

Analyzing the Impact of Interest Rates and Inflation on Car Sales Using Data Analysis

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Introduction: Interest rates and inflation play crucial roles in the automotive industry by influencing consumer purchasing power, financing costs, and overall demand for vehicles. As these economic indicators fluctuate, they impact both new and used car sales, affecting manufacturers, dealerships, and financial institutions. Our project aims to analyze the relationship between interest rates, inflation, and car sales using statistical analysis and historical data trends.

Topic: This project will investigate how changes in Federal interest rates and inflation affect car sales using historical data from Statista and Kaggle. By analyzing trends and correlations, we aim to understand the extent to which these economic factors impact consumer purchasing decisions.

Hypothesis:

- **Null Hypothesis (H_0):** There is no significant relationship between interest rates, inflation, and car sales. Changes in these economic indicators do not directly affect car sales volume.
- **Alternative Hypothesis (H_1):** There is a significant relationship between interest rates, inflation, and car sales. As interest rates and inflation increase, car sales decline due to higher financing costs and reduced purchasing power, whereas lower interest rates and inflation levels lead to increased car sales due to more affordable loans and stable prices.

Dataset: We used the following datasets:

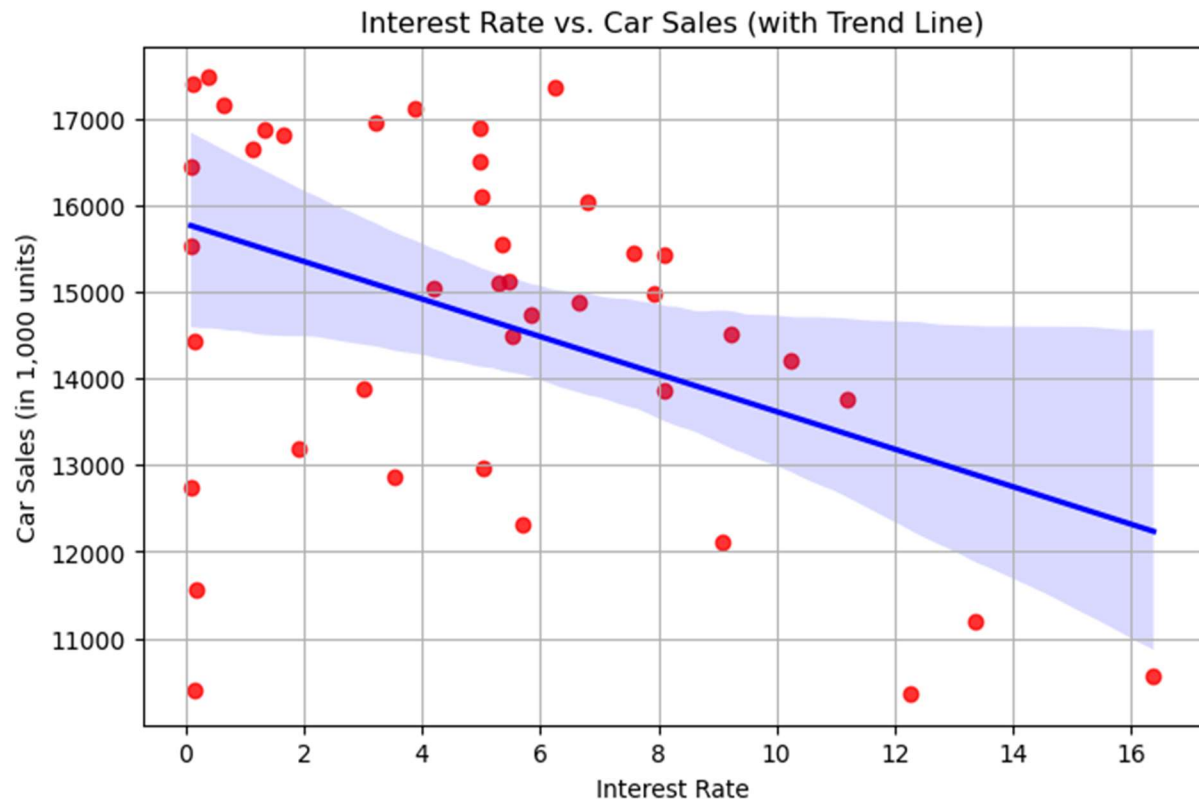
1. Car Sales Data –(<https://www.statista.com/statistics/199983/us-vehicle-sales-since-1951/>): Provides car sales by year.
2. Interest Rates Data - (<https://www.kaggle.com/datasets/federalreserve/interest-rates>):
This dataset provides historical interest rate trends, including federal funds rates and loan interest rates relevant to vehicle financing.

Data Preprocessing:

- Cleaned and preprocessed the datasets by handling missing values and removing inconsistencies.
- Only kept relevant columns.
- Merged datasets based on time periods to align car sales with corresponding interest rates.
- Conducted exploratory data analysis (EDA) to identify trends and potential correlations.

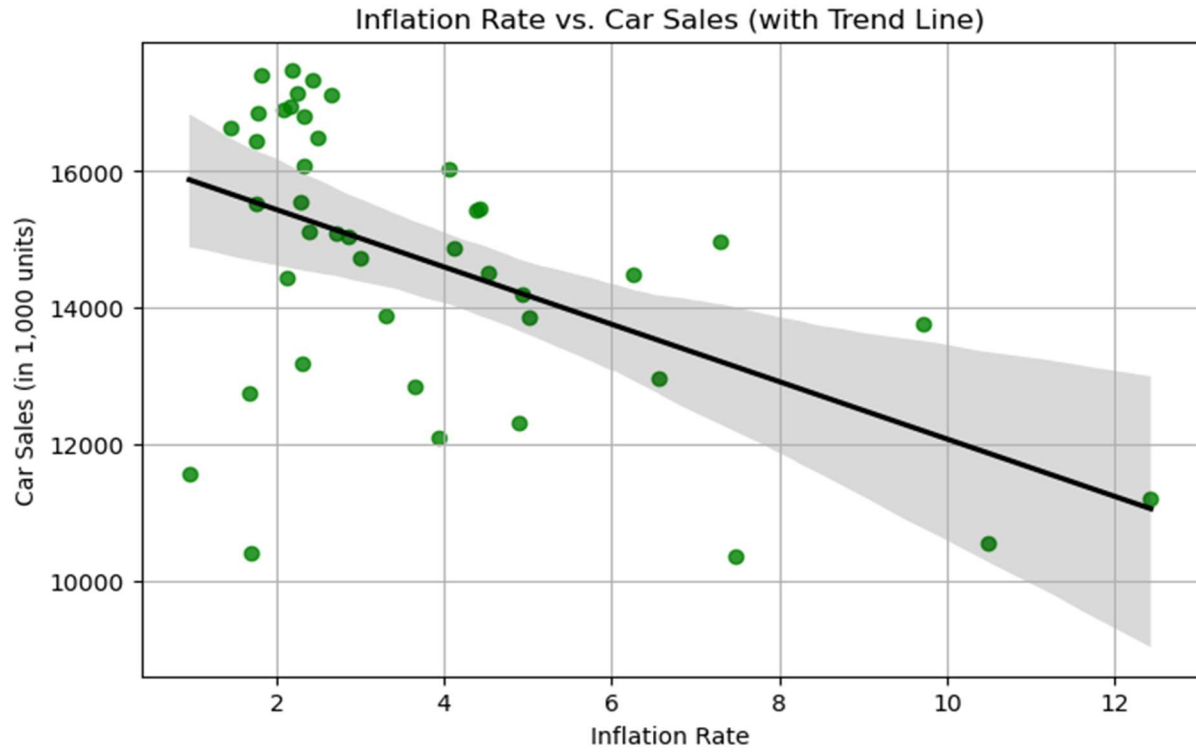
Data Visualization and Correlation Analysis

1. Scatter Plot with Trend Line (Interest Rate vs. Car Sales)



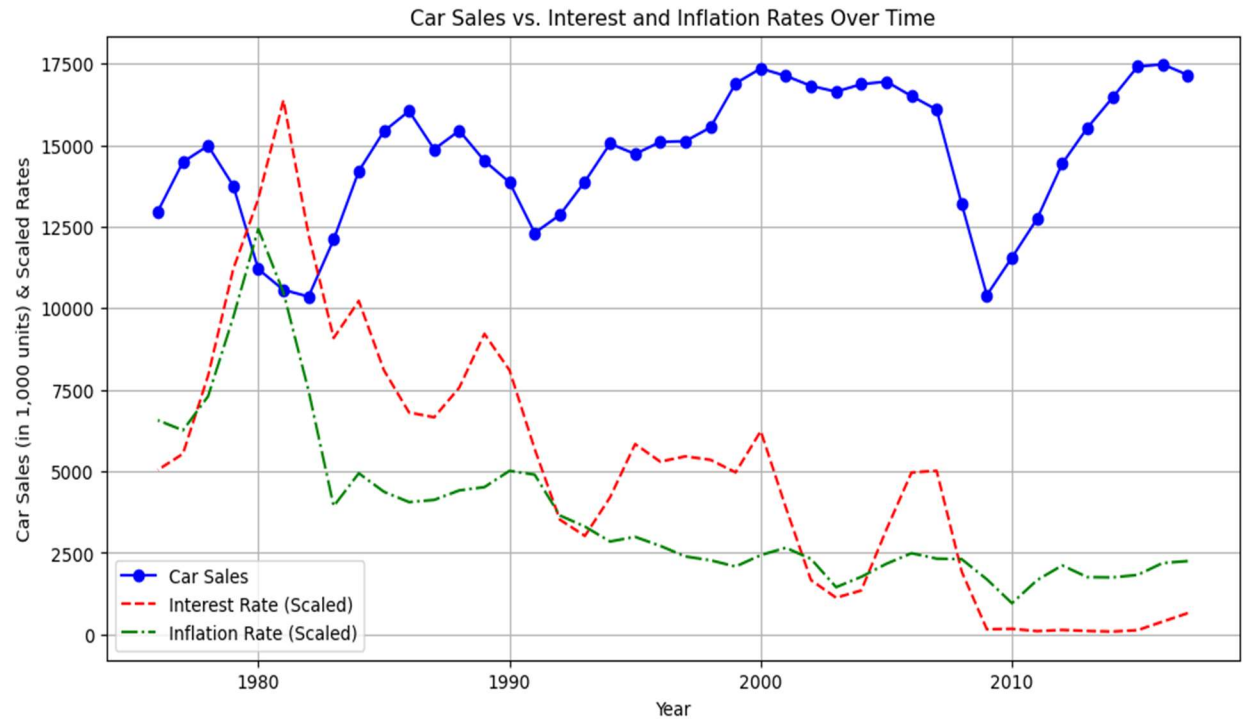
This scatter plot shows a clear negative trend between interest rates and car sales. When interest rates go up, car sales usually go down. This makes sense because higher interest rates mean loans are more expensive, which can discourage people from financing a vehicle. The downward trend line supports our hypothesis that interest rates have a direct impact on car sales.

2. Scatter Plot with Trend Line (Inflation Rate vs. Car Sales)



The second scatter plot also shows a negative relationship, this time between inflation and car sales. As inflation increases, car sales tend to decrease. This could be because rising prices lower people's purchasing power, making it harder to afford big purchases like cars. The trend line highlights this inverse relationship, even though there's some variation in the data.

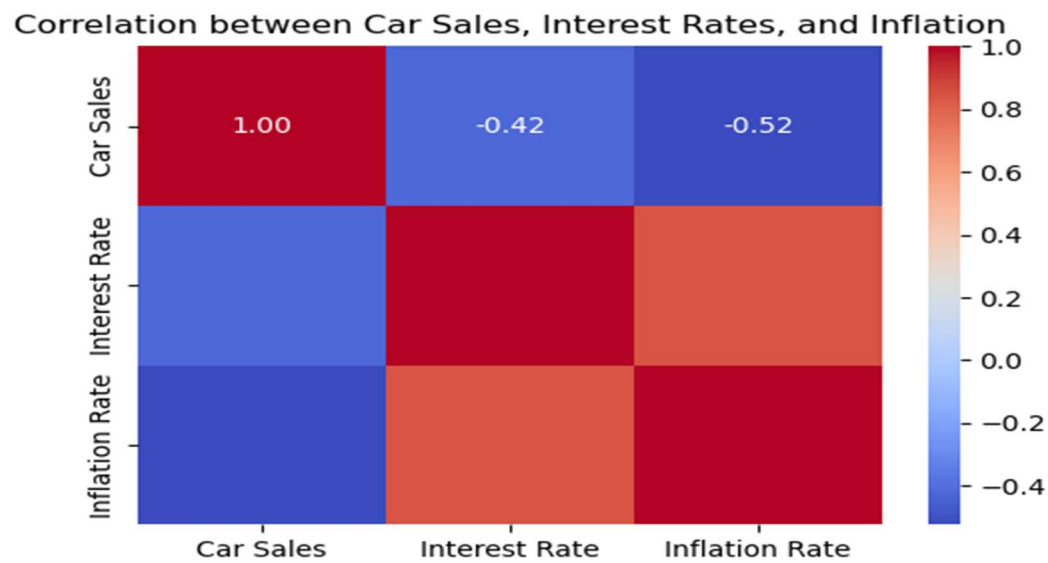
3. Line Plot Over Time (Car Sales, Interest Rates, and Inflation)



In the line plot, we can see how car sales, interest rates, and inflation have changed over time.

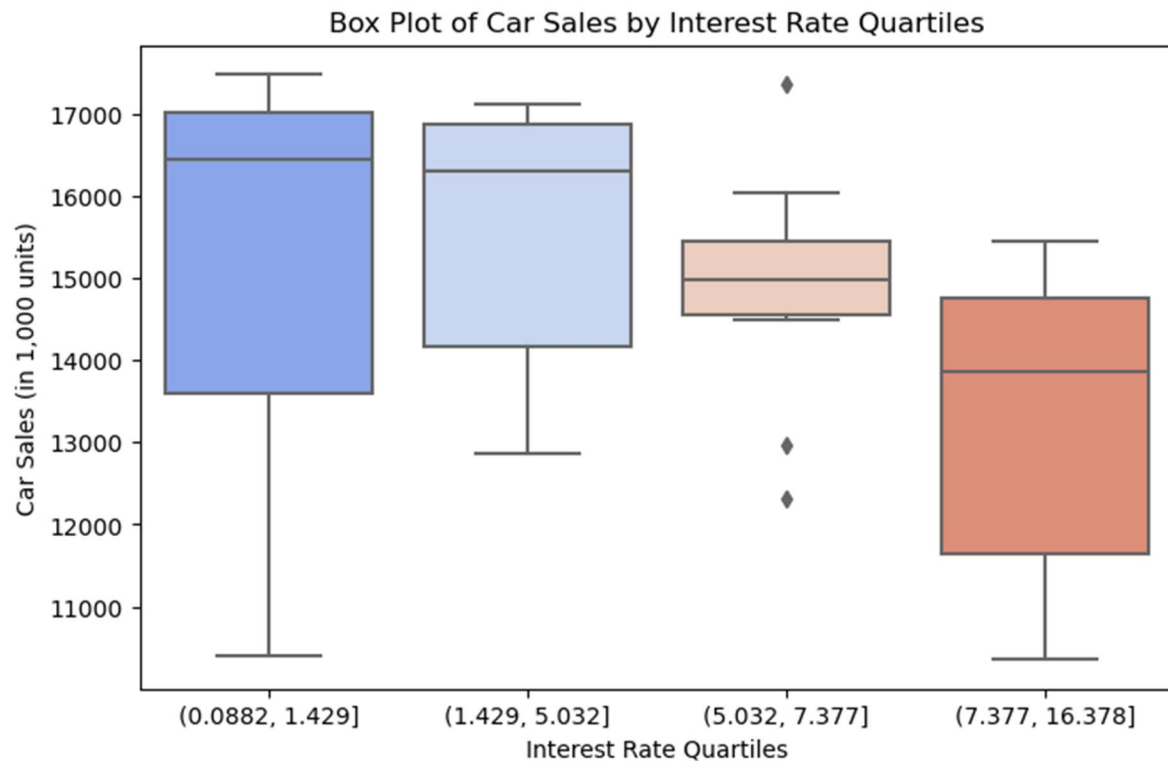
There's a noticeable pattern: when both interest and inflation rates are high, car sales drop. On the other hand, when these rates are low, car sales seem to go up. This long-term view helps us understand how economic changes influence consumer behavior in the car market.

4. Heatmap (Correlation between Car Sales, Interest Rates, and Inflation Rates)



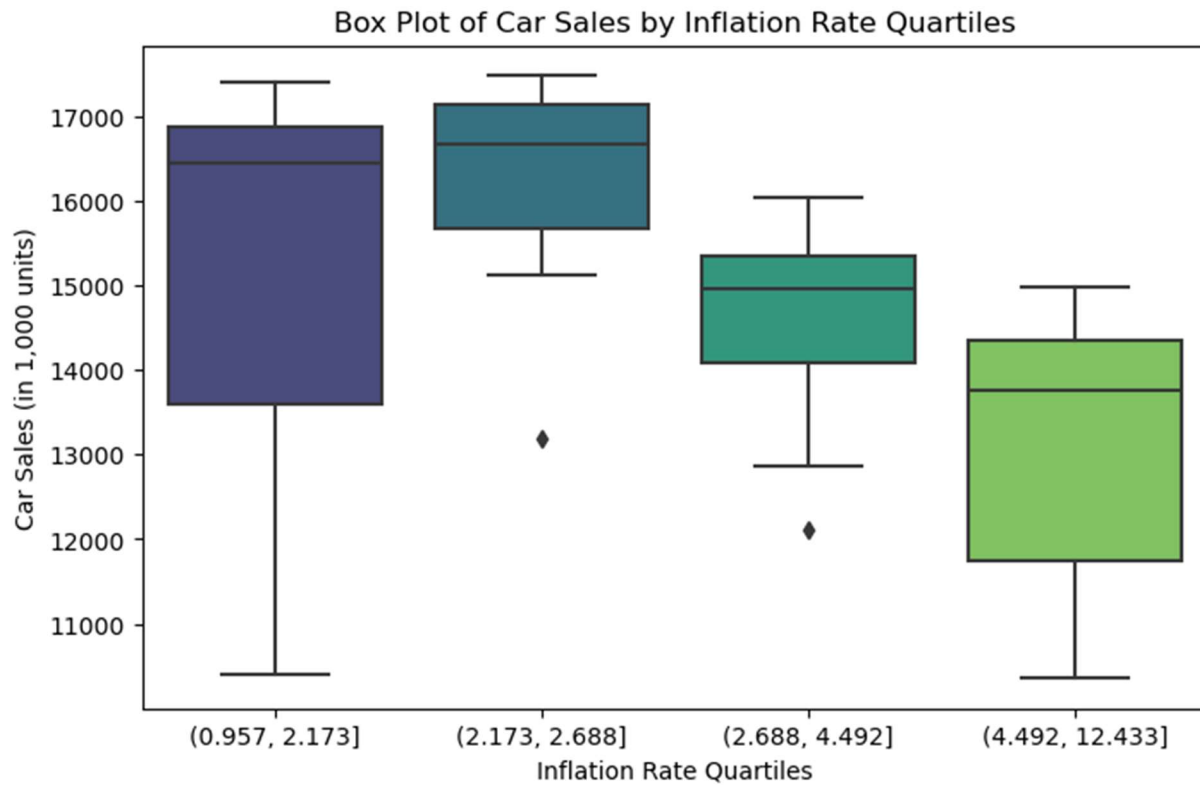
The heatmap shows the strength of the relationships between the variables using correlation values. It confirms that car sales are negatively correlated with both interest and inflation rates. While the correlations aren't extremely strong, they are definitely noticeable, which supports our idea that these factors play a role in how many cars get sold.

5. Box Plot of Car Sales by Interest Rate Quartiles



This box plot breaks car sales into groups based on interest rate levels. It shows that when interest rates are low, car sales are generally higher. As we move to higher interest rate quartiles, car sales decrease. This supports the idea that lower loan rates encourage more people to buy cars.

6. Box Plot of Car Sales by Inflation Rate Quartiles



Like the previous plot, this one looks at how car sales vary based on inflation rate levels. The results are similar: lower inflation rates are linked to higher car sales. Higher inflation seems to reduce consumer spending, which likely affects major purchases like vehicles.

Challenges and Limitations

- **Data Quality:** Some missing values and inconsistencies required preprocessing.
- **Outliers:** Certain extreme values influenced visualization results.
- **Subjective Interpretation:** As this analysis is visualization-based, deeper statistical tests would be required for formal confirmation.

Recommendations & Future Work

- Conduct more refined statistical hypothesis testing (e.g., regression analysis) to quantify relationships.
- Expand the dataset to verify consistency across different samples.
- Utilize machine learning techniques to predict trends based on correlations observed.
- Develop an interactive dashboard for dynamic exploration of the data.

Conclusion

Overall, all the visualizations arrive to the same conclusion: there is a negative relationship between car sales and both interest and inflation rates. As these rates rise, car sales tend to fall. This supports our alternative hypothesis and shows that economic conditions, especially financing costs and price stability—have a big impact on people’s ability and willingness to buy cars.