# Optimal Pricing Based on Demand Elasticity

**Project Report**

## Executive Summary

This project analyzes historical retail sales data to estimate the price elasticity of demand across various product categories and determine optimal pricing strategies to maximize revenue. Using regression modeling, we segment products by elasticity type (elastic/inelastic) and simulate revenue outcomes under alternative pricing scenarios. Our findings reveal that most product categories exhibit inelastic demand, indicating opportunities for strategic price increases.

## Data Overview

Dataset Source: Kaggle (Retail Product and Sales Data)

Time Period: 2023

Key Columns: Transaction ID, Date, Customer ID, Gender, Age, Product Category, Quantity, Price per Unit, Total Amount

Data Preparation: Cleaned missing values and outliers; Aggregated sales by Product Category and Price; Calculated demand per price point; Created features for further analysis.

## Methodology

Elasticity Estimation:

Applied log-log linear regression to estimate price elasticity:  
 log(Q) = α + β \* log(P)  
where β is the elasticity coefficient.

Revenue Simulation:  
 Simulated expected revenue using: R = P \* Q(P) = P \* aP^b  
Identified price P\* that maximizes R

Tools Used: Python (pandas, statsmodels, matplotlib, numpy); Jupyter Notebook

## Analysis Results

### Product Category: Beauty

Estimated Elasticity: 0.02

Model R²: 0.27

Optimal Price: $500.00

Maximum Revenue: $1,292.21

### Product Category: Clothing

Estimated Elasticity: 0.00

Model R²: 0.01

Optimal Price: $500.00

Maximum Revenue: $1,277.53

### Product Category: Electronics

Estimated Elasticity: 0.02

Model R²: 0.22

Optimal Price: $500.00

Maximum Revenue: $1,272.89

## Category-Level Summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Category | Elasticity | R² | Optimal Price | Max Revenue |
| Beauty | 0.02 | 0.27 | $500.00 | $1,292.21 |
| Clothing | 0.00 | 0.01 | $500.00 | $1,277.53 |
| Electronics | 0.02 | 0.22 | $500.00 | $1,272.89 |

## Recommendations

- Beauty: The low elasticity indicates that demand is not highly sensitive to price changes.

This means raising prices is unlikely to significantly reduce quantity sold, making higher prices more profitable. Consider increasing price to $500 or higher to capitalize on inelastic demand.

- Clothing & Electronics: Demand also appears inelastic. The model suggests no relationship between price and demand—likely due to limited data or a pricing ceiling already being reached.

I recommend maintaining current pricing unless further data collection improves model reliability. Alternaive;ly, conduct A/B pricing tests to validate optimal pricing in the real world.