A Genetic Algorithm Approach to the Integrated Inventory-Distribution Problem of a Retail Supply Chain of Perishables

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Managing retail supply chains of perishables is significantly complex due to the limited shelf life and the higher level of demand uncertainty at retail level. After conducting a comprehensive literature review, it is concluded that the consumer buying behavior for perishables at retail level is highly dependent on the freshness and the availability of the products on the display. The most highlighted fact in the literature about perishables in retailing is the importance of achieving a better service level at the lowest possible cost. Thus, the objective of the study was made threefold. Firstly, we formulate an integrated inventory – distribution problem of a three echelon retail supply chain as a Mixed Integer Non-linear programming model. The novelty of the proposed model is that we address demand uncertainty, freshness dependency of demand, display availability dependency of demand and the perishability simultaneously in the same formulation. Furthermore, we propose separate formulations for different issuing policies at both retail and distribution center levels. Secondly, the developed models are validated by solving small size instances of the problem using LINGO 17.0 Optimization software. Most of the real world scenarios involve multi – retailers, multi – distributors, multi – products with large instances which makes the proposed model NP-hard. Therefore, a genetic algorithm which achieves high quality near-optimal solutions in a reasonable time, is proposed to solve larger instances of the problem finally. The authors have elaborated the GA with numerical examples and compared the results. The outcome of the study proposes the GA approach as the best solution to reduce the total cost while providing a higher service level.

Keywords: Genetic algorithm, Integrated inventory-distribution problem, Perishables, retailing, Service level approach