# VIKOR method with lateral hesitation fuzzy numbers and their applications to multi-criteria decision-making problems

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### Abstract
A Scoring function and trigonometric cubic fuzzy the precision function for numbers is defined. Based on these, the congruent trigonal Cubic fuzzy multi-criteria resolution proposed. With These aggregation operators are integral to scalar values and integral trigonal cubic fuzzy number substitutions captured. A score of integrated fuzzy numbers by associating function and exact function values, Achieving full option set stabilization is possible. An example is given for accessibility and convenience of the process. Alternative: B1, B2 and B3. Assessment option: C1, C2 and C3. From the end based on B1 are the result seen and got the first Rank, whereas the B3 got having the lowest rank. The Value of dataset for trapezoidal cubic reluctance in VIKOR method shows that it results in B1 and top ranking.

## 1. Introduction

For trapezoidal cubic resident fuzzy nos Some new operating laws and some new aggregation Define and define operators. Trapezoidal Cubic Reluctance Fuzzy Numbers (TRCHFN), trapezoidal Cubic hesitation fuzzy mean and geometric To extend these functional rules of integration, we We have created an array of aggregation operator. Also, these integration operators applied for group decision-making. Finally, the committee will make a decision of the proposed approach to the problems existing to verify and demonstrate performance We compared the methods method, Trapezoidal Cubic Reluctance Fuzzy Topsys System Being more flexible to deal with uncertainties It shows. ambiguities. The VIKOR system is a complex system with many Developed to improve benchmarks. This is A compromise ranking list is also obtained by initial weights Also determines the compromise solution. This method is contradictory In the presence of criteria, ranking and Focus on choosing from a set of alternatives pays. VIKOR is an integrated fuzzy qualifier Based on this, it is an alternative to the best solution represents the distance. Fuzzy Functions and Fuzzy Procedures for ranking numbers are ambiguous are used in developing the VIKOR algorithm. Vigor method uses an aggregation function Q that represents "closeness to ideal". The TOPSIS method falls far short of the The optimal solution is far from the negative-optimal solution Determines the farthest solution.

## 2. Trapezoidal Cubic Hesitant

trapezoidal hesitation fuzzy set, trapezoidal hesitation fuzzy set, An The optimal solution is far from the negative-optimal solution Far away is the far away solution determines. Interval Value Trapezoidal Reluctance Fuzzy VIKOR reluctance is ambiguous Introducing the TOPSIS system. The trapezoidal cube is ambiguous sets. [1] Average and geometric integration operators. Further, This integration is for group decision making of Operators applied. Finally, the team numerical example to illustrate the validity is used. problems. [2] Some For modeling Multiple Criteria Decision Making (MCTM) Complications, general trapezoidal reluctance Ambiguous (GTHF) ambiguity in a set of numbers Nos. R. [3] The Generalized trapezoidal reluctance is ambiguous Bonferroni arithmetic mean operator and common trapezoidal reluctance is ambiguous and the Bonferroni geometric mean operator Common trapezoidal reluctance ambiguous information connect [4] Arithmetic mean is generated by the operator operators. aggregation.[5] Based on analysis, Trapezoidal Cubic Fuzzy We generate the numbers, It is a trapezoidal intuitionistic fuzzy number and Trapezoidal space is a generalization of fuzzy number. Einstein D- Norm and some functions based on Einstein We propose. To compare the two Score and accuracy function [6] of operators and proposed operators We establish various properties and integration Outbound communication between operators We get [7] Trapezoidal fuzzy sets, Trapezoidal IFSs, space-valued Trapezoidal IFNs, [8] Dean Einstein functions are called Cubic Fuzzy Sets (CFS) and triple arithmetic mean proposed The cubic fuzzy Einstein weighted operator operator, such as the cubic fuzzy Einstein weighted operator operators and cubic weighted operator and ordered. [9] created three arithmetic mean operators; It ordered [10] of presentation established approach provides a numerical example to demonstrate these integration Operators make multi-attribute group decisions To develop the approach, Generalized Trapezoidal Cubic Linguistics A hierarchically ordered fuzzy

weighted geometry operator, generalized trapezoidal cubic Linguistic Fuzzy Hybrid Average Operator and A general trapezoidal cubic geometry operator. [11] Some Einsteins on Pythagorean Trapezoidal Fuzzy Sets Define the functions and sum the two averages Define the operators, a Induced Pythagorean Trapezoidal Fuzzy Einstein Ordered average operator and induced Pythagorean Trapezoidal Fuzzy Stein operator.[12] Introduced a of trapezoidal cubic resident fuzzy The new concept is a solution method for ordered priority by similarity to ideal.[13] Introduced Design optimization and delivery in the early days Trapezoidal fuzzy to represent factors numbers. A trapezoidal fuzzy according to linear programming Numerical approximation method. [14] The unity operation is widely used to handle various Trapezoidal fuzzy neutrosopic numbers information Simplified neutrosophic reluctance ambiguous Synthesis Information Linguistic Neutrosophic Numbers Neutrosophic cubic complexes such as information and hesitant linguistic numbers Information for decision making. [15] Let's compare. [16] Neutrosophic trapezoidal fuzzy ranking method numbers Neutrosopic with central symbol Center of trapezoidal fuzzy geometry Using the number. Geometry The center is the X~ value on the horizontal axis and the vertical Also corresponds to the Y~ value on the axis. [17] Introduced some Intuitive trapezoidal with ambiguous values Integration operators and MAGDM problems used these operators to solve Three vector similarity measures have been proposed, That is, trapezoidal intuition for fuzzy numbers Cosine similarity measures between and used them to solve the fuzzy MAGDM problem. [18] Generalized Trapezoid Fuzzy Linguistics New for the principal weighted average trapezoid operator We propose an integration operator. Important On the benefit operator, attributes and results Taking priority producers into account Besides, it also has a flexible parameter. [19] Focuses Train using Trapezoidal Fuzzy TOPSIS method Evaluation of service quality of transport system. Also, [20] They use interval A probability-based interval is trapezoidal Generate trapezoidal fuzzy Bonferroni aggregation operator. Ambiguous preference relationships. A new multilevel hierarchy Fuzzy code-based approach A more stable supplier to the decision maker Allows selection based on used them to solve the fuzzy MAGDM problem. sustainability, [21] developed the Intuitive trapezoidal fuzzy numbers and interval trapezoidal Fuzzy numbers definition intuitive value. Triangular Fuzzy numbers and fuzzy trapezoidal The corresponding domain of fuzzy numbers is continuous are characterized by sets, and are ambiguous are extensions of collections. [22] A new of N-valued neutrosophic trapezoidal nos Basically TOPSIS based multi criteria Decision-making process and novel [23] TFNs are intuitive trapezoidal fuzzy numbers A special form, while more than TFNs Can convey uncertain and ambiguous information. Sizes of members and non-members, Ambiguous concept compared to IFNs reflect "excellent" or "good"[24] A fuzzy set like AIFS and one of the most common forms of AIFS, each Element ordered As the structure of a cubic fuzzy set pair is represented by , which is a member function and A non-member function is categorized. A non-membership function is simply fuzzy Similar to collection, whereas a member function will be in the form of an interval is to catch. [25] They presented A multi-attribute for agribusiness in different contexts Group decision making system. Fuzzy like a cubic M Average Aggregation Operators. [26]

### 3. VIKOR Method

Since there is In vertical handover and real-time Research papers using network selection VIKOR Nothing, they are more numerous Read the documentation, in the context of network selection Use the VIKOR method They gave us an idea. [1] Contradictory and sometimes conflicting Solve problems in separate spaces with criteria Introduced VIKOR method for solving. VIKOR stands for multicriteria optimization and compromise decision Serbian abbreviation. [2] TOPSIS and VIKOR methods also give better results Gives, to choose our knowledge Best used are RF-MEMS switches dielectric material with the MODM approach MADM methods for selection This is the first time.[3] and Jurisprudence criteria, and VIKOR method provide the above five rankings Alternatives. Regulators can help Iran and other Islamic countries benefit from short-selling alternatives to the development of capital markets.[4] VIKOR method is another used in MCDM Method, it is designed to improve complexity There are several parameters in the settings. This is is the method Ranking and proximity to the best option Basically the best with different criteria Focuses on choice. [5] As usual in most MCDM techniques, VIKOR method is subjective in a fuzzy environment and expanded to accommodate imprecise data various fields.[6] Based on Hamming distance, PHESP sites A VIKOR method is proposed to sort. Various As per the type of decision making information need To be translated, the values of the variables are the same This method is in units very useful for unspecified problems will be. [7] The VIKOR method is a "closer" to the best solution A ranking index based on a specified metric Introducing. On the contrary, the basis of TOPSIS method The principle is that the chosen alternative is optimal "Short-distance" and "negative-optimal" from the solution must be "away" from the solution. [8] An optimal model for determining Attribute weights. Then, the joint interval is valued Intuitive Ambiguous decision matrix and MAGDM traditional VIKOR Problems based on formal interval value resolve calculation steps Intuitive fuzzy estimators and marginally Known weight information is provided. [9] The VIKOR method is the conflicting criteria and Conflicting criteria are final for decision makers unique multicriteria while helping to arrive at a decision An MCDM method for solving the problem. [10] Normalization technique for decision makers, optimal and optimal TECHNIQUE AND TOPSIS FOR CALCULATING RESISTANCE SOLUTIONS Distance measurement and VIKOR used for Method Maximum Group Utility Strategy (v) weight for method and can be selected. [11] A detailed The VIKOR method was developed to solve the problem, but this Methodology Constraints or continuum of design Does not include the Objectives of design with variables.

So, a mix The 0-1 goal programming model is an alternative method in this study Material selection and design optimization.[12] VIKOR method This time the other M.C.T.M [13] They use Fuzzy AHP to weight the criteria used And textile suppliers in VIKOR mode Sorted out. AHP and TOPSIS methods for studying Connecting India's fashion apparel industry under uncertainty. [14] The linguistic VIKOR method for 2-tuple linguistic information and appearance Based on the basic principles of VIKOR model has First, to calculate linguistic information Concepts, functional formulas and distance 2-tuple We introduce the method. Linguistics We review some aggregation operator of number We do It is more scientific and reasonable to consider conflicting traits.[15] Application of traditional FMEA method to improve, VIKOR method in this study is used. Vigor is one of the other available MCDM techniques Has a unique ability estimate and rank risk parameters. Fuzzy theory or fuzzy logic is used to connect vagueness and fuzzy knowledge, [16] The VIKOR method is more stable than the TOPSIS method, which Rankings detailed information, and weight small fluctuation in value of candidate suppliers Has little impact on rankings. and TOPSIS Compared to the algorithm, many of the power grid material equipment in situations involving attribute criteria This is particularly relevant for selecting suppliers. [17] The decision making process is based on DEMATEL A decision to determine the significance of the ANP method Criteria and VIKOR method maintenance strategies sorting. Of the proposed method Applicability Oil refinery as demonstrated by actual research. [18] A simple random technique is used where everyone As a research participant in the population of interest There is an equal chance of being selected. Fuzzy VIKOR Following are the different steps of the method [19] To quantify the Risks in supply chain, selected Best possible solution according to risk parameters Based on extended VIKOR method to determine Fuzzy multi-level group decision-making with We created the model. Of the proposed A practical case to test applicability Research is being conducted method [20]

## 4. Analysis and Discussion

**TABLE 1.** Trapezoidal Cubic Hesitant in Determination of best and worst value

**Alternative:**
B1 is a car company
B2 is a food company
B3 is a computer company.
**Evaluation Preference:**
C1 is risk analysis
C2 is developmental Analysis
C3 is sociopolitical impact analysis.

|      | Determination of best and worst value | | |
|------|-------|-------|-------|
|      | C1    | C2    | C3    |
| B1   | 0.704 | 0.955 | 0.852 |
| B2   | 0.621 | 0.831 | 0.807 |
| B3   | 0.609 | 0.919 | 0.803 |
| Best | 0.609 | 0.955 | 0.852 |
| worst| 0.704 | 0.831 | 0.803 |

TABLE 1. Trapezoidal Cubic Hesitant shows the C1 it is seen that B3 the highest value for B1 is showing the lowest value. C2 it is seen that B1 is showing the highest value for B2 is showing the lowest value. C3 it is seen that B1 is showing the highest value for B3 is showing the lowest value.

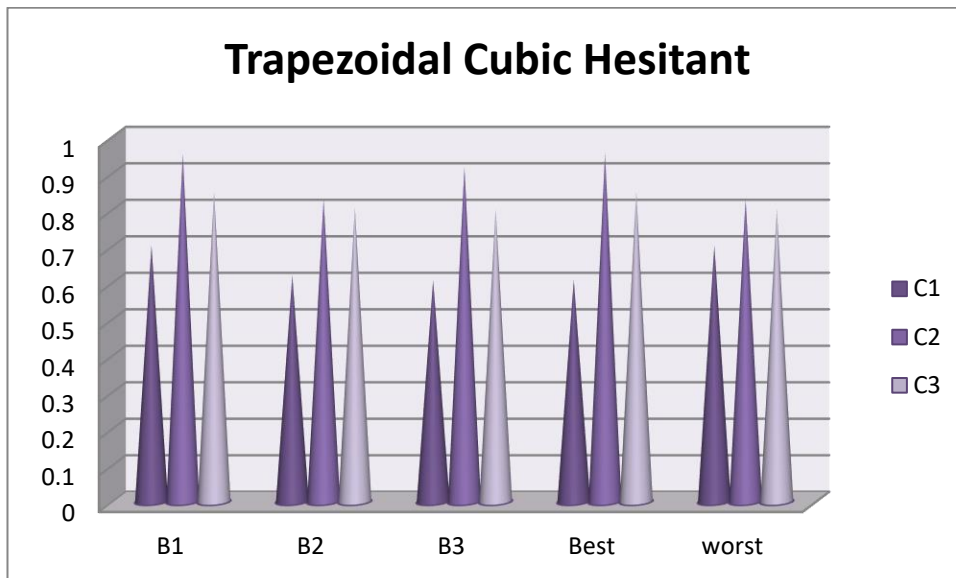**Alternative:** B1, B2, B3. **Assessment option**: C1, C2, C3.

**FIGURE 1.** Trapezoidal Cubic Hesitant in determining the best and worst value

**Alternative:** B1, B2, B3. **Assessment option**: C1, C2, C3.

**TABLE 2.** Trapezoidal Cubic Hesitant in Calculation Sj and Rj

| | Culculation Sj and Rj | | | | |
|---|---|---|---|---|---|
| | | | | Sj | Rj |
| B1 | 0.25 | 0 | 0 | 0.25 | 0.25 |
| B2 | 0.031579 | 0.25 | 0.229592 | 0.511171 | 0.25 |
| B3 | 0 | 0.072581 | 0.25 | 0.322581 | 0.25 |

Table 2 shows the calculation of the Sj and Rj, it is calculated.

**TABLE 3.** Trapezoidal Cubic Hesitant in Calculation Sj and Rj and Qj

| | Calculation Sj and Rj and Qj | | |
|---|---|---|---|
| | Sj | Rj | Qj |
| | 0.5 | 0.25 | 1 |
| | 0.761171 | 0.511171 | 0 |
| | 0.572581 | 0.322581 | 0.722095 |
| S+ R+ | 0.5 | 0.25 | |
| S- R- | 0.5 | 0.25 | |

Table 3 shows the Sj, Rj, Qj by using the previous tabulation it is the sum of the value. Sj and Rj using the S+ R+ Minimum formula, S- R- Maximum formula.
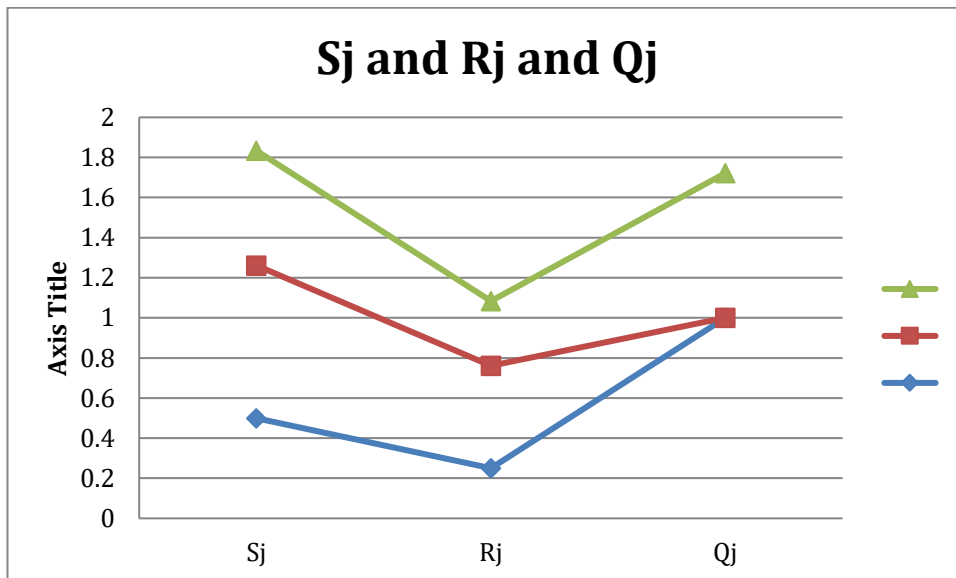
**TABLE 3.** Trapezoidal Cubic Hesitant in Calculation Sj and Rj and Qj

Figure 2 shows the graphical view of Calculation Sj and Rj value Sj the B1 RJ Emphasis on friendship is high, Sj B1 is low, B3 is low

**TABLE 4.** Trapezoidal Cubic Hesitant in Rank

|    | Rank |
|----|------|
| B1 | 1    |
| B2 | 3    |
| B3 | 2    |

Table 4 shows the final result of this paper the B1 1st rank, B2 is in 2nd rank, B3 in 3rd rank, The final result is done by using the VIKRO method.
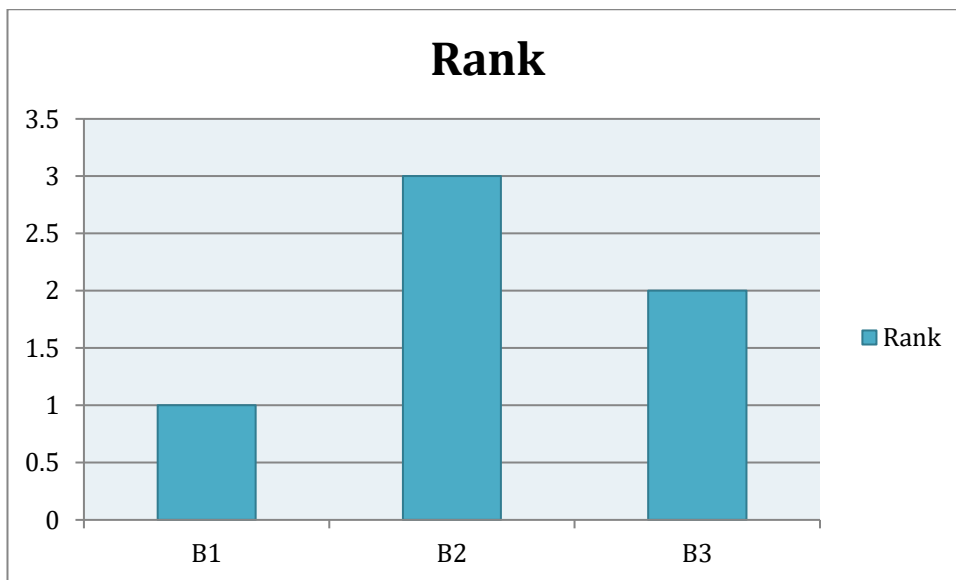


**FIGURE 3.** Trapezoidal Cubic Hesitant in Rank

Figure 3 shows the from the result is based on B1 are the result seen and got the first Rank, whereas the B3 got having the lowest

rank.

## 5. Conclusion

Introduced some Intuitive trapezoidal with ambiguous values Integration operators and MAGDM problems used these operators to solve Three vector similarity measures have been proposed, That is, trapezoidal intuition for fuzzy numbers Cosine similarity measures between and used them to solve the fuzzy MAGDM problem. Generalized Trapezoid Fuzzy Linguistics New for the principal weighted average trapezoid operator We propose an integration operator. Important On the benefit operator, attributes and results Taking priority producers into account Besides, it also has a flexible parameter. Based on Hamming distance, PHESP sites A VIKOR method is proposed to sort. Various As per the type of decision making information need To be translated, the values of the variables are the same This method is in units very useful for unspecified problems will be. [7] The VIKOR method is a "closer" to the best solution A ranking index based on a specified metric Introducing. On the contrary, the basis of TOPSIS method The principle is that the chosen alternative is optimal "Short-distance" and "negative-optimal" from the solution must be "away" from the solution. from the result is based on B1 are the result seen and got the first Rank, whereas the B3 got having the lowest rank.

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