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Statistical Data Integration with Maps using Dot Density

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Abstract:

When referring to large datasets containing information about population and attempting to map them, there are several methods to try. In statistical thematic maps, data is aggregated generally into administrative areas, and then presented in one of a few possibilities. The dot density mapping technique is a method that can represent the single data entry, but still hide its identifying information, so it cannot be discovered on the map and thus keep statistical confidentiality, but still show its spatial distribution. Dot density maps do a wonderful job in depicting raw population data and integrating them into maps. This paper will provide some methods the Bureau uses to exploit this method's advantages and override its limitations. These examples are based on research and publications that were done at the Bureau's Geography Sector.

The dot density method is used at the Bureau to map an intriguing topic- religion in Israel. The database relies on the Population Register, which also hold an attribute of a person's religion. This data is then summarised by quantity per religion to cities or small statistical areas.

Mapping religion was done in a few projects. A map of the entire country was prepared, depicting major population groups and religions in Israel; City maps of cities with a mixed population were mapped by small statistical areas. These maps take advantage of the dot density's advantage of colour differentiation – in these maps two parameters are used: dot value and dot colour for the thematic side of the depiction, and dot size for adjusting the dot's display to the map's scale.

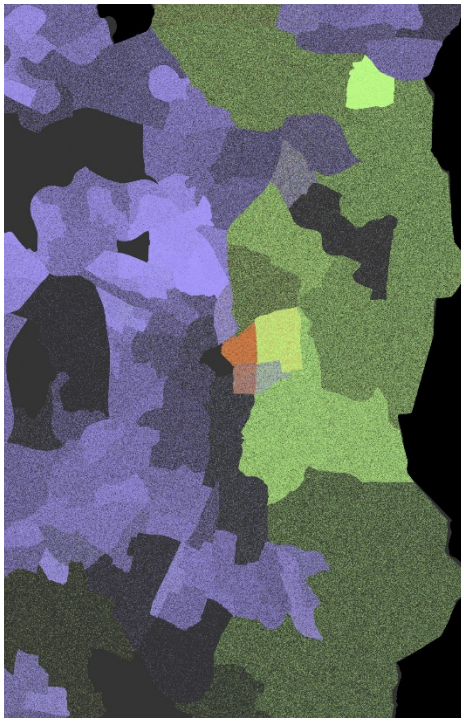

Figure 1. Religion map of Central Jerusalem (Purple=Jews, Green=Muslims, Red=Christians). Jerusalem's population density and religions are mapped by statistical areas, depicting a distinct geographic division between the different religions in the city. Eastern Jerusalem is mostly Muslim and Christian, and Western Jerusalem – Jewish. In the centre of the map – the Old City, again divided into quarters with distinct religious homogeneity.

In this map, 1 dot= 1 person, coloured by his/her religion. A map of Jerusalem and its surrounding covers about a million inhabitants, so the map too contains about a million dots. This large number of dots creates a problem when exporting the map into a PDF file or drawing on an online platform. The only way around this, beside changing the dot value and thus drawing less dots, is to export the project to a jpeg file, which may harm the quality and print quality of the final map.

Scale sensitivity is a major issue in dot density maps. The dot size has to be modified with each scale change to allow the best display performance. Once the proper dot size is established, the thematic depiction decisions are reduced to dot value and dot colour.

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However, there are disadvantages when leaving the 1:1 dot: person ratio. Once the dot value goes up, the maps start to lose information. If a ratio of 1:100 is established, then an area with 199 inhabitants will depict only 1 dot, meaning 99 inhabitants are mis-represented. Possible corrections could be changing the dot value, but then the dots clutter too much. This could be corrected again with adjusting the dot size, but then isolated areas with a high value of population will hardly be seen on the map. Trial and error help refine the optimal display, but only to a certain extent.

In order to overcome this problem, the layer containing population data was duplicated and filtered into two layers: 1) statistical areas with 1,200 inhabitants or more 2) statistical areas with less than 1,200 inhabitants, or a calculation of the remainder of the subtraction from units of 1,200. Layer 1 was given a black dot with a value of 600. Layer 2 was given a slightly smaller dot size, a pink colour and a dot value of 30.

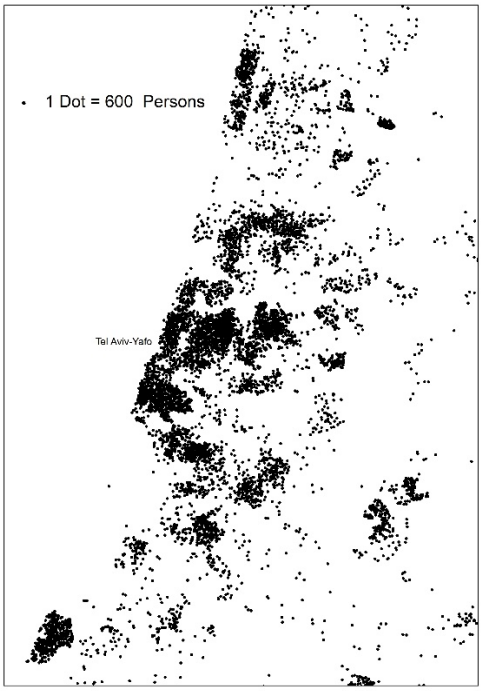

Figure 1. Population map of the Tel Aviv Metropolitan Area in central Israel, using one layer of dot density.

1 dot= 600 persons (in black).

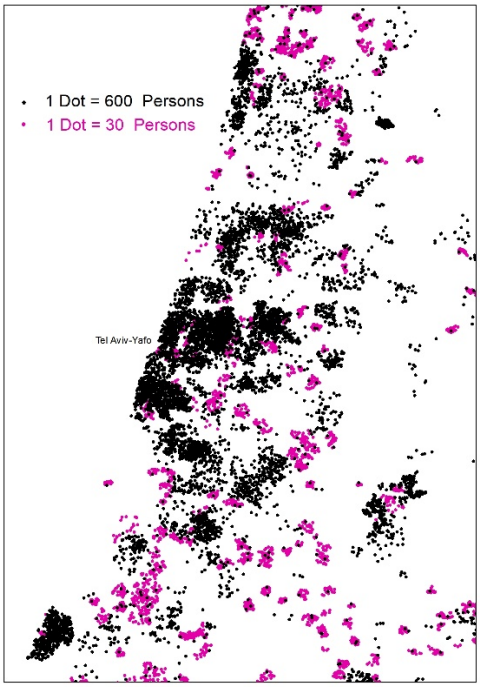

Figure 2. Population map of the Tel Aviv Metropolitan Area in central Israel, using two layers of dot density.

1 dot= 600 persons in black, 1 dot=30 persons in pink.

Figure 1 shows the depiction of layer 1 only in and around the Tel Aviv Metropolitan Area. There is a tremendous loss of data due to the high dot value. Small villages and population in small town are absent from the map. Figure 2 shows both layers. The pink colour completes the depiction of most of the dataset, and also allows the reader to distinguish low population areas on the map.

Dot density maps are a great way for integrating data into maps. There is a lot of flexibility with this method. The correct balance between scale adapted dot size and dot value and colour may yield highly informative maps. A detailed population dataset can be mapped with great precision while bypassing this method's main disadvantage of aggregating data by dot value, by duplicating the layer and mapping low quantity areas with different symbology, thus keeping statistical confidentiality while depicting its spatial distribution.

References

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