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MAUP

The Modifiable Areal Unit Problem or MAUP, also called the ecological fallacy, is a common issue in geographic and spatial analysis. It is a source of statistical bias that can drastically affect the results of data analysis. This is due to the arbitrary nature of boundaries or most enumeration units. According to Openshaw, "the areal units (zonal objects) used in many geographical studies are arbitrary, modifiable, and subject to the whims and fancies of whoever is doing, or did, the aggregating." (Openshaw 1983). MAUP shows the need for considering space and the nature of boundaries in one's analysis, along with many uncertainties that go with real-world analysis. This article discusses what the MAUP is, how is can be misused, and methods for avoiding it.

When doing spatial analysis in a geographic information system (GIS) it is common to group data by area, and the short of MAUP is, using different scale (or aggregation) and zones (or grouping) can produce different and misleading results or errors. There are two different ways that MAUP happens, as mentioned above, the use of different scale or different zones can cause different errors.

The scale of the units that data is group into for GIS analysis can produce various results. Whether is it entire countries as units, states, counties, cities, or census tracts, the results will vary based upon how the data is aggregated. Which can mean that extreme values become less common and the scale increases, because those extreme values are averaged with non-extreme values. This can cause important data to be lost due to this effect, giving a sense that area is more similar then it actually is. For example, the percentage rate of population for the entire United States is different from the state of Alabama, which is different from Jefferson County, which is different from Birmingham, which is different from a neighborhood in Birmingham. This can be seen in the maps below (Figure 1) which show the percentage of the population over the age of 65 in Alabama.

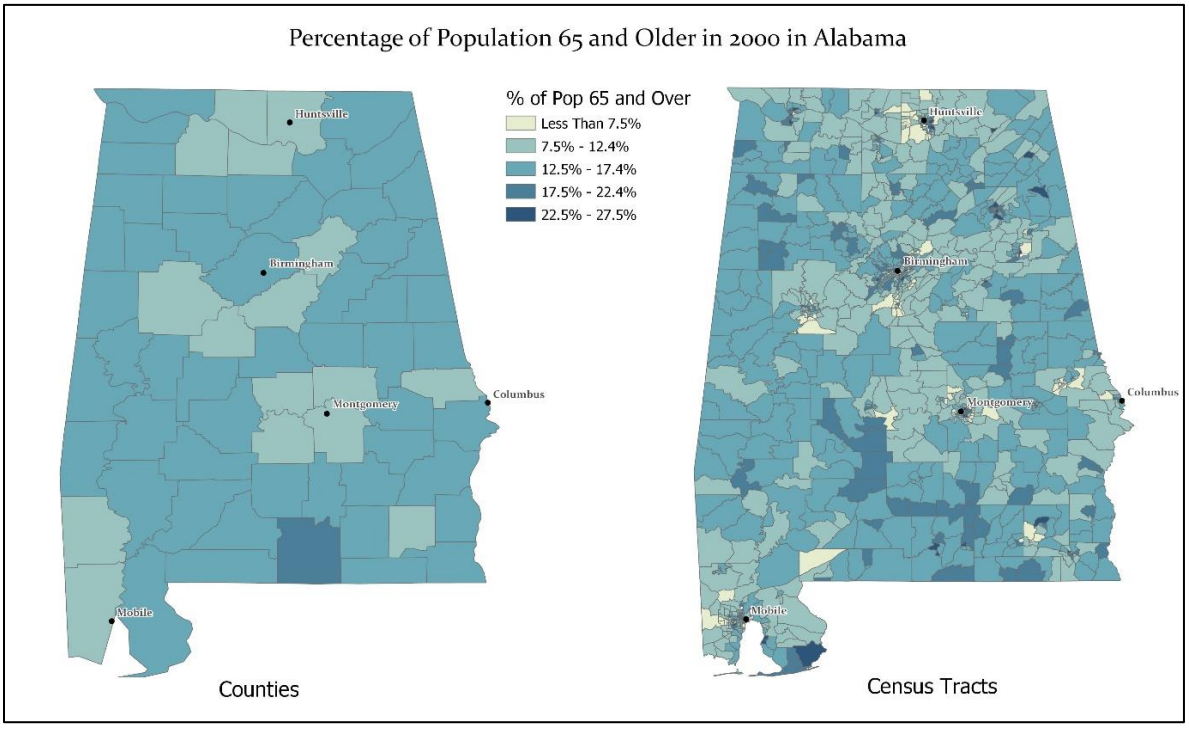

Figure 1 Scale MAUP comparison

The map on the left shows the counties in Alabama as the scale of units, while the map on the right shows the census tracts as the scale of units. As can be seen there is much less extreme values in the map of the counties, which the census tracts have both more extremes in both higher and lower percentages. This example just

shows the importance of choosing the correct scale to match what is trying to be studied, and if it is not possible to choose the scale be aware of the implications of that scale. Also, if possible always choose larger scale because that data can always be aggregated while smaller scale data cannot be divided into larger scale as easily.

Zones or grouping of data can also cause analytical issues as well even if the units are of similar size or scale. While there may be issues or errors in a research project due to zone MAUP, it can also be used to manipulate or skew results as well. In Figure 2 below, the maps show two different aggregations of Alabama into districts Plan A and Plan B.

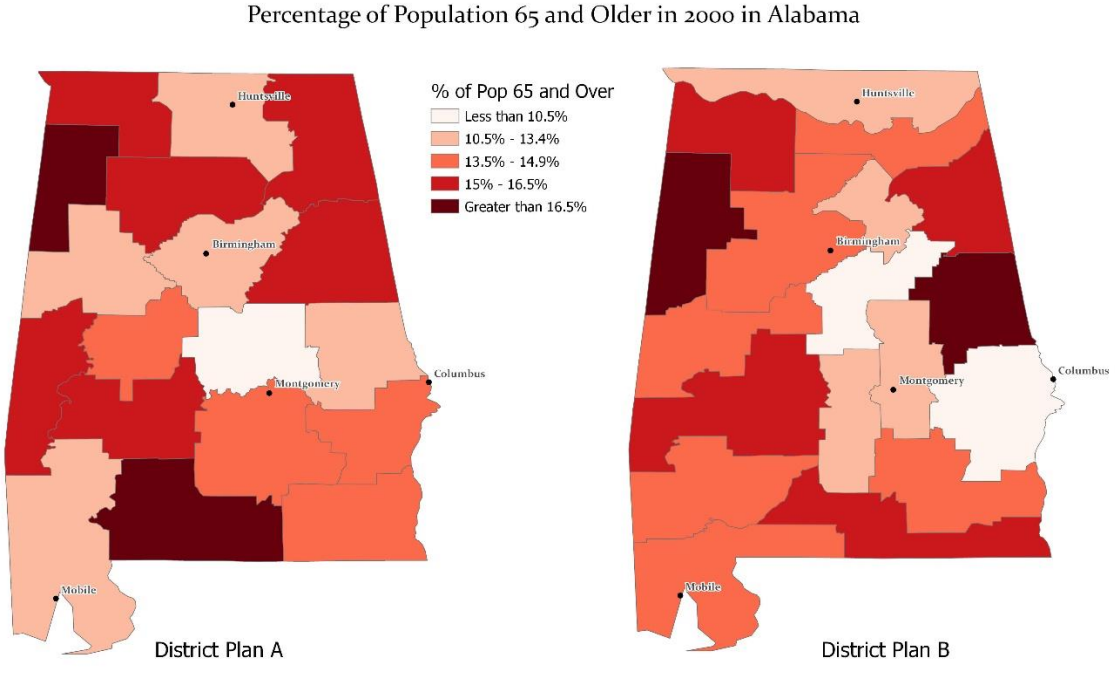

Figure 2 Zone MAUP comparison

Even though each district is very similar in size, there can be drastic changes in groupings due to which counties are group together. This can be seen when comparing the two districts near Columbus, in Plan A the district that contains Columbus has can percentage of population over 65 of 13.5-14.9 percent while the district just north of Columbus is 10.5-13.4 percent. In Plan B the district Columbus falls in is now less than 10.5 percent and the district north of Columbus in now greater than 16.5 percent. As can be seen in this example the districts went from being in the intermediate ranges to the extreme ends of the ranges in Plan B just based on reshaping the districts. This type of zone MAUP or grouping of areas to shape the make-up of a district or area has a term in politics: gerrymandering or political redistricting. This is a practice that is done to serve the interests or political parties and politicians. Gerrymandering is done by linking voting blocs of people who will vote for a specific person or group together through thin connections, while splitting people opposed to that group or person minimizing their influence in the same areas.

Both of the two types of MAUP along with the examples and figures above serve to illustrate that both there can be intentional and unintentional misuse of spatial data that can have real world effects. For individuals doing research or studies, there needs to be an understanding that although one can create their own zones for the purpose of research it must be done critically, and with an understanding of how those groupings can shape

the data. Additionally, if more data is available it would be wise to create multiple maps at multiple scales so that a more complete picture of distribution can be seen. Also, other types of symbolization could be more appropriate, such as a dot map, that could tell more about the spatial distribution of a phenomena that is being studied. The important take away on MAUP is just to have an understanding of what it is, and how it can be used, so that a critical eye can be used when creating these maps and doing research.

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