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# Uncertain Multiobjective Travelling Salesman Problem

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## Abstract

Travelling salesman problem is a fundamental combinatorial optimization model studied in the operations research community for nearly half a century, yet there is surprisingly little literature that addresses uncertainty and multiple objectives in it. A novel TSP variation, called uncertain multiobjective TSP (UMTSP) with uncertain variables on the arc, is proposed in this paper on the basis of uncertainty theory, and a new solution approach named uncertain approach is applied to obtain Pareto efficient route in UMTSP. Considering the uncertain and combinatorial nature of UMTSP, a new ABC algorithm inserted with reverse operator, crossover operator and mutation operator is designed to this problem, which outperforms other algorithms through the performance comparison on three benchmark TSPs. Finally, a new benchmark UMTSP case study is presented to illustrate the construction and solution of UMTSP, which shows that the optimal route in deterministic TSP can be a poor route in UMTSP.

### Keywords:

Uncertainty Modelling; Travelling Salesman Problem; Multiobjective Optimization; Artificial Bee Colony Algorithm

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## 1. Introduction

Travelling salesman problem (TSP) is a well-known NP-hard problem in combinatorial optimization, almost every new approach for solving engineering and optimization problems has been validated on TSP. The first efficient algorithm for relatively big problems was presented just in the paper Dantzig et al. (1954). Since

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