

Conjoint Analysis Using Part-Worth Utility

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ABSTRACT

Conjoint analysis is a method used to understand consumer preferences for products and services. It is applied to identify the importance of each attribute based on consumer decisions. In this case, the value or weight of each attribute is required to determine the highest value that influences consumer decision-making. This study aims to analyze the method used in conjoint analysis and to examine the relationship between part-worth utility values and the attributes and levels in conjoint analysis. The method employed is the part-worth utility approach, which aims to identify the highest value of each attribute and highlight the combination of attributes that influence consumer decision-making. The results of the study show that part-worth utility provides coefficient estimates at each attribute level in conjoint analysis, thereby generating utility values and allowing for the determination of the relative importance of each attribute. The combination of conjoint analysis and part-worth utility methods produces clear and accurate relative importance values in measuring consumer preferences.

INTRODUCTION

In this advanced era, there are many places to make it easier to share opinions, opinions, and preferences for a product and service. In general, social networking platforms, review sites, discussion forums, and blogs are channels used by users to express their views, thoughts, and perceptions about specific products, activities, and services (Saraswathi et al., 2023). The number of forums to share opinions has become a new forum to improve products and services for companies or provide services. In this case, a conjoined analysis is carried out to determine the preferences of each user in a product or service to improve products and services based on user needs. Conjoin analysis is a method that can be used to determine consumer preferences based on the level of interest (Tjiandra et al., 2023). Preferences are a factor that is part of consumer behavior.

Preference is an individual's opinion about preferring one thing over another (Cahyanti & Najib, 2016). Attributes are considered by users to like or dislike and accept or dislike, therefore a combined analysis is needed to know and understand the preferences of consumer needs or preferences that are used as input in providing services. The application of combined analysis is expected to maximize the results of the analysis of public opinion and focus on each attribute provided. Combined analysis is not only used for marketing of products and services, in the study (Hilbers et al., 2024) research was conducted using combined analysis to find out the interest of the Dutch population in the development of road infrastructure in the Netherlands. In addition, another study was conducted by (Muthulingam et al., 2023) to find out patient preferences in the selection of treatment for opioid use disorder.

The analysis process requires a utility or usability value to show the weight of the importance level of an attribute, therefore the part-value utility or known path value utility is used to determine the value of the attribute in the conjoined analysis. Part-value utilities are widely used in the conjoin analysis method. Part-value is the usability value of an individual's preferences which contains the level of likability of each attribute used (Perkasa, 2020). Important results in the analysis can be determined using part-value utility, therefore conjoin analysis can be developed using part-value or utility functions to determine the level of consumer preference for products and services (Pertiwi & Murni, 2023).

Therefore, this article discusses conjoined analysis using the part-value utility approach to determine the most preferred attributes, in accordance with consumer opinions and views in decision-making so that it can optimize services or services in a company.

This research aims to provide insights into business decision-making, ensure that the products offered can meet market expectations and needs, and optimize product features to increase consumer attractiveness and satisfaction. Using a combined analysis of companies and service providers can improve the quality according to the needs of the individual users. By utilizing the usability values generated from the part-value utility and the attributes and levels of the

conjoined analysis. It is hoped that this research can provide insight into conjoin analysis with part-value utility.

LITERATURE REVIEW

Conjoin analysis is an analysis method used to quantify assessment data obtained from individuals regarding preferences for the choice of attributes of a product or service. In the study (Utama & Antonio, 2022), conjoined analysis was used to measure how important each attribute is to consumers in ready-to-drink processed products. The attributes used are shape, color, and volume with each of the 3 levels of each attribute. The results of the study show the highest importance value, namely in the shape attribute. Another study has been conducted by (Perkasa, 2020) to determine the influence of consumer preferences in choosing e-wallets in the city of Bandung, with the results of a combination of research that has the highest importance value, namely security with the availability of payment transaction codes. Another study using conjoin analysis was conducted by Hilbers et al. (Hilbers et al., 2024) in 2023 for road and infrastructure construction in the Netherlands using a population survey of 600 respondents. Based on previous research that has focused on attributes, levels, and value of interests but does not explain the part-value utility approach in more depth. Therefore, in this article, we discuss how the part-value utility approach in conjoined analysis, can determine attributes and levels according to consumer opinions and views, in decision-making so that it can optimize services or services in a company.

METHODOLOGY

This research uses the research method of literature studies and related journals obtained from Scopus. Bibliometric network visualization (VosViewer), conjoin analysis, and part-worth utility will be the three bases for this research to be conducted.

Visualization of Viewer Equations (VosViewer)

VOSviewer is a software that can visualize network maps easily and for free. VOS ("similarity visualization") is a concept for visualizing and analyzing patterns in data that has been developed for less than two decades (Bukar et al., 2023). VOSviewer was developed in the Netherlands, precisely at Leiden University by the Center for Science and Technology Studies (CWTS) (Bukar et al., 2023).

VOSviewer uses a network-based approach that results in each element (title, author, journal, or keyword) represented as a cluster of different colors. The larger the circle of each cluster variable, the more widely used, and interrelated with other cluster variables. The mapping generated by VOSviewer from bibliographic data related to conjoined analysis obtained from Scopus is shown in Figure 1.

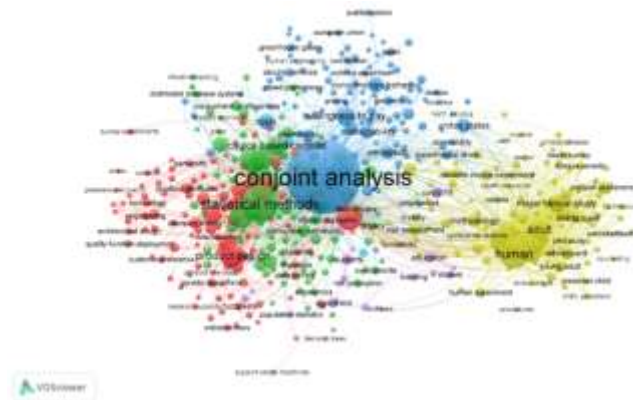


Figure 1. VosViewer Visualization Combined Analysis

Figure 1 shows a visualization of the conjoined analysis of the analysis in the VosViewer application. As seen in Figure 1, conjoint analysis has the largest cluster in blue, which means that the method is widely used in conjunction with other keywords. In Figure 4.1, the larger the circle of each variable, the more widely used, and interrelated with other variables. This indicates that conjoint analysis is widely used in research related to other keywords.

Conjoin Analysis

Conjoin analysis is a multivariate technique that is used specifically to understand how respondents develop preferences of all types of objects (services, products and ideas) so that they can produce attributes on certain services, products or objects that are mostly desired by consumers (Tjiandra et al., 2023). Yamaguchi et al., (2024) posited that a conjoined analysis involves asking respondents to select the most desirable product from several hypothetical profiles, which helps researchers understand their preferences regarding performance and price. Preferences reflect consumer satisfaction with a product and service (Arianto et al., 2024). In conjoint analysis, there are stages in its application. Conjoin analysis is a multivariate technique that is used specifically to understand how respondents develop preferences of all types of objects (services, products and ideas) so that they can produce attributes on certain services, products or objects that are mostly desired by consumers (Tjiandra et al., 2023). Yamaguchi et al., (2024) posited that a conjoined analysis involves asking respondents to select the most desirable product from several hypothetical profiles, which helps researchers understand their preferences regarding performance and price. Preferences reflect consumer satisfaction with a product and service (Arianto et al., 2024). In conjoint analysis, there are stages in its application.

Determining the number of attributes and levels to be chosen, the general characteristics of attributes and levels are that they can be easily communicated to respondents (communicable) and can be practiced appropriately (Julianisa et al., 2016). In determining attributes and levels is done according to the purpose of the study, attributes are characteristics or features of a product or service that are considered important by consumers, while levels are variations of each attribute.

Conjoin analysis determines attributes based on their categories and usability functions so that they involve part-value estimation, which is the usability or utility value attributed by consumers to their attributes and levels (Arianto et al., 2024). Coucke et al., (2023) stated that attributes are the characteristics of a product (color, shape, price). Each attribute consists of different levels or levels, which are different expressions of the characteristics of the selected attribute. For example, the 'color' attribute can consist of the 'red' and 'blue' tiers.

After determining the attributes and the next level determining the number of stimuli, the stimuli are a combination of attributes and levels that will be evaluated according to the respondent's preferences. An excessive amount of stimuli is not good for respondents because it takes up a lot of time (Tjiandra et al., 2023). Therefore, in conjoin analysis, a presentation method is used that affects the number of stimuli on attributes and levels. In this regard, there are several percentage methods in the conjoin analysis used in determining the number of stimuli, there are three presentation methods which are described as follows.

1. Full Profile Method
2. Pairwise Comparison Method
3. Trade-Off Method

The presentation method is used for the decision-making process by the respondent later, and can help reduce the amount of stimuli. After determining the presentation method, the sample will be determined, the sample is a group of respondents who are selected to give their assessment or preference for stimuli. In determining the sample or respondents, it is divided into 2 categories, namely non-probability sampling and probability sampling.

After selecting the sample, the sample will select and evaluate the stimuli determined based on the sample preference so as to get data on the results of the sample answer. Next, collect data from the sample answer results which will later be used to determine the utility value and importance value on the attributes and levels that have been given. In order to make it easier to determine the results of the analysis, it is necessary to make a plot of the part-value function (Julianisa et al., 2016).

Utilitas Part - Worth

A part-value utility is a value or weight given to a particular path in an analysis. Utility is an assessment of preferences by individuals that describes the usability value of a product. Part-value in conjoin analysis describes the strength or importance of an attribute or level. Part-worth utilities are widely used in other methods including statistical analysis, network algorithms, or other mathematical approaches.

The weights at each attribute level are referred to as "part-worth utility" (Utama & Antonio, 2022). The number of levels per attribute will determine the level of interaction that can be tested, so having more levels on each factor will provide a more precise estimate of the utility value (Valencia-Romero * Lugo, 2016). Part-value utility produces a relative importance value which is a comparative value in the respondent's decision-making in choosing a product

or service, the relative value of importance is used to show the highest ranking in each attribute interest for the respondent.

The part-value utility approach in conjoin analysis is used to find out the usability value of each attribute that the conjoin analysis produces. The usability value or utility value will provide a weight that can determine the level of likability for each attribute or level generated in the conjoin analysis so that the part-value utility is needed in the conjoin analysis. A part-value utility in a conjoin analysis can analyze a product or service on each of the attributes that are most in demand based on the value/weight produced. Part-worth utilities can generate relative value of interest that is a comparison for the stimuli most demanded, the greater the relative value of interest the more influential it is in consumer decisions. The steps required to achieve the research objectives are shown in the flowchart in Figure 2.

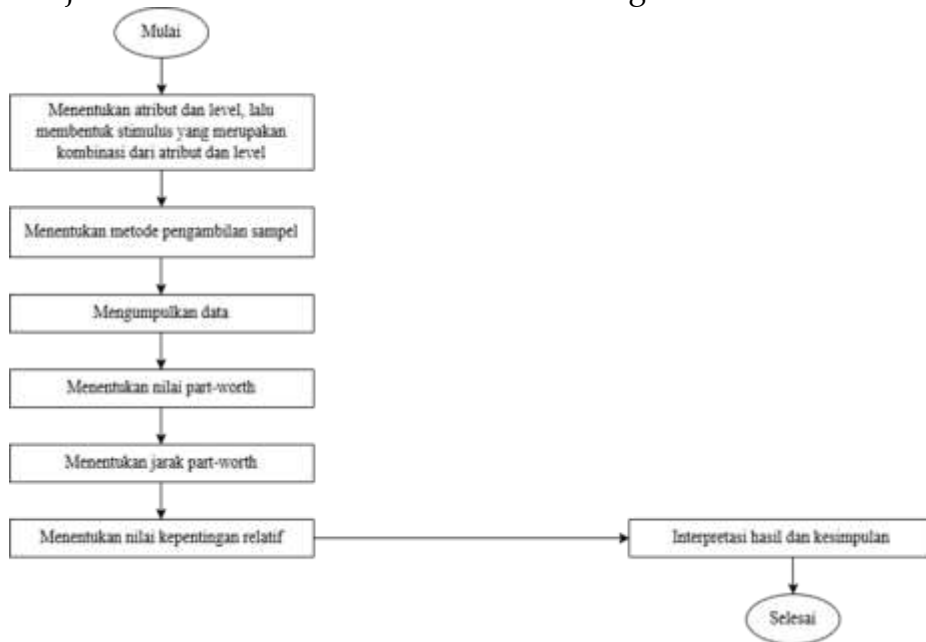


Figure 2. Flowchart

RESEARCH RESULT AND DISCUSSION

Conjoin analysis is commonly used by production or service companies to determine the preferences of consumers who use products or services. Preferences are defined as choices made by consumers over the products and services used (Firdaus, 2023). These preferences will determine what products and services consumers will choose to meet their needs. A product or service is described in a conjoined analysis as an attribute and a level so as to produce a stimulus that is a combination of attributes and levels. Each attribute has a different level, for example, Atribut_1 with a level (a, b, c), and Atribut_2 with a level (d, e, f). Table 1 is an example of attributes that can be used to determine attributes and levels in the conjoined analysis.

Table 1. Atribut and level

Atribut	Level
Atribut_1	a
	b

	c
Atribut_2	d
	e
	f
	g
Atribut_3	h
	i
	j
Atribut_4	k
	l
	m
Atribut_5	n
	o

After determining the attributes and level of the number of stimuli, the stimuli are a combination of attributes and levels. The number of stimuli produced is called a stimulus, in determining the stimulus in the conjoint analysis, fractional factorial design can be used to minimize the combination of attributes and excessive levels (Ary Maxxi, 2015). The number of stimuli will affect consumers and take a lot of time during the survey filling out process. In conjoint analysis, there are three approaches to forming stimuli, namely full profile, pairwise comparison, and trade-off (Tjiandra et al., 2023).

1. Full Profile Method

Full profile is a method used to collect evaluations from respondents by displaying existing attributes at all levels (Perkasa, 2020). Respondents will be given the entirety of their attributes and levels without being determined on certain parts only, so that respondents can evaluate freely and according to the respondent's wishes. The full profile method can reduce the number of stimuli through the use of fractional factorial design (Mastriswadi & Herianto, 2017).

2. Pairwise Comparison Method

Pairwise comparison approach, where respondents evaluate two attributes simultaneously until all possible combinations of the two profiles are evaluated (Julianisa et al., 2016). In contrast to the full profile in the pairwise comparison method, respondents will be given several choices that are paired and interrelated.

3. Trade-Off Method

The trade-off method is easy for respondents to understand and avoids two attributes at the same time. However, this method has a disadvantage because it can only compare two attributes at a time, thus sacrificing (trade-off) one of the attributes (Julianisa et al., 2016).

The presentation method that is commonly used in conjoint analysis research is a full profile where respondents will be given the entirety of attributes. The assessment of the full profile method can be done by providing a rating with a Likert scale. This method is most popular because it is close to the real form and is able to reduce the number of comparisons with fractional

factorial design (Mastrisiswadi & Herianto, 2017). Furthermore, sampling and sampling methods in conjoined analysis are divided into two, namely non-probability sampling and probability sampling.

1. Non-Probability Sampling

Non-probability sampling is a method that selects elements of the population being studied using a non-random method, namely a subjective method (Cobo et al., 2025). Tutz (2023) stated that non-probability sampling shows that the inclusion of observations can produce significant.

2. Probability Sampling

Probability sampling means that every item in the population has an equal opportunity to be included in the sample (Firmansyah & dede, 2022). In contrast to non-probability sampling, probability sampling uses samples that are not aimed at a group or individual.

The sampling method that is commonly used in conjoin analysis is purposive sampling which is included in non-probability sampling. In recent years, non-probability samples have grown rapidly, and estimates of non-probability data have been investigated more intensively by the survey methodology community so that non-probability samples are widely used in conjoin analysis (Cobo et al., 2025). (Ary Maxsi, 2015) stated that the number of samples to be taken using the purposive sampling method is calculated using the slovin formula as follows.

$$S = \frac{N}{(1+N.e^2)} \quad (1)$$

With,

S : Number of samples

N : Total population

e : percentage of inaccuracy tolerance due to sampling error of 10%

Slovin is used to determine a representative sample size taking into account the desired margin of error. After determining the sample, the sample will be asked to assess the stimuli given. This assessment is carried out through a survey specifically designed for conjunctive analysis. The sample used can be adjusted to the purpose of the study. According to (Widyawati et al., 2014) in general, the basic model of conjoin is written as

$$U(X) = \sum_{i=1}^m \sum_{j=1}^k a_{ij}x_{ij} \quad \text{untuk } i = 1, 2, \dots, m; j = 1, 2, \dots, k_i \quad (2)$$

With,

$U(X)$: Total Utility

a_{ij} : utility values of the I attribute (I : 1,2,3,...,m) and the J level (J : 1,2,3,...,k)

k : Number of J attribute levels

m : Number of attributes to i

x_{ij} : Variable Dummy Attribute I-I Level J (1 = Status Appeared; 0 = Level Not Appeared)

The results of the sample assessment will determine the level of importance, in this case, part-worth utility is needed to determine the relative importance of attributes and levels. Total utility equation model ($U(X)$) in equation 2 is used to estimate the level of consumer preference for a product and

service based on the part-worth value of each level in each way of attributes that have been obtained through estimating regression parameters using multiple linear regression (Arianto et al., 2024). Multiple linear regression models in conjoint analysis are used to determine the relationship between the independent variable and the dependent variable (Wibowo et al., 2024). Pertiwi & Murni (2023) suggested equation 2 obtained from the multiple linear regression equation as follows.

$$\hat{y} = a_0 + a_{11}X_{11} + a_{12}X_{12} + \dots + a_{ij}X_{ij} + \dots + a_{mk_m}X_{mk_m} \quad (3)$$

With

- \hat{y} : the overall opinion of consumers is presented as an independent variable
 $X_{11}, X_{12}, \dots, X_{ij}, \dots, X_k$: a dummy variable that represents the level of each of its attributes
 $a_0, a_{11}, a_{12}, \dots, a_{ij}, \dots, c$: Guess Coefficient of Dummy Variable
 $a_{mk_m}X_{mk_m}$:
The last attribute (attribute to m) with the last level (level i

Equations 2 and equation 3 are used to determine a level of each selected attribute, using dummy variables with 1 (selected) and 0 (not selected). On equation 3, $a_{mk_m}X_{mk_m}$ is the last attribute and level with the index m p indicating the last attribute (the m attribute) and the index k_m indicating the last level of the m attribute. (Kholibrina & Aswandi, 2020) posited that greater utility value indicates greater preference. The lowest utility value indicates that the attribute has less influence on consumer decisions, which does not mean that the attribute is disliked by consumers but less desired by consumers. The value of utility can be negative and positive, if the value of utility is at a negative value, then it can be concluded that the level of the attribute is lacking or not liked by consumers, if the value of the utility has a positive value, then it can be concluded that the level is preferred by consumers (Pertiwi & Murni, 2023).

The relative importance value is the value that is a comparison in the respondent's decision-making in choosing a product or service, the relative importance value is used to show the highest ranking in each attribute interest for the respondent. By analyzing the level of importance, priority for improvement in the performance of a product's attributes can be determined (Kurniati et al., 2016). Relative importance values were used in the conjoint analysis to determine the highest ranking on each stimulus for respondents. The value of relative importance is obtained by determining the value of the part-value obtained from equation 2 and the distance of the part-value. According to (Pertiwi & Murni, 2023), to determine the highest level on part-worth utility is obtained by the steps outlined below.

1. *Determining the value of part – value* (a_{ij})
2. *Determining part – value distance*
 $I_j = \max(a_{ij}) - \min(a_{ij})$
3. *Determining the value of relative importance*
 $W_j = \frac{I_j}{\text{total distance of part-worth across all attributes}} \times 100\%$

With

- a_{ij} : The Part-Value value of the Jth attribute at the Ith level
- I_j : Part-Value Distance for the Jth Attribute
- W_j : The relative importance of the J attribute
- j : attribute
- i : level of each attribute

The part-value value is obtained using equation 2 and equation 3, from the result of the part-value value (a_{ij}) Next, determine the distance of the part-value with the largest part-value value on an attribute minus the smallest part-value value. Next, determine the relative importance value of an attribute using the part-value distance divided by the total number of part-value distances of all attributes and then multiplied by 100%. After determining the relative importance, the highest to the lowest relative interest value is obtained. From the results of the part-value value, the part-value distance can be determined, and from the part-value distance can be determined the value of relative importance which is the assessment to determine the most desirable combination of attributes. The relative importance can be determined by a combination of attributes and levels that have the highest relative importance value so that it becomes the highest influence for consumers in decision-making. Meanwhile, the lowest relative importance value has less influence on decision-making for consumers.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the discussion, the part-value utility can be used to determine the usability value or level of importance in the conjunct analysis. Part-value utility is used in identifying the importance of each attribute based on consumer needs. With conjoined analysis, the researcher can determine attributes and levels, determine the presentation method, determine the number of stimuli, and determine the sample sampling method so that the research is more focused and clear according to the purpose of the study. One of the approaches used in the conjoin analysis is the part-value utility which is used to find the highest value of each attribute that influences decision-making for consumers. The results show that the utility of part-value provides an estimate of the coefficient at the level of each attribute in the conjoin analysis so as to produce a usability value and can determine the value of the relative importance of each attribute. The combination of methods on conjoin and part-value utility analysis results in clear and accurate relative importance values.

ADVANCED RESEARCH

This study has certain limitations; therefore, future research is recommended with broader scope and approach to obtain more optimal results.

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