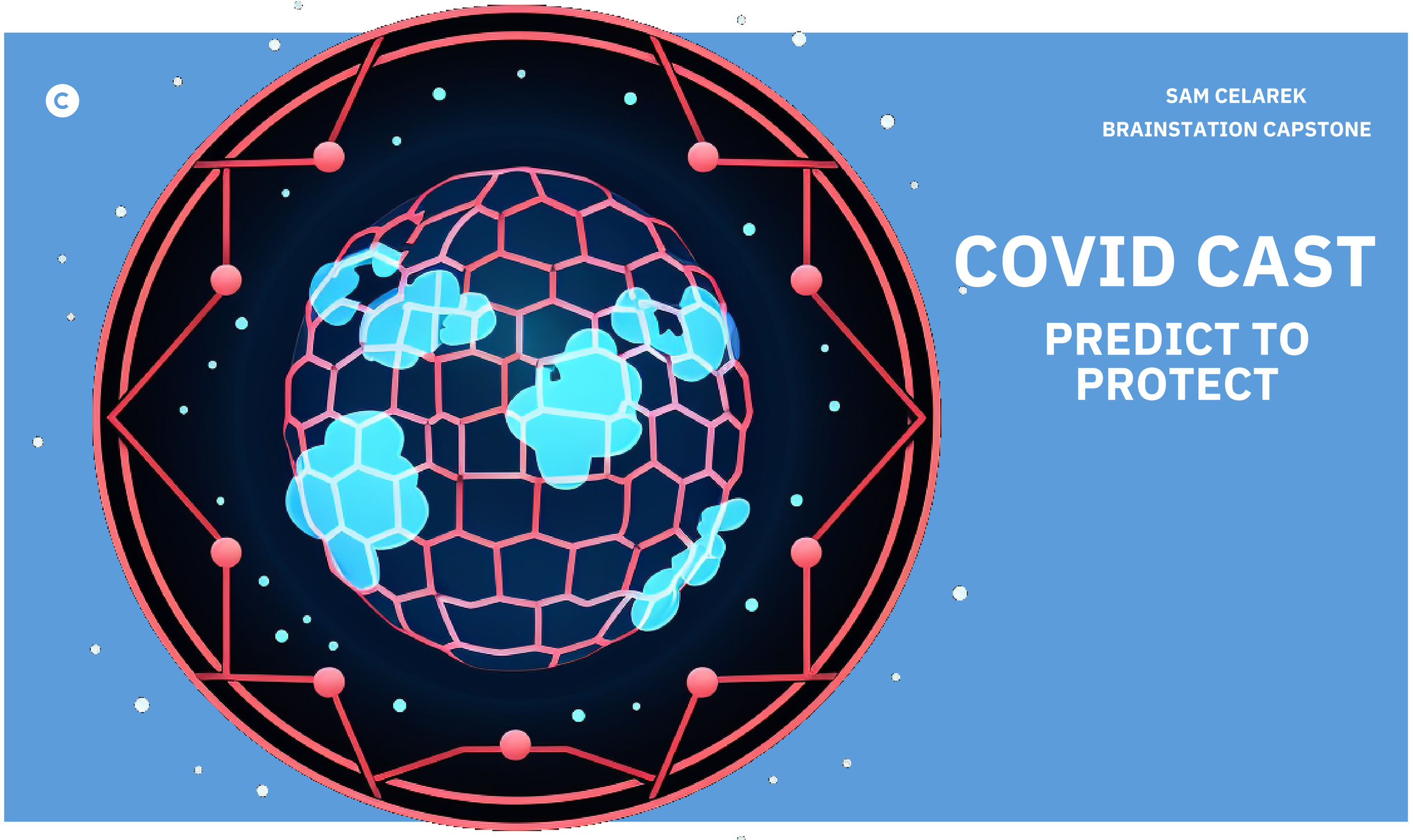
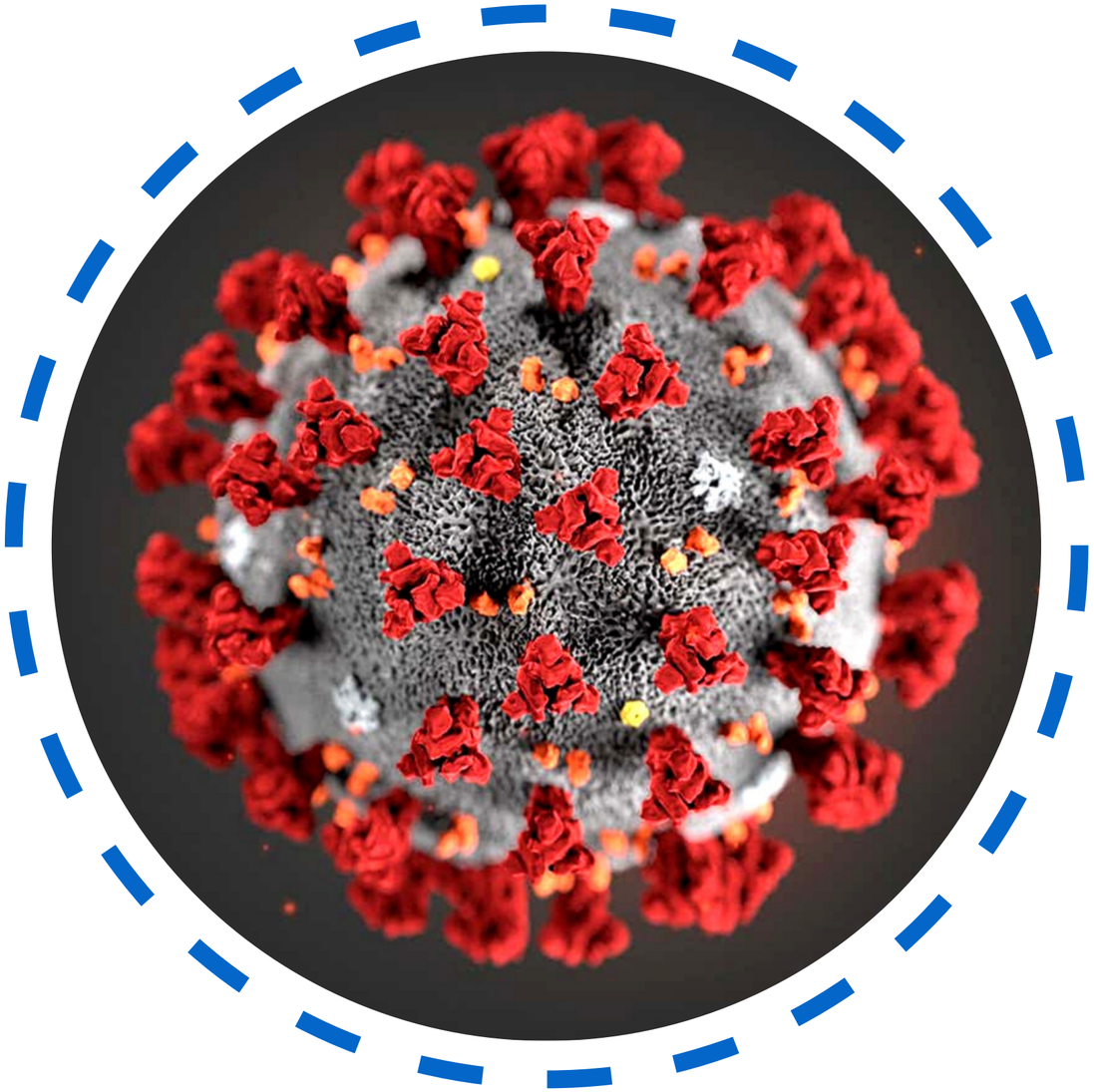


SAM CELAREK

BRAINSTATION CAPSTONE

COVID CAST

PREDICT TO PROTECT



THE PROBLEM

Pandemics are an existential threat.

COVIDCASTS GOAL

Predict to Protect.

Time Line of Covid

OUTBREAK

First death in January 2020.

January
59 Cases
1 Dead

March
1m Cases
100k Dead

PANDEMIC!

By March 2020, COVID on every continent.

WORLD UNDER SEIGE

By July, 1/3 of the world in lockdowns. New Delta Variant,

August
30m Cases
1m Dead

December
100m Cases
2m Dead

THE COMEBACK

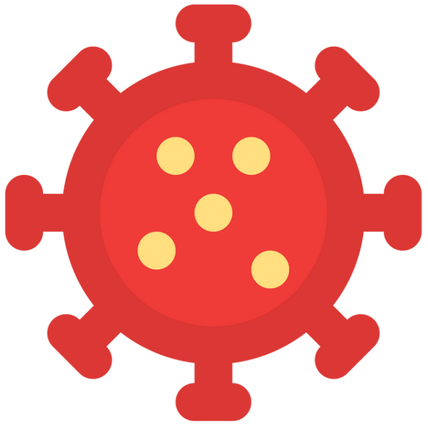
First vaccines in 2020 December.

WHAT'S NEXT?

Today
760m Cases
7 m Dead

COVIDCast:

SIRD MODEL



REPRODUCTION RATE

How many people get infected from one sick person!?

Time Series Models

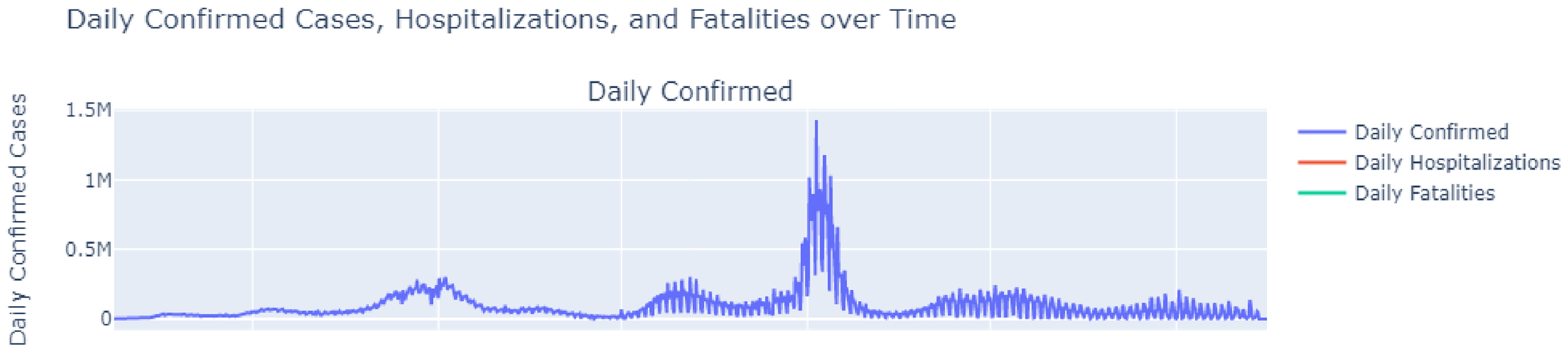
1. SARIMAX
2. PROPHET

TARGET FEATURES

NATIONAL US DATA

NEW CONFIRMED 🎯

The number of new confirmed COVID-19 cases on the given date.



DATA COLLECTION

COVSIRPHY

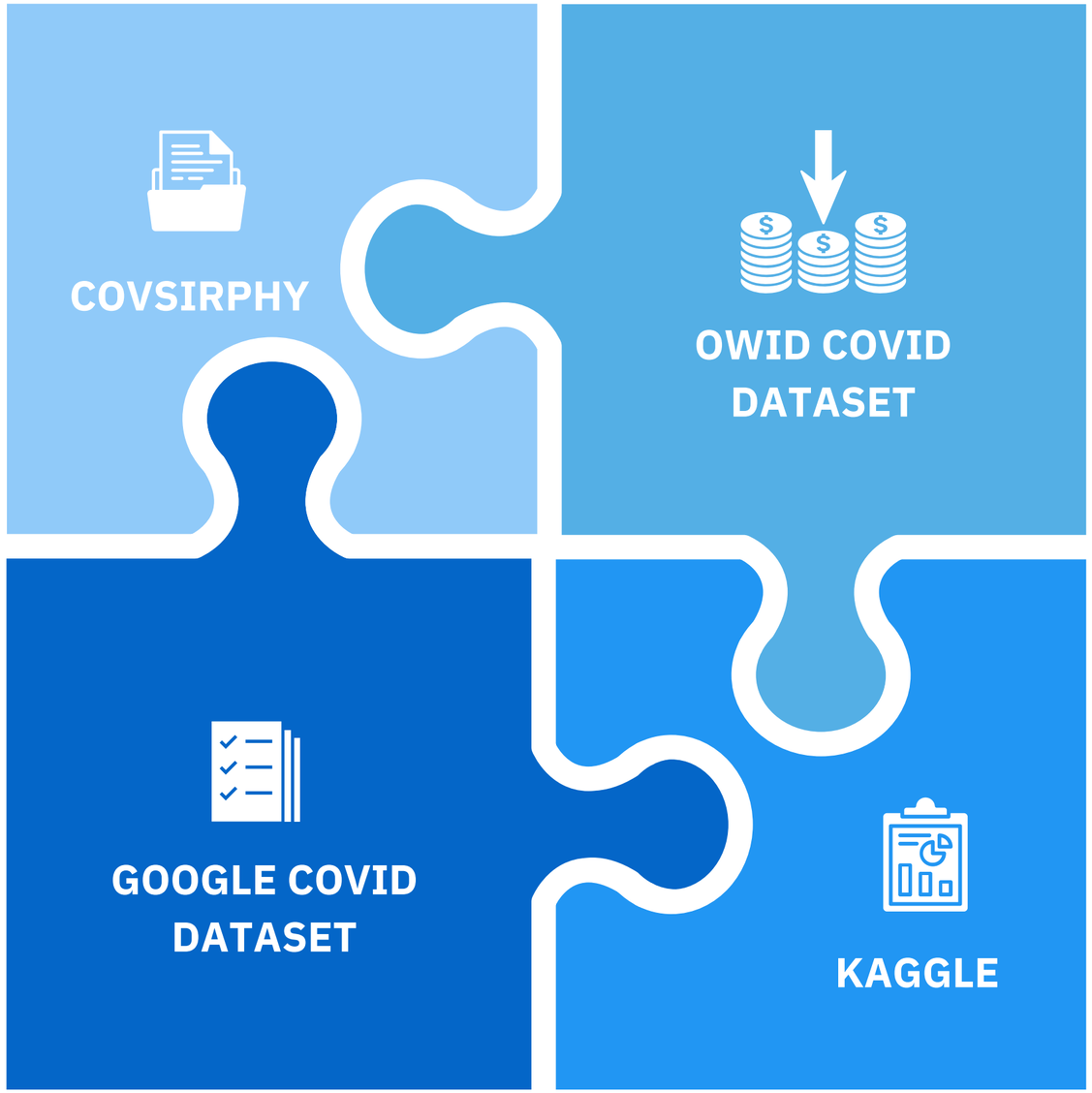
- Epidemiological Modeling.
- Real Time Global Covid Datasets.

GOOGLE DATASET

- Weather, Mobility, Regulation
- Stopped 9/15/2022

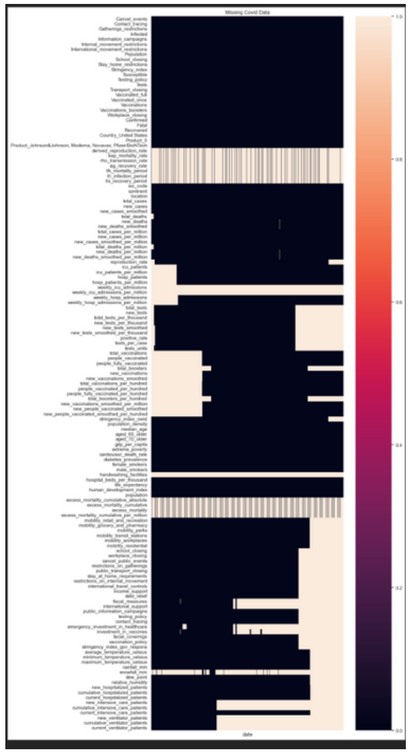
OWID COVID DATASET

- Hospitalizations, Testing, Excess Morbidity.

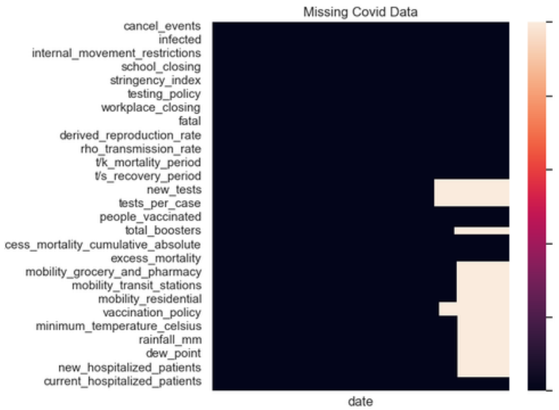


The Stages of Cleaning

1142 x 141 columns, 30% nulls



1142 x 59 columns, 7% nulls



1131 x 45 columns

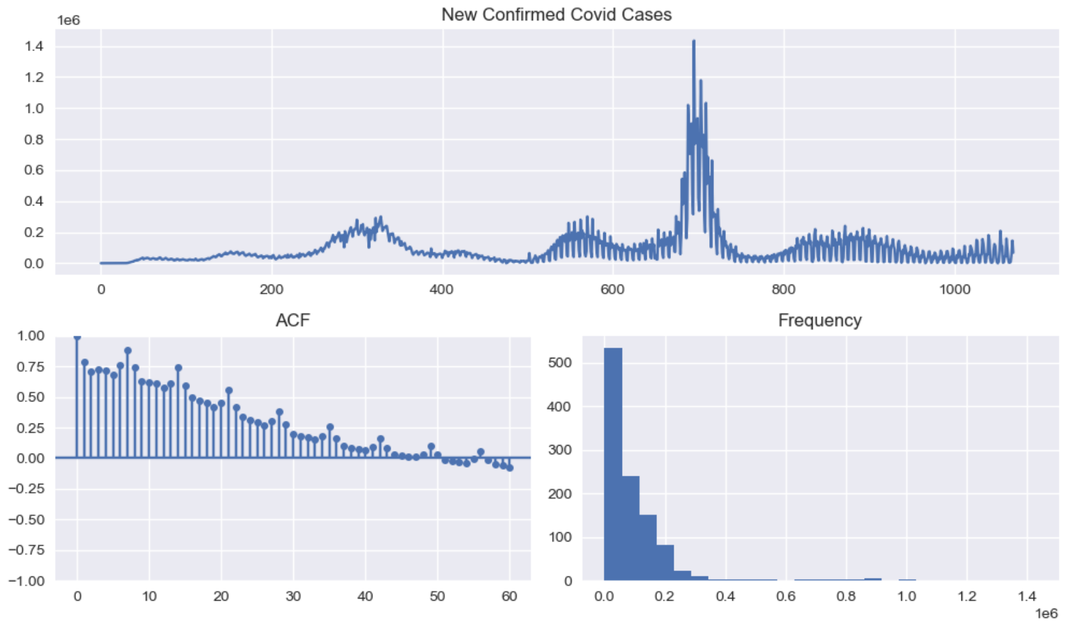
1. IMPUTING FROM OTHER DATASETS
2. INTERPOLATE
3. FILLNA AND DERIVE
4. REMOVE COLUMNS, NARROW RANGE

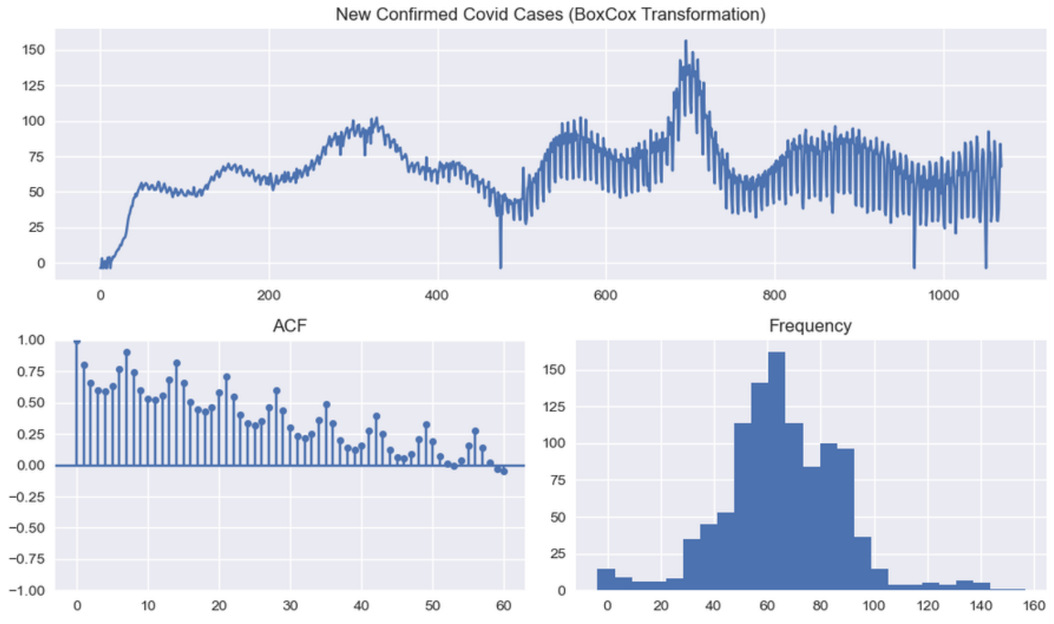
TIMES SERIES PREPROCESSING FOR SARIMAX

d:
Find the Difference

q, p:
ACF, PACF

P, D, Q, M:
Seasonality





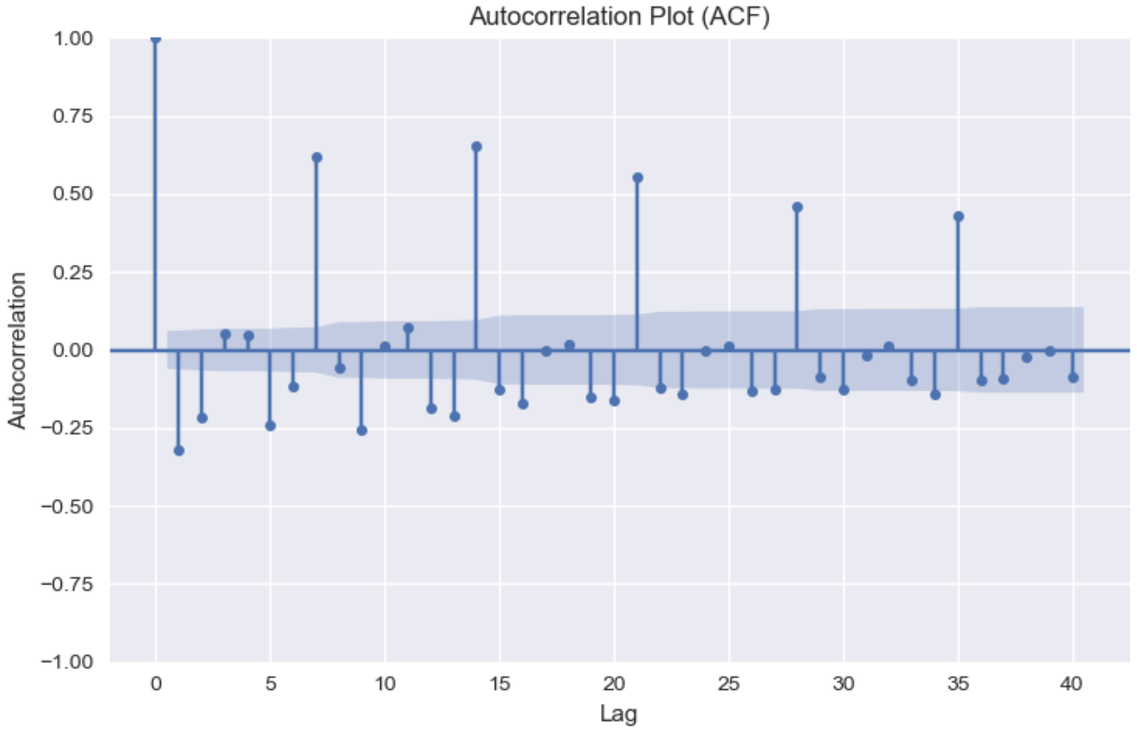
FINDING THE ORDER OF ARIMA

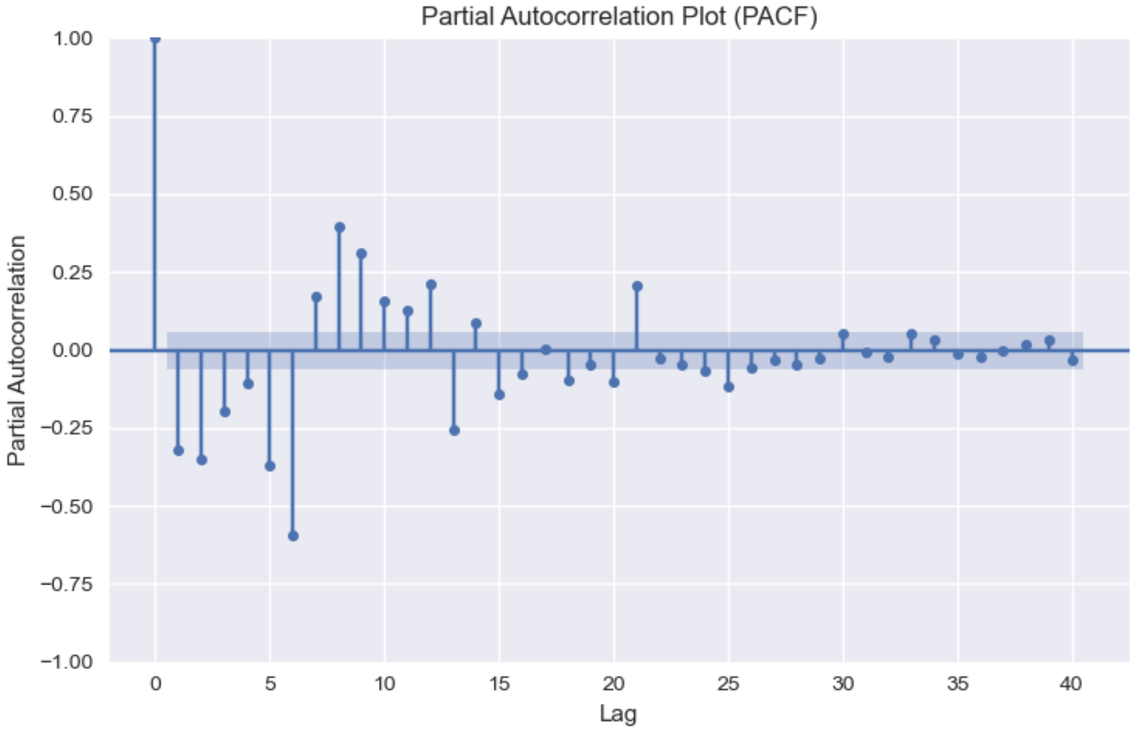
AUTOCORRELATION

- Decays relatively quick
- q = 2-3 Moving Average Lags

PARTIAL AUTOCORRELATION

- Remains significant out to several terms
- Seasonal effect likely important
- p = 5-6 Autoregression Lags





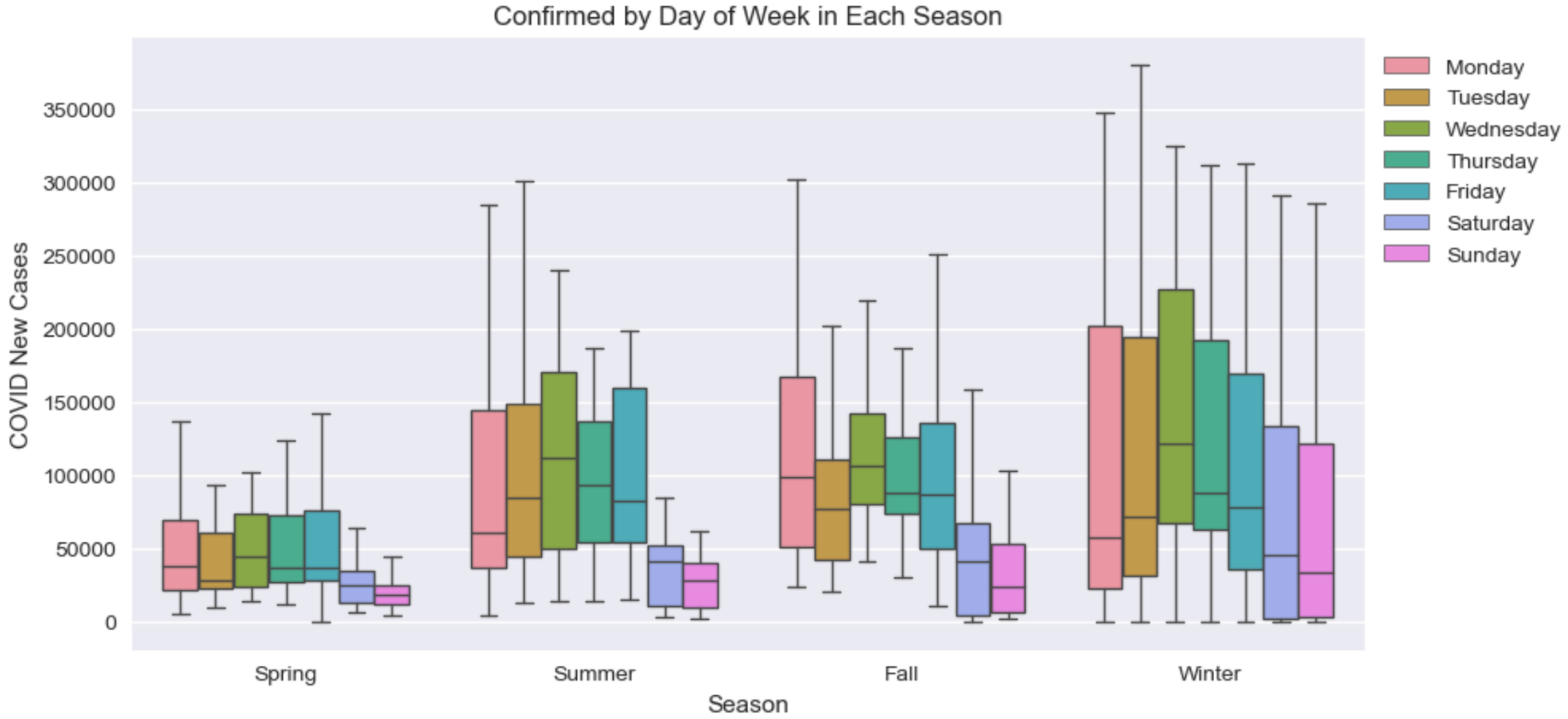
SEASONALITY

WEEKLY CORRELATION

- Rise and Fall throughout every week
- Wednesday is peak, Sunday is trough
- m = 7 day periods

QUARTERLY CORRELATION

- Winter sees higher number and more variance
- Spring is consistently the lowest



SARIMAX MODEL

p, d, q
3, 0, 2

ARIMA ORDER

- Recent COVID data was predictive

P, D, Q, M
2, 1, 1, 7

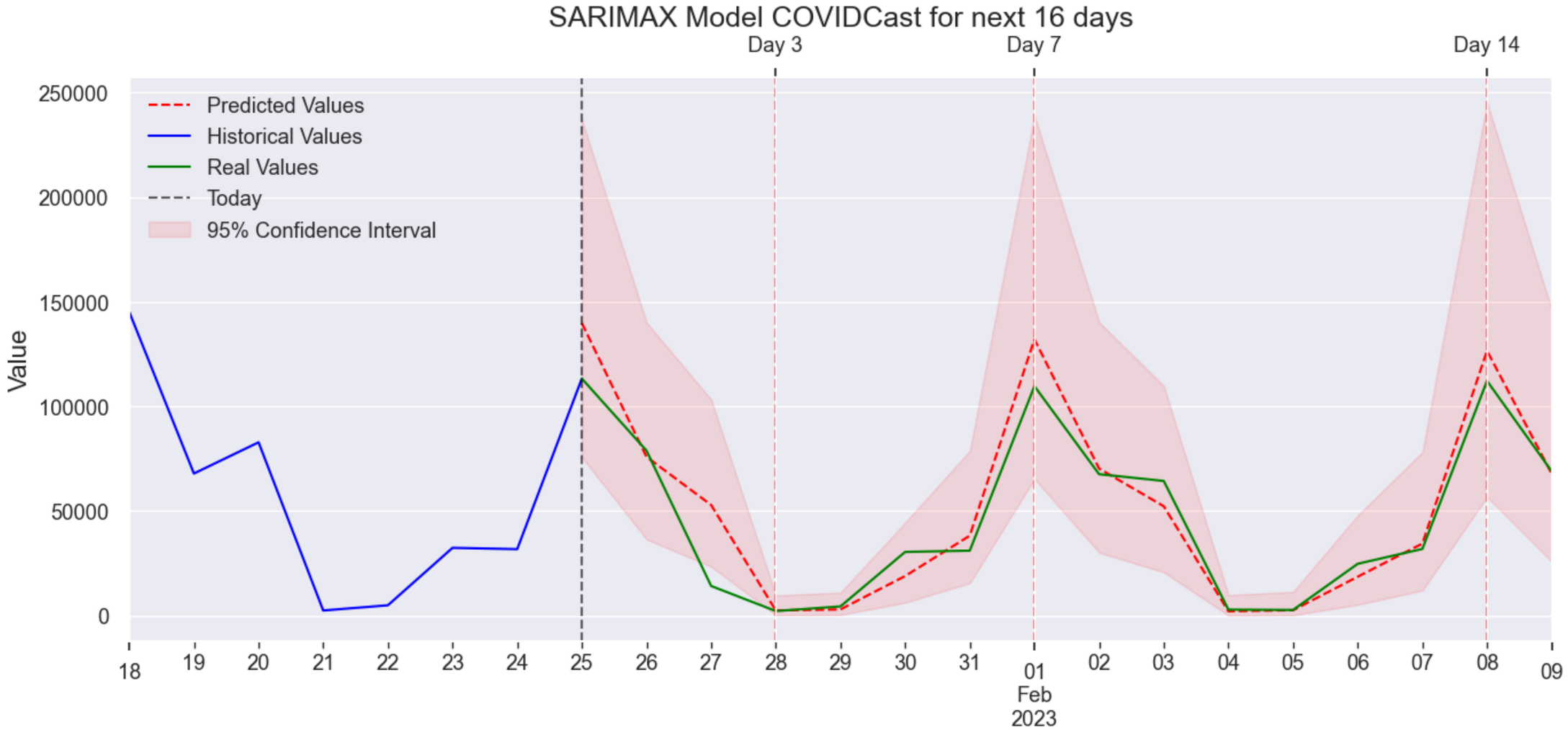
SEASONAL ORDER

- Strong weekly effects

6

EXOGENOUS VARIABLES

Stringency, r, vaccinations, hospitalized patients, mortality, month



PROPHET MODEL

10

CHANGE POINT

- Very Flexible

0.1

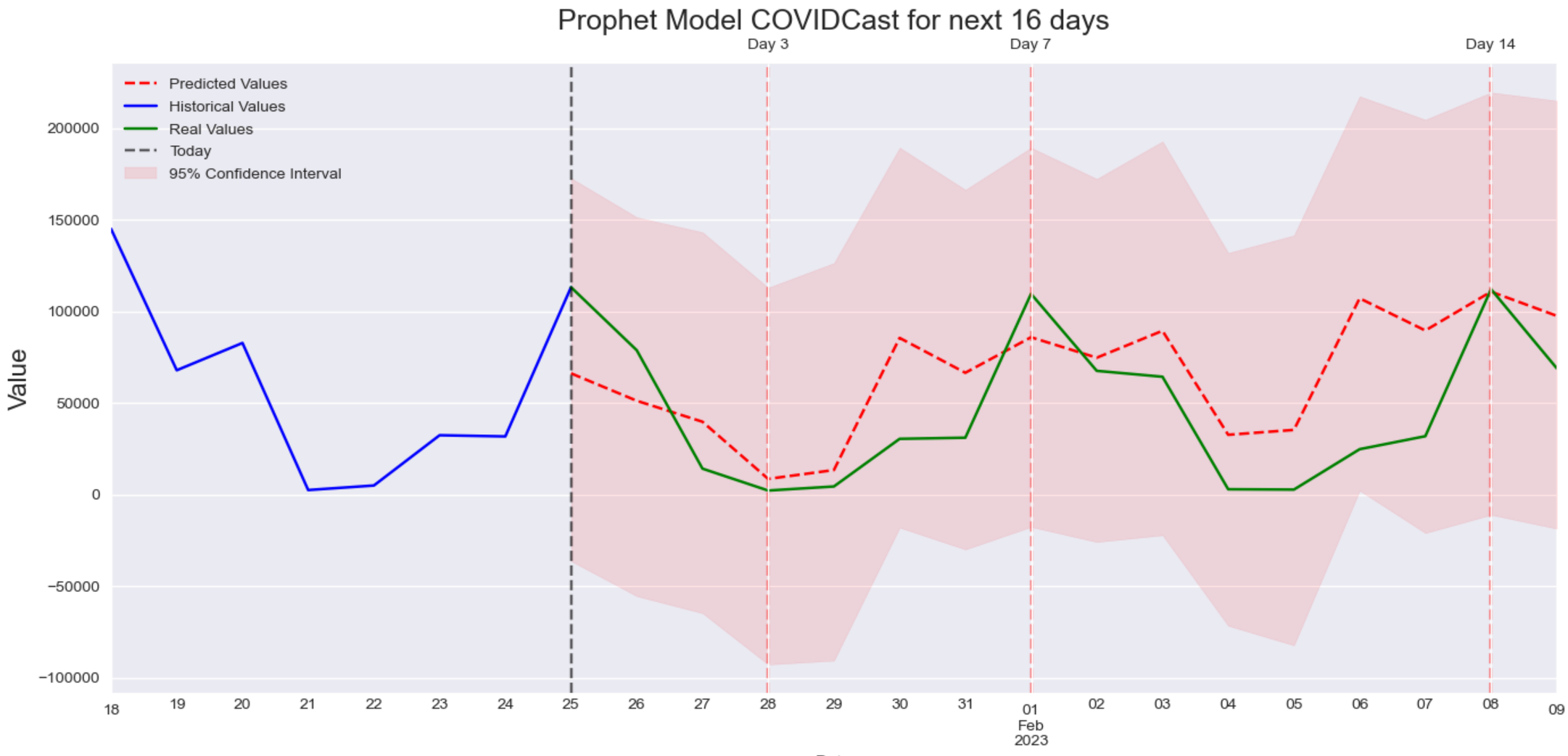
SEASONALITY

- Strong weekly effects

19

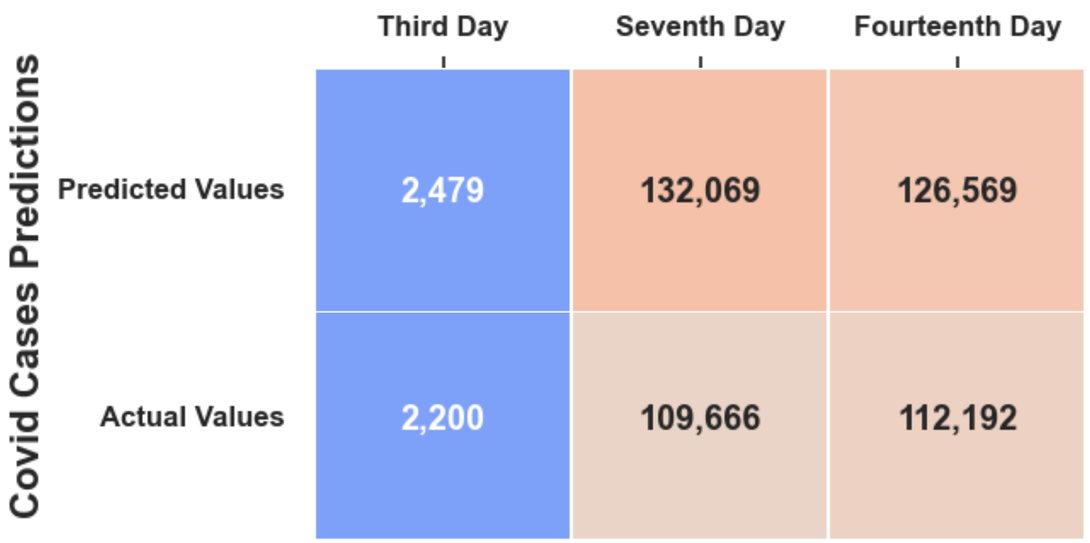
EXOGENOUS VARIABLES

- Hospitalizations, and SIRD parameters



COVID CAST

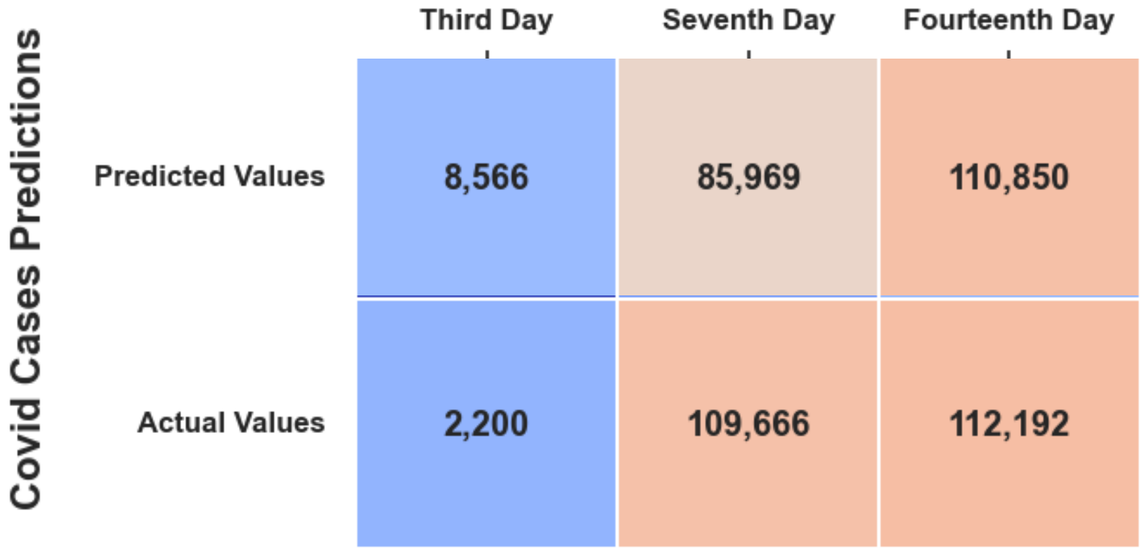
SARIMAX MODEL



Model's Cross Validation Scores over a 14 day Time Horizon

Mean Absolute Error: 38,691 Covid Cases

PROPHET MODEL



Model's Cross Validation Scores over a 14 day Time Horizon

Model Coverage: 75%

Mean Absolute Error: 56,582 Covid Cases

HEAD TO HEAD

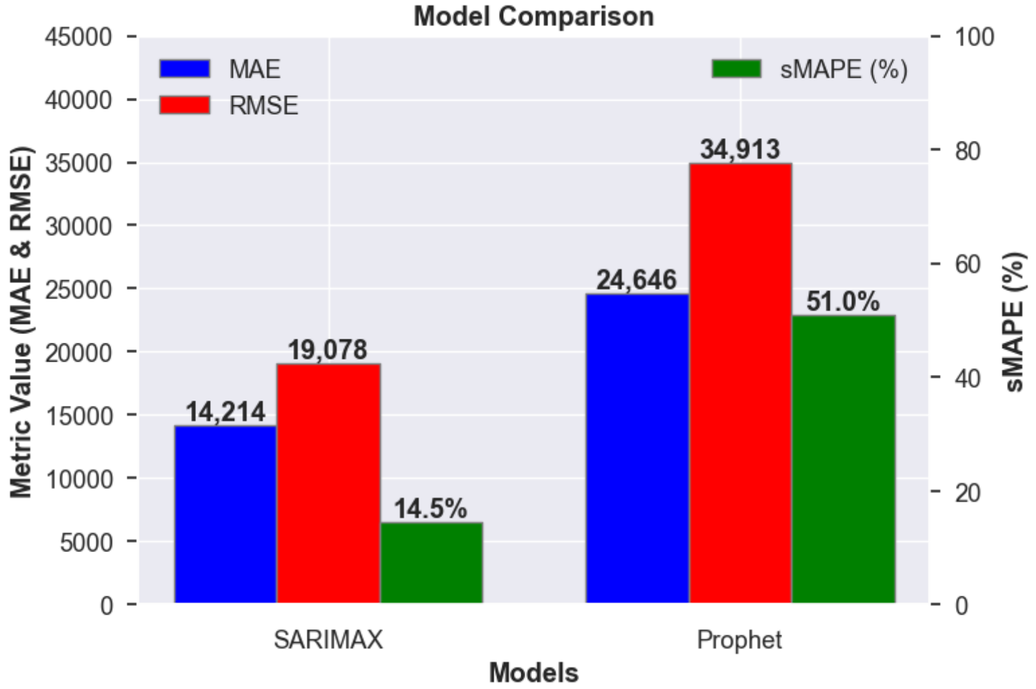
Performance on Unseen Data

SARIMAX

Order: (3, 0, 2)

Season: (2, 1, 1, 7)

Exog: 6



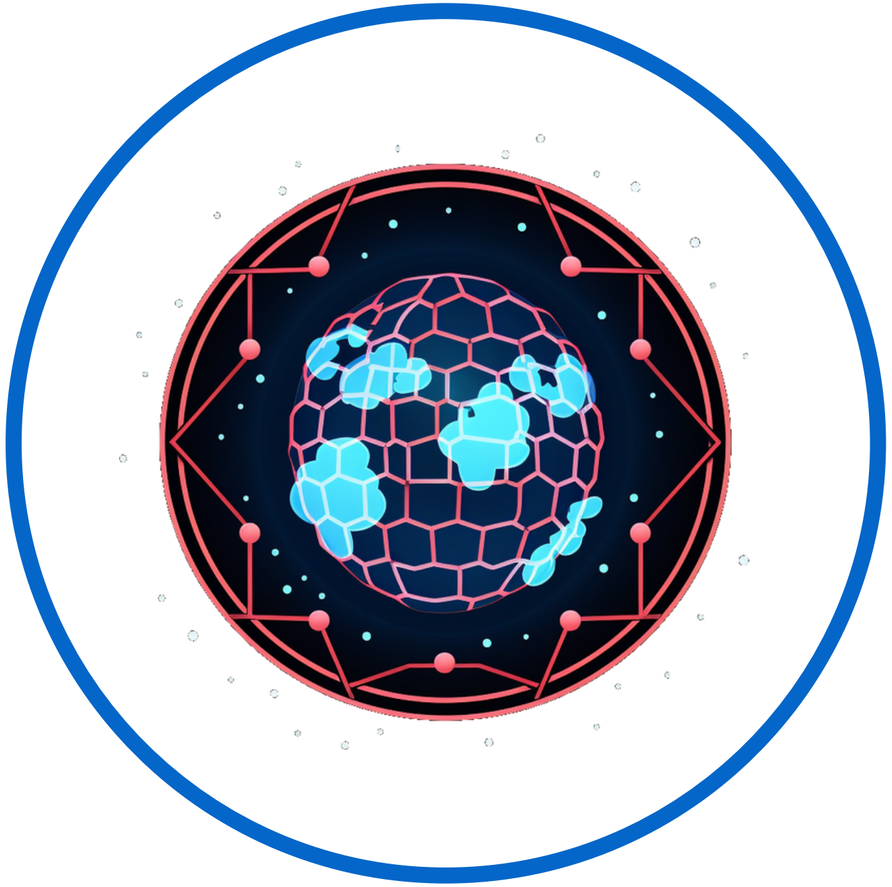
PROPHET

Change Points: 10

Seasonal: 0.1

Exog: 19

Next Steps...



1. DEPLOY
2. CHANGE TARGET VARIABLE
3. RNNS
4. PREDICT TO PROTECT

BRAINSTATION

THANK YOU

REACH OUT TO SAM:

SCELAREK@GMAIL.COM

LINKEDIN.COM/IN/SAM-CELAREK/

GITHUB.COM/SCELAREK