

SCALING AND DIMENSIONAL ANALYSIS IN POLITICAL SCIENCE

Dimensional perspectives are common in thinking about politics. This course covers the methodology of dimensional analysis -- the scaling techniques and their philosophical implications. The dimensional approach is based in geometry, so visual displays will be emphasized. Theoretical perspectives on methods, scaling, and dimensions will also be presented. The methods presented are a variety of techniques for scaling, broadly defined, including unfolding analysis, proximity scaling, Guttman scaling, cluster analysis, factor analysis, and multidimensional scaling. These methods provide means for:

- data reduction (reducing a large number of variables into a smaller set of composites),
- examining dimensionality (representing the data in terms of the smallest possible number of unobserved underlying factors), and
- measurement (scoring cases on the underlying dimensions and using those scores in further analysis).

The Course:

The course will be presented as a "module" is part of an on-going program of graduate Instruction in Advanced Quantitative Analysis by the Departments of Political Science on four CIC campuses (Illinois, Michigan, Ohio State, and Wisconsin) using interactive video and WebCT.

Approach:

The basic theory of each technique covered will be presented in class. Computer output for the techniques will be distributed and will be explained in detail, after which students will be expected to run the programs themselves and interpret the output. Readings will include both methodological presentations and substantive examples.

Mathematical Level:

Most techniques covered in this course require only simple algebraic manipulations and geometric insights. Familiarity with matrix algebra will be useful for factor analysis.

Requirements:

- 1) Students will be expected to use relevant computer programs and interpret the results.
- 2) A report (5 pages) on an article in your substantive field that uses the techniques treated in this class. **Due:** October 27.
- 3) A term paper analyzing a set of data of your choosing from a dimensional perspective, using whichever techniques are most appropriate. The best papers are generally those which use multiple dimensional techniques on the same data and compare the results. **Due:** November 17.
- 4) A takehome final exam will be given. **Due:** December 1 at noon.

Incompletes are strongly discouraged.

Audits:

Audits for OSU only under special students will be permitted only under special circumstances -- see the instructor for permission. Audit cards will be signed at the end of the term only for OSU students who audit the entire course and who fulfill at least one of the four course requirements listed above.

Texts:

No single textbook covers all of the topics in this course. The full-length books which have been written on these topics are generally out-of-print, partially out-of-date, very expensive, and/or overly mathematical. As a result, several paperbacks will be used in this course as text-substitutes:

- Abbott, Flatland (or Burger, Sphereland)
- Several Sage monographs on scaling:
 - Jacoby, Data Theory and Dimensional Analysis (Sage #78)
 - McIver & Carmines, Unidimensional Scaling (#24)
 - Kruskal & Wish, Multidimensional Scaling (#11)
 - Kim & Mueller, Introduction to Factor Analysis (#13)
 - Kim & Mueller, Factor Analysis (#14)
 - Long, Confirmatory Factor Analysis (#33)
 - Aldenderfer & Blashfield, Cluster Analysis (#44)

Assignment:

Read Flatland (or Sphereland) as soon as it becomes available. We will discuss it in class early in the term. These are unusual books about dimensional thinking. Their allegorical style is useful in achieving an understanding of dimensional spaces. Unfortunately Flatland is written in a sexist style that tells much about the intellectual society of its era.

Computer Programs: There are several scaling procedures in SPSS, SAS, and SYSTAT:

SPSS will be used for the basic analysis in class. You can use whichever package you prefer, but be very careful that it makes sense to analyze the matrix you are analyzing.

Confirmatory factor analysis can be performed through LISREL, AMOS, and several other computer programs. (SPSS included LISREL in some of its earlier versions, but does not currently include it.) LISREL will be used for the basic analysis in class, but you can use whichever program is available for your use.

Course Topics:

The logical order of topics in this course is to start with an elaborate presentation of data theory, move to scaling models with an emphasis on unidimensional procedures such as Guttman scaling, and then turn to scaling methods with a focus on factor analysis and multidimensional scaling. However, multidimensional scaling and factor analysis are the two most important techniques to cover in the course, and it is important to cover them early and with sufficient time. As a result, the course module will focus mainly on scaling methods.

The first day will introduce dimensional perspectives, present data theory, and then briefly summarize unidimensional techniques such as Guttman scaling and unfolding analysis. That will be a prelude to major treatment of multidimensional scaling and briefer treatment of cluster analysis. Factor analysis will be the final major topic, with comparisons at the end to multidimensional scaling. (The syllabus lists several related techniques as "extensions" and provides readings on them that would be useful if you ever need to use those methods.) Several of the methods will be presented one week, with time in the first hour the following week to go through them again after you've used them on the computer.

READING ASSIGNMENTS

The syllabus includes a comprehensive listing of the relevant research literature, including examples and references. The readings marked with asterisks are most essential. The short version of the reading assignments below gives the most useful readings. As to the readings listed for the first day, go through Flatland and Dimensionland and chapters 1, 3, 4, and 7 of the Jacoby Sage manuscript, and if you have more time, go through part of the McIver & Carmines Sage monograph. Also, try to read some of the examples cited throughout the syllabus, so that you see how the techniques are actually used in political science research. The references in the syllabus give some of the original presentations of the techniques as well as more recent textbook treatments; these should be useful if you need to delve further into a technique for your own research.

September 29: Data Theory and Unidimensional Scaling

*Dimensionality: Abbott, Flatland (or Burger, Sphereland)

Data Theory: Jacoby, Data Theory and Dimensional Analysis, chaps. *1, 2, *3, *4, *7 (skim 5).

Guttman Scaling: McIver & Carmines, Unidimensional Scaling, pp. 40-71.

Proximity Scaling: Weisberg, "Scaling Models for Legislative Roll-Call Analysis," APSR, December 1972, 1306-15.

Unfolding Analysis: McIver & Carmines, Unidimensional Scaling, pp. 71-89.

*Unidimensional Scaling: Weisberg, "Dimensionland," AJPS, 1974, 743-65, 774-76.

October 6: Multidimensional Scaling (continued first hour of Oct. 13)

*J. Kruskal & Wish, Multidimensional Scaling, pp. 7-60, 73-92.

Rabinowitz, "Nonmetric Multidimensional Scaling and Individual Difference Scaling" in Berry and Lewis-Beck, New Tools for Social Sciences, chap. 4, pp. 77-107.

October 13: Cluster Analysis (continued first hour of Oct. 20)

*Aldenderfer & Blashfield, Cluster Analysis.

October 20: Component and Factor Analysis (continued Oct. 27)

*Kim & Mueller, Introduction to Factor Analysis.

*Kim & Mueller, Factor Analysis, pp. 7-29, 41-78.

Wickens, Thomas D. (1995) The Geometry of Multivariate Statistics, Erlbaum, chap. 9.

October 27: Continuation of Factor Analysis

No new reading

November 3: Factor Rotation and Confirmatory Analysis

*Factor Rotation: Kim & Mueller, Factor Analysis, pp. 29-41.

*Confirmatory Analysis: Long, Confirmatory Factor Analysis.

November 10

No class (Veteran's Day Observed)

November 17: Hour 1: Factor Analysis (continued)

November 17: Hour 2: Methods Comparison

*Weisberg, "Dimensionland," AJPS, 766-74.

Davison, Multidimensional Scaling, chapter 9.

CLASS SCHEDULE AND RESEARCH LITERATURE □

Sept. 29: Introduction

Hour 1: Data Theory

Readings:

Jacoby, "Dimensional Analysis in Political Science," The Political Methodologist, Fall 1990.

Jacoby, Data Theory and Dimensional Analysis, chaps. *1, 2, *4, *7 (skim 5).

References:

Hensler & Stipak, "Estimating Interval Scale Values for Survey Item Response Categories," AJPS, August 1979, 627-49.

Lodge & Tursky, "Comparisons between Category and Magnitude Scaling of Political Opinion Employing SRC/CPS Items," APSR, March 1979, 50-66.

Brady, "The Perils of Survey Research: Inter-Personally Incomparable Responses," Political Methodology, 1985, 269-91.

Brady & Ansolabehere, "The Nature of Utility Functions in Mass Publics," APSR, March 1989, 143-63.

Hour 2: Unidimensional Scaling

Guttman Scaling

Readings:

*McIver & Carmines, Unidimensional Scaling, pp. 40-71.

References:

Zwick, "Some Properties of the Correlation Matrix of Dichotomous Guttman Items," Psychometrika, 1987, 515-20.

Maranell (ed.), Scaling, chapters 12-18.

Coombs, A Theory of Data, chapters 10-11.

Torgerson, Theory and Methods of Scaling, chapters 12-13.

MacRae, Issues and Parties in Legislative Voting, chapter 2.

Gorden, Raymond L. (1977) Unidimensional Scaling of Social Variables: Concepts and Procedures.

van der Ven, A. H. G. S. (1980) Introduction to Scaling.

Proximity Scaling

Examples:

Weisberg, "Scaling Models for Legislative Roll-Call Analysis," APSR, December 1972, 1306-15.

Baum, "Policy Goals in Judicial Gatekeeping," AJPS, 1977, 13-35.

Wood & Jacoby, "Interparty Cleavage in the British House of Commons," AJPS, Feb. 1984, 203-23.

References:

Coombs, A Theory of Data, chapters 14-15.

Unfolding Analysis

Readings:

*McIver & Carmines, Unidimensional Scaling, pp. 71-89.

Examples:

Butler & Stokes, Political Change in Britain, pp. 200-05 (unabridged ed.).

Norpoth, "The Parties Come to Order!" APSR, 1979, 724-36.

Jacoby, "Unfolding the Party Identification Scale," Political Methodology, 1982, 33-59.

References:

Coombs, A Theory of Data, chapters 5.0-5.6, 9.1, 18.

Poole, "Least Squares Metric, Unidimensional Unfolding," Psychometrika, 1984, 311-23.

Poole, "Least Squares Scaling of Multivariate Linear Models," Psychometrika, 1990, 123-49

van der Ven, A. H. G. S. (1980) Introduction to Scaling. Wiley.

Unidimensional Scaling

Readings:

*Weisberg, "Dimensionland," AJPS, 1974, 743-65, 774-76.

*Jacoby, Data Theory and Dimensional Analysis, chapters 3 and 7 (and skim 5).

References:

Coombs, Dawes, & Tversky, Mathematical Psychology, pp. 31-38.

Scott, "Attitude Measurement," in Lindzey & Aronson (eds.), The Handbook of Social Psychology, 2nd. ed., Vol. II, chapter 11.

Wolters, "Models of Roll Call Behavior," Political Methodology, 1978, 7-54.

Extensions: Multi-Category and Probabilistic Variants of Guttman Scaling

Examples: Jacoby, "Variability in Issue Alternatives and American Public Opinion," Journal of Politics, May 1990, 579-606.

Jacoby, "Public Attitudes toward Government Spending," AJPS, May 1994, 336-61.

Jacoby, "The Structure of Ideological Thinking in the American Electorate," AJPS, May 1995, 314-35.

References: Niemoeller & van Schuur (1983) "Stochastic Models for Unidimensional Scaling," in McKay, Schofield, & Whiteley (eds.), Data Analysis and the Social Sciences. Pinter.

Proctor, "A Probabilistic Formulation and Statistical Analysis of Guttman Scaling," Psychometrika, 1970, 73-78.

Mokken, Robert J. (1970) A Theory and Procedure of Scale Analysis. Mouton.

- McCutcheon (1987) Latent Class Analysis. Sage, #64.
 Andrich (1988) Rasch Models for Measurement. Sage, #68.
 Bartholomew, David J., and Martin Knott (1999) Latent Variable Models and Factor Analysis, 2nd ed. Arnold.

Extensions: Scaling Stimulus Comparison Data (including Thurstone scaling, Likert scaling, and Magnitude scaling)

- References:* McIver & Carmines, Unidimensional Scaling, pp. 7-40.
 Lodge & Tursky, "On the Magnitude Scaling of Political Opinion in Survey Research," AJPS, 1981, 376-419.
 Lodge (1981) Magnitude Scaling. Sage, #25.
 Spector, Paul E. (1992) Summated Rating Scale Construction. Sage #82.
 DeVellis, Robert F. (1991) Scale Development. Sage.
 Steenbergen, "Item Similarity in Scale Analysis," Political Analysis, Summer 2000, 261-83.

October 6: Multidimensional Scaling

Readings:

- *J. Kruskal & Wish, Multidimensional Scaling, pp. 7-60, 73-92.
 *Rabinowitz, "Nonmetric Multidimensional Scaling and Individual Difference Scaling" in Berry and Lewis-Beck, New Tools for Social Sciences, chap. 4, pp. 77-94.
 Rabinowitz, "An Introduction to Nonmetric Multidimensional Scaling," AJPS, 1975, 343-90. Also reprinted in Asher, Weisberg, Kessel, & Shively, Theory-Building and Data Analysis in the Social Sciences. This is an excellent introductory piece.
 Jones, "Some Considerations in the Use of Nonmetric Multidimensional Scaling," Political Methodology, Fall, 1974, 1-31.
 Berry, "On the Use of External Criteria to Interpret Spatial Structures," Political Methodology, 1979, 424-35.

Examples:

- Weisberg & Rusk, "Dimensions of Candidate Evaluation," APSR, 1970, 1167-85.
 Robinson & Hefner, "Perceptual Maps of the World," Public Opinion Quarterly, 1968, 273-80.
 Hoadley, "The Emergence of Political Parties in Congress, 1789-1803," APSR, 1980, 757-79.

References:

- Kruskal, "Multidimensional Scaling," Psychometrika, 1964, 1-27, 115-29.
 Schiffman, Reynolds, & Young (1981) Introduction to Multidimensional Scaling. Academic Press.
 Coxon with Jones (1983) "Multidimensional Scaling," in McKay, Schofield, & Whiteley (eds.), Data Analysis and the Social Sciences. Pinter.
 Davison (1983) Multidimensional Scaling. Wiley.
 Young & Hamer (1987) Multidimensional Scaling: History, Theory, and Applications. Lawrence Erlbaum Associates.
 Cox & Cox (1994) Multidimensional Scaling, Chapman & Hall.

Borg & Groenen (1997) Modern Multidimensional Scaling. Springer-Verlag.

Extensions: Multidimensional Unfolding

Examples: Daalder & Rusk, "Perceptions of Party in the Dutch Parliament," in Patterson & Wahlke (eds.), Comparative Legislative Behavior, 143-49, 169-98.

References: Rabinowitz, "A Procedure for Ordering Pairs Consistent with the Multidimensional Unfolding Model," Psychometrika, 1976, 349-73.

Schönemann, "On Metric Multidimensional Unfolding," Psychometrika, 1970, 349-66.

Jacoby, "Inconsistent Preferences and the Multidimensional Unfolding Model," Political Methodology, 1985, 201-20.

Poole & Rosenthal, "A Spatial Model for Legislative Roll Call Analysis," AJPS, May 1985, 357-84.

Koford, "Dimensions in Congressional Voting," APSR, Sept. 1989, 949-62.

Koford, "On Dimensionalizing Roll Call Votes in the U.S. Congress," AJPS, Sept. 1991, 955-75.

Brady, "The Dimensional Analysis of Ranking Data," AJPS, Nov. 1990.

Londregan, "Estimating Legislators' Preferred Points," Political Analysis, Winter 2000, 35-56.

Poole, "Nonparametric Unfolding of Binary Choice Data," Political Analysis, Summer 2000, 211-37.

Extensions: Directional, Metric, and Confirmatory Approaches

Examples: Rabinowitz, Macdonald, and Listhaug, "New Players in an Old Game," Comparative Political Studies, 1991, 147-85.

References: Ramsay, "Maximum Likelihood Estimation in Multidimensional Scaling," Psychometrika, 1977, 241-66.

Brady, "Statistical Consistency and Hypothesis Testing for Nonmetric Multidimensional Scaling," Psychometrika, 1985, 509-37.

Brady, "Statistical Properties of Metric Multidimensional Scaling," paper presented at the 1990 Annual Meeting of the American Political Science Association.

Brady, "Dimensional Analysis of Ranking Data," AJPS, Nov. 1990, 1017-48.

Brady, "Traits versus Issues: Factor versus Ideal-Point Analysis of Candidate Thermometer Ratings," Political Analysis, 1990, 97-129.

Jacoby, "Testing the Effects of Paired Issue Statements on the Seven-Point Issue Scales," Political Analysis, 1993, 61-111.

Poole, "Recovering a Basic Space from a Set of Issue Scales," AJPS, July 1998, 954-93.

Extensions: Individual Differences Scaling

Readings: *Kruskal & Wish, Multidimensional Scaling, pp. 60-73, 92-93.

*Rabinowitz, "Nonmetric Multidimensional Scaling and Individual Difference Scaling" in Berry and Lewis-Beck, New Tools for Social Sciences, chap. 4, pp. 94-107.

Examples: Converse, "The Problem of Party Differences in Models of Voting Change," in Jennings & Zeigler (eds.), The Electoral Process, pp. 175-207.

Nygren & Jones, "Individual Differences in Perceptions and Preferences for Political Candidates," Journal of Experimental Social Psychology, 1977, 182-97.

Marcus, Tabb, & Sullivan, "The Application of Individual Differences Scaling to the Measurement of Political Ideologies," AJPS, 1974, 405-20.

Zinni, Rhodebeck, and Mattei, "The Structure and Dynamics of Group Politics: 1964-1992," Political Behavior, 1997, 247-82.

References: Carroll & Chang, "An Analysis of Individual Differences in Multidimensional Scaling via an N-Way Generalization of 'Eckart-Young' Decomposition," Psychometrika, 1970, 283-319.

Takane, Young, & de Leeuw, "Nonmetric Individual Differences Multidimensional Scaling: An Alternating Least-Squares Method with Optimal Scaling Features," Psychometrika, 1977, 7-67.

Carroll, "Individual Differences and Multidimensional Scaling," in Shepard, Romney, & Nerlove (eds.), Multidimensional Scaling, Vol. I, pp. 105-25.

Arabie, Carroll, & DeSarbo (1987) Three-Way Scaling and Clustering. Sage, #65.

Extensions: Alternating Least Squares for Optimal Scaling

Readings: Jacoby, "Levels of Measurement and Political Research," AJPS, 1999, 271-301.

Jacoby, Data Theory and Dimensional Analysis, chapter 6.

References: Young, "Quantitative Analysis of Qualitative Data," Psychometrika, 1981, 357-88.

Young, de Leeuw, & Takane, "Regression with Qualitative and Quantitative Variables: An Alternating Method with Optimal Scaling Features," Psychometrika, 1976, 505-29.

de Leeuw, Young, & Takane, "Additive Structure in Qualitative Data: An Alternating Method with Optimal Scaling Features," Psychometrika, 1976, 471-503.

October 13**Hour 1: Multidimensional Scaling****Hour 2: Cluster Analysis****Readings:**

*Aldenderfer & Blashfield, Cluster Analysis.

Examples:

MacRae, "A Method for Identifying Issues and Factions from Legislative Votes," APSR, 1965, 909-26.

Jenkins-Smith with St. Clair and Woods, "Explaining Change in Policy Subsystems," AJPS, 1991, 851-80.

References:

Bailey, "Cluster Analysis," in Heise (ed.), Sociological Methodology, 1975.

Johnson, "Hierarchical Clustering Schemes," Psychometrika, 1967, 241-54.

Sattath & Tversky, "Additive Similarity Trees," Psychometrika, 1977, 319-45.

Gordon, A. D. (1999) Classification, 2nd ed. Chapman and Hall.

Dunn-Rankin, Peter (1983) Scaling Methods. Erlbaum.

October 20**Hour 1: Cluster Analysis****Hour 2: Factor and Component Analysis****Readings:**

*Kim & Mueller, Introduction to Factor Analysis.

*Kim & Mueller, Factor Analysis, pp. 7-29, 41-78.

Armstrong, "Derivation of Theory by Means of Factor Analysis," American Statistician, December 1967, 17-21.

Wickens, Thomas D. (1995) The Geometry of Multivariate Statistics, Erlbaum, chap. 9.

Examples:

Rabinowitz, Gurian, & Macdonald, "The Structure of Presidential Elections and the Process of Realignment, 1944 to 1980," AJPS, Nov. 1984, 611-35.

References:

Harman, Modern Factor Analysis, chapters 2, 4.9, 4.10, 5.7, 8.3, 8.7, pp. 133-134, 136-137 (2nd edition).

Rummel, Applied Factor Analysis, chapters 2, 7, 8, 19.

Mulack, The Foundations of Factor Analysis, chapters 1-8, 13-16.

Gorsuch, Factor Analysis, chapters 1-8, 17-18.

Dunteman (1989) Principal Components Analysis. Sage, #69.

Weller & Romney (1990) Metric Scaling: Correspondence Analysis. Sage, #75.

- Jackson, J. Edward (1991) A User's Guide to Principal Components. Wiley.
- Comrey, Andrew L. & Howard B. Lee. (1992) A First Course in Factor Analysis, 2nd ed. Erlbaum.
- Basilevsky, Alexander (1994) Statistical Factor Analysis and Related Methods: Theory & Applications. Wiley.

Oct. 27 Factor Analysis (Continued)

November 3

Hour 1: Rotation and Configuration Analysis

Readings:

*Kim & Mueller, Factor Analysis, pp. 29-41.

Examples:

Tanter, "Dimensions of Conflict Behavior Within and Between Nations," Journal of Conflict Resolution, 1966, 41-64.

References:

- MacRae, Issues and Parties in Legislative Voting, pp. 110-13, 126-30.
- Schönemann, "A Generalized Solution of the Orthogonal Procrustes Problem," Psychometrika, 1966, 1-10.
- Schönemann & Carroll, "Fitting One Matrix to Another," Psychometrika, 1970, 242-55.
- Mulack, The Foundations of Factor Analysis, chapters 9-12.
- Cox & Cox (1994) Multidimensional Scaling, chapter 5.

Hour 2: Confirmatory Factor Analysis (the measurement model in LISREL)

Readings:

*Long, Confirmatory Factor Analysis.

Examples:

- Knoke, "Stratification and the Dimensions of American Political Orientations," AJPS, November 1979, 772-91.
- Sullivan, Marcus, Feldman, & Piereson, "The Sources of Political Tolerance," APSR, March 1981, 92-106.
- Feldman, "Structure and Consistency in Public Opinion," AJPS, May 1988, 416-40.
- Green, "On the Dimensionality of Public Sentiment toward Partisan and Ideological Groups," AJPS, August 1988, 758-80.
- Weisberg, Haynes, and Krosnick, "Social-Group Polarization in 1992," in Weisberg, ed., Democracy's Feast, Chatham House, pp. 241-59.
- Craig, Martinez, and Kane, "The Structure of Political Competition: Dimensions of Candidate and Group Evaluation Revisited," Political Behavior, 1999, 283-304.
- Funk, "Bringing the Candidate into Models of Candidate Evaluation," Journal of Politics, August 1999, 700-20.

References:

- Bollen, Structural Equations with Latent Variables, chapter 7.
- Carmines & McIver, "An Introduction to the Analysis of Models with Unobserved Variables," Political Methodology, 1983, 51-102.
- Van Schuur, Wijbrandt, and Kiers, "Why Factor Analysis Is Often the Incorrect Model for Analyzing Bipolar Concepts and What Model to Use Instead," Applied Psychological Measurement, 1994: 97-110.
- Muthén, "Contributions to Factor Analysis of Dichotomous Variables," Psychometrika, 1978: 551-60.

Nov. 10: No Class (Veteran's Day Observed)**November 17****Hour 1: Factor Analysis (Continued)****Hour 2: Method Comparisons****Readings:**

*Weisberg, "Dimensionland," AJPS, 766-74.
Davison, Multidimensional Scaling, chapter 9.

Examples:

Holloway, "Forty Years of United Nations General Assembly Voting," Canadian Journal of Political Science, 1990, 279-96.

References:

MacCallum, "Relations between Factor Analysis and Multidimensional Scaling," Psychological Bulletin, 1974, 505-16.

Two further OSU rules:

All of the work you do in this course is expected to be your own. Absolutely no cheating or plagiarism (using someone else's words or ideas without proper citation) will be tolerated. Any cases of cheating or plagiarism will be reported to the university committee on academic misconduct and handled according to university policy.

Students with disabilities are responsible for making their needs known to the instructor and seeking available assistance in a timely manner. Course materials are available in alternative formats upon request. For such materials, please contact Mr. Wayne DeYoung, 2140 Derby Hall, 154 North Oval Mall, 292-2880.