Algebraic Structures of the Specialized Cartesian Product $\times_7$ over Intuitionistic Linguistic Fuzzy Sets

D. Kavitha[1*], C. Ragavan[2*], S. Senthilkumar[3] and Grienggrai Rajchakita[4]

1*Department of Computer Science, Sri Vidya Mandir Arts & Science College, Uthangarai 636 902, Tamil, Nadu, India

2* Department of Mathematics, Sri Vidya Mandir Arts & Science College, Uthangarai 636 902, Tamil Nadu, India

3 Department of Mathematics, Sri Vidya Mandir Arts & Science College, Uthangarai 636 902, Tamil Nadu, India

4 Department of Mathematics, Faculty of Science, Maejo University, Thailand

*Corresponding author e-mail: kavikannan15@gmail.com and ragavanshana@gmail.com

Abstract: Abstract n this article, we introducing the algebraic and Cartesian Product $\times_7$ on Intuitionistic Fuzzy Linguistic sets under the specialized Cartesian product $\times_7$. We establish and verify several propositions that extend classical set-theoretic laws into the intuitionistic linguistic fuzzy environment. In particular, we demonstrate that the Cartesian product ×7 distributes over union and intersection for ILTS, such that $A \cup (B\times_7 C) = (A\times_7 B) \cup (A\times_7 C)$ and $A \cap (B\times_7 C) = (A\times_7 B) \cap (A\times_7 C)$, where A, B are linguistic intuitionistic fuzzy terms over the universe E_1, and C is a linguistic intuitionistic fuzzy term over E_2. Furthermore, we verify that the Cartesian product $\times_7$ is associative with respect to union and intersection, given by $A\times_7 (B \cup C) = (A\times_7 B) \cup (A\times_7 C)$ and $A\times_7 (B \cap C) = (A\times_7 B) \cap (A\times_7 C)$, illustrating its compatibility with fundamental set operations. In addition, we prove five theorems with illustrative examples that further strengthen the algebraic foundation of linguistic intuitionistic fuzzy theory. These findings highlight the compatibility of the Cartesian product $\times_7$ with classical set operations and support its applicability in uncertain, linguistic, and decision-making environments.

Keywords: Intuitionistic linguistic fuzzy term, Cartesian Product ×7, Operations, Union, Intersection, Fuzzy Logic; Linguistic Variables, $\times_7$.

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