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A Multi-Criteria Decision Making Method for Tourist Location Selection

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Abstract*: *In this paper, we consider the major recognized downside in the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) strategy, the rank reversal issue and propose a modification in the progress of ideal solutions calculation in the original algorithm of Hwang and Yoon in order to resolve the issue. The Rank reversal problems happen when rank orders of existing choices are anomalously reordered because of the addition or removal of an alternative in the choice space. Here the class of decision criterion has additionally been organized which may have a place to either cost or benefit group. A simplest representation of the modification has been done through some numerical illustrations to resolve the rank reversal issue. After a careful examination, the modified algorithm has been effectively applied in choosing an appropriate tourist location along with the result validation.

Index Terms*: *Ideal Solutions (PIS & NIS), MCDM, Rank Reversal.

I. INTRODUCTION

Decision-making is the process of analyzing different alternatives and choosing a final one based on the available data, decision maker's priority and belief. We are directly or indirectly involved with some kind of decision making process in our daily life. For many years, researchers pay a great attention towards the common decision-making process and analyses the methods to make them more refined and simpler. Problems involving more than one criterion to be evaluated against the available alternatives rise to the multi-criteria decision making (MCDM) process.

A number of MCDM methods exist to deal with the conflicting criterion including cost and benefit aspects. TOPSIS is an MCDM method of these, proposed by Hwang and Yoon in 1981. The method is based upon the logic of choosing an alternative which is measured in terms of the minimum geometric gap from the positive ideal solution (PIS) and the maximum gap from the negative ideal solution (NIS). The logic of the method is based on many advantages: (i) rational (ii) easy to understand (iii) simple (iv) a straightforward computation (v) applicable to both qualitative and quantitative data and many more. Ultimately a clear performance measure exists for all alternatives with respect to each attribute, which can be visualized through a sequence of ranks. However, the rank reversal issue is one of the major disadvantages in TOPSIS identified by various researchers where the existing alternatives' relative importance gets altered with the addition or removal of a new alternative to the decision problem. In many cases it leads to a complete rank reversal case which completely reverses the rank order of available alternatives to that of before. Even some cases, the best performed alternative becomes the worst after removal or inclusion of a new one in the decision making process. Hence, leads to an unacceptable situation for the decision makers. This paper presents a novel approach of modified TOPSIS to deal with the problem of rank reversal. A mathematical presentation of the modifications in the algorithm has been explained with the help of suitable numerical examples. Also the cost and benefit aspects of different criteria have been considered along with a tourist location selection application. The remaining paper has been organized as follows. Section 2 represents the background study. The TOPSIS framework has been explained in section 3. Section 4 and 5 contain the problem discussion and modifications in the TOPSIS method (using some solved examples) respectively. A suitable location for spending vacation has been chosen by the modified algorithm in section 6 and finally section 7 represents the conclusion.

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II. BACKGROUND STUDY

MCDM is the branch of operation research performs decision making in the presence of conflicting multiple criteria where every required criterion may be measured through different units of measurement and different preference level. The criteria sometimes represented and solved with numerical representation and sometimes these may be subjectively represented. In such problems, the decision making and ranking are done through a qualitative or quantitative assessment of the criterion data. Always a preference level for the criteria is maintained through a corresponding random weight assignment procedure.A number of MCDM methods available in the literature [1]-[2] for solving the practical multi-objective problems. TOPSIS is a method one of them, revised by Hwang and Yoon [1] as a replacement of ELimination Et Choix Traduisant la REalite (ELECTRE). The concept of the algorithm is based on calculating each alternatives distance from two tragic ideal solutions, leads to an ordered ranking and final decision making. Among the MCDM approaches the method has a wide range of applications.

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Dozens of researchers have solved many complex problems using TOPSIS in different areas. The method has been modified and extended for solving various kinds of exclusive problems. Hwang et al. [3] applied his TOPSIS algorithm in various MCDM applications. Chi et al. [4] proposed a knowledge-based group decision support system (GDSS) for site selection problem. The GDSS has applied TOPSIS for identifying a little subset of candidate locations out of the subsequent data repository. Behzadian et al. [5] expressed many ideas by indicating the broad view of the TOPSIS method with successful implementation and global popularity. In their representation they have collected 266 journal papers on TOPSIS and have represented them abstractly. A new glow-worm swarm optimization (GSO) algorithm has been presented by Jayakumar et al. [6] that generates the optimized result for a multi-objective functions in environmental economic dispatch (MOEED) problem. In their proposed model, TOPSIS has been employed as the MCDM ranking tool for a simultaneous optimization of all the objectives. For ensuring the feasibility of employing topic modelling for the assessment of competitive brands, Chen et al. [7] proposed a standalone methodology named 'Weights from Valid Posterior Probability (WVAP)' that ranks various products using TOPSIS for visualization of the market structure from different angles. Chen [8] modified the TOPSIS and extends it to a fuzzy-TOPSIS environment by rating the alternatives and weights of each criterion. He described the methodology in terms of linguistic values using triangular fuzzy numbers. Since then, the version of fuzzy TOPSIS method has been expanded to its territory and has been used in many fields. Maity and Chakraborty [9] announced TOPSIS as a perfect MCDM method, which is capable to lead a best decision making scenario in the presence of conflicting criterions and alternatives. Along with the broad applications of the method including so many of its advantages, certain flaws in it also exists. Amongst these, the major one to be discussed is the rank reversal issue of the method. For the first time Ren et al. [10] explored the problem of rank reversal in TOPSIS, where he developed a novel method called M-TOPSIS for avoiding it. Wang and Luo [11] shown that due to addition or removal of a new alternative the ranking orders get affected but they did not imposed any solution to it. Kong [12] tried to preserve the ranks in TOPSIS method by identifying the fundamental cause of the rank reversal problem and suggested improvements in it based on the decision maker's subjective preferences. Saaty and some authors have identified the same problem in the method of 'analytic hierarchy process (AHP)' and tried to solve it in a number of ways [13]-[18]. In this paper, we have applied a minimum correction in the TOPSIS method to deal with the recovery of rank reversal problem in it. A number of numerical illustrations are being used to verify the sustainability of the modification and finally the algorithm has been used to choose a best location for the visitors/ tourists with different types of criteria considering both cost and benefit aspects in it.

III. TOPSIS FRAMEWORK

MCDM, involves a set of alternatives need to be examined against all the required criteria. It helps the decision-maker to make an ultimate choice amongst the conflicting alternatives. Thus, the optimal solution is the compromised one based on decision-makers preferences. The method TOPSIS stands on the concept of evaluating each alternative from PIS and NIS and the final ranking is generated by means of the closeness coefficient value.

Algorithmic steps of TOPSIS are described as follows:

(i) [Formulate decision matrix D]: m number of alternatives and n number of criteria

$$D = \begin{bmatrix} x_{11} & x_{12} & & x_{1n} \\ x_{21} & x_{22} & & x_{2n} \\ & & & \\ x_{m1} & x_{m2} & & x_{mn} \end{bmatrix}$$

Where x_{ij} =performance measure of the alternatives with respect to the criterion.

(ii) [Normalized decision matrix DN]: An element $n_{ij} \in N$ (normalized decision matrix) is obtained as,

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^{2}}} \quad \textbf{(1)}$$

(iii) [Construction of the weighted normalized decision matrix W]: The associated weights w_n for the corresponding criterion are multiplied with the normalized values n_{ij}.

$$W = \begin{bmatrix} n_{11}w_1 & n_{12}w_2 & & n_{1N}w_N \\ n_{21}w_1 & n_{22}w_2 & & n_{2N}w_N \\ & & & \\ n_{M1}w_1 & n_{M2}w_2 & & n_{MN}w_N \end{bmatrix}$$

(iv) [Determine the ideal Solutions]:

The PIS,

$$p^{*} = \{(\max w_{ij} \mid j \varepsilon J), (\min w_{ij} \mid j \varepsilon j^{'})\} \quad (2)$$

The NIS,

$$p^{-} = \{(\min w_{ij} \mid j \varepsilon J), (\max w_{ij} \mid j \varepsilon j^{'})\} \quad (3)$$

Where $i= 1,2,3\ldots\ldots M$ and $j= 1,2,3\ldots\ldots N$

J: Benefit criteria

J': Cost criteria.

(v) [Calculation of the Separation Measure]: N-dimensional Euclidean distance used to measure distance of alternatives from both the hypothetical solutions.

$$P_{i*} = \left(\sum (w_{ij} - w_{j*})^{2}\right)^{1/2}, i = 1,2,3,4.......M \quad (4)$$

Where P_{i*} = Measured Euclidean distance of each alternative from PIS.

$$P_{i-} = \left(\sum (w_{ij} - w_{j-})^2\right)^{1/2}, i = 1,2,3,4.......M \qquad (5)$$

Where P_{i-} = Measured geometric distance of each alternative from NIS.

(vi) [Relative closeness to the Ideal Solution]: Relative closeness of the alternatives are measured through:

$$C_{i*} = P_{i-} / (P_{i*} + P_{i-}),\ 0 \le C_{i*} \le 1, i = 1,2,3,4,......M \qquad (6)$$

(vii) [Alternative ordering]: According to the closeness to the ideal solutions the alternatives are ranked and the best one is chosen.

should *not* be selected.

IV. RANK REVERSAL PROBLEM AND DISCUSSION

In this section we have examined and illustrated the problem of rank reversal through a number of considered numerical examples with addition, removal and replacement of alternatives to the original decision matrix.

Firstly the numerical examples are being solved using original TOPSIS method proposed by Hwang and Yoon [1] with some random criterion weight consideration. Next another alternative is inserted to the decision matrix to observe the existence of rank reversal through the modified ranks and relative orders of the alternatives.

Numerical example-I:

Let us consider a decision making problem involving '3' candidate solutions (alternatives) and '2' attributes (criteria). Each of the criteria has been assigned with some random weight 'w'. Suppose 'w_1' is the associated weight to criteria 'C_1' and 'w_2' is to that of 'C_2'. If w_1= 0.5 & w_2= 0.5, according to the original TOPSIS algorithm the alternatives closeness coefficient and the corresponding ranks obtained are represented in table 1.

Table 1 Numerical example-1 using original TOPSIS

	C_1(0.5)	C_2(0.5)	Closeness coefficient	Rank
A_1	5	2	0.3204	3
A_2	4	3	0.4833	2
A_3	6	3	1	1

The rank orders of the '3' alternatives are: A_3>A_2>A_1. After inserting a new alternative A_4 in the above matrix (table 1), the further rank orders are represented in table 2 along with its corresponding closeness coefficient value.

Table 2 Numerical example-1 with added alternative

	C_1(0.5)	C_2(0.5)	Closeness coefficient	Rank
A_1	5	2	0.4574	3
A_2	4	3	0.4449	4
A_3	6	3	0.596	1
A_4	1	6	0.4813	2

From the tabulated rank orders in table 2, we see that the relative rank orders of A_1 and A_2 are changed and are illogically reordered. Before the new alternative was added the order was A_3>A_2>A_1. After the addition of the new one (A_4) the relative order of same alternatives becomes: A_3>A_1>A_2.

Similarly, table 3 is listed with the results of '3' alternatives, by the replacement of alternative A_3 of the initial decision matrix (table 1) with some modified decision values.

Table 3 Numerical example-I with replaced alternative

	C_1(0.5)	C_2(0.5)	Closeness coefficient	Rank
A_1	5	2	0.5193	1
A_2	4	3	0.5154	2
A_3	1	6	0.4807	3

From the above tabulated rank orders (table 3), we see that A_1 which was the worst alternative (table 1) now becomes the best one. The above tabulated ranks show a clear issue of rank reversal in the original TOPSIS methodology. Some of the issues of rank reversal we noticed that while a new alternative is added, it completely affects derivation process of the PIS and NIS, so as the rank order.

Based on the previous norms proposed by many researchers [19]-[20] to solve the rank reversal issue, the normalized values in the decision matrix are generated by equation (7):

$$n_{ij} = x_{ij} / \max(x_{ij}) \qquad (7)$$

To verify the logic, we have applied the above formulae to calculate the normalized value in the considered example. After applying the modifications to the TOPSIS method, the resulted decision and ranks are tabulated in table 4.

Table 4: Numerical example-I with maximum value consideration

	C_1(0.5)	C_2(0.5)	Closeness coefficient	Rank
A_1	5	2	0.309	3
A_2	4	3	0.5	2
A_3	6	3	1	1
Max	6	3	-	-

The rank orders as per table 4 generated are A_3> A_2> A_1.To judge the effect of rank reversal w. r. t to the above modification in the algorithm, we have added a new alternative to the decision matrix and the respective rank orders are presented in table 5.

Table 5. Numerical example-1 with maximum value consideration and added alternative

	$C_1(0.5)$	$C_2(0.5)$	Closeness coefficient	Rank
A_1	5	2	0.4924	2
A_2	4	3	0.4673	3
A_3	6	3	0.6296	1
A_4	1	6	0.4444	4
Max	6	6	-	-

Even after the applied modifications still we see that the rank orders of alternatives A_1 and A_2 gets changed abnormally (table 5) due to the addition of the new alternative. Hence the issue is still unsolved.

V. PROPOSED MODIFIED TOPSIS

According to the tabulated results of numerical example-1, it is seen that PIS (p_i^*) is related with {Max C_1, Max C_2} and NIS (p_i^-) is related with {Min C_1, Min C_2}. Upon introducing the new alternative the PIS and NIS values are updated with relation to the updated boundary values. Hence, a constant and appropriate PIS and NIS value for all alternatives can resolve the issue. For doing the same, it is possible to derive the best set of ideal values in 'absolute' terms, by including the maximum and minimum boundary values as two dummy alternatives in the decision matrix, which will derive the NIS with the worst possible values for each existing criteria and the PIS with the best. To achieve the above modified property in the original algorithm, the mathematical formulation may be represented as:

(i)

$$S = \{x_{ij} \mid x_{ij} \varepsilon Z\} \; where\, Z = any\, real\, number\, and$$

$$s_0 = \max(S), s_n = \min(S) \qquad (8)$$

Where, $S = \{s_n......s_0\}$.

(ii) For the normalization step we will take the use of equation 7 which is verified that $n_{ij}<1$. Now, with the introduction of two dummy alternatives (s_0, $s_{0.......}$ s_0) and (s_n, $s_{n........}$ s_n), the normalized decision matrix can be calculated as:

$$n_{ij} = x_{ij} / s_0 \qquad (9)$$

For (s_o, s_o, s_o, $s_{o.....}$ s_o),

$$n_{ij} = (s_0 / s_0, s_0 / s_0 .....s_0 / s_0) = (1,1,......1) \qquad (10)$$

Similarly for, (s_n, s_n, $s_{n,.....}$ s_n),

$$n_{ij} = (s_n / s_0, s_n / s_0 .....s_n / s_0) \qquad (11)$$

(iii) The ideal solutions are calculated using the following equations.

$$p^* = \{(w_i | j\varepsilon J), (w_i * s_n/s_0 | j\varepsilon j')\} \qquad (13)$$

$$p^- = \{(w_i * s_n/s_0 | j\varepsilon J), (w_i | j\varepsilon j')\} \qquad (14)$$

Due to the constant values of s_n and s_0, the P^* and P^- values will also remain fixed for any number of alternatives in a defined range.

A. Numerical Illustrations

For proving the above modifications, let us consider a number of numerical illustrations, using some assumed values of 'S', few alternatives , criteria and corresponding weights .

Numerical example-II

To prove our modifications, let us assume numerical example-II with '3' alternatives and '2' criteria, where the decision matrix is generated in the range [0, 6]: S= {0, 1, 2, 3, 4, 5, 6}, s_0= 6 and s_n= 0.The criterion weights are considered as 0.5 for both the criterion (w_1= w_2=0.5).The rank results of the alternatives along with the decision matrix are listed below in table 5.

Table 5 Decision matrix and ranks with 3 alternatives

	$C_1(0.5)$	$C_2(0.5)$	Closeness coefficient	Rank
A_1	5	2	0.309	3
A_2	4	3	0.5	2
A_3	6	3	1	1
Max	6	3	-	-

The rank order of the '3' alternatives resulted are: A_3>A_2>A_3. Now, from the decision matrix value range (0, 6) the set of ideal alternatives are (6, 6) and (0, 0) respectively. After addition of the new alternative and the two dummy alternatives (6, 6) and (0, 0) in the decision matrix the resulted closeness coefficient and corresponding rank orders are tabulated in table 6.

Table 6: Decision matrix with dummy and new alternative

	$C_1(0.5)$	$C_2(0.5)$	Closeness coefficient	Rank
A_1	5	2	0.5664	4
A_2	4	3	0.5810	3
A_3	6	3	0.6910	1
A_4	2	6	0.6124	2
A_5 (D_1)	6	6	-	-
A_6 (D_2)	0	0	-	-
Max	6	6	-	-

Now we can observe that the alternative orders are genuinely gets changed after the addition of new alternative, which is A_3>A_4>A_2>A_1. Here the relative order of original 3 alternatives remains unchanged as: A_3>A_2>A_1.

Numerical example-III

To ensure the modifications in the method, we have solved another example (numerical example- III) with some different criterion weight and value range with '3' initial alternatives. Here the decision matrix is constructed in the range (0, 5). The weights are w_1=0.4 and w_2=0.6 respectively. The assumed decision matrix and rank order of alternatives have been represented in table 7.

Table 7 Numerical example-II decision matrix and results

	$C_1(0.4)$	$C_2(0.6)$	Closeness coefficient	Rank
A1	2	5	0.6667	1
A2	2	4	0.5729	2
A3	5	1	0.3333	3
Max	5	5	-	-

From table 7, the rank orders of the '3' alternatives obtained are $A_1>A_2>A_3$. After addition of the fourth alternative (A_4 = (3, 3)) and two dummy alternatives (5, 5) and (0, 0) in the decision matrix the corresponding ranks obtained are presented in table 8.

Table 8 Decision matrix with Modified TOPSIS

	C1(0.4)	C2(0.6)	Closeness coefficient	Rank
A1	2	5	0.5714	1
A2	2	4	0.4818	2
A3	5	1	0.4286	3
A4	3	3	0.4415	4
A5 (D1)	5	5	-	-
A6 (D2)	0	0	-	-
Max	5	5	-	-

The ranking results of '4' alternatives obtained are: $A_1>A_2>A_3>A_4$. In this example also it is clearly visualized that the rank orders are not affected due to the presence of dummy alternatives as the best possible alternative and worst possible alternative.

Using the above derivations, the modified TOPSIS algorithmic framework is represented in figure 1.

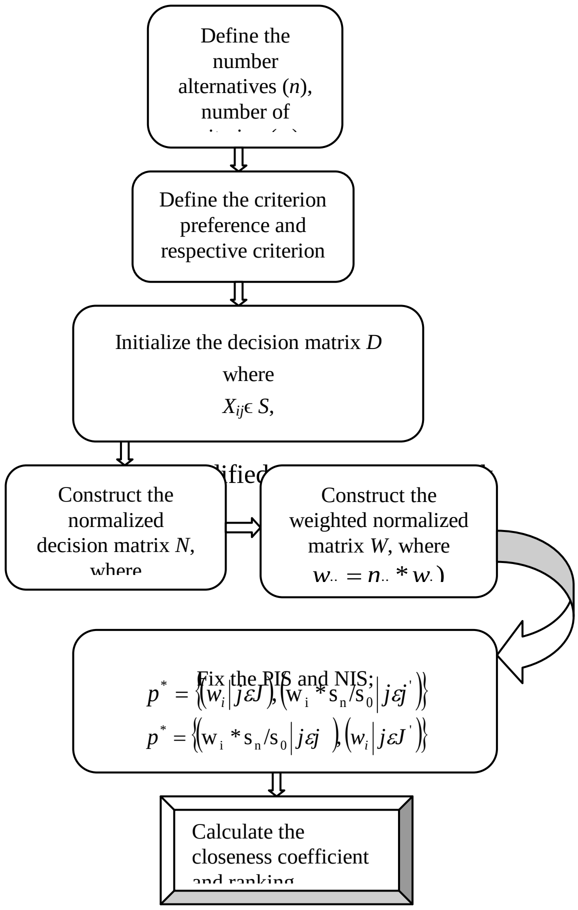

Fig. 1 Modified TOPSIS Framework

VI. APPLICATION FOR A TOURIST LOCATION SELECTION PROBLEM

For making a benefited decision, the above modified integrated methodology can be applied to a variety of situations. After validating the results we have applied the method for determining the best location for spending vacation that will expand and tackle the customer expectations. Millions of tourist even visit from abroad for enjoying their vacation and increasing their globalized purposes to many intercontinental places. Location decision for this is a systematic planning phenomenon aiming at spending a healthy vacation tour. Affordable cost, maximum fun, suitable travelling facility and a pleasant weather are some of the important criteria to make a suitable location selection decision. In the application problem, we have considered four numbers of criteria named: cost, fun, ease of travel and weather condition. The chosen numbers of location alternatives are evaluated along with these criteria. Out of the four criteria one (affordability) is the cost criterion and the other three are the benefit criteria. Figure 2 depicts the hierarchical problem structure for the 'tourist location selection problem' to determine a best location for the desired purpose.

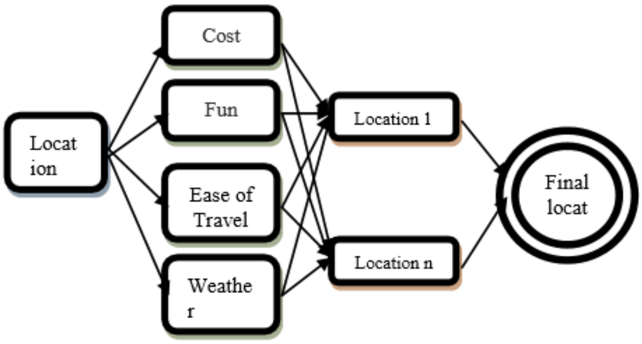

Fig. 2 Hierarchical Problem Structure for Location Selection

With the above problem structure by considering the cost and benefit aspects; the decision matrix along with its closeness coefficient and corresponding ranks obtained for '15' locations are represented in table 9. Different criteria weights we have considered are: affordability: 0.5, fun: 0.3, ease of travel: 0.2, weather condition: 0.2. The decision matrix is formulated in the range: [0, 6].

le 9 Rank orders of initial location alternatives

Criterion/ Alternative	Affordability / Cost	Fun	Ease of Travel	Weather Condition	Closeness Coefficient	Rank
Criterion Weight	0.5	0.3	0.2	0.2	-	-
Location-1	1	5	4	4	0.7949	3
Location-2	4	4	5	5	0.5465	8
Location-3	5	3	2	4	0.3196	13
Location-4	2	3	2	5	0.5963	4
Location-5	5	3	3	5	0.3717	12
Location-6	6	5	5	3	0.4139	11
Location-7	1	5	6	6	0.9009	2
Location-8	4	1	1	1	0.2511	14
Location-9	1	2	2	2	0.5532	7
Location-10	2	3	3	3	0.5806	5
Location-11	5	1	1	1	0.1329	15
Location-12	1	6	6	6	1	1
Location-13	4	4	4	4	0.5029	10
Location-14	5	5	5	5	0.5067	9
Location-15	3	4	3	4	0.5745	6

As per the results obtained the rank orders of the locations are: Location-12> Location -7> Location -1> Location -4> Location -10> Location -15> Location -9> Location -2> Location -14> Location -13> Location -6> Location -5> Location -3> Location -8>Location -11. After adding '5' new locations as added alternatives to the original decision matrix the rank orders of the resulted '20' locations obtained are represented as follows in table 10.

Table 10 Rank orders after added location alternatives

Criterion/Alternative	Affordability/ Cost	Fun	Ease of Travel	Weather Condition	Closeness Coefficient	Rank
Criterion Weight	0.5	0.3	0.2	0.2	-	-
Location-1	1	5	4	4	0.7949	3
Location-2	4	4	5	5	0.5465	12
Location-3	5	3	2	4	0.3196	18

Location-4	2	3	2	5	0.5963	7
Location-5	5	3	3	5	0.3717	17
Location-6	6	5	5	3	0.4139	16
Location-7	1	5	6	6	0.9009	2
Location-8	4	1	1	1	0.2511	19
Location-9	1	2	2	2	0.5532	11
Location-10	2	3	3	3	0.5806	9
Location-11	5	1	1	1	0.1329	20
Location-12	1	6	6	6	1.0000	1
Location-13	4	4	4	4	0.5029	14
Location-14	5	5	5	5	0.5067	13
Location-15	3	4	3	4	0.5745	10
Location-16	3	4	2	1	0.4822	15
Location-17	1	4	5	2	0.6967	6
Location-18	2	4	4	5	0.7113	4
Location-19	3	5	1	5	0.5851	8
Location-20	2	5	4	3	0.7078	5

The rank orders of the locations using our modifications are: Location-12> Location -7> Location -1> Location -18> Location -20> Location -17> Location -4> Location -19>Location -10> Location -15> Location -9> Location -2> Location -14> Location -13> Location -16>Location -6> Location -5> Location -3> Location -8>Location -11. Hence, the relative rank orders of the previous alternatives remained unchanged.Again we have added 15 more location alternatives to the original decision matrix to validate the relative rank orders of the previous set of alternatives out of the aggregated alternatives ranking. The location dataset along with the rank order obtained are represented in table 11.

Table 11 Rank orders after further added location alternatives

Criterion/ Alternative	Affordability/ Cost	Fun	Ease of Travel	Weather Condition	Closeness Coefficient	Rank
Criterion Weight	0.5	0.3	0.2	0.2	-	-
Location-1	1	5	4	4	0.7949	4
Location-2	4	4	5	5	0.5465	20
Location-3	5	3	2	4	0.3196	33
Location-4	2	3	2	5	0.5963	14
Location-5	5	3	3	5	0.3717	29
Location-6	6	5	5	3	0.4139	26
Location-7	1	5	6	6	0.9009	3
Location-8	4	1	1	1	0.2511	34
Location-9	1	2	2	2	0.5532	19
Location-10	2	3	3	3	0.5806	16
Location-11	5	1	1	1	0.1329	35
Location-12	1	6	6	6	1.0000	1
Location-13	4	4	4	4	0.5029	23
Location-14	5	5	5	5	0.5067	22
Location-15	3	4	3	4	0.5745	18
Location-16	3	4	2	1	0.4822	24
Location-17	1	4	5	2	0.6967	9

Location-18	2	4	4	5	0.7113	6
Location-19	3	5	1	5	0.5851	15
Location-20	2	5	4	3	0.7078	7
Location-21	6	5	2	1	0.3370	32
Location-22	6	5	4	1	0.3693	30
Location-23	4	6	2	6	0.5789	17
Location-24	4	6	4	6	0.6197	13
Location-25	1	6	2	6	0.7714	5
Location-26	3	4	6	6	0.6734	12
Location-27	6	5	1	5	0.3890	27
Location-28	2	6	1	5	0.6806	10
Location-29	4	3	2	1	0.3408	31
Location-30	6	5	4	2	0.3802	28
Location-31	4	6	3	1	0.5107	21
Location-32	5	3	4	6	0.4219	25
Location-33	1	4	6	1	0.6739	11
Location-34	1	6	4	1	0.7048	8
Location-35	1	6	5	6	0.9335	2

After successively adding further 15 more locations to the previous location dataset the rank orders obtained are: Location-12> Location-35> Location -7> Location -1> Location-25> Location -18> Location -20> Location-34> Location -17> Location-28> Location-33> Location-26> Location-24> Location -4> Location -19>Location -10> Location-23> Location -15> Location -9> Location -2> Location-31>Location -14> Location -13> Location -16> Location-32>Location -6> Location-27> Location-30>Location -5> Location-22> Location-29> Location-21>Location -3> Location -8>Location -11.Here even the rank orders and relative importance of previous alternatives are preserved proving the validity of our modifications in the algorithm.

I. CONCLUSION

Since such rank reversal problem violates the property of utility theory, the acceptance of the TOPSIS method can raise to a controversy. Through our corrections, we have analyzed and verified this serious issue of the method and pointed out two major solving factors of it. The first is related to the normalization of decision matrix and the second to the definition of the PIS and the NIS. Now the modified method which is quite straight forward one can be suitably applied by the decision maker in any of the decision application. In this paper, the location selection problem for spending vacations has been perfectly solved by using the modified TOPSIS framework along with overcoming of the rank reversal problem. In recent years, tourism has emerged as an opportunity to utilize the natural work power potential of the country. A satisfactory location selection will surely help the tourists by the proposed methodology without any ambiguity and full of comfortability.

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