Statistical Analysis of COVID-19 Data with Stock Market Trends

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Introduction

- Purpose of research
- Data collection and organization
- Hypothesis testing
- Relevant graphs
- Correlation analysis
- Conclusion

Purpose of Research

Research Questions

- Did the COVID-19 pandemic have a significant long-term effect on the U.S. stock market?
- What particular sector of the economy was affected the most?
- Did the vaccination rate in the U.S. have any effect on the stock market?

Research Significance

- To see why different companies perform better than others during these times.
- To better reflect the long-term effects of the pandemic on the U.S. economy.

Data Collection

Process

- COVID-19 daily cases, percentage of U.S. population fully vaccinated, stock prices, and percent change of stock prices
- Stock data ranges from June 1, 2018 to December 31, 2021
- Dow Jones 30 companies categorized in 5 sectors with top 3 at end of 2020

Economic Sectors

- Technology
- Healthcare
- Finance
- Industry
- Consumer Services

Sector	Ranking & Stock Name
Technology	#4: Microsoft Corp (MSFT)
	#8: Salesforce.Com Inc (CRM)
	#13: Apple Inc (AAPL)
Healthcare	#1: UnitedHealth Group Inc (UNH)
	#7: Amgen Inc (AMGN)
	#15: Johnson & Johnson (JNJ)
Finance	#2: Goldman Sachs Group Inc (GS)
	#6: Visa Inc (V)
	#12: American Express Co (AXP)
Industry	#9: Boeing Co (BA)
	#10: Caterpillar Inc (CAT)
	#11: Honeywell International Inc (HON)
Consumer Services	#3: Home Depot Inc (HD)
	#5: McDonald's Corp (MCD)
	#20: Walt Disney Co (DIS)

Hypothesis Testing for Percent Change of Stock Prices

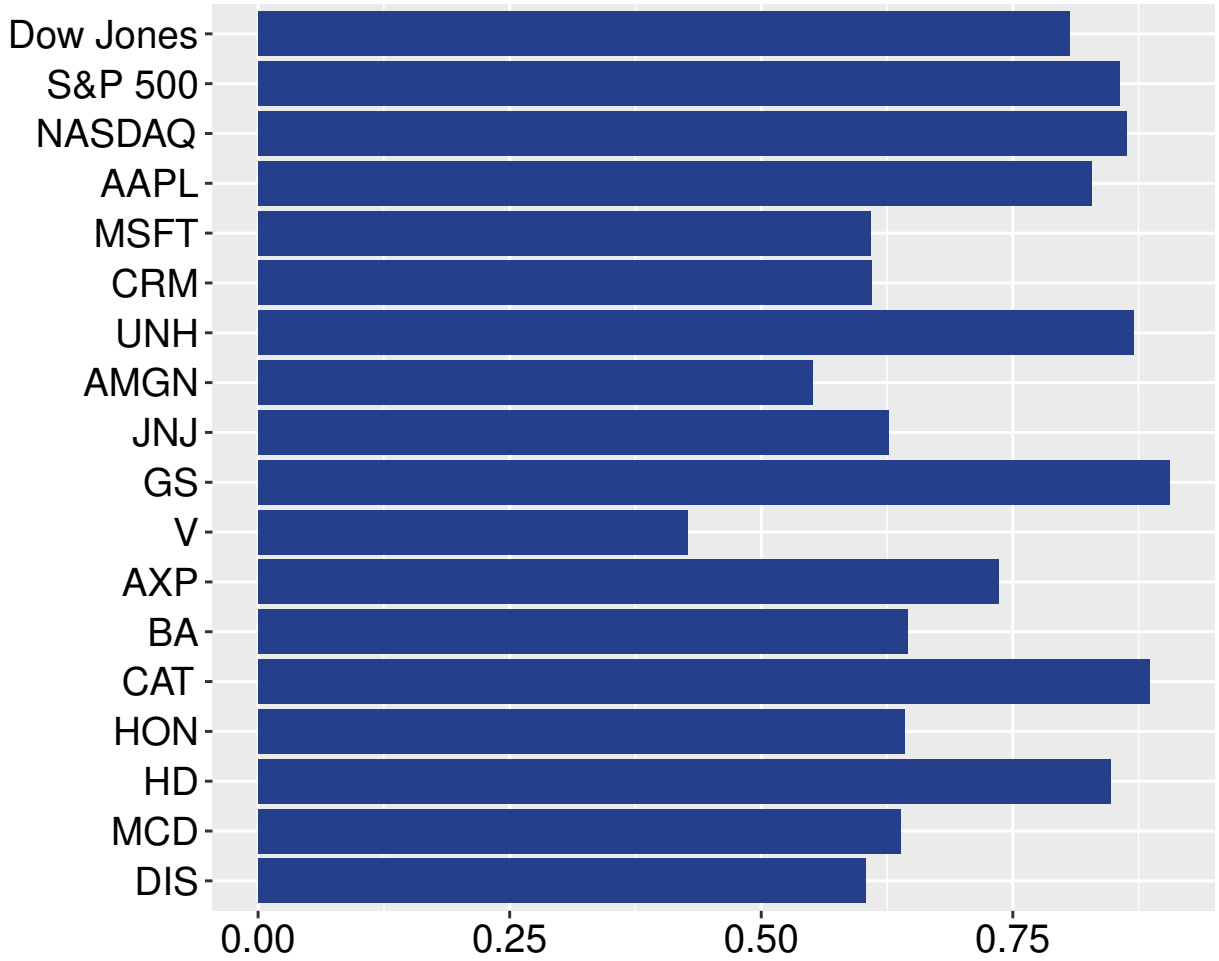
The t-test was chosen for all hypothesis testing because:

- Comparison of the means
- Population variance is unknown
- Sample size is greater than 30
- Normal distribution due to Central Limit Theorem

μ_A: mean percent change of stock price before March 1, 2020
μ_B: mean percent change of stock price after March 1, 2020

Null Hypothesis (H_0):	$\mu_A = \mu_B$
Alternative Hypothesis (H_1):	$\mu_A > \mu_B$

P-Values for Percent Change of Stocks



Results: do not reject the null hypothesis in any case

Hypothesis Testing for Stock Prices

μ_A: mean stock price before March 1, 2020
μ_B: mean stock price after March 1, 2020

Null Hypothesis (H_0):	$\mu_A = \mu_B$
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Short-term: February 1, 2020 to March 31, 2020
Long-term: June 1, 2018 to December 31, 2021

Results: reject the null hypotheses in short-term but not the long-term

P-Values for Short and Long Term

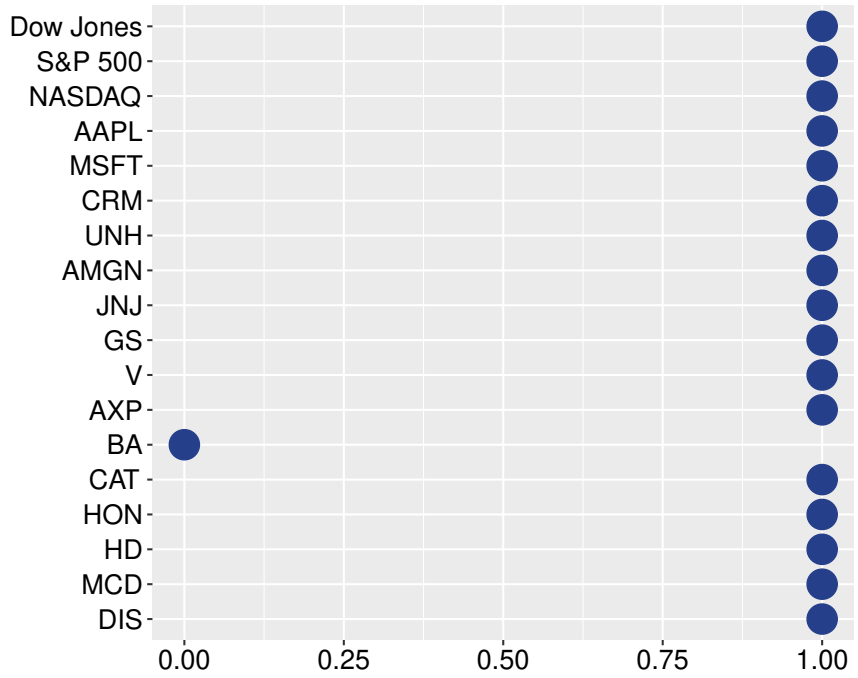


Figure 1: Long-term

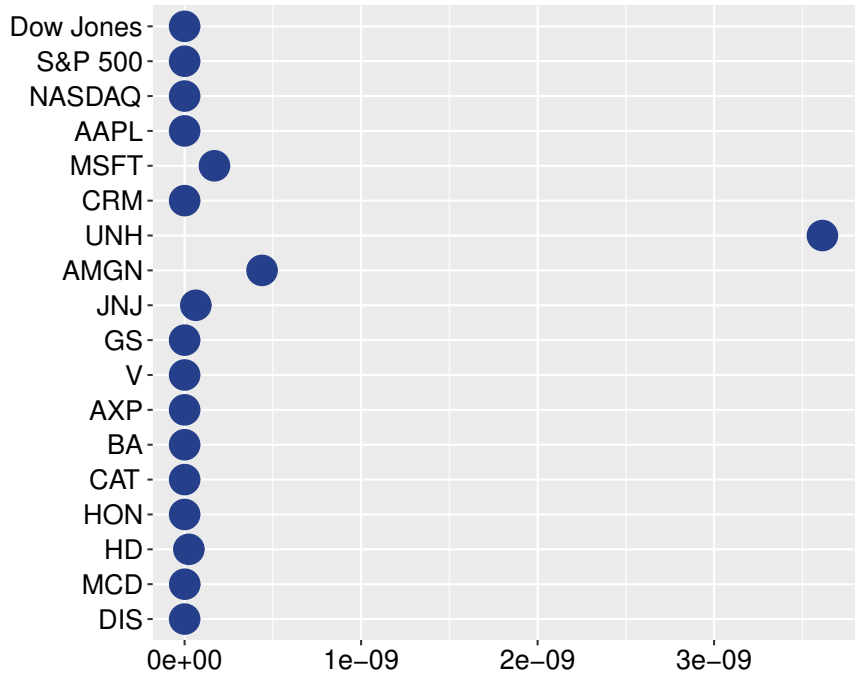


Figure 2: Short-term

BA vs. AAPL

Figure 3: Boeing Co.

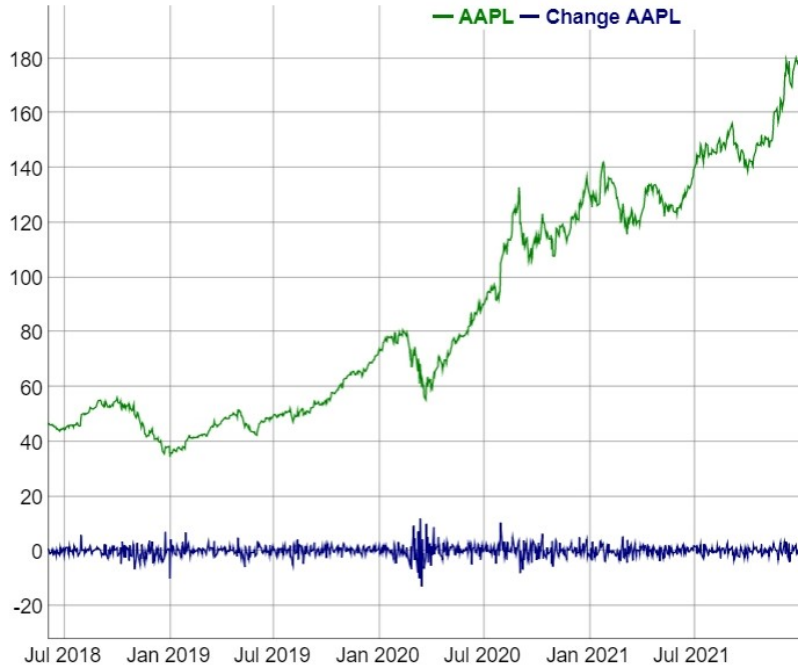


Figure 4: Apple Inc.

Hypothesis Testing for Vaccination Efforts

μ_A: mean percent change of stock prices before January 1, 2021
μ_B: mean percent change of stock prices after January 1, 2021

Null Hypothesis (H_0):	$\mu_A = \mu_B$
Alternative Hypothesis (H_1):	$\mu_A < \mu_B$

Results: do not reject the null hypotheses in any case

Stock Index	P-Value
Dow Jones	0.3795
S&P 500	0.3156
NASDAQ	0.5531

Graphs for Dow Jones

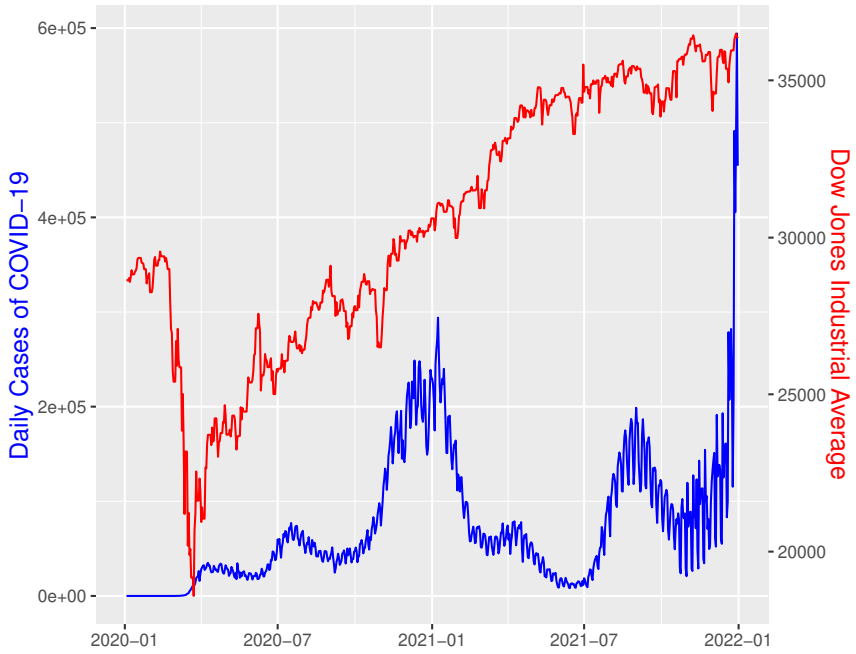


Figure 5: COVID-19 vs. Dow Jones

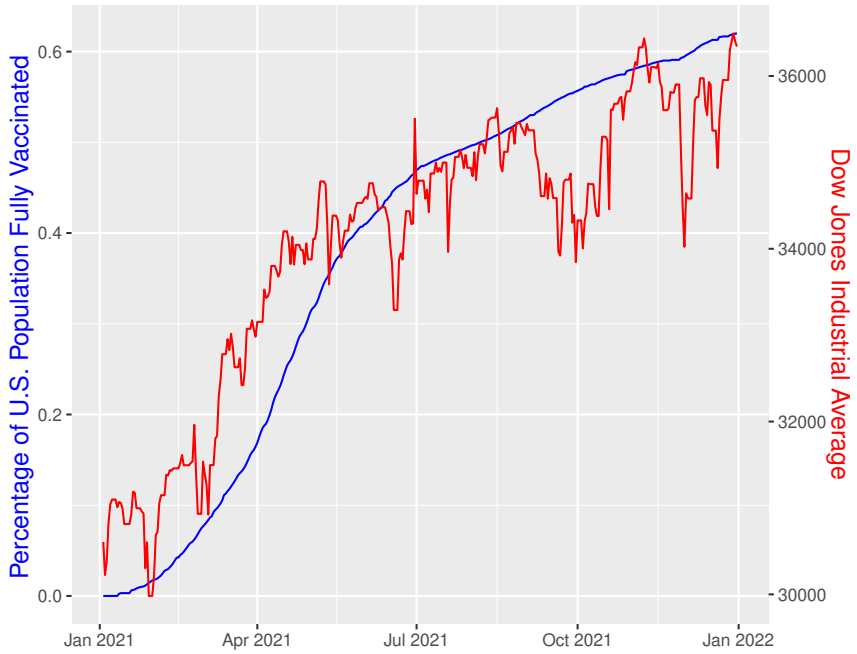
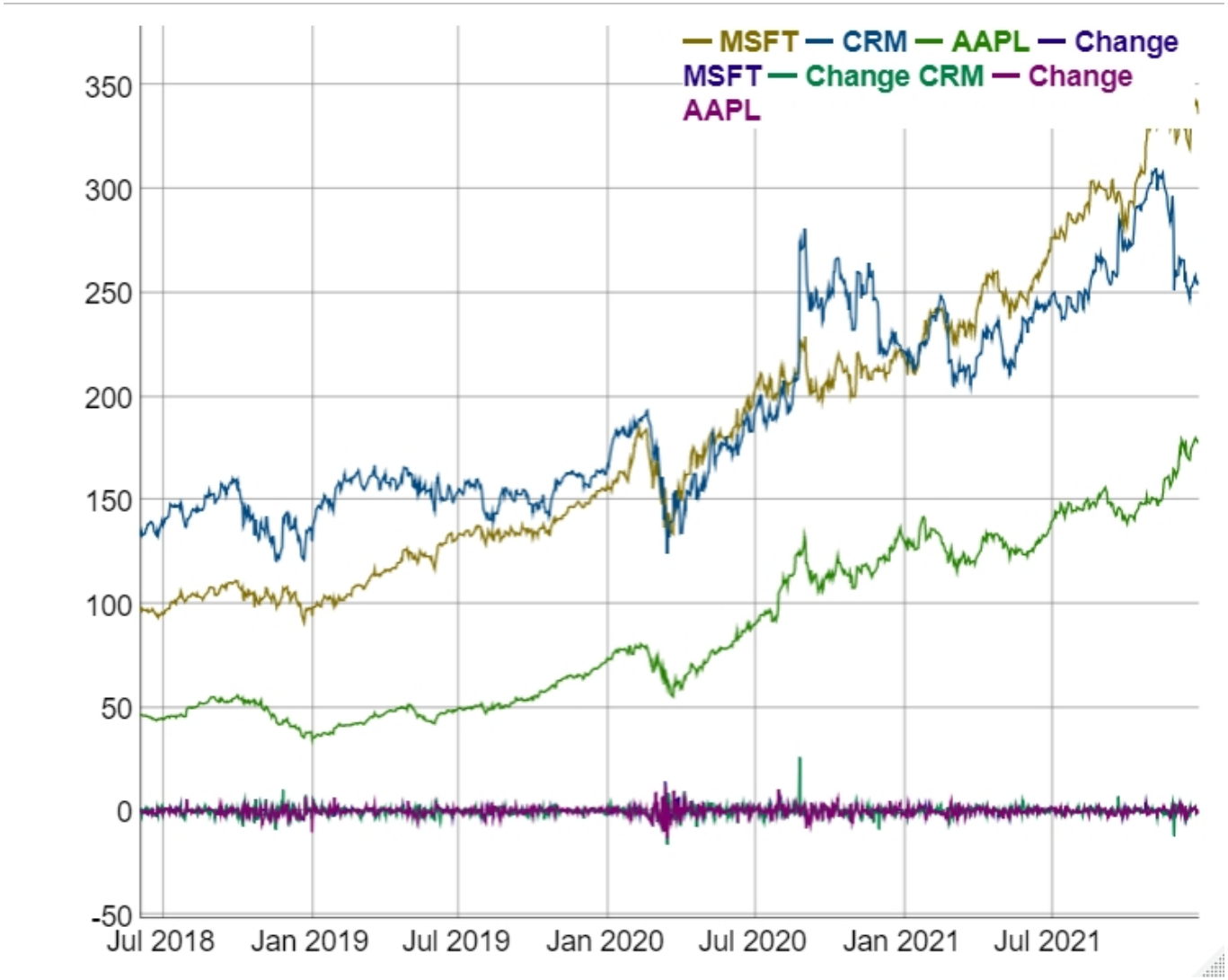
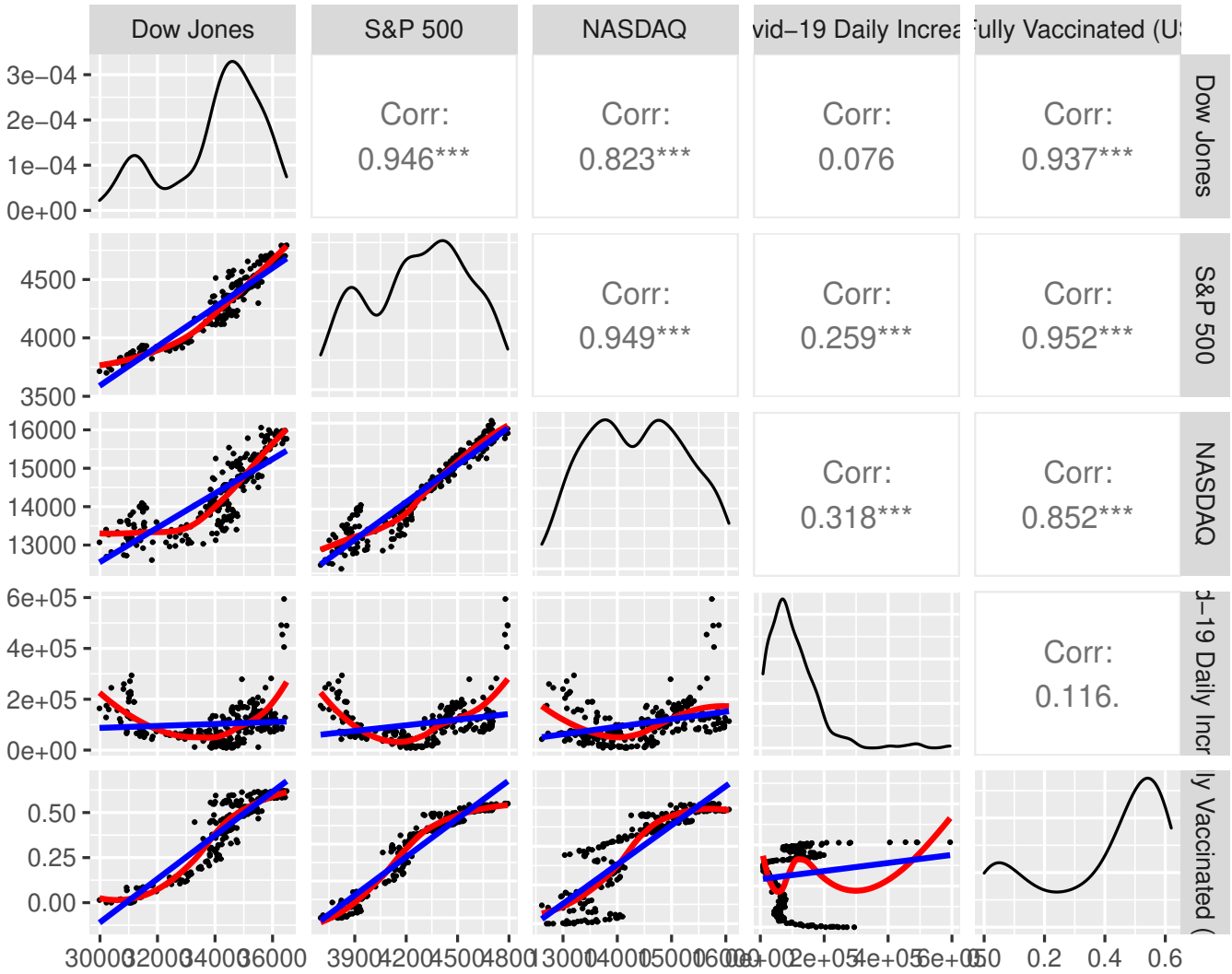


Figure 6: Vaccination vs. Dow Jones

Graph for Technology Sector



Correlation Analysis



Conclusion

Main Results

- COVID-19 affected the stock market as a one-time event in March 2020.
- Some companies were more affected by COVID-19 depending on their service or product.
- Vaccination percentage is more strongly correlated with stock market trends than COVID-19 cases.
- No sector of the economy performed better or worse than another.

Limitations and Future Research

- Only 15 companies researched
- Smaller companies not represented

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