Statistical Analysis (During Covid)

1. Introduction

The primary goal of this analysis is to evaluate the impact of significant COVID-19-related events on the performance of four key sectors: Technology (XLK), Healthcare (XLV), Energy (XLE), and Financials (XLF). Using daily stock data from **2017 to 2023**, we focus on key dates during the pandemic to observe the changes in market behavior. The analysis relies on a series of statistical tests to determine if the reactions in the market were significant.

2. Data Overview

Data was collected from the Alpha Vantage API, covering the daily closing prices of the following sectors:

- **Technology (XLK)**

- **Healthcare (XLV)**

- **Energy (XLE)**

- **Financials (XLF)**

The key events analyzed are:

1. **Wuhan Lockdown**: January 23, 2020

2. **COVID-19 Pandemic Declaration**: March 11, 2020

3. **Initial US Lockdowns**: March 15, 2020

4. **Vaccine Trials and Announcements**: June 1, 2020

5. **Second COVID-19 Wave**: October 1, 2020

6. **Vaccine Rollout**: December 15, 2020

7. **COVID Lockdown End**: July 1, 2021

3. Methodology

The analysis involved examining the daily stock returns (percentage change in closing prices) for each sector around the key events. The steps included:

1. **Data Segmentation**:

    o We segmented the data into a 60-day window before and after each key event.

2. **Paired T-Test**:

   o **Purpose**: To determine if there was a statistically significant difference in the average returns before and after each event.

   o **Null Hypothesis (H$_0$)**: There is no significant difference in average returns before and after the event.

   o **Alternative Hypothesis (H$_1$)**: There is a significant difference in average returns before and after the event.

3. **Data Processing**:

   o For each event and sector, the analysis extracted returns data from a 60-day window before and after the event date.

   o A paired T-test was performed to assess whether the mean returns differed significantly before and after each event.

4. Results

The T-tests were conducted for each sector and each event, and the outcomes were summarized in a CSV file named T_Test_Results.csv. Here's a snapshot of the findings:

Event	Sector	T-Statistic	P-Value	Significant (P < 0.05)
Wuhan Lockdown	Technology (XLK)	-1.237	0.224	No
Pandemic Declaration	Healthcare (XLV)	0.810	0.423	No
Initial US Lockdowns	Energy (XLE)	2.418	0.020	Yes
Vaccine Trials	Financials (XLF)	-0.992	0.327	No
Vaccine Rollout	Technology (XLK)	0.432	0.668	No
Second Wave	Energy (XLE)	1.663	0.104	No
COVID Lockdown End	Healthcare (XLV)	0.404	0.688	No

5. Discussion

The analysis revealed some interesting insights:

- The **Energy sector (XLE)** showed a statistically significant change in returns during the initial US lockdowns (p-value = 0.020), likely reflecting disruptions in energy consumption and oil price volatility.

- Other sectors, such as **Technology (XLK)** and **Healthcare (XLV)**, demonstrated resilience, with no statistically significant changes in the 60-day windows around key COVID-19 events.

- The absence of statistically significant impacts in many cases suggests that while market volatility was evident during COVID-19, the returns did not deviate significantly over the periods analyzed.

6. Limitations

- The analysis only considered specific COVID-19-related events and their 60-day windows. Other external factors during the same periods were not accounted for.

- Using a paired T-test assumes that returns are normally distributed, which is not always true for financial data.

7. Conclusion

The statistical analysis demonstrated that, while some events had noticeable impacts on specific sectors (ex. Energy during initial lockdowns), the overall effects across all sectors were not statistically significant for most of the COVID-19-related events analyzed.

8. Future Work

- Consider a more comprehensive analysis with alternative statistical tests

- Consider other events may have impacted stock movement during Covid-19