

A Bayesian Early Warning System of Public Opinion in Social Networks in Colleges and Universities

Jing Song¹ Yun ke²

1 College of Suqian
Suqian, Jiangsu, China

2 College of Humanities and Law
Wuhan Technology and Business University
Wuhan, Hubei, China

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I. INTRODUCTION

Network public opinion is mainly refers to the collection of people's evaluation, cognitive orientation, behavioral trends and other reactions for these events with the network media communication. Because of its sudden, explosive and real-time characteristics, if unable to implement appropriate and accurate guidance and supervision to the network public opinion, It will cause a great impact on public safety. Ceng Runxi think that internet public opinion is the collection of people's cognition, attitudes, emotions and behaviors of events that generate by the stimulation of various events and spread by the Internet [1-3].

The liberalization and information diversification of universities cyberspace is a "double-edged sword."It is the way for students to find information resources and the favorable tool for management publish a policy notification quickly and directly, but it also can give some people opportunity use the Internet to spread rumors and false information, generate universities network public opinion. Some people also use the Internet to incite the students' emotions, making network negative public opinion intensification, posing a threat to the students and the university management. Therefore, guiding the university network public opinion and controlling the development of university network public opinion has become urgent priority in university management, It also makes the research of universities network public opinion early warning mechanism become a top priority.

In recent years, the Bayesian network method has been widely used in artificial intelligence and data mining. It reveals the conditional probability distribution and the causal link between the objective events, and It is also an important tool for uncertainty reasoning. This paper uses Bayesian network to make a forecasting for the risk of university network public opinion, through building risk topology composed by dynamic node key factors, the appropriate early warning mechanism is established.

II. MEANING AND SUPPORTING TECHNOLOGY OF UNIVERSITY NETWORK PUBLIC OPINION EARLY WARNING MECHANISM

A. *Meaning of University Network Public Opinion Early Warning Mechanism*

University network public opinion early warning mechanism is refers to respect the consistency, commonality, directional characteristics of the university network public opinion, with the existing organization or channels, establish appropriate monitoring mechanisms to collect and analyzes public opinion, summarize the rational composition and trend Analyzes of university network public opinion, rationalize management policy. According to the law of the university network public opinion, previously grasp the impending social change, guide people to make a scientific, rational judgment and response. College Network public opinion often occur in place where public opinion express concentration and public opinion pass flow freely. The establishment of university network public opinion early warning mechanism should also grasp the mass organizations and public media in school campus [4].

B. *Supporting Technology of University Network Public Opinion Early Warning Mechanism*

The content analysis method is a research method that objective, systematic and quantitative describe the disseminate content. In fact, it is to analyze the information and change of disseminate content. The advantages of content analysis method are: objective, structured study, non-contact and combine of quantitative and qualitative. Quantitative and qualitative combination is the most fundamental advantages of content analysis, it uses the qualitative research as a precondition, identify characteristics that can reflect the document content and transform it into quantitative data.

Data mining is a technology that extract useful information and knowledge form large number incomplete,

vague and random data. With the development of information technology, data mining not only can discover and traverse the past data, but also can identify potential linkages between them and promote the exchange of information. Data Mining Technology analyzes the related Information of university network public opinion early warning mechanism, find the networking hidden in the information, and by build model forecast and early warning to the future data.

This paper constructs a dynamic risk topology use Bayesian networks and establish a university network public opinion early warning mechanism.

III. UNIVERSITY NETWORK PUBLIC OPINION EARLY WARNING MECHANISM BASED ON THE BAYESIAN NETWORK MODELING

A. Principle of Bayesian Network

Bayesian networks is a special kind of causal inference network, It is a directed acyclic graph which consists by the nodes and segment, each node represents a random variable, the probability distribution described the probability value of the variable which in each state collection, each segment representative the dependency of joint or inference between two nodes. The inference model of Bayesian network shown in figure 1, the network node is divided into hypothesis node (H node) and event node (E nodes). The hypothesis node represents a person's subjective perception of something, the event node represents the objective facts occurring in a temporal range. Through these objective facts we can calculate the conditional probability of the hypothesis node.

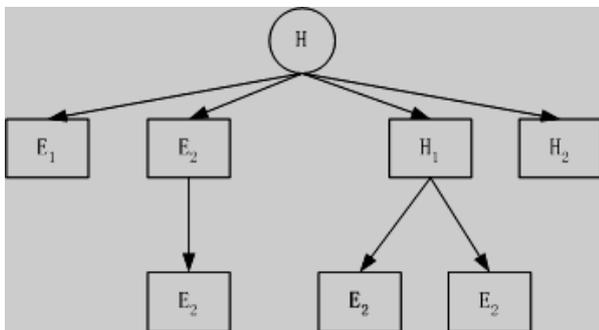


Figure 1 The Bayesian network

This paper use the tree Bayesian Network as a reasoning model, its structural features for each node can have only one parent. Considering a typical tree Bayesian networks, node X have m child nodes and one parent node U, The structure as shown in figure 2.

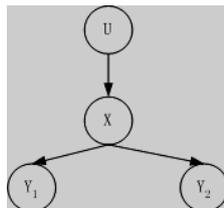


Figure 2 The tree Bayesian Network structure

The variable definition in algorithm is :

Bel represents the state probability distribution of node, λ represents the diagnostic information obtained from the child node, π represents the causal information obtained from the parent node, α represents the normalization factor.

Then:

Step1: Update the confidence degree

$$Bel(x) = \alpha \lambda(x) \pi(x)$$

$$\lambda(x) = \prod_j \lambda_{y_j}(x)$$

$$\pi(x) = \pi_x(u) \times M_{x1U}$$

Step2: Bottom-up update

$$\lambda_x(u) = \lambda(x) \times M_{x1U}$$

Step3: Up-bottom update

$$\pi_{y_i}(x) = \alpha \pi(x) \prod_{K \neq j} \lambda_{y_k}(x)$$

Bayesian network updates are triggered by events, so Bayesian network is a reasoning process based on the diagnostics. It is similar to the human thinking of situation assessment [5-6]. From the perspective of cognitive science, the inference result Bayesian network has high reliability.

B. Determine the Bayesian Network Structure

This paper uses dynamic Bayesian network structure, take the method of probability calculation and statistics, combine with expert evaluation, analyze and calculate the existing information and data, has the ability that information and time grand calculate. Dynamic Bayesian network mainly consists of two parts: 1, the initial state (Bayesian network N0), 2, Bayesian network with two or more time segments (Bayesian network N). As shown in Figure 3.



Figure 3(a) Bayesian network N0

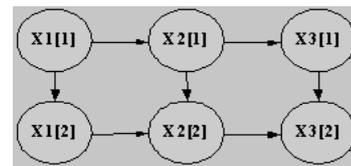


Figure 3 The dynamic bayesian network

As can be seen from Figure 3, this reasoning fit the evolving law of emergencies. This paper establishes the key scene of university network public opinion by using dynamic Bayesian network model and analyze the main elements. Overall, the probability calculation of dynamic Bayesian network must follow the following rules [7-8]: Dynamic Bayesian network reference the Bayesian Network, using the probabilistic integral to express uncertainty, and for the probability integral, the basic rules is uses the probability of key events:

$$P(A, B) = P(A/B)P(B) \tag{1}$$

In the formula 1, $P(A, B)$ represents the actual probability of event A and B, $P(B)$ represents the absolute Probability of event B, $P(A/B)$ represents the conditional probability of event A in the case of event B occurs. $P(A/B)$ can be changed as:

$$P(A/B) = \frac{P(B/A)P(A)}{P(B)} \tag{2}$$

When it comes to multi-source information fusion, Bayes' rule needs to be extended:

$$P(M_i/\bar{e}) = \frac{P(\bar{e}/M_i)P(M_i)}{\sum_{i=1}^H P(\bar{e}/M_i)P(M_i)} \tag{3}$$

$P(M_i)$ is the priori probability, $P(M_i/\bar{e})$ is the conditional probability.

IV. EXAMPLE ANALYSIS

In July 4, 2007, the degree event of Huazhong University of Science and Technology are spreading, the home of Tianya, Maopu, Sina blog are reporting related content, but most reports are not objective. This paper using the case make the network predictive analysis.

A. Determine the Node Variable

Aiming at the network public opinion of the degree door event object in Huazhong university of science and technology, these objects are used as a node of the network. In emergencies, the subjective and objective data are mainly used to quantify the level at the end of the index, respectively. In this case, this paper chooses the following five node as the bayesian network nodes: netizens X1, traditional media (including television news, newspapers, etc.) X2, emerging media (such as the official weibo, official WeChat) X3, government (including the official journal, video conference, etc.) X4, folk communication (public, such as leisure places spread) X5.

B. Determine the Relationship of the Networked Node

By related experts' score is provided for a particular node, we can determine the causal relationship between nodes. Then through the type (4) we can further calculate the probability value X of the current node. Assume that the event reasonable threshold value is 0.7.

$$\bar{X} = \frac{X_1 + X_2 + \dots + X_n}{n} = \frac{\sum_{i=1}^n X_i}{n} \tag{4}$$

In this article, 10 experts are selected to give scores for the node X1, X2, X3, X4, X5 in order to analysis. By type (4), the arithmetic mean of each node \bar{X} can be obtained. It can be seen in table 1.

TABLE I THE EXPERT EVALUATION VALUE OF VARIABLES X1, X2, X3, X4, X5 NODE VARIABLES' CAUSAL RELATIONSHIP

Bayesian network node variables	Expert1	Expert2	Exper3	Expert4	Expert5	Exper6	Expert7	Exper8	Expert9	Expert10
X1	0.821	0.836	0.914	0.922	0.767	0.682	0.944	0.903	0.871	0.865
X2	0.752	0.734	0.785	0.791	0.811	0.901	0.776	0.842	0.978	0.935
X3	0.917	0.922	0.938	0.944	0.951	0.928	0.907	0.894	0.865	0.891
X4	0.644	0.874	0.935	0.951	0.952	0.768	0.799	0.835	0.924	0.922
X5	0.825	0.832	0.834	0.874	0.895	0.756	0.815	0.823	0.924	0.956

C. Determine the Conditional Probability

This article assumes that the emergency network public opinion one node variable G must occur, so its True (T) is 1, False (F) is 0. The conditional probability of other Bayesian networks nodes are given by 10 experts according to the development and changes law of the network public opinion analysis. When G = T, for X1[1], if ten experts give scores for T were 0.8, 0.8, 0.9, 0.9, 0.8, 0.7, 0.95, 0.9, 0.9, 0.9, and their average 0.855 were calculated. Thus when it is F, F = 1-0.855 = 0.145; When G = F, for X1[1], if ten experts give scores for T were 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, and their average 0 were calculated. Thus when it is F, F = 1-0 = 1. The accessor method of X1 [2], the X1[3], the X1[4], the X1[5] is the same as the X1[1]. In this article, we only give the users X1's determine values the of conditional probability. The details are shown in table 2.

TABLE II X1[1], X1[2], X1[3], X1[4], X1[5] SESSION'S CONDITIONAL PROBABILITY OF X1

G		
X1[1]	G=T	G=F
T	0.855	0
F	0.145	1
X1[2]	X1[1]=T	X1[1]=F
T	0.811	0.402
F	0.189	0.598
X1[3]	X1[2]=T	X1[2]=F
T	0.900	0.300
F	0.100	0.700
X1[4]	X1[3]=T	X1[3]=F
T	0.843	0.283
F	0.157	0.717
X1[5]	X1[4]=T	X1[4]=F
T	0.811	0.386
F	0.189	0.614

D. Determine the State Probability

According to the expert grading, the correlation probability is used to compute the probability of whether a node variables happens, such as the state probability P(X1) of X1 is follows,

$$P(X1|1) = P(X1|1 / G = T) \times P(G = T) + P(X1|1 / G = F) \times P(G = F)$$

We can predict the dynamic of netizen X1, traditional media X2, emerging media X3 , government X4, folk dissemination X5 in time T2. According to the dynamic prediction of T2, the dynamic of T3 can be obtained, and it can recursive until the end of the event when the predicted is over. The specific results are shown in table 3.

TABLE III X1[1], X1[2], X1[3], X1[4], X1[5] SESSION'S STATE PROBABILITY OF X1

G	
T=1	F=0
X1[1]	T=0.855×1+0×0=0.855
	F=0.145×1+1×0=0.145
X1[1]	
X1[2]	T=0.811×0.855+0.402×0.145=0.752
	F=0.189×0.855+0.598×0.145=0.248
X1[2]	
X1[3]	T=0.9×0.811+0.3×0.189=0.787
	F=0.1×0.811+0.7×0.189=0.213
X1[3]	
X1[4]	T=0.843×0.9+0.283×0.1=0.787
	F=0.157×0.9+0.717+0.1=0.213
X1[4]	
X1[5]	T=0.811×0.843+0.386×0.157=0.861
	F=0.189×0.843+0.614×0.157=0.139

The calculation method of X2, X3, X4, X5 is similar with X1, the T of X1[1] is 0.855, the X1[2] 's is 0.752, the X1[3]'s is 0.787, the X1[4]'s is 0.787, the X1[5]'s is 0.861. And we can also calculate that the rest of the associated probability T of each node were greater than 0.7.

Results show that, when the events listed in this paper happen, like the media, Internet users, such as public's attention on this incident will increase, and it will not present a trend remains constant or reduced. Therefore, it can provide the basis for related department.

V. CONCLUSION

University network early warning mechanism has a considerable help for controlling the public opinion in university management and maintaining a stable campus. With the correct understanding and strategy of the management of colleges and universities, it can effectively prevent and construct the university network public opinion crisis. More scholars and institutions conduct research about early warning mechanism of network public opinion in colleges and universities, which has led to a constant improvement. And the effective control of the outbreak of the crisis of public opinion is no longer a dream.

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