A BEHAVIOR SIMULATION-BASED APPROACH TO IMPROVE RETAIL PERFORMANCE: A COMPREHENSIVE FRAMEWORK

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ABSTRACT

The retail industry is undergoing a profound transformation, driven by technological advancements including AI and evolving consumer behaviors. However, what retail decision making lacks at present is knowledge of and integration of ways to factor in customer behavioral drivers in purchase decisions. We show how this can be done through a four-step approach that will create a behavior simulation model for retail use cases. We use a real world problem as a guiding example to explain our approach. Our approach enables retailers to use behavioral drivers to nudge customers and better explainability of the decisions.

1   INTRODUCTION

In today's retail landscape, to build say, better pricing and promotion strategies, it is becoming increasingly crucial for industry players to go beyond traditional approaches and embrace a more holistic understanding of consumer behavior. One such powerful avenue is to tap into the vast reservoir of insights in consumer behavior literature, such as models that explain the intricacies of shoppers' preferences, decision-making processes, and purchasing patterns. By operationalizing this knowledge through a behavior model driven simulation, retailers can enhance marketing strategies, customer experience, and greater success in a highly competitive market. In this abstract we provide a 4 step process to create a simulate-ready behavior model.

2   APPROACH

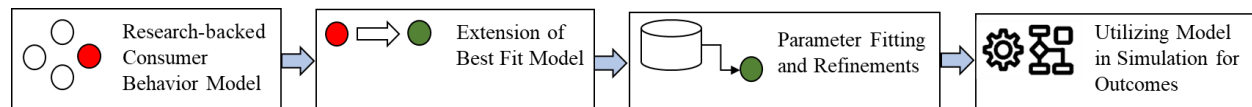The four-step process is given below. We use an example to better convey the solution:

Figure 1: Framework involving the four step process

Problem statement: Impact of price perception on retailer KPIs
Step 1: Research-backed Consumer Behavior Model
    This involves identifying the consumer behavior model in literature that best-fits the given problem statement. We delved into price perception literature (Mazumdar et al., 2005) and identified the most suitable memory-based reference price model (Briesch et al. 1997). By selecting the best fit model as a foundation, we can leverage its established frameworks, algorithms, and methodologies, saving time and effort in the development process.

Step 2: Extension of Best Fit Model
    In this step, we take the existing behavior model that aligns with the problem statement and extend it to incorporate additional factors which may be relevant for the problem. We extended the reference price

model by incorporating promotion cues. We used this augmented model to estimate consumers' brand choices over time, taking into account the influence of promotions. We also included models of customer purchase timing and purchase quantity, essential to identify sales in CPG retail.

Step 3: Parameter Fitting and Refinements

Once the extended model/s is in place, parameter fitting and refinements are performed to quantify the model. This involves calibrating the model's parameters using real-world data specific to the retail use case. We used historical sales records and consumer demographics data to train and fine-tune the three models mentioned earlier. These models were trained using logistic regression, multinomial logistic regression and Poisson regression method respectively. This is crucial as the accuracy of the model enables the simulation model to generate reliable predictions and outcomes that mirror the real-world retail environment.

Step 4: Utilizing the Model in Simulation to Identify Optimal Outcomes

Finally, we generate a synthetic population of consumers, which conforms to the distribution of population of interest and contains the relevant variables. This include demographic variables like household size, income, and the generated factors like reference price, loyalty, household inventory levels, etc. For each customer, the generated factors are initialized. Next, the behavior model/s is attached to each agent in the population. The promotions of a brand act as a lever which dictates the price of a brand at any given time t and based on the three models, the customer decides to purchase a brand at purchase occasion t. By running multiple simulations and varying the promotion cues, retailers can evaluate different promotional strategies and make informed decisions. Overall, the process led us to generate optimal promotion cue (consists of promotion depth, duration, depth and frequencies) for CPG brands (Sarkar et al., 2023). We found that reference price falls substantially due to longer promotion duration (Fig 2a). While promotions have a positive impact on sales, increasing promotion duration has diminishing returns.
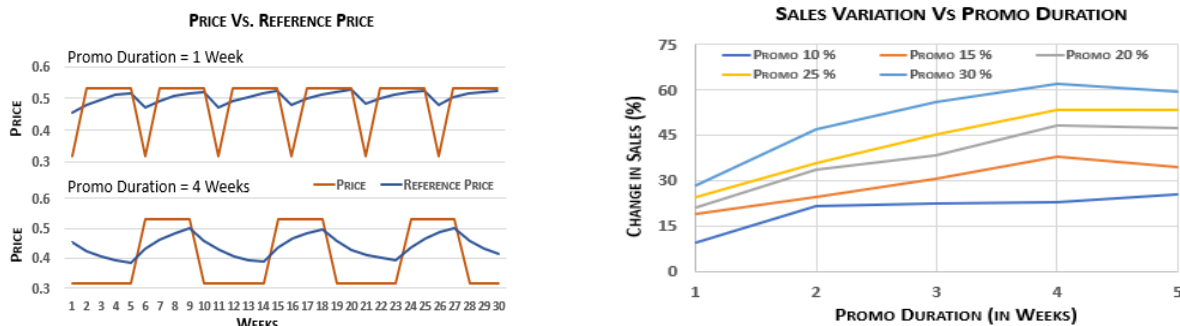

Figure 2: a) Reference price with price, b) Change in sales vs promotion duration

3   CONCLUSION

Our four-step approach offers a comprehensive methodology for creating a behavior driven simulation model tailored specifically for retail use cases. Using such an approach, retailers can harness the power of behavior driven simulations to drive data-driven decision-making. The method also have better explainability of outcomes, as it demonstrates the influence of behavioral factors on macro-level outcomes.

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