Exploration of COVID-19 tracking data from multiple resources

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Contents

Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by a new type of coronavirus: severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The outbreak first started in Wuhan, China in December 2019. The first kown case of COVID-19 in the U.S. was confirmed on January 20, 2020, in a 35-year-old man who teturned to Washington State on January 15 after traveling to Wuhan. Starting around the end of Feburary, evidence emerge for community spread in the US.

We, as all of us, are indebted to the heros who fight COVID-19 across the whole world in different ways. For this data exploration, I am grateful to many data science groups who have collected detailed COVID-19 outbreak data, including the number of tests, confirmed cases, and deaths, across countries/regions, states/provnices (administrative division level 1, or admin1), and counties (admin2). Specifically, I used the data from these three resources:

- JHU (https://coronavirus.jhu.edu/)
  - The Center for Systems Science and Engineering (CSSE) at John Hopkins University.
  - World-wide counts of coronavirus cases, deaths, and recovered ones.
  - https://github.com/CSSEGISandData/COVID-19
- NY Times (https://www.nytimes.com/interactive/2020/us/coronavirus-us-cases.html)
  - The New York Times
  - "cumulative counts of coronavirus cases in the United States, at the state and county level, over time"
  - https://github.com/nytimes/covid-19-data

- COVID Trackng (https://covidtracking.com/)
  - COVID Tracking Project
  - "collects information from 50 US states, the District of Columbia, and 5 other US territories to provide the most comprehensive testing data"
  - https://github.com/COVID19Tracking/covid-tracking-data

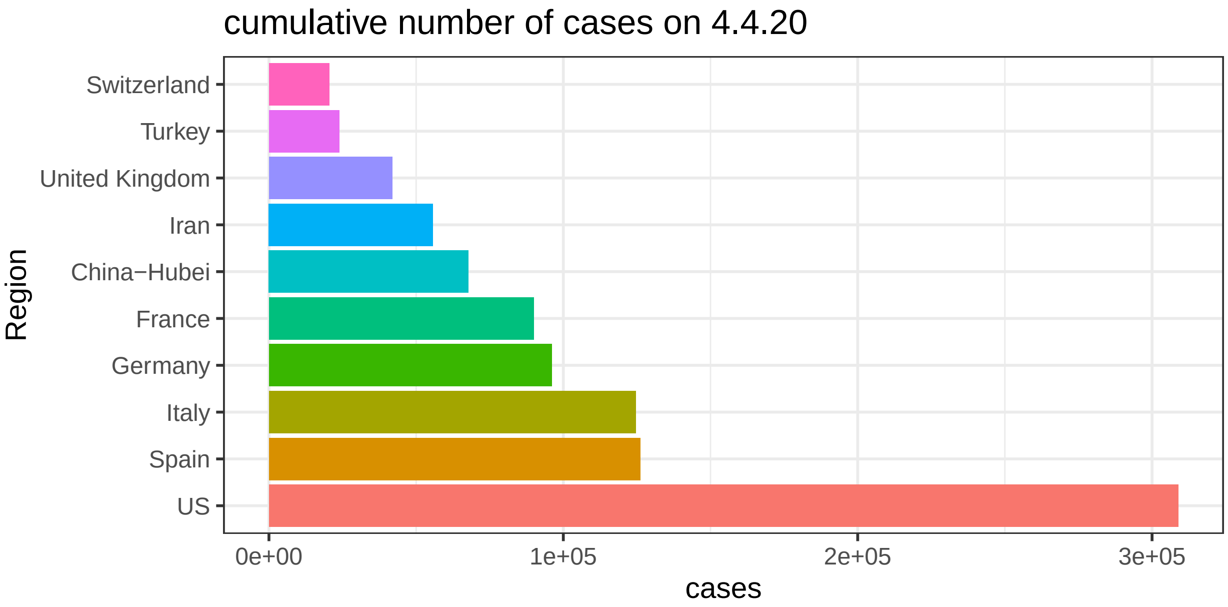
JHU

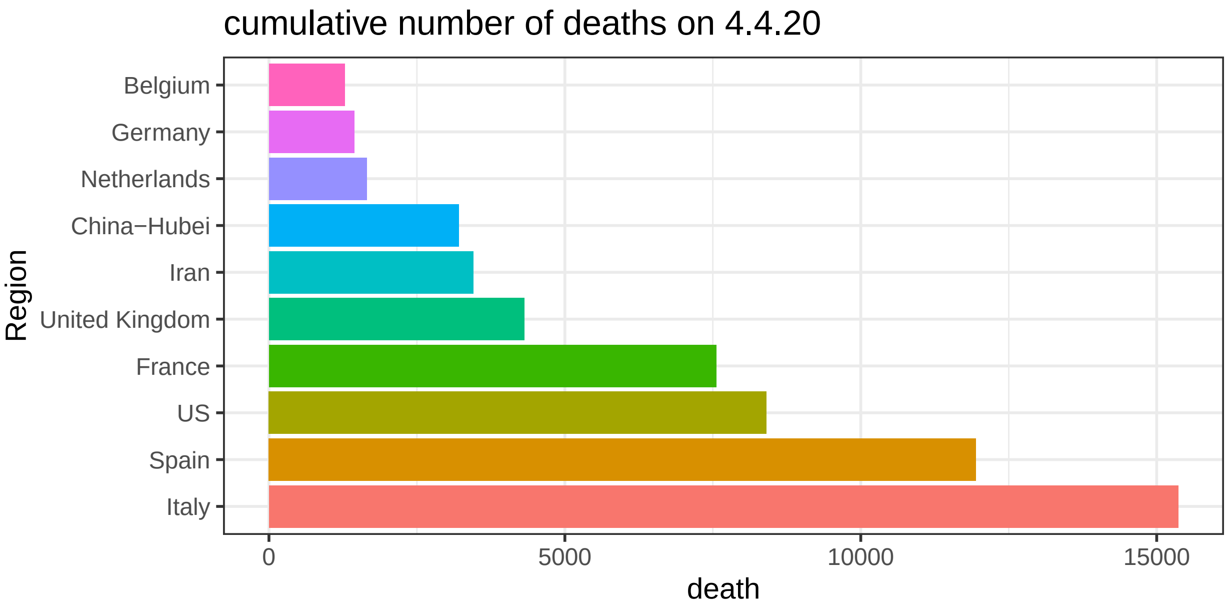
Assume you have cloned the JHU Github repository on your local machine at "../COVID-19".

time series data

The time series provide counts (e.g., confirmed cases, deaths) starting from Jan 22nd, 2020 for 253 locations. Currently there is no data of individual US state in these time series data files.

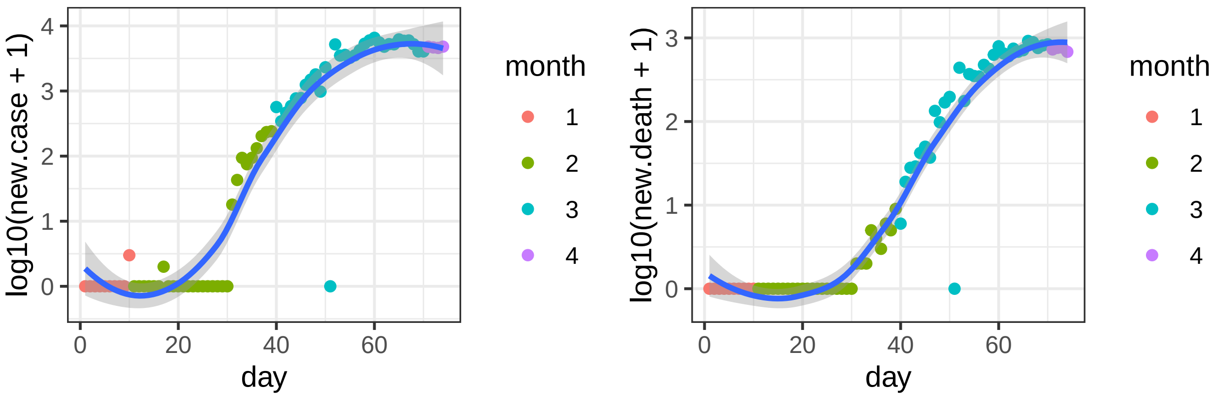
Here is the list of 10 records with the largest number of cases or deaths on the most recent date.





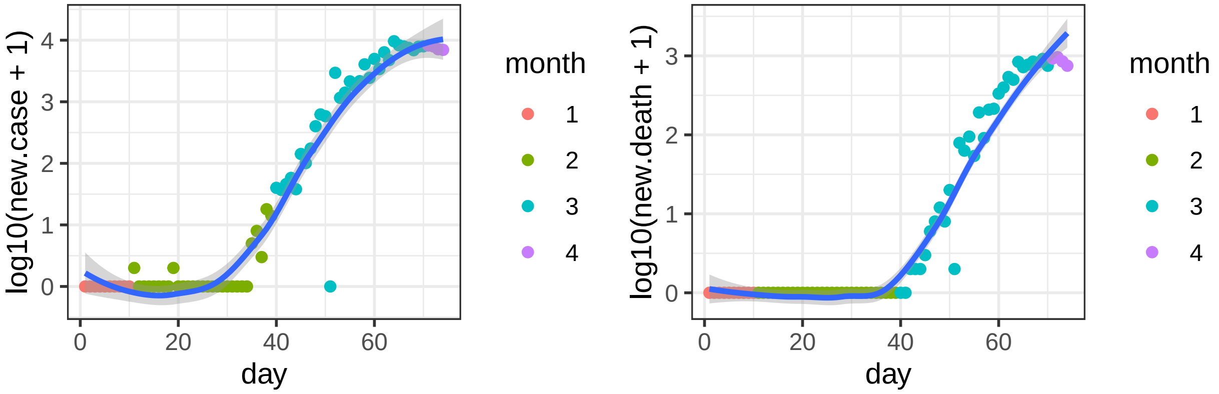
Next, I check for each country/region, what is the number of new cases/deaths? This data is important to understand what is the trend under different situations, e.g., population density, social distance policies etc. Here I checked the top 10 countries/regions with the highest number of deaths.

Italy



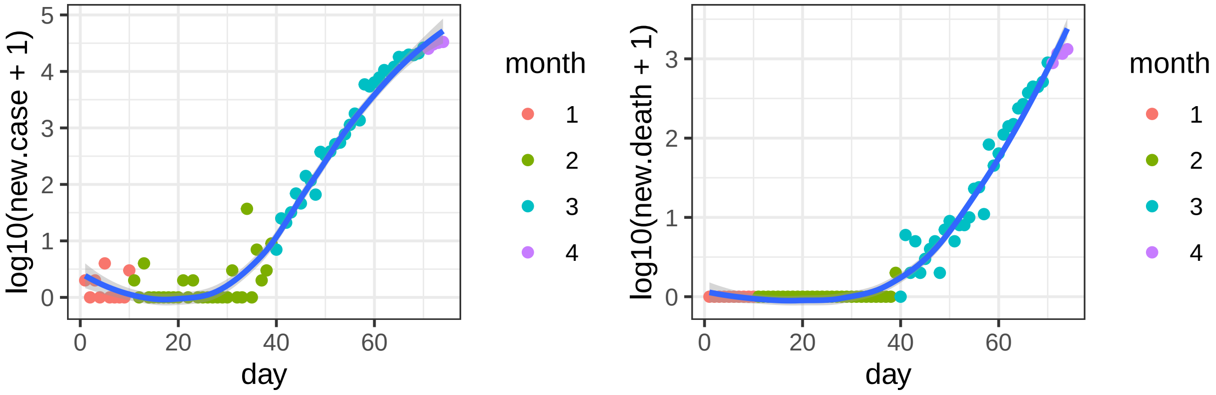
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Spain



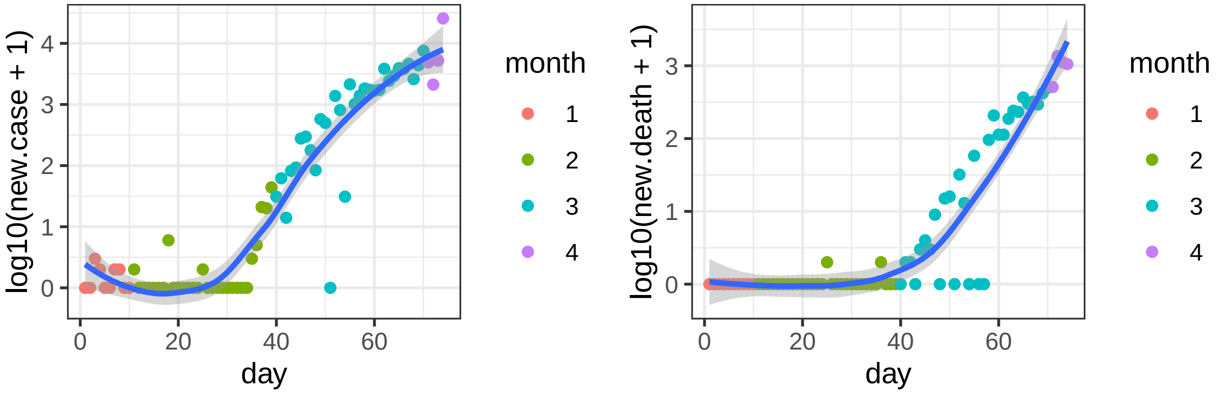
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

US



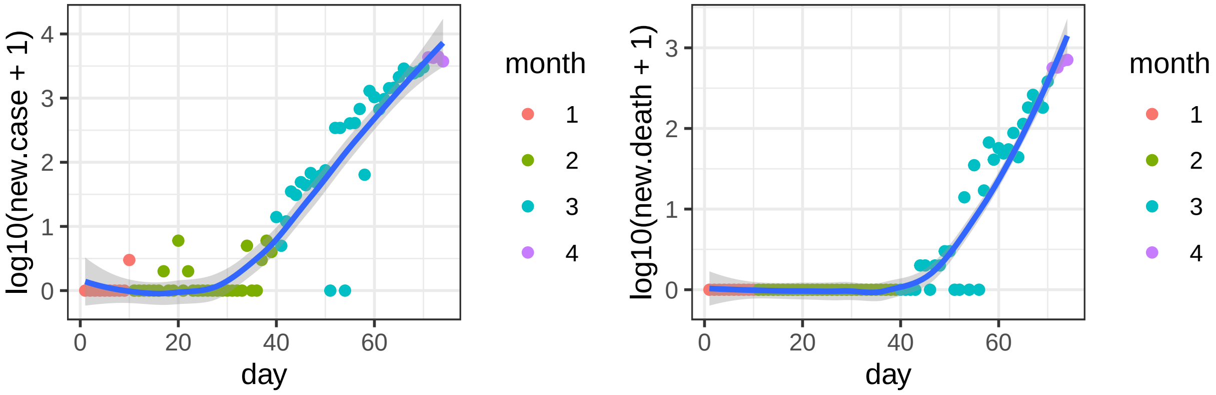
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

France



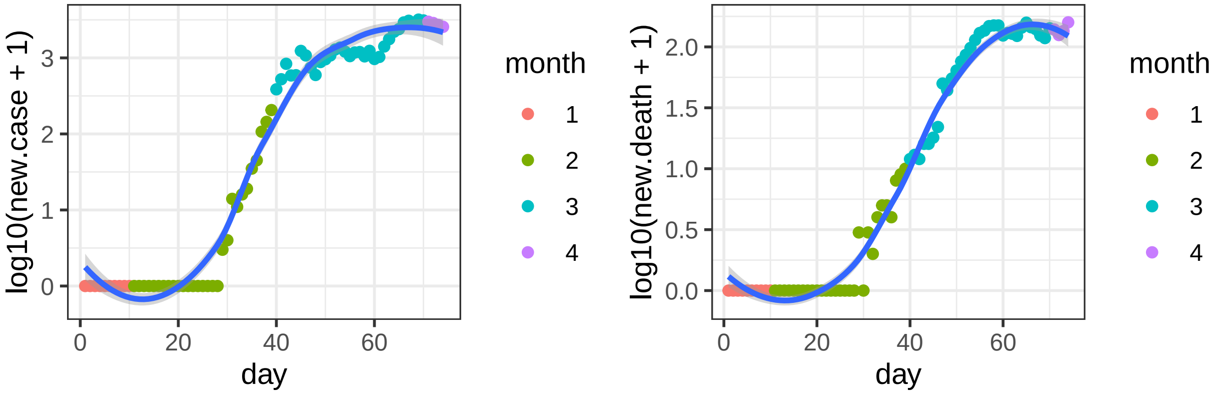
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

United Kingdom



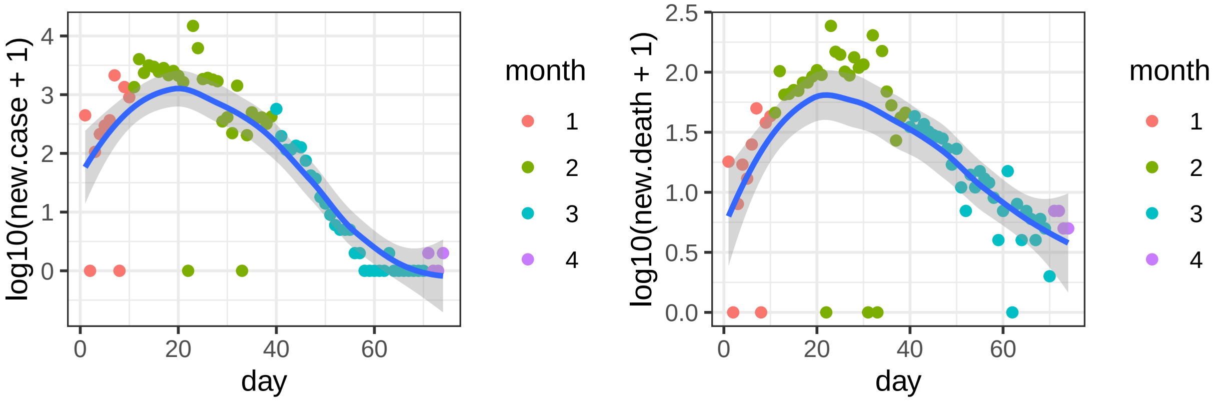
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Iran



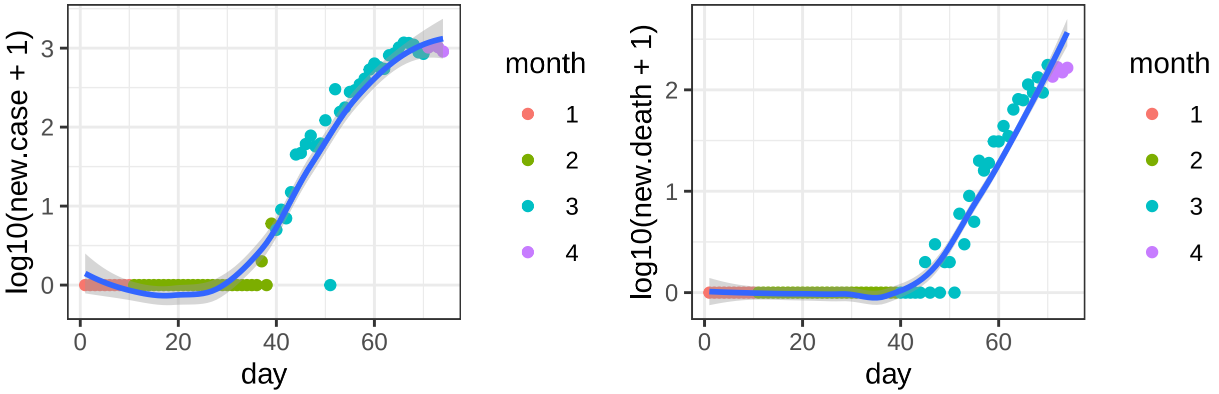
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

China−Hubei



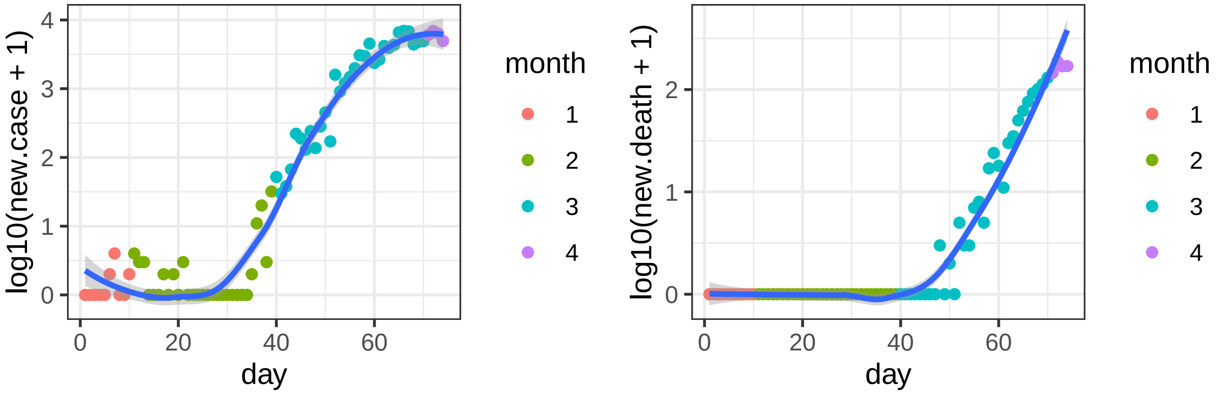
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Netherlands



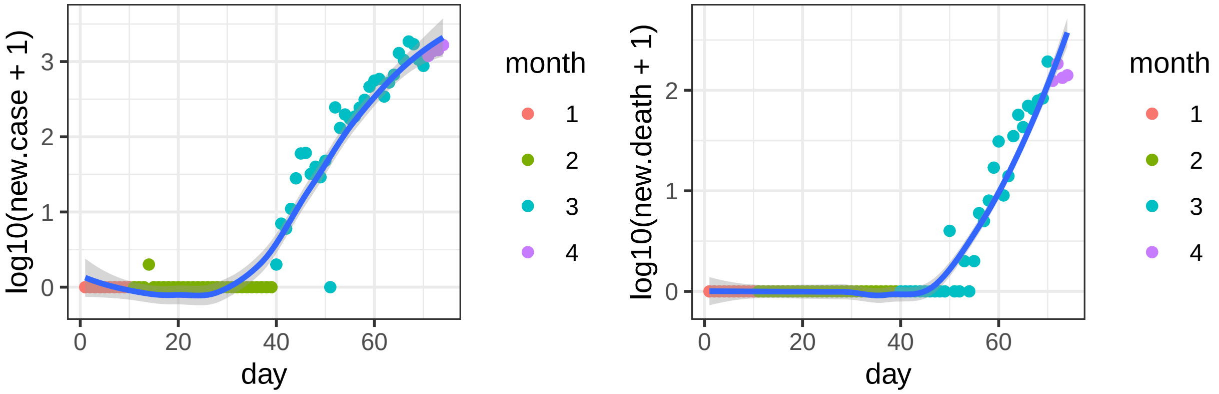
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Germany



data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Belgium

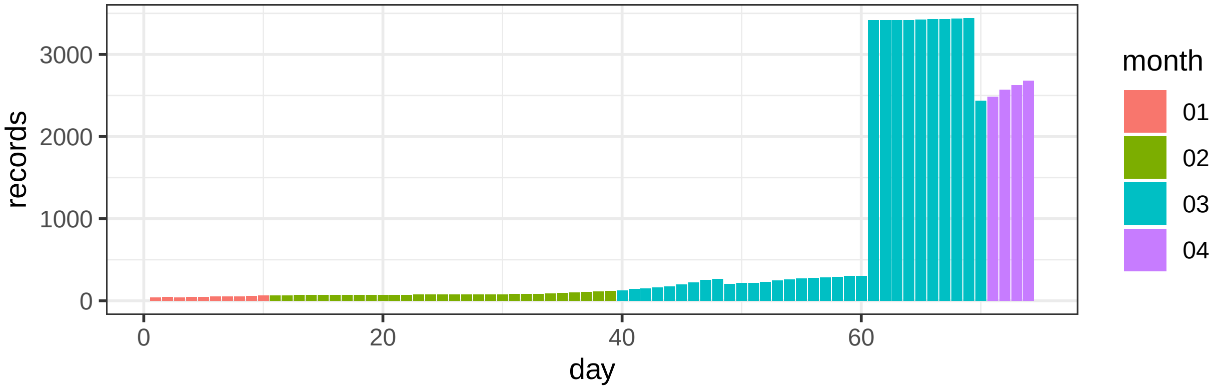


data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

daily reports data

The raw data from Hopkins are in the format of daily reports with one file per day. More recent files (since March 22nd) inlcude information from individual states of US or individual counties, as shown in the following figure. So I turn to NY Times data for informatoin of individual states or counties.

number of records in Hopkins daily reports



data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

NY Times

The data from NY Times are saved in two text files, one for state level information and the other one for county level information.

The currente date is

```
## [1] "2020-04-03"
```

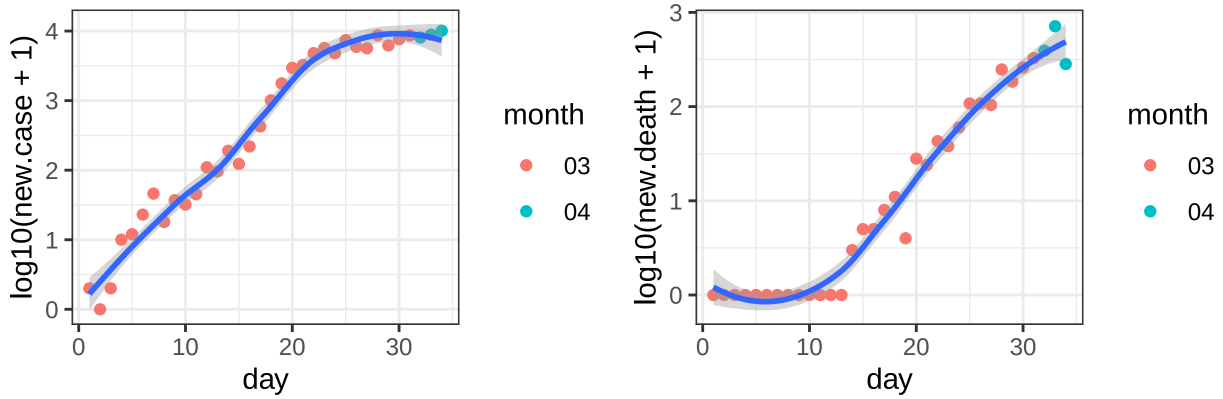
state level data

First check the 10 states with the largest number of deaths.

```
##            date         state fips  cases deaths
## 1753 2020-04-03      New York   36 102870   2935
## 1751 2020-04-03    New Jersey   34  29895    647
## 1743 2020-04-03      Michigan   26  12670    478
## 1739 2020-04-03     Louisiana   22  10297    370
## 1771 2020-04-03    Washington   53   6966    293
## 1724 2020-04-03    California    6  12569    282
## 1734 2020-04-03      Illinois   17   8904    211
## 1730 2020-04-03       Georgia   13   5967    198
## 1742 2020-04-03 Massachusetts   25  10402    192
## 1729 2020-04-03       Florida   12  10260    169
```

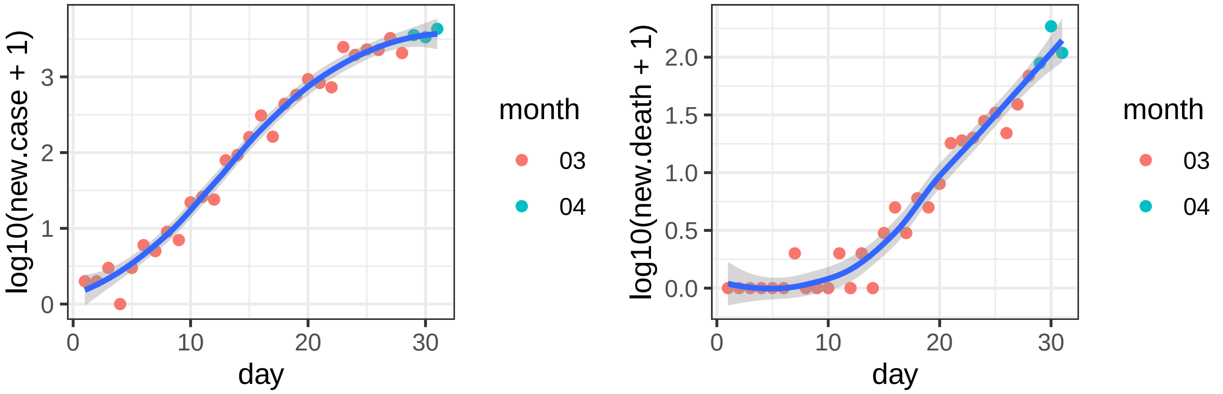
For these 10 states, I check the number of new cases and the number of new deaths. Part of the reason for such checking is to identify whether there is any similarity on such patterns. For example, could you use the pattern seen from Italy to predict what happen in an individual state, and what are the similarities and differences across states.

New York



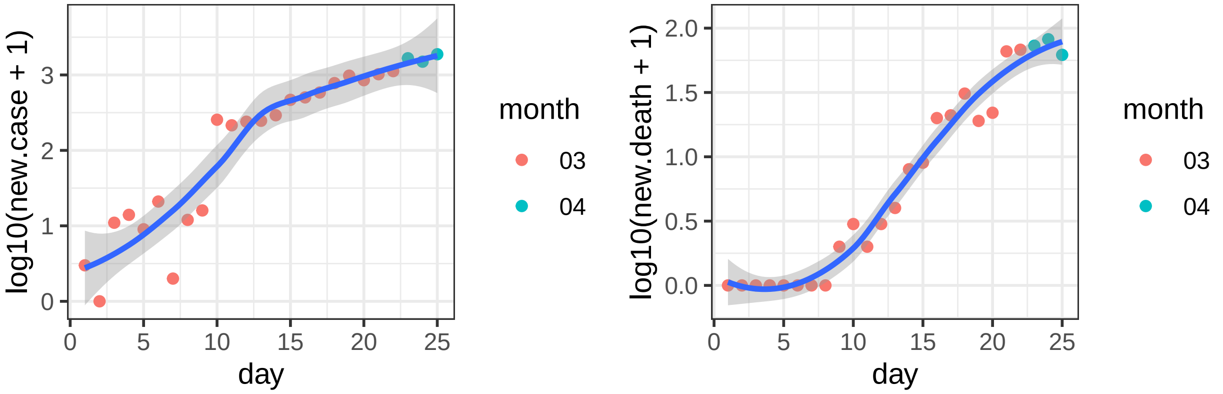
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

New Jersey



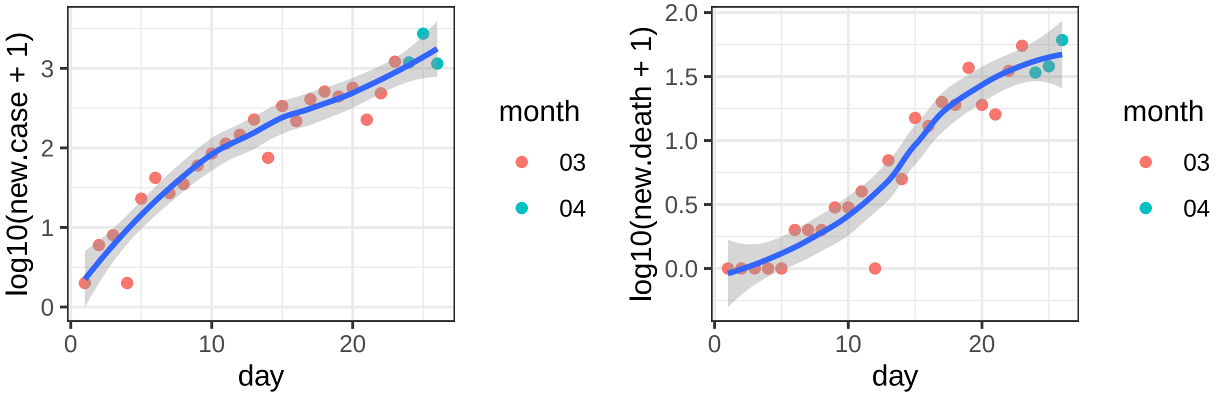
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−04

Michigan



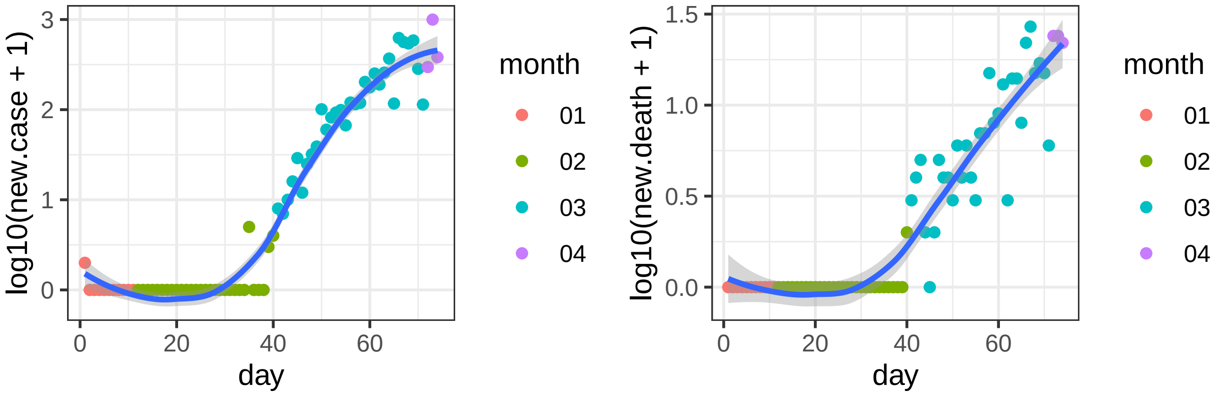
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Louisiana



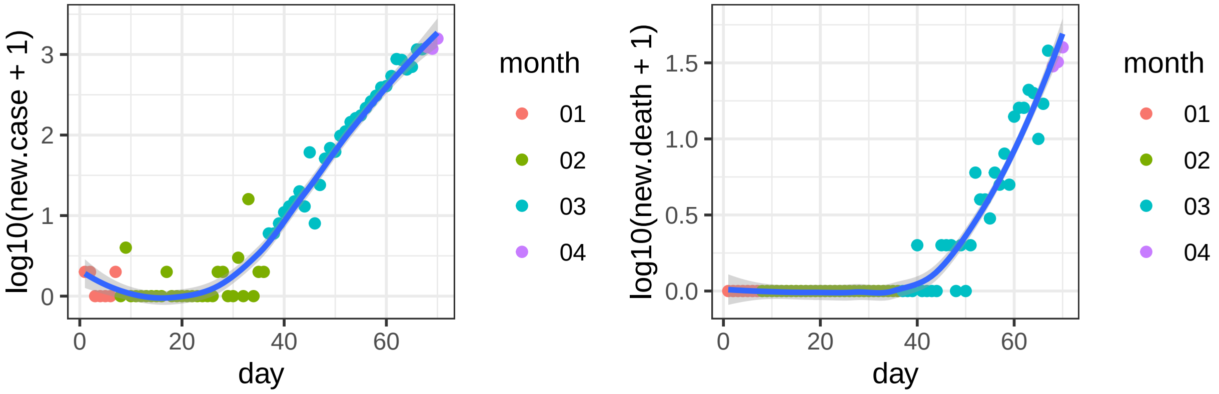
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−09

Washington



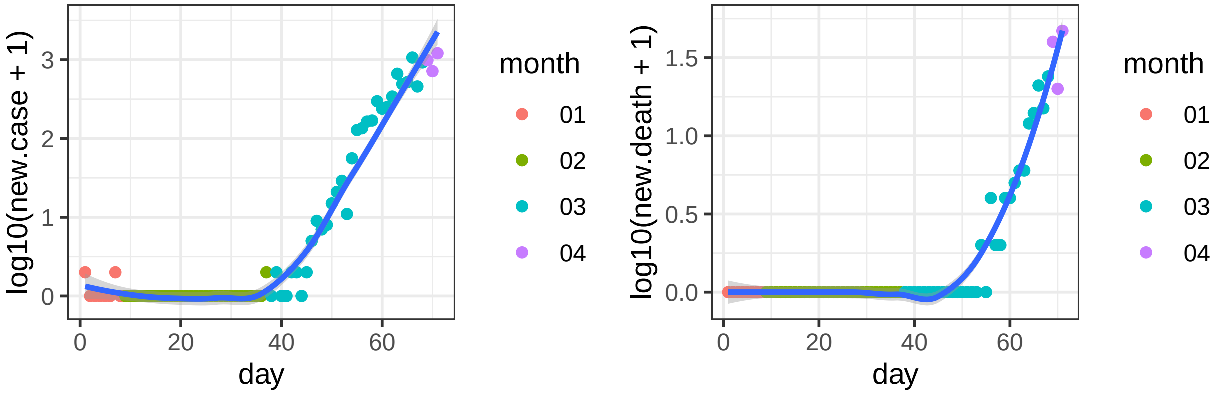
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−21

California

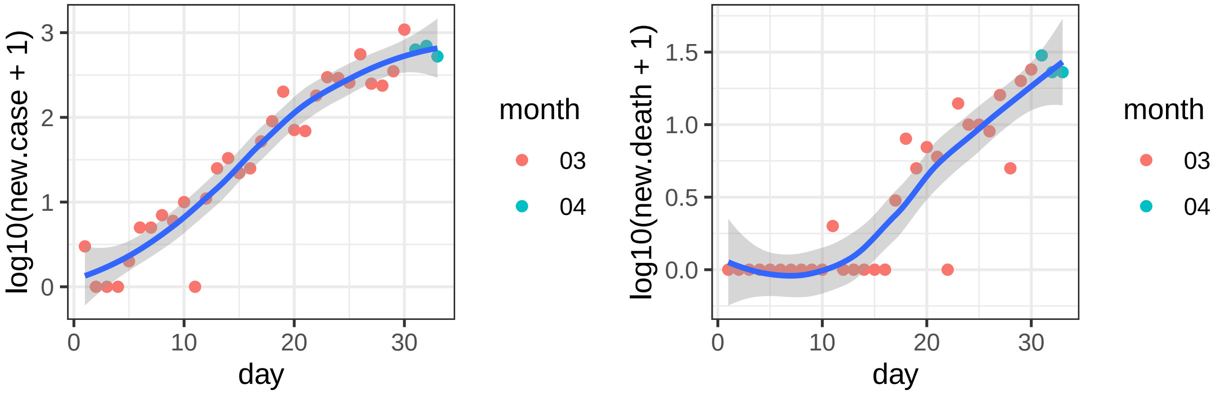


data source: https://github.com/nytimes/covid−19−data, day 1 is 01−25

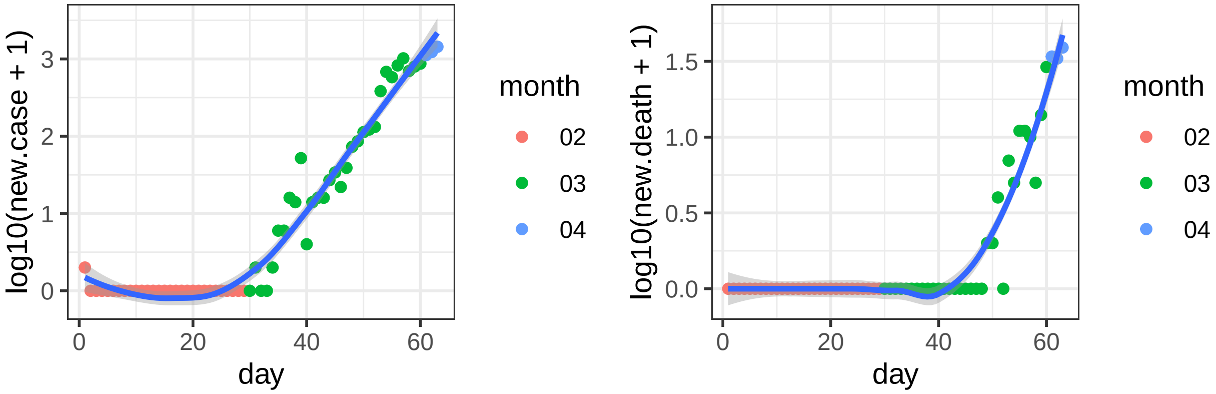
Illinois



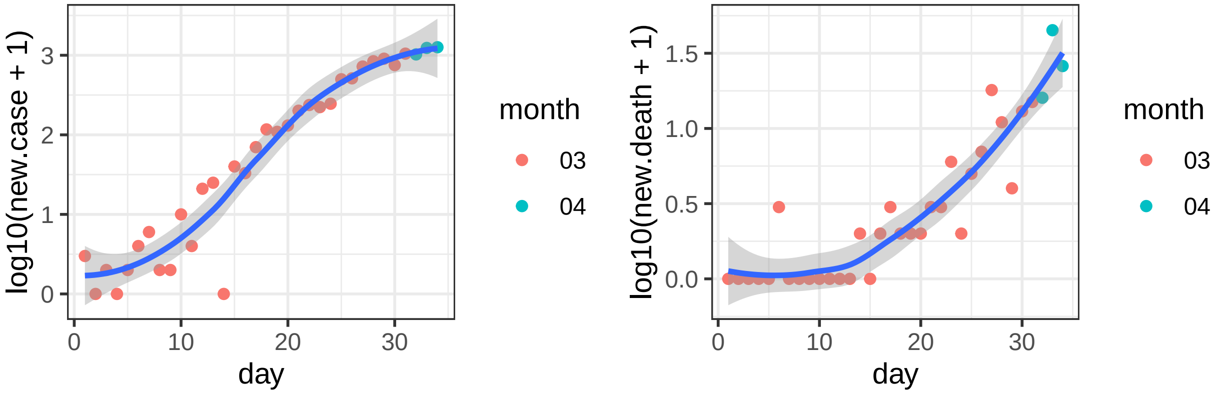
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−24


Georgia

data source: https://github.com/nytimes/covid−19−data, day 1 is 03−02

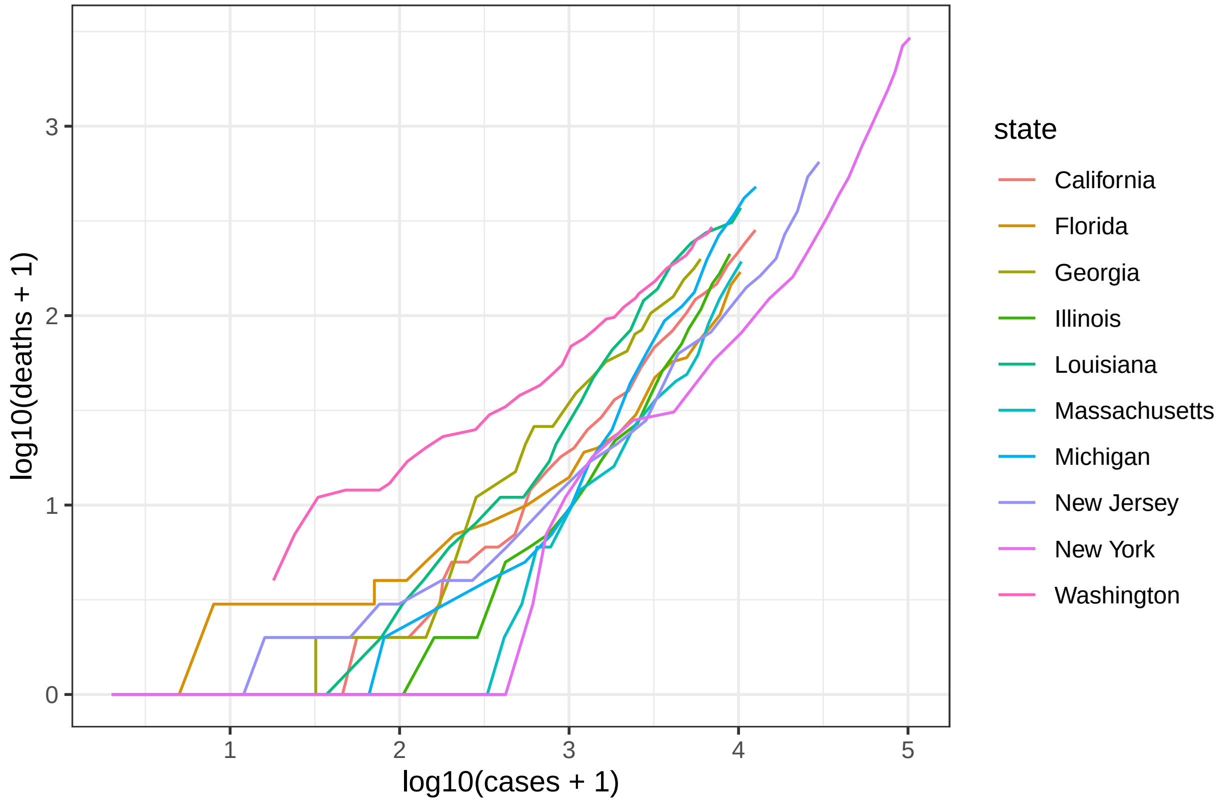

Massachusetts

data source: https://github.com/nytimes/covid−19−data, day 1 is 02−01


Florida

data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

Next I check the relation between the **cumulative** number of cases and deaths for these 10 states, starting on March



data source: https://github.com/nytimes/covid−19−data

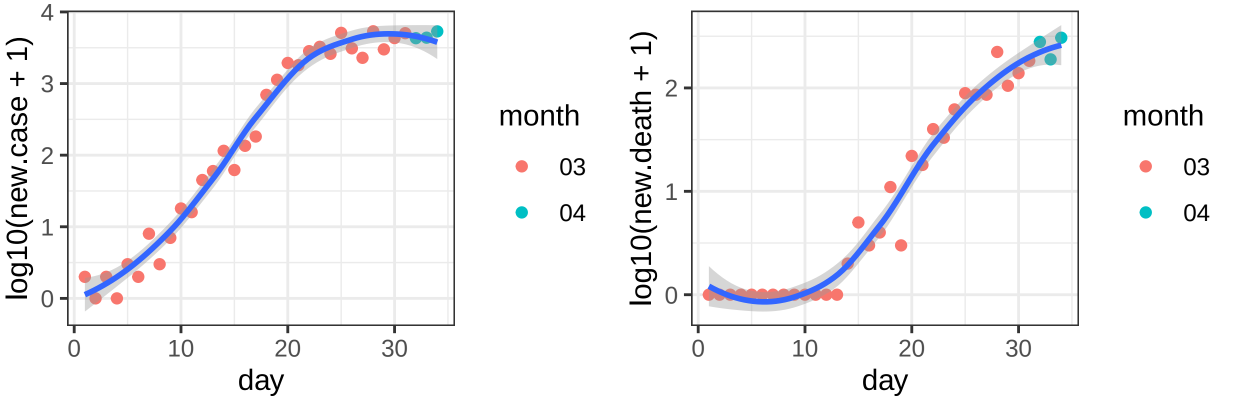
county level data

First check the 10 counties with the largest number of deaths.

```
##             date        county      state  fips cases deaths
## 29880 2020-04-03 New York City   New York    NA 57160   1867
## 29904 2020-04-03       Unknown   New York    NA    37    608
## 29525 2020-04-03         Wayne   Michigan 26163  6096    223
## 30720 2020-04-03          King Washington 53033  2789    188
## 29373 2020-04-03       Orleans  Louisiana 22071  3476    148
## 29012 2020-04-03          Cook   Illinois 17031  6473    141
## 29879 2020-04-03        Nassau   New York 36059 12024    138
## 29507 2020-04-03       Oakland   Michigan 26125  2540    136
## 29809 2020-04-03        Bergen New Jersey 34003  4866    132
## 29814 2020-04-03         Essex New Jersey 34013  3067    118
```

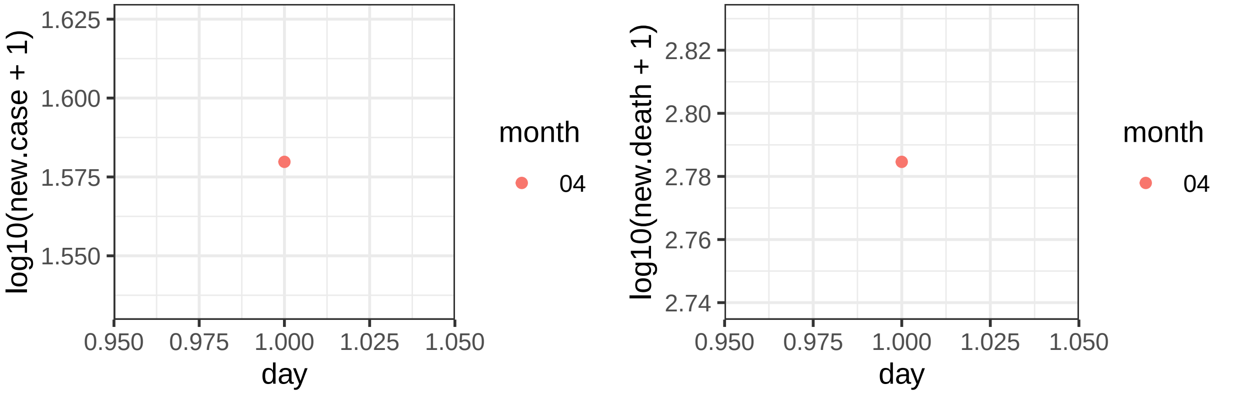
For these 10 counties, I check the number of new cases and the number of new deaths.

New York City_New York



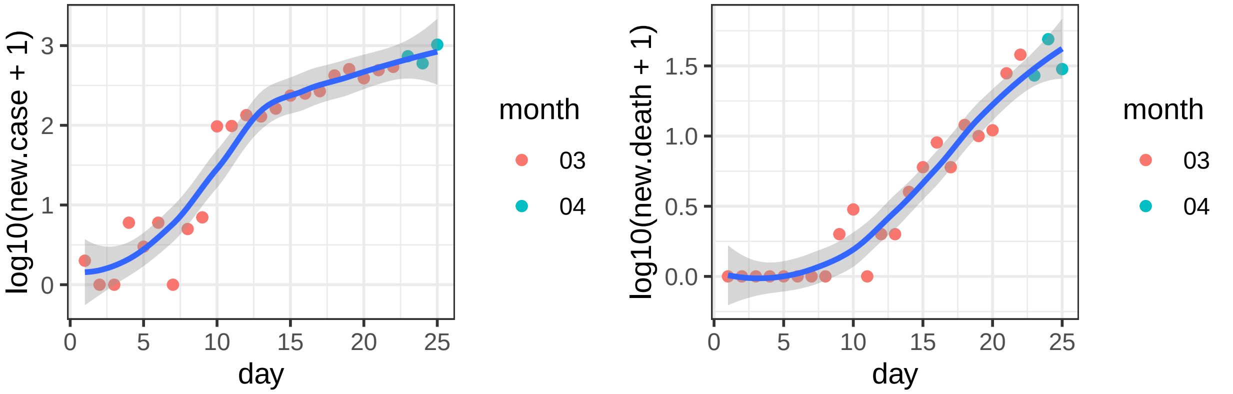
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

Unknown_New York

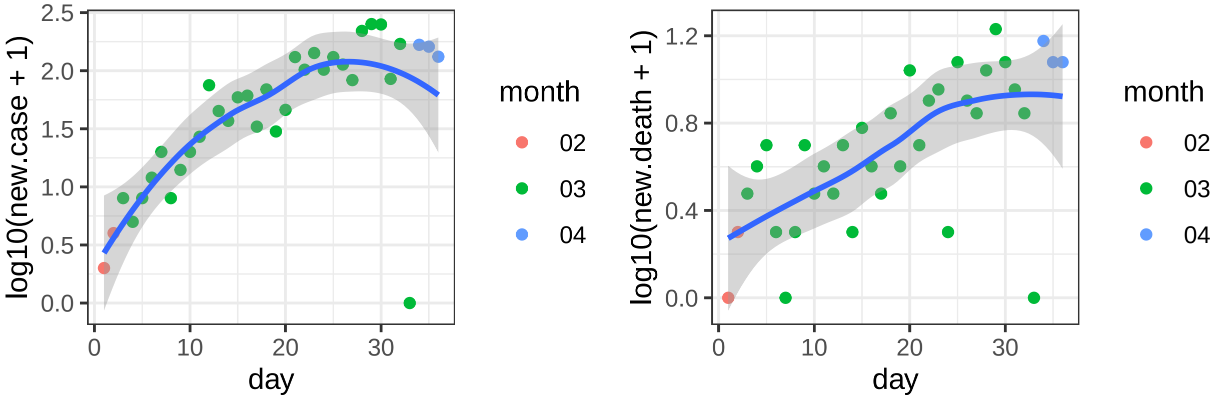


data source: https://github.com/nytimes/covid−19−data, day 1 is 04−03

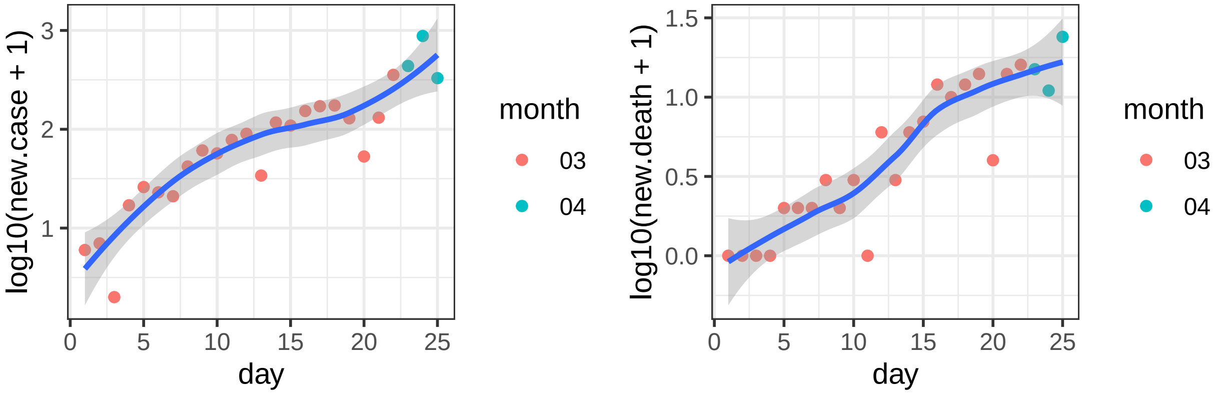
Wayne_Michigan



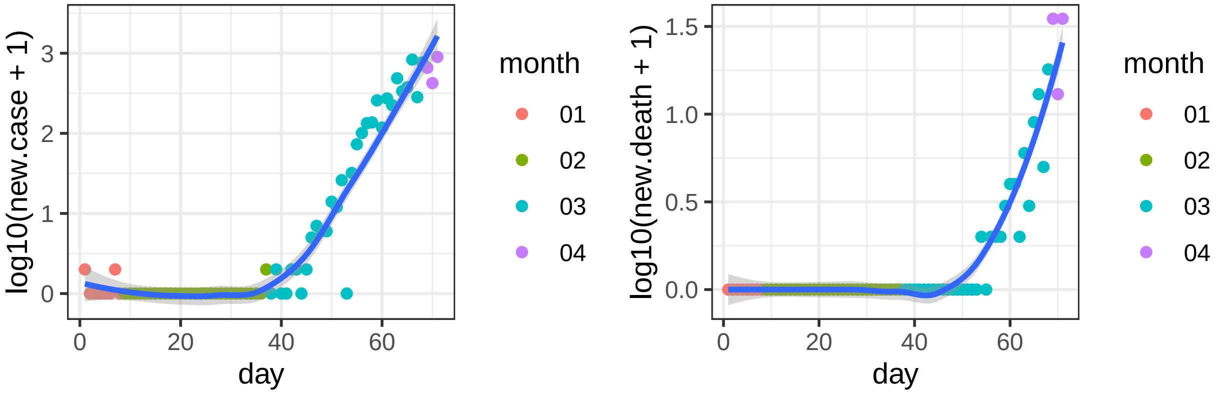
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10


King_Washington

data source: https://github.com/nytimes/covid−19−data, day 1 is 02−28

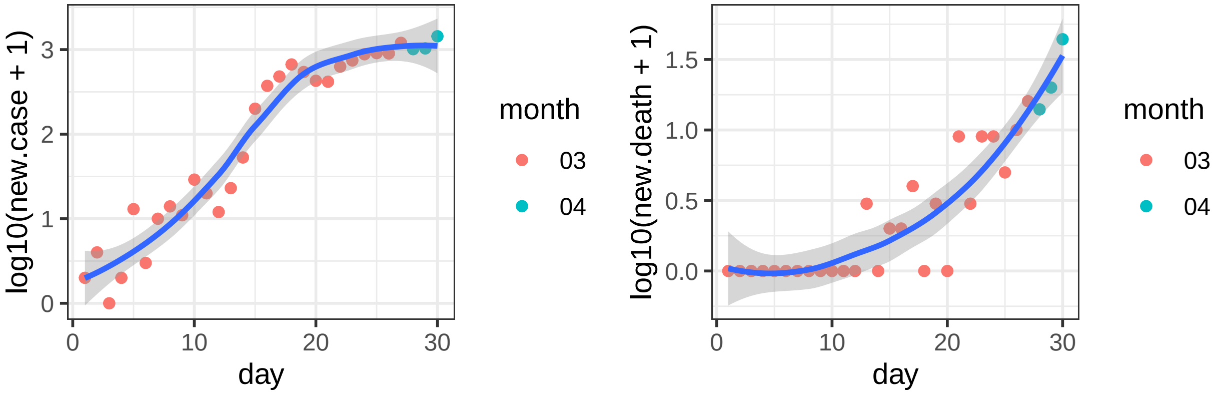

Orleans_Louisiana

data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10


Cook_Illinois

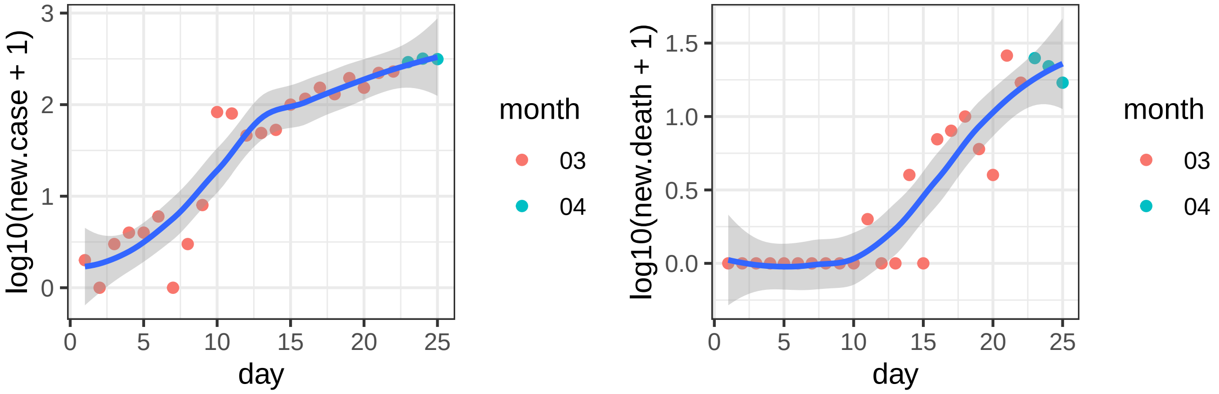
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−24

Nassau_New York



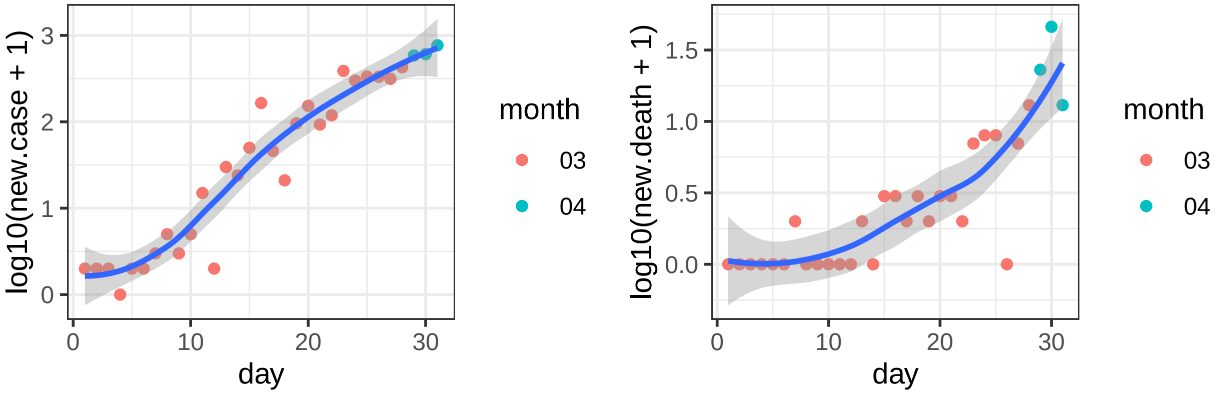
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

Oakland_Michigan

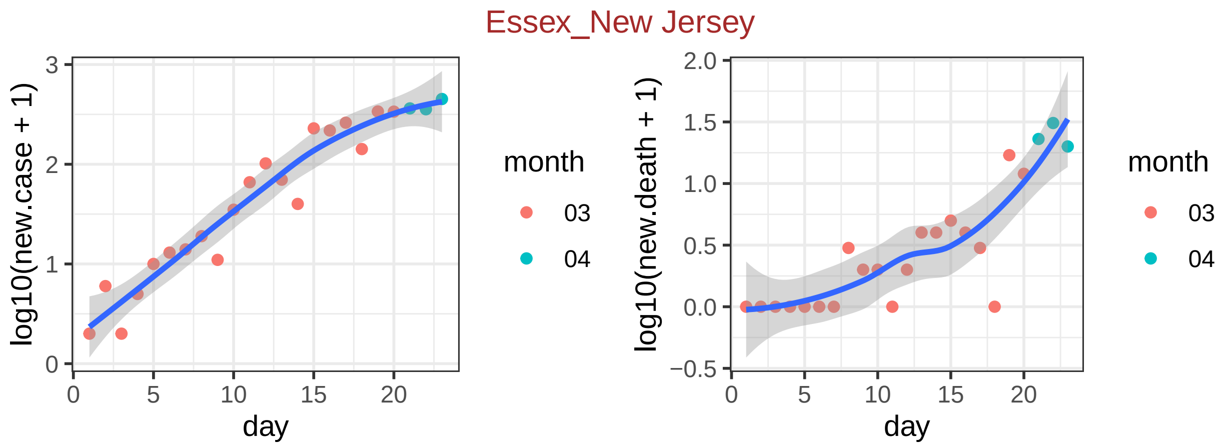


data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Bergen_New Jersey



data source: https://github.com/nytimes/covid−19−data, day 1 is 03−04

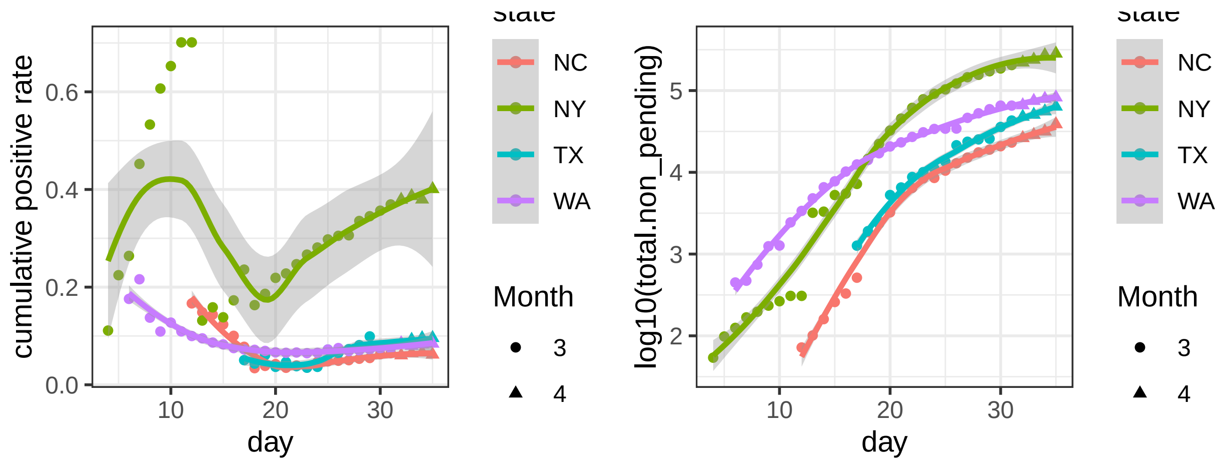


data source: https://github.com/nytimes/covid−19−data, day 1 is 03−12

COVID Trackng

The positive rates of testing can be an indicator on how much the COVID-19 has spread. However, they are more noisy data since the negative testing resutls are often not reported and the tests are almost surely taken on a non-representative random sample of the population. The COVID traking project proides a grade per state: "If you are calculating positive rates, it should only be with states that have an A grade. And be careful going back in time because almost all the states have changed their level of reporting at different times." (https://covidtracking.com/about-tracker/). The data are also availalbe for both counties and states, here I only look at state level data.

Since the daily postive rate can fluctuate a lot, here I only illustrae the cumulative positave rate across time, for four states with grade A data. Of course since this is an R markdown file, you can modify the source code and check for other states.



github.com/COVID19Tracking/, cumulative positive rate on 0404: 0.08(WA) 0.10(TX) 0.40(NY) 0.06(NC)

Session information

```
sessionInfo()
```

```
## R version 3.6.2 (2019-12-12)
## Platform: x86_64-apple-darwin15.6.0 (64-bit)
## Running under: macOS Catalina 10.15.4
##
## Matrix products: default
## BLAS:   /Library/Frameworks/R.framework/Versions/3.6/Resources/lib/libRblas.0.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/3.6/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
## [1] httr_1.4.1    ggpubr_0.2.5  magrittr_1.5  ggplot2_3.2.1
##
## loaded via a namespace (and not attached):
##  [1] Rcpp_1.0.3       pillar_1.4.3     compiler_3.6.2   tools_3.6.2
##  [5] digest_0.6.23    evaluate_0.14    lifecycle_0.1.0  tibble_2.1.3
##  [9] gtable_0.3.0     pkgconfig_2.0.3  rlang_0.4.4      yaml_2.2.1
## [13] xfun_0.12        gridExtra_2.3    withr_2.1.2      dplyr_0.8.4
## [17] stringr_1.4.0    knitr_1.28       grid_3.6.2       tidyselect_1.0.0
## [21] cowplot_1.0.0    glue_1.3.1       R6_2.4.1         rmarkdown_2.1
## [25] purrr_0.3.3      farver_2.0.3     scales_1.1.0     htmltools_0.4.0
## [29] assertthat_0.2.1 colorspace_1.4-1 ggsignif_0.6.0   labeling_0.3
## [33] stringi_1.4.5    lazyeval_0.2.2   munsell_0.5.0    crayon_1.3.4
```