Basics of Pricing Analytics

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Sources:

Bodea, T. and Ferguson, M., 2012. Pricing Segmentation And Analytics. New York: Business Expert Press

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Harvard Business Review. 2020. A Refresher On Price Elasticity

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Key Concepts

Pricing analytics

Use of historical data to determine the best prices to set for future sales

Factors that affect pricing

- Nature of the product or service (features, delivery, conditions of sale, channel)
- Competing alternatives (both direct and indirect)
- Customers' valuation of the product, needs, and purchasing behavior

Utility

Value that a product or service provides to a customer

Willingness-to-Pay

Maximum willingness-to-Pay (WTP), the maximum price at which the consumer would buy a good

Search cost

Cost of searching and purchasing the product from another location or source

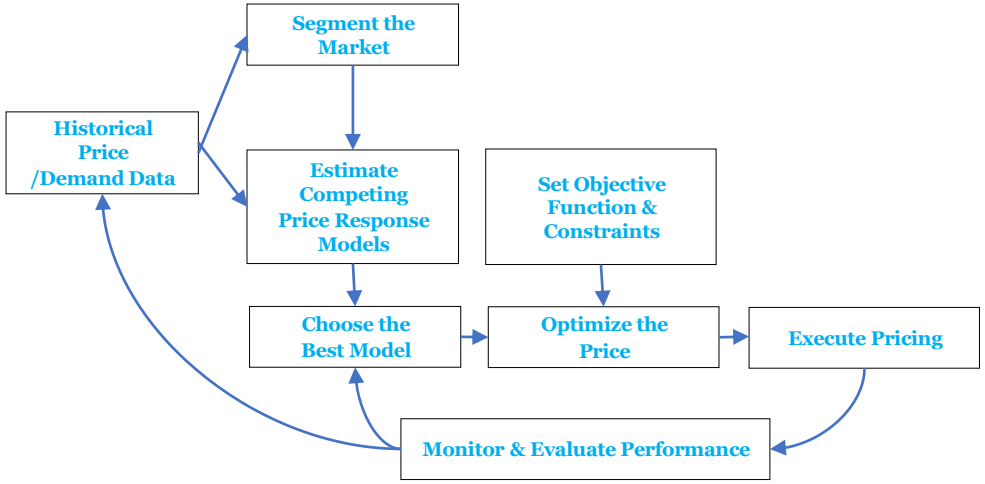
Price elasticity (ε)

$$\varepsilon = \frac{Percentage\ change\ in\ quantity\ demanded}{Percentage\ change\ in\ price}$$

Properties of Price elasticity:

- Always <0
- Independent of units
- Depends on the price at which it is measured
- Depends on level of measurement
- Depends on time period of measurement
- $|\varepsilon| < 1$ (inelastic), raising price will increase revenue
- $|\varepsilon| = 1$, revenue is independent of price;
- $|\varepsilon| > 1$ (elastic), raising price will decrease revenue

Pricing Analytics Process



Historical Price/Demand Data

Test & handle data for Accuracy, Outliers & Missing values

Estimate Competing Price Response Models

Price-Response function/model:

Specifies demand for the product of a single seller as a function of the price offered by that seller i.e., describes how customers are expected to respond to our pricing actions

It is estimated using econometric techniques such as linear or nonlinear regression

Common Price-Response functions:

Price-Response function	Formula	WTP Distribution	Description
Linear	$d(p) = D + m \cdot p$	Uniform	D represents the intercept term, p is the independent variable, and m is the slope
Constant Elasticity	$d(p) = C \cdot p^{\varepsilon}$	Exponential	C > 0 and ε are parameter values*
Power	$d(p) = \frac{\alpha \cdot D}{p^{\beta} + \alpha}$	Weibull	D > 0, α, and β are parameter values*
Logit	$d(p) = \frac{C \cdot e^{a+b \cdot p}}{1+e^{a+b \cdot p}}$	Gumbel	where C > 0, a, and b are parameter values*

Note:

*estimated by fitting equation to the price/demand data

d(p) = the demand expected to materialize at a price p

Segment the Market

Find the different consumer attributes where consumers with similar attributes have the same (or similar) price-demand responses

Set Objective Function & Constraints

Objective function

Specifies what we are trying to achieve (maximize profits, meet a market share target, etc.)

Common Types of Objective functions:

Revenue optimization: Find the price 'p' that maximize Revenue

R(p) = pD(p) ; where p is the Price
D(p) is the demand at price p
R(p) is revenue at price p

Profit optimization: Find the price 'p' that maximize Profit

Profit(p) = (p-c)D(p) ; where p is the Price
D(p) is the demand at price p
c is the cost of producing one unit

Profit is maximized when marginal revenue = marginal cost

Marginal cost

Change in the revenue when one additional unit of a product is sold

Marginal revenue

Additional cost incurred in the production of one more unit of a good or service

Constraints

Constraint is the limit on what we can do (capacity, capital, margin, etc.)

Optimize the Price

Optimal Price

The price (or set of prices) that results in the best value of the objective function while the required resources needed to achieve the objective function value remain within the limits specified by the model constraints

Execute Pricing

Process of presenting the right prices to the right set of consumers in the right way

Monitor & Evaluate Performance

Market feedback occurs at 2 levels:

- Analysis of alternatives: Effects of the most recent actions monitored so that immediate action can be taken if necessary
- Updates the parameters of the price-response functions

Python Packages for Price Optimization:

- cvxpy
- scipy.optimize