Improving Decision Support in Walmart's Fresh Produce Modular Design

University of Arkansas Industrial Engineering

Chase Kilty, Cherzulyn Garcia, Elizabeth Laster

Acknowledgments

Industry Partner:
Walmart Inc.

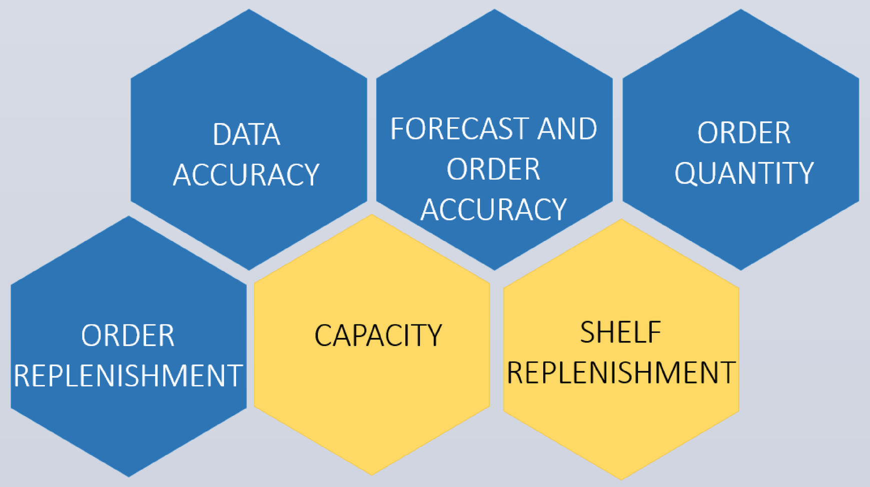
Primary Points of Contact:
Nicole Ryner, Director – Modular & Space Data Strategy
Keith Tisdale – Senior Manager II, Analytics - Category Space & Modular Development Produce

Abstract

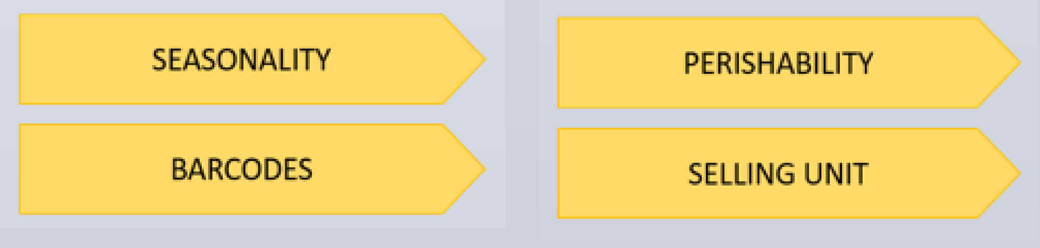
Walmart entered the grocery business in 1988 with the desire to become a one stop shop for customers worldwide. Grocery has grown and is responsible for over half the company's annual revenue. Within grocery, Walmart's fresh produce is responsible for approximately $12.5 billion dollars in annual sales and is essential for driving store traffic and repeat visits from customers. However, produce creates perishable inventories that drive waste and Walmart wants to design their fresh produce sections to reduce this waste while also balancing the occurrence of stock outs. Our team has developed a decision support tool that will aid Walmart in their modular design process by identifying produce stock keeping units (SKUs) that are underperforming. The tool takes historical sales data from store clusters and calculates weekly averages of sales, dollars lost due to waste, and throw percentage per SKU. It then indexes these values against the Walmart average to identify SKUs that need further attention from modular design managers. The tool's output enables better informed decision making when determining the amount of space to allocate to each SKU within Walmart's fresh produce departments. To provide further analysis, our team utilized the output of the tool to rank SKU performance based on their weekly throw percentage and weekly waste. Poor performing and well performing SKUs were then paired using a simple transportation model that paired SKUs based on similar sales volume. This provided Walmart recommendations on SKUs that can swap bin space allocation to improve waste and throw percentage without affecting weekly sales.

Current Issue

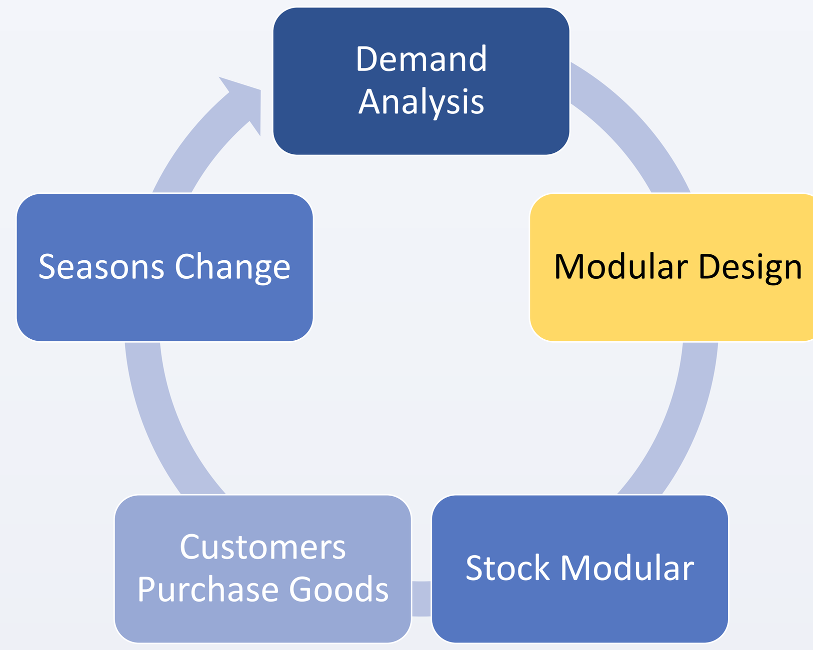
Every year, grocery stores throw billions of pounds of food due to six different organizational issues. The focus of this project was directed towards in-store processes of space allocation and shelf replenishment.



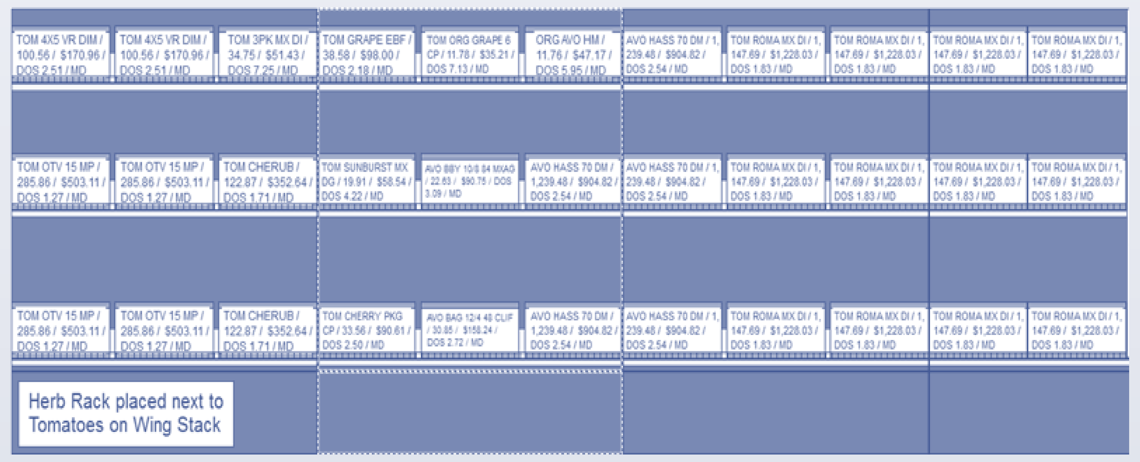
Fresh produce creates unique challenges when maintaining inventory and replenishment accuracy. These four factors below make correct modular design and replenishment methodology essential for maintaining a successful, efficient produce department



System Description



Walmart uses modular design to create exact representations of store layouts. The modulars are designed using JDA Space Planner. JDA Space Planner is able to incorporate many inputs into the modular design process. These include customer loyalty, customer demographics, product substitutability, and demand transferability.

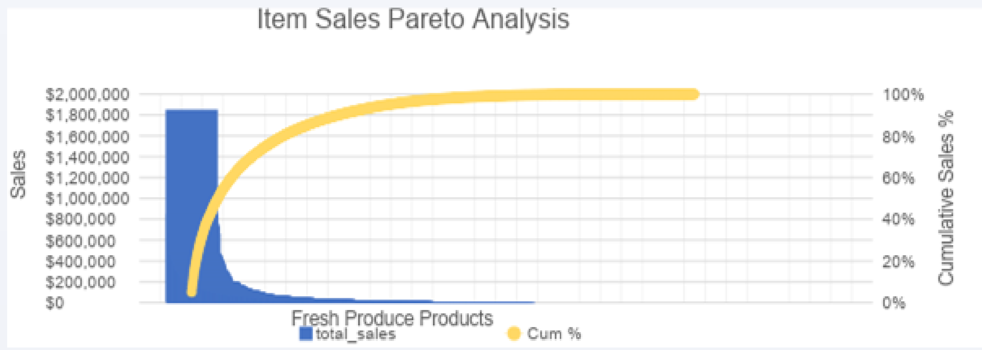


This is a current modular, designed using JDA Space Planner. Our project is designed to improve decision support in the modular design process by identifying poor performing SKUs.

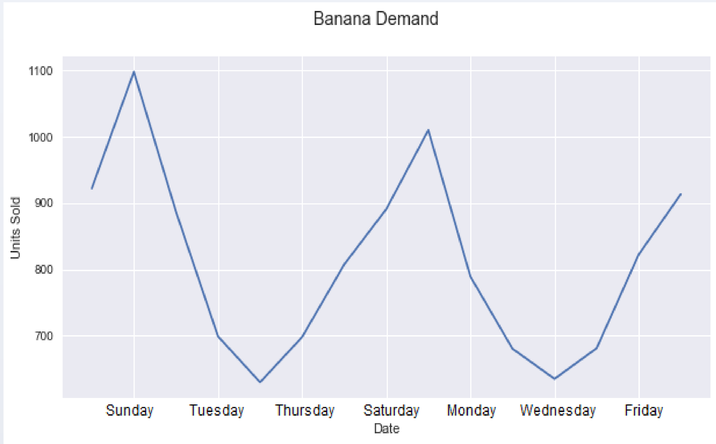
Analysis Process

This graphic details the high level process that turned the original product data file into SKU performance rankings by store. It included understanding the data, eliminating inaccurate data points, removing SKUs outside the scope of the project, and determining correct metrics to measure SKU performance.

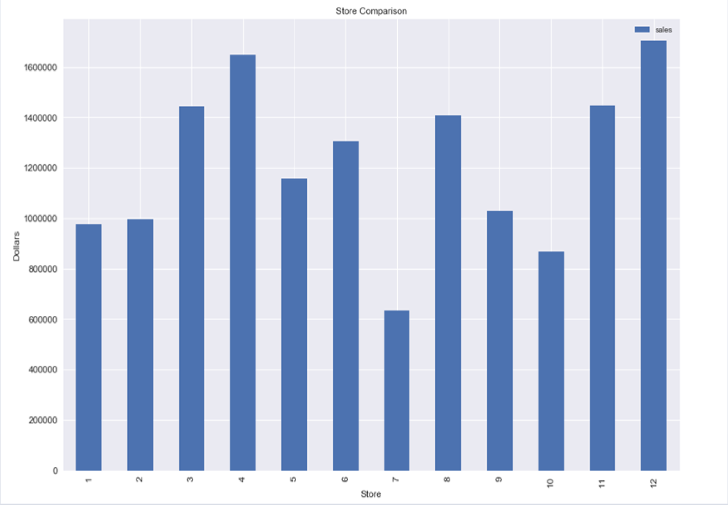
Preliminary Analysis



The initial data file contained over 36 million lines of daily sales data and was pulled from a network of 12 stores. A pareto analysis identified the SKUs responsible for generating the majority of Walmart's fresh produce sales.

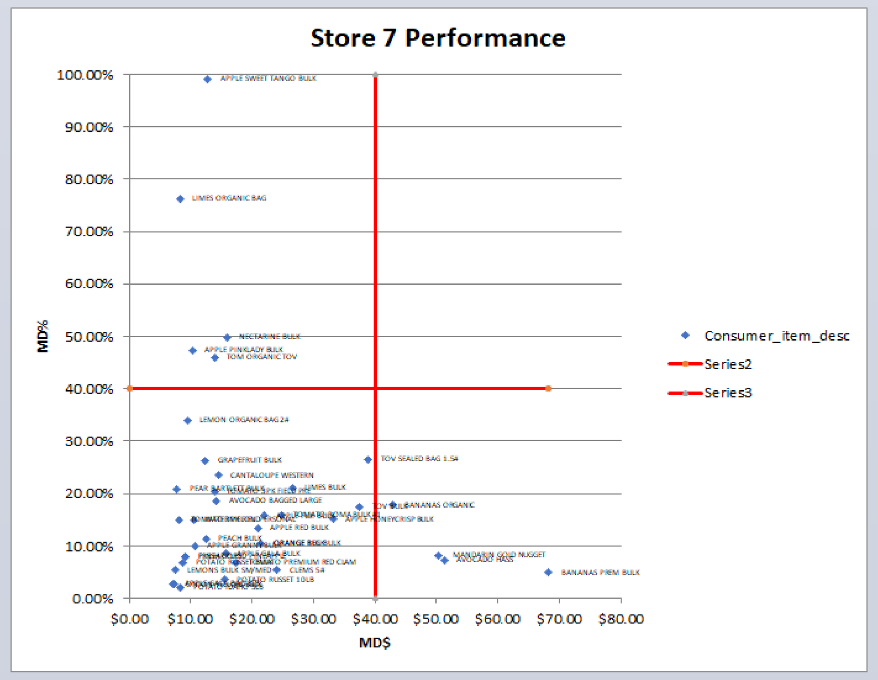


Graphing the demand of each item identified a weekly trend. Due to this pattern, our team decided to compare SKU performance based on weekly averages of sales and markdowns.



Each store was analyzed separately based on differences in sales and markdown volumes. The scope of the project was also narrowed to fruit SKUs to ensure our team was dealing with items sold on the same fixtures and within Reusable Plastic Containers (RPCs) with the same dimensions.

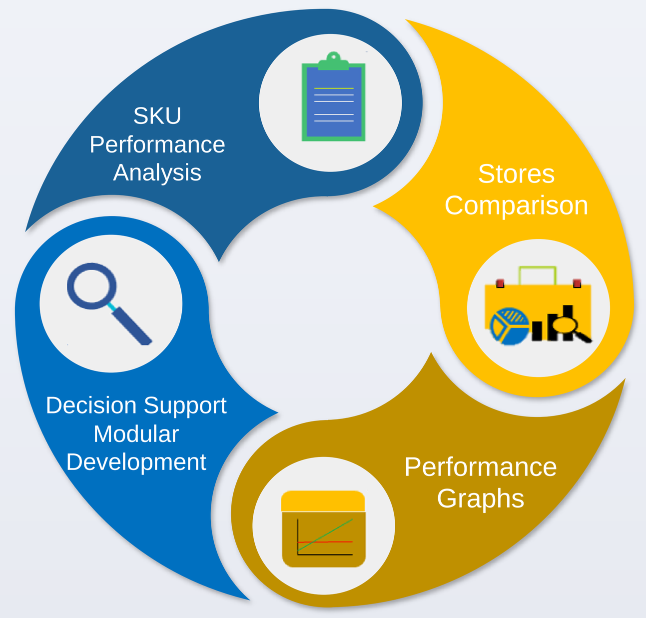
Performance Graphs



Many of the SKUs with the highest markdown dollars also had the highest average in sales. Markdown percent was calculated to provides a metric that identifies how often a SKU is thrown away in comparison to its sales. This chart is an example of SKUs plotted by their average weekly markdown dollars and average weekly markdown percent. The further the SKU from the origin, the worse it is performing on a weekly basis.

Decision Support Tool and Modeling

The tool uses historical sales data from a network of stores and calculates the average weekly sales, markdown dollars, and markdown percent for each SKU. The user can then select specific stores and the tool will highlight SKUs that are performing below or above average with a color coded format. The tool also generates graphs to visualize SKU performance based on their weekly markdown dollars and markdown percent. The tool enables better informed decision making by modular design managers by analyzing previous performance and identifying SKUs that require modular design changes in the future.



Our team utilized the logic behind a simple transportation model to provide recommendations on modular design improvements. SKU performance was ranked based on their distance from the origin and then the list of SKUs was split in half. SKUs were then paired in a way to minimize the difference in their average weekly sales. This generated a recommendation pairing in a way that would have the least amount of effect on weekly sales. This model works under the assumption that each SKU is currently allocated more than one bin. This ensures that SKUs are remain in the produce section and assortment is maintained.

Model Formulation

$$Min \sum_{i=1}^{\frac{n}{2}} \sum_{j=1}^{\frac{n}{2}} C_{ij} X_{ij}$$

s.t.

$$\sum_{i \in I} X_{ij} = 1 \qquad j = 1, \ldots, \frac{n}{2}$$

$$\sum_{j \in J} X_{ij} = 1 \qquad i = 1, \ldots, \frac{n}{2}$$

$$X_{ij} \in \{0, 1\}$$

C_{ij} = Difference in average weekly sales between SKU i and SKU j

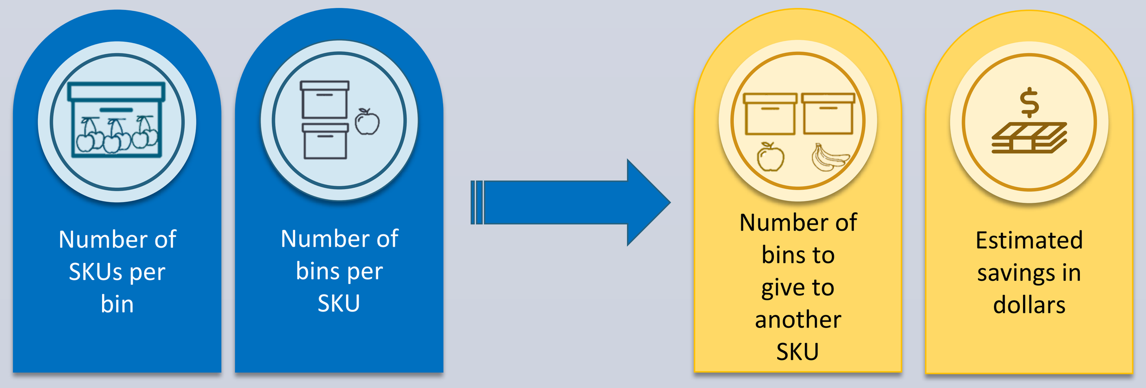
X_{ij} = 1 if SKU i is paired with SKU j

n = Number of SKUs analyzed in store

I = Top 50% of SKUs in store based on performance ranking

J = Bottom 50% of SKUs in store based on performance ranking

Future Recommendations



Data on modular capacity associated with the analyzed sales data could improve the tool in the future. It would allow for more detailed recommendations on the amount of space to allocate to each SKU and associate cost savings with the recommendation.