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Evaluating University Crisis Management: A Neutrosophic LogTODIM Framework for Public Opinion

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Abstract: The evaluation of public opinion management capability for public crises in universities assesses the ability of universities to guide and handle public opinion during crises. The evaluation covers areas such as opinion monitoring, crisis response, information dissemination, and media communication. Through a systematic assessment, universities can improve their crisis management capabilities, reduce the spread of negative public opinion, and maintain campus stability and reputation. The public opinion management capability evaluation for public crises in universities is multiple-attribute group decision-making (MAGDM). Recently, the Logarithmic TODIM (LogTODIM) technique was interpreted to cope with MAGDM. The single-valued neutrosophic sets (SVNSs) are interpreted as decision tools for characterizing fuzzy data during the public opinion management capability evaluation for public crises in universities. In this study, the single-valued neutrosophic number combined Logarithmic TODIM (SVNN-Com-LogTODIM) technique based on the SVNN Hamming distance (SVNNHD) and SVNN Euclidean distance (SVNNED) is interpreted to solve the MAGDM under SVNSs. Conclusively, numerical study for public opinion management capability evaluation for public crises in universities is interpreted to elucidate the SVNN-Com-LogTODIM technique through comparative analysis.

Keywords: Multiple-attribute group decision-making (MAGDM); SVNSs; entropy; Logarithmic TODIM; public opinion management capability evaluation

1. Introduction and Background

In modern society, public crisis governance has become a practical issue that all countries around the world must face. Although the focus of research on public crisis governance and the construction of governance systems varies across nations, China has achieved a significant shift from "administrative single-response" to "socialized comprehensive emergency response" through institutional changes centered on the "One Plan, Three Systems" framework. This has coordinated the previously fragmented emergency management landscape and strengthened the top-level design of emergency management, advancing towards more powerful, orderly, and effective public crisis governance. By reviewing the evolution of China's public crisis governance, we can clearly see some distinct characteristics that differ from those of other countries. It is these distinctive features that support the modernization of China's public crisis governance and help us better understand the developmental logic of the country's emergency management system with Chinese characteristics. Over the past few years, research on public crisis governance has seen a significant increase, covering various aspects of crisis management. Zheng and Lou [1] explored the regional coordination mechanisms in China's public crisis emergency management. They pointed out several shortcomings, such as insufficient international governance capabilities for online public opinion, the need to enhance the informatization level, and the imperfect mechanisms for emergency material supply. The study suggested that future work should focus on strengthening regional coordination through digital means to improve overall emergency management capabilities. Zeng [2] analyzed the emergency response to the COVID-19 pandemic in Nanjing and highlighted the difficulties local governments face in managing sudden online public opinion. The study emphasized the importance of local governments' emergency management capabilities, especially in handling online public opinion during major public crises. Focusing on the challenges faced by universities, Xu, Bao and Chen [3] proposed a targeted educational guidance mechanism for universities to cope with public crises. They explored how information dissemination, psychological crisis intervention, ideological education, and other methods could help students deal with the negative impacts of the pandemic. The research specifically addressed how the pandemic affected students' mental health and academic performance, providing a four-entry intervention strategy. Simultaneously, Wen and Qiu [4] used big data and social network analysis to study the dissemination and governance of online public opinion during sudden public crises. They found that official government platforms played a crucial role in guiding public opinion in online networks. Ding [5] approached the issue from the perspective of mediatized governance, exploring how mediatized governance can be used in major public crisis events. The study emphasized the importance of mediatized governance in restoring facts, guiding public opinion, and shaping consensus, but also acknowledged the challenges it faces. The study emphasized the need to carefully balance information disclosure and public opinion guidance. Following this, Xie and Yang [6] focused on the deficiencies of local governments in the post-pandemic era, especially in policy implementation, smart epidemic prevention, intergovernmental collaboration, public relations, and emergency governance. The article proposed that local governments should enhance their emergency management capabilities through technological means and collaborative governance mechanisms.

Moving into 2023, research became more focused on specific issues like online public opinion governance and data governance. Wang and Yi [7] analyzed the "Leadership Message Board" on People's Daily Online to explore the response capabilities of digital governments during public health crises. They found that digital governments effectively guided public opinion through online platforms and acted as "buffers" during the pandemic. Zhu and Li [8] studied the governance of online rumors during sudden public crisis events, proposing a collaborative governance model centered on national governance to combat the spread of rumors and the phenomenon of group polarization. Sun [9] drew insights from history, examining how the governance philosophy of Zichan, a statesman from the Spring and Autumn period, could inform modern public crisis management. The study pointed out that Zichan's emergency management strategies, such as "being prepared" and "transparent governance," provided valuable lessons for modern crisis response. Subsequently, Zhao, Cui, Liu, Chen and Liang [10] used sentiment analysis techniques to examine local governments' online public opinion management strategies during sudden public crisis events. Through a case study of the Tonghua City material distribution crisis, the article revealed the main contradictions governments face when responding to public opinion and proposed corresponding strategies. Finally, Li and Xu [11] conducted a bibliometric analysis of the research hotspots in data governance during public crisis response. They found that data governance revolves around the relationship between "context-subject-object," with research hotspots including information technology empowerment, collaborative governance, online public opinion governance, and personal data protection.

The public opinion management capability evaluation for public crises in universities is a multiple-attribute group decision-making (MAGDM) problem due to several reasons: (1) Multiple stakeholders involved: The evaluation process typically involves various experts and decision-makers from different fields, such as communication specialists, crisis managers, public relations officers, and university administrators. Each participant brings their own perspective, expertise, and judgment, making it a group-based task. The involvement of multiple stakeholders ensures a more comprehensive and accurate assessment of the university's capability to manage public opinion during a crisis. (2) Complex and diverse evaluation criteria: The evaluation of a university's public opinion management capability is influenced by numerous attributes or criteria, such as crisis communication strategies, transparency, media relations, social media monitoring, response speed, and stakeholder engagement [12, 13]. These factors need to be considered simultaneously, and they often carry different levels of importance, making the problem multi-attribute in nature. (3) Fuzzy and uncertain information: In the context of public crisis management, the information available during a crisis can often be uncertain or evolving, especially when dealing with rapidly changing public sentiment or incomplete data [14, 15]. Different experts may have different views or uncertainties regarding the effectiveness of certain strategies, requiring decision-making techniques that can handle such uncertainties. Group decision-making allows for the aggregation of diverse opinions to reach a more balanced and well-rounded conclusion[16-19]. Considering these factors, the evaluation of public opinion management capability for public crises in universities naturally becomes a MAGDM problem, as it involves the collective input of multiple decision-makers and the assessment of complex, multidimensional criteria. Recently, LogTODIM technique LogTODIM [20, 21] was interpreted to put forward MAGDM. The SVNSs [22, 23] are interpreted as decision tool for characterizing fuzzy data during the public opinion management capability evaluation for public crises in universities. In this study, the SVNN-Com-LogTODIM approach is interpreted to put forward MAGDM under SVNSs. Conclusively, numerical study for public opinion management capability evaluation for public crises in universities is interpreted to validate the SVNN-Com-LogTODIM through comparative analysis. The major research motivations of this study are interpreted: (1) Entropy technique is interpreted the weight with SVNSs; (2) SVNN-Com-LogTODIM approach is interpreted to put forward the MAGDM for SVNSs; (3) Conclusively, numerical study for public opinion management capability evaluation for public crises in universities is interpreted and (4) serval comparisons are interpreted to validate the SVNN-Com-LogTODIM.

2. Preliminaries

Wang et al. [22] interpreted the SVNSs

Definition 1 [22]. The SVNSs is interpreted:

$$ZA = \left\{ \left(\phi, ZT_A(\phi), ZI_A(\phi), ZF_A(\phi) \right) \middle| \phi \in \Phi \right\} \tag{1}$$

where $ZT_A(\phi), ZI_A(\phi), ZF_A(\phi)$ presents truth-membership, indeterminacy-membership and falsity-membership, $ZT_A(\phi), ZI_A(\phi), ZF_A(\phi) \in [0,1]$ and meets $0 \le ZT_A(\phi) + ZI_A(\phi) + ZF_A(\phi) \le 3$.

The SVNN is interpreted as: $ZA = (ZT_A, ZI_A, ZF_A)$, $ZT_A, ZI_A, ZF_A \in [0,1]$, and $0 \le ZT_A + ZI_A + ZF_A \le 3$.

Definition 2 [24]. Let $ZA = (ZT_A, ZI_A, ZF_A)$ be SVNN, a score value is interpreted:

$$SV(ZA) = \frac{(2 + ZT_A - ZI_A - ZF_A)}{3}, \quad SV(ZA) \in [0,1]. \tag{2}$$

Definition 3[24]. Let $ZA = (ZT_A, ZI_A, ZF_A)$ be SVNN, accuracy value is interpreted:

$$AV(ZA) = \frac{1 + ZT_A - ZF_A}{2}, \; AV(ZA) \in [0,1]. \tag{3}$$

Peng et al. [24] interpreted the order for SVNNs.

Definition 4[24]. Let $ZA = (ZT_A, ZI_A, ZF_A)$ and $ZB = (ZT_B, ZI_B, ZF_B)$ be SVNNs, $SV(ZA) = \frac{(2 + ZT_A - ZI_A - ZF_A)}{3}$ and $SV(ZB) = \frac{(2 + ZT_B - ZI_B - ZF_B)}{3}$, and $AV(ZA) = \frac{1 + ZT_A - ZF_A}{2}$ and $AV(ZB) = \frac{1 + ZT_B - ZF_B}{2}$, then if $SV(ZA) < SV(ZB)$, then $ZA < ZB$; if $SV(ZA) = SV(ZB)$, then (1)if $AV(ZA) = AV(ZB)$, then $ZA = ZB$; (2) if $AV(ZA) > AV(ZB)$, then $ZA < ZB$.

Definition 5[22]. Let $ZA = (ZT_A, ZI_A, ZF_A)$ and $ZB = (ZT_B, ZI_B, ZF_B)$ be SVNNs, the operations are interpreted:

(1) $ZA \oplus ZB = \left(ZT_A + ZT_B - ZT_A ZT_B, ZI_A ZI_B, ZF_A ZF_B \right);$

(2) $ZA \otimes ZB = \left(ZT_A ZT_B, ZI_A + ZI_B - ZI_A ZI_B, ZF_A + ZF_B - ZF_A ZF_B \right);$

(3) $\lambda ZA = \left(1 - \left(1 - ZT_A\right)^{\lambda}, \left(ZI_A\right)^{\lambda}, \left(ZF_A\right)^{\lambda} \right), \lambda > 0;$

(4) $\left(ZA\right)^{\lambda} = \left(\left(ZT_A\right)^{\lambda}, \left(ZI_A\right)^{\lambda}, 1 - \left(1 - ZF_A\right)^{\lambda} \right), \lambda > 0.$

Definition 6[25]. Let $ZA = \left(ZT_A, ZI_A, ZF_A \right)$ and $ZB = \left(ZT_B, ZI_B, ZF_B \right)$, then SVNN Hamming distance (SVNNHD) and SVNN Euclidean distance (SVNNED) are interpreted:

$$SVNNHD\left(ZA, ZB\right) = \frac{\left|ZT_A - ZT_B\right| + \left|ZI_A - ZI_B\right| + \left|ZF_A - ZF_B\right|}{3} \quad (4)$$

$$SVNNED\left(ZA, ZB\right) = \sqrt{\frac{\left|ZT_A - ZT_B\right|^2 + \left|ZI_A - ZI_B\right|^2 + \left|ZF_A - ZF_B\right|^2}{3}} \quad (5)$$

The SVNNWG technique is interpreted:

Definition 8[24]. Let $ZA_j = \left(ZT_j, ZI_j, ZF_j \right)$ be SVNNs, the SVNNWG technique is interpreted:

$$\begin{aligned} & \text{SVNNWG}_{zw}\left(ZA_1, ZA_2, \ldots, ZA_n\right) \\ & = \left(ZA_1\right)^{zw_1} \otimes \left(ZA_2\right)^{zw_2}, \ldots \otimes \left(ZA_n\right)^{zw_n} = \underset{j=1}{\overset{n}{\otimes}} \left(ZA_j\right)^{zw_j} \\ & = \left(\prod_{j=1}^{n} \left(ZT_{ij}\right)^{zw_j}, 1 - \prod_{j=1}^{n} \left(1 - ZF_{ij}^{k}\right)^{zw_j}, 1 - \prod_{j=1}^{n} \left(1 - ZT_{ij}^{k}\right)^{zw_j} \right) \end{aligned} \quad (6)$$

where $zw = \left(zw_1, zw_2, ..., zw_n\right)^T$ be weight of ZA_j, $zw_j > 0, \sum_{j=1}^{n} zw_j = 1.$

3. SVNN-Com-LogTODIM technique for MAGDM with entropy

3.1. SVNN-MAGDM information

The SVNN-Com-LogTODIM technique is interpreted for MAGDM. Let $ZA = \left\{ ZA_1, ZA_2, \cdots, ZA_m \right\}$ be alternatives, and $ZG = \left\{ ZG_1, ZG_2, \cdots, ZG_n \right\}$ be attributes with weight $r\omega$, where $z\omega_j \in \left[0,1\right], \sum_{j=1}^{n} z\omega_j = 1$ and invited experts $ZE = \left\{ ZE_1, ZE_2, \cdots, ZE_q \right\}$ with expert's weight $zw = \left\{ zw_1, zw_2, \cdots, zw_t \right\}$, where $zw_j \in \left[0,1\right], \sum_{k=1}^{t} zw_k = 1$. Then, SVNN-Com-LogTODIM technique is interpreted for MAGDM.

(1). Elucidate the SVNN-matrix $ZM^t = \left[ZM_{ij}^t \right]_{m \times n} = \left(ZT_{ij}^t, ZI_{ij}^t, ZF_{ij}^t \right)_{m \times n}$ and average matrix $ZM = \left[ZM_{ij} \right]_{m \times n}$:

$$ZM^{t}=\left[ZM_{ij}^{t}\right]_{m\times n}=\begin{array}{c} \\ ZA_1 \\ ZA_2 \\ \vdots \\ ZA_m \end{array}\begin{array}{c} \begin{array}{cccc} ZG_1 & ZG_2 & \dots & ZG_n \end{array} \\ \begin{bmatrix} ZM_{11}^{t} & ZM_{12}^{t} & \dots & ZM_{1n}^{t} \\ ZM_{21}^{t} & ZM_{22}^{t} & \dots & ZM_{2n}^{t} \\ \vdots & \vdots & \vdots & \vdots \\ ZM_{m1}^{t} & ZM_{m2}^{t} & \dots & ZM_{mn}^{t} \end{bmatrix}\end{array} \tag{7}$$

$$ZM=\left[ZM_{ij}\right]_{m\times n}=\begin{array}{c} \\ ZA_1 \\ ZA_2 \\ \vdots \\ ZA_m \end{array}\begin{array}{c} \begin{array}{cccc} ZG_1 & ZG_2 & \dots & ZG_n \end{array} \\ \begin{bmatrix} ZM_{11} & ZM_{12} & \dots & ZM_{1n} \\ ZM_{21} & ZM_{22} & \dots & ZM_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ ZM_{m1} & ZM_{m2} & \dots & ZM_{mn} \end{bmatrix}\end{array} \tag{8}$$

Based on SVNNWG, the $ZM=\left[ZM_{ij}\right]_{m\times n}=\left(ZT_{ij},ZI_{ij},ZF_{ij}\right)_{m\times n}$ is interpreted:

$$ZM_{ij}=\overset{t}{\underset{k=1}{\otimes}}\left(RM_{ij}^{k}\right)^{rw_k}=\left(1-\prod_{k=1}^{t}\left(ZT_{ij}^{t}\right)^{zw_k},\prod_{k=1}^{t}\left(ZI_{ij}^{t}\right)^{zw_k},\prod_{k=1}^{t}\left(ZF_{ij}^{t}\right)^{zw_k}\right) \tag{9}$$

(2). Normalize the $ZM=\left[ZM_{ij}\right]_{m\times n}=\left(ZT_{ij},ZI_{ij},ZF_{ij}\right)_{m\times n}$ into $ZM^{N}=\left[ZM_{ij}^{N}\right]_{m\times n}$ $=\left(ZT_{ij}^{N},ZI_{ij}^{N},ZF_{ij}^{N}\right)_{m\times n}$.

For benefit attributes:

$$ZM_{ij}^{N}=\left(ZT_{ij}^{N},ZI_{ij}^{N},ZF_{ij}^{N}\right)=\left(ZT_{ij},ZI_{ij},ZF_{ij}\right) \tag{10}$$

For cost attributes:

$$ZM_{ij}^{N}=\left(ZT_{ij}^{N},ZI_{ij}^{N},ZF_{ij}^{N}\right)=\left(ZF_{ij},ZI_{ij},ZT_{ij}\right) \tag{11}$$

3.2. Compute the attributes weight by entropy.

Entropy [26] is interpreted the weight. The normalized SVNN-matrix $SVNN_{ij}$ is interpreted:

$$SVNN_{ij}=\frac{\left(SV\left(ZT_{ij}^{N},ZI_{ij}^{N},ZF_{ij}^{N}\right)+AV\left(ZT_{ij}^{N},ZI_{ij}^{N},ZF_{ij}^{N}\right)+1\right)}{\sum_{i=1}^{m}\left(SV\left(ZT_{ij}^{N},ZI_{ij}^{N},ZF_{ij}^{N}\right)+AV\left(ZT_{ij}^{N},ZI_{ij}^{N},ZF_{ij}^{N}\right)+1\right)}, \tag{12}$$

The fuzzy Shannon entropy (FSE) is interpreted:

$$FSE_j=-\frac{1}{\ln m}\sum_{i=1}^{m}SVNN_{ij}\ln SVNN_{ij} \tag{13}$$

and $SVNN_{ij}\ln SVNN_{ij}=0$ if $SVNN_{ij}=0$.

Then, the weight information is interpreted:

$$z\omega_j=\frac{1-FSE_j}{\sum_{j=1}^{n}\left(1-FSE_j\right)},\quad j=1,2,\cdots,n. \tag{14}$$

3.3. SVNN-Com-LogTODIM approach for MAGDM

The SVNN-Com-LogTODIM approach is interpreted to solve MAGDM.

(1) Elucidate relative weight:

$$rz\omega_j = z\,\omega_j \Big/ \max_j z\omega_j, \quad (15)$$

(2) The fuzzy dominance degree (FDD) of ZA_i over ZA_t for ZG_j is interpreted in light with SVNNHD and SVNNED:

$$FDD_j\left(ZA_i, ZA_t\right) = \begin{cases} \frac{1}{2}\left(\frac{rz\omega_j \times \log\left(1+10\rho DVNNHD\left(ZM_{ij}^N, ZM_{tj}^N\right)\right)}{\sum_{j=1}^{n} rz\omega_j} + \frac{rz\omega_j \times \log\left(1+10\rho DVNNED\left(ZM_{ij}^N, ZM_{tj}^N\right)\right)}{\sum_{j=1}^{n} rz\omega_j}\right) & \text{if } SV\left(ZM_{ij}^N\right) > SV\left(ZM_{tj}^N\right) \\ 0 & \text{if } SV\left(ZM_{ij}^N\right) = SV\left(ZM_{tj}^N\right) \\ \frac{1}{2}\left(-\frac{rz\omega_j \times \lambda \log\left(1+10\rho DVNNHD\left(ZM_{ij}^N, ZM_{tj}^N\right)\right)}{\sum_{j=1}^{n} rz\omega_j} - \frac{rz\omega_j \times \lambda \log\left(1+10\rho DVNNED\left(ZM_{ij}^N, ZM_{tj}^N\right)\right)}{\sum_{j=1}^{n} rz\omega_j}\right) & \text{if } SV\left(ZM_{ij}^N\right) < SV\left(ZM_{tj}^N\right) \end{cases} \quad (16)$$

where λ and $\rho \in [1,5]$ is from [20].

The $FDD_j\left(ZA_i\right)$ for ZG_j is interpreted:

$$FDD_j\left(ZA_i\right) = \left[FDD_j\left(ZA_i, ZA_t\right)\right]_{m\times m}$$

$$= \begin{array}{c} \\ ZA_1 \\ ZA_2 \\ \vdots \\ ZA_m \end{array} \begin{array}{c} \begin{array}{cccc} ZA_1 & ZA_2 & \cdots & ZA_m \end{array} \\ \begin{bmatrix} 0 & FDD_j\left(ZA_1, ZA_2\right) & \cdots & FDD_j\left(ZA_1, ZA_m\right) \\ FDD_j\left(ZA_2, ZA_1\right) & 0 & \cdots & FDD_j\left(ZA_2, ZA_m\right) \\ \vdots & \vdots & \cdots & \vdots \\ FDD_j\left(ZA_m, ZA_1\right) & FDD_j\left(ZA_m, ZA_2\right) & \cdots & 0 \end{bmatrix} \end{array}$$

(3) Elucidate the $FDD\left(ZA_i, ZA_t\right)$ of ZA_i over other alternatives:

$$ZDD\left(ZA_i, ZA_t\right) = \sum_{j=1}^{n} ZDD_j\left(ZA_i, ZA_t\right) \quad (17)$$

The $FDD = FDD\left(ZA_i, ZA_t\right)_{m\times m}$ is interpreted:

$$FDD = FDD\left(ZA_i, ZA_t\right)_{m\times m}$$
$$= \begin{bmatrix} & ZA_1 & ZA_2 & \cdots & ZA_m \\ ZA_1 & \sum_{j=1}^{n} FDD_j\left(ZA_1, ZA_1\right) & \sum_{j=1}^{n} FDD_j\left(ZA_1, ZA_2\right) & \cdots & \sum_{j=1}^{n} FDD_j\left(ZA_1, ZA_m\right) \\ ZA_2 & \sum_{j=1}^{n} FDD_j\left(ZA_2, ZA_1\right) & \sum_{j=1}^{n} FDD_j\left(ZA_2, ZA_2\right) & \cdots & \sum_{j=1}^{n} FDD_j\left(ZA_2, ZA_m\right) \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ ZA_m & \sum_{j=1}^{n} FDD_j\left(ZA_m, ZA_1\right) & \sum_{j=1}^{n} FDD_j\left(ZA_m, ZA_2\right) & \cdots & \sum_{j=1}^{n} FDD_j\left(ZA_m, ZA_m\right) \end{bmatrix}$$

(4) Elucidate the overall $FDD\left(ZA_i\right)$ of ZA_i:

$$FDD\left(ZA_i\right) = \frac{\sum_{t=1}^{m} FDD\left(ZA_i, ZA_t\right) - \min_i \left\{\sum_{t=1}^{m} FDD\left(ZA_i, ZA_t\right)\right\}}{\max_i \left\{\sum_{t=1}^{m} FDD\left(ZA_i, ZA_t\right)\right\} - \min_i \left\{\sum_{t=1}^{m} FDD\left(ZA_i, ZA_t\right)\right\}}. \quad (18)$$

(5) Sort and select the optimal alternative with $FDD\left(ZA_i\right)$, the greater $FDD\left(ZA_i\right)\left(i = 1, 2, \cdots, m\right)$ is better choice.

4. Numerical example and comparative analysis

4.1. Numerical example

The evaluation of public opinion management capabilities for public crises in universities is the process of assessing how effectively universities handle and guide public opinion during sudden crises. As an important part of society, universities involve multiple stakeholders, such as students, faculty, parents, the public, and government departments. Therefore, how universities respond to external public opinion pressure during a crisis directly impacts their reputation, image, and internal stability. In the event of a crisis, a university's ability to manage public opinion is not only about quickly addressing the situation but also about effectively communicating with the public, media, and related stakeholders. In the early stages of a crisis, information spreads rapidly, especially in today's era of widespread social media, where public sentiment and the direction of public opinion can escalate quickly. If a university lacks effective public opinion management capabilities, the uncontrolled spread of information may exacerbate the crisis and lead to greater societal impact.

Thus, the core of evaluating a university's public opinion management capabilities lies in assessing whether the university can promptly grasp the direction of public opinion, make quick decisions, and communicate with the public in a reasonable manner to alleviate negative emotions and misunderstandings after a crisis occurs. In this process, transparent and timely information release is crucial to effectively reduce external suspicion and dissatisfaction. At the same time, the communication strategy during a crisis should consider the needs and concerns of different groups, using appropriate channels and methods to convey information, ensuring the accuracy and consistency of the information. Moreover, post-crisis recovery and reflection are equally important components of a university's public opinion management capabilities. The end of a crisis does not mean the problem is fully resolved. After the situation has calmed, universities need to review and reflect on the entire process, identify shortcomings, and propose improvement plans to prepare for similar crises in the future. This continuous improvement process helps universities enhance their ability to navigate complex public opinion environments and maintain their positive image in the eyes of the public. In summary, the evaluation of public opinion management capabilities for public crises in universities is not only an assessment of crisis response capabilities but also a comprehensive evaluation of how universities maintain transparency in communication, ensure smooth information dissemination, and engage in post-crisis reflection and improvement. This evaluation helps universities continuously enhance their ability to handle public crises, minimize the spread of negative public opinion, and maintain campus stability and public trust. The public opinion management capability evaluation for public crises in universities is MAGDM. Therefore, the public opinion management capability evaluation for public crises in universities is interpreted to demonstrate the SVNN-Com-LogTODIM technique. Five comprehensive universities $ZA_i\left(i=1,2,3,4,5\right)$ are interpreted with different attributes (See Table 1).

Table 1. Four attributes for public opinion management capability evaluation for public crises in universities

Attributes	Attribute Description
ZG_1-Opinion Monitoring and Early Warning Capability	Assesses whether the university can monitor, analyze, and issue early warnings about public opinion in a timely manner through various channels (social media, news, etc.).
ZG_2-Crisis Response and Decision-Making Capability	Evaluates the effectiveness and timeliness of the university's crisis response and decision-making, including the ability to form an emergency team and implement strategies.
ZG_3-Information Release and Communication Capability	Assesses whether the university releases information in a timely, transparent, and accurate manner during a crisis, and whether it communicates effectively with stakeholders.

ZG_4-Post-Crisis Recovery and Reflection Capability	Evaluates the university's ability to recover from the crisis and reflect on the experience, ensuring measures are taken to prevent future crises and improve management.

Five possible comprehensive universities are evaluated in light with linguistic scales (See Table 2) through four attributes and three experts $ZE_t\left(t=1,2,3\right)$ with expert's weight $rw=\left(1/3,1/3,1/3\right)$.

Table 2. Linguistic scales and SVNNs

Linguistic Terms	SVNNs
Exceedingly Terrible-ZET	(0.0000, 1.0000, 1.0000)
Very Terrible-ZVT	(0.1000, 0.9000, 0.9000)
Terrible-ZT	(0.3000, 0.7000, 0.7000)
Medium-ZM	(0.5000, 0.5000, 0.5000)
Well-ZW	(0.7000, 0.3000, 0.3000)
Very Well-ZVW	(0.9000, 0.1000, 0.1000)
Exceedingly Well-ZEW	(1.0000, 0.0000, 0.0000)

The SVNN-Com-LogTODIM technique is interpreted to solve the public opinion management capability evaluation for public crises in universities.

Step 1. Elucidate the SVNN-matrix $ZM^t=\left[ZM_{ij}^t\right]_{5\times4}=\left(ZT_{ij}^t,ZI_{ij}^t,ZF_{ij}^t\right)_{5\times4}$ (See Table 3-5).

Table 3. Evaluation from ZE_1

	ZG_1	ZG_2	ZG_3	ZG_4
ZA_1	ZVW	ZM	ZT	ZM
ZA_2	ZVT	ZVT	ZVW	ZW
ZA_3	ZVW	ZVW	ZW	ZM
ZA_4	ZW	ZVT	ZM	ZW
ZA_5	ZM	ZM	ZVT	ZVT

Table 4. Evaluation from ZE_2

	ZG_1	ZG_2	ZG_3	ZG_4

ZA1	ZT	ZM	ZVW	ZVW
ZA2	ZM	ZVT	ZM	ZVW
ZA3	ZW	ZVT	ZM	ZM
ZA4	ZW	ZT	ZW	ZVT
ZA5	ZW	ZVW	ZW	ZVT

Table 5. Evaluation from ZE_3

	ZG1	ZG2	ZG3	ZG4
ZA1	ZM	ZW	ZVW	ZT
ZA2	ZM	ZVT	ZVW	ZM
ZA3	ZVW	ZVW	ZVT	ZVW
ZA4	ZVW	ZW	ZM	ZVT
ZA5	ZT	ZM	ZT	ZT

Then according to SVNNWG technique, the $ZM = \left[ZM_{ij}\right]_{5\times4}$ is interpreted (See Table 6).

Table 6. The $ZM = \left[ZM_{ij}\right]_{5\times4}$

	ZG1	ZG2
ZA1	(0.6534, 0.1942, 0.2415)	(0.7111, 0.1241, 0.1735)
ZA2	(0.4185, 0.3426, 0.5018)	(0.6023, 0.2486, 0.3362)
ZA3	(0.7406, 0.1214, 0.3223)	(0.5324, 0.2134, 0.4106)
ZA4	(0.5258, 0.2124, 0.4214)	(0.7201, 0.1145, 0.1772)
ZA5	(0.6032, 0.1382, 0.4225)	(0.6205, 0.2354, 0.3205)
	ZG4	ZG3
ZA1	(0.5273, 0.3241, 0.3956)	(0.8045, 0.1284, 0.1654)
ZA2	(0.7205, 0.1273, 0.1631)	(0.5038, 0.2428, 0.3932)
ZA3	(0.6473, 0.1452, 0.3125)	(0.7051, 0.1294, 0.1712)
ZA4	(0.6375, 0.2145, 0.3241)	(0.6375, 0.2145, 0.3241)
ZA5	(0.7406, 0.1214, 0.1641)	(0.5251, 0.3245, 0.3241)

Step 2. Normalize the $ZM = \left[ZM_{ij}\right]_{5\times4}$ into $ZM^N = \left[ZM_{ij}^N\right]_{5\times4}$ (See Table 7).

Table 7. The $ZM^N = \left[ZM_{ij}^N\right]_{5\times4}$

	ZG$_1$	ZG$_2$
ZA$_1$	(0.6534, 0.1942, 0.2415)	(0.7111, 0.1241, 0.1735)
ZA$_2$	(0.4185, 0.3426, 0.5018)	(0.6023, 0.2486, 0.3362)
ZA$_3$	(0.7406, 0.1214, 0.3223)	(0.5324, 0.2134, 0.4106)
ZA$_4$	(0.5258, 0.2124, 0.4214)	(0.7201, 0.1145, 0.1772)
ZA$_5$	(0.6032, 0.1382, 0.4225)	(0.6205, 0.2354, 0.3205)
	ZG$_4$	ZG$_3$
ZA$_1$	(0.5273, 0.3241, 0.3956)	(0.8045, 0.1284, 0.1654)
ZA$_2$	(0.7205, 0.1273, 0.1631)	(0.5038, 0.2428, 0.3932)
ZA$_3$	(0.6473, 0.1452, 0.3125)	(0.7051, 0.1294, 0.1712)
ZA$_4$	(0.6375, 0.2145, 0.3241)	(0.6375, 0.2145, 0.3241)
ZA$_5$	(0.7406, 0.1214, 0.1641)	(0.5251, 0.3245, 0.3241)

Step 3. Elucidate the weights (See Table 8):

Table 8. The attributes weight

	ZG$_1$	ZG$_2$	ZG$_3$	ZG$_4$
$z\omega$	0.2706	0.2643	0.2511	0.2140

Step 4. Elucidate the relative weights (See Table 9):

Table 9. The relative attributes weight

	ZG$_1$	ZG$_2$	ZG$_3$	ZG$_4$
$rz\omega$	1.0000	0.9768	0.9275	0.7913

Step 5. Elucidate the $FDD = FDD\left(ZA_i, ZA_t\right)_{5\times5}$ (See Table 10):

Table 10. The $FDD = FDD\left(ZA_i, ZA_t\right)_{5\times5}$

Alternatives	ZA$_1$	ZA$_2$	ZA$_3$	ZA$_4$	ZA$_5$
ZA$_1$	0.0000	-2.1665	2.2825	-2.5238	1.2182
ZA$_2$	-0.2551	0.0000	2.2102	0.2018	-2.5548
ZA$_3$	1.8601	-2.8928	0.0000	-3.1024	1.7670
ZA$_4$	-0.8406	-1.1958	2.6957	0.0000	-0.8241
ZA$_5$	1.6385	-3.0637	-0.1702	-2.8313	0.0000

Step 6. Elucidate the $FDD\left(RA_i\right)\left(i=1,2,\cdots,5\right)$ (Table 11).

Table 11. The $FDD\left(RA_i\right)\left(i=1,2,\cdots,5\right)$

Alternatives	ZA_1	ZA_2	ZA_3	ZA_4	ZA_5
SVNNDD	0.7595	0.9453	0.4830	1.0000	0.0000

Step 7. Conclusively, the order is interpreted: $ZA_4 \succ ZA_2 \succ ZA_1 \succ ZA_3 \succ ZA_5$, and thus the optimal comprehensive university is ZA_4.

4.2. Comparative analysis

The SVNN-Com-LogTODIM is compared with SVNNWA technique [24] and SVNNWG technique[24], SVNN-CODAS technique [27], SVNN-EDAS technique [28], SVNN-TOPSIS technique [29] and SVNN-TODIM technique [30]. The final comparative order is interpreted in Table 12 and Figure 1.

Table 12. Order for different techniques

Different Techniques	Order
SVNNWA technique [24]	$ZA_4 \succ ZA_2 \succ ZA_1 \succ ZA_3 \succ ZA_5$
SVNNWG technique[24]	$ZA_4 \succ ZA_2 \succ ZA_3 \succ ZA_1 \succ ZA_5$
SVNN-CODAS technique [27]	$ZA_4 \succ ZA_2 \succ ZA_3 \succ ZA_1 \succ ZA_5$
SVNN-EDAS technique [28]	$ZA_4 \succ ZA_2 \succ ZA_1 \succ ZA_3 \succ ZA_5$
SVNN-TOPSIS technique [29]	$ZA_4 \succ ZA_2 \succ ZA_1 \succ ZA_3 \succ ZA_5$
SVNN-TODIM technique [30]	$ZA_4 \succ ZA_2 \succ ZA_1 \succ ZA_3 \succ ZA_5$
The SVNN-Com-LogTODIM technique	$ZA_4 \succ ZA_2 \succ ZA_1 \succ ZA_3 \succ ZA_5$

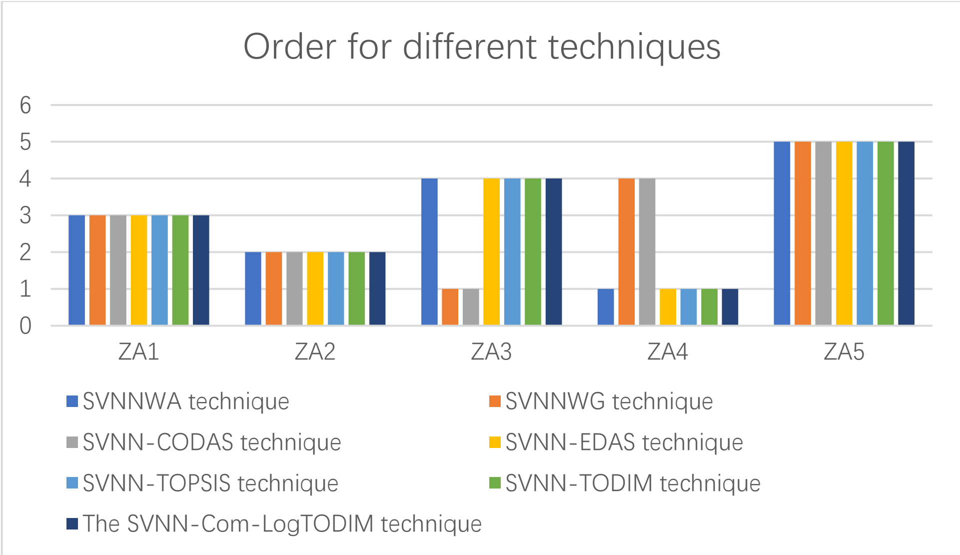

Figure 1. Order for different techniques

From detailed analysis, it could be interpreted that order of these approaches is slightly different, however, these techniques have same optimal comprehensive university and worst comprehensive university. This interpreted the SVNN-Com-LogTODIM is effective.

5. Conclusion

The evaluation of public opinion management capabilities for public crises in universities plays a crucial role in helping institutions establish sound mechanisms for managing public sentiment and effectively responding to and mitigating the challenges posed by crises. This evaluation encourages universities to maintain transparency during emergencies and ensure that public opinion is guided in a positive direction, thereby reducing unnecessary social panic and negative consequences. Through a structured assessment system, universities can identify weaknesses in their crisis response, improve communication with society and the media, and engage in effective post-crisis reflection, ultimately enhancing their overall crisis management capabilities and ensuring campus harmony and stability. The public opinion management capability evaluation for public crises in universities is MAGDM. Currently, the LogTODIM technique was interpreted to put forward the MAGDM. The SVNSs are interpreted as decision tool for characterizing fuzzy data during the public opinion management capability evaluation for public crises in universities. In this study, the SVNN-Com-LogTODIM approach is interpreted to solve the MAGDM under SVNSs. Conclusively, numerical study for public opinion management capability evaluation for public crises in universities is interpreted to validate the SVNN-Com-LogTODIM approach through comparative analysis.

There are some potential research limitations for public opinion management capability evaluation for public crises in universities. These limitations could be addressed through further studies aimed at assessing the impact of public opinion management capability evaluation for public crises in universities.

(1) Strengthening Empirical Validation and Model Optimization. Future research should further combine real-world cases of university crisis management to conduct empirical validation of the SVNN-Com-LogTODIM model. By collecting public opinion data from actual applications, the model's performance under different crisis scenarios can be tested, and its applicability in complex environments can be verified. At the same time, based on feedback from real data, the model's parameter settings and weight allocation can be optimized to enhance its robustness and flexibility in various crisis contexts.

(2)Incorporating Dynamic Public Opinion Monitoring and Real-Time Feedback Mechanisms. To better handle the dynamic nature of public opinion, future studies should consider integrating real-time public opinion monitoring with the decision-making process of the model. By leveraging big data analysis and artificial intelligence technologies, real-time data from social media, news, and other sources can be collected, allowing dynamic adjustments to the SVNN-Com-LogTODIM model's parameters. This dynamic feedback mechanism could improve the model's responsiveness and decision accuracy in handling sudden public crises.

(3) Integration and Expansion of Multiple Decision-Making Methods. Further research could explore combining the SVNN-Com-LogTODIM method with other multi-attribute decision-making approaches (such as AHP and TOPSIS) to construct a more comprehensive decision support framework. By integrating the strengths of different methods, a multidimensional and multi-layered evaluation system can be established, enabling a more thorough analysis and response to complex public opinion crises, thereby enhancing the comprehensiveness and precision of decision-making. Additionally, the introduction of emerging technologies such as sentiment analysis could further enrich the model's ability to handle subjective factors.

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