Solving the transportation problem when faced with uncertain data: A novel algorithm

In mathematics and logistics, the transportation problem has been studied for a very long time from many different angles. The objective when trying to solve this problem is finding the optimum solution to minimize the cost of distributing an abstract "product" from multiple sources to multiple destinations. While optimum solutions can be easily calculated when every aspect of the problem is known, such cases in real life are rare; most of the time, we have to deal with uncertain information, vague knowledge on some parameters, or merely statistical information and assumptions.

The branch of mathematics that deals with such uncertainty-ridden problems is called "fuzzy mathematics," whose counterpart is "crisp mathematics." Although researchers have tackled fuzzy problems and proposed fuzzy algorithms for solving them over decades, there are many variants with different scopes of application. In particular, Pythagorean fuzzy sets are a mathematical tool for representing uncertain values and allow for solving fuzzy problems that previous models and algorithms could not handle. These problems are formulated in what is known as a Pythagorean fuzzy environment, which applies to many real-life scenarios.

We noted that there were no existing algorithms for calculating optimal solutions to the transportation problem under a Pythagorean fuzzy environment. Therefore, we present in our paper the first algorithm for solving this type of fuzzy transportation problems.

Our algorithm consists of three models for solving transportation problems under different levels of uncertainty in the available data. These models correspond to three different types of Pythagorean fuzzy environments, with each type being progressively more uncertain and complicated than the previous one. We also present numerical examples illustrating how our algorithm operates and analyze the obtained results.

In short, our approach fills a gap in the current literature and shows a new way of handling different levels of uncertainty in transportation problems. The real-life applications of algorithms for solving transportation problems are many, and can result in significant economic and environmental benefits through the increased efficiency that can be achieved when operating according to an optimal solution. In the future, our approach could be used, for example, to tackle job scheduling, resource allocation, and shortest-path problems.

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