

Measuring Areal Dispersion in US Congressional Districts: A Nationwide Comparison of Geographic Compactness Measures

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Questions: Do different measures of areal dispersion produce similar assessments of the geographic compactness of US Congressional districts? Which Congressional districts were the least compact after the 2000 redistricting round?

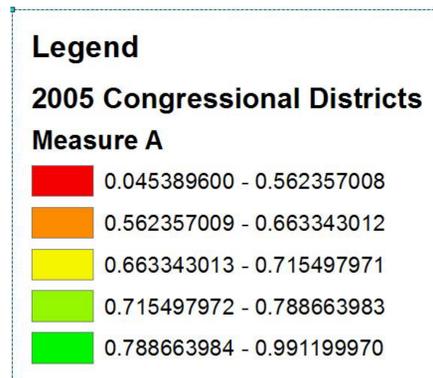
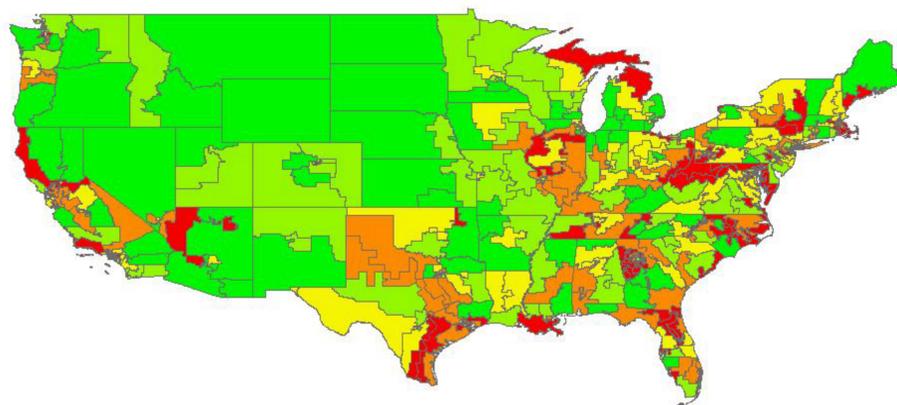
Background: Every ten years, states redraw boundaries between congressional districts. Judges consider geographic compactness in evaluating redistricting proposals since the Voting Rights Act of 1965 contains a compactness requirement and since the Supreme Court reaffirmed the importance of that requirement in *Thornburg v. Gingles* (1986). Now that the next round of redistricting has begun after the 2010 census, examining compactness measures is both timely and relevant.

Literature: Scholars have proposed over 30 different measures of areal dispersion. Just a few are still considered by academics and are used in litigation. But there has not been any systematic effort to apply these dispersion measures to more than just a few states (Hofeller and Grofman 1990; Niemi et al. 1990). This project is the first to consider how districts across the US compare with respect to the few measures of areal dispersion that are still relevant in the academic and legal communities.

Data and Methods: All data used was available on the US Census website: population data is taken from the 2000 Census, and the district lines are from the 109th Congress. I consider only the 48 contiguous states. Methods are taken from Altman 1997; I consider the three measures Altman identifies that are most commonly used to assess areal dispersion. In all three subsequent maps, low values (signified by red) indicate high areal dispersion and low compactness, while higher values (signified by green) indicate low areal dispersion and higher levels of compactness.

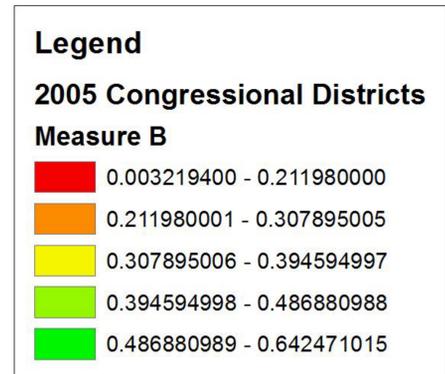
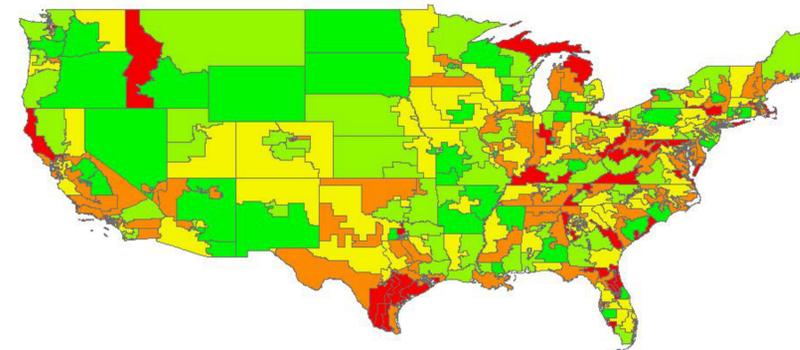
Measure A: Ratio of District Area to Area of Convex Hull Containing District

Measure A for Compactness 2005 Congressional Districts



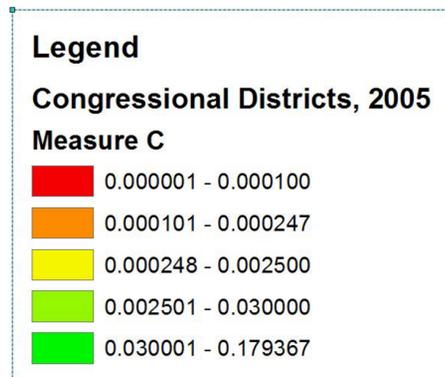
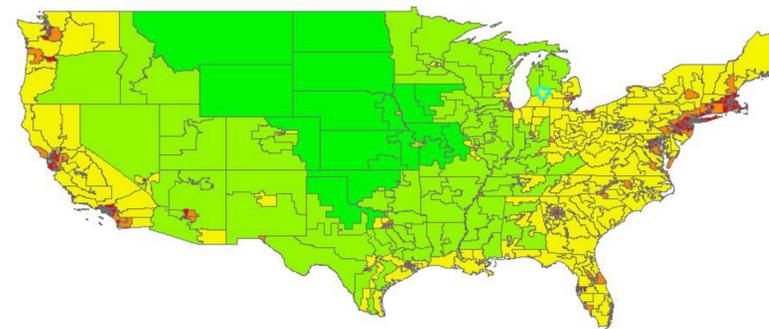
Measure B: Ratio of District Area to Area of Smallest Circumscribing Circle

Measure B for Compactness 2005 Congressional Districts



Measure C: Normalized Variance of Distances from Moment of Inertia to Points in District

Measure C for Compactness 2005 Congressional Districts



Results and Conclusions: Measure A and Measure B measure something similar with respect to areal dispersion: Kendall's tau (a correlation statistic for the agreement between two rank-orderings) for the two measures is 0.77. But Measure C, an equally common measure of compactness in litigation and scholarly work, has a Kendall's tau of just 0.43 with Measure A and 0.36 with Measure B. As the maps show, Measures A and B identify non-compact districts well: consider the red and orange districts in Arizona, Illinois, and Texas. These districts are not picked up by Measure C, which seems to only identify non-compact districts in urban areas with high population densities. Thus, this analysis preliminarily suggests - empirically - that **Measures A and B do a better job of measuring picking up unusual areal dispersion than Measure C does.**