UNIVERSITI TEKNOLOGI MARA

RELATIVE COMPLEXITY INDEX FOR DECISION-MAKING AND A SIMPLIFIED MULTI-GRANULAR LINGUISTIC TERM SETS METHOD

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

In the decision-making area, researchers claimed to propose a less complex method as compared to others. However, there is a lack of empirical justification for it. It is important to reduce the complexity level in a decision-making procedure since complexity imposes a high degree of uncertainty, is time-consuming, low level of accuracy and the efficiency of the result is uncertain. Hence, it is best to have a less complex level of decision-making method. This research applies Big-O notation from the computational area in determining the complexity level of the decision-making method. Applying Big-O notation in classifying the complexity of a decision-making method resulted in some cases having the same level of complexity despite the difference of steps involved. Hence, this research introduces a Relative Complexity Index (RCI) that complements the Big-O notation in classifying the complexity of a decision-making method. RCI is important as it will determine which decision-making method (within the same ability) has a less complexity level as compared to others. Then, validation of the relative complexity index method is made by applying it to some decision-making methods. In general, the decision-making method that uses crisp value has less complexity level compare to the method that uses fuzzy numbers due to the nature of fuzzy numbers involving several values. Further analysis is made involving The Technique for Order of Preference by Similarity to Ideal Solution, Analytic Hierarchy Process, and Multi-granular Linguistic Term Set (MGL) to validate the proposed RCI. MGL has a higher complexity level compare to AHP and TOPSIS accordingly. Then, an improved procedure of heterogeneous group decision-making (traditional multi-granular fuzzy linguistic modeling based on fuzzy membership) with a less complexity level is proposed. The heterogeneous group decision-making method gives rise to a higher complexity level due to the additional process of unifying since the output determined by the decision-maker is from different linguistic term sets or different types of scale compared to the homogeneous group decision-making method. This thesis introduced a process called the parallel process of cardinality (PPC) into the unifying process followed by the aggregation and evaluation process. The whole process is called A Simplified Multi-Granular Linguistic Method (SMM). The RCI found that SMM to have a less complexity level compares to other methods of traditional multi-granular fuzzy linguistic modeling based on fuzzy membership. Hence, by having SMM, a method that has the same ability as the other (within the same group), but with a less complexity level is introduced. SMM is applied to an application of an investment company where the company has several options on where to invest money such as the car industry, food company, computer company, and army industry. The data used is from previous literature. Evaluation of the complexity level of SMM using RCI by comparing it with other decision-making methods within the same category is conducted. The result obtained is the SMM having the lowest value of RCI compare to other decision-making methods within the same category.

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