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Speed optimization and bunkering in liner shipping in the presence of uncertain service times and time windows at ports. (English) Zbl 1394.90076

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Summary: Recent studies in maritime shipping have concentrated on environmental and economic impacts of ships. In this regard, fuel is considered as one of the important factors for such impacts. In particular, the sailing speed of the vessels affects the fuel consumption directly. In this study, we consider a speed optimization problem in liner shipping, which is characterized by stochastic port times and time windows. The objective is to minimize the total fuel consumption while maintaining the schedule reliability. We develop a dynamic programming model by discretizing the port arrival times to provide approximate solutions. A deterministic model is presented to provide a lower bound on the optimal expected cost of the dynamic model. We also work on the effect of bunker prices on the liner service schedule. We propose a dynamic programming model for bunkering problem. Our numerical study using real data from a European liner shipping company indicates that the speed policy obtained by proposed dynamic model performs significantly better than the ones obtained by benchmark methods. Moreover, our results show that making speed decisions considering the uncertainty of port times will noticeably decrease fuel consumption cost.

MSC:

90B06 Transportation, logistics and supply chain management
90C90 Applications of mathematical programming
90B90 Case-oriented studies in operations research
90C39 Dynamic programming
90B35 Deterministic scheduling theory in operations research

Keywords:

transportation; OR in maritime industry; fuel cost; dynamic programming

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