Ideal Point Estimation

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Introduction

Political scientists have used ideal point estimation primarily to operationalize spatial models of politics, which requires measuring the preferences of actors within a conceptual latent space. The concept of ideal point estimation integrates theoretical ideas from spatial models in economics and political science with measurement theory from psychometrics. Theoretically, the core idea is that a low-dimensional latent preference structure explains behavioral choices and judgments of stimuli. Empirically, the aim is to estimate models of the latent spatial properties of data that can predict an observed set of choice and response data.

A central concern of ideal point estimation work in political science has been the generation of meaningful measures of the intervals between the coordinates of actors and the stimuli to which they respond. The major focus of modern Ideal point estimation work has thus been on establishing empirical spatial models with a theoretical basis for the estimated locations of actors for use in empirical studies requiring continuous latent measures of preferences.

The early development of this work began as part of the study of legislative voting, chiefly among members of the US Congress. This work then extended to other legislative and judicial voting environments, and eventually to a wide array of different political choice behavior that can be understood through the lens of the spatial models, from speech to social media activity. Meanwhile, related approaches have long been applied to survey data with sophisticated methods to generate measures of actors' latent preferences, including from multiple data sources. Numerous applications have emerged in the last several decades and continue to grow rapidly, producing an array of measurement techniques related to ideal point estimation applied to numerous topics in political science, especially political ideology.

The following bibliography is limited mainly to work focused on or contributing to the literature on the measurement of ideal points. Nevertheless, several applications of ideal point estimation are included due to their influence on ideal point measurement.

Spatial Models of Voting Behavior

Numerous studies have attempted to analyze elite voting behavior in settings such as legislatures and courts. Beginning with MacRae's 1958 work on US congressional voting, numerous innovations on these approaches have emerged to study the structure and dynamics of legislative voting and judicial decisions, as well as various historical legislative contexts, legislatures outside the United States, and international bodies. In particular, this literature heavily influenced topics such as polarization in the US Congress. Interpreting legislative and judicial voting environments led to some of the most important innovations in ideal point estimation, such as the influential NOMINATE method (Poole and Rosenthal, 1985, 1997), numerous methods based on item response theory and estimation via Bayesian simulations (e.g., Martin and Quinn 2002; Jackman et al. 2004), as well as nonparametric methods such as Optimal Classification (Poole, 2000).

MacRae, Duncan, Jr. 1958. Dimensions of congressional voting: A statistical study of the House of Representatives in the Eighty-first Congress, Berkeley: University of California Press

A path-breaking study applying methods to understand latent patterns of dimensionality to the US Congress.

Herbert F. Weisberg. "Scaling Models for Legislative Roll-Call Analysis." *The American Political Science Review*, vol. 66, no. 4, 1972, pp. 1306–15.

An important piece in the development of spatial models of voting, Weisberg uses a variation of the unfolding model, the proximity model, for scaling legislative roll-call votes and contrasts this with the then widely used Guttman scale model.

Poole, K.T. and Rosenthal, H., 1985. A spatial model for legislative roll call analysis. *American Journal of Political Science*, pp.357-384.

Poole and Rosenthal introduce the NOMINATE method for estimating coordinates from observed roll call data, using a probabilistic model and a spatial utility function.

Introduces the NOMINATE program for one-dimensional analysis with application to roll call voting data for the U.S. House and Senate.

Poole, K.T., 2000. Nonparametric unfolding of binary choice data. *Political Analysis*, *8*(3), pp.211-237.

Introduces the optimal classification method of nonparametric unfolding for binary data based on maximizing the correct classification of votes via a series of cutting planes.

Heckman JJ, Snyder JM. Linear Probability Models of the Demand for Attributes with an Empirical Application to Estimating the Preferences of Legislators. Rand J Econ. 1997;28: S142–S189.

Presents a linear probability model for ideal point estimation for binary data.

Londregan J. Estimating Legislator's Preferred Points. Polit Anal. 2000;8: 35–56.

Shows that standard maximum-likelihood estimators result in biased estimates unless the number of choices and individuals is large and proposes a random-effects approach.

Lewis, Jeffrey B., and Keith T. Poole. "Measuring bias and uncertainty in ideal point estimates via the parametric bootstrap." *Political Analysis* 12.2 (2004): 105-127.

Introduces an uncertainty measure for the W-NOMINATE model via parametric bootstrap.

Lauderdale, Benjamin E. "Unpredictable voters in ideal point estimation." *Political Analysis* 18.2 (2010): 151-171.

Introduces a Bayesian ideal point estimation method based on a heteroskedastic estimator that obtains parameters that capture the degree to which data are not explained by the main dimensions of variance.

Rosenthal H, Voeten E. Analyzing Roll Calls with Perfect Spatial Voting: France 1946-1958. Am J Pol Sci. 2004;48: 620–632.

An application of Poole's 2000 optimal classification method to data from the French Fourth Republic and an overview of the advantages over parametric methods in the context of perfect spatial voting.

Jackman S. Multidimensional Analysis of Roll Call Data via Bayesian Simulation: Identification, Estimation, Inference, and Model Checking. Polit Anal. 2001;9: 227–241.

Discusses the importance of Bayesian methods for incorporating prior restrictions on vote parameters to assess dimensionality and understand the substantive content of the dimensions.

Clinton J, Jackman S, Rivers D. The statistical analysis of roll call data. Am Polit Sci Rev. 2004;98: 355–370.

Develops a Bayesian IRT model for ideal point estimation for roll call data. This model has been widely used because of its flexibility in using its parameters to account for various political contexts and for integrating the measurement of ideal points with applications in legislative studies.

Bafumi J, Gelman A, Park DK, Kaplan N. Practical Issues in Implementing and Understanding Bayesian Ideal Point Estimation. Polit Anal. 2005;13: 171–187.

Proposes approaches to improving inferences in Bayesian ideal point estimation, such as hierarchical modeling and linear transformations.

Carroll R, Lewis JB, Lo J, Poole KT, Rosenthal H. Comparing NOMINATE and IDEAL: Points of difference and Monte Carlo tests. Legislative Studies Quarterly. 2009;34: 555–591.

Compares the NOMINATE to the Clinton Jackman and Rivers 2004 model for ideal point estimation, with particular focus on how the assumptions of the models and computational methods vary in simulation data.

Rosas G, Shomer Y, Haptonstahl SR. No News Is News: Nonignorable Nonresponse in Roll-Call Data Analysis. Am J Pol Sci. 2015;59: 511–528.

Introduce an estimator modeling nonresponse along with vote choice.

Peress M. Small Chamber Ideal Point Estimation. Polit Anal. 2009

Proposes an estimator intended for cases of small numbers of voters.

Carroll R, Lewis JB, Lo J, Poole KT, Rosenthal H. The Structure of Utility in Spatial Models of Voting. Am J Pol Sci. 2013;57: 1008–1028.

Introduces the alpha-NOMANATE Bayesian ideal point estimation model in which utility functions are a mixture of the quadratic and Gaussian functions.

Ideal point estimation using other behavioral data

Although voting data in legislatures, courts, and other bodies formed the first wave of applications motivating ideal point estimation work, adapting ideal point estimation techniques to other forms of observed behavior data has been a fruitful area of research. This is particularly important because of the considerable limitations of legislative voting data for understanding elite preferences, given the lack of appropriate data in many contexts. The intuition of underlying latent space explaining observed behavior data has accordingly been applied to various alternative sources of data, such as speech (e.g., Slapin and Proksch 2009) and other parliamentary activities (e.g., Kellermann 2012). Meanwhile, data such as interactions on social media have been used for both mass and elite preference generation (e.g., Barbera 2015).

Poole KT. Dimensions of Interest Group Evaluation of the U.S. Senate, 1969-1978. Am J Pol Sci. 1981;25: 49–67.

Applies multidimensional unfolding to interest group ratings of members of the U.S. Senate to identify coordinates for senators and interest groups.

Barberá P. Birds of the Same Feather Tweet Together: Bayesian Ideal Point Estimation Using Twitter Data. Polit Anal. 2015;23: 76–91.

Introduces a Bayesian spatial model to use the following activity on the social media platform Twitter to infer the preferences of elite actors and users.

Bond R, Messing S. Quantifying Social Media’s Political Space: Estimating Ideology from Publicly Revealed Preferences on Facebook. Am Polit Sci Rev. 2015;109: 62–78.

Introduces a scaling method for obtaining ideal point estimates using data from the Facebook social media platform.

Slapin JB, Proksch S-O. A scaling model for estimating time-series party positions from texts. Am J Pol Sci. 2008;52: 705–722.

Introduces the WORDFISH scaling method for estimating ideal points based on latent patterns from word frequencies in text data.

Alemán E, Calvo E, Jones MP, Kaplan N. Comparing Cosponsorship and Roll-Call Ideal Points. Legislative Studies Quarterly. 2009;34: 87–116.

Uses bill cosponsorship data from the U.S. House of Representatives and the Argentine Chamber of Deputies to estimate ideal points.

Bonica A. Mapping the ideological marketplace. Am J Pol Sci. 2014;58: 367–386.

Introduces a negative binomial IRT model for campaign donation data capable of measuring candidate and donor ideology. The approach provides a means of comparing both candidates and incumbents in various contexts in the US system.

Kellermann M. Estimating Ideal Points in the British House of Commons Using Early Day Motions. Am J Pol Sci. 2012;56: 757–771.

Because of the inability to generate meaningful individual preferences from voting data in the UK Parliament, this article estimates MP preferences using early-day motions.

Ideal point estimation for survey analysis

Scaling approaches have long been used for survey analysis, and while much of the political science literature on spatial models is based on observed behavior, the field has increasingly focused on adapting ideal point estimation frameworks to survey data applications. A particular focus of this literature is analyzing data from ordinal issue scales (e.g., left-right or policy placements of respondents, politicians, or parties) which are survey items especially suited to interpretation via empirical spatial models. A related area is the use of scaling methods as a means to address comparability challenges within and between surveys.

Poole KT. Recovering a basic space from a set of issue scales. Am J Pol Sci. 1998; 954–993.

Introduces the Blackbox scaling method for directly analyzing a matrix of issue scale data to estimate stimuli and respondent locations in a latent space, in multiple dimensions, and in the presence of missing data.

Tausanovitch C, Warshaw C. Measuring constituent policy preferences in Congress, state legislatures, and cities. J Polit. 2013;75: 330–342.

Conducts a joint scaling of a large amount of survey data to establish citizen policy preference measures at the level of congressional districts, state legislative districts, and local municipalities.

Aldrich JH, McKelvey RD. A Method of Scaling with Applications to the 1968 and 1972 Presidential Elections. Am Polit Sci Rev. 1977; 111–130.

Introduce an influential measure to use survey data to estimate locations of stimuli such as political candidates and ideal points of survey respondents in a comparable space using respondents' placement of stimuli positions as linear distortions of the true locations.

Hare C, Armstrong DA, Bakker R, Carroll R, Poole KT. Using Bayesian Aldrich-McKelvey Scaling to Study Citizens' Ideological Preferences and Perceptions. Am J Pol Sci. 2015.

A Bayesian adaptation of the Aldrich-McKelvey scaling method for correcting for some forms of differential item functioning in estimating the positions of political stimuli and survey respondents from issue scale data, particularly for contexts with missing data, such as bridging surveys.

Barber, Michael J. 2016. "Representing the Preferences of Donors, Partisans, and Voters in the US Senate." Public Opinion Quarterly 80:225–249.

Estimates comparable ideological preferences for donors, senators, and constituents using surveys of voters and campaign contributors, emphasizing the Senator's alignment with the latter.

Bonica, Adam and Michael J. Woodruff. 2014. A Common-Space Measure of State Supreme Court Ideology. The Journal of Law, Economics, and Organization.

Uses campaign finance data to generate ideal points for nine state supreme courts in a common space via an IRT model.

Hare C, Liu T-P, Lupton RN. What Ordered Optimal Classification reveals about ideological structure, cleavages, and polarization in the American mass public. Public Choice. 2018;176: 57–78.

Extends Poole's 2000 optimal classification model to ordinal data for applications to scales in survey data.

Estimating Comparable Preferences with Dynamic Models and Bridging methods

In addition to the core literature on ideal point models themselves, considerable emphasis has been placed on various ways in which comparable ideal point estimates can be generated based on data from different sources, typically across time (e.g., between time periods in a legislature or court) or across sets of actors (e.g., between two or more legislatures, between different sets of survey respondents). In some cases, the aim is to establish a link between the preferences of mass and elite actors, sometimes by combining survey and behavior data into the same models.

Poole, K.T. and Rosenthal, H., 1997. *Congress: A political-economic history of roll call voting*. Oxford University Press.

Use a dynamic version of the NOMINATE method (D-NOMINATE), which produces comparable ideal points across time by using overlapping continuing members to examine the temporal patterns of roll call voting in the US.

McCarty, Nolan M., Keith T. Poole and Howard Rosenthal. 1997. Income Redistribution and the Realignment of American Politics. AEI Studies on Understanding Economic Inequality Washington, DC: AEI Press.

Introduces the widely used DW-NOMINATE estimation approach for dynamic estimation of ideal points from voting data, differing from D-NOMINATE (Poole and Rosenthal 1997) in its error assumptions and use of a salience weight.

Martin, Andrew D., and Kevin M. Quinn. "Dynamic ideal point estimation via Markov chain Monte Carlo for the US Supreme Court, 1953–1999." *Political analysis* 10.2 (2002): 134-153.

Develops a measure of comparable policy preferences of US Supreme Court justices across time using a dynamic Bayesian ideal point model aimed at measuring the change in justice preferences.

Bailey MA, Strezhnev A, Voeten E. Estimating Dynamic State Preferences from United Nations Voting Data. J Conflict Resolut. 2017;61: 430–456.

Uses an ordinal spatial model to estimate state ideal points in the UNGA across time using the content of the UN's agenda as a bridging method to make comparable estimates.

Shor B, McCarty N. The Ideological Mapping of American Legislatures. Am Polit Sci Rev. 2011;105: 530–551.

Makes use of data from a survey of state legislative candidates to generate comparable ideal points for members of US State legislatures and the US Congress.

Bafumi J, Herron MC. Leapfrog representation and extremism: A study of American voters and their members in Congress. Am Polit Sci Rev. 2010;104: 519–542.

Combines mass survey and legislative voting data to generate comparable mass and elite preference measures for the US Congress, showing that members are more extreme than voters.

Lewis JB. Estimating Voter Preference Distributions from Individual-Level Voting Data. Polit Anal. 2001;9: 275–297.

Proposes a method for using individual-level voting data to measure the distribution of voter ideal points.

Jackman S. Multidimensional Analysis of Roll Call Data via Bayesian Simulation: Identification, Estimation, Inference, and Model Checking. Polit Anal. 2001;9: 227–241.

Emphasizes the value of Bayesian methods in enabling the use of vote-specific parameters in higher-dimensional ideal point estimation to help identify the model and incorporate prior beliefs about dimensions.

Bailey MA. Comparable Preference Estimates across Time and Institutions for the Court, Congress, and Presidency. Am J Pol Sci. 2007;51: 433–448.

Generates comparable ideal point estimates for US Presidents, Supreme Court Justices, and both houses of Congress using bridged observations.

Epstein L, Martin AD, Segal JA, Westerland C. The Judicial Common Space. Journal of Law, Economics, & Organization. 2007;23: 303–325.

Generates comparable ideal point estimates for the US federal judiciary, using a transformation method and nominations information.

Jessee S. (how) can we estimate the ideology of citizens and political elites on the same scale? Am J Pol Sci. 2016;60: 1108–1124.

Explores issues with ideal point estimates based on joint scaling of citizens and elites and proposes solutions to improve the validity of these estimates.

Recent innovations

The last several years have produced important refinements to ideal point estimation methods for political applications. This work has the potential to open up new avenues of analysis by overcoming the weaknesses of standard methods of ideal point estimation or by including additional features that may lead to wider applicability. This list focuses on several within the field of political science.

Imai K, Lo J, Olmsted J. Fast estimation of ideal points with massive data. Am Polit Sci Rev. 2016;110: 631–656.

Introduces an approach to estimate ideal point models using the expectation-maximization algorithm to substantially improve the computational efficiency of Bayesian ideal point estimation to enable application to much larger data sources.

Moser S, Rodríguez A, Lofland CL. Multiple Ideal Points: Revealed Preferences in Different Domains. Polit Anal. 2021;29: 139–166.

Develop an ideal point estimation in which voter preferences are allowed to differ by policy domain.

Peress, Michael. “Large-Scale Ideal Point Estimation.” *Political Analysis* 30 (2021): 346 - 363.

Develops a methodology for efficiently estimating multidimensional ideal points for computationally intensive large-scale applications.

Goplerud M. A Multinomial Framework for Ideal Point Estimation. Polit Anal. 2019;27: 69–89.

Introduces a multinomial Bayesian ideal point estimation method that generalizes and unifies various common models and incorporates multiple estimation methods.

Tahk A. Nonparametric Ideal-Point Estimation and Inference. Polit Anal. 2018;26: 131–146.

Introduces a nonparametric approach to ideal point estimation that allows for formal hypothesis tests.

Kim IS, Londregan J, Ratkovic M. Estimating Spatial Preferences from Votes and Text. Polit Anal. 2018;26: 210–229.

Introduces a model to jointly estimate votes and speech with a sparse Gaussian copula factor model.

Overviews of the topic

The following publications include chapters from edited volumes and two books that provide an overview of the concepts behind ideal point estimation from a political science perspective and discussions of common applications.

Hare C, Poole KT. Psychometric methods in political science. The Wiley Handbook of Psychometric Testing. Chichester, UK: John Wiley & Sons, Ltd; 2018. pp. 901–931.

Traces the influence of psychometric methods on political science with an overview of common methods.

Treier, S. Bayesian ideal point estimation. The SAGE handbook of research methods in political science and international relations, 2, 910-936. 2020

Presents an overview of Bayesian forms of ideal point estimation.

McCarty N. Measuring Legislative Preferences. Oxford University Press; 2011.

Provides an accessible overview of ideal point estimation literature focused on legislative voting, with a focus on differences among methods and from interest group ratings.

Poole KT. Spatial Models of Parliamentary Voting. Cambridge University Press; 2005.

Poole presents a broad overview of the concepts behind scaling methods intended to provide ideal point models for legislative voting data. The book is particularly valuable for its detailed discussion of the intuition behind the NOMINATE and Optimal Classification methods.

Armstrong DA, Bakker R, Carroll R, Hare C, Poole KT. Analyzing spatial models of choice and judgment. 2020.

This book provides an applied overview of ideal point estimation methods in political science, with a focus on those based on empirical spatial models, including various data structures and Bayesian methods. The book focuses on applications implemented in the R statistical software.

Statistical software packages

Below are several packages with functions for ideal point estimation associated with political science applications for the R statistical software environment that are distributed via the Comprehensive R Archive Network (CRAN). In addition to this list, numerous other packages are distributed outside this repository, including most of the latest innovations and models for specialized purposes.

Mair P, Groenen PJF, de Leeuw J. More on Multidimensional Scaling and Unfolding in R: smacof Version 2. J Stat Softw. 2022;102: 1–47.

The smacof package contains several R functions for multidimensional scaling and unfolding based on stress minimization using majorization.

Poole KT, Lewis JB, Rosenthal H, Lo J, Carroll Royce. Recovering a basic space from issue scales in R. Journal of Statistical Software. 2016.

Implements the Blackbox scaling method (Poole 1998) in R

Poole K, Lewis JB, Lo J, Carroll R. Scaling Roll Call Votes with wnominate in R. J Stat Software 2011;42: 1–21.

Implements the W-NOMINATE scaling (Poole and Rosenthal 1985) method in R

Poole K, Lewis JB, Lo J, Carroll R. "Package 'oc'." (2020).

Implements the Optimal Classification scaling method (Poole 2000) in R

Carroll, R., Hare, C., Lewis, J. B., Lo, J., Poole, K. T., & Rosenthal, H. (2017). Alpha-NOMINATE: Ideal point estimator.

Implements the Bayesian alpha-NOMINATE scaling method (Carroll et al. 2013) in R.

Kubinec, Robert, Jonah Gabry, Ben Goodrich, and Maintainer Robert Kubinec. "Package 'idealstan'." (2019).

A package for Bayesian ideal point estimation using the STAN software within R.

Jackman, Simon, Alex Tahk, Achim Zeileis, Christina Maimone, Jim Fearon, Zoe Meers, Maintainer Simon Jackman, and M. A. S. S. Imports. "Package 'pscl'." *Political Science Computational Laboratory* 18, no. 04.2017 (2015).

A package including the 'ideal' function for Bayesian ideal point estimation in R (Clinton Jackman and Rivers 2004) and functions to organize roll call datasets for analysis

Imai, Kosuke, James Lo, Jonathan Olmsted, and Maintainer James Lo. "Package 'emIRT'." (2015).

Implements the expectation maximization algorithm (Imai et al. 2016) for estimation of several widely-used IRT models in R.

Martin, Andrew D., Kevin M. Quinn, Jong Hee Park, and Maintainer Jong Hee Park. "Package 'MCMCpack'." (2022): 64-67

Contains a range of R functions for Bayesian statistical applications, with several designed for ideal point estimation.

Benoit, K., Watanabe, K., Wang, H., Nulty, P., Obeng, A., Müller, S., & Matsuo, A. (2018). quanteda: An R package for the quantitative analysis of textual data. *Journal of Open Source Software*, *3*(30), 774.

Along with many functions for text analysis, this pacakge includes functions to apply the Wordfish scaling method (Slapin and Proksch 2008) for text data in R.

Zhou X. Hierarchical Item Response Models for Analyzing Public Opinion. Polit Anal. 2019;27: 481–502.

Introduces an R package for hierarchical item response models for survey analysis.