[Gerrymandering analyzer from Prof. Sam Wang, Princeton University](gerrymander.princeton.edu)

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

The VA delegation has 11 seats, 3 Democratic/other and 8 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 41.5% (raw), 43.8% 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 0.74.

Analysis of Intents: Lopsided wins by one side
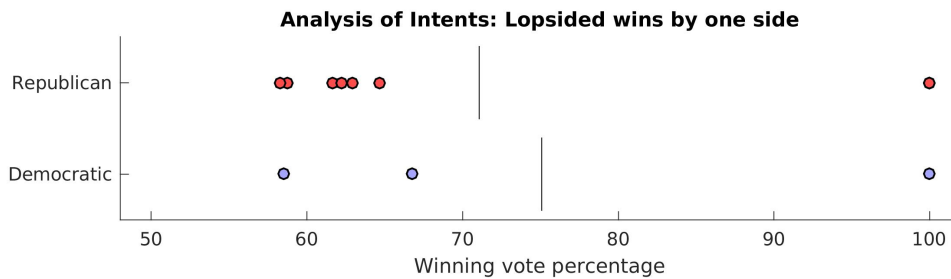
Second Test of Intents: Probing for asymmetric advantage for one party (mean-median difference and/or chi-square test): The choice of test depends on whether the parties are closely matched (mean-median difference) or one party is dominant (chi-square test of variance).
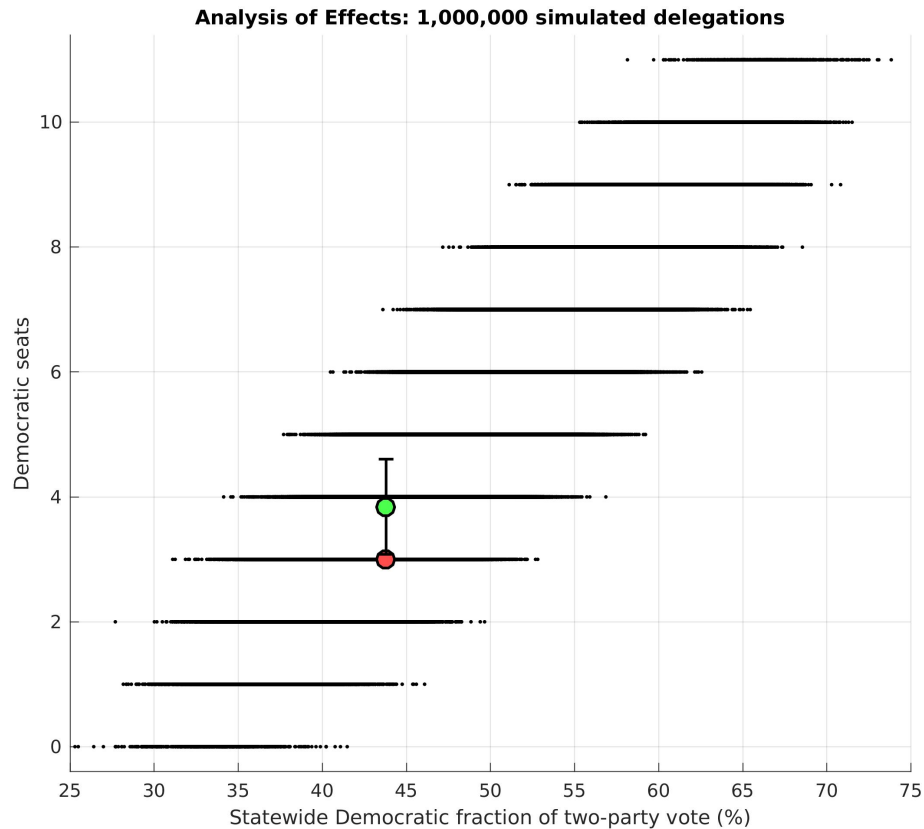
When one party is dominant statewide, it gains an overall advantage by spreading its strength as uniformly as possible across districts. The statistical test to detect an abnormally uniform pattern is the chi-square test, in which the vote share of the majority party-controlled seats are compared with nationwide patterns.

The standard deviation of the Republican majority's winning vote share is 6.6%. At a national level, the standard deviation is NaN%. This difference is not statistically significant ($p > 0.05$).

Analysis of Intents: Chi-square test for unusually uniform outcomes
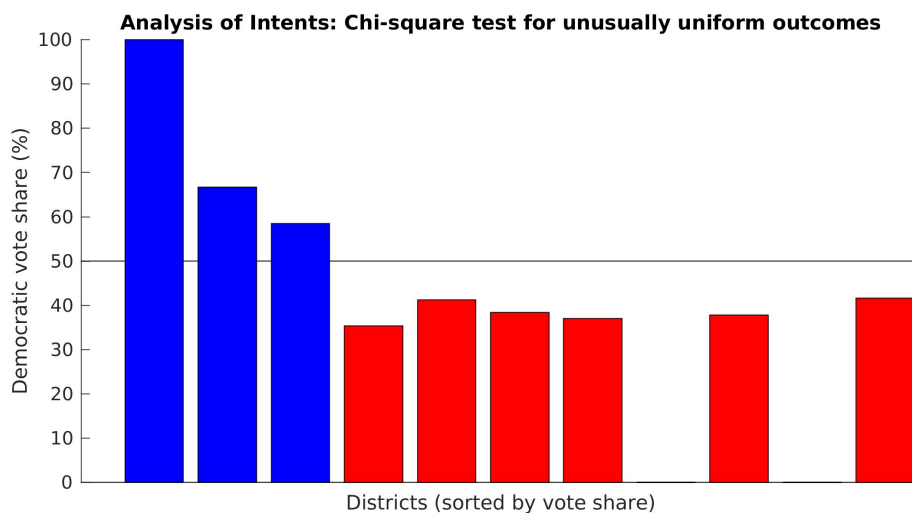
Test of Effects: How many extra seats did either party gain relative to party-neutral sampling? (fantasy delegations): It is possible to estimate how the state's delegation would be composed if votes were distributed according to natural variations in districting. This is done by drawing districts at 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.

Analysis of Effects: 1,000,000 simulated delegations

Democratic seats (y-axis)

Statewide Democratic fraction of two-party vote (%) (x-axis)

In this election, the average Democratic vote share across all districts was 43.8%, and Democrats won 3 seats. 7715 fantasy delegations with the same vote share had an average of 3.8 Democratic seats (green symbol), with a standard deviation of 0.8 seats (see error bar). The actual outcome (red symbol) was therefore advantageous to Republicans. However, this advantage was not statistically significant.

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.