Dynamic Customer Service Levels: Evolving Safety Stock Requirements for Changing

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Summary: Food retailers use holidays and promotions to differentiate themselves, attract new customers, and create a lasting price impression. Often, safety stock levels during these periods do not meet business needs, leading to high manual orders. In this research we partner with inventory managers and buyers from a large food retailer to propose a methodology that dynamically sets safety stock levels on these important products. Through simulation, we show that dynamic cycle service levels can reduce a firm's inventory while maintaining high product availability.

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KEY INSIGHTS

1. A firm that manages items with varying importance throughout the year can use dynamic service levels to have the right inventory at the right time.
2. To build trust in an inventory policy, insight and experience of key stakeholders should be used in developing the policy.
3. When setting safety stock levels, buffering for uncertainty in forecasts instead of demand leads to better product availability.

Introduction

Retail Business Services (RBS) is one of the largest food retailers in the US operating nine different brands, each with a different go-to-market strategy. One of the southern brands is a high-low retailer that drives sales through weekly promotions. To meet the goals of these promotions, retailers put immense pressure on the supply chain to maintain high on shelf availability. In response, demand management teams and retail stores often disregard normal inventory policies in favor of a "don't be out of stock" mentality. This emotionally-driven inventory policy leads to large manual orders by both retail stores and distribution centers (DCs). This research develops a method to alleviate manual orders during promotions and holidays by creating dynamic cycle service levels (CSLs).

Operational Context

At RBS, as with most retailers, items have varying importance throughout the year. Canned pumpkin is a top item during Thanksgiving, but is quickly relegated to the bottom of the list in June. A slow-moving shampoo, when displayed and promoted, can become a retailer's top selling item. Figure 1 shows an item with seasonally focused demand and the huge swings in inventory during the holiday seasons. Currently RBS uses an inventory policy that sets an item's safety stock levels at the distribution center (DC) based on the levels of inventory at their retail stores. This policy is entirely based on what has already happened and not rooted in the future needs of the business. Consequently, the inventory management group employs manual practices outside of their normal inventory policy. These manual interventions require extra touches by the inventory buyers and emotional ordering leads to excess inventory. Our research sought to eliminate these manual interventions while incorporating the buyer's insight and expertise into an inventory model.

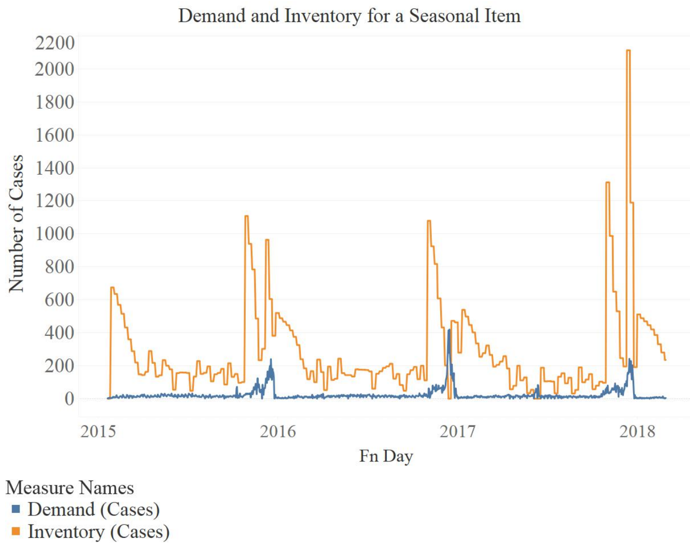

Figure 1: Demand and inventory for a seasonal item

Method and Simulations

Manual orders often occurred because the inventory policy did not address several criteria that management used to determine important items. Through interviews with buyers and management, we found four different classification criteria: Promotion (P), Key Item (KI), Seasonal (S), and Vendor Dependability (VD). Using these classification criteria, we partnered with the management group to create a decision frame that assigned a desired cycle service level (CSL) to an item based on which classification criteria it met. This CSL was then used to determine the k factor that, when multiplied with the standard deviation of demand or forecast error over lead time, gave the desired level of safety stock for an item.

Figure 2 shows a simplified decision frame similar to the one created through our discussions with RBS inventory managers. RBS identified the four criteria to create 16 unique CSL classes. During each replenishment an item's class is recalculated thus creating dynamic safety stock levels.

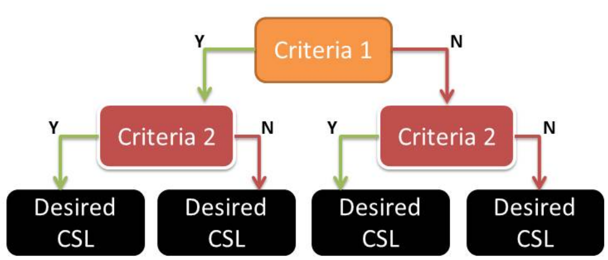

Figure 2: Simplified decision frame

We then incorporated this decision frame into the MRP inventory policy used by RBS. This policy is an extension of the periodic review policy *(R,s,S)* in which every R days the inventory is reviewed. In the *(R,s,S)* policy, if the inventory position is less than a safety stock level *s*, a replenishment is created up to the level *S*. In the MRP model, inventory is also reviewed every *R* days, and an order is created looking at the inter-delivery delivery time, which is the time between two subsequent deliveries. An order is generated such that the inventory does not fall below the safety stock level *s* during the inter-delivery time. On each ordering day, the MRP policy looks at where an item falls in the decision frame and uses the corresponding CSL to set the safety stock level for that replenishment.

To evaluate the effectiveness of dynamic CSLs, we constructed two different simulations. The first used VenSim to model the system dynamics of the MRP policy. VenSim creates a visual flow of the replenishment policy and allows a user to change the CSLs of each class in the decision frame using sliders. This simulation also has a dashboard that allows a user to examine the tradeoffs of having different CSLs assigned to different classes in the decision frame. The VenSim simulation is highly interactive and helps users build intuition around the ordering flows and the effects of safety stock levels. We ran a second set of simulations in RELEX, RBS' forecast and replenishment software. These simulations used the current system settings and results could easily be implemented in production.

Using each software, we ran a variety of different simulations comparing the current system settings to the dynamic cycle service levels set through the decision frame. Additionally, we examined the impact of setting safety stock levels using the standard deviation of demand or the standard deviation of forecast error. We selected a diverse set of items including both fast and slow movers and items with frequent and infrequent promotional schedules. Our item selection criteria also included items that were frequently manually ordered or had specific seasonal importance.

Results and Discussion

The system dynamics and RELEX simulations, allowed us to first examine the benefits of the two different standard deviation calculations. We ran fixed CSL simulations using the standard deviation of demand and standard deviation of forecast error. Across all items in both simulations, inventory reductions ranged from 4% to 10% when using the standard deviation of demand instead of forecast error. However, these reductions in inventory also led to between a 0.3% and 2.4% reduction in product availability. Therefore, when product availability is critical, a firm should use the standard deviation of forecast error instead of demand.

In the next set of simulations, we compared dynamic CSLs with the current policy of fixed CSLs. Using the dynamic CSLs from the decision frame, simulations showed a reduction in inventory while achieving a higher fill rate than fixing the CSL at 90%. The simulation in RELEX showed that the dynamic policy had the biggest inventory benefits for fast moving, highly promoted items. The dynamic policy reduced lost sales by an average of 2%, but increased inventory by an average of 4.7% across fast movers.

The CSLs assigned to each class in the decision frame were determined based on management's experience and perceived importance. In the third set of simulations, we used the VenSim model to find CSL values in the decision frame that would achieve the same product availability as the current system settings while reducing inventory. This approach sought to carry lower inventory by carrying less safety stock during non-promoted or non-seasonal times of year. Overall, this approach reduced inventory on the simulated items by an average of 10% while maintaining the same product availability as the fixed CSL approach**.** Figure 3 shows that inventory was dramatically reduced during non-promotional periods, but increased during promotions.

The simulations not only showed the benefits of dynamic CSLs but could also be used to tailor this process to a firm's specific needs. Using the system dynamics model, a firm can reduce inventory carrying costs without a reduction in product availability. By adjusting desired CSLs through simulation, a firm can find the right safety stock levels that lead to a desired product availability and inventory level. Using different CSLs to represent different levels of product importance ensures that a firm does not carry excessive inventory. Additionally, a firm can adjust classification criteria to meet to needs of their business and build trust in the system.

Conclusions

Due to exogenous factors such as management pressure, inventory management groups often deviate from a mathematical inventory policy. Incorporating managerial insights into an inventory policy creates greater buy in to the system. In practice an inventory policy should cater to the changing needs of the business and be easily understood by all operators. As all items do not receive the same attention throughout the year, their levels of safety stock should reflect this. Incorporating dynamic cycle service levels into an inventory policy helps a firm have the right inventory at the right time.

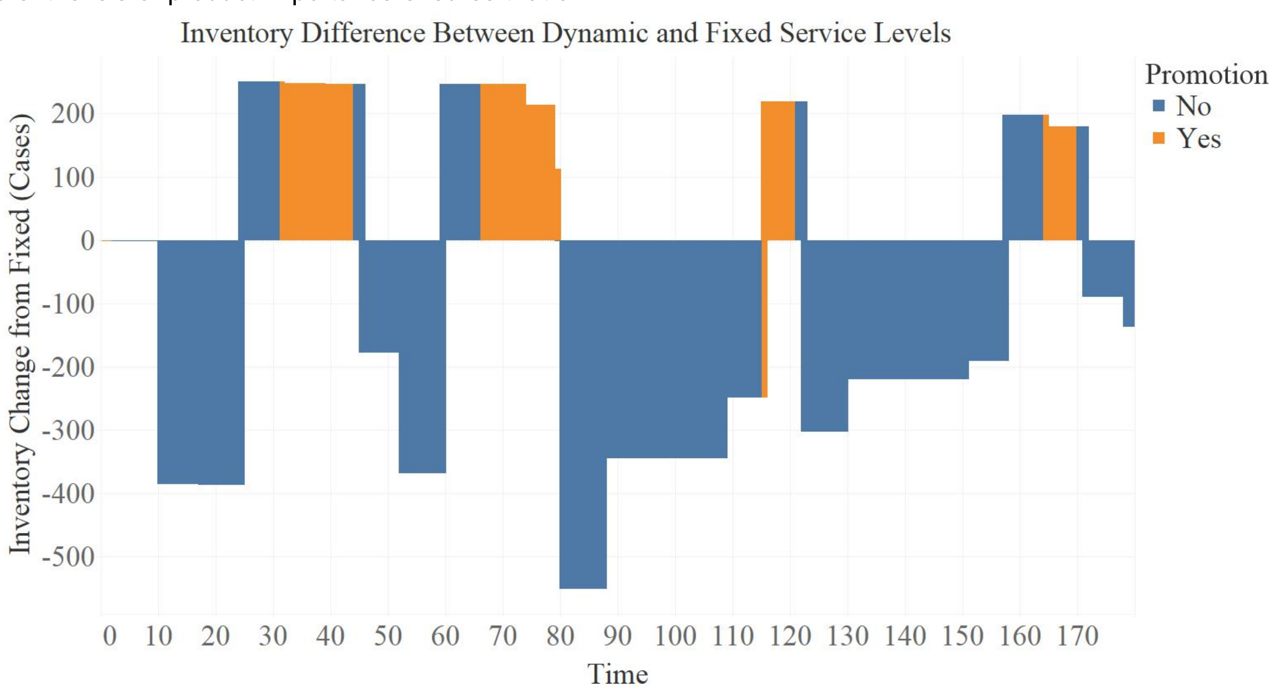

Figure 3: Inventory differences between dynamic and fixed service levels