

GROUP WORK PROJECT # _1_
GROUP NUMBER: ____4801____

MScFE 600: FINANCIAL DATA

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Statement of integrity: By typing the names of all group members in the text boxes below, you confirm that the assignment submitted is original work produced by the group (excluding any non-contributing members identified with an “X” above).

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Use the box below to explain any attempts to reach out to a non-contributing member. Type (N/A) if all members contributed.

Note: You may be required to provide proof of your outreach to non-contributing members upon request.

N/A

Step 1: Magnifying Risk Factors:

| | Leverage Challenges | Non-linearities Challenges |
|--|--|--|
| Money at a fixed rate for an unsecured purchase | -> Unsecured Debt: the loan is not secured by any collateral, instead, it is guaranteed by the credit of the borrower. Leverage exists if the credit limit utilized is higher than the actual cash. | -> Credit Score and Risk: the risk of lending is not linear with the credit score, utilization, or interest rate, making modeling and prediction of risk challenging. |
| Money at a floating rate for a secured purchase | -> Collateral Value: the value of the collateral to the loan (loan-to-value ratio, LTV) is critical for the risk to the lender. Since the collateral value may fluctuate, a higher leveraged loan (having a higher LTV) is riskier than others. -> Borrower's Leverage: a higher LTV also usually indicates the borrower paid less downpayment, and the financial leverage on the borrower side also significantly affects the risk of lending. | -> Credit Score and Risk -> Collateral Value: a non-recourse loan is similar to selling a put option. When the collateral price drops below the loan value, the borrower may default and choose not to pay. In this case, the loss may be up to 100%. |
| Money at a fixed rate for a business for a construction loan | -> Borrower's Leverage: occurs when a company takes out a loan to fund a building project. While the interest rate on fixed-rate loans doesn't change over the course of the loan, labor and material costs might. In the event that labor and material costs rise, the borrower's profit margin could fall or even become negative. This is so even though construction costs have gone up, the fixed-rate loan payments will stay the same. | -> Collateral value: If the real estate market or economy deteriorates, the loan amount may drop, making it more challenging for the borrower to refinance the loan or sell the property to pay off the debt. -> Unexpected costs: Unexpected expenses can raise the project's overall cost. Examples of these expenses include construction delays and unanticipated repairs. This may strain the borrower's finances and make repayment challenging. -> Market oscillations: The construction sector may be impacted by changes in the economy, such as inflation or deflation. Businesses may find it difficult to adjust to unforeseen changes in the market, and |

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| | | fixed-rate loans may not react to shifting economic conditions. |
| Publicly traded Equity | <p>-> Borrowed Fund: Investors using borrowed funds to buy publicly traded equity are magnifying their exposure in the market which can lead to greater leverage challenges.</p> <p>-> Using Derivatives: Leverages Challenges can be also introduced through derivative instrument trading of the publicly traded equity.</p> | <p>-> Idiosyncratic risk: Some news and events can exhibit non-linear reactions in the publicly traded fund.</p> <p>-> Derivative nature: The non-linear payoff structure of derivative instruments can also increase non-linearities challenges.</p> |
| Publicly traded bond | <p>-> Borrowed Fund: Investors using borrowed funds to buy publicly traded bonds are magnifying their exposure in the market which can lead to greater leverage challenges.</p> | <p>-> Interest rate Change: A change in interest rate can exhibit non-linear price movement in bonds.</p> |
| An illiquid security | <p>-> Limited borrowing capacity: Because there aren't many active markets, illiquid securities may have a limited ability to borrow money.</p> <p>-> Difficulty in Valuation: Investors may find it challenging to determine the right level of leverage if there are no established market valuation standards because illiquid securities frequently lack regular trading and transparent prices.</p> <p>-> Higher cost of capital: There may be a higher cost of capital when using leverage for illiquid securities.</p> | <p>-> Price Impact: Trading large quantities of illiquid securities can have a negative impact on their price and possibly result in losses.</p> <p>-> Limited exit options: Investors may find it challenging to quickly exit positions in illiquid securities due to the absence of an active secondary market, particularly in times of market downturn, recession, or financial strain.</p> <p>-> Volatility Spikes: Unevenly volatile markets can have abrupt swings, particularly in the presence of little trading activity. This can result in non-linear price fluctuations, which makes it challenging for investors to anticipate and effectively manage risk.</p> <p>-> Increased Sensitivity to News and Events: Because of their lower trading volume, illiquid securities may be more susceptible to particular news or events. This could lead to a non-linear price response, which could cause abrupt and unanticipated changes</p> |

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| | | in the value of the securities. |
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Step 2: Statistical Related Challenges

| | Liquidity Challenges | Regulation Challenges |
|--|--|--|
| Money at a fixed rate for an unsecured purchase | -> Cash Flow: prediction and management of the cash flow is needed to prevent any sudden increase in borrowing or higher default rates. | -> Customer Protection Laws: the fees chargeable and debt liability of borrowers are limited by law, complying with the law while being profitable is challenging. -> Risk Management: regulation usually requires the lenders to have enough capital and strict risk management standards. |
| Money at a floating rate for a secured purchase | -> Loss in foreclosure: since collateral is usually illiquid assets (e.g. house), foreclosure may lead to significant unexpected loss, especially in down markets. | -> Risk Management: regulations require the originators of mortgages to comply with risk management standards, e.g. capital requirements and securitization of mortgages. |
| Money at a fixed rate for a business for a construction loan | -> Low liquidity: It might be challenging to sell or refinance the loan before it expires. This is so that the investor cannot purchase the loan from the borrower and earn a higher return because interest rates are fixed. -> Less flexibility in cash flow: companies have to adhere to set payment schedules. Overall liquidity may be impacted if a construction project experiences delays or unforeseen expenses that make it difficult to maintain the cash flow required to pay off debt. -> Limited capacity to adjust to market conditions: Because interest rates are fixed, | -> Adherence to regulatory standards: Financial authorities have imposed a number of regulatory standards on construction loans. -> Environmental and safety laws: Tight environmental and safety laws are frequently applicable to construction projects. The construction process will become more complicated as a result of these regulations, which could also increase costs. -> Zoning and Permitting Requirements: Complying with zoning regulations and obtaining required permits can present legal challenges that can impede construction projects, thereby |

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| | businesses may lose out on chances to profit from interest rate reductions. While fixed rates offer stability, they restrict the potential to lower interest expenses in the event that market rates decline. | impeding project progress and, ultimately, the debt repayment schedule. -> Modifications to interest rate laws: Regulators have the authority to alter interest rate laws, which could have an impact on fixed-rate loan terms and conditions. |
| Publicly traded Equity | -> Illiquid stocks: less attractive for Institutional investors to buy blocs of shares. -> Attractive to activism: Activist investors can target less liquid equity for a costly exit. | -> Adverse selection: Informed traders can have an edge -> Insider trading |
| Publicly traded bond | -> Fragmentation: Different bonds issued by different issuers, different maturities, and different coupons will have varying liquidity. -> Borrowing issue: Difficulty in borrowing illiquid bonds due to owner preferences. | -> Adverse selection: The issuer can issue a Risky bond as there is information asymmetry. -> Model Error: Rating agencies can rate risky bonds as safe. |
| An illiquid security | -> Price Impact: Trading even a small volume of illiquid securities can have a big influence on their price because of the small number of traders and market participants. When trying to execute trades, investors might run into wider bid-ask spreads and non-linear price fluctuations. -> Extended holding times: It can be difficult to sell illiquid securities quickly, which results in extended holding times. Long-term capital constraints brought on by this lack of liquidity can make it more difficult to reallocate capital or seize new investment opportunities. | -> Reporting: The absence of uniform market practices and valuation standards can make accurate and timely reporting challenging. -> Valuation: Estimating an illiquid security's fair market value is frequently arbitrary and may rely more on internal models. -> Market manipulation: To guarantee honest and open trading procedures, regulators can take action to identify and stop market manipulation activities. |

| | | |
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| | <p>-> Higher transaction costs: Securities with low liquidity frequently have higher transaction costs. Increased transaction execution costs and wider bid-ask spreads could lower overall investment returns.</p> | |
|--|--|--|

Step 3: Identifying Data

- **Money at a fixed rate for an unsecured purchase (e.g. credit card) for an individual.**
 1. **Data Type:** loan amount, credit score, income and employment status, other debts, utilization rates, interest rates, employment income, savings account amount
 2. **Data Preprocessing:** modeling credit risk, scoring models or borrower, default probability analysis
 3. **Data Frequency:** Monthly, Quarterly, Annually, and all history
 4. **Data Class:** Credit
 5. **Data Source:** credit bureaus, banks, customer submission, interest rate indexes
 6. **Data Variety:** Actual Data, Modeled Data, Adjusted Data, Relative Data
- **Money at a floating rate for a secured purchase (e.g. home or automobile) for an individual.**
 1. **Data Type:** property value, loan amount, credit score, income and employment status, other debts, utilization rates, interest rates, market trends, market liquidity
 2. **Data Preprocessing:** modeling credit risk, scoring models or borrowers, default probability analysis, market modeling, collateral valuation, interest rate prediction, liquidity modeling
 3. **Data Frequency:** Monthly, Quarterly, Annually
 4. **Data Class:** Credit, real estate
 5. **Data Source:** credit bureaus, banks, customer submission, interest rate indexes, property dealers
 6. **Data Variety:** Trade Data, Actual Data, Observed and Modeled Data, Adjusted Data, Relative and Absolute Data.
- **Money at a fixed rate for a business for a construction loan.**
 1. **Data Type:** Loan value, collateral value, current debt amount, interest expense, economic indicators affecting the construction industry (e.g., GDP, housing starts), Credit ratings of borrowers, interest rates, and regulatory changes.
 2. **Data Processing:** Loan performance metrics, Volatility of interest rates, and construction market indicators
 3. **Data Frequency:** Weekly, Quarterly, Annually
 4. **Data Class:** Credit, fixed income, real estate
 5. **Data Source:** Financial Statements, Industry Data, Company Data, Economic Indicators

6. **Data Variety: Actual Data, Observed Data, Estimated Data, Modeled Data, Real-time data**
- **Publicly traded Equity (e.g. common stock) – that is, securities lending of a Stock.**
 1. **Data Type: OHLC prices, Volume, Dividend yields, EPS, P/E Ratio, Market Cap, Beta, Dividend yield, Volatility**
 2. **Data Processing: Adjustments for stock splits and dividends, Financial ratio Calculation, Stock price volume analysis, Volatility analysis, Leverage analysis, Stress test**
 3. **Data Frequency: Daily, Quarterly, weekly, Annually, HFT**
 4. **Data Class: Equity, VIX**
 5. **Data Source: Exchanges, Financial Reports, Financial statements, Data Brokers, Alternative data providers**
 6. **Data Variety: Quote data, Trade Data, Modeled Data, Alternative Data**
 - **Publicly traded bond (e.g. treasury bond, corporate bond) – that is, securities lending of a bond.**
 1. **Data Type: Rating Data, Yield to maturity, Credit Spreads, Coupon Rates, Duration, Liquidity, Volatility**
 2. **Data Processing: Levels, Price to Yield, issuer creditworthiness, Volatility analysis, Leverage analysis, Stress test, Liquidity Analysis**
 3. **Data Frequency: Varying frequency, Event-Driven, Alternative data**
 4. **Data Class: Credit data, Central bank**
 5. **Data Source: Exchanges, Brokers, Credit rating agencies, central banks data, market survey, alternative data brokers.**
 6. **Data Variety: Modeled data, Trade data, Alternative data**
 - **An illiquid security – Small-cap stocks.**
 1. **Data Type: market capitalization, shares outstanding, financial statements**
 2. **Data Processing: stock prices, dividend yields, financial ratio,**
 3. **Data Frequency: Daily, Quarterly, Weekly, Annually**
 4. **Data Class: Equity, Market Indices**
 5. **Data Source: Exchanges, Financial Reports, Financial statements**
 6. **Data Variety: Quote data, Modeled data, Trade data**

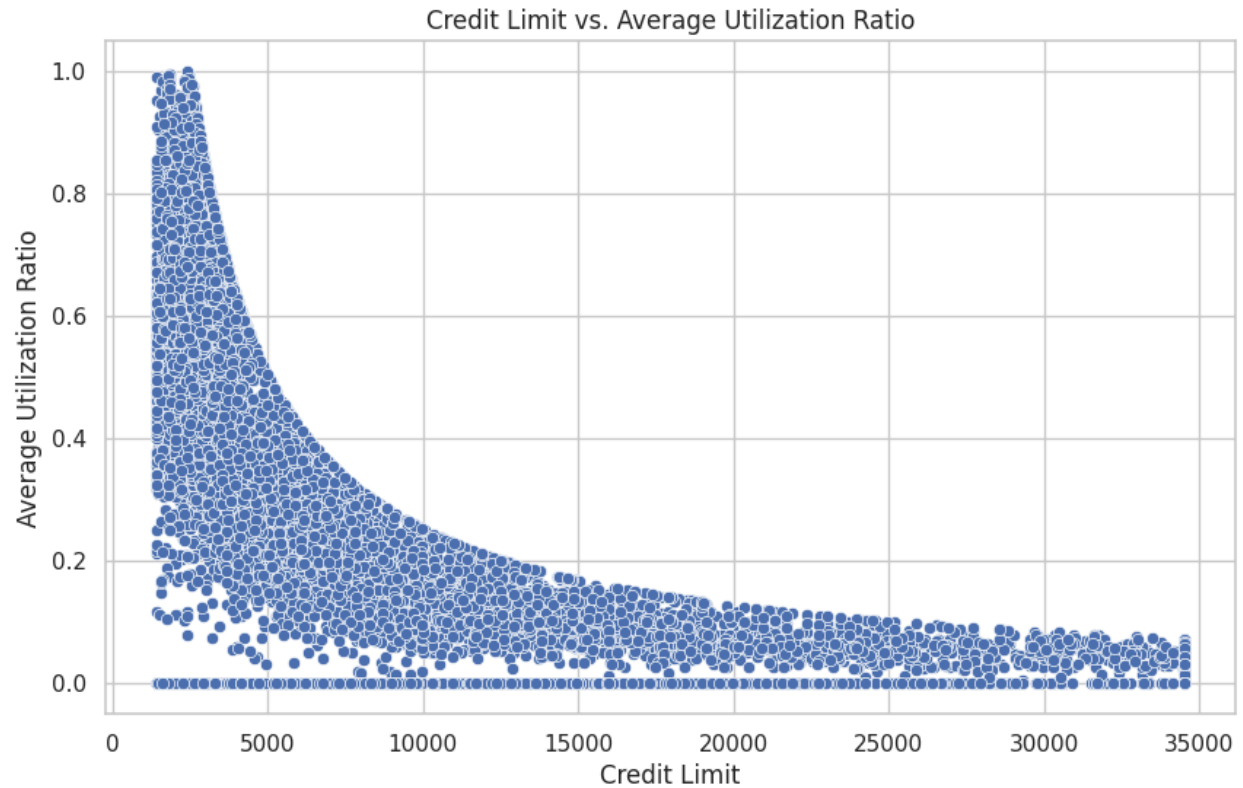
Step 6: Describe how the data can help to meet the challenge

1. Money at a fixed rate for an unsecured purchase

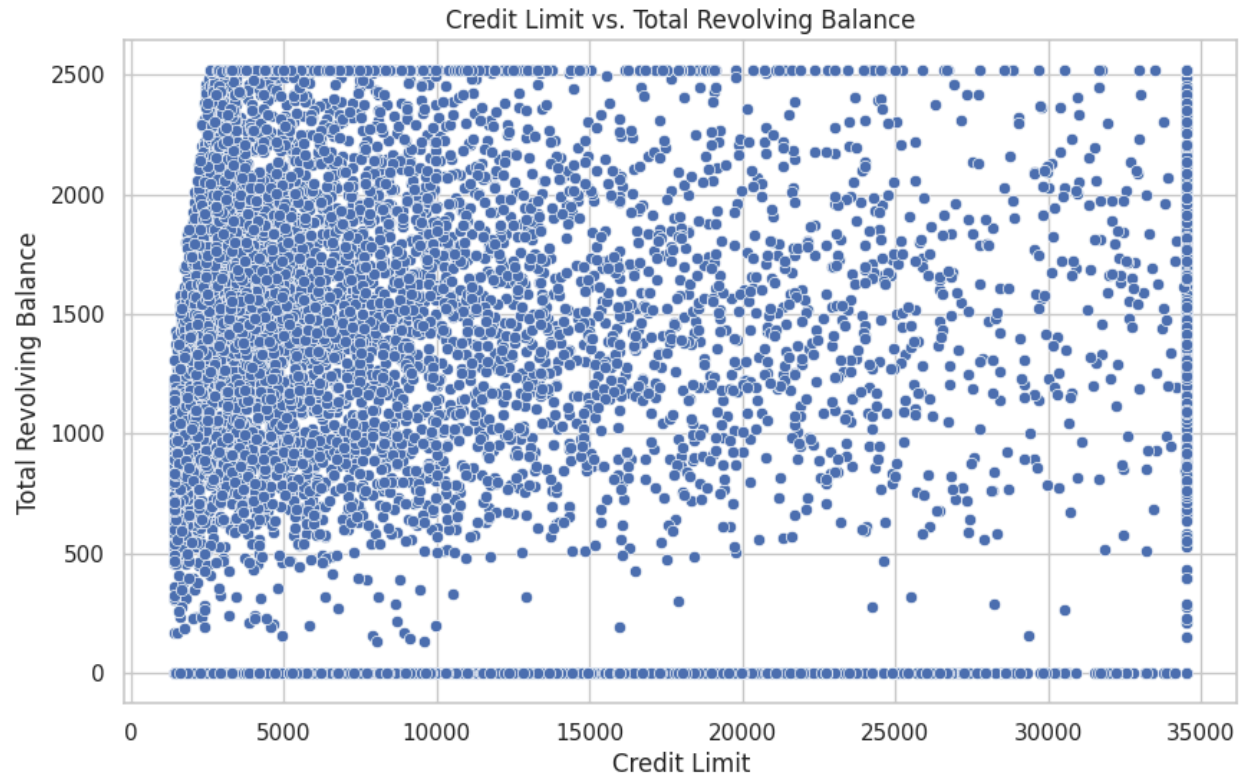
We use the Credit Card customers dataset found on Kaggle which contains 10000 entries with the following key attributes:

- CLIENTNUM: A unique identifier for each customer.
- Attrition_Flag: Indicates whether the customer is an existing customer or has left the bank.
- Customer_Age: Age of the customer.
- Gender: Gender of the customer.
- Dependent_count: Number of dependents for the customer.
- Education_Level: Educational level of the customer.
- Marital_Status: Marital status of the customer.
- Income_Category: Income category for the customer.
- Card_Category: Type of card held by the customer.
- Months_on_book: Number of months the customer has been with the bank.
- Total_Relationship_Count: Total number of products held by the customer with the bank.
- Months_Inactive_12_mon: Number of months the customer was inactive in the last 12 months.
- Contacts_Count_12_mon: Number of contacts with the customer in the last 12 months.
- Credit_Limit: Credit limit on the customer's credit card.
- Total_Revolving_Bal: Total revolving balance on the credit card.
- Avg_Open_To_Buy: Average open-to-buy credit line (credit limit minus the revolving balance).
- Total_Amt_Chng_Q4_Q1: Change in transaction amount, from Q4 to Q1.
- Total_Trans_Amt: Total transaction amount in the last 12 months.
- Total_Trans_Ct: Total number of transactions in the last 12 months.
- Total_Ct_Chng_Q4_Q1: Change in transaction count, from Q4 to Q1.
- Avg_Utilization_Ratio: Average card utilization ratio.

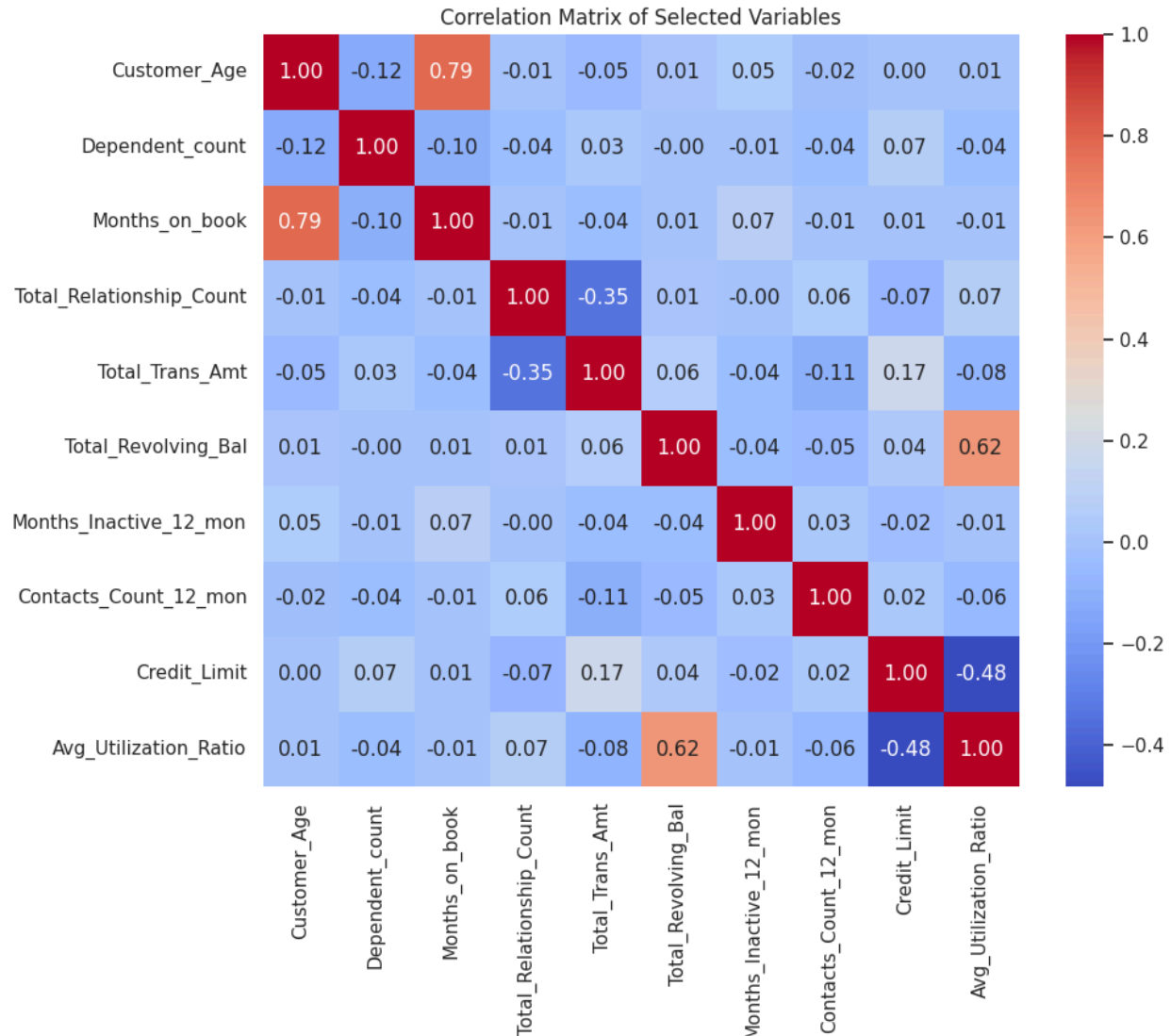
The dataset contains the key attributes of an unsecured purchase borrower and could be used to understand the challenges involved in lending money without collaterals.



The above figure shows the relationship between Credit Limit and Average Utilization Ratio. We could see a customer given a higher credit limit not necessarily utilizing a higher amount of their credits. The above figure shows that the leverage of credit limits is higher for those with lower credit limits, which is a warning sign that lenders should be more careful with those with lower credit limits but higher utilization ratios.



From the above figure, we can see the relationship between credit limit and revolving balance seems to be non-linear. While some customers with increased credit limits have bigger revolving balances others do not use their full available amount of credits. This pattern suggests a wide variety of behaviors with regard to how various customers use their credit.



From the above figure, we found that most of the variables are not linearly correlated, especially for the credit limit. This shows that the assignment of credit limit itself is a very challenging task, in which the model must consider the non-linearity of variables and data.

These graphical representations highlight the complexity and non-linearity of connections in the data. They emphasize the difficulty in forecasting credit risk from variables such as credit limit, and transaction behavior because these associations do not occur along a straight line.

To overcome the obstacles associated with unsecured debt and non-linear credit risk, advanced statistical models or machine learning techniques can be used to understand customer behavior and risk more accurately. These models may describe the nonlinear relationships between several factors better than their linear analogs.

2. Money at a floating rate for a secured purchase

In this scenario, we use a very large real-world dataset from the Home Mortgage Disclosure Act (HMDA) covers all mortgage decisions made in 2015 for the state of New York.

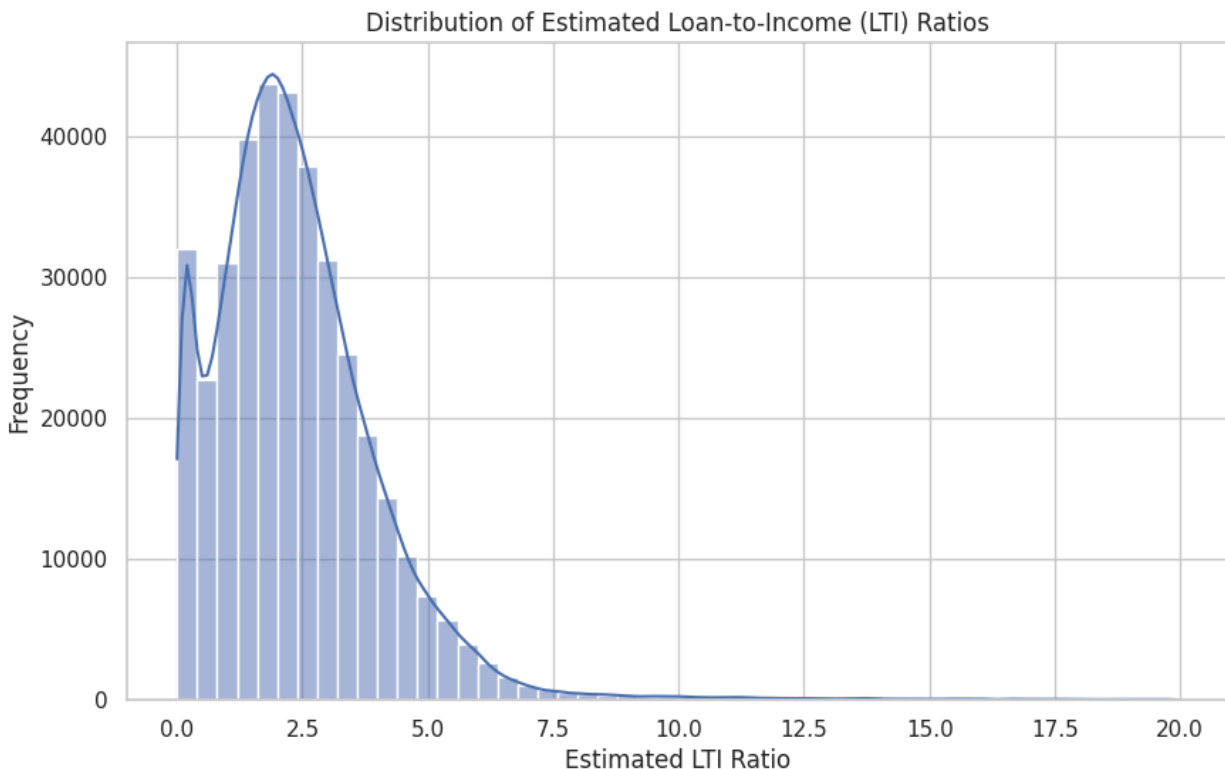
Since the dataset contains many irrelevant columns, we consider only the following columns.

- **Action_taken_name:** This column represents the action taken on the mortgage application, indicating whether the loan was approved, denied, or other actions.
- **Applicant_income_000s:** It represents the applicant's income in thousands of dollars. This variable provides information about the financial capacity of the mortgage applicant.
- **Applicant_race_name_1:** This column contains the race of the primary applicant. It provides demographic information about the applicant's racial background.
- **Applicant_sex_name:** It represents the gender of the primary applicant, indicating whether they are male, female, or have not disclosed their gender.
- **Co_applicant_race_name_1:** Similar to 'applicant_race_name_1,' this column contains the race of the co-applicant, if applicable.
- **Co_applicant_sex_name:** Similar to 'applicant_sex_name,' this column represents the gender of the co-applicant, if applicable.
- **Denial_reason_name_1:** Denotes the primary reason for the denial of the mortgage application, if applicable.
- **Lien_status_name:** Indicates the lien status of the property, which can be important for assessing the type of mortgage.
- **Loan_purpose_name:** Represents the purpose of the loan, such as home purchase, refinancing, or home improvement.
- **Loan_type_name:** It specifies the type of loan, including conventional, FHA-insured, VA-guaranteed, or other types.
- **Owner_occupancy_name:** Indicates whether the property is owner-occupied, a rental property, or not applicable.
- **Hud_median_family_income:** Represents the median family income for the area in which the property is located. This information is useful for assessing the economic context of the loan.
- **Loan_amount_000s:** Denotes the loan amount in thousands of dollars. It provides information about the size of the mortgage.
- **Number_of_1_to_4_family_units:** This column contains the number of 1 to 4 family housing units in the area where the property is located.
- **Number_of_owner_occupied_units:** It represents the number of owner-occupied housing units in the area where the property is located.
- **Minority_population:** Indicates the percentage of minority population in the area where the property is located. This can be relevant for understanding demographic characteristics.
- **Population:** Denotes the total population in the area where the property is located.
- **Rate_spread:** This column may indicate the difference between the annual percentage rate (APR) on the loan and the average prime offer rate. It can provide insights into interest rate variations.

Below is the statistics of the numerical columns.

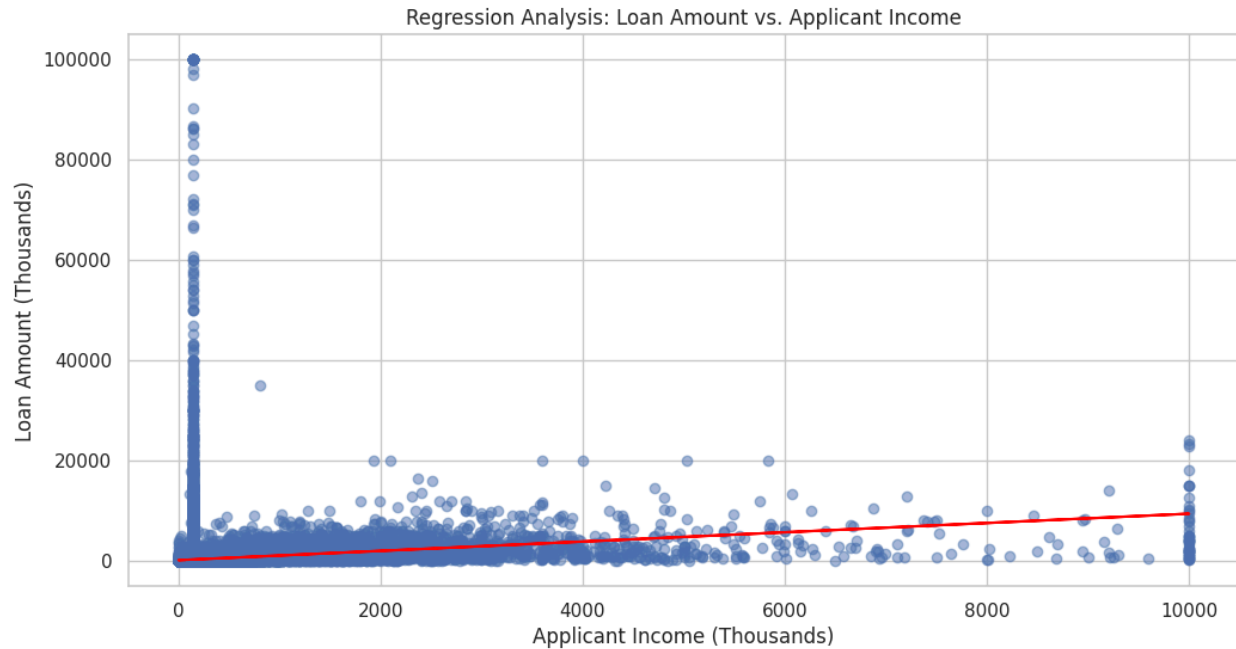
| | applicant_income_000s | hud_median_family_income | loan_amount_000s | number_of_1_to_4_family_units | number_of_owner_occupied_units | minority_population | population | rate_spread |
|-------|-----------------------|--------------------------|------------------|-------------------------------|--------------------------------|---------------------|---------------|-------------|
| count | 378651.000000 | 437987.000000 | 439654.000000 | 437418.000000 | 437605.000000 | 437958.000000 | 437958.000000 | 8740.000000 |
| mean | 140.145794 | 78224.312365 | 333.324287 | 1511.690207 | 1214.083619 | 29.204953 | 4749.286877 | 2.525990 |
| std | 268.471316 | 16235.407726 | 1173.204181 | 790.503400 | 609.379415 | 29.032513 | 1881.876014 | 1.587436 |
| min | 1.000000 | 57200.000000 | 1.000000 | 6.000000 | 2.000000 | 0.340000 | 1.000000 | 1.500000 |
| 25% | 58.000000 | 69000.000000 | 102.000000 | 965.000000 | 748.000000 | 7.780000 | 3439.000000 | 1.610000 |
| 50% | 90.000000 | 71300.000000 | 208.000000 | 1520.000000 | 1196.000000 | 17.230000 | 4554.000000 | 1.820000 |
| 75% | 142.000000 | 82700.000000 | 366.000000 | 2009.000000 | 1640.000000 | 39.220001 | 5892.000000 | 2.660000 |
| max | 9999.000000 | 109000.000000 | 99999.000000 | 6345.000000 | 6454.000000 | 100.000000 | 26588.000000 | 14.640000 |

Now considering the leverage of the borrowers, since we do not have the information of the collateral value, we define a new way to measure the leverage, the Loan-to-Income (LTI) ratio, which is the ratio of the loan amount to the income of the applicant.

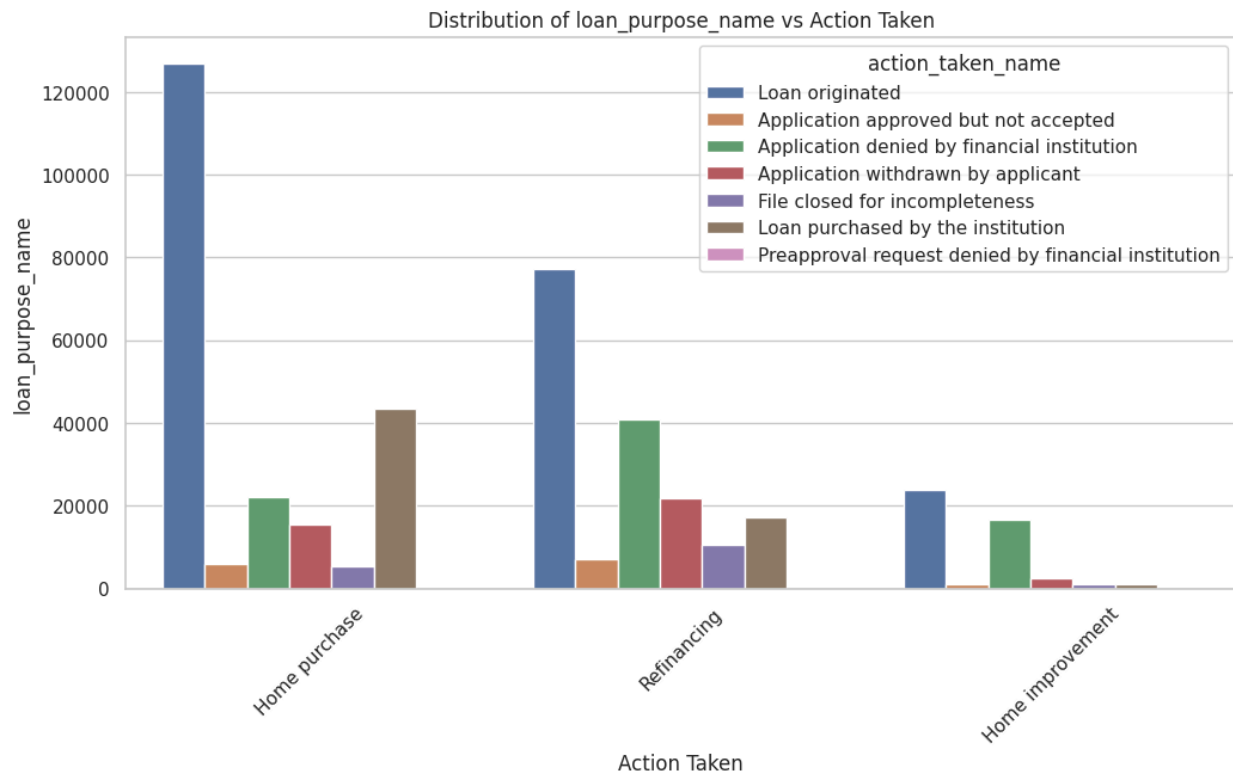


| | |
|-------|---------------|
| count | 377342.000000 |
| mean | 2.421828 |
| std | 1.761018 |
| min | 0.000521 |
| 25% | 1.289855 |
| 50% | 2.166667 |
| 75% | 3.211538 |

We could observe that the vast majority has an LTI ratio of 1.28-3.21, with a mean of 2.42. Note the data is longtailed on the right-hand side, indicating some of the applicants are having very high LTI ratio thus meaning it is highly leveraged, and they might not be able to repay the loan if they lose the income.



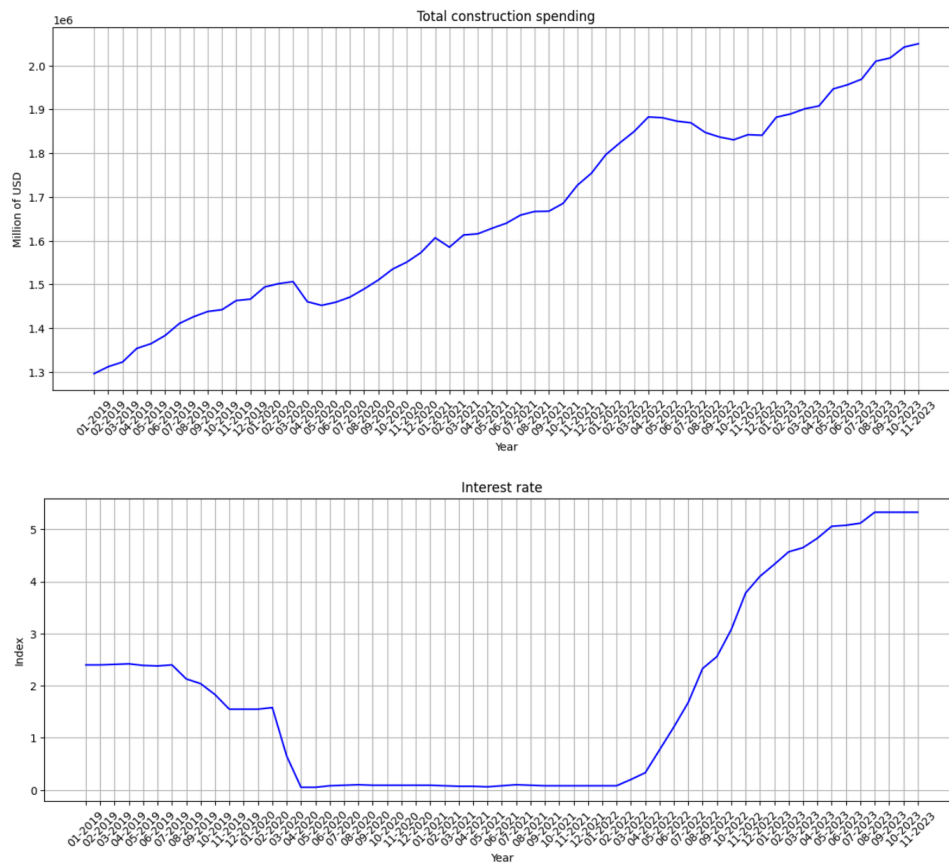
In the above figure, we observe a positive relationship between the applicant's income and loan amount. However, the correlation coefficient is only 0.196, indicating a not-so-linear relationship.

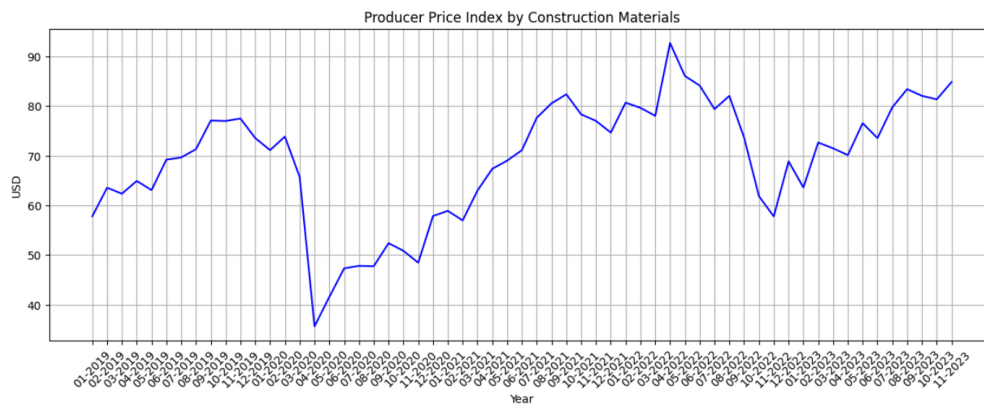
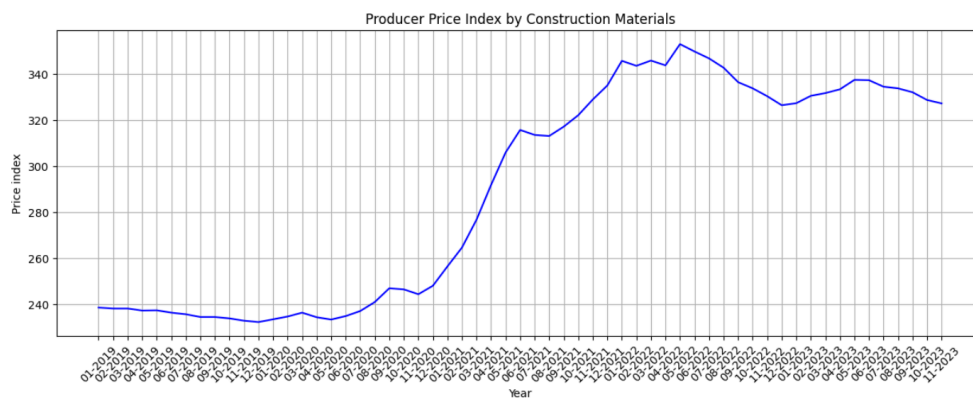
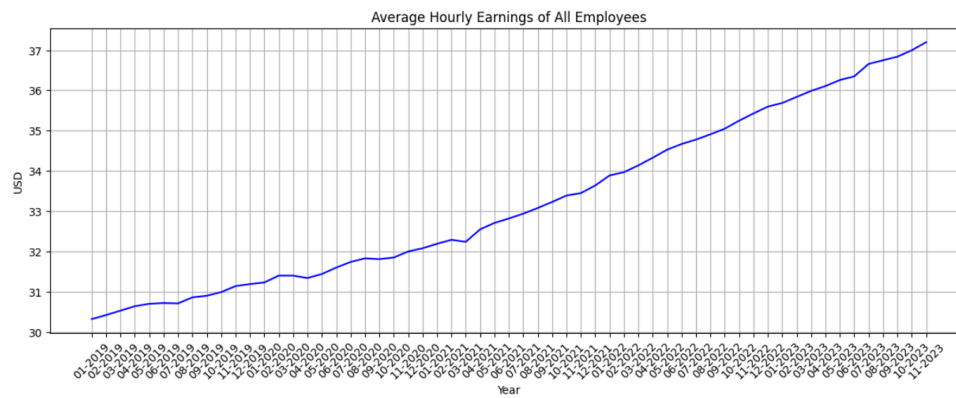
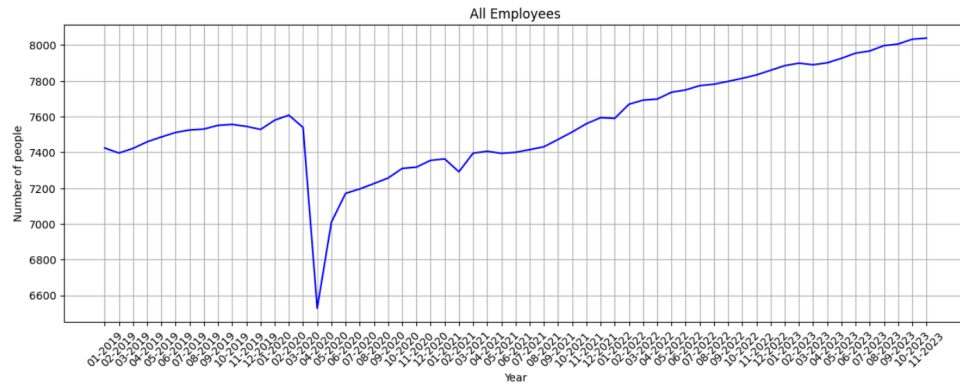


For the loan outcome (action), we observe some correlation with certain features. For example, the figure above shows that refinancing and home improvement have a higher rate of rejection compared to home purchases, possibly due to the collateral value and recourse problem.

3. Money at a fixed rate for a business for a construction loan

We assess Welltower's (REITs) fixed-rate construction project business loans using US market economic and construction industry data. I selected industry indicators for it, including total construction spending, which assesses the amount spent on construction over time, all employees, which represents the number of workers in the sector, and average hourly wages of all producing employees, which indicates the amount of spending. An overview of the construction and real estate markets can be obtained by looking at salaries for industry workers, price indexes for building materials, interest rates, including the Federal Reserve interest rate, and loans secured by real estate. Thus, if interest rates rise to a level comparable to 2023 and other industry indicators raise the risk level of the construction industry and their impact, the economy and industry's current level of risk will be demonstrated. The stock price reflects the above figure, which is associated with the company's performance.





GROUP WORK PROJECT # _1_
Group Number: ____4801_____

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Both Welltower's fixed interest rate lending and the lending bank's fixed interest rate are impacted by changes in the aforementioned indices. Industry indicators like employment, spending, and raw material costs all have a negative impact on the industry's future when there is severe market volatility. This raises the risk of lending and the cost of borrowing money with interest fixed rates and the opposite.

| | Total Construction Spending | All Employees | Average Hourly Earnings of All Employees | Producer Price Index by Construction Materials | Interest rate | Loans Secured by Real Estate | Stock price |
|---|-----------------------------------|------------------|--|---|------------------|------------------------------------|----------------|
| Total Construction Spending | 1.000000 | 0.764239 | 0.981062 | 0.915350 | 0.509093 | 0.934618 | 0.562920 |
| All Employees | 0.764239 | 1.000000 | 0.783897 | 0.681477 | 0.764367 | 0.654550 | 0.719459 |
| Average Hourly Earnings of All Employees | 0.981062 | 0.783897 | 1.000000 | 0.879501 | 0.627082 | 0.985315 | 0.489235 |
| Producer Price Index by Construction Materials | 0.915350 | 0.681477 | 0.879501 | 1.000000 | 0.323758 | 0.826115 | 0.628616 |
| Interest rate | 0.509093 | 0.764367 | 0.627082 | 0.323758 | 1.000000 | 0.599052 | 0.304177 |
| Loans Secured by Real Estate | 0.934618 | 0.654550 | 0.985315 | 0.826115 | 0.599052 | 1.000000 | 0.301036 |
| Stock price | 0.562920 | 0.719459 | 0.489235 | 0.628616 | 0.304177 | 0.301036 | 1.000000 |

4. Publicly traded Equity (e.g. common stock) – that is, securities lending of a Stock.

For Publicly traded Equity we have used 5 years of data from NVIDIA, which is a leading American multinational technology company, renowned for its graphics processing units (GPUs) and AI-driven computing solutions. Specializing in GPU design for gaming, professional markets, and data centers, Nvidia has played a pivotal role in advancing visual computing and artificial intelligence technologies.

We are considering volatility analysis, Leverage analysis, and Stress test as our factors to understand whether these would solve our problem or not Let's first understand why we have chosen these factors.

How these Graphs Address the Financial Challenge:

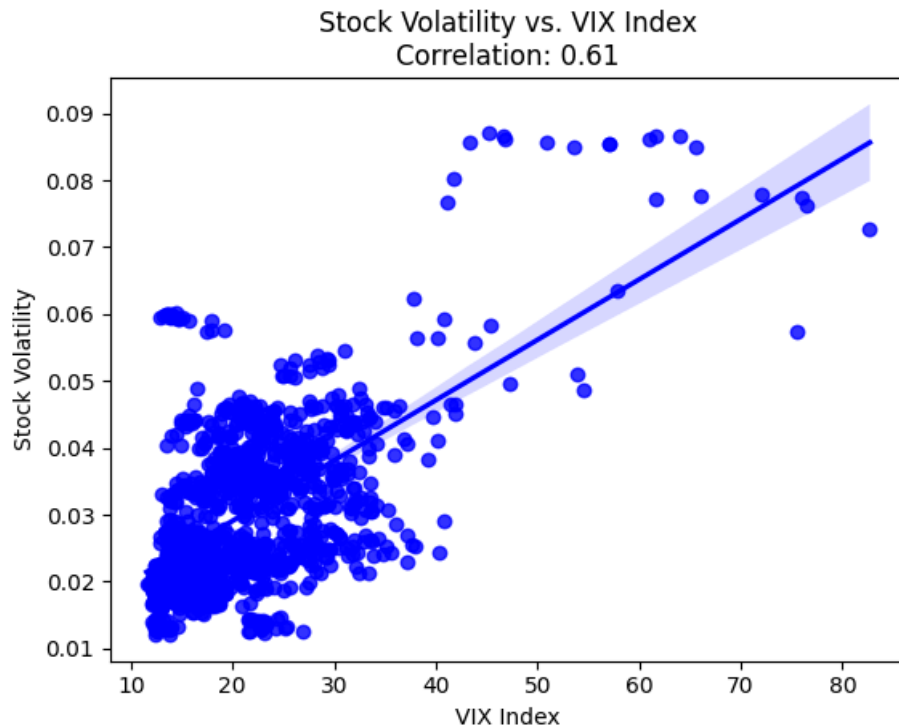
Our primary task is to assess if this asset is worthy of lending money or not, thus together these graphs allow us to present a thorough picture of the market dynamics around the equity that is publicly traded. Using volatility analysis the financing team can spot periods of possible historical price fluctuations of the asset, and provide insights into its stability and susceptibility to market uncertainties. Leverage analysis can help to determine the relationship between different market microstructure factors and how it provides more insights Lastly stress testing enhances our risk assessment by simulation an extreme event scenario and how our asset would perform during adverse market conditions.

Volatility analysis (ATR: Average True Range Vs Stock Price):



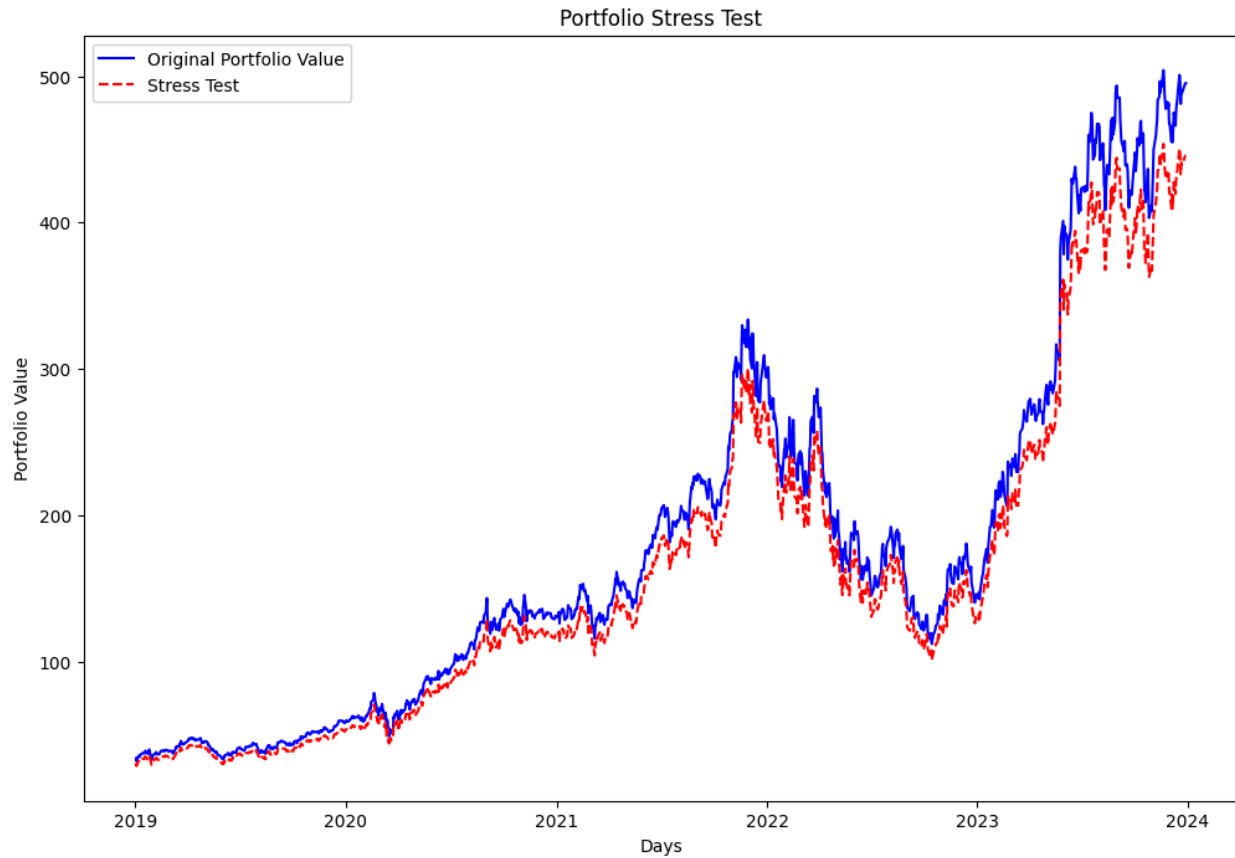
Here we are Visualizing ATR VS NVDA stock Price, we can see ATR always remains high and stock price also supports this volatility which means our asset had strong momentum during the last 5 years and it is sustaining the trend as well which means our assets perform well during even during high volatility.

Leverage analysis (VIX vs Stock volatility):



Here we can see there is a 0.61 correlation coefficient between Stock volatility and VIX(Volatility index) and this positive correlation suggests that periods of higher stock market volatility tend to impact stock volatility in a moderately positive way and as we have already defined high volatility is helping our stock with strong momentum which makes our asset safer during even time of high volatility.

Stress test :



Here we have used a stress test in which a stress function applies a stress factor which is 0.1 (10%) in our case, it represents the portfolio values under stress. We are plotting the comparison between our portfolio value and stress value and we can see there is not much difference between portfolio value and stress value which signifies our asset performs well even during extreme scenarios.

Publicly traded bond (e.g. treasury bond, corporate bond) – that is, securities lending of a bond.

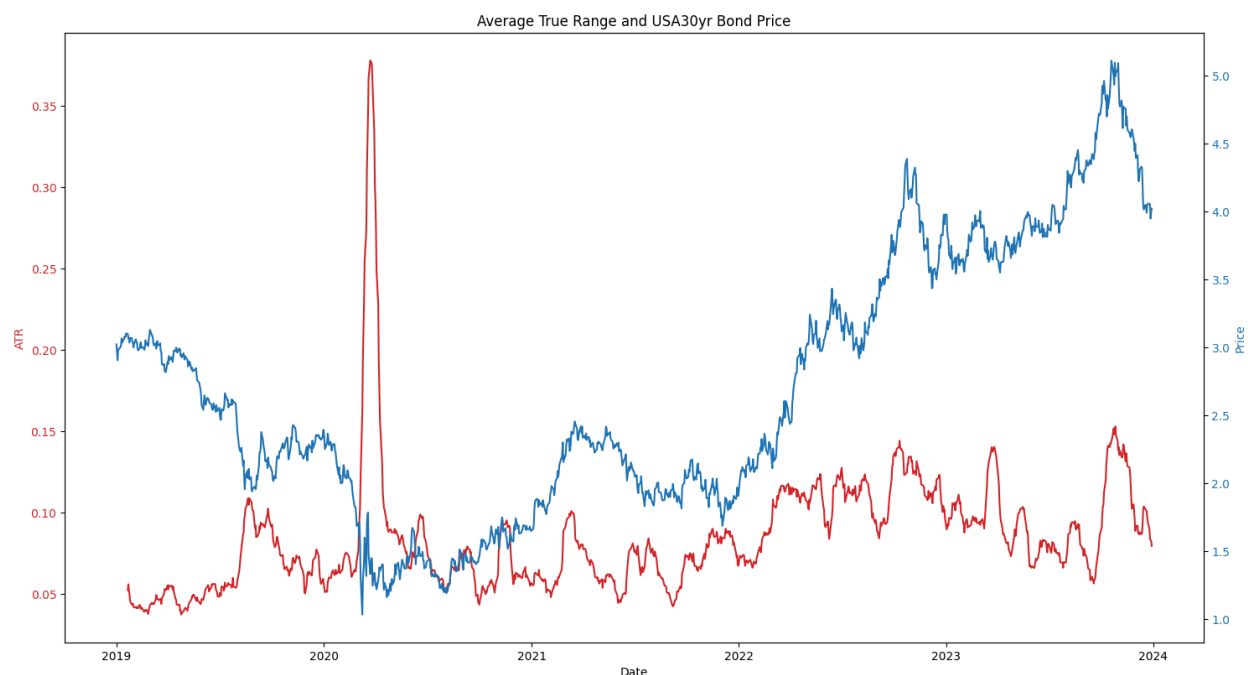
For Publicly Traded Bond we have used 5 years of data of US govt 30 years treasury bonds, which a long-term fixed-income securities issued by the United States Department of the Treasury, representing a reliable and low-risk investment option for investors seeking stable, long-term returns on their capital and we have also used 5-year Federal funds effective rate for comparison purposes.

We are considering volatility analysis, Leverage analysis, and Stress test as our factors to understand whether these would solve our problem or not Let's first understand why we have chosen these factors.

How these Graphs Address the Financial Challenge:

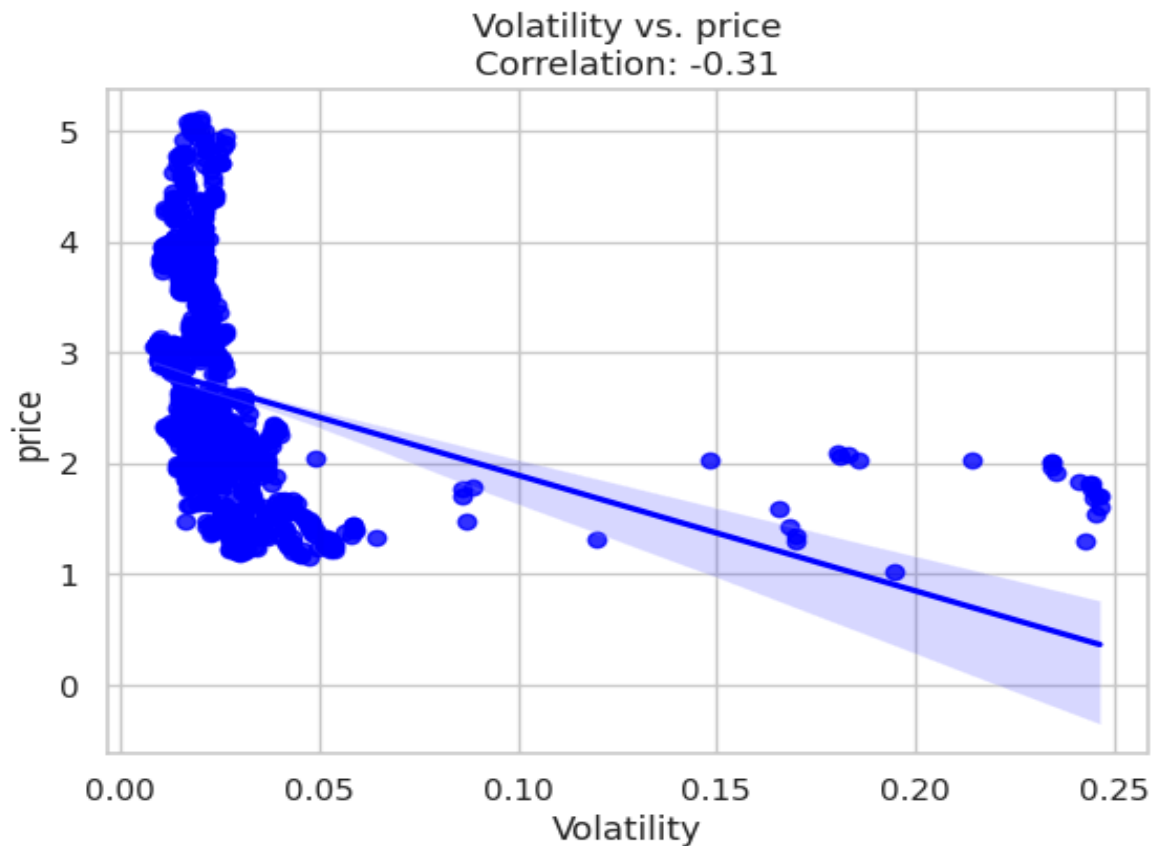
Our primary task is to assess if this asset is worthy of lending money or not, thus together these graphs allow us to present a thorough picture of the market dynamics around the equity that is publicly traded. Using volatility analysis the financing team can spot periods of possible historical price fluctuations of the asset, and provide insights into its stability and susceptibility to market uncertainties. Leverage analysis can help to determine the relationship between different market microstructure factors and how it provides more insights Lastly stress testing enhances our risk assessment by simulation an extreme event scenario and how our asset would perform during adverse market conditions. Setting competitive lending rates and controlling the risk involved in lending bonds in various interest rate situations require the use of this information.

Volatility analysis (ATR: Average True Range Vs Stock Price):



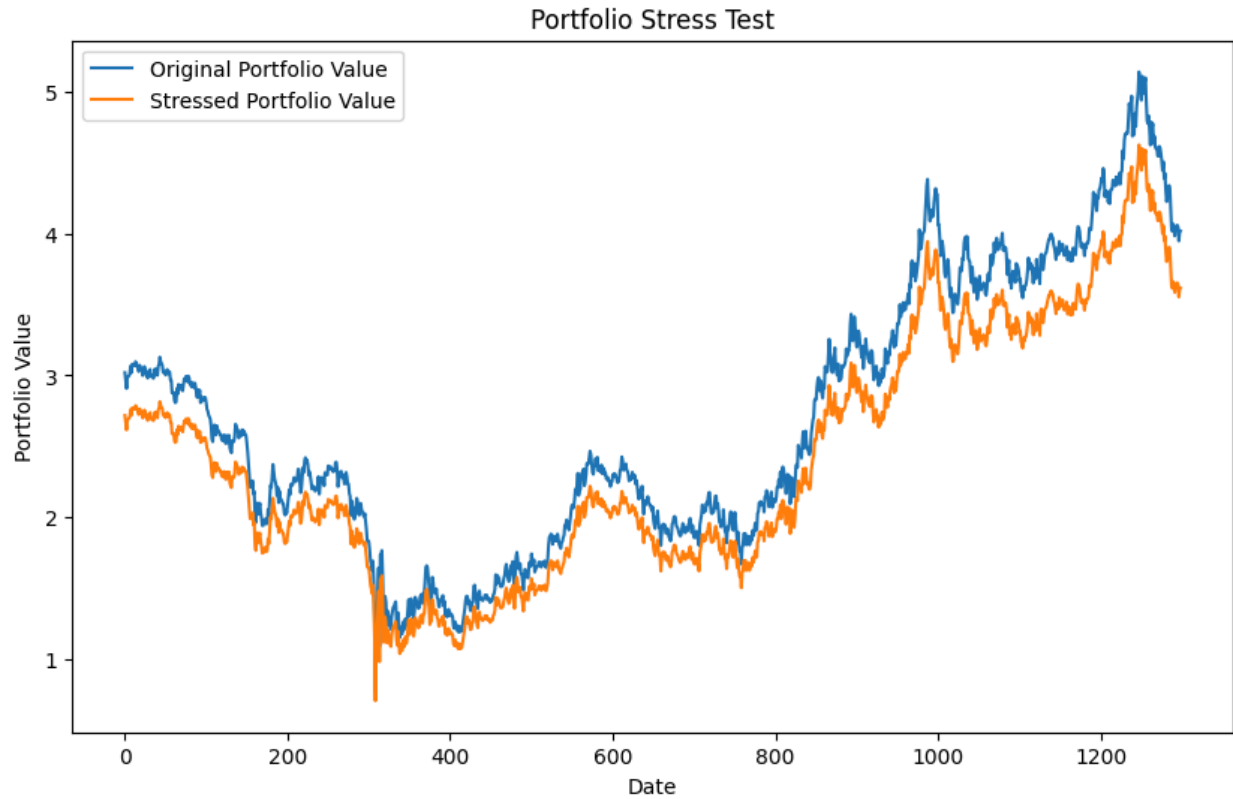
Here we are Visualizing ATR VS BondPrice, we can see ATR was high during COVID-19 (20-21) and high volatility resulted in a price decline in bonds but if we look further years the volatility has not much increased and stayed in a range but the price is still increasing. Which signifies there is a slightly negative correlation between Volatility and the price of the bond. Let's see the correlation between them.

Leverage analysis (Volatility Vs Log_return):



As we have discussed the hypothesis volatility has not much increased and stayed in a range but the price is still increasing. Which signifies there is a slightly negative correlation between Volatility and the price of the bond. It is now confirmed by the correlation coefficient of Volatility and Bond Price have a negative correlation which means as volatility stayed low the price increased.

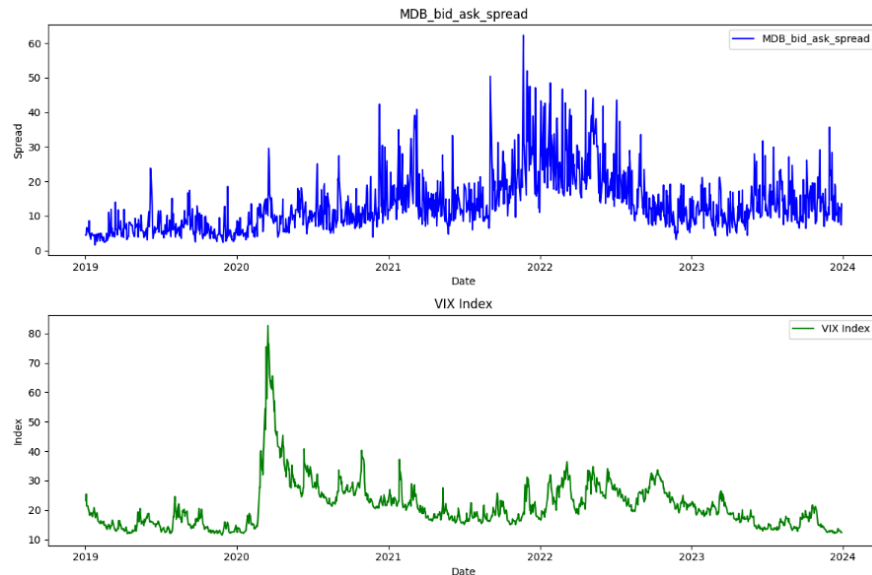
Stress test :



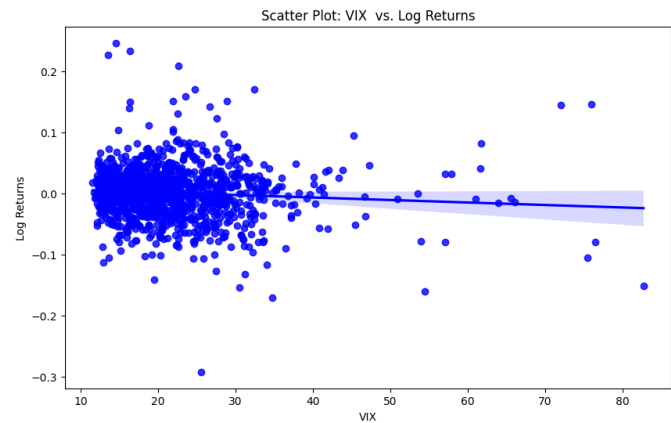
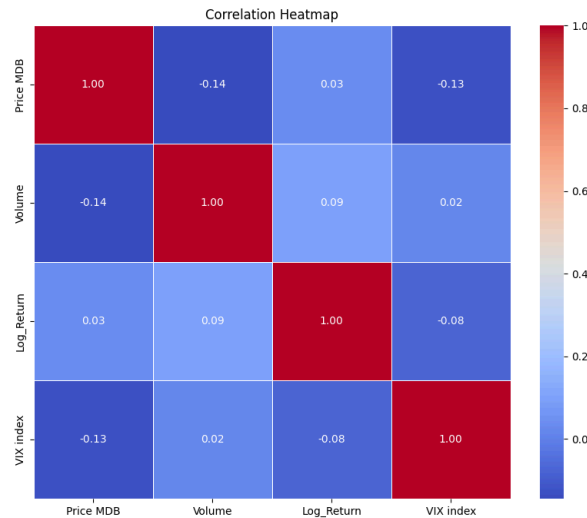
Here we have used a stress test in which a stress function applies a stress factor which is 0.1 (10%) in our case, it represents the portfolio values under stress. We are plotting the comparison between our portfolio value and stress value and we can see there is not much difference between portfolio value and stress value which signifies our asset performs well even during extreme scenarios.

6. An illiquid security – Small-cap stocks

Investors tend to become more risk-averse as the VIX rises. Small-cap stocks may become less in demand as a result, increasing their illiquidity. Furthermore, market makers may find it more challenging to supply liquidity for small-cap stocks as the VIX rises. Higher trading expenses and broader bid-ask spreads may also result from this.



You can reduce the risk of illiquidity by averaging the VIX or creating a VIX index where you sell small-cap stocks when the VIX rises above the safe level. This is due to the fact that a higher VIX denotes a more volatile market, which can make it more challenging to buy and sell small-cap stocks. On the other hand, repurchasing small-cap stocks when the VIX declines is done so because a lower VIX denotes less market volatility, which can facilitate the purchase and sale of small-cap stocks.



Because companies with higher market capitalization are typically thought to be less liquid because they have more shares to trade and are more likely to be followed by institutional investors, market capitalization and the number of outstanding shares are important indicators to evaluate a stock's liquidity. Furthermore, financial statements offer a summary of a business's financial situation and can be used to pinpoint firms that are most likely to lack liquidity. Shares of companies with poor financials may be less liquid because they are less likely to draw in investors.

Project Google Colab Link:- [Group 4801_Group Work Project_2.ipynb](#)