HNR-1304 – MATHEMATICS OF DEMOCRACY
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TEST 2 (GERRYMANDERING) REVIEW

- For this test, you should know all the things we have learned about gerrymandering, including: creation of districts, how to draw districts in favor of one party or the other (or "fair" districts), compactness measures, efficiency gap, partisan symmetry, and outlier methods. I will include a "cheat sheet" listing all formulas for compactness measures and efficiency gap, though you will need to know the correct notation/procedures for how to implement them. You will also need to know the process for how to construct and interpret a symmetry graph, as well as interpret outlier analysis data.
- You should also be able to answer questions if given a NEW method of analyzing gerrymandering, even if it is one we have not seen before.

On this sheet are some questions to start to get you thinking about the material we have studied. You should NOT assume that just doing these problems will completely prepare you for the test. You should also NOT assume that any of these questions will be on the test, and should certainly NOT assume that these questions will be *exactly* the test. You may have had teachers in the past who gave you some test review questions, and then gave you a test that was basically identical to the test review. I am not one of those teachers.

There are also a number of good questions in the textbook (in the gerrymandering chapter that is on blackboard), and those are also good for studying for the test.

(1) Answer the questions below about the state of Wombatland, which recently had an election with the following results:

District	% Republican	% Democrat
1	70	30
2	10	90
3	75	25
4	63	37
5	61	39
6	12	88

(a) At first glance (with only a minimal amount of calculation), does it look like the districts have been gerrymandered? Why or why not?

(b) Calculate the efficiency gap and also make a symmetry graph for this election in Wombatland. Do those seem to support or conflict with your conclusions from part (a)? If so, how?

(c) Using the Outlier Analysis (Percent) Excel spreadsheet, can you make a distribution of percentages (that is, group the votes in a certain way) where the result above would NOT seem to be an outlier?

(2) Consider the following state with a Blue party and a Yellow party. There are a total of 42 squares with 18 blue and 24 Yellow. The state must be split up into 6 districts of 7 squares each.

(a) Draw two maps, one in which the districts are relatively *compact* and the districts are drawn in such a way as to favor one particular party.

(b) Draw districts that are *less* compact but are more "fair."

(c) Use square compactness measures to support your claims of which districts are more or less compact.

(d) Calculate the efficiency gap for each of the district maps your came up with. Does the efficiency gap identify which is gerrymandered and which is not?
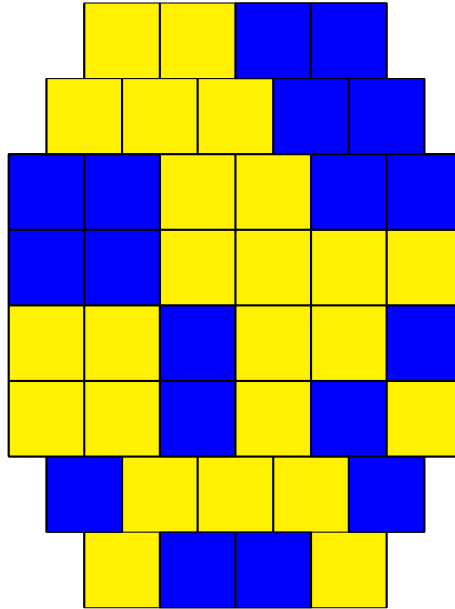
(3) Currently the way that gerrymandering/districting happens in most states in this: state legislatures make up district maps, often in dubious ways for reasons that they don't explain, and the maps then get challenged in court as illegal gerrymanders. Suppose instead that states had to present their maps and affirmatively explain *why* their maps are good. If you were drawing your own district maps, what aspects of the map would be most important to you to demonstrate that your maps are fair, and why? You should discuss a particular example state of your own choosing (like NC, or Wisconsin, or wherever).