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Conjoint Analysis: Peering Behind the Jargon

Conjoint analysis provides a method for anticipating how consumers will react to any defined combination of marketing variables, though they simply rate or rank a limited number of combinations. By analysing their responses, one can develop a durable database for responding to the 'what if' questions constantly faced by managers.

Jerome Weisner, Provost of MIT, said, "If you can't explain it in simple English, you don't understand it." Our aim here is to share our understanding of conjoint analysis in simple English.

What is Conjoint Analysis?

The term "conjoint analysis" suggests only a technique for analysing data. The technique actually has two components: a procedure for collecting data and a procedure for analysing data. We discuss both.

The primary virtue of conjoint analysis is that it can provide durable, cost-efficient information on new product concepts or alternate marketing scenarios. Normally one tests, for example, a limited number of new product concepts to determine market potential. If a new configuration or marketing scenario is encountered later, another concept test is necessary.
With conjoint analysis, we often can assess the potential of a new configuration even if that specific concept was not included in the original research. Thus, the information base is durable. It is equally true that at any given point in time one can ask "what if" questions about the market potential for new product concepts even though only a limited number of those concepts were actually used in the research. Thus, the technique is highly cost efficient.

To What Types of Management Problems Is Conjoint Responsive?

Managers constantly are faced with "what if" questions. What will happen to consumer demand if we change the product features? What will happen if we change the price level? What will happen if we change the brand name? What will happen if we change the type of coupon we use? What will happen if we change our channel of distribution? What will happen to our brand if a competitor changes its product, pricing, or approach to sales promotion? Conjoint can be used to help managers systematically examine all of these situations and thereby reduce the risks of making a bad decision.

How Does Conjoint Analysis Work?

In a normal application of conjoint, many of the variables listed above might be manipulated concurrently. However, to communicate the basic principles most clearly, we limit the following example to different levels of only two variables, brand and price.

Conjoint Analysis reduces the risk of making bad decisions

Suppose a man seeking a cartridge camera for personal use is asked whether he would prefer a major brand or a store brand. The respondent will probably prefer a major brand when prices are equal. Likewise, the respondent naturally will prefer the lowest price for the identical cameras. Suppose we give the respondent eight choices and ask him to rank them in terms of preference. Each of the eight choices is defined by one level of brand and one level of price:

	$
Major brand	80
Major brand	50
Major brand	30
Major brand	20
Store brand	80
Store brand	50
Store brand	30
Store brand	20

From what we have stated so far, the respondent's first choice is the major brand at $20 and the last choice is the store brand at $80. But what about the remaining choices? Will our respondent pay an extra $10, $20, or even $60 to get the major brand?

The respondent must make a trade-off between price and brand. After the first choice (major brand at $20), the second choice is either major brand at $30 or store brand at $20. If the respondent's second choice is major brand at $30, he has traded a higher price to get the major brand; if the respondent's second choice is the store brand at $20, he has traded the preferred brand to get a lower price. Thus, in making subsequent choices, the respondent must give up the desired level of one variable to get the desired level of the other variable.

Suppose our respondent has rank-ordered the eight alternatives as in Table 1. (The largest number, 8, indicates the most preferred alternative – the higher the number, the more preferred the alternative)

From rank-order data we can calculate utility value

Table 1
RESPONDENT'S RANKING OF EIGHT CAMERA BRANDS

Price $	Major Brand	Store Brand	Average Rank
20	8	6	7.0
30	7	4	5.5
50	5	2	3.5
80	3	1	2.0
Average rank	5.75	3.25	

From these data, the importance or value of each feature (major brand, store brand, $20, $30, etc.) is transferred into a numerical representation called a "utility value." This utility value reflects how influential each feature in this respondent's evaluation. The higher the utility value, the more influential the feature.

Utilities are calculated correctly by a variety of methods including several "dummy variable regression" approaches, such as ordinary least square (OLS), MONANOVA, or LINMAR. For illustration, we have calculated the utilities by setting the largest average rank equal to a utility of 1.0, the smallest average rank equal to 0.0, and the average ranks of the other features proportional to these two points. This approach yields easy-to-understand utilities in the proper relationship. (A widely used approach provides utility scores with position and negative values that sum to zero).

The utilities of each level of price and of brand, given the rank orders, are shown in Table 2. When these utility values are added together for one feature of brand and one feature of price, they equal a total utility for that particular combination. The rank order of these total utilities must correspond to the original rank order. In Table 3 we have reconstructed the original rank orders by adding together the utilities for each feature.

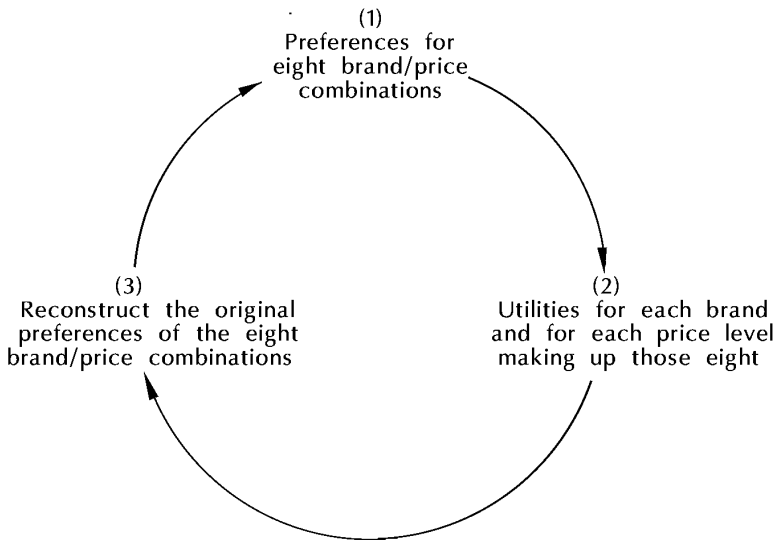
Table 2
RESPONDENT'S UTILITY VALUES FOR EIGHT CAMERA BRANDS

Price $	Major Brand	Store Brand	Average Rank	Utility
20	8	6	7.0	1.00
30	7	4	5.5	0.70
50	5	2	3.5	0.30
80	3	1	2.0	0.00
Average rank	5.75	3.25		
Utility	0.75	0.25		

Table 3
RANK ORDER OF RESPONDENT'S TOTAL UTILITIES

Price $	Major Brand	Store Brand	Marginal
20	8 (1.75)	6 (1.25)	1.00
30	7 (1.45)	4 (0.95)	0.70
50	5 (1.05)	2 (0.55)	0.30
80	3 (0.75)	1 (0.25)	0.00
Average rank	0.75	0.25	

1.75 = .75 (major brand utility) + 1.00 ($20 utility)



The answer is that in real applications we want to have consumers' evaluations of more alternative scenarios than our respondents can evaluate. Because of fatigue and/or frustration, respondents can evaluate only a limited number of items. Conjoint must use this limited set of evaluations to determine respondents' preference for each factor level and, subsequently, all product alternatives in a scenario of interest.

The number of scenarios is large because:

1. We are interested in many dimensions (coupon value, types of store, electronic flash, etc.)

2. We want the consumers' reactions to small differences in a continuous variable, such as price (ie. $25, $35, £45, $55, $75)

The number of alternatives increases dramatically with the addition of more dimensions. If there were only four dimensions at four levels each, 256 alternatives would be specified – a number beyond a respondent's ability to evaluate.

However, we can study all the alternatives without unduly burdening our respondents. We can develop utility scores for the 16 levels (four dimensions at four levels each) of variables by having respondents evaluate a limited number of concepts (e.g. 24). We can manipulate these utility scores to determine how consumers would have reacted to all combinations. Thus, we can determine consumer reaction to alternatives they did not see.

With conjoint analysis, we can study many alternatives without burdening respondents

How Do We Obtain Consumers' Preferences When We Extend to More Dimensions and Features?

The camera example is limited to two variables for illustrative purposes. Suppose we expand the example to include a total of six brands and add a coupon with three values - $2, $5 and $10. These three dimensions – brand (6 levels), price (4 levels), and coupon value (3 levels) – yield 72 (6x4x3) unique combinations of possible market offerings.

Respondents probably would not be able to respond to all 72 stimuli. As an alternative, however, the researcher can select a subset[1] of the 72 so that the utility (or value) of each of the 13 factor levels can be measured accurately.

This approach allows as few as 18 different stimuli to be shown to every respondent. All respondents see the same ones. Each combination is shown to respondents on a card having one brand, one price, and one coupon value. The respondent is asked to rank the cards in order of personal preference. Utility scores for each feature are then calculated from this set of preference data.

[1] The selection of a subset that provides an "orthogonal array" can be done manually but is normally done much more quickly by using commercially available computer programmes designed for this purpose. The orthogonal array identifies a subject of the 72 stimuli, ensuring that the factor level of one dimension is dependent of every other factor level. For example, the stimuli with the Fuji brand must include both high-price options as well as both low-price options. Failure to do so would mean that respondents' answers could not be decomposed into utilities for price and brand.

How do we Obtain Consumers' Preferences for Levels of Continuous Variables such as Price that were not Specifically Tested?

The utility for prices not included can be obtained by interpolation. If we assume that the utility for price is liner, between $30 and $50, the estimated utility for $40 would be halfway between the utilities for $30 and $50 or, for this respondent, .50, which is midway between .70 and .30.

The utility for the major brand at $40 would be 1.25 (.75 for major brand plus the derived utility, .50 for $40). This utility is the same as the store brand utility at $20. Thus, this respondent is willing to pay up to, but not more than, $20 to acquire the major brand.

How can this Conjoint Approach be used to Anticipate Consumers' Reactions to Alternate Marketing Situations?

Though many different marketing situations, involving product features, brand names, price levels, advertising claims, or sales promotion variables, could be used to illustrate how consumers would react, we continue to limit our discussion to our camera example. Assume we have collected the necessary information to generate utilities in the cartridge camera category for brand, price, and coupon value. In the real study many respondents are interviewed, with utilities generated for each, but we restrict this exercise to three respondents so we can examine each person carefully (see Table 4).

Suppose we are the managers of brand X. The current situation is that our camera's price is $30, Y's is $20, and Z's is $50. All brands have a $2 coupon. Relative values for each camera are determined by adding the utilities for each camera's features.

Camera preferences, as determined by the highest additive utility, for Adam, are shown in Table 5. Given this scenario,

Table 4
UTILITY VALUES FOR THREE RESPONDENTS

	Respondent		
	Adam	**Bob**	**Carl**
Brand			
X	0.50	0.80	0.33
Y	0.80	0.35	0.33
Z	0.40	0.10	0.33
Price ($)			
20	1.00	0.70	1.00
30	0.80	0.60	0.80
50	0.00	0.20	0.50
80	0.00	0.00	0.00
Coupon value ($)			
2	0.20	0.20	0.20
5	0.75	0.20	0.30
10	0.95	0.60	0.80

Adam prefers Y. It has his highest total utility (2.00).
By the same approach, Bob prefers X and Carl prefers Y.

Now Let's Change the Conditions: What Would Be The Effect of Introducing a $5 Coupon for Brand X?

Adam would now prefer X instead of Y, because his utilities would be Y = 2.00, X = 2.10, Z = 0.60. Bob would still prefer X, as his total utilities would be Y = 1.25, X = 1.60, Z = 0.30. Carl would still prefer Y, as his total utilities would be Y = 1.53, X = 1.60, Z = 1.30. Thus, the $5 coupon for brand X changed Adam's preference; now he prefers brand X. However, the increase to a $5 coupon for brand X is not sufficient to change Carl's preference; he still prefers Y.

How Would Consumer Reaction to a Marketing Mix Change be Evaluated with an Actual Research Study?

The preceding procedure is used for each respondent regardless of sample size. Each respondent's preference is determined for a particular scenario. The total number of respondents preferring each alternative is then obtained.

The responses of interest must be included within the maximum and minimum ranges of the variables tested for a sample of relevant respondents. Assuming the three camera brands are available at the indicated price/coupon levels, we can estimate the preference among the respondents as illustrated in Table 6.

Table 5
UTILITY VALUES FOR RESPONDENT ADAM

Brand	(X)	0.60	(Y)	0.80	(Z)	0.40
Price	($30)	0.80	($20)	1.00	($50)	0.00
Coupon Price	($2)	0.20	($2)	0.20	($2)	0.20
Total utility		1.60		2.00		0.60

Table 6
RESPONDENT'S ESTIMATED PREFERENCES FOR THREE CAMERA BRANDS

Brand	Price ($)	Coupon Value ($)	% Preferring
X	40	5	50
Y	20	2	35
Z	80	10	15

The marketing mix can be changed (see Table 7) and the expected consumer effect can be assessed by comparing consumer preference for each of these scenarios. For example, brand X reduces its price to $30.

This stimulated consumer response is based on a first-choice model – this is, the respondent selects the one alternative for which he has the highest utility. This estimated proportion for each alternative is the manager's assessment of the probable impact.

Consumer preferences for any combination of tested brands, prices and coupon values can be estimated. In addition, values for continuous variables (price, coupon value) not tested but between end-points ($20 and $80 for price) can be included by interpolation.

A Summary – How Can Conjoint Analysis be Used in Marketing Research?

Conjoint analysis provides a method for anticipating how consumers will react to an almost infinite set of marketing scenarios involving different levels of price, quality, durability, advertising claims, sales promotion and other variables. This can be done by asking respondents to evaluate (rate or rank) between 16 and 32 different combinations of variables called "profiles"[2]. In other words, by having consumers perform a relatively simple task, we develop a durable and cost-effective database for responding to the "what if" questions constantly faced by managers.

[2] If you decide that the consumer is being asked to consider too many variables at once in each profile, the task can be broken up into several simpler tasks by using "linked variables" that still enable the researcher to develop a single set of utility values.

Table 7
EFFECTS OF CHANGE IN MARKETING MIX ON RESPONDENTS' PREFERENCES

Brand	% Preferring Each Brand for Original Situation	% Preferring Each Brand After X's Change in Price	Change (%)
X	50	55	+5
Y	35	35	0
Z	15	10	5