

Supporting Product Innovation by Categorizing Products, Analyzing Flavors, and Defining Historical Trends



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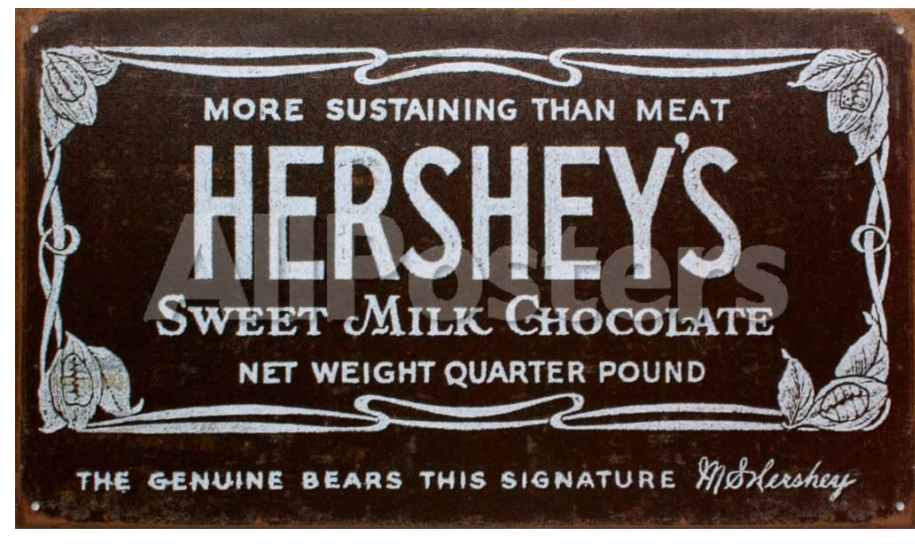
The Hershey Company Background

In 1894, Milton S. Hershey founded The Hershey Company and established its headquarters in Hershey, PA. The first chocolate bar was made in 1900 and first factory was constructed three years later. Hershey's regional office in Bentonville, AR opened in the summer of 2018.

Portrait of Milton S. Hershey



Hershey's Original Chocolate Bar



Hershey's Regional Office in Bentonville, AR



Today, Hershey owns more than 80 different brands and offers a wide variety of products, but most commonly known for their iconic chocolate bar. In 2018, Hershey led both the U.S. confectionery and chocolate markets, having a total market share of 30.3% and 43.5% respectively.

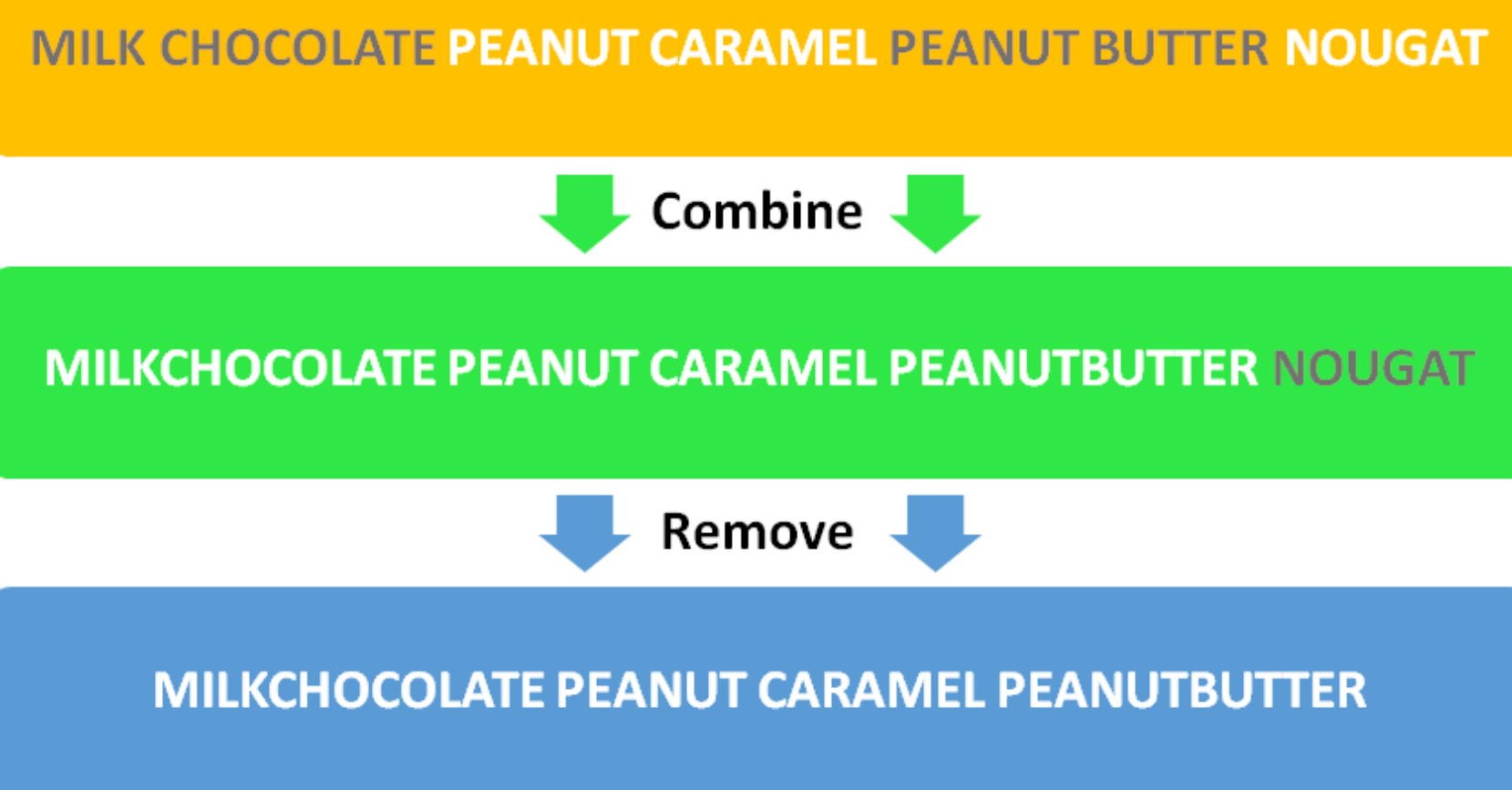


Solution Design



Data Cleansing

- Combine two-worded descriptions to differentiate between similar flavors and reduce error
- Remove non-value added descriptors that are not directly related to a meaningful flavor
- Products are left with descriptions that only contain the key terms explicitly defining its flavor composition

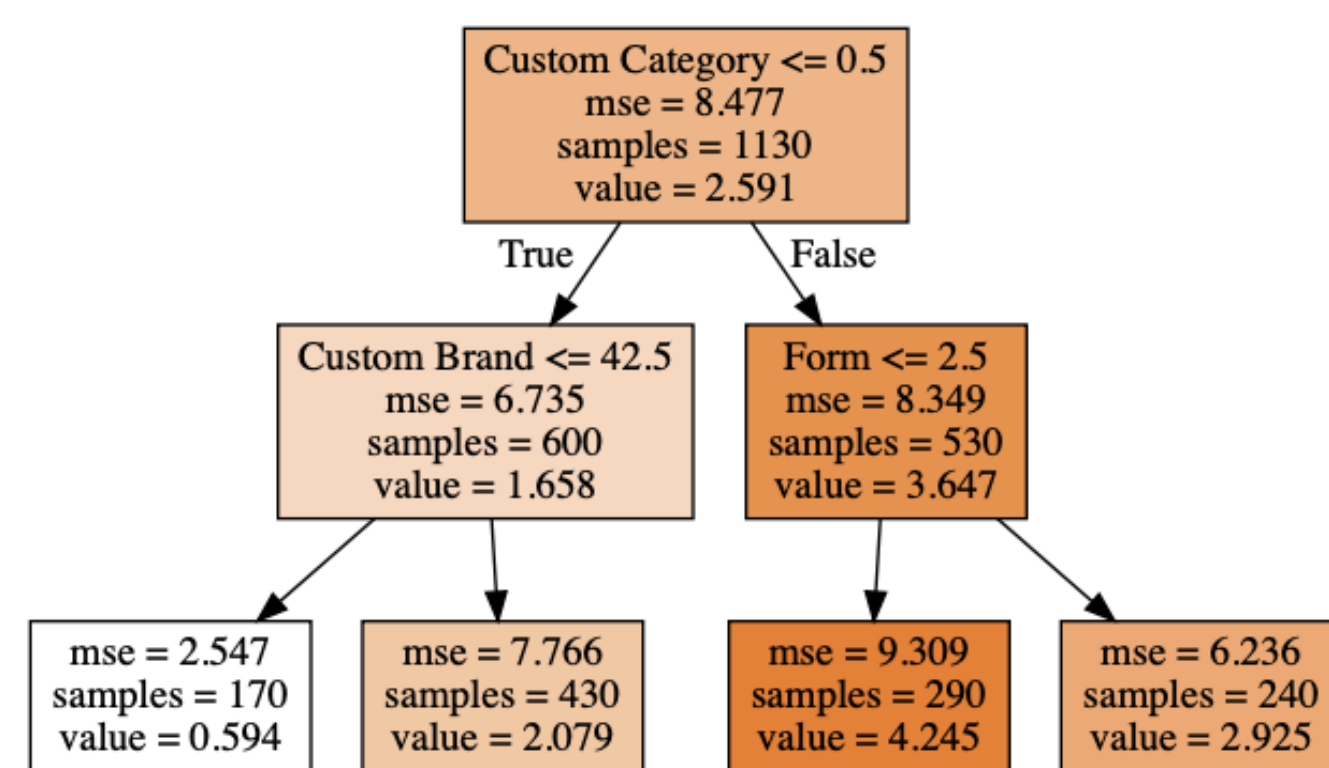
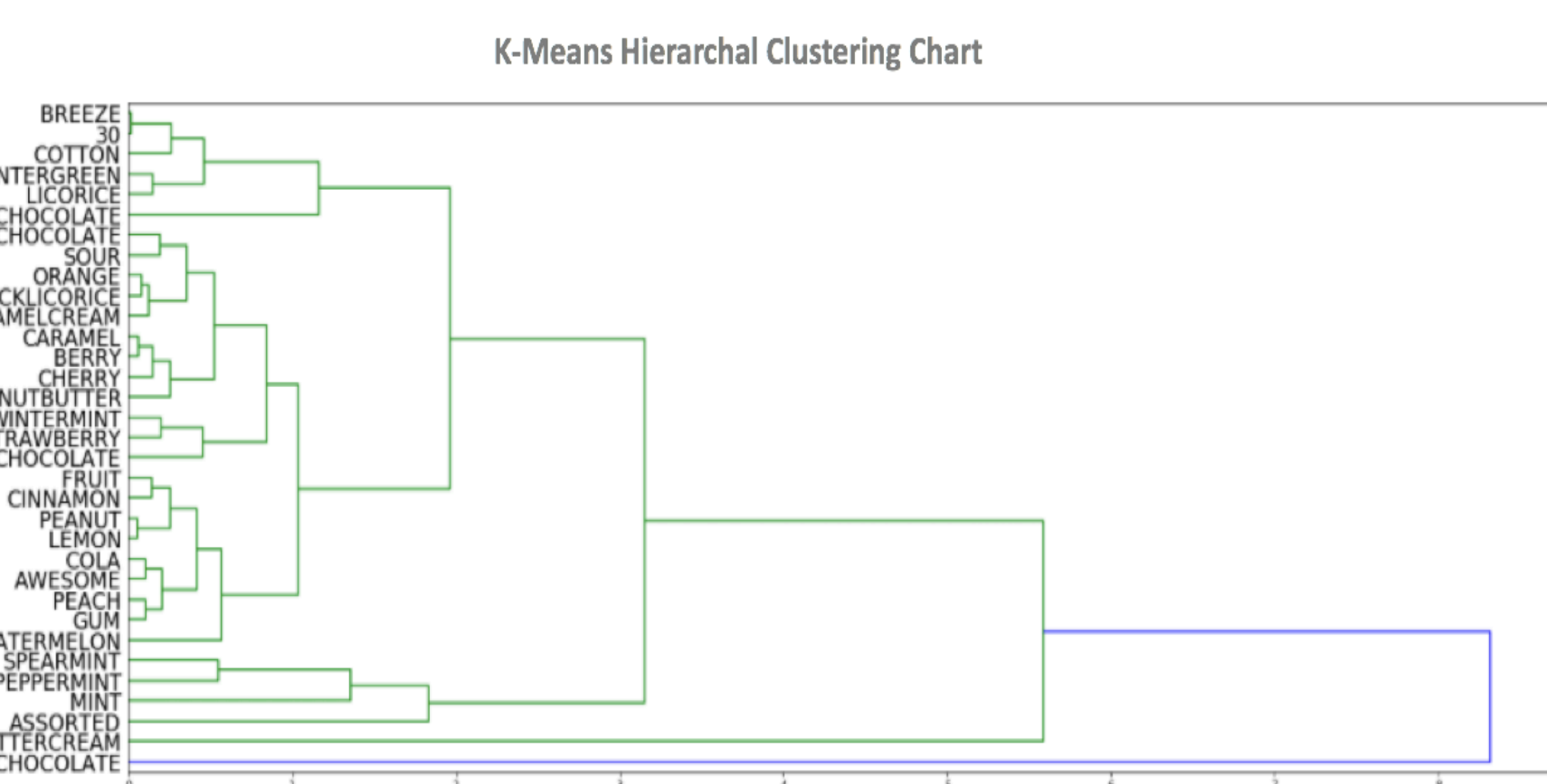
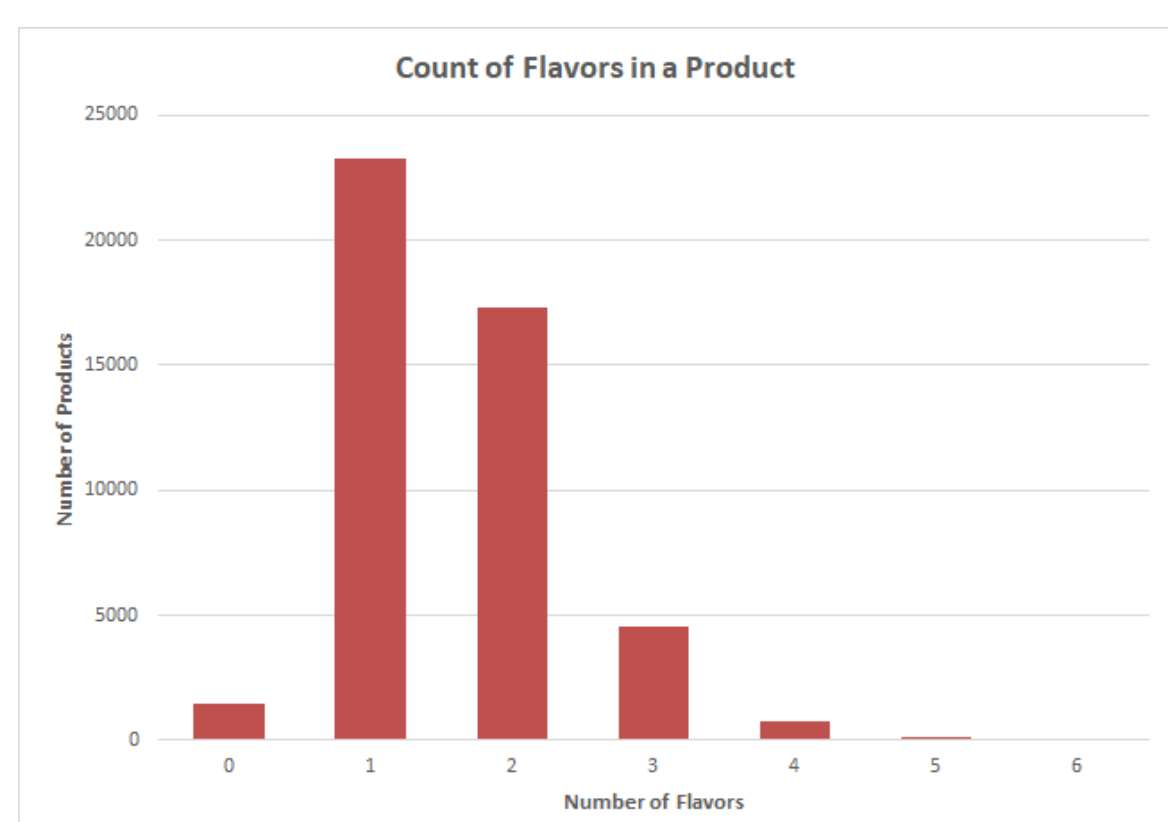
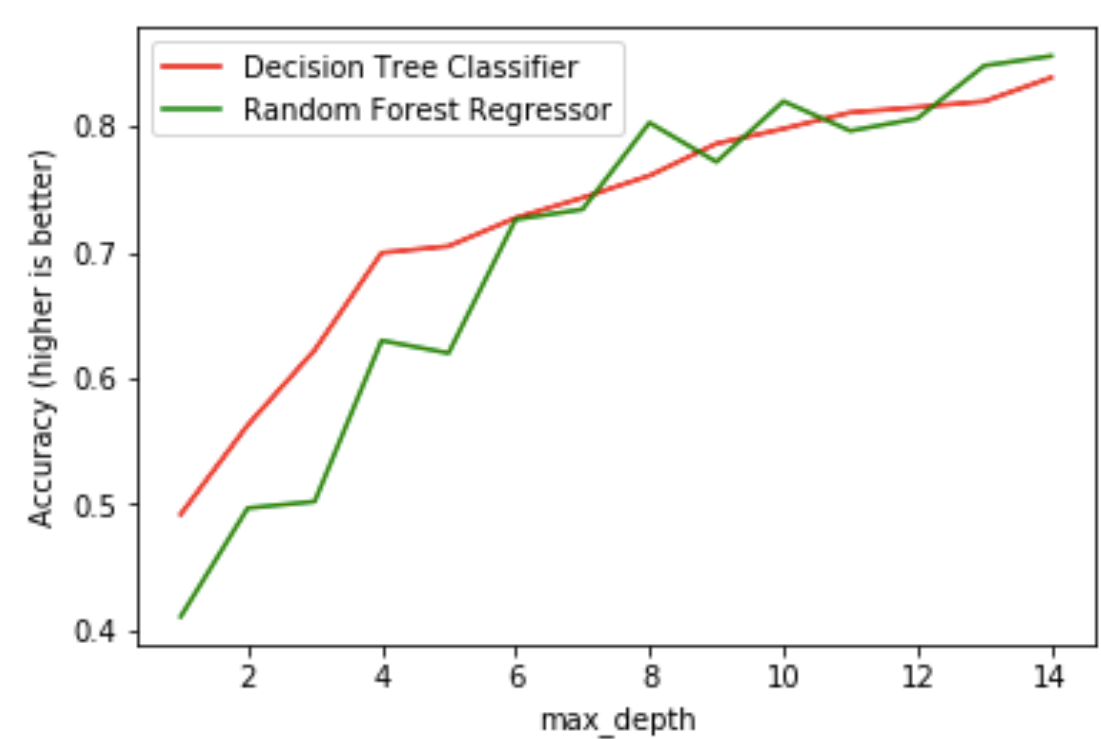


Statistical Techniques to Understand Data Characteristics

The key to developing a high quality method to categorize products and identify flavor trends was through data analytics and manipulation. As the project progressed, the depth of our team's data processing expanded to nearly all project development areas such as flavor cleansing, alternative decision methods, category validation, and supported our mixed-integer programming model for optimization.

Identifying flavor significance using the flavor/scent data required extensive string variable alterations and filtering to account for the multitude of naming inconsistencies. This allowed us to show flavor statistics and opened the door to Decision Tree Classifiers, Random Forest Regressors, K-Means Clustering, and Hierarchical Dendrograms of clusters algorithms.

All of these methods strengthened our ability to identify multiple levels of product grouping and paved the way to defining the Capstone categories.



Optimization Model Development

Using VBA coding in Excel, a priority matrix is used to assign products to specific categories based on the products flavor profile.

The objective function (1) maximizes both the priority level and total number of categories. It ensures that as many descriptive flavor categories are created subject to a dollar sales threshold.

The optimization model was checked for error in Ampl and executed in Python to display product assignments to new flavor categories.

Objective:

$$\max N + \sum_{i=1}^n U_i \quad (1)$$

Subject To:

$$\sum_{j=1}^m X_{ij} = 1 \quad \forall i \quad (2) \quad \sum_{j=1}^m C_j = N \quad (6)$$

$$\sum_{i=1}^n (T_i * X_{ij}) \geq M \quad \forall j \quad (3) \quad X_{ij} \leq P_{ij} \quad \forall i, j \quad (7)$$

$$\sum_{i=1}^n X_{ij} \leq L * C_j \quad \forall j \quad (4) \quad \sum_{j=1}^m (X_{ij} * P_{ij}) = U_i \quad \forall i \quad (8)$$

$$C_j \leq L * \sum_{i=1}^n X_{ij} \quad \forall j \quad (5)$$

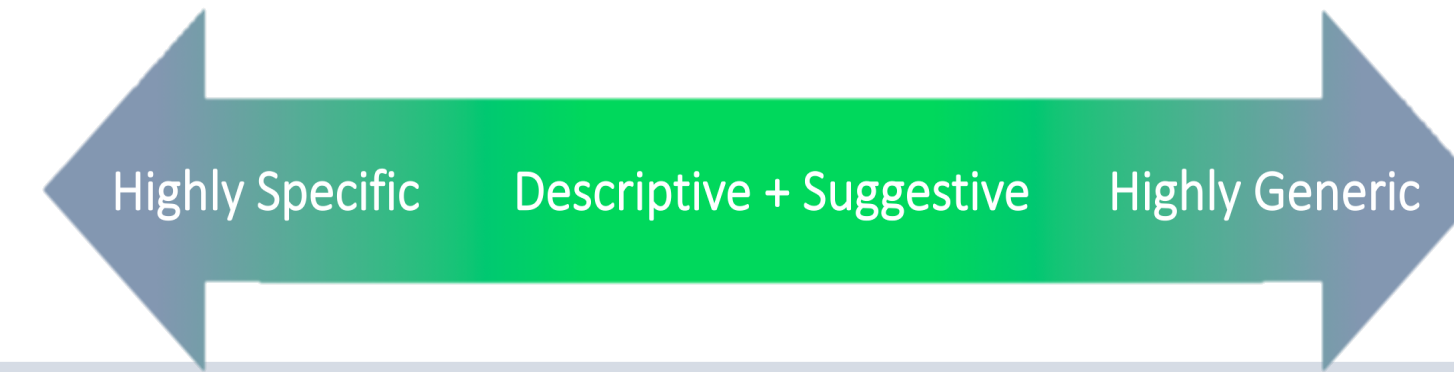
Problem Definition

The Strategy, Planning, and Analytics (SPA) team at Hershey's Walmart and Sam's Club Office struggles with inconsistent flavor descriptions and inadequate flavor groupings that hinder their ability to perform comprehensive data analysis on consumer purchases.

Before the team can perform analysis on flavor trends, they spend about 40 hours annually sorting products by flavor type. This step is highly labor intensive and reduces the time they can spend on value-added tasks. Once the analysis is complete, the SPA team provides the supply chain and sales teams with results to influence buyer negotiations.

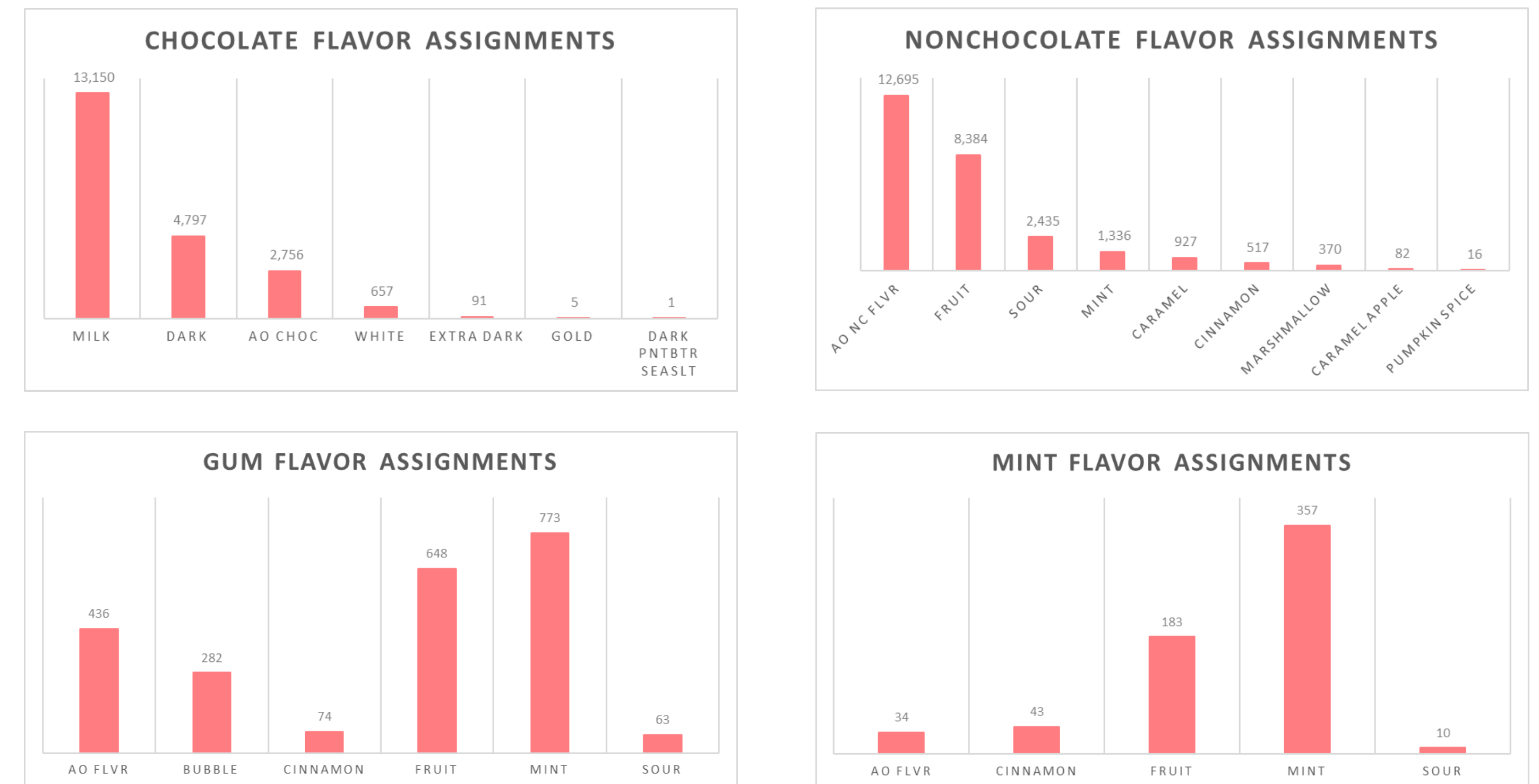


To reduce the time spent on manually sorting products by flavor, this project provides the SPA team with new, automatic Capstone flavor category assignments to serve as a 'happy medium' between the current category extremes.



Baseline Analysis

The baseline analysis revealed that nearly half of all non-chocolate products and approximately 3,000 chocolate products are automatically sorted into a 'catch-all' flavor category where no meaningful flavor information exists.

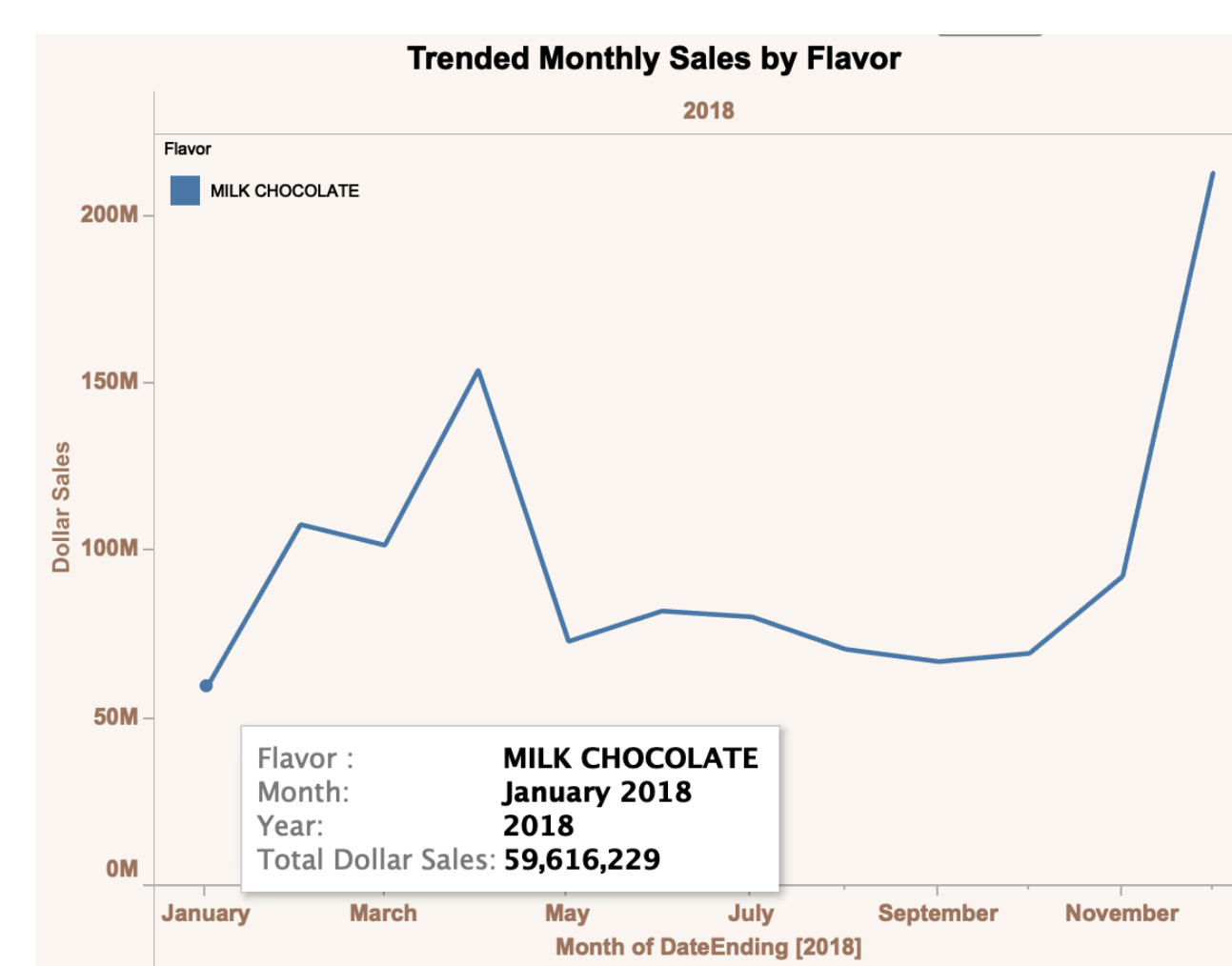
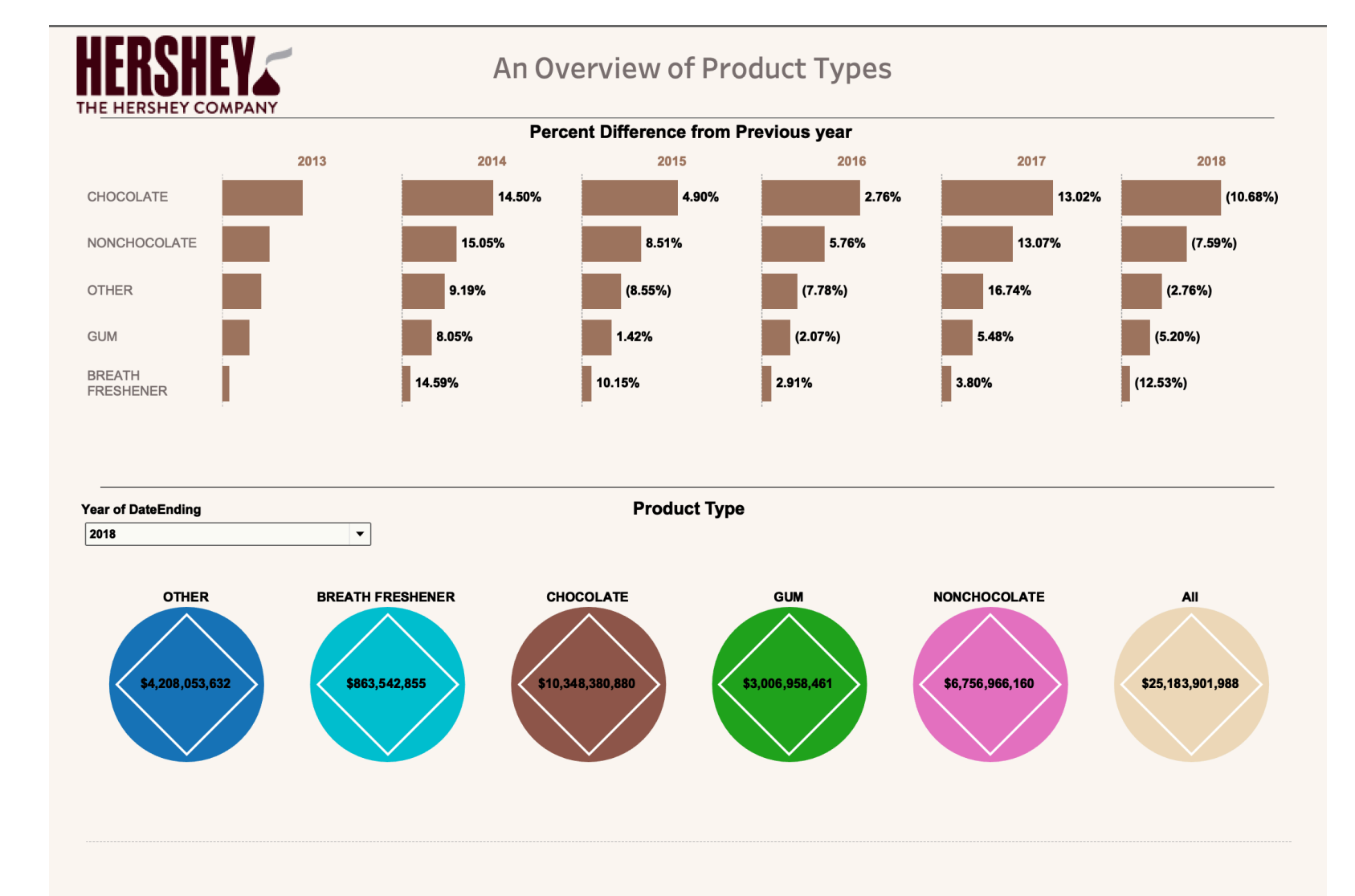


The broad flavor categories do not give enough insight into flavor trends across all products. By developing descriptive and meaningful flavor categories, The SPA team will have the ability to track consumer trends by flavor.

Tableau Dashboard

The categorical outputs from the optimization model are imported into Tableau to visualize the flavor trends.

The main Tableau dashboard contains general information about the total monthly sales for each product type and leads to a secondary dashboard containing more detailed information and charts.



The secondary dashboards are designed to display highly detailed information about the top performing custom key flavor values, flavors, product brands.

A line graph is used to display the monthly sales trends to understand the behavior of different flavors throughout the year. For each flavor, highlights the peak sales periods are emphasized.

