Data Visualization Project: Analyzing the U.S. Housing Market Using Time-Series Data

Name: Rian Renold Dbritto

NUID: 002026598

Date: November 5, 2025

Analysis Report

Data Collection and Methodology

This project analyzes U.S. housing market dynamics from 2005 to 2025 using four critical time-series datasets obtained from the Federal Reserve Economic Data (FRED): median home prices (MSPUS), 30-year fixed mortgage rates (MORTGAGE30US), new privately-owned housing starts (HOUST), and vacant housing units (EVACANTUSQ176N). These metrics were selected to provide comprehensive insight into pricing trends, borrowing costs, construction activity, and inventory availability. The datasets were integrated using temporal indexing in Python, with Pandas handling data manipulation and Matplotlib/Seaborn generating visualizations. After addressing missing values resulting from different collection frequencies, seven complete quarterly observations spanning October 2009 to July 2021 were analyzed, covering a period that includes recovery from the 2008 financial crisis and the COVID-19 pandemic housing boom.

Key Trends in Home Prices and Mortgage Rates

The analysis reveals dramatic upward momentum in median home prices, which increased 80% from $219,000 in October 2009 to $395,200 by July 2021. This appreciation occurred in distinct phases: stable recovery through 2010, gradual growth from 2010-2015, steady acceleration from 2015-2020, and explosive post-pandemic growth with a 17% increase in just nine months during 2020-2021. Individual line charts effectively illustrate this sustained appreciation, with the 6-month rolling average visualization smoothing short-term fluctuations to emphasize the underlying bullish trend. Conversely, mortgage rates declined consistently from 5.08% to historic lows of 2.88%, reflecting Federal Reserve monetary easing policies implemented after the 2008 crisis and intensified during COVID-19. The annotated visualization marking the 2008 financial crisis and COVID-19 pandemic periods clearly demonstrates how these economic events shaped price trajectories.

Relationships Between Housing Metrics

The dual-axis comparison chart and correlation heatmap reveal critical interdependencies among variables. Most significantly, median home prices exhibit a strong negative correlation with mortgage rates (-0.95 based on the heatmap), confirming that lower borrowing costs directly stimulate demand by improving monthly payment affordability. As rates reached record lows around 2020, home prices accelerated dramatically.

Housing starts nearly tripled from 534,000 to 1,597,000 units, showing positive correlation with home prices (0.89) as rising values incentivized construction. However, vacant units simultaneously declined 20% from 19.0 million to 15.2 million units, demonstrating that supply consistently lagged demand despite increased construction, creating highly competitive market conditions characterized by bidding wars and limited inventory.

Cyclical Patterns and Economic Event Impacts

While the dataset's quarterly frequency limits seasonal analysis, longer economic cycles are evident through the yearly average dashboard visualization. The 2008 financial crisis created prolonged market suppression with depressed prices and minimal construction through 2010, requiring nearly a decade for full recovery. In stark contrast, the COVID-19 pandemic produced opposite effects—rather than suppressing the market, it triggered an unprecedented boom. The annotated graph clearly highlights this divergence: post-2020 prices surged due to record-low mortgage rates enabling remote work migration, pandemic-era lifestyle changes increasing housing demand, limited inventory from construction disruptions, and increased investor activity. The housing starts versus vacant units comparison effectively illustrates how new construction was rapidly absorbed, with opposite directional movements confirming supply-demand imbalances.

Conclusions and Implications

This analysis demonstrates that the U.S. housing market experienced sustained appreciation driven primarily by accommodative monetary policy and insufficient supply response. Despite housing starts nearly tripling, persistent inventory decline confirms structural barriers limiting adequate supply growth including zoning regulations, land constraints, and labor shortages. The market's demonstrated sensitivity to interest rates presents risks as policy normalizes, with future trajectories depending on rate adjustment pace, construction capacity expansion, and regulatory reforms addressing housing affordability challenges for American families.