

# **Bunker management for tramp ships with stochastic fuel prices and stochastic service times**

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## **Abstract**

This study presents the routing and bunker optimization problem from the perspective of a ship-owner engaged in a voyage charter contract. In this framework, the ship-owner must decide where to deviate for bunkers, and the quantity to load. Additionally, the vessel route and speed are determined to fulfill contractual obligations while considering the weather and navigational uncertainties. We formulate the problem as a multi-stage stochastic optimization model where a ship-owner fulfills the vessel fuel requirements by forward and spot contracts.

We show we can model this problem to consider the dynamics of the vessel's draft and consumption based on the speed decision. Moreover, the stochastic bunkering service times are introduced via scenarios constructed from vessels' Automatic Information System (AIS) records. Some scenarios show that ports even with lower fuel prices can lead to more costly decisions based on inefficient service. Despite the influence of bunkering service time on the optimal solution, our study is as far as we know the first to assess this relationship.