Pricing Strategy Analysis Using Price Elasticity Modelling

By: Aditya Prabhu

Table of Contents

Objective

Problem:
Pricing is one of the most powerful levers businesses can use to drive profitability. Setting the right price affects both demand and revenue, and without data-driven insights, businesses risk underpricing or overpricing their products.

Goal:
In this project, I aim to analyse how product prices influence sales quantities using the concept of price elasticity of demand. I will:

- Estimate the price elasticity of demand for products
- Simulate how revenue changes under different pricing scenarios
- Recommend actionable pricing strategies to maximise revenue while minimising volume loss

Business Impact:
Understanding elasticity enables strategic price setting, which can improve profit margins without harming market competitiveness.

Data Understanding

Dataset Used: Olist Brazilian E-commerce Dataset (public Kaggle dataset)

Files Included:

- `order_items` – contains details of each product in every order, including price
- `products` – includes product category and product ID

Key Variables Identified:

- `product_id`: unique identifier for each product
- `price`: price of each product in each order
- `product_category_name`: category of each product

Initial Exploration:
I checked the shape, missing values, and previewed the datasets to understand the data structure and determine relevant columns for the analysis.

Data Cleaning and Preparation

To prepare the data for analysis:

1. I merged `order_items` with `products` using `product_id` to combine price and category information.

2. I aggregated the data to calculate:

    - **Total quantity sold per product** by counting the number of orders containing each product

    - **Average price per product** by taking the mean of prices across orders

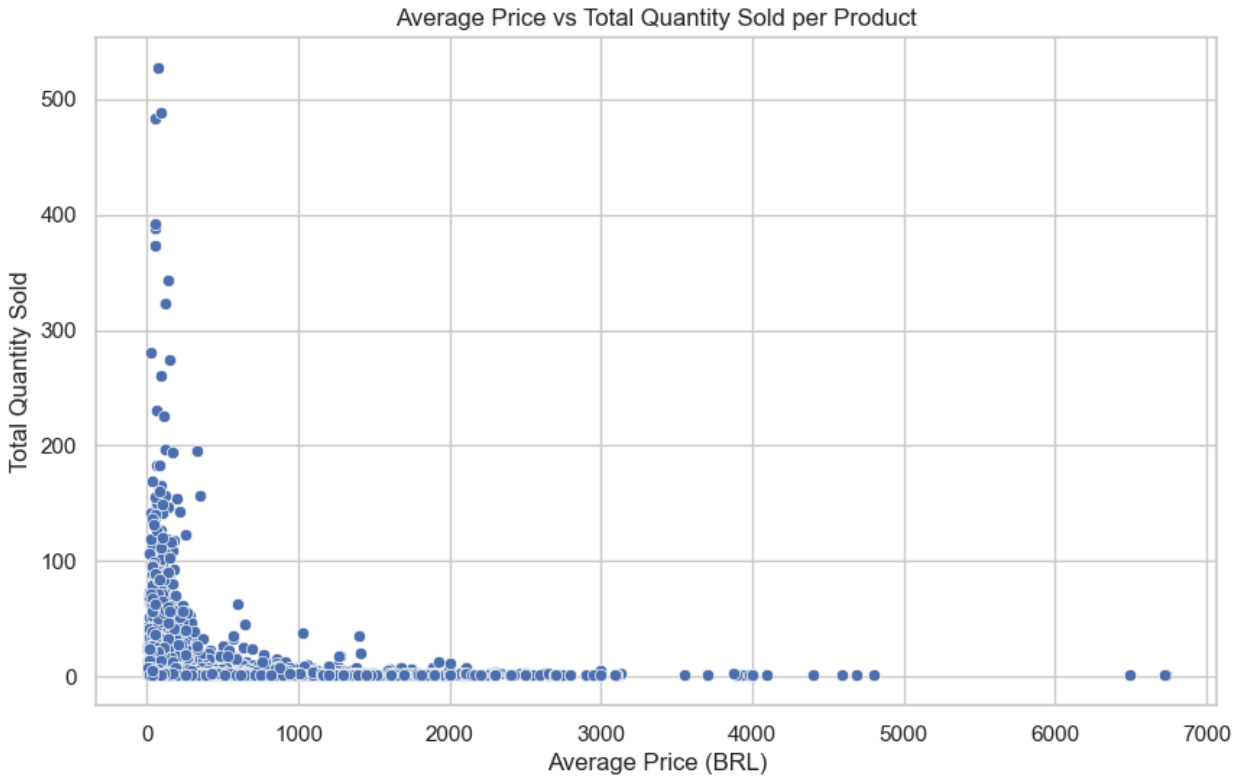
3. I removed any records with zero or negative prices to maintain realistic economic analysis.

4. Data types were checked and ensured to be appropriate for regression modelling.

This cleaning process ensured that my dataset was structured correctly for subsequent analysis steps.

Exploratory Data Analysis

I created a scatterplot to visualise the relationship between average price and total quantity sold per product.



Observations:

- There is a **clear negative relationship** where products with higher prices tend to have lower quantities sold.
- Most products are priced under BRL 1000, with quantities sold ranging widely, indicating varied demand patterns across categories.

This EDA step validated economic theory and set the foundation for elasticity modelling.

Price Elasticity Modelling

Method Used:
I applied a **log-log linear regression model** to estimate the price elasticity of demand:

- **Dependent Variable:** log(total quantity sold)
- **Independent Variable:** log(average price)

Using the statsmodels OLS function, I obtained the following key result:

- **Elasticity Coefficient:** -0.0592

Interpretation:

- The negative coefficient indicates an **inverse relationship** between price and quantity sold.
- The **absolute value of elasticity is less than 1**, meaning **demand is inelastic**. Customers are relatively insensitive to price changes for these products.
- The model's p-value for the coefficient was **significant ($p < 0.05$)**, confirming the reliability of this result.

Revenue Simulation

To understand the practical business impact, I simulated revenue changes under different price increase scenarios (5%, 10%, and 20%).

Price Increase	Revenue Change (%)
5%	+4.7%
10%	+9.4%
20%	+18.6%

Insights:

- Due to inelastic demand, increasing prices led to an increase in overall revenue despite a minor reduction in quantity sold.

- The marginal revenue gain decreased as price increase percentage rose, reflecting diminishing returns at higher price changes.

Business Recommendations

1. **Implement Strategic Price Increases**
   Why: The demand inelasticity indicates that slight increases in price will not cause significant volume loss.
   Recommendation: Increase prices by **5-10%** on inelastic products to maximise revenue and profit margins without harming sales significantly.

2. **Continuous Monitoring Post-Implementation**
   Why: Elasticity may change over time due to market dynamics, competition, or customer preferences.
   Recommendation: Monitor quantity sold and revenue closely after implementing price changes to ensure that demand patterns remain consistent with analysis predictions.

3. **Category-Specific Elasticity Analysis (Future Work)**
   Why: Different product categories may have varying elasticity, and granular analysis can refine pricing strategies further.
   Recommendation: Conduct category-level elasticity modelling to identify products with elastic demand where price reductions could boost volume.

Conclusion

In this project, I conducted a price elasticity analysis using the Olist Brazilian E-commerce dataset. The findings revealed that demand for most products is inelastic, suggesting that the business has room to increase prices moderately to enhance revenue without losing significant sales volume.

This analysis demonstrates how data-driven pricing decisions can directly contribute to higher profitability and strategic market positioning.