

Study of Impact of Covid-19 in Indian Stock Market and GDP Response

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Abstract— The covid - 19 pandemic which brought the world countries to a standstill also had its effects in the field of economy to great extents. In this paper we have studied and analyzed the effects of this global pandemic on the stock markets and gdp growth of India using various machine learning models namely linear regression, multiple linear regression, polynomial regression and support vector regression. We have also tried the Statistical model namely ARIMA.

Keywords— Stock market, COVID-19, Financial markets, GDP, Economic downturn.

I. INTRODUCTION

The outbreak of the highly contagious COVID-19 pandemic came as a surprise event with unprecedented uncertainty with respect to how deadly disease really is and whether and when we can get a vaccine. In response, governments across the world scrambled with emergency actions, such as lockdowns, travel restrictions, testing and quarantining, and economic packages. The main purpose of these actions was to ensure social distancing among people to contain the spread of the disease on the one hand, while to minimize the adverse economic impact on the other hand. However, these actions generated additional uncertainty regarding their effectiveness and impact.

The COVID-19 is the acronym used for CoronaVirus Disease 2019. This virus causes pneumonia of unknown cause first detected in Wuhan, China, and first reported to the World Health Organization (WHO) on 31st December, 2019. The World Health Organization announced the official designation of this deadly virus on February 11, 2020. On March 11, it declared COVID-19 a pandemic, pointing to over 118,000 cases of the coronavirus illness in 110 countries and territories around the world and the sustained risk of further global spread.

This Pandemic COVID-19 affected the economies of the world and India was also among those nations. Due to the lockdown ordered by the government of India, everything

came to halt in this busiest country. The crashing of the global market economy, major drop in oil prices, and increasing unemployment are some of the impacts of the pandemic COVID-19 that affected almost all countries in the world. India was also not far behind to get the impact of COVID-19 on their economic growth, development, economy and stock market. India has a robust stock market that reacts and responds well to the global situation.

Coronavirus will impact India's economic process "severely", because the COVID-19 lockdown is causing significant disruption across multiple sectors, including manufacturing, oil, financial, among others, says a report.

This study contributes to the literature in at least two important ways:

i) First, we contribute to the studies which have examined the stock market response to different disasters and crises. We complement these studies by examining the stock market reaction to COVID-19 pandemic.

ii) Second, we contribute to the recently emerging literature which examines the impact of COVID-19 on financial markets.

The rest of the paper proceeds as follows: Section 2 outlines our sample data construction procedures. Section 3 presents the machine learning models and statistical models applied here briefly. Final section concludes the study.

II. DATA COLLECTION

For the purpose of this study, we mainly collected data from two main sources:

Daily stock market (NIFTY 50) data was collected from the https://www1.nseindia.com/products/content/equities/indices/historical_index_data.htm website. This data was available

for around 15 years. To maintain consistency, we choose only a time range from 1st December 2019 to 1st November 2020.

| | Date | Open | High | Low | Close | Shares Traded | Turnover (Rs. Cr) |
|---|-------------|----------|----------|----------|---------|---------------|-------------------|
| 0 | 02-Dec-2019 | 12137.05 | 12137.15 | 12023.70 | 12048.2 | 720945335 | 23113.18 |
| 1 | 03-Dec-2019 | 12067.65 | 12068.60 | 11956.40 | 11994.2 | 605789334 | 18203.76 |
| 2 | 04-Dec-2019 | 11969.95 | 12054.70 | 11935.30 | 12043.2 | 747193818 | 22132.83 |
| 3 | 05-Dec-2019 | 12071.25 | 12081.20 | 11998.75 | 12018.4 | 562228745 | 19589.81 |
| 4 | 06-Dec-2019 | 12047.35 | 12057.05 | 11888.85 | 11921.5 | 609221205 | 18245.49 |

Fig 1 : A sample data of the NIFTY 50 dataset

Lastly, we downloaded the GDP data from <https://tradingeconomics.com/india/indicators>, for a time range from January 2019 to July 2020.

| Year | GDP Growth Rate | GDP (agriculture) in BILION | GDP (construction) in BILION | GDP (public Administration) in BILION | GDP (services) in BILION | GDP (Manufacturing) in BILION |
|------------|-----------------|-----------------------------|------------------------------|---------------------------------------|--------------------------|-------------------------------|
| 0 Jan-2019 | 5.6 | 5886.79 | 2594.49 | 4328.42 | 731.38 | 5067.19 |
| 1 Feb-2019 | 5.7 | 5911.99 | 2730.46 | 4375.64 | 716.59 | 5144.00 |
| 2 Mar-2019 | 5.3 | 5911.99 | 2730.46 | 4375.64 | 716.59 | 5144.00 |
| 3 Apr-2019 | 5.7 | 5911.99 | 2730.46 | 4375.64 | 716.59 | 5144.00 |
| 4 May-2019 | 5.2 | 4396.43 | 2628.29 | 4174.83 | 616.28 | 5789.36 |

Fig 2 : A sample data of the GDP value dataset

We pre-processed this data before visualizations and dropped a few unnecessary columns.

III. ECONOMIC DOWNTURN

Even before the COVID-19 outbreak, which led to a shutdown of the economy and made way for the worst contraction of India's GDP in decades in the April-June quarter, the economy was already witnessing a slowdown. After reporting its first case in late January 2020 in the southern state of Kerala, India introduced rigorous airport screenings for the coronavirus (COVID-19). The following weeks saw a quick succession of events leading to a suspension of all travel in and out of the country by March 22.

Economists slashed GDP rates for the foreseeable future due to the obvious impact of the lockdown. However, it was also estimated that the country might bounce back quickly because of its industry composition, with unorganized markets being largely dominant. Losses from organized sectors amounted to an estimated nine trillion rupees in late March, projected to increase with the prolonging of the lockdown. Unsurprisingly, the most affected industries included services and manufacturing, specifically travel & tourism, financial services, mining and construction, with declining rates of up to 23 percent between April and June 2020.

The lockdown in India will have a sizable impact on the economy mainly on consumption which is the biggest component of GDP.

India's total electronic imports is equal to 45% that of China. Around one-third of machinery and almost two-fifths of organic chemicals that India purchases come from China. For automotive parts and fertilisers, China's share in India's import is more than 25%. Around 65 to 70% of active pharmaceutical ingredients and around 90% of certain mobile phones come from China to India.

Developing countries like India have more fragile economic and social fabric and the present situation will create more suffering for the unorganized sectors and migrant labour. Borrowing the words of former RBI governor C Rangarajan "Government of India must provide lifelines to businesses - extend loans and tax waivers to small businesses and the self-employed to retain staff -- give direct support to severely affected industries and provide more funds to states, tax waivers to households etc."

IV. DATA VISUALIZATION

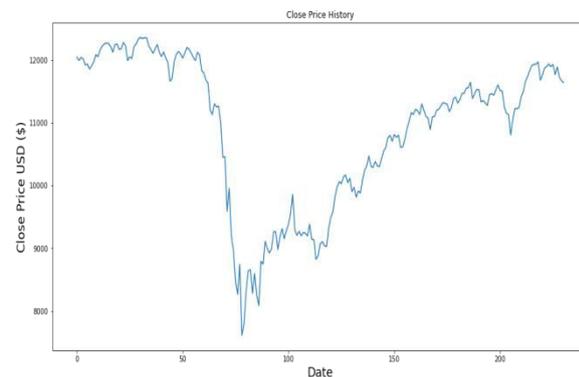


Fig 3 : Line plot of the close price value in the NIFTY 50 dataset

The above line plot shows the close price value of the NIFTY 50 stocks over a ten-month period. As time progresses from left to right, points connect the monthly stock close price values. We can read from the general slope of the line and its vertical positions that the close price value fell gradually between March and early April, then the value improved in late September and October.

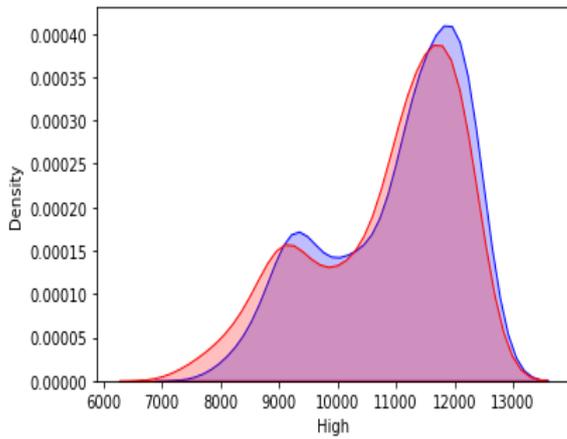


Fig 4 : KDE plot of High and Low values in the NIFTY 50 dataset. (red - low, blue - high)

This KDE plot represents the continuous probability density curve of the “High” and “Low” variables in the stock market dataset.

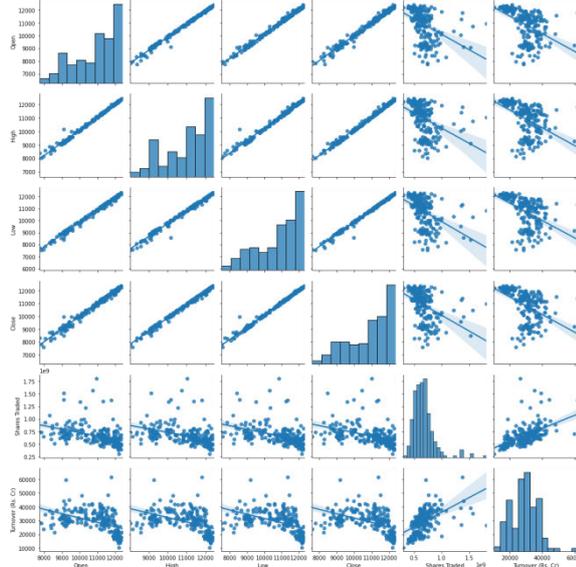


Fig 6 : Pair plot for the NIFTY 50 dataset

This pair plot helps us visualize the distribution of the single variables, along with the relationship between the variables in the stock market dataset. The pair plots are a great method to identify trends for follow-up analysis.

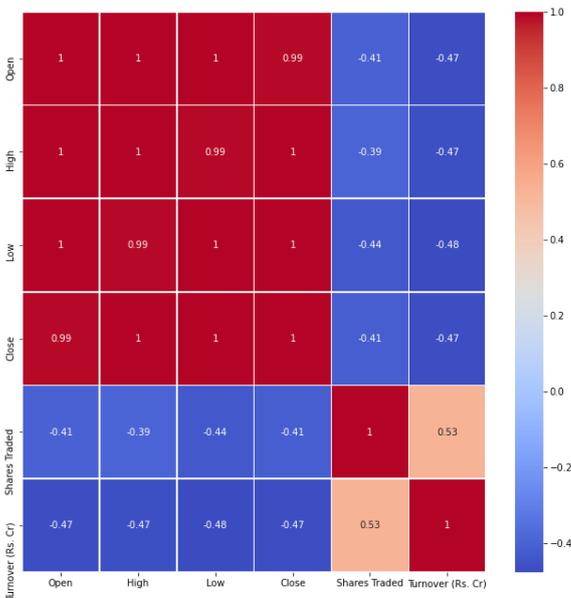


Fig 5 : Heatmap for the NIFTY 50 dataset

This heatmap shows the correlation between the various variables available in the stock market dataset.

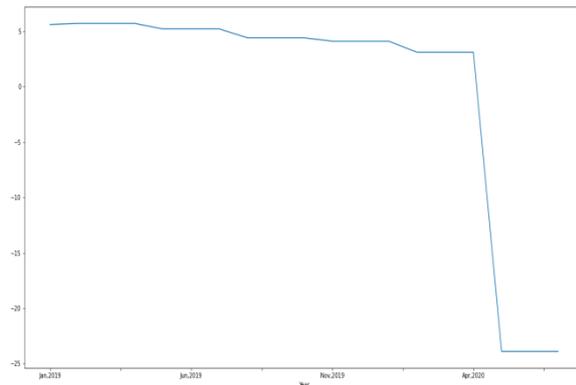


Fig 7 : Line plot of the GDP growth rate in the GDP dataset

The above line plot shows the GDP growth rate over a 19 months period. From the slope of the line, we can infer that GDP growth rate fell down sharply in the early April 2020.

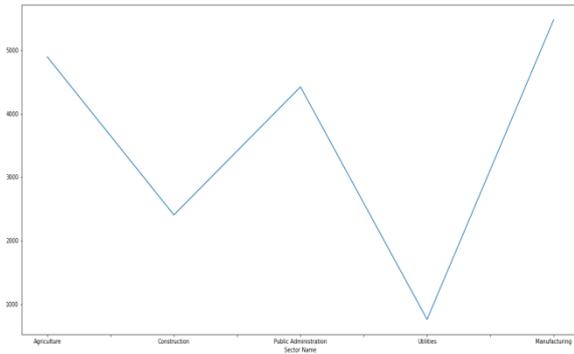


Fig 8 : Line plot of the mean GDP values of different sectors in the GDP dataset

This line plot shows how the mean GDP value of different sectors - agriculture, construction, public administration, utilities, and manufacturing vary in a time range of 19 months, ie., from January 2019 to July 2020.

V. APPLYING MACHINE LEARNING ALGORITHMS TO PREDICT THE FUTURE STOCK MARKET AND GDP VALUES

Regression in machine learning

It is one of the most widely used techniques of machine learning for predictive modelling. For our methodology, we are using linear regression, multiple linear regression, polynomial regression, and SVM regression.

Linear regression

Linear regression is a supervised machine learning algorithm that models the data linearly. Linear regression with polynomial terms attempts to create a polynomial function that fits the given data. Here the relationship between the independent and dependent variable is modelled as a kth degree polynomial.

Fig 9 : Linear regression model for the NIFTY 50 dataset

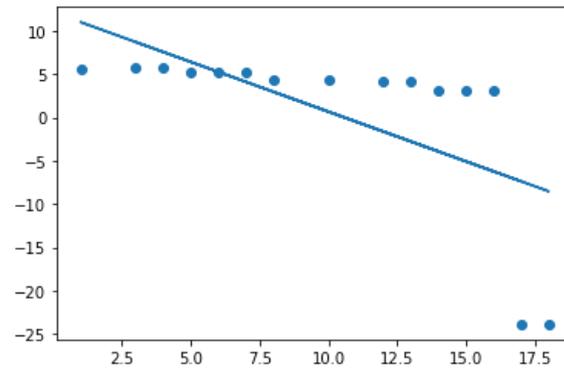


Fig 10 : Linear regression model for the GDP dataset

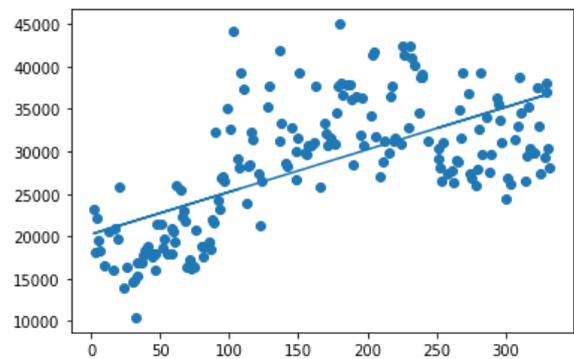
The first and second plots represent the linear regression for the NIFTY 50 stock market data and the GDP data respectively.

Multiple linear regression

Multiple linear regression is a highly established statistical technique used in stock market analysis. It allows the analyser to consider multiple variables which affect the quantity to be predicted. The quantity to be predicted is usually referred to as the independent variable. The various factors which demonstrate a strong correlation with the independent variable are referred to as the dependent variables. The measure by which the dependent variable changes due to a unit change in the independent variable is known as the regression coefficient of that independent variable.

Polynomial regression

As we know the growth of a stock market is never linear like a line, hence, we should not use first-degree linear equations here. We need higher-order polynomial equations. In statistics, polynomial regression is a form of regression analysis in which the relationship between the independent variable x and the dependent variable y is modelled as an nth degree polynomial in x. Polynomial regression fits a nonlinear relationship between the value of x and the corresponding conditional mean of y, denoted E(y |x).



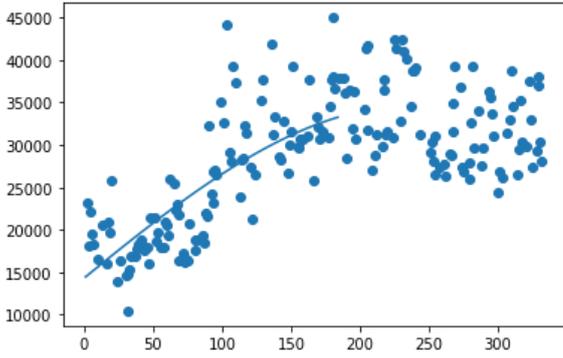


Fig 11 : Polynomial regression model for the NIFTY 50 dataset

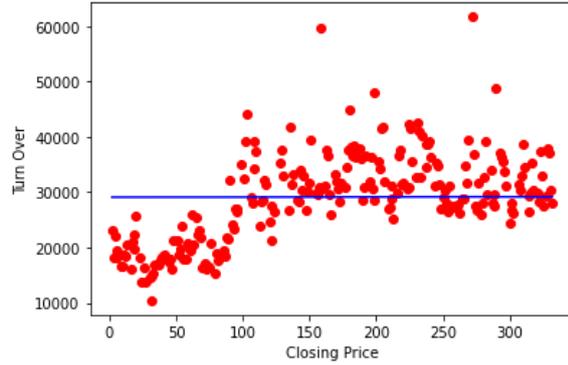


Fig 13 : SVM regression model for the NIFTY 50 dataset

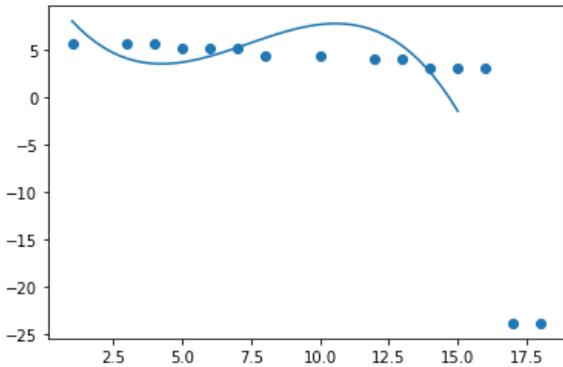


Fig 12 : Polynomial regression model for the GDP dataset

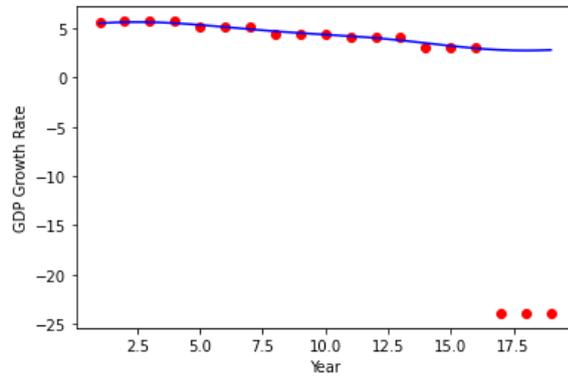


Fig 14 : SVM regression model for the GDP dataset

The first and second plots represent the polynomial regression for the NIFTY 50 stock market data and the GDP data respectively.

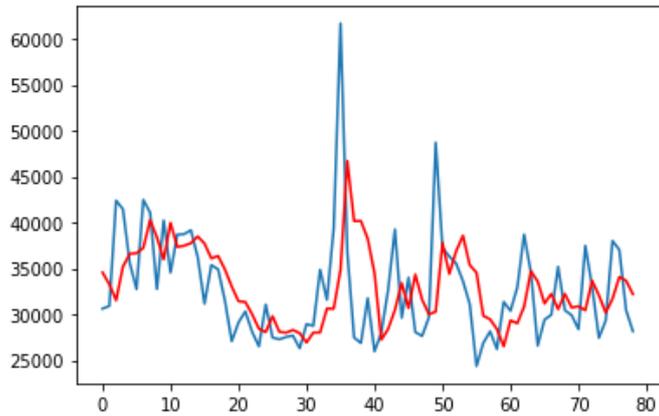
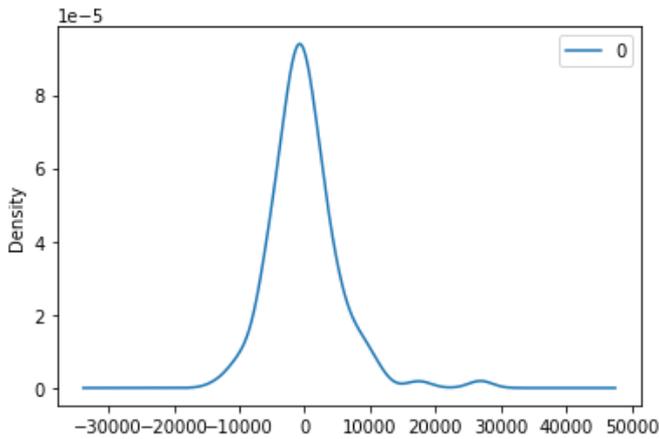
SVM regression

Support Vector Machines are one of the best binary classifiers. They create a decision boundary such that most points in one category fall on one side of the boundary while most points in the other category fall on the other side of the boundary.

The first and second plots represent the SVM regression for the NIFTY 50 stock market data and the GDP data respectively.

ARIMA Model

An autoregressive integrated moving average model is a generalization of an autoregressive moving average model. Both of these models are fitted to time series data either to better understand the data or to predict future points in the series. The data was modified accordingly to fit the ARIMA model.



The first plot represents the Model and second plot represents the actual predicted outputs of the NIFTY 50 dataset.

The ARIMA model provides the following results. So we find that ARIMA presents the best model with test RMSE value '6013.177'.

VI. RESULTS AND CONCLUSION

By applying the above mentioned four machine learning algorithms, we get to know that multiple linear regression gives the best results for both stock market (NIFTY 50) data and GDP data in Machine Learning models and ARIMA Model gives best results on the whole.

From the visualizations, we note that the stock market and GDP in India has gone down due to COVID - 19 pandemic but the aftermath is very slow. It is now slowly picking up. This shows how the global pandemic had its effects in India.

We applied the multiple linear regression model to predict the future stock market turn over for 2nd November 2020, and the

GDP of December 2020. This was predicted as a sample. It can be further extended to predict the other future data.

OUTPUT :

Prediction Of Turnover for 2nd November,2020 : [5291776.56056893]

Prediction of GDP for December,2020 : [-26.70061243]

So, we see that it will take time for the Stock Market and GDP to increase.

India is the country with the second largest population in the world, so the pandemic is especially dangerous for India. The COVID-19 affected almost all stock markets around the world. The world stopped due to the virus outbreak and it pushed the world into the great crisis of the century.

The growth and development of any stock market depends upon the strong economy of the country and this COVID-19 is a major hindrance in the overall growth of the economy.

The impact of the pandemic on economic activity can be felt far beyond the aviation, transport, tourism and hospitality areas. Analysts see some contribution to the GDP quarter from January to March 2020, due to the pandemic.

From the visualizations that we've made, we notice that the pandemic has made a negative impact on the stock market prices of India. The pandemic greatly affected the transportation, mining, electric and heating, and environmental industries. However, the manufacturing, information technology, education, and health industries strongly responded to the pandemic in a positive fashion, providing a boost to confidence on the stock market.

Given the setbacks that the current state of the economy is encountering, it has been predicted that the economy is likely to be hit by a lower growth rate in the last quarter of the current fiscal year. However, if the outbreak continues to rise, then the growth rate in the first two quarters of the next financial year might be subdued.

Keeping in mind the negative effects of COVID-19, many international organizations and credit agencies have revised the growth projections. Restrictions of travelling both at the international and domestic level, disruptions in the supply

chain, and declining investment demand and consumption will contribute to the sluggish growth rate.

At this point, the probability that COVID-19 reaches anything close to the Great Influenza Pandemic seems remote, given epidemiological differences, advances in public health, and mitigating policies at play. In any event, the large potential losses in lives and economic activity justify the substantial expenditure of resources to attempt to limit the damage.

In effect, countries like India have been pursuing policies of lowering real GDP as ways to curb the spread of the disease. There is clearly a difficult trade-off here concerning lives versus material goods, with little ongoing discussion about how this tradeoff should be assessed and acted upon.

ACKNOWLEDGMENT

We are extremely grateful to our professor, Dr B. Malar for giving us the golden opportunity to do this interesting project on the topic, "Stock market and GDP response to COVID-19 in India". This project would not have been possible without her valuable teachings.

We would also like to thank our friends, whose competitive nature helped us set high expectations for ourselves.

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