**Is it Elastic?**
*Inflation, Problematic. Prices, Automatic.*

**A MODEL BASED APPROACH TO DECOMPOSE SALES SIGNALS AND ESTIMATE SALES CHANGE GIVEN PRICE**
Faculty Advisor: Thodoris Lykouris, Ph.D | Unilever Leads: Syed Haider Ph.D, Zeya Luo, Saloni Mishra | MIT Team: Rahul Kasar, Jay Li

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**REDUCED DOLLAR ERROR OF SALES PREDICTIONS BY $5 MILLION AFTER PRICE CHANGES**

**SALES BREAKDOWN FOR OVER 20000 TIME SERIES INTO SEASONAL AND MACROECONOMIC FACTORS**

**A 14% INCREASE IN ACCURACY FROM MODEL COMPARED TO PREVIOUS ESTIMATES OF ELASTICITY**

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**MOTIVATION**

**Problem**
Unprecedented inflation has led to necessary price increases.

**Goal: Find Elasticity**
1% increase in Price → ?% change in Demand

**Business Impact**
Accurate Elasticities → Informed Price Change → Increased Sales Revenue

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**DATASETS USED:**

- **POS Sales Data:** Product, Weekly Sales, Average Price, Region
- **Macroeconomic Features:** Inflation, Supply Chain, Distribution unique to Unilever

**Number of Categories:** 19
**Number of Regions:** 226
**Total number of Products:** 1707
**Total number of rows in Sales data:** 30 million

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**CURRENT METHOD:**

\[
\text{Elasticity} = \frac{\log_{10}(1 + \%\text{UnitChg})}{\log_{10}(1 + \%\text{PriceChg})}
\]

**Used For:**
- Estimating the effects of price changes,
- Categorizing Unilever’s products.

**Issues:**
- Creates estimate from two points in the data.
- Does not consider seasonality and trend.
- Does not account for macroeconomic factors.

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**BUSINESS READY POWERBI DASHBOARD**

**SHOWS**
How each signal contributes to a product’s sales

**IMPACT**
Understanding of product behavior and reactions

**SHOWS**
Expected sales for a given price increase

**IMPACT**
Dynamic and more accurate predictions

**SHOWS**
Elasticity values and metrics for all products

**IMPACT**
Category outlook and sorting of products tiers

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**STEP 1: GOAL:** Remove impact of all features except price

**HOW:** Using Prophet model with seasonality and external regressors

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**Original Sales Data**
Premium Ice Cream Brand

**Price Independent Sales**
Adjusted using Additive, Zero Trend

**PRICE Driven SALES**
Calculated as: Original Sales – Price Independent Sales

**Elasticity Coefficients**

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Revenue Elasticity</th>
<th>Sales Elasticity</th>
<th>Auctual Sales</th>
<th>Dollar Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>2023</td>
<td>0.046</td>
<td>0.125</td>
<td>12381</td>
<td>1382</td>
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<tr>
<td>2021</td>
<td>0.126</td>
<td>0.257</td>
<td>24863</td>
<td>3053</td>
</tr>
</tbody>
</table>

**STEP 2: GOAL:** Use price to explain the remaining variation in sales

**HOW:** Linear regression, shifting 52-week window

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**STAKEHOLDERS**
We would like to thank all the members of the Unilever team for their feedback during this process. Special thanks to the Data and Analytics team: Syed Haider, Zeya Luo and Saloni Mishra. The Pricing team: Marc Becker and Brett Griswold. And the project leads: Ansu Kurian and Matt Algar.

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**NEXT STEPS**
Implemented Model in Cloud to update automatically
Follow up on Business team after series of price changes.

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**CITATIONS**