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Inventory Models with MAP Demands and Random Replenishment

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Abstract

Combining the study of queuing with inventory is extremely common and such systems are mentioned as queuing-inventory systems within the literature. These systems occur naturally in practice and are studied extensively within the literature. The inventory systems considered within the literature generally include (s,S)-type. However, during this paper we glance at opportunistic-type inventory replenishment during which there's an independent point process that's wont to model events that are called opportunistic for replenishing inventory. When a chance (to replenish) occurs, a probabilistic rule that depends on the inventory level is employed to work out whether to avail it or not. Assuming that the purchasers arrive consistent with a Markovian arrival process, the stress for inventory occur in batches of varying size, the stress require random service times that are modeled employing a continuous-time phase-type distribution, and therefore the point process for the opportunistic replenishment may be a Poisson process, we apply matrix-analytic methods to review two of such models. In one among the models, the purchasers are lost when at arrivals there's no inventory and within the other model, the purchasers can enter into the system albeit the inventory is zero but the server has got to be busy at that moment. However, the purchasers are lost at arrivals when the server is idle with zero inventory or at service completion epochs that leave the inventory to be zero. Illustrative numerical examples are presented, and a few possible future work is highlighted.

Keywords: Queuing-Inventory Systems; Algorithmic Probability; Batch Demands; Random Opportunities; Lead Times; Matrix-Analytic Methods

Introduction

Models for inventory management under uncertainty are studied extensively the 2 key questions of when and the way many to order are addressed under a spread of things like the character of inventory review (continuous or periodic), order quantity (fixed or variable), time interval for an order to be fulfilled (negligible, constant or random), nature of demand (deterministic or random), and other factors to optimize a function of varied costs like ordering, carrying inventory, lost sales, etc. Most models assume one supplier and glued cost of replenishment. Some models incorporate the supply of random opportunities for replenishment which can lower system costs thanks to reduced cost and/or ordering cost. We ask them as opportunistic replenishment. Friend studied systems with special opportunities occurring consistent with a Poisson process. These opportunities, which can be exercised only at the moment of their occurrence, are offered for an equivalent unit price but at reduced or zero ordering cost. Hurter and Kaminsky extend this model to systems where the special opportunities could also be exercised during a random period. Silver, Robb, and Rahnama developed an efficient heuristic for the Hurter and Kaminsky model. Gurnani considered periodic review systems and used theory of games to review the economics of placing a special order between reviews if a reduced sale is obtainable . Moinzadeh Mathematics 2021, 9, 1092 2 of 25 considered systems with constant demand rate, zero time interval and special discounted opportunities occurring at exponentially distributed intervals, and obtained optimal order quantity at regular price when inventory reaches zero, and therefore the threshold and order quantity at discounted price. Feng and Sun suggest modifying the (s, S) policy to a four-parameter system (threshold and order quantity for normal and discount purchases) and proposed a bisection search procedure to work out the optimal values of the four parameters. Goh and Sharafali consider the model in and incorporate the policy of passing the value reduction thanks to special purchases downstream to extend demand. Chaouch considers the model in when special and regular prices are valid over alternating exponential intervals. Tajbakhsh and Zolfaghari consider systems with discounts offered at exponential intervals with the discount price given by a discrete variate and develop optimal order quantities at each special price and further extended the model to the case of multiple suppliers. Karimi-Nasab and Konstantaras consider a system with constant demand, periodic random review intervals (uniformly distributed or exponential subject a maximum and minimum) and random special sale offers, and determine maximum inventory level for normal purchases, and a better maximum for special purchases. Den Boer and Zwart consider a system where the management makes simultaneous decisions on whether to require advantage of the special discounted offer, and therefore the asking price of a unit almost like All the above references assume that the time interval for receiving a special replenishment is negligible. altogether the above models, it's assumed that the special opportunities for replenishment are always considered as a supplement to the traditional replenishment process. In many situations like drugstores, groceries, small supermarkets, etc., the suppliers visit the retailers randomly (but frequent) intervals to supply special sales. This raises the likelihood that for a few systems it's going to be more economical to manage inventory solely supported special offers. this is often particularly attractive for non-critical items (e.g., canned food , generic medication) where stock outs aren't critical. Special replenishment opportunities offer lower cost and/or reduced ordering cost, and are usually available at once . Inventory models discussed above assume that the time to process a requirement is negligible. In many situations, completing a customer's service requires other resources, additionally to the item(s) in inventory (e.g., requiring a pharmacist to process the sale for prescription medication). Such inventory systems are mentioned as queuing-inventory (QI) models or inventory models with positive service time, and have received an excellent deal of attention recently. Research in queuing-inventory systems could also be classified supported features like the character of customer arrival process, service time distribution, server vacation, service discipline, customer behavior, inventory review policy, replenishment policy, stock-out assumptions, perishability of units, time interval for replenishment, among others. We refer the readers to Krishnamurthy, Shajin, and Narayanan for a general review of queuing-inventory models.

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