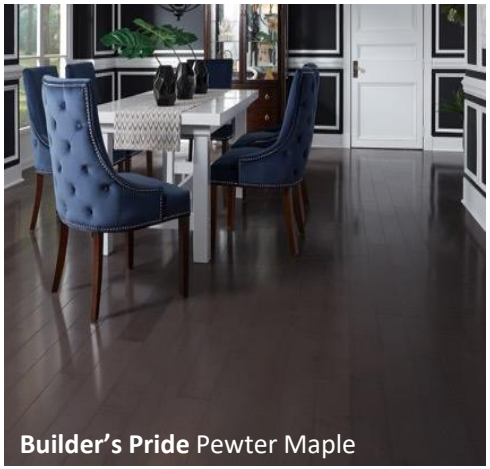


LUMBER LIQUIDATORS

Data Science at a Specialty Retailer

Nov 3, 2018

Bryan Kelley

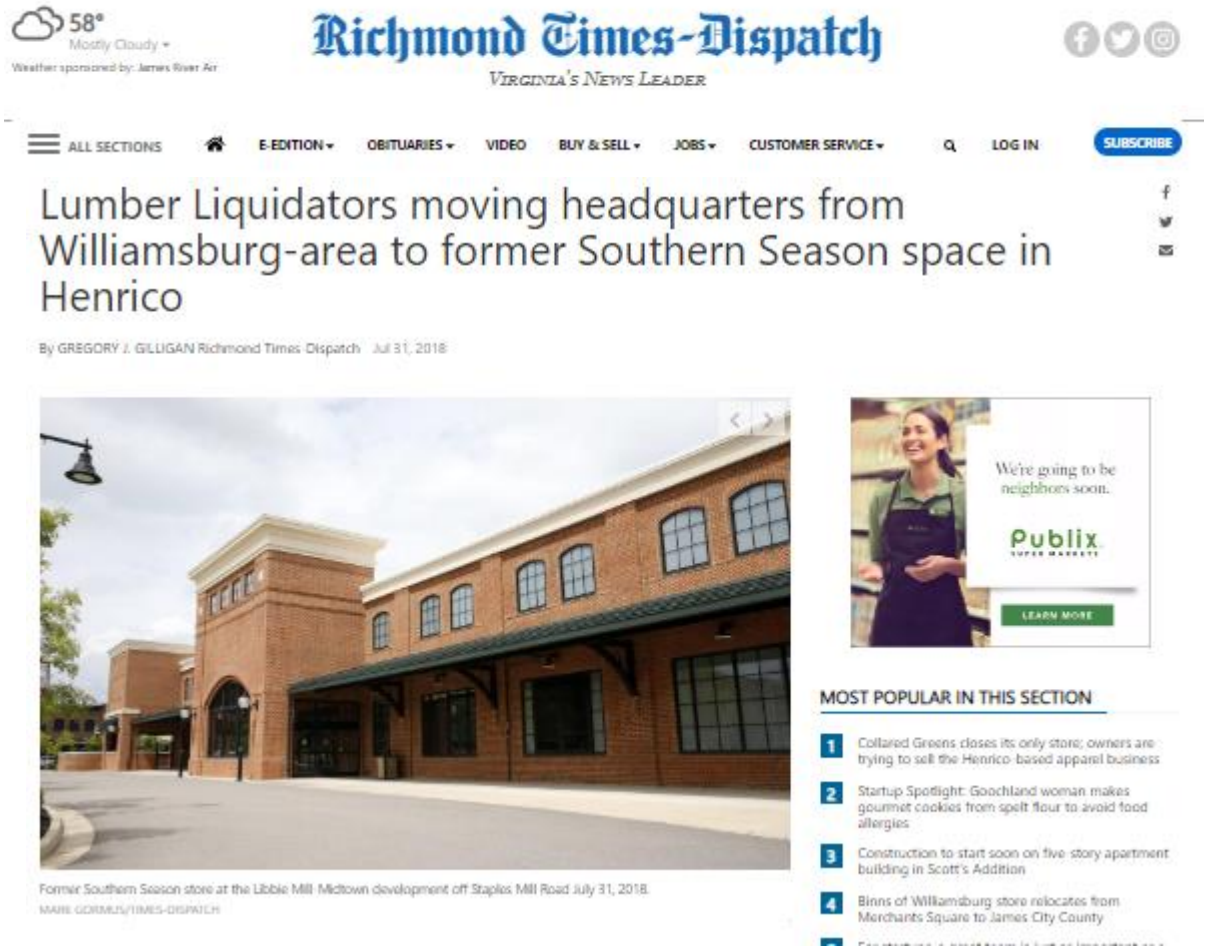
DAPT 2016

Lumber Liquidators

- Founded 1993; NYSE 2007
- Flooring Retailer: Solid wood, Engineered, Bamboo, Vinyl, Laminate, and more
- 400+ stores USA and Canada
- DIY and Pro customers; $1B+ annual revenue

Coming Soon!

- Targeting Q4 2019 to move to new Libbie Mill HQ (Staples Mill and Broad)



58° Mostly Cloudy

Weather sponsored by: James River Air

Richmond Times-Dispatch

VIRGINIA'S NEWS LEADER

ALL SECTIONS | E-EDITION | OBITUARIES | VIDEO | BUY & SELL | JOBS | CUSTOMER SERVICE | LOG IN | SUBSCRIBE

Lumber Liquidators moving headquarters from Williamsburg-area to former Southern Season space in Henrico

By GREGORY J. GILLIGAN Richmond Times-Dispatch Jul 31, 2018

Former Southern Season store at the Libbie Mill Midtown development off Staples Mill Road July 31, 2018.

MARE GORMUS/TIMES-DISPATCH

MOST POPULAR IN THIS SECTION

1. Collared Greens closes its only store; owners are trying to sell the Henrico-based apparel business
2. Startup Spotlight: Goochland woman makes gourmet cookies from spelt flour to avoid food allergies
3. Construction to start soon on five-story apartment building in Scott's Addition
4. Binns of Williamsburg store relocates from Merchants Square to James City County

My Role

- Manager, Financial Planning & Analysis
  - Wrangler of big data
  - Answerer of tough questions
  - Nay-sayer and parade-rainer (most of the time)
- Financial Planning & Analysis
  - Unit within Finance
  - Budgeting and planning
  - Analysis of new initiatives and tests
  - Corporate strategy development
  - Reporting and BI
- Partner with
  - Supply Chain, Store Operations, Marketing, Merchandising, and Finance

Three Examples

- Budgeting and Planning
  - Prophet package in R to create daily Total Company sales forecasts
- Supply Chain / Inventory Management
  - Cluster package in R as input to ABC inventory management
- Merchandising
  - Price Elasticity modeling for planning price changes for our assortment

Daily Total Company Sales Forecasting

- Problem:
  - Company must plan for certain levels of sales in order to manage expenses accordingly
  - Each month the total company financial plan must be broken down from a top-line number and spread to each day and store

- Solution:
  - Use the Prophet package in R to create a timeseries forecast for Total Company sales at the day level and spread the monthly financial plan down to the individual day

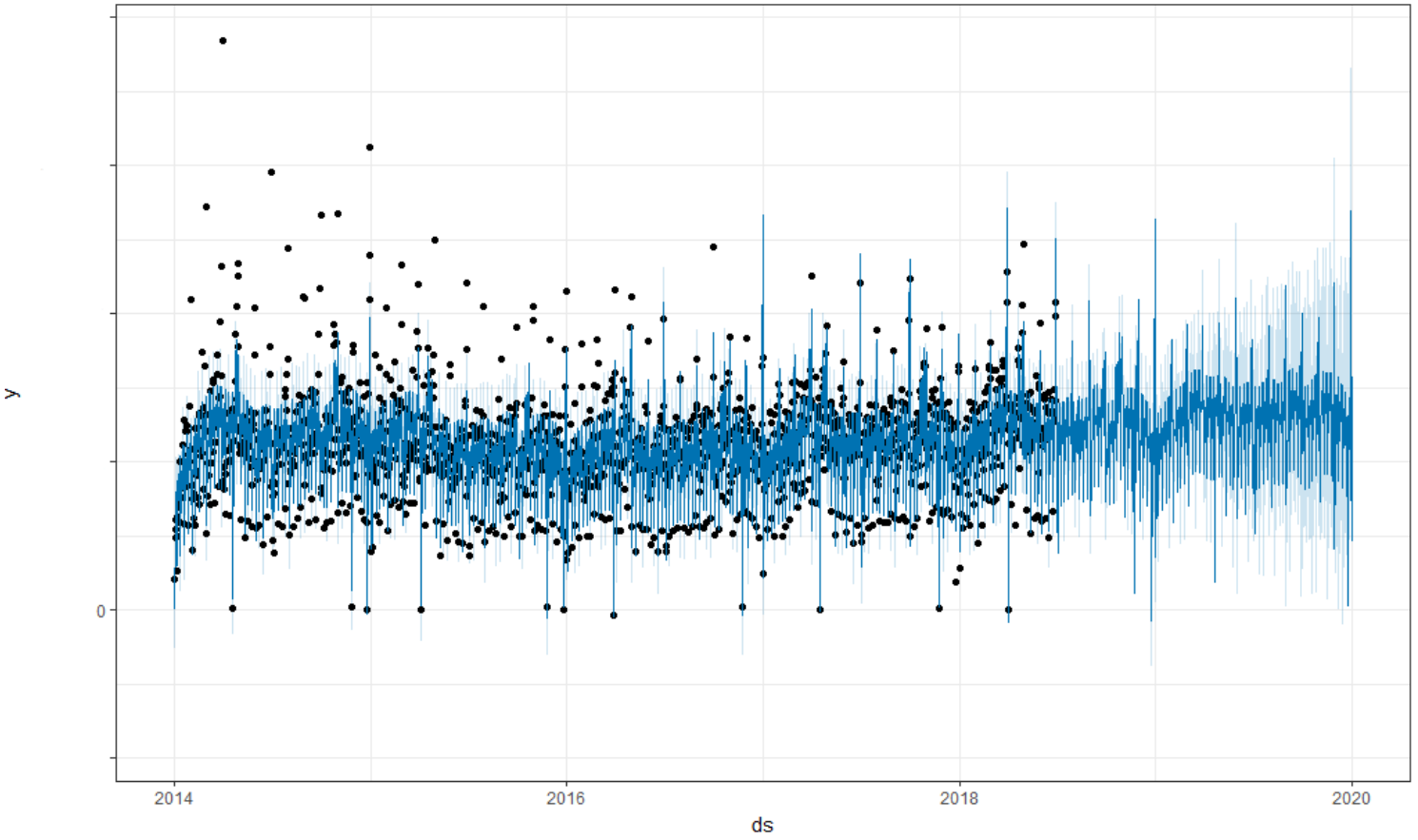
Daily Total Company Sales Forecasting

- Prophet
  - Open source forecasting package
  - Developed by Sean J. Taylor and Ben Letham at Facebook

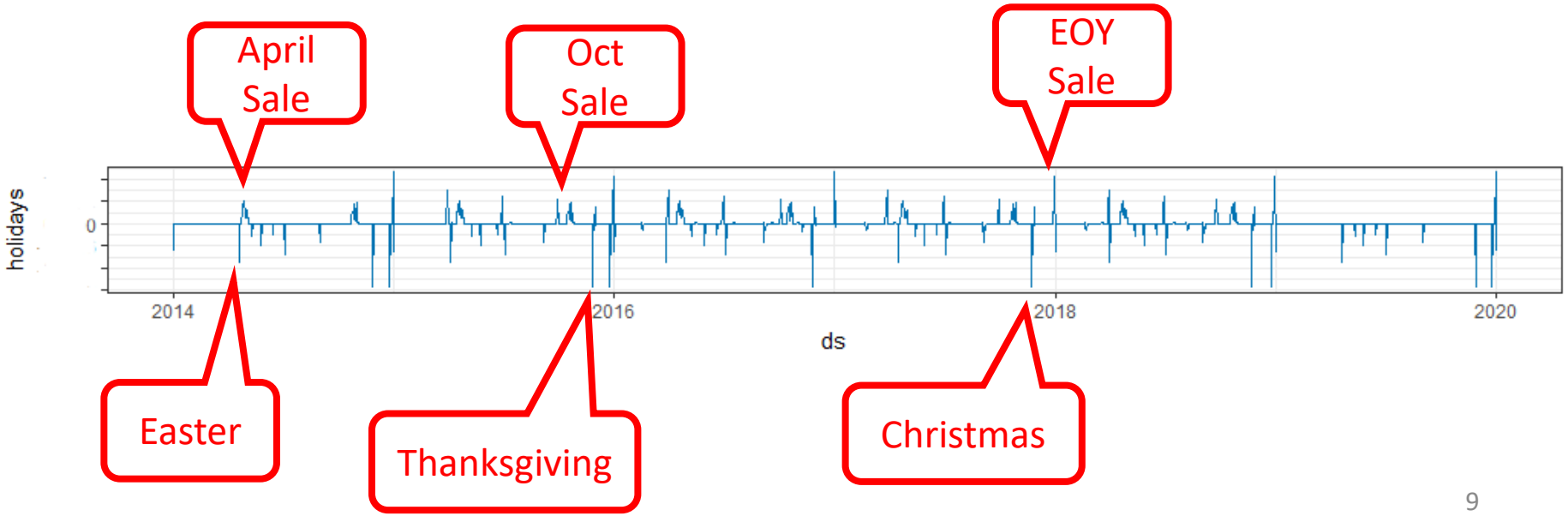
- *At its core, the Prophet procedure is an additive regression model with four main components:*
  - *A piecewise linear or logistic growth curve trend. Prophet automatically detects changes in trends by selecting changepoints from the data.*
  - *A yearly seasonal component modeled using Fourier series.*
  - *A weekly seasonal component using dummy variables.*
  - *A user-provided list of important holidays.*
- https://research.fb.com/prophet-forecasting-at-scale/

Daily Total Company Sales Forecasting

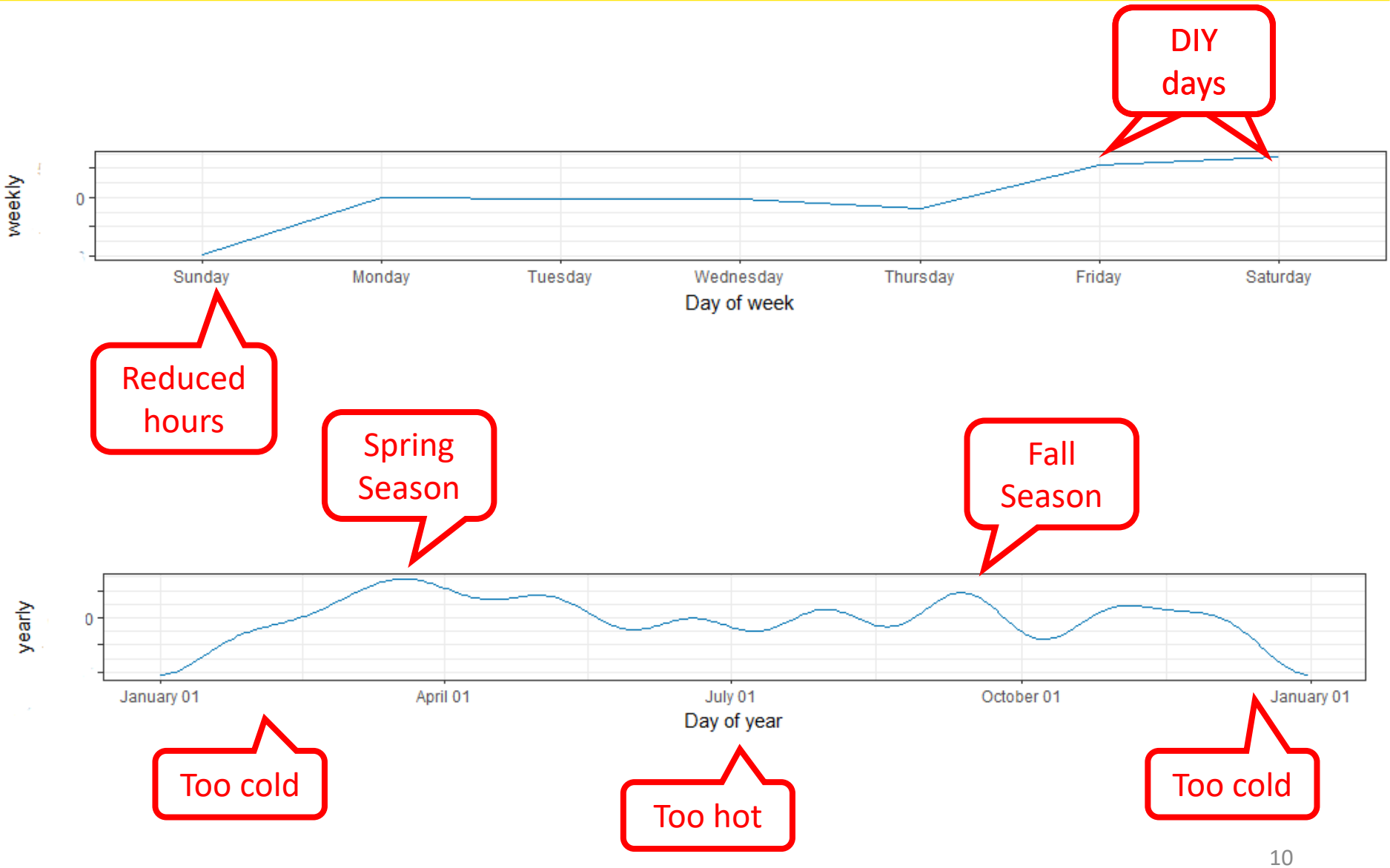
- Forecasting the amount of $ picked up by customers each day (PGI)
- Retailers are closed, have promotions and marketing, and are subject to consumer demand



Daily Total Company Sales Forecasting

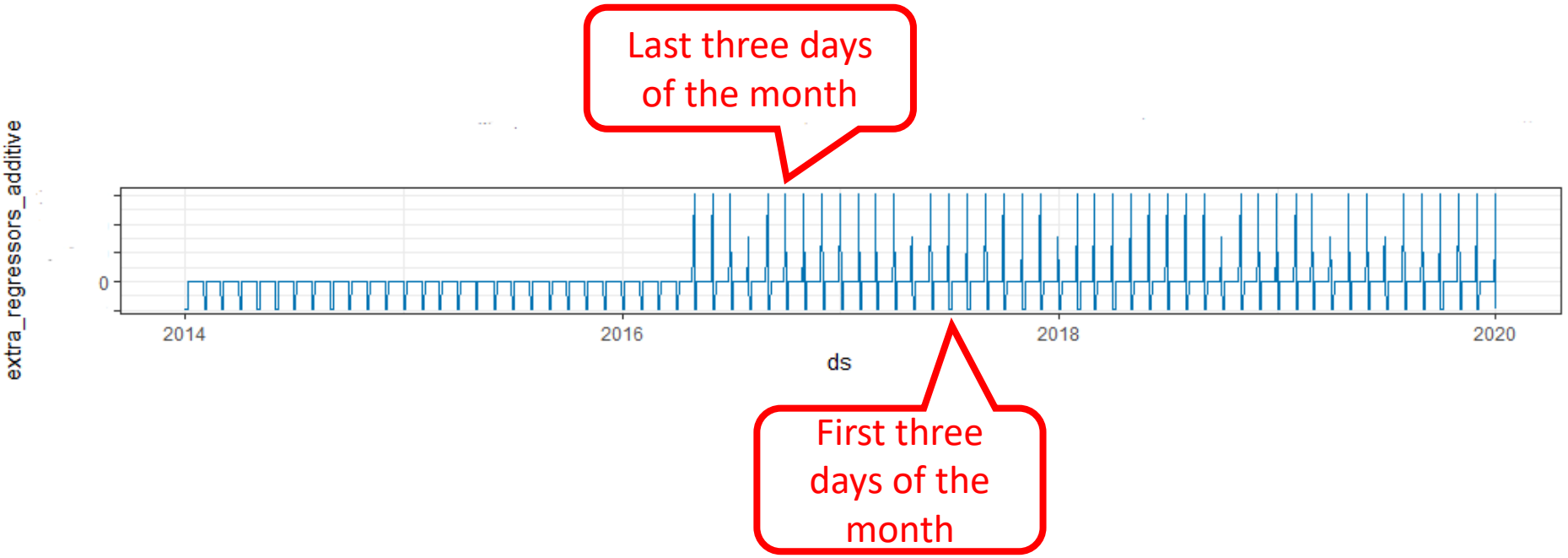


Daily Total Company Sales Forecasting



Daily Total Company Sales Forecasting

- We are a commissioned-based sales force
- Know your business but more importantly…FOLLOW THE MONEY



ABC Inventory Management

- Problem
  - Customers can only buy what we have in stock
  - Maintain inventory levels that allow for customers to buy what they are looking for
  - There is limited resources on the Inventory Management team and limited budget for inventory investments

- Solution
  - Categorize the articles in our assortment using clustering techniques in R
  - “A” SKU’s receive incremental oversight as they are key performing SKU’s in the assortment
  - “C” SKU’s receive incremental investments; more volatile SKU’s with flow or forecasting challenges

ABC Inventory Management

- Shiny app for data exploration with business partners

Inventory ABC

Clustering Method

K-means

- K-Means - Starts by drawing a center point then adds observations
- PAM - Partitioning Around Medoids - Advanced form of K-means clustering
- Hierarchical - Starts by putting each observation in an individual cluster and reducing them down
- Ward D - Variation of Hierarchical method
- Single - Variation of Hierarchical method
- Agnes - Advanced form of Hierarchical method

Cluster count

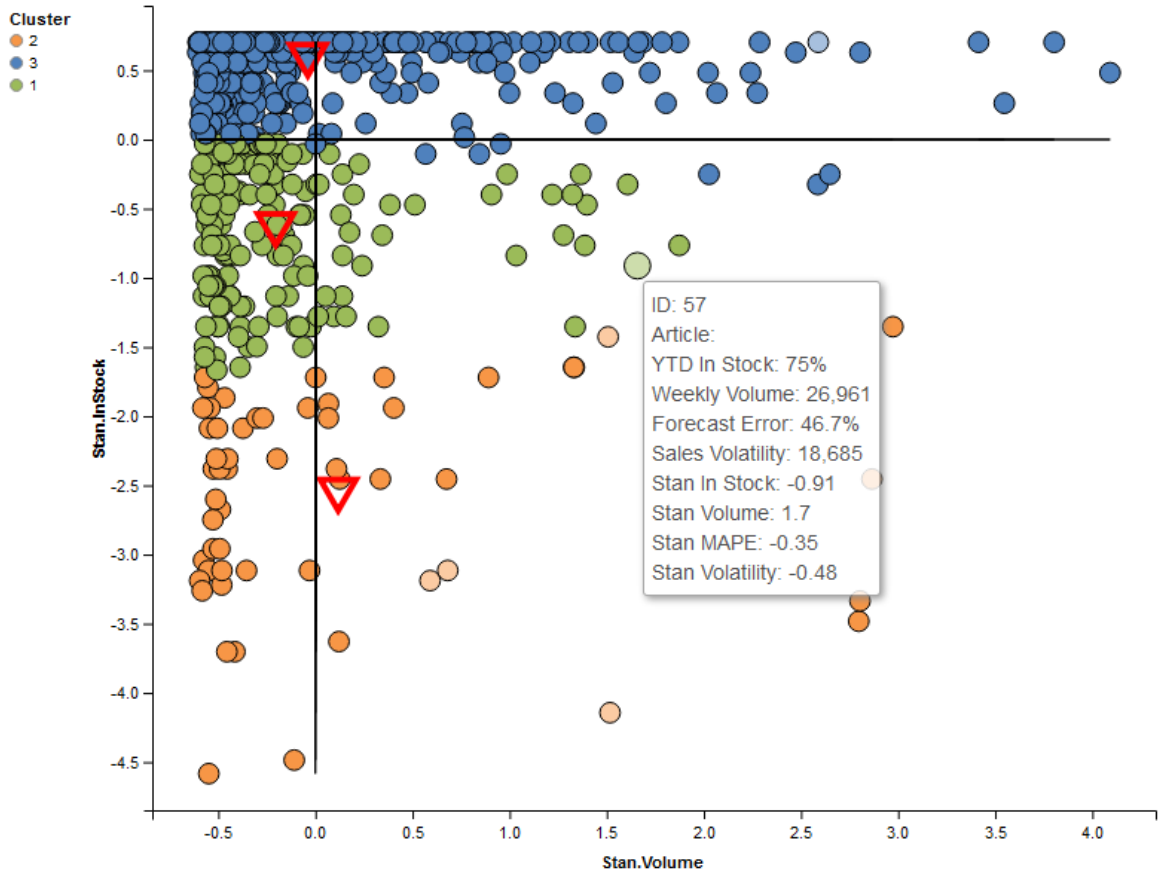
3

Columns to cluster:

- [x] Stan.Volume
- [x] Stan.InStock
- [ ] Stan.MAPE
- [ ] Stan.RelStdDev

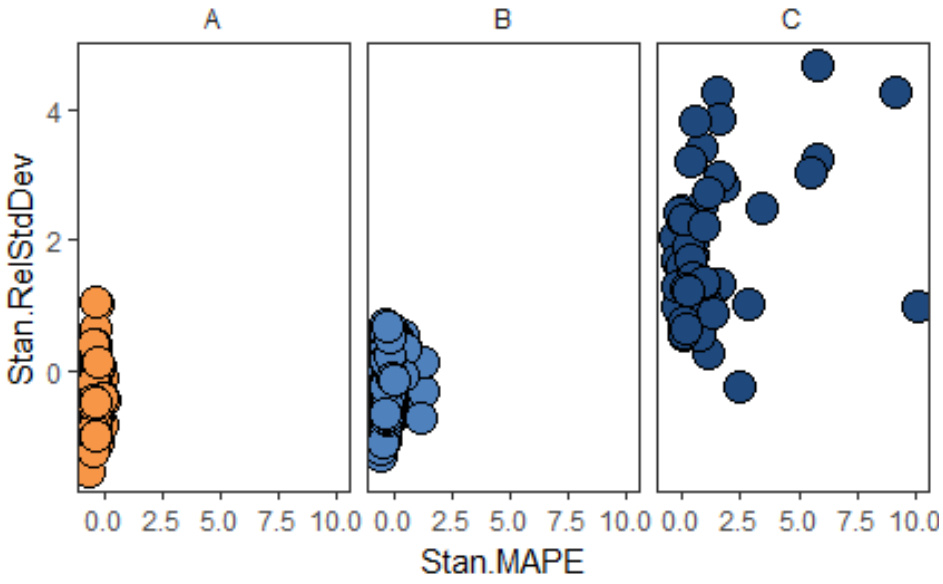
Exclusions:

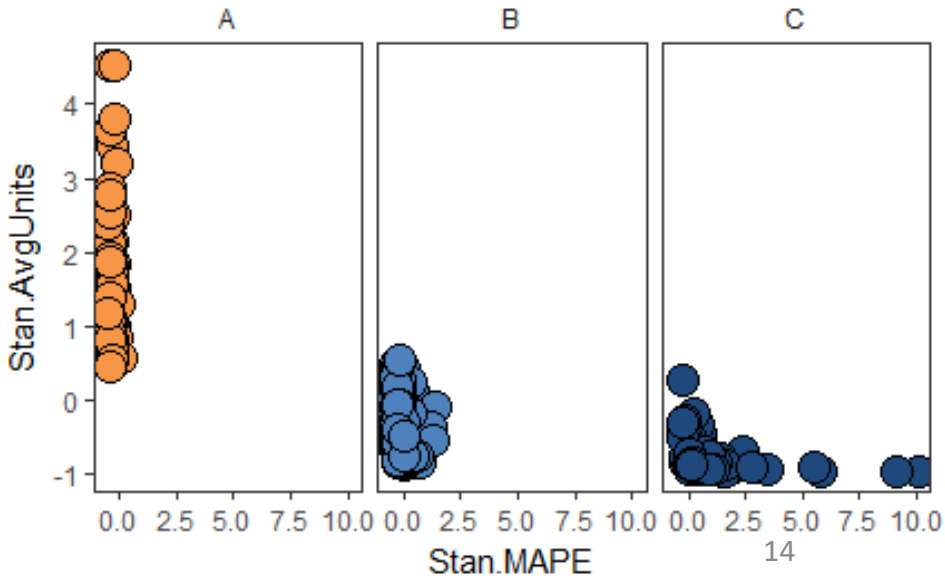
9444-8FH, 9444-8BB-CL, 9444-8CA-CL, 9444-10DD4, 9444-8PO, 9444-5CRO, 9444-5RO, 9444-4EO, 9445-HSQCNH5, 9445-MFCHE3, 9444-CCPSH4, 9445-CCPSH4



ABC Inventory Management

- Inputs to clusters:
  - Sales Volatility (measured by relative standard deviation)
  - Forecast Error (measured by MAPE)
  - Sales Volume (measured by units sold)
- Methodology
  - Partition Around Medoids “PAM”, more modern version of k-means clustering





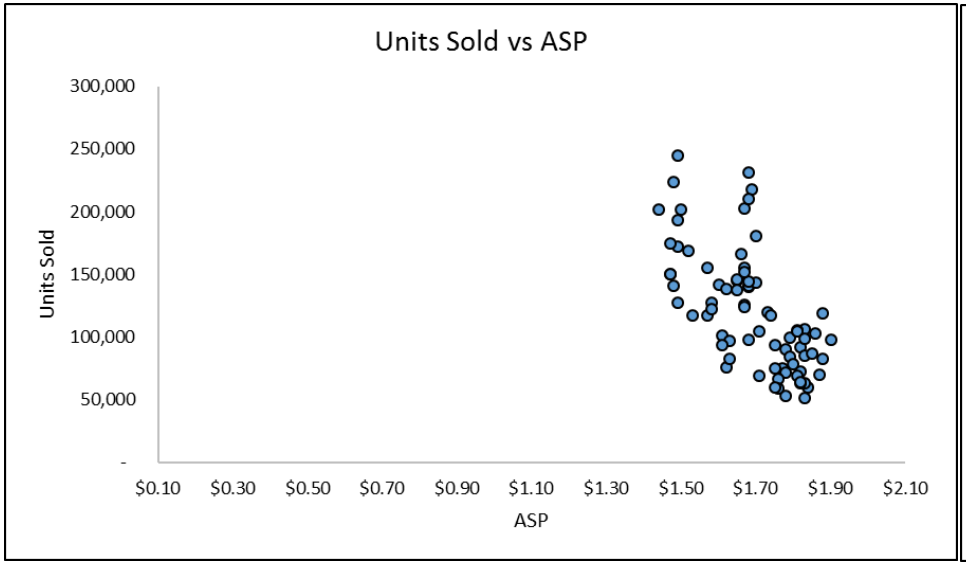
Price Elasticity Modeling

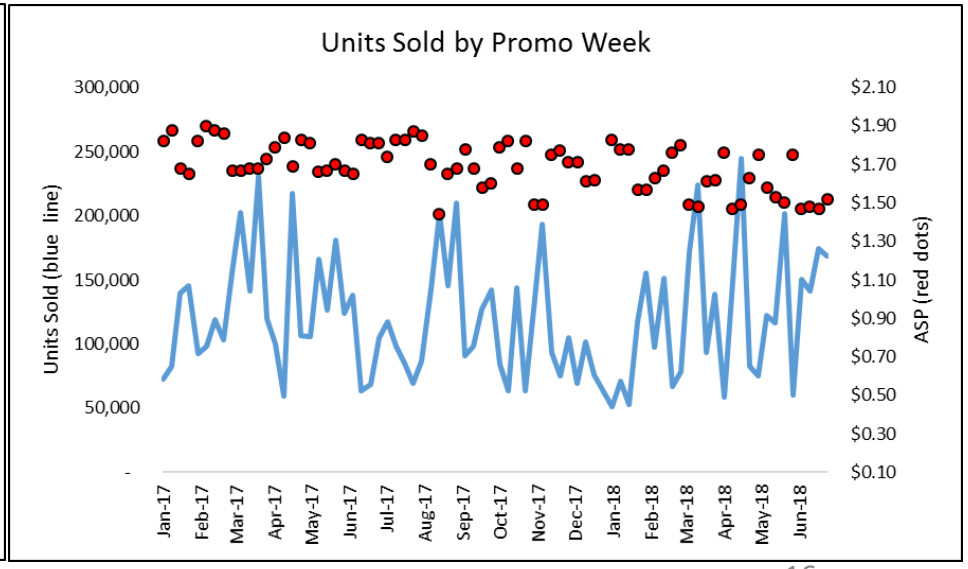
- Problem
  - Where should Category Managers set prices to optimize the profit we receive from sales?
  - Raise prices too high, don't sell enough units. Make prices too low, don't make enough profit

- Solution
  - Create a workbook that allows Category Managers to see their optimal sales price for each article

Price Elasticity Modeling

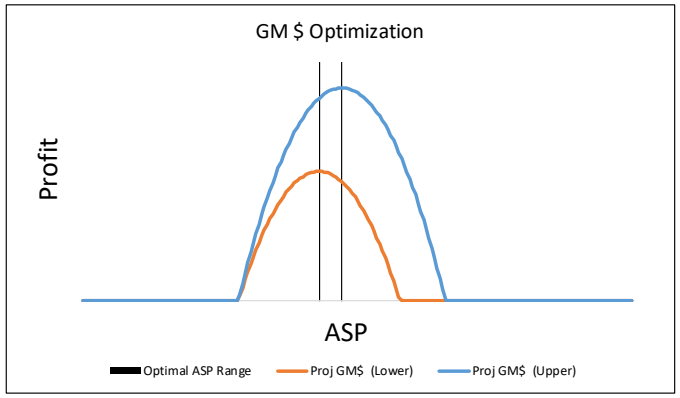
- Price elasticity formula: $$\epsilon = \frac{\%\triangle Q}{\%\triangle P} = \frac{\partial Q}{\partial P} \cdot \frac{P}{Q}$$
- Use R to iterate through each article in our assortment to determine the relationship between change in quantity and change in price
- Write output to Excel planning workbook

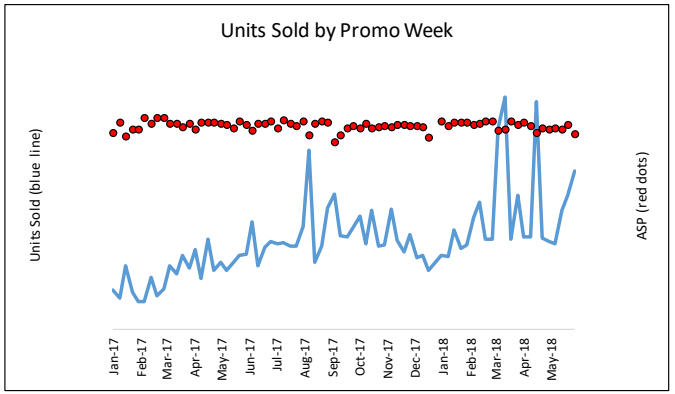


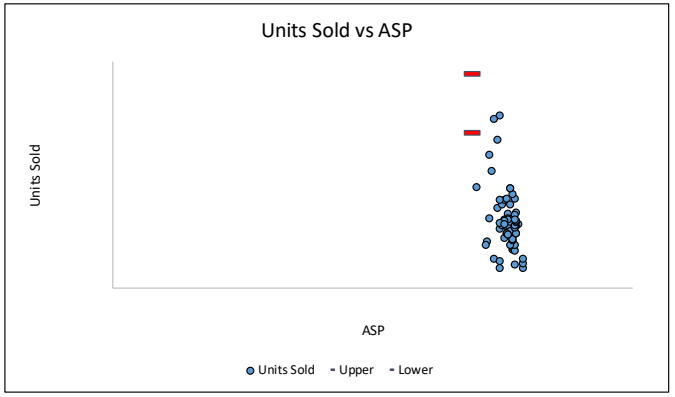


Price Elasticity Modeling

Price Elasticity Worksheet		
Article Description		
Enter the Old Article Name (IP Articles only)		
Article		
Category		
Class		
Avg Units Ordered per Week	**118,104**	
Avg ASP	**$**	**1.99**
Price Elasticity	-4.22	
Volatility Index (Relative Std Deviation)	20%	
Volatility	**Low Volatility**	
Weeks of sales data	**87**	
Modeling Scenario		
New ASP (include assumptions about discounting)	**$**	**1.79**
ASP Change	$	- 0.20
Will this article be shown as a picture (room shot or small sample) in Marketing materials during a large event?	**Yes**	
Promotional lift		102,657
Projected Impact (per week)		
Proj. Units Change	**+204,145**	
Lower estimate	**270,371**	
Higher estimate	**374,126**	
Projected GM $		
Total Landed Cost per Unit	$	1.56
Override Total Landed Cost per Unit (leave blank for default)	$	-
Proj. GM %	13%	
Optimal ASP for GM$ (Lower)	**$**	**1.85**
Optimal ASP for GM$ (Upper)	**$**	**1.93**







In Summary

- Using advanced analytic tools like R has several benefits over traditional tools
  - Overcome limitations of corporate data infrastructure
  - Blend multiple data sources together
  - Conduct analyses faster and at greater scale
  - Documented and repeatable analysis for the next analyst
  - Pre-built advanced statistical packages

- Drawbacks
  - You'll likely be on your own
  - Learning curve
  - Not likely the best choice for small / quick tasks

Thank You!

https://www.linkedin.com/in/bryan-kelley-rva/