Machine Learning; Worth the Price of Admission?

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Sponsor: King's Hawaiian

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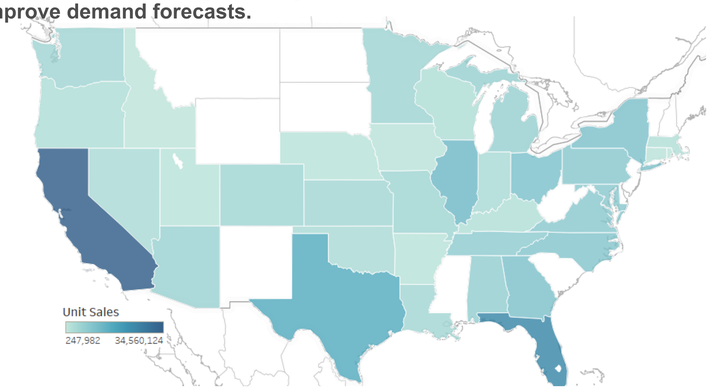
Motivation / Background

Highly seasonal build-to-stock CPGs rely on demand forecasts to plan their business. Forecast accuracy effects everything from capacity planning to order fulfillment to the inventory carried as safety stock. Poor forecasts affect holiday sales, growth potential, and obsolescence. Companies are seeking new ways to understand their customers and improve demand forecasts.



King's Hawaiian demand heat map for core products (2017)

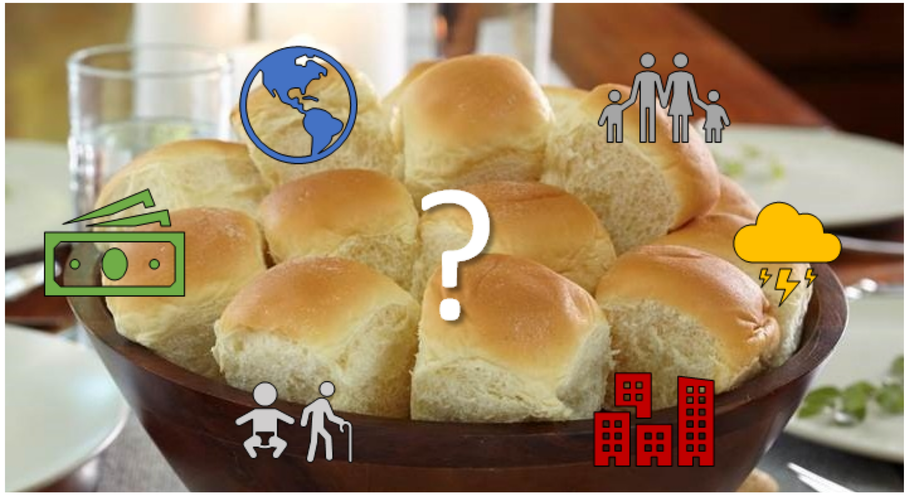
Key Question / Hypothesis

Is the improvement in demand forecast accuracy from a machine learning process over traditional statistical methods significant enough to justify the increased costs?

- **Which type of machine learning model should be selected?**
- **What data should be included to improve forecast accuracy?**
- **Can forecast accuracy be improved by increasing granularity of data?**

Relevant Literature

- **Ahmed, N. K., Atiya, A. F., Gayar, N. E., & El-Shishiny, H. (2010). An empirical comparison of machine learning models for time series forecasting. Econometric Reviews, 29(5-6), 594-621.**
- **Carbonneau, R., Laframboise, K., & Vahidov, R. (2008). Application of machine learning techniques for supply chain demand forecasting. European Journal of Operational Research, 184(3), 1140-1154.**



Methodology

1 Identify Alternative Data Potentially Affecting Demand

- **Actual Consumption**
- **Geography**
- **Socioeconomic**
- **Climate**
- **Shipments -> Only data source in current approach**

2 Prepare Data for Analysis

- **Data Exploration (e.g. trends, seasonality, outliers)**
- **Data Processing (e.g. aggregation)**
- **Data Integration**
- **Feature Engineering (i.e. selecting most relevant features)**

3 Apply Advanced Data Analytics

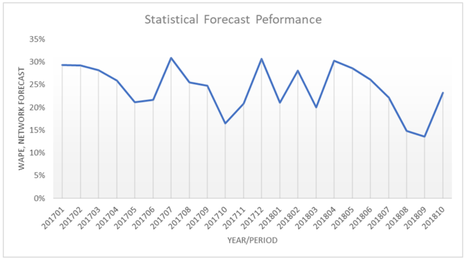
- **Multiple machine learning models with varying parameters**
  - **Artificial neural network**
  - **Support vector regression**
  - **Random forest**

4 Determine Whether It Is Worth the Effort

- **Performance measures compared to baseline**
  - **WAPE, WMAPE**
- **Estimate financial impact**
  - **Safety stock effect vs. cost of advanced analytics capability**

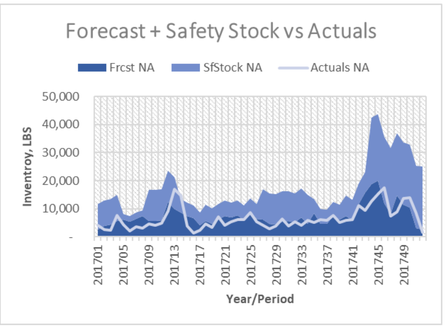
Invest in advanced data analytics capability?

Initial Results



- **Currently, applying Holt-Winter approach results in 15-30% monthly error for the total network**
- **99.5% service level is achieved with the safety stock calculated using the weekly forecast error**

- **Improving the forecast error will have a positive impact on current levels of safety stock**
- **However, the question is whether it will it be large enough to justify the cost of data and machine learning capability**



Example for a specific 3PL

Expected Contribution

This research will improve demand forecast accuracy by incorporating external data sources and machine learning, including a process for selecting relevant features from publicly available data.

The methodology will determine the threshold of forecast improvement required to lower safety stock to financially justify the increased costs of more advanced forecast techniques.

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