Chapter 8
Social Network Analysis: Self-Organizing Map and WINGS by Multiple-Criteria Decision Making

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ABSTRACT

Social network analysis (SNA) is an attractive problem for a long time when social communities were popular since 2010. Scholars like to explore the meaning behind the numerous interactions generated at these social media sites. The primary and essential issue of SNA is to monitor, estimate, and engage the potential influencers who are most relevant and active to network. If we can analyze the social network this way, business enterprises could use minimal efforts to sustain the activity of influential users, improve sales, and enhance their reputations. In this chapter, a research framework based on multiple-criteria decision making (MCDM) is proposed. The authors will show how scholars could use dynamic self-organizing map (SOM) based on multiple-objective evolving algorithm (MOEA) and static weighted influence non-linear gauge system (WINGS) to analyze a social network. Finally, comparisons are made between the innovative approaches and the methods in tradition.

INTRODUCTION

Social networking sites become very popular after 2010 (Yang et al., 2016). It has been concluded that almost 98% of Internet users referring to other users' opinions while making travel plans (Hyan Yoo & Gretzel, 2008). Therefore, if decision-makers could focus on key influencers/customers in a social network, it could take minimal effort/cost to retain their customers and promote their reputations. In the past, most related papers come from the consideration of only a single objective or criterion in Social Network Analysis (SNA). It remains a challenge or lacks the methodology to identify those active influencers in a social network by the multi-objective method. Considering the power of Multiple Criteria Decision Making (MCDM) in many academic fields, we try to find the major influencers in a social network through innovative approaches in this chapter. SNA and MCDM resolve the problem of finding key influencers and provide new insights. We review the efforts from the past and watch what is happening now. Of course,

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Background

Multi-Criteria Decision Making (MCDM) methods are trendy in ranking alternatives or finding the Pareto optimum in operational research (Asghar, 2009). Nowadays, social media sites like Facebook (FB), Twitter, or Instagram are frequent fevers/fashions for business organizations to retain their loyalty. Social media sites' popularity means numerous customer data on sites are generated to form a big data set now. In the traditional ranking problem of MCDM, the number of alternatives is small. However, if we want to rank the node in a social network by MCDM; actually, the number of nodes and edges could be hundreds, thousands, even millions. In such a case, machine learning or evolutionary algorithm are valuable to solve the challenge (Graupe, 2013). The corresponding difficulty of dealing with the big data of social networks is seldom discussed in the traditional field of MCDM (Gandhi & Muruganantham, 2015).

To clarify our idea and the aim of the chapter, we present two different models via MCDM to deal with the node data from FB in the flow chart of Figure 1. First of all, the literature review of SNA and its corresponding SOM for methodology is provided. Second, the fundamentals of MCDM are reviewed, and their applications for SNA are presented. According to the literature review, it concluded that the SNA based on MCDM is relatively less. Third, we propose two different MCDM models: dynamic and static, to classify the nodes in a social network. The first one is Multi-objective SOM, a particular map from Artificial Neural Networks (ANNs) by dynamic evolution. The second one is WINGS, derived from Decision Making and Trial Evaluation Laboratory (DEMATEL), and can be widely used as a structural model for the static analysis of intertwined factors and causal relations between them. The traditional SOM is extended to minimize the weighted sum of squared errors during training; this view is original. Besides, the eigenvector centrality is famous for many years in SNA. The WINGS is innovatively used to identify the influential nodes in addition to eigenvector centrality. Finally, the computing results are compared with the traditional methodology to show the performance.

Figure 1. Flow chart of methodlogy