Chapter 12
Fuzzy Social Network Modeling for Influencing Consumer Behavior

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ABSTRACT

Social networks have become an important component in most companies' bag of tools for managing and influencing consumer behavior. It is imperative for modern organizations to fully understand these social networks and have at their disposal an armada of tools to intelligently model and manipulate these complex structures in order to accomplish their goals. In order to most effectively and intelligently use social networks, decision makers and planners must be able to bring to bear their expertise, experience, and professional intuition on issues involving these networks. This requires an understanding, comprehension, and view of social networks that is compatible with their human cognition and perception. They must be able to understand the structure and dynamics of social networks in terms of human-focused concepts. In this chapter, the authors investigate and describe the use of the FISNA technology to help in the modeling of consumer behavior-related concepts in social networks.

INTRODUCTION

A social network provides a vast amount of information in the form of a social graph of human relationships, interactions and behaviors. This kind of information is extremely useful to organizations interested in influencing and managing consumer behavior. Identifying people who are high influencers in their social circle, known as opinion leaders and trendsetters, can be useful in the preliminary steps of preparing a marketing plan and strategy (Doyle, 2007). Marketers are interested in distinguishing followers and trendsetters for music, fashion, and media; the buying patterns of trendsetters provide insights for future trends, directly and indirectly impacting the sale of products (Maldonado, 2010). The design and introduction of new products is often aided by

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the advise of these leaders. For example, in the pharmaceutical industry, key opinion leaders are medical professionals whose opinions are frequently consulted for decisions in products and treatments (Nair, Manchanda & Bhatia, 2010). An important class of systems used for influencing consumer behavior are the recommender systems (Cosley etc., 2003; Yager, 2003a; Yager, 2004; Lakiotaki, Matsatsinis & Tsoukias, 2011; Ricci, Rokach & Shapira, 2011; Shambour & Lu, 2011; Konstan & Reidel, 2012; Kim, 2014). Word of mouth is one important method of influencing consumer actions. Interest has focused on the use of social networks to emulate the word of mouth phenomenon (Brown, Broderick & Lee, 2007; Dwyer, 2007; De Bruyn & Lilien, 2008; Lee & Youn, 2009). An important aspect of the use of social networks in this consumer environment is getting an understanding of how various demographics affect people's interactions with social networks (Park, Kee & Valenzuela, 2009; Barker, 2012; Trepte & Reinecke, 2013; Wu, Cheung, Ku & Hung, 2013).

The complex inter-relational structure of these social networks (Carrington, Scott & Wasserman, 2007) greatly complicates the task of extracting the kinds of information desired by marketers. Our goal here is to provide a language that can be used to intelligently query a social network. Here we shall describe fuzzy set operators developed by Yager (2008, 2010a, 2010b) that can be used to develop human focused network information retrieval techniques.

Considerable recent interest has been focused on the role of social relational network sites such as Facebook, Myspace and LinkedIn in major companies marketing strategy (Boyd & Ellison, 2008; Mangold & Faulds, 2009; Heinonen, 2011)

In trying to extend our capabilities to analyze social relational networks, an important objective is to associate human concepts and ideas with these networks. Since human beings predominantly use linguistic terms, in which to communicate, reason and understand, we are faced with the task of trying to build bridges between human conceptualization and the formal mathematical representation of the social network.

Consider for example a concept, such as "leader." An analyst may be able to express, in linguistic terms, using a network relevant vocabulary, the properties of a leader. Our task then becomes a translation of this linguistic description into a mathematical formalism that allows us to determine how true it is that a particular node in a network, representing a person. is a leader.

In this work we began looking at the possibility of using fuzzy set methodologies and more generally granular computing (Zadeh, 1998; Lin, Yao & Zadeh 2002; Bargiela & Pedrycz 2003; Yager, 2006) to provide the necessary bridge between the human analyst and the formal model of the network.

Our interest in focusing on this technology is based on the confluence of two important factors. One of these is that fuzzy set theory and particularly, Zadeh's paradigm of computing with words (Zadeh, 1996, 1999) which was especially developed for the task of representing human linguistic concepts in terms of a mathematical object, a fuzzy subset. Fuzzy logic has a large repertoire of operations that allows for the combination of these sets in ways that mimic the logic of human reasoning and deduction. The second important factor is the nature of the formal mathematical model of social networks. The standard formal model used to represent a social network is a mathematical structure called a relationship. Using this structure, the members of the network constitute a set of elements, the connections in a network are represented as pairs of elements, and the network is viewed as the set of all these pairs. The key observation here is that the standard form of network representation is in terms of set theory. The fact that the underlying representation of the social network is in set theoretic terms makes it well suited to a marriage with the fuzzy set approach. In Figure 1 we show the FISNA, Framework for Intelligent Social Network Analysis.