

THE METRIC GEOMETRY AND GERRYMANDERING GROUP

THE THEORY AND DATA OF REDISTRICTING

The **Metric Geometry and Gerrymandering Group** is a Boston-based team of mathematicians working on applications of geometry and computing to U.S. redistricting.

Gerrymandering is a direct threat to our democracy, undermining fundamental principles like equal protection under the law and public confidence in elections. We aim to address gerrymandering through scholarly research, public engagement, and expert consulting.

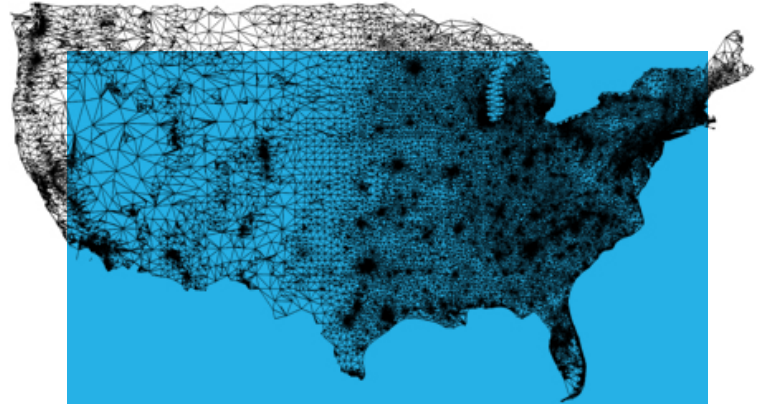
Moon Duchin (Tufts Mathematics & Tisch College) and **Justin Solomon** (MIT Computer Science & Artificial Intelligence Lab) lead a core group of dozens of multidisciplinary scholars and redistricting practitioners and a wider network of hundreds of varied technical experts.

RESEARCH, TOOLS, TRAINING

In 2017–2018, MGGG held a cycle of five **Geometry of Redistricting Workshops** around the country combining talks and panels with specialized trainings for expert witnesses, educators, coders, and mapmakers. More than 1200 people attended these workshops.

In Summer 2018, MGGG ran the first annual **Voting Rights Data Institute**, bringing fifty-two undergraduate and graduate student fellows together for six weeks of intense work. The fellows advanced our research and tool development using geometry, computing, statistics, political science, and law.

This brochure surveys three of the more than twenty-five active MGGG projects.



MGGG MISSION

Produce cutting-edge scholarly research on the mathematics of redistricting

Consult on best practices for redistricting bodies, citizen initiatives, and reform efforts

Train scholars from quantitative fields to serve as experts in court and for community groups

Engage the public through direct outreach

Help educators design courses that fuse mathematics and civics

Visit us Online: mggg.org

Make a donation: tinyurl.com/tipgerry

Email us at gerrymandr@gmail.com



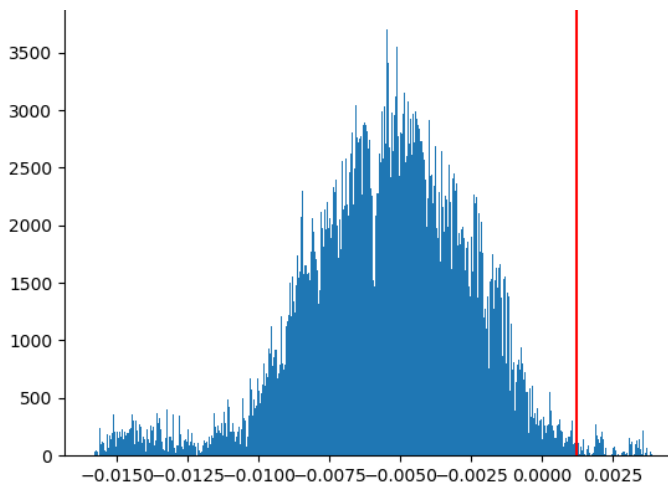
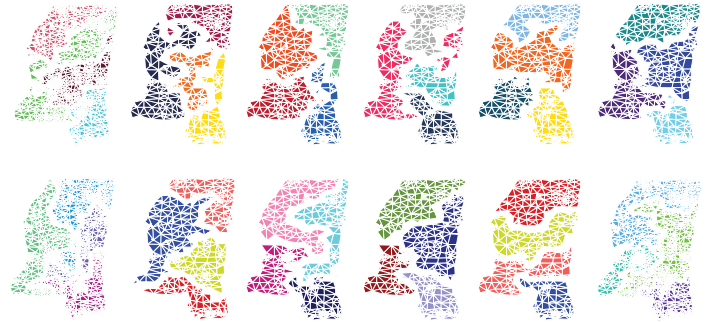
Jonathan M. Tisch
College of Civic Life

ALGORITHMS TO STUDY DISTRICTING ALTERNATIVES

Tool Spotlight: Markov Chain Monte Carlo

THE UNIVERSE OF POSSIBLE DISTRICTING PLANS

To tell whether a particular redistricting plan is a gerrymander, we must compare it to other valid plans to get a baseline for evaluating whether there is **undue advantage** for one party or candidate. VRDI Fellows developed code implementing the **Markov chain Monte Carlo** (“MCMC”) method to generate large ensembles of possible districting plans tailored to the law of particular states and jurisdictions.



DETECTING OUTLIERS

MCMC works by making many tiny changes to a plan at the level of its building blocks, such as precincts or census blocks. At each step, validity checks ensure that population parity, contiguity, and any other requirements are maintained. The aim is to build a representative sample of valid plans. The entire ensemble of plans can then be analyzed to determine whether a proposed plan behaves as though only chosen by the stated principles, or whether it is an **extreme outlier** in partisan, racial, or other attributes.

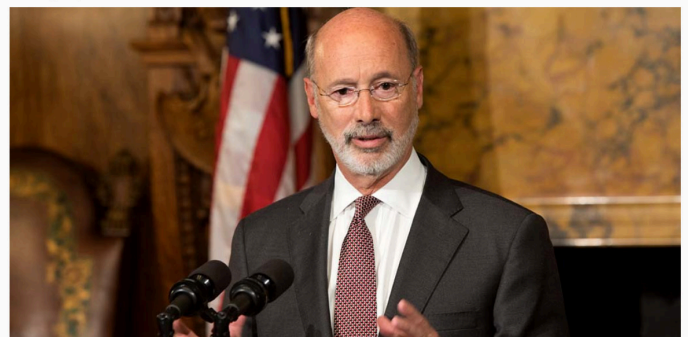
BREAKING THE LEGAL LOGJAM

In early 2018, MGGG’s Moon Duchin consulted for Pennsylvania Governor Tom Wolf, using an MCMC ensemble to assess the partisan skew of a proposed redistricting plan proposed by PA Legislators as part of the successful effort to enact a neutral map.

MGGG is currently collaborating with **Common Cause** and **OneVirginia2021** to discuss the **future of ensemble analysis in citizen initiatives and other reform efforts**. Our MCMC tool is already available to researchers, experts, and the public.

Governor Wolf to Enlist Non-Partisan Mathematician to Evaluate Fairness of Redistricting Maps

January 26, 2018



NATIONAL ISSUES, PRESS RELEASE, REDISTRICTING, VOTING & ELECTIONS

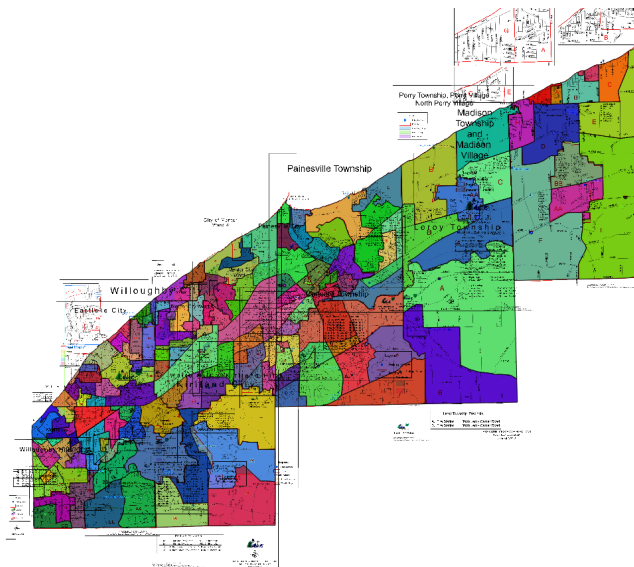
Harrisburg, PA – Governor Wolf today announced he will enlist a non-partisan mathematician, Moon Duchin, Ph.D. an Associate Professor of Mathematics from Tufts University, to provide him guidance on evaluating redistricting maps for fairness. Governor Wolf has made clear since the Supreme Court ruled the

FAIRNESS & ACCURACY IN REDISTRICTING

Project Spotlight: Citizenship and Census 2020

POPULATION ACCURACY

Every ten years, the Census enumerates the residents in each U.S. state and territory. These population counts are used to apportion seats in the House of Representatives to the states and to redraw all kinds of electoral districts. **In 2020, the Census Bureau plans to introduce a question about respondents' citizenship status.** There is growing concern that this question will lead many—especially members of vulnerable groups—to not respond to the Census.

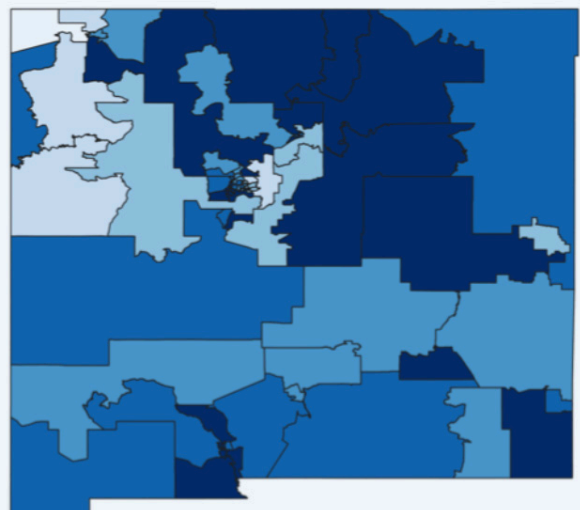


THE RISKS OF UNDERCOUNT

Having an accurate population count is essential for fair redistricting and equitable funding for social programs. To achieve the longstanding ideal of **One Person, One Vote**, mapmakers and policymakers need to know where people live with a high degree of accuracy. Population counts are also used to determine funding for government programs like SNAP (food stamps). Without accurate population counts, the most vulnerable populations risk losing representation and crucial financial support.

SPATIALIZING THE IMPACT

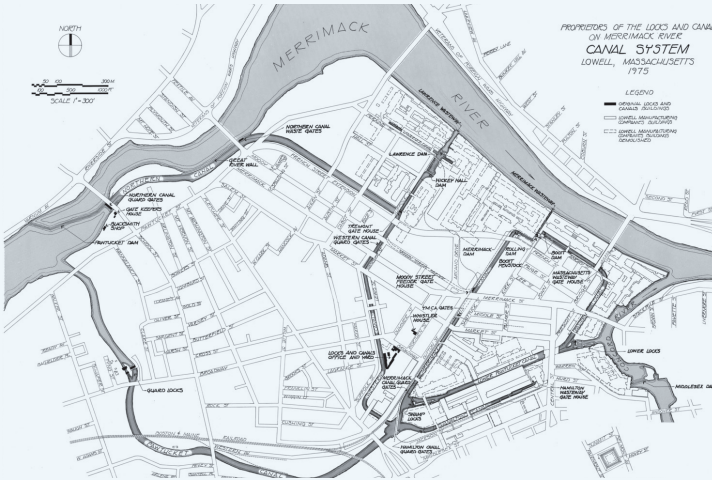
One VRDI project launched a study of statistical and modeling approaches to estimating the impact of the citizenship question. There are several methods for estimating undercount, but by **fusing GIS, statistics, and computational algorithms**, we can help spatially pinpoint the effects. Our initial study showed that the projected undercount in Latino population could threaten several voting rights districts near El Paso, Texas and Albuquerque, New Mexico.



TOOLS FOR COMMUNITY GROUPS

Tool Spotlight: *Districtr App*

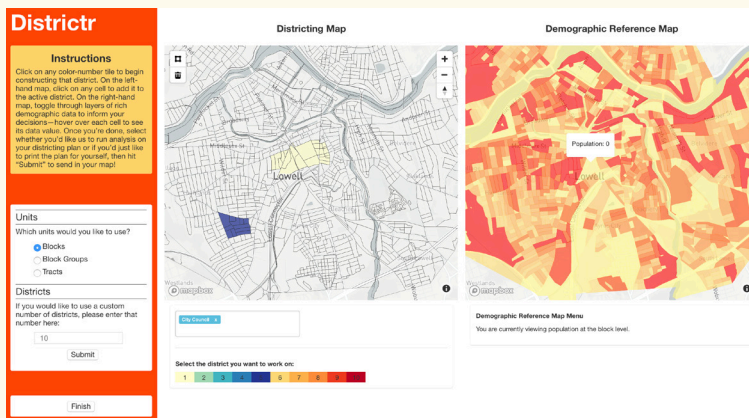
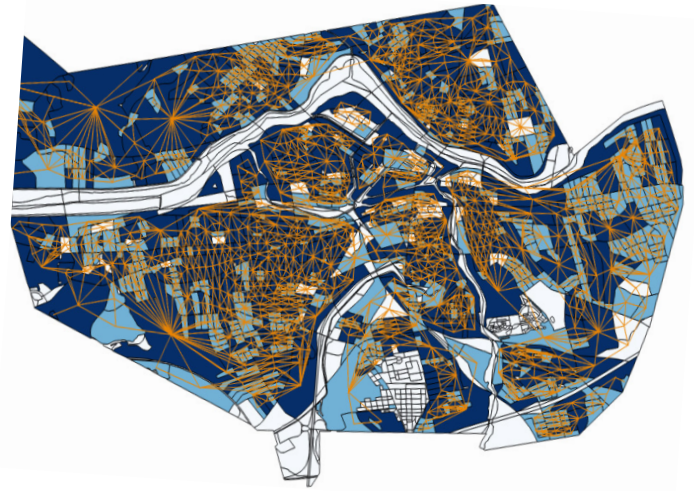
LOCAL ELECTIONS MATTER



We've built a free app called Districtr to give more people the ability to build local districting maps on their own. Districtr got its start examining Lowell, MA, where the **Lawyer's Committee for Civil Rights and Economic Justice** is **challenging the city's at-large electoral system** for City Council and school board elections and is looking to the community for input. At-large voting systems can often be shown to structurally exclude minority populations from the opportunity to elect a candidate of choice, making them a key battleground for voting rights.

A VOICE FOR THE COMMUNITY

When a voting system is successfully challenged, the standard recourse is to change to a districted system, where each district elects one representative. **Communities want to feel that they have a voice in the districting process.** Districtr allows users to leverage their knowledge of city geography and community structure while comporting with rules like population parity.



IT'S NEVER ONE-SIZE-FITS-ALL

Sometimes, even the best-drawn districts are not the most effective way to secure fair representation.

As our research shows, districts do perform better than citywide at-large systems in terms of fair representation for minority groups, but may still fall far short of expectations. So we have built Districtr to interact with our suite of analytic software. Often, ensemble analysis reveals that transferable vote systems would be preferable to meet community goals.