

Research on the Network Public Opinion Pre-warning Based on Analytic Hierarchy Process

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Abstract—The article constructed a scientific, complete and practical index system about online public opinion after reading a large number of books and articles. Then it obtained the data through questionnaires, using the analytic hierarchy process to analyze the data and calculate weight of the indexes; finally, it evaluated 40 pieces of network public opinion in 2012 by using analytic hierarchy process.

Keywords- online public opinion; index system; pre-warning; Analytic Hierarchy Process

I. INTRODUCTION

With the rapid development of information technology, the Internet has become the most widely used 'the fourth media for today's influence', after the broadcast, TV, newspaper. Equality, open, hidden, fast, cross temporal and spatial are its characteristics, and the public regard it as one of the most important platform of information acquisition and dissemination. Network become a melting pot of all kinds of ideas, attitudes and opinions, expand remarks channels of ordinary people and to improve the efficiency of information dissemination conducive to the popularity of science and technology and the development of socio-economic, but on the other hand improperly remarks easily initiate a network of public opinion crisis. Therefore, network public opinion must be fast and effective analysis and warning early and eliminate the crisis in the bud, avoid the enlargement of adverse events. Based on this, the paper constructs the network public opinion pre-warning model, and uses AHP method to make assessment of online public opinion pre-warning.

II. CONSTRUCTION OF INDEX SYSTEM OF ONLINE PUBLIC OPINION PRE-WARNING

Based on the existing literature, this paper constructs the index system of online public opinion pre-warning (see TABLE I , see the end of the article). The index system is

divided into three layers, the first layer is the target layer, and the middle layer is the criterion, the lowest layer is the factor layer, each layer is corresponding to different levels of index. The target layer is corresponding to the first layer index, it is the comprehensive index of network public opinion, and the index reflects the comprehensive situation of network public opinion, the results of the index value directly determines the online public opinion pre-warning level. The second layer index consists of information activity of network public opinion, attention of online public opinion, sentiment of online public opinion, the sensitivity of network public opinion, as the criterion layer index system. Public opinion reflects the characteristics of itself, public opinion propagation is embodied in the development of public opinion, and public opinion is the reaction of public audience to public events. The bottom layer is composed of the factor layer and their corresponding index.

III. DESIGN OF ONLINE PUBLIC OPINION PRE-WARNING MODEL BASED ON AHP

AHP is a multi-objective decision making method, it is a combination of qualitative and quantitative research, and it is proposed by Saaty who is an operational research expert of American in the nineteen seventies; it is especially suitable for quantifying qualitative experience of decision makers, AHP can generally be divided into four steps: setting up the hierarchy structure, constructing judgment matrix and assignment, rank ordering (calculate the weight vector) and inspection, the level of total order and inspection.

A. setting up the hierarchy structure

By using the analytic hierarchy process should first clear the decision problems and make them organized, hierarchical, and establish the hierarchical structure. The hierarchical structure includes target layer, criterion layer and measure layer.

The target layer is the most senior; it is the preset goals of solving the problems. First we analyze the decision problem,

get the goal to reach, and make the goals as the target layer elements. The target layer elements should be unique, that is, one and only one element. The criterion layer is the middle layer; it represents the rules of achieving the goals. In the complicated decision problems in reality, the guidelines to achieve the goals are usually more, and then it must analyze the relationship between different criteria, find out the main standards and secondary standards of membership, and be hierarchical and grouping. The upper element is composed of the lower elements, and controls the lower elements; the same layer element can be divided into several different groups, the same group elements are subject to upper layer elements with similar properties. Measure layer is for the lowest layer, and it delegates the measures that goals needed to achieve, usually refers to the solution of decision problems below the above criteria.

The decision factors and position of each level is determined, connected by wires to the relationship is the hierarchical structure.

B. constructing judgment matrix and assignment

After establishing the hierarchical structure, there will be downward subordinate relations criterion as the first element on the left upper corner of the judgment matrix, the subordinate elements in turn toward the back, repeat this step matrix can be obtained. By using the expert scoring method for multiple comparison the importance of judging matrix elements, and used 1-9 scaling method for assignment, as shown in TABLE II.

TABLE II. DEFINITION TABLE OF IMPORTANT SCALE

Importance of scale	meaning
1	Compared with the element i and element j are equally important
3	Element i compared with element j , element i is a little important
5	Element i compared with element j , i is obviously important
7	Element i compared with element j , i is strongly important
9	Element i compared with element j , i is extremely important
2,4,6,8	Between the above comparison
reciprocal	The reciprocal of the ratio of above importance comparison

We issue forty survey questionnaires to the school and the corresponding research institute experts, all questionnaires are collected, the effective questionnaires are thirty-eight, the effective rate of recovery is ninety-five percent. We use Cronbach α coefficient to do reliability test, and analysis results show that the overall Cronbach α coefficient of the questionnaire is between 0.672 to 0.987, are not less than 0.6, so it passes the reliability test. Validity test results show that, the KMO value is 0.932, P value is 0.00047, so the data are suitable for factor analysis; factor analysis results show that all the indexes generate 4 common factors, they explain 82.21% of the population variance, the factor loading of indexes are between 0.51 to 0.92, they all are more than 0.4, so the questionnaire also passes the validity test. Each level of judgment matrix and the results of weight are shown in TABLE III to TABLE X..

TABLE III. A-B LAYER JUDGMENT MATRIX AND WEIGHT COEFFICIENT

A	B ₁	B ₂	B ₃	B ₄	Weight W_i
B ₁	1	7	2	6	0.524
B ₂	1/7	1	1/5	1/3	0.054
B ₃	1/2	5	1	5	0.325
B ₄	1/6	3	1/5	1	0.097

TABLE IV. B₁-C_i (i=1,2) LAYER JUDGMENT MATRIX AND WEIGHT COEFFICIENT

B ₁	C ₁	C ₂	Weight W_i
C ₁	1	2	0.667
C ₂	1/2	1	0.333

TABLE V. B₂-C_i (i=3,4,5) LAYER JUDGMENT MATRIX AND WEIGHT COEFFICIENT

B ₂	C ₃	C ₄	C ₅	Weight W_i
C ₃	1	1/5	1/3	0.109
C ₄	5	1	2	0.582
C ₅	3	1/2	1	0.309

TABLE VI. B₃-C_i (i=6,7,8) LAYER JUDGMENT MATRIX AND WEIGHT COEFFICIENT

B ₃	C ₆	C ₇	C ₈	Weight W_i
C ₆	1	1/4	1/2	0.136
C ₇	4	1	3	0.625
C ₈	2	1/3	1	0.238

TABLE VII. B₄-C_i (i=9,10) LAYER JUDGMENT MATRIX AND WEIGHT COEFFICIENT

B ₄	C ₉	C ₁₀	Weight W_i
C ₉	1	3	0.750
C ₁₀	1/3	1	0.250

TABLE VIII. C₆-D_i (i=6,7,...,13) LAYER JUDGMENT MATRIX AND WEIGHT COEFFICIENT

C ₆	D ₆	D ₇	D ₈	D ₉	D ₁₀	D ₁₁	D ₁₂	D ₁₃	Weight W_i
D ₆	1	7	5	2	1	6	4	3	0.271
D ₇	1/7	1	1/3	1/4	1/6	1	1/3	1/5	0.031
D ₈	1/5	3	1	1/2	1/3	3	1	1/4	0.068
D ₉	1/2	4	2	1	1/6	5	2	1	0.118
D ₁₀	1	5	3	6	1	7	3	2	0.268
D ₁₁	1/6	1	1/3	1/5	1/7	1	1/2	1/3	0.033
D ₁₂	1/4	3	1	1/2	1/3	2	1	1/3	0.068
D ₁₃	1/3	5	4	1	1/2	3	3	1	0.143

TABLE IX. C₇-D_i (i=14,15,...,21) LAYER JUDGMENT MATRIX AND WEIGHT COEFFICIENT

C ₇	D ₁₄	D ₁₅	D ₁₆	D ₁₇	D ₁₈	D ₁₉	D ₂₀	D ₂₁	Weight W_i
D ₁₄	1	8	6	3	1	7	3	2	0.263
D ₁₅	1/8	1	1/2	1/5	1/7	1	1/4	1/6	0.027
D ₁₆	1/6	2	1	1/3	1/4	4	1	1/5	0.055
D ₁₇	1/3	5	3	1	1/7	6	3	1	0.122
D ₁₈	1	7	4	7	1	5	4	3	0.286
D ₁₉	1/7	1	1/4	1/6	1/5	1	1/3	1/4	0.028
D ₂₀	1/3	4	1	1/3	1/4	3	1	1/4	0.065
D ₂₁	1/2	6	5	1	1/3	4	4	1	0.153

TABLE X. $C_8 - D_i$ ($i=22,23,\dots,29$) LAYER JUDGMENT MATRIX AND WEIGHT COEFFICIENT

C_8	D_{14}	D_{15}	D_{16}	D_{17}	D_{18}	D_{19}	D_{20}	D_{21}	Weight W_i
D_{22}	1	9	5	3	1	8	5	2	0.267
D_{23}	1/9	1	1/3	1/6	1/8	1	1/3	1/6	0.024
D_{24}	1/5	3	1	1/4	1/5	6	1	1/7	0.053
D_{25}	1/3	6	4	1	1/8	7	5	1	0.130
D_{26}	1	8	5	8	1	6	4	2	0.279
D_{27}	1/8	1	1/6	1/7	1/6	1	1/4	1/6	0.022
D_{28}	1/5	3	1	1/5	1/4	4	1	1/6	0.051
D_{29}	1/2	6	7	1	1/2	6	6	1	0.175

C. rank ordering (calculate the weight vector) and inspection

When n equals 1 to 9, RI given by Satty are shown in TABLE XI

TABLE XI. RI VALUE TABLE

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Of coincidence test, by formula $CI=(\lambda \max -n)/(n-1)$, we know $CI=(4.158-4)/(4-1)=0.053$, Table.11 shows that when $n=4$, $RI=0.9$, and by formula $CR=CI/RI=0.053/0.9=0.059<0.1$, so the consistency of judgment matrix of the target layer and rule layer is satisfied.

The same can be: CR of judgment matrix B1-Ci is 0.000, CR of judgment matrix B2-Ci is 0.003, CR of B3-Ci is 0.016, CR of judgment matrix B4-Ci is 0.000, CR of judgment matrix C6-Di is 0.038, CR of judgment matrix C7-Di is 0.062, CR of judgment matrix C8-Di is 0.084, they all less than 0.1, so the consistency of all judgment matrixes are satisfied.

D. The weight of each index and the comprehensive weights

On the basis of above, finally we get the weights of the whole index system and their comprehensive weights, the results are shown in TABLE I.

IV. APPLICATION EXAMPLES

Using AHP to evaluate 40 cases of online public opinion randomly selected in 2012. They are island fishing operations, electric business price war, Chinese children test of transgenic rice, Beijing storm, Liu Xiang incidents, Yiliang earthquake, Yang Dacai "smile" cousin, Diaoyutai parade, Zhou Kehua Chongqing door event, serious traffic accident of Yanan, Shenyang shops closed, Chongqing beauty, Suzhou building long underwear Tucao, events in Shifang, Harbin Yangming beach bridge collapse, big fire in Jixian County in Tianjin, China Southern airline stewardess is hit, Wuhan elevator falling accident, Bo Xilai series of cases, the earthquake of Yangzhou in Jiangsu, Guangzhou Yuexiu District Committee hit airline stewardess, teacher's Day gifts, Macheng own desk incident, Panzhihua coal mine explosion, President of PKU Zhou Qifeng kneel female, Hangzhou housing collapse, Zou Hengfu revealed the promiscuous event of PKU, Panjin demolition shooting events, group events in Qidong, Beijing Metro knife hijacked, hawker hold urban management thigh, Yunnan serial disappearance, the US say no to Confucius Institute, Wang Laoji trademark case, eat empty rates

businesswoman turned the county leaders, former badminton champion airspace rates, vice mayor, deputy director of cycling hold a gun beat reporters. Introducing normalization method to make indexes being dimensionless before calculation, and it makes the comparability of scoring stronger. The formula of the comprehensive score (we mark it as OM) is:

$$OM=\sum_{i=1}^3 \omega_i \beta_i$$

For w_i is the weight of each index, β_i is the normalized value of the score of online public opinion in the index, the results as shown in TABLE XII.

TABLE XII. THE SCORE OF ONLINE PUBLIC OPINION EVALUATION

events	score
island fishing operations	0.5677
electric business price war	0.1828
Chinese children test of transgenic rice	0.0902
Beijing storm	0.4741
Liu Xiang incidents	0.2718
Yiliang earthquake	0.0762
Yang Dacai "smile" cousin	0.1593
Diaoyutai parade	0.2162
Zhou Kehua Chongqing door event	0.0678
serious traffic accident of Yanan	0.0326
Shenyang shops closed	0.1446
Chongqing beauty	0.0295
Suzhou building long underwear Tucao	0.0239
events in Shifang	0.0243
Harbin Yangming beach bridge collapse	0.0232
big fire in Jixian, Tianjin	0.0115
China Southern airline stewardess is hit	0.0149
Wuhan elevator falling accident	0.0113
Bo Xilai series of cases	0.1365
the earthquake of Yangzhou in Jiangsu	0.0601
Guangzhou Yuexiu District Committee hit airline stewardess	0.0097
teacher's Day gifts	0.0068
Macheng own desk incident	0.0146
Panzhihua coal mine explosion	0.0046
President of PKU Zhou Qifeng kneel female	0.0154
Hangzhou housing collapse	0.0051
Zou Hengfu revealed the promiscuous event of PKU	0.0034
Panjin demolition shooting events	0.0066

group events in Qidong	0.0036
Beijing Metro knife hijacked	0.0158
hawker hold urban management thigh	0.0047
Yunnan serial disappearance	0.2096
the US say no to Confucius Institute	0.0270
Wang Laoji trademark case	0.0861
eat empty rates businesswoman turned the county leaders	0.0316
former badminton champion airspace rates	0.0368
vice mayor rides his daughter	0.2646
deputy director of cycling hold a gun beat reporters	0.0516
cooking oil rise in price	0.0770
nutritious lunch in Jinzhai, Anhui	0.0027

From TABLE XII , 40 cases of online public opinion randomly selected in 2012, the score in the top three are island fishing operations, Beijing storm, Liu Xiang incidents, and they are involved in the state sovereignty, the capital of catastrophic accidents, sports stars for their journey to arise suddenly event, have caused the most extensive attention, the score in accordance with the reality effect of the online public opinion, it has stronger rationality.

V. CONCLUSIONS

This article constructs the index system of online public opinion from four aspects; they are the sensitivity of online public opinion, the strength of online public opinion, the information activity of online public opinion and the emotional tendency of online public opinion. To use AHP method to determine each index weight and establish the influence degree

of each index on the online public opinion pre-warning. The effect degree from high to low is: sensitivity of online public opinion> the information activity of online public opinion> emotional tendency of online public opinion> the strength of online public opinion. Finally, using example to verify the analytic hierarchy process to the index system of evaluation has strong rationality. It provides a new method to solve the online public opinion pre-warning.

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TABLE I. EACH INDEX WEIGHT OF ONLINE PUBLIC OPINION AND COMPREHENSIVE WEIGHT

Target layer	Criterion layer (B)	weight	Factor layer(C)	weight	Index layer (D)	weight	Comprehensive Weight of index
index system of online public opinion pre-warning (A)	sensitivity of online public opinion (B ₁)	0.524	Content sensibility(C ₁)	0.667	Degree of content sensibility(D ₁)	1	0.350
			Figure sensibility(C ₂)	0.333	Degree of figure sensibility(D ₂)	1	0.174
	strength of online public opinion (B ₂)	0.054	Breadth of Channels of spread(C ₃)	0.109	Diversity of spread channels(D ₃)	1	0.006
			Gross Cyber citizen(C ₄)	0.582	Total number of involved netizen(D ₄)	1	0.031
			The regional distribution of netizen (C ₅)	0.309	Geographic distribution of netizen (D ₅)	1	0.017
	information activity of online public opinion (B ₃)	0.325	The news channel of information activity (C ₆)	0.136	sum of publishing news (D ₆)	0.271	0.012
					Amount of news browsing (D ₇)	0.031	0.001
					Sum of evaluating news(D ₈)	0.068	0.003
					Sum of reprinting news (D ₉)	0.118	0.005
					Change rate of news released (D ₁₀)	0.268	0.012
					Change rate of news browse (D ₁₁)	0.033	0.001
					Change rate of news (D ₁₂)	0.068	0.003
					Change rate of news reprint (D ₁₃)	0.143	0.006
			Forum channel of information activity (C ₇)	0.625	total number of posting BBS (D ₁₄)	0.263	0.053
					total number of clicking BBS (D ₁₅)	0.027	0.005
					total number of following BBS (D ₁₆)	0.055	0.011
					total number of BBS reprint (D ₁₇)	0.122	0.025
					Change rate of BBS post (D ₁₈)	0.286	0.058
					Change rate of BBS reprint click(D ₁₉)	0.028	0.006
					Change rate of BBS follow (D ₂₀)	0.065	0.013
					Change rate of BBS reprint(D ₂₁)	0.153	0.031
			Micro-blog channel of information activity (C ₈)	0.238	Total number of tweeting(D ₂₂)	0.267	0.021
					Sum of reading Micro-blog (D ₂₃)	0.024	0.002
					Sum of Micro-blog comment(D ₂₄)	0.053	0.004
					Sum of Micro-blog reprint(D ₂₅)	0.130	0.010
					Change rate of tweeting (D ₂₆)	0.279	0.022
					Change rate of reading Micro-blog (D ₂₇)	0.022	0.002
					Change rate of Micro-blog comment(D ₂₈)	0.051	0.004
					Change rate of Micro-blog reprint(D ₂₉)	0.175	0.014
	Emotional tendency of online public opinion(B ₄)	0.097	Attitude tendency(C ₉)	0.61	Opinion tendency of netizen (D ₃₀)	1	0.059
			Behavior tendency(C ₁₀)	0.39	Action tendency of netizen (D ₃₁)	1	0.038