



# A MULTIVARIATE STATISTICAL ANALYSIS TECHNIQUE: CONJOINT ANALYSIS

Dr. Hakan Tahiri MUTLU



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## **PREFACE**

Conjoint analysis, which is a multivariate statistical technique, is used to investigate the relationships between variables and levels when some variables cannot be measured in real terms and are expressed as levels qualitatively.

Conjoint analysis consists of the combination of the words “consider” and “jointly”, which means joint effect or thinking together. Conjoint analysis is also called “Association Analysis”.

The main premise of conjoint analysis, also called trade-off analysis, which is aimed at consumers' decision-making mechanisms, is to make a decision by considering more than one factor together in purchasing a product or service. In conjoint analysis, the main objective is to determine the utility functions based on the values that the different features of the product have on people. Therefore, Conjoint analysis is a market research technique for measuring the characteristics that are effective in determining the demand.

In this study, structure of conjoint analysis, history, usage areas, application stages, analysis conditions and types of conjoint analysis are given in detail.

Dr. Hakan Tahiri MUTLU



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## 1. Conjoint Analysis Concept

Conjoint analysis is an analysis that deals with the joint effect of two or more variables on a dependent variable. Conjoint analysis is a market research technique especially used by marketers to determine what features a new product should have and how it should be priced. In other words; it is a multivariate analysis approach used to investigate consumers' reactions to a product or service. In addition, it is one of the terms used to explain the wide usage areas of the techniques used in estimating the value that people give to the qualities and features that define the product and service (Camlidere, 2005;5).

With conjoint analysis, consumers can determine the relative importance of the product or service when choosing a product or service. They also enable estimation of the market shares of the product or service if the levels of features change. In addition, conjoint analysis determines the most preferred product or service composition. It is one of the main methods that can be applied in segmenting the market according to those who have preference over product or service factors. The most important point in this technique is that making complex decisions, especially the purchasing decision, is not based on a single factor or criterion, and it is a method in which decisions are made by considering many factors together. The name of the analysis comes from this logic of thinking together (Aslan, 2006;48).

Conjoint analysis is used to test the product concept. However, conjoint analysis is mostly used in marketing research before the development of a new product or the updating of an existing product, to determine whether the product can hold on to the market and whether it is possible to compete with competing products. Conjoint analysis is used to test the reaction of consumers to the product concept, to estimate the trial rate at the time the product is introduced to the market, and to determine how the concept can be improved.

With this analysis technique, the application is carried out using decision cards created through combinations that are defined in a realistic way (Aydin, 2019;41). In conjoint analysis, low wages are generally

preferred to higher wages when the relative values in each of the attributes or all other attributes are the same. Individuals have different sensitivity to the price difference between high wages and low wages. While some individuals are insensitive to price differences, some individuals do not consider paying high prices for the product. For example, a person who prefers brand X to brand Y does not care about the amount of wages for the brand (Dikici, 2006;3).

Conjoint analysis is closely related to experimental experience. For example; a soap-producing chemist can test this relationship with a simple analysis of variance with the data he will obtain from the applications he will make in the laboratory to measure the effect of temperature on soap density. On the other hand, in situations involving human behavior, it is difficult to act with experiments, that is, with controllable factors. In the same example; if the decision of whether the soap smell should be intense or light, or whether it will be promoted as a cosmetic product or a cleansing product, is taken according to experience, this cannot be measured quantitatively. From this point of view, conjoint analysis is generally used to measure subjective judgments (Tuncali, 2007;19).

There are two important views regarding conjoint analysis. The first of these is to define the product or service as combinations of quality levels, and the other is to determine these quality levels and consumers' thoughts about that product or service. With this analysis, the importance given by individuals to any product is equal to the sum of the benefits that will arise from all the determined features of that product; then it is accepted that the probability of purchasing that product is in proportion to the benefits obtained from that product. Benefit, on the other hand, is a subjective phenomenon that varies from individual to individual. Therefore, it is extremely difficult to find solutions to these problems without the help of conjoint analysis (Yigit, 2008;25).

In conjoint analysis, since the features and levels are hypothetically created by the researcher, the importance of each feature and the value of each feature can be defined by the respondent's rating. Today, conjoint analysis is also used in new product development, new product concept,

market segmentation, competitive analysis, pricing, advertising and distribution channel preference (Basaran, 2010;7).

Before a new product is produced or an existing product is updated, product planners or managers want to know how consumers will respond to it. For this reason, an answer to this question is sought by conducting a study before producing. For this purpose, the variables that can be considered to be important about the product to be produced and their levels are determined, and a questionnaire consisting of the combinations of the levels of these variables is created. For these level combinations, consumers are asked to make a correct order of preference or give preference points to the ones they prefer the least from the most preferred (Sahinkanat, 2013;35). In each combination, there is the state of a service with different levels. Therefore, the combinations included in the analysis must be real or hypothetical. When it is necessary to make definitions about the features of a service under examination, the information about what these features are is discussed under the name of factor (Akdemir, 2019;53). Conjoint analysis presents certain features of a product or service to customers in various combinations and asks customers to prioritize or rate among these combinations according to their preferences. The main purpose of conjoint analysis is to determine which combinations of factors customers prefer more, and to reflect these factors to the product or service process (Satici, 2019;12).

Conjoint analysis is a traditional method of market researchers. In addition, it has recently entered new areas such as operations management, transportation and food studies. Studies show that studies with conjoint analysis have increased recently. The reason for this increase can be shown as this method is easy to apply, reliable and there are many commercial software and estimation programs in the market (Ucurum, 2018;28).

Conjoint analysis is defined as considering many factors together and making these decisions without a single factor or single criterion while making complex decisions, including the purchase decision. Consumers, who want to get maximum benefit from the product, give different importance to the benefits of products and services. Therefore,

in a study in which factor analysis is used, participants may tend to give more importance to the relevant benefit than they actually do, since each question will be evaluated abstractly from other questions, and the validity and reliability of the study will be damaged. Therefore, conjoint analysis should be used instead of factor analysis in such studies.

Conjoint analysis, unlike other multivariate techniques, combines researchers' selected levels of each trait; provides a set of real or hypothetical goods and services. Conjoint analysis; regarding the products analyzed, it is based on the principle that the customers evaluate the product features in a common framework while choosing the product. Relational values are calculated between the answers to the questions asked to the participants and the characteristics of each product. In this way, unlike other analysis methods that grade according to the answers given by the participants according to the product characteristics, it separates the products according to their characteristics and determines the values that the participants gave to these features (Ozgultekin, 2020;3).

Conjoint analysis is a preference determination method. This method measures how the potential consumer will react in a given situation. For example, it means that it measures which recreation area it would prefer to visit from a range of offered areas. Contrary to the stated preference methods of conjoint analysis, there are declared preference methods. In the preference studies explained, the real behaviors of those who choose their preferences are examined. The types of products to be evaluated by the participant are determined by the researcher and this product has many features. The researcher can determine the Features of the product as he wishes, and therefore it is hypothetical. There are two main views on conjoint analysis. The first of these is to define the product or service as combinations of quality levels, and the other is to determine these quality levels and consumers' judgments about that product or service (Durmaz, 2022;23).

Marketers state that the word conjoint is a combination of the words “considered jointly”, meaning that the features of products or services are “thinking together” by the participants. The adjective

“conjoint” derives from the verb “to conjoin”, which means to join together. The conjoint analysis approach is based on individuals' interests arriving at some choices from various qualities and characteristics in their alternative choices. Users evaluate the feature levels that make up alternative preferences according to some rules to form a general view (Yalcin, 2016;16). In many studies, the word “conjoint” is used as an indicator of the existence of values that cannot be measured when considered individually, but can be measured when considered together (Ozcagli, 2020;21).

Conjoint Analysis is similar to multidimensional scaling in that it measures consumer preferences or psychological decisions. Conjoint analysis, like multidimensional scaling, is based on the subjective preference of the respondent. However, while objects in Multidimensional Scaling constitute products or brands, in conjoint analysis, the object consists of combinations (combinations) of quality levels determined by the researcher. While Multidimensional Scaling depicts objects in a multidimensional space of perception and preference in order to paint a spatial map, Conjoint analysis tries to develop utility functions attributed to each attribute level by the consumer (Dinc, 2010;4).

Conjoint measurement shows that it is an indirect measurement way in terms of attitudes and it forces people to make choices. Conjoint measurement makes a measurement that is more concrete, more realistic, more tangible and less affected by social desirability error than traditional measurements (Dengiz, 2017;27).

With market simulation, conjoint analysis allows the researcher to define certain competitive conditions (specific products in competition with other products) and reflects the share of preferences according to participants' estimated partial benefit scores. These simulators allow researchers and managers to test various scenarios (Topcu, 2018;28).

Conjoint analysis measures the extent to which consumers attach importance to the features of the product or service when choosing products and services. The purpose of this measurement technique is to

analyze the purchasing behaviors of consumers in the product or service alternatives examined within the scope of the research, rather than asking consumers a question such as “how important is the x product feature to you when purchasing this product”. In many applied projects, when the product or service features and importance levels asked to the consumers are questioned, all the features have always been found to be very important (Kamci, 2017;20).

Before a new product is produced or an existing product is updated, managers want to know how consumers will react to it. For this reason, an answer to this question is sought by conducting a research before production. For this purpose, the variables that may be thought to be important about the product to be produced and the levels of these variables are determined, and a special questionnaire is prepared including the combinations of these levels. For these level combinations, consumers are asked to make a preference order or give preference points from the most preferred to the least preferred. Thus, conjoint analysis emerges as a marketing research that determines consumer preferences for the product and is used in the realization of this and gives an idea to the managers (Arslan, 2016;30).

Because of the significant variation in consumer preferences among individuals, conjoint analysis is often performed at the individual level. Most private sector applications of conjoint analysis involve some form of consumer choice simulation. They compete with each other in the market by each of several product/service profiles to see what share of options will be produced. Conjoint analysis is also useful in market segmentation. The idea is to divide a heterogeneous population into more homogeneous segments of consumers so that different marketing strategies can be tailored to different consumer segments to achieve maximum marketing results. It now seems useful to adopt the name “conjoint analysis” to encompass emphasizing models and techniques in converting subjective responses to predictive parameters (Green and Srinivasan, 1978;103).

Conjoint analysis is a research technique used to predict or determine how participants develop their preferences and to measure the

tradeoffs people make when making decisions for products/services. Conjoint analysis is based on the premise that subjects evaluate the actual or hypothetical value or utility of a product/service/idea by combining the discrete amounts of benefit provided by each feature. Conjoint analysis is a decomposition technique because a subject's overall assessment is decomposed to give utility programs for each predictive variable and each level of a predictive variable (Schaupp & Bélanger, 2005;96).

Conjoint analysis emerged from the field of unified measurement in mathematical psychology. Conjoint analysis is used to investigate the joint effect of a set of independent variables on an ordinal scale measure dependent variable. Conjoint analysis is based on a main effect analysis of variance model. The hypothetical product preferences defined by the attribute combinations provide data. Conjoint analysis breaks down judgment data into components based on the qualitative characteristics of products. A numerical partial value utility value is calculated for each level of each attribute. Large part value utilities are assigned to the most preferred levels and small part value services are assigned to the least preferred levels. Attributes with the largest partial value usage range are considered the most significant preference estimate. Conjoint analysis is a statistical model with error term and loss function. Conjoint analysis is used to determine the importance of each feature and the partial value utility for each level (Kuhfeld, 2010;682).

Despite more than 20 years of collaborative research and hundreds of methodological papers, few studies have been published as formal tests of whether conjoint analysis actually works for significant predictions. Conjoint methods have some widely accepted shortcomings. For example, respondents sometimes use simplification strategies to answer difficult full-profile tasks (Orme, Alpert and Christensen, 1997).

Conjoint analysis is used to determine how people prefer different features of a product or service. In this respect, conjoint analysis can better predict consumer preference by summing the utility scores of all individual products. It not only provides the evaluation of product characteristics, but also scores the quantification of the quality effect in



terms of multi-signature setting and utility. It has been observed that conjoint analysis has become an increasingly popular method for determining and understanding the combined effects of product characteristics and preferences for a product (Koo and Koo, 2010;328).

Conjoint Analysis requires some prior basis for selection of features. Trying to determine which variables should be included can be theoretical or derived from other research such as surveys. Conjoint analysis begins with a comparison of each attribute and then examining the fragment value estimates for each attribute. Conjoint analysis results are an estimate of the value of each attribute and each part of each attribute. Conjoint analysis can evaluate the relativity of each feature. In conjoint analysis, it determines an importance value for each participant and each feature (Turan, 2006;8).

A key feature of conjoint analysis is that customers evaluate product profiles that consist of multiple interconnected items, such as attributes or features. Conjoint analysis is a statistical method, also called multiple features. Customers evaluate the different combined items product concepts shown. Obviously, conjoint analysis isn't perfect, but uncertainty reduction is a necessary asset in businesses. Taking into account all its assumptions and flaws, it outperforms other methods (Lucio, 2015;33).

Conjoint analysis is a discrete choice model used to analyze the choice of a variable, between alternatives available to potential buyers of the decision-making product for an alternative from a set of mutually different products. The first step in designing a conjoint analysis is to identify the attributes of an analysis. Attribute is the feature of a product that a buyer may consider important when purchasing the product (Adekunle, 2015;14).

Conjoint analysis is a multivariate methodology developed to understand consumer preferences for a service or product. The total utility of a product or service is a concept that is used to measure its value and represents subjective preference judgment (Moran & Fernando, 2014;30). It works by asking respondents to choose between hypothetical

products or services available to them, to rank, rate, or rate them. These hypothetical evaluations are used to determine the benefits of the individual characteristics that make up the product or service and to draw conclusions. In the early period of conjoint analysis, it was also popular to ask participants to evaluate many things by ranking (or rating) the product alternatives printed on the cards.

Conjoint analysis is a widely used statistical procedure designed to test the effects of various factors. There are numerous studies that use conjoint analysis to model the effects of a product's characteristics on consumer choice. Thus, by investigating consumers' preferences for a product category with different combinations of feature levels, the relative importance of these features can be determined by conjoint analysis. Conjoint analysis is probably the most important and successful technique in this field to represent consumer preferences and in consumer research. There must be a functional form to represent consumer preferences. A functional form that relates consumer preferences to product characteristics is called preference model in combined analysis (Zhu, 2007;13).

Conjoint analysis can also be defined as a technique that determines the reasons behind the decision to choose a particular product and daily decisions based on the trade-off between various decisions regarding consumers' preferences. Conjoint analysis determines which features affect a customer and to what extent. The probability of the consumer avoiding purchasing any product can also be estimated and, once the size of the potential market is known, these can easily be turned into an estimate of their market share. Until now, conjoint analysis has been used in many different ways by many researchers for different purposes such as estimation. Some conjoint studies may give inaccurate estimates of market share because they ignore the fact that certain product characteristics will have different effects on different individuals (Jahanbin, 2015;22).

Since its introduction in the early 1970s, the Konjoint has not been used solely for analysis. He wanted to answer the question of not only consumer preferences or intentions to purchase existing products, but

also how consumers might react to potential changes in the existing product or a new product being introduced. According to Malhotra and Birks (2007), conjoint analysis is defined as “...the importance consumers attach to salient qualities and the benefits they attribute to their level of consumption.” Conjoint analysis is also defined as a technique that determines the reasons behind it. Conjoint analysis, It determines what kind of decision and to what extent features affect a customer. For example, it helps researchers to understand an individual's preferences based on why and how a consumer prefers mobile phone A to mobile phone B (Jahanbin, 2015;21).

Conjoint analysis is a method used to reveal or measure consumer preferences for various products. There are several stages in the design and analysis of conjoint analysis, specifically for:

- 1) to determine the qualifications and qualification levels to be included in the study,
- 2) scenarios that choose its presentation (rating, ranking or selection),
- 3) produce a survey tool,
- 4) reveal preferences and
- 5) analyze the responses.

## **2. History of Conjoint Analysis**

Conjoint analysis is not a new analysis method, although it has been popular lately. On the contrary, it has been in use for almost half a century, and the area is even claimed to date back to the 1920s. In addition, conjoint analysis methods started to develop rapidly in the late 1950s and early 1960s (Durmaz, 2022;19).

The foundations of the conjoint technique were first laid in 1964 by the mathematician psychologist Luce and the statistician Tukey (Lucio, 2015;34). Krantz in 1964 and Tversky in 1967 contributed to the technique with their articles. Later, Kruskal (1965), Carroll (1969) and Young (1969) developed algorithms for conjoint analysis (Yigit, 2008;26 & Aslan, 2006;48).

Since the late 1970s, many applications of conjoint analysis have been observed in academic and commercial market/marketing research. The increase in the use of conjoint analysis was seen in the late 1980s and early 1990s. In these years, the main use of the technique in the field of marketing was seen in studies related to market share, pricing and new product development, both in Europe and the USA. Green and Krieger (1989) evaluated conjoint analysis in new product design and optimization. Paul Green has published nearly 100 articles and written books on conjoint analysis, and has contributed greatly to the development of analysis (Dinc, 2010;5).

This analysis method was adapted to marketing research by Paul Green in the 1970s. It tries to understand the complex thoughts of customers about choosing a product or service, based on how important the criteria that make up that product or service are and how they are preferred by customers (Dengiz, 2017;27). The first form presented by Green and Rao in 1971 is called conjoint metering. The theory of this method concerns both the evaluation score (the dependent variable) and the predetermined composition rules and the measurement scales of the functions of each feature level (independent variables). These rules are based on the axioms set forth by Krantz and Tversky (1971) (Topcu, 2018;27).

Cattin and Wittink reported 698 conjoint projects involving 17 businesses for the period 1971-1980. Conjoint studies were also widely used in economics and business administration in the 1980s. Wittink and Cattin stated that between 1981 and 1985, 66 businesses in the United States carried out a total of 1062 conjoint studies. In the study conducted by Wittink, Vriens and Burhenne, it was revealed that there were a total of 956 projects by 59 enterprises in Europe in the years 1986-1991 (Ozcagli, 2020;21). Krantz (1964), Tversky (1967), Kruskal (1965), Young (1969), Wittink (1979), Louviere and Woodworth (1983) contributed to the development of conjoint analysis.

It was found in marketing research and multivariate statistical techniques books with the article study of Gren and Srinivasan in 1978. This article study has been the main source of many studies and has been

included in marketing research and multivariate statistical techniques books. Later, in the research conducted by Green and Krieger in 1989, conjoint analysis was examined in terms of new product design and optimization (Dikici, 2019;4 & Aktas, 2018;8). Computer programs and algorithms have been developed for various analysis approaches used in conjoint analysis.

The main reasons why conjoint analysis is so widely accepted are software packages that are easy and inexpensive, and it determines the optimum product features (Satici, 2019;13). The most important of these are MONANOVA (Monotonic Analysis of Variance) presented by Kruskal in 1965, PREFMAP program carried out by Carrol in 1973, and LINMAP program developed by Shocker and Srinivasan in 1977.

Another innovation brought by commercial computer programs in the early 1980s to conjoint analysis was the development of market simulators in which predictive situations can be examined. The databases, which were created by taking the behaviors and preferences of the subjects participating in the study, started to be used to answer the question of how they would be met by the companies. These simulators, where managers can easily see the effects of the differences they will make on their existing products in the market, have been very useful in estimating market share (Arslan, 2016;32). Towards the end of the 1980s, studies with conjoint analysis increased and the acceptance of analysis, especially in the field of market research, increased (Ucurum, 2018;27).

In 1985, Steve Herman and Bretton-Clark published the computer program on Green's work based on the full profile method. Also in 1985, Johnson and his new company Sawtooth Software developed the adaptive conjoint analysis software system. During the 1990s, the application of conjoint analysis increased and spread to almost every field. The widespread use of conjoint analysis in marketing has led to its use in many other areas such as new product development for consumers, segmentation, industrial marketing, pricing and advertising. In 1993, selection-based conjoint analysis commercial software was published by Sawtooth Software (Yalcin, 2016;20).

With the “Adapted Conjoint Analysis” software designed by Johnson and Swtoot (1985), participants were provided with real-time pairwise comparison matrices in the computer environment and more realistic answers were provided. Again, with the spread of personal computer technologies, the software prepared by Steve Herman and Betton-Clark (1988) based on Green's studies and presented to IBM also contributed significantly to the use of conjoint analysis. Later, new ones such as SPSS Categories (1990) and Intelligent Marketing System's Consurv (1993) were added to these software, enabling conjoint analysis to be applied in a computer environment in a way to obtain faster and more realistic results (Ozgultekin, 2020;7).

**Table 1.** Development of conjoint analysis (1974–2000) (Source: Yigit, 2008;28)

Choice-based conjoint	McFadden (1974); Gensch and Recker (1979); Batsell and Lodish (1981); Mahajan, Green and Goldberg (1982); Louviere and Woodworth (1983)
Three-way multivariate conjoint analysis	DeSarbo, Carroll, Lehmann, O'Shaughnessy (1982)
The effect of a set of attribute levels on the derived conjoint	Wittink, Krishnamurthi and Nutter(1982)
Constrained parameter estimation in conjoint analysis	Srinivasan, Jain and Malhotra (1983)
Hybrid models for conjoint analysis	Gren, Goldberg and Montemayor (1981); Green (1984)
Introduction to Bretton-Clark full profile conjoint techniques	Herman (1988)
Introduction to conjoint analysis adapted from Sawtooth software	Johnson (1987)
Factor analysis approach to specialized conjoint analysis	Hagerty (1985)
Conjoint analysis and MDS as a pair	Gren, Krieger and Carroll (1987)
Reliability and validity test	Bateson, Reibstein and Boulding (1987)
Estimating and segmenting simultaneous conjoint parameters	Kamakura (1988)
Bretton-Clark second generation, full profile version of programs	Herman (1988)

Combiner-compensatory explanatory models	Srinivasan (1988)
Part segmentation by optimizing features	Gren, Krieger and Zelnio (1989)
Compensatory model problems in the negatively correlated environment	Johnson, Meyer and Ghose (1989)
New experimental designs for Konjoint	Steckel, DeSarbo and Mahajan (1991)
Minimum selling price model for optimal pricing	Kohli and Mahajan (1991)
Revisit experimental preference analysis	Batsell and Louviere (1991)
Hidden class conjoint analysis	DeSarbo, Wedel, Vriens and Ramaswamy (1992)
Restricted Partworth estimate	Van der Lans and Heiser (1992)
Modeling hierarchical conjoint methods	Oppewal, Louviere and Timmemans (1994)
Current variables in hidden class modeling	Kamakura, Wedel and Agrawal (1994)
Hierarchical Bayesian (HB) models for conjoint analysis	Allenby, Arora and Ginter (1995); Alie and Ginter (1995); Lenk, DeSarbo, Green and Young (1996)
Comparison of metric conjoint models	Vriens, Wedel and Wilms (1996)
Benefit-balanced experimental designs	Huber and Zwerina (1996)
Competitive interaction simulators	Choi, DeSarbo, and Harker (1990); Green and Krieger (1997)
Mixture models for partitioning	Wedel and Kamakura (1998)
Commercial Windows-based and selection-based conjoint	Sawtooth software (1999)
Kruger and Green's hybrid selection-based conjoint model	Vavra, Green and Krieger (1999)
Hidden class conjoint analysis	Ramaswamy and Cohen (2000)
Application of HB to the internet recommendation system	Ansari, Essgaier and Kohli (2000)
Responses to lag times and conjoint analysis	Haajer, Kamakura and Wedel (2000)

### **3. Purpose of Conjoint Analysis**

The main purpose of conjoint analysis is to determine which combinations of attributes are most preferred by responding consumers and to develop utility functions by determining the values they give to different attribute levels and their utility coefficients (Ucurum, 2018;28). One of the main purposes of the analysis is; the aim is to determine the positive-negative or liked-unlike aspects of the product in the market and to eliminate the negative / undesirable aspects. In other words, conjoint analysis seeks an answer to the question of what features the product should have. The analysis is basically based on the view that individuals do not have a single factor in their decision making, on the contrary, they make choices by considering many factors together (Aktas, 2018;7).

If the general objectives of the analysis are evaluated from a business point of view;

- To determine the contribution of product features and levels to consumer preferences (marginal contribution),
- Creating a model that can explain consumer decisions,
- Designing products with optimum features,
- To be able to learn beforehand the features of preference between products with different features,
- To be able to catch product opportunities that are not currently in the market but that may have sales potential,
- To be able to identify the consumer groups that give importance to the different features of the products (Yaman, 2017;45).

### **4. Advantages and Disadvantages of Conjoint Analysis**

Participants in conjoint studies are forced to make a trade-off, especially in their purchasing decisions. In real life, when purchasing a product or service, a consumer generally does not have the option to buy more than the most desired factors and less than the least desired features (Aslan, 2006; 50). For this reason, the most important advantage of conjoint analysis is that physical objects can be used and individual preferences can be measured (Camlidere, 2005;9).



Because the ranking method is a direct measurement, it is not very effective in determining the importance that the consumer has for certain factors and predicting the consumer's evaluation and comparison of varying levels of different factors. Conjoint analysis, unlike the aforementioned methods, allows to measure the degree of importance consumers attach to each factor related to this product or service, and the degree of preference for each level of each factor (Dinc, 2010;7).

Mostly, in all customer satisfaction studies, interviewees evaluate a single scenario rather than changing product or service scenarios. With conjoint analysis, instead of taking a single measurement from each individual, it is possible to see a series of scenarios with varying feature levels. Thus, the relative importance of product or service features becomes better (Sahinkanat, 2013;47). The feature that makes conjoint analysis advantageous compared to other statistical analysis techniques is that it offers the opportunity to compare attributes quantitatively. Thus, concepts that are not expressed numerically are transformed into data that can be expressed numerically and easily interpreted. With the conjoint analysis, the relative importance of the factors can be determined with the scenarios created by different factor levels (Ucurum, 2018;28).

Conjoint analysis enables a hypothetical series of goods or services to be obtained. Thus, it can be predicted whether the product or service will hold up in the market. Before the product is put on the market, it can be predicted whether the product will be in demand as a result of the important information provided by the experiment. The features used in the analysis consist of dependent variables measured with an ordinal or classifier scale, or independent variables measured with an interval or proportional scale (Aktas, 2018;12).

It is a convenient method to construct scenarios in which the levels of criteria, qualities and characteristics come together by changing. In this way, the relative importance of criteria, qualities or features that may differ in interpretation from person to person can be better revealed. Therefore, it gives detailed information about the variables and levels

that can be used to design in order to reveal the best service (Akdemir, 2019; 56).

While designing a product, it directs the design team about consumer demands and as a result, consumer demands are transferred to product design. In the conjoint analysis, since the consumer is expected to make a choice among the product types offered to the consumer, while the features suitable for the product are determined, the features that the consumer does not prefer are also determined. In addition, it enables the consumer's needs and preferences to be determined realistically. In addition, there are more powerful programs today than in the past; therefore, the reliability of the analysis results has increased (Durmaz, 2022;32). Conjoint analysis is a less expensive and easy to understand method compared to other methods. With the development of computer programs for analysis in recent years, the number of missing data has decreased and the reliability of the analysis has increased (Satici, 2019;15).

The set of features of the product or service to be evaluated should be presented in a realistic way. Conjoint analysis is more useful on functional-based products or services rather than image-based products. In addition, it is argued that conjoint analysis is more useful for rarely purchased products than for frequently used products (Dikici, 2006;9).

Although the disadvantages of conjoint analysis are mentioned; the main reason for this is that the cost of the research can be high compared to the research area. Because, due to the examination of the factors at different levels, it is necessary to use the verbal, pictorial or real versions of the combinations of the features of these factors to the participants, thus increasing the cost. For example, when it comes to testing different types of TV commercials, the research cost may increase significantly (Aslan, 2006;51).

Another disadvantage is that it is difficult to use for product positioning research due to the lack of a procedure to translate perceptions of real features (Camlidere, 2005;9).

One of the most important problems of Conjoint Analysis is that the problem becomes complicated when there are many attributes. Therefore, the analysis should be limited to a maximum of 30 attributes. Another disadvantage of conjoint analysis is that the search cost can be high. Testing all factor levels one by one among the people participating in the research increases the cost in sectors such as the advertising sector (Dinc, 2010;8).

In the conjoint analysis, inconsistent results can be obtained in cases where not all of the features and levels are known before the research. If the features and levels are too many, the research can become complicated (Sahinkanat, 2013;47).

The issue of correctly determining the features and levels of the product or service is another disadvantage of conjoint analysis. In addition, the fact that there are many features and levels causes the combinations created to be high, which creates difficulties for the participants to evaluate the scenarios (Yalcin, 2016;21).

Another problem is that the qualifications and levels are known before the research; the features of a product or service to be evaluated should be researched and presented to respondents in a realistic way (Ucurum, 2018; 29).

Using subjective definitions in the definition of variables and levels may cause misunderstanding of variables and levels. Conjoint analysis is a more effective method on functional-based products rather than image-oriented products. Likewise, it is a more effective method for products that are purchased much less frequently than frequently purchased products. However, it is difficult to use for product positioning research (Satici, 2019;15).

Inconsistencies can be seen in the analysis results if all of the features and levels that are the subject of the research are not known before the research. In case the number of features and levels is high, it is inevitable for the research to become complicated. Therefore, the analysis should be limited to a maximum of 30 attributes (Ozgultekin, 2020;10).

One of the disadvantages faced by conjoint analysis is that it tends not to be reproducible. When the exact same research is applied to the same participants, the differences between the benefit estimates in the analysis results have led to a comprehensive discussion (Durmaz, 2022;32).

Other disadvantages of conjoint analysis are (Aktas, 2018;12);

- The complexity of the information gathering phase,
- His view of the reduced set of interconnected features,
- There is no method to translate into opinions about real features,
- If the feature and feature levels are high, the analysis becomes complex,
- It can be expressed as the fact that consumer characteristics cannot be directly reflected in the model.

## **5. Concepts Related to Conjoint Analysis**

### **5.1. Features (Variable)**

These are the definitions that the researcher can see about the product and its effect on the other as it changes. Features must be defined with different values on at least two levels. There should be a relationship between the characteristics in such a way as to enable respondents to make rational assessments. It is this correlation that is expected to be among the features that make the product believable. An example of this is the positive correlation between price and quality variables (Tuncali, 2007;23-29).

A feature (variable) is a description that defines the product and distinguishes it from other products in its category. At the same time, they are the variables on which the researcher makes changes in order to measure the effect on another variable. For example; in a research to be carried out in the category of mobile phones, the brand, dimensions, price, weight of the phone, promotion if any, or whether it has a camera can be given as examples of features that can be used in the study (Degerli, 2010;14-15).

In conjoint analysis, predictive variables were measured with a classifier or ordinal scale. Features should be represented by two or more values (Basaran, 2010;18-22). When price and quality features are considered in a product design, one of the combinations that will occur will be high price and low quality. In such a case, there is an unconvincing situation for the participants. Therefore, attention should be paid to the correlation between features in combinations (Yalcin, 2016;17-19). For example, in a study investigating the preferences of purchasing a car with conjoint analysis, variables such as fuel consumption, price, body type, etc. can be defined as the features involved in decision making (Dengiz, 2017;28). In addition, the sound level and motor power of the vacuum cleaner can be given as an example (Satici, 2019;15-19).

## 5.2. Level

It is the name given to structures that can be numerical or verbal that describe every feature of the product. Each feature should be defined by at least two levels (Derli, 2010;14-15). In order to get healthy evaluations, it is appropriate that the features defined at the verbal level in practice contain at most 4 or 5 levels. However, if a feature is measured with at least an intermittent scale and is defined with levels, the number of levels may be higher (Tuncali, 2007;23-29). If the factor is obtained by measurement, the number of levels is reduced. If the quality, such as a package, is variable, the original values can be used as the level (Basaran, 2010; 18-22).

Examples of features and levels of a car can be given as follows;

- Brand: A, B, C, D
- Fuel Type: Diesel, Gasoline, Electric, Hybrid, LPG
- Body Type: Sedan, Hatchback, Stationwagon, Coupe
- Price: 400.000 ₺, 600.000 ₺, 800.000 ₺

When the above example is examined, brand, fuel type, body type and price are product features, while A, B, C, D, diesel, gasoline, electric, hybrid, LPG, sedan, hatchback, stationwagon, coupe, 400.000 ₺, 600.000 ₺ and 800.000 ₺ features represent levels.

The levels that can be attributed to the product features in a sample study for a mobile phone preference are as follows;

- Brand: Apple, Xiaomi, Huawei, Samsung, Oppo, Poco
- Pen: Yes, No
- Camera: 16 MP, 20 MP, 24 MP, 32 MP
- RAM: 4GB, 6GB, 8GB
- Internal Memory: 32GB, 64GB, 128GB, 256GB

### **5.3. Orthogonality**

It explains the state of independence among the features of the product that the researcher is interested in (Tuncali, 2007;23-29). In other words, there is no dependency between the features of the product or service evaluated (Satici, 2019;15-19). In conjoint analysis, orthogonality refers to the determination of the effect of changing each feature level and its independence from the effects of other changing feature levels and experimental errors. In other words, it is the state of independence between the variables of interest (Yalcin, 2016;17-19).

### **5.4. Trial Combination**

The trial combination is the sum of the levels of product attributes evaluated by the participants in the study. In other words, it represents the sum of the set of product alternatives, in which each product is reflected as a combination of specified features and levels. For example, in a case where there are 4 features and 2 levels for each feature, a total of 16 attempts are made. In most analyses, the number of trials is larger than respondents can assess. Thus, rather than layouts containing all trial combinations, segmented layouts are evaluated to the participants. In the segmented approach, a subset of the trial combination is used. The feature of this layout created later is that it provides orthogonality between the variables (Arslan, 2016;33). Such schemes can be created using computer programs developed for conjoint analysis. Thus, experimental setups that are both statistically competent and more economical in application can be created (Tuncali, 2007;23-29)

For example; 243 (3X3X3X3X3) trial combinations are created in a study defined by 5 features, each consisting of 3 levels. Research usually uses an orthogonal set partitioned within these trial combinations, rather than all trial combinations. With the software developed today, it is possible to create these sets much more easily.

For example; for a study consisting of 3 features, the trial combinations will be created as follows in the display with the full profile method: Let's assume that the 3 features to be used in the study are brand, price and camera.

- The levels for the brand feature are “Samsung”, “Apple” and “Oppo”,
- The levels for the price feature are “8,000 ₺-10,000 ₺”, “10.000 ₺-14,000 ₺” and “above 14.000 ₺” and
- For the camera feature, “20 MP and below camera”, “32 MP” and “40 MP and above camera”

let's imagine it is. When the number of levels planned to be included in the study for each feature is multiplied, the total trial combination will be found. In this example, the number of trial combinations would be  $3 \times 3 \times 3 = 27$  (for 3 level brand, 3 level for price, 3 level for camera).

### **5.5. Trade – Off**

It is a method that allows the respondent to evaluate the levels of all the features of the product by comparing them two by two. Thus, although all combinations can be tested, its applicability in real life research is limited due to the high number of features and levels. In order to be applicable, the number of features and levels must be very low (Satici, 2019;15-19).

### **5.6. Full Profile Method**

In this method, the cards consisting of the combination of all the features selected for the study are presented to the participants on the computer screen or on paper, and they are asked to sort or score and evaluate the cards (Yalcin, 2016;17-19).

### **5.7. Component Comparison Method**

This method can be defined as a combination of trade-off and full profile methods. Respondents are asked to choose one of the products with the features on two different cards. The products in the pairs shown do not include all the features (Tuncali, 2007;23-29). In this method, participants are asked to make an evaluation by choosing one of them by presenting double cards with levels of all or some features (Yalcin, 2016;17-19).

The difference from the full profile method is that different levels of all factors are not included in one profile. In recent years, it has been preferred in commercial applications as an alternative to the trade-off method. The disadvantage of the method is that realistic results cannot be achieved because all factors are not included in the profiles, and as the number of factors and levels increases, respondents have difficulty in making decisions (Yigit, 2008;47).

### **5.8. Creating Trial Combinations**

In order to obtain reliable information about the researched subject, it is important to determine the variables and their levels in the cards that the respondent will evaluate. While these trial combinations will be determined as fixed, there are also computer programs in which different cards can be evaluated randomly for each respondent (Tuncali, 2007;23-29).

In conjoint analysis, it is very important to determine what the variables and their levels will be in the cards that will be presented to the respondent for evaluation, in terms of obtaining realistic and healthy information on the researched subject. At this stage of the analysis, the cards that will be presented to the respondent, selected from different combinations and containing the product features, are determined (Yigit, 2008;47).

### **5.9. Making Consumer Choices**

In determining consumer preferences, situational preferences are the method most frequently used in conjoint analysis in the preference



structure defined by Green and Srinivasan (1978). Situational preferences are divided into three: self-explanatory approaches, conjoint approaches, and hybrid approaches. While the evaluation is done with a self-explanatory approach, each level of each variable is evaluated independently of each other. When this approach is used, the respondent scores the created cards according to his preference. In this method, the small number of cards provides more objective answers. In conjoint approaches, the respondent evaluates a defined product or service by scoring or ranking. Thus, it is possible to choose between different products. In hybrid approaches, the denominator measurement features of these two methods are combined. The respondent evaluates each variable independently (Tuncali, 2007;23-29).

### **5.10. Partial Value**

It is the name given to the total preference or benefit associated with each feature of each variable of the product or service of interest (Tuncali, 2007;23-29). Many times, consumers cannot directly express the underlying reasons for choosing a product. However, with conjoint analysis, each feature of the product and the contribution of the levels of that feature to the consumer's preference can be determined according to the product preferred by the consumer. This contribution is characterized as a partial benefit of that feature and level. For example, price will be a much more important criterion, especially for people of low socioeconomic status. In a mobile phone preference study conducted among people with low socioeconomic status, if the price feature levels are “3000 ₺ and below”, “3000 ₺-5000 ₺”, “5000 ₺ - 7500 ₺”, “7,500 ₺ and above”, the consumer's tendency is low price. will be in the direction of the “3000 ₺ and below” level will have the maximum partial benefit value. However, as the price increases, the partial benefit may decrease and even take negative values. The negative value of partial benefit indicates that the preference of trial combinations created with that price level will be lower (Dereri, 2010;14-15). It is the estimation of the contribution of each feature and level of a product or service to the main usefulness by conjoint (Satici, 2019;15-19).

### **5.11. Basic Effects**

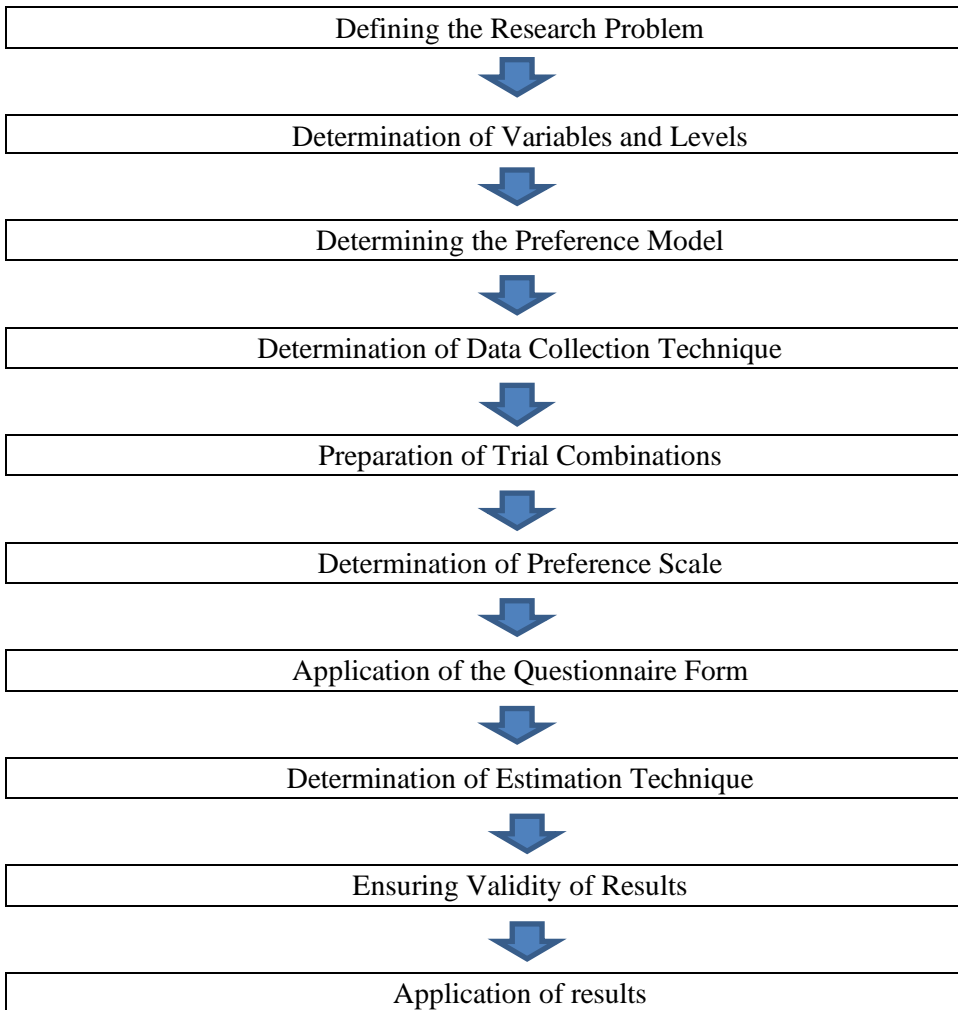
It is called the direct effect of each feature of the product on the dependent variable (Tuncali, 2007;23-29).

### **5.12. Correlation Between Features**

Inter-trait correlation is the presence of a negative or positive relationship between traits that renders combinations meaningless. An example of negative correlation is the weight of the car and its performance. As the weight of the car increases, its performance is expected to decrease. Therefore, the realism of a combination of both weight and performance is unthinkable. An example of a positive correlation is price and quality. The higher the price, the higher the quality is expected. A combination of low price and high quality cannot be considered credible (Satici, 2019;15-19). It is the correlation between features, also known as environmental correlation, that makes feature combinations incredible or meaningless (Ozcagli, 2020;23).

## **6. Application of Conjoint Analysis**

In a study to be conducted using conjoint analysis, the following steps are followed.



### **6.1. Selecting and Defining the Research Problem**

In order to define the research problem, what is desired to be achieved with that research must be determined first. The purpose of conjoint analysis is to determine how to create a product that can attract and appreciate consumers. In addition, it is among those targeted to increase its market share by developing the product. In the research problem, the variables and their levels should be definable and solvable. In order for the research results to be healthy, it is very important to be able to select the sample that fully represents the target consumer group.

For this reason, it is also very important to decide on the selection method of the sample that represents the research population well (Erdogan, 2006;10-26).

As in all research steps, the first step in conjoint analysis is to determine the purpose of the research. A study on conjoint analysis has two aims. The first is to determine the predictive variables and their contributions to consumer choices. For example; within the scope of conjoint analysis, the effect of the name of the airline company on the purchase of a plane ticket or the effect of the annual fee or credit limit on the use of credit cards are investigated within the scope of conjoint analysis. The second goal is to create a valid model that detects the combination of features created by consumer judgments. The researcher must first identify all the factors that add value or benefit to the product or service in question and identify all critical decision variables involved in the consumer's selection process. At this stage, all the positive and negative factors in the total value of the product or service should be explained. Giving more weight to positive factors in the research may distort the opinions of the interviewees. In addition, if a negative factor is not added to the research, the fact that the interviewees subconsciously consider this factor may render the research invalid (Dikici, 2006;12-13).

In most studies that work with statistical analyzes, first of all, the problem is defined and the most appropriate model is decided after the purpose of the research to be done for this problem is determined. Before applying the conjoint analysis, these definitions should be determined in accordance with the analysis (Durmaz, 2022;35-47). Like every study, conjoint analysis begins with defining the problem and determining the purpose of the study. In conjoint research, this aim is usually to determine what features the products preferred in the market have. In other words, when choosing a product, it is determining which features in that product are important. Therefore, for which product/service group the research is being conducted, the features of the product and the levels of the features are carefully determined. The reliability of conjoint analysis is closely related to the number of features and levels. Since the number of features and levels will increase the number of profiles to be

created, it will reduce the probability of correct answers to be received from the respondents (Kocak, 2021; 17-21).

Before starting the application of conjoint analysis, first of all, the problem is defined and the purpose of the research is determined. After that, the variables and levels of the problem are determined. One of the most important things in determining factors and levels is numbers. For this reason, it should be studied with a sufficient number of levels and factors that fully reflect the problem and use all the determining features (Ozcagli, 2020; 28-38).

The first stage of conjoint analysis is defining the research problem; in other words, it is the determination of the purpose of the research and the framework on which decisions the results of the analysis will be effective. The research generally consists of two main objectives. First purpose; in the selection of a product or service in the market by consumers; it is to determine the estimation variables related to which features they evaluate products or services and the contribution of these variables to consumer preferences. The second purpose is; it is the creation of a valid model that determines the combination created according to the judgments of consumers and the determination of what features consumers want a product or service (Ozgultekin, 2020; 10-20).

## **6.2. Determining the Variables and Levels to be Used in Conjoint Analysis**

While determining the variables and levels, the characteristics that affect the consumer preference about the product are determined. At this stage, the consumer's ideas on the subject and the manufacturer's ideas should be considered together. What is important here is how to generalize the various alternatives to the product. While economically priced and useful product features are determined for the consumer, low-cost, high-profit product features are determined for the producer (Erdogan, 2006;10-26). After defining the research problem, the next step is to determine the factors of the product and the levels of these factors. It is important to determine the number of factors and whether

there is a linear connection problem between the factors (Dikici, 2006;12-13).

The level and feature definition of the product to be researched is at the center of the conjoint analysis design. Determining the level and features correctly is very critical for the success of the study. As mentioned before, one of the disadvantages of conjoint analysis is that the researcher may not give accurate results as a result of unqualified preparation of the level and characteristics of the researcher. Levels and features should be oriented towards the purpose of the research and the solution of the problem and should cover all possibilities for the desired product. However, the features and levels that are thought to be unnecessary and will not affect the results of the research should not be included in the study. Another point to be noted is that the levels and characteristics are easily understood and perceived the same by the participants. Otherwise, the participants may misunderstand the options and evaluate inconsistent results, or each participant may misunderstand the levels and features in the same way (Durmaz, 2022;35-47).

The researcher must first define the complex features of the product or service. Then it should determine the appropriate Features and their levels for use in conjoint analysis. At this stage, the researcher should pay attention to the following points:

- Their Features and levels should be the determining factor of the product they belong to.
- Features and levels should be created in such a way that they are not perceived differently by different respondents.
- Features and levels should be easily perceptible by respondents (Ozcagli, 2020;28-38).

If the levels of the selected features for conjoint analysis are defined in such a way that they cannot be used, the product cannot be simulated at all. If a feature is not included in the analysis and does not fall within the limits of two determined levels, no information can be obtained about how respondents will respond to this level. To summarize, the variables should be explained clearly and clearly, and

then significant levels should be determined for each variable. If a variable is numerical, it is necessary to determine its levels and the class range for the levels (Camlidere, 2005;15).

### **6.3. Determining the Level of Measurement for the Dependent Variable**

Before starting the data collection process; it is necessary to determine at which measurement level the consumer choice, which is defined as the dependent variable, will be measured. The scales used for the dependent variable; non-metric (intermittent) scale and metric (sorter and classifier) scales. Depending on the purpose of the research, the dependent variable is; may be the order of preference given to the choice cards presented to the respondent. Accordingly, the respondents divide the presented selection cards into three parts, according to their preference importance, as products that are strongly liked, products that are undecided, and products that are absolutely undesirable. After that, the sorting process starts from the most popular to the least liked. The metric scale type used for the dependent variable is the equidistant scale. The selection cards created with this scale are given 1 points from 0 to 10. It is assumed that the scoring for each selection card is independent of each other. Researchers using the evenly spaced scale for the measurement of the dependent variable believe that scoring is more convenient for the respondent and easier than ranking. Those who advocate the use of preference rankings argue that the ranking correctly represents the consumer behavior in the market (Erdogan, 2006;10-26).

### **6.4. Data Collection Methods**

In conjoint analysis, the sample size varies widely. While some authors state that the sample size should be between 100 and 1000, but the sample size between 300 and 550 is very common, other authors state that the sample size may be less than 100. Although the sample size is very small in conjoint analysis, it has a representative feature. This is because each interviewer is asked a combination of multiple essays. In this way, the total number of samples will be the total profile “number of cards” × “number of interviews” to be shown to the interviewers. In

other words, if a total of 100 interviews were conducted in a survey consisting of 15 questions, the sample would be 1500 people. However, it should also be checked whether the number of samples is sufficient for subgroup analyzes (Dayetli, 2010;31).

Questionnaires can be asked to respondents in the form of a one-on-one survey, e-mail, or computerized interview. Today, with the increase in the use of computers, the survey method via e-mail is widely used. Surveys conducted via e-mail can save cost and time, but have drawbacks as they are not conducted face-to-face with respondents. There may be hesitations about the respondents answering the application correctly without getting bored. Attention should be paid to this situation. Although the one-to-one survey method is disadvantageous in terms of time and cost, it is preferred more than other methods in terms of being healthy (Dinc, 2010;22).

After the characteristics and levels are determined, the researcher must decide how to collect the data. In the conjoint analysis, the answers to be obtained from the respondents can be obtained by showing various pictures and figures, or by creating the most commonly used trial combinations. In conjoint analysis, data is obtained by presenting the trial combinations to the respondents. In the study, the combinations were formed according to the variables and levels determined for the research problem. After determining the researcher factors and levels, they decide on the presentation of stimuli, the type of response variable and data collection methods (Cengiz, 2009;29).

Creating trial combinations is of great importance in the application of conjoint analysis. Because the consumer is presented with the variables related to the features that affect his decision making and combinations formed with their levels, and by using these, the consumer's real thoughts are tried to be estimated. Assume that in a research problem there are 5 variables related to a product and each variable has three levels. Here,  $3 \times 3 \times 3 \times 3 \times 3 = 243$  combinations must be formed. Data in conjoint analysis; it is obtained by presenting the combinations created according to the variables and levels determined for the research problem to the consumer at the time of



consumption. The applied data collection methods can be the full profile method or the two features simultaneously (trade off) method. (Erdogan, 2006;10-26).

### **6.5. Methods and Ways of Presenting the Combinations of Variable Levels to the Respondent**

While determining the variables and levels, the characteristics that affect the consumer preference about the product are determined. At this stage, the consumer's thoughts on the subject and the producer's thoughts should be considered together. Determined variables and levels should be understandable and should not allow other meanings to be inferred. In the meantime, it is necessary to determine the levels that can be significant for the variables. If a variable is numeric, it is necessary to determine the class range for the levels. Class spacing needs to be realistic. The amount of variables and their levels should be kept as low as possible (Erdogan, 2006;10-26).

### **6.6. Determining the Preference Function**

In the conjoint analysis study, the mathematical functions used to determine the relationship between the levels of the features determined for the analysis of the product or service and the preference of the features are called preference functions. The preference model forms the basis for determining the partial benefit values of the features on the basis of level (Durmaz, 2022;35-47). In general, in conjoint analysis, preference functions are divided into three as vector function, ideal point function and piecewise function by least squares estimation method (Erdogan, 2006;10-26).

The vector model estimates the least number of parameters, assuming the linear functional format. The piece value model estimates the largest number of parameters as it allows for the most general functional form, and the ideal point model is between these two extremes. The partial value function model is also the most widely used in practice (Schaupp & Bélanger, 2003;102).

### 6.6.1. Vector Function

The Vector Function was developed by V. Srinivasan and Allan D. Shocker and Parker Srinivasan and is designated as the 'Composite (Composite) Decision Function'. In this function, a continuous function is used to indicate the effects of variables on consumers' product preferences. Estimates a single preference multiplied by the values of the levels. This function shows that the preference will increase as the levels of the  $k$ th variable go from worst to best. It is stated that if the variable levels go from bad to good, that preference will increase linearly, and if it goes from good to worse, the preference will decrease (Erdogan, 2006;10-26).

When the preference level of a feature increases or decreases in the vector function, the preference of the variable also moves linearly. The vector function works linearly as can be seen from the equation. If the preference level increases, the preference for the variable also increases linearly. If the preference level decreases, the preference for the variable decreases linearly. For example, as the camera quality of a phone increases, the amount of preference also increases (Durmaz, 2022;35-47).

The ideal vector model is the simplest bounded model. The reason for this is that it predicts a single preference multiplied by the values of the levels (Sönmez, 2008: 27). However, it is also preferred when there is a linear relationship between the variable levels and the preference of the variable (Ozcagli, 2020; 28-38).

Ideal vector model; it is based on the assumption that the scores and ranks of a factor are preferentially linear. In this model, a continuous function is used to represent the relationship between variables and consumers' product or service preferences. A single preference multiplied by the level values is estimated (Ozgultekin, 2020;10-20).

The vector function is used only for numerical variables and when there is a linear relationship between the levels of the variable and the preference for that variable. It is said that if the variable levels go from bad to good, the preference for that variable will increase linearly, and if

the variable levels go from good to bad, that variable preference will decrease linearly. These linear increasing and decreasing definitions are made by considering general economic theory and natural consumer behavior (Camlidere, 2005;16).

Conjoint analysis of course also works with numerical attributes. In such a case, a vector model can be considered. It means that the utility of a particular feature will increase (or decrease) linearly with its values, that is, its levels (Sklenářik, 2015;15)

### **6.6.2. Ideal Point Function**

The Ideal Point is the level of the variable that corresponds to the vertex of the parabola represented by a quadratic function. In this model, it is stated that the preference will decrease as you move away from the ideal variable level. The ideal point function used in this model is an example of a nonlinear function. This function is generally used for qualitative characteristics such as taste and smell (Erdogan, 2006;10-26).

Unlike the vector function, the ideal point function does not explain the preference level and variable preference relationship linearly because it is non-linear. In the ideal point function, the preference level appears low except for the ideal point (Satici, 2019:25). The function is a parabola. For example, the screen size of a phone positively affects the consumer's preference up to a certain level, but after a certain size, the phone starts to affect the consumer's preference negatively, since the phone will be useless (Durmaz, 2022; 35-47).

This model describes the optimum level of a variable. It is a continuous and nonlinear function. According to the ideal point model, it is seen that the utility value decreases as it moves away from the ideal point. This model is mostly used for attribute variables (Ozcagli, 2020;28-38).

Ideal point model; it is based on the assumption that a factor score or rank will be related to preference in the direction of decreasing preference. The ideal point is the level of the variable at the apex of a curve represented by a quadratic function. According to this model; if

other variables are constant, the levels closer to the ideal point of a variable are more preferred (Ozgultekin, 2020;10-20).

The ideal point model also works with numerical attributes. In principle, it is based on a quadratic function and is used in a situation where the benefit does not increase or decrease (Sklenařík, 2015;15).

### **6.6.3. Partial Utility Function**

This model is simpler than other models and is the most preferred model in practice. In this model, the utility coefficient values of each variable level are considered to be an additive function. Each level is allowed to have its own partial benefit value (Erdogan, 2006;10-26).

The piecewise function is the most flexible of the two function models mentioned above. This function does not put the preference level and variable preference into a specific function pattern like other functions. The piecewise function is a function model mainly used for conjoint analysis. In the piecewise function, each new preference level determines independent variable preferences. The preference level can be calculated separately for each variable preference (Durmaz, 2022; 35-47).

The partial benefit model is the most general, allowing each level to have its own estimate of partial benefit. The number of values predicted when utilizing this model increases rapidly when features and levels are included. The reason for this is that each new level has a separate benefit estimate (Ozcagli, 2020; 28-38).

In this model, factor levels are categorical and there are no assumptions about the relationships of factor ranks or scores. The model is expressed as a combination of ideal vector and ideal point models. The preference score of a variable is an additive function of the utility coefficient values of the levels of this variable (Ozgultekin, 2020;10-20).

The piecewise function is the simplest and most widely used preference function. This model describes feature benefits by a piecewise linear curve. Generally, the piecewise function is used as a preference function in studies involving variables such as color and odor. The

piecewise function reflects the utility function that gives the different utility (piece value) value at each  $j$  level of the given feature. In conjoint analysis, the number of levels is usually restricted to less than five. However, in reality, this number can vary from two to nine or more (Camlidere, 2005;20).

The partial values model, as edited by Hebrák, can be used on its own. Relative simplicity and flexibility are recognized as the most frequently used features. The usefulness of individual features (and thus their level) is indicated using a dashed line. Curves created by combining individual straight lines from partial estimates of the given utilities show linearity when it comes to levels of quality or degree of usefulness (Sklenařík, 2015;15).

## **6.7. Determination of Benefit Coefficients and Proportional Significance Values**

### **6.7.1. Techniques Used in Finding the Utility Coefficients**

The definition of the research problem, the data collection technique to be used, and the estimation of the benefit coefficients are of great importance in order to find the research results with the survey study conducted after the preference function has been determined. The techniques used to determine the utility coefficient of variable levels in conjoint analysis are grouped into three groups. If the dependent variable is measured with an ordinal scale, non-metric methods are used for the estimation of the utility coefficients. Techniques in this class; monotonic analysis of variance (MONANOVA), PREFMAP, Johnson's non-metric "trade-off" approach and LINMAP techniques. While MONANOVA is the more preferred method, it is used for the partial utility function, while LINMAP is used for the ideal-point method. The dependent variable I buy-don't buy; LOGIT and PROBIT models are used in cases where values such as I prefer-I do not prefer. Among the probabilistic approaches, LOGIT provides maximum likelihood estimations, and the use of this model requires the assumption of "independence of irrelevant alternatives", which may not yield realistic results when examining consumer behavior. The PROBIT model is used for pairwise

comparisons with independent data. However, this estimation method may not give the maximum likelihood estimation (Erdogan, 2006;10-26).

### **6.7.2. Determination of Proportional Significance Values**

In conjoint analysis, after all variables, level, data collection technique, selection of data analysis method, determination of benefit coefficients; the results for determining consumer preferences are obtained by the interpretation of the utility coefficients. The benefit coefficients related to each variable level are estimated separately from the preference scores given by the respondents to the trial combinations. By using the individual benefit coefficients, the proportional importance values, that is, the weight values, which show how much each respondent attaches importance to the variables of the product, are determined one by one (Erdogan, 2006;10-26).

## **6.8. Selection of Presentation Method**

Once a preference model has been chosen, the next step is to determine the way preferences are presented to participants for evaluation. This stage is one of the most important stages. If a wrong method is applied, the analysis process may lose its reliability. In addition, returning and editing can cause great losses in terms of time and financial costs. There are three types of presentation (Durmaz, 2022;35-47):

### **6.8.1. Trade-Off Method**

In the trade-off method, respondents are expected to evaluate two products containing two features. As the participant evaluates the products presented, other products are also presented for evaluation and the study is thus completed. The trade-off method is the simplest of the three methods. The difficulty of the trade-off method is that as the number of features of the product increases, the number of trial combinations also increases. It can be very difficult to complete the survey for the participant who is expected to receive responses to many presentations. In addition, since the participant who answers too many

presentations will lose their reasoning ability and focus after a certain number of presentations, wrong choices may occur and the study may lose its reliability (Durmaz, 2022; 35-47).

Dual evaluation is made for all levels of the features and the respondent is expected to rank the profiles according to his/her preference. In this method, full factorial design is applied (Kocak, 2021;17-21).

In this method, cards are prepared to be presented to the respondents. This card contains profiles prepared using different levels of all factors. These cards are presented to the respondents and asked to rank them according to their choices. The number of profiles may vary according to the number of factors and levels used in the research.

There are advantages and disadvantages to the use of this method. The most advantageous aspect of the method is that since the levels of only two variables are evaluated in each selection, it is easier for the participants to answer, while it is easier for the researcher to compile the data. Evaluation of the levels of two features in the method may provide a disadvantage for some studies. Since the number of selection cards will increase in studies where the number of variables and levels is high, it may be difficult for the participants to make healthy decisions and the research results may be far from being realistic. For this reason, the two-factor method is generally used only in the answers measured with the classifier and ordinal scales (Ozgultekin, 2020;10-20).

Advantages of this method;

- More realistic results are achieved as each level of the factors is found in trial combinations.
- Data is easier to compile as only the levels of two variables are taken in each table.
- The environmental relationship between the factors is explained more clearly.
- It provides convenience to the respondent.

- In case of too many factors and levels, it reduces the number of profiles to a number that responders will not have difficulty in ranking with the fractional factorial order method, where more important factors and levels are taken into account.
- Conducting the study by the researcher is facilitated.

Disadvantages of this method;

- As the number of variables and levels increases, the number of tables increases.
- As the number of factors and factor levels increases, the probability of finding the right information decreases.
- Even if there is a small number of levels, it may cause the respondent to get bored and not be able to make the right decision, since many decisions are required.
- It can only be used for (non-metric) responses measured with classifier and ordinal scales (Camlidere, 2005;21-22).
- Using only two features at a time may result in some loss of authenticity of results.
- Although the respondents make less decisions, it can be difficult for the respondents due to the complexity of the decisions.
- It does not take into account the dual and multiple interactions between the factors (Ozcagli, 2020;28-38).

**Table 2.** Trade-off method presentation card (Source: Ozgultekin, 2020;16)

		BRAND		
		X	Y	Z
PRICE	F1	1	9	2
	F2	8	3	6
	F3	5	7	4

### 6.8.2. Full Profile Method

When applying the conjoint analysis, the approach that can be expressed as the full profile approach, which is applied by specifying all possible combinations without choosing from the combinations created, can be used. In this method, participants participating in the research are



evaluated by presenting all the features and qualities related to the product or service (Erdogan, 2006: 15). In this method, each trial combination is defined separately on a profile card. Cards with a different combination of all factors and levels of products or services are subject to preference ranking or scoring by the participants (Ozgultekin, 2020;10-20).

If the cards presented to the participant are too many, the participants may lose their focus and not be able to make product evaluations in a way that reflects their preferences. Therefore, the number of cards presented to the participant should be small. If the number of levels and features is not high, the number of combinations will be less. Combinations can be presented to the participant in this way. However, if the number of levels and features is high, the number of combinations with orthogonal design should be reduced to low numbers and presented to the participant.

The full profile method is the most preferred method. It is quite simple in terms of survey management. Since all the features are presented to the participant, the participant's imagination and evaluation of the product is also an advantage in terms of the method (Durmaz, 2022; 35-47). The disadvantage of this method is that the number of combinations increases exponentially when the number of features and levels is high. Therefore, in cases where the number of features is high, fractional factorial design is used to create profiles (Kocak, 2021;17-21).

Although the respondent makes fewer decisions in the full profile method, the respondent has difficulty because these decisions are complex. Among the advantages of the full profile method are; the levels

of each trait in a trial combination are more clearly defined, the relationships among traits are clearly visible, and a better use of possible preference structure types. It is easier to see the probability and change of purchase intention, which is difficult to answer in the trade-off approach, in the full profile method (Ozcagli, 2020; 28-38).

Full-profile conjoint analysis has been a mainstay of the conjoint community for decades. Scientists have proposed the full profile approach to measure about six attributes. This number varies from project to project, depending on the length of the attribute level text, the familiarity of the participants with the category, and whether attributes are displayed as prototypes or images. While full profile conjoint analysis can be used for paper-and-pencil studies, adaptive conjoint analysis must be performed via computer. It can also be used for full profile conjoint analysis, computer-assisted personal interviews and internet surveys (Ozuak, 2021;9).

The advantages and disadvantages of the full profile approach can be listed as follows.

Advantages;

- More realistic product descriptions are obtained as all variables and levels are used.
- Since more preference types are used at the same time, it enables the respondent to score in less time and more accurately.

- Consumers' interest in the product with the features offered to them and their interest in that product while purchasing the product can be determined.

Disadvantages;

- As the number of features increases, the number of possible combinations will also increase, and the respondent will tend to simplify the process by concentrating on only a few features, which will make it difficult to obtain reliable results.
- The order of the features written on the trial combination card may affect the respondent while ranking these cards (Camlidere, 2005;22).

It has been argued that the full profile approach provides a more realistic description of stimuli by describing them. It shows factors in real stimuli, taking into account the potential environmental correlations between and possibly the levels of each of the factors. Another advantage of the full profile method is to directly measure general preference judgments using behavioral constructs such as purchase intention (Schaupp & Bélanger, 2003;102).

The full profile approach is also referred to as the concept assessment task and uses all of the factors as shown on the explanatory stimulus card for a situation. The main argument approach favoring the full profile is that by describing the levels of each of the factors, taking into account the stimuli and possible environmental conditions, correlations between factors in real stimuli give a more realistic explanation. On the other hand, it has the disadvantage of performing

several factor tasks for the respondent by having to think at the same time (Green, & Srinivasan, 1978;105).

**Table 3.** Full profile method presentation card (Source: Ozgultekin, 2020;15)

Brand :	X
Model :	Y
Number of Seats :	5
Color :	Red
Price :	TL

### 6.8.3. Component Comparison Method

The component comparison method is a blend of the trade-off and full profile method. In this method, the researcher presents two products with all their features to the participant and waits for him to choose between two product combinations. In this approach, the respondent uses a ratio scale to indicate the preference of one profile over the other. The most important feature of this method is the presence of all features in the profile (Ozcagli, 2020; 28-38). Two profiles are shown to the responder and these profiles do not include all features. It is desirable to choose one of the two profiles (Kocak, 2021;17-21).

The advantages and disadvantages of this method are similar to the other two methods. The advantage is that the participant can easily compare and evaluate the two products, as it expects the participant to choose any of the two products it offers. The disadvantage is that if the number of levels and features is high, the evaluation process becomes challenging (Durmaz, 2022;35-47).

As in the full profile method, the features of the product or service are presented to the preference of the participants, while they are asked to make a binary comparison, as in the two factor method. In some research studies, it can be used as an alternative method that can complete the deficiencies of the other two methods. However, in this method, it is difficult to reach realistic results because all the features of the selection set are not included. Again, if the number of features and

levels increases, it will not be possible to reach reliable answers and reliable answers given by the participants (Ozgultekin, 2020;10-20).

The difference from the full profile method is that different levels of all factors are not included in one profile. In recent years, it has been preferred in commercial applications as an alternative to the trade-off method. The disadvantage of the method is that realistic results cannot be achieved because all factors are not included in the profiles, and as the number of factors and levels increases, respondents have difficulty in making decisions (Yigit, 2008;47).

**Table 4.** Component comparison method presentation cards (Source: Ozgultekin, 2020;15)

Brand	:	X	Y
Colour	:	Red	Black
Price	:	1.500 TL	1.000 TL

## 6.9. Creating Trial Combinations

One of the most important stages in the application phase of conjoint analysis is the creation of trial combinations. Trial combinations are obtained by evaluating the Features and levels of products by various methods. Combinations are presented to the participant according to the chosen presentation method. Trial combinations are basically three types (Durmaz, 2022;35-47):

### 6.9.1. Multi-Agent Layout (Factorial Layout)

Another of the experimental design methods frequently used in conjoint analysis is the factorial arrangement method. It is a type of experimental design that envisages the use of all combinations in research involving a small number of factors and levels. The factorial order method enables the selection of the most appropriate combinations and offers useful perspectives to help see the interactions of the variables. For example; in a work with 4 features, each with 2 levels;  $2 \times 2 \times 2 \times 2 = 16$  combinations are offered to the participants. It is easy for the participants to evaluate these combinations. However, as the number of combinations increases, the probability of participants to give a

consistent response decreases. For example, for a 3-level 4-featured product or service,  $3 \times 3 \times 3 \times 3 = 81$  combinations occur. It becomes difficult for the participants to evaluate without being exposed to factors such as distraction or boredom (Ozcagli, 2020;28-38).

### **6.9.2. Segmented Multi-Agent Layout (Discrete Factorial Layout)**

Partitioned factorial schemes are a useful and economical scheme with many factors. In this scheme, leaving high-order interactions aside, main effects and two-factor variations can be calculated without distortion. On the other hand, it helps us to reach conclusions about the effects of many factors, and helps us to do detailed research on which factors (Ozcagli, 2020; 28-38).

### **6.9.3. Orthogonal Layout**

Orthogonal layouts are generally preferred in market research. This is because if a model is estimated according to orthogonal order, the prediction coefficients are obtained with minimum variance. Thus, non-orthogonal layouts can be used in some research problems or experiments can be converted to some known orthogonal layouts (Ozcagli, 2020; 28-38).

## **6.10. Determination of Estimation Technique**

When defining a measurement, there are two basic alternative scales for the dependent variable, metric and non-metric. In this study, metric measurement method is used. The advantage of the main metric method is the increased information content potentially available at scales (Schaupp & Bélanger, 2003;102).

Analysis techniques in this step are divided into three (Ozcagli, 2020;28-38);

- Metric techniques
- Non-metric techniques
- Probabilistic techniques

### **6.10.1. Metric Methods**

In the analysis, metric methods are used if the dependent variable is proportional or evenly spaced scaled. Metric conjoint analysis methods are used more than non-metric methods. Techniques used in this group; dummy variable regression (ordinary least squares method) and minimization of the sum of absolute errors. Among these techniques, the dummy variable regression method is more advantageous and easier to implement, as it provides the opportunity to calculate the standard errors of the parameters (Ozcagli, 2020; 28-38). In the absolute error minimization technique, constraints can be placed by the researcher instead of the estimated parameters. This technique is more powerful than the dummy variable regression technique (Yalcin, 2016;41).

### **6.10.2. Non-Metric Methods**

Techniques in this group are MONANOVA (Monotonic Analysis of Variance), PREFMAP, Johnson's non-metric trade-off approach, and LINMAP techniques. Among these methods, MONANOVA is limited to the utility function model, while other methods can be used for both vector and utility function models (Ozcagli, 2020; 28-38).

Non-metric techniques such as PREFMAP, LINMAP POLYCON, which were used with ordinal scale in the early days of conjoint analysis, lost their importance with the use of metric scale data. The MONANOVA approach was developed by Kruskal in 1965 for conjoint analysis without multidimensional scaling. The method was regulated by Johnson in 1975 with the calculation of partial utility values. Nowadays, non-metric techniques are preferred in conjoint analysis (Yalcin, 2016;41).

### **6.10.3. Probabilistic Techniques**

The Logit and Probit models are used in cases where the dependent variable takes categorical values such as I prefer – I prefer or I buy – I buy. The logit model requires the assumption of 'independence of unrelated variables' (Ozcagli, 2020;28-38).

Conditional logit or multinomial logit models from MONANOVA and Logit models are used in selection-based conjoint analysis studies. While the predictions made using the Sawtooth Software program are made with the multinomial logit model, XLSTAT uses conditional logit (Yalcin, 2016;41).

### **6.11. Ensuring Validity of Results**

Conjoint analysis is a model used to predict the prediction of elections. The importance of analysis lies in its additive nature, which enables it to predict customer preferences in a timely and meaningful way. Many recent studies have pointed to the validity of conjoint analysis results. The validity of conjoint analysis is examined as both internal validity and external validity. Internal validity includes investigating the suitability of the determined compound rule. In many studies, the researcher has to be empirically limited in assessing the validity of the two model shapes in the whole study due to the difficulty of collecting data. Therefore, the researcher should compare the model shapes with a preliminary study to understand which model is suitable. External validity is a concept that indicates the representative ability of the sample. When the conjoint results are used for selection simulation purposes, it becomes especially important that the sample always represents the population (Ozcagli, 2020;28-38).

There are different ways to test that the results obtained by conjoint analysis are valid and reliable. Re-performing a previous analysis using the same participants and the same questions on a different date and comparing the results of both analyzes is one of the methods used to test reliability. With this method, by calculating the correlation between the scores or rankings obtained from both studies; if the correlation is high, it is concluded that the research in question is reliable (Ozgultekin, 2020;10-20).

Reliability is the consistency, in other words, the stability of the research itself. Reliability tests used in the evaluation of the results obtained can be done for the benefit coefficients of the variable levels obtained based on the estimated dummy variable regression coefficients



or for the preference scores given by the subjects. The purpose of evaluation reliability is to reveal the effect of each subject's choices on the model's estimation (Sahinkanat, 2013;67).

## **6.12. Application of Results**

Conjoint analysis; research can have significant effects in terms of the purpose, subject, target audience and the market that will use the research results. Especially in the field of marketing, it provides a target-setting and guiding contribution in the field of market research on new products or services that will be released to the market. It can also provide statistical data to manufacturers/marketers within the scope of determining the target audience of existing products or services and carrying out marketing activities for potential consumer groups. Research results; it affects the decisions of those who request the research (manufacturers/marketers), which can be listed as introducing new products to the market, improving the existing product, maintaining the cost/profitability balance, or increasing/decreasing advertising activities (Ozgultekin, 2020;10-20).

The results found in the analysis are essentially the sum of the estimated utility values for each individual. It is possible to use these results directly and to determine the relative importance of each variable that is determined to be important for the consumer. In this way, the individual decision processes of consumers are determined. The areas where the results obtained are mostly used are the marginal profitability analysis of the ideal product combination determined by the consumer for the purpose of new product design or improvement of the existing product, conjoint simulators and market segmentation (Tuncali, 2007;48).

The results of conjoint analysis provide important input to individuals who will make marketing decisions about strategic marketing and sales decisions. Especially understanding the market preferences, estimating market shares, developing marketing strategies and segmenting the total market etc. The results guide what decision makers do. The results found in the analysis are essentially the sum of

the estimated utility values for each subject. It is possible to determine the relative importance of each feature that is determined to be important for the direct use of these results and for the consumer. In this way, the individual decision processes of consumers are determined (Sahinkanat, 2013;67).

### **6.13. Market Segmentation**

In the results of the analysis, the preferences of the consumers are determined after the benefit coefficients in the product features are calculated. However, if the study is general, the target audience may not be completely clear. In other words, the preferences of consumers can change in every age range and every socio-economic status change. For this reason, if the data is analyzed after first grouping the participants according to their demographic and socioeconomic characteristics, the preferences of the target groups will be determined clearly. Product demands can be supplied according to determined groups (Durmaz, 2022;47).

For market segmentation, individuals are divided into groups according to their individual preferences and some demographic characteristics obtained as a result of the analysis. Thus, it can be determined which factor and which level is more important in different groups. Accordingly, it will be easier for the producers to determine the target audience for the product they will produce and products can be produced for those consumer groups (Basaran, 2010;51).

A group of scientists have done conjoint studies on market division and their basic ideas are as follows (Ozcagli, 2020; 28-38):

- Market segmentation requires that customer preferences for products or services differ.
- These different choices made for products or services depend on personal variables (demographic characteristics, product use, brand loyalty, psychological structure), situational variables (eg beverage preferred for food eaten, etc.) and their interactions.

- Firms may react to the difference in preference resulting from changes in the current product or service, distribution and promotion.
- A change in a company's product may include decisions to add new features to the product or to remove some existing features from the product.

#### **6.14. Profitability Analysis and Efficiency**

Conjoint analysis results can also be used in the marginal profitability analysis of product design, which is used as a complement to the product design decision. Knowing the cost of each factor that makes up the product enables the calculation of the cost for each product. If the product or service planned to be produced is structured according to the analysis and the costs of the factors that make up the product are known, the potential share in the market and the amount of sales can be estimated when the product is put on the market (Durmaz, 2022;47).

#### **6.15. Conjoint Simulators**

Early implementations of selection simulators remain fairly simple by today's standards. Early implementations had a limited nature, including many product variants and a matrix of utility coefficients. In our time, election simulator applications have become a versatile study. Three types of simulations can be prepared as simple product, multiple products and product variety of the company. Selection simulators have become simple to implement thanks to their different usage areas. However, the availability of simulating different and many new product concepts with a simple step in order to perform sensitivity analysis has led to the development of its use (Ozcagli, 2020; 28-38).

With conjoint simulators, market share can be determined for a real or hypothetical card/screen. In this method, combinations of product and service features that are not offered to the consumer, but that are thought to be possible, or a company's feature that will enter the market are revealed. By using the utility coefficients of the variable levels calculated in the analysis, the expected preference scores for these combinations are

calculated. The product with the highest value in the calculated preference points can be offered to the market (Durmaz, 2022;47).

## **7. Techniques Used in Conjoint Analysis**

### **7.1. Adaptive Conjoint Analysis**

This type of conjoint analysis is used in surveys when there are many product features. Researchers often use it to determine the key features that should be included in the product, not the best option to determine the price. For example, the interviewer asks the participants to choose their relative preferences from various features (Ozuak, 2021;9).

Adaptive conjoint analysis became very popular conjoint software in terms of tools and methods in both Europe and the USA during the 1990s. Although adaptive conjoint analysis is a friendly practice for both analyst and respondent, it is not the best approach in every situation. The main advantage of adaptive conjoint analysis is that it measures more features than others and allows the use of the known full profile method. This analysis method contains up to 30 features. The results of the adaptive conjoint analysis are similar to the full profile approach, and this model is the main effect model, meaning there is no interaction between them. This can be limiting in estimating price sensitivity for pricing studies, which are sometimes important (Turan, 2006;10).

Adaptive Conjoint Analysis was developed by Johnson from the swap matrix model. The method was analyzed in 2 Features simultaneously and the compounds were allowed to face problems with many Features such as 12 to 24. Johnson saw that the participants found it difficult to cope with a large number of tables and developed a computer program to give realistic responses and to realize them (Lucio, 2015;36).

Hebák mentions some minor shortcomings of the adaptive method, such as the inconsistency of the scales in the direct and indirect stages. For this reason, the adaptive conjoint analysis approach was criticized shortly after its introduction. Since these criticisms outweigh the advantages of the method, variants of adaptive conjoint analysis are

studied. It is still widely used in marketing research for studies with a large number of features (Sklenařík, 2015;20).

Adaptive conjoint analysis was the first computer-assisted method and was the most popular application of the 1990s. There are three stages in this analysis method. First, participants rank the levels within each trait. Second, participants rate the significance of the difference between best and worst (each feature on a 4-point scale; 1: not at all important, 2: somewhat important, 3: very important, 4: extremely important). Finally, participants rate a series of pairwise comparisons on scales from 1 to 9 (1 indicates strongly preferred; 5 indicates no preference; and 9 strongly prefers). However, there is evidence to suggest that the length of the qualification and the qualifications are influenced by additional factors such as respondent familiarity.

In adaptive conjoint analysis, the respondent does not have to evaluate all product features at the same time and can evaluate without getting bored with the survey, as in many studies. While the full profile gives good results in studies with up to 6 factors, 30 product features can be found simultaneously in adaptive conjoint analysis. However, in practice, 8-15 features are generally included. In the case of six or less features, adaptive conjoint analysis is at least as successful as other techniques using the full profile method (Coxon, 2013; 40-41).

It is not possible to prepare adaptive conjoint analysis without a four-part Sawtooth Software. In adaptive conjoint analysis, models that do not determine the main effects are used, as in many conjoint analysis approaches. This method is very effective in estimating price sensitivity (Yigit, 2008;61).

The main disadvantage of adaptive conjoint analysis is that it adapts to the preferences of individuals and is managed by the computer. Computer access and computer literacy may be limited, as this can be a problem in younger age groups. Besides, another disadvantage for the technique is main effect-based, as with most traditional conjoint approaches. That is, each attribute is measured independently of other attributes. It does not take into account possible and strong interactions

between attributes. This situation causes some limitations in pricing studies and in estimating price sensitivity for each product brand included in the study.

The general operation of the adaptive conjoint analysis method is to determine the opinions of the respondents with a 7-point Likert scale. Application stages; it consists of 4 parts: ranking the factor levels by the respondents, determining the importance of the factors by the respondents, presenting the pairwise comparison questions to the respondents, and determining the purchasing probability by the respondents (Dinc, 2010;34).

## **7.2. Value Analysis**

Conjoint value analysis is a useful method in studies of up to six variables and is performed by conducting a paper survey. Conjoint value analysis identifies interactions between features and a set of benefits for each variable using a full profile, trade-off, or component comparison method. In the Full-Profile approach, Konjoint value analysis uses only one way to measure price sensitivity in personal attributes. This helps to determine price sensitivity in a single individually priced product package (Yigit, 2008;63).

The conjoint value analysis system consists of three parts (Yigit, 2008;63):

- i. Conjoint survey; designing modules that are both single concept and paired full profile designs of products
- ii. Calculation of modules with utility values of each responder for each level of each factor
- iii. Analysis module of market simulators allowing testing of alternative product scenarios

The biggest advantage of the method is that it can be applied on paper. The selection mechanisms prepared are presented to the respondents; ranking or scoring. If the number of factors and levels is not too large, it will be difficult for the respondents to answer because a large

number of selection cards will be formed and the representation power of the application decreases (Dinc, 2010;36-37).

Conjoint value analysis, which is designed for studies with paper and pencil, allows application in computer environment if the Ci3 package program is used. In conjoint value analysis, monotonous regression and least squares method are used to calculate the benefits; a series of benefits is calculated for each subject. These calculations are done with the full profile card layout, pairwise comparison or trade-off matrix. It is possible to measure up to 6 features, with the number of levels not exceeding 15. In the use of composite features, conjoint value analysis can measure the interactions between features such as brand and price. For example, 2 features, each with 2 levels, can be combined into 4 levels of features.

However, interactions are evaluated in a limited way in conjoint value analysis. Interactions between traits with more than 2 or more levels can be better measured in selection-based conjoint analysis. In addition to the traditional conjoint analysis design, conjoint value analysis offers a nice approach to the price sensitivity measurement of features and this provides a lot of convenience in applications related to price sensitivity of the service and product (Sahinkanat, 2013; 72).

### **7.3. Traditional Full Profile Conjoint Analysis**

The traditional method of conjoint analysis is based on Green's famous article published in the early 1970s, and thus the analysis began to be used in a marketing research setting. Traditional conjoint analysis is characterized by a simple additive model (known as the full profile). Green and Srinivasan (1990) suggest using the full profile method when the number of features is six or less. Orme (2003) stated that the full profile approach is useful for measuring about six attributes. Conventional conjoint analysis calculates the piece value set for each individual using traditional methods, either by full profile card ranking (ranking or ranking) or by binary grading. Up to 30 features can be measured with 15 levels in this method, but Orme (2003) never recommended it.

Participants are required to rate all possible combinations of levels listed, from best to worst. Based on the observed preferred order, researchers can statistically infer which traits are most important to each individual. The biggest limitation of this method is increasing the number. Qualifications mean that you need to ask more questions to the respondent in order to get good results (Lucio, 2015;36).

Traditional conjoint analysis is handled in two different ways: single profile (ranking or ranking) and pairwise comparison (grading only). In the traditional conjoint analysis technique, according to some sources, a simple main effect model covering up to 6 features, in other words, a model form without interaction effects is characterized. In traditional conjoint analysis applications, few features related to the product or service of interest are included. In practice and business studies, products or services have 25 or 30 features, and as the number of features increases, traditional conjoint analysis becomes increasingly difficult to apply. For this reason, it is necessary to perform the application with an appropriate technique (Sahinkanat, 2013;68).

#### **7.4. Choice Based Conjoint**

In this analysis, participants are asked to imitate their purchasing behavior while answering the questionnaire. Respondents provide answers based on real-life products that they would choose in real life when considering certain prices and features. Selection-based conjoint analysis, also known as discrete selection conjoint analysis, is one of the most widely used types of conjoint analysis (Dikici, 2019;14).

Selection-based conjoint analysis became popular in the early 1990s and then became widely used all over the world. There are several reasons for its popularity, and selection-based analysis differs from other methodologies. A preferred product is similar to what buyers actually do in the market. Instead of ranking or ranking, it prefers by choosing from concepts. In the choice-based analysis, the respondents are given the option of “no” and the participant can say “I would not”. Selection-based conjoint analysis is not suitable for large-scale studies in terms of number of attributes.



In the choice-based analysis, options containing different combinations of a product or service are presented to individuals and they are asked to indicate which one they will choose. Response options are either in the form of a choice (e.g., A or B) or graded response (i.e. strongly prefer A, prefer A, indifferent, prefer B, strongly prefer B).

Conjoint analysis based on choice is also widely popular in choice behavior as it mimics the real world. It more accurately simulates the psychological process because it is less abstract than ranking and grading. Likewise, consumers do not individually rank or rank product/service alternatives. Selection-based analysis can be pen-paper-based or computer-controlled (online) (Coxon, 2013;39).

Many experts agree that each of the respondents has different personal characteristics, and while their answers are analyzed collectively or as a group, some personal wishes and expectations of the respondents are not clearly seen. For this reason, the desired results may not be obtained in group-level models. In selection-based analysis, as a result of pairwise comparison, one product will definitely be preferred over the other, and this will allow to see which product is preferred and that product features. Pairwise comparison can be critical in many studies. For example, in a product with a low price in terms of price, some desired features may be ignored. In this case, while determining the other variables that are important when choosing product features, while scoring or ranking, features will not show their importance as important as they are. Another positive aspect of the selection-based analysis is that the calculation processes of this method are very short, although other methods do many calculations (Yigit, 2008;62-63).

Selection-based conjoint analysis can measure up to 6 attributes, up to 9 levels. It can be applied by computer or by using pen and paper. Respondents are presented with a set of questions and options and are asked to choose the appropriate one. For each question, only one answer is marked and if none is appropriate, they mark the option none. The method allows to measure interactions. Interactions can play a critical role in many applications, such as pricing research. In many applications,

studies conducted at the individual level do not provide sufficient information to measure interactions (Dinc, 2010;36).

**Table 5.** Conjoint analysis techniques selection criteria (Source: Sahinkanat, 2013;73)

	<b>Traditional conjoint analysis</b>	<b>Adaptive conjoint analysis</b>	<b>Selective conjoint analysis</b>	<b>Conjoint value analysis</b>
6 or fewer features	X	X	X	X
10 or more features		X		X
Questionnaire	X	X	X	X
Interactions			X	X
Small sample		X		X
Individual-level benefits	X	X		X

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