Pricing Recommendations

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# Problem Statement

As of today our pricing experiments are based on our understanding of consumer behavior - “what can/might work”. There could be opportunities to identify effective pricing strategies based on historical trends of purchase behavior. Another important aspect is to be able to devise and execute pricing strategies at a more granular level, e.g. at PID level.

Two major areas of improvements:

1. Pricing experiments are not enough granular (PID or AG level)
2. Pricing experiments are based on “soft” understanding of customer behavior. There can be more opportunities

Example of opportunities:

1. We have been selling “XX” PID at Rs. YY. We should try to sell this at Rs. ZZ because it is expected to show very low elasticity of demand.
2. PID XX is similar to PID YY in all aspects of performance - while it is priced lower. We should try increasing the price of XX to match that of PID YY.

# Objective

Device, a pricing strategy for Lenskart that has foundations in data, is granular and scalable. It should be able to provide pricing recommendations that can be tested in the field and then scaled up.

# Quick Literature review (what are others doing in this area)

1. <https://towardsdatascience.com/mastering-the-art-of-pricing-optimization-a-data-science-solution-eb8befb79425>

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# Possible Approaches

**Approach 1: Clustering**

Hypothesis: There will be PIDs that will be similar on account of attributes, sales performance, etc. - BUT different on pricing. We can cluster PIDs based on NON-Pricing/ATV metrics and see which ones can have a potential to increase prices.

1. Data to be used for clustering
   1. Attributes
   2. Rate of sale
   3. Merch grids
   4. Location? - circles may be
   5. Revenue share (will be price)
   6. Percentage gross margin
   7. Percentage new customers

**Approach 2: Determine price<>demand relationship using ML (price elasticity)**

Some thoughts:

Max RGM - while walking on a pricing/demand curve for a particle PID or AG.

Complicated - we might not have different price points for the same PID across time - hence getting to an elasticity of Price/demand equation will be challenging/complex. We can use “similarity” to find this.

OR give a shot at “eyeware demand curve” using data from different PIDs that we have. Use the curve to identify what is the best place for a particular PID to sit on that curve?

Profit = Price \* quantity - cost/unit \* quantity

Different price/quantity combinations - to MAX profit;

Constraints:

1. Pricing constraints
2. Quantity constraints
3. Cost

Frame and lens -

frame + lens

**Action items (14th Aug):**

1. Get PID level data:
   1. June 2023 onwards
   2. Order data merge with PID data → pid wise order details; prices , quantity sold.

**Dataset:**

* Item level data is used for analysis. Duration of the data is from 2023-06-01 to 2024-09-12.
* The dataset contains day on day information of PID along with its price on that particular day and quantity sold.
* No of unique products - 11224
* Brands: JJ, VC, AIR, Hustler
* No of orders in above mentioned time period - 99,50,685

| **no of unique price** | **no of unique products** |
| --- | --- |
| **1** | **4426** |
| **3** | **3076** |
| **2** | **2709** |
| **4** | **943** |
| **5** | **64** |
| **6** | **4** |
| **7** | **1** |
| **8** | **1** |

Table: merchandising.product\_attribute\_snapshot

This table summarizes the distribution of products according to the number of unique prices available for each product. It shows how many products have a specific count of unique prices.

For ex : row 1 tells us there are 4426 products which have had only one unique price in the observed time period.

**Overview of PIDs of interest**

For now only the PIDs with unique price points of 4 and 5 are analyzed as these are the price points expected to have variance. In those also further breakdown is done in accordance with core attributes i.e only the PIDs with core,continuity and sizing and whose volume is greater than 8800 are taken into account.

Summary of PIDs with unique price 4 and 5 are shown below:

| **Unique Price** | **Unique Products** | **Core** | **Continuity** | **Sizing** | **Disabled** | **Discontinued** | **Others** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 4 | 943 | 12 | 89 | 16 | 20 | 457 | 349 |
| 5 | 64 | 4 | 14 | 1 | 1 | 17 | 27 |

After taking into consideration only the PIDs with Core,Continuity and Sizing

| **Unique Price** | **Unique Products** | **Total Units** | **Total Revenue** | **Unique Products (greater than 8800 units)** | **Total Units** | **Total Revenue** |
| --- | --- | --- | --- | --- | --- | --- |
| 4 | 117 | 7,25,627 | 1,80,04,55,567 | 31 | 4,69,091 | 1,19,02,46,989 |
| 5 | 19 | 3,44,866 | 61,39,97,983 | 5 | 3,28,036 | 55,40,98,444 |

**Finding Elasticity**

In accordance with above data arc elasticity was calculated for each product (64 products) which has a number of unique prices of 5.

Details of which can be found [here](https://docs.google.com/spreadsheets/d/1NhCvxvyZFdsV_mbkjqtes2qNLjuUBCgxBnTy08dKJPk/edit?gid=0#gid=0)

# Methodology

The price recommendation methodology is structured into three key steps:

1. **Determining Base Sales**: This involves isolating the trend component from the time series by removing seasonal fluctuations to establish the base sales.
2. **Estimating Price Elasticity**: The trend is then regressed onto the price to calculate the price elasticity, providing insight into how sensitive sales are to changes in price.
3. **Optimizing Revenue**: Revenue is optimized using the formula:

**Optimized Revenue = Optimized Base Units × Optimized Price**.

The idea is to optimize price in such a way that revenue is maximized.

Optimized Base Units = Base Units + Change in units at an optimized price

Change is Base Units = Base Units \* Price Elasticity \* [(Optimized Price - Current Price)/Current Price]

Therefore, final equation becomes

**Optimized Revenue = (Base units + (Base units \* Price Elasticity \* [(Optimized Price — Current Price) / Current Price]\* (Optimized Price)**

The above equation is optimized to give

**Optimized Price = [Current Price \* (Price Elasticity - 1)] / (2\*Elasticity)**

Definition of variables used above:

Base Units = Average unit sales at current price

Price Elasticity = Computed From Step 2 for an item

Current Price = Latest Selling Price

After getting the optimized price, we can calculate the net profit after subtracting the cost at both current and optimized price and the net gain percentage.

**Observations:**

**Positive Elasticities**: This indicates that increasing prices would result in higher demand, and lowering prices would reduce demand, which is counterintuitive for typical price optimization. In these cases, there is no clear upper limit for optimizing prices, so we will exclude these products (PIDs) from our price recommendation process, as no optimal price point can be identified.

**Negative Elasticities**: These are the key focus for price optimization, as they reflect the expected relationship where increasing prices decreases demand. We categorize them into two segments:

* **Elasticities between 0 and -1**: These products are less sensitive to price changes. A price increase here can still yield a net gain, as demand will decrease only slightly in response. This group represents an opportunity to raise prices without significantly impacting sales volume.
* **Elasticities below -1**: These products are highly sensitive to price changes. A small price increase would result in a significant drop in demand. In such cases, the optimal strategy would be to lower prices to boost sales volume, thereby driving higher revenue through increased product turnover.

The above methodology is run for 36 PIDs where we have 4 and 5 unique price points which have considerable high volume and core tagged with core,continuity and sizing. Among them observations for PIDs with actionable(statistical significance) can be found [here](https://docs.google.com/spreadsheets/d/1LCWHqVgUu8MHu6qVkEnHvJE3hdzgIlDHDv9N2B5Z4nw/edit?gid=0#gid=0)

# Validation

To validate the recommended pricing strategy derived from the optimization, we will monitor changes in demand after implementing the suggested price adjustments. By removing seasonality and focusing on the underlying trend, we will assess whether the changes in demand aligns with the projections from our model. If the observed demand follows the expected trend, this will confirm the accuracy of the elasticities and the effectiveness of the price recommendations.