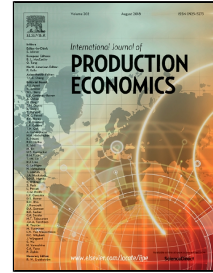


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An inventory replenishment system with two inventory-based substitutable products

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Abstract. In a supermarket, two mutually substitutable products with the same price are usually arranged one next to the other such as Coke and Pepsi colas, Campbell and Progresso soups, Breyer and Friendly ice creams, etc. It is evident that a large pile of products (e.g., colas, soups, baked goods, fruits, vegetables, etc.) displayed in a supermarket often induces customers to buy more because of its visibility, variety, and freshness. Hence, high inventory of one product provides consumers various choices, and makes this product preferable. In short, the demand for one product is positively influenced by its displayed stock level while negatively impacted by the displayed stock level of the other product. With the demand being stock-dependent, it may be profitable to maintain high stock level at the end of the replenishment cycle. The common inventory assumption of zero-ending inventory is extended to non-negative ending inventory. Hence, we first propose an inventory model with two inventory-based substitutable products to determine the optimal replenishment time and the ending inventory levels for both products in order to maximize the total annual profit. We then demonstrate that the total annual profit is strictly pseudo-concave with respect to the decision variables, which reduces the search for the global maximum to a local optimum. We also use simple economic interpretations to explain theoretical results. Furthermore, the theoretical results reveal that the optimal replenishment time is whenever one of two substitutable products is sold-out. Finally, numerical examples and sensitivity analyses are presented to highlight several managerial implications.

Keywords: Inventory System, Substitutable products, Stock-dependent demand, Optimality.

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