Discounted Cost Optimization in Make-to-Stock Production-Inventory Systems with Continuous Replenishment and Backorders under the Base-Stock Policy

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Abstract

Consider a continuous-review single-product Make-to-Stock (MTS) production-inventory system with backorders. The demand process consists of mutually independent iid interarrival times and iid demand sizes. Replenishment is continuous and governed by the base-stock policy as follows: it proceeds at a constant rate while the inventory level is below the base-stock level, and is suspended, otherwise. The system incurs two types of costs, depending on its operational mode: in normal mode, the inventory level is non-negative, and a carrying cost is incurred at a constant rate (holding cost), while in underage mode, the inventory level is negative in the sense that some inventory is backordered, and an underage cost is incurred in terms of some underage penalty per stockout event. The cost function under study is the expected discounted cost over an infinite time horizon, given the initial inventory level.

The goal of this paper is to optimize the expected discounted cost over an infinite time horizon with respect to the base-stock level and replenishment rate parameters. To this end, we derive the expected discounted total cost function via a renewal approach. We then proceed to derive the partial derivatives with respect to the aforementioned parameters, and use them to obtain the corresponding optimal minimal-cost solution.

Keywords and Phrases: Base-stock policy, Continuous replenishment, Production-inventory systems, Expected discounted cost.