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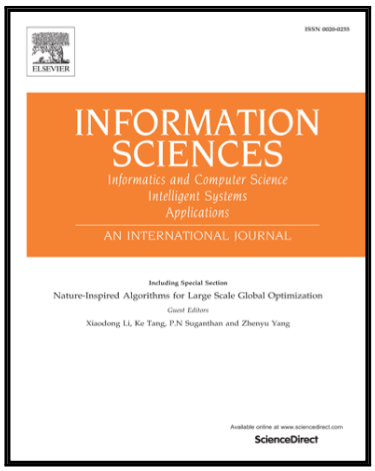

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Analysis of fuzzy Hamacher aggregation functions for uncertain multiple attribute decision making

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Abstract

As generalizations of algebraic and Einstein t-norms and t-conorms, Hamacher t-norm and t-conorm have been widely applied in fuzzy multiple attribute decision making (MADM) to combine assessments on each attribute, which are generally expressed by Atanassov's intuitionistic fuzzy (AIF) numbers, interval-valued intuitionistic fuzzy (IVIF) numbers, hesitant fuzzy (HF) elements, and dual hesitant fuzzy (DHF) elements. Due to the fact that AIF numbers and HF elements are special cases of IVIF numbers and DHF elements, respectively, two propositions can be established from analyzing numerical examples and real cases concerning MADM with IVIF and DHF assessments in the literature: (1) the monotonicity of alternative scores derived from Hamacher arithmetic and geometric aggregation operators with respect to the parameter *r* in Hamacher t-norm and t-conorm; and (2) the relationship between alternative scores generated by Hamacher arithmetic and geometric aggregation operators, given the same *r*. Here, we provide the theoretical proof of these two propositions in the context of MADM with IVIF and DHF assessments. With the theoretical support of these propositions, the meaning of *r* in MADM is explained, and a new method is proposed to compare alternatives in MADM with consideration of all possible values of *r*. Two numerical examples are solved by the proposed method and the other two existing methods to demonstrate the applicability and validity of the proposed method and highlight its advantages.

Keywords: Hamacher t-norm and t-conorm; Interval-valued intuitionistic fuzzy set; Dual hesitant fuzzy set; Arithmetic and geometric aggregation operators; Monotonicity

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