GROUP WORK PROJECT # 1
Group Number: 3507

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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Team member 3	**Bharat Swami**

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.

Six different scenarios -

1. Money at a fixed interest rate for an unsecured purchase
2. Home Mortgage: Money at a floating rate for secured purchase for an individual
3. Money at a fixed rate for a construction loan
4. Publicly traded stock (useful for short-selling by borrowers)
5. 10-year US Treasury Bonds : Publicly traded bonds
6. An illiquid asset, (You can choose any)

Step 1 : Collateral Related Risks

Scenario	Financial Risk	Collateral Risk
Money at a fixed interest rate for an unsecured purchase	● Customer default risk: individual may fail to repay debt while there is no collateral against the default ● Interest rate risk: the interest is pre-determined and fixed at the beginning of debt issuance which later might not align with inflation in reality	
Mortgage Loan	● Default Risk : There is a default risk associated with the mortgage loan. The borrower may not be able to pay back the mortgage principal due to financial conditions. ● Interest Rate Risk : The mortgage loans have interest payments and since the mortgage loan is on floating rate, maybe during the time of interest rate increases which increases the interest payments. In this case the borrower may not be able to pay interest payments on time. ● Prepayment Risk: Sometimes the borrower has obligations	There is a collateral risk associated with the mortgage loans. ● Mortgage loans may be of Non-Remorse type. which basically includes the home itself as collateral. Personal assets of the borrower are not included as collateral, which increases the risk for lenders. In this case the borrower has no obligation with his personal assets to pay back the lender. ● Loan may be of Remorse type which includes the personal assets of borrowers as collateral

	of prepayment of principal amount. In this case the borrower may not be able to do so. Or the borrower may refinance the loan which also increases the financial risk.	other than home itself. It reduces the risk for lenders. But if the personal assets of the borrower are not able to cover the loan then the lender is at risk.
Money at a fixed rate for a business for a construction loan	● A construction loan - is a loan security used to finance the building or renovation of a home or a real estate project ● Financing Challenges ○ Failure to complete the intended project with the provided/ available funds ○ Inflation and emergence of unexpected cots leading to deviation from the stipulated budgets ○ Lack of accountability of the acceptable use of funds ○ Insufficient information on the progress of the projects	
Publicly traded stock		● Investor default risk: borrower might not be able to pay any additional interest fees or to cover position ● Value risk: the stock price returned in the end of period could be usually lower than the initial as it is common that borrower foresee a directional prediction in price move and perform short-selling event from the lending ● Company default risk: less likely to happen, but when company defaults, stock price usually goes to zero

		value
10-year US Treasury Bond	• Inflation : With increase in the inflation, the return from the Bond may reduce. Since Treasury bonds have low yields as compared to other investments and with increase in inflation, it may reduce the returns or may wipe out the returns completely. • Interest Rate Risk : Treasury bonds have interest rate payments which may be quarterly or semi-annually or annually. Interest rate risk has two sides. If interest rates decrease the interest rate payments decrease which reduces return on bonds and also the cost of bonds increases. And if interest rate increases it may be difficult to sell the bonds in secondary markets. • Opportunity Cost: It may be possible there are other investments with the same level of risk as bonds but returns are high. We may miss this opportunity to get higher return by investing these bonds	Collateral Risks with Treasury bonds are only associated when we are using some collateral for buying bonds. Like investors may use personal assets as collateral to buy bonds. This scenario has lots of risk associated with it. Interest rates may increase on loans which reduce the overall return. Inflation may reduce the return on bonds. In the worst case, returns from bonds may be nullified by any of the above scenarios and investors default on loans which will lose his personal assets used as collateral.

An illiquid Security		• Examples of illiquid asset are Real Estate and Art. These assets are not easily convertible to cash
		• Collateral Challenges
		  ○ These assets have a high bid-ask spread hence this makes them highly illiquid
		  ○ These assets are also highly susceptible to volatility decreasing the desirability.

Step 2 : Statistical Related Challenges

Scenario	Volatility	Correlation
Money at a fixed interest rate for an unsecured purchase	• Customer's credit rating: reflect borrower's default risk	• Inflation rate: e.g. if CPI level is higher, more cash flow might go to consumption instead of repaying debt • Interest rate: if interest rate increases and is more than the fixed rate set, repayment might be easier as there could be higher return from other investment to cover the debt payment • Unemployment rate: when consumer loses income, it is harder to meet repayment schedule
Mortgage Loan	• Inflation • Interest Rate	• Interest Rate • Time to Maturity • Underlying Collateral • FICO Rate of borrower • Inflation
Money at a fixed rate for a business for a construction loan	• There is a negative correlation between interest rates and the rate of borrowing of construction loans. As the rate of interest increases, the rate of borrowing for construction loans decreases. This is because borrowers would have to pay more to	• There is a negative correlation between interest rates and the rate of borrowing of construction loans. As the rate of interest increases, the rate of borrowing for construction loans decreases. This is because borrowers

	acquire loans. ● Construction materials would also be more expensive if the interest rates are high, hence the customer will be reluctant to purchase.	would have to pay more to acquire loans. ● Construction materials would also be more expensive if the interest rates are high, hence the customer will be reluctant to purchase.
Publicly traded stock	● Stock price movement and volatility: value received depends on the stock price movement of the underlying asset and thus its price volatility	● Company's credit rating: the rating of the company which issues the shares reflect highly the performance of the corporation, and major market factors, such as liquidity or market cap in the market, which would affect the lending fee and also reflect the default risk
10-year US Treasury Bond	● Maturity Date ● Interest Rate ● Underlying Asset	● Interest Rate ● Inflation ● Critical News (maybe fake) ● International Relations
An illiquid Security	● Due to the volatility of prices of construction materials, assets such as real estate tend to be volatile. Mortgage loans are also affected by interest rates hence this creates an even greater risk of volatility	

Step 3 and 4 : Identifying Data and "Go Get Data"

1. Money at a fixed interest rate for an unsecured purchase

   Data source: https://fred.stlouisfed.org/

Data	Notes
Customer's credit rating	Private and individual data, proxy as FICO score; daily data with earliest availability from 2017
Interest rate	Daily data with earliest availability from 1954
CPI (proxy of inflation)	Monthly data with earliest availability from 1947
Unemployment rate	Monthly data with earliest availability from 1948

2. Home Mortgage:

Data	Note
Type	Asset Rate (Interest Rate)
Processing	Mortgage Yield
Frequency	Daily Return
Class	Credit lend
Source	Mortgage Lender (Commercial Banks)
Variety	Historical Date (past 10 years)

3.

- 'A' Represents Scenario 3 – Money at a fixed rate for a construction loan.
- 'B' Represents Scenario 4 - An Illiquid Security

Security	**Identification**
Data Type	a) Asset/ Economic data b) Asset / Economic data
Data Processing	a) Raw prices, volatilities b) Raw prices, Returns, Volatilities

Data Frequency	a) Varying Frequency
Data Classes	a) Credit Data b) Equity data, Real Estate
Data Source	a) Exchanges, Dealers b) Exchanges, Brokers, Dealers
Data Variety	a) Actual data vs. Estimated Data b) Trade data vs. Quote data

4. Publicly traded stock

Data source: https://www.investing.com/

Data	**Notes**
JPM share price	Daily data with earliest availability from 2017
Company's credit rating	Credit vendor/ cds data; daily data with earliest availability from 2017

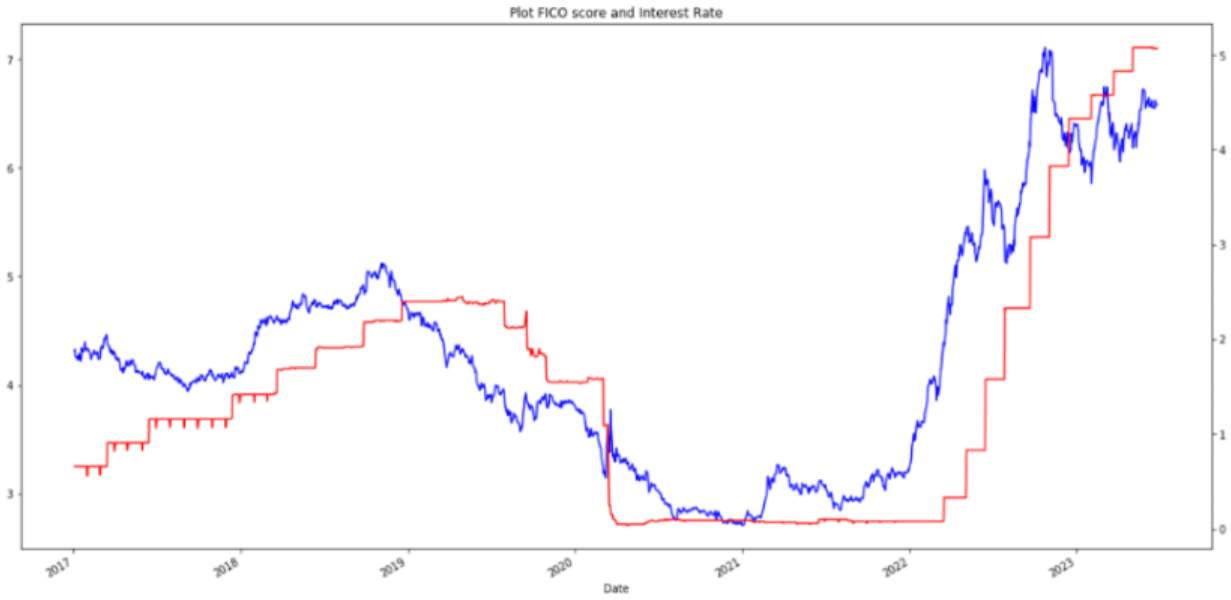
5. 10-year US Treasury Bond:

Data	Note
Type	Asset Rate (Interest Rate)
Processing	Bond Yield
Frequency	Weekly Return
Class	Bonds
Source	US Treasury Bonds
Variety	Historical Date (past 10 years)

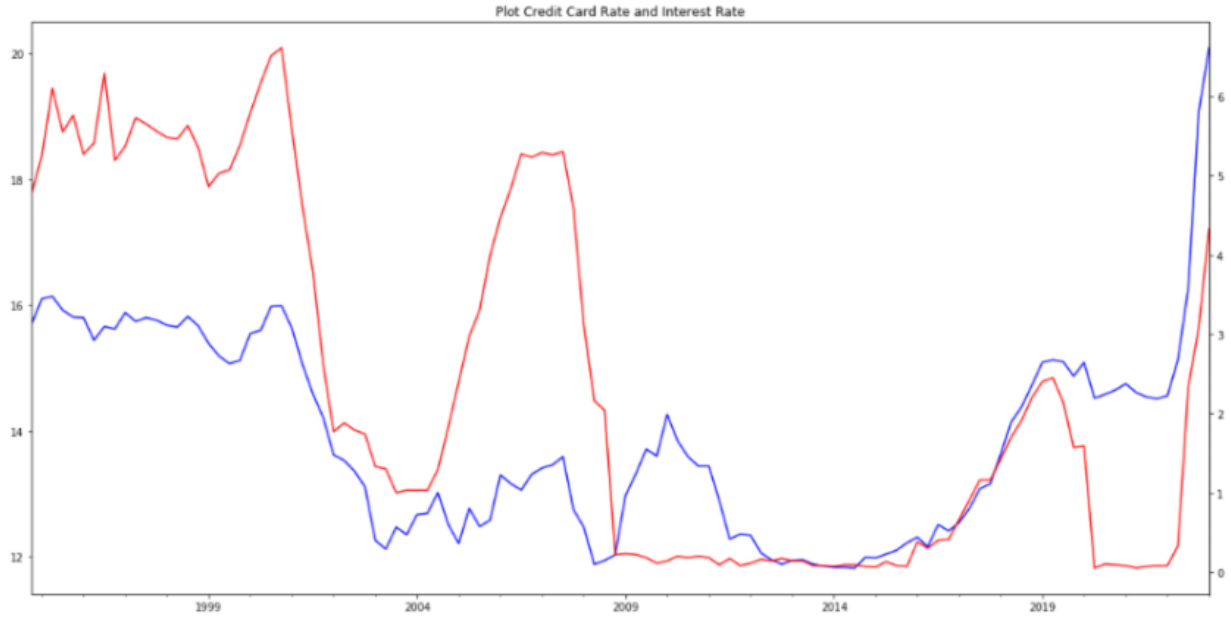
Step 5 and 6 : Perform exploratory data analysis and Describe how the data can help to meet the challenge.

Please Refer to the attached Jupyter Notebook.

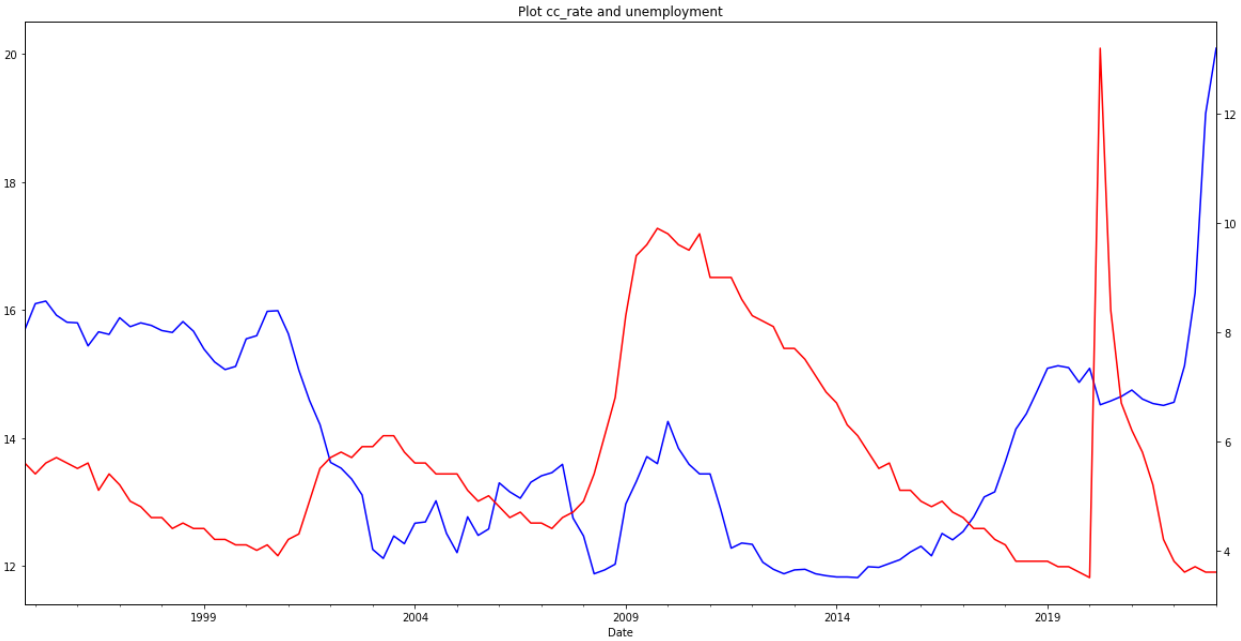
Scenario 1:



By looking at the blue line which shows the percentage level of FICO score scoring higher than 740 and the interest rate level in red, a negative relationship holds between the two time series with some time latency in the 7-year time. For instance, when interest rate starts to climb from mid-2018 to early 2019, the FICO score begins to decrease starting from early 2019 and attains the lowest level till late 2020. While the interest rate stays at a stable level from early 2020 to early 2022 afterwards, the FICO scores has a steadily increasing trend. Hence, from the graph above, interest rate seems to be a leading indicator and negatively affects the FICO score. Hence, any major interest rate change or directional trend should be kept under consideration while setting the fixed rate of lending for the financing team to attain a reasonable lending rate.



While looking at the credit card rate in blue and the FED interest rate in red, a similar trend can be observed for the both time series since the 1990s. Also from the plot the rate could be quite fluctuating over a short time period which could indicate there might be interest rate risk related for a fixed-rate product. This should help the lending team to set constraints on the length the lending contract with the prediction on any governmental policy on the interest rate.



By looking at the credit card rate in blue and unemployment rate in red, a reverse relationship between the two time series can be observed most of the time. Hence, unemployment rate could be an macroeconomic indicator for examining the consumer's stress test and thus the default risk prediction. The lending team could then adjust the credit rate accordingly.

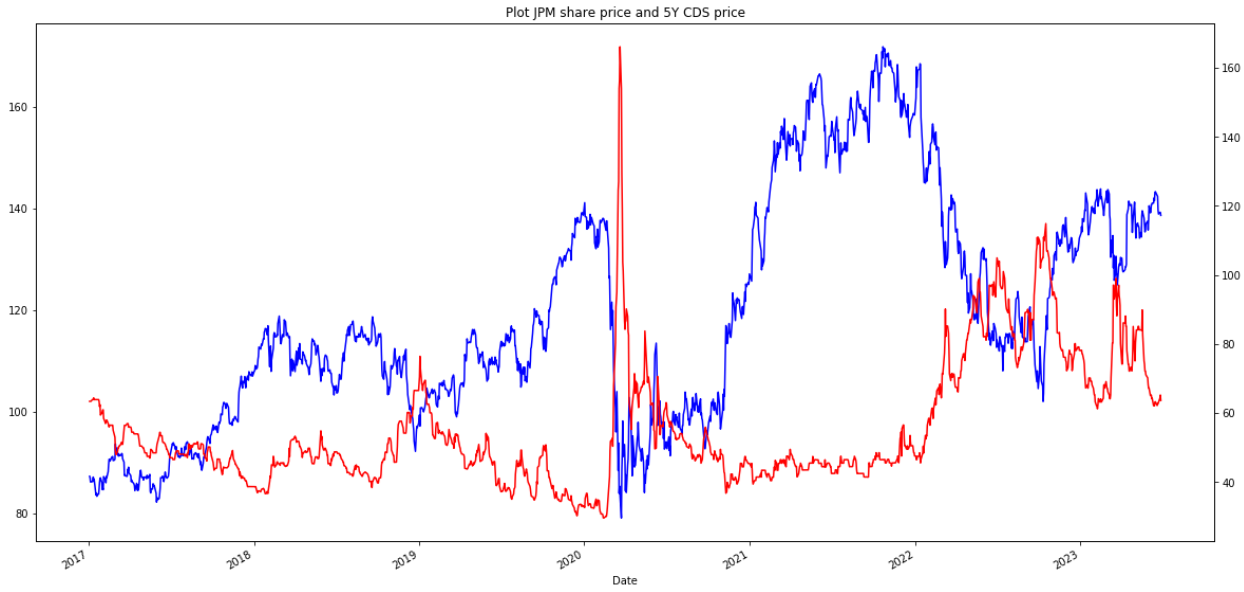
Scenario 2:

From the analysis we can see that there is a strong correlation between the Mortgage rate and GDP of the country. From the analysis it comes out 0.99965, which is a nearly perfect correlation between two variables. We can say mortgage rates are strongly correlated to GDP.

It is very important to take the GDP of a country as one of the variables in inclusion of Mortgage rate in the Portfolio of a client.

We can also see that 10 year Treasury bonds have a strong correlation with the mortgage rate in the country (USA). It is about 0.9094, which is less strong as compared to GDP of the country but its worth as one of features in calculation of Mortgage rate.

Scenario 4:



The share price of JPM shown in blue and its 5Y credit default swap price in red has an obvious inverse relationship. While credit default swap is an instrument with its price reflecting the probability of default of the company, which could be easily affected by daily company news or estimates in the market. Thus it is a good data source to identify if there is any negative sentiment in the market which may drive the price of the lending shares down.

Scenario 5:

From analysis we find that the correlation between Inflation and Bonds is positive and about 0.730522, which is a pretty good conclusion. As Inflation increases bond yield also increases, which we already know because of increase in interest rate in market.

We can also see that bonds and GDP of a country has almost no correlation or we can say it is very less positively correlated.