

# “Gerrymandering in the Laboratory”

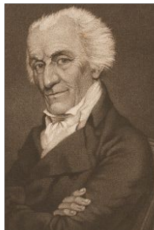
SunAh An    Buddy Anderson    Cary Deck

The University of Alabama

EC698 November 15, 2021

# What is gerrymandering?

- ▶ The manipulation of the boundaries of electoral constituencies to favor one election outcome over another
- ▶ Etymology began in 1812 when Massachusetts Governor Elbridge Gerry, signed a bill redrawing state senate districts



Elbridge Gerry



Gerry's Salamander

# Literature Review

- ▶ Optimal Gerrymandering
  - ▶ Two types of voters (Owen and Grofman 1988)
  - ▶ Continuum of perfectly observable types (Gilligan and Matsusaka 1999)
  - ▶ Imperfectly observable types (Friedman and Holden 2008; Gul and Pseendorfer 2010; Kolotilin and Wolitzky 2020)
- ▶ Implications of Gerrymandering
  - ▶ Majority minority districts (Cameron, Epstein and O'Halloran 1996; Grigg and Katz 2005)
  - ▶ Participation (Hayes and McKee 2009)
  - ▶ Policy choice (Shots 20002; Besley and Preston 2007)
  - ▶ Polarization (McCarty, Pool, and Rosenthal 2009)

# Our Contest Map

- ▶ A Map consists of 3 Districts that each contain 3 Zones
- ▶ Districts are referenced by their color: White, Light Gray, and Dark Gray
- ▶ Players A and B compete for a prize of  $V$  by choosing effort expenditures, or bids, for each District
- ▶ To win the contest a player must win the majority of the Districts

|   |   |   |
|---|---|---|
| A | A |   |
| A |   | B |
|   | B | B |

*Gerry<sub>B</sub>*

|   |   |   |
|---|---|---|
| A | A |   |
| A |   | B |
|   | B | B |

*Symm<sub>1,1</sub>*

|   |   |   |
|---|---|---|
| A | A |   |
| A |   | B |
|   | B | B |

*Symm<sub>1,3</sub>*

|   |   |   |
|---|---|---|
| A | A |   |
| A |   | B |
|   | B | B |

*Symm<sub>3,1</sub>*

|   |   |   |
|---|---|---|
| A | A |   |
| A |   | B |
|   | B | B |

*Gerry<sub>A</sub>*

# Theoretical Predictions

- ▶ Player  $i$ 's expected payoff is  $E\pi_i = \rho_i V - \sum_d e_{i,d|M}$  for
  - ▶ the probability  $\rho_i$  that player  $i$  wins the Map and
  - ▶ the expenditure  $e_{i,d|M}$  of player  $i$  in district  $d$  on the given Map  $M$

|   |   |   |
|---|---|---|
| A | A |   |
| A |   | B |
|   | B | B |

$Symm_{1,1}$

- ▶ The winner of District W wins the contest
- ▶ Standard Tullock Contest for lone, unclaimed Zone in White District
  - ▶  $E\pi_i = \frac{e_{i,W}}{e_{i,W} + e_{j,W}} V - e_{i,W}$  for  $j \neq i$
  - ▶  $e_{A,W}^* = e_{B,W}^* = \frac{V}{4}$  and  $\rho_i = 50\%$

# Theoretical Predictions

Table: Summary of theoretic predictions

| Map          | District    | $e_{A M}^*$    | $e_{B M}^*$    | $\rho_A$      | $\rho_B$      |
|--------------|-------------|----------------|----------------|---------------|---------------|
| $Symm_{1,1}$ | W           | $\frac{1}{4}V$ | $\frac{1}{4}V$ | $\frac{1}{2}$ | $\frac{1}{2}$ |
| $Symm_{1,3}$ | W           | $\frac{3}{8}V$ | $\frac{3}{8}V$ | $\frac{1}{2}$ | $\frac{1}{2}$ |
| $Symm_{3,1}$ | W, L, and G | $\frac{1}{8}V$ | $\frac{1}{8}V$ | $\frac{1}{2}$ | $\frac{1}{2}$ |
| $Gerry_A$    | W           | $\frac{1}{4}V$ | $\frac{1}{4}V$ | $\frac{3}{4}$ | $\frac{1}{4}$ |
| $Gerry_B$    | W           | $\frac{1}{4}V$ | $\frac{1}{4}V$ | $\frac{1}{4}$ | $\frac{3}{4}$ |

# Experimental Design

- ▶ 8 sessions (8 subjects per session)
- ▶ Sessions progress in 3 Stages

Stage 1: 10 periods selecting only effort bids

Stage 2: 3 periods selecting preferred map and effort bids

Stage 3: 1 period selecting preferred map prior to role and effort bids assignment

- ▶ Subjects randomly matched every period
- ▶ One period selected at random for payment
- ▶ Prize value  $V = 80$
- ▶ Exchange rate of 4 \$Lab = 1 \$US
- ▶ Programmed in Ztree (Fischbacher 2007)
- ▶ Conducted at TIDE Lab with \$5 participation payment

# Experimental Design

|   |   |   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
|---|---|---|---|---|--|---|--|---|---|---|---|---|--|---|--|---|--|---|---|---|---|---|--|---|--|---|--|---|---|---|---|---|--|---|--|---|--|---|---|---|---|---|--|---|--|---|--|---|---|
| <table><tr><td>A</td><td>A</td><td></td></tr><tr><td>A</td><td></td><td>B</td></tr><tr><td></td><td>B</td><td>B</td></tr></table>   | A   | A   |   | A   |  | B |  | B | B | <table><tr><td>A</td><td>A</td><td></td></tr><tr><td>A</td><td></td><td>B</td></tr><tr><td></td><td>B</td><td>B</td></tr></table> | A | A |  | A |  | B |  | B | B | <table><tr><td>A</td><td>A</td><td></td></tr><tr><td>A</td><td></td><td>B</td></tr><tr><td></td><td>B</td><td>B</td></tr></table> | A | A |  | A |  | B |  | B | B | <table><tr><td>A</td><td>A</td><td></td></tr><tr><td>A</td><td></td><td>B</td></tr><tr><td></td><td>B</td><td>B</td></tr></table> | A | A |  | A |  | B |  | B | B | <table><tr><td>A</td><td>A</td><td></td></tr><tr><td>A</td><td></td><td>B</td></tr><tr><td></td><td>B</td><td>B</td></tr></table> | A | A |  | A |  | B |  | B | B |
| A   | A   |   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| A   |   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
|   | B   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| A   | A   |   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| A   |   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
|   | B   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| A   | A   |   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| A   |   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
|   | B   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| A   | A   |   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| A   |   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
|   | B   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| A   | A   |   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| A   |   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
|   | B   | B   |   |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |
| <div>Effort in Dark Grey District <input type="text"/></div> <div>Effort in Light Grey District <input type="text"/></div> <div>Effort in White District <input type="text"/></div> | <div>Effort in Dark Grey District <input type="text"/></div> <div>Effort in Light Grey District <input type="text"/></div> <div>Effort in White District <input type="text"/></div> | <div>Effort in Dark Grey District <input type="text"/></div> <div>Effort in Light Grey District <input type="text"/></div> <div>Effort in White District <input type="text"/></div> | <div>Effort in Dark Grey District <input type="text"/></div> <div>Effort in Light Grey District <input type="text"/></div> <div>Effort in White District <input type="text"/></div> | <div>Effort in Dark Grey District <input type="text"/></div> <div>Effort in Light Grey District <input type="text"/></div> <div>Effort in White District <input type="text"/></div> |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |   |  |   |   |

Figure: Effort selection for each Map



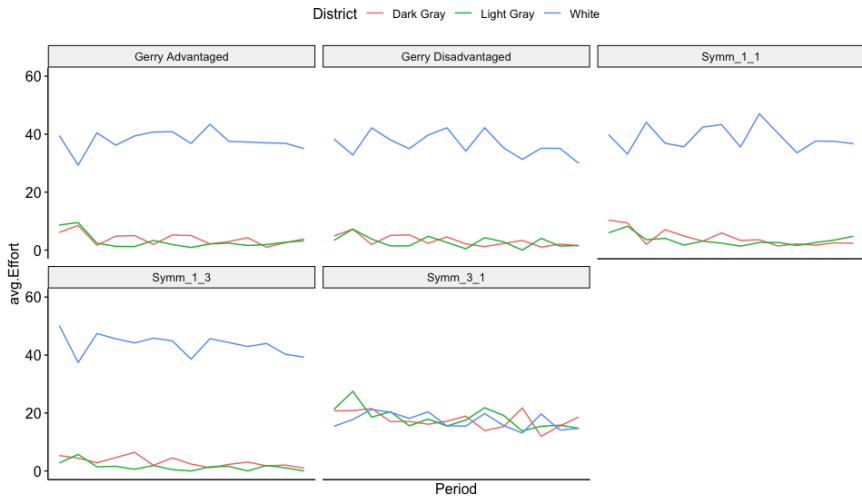
# Bidding Behavior Relative to Theory

Table: Equilibrium vs Observed Bids

| Map                 | District    | Equilibrium | Observed |
|---------------------|-------------|-------------|----------|
| $Symm_{1,1}$        | W           | 20          | 40.2     |
| $Symm_{1,3}$        | W           | 30          | 43.4     |
| $Symm_{3,1}$        | W, L, and G | 10          | 17.6     |
| Gerry Advantaged    | W           | 20          | 39.2     |
| Gerry Disadvantaged | W           | 20          | 36.3     |

Players A and B do not exhibit different bidding behavior We analyze the gerrymandered maps in the context of advantages and disadvantages

# Stage 1 Results



Average bidding behavior over Stage 1

# Stage 1 Results

**Table:** Effect of Map Configuration on Total Bid in Stage 1

|                     | Effort             |
|---------------------|--------------------|
| Adv                 | -1.470 (1.207)     |
| Disadv              | -3.656*** (1.207)  |
| Symm_1_3            | 1.417 (1.207)      |
| Symm_3_1            | 7.189*** (1.207)   |
| Constant            | 47.400*** (0.853)  |
| Observations        | 3,200              |
| R <sup>2</sup>      | 0.028              |
| Residual Std. Error | 21.588 (df = 3195) |

*Note:* \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

# Thoughts on Gerrymandering?

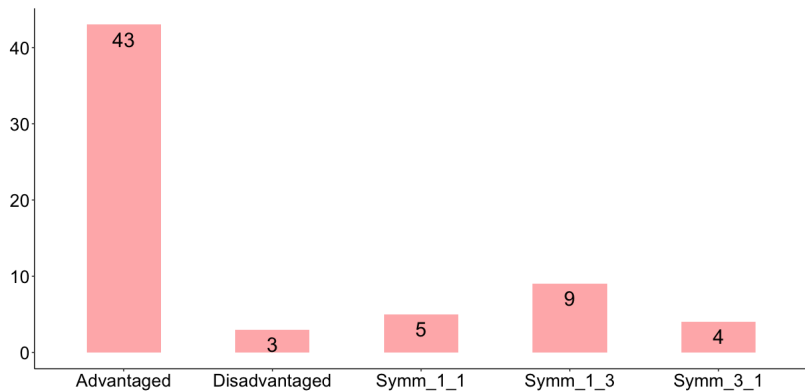
Subjects were asked:

*Do you support gerrymandering (the manipulation of the boundaries of electoral constituencies to favor one election outcome over another)?*

Responses:

- ▶ Yes: 3
- ▶ No: 61

## Stage 2: Map Selection



# Politics and Gerrymandering

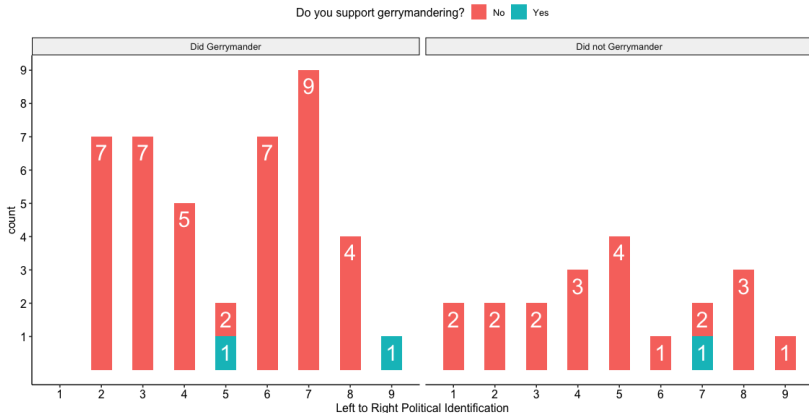
Subjects were also asked:

*On a scale of 1 to 9, how would you describe your political views with 1 being extremely liberal (i.e. to the left of the Democratic Party), 5 being centrist (i.e. falling between the Democratic Party and the Republican Party), and 9 being extremely conservative (i.e. to the right of the Republican party).*

Responses:

| 1 | 2 | 3 | 4 | 5 | 6 | 7  | 8 | 9 |
|---|---|---|---|---|---|----|---|---|
| 2 | 9 | 9 | 8 | 7 | 8 | 12 | 7 | 2 |

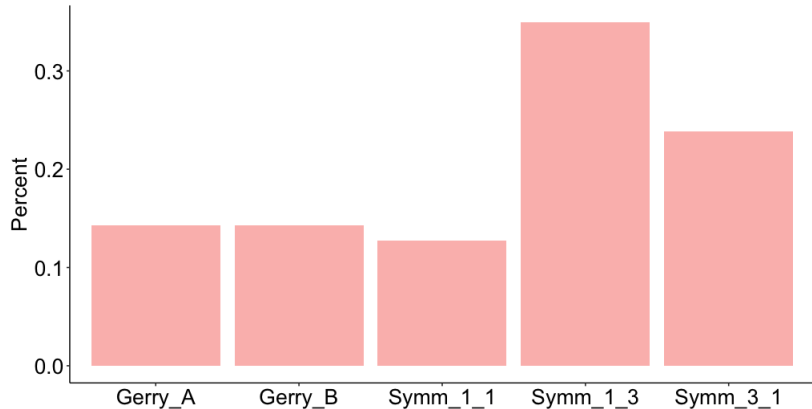
# Politics and Gerrymandering



$\chi^2$  test rejects gerrymandering depends on political views  
(p-value = 0.3106)

## Stage 3: Map Selection

People tend to pick symmetric maps when they do not know their role, **but not the socially optimal map**.





# Summary

- ▶ Subjects bid in an intuitive manner
  - ▶ (largely) ignore non-competitive districts
  - ▶ (over)bid on competitive districts on average
  - ▶ evidence in  $Symmetric_{3,1}$  of minimal winning coalitions
  - ▶ gerrymandering leads disadvantaged people to be discouraged on average
- ▶ View on gerrymandering
  - ▶ report not liking gerrymandering, regardless of political persuasion
  - ▶ prefer to compete on inefficient but “fair” maps when they cannot be self-serving
  - ▶ overwhelmingly engage in gerrymandering when they can