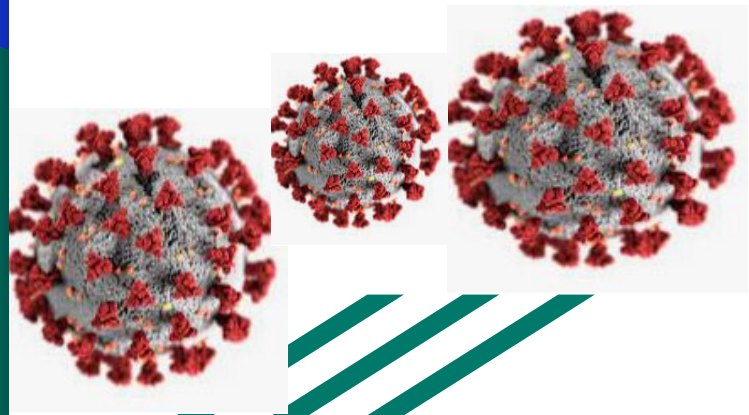
PATH TO HERD IMMUNITY

TIME SERIES ANALYSIS USING COVID-19



Team Members

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What is Herd Immunity?

1. 'Herd immunity', also known as 'population immunity', is the indirect protection from an infectious disease that happens when a population is immune either through vaccination or immunity developed through previous infection.
2. With the availability of the COVID-19 vaccine, we present our best estimate of the path to COVID-19 herd immunity / normality
3. We are focusing on a time series model to predict when the world population will be 70% vaccinated.
4. It is the level needed to reach "herd immunity" and It will allow travel and trade freely between countries. and world will go back to the normal

Data Exploration and EDA Analysis

1. **Where did the data come from?**

Our complete COVID-19 dataset is a collection of the COVID-19 data maintained by Our World in Data. It is updated daily and includes data on confirmed cases, deaths, hospitalizations, testing, and vaccinations as well as other variables of potential interest.

2. **EDA Analysis conclusion**

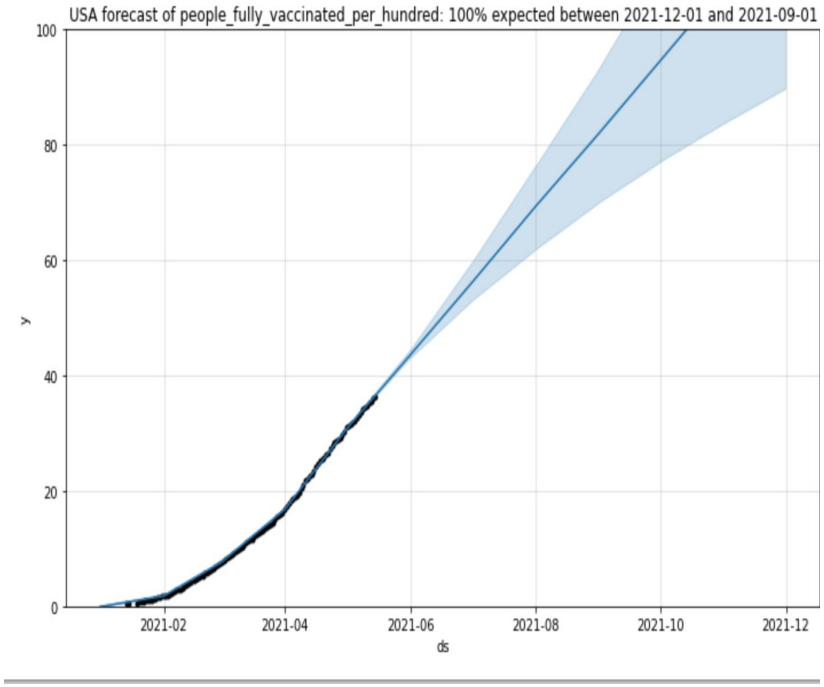
we have plotted people full vaccinated in the world graph on a World Map this shows:

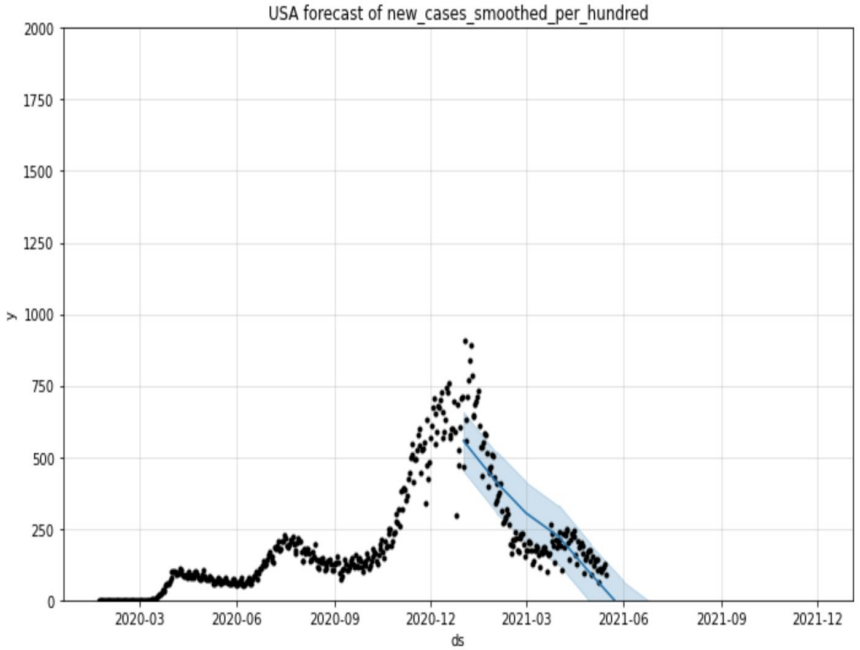
- Countries like USA, Chile, Alaska have vaccinated majority of their population.
- Countries like Russia, Brazil have reached on a little bit higher side vaccination rate
- Countries like Canada, India still have less vaccinated people as per population

Prophet Model Definition

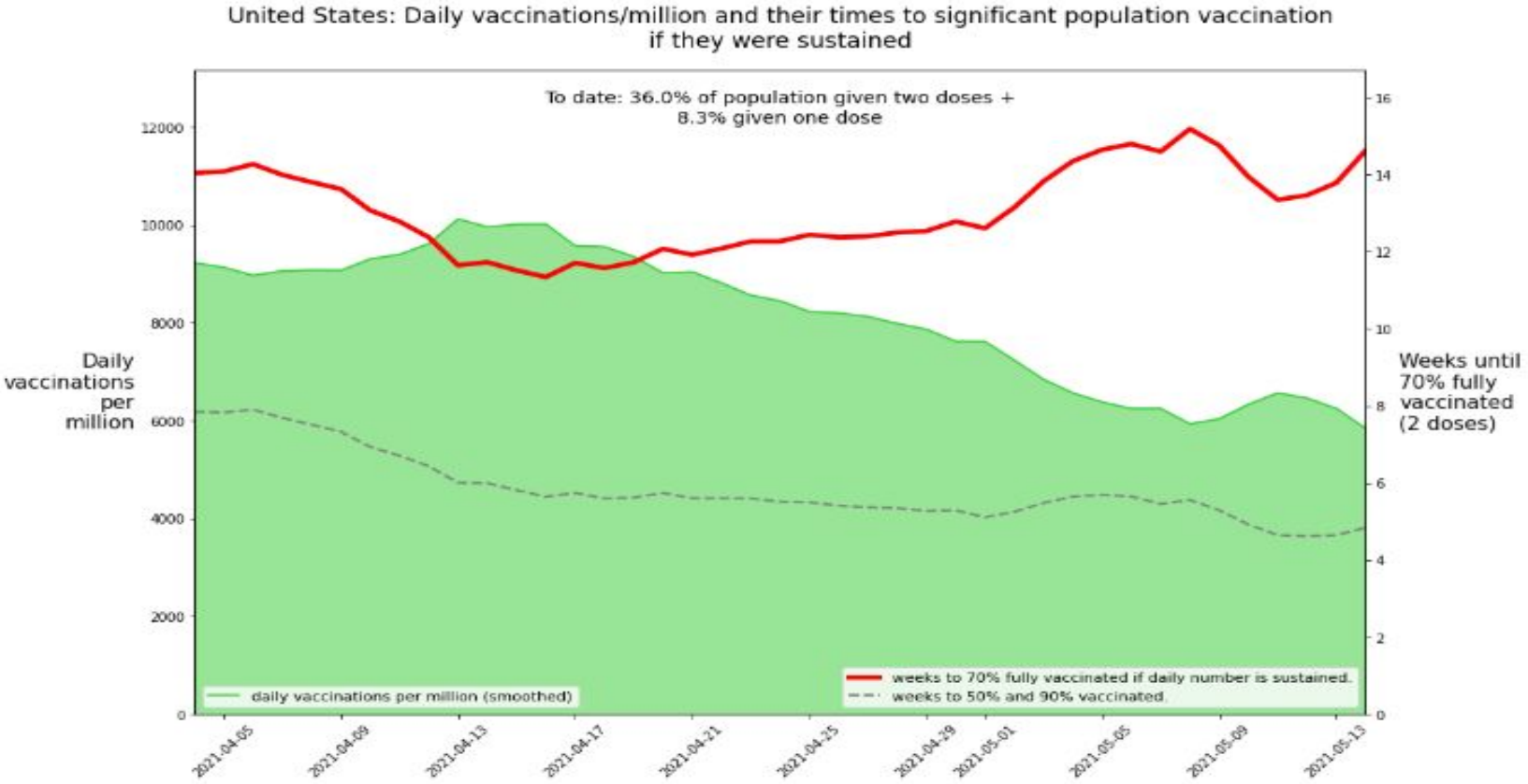
- Prophet is an open-source library developed by Facebook and designed for automatic forecasting of univariate time series data.
- A piecewise linear or logistic growth curve trend.
- Prophet automatically detects changes in trends by selecting changepoints from the data.
- The input to Prophet is always a dataframe with two columns: **ds** and **y**. The ds (datestamp) column should be of a format expected by Pandas.The y column must be numeric, and represents the measurement we wish to forecast.

Prophet Model-Infection vs Vaccination





Prophet Model vs Statistical -Conclusion



ARIMA and LSTM

We used these model to calculate the herd immunity for world population

1. **ARIMA - Auto Regressive Integrated Moving Average**

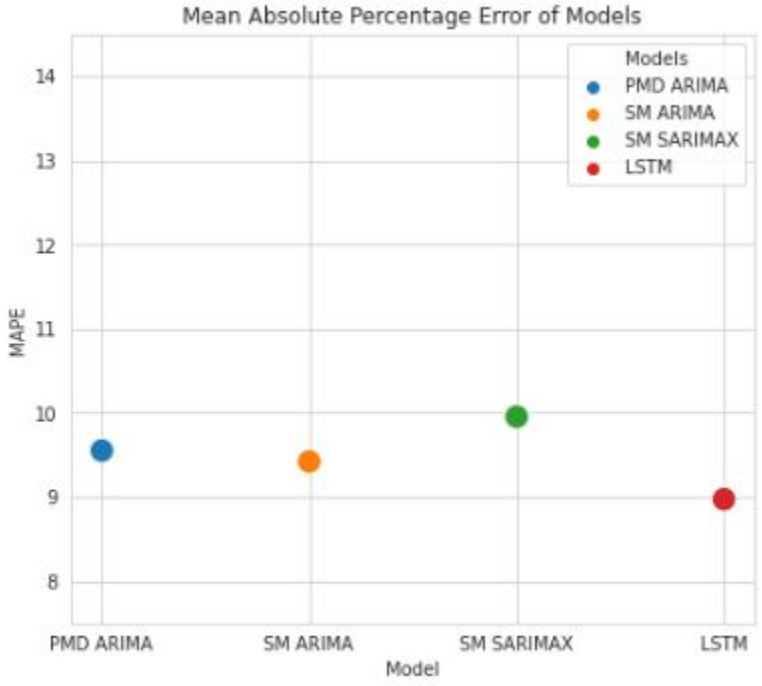
   p — the number of autoregressive
   d — degree of differencing
   q — the number of moving average terms
   m — refers to the number of periods in each season
   (P, D, Q)— represents the (p,d,q) for the seasonal part of the time series

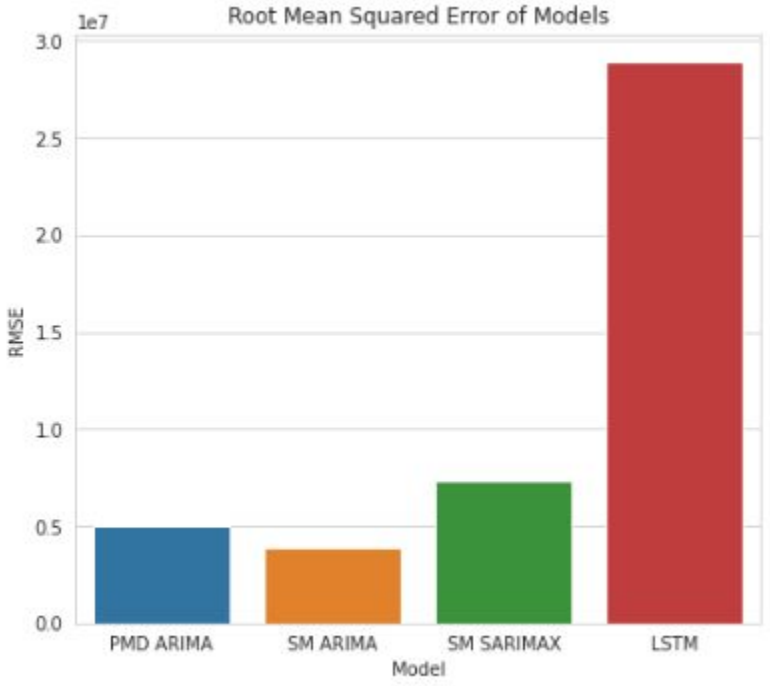
2. **LSTM - Long Short Term Memory networks**

   It is a special kind of recurrent neural network that is capable of learning long term dependencies in data.

   This is achieved because the recurring module of the model has a combination of layers interacting with each other.

ARIMA and LSTM Model Conclusion





Estimated Herd Immunity Dates

Future Steps

1. In the LSTM model RMSE and MAPE values are very high, We need to work on the tuning of this model.
2. There are different types of LSTM model like Stacked,Bidirectional, Multivariate CNN to reach the minimum RMSE and MAPE value
3. Prophet Model : Prediction is done based on Vaccination rate data and hence Herd immunity predictions is achieved. Few countries are still facing issues after vaccinating 70% of the population hence type of vaccine plays a major role.
4. Data can be gathered related to different vaccine types used worldwide and predict the effectiveness of that vaccine which can be used to predict Herd Immunity graph.

References

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   b. Website : https://ourworldindata.org/
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5. Other References
   a. Exponential Smoothing: https://towardsdatascience.com/holt-winters-exponential-smoothing-d703072c0572

Thanks Everyone !

Any Questions?