Broadening the Dimensions of Political Opinion: A Statistical Exploration with PCA and Factor Analysis

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Abstract

This study looks at the complexity of political views in the U.S. It uses statistical methods of principal component analysis (PCA) and factor analysis (FA) to go beyond simple "liberal" or "conservative" labels. By studying survey data from the Pew Research Center, a reputable nonpartisan source of public opinion research, it aims to uncover the layered structure of political thought and gain a clearer understanding of public attitudes. The results identify seven major dimensions of political opinion, including trust in government, social fairness, foreign policy, taxes, attitudes toward government, discrimination, and religion. The findings also provide valuable insights for politicians and media organizations, allowing them to better understand public sentiment and improve their messaging. While the study acknowledges potential limitations, including the possibility of data loss during the simplification process, it provides a new perspective for understanding political attitudes.

Introduction

Today, political views are more diverse and complex. Political strategists need a deep and thorough understanding of public opinion. For example, during elections, politicians want to run more targeted campaigns that will boost their approval ratings. They do this by identifying the political views and key social concerns of the people in their constituencies. This study uses statistical tools—PCA and FA—to reveal various patterns in American political views. It analyzes survey data to move beyond traditional labels.

Literature review

Previous research in this area has emphasized the multidimensionality of political beliefs. Schmidt (2017) introduced the Religious Political Sophistication Scale (RPS) to explore the interaction between religious identity and political preferences. Cramer (2020) studied how racism affects public opinion, arguing that traditional measures fail to capture changing views. Guyon and Elisseeff (2003) focused on dimensionality reduction techniques, such as PCA and clustering, emphasizing their usefulness in interpreting large data sets. Our study builds on this work, applying these methods to modern survey data, aiming to refine political classifications beyond binary classifications.

Methods

1. Data Preparation

1.1. Variable Selection: Survey questions related to political opinions (columns 26–98) were extracted from the original dataset.

1.2. Missing Data: Columns with missing values were removed, resulting 30 columns remained. This ensured a complete data matrix for PCA and Factor Analysis.

2. Exploratory Data Analysis (EDA)

2.1. Data Summary and Missing Value Analysis: The dataset initially contained 74 questions. After handling missing values by removing incomplete answers, the dataset was reduced to 30 complete columns.

2.2. Data Transformation and Dummy Encoding: All categorical variables were converted to dummy variables. The options for each question were converted to separate binary features. After dummy coding, the dataset expanded to a high-dimensional feature space with more than 100 columns.

3. Principal Component Analysis (PCA)

3.1. Dimensionality Reduction: Because of the high number of survey questions, PCA was applied to reduce the dataset's dimensionality while retaining as much variance as possible. The explained variance ratio and cumulative variance were calculated for each principal component.

3.2. Component Selection: A scree plot of explained variance (Appendix Plot 1) and a scree plot of eigenvalues (Appendix Plot 2) were generated, and the "elbow" point was identified to manually select a smaller number of components for FA. This step balanced variance explained with interpretability, reducing the focus to 7 components.

4. Factor Analysis

4.1. Factor Extraction: Using the 7 components identified from the scree plots, Factor Analysis was conducted to extract interpretable latent factors.

4.2. Rotation: Varimax rotation was applied to simplify the factor structure, making the loadings more interpretable and reducing cross-loadings, which occurs when a variable has significant loadings on multiple factors, making it difficult to determine which factor the variable truly belongs to.

4.3. High-Loading Variables: Because the threshold of 0.4 ensures practical significance without excessive overlap, variables with absolute factor loadings > 0.4 were considered significant contributors to each factor. These variables were matched with their corresponding survey question descriptions to facilitate thematic interpretation.

Results

After applying PCA and Factor Analysis, eight factors were identified, each representing a key dimension of political opinion in the United States. The following sections describe each factor with examples of high-loading variables:

Factor 1: Trust in governance and economic systems

- Theme: Reflects opinions on national governance, economic policies, and trust in leadership.
- Key Indicators: Dissatisfaction with national governance (q1_2.0); disapproval of tax laws (q70_2.0); belief that large corporations make too much profit (q50a_2.0).

Factor 2: Perceptions of social fairness

- Theme: Captures concerns about economic fairness and fairness between different racial groups.
- Key Indicators: Perceived discrimination against Black individuals, Hispanics, and Whites (q61_9.0); concern that wealthy people do not pay their fair share of taxes

(q65c_9.0); belief that the economic system unfairly favors powerful interests (q50d_9.0).

Factor 3: Foreign policy stances

- Theme: Represents views on U.S. foreign policy, global engagement, and international cooperation.
- Key Indicators: Preference for the U.S. to align with allies (q50b_2.0); support for the U.S. to participate actively in world affairs (q50c_1.0).

Factor 4: Tax fairness concerns

- Theme: Concerns about public understanding and fairness of the federal tax system.
- Key Indicators: Understanding of how tax laws impact individuals (q71_1.0).

Factor 5: Emotional reactions to governance

- Theme: Reflects emotional reactions, such as frustration or distrust of government institutions.
- Key Indicators: Frustration or anger toward the federal government (q20_1.0).

Factor 6: Perceived social discrimination

- Theme: Captures beliefs about discrimination and its impact on society.
- Key Indicators: Discrimination against Black individuals and Hispanics (q61_2.0).

Factor 7: Role of religion in political matters

- Theme: Measures views on whether religion should influence political decisions.
- Key Indicators: Support for churches expressing political views (q69_2.0); belief that religious institutions should stay out of politics (q69_1.0).

Conclusion

This study summarizes American political opinions in seven major areas: trust in government, social fairness, foreign policy, political sentiment, tax policy, social discrimination, and religious views. Together, these areas reveal the breadth and complexity of public opinions.

The findings provide valuable guidance for politicians and government officials. By understanding these factors, they can develop more targeted policies and messages to address specific public concerns. For example, those aiming to attract voters concerned about tax fairness should focus on clear policies to address wealth inequality and corporate responsibility, while those seeking support from groups that value religious politics may need to frame their positions around values and faith-based governance.

However, this study has some limitations. Removing columns with missing data may introduce bias, and using dummy variables may ignore some of the complexity in the responses. Future research can be expanded by including more demographic and geographic variables or through techniques such as clustering or predictive models to gain deeper insights.

In conclusion, political opinions should not be explained by simple categories. They are influenced by multiple overlapping factors. This study provides a deeper exploration of these opinions to help policymakers better understand and address the different needs and concerns of the public.

Reference

Cramer, Katherine. “Understanding the Role of Racism in Contemporary US Public Opinion.” *Annual Review of Political Science 23*, no. 1 (2020): 153–169. https://doi.org/10.1146/annurev-polisci-060418-042842.

Guyon, Isabelle, and André Elisseeff. "An Introduction to Variable and Feature Selection." *Journal of Machine Learning Research* 3 (2003): 1157–1182.

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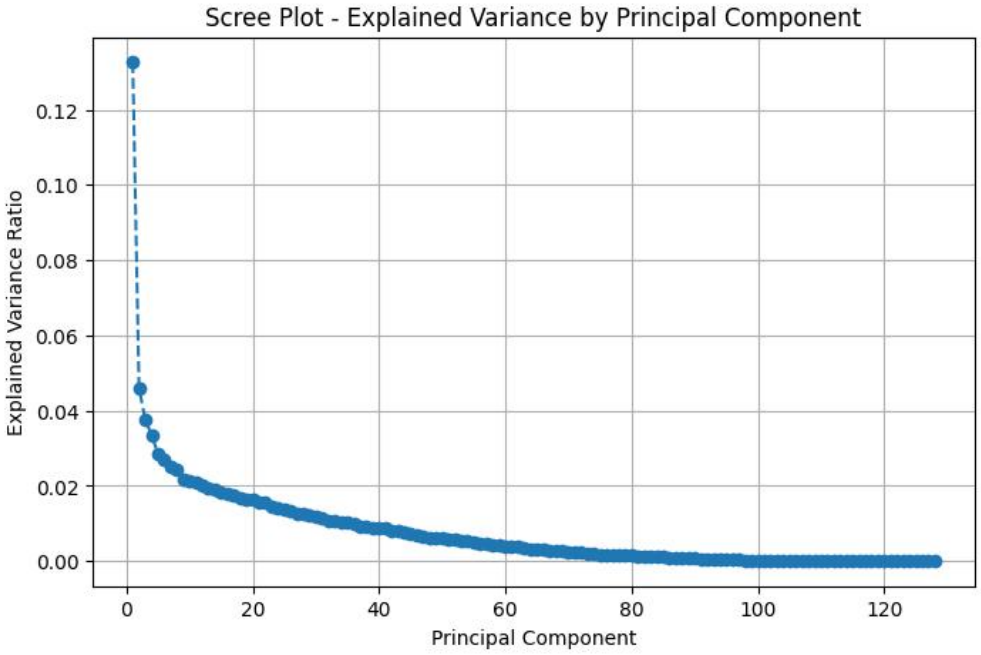
Appendix

Plot 1 -



Plot 2 -