

SELECTION OF CAR USING FUZZY AHP AND FUZZY TOPSIS METHOD BY MCDM APPROACH

Banoth Nikhil Kumar

Mechanical Engineer, B.tech, NIT Kurukshetra

Abstract - With the automotive industry offering diverse vehicles to cater to various needs, selecting the ideal car becomes challenging. The study highlights the rising significance of cars as a necessity, exemplified by India's car ownership rate. The paper employs a Multi-Criteria Decision-Making (MCDM) approach, focusing on cost, safety, comfort, and performance, with 14 sub-criteria, for a comprehensive evaluation structure.

The research employs Fuzzy AHP and Fuzzy TOPSIS methods to handle the uncertainties inherent in decision-making processes. These techniques integrate fuzzy set theory to realistically capture real-world complexities. The goal is to systematically evaluate and choose cars based on individual preferences and priorities. The findings reveal that Alternative A (SWIFT) is the optimal choice among evaluated options like BALENO, NEXON, and HARRIER. Both consumer preferences and expert opinions align in favor of SWIFT. The Fuzzy Analytical Hierarchy Process (FAHP) confirms SWIFT's excellence across criteria.

Additionally, the Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (FTOPSIS) solidifies this conclusion. FTOPSIS demonstrates SWIFT's minimal deviation from the positive ideal solution and significant separation from the negative ideal solution. Calculated CCI values rank SWIFT as the top choice, followed by BALENO, NEXON, and HARRIER. The paper's significance lies in providing potential car buyers with an informed decision-making framework to navigate the overwhelming car market. By combining fuzzy sets with established MCDM methods, the research enhances decision-making accuracy. The study contributes to MCDM knowledge and practical car selection insights, benefiting both consumers and the industry. Ultimately, the study reinforces SWIFT's superiority across cost, safety, comfort, and performance domains, demonstrating the effectiveness of the MCDM approach in complex decision scenarios.

Key Words: Fuzzy AHP, Fuzzy TOPSIS, MCDM etc.

1. INTRODUCTION

Cars serve as vital transportation tools for work, school, and more. With 22 cars per 1000 people in India, automobiles have become a necessity, driven by the industry's focus on broader accessibility. This shift has led to a diverse range of car designs and features catering to various economic segments. While cost is a pivotal factor, choosing a car involves weighing multiple considerations: fuel efficiency, safety features, reliability, and maintenance costs. The digital era has brought online platforms for car buying, like Car Wale, Car DEKHO, and more, offering information on features and costs. Given the diverse preferences of customers, car manufacturers have

introduced an array of features, including hybrid and electric technologies. This vast variety of options has made car selection intricate. Thus, the study employs a Multi-Criteria Decision-Making (MCDM) approach to comprehensively evaluate factors such as cost, safety, comfort, and performance.

The research paper focuses on four main criteria and 14 sub-criteria, making it a comprehensive MCDM problem. It utilizes Fuzzy AHP and FTOPSIS methods to address uncertainties in decision-making. Fuzzy sets offer a more realistic representation of complex real-world situations.

By embracing the intricacies of car selection, the study enhances decision-making accuracy. The Fuzzy AHP method aids in weighing criteria, while FTOPSIS reinforces the decision by ranking alternatives based on their closeness to ideal solutions.

In conclusion, the research provides a systematic approach to tackle car selection complexities. It showcases the value of employing MCDM techniques, integrating fuzzy sets, to navigate intricate choices and align them with individual preferences.

2. LITERATURE REVIEW

The analysis encompasses several notable studies that shed light on the effectiveness of MCDM in making informed decisions.

In the context of car selection, the work of Chaubey stands out as an example where TOPSIS was employed to assist middle-class families in choosing suitable cars. Similarly, Ulkhaq et al. undertook a comparative study of two car models using Analytic Hierarchy Process (AHP) and TOPSIS methods to establish a preference between them. Apak et al.'s investigation delved into consumer luxury car preferences through AHP, revealing critical factors like flexibility and brand image.

Furthering the discourse, Sarkar et al. exhibited the potential of Fuzzy FTOPSIS for family car selection, while Zulqarnain et al. illustrated TOPSIS application in car evaluation. In a different vein, Nguyen's research addressed the influence of various factors on car selection via MCDM, and Ali et al. employed Full Consistency Fuzzy TOPSIS for car ranking.

Expanding beyond the automotive sector, Panchal et al. navigated sustainable oil selection using a combination of fuzzy AHP, FTOPSIS, and fuzzy evaluation based on distance from average solution (FEDAS) methods. Guler et al. innovatively merged GIS techniques and MCDM to identify suitable electric vehicle charging station locations. Issa et al. developed an approach merging AHP and fuzzy TOPSIS for selecting optimal deep excavation supporting systems in construction projects.

Further studies also delve into various areas: Ghaleb et al. analyzed manufacturing process selection using TOPSIS,

Ramya et al. utilized GIS and MCDM for agro-based industry location assessment, Stevic et al. examined SAW and TOPSIS for cultural heritage site attractiveness evaluation, and other researchers explored MCDM techniques across diverse domains.

2.1 RESEARCH GAP AND HIGHLIGHTS

The evolution of decision models for car selection has advanced, yet certain avenues remain unexplored. While existing studies often focus on specific aspects of car selection in localized contexts, a comprehensive Multi-Criteria Decision-Making (MCDM) approach that integrates various factors is lacking. Moreover, few studies have harnessed fuzzy set theory and MCDM techniques to manage uncertainties in this context. This research gap highlights the need for a holistic investigation that systematically evaluates car options while addressing uncertainties.

Highlights:

1. **Localized Car Selection Studies:** Prior research by Chaubey (2020) and Ulkhaq et al. (2018) has concentrated on specific car selection scenarios, omitting the diverse considerations faced by individuals. These studies offer insights but fall short of encompassing the breadth of car selection factors.
2. **Luxury Car Preferences:** Apak et al. (2012) explore luxury car preferences, emphasizing brand image and flexibility. This emphasis on non-functional aspects warrants further exploration within a broader car selection context.
3. **Fuzzy Set Theory in Car Selection:** Sarkar et al. (2020) and Zulqarnain et al. (2020) apply fuzzy set theory to car selection, addressing imprecision in decision-making. Integrating these approaches within a comprehensive MCDM framework for car selection presents a unique opportunity.
4. **Multi-Criteria Decision-Making for Car Selection:** Nguyen (2021) and Ali et al. (2020) exemplify MCDM for car selection, highlighting criteria like price and safety. However, these studies often narrow their focus to specific geographical regions, necessitating a broader scope to capture a wider array of preferences and contexts.
5. **Application beyond Car Selection:** Researchers like Panchal et al. (2021), Guler et al. (2020), Issa et al. (2022), Ghaleb et al. (2020), Ramya et al. (2019), and Stevic et al. (2019) demonstrate MCDM's applicability in diverse domains. These applications underscore the versatility of MCDM techniques and their potential in addressing intricate decision challenges.

Given the identified research gap and these highlights, this study aims to contribute a comprehensive, context-independent approach to car selection. It integrates MCDM techniques, fuzzy set theory, and a holistic criterion assessment. This approach empowers decision-makers with a wider range of considerations while accommodating uncertainties intrinsic to the decision-making process.

3. TOOLS AND TECHNIQUES

To address the research goals, this study introduces a comprehensive solution approach that combines Fuzzy Analytic Hierarchy Process (FAHP) and Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS). These methods enable systematic evaluation of car alternatives, integrating expert insights, criterion importance, and objective assessment.

3.1 Initial Phase:

The first phase entails an in-depth literature review and expert consultations to establish criteria, sub-criteria, and alternatives. This groundwork forms the foundation for subsequent phases of the integrated decision framework

3.2 Fuzzy Analytic Hierarchy Process (AHP):

The second phase employs the Fuzzy Analytic Hierarchy Process (FAHP), an extension of AHP introduced by SAATY in 1980. AHP structures decision-making hierarchically, starting with the overarching goal and breaking down to criteria, sub-criteria, and alternatives. A hierarchy based on predetermined criteria is created. Experts' subjective inputs, gathered through interviews or questionnaires, generate pair-wise comparison matrices. These matrices determine the relative importance of criteria and sub-criteria.

The Fuzzy Analytic Hierarchy Process (FAHP) redefines decision-making by tackling uncertainties head-on. It embraces the inherent fuzziness and imprecision in real-world decisions, surpassing rigid frameworks. With linguistic variables, FAHP captures qualitative nuances, shattering one-dimensional evaluations. In complex decision landscapes, FAHP empowers decision-makers to consider multiple perspectives, yielding comprehensive assessments. Amid ambiguity, FAHP stands as a steadfast guide, enabling informed choices and robust decisions even in intricate scenarios.

Steps for the fuzzy AHP are as follows: -

STEP 1: Draw the hierarchical chart.

STEP 2: Define fuzzy numbers for performing the pair-wise comparisons.

STEP 3: Create the pair-wise comparison matrix using fuzzy numbers.

$$A = \begin{bmatrix} 1 & a_{21} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & 1 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & a_{21} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & 1 \end{bmatrix}$$

STEP 4: Calculate S_i for each row of the pair-wise comparison matrix.

S_i can be calculated using the following formula:

$$S_i = \sum_{j=1}^m M_{gi}^j * \left[\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j \right]^{-1}$$

Where i represents the row number and j denotes the column number. In the formula, M_{gi}^j is triangular fuzzy numbers of pair-wise comparison matrix. In the above formula.

$$\sum_{j=1}^m M_{gi}^j = \left(\sum_{j=1}^m l_j \quad \sum_{j=1}^m m_j \quad \sum_{j=1}^m u_j \right)$$

$$\left[\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^n u_i} \quad \frac{1}{\sum_{i=1}^n m_i} \quad \frac{1}{\sum_{i=1}^n l_i} \right)$$

In the above formulas, u_i , m_i , and l_i are the first, second, and third components of the fuzzy numbers, respectively.

STEP 5: Compute the magnitude of S_i with respect to each other.

In general, if $M_1 = (l_1, m_1, u_1)$ and $M_2 = (l_2, m_2, u_2)$ are two triangular fuzzy numbers, then, the magnitude of M_1 with respect to M_2 can be defined as follows:

$$V(M_2 \geq M_1) = HGT(M_1 \cap M_2) = \mu_{M_2}(d) = \begin{cases} 1 & \text{if } m_2 \geq m_1 \\ 0 & \text{if } l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & \text{otherwise} \end{cases}$$

On the other hand, the magnitude of a triangular fuzzy number from k as another triangular fuzzy number can be obtained by the following formula:

$$V(M \geq M_1, M_2, \dots, M_k) = V[(M \geq M_1) \text{ and } (M \geq M_2) \text{ and } \dots \text{ and } (M \geq M_{1k})] \\ = \min V(M \geq M_i) \quad i = 1, 2, 3, \dots, k$$

STEP 6: Compute the weight of the criteria and alternatives in the pair-wise comparison matrix.

The following formula can be used for this purpose:

$$d'(A_i) = \min V(S_i \geq S_k) \quad k = 1, 2, 3, \dots, n, \quad k \neq i$$

Therefore, the non-normalized weight vector can be given as follows:

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n))^T \quad A_i (i = 1, 2, \dots, n)$$

STEP 7: Calculate the final weight vector.

To calculate the final weight vector, the calculated weight vector in the previous step should be normalized, then:

$$W = (d(A_1), d(A_2) \dots d(A_n))^T$$

3.3 Fuzzy TOPSIS: -

The third phase of the study utilizes the FTOPSIS method for ranking the alternatives. This phase involves Fuzzy-TOPSIS method, as the simplicity of its mathematical algorithm makes FTOPSIS method much easier in comparison to other methods, which will provide the ranking of the alternatives. Fuzzy TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) is a Multi-Criteria Decision Making (MCDM) method that incorporates fuzzy logic into the TOPSIS technique. TOPSIS is a widely used decision-making method that helps rank alternatives based on their similarity to ideal and negative ideal solutions. Fuzzy TOPSIS extends this approach to handle uncertainty and vagueness in decision-making problems where the criteria and alternatives may not have precise values. In fuzzy TOPSIS, the decision criteria and alternatives are described using fuzzy numbers instead of crisp values. Fuzzy numbers represent uncertainty by assigning a membership function to each value. These membership functions indicate the degree of membership of a value to a fuzzy set.

The Fuzzy TOPSIS method involves the following steps:

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STEP 1: Determine the decision criteria: Identify the factors or criteria that are relevant to the decision problem. For each criterion, specify the fuzzy numbers that represent the performance of each alternative.

STEP 2: Construct the combine decision matrix: Take the data from several different customers and construct matrices according to their data. Then construct the single matrix by using the given conditions.

$$x_{ij} = (a_{ij} \quad b_{ij} \quad c_{ij})$$

In which.,

$$a_{ij} = \min_k [a_{ij}^k],$$

$$b_{ij} = \frac{1}{k} \sum_{k=1}^3 b_{ij}^k,$$

$$c_{ij} = \max_k [c_{ij}^k]$$

STEP 3: Construct the fuzzy decision matrix: Create a matrix where the rows represent the alternatives, and the columns represent the normalized fuzzy values for each criterion.

$i = 1, 2, 3, \dots, m$; and $j = 1, 2, 3, \dots, n$;

$$r_{ij} = \left[\frac{a_{ij}}{c_j^+} \quad \frac{b_{ij}}{c_j^+} \quad \frac{c_{ij}}{c_j^+} \right]$$

$$c_j^+ = \max_i [c_{ij}] \text{ (Benefit criterion)}$$

$$r_{ij} = \left[\frac{a_j^-}{c_{ij}} \quad \frac{a_j^-}{b_{ij}} \quad \frac{a_j^-}{a_{ij}} \right]$$

$$a_j^- = \min_i [a_{ij}] \text{ (Cost criterion)}$$

$i = 1,2,3\dots m$; and $j = 1,2,3\dots n$;

r_{ij} are elements from decision matrix normalized(R).

x_{ij} are elements from decision matrix X.

STEP 4: Determine the weighted normalized decision matrix: Assign weights to the criteria based on their relative importance. Multiply the normalized values in the decision matrix by the corresponding weights to obtain the weighted normalized decision matrix.

$$v_{ij} = w_j r_{ij}$$

W_j are the weights that have been determined,

r_{ij} are elements from decision matrix normalized(R).

And v_{ij} are elements weighted normalized (v)

STEP 5: Calculate the fuzzy positive ideal solution (FPIS) and fuzzy negative ideal solution (FNIS): Determine the positive ideal and negative ideal solutions by aggregating the best and worst values for each criterion, respectively. This step involves calculating the fuzzy weighted sum of each criterion for all alternatives.

$$v_i^+ = \left\{ \begin{array}{l} \max_i \\ i \\ \min_i \\ i \end{array} \quad \begin{array}{l} v_{ij} \\ v_{ij} \end{array} \right\}$$

$$v_i^- = \left\{ \begin{array}{l} \min_i \\ i \\ \max_i \\ i \end{array} \quad \begin{array}{l} v_{ij} \\ v_{ij} \end{array} \right\}$$

Where:

v_i^+ = max. if i is the criterion of advantage (benefit)

v_i^+ = min. if i is the cost criterion (cost)

v_i^- = min. if i is criterion of advantage (benefit)

v_i^- = max. if i is criterion of (cost)

Then, determined the positive ideal solution (A^+) and negative (A^-)

$$A_j^+ = \max(v_1^+, v_2^+, \dots, v_n^+)$$

$$A_j^- = \min(v_1^-, v_2^-, \dots, v_n^-)$$

A^+ is the maximum value of each criterion.

A^- is the minimum value of each criterion.

STEP 6: Calculate the separation measures: Compute the distances between each alternative and the FPIS and FNIS to quantify their similarity to the ideal and negative ideal solutions. Various distance metrics can be used, such as Euclidean distance or cosine similarity.

$$D_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - A_j^+)^2}$$

$$D_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - A_j^-)^2}$$

D_i^+ is an ideal solution calculation of the distance from the positive (v_j^+) and the normalized weighted matrix elements (v_{ij}), and a calculation of the distance from the negative Ideal solution (v_j^-) and the normalized weighted matrix (v_{ij}).

STEP 7: Calculate the relative closeness to the ideal solution: Calculate the relative closeness for each alternative by dividing the distance to the FNIS by the sum of the distances to the FPIS and FNIS.

$$CC_i = \frac{D_i^-}{D_i^- + D_i^+}$$

CC_i is the preference value for each alternative of calculating the value of a positive distance (D_i^+) and negative distance value (D_i^-).

STEP 8: Rank the alternatives: Rank the alternatives based on their relative closeness values. The alternative with the highest relative closeness is considered the most favorable.

4. METHODOLOGY AND RESULTS

As represented by Fig 4.1 we have taken four car alternatives namely Baleno, Tata Nexon, Tata Harrier and Swift. For comparing these alternatives we have taken four criteria: cost, comfort, safety and performance and 14 sub-criteria were selected. Survey was conducted and opinions of experts were taken and converted to mathematical numerals with the help of Table given in Fig.4.2. Tables numbering 1 to 5 show numerals obtained. These numerals were kept in mathematical model and then weights are found i.e. local weights, global weights and finally global rank is found as shown by Table 6.

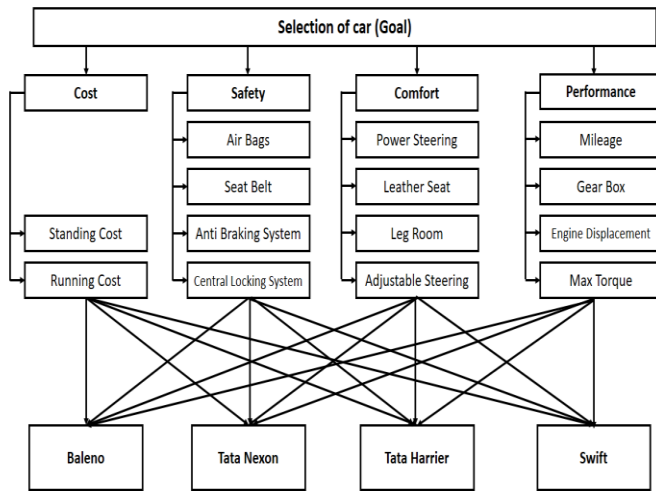


Fig 4.1 Hierarchical chart for selection of car problem

Fuzzy judgment	TFN scale
Approximately important	(1/2, 1, 2)
Approximately x time more important a	(x-1, x, x+1)
Approximately x time less important	(1/(x+1), 1/x, 1/(x-1))
Between y and z time more important b	(y, y+z/2, z)
Between Y and Z time less important	(1/z, 2/(y+z), 1/y)

Fig.4.2 Fuzzy Linguistic scale

GOAL	COST			SAFETY			COMFORT			PERFORMANCE		
COST	1/1	1/1	1/1	1/3	1/2	3/1	1/2	2/3	1/1	1/4	1/3	4/1
SAFETY	1/3	2/1	3/1	1/1	1/1	1/1	1/1	2/1	3/1	1/2	1/1	2/1
COMFORT	1/1	3/2	2/1	1/3	1/2	1/1	1/1	1/1	1/1	1/3	1/2	3/1
PERFORMANCE	1/4	3/1	4/1	1/2	1/1	2/1	1/3	2/1	3/1	1/1	1/1	1/1

Table 1: Fuzzy comparisons matrices at the first level

COST	STANDING COST			RUNNING COST		
STANDING COST	1/1	1/1	1/1	1/1	3/2	2/1
RUNNING COST	1/2	2/3	1/1	1/1	1/1	1/1

Table 2: Fuzzy comparisons for cost criteria w.r.t sub criteria

SAFETY	AIR BAGS			SEAT BELT			ABS			CLS		
AIR BAGS	1/1	1/1	1/1	1/2	1/1	2/1	1/4	1/3	4/1	2/1	3/1	4/1
SEAT BELT	1/2	1/1	2/1	1/1	1/1	1/1	1/1	2/1	3/1	2/1	3/1	4/1
ABS	1/4	3/1	4/1	1/3	1/2	1/1	1/1	1/1	1/1	1/1	2/1	3/1
CLS	1/4	1/3	1/2	1/4	1/3	1/2	1/3	1/2	1/1	1/1	1/1	1/1

Table 3: Fuzzy comparisons for safety criteria W.R.T sub-criteria

COMFORT	POWER STEERING			LEATHER SEAT			LEG ROOM			ADJUSTABLE STEERING		
POWER STEERING	1/1	1/1	1/1	1/2	1/1	2/1	1/1	2/1	3/1	1/2	1/1	2/1
LEATHER SEAT	1/2	1/1	2/1	1/1	1/1	1/1	1/2	1/1	2/1	2/1	3/1	4/1
LEG ROOM	1/3	1/2	1/1	2/1	1/1	1/2	1/1	1/1	1/1	1/1	2/1	3/1
ADJUSTABLE STEERING	1/2	1/1	2/1	1/2	1/3	1/2	1/3	1/2	1/1	1/1	1/1	1/1

Table 4: Fuzzy comparisons for safety criteria W.R.T sub-criteria

PERFORMANCE	MILEAGE			GEAR BOX			ENGINE DISPLACEMENT			MAX TORQUE		
MILEAGE	1/1	1/1	1/1	1/3	1/2	3/1	1/2	1/1	2/1	1/1	2/1	3/1
GEAR BOX	1/3	2/1	3/1	1/1	1/1	1/1	1/1	3/2	2/1	1/1	2/1	3/1
ENGINE DISPLACEMENT	1/2	1/1	2/1	1/2	2/3	1/1	1/1	1/1	1/1	1/1	2/1	3/1
MAX TORQUE	1/3	1/2	1/1	1/3	1/2	1/1	1/3	1/2	1/1	1/1	1/1	1/1

Table 5: Fuzzy comparisons for safety criteria W.R.T sub-criteria

CRITERIA	LOCAL WEIGHT	SUB CRITERIA	LOCAL WEIGHT	GLOBAL WEIGHT	GLOBAL RANK
COST	0.28194	STANDING COST	0.31579	0.08903	4
		RUNNING COST	0.68421	0.19290	1
SAFETY	0.23172	AIR BAGS	0.20550	0.04762	11
		SEAT BELT	0.13889	0.03218	14
		ABS	0.19859	0.04602	12
		CLS	0.45702	0.10590	2
COMFORT	0.26559	POWER STEERING	0.23117	0.06139	7
		LEATHER SEAT	0.18361	0.04876	10
		LEG ROOM	0.23226	0.06168	6
		ADJUSTABLE STEERING	0.35297	0.09374	3
PERFORMANCE	0.22075	MILEAGE	0.24164	0.05334	8
		GEAR BOX	0.18044	0.03983	13
		ENGINE DISPLACEMENT	0.23415	0.05169	9
		MAX TORQUE	0.34376	0.07589	5

Table 6: Local weight and Global weight of criteria and sub-criteria with Global ranking

Like this our Fuzzy AHP part ends and Fuzzy TOPSIS part starts Table 6 will be used again for final calculation purpose for making Normalized weightage Fuzzy Table. For the purpose of applying Fuzzy TOPSIS model we will again go to experts and ask the level of importance of each criteria and sub- criteria. Now to convert their opinions into mathematical numerals for model setup again we have linguistic conversion table 7.

Linguistic terms	Scale values (TFNs)
Extremely High (EH)	(6,7,8)
Very High (VH)	(5,6,7)
High (H)	(4,5,6)
Medium (M)	(3,4,5)
Low (L)	(2,3,4)
Very Low (VL)	(1,2,3)

Table 7: Linguistic terms for alternative ratings

This data converted from speech to numerals is kept in mathematical methods as given under Fuzzy TOPSIS. After processing data first we will get Combined Decision Matrix which will be converted to Normalized decision matrix which will be finally converted to Normalized weightage Fuzzy decision matrix. At this step the weights found by us using Fuzzy AHP are mixed with Fuzzy TOPSIS calculations and finally we get closeness coefficients and Final Ranking Matrix which will give us answer to our query that which car is best as per demands for customers and taken criteria and sub- criteria.

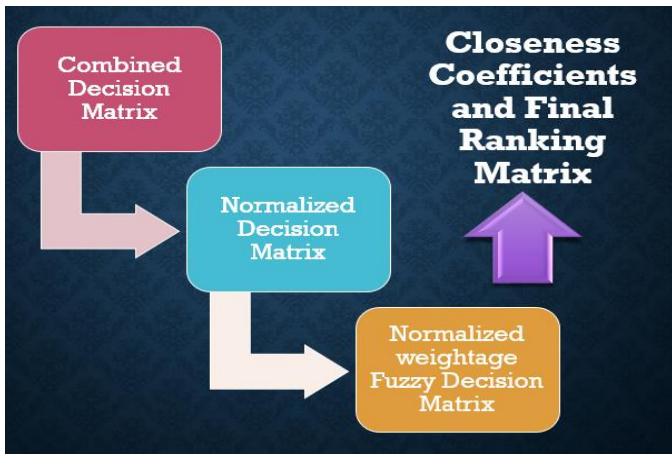


Fig.4.3 Process for getting final ranking matrix.

CAR	DI+	DI-	Cci	RANK
BALENO	0.121328	0.078046	0.391455	2
NEXON	0.125823	0.076028	0.376656	3
HARRIER	0.128866	0.0747	0.366956	4
SWIFT	0.060334	0.138994	0.697313	1

Table 8 : Closeness Coefficients and Final Ranking Matrix

Table 8 Contains final result of our Analysis as per it SWIFT car secured rank 1 as it is most suitable to choose on basis of criteria and sub- criteria taken by us and as per our calculations.

5. CONCLUSION

After employing the Multi-Criteria Decision Making (MCDM) method to evaluate the car selection criteria of cost, safety, comfort, and performance, the following results and conclusions have been derived Among the alternatives considered - Alternative A (SWIFT), Alternative B (BALENO), Alternative C (NEXON), and Alternative D (HARRIER) - it becomes evident that Alternative A (Swift) emerges as the optimal choice, a determination validated by both customer and expert preferences. The FAHP method facilitated a comprehensive assessment of the relative importance of the criteria, underscoring the prominence of Alternative A in terms of cost, safety, comfort, and performance. Moreover, the FTOPSIS method further solidified this conclusion, illustrating that Alternative A demonstrates the least divergence from the positive ideal solution and the most considerable separation from the negative ideal solution. Utilizing the FTOPSIS method, the car options have undergone a ranking process considering their respective closeness coefficient (CCi) values. The CCi values calculated for BALENO, NEXON, HARRIER and SWIFT are 0.391455, 0.376656, 0.366956, and 0.697313, respectively. Consequently, the sequence of cars based on this assessment is as follows: SWIFT > BALENO > NEXON > HARRIER. Hence, the SWIFT is ranked highest, followed by comfort, and commendable BALENO, NEXON, and HARRIER, indicating their relative

performance according to the FTOPSIS assessment. Alternative A (Swift) as the preferred selection, reflecting its strong attributes in terms of cost-effectiveness, safety standards, passenger performance.

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