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An Analysis of numerical methods for multi-attribute group decision making

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Abstract

Settling Multiple Attribute Group Decision Making (MAGDM) issues has become one of the main exploration projects in the new patterns. The data or information is as Intuitionistic Triangular Fuzzy Number (ITrFN). The loads are gotten from the mathematical arrangements of fractional differential equations of Laplace's equation and poisson's equation. The loads got from the strategies are applied in decision making issues. The Intuitionistic Triangular Fuzzy Arranged Weighted Averaging (ITrFOWA) administrator and the Intuitionistic Triangular Fuzzy Crossover Conglomeration (ITrFHA) administrator are utilized to join the decision framework. Distance capability is utilized as an instrument for positioning the best other options. Mathematical delineation is proposed to show the adequacy of the technique.

Keywords: Multi Attribute Group Decision Making (MAGDM), Laplace’s Equation, Poisson’s Equation, Intuitionistic Triangular Fuzzy Number (ITrFN)

Introduction

In Intuitionistic Fuzzy sets, Triangular Intuitionistic Fuzzy sets is an exceptional case with two portrayals in particular the Triangular Fuzzy Portrayal and the Intuitionistic Fuzzy Portrayal. In Fuzzy set hypothesis Atanassov.K has presented the idea of Intuitionistic Fuzzy sets and Administrators over span esteemed intuitionistic fuzzy sets. Chen, Y., and Li, B. given a few new strategies to Multiple Attribute Group Decision Making Issues with Triangular Intuitionistic Fuzzy data, attribute values as Triangular Intuitionistic Fuzzy number. Here the data about the attribute loads is gotten from the Mathematical arrangement of Incomplete Differential Equation. Balagurusamy.E and Arumugam.S and Thangapandi.A. has tackled different Mathematical Techniques with Use of PC. The Mathematical Outline is used from Shouzhen and Zeng et.al, (2016) and it is utilized in Multiple Attribute Decision Making Issues. Li, D.F. has fostered the multi attribute decision making models and techniques utilizing intuitionistic fuzzy sets. Chen, Z., et, al. proposed in fuzzy phonetic term set for multiple rules group decision making models. Li, D. F. acquainted with find the new strategy to positioning the triangular Intuitionistic Fuzzy numbers to MAGDM Issues.

Collection administrators to be perceived as another course of consolidating numerous Mathematical qualities in to a solitary worth. These collecting administrators are utilized in the field of Arithmetic, Material science,

Multiple attribute decision making (MADM) is a significant piece of present day decision science. It has been widely applied to different regions like society, financial matters and the executives, military and designing innovation. For instance, project assessment, monetary assessment, speculation decision-making, and so on. Since the article things are fuzzy, vulnerability and human reasoning is vague, most of multi-attribute decision-making issues are dubious and equivocal, which are called fuzzy multiple attribute decision-making (FMADM). Since Bellman and Zadeh at first proposed the fuzzy decision-making model in light of the fuzzy hypothesis, FMADM has been getting an ever-increasing number of considerations from scientists. Numerous accomplishments have been made in research on FMADM issues in light of the different attribute values, for example, stretch numbers, triangular fuzzy numbers, trapezoidal fuzzy numbers and so on.

MAGDM is perhaps of the most widely recognized movement in present day culture, which includes choosing the ideal one from a limited arrangement of options as for an assortment of the predefined rules by a group of specialists with a high aggregate information level on these specific measures. The fact that experts could give makes right when a group of specialists needs to pick an answer from among a few other options, inclination relations one kind of evaluation. Inclination relations are examinations between two choices for a specific attribute. A higher inclination connection intends that there is a more significant level of inclination for one option over another.

Nonetheless, various specialists might utilize different appraisal types to communicate the inclination connection. Conceivable in group decision making various specialists express their inclination in various organizations.

Multiple Attribute Group Decision Making Methodology

Assessment and Transformation of Preference Relations

There are two sorts of inclination relations that are generally utilized. One is fuzzy inclination relations, in which rij means the inclination degree or force of the other option i over j [32-35]. In the event that rij = 0.5, it implies that other options i and j are apathetic; if rij = 1, it implies that other option i is totally liked to j, and if rij > 0.5, it implies that other option i is liked to j. rij is correspondingly added substance; that is, $rij + rji = 1$ and $rii = 0.5$.

The other broadly utilized sort of inclination relations is multiplicative inclination relations, in which aij shows a proportion of inclination power for elective i to that of option j; that is, it is deciphered as implying that other option i is aij times on par with elective j [17]. Saaty [3] recommended estimating aij on a number scale going from 1 to 9. On the off chance that aij = 1, it implies that other options i and j are uninterested; if aij = 9, it implies that other option i is totally liked to j, and if $8 \geq rij \geq 2$, it implies that other option i is liked to j. Moreover, $aij \times aji = 1$, and $aij = aik \times akj$.

Assessment Aggregation for a Heterogeneous Group of Experts

For every correlation between a couple of options, the inclination relations given by various specialists would shift. Hsu and Chen proposed a way to deal with total fuzzy conclusions for a heterogeneous group of specialists. Then, at that point, Chen altered the methodology and Ölçer and Odabaşi present it as the accompanying six-step system.

(1) Calculate the Degree of Agreement between Each Pair of Experts. For a comparison between two alternatives, let there be E experts in the decision group, (a_1, a_2, a_3, a_4) and (b_1, b_2, b_3, b_4) are the preference relations provided by experts a and b, $1 \leq a \leq E$, $1 \leq b \leq E$, and $a \neq b$. The similarity between these two trapezoidal fuzzy numbers, S_{ab}, can be measured by

$$S_{ab} = 1 - \frac{|a_1 - b_1| + |a_2 - b_2| + |a_3 - b_3| + |a_4 - b_4|}{4}. \quad (7)$$

(2) Construct the Agreement Matrix. After all the agreement degrees between experts are measured, the agreement matrix (AM) can be constructed as follows:

$$\mathrm{AM} = \begin{bmatrix} 1 & S_{12} & \cdots & S_{1E} \\ S_{21} & 1 & \cdots & S_{2E} \\ \vdots & \vdots & S_{ab} & \vdots \\ S_{E1} & S_{E2} & \cdots & 1 \end{bmatrix}, \quad (8)$$

in which $S_{ab} = S_{ba}$, and if $a = b$, then $S_{ab} = 1$.

(3) Calculate the Average Degree of Agreement for Each Expert. The average degree of agreement for expert a (AA_a) can be calculated by

$$\mathrm{AA}_a = \frac{1}{E-1} \sum_{b=1, a \neq b}^{E} S_{ab}, \quad \forall a. \tag{9}$$

(4) Calculate the Relative Degree of Agreement for Each Expert. After calculating the average degree of agreement for all experts, the relative degree of agreement for expert a (RA_a) can be calculated by

$$\mathrm{RA}_a = \frac{\mathrm{AA}_a}{\sum_{a=1}^{E} \mathrm{AA}_a}, \quad \forall a. \tag{10}$$

(5) Calculate the Coefficient for the Degree of Consensus for Each Expert. Let ew_a be the weight of expert a, and $\sum_{a=1}^{E} \mathrm{ew}_a = 1$. The coefficient of the degree of consensus for expert a (CC_a) can be calculated by

$$\mathrm{CC}_a = \beta \cdot \mathrm{ew}_a + (1-\beta) \cdot \mathrm{RA}_a, \quad \forall a, \tag{11}$$

in which β is a relaxation factor of the proposed method and $0 \leq \beta \leq 1$. It represents the importance of ew_a over RA_a. When $\beta = 0$, it means that the group of experts is considered to be homogeneous.

(6) Calculate the Aggregation Result. Finally, the aggregation result of the comparison between two alternatives i and j is $\tilde{r}_{ij}$, where

$$\begin{aligned} \tilde{r}_{ij} = \mathrm{CC}_1 \otimes \tilde{r}_{ij}(1) \oplus \mathrm{CC}_2 \otimes \tilde{r}_{ij}(2) \oplus \cdots \oplus \mathrm{CC}_a \\ \otimes \tilde{r}_{ij}(a) \oplus \cdots \oplus \mathrm{CC}_E \otimes \tilde{r}_{ij}(E). \end{aligned} \tag{12}$$

Conclusion

This paper proposes a system for tackling multiple attribute group decision making issues. In the proposed system, the change of evaluation type, the property of consistency, the heterogeneity of a group of specialists, the assurance of weight, and scoring of choices are totally thought of. It would be a valuable device for decision creators in various enterprises. A survey of the writing connected with this examination proposes that no past exploration has tended to every one of the issues at the same time. The proposed method has a few significant properties as follows.

- Specialists can give their inclination relations in different organizations, which can then be changed into a standard kind.
- Since all inclination connection types are changed into fuzzy inclinations, and specialists just give inclination relations among choices and , it is feasible to develop inclination relations frameworks that fulfill the property of added substance consistency.
- Specialists who are profoundly dissimilar from the group mean will have their loads diminished.

- The loads of each attribute rely upon the level of variety; the higher the variety of the attribute, the higher its weight.
- Decision creators can choose reasonable MADM techniques, like SAW, GRA, or TOPSIS, for the last positioning step.

In the proposed method every one of the means are embraced in light of perceptions made in the connected writing and are perceived by supervisors who are not specialists in fuzzy hypothesis, group decision making, MADM, or comparative issues. A mathematical model was portrayed to outline the proposed method. It was exhibited that the proposed strategy is basic and powerful and can be effectively applied to other comparable viable issues.

Reference

1. H. M. Hsu and C. T. Chen, "Aggregation of fuzzy opinions under group decision-making," *Fuzzy Sets and Systems*, vol. 79, no. 3, pp. 279–285, 1996.
2. S. M. Chen, "Aggregating fuzzy opinions in the group decision-making environment," *Cybernetics and Systems*, vol. 29, no. 4, pp. 363–376, 1998.
3. S. A. Orlovsky, "Decision-making with a fuzzy preference relation," *Fuzzy Sets and Systems*, vol. 1, no. 3, pp. 155–167, 1978.
4. L. Kitainik, *Fuzzy Decision Procedures with Binary Relations: Towards a Unified Theory*, vol. 13, Kluwer Academic Publishers, Dordrecht, The Netherlands, 1993.
5. J. Kacprzyk, "Group decision making with a fuzzy linguistic majority," *Fuzzy Sets and Systems*, vol. 18, no. 2, pp. 105–118, 1986.
6. S. Cebi and C. Kahraman, "Developing a group decision support system based on fuzzy information axiom," *Knowledge-Based Systems*, vol. 23, no. 1, pp. 3–16, 2010.
7. Z. Zhang and X. Chu, "Fuzzy group decision-making for multi-format and multi-granularity linguistic judgments in quality function deployment," *Expert Systems with Applications*, vol. 36, no. 5, pp. 9150–9158, 2009.
8. J. Lu, Y. Zhu, X. Zeng, L. Koehl, J. Ma, and G. Zhang, "A linguistic multi-criteria group decision support system for fabric hand evaluation," *Fuzzy Optimization and Decision Making*, vol. 8, no. 4, pp. 395–413, 2009.
9. S. J. Chuu, "Group decision-making model using fuzzy multiple attributes analysis for the evaluation of advanced manufacturing technology," *Fuzzy Sets and Systems*, vol. 160, no. 5, pp. 586–602, 2009.

10. F. E. Boran, S. Genç, M. Kurt, and D. Akay, "A multi-criteria intuitionistic fuzzy group decision making for supplier selection with TOPSIS method," *Expert Systems with Applications*, vol. 36, no. 8, pp. 11363–11368, 2009.
11. S. Bozóki, "Solution of the least squares method problem of pairwise comparison matrices," *Central European Journal of Operations Research (CEJOR)*, vol. 16, no. 4, pp. 345–358, 2008.
12. E. Herrera-Viedma, F. Herrera, F. Chiclana, and M. Luque, "Some issues on consistency of fuzzy preference relations," *European Journal of Operational Research*, vol. 154, no. 1, pp. 98–109, 2004.
13. Z.-P. Fan, J. Ma, Y.-P. Jiang, Y.-H. Sun, and L. Ma, "A goal programming approach to group decision making based on multiplicative preference relations and fuzzy preference relations," *European Journal of Operational Research*, vol. 174, no. 1, pp. 311–321, 2006.
14. E. Herrera-Viedma, F. Herrera, and F. Chiclana, "A consensus model for multiperson decision making with different preference structures," *IEEE Transactions on Systems, Man, and Cybernetics Part A:Systems and Humans.*, vol. 32, no. 3, pp. 394–402, 2002.
15. F. Chiclana, F. Herrera, and E. Herrera-Viedma, "Integrating three representation models in fuzzy multipurpose decision making based on fuzzy preference relations," *Fuzzy Sets and Systems*, vol. 97, no. 1, pp. 33–48, 1998.
16. F. J. Cabrerizo, I. J. Pérez, and E. Herrera-Viedma, "Managing the consensus in group decision making in an unbalanced fuzzy linguistic context with incomplete information," *Knowledge-Based Systems*, vol. 23, no. 2, pp. 169–181, 2010.
17. J. C. Lu, T. Yang, and C. Y. Wang, "A lean pull system design analysed by value stream mapping and multiple criteria decision-making method under demand uncertainty," *International Journal of Computer Integrated Manufacturing*, vol. 24, no. 3, pp. 211–228, 2011.
18. T. Yang, Y.-F. Wen, and F.-F. Wang, "Evaluation of robustness of supply chain information-sharing strategies using a hybrid Taguchi and multiple criteria decision-making method," *International Journal of Production Economics*, vol. 134, no. 2, pp. 458–466, 2011.
19. T. Yang and C. C. Hung, "Multiple-attribute decision making methods for plant layout design problem," *Robotics and Computer-Integrated Manufacturing*, vol. 23, no. 1, pp. 126–137, 2007.
20. D. Ju-Long, "Control problems of grey systems," *Systems & Control Letters*, vol. 1, no. 5, pp. 288–294, 1982.