BAX 442 001 002 - Advanced Statistics - Homework 1
Amit Gangane, Varun Rao, Shivani Tayade, Sravya Bhaskara, Karishma Mehta

Conjoint Analysis

Conjoint analysis is a set of rules and methods that helps in determining how much an attribute contributes to a consumer's utility. This can also be considered as part of the worth of an attribute. It is a helpful tool in deriving the underlying utilities and preferences of consumers by looking at their decisions.

Conjoint analysis can be conducted using the following steps:

1. Defining the attributes and attribute levels: Identifying key attributes of the product that are likely to influence consumer preferences. For example, for a mobile phone, the attributes may include screen size, memory, brand, and price. Each attribute can have two or more levels.
2. Creating a set of profiles: With various attribute levels, product profiles can be created with each profile representing a different product configuration.
3. Collecting preference data: Asking consumers to rank the different profiles.
4. Analyzing the data: Use statistical methods to estimate the partworths for the different attribute levels.

Applications

There are many real-world applications for conjoint analysis, including:

1. Product Launch and Development: Optimal combination of features for a new product will maximize consumer preferences.
2. Pricing: Determination of optimal pricing for a product, taking into account consumer preferences for different attributes.
3. Market Segmentation: Identifying groups of consumers with similar preferences that can be targeted with personalized experience.

Benefits

With the help of conjoint analysis, we can determine consumer choices and preferences before even the actual production. Some of them are the following:

1. Partworth: The actual numerical worth of a particular feature to a consumer.
2. Attribute Importance: The relative importance of different attributes to the overall utility of a product. This can be calculated by comparing the range of partworths for each attribute.
3. Best Product designs: We can match the attributes with the highest partworths and get the best product designs, most preferred by consumers.
4. Willingness to pay (WTP): Total money a consumer is willing to pay for an attribute level.

5. Market Share: Fraction of the market that a product with a specific profile is expected to capture. This can be calculated by taking into account the partworths of the attribute levels and the prices.
6. Optimal Prices: Compare revenue in different price levels and finding the most optimal price wherever revenue is maximized.

Results and Interpretation

1. Partworths for each attribute level

	Estimates	Std Errors	T-values
Intercept	8.385877	0.2581219	32.488053
Screen Size 75	2.600052	0.2566417	10.131059
Screen Size 85	4.330155	0.2570949	16.842631
Resolution(4K)	5.446445	0.2105568	25.866862
Sony	2.083766	0.2105561	9.896492
Price	-3.951746	0.2105567	-18.768086

The estimates are the estimated partworths for each attribute. Higher estimate value shows higher partworth value and hence greater consumer preference.

2. Attribute Importance of each attribute

Attribute importance is calculated based on the range of partworths for each attribute (highest - lowest). The results are as follows:

Screen Size	Resolution (4K)	Brand (Sony)	Price
13.1%	41.2%	15.8%	29.9%

Looking at the results, it can be said that resolution has the highest importance and greatly influences consumer utility, followed by Brand, then screen size and finally price.

3. Willingness to pay for each non-price attribute level

Calculated willingness to pay (WTP) for each non-price attribute level:

Screen Size 75 inch	Screen Size 85 inch	Resolution(4K)	Sony Brand
$328.98	$547.88	$689.12	$263.65

Willingness to Pay is calculated by taking into account utilities per dollar and the partworths of each attribute level. From the results, consumers are willing to pay a premium for 4K Resolution followed by large screen size.

4. Optimal price

The optimal price is calculated in an iterative manner by first estimating the utility which incorporates the partworths of all the attributes. Using that, the attractiveness score for each attribute is calculated by exponentiating the utility representing the relative preference of the product. Then, the market share is computed by taking the fraction of each attractiveness score from the total. Using the market share, finally the sales (market size times market share) and profit (Margin times sales) are determined. In the end, the optimal price of **$2100** is calculated as the price where there is maximum. At $2100, there is a balance achieved between a higher margin and a reasonable level of sales and market share.

5. Maximum profit

The maximum profit of **$19.72** is computed at the optimal price of $2100, where profitability is maximized by creating a balance between unit margins and sales volume.

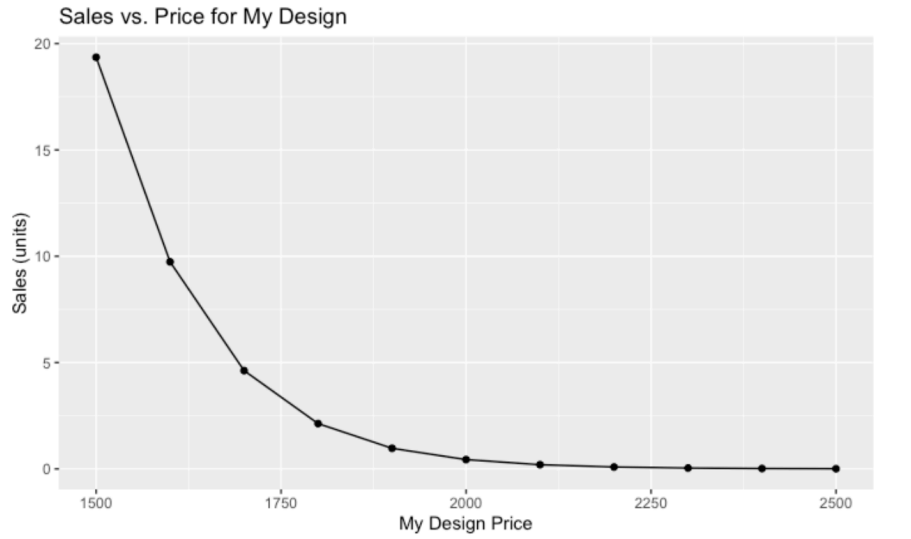
6. Market share associated with optimal price

At $2100, the market share is **0.197%**, reflecting a small but profitable portion in the market. The relative attractiveness score for each product (exponential utility) is used to calculate the market share. The low market share signifies that the new designed product is positioned as a premium product, trading volume for maximum profitability.

Price <dbl>	Profit <dbl>	Market_Share <dbl>
2100	19.71559	0.001971559

7. Plot market shares as a function of prices

The plot shows how market share changes with price showcasing a steep decline in market share as price increases beyond $2100. As the price increases, the number of units sold decreases sharply. This signifies price sensitivity in this market segment for consumers. It is important to create a balance between demand and cost to optimize profitability.



8. Plot profit as a function of prices

This plot shows how profit greatly increases as we increase the price and peaks at $2100 confirming it to be the optimal price. Beyond $2100, the reduction in market share leads to decreased total profit. This plot validates our calculations of the optimal price visually and aligns with the maximum profit value.