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An MAGDM based on constrained FAHP and FTOPSIS and its application to supplier selection☆

Zhiping Chen [a,*], Wei Yang [a,b]

[a] Department of Scientific Computing and Applied Software, Faculty of Science, Xi'an Jiaotong University, 710049 Xi'an, Shaanxi, PR China

[b] Department of Mathematics, School of Science, Xi'an University of Architecture and Technology, 710055 Xi'an, Shaanxi, PR China

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ABSTRACT

The multiple attribute decision making (MADM) is widely used to rank alternatives with respect to multiple attributes. A new method for the multiple attribute group decision making (MAGDM) is proposed in this paper. In our method, linguistic terms are used during the whole evaluation process, the constrained fuzzy analytic hierarchy process is adopted to measure the relative importance of attributes, which is converted into the deterministic weight vector by using the extent analysis technique, the fuzzy TOPSIS is then used to rank the alternatives. With these improvements and other transformation skills, our new algorithm can better resolve the fuzzy information by decreasing its uncertain level, more scientific and accurate attribute weights can thus be obtained. More importantly, it can significantly reduce the computation amount and can provide more reasonable and robust ranking results. All these advantages are demonstrated by applying our new method to two supplier selection problems, typical complex MAGDM problems investigated extensively due to their practical importance. The sensitivity analysis and comparison with existing approaches sufficiently show the practicality, robustness and efficiency of our new algorithm, which can be applied to different kinds of complex MAGDM problems in reality.

1. Introduction

The multiple attribute decision making (MADM) is an important research area in modern decision making science. It has been widely applied in many fields such as economy, environment and management. Two typical MADM methods are the analytic hierarchy process (AHP) and the technique for order preference by similarity to an ideal solution (TOPSIS). The AHP is proposed by Saaty [1]. It has received more and more attention [2–5] since its appearance. This method is clear in structure and easy to understand. Nevertheless, it requires pairwise comparisons between attributes and alternatives in order to set up decision matrices, which result in huge computation and low accuracy. The TOPSIS is proposed by Hwang and Yoon [6]. They think that a good alternative should be the one that is nearest to the positive ideal alternative, and at the same time, is farthest from the negative ideal alternative. The TOPSIS has been studied and applied extensively [7–15]. In TOPSIS, it is necessary to assign attribute weights of alternatives to reflect their relative importance. At present, the equal weight is usually adopted for simplicity, or the attribute weights are subjectively determined, the shortcomings of these methods are obvious. In practice, different attributes have different importance, so it is not reasonable to assign them equal weights. While for the weights selected subjectively, one can hardly guarantee their objectivity and reasonability during the

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* Corresponding author. Tel.: +86 29 82660954; fax: +86 29 82663938.
E-mail addresses: zchen@mail.xjtu.edu.cn (Z. Chen), yangweipyf@yahoo.com.cn (W. Yang).

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