Redistricting technology through the ages
The modern era of redistricting, 1971–
The modern era of redistricting, 1971–

• pre-computer age 1971–1990
The modern era of redistricting, 1971–

- pre-computer* age 1971–1990

*(mostly)
The modern era of redistricting, 1971–

- pre-computer* age 1971–1990
- PC age 1991–2010

*(mostly)
The modern era of redistricting, 1971–

- pre-computer* age 1971–1990
- PC age 1991–2010
- Internet age 2011–

*(mostly)
Census tabulation

1790–1870

Source: U.S. Census Bureau
Census tabulation

1790–1870

“Clerks who made tally marks or added columns of figures with a pen or a pencil.”

Source: U.S. Census Bureau
Census tabulation

1790–1870
“Clerks who made tally marks or added columns of figures with a pen or a pencil.”

1880
“A tabulating machine: a wooden box in which a roll of paper was threaded past an opening where a clerk marked the tallies in various columns and then added up the marks.”

Source: U.S. Census Bureau
Census tabulation

1890–1940

Hollerith machine

Source: Computer History Museum
Census tabulation

1951
UNIVAC I computer

Source: U.S. Census Bureau
1971: Very little computerization

- Perhaps only CA, DE, IA, GA, WA use computers.
- Census small geographies were not very useful.
1971: Very little computerization

- Perhaps only CA, DE, IA, GA, WA use computers.
- Census small geographies were not very useful.

1975: PL94-171

- 1975: Congress passes PL94-171 to allow states to work with the Census on geographies. NCSL plays key role in getting it passed.
1981

• Census data not perfect, but much better than 1971.

• Even for the states that did use computers, incredibly labor-intensive process.
Let’s draw some districts!
Let’s draw some districts!
Let’s draw some districts!
Let’s draw some districts!
**Step 1. Receive data from the Census**

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Step 2. Print out a really big map.
Step 1. Receive data from the Census

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Step 2. Print out a really big map.
Step 3. Crawl around on your hands and knees with dry erase markers, drawing districts on acetate.
Step 1. Receive data from the Census

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Step 4. Record district-tract assignments onto punch cards.

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### Step 5. Drive to the local university. Run the punch cards through the mainframe overnight.
Step 1. Receive data from the Census

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Step 5. Drive to the local university. Run the punch cards through the mainframe overnight.

Step 6. Pick up your report.

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<tr>
<td>A</td>
<td>25,910</td>
<td>20,728</td>
<td>7,773</td>
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<td>1,410</td>
<td>1,128</td>
<td>423</td>
</tr>
<tr>
<td>C</td>
<td>2,909</td>
<td>2,327</td>
<td>873</td>
</tr>
<tr>
<td>D</td>
<td>32,809</td>
<td>26,247</td>
<td>9,843</td>
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Step 7. Did you achieve your objectives? No? Go back to step 2.
1981

Young man... can you spare a moment?

Redistricting hearings

Legislature

Secret meetings

Source: UNC Library
1991: The culmination of some mid-80s revolutions

• In the mid-80s, revolutions were underway...
1991: The culmination of some mid-80s revolutions

- In the mid-80s, revolutions were underway...
  - ... in the Census: TIGER
1991: The culmination of some mid-80s revolutions

- In the mid-80s, revolutions were underway...
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  - ... in computer hardware: faster, smaller, cheaper
  - ... in computer software: graphical user interfaces (GUIs), geographic information system (GIS)
  - ... in the law: Gingles factors
1 Out of 3 CIOs Lose Their Jobs.

- Were they unable to communicate their strategies?
- Did they make uninformed technology decisions?
- Were they overwhelmed by the issues?

Makes You Wonder About The Advice They Were Getting.

As a subsidiary of International Data Group, the world's leading supplier of information on information technology, Technology Investment Strategies Corporation is uniquely positioned to provide a comprehensive set of research and consulting services dealing with the most critical information technology issues of the day.

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*Source: Computerworld article, February 1996
1 Out Of 3 CIOs Lose Their Jobs.

As a systems analyst, I've been following the developments in the computer industry closely. The recent news about the rise in CIO job losses is alarming. While some companies are cutting costs, others are failing to adapt to the changing market. It seems that the decision to outsource IT services is becoming more common.

Okay.
You're using dBASE. You're trying to develop a payroll application for the entire company, and you've just hit the wall. So the first thing you do is try a few workarounds, then some more. And ignore the fact that you don't have any decent backup and recovery, data integrity, database security or multi-user concurrency.

No big deal. It's only the fate of the company, your closest friends, and their children.

dBASE was the computing environment of the 80's. Back before businesses became dependent on LAN's and multi-user applications. ORACLE is the computing environment for the 90's. From the very beginning, Professional ORACLE was designed for multi-user workgroup applications. Its SQL architecture is built in (not tacked on like dBASE) and includes all the fourth generation development tools you need to develop applications that run on over 50 different platforms. And every major operating system, even OS/2.

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And if, after 30 days, you're not happy with it, return it for a full refund.

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Register now for the Oracle 1990 International User Week, Oct. 1-6, Dallas, Texas. Call the number above.
1 Out of 3 CIOs Lose Their Jobs.

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Agenda
8:30 Registration and coffee
9:00 Seminar begins
10:30 Break
12:00 Lunch

Seminar dates and locations

Athens, GA
August 13
Baton Rouge, LA
September 17
Dallas, TX
October 1
Denver, CO
October 15
Los Angeles, CA
November 12
Miami, FL
November 19
Minneapolis, MN
December 10
Pittsburgh, PA
December 17
San Francisco, CA
January 7
Seattle, WA
February 4
Washington, DC
February 11

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You'll also see a series of tools for improving performance throughout your SSA network. And you'll have a chance to exchange insights on a variety of subjects with other systems management professionals from your area.
2001

- Commercial off-the-shelf software available: CityGate, Maptitude
- Can be run off of laptops
- Uses of the Internet are rudimentary
- Some legislatures still building their own software
2011: The Internet age

- Free Internet redistricting software: Dave’s Redistricting App, DistrictBuilder
- Public workstations
- Increased access
- Great data journalism
2021

- Proliferation of free online tools
2021

- Proliferation of free online tools
- States seeing unprecedented interest in redistricting
2021

- Proliferation of free online tools
- States seeing unprecedented interest in redistricting
- Legislatures, commissions, soliciting public input
Beyond 2021

• Anyone can draw a map now.

• Soliciting public input is great, but how are legislatures supposed to make sense of all this public input?
Split Decisions
Guidance for Measuring Locality Preservation in District Maps

November 2021
What’s a locality?

- Counties
- Communities of interest (COIs)
- Cities, towns, municipalities (Census term: “incorporated places”)
- Unincorporated communities (Census term: “census-designated places”)
- American Indian reservations and associated statistical areas
- ...
Why keep localities whole?
Why keep localities whole?

- Preserve political power
Why keep localities whole?

- Preserve political power
- Empower communities
Why keep localities whole?

- Preserve political power
- Empower communities
- Inform voters
Why keep localities whole?

- Preserve political power
- Empower communities
- Inform voters
- Simplify election administration
Statutory requirements

• Detailed rules (OH):

  …of the eighty-eight counties in this state, sixty-five counties shall be contained entirely within a district, eighteen counties may be split not more than once, and five counties may be split not more than twice. The authority drawing the districts may determine which counties may be split…No two congressional districts shall share portions of the territory of more than one county, except for a county whose population exceeds four hundred thousand…

• Ambiguous rules (ID):

  …[t]o the maximum extent possible, districts shall preserve traditional neighborhoods and local communities of interest.
One way to measure split localities: Just count them
Another way:
Count the pieces
What’s wrong with just counting splits or pieces?
What’s wrong with just counting splits or pieces?

- They don’t take into account where people are. People need representation, not land.

- A 99/1 split counts the same as a 50/50 split.

- Splitting a low-population locality counts the same as splitting a high-population locality.
A better way:
Population-based metrics

- Effective splits
- Conditional entropy
- Square root entropy
- Split pairs
A better way:
Population-based metrics

- Effective splits
- Conditional entropy
- Square root entropy
- Split pairs
“Split pairs” metric

28 pairs of people
“Split pairs” metric

28 pairs of people
“Split pairs” metric

28 pairs of people
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20/28 pairs of people are split, for a score of 20/28 = 0.71
“Split pairs” metric

20/28 pairs of people are split, for a score of $20/28=0.71$

A random person does not remember his congressional district, so he picks a person randomly from his locality and asks what that person’s district is. Then he guesses that he lives in the same district. What is the probability of guessing wrong? The split pairs metric.
Where to try these metrics?

- Currently:
  - Princeton Gerrymandering Project report card
  - Representable
Florida 2021 Draft Staff Congressional Map H000C8001

Overall Grade: F
- Significant Republican advantage.

Partisan Fairness: F

Competitiveness: C
- Similarly competitive relative to other maps that could have been drawn

Geographic Features: C
- Compact districts, typical number of county splits

Metrics:

Partisan Fairness
- Frequency of Democratic wins out of 28 districts
- 300k-500k maps
- Fair range

Competitiveness
- F

Geographic Features
- Compactness (Avg. Reock)
- 0.420

Additional metrics:
- Packed Wins: 2.3% favoring R
- Mean-Median: +3% R
- Partisan Bias: +7.1% R
- Minimum Reock: 0.115
- Average Popper: 0.276
- Minimum Popper: 0.084
- Split Pairs: 0.399
Metrics of locality splitting/preservation in district maps

This code accompanies the Center for Democracy & Technology report, Split Decisions: Guidance for Measuring Locality Preservation in District Maps, by Jacob Wachspress and William T. Adler.

This repository contains Python code that implements a number of metrics for quantifying locality (e.g. county, community of interest) splitting in districting plans. The metrics implemented are:

- Geography-based
  - Number of localities split
  - Number of locality-district intersections
- Population-based
  - Effective splits
  - Conditional entropy
  - Square root entropy
  - Split pairs
Thanks!