

Seeking Inventory Control Answers Via Research.
Incomplete Inventory Information: The Next Challenge in Inventory Control

By Suresh P. Sethi

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Inventory control is one of the most important topics in management science. A systematic analysis of inventory problems began with the development of the classical Economic Order Quantity formula in 1913. Since then, an enormous amount of literature has accumulated on inventory control problems. One of the critical assumptions in this vast literature has been that the current level of inventory is fully observed. Some of the most celebrated results such as optimality of base-stock or (s,S) policies have been obtained under the assumption of full observation. Yet it is often the case in practice that the inventory level is only partially observed. Most of the well-known inventory policies are not only non-optimal, but also not usable in practice in partial observation environments.

The reasons for partial observation of the current inventory level are many. Inventory records or cash-register information differ from actual inventory because of a variety of factors including transaction errors, theft, spoilage, misplacement, unobserved lost demands and information delays. As a result, what are usually observed are surrogate measures such as cash-register records and rain checks, also called signals related to the inventory level. At best, these relations may provide only the probability distribution of current inventory level. Therefore, the relevant state in the inventory control problems is not the current inventory level but rather its distribution given the observed signals. Thus, the analysis for finding optimal production or ordering policies takes place generally in the space of distributions.

With support from National Science Foundation and Texas Advanced Research Program, Alain Bensoussan, Metin Çakanyildirim and I are developing methods for analysis of inventory control problems with incomplete information. This research can be used to lower inventory management cost and increase revenue for manufacturers and retailers where prevailing circumstances lead to inaccurate inventory records. Also, the research can be used to justify investments into technologies such as radio frequency identification (RFID) that can help provide better inventory records.
