Optimization of Inbound and Outbound Delivery Scheduling under Stochastic Dynamic Demand

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Abstract

In this paper, we consider a joint inbound and outbound delivery scheduling problem applicable for a vendor operating under a vendor-managed inventory contract. Under the terms of the contract, the vendor has flexibility over the timing and quantity of resupply decisions at a group of retailers located in a given geographical region. Each retailer generates a stochastic order stream transmitted to the vendor using electronic data interchange capability. In this setting, employing a temporal shipment consolidation policy allows the vendor to hold smaller orders from the retailers and to release them in a combined load realizing transportation scale economies and improving truck utilization. Both the inbound and outbound deliveries incur fixed and linear costs leading to a challenging stochastic dynamic programming formulation of the problem at hand. We examine the optimal joint policy specifying the inbound and outbound delivery schedules so that transportation economies of scale are realized without excessive inventory holding and/or order delay. We characterize the structure of the exact policy and prove that clearing policies are not necessarily optimal.

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