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# Online value-scale generator for proportional symbol maps

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**Abstract:**

Proportional symbol maps are one of the most popular methods of thematic mapping suitable for the visualisation of quantitative unnormalized data. Proportional symbols may be related to point features, aggregated data for polygons and rarely also to line features. One of the main advantages of this method, in contrary to choropleth maps, is that the actual proportional symbols are not influenced by the cartographic projection with respective distortions nor by the diversity of area sizes of the enumeration units (Kraak et al., 2020).

To visualise the quantity, proportional symbol maps follow principles according to the dimensionality of the symbols. For one-dimensional symbols (e.g. columns), the phenomenon values grow up accordingly to the shape height, while for two-dimensional symbols (most frequently circles, squares, and triangles), the phenomenon values grow up accordingly to the symbol area. Sometimes, this mathematical scaling is adjusted by multiplying it by a factor aiming to lower the underestimation of values by map users when reading 2D symbols (Flannery compensation).

Proportional symbol maps have the advantage of the values not being aggregated to classes as in graduated symbol maps, and, therefore, exact values instead of only intervals are achievable. However, it is difficult for map users to measure the area of a proportional symbol when aiming to measure the exact value. For this reason, value scales should be present in map legends showing the dependency of some easily measurable symbol parameter (circle diameter, square side, triangle height etc.) on the phenomenon value. Unfortunately, current GIS software gives us only the possibility of generating a simple legend consisting of several labelled symbols of different sizes (figure 1).

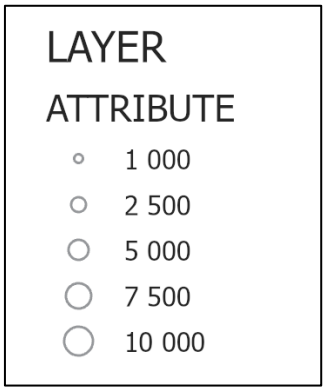


Figure 1. Simple map legend generated for proportional symbol maps in ArcGIS Pro.

To fill this gap, an online tool for generating value scales according to set parameters was designed. This tool supports multiple 2D shapes (circle, square, triangle, pentagon, hexagon) and 1D shapes (column, apex). Users only need to fill in the necessary parameters in a web form including the phenomenon minimum and maximum values, symbol shape, minimum symbol size, desired scalebar length, number of scalebar subdivisions, font size for labels, the typographic format of numerals and output file format (figure 2). The tool currently supports SVG (Scalable Vector Graphics) and PDF (Portable Document Format) as outputs, both provided in vector representation (including editable labels as glyphs) enabling the users to use the result directly or upgrade it using graphic design software. Users also may define their own values for scalebar divisions, otherwise, these are generated automatically. For 1D shapes, the column width parameter is required in addition.

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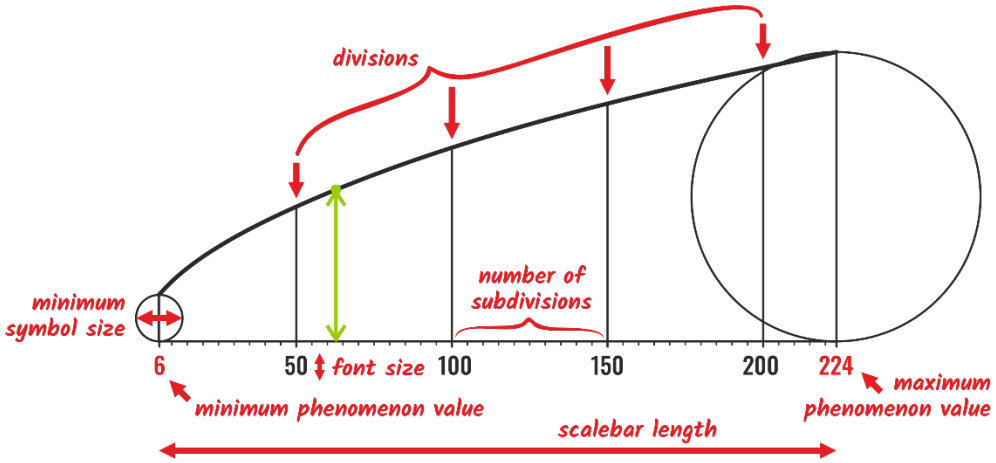


Figure 2. Mandatory and optional input parameters for value-scale generator.

The processing is realised using a Python script located on a web server receiving the values sent from the HTML form via POST requests. After processing the values and calculating the vertices of a curve (2D shapes) or straight line (1D shapes), the result is drawn using the Cairo module and returned to the website. Direct edits of the output file code are performed when generating editable labels for SVG file format as this functionality is not supported by the Cairo module. The resulting graphics are previewed online in the SVG file format (figure 3) and provided for download in both SVG and PDF.

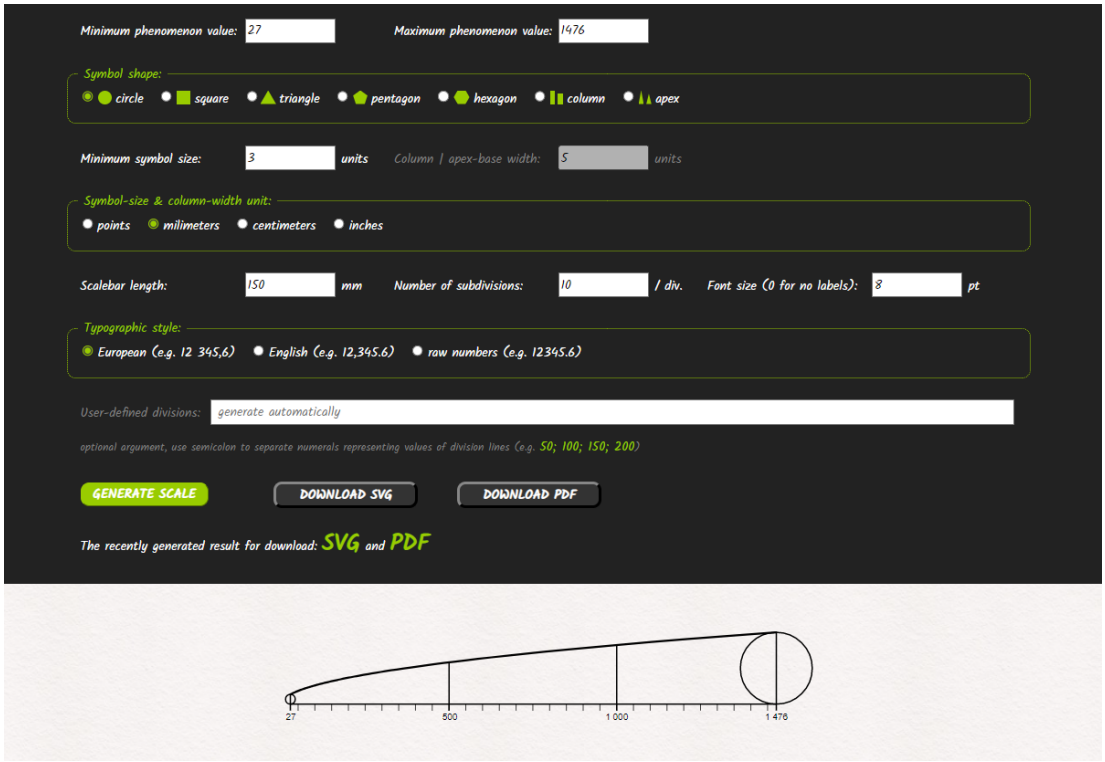


Figure 3. The online user interface of the generator applying HTML code, CSS styling and Javascript features.

The user interface (figure 3) as well as the background processing script is still in the process of finalising and optimising. However, the tool is expected to be ready and published soon during the spring season of 2023 to help cartographers make maps more precise and easy-to-read. The presented online tool is platform-independent and may be used remotely without any restrictions to a specific GIS software used for mapping. Therefore, it may be useful for cartographers designing maps in ArcGIS, QGIS, any graphic design software or wherever else.

## References

Kraak, M. J., Roth, R. E., Ricker, B., Kagawa, A. and Le Sourd, G., 2020. Mapping for Sustainable World. United Nations: New York, USA.


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