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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 2	**Jose Roberto Velazquez Gonzalez**
Team member 3	**Jemish Rasikbhai Naliyapara**

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: Collateral Related Risks

	Financing Risks	**Collateral Risks**
Scenario 1. Money at a fixed rate for an unsecured purchase (e.g. credit card) for an individual.	Risk of borrower defaulting on payments	N/A (no collateral)
	Creditworthiness assessment challenges	
Scenario 2. Money at a floating rate for a secured purchase (e.g. home or automobile) for an individual.	Interest rate risk (variable rate)	Decline in the value of collateral (e.g., market crash)
	Credit risk if the borrower defaults	Physical damage to collateral (e.g., fire)
	Collateral valuation and appraisal challenges	Legal issues with collateral (e.g., title disputes)
Scenario 3. Money at a fixed rate for a business for a construction loan.	Risk of project delays or cost overruns	Decreased value of constructed property
	Business solvency risk	Construction defects or quality issues
	Compliance with zoning and regulatory requirements	Environmental contamination affecting property
Scenario 4. Publicly traded Equity (e.g. common stock) – that is, securities lending of a stock.	Counterparty risk	Risk of market price decline for borrowed equity
	Market liquidity risk	Legal and operational challenges in lending process
	Margin call risk (short notice return)	
Scenario 5. Publicly traded bond (e.g. treasury bond, corporate bond) – that is, securities lending of a bond.	Counterparty risk	Market liquidity risk
	Market liquidity risk	Legal and operational challenges in bond lending
	Credit risk on borrower	Limited market for selling or transferring security
Scenario 6. An illiquid security – you choose the security.	Valuation challenges for illiquid assets	Limited market for selling or transferring security
	Risk of adverse events impacting	Legal and regulatory complexities

	asset's value	
	Challenges in determining fair value	

Step 2. Statistical Related Challenges

	Volatility Challenges	**Correlation Challenges**
Scenario 1. Money at a fixed rate for an unsecured purchase (e.g. credit card) for an individual.	Creditworthiness fluctuations affecting borrower's repayment	Correlation between economic conditions and individual defaults
	Economic downturn impacting borrower's income and creditworthiness	
Scenario 2. Money at a floating rate for a secured purchase (e.g. home or automobile) for an individual.	Housing market volatility affecting collateral value	Correlation between interest rates and housing market trends
	Mortgage interest rate fluctuations impacting monthly payments	Correlation between local economic conditions and defaults
Scenario 3. Money at a fixed rate for a business for a construction loan.	Construction cost fluctuations impacting project feasibility	Correlation between project timelines and market conditions
	Interest rate volatility affecting financing costs	Correlation between regulatory changes and project delays
	Stock price volatility affecting collateral value	Correlation between market trends and counterparty risk
Scenario 4. Publicly traded Equity (e.g. common stock) – that is, securities lending of a stock.	Market volatility fluctuations impacting collateral returns	Correlation between economic conditions and stock movements
Scenario 5. Publicly traded bond (e.g. treasury bond, corporate bond) – that is, securities lending of a bond.	Bond price volatility affecting collateral value	Correlation between credit risk and borrower defaults
	Market liquidity fluctuations impacting bond lending	Correlation between interest rate changes and bond market trends
Scenario 6. An illiquid security – you choose the	Difficulty in determining the fair market value of illiquid assets	Limited correlation data due to the illiquid nature of the security

security.	Risk of adverse events impacting asset value unpredictably	Correlation between legal and regulatory changes and security value

Step 3. Identifying Data

Scenario 1: Money at a fixed rate for an unsecured purchase (e.g. credit card) for an individual.

We want to collect the personal saving rate, Total consumer credit owned and securitized and federal funds rate to assess the default risk and creditworthiness. Characteristics of the data can be given as follows:

1. **Data Type:** Personal saving rate, Total consumer credit owned and securitized and Federal funds rate
2. **Data Processing:** Correlation between Delinquency Rate and Total Consumer Credit Owned and Securitized
3. **Data Frequency:** Quarterly and at triggered events like a missed payment
4. **Data Class:** Personal data
5. **Data Source:** Fred and Yahoo Finance
6. **Data Variety:** Actual Data, Observed Data

Scenario 2: Money at a floating rate for a secured purchase (e.g. home or automobile) for an individual

We want to collect the individual's credit history and interest rate data to assess the default risk and creditworthiness. Characteristics of the data can be given as follows:

1. **Data Type:** Credit Report, Interest rate data, housing market data
2. **Data Processing:** Interest rate movement, FICO score
3. **Data Frequency:** Quarterly and at triggered events like a missed payment
4. **Data Class:** Personal data, Real Estate Data
5. **Data Source:** Real estate agencies, central banks, and CRAs like Equifax, Experian (in the USA), Collection Agencies
6. **Data Variety:** FICO score vs. Interest rate data

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

We want to collect the Business's financials like cash flow, income statement, and commodity market data to assess the creditworthiness and default risk. Characteristics of the data can be given as follows:

1. **Data Type:** Business balance sheets, commodity market data, interest rate data
2. **Data Processing:** Interest rate movement, Cash flow and Income statements
3. **Data Frequency:** Monthly
4. **Data Class:** Economics data, Business credit report
5. **Data Source:** Company's website, commodity market exchanges, central bank
6. **Data Variety:** income statement vs. commodity price, income statement vs. interest rate, project details

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

We want to collect the counterparty creditworthiness data and underlying stock data to assess the creditworthiness and default risk. Characteristics of the data can be given as follows:

1. **Data Type:** IVX index data, AMD stock price data, PHLX Semiconductor index
2. **Data Processing:** AMD stock price history, VaR of underlying stocks, Index history
3. **Data Frequency:** Daily and Weekly
4. **Data Class:** Equity data and P&L statement of the borrower
5. **Data Source:** Stock exchanges, borrower's broker, Fred and Yahoo Finance
6. **Data Variety:** Stocks' daily return

Scenario 5: Publicly traded bond (e.g. treasury bond, corporate bond) – that is, securities lending of a bond.

We want to collect the counterparty creditworthiness data and Bond price data to assess the creditworthiness and default risk. Characteristics of the data can be given as follows:

1. **Data Type:** Borrower's default data, Bond price data, interest rate data
2. **Data Processing:** Borrower's trading history, Maturity of Bond, rating of Bond
3. **Data Frequency:** Quarterly or whenever CRAs change the rating of Bond
4. **Data Class:** Bond data and Borrower's P&L statements
5. **Data Source:** OTC, central banks, borrower's broker
6. **Data Variety:** Interest rate vs Bond yield, Borrower's track record

Scenario 6: An illiquid security – Private Equity

We want to collect the counterparty due diligence to assess the creditworthiness and default risk. Characteristics of the data can be given as follows:

1. **Data Type:** Financial data of borrowing institution or individual
2. **Data Processing:** Historical financial performance data, such as revenue, profit margins, and debt levels
3. **Data Frequency:** Quarterly or annually
4. **Data Class:** Financial data
5. **Data Source:** Institution's audited financial reports and annual reports
6. **Data Variety:** Sectors' performance vs institution's financial performance

Step 4. Go get the data

Housing Price Index Dataset (USA):
Master HPI Data (Appends Quarterly and Monthly Data):
https://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index-Datasets.aspx

Federal Funds Effective Rate (USA):
FEDFUND from FRED.: https://fred.stlouisfed.org/series/FEDFUNDS

Real Estate Loans: Commercial Real Estate Loans
CREACBM027NBOG from FRED: https://fred.stlouisfed.org/series/CREACBM027NBOG

Unemployment Rate (USA):
UNRATE from FRED: https://fred.stlouisfed.org/series/UNRATE

US Commodity Index (USCI):
Yahoo Finance: https://finance.yahoo.com/quote/USCI/

United States 10-Year Bond Yield:
investing.com: https://in.investing.com/rates-bonds/u.s.-10-year-bond-yield-historical-data

Personal Saving Rate (PSAVERT)
https://fred.stlouisfed.org/series/PSAVERT

Total Consumer Credit Owned and Securitized (TOTALSL)
https://fred.stlouisfed.org/series/TOTALSL

Delinquency Rate on Credit Card Loans (DRCCLACBS)
https://fred.stlouisfed.org/series/DRCCLACBS

Solitario Resources Corp. (XPL)
https://finance.yahoo.com/quote/XPL

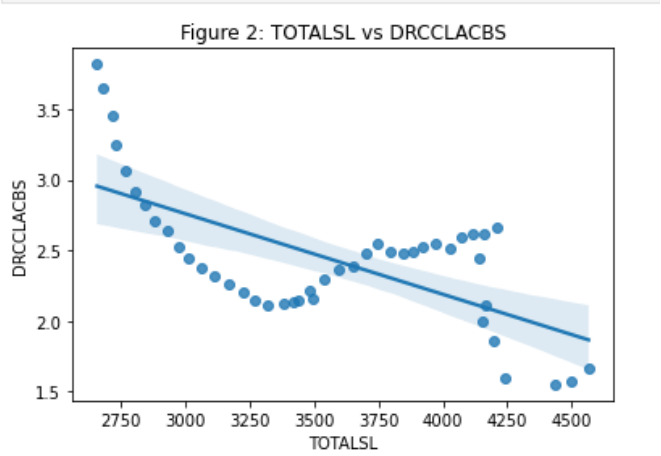
Step 5. Perform exploratory data analysis

Scenario 1. Money at a fixed rate for an unsecured purchase for an individual.

Figure 1:

	PSAVERT	TOTALSL	FEDFUNDS	UNRATE	DRCCLACBS
PSAVERT	1.0000	0.3804	-0.1048	0.5447	-0.1923
TOTALSL	0.3804	1.0000	0.4371	-0.4631	-0.6616
FEDFUNDS	-0.1048	0.4371	1.0000	-0.6025	0.1314
UNRATE	0.5447	-0.4631	-0.6025	1.0000	0.3593
DRCCLACBS	-0.1923	-0.6616	0.1314	0.3593	1.0000

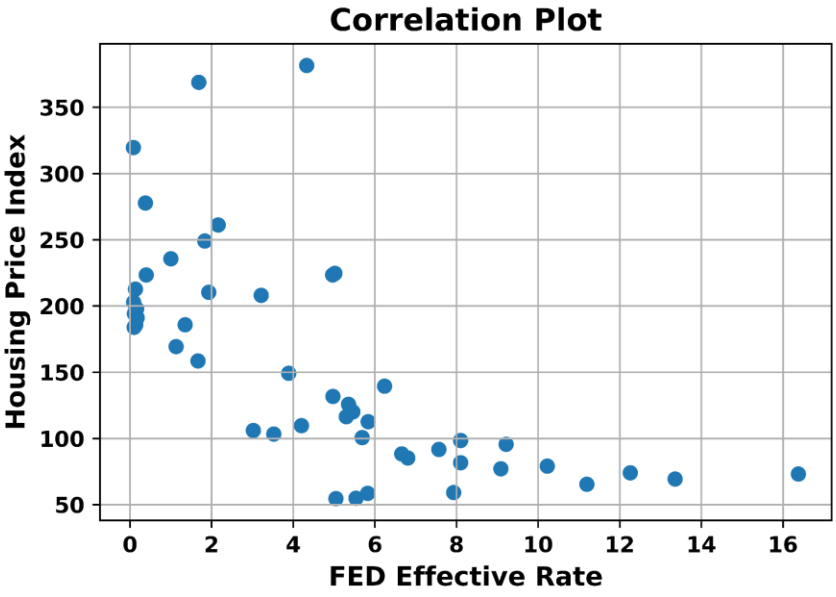
Figure 2:



The above sheet and plot show the moderately high negative correlation between the Delinquency Rate on Credit Card Loans and Total Consumer Credit Owned and Securitized. Its correlation coefficient is -0.67. It also shows unemployment is an important factor of delinquency on Credit Card Loans. The correlation coefficient is 0.359.

Scenario 2. Money at a floating rate for a secured purchase (e.g. home or automobile) for an individual

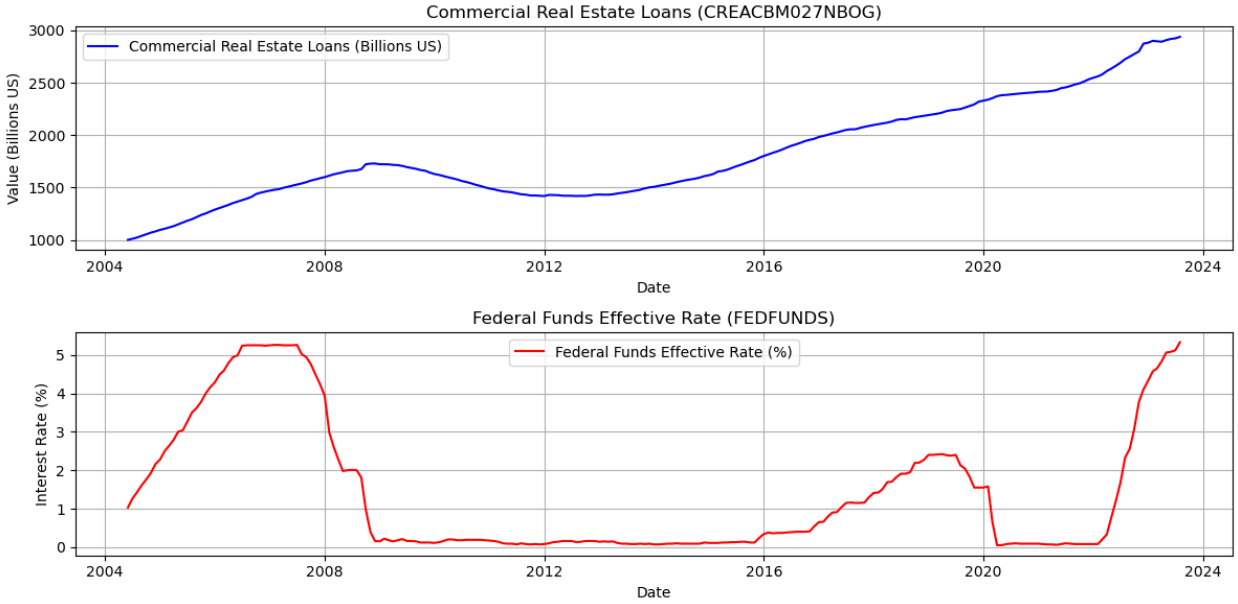
Figure 3:



The above plot represents the correlation between the FED effective interest rate and the US housing price index. Its Pearson correlation coefficient is -0.67, and Spearman's rank correlation coefficient is -0.77.

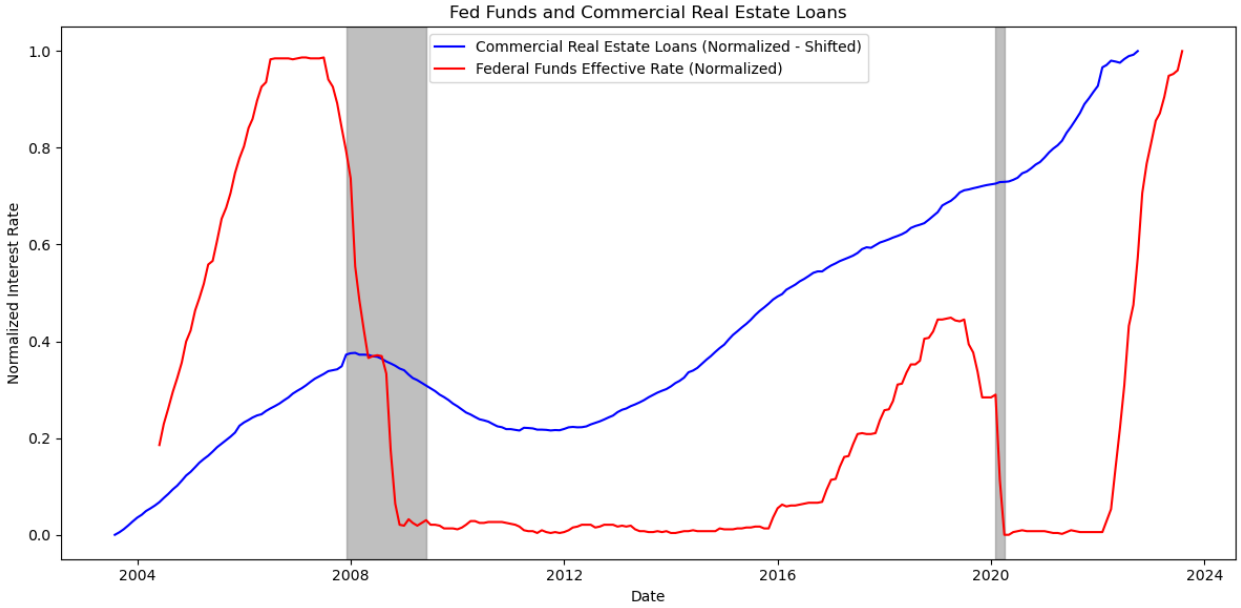
Scenario 3. Money at a fixed rate for a business for a construction loan.

Figure 4:



The data shows that commercial real estate lending activity tends to moderate in the months following Federal Reserve interest rate cuts, suggesting a potential delayed relationship between the two.

Figure 5:



Lagging commercial real estate loans by 10 months and normalizing the data reveals a relationship between loan activity and Fed funds rate cuts in the initial cycle. However, the second round of cuts only slowed but did not reverse loan growth.

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

Figure 6:

	SOX_Return	IVX_Return	AMD_Return
SOX_Return	1.000	-0.040	0.585
IVX_Return	-0.040	1.000	-0.045
AMD_Return	0.585	-0.045	1.000

Figure 7:

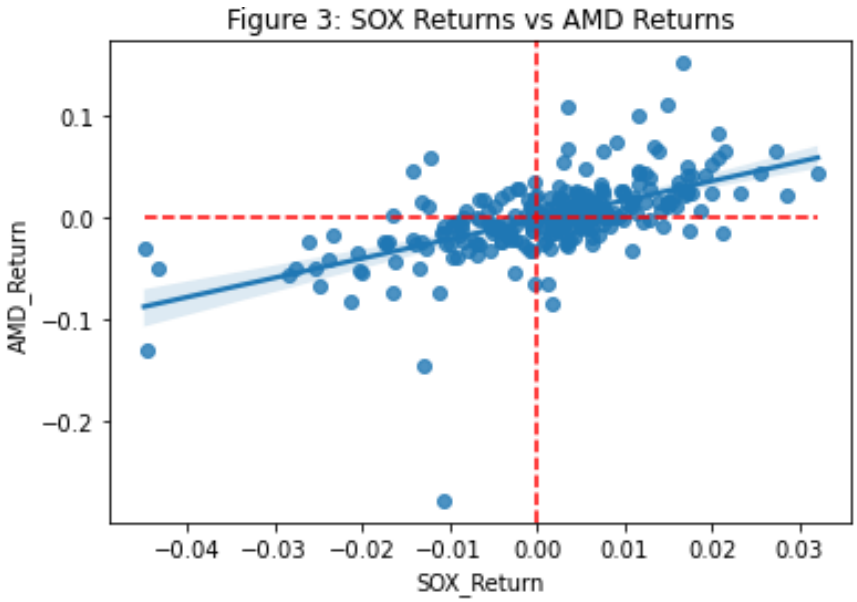
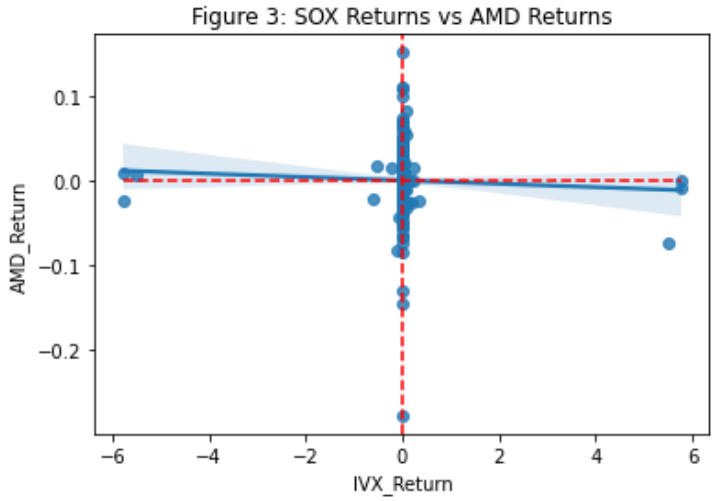
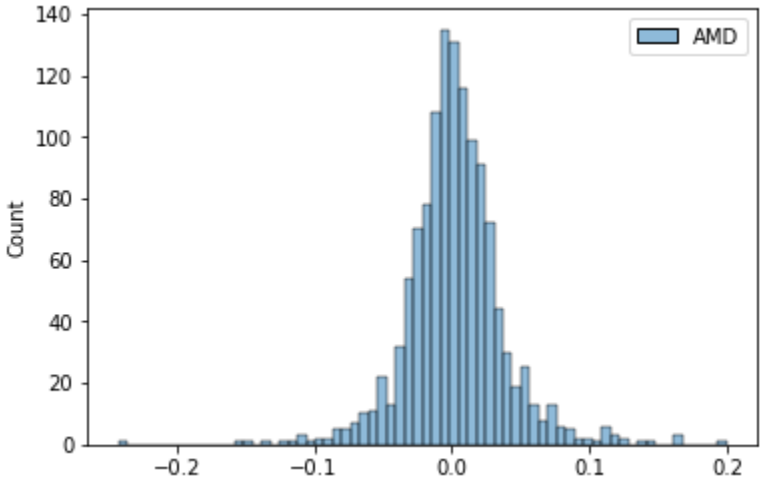


Figure 8:



For scenario 4 about lending of a stock. We choose AMD as the target stock and compare the return with the daily variance of IVX and PHX semiconductor index. data shows AMD has a positive moderate Correlation. The correlation coefficient is 0.585. The implied Volatility Index shows negligible correlation with the stock.

Figure 9:

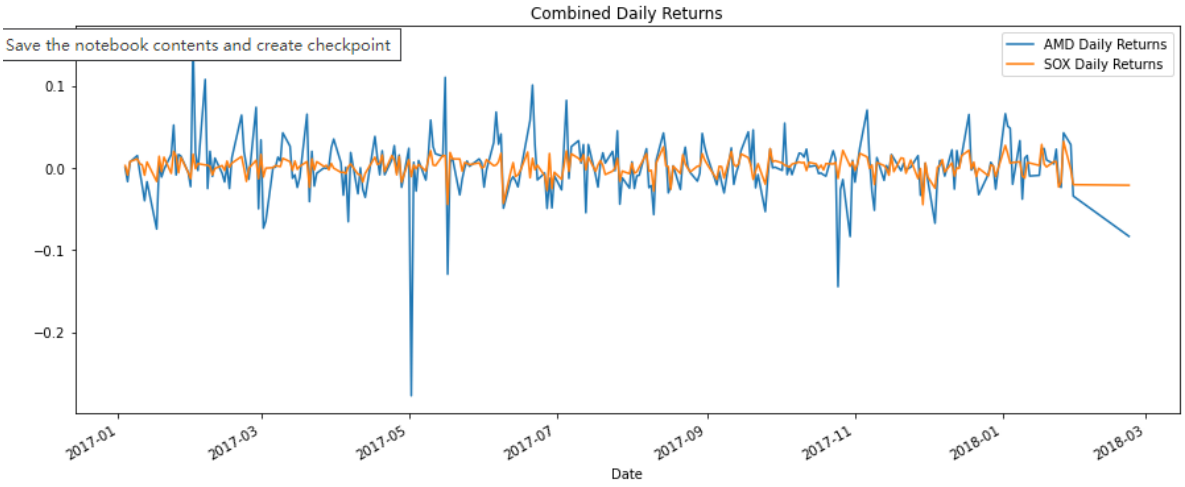


Histplot shows AMD stock returns got:

1. Skewness: [0.15096844]
2. Kurtosis: [4.99671003]

With 95.00% confidence, we can say the most our portfolio will lose in a day is -5.040% using historical VaR

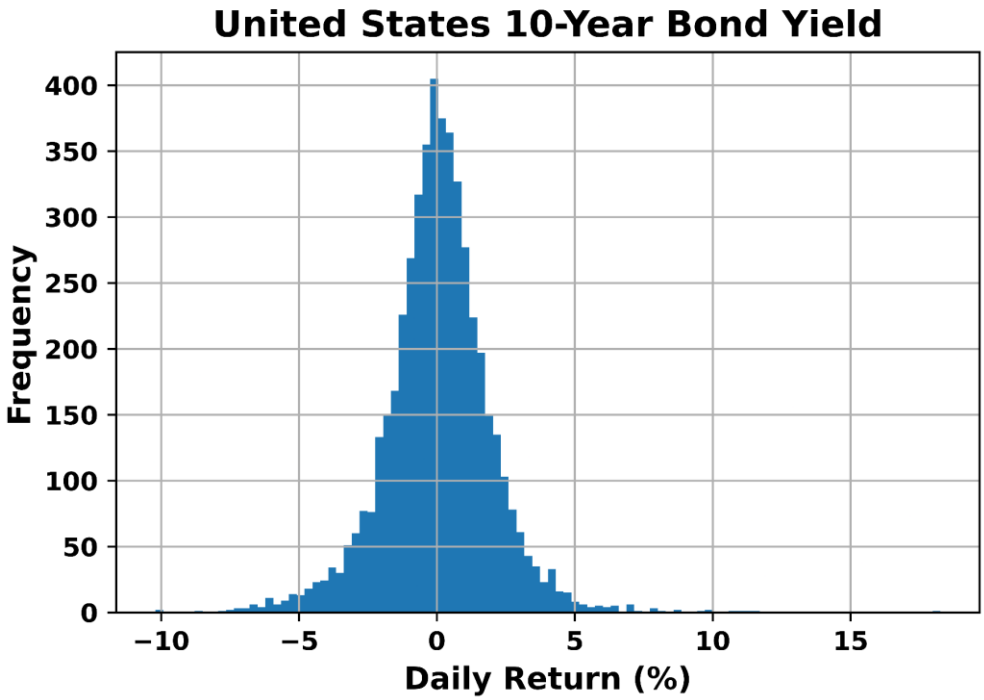
Figure 10:



SOX daily returns trend is smoother than AMD daily returns.

Scenario 5. Publicly traded bond (e.g. treasury bond, corporate bond) – that is, securities lending of a bond.

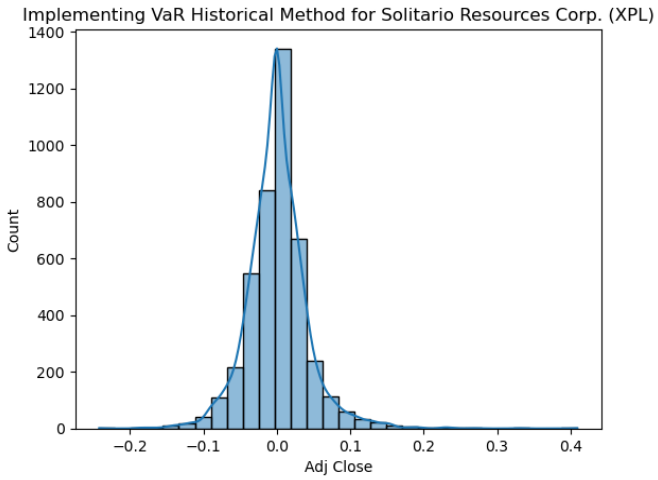
Figure 11:



The above plot represents the return distribution of the United States 10-year Bond Yield. We use the last 20 years' data for the distribution plot. Its average daily return is 0.041%, with a standard deviation 1.94. This distribution is positively skewed with a skewness of 0.19 and a kurtosis value 4.19.

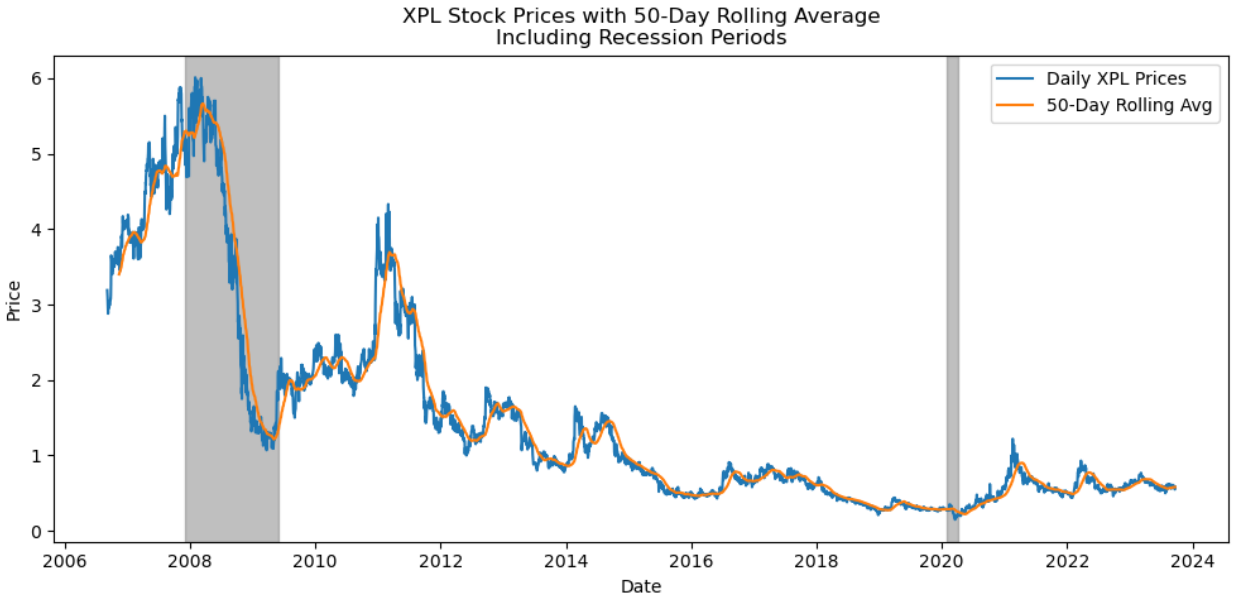
Scenario 6. An illiquid security – Private Equity

Figure 12:



The distribution has fat tails rather than a perfectly normal distribution. This suggests more extreme positive and negative returns than expected in a normal bell curve.

Figure 13:



A historical price chart for XPL with moving averages and recession shading reveals poor stock performance during downturns, yet expansions in the stock price tend to follow recessions.

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

Scenario 1. Money at a fixed rate for an unsecured purchase for an individual.

From Figures 1 and 2 data, we can figure out that the two main factors linked to the credit card delinquency rate are the unemployment rate, which implies low or no incoming source. Surprised that based on analyzed data, Fed funds rate variance does not affect the public's borrowing action.

Scenario 2. Money at a floating rate for a secured purchase (e.g. home or automobile) for an individual.

Figure 3 represents the correlation plot between the FED effective interest rate and the US housing price index. This scatter plot shows a negative correlation between interest rates and housing prices. We can use interest rate relationships to assess collateral like a house. We can lend money for secured purchases like a house by assessing the Fed's effective interest rate and housing price index. Additionally, this relation also helps to assess the credit risk for lending money at a fixed rate for a business for a construction loan.

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

Figures 4 and 5 show the relationship between commercial real estate lending activity and Federal Reserve interest rate cuts. The 10-month lagged data reveals that rate cuts precede a slowdown in lending activity in the initial cycle. This demonstrates that interest rate fluctuations can impact construction project financing and feasibility. Monitoring Fed policy and interest rate changes can help assess risk when lending money at a fixed rate for construction projects. The data provides signals about future lending conditions based on Fed actions.

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

From Figure 6,7,8 data, we could use the overall semiconductor market performance index SOX as the indicator for AMD stock lending. And the semiconductor stock performance is independent of macroeconomic volatility. Figure 10 shows that the SOX index got less variance compared with a single stock, but the trend during a short time is related and comparable to some degree.

Scenario 5. Publicly traded bond (e.g. treasury bond, corporate bond) – that is, securities lending of a bond.

Figure 11. represents the return distribution of the United States 10-year Bond Yield. It can help us to mitigate the credit risk of lending bonds to the individual or institution. We can calculate the value at risk (VaR) for a certain confidence interval, and from VaR, we can decide the margins for lending bonds.

Scenario 6. An illiquid security.

Figures 12 and 13 show the return distribution and price history for the stock of a mining company, Solitario Resources Corp (XPL). The return distribution has fat tails, indicating a higher likelihood of extreme price swings. The price chart shows poor performance during recessions but expansions after downturns. This data demonstrates the valuation uncertainty and liquidity challenges inherent with an illiquid small-cap stock. Tracking metrics like trading volumes and relating performance to macroeconomic trends can help assess the fair value and saleability of such illiquid assets when used as collateral. The data provides perspective on the risks posed by market conditions and macroeconomic cycles.