

CONJOINT ANALYSIS: A STRATEGIC TOOL FOR PRODUCT RESEARCH

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ABSTRACT

Despite efforts by companies to offer products that meet customers' needs, a large percentage of them still fail. One of the reasons for product failure is negligence on the part of the company to find out what customers want and how they want it. The fulfillment of customers' needs and wants in a profitable way requires that companies understand the attributes of their product(s) that are most valued by the customers. Such information can lead to the creation of optimal value propositions. This study considered how conjoint analysis could be used to aid this process. It discussed the role of conjoint analysis in the determination of buyers' responses to a product during concept testing and test marketing and also for the modifications of existing products. It also demonstrated how Microsoft Excel could be used for conjoint analysis by companies when developing new products or when managing existing products in the face of intense competition.

Keywords: customer, new products, existing products, conjoint analysis, company, competition.

INTRODUCTION

Globally, companies are faced with numerous difficult decisions directed at assessing and maximizing future profitability, sales, and market share for new product entries or modifications of existing products given the current offering of competitors. Decisions about product attributes including price play a significant role in the success or failure of new products (McNally and Schmidt, 2011). Developing the "right" new product is critical to a company's success and is often cited as a key competitive dimension (Chao and Kavadias, 2008). Companies often spend a lot of resources developing new products only to find that consumer adoption is much lesser or much slower than expected. Sometimes the problem is that the final product fails to deliver on its promises.

However, the problem is that the company has not properly estimated the product's market potential. Product research enables management to select more effective, more efficient, less risky and more profitable alternatives that can maximize sales (Cooper and Schindler, 2006). Product research is a component of marketing research that provides information and intelligence on the attributes of a good or service that could satisfy a recognized need or want of consumers. It involves concept testing, determination of optimal product design, package tests, test marketing, product modification, brand positioning and repositioning (Kotler and Keller, 2006). Conjoint analysis is one of the techniques that could be useful for such purpose. The objective of conjoint analysis is to determine the combination of a limited number of attributes that is most influential on customers' choice or decision making. Achieving marketing success with a new product requires that

market needs and preferences be determined (Kotler and Keller, 2006). This is applicable to both local and foreign market. By using conjoint analysis, a company can answer questions such as: which product attributes are important or unimportant to the consumer? What levels of product attributes are the most or less desirable in the consumer's mind? Should pricing or other attributes of current products be modified in response to competition? Each of these identified management problems may be addressed and solved using the technique of conjoint analysis. If the management of a company knows what customers either local or international really value, then they know where to put their strategic efforts.

Despite the extensive use of conjoint analysis in American and European companies (Sawtooth Software, 2002), it is relatively not used by marketing researchers in developing countries (Kotri, 2006). Using the technique of conjoint analysis requires a thorough knowledge of statistical data analysis such as logistic regression, multinomial logit and probit which may discourage its use. In order to make conjoint analysis easy for in-house use by companies, the application of Microsoft Excel was introduced by Dobney (2000). So far, the demonstration of conjoint analysis with excel used ranking and rating approach of conjoint analysis (Dobney, 2000) with none on choice-based conjoint. To fill this gap, this study demonstrated how to use Excel for choice-based conjoint analysis. It also described the approach of conjoint analysis and discussed the role of conjoint analysis in new product development and in the management of existing products.

THE APPROACH OF CONJOINT ANALYSIS

Green and Srinivasan (1978) defined Conjoint analysis as any decompositional method that estimates the structure of preferences given overall evaluation of a set of alternatives that are pre-specified in terms of levels of different attributes. In this study, it is defined as a survey method of data collection and analysis for eliciting preferences for a product. It is based on the premise that the relative values of attributes considered jointly can better be measured than when considered in isolation. Its critical assumption is that preference for an object is a function of the specific attributes of the object rather than the object per se (Min, 2007). Conjoint analysis was introduced to marketing 40 years ago in a seminal paper by Green and Rao (1971) where the conjoint measurement theory developed in psychology by Luce and Turkey (1964) was adapted to the solution of marketing problems. Since then, it has become an important marketing research tool that is being used extensively in marketing to analyze consumer trade-offs, understand how customers make purchase decisions and predict consumer behaviour as well as determine how people value different features that make up an individual product for the purpose of providing products that better meet customers' needs (Green and Srinivasan, 1978, Green, Carroll and Goldberg, 1981, Green and Srinivasan, 1990, Chen and Hausman, 2000 and Green, Krieger and Wind, 2001).

Steps in Developing a Conjoint Analysis Study

According to Ryan and Farrar (2000), the application of conjoint analysis involves the following stages:

Stage 1: Identification of Attributes: These are the dimensions on which products are described. The first step in conjoint analysis is to identify and choose objective attributes that describe the product such as colour, size or price. If a policy question is being addressed, the attributes will be predefined. Where the attributes are not predefined, literature reviews, group discussions and individual interviews will be necessary to identify the attributes. Orme (2010) states that attributes should cover the full range of possibilities for the product and they should be independent with no overlapping meaning.

Stage 2: Assigning Levels to the Attributes: Levels represent the different realizations of the attributes that we find in the marketplace. This step involves choosing the options for each attribute. The levels must be plausible and actionable. Levels assigned to the attributes may be cardinal (for example, the attribute of size, may have levels of 250g, 500g or 1000g) or ordinal (for example, small, medium or big).

Stage 3: Design Product Profiles: At this stage, products are defined as a combination of levels of different attributes. When the attributes are many, the product profiles that will be used should be a subset of the possible universe of product profiles. This is because all the profiles generated cannot be included in the questionnaire.

Stage 4: Select the Presentation Medium: Choose the form in which the combinations of attributes are to be presented to the respondents. According to Mora (2011), the presentation of profiles is not restricted to text. Other options include verbal presentation and pictorial presentation.

Stage 5: Select the Technique to be used to analyze the Collected Data: The part-worth model is the model used to express the utilities or the measure of desirability of the various attributes levels. This can be estimated with different techniques such as ordinary least square regression analysis and logistic regression.

CONJOINT ANALYSIS METHODOLOGY

Conjoint analysis requires respondents to make a series of trade-offs between different levels of product attributes. Since the introduction of conjoint analysis, three principal approaches have emerged, the full profile conjoint, adaptive or hybrid conjoint and choice-based conjoint (Bakken and Frazier, 2006). These approaches vary in the methods of eliciting preferences and estimating utility. In a full profile conjoint, product alternatives are presented as complete profiles consisting of one level for each of the attributes. Respondents consider each of the profiles one-at-a-time and either rate them on some preference measure or rank order them. With ranking, the respondents are asked to list the profiles in order of preference, that is, from most preferred to least preferred using cards. Researchers later found out that the rating method which requires respondents to give each trade-off scenario a score, of say 1 to 10, indicating the level of appeal gave better results (Krieger et al, 2004). The ranking and rating exercise will reveal each respondent's priorities and

preferences (Bakken and Frazier, 2006). The drawback in this approach is that the number of attributes that can be used is highly restricted usually 4 to 6. That is why Green and Srinivasan (1990) argued that full profile conjoint should be used when the number of attributes included in the conjoint study is small (up to six). The adaptive or hybrid conjoint analysis was introduced by Richard Johnson at Sawtooth Software in 1985 as a reaction to the number of attributes problem especially, the limitation of full profile conjoint in terms of the number of attributes that it can handle (Bakken and Frazier, 2006). It combines stated preferences and attribute importance ratings with a paired comparison tasks. Rather than ask respondents to evaluate all attributes at the same time as in full-profile, it reduces the levels in each profile and asks respondents to evaluate a few profiles which are referred to as partial profiles using pair-wise rating. With this approach, the researcher can handle up to 30 attributes (Green and Srinivasan, 1990). For rating and ranking-based conjoint methods, the basic weighted additive model can be stated as follows:

$$r_k = \beta_0 + \sum_{j=1}^J \sum_{m=1}^M \beta_{jm} \cdot x_{jm} + \varepsilon_k$$

Where:

r_k = response for option k ;

β_0 = intercept or constant

β_{jm} = partworth utility of level m of attribute j ;

$x_{jm} = 1$ if option k has level m on attribute j else $x_{jm} = 0$

ε_k = error term

The partworth utilities are estimated, usually by applying multiple regression, such that the sum of squares between empirically observed responses r_k (ratings or rankings) and estimated responses r_i is minimal. In more recent years, it has become common practice to use choice-based conjoint analysis because it closely resembles real life decisions. It is the application of discrete choice modeling to understanding consumer decision making. The groundwork for modeling choice among multiple alternatives was laid by Dan McFadden in 1973 (Sawtooth Software, 2008). In 1983, Louviere and Woodworth introduced an approach that used only a choice task by integrating the mathematics of discrete choice modeling with conjoint analysis (Sawtooth Software, 2008). This became the basis of choice-based conjoint analysis in the 1990s. The main characteristic distinguishing choice-based conjoint analysis from other types is that respondents do not rank or rate a series of profile; they simply observe a set of available alternatives and chose the most preferred alternative. Respondents could be asked to evaluate two or more profiles at a time and to indicate their preferences by making a choice (Hauser, 2002). In addition, choice-based conjoint analysis enables the researcher to include a "none" option for respondents which might read "I wouldn't choose any of these". The utility associated with a profile is given as:

$$U_{ij} = \beta x_{ij} + e_{ij}$$

Where:

U_{ij} = the utility of respondent i associated with profile j (this could be profile A or B)

β = a vector of parameters to be estimated

x_{ij} = a vector of attributes of profile j presented to respondent i

e_{ij} = the stochastic portion of the utility function

Respondent i would choose profile A over profile B if $U_{iA} > U_{iB}$, and the probability of such choice is $P_i(A) = \text{Prob} \{ \beta x_{iA} + e_{iA} \geq \beta x_{iB} + e_{iB} \}$

THE ROLE OF CONJOINT ANALYSIS IN PRODUCT DEVELOPMENT

A company develops new products to increase sales and profits, to respond to changing customer needs, to gain competitive advantage, to meet technological changes and to diversify risk. However, developing and introducing new products is frequently expensive and risky (Pride and Ferrell, 2008). A major breakthrough of conjoint analysis in product research is in new product development. It could be used to measure, analyze and predict customers' responses to new products and also to estimate the price customers will be willing to pay. Developing the "right" new product is therefore crucial and if a new product must succeed, it must consist of the desired attributes that the customers want. It should be able to satisfy their needs and it should be planned.

The planning process involves the stages of new product development which include idea generation, ideas screening, concept development and testing, business analysis, prototype development, test marketing and commercialization (Bearden, Ingram and LaForge, 2007). The two critical stages where conjoint analysis could be useful are concepts testing and test marketing. Concept development and testing involve a description of the proposed product including its features and its probable price and presenting it to appropriate target consumers through a survey (Kotler and Keller, 2006). This allows companies to model and test different product options to evaluate likely market preferences and potential share, revenue and profit, all based on what customers' really value.

It provides opportunity for companies to determine customers' initial reaction to a product idea before investing resources in its production. The result of concept testing can help a company better understand the product attributes and benefits that are most important to potential customers. Test marketing is when the product prototype is made available in certain geographical areas considered to be representative of the market to study consumers' response to it. The aim is to determine the extent to which potential customers will buy the product. This enables a company to put new products and their supporting marketing programmes through validating tests prior to full-scale product launches.

Usually, when testing the viability of new products, potential consumers are asked to indicate how important some attributes are to them. The technique of conjoint analysis has been proved to be better than other approaches to understanding consumer preferences and decision-making such as Contingent Valuation, ordinary surveys and focus group estimates because it provides opportunities for respondents to answer survey questions as if they were placed in a real market situation (Hauser and Rao, 2002 and Kotri, 2006). It also estimates the relative importance of different attributes and the various levels of the attributes of a product which allows the policy maker to observe the individual impact of each

attribute on the overall benefit (Krieger Green and Wind, 2004). It can produce results that may not be obtained from compositional approach where respondents are asked to directly state their assessment of the importance of the attributes (Orme, 2010).

THE ROLE OF CONJOINT ANALYSIS IN MANAGING EXISTING PRODUCTS

Conjoint analysis is also useful for managing existing products in order to overcome intense competition in the business environment. Whenever a new product succeeds, competing products are bound to spring up and these products could have a significant impact on profits or market share if a company does not make any change in its products overtime (Kotler and Keller, 2006). Also, the markets are highly dynamic. What was a profitable product yesterday may not be tomorrow because customers' attitudes and preferences change overtime (Pride and Ferrell, 2008). For a company to maintain its market share, it must seek for ways of improving the product by finding out the attributes that are currently appealing to the consumers. Conjoint analysis could be used to find out if customers are satisfied with the current product or they want a change in some of the product attributes. In designing the choice-based conjoint questionnaire, the current product is displayed consistently with prospective versions of the product. Analysis of the responses will indicate the action to be taken.

CONJOINT ANALYSIS USING EXCEL

In this demonstration, the choice-based conjoint was used because it tries to mimic the actual purchase decision process for products within a competitive context. Also, it includes the "none" option which indicates a buy or non-buy decision. By selecting that option, a respondent can contribute information about the decrease in demand to be expected if the product becomes unattractive in some ways. In this case, the proposed new product is a multipurpose soap.

Table 1: Attributes and Levels of the Proposed Soap

Attributes	Levels
Type	Liquid, Solid
Size	Small, Big
Use	Washing/Bathing only, Multipurpose
Scent	With scent, No scent

With four attributes and two levels each for three attributes and three levels for one attribute, it is possible to form twenty-four possible product profiles ($2 \times 3 \times 2 \times 2$). Since they are few, they can all be tested but if they are many say 108, then orthogonal selection will be necessary. In this case, respondents were shown twenty-four hypothetical offers formed by combining varying levels of the attributes and combined to form twelve choice items.

Table 2: A Sample of a Conjoint Profile

If you were to buy soap and these were your only options, which would you choose?

Attributes	Option 1	Option 2	
Type	Liquid	Liquid	None
Size	Small	Small	I wouldn't choose any of these
Use	Bathing only	Multipurpose	
Scent	With scent	Without scent	

They were then asked to make a choice. The respondents' answers will indicate whether the product concept (multipurpose soap) has a broad and strong consumer appeal or not. The objective is to derive the utility values that consumers attach to varying levels of soap attributes. When preference data are collected from a sufficient sample of target customers, the data could be used to estimate the market share of the product. A pilot study of 10 respondents is shown in the excel sheet below:

Table 3: Excel Demonstration of Choice-Based Conjoint Analysis

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Type		Size		Use				Scent	A/L	TNTC	TNTO	Utility
2	Solid	Liquid	Small	Big	Wash	Bath	Multipurpose	Scent	No				
3	8	4	5	7	4	4	0	10	2				
4	7	5	5	7	2	5	1	10	2	Solid	80	120	0.67
5	8	4	4	8	4	3	1	11	1	Liquid	40	120	0.33
6	9	3	6	6	2	6	0	9	3	Small	50	120	0.42
7	8	4	4	8	1	7	0	11	1	Big	70	120	0.58
8	10	2	4	8	2	5	1	9	3	Washing	26	80	0.32
9	5	7	5	7	3	5	0	10	2	Bathing	50	80	0.63
10	8	4	6	6	4	4	0	10	2	Multipur	4	80	0.05
11	9	3	7	5	2	6	0	9	3	Scent	100	120	0.17
12	8	4	4	8	2	5	1	11	1	No Scent	20	120	0.17

A/L = Attribute Level, TNTC = Total Number of Time Chosen , TNTO = Total Number of Time Occurred,

Table 3 shows the Excel analysis of customers' preference for soap. The figures from row 3 to row 12 were derived from the number of times those attribute levels were chosen by the respondents. In the demonstration above, there are 10 respondents. To get the total number of times each attribute level was chosen, add up the number of times each attribute level was chosen by the 10 respondents, that is, for the attribute level of solid soap, we have $8+7+8+9+8+10+5+8+9+8 = 80$. Also, the column of "number of times each attribute level occurred" was derived by counting the number of times each attribute level occurred in the questionnaire. Based on the notion of balance, each attribute is expected to appear approximately the same number of times. A careful look at table 3 shows that each attribute occurred equally which is 240 times. The last column indicates the utility level which is calculated by dividing "total number of times an attribute level was chosen" by "total number of times it occurred". The utility value ranges between 0 and 1. The higher the value, the more preferred the attribute level. The attribute levels that have a high utility value (above 0.50) are descending as follows: scent, solid, bathing and big. This indicates that the most preferred soap is a big solid bathing soap with scent (table 3).

Table 4: Importance of each Attribute

Type	19.5%
Size	09.3%
Use	33.3%
Scent	37.9%

Table 4 shows the importance of each attribute. This was calculated by dividing the difference between the best and worst level on each attribute by the sum of the difference between the best and worst levels of all attributes. Given the attributes tested, it shows that scent has a larger impact on decision making when considering buying soap. This is followed by use, type and size. The preference

indicated above could be used to determine the type of soap to produce. Since multipurpose soap is not significant, the idea of introducing a multipurpose soap should be dropped. This is because it will not contribute much to market share and profitability. Incorporating these values in decision making ultimately may result in decisions that better reflects the preferences of customers and increase in corporate performance.

CONCLUSION

Understanding customer needs and designing appropriate products is a crucial success factor in today's highly competitive market. The goal of product research is to identify products that would maximize the market share and profit of a product given a company's limited resources. This paper has discussed the potential of using conjoint analysis for analyzing customers' preferences for new and existing products. However, its use is subject to the limitation of the small number of product attributes that can be effectively analyzed. When the attributes and levels are few, it is possible to evaluate all possible combinations. However, when the product attributes and levels are very many, fractional factorial designs and orthogonal designs could be used to create a smaller design that is still large enough to estimate the utility of each of the attribute levels or to estimate the effects the researcher is interested in.

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Corrections

The errors noted in this article are corrected. The following are the descriptions:

1. In the last sentence of the 2nd paragraph in the introduction, the words are "really value" and not "appreciate value".
2. Under conjoint analysis methodology, there is no negative sign in the first equation. It is only addition.
3. The 2nd equation on page 4 was completely omitted. After the sentence "The utility associated with a profile is given as ": This has been inserted.
4. On that same page 4, the second "Sawtooth Software" with no year is corrected
5. In table 3, the word under G is Multipurpose and not multiple. The abbreviation A/L is corrected in the interpretation under the table 3 which was showing A/C. In addition, the figures for serial number 10 were misplaced. K=4, L=80 and M=0.05.

The errors are sincerely regretted.

Production Editor