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Model of Regional Tourism Competitiveness: Fuzzy Multiple-Criteria Approach (FDM-FAHP-PROMETHE II Framework)

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Abstract:

Purpose: *The aim of the article is to build a research, comprehensive and objective model that takes into account various factors determining the regional tourism competitiveness on the example of 21 counties in the West Pomeranian Voivodeship.*
Degign/Methodology/Approach: *The model uses the concept of fuzzy numbers, the Delphi method and two multi-criteria methods: AHP and PROMETHE II. An important scientific contribution to the issue of regional competitiveness of tourism is an in-depth look at several dozen different criteria, that have an impact on it. Collected data and the used research methods made it possible to reliably select those that should be noticed and developed by various stakeholders in the region.*
Findings: *The main conclusion resulting from the research is the fact that the most important criteria for the level of tourist competitiveness of a destination include natural tourist attraction, anthropological tourist attractions, accommodation base, recreational infrastructure and catering base; whereas the criterion of safety and facilities for disabled tourists and para-tourist infrastructure is of little importance. The county with the highest level of tourism competitiveness is Kołobrzeg county, and the lowest - Pyrzycki county.*
Practical implications: *An important scientific and practical contribution to the issue of regional competitiveness of tourism is an in-depth look at several dozen different criteria, that have an impact on it. Collected data and the used research methods made it possible to reliably select those that should be noticed and developed by various stakeholders in the region.*
Originallity value: *Comprehensive approach to tourism competitiveness of regions with the use of multi-criteria method, which in an objective way indicates the aspects, features, attributes, factors evaluated as key in building the entity's position on the market.*

Keywords*: Tourism competitiveness, region (county), FDM, FAHP, PROMETHEE II.*
JEL codes: *Z3, P 25, C30.*
Paper Type: *A research study.*

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1. Introduction

The regional tourism competitiveness is a destination's ability to effectively distinguish itself in relation to various groups of recipients. It is not a new issue, and it has been the subject to many research studies. However, the study of tourism competitiveness should be constantly monitored due to the dynamic development of tourism and the changing needs of entities in this specific market (from tourists, entrepreneurs, to tourism organisations, and many others). The concept of competitiveness has appeared in many fields of science and various analyses - theoretical and empirical - over the years. The concept of competitiveness covers, inter alia, economies, countries, territorial units, products or economic entities in relation to certain industries (d'Hauteserre, 2000; Kozak and Rimmington, 1999; Pearce, 1997; Porter, 1990).

The discussion on tourism competitiveness of areas comes down to looking for factors that allow objectively and subjectively (due to the type of assessor, e.g., entrepreneurs, tourists) determining its level with the available analytical tools. In these considerations, 21 counties of the West Pomeranian voivodship, which are considered attractive for tourists, e.g., due to them being included in the national accommodation facility base, were analysed. According to data from July 31, 2020 (Główny Urząd Statystyczny, 2020), the voivodship has the largest accommodation base in the country, in the number of 141 thousand beds, located in 1484 tourist facilities (14.4% of facilities in the country), which constitute over 18% of the national base.

The West Pomeranian Voivodeship, located in the north-western part of Poland, covers over 22.9 thousand km^2, and is inhabited by over 1.68 million people (Eurostat, 2019). It borders Germany to the west, the Lubuskie and Wielkopolskie Voivodeships to the south, the Pomeranian Voivodeship to the east, and Sweden and Denmark, through the Baltic Sea, to the north. The capital of the voivodeship is Szczecin. The island of Wolin and a part of the island of Usedom lie within the administrative boundaries of the voivodeship.

The West Pomeranian Region lies within the area of the Weichselian glaciation, which had the greatest impact on shaping of landscapes of diverse natural values. Characteristic features of this area are numerous lakeside lands with rich fauna and flora, clean waters, and above all, the 185-kilometre-long strip of the Baltic coast, sandy beaches, separated from the mainland by dunes with unique vegetation and cliffs. The landscape includes numerous hilly moraines, lobelia lakes, peat bogs with characteristic moss vegetation and a network of rivers. The specificity of the region's location and the resulting variety of natural and landscape values contribute to the high tourist attractiveness of this area.

When examining the tourism competitiveness of the West Pomeranian Voivodeship, it was assumed that the spatial area constituting the research base would be a county,

i.e., a local government unit and second-degree administrative division in Poland. This resulted mainly from the need to obtain reliable statistical material.

Moreover, it is worth emphasizing that the powers of the county in Poland include public tasks in the field of physical culture and tourism. Thus, the county self-government has a clear statutory authorization to conduct activities in the field of tourism. The West Pomeranian Voivodeship is divided into 18 counties (Kołobrzeg, Koszaliński, Gryficki, Kamieński, Sławieński, Stargard, Drawski, Szczecinecki, Goleniowski, Myślibórz, Wałecki, Gryfiński, Police, Choszczno, Świdwin, Białogard, Łobeski, Pyrzycki) and 3 cities with county rights (Szczecin, Świnoujście and Koszalin).

Due to the diversity of the tourism product of the analysed region, it is extremely difficult to identify the most competitive tourist area. This is because of the differences existing between individual parts, whose tourism potential is determined by many factors. The aim of the article is to build a research model that takes into account various factors determining the tourism competitiveness on the example of 21 counties in the West Pomeranian Voivodeship. The model uses the concept of fuzzy numbers, the Delphi method and two multipl-criteria methods: AHP and PROMETHE II.

2. Literature Review

2.1 Research on Tourism Competitiveness

Critical analysis of scientific literature, as part of the deliberations, was based on an attempt to discuss the concept of competitiveness from its general economic importance, through its definition in the field of tourism, to establishing the essence of area significance.

In general economic terms, the scientific discussion on competitiveness was undertaken by (d'Hauteserre, 2000; Dwyer *et al.,* 2000; Kalaiya and Kumar, 2015; Kozak and Rimmington, 1999; Pearce, 1997; Porter, 1990) referring it especially to developmental aspects of the economy. On the other hand, tourism competitiveness of purely economic importance is defined by (Knežević Cvelbar *et al.,* 2016) as the total share of tourism in GDP per employee in the tourism industry. The problem of improving the competitiveness of products on a microeconomic and macroeconomic scale was discussed by Lee, Hsieh, and Brown (2019), Rosca (2019), and Tfaily (2018), who referred to individual business entities or regional clusters. Although most of these considerations are theoretical, I. Dzhamyshev proposes a specific methodology in the field of competitiveness (e.g., method of expert and point evaluation) (Zakharchenko *et al.,* 2020).

In the past, tourism competitiveness of a destination was discussed from various perspectives, including environmental (Mihalič, 2000), economic (Buhalis, 2000)

and socio-cultural (Strickland-Munro *et al.*, 2010) factors. According to the OECD, tourism competitiveness of an area consists in its ability to optimize the attractiveness of various target groups, while ensuring the quality of the offered products while maintaining the principles of sustainable development (Dupeyras and MacCallum, 2013).

Tourism competitiveness from the point of view of an area is defined in the literature not only based on the features that create it, but also the perspectives of entities evaluating it, e.g. tourists, entrepreneurs, investors. Nica (2015) draws attention to the cultural heritage indicator, which includes elements of tangible culture (buildings, works of art, landscapes, gastronomy) and intangible culture (traditions, language, folklore, music). It plays a great role, as it emphasizes the unique features of a given country, which influence the choice of a specific tourist destination by tourists.

Tourism competitiveness and its elements were discussed by Buhalis (2000) and Goffi (2013), who clearly underlined its key role in gaining an advantage over other destinations. Monica and Olimpia (2020) emphasize that the aspect of tourism competitiveness of an area may determine the success of individual economic entities in a given place. Whereas, Krstic, Jovanovic, Jankovic-Milic, and Stanisic (2016) indicate that tourism competitiveness is of great importance in the process of building an area development strategy and in decisions made by local authorities. An area that uses competitiveness-building mechanisms based on unique natural resources, requiring buyers, developed industry infrastructure and conditions to compete, may achieve a competitive advantage over other entities (Lee *et al.*, 2019). The indicated elements can and should be subject to strategic actions of territorial units, such as: dislocation development, balanced development and regional tourism competition and cooperation development (Huang and Quan, 2019).

The theoretical and empirical considerations of scientific works present various models of tourism competitiveness, where the key role is played by the defined objective and subjective indicators necessary to quantify the level of competitiveness of an area. In line with current trends, Krstic, Jovanovic, Jankovic-Milic, and Stanisic (2016), and Ritchie and Crouch (2003) emphasize the importance of the idea of sustainable development in the structure of these models, by comparing tourism competitiveness of countries. As emphasized by Porter (1990), the competitive position of a country is influenced by various factors that characterize it, including national values, culture, economic structure or history.

The attributes of an area may determine its attractiveness among various target groups, from residents, entrepreneurs, to investors and tourists. From the point of view of tourism competitiveness, it is necessary to define a set of elements that will collectively attract attention, i.e., natural and anthropogenic resources, tourist and para-tourism infrastructure, level of availability, quality of human resources, price-quality ratio, level of environmental protection, area management policy, visitors'

needs or the scope of cooperation and partnership between institutions. Monica and Olimpia (2020) presented a detailed review of the literature in the field of methods, features and indicators that allow assessing the degree of tourism competitiveness in the work entitled “Theoretical framework about tourism destinations competitivenes.

In research on tourism competitiveness, it can be identified with tourism attractiveness. Tourism competitiveness is the ability to create such a tourism offer (tourism product) that will make a city, region or country stand out from and be more attractive than others, and, as a result, it will attract tourists and develop tourism in its territory, thus increasing its socio-economic benefits (Anszperger, 2017). From a tourist's point of view, the competitiveness of an area may mean "the ability to deliver value and experience that are more satisfying than those offered by other destinations" (Vengesayi, 2003). The above statement clearly shows that with regard to tourism, competitiveness may be subjective. It may result from the motives of making a trip, tourist experience, temporary emotions, etc.

2.2 Factors Determining the Tourism Competitiveness of an Area

Based on the literature review, Table 1 presents selected concepts of factors influencing the tourism competitiveness of a destination. The presented models have been arranged chronologically and broken down into criteria and sub-criteria.

Table 1. *Selected factors determining the regional tourism competitiveness.*

Concept author	Criteria / sub-criteria determining the tourism competitiveness of an area
Zakharchenko Metil & Soroka (2020)	**5 criteria:** **1.** Quality of services which is provided **2.** Rationality of service nomenclature **3.** Service culture **4.** Terms of service **5.** Availability of the service
Calderwood & Soshkin (2019)	**4 super-criteria, 14 criteria and 90 sub-criteria:** **1. Enabling Environment** • Business Environment (12 indicators) • Safety and Security (5 indicators) • Health and Hygiene (6 indicators) • Human Resources and Labour Market (9 indicators) • ICT Readiness (8 indicators) **2. T&T Policy and Enabling Conditions** • Prioritization of Travel and Tourism (6 indicators) • International Openness (3 indicators) • Price Competitiveness (4 indicators) • Environmental Sustainability (10 indicators) **3. Infrastructure** • Air Transport Infrastructure (6 indicators) • Ground and Port Infrastructure (7 indicators) • Tourist Service Infrastructure (4 indicators) **4. Natural and Cultural Resources** • Natural Resources (5 indicators) • Cultural Resources and Business Travel (5 indicators)

Huang & Quan (2019)	**3 criteria and 14 sub-criteria:** **1. Tourism current competitiveness:** • domestic tourist/10^6 person-times • international tourists/10^6 person-times • domestic income/10^9 yuan • total tourism income/10^9 yuan **2. Tourism support competitiveness** • per capita green area/km^2 • green area coverage in built-up areas/% • added value of the tertiary industry as a share of GDP/% • per capita GDP/yuan • number of scenic spots above 3A • number of tourist agency • number of star-hotels **3. Tourism potential competitiveness** • number of students in higher education schools per 10 000 people • annual passenger traffic/10^6 person-times • tourism revenue as a share of GDP/%
Fu & Chen (2019)	**4 criteria and 24 sub-criteria:** 1. Core resources 2. Tourism industry 3. Supporting resources 4. Tourism destination management
Krstic, Jovanovic, Jankovic-Milic & Stanisic (2016)	**13 criteria:** 1. Policy rules and regulations 2. Environmental sustainability 3. Safety and security 4. Health and hygiene 5. Prioritisation of T&T 6. Air transport infrastructure 7. Tourism infrastructure 8. ICT infrastructure 9. Price competitiveness in the T&T industry 10. Human resources 11. Affinity for T&T 12. Natural resources 13. Cultural resources
Dupeyras & MacCallum (2013)	**4 criteria**: 1. Indicators measuring the tourism performance and impacts; 2. Indicators monitoring the ability of a destination to deliver quality and competitive tourism services 3. Indicators monitoring the attractiveness of a destination 4. Indicators describing policy responses and economic opportunities
Bąk & Wawrzyniak (2012)	**2 criteria and 7 sub-criteria:** **1. Tourist traffic intensity** • Schneider's index, defining the number of people choosing overnight stays per 100 permanent residents • factor of utilization of the accommodation capacity, which indicates how many days during the year one bed was occupied • tourist traffic density indicator specifying the number of tourists per 1 km^2 **2. The attractiveness of the natural environment** • population using sewage treatment plants in% of the total population

	• gaseous air pollutants retained in devices for pollution reduction in % of generated pollutants • a legally protected area with special natural values in % of the total area • natural monuments per 1 km^2
Milewski (2005)	**8 criteria and 34 sub-criteria:** 1. Tourist values 2. Accommodation facilities 3. Catering facilities 4. Transport accessibility 5. Natural phenomena 6. Environmental protection 7. Service infrastructure 8. Technical infrastructure

Source: *Own elaboration based on: (Bąk & Wawrzyniak, 2012; Calderwood & Soshkin, 2019; Dupeyras & MacCallum, 2013; Fu & Chen, 2019; Huang & Quan, 2019; Krstic i in., 2016; Milewski, 2005; Zakharchenko i in., 2020).*

The presented models indicate that there are many approaches to assessing the level of tourism competitiveness of a destination, with their scope being ambiguous and very wide. Table 2 proposes an original concept of assessing the level of tourism competitiveness in the West Pomeranian Voivodeship. The proposed set of factors determining the tourism competitiveness of the West Pomeranian Voivodeship is the result of an in-depth analysis of the literature on the subject, discussions with representatives of the tourism industry and the availability of objective statistical data.

Table 2. *The concept of evaluation of tourism competitiveness of counties of Western Pomeranian voivodship*

Factors determining the West Pomeranian tourist competitiveness	
Criteria	**Sub-criteria**
Natural tourist attraction	1. forest cover (%) 2. water area (km^2) 3. nature monuments (no.) 4. legally protected areas (%) 5. recreation parks (no.) 6. lawns (no.)
Anthropological tourist attractions	7. monuments (no.) 8. centres of culture, clubs and community centres (no.) 9. museum pieces (no.)
Recreational infrastructure	10. bicycle paths (km.) 11. fields (volleyball, basketball, football, tennis courts, no.) 12. pools (indoor and outdoor, no.) 13. gyms and spa (gym, sauna, solarium, spa and rehabilitation, physical therapy, fitness, yoga, aerobics, no.) 14. billiards, ping pong, bowling, mini-golf (no.) 15. tourist rental (water and sports equipment, no.) 16. children's playroom (no.) 17. artistic and sports events (no.)

Accommodation base	18. accommodation per 1000 inhabitants 19. hotels in total (no.) 20. accommodation facilities for short-term accommodation (no.) 21. diversification of the accommodation base 22. occupancy rate of beds % 23. use of accommodation places for 1000 inhabitants 24. accommodation provided to foreign tourists in tourist accommodation establishments per 10 thousand. inhabitants
Catering base	25. restaurants (no.) 26. bars and cafes (no.) 27. canteens (no.) 28. catering point (no.)
Transport availability	29. municipal and district roads with hard surface (km / 100 km^2) 30. taxis (no.) 31. number of bus (with trolleybus) and tram stops in total
Environmental protection	32. emission of gaseous pollutants in tonnes 33. waste collected selectively during the year (tons) 34. emission of dust pollutants (tons)
Para-tourist infrastructure	35. number of pharmacies 36. number of supermarkets 37. total population per generally accessible pharmacy 38. total number of clinics
Safety and facilities for disabled tourists	39. entry ramp (no.) 40. the door opens automatically (no.) 41. elevator adapted for the mobility impaired (no.) 42. car park with designated places for people with physical disabilities (no.) 43. offenses detected by the police in completed preparatory proceedings for 10.000 inhabitants 44. fires per 1000 inhabitants 45. local threats per 1000 inhabitants

Source: *Own elaboration.*

Data on the factors determining the West Pomeranian tourist competitiveness are primarily derived from the Central Statistical Office. In case of water area it is a Map of Hydrographic Division of Poland, monuments - Register of real estate monuments of the voivodeship, excluding archaeological monuments and diversification of the accommodation base is based on data from the Central List of Hotel Facilities in Poland. This sub-criteria is subjective index (is an indicator taking the value from 1 to 5, related to the number of accommodation facilities and the variety of types of these facilities; the value of 1 means very small variety of accommodation facilities, 3 means medium variety, and 5 means very large variety).

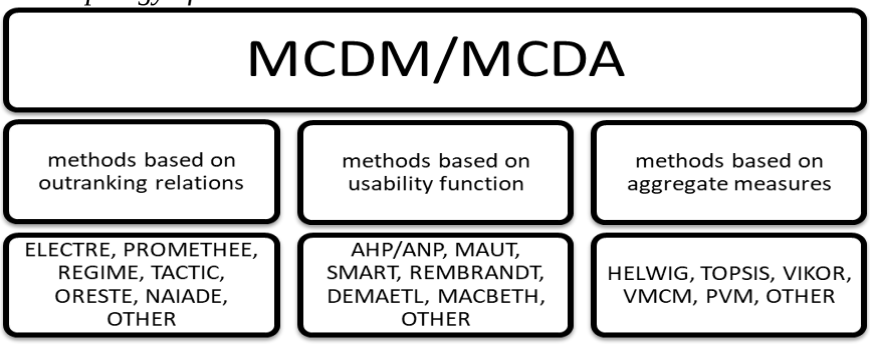
3. Methodology and Research Results

3.1 Multiple Criteria Decision Making Methods and Research Model

One of the proposals for the tourism competitiveness research, taking into account the geographical, ecological, infrastructural, economic and social complexity of the analysed regions, is the use of multiple-criteria decision making methods (MCDM) or multiple-criteria decision analysis (MCDA) (Bana e Costa and Vansnick, 1999;

Charnes *et al.*, 1978; Saaty, 1988; Vincke and Brans, 1985), The International Society on Multiple Criteria Decision Making defines the MCDM / MCDA[4] as an area dealing with the study of methods and procedures that take into account many, often contradictory criteria and support the processes of selecting and organizing the analysed phenomena and objects (Figure 1), (Bedir *et al.*, 2016; Behzadian *et al.*, 2010; Ruano, 2018; Saaty and Ergu, 2015; Trzaskalik, 2014).

Figure 1. *Topology of multi-criteria methods*



Source: *Own elaboration based on: (Bana e Costa and Vansnick, 1999; Duch et al., 2000; Edwards and Barron, 1994; Saaty, 2002).*

The study also used the fuzzy delphi method, which is characterized by four basic elements: independence of expert opinions, anonymity of expressed judgments, multi-stage nature of the proceedings, and the desire to agree and sum up the opinions of participants. In the literature on the subject, the delphi method is defined as a method of structuring the process of group communication, in order to ensure the effectiveness of the community of independent people who, as a whole, seek to solve a complex problem (Turoff and Linstone, 2002). The delphi approach is included in the group of research methods in the sphere of creative thinking and defined as a multi-stage evaluation technique based on selection analysis of the collected empirical data (Landeta, 2006; Pill, 1971). Due to the fact that the traditional delphi method has certain limitations, which include, above all, a long procedure time (and the associated high research costs), scientific research often uses its modification, fuzzy delphi method (Lin, 2013; Ocampo *et al.*, 2018).

The concept of counties tourism competitiveness, in combination with the idea of fuzzy research methods, made it possible to present a research model based on: the heuristic fuzzy delphi method (FDM), to determine the factors describing the counties tourism competitiveness; the fuzzy AHP (Analytic Hierarchy Process) method to determine the weights of selected criteria and sub-criteria and

[4] *The problems of multiple-criteria decision-making and multiple-criteria decision analysis (MCDM / MCDA) are divided into two main categories of methods: multiple attribute decision making (MADM) and multiple objective decision making (MODM).*

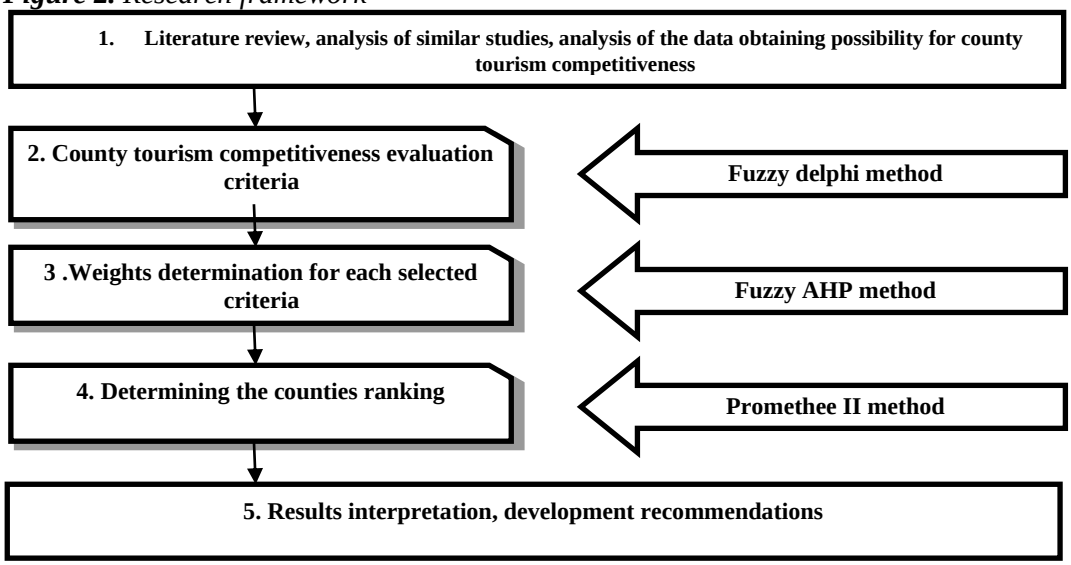
PROMETHEE II (Preference Ranking Organization Method for Enrichment Evaluation) method to build a ranking of tourism competitiveness in studied regions.

The literature review indicates the use of research models based on multi-criteria methods to analyze tourism issues such as: transport and tourism development (Liu *et al.*, 2013), cultural potential in tourism (Stević *et al.*, 2019), potential of sports attractions in tourism (Yang *et al.*, 2020), sustainable ecotourism (Chuang *et al.*, 2013) and many others.

Therefore, it is assumed that the choice of a research method or a combination of several methods is a key issue for the analysis of tourism competitiveness in a selected region. The following stages were distinguished in the research model (Figure 2):

1. Literature review and data availability analysis in the context of counties tourist competitiveness.
2. Criteria and sub-criteria selection determining tourist competitiveness (FDM).
3. Determining weights for selected criteria and sub-criteria (FAHP).
4. Establishing counties ranking (Promethee II).
5. Results interpretation and development recommendations.

Figure 2. *Research framework*



Source: *Own elaboration.*

3.2 County Tourism Competitiveness – Fuzzy Delphi Method (FDM)

The main study purpose is to answer the question about the level of counties tourism competitiveness the West Pomeranian Voivodeship based on selected criteria. The

basic problem at this stage of the research is the factor selection describing tourism competitiveness and the determination of data sources. Based on the literature review, an expert panel was developed and 9 criteria and 54 related sub-criteria were proposed. Nine experts representing three areas of activity were invited to the panel: the tourism sector - 3 hotel managers, the local government sector - 3 county officials and the academic sector - 3 academics specializing in regional tourism. The expert panel was divided into 2 stages:

1. Selection and acceptance of key criteria for tourism competitiveness.
2. Selection and acceptance of key sub-criteria (factors determining tourism competitiveness within the adopted criteria).

The research procedure using the fuzzy delphi method (both for stage 1 and stage 2) was as follows:

1. Selected criteria and sub-criteria assessment (the seven-point Likert scale).
2. Fuzification of the obtained values using triangular fuzzy numbers
3. Data aggregation.
4. Data defuzification.
5. Estabilishing the acceptance threshold; selection of criteria and sub-criteria.

After the selection of the triangular fuzzy spectrum, experts‘ linguistic expressions (opinions) are collected and fuzzified. In the second step, experts‘ opinions were aggregated according to formula 1:

$$F_{agr} = \left(min\{l\}, (\prod_{i=1}^{n}\{m\})^{\frac{1}{n}}, \max\{u\} \right) \quad (1)$$

In order to establish the criteria (or sub-criteria) acceptance threshold, the aggregated values were defuzzified with Centre of area method according to formula 2:

$$COA = \frac{(l+m+u)}{3} \quad (2)$$

The last point at this stage, was to establish the acceptance threshold *S=0,6*, to filter and select the appropriate criteria (all 9 were accepted, Table 2) and sub-criteria (45 of 54 were accepted). The final list of all sub-criteria with description is provided in Annex A.

3.3 Estimation of Tourism Competitiveness - Fuzzy Analytic Hierarchy Process (FAHP)

The next stage of the research was to calculate weights for the proposed criteria and sub-criteria using the fuzzy AHP (Fuzzy Analytic Hierarchy Process). AHP is one of the multiple-criteria decision making technique, which was developed to solve

complex problems in various areas (Saaty, 1987). The basic assumption of the AHP method indicates the possibility of decomposing the decision problem into the hierarchical structure and the selection of the optimal variant in given conditions, according to the adopted criteria (and sub-criteria).

The main limitation of the AHP method is the inability to capture the ambiguities or inaccuracies associated with making decisions in a group. To address these deficiencies, the combination of AHP and fuzzy theory has been proposed (FAHP), allowing authors to more accurately assess the problem and integrate incomplete and uncountable information (Chen, 2000).

The most important step in FAHP, is creating a pair-wise comparison matrix, where crisp numeric values are converted into fuzzy numbers, using selected membership function (the most commonly used is triangular membership function, formula 3):

$$\tilde{A} = (l, m, u) \tag{3}$$

The main purpose of pairwise comparisons is to evaluate how many times one element outweighs another in terms of their relative importance. If element A is favoured very strongly over B, the fuzzy number is $\tilde{A} = (6,7,8)$ and the fuzzy reciprocal value is $\tilde{A}^{-1} = (\frac{1}{8}, \frac{1}{7}, \frac{1}{6})$ according to formula 4:

$$\tilde{A}^{-1} = (u, m, l)^{-1} \tag{4}$$

The second step in the FAHP is consistency ratio (*C.R.)* verification. It is assumed that the value of *C.R.* for matrix (3 × 3) and (4x4), should be adequate accordingly, less than or equal to 5% and 8%, while for larger matrices it should not exceed 10% (*C.R.* ≤ 10%). In that case consistency ratio *C.R.* is accepted, and the comparisons made are considered consistent. At this stage, FAHP method is based on the calculation of a defuzzified, normalized matrix for selected criteria and the largest own size of the matrix (λ_{max}). The author of the method proved that pairwise comparisons are all the more consistent, when the λ_{max} value is similar to the number of matrix elements n. On this basis, the calculation of the *C.I* consistency index (according to the formula 5):

$$C.I. = \frac{\lambda_{max} - n}{n-1} \tag{5}$$

and consistency ratio *C.R.* were proposed (formula 6):

$$C.R. = \frac{100\% * C.I.}{R.I.} \tag{6}$$

where *R.I* is a random consistency index, generated from several thousand matrices.

After verifying that the experts' opinions are consistent, fuzzy geometric mean $\tilde{r}_i$ (formula 7) and fuzzy weights $\tilde{w}_i$ for all the criteria were calculated (formula 8):

$$\tilde{r}_i = \left((\prod_{i=1}^{n} \{l\})^{\frac{1}{n}}, (\prod_{i=1}^{n} \{m\})^{\frac{1}{n}}, (\prod_{i=1}^{n} \{u\})^{\frac{1}{n}} \right) \quad (7)$$

$$\tilde{w}_i = \tilde{r}_i \otimes (\tilde{r}_1 \oplus \tilde{r}_2 \oplus \ldots \oplus \tilde{r}_n)^{-1} \quad (8)$$

Next, fuzzy weights were defuzzified into crisp values w_i , with centre of area method (formula 9) and then normalized to w_{i-norm} values, according to formula (10):

$$w_i = \frac{(l_i + m_i + u_i)}{3} \quad (9)$$

$$w_{i-norm} = \frac{w_i}{\sum_{i=1}^{n} w_i} \quad (10)$$

Finally, based on the geometric mean, the results from 9 experts were aggregated and thus the final weights for the 9 criteria were obtained (Tables 3, 4 and 5).

Table 3. *Fuzzy AHP pairwise comparison of 9 criteria and weight calculation by Expert 1 – part 1*

	NTA			**ATA**			**RI**			**AB**			**CB**		
NTA	**1.00**	**1.00**	**1.00**	1.00	1.00	1.00	2.00	3.00	4.00	1.00	1.00	1.00	1.00	2.00	3.00
ATA	1.00	1.00	1.00	**1.00**	**1.00**	**1.00**	1.00	1.00	1.00	1.00	2.00	3.00	2.00	3.00	4.00
RI	0.25	0.33	0.50	1.00	1.00	1.00	**1.00**	**1.00**	**1.00**	1.00	2.00	3.00	2.00	3.00	4.00
AB	1.00	1.00	1.00	0.33	0.50	1.00	0.33	0.50	1.00	**1.00**	**1.00**	**1.00**	2.00	3.00	4.00
CB	0.33	0.50	1.00	0.25	0.33	0.50	0.25	0.33	0.50	0.25	0.33	0.50	**1.00**	**1.00**	**1.00**
TA	0.20	0.25	0.33	0.20	0.25	0.33	0.17	0.20	0.25	0.17	0.20	0.25	0.25	0.33	0.50
EP	0.17	0.20	0.25	0.20	0.25	0.33	0.17	0.20	0.25	0.25	0.33	0.50	0.25	0.33	0.50
PI	0.17	0.20	0.17	0.20	0.25	0.33	0.25	0.33	0.50	0.17	0.20	0.25	0.25	0.33	0.50
SFD	0.17	0.20	0.25	0.20	0.25	0.33	0.17	0.20	0.25	0.17	0.20	0.25	0.17	0.20	0.25

Source: *Own elaboration.*

Table 4. *Fuzzy AHP pairwise comparison of 9 criteria and weight calculation by Expert 1 – part 2*

	TA			**EP**			**PI**			**SFD**		
NTA	3.00	4.00	5.00	4.00	5.00	6.00	4.00	5.00	6.00	4.00	5.00	6.00
ATA	3.00	4.00	5.00	3.00	4.00	5.00	3.00	4.00	5.00	3.00	4.00	5.00
RI	4.00	5.00	6.00	4.00	5.00	6.00	2.00	3.00	4.00	4.00	5.00	6.00
AB	4.00	5.00	6.00	2.00	3.00	4.00	4.00	5.00	6.00	4.00	5.00	6.00
CB	2.00	3.00	4.00	2.00	3.00	4.00	2.00	3.00	4.00	4.00	5.00	6.00
TA	**1.00**	**1.00**	**1.00**	1.00	2.00	3.00	0.33	0.50	1.00	0.33	0.50	1.00

EP	0.33	0.50	1.00	**1.00**	**1.00**	**1.00**	1.00	1.00	1.00	4.00	5.00	6.00
PI	1.00	2.00	3.00	1.00	1.00	1.00	**1.00**	**1.00**	**1.00**	2.00	3.00	4.00
SFD	1.00	2.00	3.00	0.17	0.20	0.25	0.25	0.33	0.50	**1.00**	**1.00**	**1.00**

Source: *Own elaboration.*

Table 5. *Fuzzy AHP pairwise comparison of 9 criteria and weight calculation by Expert 1 – part 3, (l - lower fuzzy number, m - middle fuzzy number, u - upper fuzzy number, COA – centre of area (defuzzification method))*

	Geometric mean			**Fuzzy weight**			**Centre of area**	**Weight**
	l	**M**	**u**	**l**	**m**	**u**		
NTA	1.94	2.43	2.86	0.13	0.21	0.32	0.22	**20.42%**
ATA	1.76	2.26	2.70	0.12	0.19	0.30	0.20	**19.00%**
RI	1.59	2.09	2.59	0.11	0.18	0.29	0.19	**17.80%**
AB	1.45	1.87	2.47	0.10	0.16	0.27	0.18	**16.54%**
CB	0.82	1.11	1.54	0.06	0.10	0.17	0.11	**9.96%**
TA	0.32	0.42	0.60	0.02	0.04	0.07	0.04	**3.86%**
EP	0.43	0.52	0.68	0.03	0.04	0.08	0.05	**4.62%**
PI	0.45	0.57	0.70	0.03	0.05	0.08	0.05	**4.88%**
SFD	0.26	0.34	0.43	0.02	0.03	0.05	0.03	**2.92%**
Sum	**9.01**	**11.61**	**14.57**			**Sum**	**1.08**	**100.00%**
Reciprocal	**0.07**	**0.09**	**0.11**					

Source: *Own elaboration.*

The next stage of the FAHP analysis was the application of the same analytical technique (formulas 3 – 10) to all sub-criteria. In the presented research model, the analysis covers 9 groups of criteria (comparison of all sub-criteria within the criteria group) and was performed by 9 experts (81 tables).

After accepting (FAHP consistency test, CR<10%) and combining (geometric mean) the 9 experts assessments for all pairwise comparisons (criteria and sub-criteria), the results were obtained for:

- weights for 9 criteria,
- local weights for 45 sub-criteria
- global weights for 45 sub-criteria (product of criteria weight and local sub-criteria weight, Table 6).

Table 6. *List of global weights for all 45 sub-criteria*

NTA1	NTA2	NTA3	NTA4	NTA5	NTA6		
6.05%	6.86%	3.17%	2.12%	1.35%	0.88%		
ATA1	ATA2	ATA3					
7.30%	5.94%	4.26%					
RI1	RI2	RI3	RI4	RI5	RI6	RI7	RI8
2.09%	1.35%	2.08%	1.16%	0.82%	0.69%	0.59%	2.04%
AB1	AB2	AB3	AB4	AB5	AB6	AB7	
2.36%	3.19%	2.96%	2.41%	1.44%	1.50%	1.14%	
CB1	CB2	CB3	CB4				
5.38%	2.64%	1.67%	0.95%				

TA1	TA2	TA3				
3.48%	2.86%	0.83%				
EP1	EP2	EP3				
2.64%	3.64%	1.86%				
PI1	PI2	PI3	PI4			
1.85%	0.56%	1.45%	1.29%			
SFD1	SFD2	SFD3	SFD4	SFD5	SFD6	SFD7
0.57%	0.69%	0.96%	1.21%	0.74%	0.56%	0.42%

Source: *Own elaboration.*

3.4 Ranking of Counties' Competitiveness in the Western Pomeranian Voivodship in 2017-2019 – Promethee II Method

The next stage of the research, the Promethee II method was adopted to determine the ranking of counties tourism competitiveness according to the selected criteria. In the PROMETHEE II method (Preference Ranking Organization Method for Enrichment Evaluation), pairwise comparisons and the outranking relation are used. This method combines positive and negative preference flows to determine how much a given variant exceeds others and how much it is exceeded by other variants. For each pair of variants, an aggregated preference index is computed, followed by the positive and negative flow of outranking.

An important element in the Promethee II analysis is to understand the nature of the assessment, which can take on the characteristics of beneficial or non-beneficial (cost) criteria. In the analysed example, sub- criterion EP1 – emission of gaseous pollutants, EP3 – emission of dust pollutants, SFD5 – offenses detected by the police in completed preparatory proceedings, SFD6 – fires, SFD7 – local threats are cost criteria (the desired value should be kept to a minimum); the remaining sub-criteria are beneficial for which the desired values are going to the maximum.

The second stage of the analysis is the normalization of the values in the decision matrix; for the beneficial criteria - formula 11; for the non-beneficial criteria – formula 12:

$$R_{ij} = \frac{[x_{ij} - \min(x_{ij})]}{[\max(x_{ij}) - \min(x_{ij})]} \quad (11)$$

$$R_{ij} = \frac{[\max(x_{ij}) - x_{ij}]}{[\max(x_{ij}) - \min(x_{ij})]} \quad (12)$$

where:

- i = 1,2, ..., m
- j = 1,2, ..., n
- x_{ij} - value for column j and row i
- R_{ij} - normalized value for column j and row i

- min, max - minimal and maximal values

The next stage of the analysis was to calculate the difference of individual county with respect to each other, with regard to the selected criteria. Subsequently, according to the basic preference function in Promethee II method, values <= 0 were assigned the value 0 (formula 13), and the other results, i.e., values> 0, remained unchanged (the difference between counties was retained, formula 14). The results for 21 counties and NTA sub-criteria are presented in Table 7.

$$P_j(a,b) = 0 \quad dla\ R_{aj} - R_{bj} \leq 0 \qquad (13)$$

$$P_j(a,b) = \left(R_{aj} - R_{bj}\right) \quad dla\ R_{aj} - R_{bj} > 0 \qquad (14)$$

Then, based on the weights obtained with the fuzzy AHP method, the weighted difference of individual preference functions were calculated (formula 15) and the results for all rows were summed (formula 16).

$$w_j * p_j(a,b) \qquad (15)$$

$$\frac{\sum_{j=1}^{n} w_j * p_j(a,b)}{\sum_{j=1}^{n} w_j} \qquad (16)$$

where:

- w_j – weighting for the criterion in column j
- $\sum_{j=1}^{n} w_j$ sum of weights for all criteria = 1 (100%)

Based on the obtained results, the matrix of the aggregated preference function was built for the 21 examined counties (m = 21) and the positive (formula 17) and negative (formula 18) values of the preference flows φ^+ and φ^- were calculated.

$$\varphi^+ = \frac{1}{m-1}\sum_{b=1}^{m} P(a,b) \qquad (a \neq b) \qquad (17)$$

$$\varphi^- = \frac{1}{m-1}\sum_{b=1}^{m} P(b,a) \qquad (a \neq b) \qquad (18)$$

The last step in the PROMETHEE II method is to determine the overall ranking of the analysed decision variants by calculating the flow of net preferences (formula 19). The results sorted in descending order are presented in Table 8.

$$\varphi(a) = \varphi^+(a) - \varphi^-(a) \qquad (19)$$

Table 7. *Calculation after taking into account global weights (sum applies to all 45 sub-criteria)*

County difference/weight		NTA1	NTA2	NTA3	NTA4	NTA5	NTA6	…	SFD7	Sum
		6.05%	6.86%	3.17%	2.12%	1.35%	0.88%	⋯	0.42%	
C1 -	**C2**	0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	⋯	0.0050	**0.0928**
C1 -	**C3**	0.0000	0.0000	0.0000	0.0000	0.0092	0.0000	⋯	0.0050	**0.0848**
C1 -	**C4**	0.0056	0.0000	0.0000	0.0000	0.0037	0.0000	⋯	0.0000	**0.0514**
C1 -	**C5**	0.0262	0.0000	0.0000	0.0000	0.0037	0.0000	⋯	0.0000	**0.0937**
C1 -	**C6**	0.0095	0.0000	0.0000	0.0000	0.0000	0.0000	⋯	0.0050	**0.1310**
C1 -	**C7**	0.0171	0.0000	0.0000	0.0000	0.0110	0.0125	⋯	0.0453	**0.1448**
C1 -	**C8**	0.0251	0.0000	0.0000	0.0000	0.0000	0.0000	⋯	0.0050	**0.1052**
C1 -	**C9**	0.0000	0.0000	0.0000	0.0000	0.0018	0.0076	⋯	0.0101	**0.0599**
C1 -	**C10**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	⋯	0.0151	**0.0659**
C1 -	**C11**	0.0090	0.0000	0.0070	0.0000	0.0165	0.0000	⋯	0.0000	**0.1317**
C1 -	**C12**	0.0438	0.0000	0.0063	0.0002	0.0000	0.0036	⋯	0.0000	**0.1736**
C1 -	**C13**	0.0163	0.0000	0.0000	0.0000	0.0147	0.0143	⋯	0.0151	**0.1140**
C1 -	**C14**	0.0211	0.0000	0.0000	0.0000	0.0000	0.0000	⋯	0.0000	**0.0935**
C1 -	**C15**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0148	⋯	0.0000	**0.0853**
C1 -	**C16**	0.0071	0.0000	0.0000	0.0000	0.0147	0.0081	⋯	0.0101	**0.0913**
C1 -	**C17**	0.0000	0.0000	0.0000	0.0000	0.0128	0.0000	⋯	0.0151	**0.1069**
C1 -	**C18**	0.0121	0.0000	0.0000	0.0000	0.0000	0.0000	⋯	0.0151	**0.1043**
C1 -	**C19**	0.0084	0.0000	0.0011	0.0000	0.0037	0.0031	⋯	0.0000	**0.1078**
C1 -	**C20**	0.0308	0.0000	0.0033	0.0000	0.0000	0.0000	⋯	0.0000	**0.2151**
C1 -	**C21**	0.0252	0.0000	0.0063	0.0000	0.0165	0.0166	⋯	0.0302	**0.2195**

Source: *Own elaboration.*

Table 8. *Final competitiveness counties ranking*

No.	County name	C. no.	Ranking	%
1	Kołobrzeski	C8	1.09	100.00%
2	Szczecin	C20	0.52	47.73%
3	Koszaliński	C9	0.41	38.02%
4	Gryficki	C5	0.35	32.49%
5	Kamieński	C7	0.27	25.11%
6	Sławieński	C13	0.27	24.79%
7	Świnoujście	C21	0.14	12.60%
8	Stargardzki	C14	-0.05	-4.36%
9	Koszalin	C19	-0.06	-5.64%
10	Drawski	C3	-0.07	-6.79%
11	Szczecinecki	C15	-0.12	-11.27%
12	Goleniowski	C4	-0.16	-14.73%
13	Myśliborski	C10	-0.17	-15.31%
14	Wałecki	C17	-0.17	-15.81%
15	Gryfiński	C6	-0.24	-21.78%
16	Policki	C11	-0.27	-24.44%
17	Choszczeński	C2	-0.27	-24.83%
18	Świdwiński	C16	-0.30	-27.74%
19	Białogardzki	C1	-0.34	-31.21%

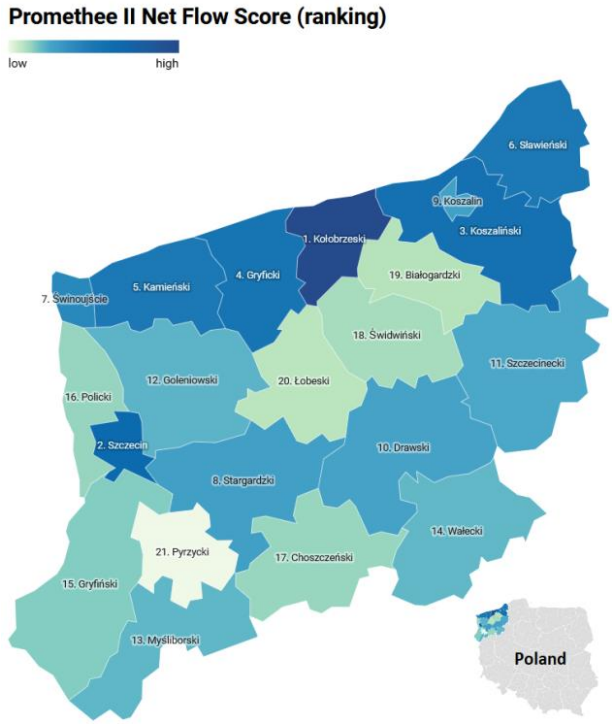
20	Łobeski	C18	-0.35	-31.95%
21	Pyrzycki	C12	-0.48	-43.89%

Source: *Own elaboration.*

4. Results and Discussion

The first step in the analysis is to build a map of counties in the West Pomeranian (WP) Voivodeship based on the final ranking of the Promethee II method (Figure 3), which, together with the obtained results, enables the initial division of the WP Voivodeship into clusters. Assuming that the best result obtained for the kołobrzeski county is 100%, the percentages were calculated for the remaining counties and a division of the WP voivodeship into 5 clusters was proposed (Figure 4).

Figure 3. *Final tourism competitiveness ranking - graphical approach*

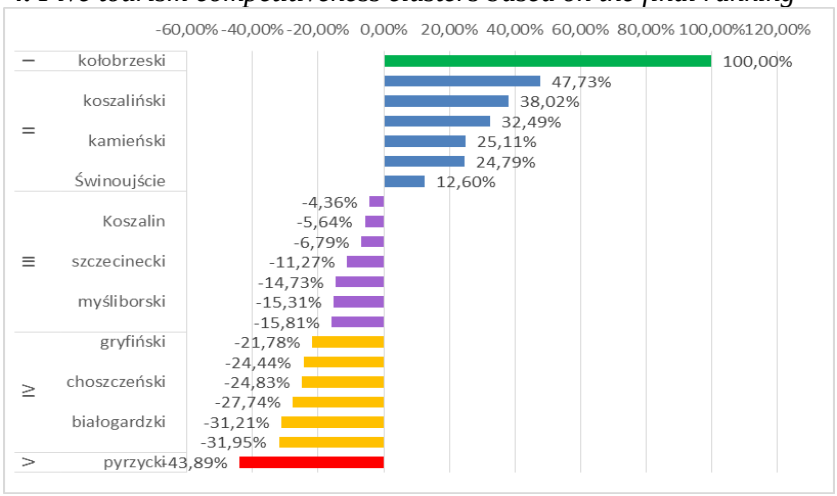


Source: *Own elaboration based on Data Wrapper.*

The presented ranking allowed for the identification of 5 counties clusters characterized by selected criteria and sub-criteria. The competitiveness of Kołobrzeg county, as a representative of cluster I, is determined by a very high level of sub-criteria in the field of recreational, accommodation and catering infrastructure, a high level of transport accessibility, as well as safety and facilities for tourists with disabilities. Moreover, there was noted a varied level of sub-criteria (among natural and anthropogenic values) such as, low level of forestation, water areas or a small number of historic monuments, but a high or very high level of recreational parks

and a large green areas. Among almost all analysed sub-criteria of Kołobrzeg county, their high or very high level is noticeable, which results in the first position in the ranking.

Figure 4. *Five tourism competitiveness clusters based on the final ranking*



Source: *Own elaboration.*

The competitiveness of the counties located in cluster II is determined by a greater level diversificationof the analysed sub-criteria, especially in terms of natural and anthropogenic values. The level of the analysed sub-criteria was predominantly high, especially with regard to the criterion of recreational and catering infrastructure, accommodation and transport accessibility.

A noticeable decrease in the value of sub-criteria was recorded among the counties belonging to cluster III and IV. In this case, the dominant indicators showed a low tourism competitiveness of the studied areas. The criterion that influenced the assignment to clusters III and IV was primarily related to the sub-criteria in the field of natural values. Their high rates made it possible to achieve a higher position in the ranking. Moreover, there is a noticeable low level of sub-criteria in regards to accommodation and recreation infrastructure, catering and facilities for people with disabilities. The indicated counties also faced a problem concerning the municipal management in terms of the amount of segregated waste. Cluster V includes Pyrzycki county, whose tourism competitiveness is determined by the low or very low level of almost all analysed sub-criteria, excluding such aspects as: recreational parks, monuments or safety aspects.

In the next step, the impact of individual sub-criteria on the tourism was analysed (the types of criteria were divided by colour (green - NTA, red - ATA, ... SDF - teal, etc.). Each column is proportional to the contribution of one sub-criterion (flow value times the global weight of the sub-criterion) to the final net flow score

(tourism competitiveness performance). Positive (upward) columns correspond to good features while negative (downward) columns correspond to weaknesses.

Figures 5 6, 7, 8 show the results for the first two (Kołobrzeski country and Szczecin county) and the last two counties in the ranking (Łobeski and Pyrzycki). An important element of conducting scientific research is a critical approach to the obtained results and the selected research model. From this point of view, it is assumed that the proposed concept is universal, but it can also be a starting point for further, in-depth analyses and scientific discussions, indicating potential modifications of specific elements, both in terms of content and methodology. The most important of them include:

1. The key stage of the analysis is the proper selection of criteria and sub-criteria determining the level of tourism competitiveness of the studied regions. From this point of view, the proposed set of 45 factors is a subjectively selected set, that may be subject to any modification, depending on the purpose of the study and the scope of the analysed data.
2. The second important element influencing the final result of the study are the weights of individual factors determining the region tourism competitiveness, (the point of view and the distribution of emphasis by a selected group of experts).
3. In the adopted FDM and FAHP methods, the main role is played by the knowledge of experts who evaluate criteria and sub-criteria based on their own experience and competences. From this point of view, both the purpose of the analysis and the selection of individual experts are important for the final results of the study.
4. In terms of methodology, the following methods deserve attention: FDM, FAHP and PROMETHEE II. A question arises about the possibility of modifying the research model both in the area of selecting methods (e.g., parallel analysis of tourism competitiveness based on other models (e.g., AHP, TOPSIS, ELECTRE, VIKOR etc.) and comparing the results, and in the method itself (e.g. no fuzzy logic in the delphi and AHP methods, changing the data normalization formula, using other preference functions in the PROMETHEE II method, etc.).

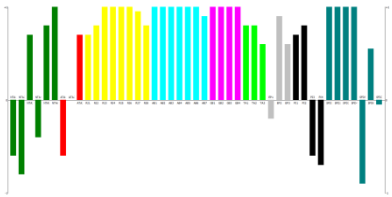


***Figure 5. The impact of sub-criteria on the** Kołobrzeski county tourism competitiveness (ranking no. 1).*

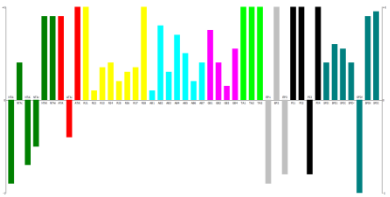


***Figure 6. The impact of sub-criteria on the** Szczecin county tourism competitiveness (ranking no. 2).*

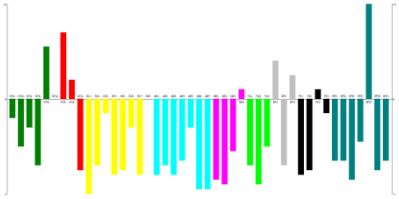


***Figure 7. The impact of sub-criteria on the** Łobeski county tourism competitiveness (ranking no. 20).*

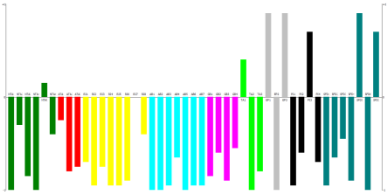


***Figure 8. The impact of sub-criteria on the** Pyrzycki county tourism competitiveness (ranking no. 21).*

***Source:** Own elaboration based on Visual Promethee software.*

To sum up, it should be noted that regardless of the substantive problems (selection of criteria and sub-criteria, selection of the surveyed regions, weighting factors) and methodological (model selection), the use of multiple-criteria methods is increasingly used among decision-makers responsible for regional tourism policy. Each subsequent empirical study and new computational models are a step towards the search for decision-making tools describing the socio-economic reality in the context of the region tourism competitiveness.

5. Recommendations for Future Research

According to the authors, it may be an interesting direction for future research to look at the issues of tourism competitiveness in the context of changes in tourism preferences in the face of the Covid-19 virus pandemic. A sharp decline in tourist trips, inaccessibility of recreational centres and catering points may completely change the perception of the counties tourism competitiveness.

Moreover, in such an unusual situation as a global pandemic, it may turn out that the selected sub-criteria change their character and are no longer such important factors determining tourism competitiveness (and in extreme cases, the vectors may be reversed: the beneficial criteria becomes a non-beneficial or vice versa).Therefore, it seems justified to re-examine the level of tourism competitiveness of 21 counties in the West Pomeranian Voivodeship, based on the FDM-FAHP-PROMETHEE II model for 2020.

6. Conclusions

The conducted theoretical and empirical research can be considered the basis for further, in-depth research and scientific discussions. However, it is already possible to make a preliminary summary concerning both the theoretical area, in terms of the issues of tourism competitiveness, and the empirical area, concerning the studied area, i.e., the West Pomeranian Voivodeship.

The most important conclusions regarding the issues of tourism competitiveness of the West Pomeranian Voivodeship include:

1. The most important criteria for the level of tourism competitiveness of an area include natural tourist attraction, anthropological tourist attractions, accommodation base, recreational infrastructure and catering base. The criterion of safety and facilities for disabled tourists and para-tourist infrastructure is of little importance for the level of tourism competitiveness.
2. Taking into account the geographical distribution of the surveyed counties, the areas with the highest level of tourism competitiveness are coastal areas, which is primarily related to the access of these areas to the Baltic Sea, as well as a large number of accommodation facilities, attractions being the target of cognitive tourism and entities providing leisure time management services during unfavourable weather conditions.
3. Counties with a relatively high level of tourism competitiveness include areas with access to water reservoirs in the form of lakes and rivers, which are the basis of water tourism, in particular canoeing and sailing tourism, which the West Pomeranian Voivodeship is particularly associated with.
4. Counties characterized by a relatively high level of tourism competitiveness are also areas with large and medium-sized cities that have tourist potential in the form of a large number of anthropogenic attractions, which is the basis of cognitive tourism.
5. The county with the highest level of tourism competitiveness is Kołobrzeg county (a health resort, with access to the sea, a very large number of accommodation (including hotels providing services at the highest level and amenities dedicated to spa tourism), recreational and catering facilities, characterized by high accessibility). Whereas county with the lowest tourism competitiveness was Pyrzycki county (characterized by the lack of a tourist image associated with insufficient tourist potential in terms of the main criteria determining the tourism competitiveness of a destination).

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