

“What Will Customers Buy?”

Recommendations with Price Range Forecasts

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About Macy's Inc



- USA's most iconic department store
- Founded in 1858, 166 years history
- 519 stores in USA & online ecommerce
- Offers fashion, beauty, home essentials
- Annual revenue of \$24B in 2023

Problem Statement

Personalization Team's Next Best Action initiative wants to **promote products** in **preferred price ranges** of customers in next quarter. Predicting each customer's price range will help enhance marketing and recommendation.

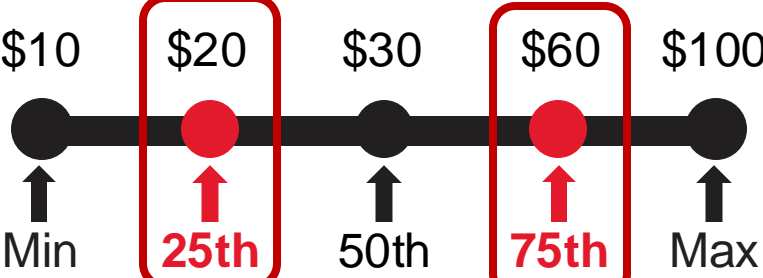


Problem Decomposition



Prediction Target Variable

25th, 75th percentile spend per item
For each individual customer



Forecasting Period

- Quarterly Level
- Normal Quarter: Q1, Q2, Q3
- Peak (Holiday) Quarter: Q4



3 Product Levels

- General Merchandise Manager
- Parent Division
- Merchandise Division



Example Output Result

- Customer A will prefer to spend between **\$55** and **\$75** over 2024 Q2
- Product types like **jeans**, **shirts**, and **tops** could be recommended

Data



Transaction

- Item Purchase Quantity
- Item Purchase Amount



Product

- Product SKU
- Product Hierarchy



Customer Loyalty

- Customer Loyalty Tier (Bronze, Silver, Gold, Platinum)



Online Activity

- Customer Browsing History
- Online Interaction Record

Scope: 2018Q1 - 2024Q1 | Omnichannel

40M

Customers / Year

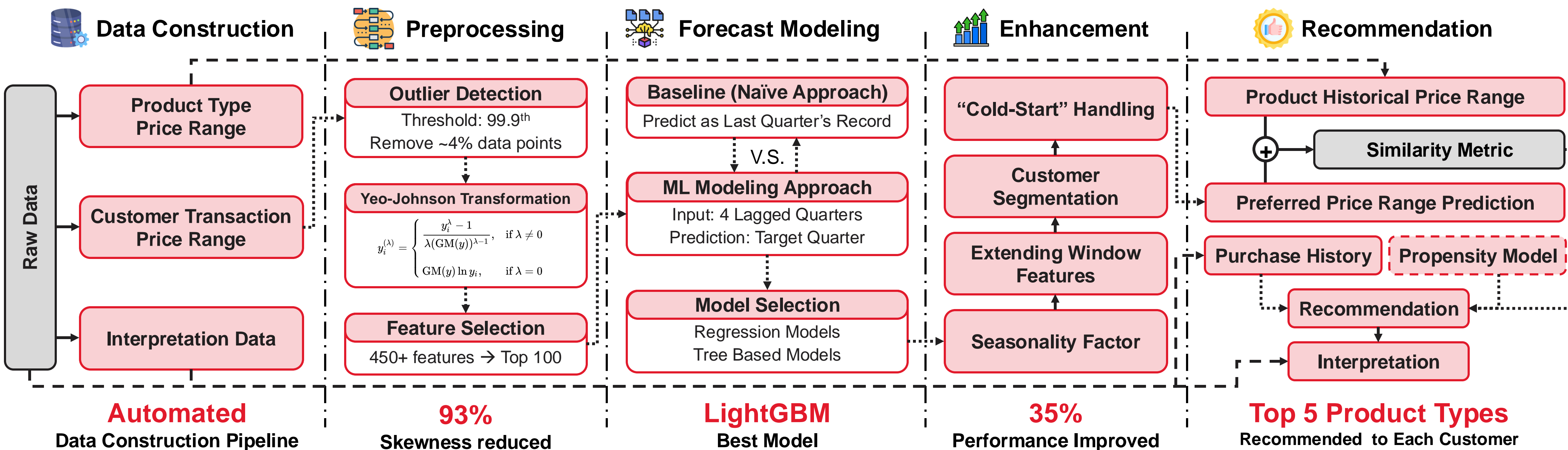
250M

Transactions / Year

1K

Product Types

Methodology



Forecasting Modeling Results

Best Model

\$21 MAE **+28%** Over Baseline
63% wMAPE **+28%** Over Baseline

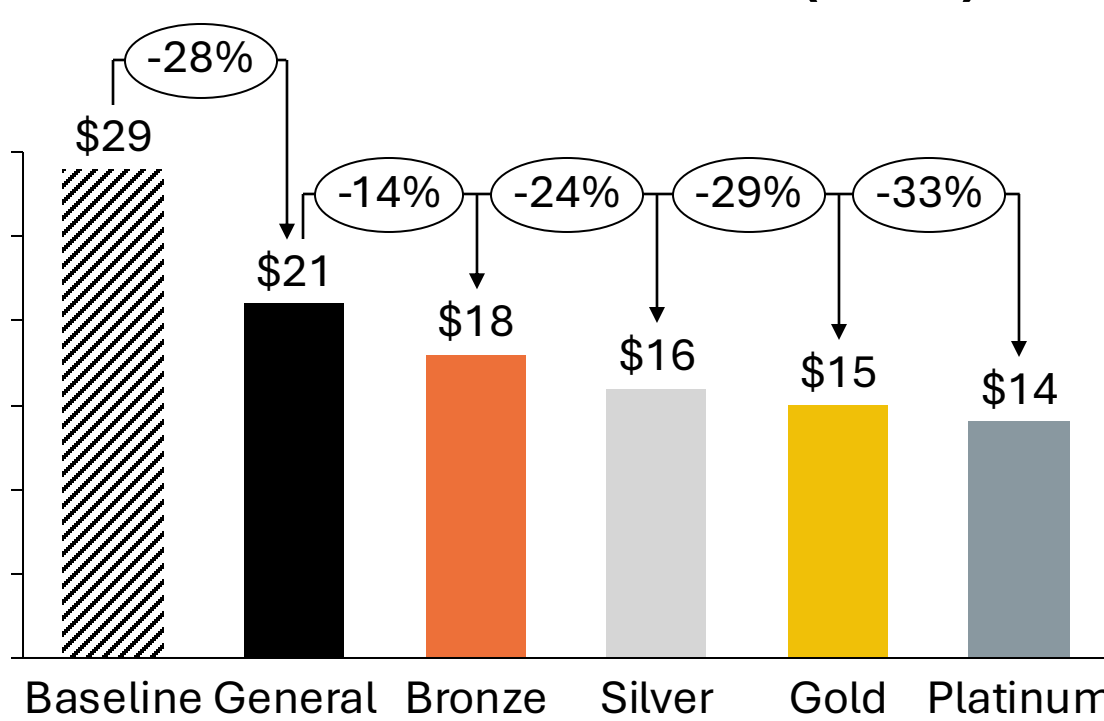
Modeling Each Loyalty Tier

- Up to +33% MAE** Over Best Model
- Up to +16% wMAPE** Over Best Model

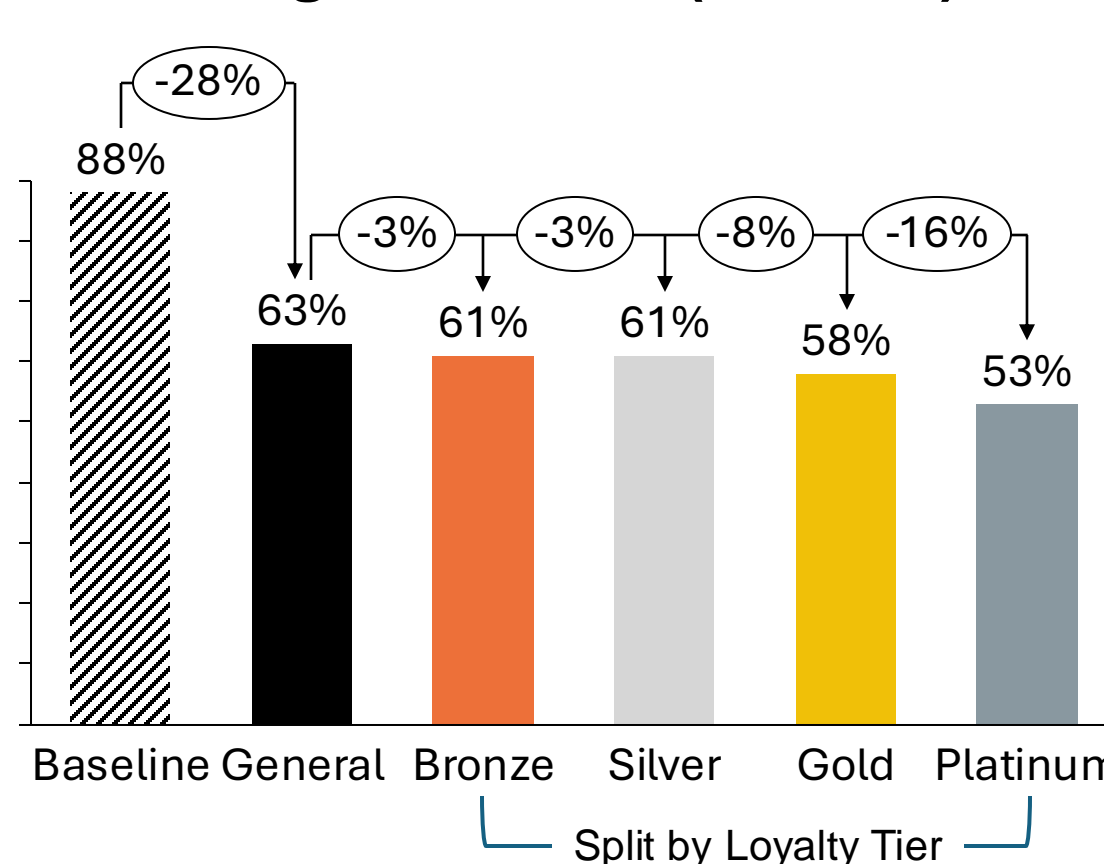
Top Features

- Total Number of Items Purchased
- 75th Quantile Item Price
- 25th Quantile Item Price
- Minimum Item Price Purchased
- Total Customer Spend

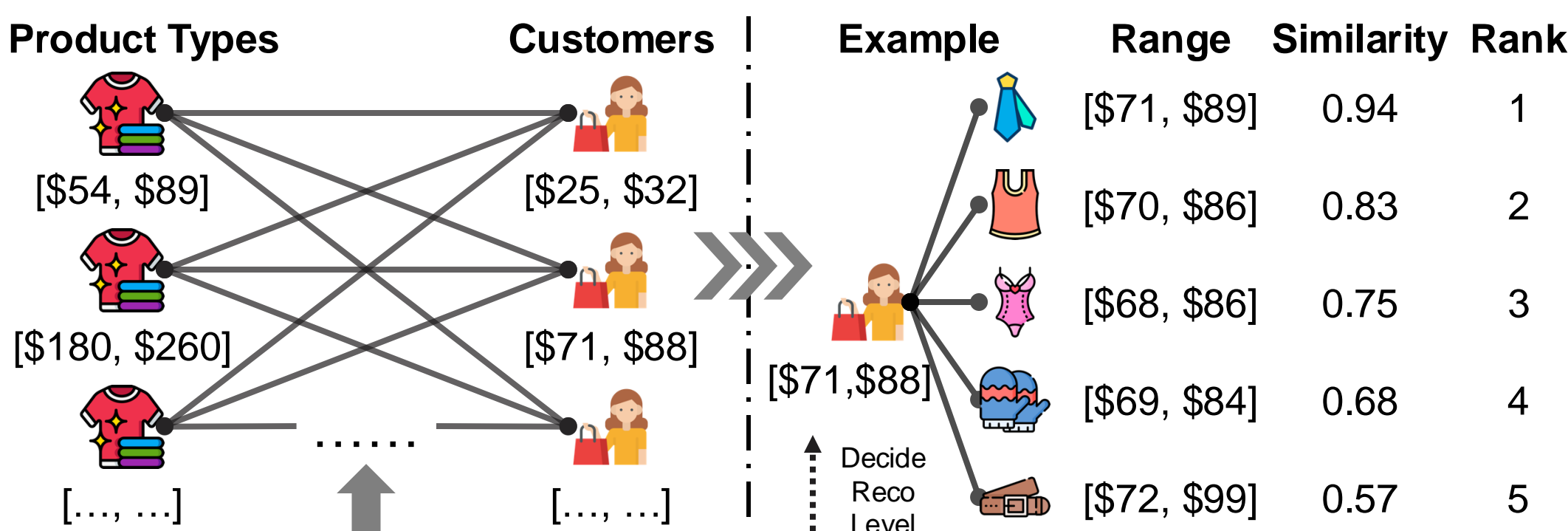
Mean Absolute Error (MAE)



Weighted MAPE (wMAPE)



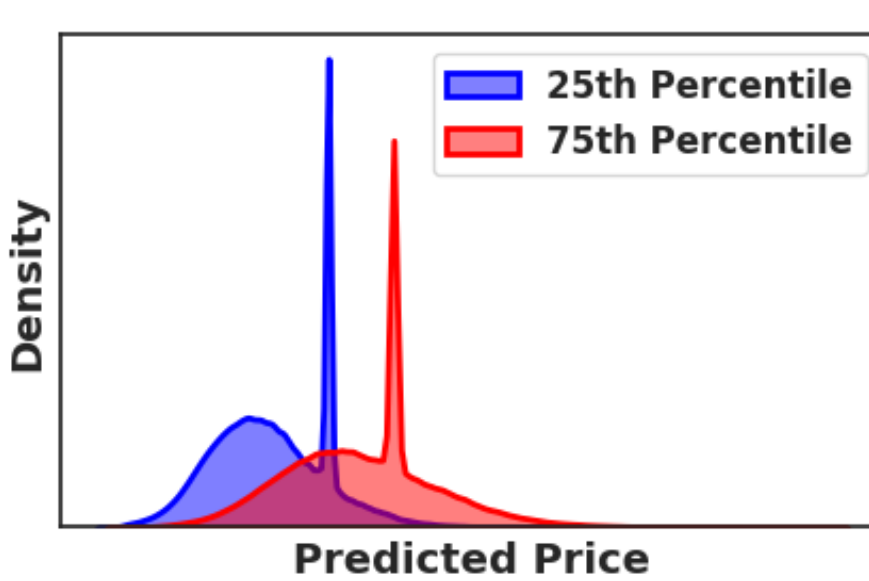
Product Type Recommendation



$$\text{Similarity Score} = \frac{P \cap C}{P \cup C}$$

P: Product Type Price Range [25th, 75th]
C: Predicted Price Range [25th, 75th]

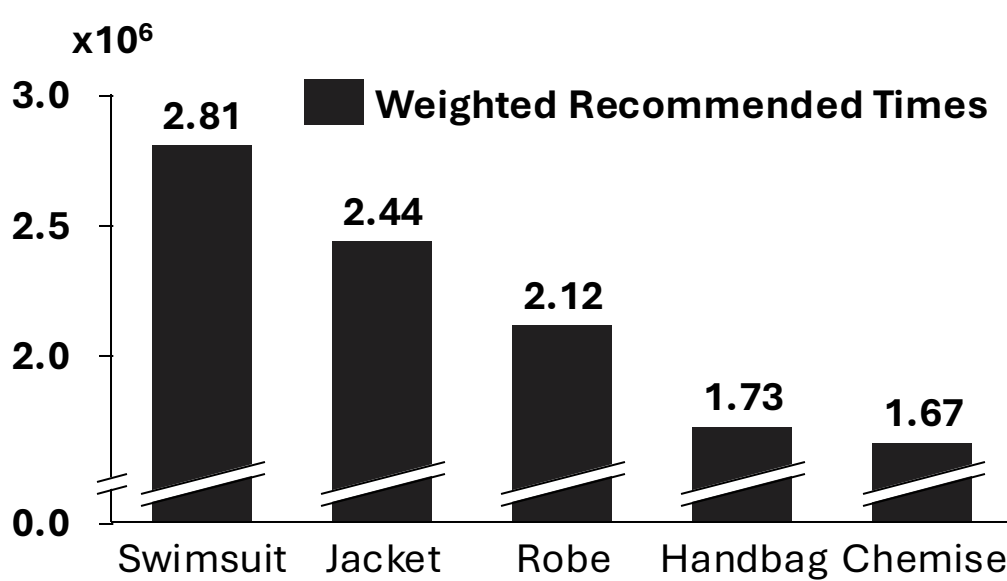
KDE Plot of Predicted Bounds



External Product Level Propensity Model

Predict which product level customer will make purchase in using propensity model. Then make recommendation on product type using product price range and predicted customer preferred price range based on similarity metric and recommend top 5.

Example Recommendation Distribution



Business Use Case

Integrate Into Existing Recommendation Process



Use existing model to find product level customer will purchase in



Use our model and recommendation system to find most relevant product types for each customer



Filter Products in Email, Notification, Feed page Recommendation

Business Impact



Levi's Men's Big & Tall 541™ Athletic Fit...
\$69.50
Sale \$48.65
★★★★☆ (386)

Maintain Continuous Selling: Recommend customers products of top recommended product types within their predicted preferred range.

Detect Upselling Opportunities: Recommend customers products of top recommended types that are not their historical preferred ones.

Cross-selling: Recommend customers products between their predicted 75th percentile and historical max spend on an item.