One size science does not fit all

Applying markdown optimization in softlines
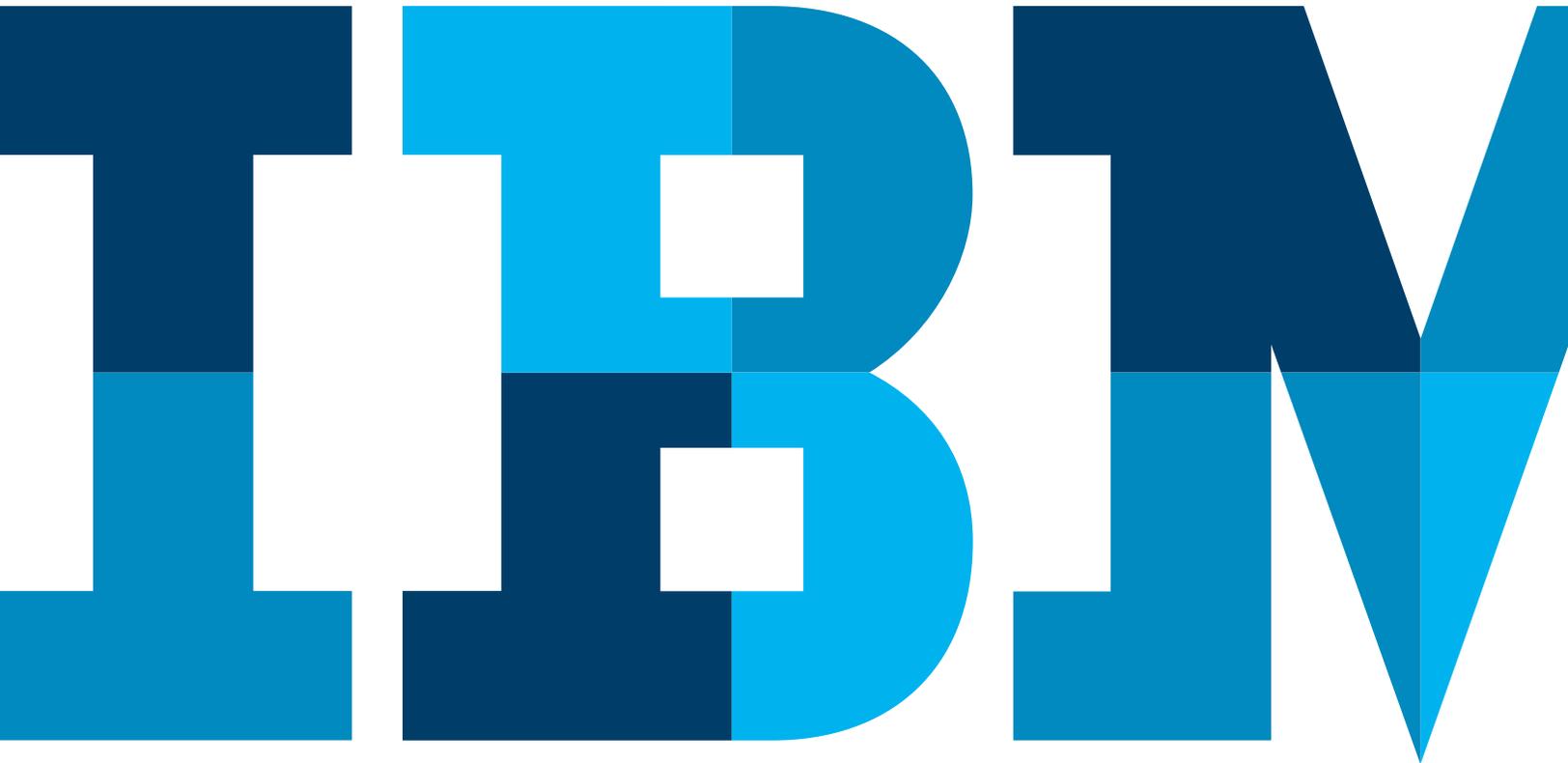
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Introduction

Softlines retailers face a specific set of challenges when it comes to maximizing sell-through and profit margins. While the trend-spotting, product design, and buying processes have long been considered art forms by expert practitioners in softlines retailing, current business pressures suggest a more empirical approach may be required.

Until recently, softlines retailers have shied away from implementing science-based markdown optimization solutions primarily for two reasons:

1. They use a "markdown budget" as their safety net, a pre-planning of the profit they predict they will lose by marking down their merchandise. If they stay within this offset budget they do not perceive any loss of profit. But in reality this cushion has prevented them from seeing the ineffective decisions they are making—in other words, they are literally throwing money away.

2. Many of the solutions available were developed for use in the Fast Moving Consumer Goods (FMCG) sector where products have a longer shelf life, inventory is flowing continually, and historical performance data is available to support forecasting of demand.

Softlines, and in particular fashion retail, is very unique, with the majority of the merchandise changing every season and being sold for a short period of time before the next season's merchandise arrives. These dynamics have created the need for a softlines-specific, scientific approach to optimization of markdowns that drive improved sales and profits in a challenging economic climate.

This paper examines in more detail the challenges, the state-of-the-art from a science perspective, and the IBM approach to supporting markdown optimization in softlines retail.

Softlines specific challenges

Softlines—generally defined as apparel, fashion and home goods—is a set of merchandise with its own rhythms, own timing, own challenges. A large proportion of softlines merchandise is expected to be on the shop floor for one season only, and virtually everything about the forecasting, ordering, merchandising, pricing, promoting and in-store practices is geared to that reality. Contrast that with fast-moving consumer goods categories, whose assortments may be dominated by staple items which may be regarded as perennial.

In the softlines world, merchandise from multiple sources must arrive in sync for each season, even though lead times may vary. Seasons wind down rapidly—often as quickly as 12 weeks, allowing little time for mid-course adjustments. Traditionally many items in the assortment are sourced from overseas factories due to cost-of-goods considerations, but the savings may come at the price of very early commitments—some orders must be confirmed months in advance.

These characteristics, together with others listed in Figure 1, make softlines merchandise more challenging to forecast with respect to future demand than standard FMCG categories.

	FMCG	Softlines
Merchandise	• Unlimited inventory • Continual flow of goods • Freshness = Perishables	• Short, finite lifecycle • Limited inventory • Often one shipment • Freshness = Fashion/Trends
Assortment Dynamics	• Relatively consistent assortment across the year • Lower SKU counts	• Frequent change of assortment • Limited inventory carry over to next season • Massive item counts (style/color/size) • Offshore sourcing
Price Influences Demand	• Base Price Optimization is king • Promotions highly supplier funded • Every Day Low Price	• Initial Price planning is driven by Mark Up • Promotions are king • Hi/Lo pricing
Clear Residual Inventory	• Markdowns taken at defined intervals	• Continuous markdown cycle • Supplier negotiation for markdown money
Merchandise Hierarchy	• More flexible Category Management	• Dominates planning and thinking
Merchandising Space and Place	• Limited Shelf Space • Planogramming	• Limited Floor Space • Visual Merchandising
Customer Understanding	• Guided by data • Embrace sophisticated analytics	• Guided by "experience" (more art than science) • Less accepting of analytics

Figure 1: The characteristics of softlines retailing differ from standard FMCG retailing

Short lifecycle and lack of historical data

Unlike the situation in FMCG, softlines retailers are seldom selling the same items season to season, year to year. This means demand forecast methods that are well proven in FMCG are not entirely appropriate. At best, they will be directionally correct. Rarely will there be long-term baselines upon which to base accurate forecasts. This is true except for a few wardrobe basics, certain styles of branded merchandise, or home textiles.

At a style and item level there is almost never any direct historical data, since fashion moves fast and designs change year over year. Dealing with this issue requires a different scientific approach, namely intelligent borrowing of information across multiple dimensions.

Broken inventory effects

When merchandise nears the end of its lifecycle we are often faced with a different problem known as "broken inventory". As inventory decreases the item loses visibility on the shop floor, which in turn affects demand. Furthermore, the retailer will start running out of certain sizes, with more popular sizes like Medium and Large tending to be the first to go. This too affects sales of the item since people are not going to switch from one size to another. These aspects of the business problem require a model form that captures the relationship between demand and inventory levels.

Dynamic environment

A reality of Retail is that sometimes things just do not happen as planned. Due to the short lifecycle of softlines merchandise and lack of historical data for individual items that are currently selling, it is critically important to be able to react quickly by taking into account the latest information.

Softlines requires a markdown process that will automatically re-model and re-optimize every week of the selling season to ensure that fashion and other softlines retailers have the best possible markdown plan going forward at any point of time.

The IBM approach

For softlines retailers, IBM® Markdown Optimization leverages softlines-specific demand forecasting science to determine the precise markdown depth required to meet merchandising objectives. Based on demonstrated pricing models for short-lifecycle merchandise, these advanced techniques require less data than traditional statistical forecasting tools and deliver more robust results.

Intelligent information borrowing

To deal with the lack of direct historical sales data, IBM solutions intelligently borrow information from other stores and other items in the class using a hierarchical approach. As an example, let us take a look at our elasticity calculation.
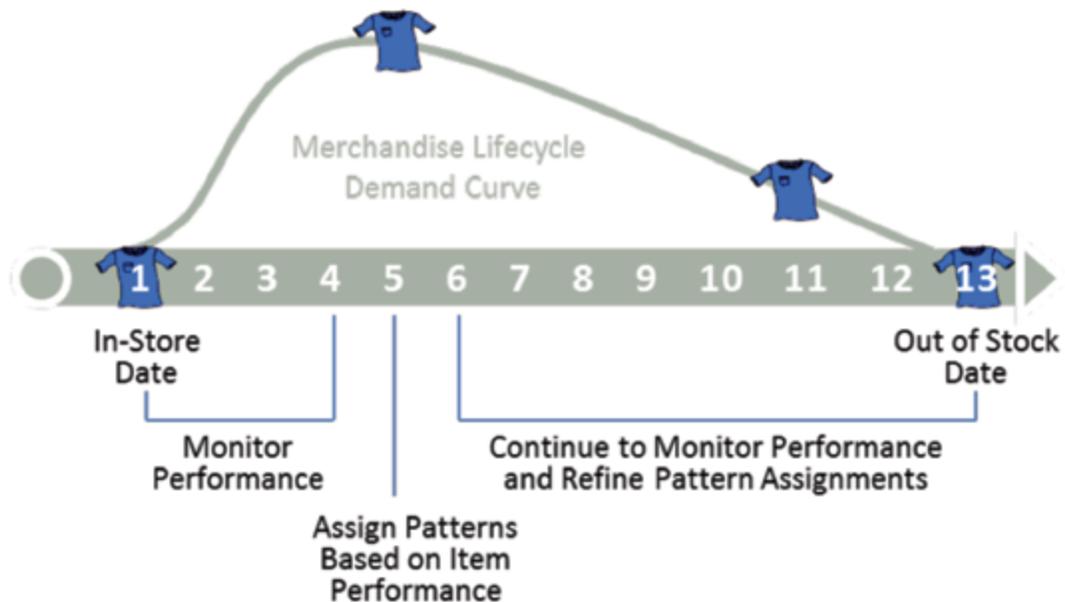

Figure 2: Stages of the markdown optimization process across a typical season

Price elasticities are calculated by examining response to price changes before and after a markdown event, but often at the point of decision there are no markdown events for a particular store-item. Even if there has been one, a small number of markdown events do not contain enough data to yield a robust elasticity. To address this issue, we calculate an average elasticity across an entire cluster of similar stores that are defined by first identifying key items for each store and running clustering algorithms on the sales behavior of the key items—within the cluster there will likely be many more events from which to infer elasticity. Key items are automatically selected using an algorithm which balances sales volumes (to detect the most influential items in each class) and item descriptions (to verify we maintain diversity in that set of items). In cases where there is insufficient information on sales transactions, we will move up the merchandise hierarchy and look at the average elasticity across all items in the class.

Different elements of the models—elasticities, seasonality, baseline—are calculated slightly differently, but they all intelligently borrow information from different aggregation levels in the same manner.

Looking at sell through rather than sales

Figure 3 below depicts actual softlines data for one class of merchandise. As we can see, average sales are proportional to on-hand inventory, particularly at the end of an item's lifecycle.

A big reason for this is the broken inventory effect mentioned earlier. Sales decline due to lack of visibility, and also a lack of availability in terms of sizes.

To capture this effect, IBM solutions model sell through rather than absolute sales. Sell through is defined by the percentage of on-hand inventory sold, and enables us to provide a forecast for sales if we know what the on-hand inventory levels are. This formulation helps to ensure that sales forecasts will be adjusted appropriately as inventory goes down, and the broken inventory effect is captured.
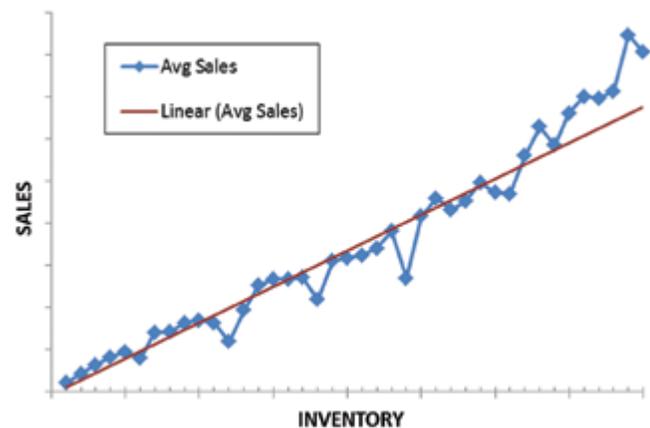

Figure 3: Comparing sales and inventory data for one class of merchandise

Weekly re-models and re-optimization

Given the value of every new week of information, IBM Markdown Optimization helps retailers adapt to rapidly changing business environments by supporting weekly re-models and re-optimizations. As soon as the latest data comes in (weekly or daily) it is used in combination with the previously available historical data to automatically re-model and update the forecasts. This approach is essential for markdown of short lifecycle merchandise where timely and accurate price actions are critical throughout the markdown period. Re-optimizations are then triggered to help ensure that the retailer has the most up-to-date markdown schedule going forward that aligns with their previously defined goals. Throughout the process, retailers can update their goals / constraints and re-optimize.

In Figure 4 below is a high-level example of how the re-optimizations work. At the beginning of the season an initial markdown plan will be produced which outlines a schedule of the recommended, optimal markdowns to be taking on a given week. In addition, IBM Markdown Optimization creates a forecast of the expected sales at this price cut, and what the inventory profile will look like over time. The retailer will then execute the plan for the first week.

Week	0	1	2	3	4	5	6	7	8
Price		$10	$10	$8	$8	$8	$6	$6	$6
Markdown %		0%	0%	20%	20%	20%	40%	40%	40%
Fct Sales		10	10	20	20	20	40	40	40
Fct Inventory	200	190	180	160	140	120	80	40	0

Figure 4: Initial markdown plan for the season

Week	0	1	2	3	4	5	6	7	8
Price		$10	$10	$8	$8	$8	$8	$8	$8
Markdown %		0%	0%	20%	20%	20%	20%	20%	20%
Fct Sales			13	30	30	30	30	30	30
Fct Inventory	200		160	130	100	70	40	10	0
Actual Sales		17							
Actual Inv		183							

Figure 5: Re-optimization of the markdown plan based on first week of actual data

In this example, as the first week's actual data comes in, we see in Figure 5, that we have under-forecasted by 7 units. Instead of 190 units of inventory left, we now have 183.

The system will synthesize the updated information and learn from it, in this case adjusting forecasted sales upwards. The IBM Markdown Optimization solution now predicts we will sell 13 units in week 2 instead of 10. Knowing this, the re-optimization has also proposed a new markdown schedule, in red above. It recommends that we will not have to take such a deep markdown in the last 3 weeks of the season and should maintain the 20 percent price cut through to the end of the season.

The retailer executes the plan for the following week (week 2), and the data synthesis and re-optimization cycle continues until we hit the end of the markdown period.

IBM Markdown Optimization: case study

A mid-sized Department Store retailer featuring a wide range of merchandise including apparel, accessories, footwear, and home fashions, had aggressively expanded over the previous four years, opening more stores and posting year-over-year average sales growth of 10 percent.

They faced unique challenges due to their broad assortment, and their traditional method of national-level markdown pricing was not providing a necessary competitive pricing edge.

By implementing IBM Markdown Optimization the retailer was able to take a more science-based approach to mark-downs, helping them to achieve significant gains in gross margin and improved inventory productivity. With the help of IBM Markdown Optimization, the retailer:

- Quantified that a "one price fits all" approach does not work. Different selling patterns per store required different markdown levels at different times.
- Established a streamlined markdown process, reducing the time spent reviewing prospective markdown opportunities and increasing consistent decision-making throughout their organization.
- Improved sales margins while maintaining residual inventory margins, ultimately delivering significant improvements in gross margin.

Conclusion

At the end of every season, clearance pricing and markdowns are a necessary evil in order to sell through remaining inventory, making room for next season's merchandise. Given the inherent complexity, using a fixed set of percentages implemented on a standard schedule across all stores is a standard practice. Unfortunately, this arbitrary method fails to take into account store-specific price elasticity, store-level inventory on hand, and the sales velocity or customer demand at each store, broken down to an item level, and few, if any, question its effectiveness. The result? Softlines retailers are missing a massive opportunity to add millions to their bottom line.

There is a better alternative. IBM Markdown Optimization leverages softlines-specific demand forecasting science to determine the precise markdown depth required to meet merchandising objectives. Based on tested pricing models for short-life merchandise, these advanced techniques require less data than traditional statistical forecasting tools to help softlines retailers:

- Optimize volume, revenue and profit
- Increase sell-through rates
- Reduce the level of excess end-of-season inventory requiring deep markdowns
- Make better decisions by simulating scenarios and comparing outcomes
- Improve productivity by automating and streamlining routine markdown tasks

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