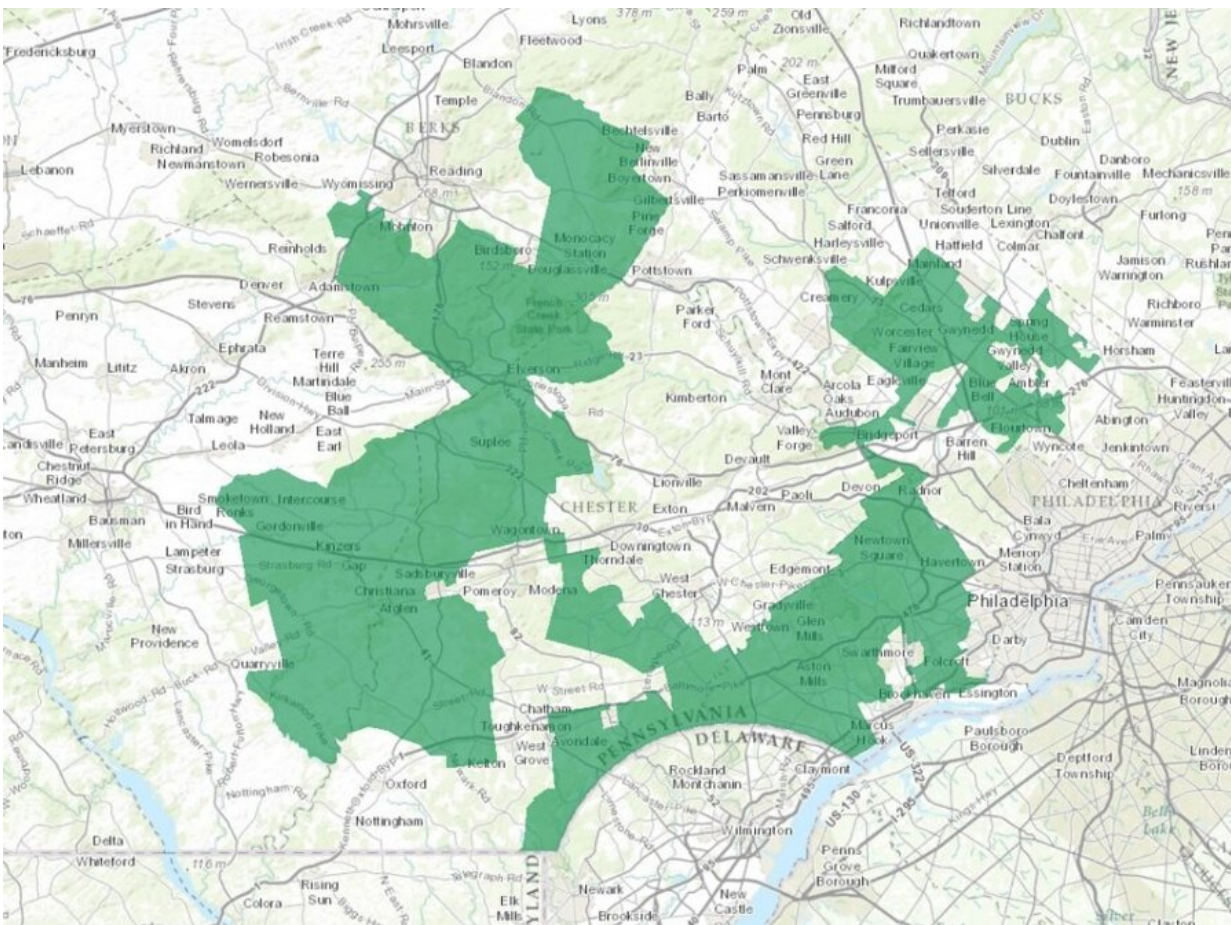# Mathematicians' work helps change how people vote

November 8 2019, by Heidi Opdyke

A green outline shows Pennsylvania's 7th Congressional district prior to redrawing in 2018. The district was called "Goofy Kicking Donald Duck" for its odd shape, and was often pointed to by pundits and experts as one of the most gerrymandered districts in the country. Credit: Carnegie Mellon University

As U.S. courts debate gerrymandering—the process of carving up electoral districts to disproportionately benefit one political party—Wes Pegden's work is helping to shape redistricting maps more fairly.

Pegden, an associate professor of mathematical sciences at Carnegie Mellon University, has developed mathematical theorems that can be used to establish rigorously that districtings are gerrymandered. Pegden collaborated on the research with co-authors Maria Chikina (University of Pittsburgh, Computational and Systems Biology), Alan Frieze (CMU, Mathematics) and Jonathan Mattingly (Duke University, Mathematics).

Pegden's first paper on the subject, published in 2017 in the *Proceedings of the National Academy of Sciences*, formed the basis of expert testimony he gave in a lawsuit brought by the League of Women Voters, which led the Pennsylvania Supreme Court to order a new Congressional map be drawn for the state. The new map was used in the 2018 election. Pegden also testified in a lawsuit in North Carolina that led to the redrawing of the North Carolina House and Senate maps based on more recent mathematical tools developed by Pegden and co-authors.

"What we've been able to do here is take established mathematical objects in probability theory and prove new things about them, which allow us to use these objects to analyze districtings in a statistically rigorous way," Pegden said. "The point is that when our method finds that a district is gerrymandered, a court can be confident that this is an objective conclusion about the extent to which the districting was optimized for partisan bias against the actual set of alternatives, which were available to the mapmaker, rather than a subject judgment based on our intuition for what might be expected."

Pennsylvania Gov. Tom Wolf appointed Pegden to the Pennsylvania Redistricting Commission, which was aimed at developing proposals to make redistricting more fair. The commission completed its work in

August and recommended forming an 11-member bipartisan commission to draw three maps that would then be voted on by all or part of the state's General Assembly.

Beyond simply determining whether a map is gerrymandered or not, Pegden has helped develop a new redistricting protocol that could lead to fairer maps. The process would involve members of one political party in a state drawing districts to their liking, and then members of the other party being given the chance to "freeze" one district before remapping the others. Each party would continue taking turns freezing and redrawing the remaining districts, in a protocol which produces a map accounting for both parties' preferences. Pegden developed the protocol with Associate Professor of Computer Science Ariel Procaccia and visiting student Dingli Yu.

Provided by Carnegie Mellon University