aiHackCovid:

an exploratory ML analysis of Covid-19 epidemiological and socio-political data.

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Team 2 Presentation

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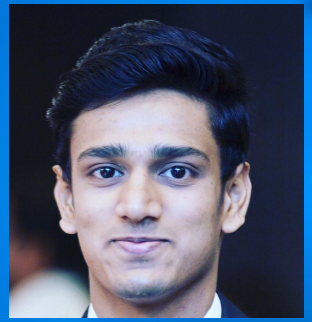

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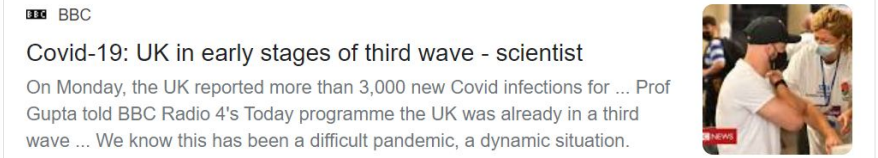
GOALS:

Explore the policies adopted by the different European countries, trying to highlight similarities and patterns among them

Develop a predictive model able to predict the number of deaths on N-days in future



DATA: exploratory analysis

From the **OxCGRT dataset**:

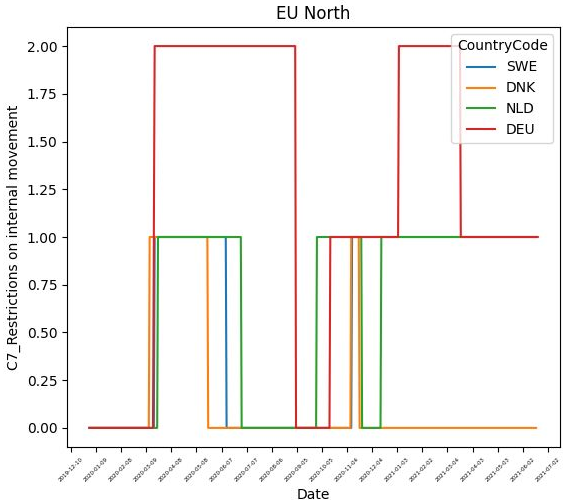
- C2 index (workplace closing)
- C3 index (cancellation of public events)
- C7 index (restrictions on internal movement)

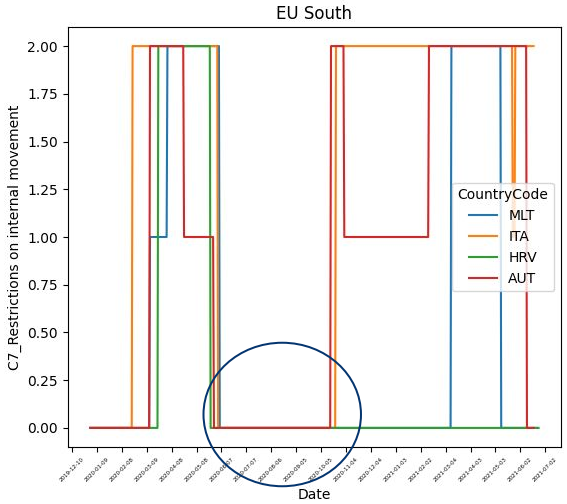
→ To look at how countries have managed choices with an high social impact

- H4 index (emergency investment in healthcare)

→ To look at how countries are providing resources to healthcare

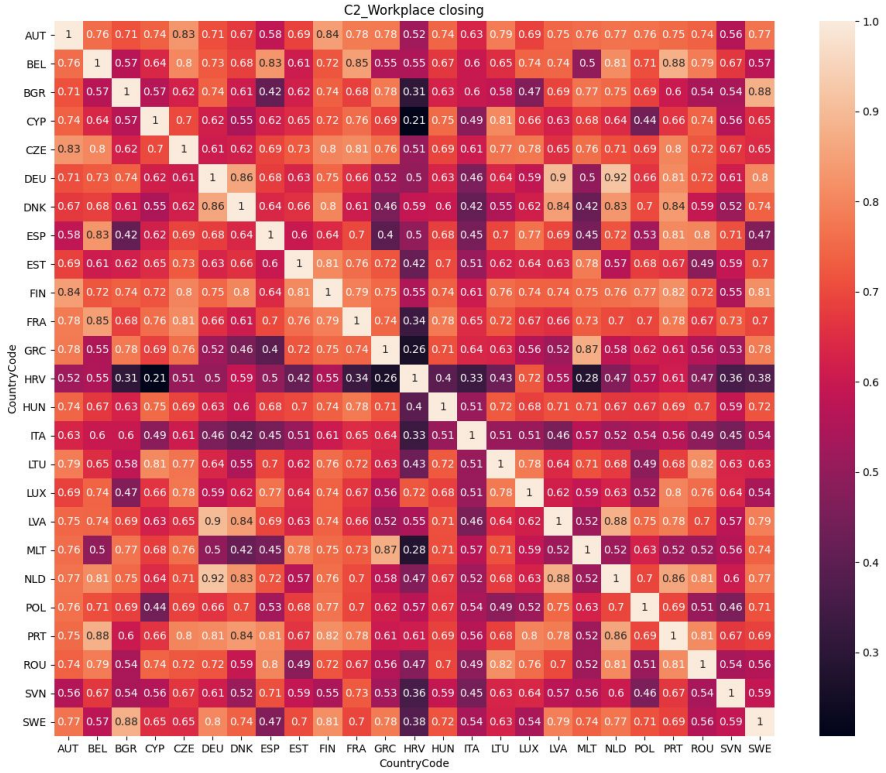
RESULTS: C7 index





- North European countries (excepting for Germany) have not adopted very stringent restrictions on internal movements.
- South European countries have adopted prolonged and maximal level of restrictions, with the exception of summer months.

RESULTS: C2 index

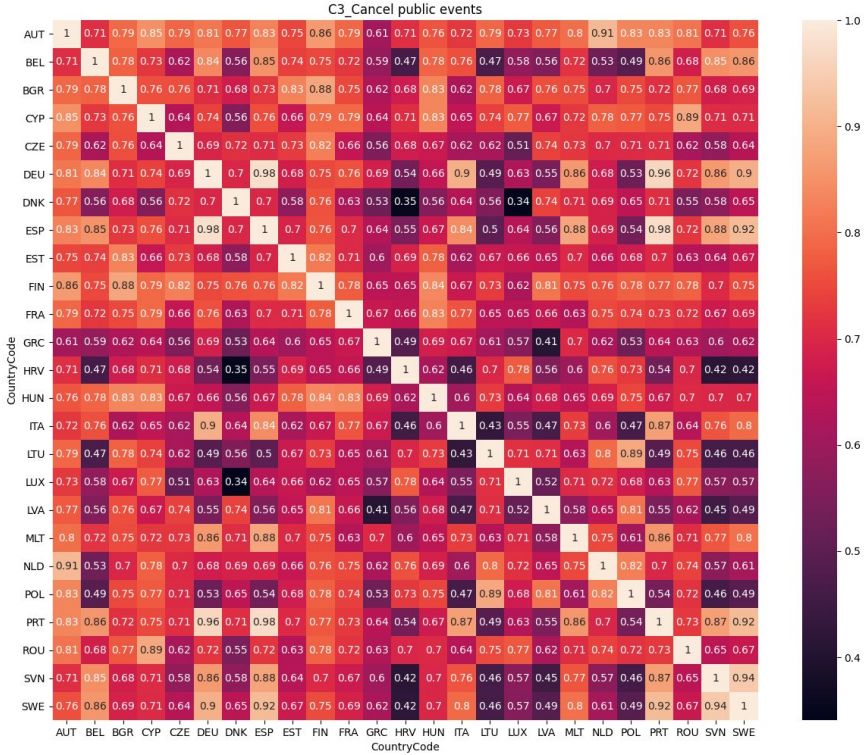


- Strongest and longer lasting workplace closures have been adopted in Germany, Italy, Greece and France.

BUT HOW MUCH ARE THESE MEASURES SIMILAR TO EACH OTHER?

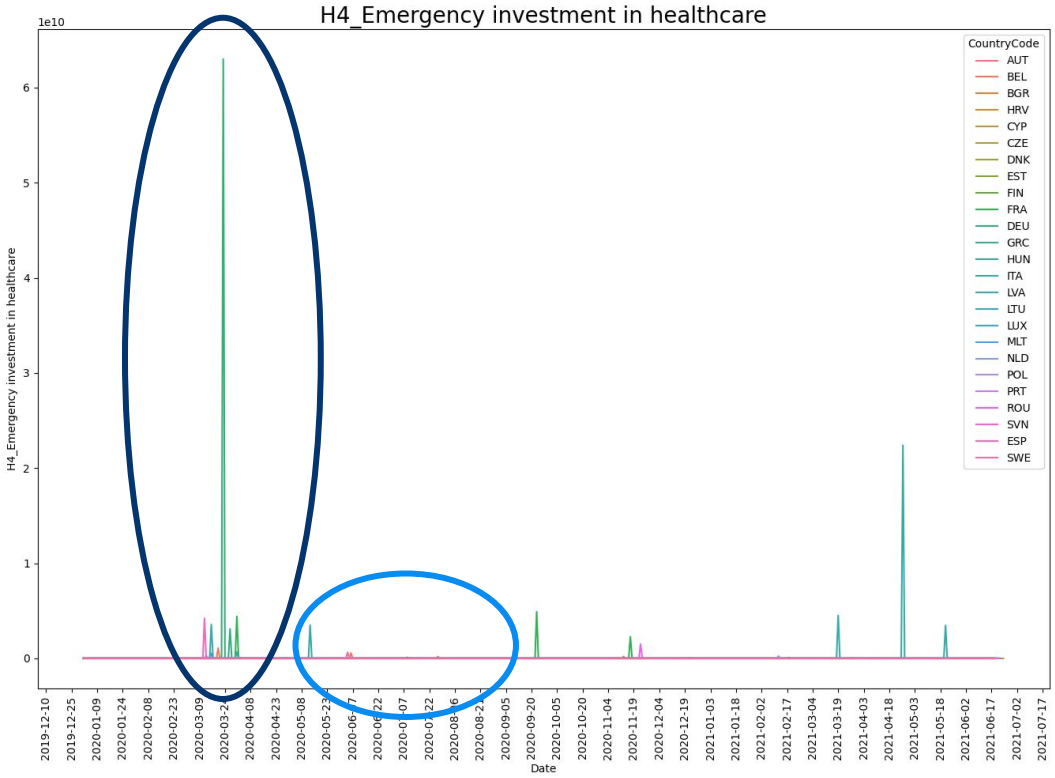
- The strongest correlation is between Netherlands and Germany (0.92). The weakest one is between Croatia and Cyprus (0.21).

RESULTS: C3 index



- Only Netherlands, Croatia and Greece had removed restrictions during the summer months of the last year.
- The majority of the countries maintained cancellation of public events during the whole pandemic period.

RESULTS: H4 index

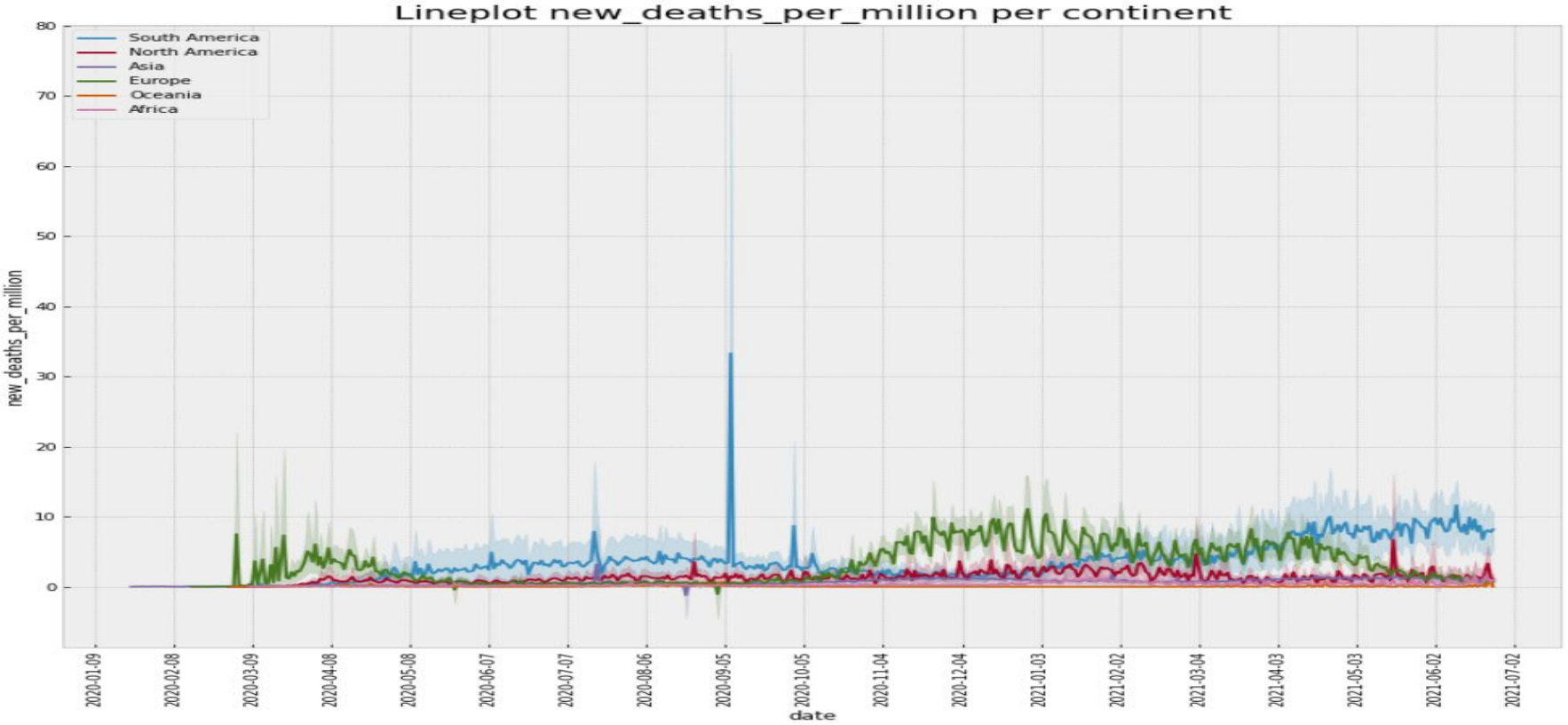


- Not all the countries have done emergency investment in healthcare.
- Higher investments were done during the first pandemic wave.
- During the summer period, when COVID19 cases were decreasing, almost no investment in any country was done.

DATA: predictive model

➢ **Owid Covid-19 dataset**

Observing the global scenario



DATA: predictive model

- **Owid Covid-19 dataset**
- **Predictive model** characterized by:

Inputs variables	
Stringency score	It is the current stringency score.
Vaccination ratio	Total people vaccinated (at least one dose)/Total population in 2020
Reproduction rate	It is the current reproduction rate. If it is <1, the pandemic has subsided towards an endemic.
Positive rate	It is the share of COVID19 that are positive, giving as a rolling 7-day average
Predictable variable:	
N° of deaths per million	

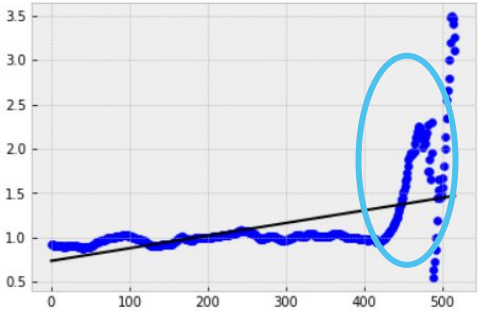
METHODS: preprocessing

1. Problem of **missing data** into the dataset:
   - put equal to the n° of deaths until 22-01-2020
   - put equal to 0 the n° of persons vaccinated before the starting of vaccinations
   - put equal to 0 the positive rate until 01-01-2020

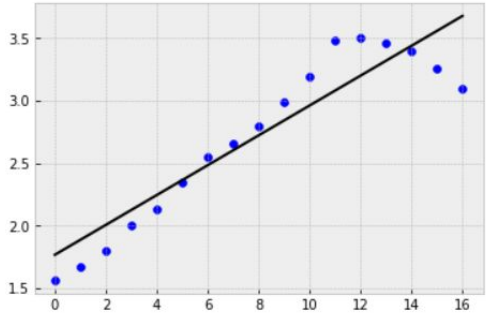
2. **Normalization** of data

3. Handling the **reproduction rate**:

Regression model fit over the entire dataset.



Model Score: 0.32028641382865386



Model Score: 0.9099349772494968

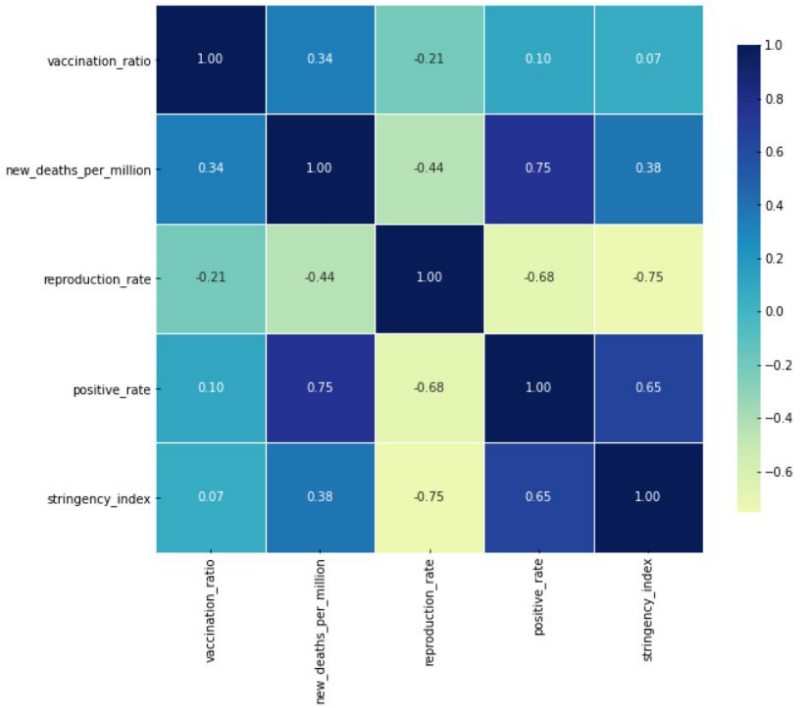
Regression model fit from 500 days back from 23-06-2021.

References to [1], [2], [3].

METHODS: exploratory analysis

Scaled data graph which shows how the different features evolve through time.

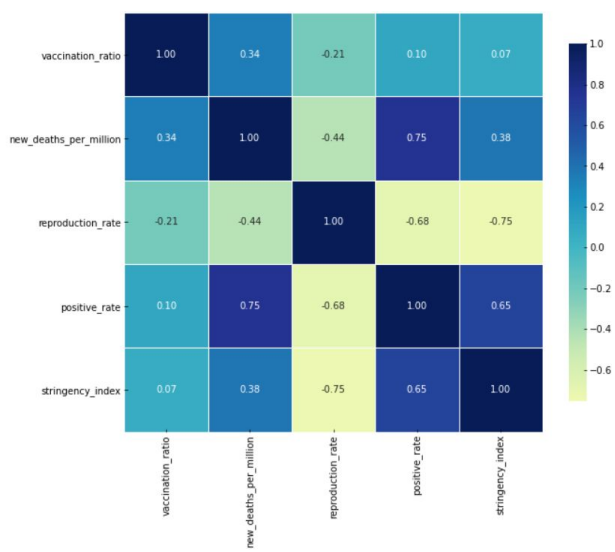
METHODS: exploratory analysis



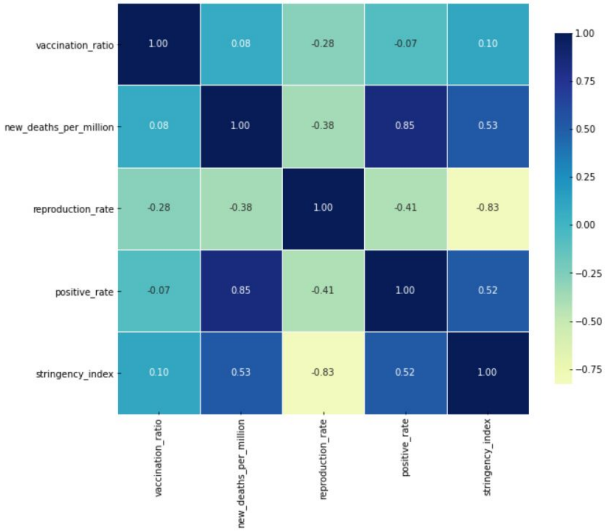
- Strong positive correlation between the positive rate and the new deaths per million (0.75).
- Strong negative correlation between the reproduction rate and the stringency index. (-0.75).
- Strong positive correlation between the stringency index and the positive rate (0.65).
- Strong negative correlation between the reproduction rate and the positive rate (-0.68).

METHODS: exploratory analysis

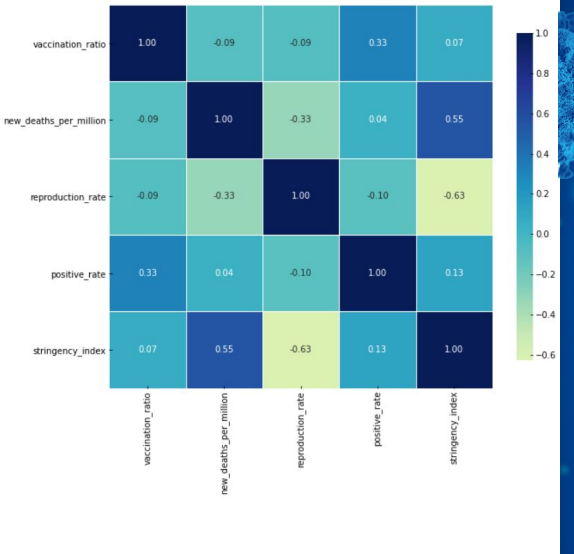
Correlation Matrices



a) Global



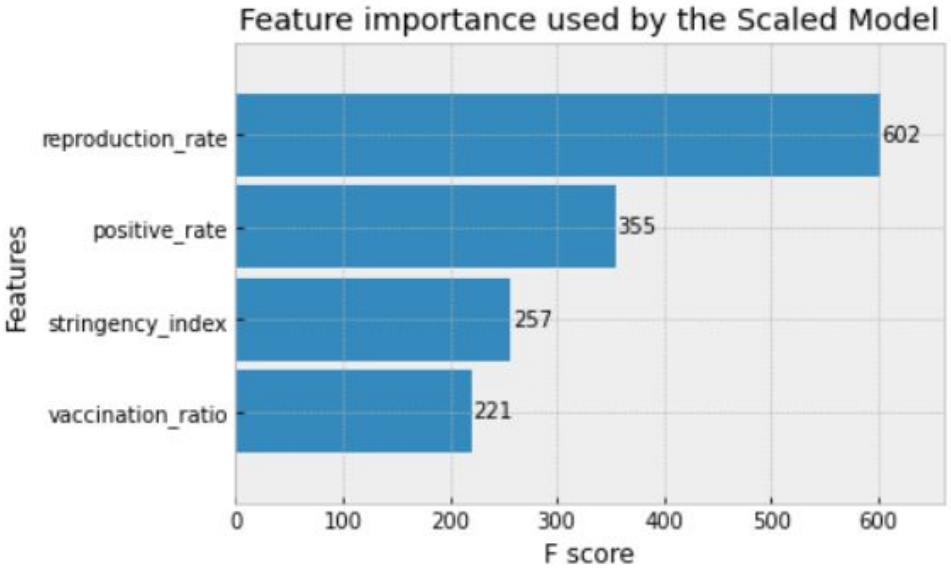
b) EU



c) NL

RESULTS: predictive model

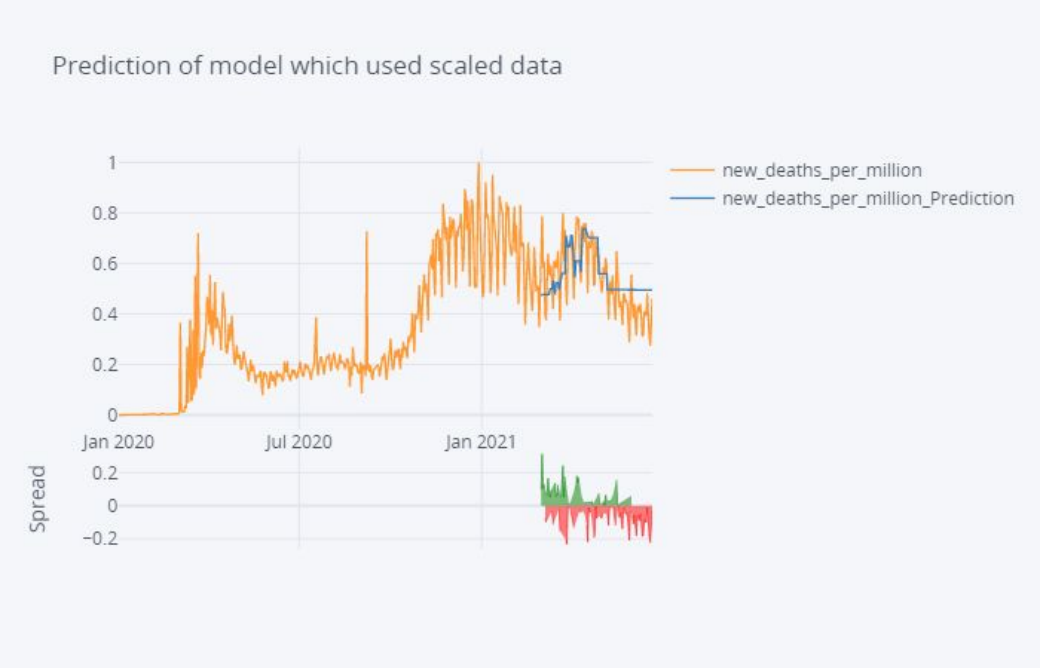
We use the XGBOOST tree based regressor model for predictions



The **reproduction rate** plays a significant role in determining the number of new deaths per million.

THIS CAN'T BE APPRECIATED BY SIMPLY LOOKING AT THE DATA!

RESULTS: predictive model



Global

METHODS: Synthetic data projection

Vaccination ratio: Approach- linear regression model.

Reason - This has to keep increasing because of all the vaccination drives happening in the world. So the max value for vaccination ratio is 1

Stringency index: Approach - ARIMA / linear regression model

Reason - This can be projected using a regression model as we see that it keeps decreasing gradually over a period of time.

positive rate: Approach - ARIMA / RNN model

Reason - This has got the second highest F-score on the XGboost model and having a good estimate at future point of time(synthetic data) will directly impact our prediction on that future date

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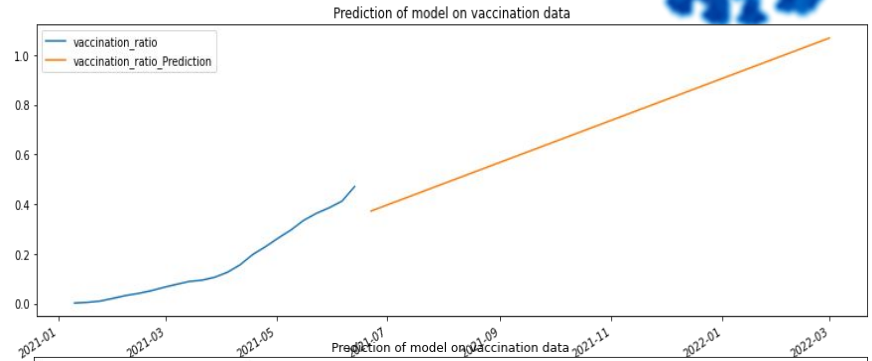
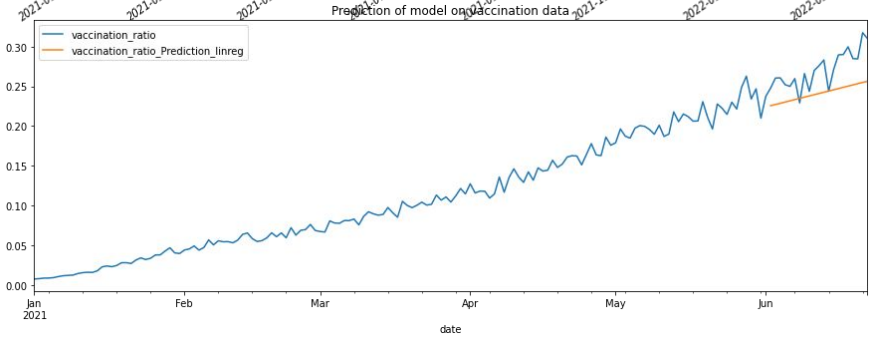
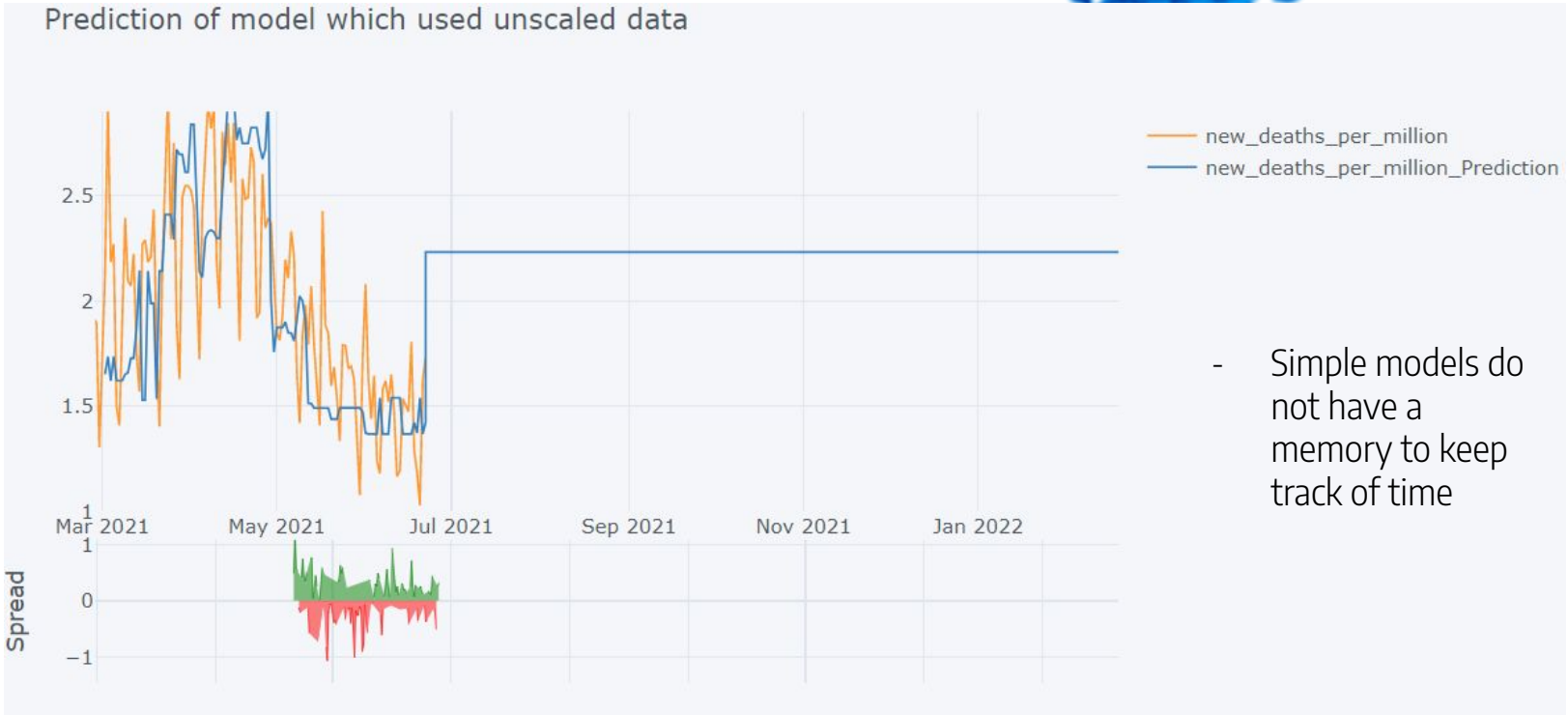
Projection for NL



Projection Globally



RESULTS: Synthetic data projection



- Simple models do not have a memory to keep track of time

What did not work!

- XGBOOST model gave us a baseline inference, now we can focus on more memory based architectures for predicting new_deaths_per_million
- LSTM network captures the data trend for a 30 day window, still for larger time windows the predictions are off.

WHAT'S NEXT?

- Explore, quantitatively, the way the different policies adopted by the different countries have influenced over the spread of COVID 19 and over the deaths, with the aim to define the most **efficient strategy**.

- Refine the regression model when data about **vaccination effectiveness** in the population.

- Try better models for the projection.

REFERENCES:

[1] Wu, J.T., Leung, K., Bushman, M., Kishore, N., Niehus, R., de Salazar, P.M., Cowling, B.J., Lipsitch, M., Leung, G.M.: Estimating clinical severity of COVID-19 from the transmission dynamics in Wuhan, China. Nat. Med. 26, 1–5 (2020) (https://www-nature-com.proxy-ub.rug.nl/articles/s41591-020-0822-7)

[2] Lai, C.C., Shih, T.P., Ko, W.C., Tang, H.J., Hsueh, P.R.: Severe acute respiratory syndrome coronavirus 2 (SARSCoV-2) and corona virus disease-2019 (COVID-19): the epidemic and the challenges. Int. J. Antimicrob. Agents 55(3), 105924 (2020) (https://pubmed.ncbi.nlm.nih.gov/32081636/)

[3] . Liu, Y., Gayle, A.A., Wilder-Smith, A., Rocklöv, J.: The reproductive number of COVID-19 is higher compared to SARS coronavirus. J. Travel Med. 27(2), 1 (2020) (https://pubmed.ncbi.nlm.nih.gov/32052846/)

Thanks for your kind attention!

Any questions?

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