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Note on the Application of Intuitionistic Fuzzy TOPSIS Model for Dealing With Dependent Attributes

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ABSTRACT

In this article, the effectiveness of the intuitionistic fuzzy TOPSIS model (IF-TOPSIS$_{EF}$) is tested for addressing, capturing, and resolving the effect of correlation between attributes, otherwise called the dependency of attributes. This was achieved by using several normalization methods in the implementation of the IF-TOPSIS$_{EF}$ model. Furthermore, the result of the computation is compared with the one obtained when the normalization methods are implemented using a traditional TOPSIS model. The study contributes and extends the state of the art in TOPSIS method study, by addressing, capturing and resolving the effect of correlation between attributes otherwise called dependency of attributes.

KEYWORDS

Dependency of Attributes, IF-TOPSISEF, Intuitionistic Fuzzy TOPSIS Model, Traditional TOPSIS Model

1. INTRODUCTION

TOPSIS is one of the most widely used decision-making techniques (Aikhuele & Turan, 2017). It was developed by Hwang and Yoon in 1981, and is based on the concept that the most appropriate alternative in a set of alternatives should have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution. Where the positive ideal solution tends to maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria (Behzadian et al., 2012). The method has a compensatory aggregation, that compares sets of alternatives by

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identifying the weights for each criterion, and the normalize the scores for the criterion and calculating the geometric distance between each of the alternative and the ideal alternative, which is regarded as the best score in each of the criterion. The rating and assigning of weight are done by a group of decision makers hence the process is said to be imprecise, since human judgments are vague and cannot be estimated with exact numeric values. However, to resolve the ambiguity arising from the rating scale and vague human judgments, Chen (2000) presented an extension of the TOPSIS model to the fuzzy environment, giving numerical example of a system analysis engineer selection for a software company.

Ever since, several other authors have contributed and extended the TOPSIS model in the fuzzy environment, some of which include, Awasthi et al (2011) who presented a fuzzy TOPSIS model for the evaluation and selection of the best location for siting an urban distribution centre, the model used the fuzzy set-based theory for quantifying the criteria values under uncertainty. Chen and Tsao (2008) proposes an extension of the TOPSIS method based on interval-valued fuzzy sets in decision analysis, using a comprehensive experimental analysis to observe the interval-valued fuzzy TOPSIS results yielded by different distance measures. Chu (2002) applied the fuzzy TOPSIS model for the selection of plant location, where the ratings and weights assigned by decision makers are averaged and normalized into a comparable scale. Tsaura et al. (2002) applies the fuzzy set theory for the evaluation of service quality of an airline company. Ding (2011) uses the fuzzy TOPSIS model for improving the quality of decision making and for ranking alternatives, the fuzzy TOPSIS model also accounts for the classification of criteria by integrating the weight of criteria and that of the sub-criteria.

Yong-tao et al. (2010) applies the Fuzzy TOPSIS approach in assisting contractors in selecting appropriate projects for bidding, the model which considered multiple attributes, integrates the opinions of a group experts. Linguistic terms were used in gathering the expert's opinion and was later converted to the triangular fuzzy numbers for onward ratings of alternatives. Aguarón-Joven (2015), discuss the assumption in TOPSIS methodology that all contemplated attributes are independent in nature, they further suggest the need to extend the state of the art to address the dependency issue of attributes since TOPSIS model measures distances in the Euclidean norm. The majority of published literature on the TOPSIS methodology has always assume the independency of attributes. In this paper however, some examples have are presented to show the effectiveness of the Intuitionistic fuzzy TOPSIS model which is based on exponential-related function (IF-TOPSIS$_{EF}$) originally proposed in (Aikhuele & Turan, 2017; Aikhuele & Turan, 2016) for dealing with attributes dependency issues. This is achieved by implementing the traditional TOPSIS model originally proposed by Hwang & Yoon (2000) using several normalization methods and then compared the results with the ones from the IF-TOPSIS$_{EF}$ under the same condition. The study contributes and have extend the state of the art in the study of TOPSIS methodology by addressing, capturing and resolving the effect of correlation between attributes otherwise called dependency of attributes.