

Analysis of the IHME COVID 19 Forecasting Model – July 14th Update

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Outline

- ❖ One revision to IHME model since July 7th
- ❖ A look at projected death through August 4th
- ❖ A look at infections
- ❖ Trend in death totals
- ❖ Distribution of daily deaths compared to the March 26th model
 - ❖ Focus on the 8 persons per million switch point
 - ❖ 90th percentile for governments taking action
- ❖ Cumulative deaths compared to the March 26th model



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Introduction

- The COVID 19 virus is having a major effect on the economy with an unemployment rate of 11%
- Since the middle of March, nearly 50 million U.S. workers filed for unemployment due to the shut down a significant share of the economy
- The Institute for Health Metrics and Evaluation (IHME) at the University of Washington is playing a large role in the formation of policy
 - The data used in this analysis is sourced from <http://www.healthdata.org/covid>
- It is important to document and understand the ex-post performance of the model and the periodic revisions that are made to that model
- Actual Deaths are from <https://covidtracking.com/>
- This is an update of the July 7th discussion



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The IHME Modeling Approach

- Revised the death model
- Use a spline function to log cumulative deaths versus log cumulative cases
- Death predictions made based on cases over time
- Unsmoothed daily deaths and the predicted daily deaths used to fit a spline
- Sample standard deviation developed using 1,000 draws from the residuals
- Provide estimates based upon what is expected to happen, mandates easing, and estimates with 95% wearing masks
- Expected to happen assumes easing occurs until a threshold of a daily death rate of 8 per million
- Paper is still in the peer review process



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Projected August 4th Deaths from the March 26th, June 24th, June 29th, and July 6th Models

	3/26	6/24	6/29	7/6		3/26	6/24	6/29	7/6
Alabama	1,732	1,415	1,395	1,572	Hawaii	390	21	21	18
Alaska	129	16	14	14	Idaho	84	110	105	106
Arizona	1,613	3,440	3,111	3,137	Illinois	2,360	7,814	7,936	7,809
Arkansas	762	605	513	437	Indiana	940	2,908	2,760	2,806
California	4,306	8,613	8,167	9,109	Iowa	138	823	793	787
Colorado	2,151	1,783	1,854	1,781	Kansas	687	341	343	366
Connecticut	378	4,465	4,487	4,479	Kentucky	605	688	670	719
Delaware	827	490	557	556	Louisiana	1,897	3,816	3,822	3,752
Florida	6,766	6,663	6,006	6,293	Maine	3,013	113	114	117
Georgia	2,777	4,387	3,982	3,301	Maryland	1,171	3,446	3,390	3,477



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Projected August 4th Deaths from the March 26th, June 24th, June 29th, and July 6th Models

	3/26	6/24	6/29	7/6		3/26	6/24	6/29	7/6
Massachusetts	1,782	8,490	8,868	9,201	New Mexico	514	686	660	650
Michigan	2,862	6,369	6,375	6,481	New York	15,546	31,714	32,566	31,727
Minnesota	2,146	1,725	1,711	1,726	North Carolina	1,721	1,669	1,797	1,706
Mississippi	2,292	1,164	1,507	1,557	North Dakota	171	88	86	89
Missouri	1,055	1,672	1,367	1,326	Ohio	1,203	3,345	3,515	3,725
Montana	282	27	29	22	Oklahoma	1,149	464	447	466
Nebraska	424	381	380	386	Oregon	469	353	301	271
Nevada	568	667	684	693	Pennsylvania	1,579	7,215	7,395	7,647
New Hampshire	351	526	523	470	Rhode Island	306	1,083	1,137	1,101
New Jersey	2,096	13,581	15,713	15,943	South Carolina	1,043	951	1,033	1,420



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Projected August 4th Deaths from the March 26th, June 24th, June 29th, and July 6th Models

	3/26	6/24	6/29	7/6		3/26	6/24	6/29	7/6
South Dakota	204	138	147	143	Virginia	2,053	1,745	2,024	2,446
Tennessee	1,067	829	1,028	1,003	Washington	1,670	1,538	1,563	1,559
Texas	4,150	5,114	4,712	4,504	West Virginia	543	105	116	106
Utah	502	277	264	247	Wisconsin	1,309	940	1,014	995
Vermont	95	61	62	58	Wyoming	132	20	21	18
United States	82,141	145,490	147,693	148,934					



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IHME Model Prediction Changes from July 6

- The model revision released on July 6th increased the cumulative expected death in 22 states from the June 29th model
 - Increases in Alabama, Arizona, California, Florida, Idaho, Indiana, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, Nevada, New Jersey, North Dakota, Ohio, Pennsylvania, South Carolina, Virginia
- The model revision released on July 6th has higher cumulative expected death in 25 states and lower cumulative expected death in 25 states compared to the original model
 - Increases in Arizona, California, Connecticut, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Missouri, Nevada, New Hampshire, New Jersey, New Mexico, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Texas, Virginia



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COVID-19 Cases Percent of Population

	7/6	7/14		7/6	7/14		7/6	7/14
Alabama	0.93%	1.16%	Hawaii	0.08%	0.09%	Massachusetts	1.60%	1.63%
Alaska	0.16%	0.22%	Idaho	0.48%	0.66%	Michigan	0.74%	0.78%
Arizona	1.44%	1.76%	Illinois	1.18%	1.24%	Minnesota	0.69%	0.76%
Arkansas	0.81%	0.99%	Indiana	0.72%	0.78%	Mississippi	1.08%	1.26%
California	0.72%	0.87%	Iowa	1.02%	1.14%	Missouri	0.42%	0.50%
Colorado	0.60%	0.65%	Kansas	0.58%	0.69%	Montana	0.12%	0.18%
Connecticut	1.32%	1.33%	Kentucky	0.39%	0.45%	Nebraska	1.04%	1.12%
Delaware	1.27%	1.33%	Louisiana	1.47%	1.77%	Nevada	0.77%	0.96%
Florida	1.00%	1.36%	Maine	0.26%	0.27%	New Hampshire	0.44%	0.45%
Georgia	0.95%	1.17%	Maryland	1.16%	1.23%	New Jersey	2.00%	2.05%

Data from <https://www.worldometers.info/coronavirus/country/us/> July 14, 2020



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COVID-19 Cases Percent of Population

	7/6	7/14		7/6	7/14
New Mexico	0.65%	0.74%	South Dakota	0.81%	0.86%
New York	2.18%	2.21%	Tennessee	0.78%	0.98%
North Carolina	0.73%	0.85%	Texas	0.76%	0.99%
North Dakota	0.51%	0.59%	Utah	0.81%	0.96%
Ohio	0.50%	0.58%	Vermont	0.20%	0.21%
Oklahoma	0.44%	0.47%	Virginia	0.78%	0.85%
Oregon	0.25%	0.30%	Washington	0.50%	0.57%
Pennsylvania	0.75%	0.79%	West Virginia	0.20%	0.25%
Rhode Island	1.62%	1.66%	Wisconsin	0.56%	0.65%
South Carolina	0.92%	1.17%	Wyoming	0.30%	0.34%

Data from <https://www.worldometers.info/coronavirus/country/us/> July 14, 2020



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COVID-19 Case Summary

- The U.S. infection rate was 0.93% as of July 6th
- The U.S. infection rate is 1.07% as of July 14th
- The state range of infection rates is 2.21% for New York to 0.09% for Hawaii
- Seventeen states have had an infection rate greater than 1% (up from fourteen)
- Thirty-three states have had an infection rate of less than 1%



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Trend Analysis in Daily Death since June

	6/1 – 6/29	6/15 – 7/14		6/1 – 6/29	6/15 – 7/6		6/1 – 6/29	6/15 – 7/14
Alabama	0.01	0.15	Hawaii	0.01	0.00	Massachusetts	-1.81	-0.71
Alaska	0.01	0.01	Idaho	0.00	0.04	Michigan	-0.34	0.05
Arizona	0.41	1.20	Illinois	-2.53	-1.47	Minnesota	-0.61	-0.31
Arkansas	0.13	-0.09	Indiana	-0.59	-0.38	Mississippi	-0.03	0.20
California	0.03	1.21	Iowa	-0.35	-0.05	Missouri	-0.05	-0.18
Colorado	-0.30	-0.20	Kansas	-0.07	-0.02	Montana	0.00	0.04
Connecticut	-0.52	-0.18	Kentucky	-0.09	0.02	Nebraska	0.00	-0.17
Delaware	-0.11	-0.03	Louisiana	-0.39	0.11	Nevada	-0.07	0.25
Florida	-0.05	1.47	Maine	-0.04	0.02	New Hampshire	-0.10	-0.07
Georgia	-0.57	-0.48	Maryland	-0.51	-0.37	New Jersey	7.32	-3.54



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Trend Analysis in Daily Death since June

	6/1 – 6/29	6/15 – 7/14		6/1 – 6/29	6/15 – 7/14
New Mexico	-0.12	-0.03	South Dakota	0.02	0.02
New York	-1.78	-0.68	Tennessee	-0.02	0.19
North Carolina	-0.19	-0.17	Texas	0.33	2.06
North Dakota	-0.06	-0.04	Utah	-0.01	0.05
Ohio	-0.89	-0.17	Vermont	0.00	-0.01
Oklahoma	0.00	0.07	Virginia	0.03	0.11
Oregon	0.01	0.02	Washington	0.03	0.15
Pennsylvania	-1.51	-0.56	West Virginia	-0.03	0.00
Rhode Island	-0.14	-0.31	Wisconsin	-0.11	-0.20
South Carolina	0.02	0.52	Wyoming	-0.01	-0.01



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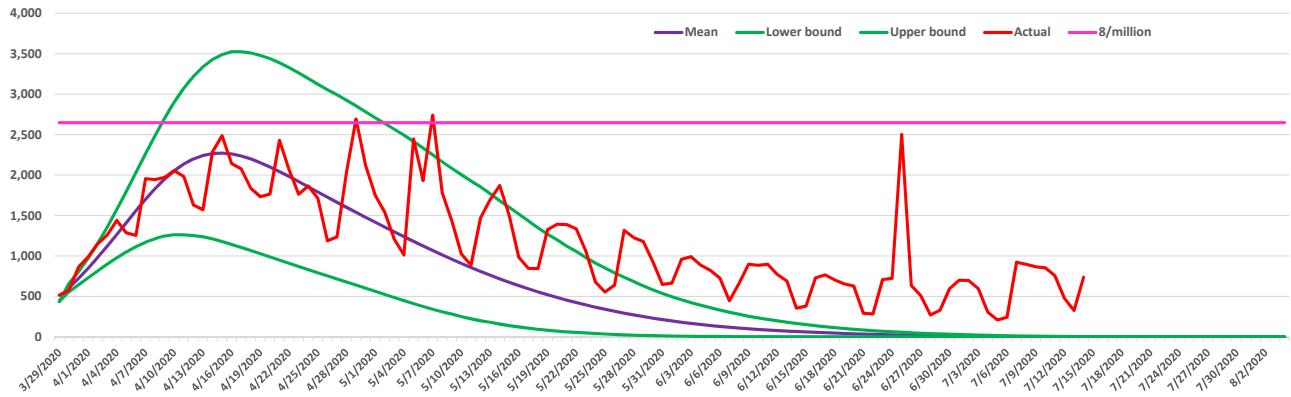
Trend Analysis Summary

- The U.S. has experienced a **5.69 decrease** per day from June 1 – June 29 and **2.47 decrease** per day from June 15 – July 14.
- From the June 1 to June 29 period to the June 15 to July 14 period, nine states have seen a lowering in the trend of death
 - Alaska, Arkansas, Hawaii, Missouri, Nebraska, New Jersey, Rhode Island, Vermont, Wisconsin
- Since June 15, 26 States have had a decrease in daily death of greater than 0.01 per day (down from 30)
- Since June 15, 22 States have had an increase in daily death of greater than 0.01 per day (up from 14)
- Since June 15, 2 States have had a 0.00 increase/decrease in death per day



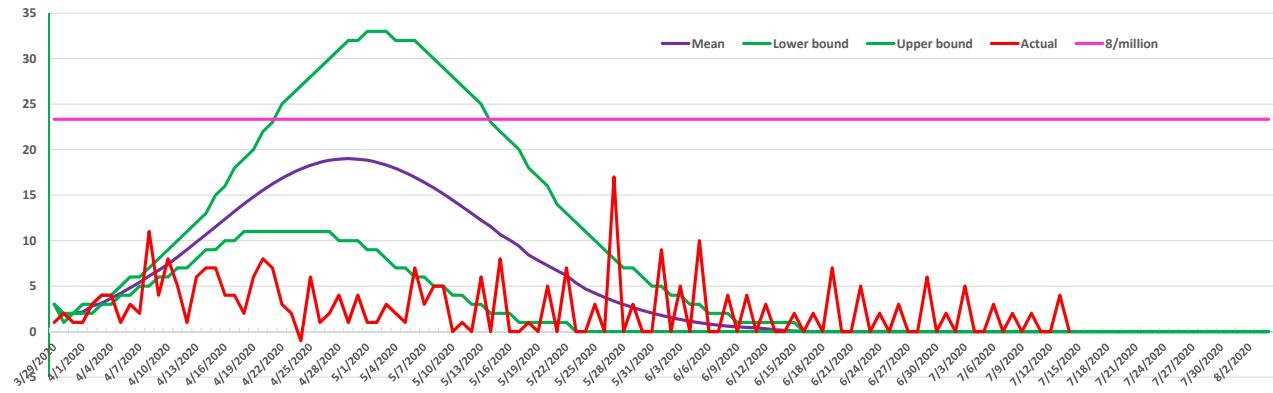
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U.S. COVID 19 Daily Death Projections March 26



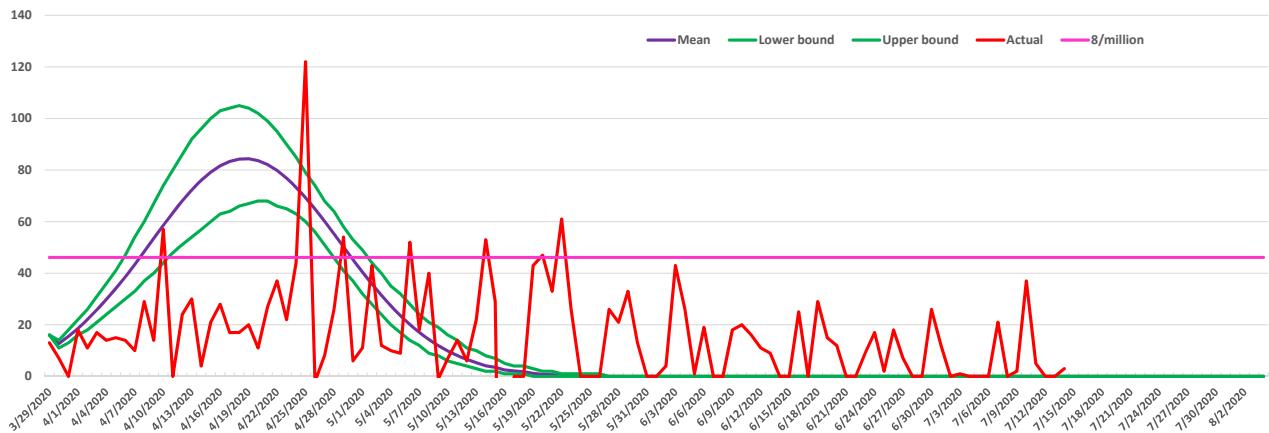
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Kansas COVID 19 Daily Death Projections March 26



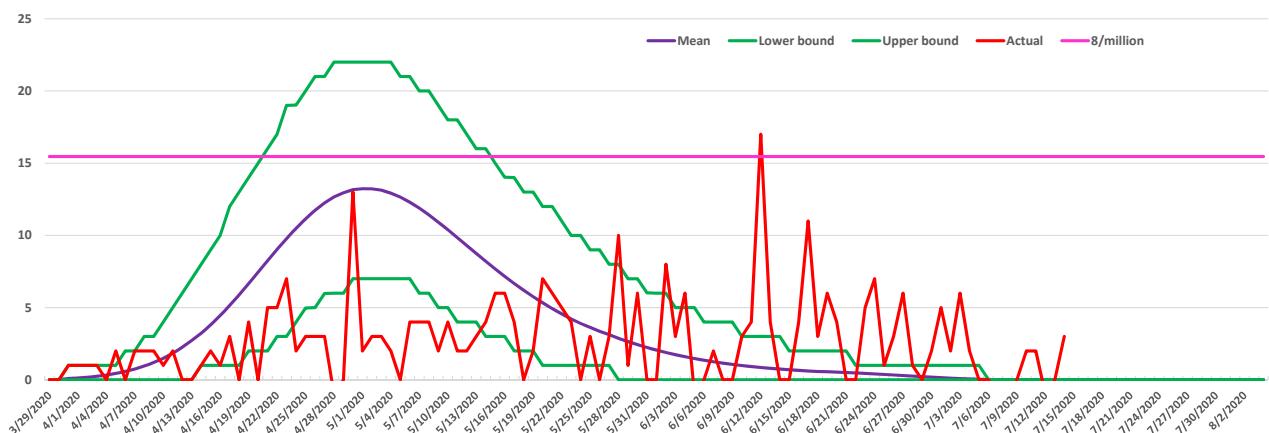
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Colorado COVID 19 Daily Death Projections March 26



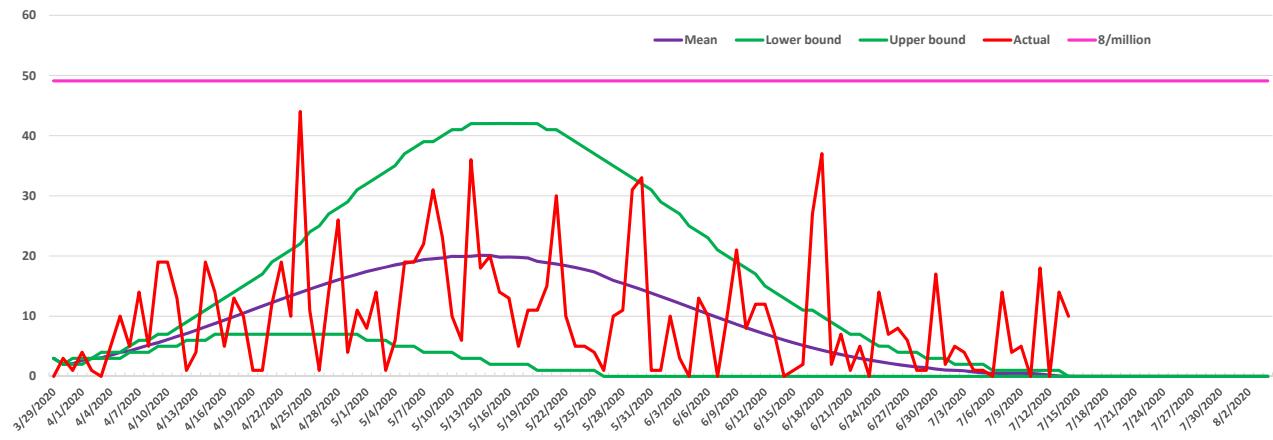
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Nebraska COVID 19 Daily Death Projections March 26



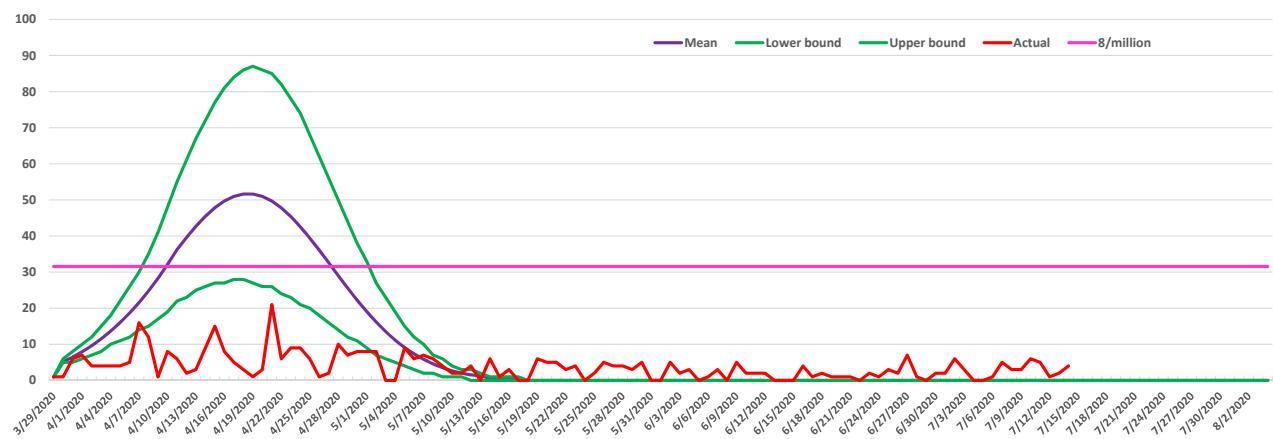
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Missouri COVID 19 Daily Death Projections March 26



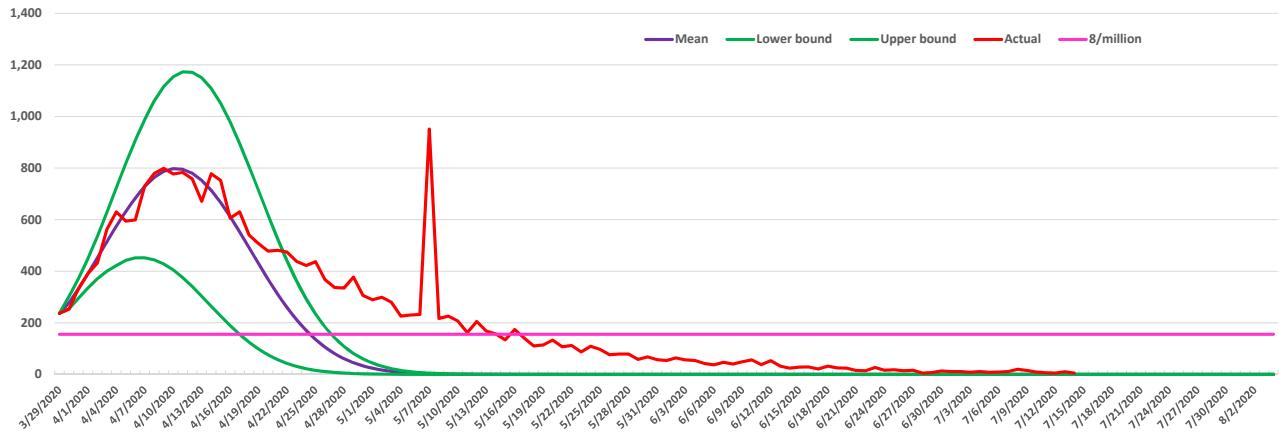
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Oklahoma COVID 19 Daily Death Projections March 26



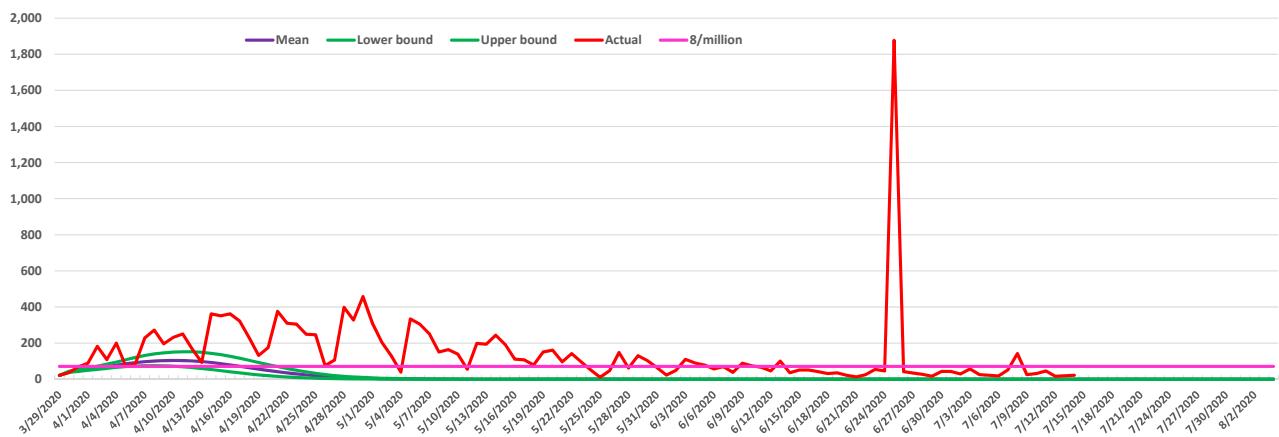
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New York COVID 19 Daily Death Projections March 26



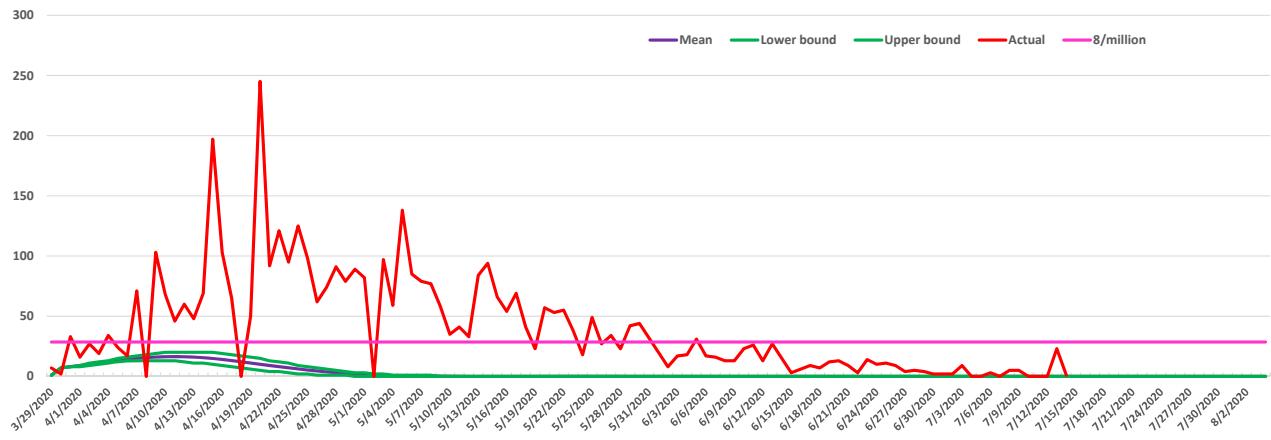
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New Jersey COVID 19 Daily Death Projections March 26



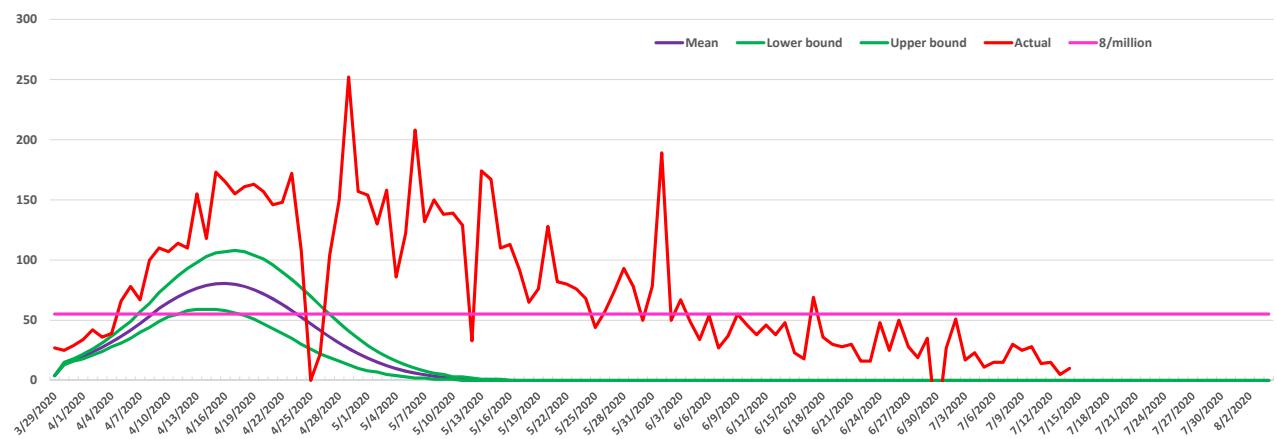
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Connecticut COVID 19 Daily Death Projections March 26



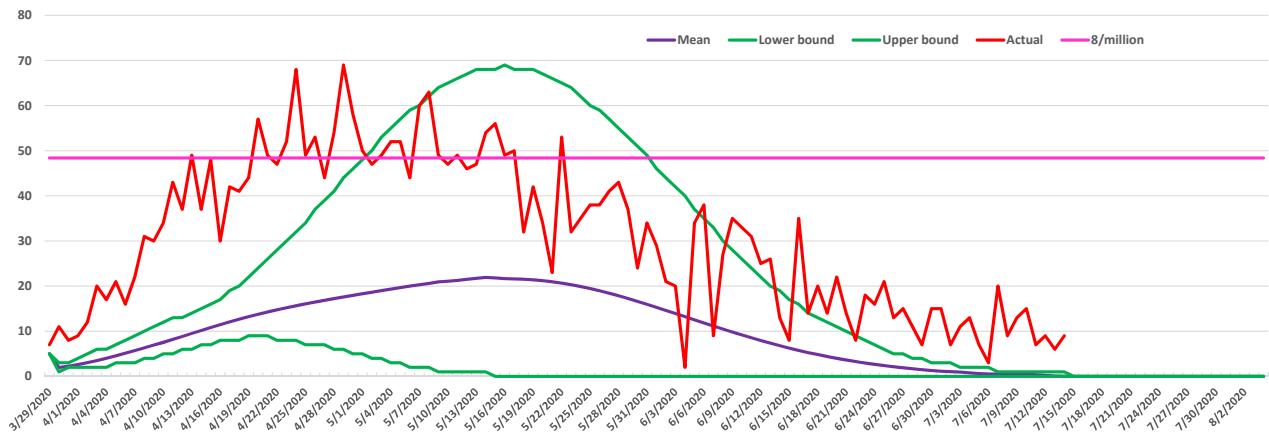
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Massachusetts COVID 19 Daily Death Projections March 26



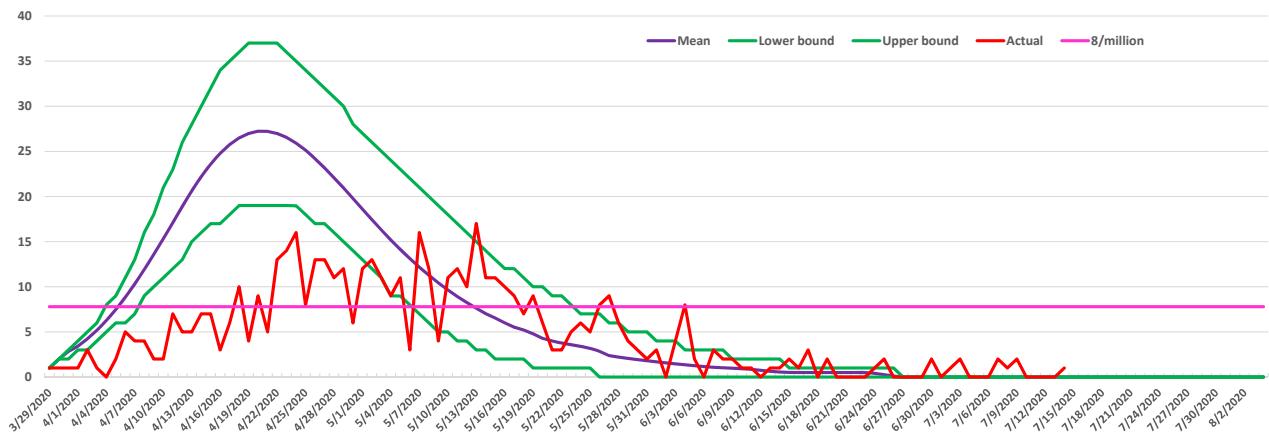
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Maryland COVID 19 Daily Death Projections March 26



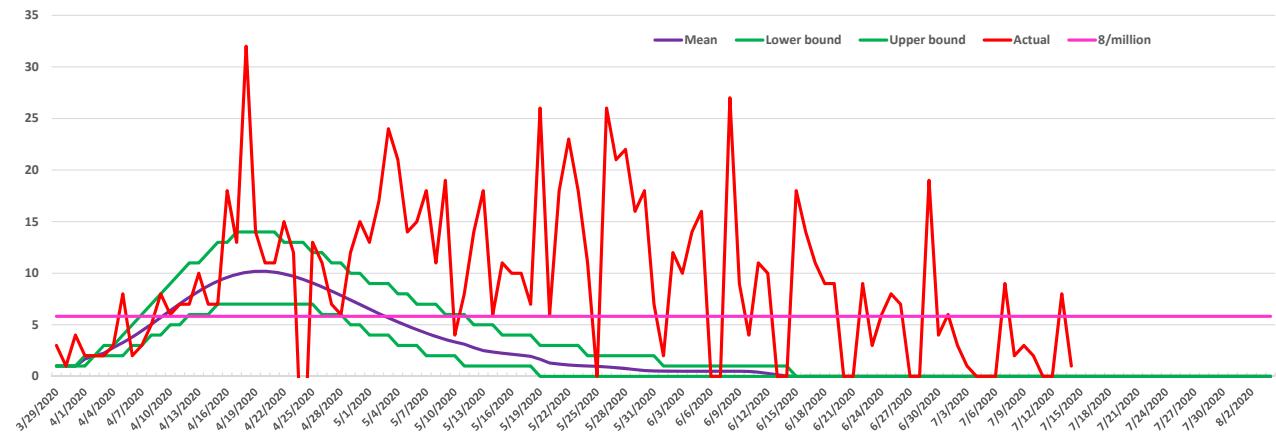
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Delaware COVID 19 Daily Death Projections March 26



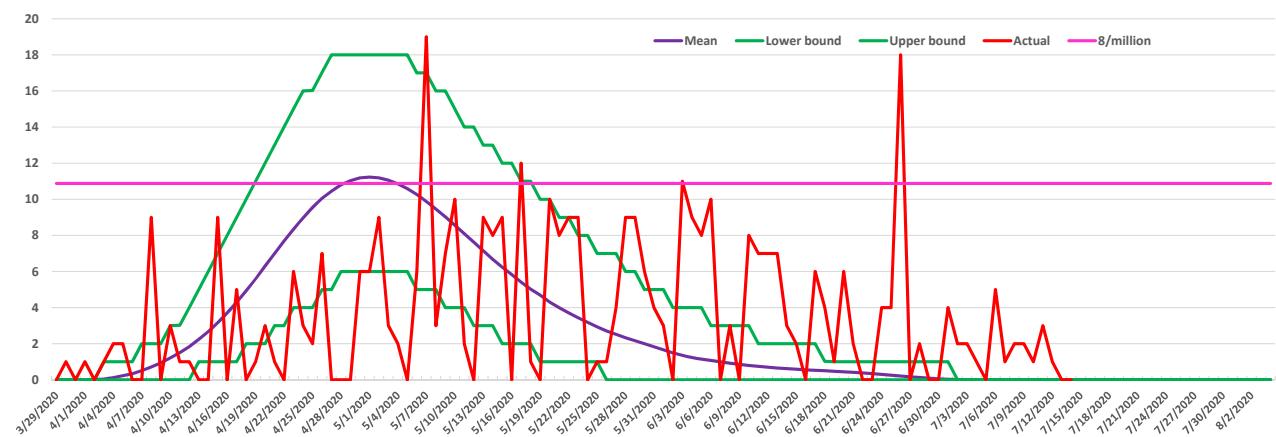
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Rhode Island COVID 19 Daily Death Projections March 26



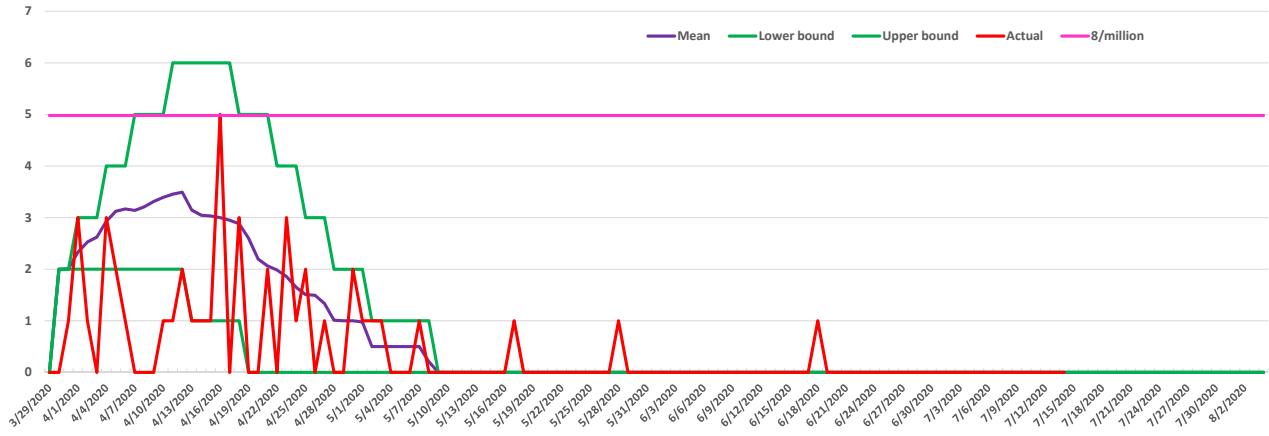
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New Hampshire COVID 19 Daily Death Projections March 26



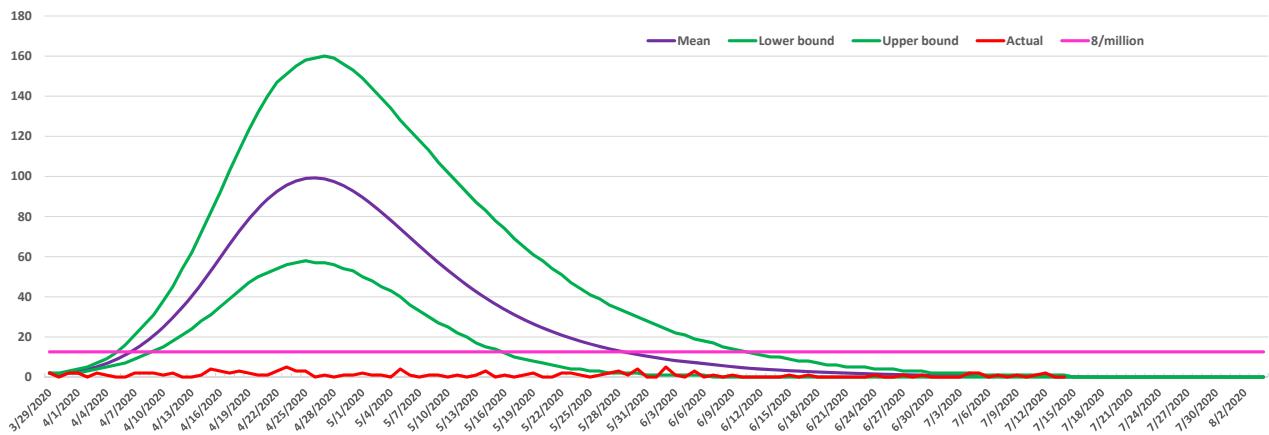
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Vermont COVID 19 Daily Death Projections March 26



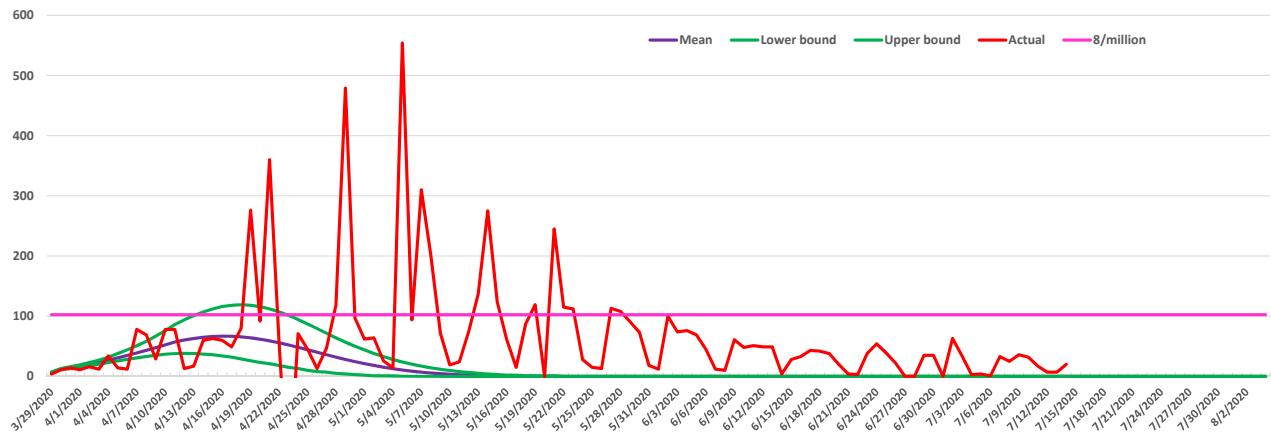
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Maine COVID 19 Daily Death Projections March 26



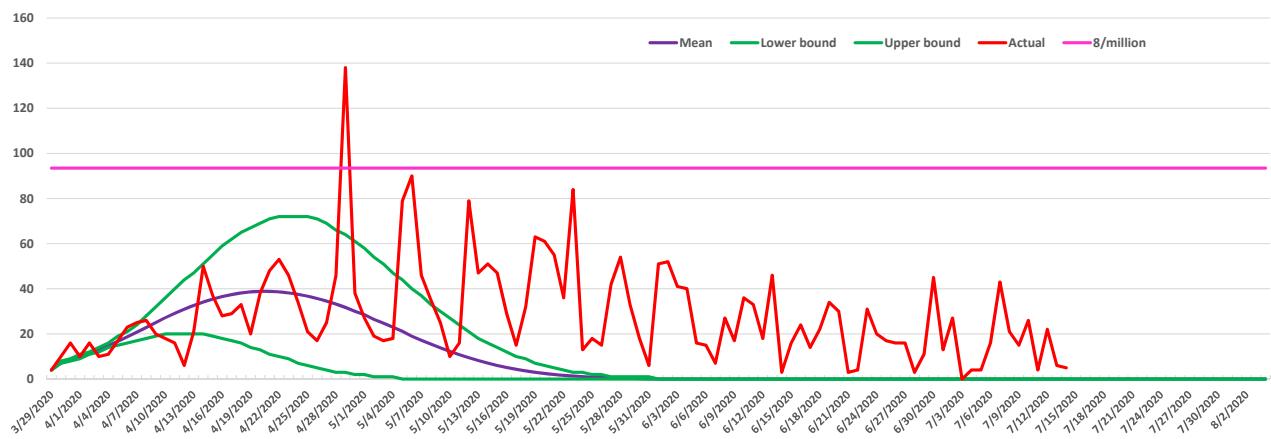
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Pennsylvania COVID 19 Daily Death Projections March 26



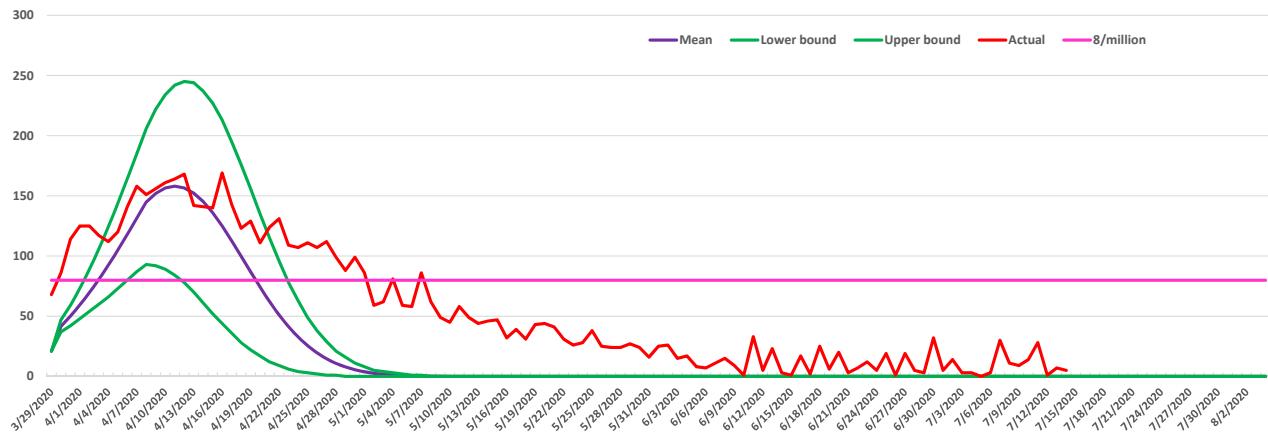
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Ohio COVID 19 Daily Death Projections March 26



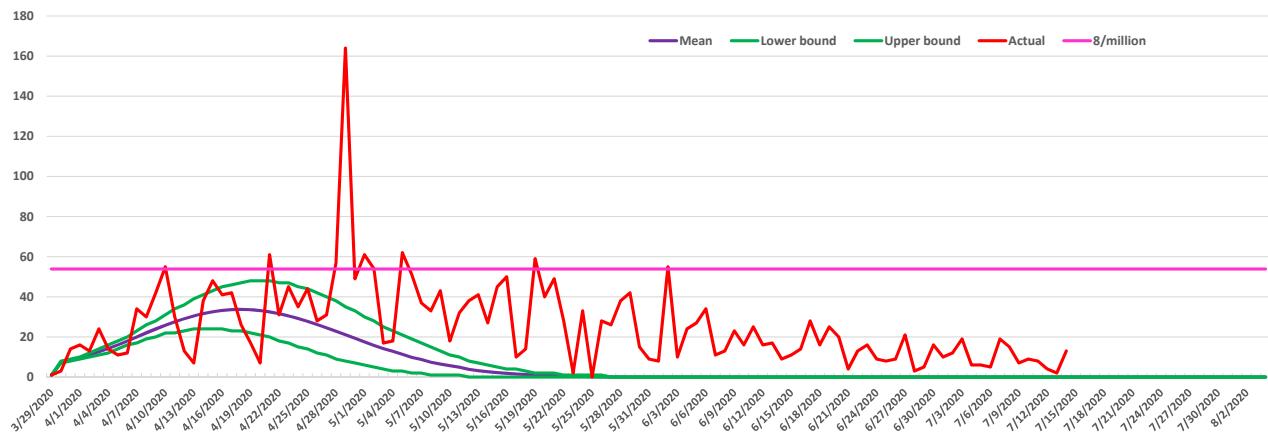
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Michigan COVID 19 Daily Death Projections March 26



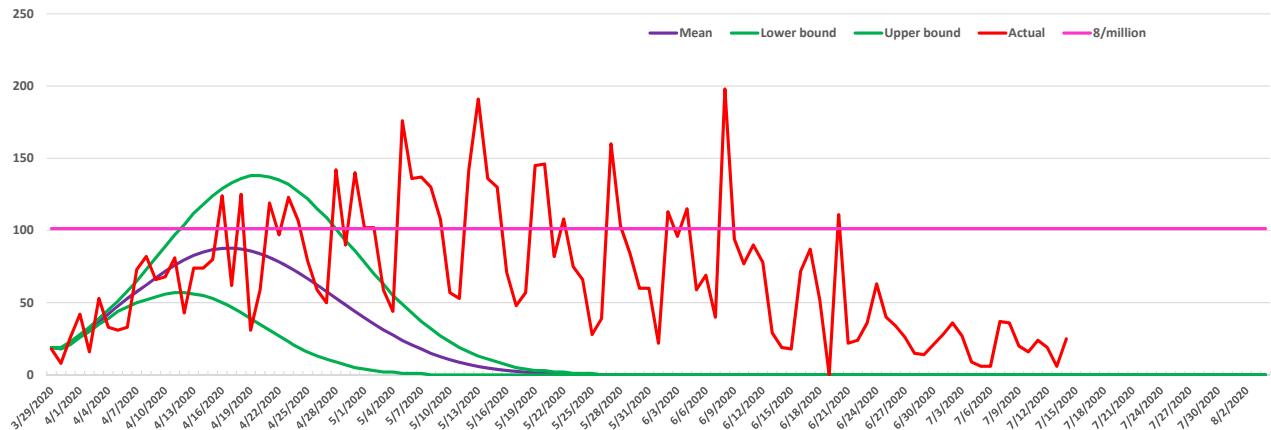
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Indiana COVID 19 Daily Death Projections March 26



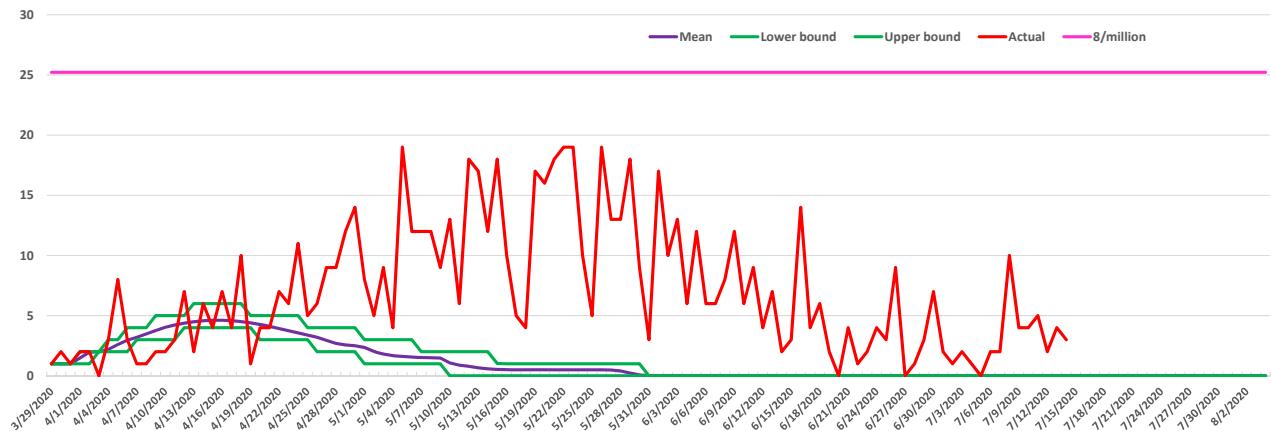
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Illinois COVID 19 Daily Death Projections March 26



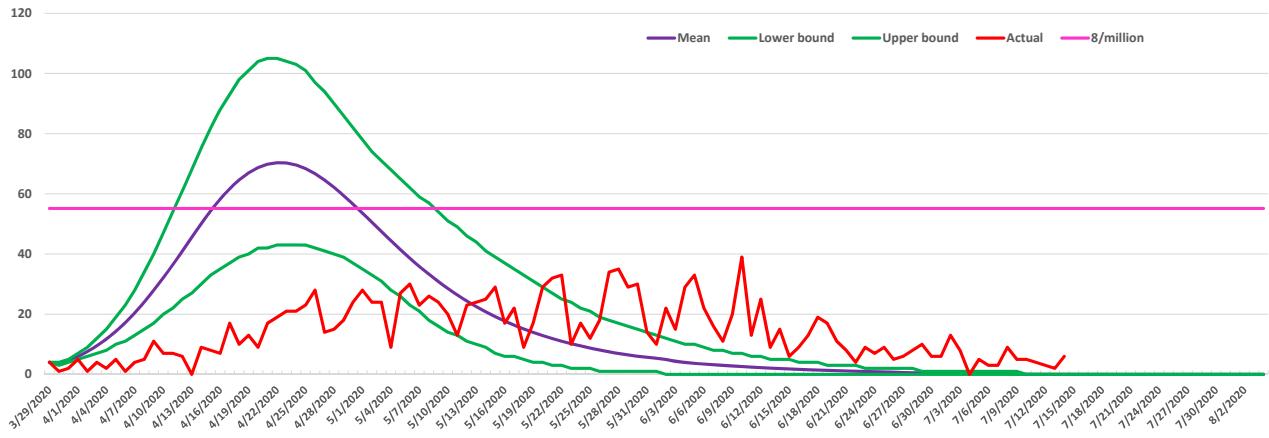
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Iowa COVID 19 Daily Death Projections March 26



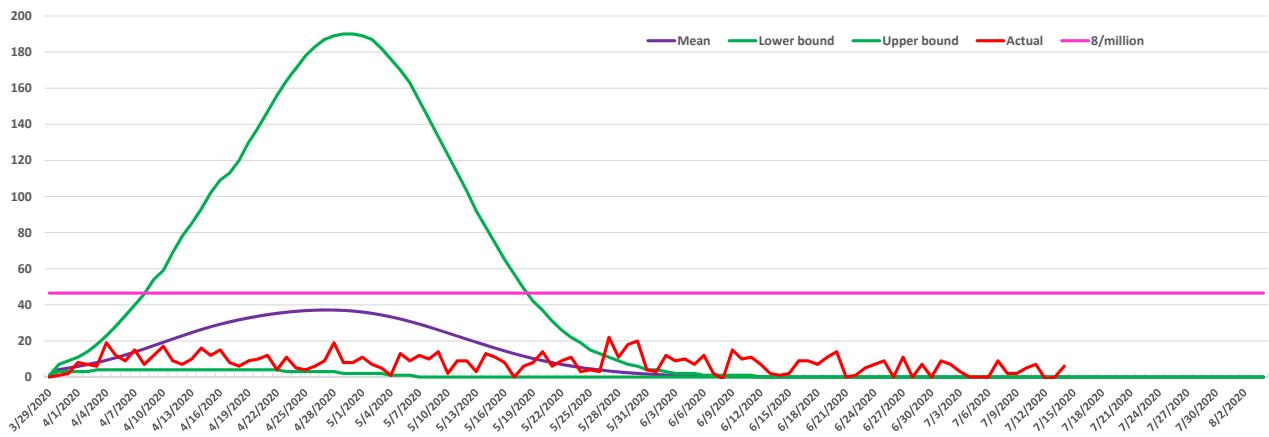
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Minnesota COVID 19 Daily Death Projections March 26



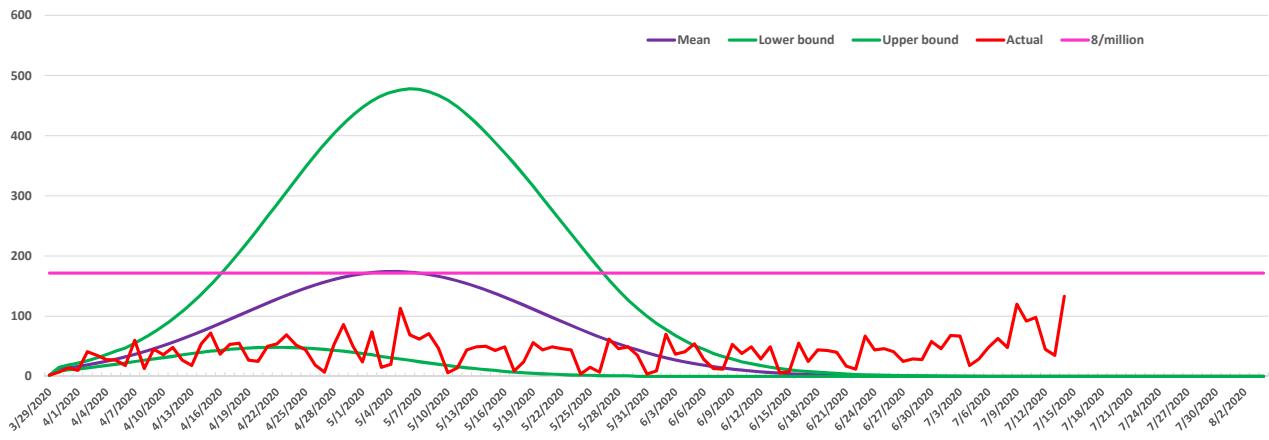
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Wisconsin COVID 19 Daily Death Projections March 26



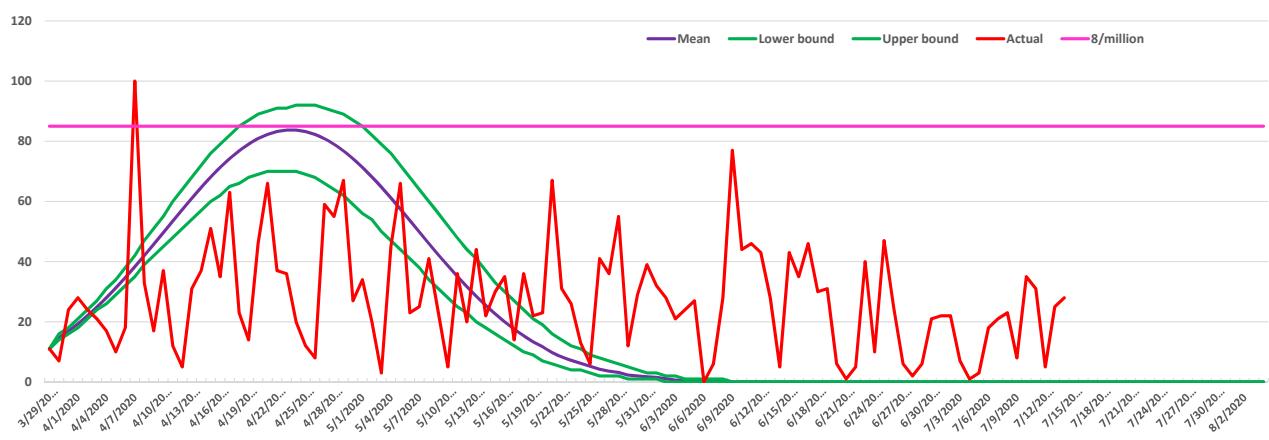
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Florida COVID 19 Daily Death Projections March 26



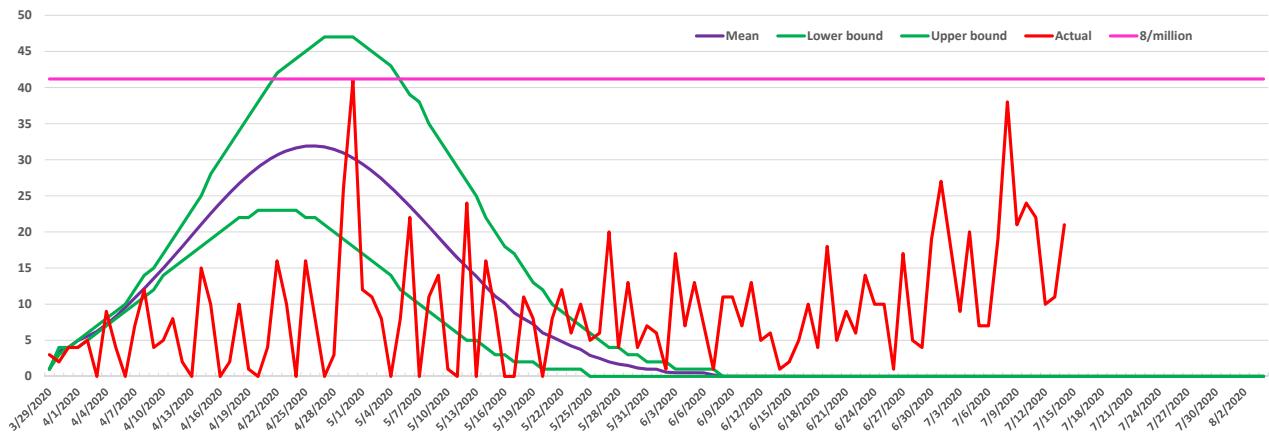
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Georgia COVID 19 Daily Death Projections March 26



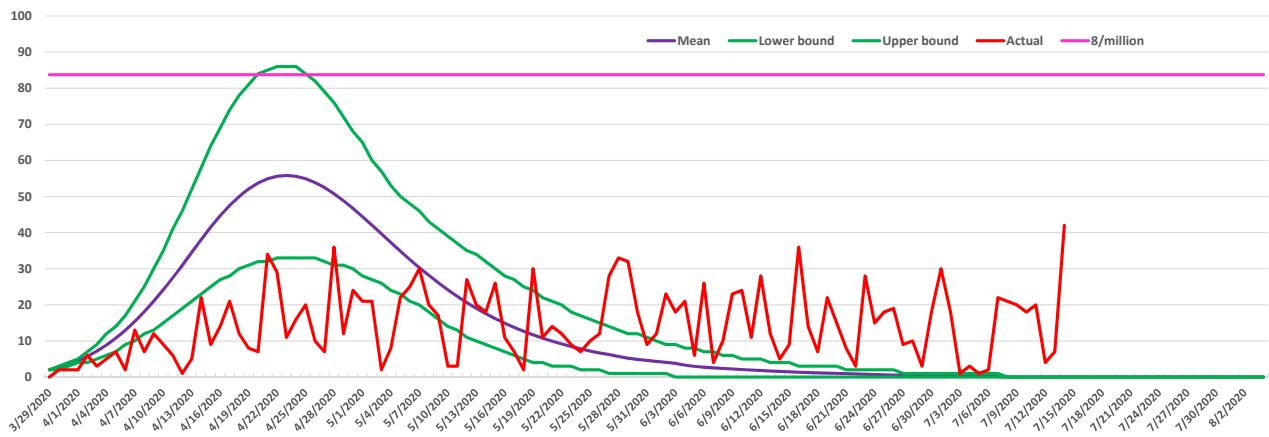
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South Carolina COVID 19 Daily Death Projections March 26



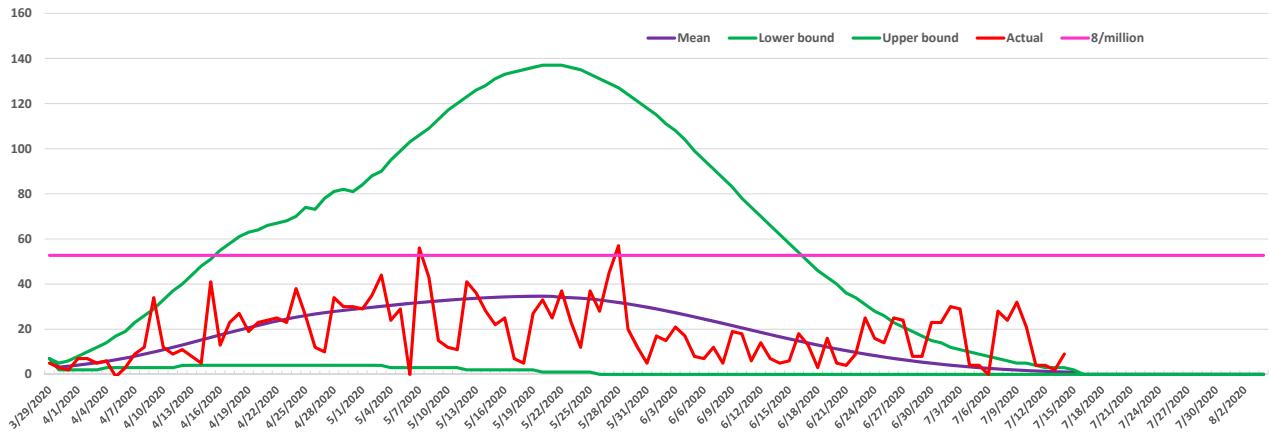
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North Carolina COVID 19 Daily Death Projections March 26



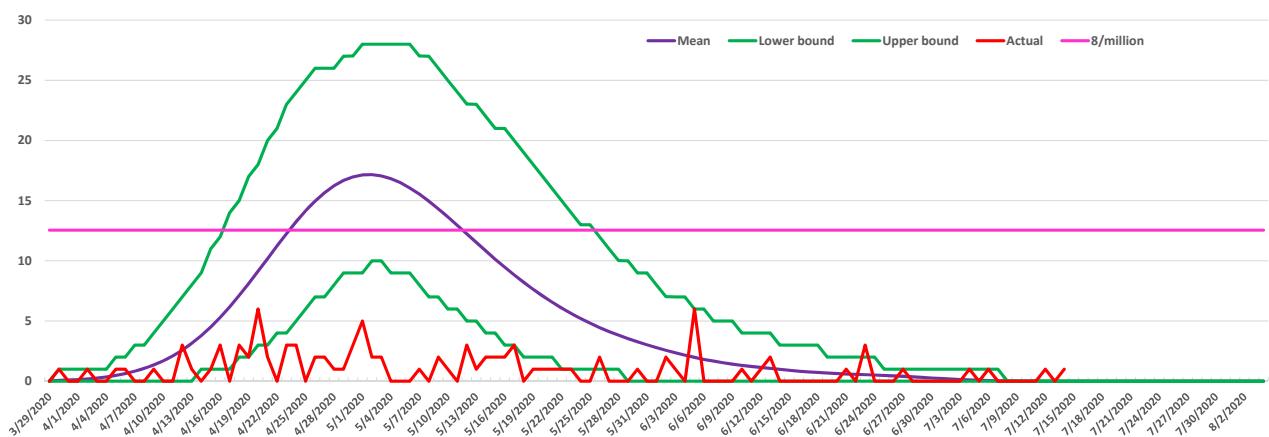
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Virginia COVID 19 Daily Death Projections March 26



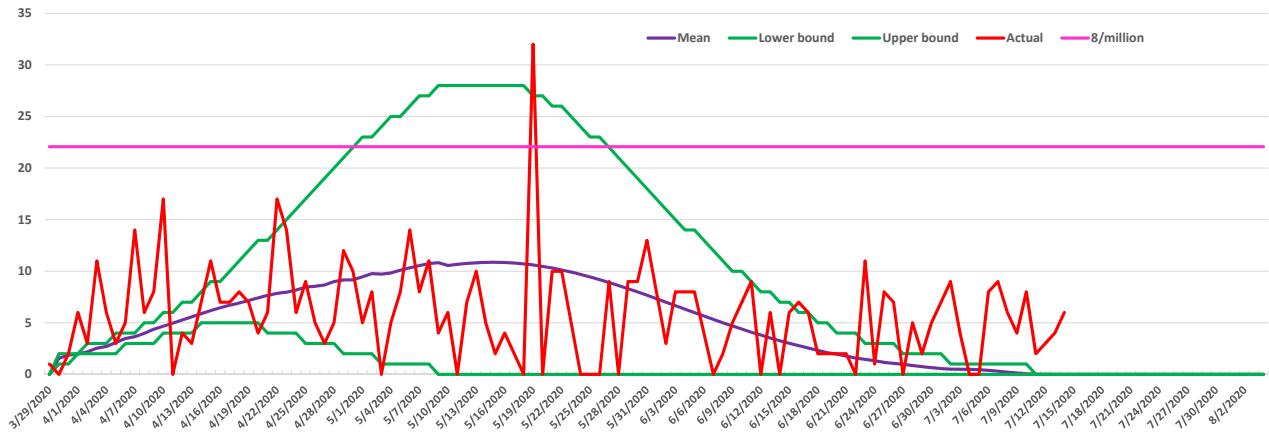
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West Virginia COVID 19 Daily Death Projections March 26



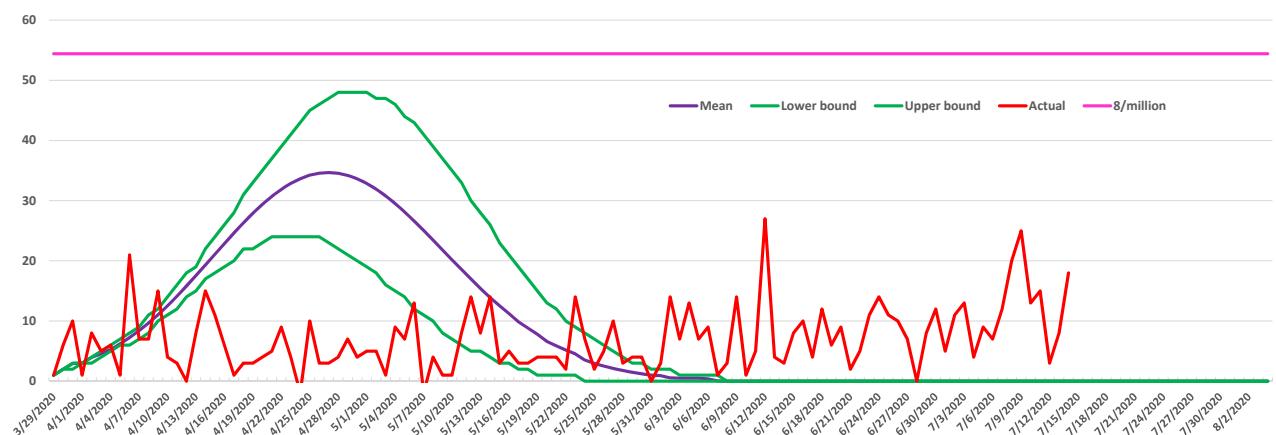
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Kentucky COVID 19 Daily Death Projections March 26



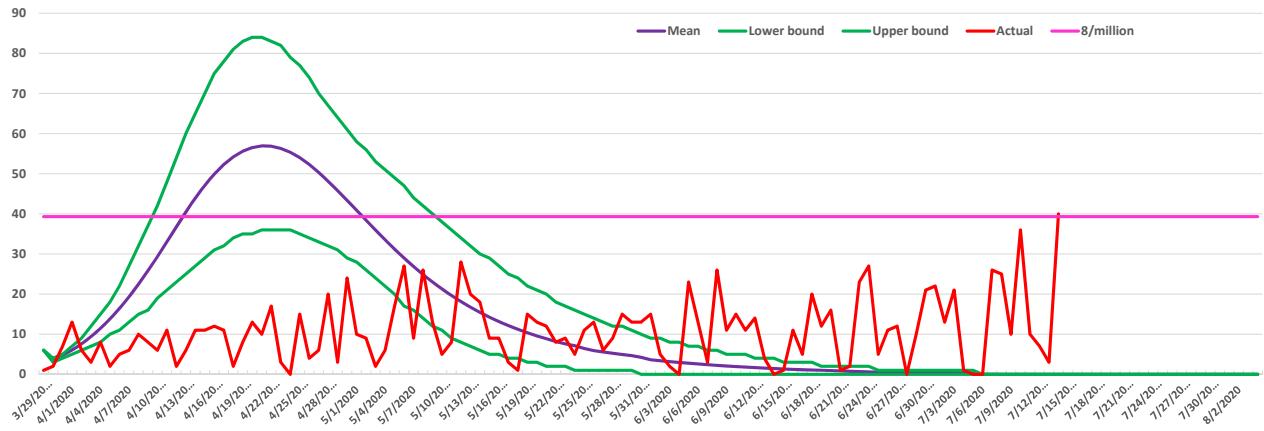
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Tennessee COVID 19 Daily Death Projections March 26



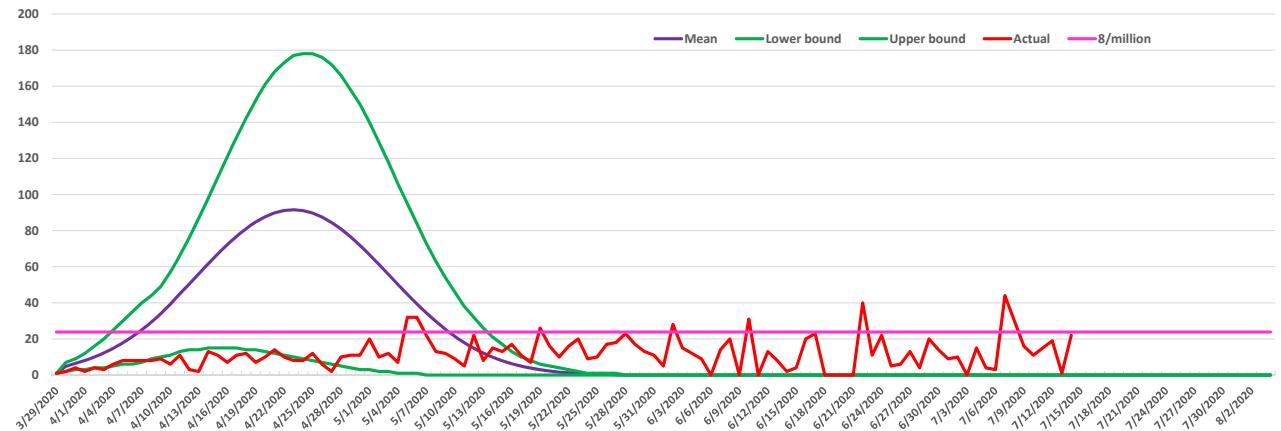
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Alabama COVID 19 Daily Death Projections March 26



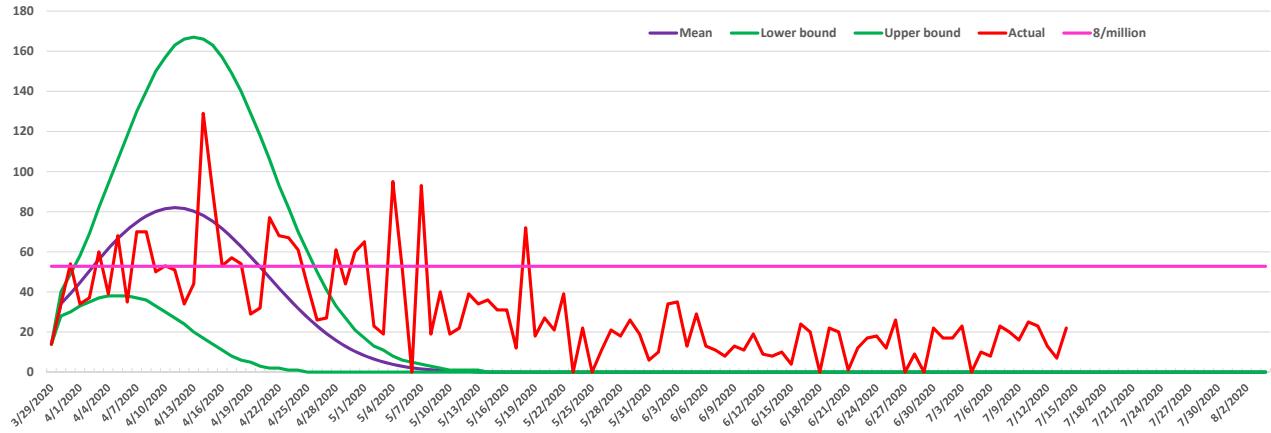
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Mississippi COVID 19 Daily Death Projections March 26



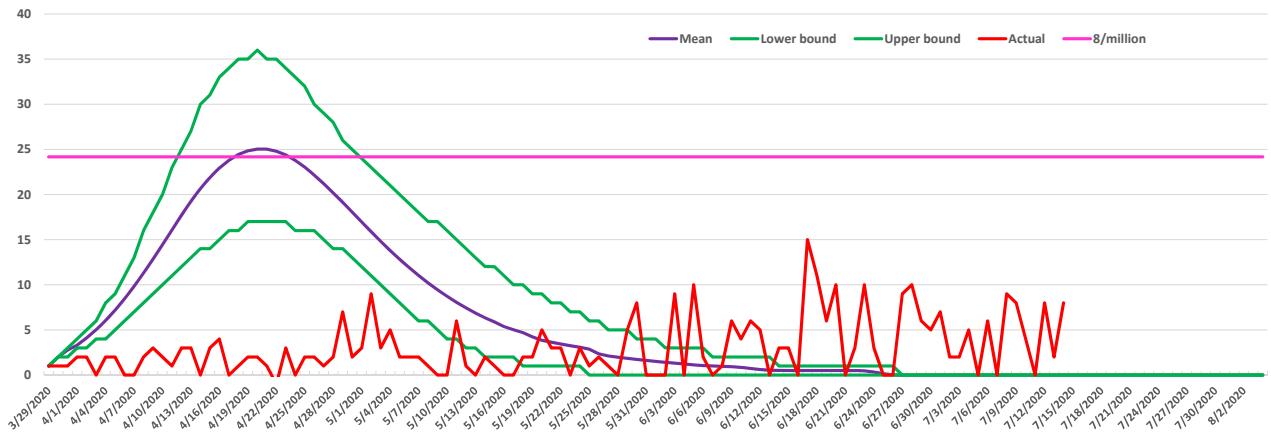
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Louisiana COVID 19 Daily Death Projections March 26



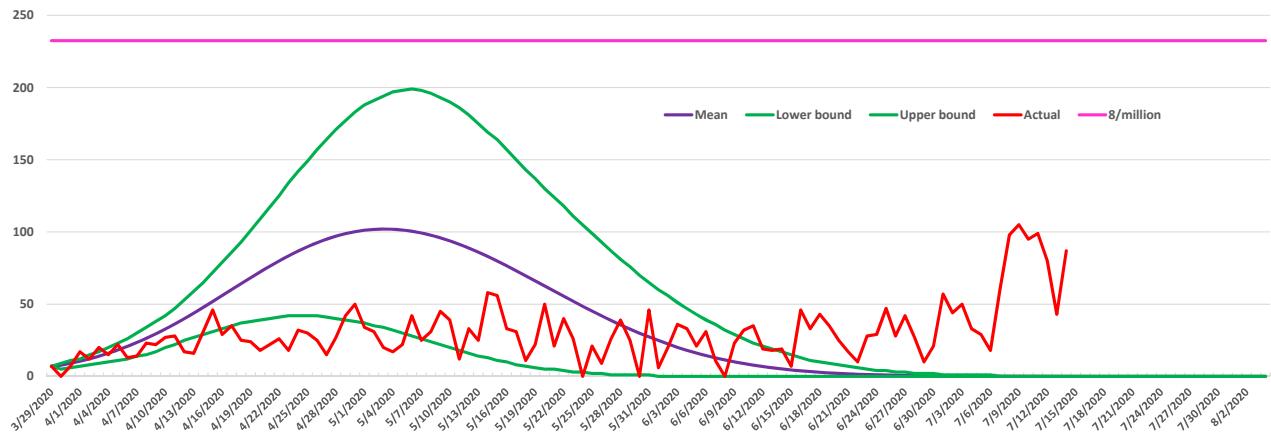
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Arkansas COVID 19 Daily Death Projections March 26



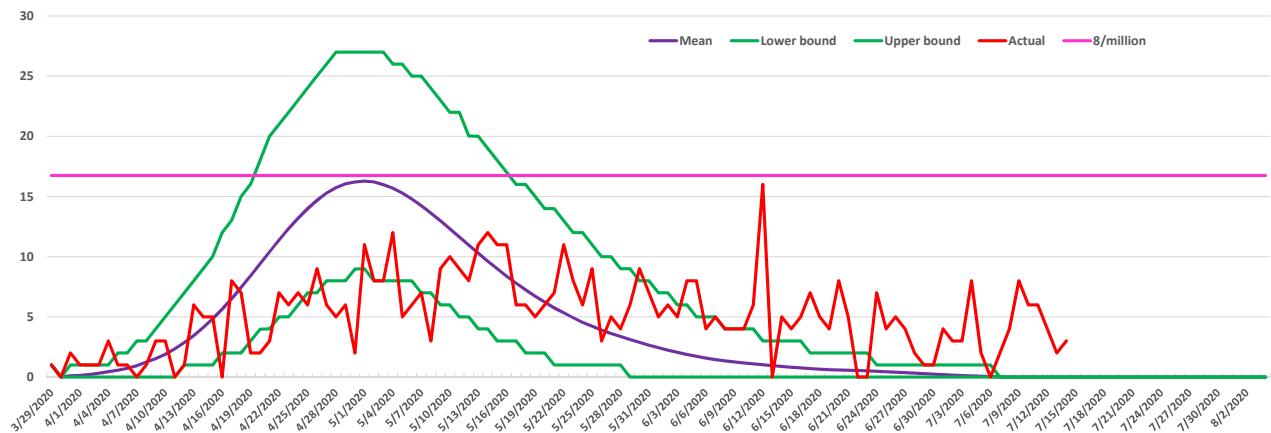
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Texas COVID 19 Daily Death Projections March 26



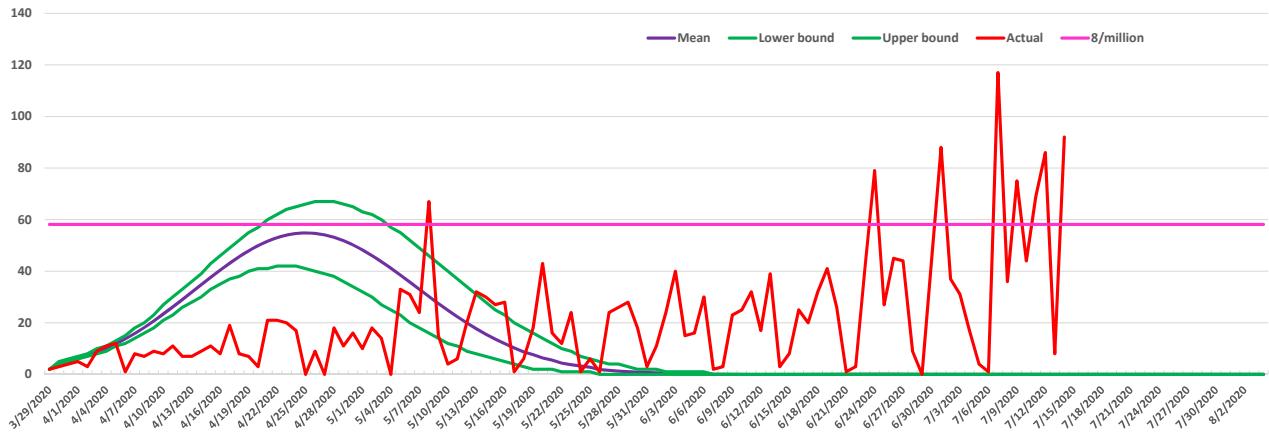
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New Mexico COVID 19 Daily Death Projections March 26



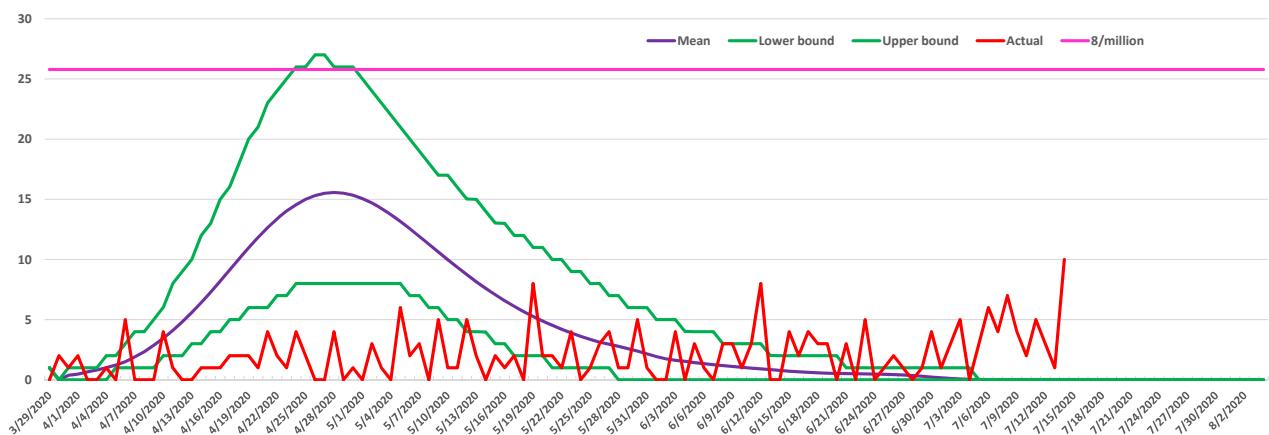
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Arizona COVID 19 Daily Death Projections March 26



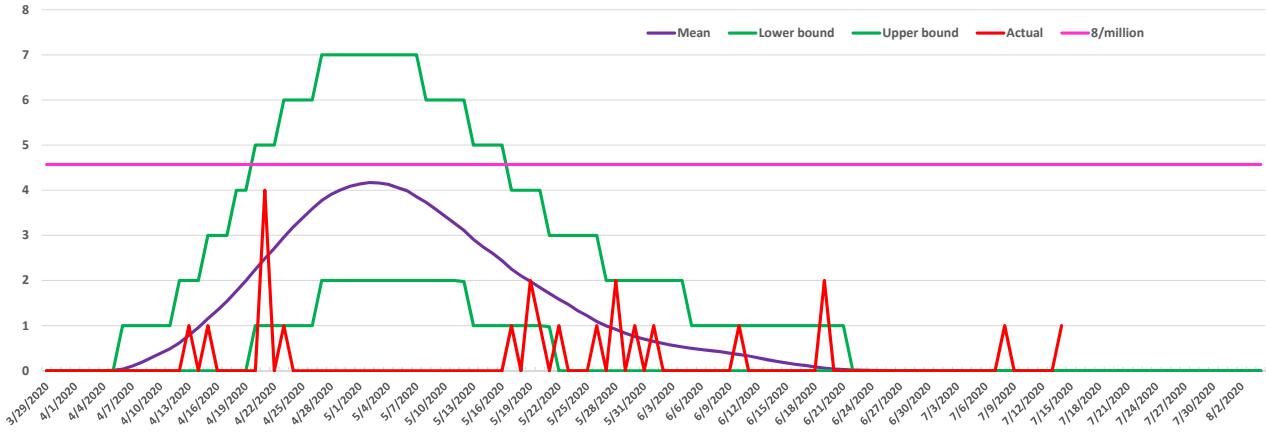
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Utah COVID 19 Daily Death Projections March 26



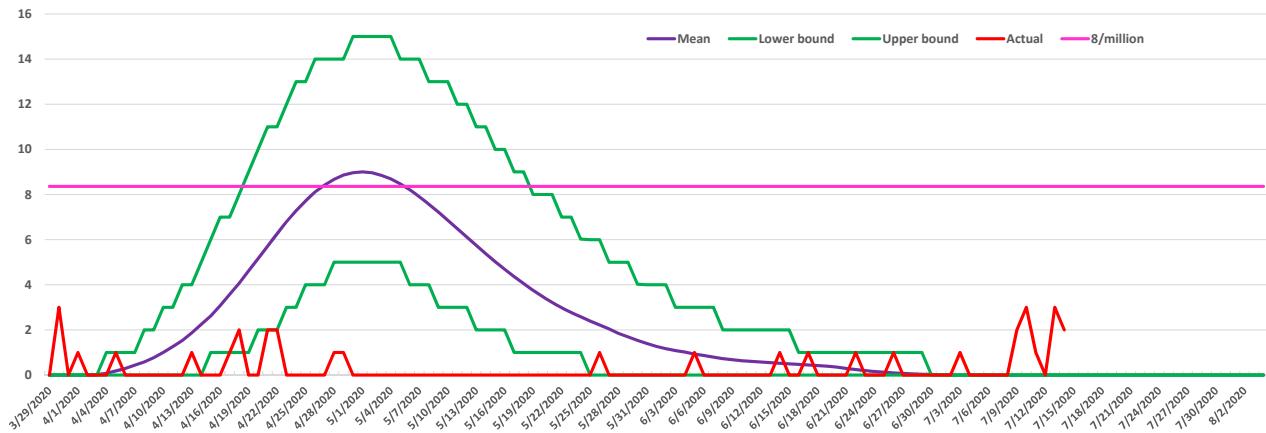
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Wyoming COVID 19 Daily Death Projections March 26



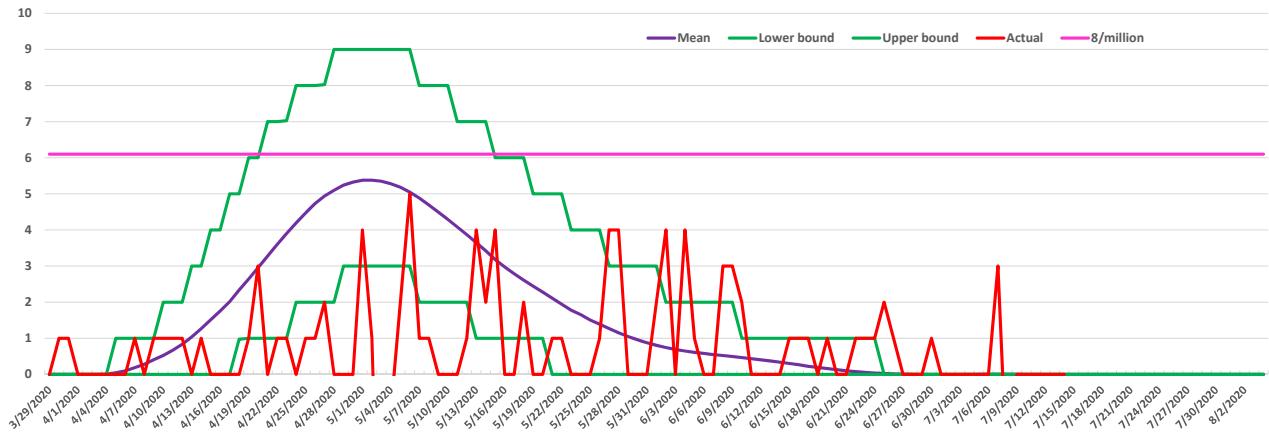
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Montana COVID 19 Daily Death Projections March 26



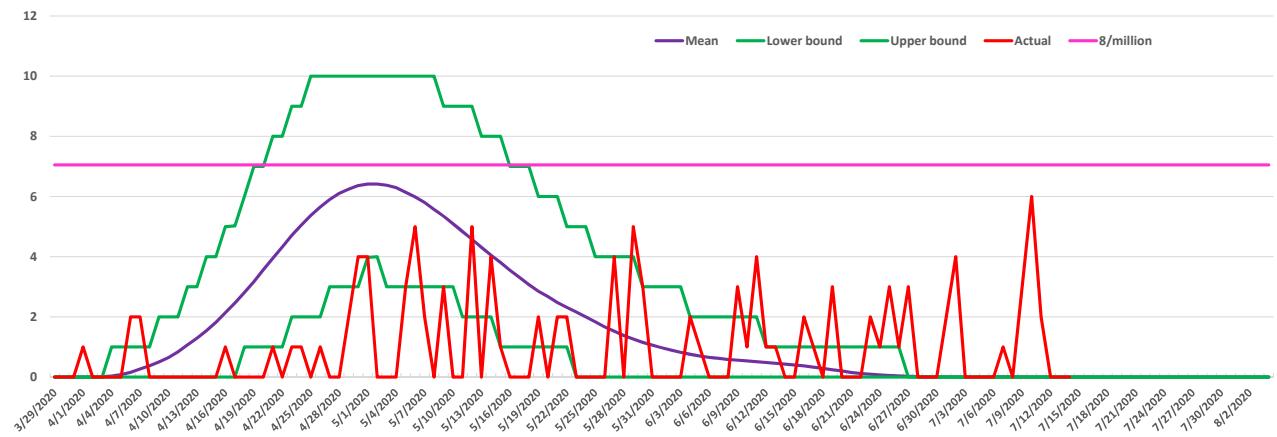
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North Dakota COVID 19 Daily Death Projections March 26



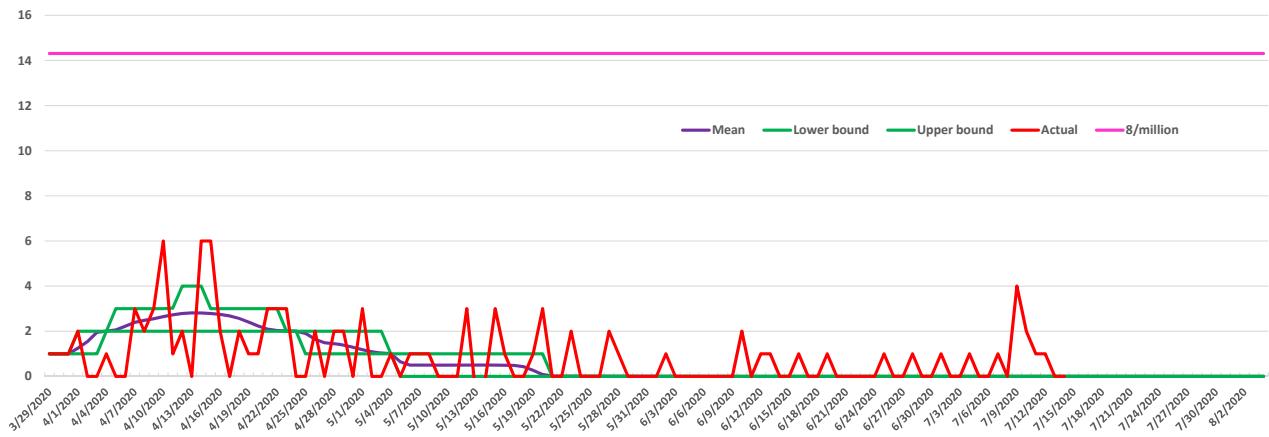
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South Dakota COVID 19 Daily Death Projections March 26



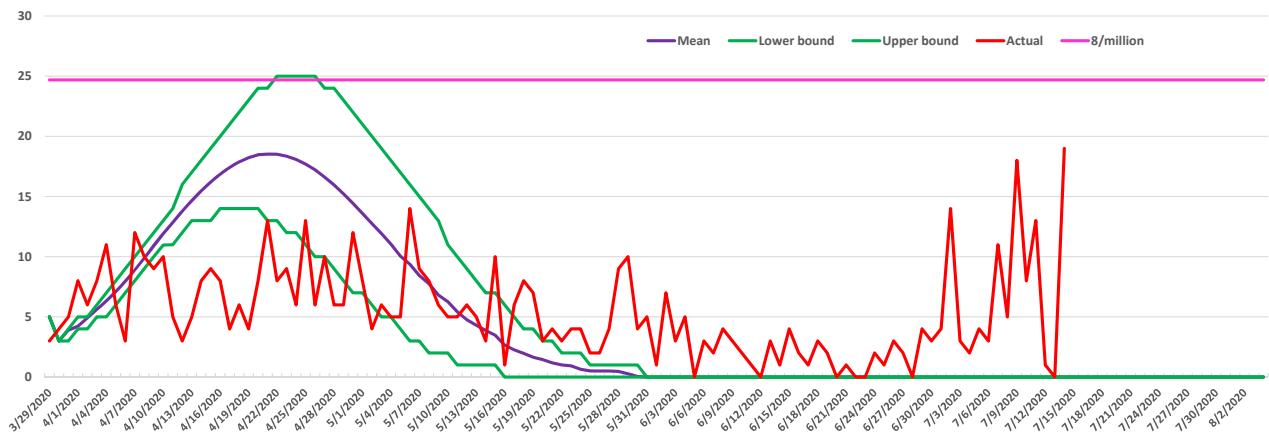
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Idaho COVID 19 Daily Death Projections March 26



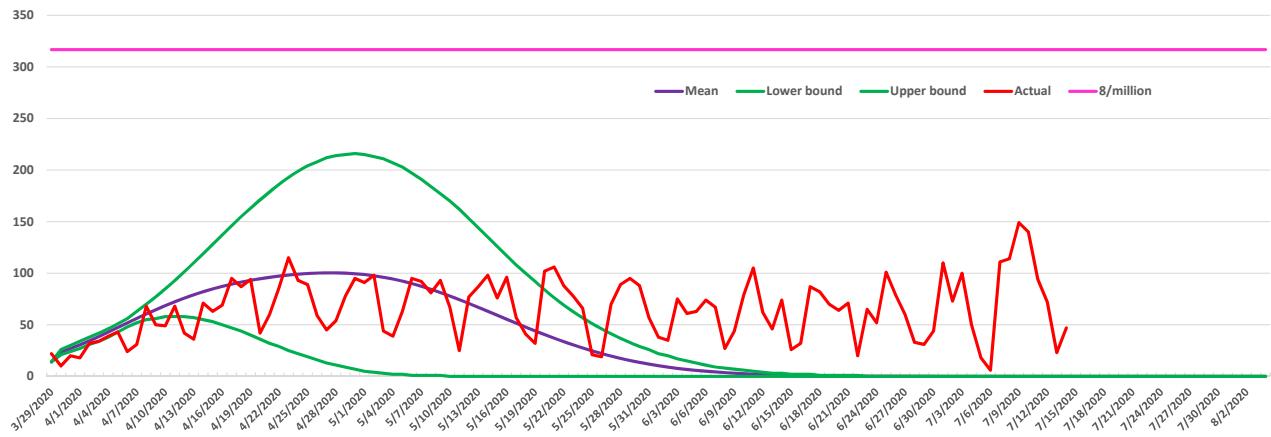
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Nevada COVID 19 Daily Death Projections March 26



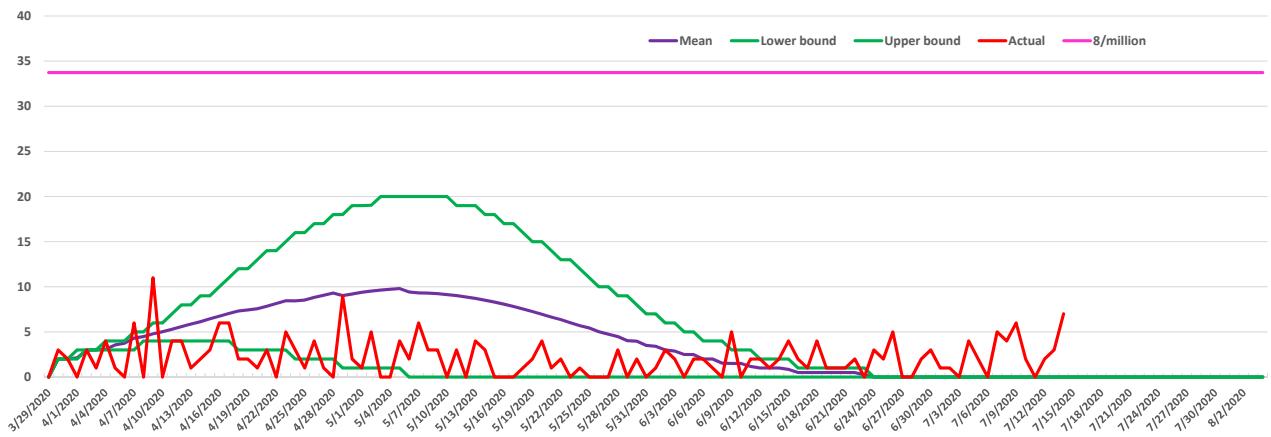
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California COVID 19 Daily Death Projections March 26



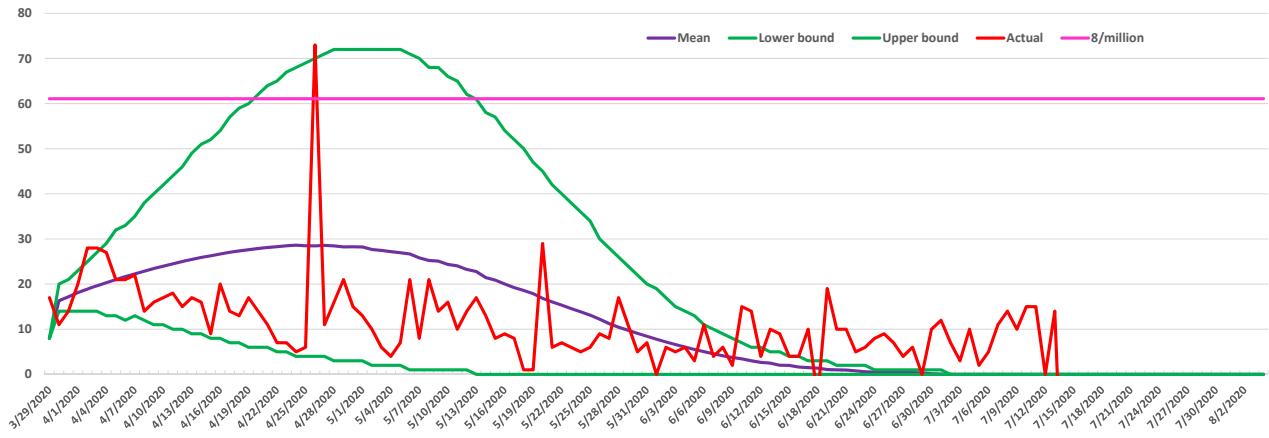
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Oregon COVID 19 Daily Death Projections March 26



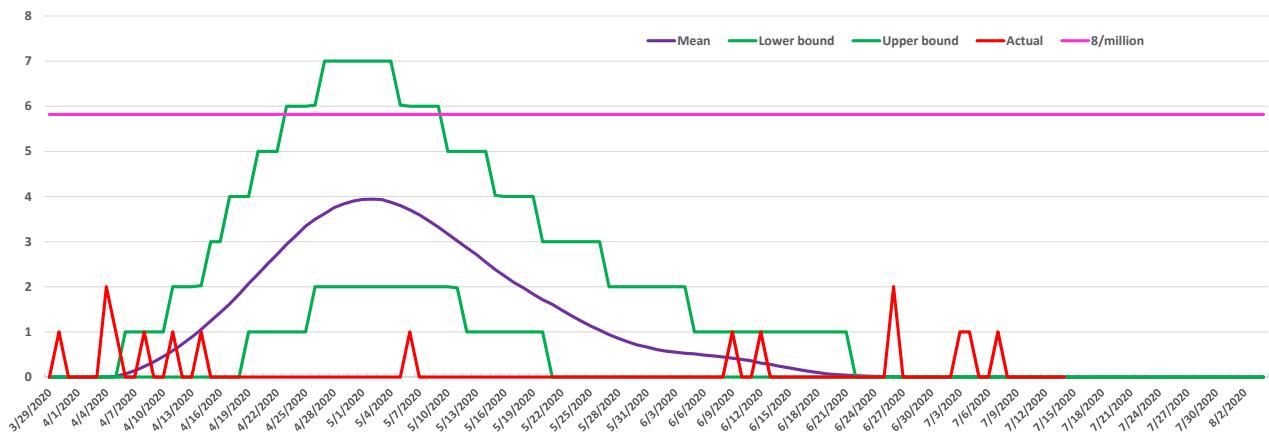
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Washington COVID 19 Daily Death Projections March 26



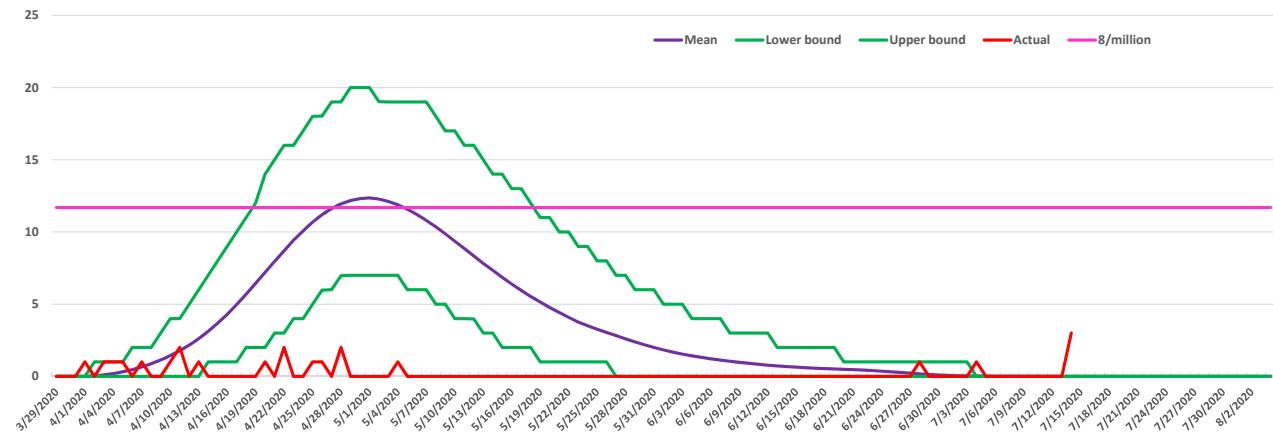
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Alaska COVID 19 Daily Death Projections March 26



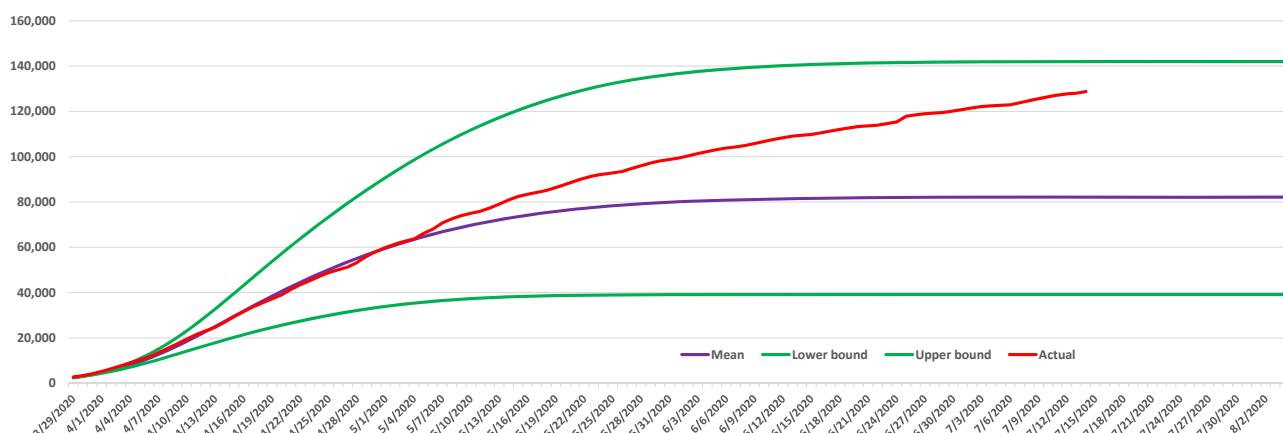
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Hawaii COVID 19 Daily Death Projections March 26



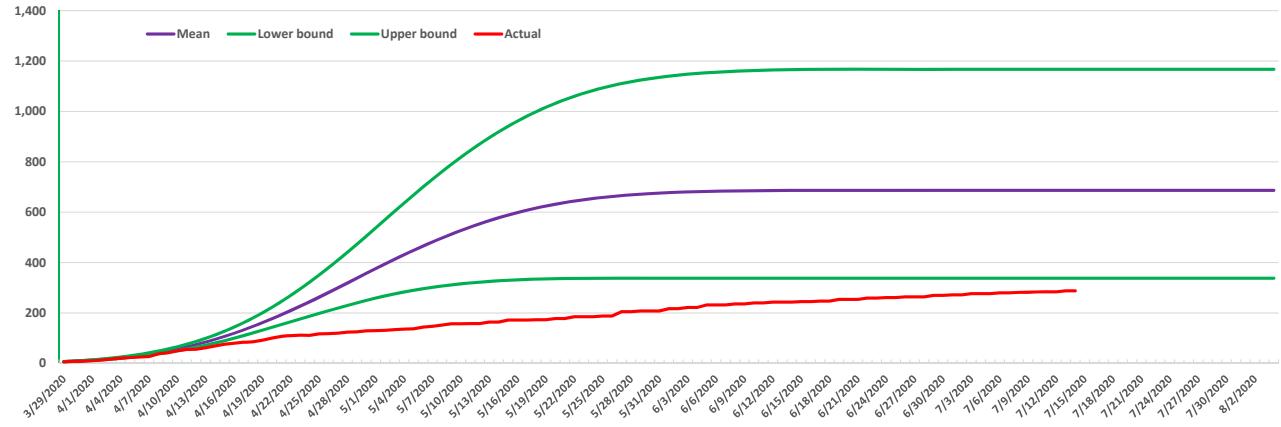
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U.S. COVID 19 Cumulative Death Projections



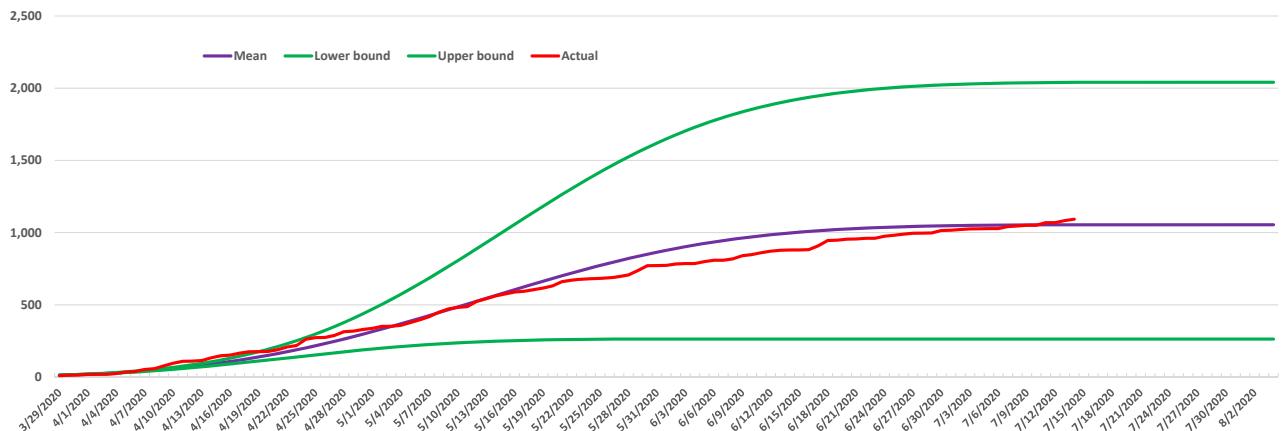
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Kansas COVID 19 Cumulative Death Projections



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Missouri COVID 19 Cumulative Death Projections March 26



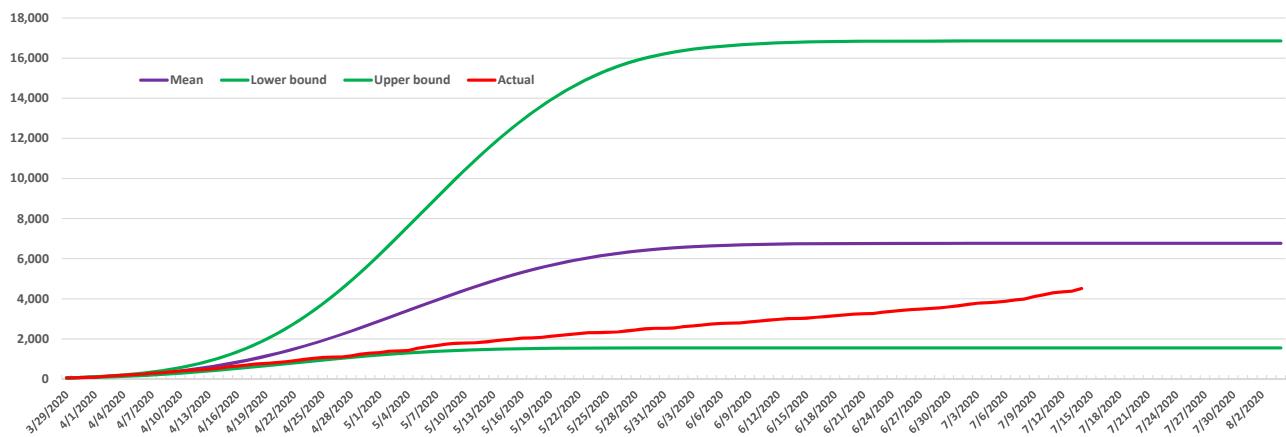
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New York COVID 19 Cumulative Death Projections



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Florida COVID 19 Cumulative Death Projections March 26



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Cumulative Death Projections

- Comparing July 6th Cumulative deaths with the original IHME projections
- Thirteen states are above the mean and above the 95% confidence interval
 - Arizona, Connecticut, Illinois, Indiana, Iowa, Maryland, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, Rhode Island
- Nine states are above the mean but within the 95% confidence interval
 - California, Georgia, Idaho, Kentucky, Louisiana, Missouri, New Mexico, Nevada, New Hampshire,
- Sixteen states are below the mean but within the 95% confidence interval
 - Alabama, Florida, Minnesota, Mississippi, Nebraska, North Carolina, North Dakota, Oregon, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, Washington, Wisconsin
- Twelve states are below the mean and below the 95% confidence interval
 - Alaska, Arkansas, Colorado, Delaware, Hawaii, Kansas, Maine, Montana, Oklahoma, Utah, West Virginia, Wyoming



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Concluding Thoughts

- The distribution of death by age group for COVID-19 continues to be similar to the distribution of death from all causes
- The U.S. COVID-19 infection rate is 1.07% of the population
- Since June 15 the trend analysis in daily death has been a reduction of 2.47 deaths
- Using IHME's metric of 8 deaths per million as a indicator for reduced economic activity, only five states are relatively close or above that metric during the last week; Alabama, Arizona, Mississippi, New Jersey, and Rhode Island
- Twenty-six states have had a decreasing trend for daily deaths, twenty-two have experienced an increasing trend
- The U.S. Cumulative Death Total through July 14th is above the mean but within the 95% confidence band



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Kansas COVID Deaths by Age Group

Age Group	Number of Deaths	Percent of COVID Deaths	2018 Mortality Rates
25-34	2	0.7%	1.8%
35-44 years	6	2.0%	2.5%
45-54 years	14	4.7%	4.8%
55-64 years	44	14.7%	12.8%
65-74 years	60	20.1%	18.2%
75-84 years	68	22.7%	23.4%
85+ years	105	35.1%	34.2%
Total	299	100%	97.6%

<https://www.coronavirus.kdheks.gov/160/COVID-19-in-Kansas>, July 14, 2020

https://www.kdheks.gov/phi/AS_Tables/AS_2018_Tables_and_Figures/general_mortality/Table_E4.pdf, July 14, 2020



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U.S. COVID Deaths by Age Group

Age Group	Number of Deaths	Percent of COVID Deaths	2017 Mortality Rates
15-24 years	157	0.1%	0.2%
25-34 years	844	0.7%	1.1%
35-44 years	2,169	1.8%	2.1%
45-54 years	6,021	5.0%	6.0%
55-64 years	14,693	12.1%	13.2%
65-74 years	25,268	20.8%	18.9%
75-84 years	32,066	26.4%	23.4%
85+ years	40,125	33.1%	31.2%
Total	121,374	99.97%	98.87%

<https://data.cdc.gov/NCHS/Provisional-COVID-19-Death-Counts-by-Sex-Age-and-S/9bhg-hcku>, July 14, 2020



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Kansas COVID and General Mortality by Age Group

Age Group	COVID Deaths	COVID Deaths per 1000	2018 Mortality Rate per 1000
Under 1 year	0	0.00	6.3
1-24 years	0	0.00	1.2
25-34 years	2	0.01	1.3
35-44 years	6	0.02	1.9
45-54 years	14	0.04	3.9
55-64 years	44	0.12	9.3
65-74 years	60	0.23	18.9
75-84 years	68	0.51	47.5
85+ years	105	1.60	142.1

<https://www.coronavirus.kdheks.gov/160/COVID-19-in-Kansas>, July 14, 2020

https://www.kdheks.gov/phi/AS_Tables/AS_2018_Tables_and_Figures/general_mortality/, July 14, 2020



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U.S. COVID and General Mortality by Age Group

Age Group	COVID Deaths	COVID Deaths per 1000	2018 Mortality Rate per 1000
Under 1 year	9	0.00	5.67
1-14 years	22	0.00	0.17
15-24 years	157	0.00	0.74
25-34 years	844	0.02	1.33
35-44 years	2,169	0.05	1.95
45-54 years	6,021	0.14	4.02
55-64 years	14,693	0.35	8.86
65-74 years	25,268	0.85	17.91
75-84 years	32,066	2.18	44.73
85+ years	40,125	6.20	135.74

<https://data.cdc.gov/NCHS/Provisional-COVID-19-Death-Counts-by-Sex-Age-and-S/9bhg-hcku>, July 14, 2020

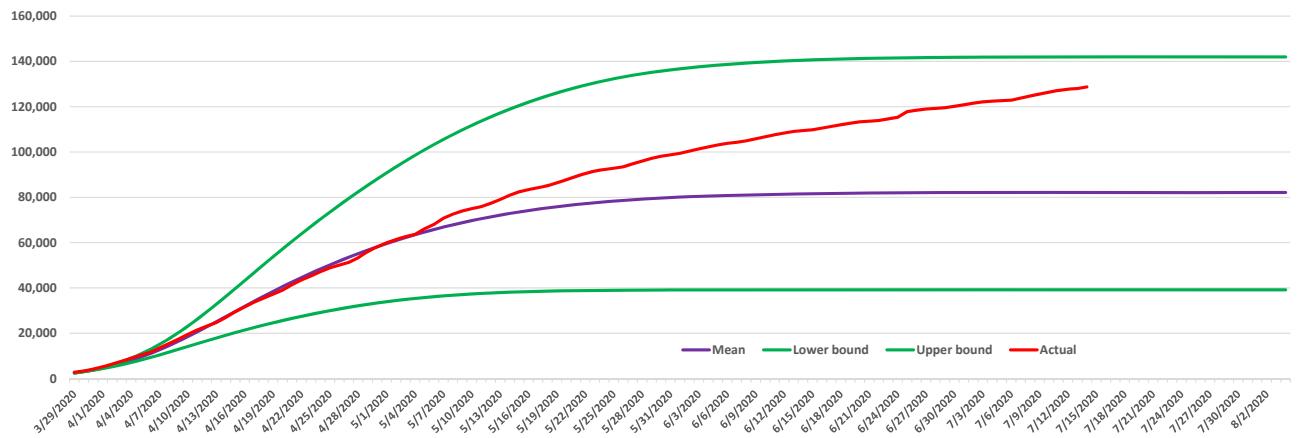


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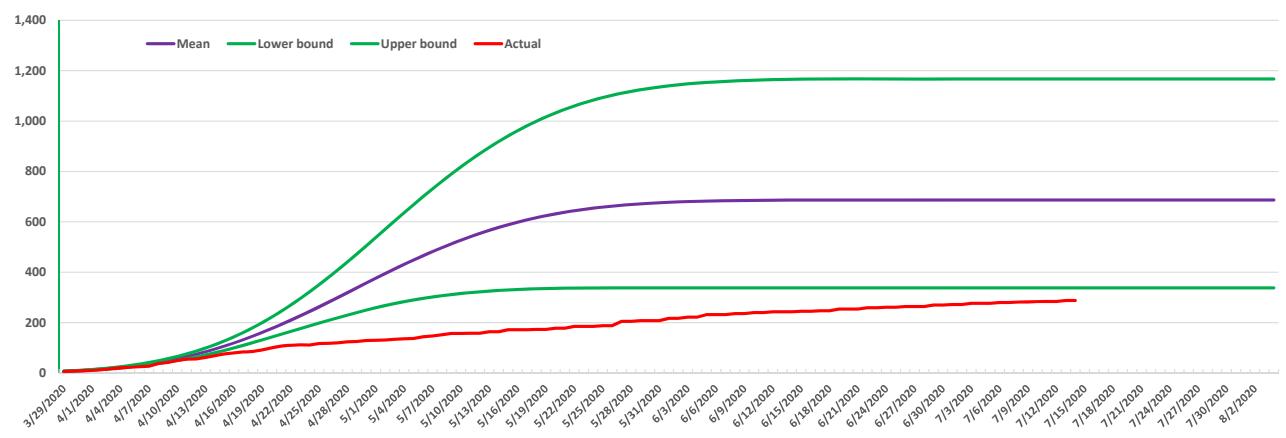
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U.S. COVID 19 Cumulative Death Projections



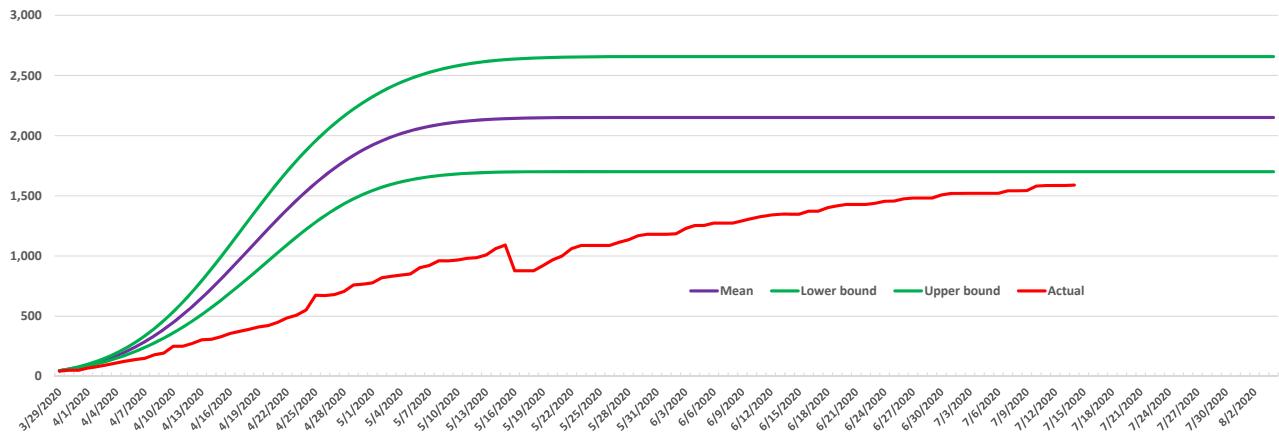
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Kansas COVID 19 Cumulative Death Projections



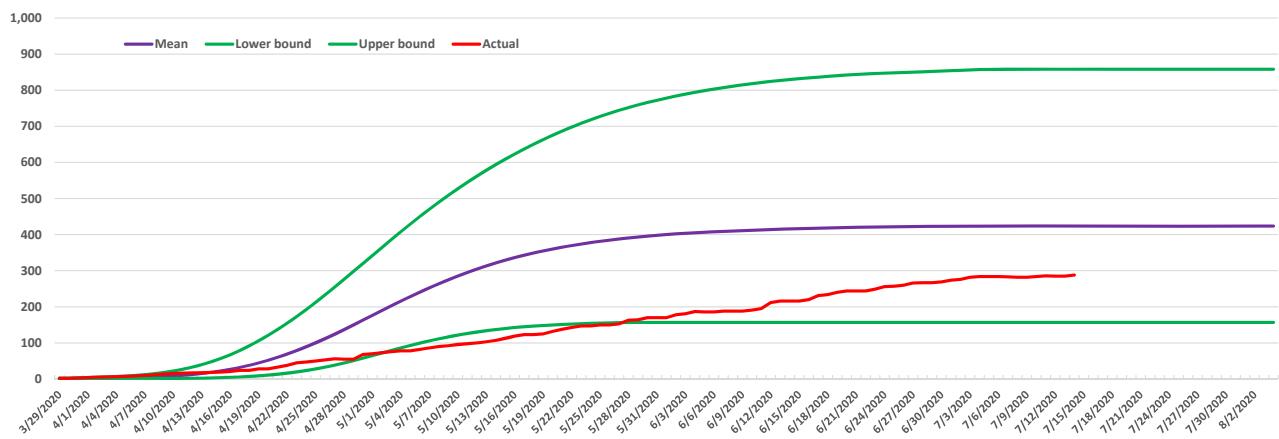
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Colorado COVID 19 Cumulative Death Projections March 26



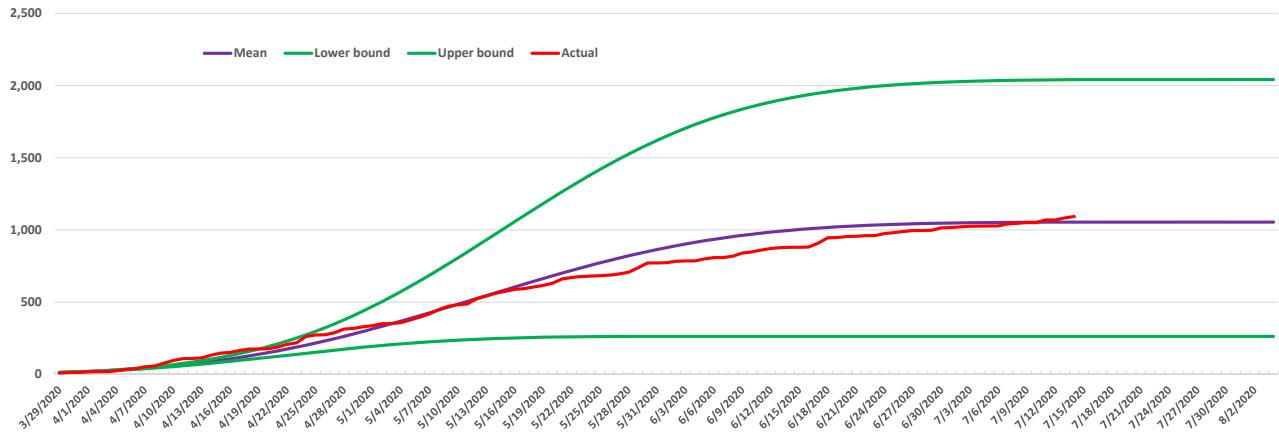
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Nebraska COVID 19 Daily Death Projections March 26



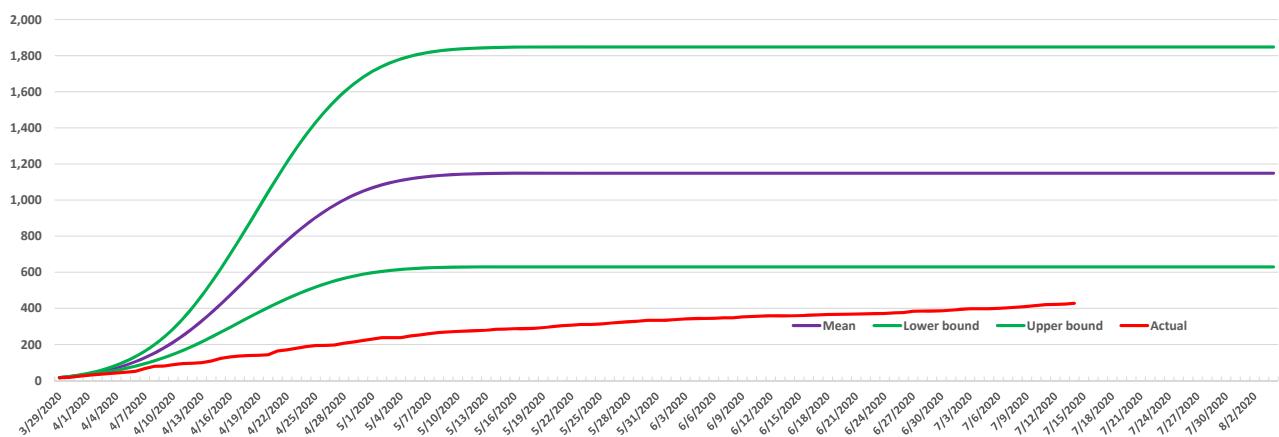
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Missouri COVID 19 Cumulative Death Projections March 26



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Oklahoma COVID 19 Daily Death Projections March 26



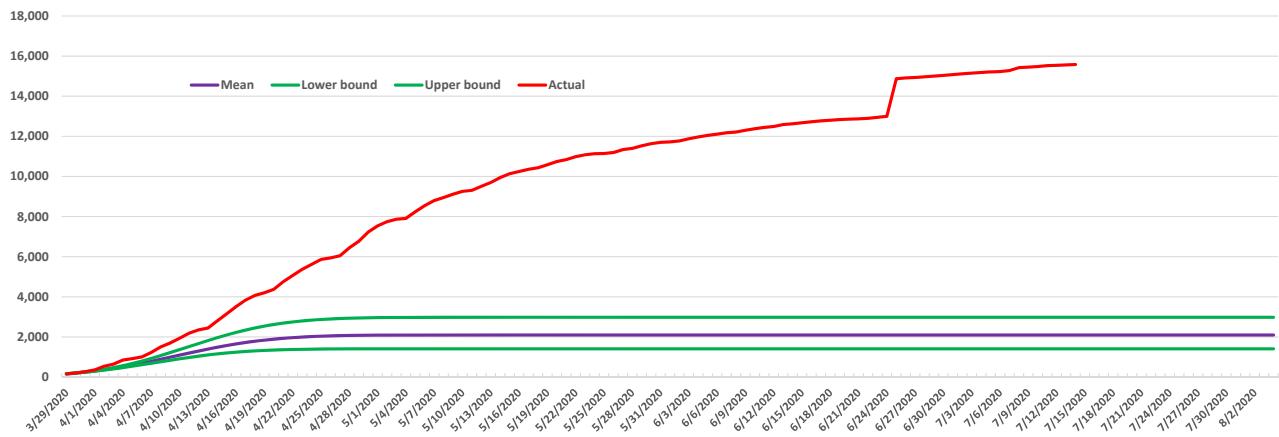
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New York COVID 19 Cumulative Death Projections



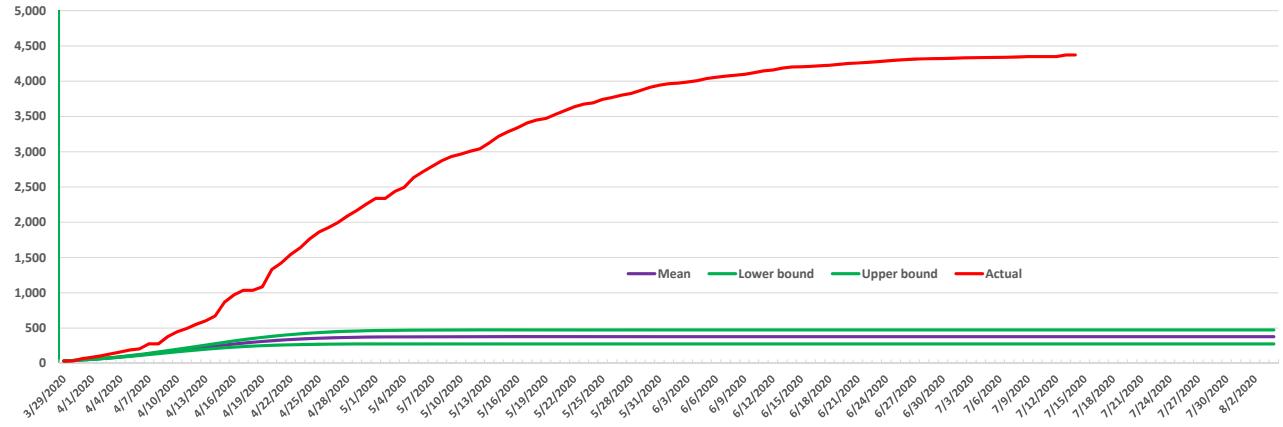
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New Jersey COVID 19 Cumulative Death Projections



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Connecticut COVID 19 Cumulative Death Projections



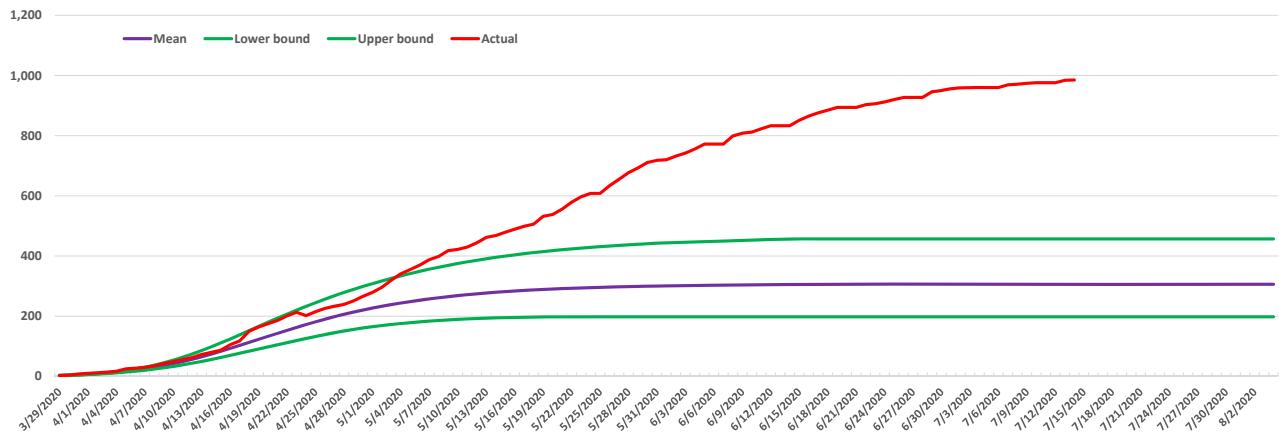
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Massachusetts COVID 19 Cumulative Death Projections



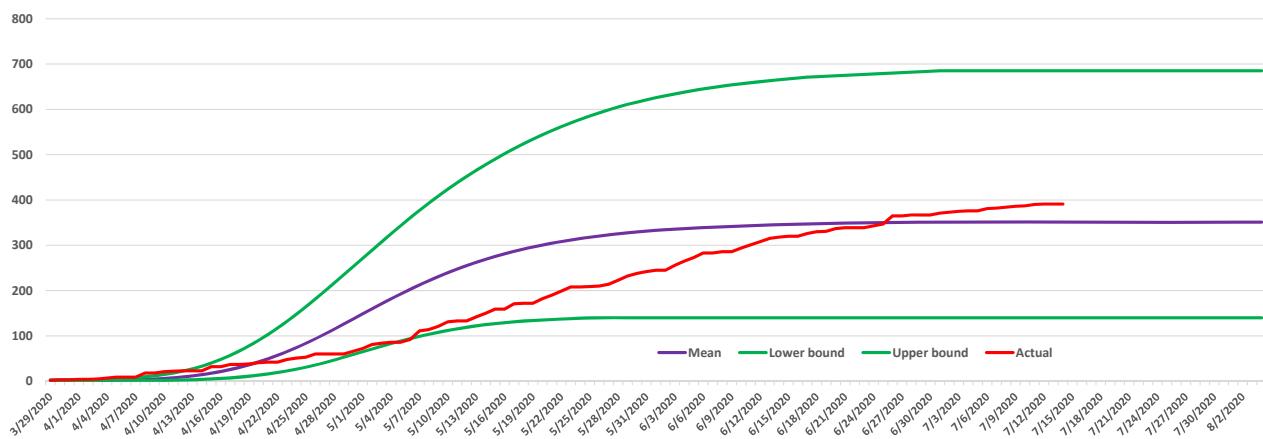
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Rhode Island COVID 19 Cumulative Death Projections March 26



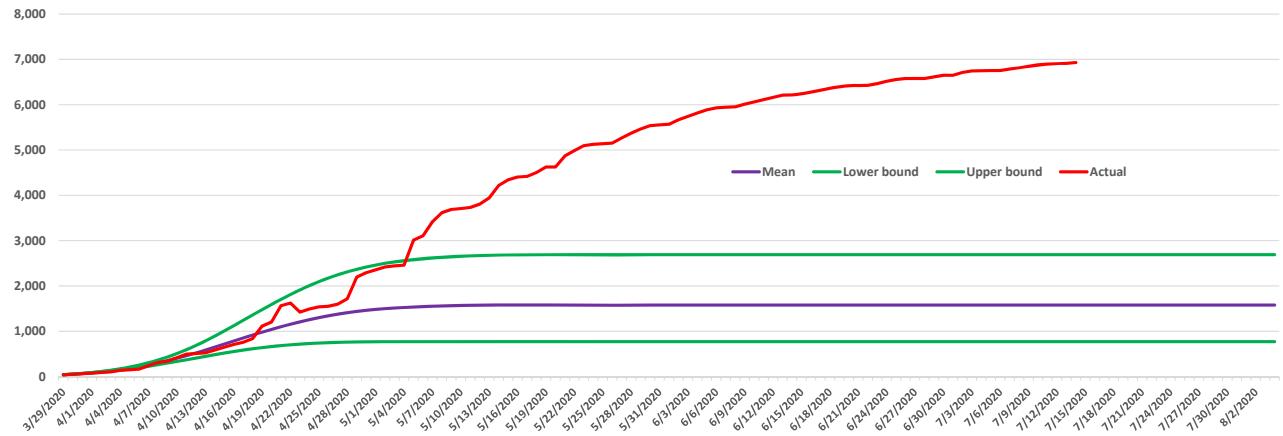
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New Hampshire COVID 19 Cumulative Death Projections



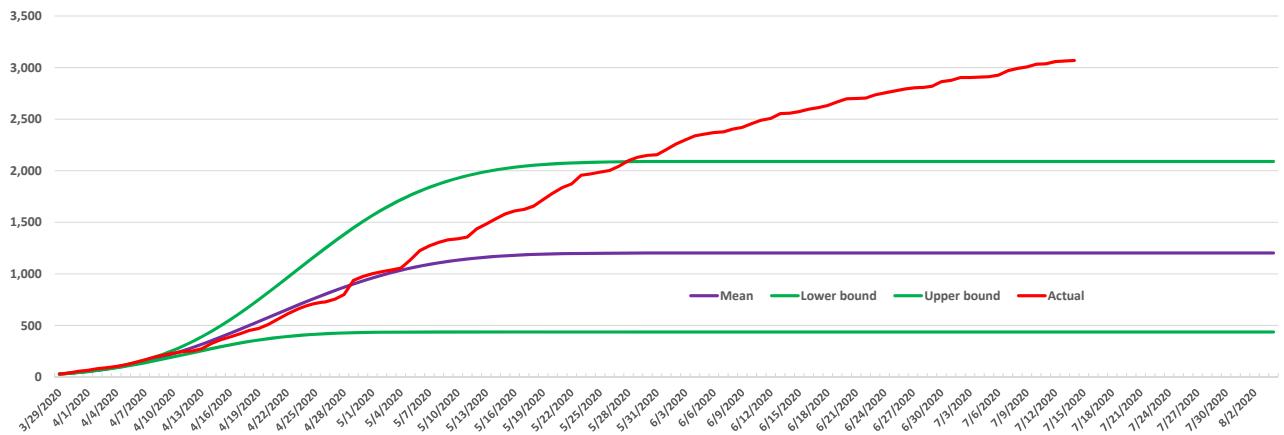
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Pennsylvania COVID 19 Cumulative Death Projections



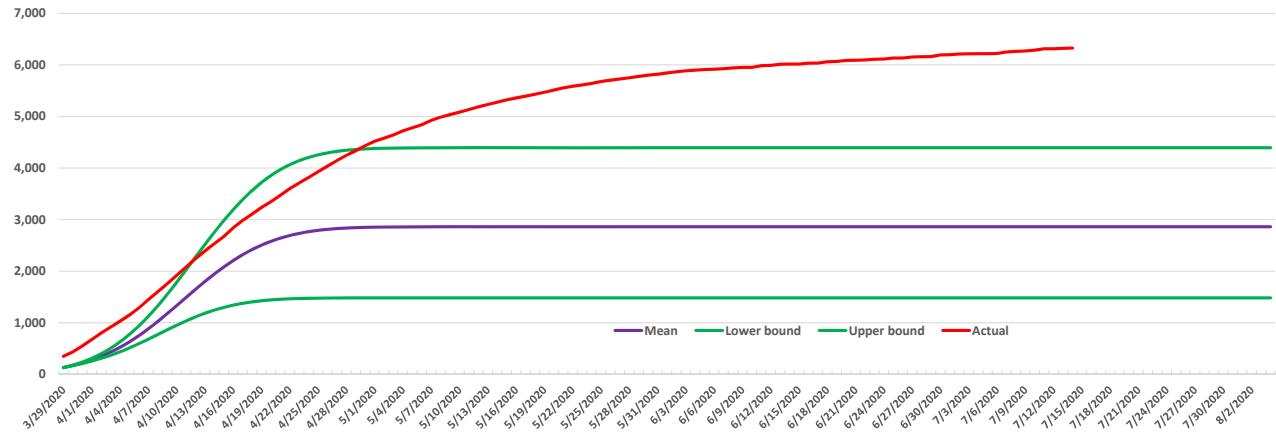
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Ohio COVID 19 Cumulative Death Projections March 26



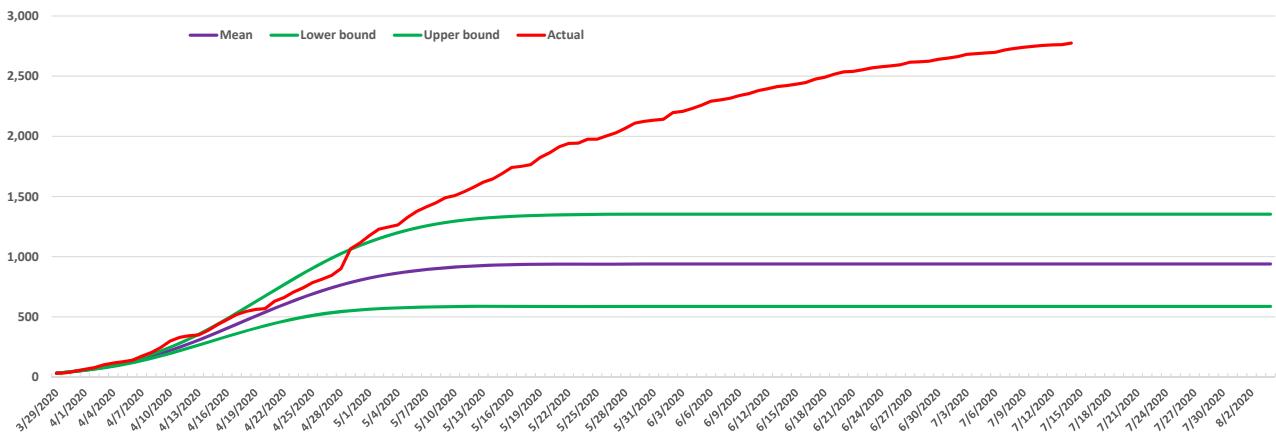
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Michigan COVID 19 Cumulative Death Projections



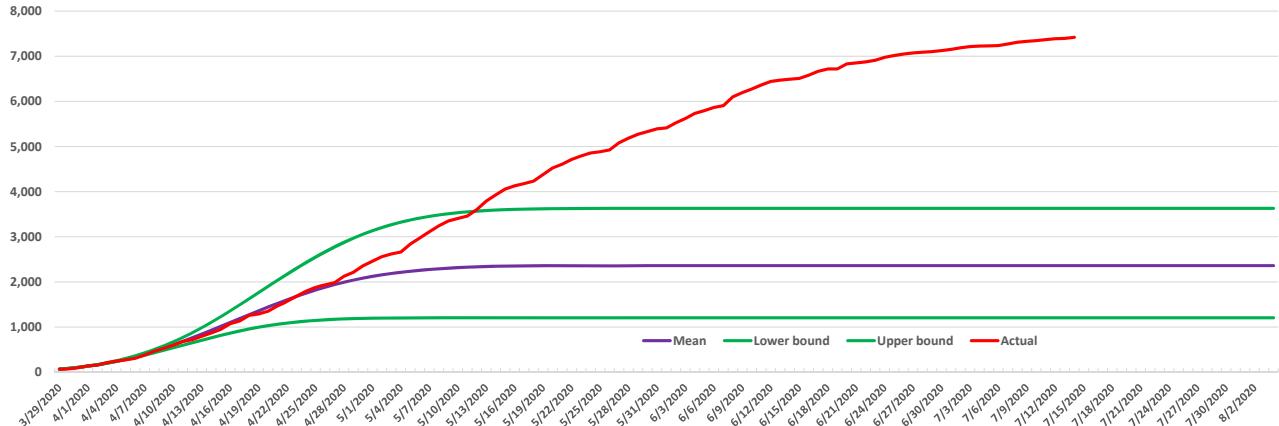
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Indiana COVID 19 Cumulative Death Projections March 26



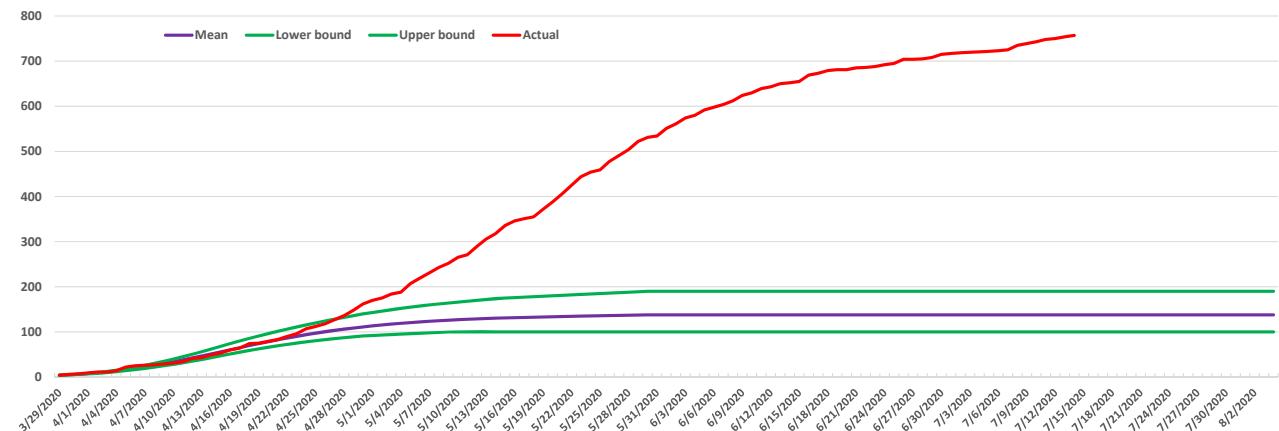
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Illinois COVID 19 Cumulative Death Projections March 26



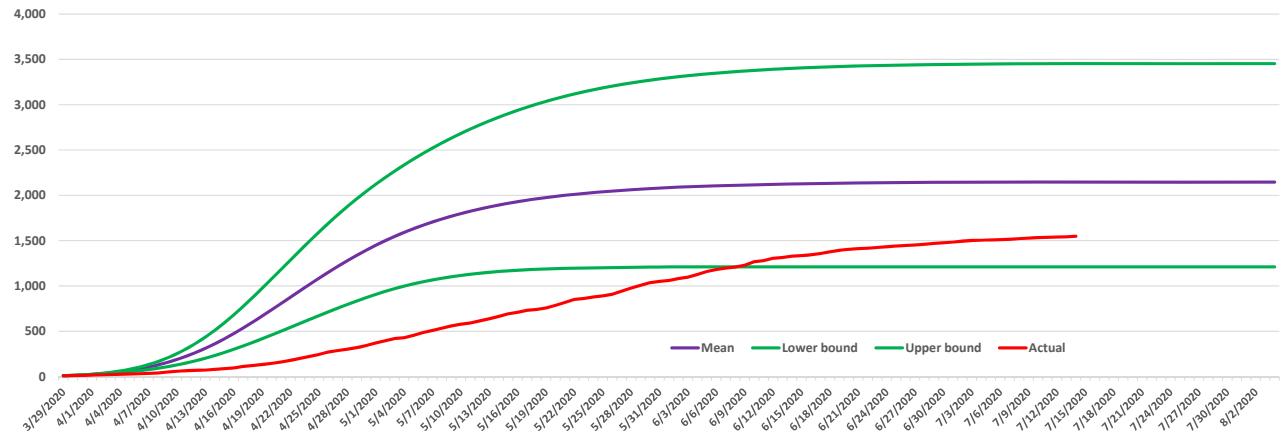
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Iowa COVID 19 Daily Death Projections March 26



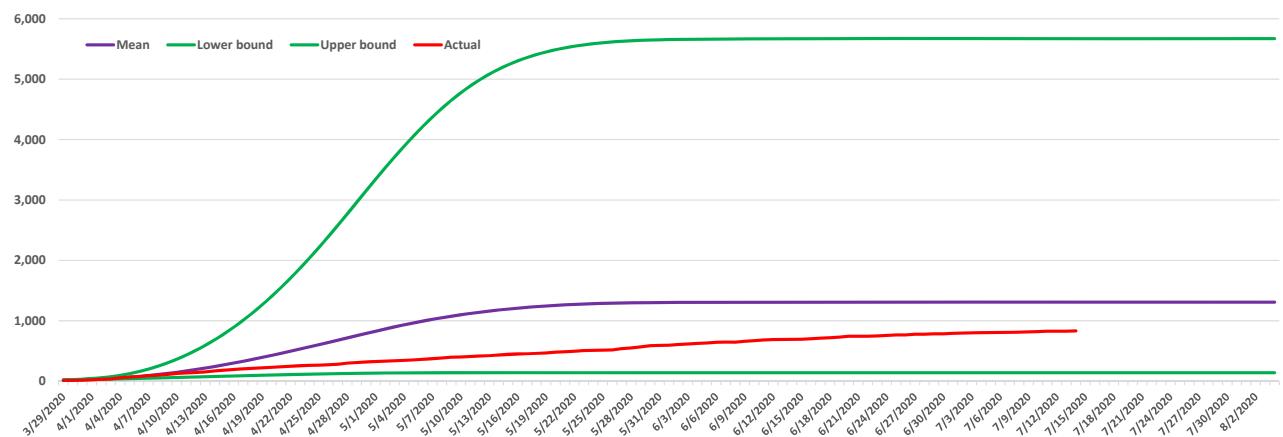
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Minnesota COVID 19 Cumulative Death Projections



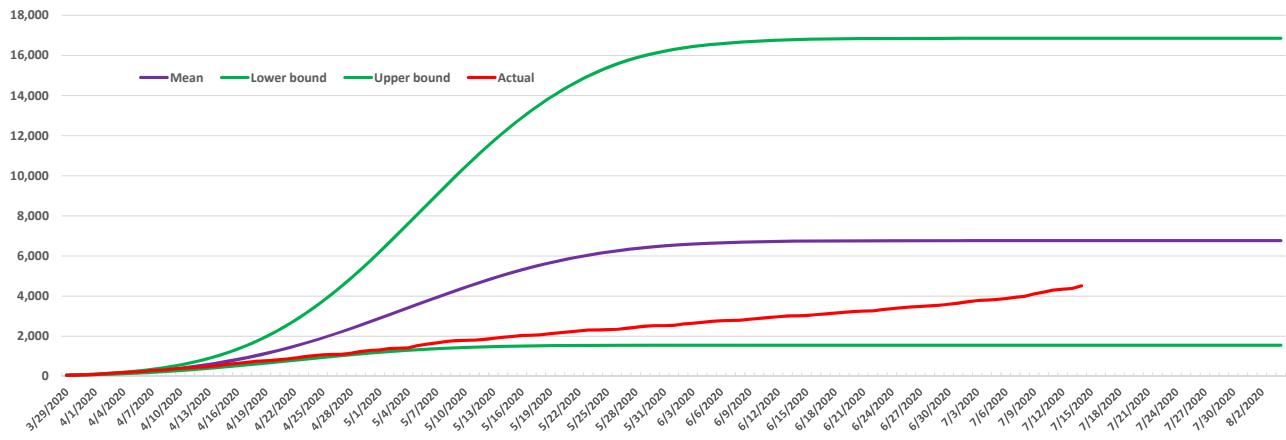
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Wisconsin COVID 19 Cumulative Death Projections



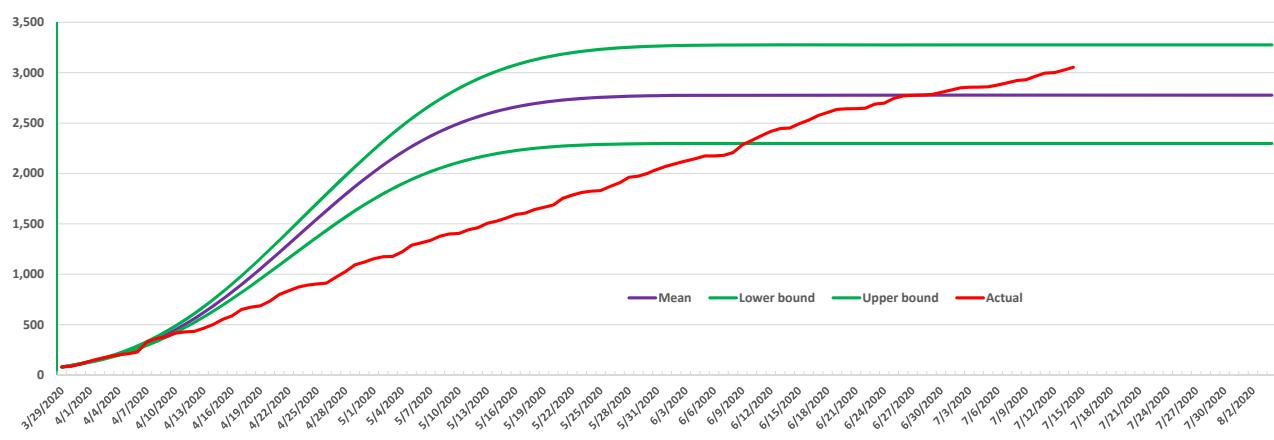
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Florida COVID 19 Cumulative Death Projections March 26



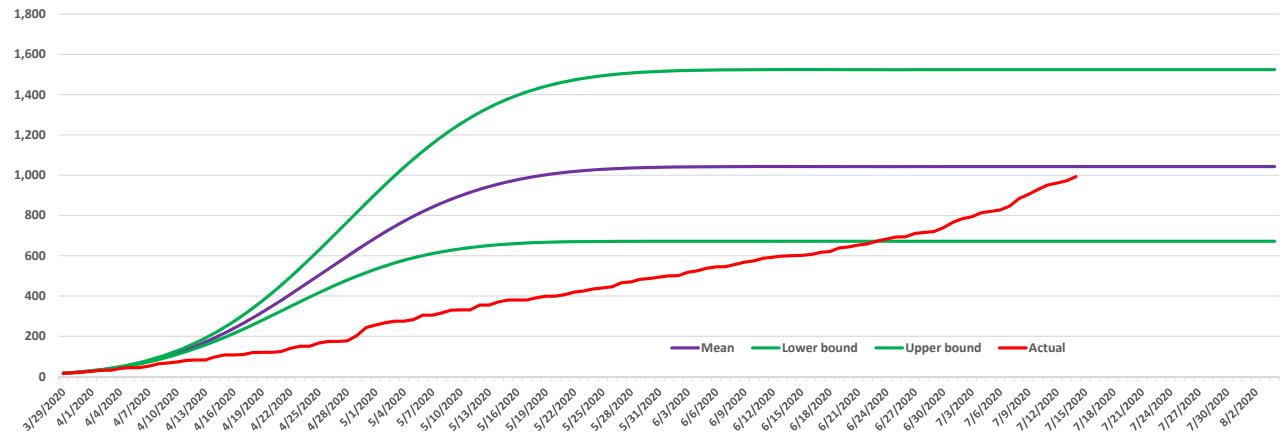
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Georgia COVID 19 Cumulative Death Projections



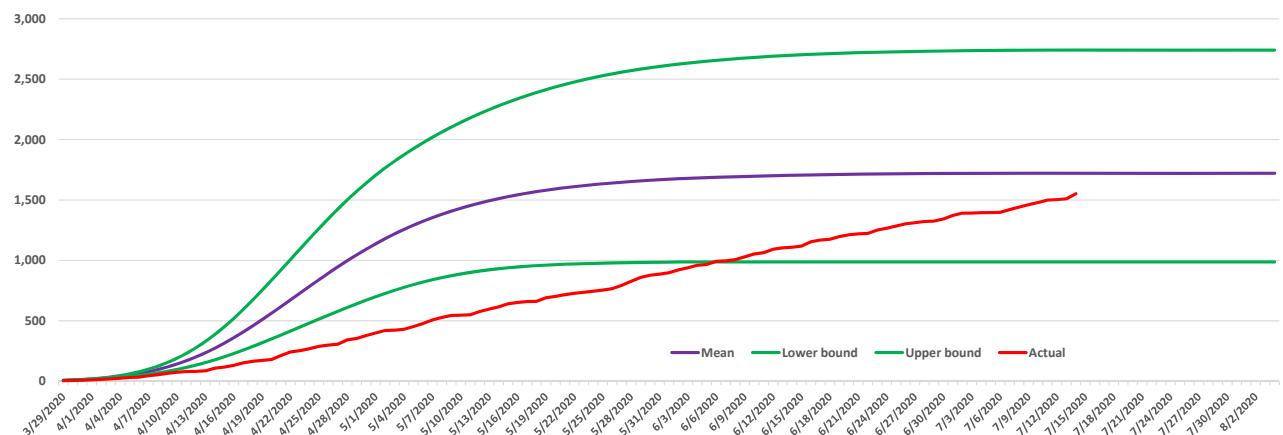
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South Carolina COVID 19 Cumulative Death Projections



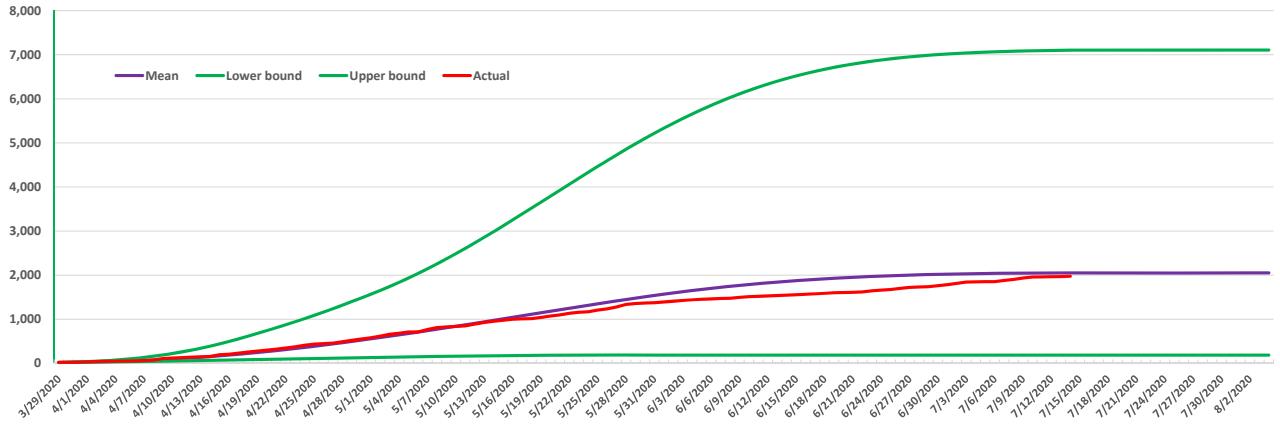
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North Carolina COVID 19 Cumulative Death Projections



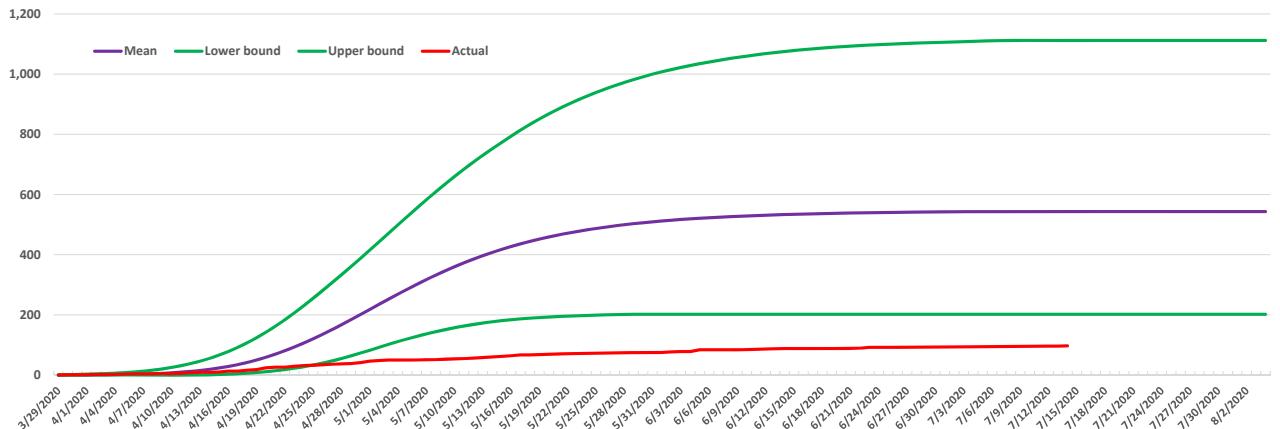
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Virginia COVID 19 Cumulative Death Projections



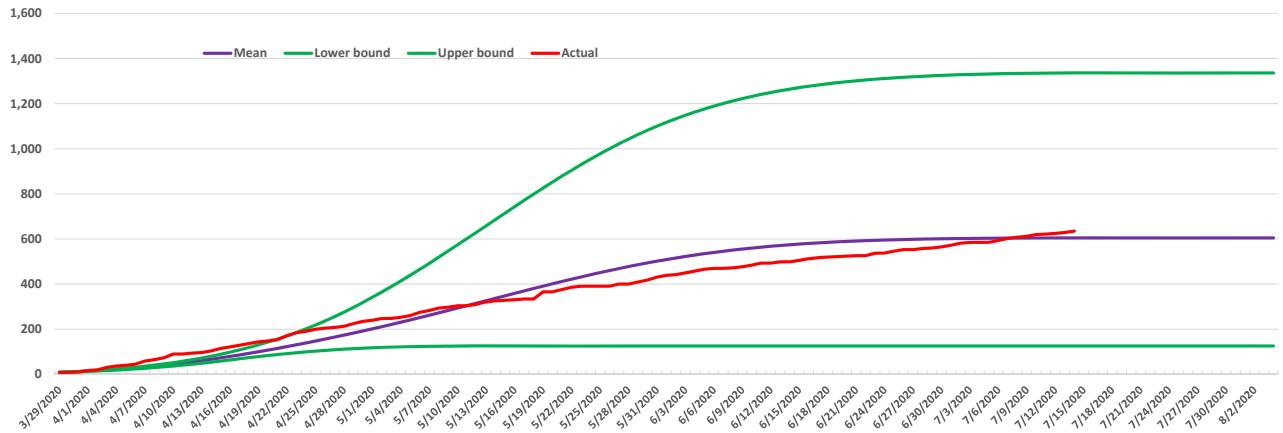
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West Virginia COVID 19 Cumulative Death Projections



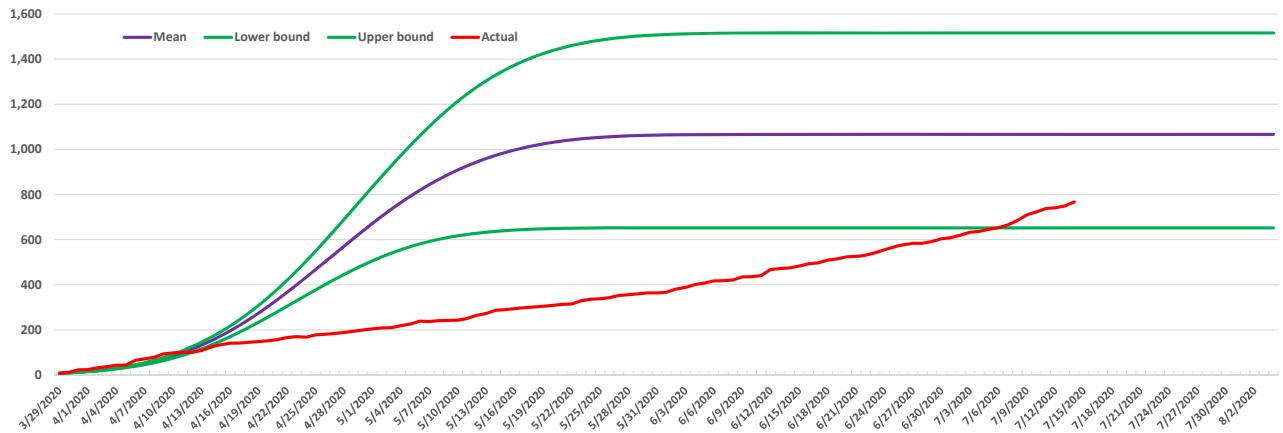
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Kentucky COVID 19 Cumulative Death Projections March 26



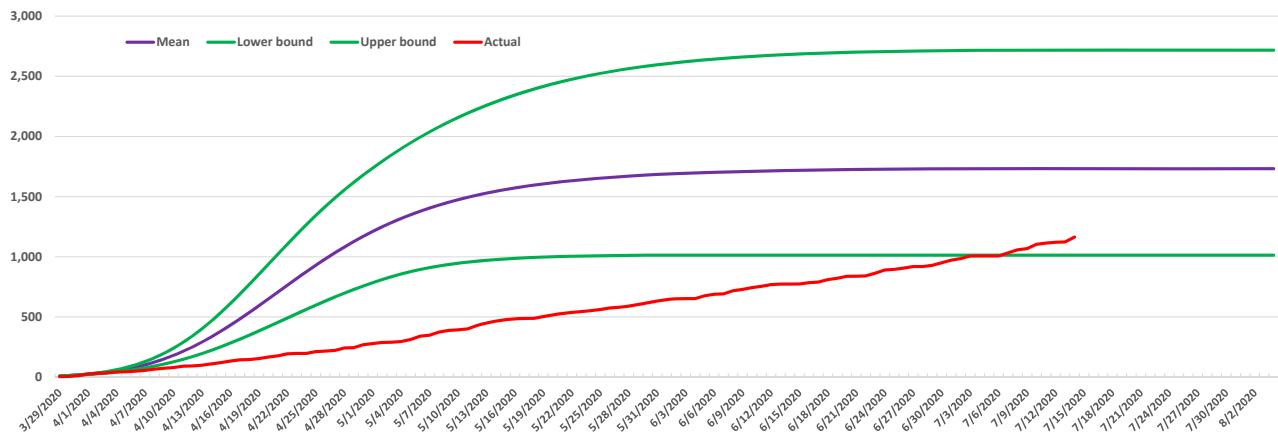
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Tennessee COVID 19 Cumulative Death Projections March 26



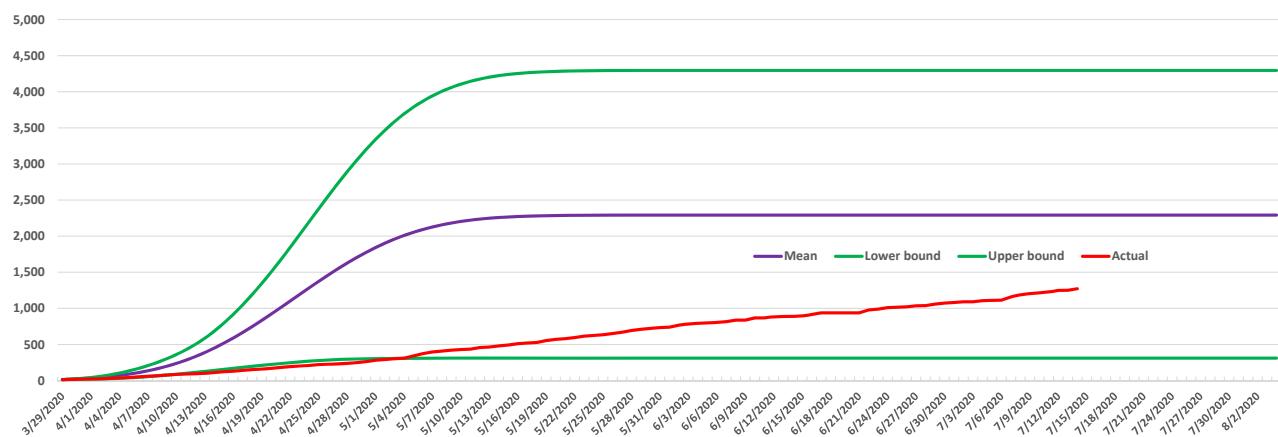
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Alabama COVID 19 Cumulative Death Projections March 26



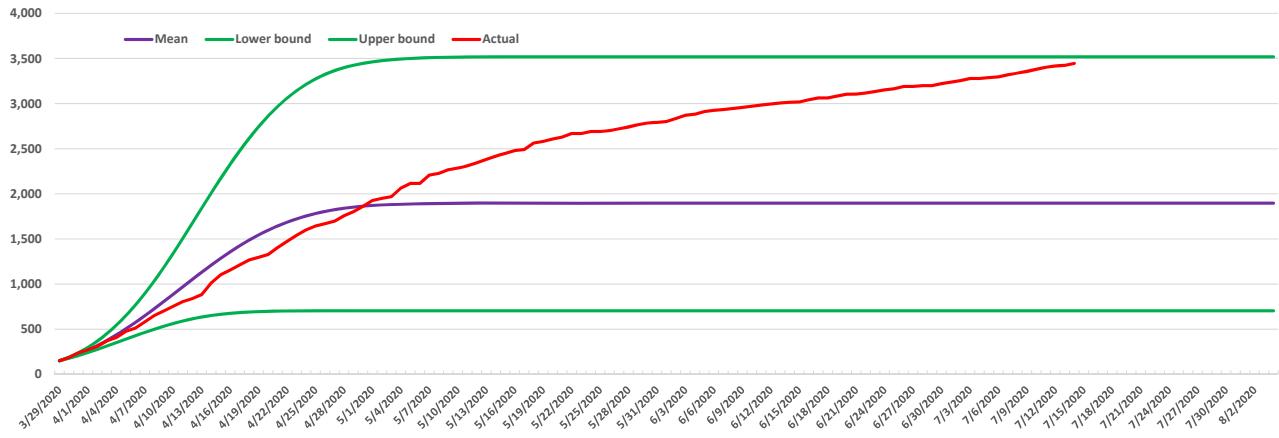
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Mississippi COVID 19 Daily Death Projections March 26



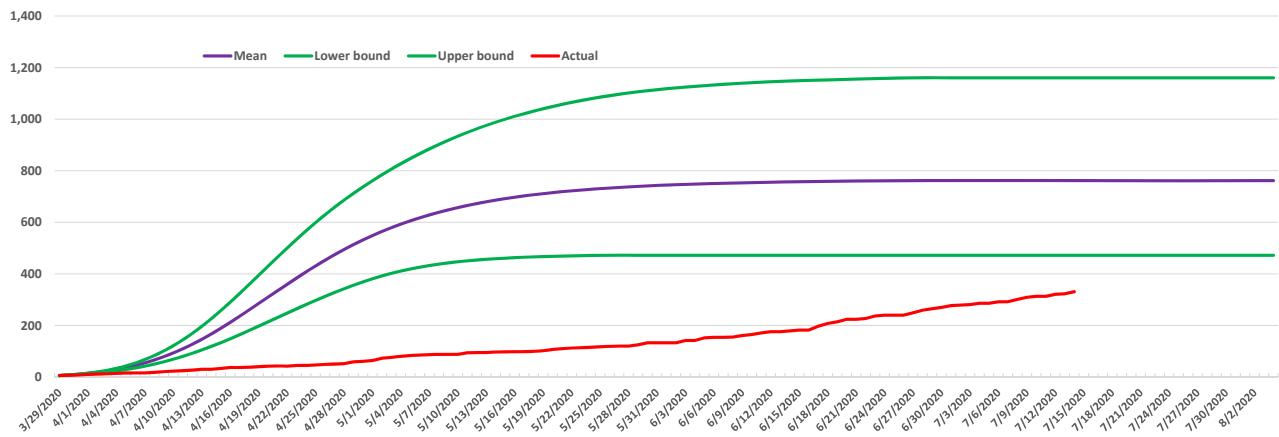
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Louisiana COVID 19 Daily Death Projections March 26



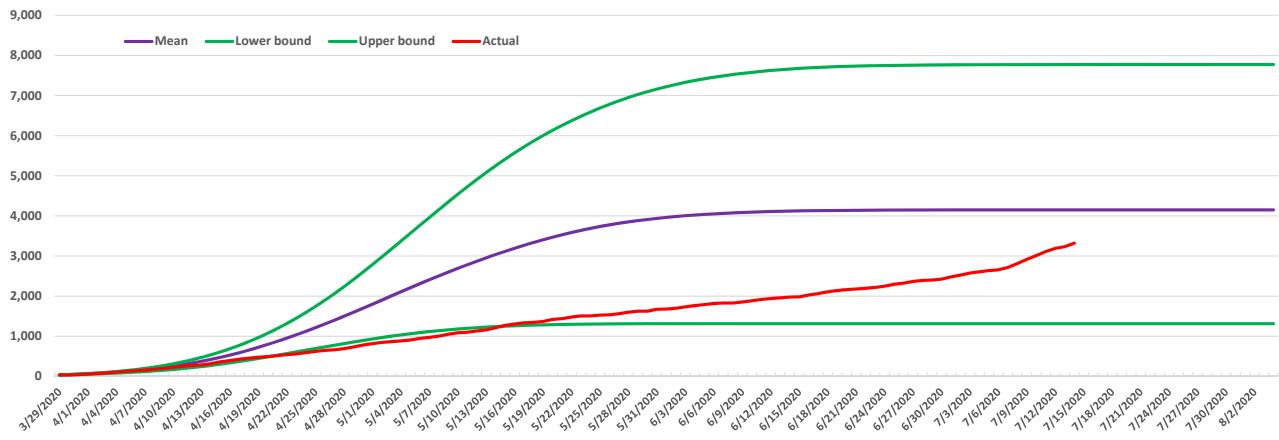
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Arkansas COVID 19 Cumulative Death Projections March 26



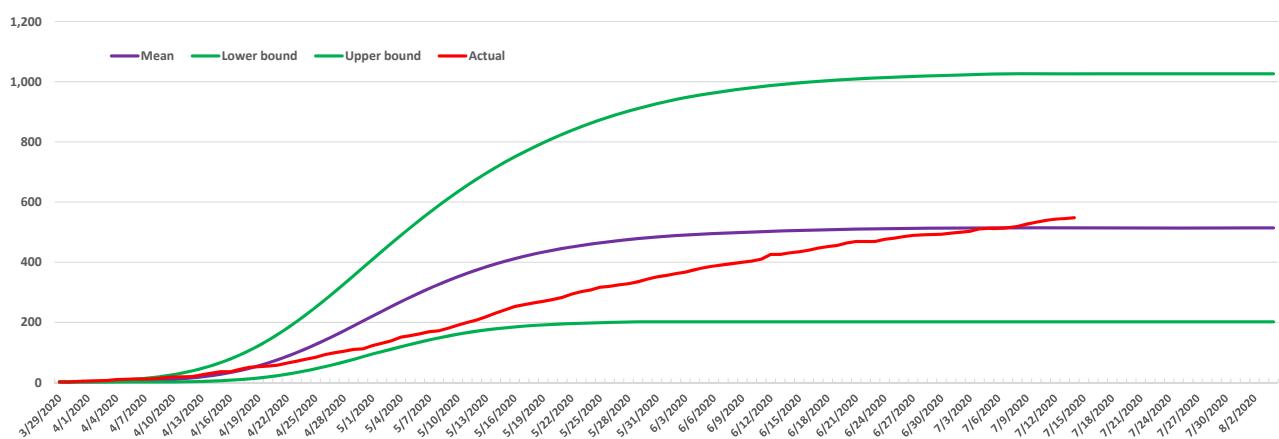
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Texas COVID 19 Daily Death Projections March 26



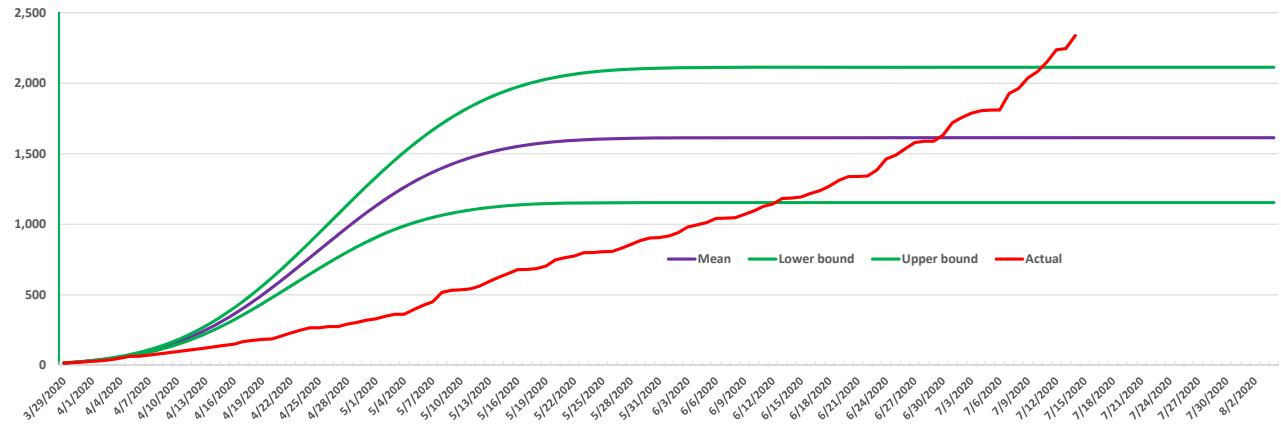
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New Mexico COVID 19 Daily Death Projections March 26



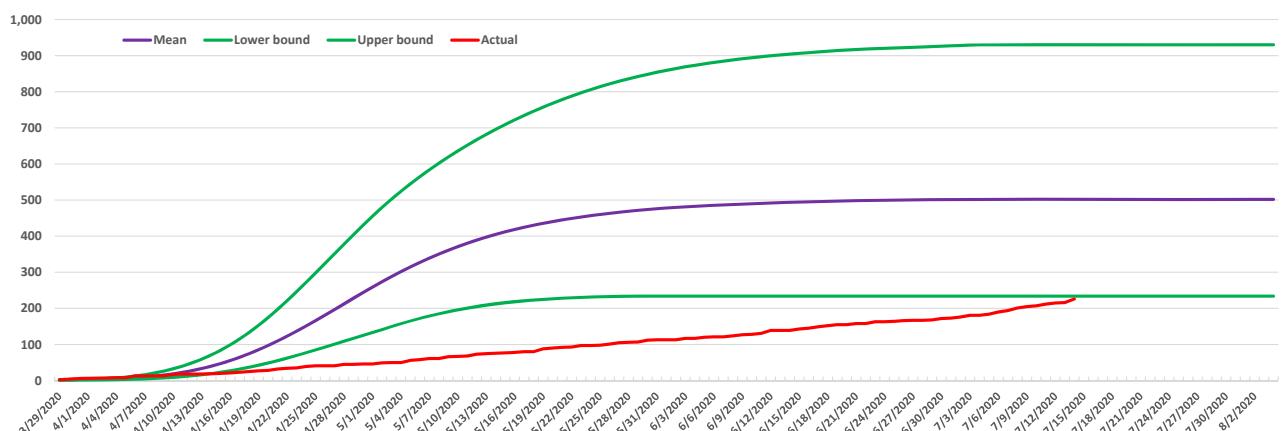
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Arizona COVID 19 Cumulative Death Projections



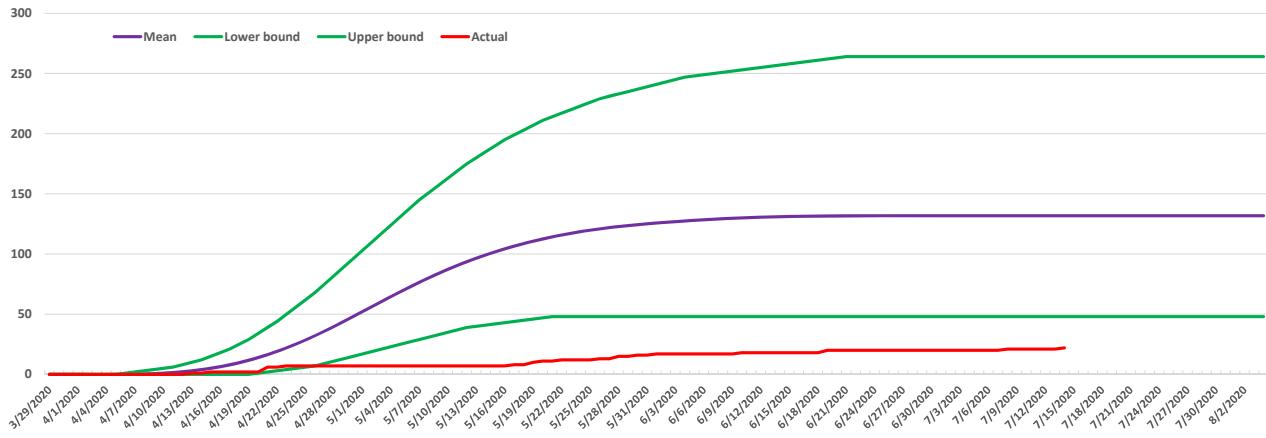
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Utah COVID 19 Daily Death Projections March 26



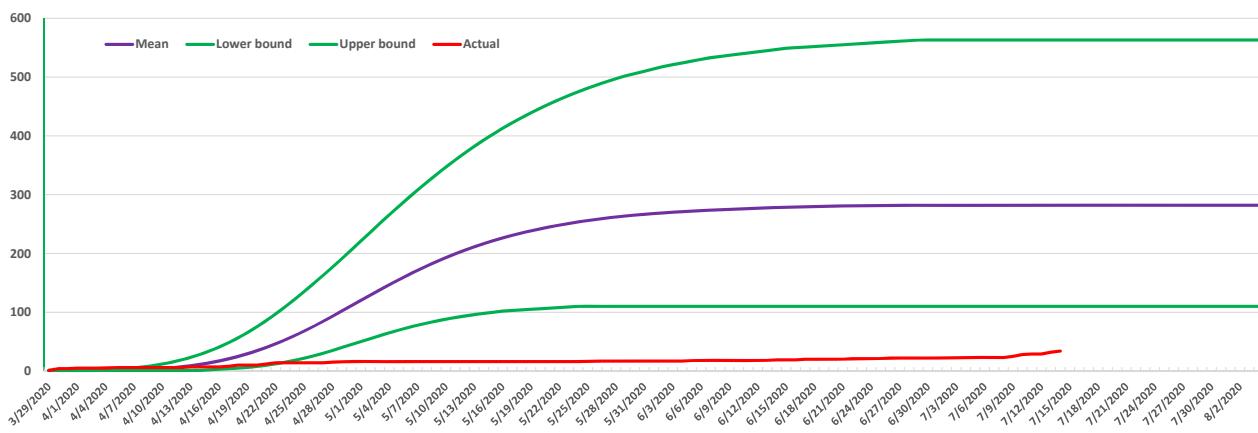
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Wyoming COVID 19 Cumulative Death Projections March 26



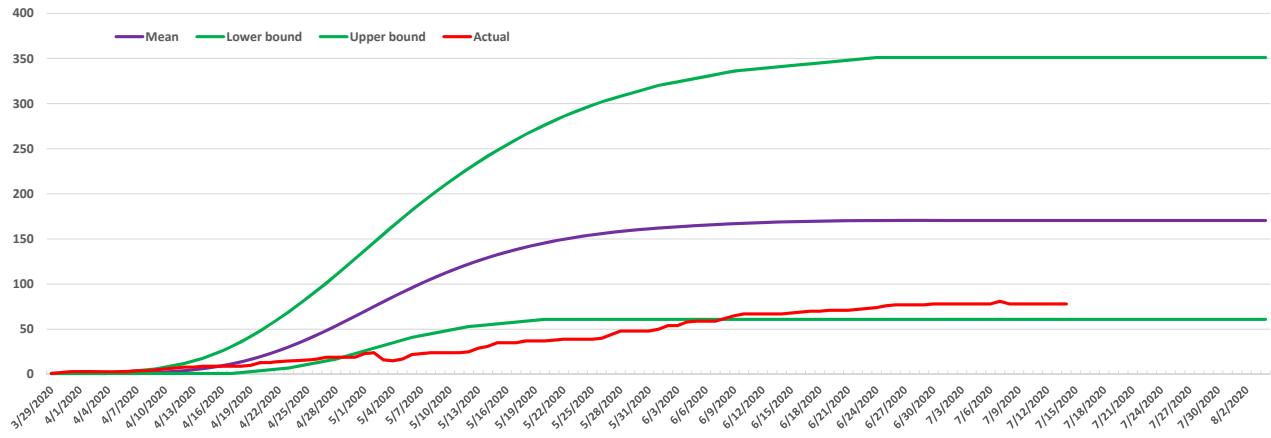
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Montana COVID 19 Cumulative Death Projections



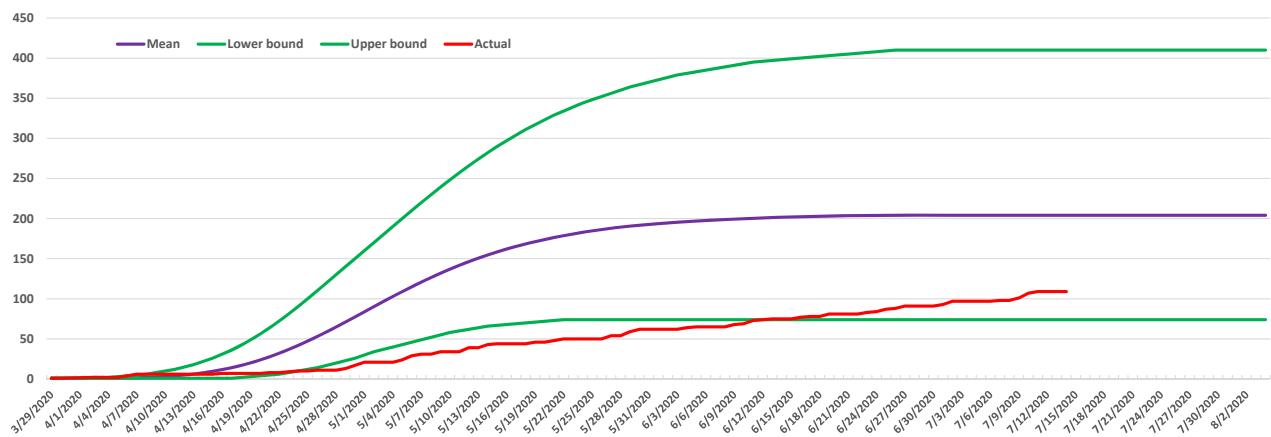
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North Dakota COVID 19 Cumulative Death Projections March 26



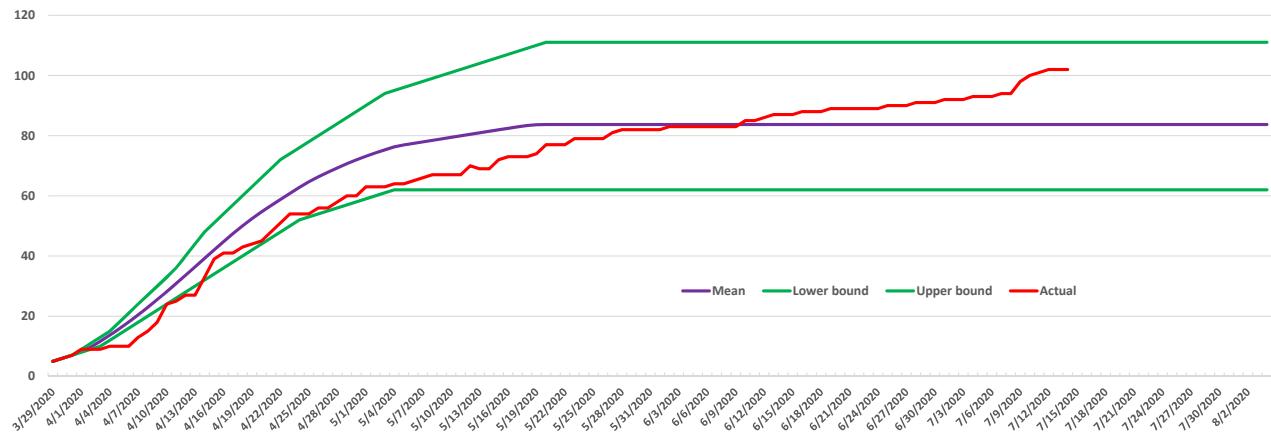
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South Dakota COVID 19 Daily Death Projections March 26



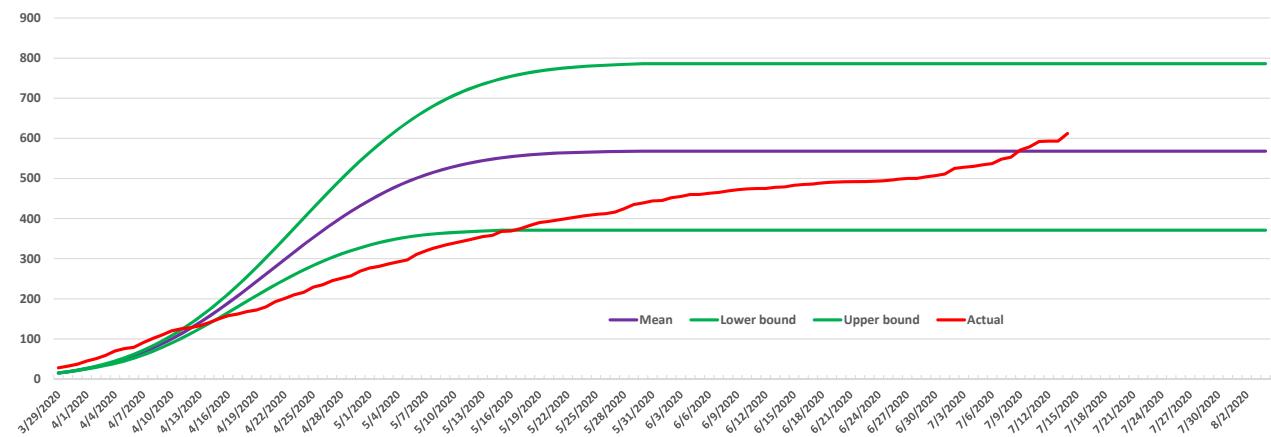
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Idaho COVID 19 Cumulative Death Projections March 26



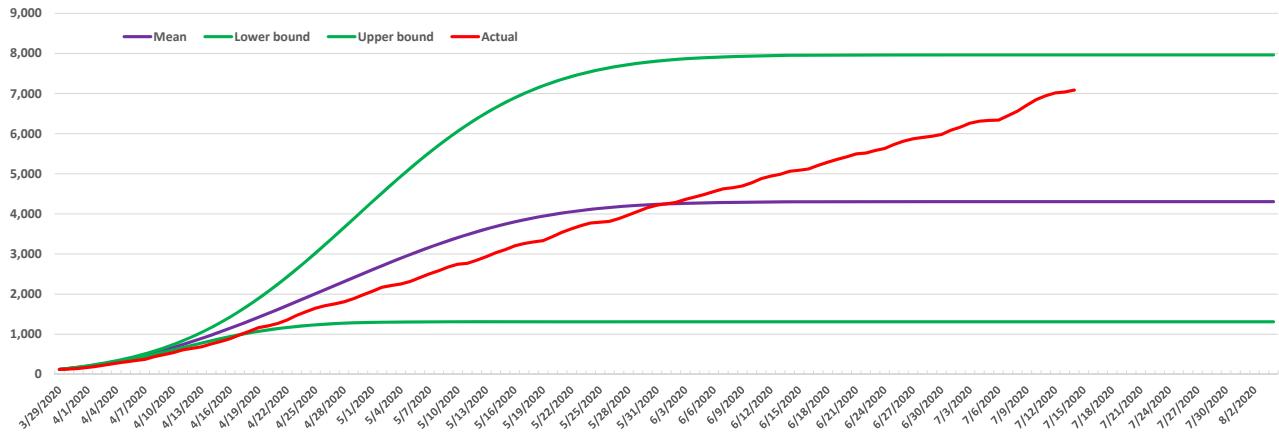
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Nevada COVID 19 Cumulative Death Projections



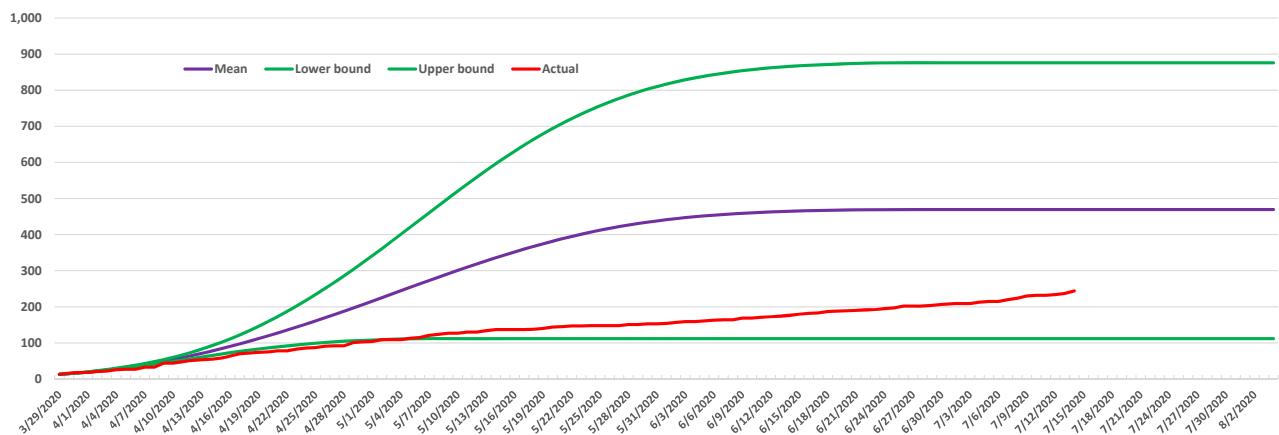
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California COVID 19 Cumulative Death Projections March 26



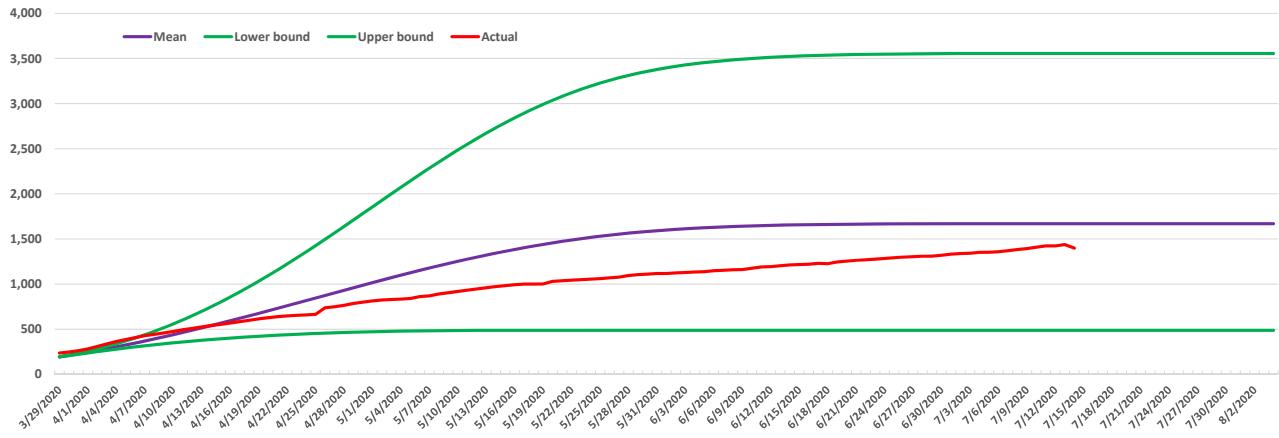
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Oregon COVID 19 Cumulative Death Projections March 26



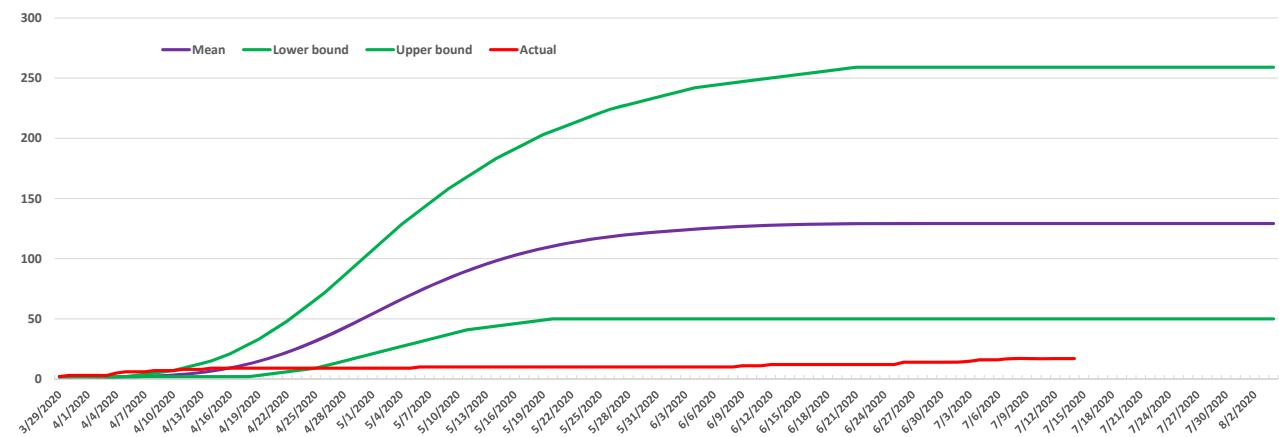
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Washington COVID 19 Cumulative Death Projections March 26



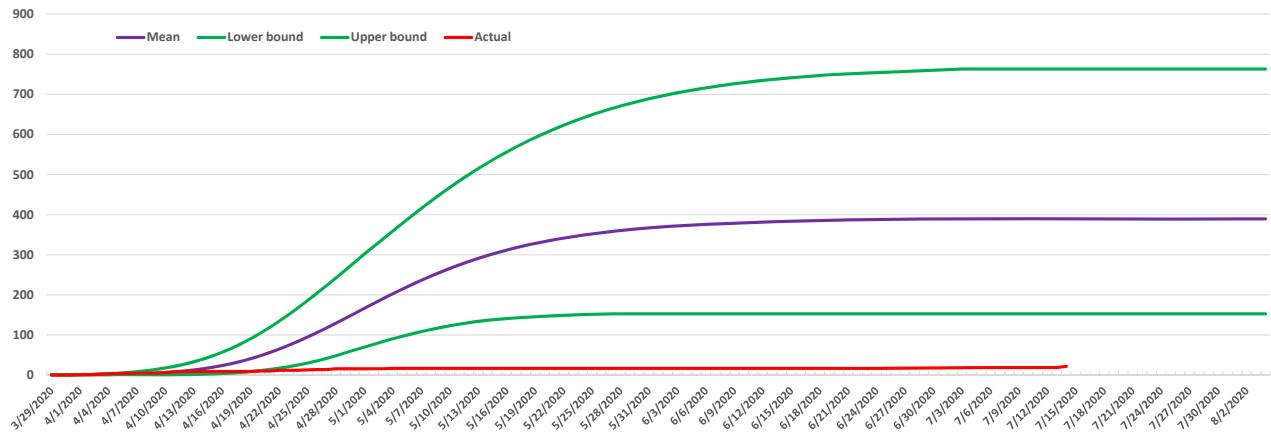
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Alaska COVID 19 Cumulative Death Projections March 26



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Hawaii COVID 19 Daily Death Projections March 26



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