



Achieving Profitability

Profit Margin Validation & Models

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Agenda

-
- 3** Company Background
 - 4** Business Problem & Available Data
 - 6** Our Goals & Approaches
 - 7** Profit Margin Validation
 - 11** Profit Margin Model
 - 18** Our Achievements
 - 20** Future Endeavors

Company Background

Construction Sites Services

Products

- 2 Major **Categories**:
 - Construction Supplies
 - Welding Equipment
- Hundreds of **Product Classes** Under Each
- Dozens of **Items** under Each Product Classes

Prices

- **Target Profit Margins** (Revenue - Cost/Revenue) for Product Classes
- Set Prices based on Target Margins, Costs, Customer Categories, and etc
- In Practice, **salespersons** set prices more flexibly



Business Problem



Increase Profits?

- Cost
- Revenue

Do Profits Meet their Targets?



Profit Margin

Available Data

Products

- Categories
- Classes
- Items
- Date (Year, Month)
- Stock Status
- Target Margins

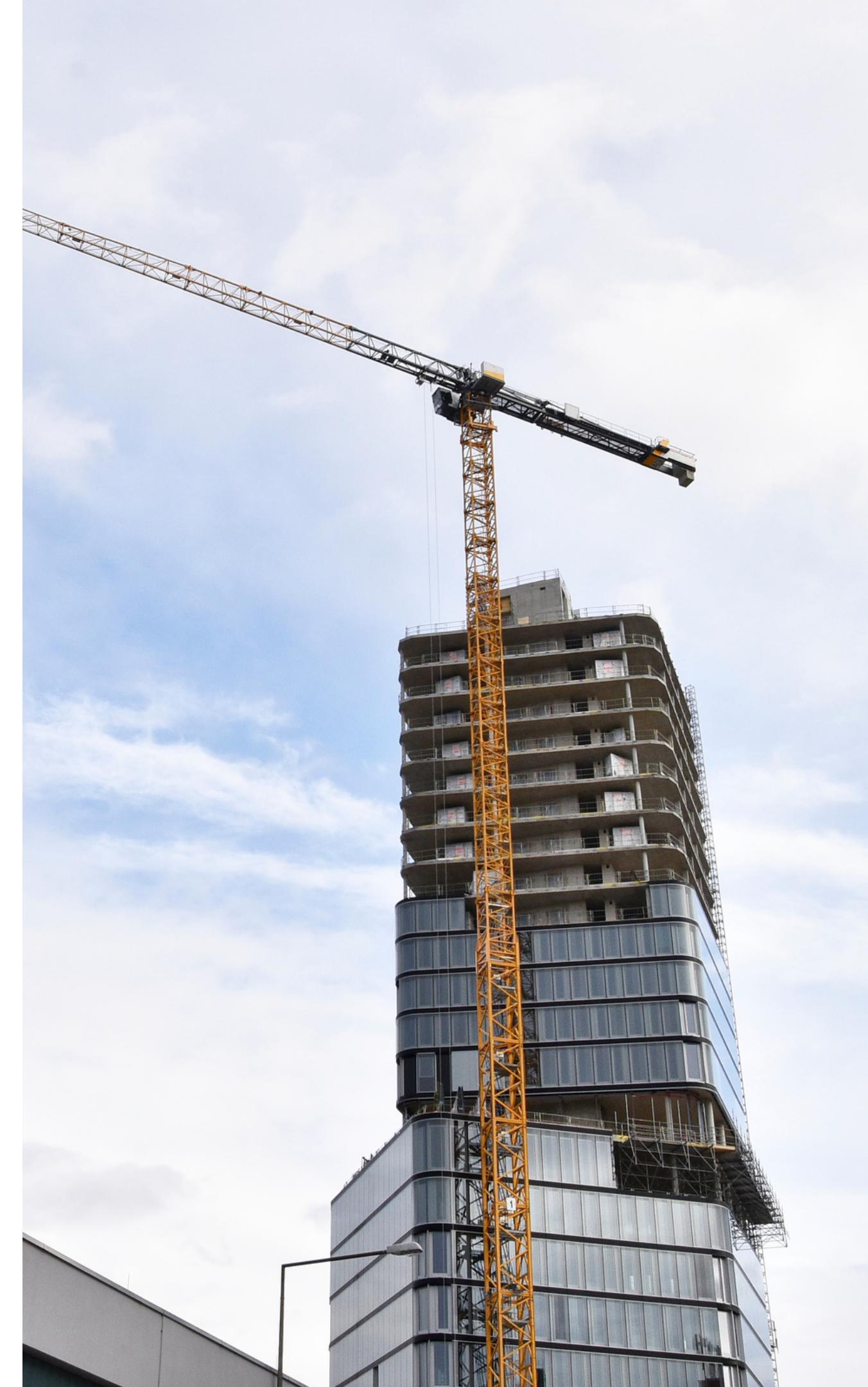
Prices

- Quantity
- Cost
- Prices
- Customer Categories

Other

- Buyer Companies
- Salesmen

Time Span: 2016 - 2023 (System Migration: 2019)



Our Goals

Help our client identify gaps between actual and target **profit margins**; How should AMECO more accurately set the profit margin?



Goal # 1

Identify whether problems exist through **Validation**



Goal # 2

Predict the realistic profit margins through **Modeling**



Goal # 3

Recommendations

Profit Margin Validation

Initial Examination Formula: $(\text{Price} - \text{Cost})/\text{Price}$ in%

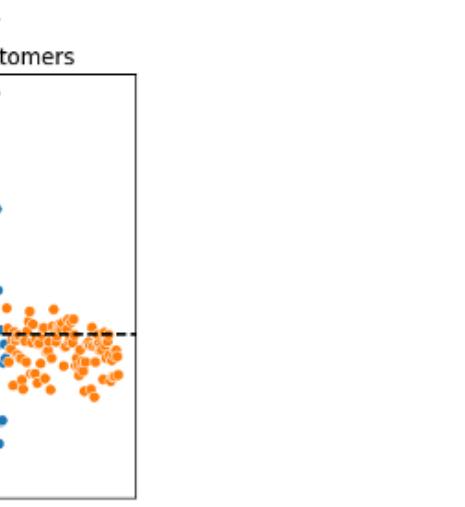
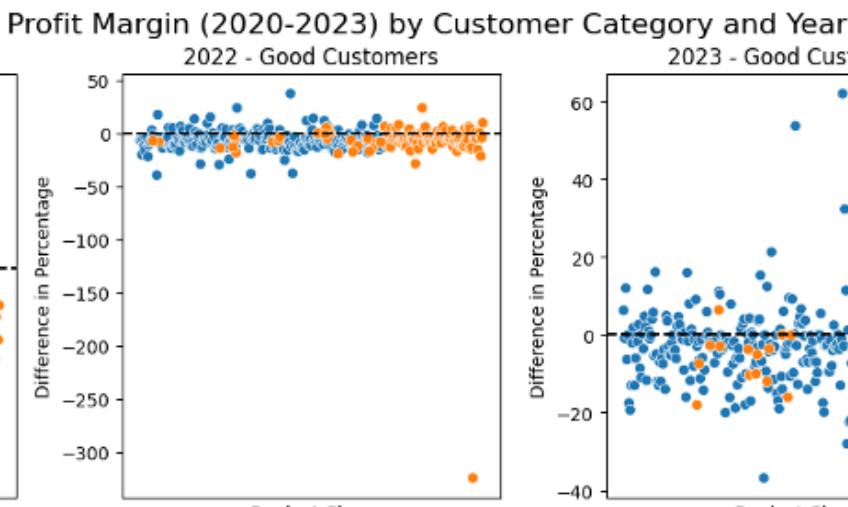
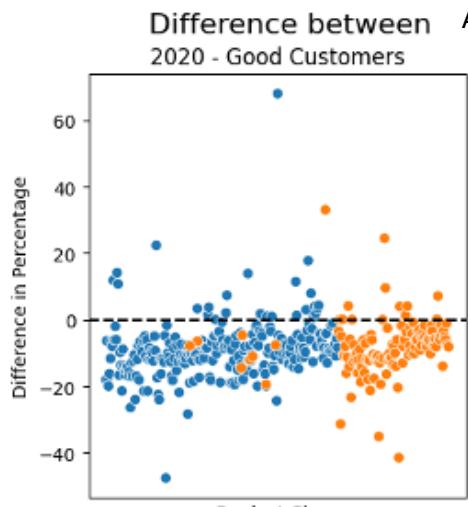
2020

2021

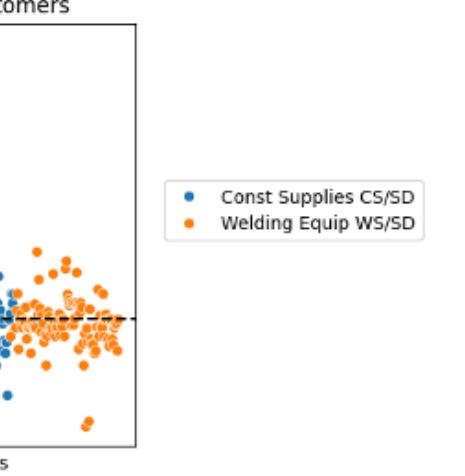
2022

2023

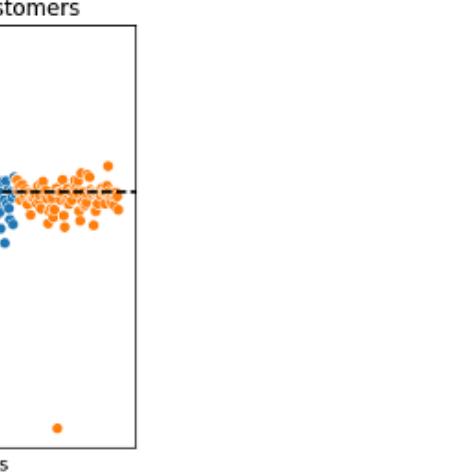
Good



Best



Better



Observation 1:

Extreme Low Profit Margins (%)

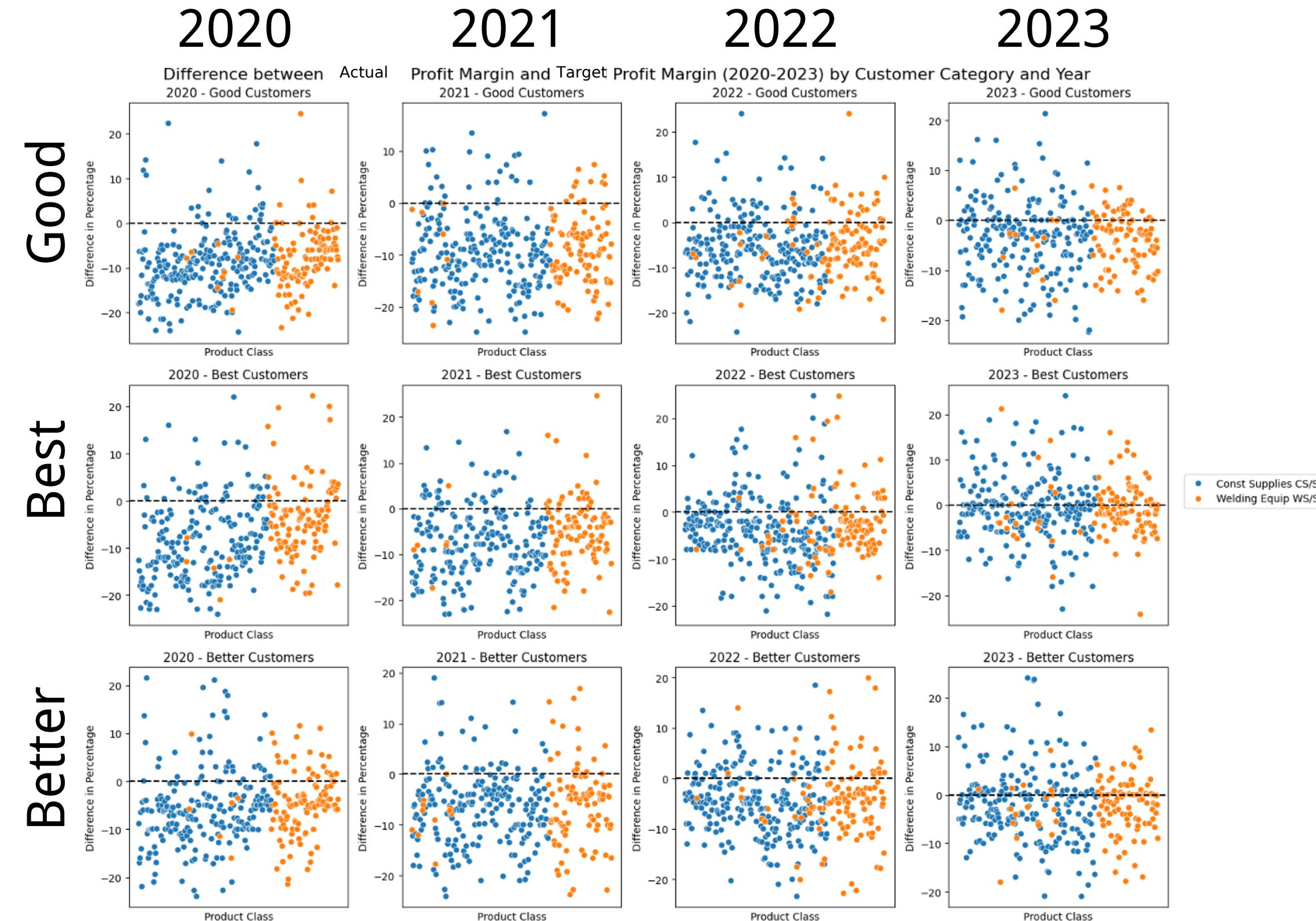
Observations 2:

Cluster more below Baseline

Figure: Scatterplots of Difference between Actual Margin and Target Margin in Percentage

Profit Margin Validation

Common Pattern Analysis



Observation 1:

More Classes Achieve Baseline Over Time

Observations 2:

Poor Performance in Good Customer compared to Other Two Categories

Observation 3:

Best Customer Category Improves

Figure: Scatterplots of Difference between Actual Margin and Target Margin in Percentage

Statistical Validation

Paired Sample t-test



Actual vs. Target Margin

	2020	2021	2022	2023
Good	<0.0001	<0.0001	<0.001	0.016
Better	<0.0001	<0.0001	<0.001	0.054
Best	<0.0001	<0.0001	<0.001	0.649

Table: P-Value Table for Construction Supplies Items

Observation 1:

More Classes Achieve Baseline Over Time

Observations 2:
Great Improvements in 2023

Profit Margin Validation

Business Implications

Product Classes Underperform

- Brushes Handles
- Cutting Tools Miscellaneous
- Electrical Miscellaneous
- **Hand Tools Plumb Bobs**
- **Hose Wire Cable Welding Hose**
- Hydraulic Repair Parts
- Maintenance Rags
- Material Handling Furn/Shelving
- Safety Boots
- Safety Lens
- Filler Mtl Cut Lengths Alloys
- MIG Equipment Accessories

Product Classes Overperform

- Apparatus Fittings
- Electrical Ground Indicators
- Power Tools Expanders
- Safety Miscellaneous



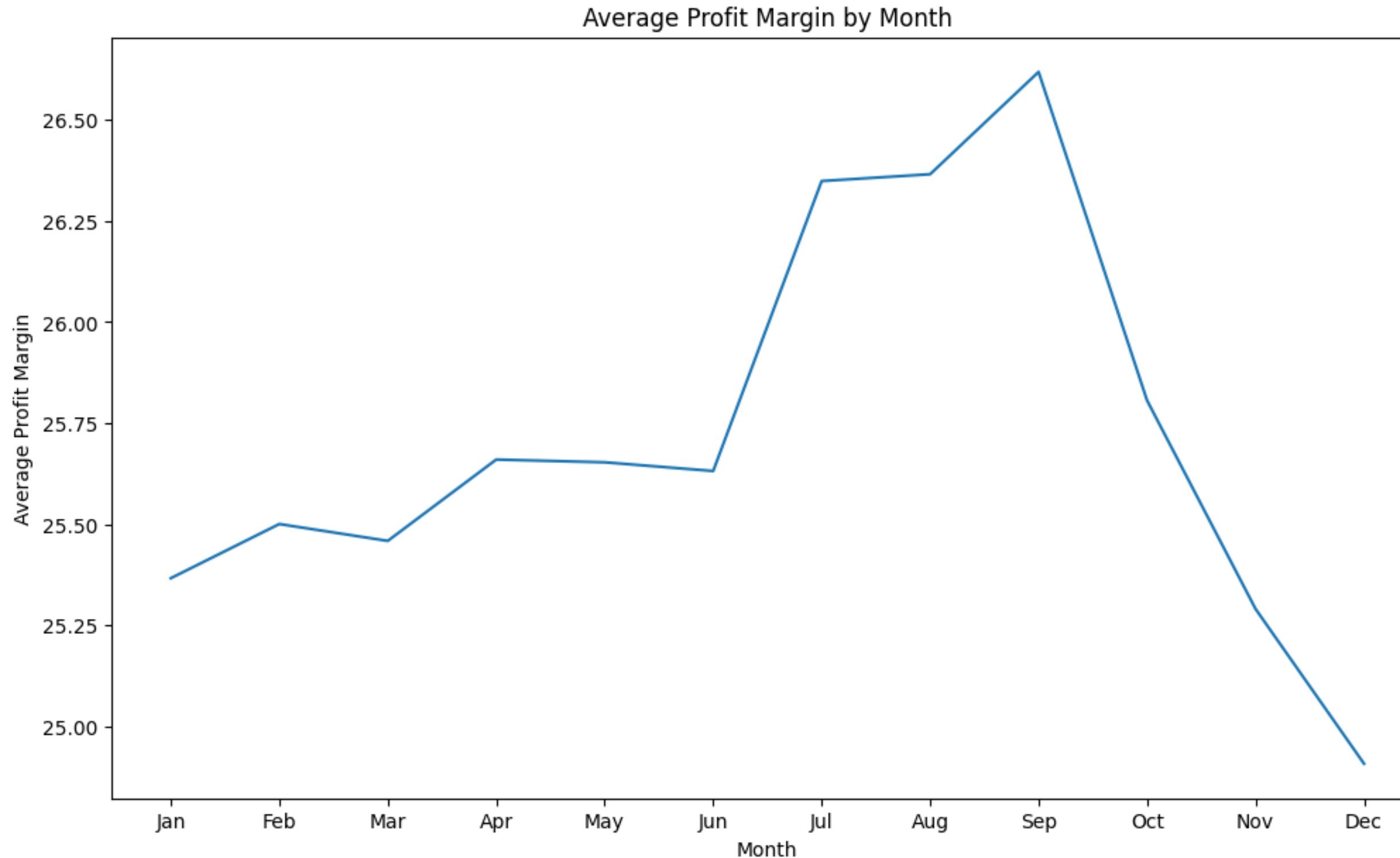
**Adjust Target Profit Margins
for these product classes!**

**Can we predict more
realistic profit margins
for each product
class?**



Profit Margin Modeling

Exploratory Data Analysis (EDA)



Observation 1:
Seasonal Pattern Exists

Observations 2:
High Peak from Jul to Sep

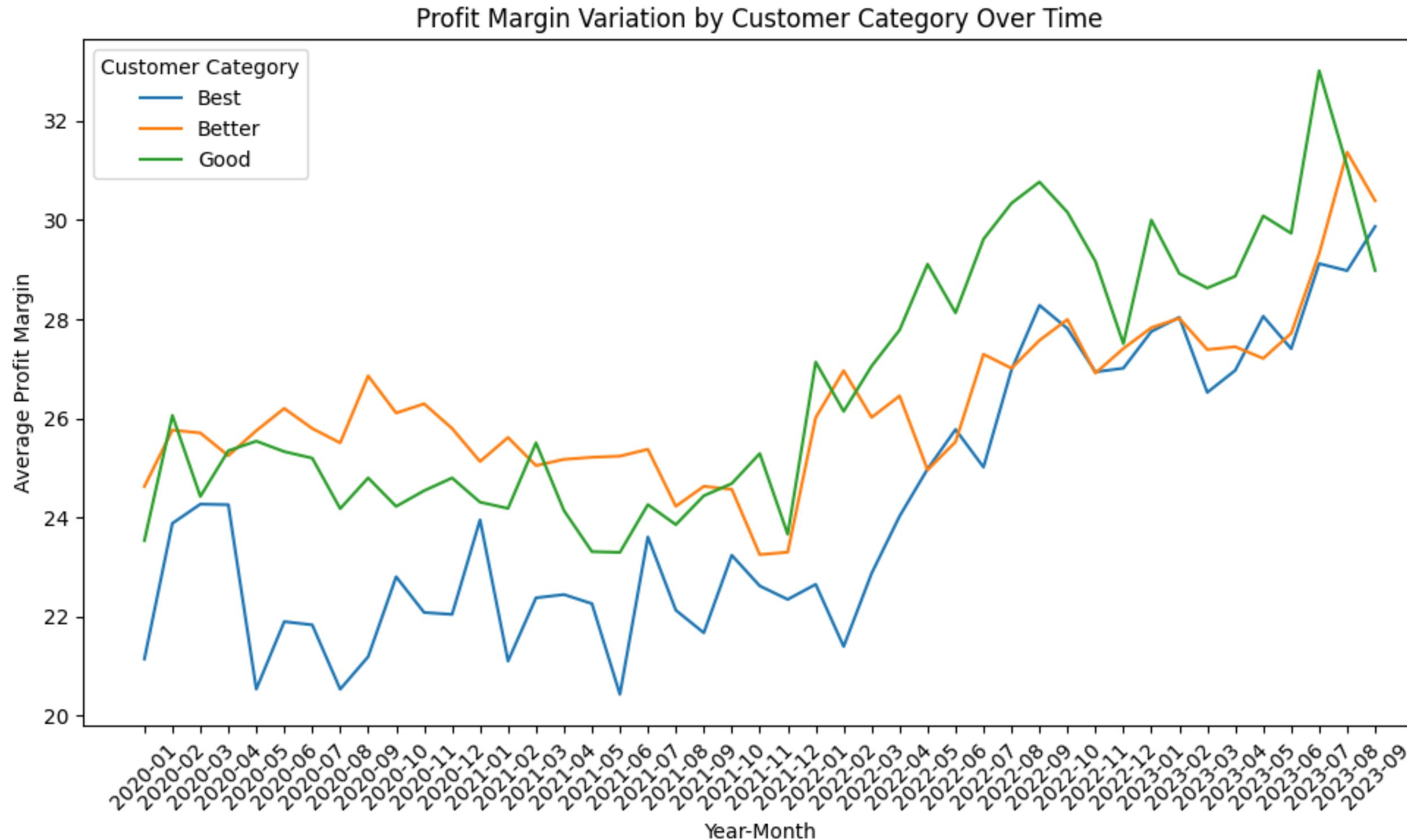
Model Selection & Results

Selected models and predict profit margins

	Reason	Variable	Average RSME
Random Forest	Well-performed when the relationship is complex.	Month, Customer Category	6.97

Profit Margin Modeling

Exploratory Data Analysis (EDA)



Observation 1:

Time series effects exist

Observations 2:
Increases after Pandemic

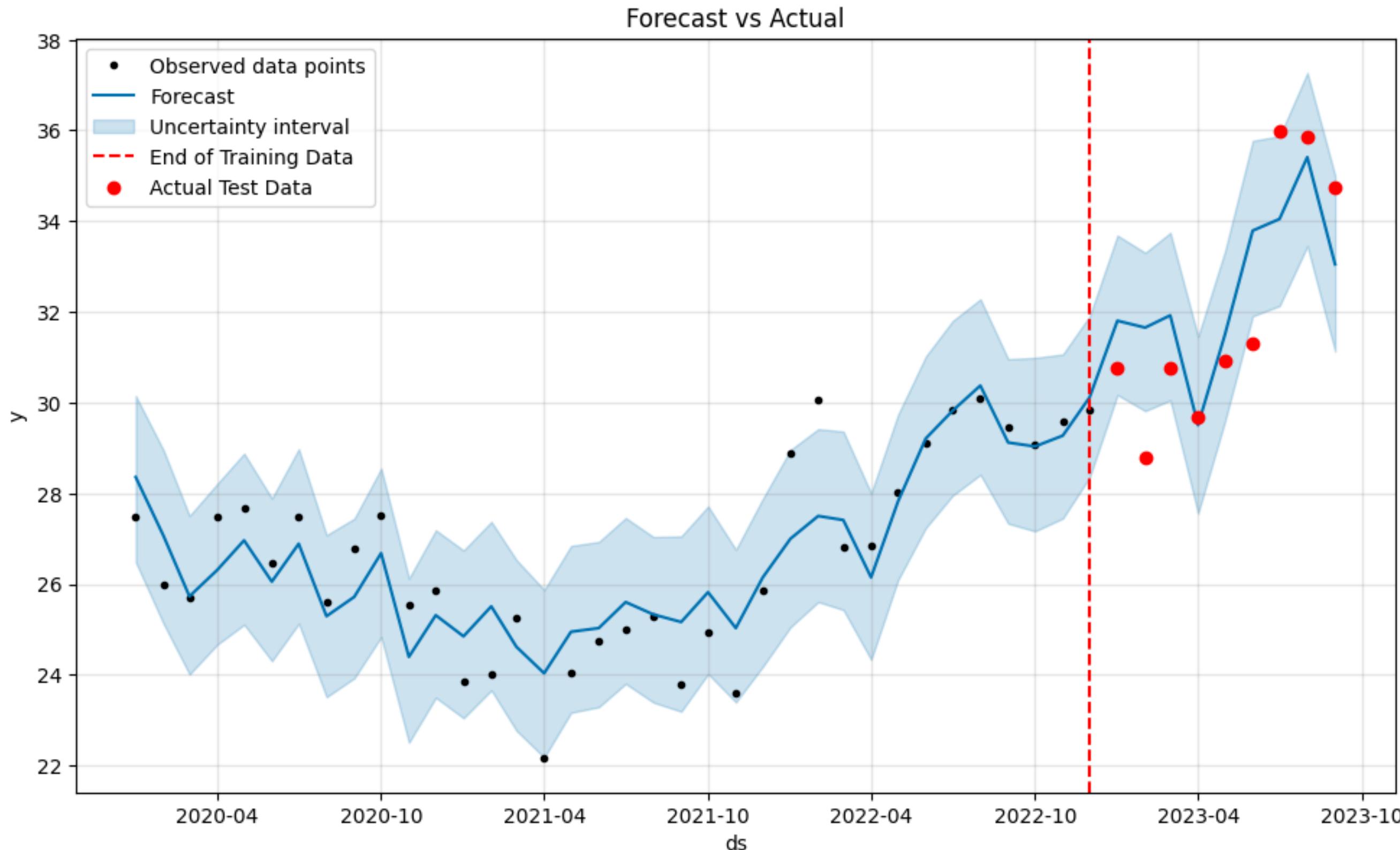
Model Selection & Results

Selected models and predict profit margins

	Reason	Variable	Average RSME
ARIMAX	Able to capture both stationary and non-stationary trends, and able to add category variables.	Year, Month, Customer Category	8.02
Prophet	Sensitive with seasonal patterns and events. Robost to shifts in the trend.	Year, Month, Customer Category	8.99
Random Forest	Well-performed when the relationship is complex.	Month, Customer Category	6.97

Model Results

Different Performances by Product Class

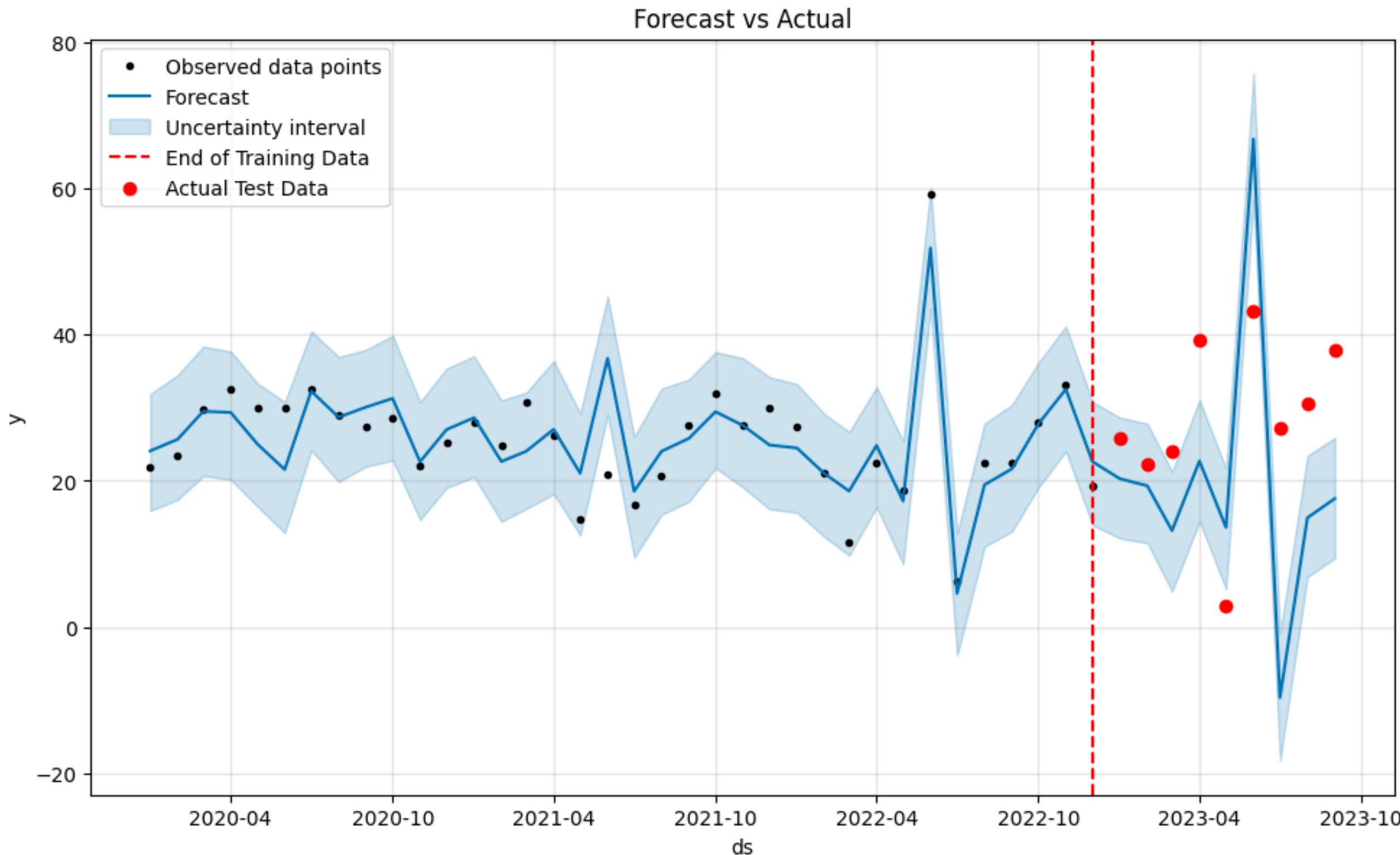


Safety Tools

rmse: 1.63

Model Results

Different Performances by Product Class



Abrasive
Miscellaneous

Our Achievements

How our results help answer these business questions?



Goal # 1

Identified the gaps between actual and target profit margins

Discovered product lists our clients can focus on



Goal # 2

Used models to predict true profit margins

Identified true profit margins for several product classes



Goal # 3

Recommendations



Future Endeavors

- ▶ Dig into root causes of outlier product classes
- ▶ Transform our technical models to non-technical audiences
- ▶ Complete the final delivery to clients



Thank You