Gerrymandering and Efficiency Gap in NC and MD

After completing this lesson, students should be able to:

• Use spreadsheet formulas to calculate efficiency gaps from election data.
• Use efficiency gaps to describe trends in gerrymandering over time and compare gerrymandering between states.
Before Class

- Watch the following videos:
  1. this 3 minute video on basic formulas in Google Spreadsheets
  2. this 4 minute video on IF statements and relative and absolute references
- Answer the questions:
  1. What does the following spreadsheet formula do? \(=\text{IF}(B7 > B8, B7, B8)\)
     (a) It gives the difference of the two numbers in cells B7 and B8.
     (b) It gives the number in cell B7 if it is bigger than the number in cell B8, otherwise it leaves the cell blank.
     (c) It gives the maximum of the two numbers in cells B7 and B8.
  2. In the first figure, what formula(s) could be used to get the total in cell B7 from the other cells?
     (a) \(= 12 + 3 + 4 + 5 + 6\)
     (b) \(= B2 + B3 + B4 + B5 + B6\)
     (c) \(= \text{TOTAL}(B2, B3, B4, B5, B6)\)
     (d) \(= \text{SUM}(B2 : B6)\)
3. In the attached figure, the formula “=(B2/B7)*100” is used to calculate the percent of votes in cell C2, and then dragged down to update the formula. What is going wrong to give us the #DIV0! error and how can we fix it?

(a) When we drag down the formula by one row, it is updating the address B2 to B3 and updating the address B7 to B8. We don’t want the addresses to change. We can fix the formula using dollar signs: “=(B$2/B$7)*100” and then the addresses won’t change.

(b) When we drag down the formula by one row, it is updating the address B2 to B3 and updating the address B7 to B8. We don’t want the addresses to change. We can fix the formula using percent signs: “=(B%2/B%7)*100” and then the addresses won’t change.

(c) When we drag down the formula by one row, it is updating the address B2 to B3 and also updating the address B7 to B8. We want B2 to update to B3 but we don’t want B7 to change. We can fix the formula using a dollar sign: “=(B2/B$7)*100” and then only the B2 will change, not the B$7, when we drag down.

(d) When we drag down the formula by one row, it is updating the address B2 to B3 and also updating the address B7 to B8. We want B2 to update to B3 but we don’t want B7 to change. We can fix the formula using a percent sign: “=(B2/B%7)*100” and then only the B2 will change, not the B%7, when
we drag down.
North Carolina and Maryland

Calculate the efficiency gap for North Carolina districts for the 2016 election, and compare to the efficiency gaps in other years. See https://er.ncsbe.gov/ for data. There is a spreadsheet on google drive at https://tinyurl.com/uncMath115StudentSpreadsheets that can help you organize this data.

Also look at Maryland for recent years. See https://elections.maryland.gov/elections/2020/index.html for data.
How do the efficiency gaps compare for various years (2010 - 2018) and between states (NC and Maryland)? What patterns and trends do you see and can you explain them?
Suppose you wanted to convince a judge that gerrymandering was taking place in certain state, and you say, “Just look at the efficiency gap, it’s over 15%!” But the judge comes back and says, “So? Is that a bad value?” How can you convince someone that it is ... or is it?
Threshold values

**Question.** Look at the file of efficiency gaps for each state for the 2016 congressional elections. Set a criteria for how to tell if an efficiency gap is too high, and be ready to defend your choice. Do you notice anything about what kinds of states tend to have high efficiency gaps?
Based on the graphs below, which threshold would you set for the efficiency gap, so that any state with a higher efficiency gap than that threshold is suspicious for gerrymandering? (PollEv)

A. 0.05  B. 0.10  C. 0.15  D. 0.20  E. 0.25  F. 0.30  G. 0.35  H. 0.40  I. 0.45  J. 0.50
What relationship do you notice about the number of districts and the size of the efficiency gap?

To neutralize this relationship, some people look at the product of and instead of efficiency gap by itself.
Based on the graphs below, which threshold would you set for the efficiency gap times seats, so that any state with a number than that threshold is suspicious for gerrymandering? (PollEv)

A. 0.05    B. 0.10    C. 0.15    D. 0.20    E. 0.25    F. 0.30    G. 0.35    H. 0.40    I. 0.45    J. 0.50
Stefanopolis and McGhee suggest a threshold of \[
\text{efficiency gap} \times \text{number of districts} >
\]

That is, a state is suspicious for gerrymandering if \[
\text{efficiency gap} \times \text{number of districts} >
\]

This is equivalent to the formula \[
\text{efficiency gap} >
\]
**Question.** Is the efficiency gap a good measure of gerrymandering? What other information would be useful if we wanted to convince a court that a state does or does not have gerrymandered districts?
1. Make a private copy of the election data spreadsheet for the 2018 NC State Senate Election, (click on File > Make a copy) and calculate the efficiency gap using spreadsheet formulas, and answer the following questions:

(a) What formula did you write in cell F2 to find the number of wasted votes for Democrats, based on other cells?

(b) What formula did you write in cell F52 to find the total number of wasted votes for Democrats, in terms of other cells?

(c) What formula did you write in cell I55 to find the efficiency gap, in terms of other cells?

(d) What is the efficiency gap?

(e) Who does it favor, Democrats or Republicans?

(f) How many seats did Democrats win and how many did Republicans win?

(g) What percent of the entire vote was Democrat and how much was Republican?

(h) How many seats might you expect the Democrats to win and Republicans to win based on the percents in the previous question?

(i) How many “extra” seats did the Democrats or Republicans win compared to
the expected number?

(j) Nicholas Stephanopolous and Eric McGhee suggest an efficiency gap threshold of $2/n$, where $n$ is the number of seats (i.e. the number of districts), and that any efficiency gap above this is suspicious for gerrymandering. Does the efficiency gap you found exceed this threshold?