

## A Summary of Some COVID-19 Data

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This document is available on the web at [https://young.physics.ucsc.edu/covid19\\_summary.pdf](https://young.physics.ucsc.edu/covid19_summary.pdf).

The figures presented show deaths from COVID-19 up to, and including, July 8.

Data is also available for the number of cases, but I felt that these figures are less reliable because they are so dependent on the number of tests being carried out. This varies from locale to locale and as a function of time. Of course there is also quite a bit of uncertainty too as to whether all COVID-19 deaths are recorded as such. Note too, that the number of daily deaths can continue to increase for a while even when the daily number of hospitalizations goes down. Thus the death count has a delay in showing trends. The best data would be for COVID-19 hospitalizations but I don't know where to find this, at least for a range of locales.

The source of the data that I plot is [here](#).

Note that the goal is to bend the curve for the cumulative number deaths away from the straight line (exponential) increase and eventually have it horizontal (flattening the curve). A useful quantity to give an idea of the rate of spread of the disease is the number of days for the deaths to double (assuming a constant rate). Several of the figures show the inverse of this, which we have get small and decrease eventually to zero.

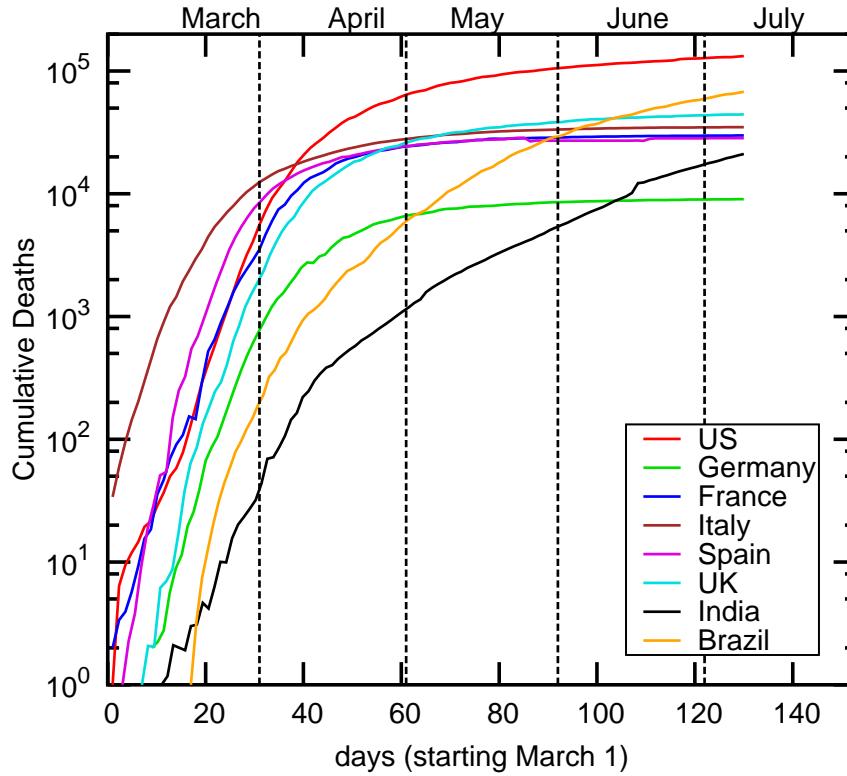
Data is shown for several countries: Italy, United Kingdom, United States, Germany, Brazil and India, and for several regions of the United States: New York State, California, Los Angeles County, and the San Francisco Bay Area.

Here are some comments:

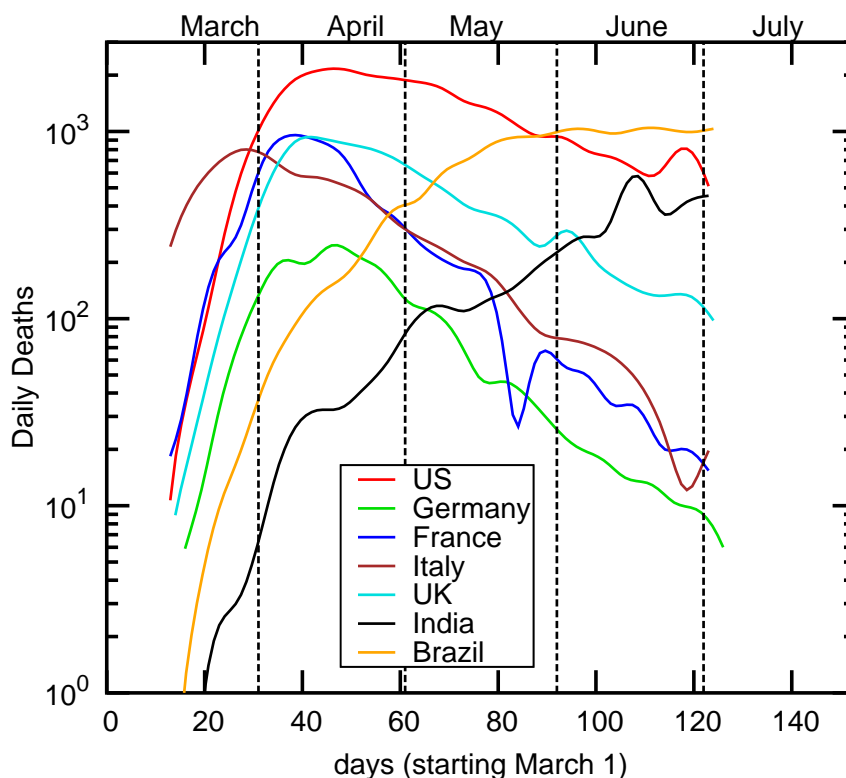
- In France, Italy and Germany the number of daily deaths is *decreasing* roughly exponentially. Great.
- In the UK the number of daily deaths is decreasing exponentially but somewhat more slowly
- In the US the number of daily deaths is only going down very slowly. Doesn't this mean that it is premature to open up the "lockdown" in a big way?
- India is a concern. The number of daily deaths continues to increase. Especially since the country has a population of 1.3 billion, one hopes that this number will start to decrease soon.
- Brazil is also a concern. The number of daily deaths continues to increase rapidly and is now about the same as the US, which is going down (albeit slowly).
- Within the US, the state of New York, which leads the US in deaths and cases, and had a calamitous March, has succeeded reducing the number of daily deaths exponentially after about April 10. Good.

- In California, and especially the San Francisco Bay Area, the death rate is much less than in New York. However, the number of daily deaths is not currently decreasing, mainly due to the Los Angeles area. Why not? Presumably because the “lockdown” (known as shelter-in-place) has been lax.

### I. COMPARISON OF DEATHS IN SEVERAL COUNTRIES



The above figure shows the cumulative number of deaths for several countries on a log scale. The log scale is useful because an exponential growth appears as a straight line. In this plot you can compare trends and overall numbers for the different countries.



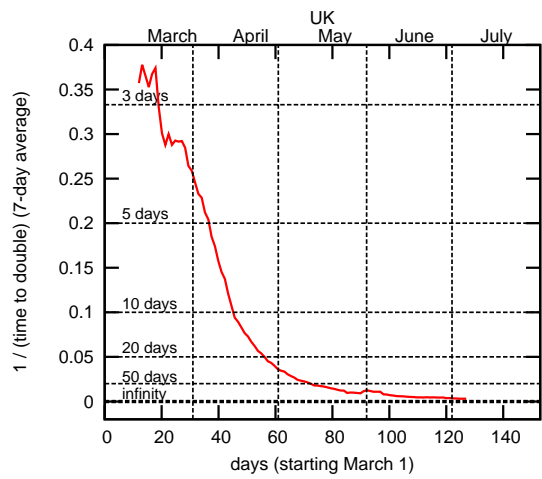
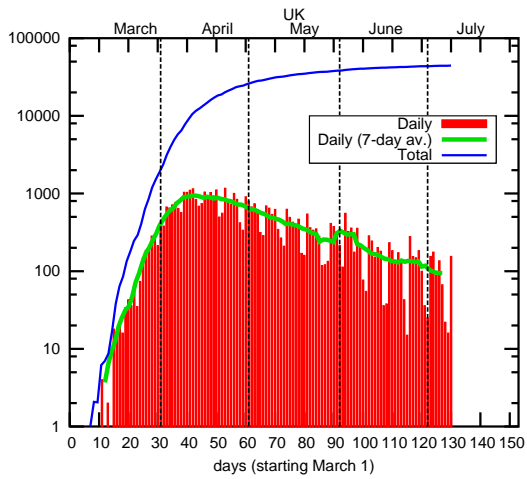
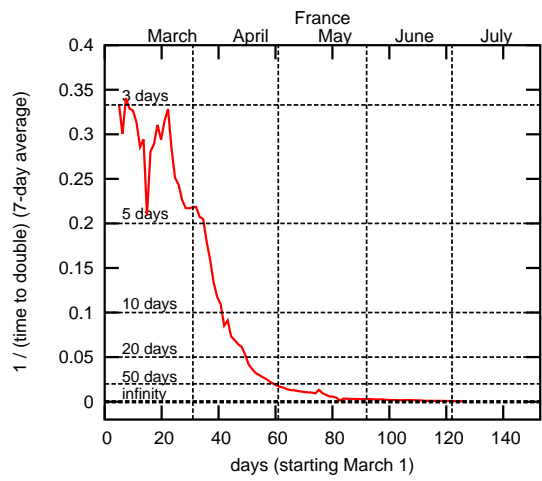
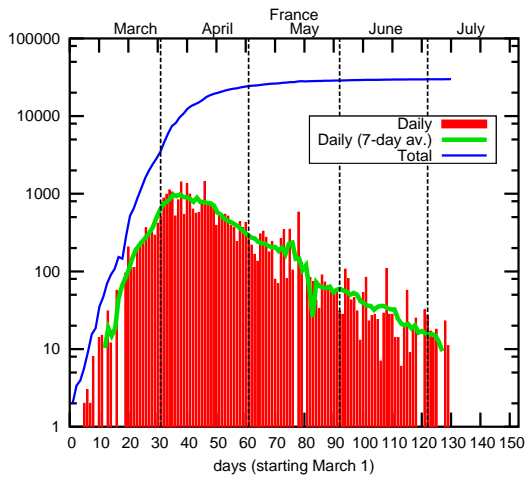
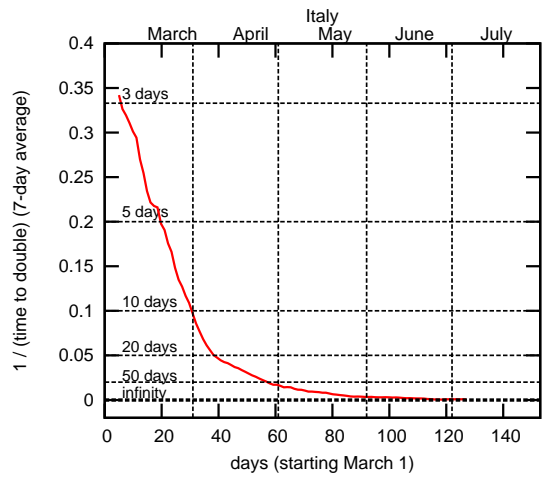
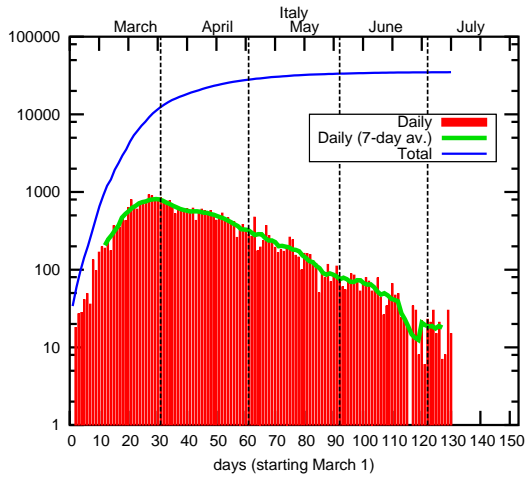
The above figure shows the corresponding number of daily deaths. Germany, France and Italy have an exponentially decreasing number which is now down to around 10. The number in the UK is decreasing but is around 100. The number in India is increasing (worrying) and that in Brazil is large and flat. The number in the US is large and apparently decreasing slightly, but the number of daily cases has rapidly increased recently which could lead to an increase in daily deaths in the near future.

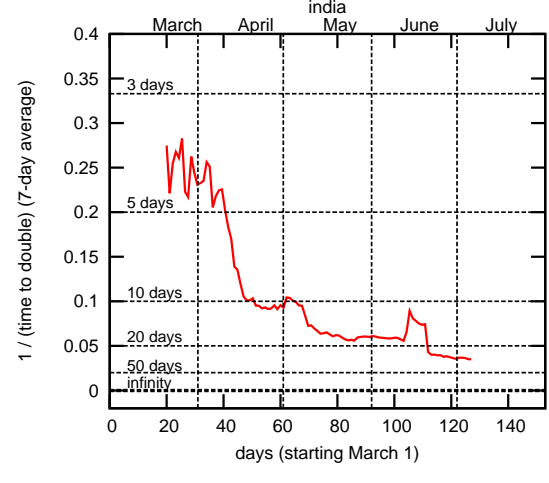
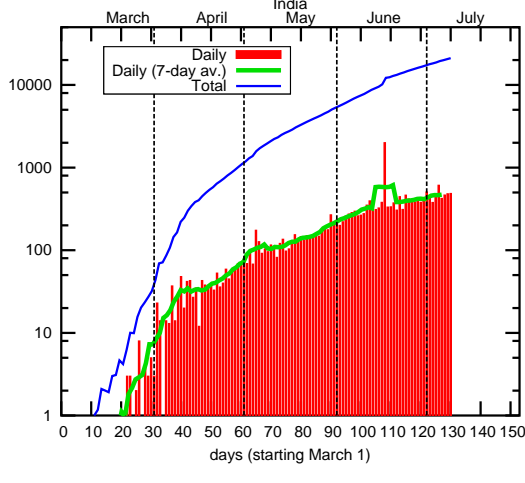
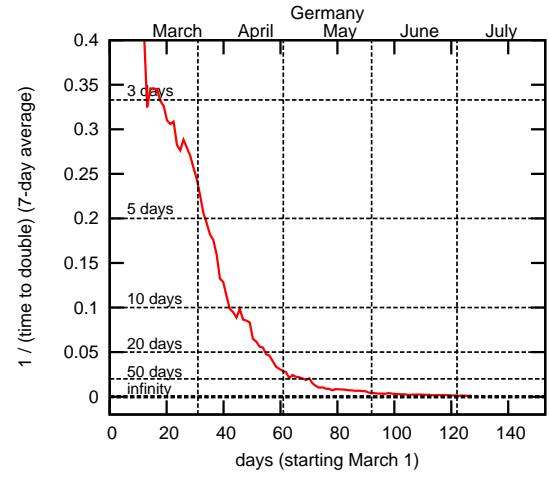
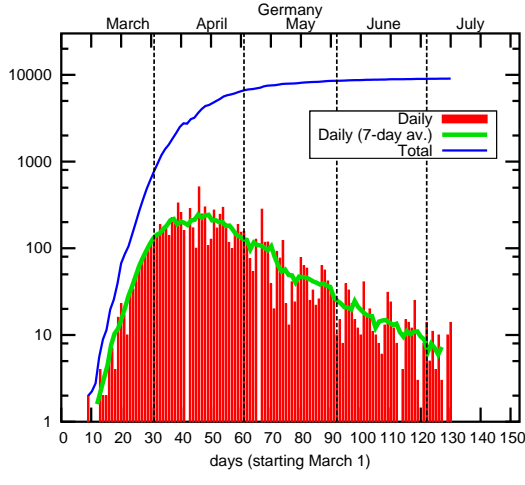
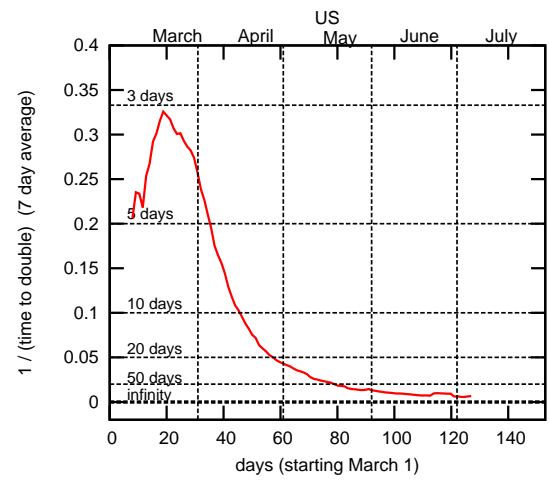
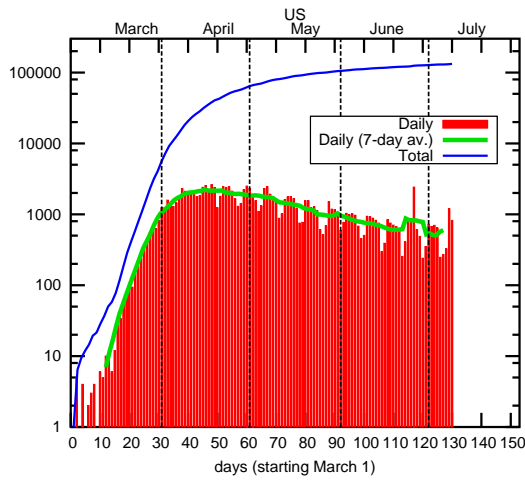
For each country I next show a pair of figures. The first shows the daily number of deaths as well as the cumulative number. In addition a 7-day average of the daily deaths is presented. This has a smoother behavior, in which it is easier to see trends, than the raw data for the daily deaths.

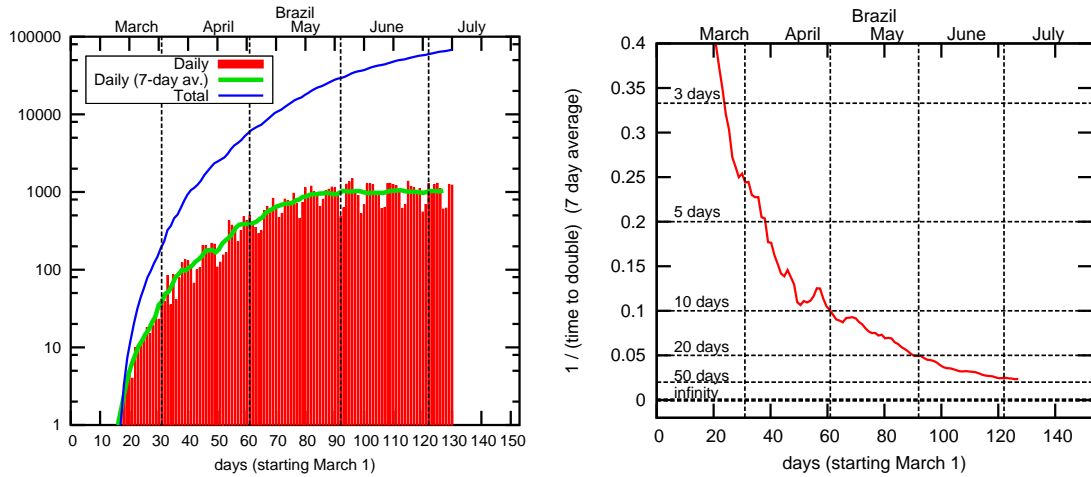
The second shows a measure of the rate of exponential increase,

$$\frac{d}{dt} \log_2 N(t), \quad (1)$$

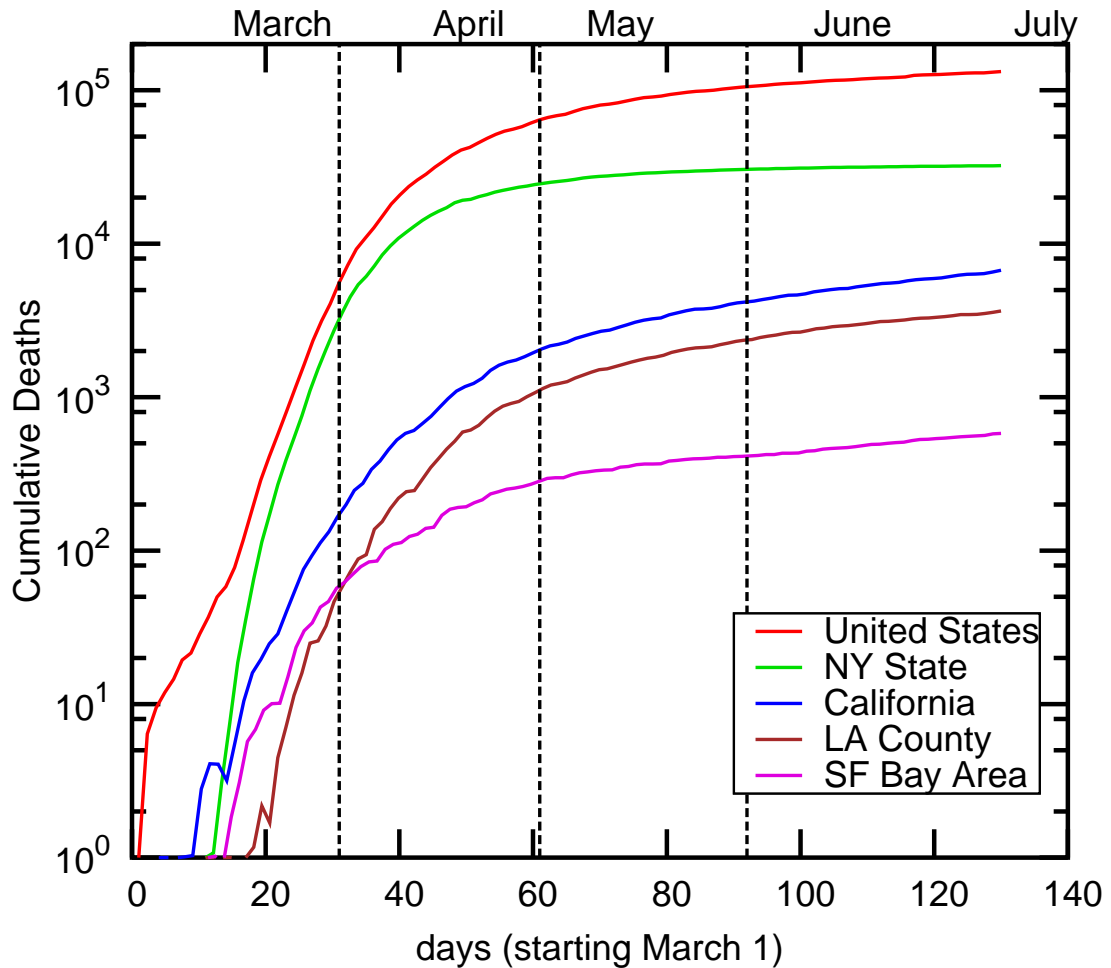
where  $N(t)$  is the cumulative number of deaths. This is the inverse of the number of days to double (assuming the exponential growth were to stay constant). Don't worry if the maths is unfamiliar; the formula is simply  $1/(\text{number of days to double})$ . The figures showing  $1/(\text{number of days to double})$ , are a 7-day average i.e. they are computed from the number of deaths averaged over the current day and the previous 6 days. This gives smoother plots, for which it is easier to see trends, than plots of the daily data.





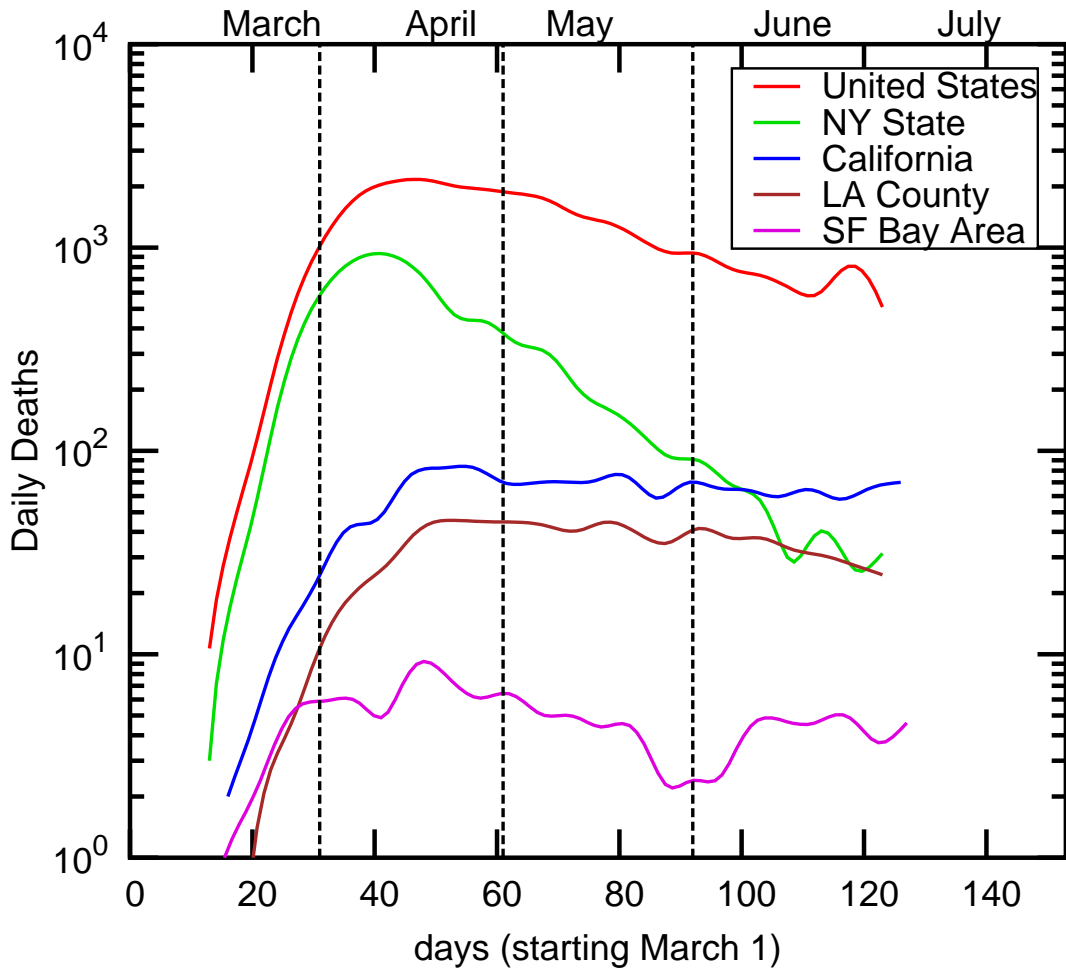


## II. DEATHS IN SEVERAL REGIONS OF THE US



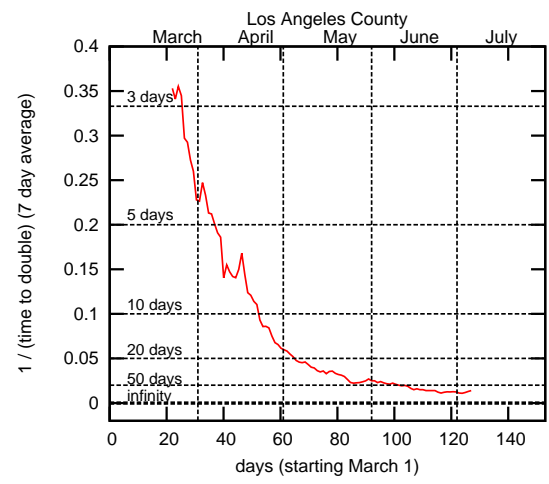
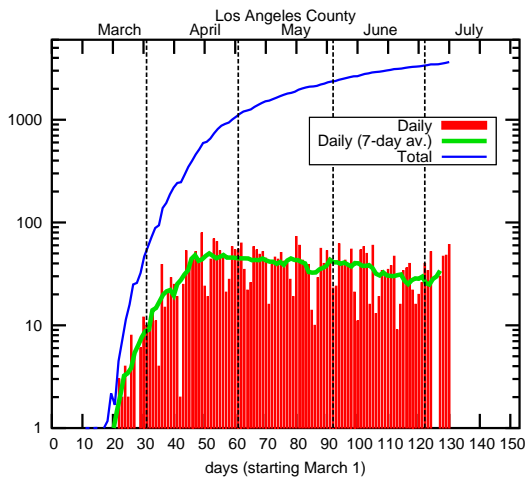
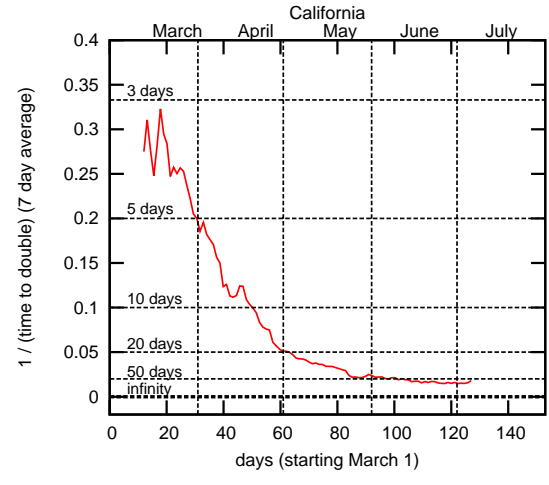
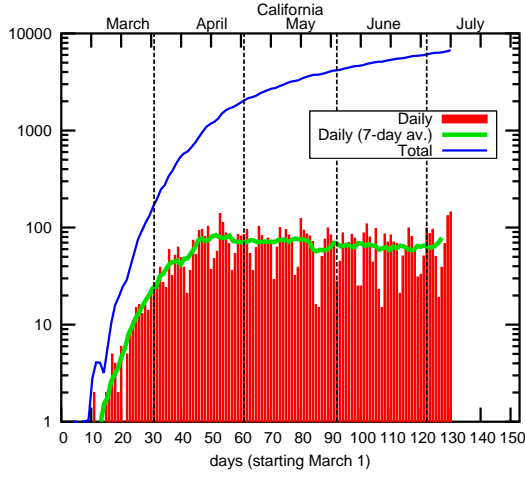
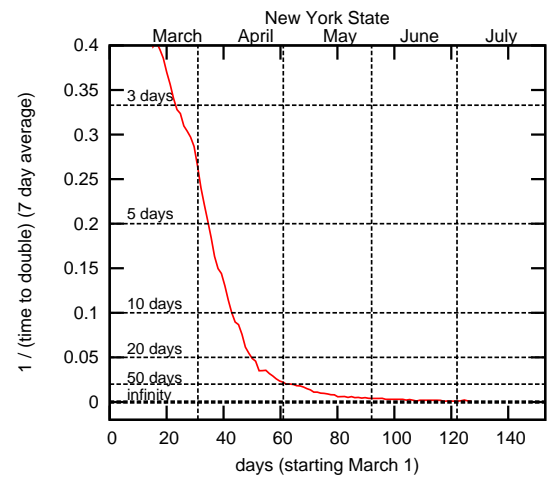
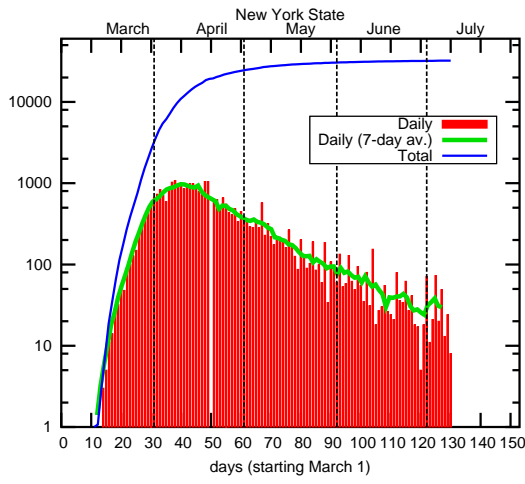
The above figure shows the cumulative number of deaths in several parts of the US, as well as the total number in the country. The US deaths are dominated by New York state and the California deaths by Los Angeles County (which has about a quarter of the State's population). The San

Francisco Bay area data is for the six counties that enacted a shelter-in-place regulation on March 16 (San Francisco, Santa Clara, San Mateo, Marin, Contra Costa, and Alameda).

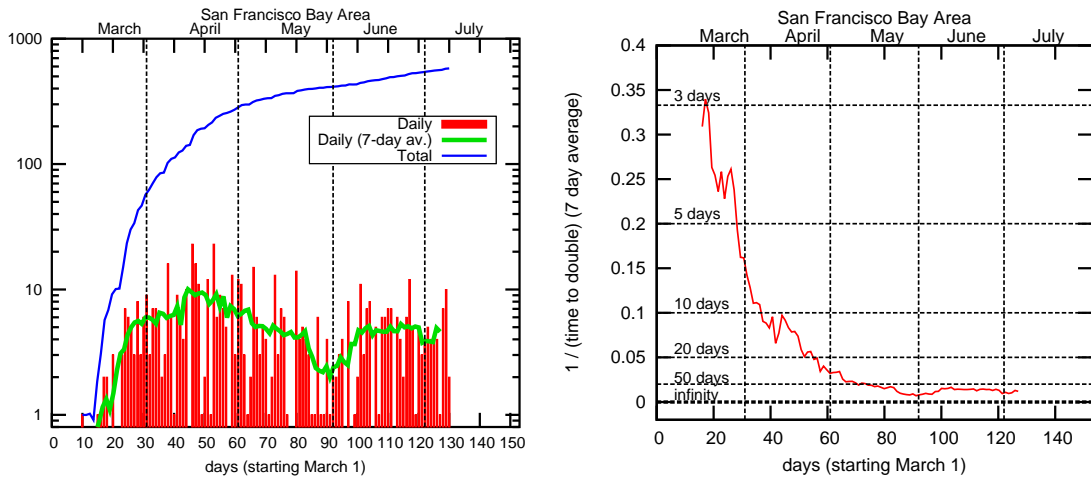


The above figure shows the corresponding number of daily deaths. The failure of California (as well as other states not shown) to get this number to decrease substantially from the peak (as New York has succeeded in doing) is worrying, especially since the number of daily cases has recently increased rapidly, which could lead to an increase in the death rate in the near future.

I now show two figures for each region in the same format as in the previous section.







### Acknowledgments

The motivation to produce these graphs came from the interesting analysis and commentary in <https://www.icts.res.in/COVID-data-commentary/>, and from an email exchange with Sriram Shastry and Michael Dine.