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THE EDUCATIONAL AND CULTURAL RANKING OF LOWER SILESIAN CITIES

RANKING MIAST WOJEWÓDZTWA DOLNOŚLĄSKIEGO W WYMIARZE EDUKACYJNO-KULTURALNYM

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Summary: The educational and cultural dimension is a multivariate category, characterized by many attributes (e.g. number of students and academic teachers, educational institutions, library readers, library borrowers and visitors to the museums, etc.). This means the possibility of perceiving regions as objects of multidimensional statistical analysis, and ordering them according to a certain criterion. The paper presents the similarities and differences between selected cities of the Lower Silesia region with a population of over 30,000 inhabitants in the educational and cultural scope. For this purpose, a set of diagnostic variables (stimulants and destimulants) was defined. This allowed specifying the most and least differences between the surveyed objects and consequently the order of the cities from the best city to the worst one. Finally, this allowed the creation of the educational and cultural ranking of Lower Silesian cities.

Keywords: multidimensional statistical analysis, educational and cultural situation of cities, Lower Silesia region.

Streszczenie: Wymiar edukacyjno-kulturalny to kategoria złożona, charakteryzowana przez wiele atrybutów (np. liczbę: uczniów i studentów, nauczycieli akademickich, placówek edukacyjnych, czytelników bibliotek, wypożyczeń księgozbiorów czy osób zwiedzających muzea). Oznacza to możliwość postrzegania regionów (gmin, powiatów, województw) jako obiektów wielowymiarowej analizy statystycznej, a co za tym idzie – np. porządkowania ich według określonego kryterium. W artykule zbadano podobieństwa oraz różnice między wybranymi regionami województwa dolnośląskiego w postaci miast o liczbie ludności powyżej 30 000 mieszkańców w wymiarze edukacyjno-kulturalnym. W tym celu wytypowano zbiór zmiennych diagnostycznych w postaci cech (stymulant oraz destymulant) określających m.in. kulturalną wartość poszczególnych miast. Pozwoliło to na wyspecyfikowanie elementów najbardziej oraz najmniej różnicujących badane obiekty, a dzięki temu uporządkowanie miast od najlepszego do najgorszego. Ostatecznie umożliwiło to utworzenie edukacyjno-kulturalnego rankingu miast województwa dolnośląskiego.

Słowa kluczowe: wielowymiarowa analiza statystyczna, sytuacja edukacyjno-kulturalna miast, województwo dolnośląskie.

1. Introduction

In the development of regions, cities play a central role. They concentrate most of the economic and social activity of the region in which the greatest disproportions in the field of the potential are observed. Cities are the centers of social and economic, as well as scientific and cultural life.

The educational and cultural dimension is a multivariate category, characterized by many attributes (e.g. number of students and academic teachers, educational institutions, library readers, library borrowers and visitors to the museums, etc.). This means the possibility of perceiving regions as objects of multidimensional statistical analysis, and ordering them according to a certain criterion.

The aim of the article is a comparative analysis of the educational and cultural situation of Lower Silesian cities with a population of over 30,000 inhabitants. For this purpose, a set of diagnostic variables which identify the educational and cultural value of the cities was defined to show the relations between the compared objects as a ranking of Lower Silesian cities.

In the design of the ranking, the method of multidimensional statistical analysis in the form of linear ordering using the GDM distance measure (GDM1 for metric data) was applied. The source data was downloaded from the Local Data Bank of the Central Statistical Office of Poland (analyzed data are from 2013 to 2016). In the all calculations the environment of R program and the clusterSim R package were used.

2. Research tool applied

For the purposes of determining the similarities and differences in the educational and cultural situation of Lower Silesian cities, the method of linear ordering was used in this study. The method enables ordering the objects from the best one to the worst one according to a considered criterion. The theoretical basis of the method and example of ordering the application in marketing research were presented in Hellwig's[1] work [Hellwig 1968]. This publication initiated intensive research in this area, which resulted in further proposals for linear ordering methods [Bartosiewicz 1976; Borys 1978; Cieślak 1974; Nowak 1984; Pluta 1976; Strahl 1978; Walesiak 1993].

The process of ordering objects is based on the method using the features of the synthetic measure of development – SMR [Hellwig 1968; Borys 1978; Strahl 1978]. It is very useful when the subject of the study is the development level of a phenomenon described by a set of many features that can be replaced with one synthetic variable. SMR is determined for each object, provided that the following assumptions are met:

[1] The concept of the pattern of development and the measure of development were first presented by Z. Hellwig in English at the UNESCO Conference in Warsaw in 1967 [Hellwig 1967].

- the subject of the analysis is a non-empty and finite set of objects and a finite set of variables relevant to the study, presented at least on the ordinal scale, comparable as a result of the normalization,
- there is a synthetic criterion for organizing objects which do not undergo direct measurement and the ordering relation is greater than the relation.

The research procedure allowing the visualization of linear ordering results for the set of objects using the GDM1 distance measure for metric data includes the following steps[2] [Walesiak 2016]:

1. The set of objects and the set of variables related to the analyzed complex phenomenon are determined. The variables used to describe the objects should be measured on a metric scale. The matrix $X = [x_{ij}]$ of observations is constructed where: x_{ij} – j-th variable value for i-th object, i = 1, …, n – object number and j = 1, …, m – variable number.

2. Among the variables the stimulants and destimulants are distinguished. If there are nominants as preferential variables they are transformed into stimulants.

3. To be comparable the data are normalized using a normalization formula [Walesiak 2006] into a normalized data matrix $[z_{ij}]$.

4. The pattern object (as the upper pole of development) and/or the anti-pattern object (as the lower pole of development) are fixed.

5. The distances between objects and pattern (or anti-pattern) using the GDM1 distance measure [Walesiak 2006; 2011] are calculated and arranged into a distance matrix $[\delta_{ij}]$.

6. The objects are ordered according to the increasing values of the GDM1 distance (the upper pole of development) or according to the decreasing values of the GDM1 distance (the lower pole of development).

7. The graphical presentation and interpretation of the linear ordering results are presented.

3. Conducted research

In the conducted research, all Lower Silesian cities with a population of over 30,000 inhabitants were selected. This means, that in the comparative analysis the following 13 cities of the Lower Silesia region were included: Bolesławiec, Zgorzelec, Jelenia Góra, Głogów, Lubin, Legnica, Bielawa, Dzierżoniów, Świdnica, Wałbrzych, Oleśnica, Oława and Wrocław. According to the data from 2016, Wrocław (the capital of the Lower Silesia region) is the city with the largest population (637 638 inhabitants), while Bielawa is the least populated (30 357 inhabitants) among the analyzed cities.

In order to identify the "best" and "worst" cities, as well as cities characterized by a specific cultural similarity, in the study the variables defining particular

[2] The general procedure of linear ordering for metric data based on a pattern object and the research procedure allowing the visualization of linear ordering results for the set of objects for metric data were presented by M. Walesiak [2016].

characteristics of the analyzed objects were specified. The selection of the diagnostic variables was made taking into account the statistical criteria. These restrictions mean that the original set of 16 characteristics was reduced. First, in the assessment we analyzed the coefficients of variation calculated for each variable, taking as a criterion for the exclusion of the given feature the coefficient of variation less than or equal to 4%, and in the evaluation of the correlation of variables a parametric method of selection of Hellwig's features was used [Hellwig 1981], taking the critical value of the correlation coefficient equal to 0.8 or higher. In this way, the original set of features was reduced to 11 indicators. Finally, the following diagnostic features were used (where: S – stimulants and D – destimulants):

x_1 – city population per 1 library facility (D),

x_2 – library collection per 1000 inhabitants of a city (S),

x_3 – number of public libraries' readers per 1000 inhabitants of a city (S),

x_4 – number of books' borrowed per 1 reader (S),

x_5 – number of centers, houses and cultural centers, clubs and common rooms per 1000 inhabitants of a city (S),

x_6 – city population per 1 place in cinemas (D),

x_7 – number of clubs per 1000 inhabitants of a city (S),

x_8 – number of club members per 1000 inhabitants of a city (S),

x_9 – number of artistic and entertainment, interdisciplinary and sports events per 1000 inhabitants of a city (S),

x_{10} – number of students per 1 branch in primary schools (D),

x_{11} – number of students per 1 branch in post-secondary schools (D).

Some examples of the variable values for all the analyzed objects for 2016 are presented in Table 1.

Table 1. Values of diagnostic variables of Lower Silesian cities (2016)

Specification item	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
Bolesławiec	19 583,50	3425,26	175,18	16,59	0,0255	83,51	0,6128	0,1277	19,51	22	13
Zgorzelec	7 772,25	2418,96	155,69	15,36	0,0322	53,51	0,5468	0,2573	8,75	19	32
Jelenia Góra	11 503,43	2656,13	137,98	23,32	0,0497	48,45	1,1798	0,0869	21,57	21	14
Głogów	17 073,00	1635,62	143,74	20,35	0,0146	135,23	0,4393	0,6296	22,45	21	18
Lubin	14 630,80	1500,16	134,78	24,24	0,0410	43,88	0,0957	0,7245	2,91	23	17
Legnica	6 294,88	3042,39	142,40	21,68	0,0298	76,42	0,3177	0,3475	7,52	21	24
Bielawa	30 357,00	2114,24	138,17	26,51	0,0659	379,46	0,6259	0,2635	16,04	21	19
Dzierżoniów	16 892,50	3041,70	187,56	29,86	0,0296	72,81	0,2960	0,0888	10,92	20	12
Świdnica	11 591,80	2356,87	217,54	17,19	0,0345	55,84	0,2243	0,0690	7,44	20	17
Wałbrzych	10 415,27	2522,14	136,61	22,35	0,0175	62,23	0,5673	0,1309	25,78	21	23
Oleśnica	18 683,00	1823,40	205,66	17,44	0,0535	122,51	0,5620	0,0535	19,83	22	17
Oława	8 193,25	2245,87	139,44	22,92	0,0610	94,99	0,3967	0,1526	12,08	21	12
Wrocław	16 350,85	1648,73	206,13	14,98	0,0204	47,54	1,0789	0,3795	7,43	20	19

Source: Local Data Bank of the Central Statistical Office of Poland.

4. Study results

A comparative analysis of Lower Silesian cities in the educational and cultural scope shows that from the point of view of the included indicators, "the most cultural" city (in three out of the four analyzed periods, including the last analyzed year, 2016) is Jelenia Góra (see Table 2), while "the least cultural" (depending on the analyzed year) is Lubin (2016), Oleśnica (2015) and Wałbrzych (2013-2014). Oława was first in the educational and cultural ranking in 2013. In the group of cities that stand out above the average there are Oława, Dzierżoniów and Bolesławiec. The city significantly far removed from the pattern is Wrocław, which seems to be a consequence of the included set of variables, where in the majority of cases the indicators taking into account the population of a given city predominate. The obtained results confirm that access to cultural institutions (cultural houses and centers, clubs) as well as the calendar of artistic events, etc. per 1000 inhabitants, is surprisingly better in many of the Lower Silesian cities than in Wrocław (see Table 2).

Table 2. Distances of the cities from the pattern object (2013-2016)

Specification item	Year			
	2013	2014	2015	2016
Jelenia Góra	0,2494	**0,2018**	**0,2101**	**0,2199**
Dzierżoniów	0,4211	0,3881	0,3612	0,2785
Oława	**0,1630**	0,2917	0,2784	0,3195
Wrocław	0,4751	0,4643	0,4390	0,3777
Bolesławiec	0,4866	0,3397	0,3940	0,3820
Wałbrzych	0,5362	0,5113	0,4762	0,3843
Legnica	0,4023	0,3889	0,4030	0,3899
Świdnica	0,3638	0,4065	0,4078	0,3934
Oleśnica	0,4616	0,4473	0,4988	0,4106
Głogów	0,4872	0,3897	0,4655	0,4159
Zgorzelec	0,4544	0,4707	0,4515	0,4328
Bielawa	0,4066	0,4483	0,4290	0,4477
Lubin	0,3927	0,4176	0,4813	0,5067

Source: own elaboration using R program.

The largest changes in the order of the cities were recorded in 2016. A notable conclusion is something like "chasing the leaders" by a group of cities (Legnica, Boleslawiec, Świdnica, Wrocław, Zgorzelec, Oleśnica, Wałbrzych, and Głogów) in 2016 in comparision to previous years. Among the "chasing cities", Wrocław and Wałbrzych recorded the biggest shift towards the leaders (see Figures 1-4 and Figure 5).

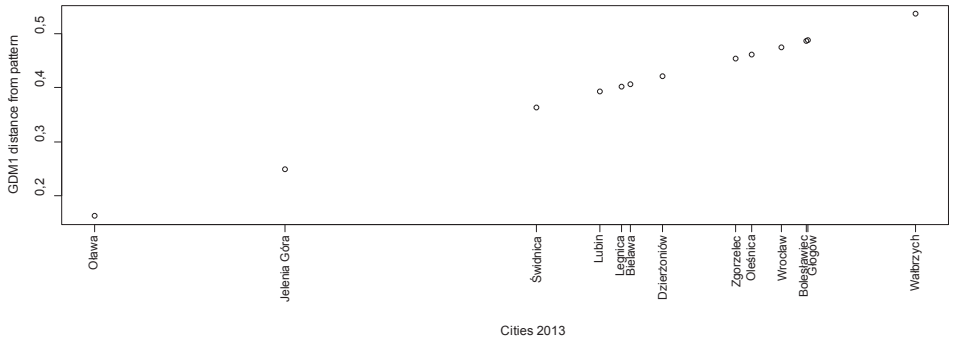

Fig. 1. Ranking of Lower Silesian cities from the best to the worst (2013)

Source: own elaboration using R program.

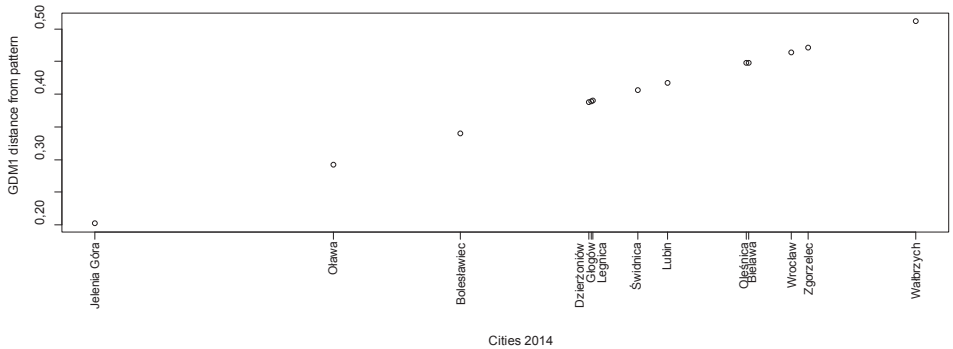

Fig. 2. Ranking of Lower Silesian cities from the best to the worst (2014)

Source: own elaboration using R program.

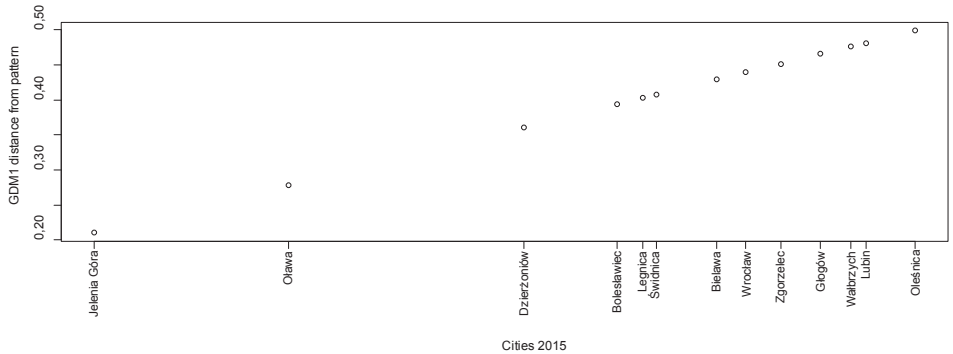

Fig. 3. Ranking of Lower Silesian cities from the best to the worst (2015)

Source: own elaboration using R program.

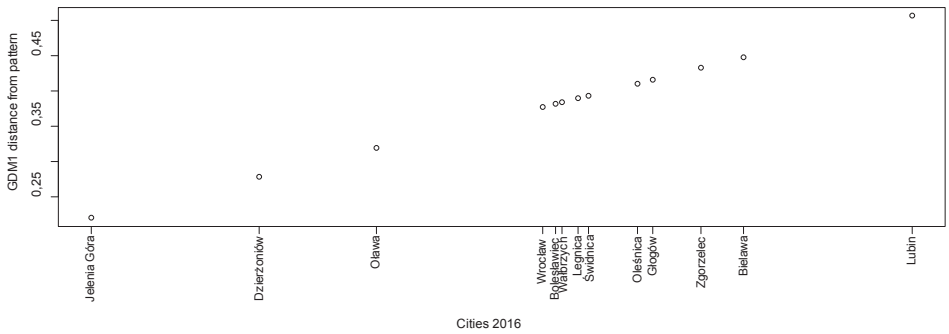

Fig. 4. Ranking of Lower Silesian cities from the best to the worst (2016)

Source: own elaboration using R program.

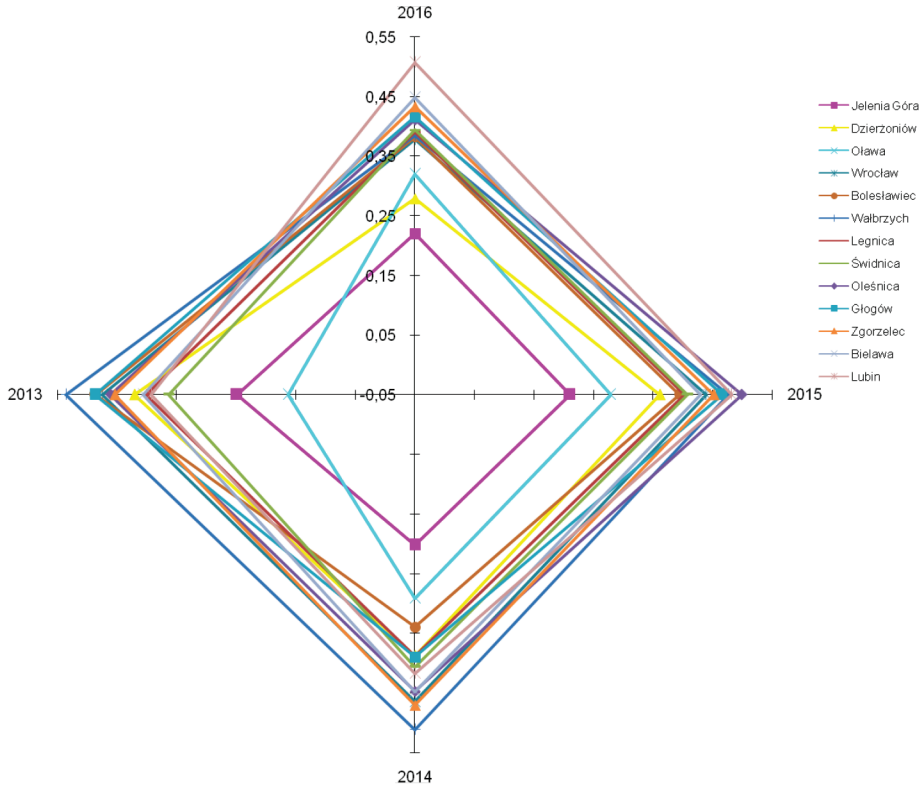

Fig. 5. Change of the rankings of Lower Silesian cities (2013-2016)

Source: own elaboration using R program.

From all the analyzed cities, Lubin recorded the largest regression in the ranking, systematically worsening its position in subsequent years (2013 – 4th place; 2014 – 8th place; 2015 – 12th place; 2016 – last, 13th place).

5. Conclusions

The research carried out in the form of linear ordering showed that there are major differences between the analyzed cities in their educational and cultural situation. In addition to selecting "the best" cities for each of the analyzed periods, the results of the research showed the smallest changes in the position of cities between 2013 and 2016, which indicate the regression and the progression of the selected cities.

The presented research confirms the need for further rankings of Lower Silesian cities in the educational and cultural dimension. The results presented in the article of linear ordering with limited data availability allow only for a preliminary analysis of the situation, which means that they do not exhaust the problem and should be treated as an introduction to further research.

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