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Applied Conjoint Analysis

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To the memory of esteemed Professor Paul E. Green, founder of conjoint analysis methods, a revered scholar, a wise advisor, and a dear friend.

Preface

I started this project some 10 years back; Professor Paul Green assisted me in the early phase of this work.

During the last 5 years or so, there have been several interesting developments in the conjoint analysis methods and models, notably incentive-aligned methods. I attempted to incorporate these yet keeping the basic thrust of the applied nature of this work. New methods appear on an almost daily basis. It is rather difficult to keep the coverage current. But, I tried to be up to date as much as feasible.

My intent is to bring various conjoint analysis methods to a level understandable to students and practitioners without losing rigor. As I ventured on this book, I soon realized how vast this field had become. Selection of topics and illustrations has become a difficult task. Nevertheless, I hope that this book presents an array of applications in marketing in a reasonably comprehensive manner. The edited book by Anders Gustafsson, Andreas Herrmann, and Frank Huber, *Conjoint Measurement: Methods and Applications*, Fourth Edition, Springer, 2007, in particular will be a good complement to this work. I wish that I was able to devote space to various behavioral aspects of choice.

I am grateful to several people in helping me make sure that this work is of a high caliber. These include two anonymous reviewers of my early versions and several colleagues such as Olivier Toubia and Oded Netzer of Columbia. My thanks are due to Abba Krieger of the Wharton School whose encouragement provided the necessary impetus to complete this work. Seenu Srinivasan of Stanford gave me early access to his paper on adaptive self-explicated method. Young-Hoon Park of Cornell gave me early access to his paper on barter conjoint, which is covered in Chap. 9; he also was a sounding board for ideas on organizing materials in Chap. 3. Sundar Balakrishnan of the University of Washington, Bothell, kindly reviewed the material on genetic algorithms for product design. Steve Gaskin graciously reviewed the material on legal applications covered in Chap. 8. Wes Hutchinson of the Wharton School kindly shared his working paper on self-designed products. Carolyne Saunders, a doctoral student in marketing at Cornell University, carefully read this volume and made several suggestions to enhance clarity. Yu Yu of Georgia State University helped with the analysis reported in Chap. 4. Chang Hee

Park of Binghamton University assisted me with the WinBUGS analysis reported in Chap. 4.

I am grateful to Brian Orme of Sawtooth Software for giving me access to their versatile software, which now includes several newer methods, not all of which are discussed here.

I appreciate *Marketing Letters* for allowing me to reproduce a paper written based on the 2008 Choice Symposium as a supplement. This paper, published in this journal (Vol. 19, December 2008 issue), gives a contemporary view of where conjoint methods stood a short while back.

I thank Christian Rauscher, editor from Springer, for his patience with the completion of this volume. Finally, I thank Saroj Rao for her help and patience throughout this project.

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Chapter 1
Problem Setting

1.1 Introduction

1.1.1 Marketing Decisions and Role of Consumer Choice

Several interdependent decisions are involved in the formulation of a marketing strategy for a brand (of a product or service). These include not only decisions about the product's characteristics but also its positioning, communication, distribution, and pricing to chosen sets of targeted customers. The decisions will need to be made in the wake of uncertain competitive reactions and a changing (and often unpredictable) environment. For a business to be successful, the decision process must include a clear understanding of how customers will choose among (and react to) various competing alternatives. It is well accepted in marketing that choice alternatives can be described as profiles on multiple attributes and that individuals consider various attributes while making a choice. While choosing, consumers typically make trade-offs among the attributes of a product or service. Conjoint analysis is a set of techniques ideally suited to studying customers' choice processes and determining tradeoffs.

Conjoint analysis is probably the most significant development in marketing research over the last 30 years or so. Since its introduction to marketing research in 1971 (Green and Rao 1971), it has been applied in several thousand applied marketing research projects. The method has been applied successfully for tackling several marketing decisions such as optimal design of new products, target market selection, pricing a new product, and competitive reactions. A significant advantage of the method has been its ability to answer various "what if" questions using market simulators; these simulators are based on the results of an analysis of conjoint data collected on hypothetical and real choice alternatives.

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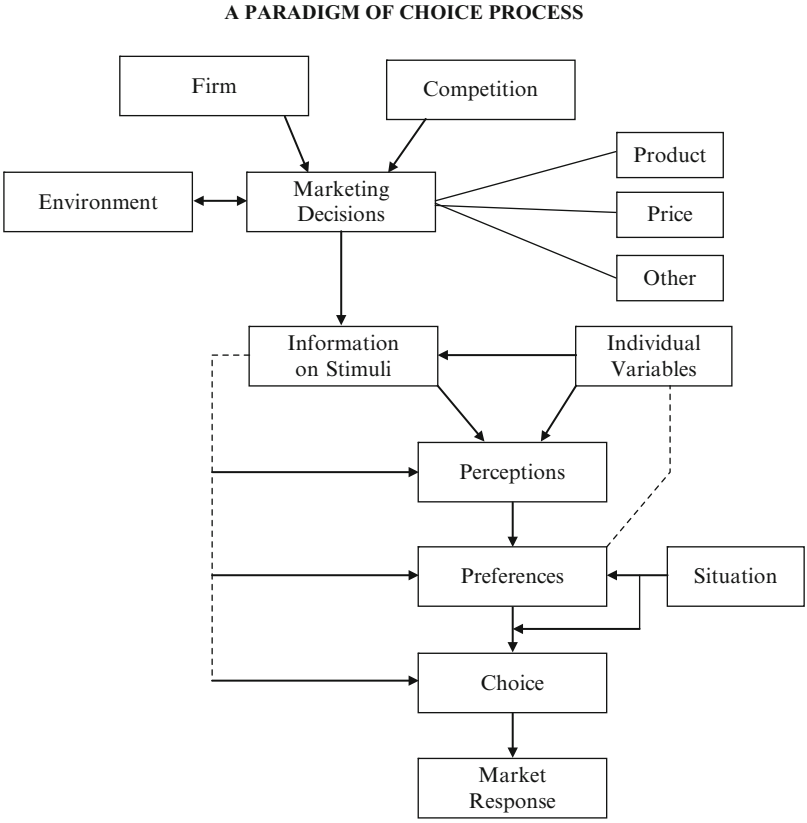

Fig. 1.1 A paradigm of choice process

1.1.2 A Framework for Understanding Consumer Choice

Established methods of marketing research are often used in developing an understanding of consumers' choice processes. A marketing research study involves the study of consumer perceptions, preferences, and choices in a set of choice situations. A streamlined view of how various consumer behavior constructs are related is shown in Fig. 1.1. Beginning at the top of the figure, a marketing manager makes decisions about her brand in light of the information gathered from the environment. According to this view, a consumer assimilates the information across all (considered) alternatives and forms perceptions about the choice set. These perceptions form the basis for preferences toward the alternatives; one should note that both the perceptions and preferences can be idiosyncratic to the individual. Stated differently, this paradigm incorporates individual heterogeneity in the way information on alternatives is assimilated by the individuals. The next stage in this process is the way preferences get translated into choices; it is an individual's preferences which form the basis for choices in the marketplace. An individual's

preferences will naturally be modified by characteristics of the choice situation (e.g. choices made for one's own consumption or for a gift, changes in one's income and so on). Finally, aggregation of the choices by all potential consumers will lead to a prediction of the overall market response (e.g., sales of an item).

1.2 Origins of Conjoint Analysis

While the foundations of conjoint analysis go back to at least the 1920s, it is generally agreed that the seminal paper by Luce and Tukey (1964) on the theory of conjoint measurement formed the basis for the applied field of conjoint analysis. The development of the field was aided considerably by the proliferation of algorithms for the computations involved.

Conjoint measurement is concerned with determining the joint effect of levels of two or more attributes of stimuli on the total evaluative judgments of a set of stimuli (see Rao 1977 for a review of conjoint measurement in marketing analysis). The objective is to decompose the total evaluation into component scores, imputable to each attribute level or combination of attribute levels. The theory is concerned with the conditions under which there exist measurement scales for both the evaluative score (dependent variable) and each attribute level (independent variables), and a pre-specified composition rule. All are based on formal axiomatic system formulated by Krantz et al. (1971), including the axioms of consistency, transitivity, and attribute independence. The evaluative score can be categorical, ordinal or interval-scaled. For example, consider an individual's evaluation of a pair of running sneakers described on two attributes of price and quality (e.g., $70 per pair and medium quality); these responses can be categorical (e.g. suitable for serious young runners, for casual young runners, or for retirees), ordinal (e.g., very good, good, bad or very bad value for money), or interval-scaled (e.g., a rating on a 10 point scale on value for money). With such evaluation scores of price and quality on a number of profiles, an analyst can develop a utility function for the individual. Calling the functions for price and quality v_p, and v_q respectively (called partworth functions), the composite specification for the evaluation can be additive as $a*v_p + b*v_q$ or polynomial as $a*v_p + b*v_q + c*v_p*v_q$ or some other formulation. The axioms enable the analyst to choose the appropriate specification.

In the course of implementing conjoint measurement methods to applied business problems, such as those encountered in marketing, the emphasis on theoretical aspects of measurement has given way to the more pragmatic issues of design of studies and analysis of data. This is due to various intricacies in testing[1] whether the axioms are satisfied in the data collected. The testing procedures require extensive data and are highly complicated even for a small number of respondents. This process became frustrating for applied researchers.

[1] See Corstjens and Gautschi (1983) for detailed methods for testing these axioms.

The methodology that has evolved to handle these problems is popularly called "conjoint analysis" to reflect the stated distinction. Conjoint analysis refers to any decompositional method that estimates the structure of a consumer's preferences[2] in terms of the levels of attributes of the alternatives. The methodology quite heavily uses statistical experimental design and parameter estimation methods.

Conjoint analysis is quite closely related to other developments in Information Integration Theory and its associated method of Functional Measurement (Anderson 1970). The functional measurement approach involves the use of analysis of variance (ANOVA) methods for problems of information integration. These methods have been applied in a variety of contexts dealing with understanding and modeling the process of judgment and groups including Social Judgment Theory and its related method of Policy Capturing.[3] Early applications in psychology were concerned with the modeling of clinical judgments (Dawes and Corrigan 1974), which basically involved estimating a multiple regression model between the overall judgments of an object and its characteristics (for example, relating the characteristics of a job candidate to a job in a company).

Thus, the conjoint analysis approach is decompositional in nature as contrasted with the approaches of Fishbein (1967) and Rosenberg (1956) which are compositional or buildup methods. The compositional approaches were popular in marketing research in the 1970s and 1980s. In these methods,[4] the overall attitude (or preference) towards an object is expressed as a weighted sum of the importance of attributes and the scores of the object on various attributes. This formulation is utilized in the self-explicated methods of conjoint analysis (described in Chaps. 2 and 5). Further, the self-explicated methods can be integrated in some of the models by which conjoint analysis is implemented in practice (e.g., the hybrid modeling approach); we will describe these in Chaps. 2 and 3.

The methods of conjoint analysis are quite distinct from those of multiattribute utility estimation developed by Keeney and Raiffa (1976). This approach derives the utility function deductively from a set of assumptions and the parameters of the function are obtained from tradeoff judgments and from preferences for alternative gambles. The theory is normative as opposed to that in conjoint analysis which is descriptive (or paramorphic). Further, the data collection procedures needed for estimating these multiattribute utility functions are quite complicated and tedious. Accordingly, these methods are not used much in marketing studies.

[2] This method is quite similar to preference analysis in multidimensional scaling which focuses on estimating the ideal points for or weights on perceptual dimensions. These functions will be described in Chap. 2.

[3] A computer software called Policy-PC offered by the Executive Decision Services, Albany, NY allows for a menu of utility functions.

[4] See Wilkie and Pessemier (1973) for a comprehensive review.