

# Qualitative and quantitative assessment of the correctness of the development of area cartograms

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**Abstract:**

In assessing the correctness of the development of area cartograms, two approaches can be distinguished: qualitative and quantitative. The qualitative approach compares descriptively the features of selected cartograms, e.g. topology, shape and orientation. In the quantitative approach, indicators are developed that can measurably indicate differences in the correctness of the development of cartograms.

It should be remembered that none of the generating cartograms will be "perfect". In each of them, the shape, topology or orientation of the units will be distorted. It is important that the developed cartogram does not mislead the users and that the use of the cartogram introduces additional information on the map, while not hindering its analysis. The introduction of methods for assessing the correctness of the development of area cartograms could help in the making of more useful maps. Quantitative methods of comparing the correctness of the development of area cartograms seem to be justified in presentations that are developed automatically.

After analyzing the source material, it was noticed that currently in the literature on the subject more often it is possible to find qualitative than quantitative methods of comparing the classes of area cartograms or assessing the correctness of the developed maps. The publications that appeared after 2009 were taken into account. The assumption of the analysis of the literature was to find a basis for comparing the currently developed area cartograms, with particular emphasis on automatically developed cartograms (Table 1).

Publication (year)	Method of comparison (qualitative / quantitative)	Class of area cartograms / traditional maps
B. Dent and others (2009)	qualitative	Contiguous and noncontiguous cartograms
L. Ch. Rost (2018)	qualitative	Different classes of area cartograms and traditional maps
K. Field (2017)	qualitative	Different classes of area cartograms
Nusrat i Kobourov (2016)	qualitative	Different classes of area cartograms
R.E. Roth and others (2010)	qualitative	Different classes of area cartograms and traditional maps
Nusrat, Alam and Kobourov (2018)	qualitative	Different classes of area cartograms
ScapeToad	quantitative	Gastner-Newman Cartogram
B. Kronenfeld (2018)	quantitative	Contiguous cartograms
Brunsdon, Charlton (2015)	quantitative	Gastner-Newman Cartogram
J. Oorschot (2018)	quantitative	Near-Dorling Cartograms

Table 1. Review of the literature on the subject in the field of the qualitative and quantitative assessment of the correctness of the development of area cartograms.

Only a few programs / algorithms for generating area cartograms contain assessment of the developed map. Unfortunately, this assessment is mostly concerned with the issue of a representation of the value of the phenomenon. The shape of basic units or the shape of all changed area is not subject to assessment.

**Polar charts in the assessment of the correctness of the development of area cartograms**

Based on the analysis of the available literature, an original proposal for the evaluation of the generation of area cartograms has been developed. It is the development of polar diagrams, thanks to which the features of area cartograms can be presented in a simple graphical way. This will allow for graphical grouping of cartograms based on their properties. *Example 1: Three axes* (Figure 2A). The three axes are named as it is in *Cartogram Cube* (Roth and others, 2010):

- topology - preservation of the location and arrangement of units
- shape preservation,
- visual equalisation - statistical representation of the value of the phenomenon in the unit.

*Example 2: Four axes* (Figure 2B). Similar statements can be developed for a larger number of features, e.g. for those that they highlighted Nusrat and Kobourov (2016):

- visual equalisation (statistics),
- contiguity (preservation spatial contiguity),
- shape preservation (geography),
- topology.

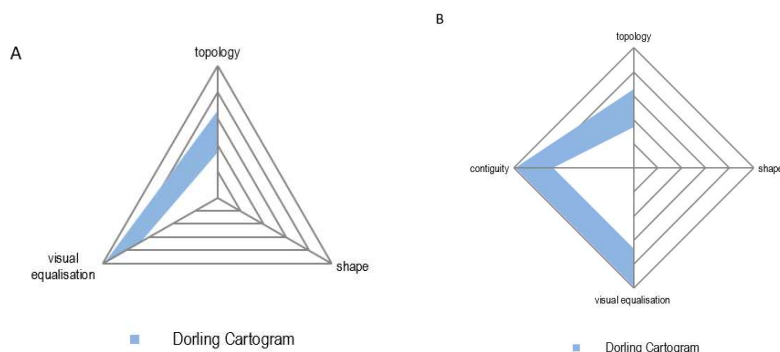


Figure 2. An example of polar charts in the assessment of the correctness of the development of area cartograms (Dorling Cartogram): A. tree axes B. four axes.

Table 2 presents a summary of the compared maps along with the assessment of the correctness of the (%). For some maps, values of "0" or "100" were indicated, in the absence or complete maintenance of a selected feature. In the rest of the cases, the following ranges were selected: 1-33 (a little), 34-66 (average), 67-99 (a lot).

Axes	Choropleth map	Noncontiguous Cartogram	Diagram Map	Dorling Cartogram	Mosaic Cartogram	Gastner-Newman Cartogram
topology	100	100	0	34-66	67-99	67-99
shape	100	0	0	0	34-66	34-66
visual equalisation	0	100	100	67-99	67-99	67-99
contiguity	100	0	0	67-99	67-100	100

Table 2. The summary of the compared cartograms along with the assessment of the correctness of the elaboration of selected features (in percent).

The graphical presentation of the correctness of the development of surface cartograms can be used in both qualitative and quantitative evaluation - then, instead of the designated classes, specific values (points) will be used, determined by the indicators of the correctness of the study (statistical, geographical and topological).

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