Holistic Pricing: Going beyond elasticity models by merging datasets through data fusion and interoperability

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Abstract

This paper addresses the basic issues with using classical Price Elasticity of Demand (PED) models for commercial applications, particularly due to their inability to apply effective constraints under dynamic market conditions. Classical models usually lead to theoretically optimal, but impractical price recommendations (e.g. unlimited price increases for inelastic goods). This study proposes the Holistic Pricing Approach (HPA), a multi-variable method that unifies data inputs from multiple sources into a single recommendation engine that helps overcome the classical model shortcomings.

The HPA method employs a data fusion system linking three unique data sources: internal economics (e.g., product cost, target gross margins), competitive intelligence (competitor's prices) and macroeconomic factors (e.g., inflation). These inputs are standardized with an interoperability layer to drive a four-step algorithmic heuristic. This includes a margin anchor price that is subject to adjustments by "competitive boundary checks" and "volume guardrails" to avoid excessive demand erosion.

The effectiveness of the HPA was validated through a theoretical simulation with truncation that was compared to a classic elasticity model. The results showed that the traditional approach maximized margin at the expense of significant volume (20% lost), while HPA successfully balanced preserving margins and market share (5% volume loss). Furthermore, the total profit dollar amount was greater for the HPA strategy, which confirms that the HPA methodology drives increasing economic value.

This study demonstrates that to protect revenue integrity, pricing must be approached as an interoperable ecosystem of constraints rather than a single dimensional elasticity calculation. This approach offers a roadmap for business leaders who, in the face of inflation, need to strike the right balance between increasing prices and preserving market share.

Keywords: Holistic Pricing, Demand Elasticity, Data Fusion, Data Interoperability, Pricing Analytics.

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1. Introduction

Price optimization is one of the most important but difficult challenges to tackle in modern commerce. The Price Elasticity of Demand (PED) model has been the prevalent go-to framework to establish prices for decades. This model assumes a direct relationship between a change in price and the resulting change in demand [1]. The standard formula for Price Elasticity of Demand (ED) is defined as:

$$\mathbf{E_D} = \frac{\textbf{\% Change in Quantity Demanded}}{\textbf{\% Change in Price}}$$

This traditional framework is one of the most important economic breakthroughs ever made, and it still helps us understand markets even today. However, for realistic commercial purposes, this approach is insufficient to make pricing decisions due to its binary nature. If a product is elastic (ED > 1), this framework suggests that a price decrease will maximize revenue. Conversely, if a product is inelastic (ED < 1), a price increase maximizes revenue. [2].

The reason why exclusively leveraging this method for price-setting in commerce isn't practical is due to its inability to consider relevant constraints. A purely mathematical application of the elasticity method suggests that for inelastic goods, price should be increased to infinity, and for elastic goods, companies should adjust pricing to almost zero, which isn't realistic. In reality, pricing is constrained by multiple factors, including costs (the minimum price to at least breakeven) and consumer willingness to pay (the maximum price the product could be sold at) [3].

Table 1. Traditional Elasticity-Based Optimization Logic

Elasticity Coefficient (E_D)	Consumer Behavior	Traditional Model Recommendation	Limitation
Elastic ($E_D > 1$)	Highly sensitive to price changes	Decrease Price to maximize revenue	Without a cost floor, the model may suggest decreasing price to near-zero to maximize volume, ignoring profitability
Unitary ($E_D = 1$)	Demand change is proportional to price change	Maintain Price	Assumes static market conditions. Ignores competitor moves or inflation
Inelastic ($E_D < 1$)	Insensitive to price changes	Increase Price to maximize revenue	Without a ceiling, the model suggests increasing price indefinitely, ignoring customer willingness-to-pay

This paper focuses on the following question: How can modern enterprises move beyond the traditional elasticity models, and leverage a multi-variable approach that includes a broader set of considerations, including competitive dynamics and internal economics at the same time? The objective of this article is to propose the Holistic Pricing Approach (HPA) as the solution.

1.1. Current Elasticity-Based Models

Current commercial applications of elasticity-based pricing attempt to mitigate the "infinity flaw" described in the introduction through truncated elasticity models:

1. Calculate ED: The system analyzes historical sales data to determine the elasticity of the product.
2. Determine direction: Based on Table 1, the system flags the product for a price increase or decrease.
3. Apply truncation: To prevent extreme pricing, the organization applies manual limits. For example, if the math suggests a 50% price increase is optimal, the system "truncates" the action at a maximum increase (e.g., +5%) [4].

While this method avoids extreme price changes, it is reactive (as opposed to preventive) and very subjective. It treats pricing as an isolated variable, independent of competitive and macroeconomic context. By simply "capping" the math, companies fail to capture the additional variables that are relevant, leaving margin on the table for inelastic goods or losing market share to competitors on elastic goods [5].

1.2. Proposed Holistic Pricing Approach (Hpa)

To overcome the limitations of elasticity-based pricing, this paper proposes the Holistic Pricing Approach (HPA). Instead of relying on a single data source (sales and price history), the HPA leverages data fusion to aggregate heterogeneous data points from multiple sources into a unified decision engine.

The HPA fuses three distinct "buckets" of data:

1. Internal Economics: Data regarding the company's cost basis, target gross margins, and historical product elasticity
2. Competitive Intelligence: Web-scraped pricing data from direct competitors, matched SKU by SKU for product comparability [6].
3. Macroeconomic Factors: External indices such as the Consumer Price Index (CPI), inflation rates and disposable income [7].

The core innovation of the HPA is data interoperability. In most organizations, these three buckets exist in incompatible formats (e.g., SQL databases, Excel sheets). The HPA leverages an interoperability layer that normalizes these inputs, maps external competitor SKUs to internal IDs and adjusts for different product attributes. This allows the algorithm to calculate a single output based on the combination of all these metrics [8].

1.3. Defintion Of Algorithm

The HPA utilizes a 4-step algorithm to determine the optimal price point for each individual SKU. This algorithm maximizes profitability and at the same time applies realistic constraints based on market realities.

The Four-Step Algorithmic Process:

Step 1: Margin Anchor (Internal Economics). The algorithm first calculates a "Base Price" [9] derived solely from internal economics. It leverages the cost basis and the company's strategic financial targets to set a price that yields the exact target Gross Margin.

$$\mathbf{P_{base}} = \frac{\mathbf{Cost}}{(\mathbf{1-Target\ Margin})}$$

Step 2: Competitive Boundary Check (Competitive Intelligence). The algorithm compares Pbase against the fused competitive intelligence dataset. It verifies if the price falls within user-defined boundaries (e.g., "Price must be within ±10% of the Market Leader")

$$\mathbf{IF\ P_{base}} > (\mathbf{CompPrice\ x\ 1.10}), \mathbf{THEN\ P_{adjusted}} = \mathbf{CompPrice\ x\ 1.10}$$

Step 3: Elasticity & Volume Guardrail (Macro/Internal): The algorithm tests the Padjusted against the product's elasticity profile. It calculates the projected impact on sales volume (ΔQ). If the projected volume loss exceeds the maximum tolerance (e.g., > -15% volume loss), the algorithm lowers the price until the volume loss is within the acceptable guardrail [10].

Step 4: Consistency & Logic (Price Laddering): Finally, the algorithm controls for "Price Ladder" consistency to ensure rational pricing within a product family. It verifies that premium attributes retain premium pricing (e.g., a 100g unit must cost more than a 50g unit).

$$\boldsymbol{IF\ P_{ItemA} < P_{ItemB}\ (where\ A\ is\ superior), THEN\ P_{ItemA}}$$

Is adjusted upwards to $\boldsymbol{P_{ItemB} + Increment}$

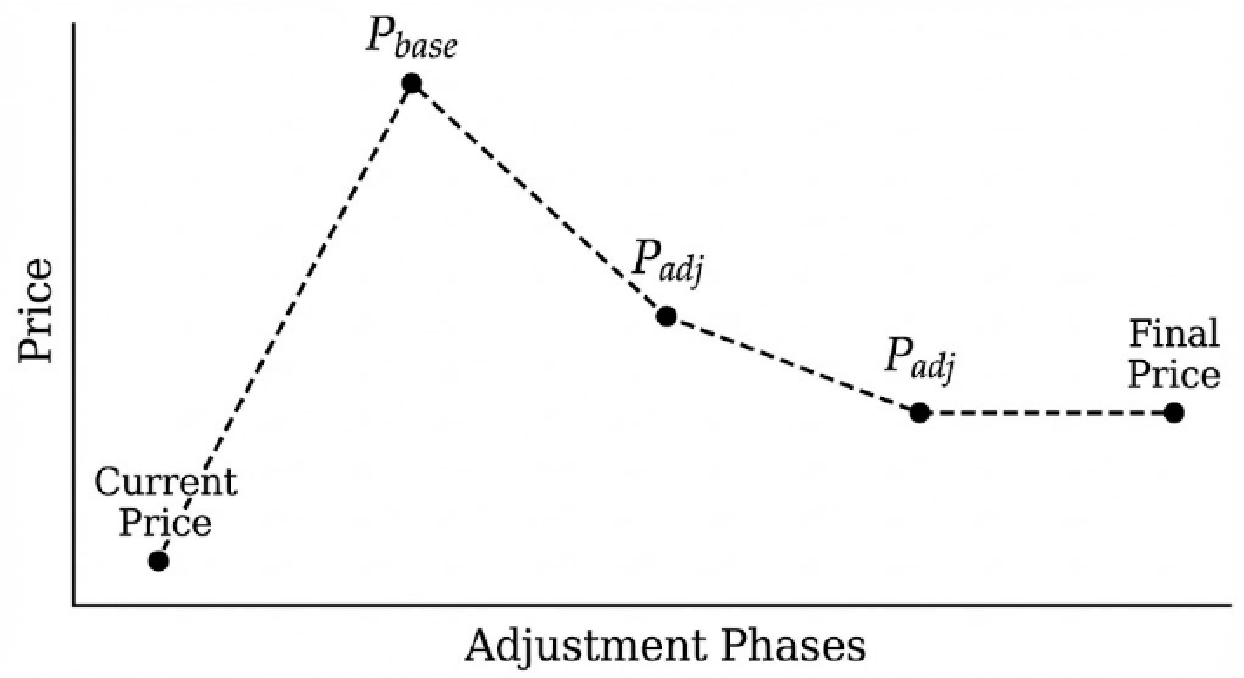

Figure 1. Algorithmic Iteration

2. VALIDATION

To validate the HPA, a theoretical simulation was conducted, comparing the traditional model against the HPA Algorithm using a example product ("Product X") under inflationary conditions.

Scenario Parameters:

- Product X Cost: Increases from \$100 to \$110 (Inflation).
- Target Margin: 50%.
- Competitor Price: Remains static at \$200.
- Elasticity (ED): -2.0 (Highly Elastic)
- The results are presented in Table 2.

Table 2. Comparative Results of Pricing Methodologies

Metric	Traditional Model (Elasticity Only)	HPA Algorithm (Proposed)	Analysis
Logic	Cost increases triggers price increase to maintain margin.	Cost increases but then checks comp price (\$200) and volume guardrail.	Traditional model ignores the competitor.
Final Price	\$220 (To maintain 50% margin)	\$205 (Constrained by comp guardrail)	HPA accepts a lower margin to save volume and maximize profit
Volume	-20% drop (Due to price hike)	-5% drop (Minor adjustment)	Traditional model destroys demand.
Profit	Lower (High margin, low volume)	Higher (Slightly lower margin, high volume)	HPA maximizes total profit dollars.

The traditional model successfully protected the percentage margin (50%) but destroyed the sales volume, resulting in lower total profit dollars. The HPA detected the competitive constraint (Step 2) and the volume guardrail (Step 3), restricting the price increase. While the HPA resulted in a lower gross margin percentage (46%), it retained significantly more market share and total profit, validating its superiority in maximizing total economic value.

3. Conclusion

This study demonstrates that relying on traditional elasticity models is no longer sufficient for modern corporate pricing. The traditional demand elasticity model, which leverages a single data source and mathematical formula to establish pricing, fails to account for the multi-dimensional nature of today's market, characterized by aggressive competition and inflationary instability.

The Holistic Pricing Approach (HPA) provides a robust alternative. By fusing multiple data points and leveraging internal, competitive and macroeconomic information into an interoperable ecosystem, companies can achieve pricing precision. This approach allows firms to navigate uncertain economic environments, protecting revenue integrity without sacrificing market share.

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