Abstract. The phenomenon of unemployment and exacerbating demographic situation can be seen as major social problem of nowadays in Poland. The paper is an attempt to compare districts of the Małopolskie voivodeship with respect to chosen features characterizing these phenomena. On the basis of the data from the Central Statistical Office and with the help of taxonomic methods, grouping of districts has been carried out with respect to the level of features under investigation. The procedure allowed for distinguishing 5 groups of significant inter-group differentiation. The application of taxonomic methods resulted in obtaining a general and, at the same time, accurate picture of differentiation of the Małopolskie voivodeship with respect to social problems being analysed and distinction of districts with the most difficult situation in this area.

Key words: unemployment, demography, taxonomy, districts

INTRODUCTION

Demography and unemployment are the two topics that arise in the research within the social situation in Poland at present. Apart from social consequences, the phenomenon of unemployment has many negative economic and political results (Kwiatkowski, 2002). The most dangerous seems to be the long-term unemployment. The deficiency of income – especially in long term – caused rapid decrease of the quality of life and in long term leads to poverty. On the other hand, the inequalities in living standard may bring about protests and civil unrest. Alcoholism, drug addiction, an increase of crime level and other social pathologies can also be treated as further consequences of unemployment.

Unemployment is a very severe experience, no matter how old the person is. Unemployment of the youth needs particular attention. Ready to work young people with no possibility to realize their plans for life leave Poland and look for some occupation abroad. On the other hand, for people close to retirement age, unemployment means low income after retirement and therefore life on the edge of poverty.

Another important social problem – not only in our country – is aging of society, which is expressed in an increasing number of post-working age people and decreasing number of those at pre-working age. This process has been observed in Poland since the 90-ties of the XX century (Szymańczak, 2012). Low level of births in Poland – in 2014 reached nearly 1,3, while the minimum level needed for simple generation replacement should fit in the interval 2,10–2,15. Such low level of births results in aging and dying out of a society.

The intensity of the phenomena discussed in the paper is different in each region of the country. Therefore the important issue is to carry out the research on the level of voivodeships and districts. In the Małopolskie voivodeship the level of unemployment differs from year to year, but is constantly lower than the country...
average. In the period of 2008–2013 this coefficient had been systematically increasing from the level of 7.5% up to the level of 11.5% (Table 1). In absolute numbers this means the increase of the level of the unemployed from 97.8 thousand in 2008 up to 164.4 thousand in 2013. In 2014 the level of unemployment dropped down to 9.9%, which means 139,0 thousand of the unemployed.

The paper is an attempt to compare districts of the Małopolskie voivodeship with respect to the level of chosen features characterizing the phenomenon of unemployment and demographic situation. On the basis of the data from GUS (n.d.) and with the help of taxonomic methods grouping procedure of districts has been carried out with respect to the similarity of the level of features under investigation. Grouping procedure was based on the algorithm constructed on the method of vector (Chomątowski, 1978) with the combination of the method of best choice (Wysocki and Wagner, 1989). The application of taxonomic methods allowed for obtaining general and at the same time accurate picture of differentiation of the Małopolskie voivodeship with respect to the social problems discussed in the paper and determination of districts in this area in which the situation is the most difficult.

**RESEARCH METHOD**

The investigation procedure was based on the following set of variables (features) describing particular districts:

- $X_1$ – the partition of the number of the unemployed at the age of 24 and less in the total number of the unemployed in the district
- $X_2$ – the partition of the number of the unemployed at the age of 45–54 in the total number of the unemployed in the district
- $X_3$ – the partition of the number of the unemployed at the age of 55 and more in the total number of the unemployed in the district
- $X_4$ – the partition of the unemployed with no occupation for the period of 24 months and more in the total number of the unemployed in the district
- $X_5$ – the unemployment rate in the district
- $X_6$ – births per 1000 people in the district
- $X_7$ – the partition of the number of people in pre-working age in the total number of people in the district.

From the initial set of variables the features for which the coefficient of variability took low values were eliminated, that is the percentage of the unemployed at the age of 25–34 years, 35–44 years and the partition of number of people at working age. The coefficient of variability for these variables takes values from the interval of 0.01–0.08, therefore these variables have no influence on the results of grouping procedure.

The data can be represented in the form of a matrix:

$$ A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} = \begin{bmatrix} a_{ij} \end{bmatrix}_{i=1,..m \quad j=1,..n} \quad (1) $$

where $a_{ij}$ denotes the value of feature $j$ (variable) in the object $i$ (district).
The starting point for grouping of objects with respect to the similarity of features under investigation is the determination of differentiation measures (Kukula, 1989):

\[
ed_{ij} = \frac{1}{2} \sum_{i=1}^{n} |a_{ij} - a_{ji}| \quad (i, j = 1, ..., n)
\]

where \( \epsilon_{ij} \) – the differentiation measure between the object \( i \) and object \( j \).

Differentiation measures computed for each pair of objects (elements \( \epsilon_{ij} \)) form the matrix of structural differentiation \( E_{ij} \).

Then the value of average differentiation amongst objects is calculated \( \bar{\epsilon} \):

\[
\bar{\epsilon} = \frac{1}{n(n-1)} \sum_{i=1}^{n} \sum_{j=1}^{n} \epsilon_{ij}
\]

that in turn serve as a basis for further calculations – zero – one matrix \( E \), the elements of which \( \epsilon_{ij} \) – are defined as follows:

\[
\epsilon_{ij} = \begin{cases} 
0, & \text{when } \epsilon_{ij} < \beta \\
1, & \text{when } \epsilon_{ij} \geq \beta
\end{cases} \quad (4)
\]

For the matrix \( E \) the method of vector elimination is then applied (Chomątowski and Sokołowski, 1978), where repeating of the division procedure with different values of \( \beta \) led to distinction of 3 groups of many elements and 2 groups with one element only (Fig. 1):

For each grouping \( l \) the value of the function of quality of classification is determined \( F^{(l)} \):

\[
F^{(l)} = \sum_{k=1}^{m} F_{ik}, \quad l = 1, ..., L
\]

where \( F_{ik} \) – the index of quality of grouping of the variable \( k \):

\[
F_{ik} = \frac{s_{ik}^2}{s_{ik}^2} / (n-1)
\]

\( m \) – the number of groups delimited at a given level of \( \beta \)

\( s_{ik}^2 \) – general variance of the variable \( k \)

\( s_{ik}^2 \) – inner-group variance for variable \( k \).

The optimum division is the division \( l_{0} \), at which the function \( F^{(l)} \) takes its highest value \( F^{(l_{0})} = \max \{ F^{(1)}, ..., F^{(L)} \} \). The value of \( \beta = \beta_{0} \) corresponding with this division is the sought step value.

**INVESTIGATION RESULTS**

The research has been carried out on the basis of the data from Local Data Base of the Central Statistical Office that represented realization of variables mentioned in the previous section for districts of the Małopolskie voivodeship in 2014. For each feature the arithmetic mean was computed, as well as standard deviation and the coefficient of variability. In addition the minimum and maximum values for these variables were given (Table 2).

From the data presented in the table 2 it follows that the districts of the Małopolskie voivodeship are differentiated significantly with respect to the level of the features chosen for the analysis. The partition of the number of people unemployed in the age of 24 and less in the total number of the unemployed oscillates from 9.4% in the Kraków district to 33.3% in Proszowicki district. The rate of unemployment takes values from 5.2% in the Kraków district to 17.1% in Dąbrowski district. These values are significantly different from average values for the voivodeship, that reach the level of 20.7 and 9.9% respectively. Similar differentiation can be observed in case of other features participating in the analysis.

On the basis of the method presented in previous sections, grouping of districts was carried out with respect to the level of the features under investigation, which led to distinction of 3 groups of many elements and 2 groups with one element only (Fig. 1):

Group I consists of 10 districts: Bocheński, Myślenicki, Gorlicki, Nowosądecki, Nowotarski, Tatrzaska, Suski, Wadowicki, Brzeski, Tarnowski.

Group II comprises 7 districts: Krakowski, Wielicki, Nowy Sącz, Chrzanowski, Olkuski, Oświęcimski, Tarnów.

Group III has 3 districts: Miechowski, Proszowicki, Dąbrowski.
Table 2. Values of individual characteristics and their characteristics in the districts of the Małopolskie voivodeship in 2014
Tabela 2. Wartości poszczególnych zmiennych i ich charakterystyki w powiatach województwa małopolskiego w roku 2014

<table>
<thead>
<tr>
<th>Districts</th>
<th>Number of the unemployed Liczba bezrobotnych</th>
<th>Feature – Cecha (%)</th>
<th>$X_1$</th>
<th>$X_2$</th>
<th>$X_3$</th>
<th>$X_4$</th>
<th>$X_5$</th>
<th>$X_6$</th>
<th>$X_7$</th>
</tr>
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<tbody>
<tr>
<td>Bocheński</td>
<td>3 698</td>
<td>26,5</td>
<td>15,1</td>
<td>11,7</td>
<td>26,5</td>
<td>9,5</td>
<td>12</td>
<td>21,1</td>
<td></td>
</tr>
<tr>
<td>Krakowski</td>
<td>8 045</td>
<td>20,1</td>
<td>18,0</td>
<td>15,8</td>
<td>20,0</td>
<td>8,5</td>
<td>10</td>
<td>19,8</td>
<td></td>
</tr>
<tr>
<td>Miechowski</td>
<td>2 010</td>
<td>28,6</td>
<td>13,4</td>
<td>10,7</td>
<td>26,3</td>
<td>9,5</td>
<td>9,9</td>
<td>17,2</td>
<td></td>
</tr>
<tr>
<td>Myślenicki</td>
<td>4 879</td>
<td>24,4</td>
<td>16,8</td>
<td>11,3</td>
<td>20,7</td>
<td>10,7</td>
<td>11,3</td>
<td>21,8</td>
<td></td>
</tr>
<tr>
<td>Proszowski</td>
<td>2 064</td>
<td>33,3</td>
<td>11,4</td>
<td>9,2</td>
<td>26,3</td>
<td>11,2</td>
<td>9,4</td>
<td>18,1</td>
<td></td>
</tr>
<tr>
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<td>17,0</td>
<td>17,9</td>
<td>17,6</td>
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<td>9,7</td>
<td>10,5</td>
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</tr>
<tr>
<td>Kraków</td>
<td>21 948</td>
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<td>20,8</td>
<td>20,5</td>
<td>22,6</td>
<td>5,2</td>
<td>9,9</td>
<td>15,7</td>
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<tr>
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<td>17,2</td>
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<td>23,0</td>
<td>12,5</td>
<td>10,6</td>
<td>20,1</td>
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<tr>
<td>Limanowski</td>
<td>8 815</td>
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<td>16,4</td>
<td>8,5</td>
<td>31,2</td>
<td>16,0</td>
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<td>24,1</td>
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<tr>
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<td>17,3</td>
<td>9,3</td>
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<td>12,3</td>
<td>23,6</td>
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<td>16,3</td>
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<td>25,7</td>
<td>13,3</td>
<td>10,2</td>
<td>21,1</td>
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</tr>
<tr>
<td>Tatrzański</td>
<td>3 679</td>
<td>23,3</td>
<td>17,0</td>
<td>14,1</td>
<td>30,1</td>
<td>13,0</td>
<td>10,2</td>
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<tr>
<td>Nowy Sącz</td>
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<td>15,4</td>
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<td>12,7</td>
<td>20,4</td>
<td>8,9</td>
<td>10</td>
<td>18,9</td>
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</tr>
<tr>
<td>Chrzanowski</td>
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<td>15,9</td>
<td>19,4</td>
<td>14,9</td>
<td>18,3</td>
<td>13,7</td>
<td>8,8</td>
<td>16,3</td>
<td></td>
</tr>
<tr>
<td>Olkuski</td>
<td>6 465</td>
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<td>17,7</td>
<td>14,5</td>
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<td>13,8</td>
<td>8,7</td>
<td>16,8</td>
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<tr>
<td>Oświęcimski</td>
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<td>21,4</td>
<td>14,2</td>
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<td>11,5</td>
<td>9,3</td>
<td>17,7</td>
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<tr>
<td>Suski</td>
<td>3 215</td>
<td>27,8</td>
<td>16,9</td>
<td>11,8</td>
<td>19,1</td>
<td>10,2</td>
<td>9,6</td>
<td>20,6</td>
<td></td>
</tr>
<tr>
<td>Wadowicki</td>
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<td>20,7</td>
<td>18,1</td>
<td>15,1</td>
<td>22,8</td>
<td>11,2</td>
<td>11</td>
<td>20,1</td>
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<tr>
<td>Brzeski</td>
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<td>11,6</td>
<td>9,9</td>
<td>20,4</td>
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<tr>
<td>Dąbrowski</td>
<td>4 114</td>
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<td>15,0</td>
<td>8,1</td>
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<td>17,1</td>
<td>9,2</td>
<td>18,5</td>
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<tr>
<td>Tarnowski</td>
<td>9 592</td>
<td>28,1</td>
<td>16,4</td>
<td>9,9</td>
<td>20,3</td>
<td>13,6</td>
<td>10</td>
<td>20,5</td>
<td></td>
</tr>
<tr>
<td>Miasto Tarnów</td>
<td>5 363</td>
<td>14,4</td>
<td>20,4</td>
<td>14,7</td>
<td>24,2</td>
<td>9,6</td>
<td>8,3</td>
<td>16,1</td>
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<tr>
<td>Total – Ogółem</td>
<td>139 027</td>
<td>20,7</td>
<td>17,9</td>
<td>13,4</td>
<td>23,3</td>
<td>9,9</td>
<td>10,2</td>
<td>19</td>
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<tr>
<td>max. (x)</td>
<td>21 948</td>
<td>33</td>
<td>21</td>
<td>21</td>
<td>31</td>
<td>17</td>
<td>12,9</td>
<td>24,1</td>
<td></td>
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<tr>
<td>min. (x)</td>
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<td>9</td>
<td>11</td>
<td>8</td>
<td>18</td>
<td>5</td>
<td>8,3</td>
<td>15,7</td>
<td></td>
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<tr>
<td>average – średnio</td>
<td>22</td>
<td>17</td>
<td>13</td>
<td>24</td>
<td>12</td>
<td>10,18</td>
<td>19,49</td>
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<tr>
<td>s(x)</td>
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<td>2,33</td>
<td>3,07</td>
<td>3,69</td>
<td>2,67</td>
<td>1,13</td>
<td>2,23</td>
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<tr>
<td>v(x)</td>
<td>0,26</td>
<td>0,14</td>
<td>0,24</td>
<td>0,16</td>
<td>0,23</td>
<td>0,11</td>
<td>0,11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Źródło: BDL (b.d.), GUS (b.d.), obliczenia własne.

2 districts: Limanowski and Kraków are totally different from all of the distinguished groups and therefore they form two groups of one element each (IV and V respectively).

The average values, standard deviation and the coefficient of variability for each typological group are presented in Table 3.
Districts of group I cover south and middle zone of the voivodeship and constitute more than a half of its total area. In this group 25.2% of the unemployed population are young people – at the age of 24 and less, 16.7% – people at the age of 45–54 and 11.6% – people at the age close to retirement. High percentage is observed for people unemployed for a long time – 23.3%, the rate of unemployment in these districts reach the average value of 12.1%. The highest (in comparison with other groups of many elements) is the percentage of people at pre-working age (20.9%) and the average level of births (10.7 per 1000 of people). People at post-working age constitute 16.3% on average. Characteristics for this group are the closest to average values for the whole voivodeship.

Group II consists of districts that cover west side of the voivodeship, districts in the neighbourhood of Kraków and two urban districts: Tarnów and Nowy Sącz. In this group the situation of unemployment in the population of young people is better – the unemployed from the group at the age of 24 and less constitute 16.5%
of the total number of the unemployed, while people in
the age close to retirement have higher partition in the
total population of the unemployed – 14.9%. The per-
centage of the people unemployed for a long time and
the rate of unemployment are lower than the relevant
characteristics in previous group – 21.7% and 10.8%.
The demographic situation in this group, on the other
hand, seems worse than in the previous group – 9.4 live
births and 18.1% pre-working age people.

Districts of group III cover the north part of the
voivodeship. In these districts most (comparing groups
with many elements) young people – almost 30% have
no occupation, while the percentage of the unemployed
at the age of 45–54 is the lowest. The relative number
of people unemployed for a long time is also highest
(26.6%), while the demographic situation is similar to
the one observed in previous group: 9.5 live births per
1000 people and 17.9% people in pre-working age.

In the Limanowski district the situation is totally
different from other groups. The features that distin-
guish this district from others are the highest relative
number of live births – 12.9% and the best age struc-
ture (24.1% of people in pre-working age) with high
level of unemployment amongst young people (26.3%),

highest percentage of people unemployed for a long
time (31.2%) and the highest level of the rate of un-
employment (16%). At the same time the partition of
people unemployed in the age close to retirement is the
lowest for this district – 8.5%.

The features under investigation have still another dis-
tribution in the Kraków district. The level of unemploy-
ment amongst the young is the lowest here (9.4%), which
is the consequence of a high percentage of students. The
percentage of the unemployed in the age close to retire-
ment is the highest (20.5%). The rate of unemployment
has the lowest level here – 5.2%, anyway, with such
a large population it means nearly 22000 people unem-
ployed in 2014, therefore the phenomenon of unemploy-
ment is a severe problem. The coefficient of live births
takes values similar to the ones of other groups (except
for Limanowski district) and is equal to 9.9%, while the
percentage of people at pre-working age is the lowest and
equals 15.7%, which means the highest percentage of
people at post-working age, i.e. about 21.5% (the parti-
tion of people in working age equals to 62.8% on average
in the districts of the voivodeship under investigation).

The complementation of the description of particu-
lar groups presented above are the values of coefficients

![Fig. 2. Average values of features in groups of districts in the Małopolskie voivodeship in 2014](image-url)

Source: own elaboration.

Rys. 2. Średnie wartości cech w grupach powiatów województwa małopolskiego
w roku 2014

Źródło: opracowanie własne.
of variability that were not mentioned because of their low levels. The unemployed at the age of 25–34 constitute 28.6% of the total number of the unemployed in the districts of Małopolskie voivodeship on average, with standard deviation $\sigma(X) = 1.3$ and the coefficient of variability $V(X)$ at the level of 0.04. Similar situation occurs in case of the unemployed at the age of 35–44. Their average share in the total number of the unemployed in 2014 is equal to 19.2% while the coefficient of variability takes the value of 0.08. The partition of people at working age has the average level of 62.8% in districts, the standard deviation $\sigma(X) = 0.73$ and the coefficient of variability $V(X) = 0.01$. These variables, displaying such low variation level, have no noticeable influence on the results of grouping.

Graphical image of differentiation of the distinguished groups is shown in the Figure 2.

The factor that has the highest impact on the differentiation of groups in the variable $X_1$ – the share of the number of the unemployed at the age of 24 and less in the total number of the unemployed and the partition of the number of the unemployed from the oldest age category.

**RECAPITULATION**

Districts of the Małopolskie voivodeship are differentiated significantly with respect to the structure and rate of unemployment, number of live births per 1000 people and the structure of population according to economic age groups. On the basis of taxonomic methods 5 groups of districts were distinguished with significant inter-group differentiation.

Group I consists of 10 districts covering south part of the voivodeship, where every fourth of the unemployed is younger than 25 and every fourth of the unemployed has remained unoccupied for 2 years. The percentage of people at pre-working age is relatively high (21% on average).

Group II comprises districts of the west side of the voivodeship, districts in the neighbourhood of Kraków and districts: Tarnów and Nowy Sącz. In these districts the level of unemployment amongst the young is the lowest, as well as the rate of unemployment.

Group III has districts that cover the area of the north part of the voivodeship, where the level of unemployment is the highest amongst the young, as well as the percentage of the people unemployed for a long time. With respect to demographic structure the situation is best in the Limanowski district and in the districts of group I.

The application of taxonomic methods allowed for obtaining general and at the same time accurate picture of the differentiation of the Małopolskie voivodeship with respect to the social problems being analyzed here. The results of the investigation may be the starting point for feedback analyses and the foundation for decision making in the economic field.

**REFERENCES**


ZRÓŻNICOWANIE POWIATÓW WOJEWÓDZTWA MAŁOPOLSKIEGO
POD WZGLĘDEM WYBRANYCH PROBLEMÓW SPOŁECZNYCH


Słowa kluczowe: bezrobocie, demografia, taksonomia, powiats

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