**Automotive Car Loan Analysis**

The attached analysis dives in to Auto Loan patterns over a 10-year period, broken down by quarter; to answer the questions below.

1. Are the number of people taking out loans increasing or decreasing?
2. Has the number of people purchasing cars increased or decreased?
3. Do trends in loan approvals correlate with trends in car purchases?

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**Data Sources**

To ensure we had consistency among all our data sets, we first reviewed the timeframe we wanted to focus on. To work with a large enough timeframe that we could see visible trends in the data. Since data for Population for 2024 was not yet available, we chose to end our pull parameter for all the data at Q4 2023. FRED (Federal Reserve Bank of St. Louis) enables a pull parameter to be set for each data set. Once we determined our range, we extracted the relevant .csv files into our GitHub repository. The files we chose are noted below:

•Balance Sheet: Total Assets: Loans to Individuals: Other Loans to Individuals: Auto Loans = <https://fred.stlouisfed.org/seriesBeta/QBPBSTASLNINDVOLNINDCARLN>

•Average Finance Rate of New Car Loans at Finance Companies, Amount of Finance Weighted = <https://fred.stlouisfed.org/series/RIELPCFANNM>

•Average Amount Financed for New Car Loans at Finance Companies = <https://fred.stlouisfed.org/series/DTCTLVENANM>

•Total Vehicle Sales = <https://fred.stlouisfed.org/series/TOTALSA>

•Auto Inventory/Sales Ratio = <https://fred.stlouisfed.org/series/AISRSA> •Population = <https://fred.stlouisfed.org/seriesBeta/POPTHM>

•API - Population Data = [https://api.census.gov/data/2019/pep/charagegroups?get=NAME,POP&for=us:\*&key={census\_key}](https://api.census.gov/data/2019/pep/charagegroups?get=NAME,POP&for=us:*&key=%7Bcensus_key%7D)

•API 2 - Population Data = <https://datausa.io/api/data?drilldowns=Nation&measures=Population>

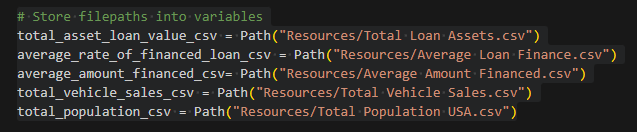
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**Data cleaning, importing and coding in “VS Code”**

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Import identified data sources from FRED.



A screen shot of a computer code

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**Question 1 Analysis:**

Are the number of people taking out loans increasing or decreasing?

Using VS Code, we created a Jupyter Notebook to analyze and clean the datasets we planned to work with. Our analysis began with the Total Asset Loan Value file.

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Our first step was to rename the column in the data set to be clear and easier to utilize within our code.

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Description automatically generated

Our next step focused on formatting the number to match the unit of measure which was “Millions of U.S. Dollars”

A screenshot of a computer code

Description automatically generated

The following step was to incorporate Loan Rates into the data frame by cleaning the data: renaming the column, removing "NaN" values, and calculating the quarterly rate by multiplying the monthly rate by 3.A screenshot of a computer program

Description automatically generated

We then focused on the data set for Average Financed Amount and cleaned the data.

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To create a comprehensive data frame for analysis, we began merging the data using the DATE column with the pd.merge function.

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Description automatically generated

To ensure these values can be utilized effectively, we validated their data types to ensure they were formatted correctly.

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We can now calculate the Average Loan Amount by first determining the interest earned each quarter and then adding it to the average financed amount. We believe this approach provides a more accurate representation of the value that can be used to divide against the Total Loan Values on the balance sheet, helping to estimate the number of people receiving loans.A screenshot of a computer

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A screenshot of a computer

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We began by constructing graphs, starting with the Total Loans over a 10-year period.A computer screen with white and orange text

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A graph with a line going up

Description automatically generated

The subsequent step involved plotting the Average Loan Amount over the 10-year periodA computer screen shot of a program

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A graph with a line going up

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Finally, we plotted the graph representing the Total People Getting Loans, which provided the insights needed to answer the question we posed.

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A graph with a line

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**Analysis:** To answer the question, "Are the number of people taking out loans increasing or decreasing?" our calculations of the estimated total number of people getting loans, show a sharp increase following the COVID-19 pandemic, followed by an equally significant decline in the subsequent quarters. Looking at these trends over the past 10 years, we can confidently conclude that the number of people taking out loans is rapidly decreasing.

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**Question 2 Analysis:**

Has the number of people purchasing cars increased or decreased??

To answer this question, we analyzed Total Car Sales data over a 10-year period. However, we recognized that this data alone didn’t fully address the question. With population growth across the U.S., simply calculating total car sales wouldn’t account for the impact of population increases on car purchases. Instead, we focused on the average number of car purchases per person, as this approach would more accurately reflect trends in car buying behavior.

Our first step was to obtain population metrics. We initially attempted to source this data from the U.S. Census via API. However, upon reviewing the data, we encountered issues with the timeframe, as the available Census data only provided population figures for 2019. We attempted to use a “For” loop to populate the different years within our scope, but we quickly realized 2019 was the only viable year in this dataset.

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Description automatically generated

We then turned to a secondary source, Data USA, to obtain the population data via API. We successfully retrieved the data and broke it down into quarterly segments.A computer screen shot of a black screen

Description automatically generated

Unfortunately, upon reviewing our data frame, we realized the data ended in 2021. While we wanted to effectively utilize an API for this metric, we felt ending the data this early would fail to represent post COVID trends accurately.

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Description automatically generated

Based on the results from our API attempts, we inevitably decided to source the data from FRED as we were able to get the annual population data within our desired timeframe. We pulled the file into our data set as indicated in our VS Code.

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Our first step was to rename the column in the data set to be clear and easier to utilize within our code and to link with pd.merge against “DATE” vs “Year”

A screen shot of a computer

Description automatically generated

To provide context for our total vehicle sales, we decided to include a graph showing the population increase over the same timeframe.A graph with lines and numbers

Description automatically generated

The following step was to incorporate Total Vehicle Sales into the data frame by cleaning the data: renaming the column, removing "NaN" values, and calculating the quarterly rate by multiplying the monthly rate by 1,000,000 as that was the accurate unit of measure indicated by the FRED dataset.

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Description automatically generated

Similarly in our previous data frame creation, to create a complete data frame for analysis, we began merging the data using the DATE column with the pd.merge function.

A screenshot of a computer screen

Description automatically generated

We can now calculate the Average Car Sales Per Person by dividing the total vehicle sales (in millions) by the population for each corresponding period. This calculation allows us to determine the average number of cars sold per person, providing a clearer view of car purchasing trends in relation to population growth over time. By examining this metric, we can better understand whether car purchases are increasing or decreasing on a per capita basis, accounting for changes in population.

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With the newly calculated metrics for Average Car Sales Per Person, we can now plot the data to draw effective insights.

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**Analysis:** To answer the question, "Has the number of people purchasing cars increased or decreased?" our calculations of the Average Car Sales Per Person show a sharp increase following the COVID-19 pandemic. Unlike the trend observed in loan data, which saw a continued decline after an initial drop, car purchases experienced a slight decline in the subsequent quarters before rebounding and trending upwards. Analyzing these trends over the past 10 years, we can confidently conclude that the average number of car purchases per person is increasing and returning to pre-pandemic levels.

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**Question 3 Analysis:**

Do trends in loan approvals correlate with trends in car purchases?

Based on the graphs we created to address our first two questions; we sought to analyze why the Estimated Total People Getting Loans did not follow the same pattern as the Average Car Sales Per Person. Initially, we hypothesized that these two metrics would show similar movements. However, upon reviewing the post-pandemic data, we observed a contrasting trend and realized further investigation was needed to understand the factors driving this opposite correlation.

A screenshot of a graph

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It didn't take long to identify the disparity between car buying trends and auto loan acquisition, and we concluded that fluctuating loan rates were likely a significant factor influencing this difference.

We decided to plot the Loan Rate over the 10-year period to examine the data further to see if it supports our hypothesis.A computer screen shot of text

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A graph with a line

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A graph with a line and arrow pointing to the end

Description automatically generated with medium confidence

After comparing the graphs together, we can clearly identify the periods of increasing rates typically corresponding to a decrease in the number of people obtaining auto loans. Making this the primary factor for people deciding to get loans.

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**Analysis:** To answer the question, "Do trends in loan approvals correlate with trends in car purchases?" we observed similar patterns in our calculations of Average Car Sales Per Person and Estimated Total People Getting Loans before the COVID-19 pandemic. However, as loan rates began to vary post-pandemic, we saw a direct correlation between these changes and our Estimated Total People Getting Loans, while Average Car Sales followed a different trajectory. Although we initially assumed that car purchases would influence the number of people taking out loans, we concluded that loan rates played a more significant role in shaping the trend for this particular metric.

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**Conclusion**

In conclusion, despite the current high inflation, there is a noticeable trend towards consumers opting to purchase cars outright rather than relying on long-term loans. As highlighted in the summary, the correlation between loan approvals and car purchases indicates that loan rates significantly influence the decision to finance vehicle purchases through loans.

This relationship is particularly evident in the post-COVID period, where loan amounts dropped to their lowest point, coinciding with a substantial increase in loan applications. Similarly, following the first quarter of 2022, as loan rates increased, there was a corresponding decline in the number of consumers choosing loan options over outright purchases.

Given these observations, it is reasonable to anticipate that as loan rates continue to rise, the trend of declining loan applications will persist. To mitigate this and generate additional revenue from loan services, car manufacturers would be well-advised to consider reducing interest rates to make long-term loan options more attractive to potential buyers.