Dynamic Society's Information Networks Based on the Complex Network Theory and the Dynamics of Infectious Disease: Part2. Model Testing

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Abstract: The predict communication situation in 2015 is obtained based on the normal distribution of the market share percentage of each kind of information transmission mode. The prediction result is compared with the reality in 2015 then. The comparison result shows that our model have great reliability since the relative error of our predict model is less than 15%.The communication situation around 2050 is predicted according to our model. The prediction result shows that the percentage of Internet, Paper and TV in the information transmission market is 0.82, 0.15 and 0.3 respectively.

Keywords: Monte Carlo Algorithm Hungary Algorithm.

1. Introduction

Based on the normal distribution of the market share of different information transmission modes, we get the predict value of the information communication situation in 2015 first and then we compare that with the reality in 2015 to validate the reliability of our model. And then we give a prediction of the information transforming situation around 2050. The changing model for public interest and opinion nowadays was also put forward. Finally, testing information-Spreading and influencing public opinion was made.

2. Testing the predicting reliability in 2015

Based on the normal distribution of the market share of different information transmission modes, we can get the predict results in 2015, which is shown in the following table:

TABLE 1. The predict Market share in 2015

Kinds	*Telegraph*	*Paper*	*Radio*	*TV*	*Internet*
percentage	0.08	0.35	0.18	0.7	0.49

Based on the data that we get from the references [10], we can get the real distribution of different information transmission modes in 2015 as follows:

TABLE 2. The real Market share in 2015 [10]

Kinds	*Telegraph*	*Paper*	*Rd*	*TV*	*Internet*
percentage	0	0.30	0.22	0.65	0.45

Based on the predict results and real results in 2015 mentioned above, we can validate the reliability of our models.

We can know that the relative error of our prediction is listed as below:

TABLE 3. The relative error of our prediction

Kinds	*Tg*	*Pp*	*Rd*	*TV*	*It*
Relative Error/%	*8*	*12.7*	*10.3*	*7.7*	*8.9*

We can know that our model is reliable considering the predict model is good enough when the relative error of our predict model is less than 15%.

3. Predicting the communication situation around 2050

In this section, we set the threshold value of the information transmission modes[1] first. And then we predict the possible Market share distribution of different information transmission modes around 2050. The accelerating network theory is then used to analyze the network degree in 2050, and we take the news of Abraham Lincoln's assassination for example to analyze the percentage of people around the world who can know the news in 30 minutes[2].

The additional symbols used in this section are as follows:

TABLE 4. Additional symbols and descriptions for information transmission modes

Symbols	*Descriptions* (different kinds of information transmission mode)
M(t)	The attaching sides of every new node
α	The variable speed
N(t)	The scale of information transforming network at the t moment
P	A constant value of probability

Based on the normal distribution model of WI, we can get the prediction market share distribution of different information transmission modes in 2050 as the following table:

TABLE 5. The predict Market share in 2050

Kinds	*Paper*	*TV*	*Internet*
percentage	0.08	0.20	0.72

Explanation: with the advancement of the new technique the development of the internet and mobile phones is an irresistible trend.

Also, we assume that in 2050, there may exist the electronic product which contains the functions of both of the mobile phones and computers.

And also since the newborn people is living in the electronic age who will have few opportunities to get touch with the paper information, so we predict that in the 2050 the percentage of newspapers is less than 15% is reliable.

The increasing rate of the sides of the information transmission network has the trend to increase in a changing rate, we name this kind of network as the accelerating network.

We can get:

$$M(t) = P \times N(t)^{\alpha} \tag{1}$$

Taking the increase of both the nodes and sides into consideration, we can get:

$$M(t) = \frac{dMs(t)}{dt} \approx Ms(t) - Ms(t-1) \tag{2}$$

$$N(t) = \frac{dNn(t)}{dt} \approx Nn(t) - Nn(t-1) \tag{3}$$

The acceleration of the information transmission internet a(t) is as follows:

$$a(t) = \frac{d\left(\frac{M(t)}{N(t)}\right)}{dt} \tag{4}$$

The definition of the acceleration network is shown below:

$$a(t) > 0 \tag{5}$$

The information transmission network is an acceleration network and we predicts around 2050 the information network will be a network which is mainly depends on the internet and it will cover all around the world.

The node degree around 2050 is about 6500 based on the node degree in twitter nowadays. When we simulate the transmission of the news that Abraham Lincoln's assassination we found that in 30 minutes there have about 48.9% people around the world can get the information.

That is to say in 2050, the capacity of the information transmission network all around the world is as the capacity of the twitter nowadays. And important information such as the assassination of

Abraham Lincoln can be spread all around the world and more than 48.9% people can get it within the time of 30 minutes.

4. The changing model for public interest and opinion nowadays

4.1 The changing model for public opinion

Based on the Cultivation Theory[3], we can know that the public opinion is mainly affected by the mainstream values of the information transmission modes that the public gets touched.

(1). Main stream effect

We assume that the influence of today's information networks to public opinion is mainly depends on the information transmission mode that is the internet and we ignore the influence of the Opinion Leaders.

We know that the information transmission in the network times has a character that the same kind of information which is liked by the people will spread more times. Thus we can know that some people who is not interested with the same information at the first time getting touch with it may be interested with it when he gets touch with the same kind of information more times. And finally his thinking to one piece of news will be decided by the mainstream media.

The theory can be explained as follows: when a person gets touch with a piece of information he may be affected first and then with time changing his thinking and reflecting to it may be correspond to his experience but when he gets touch with the same kind of information at the second and third and more times his reflect to the same information will change from the first time he gets touch with it. And finally, his thinking to one thing will be decided by mainstream media.

(2). "Echo effect" and "the spiral theory of silence"

At the first time, when a piece of news comes up, there may have three different voices: the voice of the mainstream media, the voice of people who have the same or different voice with the media.

While based on the "echo effect" theory, the culture effect will be larger when there have some people who have the same thinking with the mainstream media. And based on the spiral theory of silence those people who has different opinion with the mainstream media will be smaller and they will not speak out there voice. Thus, finally the public opinion will be correspond to the mainstream media

(3). Final results

The Cultivation Theory is just like the saying in China that is "three people spreading reports of a tiger make you believe there is one around".

Based on the accumulative effect that information have to people, we assume that the total influence to a person is as follows:

$$Tie = \sum_{i=1}^{n} F(i) \tag{6}$$

And for F(i), it obeys the following formulas:

$$F(i+1) > F(i) \quad \frac{dF(i)}{dt} < 0 \tag{7}$$

Since the public opinion is decided by each of person in the public information networks, thus we get the influence of information networks to public opinion is as follows:

$$Tpo = \sum_{node=1}^{n} Tie \tag{8}$$

Thus we can get the influence of information networks to public opinion.

And we found when the same information is spreading in the internet information network for more times, public opinion will be affected larger and finally corresponding to the mainstream media.

4.2 The changing model for public interest

In this section, we analyze the features of information transmission nowadays [3] first and then we take the fault information about shares for example to model how the public interest can be changed through information networks in today's tech-connected network[4].

The feature of information-spreading nowadays

Nowadays, the main information spreading way is the tech-connected information network, which means the information-transmission features of nowadays consist the following two aspects:

(1). The information is spreading across the surface that means if a node is an important Opinion leader in a region, his opinion may affect other's opinion mainly.

(2). The information is spreading across the networks, which means people have more time to get touch with the same information.

Take the shares for example

We assume that in an information network about shares which contains 10000 people, a right information about the prediction trend of the changing of shares tomorrow is got by one of the people in the network.

Based on the information flow model that we mentioned above, we assume that he will spread the right information to others with the probability of Pr and we set the probability that he set the wrong information to others is Pw. Pr and Pw is also suitable for other people in the network when spreading information to others.

We take two sets of different value of Pr and Pw for example.

TABLE 6. Two groups of Pr and Pw.

Number	*Pr*	*Pw*
Group 1	*0.8*	*0.2*
Group 2	*0.3*	*0.7*

We can know in the tech-connected communication network nowadays, the public interest is mainly depends on the reality degree of information. If the reality degree is higher, the public interest will be guaranteed to be higher. While if the reality degree is lower, the public interest will be lower[6].

That is to say the reality of the voice of the mainstream media has a strong impact on the public interest and we found the correlation coefficient is 0.83. If the voice is right there will have more people who will get profit from it but there will also have more people be affected on the opposite.

5. Conclusions

In this section, the model testing was put forward. And the model proves great reliability, especially in the testing procedure using the data in 2015. The information transforming situation were predicted. Also, the changing model for public interest and opinion nowadays was made. And how information spread and influence public opinion was analyzed. From the procedure mentioned above, we know our model proves practical.

6. References

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