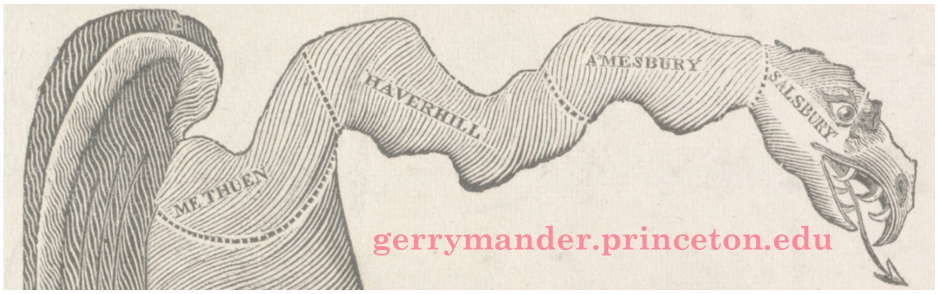


Gerrymandering analyzer from Prof. Sam Wang, Princeton University

Election to be analyzed: U.S. House election of 2014 in PA
Districts to be sampled for fantasy delegations: U.S. House results of 2014 in all states, but omitting: PA

The PA delegation has 18 seats, 5 Democratic/other and 13 Republican.
Uncontested races are assumed to have been won with 75% of the vote.
The average Democratic share of the two-party total vote was 44.3% (raw), 45.7% with imputation of uncontested races.

Analysis of Intents

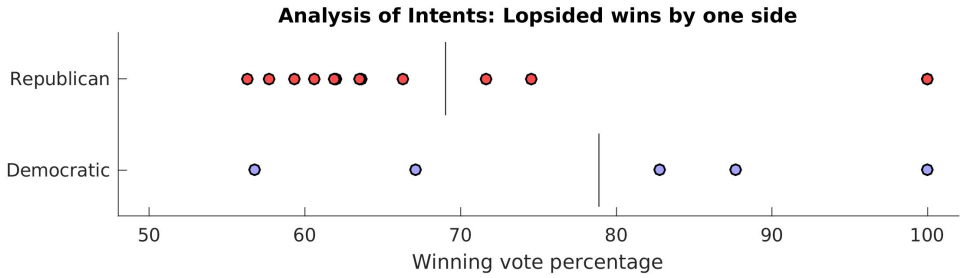
If a political party wishes to create for itself an advantage, it will pack its opponents to win overwhelmingly in a small number of districts, while distributing its own votes more thinly, but still to produce reliable wins.

Partisan gerrymandering arises not from single districts, but from patterns of outcomes. Thus a single lopsided district may not be an offense - indeed, single-district gerrymandering is permitted by Supreme Court precedent, and may be required for the construction of individual districts that comply with the Voting Rights Act. Rather, it is combinations of outcomes that confer undue advantage to one party or the other.

The following two tests provide a way of quantifying any such advantage in a set of election results.

First Test of Intents: Probing for lopsided win margins (the two-sample t-test): To test for a lopsided advantage, one can compare each party's winning margins and see if they are systematically different. This is done using the two-sample t-test. In this test, the party with the *smaller* set of winning margins has the advantage.

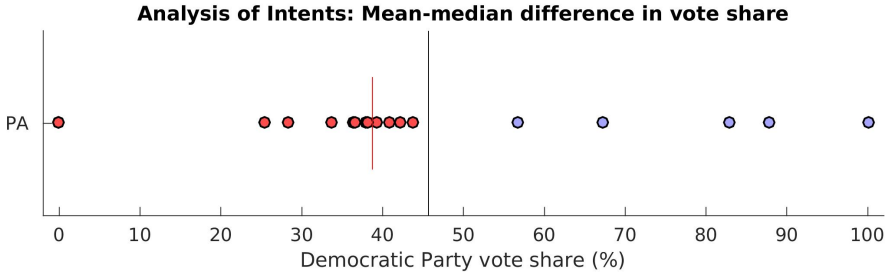
The difference between the two parties' win margins does not meet established standards for statistical significance. The probability that this difference or larger could have arisen by partisan-unbiased mechanisms is 0.20.



Second Test of Intents: Probing for asymmetric advantage for one party (mean-median difference and/or chi-square test): The choice of test depends on whether the parties are closely matched (mean-median difference) or one party is dominant (chi-square test of variance).

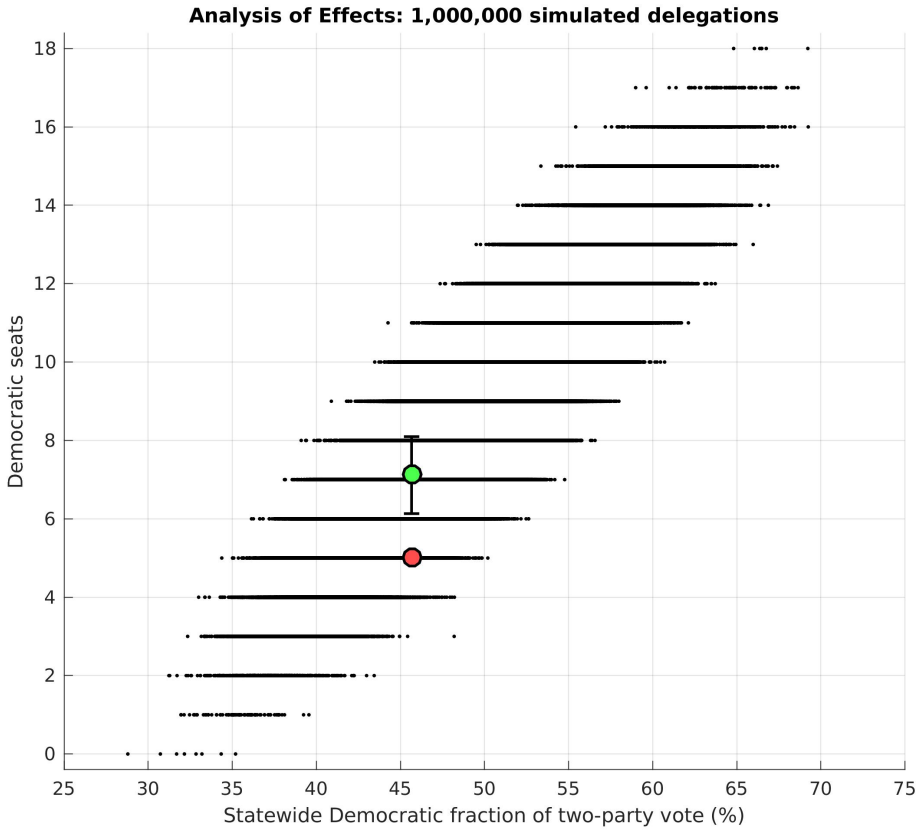
When the parties are closely matched in overall strength, a partisan advantage will be evident in the form of a difference between the mean (a.k.a. average) vote share and the median vote share, calculated across all districts.

The mean-median difference is 6.9% in a direction of advantage to the Republican Party. The mean-median difference would reach this value in 2.5% of situations by a partisan-unbiased process. This difference is statistically significant ($p<0.05$), and in a case of suspected gerrymandering is unlikely to have arisen by chance.



Test of Effects: How many extra seats did either party gain relative to party-neutral sampling? (fantasy delegations): It is possible to estimate how the state's delegation would be composed if votes were distributed according to natural variations in districting. This is done by drawing districts at random from a large national sample, and then examining combinations whose vote totals are similar to the actual outcome.

In the following simulations, individual districts used to build "fantasy delegations" were flipped at random, thus generating a partisan-symmetric distribution. Consequently, these simulations ignore population clustering and show what would occur in a fully partisan-symmetric situation.



In this election, the average Democratic vote share across all districts was 45.7%, and Democrats won 5 seats. 11164 fantasy delegations with the same vote share had an average of 7.1 Democratic seats (green symbol), with a standard deviation of 1.0 seats (see error bar). The actual outcome (red symbol) was therefore advantageous to Republicans. This advantage meets established standards for statistical significance, and the probability that it would have arisen by partisan-unbiased mechanisms alone is 0.04.

The above calculations are based on Samuel S.-H. Wang, "Three Tests for Practical Evaluation of Partisan Gerrymandering," 68 Stan. L. Rev. XX (2016). For further information, contact sswang@princeton.edu.