Diffusion Dynamics in a Networked Society

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Extended Abstract

Diffusion is the process in which the successful introduction of new products and practices into society along with invention. For decades, social scientists, economists and physicists have been interested in the fundamental and common question of how infectious diseases, new technologies practices, or new trends spread through the society. When a new technology appears into a society, its members have the chance to become aware of the innovation and to relate themselves to it. The main study on diffusion modeling is based on the Bass model. The Bass diffusion model describes the process how new products get adopted as an interaction between users and potential users. When the innovation is a good whose consumption is individual, single consumers can decide whether to adopt it or not. The Bass model also formalizes the aggregate level of penetration of a new product emphasizing two processes: external influence via advertising and mass media, and internal influence via word-of-mouth. The Bass model assumes all consumers to be homogeneous, and such diffusion models are referred to as aggregate models, and the diffusion process is shaped by a famous S-shaped curve..

However it is widely recognized that a new ideas, products, and innovation often take time to diffuse, a fact that is often attributed to some form of heterogeneity among people. Then a basic common puzzle posed by innovation diffusion is why there is often a long lag between an innovation's first appearance and the time when a substantial number of people have adopted it. There is an extensive theoretical and empirical literature on this phenomenon and the mechanisms that might give rise to it. The market is currently huge and is more complex than ever before. The amount of information has considerably increased and a consumer has a large amount of information to consider. It is not hard to imagine that a consumer spends much time thinking and hesitating before making a decision. Thus, a change in personal decision requires more time than before. Consumers may realize different benefits and costs from the innovation, have different beliefs about its benefits and costs, hear about it at different times, or delay in acting on their information. Some researchers analyze the effect of incorporating heterogeneity into three broad classes of models, contagion, social influence, and social learning. In addition, when a consumer has many neighbours, these represent many information providers and the consumer may have problems in handling their information effectively. Explanation of this relationship calls for examining the types of social interactions that link various types of heterogeneous individuals in a society.

Our societies consist of individuals and the social systems which largely determine how they behave and interact. Actions of individuals are influenced by their friends, acquaintances and neighbors, and their relationships determine the topologies of social

networks. One of the cardinal rules of human behavior is “birds of a feather flock together”. Friends of friends become friends and this property foster to emerge dense clusters of connections throughout the social networks. However, little is known, however about the dynamic processes on networks, and how these processes depend on network properties.

We begin with to discuss several examples of studies that illustrate how the structure of agent networks impacts macroscopic diffusion patterns. The discussions are divided into three classes. First, we discuss the progressive diffusion processes. Many diffusion processes are progressive in the sense that once a node switch from one state to another state, it remains with the same state in all subsequent time steps. This type of diffusion process is progressive. In this class of the diffusion process, we concentrate on the correlations between social interaction patterns and observable transmission rate at the individual level.

The diffusion process enhances an innovation via the feedback of information about its utility across different users that can be used to improve it. This aspect is similar to the micro-macro loop which is essential part of complex emergent dynamics. In this presentation we examine how social network structure impacts on the dynamic diffusion process in a networked society. Most of our social activities are substantially free of centralized management, and although we may care how it all comes out in the aggregate, our own decisions and behaviors are typically motivated by self-interests. To make the connection between microscopic behavior and macroscopic patterns of interests, we should look at the system of interactions among agents, and this can be described as the interaction topology. We focused on the stylized facts of macroscopic emergent phenomena that are results of the bi-directional interactions. Social network topologies determine a basic and important form of social interactions among agents, and microscopic behaviors of agents largely determine the diffusion patterns observed at the macroscopic level.

Especially we discuss how micro-macro loop formed via social network impacts on the qualitative aspects of diffusion process. The diffusion process enhances an innovation via the feedback of information about its utility across different users that can be used to improve it. This aspect of the diffusion process is characterized as the micro-macro loop. Understanding the nature of the relationship between different levels at which macroscopic phenomena can be observed has been made possible due to the tools and insights generated in the agent research. The direction of the research to come is to understand how the combined research of agent based modeling and complex network is essential for the study of complex diffusion process.