Chapter 13
Two–Commodity Markovian Inventory System with Set of Reorders

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ABSTRACT
This article examines a two commodity substitutable inventory system—two different brands of super computers under continuous review. The demand points for each commodity are assumed to form independent Poisson processes. The reordering policy is to place orders for both the commodities when the total net inventory level drops to any one of the prefixed levels with prescribed probability distribution. Lost sales are assumed during the stock out period. The lead time for a reorder is exponentially distributed with parameter $\mu_k$, depending on the size of the ordering quantity. The limiting probability distribution for the joint inventory levels is also evaluated. Various operational characteristics and total expected cost rate are derived. Numerical examples are provided to find optimal reorder quantity and band width $r$.

INTRODUCTION
In dealing with multi-commodity inventory system in a single location, the joint and coordinated reordering policy have been given more attention than that of individual reorder for each commodity separately. There are many advantages for joint replenishment, as they share setup costs, quantity discounts, utilize the same transport facilities, etc.

In the real life situation, the global sales agencies deal with rare electronic products like super computers with almost same configuration and identical functioning. This motivates the
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researcher to consider the substitutable commodities inventory control under joint reorder policy. In general these high tech machines are having substitutable nature because of its common number crunching behavior (General purpose computer). Keeping them in stock for sales purpose is high risk but yield high profit. Maintaining these “A” type items of ABC inventory classification, attracted many researchers in the past decade. We also assumed elongated production schedule and that the lead time distribution parameter depends on the number of items ordered.

In continuous review inventory systems, Ball and intify (1964) and Silver (1974) have considered a can-order policy, which has a can order level and a reorder level. In this policy, an item must be ordered when its inventory level reaches the reorder level and when an item in the group is ordered, other items with inventory positions at or below their respective can-order levels are also ordered. Subsequently, many articles have appeared with models involving the above policy. Another article of interest is due to Federgruen et. al (1984), which deals with the general case of compound Poisson demands and non-zero lead time. A review of inventory models under joint replenishment is provided by Goyal and Satir (1989). Kalpakam and Arivarignan (1993) have introduced \((s, S)\) policy with a single reorder level \(s\) defined in terms of the total number of items in the stock.


Xiao and Tiaojun et al. (2007) have developed a dynamic game model of a supply chain consisting of one manufacturer and one retailer to study the coordination mechanism and the effect of demand disruption on the coordination mechanism, where the market demand is sensitive to retail price and service. Shi and Kuiran and Xiao and Tiaojun (2008) analysed a supply chain consisting of a risk-neutral manufacturer selling a perishable product to a loss-averse retailer and presented the optimal ordering decision between the manufacturer and the retailer in a single period inventory with uncertain demand. Two types of contracts, buyback contract and markdown-price contract with the retailer’s loss aversion consideration are investigated, respectively.

Anbazhagan and Arivarignan (2000) have considered a two commodity inventory system with coordinated reordering policy. Anbazhagan and Arivarignan (2001) have analysed a model with a joint ordering policy which places orders for both commodities whenever the total net inventory level drops to a prefixed level \(s\). The demand points for each commodity form independent Poisson processes and the lead time is distributed as negative exponential. They have also assumed unit demands for both commodities.

Yadavalli et al. (2004, 2006) have analyzed two commodity inventory system under various ordering policies. Sivakumar et al. (2007) have considered a two commodity coordinated and individual ordering policies with renewal demands. In this policy, two reorder levels \(r_i\) and \(s_i(< r_i)\) are marked. An individual order at level \(r_i\) for \(i\)-th commodity may stand cancelled whenever the inventory level is less than or equal to \(s_i\) before replenishment and a new joint reorder for both commodities is placed.

The present work generalizes the work of Anbazhagan and Arivarignan (2001) by assuming the set of reorder levels with prescribed probability distribution for reordering. The rest of this paper is organized as follows: section 2 deals with problem formulation. Section 3 analyses part of the system and the system performance measures are computed in section 4. Section 5, total expectedcost
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