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## THE MEASUREMENT OF HOUSING PREFERENCES IN THE ANALYTIC HIERARCHY PROCESS

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### Abstract

The paper focuses on an adaptation of the AHP method to elicit housing preferences on the rental market. To assess the applicability of the AHP method for residential market analyses, a survey was conducted on a group of students from Cracow University of Economics, Poland. The students were asked to evaluate the importance of particular criteria when selecting an apartment. We identified the major methodological difficulties of the utilization of the AHP method in applied research on preferences and decision-making on the housing market. Potential solutions to the mentioned limitations were also presented.

**Keywords:** housing preferences, rental market, Analytic Hierarchy Process, decision-making, student rentals

**JEL classification:** R210, D81

## **Introduction**

The problem of housing preferences and choices on the real estate market is a complex issue. Preferences and decisions concerning the choice of a specific residential property are an effect of comparing, weighing up and assessing a number of various attributes of a real property, and, in consequence, decision options. As the existing research findings show, due to the complex character of problems occurring in such areas as construction (Dytczak, 2010) or the real estate market (Foryś, 2009), multi-criteria decision aiding methods are successfully applied here. In the other area it seems that the methods can also be a useful analytical tool, helping in a better understanding of the decision-making processes of buyers of flats, being an alternative to methods such as conjoint analysis (Głuszak, 2011). This explains the authors' interest in the AHP method and the conditions for its application in research into housing preferences on the real estate market.

The main objective of the conducted research was to verify the usefulness of the AHP method to study housing preferences on the real estate market. The scope of the research was limited to an analysis of housing preferences expressed by students of the Cracow University of Economics in respect of the choice of residential units for rent.

Three detailed objectives were subordinated to the main objective: (i) structuring a hierarchy of the determinants of the decision-making process in the area of the choice of premises for rent by the students of Cracow universities; (ii) pre-selection of decision criteria for the future structuring of a decision model in this area; (iii) elaborating an optimum way of selecting experts for the planned actual study.

### **1. The methods of aiding multi-criteria decision-making processes**

The discussed research problem comes from the area of Multi-Criteria Decision Making, MCDM, also called the Multicriteria Analysis, MCA, or Multi-Criteria Decision Aid, MCDA. Mulliner, Smallbone and Maliene (2013, p. 271) quote an MCDM definition created by Zopounidis, who perceives MCDM as “a set of methods which allow the aggregation and consideration of numerous (often conflicting) criteria in order to choose, rank, sort or describe a set of alternatives to aid a decision process”. Di Matteo, Pezzimenti and Astiaso Garcia claim that from the methodological point of view “multi-criteria decision making (MCDM) approaches deal with the evaluation of a set of alternatives in terms of numerous decision criteria with the goal of providing a choice highlighting the best alternative among the set of options” (2016, p. 2).

There are a great number of methods of scientific aiding for multi-criteria decision-making processes (see Trzaskalik, 2014; Di Matteo, Pezzimenti, Astiaso Garcia, 2016). The character of the aiding discussed here indicates the possibility to create a hierarchy of decision criteria which can be independent of each other. In the research methods useful in the modelling of decision-making processes with a hierarchical structure Dytczak and Wojtkiewicz (2010, p. 398) include the zero unitarization method, the DEMATEL method, Wrocław Taxonom, as well as the AHP and ANP methods. Góralski i Pietrzak (2011, p. 63) describe the zero unitarization method as “one of methods enabling the normalization of diagnostic variables through the analysis of the range of the characteristic. It is a universal method; it can be used to normalize various variables, regardless of their type, sign, size, units.” Yang, Shieh, Leu and Tzeng (2008, p. 160) present the DEMATEL method as a tool “to illustrate the interrelations among decision criteria and to determine the main criterion, in relation to which the efficiency of particular decision determinants or aspects of decision-making process will be examined”. And this is what Balcerowicz-Szkutnik, Sojka and Szkutnik (2013, p. 52) write about Wrocław Taxonomy: “Wrocław Taxonomy method, also called the dendric method, is a method of analysis successfully applied to combine objects into homogenous groups with regard to numerous characteristics. It leads to the formation of a coherent dendrite being a graphical illustration of the location of the objects with respect to each other based on their similarity”.

The Analytic Network Process, ANP, is the last of the methods of the modelling decision making processes with a hierarchical structure. Saaty (2001, p. 34) believes that the fundamental difference between the AHP and the ANP lies in the fact that while the AHP enables studying the influence exclusively on the basis of pairwise comparisons, the ANP enables analysing the interactions of decision criteria (simultaneously, each one with each one). At the same time, the methodological bases of both methods remain identical, the differences occur only in the way of computing the decision super matrix. Saaty suggests the application of the ANP method only when the creation of a hierarchy of equivalent criteria is difficult. Thus, the ANP method should be understood as the supplementation of the AHP for fuzzy decision-making problems, as it is not subject to so many limitations. Therefore, the AHP method was finally chosen for further analysis. As the results of the existing research with the use of the AHP in the area of housing decisions show, a limitation of the method may consist in imprecise housing preferences of buyers/decision makers (Piwowarski, Matczak, 2010). On the other hand, an example of the partial application of the AHP method for the analysis of decision processes on the real estate market can be found in Mulliner, Malys and Maliene (2016), where the functionality of the

method was limited to the creation of the super matrix of decision vectors, while skipping the stage of establishing ranks for individual decision criteria.

## 2. The applied research methodology

Research into the preferences and decision making processes of buyers of flats in Poland is present in the literature of the subject although it usually has an exploratory and descriptive character. In recent years, a number of studies of the housing preferences of young people (Urbańska, 2011; Strączkowski, Suszyńska, 2012) and students (Skotarczyk, Nowak, 2010; Kempa et al., 2015) have been conducted. The previous research findings enabled to build a proper research tool. The authors proposed the construction of a housing choice problem in the form of a hierarchical structure, where attributes concerning housing costs, location, the standard of flats, the access to shopping facilities and services, as well as accessibility to recreational areas were decision criteria. A questionnaire was the main research tool. A group of 153 respondents – leasees of flats from the Cracow University of Economics – were asked to complete an initial evaluation of the decision criteria. As a result, 125 correctly completed questionnaires were obtained.

The evaluation of the respondents' consistency was conducted in two stages, by means of an analytical and deductive method and by means of the AHP consistency test analysis.

The aim of the consistency test is to eliminate the inconsistent opinions of experts. The mathematical method of computing the Consistency Ratio (CR) is presented below:

$$CR = \frac{CI}{RI},$$

where:

*CR* – Consistency Ratio,

*CI* – Consequence Index,

*RI* – Random Index.

Experts' opinions are inconsistent when the value of the Consistency Ratio (CR) exceeds 0.1. In practice, the test of significance was carried out in the Super Decisions 2.4.0-RC1 program, and its results are discussed below.

### 3. Presentation and discussion of the research findings

The obtained results indicate the relatively low consistency of the responses given. 122 responses passed the selection with the use of the analytical and deductive method, which means that 3 responses, namely 2.4%, were rejected. At the next stage, on the level of the tests of significance, the next 84 responses were rejected, that is 68.9% of those which remained after the first stage. In consequence, 38 responses were obtained which were consistent enough to regard the respondent's reliable experts for the planned study.

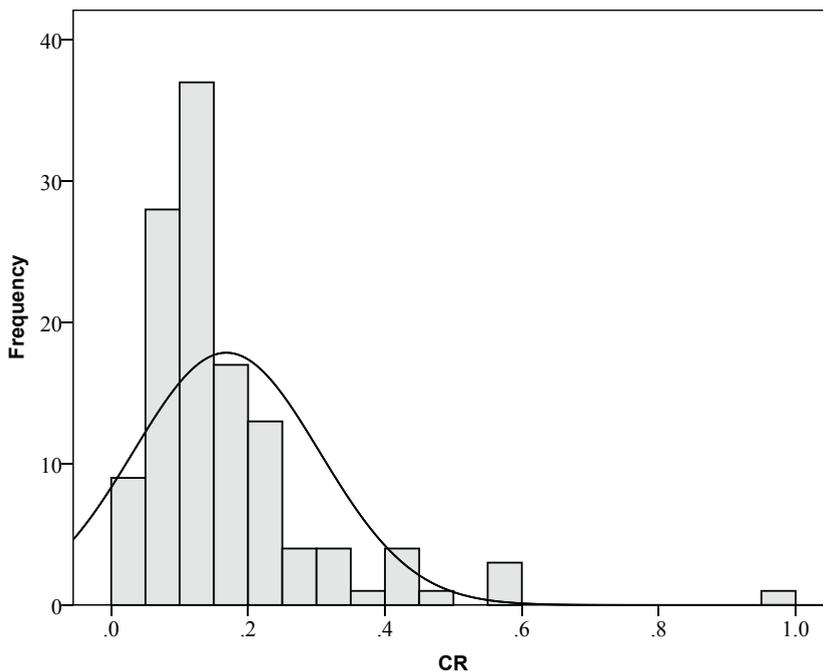


Figure 1. Distribution of the Consistency Ratio (CR) values of experts' ratings

Source: own elaboration.

When analysing the distribution of the Consistency Ratio of experts' ratings (Figure 1), it is worth noting that only a small percentage of experts were characterized by a large consistency of ratings, thus, the rating Consistency Ratio did not exceed 10%. Those were 38 decision makers, which made up 31.1% of respondents. The biggest number of ratings was in the consistency range between 10% and 15%, so above the consistency threshold limit suggested in the literature. A relatively large number of ratings was characterized by even lower consistency ( $CR > 0.2$ ).

To assess the influence of consistency on the obtained ratings of the significance of criteria, the table below lists the results for all decision makers and the groups of decision makers whose ratings were characterized by a satisfactory consistency level ( $CR < 0.1$ ).

Table 1. Average AHP criterion weights

	Mean (N = 122)	Mean when CR < 0.1 (N = 38)
Rental cost	0.32674	0.32066
Retail and services	0.09852	0.09889
Location	0.23670	0.22234
Apartment's standard	0.27493	0.28597
Recreation areas	0.06312	0.07226

Source: own elaboration.

When analysing the average weighing factors of individual decision criteria (Table 1), we should indicate that in light of the ratings of the surveyed decision makers, the following are most important for the choice of an optimum flat: *Rental cost* (average 0.32674 for all respondents), *Apartment's standard* (0.27493) and *Location* (0.23670). The infrastructure around the place of residence – *Retail and services* (0.09852) and *Recreational areas* (0.06312) – was relatively less important. The hierarchy of importance of the decision criteria would not change if we considered only the responses of decision makers with the largest consistency ( $CR < 0.1$ ). Interestingly, the weighing factors themselves would not change significantly.

The distribution of experts' (decision makers') ratings is presented in Figure 2.

The analysis of the box-plots (Figure 2) for individual decision criteria shows that decision makers differed in the assessment of individual criteria. The smallest divergences (measured with interquartile range) concerned the evaluation of the importance of *Trade and services* and *Recreational areas* criteria. In the case of the *Recreational areas* criterion, a few experts were identified who differed significantly from the others in their evaluation of the importance of this feature (including also those for whom the weighing factor of this characteristic was higher than 0.4, thus, a few times higher than the average in the surveyed group of decision makers). Therefore, we should consider them outliers.

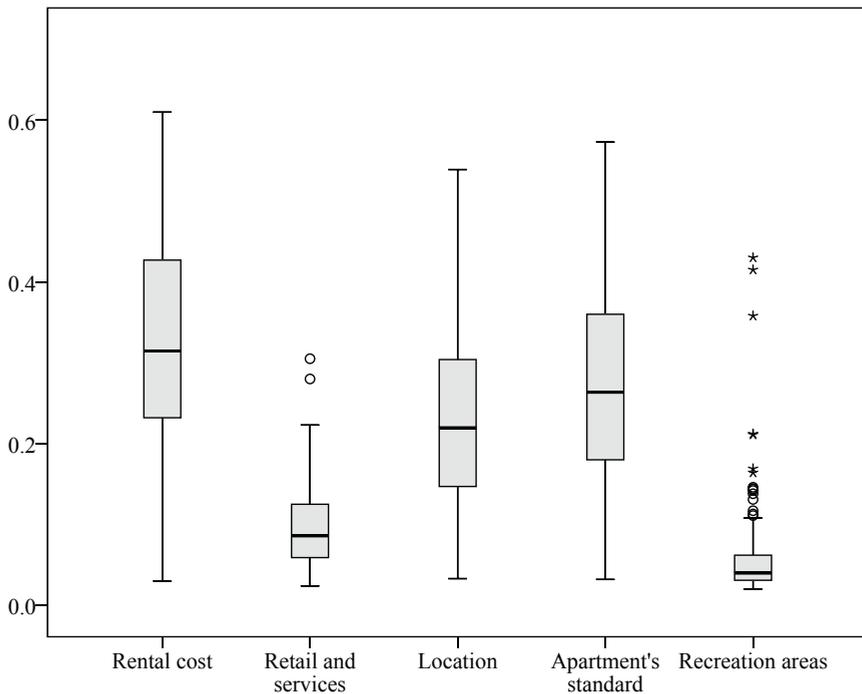


Figure 2. Distribution of experts' criterion weights

Source: own elaboration.

In order to follow carefully the relationship between the consistency of opinions and the significance of individual criteria, the scatter diagrams of the ratings for individual criteria in relation to the level of the Consistency Ratio were analysed (Figure 3).

The scatter diagram analyses do not indicate any significant relationships between the consistency of experts' responses and their ratings of the importance of individual criteria. No increase was found in the divergence of the ratings with the growth of the Consistency Ratio, either – which could be expected. Interestingly, in the case of the *Recreational areas* characteristic, particularly the large divergence of the results concerns the experts characterized by the large consistency of responses ( $CR < 0.1$ ). It may prove the inconsistent character of the decision maker group.

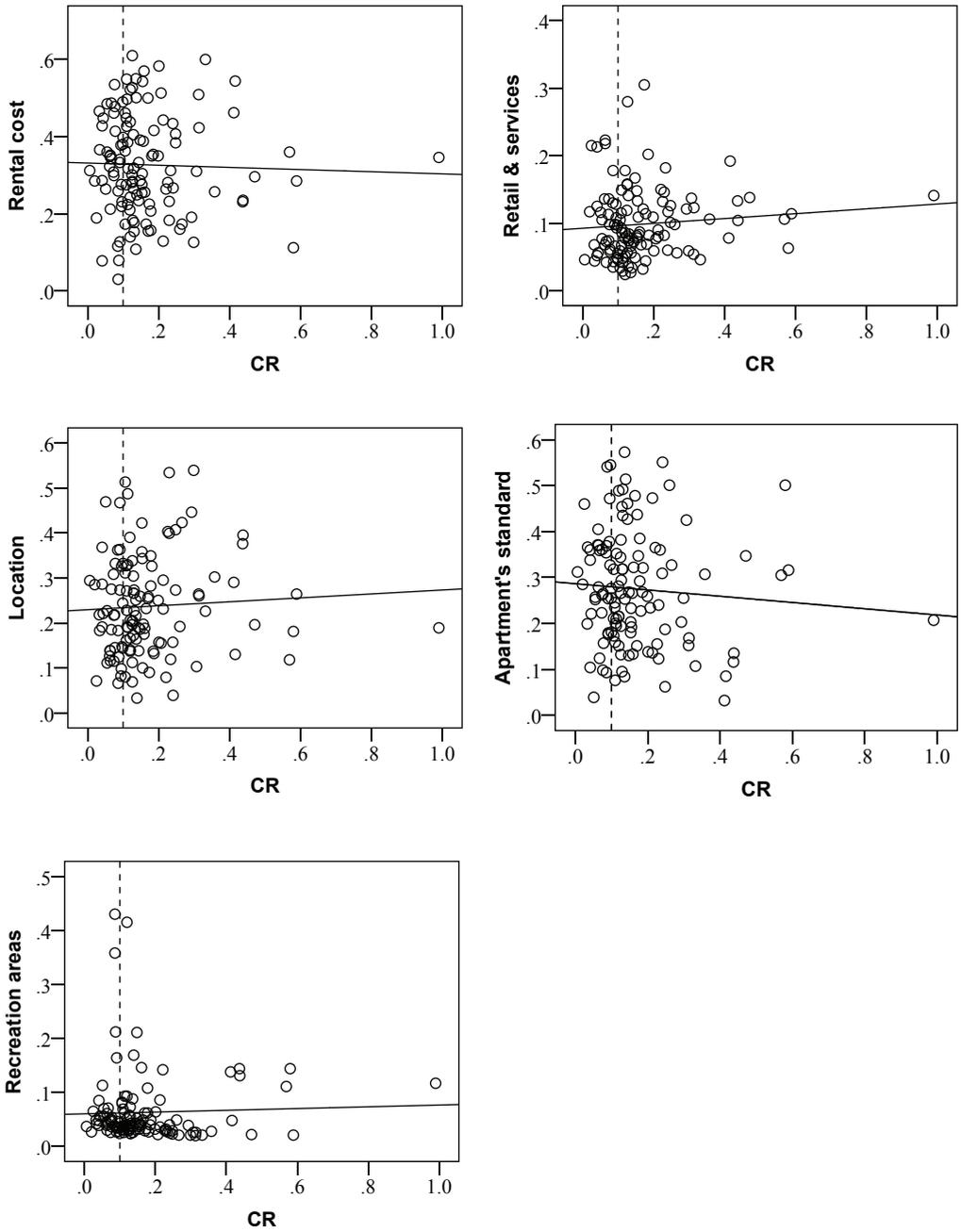


Figure 3. Consistency Ratio vs. Criterion Weights

Source: own elaboration.

## Conclusions

The study results have proven a few interesting properties of the considered objects of lease, as well as the group of experts evaluating the significance – students, in this case. It turns out that a relatively large number of the inconsistent responses of experts (namely, those for which the significance coefficient value exceeded 10%,  $CR > 0.1$ ) did not change the ranking of the significance of characteristics influencing the decision to rent a specific flat. Only the power of preferences changed slightly, however, in the discussed decision making process the significance of “*Rental cost*” and “*Location*” characteristics decreased insignificantly (from 0.32674 to 0.32066 and from 0.23670 to 0.22234, respectively), whereas the significance of “*Retail and services*” feature, “*Apartment’s standard*” feature and “*Recreational areas*” characteristics increased slightly (from 0.09852 to 0.09889, from 0.27493 to 0.28597 and from 0.06312 to 0.07226, respectively).

The conclusion which arises from the above is although a large part of the experts did not always give consistent responses, they intuitively made a rational choice of an object of lease. However, such a situation by no means can be treated as a rule in the modelling of decision making processes with the use of the AHP method. Practical applications of the AHP clearly indicate the disturbance of the distribution of ranks considering pairwise comparisons not fulfilling the condition of the rating consistency ( $CR < 0.1$ ). Hence, it is most probable that there are other reasons for the methodological divergences of the applied method and the obtained results.

When analysing the results of the conducted study, the most probable problem areas which could occur are those mentioned below, grouped according to the declared research objectives.

1. Insufficient precision of the hierarchy of decision criteria:

- imprecise nomenclature of the criteria,
- non-fulfilment of the condition of reciprocal independence of the criteria and sub-criteria.

2. The character of the study:

- the study concerned the preferences of potential lessees-students, hence, it is relatively easy to defend the accusation of a large divergence of ranks, even in the group of consistent evaluations for individual criteria ( $N = 38$ ),
- the reason for the above may be the adopted definition of expert – in the conducted study the “expert” term did not exactly mean a person possessing special knowledge in an evaluated area, with a reputed position, confidently moving in the real estate

industry, but rather a person potentially interested in the object of the decision-making process – the renting of a flat.

3. The choice of experts:

- the lack of deep knowledge of the market and specialist industry knowledge in the decision making area signalled above,
- a random, non-methodical way of choosing experts for the survey,
- low reliability of responses given by respondents (no reflection, shame in the face of giving an “incorrect, irrational response”, no willingness to participate in the survey, others),
- irrational or “pseudo-rational” way of making decisions by young people renting a flat (flat-mate, lemming-like rush, no market analysis, etc.).

The proposals of potential solutions or ways to avoid the problems presented below are shown below:

Re. 1. Insufficient precision of the hierarchy of criteria:

- making the nomenclature of the criteria more precise,
- checking whether the criteria are not dependent on each other (do not influence each other),
- grouping the criteria according to a different key than the one used in the questionnaire.

Re. 2. The character of the study:

- precise definition of the character of the study and adequate discussion of the adopted threshold consistency level – perhaps in some cases of the study of the preferences of potential lessees where objective, market-rooted opinions are not necessary, it would be justified to increase the acceptable consistency level,
- more exact explanation of the sense and the objective of the study, otherwise close observance of the definition of an expert as a person with above average knowledge about the examined phenomenon and its decision making environment.

Re. 3. The choice of experts:

- structuring the way of choosing experts – developing a set of necessary criteria to be fulfilled by an expert, including deeper knowledge of the market of flats to rent, with the simultaneous limitation of the number of experts (e.g. Saaty estimates the optimum number of experts in a study for 5–9 persons),
- in the case of studies of potential lessees’ preferences, extending the hierarchy of decision criteria, with, for example, “future flatmate’s opinion”, “fashion/trend” criteria – for the choice of experts which would be more targeted at the objective of the study,

- explanatory studies – extending the research methodology with direct explanatory interviews with experts – following the evaluation.

To sum up, the AHP method can be useful in research into housing preferences and choices on the real estate market, on the condition of considering the methodological requirements and limitations of this method in the planned research. Special attention should be paid to the issues of the proper selection of determinants and structuring the hierarchy of the decision-making process, adjusted to the subject and scope of the research, and the proper choice of experts-respondents.

## References

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- Balcerowicz-Szkutnik, M., Sojka, E., Szkutnik, W. (2013). Determinanty bezrobocia w Polsce jako czynniki strategii zarządzania przedsiębiorstwem. *Zarządzanie i Finanse: Journal of Management and Finance*, 11 (4), 35–59.
- Di Matteo, U., Pezzimenti, P., Astiaso Garcia, D. (2016). Methodological Proposal for Optimal Location of Emergency Operation Centers through Multi-Criteria Approach. *Sustainability*, 8 (1), 50. DOI: 10.3390/su8010050.
- Dytczak, M. (2010). *Wybrane metody rozwiązywania wielokryterialnych problemów decyzyjnych w budownictwie*. Opole: Politechnika Opolska.
- Dytczak, M., Wojtkiewicz, T.J. (2010). Metody wielokryterialnego wyboru systemów monitorowania. In: R. Knosala (ed.), *Komputerowo zintegrowane zarządzanie* (pp. 397–405). Tom I. Opole: Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją.
- Foryś, I. (2009). Pomiar warunków i preferencji mieszkaniowych emerytów. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu: Taksonomia Klasyfikacja i analiza danych – teoria i zastosowania*, 47, 248–255.
- Głuszak, M. (2011). Eksperyment conjoint jako metoda wyznaczania współczynników wagowych atrybutów w wycenie nieruchomości. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 850, 49–64.
- Góralski, P., Pietrzak, S. (2011). Ocena ryzyka kontynuacji działalności gospodarczej spółek ANR w aspekcie ich strategiczności oraz specyficznej funkcji rynkowej. *Zeszyty Naukowe Uniwersytetu Szczecińskiego*, 686. *Finanse, Rynki Finansowe, Ubezpieczenia*, 47, 59–69.
- Kempa, O., Krajewska, M., Palicki, S., Rącka, I., Wójta-Kempa, M. (2015). Students' Preferences On The Residential Real Estate Market In Polish Cities. *Real Estate Management and Valuation*, 23 (1), 90–102.

- Mulliner, E., Malys, N., Maliene, V. (2016). Comparative analysis of MCDM methods for the assessment of sustainable housing affordability. *Omega*, 59, 146–156. DOI: 10.1016/j.omega.2015.05.013.
- Mulliner, E., Smallbone, K., Maliene, V. (2013). An assessment of sustainable housing affordability using a multiple criteria decision making method. *Omega*, 41, 270–279. DOI: 10.1016/j.omega.2012.05.002.
- Piwowski M., Matczak, A. (2010). Modelowanie i agregacja preferencji klientów na potrzeby rynku nieruchomości. *Studia i Materiały Polskiego Stowarzyszenia Zarządzania Wiedzą*, 28, 226–237.
- Saaty, T.L. (1996). *The Analytic Hierarchy Process*. Pittsburgh, PA: RWS Publications.
- Saaty, T.L. (2000). *Fundamentals of Decision Making and Priority Theory With the Analytic Hierarchy Process* (2<sup>nd</sup> revised Ed., 1<sup>st</sup> Ed. 1994). Pittsburgh, PA: RWS Publications.
- Saaty, T.L. (2001). *The Analytic Network Process: Decision Making With Dependence and Feedback*, 2<sup>nd</sup> Ed. Pittsburgh, PA: RWS Publications.
- Saaty, T.L. (2003). Rank, normalization and idealization in the Analytic Hierarchy Process. In: *7<sup>th</sup> ISAHF Conference Proceedings* (pp. 57–64). Bali, Indonesia: ISAHF. Retrieved from: <http://www.isahf.org/2003Proceedings/paper/p03.pdf>.
- Skotarczak, T., Nowak, M.J. (2010). Preferencje mieszkaniowe kandydatów na studia oraz studentów pierwszego roku Akademii Rolniczej w Szczecinie. *Folia Pomeranae Universitatis Technologiae Stetinensis: Oeconomica*, 277 (58), 71–80.
- Stopinska, A., Strzępek, I. (2008). Jak mieszkają studenci? Analiza warunków mieszkaniowych w Krakowie. *Świat Nieruchomości*, 66, 50–53.
- Strączkowski, Ł., Suszyńska, K. (2012). Housing situation of young married couples in the light of the local housing market research. *Actual Problems of Economics*, 7, 209–220.
- Trzaskalik, T. (2014). Wielokryterialne wspomaganie decyzji, przegląd metod i zastosowań. *Zeszyty Naukowe Politechniki Śląskiej. Seria: Organizacja i Zarządzanie*, 74 (1921), 239–263.
- Urbańska, W. (2013). Warunki zamieszkiwania i preferencje mieszkaniowe młodych Polaków w 2007 i 2011. *Problemy Rozwoju Miast*, 1, 143–151.
- Yang, Y.P., Shieh, H.M., Leu, J.D., Tzeng, G.H. (2008). A novel hybrid MCDM model combined with DEMATEL and ANP with applications. *International Journal of Operational Research*, 5 (3), 160–168.
- Zopounidis, C. (1999). Multicriteria decision aid in financial management. *European Journal of Operational Research*, 119, 404–415.

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