Build a function in R for WTP, shares, price, and profit

Brandy Huang, Selina Bian, Madilyn Xu, Zicheng Zhao, Jason Wang

Conjoint Analysis

1. Introduction

Conjoint analysis is a statistical technique used to understand consumer preferences by analyzing their choices or judgments about various product or service configurations. Rather than asking directly, it observes how people value different attributes, such as price, brand, or features etc., and determines the contribution of each attribute to their overall decision-making process.

2. Measures

Generally, there are six steps to conduct a conjoint analysis:
- **Identify Attributes and Levels:** The process begins with identifying the important product attributes (e.g., brand, price, features) and their varying levels (e.g., RAM of 8GB or 16GB).
- **Create a Fractional Factorial Design:** A subset of product combinations is created using a fractional factorial design, reducing the number of configurations while retaining meaningful insights.
- **Data Collection:** Participants evaluate these configurations using methods like ranking, rating, or choice-based tasks.
- **Estimate Part-Worth Utilities:** Statistical methods, like multiple regression, are used to estimate the utility (or part-worth) of each attribute level, representing its contribution to consumer preferences.
- **Analysis and Interpretation:** Attribute importance is calculated by comparing the utility ranges. Willingness to pay (WTP) for certain features can be determined by linking utility to price. Market share simulations can predict consumer preferences for various product designs.
- **Prediction and Optimization:** The results are used to optimize product designs, pricing, and marketing strategies.

3. Benefits

The reason why people usually conduct conjoint analysis is because there are several benefits:
- **Understanding Consumer Preferences:** It reveals the underlying factors influencing consumer decisions.
- **Determining Attribute Importance:** Helps identify which product attributes are most critical for consumers.
- **Optimizing Product Design:** Supports the creation of products that align with consumer desires.
- **Predicting Market Performance:** Simulates market share and predicts the success of various product configurations.
- **Setting Optimal Pricing:** Assesses consumer price sensitivity and determines optimal pricing strategies.
- **Gaining Competitive Advantage:** Provides insights into brand perception and helps differentiate products in competitive markets.

- **Cost-Effective Decision-Making:** Allows businesses to refine strategies and reduce risks before launching products.

Limitations

Before stepping into the conjoint analysis we conducted, it is important to know that there are several limitations of conjoint analysis, and a key drawback of conjoint analysis is that its accuracy depends on the assumption that consumer preferences remain consistent across different contexts, which may not reflect real-world complexities such as emotional or situational influences on decision-making.

Findings Interpretation

1. Partworths for Each Coefficient

Partworths	Coefficients
Intercept	8.4
Screen 75 inch	2.6
Screen 85 inch	4.3
Resolution 4K	5.4
Sony	2.1
Price	-4.0

Coefficients Interpretation:
- The intercept indicates that a TV with a 65-inch screen, no 4K resolution, and the brand name of Sharp typically has a preference rank of 8.4 from consumers.
- Customers prefer TVs with a larger screen size, holding resolution, brand name, and price constant. On average, a 75-inch TV and an 85-inch TV have a preference rank of 2.6 points and 4.3 points higher than a 65-inch TV, respectively with all other factors equal.
- Customers prefer TVs with 4K resolution over those with 1K resolution, with the former receiving an average preference rank of 5.4 points higher, holding other factors constant.
- Customers prefer a Sony branded TV over a Sharp branded TV, with Sony branded TVs having an average preference rank of 2.1 points higher, holding other factors constant.
- TVs with a low price are more preferred by consumers, with a high-priced TV typically receiving a preference rank of 4 points lower than a low-priced TV, holding other factors equal.

2. Attribute Importance

Attributes	Range	Importance
Screen Size	1.7	12.88%
Screen Resolution	5.4	40.91%
Brand Name	2.1	15.91%
Price	4	30.3%

- Screen resolution is the most important factor affecting customer preference rank among 4 factors with an important of 40.91% while screen size is least important, with an important of 12.88%.

3. Willingness to Pay

Attribute	WTP
75-inch screen	$325.01
85-inch screen	$541.27
Sony-branded TV	$260.47
4K resolution	$680.81

- Consumers are willing to pay $325.01 more for a 75-inch TV screen compared to a 65-inch screen, and $541.27 more for an 85-inch screen than for a 65-inch screen.
- Additionally, they are willing to pay $260.47 extra for a Sony-branded TV to a Sharp-branded TV.
- Furthermore, consumers are prepared to pay $680.81 more for a TV with 4K resolution instead of a TV with 1K resolution.

4. Optimal Price, Maximum Profit and Market Share

With coefficients rounded to 1 digit, we have optimal points as follows:
- Optimal Price: $2126.721
- Maximum Profit: $19.50413
- Corresponding Market Share: 0.1539135%

The process involves computing the profits at different price points for my design and identifying the price that yields the highest profit, which is our optimal price.

In detail, the optimal price is calculated by testing different price points for my design. As the price changes, the utility, attractiveness, and market share are adjusted accordingly. Based on these, different sales volumes and margins are computed. By multiplying the margin and sales, the corresponding profits are determined. The optimal price and its corresponding market share are then identified by selecting the price that yields the maximum profit.

5. Plot Market Shares and Profit

Here is the visualization of market shares and profit accordingly as a part of function output:

Sales = Share x Market Size · **Profit = Margin x Sales**
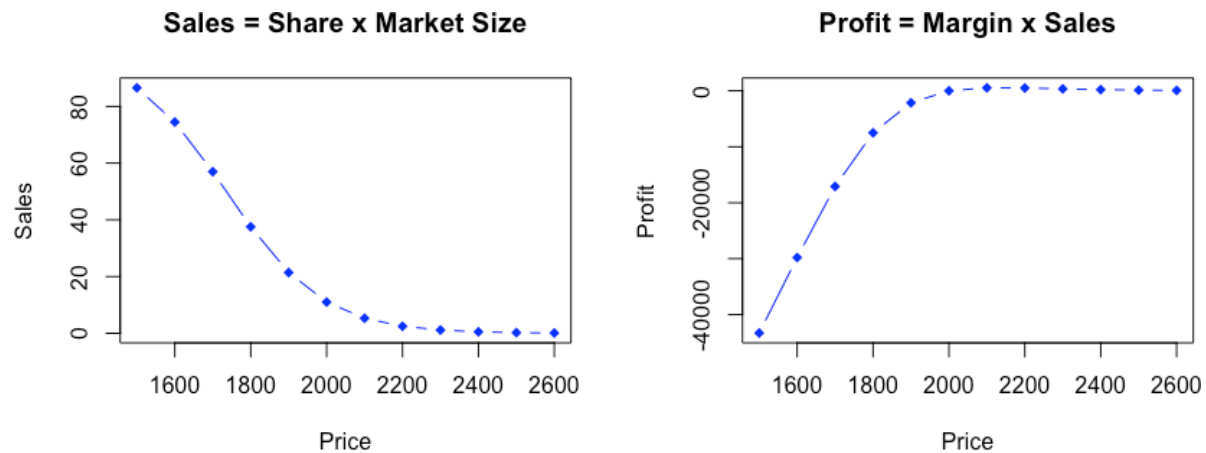
When we see these two plots together, there is a trade-off between volume and margin, which means as price increases, the company can gain more margin, but at the same time, it can lose sales volume because fewer buyers are willing to purchase at higher prices.

Plot market shares as a function of prices: This plot shows that sales start relatively high at lower prices, then decrease sharply as price rises.

Plot profit as a function of prices: In this plot, profit starts negative or low at very low prices (even though sales are high, the margin may not be enough to cover costs or drive profit). Then it climbs as the price goes up, eventually reaching a peak (the maximum profit). However, if the price becomes too high, profits will decline as sales volume drops significantly.