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FUZZY DISTANCE OF TRAPEZOIDAL FUZZY NUMBERS AND APPLICATION

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Abstract. *A natural question to human beings is whether it is reasonable to define a crisp distance between two fuzzy objects. If the two fuzzy numbers themselves are uncertain, how can the distance between them be certain? In this paper, we consider a new and different approach to calculate the fuzzy distance between two fuzzy numbers. Thus we introduce a fuzzy value distance by using graded mean integration representation of trapezoidal fuzzy number and the spread of the fuzzy number. We also discuss the distance of the linguistic data "greater or less than x", or "about x". The result shows that it is reasonable to say that "the fuzzy distance of about 3 and about 7 is about 4". Then the proposed method is applied to solve a house selection example. The house with the least fuzzy distance to the ideal house is chosen. This idea of the fuzzy distance can be used in solving many other practical problems.*
Keywords: Fuzzy number, Graded mean integration representation, Fuzzy distance, Graded mean integration ranking

1. **Introduction.** In many cases in our life, most of the data obtained for decision making are approximately known. In 1965, Zadeh [20] introduced the concept of fuzzy set theory to solve these problems. In 1978, Dubois and Prade [11] defined any of the fuzzy numbers as a fuzzy subset of the real line. Thereafter, we can use fuzzy numbers to build the mathematical model of linguistic variable under fuzzy environment.

In 1991, Kaufmann et al. [14] considered a distance measure of two fuzzy numbers combined by the interval of α-cuts of fuzzy numbers. In 1992, Liu [15] discussed three concepts of distance measures (normal distance, s-distance, sub-s-distance) of fuzzy sets. In 1997, Heilpern [12] proposed three definitions of the distance between two fuzzy numbers. These include that mean distance method is generated by expect values of fuzzy numbers, distance method is combined by a Minkowski distance and the h-levels of the closed intervals of fuzzy numbers, and geometrical distance method is based on the geometrical operation of trapezoidal fuzzy numbers. In 1998, Chen and Hsieh [7,13] defined the distance of two generalized fuzzy numbers as following: Let A and B be two generalized fuzzy numbers and $P(A)$, $P(B)$ are Graded Mean Integration Represent (GMIR) of A and B respectively. Then the distance of A and B defined as $|P(A) - P(B)|$. In 1999, I. Bloch [1] used α-cuts and Extension Principle to define the fuzzy distance based on mathematical morphology. In 2002, Saha et al. [17] proposed the notion of a fuzzy distance being formulated by first defining the length of a path on a fuzzy subset and