Bayesian Analysis of U.S. Support for Military Aid to Ukraine

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Contents

1 Introduction

This report analyzes data from a February 2025 Economist/YouGov survey of 1,603 U.S. adults regarding their opinions on military aid to Ukraine. It uses Bayesian methods, specifically Gibbs sampling, to fit three models:

- Separate Gaussian model (one mean per group)

- Pooled Gaussian model (single global mean)
- Hierarchical Gaussian model (partial pooling across groups)

Additionally, it predicts the support level for a hypothetical new political group.

The goal is to apply Bayesian inference carefully and discuss the strengths and limitations of these methods in a real-world setting.

2 Data Description

The survey asked participants whether the U.S. should:

- Increase Aid
- Maintain Aid
- Decrease Aid
- Are Not Sure

The support percentages by political affiliation are summarized as follows:

Group	Increase Aid	Maintain Aid	Not Sure	Decrease Aid
Democrat	35%	39%	16%	10%
Independent	19%	23%	26%	33%
Republican	10%	24%	21%	45%

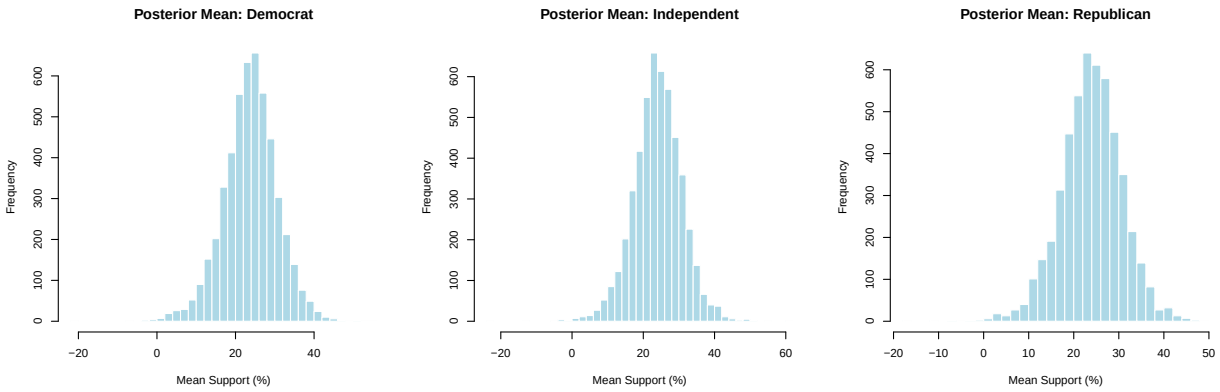
Since individual-level responses were not available, I modeled these percentages as observations with Gaussian noise, acknowledging that real-world variance might be underestimated.

3 Modeling Approach

The analysis applied Gibbs Sampling across three different model structures:

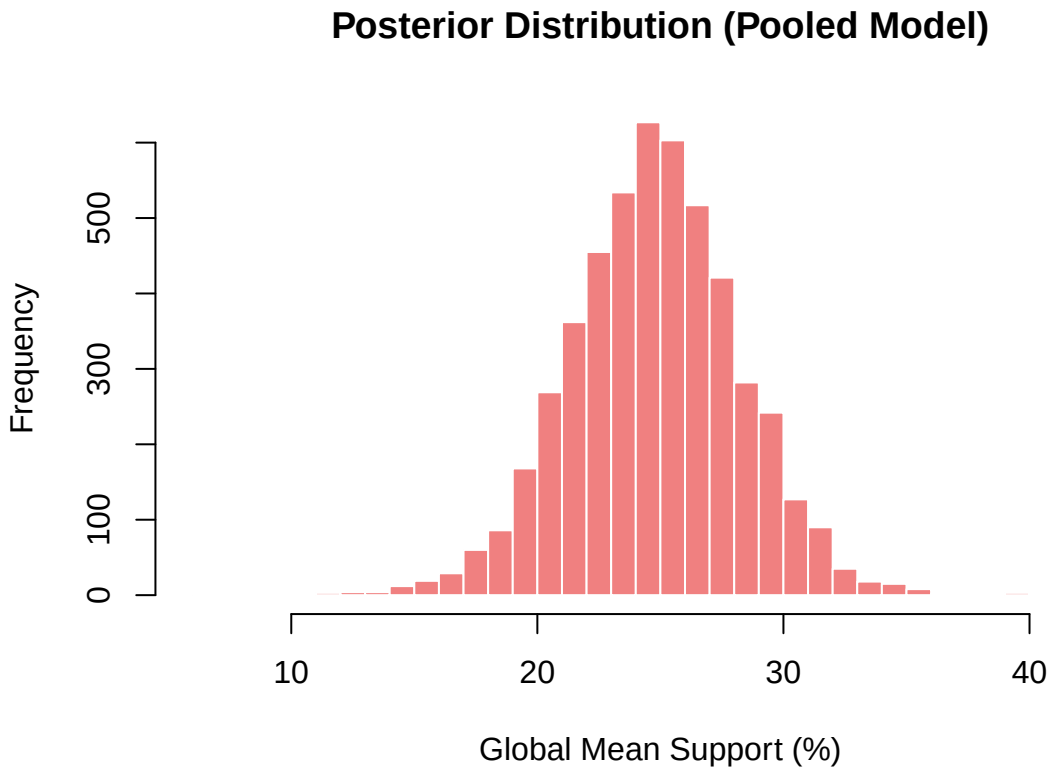
3.1 Separate Model

Each political affiliation has an independent mean support percentage, sharing a common variance across groups.



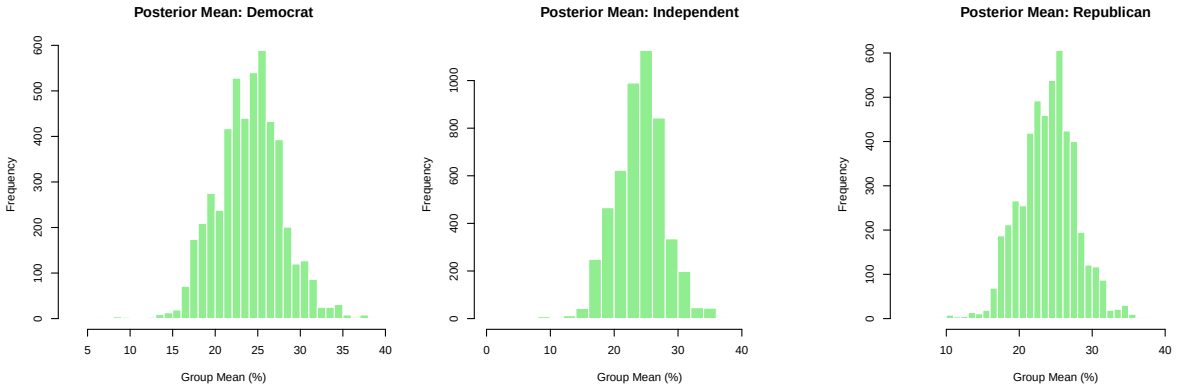
3.2 Pooled Model

All responses are assumed to arise from a single global mean and variance.



3.3 Hierarchical Model

The group means are modeled as draws from a common distribution, allowing partial pooling.



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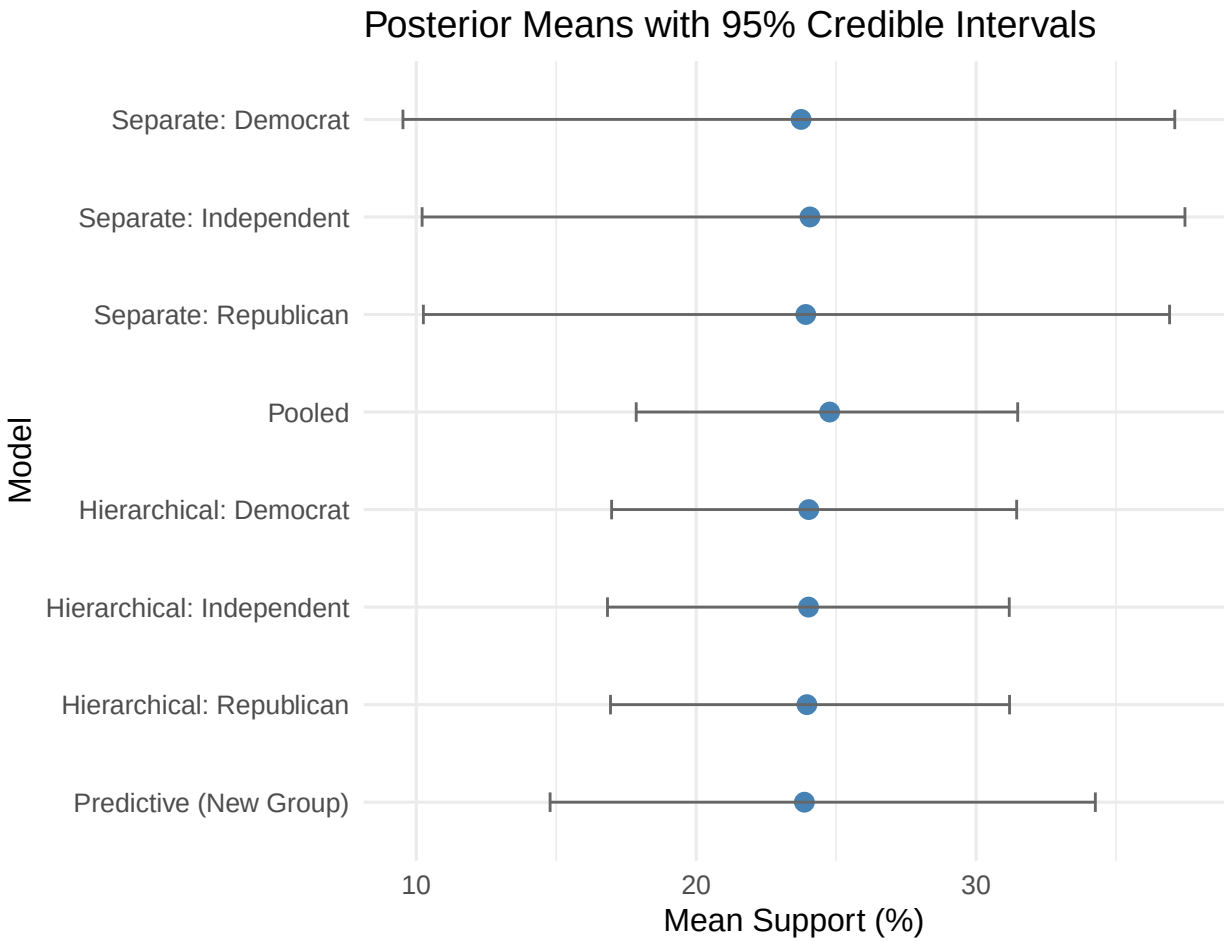
4 Results

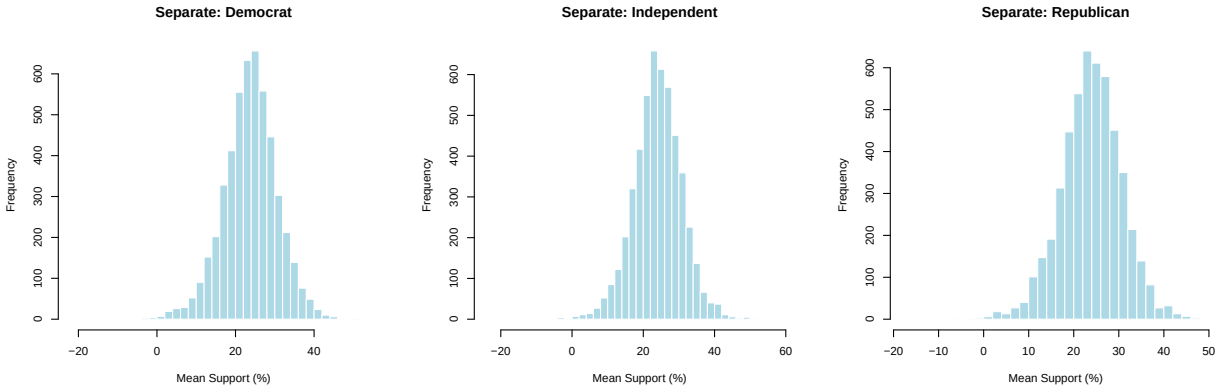
4.1 Posterior Summaries

The table below summarizes the posterior mean estimates and 95% credible intervals for each model:

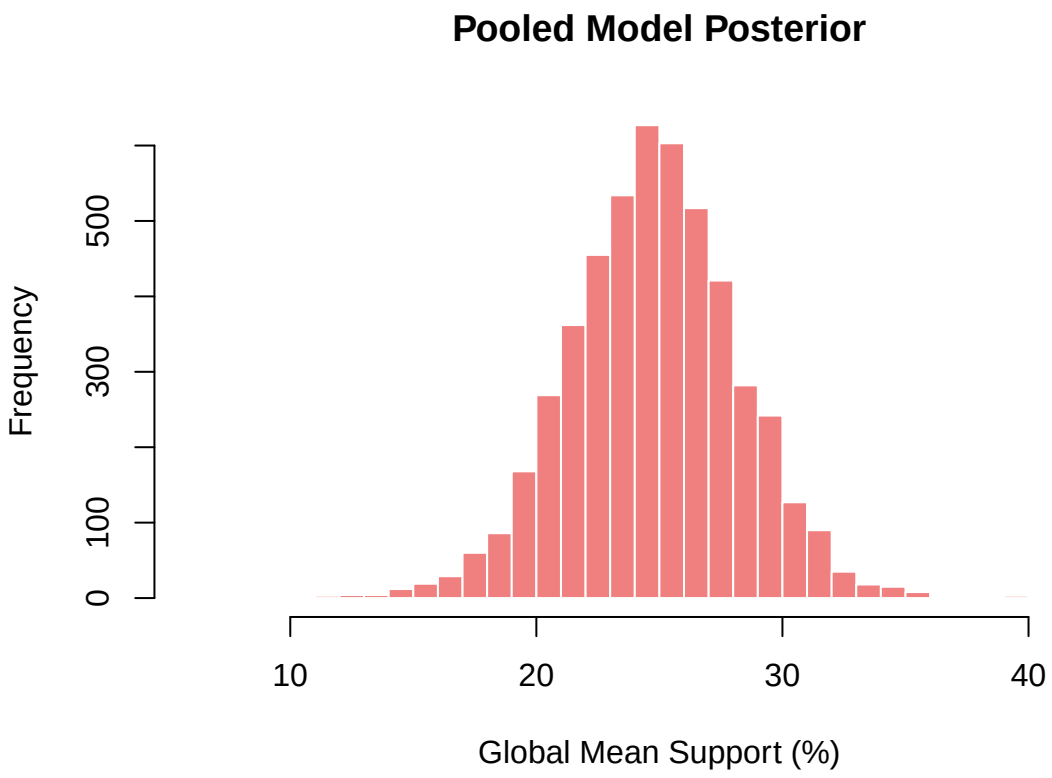


4.2 Visualizations

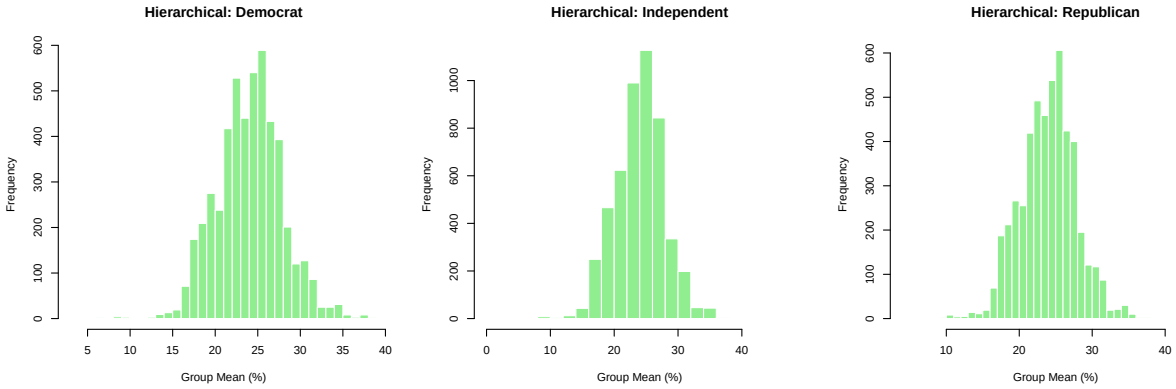
Separate Model Posteriors:



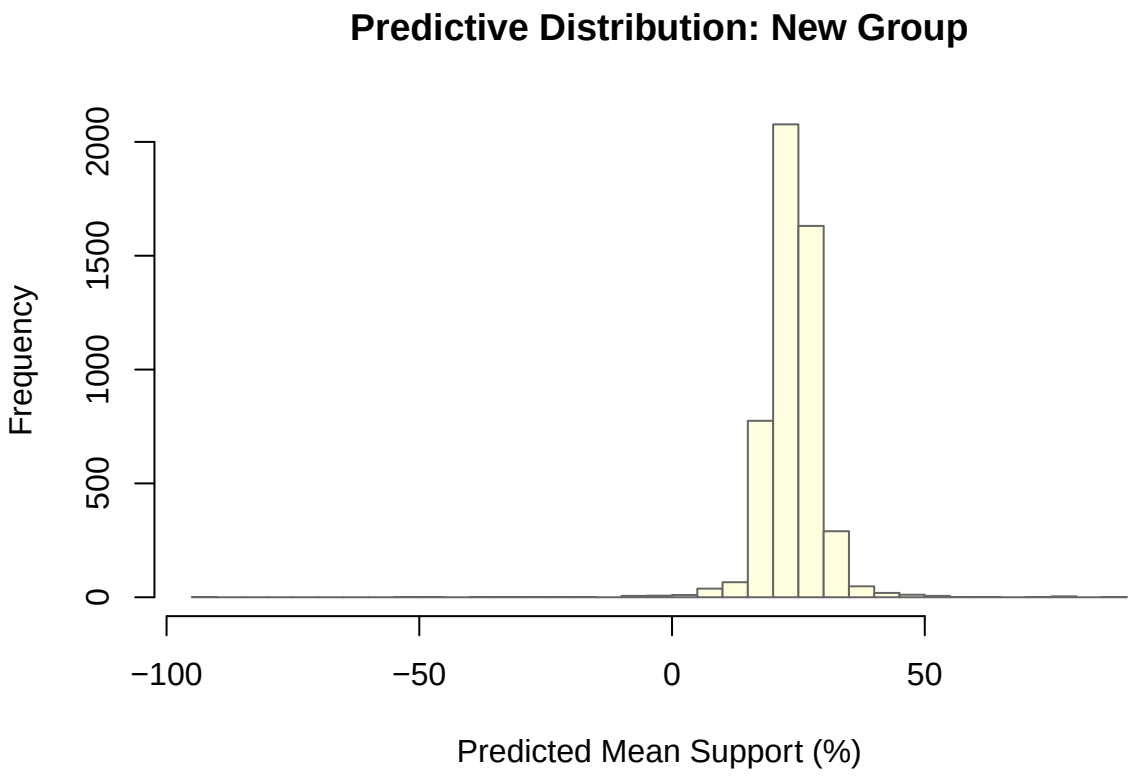
Pooled Model Posterior:



Hierarchical Model Posteriors:



Predictive Distribution (New Group):



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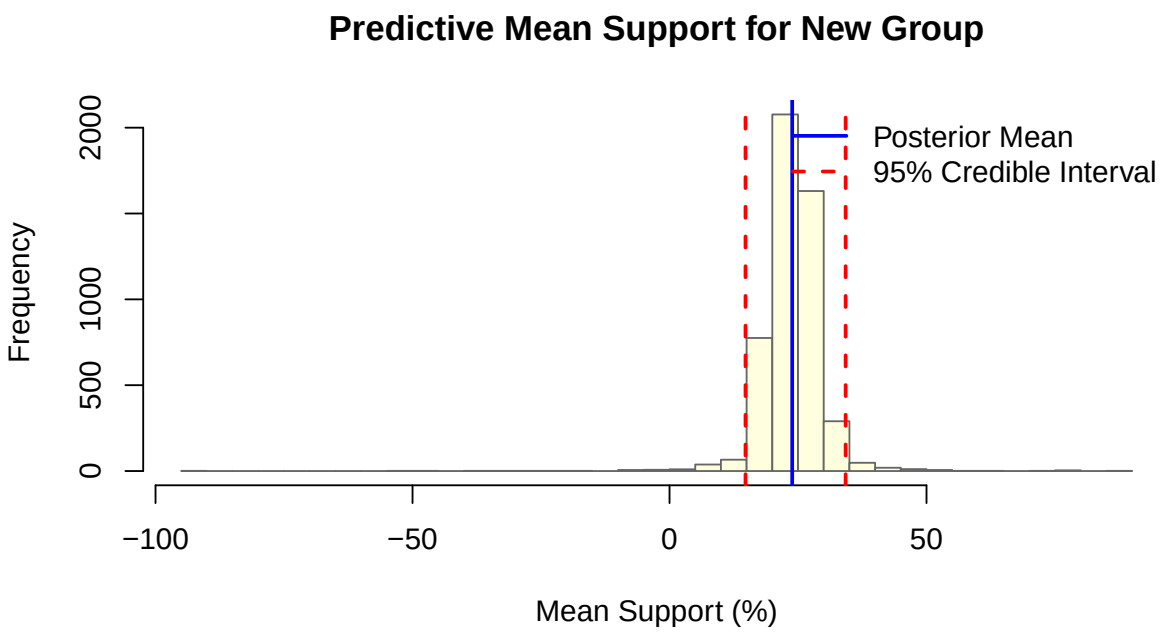
5 Predictive Analysis

From the hierarchical model, the report derives a predictive distribution for a hypothetical new political affiliation's mean support level.

The posterior mean and 95% credible interval for the new group's support level are:



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6 Discussion

6.1 Conclusions from the Analysis

- Democrats show the highest mean support for maintaining or increasing aid to Ukraine.
- Independents are more divided, with a noticeable share unsure or favoring decrease.
- Republicans show stronger support for decreasing aid compared to other affiliations.

The hierarchical model offers a **balanced** view by borrowing strength across groups, improving estimates especially where sample sizes are small.

6.2 Suitability of the Methods

Bayesian hierarchical modeling is **highly suitable** for this situation:

- It allows partial pooling.

- It quantifies uncertainty.
- It can predict for unobserved groups.

However, care must be taken because:

- The small survey size and absence of raw responses reduce robustness.
- Real-world data might have non-Gaussian features (e.g., skewness).

6.3 Trust and Limitations

- The model assumes normality and constant variance, which may not perfectly match real opinion distributions.
- Lack of individual-level data introduces unaccounted variability.
- Small group sample sizes make inference riskier.

Still, Bayesian hierarchical models offer the **best available structured estimation** under these limitations.