



# An advanced similarity measure for Pythagorean fuzzy sets and its applications in transportation problem

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## Abstract

Uncertainty is excessively a common, inevitable, and conspicuous aspect of any decision-making process, including transportation problems. Since its inception, a plethora of uncertainty representation methods has been put forward to deal with uncertainty by various researchers. Among those, fuzzy set and Intuitionistic fuzzy set is remarkably effective representation methods of uncertainty modeling. However, the existing uncertainty modeling methods have some severe limitations. Consequently, here we adopt the concept of the Pythagorean fuzzy set, an extension of the intuitionistic fuzzy set for its extensive flexibility characteristic and advantages. On the other hand, the similarity measure plays a crucial role in transportation problems under uncertainty. Therefore, we strive to introduce an advanced similarity measure of Pythagorean fuzzy sets. The proposed similarity measure is constructed based on the distances of the degree of membership, non-membership, and hesitancy of Pythagorean fuzzy sets. The present similarity measure also holds the general axioms of the similarity measure. Furthermore, we adopt some numerical examples to showcase the superiority of the proposed similarity measure and apply it to solve transportation problems. The core motive for transportation problems is minimizing transportation costs, and hence, we modified Monalisa's method of Pythagorean fuzzy sets with the help of the proposed similarity measure. The proposed method has been demonstrated with an example and compared its output with the other pre-existing methods available in the literature. At length, statistical tests and result analysis are drawn to judge the significance of the proposed method.

**Keywords** Intuitionistic fuzzy set · Pythagorean fuzzy set · Similarity measure · Transportation problem

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