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<u>Voter Turnout and the Margin of U.S. Presidential Victories by County</u>

<u>Introduction</u>
Voter turnout in U.S. presidential elections varies substantially across counties and years, raising the question of whether turnout levels influence partisan results. We examine whether higher county-level turnout is associated with larger Democratic or Republican vote margins. Our null hypothesis is that turnout has no effect on partisan margins; the alternative is that turnout is meaningfully related to vote outcomes.

<u>Data</u>
We used county-level turnout data from the MIT Election Data and Science Lab and eligible-voter estimates from StatsAmerica for the past seven presidential elections. Our main visualization is a scatter plot with turnout percentage on the x-axis and Democratic victory margin (as a share of eligible voters) on the y-axis, with 0 marking the partisan break point. An initial analysis using raw vote totals produced a misleading positive correlation due to population size: large, urban counties cast more votes and tend to favor Democrats. To address this, we converted raw vote totals to percentages, enabling valid comparisons across counties.

<u>Methods</u>
To test the relationship between turnout and partisan margin, we estimated a generalized linear model (GLM):

Democratic Lead (%) = -18.9652 - 0.1288 * Voter Turnout (%)

The slope coefficient suggests that, for every 1% increase in county voter turnout, the Democratic lead is predicted to decrease by about 0.129 percentage points. The intercept does not have a practical interpretation.

	Coef.	Std.Err.	t	P>|t|	[0.025	0.975]
Intercept	-18.965150	0.783494	-24.205863	1.075685e-127	-20.500858	-17.429441
turnout_percentage	-0.128772	0.016303	-7.898530	2.959837e-15	-0.160728	-0.096816

We then assessed standard GLM assumptions:

- Linearity: Relationship between X and Y is linear (error term is unrelated to fitted value).
- Homoscedasticity: Residuals are spread out the same everywhere.

- Normality: A histogram of residuals shows approximate normality (subtle right skew).
- Independence: Each county serves as an independent observation.

We also examined scatterplots, histograms, and summary statistics to understand variable behavior and model fit:
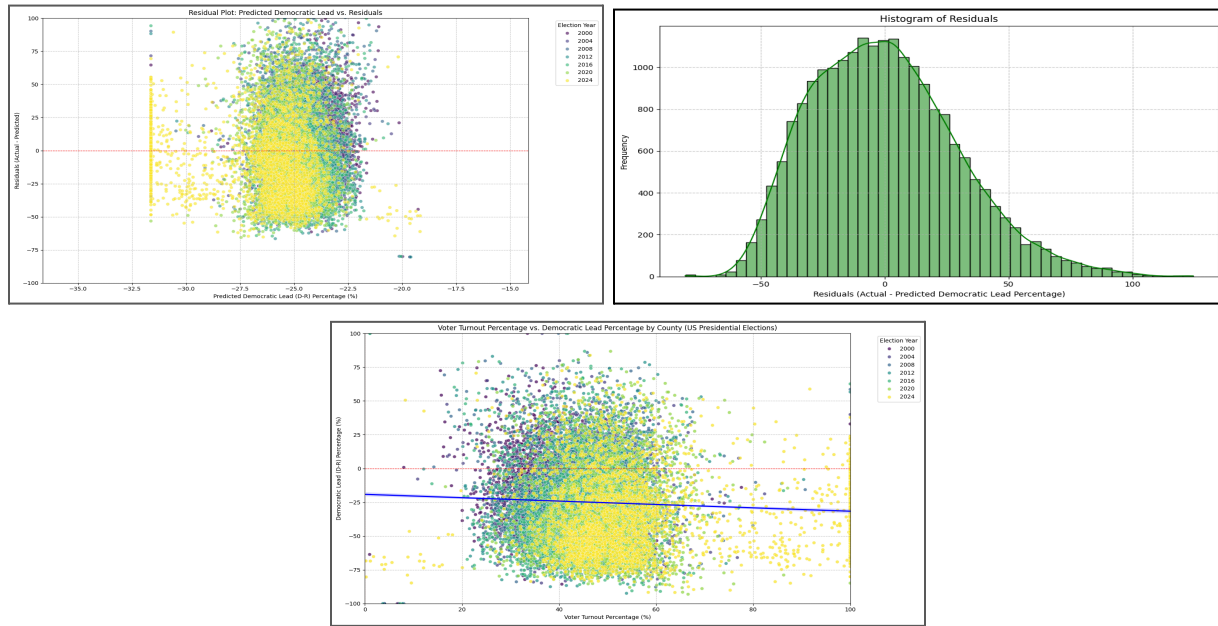
Results
Although the turnout variable is statistically significant (p-value is approximately equal to 0), its explanatory power is very low. The intercept is significant as well (p-value is approximately equal to 0). The GLM accounts for only about 3% of the variation in Democratic lead percentage, indicating that turnout has minimal predictive value for county-level partisan margins. The scatterplot supports this conclusion: points are widely dispersed with no strong slope, and both Democratic and Republican counties appear across all levels of turnout. This shows that higher turnout does not consistently benefit either party. The homoscedastic pattern further confirms that no meaningful linear relationship is present.

Conclusion
Our analysis finds no substantial relationship between county-level voter turnout and the margin by which Democrats or Republicans win presidential elections. Although turnout is statistically significant, the effect is too small to meaningfully influence county vote margins. This suggests that turnout alone cannot explain partisan outcomes and that including additional variables – such as demographics, urbanization, income, education, or historical voting trends – would greatly improve predictive accuracy. Overall, while turnout varies considerably across counties, its direct impact on presidential vote margins is limited, and a more comprehensive modeling approach is required to fully understand county-level political behavior.