Markdown Optimization Model for Retail Business

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Public Summary Report

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1 Introduction

It is crucial for retailers to determine the Markdown depth by decreasing the selling price for getting the highest margin. As a matter of fact, the markdown optimization is about recommending the best timing and price reduction by taking into account several factors, such as, the end-of-life period, future demand forecast, price elasticity, seasonality trend, current price and current inventory.

1.1 Benefits of using Markdown optimization:

- optimal discount: Markdown optimization can help retailers to find optimal discounts to their customers by analysing how they respond to an offer.

- Improve the timing: It is challenging for retailers to define when the price reduction should be applied so that they increase the margin to the maximum.

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- Management of the Omni-channel environment: Retailers can manage their pricing across multiple channels. By conducting data analysis, we can define the optimal pricing for all the business channels.

- Increase revenues: by finding the optimal price point, retailers can increase their revenues significantly.

1.2   Price elasticity:

The key element for Market optimization is to define how the products respond to price changes. In fact, items that are highly price elastic will have a large increase in demand with even small price reduction, whereas inelastic items will not move until the markdown is really deep. By measuring the PED, we are answering some crucial questions. In fact, a retailer wants to know whether;

- By lowering the price of a product, will that mean many more items are going to be sold?

- By raising the price of a product, will that affect the sales of other products?

2   Statistical Analysis:

Elastic items are easily replaceable by consumers, and considered as unnecessary items. Therefore, when the price goes up, the customer wouldn't buy this item. However, if it goes down, the customer might be convinced easily to buy this item at a lower price. On the other hand, Inelastic items are considered necessary items. In the event of a price rise, customers will still buy this item because, it is not easily replaceable, as there are no other alternatives. As a result, the demand is not much affected. At this point, lowering the price of the item wouldn't be profitable for Retailers, as they will be losing money. Determining the price elasticity of an item is a regression Analysis problem.

3   Building up the optimization model:

3.1   Forming and checking our data

As a First step, i will check the data sparsity and decide on the level on which we can perform our optimization model. Then, join the data all together in a way that is logical.

3.2   Defining Cannibalization, and picking the most negatively correlated item

Cannibalization occurs when there is a sales reduction in a given item or many items caused by the introduction of a new product or similar existing product to the list of items sold. The literatures, suggest that by including the five most significant cannibals for each product, it is going to make a great difference, in putting the optimization model in the right direction. I will calculate the correlation between the units sold and discount percentage for all possible combinations of SKUs in different brands.

3.3 Clustering

I will try to divide the items according to their price elasticity and some macro data defining the market and consumers behaviour into segments using clustering algorithm. As a matter of fact, by dividing the items into segments, I will set different price points in each segment to capture additional profits. This will solve the problem of having customers who would buy an item even at a higher price, and at the same time having customers who will not buy the item, but could buy it at a lower price, but still profitable price for the retailers.

3.4 Setting up the model

We will use a price elasticity model, as it is very intuitive to decide whether the right variables are being used with the right weight. However, at this point, it is difficult for us to determine what are the relevant variables to our model, and how does it impact our price elasticity. First, we will start with a regression model, where we will put in all of our variables, and start excluding according to the relevance, and impact of each variable. To do so, I suggested choosing the one that minimizes the Akaike or Bayesian Information Criterion.

3.5 Optimization model

Assuming that we have historical data where item price varied over time, I will train a predictive model to learn the price-demand dependency, and find a price point that maximizes the revenue. As revenue is a product of price and demand, and profit is a product of margin and demand. If a demand prediction model is built, it is sufficient to multiply the output of the model by the price of margin, to obtain a revenue of profit function that can be applied into an optimization algorithm. According to the business need and goals, constraints can be defined. For example, keeping a margin of 20%. We can add as many constraints as we want to the optimization algorithm in python.

4 Conclusion:

Once the optimized prices are calculated, it can be easy for the Retailer to calculate how the profit will vary, compared to the previous tools of pricing used. Also, by implementing the elaborated price optimization model, a Retailer could easily decide on which promotion method is more effective. For example which is better, applying a 50% off or buy one and get one?, In fact, it can be easily determined, by adding a flag of the promotion to be applied in the model. In a nutshell, having a good quality of data is going to play a big role in getting better results from the elaborated price optimization model. In addition, it can be a great tool to use, for any business decision, not only promotions. It was very challenging for me to elaborate the optimization model, in a way that is going to be used by the client easily and effectively. As a matter of fact, my client is a consultancy company, working with retailers operating in different segments, and facing different kind of challenges. By trying to keep the optimization model broad, I realised that it can be a powerful tool for any retailer, helping them in their decision making that is not only limited to markdown optimization matters.