Price elasticity modeling

Boating and fishing supplies retailer

Created customized pricing strategies based on SKU characteristics in terms of elasticity, margin profile and volume to determine the optimal price point

Boating and fishing supplier needs to rewind its pricing strategy

Picture this…

You're looking for a data-backed pricing strategy, that incorporates SKU characteristics and historical customer purchase behavior to provide optimal price by SKU. The current marketing and pricing strategies primarily based on cost-based pricing methodologies to drive volume and margin, or based on historical precedent are giving sub-optimal results.

You turn to Accordion.

We partner with your team to create customized pricing strategies based on SKU characteristics in terms of elasticity, margin profile and volume to determine the optimal price point, including:

1) Estimating price sensitivity by SKU based on purchase pattern changes that are further based on changes to effective price after accounting for promotions, seasonality and other macro factors
2) Analyzing competitor pricing information by SKU to understand relative price positioning to ensure brand positioning is not diluted
3) Formulating a pricing strategy at a SKU level-based triangulation of margin profile-based price, competitor-based price, price sensitivity-based price and other pricing thresholds (MAP price, price increase/decrease controls etc.)
4) Setting-up an automated ongoing model to identify SKUs that can have a price change, and forecasting the impact of proposed price changes

Your value is enhanced.

- You have identified 17K SKUs with a potential to take price and corresponding optimal price (based on price elasticity) that would lead to overall potential increase of margin by ~$9M (7%)

- You have drive data-driven pricing strategies that can be customized at a SKU level and forecast the revenue impact of these changes

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PRICE ELASTICITY MODELING

KEY RESULT

- ~9M increase in margin
- Optimal price for ~17K products estimated

VALUE LEVERS PULLED

- Price elasticity
- UCM (unobserved components model) time series forecasting model
- Optimization techniques

ACCORDION

Price elasticity modeling for boating and fishing supplies retailer

Situation

- To drive volume and margin, the client leveraged various marketing and pricing strategies primarily based on cost-based pricing methodologies or based on historical precedent. Client realized these strategies were consistently giving sub-optimal results.
- Partnered with the client to formulate a data-backed pricing strategy, which incorporated SKU characteristics and historical customer purchase behavior to inform optimal price by SKU
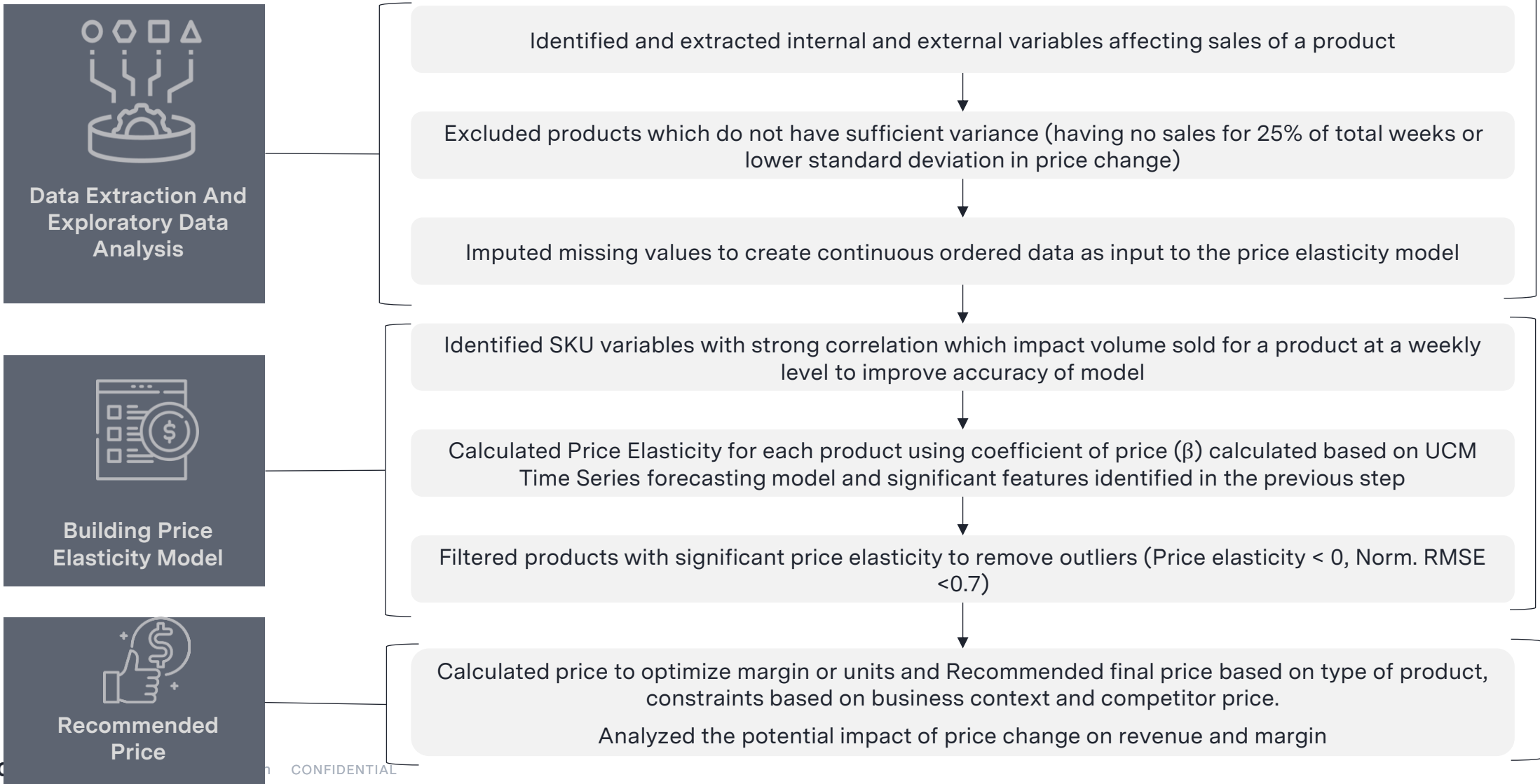
Accordion Value Add

- Estimated price sensitivity by SKU based on purchase pattern changes based on changes to effective price after accounting for promotions, seasonality and other macro factors
- Analyzed competitor pricing information by SKU to understand relative price positioning to ensure brand positioning is not diluted
- Formulated a pricing strategy at a SKU level-based triangulation of margin profile-based price, competitor-based price, price sensitivity-based price and other pricing thresholds (MAP price, price increase/decrease controls etc.)
- Set-up an automated ongoing model for the team to identify SKUs that can have a price change, and forecast the impact of proposed price changes
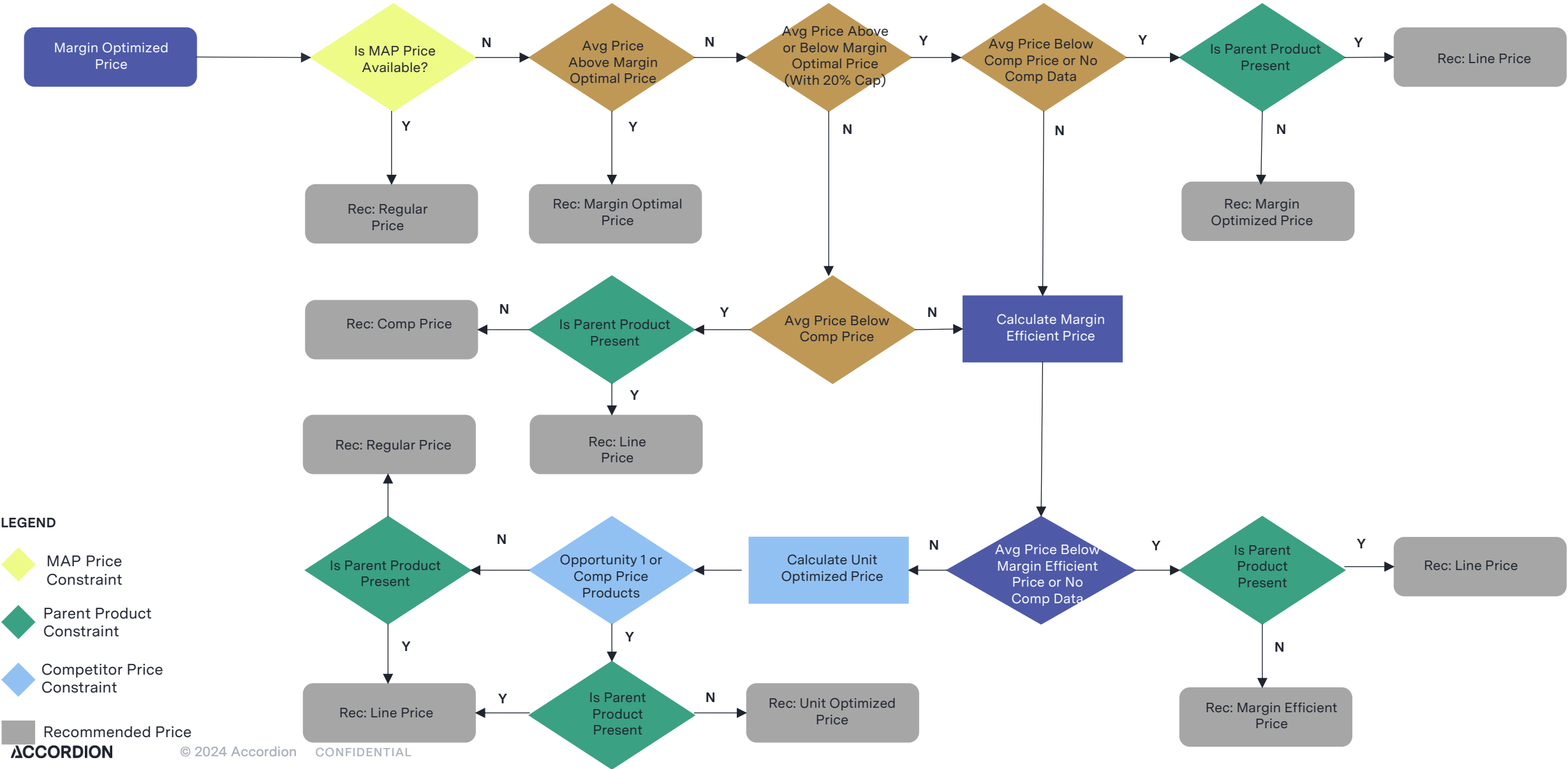
Impact

- Identified 17K SKUs with potential to take price and corresponding optimal price (based on price elasticity) which would lead to overall potential increase of margin by ~$9M (7%)
- Enabled pricing team to drive data-driven pricing decisions which can be customized at a SKU level and anticipate the revenue impact of these changes

Approach & methodology

Data Extraction And Exploratory Data Analysis

- Identified and extracted internal and external variables affecting sales of a product
- Excluded products which do not have sufficient variance (having no sales for 25% of total weeks or lower standard deviation in price change)
- Imputed missing values to create continuous ordered data as input to the price elasticity model

Building Price Elasticity Model

- Identified SKU variables with strong correlation which impact volume sold for a product at a weekly level to improve accuracy of model
- Calculated Price Elasticity for each product using coefficient of price (β) calculated based on UCM Time Series forecasting model and significant features identified in the previous step
- Filtered products with significant price elasticity to remove outliers (Price elasticity < 0, Norm. RMSE <0.7)

Recommended Price

- Calculated price to optimize margin or units and Recommended final price based on type of product, constraints based on business context and competitor price.
- Analyzed the potential impact of price change on revenue and margin

Approach & methodology

LEGEND

- MAP Price Constraint
- Parent Product Constraint
- Competitor Price Constraint
- Recommended Price

Flowchart elements:

Margin Optimized Price → Is MAP Price Available?
- N → Avg Price Above Margin Optimal Price
- Y → Rec: Regular Price

Avg Price Above Margin Optimal Price
- N → Avg Price Above or Below Margin Optimal Price (With 20% Cap)
- Y → Rec: Margin Optimal Price

Avg Price Above or Below Margin Optimal Price (With 20% Cap)
- Y → Avg Price Below Comp Price or No Comp Data
- N → Avg Price Below Comp Price

Avg Price Below Comp Price or No Comp Data
- Y → Is Parent Product Present
- N → Calculate Margin Efficient Price

Is Parent Product Present
- Y → Rec: Line Price
- N → Rec: Margin Optimized Price

Avg Price Below Comp Price
- Y → Is Parent Product Present
- N → Calculate Margin Efficient Price

Is Parent Product Present
- N → Rec: Comp Price
- Y → Rec: Line Price

Calculate Margin Efficient Price → Avg Price Below Margin Efficient Price or No Comp Data
- Y → Is Parent Product Present → Y → Rec: Line Price / N → Rec: Margin Efficient Price
- N → Calculate Unit Optimized Price

Calculate Unit Optimized Price → Opportunity 1 or Comp Price Products
- N → Is Parent Product Present → N → Rec: Regular Price / Y → Rec: Line Price
- Y → Is Parent Product Present → Y → Rec: Line Price / N → Rec: Unit Optimized Price
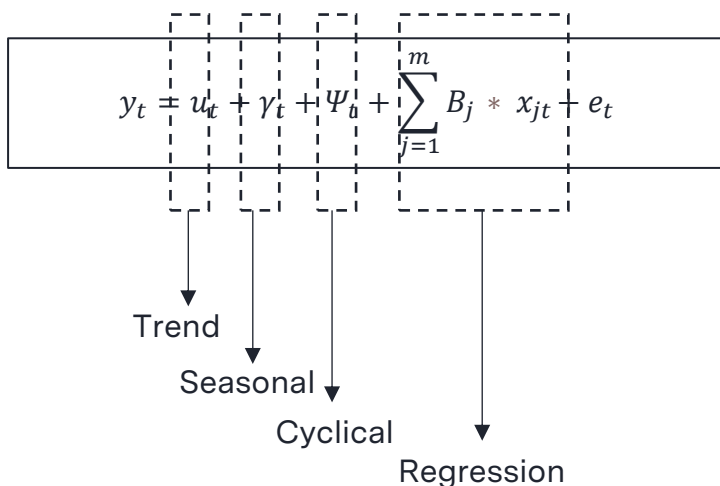
UCM time series model

Unobserved Components Model (UCM) performs a time series decomposition into components such as trend, seasonal, cycle, and the regression effects due to predictor series. It can be represented as follows:

$$y_t = u_t + \gamma_t + \Psi_t + \sum_{j=1}^{m} B_j * x_{jt} + e_t$$

Trend

Seasonal

Cyclical

Regression

The components $u_t,\ \gamma_t,\ \Psi_t$ represent the **trend**, **seasonal**, and **cyclical** components, respectively;

The term $\sum_{j=1}^{m} B_j * x_{jt}$ gives contribution of regression variables with fixed or time varying regression coefficients.
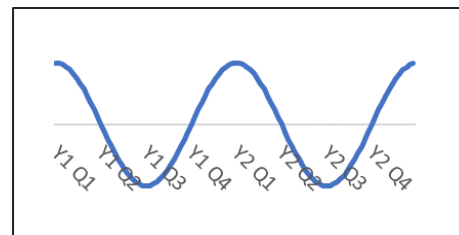
Seasonal unobserved component is capturing annual cycles and is assumed deterministic. It is implemented with 12 DOF (13-1 binary variables, 4 weeks each)
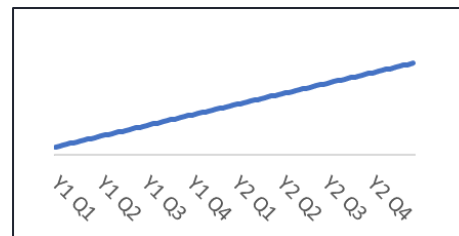
Slope unobserved component is capturing the long-term changes on quantity and is assumed deterministic
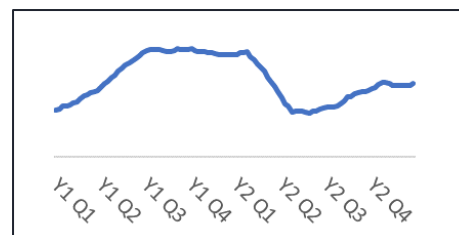
Level unobserved component is capturing the variation of the base quantity and is assumed stochastic
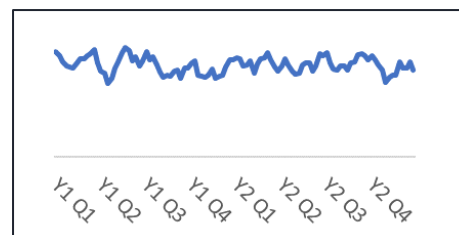
Regression components include the main external factor X_1(price) and an additional control factors like discount percentage on transactions, capturing the marketing promotional activity.

Price elasticity and recommended price

	Price Elasticity Calculated by UCM Model	Price Calculated Using Different Optimization Techniques to Maximize Margin or Units Sold	Recommended Price Based on Business Constraints (MAP Price, Line Price) and Competitor Price

Product No	Department	Parent Group	Price Elasticity	Regular Price	Average Price	Margin Optimized Price	Margin Efficient Price	Unit Optimized Price	Line Price	MAP Price	Competitor Price	Recommended Price
P1	D1	NULL	-1.136	$28.99	$28.68	$33.00	$20.46	$22.94	NULL	NULL	$20.53	$22.94
P2	D2	PG1	-0.416	$399.99	$371.69	$737.51	$427.76	$371.69	$427.76	NULL	$372.00	$427.76
P3	D3	NULL	-1.855	$0.49	$0.47	$0.39	$0.16	$0.37	NULL	NULL	$0.49	$0.39
P4	D4	NULL	-0.209	$9.79	$8.21	$24.32	$8.76	$8.21	NULL	NULL	$8.50	$8.76
P5	D5	NULL	-0.786	$11.99	$11.99	$14.49	$5.80	$9.60	NULL	NULL	$11.99	$11.99
P6	D6	NULL	-0.416	$399.99	$362.95	$723.48	$419.62	$362.95	NULL	NULL	$373.18	$373.18
P7	D7	NULL	-0.811	$82.99	$79.84	$105.39	$61.13	$63.87	NULL	$79.99	$80.00	$82.99

Learnings

1) UCM Time Series Model to forecast quantity sold and identify coefficients of dependent variables.

2) Improved understanding of price elasticity and parameters to identify its significance.

3) Understanding of optimization techniques such as quasi – Newton method and Trust-constraint optimization based on user constraints and price elasticity.

4) Impact of Price Recommendations calculated based on Business Context and Competitor Price.