A Holistic Analytics Approach for Determining Effective Promotional Product Groupings

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Abstract

The study develops an ideal promotional product grouping strategy for a Fortune 500 consumer products company. The motivation of this research stems from a desire to increase the utilization of machine learning to identify the drivers of bundling in the industry and predict what label should be assigned to an SKU. Furthermore, an optimization model is designed to maximize the revenue generated from these bundles.

Introduction

Selecting appropriate pricing tactics for promotions can have a significant impact on the bottom line. However, the promotional analysis is currently handled manually. Our research aims to establish a computationally efficient method that takes various drivers into account and ultimately maximizes revenue.
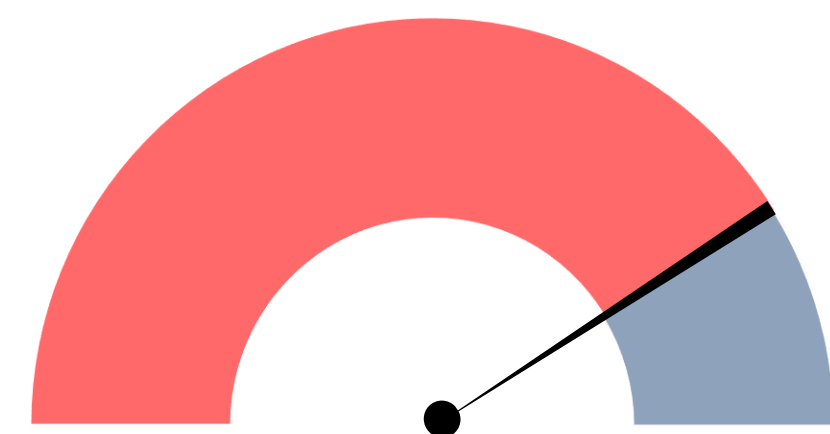
80% of the promotions generate no noticeable lift in sales, or dilute margins.

Research Questions

1) How can we identify the most successful promotion grouping amongst different competitors?
2) What are the factors that drive a successful promotion?
3) How can better predictions of promotional groupings provide decision-support to the business?

Literature Review

Study	Optimization	Driver-Identification	PPG Generation
1995, Rosenthal	✔		✔
2012, Bhargava			✔
2013, Sheikhzadeh		✔	✔
2017, Ye	✔		✔
Our Study	✔	✔	✔

Previous studies conducted in related areas either do not explain the drivers of promotion product group success or do not consider business sense behind the study. Our study aims to help the company identify the drivers of successful product groupings and subsequently generate PPGs that maximize their revenue.

Methodology

Weekly Sales Transaction → Combined Data ← Promotional Grouping

Data Preprocessing

Data Preparation
- Filter inconsistent data
- Encode categorical variables
- Normalize numerical variables

Feature Engineering
- **Promotions** – If Sale Price is less than 6% of Maximum Price
- **Duration** – Length (in days) when promotion is successful
- **Score** – Average of standardized Revenue, Quantity and Duration at Sub-Category and Size Range level

Splitting Dataset into Sub-Categories

Data - 1   Data - 2   Data - 3   ...   Data - 20

Modeling

Descriptive Analytics

Competitor Analysis
Ranked and selected the most successful PPG for every sub-category by comparing standardized score across multiple brands.

Predictive Analytics

Model – Logistic Regression
Distribution – Sigmoid
Function – Logit
Objective – To find factors driving the success of a promotion
Features used – Variant, Pack Type, Segment, Size Range, Sub-Segment, Promotions

Prescriptive Analytics

Objective Function:
Maximize (Revenue)

Decision Variables:
List of X_i to include to form PPG bundle.

Constraints:

1. $2 \le n(X_i) \le 6$
2. $X_i = \{0,1\}$
3. $\sum_{i=1}^{n} P(X_i) \le \frac{\sum_{j=1}^{N} P(x_j)}{N} * n(X_i)$
4. $\sum_{i=1}^{n} Q(X_i) * Corr(X_{i,n}) \ge \frac{\sum_{j=1}^{N} q(x_j)}{N} * 2n(X_i)$
5. $\sum_{i=1}^{n} R(X_i) \ge \frac{\sum_{j=1}^{N} n(x_j)}{N} * 2n(X_i)$
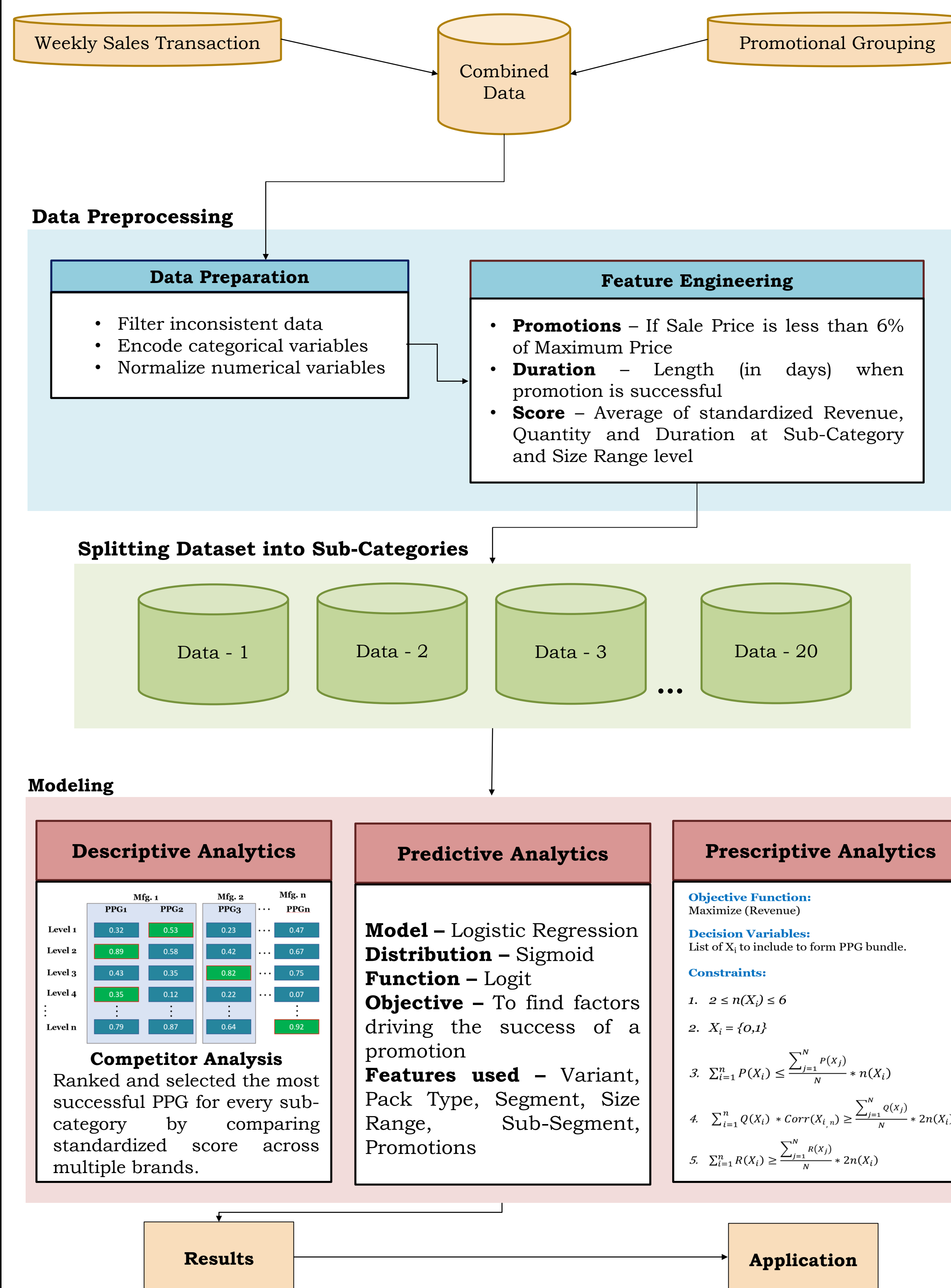
Results → Application
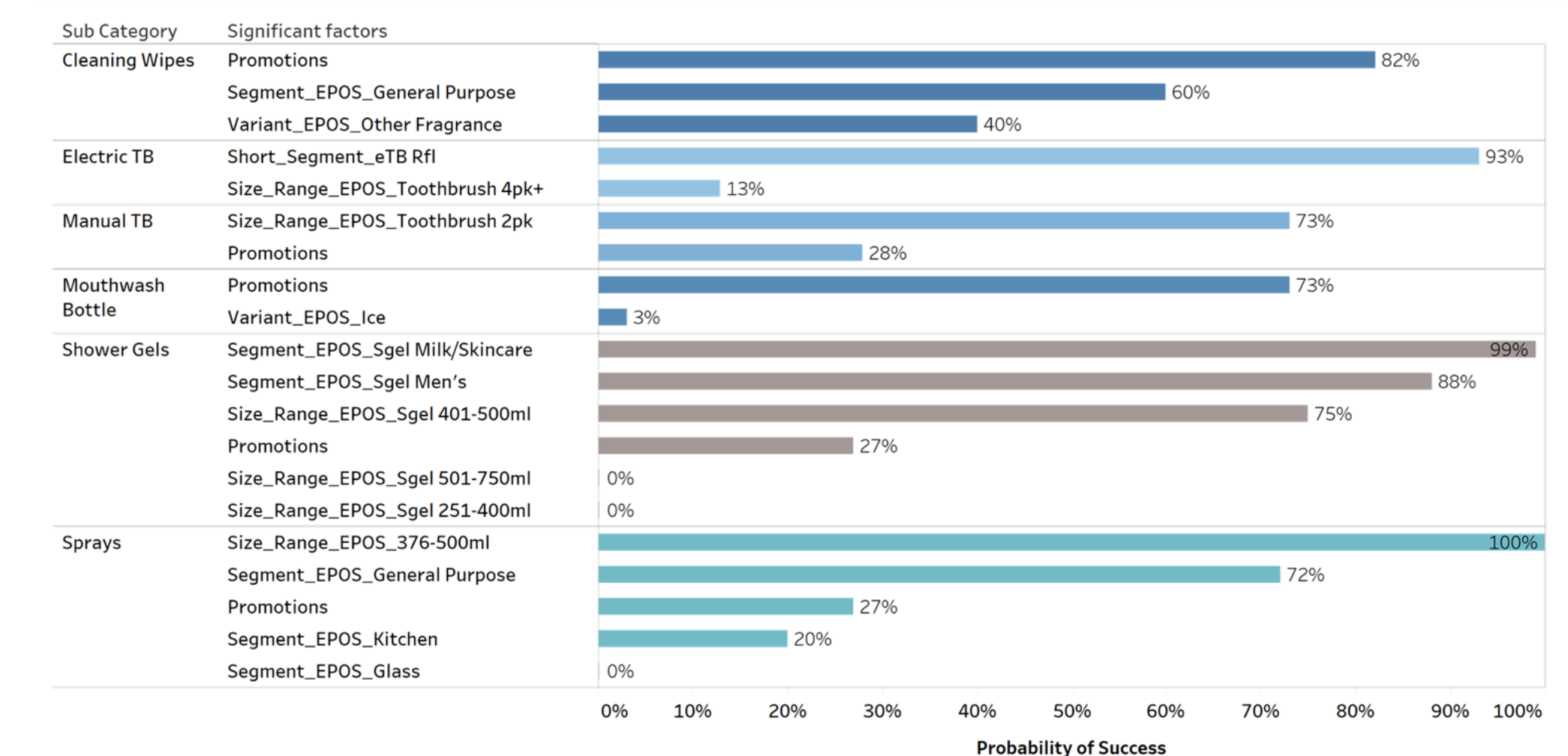
Figure 1: Process Flow

Results

Figure 2: Factors driving the success of promotion for selected sub-categories
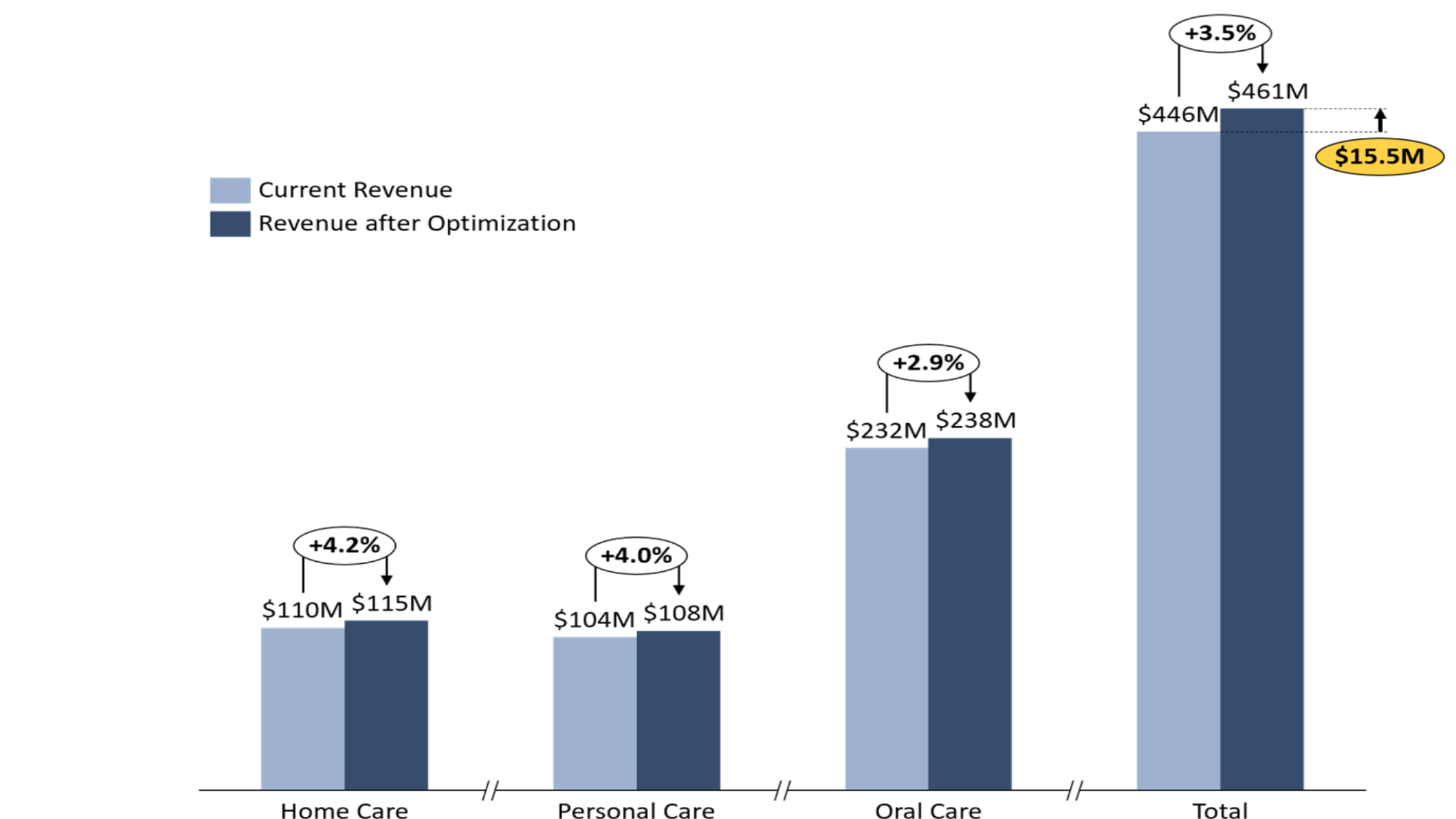

Figure 3: Growth in revenue due to optimized PPG bundle for each product category

Conclusions

- With an improved data driven approach of forming PPGs, the company has the potential to increase the revenue and quantity by 3.5% i.e., $15.5 million per year.
- The model can be extended to products within different sub-categories and brands to create attractive PPGs.
- Our study can be across multiple industries to identify opportunities to boost revenue.

Acknowledgement

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