Covid-19 Future Predictions using Machine Learning Algorithms

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Abstract: The ongoing destructive pandemic of Coronavirus Disease (COVID-19) has been the biggest virus that affected more than 190 countries and territories across the world. It seems uncontrollable in many countries and some countries have taken and implemented proper safety measures to eradicate the virus and is under process. We have used machine learning-based prediction tools. As various machine learning algorithms have proved their importance for forecasting and making future decisions. This paper aims to study, analyze and visualize the spreading of the virus in India and the world considering confirmed cases, recovered cases, and fatalities and how in real-world situations we can use machine learning models. It helps to evaluate the spread and pattern of COVID-19 in India by performing Linear Regression, and Support Vector Machine and evaluating parameters using MAE & MSE score, which is the goodness of fit measure. In training a model, the selection of the best learning model is challenging as the data has anomalies because data is not standardized. Therefore, proper study and analysis of the data should be done so that it is easy to understand and act accordingly. Using datasets from Johns Hopkins University the data has been analyzed, obtained from January 22, 2020, till May 17, 2021, for the world. Using this analysis, we can predict the confirmed cases for the following 10 days. The result proves that Linear Regression is much more accurate than the Support Vector Machine.

Keywords: COVID-19, Coronavirus disease, Data Analysis, Visualization, Supervised Machine Learning.

1. Introduction

The novel coronavirus has left the whole world with a big question mark of What's Next?. So, it is very important to analyze and understand every turn the virus is taking. Hence, we analyzed to understand the Coronavirus in detail. The datasets are taken from Johns Hopkins University. First, when there was a talk that an unknown respiratory disease is spreading in Wuhan, China everyone was curious to know about it but was not getting accurate information. . Later, this illness was named as some new type of pneumonia. This strange new pneumonia was named "COVID-19" by WHO. WHO pronounced this surge a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, as it had affected nearly 30 countries of the world.

Over the last decade, machine learning (ML) has established itself as an eminent area of study by solving a slew of extremely complex and advance real-world problems, ranging from healthcare, climate, autonomous vehicles, gaming, robotics, to image processing. Now we can use various regression models and neural networks for testing and predict for various diseases.

The analysis is done in different countries. Different features include confirmed cases, recovered cases. which shows the way a country is coping up with the disease and how well it is working. We can minimize the risk of spreading the virus by adopting simple precautionary habits like washing hands with soap or rubbing them with alcohol-based hand rubs, wearing masks, maintaining social distancing, avoiding unnecessary travels, and following the national guidelines. Many developing and underdeveloped countries do not have healthcare infrastructure like developed countries, but by the seriousness and commitment of the people, we can help in minimizing the effect of this virus. The outbreak is predicted to reach its peak in May 2021.

World Health Organization (WHO), the elite organization which came into the limelight as the virus keeps on getting disastrous. There were many unprecedented economic and healthcare challenges faced by the countries, both developed and developing. The virus shows us that no one can develop beyond the scope of the cosmos. Everyone is equally elite or poor. The datasets are taken from Johns Hopkins University, we performed linear regression and support vector machine models. Data analysis of various attributes such as mortality rate, confirmed cases, recovered cases, using Python Visualization techniques are also included in the project ((PDF) Data Analysis for COVID-19, 2020). Cases coming in coming days various possible variables are responsible for the cases to come in the upcoming days (Ghosh, Ghosh, & Chakraborty, 2020). Many countries have imposed different types of lockdowns for the public. Some places got the benefit whereas, some places didn't. Everything will depend on the citizens of the country, how closely they will follow the rules and procedures imposed.

The worst part of this virus is that one may possess the virus for so many days and still have no symptoms. Because of this reason, one may carelessly visit others and spread the virus tremendously. Though vaccines are

made at some parts, the reach is limited currently. Various companies are testing their vaccine on animals or in the labs, and some have rolled out their vaccines. After analyzing the need, it can be well prepared and sent according to the need so that wastage and shortage both do not occur. Many companies across the world are racing to produce the vaccine, many vaccines are approved by different government agencies and vaccination has also started but still, the end to this pandemic is far from over. Figure 1, shows the timeline ((PDF) Data Analysis for COVID-19, 2020), how the events unfolded in the world in the initial months.
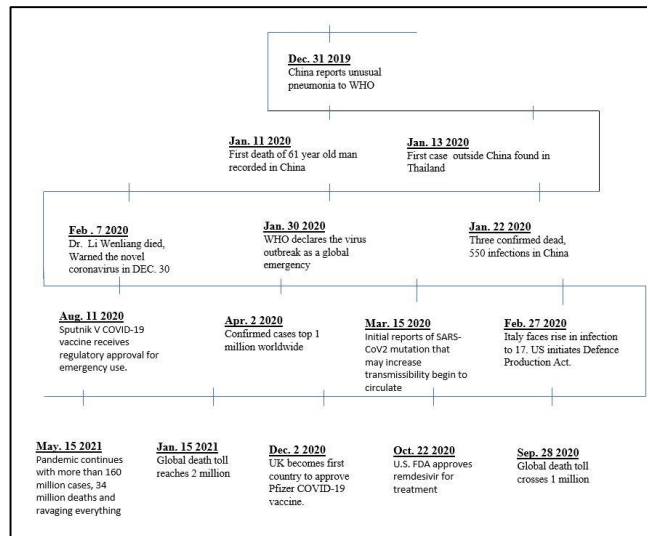

Figure 1. Timeline of COVID-19

2. Literature Survey

COVID-19 research work is going around the world. Some of them may be research work that can assist in finding different ways in recovering the patients or related to vaccines and drugs that can help patients to recover. Apart from India, various papers are published with different available models for other nations especially for China, Italy, the UK, and the USA as the number of infected patients has been high (Gambhir, Jain, Gupta, & Tomer, 2020).

The researchers in (Amirhoshang Hoseinpour Dehkordi, 2020) analyzed the transmission pattern of COVID-19 from China to different countries, based in light of every day reported cases, the observation strategy of China, South Korea, Japan, Spain and, Italy from the very first day of the outbreak, along with the different types of policies of the above-mentioned countries government in controlling the COVID-19 outbreak by the linear relation in their data.

In (Singh, Kumar, & Agarwal, 2020) authors the study carried out in the field of corona virology describes coronavirus replication notes alongside the growth of coronavirus, and cells preparation, in addition to different analyzing techniques for the virus function, widely used in the genetic techniques of coronavirus, titration techniques, and virus-cell fusion, identification of cellular receptors in addition with visualization of virus replication complexes of coronavirus, the life cycle virus in great depth.

As in (Kucharski, et al., 2020) the individuals who have recovered are deeply analyzed, which can show some insight on how to manage the active cases. Data analysts and researchers around the globe are working hard in making sense of the data available and predicting for the near future. The discovery of trend patterns, the selection of features, the forecasting methods are developed in and out to conclude.

In the paper (Ardabili, et al., 2020) To forecast the COVID-19 outbreak as a substitute to SIR and SEIR models, this paper provides a comparative study of machine learning and different soft computing models. After searching and testing a wide variety of machine learning models, two models were used that provided significant results (multi-layered perceptron, MLP, ANFIS).

World trade has already decreased in 2019, as per the World Trade Organization (Verma & Gustafsson, 2020), and now this pandemic has led to the global economic crisis. Early forecasts have projected that significant economies will lose about 2.4 to 3.0 percent of their gross domestic product (GDP) during 2020 because of the COVID-19 pandemic. The article (Verma & Gustafsson, 2020) defines the existing research areas and provides a way forward, they provided a bibliometric analysis of COVID-19 and its effect on academics, business, and the executive space.

The model in (Mittal, 2020) helps to predict national opinion with different behavior of the public. The political as well as economic impact of the virus. Different methods are used for analysis as EDA, in which cases, death and recovered are recorded and the second method of SEIR model, they also used statistical approach. In (Wang, Hu, Jiang, Lu, & Zhang, 2020) used particle swarm optimization, the current SIR model, they also offered the method for understanding the sentiment analysis and proposes the fake news detection method and researchers.

In (Latif, 2020) also used different techniques related to the analysis of different papers. The Gaussian distribution theory was used in (Li, et al., 2020) while replicating the propagation mechanism of COVID-19 to simulate the curves of mainly Hubei and Non-Hubei areas of China.

In (Furqan Rustom, 2020), the researchers have taken four famous algorithms of Machine Learning and compared them based on evaluation results from R^2 Score, R^2 Adjusted, MSE, MAE & RMSE. From all those, they chose Exponential Smoothing as the best method, Linear Regression, and LASSO gave average or second-best results whereas, SVM (Support Vector Machine) gave the worst result out of the four models. It had taken a dataset from Johns Hopkins University and performed the tests.

After taking a look at the work of different researches related to the analysis, by using different techniques and data sets from different sources we used COVID-19 datasets from Johns Hopkins University and used linear regression model for our analysis because our datasets were continuous, and with the help of inbuilt python libraries like pandas, numpy, matplotlib helped in our analysis.

3. Proposed Method For Analysis

As we are analyzing loads of data, we are trying to do it in a methodological approach by using the following steps

- First, we imported the COVID19 dataset and prepared it for analysis by dropping columns and aggregating rows.
- Choosing on and evaluating a good measure for our analysis.
- Visualizing our analysis results using Matplot, Seaborn.

4. Supervised Learning Models

In order to make predictions with an unknown input instance, a Supervised Learning model is used. In this, we teach the machine using the labeled data. Under Supervised learning, we have two types of problems. One is Regression Problems and the other one is Classification Problems. Classification is mainly about predicting a label or a class whereas regression is about predicting a continuous quantity. When we have to assign our input data into different classes, we will use classification algorithms. Regression is a predictive analysis used to predict continuous variables.

In this paper, we have used Regression analysis to understand and predict the outcome of COVID-19 using the dataset, provided by Johns Hopkins University.

Visualization helps us to understand the raw data. Here we will be analyzing the progression of the COVID-19 cases and their impact on India and other countries that have also been badly infected. The visualization of data is done using Jupyter notebook.

A mathematical technique for modeling the relationship between a dependent variable and a given set of independent variables is linear regression. We use linear regression to forecast a measured response.

In order to understand and analyze the relationships between variables, we often use several regression models. Linear Regression is one famous and efficient model. More specifically, it helps in finding out the relationship between a dependent variable and the independent variable. In Machine Learning, it is one of the statistical methods for predictive analysis.

4.1 Simple Linear Regression

In this type of Linear Regression, one dependent variable is determined by the y-intercept added to the product of slope and x-coordinate. Mathematically it is represented as

$$y = c + mx$$

Here,
y is the dependent variable,
c is the y-intercept,
m is the slope of the graph,
& x is the x-coordinate

4.2 Multiple Linear Regression

In this type of Linear Regression, one dependent variable is determined by the 'n' number of x-coordinates and their respective slopes as required. Mathematically it is represented as

$$Y_i = \beta 0 + \beta 1 x_i 1 + \beta x_i 2 + \dots \beta n x_i n + \varepsilon$$

Here,
y_i is the dependent variable,
$\boldsymbol{\beta}0$ is the y-intercept,
$\boldsymbol{\beta}1$ & $\boldsymbol{\beta}2$ are regression coefficients
m is the slope of the graph,
ε is the random error that may occur in the model

```python
plt.figure(figsize=(10,6))
plt.plot(adjusted_dates, world_cases)
plt.plot(future_forecast, linear_pred, linestyle='dashed', color='red')
plt.title('Prediction of Coronvirus cases in the World using LR', size=30)
plt.xlabel('Days since 1/22/2020', size=30)
plt.ylabel('Number of cases', size=30)
plt.legend(['Confirmed Cases', 'Linear predictions'])
plt.xticks(size=15)
plt.yticks(size=15)
plt.show()
```

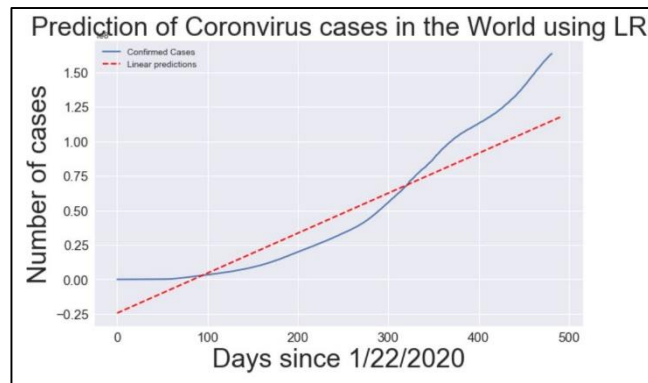**Figure 2.** Code Snippet of prediction using Linear Regression

Figure 3. Prediction using Linear Regression

4.3 Support Vector Machine

The Support Vector Machine or SVM aims to find the best line or decision boundary for categorizing n-dimensional space into classes so that new data points can be conveniently placed in the correct category in the future. The extreme vectors that help create the hyperplane are chosen by SVM.

```python
#Confirmed vs Predicted Cases
plt.figure(figsize=(10,6))
plt.plot(adjusted_dates, world_cases)
plt.plot(future_forecast, svm_pred, linestyle='dashed', color='red')
plt.title('Prediction of Coronvirus cases in the World using SVM', size=30)
plt.xlabel('Days since 1/22/2020', size=30)
plt.ylabel('Number of cases', size=30)
plt.legend(['Confirmed Cases', 'SVM predictions'])
plt.xticks(size=15)
plt.yticks(size=15)
plt.show()
```

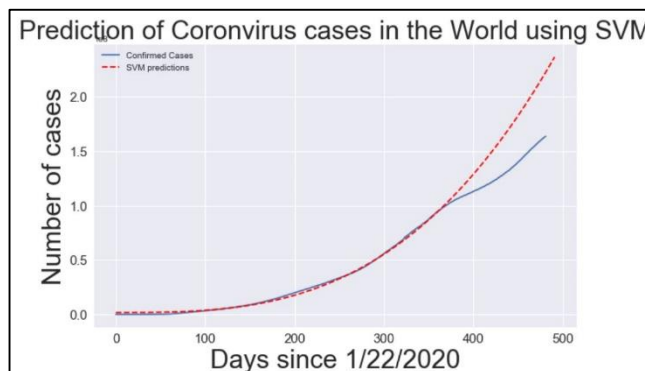**Figure 4.** Code Snippet of prediction using SVM

Figure 5. Prediction using SVM

5. Evaluation Parameters

For every study, an evaluation is required to conclude its result. In this study, we have used two parameters to measure the performance of the learning models. They are

5.1 Mean Absolute Error

We calculate MAE as the average of the absolute error value between actual or true values and the predicted values, while using absolute difference only a positive value is forced to be used.

$$\text{MAE} = \frac{\sum_{i=1}^{n}|y_i - x_i|}{n}$$

MAE is mean absolute error
y_i is the prediction,
x_i is the true value
n is the total number of data points

5.2 Mean Square Error

MSE is the loss function for algorithms, it matches by minimizing the least square error between predictions and expected values.

$$\text{MSE} = \frac{1}{n}\sum_{i=1}^{n}\left(Y_i - \hat{Y}_i\right)^2$$

MSE is the mean square error
Y_i observed value,
$\hat{Y}_i$ is the predicted value
n is the total number of data points

```
#Using Linear Regression Model to make predictions
from sklearn.linear_model import LinearRegression
linear_model = LinearRegression(normalize=True, fit_intercept=True)
linear_model.fit(X_train_confirmed, y_train_confirmed)
test_linear_pred = linear_model.predict(X_test_confirmed)
linear_pred = linear_model.predict(future_forecast)
print('MAE:', mean_absolute_error(test_linear_pred, y_test_confirmed))
print('MSE:', mean_squared_error(test_linear_pred, y_test_confirmed))

MAE: 33346833.51129428
MSE: 1183112563077000.0
```

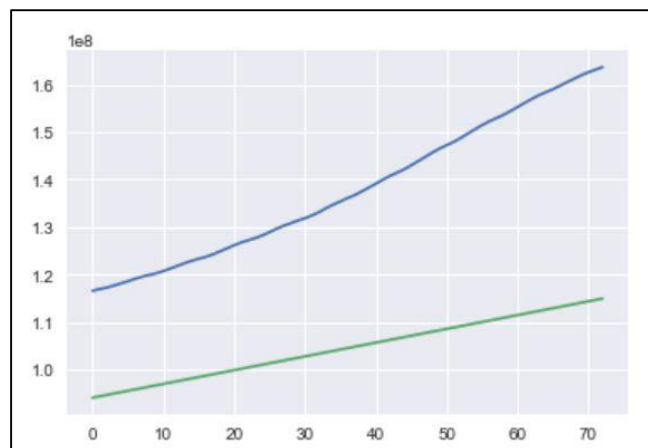**Figure 6.** MAE and MSE score using Linear Regression

Figure 7. Shows prediction and actual values using Linear Regression

```
svm_test_pred = svm_confirmed.predict(X_test_confirmed)
plt.plot(svm_test_pred)
plt.plot(y_test_confirmed)
print('MAE:', mean_absolute_error(svm_test_pred, y_test_confirmed))
print('MSE:', mean_squared_error(svm_test_pred, y_test_confirmed))

MAE: 39931726.367322266
MSE: 1704056514041975.0
```

Figure 8. MAE and MSE score using SVM and predictions

6. Data Analysis

6.1. Statistical Techniques Used in the Present Study

The spread of the COVID-19 across the World created havoc, everywhere. Figure 9 depicts the top 10 most affected countries with the parameters such as confirmed, recovered, active, deceased rate. As from Figure 10, we can see that the United States is on top of the list by more than 30 million confirmed positive cases after that India has 25 million confirmed cases followed by Brazil, France, Turkey, Russia, United Kingdom, Italy, Spain, and Germany respectively.

country	Confirmed	Deaths	Recovered	Active	Incident_Rate	Mortality Rate (per 100)
US	32996503	587196	0	0	10015.14	1.78
India	25228996	278719	21596512	3353765	1828.18	1.10
Brazil	15732836	439050	13920758	1373028	7401.62	2.79
France	5959580	108201	381249	5470130	9130.17	1.82
Turkey	5139485	45186	4971245	123054	6093.84	0.88
Russia	4900995	114619	4519888	266488	3358.35	2.34
United Kingdom	4466218	127953	15292	4322973	6579.00	2.86
Italy	4167025	124497	3727220	315308	6891.99	2.99
Spain	3619848	79502	150376	3389970	7742.20	2.20
Germany	3615896	86514	3323300	206082	4315.74	2.39

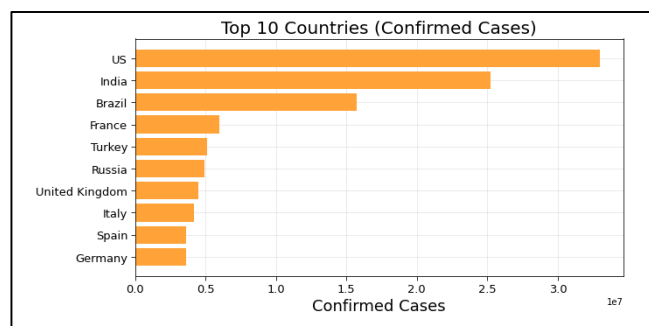**Figure 9.** Top 10 affected countries in the world

Figure 10. Top 10 affected countries in the world

While Turkey having the lowest mortality rate at 0.88, in contrast to its European partner Italy at 2.99, despite having one of the best healthcare facilities.

6.2. Countries with the most fatalities

Figure 11 outlines the top 10 most affected countries along with the statistic of deceased people across the world. From this, we can draw that in the United States nearly 600,000 people have lost their lives, after that Brazil has more than 400,000 thousand deaths followed by India, Mexico, UK, Italy, Russia, France, Germany,

and Columbia. Many developed countries were not able to control the fatality rate even when they have the most advanced healthcare system. Fatality rate also depended on the lifestyle of people, and people who already have different heart or pulmonary conditions.

However, it is difficult to believe these numbers because every country is counting its fatalities based on its measures rather than following the guidelines provided by the World Health Organisation.
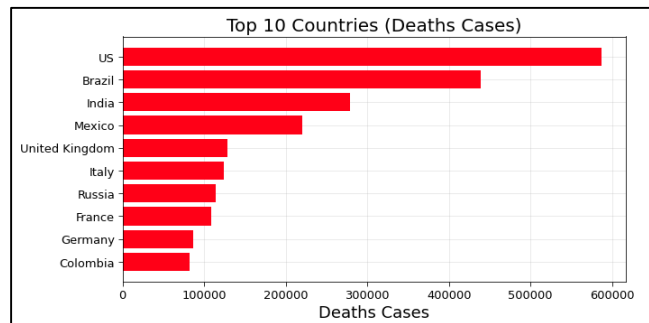

Figure 11. Top 10 countries with most fatalities in the world

6.3. Top 10 countries with highest recoveries

Figure 12 depicts the top 10 countries with the highest recoveries. India is at the top of the list with more than 20 million patients recovering after that Brazil has nearly 1.5 million patients recovering followed by the Brazil, Turkey, Russia, Italy, Germany, Argentina, Colombia, Poland, and Iran respectively. Despite having second-most cases, India leads in having most recoveries bringing down the active cases to less than 1 percent of active cases, while the USA is still struggling to bring down the number of active cases.
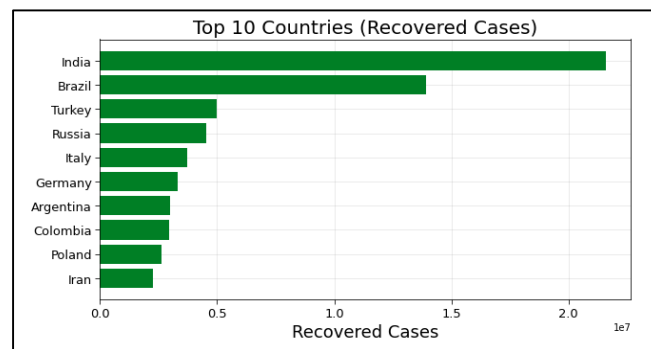

Figure 12. Countries with the most recoveries in the world

6.4. Continent wise comparison with different parameters

In figure 13, if we see that North America has the highest mortality rate and Asia has the lowest mortality rate, despite having a large population shows us that how much people are suffering in North America despite having the world best healthcare. Asia and South America are witnessing another wave of the virus with a new virus strain.

continent	Confirmed	Deaths	Recovered	Active	Incident_Rate	Mortality Rate (per 100)
Africa	4616621	125613	4137614	353394	41047.81	2.72
Asia	46743925	606557	41272461	4864907	124218.26	1.30
Australia	47058	1077	37603	8378	365.13	2.29
Europe	46309034	1052910	25089371	17424730	328174.63	2.27
North America	5459539	278337	4559622	621580	44793.03	5.10
Others	33779501	599242	733534	37418	26507.51	1.77
South America	26989824	735246	24259000	1995578	55046.23	2.72

Figure 13. Continents wise data of the world

7. Predictions On BRICS Nations

The BRICS gathering of nations – Brazil, Russia, India, China, and South Africa is significant, because of their inter-continental ties as well as because they are half of the global future GDP (Briefing & Devonshire-

Ellis, n.d.). Over the next decade, the BRICS should achieve these future goals. Whatever happens now will directly affect future trade. So how the BRICS countries are adjusting to the COVID-19 pandemic.
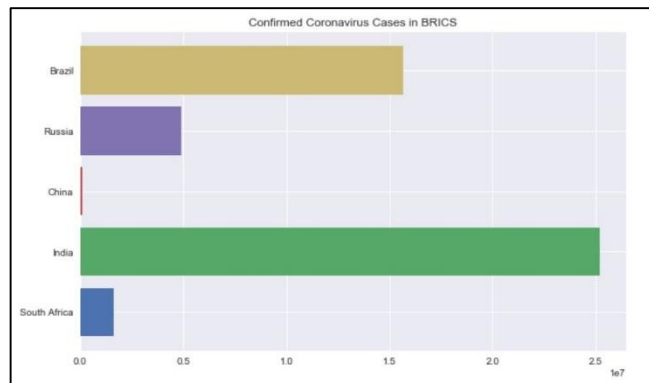

Figure 14. Confirmed cases in BRICS nations

7.1. Brazil

The potential of an already struggling economy to recover could already be diminished by a late response as the stock market is trembling and the currency is at a record low. The Brazilian government has introduced many measures to eradicate the spread of this virus. The government announced restrictions on the entry of foreign nationals coming through flights to avoid the contamination of viruses from outside the country in its borders. Schools, colleges, are suspended. Public transport has increased its attention. Brazil's Business Confidence Index is now affected by the coronavirus, which accumulates data from Manufacturing, Utilities, Commerce, and Construction, is now affected by the Coronavirus. Desires intensified fundamentally in all areas, particularly in exchange and administrations. How long will this pandemic affects the nation in the coming months, the state of decreasing certainty might also remain. Since March, the certainty of all areas that constitute the BCI has decreased (Devonshire-Ellis, 2020).

Figure 15. Prediction of cases in Brazil

7.2. Russia

Russia is hoping to take a shot but has ample assets to beat them. The state is currently helping industry and individuals but more can be done. There is some disarray concerning varying territorial methodologies. Due to coronavirus, most regions introduced 'Recommended Restrictive Measures'. Russia introduced this on March 28 (Devonshire-Ellis, 2020). The time between March 28 2020 and April 15 2020 was declared by President Putin as a paid, non-working week to minimize proliferation by encouraging self-isolation and work-from-home jobs. Russia will be feeling the squeeze from isolated actions in the European Union as the nation represent Russia's 43 percent unfamiliar exchange. Furthermore, the system of self-separation in Russia implies the conclusion of all diversion settings, eateries, and strip malls.
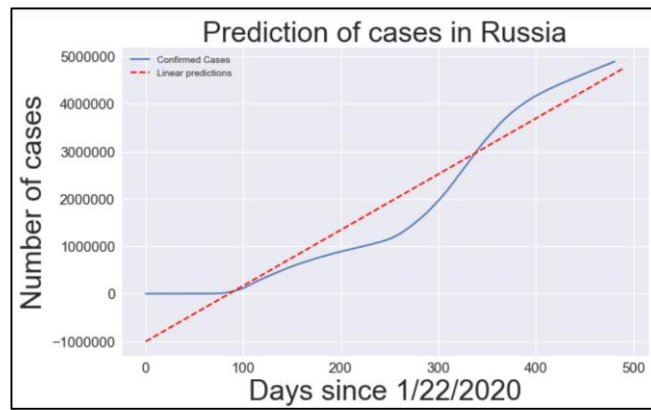
Figure 16. Prediction of cases in Russia

7.3. India

The first case was reported on 30th Jan 2020 (htt3). The cases increased mostly by local transmissions or people coming in exposure with people who have traveling history from other nations. India additionally seems to have enough to brave the financial effect and re-visitation of work. Anyway, racial pressures are likely, while the level of need among poor people may need to increase. The Indian Economy was, all things considered, experiencing a slow stage since the time demonetization and GST were executed. The 2019-20 gross domestic product figure was revised downwards from an idealistic 7 percent to 5.4 percent. In light of this, in August 2019 (Devonshire-Ellis, 2020), the government reported deep tax cuts for organizations to get the economy back into the groove.
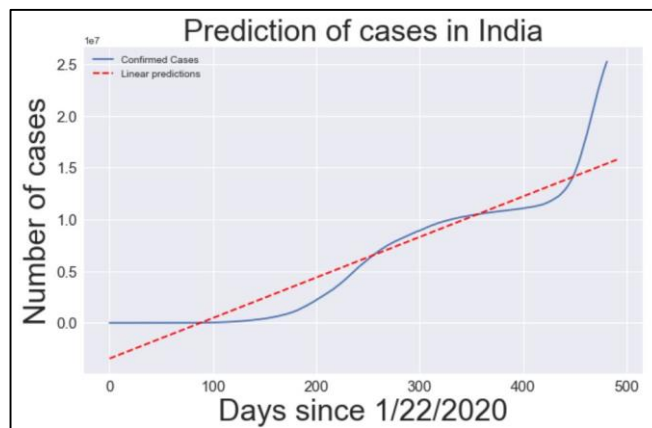

Figure 17. Prediction of cases in India

The impact of these practices has been found in an increase in the January and February 2020 PMI and Manufacturing Index.

7.4. China

China is generally on the ball and seems, by all accounts, to be the most focused as far as populace the board. Anyway, the second rush of contaminations can't be precluded. Organizations and public social events will stay just somewhat open for quite a long time with representatives expected to telecommute at some random time. The virus being evolved in China in 2019, the public mood transitioned from fear to caution in late February. People adapt to the new standard and try to cope with the social system of the facemask, though many people wear masks due to the high level of pollution in Beijing. Meanwhile, trust in the government authority reaction appears to be high. All things considered, finance managers understand that numerous sorts of business are badly affected like retail, land, and travel are the main sectors which are affected. Many individuals in these areas have either been furloughed for a while or lost their positions. Traveler laborers in the development area are enormously affected (Devonshire-Ellis, 2020). In current government estimates, a large number of these vacant positions do not exist, because although there has been a massive rise in the rate of unemployment, the real figure is almost definitely much higher. A ton of lower-acquiring people will be languishing over a drawn-out timeframe.
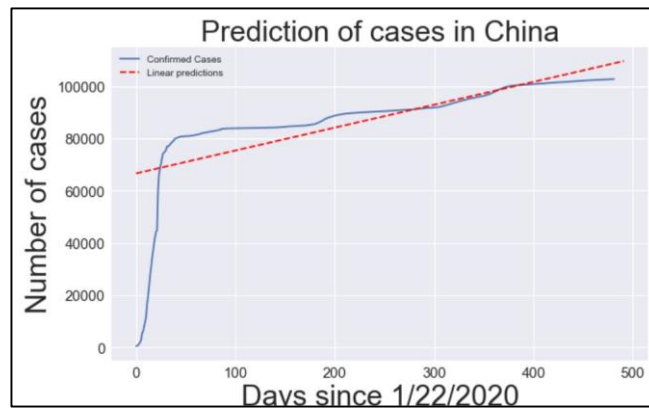
Figure 18. Prediction of cases in China

7.5. South Africa

In South Africa as well as on the mainland, main medical problems with sterilization, clean water, malnutrition, and high rates of TB and HIV are the main issues. Helpless foundations and medical care could annihilate portions of the mainland economy. Initially, around 100 people were allowed in a public gathering but from March 26, 2020, all gatherings were prohibited except funerals where a maximum of 50 people are allowed. South Africa is the nation with the fifth-most note-able number of COVID-19 cases in the world and the African landmass. The investigation further sees that financial areas generally impeded by the COVID-19 flare-up incorporate materials, training administrations, providing food and facilities (counting the travel industry), drinks, tobacco, glass items, and footwear. Little and medium endeavors are most adversely affected (Devonshire-Ellis, 2020). As the COVID 19 pandemic disrupts normal economic activity and life across the globe, world trade is predicted to plunge by between 13 percent and 32 percent in 2020 (htt).
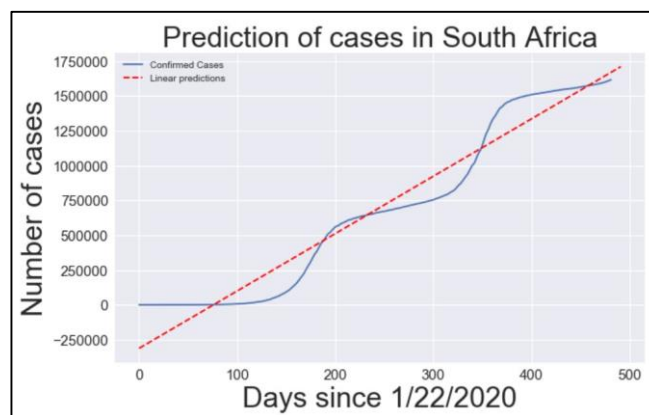

Figure 19. Prediction of cases in South Africa

The different data sets we used are from various sources and different sources (Ensheng Dong, 2020).

8. Conclusion

The increasing spread of COVID-19 has killed so many lives in the world. Researchers and government agencies had prophesied about the pandemic affecting a large area of the world population (N.C.Mediaite, 2020) (Coronavirus: Up to 70% of Germany Could Become Infected— Merkel.).

The main objective of our study paper was to examine and assess the spread of COVID-19 since the first case of the virus was found in China and the spread of the virus in the world and how this virus tested the healthcare system of the most powerful countries in the world. We also find out predictions for the BRICS nations. In addition, we analyzed patterns with the confirmed, active, recovered, and deceased cases. In the future, this study will be further continued with much more accurate algorithms and updated datasets. New Deep-Learning algorithms and methods will be infused. More accurate results will be the motive of our future work we can advance it by using different machine learning algorithms or by modeling the different models in various areas like budget management and vaccine management.

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