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Wojciech Maciejewski Jolanta Pondel

University of Business in Wrocław
Department of Management
e-mail: wojciech.maciejewski@handlowa.eu, jolanta.pondel@handlowa.eu
phone 71 333 11 27

Determining Preference Parameters as Exemplified by the Choice of University

***Abstract.** In conducting research on decision making or consumer behavior, one encounters a number of methodology issues related to respondent sampling, data collection, data analysis tools, and inference techniques used to arrive at final conclusions. Difficulties in identifying the factors determining the choice of university are attributable to their diversity, hence generalizations entail the use of appropriate statistical tools that do not always ensure objective results. The paper offers a review of selected methods used in decision-making process research and associated methodological problems.*

***Keywords:** consumer preferences, decision-making, education, choice of university, AHP*

Introduction

Given the rapidly changing needs and requirements of buyers, customer relationships should play an important part in business management. An excess supply and a wide range of available goods stand for an increasingly wider access to increasingly affordable goods. Advances in technology have led to the emergence of new distribution channels that facilitate goods purchases [Changsu et al. 2012: 385]. It is for these and other reasons that being aware of the factors influencing consumer decisions can play a key role in managing a business organization.

The awareness of how valuable the knowledge on motivations for decisions is, and how complex it can be, translates into increased interest in the findings of economics, psychology and neurobiology research [Glimcher, Fehr (eds.) 2013: 26]. Attempts are also made to employ naturalistic frameworks instead of formalized consumer behavior models in investigating strategies by observing behavior under extreme conditions, such as shortage of time or unclear preferences [Klein 2008: 456-457].

The choice of method for determining preference parameters in studying the processes and factors affecting decisions clearly bears on research outcomes. What the researcher therefore has to do at the initial stage of research process planning is account for the interdisciplinary nature of the problem and get a very good idea of what is to be learned about, what is to be achieved, and what relationships are to be found. In selecting tools and methods for data collection, sampling, data analysis, making inferences and drawing conclusions – each of the choices has an effect on the scientific merit and applicability of research outcomes [Adamkiewicz-Drwiłło 2008: 40]. Given the complexity of both the research object and subject, and the turbulent characteristics of today's marketplace where research is conducted, the selection of research methodology is the greatest challenge of all [Zhang, Wu, Olson 2005: 991-992]. Since consumer decisions concerning the same product may be influenced by different factors, consumer behavior models should be used with caution and adjusted for each type of product [Assel 1986: 26]. The paper aims, in the first place, to overview a range of tools for determining preference parameters and to provide an example of how the tools can be applied to establish the global parameter for differently-sized populations.

1. Methods for determining preference parameters

Studying consumer preferences involves determining variables affecting decisions made in the market. Variables defining motivations for consumer behaviors may be measurable or not, and yet, importantly enough, consumers find it much easier to describe their preferences in non-measurable terms. Hence, data collection methods are used that make it possible to assign numerical values to qualitative items. Applying an ordinal scale allows ranking the factors being examined according to their significance, thus even non-measurable characteristics (variables) can be described in numerical terms and then subjected to statistical processing [Szymańska 2007: 96].

Considering the type of choice preference data being collected and the expectations toward research findings, it is crucial to choose appropriate data processing

methods. Depending on what measurement is used for preferences, one of the following methods can be selected [Szymańska 2013: 241-242]:

- composition methods of preference estimation that involve comparing and evaluating products or comparing and evaluating certain product features while at the same time assessing preferences for specific product criteria. Total utility is computed as the sum-total of weights reflecting the relative priority of specific criteria and sub-criteria adopted for a given product;
- decomposition methods of preference estimation that involve comparing consumer preferences between objects being investigated. As a next step, the preferences are decomposed into preferences for individual product criteria;
- composition-decomposition methods for estimating preferences – tools that incorporate elements of preference measurement combining composition and decomposition methods.

The choice of method is primarily aligned with the type of data acquired through a specific survey. Further in the paper, an example will be given of how a decomposition method can be used to determine preference parameters, alongside an example of a method for determining global preference parameters.

2. The AHP method in determining preference parameters

Making a decision involves choosing between at least two alternatives. Each alternative may have properties or characteristics that bear on the decision maker's preference for a given option. Difficulties arise in decision making processes where weights need to be determined to prioritize choice criteria. It is often the case that it is impossible or very difficult to determine the precise weights of preferences. Decision makers find it much easier to evaluate a specific criterion in terms of "better", "worse", or "just as important". A technique that comes in handy in analyzing such data is the AHP (Analytic Hierarchy Process) method. It was developed by Thomas L. Saaty as a tool that can support making multi-criteria decisions [Saaty 1986: 841-842]. The procedure is best summarized when broken down into five transparent steps:

1. **Define the problem** – a stage where the object of analysis is established. This could be, for example, a question such as: Which university should I choose to study Management?
2. **Define the choice alternatives and criteria as well as sub-criteria** – a stage where alternative choices are specified (e.g. University A, University B), and then it is decided what criteria will be relevant for the choice (e.g. location, tuition fees) and what sub-criteria will be used to make the choice (e.g. location: city center or suburban area).

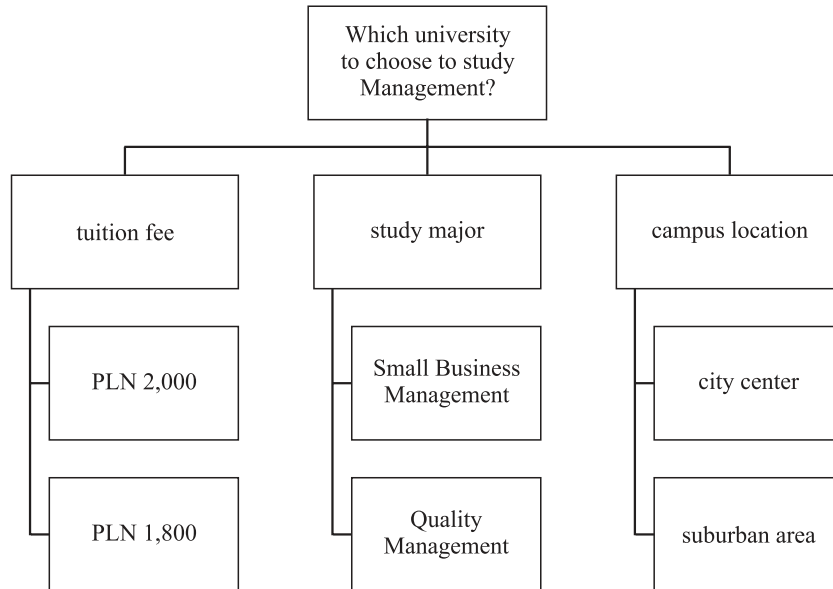


Figure 1. A set of criteria and sub-criteria in making the choice of Management program*

* The criteria and sub-criteria for the choice of university are hypothetical and are produced for the sole purpose of illustrating the application of the AHP method.

Source: own.

3. **Use a scale to prioritize the criteria against one another** (a scale can range from e.g. 9 to 1/9) – a stage that involves prioritizing the predefined criteria (e.g. study major is compared against tuition fee to establish that tuition fee is three times as significant as location).

tuition fee – study major								
9	7	5	3	1	1/3	1/5	1/7	1/9
study major – university location								
9	7	5	3	1	1/3	1/5	1/7	1/9
tuition fee – university location								
9	7	5	3	1	1/3	1/5	1/7	1/9

Figure 2. Prioritizing preferences for two selected criteria*

* The preferences are hypothetical values and are produced for the sole purpose of illustrating the application of the AHP method.

Source: own.

Preference scales shown in Figure 2 indicate that tuition fee is three times as significant as study major. If a decision maker wished to decide that study major is three times as significant for him/her as tuition fee, the value would be set to 1/3. A value of 1 means that the criteria are equally relevant.

4. **Plot the outcomes onto a matrix** – this stage involves plotting the preference parameters (values), established by prioritizing pairs of criteria, onto a matrix.

	Tuition fee	Study major	University location
Tuition fee	1	3	1
Study major	1/3	1	5
University location	1	1/5	1

Figure 3. A preferences matrix for the selected criteria

Source: own.

Matrices for the sub-criteria ascribed to specific criteria are built in a similar way.

5. **Calculate weights for individual criteria** – a stage where weights have to be calculated using two formulas.

Formula 1. A matrix of preferences for the selected criteria.

$$N = \begin{bmatrix} 1 & a_{12} & a_{13} \\ a_{12}^{-1} & 1 & a_{23} \\ a_{13}^{-1} & a_{23}^{-1} & 1 \end{bmatrix}$$

$$S_{c1} \quad S_{c2} \quad S_{c3}$$

a_{nm} – preference-scale value for the n -th criterion vis-à-vis the m -th criterion,
 S_{cn} – sum-total of the preference values.

The value of preference assigned to each criterion on prioritizing it against another is recorded in a matrix, as shown in Figure 3. Next, the columns are added up to produce the values of S_{cn} that will be then used to calculate weights from the equation given in Formula 2.

Formula 2. A matrix of preferences divided by the criteria sum-total.

$$N = \begin{bmatrix} 1 & a_{12} & a_{13} \\ S_{c1} & S_{c2} & S_{c3} \\ a_{12}^{-1} & 1 & a_{23} \\ S_{c1} & S_{c2} & S_{c3} \\ a_{13}^{-1} & a_{23}^{-1} & 1 \\ S_{c1} & S_{c2} & S_{c3} \end{bmatrix} \quad X = \begin{bmatrix} \frac{\sum \text{line1}}{n} \\ \frac{\sum \text{line2}}{n} \\ \frac{\sum \text{line3}}{n} \end{bmatrix}$$

From the equation shown in Formula 2, the values of preferences assigned when prioritizing pairs of criteria are to be divided by the sum-total of preferences S_{cn} , for each line respectively. Accordingly, the value of X_1 represents the sum-total of the first line $X_1 = \frac{1}{S_{c1}} + \frac{a_{12}}{S_{c2}} + \frac{a_{13}}{S_{c3}}$ and stands for the weight of preference for tuition fee.

Figure 4 shows the weights given by decision makers to each of the criteria and sub-criteria. Thus, in making a decision to study Management at a particular higher education institution, cost of tuition will have a weight of 0.43, majors

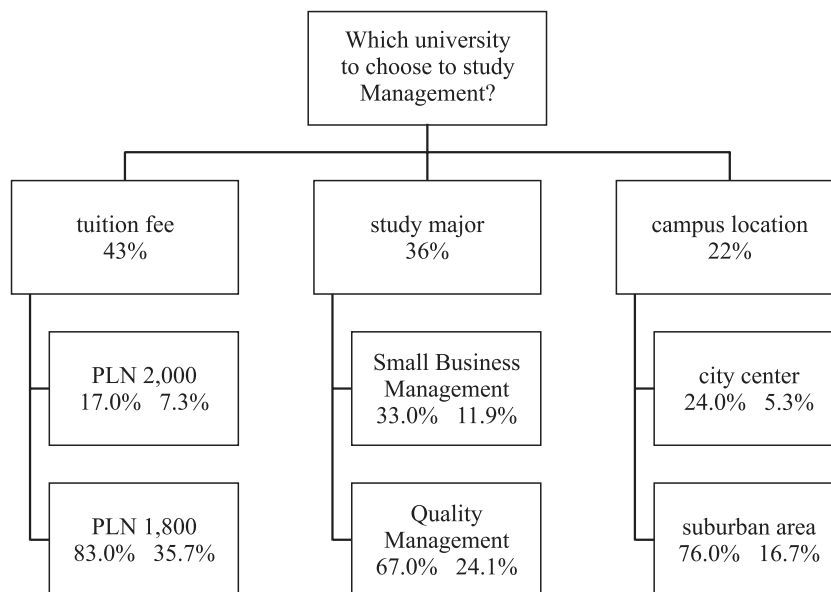


Figure 4. Weight assignment to the criteria and sub-criteria

Source: own.

available – 0.36, and campus location – 0.22.¹ The weights of preferences for all sub-criteria are known from the process of their prioritizing. For the cost of tuition, the weight of a fee at PLN 2,000 is, relative to other fees, 0.17. However, prior to any comparisons between sub-criteria, their weights need to be recalculated to account for the weight of the overarching criterion. Therefore, a tuition fee at PLN 2,000 will have a global weight of 0.073.

6. **Examine alternative choices** – the final stage of an AHP analysis where the values of weights for specific criteria and sub-criteria are added up to learn what decision would be optimal given the existing alternatives.

The decision maker is to choose among three institutions of higher learning. Each of them offers a program in Management but has some distinctive features:

- Institution A – tuition fee at PLN 2,000; major: Quality Management; location: suburban area;
- Institution B – tuition fee at PLN 2,000; major: Small Business Management; location: city center;
- Institution C – tuition fee at PLN 1,800; major: Small Business Management; location: city center.

Each of the institutions is described by criteria and sub-criteria that the decision maker is able to assess and hierarchize. Subsequent calculations yield their respective weights, making it possible to analyze the decision by adding up the global weights shown in Figure 4.

$$\text{Institution A} = 0.073 + 0.241 + 0.167 = 0.481$$

$$\text{Institution B} = 0.073 + 0.119 + 0.053 = 0.245$$

$$\text{Institution C} = 0.357 + 0.119 + 0.053 = \mathbf{0.529}$$

The highest score is garnered by Institution C, therefore this is the one that the decision maker should enroll in. Through studying the preferences for specific criteria and sub-criteria, candidates gain an insight that can help them make optimal decisions and is particularly valuable in situations where multiple factors come into play. Higher education institutions, on the other hand, can benefit from exploiting the knowledge of preferences to tailor their services to market requirements and to strengthen those areas of their operations that are vitally relevant to candidates' choices.

¹ The reason why the weights do not add up to 1 is that they have been rounded to two decimal places.

3. The issue of marginalized groups in studying choice preferences

Every population can be broken down into sub-populations that will significantly differ in terms of e.g. number and preferences. This is conspicuous in medical science, where it is almost impossible to sample a homogenous respondent group. Hence, inferences and generalizations may be questionable since experimental treatments may have a positive effect on a very limited portion of the survey sample [Lau, Ioannidis, Schmid 1998: 123].

A heterogeneous population is one that consists of many distinct individuals who can be grouped consistently, based on some criteria, to form sub-populations. Establishing global preferences may raise problems where large size discrepancies are found between sub-populations. A tool that is commonly used to address such cases is the arithmetic mean, allowing researchers to generalize many of their findings. Calculating the arithmetic mean seems to be a relatively simple and particularly effective solution in cases where the sub-populations do not differ much in terms of size. Where the differences are larger, the use of arithmetic mean causes overrepresentation of smaller sub-populations whereas bigger sub-populations will have a lesser effect on the global result. The global result may be arrived at by using a weighted arithmetic mean where each sub-population is assigned a weight in proportion to its size relative to the total population being studied. This way, each sub-population's preferences bear proportionately on the global result. This appears to be a viable solution, even though in situations where one of two sub-populations is a lot more numerous than the other, the preferences of the smaller one will be marginalized and may have hardly any effect on the global result.

In the academic year 2010-11, a survey was run in the area of Dolnośląskie (Lower Silesia) region targeting factors for the choice of a university of economics.² A special definition of a university of economics was coined for the survey to help accurately delimit the research sample.³ Based on data sourced from higher education institutions themselves, the population was known to comprise 12,904 first-year students.⁴ The respondents to be surveyed for preferences

² The survey was conducted for use in the Ph.D. dissertation by mgr Wojciech Maciejewski on "Factors for the choice of a university of economics based on the example of Dolnośląskie (Lower Silesia)" [Maciejewski 2013].

³ A university of economics was defined as any institution of higher learning based in Dolnośląskie region that offers a minimum of two study programs falling within the science of economics.

⁴ The survey involved full-time and part-time students of public and private higher education institutions in first- and second-cycle programs.

Table 1. Percentage of full-time students in respective sub-populations of students of universities of economics, divided by type of university and study program

First-cycle program in a public institution	First-cycle program in a private institution	Second-cycle program in a public institution	Second-cycle program in a private institution
47.8%	26.6%	19.9%	5.9%

Source: Maciejewski 2013.

Table 2. Preferences determining the choice of university of economics among full-time students (%)*

	Greater prestige over a public/private institution	Program not available at other public/private institutions	Superior quality of instruction over public/private institutions	Admissions process	Quality of administrative services	Other
Students in full-time first-cycle programs at public universities of economics	17.8	2.2	23.7	0.0	1.7	2.8
Students in full-time second-cycle programs at public universities of economics	40.7	0.8	26.5	1.7	0.0	3.1
Students in full-time first-cycle programs at private universities of economics	20.5	29.2	10.3	23.2	7.3	9.5
Students in full-time second-cycle programs at private universities of economics	0.0	15.4	14.1	50.0	17.9	2.6

* The respondents were allowed to select more than a single factor. Where two factors were selected, each of the factors was given a weight of 0.5; where three were selected, each was given a weight of 0.333; further weights were assigned accordingly, i.e. depending on the number of replies marked.

Source: Maciejewski 2013.

determining the choice of a university of economics were quota-sampled. First-year students in economics programs were split into sub-populations along the distinction between students of public (state-owned) and private institutions, students in first- (Bachelor's) and second-cycle (Master's) programs, and into full-

-time and part-time students. The division produced eight diversely sized sub-populations. The global result for preferences concerning the choice of a university of economics was computed separately for full-time and part-time students. The paper presents selected findings for full-time students in economics programs.

Table 1 provides a percentage breakdown showing the proportion of full-time students of economics (enrolled in different institutions and in first- or second-cycle programs) in the total population of full-time first-year students in economics programs. The largest sub-population is definitely that of students in first-cycle programs at public universities of economics. The smallest proportion of the population being surveyed is represented by second-cycle students at private universities of economics. The research aimed to ascertain the global preferences, yet there were fears that the preferences of a small-sized population would be marginalized.

Table 2 shows preferences for the choice of a university of economics. Since they vary across sub-populations, the global result had to be determined using a weighted arithmetic mean with weights expressed as roots. This method made it possible to proportionally render the general tide of responses from specific sub-populations in the global indicator, avoiding the excess influence of larger-sized sub-populations that would be effected by a weighted arithmetic mean, or the overrepresentation of smaller populations that would be visible if the arithmetic mean were used.

The arithmetic mean with weights expressed as roots can be calculated as follows from Formula 3.

Formula 3. Weighted arithmetic mean with weights expressed as roots.

$$a_g = \frac{a_1\sqrt{p_1} + a_2\sqrt{p_2} + \dots + a_N\sqrt{p_N}}{\sqrt{p_1} + \sqrt{p_2} + \dots + \sqrt{p_N}}$$

- a – numerical size of population in a given group,
- p – share of a given group in total population,
- a_g – weighted arithmetic mean with weights expressed as roots.

Using the arithmetic mean with weights expressed as root numbers to calculate global preferences for the choice of a university of economics among first-year students in full-time programs allows scientific inference while adequately accounting for the preferences of small-sized sub-populations.

Table 3 shows the result for global preferences produced by, respectively, the arithmetic mean (\bar{a}), the weighted arithmetic mean (a_w), and the weighted arithmetic mean with weights expressed as roots (a_g).

Table 3. Global preferences for the choice of a university of economics computed for first-year students in full-time programs (%)

	Greater prestige over a public/private institution	Program not available at other public/private institutions	Superior quality of instruction over public/private institutions	Admissions process	Quality of administrative services	Other
\bar{a}	19.74	11.92	18.67	18.72	6.74	4.49
a_w	23.36	7.97	21.26	7.97	3.32	4.20
a_g	22.38	9.87	20.11	12.30	4.63	4.43

Source: Maciejewski 2013.

The educational services market is broken down into the public and private sectors, differentiated primarily by the absence of tuition fees for full-time programs provided by public institutions. The considerably greater number of students in full-time programs at public higher education institutions meant that this sub-population had a substantial impact on the global result. However, the authors' principal intention was to capture global preferences for the choice of a university of economics while not downplaying underrating the private educational services sector, one that had been experiencing dynamic growth and strengthening its position in the higher education market as a whole.

The use of weights expressed as roots was proposed by W. Słomczyński and K. Życzkowski as a means to allocate vote power/weight to the European Union member states. The method, referred to as the Jagiellonian compromise, represents an alternative to the system laid down in the Treaty of Nice and adopted in the Treaty establishing a Constitution for Europe. An approach based on weights expressed as roots has multiple advantages over the existing system, being simple, objective, representative, transparent, easily expandable, moderately effective, and not too conservative [Słomczyński, Życzkowski 2015: 18]. Importantly, it inflates the vote power of smaller member states, reducing the domination of large member states, such as Germany, France, or the United Kingdom.

Conclusion

The availability of tools that come in handy in determining preference parameters enables scholars to deliver more and more accurate findings in this research area. At the same time, the quick pace of changes in the market, alongside the increasingly personalized and individualistic preferences of decision makers are forcing researchers to enhance the existing instruments and look for innovative tools. The applicability of a specific research methodology may prove very narrow, and the data may become obsolete almost from day to day due to unexpected developments in the market. Choosing a predefined set of variables reflecting consumer preferences may further compromise the relevance of the findings and make it difficult for the researcher to use them in formulating broad diagnostic statements.

An insight into consumer behaviors and consumer preferences regarding products available in market, as well as into their future expectations, is of great value to any business, hence the reliability and applicational merit of research outcomes does matter. Even the most sophisticated new tools will not be able to ensure that research findings are error-free. This realization, nevertheless, should not discourage further efforts at refining the research tools with a view to developing better and better solutions.

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Wyznaczanie parametrów preferencji przy podejmowaniu decyzji na przykładzie wyboru uczelni

Streszczenie. *Badania z zakresu podejmowania decyzji związane są z wieloma problemami metodycznymi. Składają się na to działania polegające na właściwym doborze próby badawczej, poprawnego zgromadzenia danych, doboru narzędzi analizy danych oraz końcowego wnioskowania. Trudności w poszukiwaniu czynników decydujących o wyborze uczelni wynikają z ich zróżnicowania, a ich uogólnienie wymaga zastosowania odpowiednich narzędzi statystycznych, które nie zawsze gwarantują uzyskanie obiektywnych wyników. Artykuł stanowi przegląd metod wykorzystywanych w badaniach procesów decyzyjnych oraz problemy metodyczne związane z tym zagadnieniem.*

Słowa kluczowe: *parametry preferencji, podejmowanie decyzji, edukacja, wybór uczelni, AHP*