**Conjoint Analysis for Product Feature Prioritization**

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**Problem Statement:**

The goal of this notebook is to demonstrate how to use conjoint analysis to understand customer preferences for product features. We will use a simulated dataset to determine the relative importance of different product attributes and the utility of each attribute level. This will help in making data-driven decisions for product design and feature prioritization.

**Introduction to Conjoint Analysis:**

This section introduces the concept of conjoint analysis, a statistical technique used in market research to determine how people value different attributes features, functions, benefits that make up an individual product or service. It explains the "what" and "why" of conjoint analysis with a simple example of buying a new TV.

**Key Components of Conjoint Analysis:**

This section breaks down the core components of conjoint analysis:

**Attributes and Levels:** Attributes are the features of a product, and levels are the variations of those attributes.

**Profiles or Concepts:** These are the combinations of attribute levels that are presented to respondents.

**Utility Scores:** These are the numerical representations of consumer preference for each attribute level.

**Smartphone Profiles - Code Along:**

In this section, we walk through a practical example of conjoint analysis for a smartphone.

**Study Design:** We define the attributes Battery Life, Screen Size, Price and their respective levels.

**Data Collection:** We simulate survey responses for different smartphone profiles.

**Data Analysis:** We use Ordinary Least Squares OLS regression to analyse the data and determine the utility scores for each attribute level. This helps us understand which features are most preferred by consumers.

**Expanded version - Code Along:**

This section provides a more detailed, step-by-step implementation of conjoint analysis using Python.

**Simulating Data:** We generate a dataset for a product with three attributes: Colour, Size, and Price. We simulate the choices of 1000 respondents.

**Encoding Data:** We convert the categorical data into a numerical format using one-hot encoding to prepare it for regression analysis.

**Estimating Utilities:** We use linear regression to estimate the part-worth utilities for each attribute level. These part-worths represent the preference for each specific feature.

**Relative Importance of Each Attribute:**

Here, we calculate the relative importance of each attribute.

**Calculating Importance:** We determine the importance of each attribute by looking at the range of its part-worths. A wider range indicates greater importance in the consumer's decision-making process.

**Visualization:** We create bar plots to visualize the part-worth utilities and the relative importance of each attribute. This makes the results easy to understand at a glance.

**Results:**

The analysis of the simulated data yielded the following key results:

**Part-Worth Utilities:** We obtained specific utility values for each level of the attributes Colour, Size, and Price. For example, a positive utility for 'Size\_Medium' indicates a preference for medium-sized products.

**Relative Importance:**

**Colour: 5.36%**

**Size: 77.74%**

**Price: 16.90%**

These percentages show that 'Size' is the most critical factor for consumers in this simulation, followed by 'Price' and then 'Color'.

Model Performance: The R-squared value of our model was approximately 0.009, which is low. This indicates that our simple model with random data doesn't explain much of the variance in preferences. In a real-world scenario, a higher R-squared value would be desired, and this could be achieved with more sophisticated models and actual customer data.

**Conclusion**

This notebook successfully demonstrates the application of conjoint analysis for understanding customer preferences. We have shown how to design a conjoint study, simulate and analyze data, and interpret the results to find the relative importance of different product features. The results clearly indicate that, in our simulated scenario, 'Size' is the most important attribute for consumers. This kind of insight is invaluable for businesses looking to develop products that will be successful in the market. While our model's predictive power was low due to the simulated nature of the data, the methodology presented provides a solid framework for conducting conjoint analysis on real-world data.