Trend of Current COVID-19 Pandemic in the United States

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Introduction

The objectives of this project is to explore 1) whether the COVID-19 pandemic is ending (i.e., are the numbers of new cases/deaths decreasing) specifically in the United States and 2) whether the current lockdown policies are effective against COVID-19 transmission (i.e., whether there are significant differences between the numbers of new cases/deaths pre- versus post-lockdown.

The data being used for the project is the daily data of cumulative confirmed cases of COVID-19 and cumulative deaths from COVID-19 in the United States, by county and since Jan 22nd, 2020. It is released and currently being updated on daily basis by Johns Hopkins University Center for Systems Science and Engineering.

Methods

The original dataset can be found in JHU CSSE official github repository for COVID-19 data: https://github.com/CSSEGISandData/COVID-19. There are 3338 rows and 311 columns in the raw data of cases, 3338 rows and 312 columns in the raw data of deaths.

First, the unneeded variables (for example, "Country" is useless in this project because all the interested data is for the United States) is dropped from the dataset. The original dataset also includes cases and deaths in places outside the United States (e.g., the diamond princess cruise ship); as the populations on cruise ships are poorly defined and are relatively small, they are dropped from the dataset. The data for American territories are also dropped for similar reasons. Missing values are checked and no missing value is observed for daily reported cases and deaths.

The case and death datasets are then 1) reshaped from long to wide and 2) combined for easier interpretation. Variables are renamed accordingly. The county level numbers within each state are added up to get the state level data, and state level numbers are added up to get the US national level data, listed as "US total". The cumulative case/death of the previous date is subtracted from that of the current date to calculate the daily new case/death. Because of that, the data of very first recorded date (Jan 22th) is invalid and dropped. The log transformation is used for better visualization in figures; when the log transformation produced -Inf due to 0s in the raw data, the -Infs are replaced by 0s for easier processing.

Specially, the JHU COVID-19 datasets do not include the abbreviations of US states. As such, a third-party dataset which converts full names of US states to their standard abbreviations was found in Github and used in this project: https://github.com/jasonong/List-of-US-States/raw/master/states.csv. Finally, the dataset is sorted according to state name and date. There are 16271 rows and 10 columns in the final processed version of the dataset.

Results

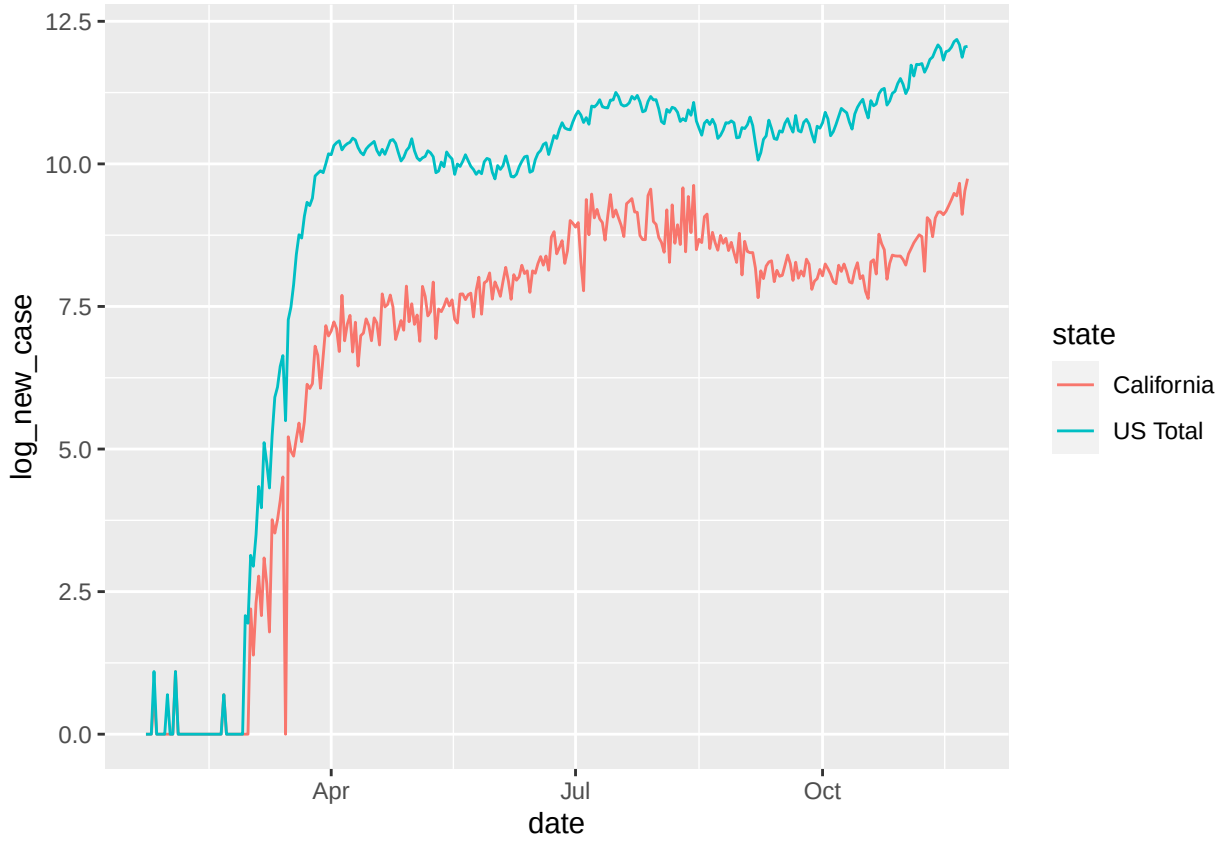
Table 1: Descriptive Stats of COVID-19 Daily New Cases/Deaths Since Jan 23rd

state	avg_new_case	max_new_case	today_new_case	avg_new_death	max_new_death	today_new_death
Alabama	772	3832	2785	11	81	13
Alaska	94	748	590	0	13	13
Arizona	1000	4877	4544	21	172	51
Arkansas	483	2312	2122	8	158	18
California	3730	16990	16990	61	278	109
Colorado	672	6439	4150	9	122	50
Connecticut	349	5271	540	16	204	10
Delaware	106	663	453	2	69	5
District of Columbia	66	335	119	2	19	1
Florida	3105	15300	8555	59	276	72
Georgia	1481	31605	3676	30	480	6
Hawaii	58	354	60	1	14	0
Idaho	309	1786	1640	3	35	8
Illinois	2196	15415	9469	40	247	150
Indiana	998	8322	5625	18	150	103
Iowa	709	5484	2992	7	48	48
Kansas	473	7707	337	5	84	0
Kentucky	530	3816	2606	6	33	17
Louisiana	731	4743	3243	21	129	39
Maine	35	255	255	1	12	12
Maryland	604	2910	1667	15	171	33
Massachusetts	688	3206	2576	34	302	20
Michigan	1133	13162	6782	30	241	154
Minnesota	922	8689	6416	11	72	38
Mississippi	471	1972	665	12	67	53
Missouri	927	9646	3967	12	189	189
Montana	187	1642	1123	2	37	16
Nebraska	378	3440	0	3	43	0
Nevada	453	2871	2871	7	38	24
New Hampshire	60	529	362	2	22	1
New Jersey	1022	4669	4275	55	483	47
New Mexico	281	3665	2099	5	33	28
New York	1977	11434	4881	112	1273	23
North Carolina	1115	4514	3100	17	67	35
North Dakota	242	2270	1004	3	37	37
Ohio	1211	11885	8536	20	147	80
Oklahoma	588	4507	2736	5	26	15
Oregon	219	1502	1000	3	21	21
Pennsylvania	1064	7010	6355	32	341	78
Puerto Rico	158	1332	348	3	21	6
Rhode Island	168	2572	851	4	114	16
South Carolina	682	2665	1678	14	80	25
South Dakota	244	2020	1011	3	53	2
Tennessee	1127	7951	1366	14	89	71
Texas	3849	21791	19481	69	678	196
US Total	40987	195469	172921	846	2603	2146
Utah	593	5352	2701	3	17	11
Vermont	12	149	48	0	4	1
Virginia	728	3242	2544	13	96	37
Washington	492	6277	3482	9	45	35
West Virginia	137	1153	969	2	26	15

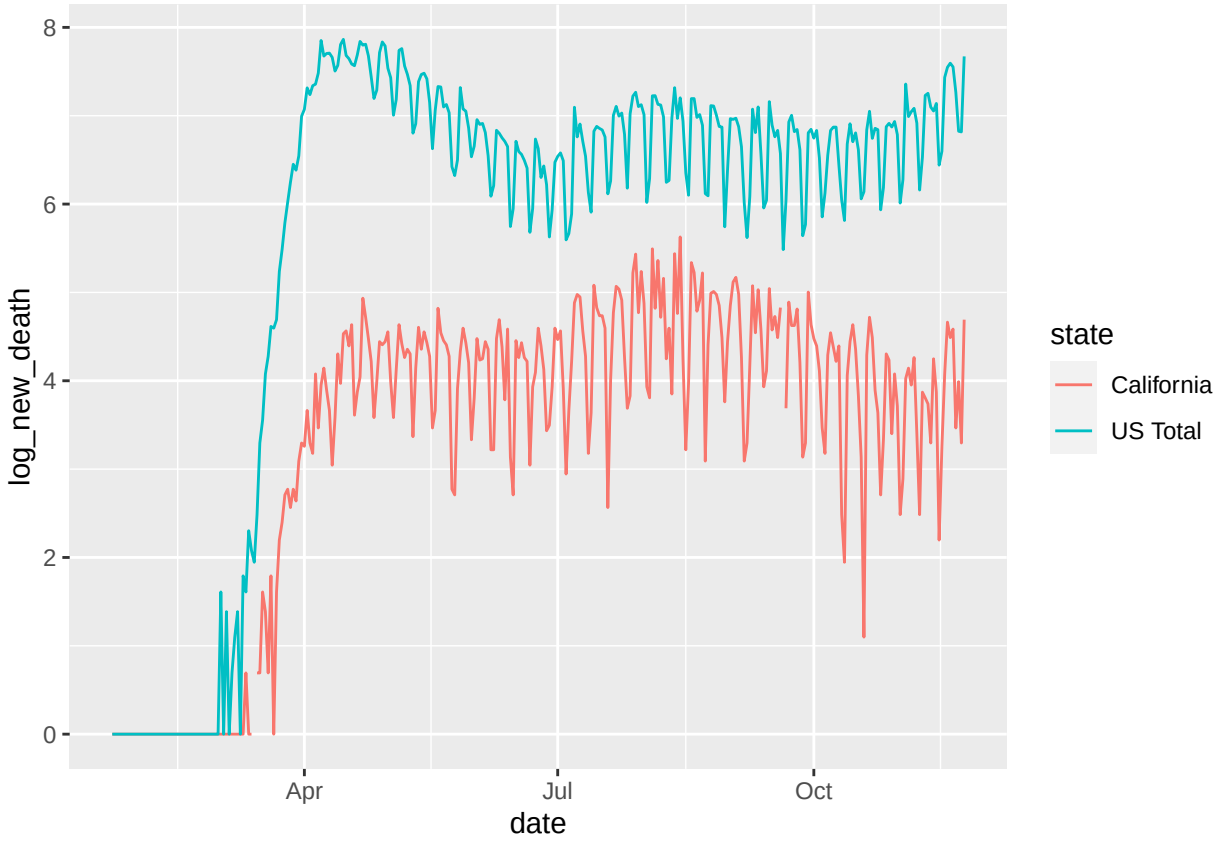
state	avg_new_case	max_new_case	today_new_case	avg_new_death	max_new_death	today_new_death
Wisconsin	1259	16956	6748	11	114	114
Wyoming	98	1262	528	1	26	0

- According to the table, the recent daily new cases are quite high throughout the United States - although in some states smaller than the major peak back in July/August, they are far larger than the average daily new cases since the start of the pandemic.
- However, the pandemic is rather mild in terms of daily new deaths - in many states, the recent daily new deaths are at about the same level as average since the start of the pandemic, and the absolute numbers are kept at a relatively low level.

Figure 1: Time series of Log of COVID-19 Daily New Cases/Deaths in California and the United States



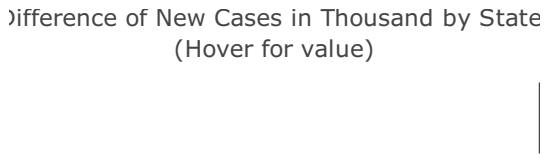
Cases



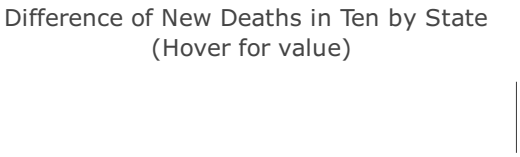
Deaths

- Along with the table, the time series also suggest that even though the new cases are increasing wildly, the numbers of daily new deaths are relatively small and do not have obvious trends of increasing like daily new cases do as the recent winter flu season begins.

Figure 2: Geo plot of Differences of Daily New Cases/Deaths Nov 16 vs. May 1 by State (Please refer to website for correct view of the figures - I could not make them show correctly in pdf)



Cases



Deaths

- Finally, the geo plot comparing the new cases/deaths pre- and post-pandemic gives similar answers as the table and figures do above. Again, the lockdown policies do not seem to have much effect on controlling cases, but are able to reduce the numbers of new deaths significantly, either on its own scale or compared to the trend of new cases.

Conclusion

Based on the table and figures, we conclude that the pandemic is still far from ending in the United States in terms of cases, but is getting better in terms of deaths. Although the recent daily new cases have once dropped significantly from the July and August peak, the time series figure suggests the new cases are having an increasing trend as the winter flu season comes in, and even though the death numbers are milder, the daily new deaths still do not have a clear declining trend yet. The pre-post comparison in geoplot figure also points out that the current lockdown policies are not quite effective against the virus transmission in this pandemic so far, but may have shown some effects in controlling the deaths due to COVID-19.