**Slides 1**

Our project is about gerrymandering. Gerrymandering is the intentional drawing of district lines to benefit one party.

In early October, just a few weeks ago, the supreme court was holding hearings on a gerrymandering case for the state of Wisconsin.

**Slide 2**

The House of Representatives has 8 seats for Wisconsin. In the case before the Supreme Court, residents who have historically [voted Democratic](https://www.brennancenter.org/sites/default/files/legal-work/Whitford__plaintiffs_findings_of_fact.pdf) filed a lawsuit accusing the Wisconsin Legislature of discriminating against Democratic candidates.

**Slide 3**

How would the legislature do that? After each census, it draws district maps for the state, in what’s called “re-districting”; those in power have an opportunity then to shape district lines to benefit their party. That is called gerrymandering.

**Slide 4**

Here’s is how it works. Think of “Circle State” which can elect 6 representatives. We could divide the Circle State into 6 districts using the shape on the left, with a district in the middle, or without it. A green legislator clearly would prefer the configuration on the left.

**Slide 5**

If gerrymandering is a pervasive issue, we should expect unfair representation at the national level. Looking at the 2016 election results we see exactly that. Republicans won the majority vote, but while they had 1% more votes, they were able to win 24% more seats.

**Slide 6**

Now, if we’ll blame gerrymandering for this, we need to find a way to measure it. Often people look for wiggly district lines as a sign of gerrymandering. See Iowa on the left. The boundaries of its 4 districts are pretty regular in shape. Contrast that to North Carolina.

**Slide 7**

How else can we measure gerrymandering? In the Wisconsin Case they are using a metric called “efficiency gap”. The metric calculates the proportion of wasted votes relative to total votes. A wasted vote is every vote for a losing party and every wining vote beyond simple majority.

**Slide 8**

For example, on the right blue voters won 5 districts with simple majority, therefore wasting zero votes. Red voters however wasted 4 losing votes per district totaling 20 wasted votes. The efficiency gap for this election is 20% favoring the blue party.

**Slide 9**

It is in this context that we frame our research questions. Was gerrymandering the cause of the representation imbalance in the 2016 election? Can the efficiency gap metric effectively assess gerrymandering? Initially we thought the answer was yes to both questions.

**Slide 10**

We did not find any visualization that asks our research questions, but we found many that address gerrymandering. Here we see one from a company called Silicon Valley Data Science. It shows how squiggly a district is (pink arrow) and it contrasts actual vs. expected wins for the state (orange arrow).

**Slide 11**

This visualization by Patrick Han provides excellent insight to assess vote efficiency. See the blue line projecting to the right at the top much further than at the bottom. Clearly democrats in Alabama had enough votes to elect two representatives instead of just one.

**Slide 12**

Princeton has an elaborate visualization that runs three statistical tests to assess the likelihood of gerrymandering. Each state is graded on a scale from “unlikely”, in green, to “very likely”, in red. The statistical model excludes states with few districts.

**Slide 13**

We begin our visualization by asking the question: Where did the votes go? We see that while republicans and democrats casted similar number of votes (about 48%), republicans won significantly more seats: 55.4%, over 44.6%. Note that third party voters elected no one.

**Slide 14**

If you belong to a party that needs lesser votes to elect a representative, you have more power. Each republican seat in the house required about 0.21% of total votes in the election. Democrats needed about 0.25% for each seat on average. Lesser votes mean more power.

**Slide 15**

The imbalance of power is starker at the state level. Each spike in the plot shows how many more votes either democrats or republicans need to win a seat in that state. We see more blue spikes in the plot because republicans have more power in more states.

**Slide 16**

There are two ways to gerrymander. Notice Alabama district 7. It is a case of “packing” blue voters into a single district where blue wins easy; that frees other districts for red wins. Notice districts 2 and 3. Here we see “cracking”, which dilutes votes.

**Slide 17**

The efficiency gap metric gives a direct measure to assess gerrymandering. Alabama is the 12th most gerrymandered state according to the index, with an efficiency gap close to 7.5%. At the top we see North Carolina and Wisconsin, where the lawsuit we discussed before was filed.

**Slide 18**

North Carolina results show blue votes “cracked” across districts 5 through 9 in the center of the plot on the left; we also see blue votes “packed” into districts 1, 4 and 12, the ones with tall blue lines. The irregular shape of the district map is suspicious, to say the least.

**Slide 19**

Now Oklahoma. It has a high efficiency gap, close to 15%, favoring democrats. But republicans won every district in Oklahoma; if there was gerrymandering at all it benefited republicans. This result points to a possible flaw with the efficiency gap calculation.

**Slide 20**

Our main insights: power imbalance at the national level is worse at the state level, and it mostly benefits republicans. Gerrymandering seems to explain many instances of imbalance. Future work is needed to review efficiency gap calculations and add maps to the visualization.