Chapter 15
MCDM Using Normalized Weighted Bonferroni Mean Operator in Fermatean Neutrosophic Environment

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ABSTRACT

Fermatean fuzzy set (FFS) is a comprehensive form of intuitionistic fuzzy set (IFS) which has wide range for truth values (TV) and false values (FV). The neutrosophic set (NS) can quantify the indeterminacy of fuzzy characteristics of the dataset

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beyond the TV and FV independently. Fermatean neutrosophic set (FNS) set is an effective tool to handle the uncertainty in multi criteria decision making (MCDM) since it incorporates the important aspects of NS as well as FFS. For MCDM, the Bonferroni mean operator, which addresses the interdependencies between attributes, is a beneficial tool in certain circumstances because of its easy accessibility and stability. In this chapter Fermatean neutrosophic normalized weighted Bonferroni mean (FNNWBM) operator is presented and their features are examined. The Fermatean neutrosophic numbers (FNN) are aggregated using FNNWBM operator and the alternatives are ranked by the FNN extended score function in MCDM. The effectiveness of the proposed operator is checked through the obtained results' simulation and comparison analysis with other existing methods.

INTRODUCTION

In contemporary decision-making scenarios, the ability to handle uncertainty and imprecision has become increasingly critical. Traditional fuzzy set theories have been instrumental in capturing vagueness within data; however, they often fall short in addressing the full spectrum of uncertainty present in complex decision contexts. Senapati and Yager (2020) presents an in-depth exploration of Fermatean fuzzy sets, aiming to elucidate their theoretical underpinnings and practical implications. Fermatean fuzzy sets have emerged as a promising extension, offering a broader range of truth values (TV) and false values (FV) to better encapsulate uncertainty. In addition to Fermatean fuzzy sets, the paper likely touches upon the significance of neutrosophic sets, introduced by Smarandache (1998) in capturing the inherent indeterminacy and ambiguity present in real-world data. Neutrosophic sets extend the traditional fuzzy set paradigm by incorporating neutral elements, thereby offering a more comprehensive representation of uncertainty. Gonul (2022) introduced Fermatean fuzzy topological spaces and Broumi (2023) discussed Fermatean neutrosophic matrices and their basic operations. Palanikumar et al. (2022) proposed neutrosophic Fermatean fuzzy soft with aggregation operators based on VIKOR and TOPSIS method for MCGDM. Furthermore, Yager (1988) may delve into the Bonferroni mean operator, which plays a crucial role in aggregating information and addressing interdependencies between attributes in multi-criteria decision-making contexts. By considering the minimum values among a set of attributes, the Bonferroni mean operator offers a robust mechanism for capturing conservative estimates and ensuring the integrity of decision outcomes. Revathy (2022) used Fermatean fuzzy normalised Bonferroni mean operator in MCDM. Kishorekumar (2022), and Ma et al (2024) used Interval-valued picture fuzzy geometric Bonferroni mean aggregation operators and interval-valued Fermatean fuzzy bonferroni mean

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