

## Probability Fuzzy Aggregation Operators in Vehicle Routing Problem

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**Abstract :** For the evaluation of unreliability levels of movement on the closed routes in the vehicle routing problem, the fuzzy operators family is constructed. The interactions between routing factors in extreme conditions on the roads are considered. A multi-criteria decision-making model (MCDM) is constructed. Constructed aggregations are based on the Choquet integral and the associated probability class of a fuzzy measure. Propositions on the correctness of the extension are proved. Connections between the operators and the compositions of dual triangular norms are described. The conjugate connections between the constructed operators are shown. Operators reflect interactions among all the combinations of the factors in the fuzzy MCDM process. Several variants of constructed operators are used in the decision-making problem regarding the assessment of unreliability and possibility levels of movement on closed routes.

**Keywords :** vehicle routing problem, associated probabilities of a fuzzy measure, choquet integral, fuzzy aggregation operator

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