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Fuzzy Comprehensive Assessment of Internet Public Opinion Response Effect Based on AHP and Entropy Method

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Abstract

Internet public opinion response assessment is a very important part of the internet public opinion. This assessment can summarize the works of public opinion response processing, and identify the strengths and weaknesses in response process to provide the basis for the future response processing. In this paper, according to the characteristics of the internet public opinion response work, we proposed a fuzzy comprehensive assessment scheme of internet public opinion based AHP and entropy method and verified the effectiveness of the scheme through the case study. This method not only can reduce subjectivity in the evaluation process and make the assessment more reasonable and accurate. , but also can provide a reference for improving the internet public opinion response works of government.

Keywords*: fuzzy comprehensive evaluation, AHP, entropy method, internet public opinion, response effect*

1. Introduction

CNNIC data shows that up to December 2014, Chinese netizens reached 649 million, Internet penetration is 47.9%, and mobile phone netizens is 557 million which has an increase of 4.8% compared with 2013. With the rapid development of the Internet, many social events through the network, rapidly spread, thus form the internet public opinion. Internet public opinion as a barometer of social conditions and public opinions, is the public opinion and attitude of public affairs reflected online. Today, as the internet public opinion is getting more and more attention, the impact of government on public opinion response process has become increasingly important. [1-4]. Response mechanisms of Internet public opinion on the general sense include three aspects - monitoring, early warning and response. In fact, this lacks assessment that is the key link. While, the assessment exactly can further explore the pros and cons of public opinion response after the internet public opinion event subsided, so as to continuously enhance the ability of internet public opinion response. Therefore, the establishment of public opinion evaluation mechanism after events has great significance to deal with internet public opinion.

Now, it has less researches for response assessment of Internet public opinion. Existing studies focus on the study of Internet public opinion response mechanisms, strategies and response abilities, and some establishment of safety evaluation index system for internet public opinion

By analyzing the relationship between response mechanisms and evolution mechanism, Shi bo [5] proposes a framework for response mechanisms and gives a strategy to deal with public crisis events. Cui Jindong *et al.* [6] analyzed the role of government micro-blog in the internet public opinion. Then according to the survey study of the situation of

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microblog in multiple provincial government, they found the problems, and proposed a targeted government microblogging construction and corresponding strategies combining the characteristics of the particular province to guide the development of internet public opinion. Xiao, Xinqiao [7] firstly analyzed the classification, characteristics and influencing factors of internet public opinion collective event in universities, then proposed the rapid response mechanisms, procedures and other related content based on this. This study provides a good reference for university handling the internet public opinion events.

Wu Yun[8] analyzed the current situation of internet public opinion response for our government, then found out the shortcomings and put forward corresponding strategies. Huang Qiaobin *et al.* [9] primarily aimed at the guide and response internet public opinion for college students. It analyzed the importance of college students' internet public opinion, and then proposed the countermeasures and suggestions for strengthening the guidance and response mechanisms of college students' internet public opinion. Jiang Juan *et al.* [10] analyzed the characteristics in the development process of internet public opinion, taking Li Gang Scandal and Mount Huang Accident as examples. They drew the related policies for guiding internet public opinion, to promote the development of internet public opinion toward the positive and healthy direction.

Xue Yijing [11] analyzes the challenges for government in enhancing the response abilities to Internet public opinion, then presents the corresponding countermeasures for provide a reference for the government to enhance the capacity to respond. Li Yue [12] built an evaluation index system of internet public opinion response capacity for local government. It used the indicators system to evaluate Henan Luohe government to find the problems and eventually put forward some countermeasures.

Lan Xinyue [13] constructed the security assessment system of internet public opinion emergency in the text to provide theoretical support for establishing early warning mechanism of emergency. Deng Shangmin *et al.* [14] constructed a security assessment index system of university internet public opinion, and use AHP and investigation to calculate the indicators weight. Xiang Zhongping[15] put forward some new ideas for internet public opinion mining, and also established a public opinion safety evaluation system to quantitatively assess the development trends of public opinion, in addition to provide guidance for the work of monitoring and early warning. Wang Qian *et al.* [16] designed the ecological monitoring and responding systems based on Internet public opinion ecosystem. It established the 3 first-level indicators of counter effect evaluation index system on the decision-making layer, which can guide the evaluation of the effect of dealing with the internet public opinion, and to improve the level of counter internet public opinion.

Based on these, this paper proposes fuzzy comprehensive assessment of internet public opinion response effect combined AHP and entropy method. The proposed scheme designs the effect evaluation indicators system; then determines the index weights by AHP and entropy method; finally, quantifies the indicators by fuzzy comprehensive evaluation, and obtains the internet public opinion response effect. So that the government can clear the advantages and disadvantages during the response process, and it can provide the reference for handling the same type event of public opinion.[17] In this paper, the second section describes the theoretical foundation of this study, including research ideas and basis of indicators construction; the third section proposes the specific processes of fuzzy comprehensive assessment of internet public opinion response effect combined AHP and entropy method; the fourth section is the case studies and analysis of the model; last section sums up the previous research, and draw the appropriate conclusions.

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2. Theoretical Foundation

This part includes two parts. The first part describes the research ideas, giving the concise introduction of methods involved in the study process; the second part analyses the relevant basis of building the indicators system, including the purpose, principles and necessity of building the indicators system for internet public opinion response effect to lay the foundation for the establishment of the indicators system later.

2.1. Research Ideas

In this paper, the fuzzy comprehensive evaluation method is used to quantify indicators combined with nonlinear characteristics in the evaluation process, obtaining quantifiable assessment result. Based on the theory of fuzzy mathematics, this method makes fuzzy mapping and fuzzy transformation by mathematical methods. According to the process of defining factors set, evaluation set, weight set and so on, it carries on fuzzy comprehensive evaluation. The general steps of fuzzy comprehensive evaluation shows below.[18]

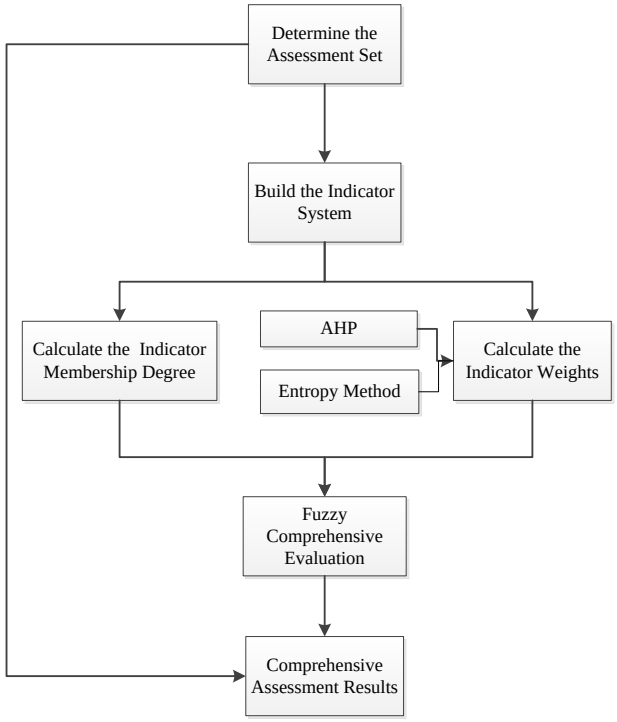

Figure 1. The Flowchart of Fuzzy Comprehensive Evaluation

An important part of internet public opinion response effect assessment is the assignment of indictor weights. By assigning the indicator weights in the established indicator system, we can distinguish the relative importance of different indicators. Whether the determination of weight is reasonable is directly related to the accuracy and scientific of evaluation. The current methods of determining the indicator weights are divided into two types:

- Subjective weighting method: like expert assessment method, AHP and so on. These methods are mainly based on the knowledge and experience of decision makers to determine the weights. The relative importance of indicators generally do not violate people's common sense, but with subjective arbitrariness. Therefore, it will affect the accuracy and reliability of decision-making.

- Objective weighting method: like entropy method, principal component analysis method and so on. These methods are mainly based on correlation among the indicators, according to a certain mathematical model, to calculate the index weights. The advantage is that fully tap the information implied in raw data, and the evaluation results are with a strong mathematical theory, corresponding the objective reality. However it ignores the knowledge and experience of decision makers, sometimes the weight obtained from them may not match the actual importance.

In practical research applications, we can use subjective and objective empowerment in combination. The two methods can overcome their shortcomings, make the results more accurate. This paper firstly uses AHP to calculate the weight of each indicator in indicator system, followed by using entropy method to amend the weights obtained from AHP according to the information provided from judgment matrixes and ultimately draws the comprehensive weights. Thus, the two methods are complementary. They can take full account of the knowledge and experience of experts; eliminate the negative impact of information entropy. On the other hand, they can reduce the impact of the subjective arbitrariness in the empowerment, making the evaluation result more objective. Specific procedures are as follows.

(1) The determination of the assessment set

Establish an assessment set $V = \{v_1, v_2, v_3, \cdots, v_n\}$. Response assessment of Internet public opinion is divided into four levels: bad, general, good and very good, which is taking n=4 to assess internet public opinion response effect. So the assessment set is $V = \{bad, general, good, very\ good\}$.

(2) The building of indicator system

When comprehensive assessment system is established, according to the division of assessment indicators of response effect assessment of Internet public opinion, the basic factor set U is roughly divided into four subsets, and each subset is divided into several assessment factors, $U_i = \{U_{i1}, U_{i2}, U_{i3}, \cdots, U_{ik}\}$. It will refer assessment indicators grading to establish a hierarchical indicator system for response effect assessment of Internet public opinion.

(3) The calculation of indicator weights

In this paper, we combine the Analytic Hierarchy Process (AHP) and entropy method to gain the comprehensive weights as the final weights.

(4) Fuzzy comprehensive evaluation

Fuzzy comprehensive evaluation uses indicator weights and fuzzy evaluation matrix to make evaluation layer by layer from the bottom to top, then obtains the comprehensive evaluation result. Finally, according to the grade evaluation set of response effect, it will use maximum membership principle to get the response effect assessment of Internet public opinion.[19]

2.2. The Basis of Indicators Construction

It follows the certain purposes and principles of building assessment system of internet public opinion response effect.

1). The purposes of constructing indicators system

Assessment of internet public opinion response effect uses the indicators system of assessment, through a detailed analysis on a specific internet public opinion event, to arrive the evaluation results of the response effect. Therefore, it is essential whether the evaluation indicators system is scientific and reasonable. Establishing the indicators system for assessment of internet public opinion response effect is mainly to select the representative evaluation indicators from all aspects of internet public opinion response, and make it as comprehensive and reasonable as possible for laying the foundation of quantitative analysis behind.

2). The principles of constructing indicators system

A scientific, reasonable and effective evaluation system should follow the following principles. [20]

(1) Scientificity: The indicators selected can reflect the characteristics of the internet public opinion response, and properly evaluate its effectiveness. Meanwhile, the indicators considered must reflect all aspects of internet public opinion response.

(2) Accountability and Operability: The indicators selected are as easy as possible to quantify. Reduce the number of subjective indicators. The indicators have clear meaning and they are representative. They are as measurable as possible, and are quantified by scientific methods for the indicators that can't be measured directly.

(3) Guiding: The indicators can reflect the objective situation of internet public opinion response, and provide reference and use for national policy makers and relevant public opinion departments.

(4) Hierarchy: Selection of indicators should have clear layers. The layers have clear relationship and relative independence to avoid overlap between indicators.

3). Analysis of the necessity

The response of Internet public opinion is that government or related departments carries out corresponding guiding and response against generating public opinion events to make it to the reasonable and healthy direction, thereby exposing the truth and purifying the Internet environment. A large number of literatures and news shows that Internet public opinion should focus on public opinion awareness, monitoring and early warning system, response options, response skills, *etc.* [21] At present, relevant departments still have some deficiencies in internet public opinion response.

(1) Public opinion awareness is not strong. Some departments are still accustomed to the traditional ideas and experiences, and don't pay enough attention to the potential guiding force of internet public opinion in mind. That made the response of internet public opinion lagging, resulting in the release of authoritative information not timely and response relatively sluggish.

(2) Guiding mechanisms of internet opinion are inadequate. In the opinion guide, a few local governments are used to follow the guide way of administration. However, in contemporary that internet information rapid develops, internet public opinion has proven that those old guiding mechanism can't meet the need of solving problems. They need to find new mechanisms to adapt to the development.

(3) Management system of internet public opinion is not sane. As the management system for internet public opinion in relevant departments is not sound and the division of labor is not clear, there are phenomena that efficiency is not high and they pass the buck to each other during the guiding process. There is also multi management that everyone manages internet public opinion, however, no management is in place. To some extent, these weakened the effective management of internet public opinion.

(4) Response ways of internet opinion response are unscientific. The first one is "Aphasia". Related government departments have maintained silence about the internet public opinion, they didn't deny nor admit. This attitude would eventually bring some negative effects to the government departments' image and the conduct of follow-up works. The second one is "Gibberish". For various reasons, some local governments used the ideas and methods of respond the traditional media to blindly refute a rumour and deny ignoring the facts. Even they had contradictory statements, and can't justify. These eventually lead to a crisis of confidence for the masses to the government. The third one is "Random Handle". For the doubt of users, some local governments handled them irresponsibly, and unwilling to do the work seriously and responsibly.

Because these problems have existed, it makes the relevant departments urgently need appropriate strategies to respond internet public opinion. Response effect evaluation is a good means. Through the evaluation, the government not only clears the final response effect. More importantly, it can obtain the advantages and disadvantages existed in the process of internet public opinion response, and accumulate lessons.

3. Fuzzy Comprehensive Assessment of Internet Public Opinion Response Effect

On the basis of the above theoretical study, this section presents the core content of this article - the method for fuzzy comprehensive assessment of internet public opinion response effect. According to research ideas given above, this section introduces the specific content of the method in detail, and clears processes and procedures.

3.1. The Building of the Indicators System

This indicators system established in this paper is as comprehensive and accurate as possible. Through assessing all aspects of response, it gets the final effect of the whole process of public opinion response. Based on the contents that response mechanisms of internet public opinion involves, we makes public opinion awareness, response skills, response process and response results as second class indicators. In public opinion awareness, it concerns the reflections on initial stages of Internet public opinion; in response skills, it focuses on the means used to respond, including online and traditional two ways; in response process, it concerns the specific approach; response results is mainly the assessment for results after the end of the response. This indicators system summarizes the content of internet public opinion response and assesses its response effect.

The selection of the indicators system for internet public opinion response effect should not only reflect internet public opinion response effect, but also through the assessment process observe which handled well, which still has problems in response. Response effect assessment system for Internet public opinion is shown in Table 1.[5, 12]

Table 1. Response Effect Assessment System for Internet Public Opinion

First Class Indicator	Second Class Indicators	Third Class Indicators	Fourth Class Indicators
Response Effect (A)	Public Opinion Awareness(A_1)	Settings of Public Opinion Agency(A_{11})	
		Qualities of Management Directors($A12$)	
		Response Attitude(A_{13})	
		Response Rate(A_{14})	
		Response Level($A15$)	
	Response Skills(A_2)	The Skills on Internet(A_{21})	Interaction In Microblog, Blog, Forums and Other Social Network Sites($A211$)
			Information Publishing on Official Websites(A_{212})
		The Skills of Media Public Relations(A_{22})	Spokesman($A221$)
			Information Publishing on Traditional Media(A_{222})
	Response Process(A_3)	Monitoring And Early Warning System($A31$)	Monitoring and Analysis System(A_{311})
			Advisory Cooperation Platform(A_{312})
		Management System($A32$)	Contingency Plans(A_{321})
			Coordination and Linkage Mechanism(A_{322})
		Guide Mechanism($A33$)	Appropriate Policies and Regulations(A_{331})
			Timeliness of Information Dissemination(A_{332})
	Response Results($A4$)	Information Transparency(A_{41})	
		Public Satisfaction(A_{42})	
		Duration of Public Opinion(A_{43})	
		Government Credibility($A44$)	

3.2. The Calculation of Indicator Weights

1). The steps of AHP determining the indicator weights

a. The building of recursion order hierarchy structure

Hierarchical structure established are shown in Table 1 in which the first class indicator is denoted as A, is response effect; the second class indicators is denoted as A_i, including public opinion awareness, response skills, response process and response results; the third class indicator is denoted as A_{ij}, including twelve further detailed indicators; the fourth class indicator is denoted as A_{ijk}, making the part of the third class indicators continue to refine.

b. The building of judgment matrix

By using the theory of 1~9 scaling method, this paper makes pairwise comparison between importance of same layer indicators to get the quantified judgment matrix.

Table 2. The Scale Meaning and Value of Judgment Matrix

No.	Level of Importance	Value
1	*i*, *j* are equally important	1
2	*S* value of *i* is higher than *j* (0.1, 0.2] (*i* is slightly more important than *j*)	3
3	*S* value of *i* is higher than *j* (0.3, 0.4] (*i* is obviously more important than *j*)	5
4	*S* value of *i* is higher than *j* (0.5, 0.6] (*i* is strongly important than *j*)	7
5	*S* value of *i* is higher than *j* (0.7, 0.8] (*i* is extremely important than *j*)	9
	2, 4, 6, 8 are respectively assigned at (0, 0.1], (0.2, 0.3], (0.4, 0.5], (0.6, 0.7]	

For the assessment system the paper proposes, we designs the questionnaire to compare the importance between the indicators. It is divided into five grades for the degree of importance of indicators in response effect assessment of Internet public opinion. They are extremely important, quite important, important, quite unimportant and extremely unimportant and their scores orderly reduce by 4-0. Then, the total score is calculated for each indicator according to the weighted value of the same indicator in questionnaires.

c. The calculation of λ_{max} for each matrix

According to the judgment matrix constructed, use MATLAB to calculate the eigenvector and eigenvalue of each judgment matrix and find the maximum eigenvalue (λ_{max}).

d. The consistency check of matrixes

In order to check the consistency of judgment matrixes, use the root method to calculate that is a relatively simple method.

Calculate consistency index *CI*: $CI = \frac{\lambda_{max}-n}{n-1}$, Where *n* is the order of the matrix;

Calculate consistency ratio *CR*: $CR = CI/RI$

The value of *RI* is shown in Table 3.

Table 3. The Value of the Average Random Consistency Index

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

When *CR*<0.10, it considers the consistency of judgment matrix is acceptable, otherwise it should make appropriate amendments to the judgment matrixes, until it passes.

d. The calculation of indicator weights

Solve each judgment matrix by sum and product method, obtaining the column vector *l*. Then the column vector normalized to get the weight vector *α*.

2). Amending indicator weights by entropy method[22]

a. Data Acquisition

According to the judgment matrix obtained from AHP, after normalization get

$$B = (b_{ij})_{m\times n}, b_{ij} \in [0,1].$$

b. The calculation of information entropy for judgment matrix

Calculate the entropy values of judgment matrix e_j.

$$e_j = -k\sum_{j=1}^{m} f_{ij} \cdot ln\, f_{ij}, \text{ which } k = \frac{1}{ln\, n}, f_{ij} = \frac{b_{ij}}{\sum_{j=1}^{n} b_{ij}} \quad (1)$$

c. The determine of entropy weight for judgment matrix

From the formula of calculate information entropy, we can see that the entropy values e_j are smaller, the amount of information is more, the more important in the overall evaluation. The formula of calculate entropy weight β_j as follows:

$$\beta_j = \frac{1-e_j}{\sum_{i=1}^{n}(1-e_j)} \tag{2}$$

3. The calculation of comprehensive weights

Use the entropy weights β_j to amend the weights α_i obtained from AHP, then get the final combined weights W_i.

$$W_i = \frac{\alpha_i \beta_i}{\sum_{i=1}^{n} \alpha_i \beta_i} \tag{3}$$

3.3. The Calculation of Indicator Membership

Membership function is the foundation of fuzzy control application. It's the key for making a good use of fuzzy control that whether the membership function properly constructed. The determination process of membership function, in essence should be objective, but everyone's recognition and comprehension for the same fuzzy concept are differences. Therefore, the determination of membership function has subjectivity. The membership function established for assessment indicators of internet public opinion response effect calculates the grade that indicators belongs of the evaluation set, then does the normalization process.

Indicators covered in this article are qualitative indicators, determining the membership of single factor by ratio method. The membership of the assessment indicator is the ratio of the numbers of every level occupied and the total number of all evaluation items for the index. Assessment indicators are divided into four levels: 1 represents bad, 2 represents general, 3 represents good, 4 represents very good. Build membership matrix R_i, $R_i = (r_{i1}, r_{i2}, \cdots, r_{in})$ (R_i is the membership of the each $v_1, v_2, \cdots, v_n$ in assessment set which *ith* indicator corresponds to, that is r_{ij}=(The number of people choose v_i for the *ith* indicator)/(The total number of people involved in the assessment), where *j*=(1,2,⋯ ,*n*).

3.4. Comprehensive Assessment of Response Effect[23]

Response effect assessment indicators established in this paper is divided into four levels, hence, we need to make three fuzzy comprehensive assessment to obtain the final results.

1). The first stage of a comprehensive assessment

From the Table 1, we can see that only some indicators have the fourth class indicators. According to the weight results calculated before, put the assessment matrixes and weight vectors of fourth class indicators into the formula $Q_{ij} = W_{ijk} * R_{ijk}$ to get the first stage of a fuzzy comprehensive assessment:

$$Q_{ij} = \begin{bmatrix} W_{ij1} * R_{ij1} \\ W_{ij2} * R_{ij2} \\ \cdots \\ W_{ijk} * R_{ijk} \end{bmatrix} \tag{4}$$

Where W_{ijk}, R_{ijk} are weight vectors and fuzzy assessment matrixes of fourth class indicators.

2). The second stage of a comprehensive assessment

According to the calculation method above, the formula to calculate the three indicators is $Q_i = W_{ij} * R_{ij}$ to get the second stage of a fuzzy comprehensive assessment:

$$Q_i = \begin{bmatrix} W_{i1} * R_{i1} \\ W_{i2} * R_{i2} \\ \cdots \\ W_{ij} * R_{ij} \end{bmatrix} \quad (5)$$

Where W_{ij}, R_{ij} are weight vectors and fuzzy assessment matrixes of third class indicators.

3). The third stage of a comprehensive assessment

Similarly, we can draw the formula $Q = W_i * R_i$ for two indicators to obtain the third stage of a fuzzy comprehensive assessment:

$$Q = \begin{bmatrix} W_1 * R_1 \\ W_2 * R_2 \\ W_3 * R_3 \\ W_4 * R_4 \end{bmatrix} \quad (6)$$

Where W_i, R_i are weight vectors and fuzzy assessment matrixes of second class indicators.

Q is the final results of the assessment, and then determine the response effect of an incident according to maximum membership principle.

4. Case Study

In order to verify the proposed evaluation method above, this paper selects the "Occupy Central" event in Hong Kong which is the second in 2014 hot events rankings of Internet public opinion according to people. com. cn monitoring to assess the response effect of this internet public opinion events.

4.1. Case Description

In Sep 28, 2014, after a series of illegal actions of blocking the road. Early in the morning, Dai Yaoting who is the associate professor of the University of Hong Kong and the sponsor of "Occupy Central" announced the "Occupy Central" was officially launched. Demonstrators illegally occupied several roads, including Admiralty, Causeway Bay, Mong Kok, *etc*. At Queensway area, Demonstrators illegally occupied the Harcourt Road, Queensway, Connaught Road Central and several roads, 9-10 traffic lanes, which are the important traffic arteries connecting the east region and west region of Hong Kong. These areas have built Hong Kong Chief Executive's Office, Government Secretariat, the Legislative Council Building and other important government facilities, and are adjacent to Hong Kong Stock Exchange, Bank of China, HSBC and other financial and business institutions. The normal order in these regions have been seriously affected by the impact of this action. This event lasted 75 days. In Dec 11, Hong Kong police succeed to remove all the obstacles in one day and open the blocked roads, which made Hong Kong major transportation hub connecting east and west district of Hong Kong back to the normal. This event posed a serious blow to the social life in Hong Kong.

4.2. Case Application

1). The calculation of indicator weights for response effect assessment of Internet public opinion

(1) Use AHP to calculate the indicator weights

a. Determine the judgment matrixes

The questionnaires were distributed to 50 experts, 48 valid questionnaires were collected, and effective recovery rate reached 96%. According to the results of the questionnaire, we got a weighted average of the indicators to compare the importance. Using Table 2, we quantified the relative importance of each level of assessment indicators, then determined the judgment matrixes through pairwise comparison.

Second class indicators are shown in Table 1. It includes public opinion awareness (A_1), response skills (A_2), response process (A_3), response results (A_4).

b. Calculate the maximum eigenvalues of judgment matrixes

First class indicators: λ_{max}=4.1213

Second class indicators: λ_{max1}=5.1175; λ_{max2}=2 ; λ_{max3}=3.0092; λ_{max4}=4.0813

Third class indicators: λ_{max21}=λ_{max22}=λ_{max31}=λ_{max32}=λ_{max33}=λ_{max33}=2

c. The consistency check

According to the above formula, calculate *CI* and *CR*, the values of *CR* are less than 0.1, which meet the requirement of the consistency check.

d. Calculate the indicator weights

The column vector is normalized to get each indicator weights.

$$\alpha_1 = [0 \quad 1 \quad 0.333 \quad 0.667]$$

$$\alpha_{11} = [0.289 \quad 0.546 \quad 1 \quad 0.864 \quad 0]; \alpha_{21} = [0 \quad 1]$$

$$\alpha_{31} = [0 \quad 1 \quad 0.4]; \alpha_{41} = [0.456 \quad 0.245 \quad 0 \quad 0.1]$$

$$\alpha_{211} = [0 \quad 1]; \alpha_{221} = [1 \quad 0]; \alpha_{311} = [1 \quad 0]; \alpha_{321} = [1 \quad 0]; \alpha_{331} = [1 \quad 0]$$

(2) Use Entropy method to calculate the indicator weights

a. Data Acquisition

According to the Table 4-13, we get the original judgment matrixes, then normalize them to obtain the following matrixes.

$$B_1 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0.333 \\ 1 & 0 & 1 & 0.333 \end{bmatrix}, B_{11} = \begin{bmatrix} 0.2 & 0 & 0 & 0 & 1 \\ 0.429 & 0.143 & 0 & 0 & 1 \\ 0.5 & 0.25 & 0 & 0.25 & 1 \\ 0.556 & 0.333 & 0 & 0.111 & 1 \\ 0.167 & 0.063 & 0 & 0 & 1 \end{bmatrix}, B_{21} = \begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix},$$

$$B_{31} = \begin{bmatrix} 1 & 0 & 0.25 \\ 1 & 0 & 0.5 \\ 1 & 0 & 0.333 \end{bmatrix}, B_{41} = \begin{bmatrix} 0.182 & 0.455 & 1 & 0 \\ 0.909 & 0.273 & 1 & 0 \\ 0.1 & 0.2 & 1 & 0 \\ 0.4 & 0.6 & 1 & 0 \end{bmatrix},$$

$$B_{211} = \begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}, B_{221} = \begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}, B_{311} = \begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}, B_{321} = \begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}, B_{331} = \begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}$$

b. The calculation of information entropy for judgment matrix

According to the Formula 1, the information entropy of judgment matrixes and normalize them. The specific results are as follows:

$$e_1 = [1 \quad 0 \quad 1 \quad 0.844], e_{11} = [1 \quad 0.571 \quad 0 \quad 0.259 \quad 0.800]$$

$$e_{21} = [0 \quad 0], e_{31} = [0.642 \quad 0 \quad 1], e_{41} = [0.892 \quad 1 \quad 0.954 \quad 0]$$

$$e_{211} = e_{221} = e_{311} = e_{321} = e_{331} = [0 \quad 0]$$

c. The determine of entropy weight for judgment matrix

According to the Formula 2 $\beta_j = \frac{1-e_j}{\sum_{j=1}^{n}(1-e_j)}$, gain the entropy weights of judgment matrixes.

$$\beta_1 = [0 \quad 0.865 \quad 0 \quad 0.135], \beta_{11} = [0 \quad 0.181 \quad 0.422 \quad 0.313 \quad 0.084]$$

$$\beta_{21} = [0.5 \quad 0.5], \beta_{31} = [0.264 \quad 0.736 \quad 0], \beta_{41} = [0.094 \quad 0 \quad 0.040 \quad 0.867]$$

$$\beta_{211} = \beta_{221} = \beta_{311} = \beta_{321} = \beta_{331} = [0.5 \quad 0.5]$$

(3) The calculation of comprehensive weights

According to Formula 3, we use entropy method to get the entropy weights β_i to amend the weights α_i obtained from AHP, and gain the final comprehensive indicator weight vectors W_i.

$$W_1 = [0 \quad 0.906 \quad 0 \quad 0.094], W_{11} = [0 \quad 0.125 \quad 0.533 \quad 0.342 \quad 0]$$
$$W_{21} = [0 \quad 1], W_{31} = [0 \quad 1 \quad 0], W_{41} = [0.331 \quad 0 \quad 0 \quad 0.663]$$
$$W_{211} = [0 \quad 1], W_{221} = W_{311} = W_{321} = W_{331} = [1 \quad 0]$$

2. The calculation of indicator membership for assessment of internet public opinion response effect

We use expert scoring method to determine the factors of membership. We invited five experts to give the scores of response effect for Hong Kong "Occupy Central" Event. By collating and calculating the scoring results, we got the membership matrixes of third and fourth class indicators $R_i = (r_{i1}, r_{i2}, \cdots, r_{in})$.

$$R_{11} = \begin{bmatrix} 0.2 & 0.6 & 0.2 & 0 \\ 0.4 & 0.4 & 0.2 & 0 \\ 0.2 & 0.6 & 0.2 & 0 \\ 0.6 & 0 & 0.4 & 0 \\ 0.2 & 0.6 & 0.2 & 0 \end{bmatrix}$$

$$R_{211} = \begin{bmatrix} 0.2 & 0.8 & 0 & 0 \\ 0.2 & 0.6 & 0.2 & 0 \end{bmatrix},$$

$$R_{221} = \begin{bmatrix} 0.2 & 0.6 & 0.2 & 0 \\ 0 & 0.8 & 0.2 & 0 \end{bmatrix}, R_{311} = \begin{bmatrix} 0.2 & 0.2 & 0.4 & 0.2 \\ 0.2 & 0.4 & 0.2 & 0.2 \end{bmatrix}$$

$$R_{321} = \begin{bmatrix} 0.2 & 0.4 & 0.4 & 0 \\ 0.2 & 0.2 & 0.6 & 0 \end{bmatrix},$$

$$R_{331} = \begin{bmatrix} 0 & 0.6 & 0.4 & 0 \\ 0.4 & 0.6 & 0 & 0 \end{bmatrix}, R_{41} = \begin{bmatrix} 0.2 & 0.6 & 0 & 0.2 \\ 0 & 0.4 & 0.6 & 0 \\ 0 & 0 & 0.8 & 0.2 \\ 0 & 0.6 & 0.2 & 0.2 \end{bmatrix}$$

3. Comprehensive assessment of response effect

(1) The first stage of a comprehensive assessment

The comprehensive assessment of the skills on internet:

$$Q_{21} = [W_{211} * R_{211}] = [0 \quad 1] \begin{bmatrix} 0.2 & 0.8 & 0 & 0 \\ 0.2 & 0.6 & 0.2 & 0 \end{bmatrix} = [0.2 \quad 0.6 \quad 0.2 \quad 0] \tag{7}$$

The comprehensive assessment of the skills of media public relations:

$$Q_{22} = [W_{221} * R_{221}] = [1 \quad 0] \begin{bmatrix} 0.2 & 0.6 & 0.2 & 0 \\ 0 & 0.8 & 0.2 & 0 \end{bmatrix} = [0.2 \quad 0.6 \quad 0.2 \quad 0] \tag{8}$$

The comprehensive assessment of the monitoring and early warning system:

$$Q_{31} = [W_{311} * R_{311}] = [1 \quad 0] \begin{bmatrix} 0.2 & 0.2 & 0.4 & 0.2 \\ 0.2 & 0.4 & 0.2 & 0.2 \end{bmatrix} = [0.2 \quad 0.2 \quad 0.4 \quad 0.2] \tag{9}$$

The comprehensive assessment of management system:

$$Q_{32} = [W_{321} * R_{321}] = [1 \quad 0] \begin{bmatrix} 0.2 & 0.4 & 0.4 & 0 \\ 0.2 & 0.2 & 0.6 & 0 \end{bmatrix} = [0.2 \quad 0.4 \quad 0.4 \quad 0] \tag{10}$$

The comprehensive assessment of guide mechanism:

$$Q_{33} = [W_{331} * R_{331}] = [1 \quad 0] \begin{bmatrix} 0 & 0.6 & 0.4 & 0 \\ 0.4 & 0.6 & 0 & 0 \end{bmatrix} = [0 \quad 0.6 \quad 0.4 \quad 0] \tag{11}$$

The comprehensive assessment of public opinion awareness:

$$Q_1 = [W_{11} * R_{11}] = [0 \quad 0.125 \quad 0.533 \quad 0.342 \quad 0] \begin{bmatrix} 0.2 & 0.6 & 0.2 & 0 \\ 0.4 & 0.4 & 0.2 & 0 \\ 0.2 & 0.6 & 0.2 & 0 \\ 0.6 & 0 & 0.4 & 0 \\ 0.2 & 0.6 & 0.2 & 0 \end{bmatrix} =$$

$$[0.362 \quad 0.370 \quad 0.268 \quad 0] \tag{12}$$

The comprehensive assessment of response results

$$Q_4 = [W_{41} * R_{41}] = [0.331 \quad 0 \quad 0 \quad 0.663] \begin{bmatrix} 0.2 & 0.6 & 0 & 0.2 \\ 0 & 0.4 & 0.6 & 0 \\ 0 & 0 & 0.8 & 0.2 \\ 0 & 0.6 & 0.2 & 0.2 \end{bmatrix} =$$

$$[0.066 \quad 0.596 \quad 0.133 \quad 0.199] \tag{13}$$

(2) The second stage of a comprehensive assessment

The comprehensive assessment of response skills and response process:

$$Q_2 = W_{21} * \begin{bmatrix} Q_{21} \\ Q_{22} \end{bmatrix} = [0 \quad 1] \begin{bmatrix} 0.2 & 0.6 & 0.2 & 0 \\ 0.2 & 0.6 & 0.2 & 0 \end{bmatrix} = [0.2 \quad 0.6 \quad 0.2 \quad 0] \tag{14}$$

$$Q_3 = W_{31} * \begin{bmatrix} Q_{31} \\ Q_{32} \\ Q_{33} \end{bmatrix} = [0 \quad 1 \quad 0] \begin{bmatrix} 0.2 & 0.2 & 0.4 & 0.2 \\ 0.2 & 0.4 & 0.4 & 0 \\ 0 & 0.6 & 0.4 & 0 \end{bmatrix} = [0.2 \quad 0.4 \quad 0.4 \quad 0] \tag{15}$$

(3) The third stage of a comprehensive assessment

$$Q = W_1 * \begin{bmatrix} Q_1 \\ Q_2 \\ Q_3 \\ Q_4 \end{bmatrix} = [0 \quad 0.906 \quad 0 \quad 0.094] \begin{bmatrix} 0.362 & 0.370 & 0.268 & 0 \\ 0.2 & 0.6 & 0.2 & 0 \\ 0.2 & 0.4 & 0.4 & 0 \\ 0.066 & 0.596 & 0.133 & 0.199 \end{bmatrix} =$$

$$[0.187 \quad 0.600 \quad 0.194 \quad 0.019] \tag{16}$$

According to the maximum membership principle, from the above results we can draw response effect assessment is “good” for Hong Kong "Occupy Central" Internet public opinion Event.

4.3. Result Analysis

The comprehensive use of AHP, entropy method and fuzzy comprehensive evaluation to a certain extent, can reduce human subjectivity, making the evaluation results more objective and scientific. According to the more accurate indicators weights obtained from the combination of AHP and entropy method, we can see that in the fourth class indicators, information publishing on official websites, spokesman, monitoring and analysis system, contingency plans and policies and regulations, these five indicators share larger weights; in the third class indicators, Response Attitude, The Skills of Media Public Relations, Management System and Government Credibility share larger weights. Government and relevant departments should focus on improving the response capacity in these areas when dealing with internet public opinion. They should correct attitude of response, strengthen skills of media and public relations, be rational use of the official websites and spokesman for publishing information, on the other hand, establish monitoring and analysis platform for timely detecting problems, strengthen their own response capacity and improve government credibility.

Through using the proposed assessment method, we assessed the response effect of Hong Kong "Occupy Central" event, and this final result is “good”. This results are also consistent with reflect on the internet, indicating that the relevant guide work of public opinion is more successful, and none have a ripple effect on the situation in the mainland. Although the result of whole response work was satisfied,

there are still some problems. You can see from the comprehensive assessment process, monitoring and early warning system and management system had the lower score, which reflected monitoring and early warning system were imperfect in that event, the management system is not sound, and the information transparency needed to be improved. These are also the common problems of government in dealing with internet public opinion events.

5. Conclusion

With the rapid development of Internet, Internet public opinion has risen sharply that gives the national society and people's lives a certain extent. Response effect assessment is an indispensable part in Internet public opinion work. Based on the current research directions of Internet public opinion response, this paper analyzed the response effect assessment system, using AHP and entropy method to calculate the index weights, then quantify the indicators in index system by applying fuzzy comprehensive evaluation, finally obtain the response effect assessment of Internet public opinion. Through the above assessment, it can confirm the advantages and disadvantages during the process, summarize and analyze the experience and lessons, and constantly improve their work to provide a reference for the handling of same type, thus contributing to develop and perfect the works of Internet public opinion response. Because the researches of internet public opinion in China started late, so far, although there have been some theoretical results, the research on internet public opinion response for government were still relatively scarce, didn't form the complete system, needs to be further in future. These will constantly improve the response capabilities of internet public opinion for government and reduce unnecessary pressure of public opinion.

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References

[1] D. Yuan, "Study on Evaluation Index System of China Internet Public Opinion Safety", Beijing: Beijing University of Chemical Technology, **(2008)**.
[2] W. Jun, Z. Tiefeng and G. Xiangyi, "Study on fuzzy comprehensive evaluation model of printing quality based on AHP method", Advanced Materials Research, vol. 174, **(2011)**, pp. 243-246.
[3] E. N. Neumann, "The SPiralof Silence: Publie Opinion Our Social Skin", The University Chicago Press, Chieago, **(1993)**, pp. 17-43.
[4] K. Gronlund, "Knowing and Not Knowing: The Intemet and Politieal Information", Seand inavian Political Studies, **(2007)**.
[5] S. Bo, "The Study on Internet Public Opinion Response Mechanisms and Strategy for Public Crisis Events", Information Studies: Theory & Application, vol. 7, **(2010)**, pp. 93-96.
[6] C. Jindong and S. Yaoyao, "Construction mechanism of government microblog of developing provinces on the target of public opinion guidance", Bio Technology: An Indian Journal, vol. 9, no. 10, **(2014)**, pp. 4027-4035.
[7] X. Xinqiao, "Research on Management and Control Mechanism of Internet Public Opinion of College Collective Incident", International Conference on Frontiers of Energy, Environmental Materials And Civil Engineering, Shanghai, **(2013)**, pp. 73-75.
[8] W. Yun, "The Current Situation and Countermeasures of Chinese Government's Dealing with Network Public Opinion", East China University of Political Science and Law, Shanghai, **(2012)**.
[9] H. Qiaobin and G. Bingxun, "Theory of University Students' Network Public Opinion Guidance and Disposal", Advances in Social and Behavioral Sciences, 2nd Asian Conference on the Social Sciences (ACSS 2014), Thailand, **(2014)**, pp. 171-176.
[10] J. Juan and Z. Xun, "Analysis on the Characteristics and Guiding Strategy of Network Public Opinion in the New Media Environment-Taking Li Gang Scandal and Mount Huang Accident as Examples",

Proceedings of 2011 International Conference on Public Administration (7TH), 7th International Conference on Public Administration, Chengdu, **(2011)**, pp. 855-859.
[11] X. Yijing, "Countermeasure Study on Chinese Government Enhancing Internet Public Opinion Response Capacity", Capital Normal University, Beijing, **(2014)**.
[12] L. Yuem, "The Coping Capacity of Local Government for Internet Public Opinion Luohe", Henan Province as an Example, Hubei University of Technology, Hubei, **(2013)**.
[13] L. Yuexin, "On Construction of Emergency Network Safety Evaluation Index System", Journal of Intelligence, vol. 7, **(2011)**, pp. 73-76.
[14] D. Shangmin and D.Yaqian, "Study on the Security Evaluation Index System of the Colleges and Universities Network Public Opinion Based on AHP", Journal of Intelligence, vol. 8, **(2012)**, pp. 31-36.
[15] X. Zhongping, "Research on Network Public Opinion Information Mining and Evaluation Index System", 2010 International Conference on Advances in Computer Science and Engineering (CSE 2010), International Conference on Advances in Computer Science and Engineering, Qingdao, **(2010)**, pp. 20-23.
[16] W. Qian, Z. Zhenji and Gao Ruize, "The Construction of Counter Effect Evaluation Index System of Internet Public Opinion Based on EMR", LISS 2014, 4th International Conference on Logistics, Informatics and Service Science (LISS), Berkeley, **(2015)**, pp. 565-570.
[17] T. L. Glasser and C.T. Salmon, "Public Opinion and the Communication of Consent, The Guilford Press, **(1995)**.
[18] Z. Fan and Z.Xinhong, "Classification and Quality Evaluation of Tobacco Leaves Based on Image Processing and Fuzzy Comprehensive Evaluation", Sensors, vol. 3, no. 11, **(2011)**, pp. 2369-2384.
[19] W. Tietao and W. Guoying, "A Model of Online Public Opinion Pre-Warning Based on Fuzzy Comprehensive Evaluation", Journal of Intelligence, vol. 6, **(2012)**, pp. 47-51.
[20] D. Yuan and Y. Fei, "Research on Information Mining and Evaluation Index System Based on the Security of Network Public Opinion", Information Studies: Theory & Application, vol. 6, **(2008)**, pp. 873-876.
[21] D. Xilin and F. Liqiu, "The Investigation of Network Public Opinion Strategies", Journal of Modern Information, vol. 5, no. 32, **(2012)**, pp. 17-20.
[22] L. Wenjing, "Research on the Application of Enterprise Value Portfolio Assessment Based on Entropy and AHP", Southwest Petroleum University, Chengdu, **(2010)**.
[23] Y. Zhen, "Study and Application of Fuzzy Comprehensive Evaluation Based on AHP", South China University of Technology, Guangzhou, **(2010)**.

