Research Question:
Which sectors from Technology, Healthcare, Energy and Finance experienced the most volatility, and which showed resilience during Covid?

Summary of API and Methodology:

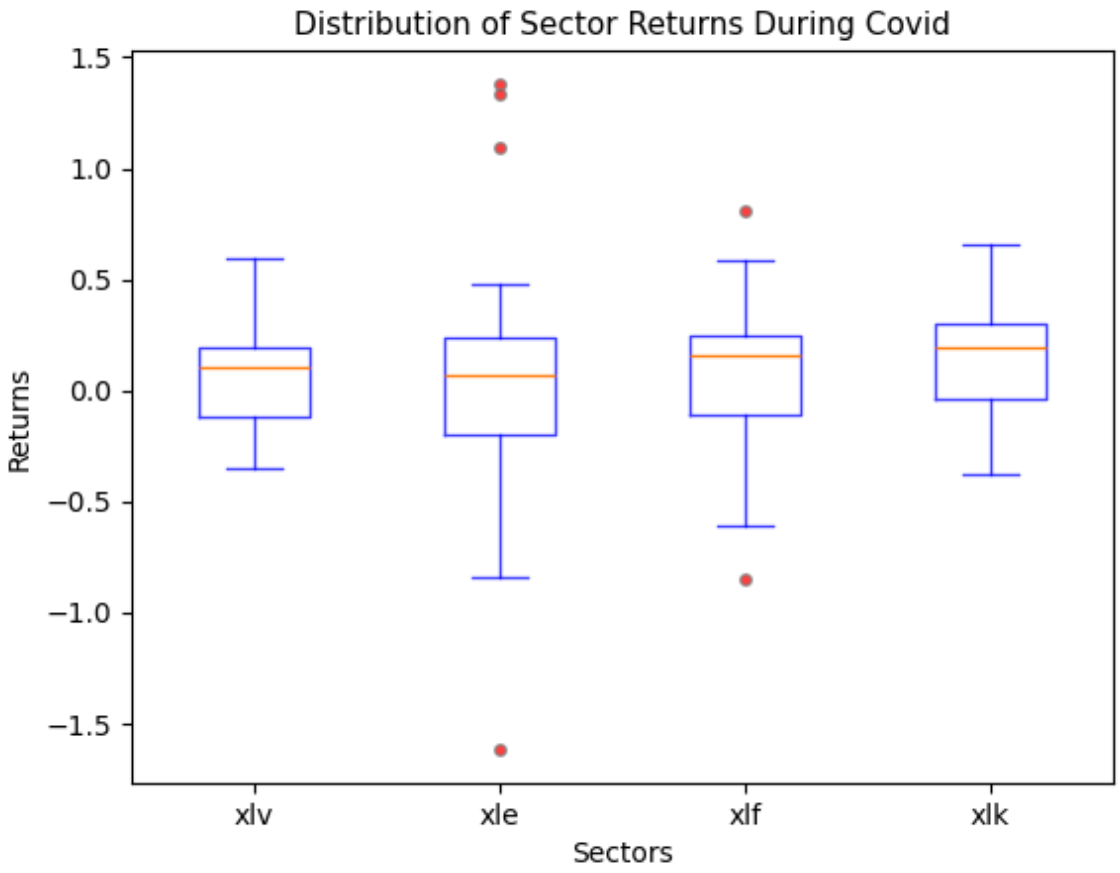
API Used
- Alpha Vantage: Used to fetch historical daily price data for the sectors.
- API Parameters used: function=TIME_SERIES_DAILY, symbol, apikey, extended_hours=false, datatype=csv

Repository Structure
- Resources Folder: Contains four CSV files with historical data for each sector, including timestamp, open, high, low, close, and volume.
- volatility.ipynb: The primary Jupyter notebook containing the script to run the analysis
- output_data Folder: Contains output images (PNG) from the analysis, such as box plots, scatter plots and bar charts.

Data Sourcing Methodology
1. Data Extraction: Data for Technology, Finance, Healthcare and Energy sectors is fetched from Alpha Vantage using the provided API and parameters, which is then saved in CSV format.
2. Data Preparation:
   - CSVs are loaded into Pandas DataFrames, and the relevant date ranges are filtered (01-01-2017 to 31-12-2023) for each of the dataframes.
   - The “timestamp” column is converted to Datetime datatype and sorted in ascending order.
   - Daily percentage changes in returns are calculated from the closing price.
   - Monthly averages and standard deviations of returns are computed.
3. The calculated monthly statistics for all the four sectors are combined into a single DataFrame.

Visualizations:

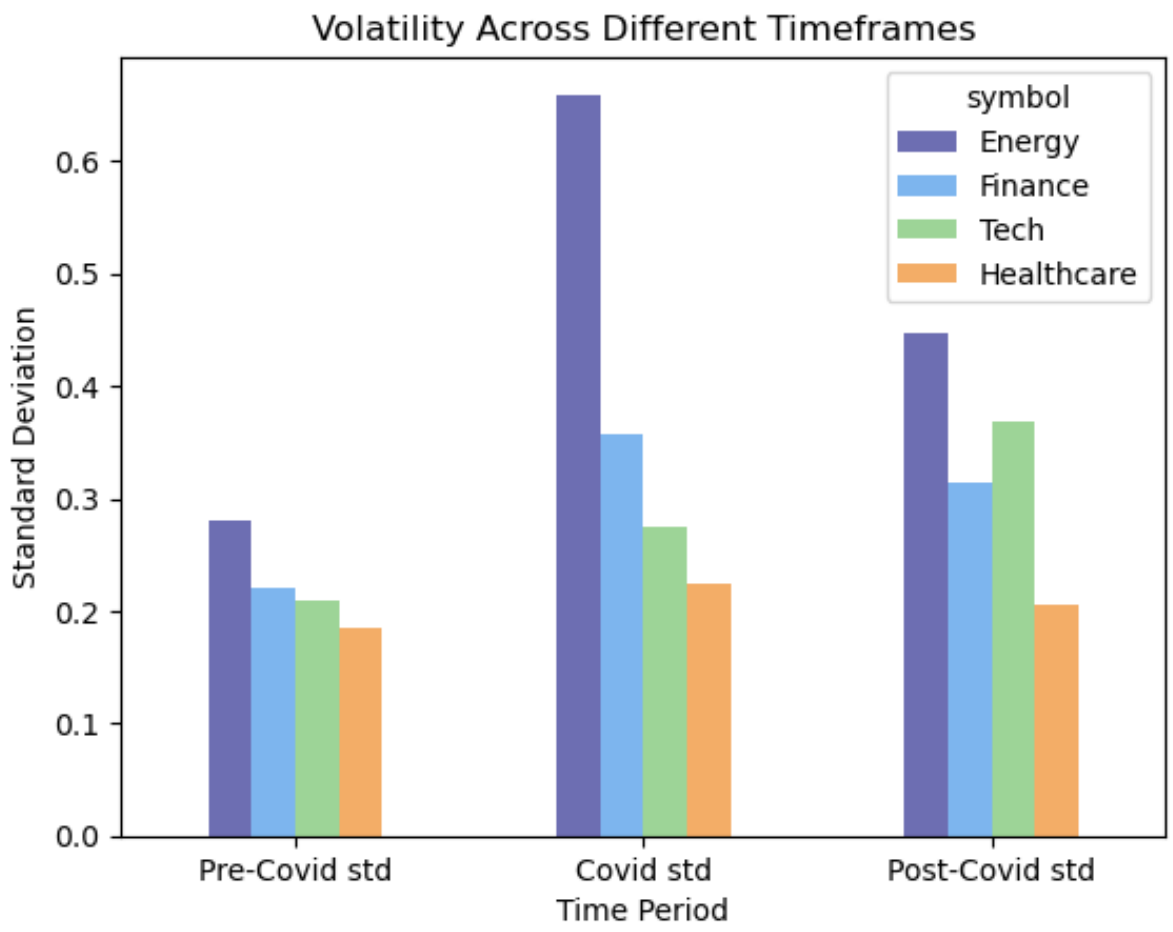
Box Plot: Visualizes the distribution of sector returns during the COVID period.



Analysis:

- The Energy (XLE) sector shows the highest volatility, indicated by highest interquartile range, long whiskers and most outliers. This sector has the lowest median returns
- The Financials (XLF) sector follows in volatility but with fewer outliers, shorter whiskers and narrower interquartile range.
- Technology (XLK) and Healthcare (XLV) showed the least variability in returns, as indicated by shorter whiskers and smaller IQR. XLK has the highest median returns.
- Despite the mean return for all four sectors being positive, the distributions of returns are negatively skewed. This indicates the presence of a few large, negative returns, likely caused by the stock market crash and economic downturn in 2020.

Multi Bar Chart:

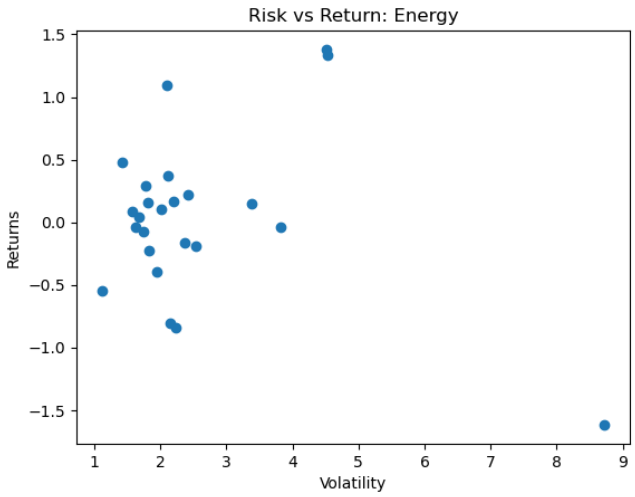


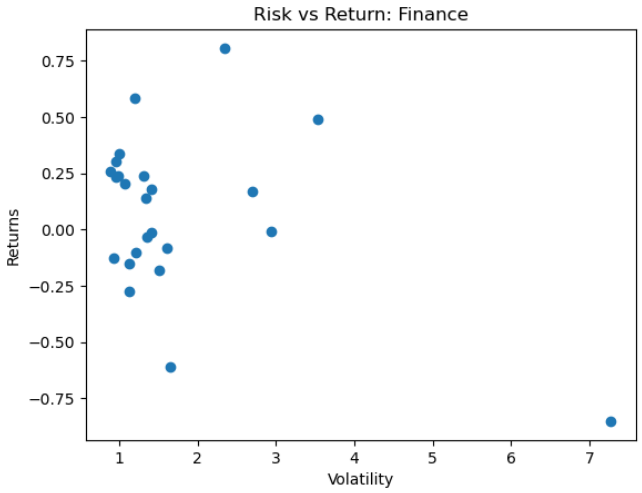
The bar chart illustrates the volatility of four sectors (Energy, Finance, Tech, and Healthcare) across three time periods: Pre-Covid, Covid, and Post-Covid. Volatility of returns is measured using standard deviation values calculated for each of the timeframes for each of the sectors.

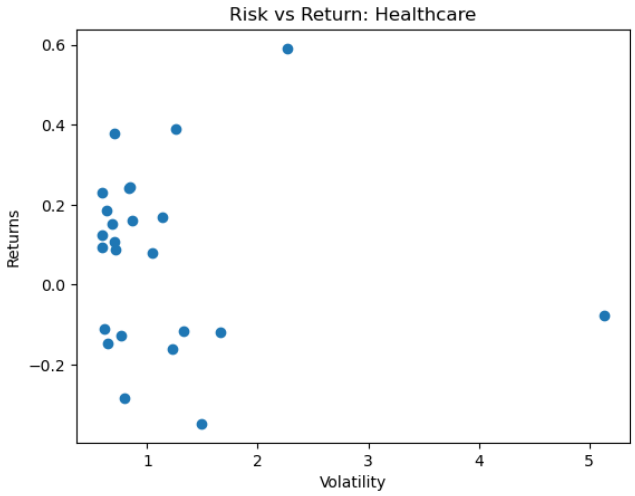
Analysis:

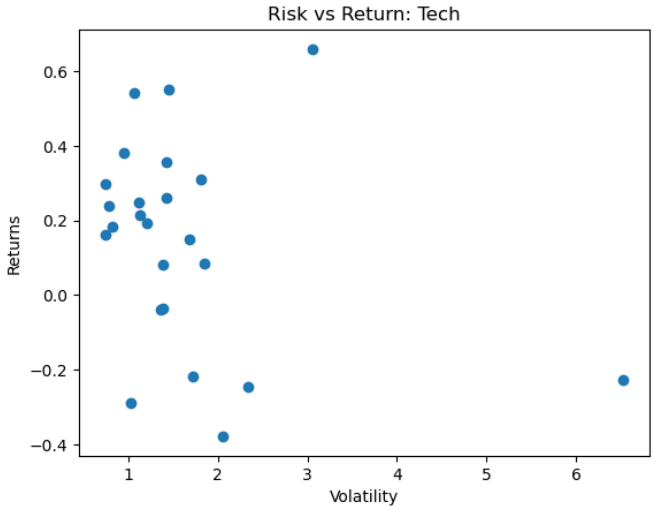
- Compared to Pre-Covid volatility, Energy(XLE) and Finance(XLF) sectors experienced a significant increase in volatility during the Covid period. The standard Deviation of Energy sector increased by 132%. While the standard Deviation of Financial sector went up by 64%.
- Tech(XLK) and Healthcare(XLV) sectors also saw an increase in volatility, but to a lesser extent. The Standard Deviation of Tech sector saw an increase of 29%. Healthcare sector's standard deviation increased by only 16%.
- Post-Covid the Energy remains relatively volatile, although the levels have decreased compared to the Covid period. The standard deviation of the energy sector has gone down to 0.45, a decrease of 33% from Covid period. The volatility of Finance and Healthcare sector also decreased. However, volatility of the Technology sector went up. Its standard deviation increased to 0.37, an increase of 33%.

Risk vs. Return Correlation Graphs:
Risk and return correlations graphs were created to observe if there was an increase in return due to increased volatility during the Covid period.









A**nalysis:** The x-axis represents monthly standard deviation and the y-axis represents the monthly average returns during covid. The correlation coefficient values are as follows:
Healthcare: -0.08
Energy: -0.19
Finance: -0.39
Tech -0.28

The correlation coefficient suggests that there is no correlation between risk level and return values during covid. The traditional risk-return paradigm was disrupted during COVID, indicating the presence of powerful market forces that significantly altered the expected relationship between risk and return.

Summary Statistics and Analysis of sectors during Covid:

Analysis of the Summary Statistics during Covid:

- Energy (XLE): This sector had the highest volatility, as indicated by its high standard deviation (0.659) and variance (0.435). While the mean return (0.039) and median return (0.066) are positive, the large spread suggests considerable fluctuations in returns, highlighting its volatility.

- Financials (XLF): With a mean return of 0.073 and a higher median return of 0.153, the Financial sector shows moderate volatility, with a standard deviation of 0.357. Its variance (0.128) also points to some variability, though much less than Energy, making it relatively less volatile.

symbol	mean	median	std	var
Energy(XLE)	0.038864	0.066138	0.659244	0.434603
Finance(XLF)	0.072919	0.152987	0.357404	0.127737
Technology(XLK)	0.145016	0.189220	0.274596	0.075403
Healthcare(XLV)	0.073003	0.100431	0.224396	0.050353

- Technology (XLK): The Technology sector displayed the highest mean return (0.145), indicating strong performance. With the low standard deviation (0.275) and variance (0.075) , Technology experienced less volatility compared to the other sectors, reflecting both high returns and relatively lower risk.

- Healthcare (XLV): Healthcare was the most stable sector, with the lowest standard deviation (0.224) and variance (0.050). The mean return (0.073) and median return (0.100) show steady performance with minimal variability, making it the most resilient sector.

- The median is greater than mean in all the four sectors which indicates negative skewness of data for all the sectors.

Conclusion:

Energy was the most volatile sector followed by Financial. Technology led in highest mean returns. While healthcare was the most resilient sector. No significant relationship of risk and return was exhibited during Covid suggesting presence of stronger market forces that affected the relationship.