Dynamic Pricing for Stochastic Container Leasing System

by

Ms Wen JIAO
PhD Candidate
Department of Logistics and Maritime Studies
The Hong Kong Polytechnic University

(Conducted in English)

Abstract:

With the substantial upsurge of container traffic, the container leasing company thrives on the financial benefits and operations flexibility of leasing containers requested by shippers. In practice, container lease pricing problem is different from consumer product pricing in consideration of the fair value of container, limited customer types and monopolistic supply market. In view of the durability of container and the diversified lease time and quantity, the pricing is a challenging task for the leasing company.

In the first part, the monopolist's nonlinear pricing problems in static and dynamic environments are examined. In particular, the leasing company designs and commits a menu of price and hire quantity/time pairs to maximize the expected profit and in turn customers choose hire quantities/time to maximize their surpluses according to their hire preferences. In a static environment, closed-form solutions are obtained for different groups of customers with multiple types subject to capacity constraint. In a dynamic environment with contemporaneous arrivals, we address two customer types and derive closed-form solutions for the problem of customers with hire time preference. We show that the effect of the capacity constraint increases with time of the planning horizon when customers have the same hire time preference; while in the case with different hire time preferences, the capacity constraint has opposite effects on the low and high type customers. Next the case of customers with hire quantity preference is discussed. We focus on the lease with alternative given sets

of hire time and use dynamic programming to derive the numerical optimal hire time sequence. Further we investigate the nonlinear pricing problem with dynamic arrivals and hire time preference. We derive the closed-form solutions and discuss the effect of capacity constraints. Compared with the solution with contemporaneous arrivals, the effect of capacity constraints reduces for the case with same hire time preference and aggravates for consistent low-type customers in the difference hire time preferences case.

The leasing company provides customer-oriented services to increase fleet efficiency and maximize profit. Advance reservation could be a segment fence for container leasing firm to vary the base price according to the supply and demand conditions. In the second part, we consider a dynamic pricing problem of a container leasing firm with unit capacity request and reservations. A reserved customer books containers some time before the pickup date and settles the rent at booking time. A walk-in customer arrives at the firm and requests the immediate lease service. The problem is modelled as a continuous-time markov decision process. Using value iteration, the properties of the optimal allocation and pricing policy are derived. We show that there exists a state-dependent rationing policy with bounded sensitivity. The optimal posted price is nondecreasing with the leased amount and the number of advance demands. Numerical experiments are conducted to study the effect of reservation on the optimal policy.

In the third part, we examine a dynamic pricing problem of a container leasing firm facing reserved customers and walk-in customers with multiple units of capacity request and fixed lease durations. We first discuss the case with same lease duration and the optimal prices for two customer types are nonincreasing in the system state. Next we partially characterize the optimal policies for different lease durations of two customer types. The optimal policies have bounded and monotone sensitivity. Finally, we propose myopic pricing policy to the dynamic pricing problem.

Bio:
Wen Jiao is a PhD candidate in the Department of Logistics and Maritime Studies, Faculty of Business, The Hong Kong Polytechnic University.

Please email to irene.lam@polyu.edu.hk for enquiries.

All are welcome!