Chapter 8
Neutrosophic Soft-Rough Matrices

Srinivasan Vijayabalaji
https://orcid.org/0000-0002-9905-7730
Anna University, India

Natesan Thillaigovindan
Arba Minch University, Ethiopia

Ranganathan Rajasekaran
Anna University, India

Kopikrishnan Sathiyaraj
AKT Memorial College of Engineering, India

ABSTRACT

This work investigates the formation of neutrosophic soft-rough matrices, building on the principles of soft-rough matrix theory. Drawing from the concepts of neutrosophic markov chains and transition matrices, we introduce novel ideas in the form of Neutrosophic soft transition matrices and Neutrosophic soft-rough transition matrices. In this research, we provide a comprehensive overview of these new matrices, detailing their properties and potential applications. By presenting several examples, we illustrate how Neutrosophic soft transition matrices and Neutrosophic soft-rough transition matrices can be utilized in various scenarios. Additionally, we discuss key results that underpin these new structures, offering rigorous proofs and explanations to support our findings.

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1 INTRODUCTION

Smarandache (2005) first coined the concept of Neutrosophic set, exemplified by three elements: truth, indeterminacy, and falsity. This innovative idea opened up new avenues for dealing with uncertainty. Following this Smarandache (2023) extended this concept to plithogenic algebraic structures. In 1982, Pawlak proposed rough sets as a method to tackle uncertainties in data analysis and decision-making processes. These rough sets provide a structured approach to handle imprecise information, marking a significant advancement in the field of uncertainty management.

Expanding on this foundation, Feng (2011) explored the theory of soft-rough sets, which is a combination of soft sets and rough sets. This amalgamation offered a nuanced understanding of uncertainty, allowing for more flexible and adaptive modeling techniques. Concurrently, Vijayabalaji (2010) contributed to this line of research by introducing soft-rough matrices, which provided a versatile framework for representing and analyzing complex systems under uncertainty. These developments underscored the dynamic nature of uncertainty management, with researchers continuously innovating to enhance existing methodologies. It was generalized to fuzzy setting by Muthukumar and Sai Sundara Krishnan (2017). Later it was generalized to cubic setting by Vijayabalaji (2018).

In recent years, bera and Mahapatra (2017) developed neutrosophic soft matrix, further enriching the landscape of uncertainty modeling. This novel approach incorporated elements from neutrosophic set theory into soft matrices, offering a fresh perspective on handling indeterminate and incomplete information. Additionally, Delia and Broumi. (2015) introduced rough neutrosophic sets.

Markov process emerged as a powerful tool for representing systems with limited memory of their past states. Within this framework, researchers like Vijayabalaji (2016) delved into the algebraic structure of fuzzy matrices, paving the way for the development of fuzzy transition matrices. These matrices provided a formal mechanism for capturing state transitions in Markov chains, facilitating informed decision-making in dynamic environments.

Building upon this groundwork, Massassati *et al.* (2023) introduced literal Neutrosophic Markov chains, expanding the applicability of Neutrosophic set theory to stochastic processes. Their work laid the foundation for exploring uncertainty within the context of Markov chains, offering insights into the interplay between randomness and indeterminacy. Moreover, they developed the Neutrosophic transition matrix, which served as a key tool for analyzing the evolution of systems under uncertain conditions.

As the research progressed, it became evident that a solid understanding of fundamental concepts was essential for advancing the field. The next section of this work focuses on providing the necessary definitions and background information

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