Customer by customer may be smarter supply strategy

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In deciding when to order more stock, retailers must do more than measure inventory. Replenishment decisions must be made customer by customer.

Within hours of Elvis Presley's death in 1977, fans began rushing to record stores and stripping the shelves of his music. One merchant saw his entire Elvis stock disappear within 10 minutes. New shipments weren't expected for days. The great business dilemma of how many new albums to order - when industry sources were estimating the Elvis fan frenzy could amount to 100 million extra records being sold in the wake of his death - left most store buyers feeling "all shook up," to say the least.

Inventory management has improved a great deal over the past 30 years, but the basic question of "to stock or not to stock," especially as occurs in the record-store example, is as timely as ever.

It would be nice to be always able to plan ahead, knowing exactly how much product customers will want and how long it will take to replenish stock. But rush orders no longer come from a plant in Indianapolis, as in Elvis' day, but from as far away as Europe or Asia, making it even more difficult for store managers to estimate the intricacies of inventory costs versus backlogging penalties.

In their new paper, "Myopic Inventory Policies Using Individual Customer Arrival Information," Victor Martínez de Albéniz and Alejandro Lago, both professors of Operations Management and Technology at IESE, attempt to synchronize replenishment orders by looking closely at

the customers' every move.

Based on their calculations, they say it can be better not to look too far down the road when ordering more of a particular product: sometimes only planning for today or tomorrow - customer-by-customer, sale-by-sale - can be the smarter supply strategy.

The model

The paper starts with a common model: A firm distributes a single product to customers, which is procured from an external supplier who is located far away. The lead-time is fixed and the inventory is managed using a standard periodic-review system with back ordering.

The firm checks the inventory level, then places an order to the supplier, who delivers the product in a certain amount of time. When the customers arrive, they are either served if there is stock on hand, or they are left waiting, to be served on a first-come, first-served basis when more inventory arrives.

At the end of the period, the firm is charged a per-unit inventory holding fee and a per-unit backlogging penalty. In time, all the information on past and present costs, prices and demand is available. It is on this model that Martínez de Albéniz and Lago formulate their policies.

Base-probability policy

The optimal replenishment policy is often a base-stock policy, meaning there is an optimal base-stock level, and one should either raise the current inventory level to that target, or do nothing if the current level is already above the target. This policy often works in simple situations when the lead time is fixed and costs are stationary.

However, for non-stationary costs and prices, there are few formulas available to compute the base-stock level, so one must use numerical optimization or simulation. While this approach "may suffer from the curse of dimensionality," the IESE professors build on other research methods that avoid the dimensionality problem in a context of single echelon, uncertain demand, cost and price, and fixed lead time.

"We concentrate on operationalizing the ordering polices, by providing, under certain conditions, closed-form formulas to determine whether to order or not."

Within the single-unit decomposition approach, the authors state the conditions under which

a so-called myopic policy is optimal.

"Our condition on the demand process is more general than what is usually assumed," they write. "For example, some academics require that the demand is stochastically increasing, while we only require that the arrival probability of a certain customer increases over time."

Furthermore, they develop a simple analytical formula to decide whether to place an order or not. They recommend a type of replenishment rule called base-probability policy. This means that an order associated with a given customer is placed if and only if its probability of arrival within the lead time is higher than a threshold determined by the cost and price processes. While this is theoretically equivalent to an optimal base-stock level, conceptually it allows the replenishment decision to be made customer by customer.

So, when it comes to replenishing a product, myopic policies can be optimal, under certain conditions. These results can be applied directly to batch ordering, they add.