Predicting House Prices

with Economic Indicators

Using Inflation, Income & Trend-Based Features

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Introduction & Project Overview

Main Objective:

- To build a predictive model that forecasts house prices using macroeconomic indicators such as income, inflation, and price growth.

Business Relevance:

- Helps stakeholders understand how economic changes impact housing affordability and pricing trends.

Scope:

- Covers data from 1962–2022, applying machine learning and SHAP explainability.

Business Problem & Significance

Domain: Real Estate / Finance

Business Problem:

"Can macroeconomic indicators be used to accurately predict median house prices in the United States?"

Challenge:

- Rising housing costs and economic volatility make price prediction more important than ever.

Why It Matters:

- Real estate firms need better forecasting tools for investments.
- Banks can assess mortgage risk more accurately.
- Policymakers can proactively adjust fiscal strategies.

Goal:

Using machine learning and interactive dashboards, we can model housing trends and uncover patterns that support smarter, data-driven decisions.

Objectives

1. **Identify economic indicators that influence house prices**

2. **Build a predictive model for house prices**

3. **Use SHAP for model explainability**

4. **Present findings through an interactive QlikView dashboard**

Dataset Overview

US Economy Case Study

Source: https://www.kaggle.com/datasets/chimavogu/us-economy-dataset

File Name	Description
Average Individual Income By Year	Contains annual U.S. income data from 1962–2021
Average Sales of Houses in Jan	Shows average house prices in January each year
Average Sales of Houses in the US	Provides quarterly house prices (target variable)
US Historical Inflation Rates	Yearly inflation rates from 1914–2022, crucial for adjusting prices

Total columns: 24
After merging: 9

Columns After Merging:
'Income',
'Income_Adj_2021',
'Income_Change',
'InflationRate',
'Income_to_Price_Ratio',
'Inflation_Adjusted_Price',
'Lagged_HousePrice',
'Income_Growth_Rate',
'Price_Growth_Rate'

Feature Engineering

Feature	Description
Income_to_Price_Ratio	Proxy for affordability
Inflation_Adjusted_Price	Shows real house price (adjusted for inflation)
Lagged_HousePrice	Previous year's price, supports trend modeling
Income_Growth_Rate	Measures economic progression year-on-year
Price_Growth_Rate	Reveals price momentum for forecasting

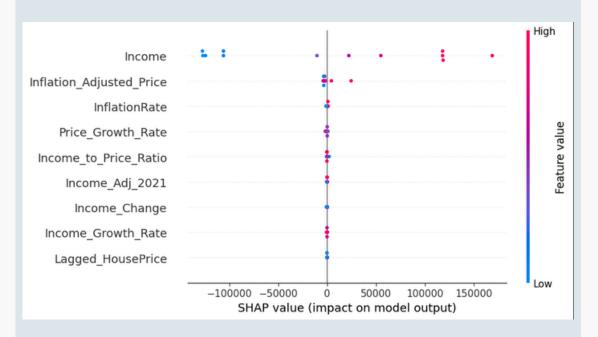# Predictive Modeling & Explainability

Modeling Approach

- **Model Type:**
  - Ensemble Stacking Regressor
- **Base Models:**
  - Random Forest Regressor
  - XGBoost Regressor
  - Linear Regression
- **Meta Learner:**
  - Linear Regression
- **Cross-Validation:**
  - 5-Fold

Performance Metrics

- R² Score: 0.9996
- RMSE: $2,321.30
- Interpretation: The model fits the data extremely well, indicating strong predictive power.

SHAP Summary Plot

- **Top Predictors:**
  - Income
  - Inflation Adjusted Price
  - Inflation Rate

These features had the largest influence on the model's output.

Insights & Recommendations

Stakeholder	Recommendation
Real Estate Firms	Use forecasts to identify growth regions and guide investment strategies.
Banks & Lenders	Incorporate model predictions to assess mortgage risk more precisely.
Policy Makers	Monitor housing affordability and inflation trends to adjust fiscal policy.

- Macroeconomic indicators can reliably predict house prices.
- Income, inflation-adjusted prices, and inflation rate were the strongest drivers of house price trends.
- Our model achieved very high accuracy ($R^2 = 0.9996$), meaning it's highly reliable for trend forecasting.

DASHBOARD

Thank you