Gerryminder: Teaching Undergraduates Redistricting with Hands-On Mapmaking

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Abstract: This paper introduces and explains the application possibilities of a software-based redistricting simulation, Gerryminder, made for undergraduates studying elections and representation with specific pedagogical application for redistricting, elections, Congress, and incumbency. Included are results from survey-based student feedback.

While this manuscript is solo-authored, the software itself is a collaboration (Teigen and Gilbertson 2004). Jeremy M. Teigen is an assistant professor of political science at Ramapo College of New Jersey. Jeffrey A. Gilbertson is a Market Rules Analyst at the Electric Reliability Council of Texas, Austin, TX.
As a reform-minded governor, Arnold Schwarzenegger recently began an attempt to alter California’s congressional redistricting process by highlighting his belief that current districts overprotect incumbents and attenuate the strength of democratic input. Additionally, he memorably described the shape of the districts as looking like they were “drawn by a drunk with an Etch-A-Sketch” (Marelius 2005, p. A3). While mid-decade and extremely acrimonious redistricting in Texas made national headlines in 2003 (McKee, Teigen, and Turgeon 2006; Riddlesperger 2004), redistricting questions have become increasingly salient in many states, providing teachers of political science with an excellent opportunity to use districting politics in the classroom to raise issues related to representation, fairness, elections, Congress, incumbency, and non-electoral political competition.

Gerryminder, a computer-based simulation of redistricting for undergraduates, puts the responsibility of political boundary drawing in the hands of students, but it also has the ability to aid instructors at teaching concepts larger than redistricting. By explicitly connecting electoral conditions to electoral outcomes, Gerryminder can satisfy course objectives for many political science classes at introductory and upper division levels. By giving students the ability to alter district lines, the simulation becomes a demonstration of the effect of elite preferences on political outcomes. By constraining students’ hands in ways similar to the legal rules facing actual political elites in state legislatures, Gerryminder helps instructors convey the effect that rules and laws have upon elite behavior. This paper serves as an introduction of, and justification for, Gerryminder—as well as being an instruction manual for implementing the simulation in an undergraduate course.

The pedagogic yield of simulations in political science is difficult to overstate. Mock elections featuring alternative voting rules or hypothetical candidates and “model” institutions
such as the UN or Congress are only two of the more common and fruitful examples of classroom activities that place students in the role of voters or political elites. Students gain insight unavailable in lecture by being forced to “think on their feet, question their own values and responses to situations, and consider new ways of thinking” (Meyers and Jones 1993, p. 93).

Personal computers hold the power to simulate many political phenomena for pedagogical purposes, elections being a prime example. During the 2004 presidential election, a software company promoted an entertaining Electoral College strategy simulation for PCs that enjoyed some notoriety (Zurcher 2004). A more realistic but older (DOS-based) computer campaign manager simulation is still in use by some instructors for courses on campaigns and elections (Fishel, Gopoian, and Stacey 1987). Simulations hold the potential to be welcome breaks from the routines of lecture and other standard classroom environments.

Gerrymandering and electoral redistricting receive treatment in most if not all introductory American government textbooks. In some texts, authors include redistricting along with their chapter on campaigns and elections (e.g. Fiorina et al. 2005; Ginsberg, Lowi, and Weir 2005). Others choose to place it within a chapter on Congress as an institution, usually with specific reference to redistricting as incumbency protection (e.g. Dye 2001). In most cases, it seems de rigueur for books to include a graphic and brief history of Elbridge Gerry’s famous North Boston salamander-shaped district from the early 19th century. The tone surrounding the texts’ treatment of redistricting is occasionally normative. One recent textbook by Lowi, Ginsberg, and Shepsle explicitly defines gerrymandering as an “unfair” drawing of lines to advantage a political party (2005, p. 173). The textbook I assign to students with a reputation as being electorally-centered (Fiorina et al. 2005), defines gerrymandering as “drawing boundary lines…to confer an advantage.”
The backdrop of a protracted and headline-generating redistricting struggle in Texas during my pedagogical apprenticeship in 2000-2004 at the University of Texas impelled me to attempt to incorporate redistricting in the classroom beyond the rather limited coverage in standard introductory textbooks. The roots of Gerryminder, a PC-based redistricting simulation that is the focus of this paper, began with a non-computer in-class activity for large lectures I had utilized repeatedly. The in-class game started by strategically allocating colored cards to each student in class (it works for large and small lectures) to form a slight majority party, a slight minority party, and a small third party (see figure 1). The cards give students an artificial party identity and strict in-party voting rules. Representatives of each color/party propose ways to divide the lecture hall into two equal sized districts, and the instructor guides the minority party into realizing the profit of a vertical line to win one seat, while the majority should clearly prefer a horizontal line since they will then win both seats.

Figure 1: Partisan alignment of lecture hall with dashed lines for prospective division

The essential lessons of the activity sought to engage students to put themselves in the role of partisan mapmaker rather than the usual role of external observer. However, since the exigencies of a large lecture hall required asking only student leaders to make decisions, the in-class activity lacked the ability to engage fully all the students. Gerryminder was born with the intent to force all the students in class to try their hand at dividing districts. Gerryminder is meant
to utilize the campus’ computer labs or the students’ personal computers to teach an important lesson experientially: that redistricting manipulates electoral outcomes through clever concentration (or dilution) of the other parties’ supporters.

Gerryminder can be thought of as a game, simulation, or activity for students who have recently received a lecture and done some rudimentary reading on apportionment, redistricting, and gerrymandering from standard introductory texts. A glossary of helpful terms is listed later in Appendix 2. Students can work alone or in pairs, at home or supervised in a computer lab. They will play the role not of an objective evaluator of “fair” or “unfair” districts, but instead as a partisan trying to maximize the seats their party wins under a single member district system by drawing district lines strategically. There are multiple levels of the game, starting at a very small map with a uniform population density that to be redistricted into only two districts—and concluding with more realistic maps with varying population density that must be divided into up to eight districts.

Along with the value of role playing political elites, I intend students to have immediate appreciation for the nature of the constitutional job of redistricting—both the partisan character of the task as well as the raw difficulty of ensuring equal sized districts. Students should recognize the fact that it is much easier to redistrict a state like Iowa, with relatively low density disparities, than a state such as Texas with high population density differences. Additionally, Gerryminder helps students perceive the ease with which black voting power in the South was diluted using redistricting. Lastly, I seek to have students see redistricting with partisan eyes to augment and improve on the typical “gerrymandering is bad” discussion. Gerryminder was designed for Introduction to Government or Introductory Political Science students who have
had a lecture that explains the concepts and the game, but the simulation also has perhaps more utility upper division courses on elections, electoral schemes, or state politics.

**Simulation Conditions and Procedure**

My assumption is that Gerryminder might occupy one full class session in the lab and a fraction of the preceding lecture for pre-simulation preparatory explanation. The session before the lab needs to explain several of the topics associated with congressional districts and elections. Appendix 2 contains a sample glossary of the necessary terms that students should understand before participating in the simulation, especially seats-to-votes ratio, gerrymander, and *Wesberry v. Sanders* (1964).

Supplementary materials, such as handouts or worksheets, aid laboratory teaching (Brown and Atkins 1987, ch. 5). To help students stay on task and provide a source of ready help, I provide a sheet (see appendix 1 for an example) that guides progress for each level as well as helping students avoid technical and substantive pitfalls. The preceding lecture should include concepts and introduce the game on the projector, and the next meeting takes place in a computer lab where students will partner up and work on the game in pairs. Alternatively, students can work alone at home on their own computers as a take-home assignment.

For all the levels of the game, colors represent parties. Usually it is the familiar blue and red, but there are instances when a third party (green) plays a small role. In keeping with the size of congressional districts, the simulation creates maps so the population of each district needs to be approximately 650,000. Importantly, cells are static within each level—they do not change their partisanship or population density. Ergo, the denominator in the seats-to-votes ratio, the “%votes” for each map, remains stable regardless of where students draw the lines.
The goal for each level is simple. Players assume the role of one party and attempt to draw legal district lines in such a way as to maximize the number of seats won for their party given static votes.¹ There are rules, however—the same ones that face elites when they draw the real district maps. The districts must accord with the *Wesberry v. Sanders* (1964) edict that the districts be equal size. The status box (“District Selection and Status”) informs the user of the target district size so students can constantly compare their districts’ population to the ideal and make changes. We have designed the game so that district sizes approximate actual congressional district populations, around 650,000. The other rule is that the districts must be contiguous, adjoining, uninterrupted wholes—every cell belonging to a district must touch (non-diagonally) another cell of the district so that there are no “islands” of a district separated from the rest.

Getting started is not difficult; consult diagram 1 for a visual screenshot of the game and the sample worksheet for help. The game loads after a brief pause and starts on level 1. This first level is simple and is intended to help illustrate the fundamentals of using Gerryminder. Note that red enjoys 60% of the overall vote on this level, so the only two outcomes possible are red and blue each win one seat or red picks up both.

To play, students simply select a district by single-clicking within the “District Selection and Status” pane in the upper right hand corner. The selected district turns yellow to indicate it is “on.” Next, the user decides whether to use “single mode” or “box mode” to assign cells on the map to the selected district. In “single mode,” the process is simple: single clicks allocate the cell under the mouse pointer to the selected (yellow) district. “Box mode” is intended for

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¹ Note, though, the game is indifferent to which party is playing. It reports the outcomes and seats/votes ratio for both parties. This feature adds to Gerryminder’s flexibility adding to the possible scenarios different instructors might prefer.
the status box in the upper right will update the population of the district and the partisan composition of the district. Naturally, the size of the districts is nonnegotiable but the partisan makeup of the districts is meant to be manipulated for partisan gain.

The point here is to illustrate the essential message of the entire game: where one draws the lines has an enormous impact on electoral outcomes. If a student divides level one’s map into two equal sized districts with a horizontal line across the middle, a very different outcome happens from if one divides with a vertical line from top to bottom. To make changes to the map, select a different district number and change cells from “2” to “1” or any of the available districts. Also, select “clear” to erase all or some cells’ district assignment to restart.

Levels one, two, and three are based on a hypothetical states without much contour and lacking much population density variance. Level one is nothing more than a square with one party holding a slight majority. Level two is the same except the party locations are not as neat. Level three incorporates a third party (green), as well as introducing a “city,” or population density variability. The third party presence can help demonstrate to students the insurmountable hurdles faced in single member district systems. I challenge the students on level three to create a map that is beneficial to green, but green lacks enough population to summon a plurality under any condition.

A bit of reality is infused starting in level four with Iowa, incorporating scattered partisan layout bearing a resemblance to Iowan politics, non-square borders, and variable density (e.g. Des Moines). Texas is level five, the final level, and it exaggerates partisan heterogeneity and has very high density disparities. Merely satisfying the Wesberry equal districts rule is challenging in itself in the Lone Star State—students (and instructors!) will find it quite
challenging to contend with multiple urban areas and disparate party support to maximize their seat share.

The status box starts out with blanks if there are no district lines drawn, but as soon as a user drags down “District Select” and choose “1” and drags a box over some portion of the map, the status bar starts reporting the districts’ size, the conditional district winner, and vote margin. During the simulation, the player’s attention should be focused on using the status box to adjust the districts’ sizes to achieve parity and then try to maximize the party’s seat share. “Sum” in the upper right status box will turn green when all cells are assigned a district, but this indication does not necessarily mean that the districts are legal.

Equal population, the Wesberry rule, must also be heeded. The “Size” indicator tells the player what the difference in population is between the largest and smallest district. There is also a legend depicting levels with varying density so players know what particular population weight each cell is. Clearly, a cell with high population density is worth more than a low-density cell and the legend reports the scale. This provides lessons about the necessity of dividing cities, allowing discussion about so-called “communities of interest” arguments against some redistricting plans.

A good strategy for students is to start on the easy levels to grasp the basic concept of district drawing for partisan purposes. The harder levels make it difficult for students to achieve district population parity, much less create maps that unseat the other party while maintaining that parity. For introductory students, starting at the first level is likely imperative. If a projector is available, everyone following along with the instructor step-by-step on level one may be prudent.
Deciding which party instructors want students to play is an important question. I deliberately alternate having the students work together trying to maximize the majority party’s seat share and the minority party’s seat share. Both scenarios have valuable pedagogic implications. Whatever an instructor decides should be reflected on the accompanying worksheet. It is clear from the denominator of the seats-to-votes ratio which party enjoys a majority in any given map, so instructors can decide whether they want students working from a majority or minority standpoint. Because the most common redistricting methods in the U.S. states has the majority at the advantage, I tend to put students in the role of a majority attempting to take advantage of the situation.

Regrettably, a crucial aspect of redistricting is left out of Gerryminder, at least in explicit form. Race and ethnicity and all it entails, such as majority-minority districts, the Voting Rights Act, and important recent Supreme Court rulings on race, redistricting, and equal protection, exemplified by *Shaw v. Reno* (1993) are ignored in the simulation for the sake of pedagogic simplicity. In this version, the hypothetical groups of voters (cells) have only two static attributes: party preference and density. This limitation should not, of course, preclude the lessons that Gerryminder teaches in lecture or discussion—in fact it would be interesting to highlight a handful of student-created maps that passed Gerryminder’s limited test but would not pass Department of Justice muster because of potential minority disenfranchisement. Redistricting in the US is intimately involved with questions of race and representation, but Gerryminder necessarily sacrifices a race variable for the sake of parsimony. With party and density information already coded visually into each cell, with color and a dot-pattern respectively, the incorporation of race and ethnicity to the scheme would likely overcomplicate the simulation (though suggestions are warmly welcomed).
Initial Student Feedback

As midterm and end-of-course evaluations help instructors troubleshoot their pedagogy, I recently sought student feedback after their experience with Gerryminder. Spring 2005 was the first time I solicited anonymous feedback in the form of a survey, during a medium-sized (and required) *Introduction to American Government* course. I sought information on student impressions of Gerryminder’s effectiveness, ease-of-use issues, student perceptions of the connection between Gerryminder’s ability to help them do well in the course, and student opinions about whether Gerryminder was appropriate for introductory level classes. The question wording of the survey can be found in Appendix x.

Initial prime concerns during development were usability and level appropriateness. Gerryminder does not present usability hurdles to students who rate themselves as less comfortable with PCs than their more computer-savvy peers. No statistical or substantively significant difference exists between students’ response to Gerryminder’s ease-of-use between students reporting high and low levels of comfort using PCs. The few students who reported “disagree” to Gerryminder’s ease-of-use complained more of inadequate documentation rather than about the software itself. The average score was 3.9 (where “1” means “strongly disagree” and “5” means “strongly agree”) to a statement that Gerryminder is easy to use.

Overwhelmingly, the sample believed that Gerryminder was appropriate for an introductory class (mean = 4.2).

Another concern involved whether students would believe that the simulation improved their scores on exams or helped them in the course, as opposed to generally augmenting their knowledge of the redistricting process. The survey was administered after the students had undergone the simulation and the subsequent midterm examination. Students were generally
neutral on the question of whether Gerryminder helped their exam scores (the mean score was 3.2 on an identical scale as above). This finding raises interesting questions about teaching toward tests and how to assess knowledge gained during non-standard instruction (simulations, in-class movies, guest speakers, activities, etc.).

Despite this question of testability, students generally believed that the simulation enhanced their understanding of the redistricting process and its implications beyond what lecture and the texts provided. The mean score 3.9 (same scale and caveat) as well as the subjective comments provide initial evidence that Gerryminder succeeds at painting a broader picture of redistricting for students. Comments such as “I usually don’t enjoy reading…but this program forced me to participate,” “a visual component definitely provided me with a better grasp,” as well as many students appreciating the opportunity to do a hands-on activity demonstrate initial evidence, with this small sample of students, that Gerryminder can provide instructors with an experientially-based simulation that is flexible enough for multiple pedagogic goals.

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Gerryminder has been a positive part of my introductory and upper division classes and I want to share its success with other instructors seeking a new simulation—both for the sake of sharing and to widen the feedback pool to improve Gerryminder. Outside technical concerns, Gerryminder might be tailored in the future to include more states or countries as well as accommodate mixed SMD systems. As mentioned, sensitivity to the racial component of redistricting is the next large step to take. Despite these current shortcomings, Gerryminder currently can fit many pedagogical needs of teaching redistricting specifically, but it also grants opportunities to address macro topics such as representation, elections, and fairness.
Appendix 1: Sample of Worksheet for Student use during Simulation

URL: http://phobos.ramapo.edu/~jteigen/gerry.html

To Play:

- The activity is here for you to maximize your party’s (color) seat take. The votes are static, but which party gets the seats is for you to decide as map makers.
- The simulation starts on level one. To begin, select a district by clicking the district number in the “District Selection and Status” window on the right. The selected district will turn yellow. To unassign a part of the map, select “Unassigned” and you can remove district assignment to one or more cells.
- After choosing a district to start assigning cells to, select “Single mode” or “Box mode” on the left hand column. In “single mode,” simply single-click individual cells to assign a cell to the district you have selected on the right hand side. In “Box mode,” you can select a rectangle of cells all at once by single-clicking twice: once in each of the opposite corners of the rectangle you would like to allocate to the selected district.
- Cities (included in level 3 and up) are much more populous than the rural areas. Pay attention to the density legend at the bottom to help estimate various population densities. Cities are denser, so districts that encompass cities will comprise fewer cells.

Helpful Hints:

- Keep your eye on the charts on the right hand side. They will help you achieve equally sized districts and let you know what percent of each district goes to which party. The Seats-to-Votes ratio monitors the overall “fairness” of your districts on the map for each party.
- A good starting strategy is for players to work together to first achieve district lines that ensure equally sized districts. Remember, all districts must add up to very near 650,000, just like real congressional districts. The “Size” box will be red if your districts are too small or too large (in population, not area).
- The essential strategy for maximizing the number of seats your party wins is to win as many districts as possible with the smallest vote share in each. This efficiency will keep you from “wasting” your voters in districts you will win handily.
Figure 1: Screenshot of Gerryminder.

Gerryminder (v3.0): A Redistricting Simulation by Jeremy M. Teigen and Jeffrey A. Gilbertson
Appendix 2: Glossary of Terms Related to Gerryminder

While Gerryminder is appropriate for introductory level undergraduate classes, I assume that students will use the software in the lab after a lecture that primes the material.\(^2\) A preparatory lecture and reading should convey the following terms and concepts to maximize the pedagogic yield of Gerryminder: vote share, seat share, seats-to-votes ratio, single member district system, proportional representation, decennial (re)apportionment, decennial redistricting, Elbridge Gerry, gerrymander, *Baker v. Carr* (1962), *Wesberry v. Sanders* (1964). The following are terms that should be introduced prior to the simulation.

**Vote share**: The percentage of the total vote a particular party wins, adding votes in all districts under a given district configuration.

**Seat share**: The percentage of the available districts (seats) a particular party wins.

**Seats-to-votes ratio**: Put simply, it measures a map’s bias—for or against a particular party. It is measured for a party given a particular district configuration (or map). By comparing what is (numerator) to what should be (denominator, it is the percent of available seats the party wins over the percent of the available votes the party wins. In other words, seat share over vote share. Values greater than one describe a map that is beneficial to the party (the party’s getting more seats than it “deserves” according to the vote share), values less than one describe a map that is biased against a party, and exactly one implies zero bias.

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\(^2\) I might add that with adequate lecture hall technology, professors can introduce Gerryminder the lecture period before the lab with a PC and projector to demonstrate the fundamentals of map drawing.
For example, imagine Wisconsin with eight congressional seats. In the 2002 election, Republicans collected 56.4% of the two party vote statewide and won 4 of the 8 seats.

\[
\frac{\% \text{seats}}{\% \text{votes}} = \frac{4}{56.4\%} = \frac{8769393}{56.4\%} = .886
\]

In other words, the current map is slightly disadvantageous to Wisconsin Republicans (since the seats-to-votes ratio is less than one), but not by much. The seats-to-votes ratio is used by the game to portray the student-made maps’ bias. The seats-to-votes ratio is the most comprehensible measure—certainly compared to alternatives beyond the scope of a introductory course, for example Gelman and King’s “bias” and “responsiveness” metrics (1994).

**Single Member District System (SMD):** district-based system with one winner per district decided by plurality rule (e.g. US Congress).

**Proportional Representation (PR):** non-district based party-list system where party vote share directly translates into seat-share. Useful as a comparative demonstration that the US method is not the only method of electing representatives. Some may choose to advocate that PR is a more “fair” or “pure” way to conduct legislative elections, though I typically entreat agnosticism.

**Decennial reapportionment:** Article one, section two of the US Constitution calls for a decennial “enumeration” of persons for the sake of allocating congressional seats by population accurately. To allocate seats to states is to apportion seats.

**Decennial (re)districting:** Gaining/losing congressional seats in the apportionment or due to state legislatures changing hands engenders the district lines to be redrawn. Districts tend

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3 For the sake of example, I arbitrarily imputed 156,627.5 votes (the average of Sensenbrenner and Kleczka’s vote shares) for Tom Petri (R) in the unopposed sixth district.
to be drawn to protect incumbents, but that is not always possible and incumbents of the minority party (in the state legislature) are occasionally pitted against each other. (Reapportionment and redistricting are often confused—reapportionment assigns the number of seats to states, redistricting assigns those seats to geographic areas within states.)

**Elbridge Gerry**: 19th century Massachusetts governor who supported a redistricting map that cleverly disadvantaged his political opponents, the Federalists. (Curiously, his name is pronounced with a hard g.)

**Gerrymander**: This term—Governor Gerry is of course the eponym—refers to a districting map that advantages one party over other(s). While most textbooks and others teach gerrymandering normatively as a negative feature of American democracy, I believe (and teach) that “gerrymander” is an empty definition since a “fair” redistricting plan is a mythical impossibility given the political and demographic realities with single-member districts. Parties that want to win, single member district systems, grossly disparate population densities, the unfeasibility or unavailability of non-partisan map drawers, technological advances with geographic information systems (GIS), and the justicability of district plans all contribute to a situation where elites will vie for control of the official pen that draws the lines. Rather than categorize some maps as “gerrymanders” and others as “not gerrymanders,” I want students to understand that there are empirical measures of bias and “gerrymander” is in the eye of the beholder.

**Baker v. Carr (1962)**: Landmark case that marks the courts’ entry into the redistricting process.

**Wesberry v. Sanders (1964)**: Redistricting case where Supreme Court mandated all districts must be of equal population size on 14th amendment grounds.
Appendix x: Feedback Survey Question Wording

1. Please rate your own computer expertise on a 0-10 scale, with 10 being very familiar with computers, Microsoft Office, software, multiple OSs, etc., and 0 being uncomfortable with computer basics, such as e-mail.

   0  1  2  3  4  5  6  7  8  9  10

2. Agree or Disagree: The Gerryminder simulation did more to help me understand redistricting than the textbooks and lecture.

   Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree

Please explain your answer:
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3. Agree or Disagree: I found the Gerryminder simulation easy to use (including the manipulation of districts and the ease of reading the statistical reports, such as Seats-to-Votes ratio and district composition).

   Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree

Please explain your answer:
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4. Agree or Disagree: The Gerryminder simulation helped prepare me for the exam and was an important way of doing well in class.

   Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree

Please explain your answer:
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5. Agree or Disagree: The Gerryminder simulation was appropriate for introductory level classes on government or political science.

   Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree

Please explain your answer:
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6. Please provide any thoughts you have that the above questions did not address. For instance, what is the part of Gerryminder that needs the most improvement before widespread usage in undergraduate classes? What is missing?
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Selected References


