REGIONAL DIFFERENCES ILLUSTRATED BY REGISTERED UNEMPLOYMENT MAPS WITH NATURAL INTERVALS *JENKS* AT LOCAL ADMINISTRATIVE UNITS LAU 2 LEVEL (NUTS 5) IN ROMANIA[1]

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In this article are illustrated the regional differences on the issues and characteristics of registered unemployment as an operational example for a socio-economic indicator, relevant for the cohesion policy. Regional differences are illustrated by "Choropleth Map" of registered unemployment classified by natural intervals Jenks at ***local administrative units*** *LAU 2 (NUTS 5) in Romania, the finest level of administrative detail. By applying dasymetric detailing the values recorded at NUTS 3 level to NUTS 5 level was diminished the ecological error. We analyse extensive type indicators as it is the number of registered unemployed in 2013 and the end of June 2014, and intensive type indicators as it is the number of unemployed densities per km² in 2013 and in June 2014. The classification technique used was the natural intervals Jenks the Arc Gis 10.2, with data provided by INS TEMPO data base. These researches results have been achieved in the Project Nucleu NP – 420115, Phase 3: Regional differences on Labour market, made in 2014, and results are used in Dynahu Project.*

Keywords: *regional differences, unemployment models, natural interval Jenks.*

The unemployment is a cohesion indicator[2] (ESPON ATLAS, 2013: 52), factor of regional differences described by different spatial patterns that could be

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[2] The registered unemployment persons is the only one cohesion indicator provided at LAU 2 by TEMPO INS, under the matrix SOM101E.

highlighted by maps. Maps as instruments for visualisation and spatial integration that allow the efficient end effective exploitation of statistical data. For Romania, ESPON published registered unemployment maps at NUTS 3 level at EU level. In this article we try to go further on to applying the dasymetric technique on registered unemployment statistical data from NUTS 3 level to NUTS 5 level, equivalent with LAU 2. One main advantage of this „higher resolution" representation is the better illustration of spatial patterns also in density attribute, minimising the errors given by the modifiable areal unit problem MAUP and ecological fallacy also. Applying the spatial analysis technique "Choropleth map with classification by Natural Intervals Jenks" in Arc Gis 10.2.3 software we identify some possible threshold for registered unemployment spatial variation useful in cohesion policy management and not only.

LITERATURE REVIEW

According to Anselin, Syabri and Kho (2006: 8) "empirical spatial data analysis exercise, starting with simple mapping and geovisualization, moving on to exploration, spatial autocorrelation analysis, and ending up with spatial regression" allow visualization, exploration and explanation of interesting patterns in geographic data also for socio-economic field, in a spatially integrated manner.

Registered unemployment in Romania as a measure of territorial unbalances represents for the authors the subject for spatial analysis, using the following methods:

- **simple mapping and geovisualization** in the regional perspective of unemployment (Lincaru and Atanasiu, 2014); mapping: choropleth maps – exploring opportunities offered by GIS technology in socio-economic and environment analysis (Lincaru et al., 2014), and this article;
- **spatial autocorrelation analysis**: global and local spatial autocorrelation statistics, with inference and visualization in *the territorial profile clustering tendency in monthly variation of registered unemployment* (Lincaru et al., 2014), detailed profile *at localities disaggregation level as case study for South Muntenia Region – Romania*, (Lincaru and Ciucă, 2011), *socio-economic dimensions in LAU 2/NUTS 5 locations by clusters given by registered unemployed people at LAU 2/NUTS 5 level in 2013 and 2010* (Lincaru et al., 2015);
- **spatial regression**: diagnostics and maximum likelihood estimation of linear: a profile of unemployment in Romania, at territorial level (Lincaru and Pirciog, 2015).

Simple mapping and geovisualisation is the method used by ESPON mainly for localisation, comparison and planning for European territories (Zanin et al., 2011: 3). Baron, Ochojski, Polko et al. (2014) analyse the public social services in Eastern Europe and illustrate public services costs in general, and also for unemployment (as well as for long term unemployment) in a model that includes aggregated data at NUTS 2/NUTS 3/LAU level. In ESPON GROSEE (2014) is presented the unemployment in the case study of Metropolitan area of Bucharest at LAU 2 level and also at NUTS 3 level as data.

VARIABLES AND DATA

Location variables LAU 2 local administrative units counting 3190 units, with polygons provided by ESRI in 2014 using SIRUTA from INS, with the role of statistical units. For each polygon it is calculated its area.

Socio economical indicator from TEMPO INS at localities level aggregated at LAU 2 level with the role of attributes: **Nsi2010, Nsi2013: SOM101E – Registered unemployed person** at the end of the month, by sex in 2010 and 2013.

METHOD

Choropleth map represents "a thematic map in which areas are distinctly coloured or shaded to represent classed values of a particular phenomenon" (Choropleth map, n.d.). Our interest phenomena is the number of registered unemployed persons. The spatial analisys technique Choropleth **map, classification by Natural Interval Jenks** in Arc Gis 10.2.3. is applied to visualise the spatial patterns for the extensive indicator "the number of registered unemployed person at LAU 2 level" and for the intensity indicator the registered unemployed density (the ratio of the number of registered unemployed persons to the LAU 2 surface).

DISCUSSIONS AND LIMITS REGARDING THE CHOROPLETH MAPS

Regarding the **Choropleth maps**, there are some hypotheses we take in consideration:

– our **contour line** is constant in time and is shaped by administrative criteria, respectively a function of the LAU 2 frontiers coordinates. Courant, Herbert and Ian (1996) described that "a *contour line (also level set, isopleth, isoline, isogram or isarithm) of a function of two variables is a curve along which the function has a constant value*". In social sciences and economics, there is important potential to describe features which vary quantitatively over the space;

– the LAU 2 level contour line that describes the statistical unit contributes to **diminish the ecological fallacy**, in comparison of using the NUTS 3 level contour line when we use aggregate data by statistical unit for registered unemployed persons. Robinson (1950) defined the concept of ecological fallacy:

> "**Ecological fallacy** occurs when an erroneous conclusion has been made about the individuals of an area based on the aggregate statistics of the area. In other words, it is a mistake when a GIS analyst assumes that statistics found in aggregate data will also be found amongst individuals within that area." (Ecological fallacy, n.d.).

– The **modifiable areal unit problem** (MAUP) defined by Openshaw (1984) is a source of ecological fallacy, making difficult to compare data, to identify significant spatial associations, multivariate coefficient regression analysis.

> "the MAUP is a statistical bias that is influenced by both the means in which point-based data is aggregated, and the districts into which that data is grouped." (Diamond 2015, cites Openshaw 1984.).

Using a smaller scale from NUTS 3 to NUTS 5/LAU 2 is a progress to better represent the spatial analysis for registered unemployment. An accurately visualisation of spatial distribution of registered unemployed could be obtained using Dasymetric Mapping Technique (Tyan-Shansky and popularised by J. K. Wright, n.d.).

> "Although **dasymetric maps** are closely related to choropleth maps, they differ in several ways. First, zonal boundaries on dasymetric maps are based on sharp changes in the statistical surface being mapped, while zonal boundaries on choropleth maps demarcate enumeration units established for more general purposes (e.g., states within the US). Second, individual dasymetric zones are developed to be internally homogeneous. In contrast, choropleth zones are not defined based on the data and, thus, have varying levels of internal homogeneity. Third, choropleth mapping methods have become standardized (including the development of common classification schemes; Slocum 1999), but the wide range of dasymetric procedures have been under researched" (Eicher and Brewer, 2001: 126).

UNIVARIATE CLASSIFICATIONS SCHEMES

Classifying numerical fields for graduated symbology is applied through some standard classification methods in ArcGIS (Classifying numerical fields, n.d.): Equal interval, Defined interval, Quantile, Natural Breaks (Jenks), Geometrical interval, Standard deviation and in GeoDa: percentile and Box, etc.

In our article we use the Jenks classification "based on the Jenks' Natural Breaks algorithm (Smith et al., 2006–2009) in view to identify the threshold levels for registered unemployment given by classes differentiated statistically knowing that:

> "**The Jenks' optimization method** is also known as the goodness of variance fit (GVF). It is a data classification to determine the best arrangement of values into classes. It is used to minimize the squared deviations of the class means while maximizing each class's deviation from the means of other groups. The method first specifies an arbitrary grouping of the numeric data, and then observations are moved from one class to another, ensuring maximum homogeneity within groups and maximum heterogeneity between groups" (Zanin et al., 2011: 25).

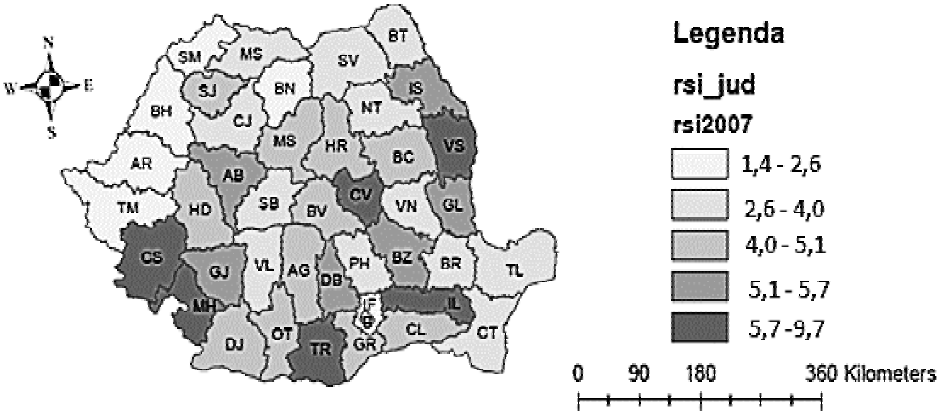
The main limit of this method is represented by the fact that „natural breaks are data-specific classifications and not useful for comparing multiple maps built from different underlying information" (Classifying numerical fields, n.d.).

RESULTS

The first sets of results are represented by The registered unemployment rate at country level (NUTS 3) in 2007 and in 2013 (*Map 1* and *Map 2*). The five classes split by Jenks intervals, in relative terms the LAU 2 distribution by categories, is illustrated for the number of registered persons in 2013 and in June 2014 in the *Map 3* and *Map 4*. Following the Jenks natural interval classification by five classes we consider that the last two classes indicates agglomerations of registered unemployed persons with critical levels.

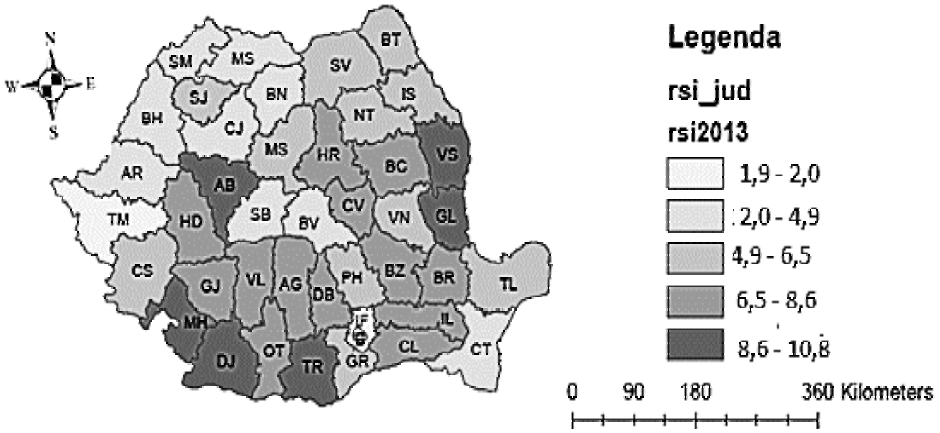
Map 1

Choropleth map, classification by Natural Interval Jenks for the registered unemployment rate at county level (NUTS 3) in 2007



Map 2

Choropleth map, classification by Natural Interval Jenks for the registered unemployment rate at county level (NUTS 3) in 2013



Source: Map realised by authors, county shape ESRI Romania 2012, data unemployment TEMPO INS.

The number of registered unemployed persons in June 2014, compared to 2013 there are the following appartenance to the critical classes identified before, indicating a dynamics by the LAU 2 levels (all with the rank of county residence with exception of Bucharest):

– **maintained** in the last two classes, the following LAU 2: Bacău, Baia Mare, Braşov, Bucureşti, Cluj-Napoca, Constanța, Drobeta-Turnu Severin, Galați, Iaşi, Timişoara;

– **entries** in these classes the following LAU 2: Brăila, Pitesti and Ploiesti – counties that have worsened unemployment performance in relative terms;

– **exits** from this classes the following LAU 2: Alba Iulia, Blaj, Botoşani, Brăila, Buzău, Oradea, Bistrița-Năsăud, Suceava and Târgovişte – counties that have improved performance in relative terms of unemployment (*Map 3* and *Table 1* and *Map 4* and *Table 2*).

Map 3

Choropleth map, classification by Natural Interval Jenks for the registered number of unemployed people in 2013 (at the end of the month) at LAU 2 (NUTS 5) level

Data source: Map realised by authors, county shape ESRI Romania 2012, data unemployment TEMPO INS FOM 104D – SOM 101 E.

Table no. 1

Selection list with the LAU 2 with the number of registered unemployed persons in 2013 higher than the critical threshold of 1670 persons

	Name	Județ / County	Nsi_2013	LAU 2 type
1	**București**	**București**	**22 070**	**Municipium**
2	**Craiova**	**Dolj**	**4 781**	**County Residence**
3	Galați	Galați	3 561	County Residence
4	Constanța	Constanța	3 001	County Residence
5	Ploiești	Prahova	2 823	County Residence
6	Râmnicu Vâlcea	Vâlcea	2 813	County Residence
7	Cluj-Napoca	Cluj	2 704	County Residence
8	Brăila	Brăila	2 647	County Residence
9	Pitești	Argeș	2 489	County Residence
10	Târgu Jiu	Gorj	2 472	County Residence
11	Iași	Iași	2 378	County Residence
12	Timișoara	Timiș	2 364	County Residence
13	Bacău	Bacău	2 204	County Residence
14	Brașov	Brașov	2 194	County Residence
15	Drobeta-Turnu Severin	Mehedinți	2 180	County Residence
16	Alba Iulia	Alba	1 919	County Residence
17	Botoșani	Botoșani	1 888	County Residence
18	Piatra-Neamț	Neamț	1 825	County Residence
19	Suceava	Suceava	1 822	County Residence
[16]	Blaj	Alba	1 814	Municipium
20	Baia Mare	Maramureș	1 749	County Residence
21	Oradea	Bihor	1 720	County Residence
22	Târgoviște	Dambovița	1 702	County Residence
23	***Buzău***	***Buzău***	***1 670***	***County Residence***

Note: Nsi_2013 the number of registered unemployed persons at LAU 2 level in 2013, TEMPO INS data source; Resedinta de judet – county residence.

The density of registered unemployed persons in 2013 was over 17,7 persons/ km^2 as a specific report for urban areas (exception for Victoria commune). In rural areas the registered unemployed persons/km^2 is below 2,5 perons/km^2 (*Table no. 3*, *Map 5*).

Map 4

Choropleth map, classification by Natural Interval Jenks for the registered number of unemployed people in June 2014 (at the end of the month) at LAU 2 (NUTS 5) level

Data source: Map realised by authors, county shape ESRI Romania 2012, data unemployment TEMPO INS FOM 104D – SOM 101 E.

Table no. 2

Selection list with the LAU 2 with the number of registered unemployed persons in 2013 higher than the critical threshold of 1 394 persons (Map 4)

	Name	Județ / County	Nsi2014_06	LAU 2 type
1	**București**	**București**	**22 348**	**Municipium**
2	**Craiova**	**Dolj**	**3 234**	**County Residence**
3	Galați	Galați	2 875	County Residence
4	Brăila	Brăila	2 145	County Residence
5	Ploiești	Prahova	2 078	County Residence
6	Constanța	Constanța	2 057	County Residence
7	Cluj-Napoca	Cluj	2 054	County Residence
8	Iași	Iași	2 041	County Residence
9	Târgu Jiu	Gorj	2 009	County Residence
10	Pitești	Argeș	1 926	County Residence
11	Brașov	Brașov	1 914	County Residence
12	Râmnicu Vâlcea	Vâlcea	1 878	County Residence
13	Timișoara	Timiș	1 826	County Residence
14	Bacău	Bacău	1 709	County Residence
15	Baia Mare	Maramureș	1 575	County Residence
16	***Drobeta-Turnu Severin***	***Mehedinți***	***1 394***	***County Residence***

Table no. 3

Selection list with the LAU 2 with the number of registered unemployed persons/km^2 in 2013 higher than the critical treshold of 17,7 persons/km^2 (Map 5)

Name	Județ / County	LAU 2 type
Bacău	Bacău	Reşedinţa de judeţ
Bârlad	Vaslui	Municipiu
Botoşani	Botoşani	Reşedinţa de judeţ
Brăila	Brăila	Reşedinţa de judeţ
Bucureşti	Bucureşti	Municipiu
Câmpia Turzii	Cluj	Municipiu
Craiova	Dolj	Reşedinţa de judeţ
Piteşti	Argeş	Reşedinţa de judeţ
Ploieşti	Prahova	Reşedinţa de judeţ
Victoria	Braşov	Comuna

Map 5

Choropleth map, classification by Natural Interval Jenks for the spatial density of registered number of unemployed people in 2013 (at the end of the month) at LAU 2 (NUTS 5) level [persons/km^2]

Data source: Map realised by authors, county shape ESRI Romania 2012, data unemployment TEMPO INS FOM 104D – SOM 101 E.

The effect of the crises and the increased acces to unemployment in rural areas is ilustrated by *Table no. 4* and *Map 6*, where the registered unemployed density in

June 2014 treshold was over 19.6 persons/km^2 in both rural and urban areas, while the first class covers only rural areas with 2,6 registered uemployed persons/km^2.

Table no. 4

Selection list with the LAU 2 with the number of registered unemployed persons/km^2 in June 2014 higher than the critical treshold of 19,6 persons/km$_2$ (Map 5)

Name	Județ / County	LAU 2 type
Piteşti	Argeş	Reşedința de județ
Bacău	Bacău	Reşedința de județ
Botoşani	Botoşani	Reşedința de județ
Brăila	Brăila	Reşedința de județ
Victoria	Braşov	Comuna
Bucureşti	Bucureşti	Municipiu
Câmpia Turzii	Cluj	Municipiu
Moreni	Dâmbovița	Municipiu
Craiova	Dolj	Reşedința de județ
Brăhăşeşti	Galați	Comuna
Giurgiu	Giurgiu	Reşedința de județ
Târgu Jiu	Gorj	Reşedința de județ
Bărbuleşti	Ialomița	Comuna
Iaşi	**Iaşi**	**Reşedința de județ**
Târgu Frumos	**Iaşi**	**Oraş**
Drobeta-Turnu Severin	Mehedinți	Reşedința de județ
Târgu Mureş	Mureş	Reşedința de județ
Roman	Neamț	Municipiu
Slatina	Olt	Reşedința de județ
Câmpina	**Prahova**	**Municipiu**
Mizil	**Prahova**	**Oraş**
Ploieşti	**Prahova**	**Reşedința de județ**
Suceava	**Suceava**	**Reşedința de județ**
Valea Moldovei	**Suceava**	**Comuna**
Râmnicu Vâlcea	Vâlcea	Reşedința de județ
Bârlad	Vaslui	Municipiu

The spreading of registered unemployment in rural areas is confirmed by the last map (*Map 7*, *Table no. 5*). In Dolj county in Greceşti and Seaca de Pădure and in Suceava county in Burla and Voinitel there was he highest unemployment increase. In these rural areas LAU 2 the number of unemployed persons increased by more than 11,72 times in 2013, compared to 2010 level. Also Halmagel (Arad), Pârjol (Bacău), Ştiubieni (Botoşani), Unguriu (Buzău), Maia (Ialomița), Viişoara (Mureş), Sârbii – Măgura (Olt), Jina (Sibiu) and in Lalosu (Vâlcea) represent the LAU 2 in which the number of unemployed persons increased by more than 7.34 times in 2013 compared to 2010 level.

Map 6

Choropleth map, classification by Natural Interval Jenks for the spatial density of registered number of unemployed people in June 2014 (at the end of the month) at LAU 2 (NUTS 5) level [persons/km^2]

Data source: Map realised by authors, county shape ESRI Romania 2012, data unemployment TEMPO INS FOM 104D – SOM 101 E.

Map 7

Choropleth map, classification by Natural Interval Jenks for the ratio of registered number of unemployed people in 2013 in compared to 2010 (at the end of the month) at LAU 2 (NUTS 5) level

Data source: Map realised by authors, county shape ESRI Romania 2012, data unemployment TEMPO INS FOM 104D – SOM 101 E.

Table no. 5

Selection list for the ratio of registered number of unemployed people in 2013 compared to 2010 (at the end of the month) at LAU 2 (NUTS 5) level, higher than the 7.34 ratio (Map 6)

Name	County	Type
Halmagel	Arad	Commune
Pârjol	Bacău	Commune
Ştiubieni	Botoşani	Commune
Unguriu	Buzău	Commune
Greceşti	**Dolj**	**Commune**
Seaca de Pădure	**Dolj**	**Commune**
Maia	Ialomița	Commune
Viişoara	Mureş	Commune
Sârbii – Măgura	Olt	Commune
Jina	Sibiu	Commune
Burla	**Suceava**	**Commune**
Voitinel	**Suceava**	**Commune**
Lalosu	Vâlcea	Commune

Bolded names – LAU 2 in which the number of unemployed persons increased by more than 11,72 times in 2013 as compared to the 2010 level.

CONCLUSIONS AND FUTURE STUDY

The registered unemployed person's representation as a visualisation of its spatial heterogeneity is still an open subject, with a lot to be improved:

> "the design of maps is mainly concerned with making choices: the choice of mapping method (proportional symbol or choropleth map, isoline or grid map, or even a cartogram), the choice of the aggregation level on which information to be depicted, the choice on the level of statistic areas and the type of data (absolute or relative representation), the choice of graphic variables (such as differences in size, value, grain, colour, direction and shape) to be used. These choices are fundamental ones, they influence peoples conception and visualisation of space" (Zanin et al., 2011: 3).

The agglomeration of unemployed persons in term of quantity and in term of intensity (number of unemployed persons/km^2) could represent some indicators for target groups and active/ activation measures designing.

– The need for specific intervention by urban and rural area designing given by high heterogeneity;

– Classification groups are homogenous by variance, but the threshold level is relative to the characteristics of group members;

The unemployment maps could provide essential inputs in active labour market policies management, with particular interest in the management of active measures. Along with the classification of spatial agglomeration of this population

in LAU 2 could be added some new insights regarding the time, infrastructures, transport costs, etc. maps for these populations. Another perspective to map the unemployment is given by applying the dasymetric technique in the future, fact that requires new data type and management (exploiting the land use potential, excluding the inhabited areas, etc.).

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În acest articol sunt ilustrate diferențe regionale privind problemele şi caracteristicile şomajului înregistrat ca un exemplu al utilizării efective pentru un indicator socioeconomic, relevant pentru politica de coeziune. Diferențele regionale sunt ilustrate prin „Hărți de tip Choropleth" pentru şomajul înregistrat, folosind metoda de clasificare intervale naturale Jenks aplicată la nivel de unități administrativ-teritoriale UAT 2 (NUTS 5) din România, cel mai bun nivel de detaliu administrativ. Prin aplicarea tehnicii dasymetric valorile înregistrate la nivel NUTS 3 sunt detaliate la nivel NUTS 5 fapt care contribuie la diminuarea erorii ecologice. Noi analizăm indicatori de tip extensiv – cum ar fi numărul şomerilor înregistrați în 2013 şi la sfârşitul lunii iunie 2014, precum şi

indicatori de tip intensiv – cum ar fi densități exprimate ca număr şomeri pe km^2 în 2013 şi în iunie 2014. Tehnica de clasificare utilizată a fost intervale naturale Jenks din Arc Gis 10.2, cu datele furnizate de baza de date INS TEMPO. Aceste rezultate de cercetare au fost realizate în cadrul proiectului Nucleu NP - 420115, Faza 3: Diferențele regionale pe piața forței de muncă, realizat în 2014, iar rezultatele sunt utilizate în proiectul Dynahu.

Cuvinte-cheie: *diferențe regionale, modele de şomaj, interval naturale Jenks.*