

Feature Dependencies in US Home Prices

Introduction

Understanding the dependencies between various economic factors and US home prices is crucial for predicting and explaining changes in the housing market. In this report, we analyze the relationships between key factors and the Home Price Index (HPI) over the last 20 years. The factors considered include Interest Rate, Consumer Price Index (CPI), Unemployment Rate, Gross Domestic Product (GDP), Median Household Income, Housing Starts, S&P 500 Index, Dow Jones Index, and 30-Year Fixed Mortgage Rate.

Methodology

We collected data from reputable sources such as the Federal Reserve Economic Data (FRED) and Yahoo Finance for the specified indicators. After data collection, we performed cleaning and preprocessing to handle missing values and ensure data consistency.

To analyze the feature dependencies, we employed various techniques including correlation analysis, regression modeling, and feature importance analysis.

Results

Correlation Analysis

We calculated the correlation coefficients between each feature and the Home Price Index (HPI). The results are as follows:

- Interest Rate: Negative correlation with HPI, indicating that higher interest rates are associated with lower home prices.
- Consumer Price Index (CPI): Positive correlation, suggesting that inflation is associated with higher home prices.
- Unemployment Rate: Negative correlation, indicating that lower unemployment rates are associated with higher home prices.
- Gross Domestic Product (GDP): Positive correlation, indicating that stronger economic activity is associated with higher home prices.
- Median Household Income: Positive correlation, suggesting that higher incomes are associated with higher home prices.

- Housing Starts: Positive correlation, indicating that more housing starts are associated with higher home prices.
- S&P 500 Index, Dow Jones Index: Positive correlation, suggesting that a strong stock market is associated with higher home prices.
- 30-Year Fixed Mortgage Rate: Negative correlation, indicating that lower mortgage rates are associated with higher home prices.

Regression Modeling

We developed regression models to understand the relationship between the features and HPI in a predictive context. The coefficients of the regression models provide insights into the impact of each feature on HPI. For example, in the Linear Regression model:

- The coefficient for Interest Rate is negative, indicating that an increase in interest rates leads to a decrease in home prices.
- The coefficient for Median Household Income is positive, indicating that higher incomes lead to higher home prices.

Feature Importance Analysis

In the Random Forest Regressor model, we analyzed the feature importances to understand the relative contribution of each feature to predicting HPI. The results indicate that factors such as GDP, Median Household Income, and the S&P 500 Index have higher importance in predicting home prices compared to other factors.

Conclusion

The analysis reveals intricate dependencies between various economic factors and US home prices. Factors such as interest rates, inflation, economic activity, income levels, housing supply, and stock market performance all play significant roles in influencing home prices. Understanding these dependencies is essential for policymakers, investors, and stakeholders in making informed decisions related to the housing market.