The Link Between Mental Health Providers and Mental Health at the County Level

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Introduction

Main Question:

Do the number of mental health professionals per county affect the number of poor mental health days?

Motivation:

- According to the Centers for Disease Control and Prevention (CDC), more than 1 in 5 adults in the U.S. is affected by mental health conditions.
- Only about half of those affected receive treatment, highlighting a significant gap in mental healthcare access and utilization.
- Understanding regional patterns in mental health can help guide policies aimed at improving mental health outcomes, inform better resource distribution, and support mental health efforts at the community level.

Data Description

Source: 2025 County Health Rankings Dataset (University of Wisconsin Population Health Institute)

- Rows: U.S. counties
- Columns: county-level metrics
    - Mental Health Providers
    - Poor Mental Health Days
    - Lack of Social and Emotional Support
    - Suicide Rate
    - Frequent Mental Distress
    - County FIPS Code
   - Added: Provider Ratio per 100k (engineering to standardize)

North Central Region of U.S has Fewer Poor Mental Health Days Compared to South Region
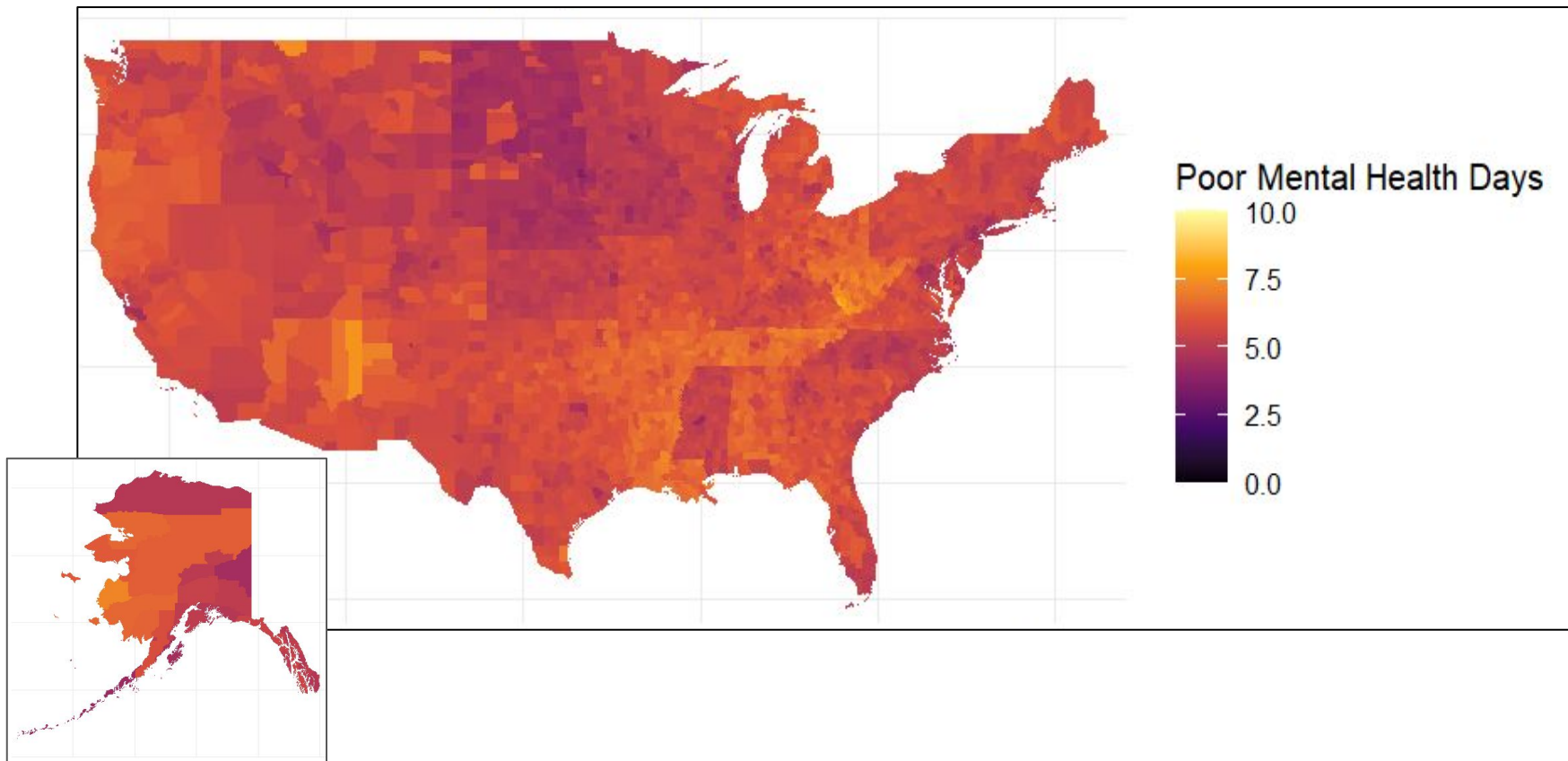
Suicide Rates Rise with Reduced Provider Access; Social Isolation Increases Risk
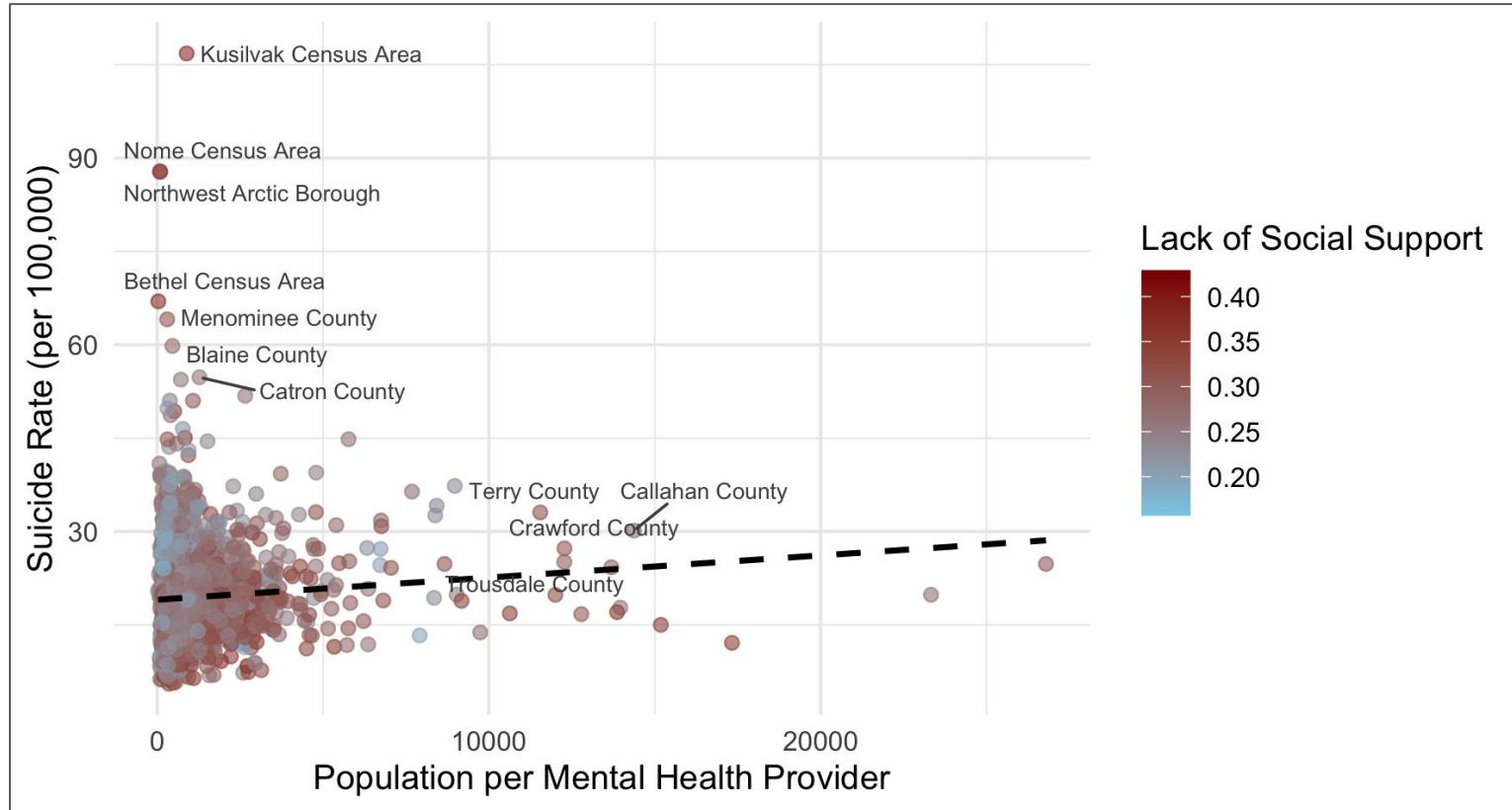
Poor Mental Health Days Increase with Decreased Social Support in Rural Alaska

Alaska: Social & Emotional Support vs. Poor Mental Health Days
Urban vs. Rural boroughs/census areas
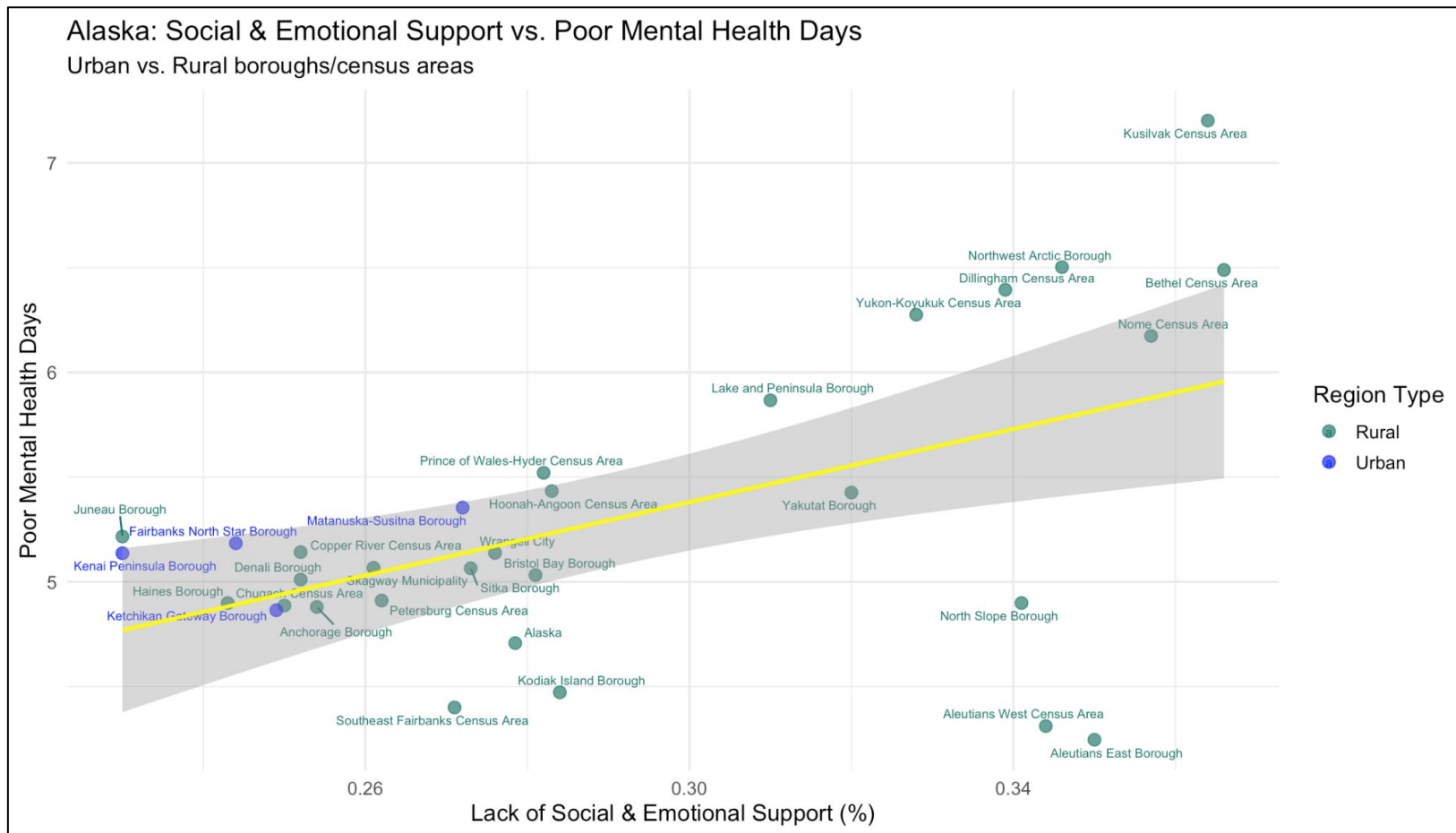
Overview of Methods

Poisson:

- Used to identify significant predictors of poor mental health days, a count-based, non-negative outcome variable.
- Overdispersion was observed, indicating variance > mean, so a quasi-Poisson model was used to account for extra variance.
- Standardized all predictors before modeling to allow direct comparison of effect sizes.

Random Forest & XGBoost:

- With a large sample size, machine learning models were also implemented for prediction.
- Used to capture nonlinear patterns that Poisson did not capture.
- Evaluated models accuracy based on RMSE (smaller = better)
- Evaluated feature importance with % increase in RMSE

Poisson Regression

Predictor	% Change in Poor Mental Health Days	95% Confidence Interval
Provider Ratio	+1.17%	[0.74%, 1.61%]
Loneliness	+3.54%	[2.98%, 4.09%]
Lack of Social Support	+0.92%	[0.34%, 1.50%]
Suicide Rate	+1.78%	[1.38%, 2.18%]

XGBoost is a slightly better predictive model than Random Forest
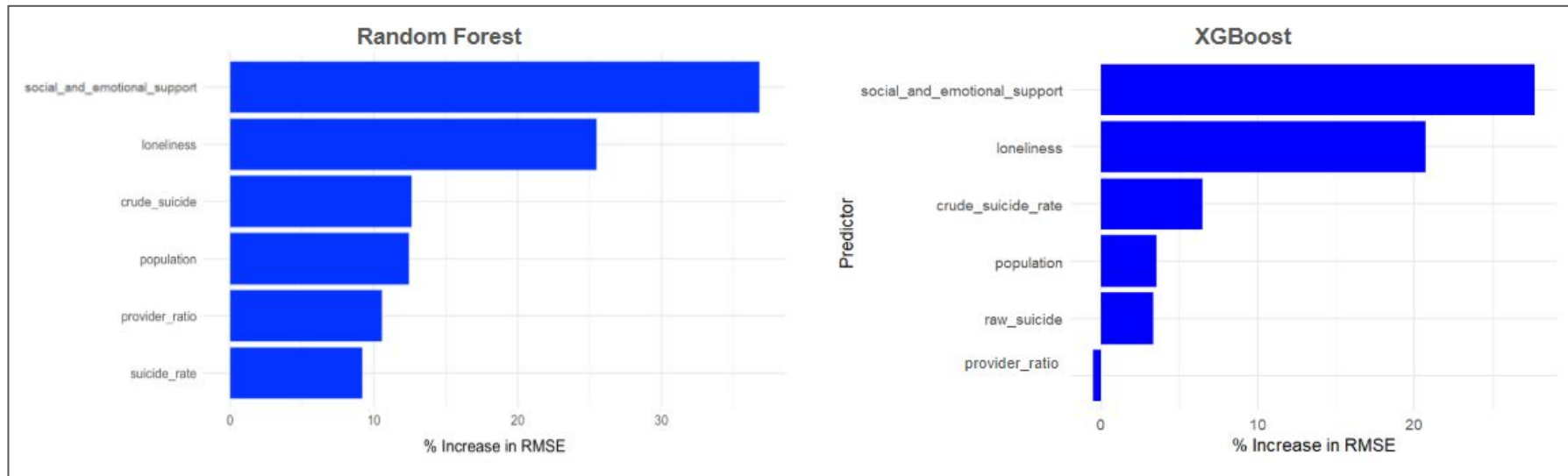
Random Forest RMSE: 0.449

XGBoost RMSE: 0.443

Recommendations

We recommend UHG/Optum implement county-informed mental health care programs, prioritizing connectedness and accessibility, especially in rural regions.

1. Partner with particular state and local governments to improve broadband access (subsidized mobile hotspots, data plans, etc.).
2. Invest in virtual therapy platforms that can connect individuals to licensed mental health providers.
3. Develop community peer-support networks where leaders and members can stand to provide social and emotional support in meetings, to be paired with virtual therapy.

Shifts the focus from solely clinical interventions to community and individual support.

Discussion

Summary

- Provider density not strongly correlated with amount of poor mental health days, with loneliness and lack of social and emotional support as top predictors
- XGBoost is a better predictive model than Random Forest
- Rural communities (ex. Alaskan counties) show worse mental health outcomes

Limitations

- Aggregated, county-level data leaves variation between individuals unknown
- Lacked more social determinants
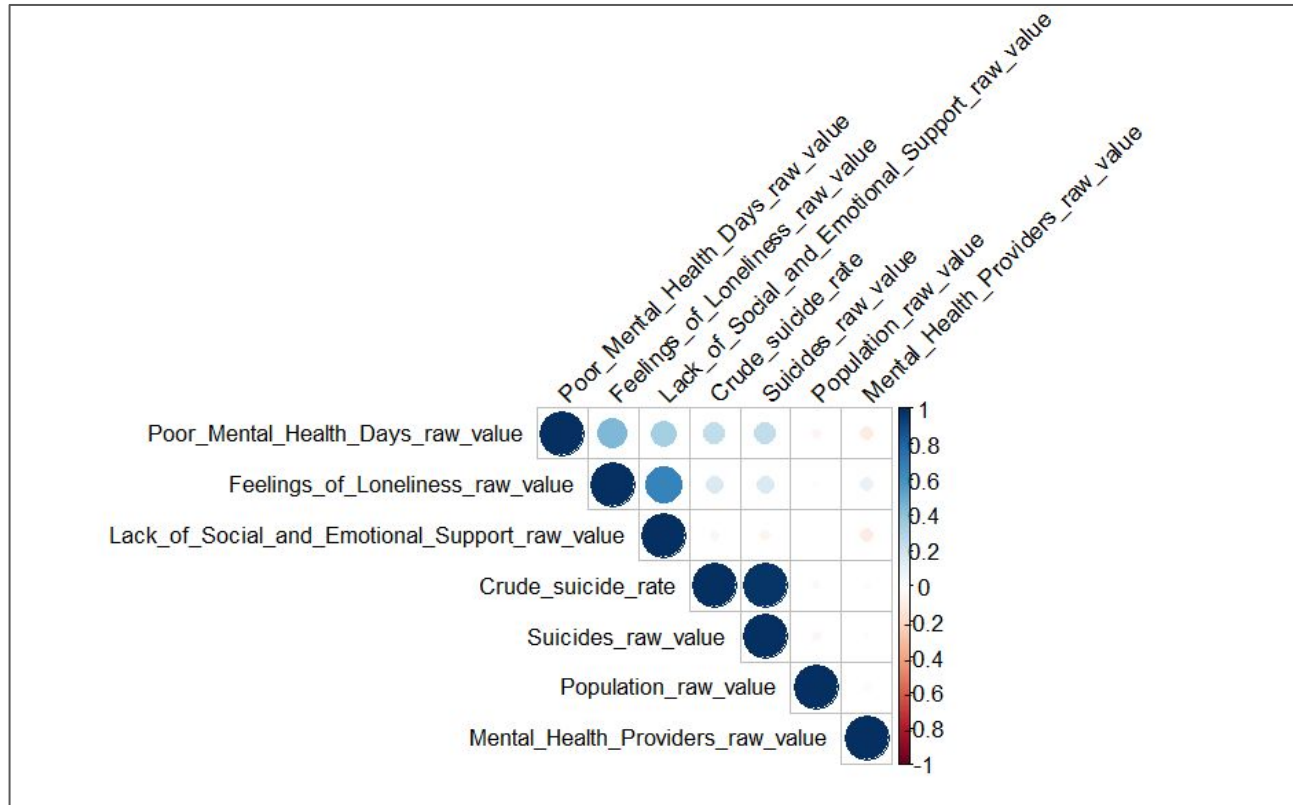- No analysis of insurance coverage rates or clinical metrics

Next Steps

- Include more geographic, economic, and behavioral health variables
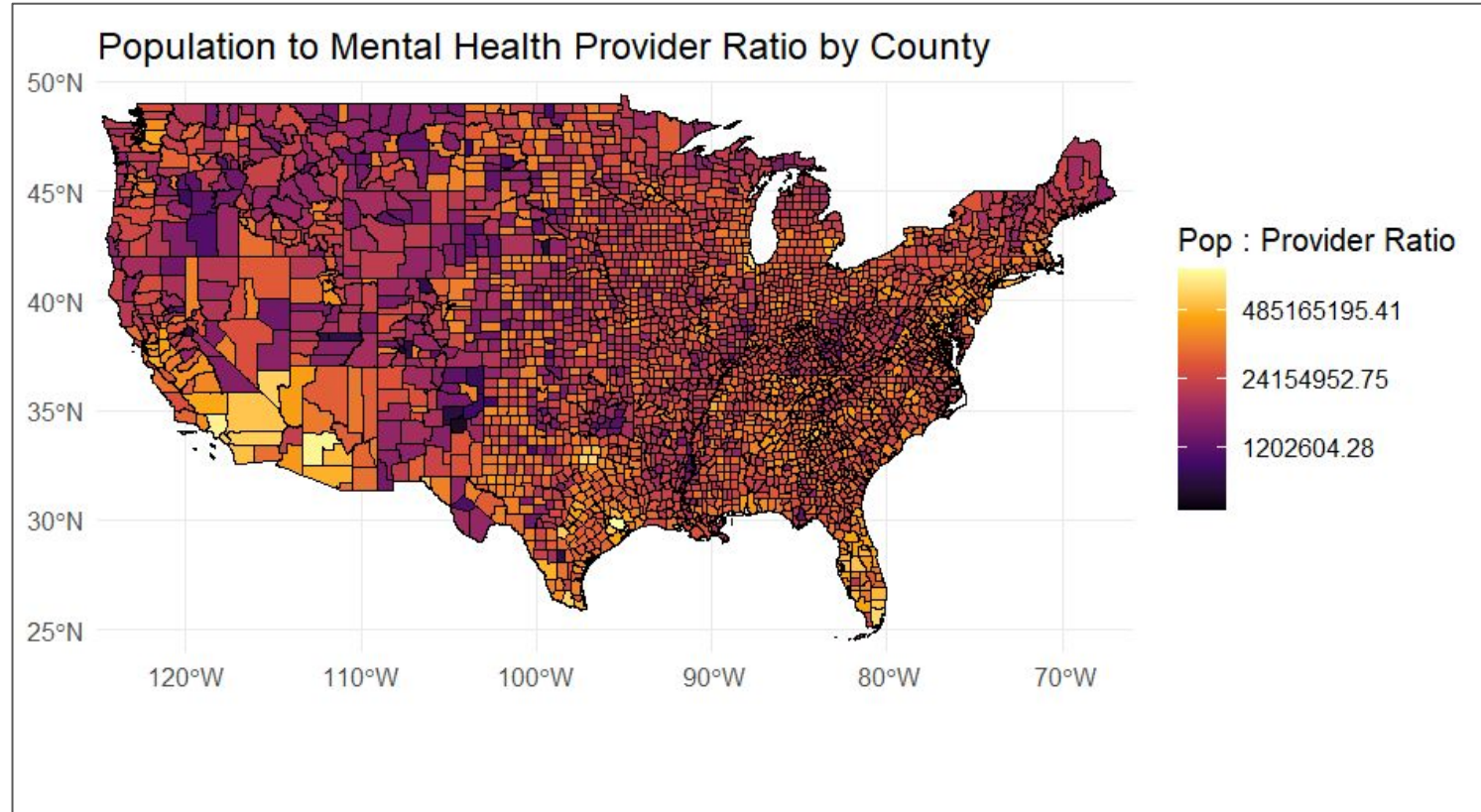- Use individual-level data

Q/A

Appendix

Feelings of Loneliness and Lack of Social and Emotional Support Show a Strong Correlation with Each Other

Southwest Region has Greater Population to Provider Ratio

Population to Mental Health Provider Ratio by County

Gain based metric placed greater importance on mental health providers than permutation based

Feature Importance: Gain vs Permutation-Based