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The mean error estimation of TOPSIS technique employing a fuzzy reference models

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ABSTRACT

The Technique for Order of Preference by Similarity to Ideal resolution (TOPSIS) may be a unremarkably used multi-criteria decision-making technique. variety of authors have projected enhancements, referred to as extensions, of the TOPSIS technique, however these extensions haven't been examined with reference to accuracy. Accuracy estimation is extremely tough as a result of reference values for the obtained results aren't far-famed, therefore, the results of every extension area unit compared to at least one another. during this paper, the author propose a replacement technique to estimate the mean error of TOPSIS with the utilization of a fuzzy reference model (FRM). This technique provides reference values. In experiments involving one,000 models, twenty eight million cases area unit simulated to estimate the mean error. Results of 4 unremarkably used normalisation procedures were compared. in addition, the author incontestible the link between the worth of the mean error and also the nonlinearity of models and variety of alternatives.

1. INTRODUCTION

Multi-criteria decision-making (MCDM) techniques area unit vital and fashionable mathematical strategies employed in a range of human activities. Generally, a call creating method involves finding the simplest possibility of all the possible alternatives. Usually, this is often achieved by hard the preference worth of every various [1]. one amongst the foremost often used MCDM strategies is that the Technique for Order of Preference by Similarity to Ideal resolution (TOPSIS). this method was 1st projected by Hwang and Yoon [2] and has been applied in an exceedingly range of fields, as well as energy [3, 4, 5, 6, 7], drugs [8, 9, 10, 11], engineering and producing systems [12, 13, 14, 15, 16, 17], safety and environmental fields [18, 19, 20, 21, 22], chemical engineering [5, 23, 24], and water resources studies [5, 20, 23, 25]. The classical TOPSIS technique has been extended to facilitate decision-making in an exceedingly fuzzy setting. this is often a awfully vital and fashionable extension [3, 4, 6, 8, 12, 13, 14, 15, 16, 18, 19, 20, 25, 26, 27, 28, 29]. the utilization of interval numbers is additionally a crucial improvement [30, 31, 32, 33]. as an example, the fuzzy extension of TOPSIS has been accustomed categorical the likelihood of success for exocrine gland island transplantation [8]. There area unit four major variants of presently used normalisation strategies for TOPSIS [34, 35]. the ultimate TOPSIS results vary looking on the tactic of normalisation, moving the rank of alternatives. This development is termed Rank Reversals [36]. Milani et al. investigated the result of normalisation norms on TOPSIS [34, 37, 38]. They complete that completely different|completely different} norms introduce different relative closeness of attributes, nevertheless for linear norms, this is often not ample to vary the rank of most popular alternatives. during this paper, the author assessed the mean error of normalisation procedures for TOPSIS employing a fuzzy reference model (FRM) and a procedure developed by the author.

2. TOPSIS PROCEDURE

The classical TOPSIS technique relies on the thought that the simplest various ought to have the shortest geometric distance from the positive ideal resolution (PIS) and also the longest distance from the negative ideal resolution (NIS) [2, 39, 40]. PIS and NIS area unit best to spot once all of the standards area unit monotonic (either increasing/profit attributes or decreasing/cost attributes). this is often a standard assumption once exploitation TOPSIS.

3. PROJECTED APPROACH

To estimate the mean error of the normalisation strategies for TOPSIS, reference values area unit needed. correct accuracy estimation is crucial for any MCDM technique, however it's remarkable within the scientific literature. during this paper, the author proposes associate degree uncomplicated approach supported symbolic logic. For this purpose, the author has developed plan of Fuzzy Reference Model (FRM). The FRM may be a multi-criteria perform of the choice maker's preferences, containing info regarding the preferences of every various. supported these models, all values of other preferences area unit far-famed a priori. the final theme of the estimation procedure used for TOPSIS is bestowed in Figure one. The bestowed procedure ought to be perennial multiple times for several FRMs, so as to generalize results of simulations during this manner, a FRM is obtained, and afterwards, a collection of alternatives is every which way elect. for every various, the preference worth from the FRM is understood however the standards area unit unknown. exploitation the smallest amount sq. technique and reference values, the coefficients of significance criteria area unit obtained then these factors area unit scaled to a add up to one. during this procedure, these numbers area unit the weights of the standards.

4. EXPERIMENTS AND RESULTS

In this paper, the author demonstrates the projected approach exploitation 2 monotonic criteria. With 2 profit criteria, five-element membership functions area unit determined for the subsequent info granules: zero.00, 0.25, 0.50, 0.75 and 1.00. the kind of fuzzy system employed in this paper applies a triangular-shaped membership perform TSMF [41], as shown in Figure a pair of.

For each combination of data granules, the multi - criteria values area unit every which way elect in order that the monotonicity of the standards was preserved. associate degree example of this action is shown in Table one. supported the info from Table one, the author known a linear model by exploitation the smallest amount sq. technique to get significance coefficients: zero.59 for criterion one and zero.72 for criterion a pair of. once rescaling, the various significance coefficients were zero.45 and 0.55. the instance surface of the model is shown in Figure three. The nonlinearity of this FRM model was zero.2341, as determined by exploitation formula (16). during this investigation, 1,000 FRMs area unit created. For one thousand models, the most error of estimation doesn't exeed zero.001 with applied math significance zero.05 [44, 45].

randomly elect (1,000 sets of three alternatives, 1,000 sets of four alternatives, and 1,000 sets of thirty alternatives). for every set, the author used the multi-criteria worth of preference from the FRM and additionally computed it by exploitation TOPSIS. during this manner, the author obtained 5 values of preference. One was the reference worth from the FRM, and 4 were computed from the normalisation strategies exploitation equations (1), (3), (5) and (7).

For any range of alternatives (in intervals from three to 30), 1,000,000 simulations were performed. supported this knowledge, analyzed normalisation strategies may be compared. the worth of the mean error for every technique is bestowed in Figure five.

5. CONCLUSIONS

A replacement approach to estimate the accuracy of TOPSIS technique with the utilization of FRM is projected. during this paper, the procedure to estimate the mean error of TOPSIS technique is incontestible. This procedure was enforced in MATLAB and tested for 2 monotonic criteria (both contained in an exceedingly set of profit criteria). One thousand FRMs were created, and 28,000 simulations were performed for every FRM. The average of error was convergent and addicted to the amount of alternatives. If the amount of alternatives area unit accrued, the worth of mean error is reduced. Therefore, we will say that the accuracy of TOPSIS depends on the extent of nonlinearity of the decision-making model. The average of error is within the vary from regarding zero.24 to 0.38 for downside with 2 profit criteria, that resulted in an exceedingly 24-38% relative error. in addition, results of 4 normalisation strategies area unit compared. technique #1 was shown to be the simplest alternative for alittle range of alternatives (five or less); technique may be a more sensible choice for a bigger range of alternatives.

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