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

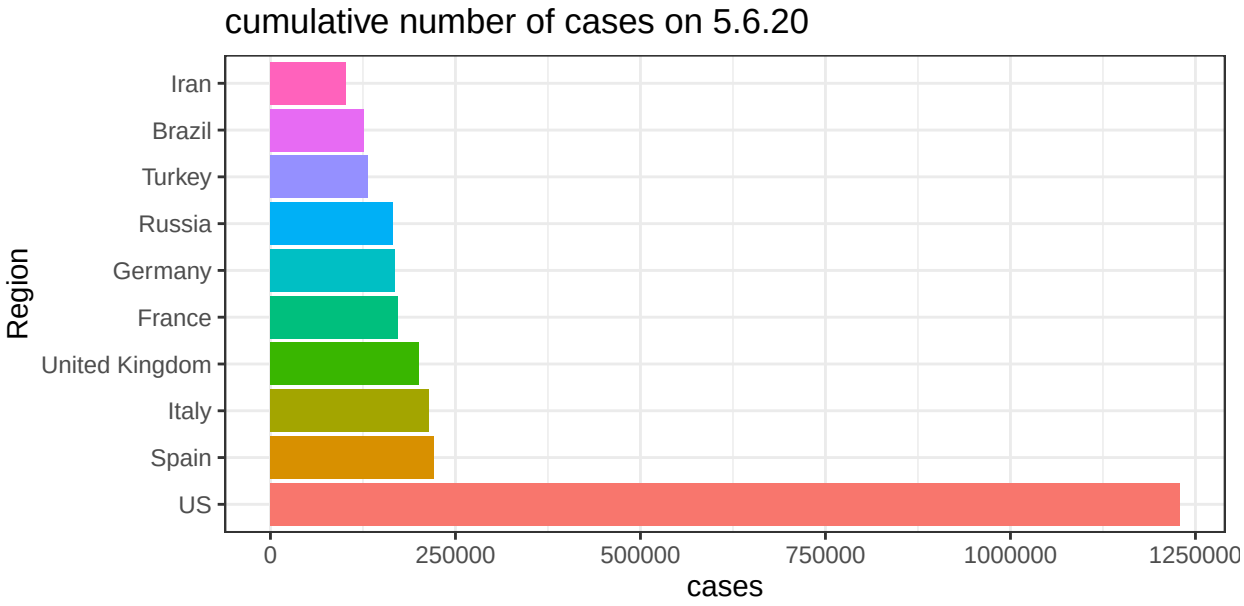
JHU

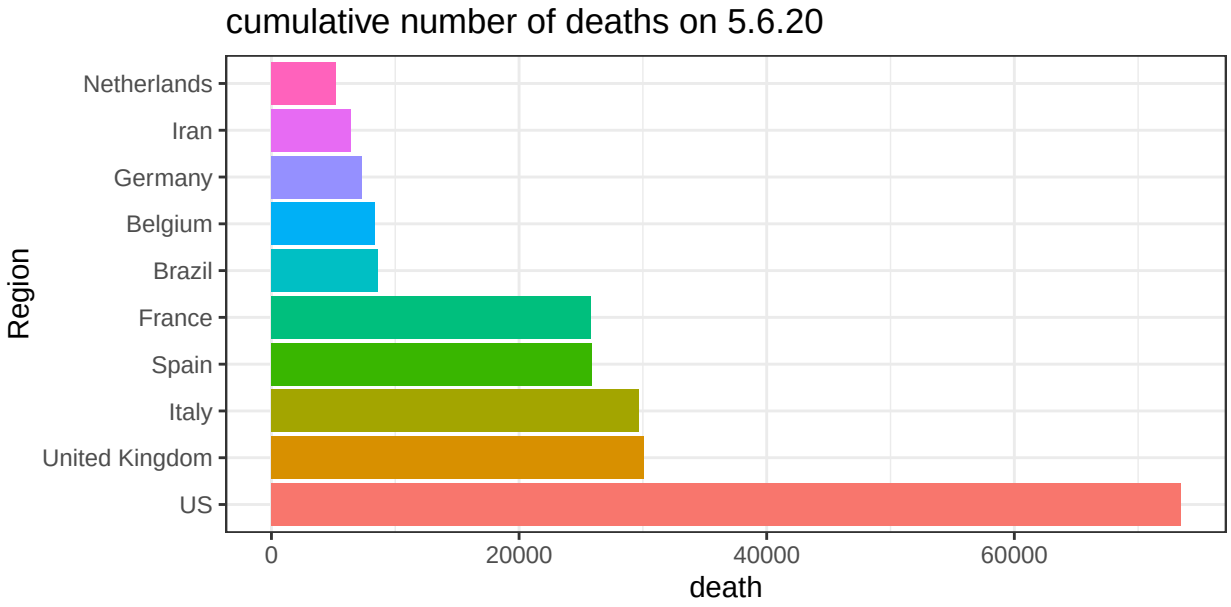
Assume you have cloned the JHU Github repository on your local machine at "../COVID-19".

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.

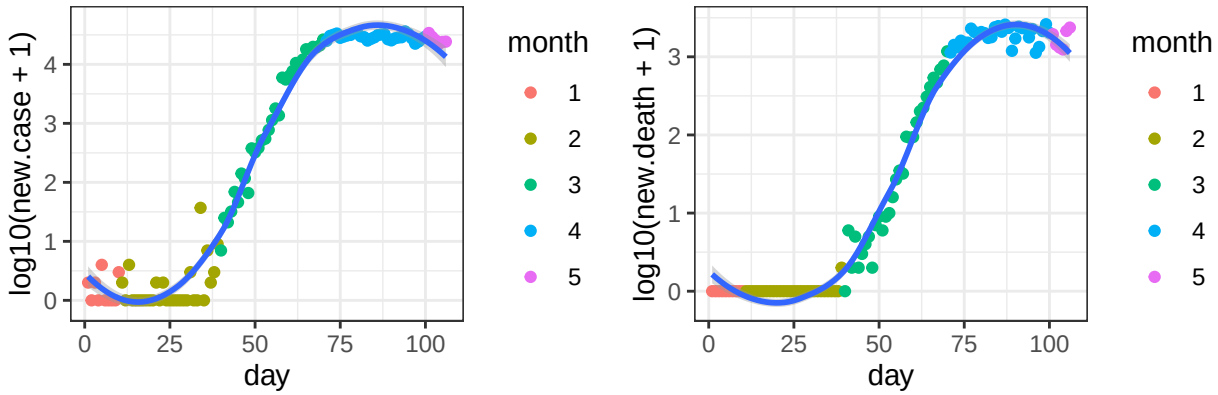
Here is the list of 10 records with the largest number of cases or deaths on the most recent date.





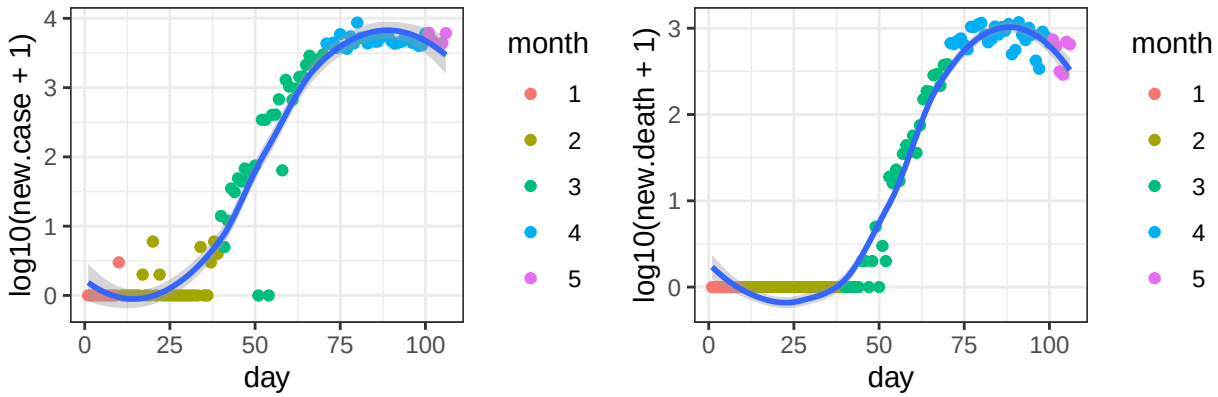
Next, I check for each country/region, what is the number of new cases/deaths? This data is important to understand what is the trend under different situations, e.g., population density, social distance policies etc. Here I checked the top 10 countries/regions with the highest number of deaths.

US



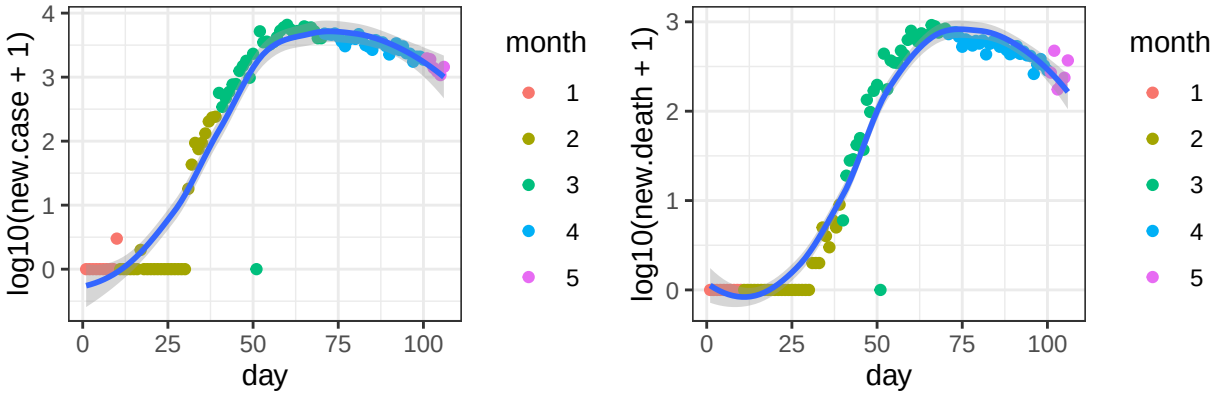
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

United Kingdom



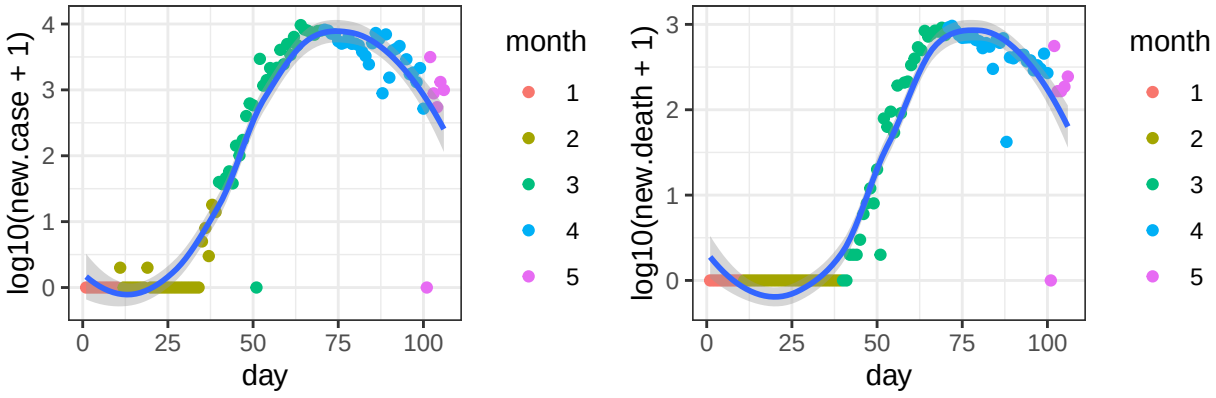
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Italy



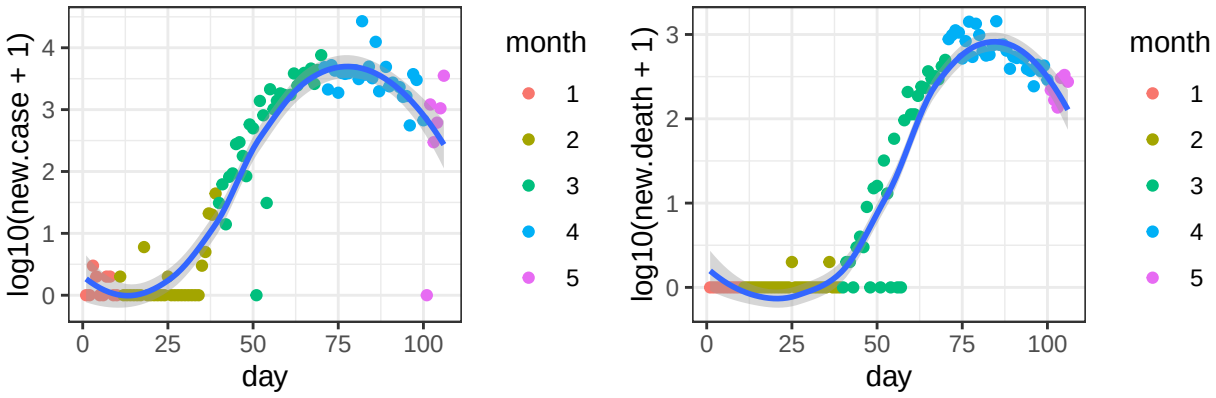
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Spain



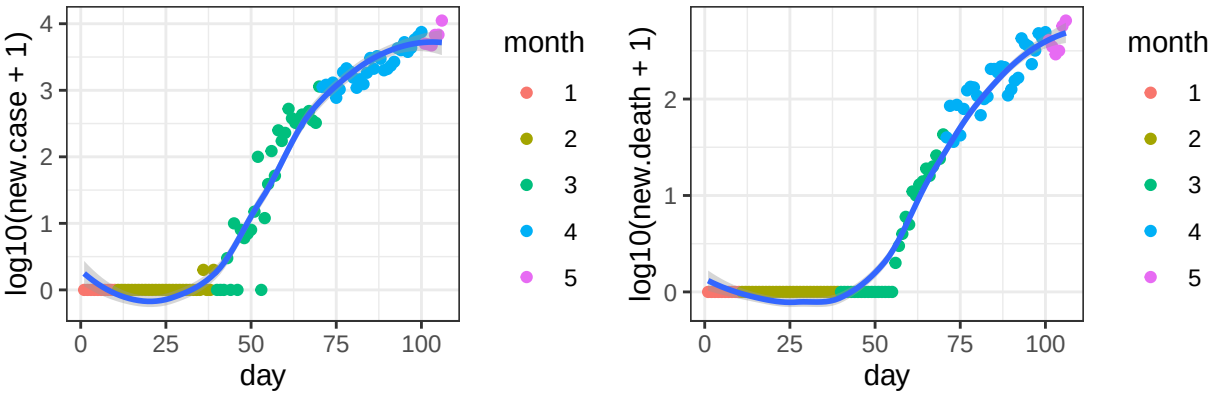
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

France



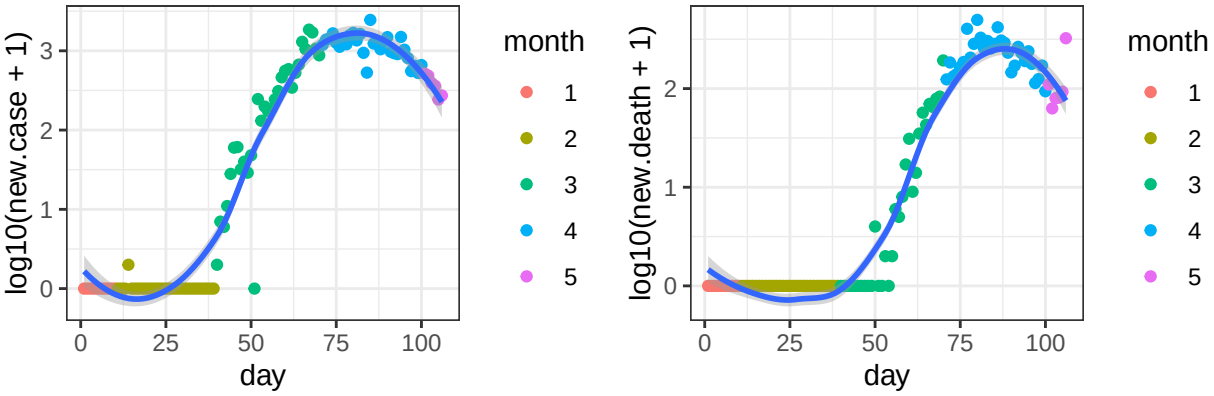
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Brazil



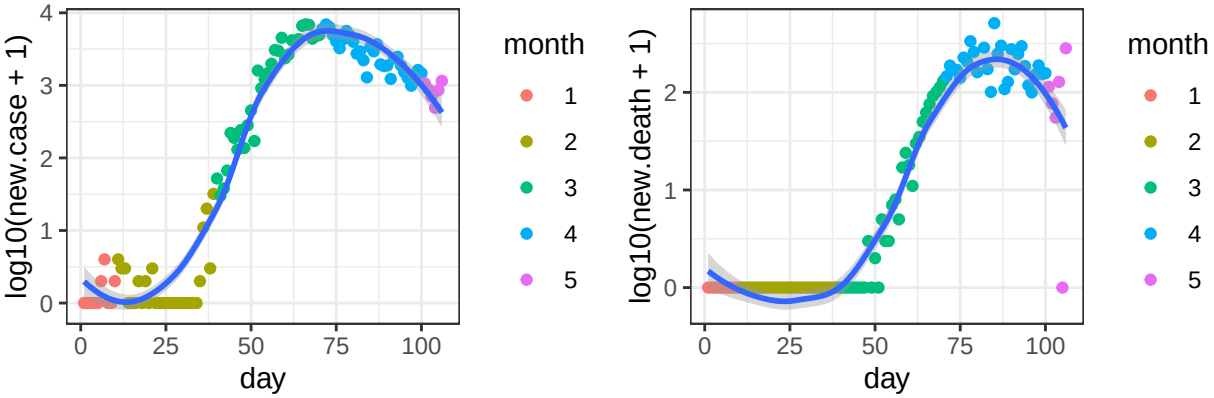
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Belgium



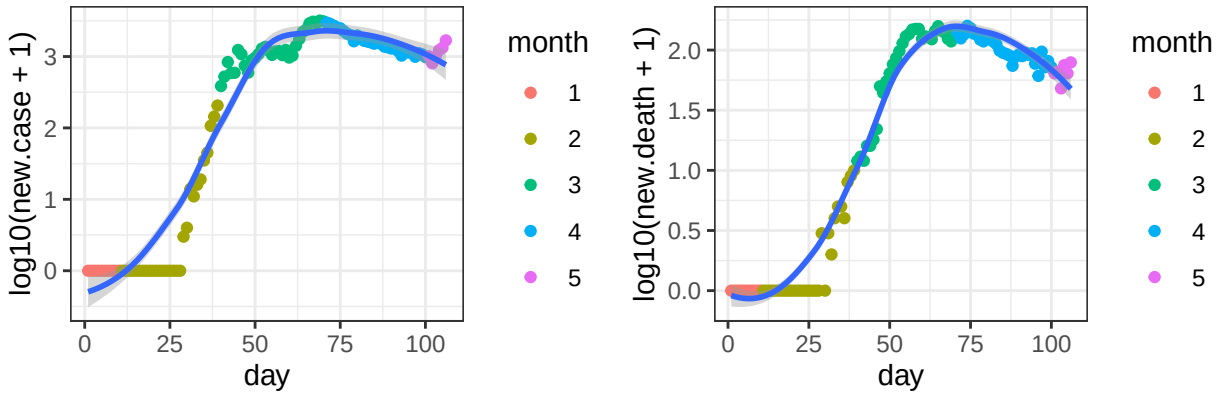
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Germany



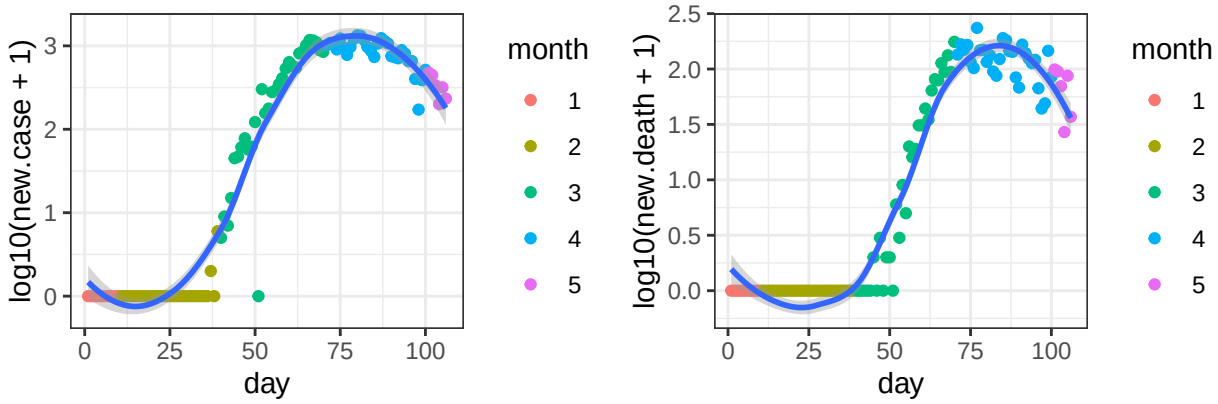
data source: https://github.com/CSSEGISandData/COVID−19, day 1 is 1/22/2020

Iran



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

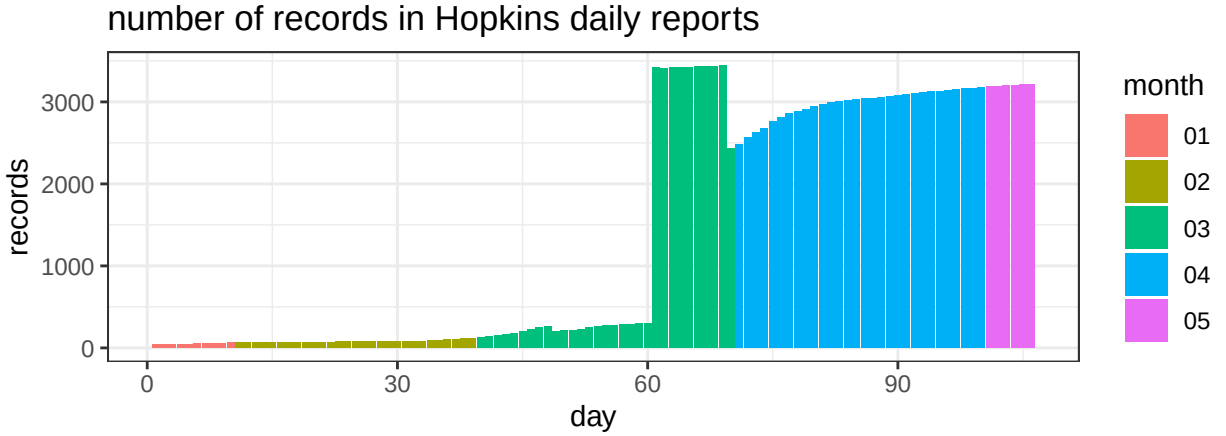
Netherlands



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

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] "2020-05-06"
```

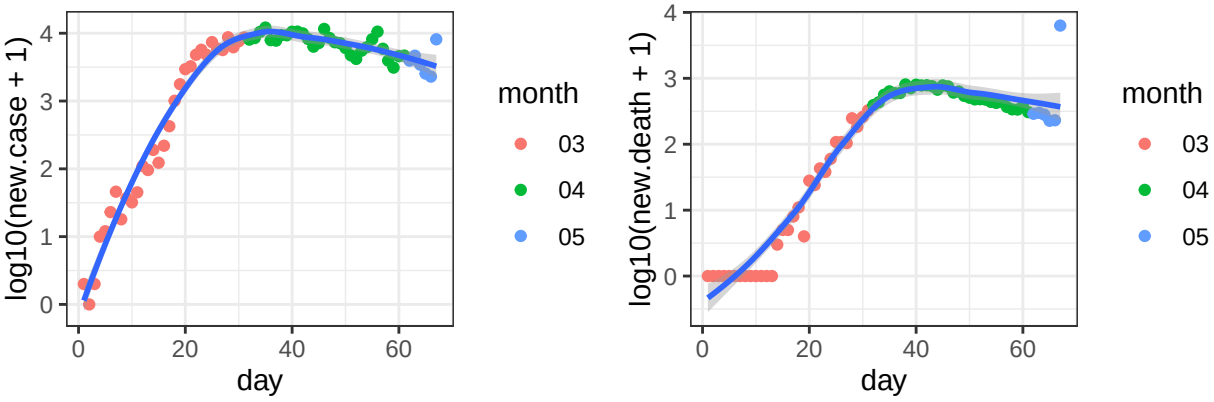
state level data

First check the 30 states with the largest number of deaths.

```
##            date                state fips  cases deaths
## 3568 2020-05-06             New York   36 329405  25956
## 3566 2020-05-06           New Jersey   34 131890   8549
## 3557 2020-05-06        Massachusetts   25  72025   4420
## 3558 2020-05-06             Michigan   26  45048   4250
## 3575 2020-05-06         Pennsylvania   42  54989   3360
## 3549 2020-05-06             Illinois   17  68164   2977
## 3541 2020-05-06          Connecticut    9  30995   2718
## 3539 2020-05-06           California    6  60787   2478
## 3554 2020-05-06            Louisiana   22  30399   2094
## 3544 2020-05-06              Florida   12  37994   1538
## 3556 2020-05-06             Maryland   24  28263   1443
## 3550 2020-05-06              Indiana   18  22286   1377
## 3545 2020-05-06              Georgia   13  29724   1309
## 3572 2020-05-06                 Ohio   39  21576   1225
## 3581 2020-05-06                Texas   48  35438    985
## 3540 2020-05-06             Colorado    8  17720    919
## 3586 2020-05-06           Washington   53  16713    881
## 3585 2020-05-06             Virginia   51  20256    713
## 3569 2020-05-06       North Carolina   37  12783    497
## 3559 2020-05-06            Minnesota   27   8579    485
## 3561 2020-05-06             Missouri   29   9164    429
## 3537 2020-05-06              Arizona    4   9707    426
## 3560 2020-05-06          Mississippi   28   8424    374
## 3577 2020-05-06         Rhode Island   44  10205    370
## 3588 2020-05-06            Wisconsin   55   8901    362
## 3535 2020-05-06              Alabama    1   8691    343
## 3578 2020-05-06       South Carolina   45   6936    305
## 3553 2020-05-06             Kentucky   21   5946    286
## 3564 2020-05-06               Nevada   32   5774    286
## 3543 2020-05-06 District of Columbia   11   5461    277
```

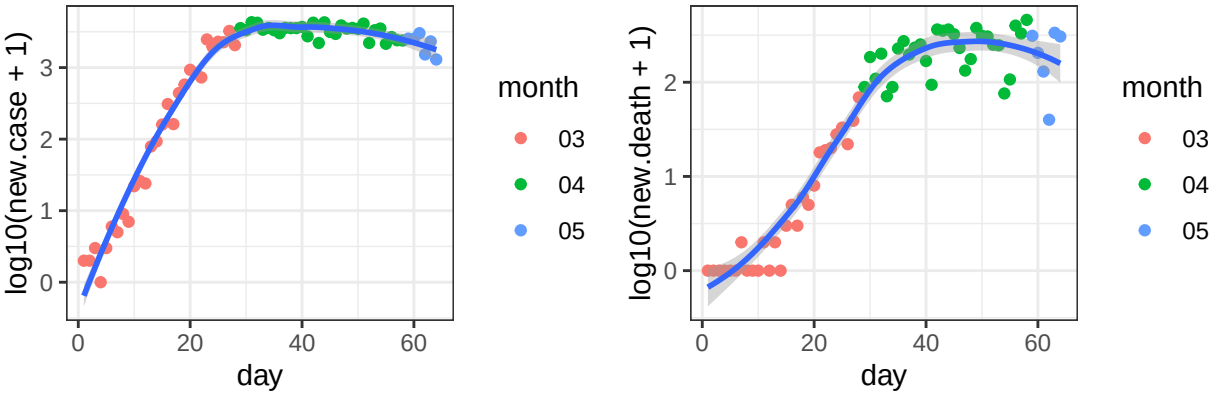
For these 20 states, I check the number of new cases and the number of new deaths. Part of the reason for such checking is to identify whether there is any similarity on such patterns. For example, could you use the pattern seen from Italy to predict what happen in an individual state, and what are the similarities and differences across states.

New York



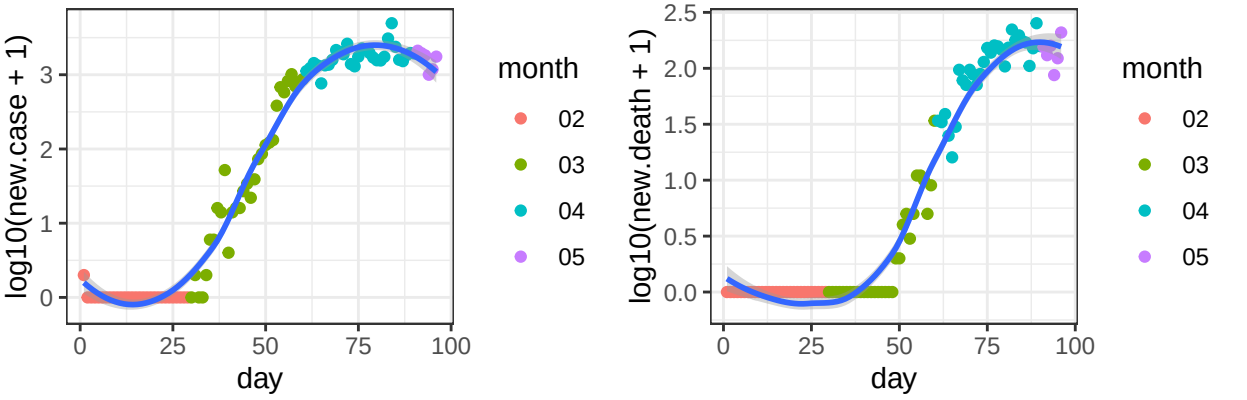
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

New Jersey



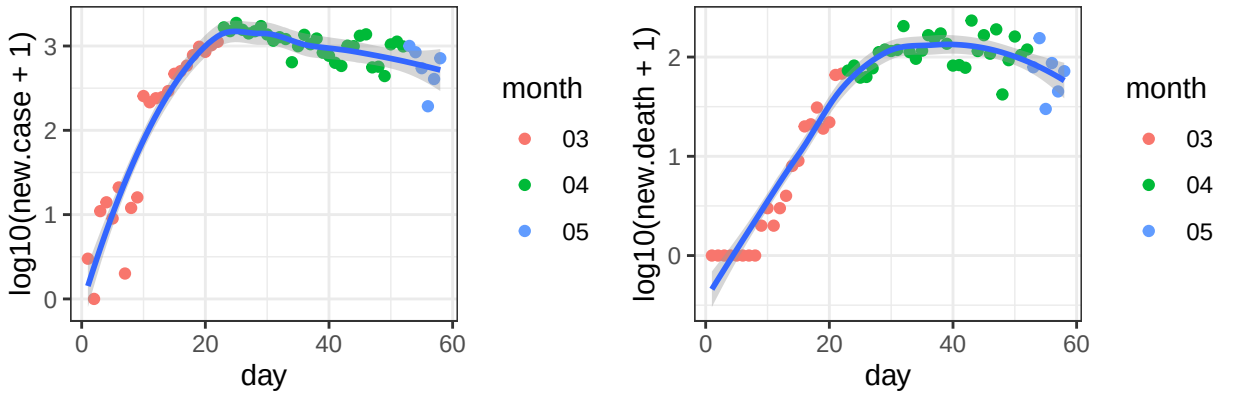
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−04

Massachusetts



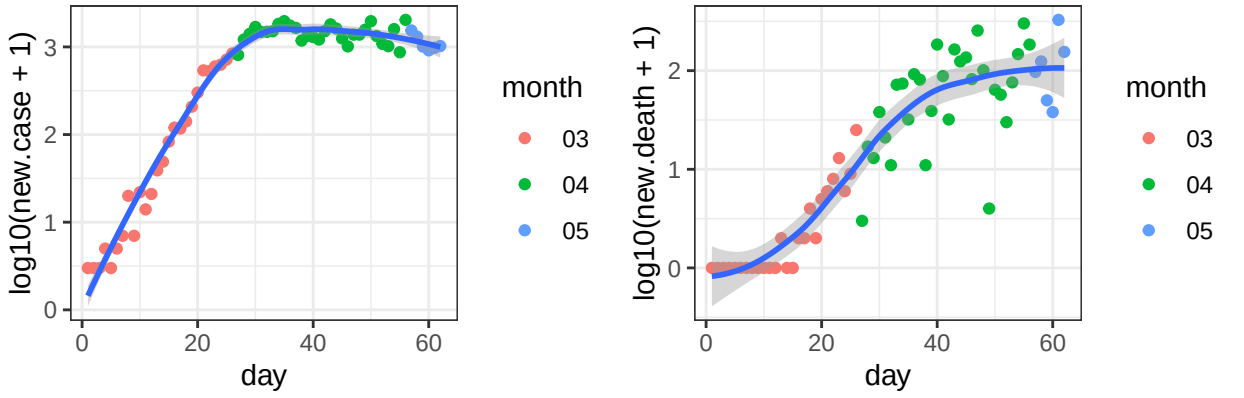
data source: https://github.com/nytimes/covid−19−data, day 1 is 02−01

Michigan



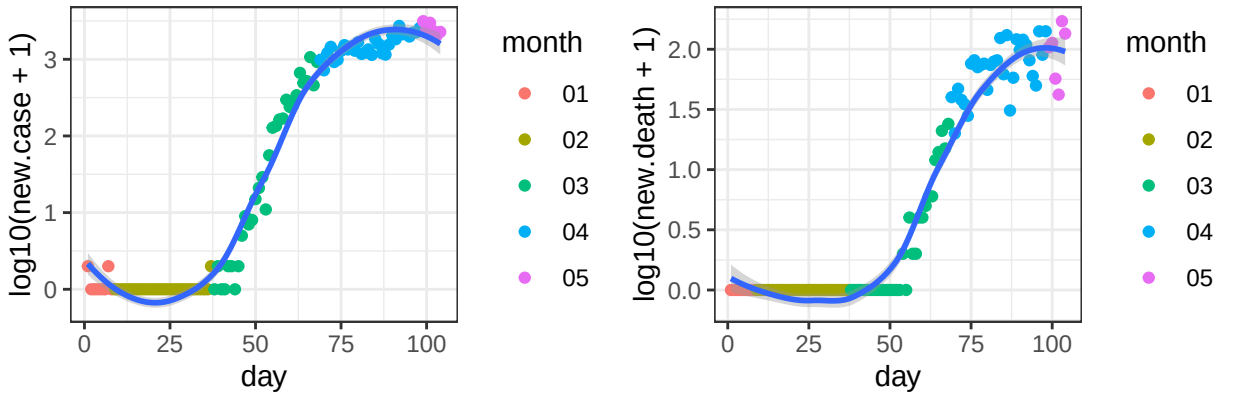
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Pennsylvania



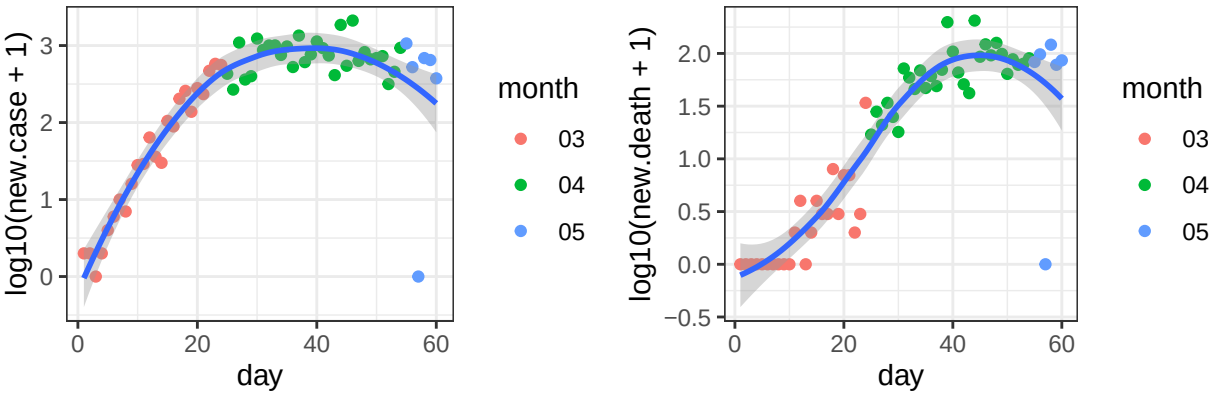
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−06

Illinois



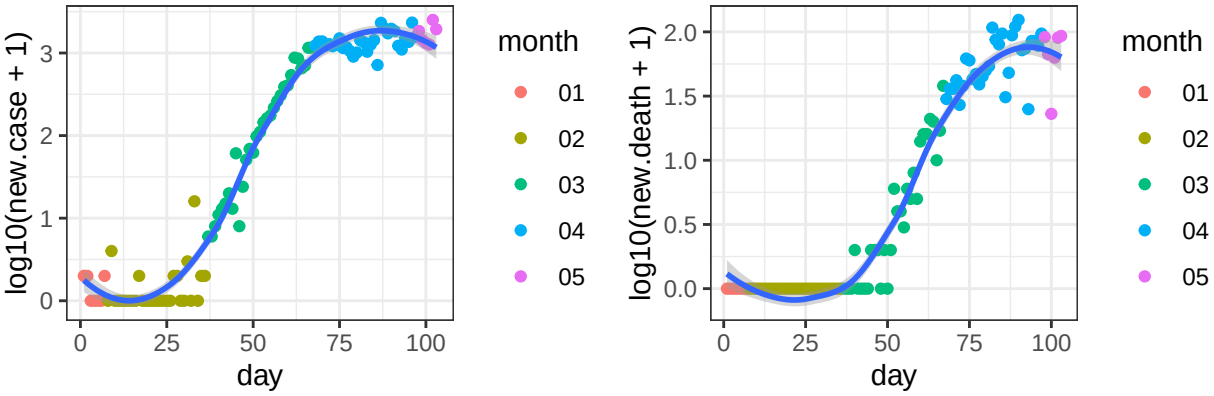
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−24

Connecticut



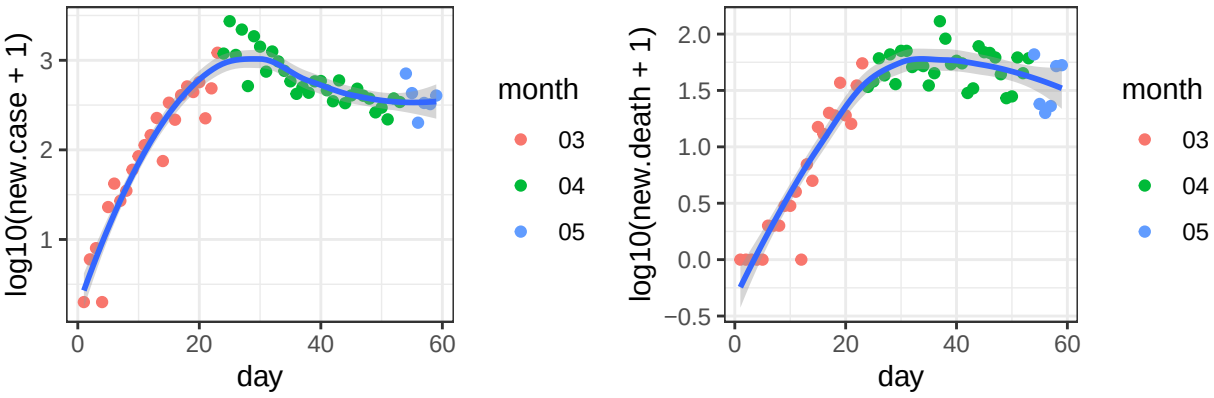
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−08

California



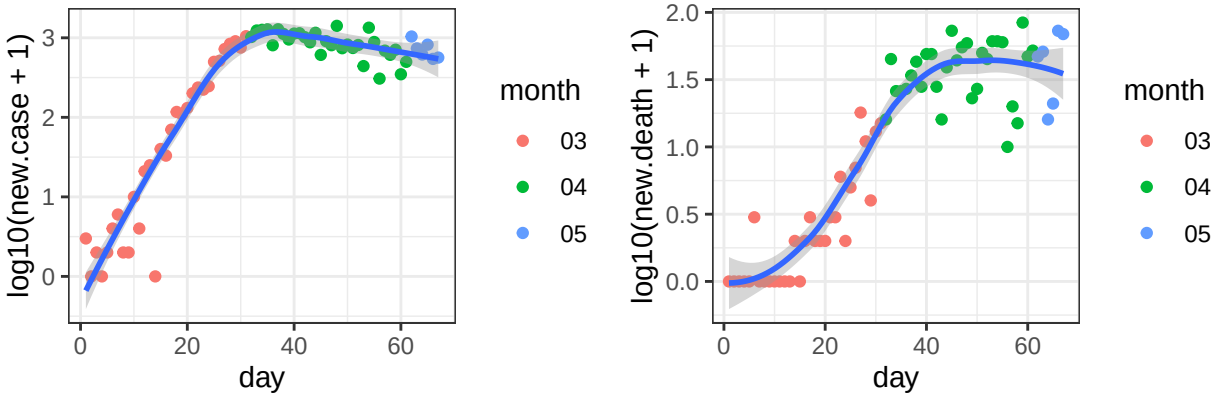
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−25

Louisiana



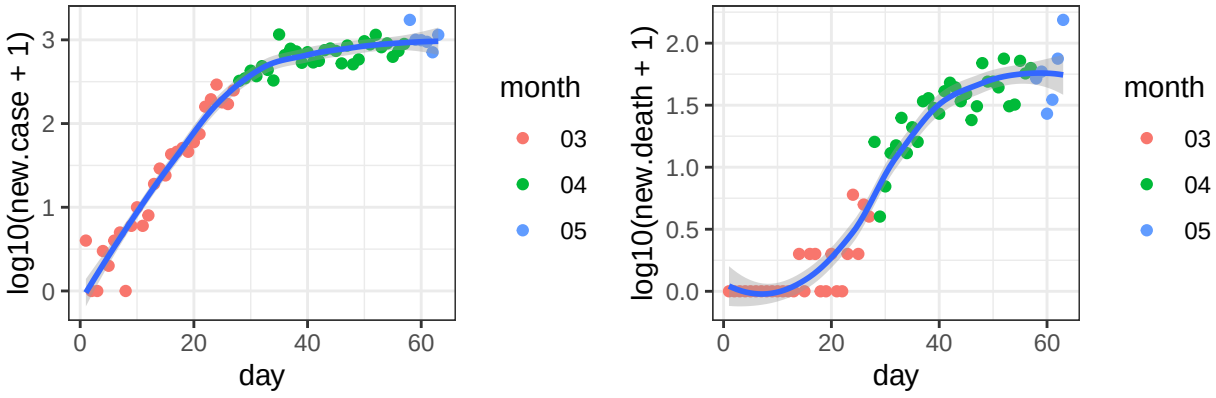
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−09

Florida



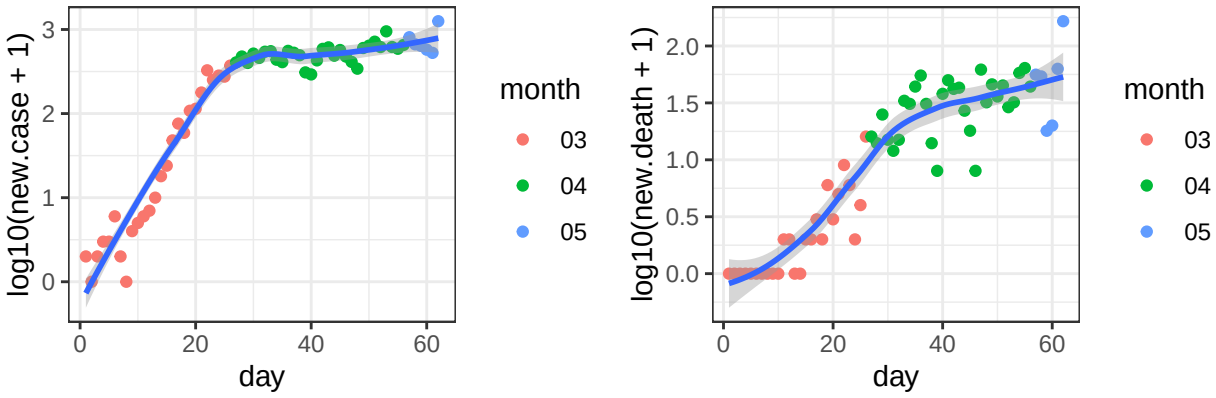
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

Maryland



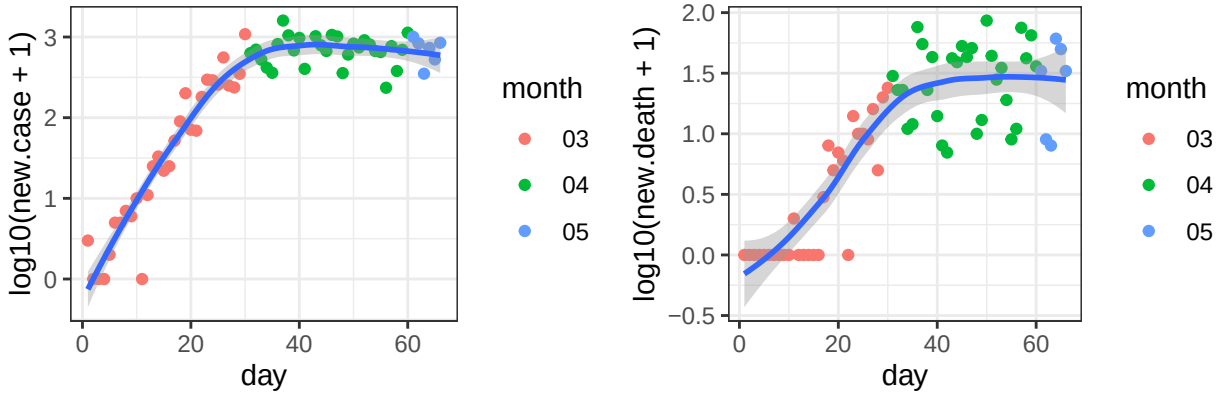
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

Indiana



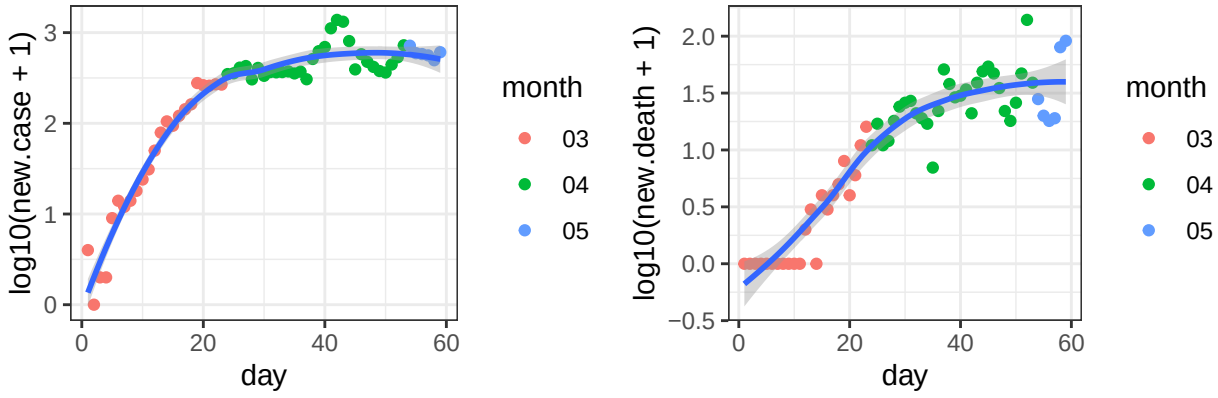
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−06

Georgia



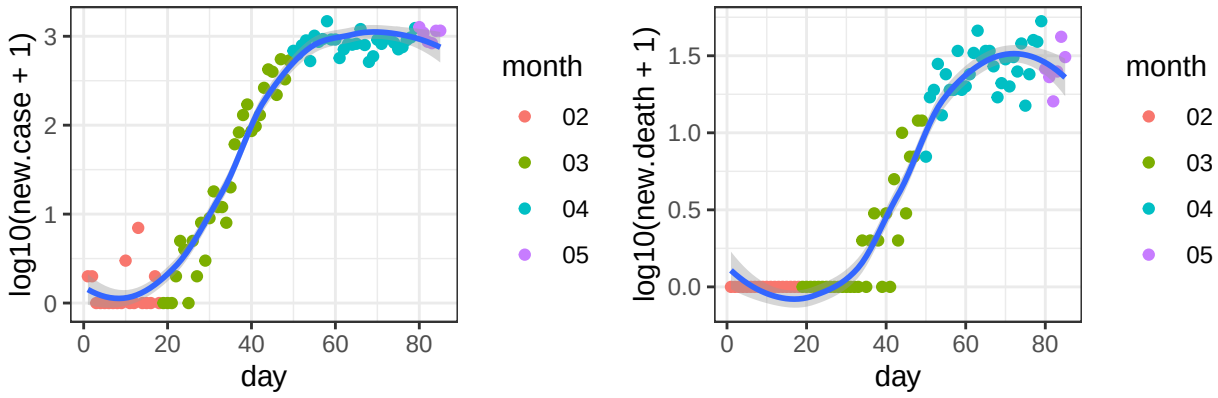
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−02

Ohio



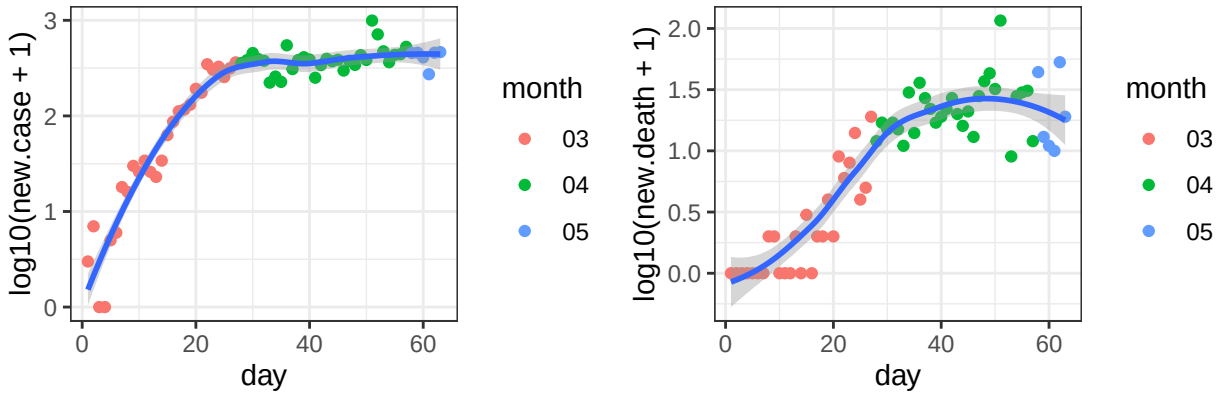
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−09

Texas



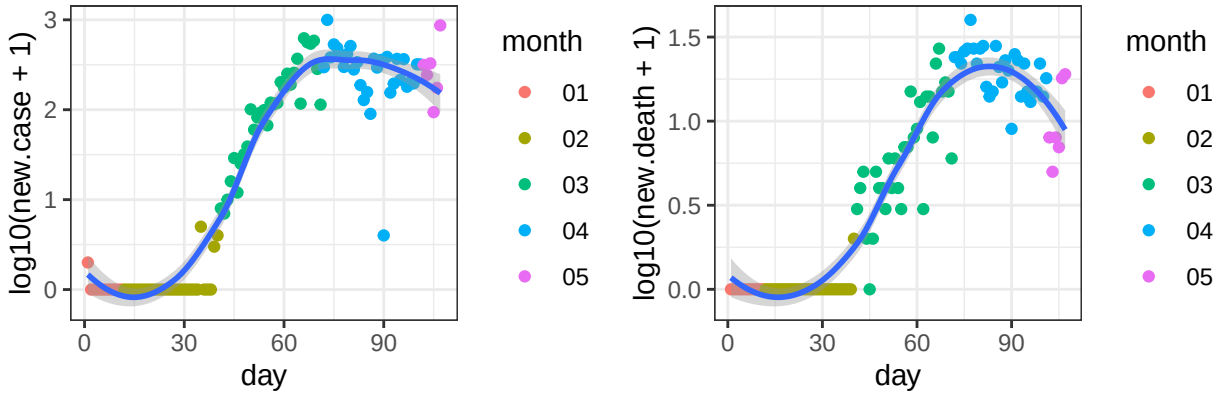
data source: https://github.com/nytimes/covid−19−data, day 1 is 02−12

Colorado



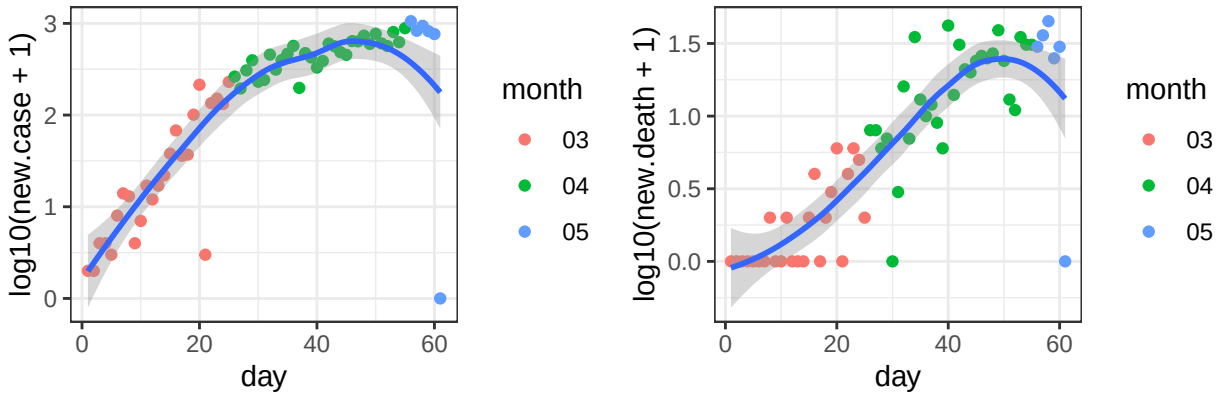
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

Washington



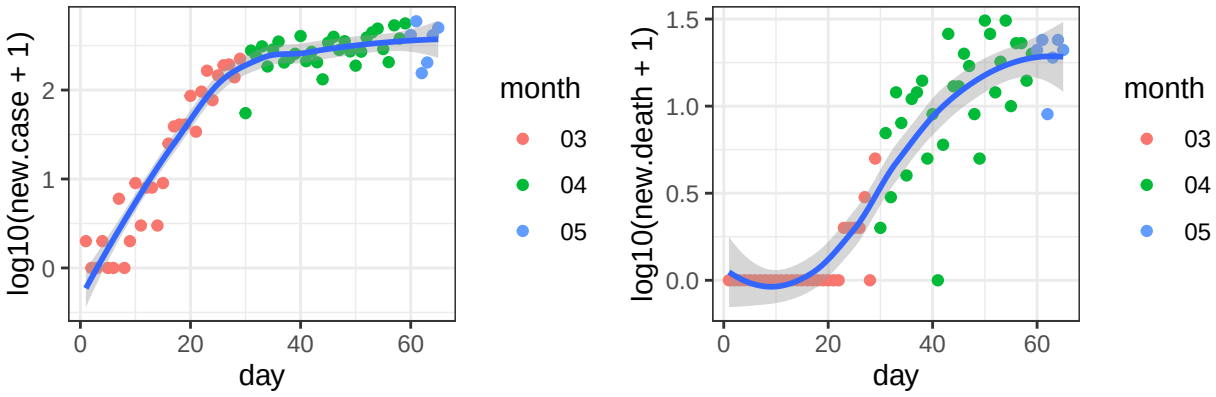
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−21

Virginia



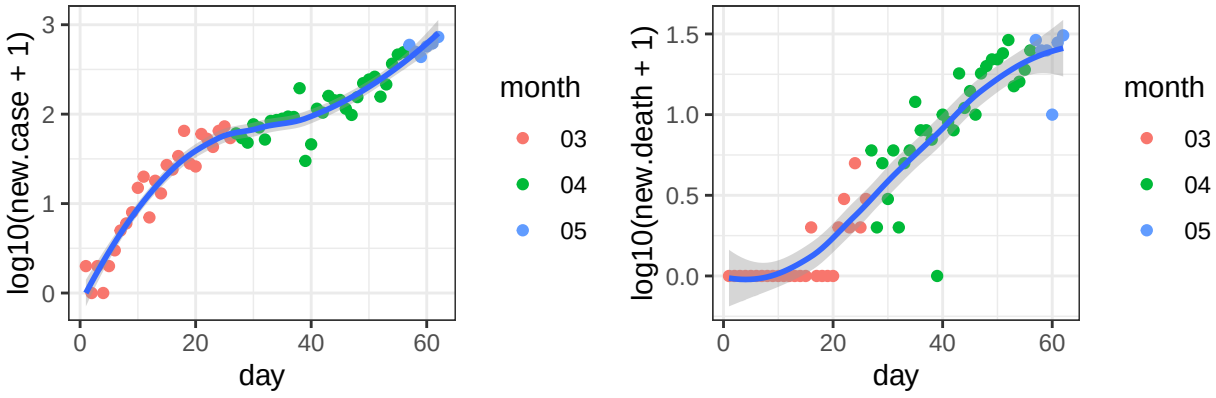
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−07

North Carolina



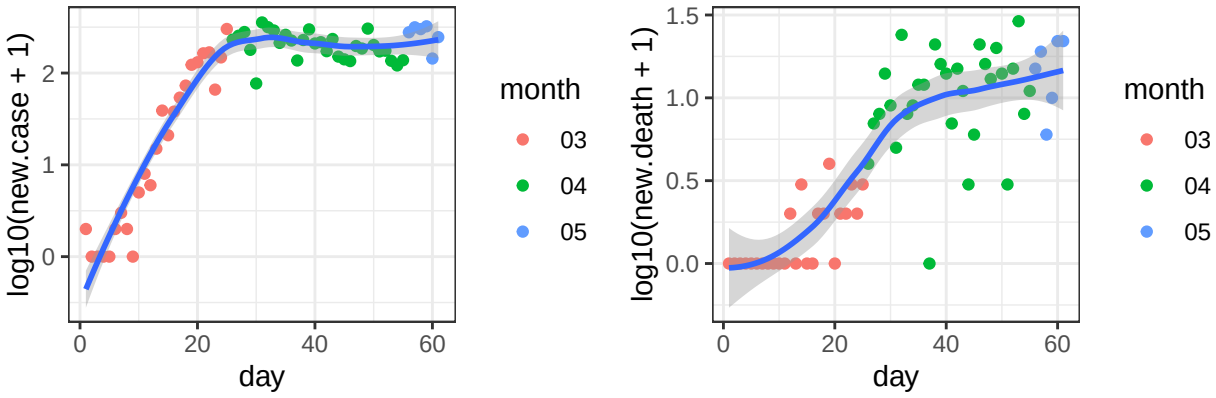
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−03

Minnesota



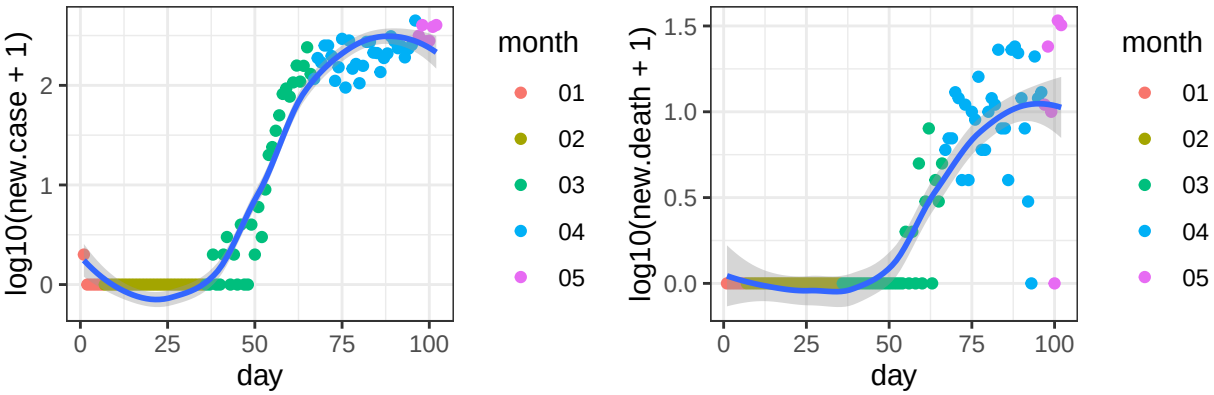
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−06

Missouri



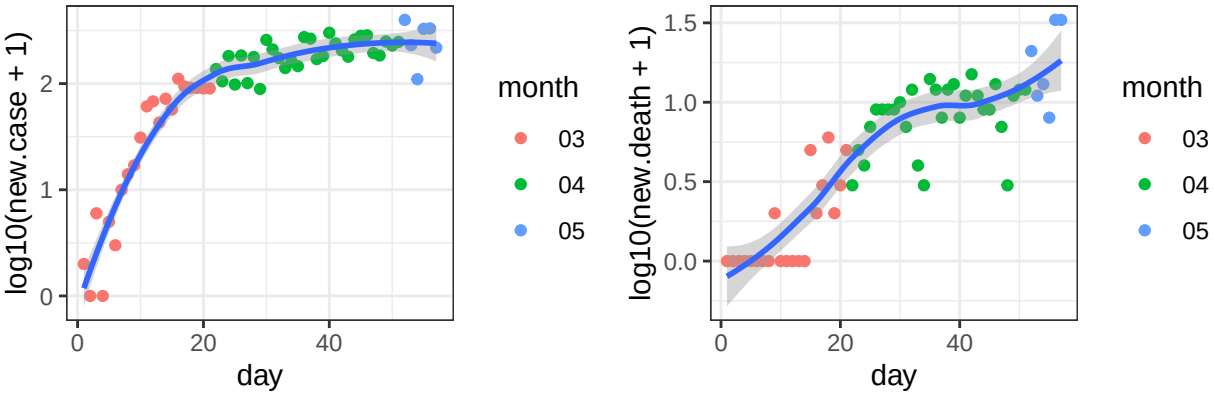
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−07

Arizona



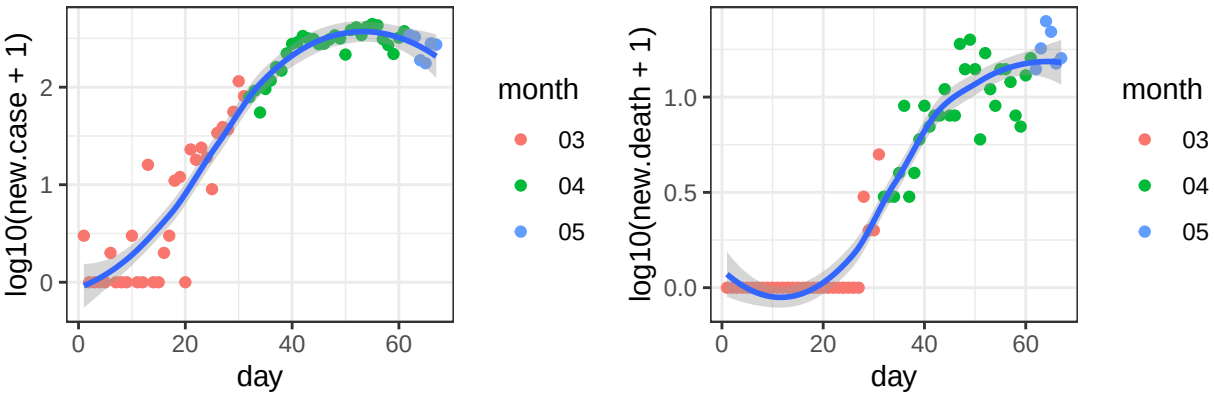
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−26

Mississippi



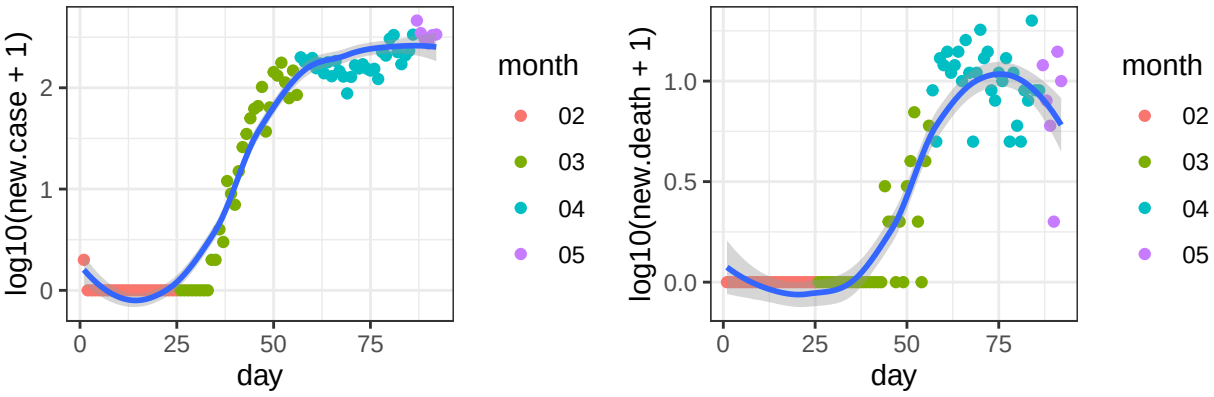
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−11

Rhode Island



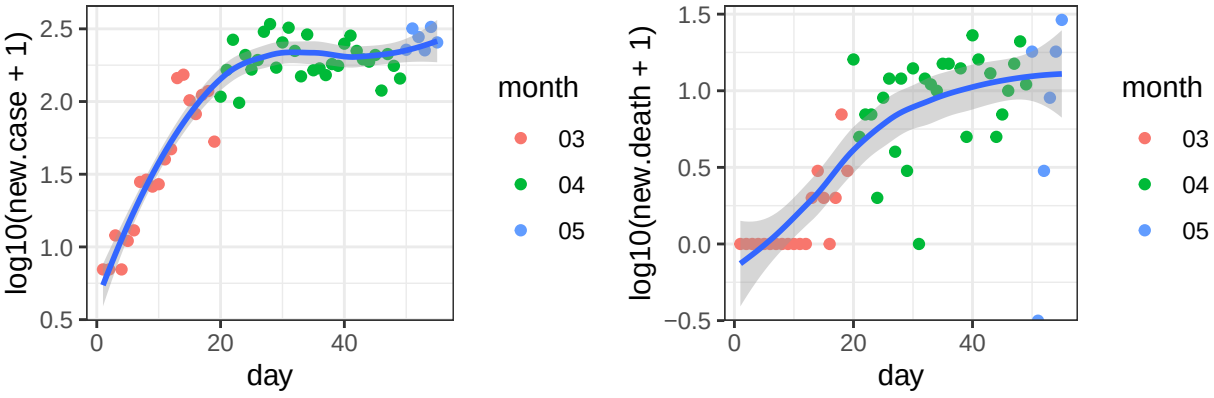
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

Wisconsin



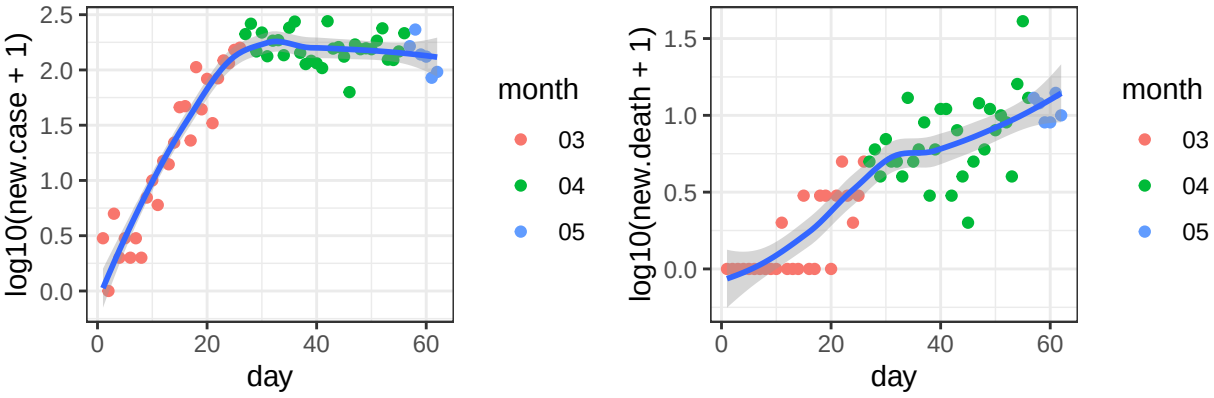
data source: https://github.com/nytimes/covid−19−data, day 1 is 02−05

Alabama



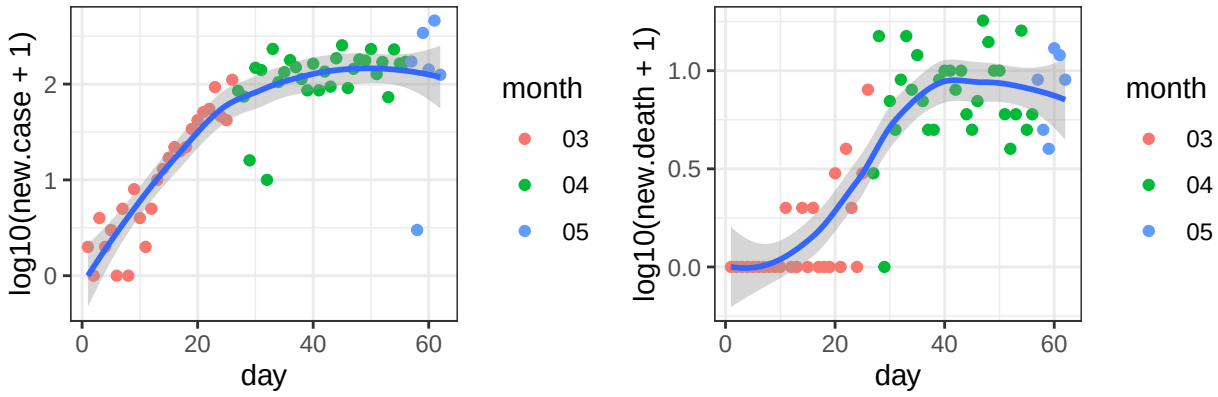
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−13

South Carolina



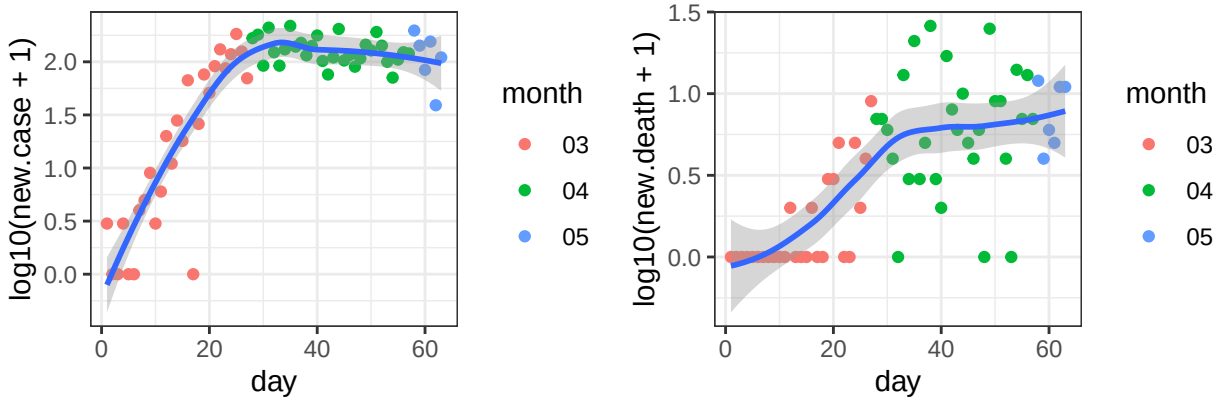
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−06

Kentucky



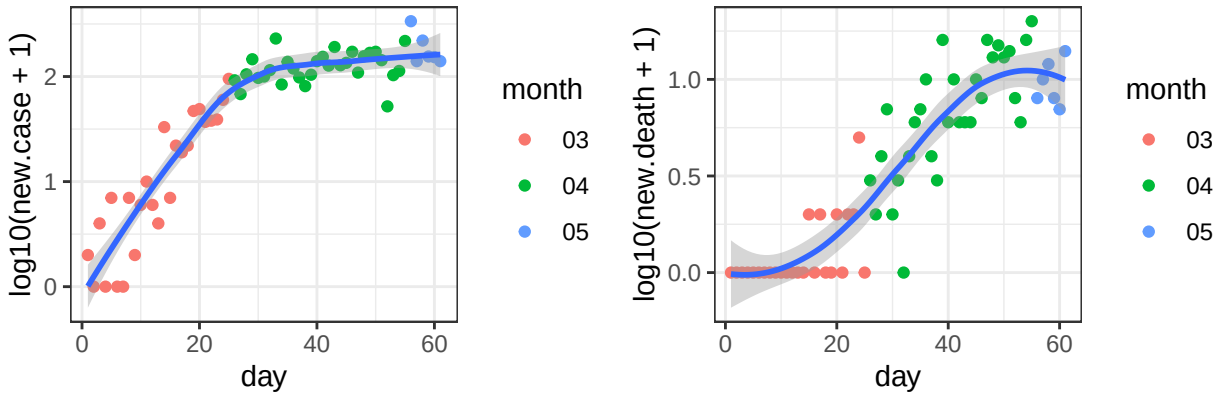
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−06

Nevada



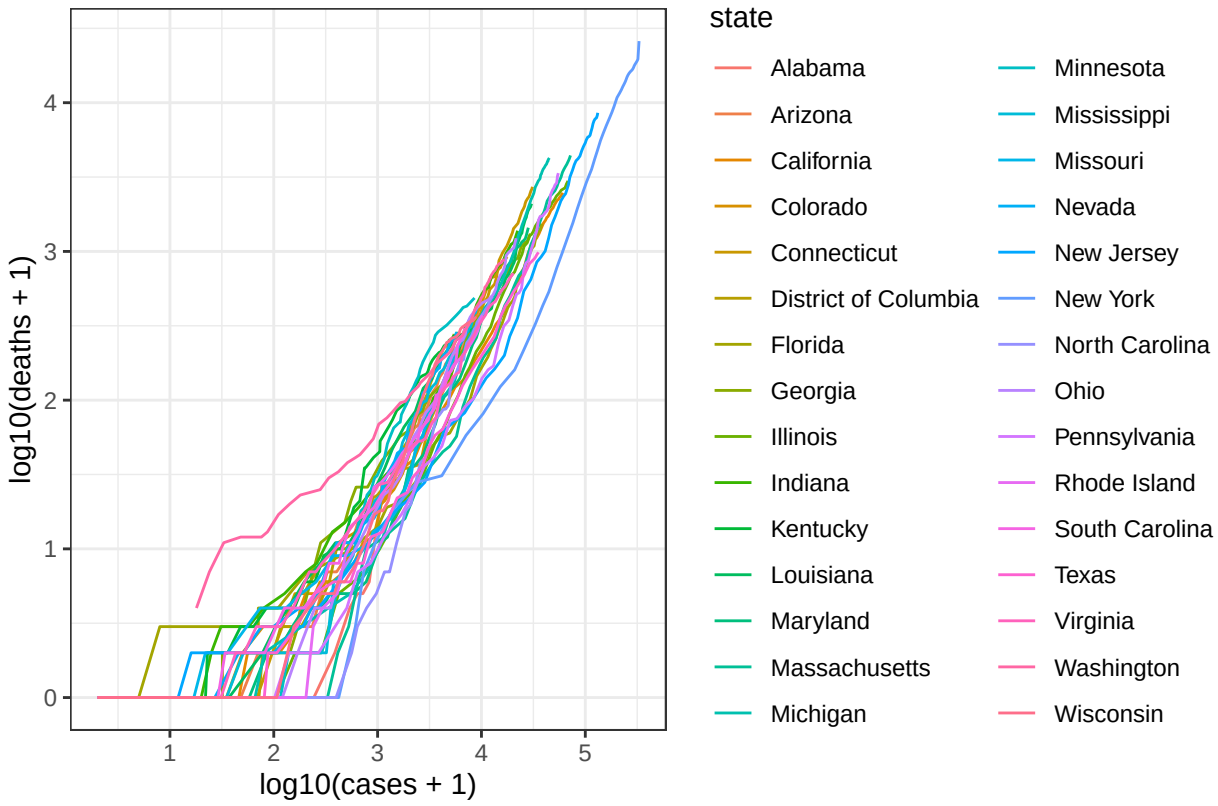
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

District of Columbia



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

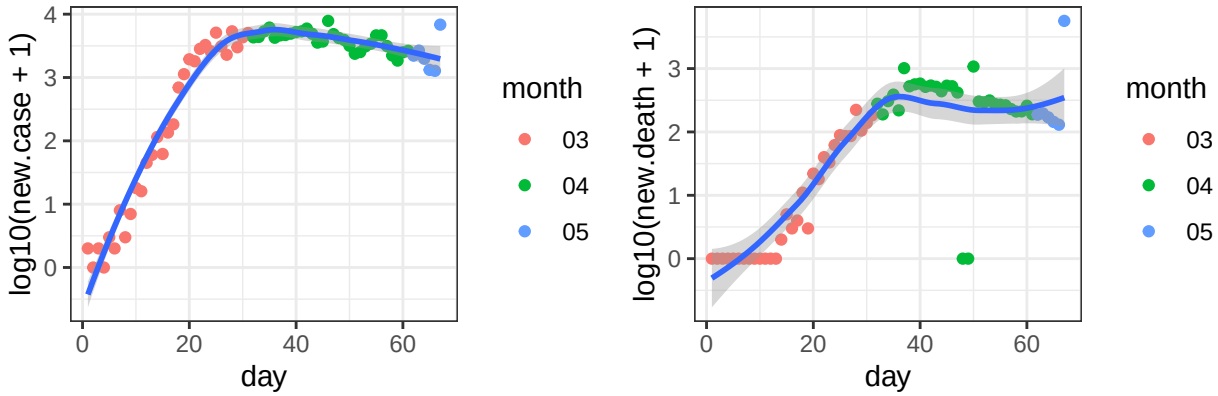
First check the 30 counties with the largest number of deaths.

```
##              date        county         state  fips  cases deaths
## 119857 2020-05-06 New York City      New York    NA 183770  18993
## 119856 2020-05-06        Nassau      New York 36059  37350   2325
## 118727 2020-05-06          Cook      Illinois 17031  46689   2004
## 119390 2020-05-06         Wayne      Michigan 26163  17571   1973
## 119876 2020-05-06       Suffolk      New York 36103  35543   1574
## 118338 2020-05-06   Los Angeles    California  6037  28644   1367
## 119782 2020-05-06         Essex    New Jersey 34013  14951   1349
## 119777 2020-05-06        Bergen    New Jersey 34003  16520   1289
## 119885 2020-05-06   Westchester      New York 36119  30426   1285
## 119305 2020-05-06     Middlesex Massachusetts 25017  16327   1070
## 118433 2020-05-06     Fairfield   Connecticut  9001  12455    952
## 119784 2020-05-06        Hudson    New Jersey 34017  16197    903
## 118434 2020-05-06      Hartford   Connecticut  9003   6530    842
## 120267 2020-05-06  Philadelphia  Pennsylvania 42101  16697    803
## 119795 2020-05-06         Union    New Jersey 34039  13604    800
## 119371 2020-05-06       Oakland      Michigan 26125   7573    774
## 119787 2020-05-06     Middlesex    New Jersey 34023  13254    706
## 119791 2020-05-06       Passaic    New Jersey 34031  13971    690
## 119358 2020-05-06         Macomb      Michigan 26099   5832    662
## 119309 2020-05-06       Suffolk Massachusetts 25025  14476    642
## 118437 2020-05-06     New Haven   Connecticut  9009   8419    629
## 119307 2020-05-06       Norfolk Massachusetts 25021   6610    596
```

```
## 119301 2020-05-06          Essex Massachusetts 25009  10344    561
## 119789 2020-05-06         Morris     New Jersey 34027   5655    491
## 119790 2020-05-06          Ocean     New Jersey 34029   7125    483
## 120879 2020-05-06           King     Washington 53033   6772    476
## 120262 2020-05-06     Montgomery   Pennsylvania 42091   4827    471
## 119226 2020-05-06       Orleans      Louisiana 22071   6608    464
## 118489 2020-05-06     Miami-Dade        Florida 12086  13370    432
## 119303 2020-05-06        Hampden Massachusetts 25013   4321    425
```

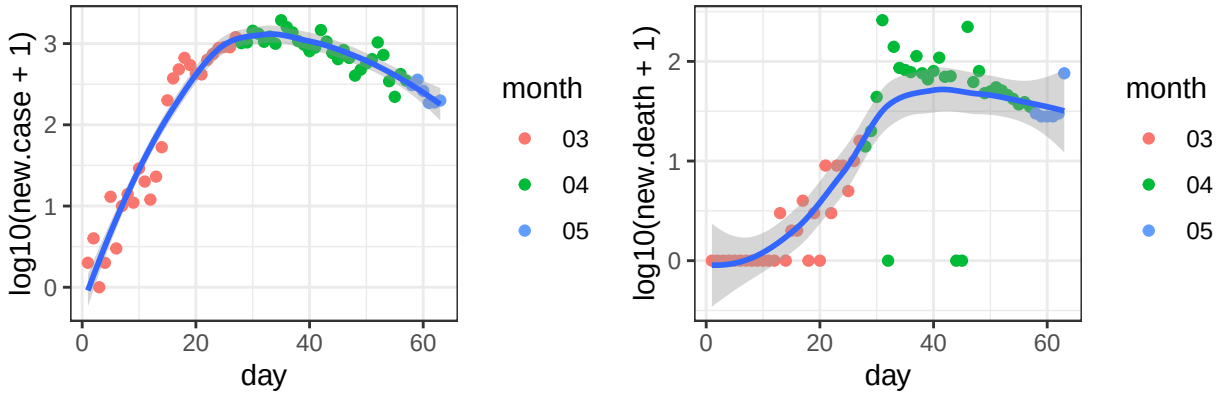
For these 30 counties, I check the number of new cases and the number of new deaths.

New York City_New York



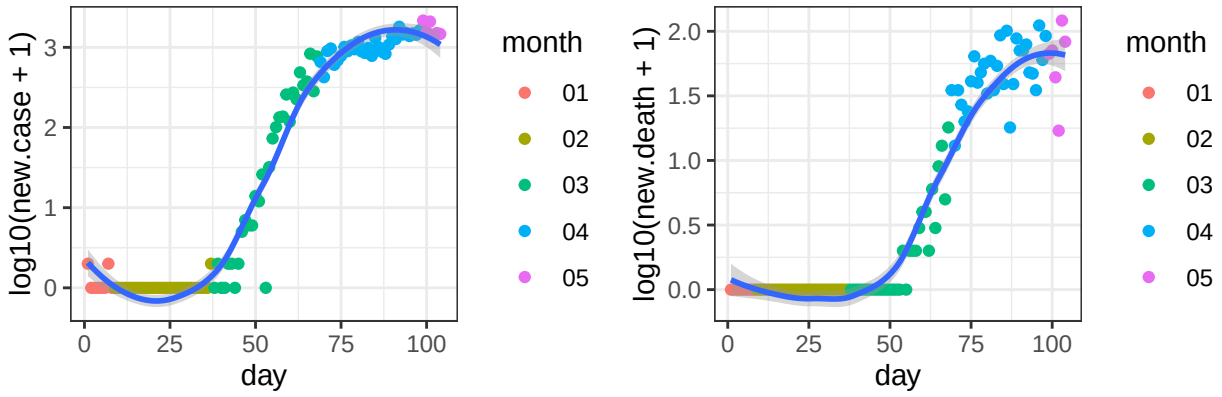
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−01

Nassau_New York



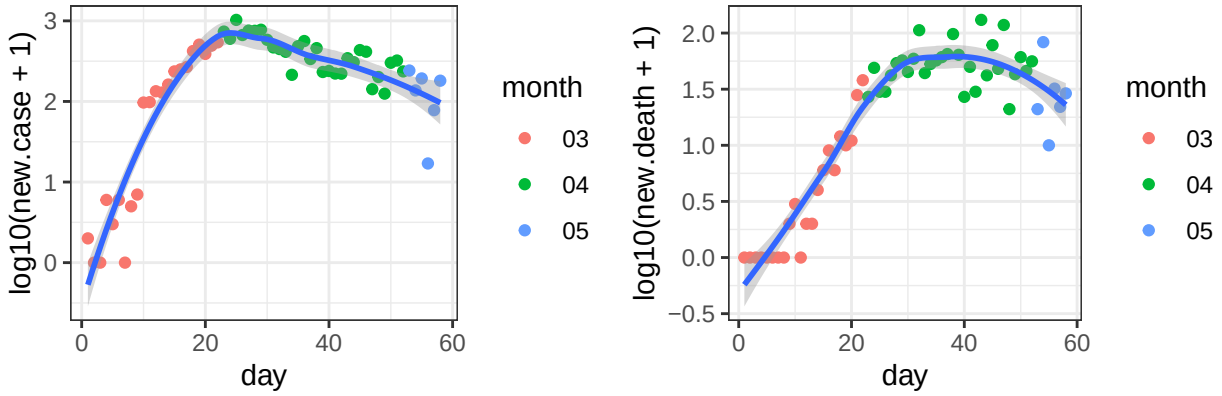
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

Cook_Illinois



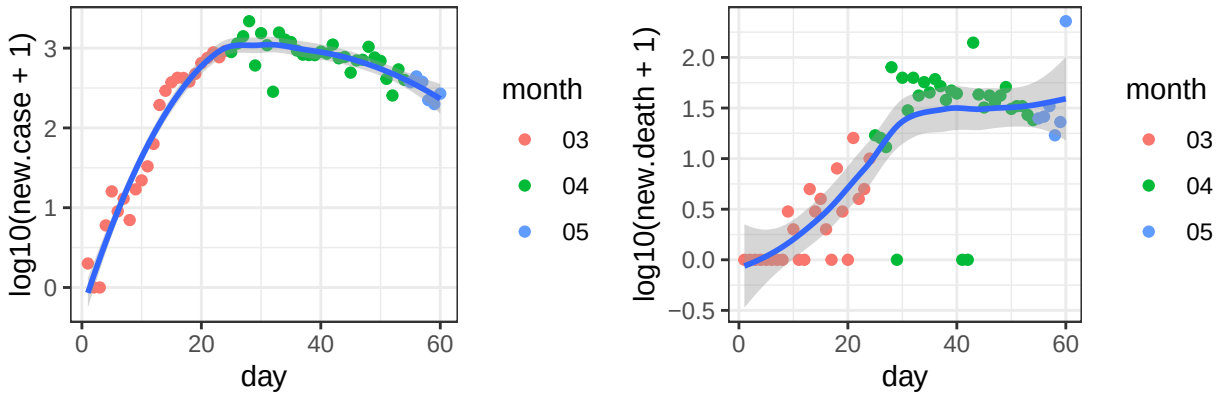
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−24

Wayne_Michigan



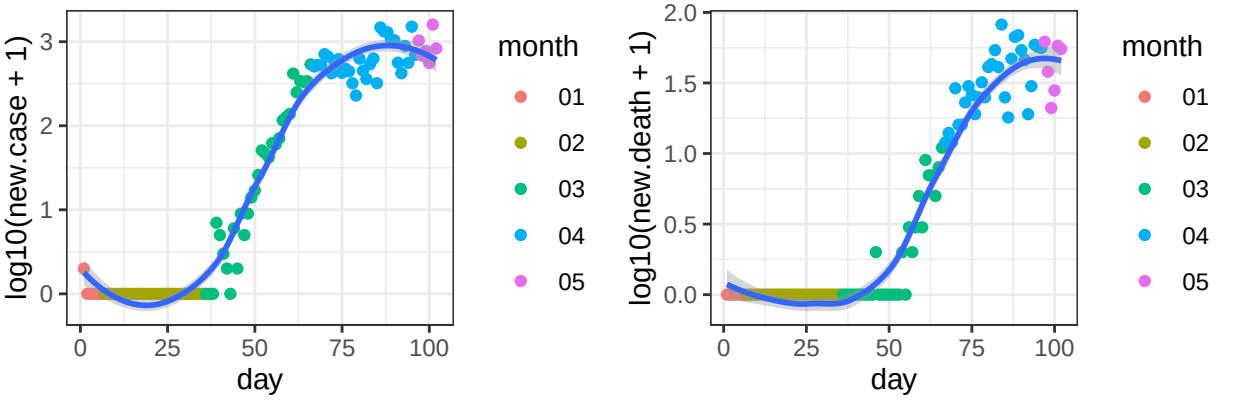
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Suffolk_New York



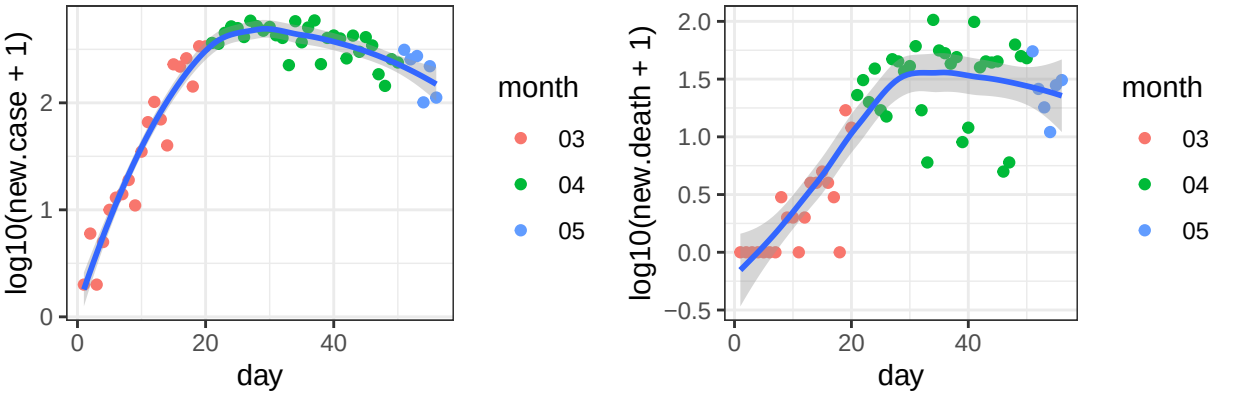
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−08

Los Angeles_California



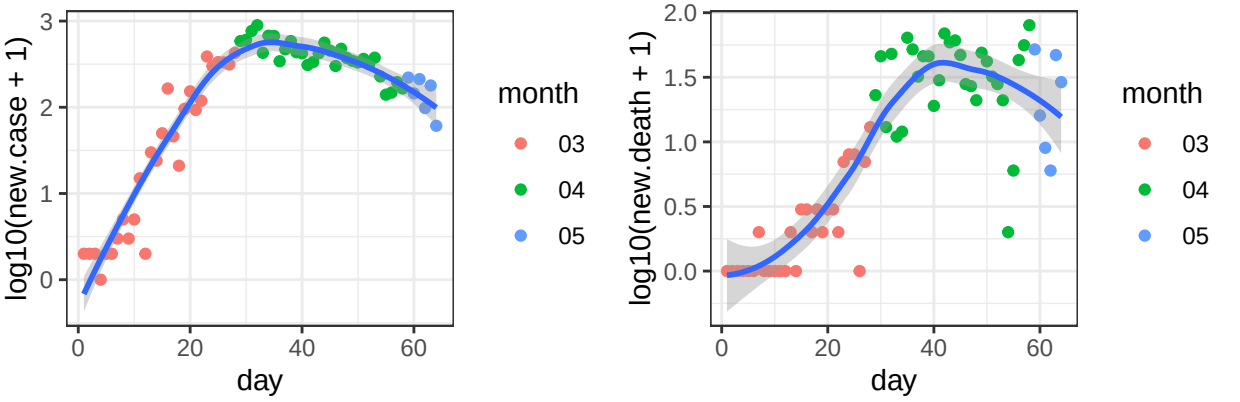
data source: https://github.com/nytimes/covid−19−data, day 1 is 01−26

Essex_New Jersey



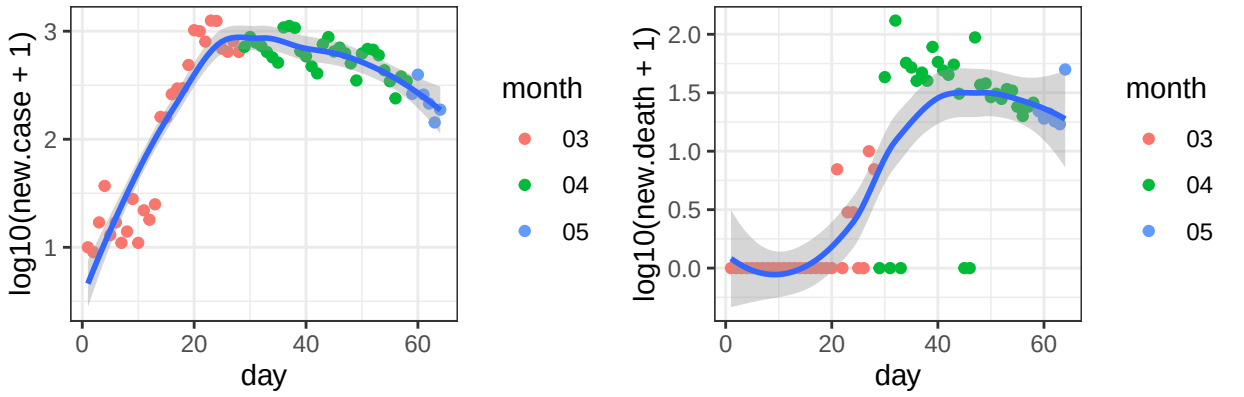
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−12

Bergen_New Jersey



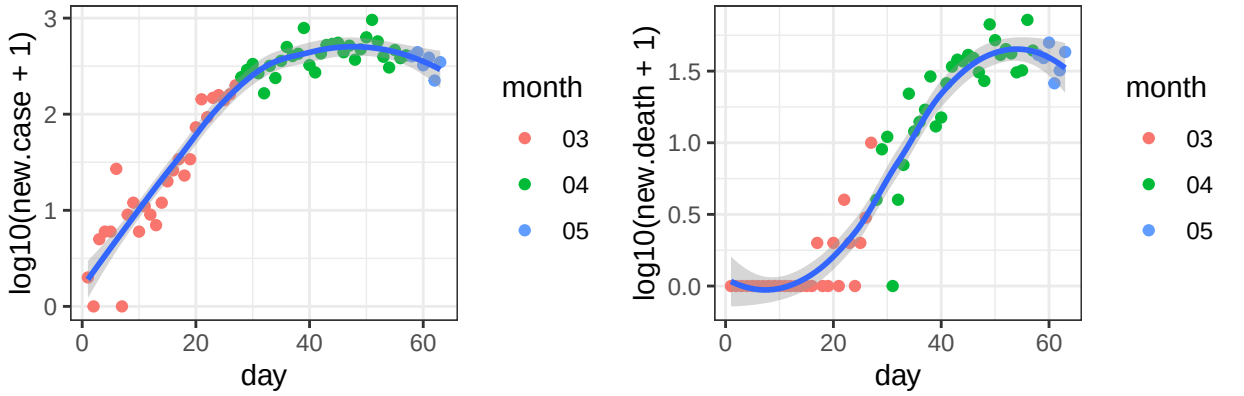
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−04

Westchester_New York



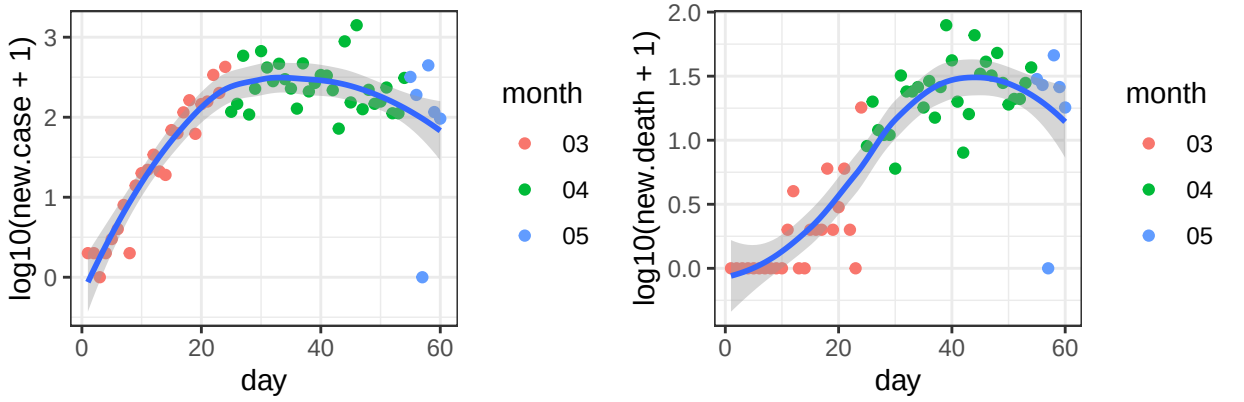
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−04

Middlesex_Massachusetts



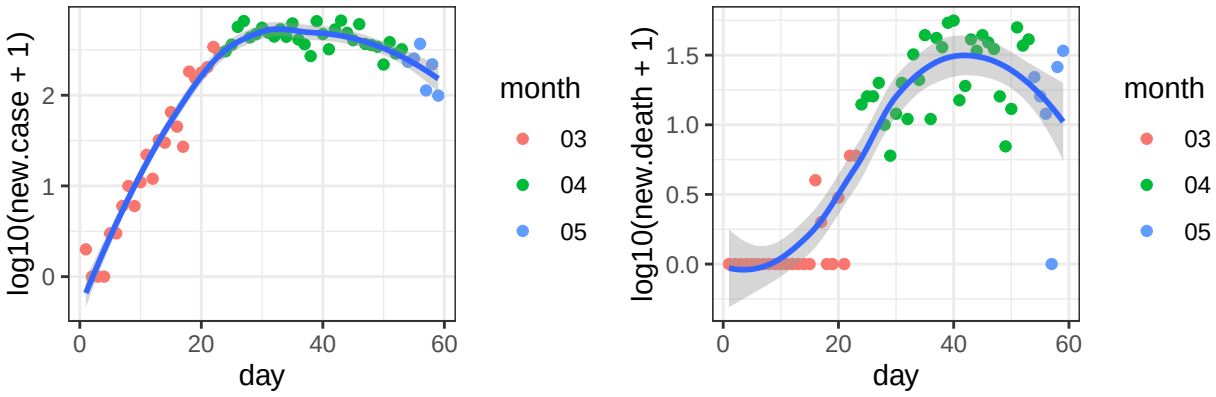
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−05

Fairfield_Connecticut



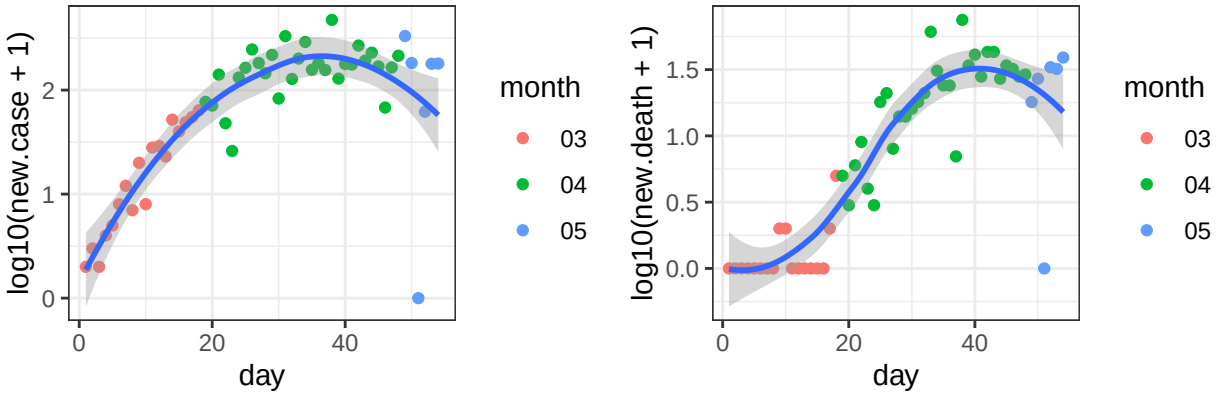
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−08

Hudson_New Jersey



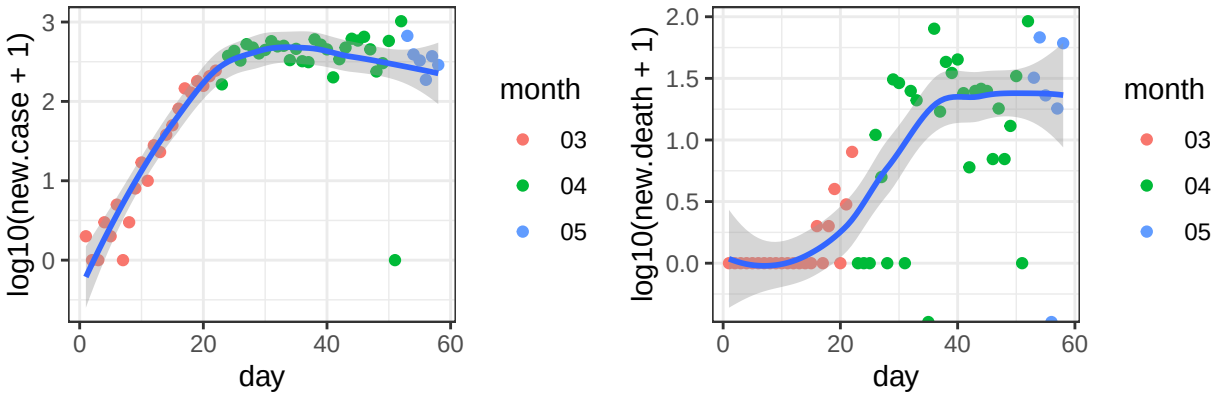
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−09

Hartford_Connecticut



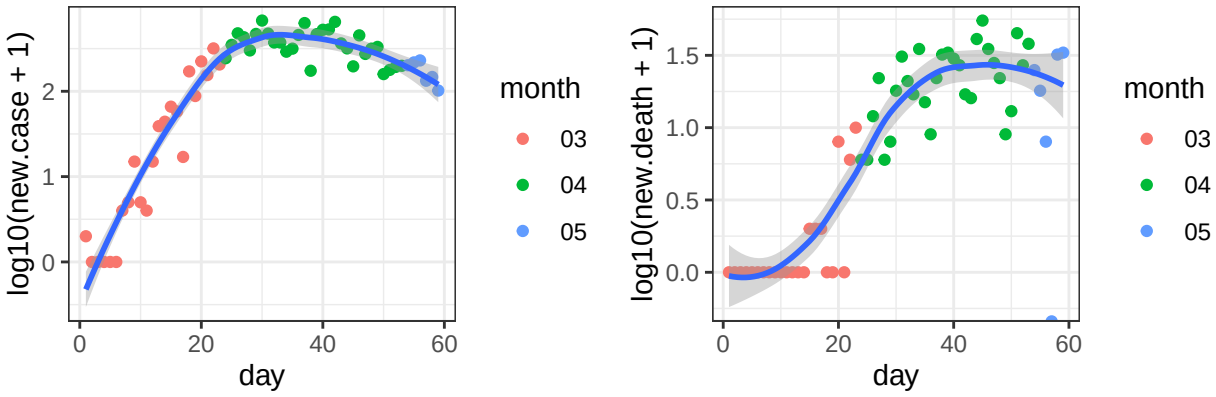
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−14

Philadelphia_Pennsylvania



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

Union_New Jersey



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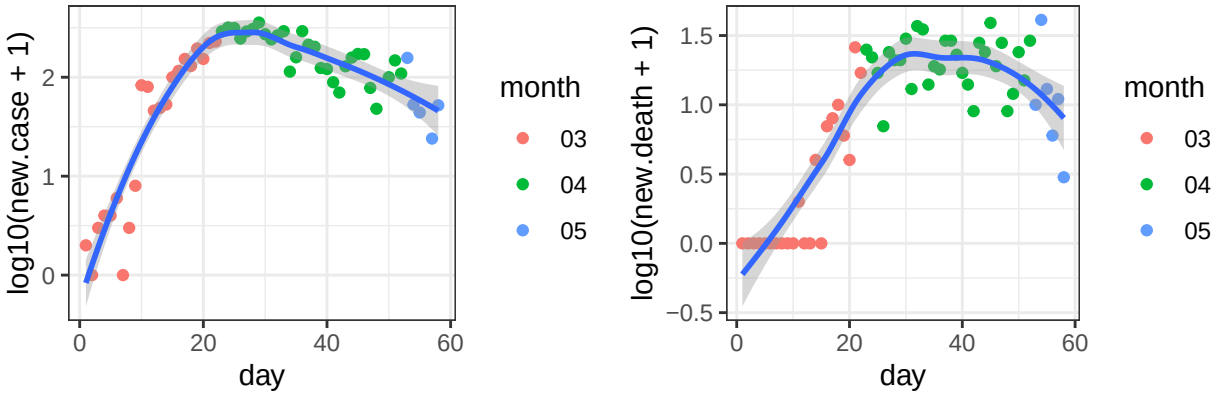
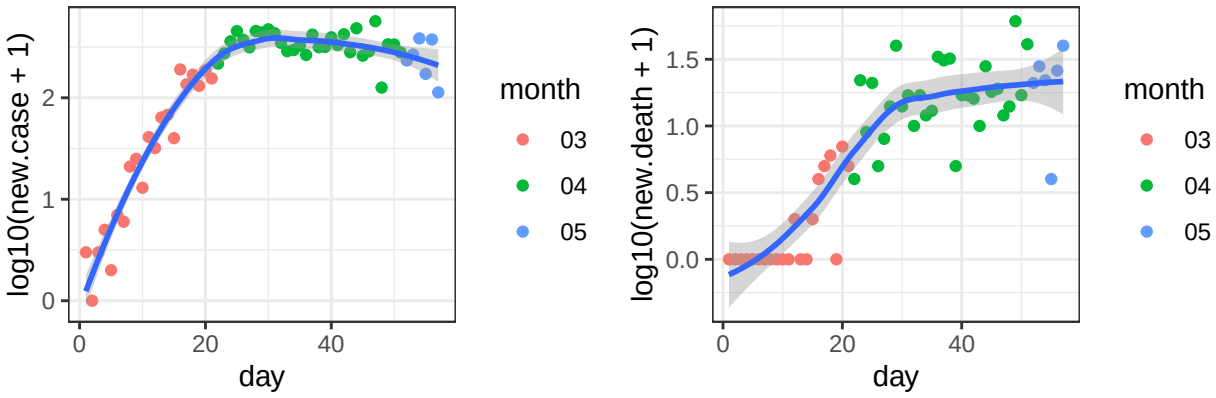
Oakland_Michigan



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

Middlesex_New Jersey



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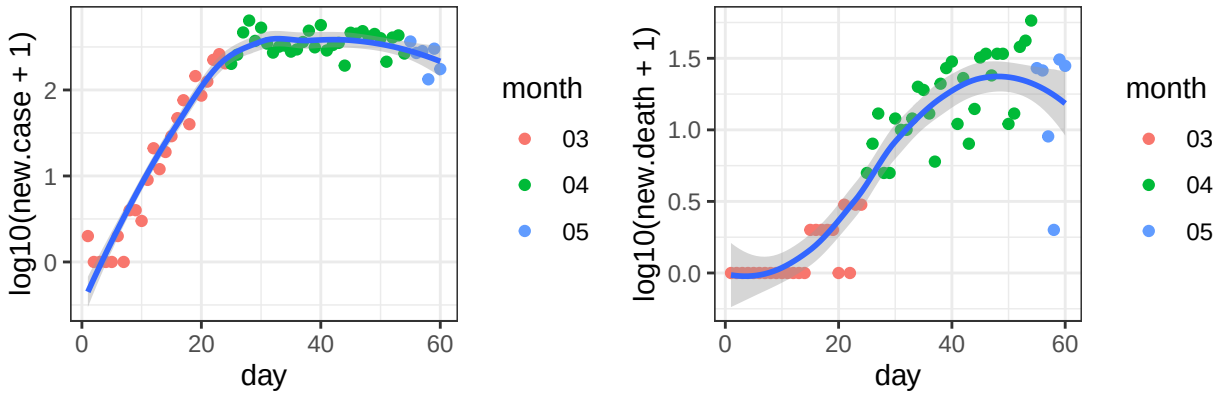
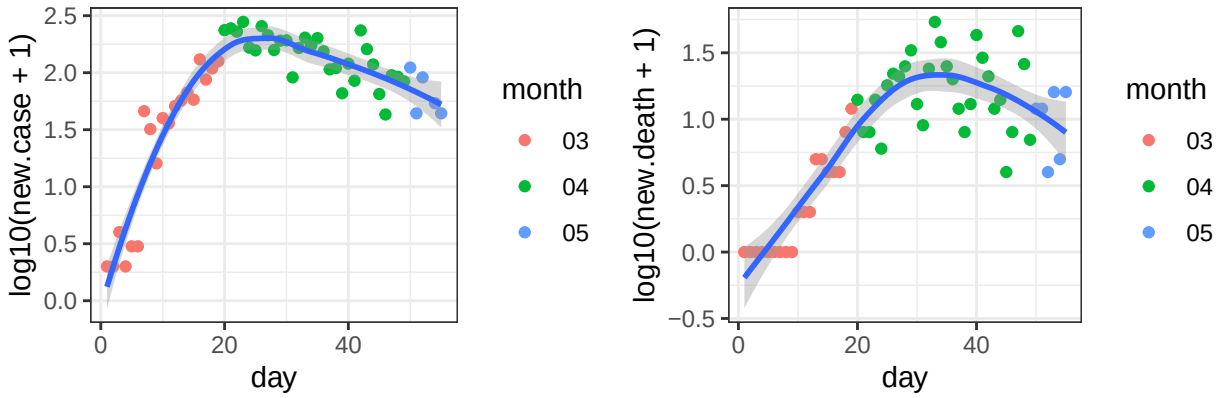
Passaic_New Jersey



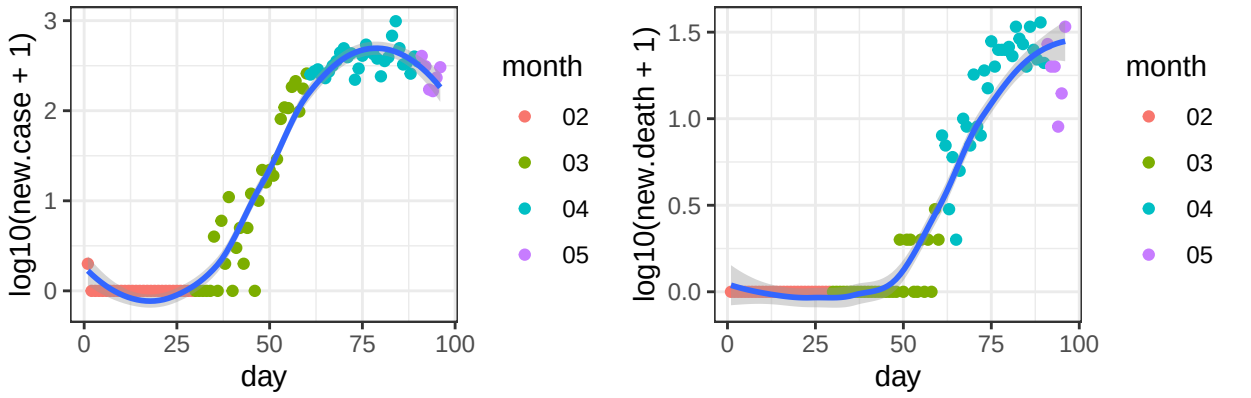
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−08

Macomb_Michigan



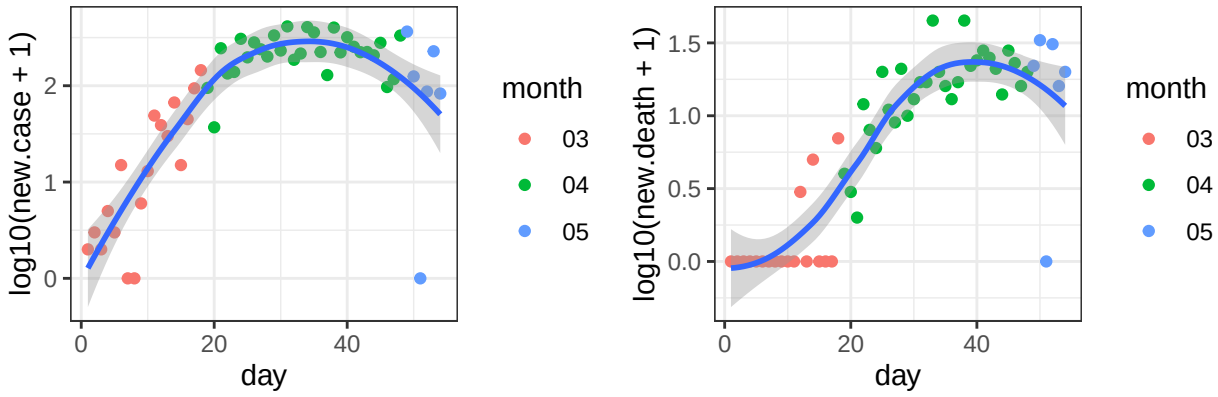
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−13

Suffolk_Massachusetts



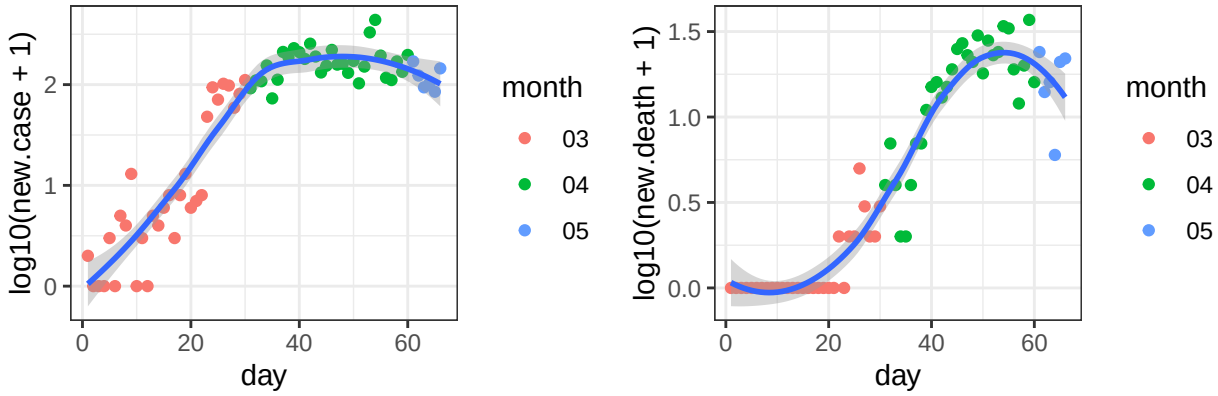
data source: https://github.com/nytimes/covid−19−data, day 1 is 02−01

New Haven_Connecticut



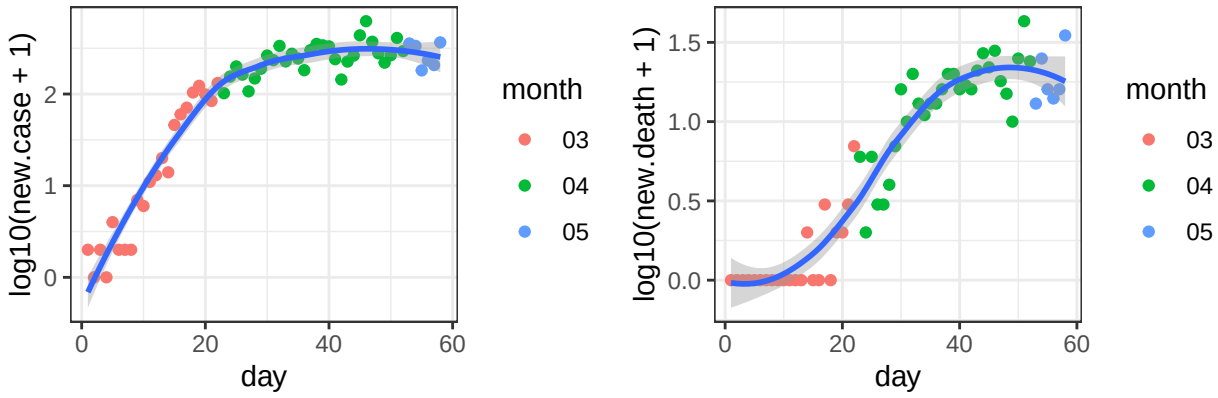
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−14

Norfolk_Massachusetts



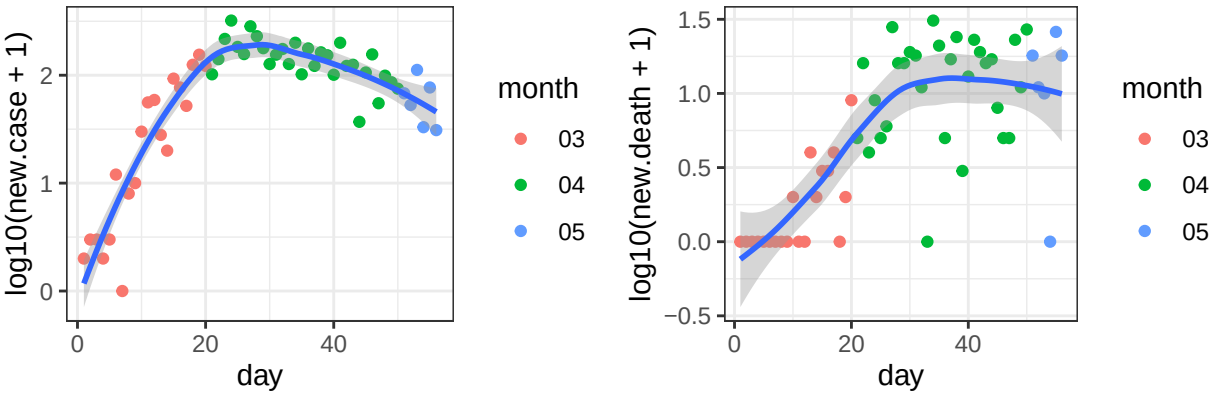
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−02

Essex_Massachusetts



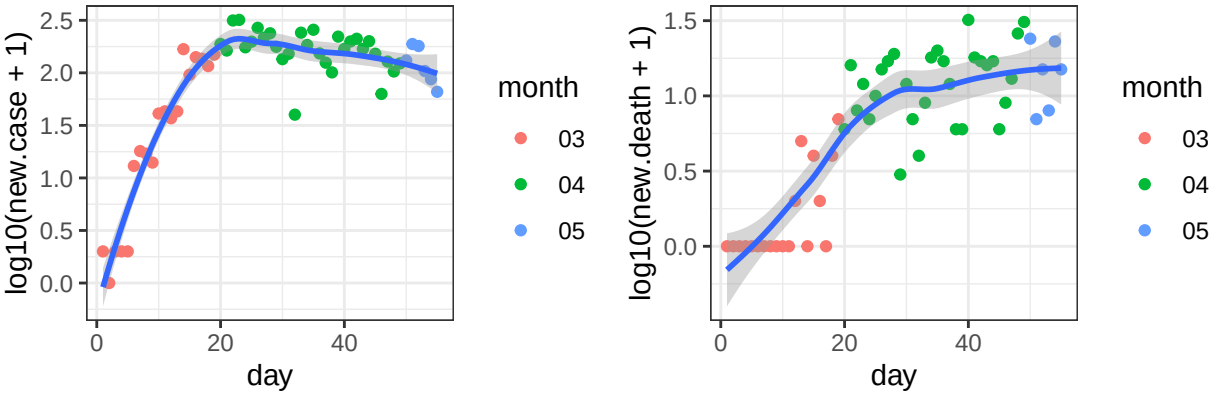
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Morris_New Jersey



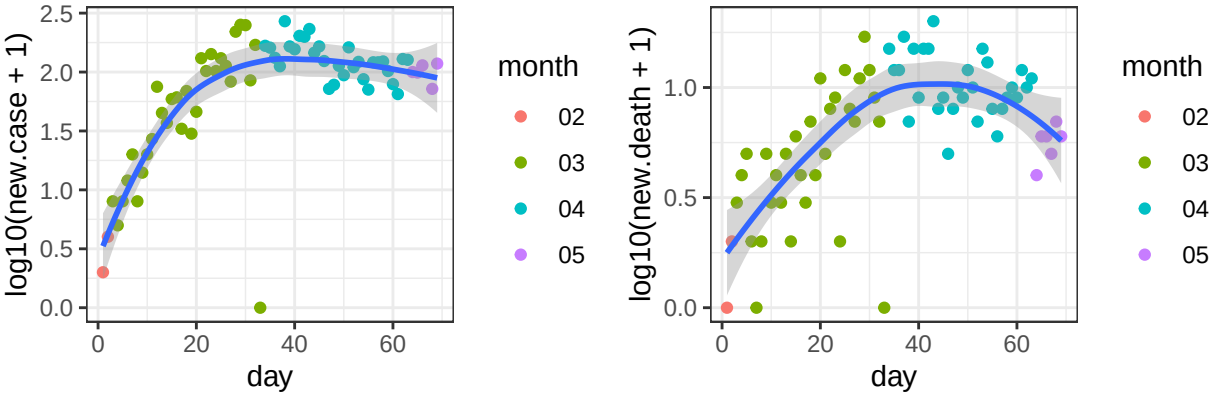
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−12

Ocean_New Jersey



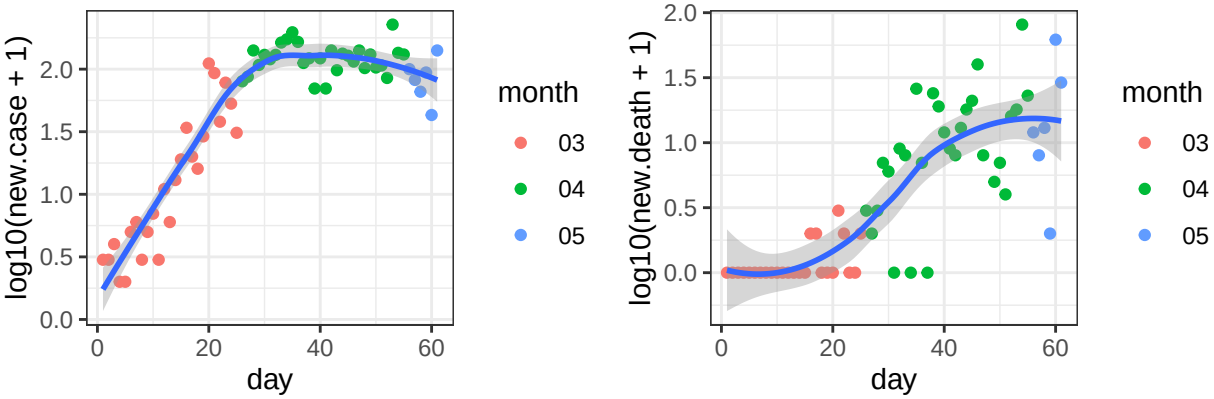
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−13

King_Washington



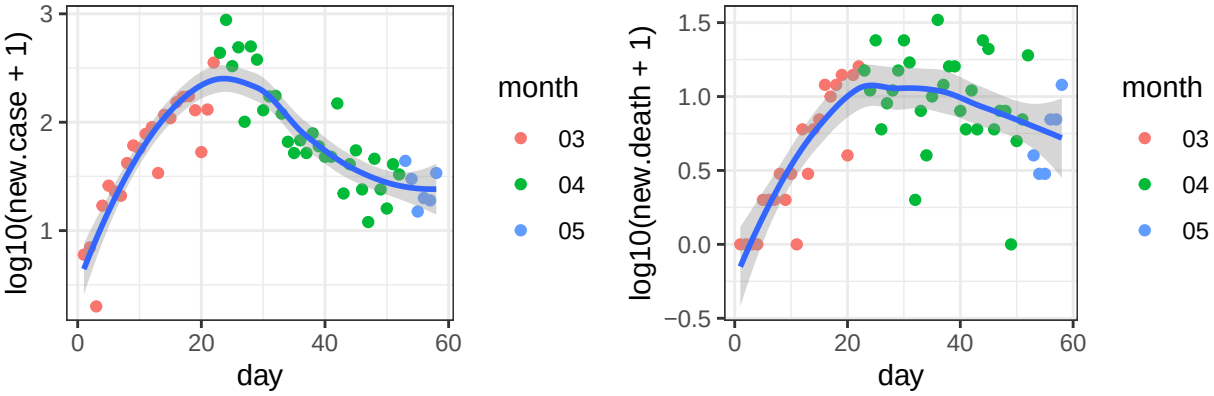
data source: https://github.com/nytimes/covid−19−data, day 1 is 02−28

Montgomery_Pennsylvania



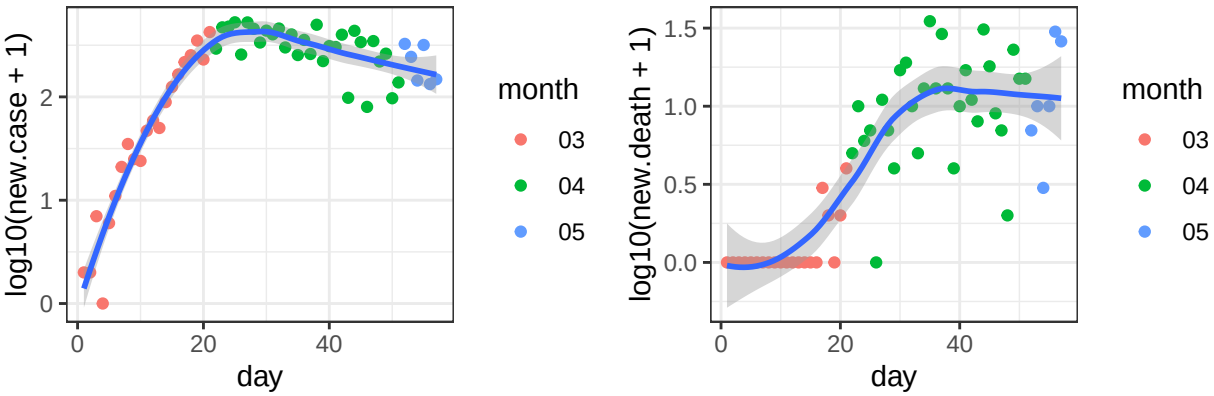
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−07

Orleans_Louisiana



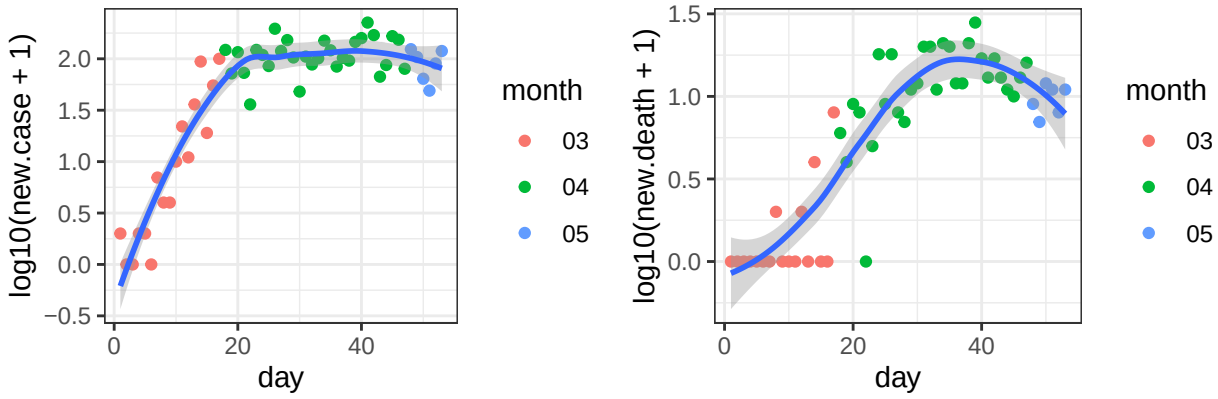
data source: https://github.com/nytimes/covid−19−data, day 1 is 03−10

Miami−Dade_Florida



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

Hampden_Massachusetts

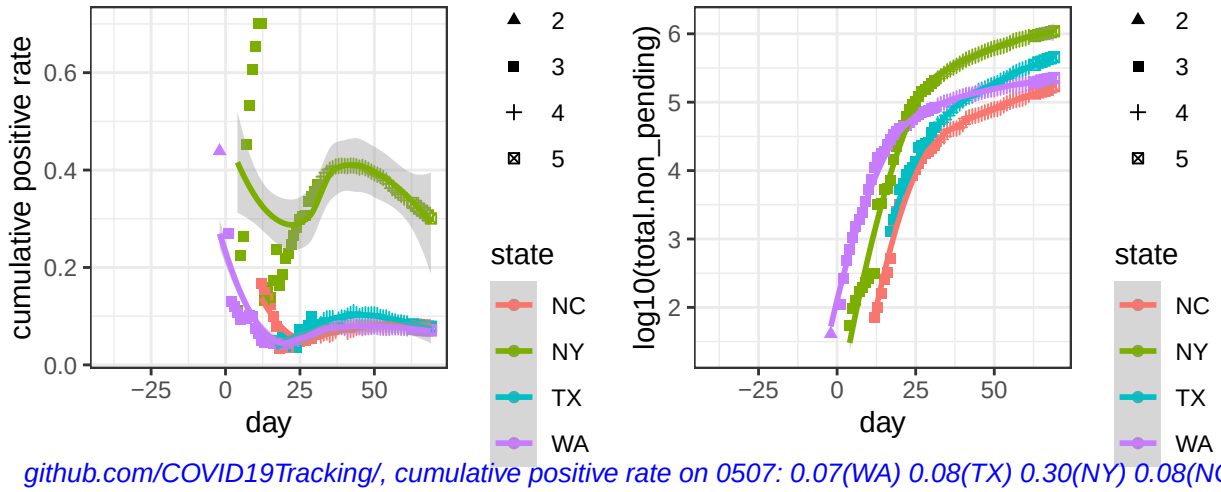


data source: https://github.com/nytimes/covid−19−data, day 1 is 03−15

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 0507: 0.07(WA) 0.08(TX) 0.30(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
```