Increasing effectiveness of resource allocation with machine learning (HUD)

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Problem

The Department of Housing and Urban Development (HUD) provides counseling services for persons who seek guidance with housing issues or topics:

- **Homebuyer Pre-Purchase**
- **Delinquencies and Foreclosures**
- Renter Services
- HUD Loan Programs

SOLUTION

Provide a user-friendly interactive dashboard that will predict the level of engagement towards HUD services at the U.S. state level
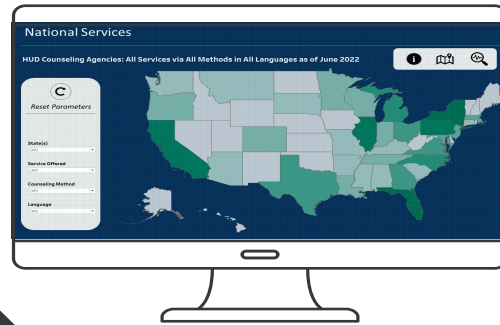
Providing these services requires an <u>adequate allocation of resources</u> in order to <u>assist</u> <u>the housing needs</u> of the program's beneficiaries

Outcome:

HUD will gauge a faster understanding of regional service needs associated with housing issues and more-effectively allocate personnel and monetary resources
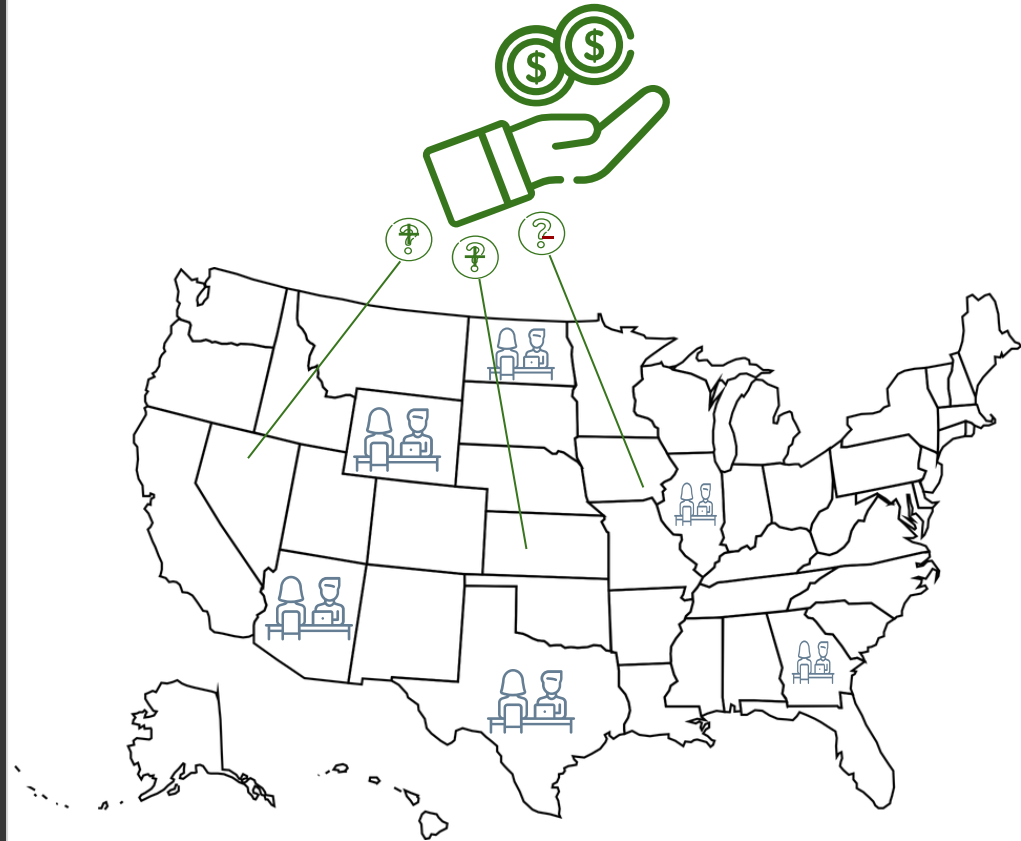
METHODOLOGY

DATA COLLECTION
Exploring possible predictors. Sourcing data from FRED, HUD, etc...

EDA
Observing whether there are trends or seasonality

DASHBOARD
Summarize results using Tableau

DATA CLEANING
Achieve comparability

MODELLING
Establish index → Time-Series VAR models for each state

METRICS:

HOUSING MARKET ACTIVITY

▶ ## HOUSE PRICE INDEX
Indication of changes in house prices (based on 2015)
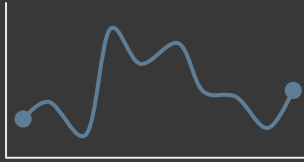
▶ ## MORTGAGE RATES
Fixed 15, 30 year mortgage rates, 5/1 ARM

▶ ## DEBT-TO-INCOME RATIO
Indication of citizen's financial liability

Metrics:

Economic health

▶ **State-level GDP**
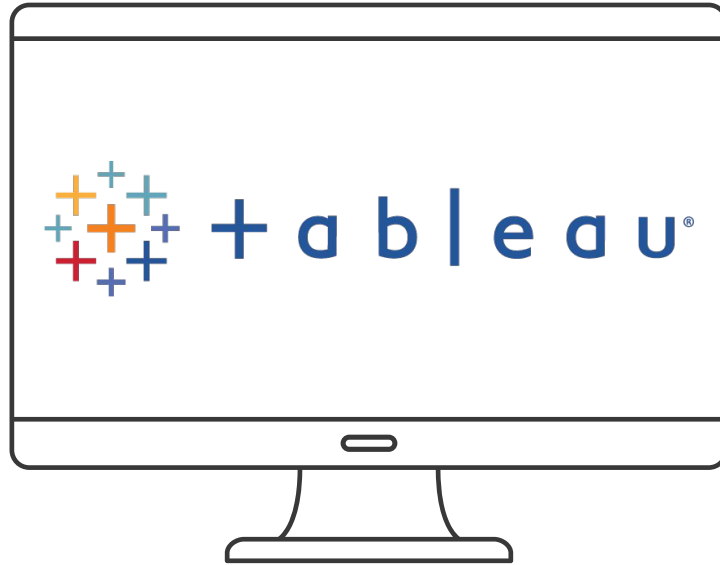Economic growth on the state level

▶ **Insured unemployment**
Initial and Continued claims

▶ **Consumer price index**
Indication of inflation

PRODUCT DEMO

Summary of Model Workflow

- Created individual VAR models for each of the 50 states and Washington D.C.

  - **Baseline**: 12 month rolling average

- Each state model has a different model MSE and a different baseline MSE

  Average baseline RMSE: 52,380
  Average model RMSE: 20,691

Limitations that we faced

Data collection

Difficulty finding certain metrics that were...

- Up-to-date

- State-level granularity

Quantifying likelihood of engagement

Defining what measure would quantify the demand of these services. Established an index for each service at a state level

Model usage and evaluation

VAR model usage and stationarity transformations resulted in a difficult interpretation process

Future considerations

For our model:
Improve the interpretability of the indices to quantify <u>how much more or less</u> assistance will citizens need in a given state.

For HUD:
Reference this dashboard and predictive model to proactively address problems that American homeowners and homebuyers have by effectively re-allocating personnel and budgetary resources. This creates more effective and optimal amounts of counseling services for citizens in need.