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IDENTITIES ON TRIANGULAR FUZZY PELL AND TRIANGULAR FUZZY PELL–LUCAS NUMBERS AND A FUZZY TOPSIS APPLICATION

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ABSTRACT

Classical Pell and Pell-Lucas number sequences are integer sequences that have been extensively studied and have a wide range of applications in number theory and applied mathematics. In this study, these sequences are transferred to the fuzzy setting as triangular fuzzy Pell and triangular fuzzy Pell-Lucas numbers, defined through the α-cut representation of triangular fuzzy numbers. First, a basic arithmetic framework for triangular fuzzy numbers is established, and this framework is used to derive the recurrence relations of the proposed fuzzy sequences. Building on this foundation, several new identities are obtained that reveal the relationships between triangular fuzzy Pell and triangular fuzzy Pell-Lucas numbers; in this way, classical results are extended to the fuzzy domain, and the algebraic relationships between the two families of sequences are clarified.

As an application, the proposed triangular fuzzy Pell numbers are incorporated into a multi-criteria decision-making framework based on the Fuzzy TOPSIS method. The linguistic variables used in the decision-making process are modeled by triangular fuzzy numbers derived from fuzzy Pell numbers, and the resulting ranking is compared with a parallel solution obtained using classical Pell numbers. The two approaches yield consistent rankings, which supports the practical reliability of the fuzzy Pell-based formulation.

The results show that triangular fuzzy Pell and triangular fuzzy Pell-Lucas numbers form a consistent algebraic structure compatible with existing fuzzy number theory, while also providing a concrete and effective tool for multi-criteria decision-making applications. This study contributes to the growing literature at the intersection of number sequences and fuzzy set theory, and suggests future research directions such as extensions to other classical sequences and alternative fuzzy decision-making methods.

***K*eywords** Triangular fuzzy Pell numbers · Triangular fuzzy Pell-Lucas numbers · α -cut · Fuzzy TOPSIS

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