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CONJOINT ANALYSIS AS A METHOD OF ANALYSING CONSUMER PREFERENCES ON EXAMPLE OF MUNICIPAL TRANSPORT MARKET

Abstract. Satisfying customers' needs, is a challenge for many companies in today's rapidly changing environment. To study customer needs and preferences conjoint analysis can be used. Conjoint analysis is a multidimensional method used to understand how consumers define their preferences for specific products or services. Conjoint analysis means constructing and conducting particular experiments among consumers in order to model their decision making process. The article is divided into two parts. In the first one the authors present general characteristics of the method and in the second one they interpret the results of their own empirical research.

Key words: conjoint analysis, customer preference, multivariate statistical analysis.

I. INTRODUCTION

Modeling of travellers' communication behavior is a part of a more complex modeling process of a trip, which is conditioned, among others, by the density of urban networks and associated with the traffic noise or lengthening of the travel time, Żochowska (2011). Mobility management can be seen as a demand-oriented approach to the development of passenger and freight transport, which aims to encourage and urge for change in the use of means of transport on the basis of a set of methods using data about the organization and coordination of flows of people, goods and information within the ongoing task, Pressl, Reiter (2003).

An important element of this process is to study the preferences of buyers, in this case travellers. The paper presents the possibilities of using research on commuters preferences as part of qualitative research to improve the competitiveness of public transport to private transport. The paper proposes to

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use in this case the conjoint analysis belonging to the group of so-called decomposing methods. The results presented in this paper are a part of a project carried out within the framework of research work financed by the study fund in 2010-2013 titled „Reference model of city logistics and the quality of life of inhabitants".

II. CHARACTERISTICS OF CONJOINT ANALYSIS

The studies of buyers' preferences are the basic research category in the model of consumer behavior. One of the methods to measure the preferences of buyers is e.g. conjoint analysis which in Polish literature got a number of terminological proposals, such as: measuring the total additive, Coombs, Dawes, Tversky (1977), measurement of multifactorial, Kaczmarczyk (1955), measuring the combined effect of variables, Walesiak (1996), the analysis of matching features, Mynarski (1996). Other proposed dates are: coincidence analysis, Altkorn, Kramer (1998), the analysis of associations, Kotler (1994) or a combination of attributes analysis, Ratajczak (1999). The variety of proposed definitions and a lack of clear interpretation of the original name make, that conjoint analysis is used very frequently. The essence of conjoint analysis is to evaluate a set of profiles (real or hypothetical products and services) described with the selected attributes (explanatory variables) in order to obtain information about the overall preferences for the profiles (a set of values of the dependent variable) made by the respondents to the survey, Green, Wind (1975). This method is often treated as a multi-element test procedure, where you can choose from a variety of data analysis paths, build a variety of models and use different techniques for estimating the parameters (partial utility), Bąk (2004). The complexity of the test procedure in the framework of conjoint analysis requires decision-making at every stage of research including among others determining the form of the model (depending on model variables, model preferences), the choice of how to collect data (solid profiles, pairwise comparisons, the presentation of pairs of attributes), the choice of the presentation profiles (physical product, the product model, a verbal description of figure), the scale of preferences (non-metric, metric) estimation method (metric: MONANOVA, PREFMAP, LINMAP, CCM, Metric: KMNK, MSAE, probabilistic: MNW, EM), assessing the credibility of the model (rating accuracy, reliability assessment), the interpretation of the results of measurements, Green, Srinivasan (1990) and the sample size determined mostly on the basis of earlier research (typical test is usually from 300 to 550 respondents), Walesiak, Bąk (2000).

III. CONJOINT ANALYSIS IN TRAVELLERS' PREFERENCE STUDY

Travellers' preference study using conjoint analysis was preceded by measuring the quality of urban transport services based on the SERVQUAL scale. The sample consisted of adult residents of three cities selected to test between 18 and 70 years of age. The sample group has been selected from the population at random, according to the second principle of randomization. Total sample size was set at 1,600 inhabitants, of which 600 interviews were carried out in Gorzow and Zielona Góra each, and 400 in Jelenia Gora. During the study two variables were monitored: age and gender. Respondents evaluated 12 different criteria of the quality of urban transport services based on available studies in the literature of this type, Scheiner (2009). Therefore, obtained evaluation of various factors (variables), combined with the psycho-graphic characteristics of the respondents are numerous and interconnected with each other, the reduction of dimensionality was performed by the use of a factor analysis, Wieczorkowska, Wierzbiński 2007.

The following dimensions were studied: punctuality and frequency of circulation of vehicles, safety and travel conditions of vehicles waiting at bus stops, availability of public transportation, ticket prices and the immediacy of connections.

To confirm the significance of the results Bartlett's test was used and assessed the adequacy of the sample to the assumptions of factor analysis methods using statistics KMO (Kaiser-Meyer-Olkin Measure of Sampling Adequacy). The degree of adequacy of testing the assumptions of factor analysis, KMO statistic measured for all the analyzed cities was above 0.9, which can be assessed as very good.

Based on the criterion of Kaiser-Gutman, Sagan (1998) and scree criterion Cattelan (Factor Scree Plot), Górniak, Wachnicki (2010) it was found that in the case of Gorzow Wielkopolski and Zielona Gora for further analysis must be used the first two factors and in the case of Jelenia Gora the first three factors should be used with own values greater than 1. It was also found that the first factor explains most of all determinants related to the conditions of movement within the city offered in the urban transport services. Variables described by the factor most often mentioned include four postulates of transport: travel time, convenience, cost and safety. The second factor (and second and third in the Jelenia Gora), is associated with additional (complementary) aspects of transport services. Variables described by the first factor were then used in the conjoint analysis.

The use of conjoint analysis to examine traveller preferences was conducted on a sample of 400 urban public transport users in one of the three cities involved in the project, in Gorzow Wielkopolski the criterion for selection of

respondents to the survey was primarily a declaration of regular use of urban public transport. As a measurement tool a questionnaire survey was used. During the study the respondents evaluated four variables, including: monthly ticket price Z_1: 40 zł (A), 80 zł (B); travel time Z_2: less than traveling by car (A), as long as the car ride (B), longer than a car drive (C); the frequency Z_3: at 10 min (A), 30 min (B), hour and less (C) and the stop distance from the place of residence Z_4: stop distance from the place of residence: 200 m (A), above 200 m (B). Respondents were asked to evaluate a set of 12 profiles out of 36 possible variants generated by the method of orthogonal plan. Utility values that each respondent is associated with a given level of the variable set by means of a least-squares method with artificial explanatory variables (to model artificial variables introduced 6), to give the same to the respondent's *s* following model:

$$\hat{Y} = b_{0s} + b_{1s}X_{1s} + \ldots + b_{6s}X_{6s}, \tag{1}$$

where: $b_{1s}, \ldots, b_{6s}$ – regression parameters; b_{0s} – intercept; $X_1, \ldots, X_6$ – artificial variables.

After estimating the relative partial utility the validity of each considered variable was specified on the basis of the following formula:

$$W_j = \frac{1}{S}\sum_{s+1}^{S} W_j^s \tag{2}$$

where: W_j^s – relative "importance" of each attribute to the *s*-respondent determined according to the formula, Hair (1995):

$$W_s^j = \frac{\max\limits_{lj}\left\{U_{jl_j^i}^S\right\} - \min\limits_{lj}\left\{U_{jl_j^i}^S\right\}}{\sum_{j=1}^{m}\left(\max\limits_{lj}\left\{U_{jl_j^i}^S\right\} - \min\limits_{lj}\left\{U_{jl_j^i}^S\right\}\right)} \times 100\% \tag{3}$$

where: $U_{jl_j^i}^S$ – partial utility *l* - the level of the *j* attribute of the *i* profile for the respondent *s* (*s* = 1, ..., *S*), *lj* - the number of levels for the *j* attribute and the *i* profile *i* = 1, ..., *n* – profile, *j* = 1, ..., *m* – the number of attributes, *S* – the number of respondents.

The summary of the relative importance of the attributes across all subjects is shown in Figure 1.
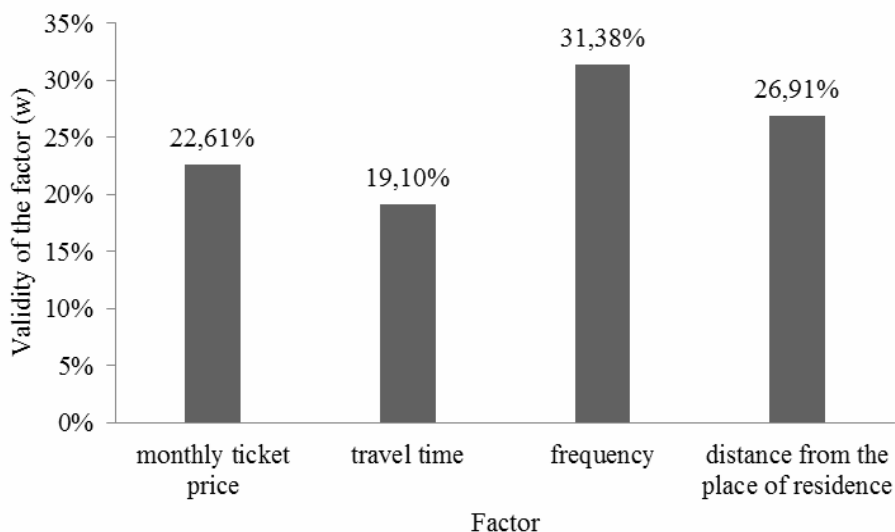
Fig. 1. The relative importance of the attributes
Source: own elaboration

The results of the study confirm the findings observed at earlier stages of the analysis. This means, that the choice of the public transport as a way to move around the city, all the factors associated with the basic demands of the transport are important. Among the four analyzed variables the most important factor influencing the decisions of the respondents is frequency and then distance from the place of residence. In last place was travel time, which in the case of residents of medium-sized cities with a relatively close distance to cover, is not as a significant factor influencing the preferences of people as the other variables analyzed.

IV. SUMMARY

The relatively small differences between the three factors under consideration: the distance to the bus stop, the price of the ticket and travel time show in principle the need to consider all the aspects for modeling the communication behavior of people using public transport. Residents of the city using public transport prefer monthly ticket prices at the current level, they are interested in access to the benefit of calls every 10 minutes and the location of the bus stop within a distance of 200m from the residence. On the other hand,

they are able to accept as long travel time in public transport as in the case of individual transport. Travel time in case of Gorzow Wielkopolski, which is relatively little crowded, is the least important factor when choosing the possibility of urban public transport as a means of movement within the city.

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**CONJOINT ANALYSIS JAKO METODA ANALIZY PREFERENCJI
KONSUMENTÓW NA PRZYKŁADZIE RYNKU MIEJSKICH USLUG
TRANSPORTOWYCH**

    Zaspokajanie potrzeb klientów jest wyzwaniem dla wielu firm w dzisiejszym szybko zmieniającym się otoczeniu. Do poznania preferencji i potrzeb klientów można wykorzystać np. analizę conjoint. Conjoint analysis jest wielowymiarową metodą wykorzystywaną do ustalenia w jaki sposób konsumenci wyznaczają swoje preferencje w stosunku do określonych produktów lub usług. Analiza conjoint oznacza projektowanie i prowadzenie eksperymentów wśród konsumentów w celu modelowania ich procesu decyzyjnego. Prezentowany artykuł podzielony na dwie części, zawiera ogólną charakterystykę metody, jak również metodykę prowadzenia badań z wykorzystaniem analizy conjoint oraz przedstawia interpretację wyników własnych badań empirycznych na temat preferencji konsumentów na przykładzie rynku transportu miejskiego.