Research on Social Marketing Strategies with An Agent-based Propagation Model

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Abstract: Considering the increasing complexity of social networks and user behaviors, it is very challenging for advertisers to formulate their strategies of selecting proper initial seed users in their social marketing efforts. In this paper, we tackle this challenge by proposing an agent-based propagation model and injecting it into typical social networks with three types of structures, i.e., Erdős-Rényi random graph, Watt-Strogatz small world graph, and Barabási-Albert scale-free graph. We instantiate this agent-based model with demographic characteristics extracted from real-world census data collected in China. By investigating the diffusion process of advertising information in these social networks, we can analyze and compare the performance of advertisers’ targeting and influencer strategies. Our experimental results indicate that advertisers adopting influencer strategies should manipulate the initial well-connected seeds to deliver information only to the potential customers instead of a wide range of generic users.

Keywords: social marketing, information diffusion, agent-based propagation model, seeding strategy.

1. INTRODUCTION

With the rapid development of social networking tools, and integration of online advertising and big data analysis, more and more advertisers now prefer to promote their products or services through the social marketing channels. In literature, social marketing is defined as the design, implementation, and control of programs calculated to influence the acceptability of social ideas, and it involves considerations of product planning, pricing, communication, distribution, and marketing research (Kotler & Zaltman, 1971), which is a much broader idea than social advertising and even social communication. Social marketing has a positive effect on the brand image, awareness and equity, which can contribute to a significant improvement in purchasing intention (Dehghani & Tumer, 2015).

Social marketing is closely related to viral marketing, where advertisers attempt to artificially create word-of-mouth advertisements among potential customers. Their main difference lies in the decay rate, which represents the rate to lose interests on sharing the given advertising information. Typically, there is one-time sharing in viral marketing as the advertising information is spread with little or no interaction. On the contrary, social marketing aims at persistent interests and growing sharing. When the decay rate increases above a certain threshold, social marketing tends to be viral marketing.

The social marketing process can be broadly modelled in terms of three components: a social network through which advertising information is propagated, a set of users that propagate the information, and a seeding strategy that activates the process by determining the initial set of targeted users chosen by advertisers (Bampo & Wallace, 2008). The seeding strategy is of particular importance, since a proper strategy can help advertisers to deliver the ideas to a wide range of target users. Generally, there are two popular seeding strategies for advertisers: selecting the best-matched users via Web cookie analysis, and selecting the influential users on the basis of their social activities (Li & Shiu, 2012). The former is called the targeting strategy, while the latter the influencer strategy.

For targeting strategies, advertisers identify the best-matched users on the basis of user profiles including gender, age, interests, purchase intentions and so on, and then launch campaigns or pass advertising information directly to them. Therefore, advertisers will have full control of the promotion process, and can manage the fine-grained audience targeting, and also can avoid the waste of limited budgets. However, those targeted users might not impose enough impacts to encourage the diffusion of the advertising information. Also, targeting advertising needs to access user profile to learn their traits, which may cause the problem of user privacy, and thus lead to the negative engagement of advertising systems (Wang et al., 2015).
For influencer strategies, well-connected individuals in social networks will be chosen to maximize spread of advertising information. Since these influential users have powerful capacity to deliver social ideas and impose strong influence on others’ acceptability, they can help advertisers build indirect connections with large amounts of users quickly, which improves both the effectiveness and efficiency of online promotions. The main disadvantage of this strategy is that some users receiving the advertising information are not the targeted ones, and will not create any values for advertisers. Generally, targeting strategies focus on the small-scale best-matched audience, while influencer strategies may broadcast advertisements to a large-scale generic audience.

It is a challenging task for advertisers to determine a proper seeding strategy in social marketing. Most advertisers are faced with budget limitations, which restrict them to select a finite number of users as their promotion targets. In addition to the complexity of social networks and user behaviours, generally advertisers are lack of ability to predict and control the diffusion process in social networks. Thus they are not able to estimate the marketing performance and further to select the proper seeding strategy.

The key to determine seeding strategies in social marketing is to figure out the diffusion mechanism of advertising information, as well as the social impact on users’ purchasing intentions or behaviours in social networks. Social marketing is not a theory in itself but rather draws from many bodies of knowledge to understand how to influence people’s behaviour (Kotler & Zaltman, 1971). Considering the factors of user preference, network influence, and propagation capability, Li & Shiu (2012) studied the diffusion mechanism to deliver advertising information over microblogging media. Todi (2008) proposed three criteria that successful advertising campaigns on social networks need to fulfil, which are unobtrusiveness, creativeness and engaging users. Psychological knowledge that is relevant and accessible to individuals is also very important for social marketing programs to foster sustainable behaviours (Mckenzie-Mohr, 2000). Stead et al. (2005) suggested that a theoretically sound framework, combined with the use of consumer research to help translate theoretical constructs into acceptable and persuasive interventions, is an important pre-requisite for the effectiveness of social marketing. Hinz et al. (2011) recommended influencer strategies for viral marketing based on empirical experiments.

The existing research efforts on the initial seeds selecting in social marketing are far from enough. However, selecting different initial seed set will not only result in different advertising information diffusion path and numbers of reaching out, but also different interventions on users’ social behaviours and purchasing intentions, and thus will influence the final marketing performance and the advertiser’s achievement. Therefore, there is a critical need to study the initial seeds selecting strategy in social marketing.

This paper is targeted at studying advertisers’ decisions on seeding strategy in social marketing for influence maximization. Inspired from infectious disease research, we establish an agent-based propagation model to investigate the information diffusion and transition between user states during social marketing. Also, we design experiments in three typical social networks: Erdős-Rényi random graph (Erdős & Rényi, 1960), Watts-Strogatz small world graph (Watts & Strogatz, 1998) and Barabási-Albert scale-free graph (Barabási & Albert, 1999) to make further investigations of our research using real-world census data in China. Our research will provide reliable support for advertisers to determine their seed users in social marketing.

The remainder of this paper is organized as follows. In Section 2, we establish an agent-based propagation model for information diffusion in social networks. Section 3 conducts experiments to make further investigation of the model, and also gives detailed analysis of the experimental results. Section 4 discusses the management insights of our research. Section 5 concludes.

2. THE MODEL

2.1 Problem Statement

A social network is modelled as a directed graph $G$. The dynamics process of social marketing can be well represented as an information cascading process, during which decentralized nodes in a network environment act on the basis of how their neighbours act at earlier time (Yu et al. 2016). Given an influence diffusion model $m$ and an initial seed set $S$, the final revenue is defined as the expected final number of active nodes, which is denoted by $R(G,m,S)$. A seed set $S$ is initialized under a seeding strategy $x$. Due to budget constraints, the size of $S$ is limited. The influence maximization problem is defined as finding the optimal seeding strategy $x^*$ to maximize the final influenced size, which is denoted as the Equation (1).

$$\begin{align*}
x^* &= \text{argmax}_{x \in S} R(G,m,x(G)) \\
\text{subject to} & \quad |x| \leq k
\end{align*}$$

(1)

In this paper, we consider the influence diffusion model of social marketing based on a propagation model inspired from the susceptible/infective/recovered (SIR) model (Saito et al., 2008). Due to similar patterns in the spread of epidemics and social contagion processes, existing research have adopted the SIR model to study on the information diffusion among social medias (Woo & Chen, 2016). And we will discussed the propagation model and also formulate the solution process for the model over the next sections.

2.2 The Propagation Model

Agent-based modeling is a powerful simulation modeling technique, which enables people to deal with complex individual behavior in complex systems. Even a simple agent-based model can exhibit complex behavior patterns and provide valuable information about the dynamics of the real-world system that it emulates (Bonabeau, 2002). Therefore we adopt an agent-based model for learning user behaviour in social marketing.
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