based model to determine the impact of different pharmaceutical and non-pharmaceutical interventions and their combinations before implementing them on the ground. They will be able to understand better which intervention may have what impact under different situations. This ability can be beneficial to policymakers in decision-making under constraints. For example, applying a non-pharmaceutical intervention like lockdown for a long duration may not be practical, or a pharmaceutical intervention like vaccination may not be possible due to the lack of available vaccines. Policymakers can mix and match intervention strategies and study their effect under hypothetical conditions using the proposed framework before implementing them on the ground. Thus, we believe the study presented in this dissertation makes several valuable contributions that can be used by academicians and policymakers alike.