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Preface

FUZZY DECISION MAKING: METHODOLOGIES AND APPLICATIONS

Decision-making under vague and imprecise data has been very popular with the extensions of ordinary fuzzy sets such as intuitionistic fuzzy sets or Picture fuzzy sets. Two dimensional fuzzy sets such as intuitionistic fuzzy sets, Pythagorean fuzzy sets or fermatean fuzzy sets and three dimensional fuzzy sets such as picture fuzzy sets, spherical fuzzy sets, or neutrosophic sets are determined based on the structure of membership functions used by the experts. Hesitancy is obtained from membership (belongingness) and non-membership degrees (non-belongingness) in two dimensional fuzzy sets whereas it is defined as a separate parameter by experts in three dimensional fuzzy sets. In this issue, we present nine quality papers on fuzzy decision making, peer-reviewed by two or three reviewers.

The first paper initiates the theory of a new hybrid model for group decision-making, namely, bipolar soft expert sets as a natural extension of two existing models. Some fundamental properties of the developed hybrid model are discussed, such as subset, complement, agree- bipolar soft expert sets, disagree- bipolar soft expert sets, union, intersection, AND operation and OR operation.

The second paper introduces a comprehensive FMEA method which allows to assign different weights to the risk parameters. The proposed FMEA model includes nine risk parameters each having a different weight obtained from CRiteria Importance Through Intercriteria Correlation (CRITIC) method. It also introduces a fuzzy version of the proposed CRITIC Based Weighted Failure Mode and Effects Analysis (CBW-FMEA) method, which employs triangular and trapezoidal fuzzy numbers. All the proposed models are applied to COVID-19 blood testing process and the results are presented comparatively.

The third paper develops the best worst method (BWM) integrated hierarchical distance based intuitionistic decision making approach to valuate

transportation service providers regarding the sustainable factors from social, environmental, economic and operational factors. The developed framework manages vague and uncertain data and it enables to present hesitation via intuitionistic fuzzy numbers. Intuitionistic BWM, which do not require to make pairwise comparisons among criteria is utilized to determine the criteria weights.

The fourth paper merges the attributes of two important concepts, namely complex intuitionistic fuzzy sets and threshold graphs, and brings up the idea of complex intuitionistic fuzzy threshold graphs (CIFTGs). In CIFTGs, it deals with thresholds of amplitude and phase term for membership grades as well as for non-membership grades and introduces the novel concept of CIFTG, as well as some related concepts such as complex intuitionistic fuzzy (CIF) alternating 4-cycle, complex intuitionistic fuzzy threshold dimension (CIFTD), and complex intuitionistic fuzzy threshold partition number (CIFTPN).

The fifth paper integrates Pythagorean fuzzy sets with axiomatic design approach to evaluate biomass conversion technologies. It is revealed that combustion is the best biomass conversion technology for the Central Anatolia Region of Turkey. The sensitivity and comparative analyses are conducted to show robustness and reliability of the results.

The sixth paper evaluates various energy sources for sustainable development of the energy sector in India from multiple sustainability factors. A fuzzy integrated analytical hierarchy process (AHP) – weighted aggregated sum product assessment (WASPAS) multi-criteria decision making (MCDM) method is developed for the evaluation and assessment of these sources. Thermal, gas, nuclear, solar, wind, biomass, and hydro energy options are used as alternatives in the study. Initially, the fuzzy AHP method is applied to determine the weights of decision criteria, and fuzzy WASPAS is applied to prioritize sustainable energy alternatives.

The seventh paper presents some novel distances and similarity measures of spherical fuzzy sets and then it introduces some novel distance measurements such as spherical fuzzy Minkowski k-Chord distance and weighted spherical fuzzy Minkowski k-Chord distance. In addition, f-similarity measures are developed under a spherical fuzzy environment. The newly defined similarity measures are applied to pattern recognition for the COVID-19 virus.

The eighth paper introduces the notion of generalized m-polar fuzzy graph of Type-I and describes its matrix representation. It also presents some useful properties, including regularity and completeness of generalized m-polar fuzzy graphs of Type-I. In addition, it demonstrates these properties by certain examples and illustrate some related results. Furthermore, it displays an application of generalized m-polar fuzzy graphs of Type-I in decision-making, that is, selection of best candidate for the post of administrator in an organization.

The last paper proposes Fuzzy KEmeny Median Indicator Ranks Accordance (F-KEMIRA) as an extension of the KEMIRA method. It constructs a decision making model involving three cost criteria, three benefit criteria, and 5 alternatives and solves it by using the proposed Fuzzy KEMIRA method.

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Guest Editor