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# MULTICRITERIA ANALYSIS OF QUALITY OF LIFE – THE CASE OF POLISH VOIVODESHIPS

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**Purpose:** This paper aims to analyze Polish voivodeships in terms of quality of life (QoL) in 2022 and determine the criteria that can be chosen to check the QoL of Polish citizens. The study shows the usefulness of using the multicriteria decision-making (MCDM) methods to create the final ranking. These kinds of analyses can be crucial for assessing the well-being of residents of given areas. They can serve as guidelines for policymakers on how to shape regional policies. MCDM methods can be seen as valuable tools for such purposes.

**Design/methodology/approach**: A set of nine criteria affecting the quality of life of Polish citizens in 2022 was chosen. The data was obtained from the Statistics Poland database. The ranking was prepared using the Preference Ranking Organization Method for Enrichment of Evaluations II (PROMETHEE II). Criteria weights were determined by Shannon's entropy method and equal weight method.

**Findings:** The study shows that considering the chosen criteria and their weights determined with Shannon's entropy method, in 2022, QoL was the highest in the Mazowieckie and Wielkopolskie voivodeships, while the lowest in Lubelskie and Warmińsko-Mazurskie voivodeships. The research results can also lead to the assumption that geographical location significantly impacts the residents' QoL.

**Research limitations/implications**: The main limitation of the study was the selection of appropriate criteria that affect QoL in Poland post-COVID-19 pandemic. The subsequent ranking results are subjective due to the high dependence on criteria. The rank is also sensitive to changes in the weights of individual criteria.

**Practical implications:** The results of the study allow us to demonstrate the diversity of Polish voivodeships in terms of the QoL of Polish citizens. At the same time, the analysis of the criteria allowed for capturing the state of well-being of the population, considering the maximization of some criteria while, at the same time, minimization of others.

**Social implications:** The paper aims to highlight the importance of using MCDM methods and tools to observe the level of quality of life on the NUTS-2 level.

**Originality/value:** The paper shows an up-to-date approach to the problem of the multicriteria assessment of QoL in Poland on a regional level.

**Keywords:** quality of life, multicriteria decision making, PROMETHEE II, entropy. **Category of paper:** Research paper.

## 1. Introduction

Quality of life (QoL) can be seen as a multidimensional concept with both objective and subjective dimensions. It can be challenging to reach a consensus on how to define QoL since it has been studied for years using various methodologies. QoL is regarded as a component of urban design and is a part of sustainable development and sustainability in general (Feneri et al., 2015). The way that modern people live makes the problem even more profound due to the fact that a person can live in one place while working and spending free time in another (Ceccato, Snickars, 1998). Overall, QoL can be seen as a complex social indicator which has its roots in economics and sociology (Imbulana Arachchi, Managi, 2023). It is one of the most important and fundamental issues in the basic categories of social statistics. The term is used in social policy, psychology, pedagogy, medicine, philosophy, economics and sociology (Roszko-Wójtowicz, Grzelak, 2018).

QoL can be viewed from two key perspectives: the subjective and the objective. Subjective QoL is one's personal view of one's own life in terms of emotional, physical and material wellbeing. The indicators that are used to describe these fields often measure the level of individual satisfaction with aspects such as social and working life, health, living environment, and wealth (Felce, Perry, 1995). Objective QoL is measured using objective criteria and external factors (e.g. social and economic indicators) except for personal feelings or the perception of one's environment. The objectivity of QoL can be linked to the fact that quantifiable data may be obtained on numerous aspects of QoL implementation, and a wide range of indicators can be employed for selected assessments (Pukeliene, Starkauskiene, 2011). A definition based on an objective evaluation proposed by Felce and Perry (1995) described QoL as *an overall general well-being that comprises objective descriptors and subjective evaluations of physical, material, social, and emotional well-being together with the extent of personal development and purposeful activity, all weighted by a personal set of values. It should be noted that this interdisciplinarity of the concept results in a multitude of definitions available in literature.* 

### Table 1.

Levels of QoL

| Level      | Objective                     | Subjective            |
|------------|-------------------------------|-----------------------|
| Individual | Objective living conditions   | Subjective well-being |
| Societal   | Quality/livability of society | Livability of society |

Source: (Delhey et al., 2002).

The research presented in this paper is based on an economic perspective of measuring QoL at the regional level. Achieving balanced growth and reducing disparities in regional development have become key concerns for policymakers, researchers, and planners. It is important to highlight that while QoL is closely linked to the concept of living standards, they represent different dimensions of well-being. Living standards primarily focus on

economic and material conditions, such as income, employment opportunities, and housing quality. In contrast, QoL encompasses both material well-being and non-material factors, including health, environmental quality, and overall life satisfaction.

Research on the QoL in Poland, especially in 2022, is of great importance for several reasons. Firstly, it was the time of international post-pandemic recovery, when assessing social wellbeing was crucial. Furthermore, Poland's economy experienced significant variations in inflation and changes in the labor market, potentially impacting the daily lives of its citizens. Also, these kinds of analyzes are important in terms of urban planning and future creation of social welfare programs.

# 2. Literature review

The analysis of various aspects and levels of QoL suggests that rather than trying to define the concept itself, it would be more effective to conduct research based on an in-depth analysis of the factors that influence it and to further classify them. Despite a growing interest in studying QoL, there is no standard classification of factors that affect it. There is also no universal methodological model for measuring it, which would also serve as a guide for the identification and systematisation of the determinants of QoL. The identification of interrelationships of the determinants proves to be a complex and time-consuming process.

The literature review shows that researchers often focus on trying to explore potential frameworks, identifying and organising the elements that shape QoL and the relationships between them. Works by various scholars show that the internal and external environment plays a crucial role in shaping QoL. The level of development of a country and its political and socioeconomic conditions give an individual the opportunity to improve their living standard and enhance overall well-being (Pukeliene, Starkauskiene, 2011).

Murgaš and Klobučník (2016) studied the QoL on a regional micro-level in 6251 Czech Republic municipalities. Their research proved that there is a substantial spatial differentiation of QoL in all hierarchical levels in the studied regions. Majeed (2018) examined how globalisation, in its economic, social and political dimensions, influenced the QoL across 44 Islamic countries over the period from 1970 to 2010. Cui et al. (2018) studied the connection between QoL and the development convergence of regional economies in China, where sustainable, high-quality growth is starting to become the key factor in driving the national economy. This can be seen as a paradigm shift from focusing on rapid economic expansion.

The literature review also shows that there are various up-to-date articles concerning the topic of QoL with regard to multicriteria decision-making. Doumpos et al. (2020) provided a quantitative approach to the problem of assessing the QoL in French municipalities. Hurajova and Hajduova (2021) pointed out that QoL can be seen as a subjective measure of happiness

that can be quantified using multicriteria techniques. Their research focused on eight regions of Slovakia with regard to nine indices representing criteria for *Technique for Order of Preference* by Similarity to Ideal Solution (TOPSIS) analysis. Muthia et al. (2024) proposed an assessment and rank for 34 Indonesian Provinces using the *Organization, Rangement Et Synthese De Donnes Relationnelles* (ORESTE) method, with 34 criteria chosen. Reig-Mullor et al. (2024) performed a comparative analysis of QoL in EU countries using *Measurement of Alternatives and Ranking according to COmpromise Solution* (MARCOS), *Evaluation Based on Distance from Average Solution* (EDAS) and TOPSIS methods. Their work described fuzzy numbers as a highly functional tool when combined with multicriteria methods.

# 3. Methods

## 3.1. Data and general problem description

Hurajova and Hajduova (2021) proposed a set of nine criteria in their research on QoL in Slovakia. Considering their work and the availability of data on Polish voivodeships, the following set of criteria was chosen:

- c1: Gross reproduction rate the criterion measures the average number of daughters a woman is expected to have during her lifetime; it significantly impacts economic stability, healthcare services, social infrastructure and overall QoL.
- c<sub>2</sub>: GDP per capita (PLN) the criterion was selected because it is one of the most widely used indicators of economic performance at both national and regional levels and has a significant impact on well-being.
- c<sub>3</sub>: registered unemployment (%) joblessness can be linked to high levels of stress, depression, anxiety and reduced overall life satisfaction. It can also lead to social isolation since not being employed can make a person feel disconnected from society.
- c4: Average monthly gross wages and salaries (PLN)- increased wages allow individuals to access, e.g. higher-quality housing, healthcare, and food and thus improve QoL.
- c<sub>5</sub>: Activity rate of persons aged 18-59/64 years (%) more active participants in the labor market mean that there is a chance of a rise in total economic productivity and the reduction of poverty levels.
- c<sub>6</sub>: at risk of poverty rate (%) poverty has a significant impact on well-being as low-income limit access to necessities and are the source of economic insecurity.
- c7: Average monthly available income for a total of 1 person (PLN).

- c<sub>8</sub>: ascertained crimes by the Police in completed preparatory proceedings a high level of criminal behavior can lead to a sense of danger and create tension among people and can contribute to the creation of mental health issues (e.g. anxiety or depression), and reduce the overall sense of well-being, thus affect QoL.
- c9: median of prices per 1 m2 of residential premises sold in market transactions (PLN)
   higher prices of properties may reflect a better standard of living.

Material conditions are of great importance for economic, physical and financial aspects of everyday life. They affect well-being, life fulfillment and the feeling of stability. The criteria which may be considered important in this area are:  $c_2$  (GDP per capita),  $c_4$  (average monthly gross wages and salaries),  $c_6$  (at risk of poverty rate),  $c_7$  (average monthly available income for a total of 1 person). Two of the criteria  $c_3$  (registered unemployment) and  $c_5$  (activity rate of persons aged 18-59/64 years) are connected to the labor market, which also plays a crucial role in shaping QoL. It affects the levels of income, job stability, social well-being and the feeling of personal satisfaction. The first criterion  $c_1$  (gross reproduction rate) was chosen due to its societal impact and  $c_8$  (ascertained crimes by the Police in completed preparatory proceedings) relates to the perception of personal safety. The last criterion, which is  $c_9$  (median of prices per 1 m<sup>2</sup> of residential premises sold in market transactions), was used as it is related to housing. All these indices can be seen as measurable and offer the possibility to perform an objective and data-driven analysis. Table 2 depicts the data that was used to conduct the research.

| Т | ab | le | 2. |
|---|----|----|----|
|   |    |    |    |

|                     | <b>C</b> 1 | <b>C</b> 2 | <b>C</b> 3 | <b>C</b> 4 | <b>C</b> 5 | <b>C</b> 6 | <b>C</b> 7 | <b>C</b> 8 | <b>C</b> 9 |
|---------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Voivodeship         | max        | max        | min        | max        | max        | min        | max        | min        | min        |
|                     | -          | PLN        | %          | PLN        | %          | %          | PLN        | -          | PLN        |
| Dolnośląskie        | 1.199      | 88480      | 4.5        | 6945.01    | 79.9       | 9          | 2234.21    | 29.03      | 6936       |
| Kujawsko-Pomorskie  | 1.223      | 68130      | 7.3        | 5888.55    | 80.6       | 17.7       | 2094       | 22.53      | 5651       |
| Lubelskie           | 1.229      | 57467      | 8          | 5909.6     | 79.1       | 22.6       | 2020.71    | 15.79      | 6564       |
| Lubuskie            | 1.213      | 66799      | 4.4        | 6014.38    | 76.3       | 13.3       | 2211.18    | 25.09      | 4951       |
| Łódzkie             | 1.282      | 77383      | 5.5        | 6210.68    | 82.6       | 14.1       | 2217.58    | 19.38      | 6223       |
| Małopolskie         | 1.286      | 72946      | 4.4        | 6824.68    | 72.8       | 13.6       | 2207.96    | 21.89      | 9273       |
| Mazowieckie         | 1.33       | 126381     | 4.3        | 7913.14    | 82.3       | 10.6       | 2601.99    | 23.3       | 9144       |
| Opolskie            | 1.195      | 66678      | 5.9        | 6134.18    | 80         | 12.1       | 1839.71    | 17.34      | 5015       |
| Podkarpackie        | 1.246      | 58221      | 8.8        | 5662.53    | 71.6       | 17.4       | 1790.68    | 12.93      | 5815       |
| Podlaskie           | 1.274      | 63697      | 7          | 6012.94    | 79.4       | 23.4       | 2309.02    | 19.44      | 6085       |
| Pomorskie           | 1.317      | 80885      | 4.6        | 6696.84    | 79         | 13.7       | 1963.51    | 23.25      | 7708       |
| Śląskie             | 1.213      | 85942      | 3.7        | 6727.57    | 77.6       | 7.8        | 2317.67    | 35.08      | 5014       |
| Świętokrzyskie      | 1.186      | 60075      | 7.8        | 5782.6     | 79.3       | 14.8       | 1937.84    | 19.77      | 5938       |
| Warmińsko-Mazurskie | 1.206      | 58536      | 8.6        | 5674.89    | 75.5       | 20.6       | 2054.32    | 19.85      | 5374       |
| Wielkopolskie       | 1.331      | 85665      | 2.9        | 6019.68    | 80.9       | 14.4       | 2032.52    | 18.9       | 6299       |
| Zachodniopomorskie  | 1.176      | 67261      | 6.7        | 6169.94    | 76.5       | 13.5       | 2295.02    | 22.28      | 6199       |

| Daia for sixieen Polish volvoaeships and hine criteria for 2 | Data | for sixteer | ı Polish | voivodes | ships a | nd nine | criteria | for | 202 | 22 |
|--|------|-------------|----------|----------|---------|---------|----------|-----|-----|----|
|--|------|-------------|----------|----------|---------|---------|----------|-----|-----|----|

Source: https://bdl.stat.gov.pl/, 23.01.2025.

The availability of data made it necessary to perform the analysis for 2022. The type of criteria was specified, considering whether the criterion should be minimised or maximised. What is worth noting is that for the chosen multicriteria algorithm, it was necessary to depict all the criteria as being maximised (by their transformation for the calculations).

### 3.2. The use of MCDM algorithms in QoL research

The use of MCDM algorithms for evaluating QoL is beneficial. They can be seen as instrumental in assessing and enhancing QoL by ranking regions, policies, or projects according to multiple factors associated with well-being. They can assist in establishing decision-making frameworks for local governments, urban planners, and policymakers, supporting them in making informed and strategic choices. PROMETHEE II can offer impartial and data-driven ranking that helps improve overall QoL.

The algorithms used for Multicriteria Decision Making (MCDM) can be divided into two types: ranking and outranking methods. Ranking methods play a vital role in decision-making processes as they enable the prioritization of alternatives in situations where multiple factors are involved. They offer an unbiased and systematic framework for the assessment and comparison of various options and ensure that well-informed and logical decisions are made. They use aggregation models, such as the weighted sum or utility functions and assume full compensation between criteria. This means that if a poor score in one criterion is visible, then it can be offset by a high score in another. Examples of such methods are *the weighted sum model* (WSM), *Analytic Hierarchy Process* (AHP) or TOPSIS.

The outranking methods, such as PROMETHEE II or ELECTRE, provide a pairwise comparison of alternatives and allow dealing with situations where some of the alternatives cannot be compared directly. Pairwise preference relations between chosen alternatives are used. Outranking methods are preferable when preference-based and nuanced decisions are to be made. For the research, PROMETHEE II was chosen as it works well for real-life applications and deals with complex quantitative and qualitative data. Moreover, it does not require normalization, which makes the results more stable and does not distort the collected data. The method uses the following steps (Brans, Vincke, 1985):

 Calculation of the preference function values for every pair of objects considering all the criteria

$$d_{ij}^{(k)} = f_i^{(k)} - f_j^{(k)}$$
(1)

$$r_{ij}^{(k)} = \begin{cases} 0 & \text{if } d_{ij}^{(k)} < 0 \\ d_{ij}^{(k)} & \text{if } d_{ij}^{(k)} \ge 0 \end{cases}$$
(2)

where:  $f_i^{(k)}$ - the value of the *k*-th criterion function for the *i*-th decision alternative  $A_i$ k = 1, ..., K and i = 1, ..., N. 2) Finding the individual preference indices for every pair of objects concerning each criterion, with preference function values normalised using one of six generalised criteria. The research uses the Gaussian criterion as it gives the decision-maker an opportunity to evaluate the differences between the alternatives in a smooth and gradual manner. The Gaussian criterion provides a gradual shift from indifference to full preference, unlike step-based preference functions, such as the Usual or V-shaped generalised criteria.

$$G_{ij}^{(k)} = \begin{cases} 0 & \text{if } r_{ij}^{(k)} = 0\\ 1 - exp\left(\frac{(-(r_{ij}^{(k)})^2}{2(s^{(k)})^2}\right) & \text{if } r_{ij}^{(k)} > 0 \end{cases}$$
(3)

The preference strength gradually increases with the growth of the value of  $r_{ij}^{(k)}$ . The growth curve has an S-shaped form. The parameter  $s^{(k)}$  falls within the range between the equivalence threshold and the preference threshold.

3) Calculation of the aggregated preference indices for each pair (i, j) of decision alternatives

$$\Pi_{ij} = \sum_{k=1}^{K} w_k \, G_{ij}^{(k)} \tag{4}$$

4) Determination of the dominance flows (positive flows  $\Phi^+(i)$ , negative flows ( $\Phi^-(i)$ )

$$\Phi^{+}(i) = \frac{1}{N-1} \sum_{j=1}^{N} w_k \Pi_{ij}$$
(5)

$$\Phi^{-}(i) = \frac{1}{N-1} \sum_{j=1}^{N} w_k \Pi_{ji}$$
(6)

5) Finding the net preference flows  $\Phi(i)$ 

$$\Phi(i) = \Phi^{+}(i) - \Phi^{-}(i)$$
(7)

A higher value of  $\Phi(i)$  shows that the alternative is highly favoured over the others. A smaller or negative value of  $\Phi(i)$  signifies that the alternative is less favoured and dominated by others. The alternatives are ordered from highest to lowest, based on  $\Phi(i)$ , with the topranked alternative representing the best option.

### 3.3. The process of weight determination for chosen criteria

In MCDM, the criteria do not always have the same level of significance. Assigning appropriate weights gives the decision-maker an opportunity to ensure that more important factors exert a more substantial influence on the outcome. Such a procedure results in a more relevant and precise ranking of alternatives. The weights can be set subjectively, e.g., based on expert opinions, experience, or the individual preference of the decision maker. When determining such weights is problematic, an alternative approach can be using objective weights, which can be derived through mathematical techniques that analyze the decision matrix and eliminate the need for input from experts or individual decision-makers. One of the most used approaches for such situations is the entropy-based one.

Entropy focuses on the level of disorder within a set or its uniqueness and helps assess the importance of individual criteria by analyzing variations in their values. This approach minimizes subjectivity and uncertainty associated with the preferences and assessments of the decision-maker (Kacprzak, 2018). The process for calculating criteria weights using Shannon's entropy can be outlined in the following steps (Al-Aomar, 2010; Kacprzak, 2018; Bartosiewicz, Jadczak, 2023):

1) The initial decision matrix undergoes stimulation and normalization, which results in a transformed matrix:

$$F = [f_i^{(k)}] for i = 1, ..., N; k = 1, ..., K$$

2) Entropy  $E_k$  and weights  $w_k$  for every criterion are calculated using the following procedure:

$$E_{k} = -\frac{1}{\ln N} \sum_{i=1}^{N} f_{i}^{(k)} \ln(f_{i}^{(k)})$$
(8)

$$d_k = 1 - E_k \tag{9}$$

$$w_k = \frac{d_k}{\sum_{k=1}^K d_k} \tag{10}$$

There are several ways to determine the criteria weights in MCDM, since they reflect the relative importance of each criterion for the decision-maker. When it comes to the determination of subjective weights one can choose the AHP method, which assigns relative and subjective weights to criteria. In the research Shannon's entropy was chosen as it is an objective weighting method, which relies on the statistical properties of a chosen dataset. Another method of weight determination, which isn't based on subjective expert opinions, is the CRITIC (Criterial Importance Through Intercriteria Correlation) method. The procedure assigns weights according to the degree of difference (variance) and the degree of conflict (correlation) between criteria, unlike entropy, which is based on uncertainty. The advantages of CRITIC are its objectivity and redundancy reduction, as it considers both correlation and variance of the dataset, however it should be noted that it can be intensive in terms of calculations. That was the reason for choosing it for the calculations.

## 4. Research results

The use of the Shannon entropy method, based on the input data, helped in finding weights for the chosen criteria. What is worth noting is that the set of weights is assigned without any influence from the decision-maker. Thus, human bias is reduced due to the lack of personal opinions.

Considering the weight values determined with Shannon's entropy method, it can be concluded that the most important criterion is  $c_3$  – registered unemployment (%), while the lowest weight value can be observed for  $c_5$  - activity rate of persons aged 18-59/64 years (%). All the weights used in the research are depicted in table 3.

Variations in the assigned criteria weights can lead to shifts in the final ranking. Equal values were assigned to each criterion, and the calculations were performed again to examine how the ranking behaves with different weights for the criteria; in this case, all the criteria had the same weight value assigned, which was equal to 1/9.

### Table 3.

The weights assigned for each of the criteria

| Criterion                    | <b>C</b> 1 | <b>C</b> 2 | <b>C</b> 3 | <b>C</b> 4 | <b>C</b> 5 | <b>C</b> 6 | <b>C</b> 7 | <b>C</b> 8 | C9     |
|------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|--------|
| Shannon's<br>entropy (set 1) | 0.0048     | 0.1365     | 0.3109     | 0.0236     | 0.0044     | 0.2579     | 0.0255     | 0.1463     | 0.0902 |
| Equal (set 2)                | 0.1111     | 0.1111     | 0.1111     | 0.1111     | 0.1111     | 0.1111     | 0.1111     | 0.1111     | 0.1111 |
| Source: our alpharation      |            |            |            |            |            |            |            |            |        |

Source: own elaboration.

The values of net preference flow  $\Phi(i)$  allow classifying the voivodeships into two groups: the dominant ones with positive values of  $\Phi(i)$  and the dominant ones with negative  $\Phi(i)$ values. The voivodeships with negative net preference flows are outperformed by other available alternatives (are surpassed by others more frequently than they surpass them). Regions with higher net preference flows are at the top of the ranking. In 2022, the group of dominant voivodeships, considering the first set of weights, includes Mazowieckie, Wielkopolskie, Śląskie, Dolnośląskie, Lubuskie, Łódzkie, Opolskie, Pomorskie and Małopolskie (the total of 9 voivodeships). It can be suggested that these regions have more substantial advantages when considering the analysed criteria. They may also be considered more reliable to live in than the lower-ranked regions. The voivodeships negative net flow with values are Zachodniopomorskie, Świętokrzyskie, Kujawsko-Pomorskie, Podkarpackie, Podlaskie, Lubelskie and Warmińsko-Mazurskie (the total of 7 voivodeships).

### Table 4.

Equal weights Shannon's entropy method weights Voivodeship Place Φ Place Φ Dolnośląskie 0.1155 0.2083 5 4 12 -0.0963 12 -0.1952 Kujawsko-Pomorskie 14 -0.1872 15 -0.3389 Lubelskie Lubuskie 8 -0.0109 5 0.1243 Łódzkie 3 0.1690 6 0.1091 9 Małopolskie -0.02039 0.0760 Mazowieckie 1 0.4213 1 0.3089 Opolskie 7 -0.0108 7 0.1061 15 -0.2511 13 -0.2173 Podkarpackie -0.2802 10 Podlaskie -0.0490 14 0.0836 0.1023 Pomorskie 6 8 Śląskie 4 0.1387 3 0.2741

The final ranking of voivodeships in Poland, based on the QoL research (2022) using equal weights and Shannon's entropy method weights

| Cont. table 4.           |    |         |    |         |
|--------------------------|----|---------|----|---------|
| Świętokrzyskie           | 13 | -0.1639 | 11 | -0.1615 |
| Warmińsko-Mazurskie      | 16 | -0.2626 | 16 | -0.3511 |
| Wielkopolskie            | 2  | 0.2063  | 2  | 0.2840  |
| Zachodniopomorskie       | 11 | -0.0824 | 10 | -0.0490 |
| Source: own elaboration. |    |         |    |         |
|                          |    |         |    |         |
|                          |    | N       |    |         |
|                          |    |         |    |         |

### C



Figure 1. Net preference values  $\Phi(i)$  for the first set of weights (based on Shannon's entropy method). Source: own elaboration.

The second set of weights showed that there were five dominant voivodeships: Mazowieckie (still at the first position), Wielkopolskie (also at the second position), Łódzkie, Śląskie, Dolnośląskie and Pomorskie. The remainder of the voivodeships can be considered dominated, with Podkarpackie and Warmińsko-Mazurskie ranked at the two last places. All the net preference flow values are depicted in the tab. 4. The analysis of both variants of the final ranking results shows that the positions of individual voivodeships can be considered relatively similar. The voivodeships dominant both times are Mazowieckie, Wielkopolskie, Łódzkie, Śląskie, Dolnośląskie and Pomorskie.



Figure 2. Net preference values  $\Phi(i)$  for the second set of weights (equal weights). Source: own elaboration.

Voivodeships with positive net flows can be seen as benchmarks for good practices. On the other hand, policymakers may focus on investing in regions with lower net preference values to enhance their overall position. The voivodeships located in the east of Poland have lower net preference flow values, which suggests that location also plays a role in shaping the overall QoL.

# 5. Discussions

This study examined QoL in Polish voivodeships in 2022 using multicriteria decisionmaking methods. The objectivity of the assessments was ensured by using two sets of weights that were calculated using Shannon's entropy method and equal weights for each of the criteria. This approach ensured that there was no need to use individual, subjective opinions of the decision-maker. The assignment of weights can be crucial for the decision process, as it affects the ranking of the alternatives. PROMETHEE II was used to rank the sixteen voivodeships, considering nine criteria affecting the QoL. The analysis of net preference flows shows that the regions located in the east of Poland have lower QoL. These are also the regions with one of the lowest GDP per capita. The voivodeship with the highest net preference flow value for both weight sets is Mazowieckie, where Warsaw (the capital of Poland) is located. The possible reason for such results may be the fact that the eastern neighboring countries of Poland (Belarus, Ukraine) generally have a lower standard of living. This difference can be observed regarding Poland's membership in the European Union, which has contributed to its more substantial and more varied economy.

Further research on the QoL in Poland should include an extended time frame, allowing for an analysis of how events such as the COVID-19 pandemic or the war in Ukraine have affected the situation of Poles in different regions over the years. Moreover, using different weights would enable a more thorough sensitivity analysis to be performed. The study could also be expanded to include a subjective set of weights derived from the individual opinions of decision-makers using different multicriteria decision-making methods, such as the AHP method combined with Saaty's weights.

To reduce the economic divide between the lower-ranked voivodeships and the leading ones the focus should be put on enhancing regional development. The policy recommendations call for an all-encompassing approach that integrates economic, social, environmental and governance-related aspects. In terms of advancing economic growth, it could be the support for small and medium enterprises or the promotion of special economic zones. Considering infrastructure investments effort for the expansion of public transportation could be made, while in terms of housing it could be the encouragement of the development of sustainable housing to promote affordability on the housing market. What is more investments in the concept of Smart Cities could be made, with some of such initiatives already being implemented i.e. "Smart City Lublin" (Lubelskie voivodeship). The concept aims at promoting the use of advanced technologies and urban management to improve overall QoL of the residents of the city (Bednarzewska, Pastuszak, 2015). Greater flexibility in the labor market should be promoted to ensure job security. Social programs should prioritize education and the development of a skilled workforce, while also encouraging the involvement of local communities and institutions in supporting regional projects and reinforcing regional identity. What is worth noting is that lower-rank Polish voivodeships implement agendas to enhance the QoL of their citizens. The example may include the European Funds for Eastern Poland 2021-2027 that aims at reducing regional disparities and the promotion of socio-economic growth by the implementation of European Regional Development Fund in Polish eastern voivodeships (Wajda, 2022).

## 6. Conclusions

The concept of QoL is interdisciplinary and multidimensional. The analysis of literature helps draw the conclusion that a large number of its interpretations and definitions are the result of exploring it from different perspectives. The study is based on a multicriteria approach to the problem of QoL due to its broad applicability, as PROMETHEE II can be used to conduct research on different fields, not only economics. The main objective of this work was to assess the QoL in Polish voivodeships using nine specific criteria.

The application of PROMETHEE II shows that Polish regions are diverse, considering the net preference values. The location of the region is of key importance in the QoL. The analysis shows that Poland's eastern regions have lower quality of life and GDP per capita. The significant disparities in QoL in different regions may lead to increased migration due to the need to find a better place to work or the search for better educational opportunities. This may lead to further widening of the regional inequalities. These problems can be further studied using a different set of criteria and weights.

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