2017 International Conference on Identification, Information and Knowledge in the Internet of Things

Improved SIR Advertising Spreading Model and Its Effectiveness in Social Network

Yi Jing[a,b], Liu Peiyu[a,*], Tang Xiaobing[b], Liu Wenfeng[c]

[a]School of information science and engineering of Shandong Normal University, Jinan 250014,China
[b]School of computer science and technology of Shandong Jianzhu University, Jinan 250101,China
[c]Department of computer and information engineering of Heze University, Heze 274015,China

Abstract

The traditional SIR model cannot fully reflect the regularity of information propagation in social networks. In this paper, the advertising spreading model which is applied to social networks is established, and the corresponding dynamic evolution equations are given. Meanwhile, due to that there is no unified evaluation criteria for the validity of spreading models currently, the application of AEI, the advertising effectiveness index to evaluate and analyze the effectiveness of spreading models is put forward in this paper. The experiment results demonstrate that the model proposed in this paper can correctly reflect the trend of advertising spreading in social network, and accurately describe the spreading process, and the validity of the model is also verified in this paper.

Keywords: social network, SIR model, advertising spreading model, AEI index

---

* Corresponding author. Tel.: +0-131-8889-9297; fax: +0-000-000-0000 .
  E-mail address: liupy@sdnu.edu.cn

1. Introduction

In social networks, due to the low cost, wide coverage and rapid spread, the advertising propagation has been widely used. Therefore, it is valuable to research the spreading of advertising information in social networks to maximize the effectiveness of advertising.

At present, researches on the propagation model mainly focus on the improvement of SIR and SEIR model[1-10]. All of these studies focus on the improvement of the propagation model, but there are few researches on the process of advertising information propagation, and there is no uniform index to verify the validity of the improved model.

In this paper, we establish a social network advertising promotion model based on SIR model. And then, the international-popular advertising effectiveness index (AEI) is applied to the effectiveness evaluation of propagation model, it provides a reference for further study of the effectiveness of the propagation model. Finally, a simulation experiment is carried out at last.

2. Model establishments

2.1. AEI advertising effectiveness index

In this paper, AEI(Advertising Effectiveness Index) is used as an index to measure the effectiveness of the model.

The calculating formula of AEI is
$$AEI = \frac{A-(A+C)\times\dfrac{B}{(B+D)}}{N} \tag{1}$$

Among them,
A: the number of people who have seen the ad and purchased;
B: the number of people who have not seen the advertisement and purchased;
C: the number of people who have seen the advertisement and not purchased;
D: the number of people who have neither seen the ads nor purchased.

2.2. Social network advertising spreading model based on AEI

The susceptible node **S** represents individuals who neither know the ad nor purchase; the spreading node **I** represent individuals who are aware of the ad and have the interest or ability to continue to disseminate and purchase; the recovery node **R** represents individuals who know the ad but lose interest to purchase or transmit. P_{SI} is the internal infection probability, P_{IR} is the recovery probability, P_{SR} is the direct recovery probability, and α is the external recovery probability.

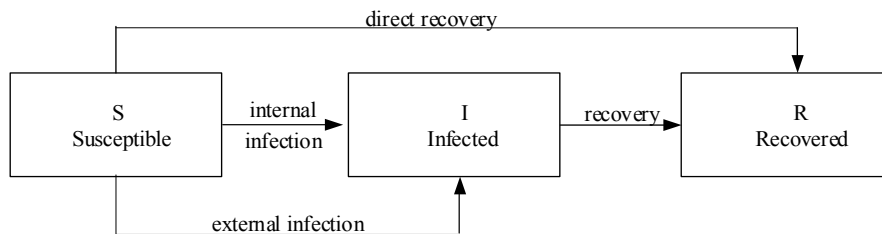The state evolution of the improved SIR advertising spreading model is shown in fig.1.

Fig.1. the evolution diagram of the improved SIR advertising spreading model in social network

3. Model analysis

Supposing N(k,t) is the total number of nodes with k degree, and，S(k,t)、I(k,t) and R(k,t) respectively represents the proportion (i.e. density) of susceptible nodes (that neither receive the ad nor purchase goods), transmitting nodes (that know the ad and purchase), and recovery nodes (that know the ad but do not purchase) with k degree at t time in social network. Accordingly, S(k,t)+I(k,t)+R(k,t)=1. Then the dynamic evolution equation of