RISK POOLING AND STOCK ALLOCATION UNDER COST AND DEMAND UNCERTAINTY

Refik Gullu
Bogazici University, Turkey, E-mail: refik.gullu@boun.edu.tr

ABSTRACT

In this paper we consider central procurement of a commodity under stochastically evolving and correlated price and demand processes, as well as the timing and quantity of allocation to demand locations. Buying and selling commodities are becoming operational decisions for many sectors. As commodity prices randomly evolve over time, and due to dependencies between demand and price processes, a better understanding of the joint price and demand risks involved in these decisions has academic as well as practical relevance. We employ multi echelon inventory theory methods, and stochastic processes commonly used in financial engineering and operations management literature. We obtain optimal centralized order quantity, and optimal allocation of this quantity among locations, up to a verifiable allocation assumption. We present structural results on the optimal timing of stock allocation. We give a novel interpretation of the allocation quantities in terms of the allocation of forecasted budget (that is, the forecast of demand multiplied by the future price) for satisfying the demand. The research considered explains the effectiveness of procurement alliances or centralized procurement activities for an exchange-traded commodity. We present optimality results that generalize available multi-echelon inventory theory findings for such a commodity under randomly evolving and correlated purchase price and demand process. This implies that by employing standard operations management tools and techniques along with financial engineering models, decision makers can obtain easy to apply guidelines for ordering and centrally allocating a commodity. We obtain bounds on the benefits obtained by using the suggested approach. With respect to the timing of the allocation, we present conditions for which the allocation is either delayed as much as possible, or each demand location should place an order separately.

Keywords: Risk management, price uncertainty, supply chain management, Logistics and Transportation, Energy Related Operations.