Chapter 1

Introduction to Inventory Replenishment Planning

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Overview

SAS Inventory Replenishment Planning uses historical demand data to determine inventory replenishment policies for single location or two-echelon distribution systems. In addition to the demand data, it uses the cost of replenishment, the cost of holding inventory, the cost of backordering (stockouts), and target service levels to drive the policy identification. These inventory replenishment policies perform better than the standard EOQ (economic order quantity) policies that do not account for variation in customer demand and replenishment order lead times.

Impact of Inventory

In most industries, inventory is the foundation of conducting business. Consider the manufacturing industry, where it is necessary to coordinate both inventory-producing and inventory-consuming activities. There are inventories for multiple processing stages at multiple locations in the course of turning raw materials into components, producing spare parts, and ultimately creating finished goods.

In the retail industry, companies maintain large volumes of different items at various locations. They must monitor quantities, estimate usage, and place orders for replenishment. Slow-moving items are discontinued, while new items are introduced.

In the service industry, inventories are critical in providing the services that customers require. For instance, where would the hospital industry be without adequate supplies of surgical instruments and medicines? And how would a major package delivery company function without an inventory of trucks and spare parts?

Inventories are the lifeblood of a business and are essential to running it efficiently and profitably. When doing business with a company, customers often will not tolerate product unavailability or delays in delivery. In some cases, a shortage may be only a small inconvenience (such as selecting a different video at the rental store), while sometimes it may cause a severe problem (such as interrupting production-line activity at a computer manufacturer). On some occasions, sporadic shortages can be expected, but frequent shortages may ultimately erode a company's reputation and reduce their market share.

Inversely, overabundant, slow-moving inventories can place a serious strain on a company's available capital and the company's ability to take advantage of financial opportunities. Frequent shortages or excessive inventories are telltale signs of a company headed in the wrong direction. Zipkin (2000) notes that "we have understood for

some time, at least in principle, that sound, careful inventory management is critical to a firm's strategic viability."

The scope of inventory-dependent operations is tremendous. In March 2002, U.S. businesses alone maintained about $1.117 trillion worth of inventories, or roughly 1.38 times their total monthly sales. Thus, effective management of inventory can have a big impact on profitability. Recently, much success has come to retailers that focus their operations on keeping their inventories lean. Less has become more, and intelligent inventory replenishment planning is a major key toward realizing that goal. In order to compete effectively in today's business world, it is imperative that adequate inventories are maintained efficiently.

Function of Inventory

Zipkin (2000) states that "most of the important functions of inventories can be understood in terms of the various types of mismatches that arise between supply and demand processes." Typically, these processes cannot be matched perfectly — as a result, inventory acts as the buffer between them to reduce the effect of their incompatibilities. As expected, conflicts often arise. The most common of these is a shortage — the failure to meet demand when it occurs. Thus, one primary function of inventory is to prevent or limit shortages. Consider some of the characteristics of supply and demand processes that Zipkin (2000) suggests can contribute to this inherent incongruity:

Supply

- economies of scale (production and delivery)
- capacity limits (production and delivery)
- delays in replenishment (order lead time)

Demand

- steady or intermittent demand
- variations in demand over time (trend, seasonality)
- unpredictable demand variations (random)

Each of these factors can contribute to uncertainty. When dealing with uncertainty, the traditional objective of inventory control models is to minimize expected costs. Consider some of the costs associated with most inventory control systems.

Inventory-Related Costs

- replenishment cost (or fixed ordering cost)
  - cost of processing orders
  - cost is independent of replenishment quantity
- inventory holding cost
  - opportunity cost of capital invested in inventory
  - warehousing cost
  - handling and counting costs
  - other costs such as insurance and taxes
- stockout cost
  - cost of backordering
  - penalty cost for lost sales

When ordering, holding, and stockout costs are all known, SAS Inventory Replenishment Planning can be used to calculate optimal inventory replenishment policies. However, estimating stockout costs can be difficult, so a service level requirement is often substituted. In this case, a heuristic algorithm can be used to calculate nearly optimal policies, subject to requirements based on a choice of several different service measures.

Zipkin (2000) states that "the distinction between predictable (or deterministic) and unpredictable (or stochastic) processes is perhaps the single most significant dividing line between different [inventory] systems." SAS Inventory Replenishment Planning takes into account this unpredictability (or uncertainty) when calculating inventory replenishment policies for use in inventory management.

Summary of Functionality

SAS Inventory Replenishment Planning provides essential aid to decision making in inventory management by answering two fundamental questions:

- When should orders be placed to restock inventory?
- How much should be ordered?

The IRP procedure in SAS Inventory Replenishment Planning provides the ability to transform raw demand transaction data and order lead time estimates into rules for managing product inventory levels. Using estimates of review-time demand and replenishment order lead time along with the associated inventory costs for ordering, holding, and stockouts, the IRP procedure calculates optimal (s, S) or (s, nQ) policies. If the stockout penalty cost is unknown, one of several service measures can be substituted and the IRP procedure can calculate nearly optimal (s, S) or (s, nQ) policies. In both cases, PROC IRP provides an estimate of service measures for the purpose of evaluating projected policy performance. For details, see Chapter 2, "The IRP Procedure."

References

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