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CARTOGRAPHIC VISUALIZATION OF TWO-COMPONENT QUANTITATIVE FEATURES RECOGNIZED IN SAMPLED FORM

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ABSTRACT

In the contemporary cartography modelling of complex features' distribution using the symbols or choropleth methods leads very often to discordance between the scale of background and the scale of main map's content. Two kinds of accuracy are distinguished: geometrical and statistical. In the paper the unification of both above mentioned scales has been proposed according to the rudimental rule of coherent visual perception of pictorial model of "reality" characterising the system of coding used in cartography.

Topological transformation of equi-area reference units to the "equivalent" form expressing the values of one component of observed feature allows to apply the same scale for symbols used for presentation of the second one. It seems to be specially important when the main subject of investigation is focused on recognizing the

apparently heterogeneous structure of phenomenon such as for instance share of minority group in the whole population.

Key words: cartographic methods, visualization, cartograms

INTRODUCTION

The development of numerous applications of GIS during last decades of XXth century caused that it is unfounded to treat a scale as a paradigm of modern cartography. It is true that verified attainments of traditional modelling allow to choose suitable level of generalization for different groups of elements creating total content of almost all kinds of topographic maps, nevertheless the needs of thematic cartography turn scientists' attention towards new approach to the necessity of presentation of all elements of maps contents with homogenous detaileness and exactness...

Organisation of multi-layer database creates the very new possibilities of varying the graphical coding of observed feature according to the importance of different parts of mapped region or other practically determined requirements.

Using GIS for producing thematic maps one can distinguish two basic groups of elements with quite different properties. The first one, gathering such elements as borders, can be characterized by independence on the scale. Multilevel hierarchic division realizes the rule of heredity according to which minuteness and accuracy of elements presented on a map is invariable. Another situation characterized elements belonging to the second group such as rivers, roads, settlement, soils or land cover, that can be treated dependently on its meaning for created model. In this case the process of generalization is usually demonstrated not only by significant reduction of number of elements (for instance from following hierarchic levels) but also by simplification of suitable graphical notation. As it has been mentioned before many information systems are organized to make obtaining the information on required level of detaileness. For example using MapInfo one can aggregate the number of clients of chosen firm in Warsaw into some groups (containing for instance 30 persons) and then – produce the dot map placing randomly each of dots in suitable region. The elements of topographic background (streets, rivers, parks) allow to correct some improper locations of dots that come into collision. The level of aggregation depends only on the scale of the map and spatial distribution of number of clients inside region studied. The level of basic, elementary information determines the possibility of elaborating the map in optimal scale but there is only one value of scale the most appropriate for total analysis of kind of spatial distribution referred to differentiation of intensity of the feature within the region. This is the operative scale proper to the nature of observed feature. Each of hierarchic level reveals different properties of objects so finding of "operative" scale of the feature allows to determine proper scale of observation. The notion: "the scale of observation" has been distinguished in the fractal geometry [7]. Applying multi-fractal technique makes it possible to divide some diversely compound object (such as for instance the coast line of Great Britain) into several parts represented by different fractal dimensions. Voss' idea [11] to use for this purpose moving unit area may be considered as the solution discovered with reference to the earlier Perkal's method of "objective generalization". Perkal has proposed to use a set of changeable circles for outward and inward approximation of the border line of given area. Applying a scale "proper for the nature of observed feature" means that using GIS cartographer has opportunity to realize a multiscale visual coding of the data dependently on character of a phenomenon.

ROLE OF SUITABLE SCALING OF BACKGROUND AGAINST MAIN MAP'S CONTENT

Each map ought to be coherent in respect of its general concept and destination. That means that projection used for given map could not be chosen separately from the list of assumptions relating to the method of presentation of groups of elements creating map's content. This is why the Mercator's projection has been officially removed from education programme in the USA as improper model for comparing the areas of continents or oceans.

Suitable scaling of background against main map's content is very important condition of right cartographic modelling, specially when given thematic map should be used as the model of distribution of extremely varied groups of elements. Just among demographic maps there are some examples of models presenting distinctly varied quantitative characteristics within area studied. It can be noticed that most of even continuous demographic features are usually collected in the sampled form related to the administrative units. Using dot method a cartographer can try to enhance the continuous nature of presented feature. However when extremely varied spatial distribution causes the effect of overlapping the dots the cartographer has to decide about repositioning signs or reducing their size.

Both of mentioned solutions are not acceptable because of accuracy and legibility of information taken from the map. Castner, probably as a first scientist, proposed to solve the problem using the changeable scale of background for the map presenting population density of the Province of Ontario [8], according to the Montmonier's suggestion to the reprojective transformations as a means of "alleviating the crowding of symbolism in high density region of a map and of achieving spatially uniform feature selection" [10]. Users of such kind of a map are not able to realise the holistic visual perception of map's content, because of scale's harmonisation of background to the varied intensity of the feature leads to the loss of traditionally treated geometrical accuracy of the map referred as the stable value of unit areas within whole mapped region. Nevertheless the elements of a background as well as a draught of a grid allows for partial analysis of features' distribution and finally – numerous examples of proper reception of maps with changeable scales point on practical usability of the method [1, 4, 5]. Specially broadly known are distortion urban plans of Falk according to Kadmon's projection [3]. Mentioned above solutions can not be treated as discontinuation of trials of bettering thematic maps. It does not mean that searching for readable model assuring fully accordance between the character of the phenomenon and mathematical organization of reference units – is doomed. There are some examples of coming back to rudimental functions of the background: being a frame organized in the same system of coding than the main map's content. This rule has been consequently realized in case of the topographic maps with Euclidean organization of spatial relations between all elements creating map's content. The role of unit area is not only to identify the element but also to determine its size and localisation. Harmonisation of method of coding with the nature of observed objects leads to proper reception of information according to the metric of mapped space.

"VALUE-BY-AREA" SCALING. EXAMPLES

Within the group of thematic maps called "cartograms" with "value-by-area" scale of reference units direct observation of the distribution of phenomenon is guaranteed. Such maps present not only results of election, relations between effects of production or level of income but also some problems of demography such as: population density or prediction of growth of population.

It is possible to develop this direction of thematic modelling in case of presentation two-component quantitative features recognized in sampled form. It can be proposed to use the background transformation to the varied scale corresponding with the value of the first component of the phenomenon. Then using the same scale for symbols situated within suitable reference areas can present the second component.

Proposed uniform model of the complex phenomenon seems to be better than the ordinary map "in the sense that it reveals more meaningful interrelationships between the base and what is mapped on it" [8].

Fig. 1. Symbol's map of unemployment in Poland (1999)

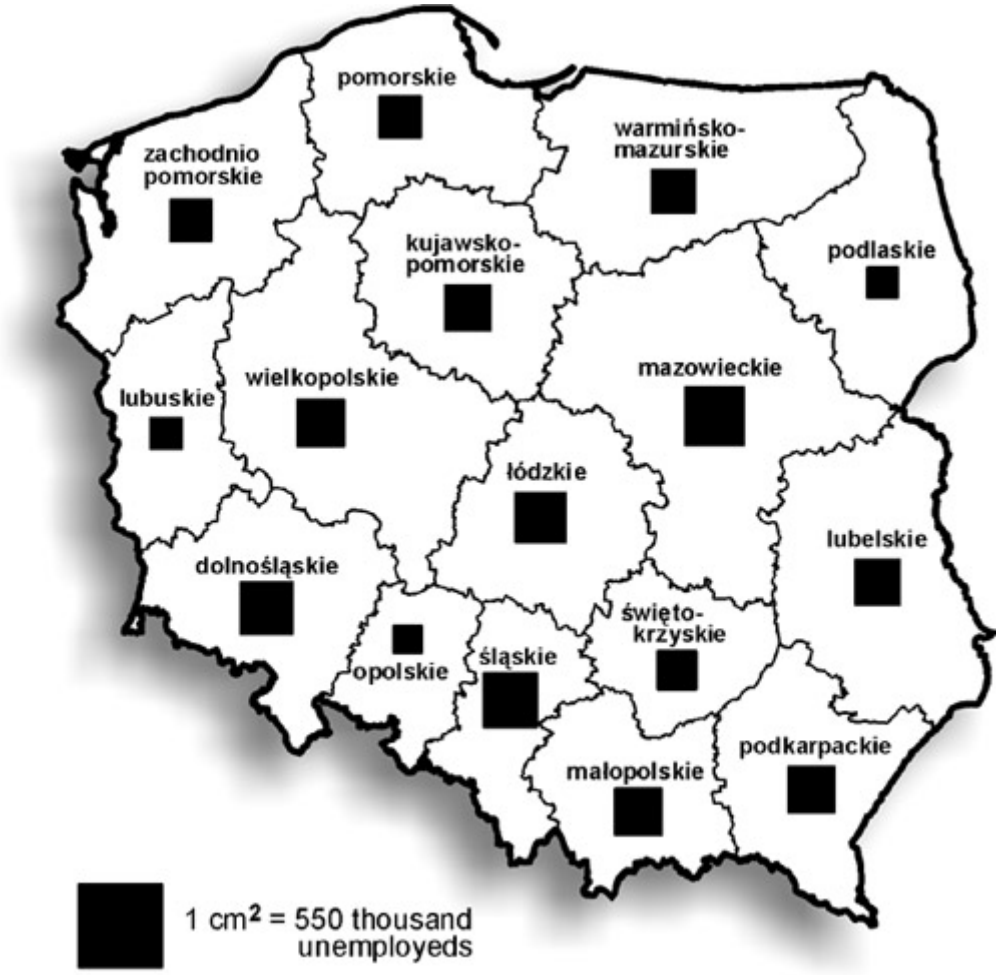
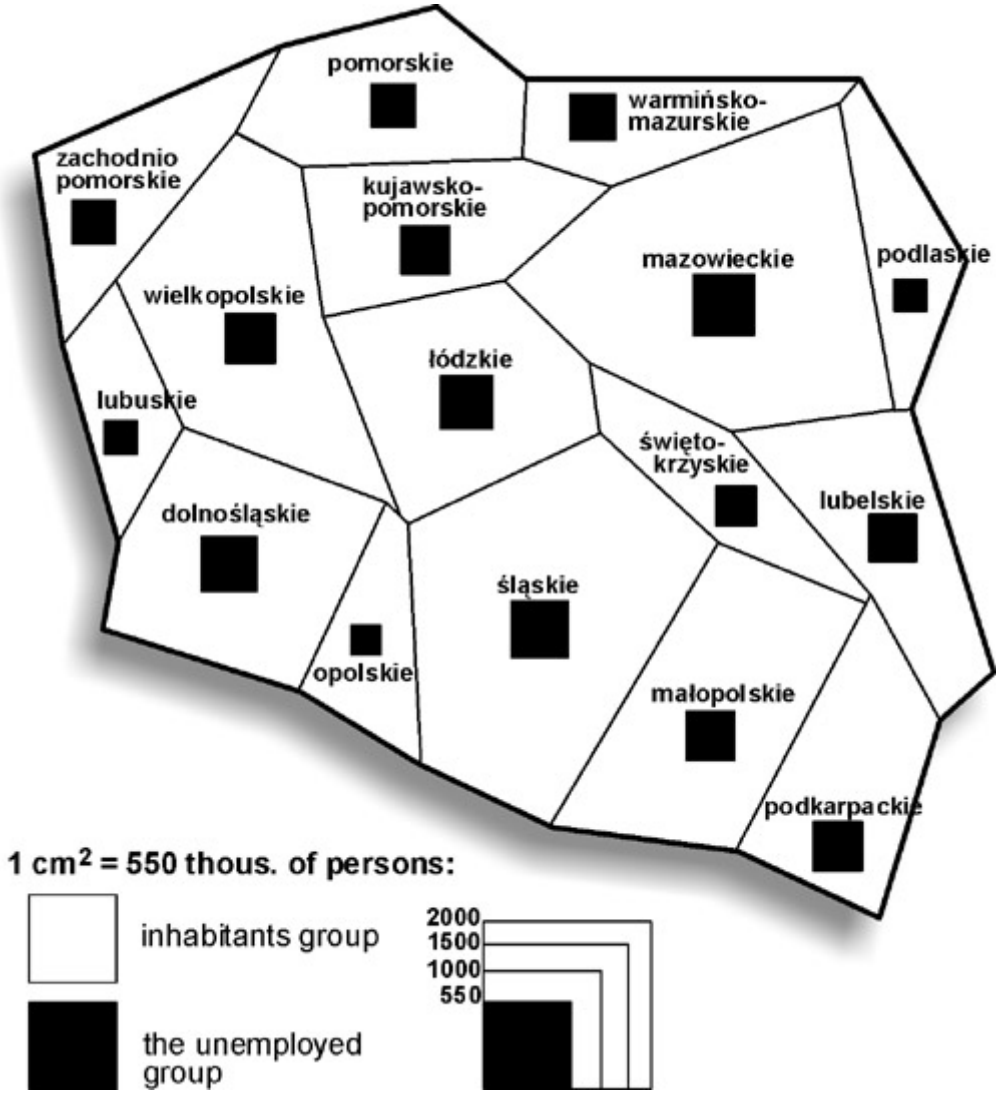


Figure 1 presents the distribution of unemployment in Poland using traditional symbols method. On the Figure 2 one can observed the anamorphic background composed from 16 new voivodships of Poland as the reference areas. Transformation of classical form of unit areas to the "value-by-area" scale corresponding with populations' level has been made using the method of successive approximation.

Fig. 2. Cartogram of the population as a background against level of unemployment in Poland (1999)

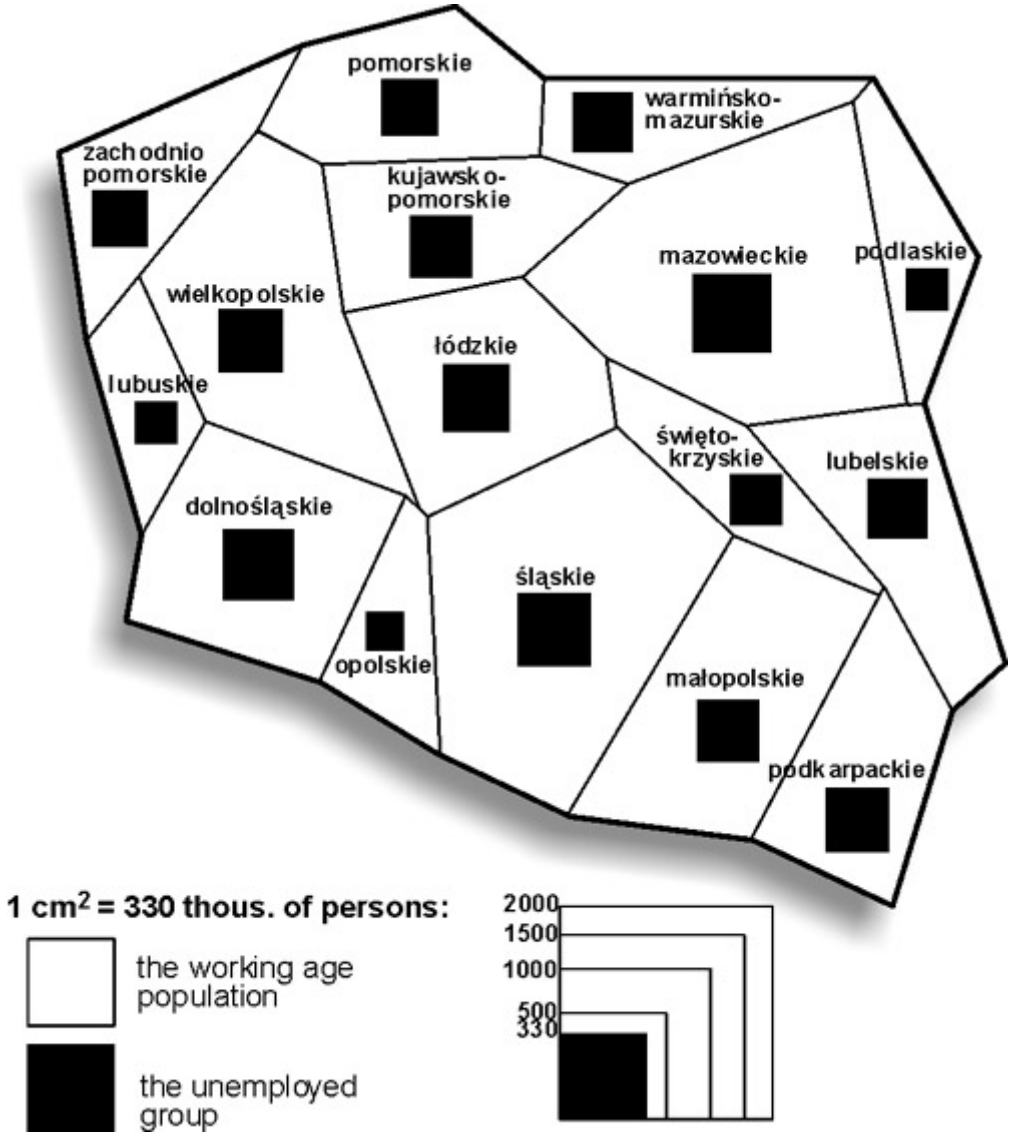


The same scale has been applied for background and for the main thematic element of map's content We can observe the effect of such change of the reference areas comparing for instance relationship between whole population and number of unemployed in such voivodeships as *śląskie* or *zachodniopomorskie*. The first map shows the relation between size of area and number of unemployed persons, the second one – the structure of unemployment.

Figure 3 presents the structure of unemployment limited to the group of people "in working age". Because of relation between the size of this group and whole population is nearly equal in all voivodships it is sufficient to change the scale of the background on the map 2 and enlarge the symbols inside the reference areas.

Obviously the shape of the symbols may be the same as reference areas. It is possible to build such confocal polygons but distinctly oriented composition seems to be the optional proposition for holistic visual perception of the model in accordance with the rules of logic and aesthetics.

Fig. 3. Cartogram of the working age population as a background against level of unemployment in Poland (1999)



The "value-by-area" scaling method can be used also in case of many demographic maps elaborated in choropleth form, specially when quantitative characteristics are connected with the size of groups rather than with the size of areas [9]. The reinstatement of rudimental functions of mathematical organizations of portrayal of such kinds of phenomena requires the reinstatement of correspondence between the metric of background and of the feature.

As "the cognitive and communicative value of a map its accuracy, reliability, completeness and its being up-to-date is conditioned by the GIS and by automated map production environment" [6] it is important to remember that thematic cartography is the part of this system and its specific requirements could not be excluded from scientifists' area of interest.

CONCLUSIONS

The “value-by-area” method should be broadly applied in case of “statistic” maps presenting data referred to the administrative units. It seems to be specially important when the spatial distribution of the phenomenon is more complicated than the composition of unit areas. Such situation characterises many of demographic maps presenting the relation between two groups of population living on a certain territory.

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