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Statistical Standards for 2021 County Board Redistricting

The following is a summary of the statistical standards for the 2021 Champaign County Board Redistricting effort by Champaign County Executive and appointed members of the Redistricting Advisory Group. These are based on generally accepted measures for redistricting.

Ideal District Population

The population for each election district shall be determined by dividing the total population of Champaign County by the number of election districts as adopted by the Champaign County Board in accordance with Illinois State law. Thus, if the County's population is 210,000 as determined by the 2020 United States Census, and the County Board has determined that there shall be ten (10) election districts, a county board election district would have an ideal equal district population of 21,000.

- The Champaign County Board adopted 11 districts as a part of their reapportionment plan.
- The population estimate of Champaign County in 2020 is 214,120 as reported by ESRI demographics.
- Utilizing this estimate, equally populated districts will have *approximately* **19,465** people.
  (214,120 people / 11 districts)

Population Deviation

The amount of inequality in a single election district is examined by determining the degree to which the population of that district varies with the ideal equal district population and shall be expressed as a measure of deviation. The "absolute deviation" is the difference between a single election district's population and the ideal population of that district. The "deviation percentage variance" is the difference between a single election district's population and the ideal population of that district, divided by the ideal population, expressed as a percentage. If the size of an ideal equal election district is 19,465 and the population of an election district is 18,491, then the absolute deviation would be 974, and the deviation percentage variance would be .05 or 5 percent.

The Absolute Deviation calculation is completed for each district in a scenario. This measure is the number of people to add or remove to reach equally populated districts.

Absolute Deviation = Individual District Population - Ideal District Population

The Deviation Percentage Variance calculation is completed for each individual district in a scenario. This measure is the percentage of people to add or remove to reach equally populated districts.

$$\textbf{Deviation Percentage Variance} = \frac{\textbf{Absolute Deviation}}{\textbf{Ideal District Population}}$$

Population Overall Range

The "overall range" is a measure of inequality most used by courts in reviewing reapportionment maps and examines the population difference between the most populous election district and the least populous election district. The "absolute overall range" is the difference in population between the most populous election district and the least populous district election in a redistricting plan. The "overall range ratio" is the ratio calculated by dividing the population of the most populous election district by the least populous election. The "overall range percentage variance" is the absolute overall range for a particular redistricting plan divided by the ideal population, expressed as a percentage. Thus, if the ideal population of an election district within a redistricting plan is 19,465 and there are eleven districts with populations of 19,103, 20,154, 19,863, 19,122, 19,553, 19,701, 19,303, 19,202, 19,350, 19,276, and 19,493 respectively, the "absolute overall range" would be 1051 (20,154 minus 19,103), the "overall range ratio" would be 1.055 (20,154 divided by 19,103), and the "overall range percentage variance" would be .0539 or 5.39 percent for that redistricting plan (1051 divided by 19,465). The overall range, specifically the overall range percentage variance is the method most used by courts in measuring population inequality for redistricting plans.

The Absolute Overall Range calculation is completed once for a districting scenario. This measure is the difference in population between the district with the greatest population and the district with the least population.

Absolute Overall Range = District with Greatest Population - District with Least Population

The Overall Range Ratio calculation is completed once for a districting scenario. This measure is a comparison of populations between the districts with the greatest and least populations.

$$\textbf{Overall Range Ratio} = \frac{\textbf{District with Greatest Population}}{\textbf{District with Least Population}}$$

The Overall Range Percentage Variance calculation is the completed once for a districting scenario. This is the measure used by most courts to determine population inequality.

$$\textbf{Overall Range Percentage Variance} = \frac{\textbf{Absolute Overall Range}}{\textbf{Ideal District Population}}$$

Smallest Majority

The "smallest majority" measurement is the smallest percentage of the county's total population that could be represented by a majority of the election districts in a redistricting plan. Thus, if the population of all election districts in a particular redistricting plan in Champaign County is 214,120 and there are eleven districts in the plan of 19,103, 20,154, 19,863, 19,122, 19,553, 19,701, 19,303, 19,202, 19,350, 19,276, and 19,493, the smallest percentage of total population of all districts that could be represented by a majority of the election districts would be 53.8 percent (the sum of the population of the six smallest election districts constituting a majority of the election districts, which population sum totals 115,356, divided by the population of all districts, 214,120).

The Smallest Majority calculation is completed once for a districting scenario. This measure is the smallest percentage of the population that is represented by a majority vote by their representatives. Should not be smaller than 50%.

$$\textbf{Smallest Majority} = \frac{\sum \textbf{Population of six smallest districts}}{\textbf{Population of all districts}}$$

SUMMARY

All these measures used together can help assess the issue of equal population. In general, equal population can be determined if the following is true.

- Absolute Deviation - smaller numbers
- Deviation Percent Variance - smaller percentages
- Absolute Overall Range - smaller number
- Overall Range Percentage Variance - close to 1 and must be greater than 1
- Smallest Majority - close to 50% and must be greater than 50%

Every submitted plan must be measured in accordance with the standards set for herein. Each measurement of each considered plan shall be publicly disclosed.

Non-population Criteria

Illinois Law

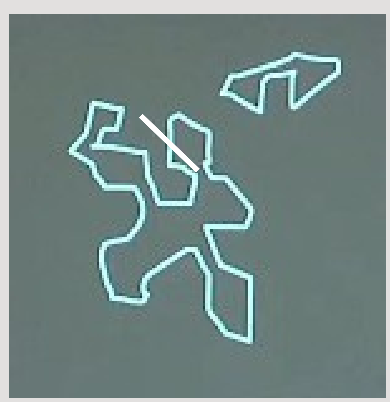
(1) Shall be equal in population to each other district.

This is assessed based upon the measures explained above.

(2) Shall be comprised of contiguous territory as nearly compact as practical.

Contiguous

Non-contiguous



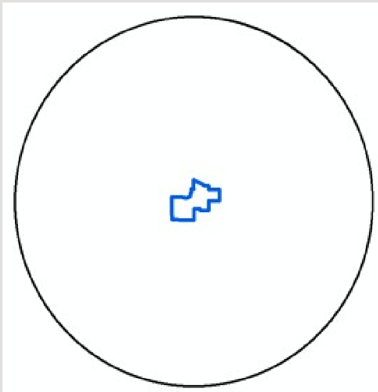
Compactness

The most compact geometric shape is a circle. Several tests can be used to rate compactness.

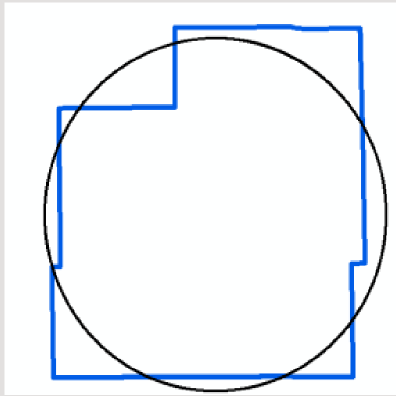
Polsby-Popper Score

The Polsby-Popper score is the ratio of the area of the district to the area of a circle with the same perimeter. The score is always between 0 and 1 with a higher score indicating a more compact district. The mean score among all districts is then used to compare districting scenarios.

The Polsby-Popper score is completed for each district in a scenario.



Less Compact: 0.43



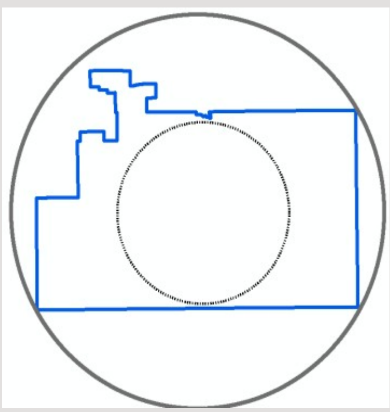
More Compact: 0.69

$$\textbf{Polsby-Popper Measure of Compactness} = \frac{4\pi * \text{Area}}{\text{Perimeter}^2}$$

Roeck and Ehrenburg Tests

The Roeck and Ehrenburg Tests are like the Polsby-Popper Score in that they are only concerned with geometry. The Roeck test calculates the ratio of area of the district to the area of the smallest circle that completely encloses the district. The Ehrenburg test calculates the ratio of area of the district to the area of the largest circle that inscribes the district.

The Roeck and Ehrenburg tests are completed for each district in a scenario.



$$\textbf{Roeck Test} = \frac{\text{Area of District}}{\text{Area of Enclosing Circle}}$$

$$\textbf{Ehrenburg Test} = \frac{\text{Area of Inscribed Circle}}{\text{Area of District}}$$

Roeck Test: 0.56
Ehrenburg Test: 0.43

Dispersion of Population

Compactness measures that are only concerned with geometry may be misleading if the dispersion of the district population is ignored. Comparing the distance between the center of population and the geographic center of the district provides a measure for dispersion of population. The population circle test also provides a useful measure.

$$\textbf{Population Circle Test} = \frac{\textbf{District Population}}{\textbf{Population of the Minimum enclosing circle for the District}}$$

Summary of Compact and Contiguous Criteria

All these measures, used together, can help assess the compactness of a district or a redistricting plan. Multiple measures should be used because each measure has its own limitations.

(3) May divide townships or municipalities only when necessary to conform to the equal population requirement.

This is assessed visually. Spatial analysis can be completed to highlight areas where townships andmunicipalities are divided.

(4) Shall be created in such a manner to limit the number of precinct splits insofar as practicable pursuant to 55 ILCS 5/2-3003(1)(a)-(d).

This is assessed visually. Analysis can be completed to highlight areas where precincts are divided however, as the precincts shall be re-drawn after the County Board Districts, high emphasis is not placed on the division of precincts.

Race

Any reapportion plan map must be consistent with the requirements set forth in the 15th Amendment to the Constitution of the United States guaranteeing the right to vote by minority citizens shall not be abridged by any state or political subdivision thereof and by the Voting Rights Act of 1965 which assures that states and political subdivisions shall not discriminate against the rights of minorities to vote and be represented by government.

Population statistics that are used for the entire population can also be used for race categories. Absolute deviation and deviation percentage variance are both suitable measures. The Herfindahl index is a measure that can be used to compare racial diversity across districts.

$$\text{Herfindahl Index} = \sum_{I=1}^{n} s_i^2$$

$$\text{Normalized Herfindahl Index} = \frac{(H - 1/N)}{1-1/n}$$

See the following page for additional explanation. The index ranges from 0 to 1 with zero being highly diverse or heterogeneous and 1 being the least diverse or homogenous.

Communities of Interest

The Redistricting Advisory Group has identified as a high priority keeping together communities of interest to preserve their voting strength. Commonly recognized communities include those of race and ethnicity, but can also define other geographic, demographic, or economic groups with common interests.

Champaign County residents are invited to draw polygons outlining suggested communities of interest for the Redistricting Advisory Group to consider though this link: https://maps.ccgisc.org/Redistrict/coi

Analysis may vary with the type of community of interest, which may be an area isolated by physical boundaries such as roads or water features, defined by platting boundaries such as neighborhoods, or defined by other characteristics signifying commonality.

Voting Patterns: Political Affiliation

The Redistricting Advisory Group shall not consider voting patterns, voting records, past election results, party affiliation, incumbency, or other such political factors in reviewing, analyzing, or adopting a Reapportionment Plan Map.

Herfindahl Index

$$\text{Herfindahl Index(H)} = \sum_{i=1}^{n} s_i^2 \qquad \text{Normalized Herfindahl Index} = \frac{(H - 1/N)}{1 - 1/n}$$

Greyed sections of the table represent raw population data.

Herfindahl Index of Racial and Ethnic Diversity
Calculations for 2001 Champaign County Board Districts

Geography Identifier (Districts)	Total population	Total Less Small Segments	Hispanic-Latino	H-L Share	White	White Share	Black	Black Share	Asian	Asian Share	Small Segements total*	Other	Herfindahl Index	Normalized Herfindahl Index
1	19812	19761	342	0.0173	17980	0.9099	1189	0.0602	208	0.0105	51	156	0.8319	0.78
2	19765	19676	462	0.0234	16331	0.8300	2360	0.1199	285	0.0145	89	175	0.7040	0.61
3	19779	19726	285	0.0144	17744	0.8995	868	0.0440	731	0.0371	53	92	0.8127	0.75
4	19680	19648	202	0.0103	18389	0.9359	378	0.0192	602	0.0306	32	70	0.8774	0.84
5	19439	19359	698	0.0359	11712	0.6050	5939	0.3068	945	0.0488	80	324	0.4638	0.29
6	19802	19744	598	0.0302	13931	0.7056	4306	0.2181	749	0.0379	58	271	0.5478	0.40
7	19788	19721	1019	0.0515	15413	0.7816	1377	0.0698	1964	0.0996	67	532	0.6283	0.50
8	19958	19927	778	0.0390	14917	0.7486	943	0.0473	3236	0.1624	31	379	0.5905	0.45
9	20175	20132	749	0.0371	14098	0.7003	2455	0.1219	2734	0.1358	43	381	0.5251	0.37
													Average	0.55
													Std. Dev.	0.20

**Small segments include American Indian or Alaskan Native, Native Hawaiian or Pacific Islander, and other*

Calculation Process

Step 1: Gather population by race data for district geographies
Step 2: Determine population less small segments
Step 3: Determine share of population for Hispanic or Latino Ethnicity using total population
Step 4: Determine Share of population by race (White, Black or African American, Asian) using total population less small segments
Step 5: Calculate Herfindahl Index for each district
(H-L Share^2)+(White Share^2)+(Black Share^2)+(Asian Share^2) = H
Step 6: Calculate Normailized Herfindahl Index
(H - 1 / number of groups used in the calculation (4)) / (1-(1/number of groups used in the calculation (4))
Step 7: The Average and Standard Deviation of the normalized Herfindahl Index provide an overall picture of the district scenario