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SI 206
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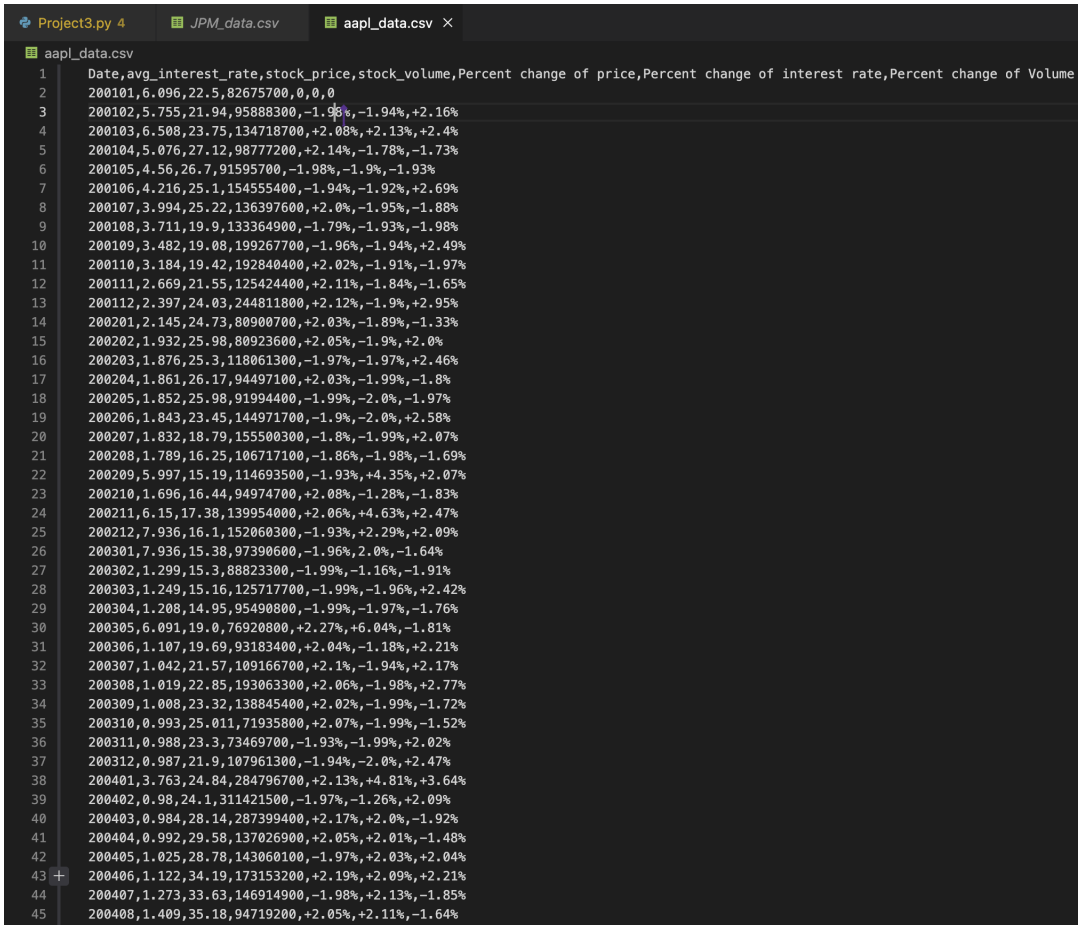
APPLE and JP Morgan Stock Price and Volume Variation With Interest Rate

1. Goals
    a. Original Goals: The original goal of our project was to calculate and quantify the relationship between the monthly variation of stock prices of companies in 4 different fields shown below with the change of interest rate of the United States by the Federal Reserve Bank.
        i. Technology: Tesla, Apple, Amazon, Google
        ii. Medical: Johnson & Johnson, Intuitive, Merc Corporation, Pfizer
        iii. Leisure: Delta Airlines, Spirit Airlines, Life Group Holdings, Hilton Hotels
        iv. Financial Firms: Goldman Sachs, Morgan Stanley, Citadel, Wells Fargo

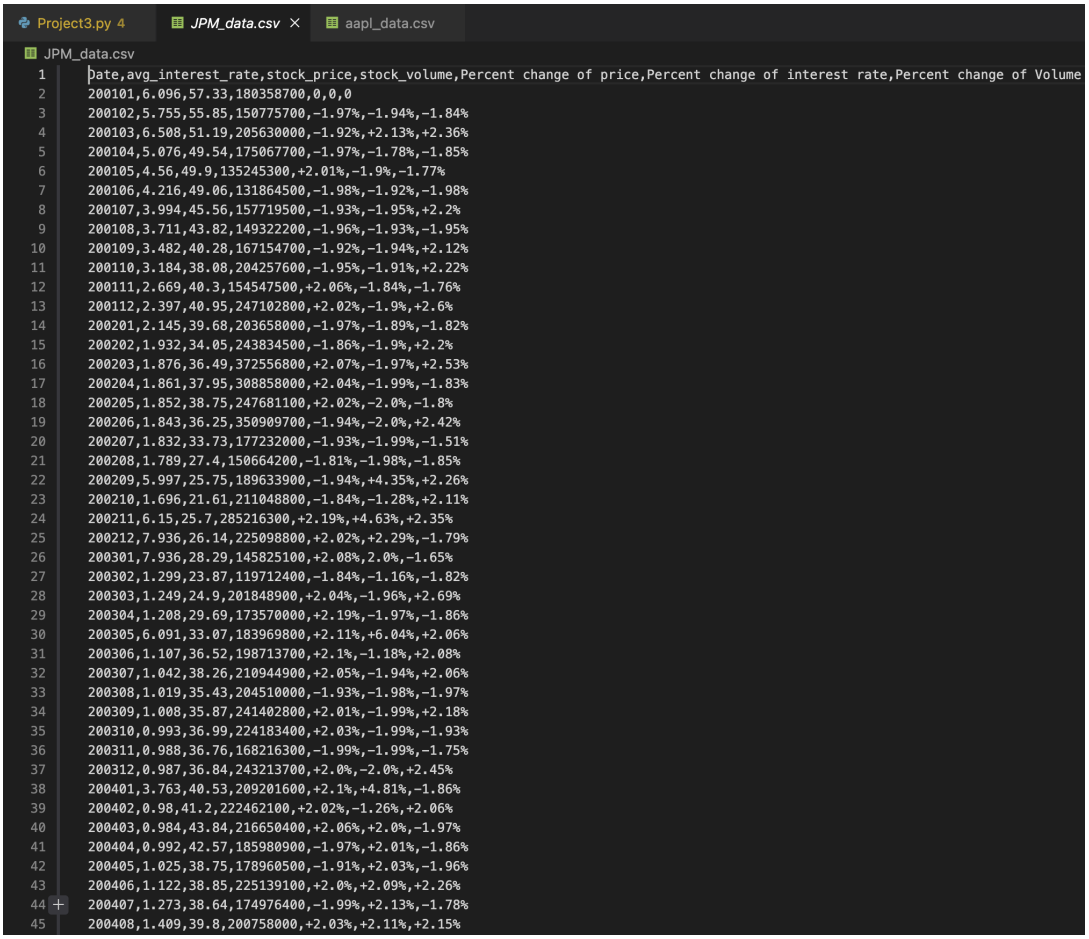
    We planned to create a line graph for comparing different stock prices and interest rates by using time as a variable. Furthermore, we intended to create a bar chart showing the stock price of a company before and after the interest rate variation.
    b. Achieved Goals: Throughout the course of the project, we have encountered some problems and hardships which will be discussed in the following section, and thus resulted in modifying the objective of the project. Instead of focusing on stock price variation in 4 different fields each fields represented with 4 different well known stocks, we chose to focus on 2 fields, technology and financial firms, which are represented with one main well known stocks: Apple (AAPL) and JP Morgan (JPM). Furthermore, we have also decided to investigate and quantify the relationship between the monthly variation of stock volume, along with price variation, and change of interest rates and visualize them.
2. Problems
    a. One major problem we faced was having overwhelming amount of data given and numer of APIs. For example, stock information of each company has different API links as well as the API for the interest rate. Each API consisted of monthly data from 1999-12-31 until 2023-04-14 which is roughly 300 rows of data per API. If we decided to pursue with the original dataset, we would have needed total of 17 APIs or 5100 rows of data, which we though would require more time than we have for this project. Thus, to ensure quality output, we chose to focus on two main company's stock price data: Apple(AAPL) and JP Morgan(JPM). Furthermore, to have more through analysis, we decided to utilize stock volume data against interest rate variation along with stock price.

b. Another problem we faced was that stock price and volume has numerous confounding variables other than interest rate variation. For example, price and volume of AAPL could increase due to technological advancement that Apple has achieved instead of due to

3. Calculations
    a. Calculation Logistics:
        i. Percent change of Interest Rate: (Interest Rate of previous month + Interest Rate of current month) / Interest Rate of previous month
        ii. Percent change of Price: (Price of previous month + Price of current month) / Price of previous month
        iii. Percent change of Volume: (Volume of previous month + Volume of current month) / Volume of previous month
    b. Calculation File:
        i. AAPL_Processed_Data.csv



ii. JPM_Processed_Data.csv



4. Instructions
    a. Since we have constructed our code for different circumstances, you just need to press the play button until the instruction tells you to stop. (Ideally you have to press play button 22 times to fullfill the tables) Each press insert one year worth of data into all tables, 12 data per press per each table sinc each data worth 1 month of data. Our data analysis start from 2001 until 2022
        i. When data base is empty: Insert 2001 data into different tables
        ii. When data is full: The program prints the following which indicate that the tables are at full capacity: "Unable to insert more data since we inserted all available data". And does not insert further data into tables.
    b. Uncomment the functions at the bottom part of the program to visualize the functions or csv files that you want to retrieve. The function options are listed in the following part.
5. Code Documentation
    a. Functions
        i. setUp(url)

1. Input: url
2. Output: dictionary of json file in accordance with the url
3. This function takes in the url of API we selected and return the dictionary of loaded json file

ii. load_interest_rate_data()
1. Loads API of Interest Rate information and retrieves the monthly average interest rate for a year for each run

iii. insert_table_JPM()
1. Loads API of JPM's stock information and retrieves the monthly stock price and volume. Then create two different tables each having the information of stock price and stock volume for corresponding date.

iv. insert_table_AAPL()
1. Loads API of AAPL's stock information and retrieves the monthly stock price and volume. Then create two different tables each having the information of the stock price and the stock volume for its corresponding date.

v. AAPL_PRICE_TIMELINE()
1. Visualizes the changes of AAPL's stock price in the timeline by using line graph
2. X-axis: time ,Y-axis: stock price

vi. AAPL_VOLUME_TIMELINE()
1. Visualizes the changes of AAPL's stock volume in the timeline by using line graph
2. X-axis: time, Y-axis: stock volume

vii. JPM_PRICE_TIMELINE()
1. Visualizes the changes of JPM's stock price in the timeline by using line graph
2. X-axis: time ,Y-axis: stock price

viii. JPM_VOLUME_TIMELINE()
1. Visualizes the changes of AAPL's stock volume in the timeline by using line graph
2. X-axis: time, Y-axis: stock volume

ix. join_interest_rate_apple_price()
1. Join INTEREST_RATE and AAPL_PRICE tables using the dat as a key integer

x. join_interest_rate_apple_volume()
1. Join INTEREST_RATE and AAPL_VOLUME tables using the dat as a key integer

xi. join_interest_rate_jpm_price()

1. Join INTEREST_RATE and JPM_PRICE tables using the dat as a key integer

xii. join_interest_rate_jpm_volume()
1. Join INTEREST_RATE and JPM_VOLUME tables using the dat as a key integer

xiii. AAPL_PRICE_Interest_rate_correlation()
1. Visualizes the correlation graph to show the correlation between AAPL's stock price and Interest rate

xiv. AAPL_VOLUME_Interest_rate_correlation()
1. Visualizes the correlation graph to show the correlation between AAPL's stock volume and Interest rate

xv. change_AAPL_PRICE_Interest_rate_correlation(lst, lst2)
1. Input: takes in two different lists that each contains the data of monthly change of stock prices of AAPL in percentage and monthly change of interest rate in percentage
2. Visualizes the correlation graph to show the correlation between the changes in stocks prices and interest rates.

xvi. change_JPM_PRICE_Interest_rate_correlation(lst, lst2)
1. takes in two different lists that each contains the data of monthly change of stock prices of JPM in percentage and monthly change of interest rate in percentage
2. Visualizes the correlation graph to show the correlation between the changes in stocks prices and interest rates.

xvii. change_AAPL_VOLUME_Interest_rate_correlation(lst, lst2)
1. Input: takes in two different lists that each contains the data of monthly change of stock volume of AAPL in percentage and monthly change of interest rate in percentage
2. Visualizes the correlation graph to show the correlation between the changes in stock volumes and interest rates.

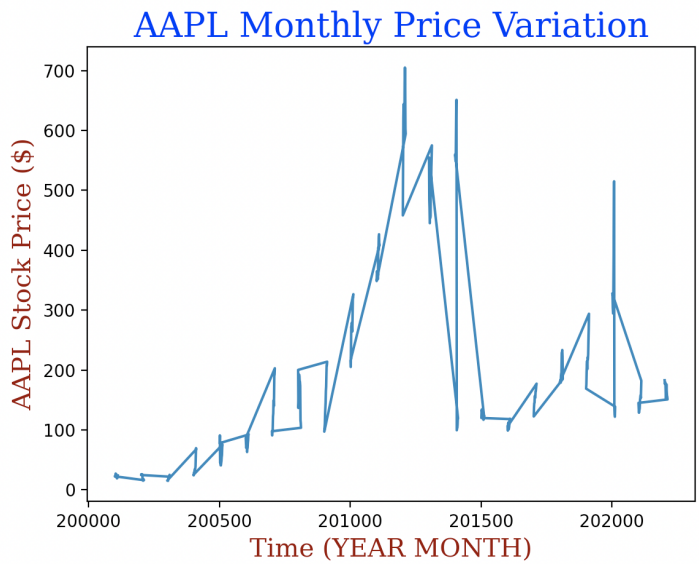
xviii. change_JPM_VOLUME_Interest_rate_correlation(lst, lst2)
1. Input: takes in two different lists that each contains the data of monthly change of stock volume of JPM in percentage and monthly change of interest rate in percentage
2. Visualizes the correlation graph to show the correlation between the changes in stock volumes and interest rates.

xix. write_AAPL_data_csv()
1. Write information about AAPL in csv which uses columns of
2. `"Date", "avg_interest_rate", "stock_price", "stock_volume", "Percent change of price", "Percent change of interest rate", "Percent change of Volume"`

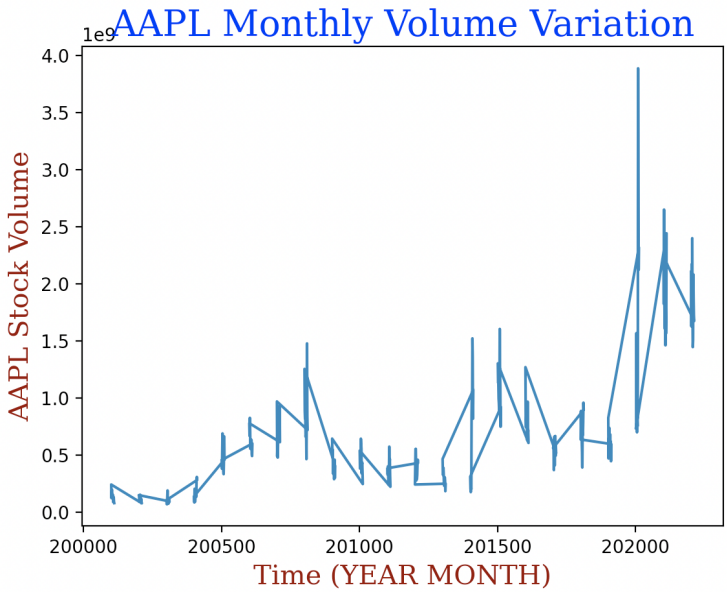
xx. write_JPM_data_csv()

1. Write information about JPM in csv which uses columns of
2. `"Date", "avg_interest_rate", "stock_price", "stock_volume", "Percent change of price", "Percent change of interest rate", "Percent change of Volume"`

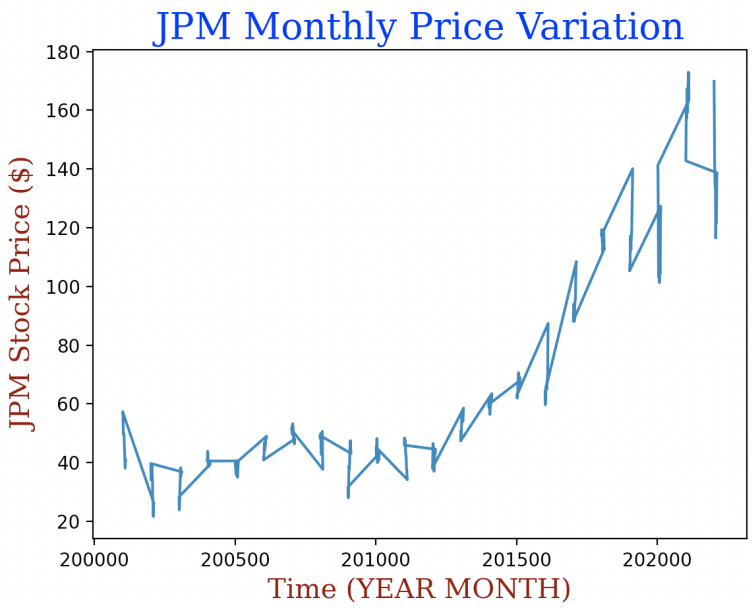
6. Visualizations
   a. Input Data Visualizations
      i. AAPL Monthly Price Variation



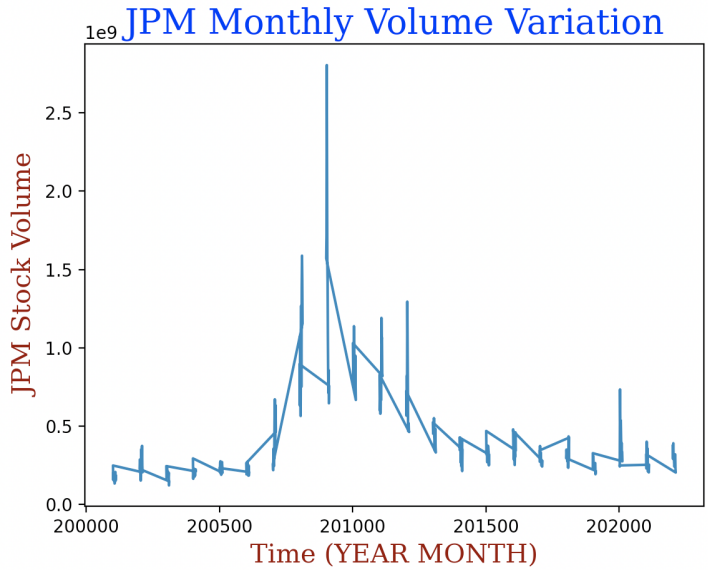
      ii. AAPL Monthly Volume Variation



iii. JPM Monthly Price Variation

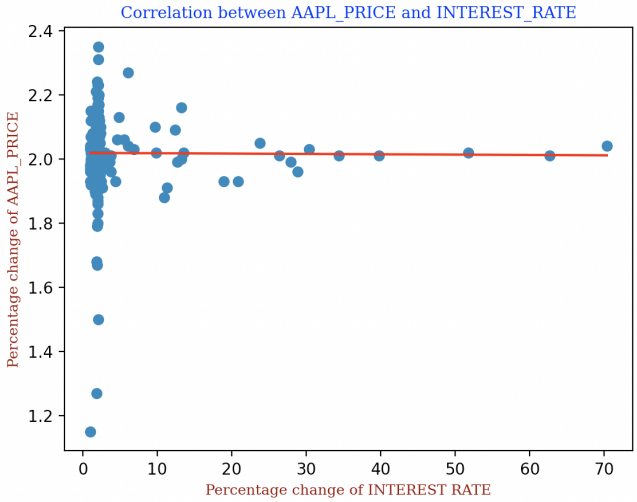


iv. JPM Monthly Volume Variation

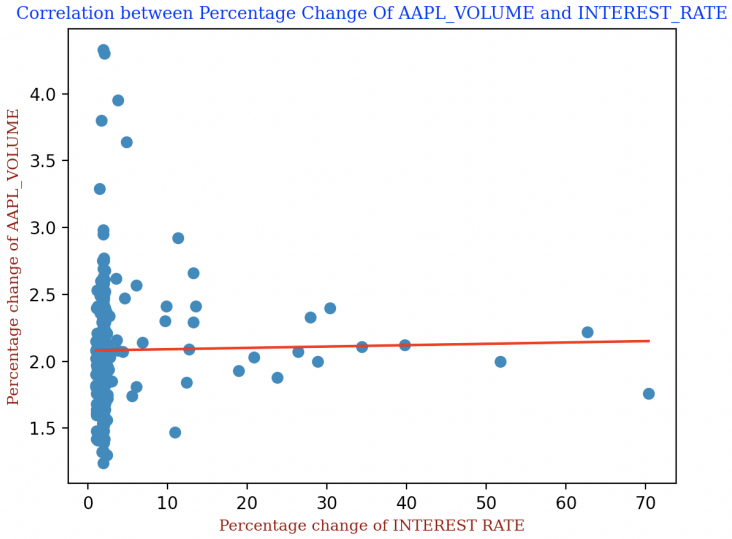


b. Processed Data Visualization

i. Correlation between AAPL_Price and Interest_rate

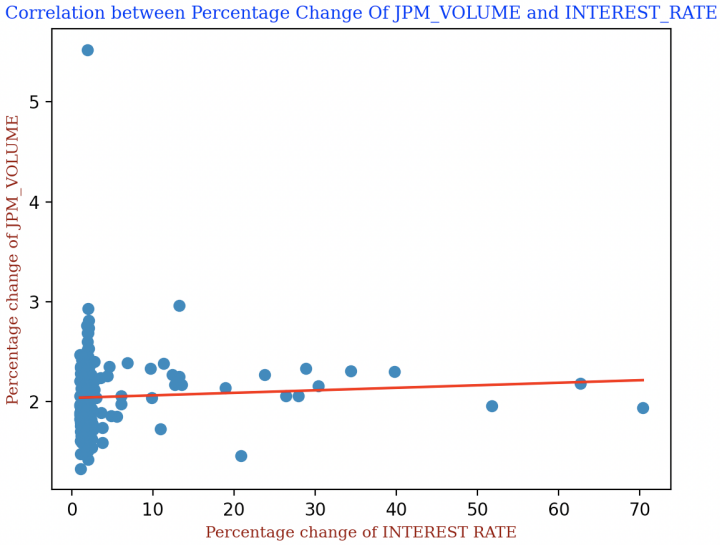


ii. Correlation between AAPL_Volume and Interest_rate



iii. Correlation between Percentage change of JPM_Price and Interest Rate

iv. Correlation between Percentage Change of JPM_Volume and Interest Rate



Resources

- API for Interest rate:
  - "https://api.fiscaldata.treasury.gov/services/api/fiscal_service/v2/accounting/od/avg_interest_rates?filter=record_date:lt:2023-03-31"
- API for AAPL Stock data:
  - "https://www.alphavantage.co/query?function=TIME_SERIES_MONTHLY&symbol=AAPL&apikey=GVVMWZMSSP5RKNCN"
- API for JPM Stock data:
  - “https://www.alphavantage.co/query?function=TIME_SERIES_MONTHLY&symbol=JPM&apikey=GVVMWZMSSP5RKNCN%22”
- Correlation graph in python
  - “https://www.geeksforgeeks.org/plotting-correlation-matrix-using-python/”