Measurement and Evaluation of Retail Promotions

By Asen Kalenderski and Satya Sanivarapu
Thesis Advisor: Dr. Chris Caplice

Topic Area: Inventory, Metrics, Optimization

Summary: Promotions involve a complicated interplay of factors and are a result of a synchronized sequence of activities between manufacturers and retailers. The outcome of promotions pivot on several elements beyond the control of any one party in the supply chain. ‘How’ a promotion performed has a more straightforward answer than ‘Why’ a promotion performed a certain way. This research attempts to define a quantitative methodology to measure performance of promotions and reveal insights to consumer product manufacturers and retailers that will help answer the ‘How’ and the ‘Why’ of promotions. The measures used are simple, but the combination of analysis creates a complex structure of many dimensions that reveals intricate insights into the functioning of the supply chain, the most important asset in executing promotions. We present to you a three dimensional framework termed the ‘Promotion Performance Cuboid’ with structural elements consisting of three foundational supply chain measures, inventory, stock-outs, and performance of sales against target forecasts. The measures when viewed together through the Promotion Performance Cuboid, tell a revealing story of the underlying dynamics of promotions and the elements that actually control promotional performance become lucid.

Introduction

Promotions were a brilliant solution for CPG manufacturers to increase demand and push their merchandize at discounted prices onto retail shelves. However, with CPG manufacturers and retailers increasing the frequency of promotions as well as the discounts offered, promotions are becoming harder to manage and profit from. Today, promotion spend accounts for one of the highest line items on the profit and loss statement for CPG manufacturers, only second to cost of goods sold. Promotion spend by CPG manufacturers is increasing at a stupendous rate, sometimes, even faster than sales. This gives

KEY INSIGHTS

1. The ‘How’ of a promotion has an easier answer than the ‘Why’?
2. The key to evaluating promotions lies in understanding the impact promotions have on stores.
3. Measures viewed in isolation tell deceiving stories.
4. End of promotion days of supply, stock-outs, and sales performance, together form critical elements in determining promotion performance.
good reason for CPG manufacturers to invest in methods to improve promotions through accurate measurement and evaluation to gain insights into promotions behavior. Measuring and evaluating promotions allows isolating characteristics that cause promotions to be successful. These characteristics may then be transferred to improve the performance of under-performing promotions.

The main scope of this research is to understand promotions and develop a methodology to measure and effectively evaluate promotion performance. What important factors should be considered when evaluating promotions? What is the effect promotions have on stores? Are there some SKUs, stores or promotions that weigh down the overall revenue or profit potential of promotions? These are some of the questions that the thesis addresses. The measurement of promotions is based on three foundational measures, end of promotion store inventory levels, stock-outs, and sales performance against promotion forecasts.

**Methodology**

The methodology pivots around three primary dimensions to measure and classify promotions. Levels of inventory by the end of promotions, stock-outs during promotions, and sales performance against promotion forecasts. The analysis can further be sliced from three perspectives. Analysis of promotions by SKUs may reveal the assortment of SKUs that perform and those that don’t. Analysis of promotions by stores may reveal the stores that are able to execute promotions well and those that don’t. Analysis by promotions may reveal the promotions that do well across all stores and those that don’t perform as well. The three perspectives put together along the dimensions of measures reveal insights into ‘How’ promotions performed and ‘Why’ they performed in the way they did. The ‘Why’ is a more difficult question to answer than the ‘How’?

Promotions impose stress on supply chain operations due to sudden spikes in demand. A promotion may hit a store and leave it with insufficient inventory during the post-promotion period. Conversely, a promotion may leave a store with excess inventory during the post-promotion period. Figure 1 is an example of a typical promotion and is a composite graph that captures the impact on unit sales, average price, and end-of-day inventory for a promoted SKU. The data for the SKU is aggregated nationally across all stores in the supply chain. On the X-axis is time (days). On the Y-axis for the first graph is total units sold across all stores by day. The second graph shows the average price of the SKU across all stores by day. The third shows the end-of-day inventory for the SKU across stores. The SKU is promoted through a price reduction from Jul 26th to Aug 2nd. The price reduction results in a tremendous spike in sales. Also interesting to note is the ramp up of inventory in the week preceding the promotion across stores. Inventory depletes rapidly during the promotion period as a result of increased sales. The increase in inventory levels depicted by the third graph reveal that retail distribution centers replenish stores during the promotion. In this example, it appears that the promotion results in stores across the supply chain holding higher inventory levels than during the average non-promotion period.

**Figure 1. Displays a timeline of Unit Sales, Average Price, and End-of-day inventory levels**

**First dimension:** Since stores vary in size and demographics plays a role in the rate of sales at a store, the levels of inventory by the end of a promotion are of little help in judging the impact that a promotion had on a store in terms excess or depleted inventory. However, the Days of Supply (DoS) measure is a better indicator in revealing inventory levels by the end of a promotion. To determine whether inventory for a SKU is in excess or not by the end of a promotion, the
difference in end of promotion DoS to the average non-promotion DoS is computed.

Second dimension: The stock-out rate reveals how prepared a store was during a promotion. A low stock-out rate is usually preferred than a high one. However, a high stock-out rate is not necessarily detrimental because it may be caused by abnormally high sales.

Third dimension: The forecast for a promotion is the target that the supply chain gears for. The sales as compared to the forecast reveal how a promotion performed. Thus, this metric is cornerstone in answering the ‘How’ of promotion performance. A positive difference between sales and forecast indicates that sales exceeded forecast. A negative difference indicates that sales fell short of forecast. If sales equals forecast is when the target is hit. Sales exceeding forecast during a promotion is not necessarily preferred because this may result in increased stock-outs and lower sales during the post-promotion period, which may not be desirable.

Thus, the methodology for measuring and evaluating promotions rests on the three pillars as defined by the three dimensions above. This thesis proposes a method to analyze promotions along the three classified dimensions and suggests corresponding implications on promotion operations in terms of replenishment frequencies and sizes, store and DC inventory levels, and SKU sales.

Promotion Performance Cuboid: Figure 2 represents the framework for measuring and evaluating performance of promotions. The Promotion Performance Cuboid framework is made up of 18 different cubes, each of which represents one possible combination of the dimensions. In turn, each cube also reveals insights into the ‘Why’ of the promotion, revealing what may have truly happened during the promotion that led to the final outcome. The X-axis represents the excess supply at stores by the end of promotions and is classified into ‘High’, ‘Green Zone’, and ‘Low’ categories. The ‘High’ represents excess supply, the ‘Green Zone’ represents an acceptable level of supply, and the ‘Low’ represents less than average levels of supply of a SKU across stores by the end of a promotion. The Y-axis represents the performance of sales against forecast and is referred to as the forecast error. The ‘Negative’ implies sales is below forecast, ‘Positive’ implies sales exceeds forecast, and sales = forecast is self-explanatory. The Z-axis represents the stock-out rate and is classified into ‘High’ and ‘Low’. If the stock-out rate is above the average non-promotion stock-out rate (1.11% computed from this dataset), it is classified as ‘High’ and otherwise as ‘Low’.

Figure 2. Promotion Performance Cuboid.

Results

The dataset analyzed spans the point-of-sale data for product category P across BoxCo’s 1820 retail stores over the period September 1st, 2013 to August 31st, 2014. There are 937 SKU-promotions during this period and the level of granularity of the data is SKU-Store-Promotion. For analysis purposes, promotions in the dataset were categorized by discount class, based on the dollar value of the gift card offered during the promotion. The most popular promotion category with the largest amount of data was the $10 gift card promotion ($10GC). SKU, Store, and Promotion level analysis were conducted by applying the previously described Promotion Performance Cuboid framework on the $10GC promotions. The dataset consisted of 1.5 million records representing SKU-Store-Promotions.

Each cube of in Figures 3 and 4 represents the distribution of the $10GC SKU-Store-Promotion dataset against the cubes in the Promotion Performance Cuboid. The percentages displayed in a cube represent the number of SKU-Store-Promotions with the combination of DoS Diff %, Stock-outs, and sales performance against forecast, represented...
by the cube. Figure 3 displays the distribution of data across cubes in the ‘Low’ stock-out rate zone and Figure 4 displays the same for the ‘High’ stock-out zone. Thus, each cube also reveals a story of the possible implications regarding replenishments, inventory levels at stores and distribution centers, and SKU sales.

For example, in Figure 3 (‘Low’ stock-outs), SKU-store-promotions that falls into the cube represented by low DoS Diff %, and ‘Positive’ Forecast error (sales exceeding forecast) account for around 13% of $10GC SKU-store-promotions. This cube reveals that end of promotion inventory levels were low, the promoted SKU sold beyond forecast expectations, and that stock-outs for the SKU were low across stores. The high sales and the low stock-outs may reveal that stores held high inventory levels. The high sales and low end of promotion inventory levels reveal that the SKU may have sold well. The low end of promotion inventory levels and the low stock-outs reveal that replenishments from DCs to stores may have been on time and of the right size. Additionally, since sales exceed forecast and the DC was able to meet the demand, the retailer DC may have been holding high levels of inventory for the SKU, beyond those recommended by the forecast. Using these insights, the retailer may revise the forecast for the SKU and make necessary adjustments to DC inventory levels to and achieve higher profits with a similar sales success.

Similar analysis and insights may be derived for the remaining 17 cubes in the Promotion Performance Cuboid. The thesis analyzes the top 4 cubes in-depth, accounting for the highest distribution of data, and arrives at possible implications for the respective cubes.

Conclusion

The Promotion Performance Cuboid is a powerful tool to measure and evaluate performance of promotions. Measuring promotions along the dimensions defined by the Promotion Performance Cuboid helps isolate characteristics that are common to successful promotions. The successful characteristics may then be transferred and applied to promotions performing below par with an objective to improve their performance. Overall, this is expected to enhance the performance of promotion events leading to an increase of revenues and the profit potential.