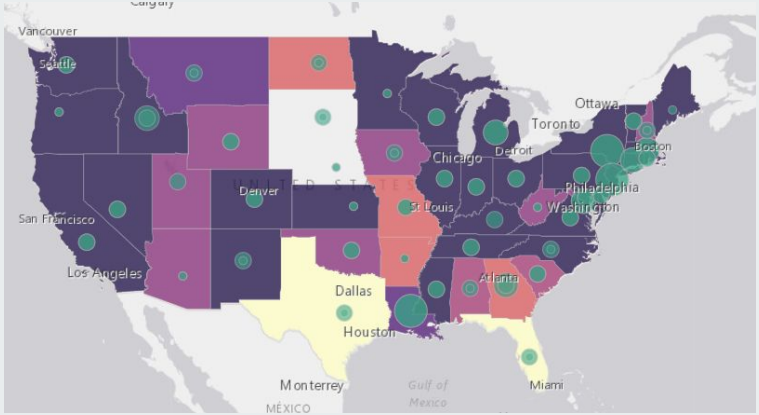
PHIGHT COVID

Help better understand and model the changes in the number of covid cases over time and the associated public health interventions



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Data Overview

- The dataset comes from **Center for Systems Science and Engineering (CSSE) at Johns Hopkins University + State/County public health websites**
- It contains data spanning from January to November 2020
- We are looking at the following variables:
  - States/Counties
  - Dates
  - Cumulative Confirmed Cases
  - Governor issued Public Health Intervention Executive Orders

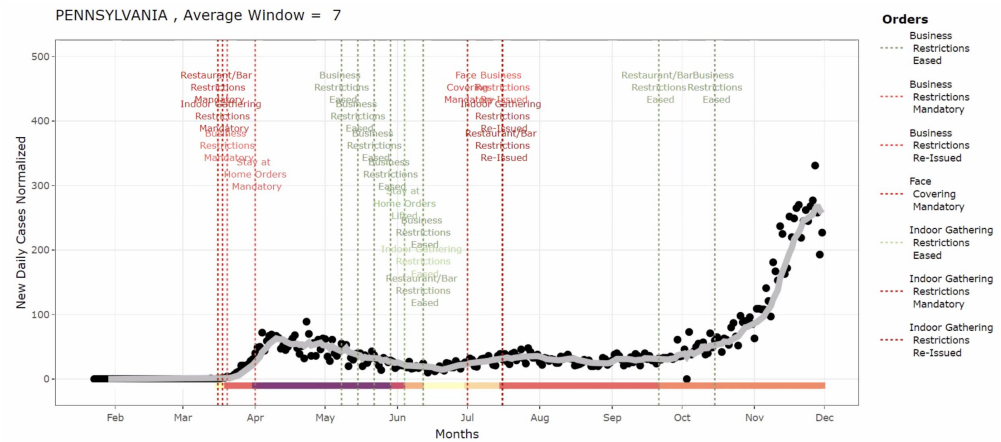
What did we add?

- **New Confirmed Cases**
  Cumulative Confirmed Cases (Today) - Cumulative Confirmed Cases (Yesterday)
- **New Confirmed Cases Normalized per 500,000**
  *New Confirmed Cases / State Population * 500,000*
- **Event Categorization**
  - Category 1: Stay at home order
  - Category 2: Non-essential business closures
  - Category 3: Indoor large gathering bans
  - Category 4: Restaurant and bar limitations/restrictions
  - Category 15: Mandatory Mask/Face Cover Order

What did we add?

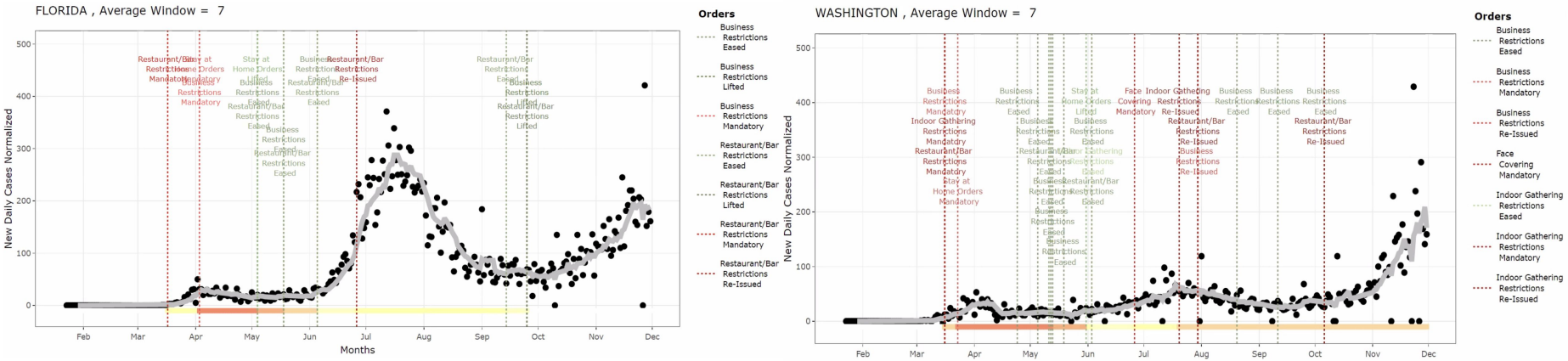
- **Scores (from 0 - 5.0)**
  - *Measures the level of strictness for public health intervention*
  - *Higher the score more restrictions and darkers color*
  - *We have a rubric on how to assign scores*
    - *For Example:*
      - *Issuing: Restaurant and bar limitations/restrictions +1.00*
      - *Easing: Restaurant: outside only dining with size limits -0.05*

Easing in Restrictions Followed by Increase in Cases

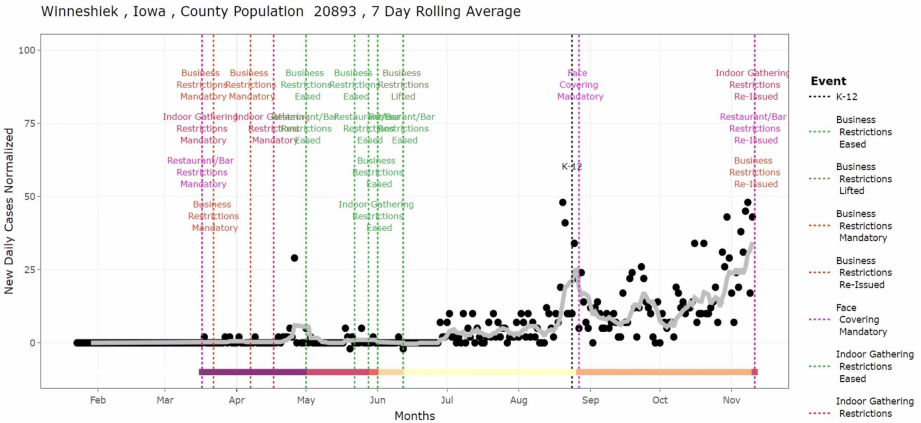


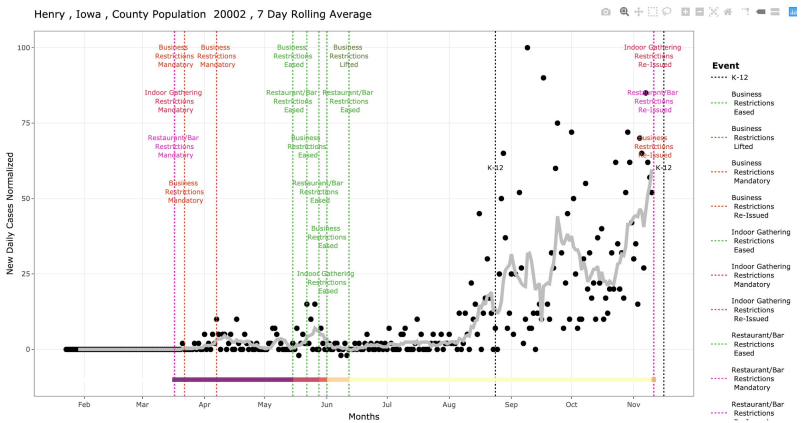
- Average Window:
  - Rolling average of cases among 7 days
- Text and Dotted Line Color
  - Red represents tightening of restrictions
  - Green represents easing of restrictions
- Score Bar: Darker color higher scores

States with Tighter Restrictions Have More Cases Under Control

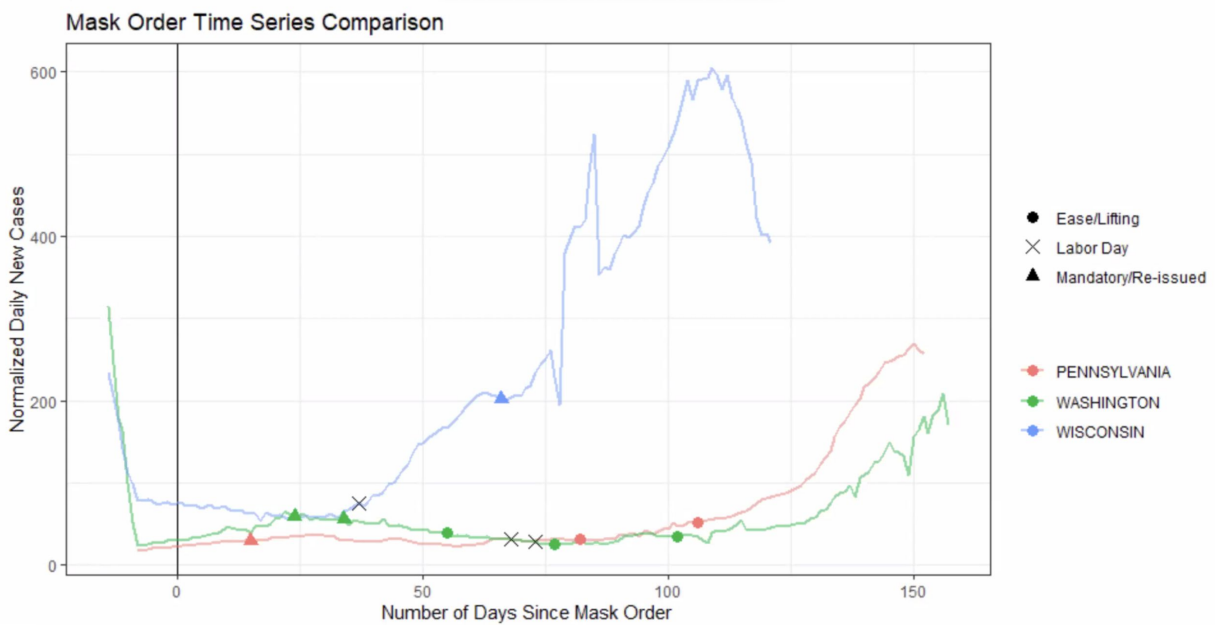


Decrease in Cases Followed By Mask Restrictions

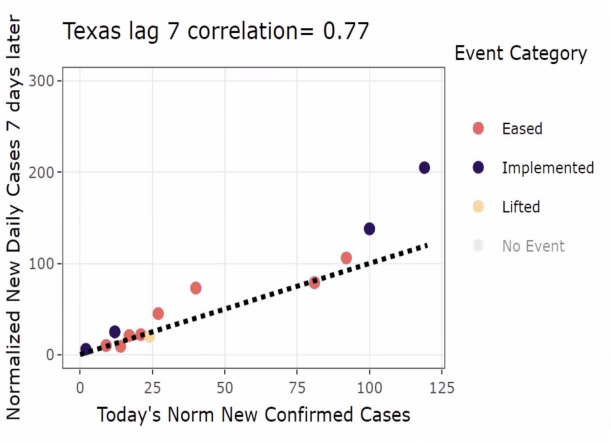


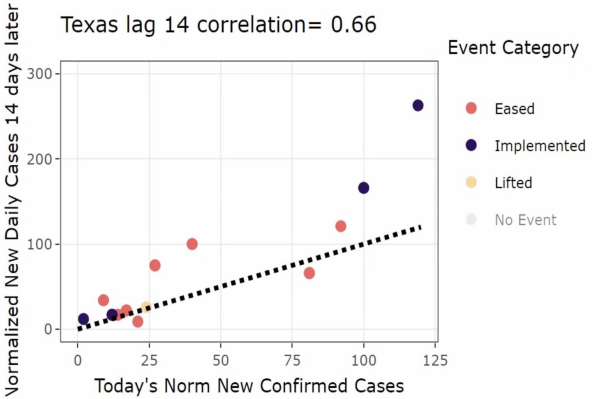


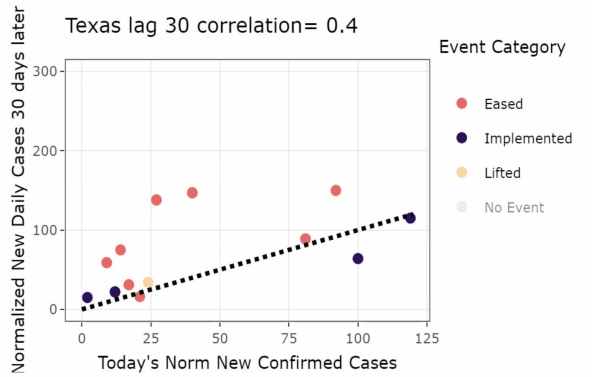
It Takes a While to See the Impact of Restrictions



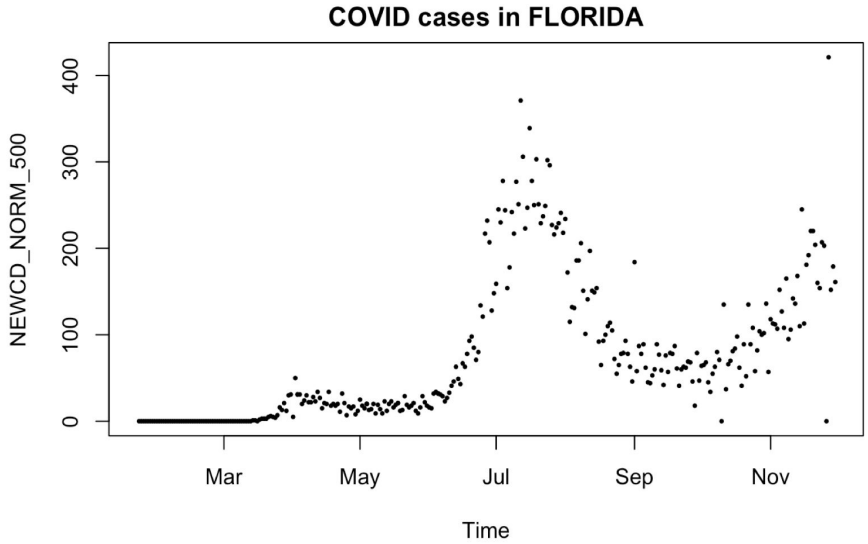
It Can Take up to 30 Days







Motivation: Model the underlying relationship/function of cases over time



Smoothing splines

$$\sum_{i=1}^{n}(y_i - f(x_i))^2 + \lambda \int f''(t)^2 dt$$

Goal: Minimize the mean squared error + estimate the penalization term lambda

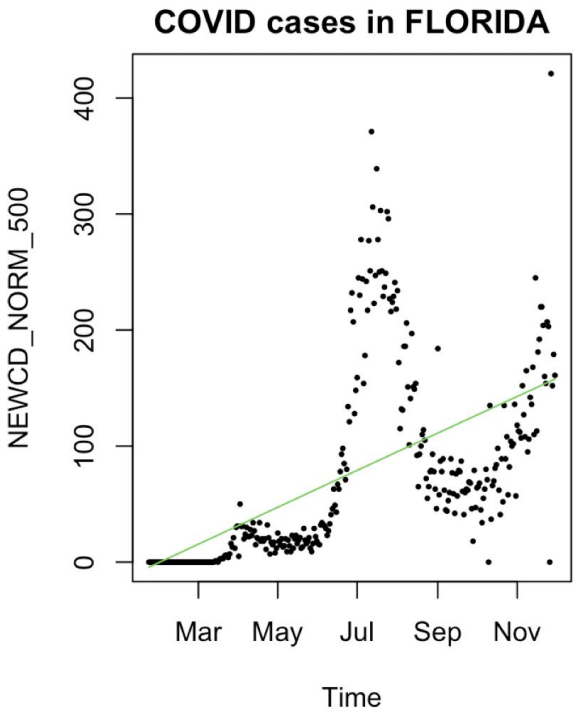
y = Number of (normalized) new cases, x = Time, integral over entire time domain

Low lambda: Overfitting and wiggly High lambda: More linear

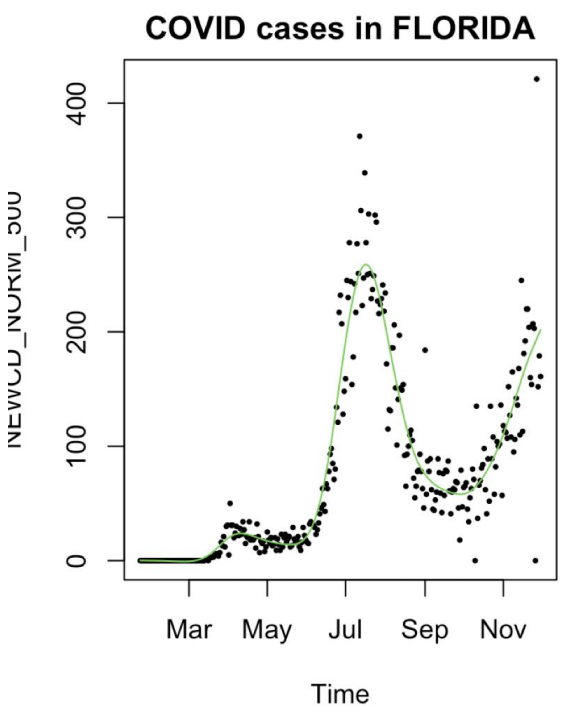
Degrees of freedom is roughly inversely proportional to lambda

Higher DF -> Lower Lambda -> Less linear, more wigglier

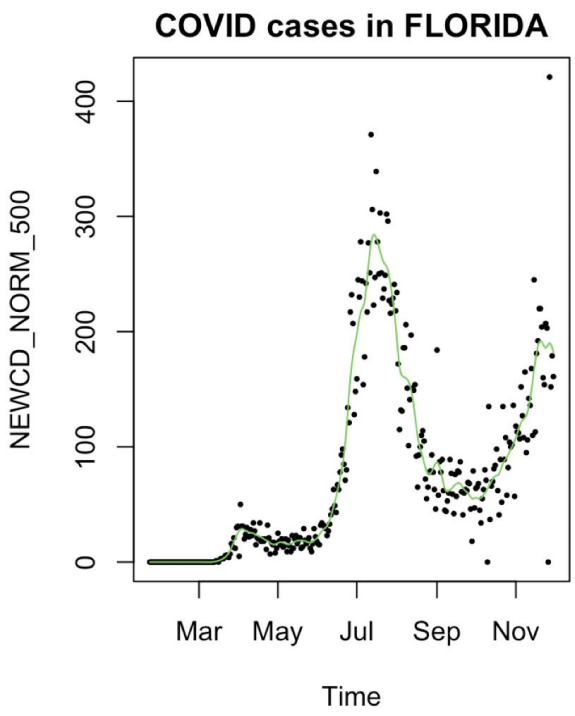
df = 2



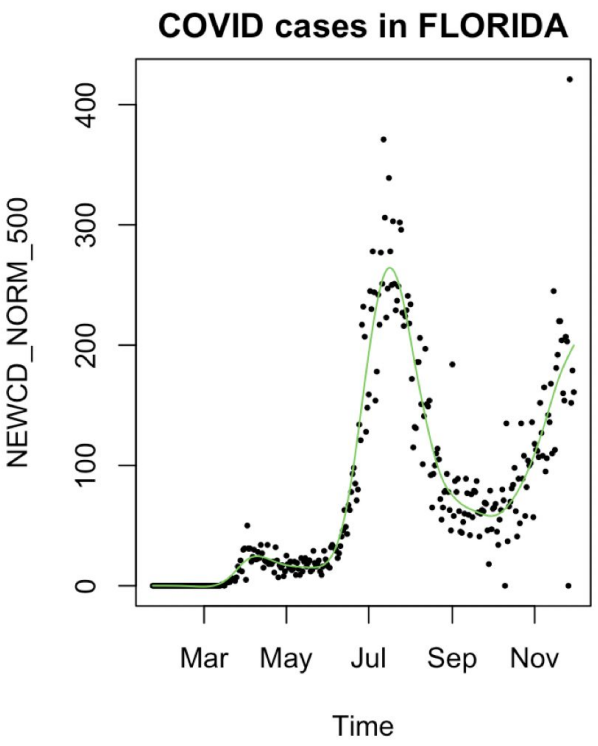
df = 15

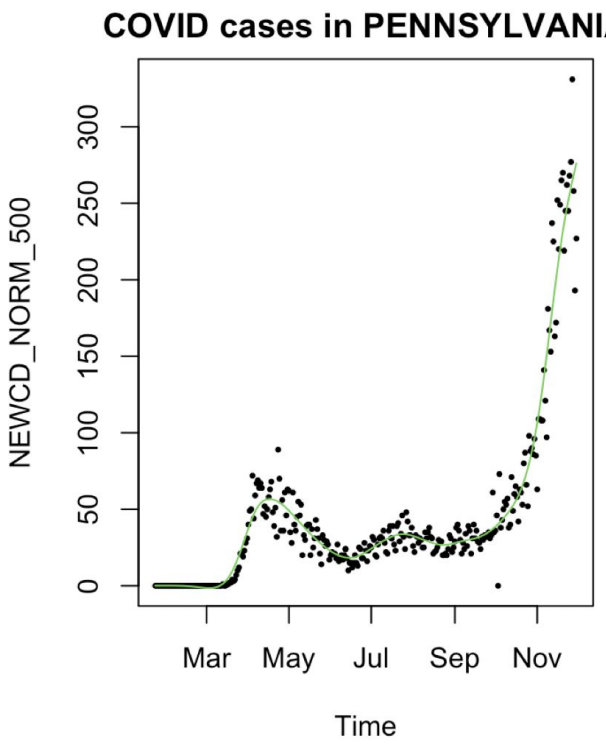


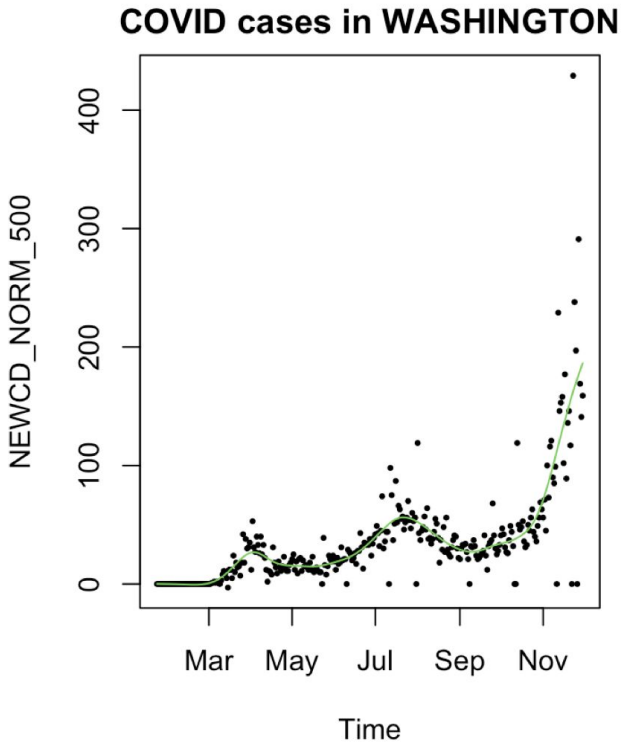
df = 50



Optimal: df=18 df=30 df=11







Future Work

- Model time series with ARMA (Autoregressive Moving Average) models
  - Incorporating multiple variables
- Update and combine new county data
- Compare effectiveness of different public health interventions statistically
- Design and Integrate UI with Shiny library
- Explore causal relationships among the variables(E.g. Deaths and scores)

Acknowledgement

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Prof. Rebecca Nugent, Dr. Seema Lakdawala

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