

Analysis of the IHME COVID 19 Forecasting Model – May 12th Update

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Introduction

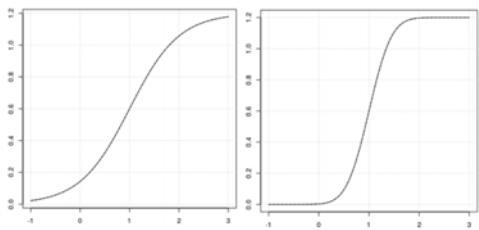
- The COVID 19 virus is having a major effect on the economy with the unemployment rate closing in on 20%
- Since the middle of March, more than 30 million U.S. workers filed for unemployment due to the shut down a significant share of the economy
- The Institute for Health Metrics and Evaluation (IHME) 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 prediction model and the periodic revisions that are made in the predictive model
- This is an update of the May 5th discussion.
- A major change in the modeling approach occurred with the May 4th model release



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Original IHME Modeling Approach

- A statistical forecasting model using a parameterized spline
 - Using CurveFit via Python
 - Fit in log space
- Assumed a sigmoid shape (logistic function)
- A bounded nonlinear optimization problem
 - Used the L-BFGS-B algorithm that requires derivatives
- Used local and national government and WHO websites
 - John Hopkins Coronavirus data
- Article has not completed peer-review as of May 12th.
- <https://www.worldometers.info/coronavirus/country/us/> and <https://covidtracking.com/>



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Changes in the May 4th IHME Modeling Approach

- The amount of smoothing of data used to estimate the parameters has occurred
 - Moved from the raw data to a three-day average to a ten-day process
- Added the number of COVID-19 cases and the COVID Hospitalizations
- Adjusting for the scale up in testing
 - As tests double, cases increase by 22%
- Moved from 7 to 13 to now 29 variables to predict
 - Using mobility, temperature, testing rates, and population density information
- An updated model was released May 10th with minor methodological changes



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Cumulative Death Change from the Original Model to the May 4 and the May 10 Release

	% Change 5/4	% Change 5/11		% Change 5/4	% Change 5/11
Alabama	33.3%	-10.3%	Hawaii	-93.8%	-95.1%
Alaska	-96.1%	-96.1%	Idaho	-0.7%	-10.2%
Arizona	-35.4%	85.2%	Illinois	169.2%	213.3%
Arkansas	-77.5%	-72.0%	Indiana	564.9%	335.4%
California	8.4%	41.3%	Iowa	998.6%	564.2%
Colorado	-37.9%	-22.1%	Kansas	-61.5%	-41.1%
Connecticut	970.6%	1,110.2%	Kentucky	-11.2%	16.3%
Delaware	-34.5%	-50.1%	Louisiana	48.7%	70.4%
Florida	-41.3%	-19.6%	Maine	-97.2%	-97.0%
Georgia	76.9%	29.5%	Maryland	87.0%	122.6%



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Cumulative Death Change from the Original Model to the May 4 and the May 10 Release

	% Change 5/4	% Change 5/11		% Change 5/4	% Change 5/11
Massachusetts	331.9%	323.3%	New Mexico	-16.3%	-25.8%
Michigan	147.4%	117.2%	New York	106.7%	103.4%
Minnesota	1.7%	-3.4%	North Carolina	-32.1%	-30.8%
Mississippi	-78.9%	-46.1%	North Dakota	-77.9%	-52.6%
Missouri	17.9%	88.1%	Ohio	112.1%	146.0%
Montana	-95.3%	-95.0%	Oklahoma	-57.0%	-59.1%
Nebraska	-10.4%	-48.5%	Oregon	-58.9%	-56.6%
Nevada	-15.4%	-10.0%	Pennsylvania	445.2%	580.5%
New Hampshire	-52.1%	-35.1%	Rhode Island	58.6%	120.6%
New Jersey	665.3%	603.7%	South Carolina	6.6%	-28.7%



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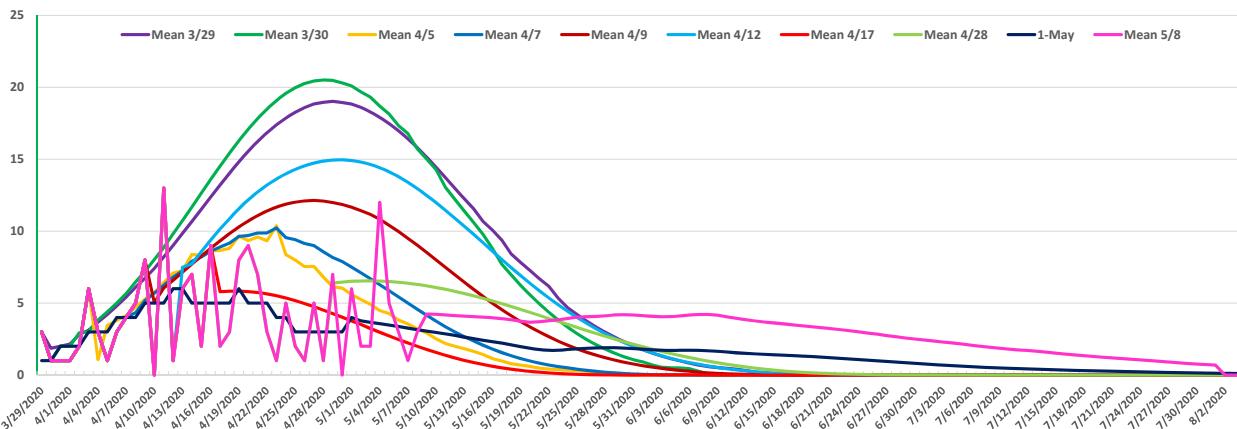
Cumulative Death Change from the Original Model to the May 4 and the May 10 Release

	% Change 5/4	% Change 5/11		% Change 5/4	% Change 5/11
South Dakota	36.8%	-18.3%	Virginia	-41.7%	-32.0%
Tennessee	-47.3%	-52.5%	Washington	-30.6%	-32.9%
Texas	-12.5%	-38.1%	West Virginia	-77.8%	-85.5%
Utah	-82.9%	-70.2%	Wisconsin	-45.2%	-48.6%
Vermont	-43.4%	-44.7%	Wyoming	-95.4%	-95.4%
United States	63.7%	67.0%			



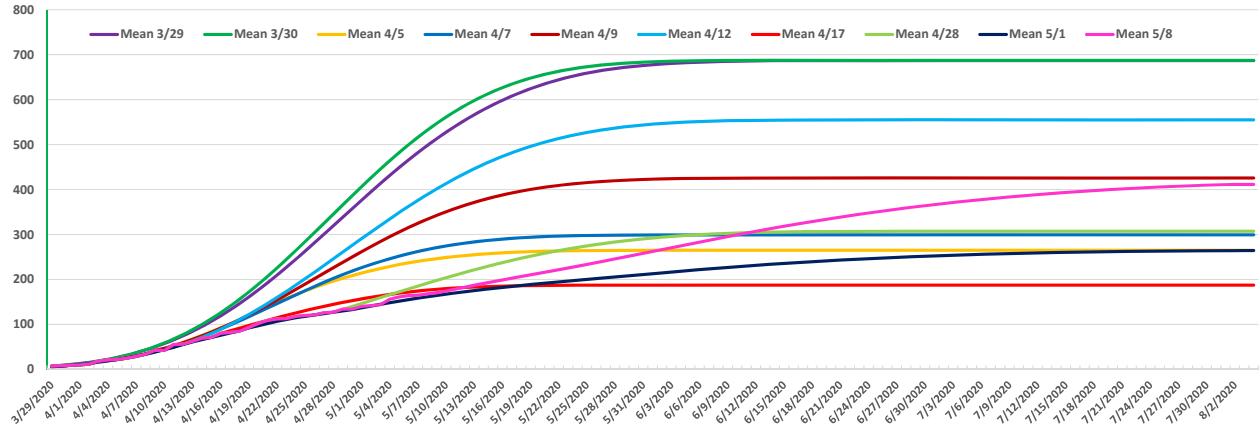
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Kansas COVID 19 Daily Death Projections Revised Forecasts



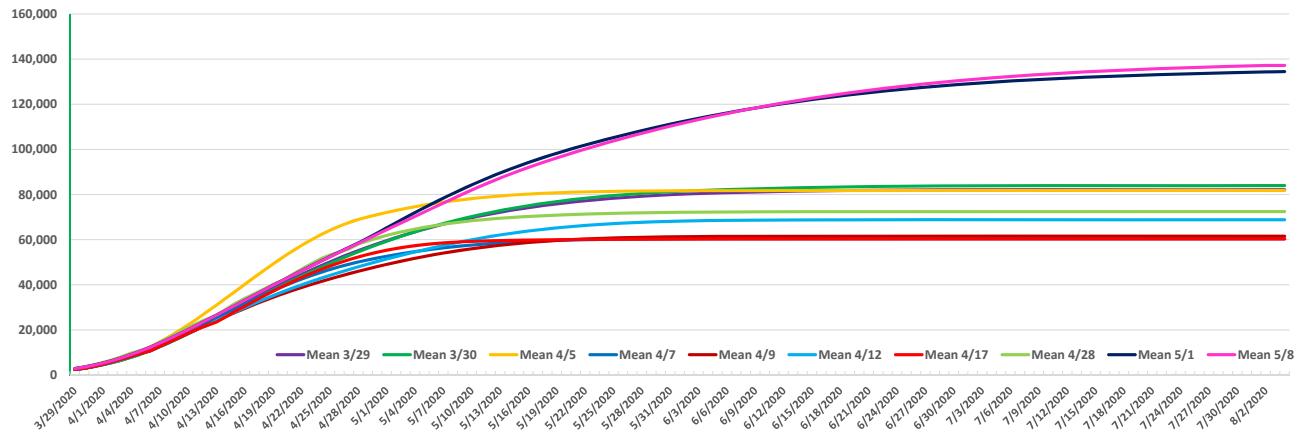
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Kansas COVID 19 Cumulative Death Projections Revised Forecasts



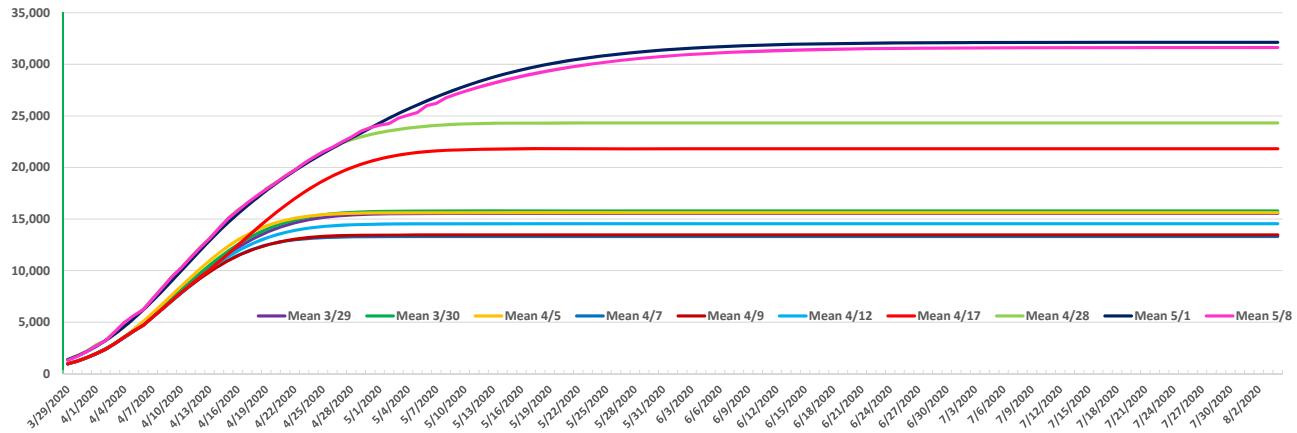
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U.S. COVID 19 Daily Cumulative Projections Revised Forecasts



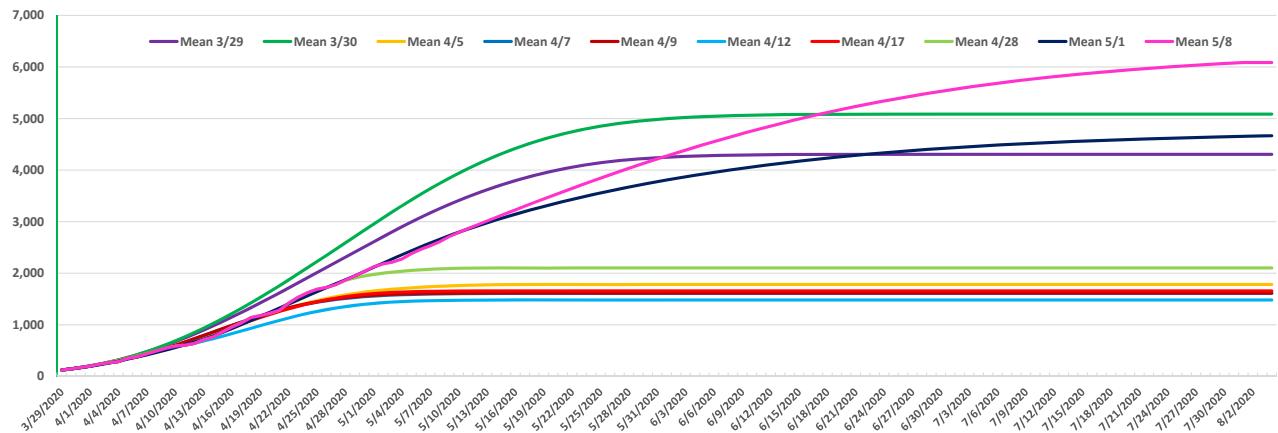
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New York COVID 19 Cumulative Death Projections Revised Forecasts



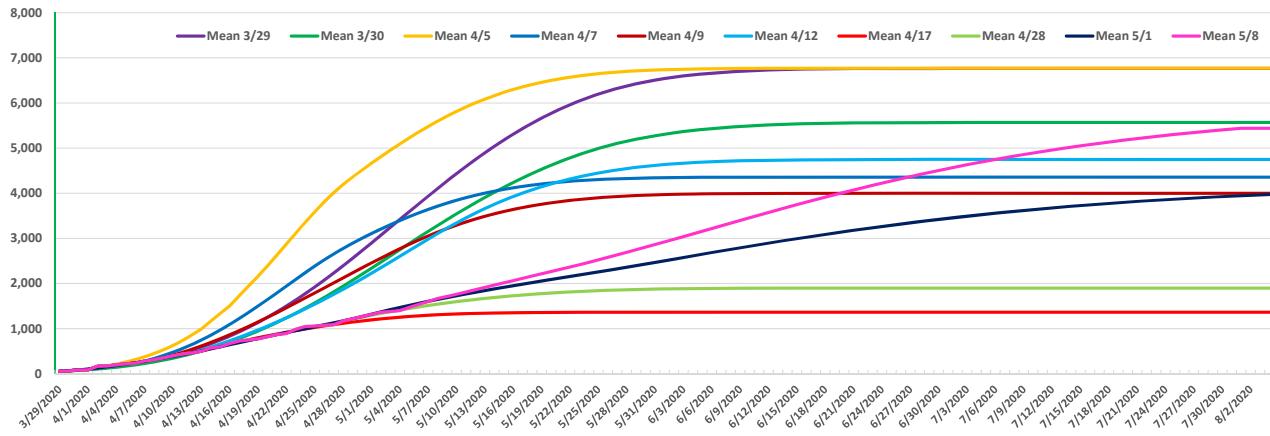
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California COVID 19 Cumulative Death Projections Revised Forecasts



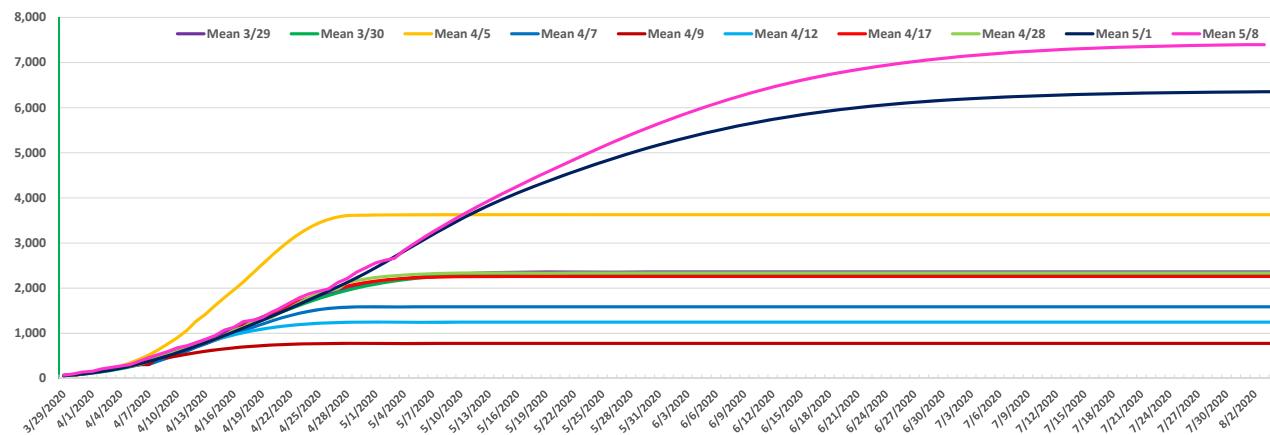
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Florida COVID 19 Cumulative Death Projections Revised Forecasts



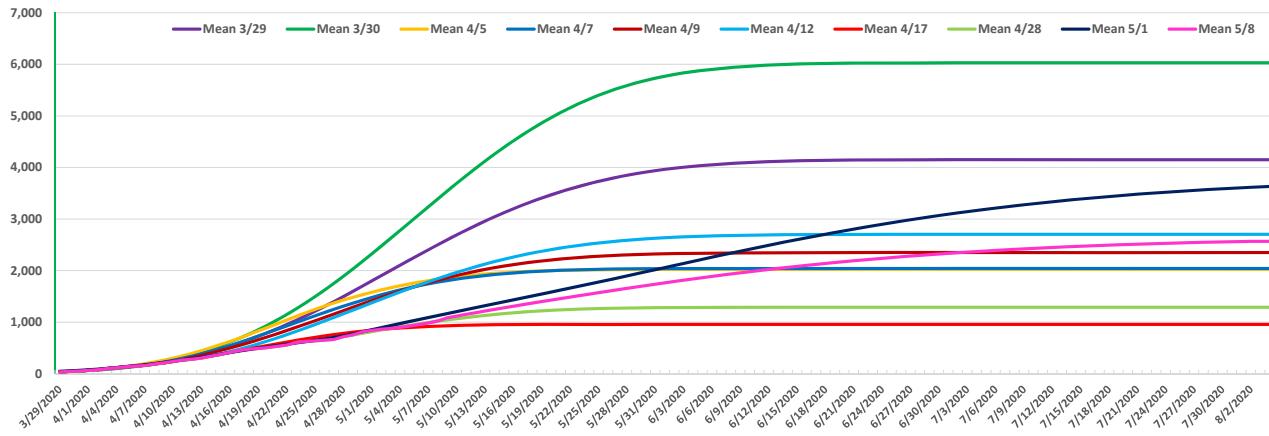
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Illinois COVID 19 Cumulative Death Projections Revised Forecasts



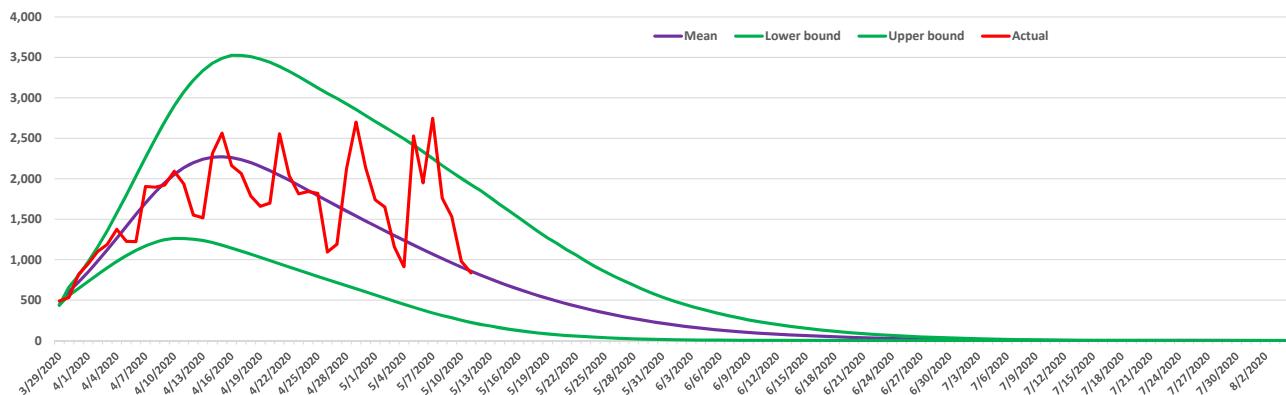
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Texas COVID 19 Cumulative Death Projections Revised Forecasts



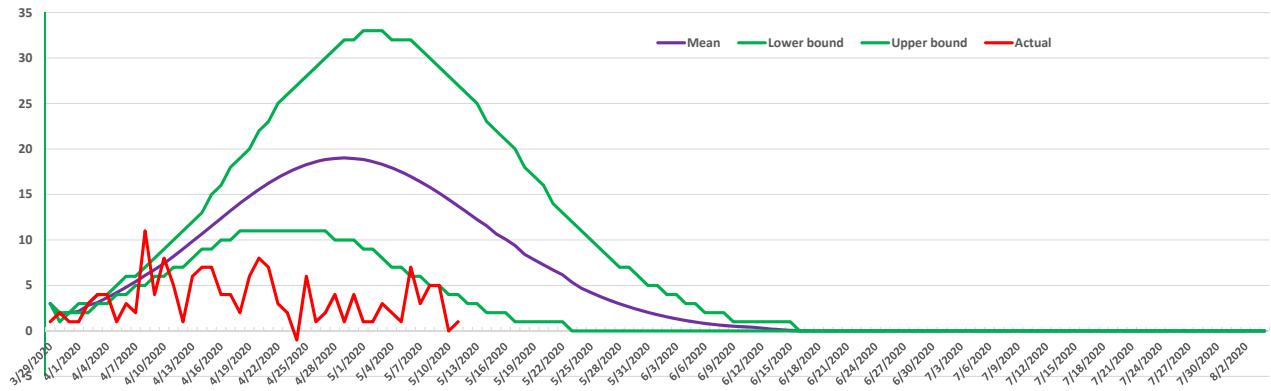
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U.S. COVID 19 Daily Death Projections March 26



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Kansas COVID 19 Daily Death Projections March 26



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Kansas COVID Deaths by Age Group

Age Group	Number of Deaths	Percent of COVID Deaths	2018 Mortality Rates
35-44 years	4	2.5%	2.5%
45-54 years	5	3.2%	4.8%
55-64 years	20	12.7%	12.8%
65-74 years	29	18.4%	18.2%
75-84 years	35	22.2%	23.4%
85+ years	65	41.1%	34.2%
Total	158	100%	95.8%

<https://www.coronavirus.kdheks.gov/160/COVID-19-in-Kansas>, May 11, 2020

https://www.kdheks.gov/phi/AS_Tables/AS_2018_Tables_and_Figures/general_mortality/Table_E4.pdf, May 11, 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	0	0.00	1.3
35-44 years	4	0.01	1.9
45-54 years	5	0.01	3.9
55-64 years	20	0.05	9.3
65-74 years	29	0.11	18.9
75-84 years	35	0.26	47.5
85+ years	65	0.99	142.1

<https://www.coronavirus.kdheks.gov/160/COVID-19-in-Kansas>, May 11, 2020

https://www.kdheks.gov/phi/AS_Tables/AS_2018_Tables_and_Figures/general_mortality/, May 11, 2020

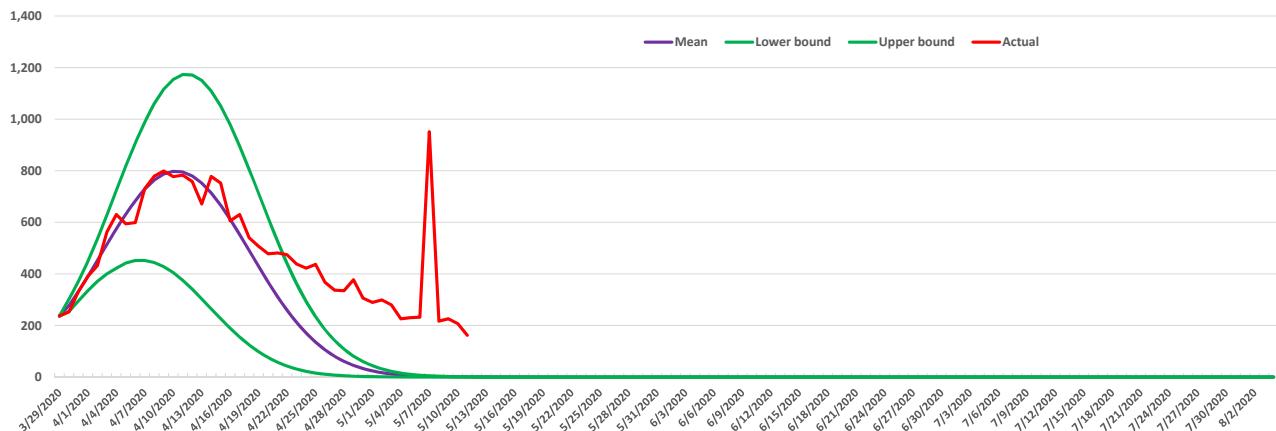


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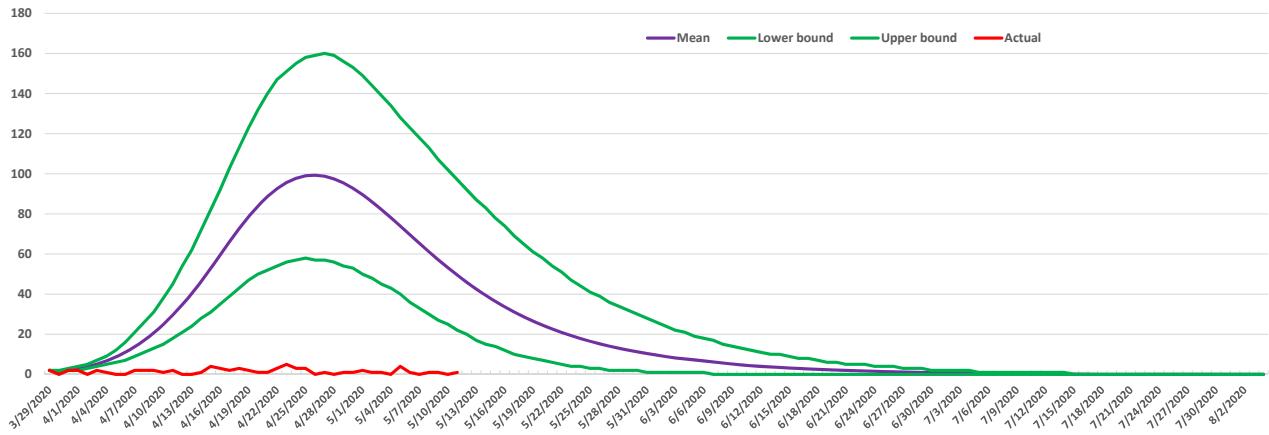


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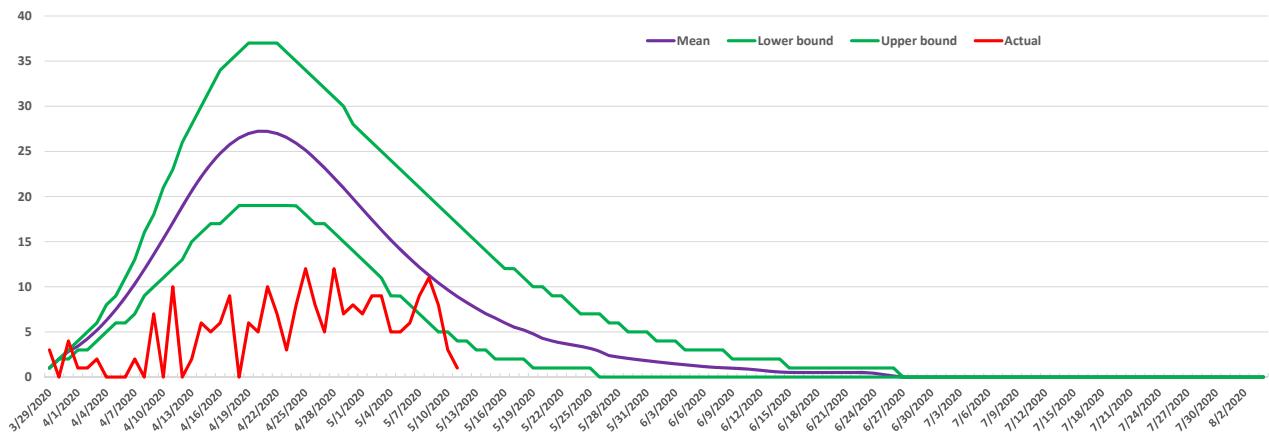
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Maine COVID 19 Daily Death Projections March 26



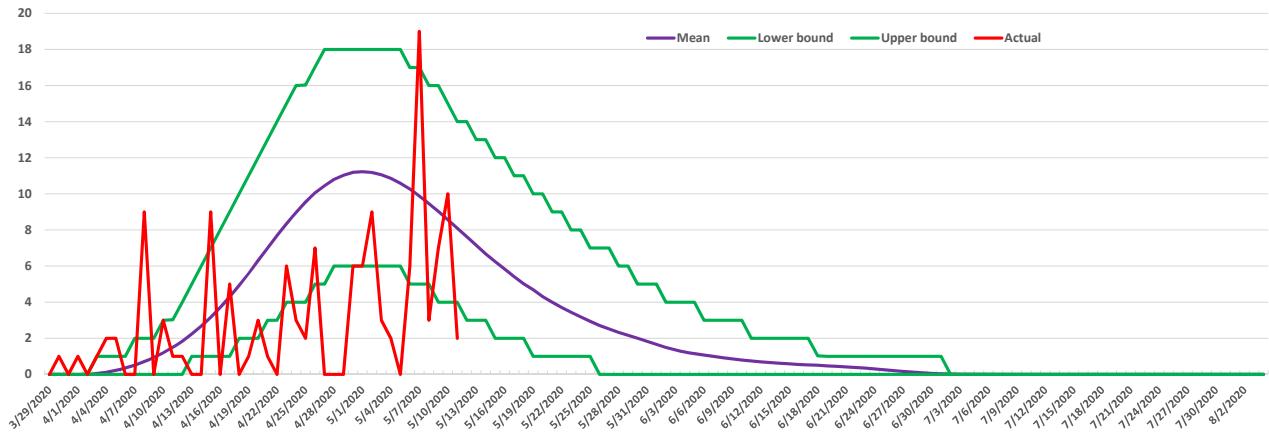
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Delaware COVID 19 Daily Death Projections March 26



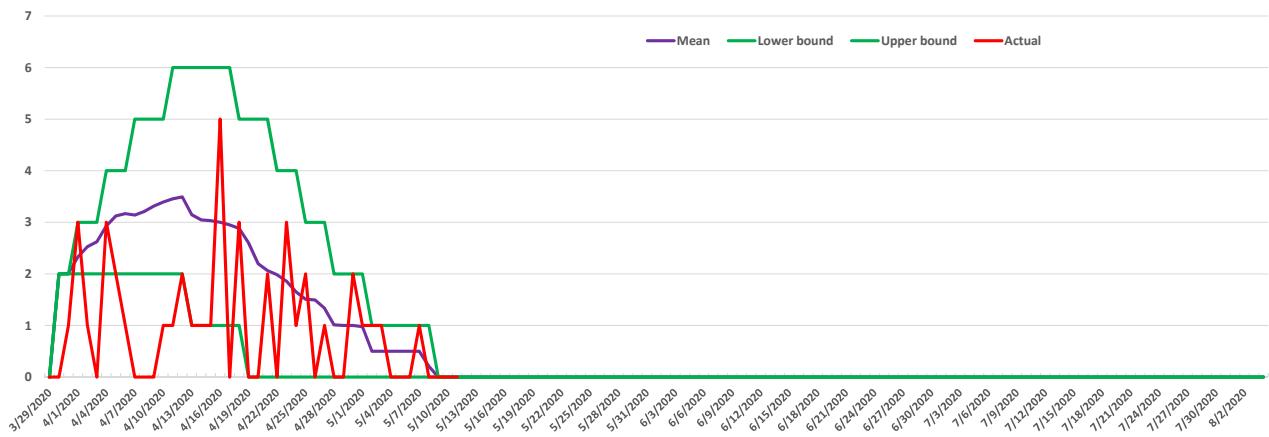
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New Hampshire COVID 19 Daily Death Projections March 26



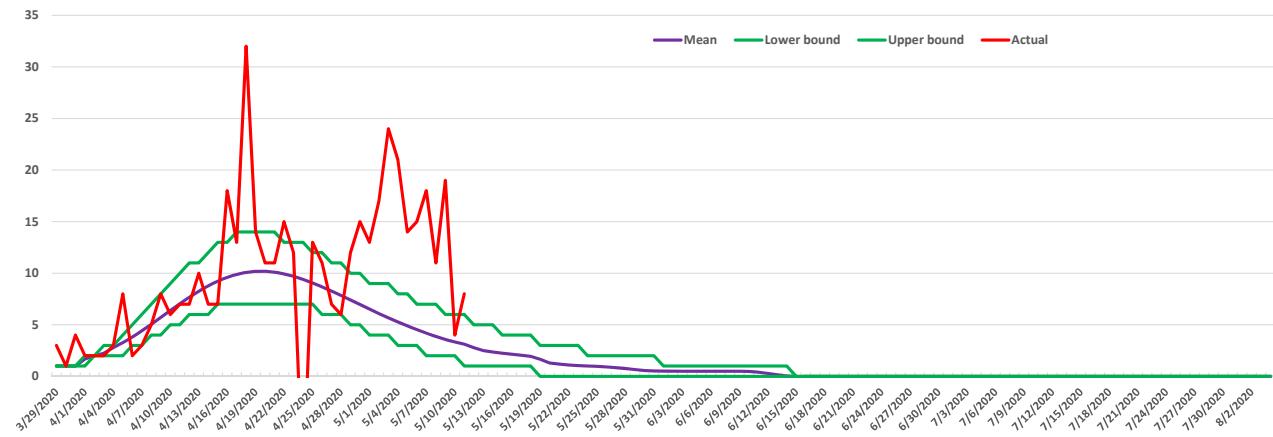
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Vermont COVID 19 Daily Death Projections March 26



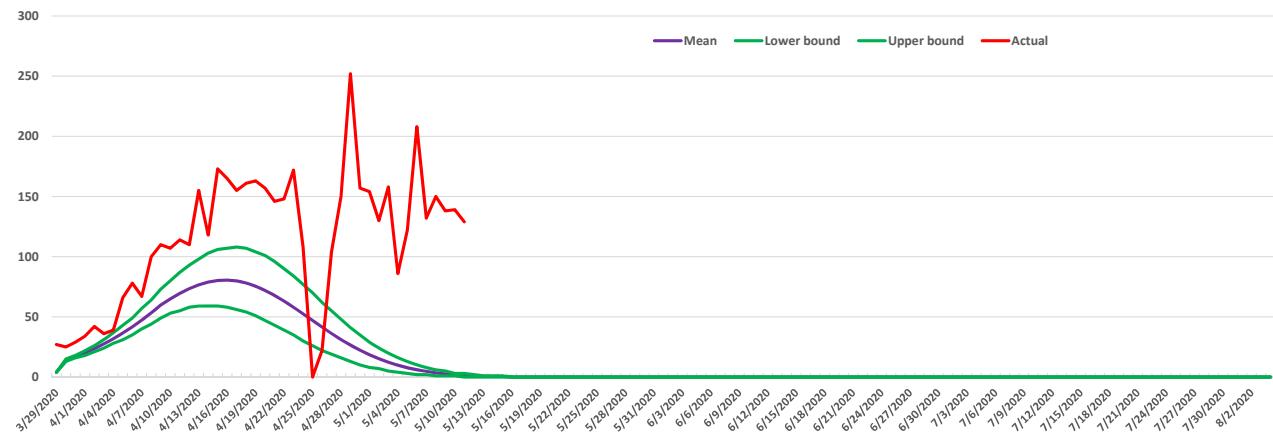
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Rhode Island COVID 19 Daily Death Projections March 26



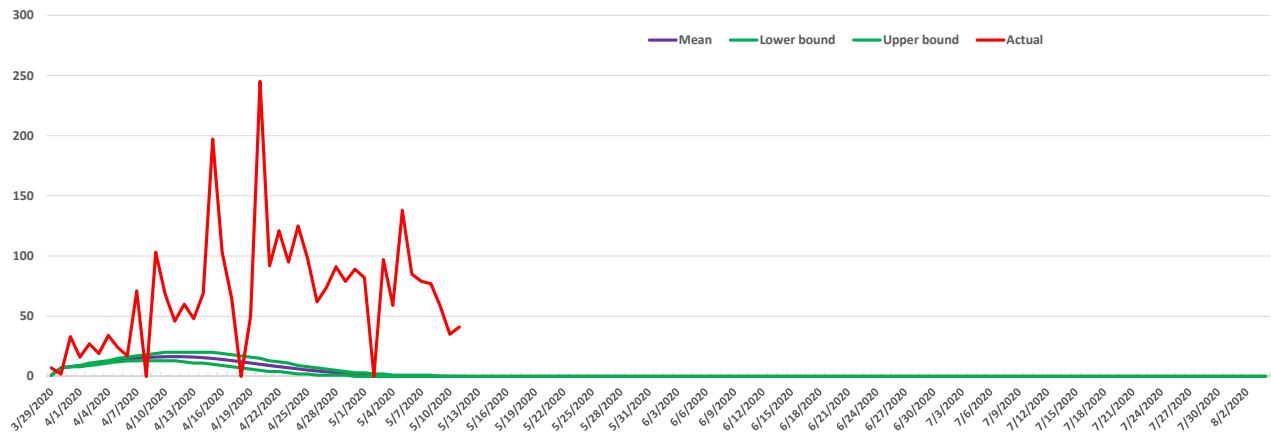
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Massachusetts COVID 19 Daily Death Projections March 26



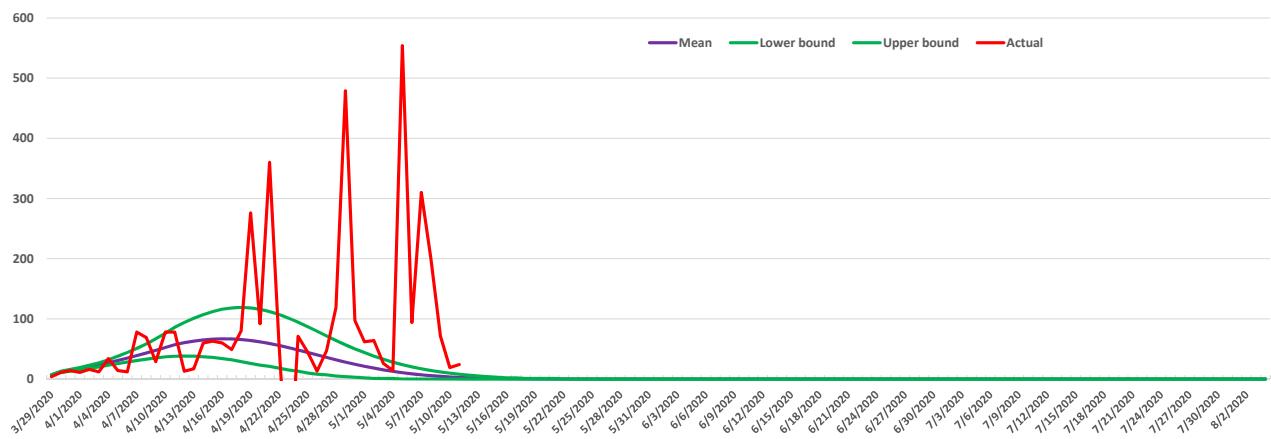
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Connecticut COVID 19 Daily Death Projections March 26



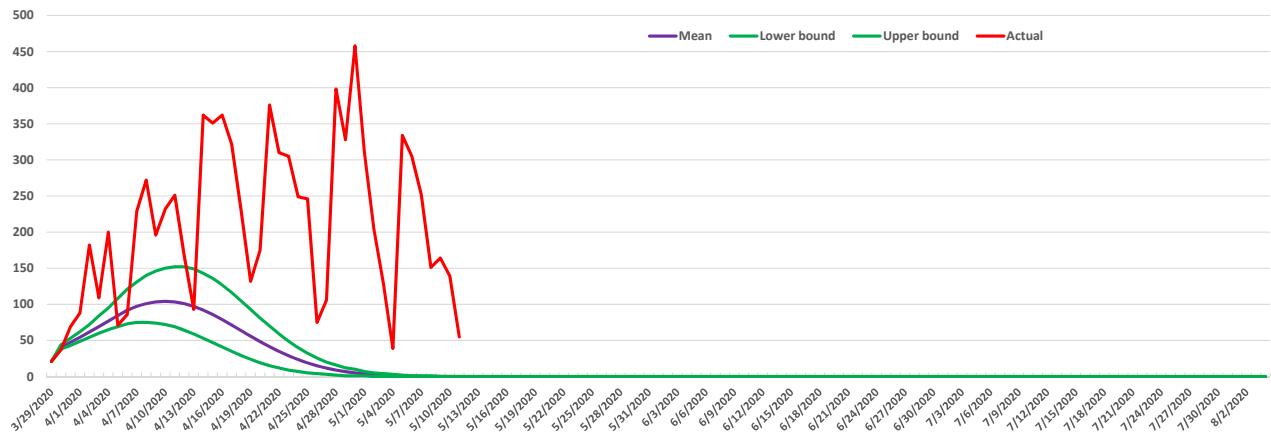
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Pennsylvania COVID 19 Daily Death Projections March 26



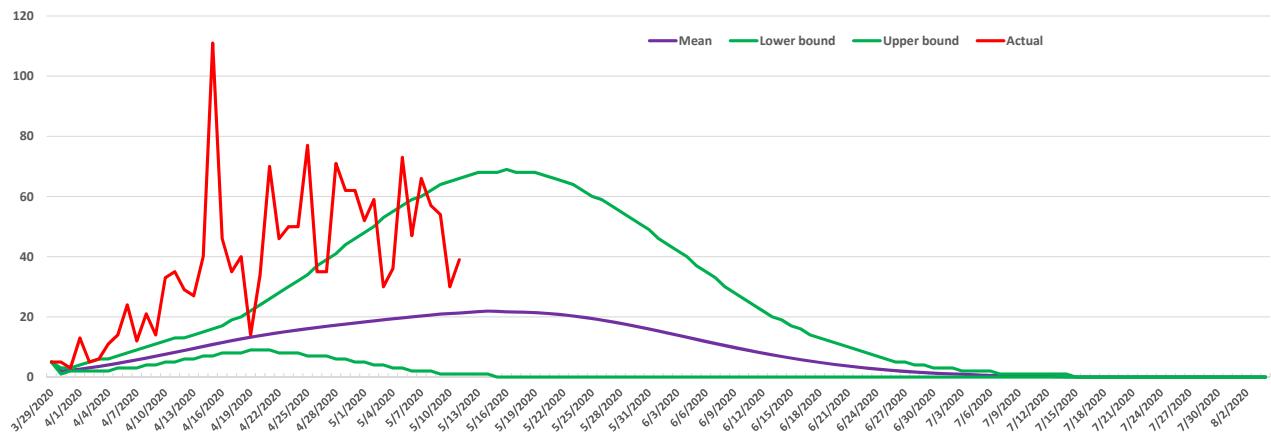
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New Jersey COVID 19 Daily Death Projections March 26



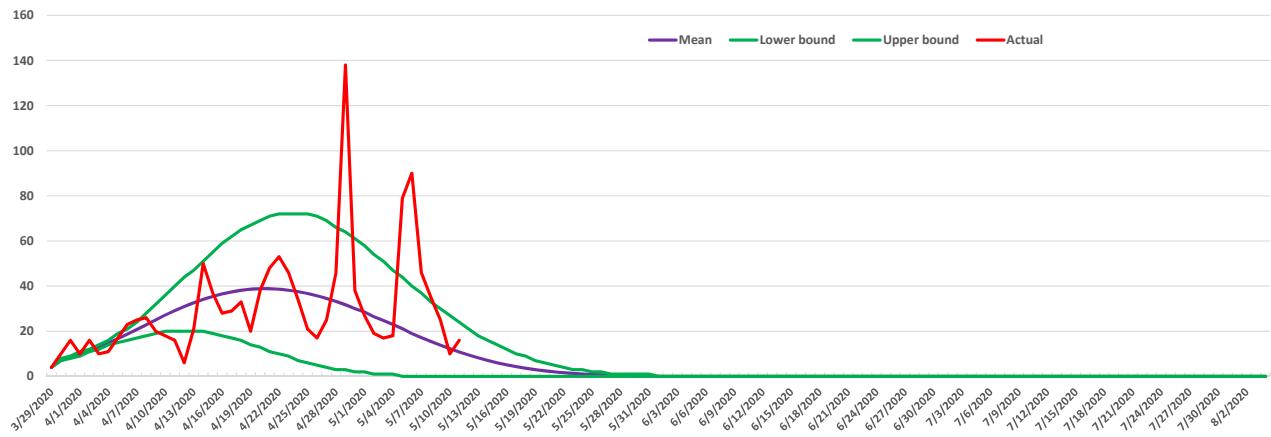
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Maryland COVID 19 Daily Death Projections March 26



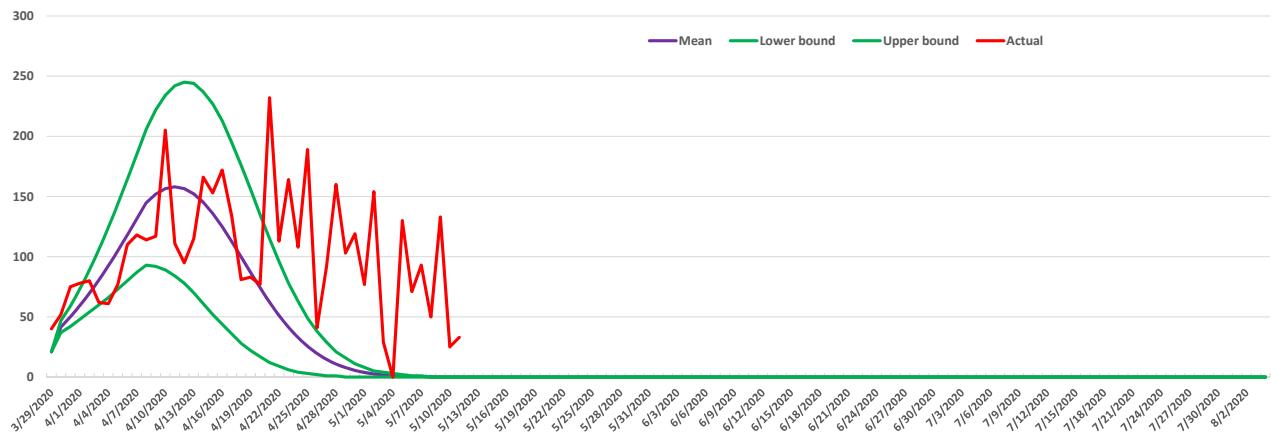
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Ohio COVID 19 Daily Death Projections March 26



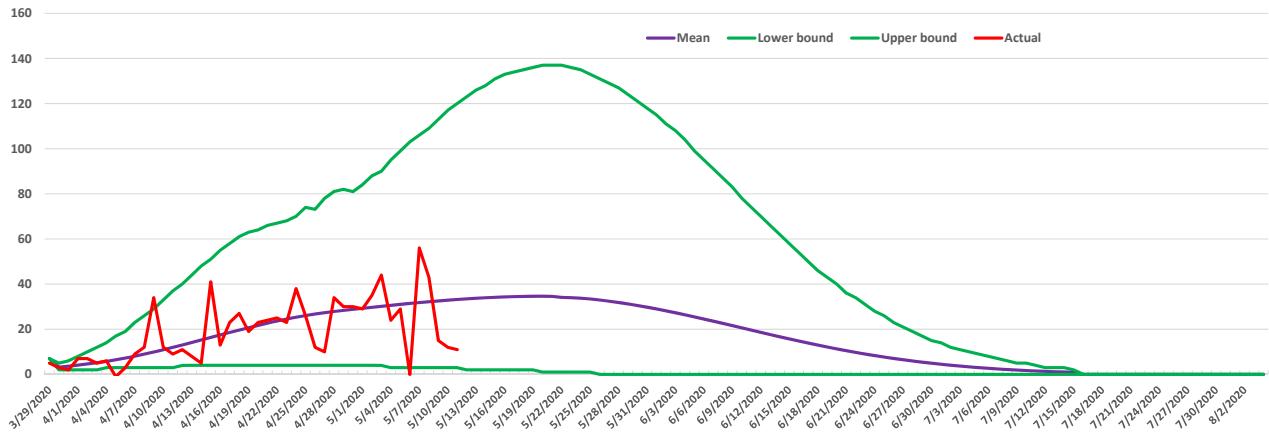
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Michigan COVID 19 Daily Death Projections March 26



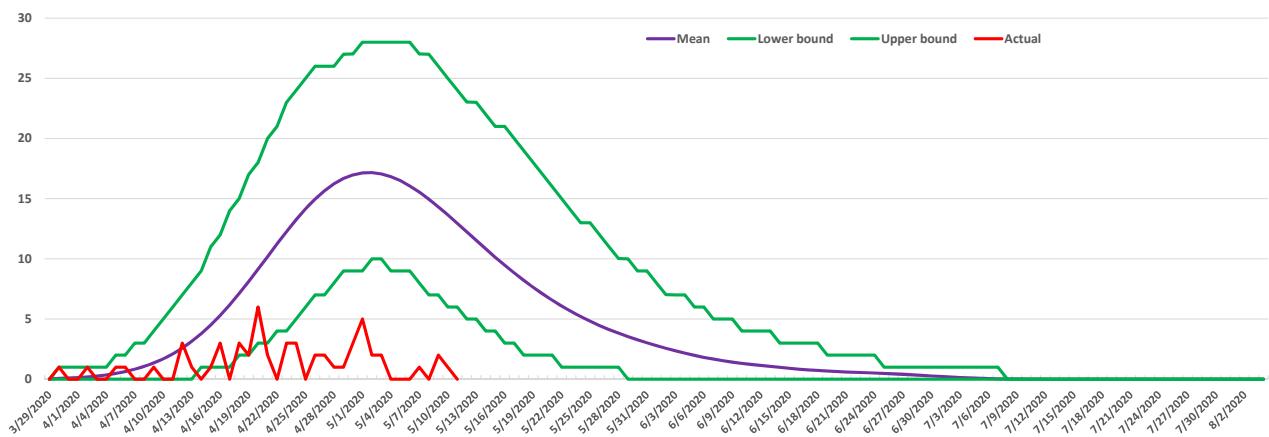
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Virginia COVID 19 Daily Death Projections March 26



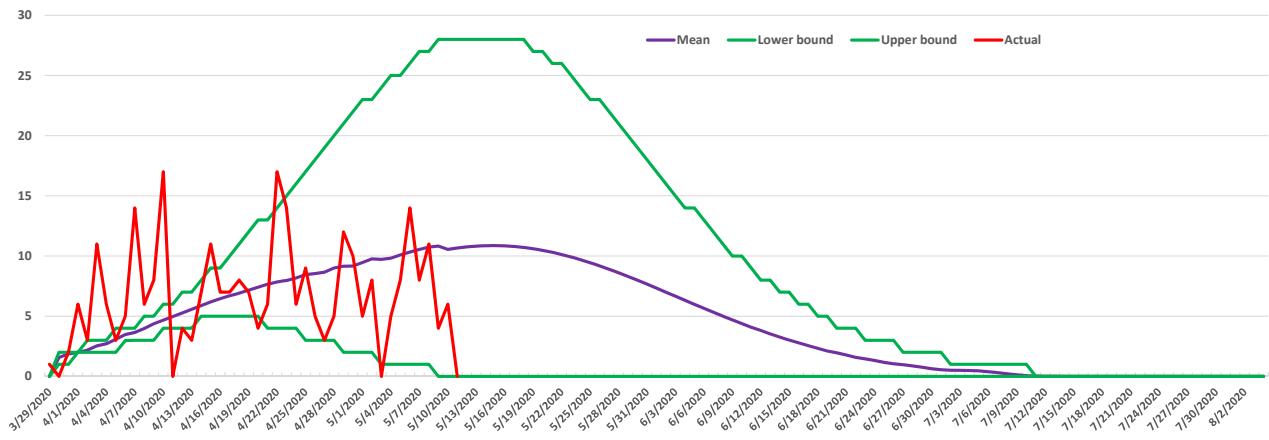
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West Virginia COVID 19 Daily Death Projections March 26



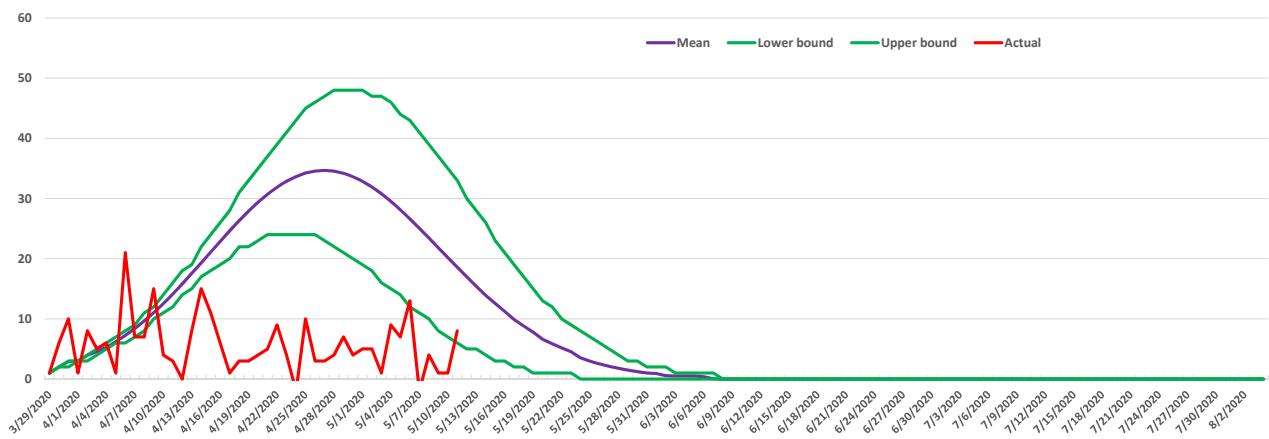
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Kentucky COVID 19 Daily Death Projections March 26



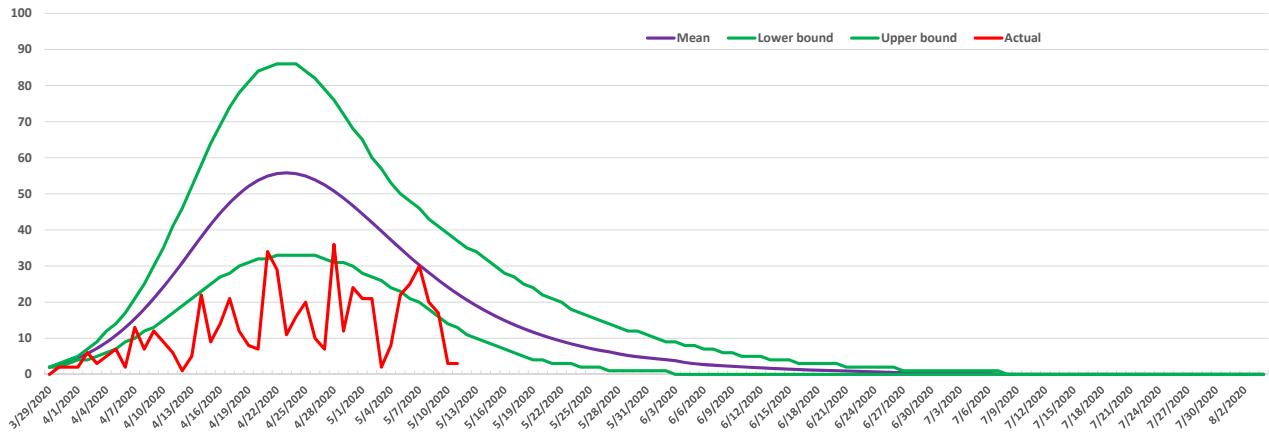
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Tennessee COVID 19 Daily Death Projections March 26



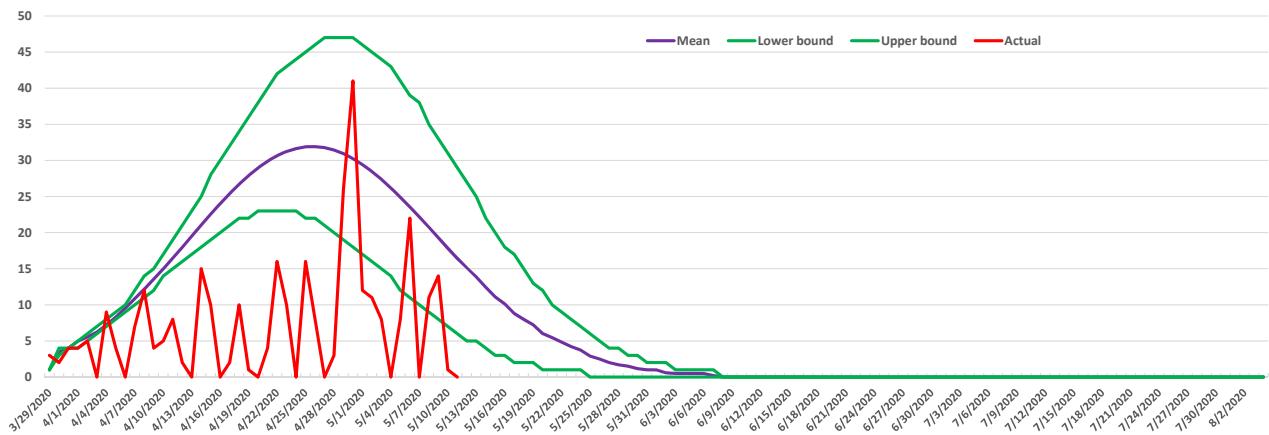
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North Carolina COVID 19 Daily Death Projections March 26



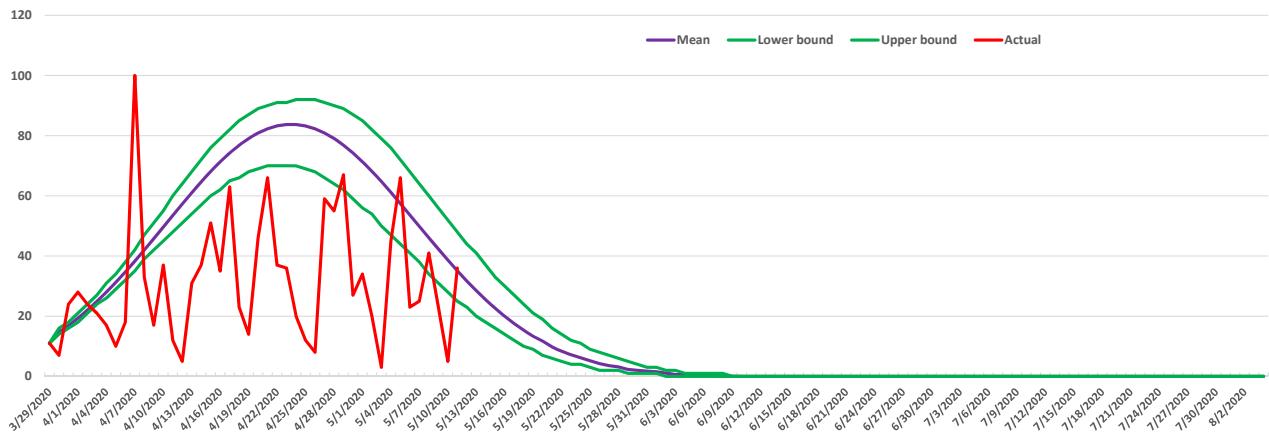
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South Carolina COVID 19 Daily Death Projections March 26



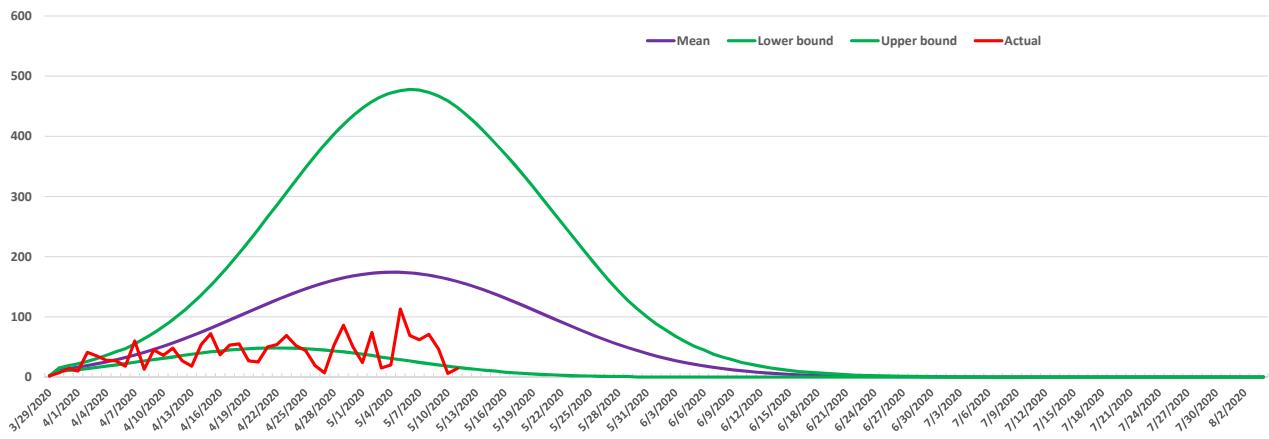
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Georgia COVID 19 Daily Death Projections March 26



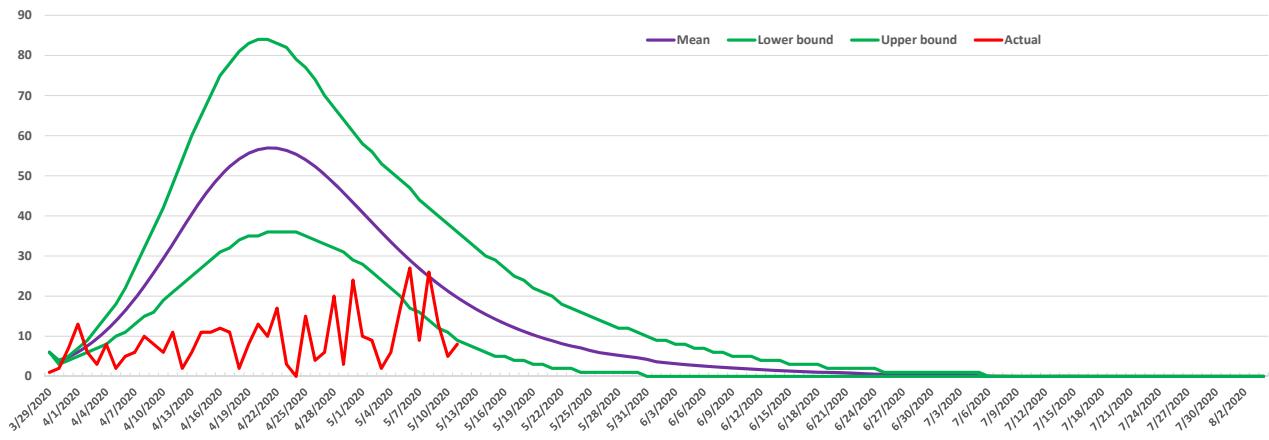
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Florida COVID 19 Daily Death Projections March 26



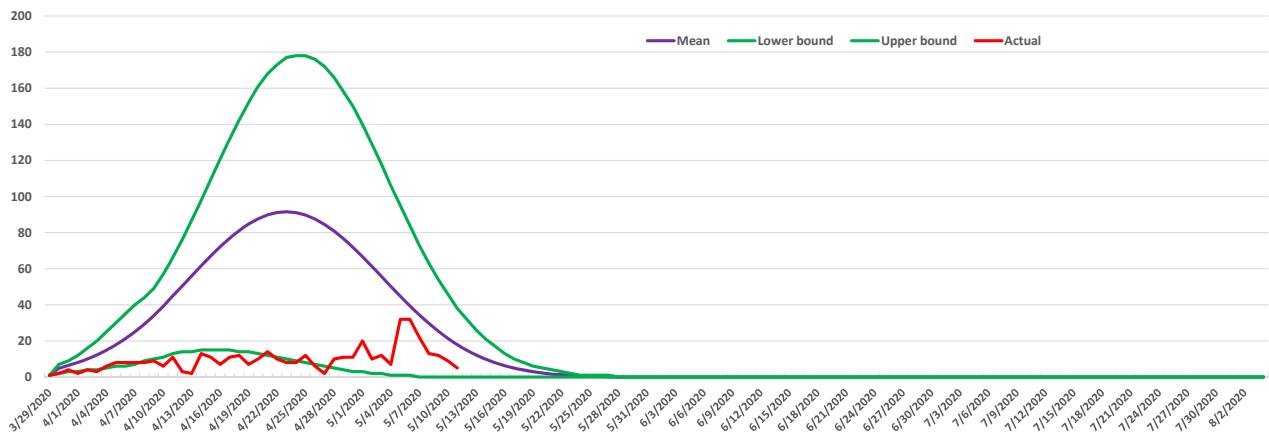
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Alabama COVID 19 Daily Death Projections March 26



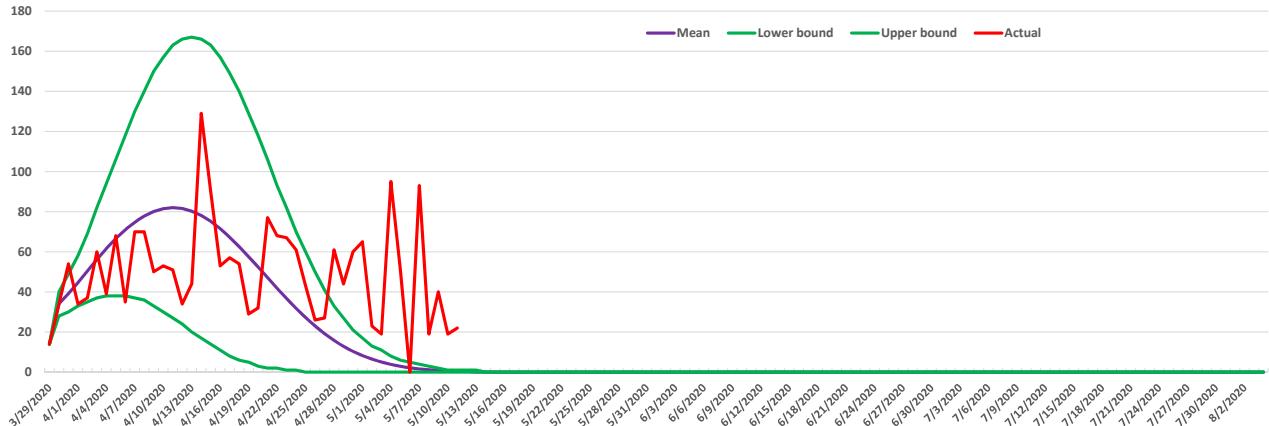
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Mississippi COVID 19 Daily Death Projections March 26



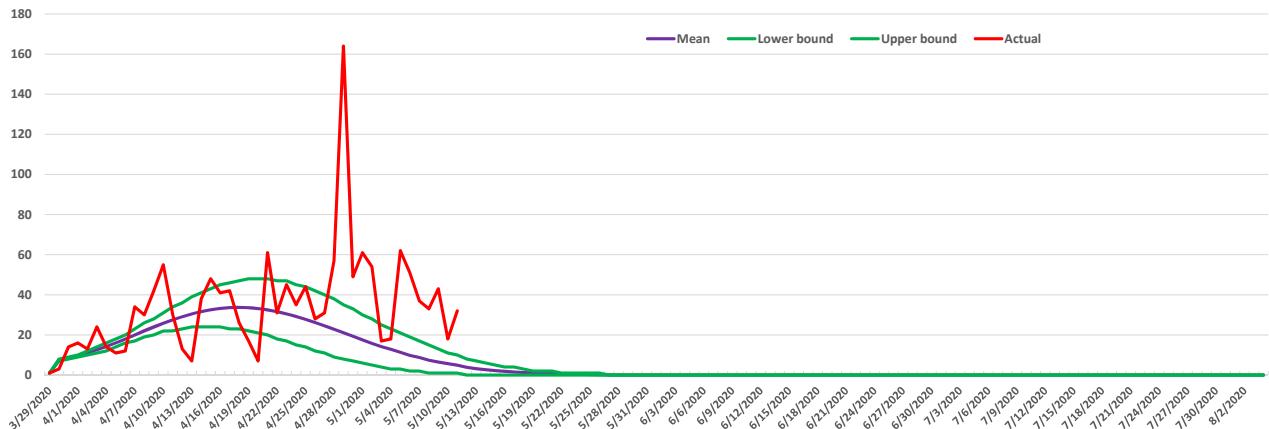
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Louisiana COVID 19 Daily Death Projections March 26



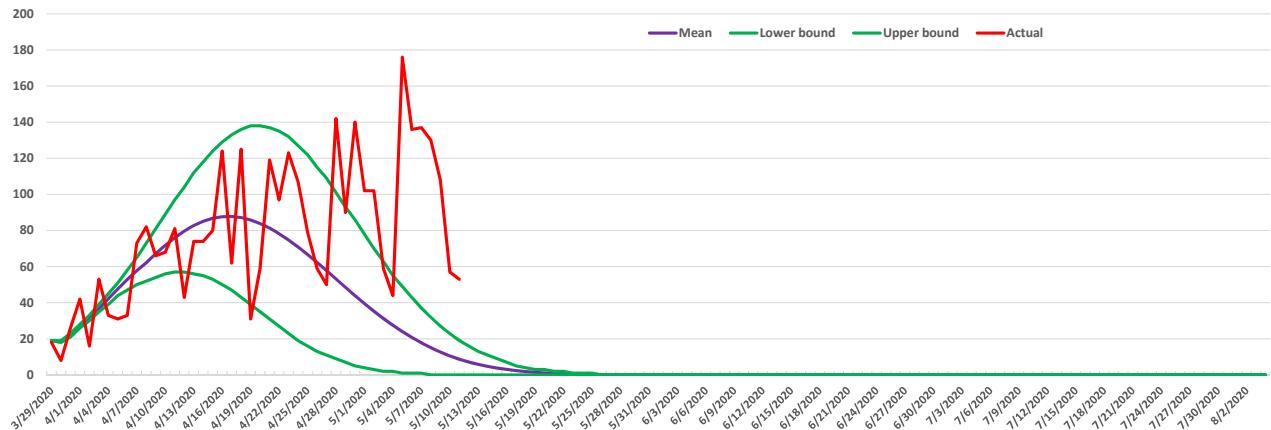
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Indiana COVID 19 Daily Death Projections March 26



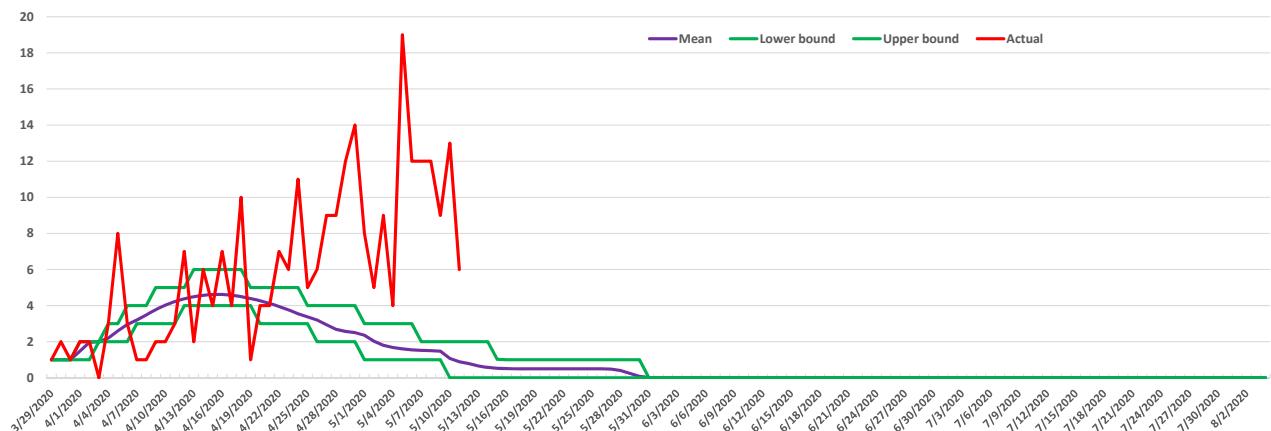
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Illinois COVID 19 Daily Death Projections March 26



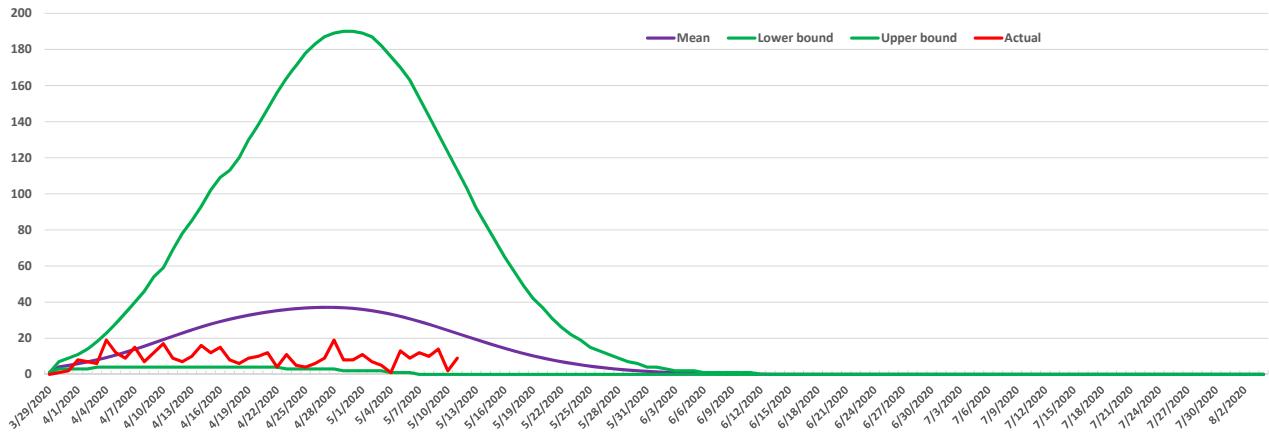
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Iowa COVID 19 Daily Death Projections March 26



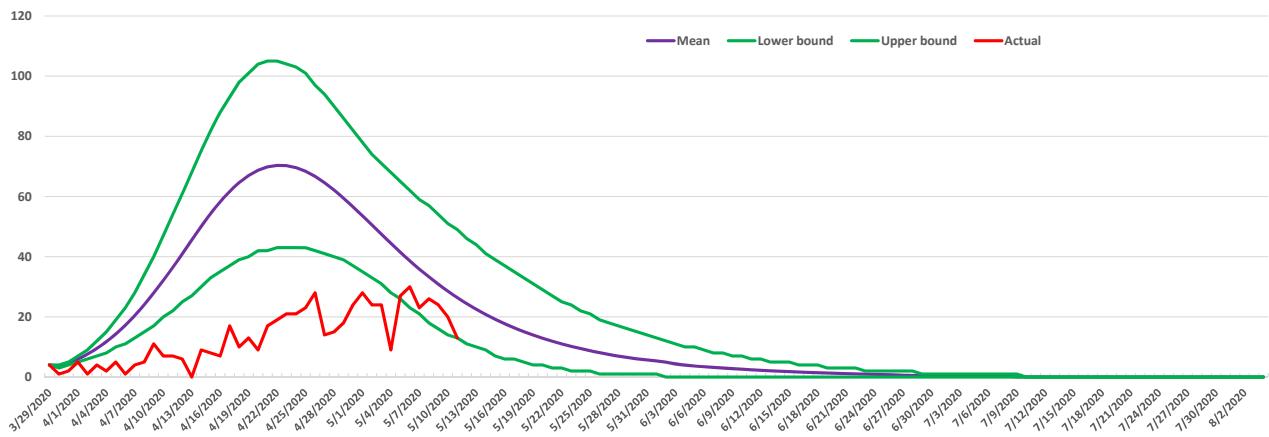
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Wisconsin COVID 19 Daily Death Projections March 26



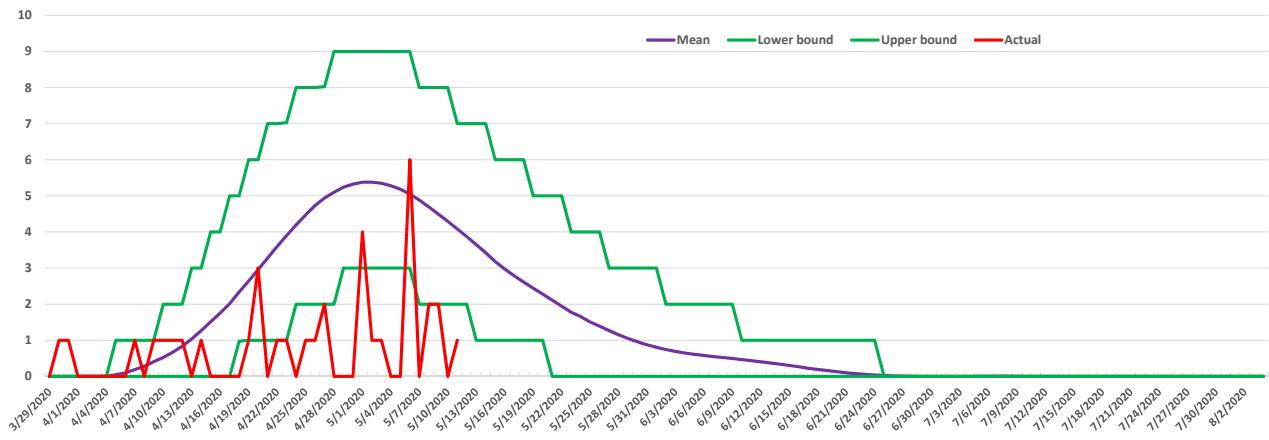
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Minnesota COVID 19 Daily Death Projections March 26



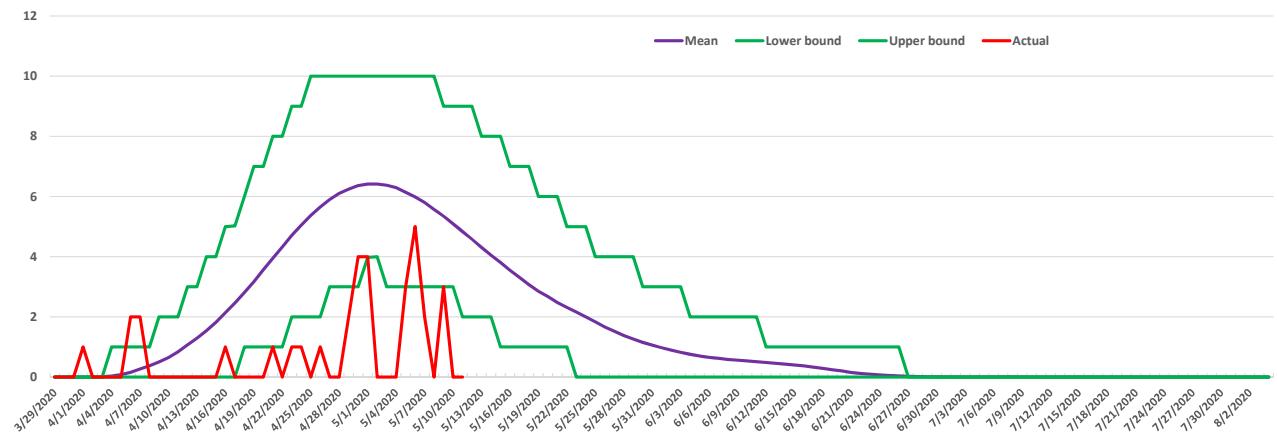
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North Dakota COVID 19 Daily Death Projections March 26



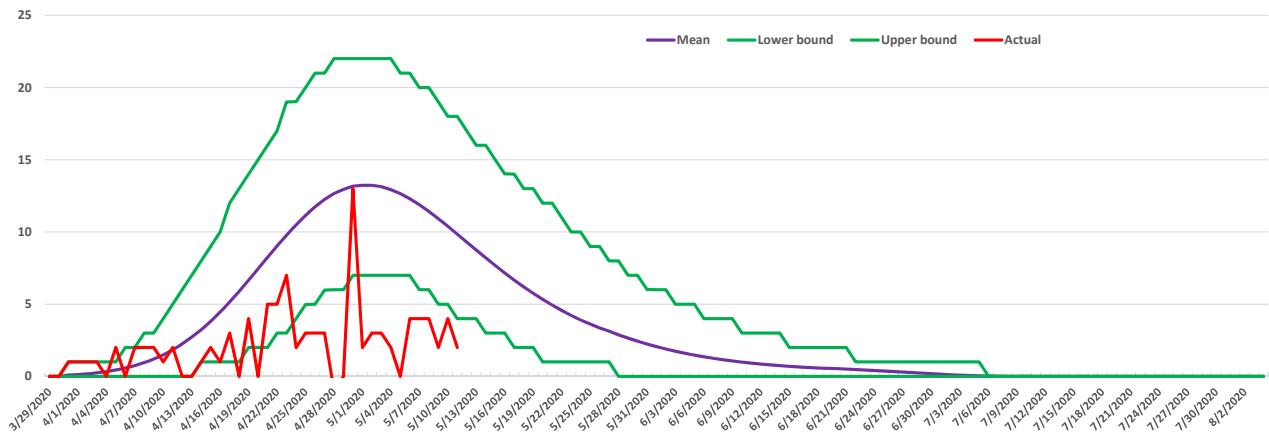
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South Dakota COVID 19 Daily Death Projections March 26



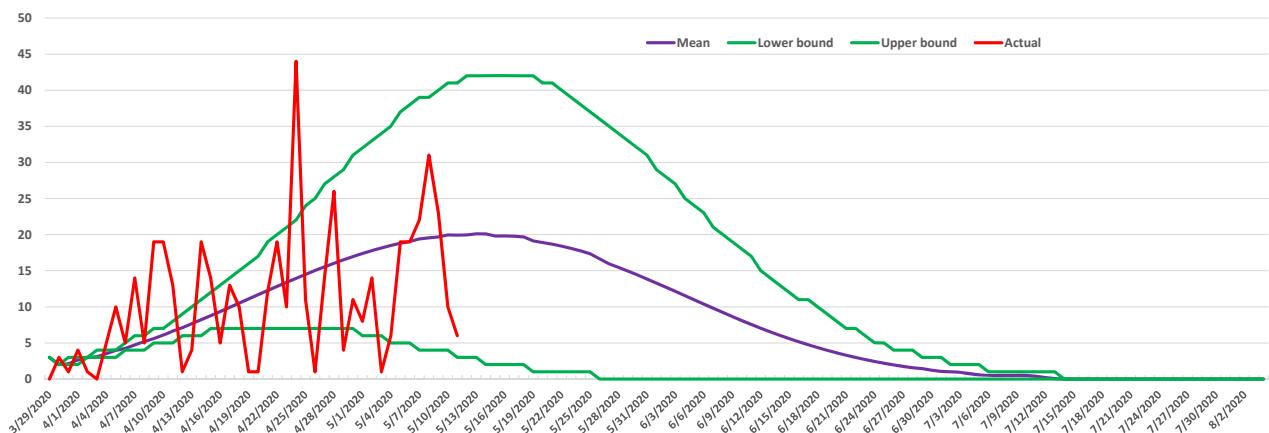
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Nebraska COVID 19 Daily Death Projections March 26



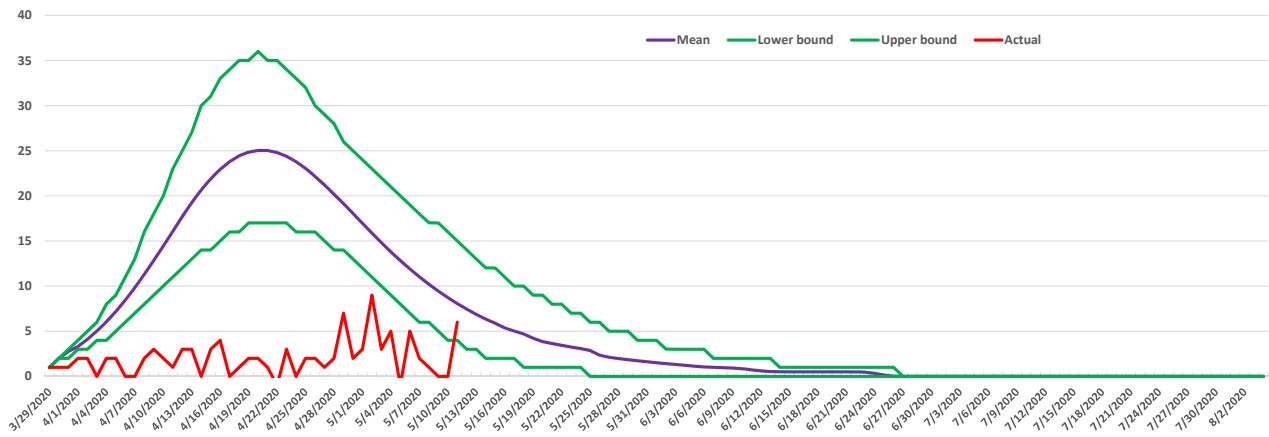
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Missouri COVID 19 Daily Death Projections March 26



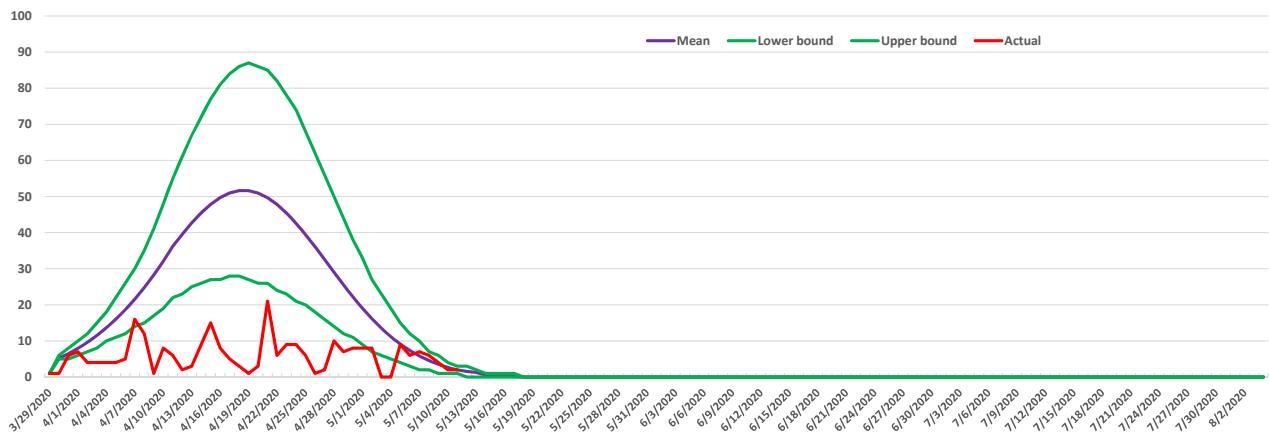
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Arkansas COVID 19 Daily Death Projections March 26



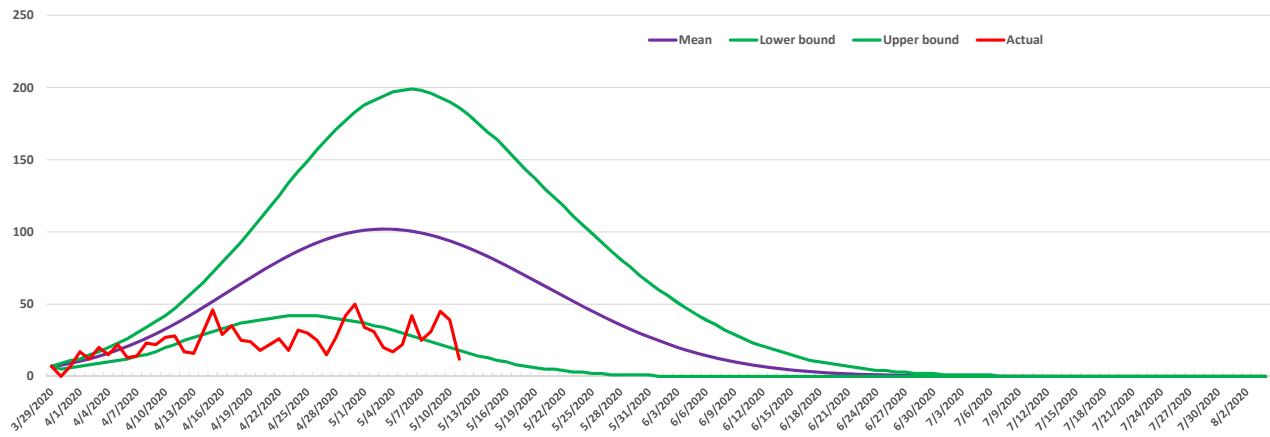
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Oklahoma COVID 19 Daily Death Projections March 26



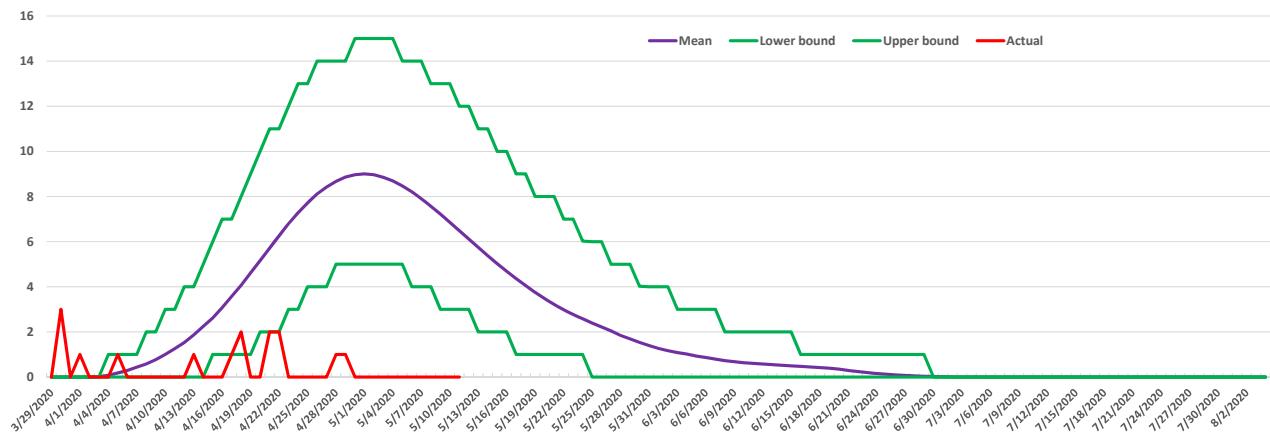
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Texas COVID 19 Daily Death Projections March 26



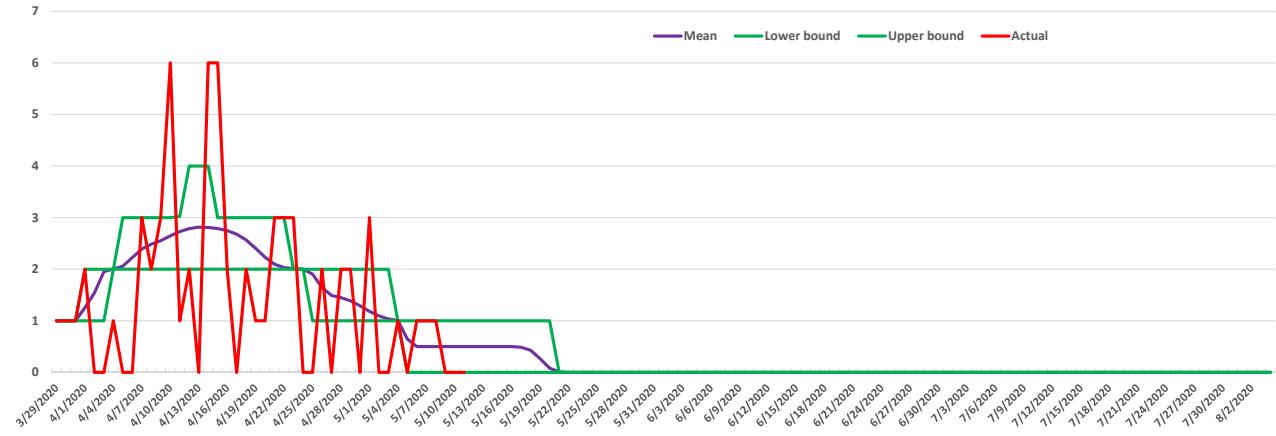
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Montana COVID 19 Daily Death Projections March 26



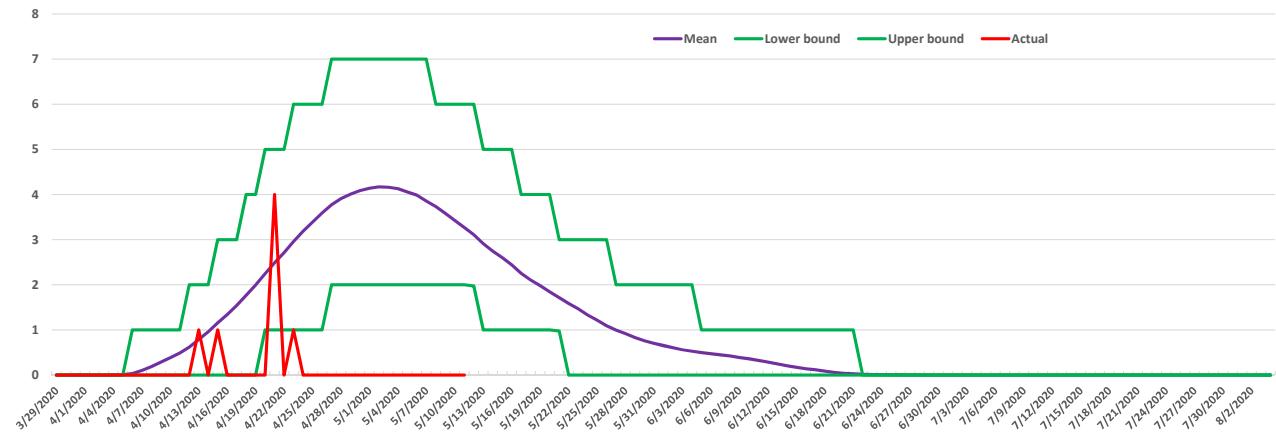
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Idaho COVID 19 Daily Death Projections March 26



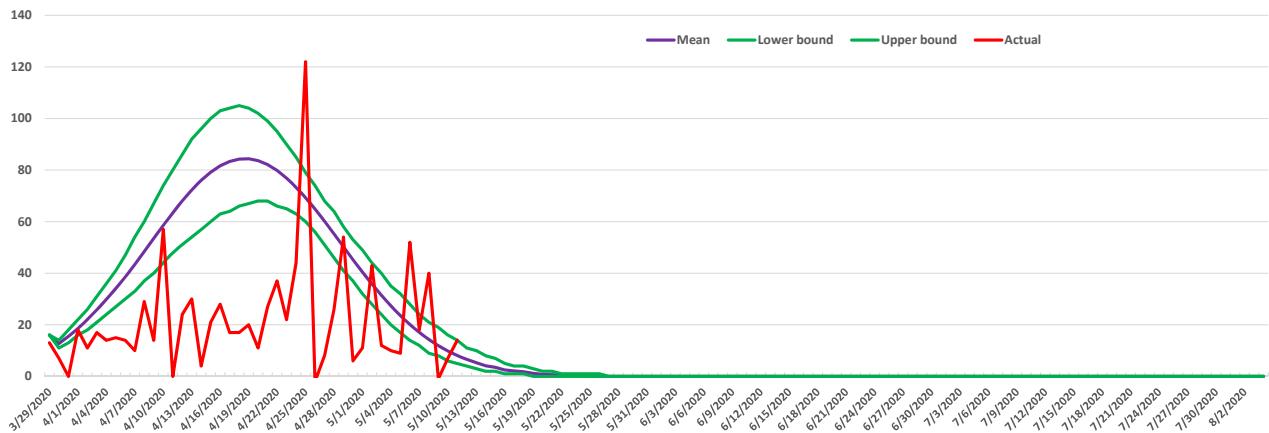
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Wyoming COVID 19 Daily Death Projections March 26



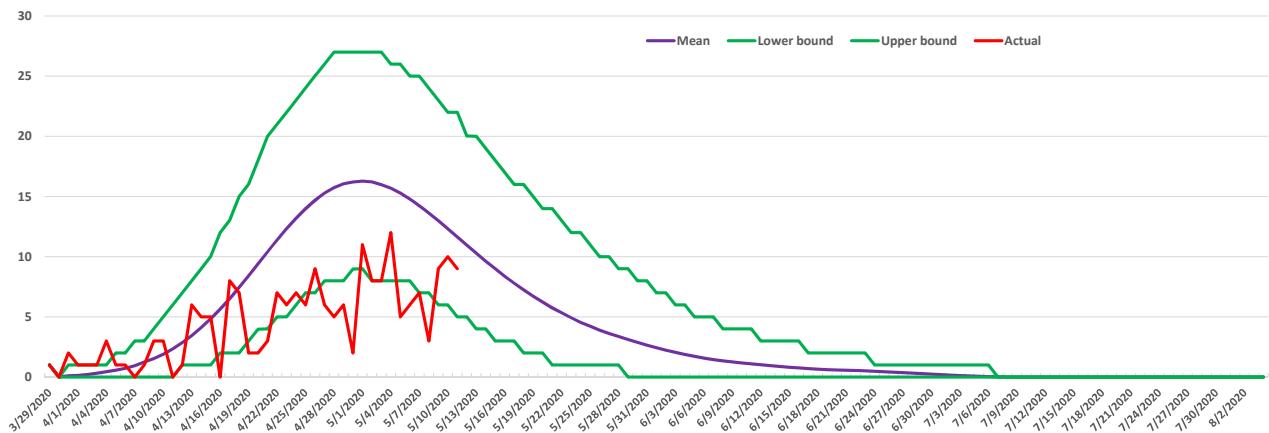
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Colorado COVID 19 Daily Death Projections March 26



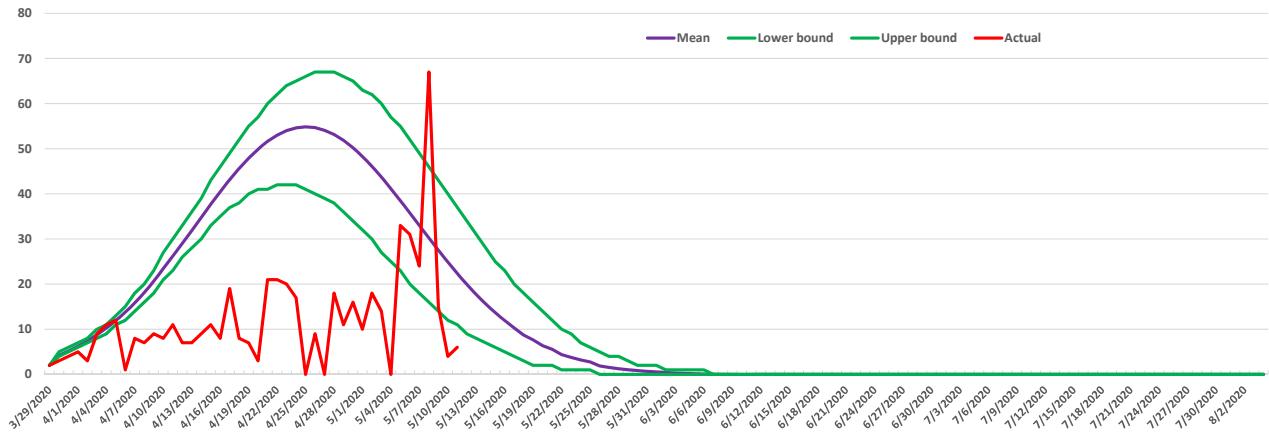
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New Mexico COVID 19 Daily Death Projections March 26



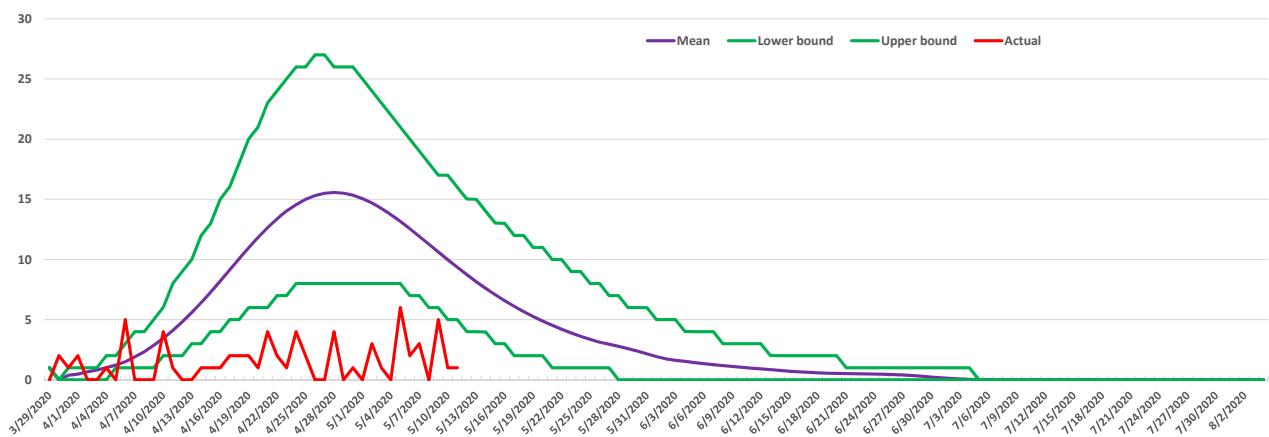
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Arizona COVID 19 Daily Death Projections March 26



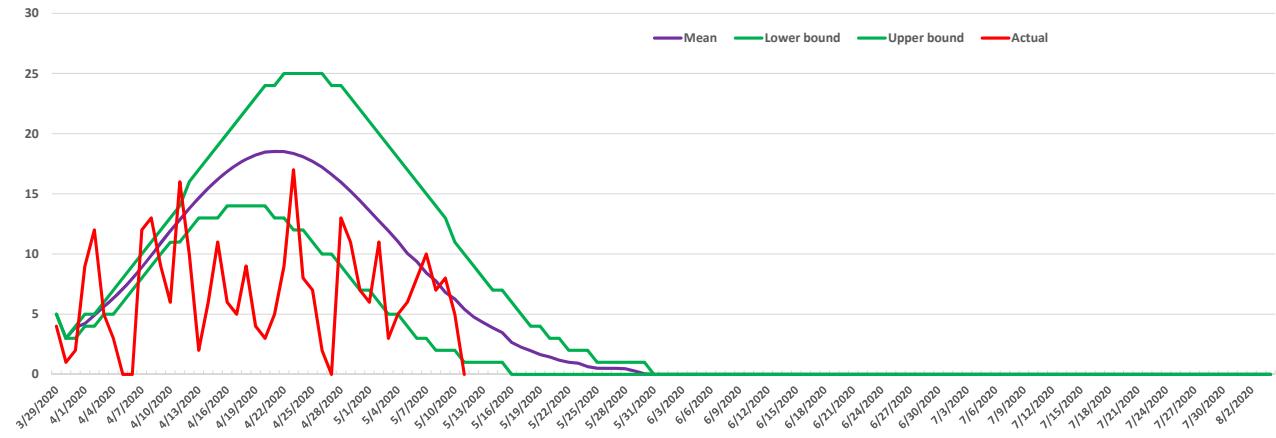
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Utah COVID 19 Daily Death Projections March 26



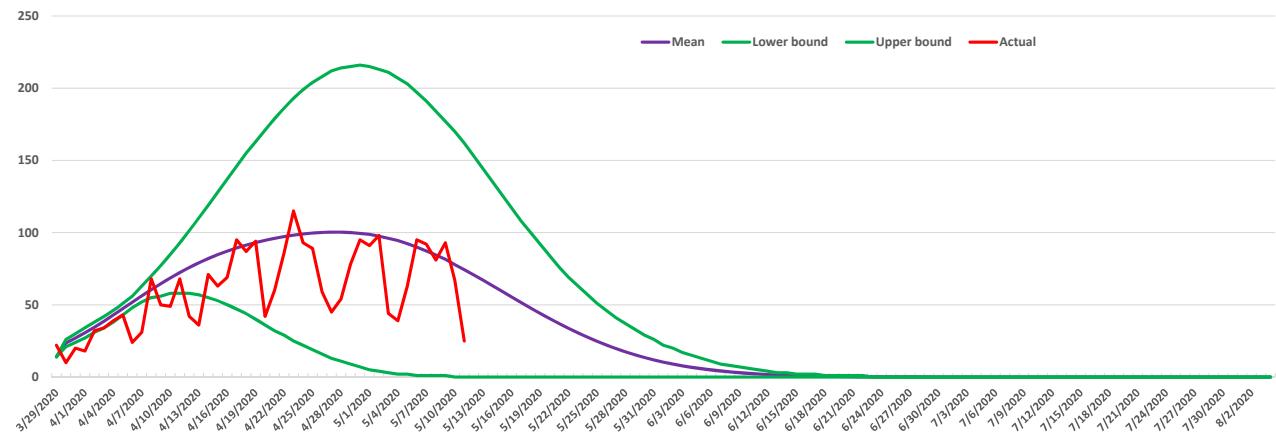
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Nevada COVID 19 Daily Death Projections March 26



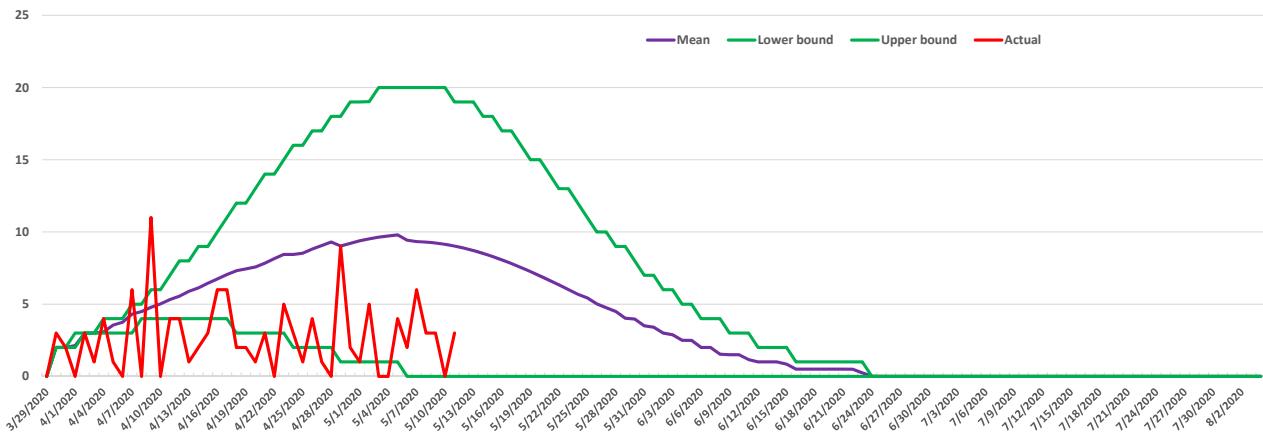
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California COVID 19 Daily Death Projections March 26



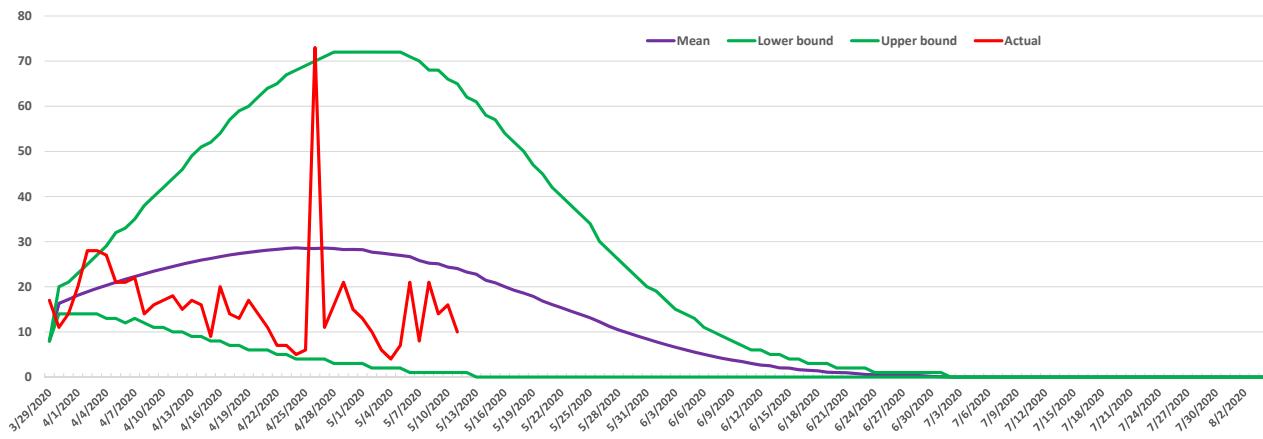
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Oregon COVID 19 Daily Death Projections March 26



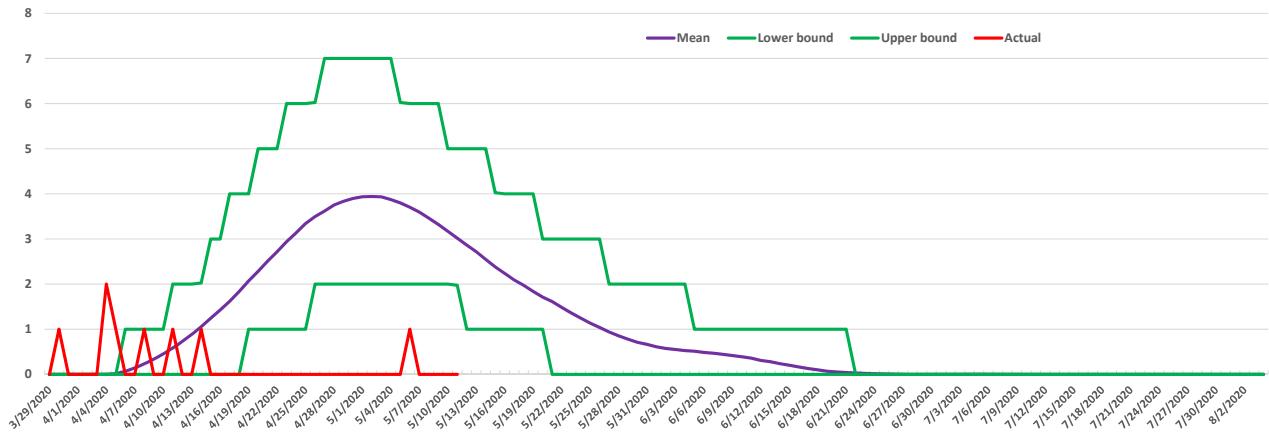
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Washington COVID 19 Daily Death Projections March 26



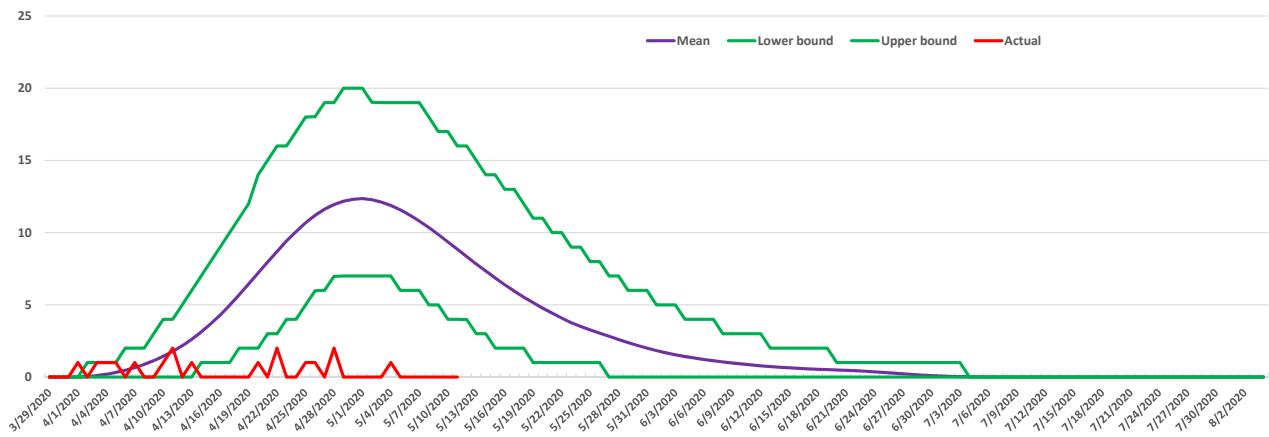
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Alaska COVID 19 Daily Death Projections March 26



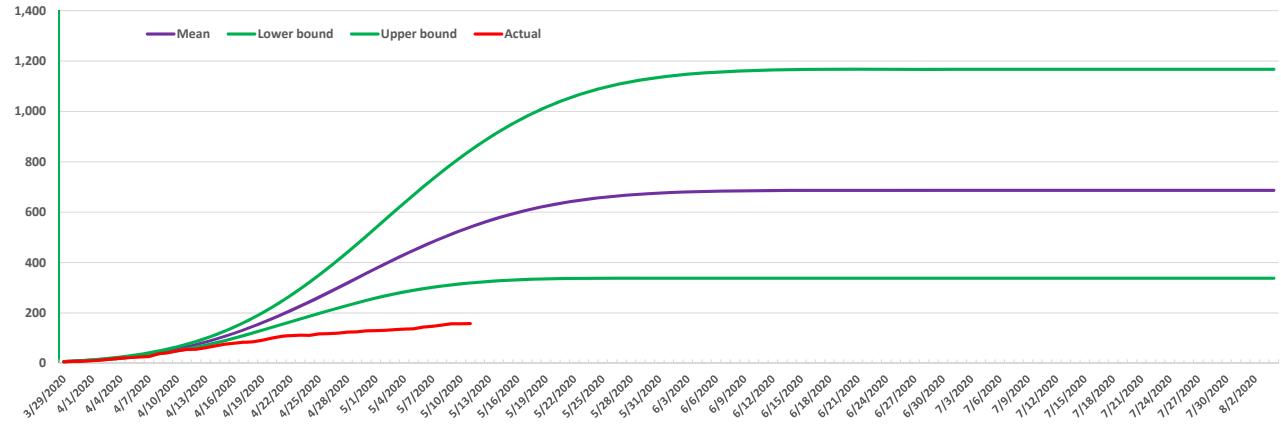
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Hawaii COVID 19 Daily Death Projections March 26



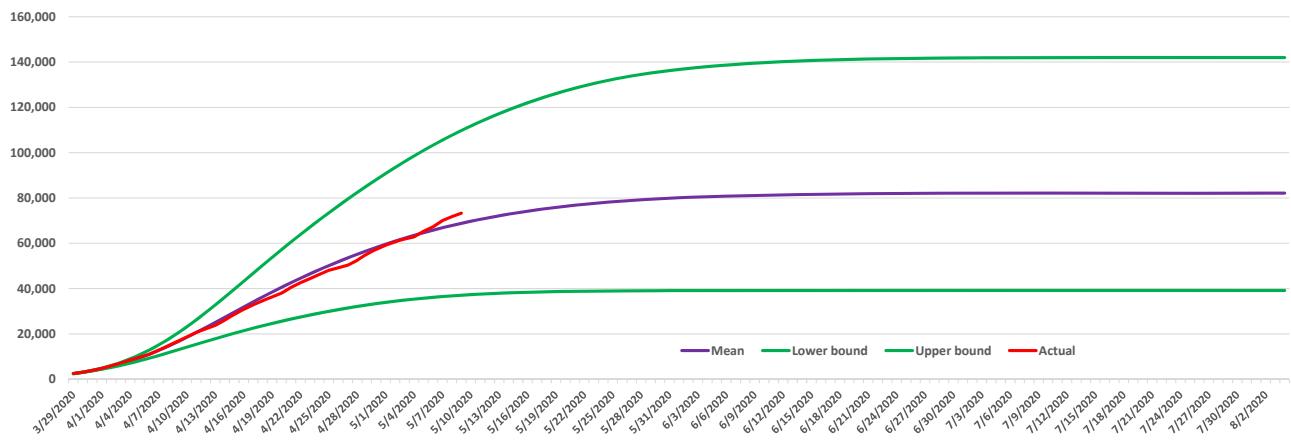
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Kansas COVID 19 Cumulative Death Projections



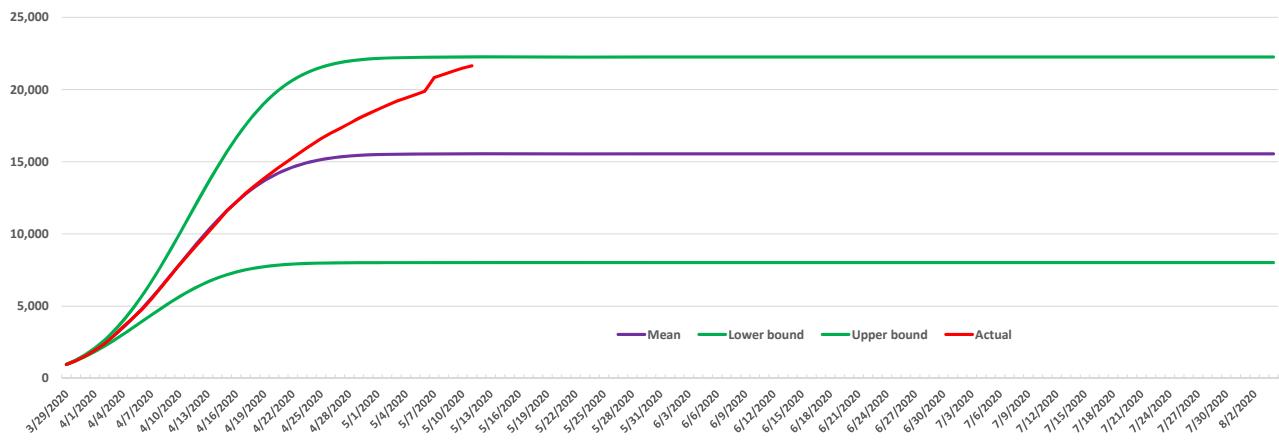
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U.S. COVID 19 Cumulative Death Projections



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New York COVID 19 Cumulative Death Projections



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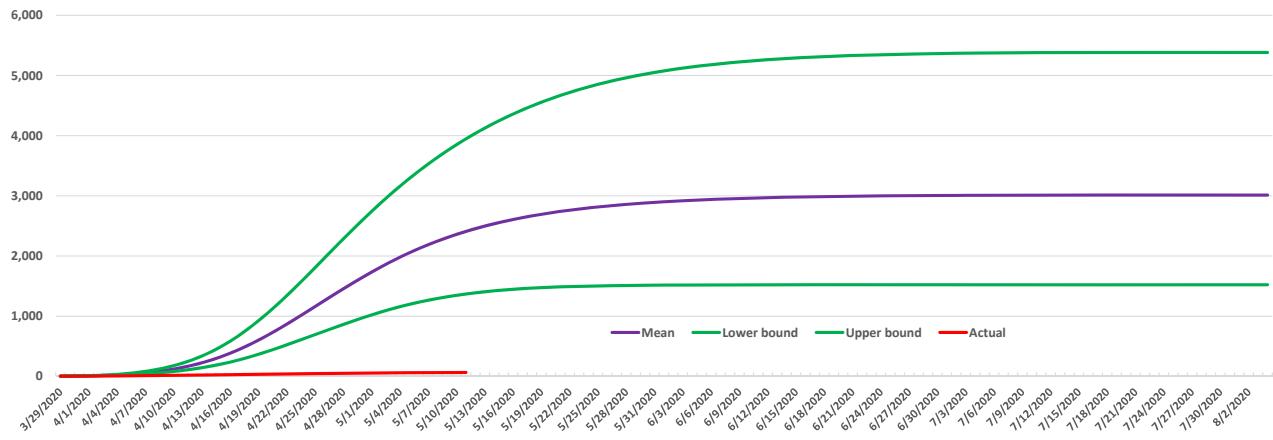
Concluding Thoughts

- The IMHE model has been used to drive policy decisions that have resulted in large negative economic effects for the U.S. in general and the agricultural economy specifically
- The change in data definition of death has had an effect on the U.S. and New York projections along with other states
 - This makes modeling extremely difficult
- Fairly large revisions to the cumulative death totals and the peak of daily deaths both upwards and downwards?
- Are the revisions due to society flattening the curve or due to inaccurate models?



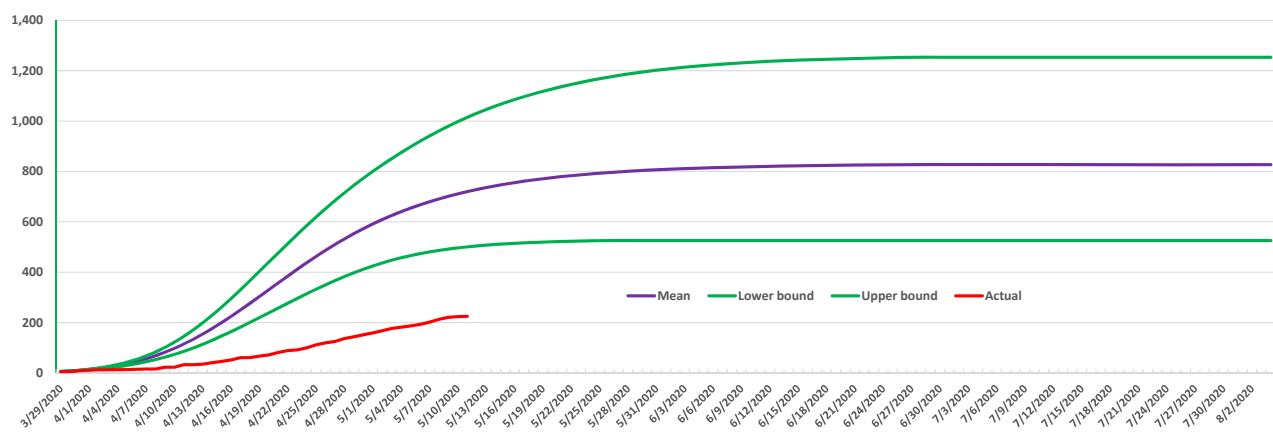
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Maine COVID 19 Cumulative Death Projections



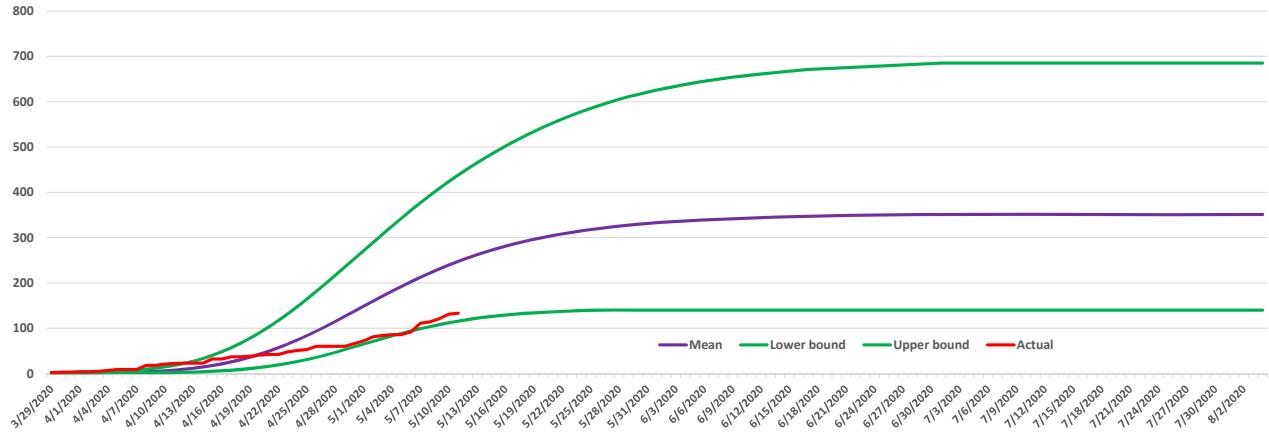
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Delaware COVID 19 Cumulative Death Projections



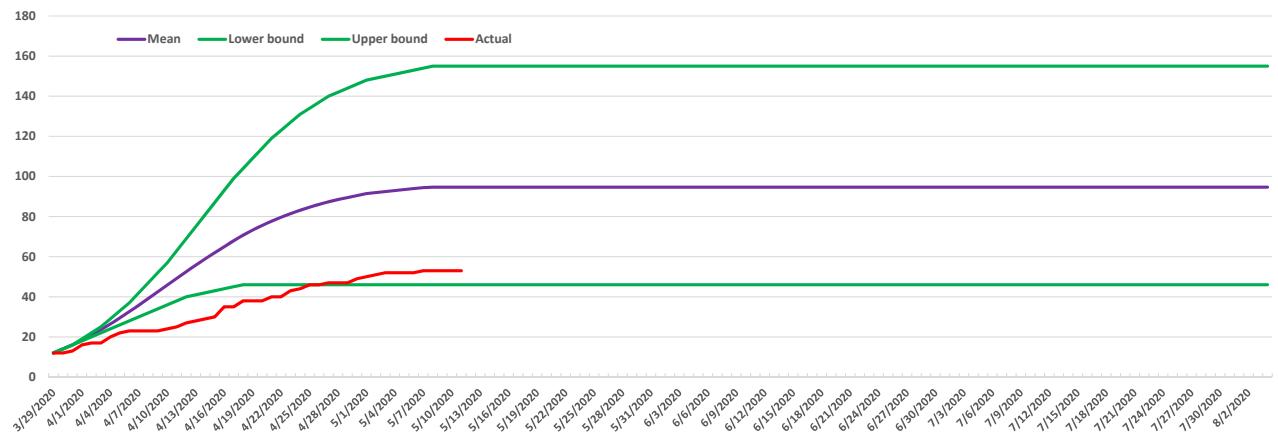
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New Hampshire COVID 19 Cumulative Death Projections



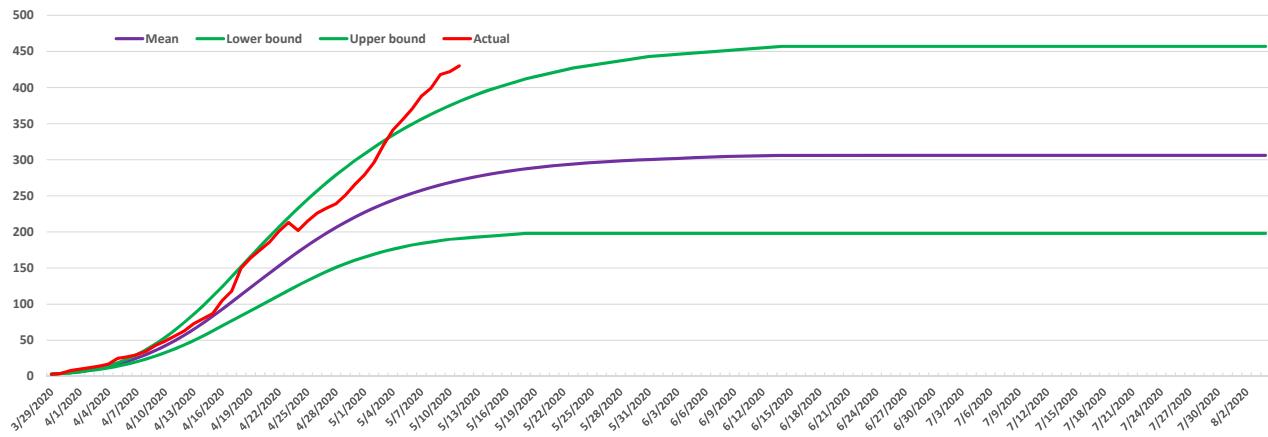
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Vermont COVID 19 Cumulative Death Projections March 26



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Rhode Island COVID 19 Cumulative Death Projections March 26



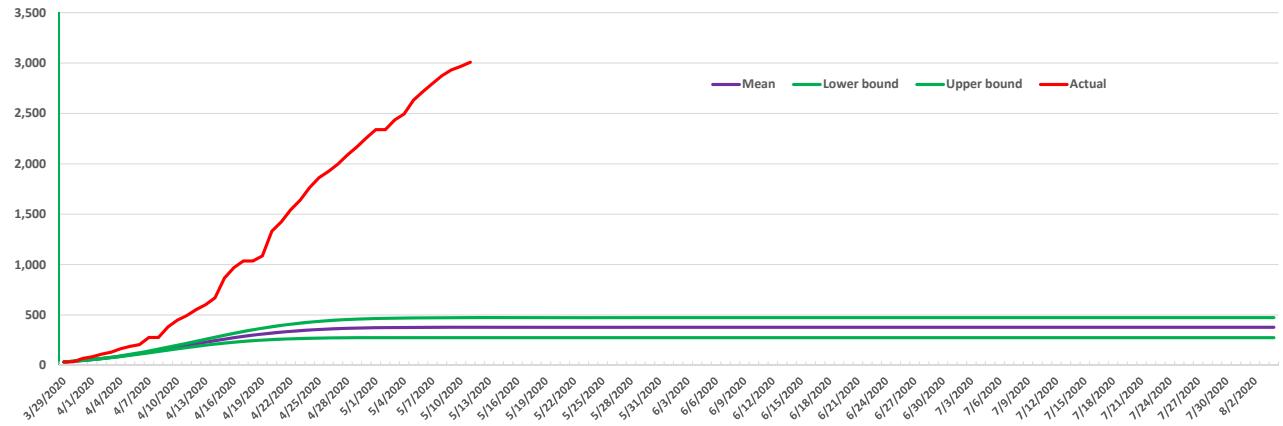
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Massachusetts COVID 19 Cumulative Death Projections



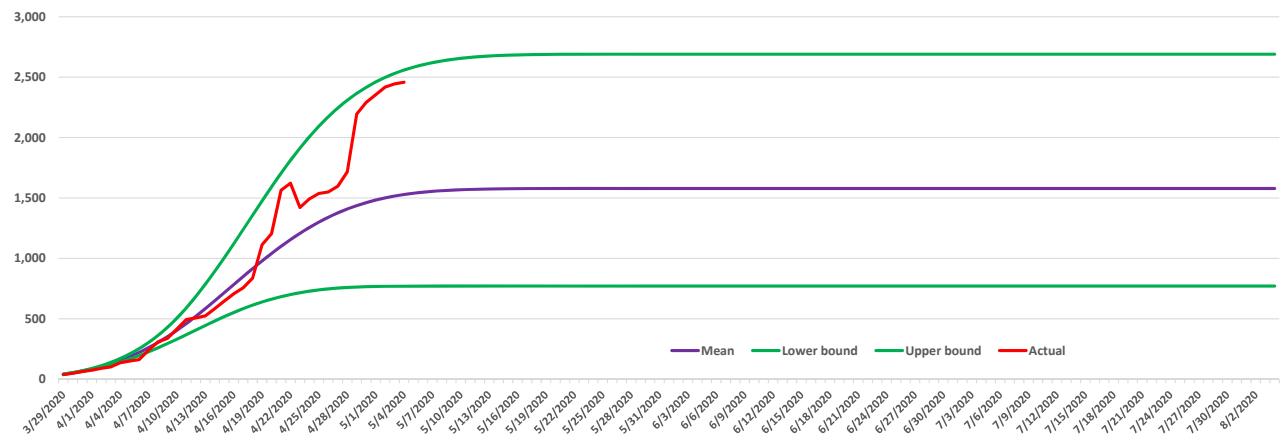
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Connecticut COVID 19 Cumulative Death Projections



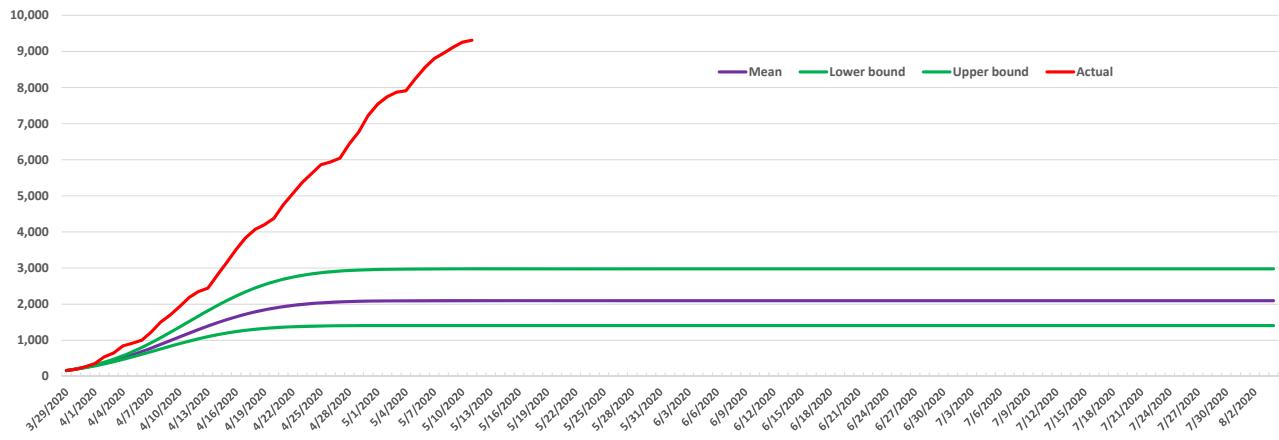
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Pennsylvania COVID 19 Cumulative Death Projections



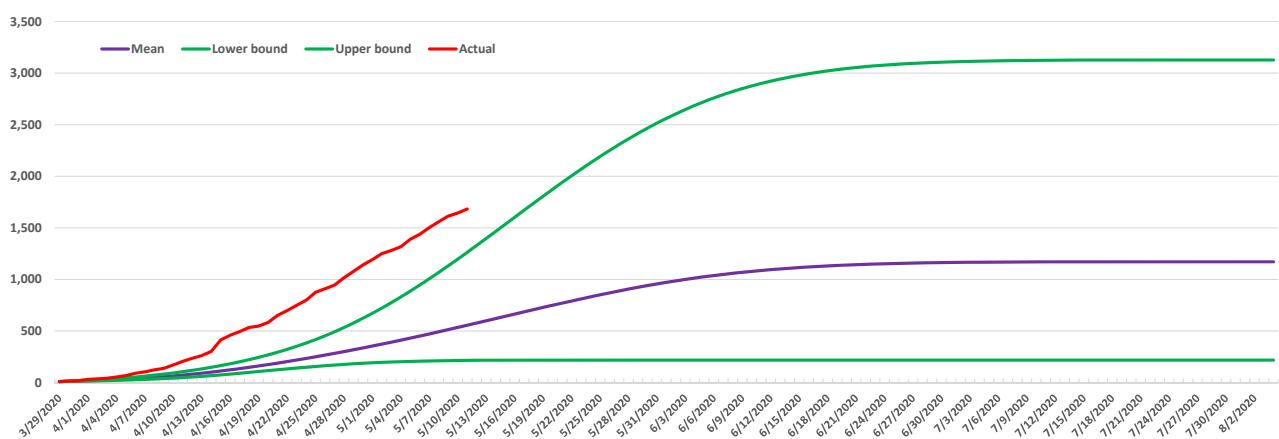
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New Jersey COVID 19 Cumulative Death Projections



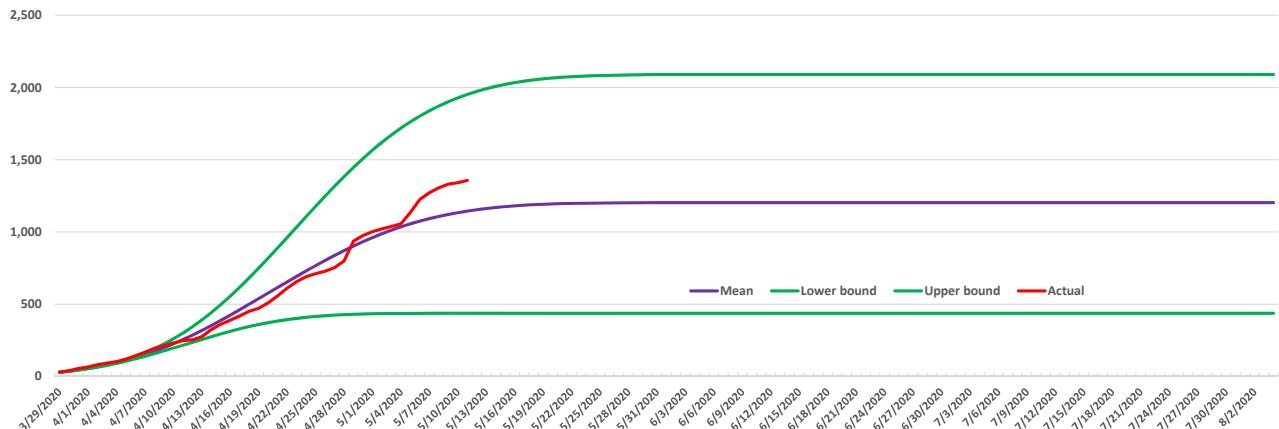
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Maryland COVID 19 Daily Death Projections March 26



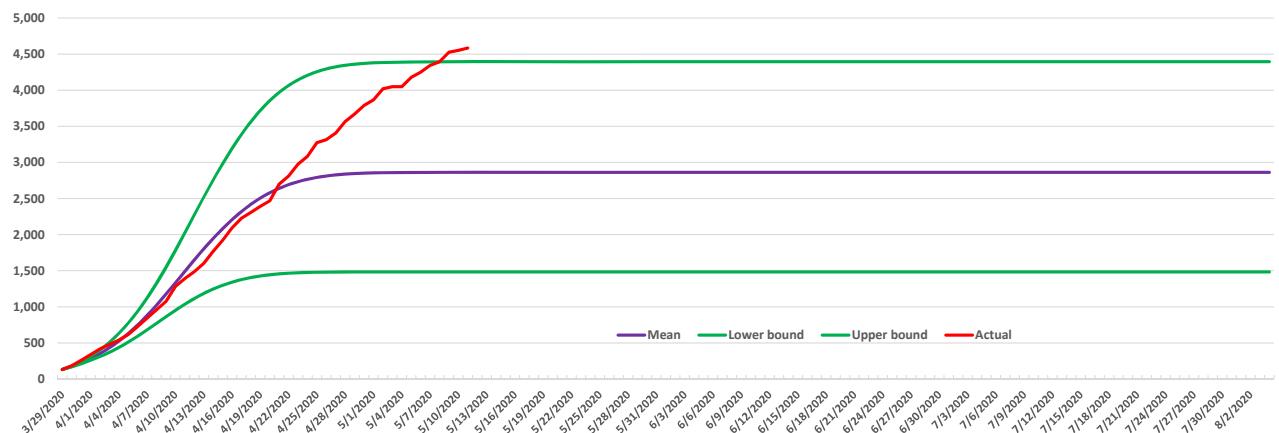
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Ohio COVID 19 Cumulative Death Projections March 26



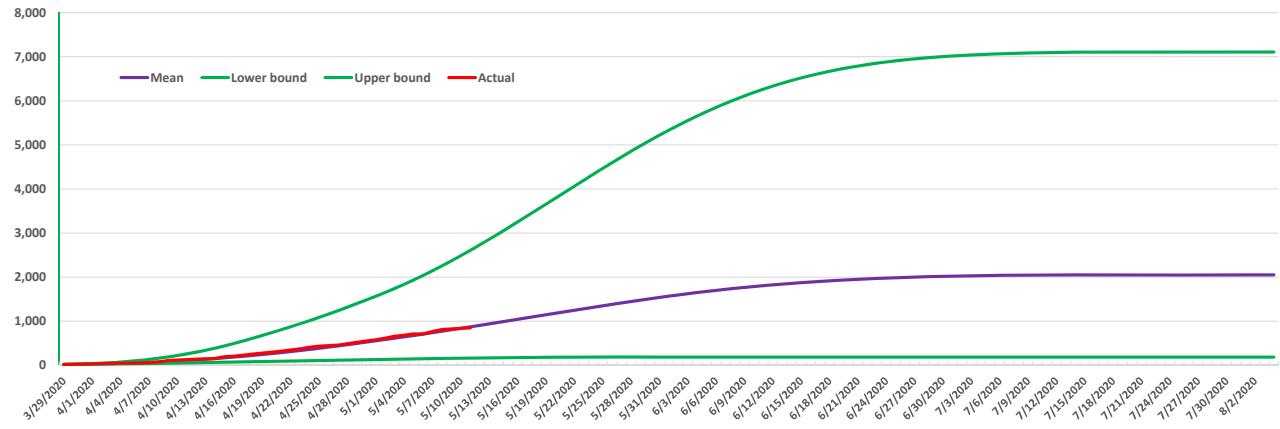
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Michigan COVID 19 Cumulative Death Projections



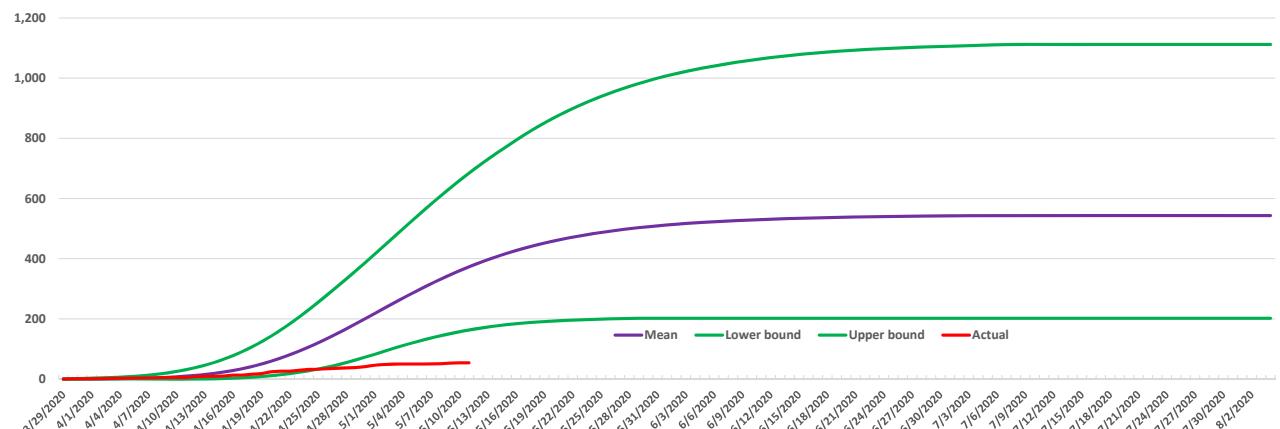
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Virginia COVID 19 Cumulative Death Projections



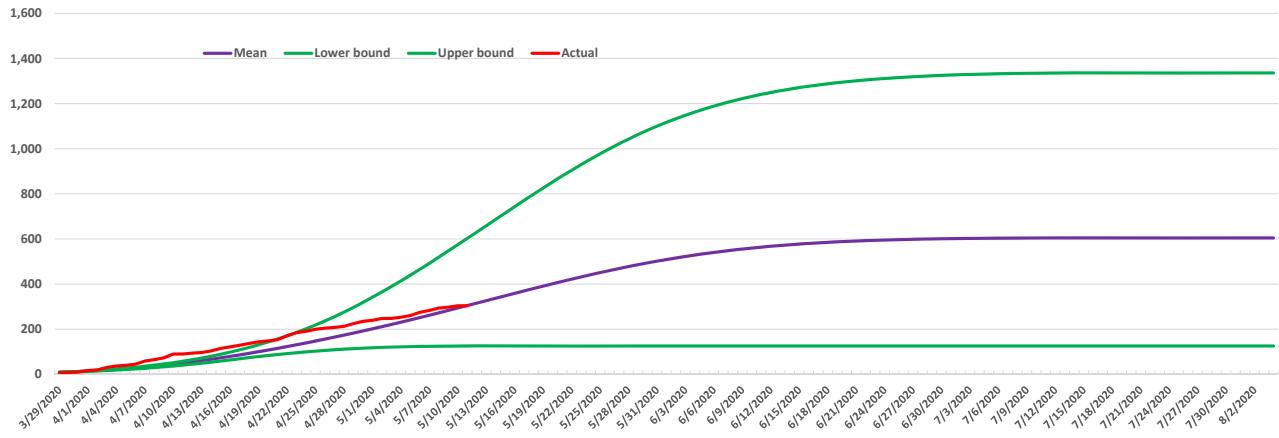
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West Virginia COVID 19 Cumulative Death Projections



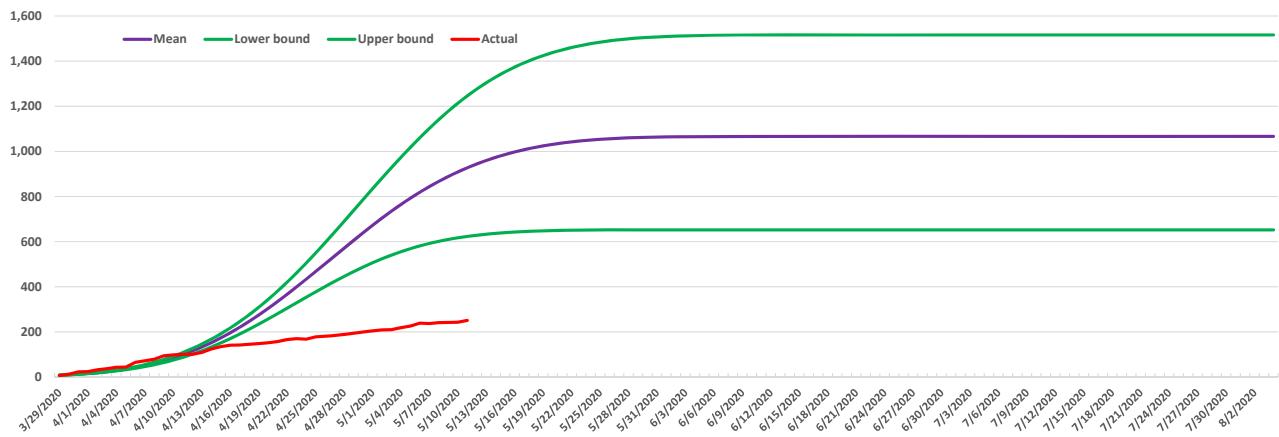
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Kentucky COVID 19 Cumulative Death Projections March 26



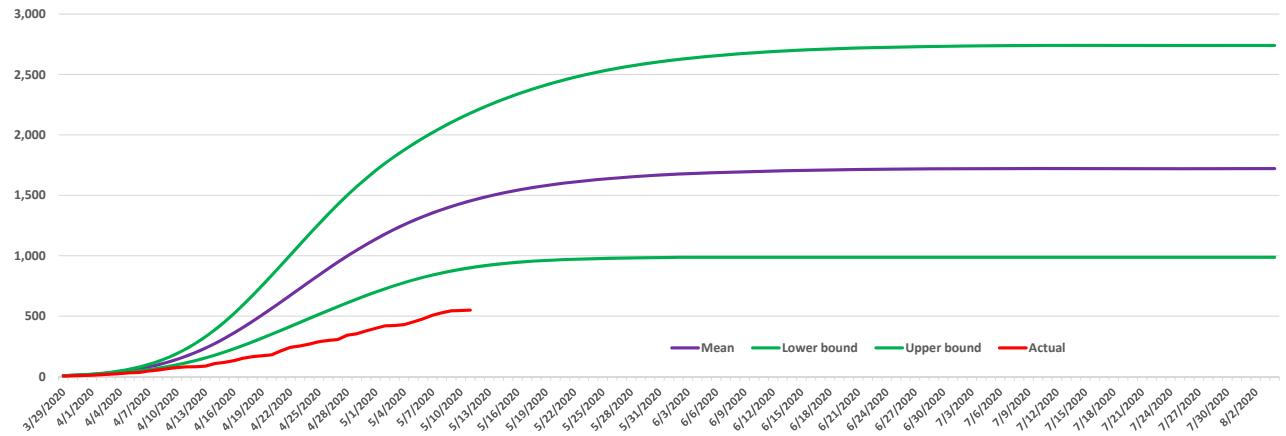
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Tennessee COVID 19 Cumulative Death Projections March 26



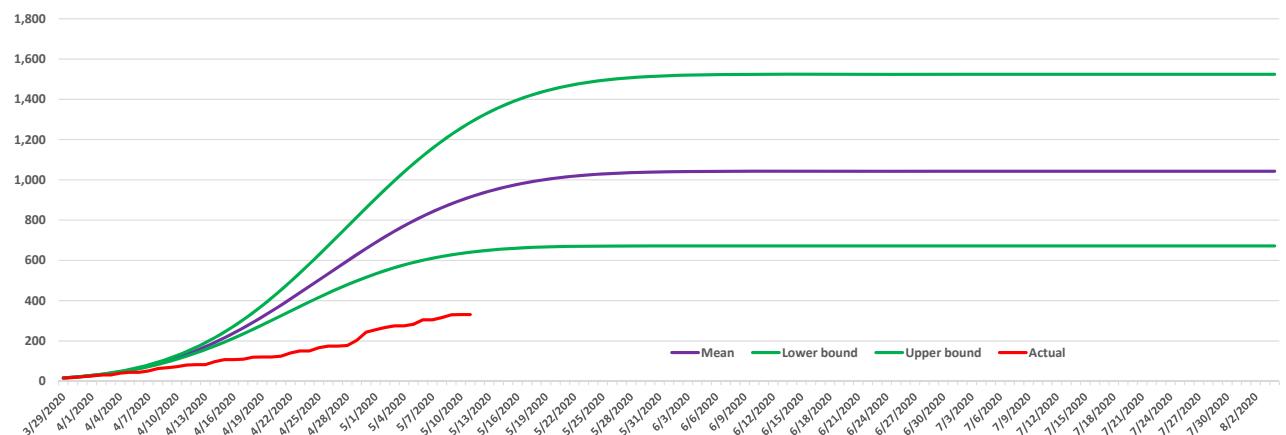
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North Carolina COVID 19 Cumulative Death Projections



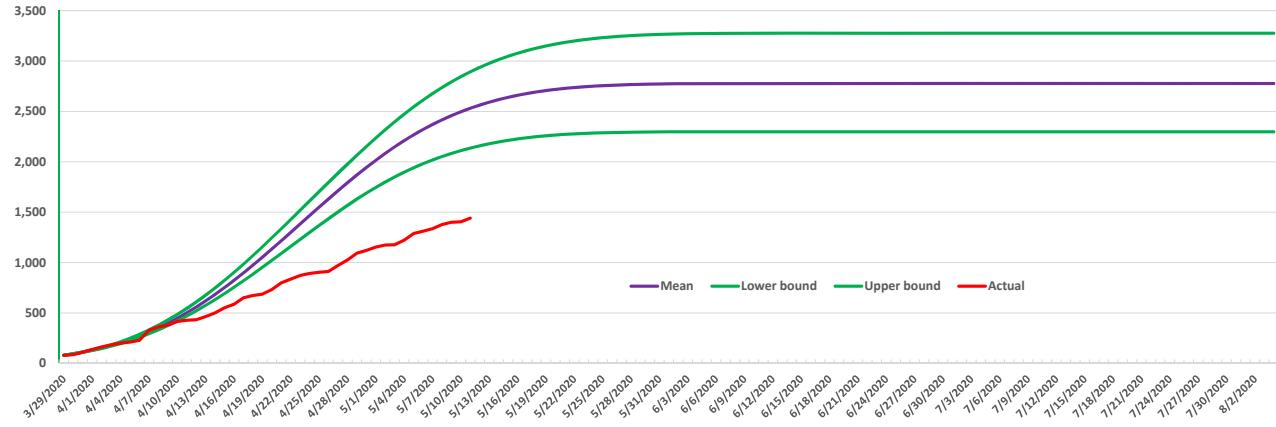
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South Carolina COVID 19 Cumulative Death Projections



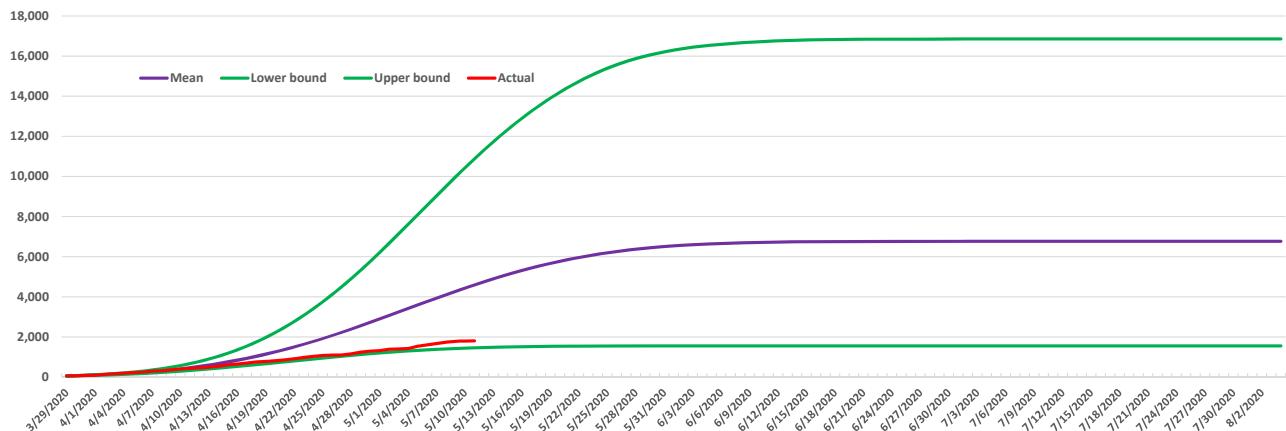
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Georgia COVID 19 Cumulative Death Projections



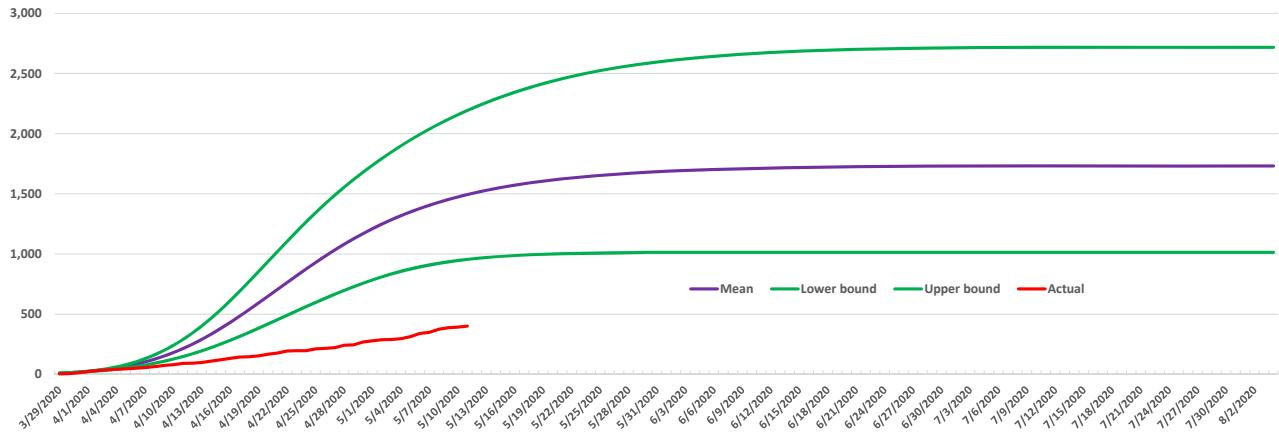
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Florida COVID 19 Cumulative Death Projections March 26



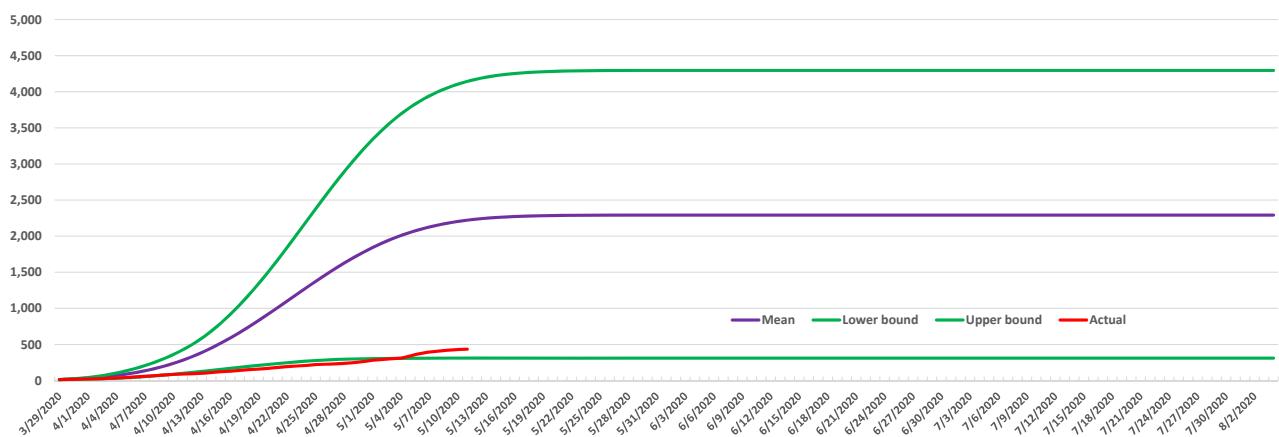
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Alabama COVID 19 Cumulative Death Projections March 26



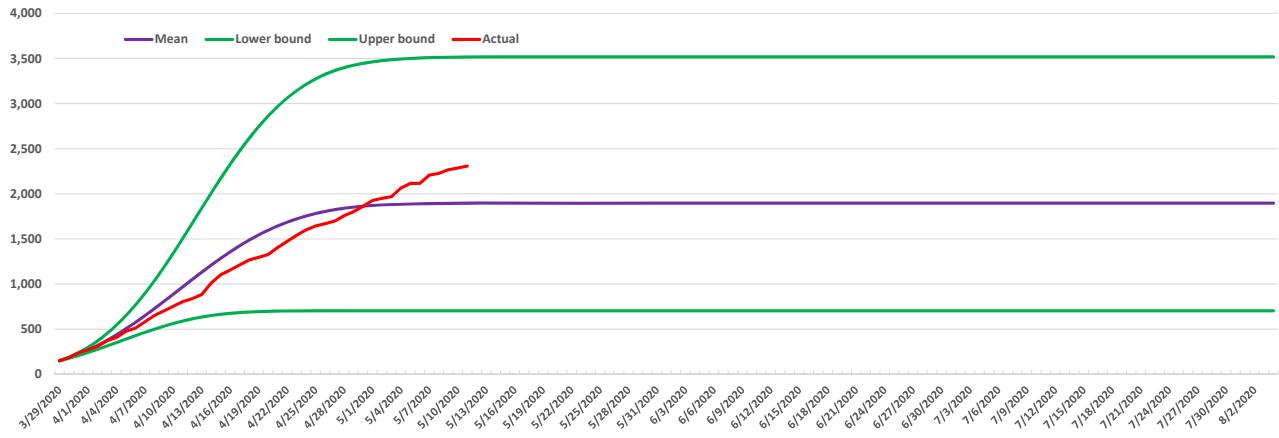
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Mississippi COVID 19 Daily Death Projections March 26



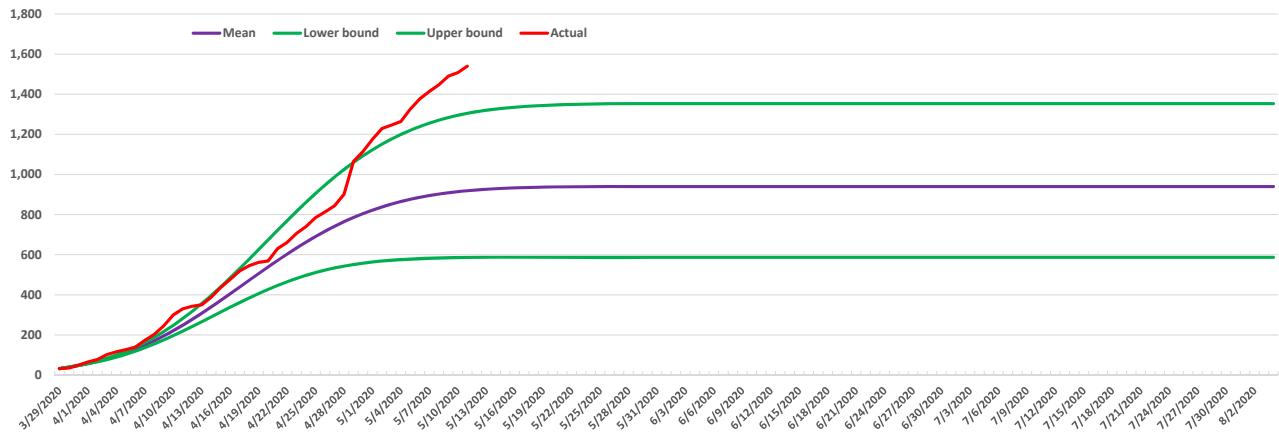
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Louisiana COVID 19 Daily Death Projections March 26



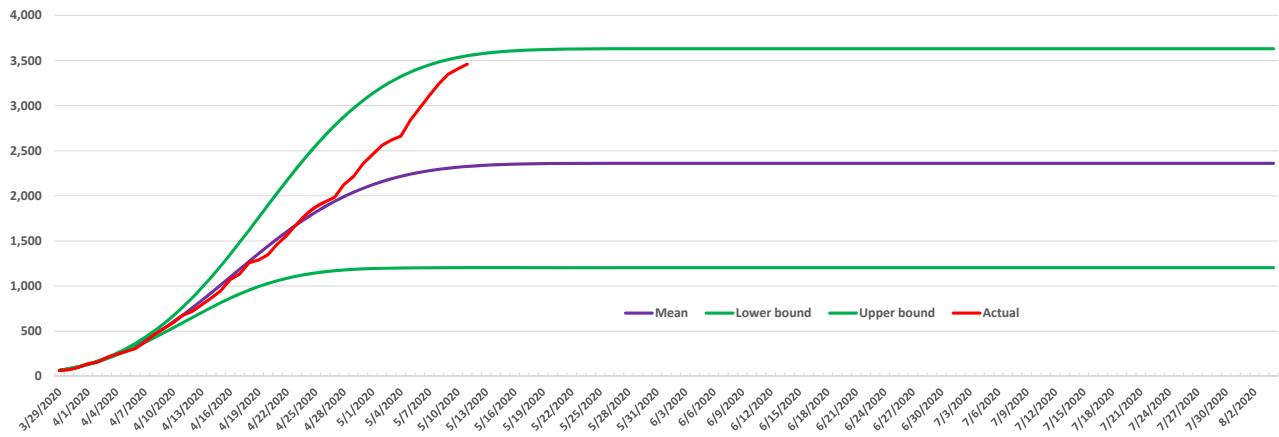
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Indiana COVID 19 Cumulative Death Projections March 26



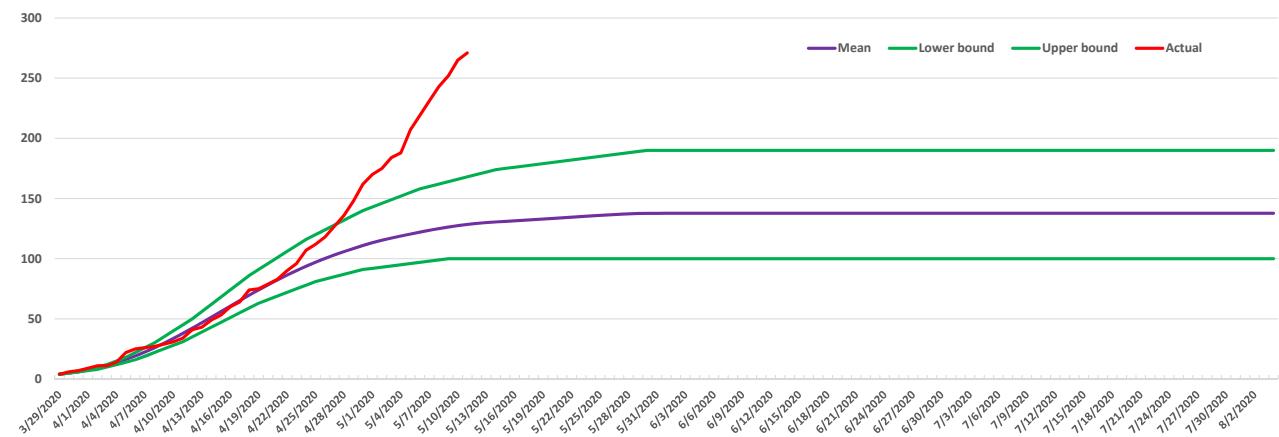
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Illinois COVID 19 Cumulative Death Projections March 26



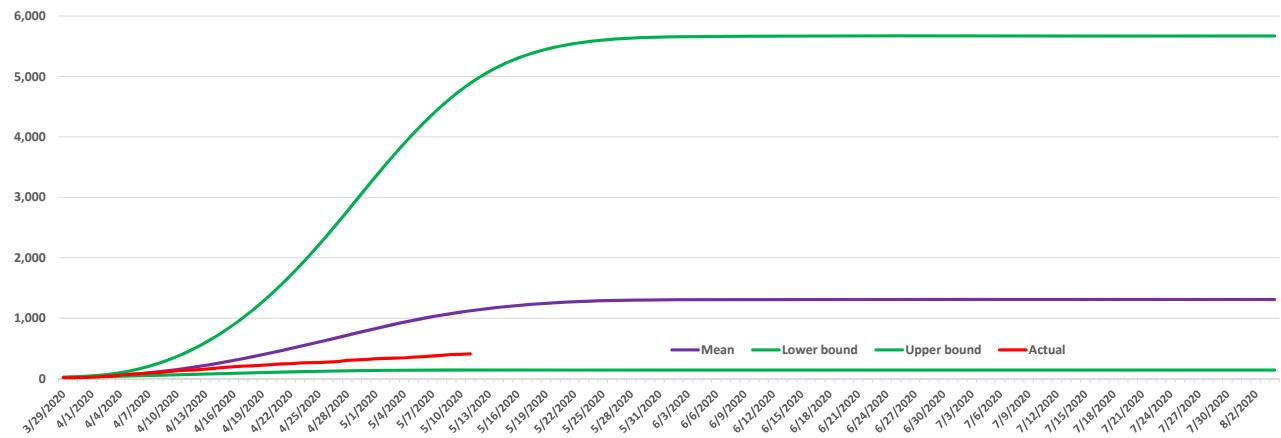
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Iowa COVID 19 Daily Death Projections March 26



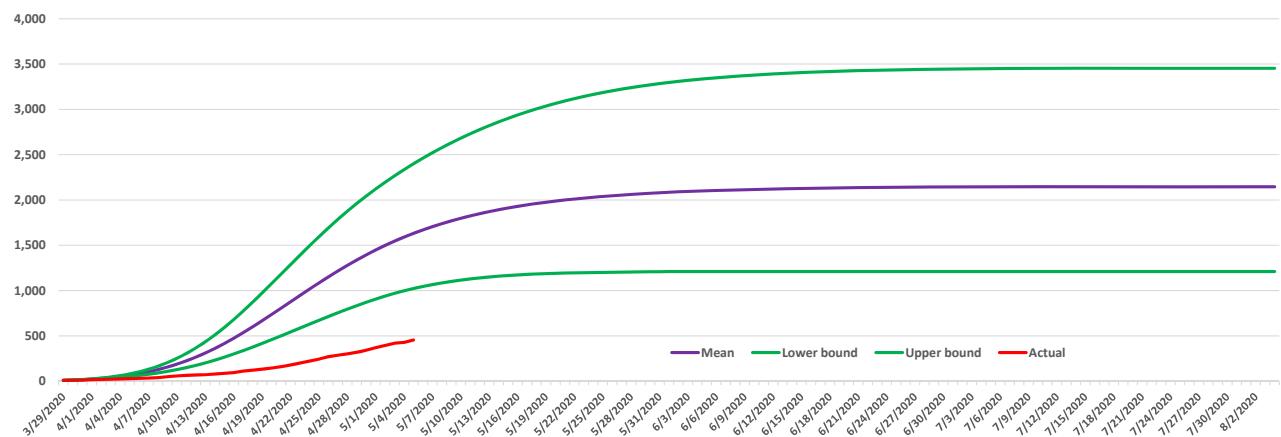
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Wisconsin COVID 19 Cumulative Death Projections



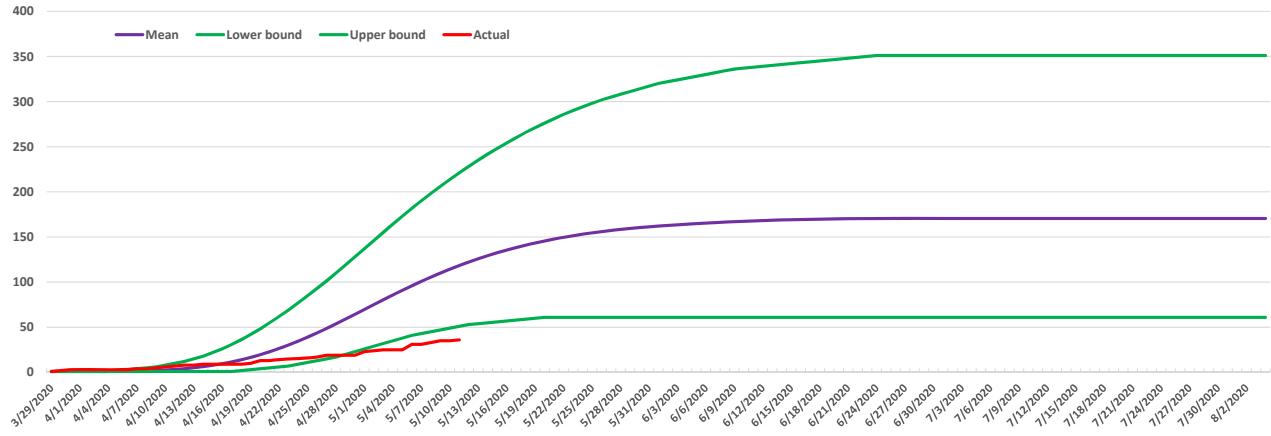
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Minnesota COVID 19 Cumulative Death Projections



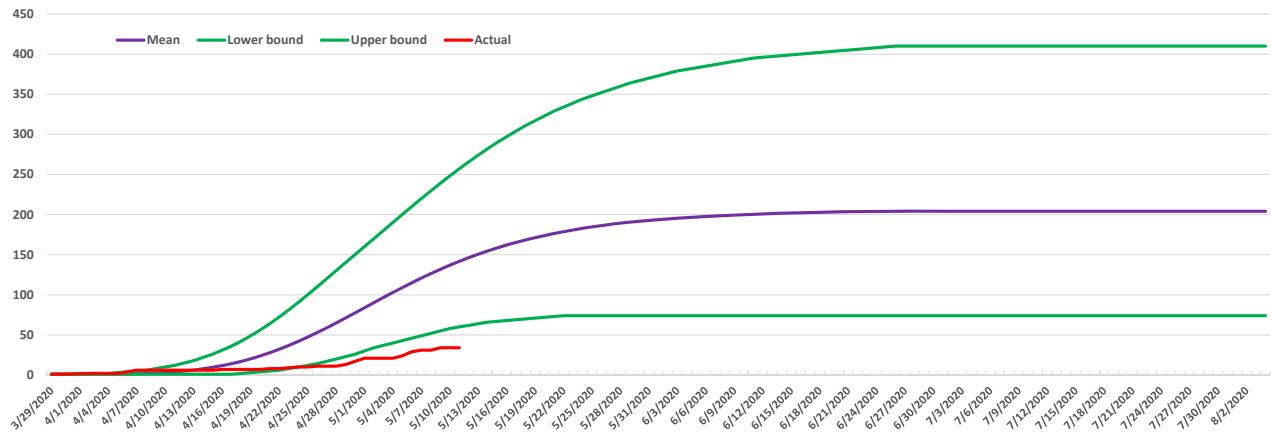
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North Dakota COVID 19 Cumulative Death Projections March 26



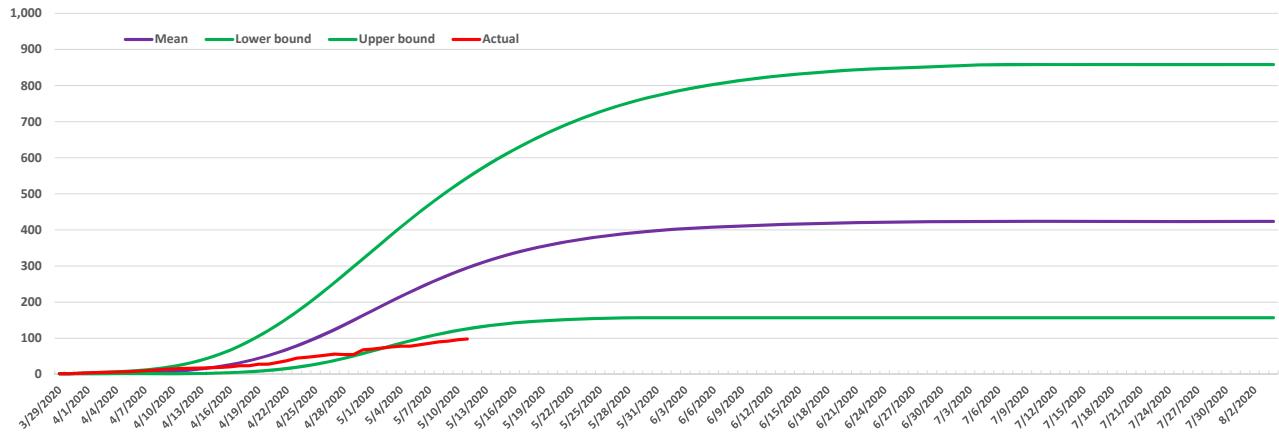
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South Dakota COVID 19 Daily Death Projections March 26



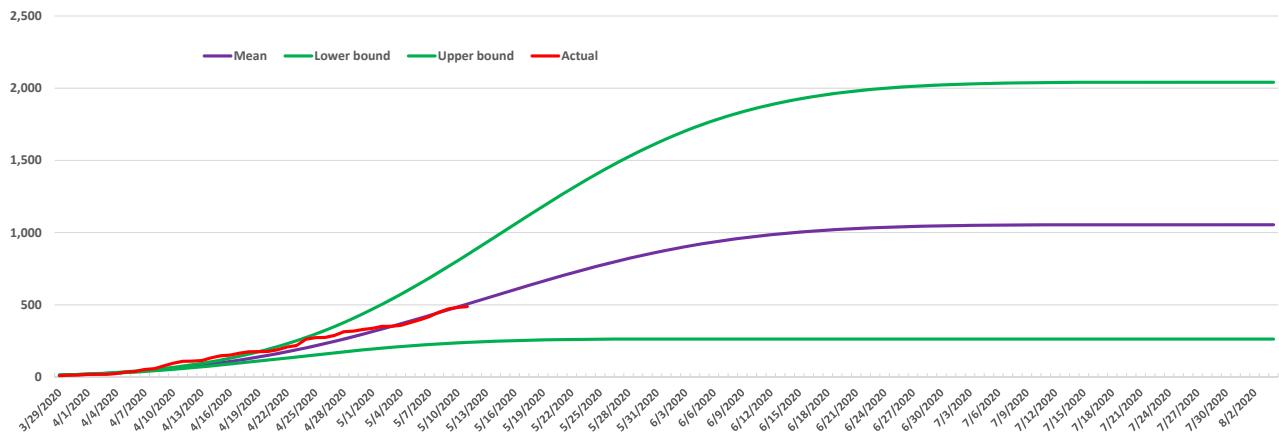
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Nebraska COVID 19 Daily Death Projections March 26



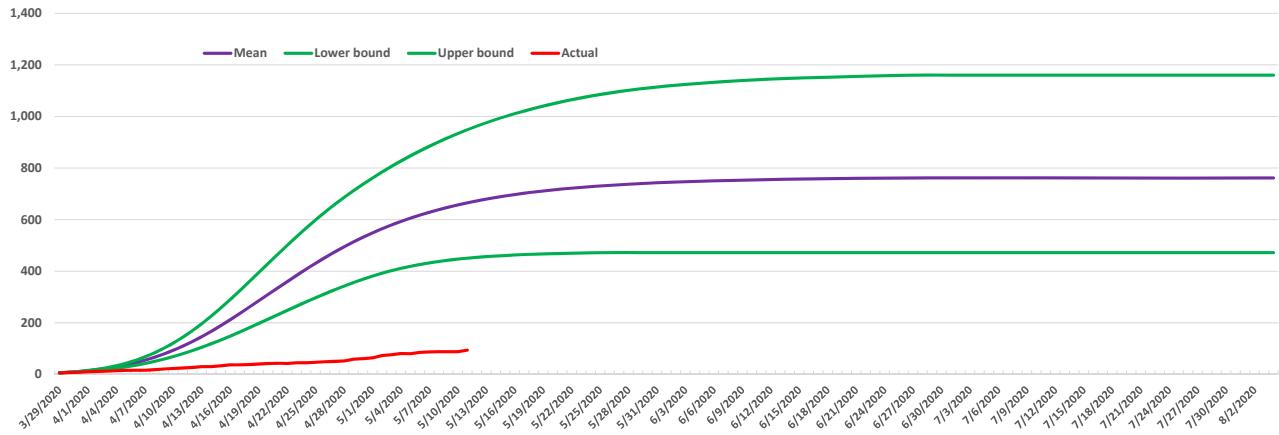
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Missouri COVID 19 Cumulative Death Projections March 26



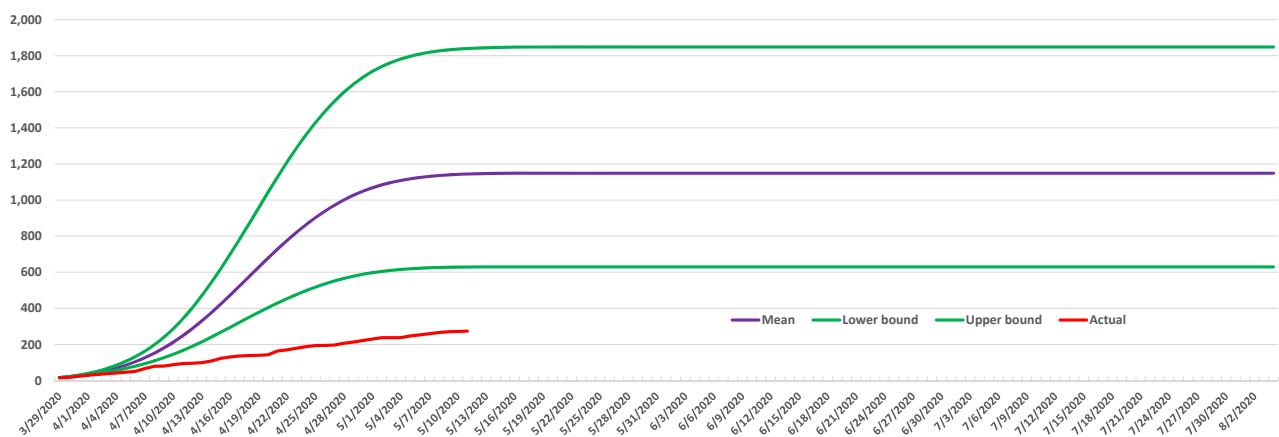
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Arkansas COVID 19 Cumulative Death Projections March 26



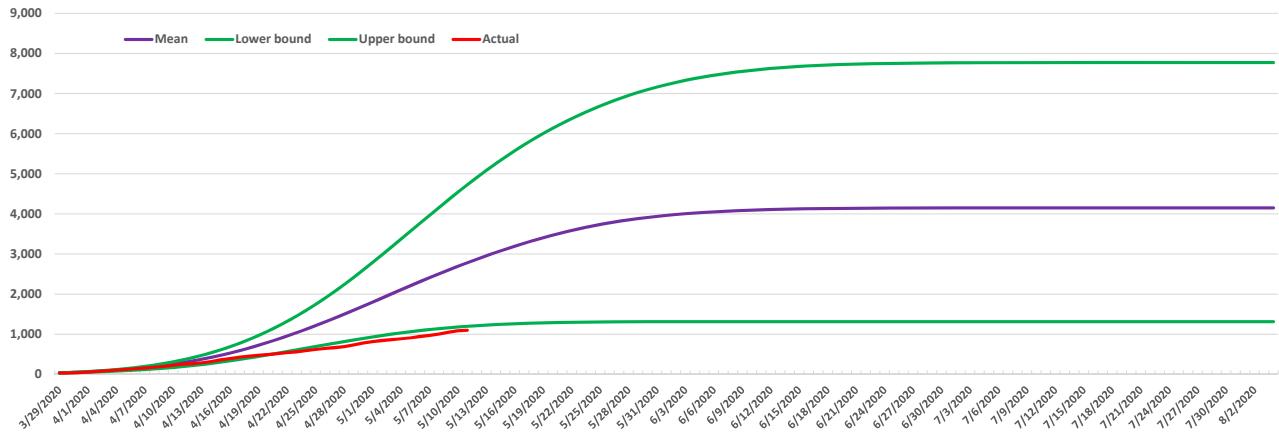
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Oklahoma COVID 19 Daily Death Projections March 26



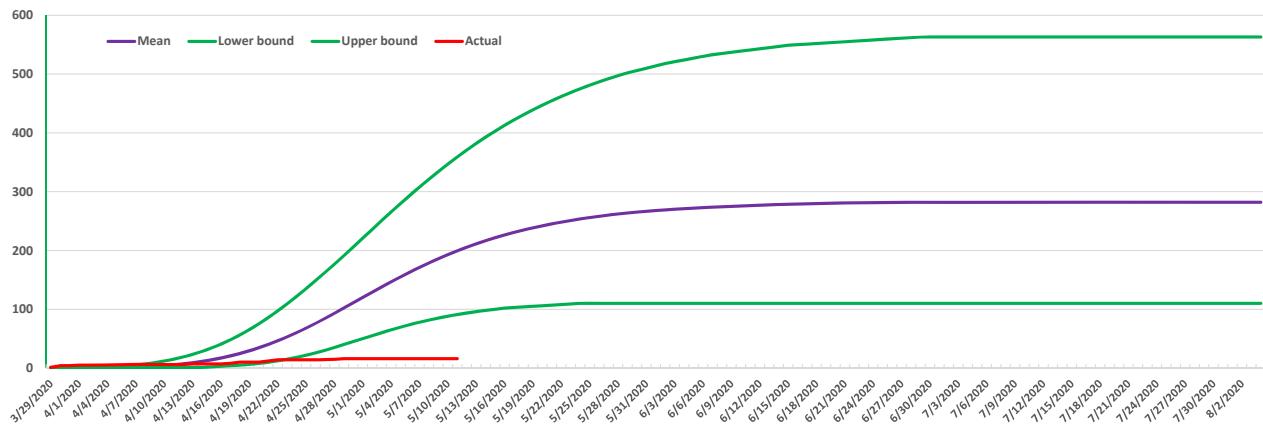
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Texas COVID 19 Daily Death Projections March 26



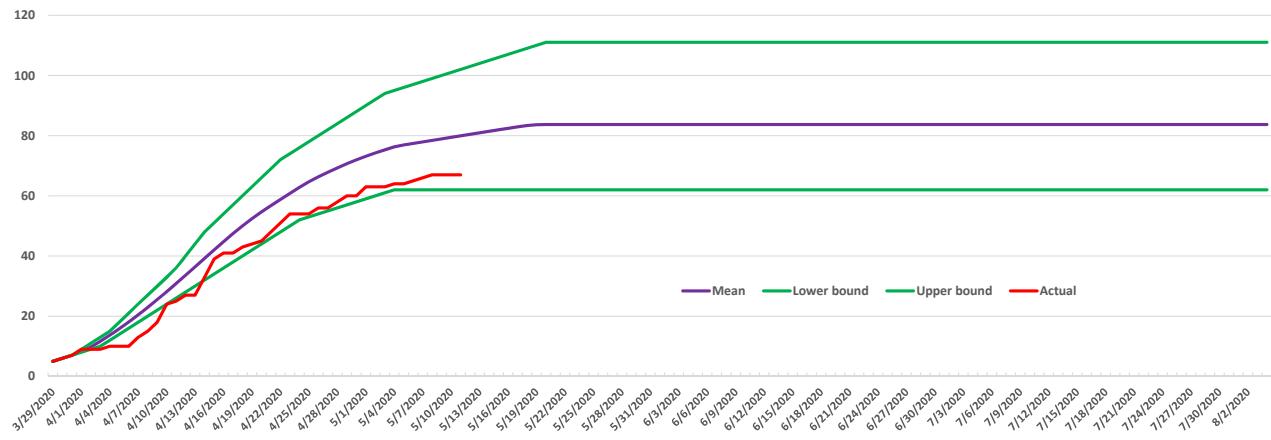
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Montana COVID 19 Cumulative Death Projections



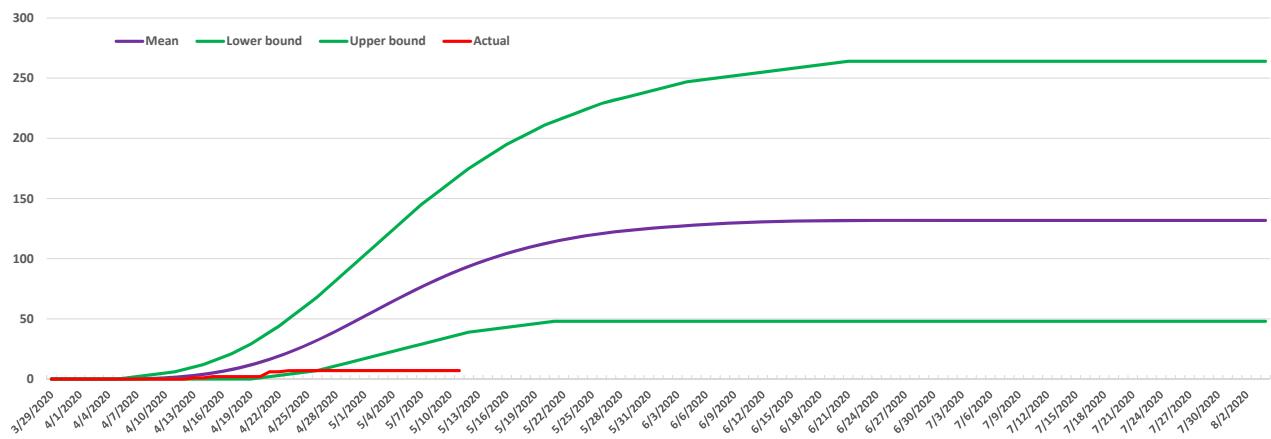
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Idaho COVID 19 Cumulative Death Projections March 26



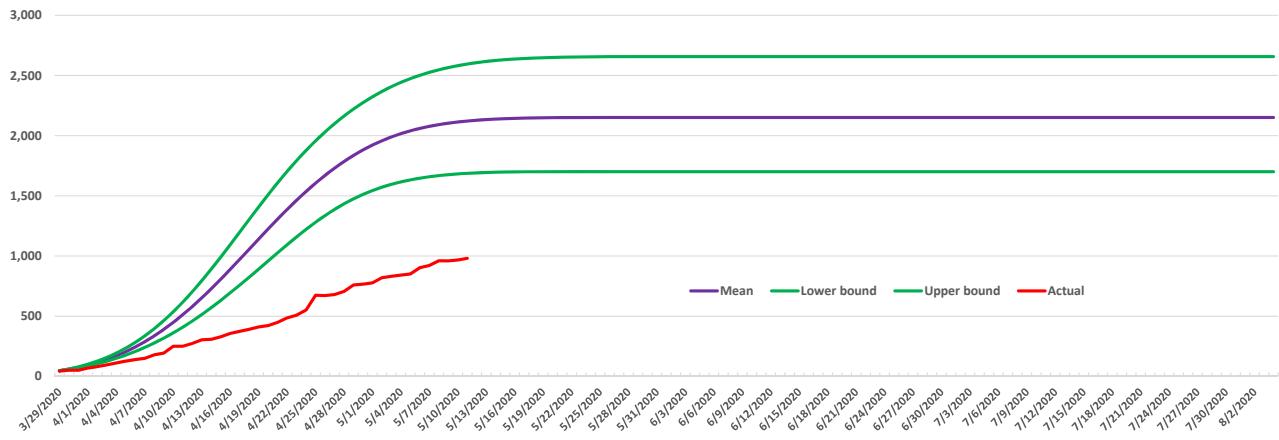
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Wyoming COVID 19 Cumulative Death Projections March 26



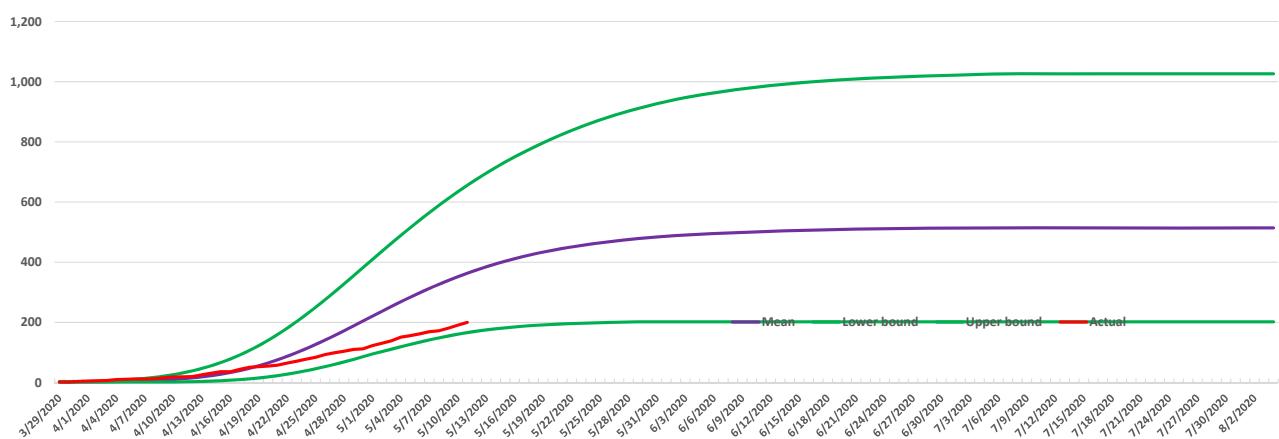
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Colorado COVID 19 Cumulative Death Projections March 26



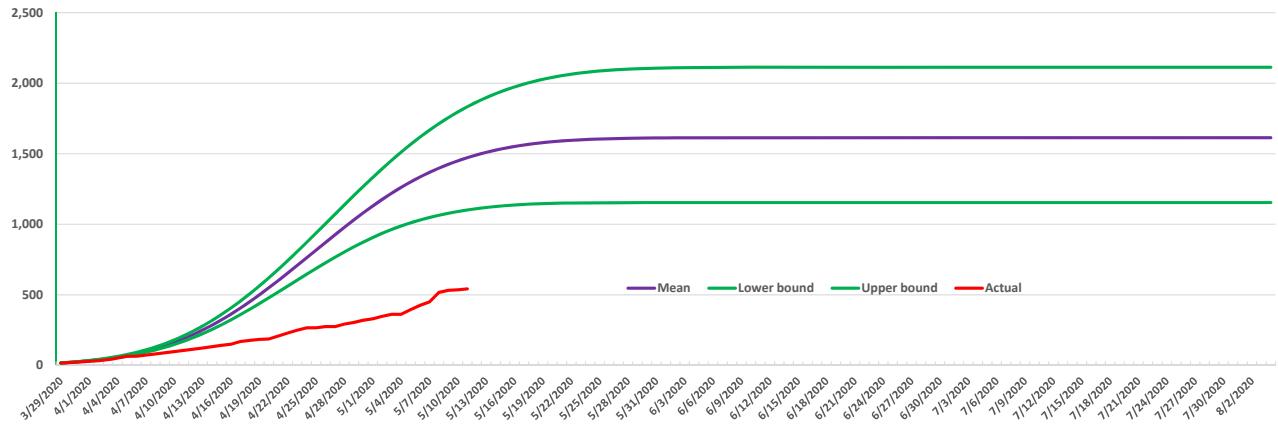
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New Mexico COVID 19 Daily Death Projections March 26



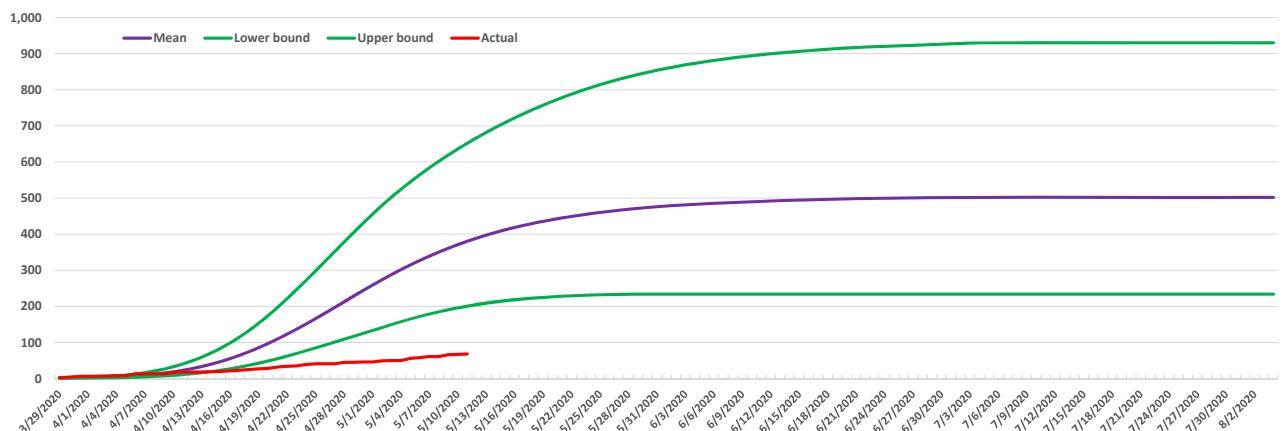
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Arizona COVID 19 Cumulative Death Projections



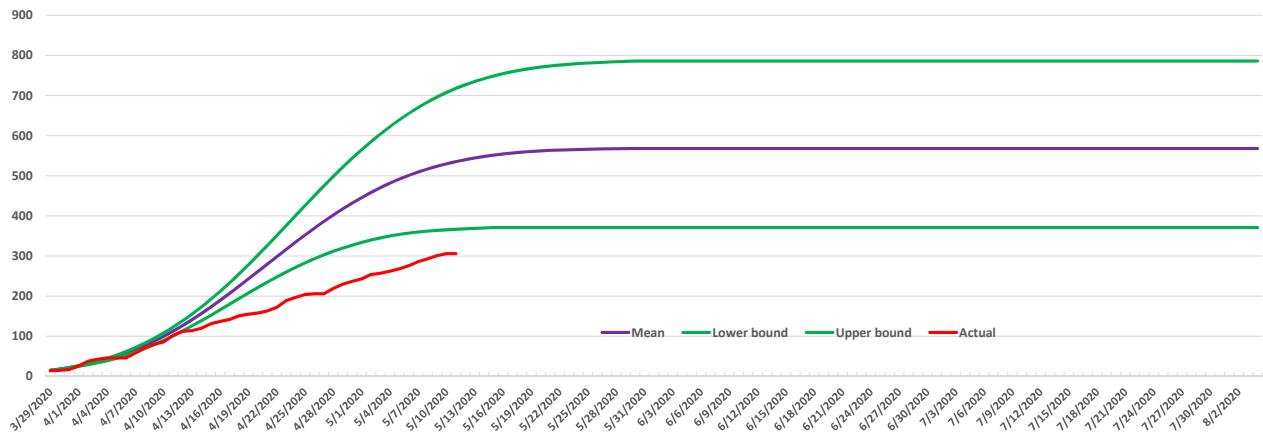
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Utah COVID 19 Daily Death Projections March 26



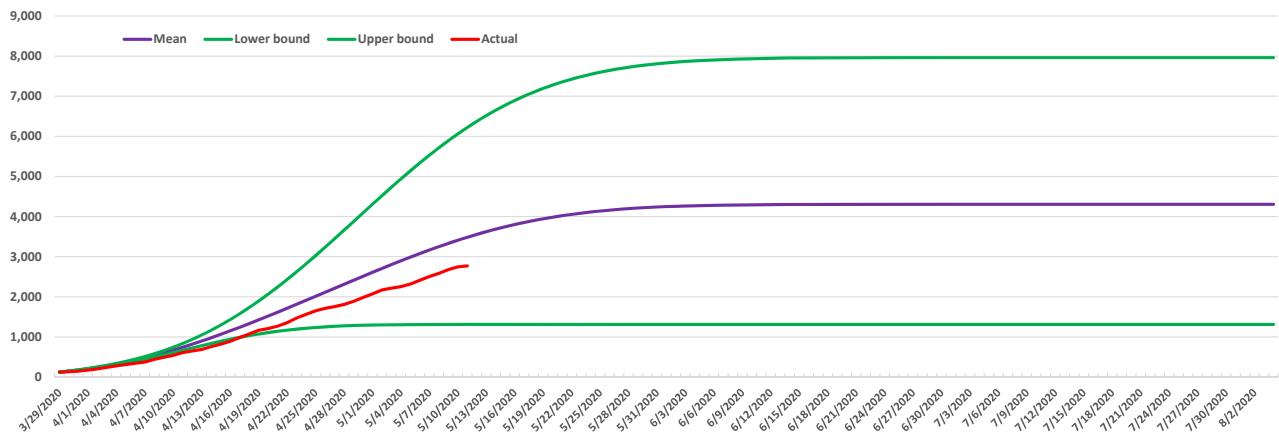
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Nevada COVID 19 Cumulative Death Projections



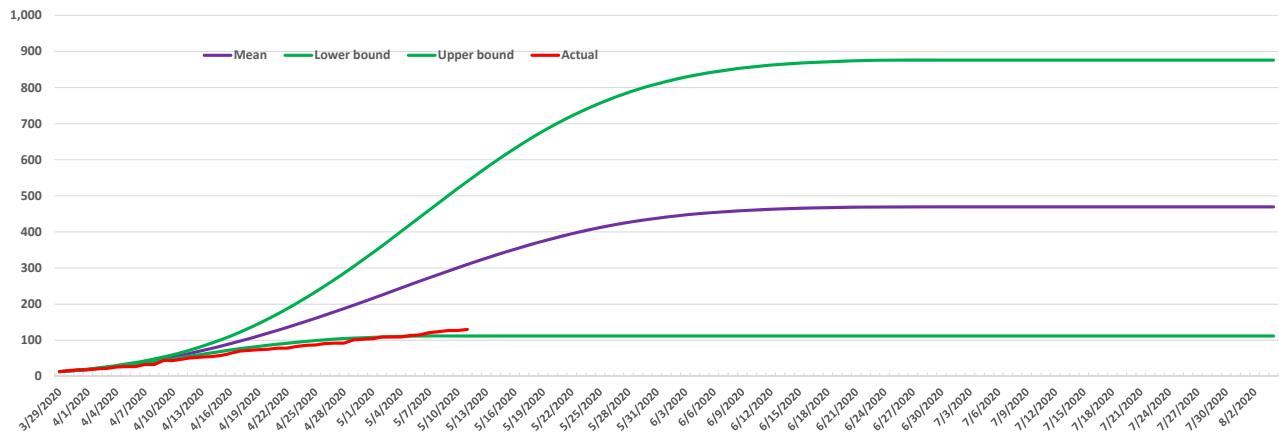
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California COVID 19 Cumulative Death Projections March 26



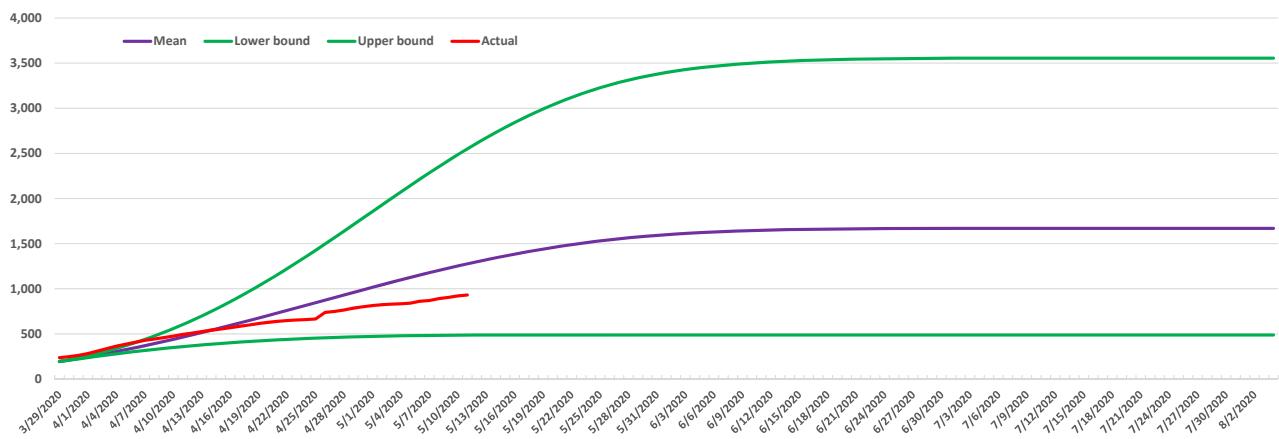
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Oregon COVID 19 Cumulative Death Projections March 26



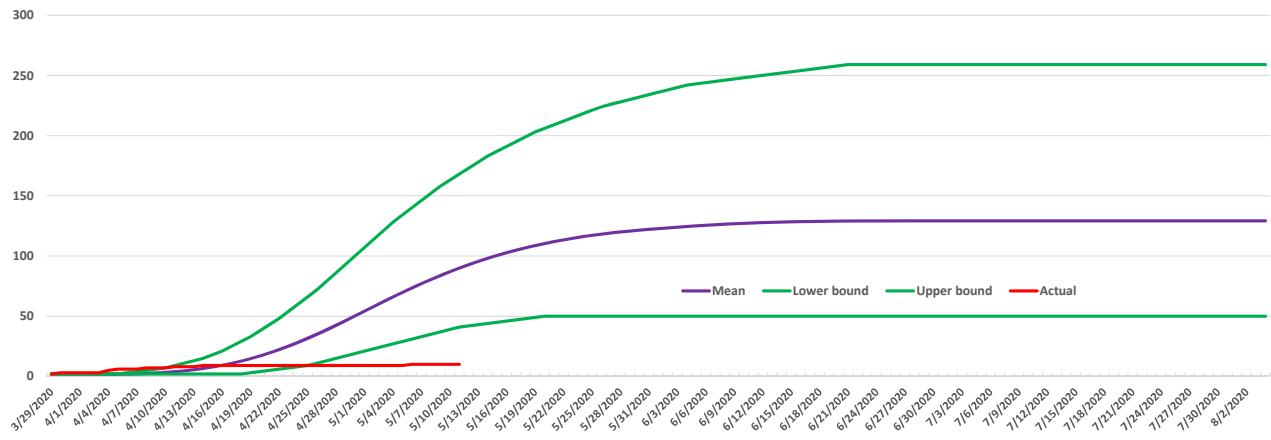
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Washington COVID 19 Cumulative Death Projections March 26



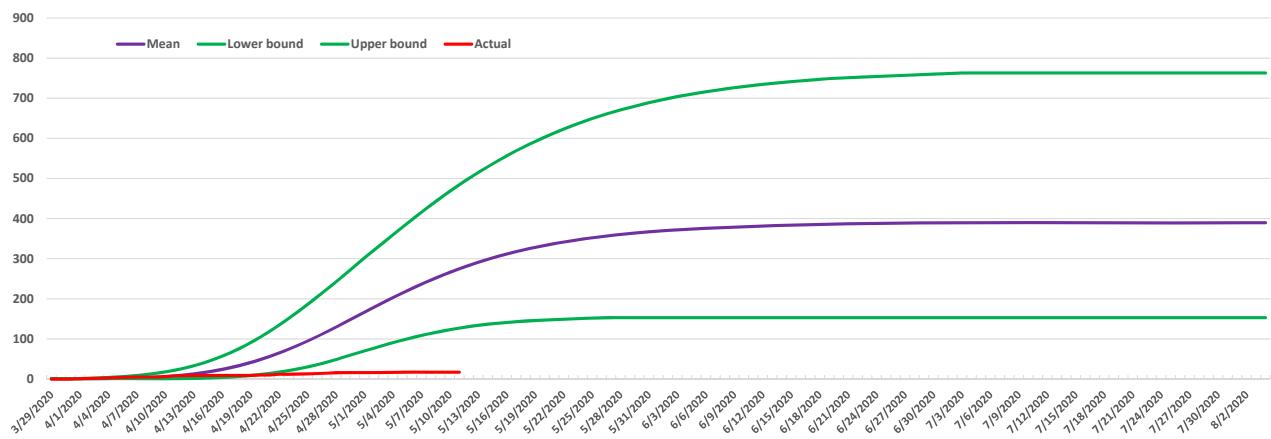
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