The Effects of Covid on the Stock Market

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Introduction

As we are starting to recover from the recent pandemic of Covid-19, there is a ton of history to look back at in just a couple of years. Many topics might be coming to mind such as the shutdown, the explosion of TikTok, facemasks, working from home, and finding new hobbies to learn or do during the very, very gruesome couple months we had to spend alone or with family. One of those hobbies happened to be what our group likes to call, "Stonks!" For our very first project, we were interested to see how much of an effect Covid-19 had on the stock market before, during, and after. We decided to use an API module provided by Finnhub and data about Covid-19 provided by the World Health Organization and CDC to truly dive deep and code our way into the rabbit hole of "Stonks!" But, first we had to pull our data.

What we are searching for...

1. Did different stocks perform differently pre-covid, during covid, and after covid?

2. Did different sectors perform differently pre-covid, during covid, and after covid?

3. Was there a change in volume during pre-covid, during covid, and after covid?

4. Do the number of covid cases in the country affect the price of the stocks?

5. Do different "covid milestones" have an effect on specific stocks?

6. Can we use a linear regression analysis to predict the future price of stocks?

7. Is there a correlation between any of the above mentioned factors with stock prices?

8. What sector was most affected by Covid-19?

9. Which sectors had the most sustained success?

The Code

- Imported a .csv file with a list of all tickers in the NASDAQ and NYSE exchanges

- For loop with our API response to loop through all of the tickers and append Ticker, Company Name, Industry, Country, and Market Cap information to empty lists

- From the DataFrame created by the empty lists, filtered for all US companies with a market cap larger than 10 billion dollars

- After dropping all duplicate tickers and N/A industries, we randomly sampled each industry we were interested in for two stocks and created a DataFrame that we were then able to pull in historical stock price data from 2019-2021

```python
# Loop through each industry to pick out all industries with more than 1 stock in it from our API response
two_stock_df = pd.DataFrame()
for industry in list(clean_company_industry.Industry.unique()):
    df_temp = clean_company_industry.loc[clean_company_industry['Industry']==industry]
    if len(df_temp) > 1:
        random_sample = random.sample(list(df_temp['Ticker']),k=2)
        df_temp = df_temp.loc[df_temp['Ticker'].isin(random_sample)]
        two_stock_df = two_stock_df.append(df_temp)
pd.set_option('display.max_rows', None)
pd.set_option('display.max_columns', None)
two_stock_df

# Loop through every industry we are interested in and append the two stocks from each industry to a DataFrame
ten_industry_df = pd.DataFrame()
ten_industry_list = ['Airlines', 'Automobiles', 'Consumer products', 'Health Care', 'Hotels, Restaurants & Leisure', 'Logistics &
for industry in ten_industry_list:
    ten_industry_df = ten_industry_df.append(two_stock_df.loc[two_stock_df['Industry']==industry])

# Save the DataFrame to a .csv file
ten_industry_df.to_csv('output/ten_industry_df.csv', index=False)
```

```python
# Import .csv files of all NASDAQ and NYSE tickers and merge the two
nasdaq = pd.read_csv('input/NASDAQ.csv')
nyse = pd.read_csv('input/NYSE.csv')
merged_exchanges = nasdaq.append(nyse)

# Create empty lists to hold API responses
ticker = []
name = []
finnhubIndustry = []
country = []
marketCapitalization = []

# Gather a series of all stock tickers from the merged file
symbol_list = merged_exchanges['Symbol']

# Append all found responses to empty lists while accounting for the API call limit
for symbol in symbol_list:
    try:
        response = fc.company_profile2(symbol=symbol)
    except:
        print(f'API limit reached... Trying again in 1 minute: {symbol}')
        time.sleep(60)
        response = fc.company_profile2(symbol=symbol)
    try:
        ticker.append(response['ticker'])
        name.append(response['name'])
        finnhubIndustry.append(response['finnhubIndustry'])
        country.append(response['country'])
        marketCapitalization.append(response['marketCapitalization'])
        print(f'Loading Ticker: {symbol}')
    except KeyError:
        print(f'Error finding Ticker: {symbol}')
```

The Code

- Defined a function to pull in weekly close data for various stocks

- Defined a function to plot stock data as well as stock data paired with covid data

- Using a single dictionary for each year, used a for loop to assign the data frame as the value to a key, acting as the "variable"

- Similar process for the plotting and formatting aspect

```python
1  # Define a function to retrieve a ticker's price for the year and format the columns
2  def stock_df(stock_name, beg_year, end_year):
3      df_name = pd.DataFrame(finnhub_client.stock_candles(stock_name, 'W', beg_year, end_year))
4      df_name = df_name.drop(['s'], axis=1)
5      rename = {'c':'Close','h': 'High', 'l': 'Low', 'o': 'Open', 't': 'Time', 'v': 'Volume'}
6      df_name.rename(columns=rename, inplace=True)
7      df_name['Time'] = [datetime.utcfromtimestamp(x).strftime('%Y-%m-%d') for x in df_name['Time']]
8      return df_name
9
10 # Define a function to create a stock chart for the price/date, volume, and cumulative Covid cases
11 def plot_chart_covid(dataframe, stock_name, year):
12     fig= plt.figure(figsize=(12,10))
13     top_plt = plt.subplot2grid((7,4), (0,0), rowspan=3, colspan=4)
14     top_plt.plot(dataframe.index, dataframe['Close'], color = '#74D3AE')
15     plt.xticks(rotation=45, fontsize=8)
16     plt.xlim([min(dataframe.index),max(dataframe.index)])
17     plt.ylabel('Stock Price')
18     plt.title(f'{stock_name} Performance Over the Year {year}')
19     middle_plt = plt.subplot2grid((7,4),(3,0), rowspan=2, colspan=4)
20     middle_plt.bar(dataframe.index, dataframe['Cumulative_cases'], color='#DD9787')
21     plt.xticks(rotation=45, fontsize=8)
22     plt.xlim([min(dataframe.index),max(dataframe.index)])
23     plt.ylabel('Cumulative Cases by Millions')
24     bottom_plt = plt.subplot2grid((7,4),(5,0), rowspan=2, colspan=4)
25     bottom_plt.bar(dataframe.index, dataframe['Volume'], color='#8A89C0')
26     plt.xticks(rotation=45, fontsize=8)
27     plt.xlim([min(dataframe.index),max(dataframe.index)])
28     plt.ylabel('Trading Volume by Millions')
29     # plt.tight_layout();
30     plt.close(fig) #added after saving/checking figs
31
32 # Define a function to create a stock chart for the price/date and volume
33 def plot_chart(dataframe, stock_name, year):
34     fig= plt.figure(figsize=(12,10))
35     top_plt = plt.subplot2grid((5,4), (0,0), rowspan=3, colspan=4)
36     top_plt.plot(dataframe.index, dataframe['Close'],color='#74D3AE')
37     plt.xticks(rotation=45, fontsize=8)
38     plt.xlim([min(dataframe.index),max(dataframe.index)])
39     plt.ylabel('Stock Price')
40     plt.title(f'{stock_name} Performance Over the Year {year}')
41     bottom_plt = plt.subplot2grid((5,4),(3,0), rowspan=1, colspan=4)
42     bottom_plt.bar(dataframe.index, dataframe['Volume'],color='#8A89C0')
43     plt.xticks(rotation=45, fontsize=8)
44     plt.xlim([min(dataframe.index),max(dataframe.index)])
45     plt.ylabel('Trading Volume by Millions')
46     # plt.tight_layout();
47     plt.close(fig) #added after saving/checking figs
```

```python
12 #using the list of tickers we create a dictionary of each ticker by year as the key and its data frame as the value
13 ticker_2019_data = {}
14 #no 2019 covid data in the US
15 ticker_2020_data = {}
16 ticker_covid_2020 = {}
17 ticker_2021_data = {}
18 ticker_covid_2021= {}
19 for ticker in tickers:
20     ticker_2019_data[f'{ticker}_2019'] = stock_df(ticker, beg_2019, end_2019)
21     ticker_2020_data[f'{ticker}_2020'] = stock_df(ticker, beg_2020, end_2020)
22     ticker_covid_2020[f'{ticker}_covid_2020'] = pd.merge(ticker_2020_data[f'{ticker}_2020'], covid20_df, how='left',on='Time').set_index('Time')
23     ticker_2021_data[f'{ticker}_2021'] = stock_df(ticker, beg_2021, end_2021)
24     ticker_covid_2021[f'{ticker}_covid_2021'] = pd.merge(ticker_2021_data[f'{ticker}_2021'], covid21_df, how='left',on='Time').set_index('Time')
25     #setting the index of each ticker data to time after merging
26     ticker_2019_data[f'{ticker}_2019'] = ticker_2019_data[f'{ticker}_2019'].set_index('Time')
27     ticker_2020_data[f'{ticker}_2020'] = ticker_2020_data[f'{ticker}_2020'].set_index('Time')
28     ticker_2021_data[f'{ticker}_2021'] = ticker_2021_data[f'{ticker}_2021'].set_index('Time')
```

Randomly Selected Stocks

Airlines:	Automobiles:	Consumer Products:	Health Care:	Hotels, Restaurants, and Leisure:	Logistics and Transportation:	Pharmaceuticals:	Real Estate:	Telecomm:	Tech:
UAL - United Airlines	TSLA - Tesla	CLX - Clorox Co	ALGN - Align Tech	LVS - Las Vegas Sands Corp	FDX - FedEx Corp	VTRS - Viatris Inc	EQIX - Equinix Inc	TMUS - T-Mobile US	AAPL - Apple Inc
DAL - Delta Airlines	GM - General Motors	EL - Estee Lauder Companies	MCK - Mckesson Corp	MGM - MGM Resorts International	UPS - United Parcel Service Inc	CTLT - Catalent Inc	PSA - Public Storage	VZ - Verizon Communications Inc	MSFT - Microsoft Corp

How did different stocks perform during & after Covid? (Airlines)

Yearly Change (%)	
Airlines 2019 Performance	12.54
Airlines 2020 Performance	-34.29
Airlines 2021 Performance	-3.38

DAL Performance Over the Year 2019

How did different stocks perform during & after Covid? (Airlines)

Yearly Change (%)

Airlines 2019 Performance	12.54
Airlines 2020 Performance	-34.29
Airlines 2021 Performance	-3.38
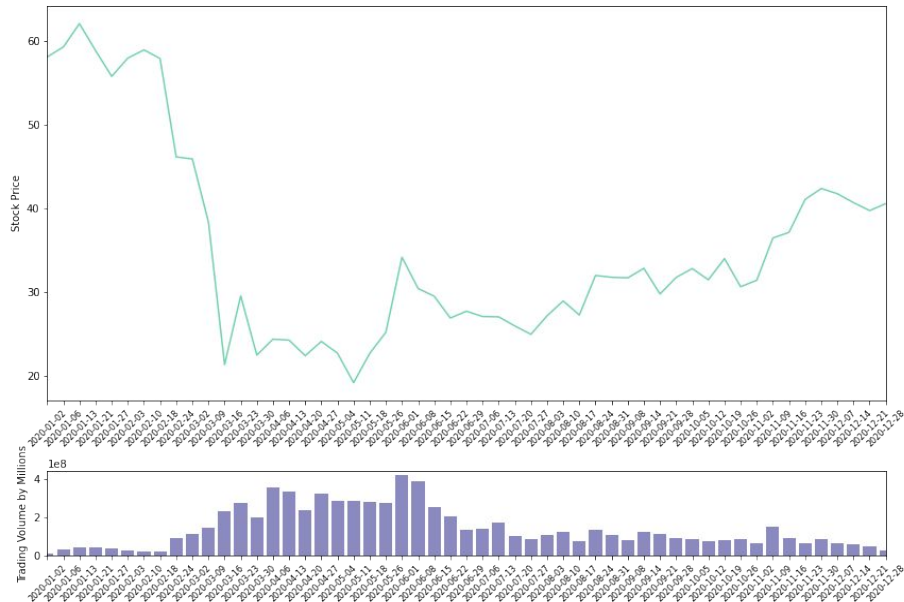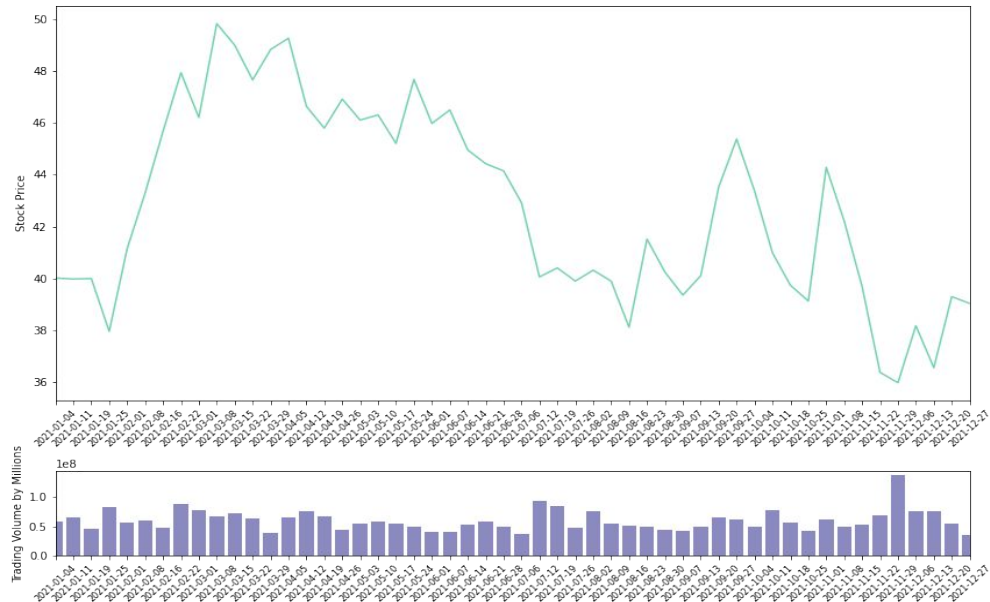
How did different stocks perform during & after Covid?
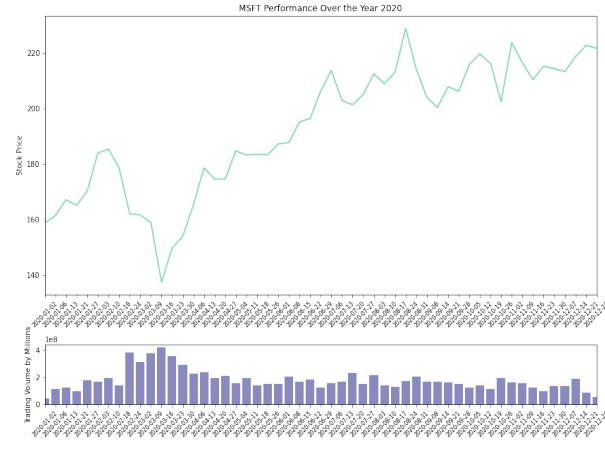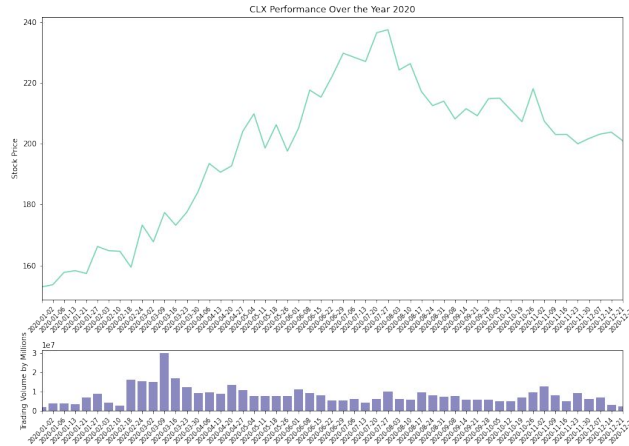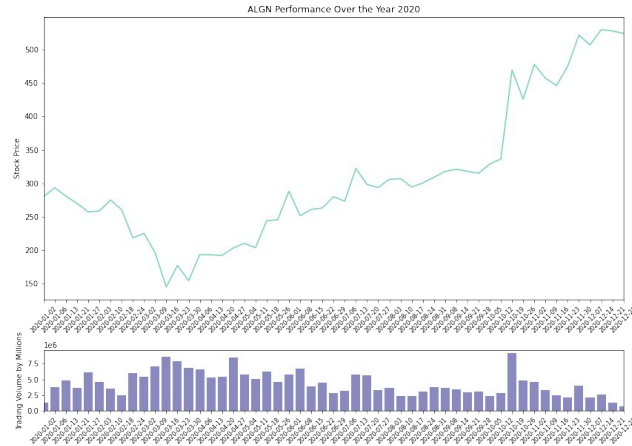
AAPL Performance Over the Year 2019

Yearly Change (%)

Technology 2019 Performance	50.56
Technology 2020 Performance	40.31
Technology 2021 Performance	36.45

How did different stocks perform during & after Covid? (Tech)

AAPL Performance Over the Year 2020
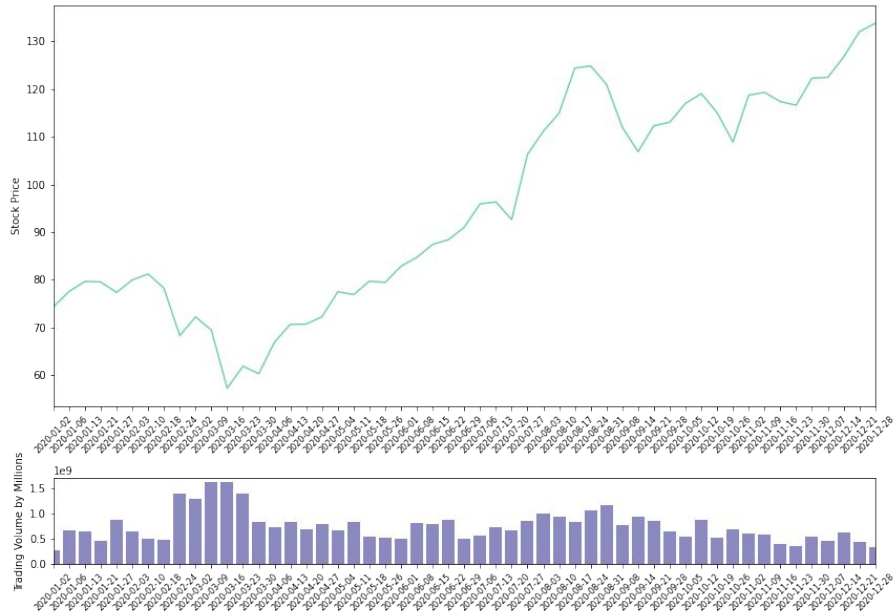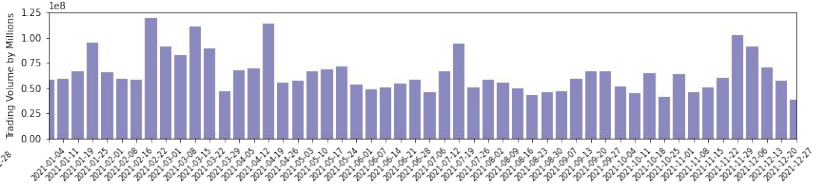
AAPL Performance Over the Year 2021
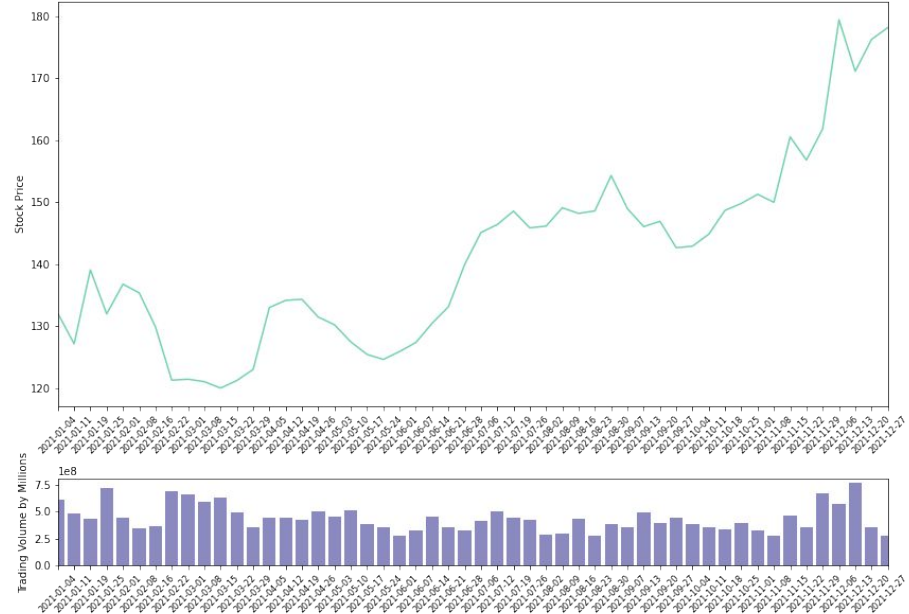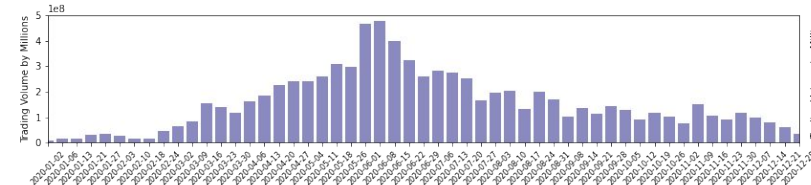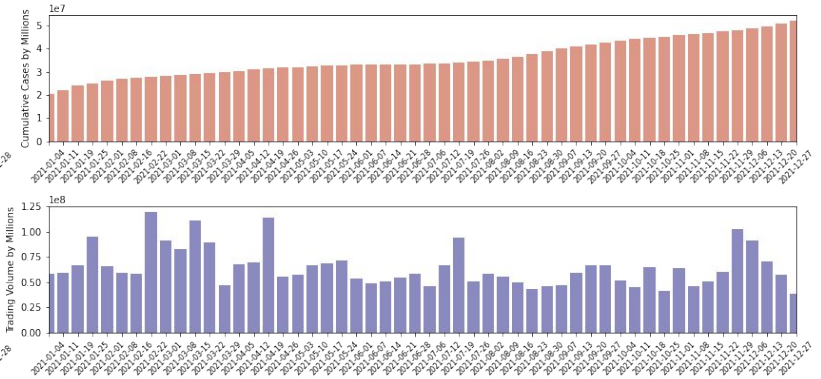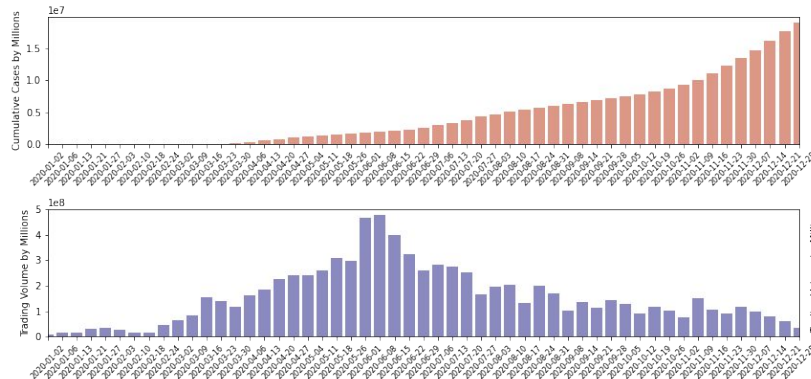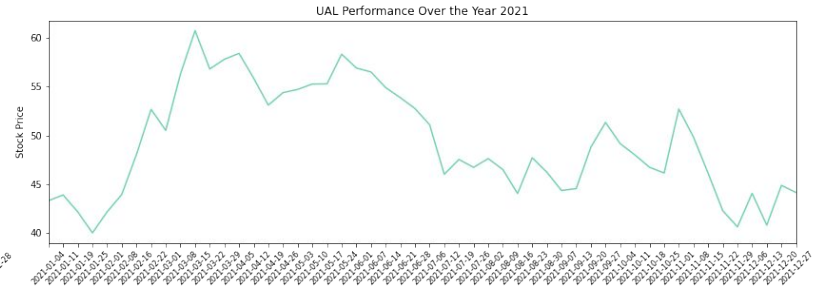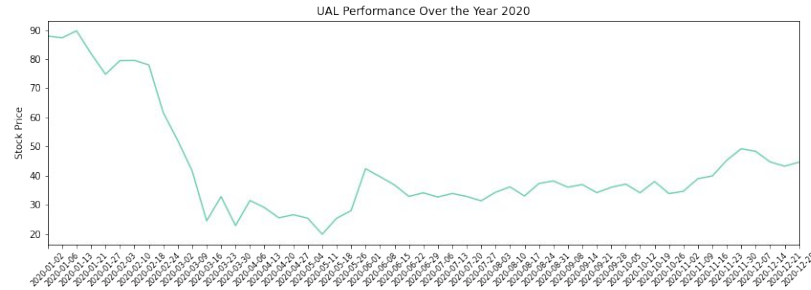
Yearly Change (%)	
Technology 2019 Performance	50.56
Technology 2020 Performance	40.31
Technology 2021 Performance	36.45

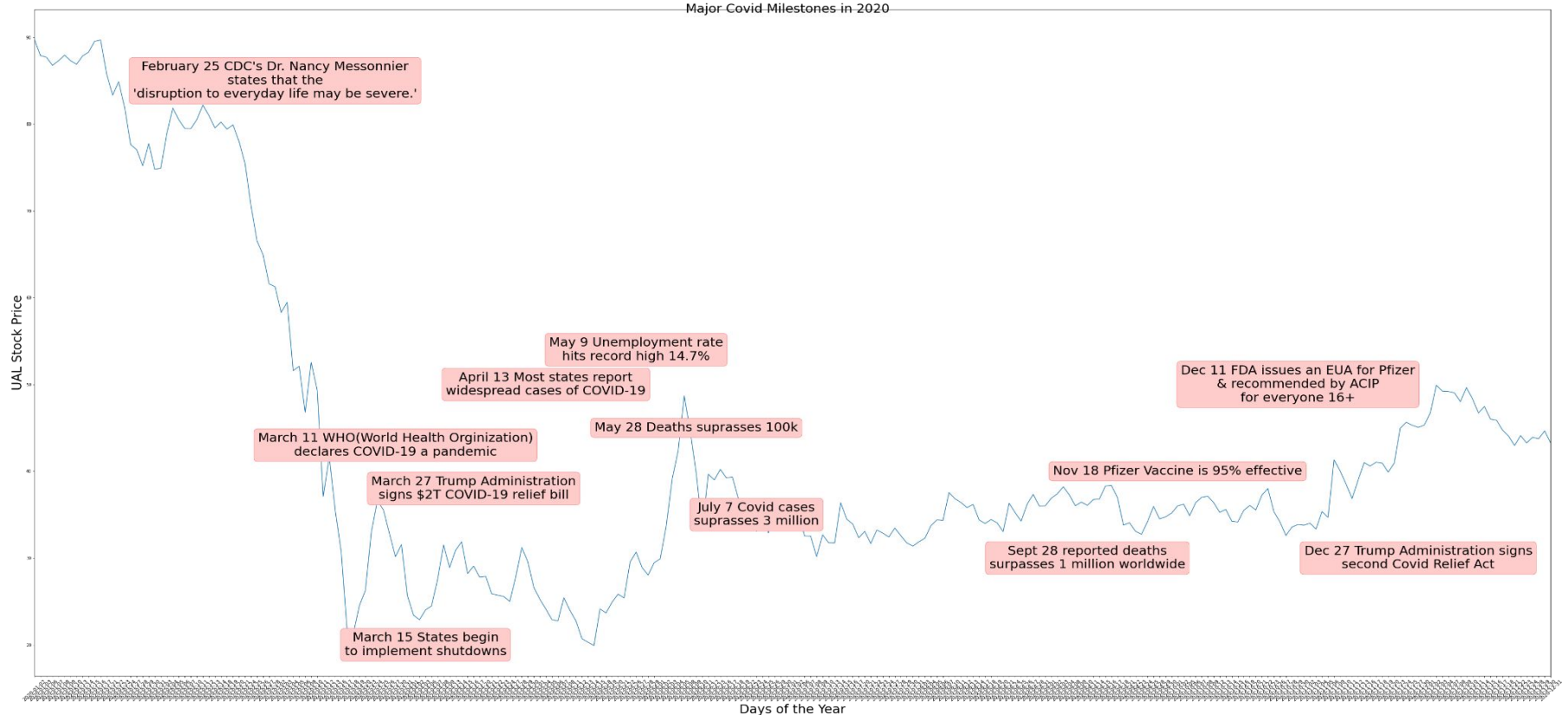How did different stocks perform during & after Covid? (Tech)

Covid Cases vs. Stock Price
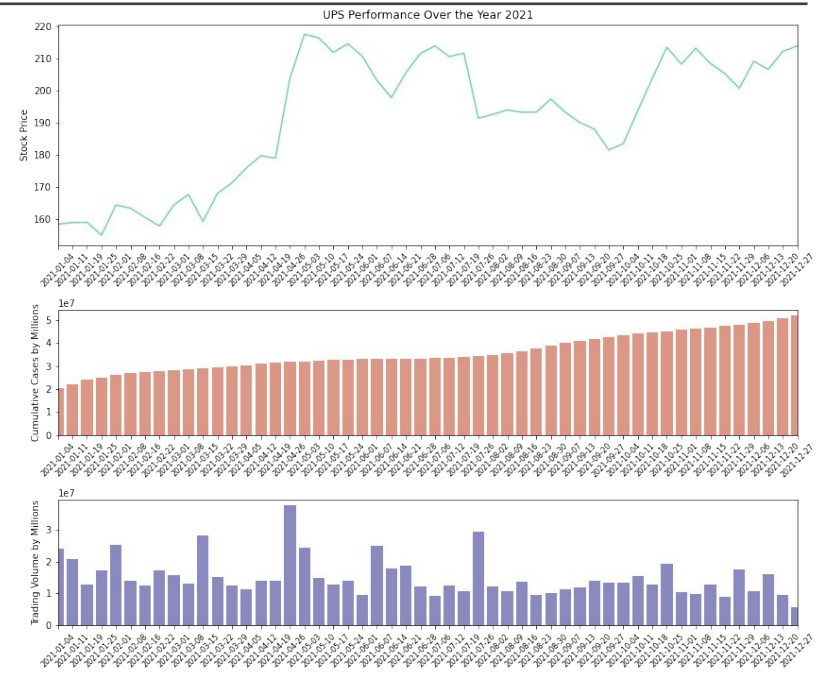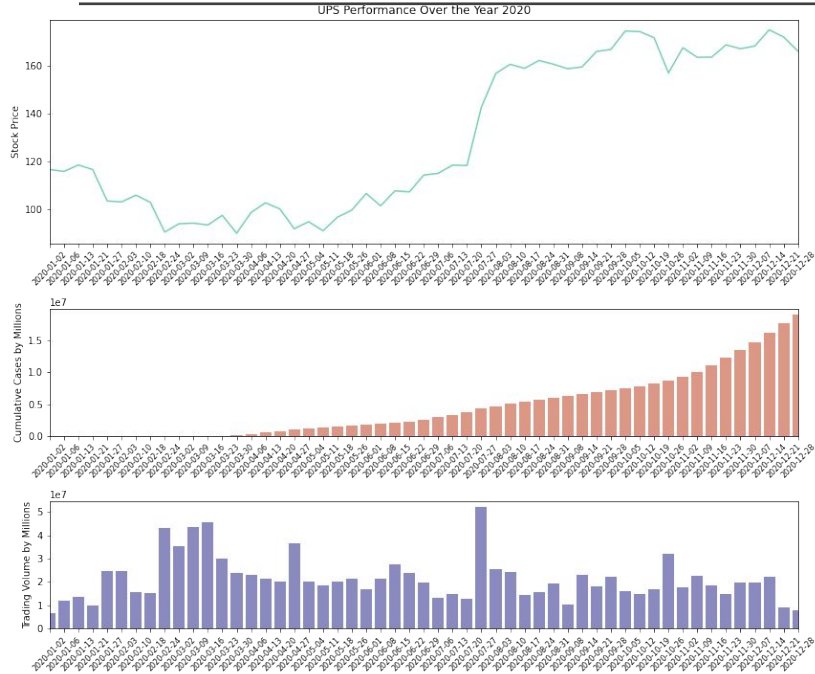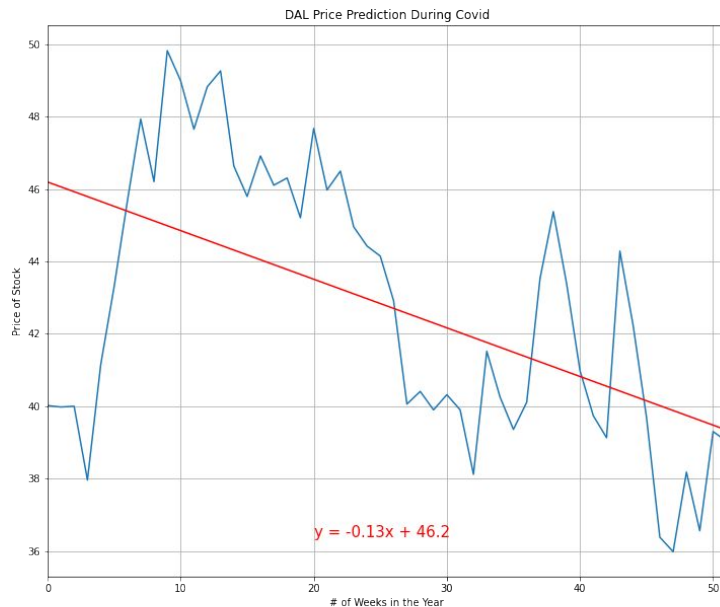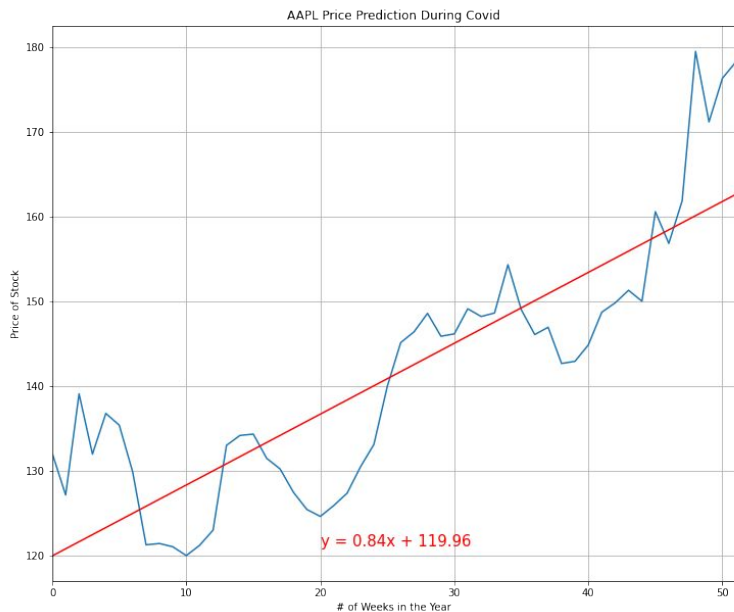
Covid Cases vs. Stock Price

Covid Milestones

Major Covid Milestones in 2020

UAL Stock Price

February 25 CDC's Dr. Nancy Messonnier
states that the
'disruption to everyday life may be severe.'

May 9 Unemployment rate
hits record high 14.7%

Dec 11 FDA issues an EUA for Pfizer
& recommended by ACIP
for everyone 16+

April 13 Most states report
widespread cases of COVID-19

May 28 Deaths suprasses 100k

March 11 WHO(World Health Orginization)
declares COVID-19 a pandemic

March 27 Trump Administration
signs $2T COVID-19 relief bill

July 7 Covid cases
suprasses 3 million

Nov 18 Pfizer Vaccine is 95% effective

March 15 States begin
to implement shutdowns

Sept 28 reported deaths
surpasses 1 million worldwide

Dec 27 Trump Administration signs
second Covid Relief Act

Days of the Year

# Linear Regression, Future Predictions, and Correlation between Covid and Stocks

Stock Sector Performance

- A random sample of stocks was chosen from the industries displayed and the average percentage increase/decrease was calculated for each industry and each year shown to the right

- Of note, TSLA was a known outlier for the Automobile industry. The average increase of 276.07% for the Automobile industry in 2020 is highly skewed by TSLA's increase of 684.16%. The Automobile industry average performance for 2020 should be approached with caution.

- Overall, it can be seen that different sectors did in fact have a different performance over the course of the three years in question. Some had highly variable returns for each year, while some had more consistent returns for each year. Some had terrible starts to 2020, yet recovered fully by the end of the year while some never fully recovered **cough cough** Airlines...

| Sector	Value
Airlines 2019 Performance	12.54
Airlines 2020 Performance	-34.29
Airlines 2021 Performance	-3.38
Automobiles 2019 Performance	17.17
Automobiles 2020 Performance	276.07
Automobiles 2021 Performance	26.05
Consumer Products 2019 Performance	16.86
Consumer Products 2020 Performance	24.50
Consumer Products 2021 Performance	9.67
Health Care 2019 Performance	24.23
Health Care 2020 Performance	11.24
Health Care 2021 Performance	15.27
Hotels Restaurants and Leisure 2019 Performance	17.27
Hotels Restaurants and Leisure 2020 Performance	16.02
Hotels Restaurants and Leisure 2021 Performance	30.13
Logistics and Transportation 2019 Performance	-2.67
Logistics and Transportation 2020 Performance	44.95
Logistics and Transportation 2021 Performance	14.27
Pharmaceuticals 2019 Performance	32.86
Pharmaceuticals 2020 Performance	19.62
Pharmaceuticals 2021 Performance	47.33
Real Estate 2019 Performance	34.99
Real Estate 2020 Performance	9.24
Real Estate 2021 Performance	44.87
Telecommunication 2019 Performance	14.45
Telecommunication 2020 Performance	32.10
Telecommunication 2021 Performance	-11.79
Technology 2019 Performance	50.56
Technology 2020 Performance	40.31
Technology 2021 Performance	36.45

Stock Sector Performance (Losers)
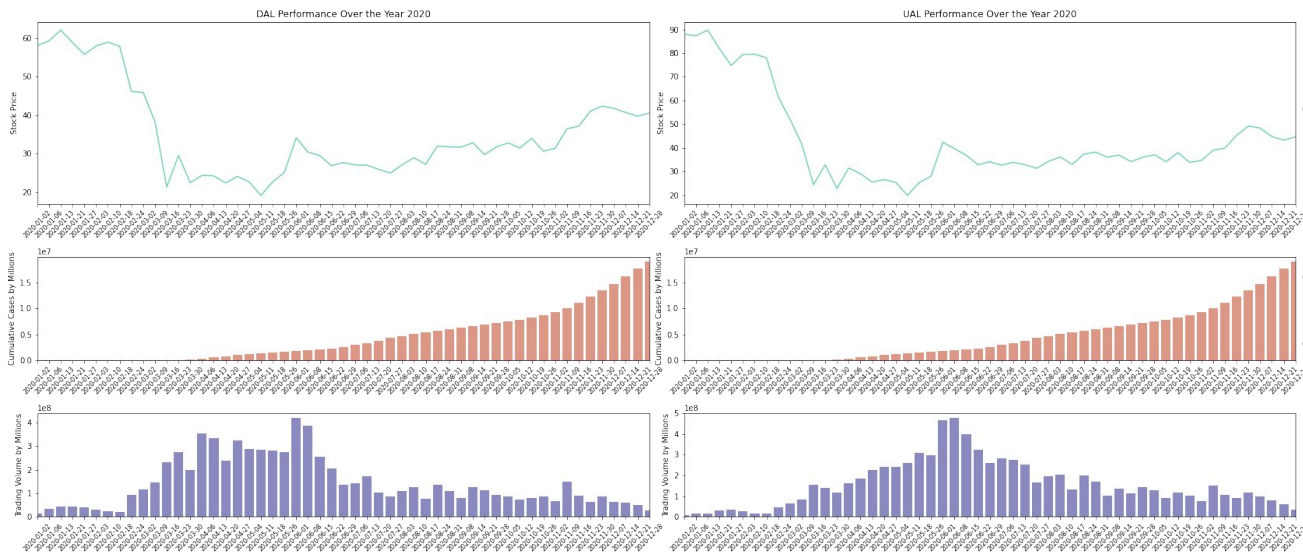
- A good handful of sectors did end up suffering during the pandemic (but also recovered), while the biggest loss was definitely in the Airlines industry.

- Average loss for 2020 was -34.29%

- 3 year average return was the only one still at a negative value (-8.38%) compared to the other sectors in question in our analysis

Stock Sector Performance (Winners)

- The Logistics and Transportation sector performed the best during Covid-19 (2020) with an average increase of 44.95%.

- Although, the 3 year average return for the Logistics and Transportation industry was only 18.85% placing it sixth on our list of ten industries.

- On a 3 year average return basis, the Technology sector (42.44%) takes the cake with the most sustained gain of all ten industries in question, with the Pharmaceuticals sector (33.27%) following close. The Tech industry posted an average return of 40.31% for 2020, placing it second on the list in 2020 returns
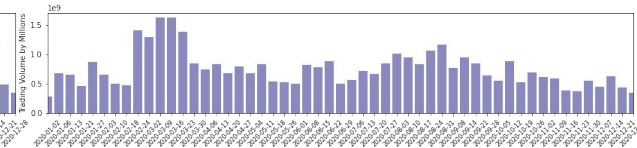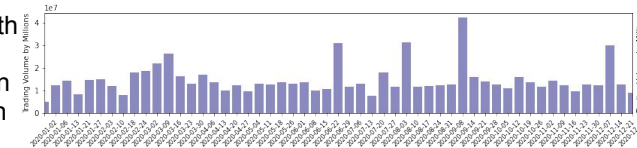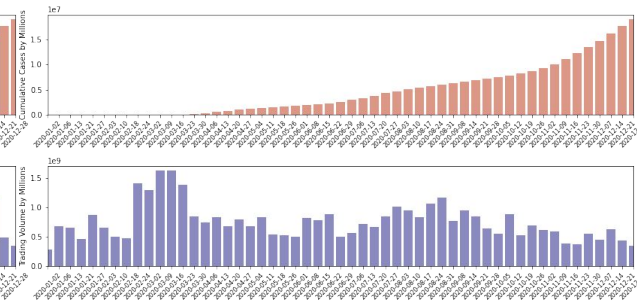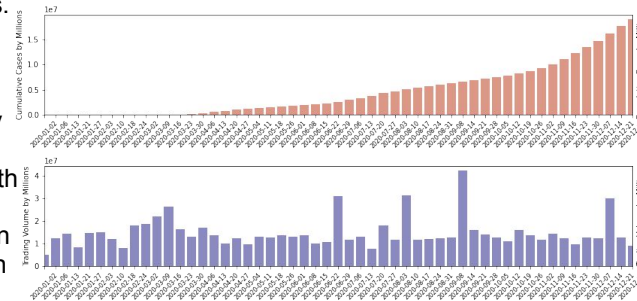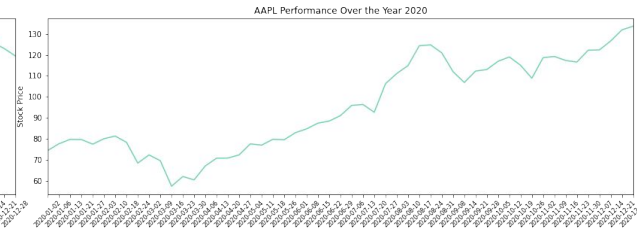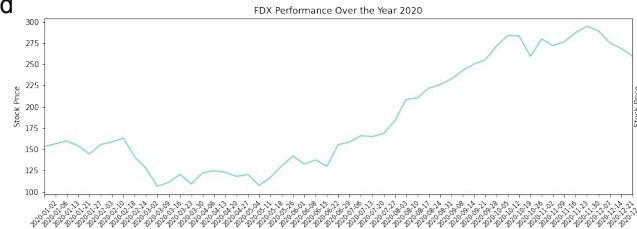
Conclusion

We all know how much of an impact Covid-19 had in all of our lives, but in the moment, it was unclear. By using what we have learned so far in class, we were able to analyze just a sample of the stock market and the effects Covid truly had and how much we have recovered since. Time sure does fly, but it's good to look back, analyze, and plan for the future just in case another outbreak or similar situation occurs.

Questions?

plt.pie(stonks)