Exploration of COVID-19 tracking data from multiple resources

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2020-04-14

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

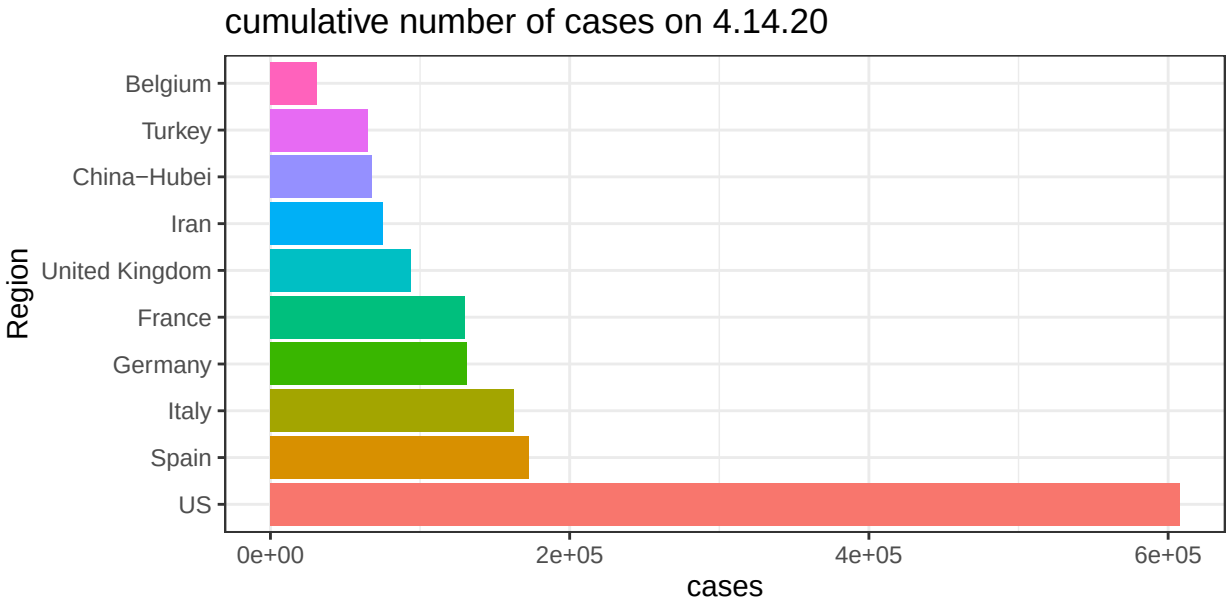
JHU

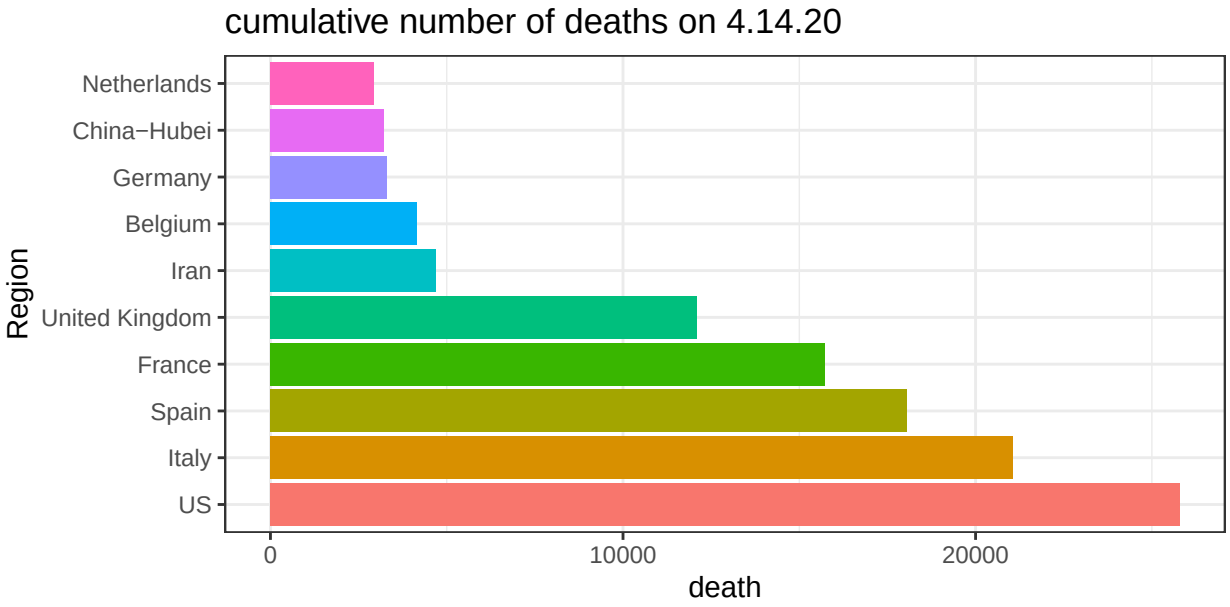
Assume you have cloned the JHU Github repository on your local machine at "../COVID-19".

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.

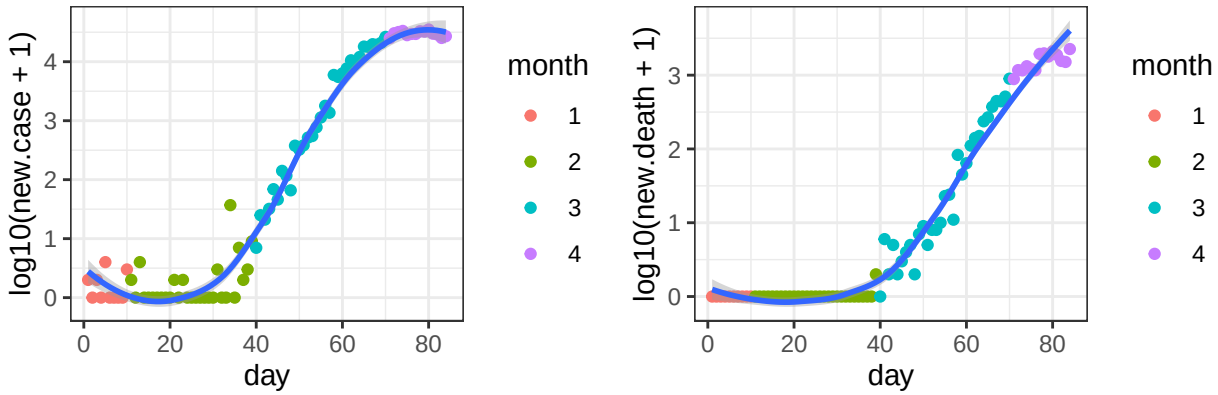
Here is the list of 10 records with the largest number of cases or deaths on the most recent date.





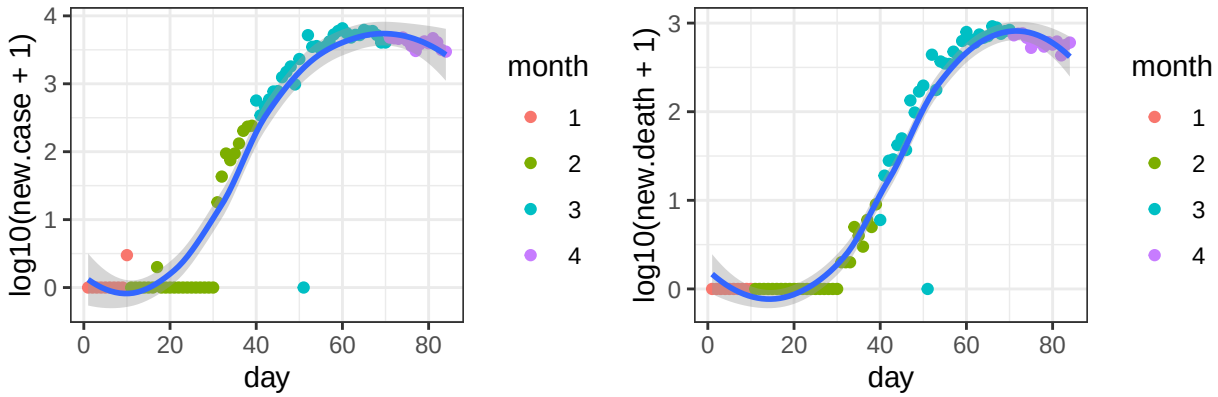
Next, I check for each country/region, what is the number of new cases/deaths? This data is important to understand what is the trend under different situations, e.g., population density, social distance policies etc. Here I checked the top 10 countries/regions with the highest number of deaths.

US



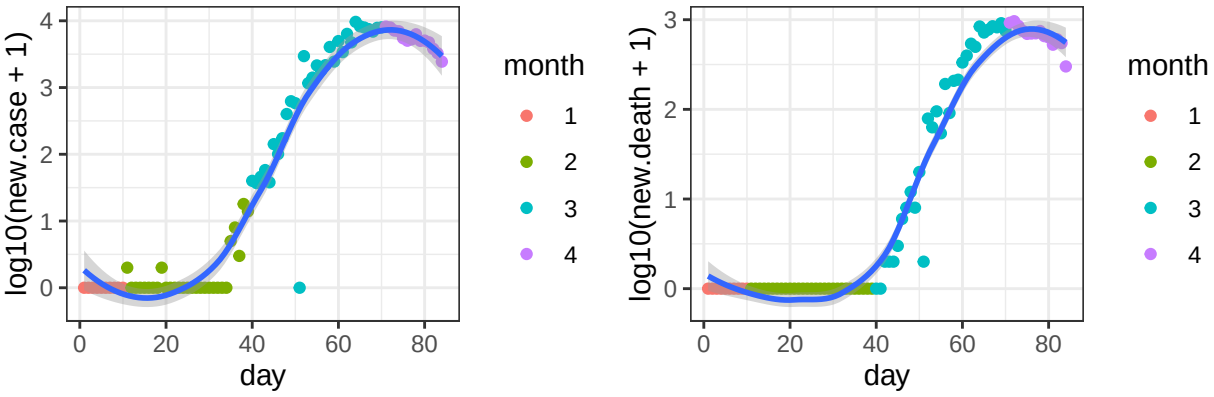
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Italy



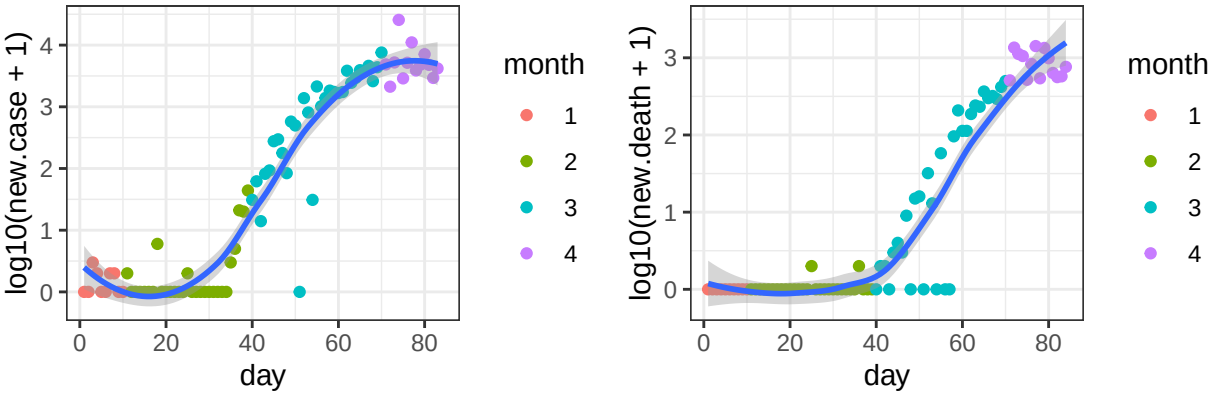
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Spain



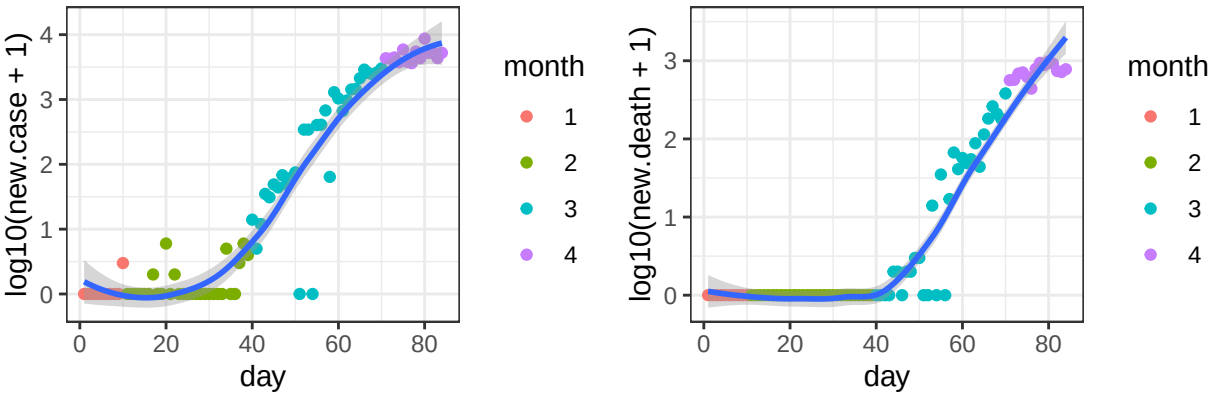
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

France



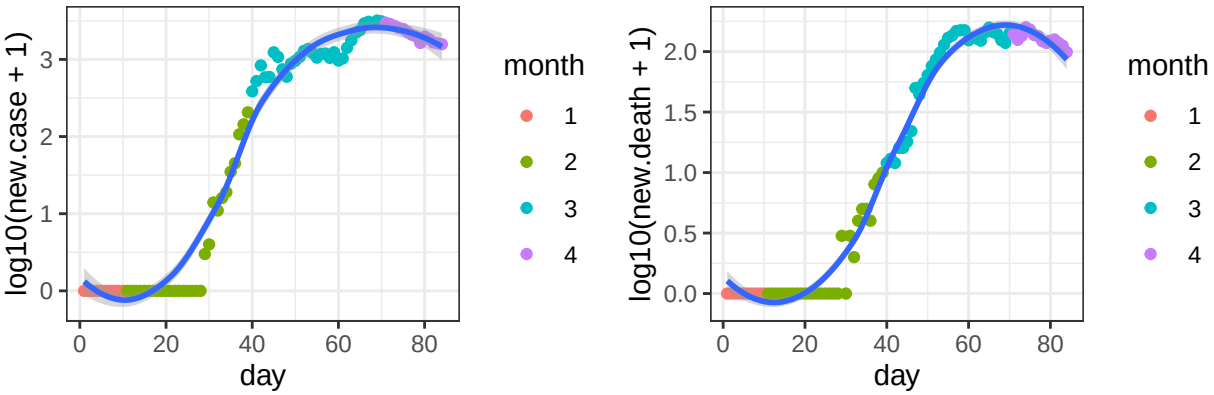
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

United Kingdom



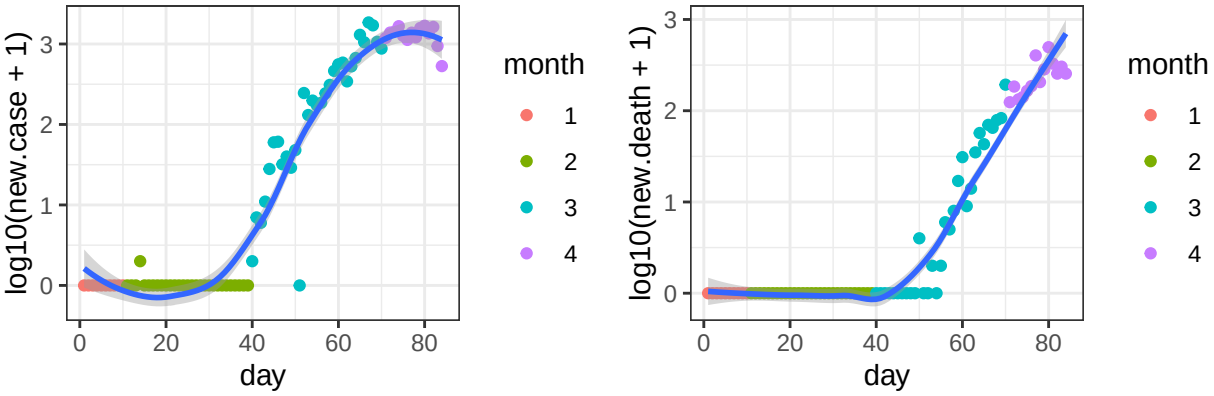
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Iran



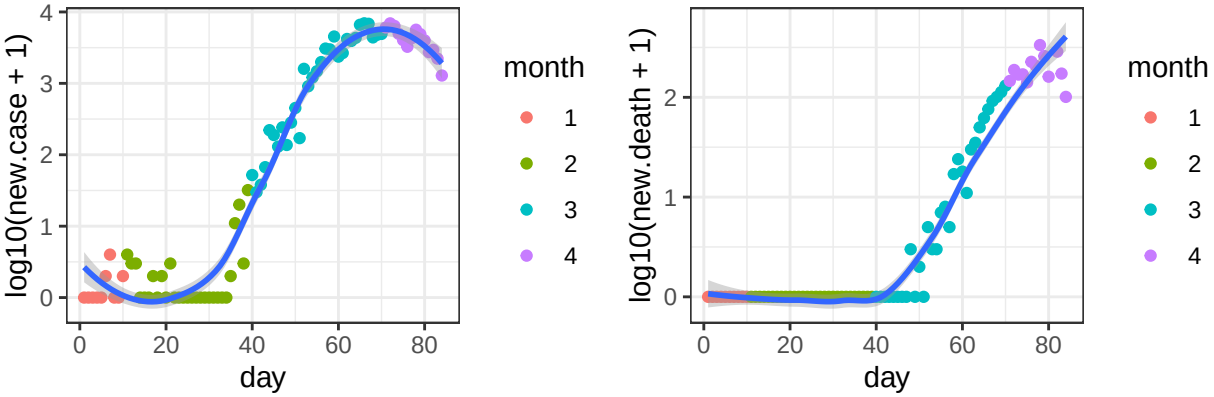
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Belgium

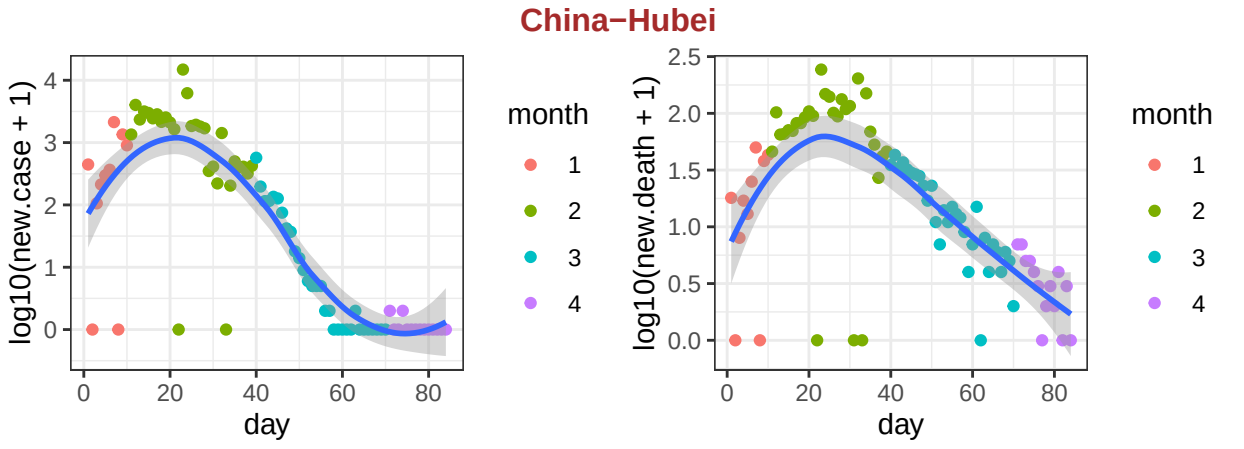


data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

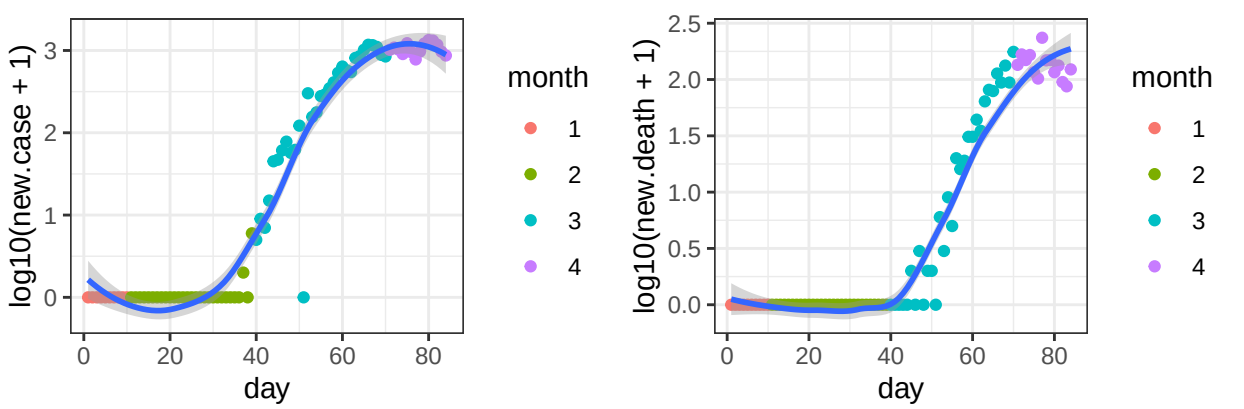
Germany



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



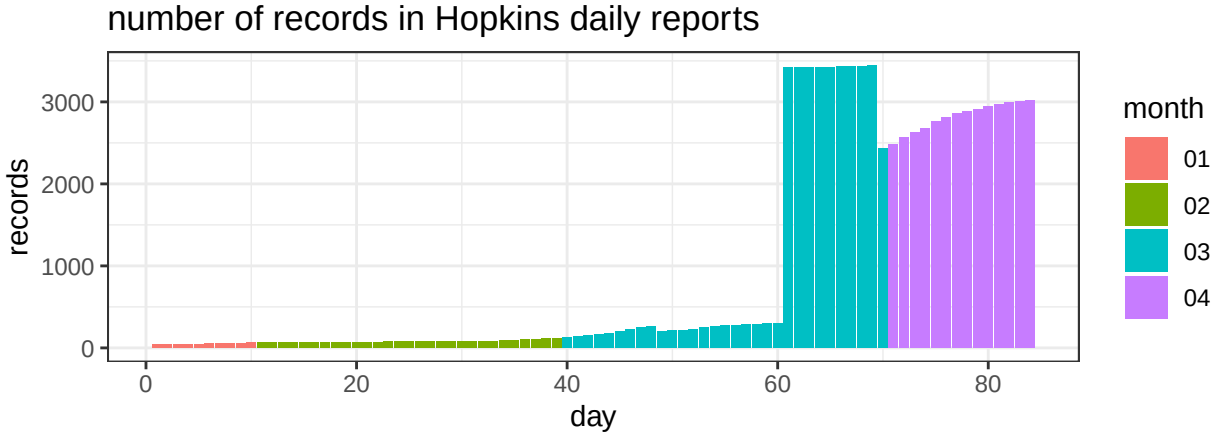
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020



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.



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

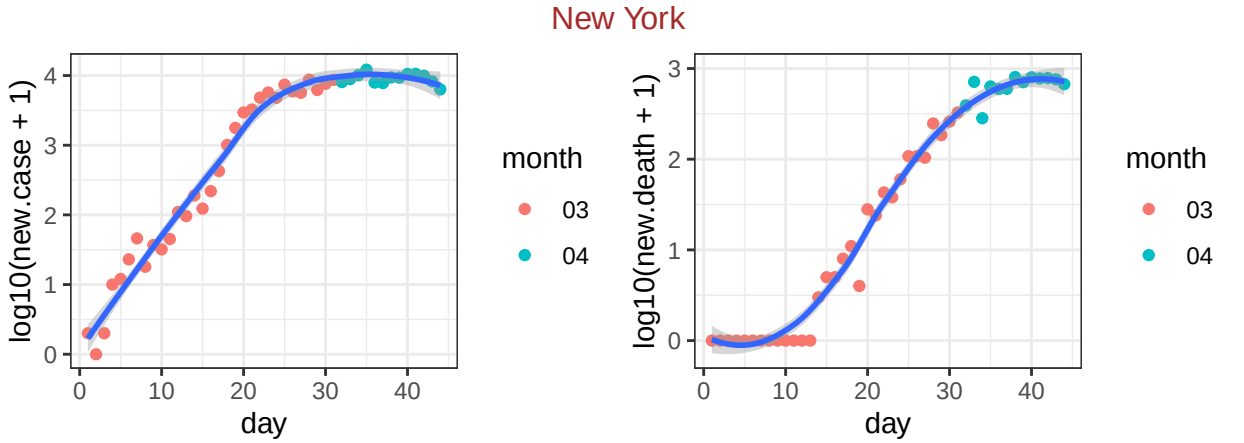
```
## [1] "2020-04-13"
```

state level data

First check the 20 states with the largest number of deaths.

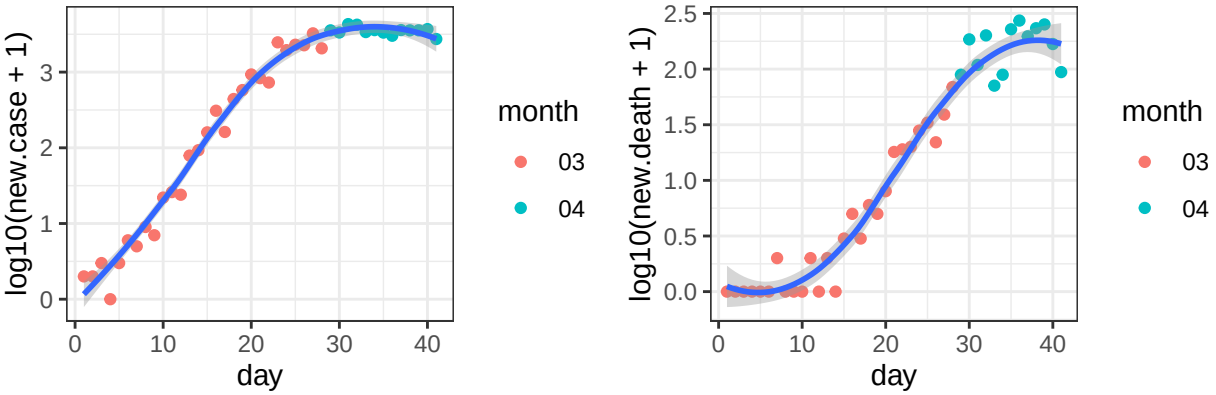
```
##            date          state fips  cases deaths
## 2308 2020-04-13       New York   36 195031  10056
## 2306 2020-04-13     New Jersey   34  64584   2443
## 2298 2020-04-13       Michigan   26  25487   1601
## 2294 2020-04-13      Louisiana   22  21016    884
## 2297 2020-04-13  Massachusetts   25  26867    844
## 2289 2020-04-13       Illinois   17  22025    800
## 2279 2020-04-13     California    6  24334    725
## 2281 2020-04-13    Connecticut    9  13381    602
## 2315 2020-04-13   Pennsylvania   42  24295    563
## 2326 2020-04-13     Washington   53  10538    525
## 2284 2020-04-13        Florida   12  21011    498
## 2285 2020-04-13        Georgia   13  13125    479
## 2290 2020-04-13        Indiana   18   8236    350
## 2321 2020-04-13          Texas   48  14488    320
## 2280 2020-04-13       Colorado    8   7691    308
## 2312 2020-04-13           Ohio   39   6975    274
## 2296 2020-04-13       Maryland   24   8936    262
## 2328 2020-04-13      Wisconsin   55   3428    155
## 2325 2020-04-13       Virginia   51   5747    149
## 2301 2020-04-13       Missouri   29   4388    137
```

For these 20 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.



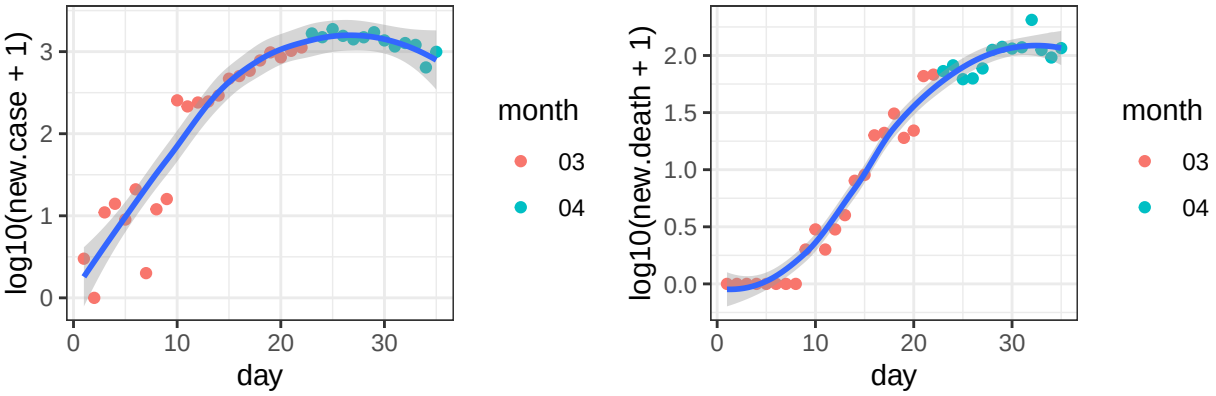
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

New Jersey



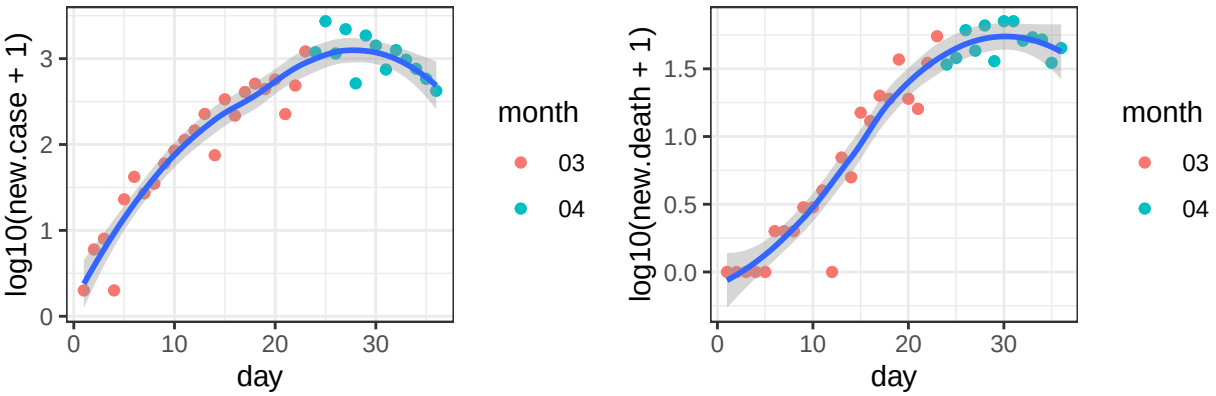
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−04

Michigan



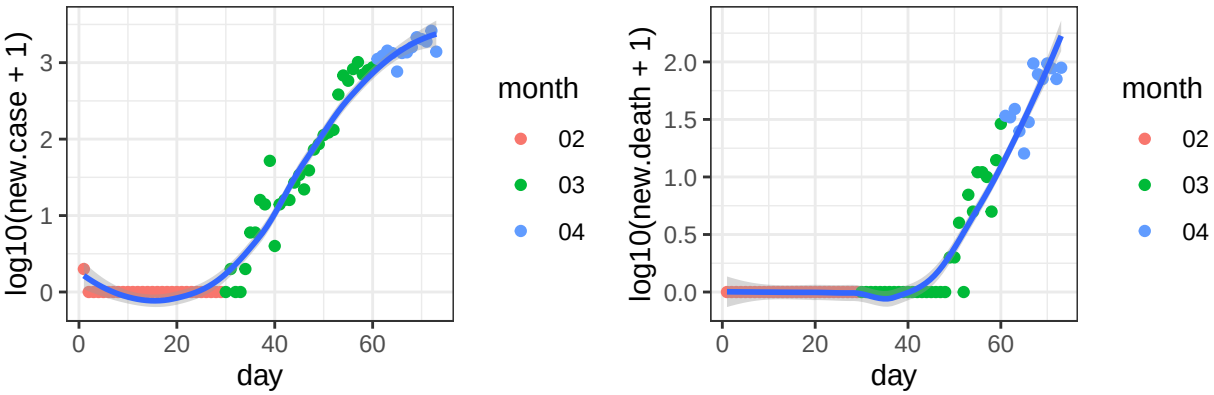
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Louisiana



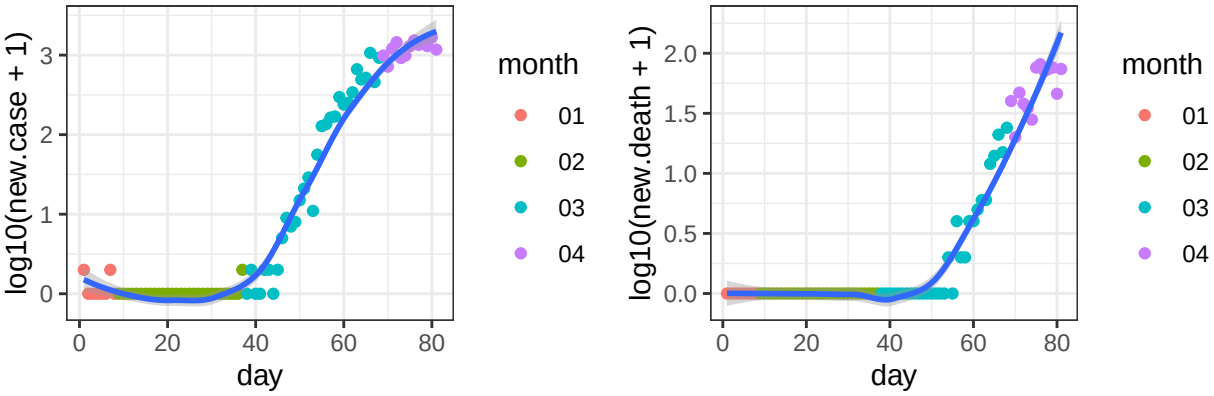
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−09

Massachusetts



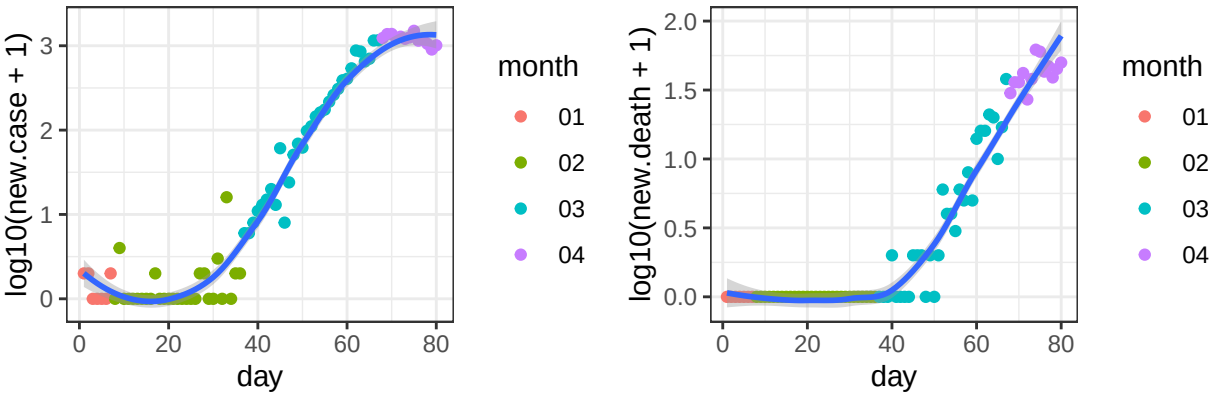
data source: https://github.com/nytimes/covid−19−data, day 1 is 02−01

Illinois



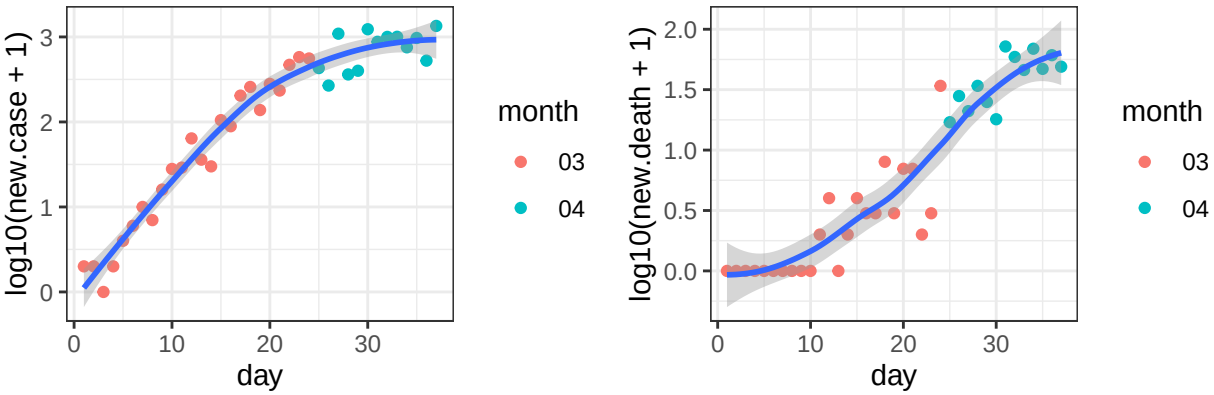
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−24

California



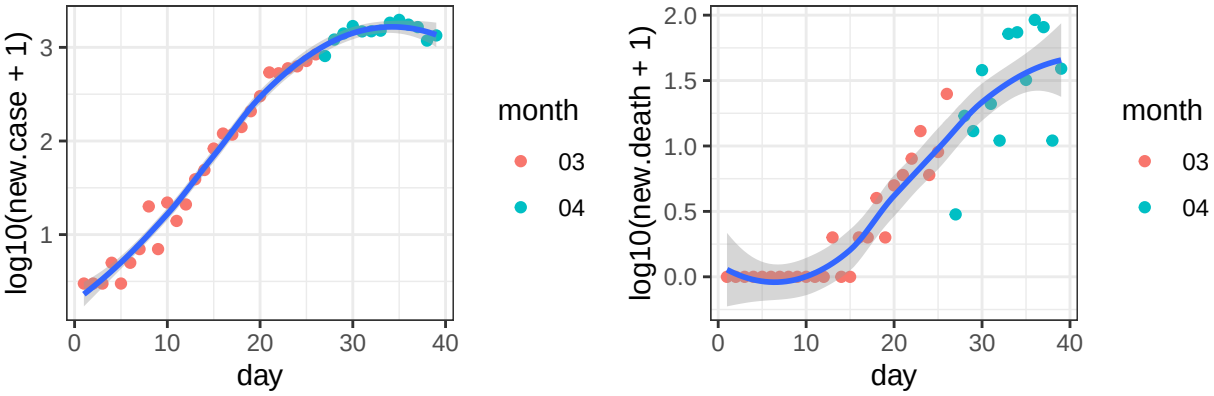
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−25

Connecticut



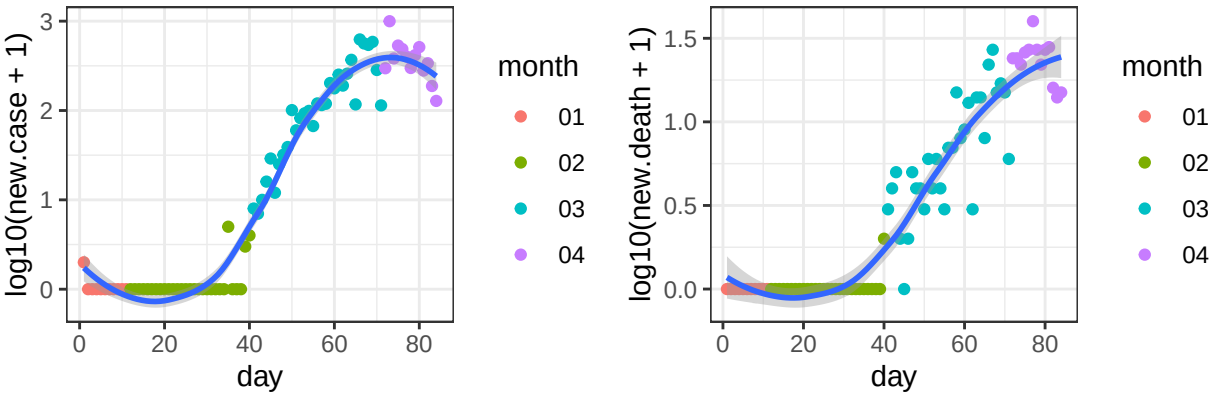
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−08

Pennsylvania



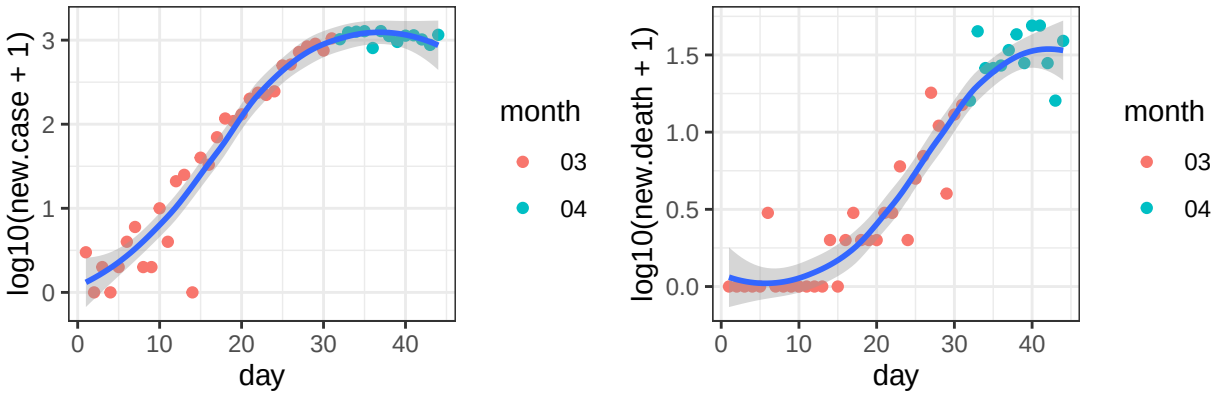
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−06

Washington



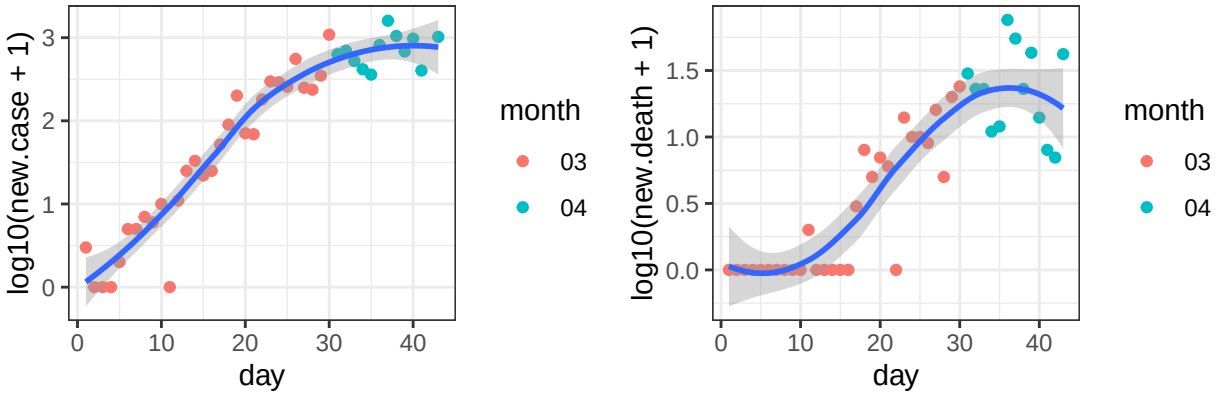
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−21

Florida



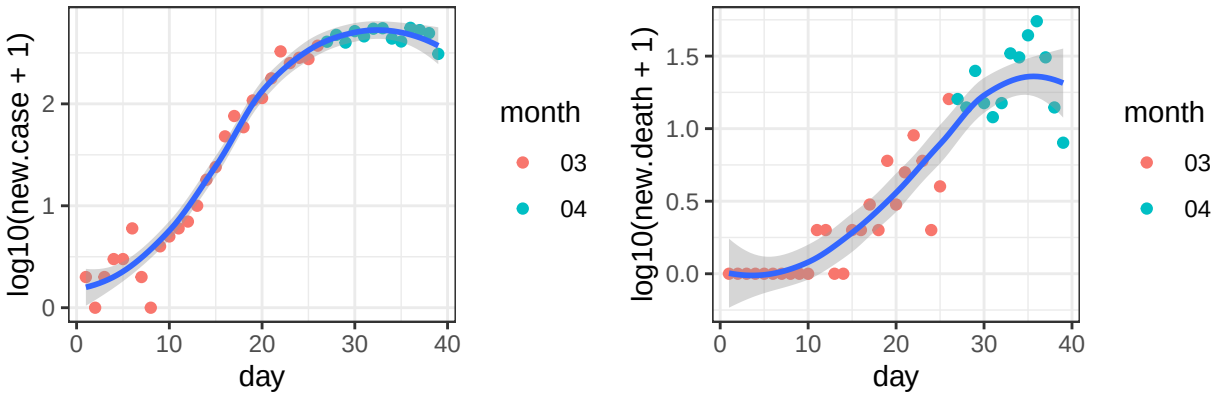
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

Georgia



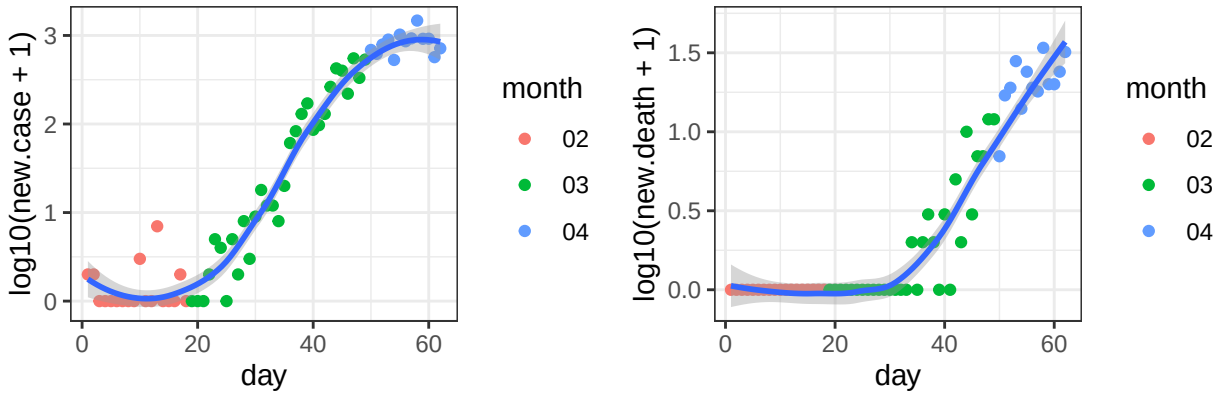
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−02

Indiana



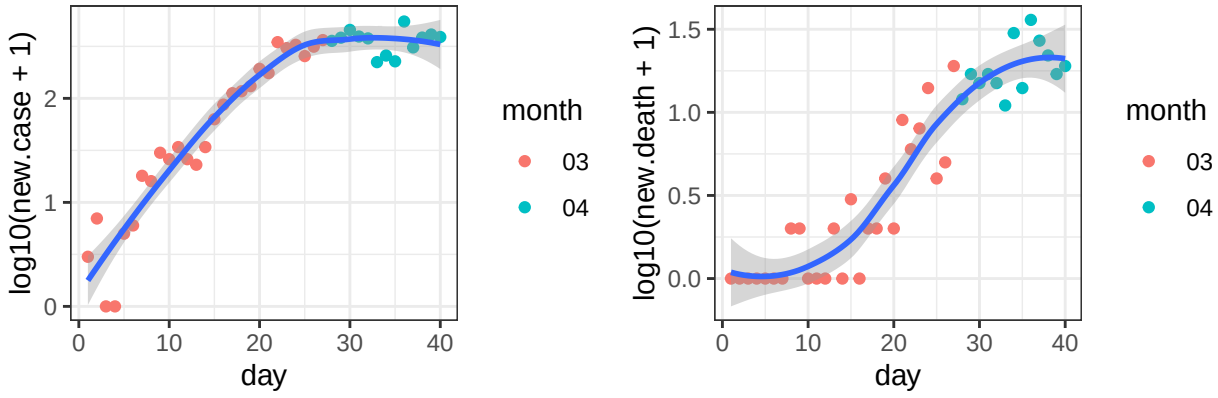
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−06

Texas



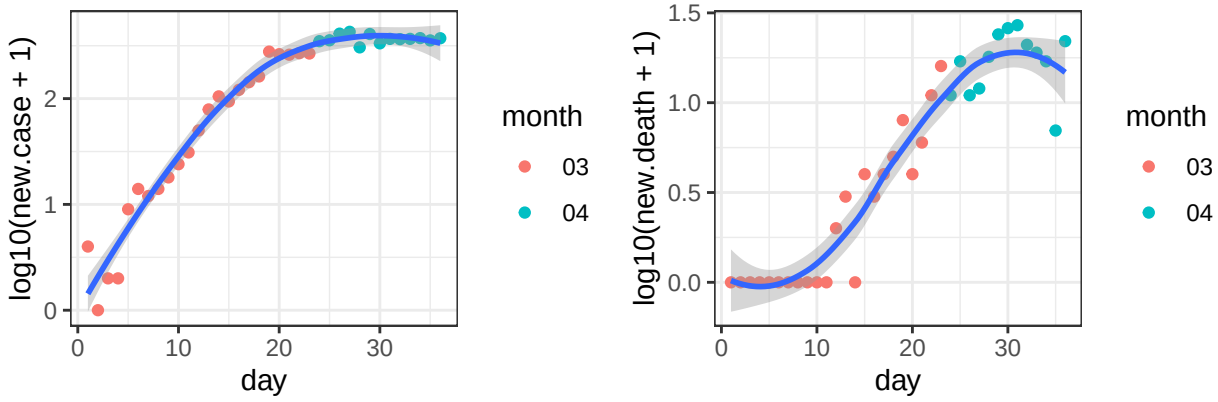
data source: https://github.com/nytimes/covid−19−data, day 1 is 02−12

Colorado



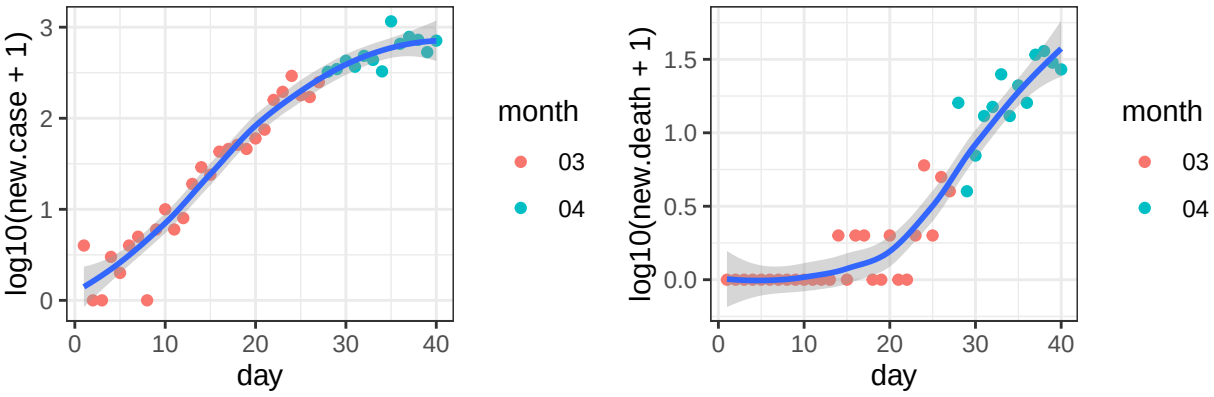
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

Ohio



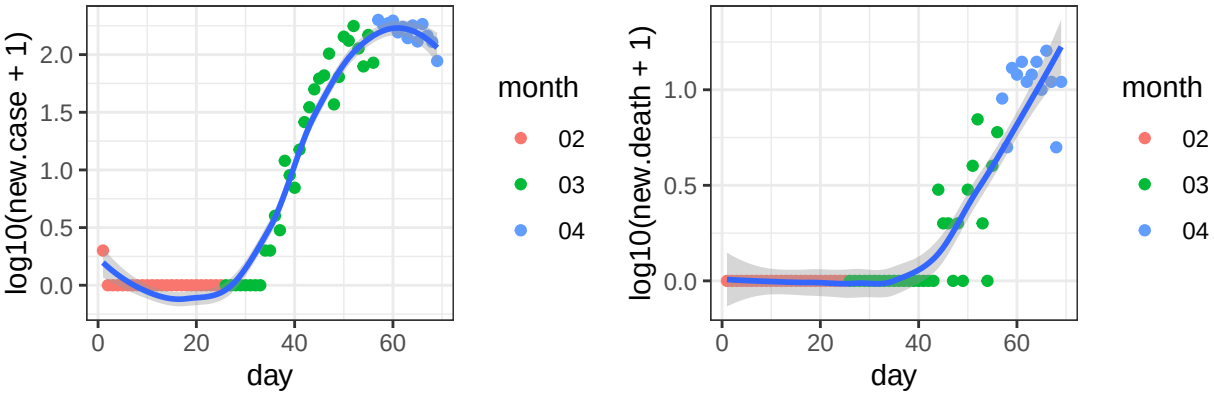
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−09

Maryland



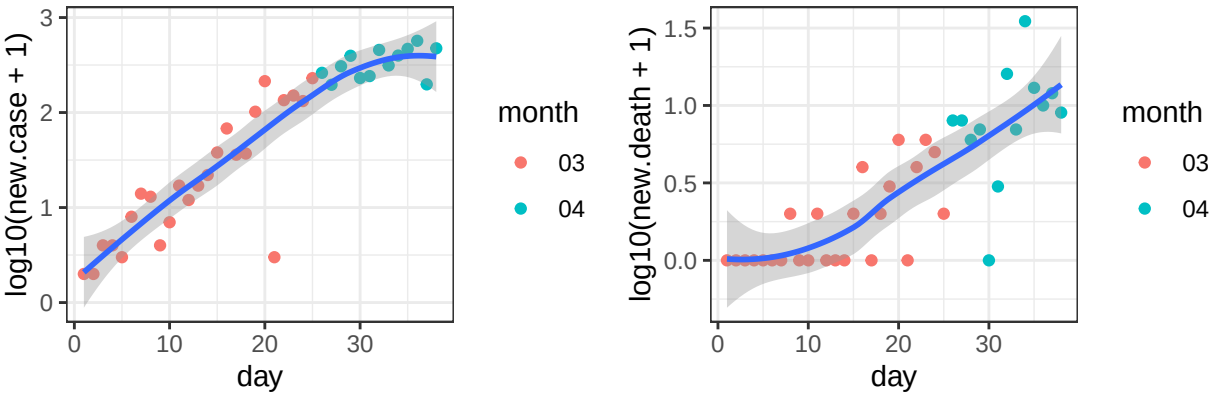
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

Wisconsin

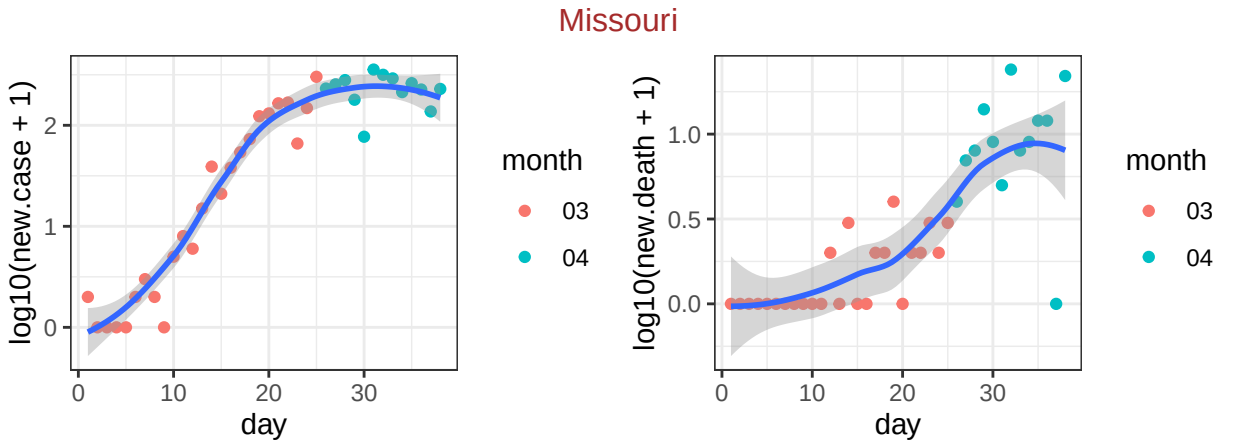


data source: https://github.com/nytimes/covid−19−data, day 1 is 02−05

Virginia

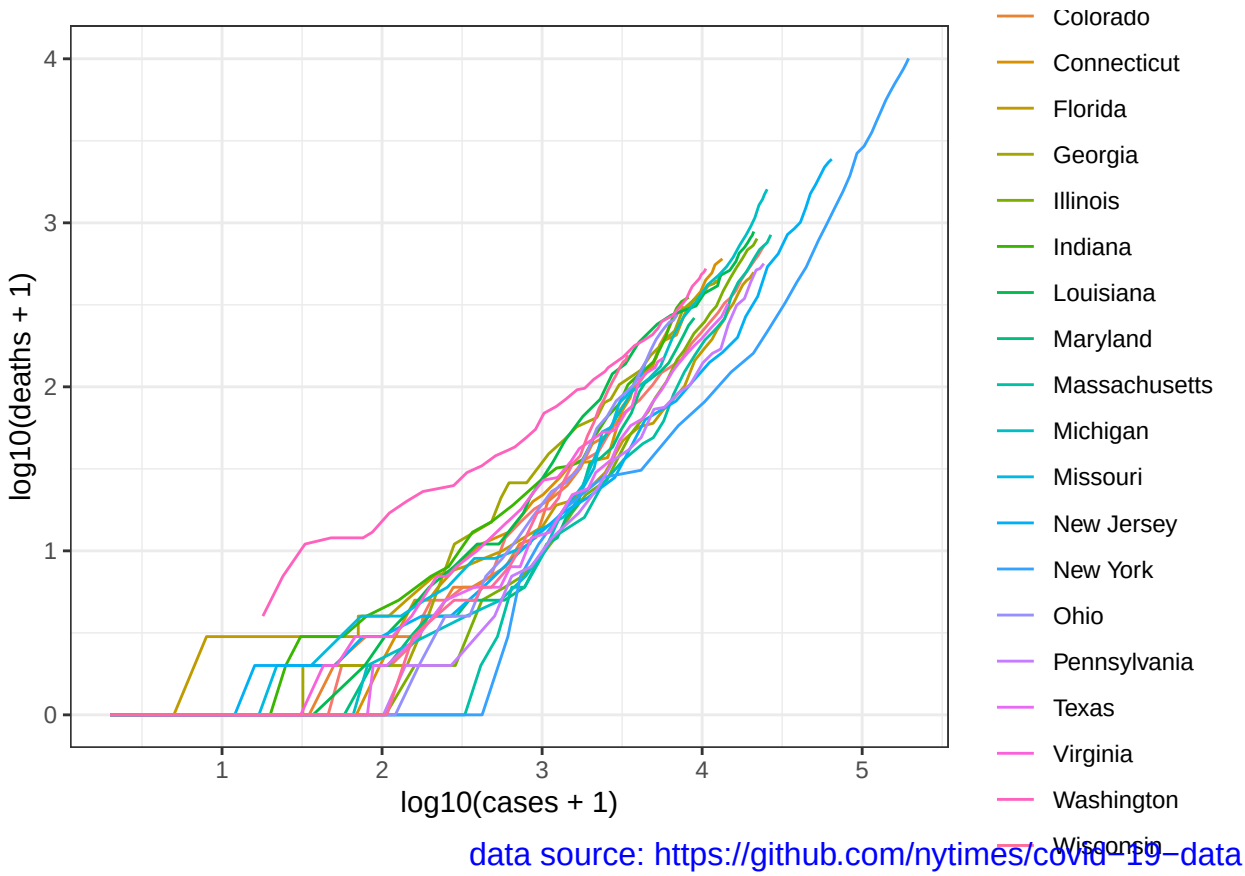


data source: https://github.com/nytimes/covid−19−data, day 1 is 03−07



data source: https://github.com/nytimes/covid−19−data, day 1 is 03−07

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

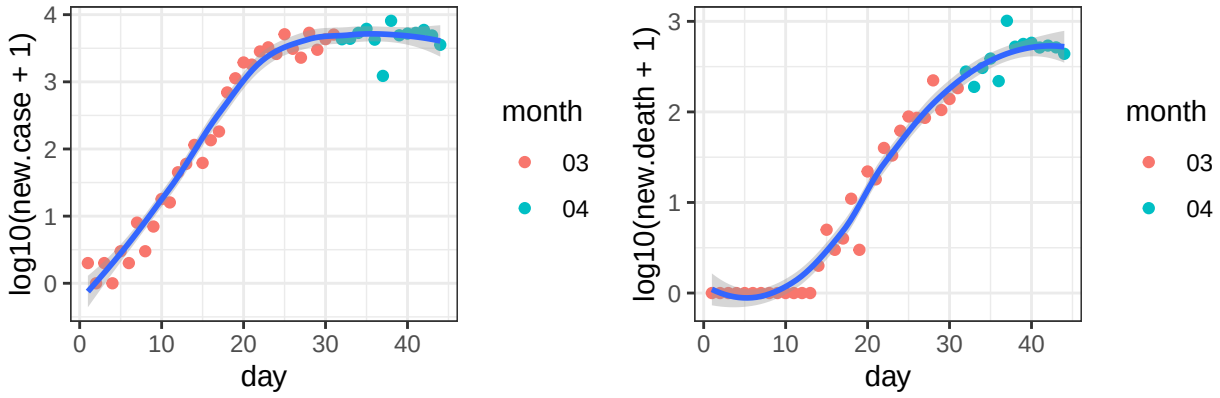
First check the 20 counties with the largest number of deaths.

```
##            date        county       state  fips  cases deaths
## 55443 2020-04-13 New York City    New York    NA 106764   7154
## 55442 2020-04-13        Nassau    New York 36059  24358   1109
## 55027 2020-04-13         Wayne    Michigan 26163  11648    760
```

```
## 55470 2020-04-13   Westchester      New York 36119  19785    610
## 55462 2020-04-13      Suffolk      New York 36103  21643    580
## 54414 2020-04-13         Cook      Illinois 17031  15474    543
## 55368 2020-04-13       Bergen    New Jersey 34003  10092    482
## 55373 2020-04-13        Essex    New Jersey 34013   7634    433
## 55008 2020-04-13      Oakland      Michigan 26125   5073    347
## 54032 2020-04-13  Los Angeles    California  6037   9420    320
## 56386 2020-04-13         King    Washington 53033   4551    298
## 54125 2020-04-13    Fairfield   Connecticut  9001   6004    262
## 54867 2020-04-13      Orleans     Louisiana 22071   5651    244
## 54995 2020-04-13       Macomb      Michigan 26099   3418    240
## 55375 2020-04-13       Hudson    New Jersey 34017   7879    236
## 55386 2020-04-13        Union    New Jersey 34039   6636    217
## 55378 2020-04-13    Middlesex    New Jersey 34023   5987    204
## 54857 2020-04-13    Jefferson     Louisiana 22051   5088    186
## 55454 2020-04-13     Rockland      New York 36087   7965    182
## 54945 2020-04-13    Middlesex Massachusetts 25017   5983    163
```

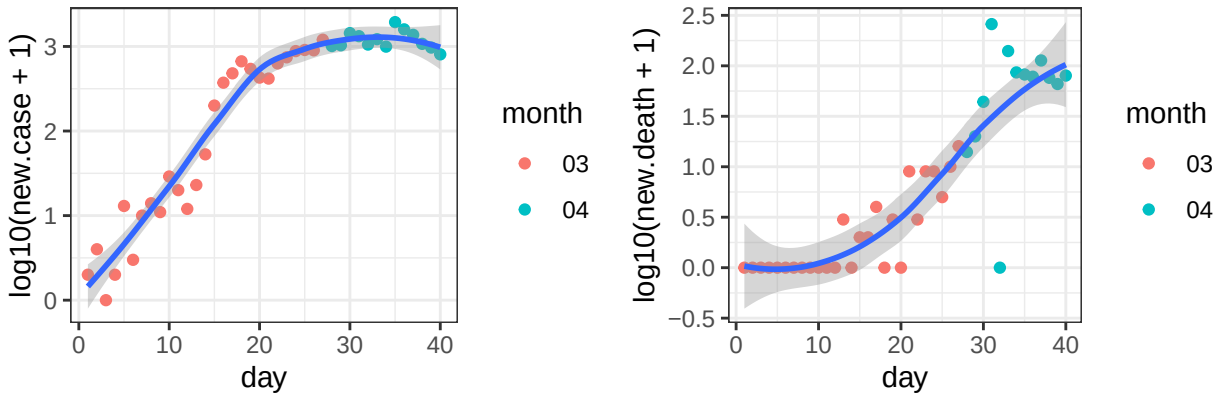
For these 20 counties, I check the number of new cases and the number of new deaths.

New York City_New York



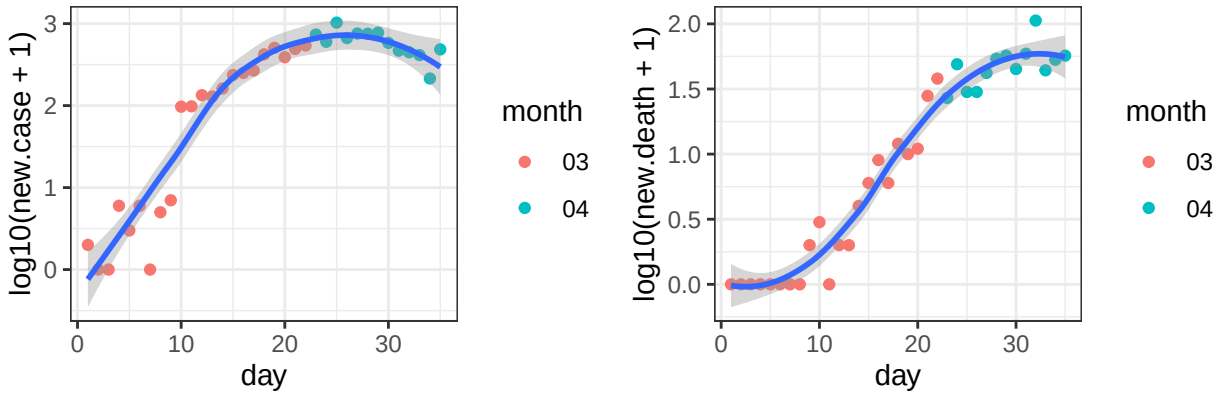
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

Nassau_New York



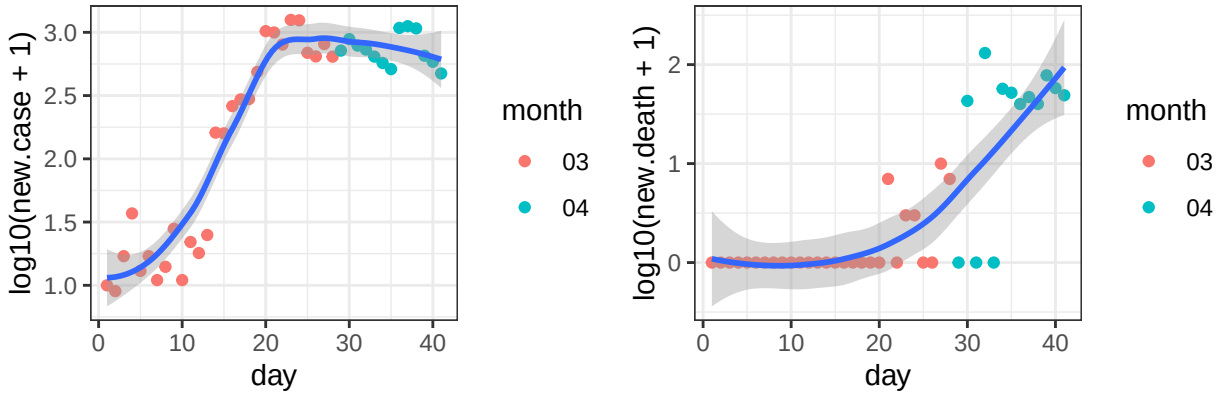
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

Wayne_Michigan



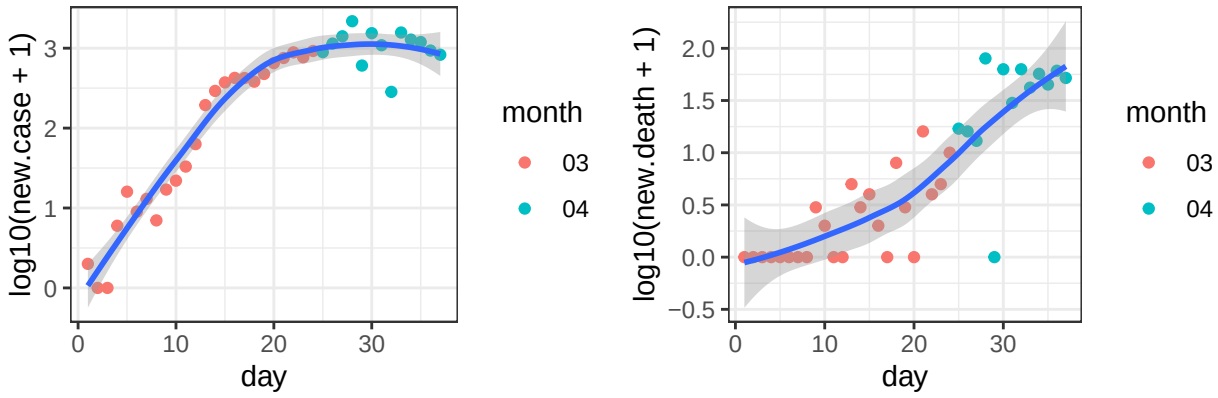
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Westchester_New York



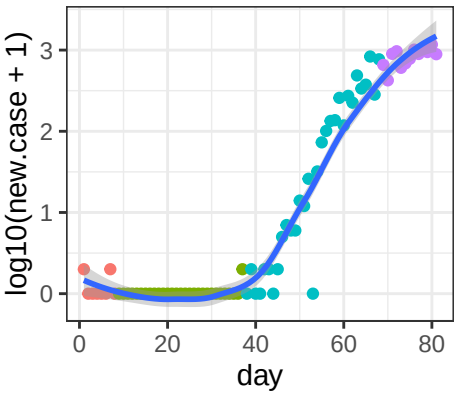
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−04

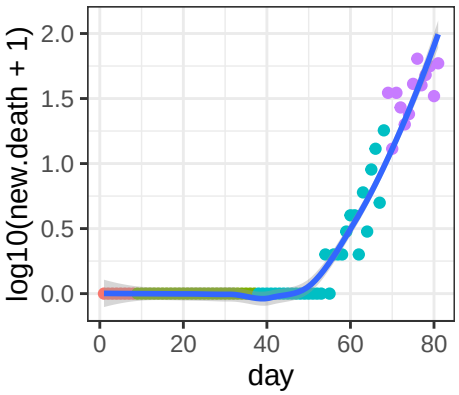
Suffolk_New York



data source: https://github.com/nytimes/covid−19−data, day 1 is 03−08

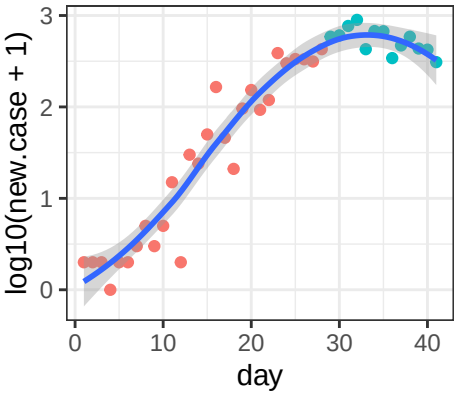
Cook_Illinois

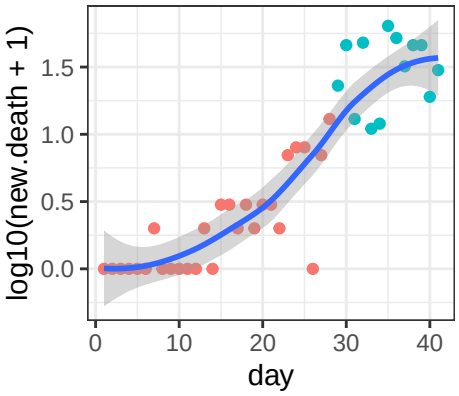




data source: https://github.com/nytimes/covid−19−data, day 1 is 01−24

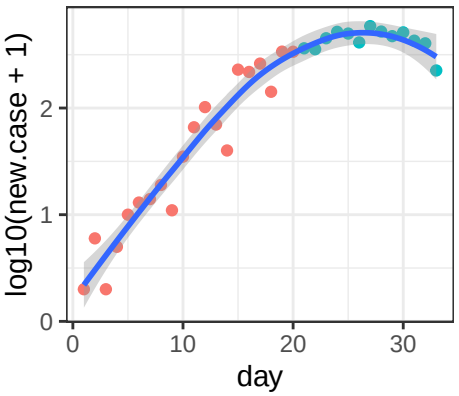
Bergen_New Jersey

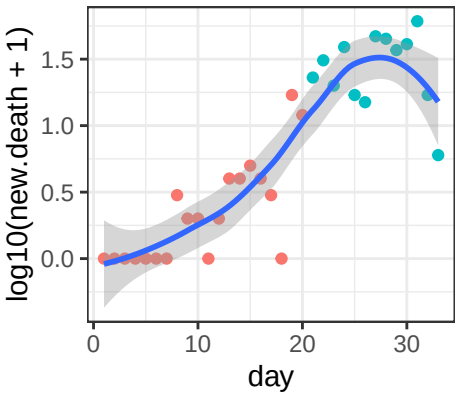




data source: https://github.com/nytimes/covid−19−data, day 1 is 03−04

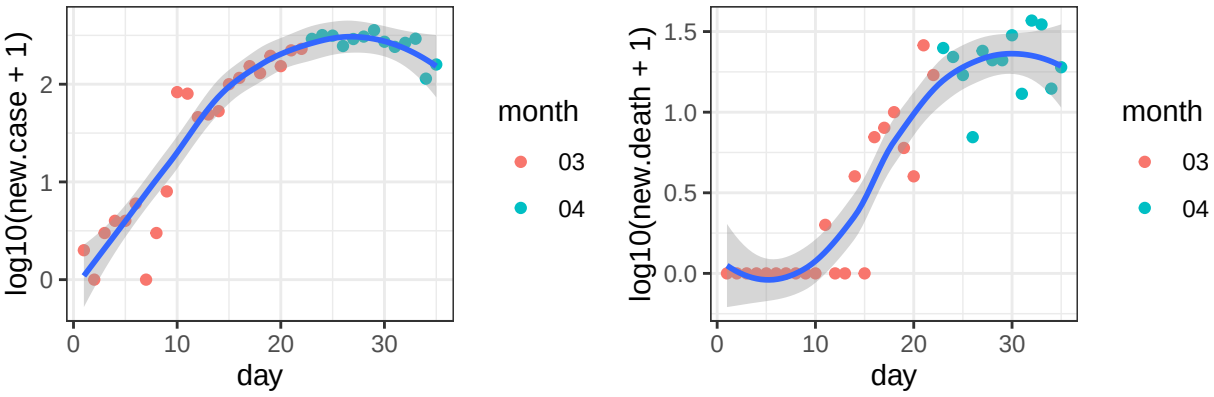
Essex_New Jersey





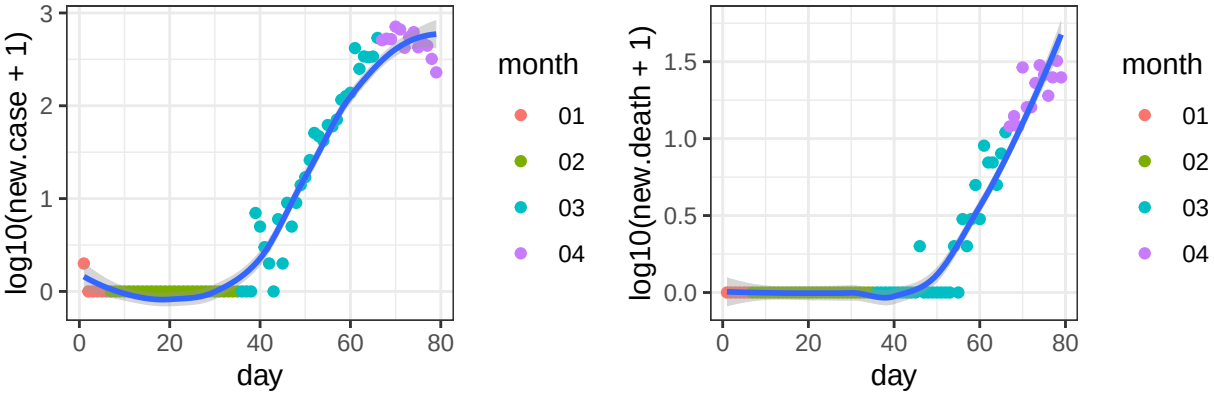
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−12

Oakland_Michigan



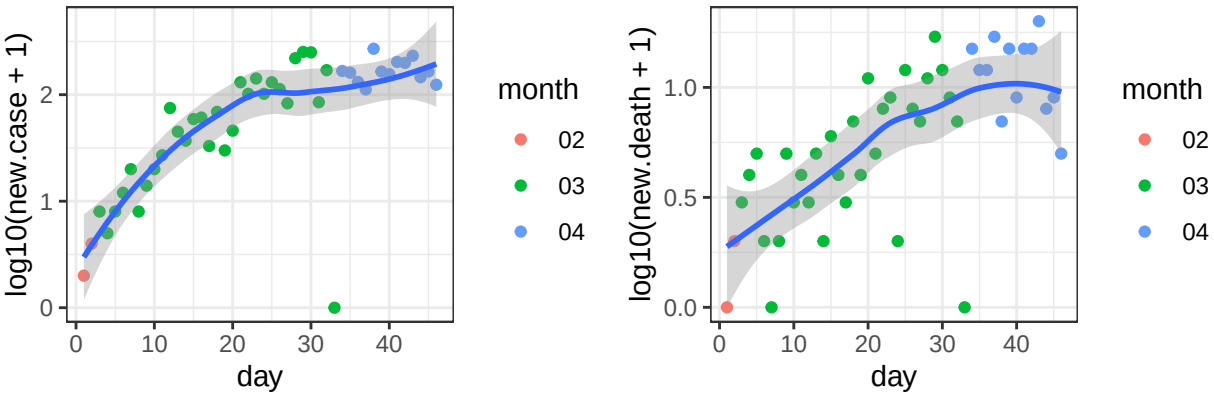
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Los Angeles_California



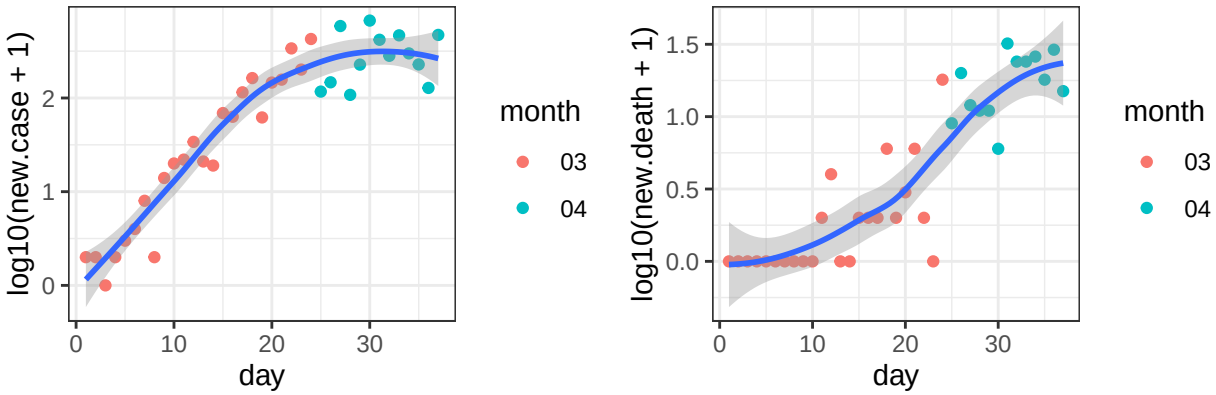
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−26

King_Washington



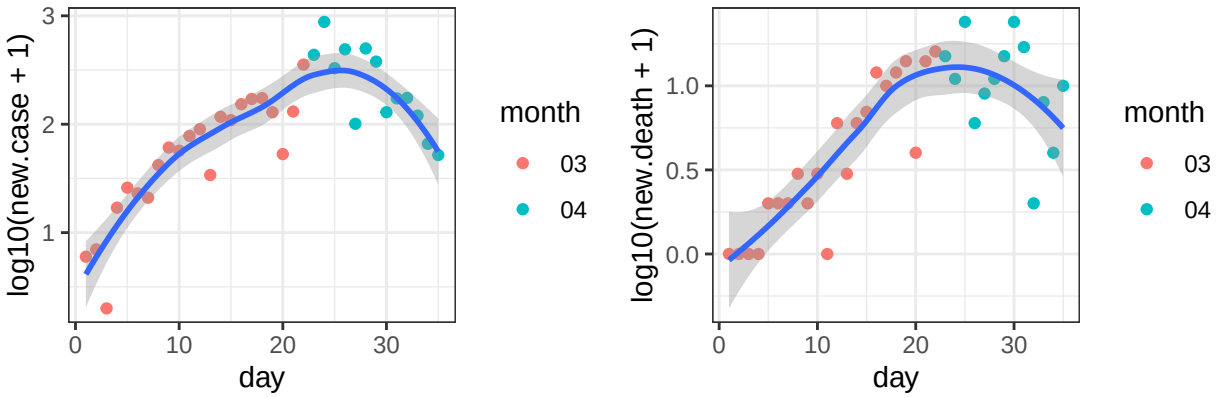
data source: https://github.com/nytimes/covid−19−data, day 1 is 02−28

Fairfield_Connecticut



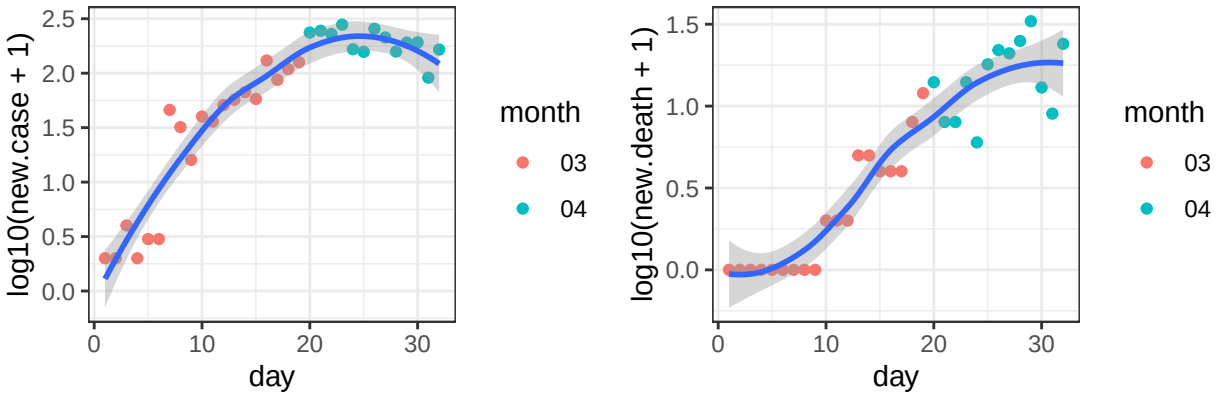
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−08

Orleans_Louisiana



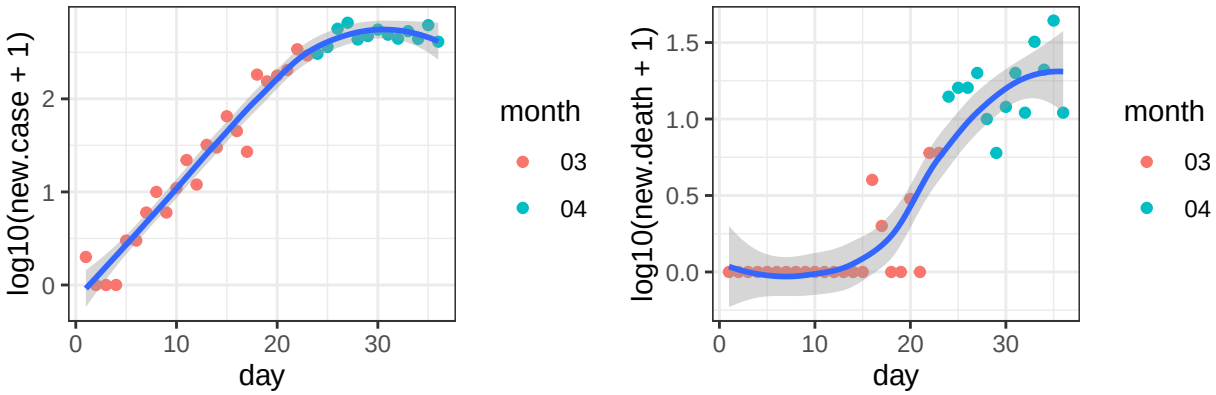
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Macomb_Michigan



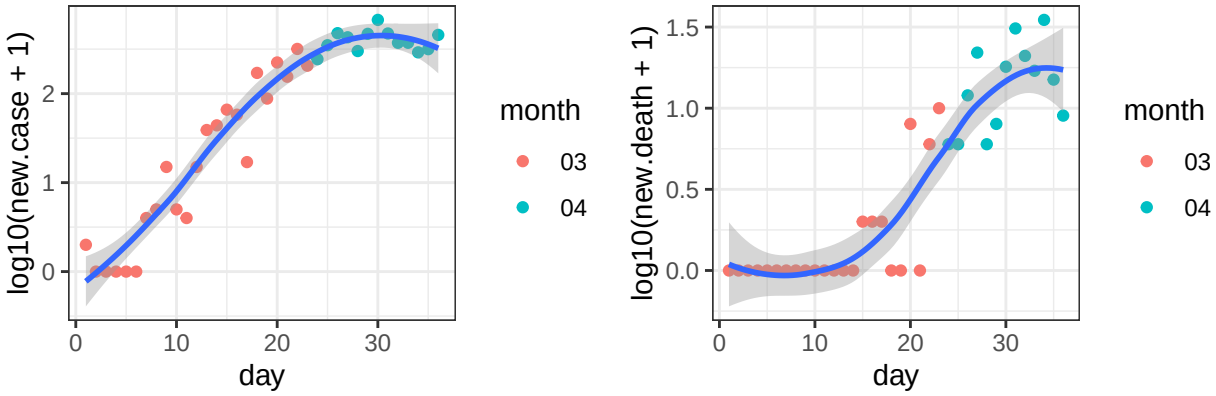
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−13

Hudson_New Jersey



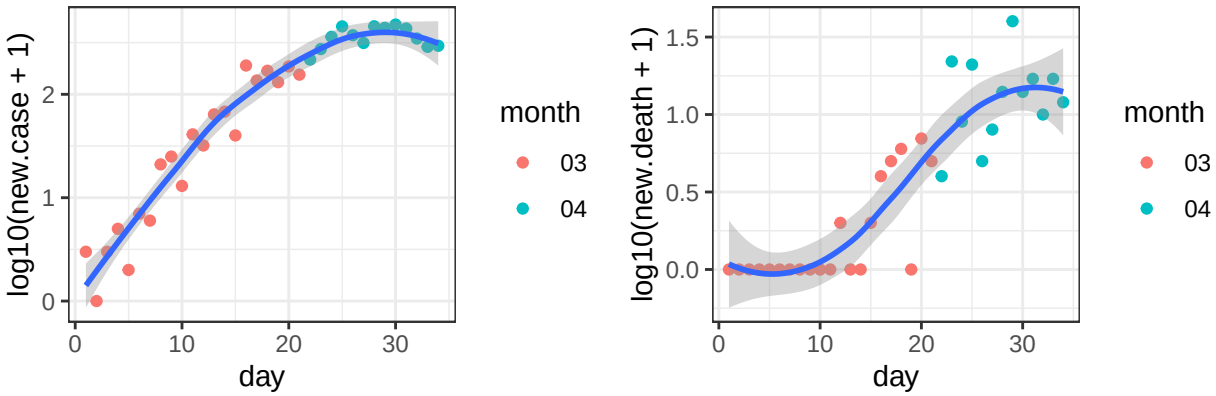
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−09

Union_New Jersey



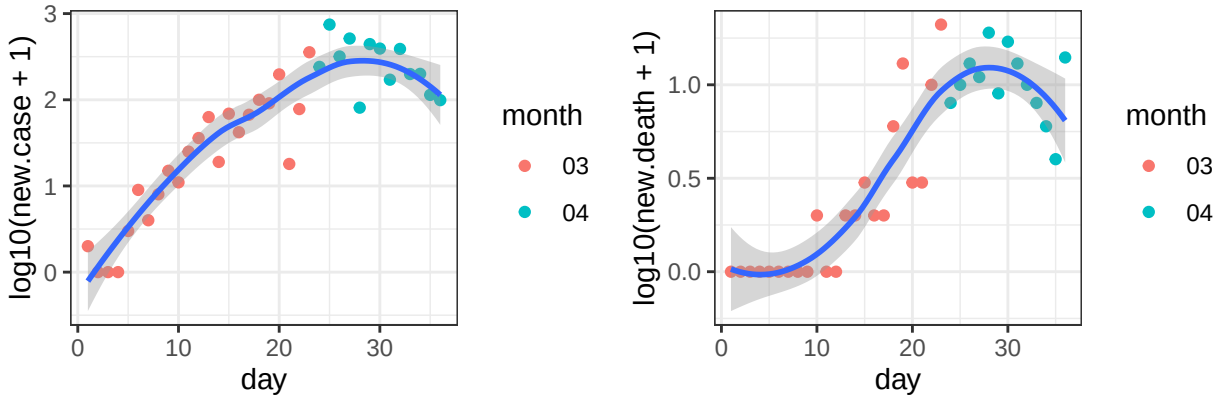
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−09

Middlesex_New Jersey



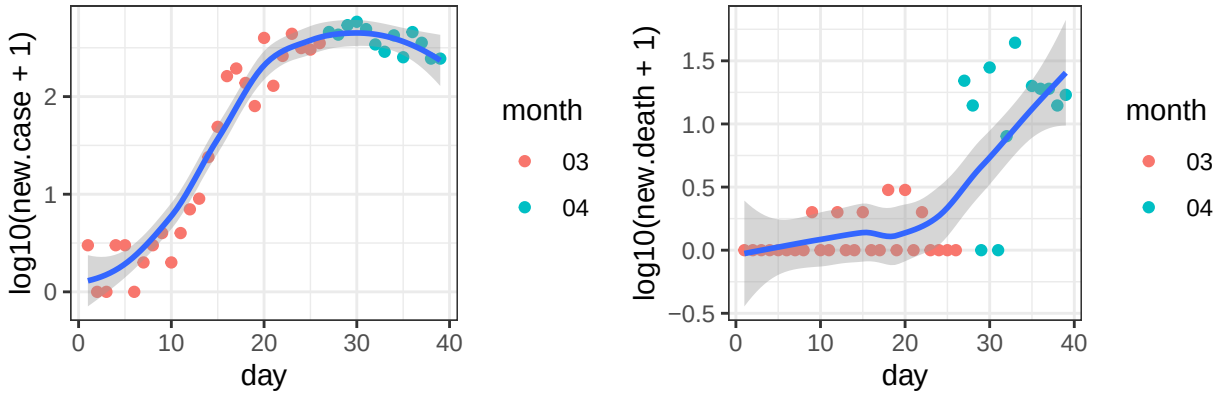
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−11

Jefferson_Louisiana



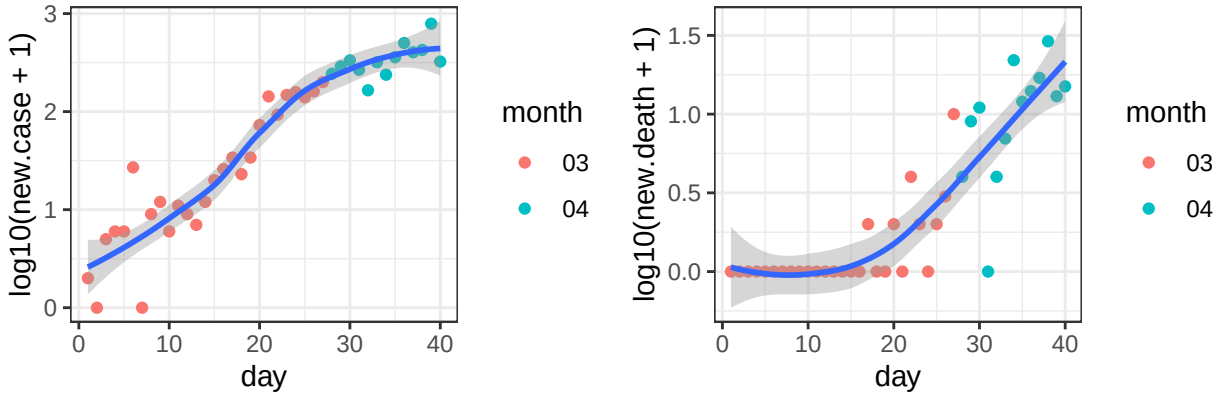
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−09

Rockland_New York



data source: https://github.com/nytimes/covid−19−data, day 1 is 03−06

Middlesex_Massachusetts



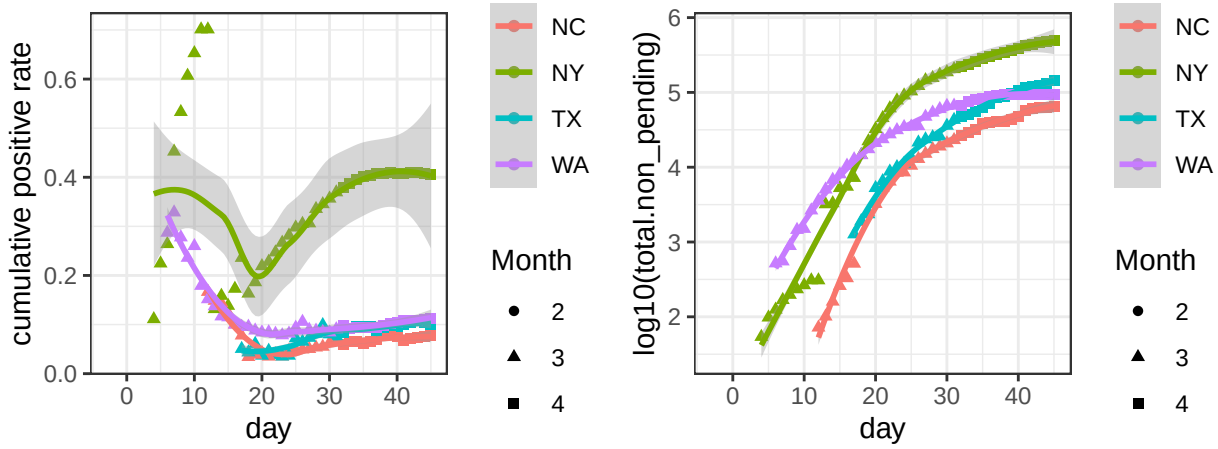
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

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 0414: 0.11(WA) 0.10(TX) 0.41(NY) 0.08(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
```