# Do Primaries Work?

Nomination Politics and the Representation of Local Partisan Preferences

*Michael G. DeCrescenzo*

*2019-09-16*

Commit `9b43c6a` on branch `write`:

```
sim improvements (see comments)
```

Dedicated to Tina Parija

I became a worse political scientist
so I could be a better person.

# *Abstract*

In contemporary electoral politics in the U.S., primary elections are widely believed to play a crucial role. Many scholars believe that primary election competition is the standout reason why classic predictions from formal models of electoral competition—that candidates take ideological positions near the median voter—fail to manifest in the real world. The general election context provides incentives for candidates to take centrist policy positions, but candidates must win their party's nomination before advancing to the general election. Because primary elections take place predominantly among voters of one political party affiliation, and because those voters tend to hold strongly partisan beliefs about political issues, candidates feel more acute incentives to take strong partisan stances on issues rather than moderate stances even amid stiff general election competition.

This story of primary elections and representation is widely believed, but is it true? Despite its prominence, the empirical evidence is unclear.The theory rests on a notion that voters make informed choices in primary elections by consulting their policy preferences and choosing the candidate with the closest policy platform. Past research has been unable to operationalize key constructs in this prediction, or it has operationalized the wrong constructs. Candidates should take more extreme positions when the primary constituency has a stronger preference for ideologically extreme policy, but studies have not directly measured the policy preferences of partisans within a candidate's district. Further, districts where partisans hold more extreme preferences should nominate candidates with more extreme campaign positions as well, but methods for estimating candidates' ideological positions have been incompletely applied to the study of primaries. Moreover, because primary elections are characterized by low levels of voter information and the partisanship of candidates is held largely constant, non-policy forces such as candidate valence and campaign spending may be more powerful than in general elections. For these reasons, the proposition that primary elections advance the ideological interest of local partisan voters is theoretically contestable.

This dissertation develops and applies new Bayesian approaches for estimating both constructs that have yet eluded the study of primary politics: the preferences of partisan voters as a group and the campaign positioning of primary candidates. With these estimates in hand, I explore the relationship between local partisan preferences and primary candidate positions. Do primary candidates position themselves relative to partisan primary voters, and is the relative extremism of partisan constituencies related to the ideological positions of the candidates they nominate?

# Contents

# *List of Tables*

# *List of Figures*

# *Acknowledgments*

I owe sincere thanks to those who supported this work. There are those who helped me professionally:

- My committee: Barry Burden, Ken Mayer, Ellie Powell, Alex Tahk, and ______ somebody
- Members of the department who provided institutional support: the "Beasts of Burden" roundtable group, Scott Straus, members of the Fall 2016 prospectus workshop course, including Micah Dillard, David Greenwood-Sanchez, Devin Judge-Lord, Dmitri Kofanov, Michael Masterson, Ben Power, Sujeong Shim, and the Election Research Center others? for financial support.
- Faculty and students at other universities who shared data or provided advice at various stages in its development: Robert Boatright, Devin Caughey, David Doherty, Seth Hill, Gary Jacobson, Georgia Kernell, Brendan Nyhan, Andrew Reeves, Michael Ting, Sarah Treul, ______ Others
- Software users and developers whose tools (and supporting community) brought the project to "operational" life and influenced my work going forward: Mara Averick, Jenny Bryan, Andrew Heiss, Mike Kearney, Thomas Lin Pederson, Kara Woo, ______ Others/sp
- The staff at various cafes in town that fueled and powered me, especially Black Locust Cafe and Johnson Public House.

I also want to thank those who provided social support as this project came to a head:

- My family, who would do anything in their power for me
- My closest friends in the program: Micah Dillard, Jordan Hsu, Rachel Jacobs, Anna Meier, Anna Oltman, Rachel Schwartz
- The Bike Gang: Josh Cruz and Erin Nelson
- My friends in other cities who always cheered me on: Marissa Finazzo, Zach Gray, Spencer Melgren, Jake Moore, Daniel Putman, Ian Servantes, India Watts

Chapter One

# *Primary Elections and Ideological Choice*

Elections are the foremost venue for citizens to influence government actors and public policy. Classic theories of voting suggest that citizens weigh the policy positions of alternative candidates and vote for the candidate whose platform most closely aligns with their own preferences (Downs 1957). Political parties simplify the voter's calculations by providing a powerful heuristic in the form of the party label, enabling voters to infer candidates' values and issue positions without expending the effort to thoroughly appraise each campaign (Campbell et al. 1960; Green, Palmquist, and Schickler 2002; Rahn 1993).

The rise of partisan polarization, however, has complicated the role of parties in U.S. politics. Although citizens, journalists, pundits, and even elected leaders frequently bemoan the bitter rhetoric and legislative gridlock that has accompanied the widening partisan divide, political scientists have identified a number of positive representational consequences to polarization. Compared to the parties of the early- and mid-1900s that political scientists believed were alarmingly undifferentiated (American Political Science Association 1950), in recent decades the Democratic and Republican Parties have taken increasingly divergent and oppositional stances across a wider variety of issues. Voters have "sorted" into partisan groups that occupy distinct ideological locations in American politics, leading to greater consistency in their issue beliefs, greater ideological abstraction in voter attitudes, and increased political participation (Abramowitz and Saunders 1998; Fiorina, Abrams, and Pope 2005; Layman and Carsey 2002; Levendusky 2009).

Even as polarization has strengthened many aspects of inter-party representation, it affects within-party representation in a number of troubling ways. Party labels provide starker informational and identity cues about candidates than in decades past, but for the typical voter, there is not much of a decision to be made. The typical voter is a partisan who intends to cast her ballot for her preferred party, whoever that candidate may be (Bartels 2000; Petrocik 2009). As party-line voting has increased, there is a sense in which polarization exacerbates the notion of partisan electoral "capture." For most voters, their choices are locked in long before Election Day. Candidates from their preferred parties have been selected through a nomination process, and voters are more likely to abstain from voting when faced with an undesirable candidate than they are to vote against their parties (Hall and Thompson 2018). Recent research supports this notion of capture amid polarization—when voters must choose between polarized candidates, they become less responsive to candidates' actual platforms and instead are more influenced by motivated reasoning and partisan teamsmanship (Rogowski 2016). Voters relax their ideological scrutiny of candidates to cast low-cost votes for their own party, weakening the influence of policy preferences in electoral representation overall.

Hate this

sense in
ich" come on

ore forgiving of
d traits?

This presents an important problem for our understanding of how elections contribute to the representation of voter preferences in government. Elections are intended to be a voter's choice over alternative political values to be expressed in government, but if the choice of candidates does not present the average partisan voter with realistic alternatives, how should we think about the "representation" of these voters' actual policy preferences? If general elections are relatively weak venue for democratic accountability, does the U.S. electoral system incorporate these preferences in other ways?

When the choice before voters in the general election does not present realistic alternatives, political scientists naturally shift their focus to the nomination of partisan candidates. V.O. Key, for example, famously studied one-party rule in the American South, asking whether competition within the Southern Democratic Party could provide a quality of representation similar to two-party competition (Key 1949). Although scholars are right to examine within-party competition, focusing on single-party dominance is a serious limitation. Within-party representation presents interesting questions that apply to far wider contexts. Even in races between viable candidates from both major parties, within-party competition plays a crucial role simply due to the fact that partisan voters almost certainly cast a vote for their own party. Rank-and-file partisan constituents are all but captured—if they are to express their policy preferences through the act of voting, their voices may register as relatively weak because they present little electoral risk to their party in the general election. The nomination stage—the primary election in particular—remains an important venue for the representation of partisans' policy views, whether the general election is closely contested or not.

what am I sayin here?

This dissertation is chiefly concerned with the policy preferences of partisan voters and their role in electoral representation through primary politics. The study of American electoral politics has not ignored the representational function of primary elections (Aldrich 2011; Cohen et al. 2009; Geer 1988; Norrander 1989), but as I discuss below, the quantifiable impact of primary voters' policy preferences in government is a startlingly open question. Several existing studies have examined other aspects of primary representation, such as the introduction of the direct primary (Ansolabehere et al. 2010), how candidates position themselves in response to the presence or threat of primary challenges (Brady, Han, and Pope 2007; Burden 2004; Hirano et al. 2010), and how primary nomination rules affect elite polarization (Hirano et al. 2010; McGhee et al. 2014; Rogowski and Langella 2015). Though these studies address interesting aspects of electoral representation and party competition, they cannot speak directly to the influence of voter preferences on (1) the positioning of candidates and (2) the outcomes of primary elections.

punch up or jus preview?

The absence of voter preferences from the empirical study of primaries is troubling because they play a crucial role in the dominant theory that relates representation to primary politics. Although the Downsian model of candidate positioning explains the incentives for candidates to stake out moderate policy positions to cater to the ideological "median voter" (Downs 1957), candidates behave differently in the real world. Instead, candidates engage in highly partisan behavior and take divergent issue stances even on salient local issues and in closely competitive districts (Ansolabehere, Snyder, and Stewart 2001; Fowler and Hall 2016). But why? Scholars and political observers have argued that because competing in the general election requires each candidate to clinch their party's nomination contest, these candidates face a combination of convergence-promoting and divergence-promoting incentives. Primary elections tend to be dominated by partisan voters who are attentive to politics and hold stronger, non-centrist issue preferences compared to the average general-election voter.[1] As a result, competition in the primary stage may present a more acute electoral threat to partisan candidates than general elections do—a "strategic-positioning dilemma" that leads candidates to take ideological issue stances in favor of convergent stances that target the median voter (Aldrich 1983; Brady, Han, and Pope 2007; Burden 2004; Hill 2015).

nsidered cites in
mment

I argue that if we were to construct ideal tests for this theory, the preferences of partisan primary voters play a key role. First, the theory predicts that candidates strategically position themselves to appeal to primary voters. That is, if we could construct an ideological summary of the partisan primary voters in a district, we ought to find that the level of voter conservatism affects the conservatism of the primary candidates' campaign stances. And second, if primary voters present a credible threat to primary candidates (specifically via their policy preferences), they should vote for the candidate who best represents their policy views. We should observe

[1] Primary elections are not *entirely* partisan affairs. States vary in their regulations that primaries be "closed" to partisan voters only, that voters must preregister with their preferred party to vote in the primary, and even whether primaries are partisan at all (see McGhee et al. 2014 for a thorough and contemporary review of these regulations). Although many observers suspect that regulations on primary openness greatly influence the ideological extremity of the primary electorate, recent survey research finds that these regulations do little to moderate the strong partisan composition of primary voters (Hill 2015).

that as the degree of primary voter conservatism increases, the probability that a more conservative candidate is nominated increases as well. These two predictions are the core empirical implications of the "strategic positioning dilemma" theory of representation in primaries, and they each require researchers to know the preferences of partisan voters within an electoral district. Yet, the preferences of the partisan constituency are either absent or dangerously misconstrued in the existing literature, and we have been unable to answer these key questions as a result.

Stated differently, this dissertation asks if primaries "work" the way we think they do. It is widely believed that primaries are effective means for voters to inject their sincere preferences into the selection of candidates and, in turn, the priorities of elected officials. Is this *actually* true? Do candidates position themselves to win the favor of primary voters? Do primary voters select the candidate who best represents their issue beliefs? And further, do institutional factors that purportedly alter the positioning incentives of candidates, such as redistricting, affect which candidates are nominated?

Not only is the evidence in support of this theory sparse or indirect,[2] its theoretical plausibility is not straightforward either. Primary elections present voters with uniquely high informational demands. Because most primary elections are held between candidates of the same party,[3] the party label does not provide the same heuristic cue for voters to impute the positions of the candidates. Although primary voters are generally informed about the typical policy positions associated with their preferred party (Hill 2015), the costs of learning about which candidate stands for which position will be higher than the information costs in a general election. Primary elections typically occur in odd months when voters are paying less attention to politics, and the press typically cover primary campaigns less closely than

[2] I elaborate on the existing evidence later in this chapter.

[3] There are a few exceptions to this general characterization of nomination elections. California, Louisiana, and Washington hold blanket primaries, sometimes called "jungle" primaries, where candidates from all parties compete on one ballot to be included in a runoff general election.

general election campaigns. In these low-information environments, voters may decide to cast their ballot for various non-policy reasons. They may vote for the familiar candidate instead of the ideologically proximate one, in which case asymmetric campaign expenditures or news coverage may advantage one candidate over the other. Candidates may determine that communicating their policy positions is less cost-effective than communicating symbolic positions by touting their incumbency or their "outsider" status. The efficacy of these appeals may be correlated with the actual ideological positions of the candidates (for example, if high-quality incumbents are more skilled at perceiving primary voter preferences,(On the perception of voter preferences by politicians, see Broockman and Skovron 2018.) positioning themselves in relation to primary voters, and at communicating symbolically powerful messages), but the information voters are acting on is itself non-spatial. In short, although the proposition that voters' policy preferences affect their primary candidate choices seems straightforward, the informational environment of the primary campaign presents voters with many incentives to vote using non-policy considerations. Indeed, the notion that "voters matter" is a theoretical orientation toward primaries that is not shared by all scholars of electoral representation. Many scholars of political parties maintain that parties retained their gatekeeping roles over party nominations even as the direct primary ostensibly removed their formal powers over candidate selection. Although primary campaigns take place, these scholars argue that an informal network of party actors wields enormous influence behind the scenes, controlling which candidates obtain access to the party's resources, donor lists, and partisan campaign labor (Cohen et al. 2009; Masket 2009).

There are two dominant obstacles that have kept the primary constituency from assuming its proper role in the the study of representation. First, and most importantly, the dominant conceptualization and operationalization of constituency preferences is unsuited the study of partisan primaries. Our working theory of primary representation, particularly as it relates to the "strategic positioning dilemma," pits two constituencies within the district against each other: the nominating constituency, which contains only nominating voters from one party, and the general election constituency, which is composed of citizens from both major parties as well as Independents. The former is theorized to prefer ideologically faithful candidates who adhere closely to the party's policy platform,[4] while the latter prefers moderate candidates in the general election. Studies routinely acknowledge this distinction in theory, but they often abandon the distinction between the two groups applied studies, instead operationalizing the preferences of all three constituencies—the general constituency and two partisan primary constituencies—using the same single and inappropriate measure: the district-level presidential vote. The presidential vote share is not suitable for the study of primary representation for the simple reason that votes are not equivalent to policy preferences or political ideology. (I refer to "ideology" in its meaning as a summary measure of an individual's issue preferences—i.e. an "ideal point"—rather than its meaning as an abstract political value set from which policy positions can be derived.) Republican voters in a district may be ideological moderates or ideological conservatives, but the fact that they all vote Republican does not inform us on their relative ideological tastes. Similarly, a district's vote outcome captures how its constituents vote on average, but because partisans tend to vote foremost for their preferred party, this average may be more strongly affected by number of voters in each party rather than their ideological preferences. The district presidential vote fails to represent primary constituent preferences both as a concept and as a feasible proxy measure, and the U.S. representation literature's reliance on this measure for decades potentially compromises its understandings of accountability under democratized party nominations. Because we have not studied primary constituency preferences, we cannot characterize their impact in electoral representation.

ideology

simulation

The second obstacle preventing a more complete study of primary representation is the failure to incorporate primary candidates' ideal points into the analysis. Although ideal point

[4]Strategic voting complicates this characterization, which I discuss below.

estimates derived from roll-call votes such as Nominate are a popular tool for measuring politicians' ideological locations (Poole 2005; Poole and Rosenthal 1997), only incumbents cast roll call votes, so these measures are unavailable for non-incumbent candidates.[5] Further, when non-incumbents enter the picture, researchers tend to focus on the positioning of general election candidates rather than primary candidates (Ansolabehere, Snyder, and Stewart 2001; Burden 2004; Canes-Wrone, Brady, and Cogan 2002). Some studies have argued that primary competition leads incumbent legislators to take non-median positions, but these studies do not observe primary candidate positions directly, instead observing the presence or threat of challengers (Brady, Han, and Pope 2007; Burden 2004). Recent advances in ideal point modeling using campaign contributions are a promising path forward (Bonica 2013, 2014; Hall and Snyder 2015), but they are not designed for the careful study of primary competition and thus contain many "post-treatment" measurement artifacts.

It must be stressed that these obstacles are not merely methodological, since the theoretical consequences are enormous. The literature's dependence on the presidential vote as a proxy for district preferences and its omission of primary candidate ideology have prevented scholars from testing basic theoretical propositions in the study of primary politics. Put simply, without serviceable measures of local partisan preferences or primary candidate positions, we can say very little about the role of primary elections in the broader democratic order of U.S. politics. This affects our knowledges of topics beyond nominations as well. To study how politicians weigh the opinions of their party's base of support against other voters in their districts, we must be able to measure the preferences of a politician's local partisan constituency.[6] As scholars explore whose voices truly matter in shaping party platforms and

[5]Studies of candidate positioning that go beyond incumbents sometimes use survey data from challenger candidates (Ansolabehere, Snyder, and Stewart 2001; Burden 2004), but the surveys only interview general election candidates. Furthermore, the rarity of these surveys limits the generalizability of their findings over time.

[6]Clinton (2006) provides suggestive evidence on the importance of this distinction. Using a cross-sectional survey, he finds that the roll-call voting behavior of Democratic members of Congress is more responsive to the district's median constituent, while Republican members respond more strongly to the average Republican

policy (Bartels 2009; Cohen et al. 2009; Gilens 2012; Grossman and Hopkins 2016; Lax and Phillips 2012), these researchers will benefit enormously from an approach to estimate the subnational preferences of partisan voters. This dissertation will demonstrate the added value of conceptualizing voter preferences in this way.[7]

I fill this gap in the representation literature by developing a new measurement model for local partisan preferences and applying these estimates to important questions of primary representation. The model builds on the work of Tausanovitch and Warshaw (2013) and Caughey and Warshaw (2015), estimating a latent index of policy liberalism within partisan groups in Congressional districts. For each district, the model estimates the mean ideal point of Democratic and Republican constituents using survey data. With these new estimates, I directly test the hypotheses that other studies have fallen short of testing. Is it truly the case that the primary constituency is a standout cause of candidate positioning? Do primary voters nominate partisan candidates for their ideological "fit"? And do institutional configurations such as gerrymandering distort these relationships in ways commonly suggested by scholars and political observers alike?

This remainder of this chapter reviews leading theoretical approaches to primary representation, highlights the importance of partisan constituent preferences, and uses formal models to demonstrate how existing approaches fail to measure the important theoretical constructs. The chapter ends by previewing the remaining chapters of the dissertation about the new measurement model (Chapter 2) and analyses that apply the new estimates to important areas of primary representation: the strategic positioning of primary candidates (3), the vote choices of primary constituents (4), and how redistricting moderates these outcomes of interest (5).

---

constituent.

[7] New work by Caughey, Dunham, and Warshaw (2018) operationalizes the average ideal points of partisans within states. I offer important extensions on their modeling approach and apply the estimates to very different substantive questions.

## 1.1 Limitations for inferring ideal points from votes

This section shows the limitations of inferring voter preferences from vote shares, using notation similar to Kernell (2009).

Georgia Kernell (2009) demonstrates the difficulty of inferring district-level preferences (median voter locations) from observed votes. First, she shows that the ordering of district medians cannot be inferred from the vote shares of one election. Suppose we wish to place districts 1 and 2 on an ideological dimension. We observe that the Republican share of the two party vote in each district is $p_1$ and $p_2$. Assuming that voter preferences are normally distributed around the median voter (equivalent to the mean voter), then vote shares can be understood as the result of the normal CDF by comparing the candidate's ideal point to the distribution of voter preferences.

$$p_i = \Phi\left(\frac{c - \mu_i}{\sigma_i}\right) \tag{1.1}$$

By inverting the normal CDF, she shows that the difference in medians $\mu_1$ and $\mu_2$ is not proportional to vote shares in each district, but to the $z$-score of the vote in each district.

$$\mu_2 - \mu_1 \propto Z\left(p_2\right) - Z\left(p_1\right), \tag{1.2}$$

The nonlinear relationship between $\mu_i$ and $p_i$ suggests that district preferences are unidentifiable without using multiple elections resulting from the same fixed set of voter preferences $\mu_i$.

Following a similar setup, I demonstrate that the task of inferring the positions of multiple parties is even more difficult. First, rather than assuming that voter preferences in a district are normally distributed with one mean and one dispersion term, we assume that voter preferences are mixture of two distributions (indexed 1 and 2). Each party votes for a Republican candidate akin to the normal CDF as before, but the vote share $p$ for the Republican reflects the size of each partisan constituency in the district as well. Suppose that the size and ideal

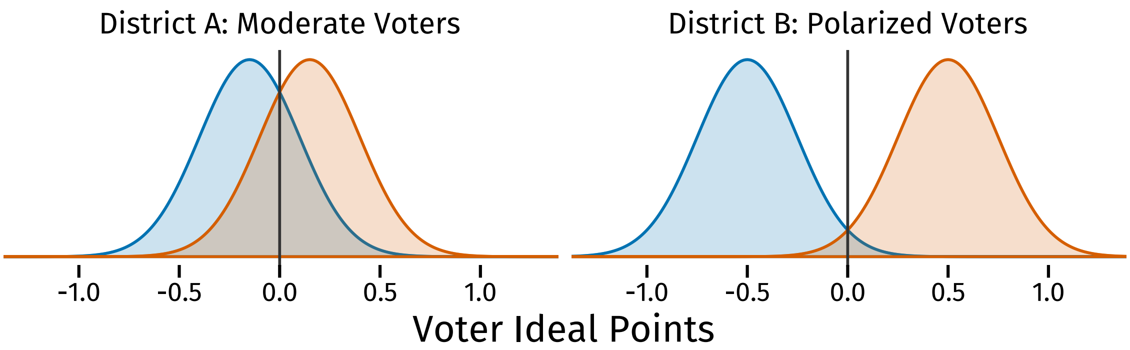


Figure 11: Two districts with identically located median voters

point of party unaffiliated is represented by a normally distributed error term $\varepsilon$:

$$p = \Phi\left(\frac{c-\mu_1}{\sigma_1}\right)\pi_1 + \Phi\left(\frac{c-\mu_2}{\sigma_2}\right)\pi_2 + \varepsilon, \tag{1.3}$$

where $p_i$ reflects the proportion of the electorate that identifies with party $i$. Isolating $\mu_1$ and $\mu_2$ in this setup is rather difficult, and the choice of simplifying assumptions is limited. We could assume that the variance of preferences in each party is equal, $\sigma_1 = \sigma_2 = \sigma$, and manipulate the equation somewhat…

$$Z(p)\,\sigma = (c-\mu_1)\,\pi_1 + (c-\mu_2)\,\pi_2, \tag{1.4}$$

but the limitations are still significant. We could not make a simplifying assumption that $\pi_1 = \pi_2$ for but a handful of districts. We might estimate $\pi_i$ from survey data but what

## 1.2 Outline for the dissertation

## 1.3 Theoretical Orientation

### *1.3.1 "Spatial" Models of Policy Preferences*

### *1.3.2 Representatives as Delegates vs. Trustees*

### *1.3.3 Proposed Model*

Value of directly modeling each party:

- identify the actual quantities of interest
- do parties "move together" or not? This is only possible to infer by modeling each party's hierarchy separately.

Chapter Two

# *Modeling the Constituency's Policy Preferences*

Intro graph. Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

In this chapter, I present the statistical model I use to estimate the policy ideal points of district-party publics. I proceed in the following major steps:

1. Review the theoretical intuitions of ideal point models, starting with the underlying utility model and describing its variants as they relate to political choice.
2. Lay out the statistical model I employ in my analysis.
3. Test the model's performance at recovering latent parameters from simulated data.
4. Describe the data used to estimate the model
5. Descriptive analysis of the estimated ideal points, with comparisons to conceptually similar measures

## 2.1 Spatial Models of Policy Choice in Political Science

Political scientists invoke ideal point models to summarize actors' policy preferences in ideological space, where preferences are represented by a location in a Euclidean $\mathbb{R}^d$ plane (for potentially high values of $d$) that represents a combination of policy outcomes in $d$ dimensions of policy concern. Political actors of various types can face "choices" over alternative policy options—legislators voting on bills, survey respondents stating their policy preferences. Analysis commonly theorize about how actors make these decisions by invoking rational choice models about actor preferences and behaviors. Actors have a utility function over policy alternatives in the ideological space, and they make policy choices that maximize their utility.

cite

What are we doing in this section:

- Ideal point models usually have an analytic basis in spatial voting models
- This model comes from a similar setup as well
- describe the theory of choice modeling applied to ideology
- theoretical basis in utility model of choice
- inferences about latent preferences estimated with a statistical model

Intuition of a *spatial* model (graphically)

- a voter has a preferred policy location
- they choose from the closer of two alternatives
- The "ideal point" ≠ ideology
  - It's an extra leap to talk about it as "ideology"
  - ideal point is an "operationalization" of a nebulous concept
  - so truly we are estimating the "ideal point" under an assumed model

Actor has choices over Right and Left. They choose the closer alternative.


More formally, choices Right and Left provide some utility to the Actor. Notationally, consider actors indexed $i \in \{1, \ldots, n\}$ who are faced with choice tasks (e.g. bills, survey items) indexed $j \in \{1, \ldots, J\}$. Let $\theta_i$ represent actor $i$'s ideal point, while $\psi_j$ and $\chi_j$ represent the Right and Left locations for choice $j$, respectively. The utility that an actor receives from a Right choice is a function of the distance between the Actor's ideal point and the Right location. The Actor maximizes their choice utility if either Right or Left falls exactly on the Actor's ideal point. The functional form of utility loss on either side of the choice location is an assumption made by the researcher—some scholars assume that utility loss follows a Gaussian curve, while others choose a quadratic utility loss (Clinton, Jackman, and Rivers 2004). For this analysis, we assume a quadratic utility loss. This choice implies a utility function over the squared distance between an Actor and a choice location. The utility Actor $i$ receives by choosing Right on choice $j$ is $U_i\left(\psi_j\right) = -\left(\theta_i - \psi_j\right)^2 + \nu_{ij}$, while the utility of choosing Left on choice $j$ is $U_i\left(\chi_j\right) = -\left(\theta_i - \chi_j\right)^2 + \eta_{ij}$, where $\nu_{ij}$ and $\eta_{ij}$ are idiosyncratic error terms.

With these utility functions laid out, it is possible to calculate the probability of $i$'s choice. Let $y_{ij} = 1$ signify the outcome that $i$ chooses Right, while $y_{ij} = 0$ signifies that $i$ chooses Left. The model so far implies that $y_{ij} = 1$ if $i$'s utility is greater for Right than for Left.

$$y_{ij} = 1 \iff U_i\left(\psi_j\right) > U_i\left(\chi_j\right) \tag{2.1}$$

The deterministic (non-error) component of Equation (2.1) is represented in Figure 21. The two parabolas represent the deterministic component of $i$'s utility loss, owed only to her distance from $\psi_j$ and $\chi_j$, respectively. The vertex of a parabola is located at its respective

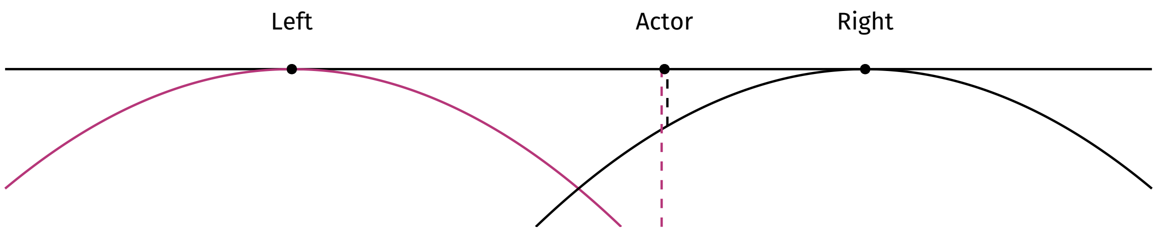


Figure 21: A representation of quadratic utility loss over policy choices

choice location, indicating that the Actor would maximize her choice utility if her ideal point were located exactly at a choice's location in policy space (setting aside the error terms). In the current example, the Actor is closer to Right than to Left, so she receives greater utility (or, less utility *loss*) by choosing Right instead of Left.

It is important to remember that Figure 21 shows only the deterministic component of choice task $j$; random error components $\nu_{ij}$ and $\eta_{ij}$ are omitted. With idiosyncratic utility error incorporated, Equation (2.1) implies that even though the Actor's distance to Right is smaller than her distance to Left, there is still a probability that $i$ chooses Left. This probability depends on the instantiated values of the idiosyncratic error terms for each choice. We can restate Equation (2.1) probabilistically:

$$\begin{aligned}\Pr\left(y_{ij}=1\right) &= \Pr\left(U_i\left(\psi_j\right) > U_i\left(\chi_j\right)\right)\\ &= \Pr\left(-\left(\theta_i-\psi_j\right)^2+\nu_{ij} > -\left(\theta_i-\chi_j\right)^2+\eta_{ij}\right)\end{aligned} \tag{2.2}$$

The probabilistic expression in Equation (2.2) serves as the basis for a statistical model of the choice between Right and Left. Rearranging terms slightly:

$$\begin{aligned}\Pr\left(y_{ij}=1\right) &= \Pr\left(-\left(\theta_i-\psi_j\right)^2+\nu_{ij} > -\left(\theta_i-\chi_j\right)^2+\eta_{ij}\right)\\ &= \Pr\left(\left(\theta_i-\chi_j\right)^2-\left(\theta_i-\psi_j\right)^2 > \eta_{ij}-\nu_{ij}\right)\end{aligned} \tag{2.3}$$

The intuition for (2.3) is that the Actor will choose the policy alternative that is nearest to her, *unless* idiosyncratic (non-policy) factors overcome her ideological considerations. Supposing that $i$ is closer to Right than to Left, $\left(\theta_i-\chi_j\right)^2$ will be larger than $\left(\theta_i-\psi_j\right)^2$, meaning that the left-hand side of the inequality (the deterministic component) will be some positive value. The only way for $i$ to choose Left would be if the idiosyncratic utility of Left over Right exceeded the deterministic utility of Right over Left. assumes?

Equation (2.3) can be rearranged to reveal an appealing appealing parametric form for $i$'s choice probability. Expanding the polynomial terms on the left side of the inequality...

$$
\begin{aligned}
\Pr\left(y_{ij} = 1\right) &= \Pr\left(\left(\theta_i - \chi_j\right)^2 - \left(\theta_i - \psi_j\right)^2 > \eta_{ij} - \nu_{ij}\right) \\
&= \Pr\left(\theta_i^2 - 2\theta_i\chi_j + \chi_j^2 - \theta_i^2 + 2\theta_i\psi_j - \psi_j^2 > \eta_{ij} - \nu_{ij}\right) \\
&= \Pr\left(2\theta_i\psi_j - 2\theta_i\chi_j + \chi_j^2 - \psi_j^2 > \eta_{ij} - \nu_{ij}\right) \\
&= \Pr\left(2(\psi_j - \chi_j)\theta_i + \chi_j^2 - \psi_j^2 > \eta_{ij} - \nu_{ij}\right) \\
&= \Pr\left(\beta_j\theta_i + \alpha_j > \varepsilon_{ij}\right)
\end{aligned}
\tag{2.4}
$$

Equation (2.4) simplifies the model by introducing the "discrimination parameter" $\beta_j$, the "difficulty parameter" $\alpha_j$, and $\varepsilon_{ij}$.[1] Following Clinton, Jackman, and Rivers (2004), it is assumed that utility errors $\eta_{ij}$ and $\nu_{ij}$ are distributed such that $\mathrm{E}\left[\eta_{ij}\right] = \mathrm{E}\left[\nu_{ij}\right]$ and that $\mathrm{Var}\left[\eta_{ij} - \nu_{ij}\right] = \sigma_j^2$. Let $\beta_j = \frac{1}{\sigma_{ij}} 2(\psi_j - \chi_j)$, let $\alpha_j = \frac{1}{\sigma_{ij}}\left(\chi_j^2 - \psi_j^2\right)$, and let $\varepsilon_{ij} = \frac{1}{\sigma_{ij}}\left(\eta_{ij} - \nu_{ij}\right)$. Parameterizing the model in this way expresses the utility comparison in a simpler, linear form. The final line reveals how the utility model reduces to binary choice models that are common in political science. Expressed as a generalized linear model with inverse link function $f^{-1}(\cdot)$...

$$
\Pr\left(y_{ij} = 1\right) = f^{-1}\left(\beta_j\theta_i + \alpha_j\right). \tag{2.5}
$$

The choice of link function depends on the parametric assumptions made about $\eta_{ij}$ and $\nu_{ij}$ (and thus $\varepsilon_{ij}$). If it is assumed that utility errors are Normal, this implies that $\varepsilon_{ij}$ is a standard Normal draw, so (2.5) is a probit model where $f^{-1}$ is the cumulative Normal distribution

[1] The practice of referring to these parameters as "discrimination" and "difficulty" parameters is inherited from item-response theory (IRT), an area of psychometrics that is similarly interested in inferring latent traits from observed response data. I describe the analogies between ideal point models and psychometric IRT models in the following section.

function. Equation (2.5) is a logistic/logit model if $\varepsilon_{ij}$ is a draw from a standard logistic distribution, which implies that $\nu_{ij}$ and $\eta_{ij}$ are distributed type-1 extreme value (Clinton, Jackman, and Rivers 2004).

it? var?

How do we interpret the parameters $\beta_j$ and $\alpha_j$? Holding the error variance ($\sigma_j$) constant, the discrimination parameter $\beta_j = \dfrac{1}{\sigma_{ij}} 2(\psi_j - \chi_j)$ grows in magnitude as the difference between the Right and Left policy alternatives increases. The discrimination parameter behaves as a "coefficient" for Actor $i$'s ideal point in Equation (2.5), meaning that the Actor places greater weight on her policy preferences when the ideological implications of the choice are greater. The difficulty parameter $\alpha_j = \dfrac{1}{\sigma_{ij}} \left(\chi_j^2 - \psi_j^2\right)$ serves as an intercept, capturing the phenomena that some policy choices present alternatives that are jointly more conservative or liberal on average. Suppose that $\alpha_i = 0$, which occurs if the Right and Left locations are equidistant from zero. In such a case, an Actor whose ideal point is located exactly at $\theta_i = 0$ would be indifferent (in expectation) to the choice of Left or Right.[2] If we give the Right alternative increasingly conservative values (increasing the value of $\psi_j$), the result is an $\alpha_j$ parameter that takes increasingly lower values. This leads to a lower probability that $i$ chooses Right, all else equal. The opposite intuition holds as the Left position becomes increasingly progressive, resulting in larger values of $\alpha_j$ that imply a higher probability of choosing Right, all else equal.

Others have noted (see Londregan 1999) that the reduced form is equivalent to the "two-parameter Rasch model" from the psychometric field of item-response theory (IRT). I briefly discuss the intuition of these models and how their intuitions relate to ideal point models.

This would imply that $\alpha_j = 0$,

increase (that is, move to the right).

An intuition for this parameter is that

for the is that $i$'s choice places greater weight

[2]This holds in logit and probit models, since $\text{logit}^{-1}(0) = 0.5$ and $\Phi(0) = 0.5$.

error

Ideology itself is unobservable. It affects the way people feel about policy, but we don't directly observe it. Explicit measures of ideological self identification are not themselves reliable because people don't understand those items and because they aren't great at predicting policy views either

TK

TK

While we do not directly observe ideal points, the individuals make are observable functions of unobserved preferences. These problems are common in micro-economic modeling—what inferences can be made about unobserved utilities from observed choices? Ideal point models, as a result, typically have a theoretical basis in a utility model.

Measurement model:

- We can't see the construct that we want, so we estimate it
- by building a model that relates the unobserved construct to observed data

### 2.1.1 Item-Response Theory

(IRT)

### 2.1.2 Ability-only model

We begin with a simple model where an individual $i$ gives a conservative response to item $j$ if they derive more utility than they would from a liberal response. Their utility function is made up of their ideal point $\theta_i$ and idiosyncratic error $\varepsilon_{ij}$. We can assume that the threshold between liberal and conservative responses is at 0; this is merely a scale and location restriction on what is otherwise an unstructured ideological space.

$$y_{ij} = I\left(\theta_i + \varepsilon_{ij} > 0\right) \tag{2.6}$$

This means $y_{ij} = 1$ when the utility is positive, and $y_{ij} = 0$ otherwise.

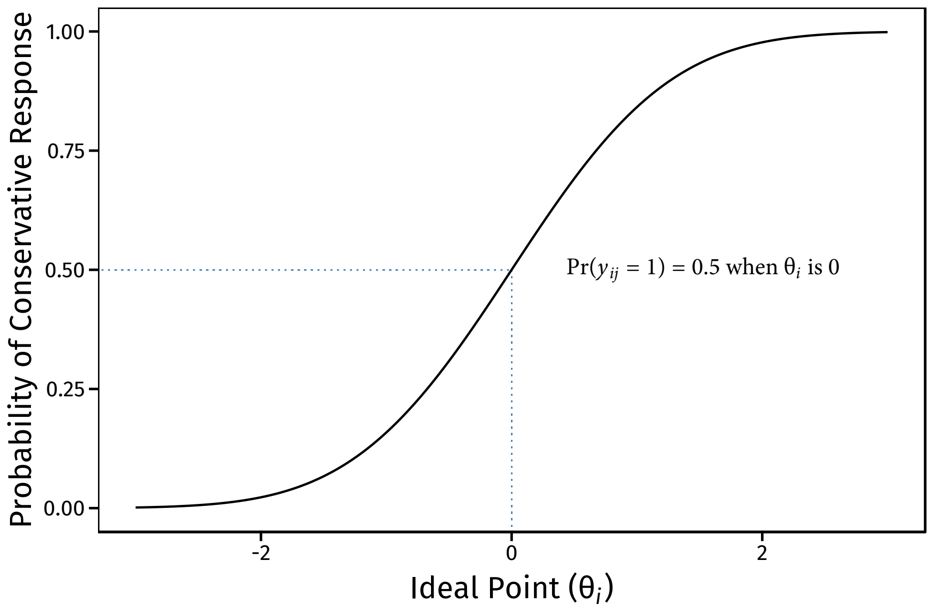


Figure 22: Ability-only model of item response

Assuming that the idiosyncratic utility is $\varepsilon_{ij} \sim \text{Normal}(0, 1)$ gives us a probit model,

$$\Pr\left(y_{ij} = 1\right) = \Phi\left(\theta_i\right), \tag{2.7}$$

where $\Phi(\cdot)$ is the Gaussian cumulative distribution function. This assumption restricts $\theta$ such that the probability of a correct response is 50% when $\theta = 0$. The scale of $\theta$ is also restricted by the assumption that $\text{Var}\left[\varepsilon_{ij}\right] = 1$.

### *2.1.3 One-parameter Rasch model*

Ability model assumes no "item effects"—there is no systematic variation at the item level that would lean to a correlated effect for one item across individuals.

This is the justification for the one-parameter Rasch model, developed in an educational testing framework. The model defines the probability that individual $i$ answers item $j$ "correctly" as a comparison between an individual $i$'s latent "ability" ($\theta_i$) and a test question $j$'s "difficulty" ($\kappa_j$). Assuming that other disturbances affecting item responses ($\varepsilon_{ij}$) are normally distributed, individual $i$'s response to item $j$ is

$$y_{ij} = I\left(\left[\theta_i - \kappa_j\right] + \varepsilon_{ij} > 0\right), \tag{2.8}$$

which yields a probit model for a discrete outcome.

$$\Pr\left(y_{ij} = 1\right) = \Phi\left(\theta_i - \kappa_j\right) \tag{2.9}$$

Adapting this model to the context of survey response, an individual respondent $i$ is asked to choose between two alternatives on policy item $j$. We let $\theta_i$ be $i$'s ideal point on a liberal-conservative dimension, where larger values of $\theta$ are more conservative, and $\kappa_j$ is the midpoint between the liberal and conservative policy alternatives. Respondent $i$ is more likely to give a conservative response on policy $j$ if their ideal point is to the "right" of the item midpoint (their ideal point is nearer to the conservative policy choice), but their response is affected by other normally distributed factors and is thus predicted only probabilistically.

### *2.1.4 Two-parameter Rasch Model*

The item-response model makes sense only under the assumption that policy issues are choices along a single underlying dimension. The one parameter model allows non-ideological factors to affect item responses but assumes that these extraneous factors are independent across items and individuals. Policy issues don't all have the same salience to partisan and ideological debate, however, so political scientists often model policy item responses using a two-parameter model. The two-parameter model includes the additional item parameter $\beta_j$, which relaxes the assumption that all items are equally related to latent ideology. This "discrimination" parameter captures how strongly the item divides the responses of liberals and conservatives.

$$\Pr\left(y_{ij} = 1\right) = \Phi\left(\beta_j\left[\theta_i - \kappa_j\right]\right), \tag{2.10}$$

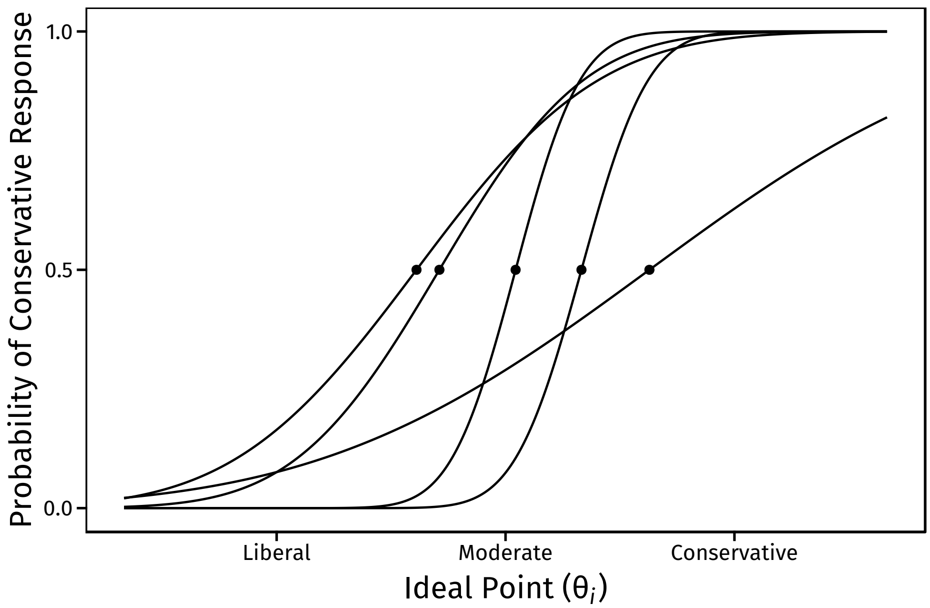


Figure 23: Examples of item characteristic curves for 5 simulated items.

#### *2.1.5 Applications of the IRT Approach*

## 2.2 Modeling Party-Public Ideology in Congressional Districts

This section outlines my group-level ideal point model for party publics. It begins by describing the connection between the individual-level IRT model and the group-level model and its implication for the parameterization of the model (Section 2.2.1). I then lay out the hierarchical model for party-public ideal points in its static form (Section 2.2.2) and its dynamic form (Section 2.2.4). Lastly, I discuss more technical features of model implementation, including prior distributions and model identification (Section 2.2.5) and parameterization in Stan (Section 2.2.6).

#### *2.2.1 Group-Level IRT Setup*

To motivate the intuition of the group model, we begin the intuition of the individual and then reparameterize it.

Assume that individuals answer policy items according to their own individual ideal points. We observe a binary response from individual $i$ to item $j$, which we model as a probabilistic outcome with probability $\pi_{ij}$.

$$y_{ij} \sim \text{Bernoulli}(\pi_{ij}) \tag{2.11}$$

Our model for the response probability is given by a probit model, following the utility intuition described above.

$$\pi_{ij} = \Phi\left(\beta_j\left[\theta_i - \kappa_j\right]\right) \tag{2.12}$$

Let $\sigma_j = \beta_j^{-1}$, so item discrimination is instead expressed as a "dispersion" parameter (Caughey and Warshaw 2015; Fox 2010).

$$\pi_{ij} = \Phi\left(\frac{\theta_i - \kappa_j}{\sigma_j}\right) \tag{2.13}$$

Assume that individuals are normal draws from the mean of their group, where a group is a party in a district.[3]

$$\theta_i \sim \text{Normal}\left(\theta_{g[i]}, \sigma_{g[i]}\right) \tag{2.14}$$

The outcome data at the group level, rather than individual Bernoulli outcomes, are expressed as grouped Binomial outcomes $Y_{gj}$: the number of conservative responses in group $g$ to item $j$ given the total number of responses per group per item, $n_{gj}$. The probability that a randomly selected individual gives a conservative response (the "true conservative probability" to item $j$ in group $g$) is $\bar{\pi}_{gj}$.

$$Y_{gj} = \text{Binomial}\left(\bar{\pi}_{gj}, n_{gj}\right) \tag{2.15}$$

[3]Notation for Normal distributions will always describe the scale parameter in terms of standard deviation $\sigma$ instead of variance $\sigma^2$. This keeps the notation consistent with the way Normal distributions are expressed in Stan code.

The probability for each item-group is given a probit model from the spatial utility model.

$$\bar{\pi}_{gj} = \Phi\left(\frac{\theta_g - \kappa_j}{\sqrt{\sigma_g^2 + \sigma_j^2}}\right), \tag{2.16}$$

where $\sigma_g$ is the standard deviation of ideal points within group $g$, which is introduced because we are now estimating the mean response within a group rather than an individual item response. Larger values of $\sigma_g$ indicate more uncertainty over the item response and attenuate $\bar{\pi}_{gj}$ toward 50%.[4]

### 2.2.2 *Geographic Model for Group Means and Scales*

Estimates for $\theta_g$ and scales $\sigma_g$ are improved using a hierarchical model.

- Using geographic data to improve estimation
- Hierarchical model accounts for multiple sources of variation
- Partial pooling estimates for groups without as much data
- First, using traditional notation. Reparameterization in Section 2.2.6 greatly improves the estimation in Stan.

We consider it a draw a distribution with hypermean $\bar{\theta}_g$ and scalar standard deviation $\psi_\theta$

$$\theta_g \sim \left(\bar{\theta}_g, \psi_\theta\right) \tag{2.17}$$

The hierarchical setup improves estimates by casting the hypermean as a conditional mean from a regression on group data. We specify this regression using geographic-level data from the districts and states where each group is located:

$$\bar{\theta}_g = \beta_{0p[g]} + X_{d[g]}\beta_{p[g]} + \alpha_{s[g]p[g]}, \tag{2.18}$$

[4]The binomial setup assumes that each of the $n_{gj}$ trials is independent conditional on the mean ideal point $\theta_g$ and the item parameters $\kappa_j$ and $\sigma_j$. This assumption is violated if individuals in a group answer multiple items—errors are not independent across items. I describe a design-weighting correction for this assumption in Section 2.2.6.

where $\beta_0$ is a constant, $X_d$ represents district-level data with coefficients $\beta$, and $\alpha_s$ represents state effects. A key feature of the hierarchical model is that the parameters are indexed by $p$ and thus dependent on the party to which $g$ belongs. This means there are two constants $\beta_{0p}$ where $p \in \{1, 2\}$ indexes party. Group-level covariates $X_g$ have coefficient vectors $\beta_p$ that vary by party as well. We include this flexibility because geographic covariates (such as racial composition) may have different correlations with ideal points depending on the party. This is a departure from the model laid out by Caughey and Warshaw (2015), which holds the geographic regression fixed for all groups in the data.

We use a similar hierarchical regression for group scales (suppressing the $g$ subscript which is implied by the combination of $d$ and $p$).

$$\log\left(\sigma_g\right) \sim \text{Normal}\left(\delta_{0p} + X_d\delta_p + \eta_{sp}, \psi_\sigma\right), \tag{2.19}$$

where $\delta_{0p}$ represents constants for each party, $\delta_p$ is a party-specific vector of coefficients on district features, and $\eta_{sp}$ are party-specific state effects.

The state effects are in turn regressions on state features.

$$\alpha_{sp} \sim \text{Normal}\left(Z_s\gamma_p + \rho_{r[s]p}, \psi_\alpha\right), \tag{2.20}$$

$$\eta_{sp} \sim \text{Normal}\left(Z_s\zeta_p + \chi_{r[s]p}, \psi_\eta\right), \tag{2.21}$$

where $Z_s$ contains state covariates which have party-specific coefficients $\gamma_p$ (for group means) or $\zeta_p$ (for group scales). Each state effect is a function of a party-specific region effect $\rho_{rp}$ (for group means) and $\chi_{rp}$ (for group scales) for Census regions indexed $r$.

### 2.2.3 Weighting for Sample Design and Repeated Observations per Individual

### 2.2.4 Dynamic Model

### 2.2.5 Priors and Identification

### 2.2.6 Model Implementation in Stan

Hierarchical models often have posterior distributions whose curvature presents difficulties for sampling algorithms (Betancourt and Girolami 2015; Papaspiliopoulos, Roberts, and Sköld 2007). To improve the estimation in Stan, I parameterize the hierarchical models in the "non-centered" rather than the "centered" form. Whereas the centered form considers $\theta_g$ as a random draw from a distribution, the non-centered parameterization considers $\theta_g$ as a function of the hypermean and a random error.

$$\theta_g = \beta_{0p} + X_g\beta_p + \alpha_{s[g]} + z_g\varepsilon \tag{2.22}$$

where $z_g\varepsilon$ represents a group-level error term. It is composed of a $z$-score that is Normal $(0, 1)$ and a scale parameter $\varepsilon$. The non-centered paramaterization has the same algebraic behavior as the centered parameterization, but it has the practical effect of improving Monte Carlo sampling by de-correlating the parameters in the hierarchical model. We can also de-center the $\alpha_{s[g]}$ term

$$\alpha_{s[g]p} = Z_{s[g]}\gamma_p + u_{sp}\tau \tag{2.23}$$

where $u_{sp}$ is a $z$-score distributed Normal $(0, 1)$, and $\tau$ is a scale factor.

We also have a hierarchical model that predicts the ideal point standard deviation within each group, $\sigma_g$. This makes the model "heteroskedastic"—we are modeling the mean ideal point within each group and the variance, conditional on hierarchical covariates. The model for $\sigma_g$ in non-centered form is as follows:

$$\log(\sigma_g) = X_g\delta_p + Z_{s[g]}\eta_p + m_g\nu + m_{sp}\lambda \tag{2.24}$$

Where $X_g$ and $Z_{sp}$ are the same group- and state-level covariates as the above regression, $\delta_p$ and $\eta_p$ are party-varying coefficients. The terms $m_g \nu$ and $m_{sp}\lambda$ are "factored" error terms for groups and states, where $m_g$ and $m_{sp}$ are each distributed Normal $(0, 1)$, while $\nu$ and $\lambda$ are scale factors.

Factoring

*IRT Model*

*Noncentered Hierarchical Model*

*Any other vector/matrix tricks?*

*Read stan files into an appendix?*

## 2.3 Testing the Model with Simulated Data

Because the model is custom-built with `Stan`, it comes with no off-the-shelf quality assurances. To test the model's ability to estimate unknown parameters, I subjected the model to a number of tests during its development. These tests proceed by simulating data from a data generating process with known parameters, fitting the model to the simulated data, and comparing the posterior estimates against their known values. This section describes these simulations and presents their results.

The model is designed to estimate group-level parameters from an individual-level data generating process. As such, I begin by simulating individual-level item response data before aggregating the data to the group level for estimation. I simulate a universe containing 20 states nested within 5 regions, allocated so each region contains 4 states. Each state contains 5 districts containing voters belonging to 2 parties, totaling 200 groups across 100 districts in the whole "country." Data for each district-party group contain responses to 40 items that are answered by 50 unique individuals apiece. For simplicity, the simulation assumes that each individual answers only one question. When the model is implemented on real data, this assumption is relaxed by the weighting scheme laid out in Section 2.2.3.

Individual partisans respond to each item probabilistically according to the individual-level item response model originally laid out in Equation (2.13). The probability $\pi$ that individual $i$ gives a conservative answer to item $j$ is

$$\pi_{ij} = \Phi\left(\frac{\theta_i - \kappa_j}{\sigma_j}\right),$$

where $\Phi()$ is the cumulative normal distribution function of ideal point $\theta_i$, item midpoint $\kappa_j$, and item dispersion $\sigma_j$. Once individual responses are simulated, the number of conservative responses summed within each item-group and supplied to the group-level likelihood model.

Simulating these individual level responses requires that we supply hyperparameter values to ideal points $\theta_i$, cutpoints $\kappa_j$, and dispersions $\sigma_j$. Beginning with the item parameters, every cutpoint value is drawn a Normal distribution with mean 0 and standard deviation 0.3. Every dispersion parameter is defined as $\sigma_j = \beta_j^{-1}$, where $\beta_j$ is a LogNormal draw with mean 0 and standard deviation 0.35 on the log scale.

Individual ideal point parameters are Normal draws within their respective district-party groups ($\theta_i \sim \text{Normal}\left(\bar{\theta}_{g[i]}, \sigma_{g[i]}\right)$), where each group has a potentially unique mean and standard deviation. As described in Section 2.2.2, group means and standard deviations are generated from hierarchical models with parameters that vary across parties.

$$\theta_g = \beta_{0p} + \mathbf{x}_d^T \beta_p + \mathbf{z}_s^T \gamma_p + \varepsilon_{dp}^{\texttt{district}} + \varepsilon_{sp}^{\texttt{state}} + \varepsilon_{rp}^{\texttt{region}} \tag{2.25}$$

$$\log(\sigma)_g = \delta_{0p} + \mathbf{x}_d^T \delta_p + \mathbf{z}_s^T \zeta_p + \nu_{dp}^{\texttt{district}} + \nu_{sp}^{\texttt{state}} + \nu_{rp}^{\texttt{region}} \tag{2.26}$$

The hierarchical regression contains district data $\mathbf{x}$, consisting of two standard normal covariates, and state data $\mathbf{z}$, containing just one standard normal covariate. Subscripts index groups $g$, districts $d$, states $s$, and regions $r$.[5] To generate group means $\theta_g$, the constants $\beta_{0p}$ are explicitly set for each party $p$: $\beta_{0,p=1} = -1$ and $\beta_{0,p=2} = 1$. This implies that, on average, party 1 is liberal, and party 2 is conservative. District coefficients $\beta_p$ and state coefficients $\gamma_p$ are all simulated as Normal draws with mean 0 and standard deviation 0.25. The hierarchical model contains party-specific error terms for districts (mean 0, std. dev. 1), states (mean 0, std. dev. 0.1), and regions (mean 0, std. dev. 0.1). The setup is similar for the generation of group-level ideal point dispersion terms $\sigma_g$. The constants $\delta_{0p}$ are set to 0.125 for both parties, coefficients for districts ($\delta_p$) and states ($\zeta_p$) are both Normal draws with mean 0 and std. dev. 0.25, and there are separate mean-0 error terms for districts (sd 0.5), states (sd 0.1), and regions (sd 0.1).

It is important to note that many of the parameters in this simulation are not hand-selected but simulated from probability distributions. This is done to obscure the true values of these parameters, ensuring that prior distributions are specified without knowledge of true values. To stress-test the model, I use weakly informative prior distributions for each parameter that are intentionally set to be wider variance than the distributions that generate each parameter's true value.

more specific

I estimate the model by storing 10,000 samples for each parameter across 10 Markov chains, 1,000 iterations per chain. I warm up each chain for an initial 1,000 iterations before saving samples.

The data were simulated to stress-test the model in a few key ways.

- Priors are simulated

[5] To simplify notation, hierarchical structure notation left implicit in these equations. In long-form, regions contain states, which contain districts, which contain groups (i.e. $r[s[d[g]]]$).

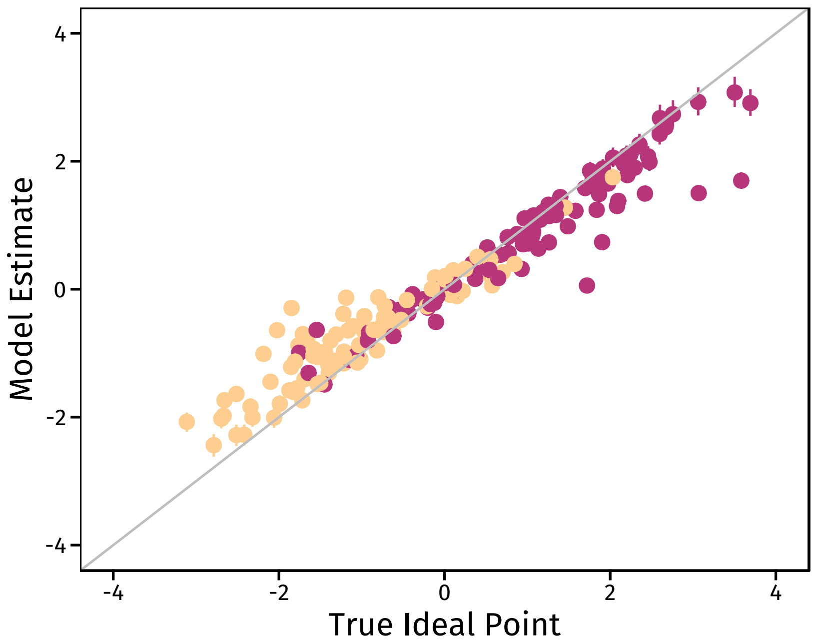


Figure 24: Testing the ideal point model on simulated data: estimated vs. "true" ideal points for district-party groups

## 2.4 Public Opinion Data

## 2.5 Model evaluation

### *2.5.1 Prior specificity*

Ratio of prior/posterior sd should exceed…what? 10 (Gelman)?

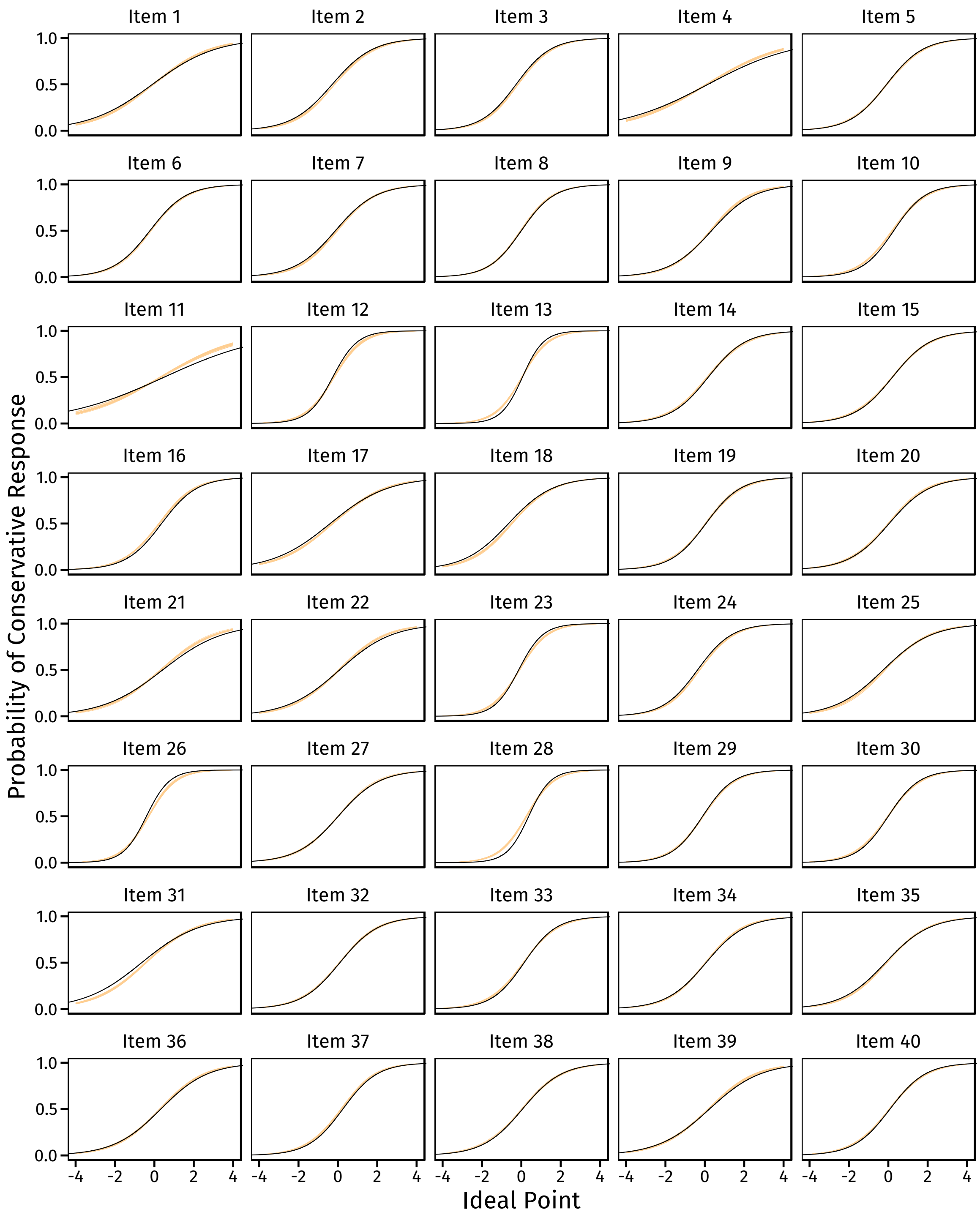


Figure 25: Testing the ideal point model on simulated data: item characteristic curves from estimated (yellow) and true (black) item parameters

Chapter Three

# *Candidate Positioning in Primary Elections*

U.S. House primary data from Pettigrew, Owen, and Wanless (2016).

## 3.1 Causality

DAGs

Controlled direct effect (ideology, holding fixed the vote in the district)

Chapter Four

# *The Constituency Decides: Preferences over Ideological Alternatives*

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Chapter Five

# *Redistricting and Ideological Representation*

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Appendix A

# *Group IRT Model*

Appendix B

# *Colophon*

This document was produced using `R`, R Markdown, LaTeX. The document was built using the `bookdown` package for `R`. The document template is a variation on TJ Mahr's `buckydown` template, which was itself an adaptation of documents designed by and for students at the Universities of Washington and Wisconsin. The PDF is typeset using pdfTeX. The body text is *MinionPro-LF* in 12pt size.

The data and source code for this dissertation have been organized into an online Git repository on Bitbucket. A hard copy of the thesis can be found in the University of Wisconsin library system.

- Git repository: https://bitbucket.org/mikedecrescenzo/dissertation
- `huskydown`: https://github.com/benmarwick/huskydown
- `bookdown`: https://github.com/rstudio/bookdown

This version of the thesis was generated on 2019-09-16 21:23:49. The repository is currently at this commit:

```
## Commit:  de703838d2565d984e5727d4407eabd9057a792c
## Author:  Michael DeCrescenzo <mgdecrescenzo@gmail.com>
## When:    2019-09-16 14:33:30
##
```

```
##      sim improvements (see comments)
##
##      - Box dir_ID variables
##      - save sim objects to Box
##      - slightly wider difficulty sd
##      - pre-identify discrimination params
##      - control adapt_delta and treedepth
##
## 2 files changed, 70 insertions, 27 deletions
## code/02-dgirt/22-sim/long-data-sim.R | -27 +68  in 13 hunks
## code/sscc/ssc-run.sh                 | - 0 + 2  in  1 hunk
```

# *References*

Abramowitz, Alan I, and Kyle L Saunders. 1998. “Ideological realignment in the us electorate.” *The Journal of Politics* 60(03): 634–652.

Aldrich, John H. 1983. “A downsian spatial model with party activism.” *American Political Science Review* 77(04): 974–990.

Aldrich, John H. 2011. *Why parties?: A second look*. University of Chicago Press.

American Political Science Association, Committee on Political Parties. 1950. *Toward a more responsible two-party system*. Johnson Reprint Company.

Ansolabehere, Stephen et al. 2010. “More democracy: The direct primary and competition in us elections.” *Studies in American Political Development* 24(02): 190–205.

Ansolabehere, Stephen, James M Snyder, and Charles Stewart. 2001. “Candidate positioning in u.s. House elections.” *American Journal of Political Science*: 136–159.

Bartels, Larry M. 2000. “Partisanship and voting behavior, 1952-1996.” *American Journal of Political Science*: 35–50.

Bartels, Larry M. 2009. *Unequal democracy: The political economy of the new gilded age*. Princeton University Press.

Betancourt, Michael, and Mark Girolami. 2015. "Hamiltonian monte carlo for hierarchical models." *Current trends in Bayesian methodology with applications* 79: 30.

Bonica, Adam. 2013. "Ideology and interests in the political marketplace." *American Journal of Political Science* 57(2): 294–311.

Bonica, Adam. 2014. "Mapping the ideological marketplace." *American Journal of Political Science* 58(2): 367–386.

Brady, David W, Hahrie Han, and Jeremy C Pope. 2007. "Primary elections and candidate ideology: Out of step with the primary electorate?" *Legislative Studies Quarterly* 32(1): 79–105.

Broockman, David E, and Christopher Skovron. 2018. "Bias in perceptions of public opinion among political elites." *American Political Science Review* 112(3): 542–563.

Burden, Barry C. 2004. "Candidate positioning in u.s. Congressional elections." *British Journal of Political Science* 34(02): 211–227.

Campbell, Angus et al. 1960. New York: John Wiley and Sons 77 *The american voter*.

Canes-Wrone, Brandice, David W Brady, and John F Cogan. 2002. "Out of step, out of office: Electoral accountability and house members' voting." *American Political Science Review* 96(01): 127–140.

Caughey, Devin, James Dunham, and Christopher Warshaw. 2018. "The ideological nationalization of partisan subconstituencies in the american states." *Public Choice* 176(1-2): 133–151.

Caughey, Devin, and Christopher Warshaw. 2015. "Dynamic estimation of latent opinion using a hierarchical group-level irt model." *Political Analysis* 23(2): 197–211.

Clinton, Joshua D. 2006. "Representation in congress: Constituents and roll calls in the 106th house." *Journal of Politics* 68(2): 397–409.

Clinton, Joshua, Simon Jackman, and Douglas Rivers. 2004. "The statistical analysis of roll call data." *American Political Science Review* 98(02): 355–370.

Cohen, Marty et al. 2009. *The party decides: Presidential nominations before and after reform*. University of Chicago Press.

Downs, Anthony. 1957. "An economic theory of democracy."

Fiorina, Morris P, Samuel J Abrams, and Jeremy C Pope. 2005. *Culture war? The myth of a polarized america*. Pearson Longman New York.

Fowler, Anthony, and Andrew B Hall. 2016. "The elusive quest for convergence." *Quarterly Journal of Political Science* 11: 131–149.

Fox, Jean-Paul. 2010. *Bayesian item response modeling: Theory and applications*. Springer Science & Business Media.

Geer, John G. 1988. "Assessing the representativeness of electorates in presidential primaries." *American Journal of Political Science*: 929–945.

Gilens, Martin. 2012. *Affluence and influence: Economic inequality and political power in america*. Russel Sage Foundation; Princeton University Press.

Green, Donald, Bradley Palmquist, and Eric Schickler. 2002. *Partisan hearts and minds*. New Haven, CT: Yale University Press.

Grossman, Matthew, and David A. Hopkins. 2016. Oxford University Press *Asymmetric politics: Ideological republicans and group interest democrats*.

Hall, Andrew B, and James M Snyder. 2015. "Candidate ideology and electoral success. Working paper: Https://dl. Dropboxusercontent.com/u/11481940/hall snyder ideology.pdf."

Hall, Andrew B, and Daniel M Thompson. 2018. "Who punishes extremist nominees? Candidate ideology and turning out the base in us elections." *American Political Science Review* 112(3): 509–524.

Hill, Seth J. 2015. "Institution of nomination and the policy ideology of primary electorates." *Quarterly Journal of Political Science* 10(4): 461–487.

Hirano, Shigeo et al. 2010. "Primary elections and party polarization." *Quarterly Journal of Political Science* 5: 169–191.

Kernell, Georgia. 2009. "Giving order to districts: Estimating voter distributions with national election returns." *Political Analysis* 17(3): 215–235.

Key, V.O. Jr. 1949. "Southern politics in state and nation."

Lax, Jeffrey R., and Justin H. Phillips. 2012. "The democratic deficit in the states." *American Journal of Political Science* 56(1).

Layman, Geoffrey C., and Thomas M. Carsey. 2002. "Party Polarization and "Conflict Extension" in the American Electorate." *American Journal of Political Science* 46(4): 786. http://www.jstor.org/stable/3088434?origin=crossref (Accessed February 22, 2015).

Levendusky, Matthew. 2009. *The partisan sort: How liberals became democrats and conservatives became republicans*. University of Chicago Press.

Londregan, John. 1999. "Estimating legislators' preferred points." *Political Analysis* 8(1): 35–56.

Masket, Seth. 2009. *No middle ground: How informal party organizations control nominations and polarize legislatures*. University of Michigan Press.

McGhee, Eric et al. 2014. "A primary cause of partisanship? Nomination systems and legislator ideology." *American Journal of Political Science* 58(2): 337–351.

Norrander, Barbara. 1989. "Ideological representativeness of presidential primary voters." *American Journal of Political Science*: 570–587.

Papaspiliopoulos, Omiros, Gareth O Roberts, and Martin Sköld. 2007. "A general framework for the parametrization of hierarchical models." *Statistical Science*: 59–73.

Petrocik, John Richard. 2009. "Measuring party support: Leaners are not independents." *Electoral Studies* 28(4): 562–572. http://linkinghub.elsevier.com/retrieve/pii/S0261379409000511 (Accessed April 16, 2015).

Pettigrew, Stephen, Karen Owen, and Emily Wanless. 2016. "U.S. House primary election results (1956-2010)." https://doi.org/10.7910/DVN/26448.

Poole, Keith T. 2005. *Spatial models of parliamentary voting*. Cambridge University Press.

Poole, Keith T, and Howard Rosenthal. 1997. "Congress: A political-economic history of roll call voting." *New York: Oxford University Press*.

Rahn, Wendy M. 1993. "The role of partisan stereotypes in information processing about political candidates." *American Journal of Political Science*: 472–496.

Rogowski, Jon C. 2016. "Voter decision-making with polarized choices." *British Journal of Political Science*: 1–22. https://doi.org/10.1017%2Fs0007123415000630.

Rogowski, Jon C, and Stephanie Langella. 2015. "Primary systems and candidate ideology: Evidence from federal and state legislative elections." *American Politics Research* 43(5): 846–871.

Tausanovitch, Chris, and Christopher Warshaw. 2013. "Measuring constituent policy preferences in congress, state legislatures, and cities." *The Journal of Politics* 75(02): 330–342.