

Analysis of the IHME COVID 19 Forecasting Model – May 5th Update

ALLEN M. FEATHERSTONE, JULIA MADDOCK, AND JONATHAN FEATHERSTONE

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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 April 28th discussion.
- A major change in the modeling approach occurred with the May 4th model release



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States Covered along with the U.S.

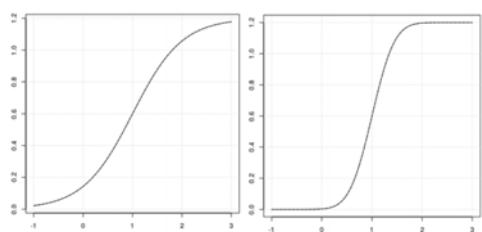
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Kansas	Texas	Colorado	Arizona
New York	Georgia	Missouri	Massachusetts
California	Michigan	Nebraska	Minnesota
Florida	South Carolina	Oklahoma	Washington
Illinois	Tennessee	Delaware	New Jersey
Pennsylvania	Rhode Island	Alaska	Arkansas
Hawaii	New Mexico	Connecticut	Maine
New Hampshire	Vermont		



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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 Covonavirus data
 - Article has not completed peer-review as of May 5th.
- <https://www.worldometers.info/coronavirus/country/us/> and <https://covidtracking.com/>



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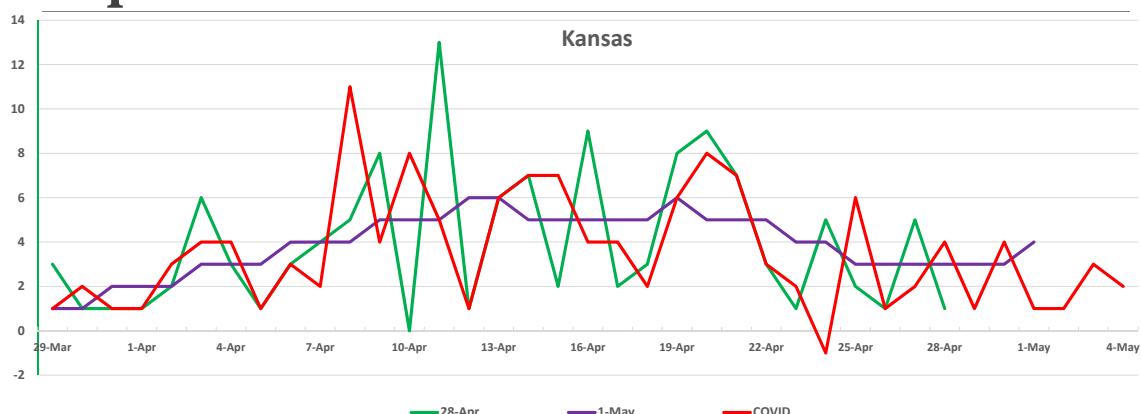
Changes in the May 4th IHME Modeling Approach

- 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



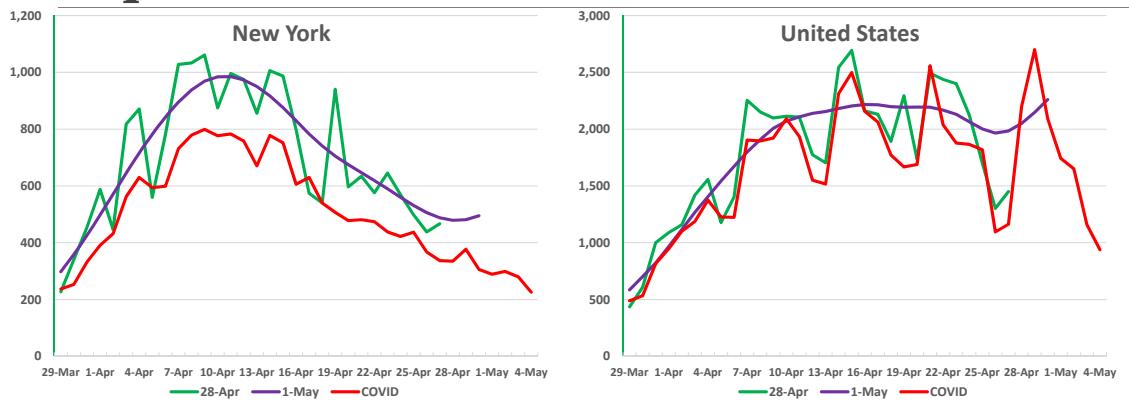
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Input Data Differences



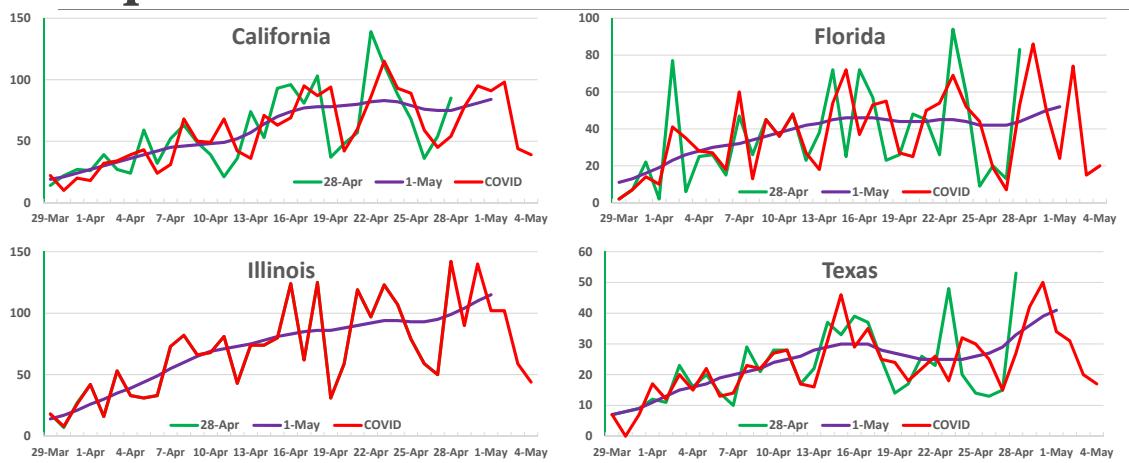
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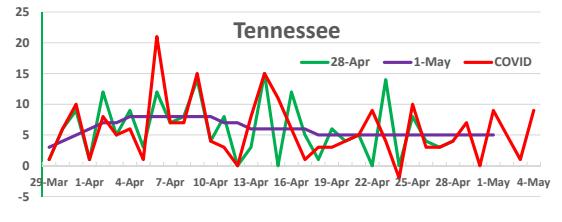
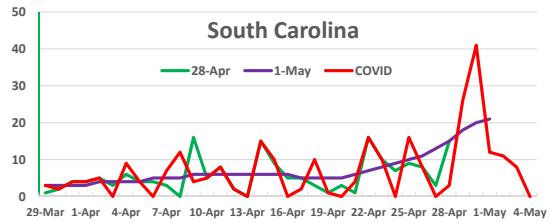
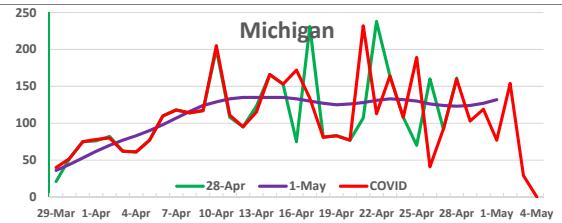
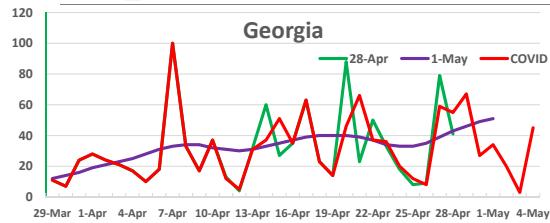
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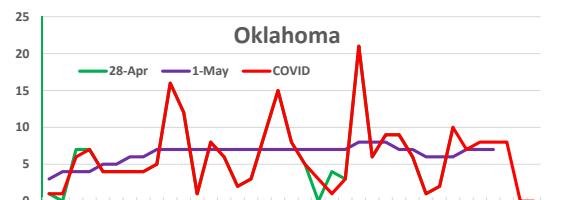
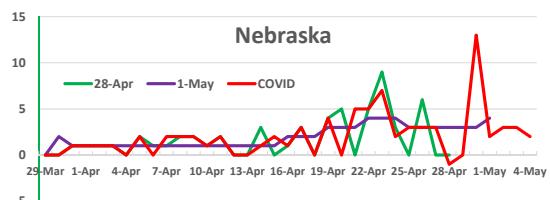
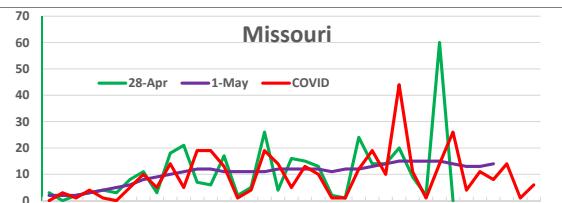
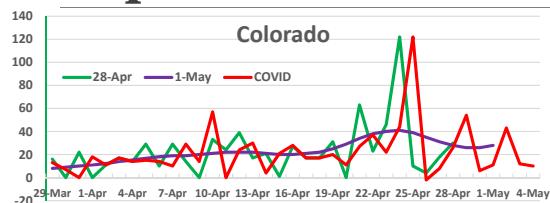
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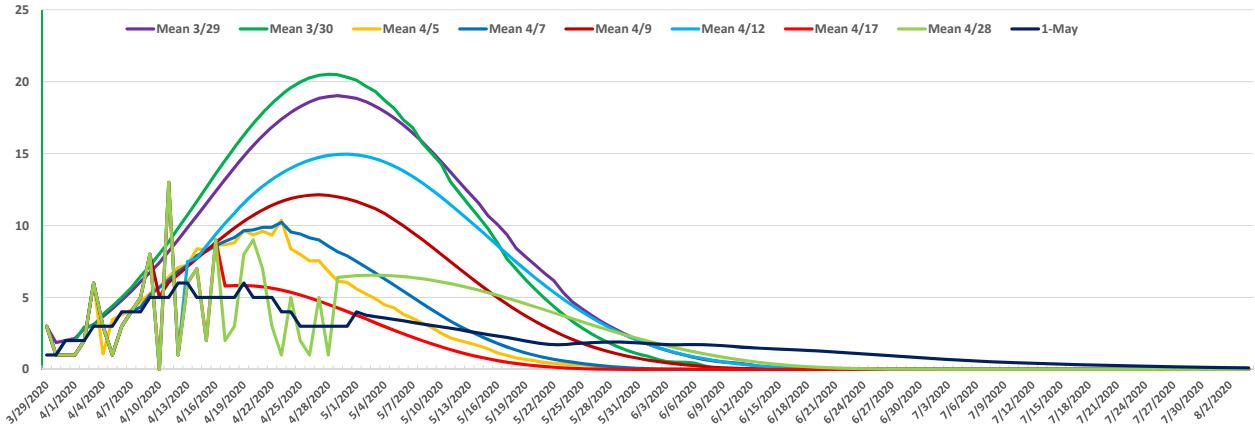
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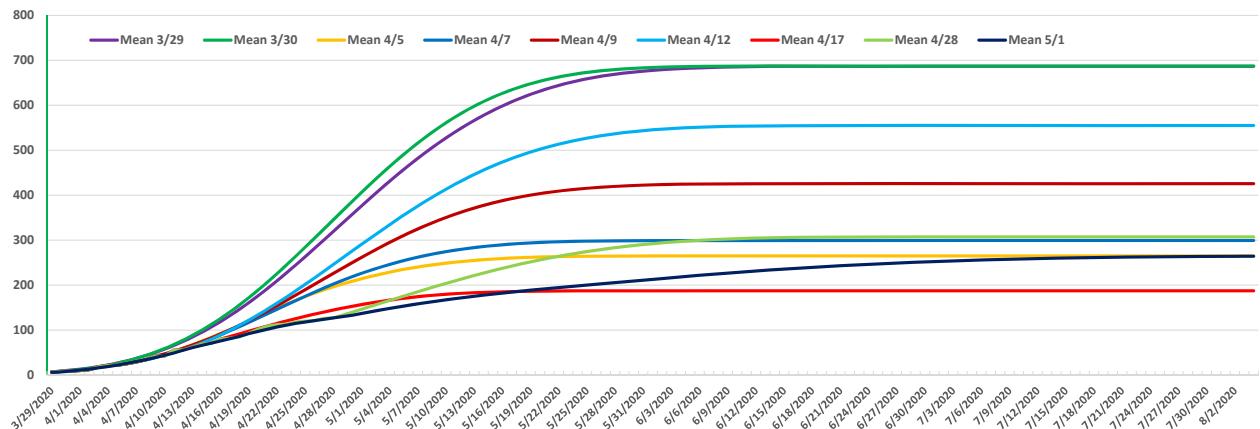
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Kansas COVID 19 Daily Death Projections Revised Forecasts



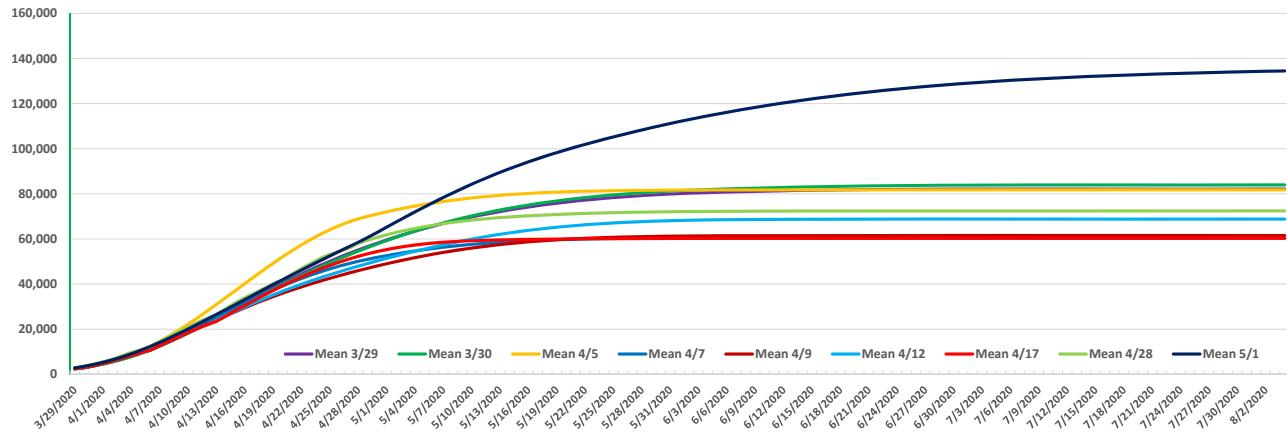
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Kansas COVID 19 Cumulative Death Projections Revised Forecasts



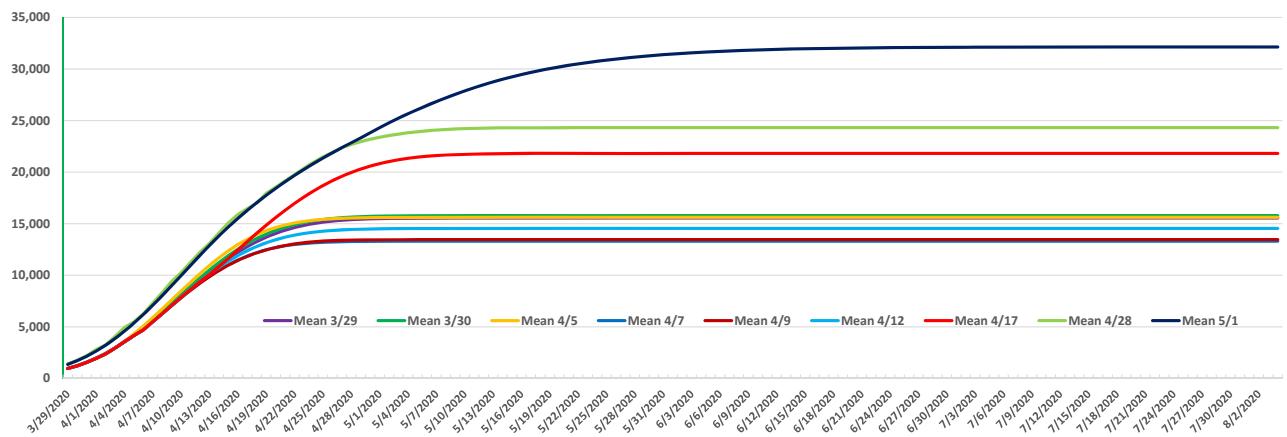
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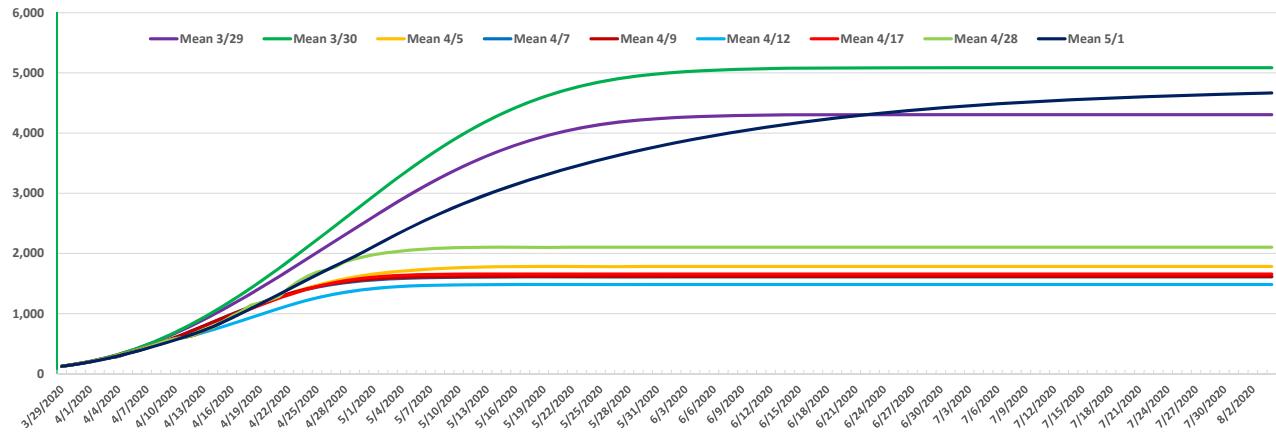
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New York COVID 19 Cumulative Death Projections Revised Forecasts



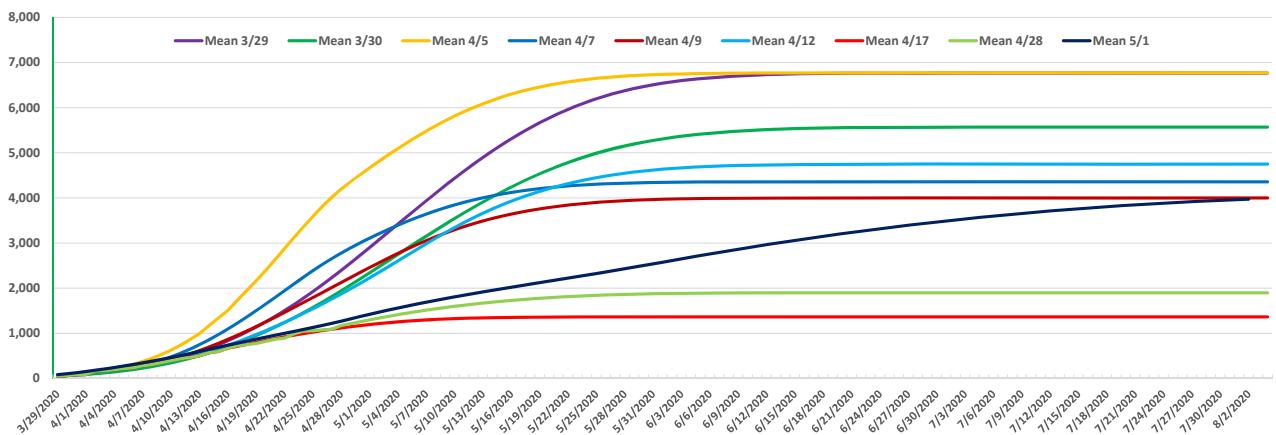
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California COVID 19 Cumulative Death Projections Revised Forecasts



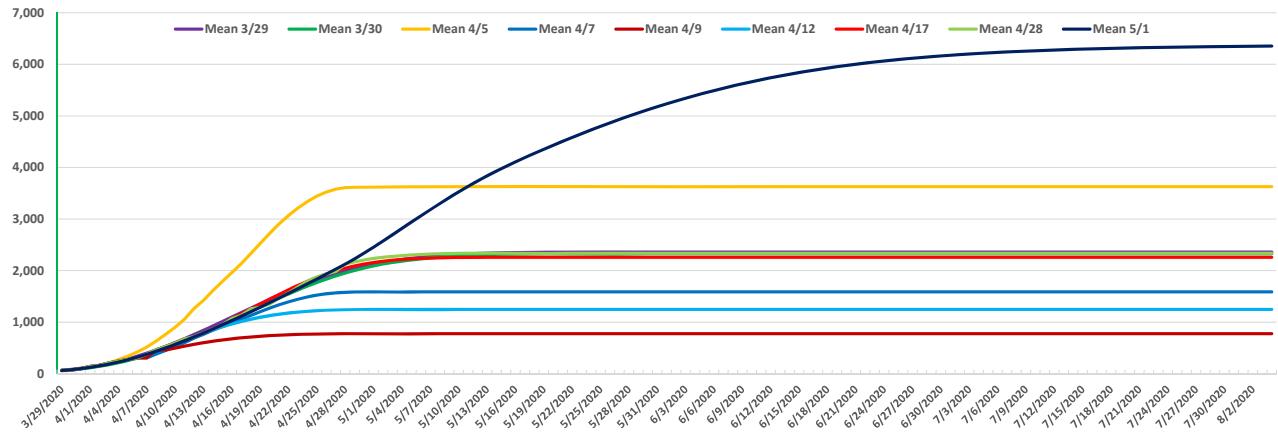
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Florida COVID 19 Cumulative Death Projections Revised Forecasts



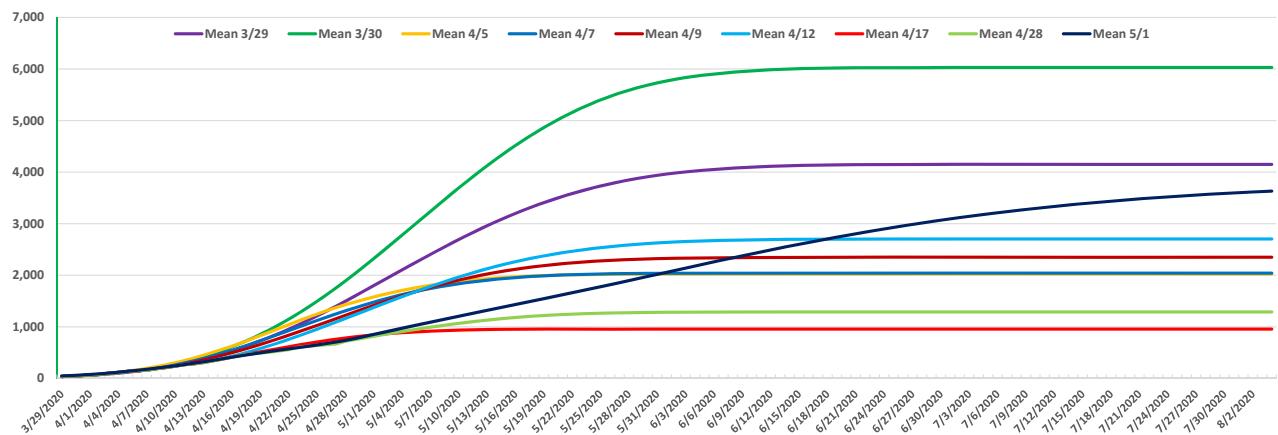
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Illinois COVID 19 Cumulative Death Projections Revised Forecasts



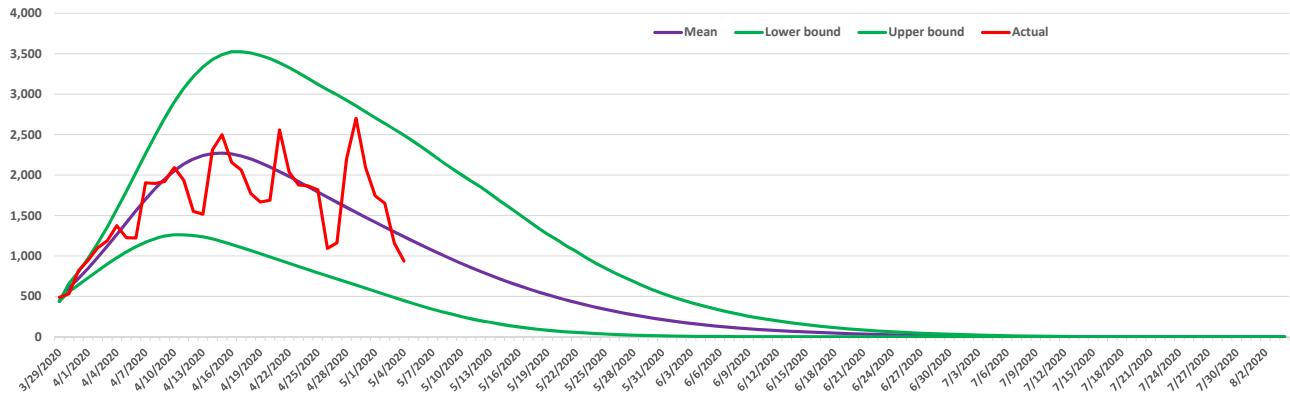
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Texas COVID 19 Cumulative Death Projections Revised Forecasts



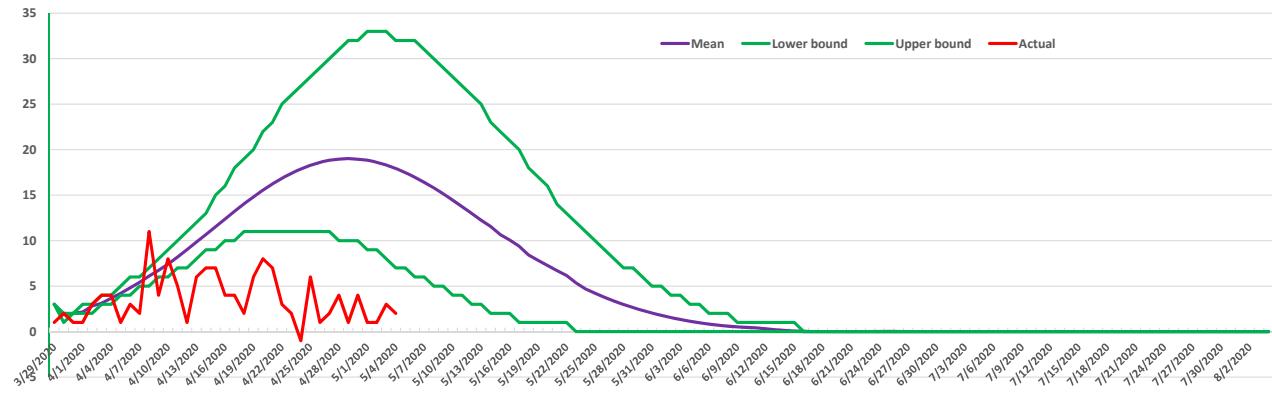
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Kansas Deaths by Age Group

Age Group	Number of Deaths	Percent of COVID Deaths	2018 Mortality Rates
35-44 years	2	0.8%	2.5%
45-54 years	4	1.8%	4.8%
55-64 years	16	9.0%	12.8%
65-74 years	27	17.5%	18.2%
75-84 years	32	23.9%	23.4%
85+ years	56	47.0%	34.2%
Total	137	100%	95.8%

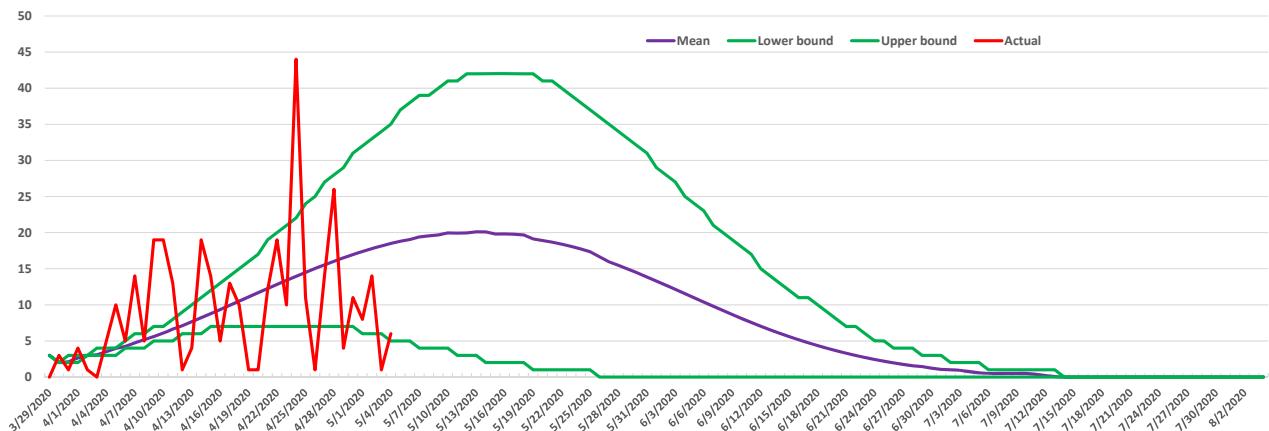
<https://www.coronavirus.kdheks.gov/160/COVID-19-in-Kansas>, May 5, 2020

https://www.kdheks.gov/phi/AS_Tables/AS_2018_Tables_and_Figures/general_mortality/Table_E4.pdf, May 5, 2020



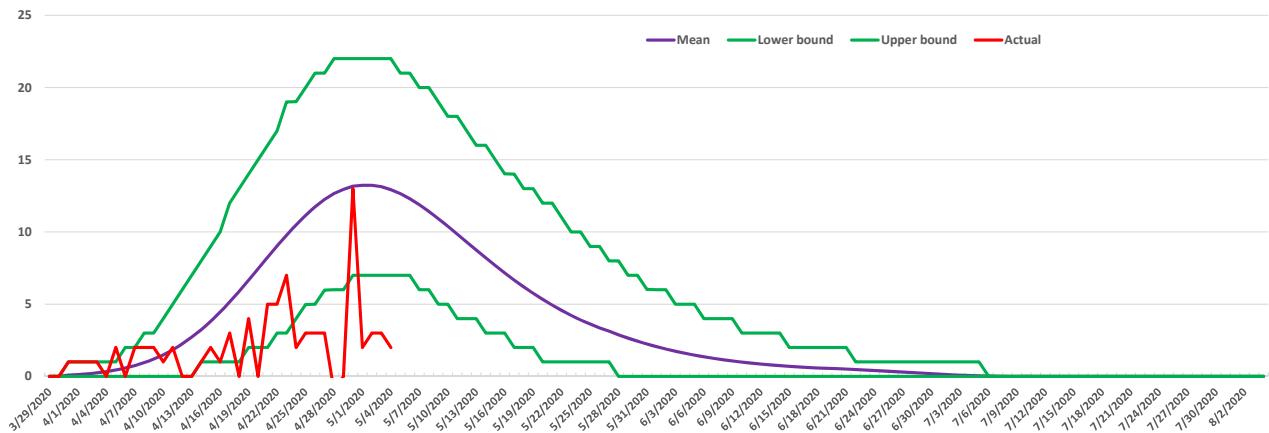
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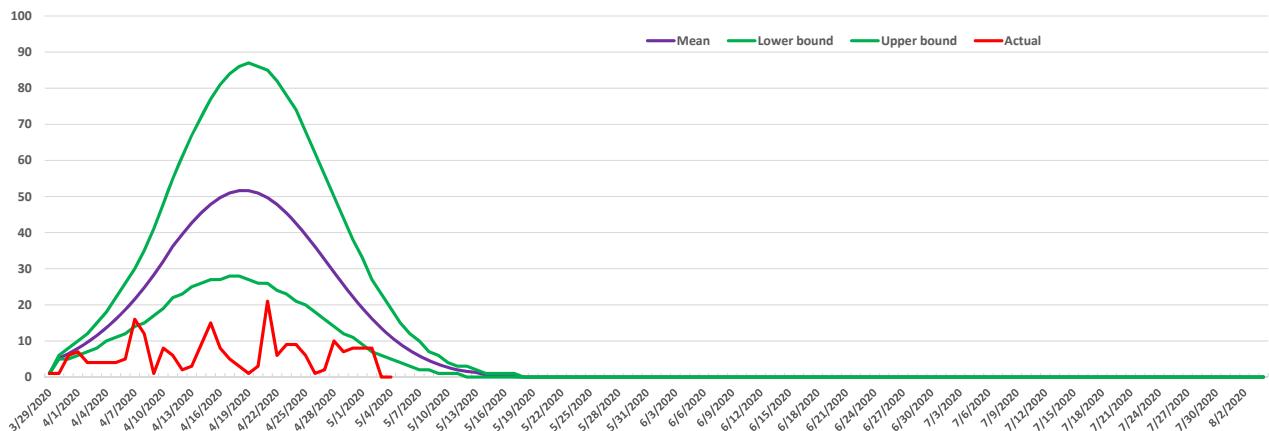
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Nebraska COVID 19 Daily Death Projections March 26



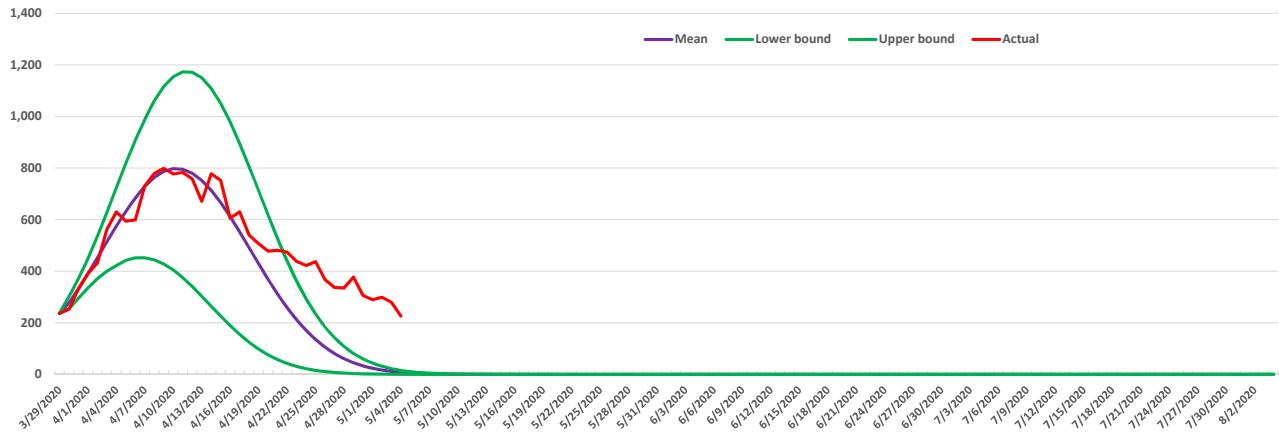
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Oklahoma COVID 19 Daily Death Projections March 26



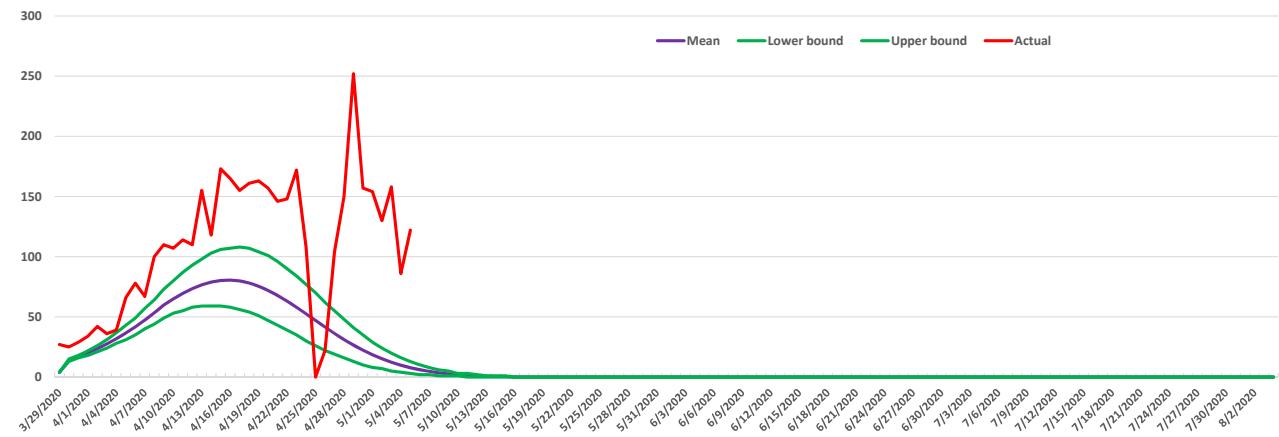
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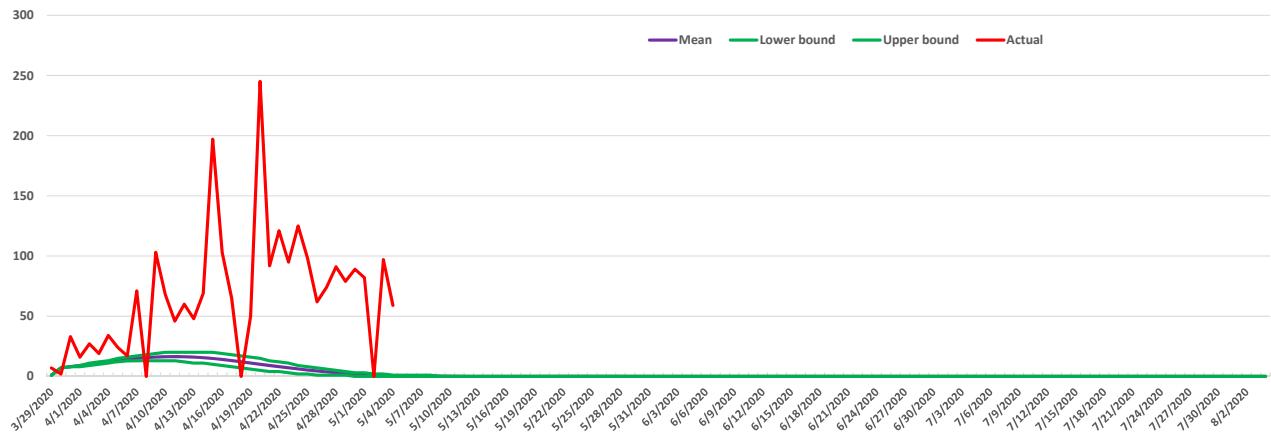
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Massachusetts COVID 19 Daily Death Projections March 26



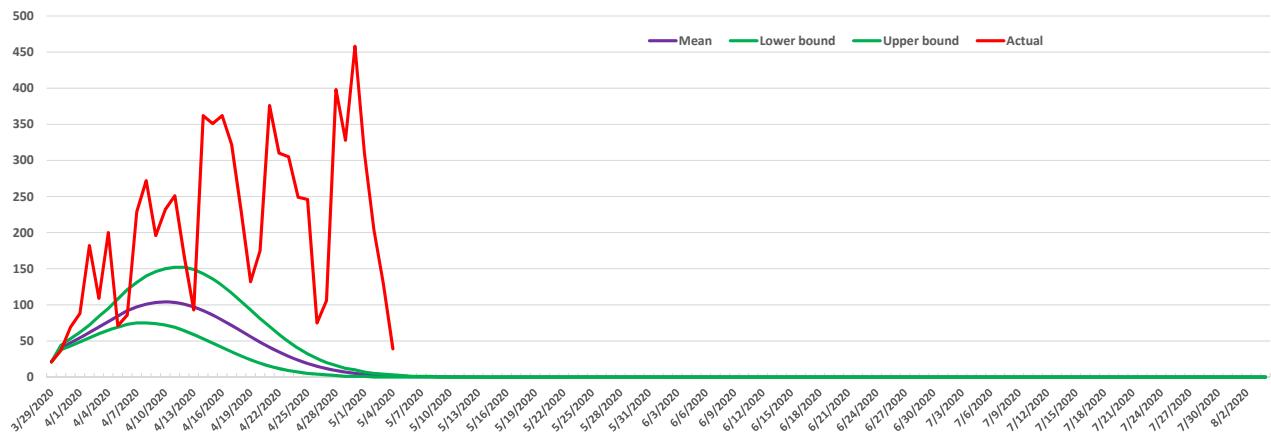
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Connecticut COVID 19 Daily Death Projections March 26



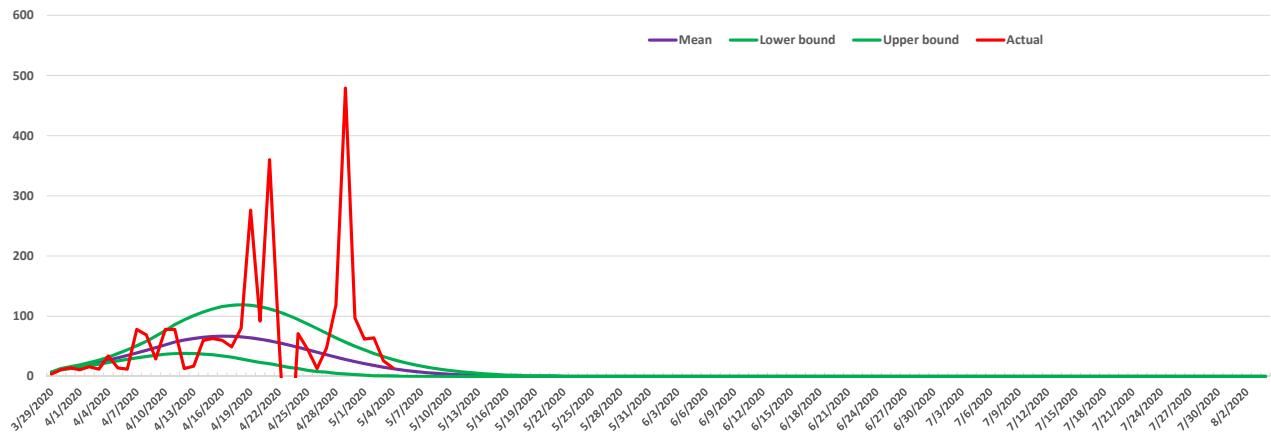
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New Jersey COVID 19 Daily Death Projections March 26



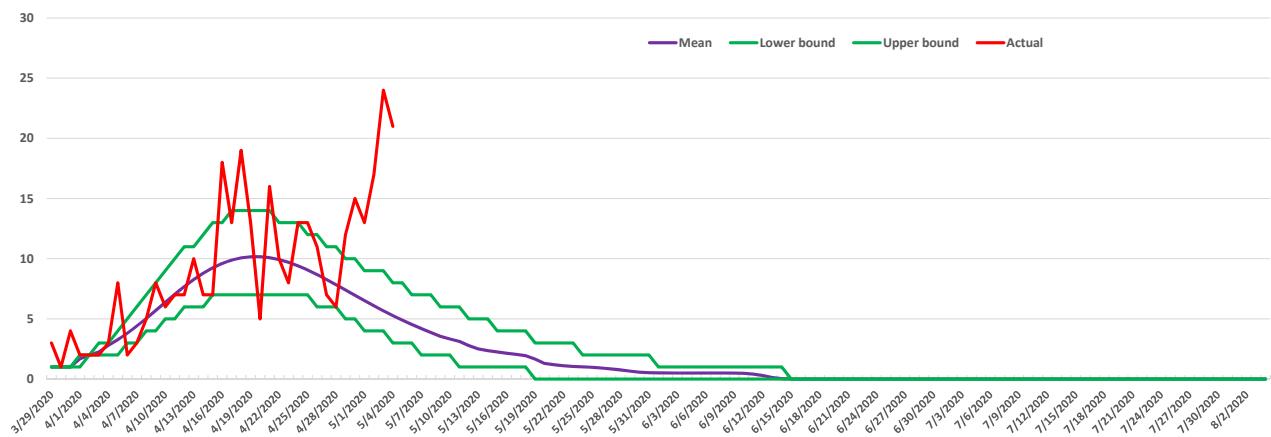
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Pennsylvania COVID 19 Daily Death Projections March 26



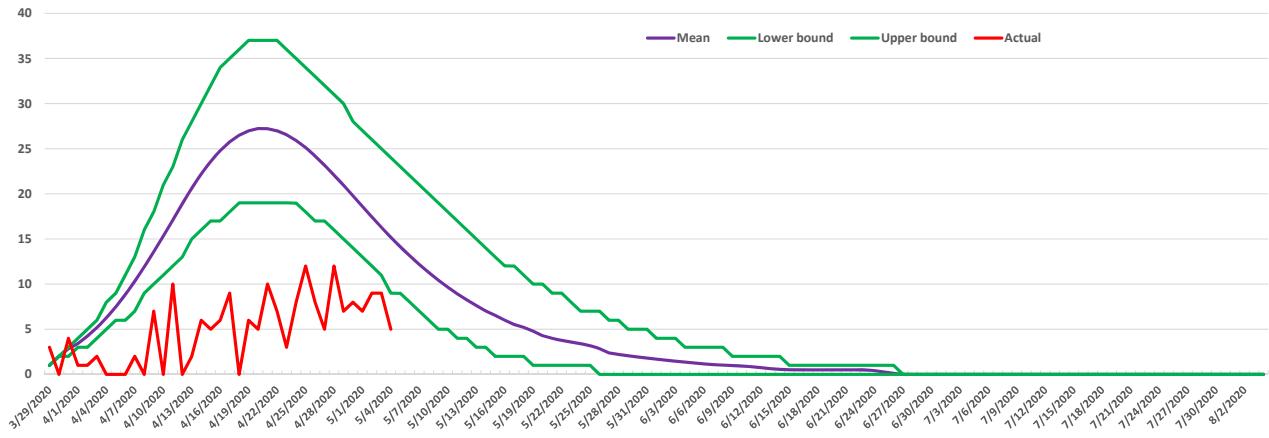
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Rhode Island COVID 19 Daily Death Projections March 26



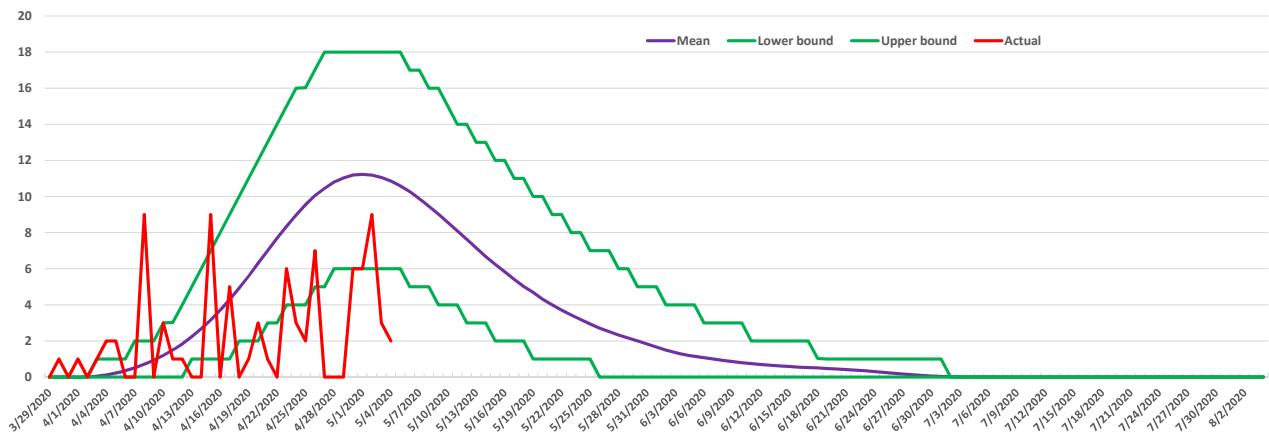
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Delaware COVID 19 Daily Death Projections March 26



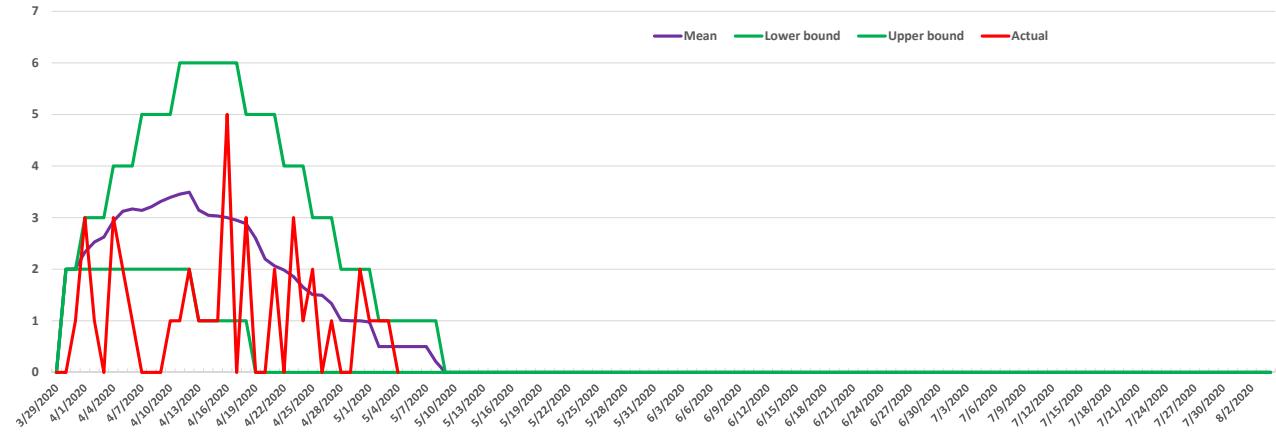
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New Hampshire COVID 19 Daily Death Projections March 26



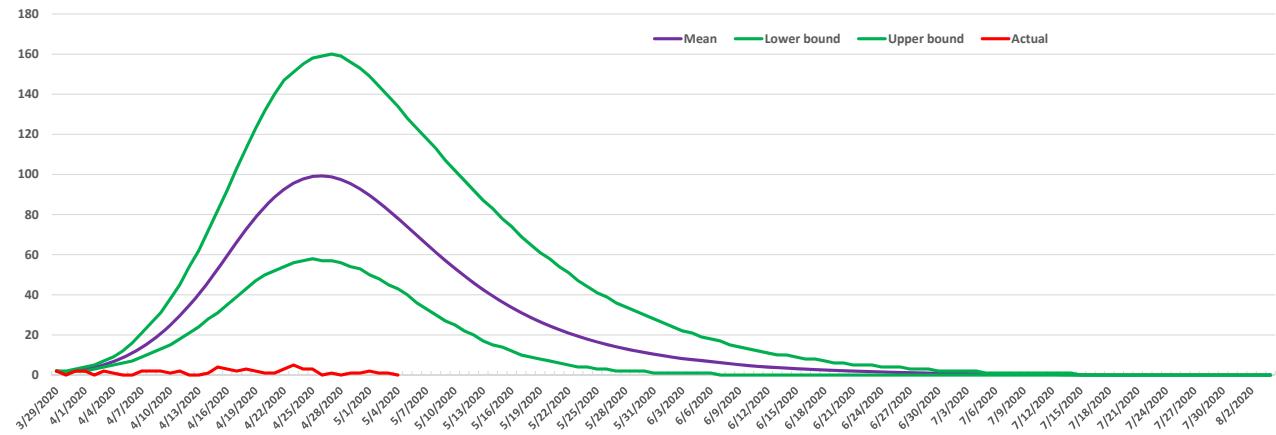
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Vermont COVID 19 Daily Death Projections March 26



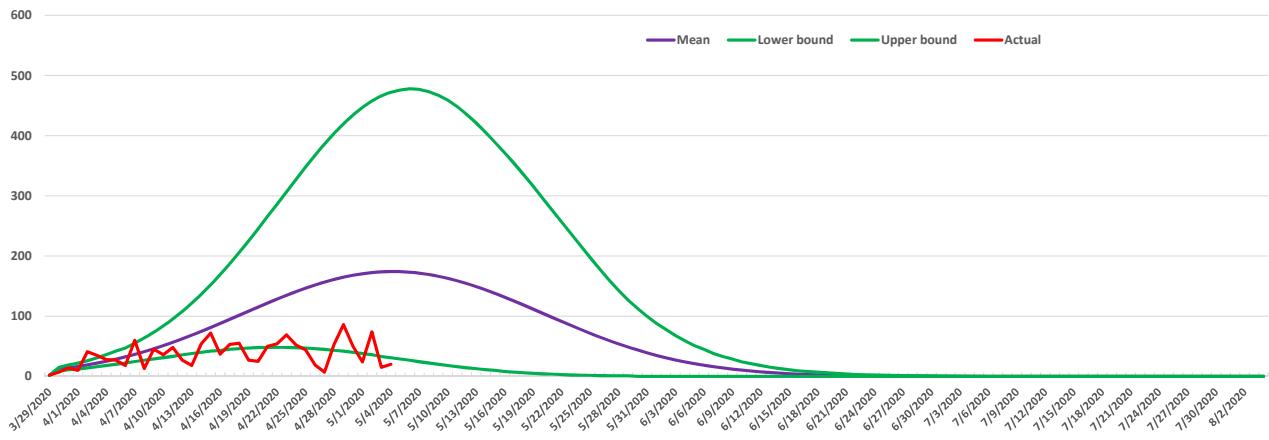
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Maine COVID 19 Daily Death Projections March 26



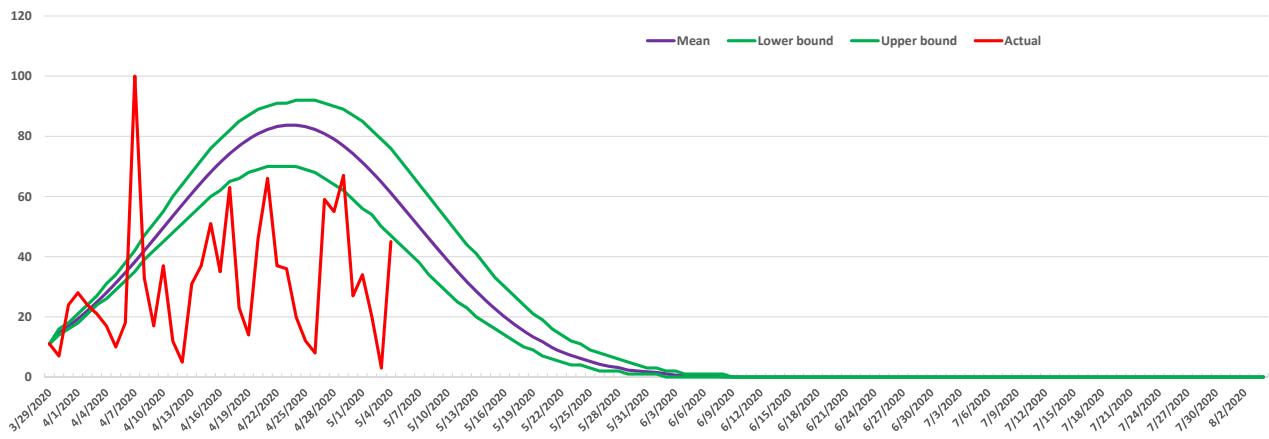
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Florida COVID 19 Daily Death Projections March 26



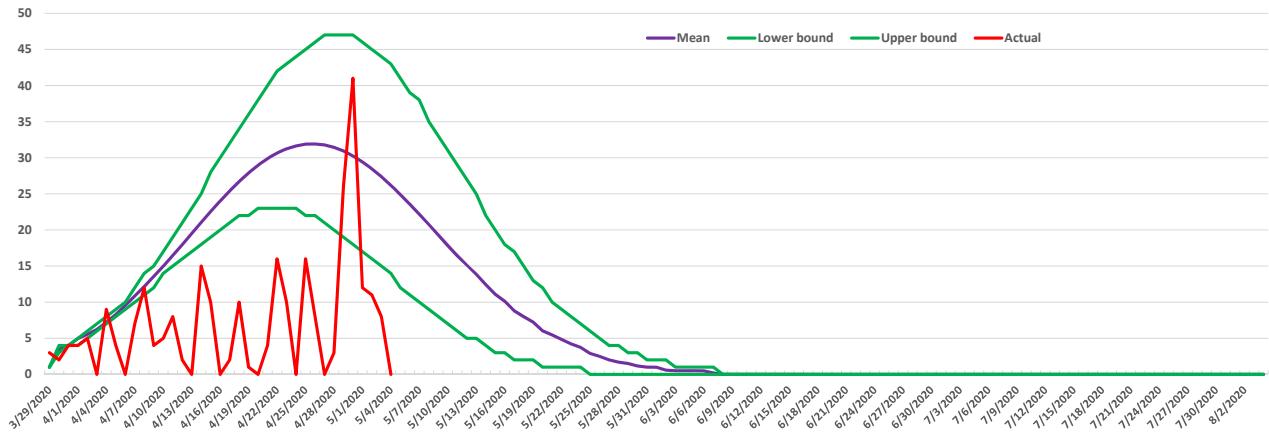
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Georgia COVID 19 Daily Death Projections March 26



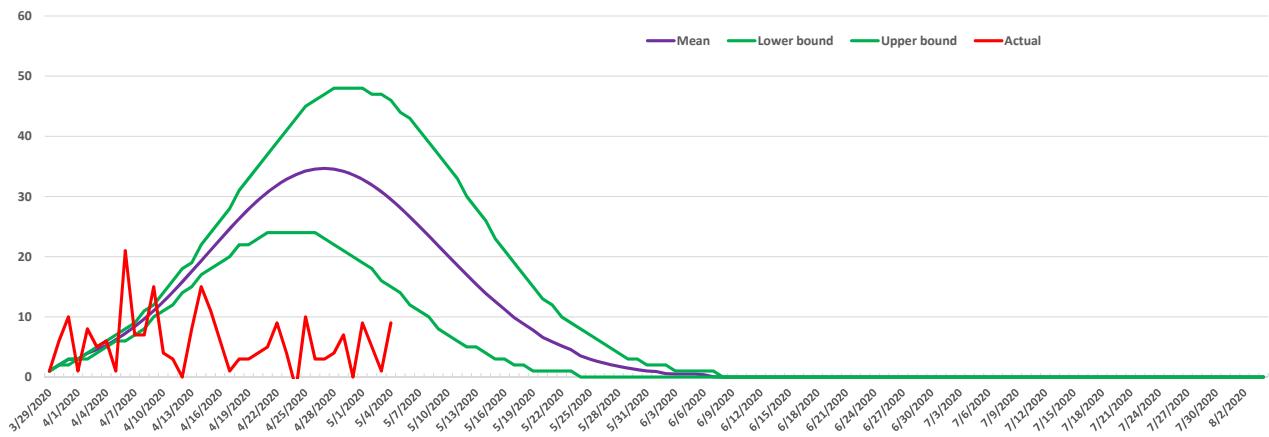
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South Carolina COVID 19 Daily Death Projections March 26



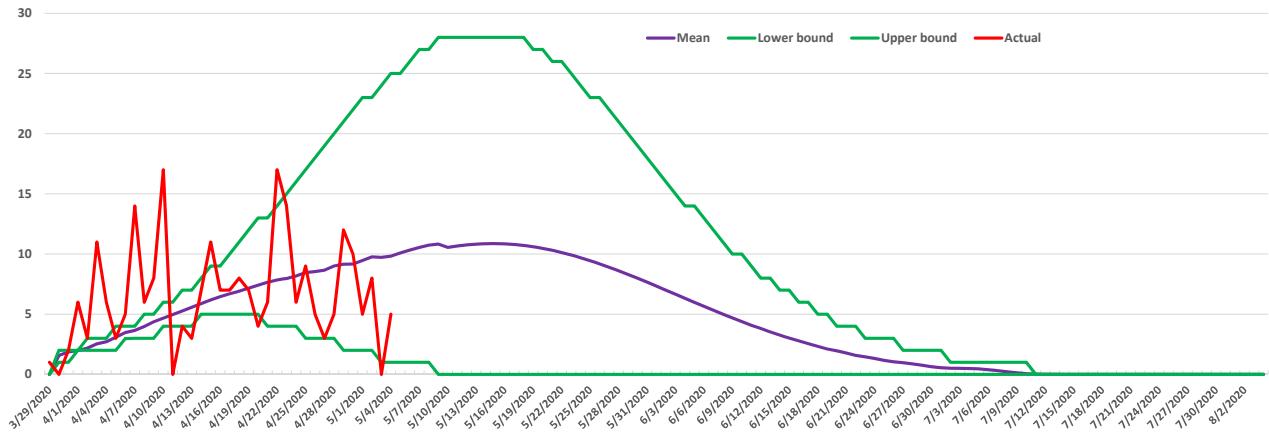
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Tennessee COVID 19 Daily Death Projections March 26



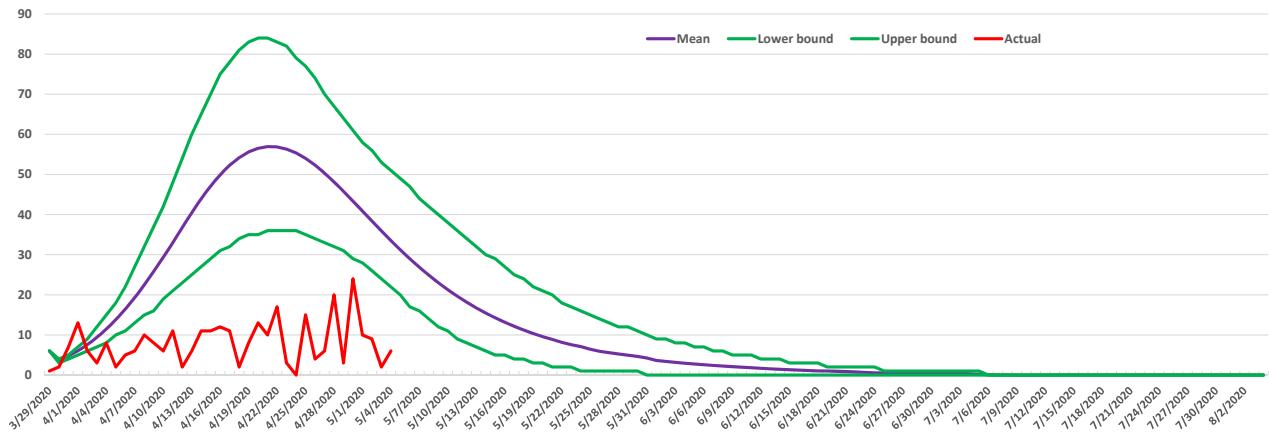
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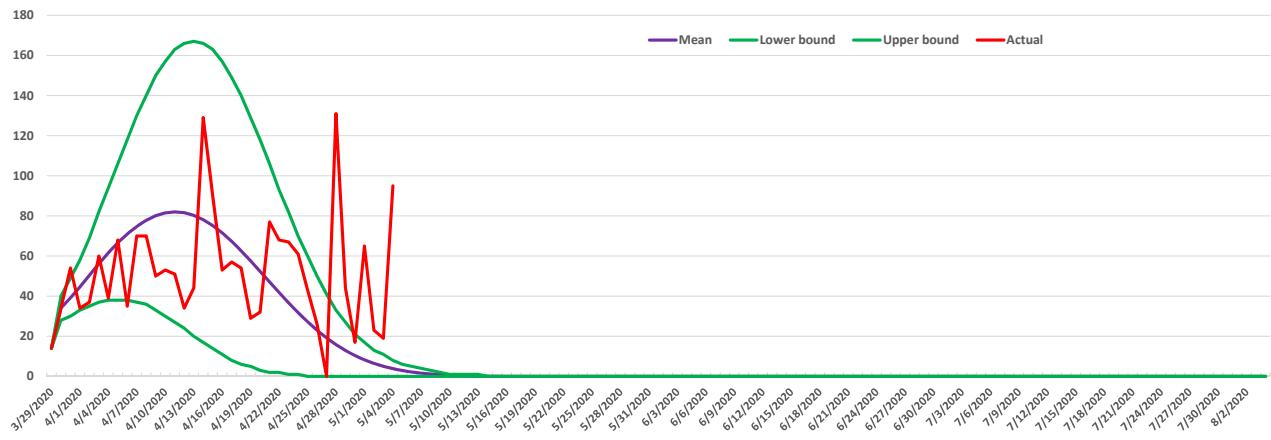
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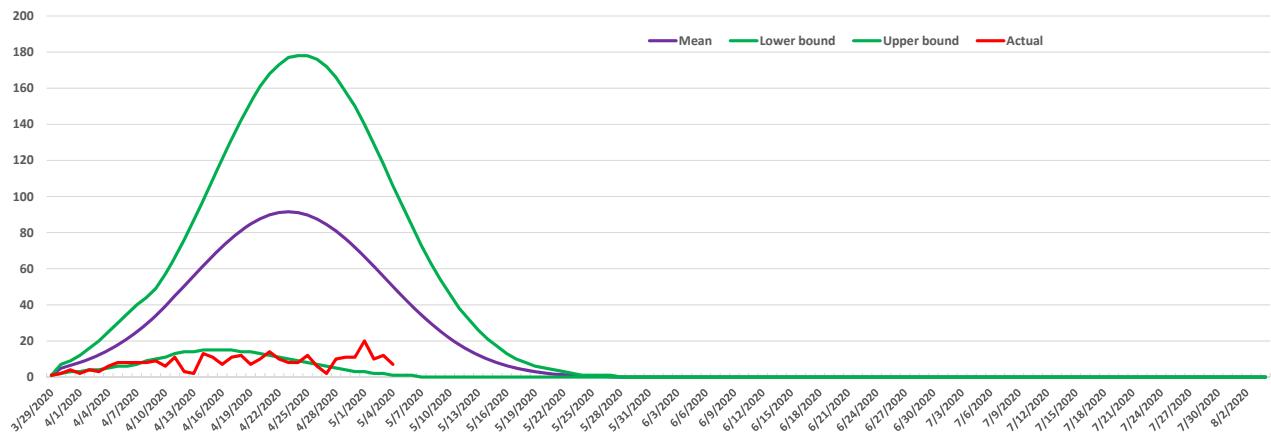
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Louisiana COVID 19 Daily Death Projections March 26



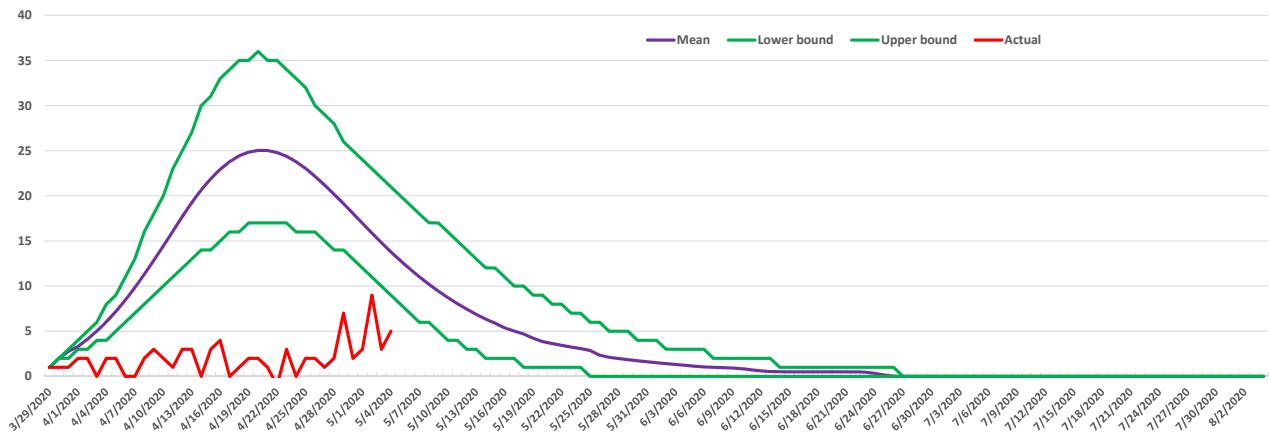
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Mississippi COVID 19 Daily Death Projections March 26



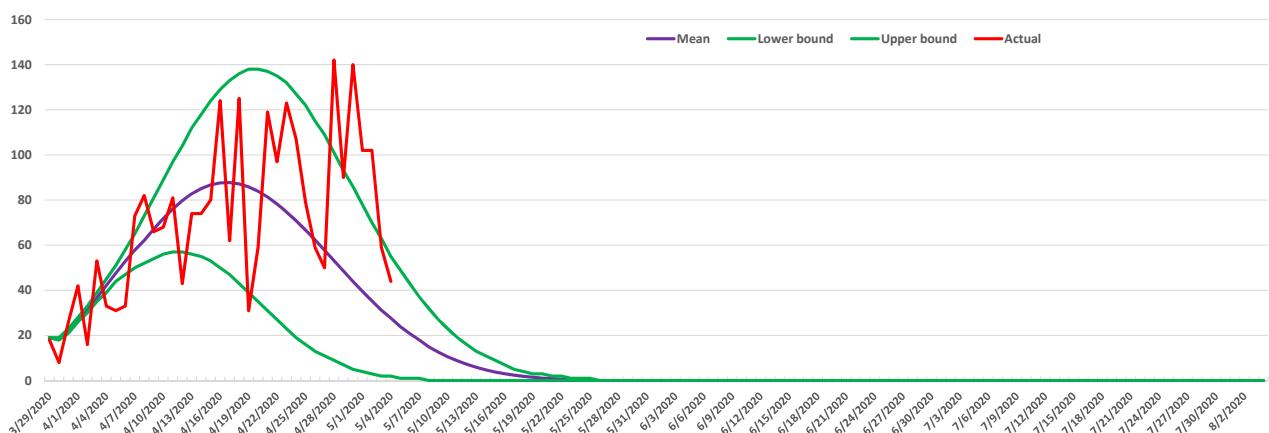
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Arkansas COVID 19 Daily Death Projections March 26



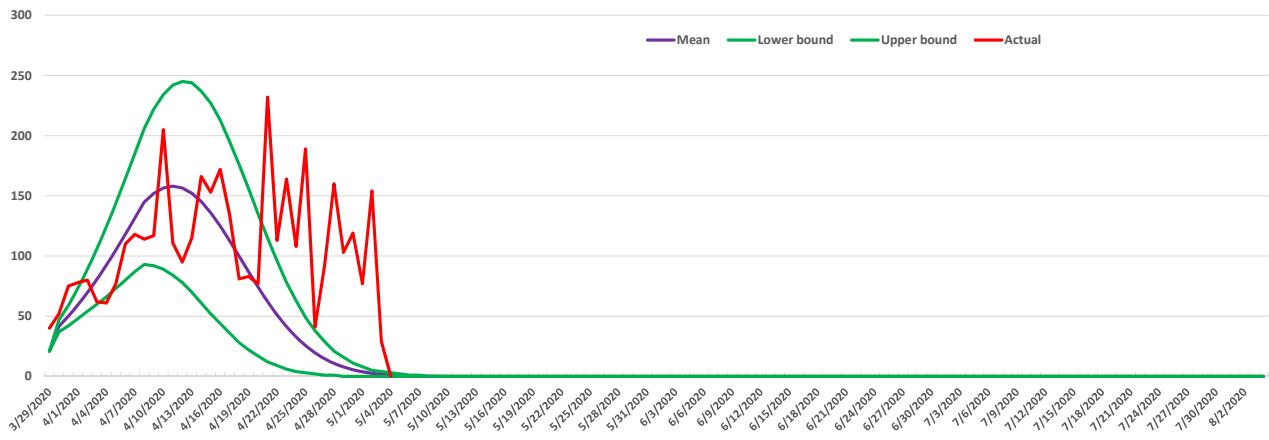
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Illinois COVID 19 Daily Death Projections March 26



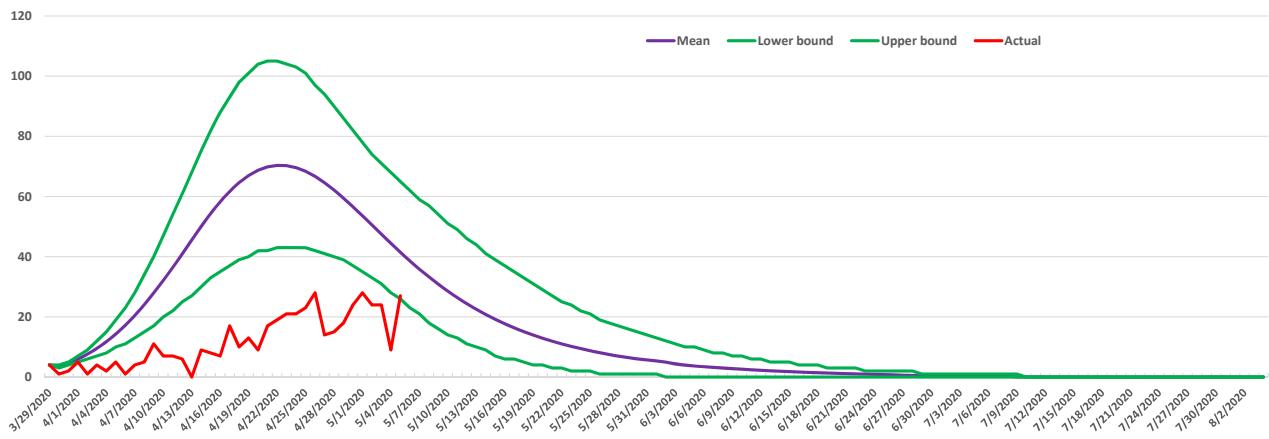
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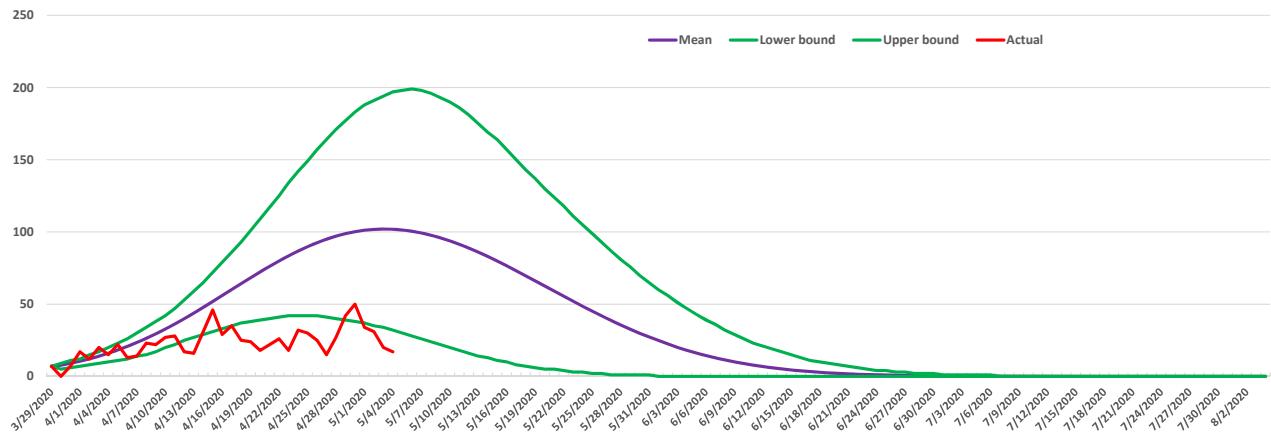
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Minnesota COVID 19 Daily Death Projections March 26



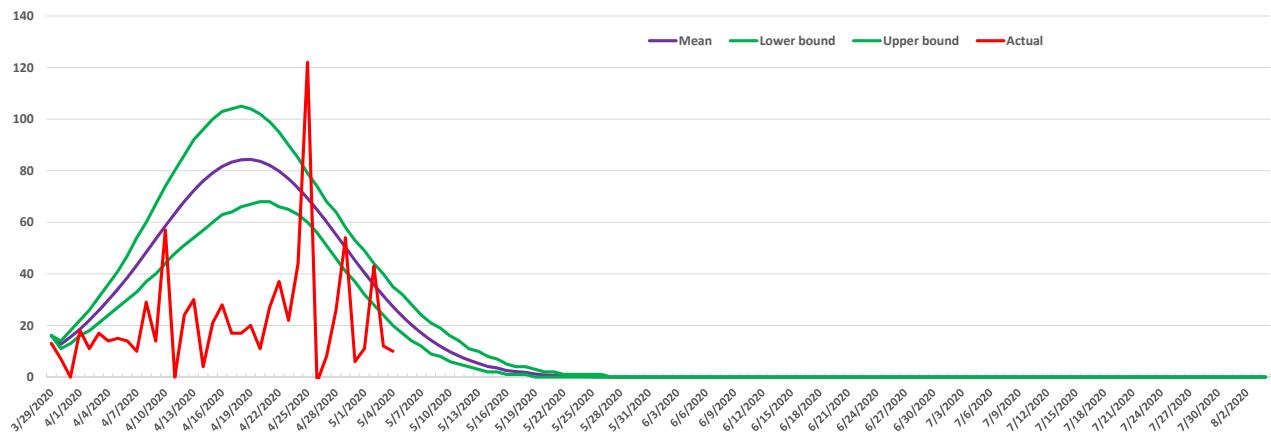
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Texas COVID 19 Daily Death Projections March 26



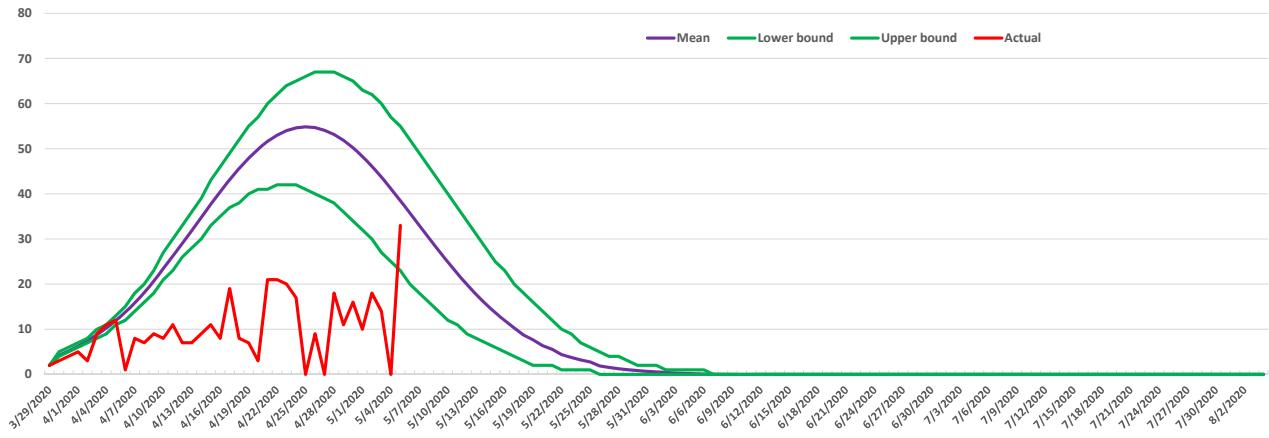
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Colorado COVID 19 Daily Death Projections March 26



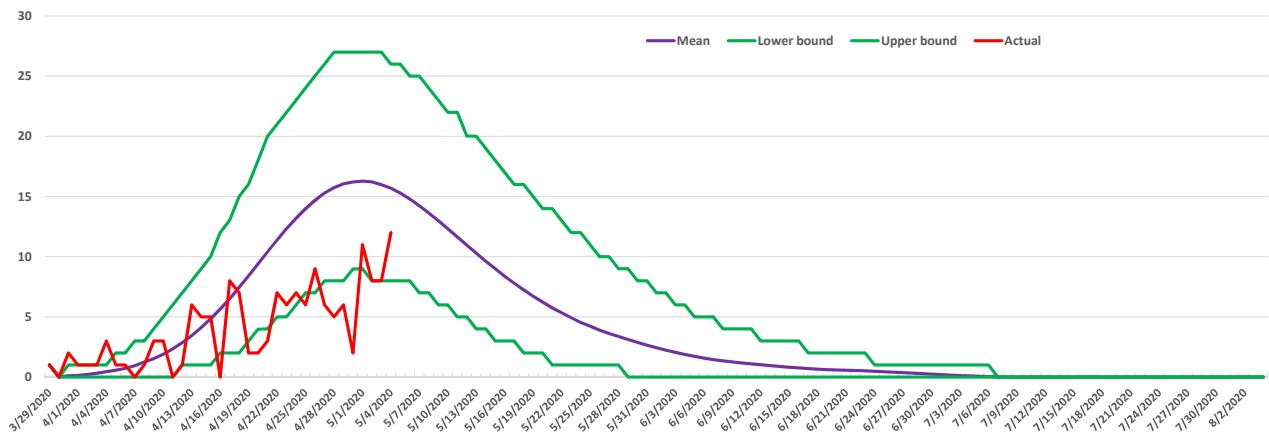
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Arizona COVID 19 Daily Death Projections March 26



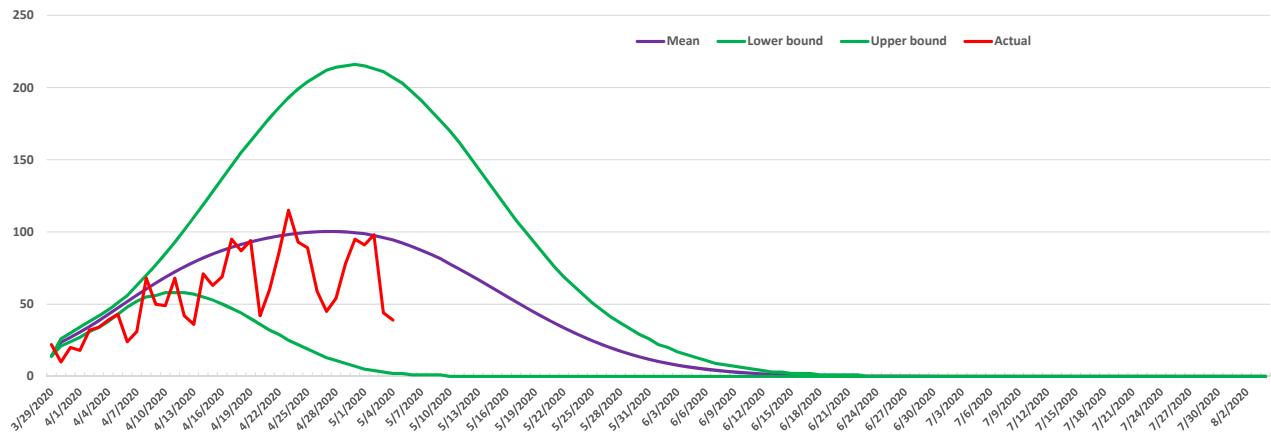
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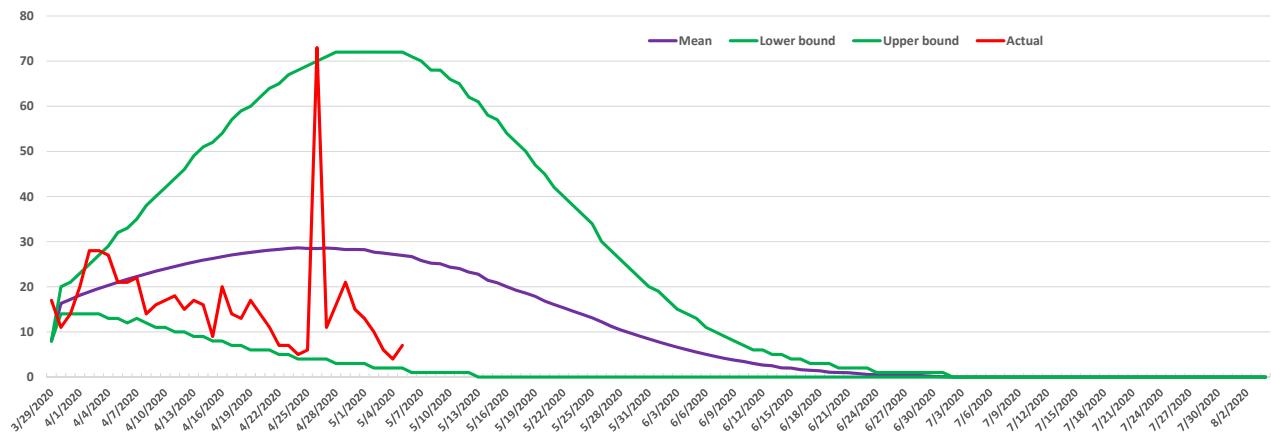
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California COVID 19 Daily Death Projections March 26



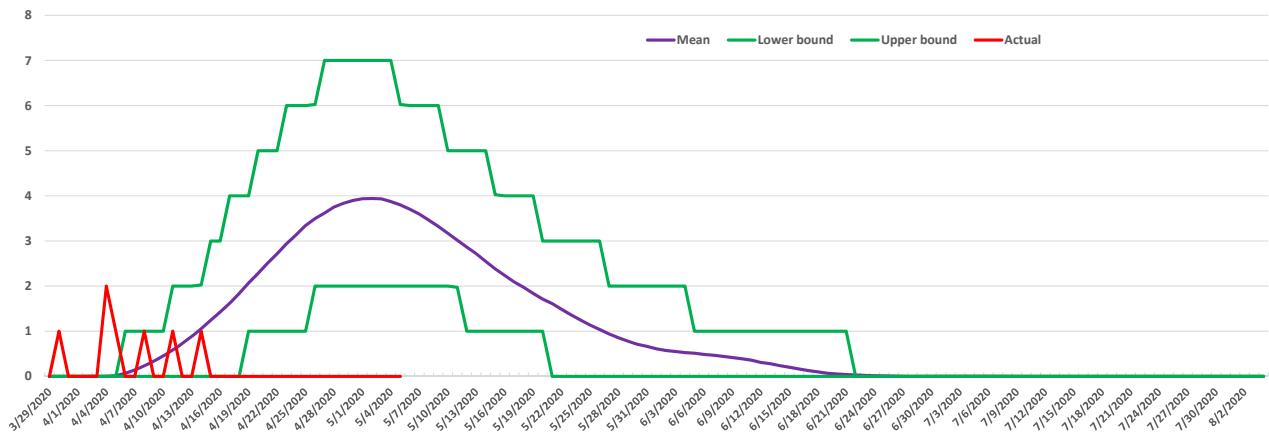
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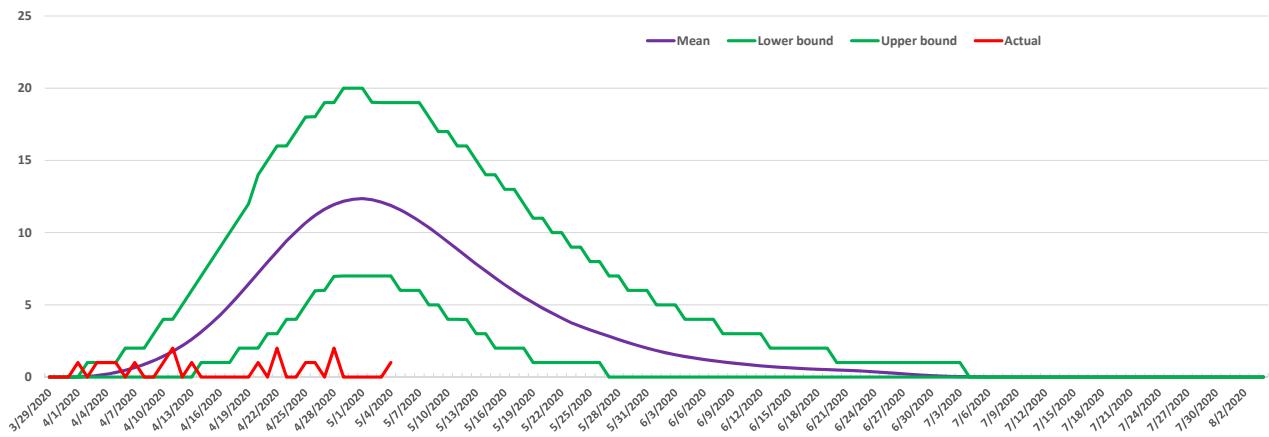
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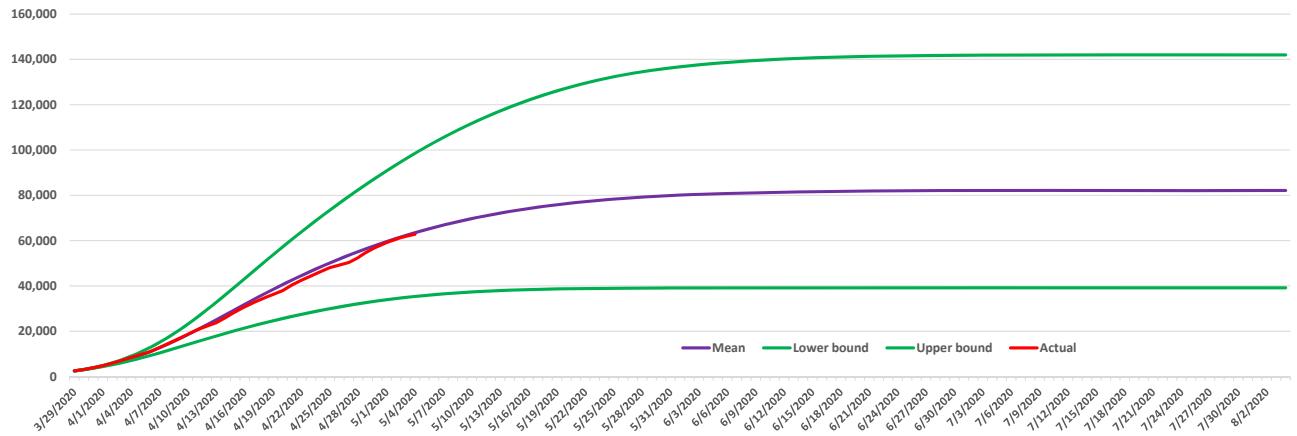
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Hawaii COVID 19 Daily Death Projections March 26



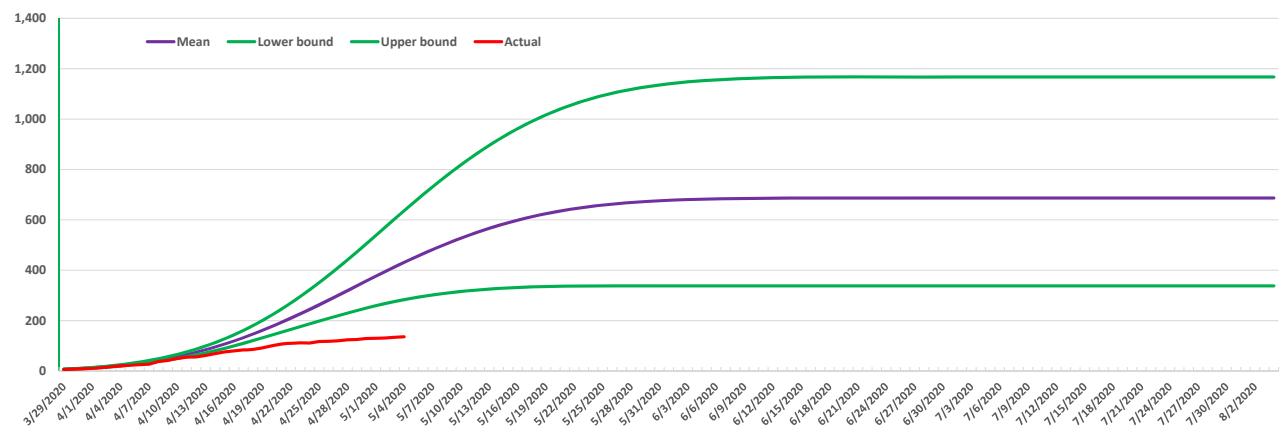
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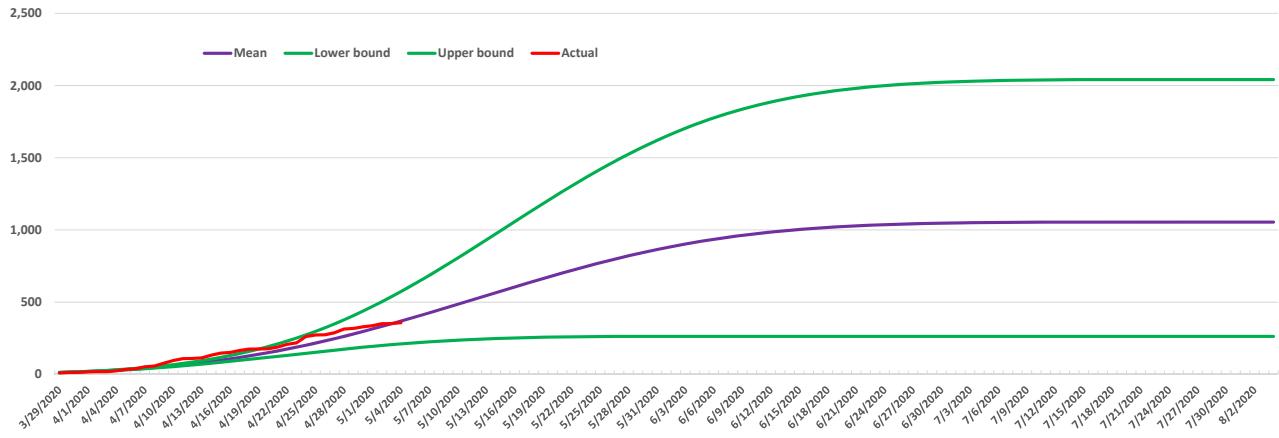
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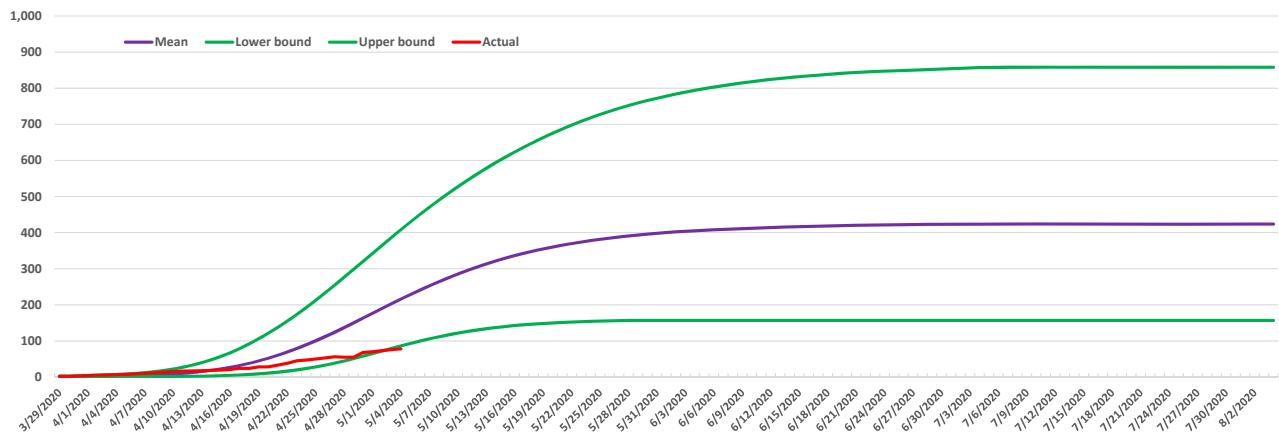
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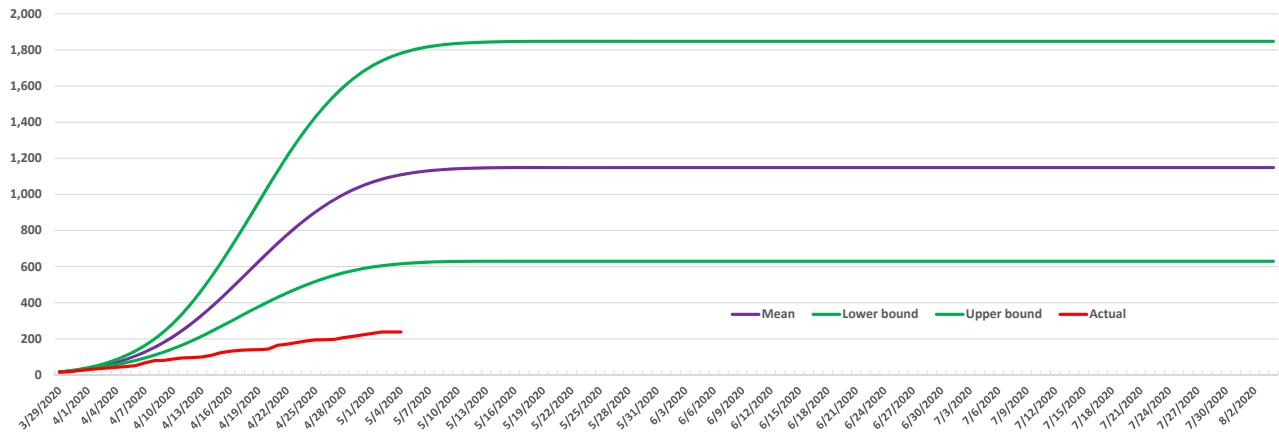
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Nebraska COVID 19 Daily Death Projections March 26



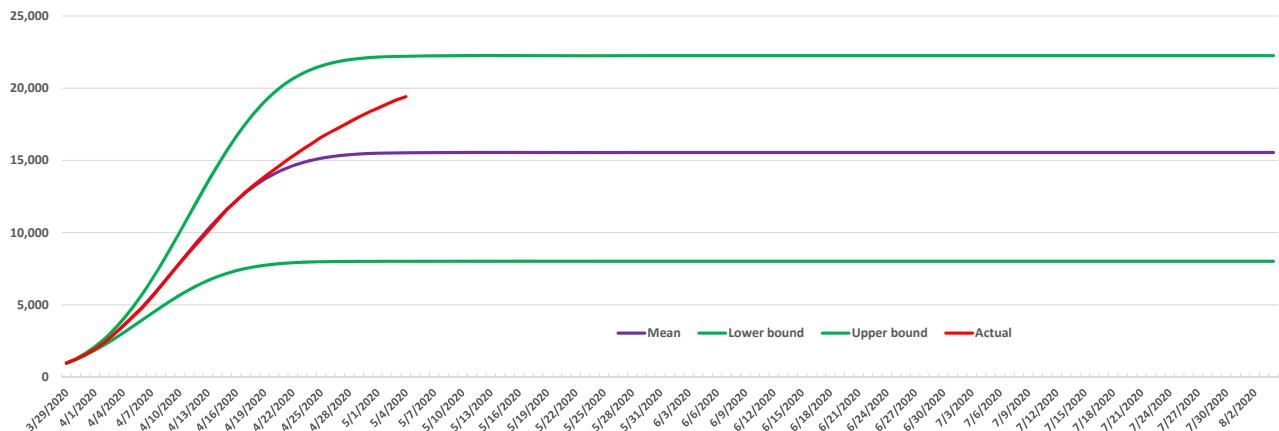
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Oklahoma COVID 19 Daily Death Projections March 26



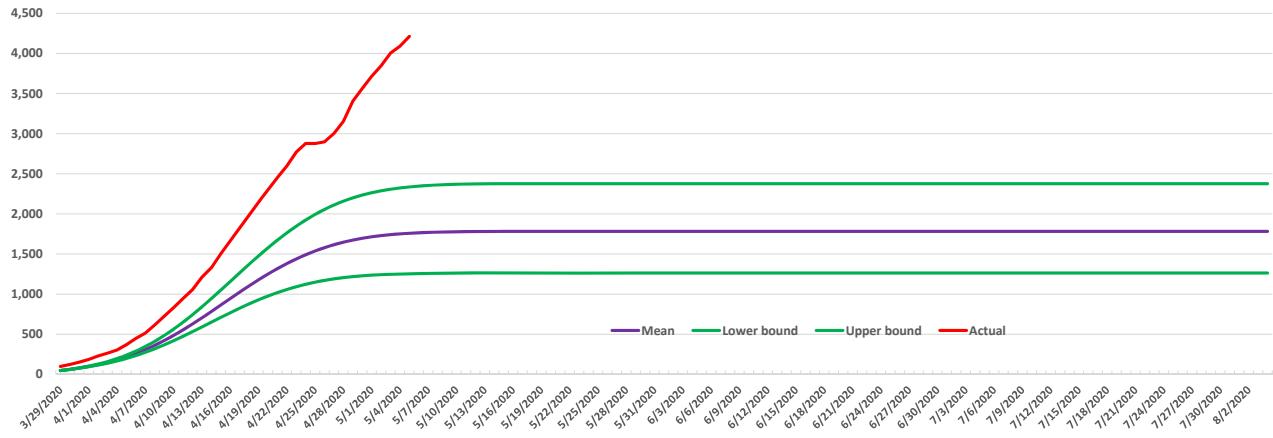
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New York COVID 19 Cumulative Death Projections



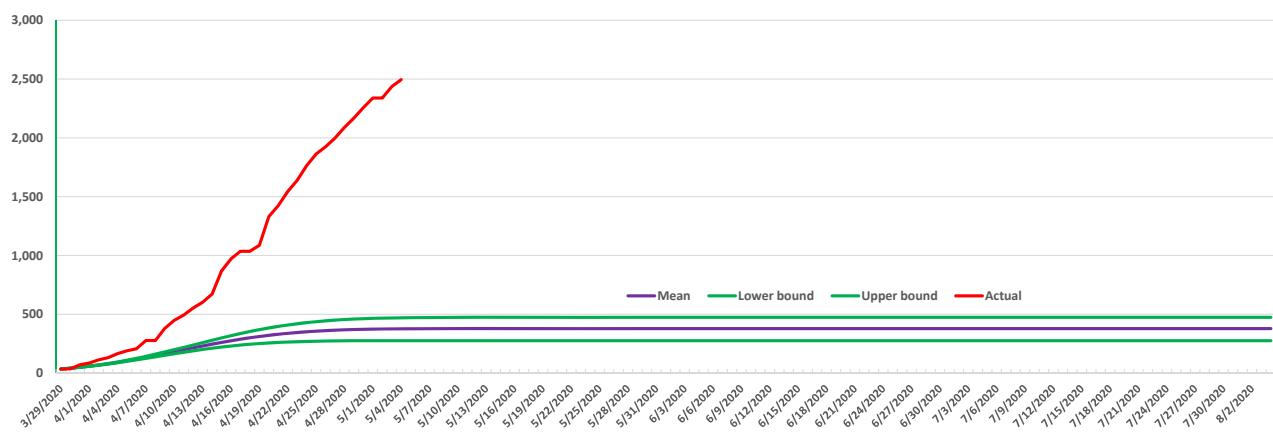
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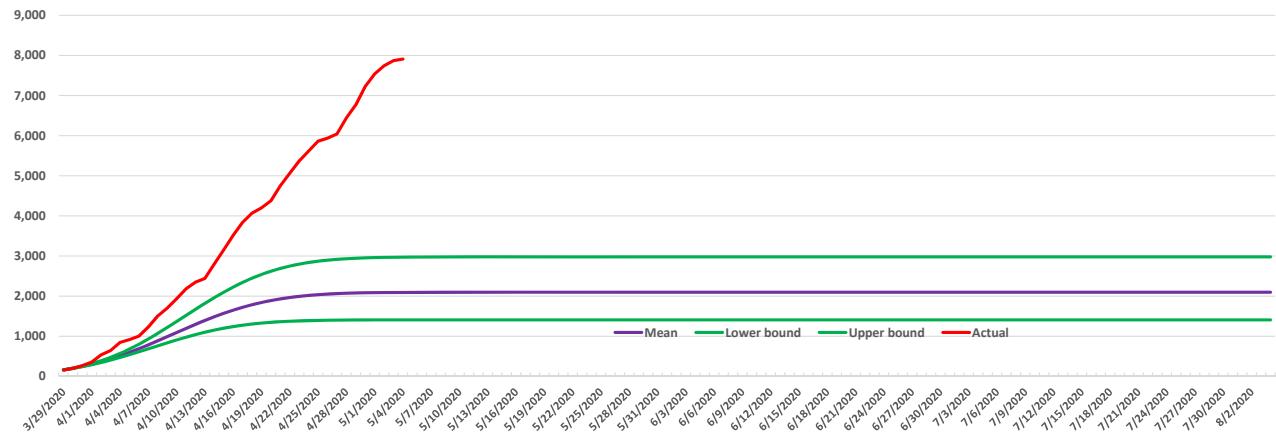
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Connecticut COVID 19 Cumulative Death Projections



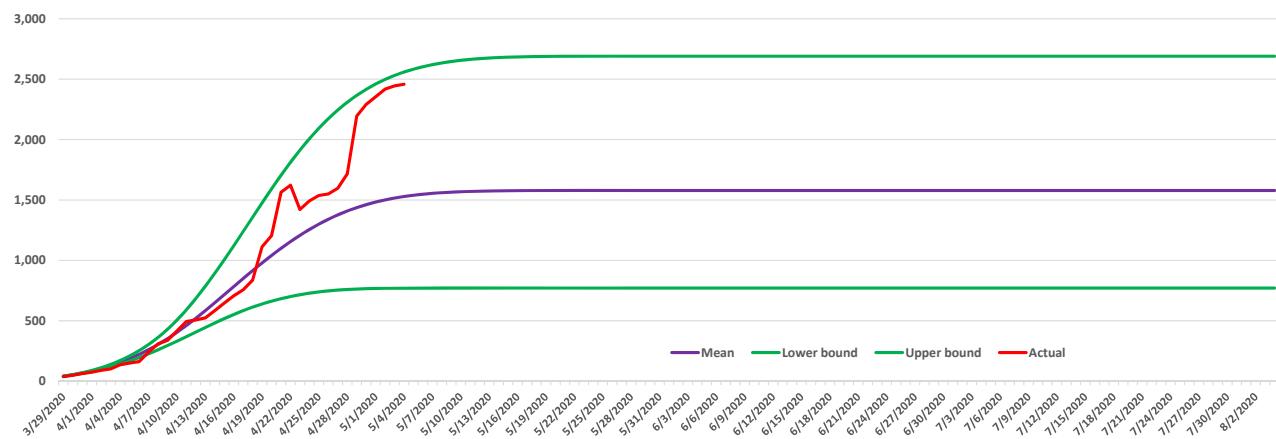
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New Jersey COVID 19 Cumulative Death Projections



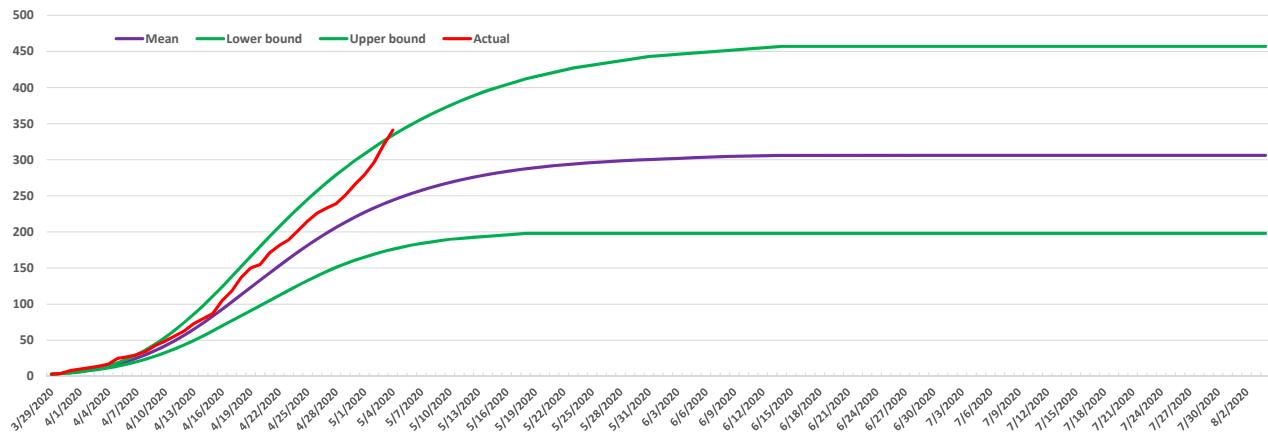
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Pennsylvania COVID 19 Cumulative Death Projections



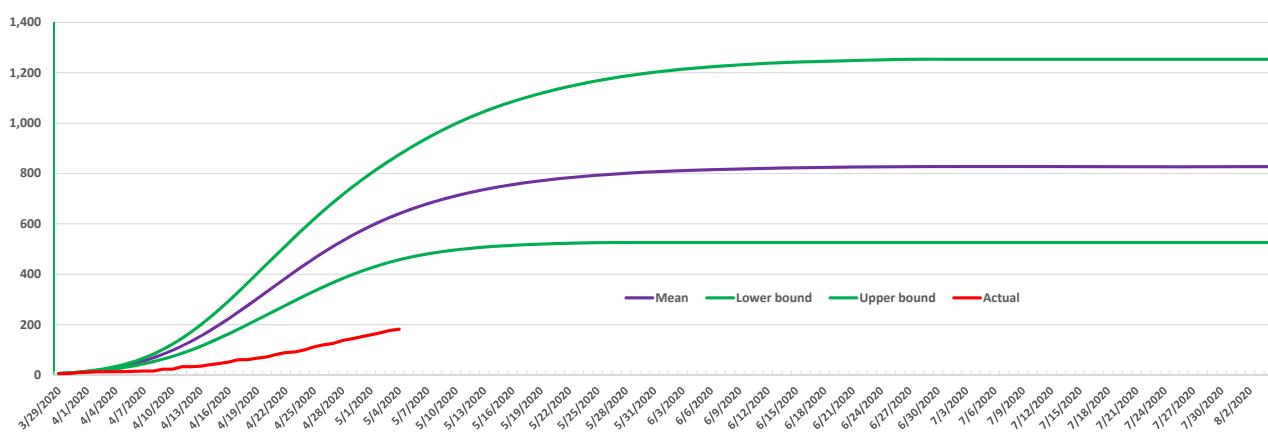
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Rhode Island COVID 19 Cumulative Death Projections March 26



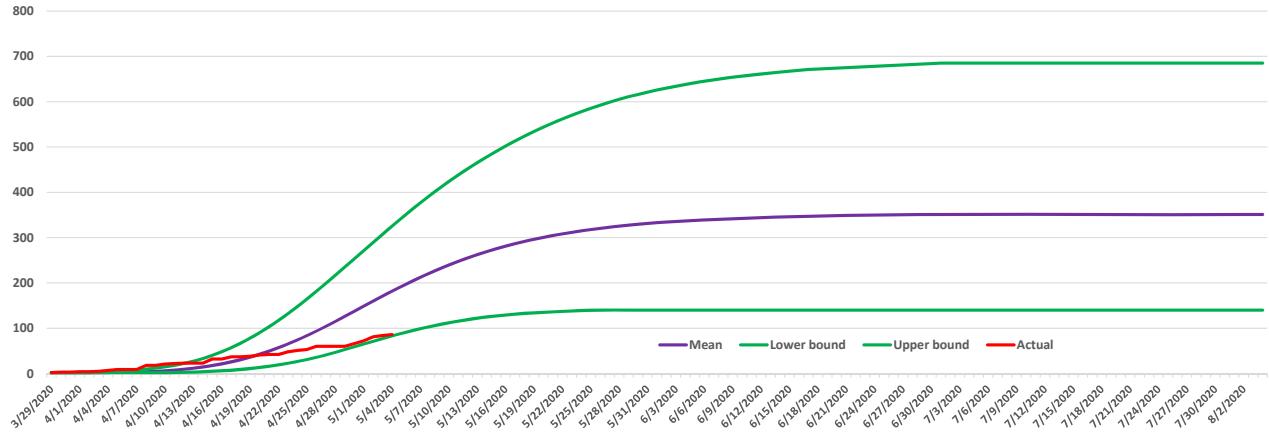
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Delaware COVID 19 Cumulative Death Projections



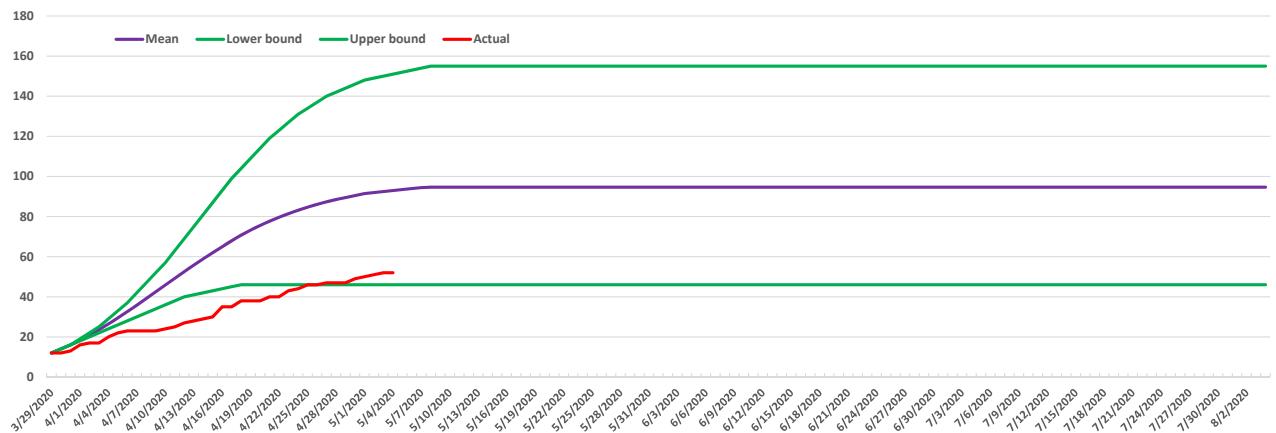
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New Hampshire COVID 19 Cumulative Death Projections



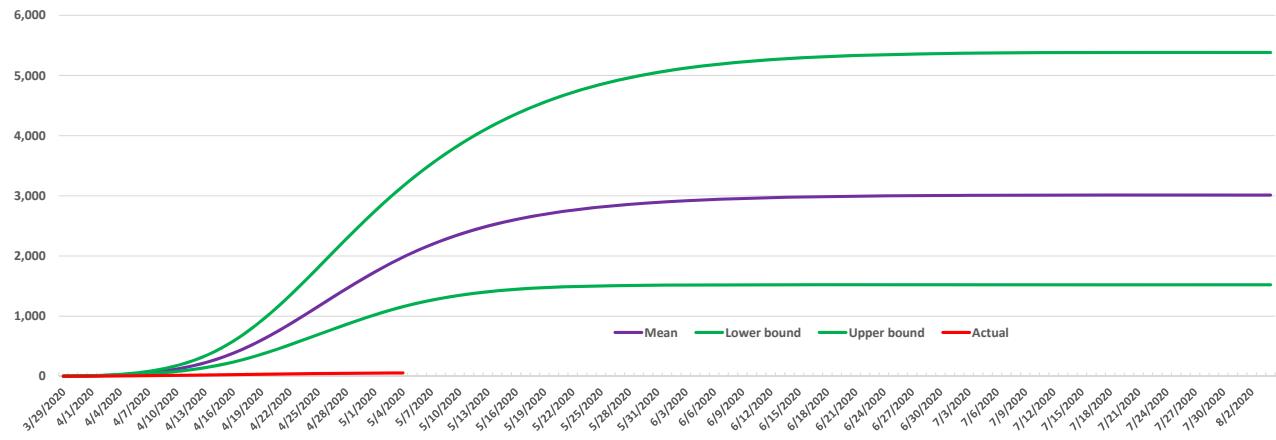
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Vermont COVID 19 Cumulative Death Projections March 26



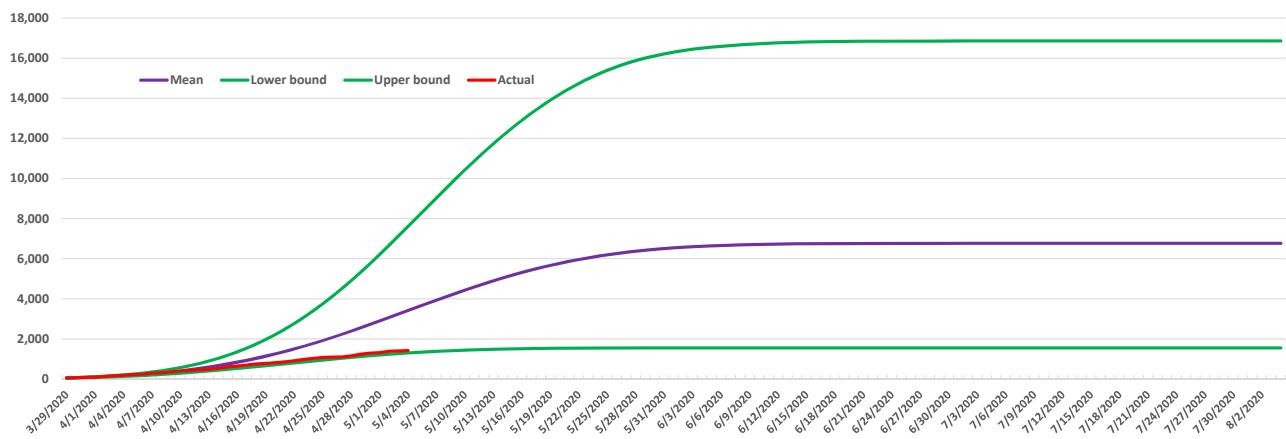
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Maine COVID 19 Cumulative Death Projections



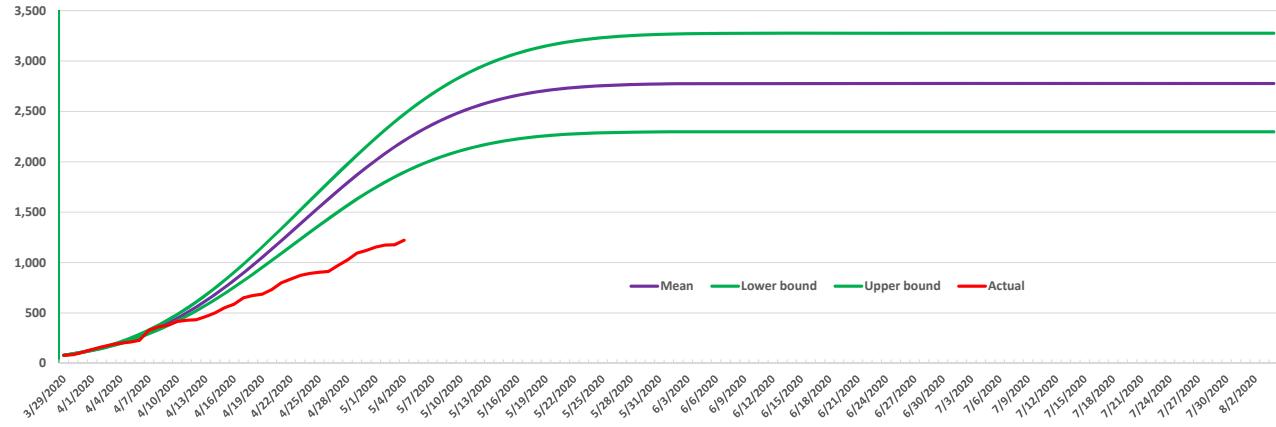
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Florida COVID 19 Cumulative Death Projections March 26



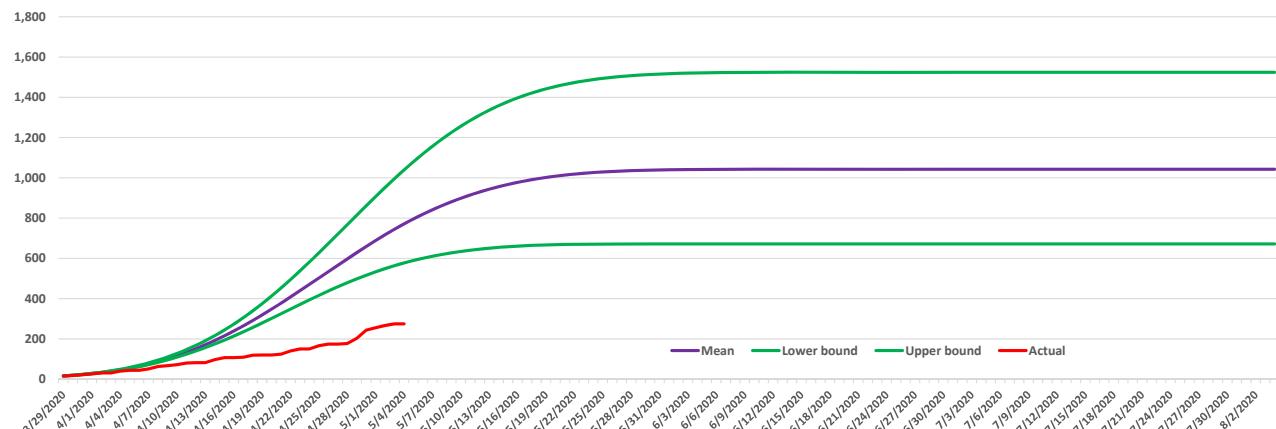
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Georgia COVID 19 Cumulative Death Projections



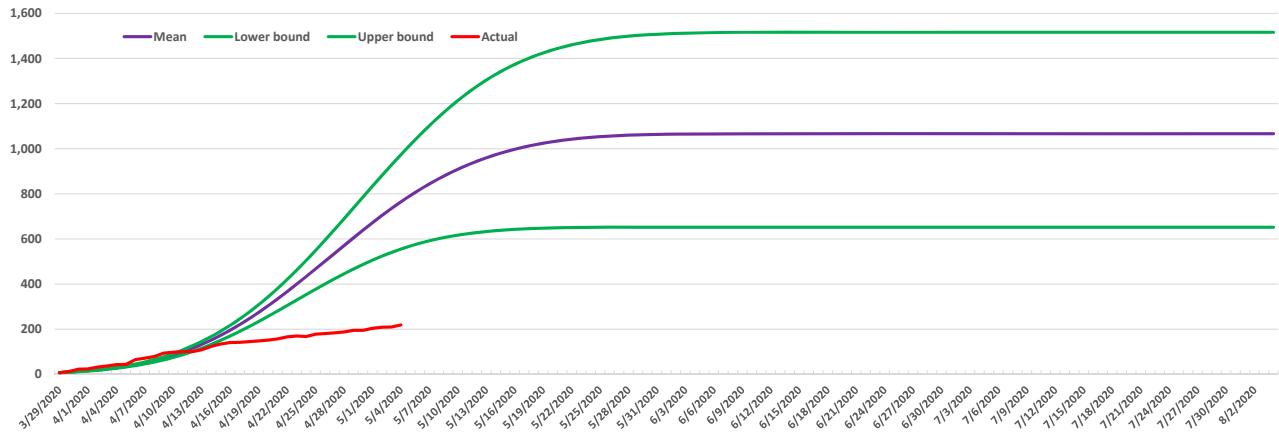
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South Carolina COVID 19 Cumulative Death Projections



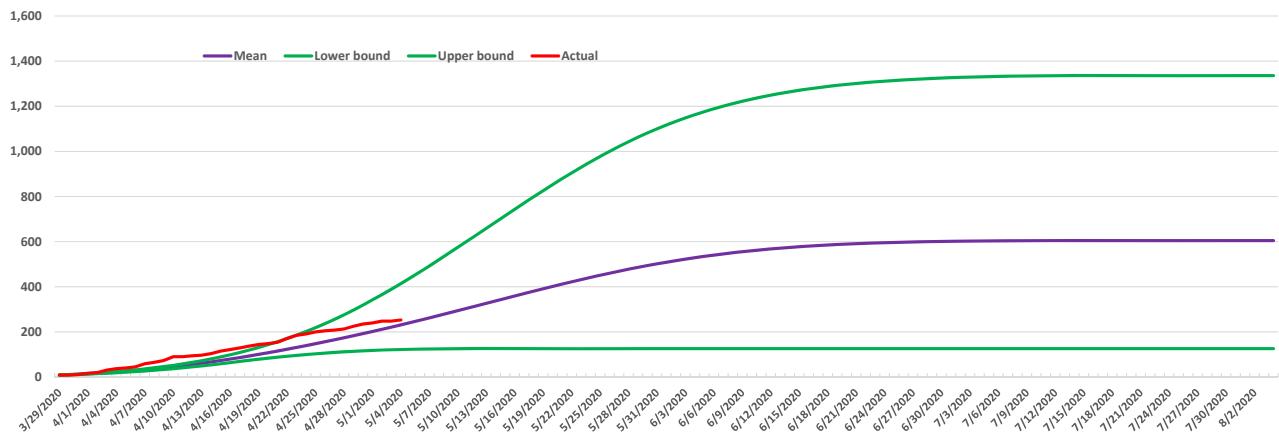
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Tennessee COVID 19 Cumulative Death Projections March 26



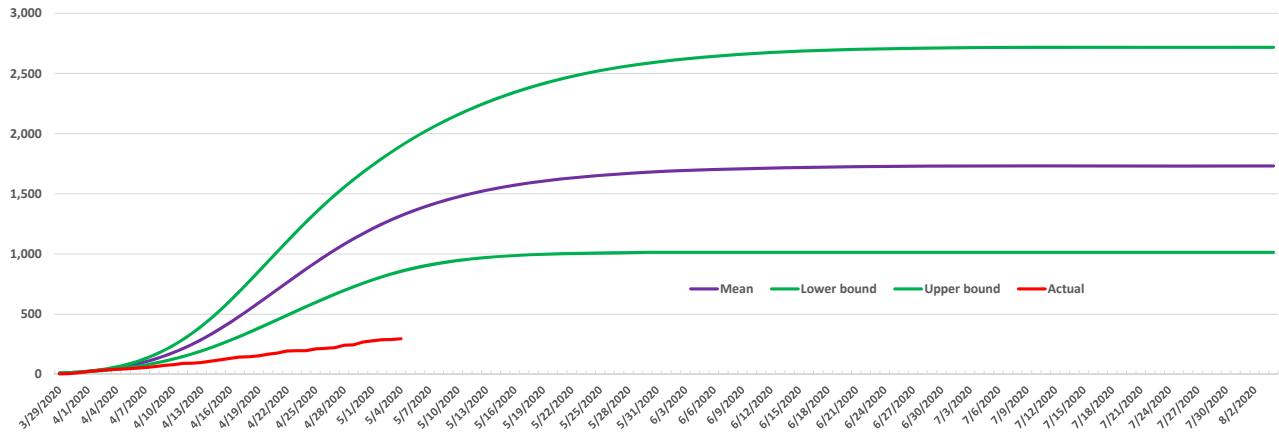
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Kentucky COVID 19 Cumulative Death Projections March 26



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Alabama COVID 19 Cumulative Death Projections March 26



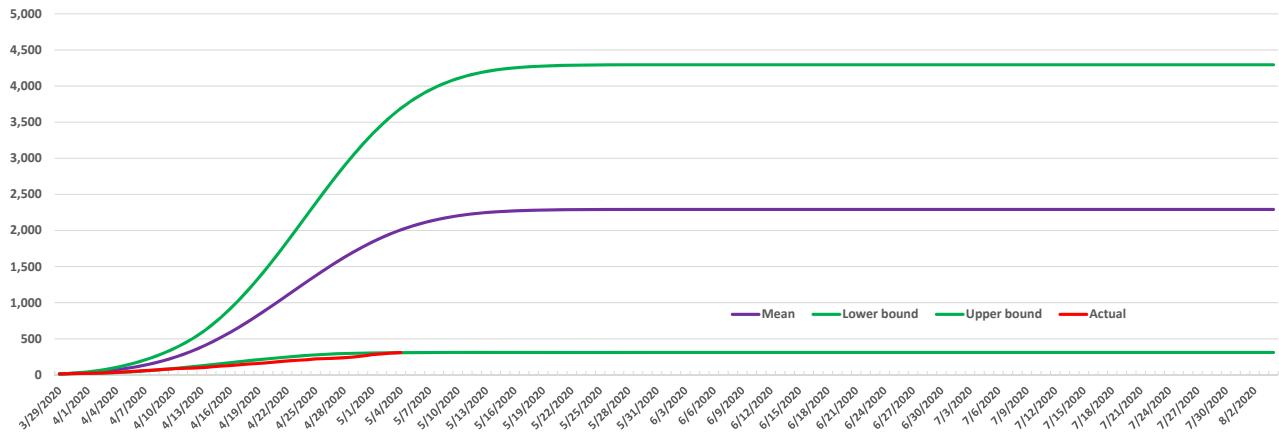
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Louisiana COVID 19 Daily Death Projections March 26



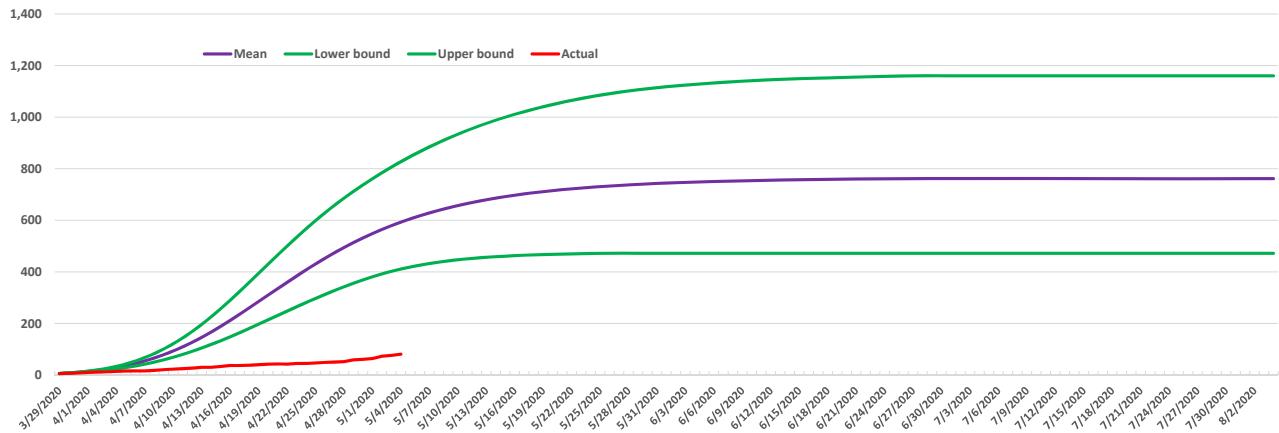
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Mississippi COVID 19 Daily Death Projections March 26



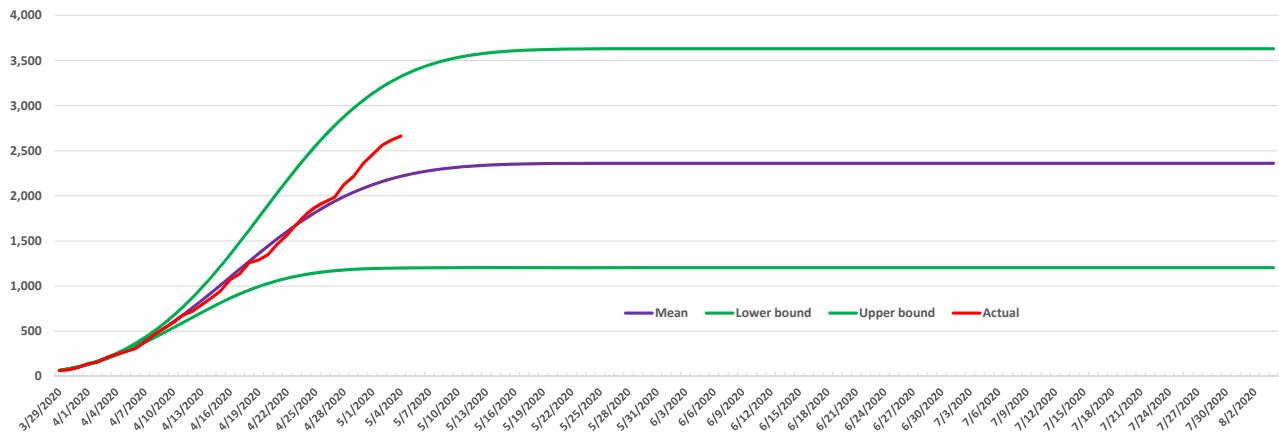
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Arkansas COVID 19 Cumulative Death Projections March 26



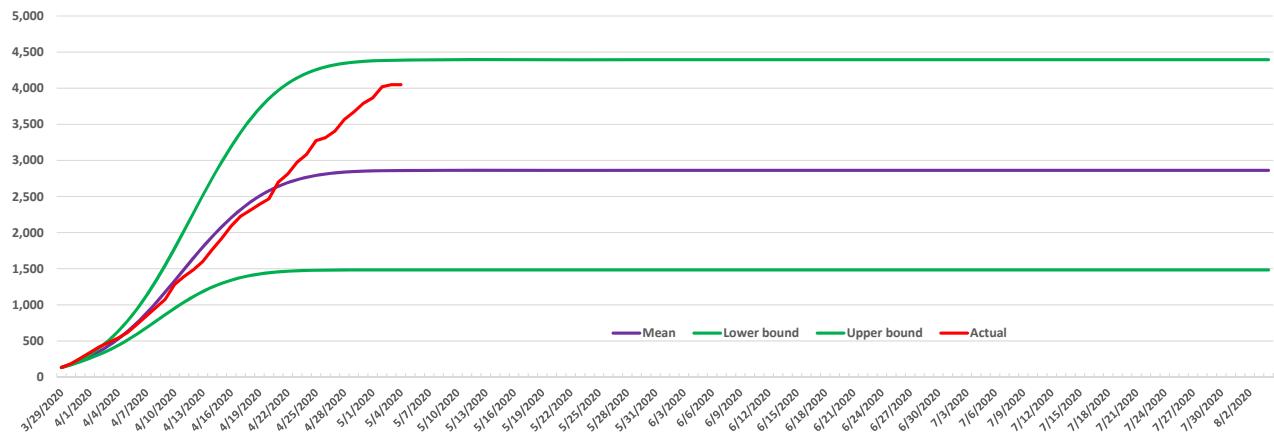
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Illinois COVID 19 Cumulative Death Projections March 26



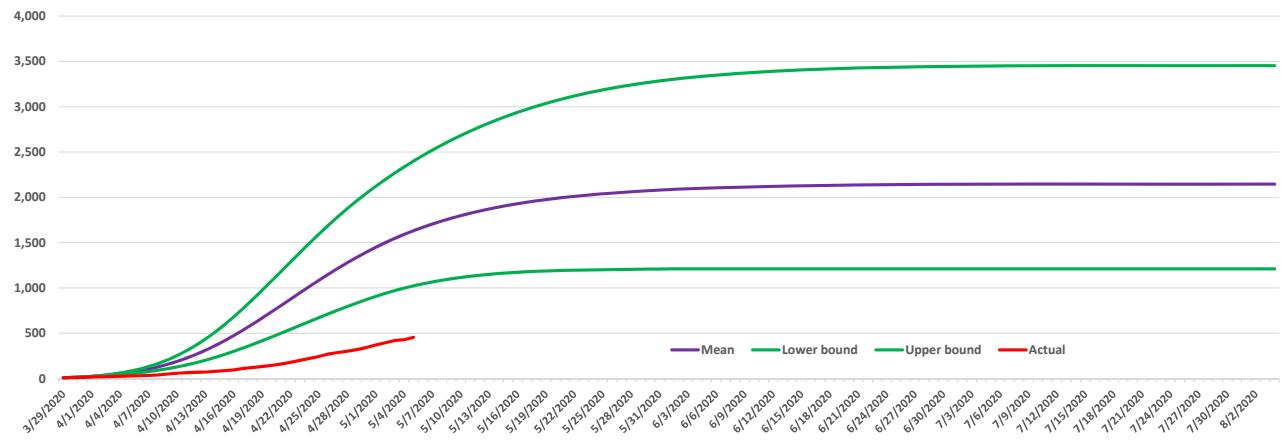
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Michigan COVID 19 Cumulative Death Projections



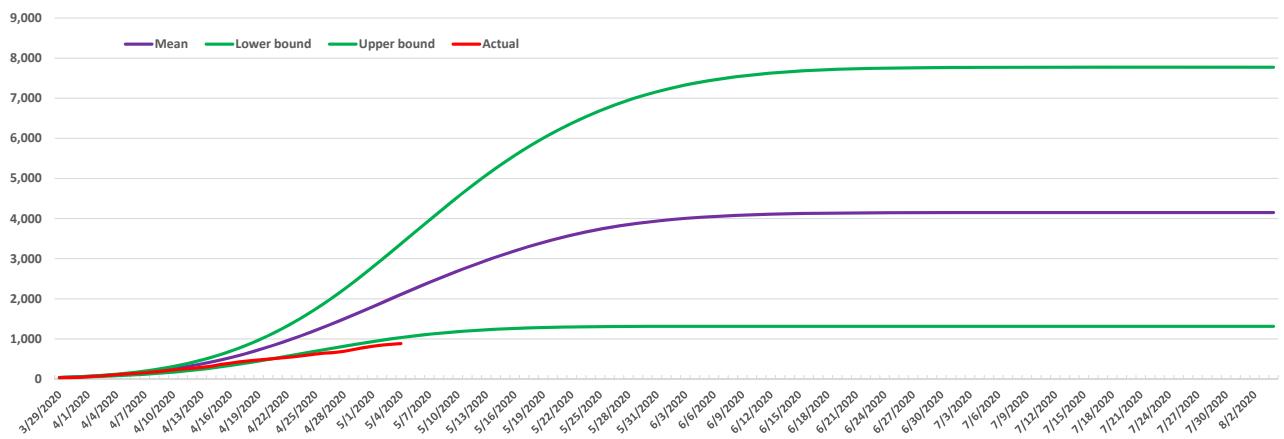
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Minnesota COVID 19 Cumulative Death Projections



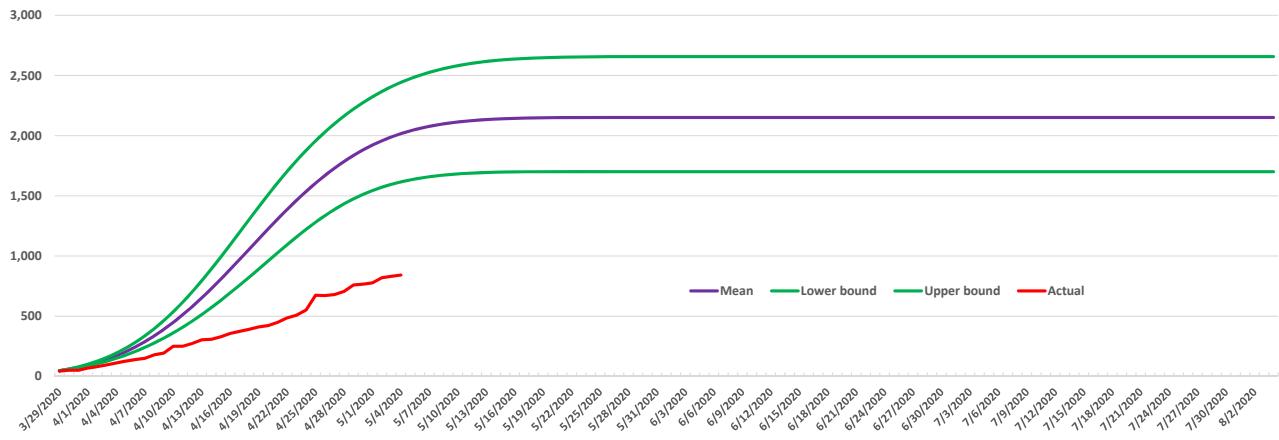
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Texas COVID 19 Daily Death Projections March 26



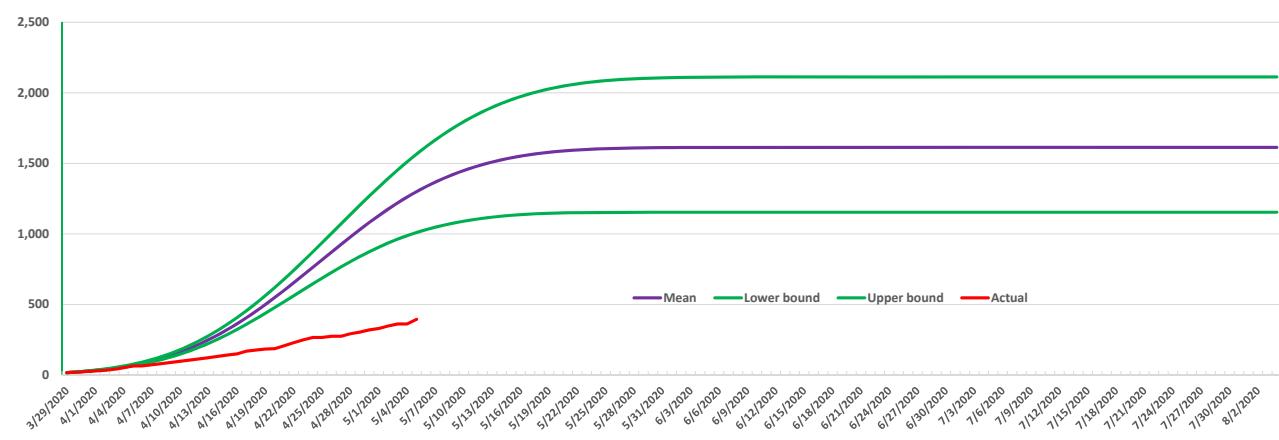
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Colorado COVID 19 Cumulative Death Projections March 26



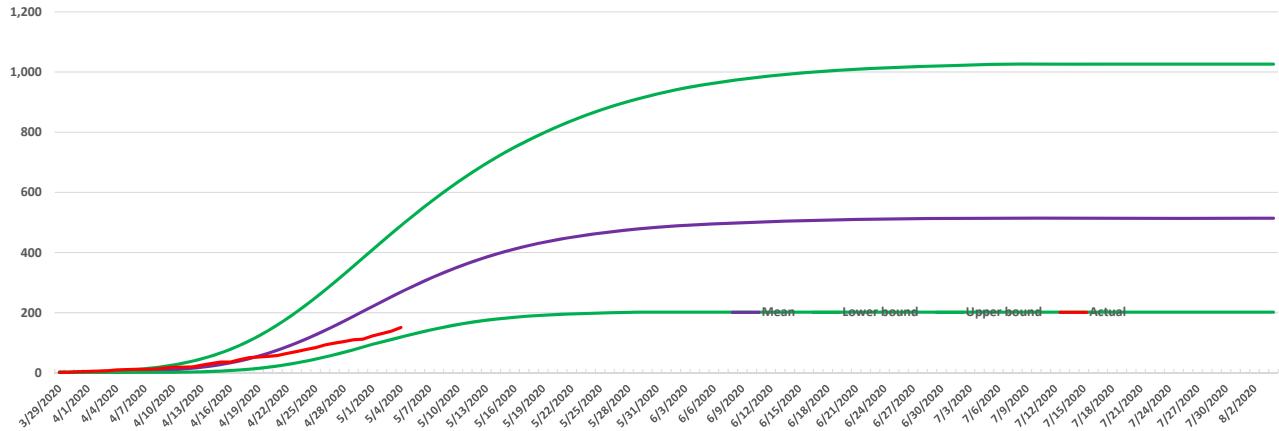
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Arizona COVID 19 Cumulative Death Projections



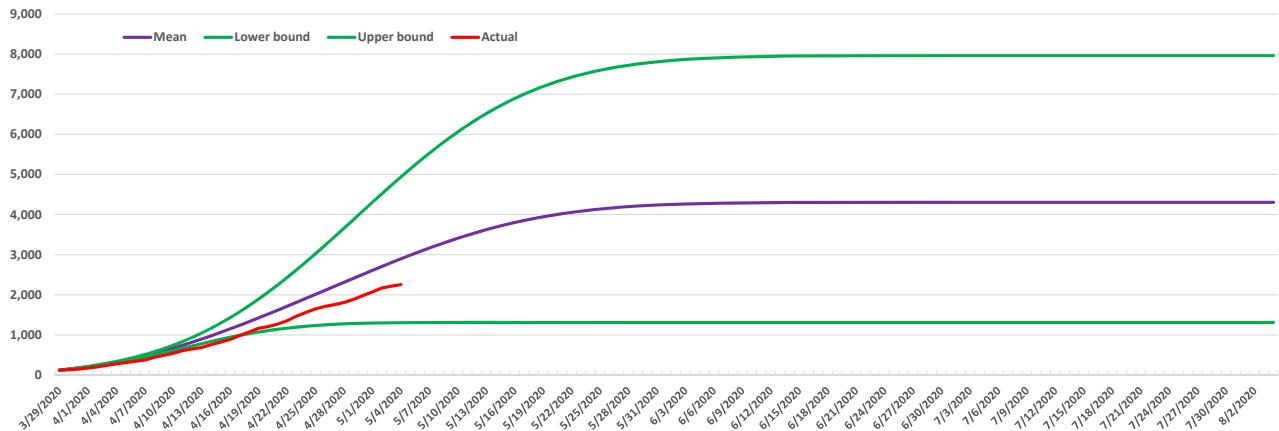
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New Mexico COVID 19 Daily Death Projections March 26



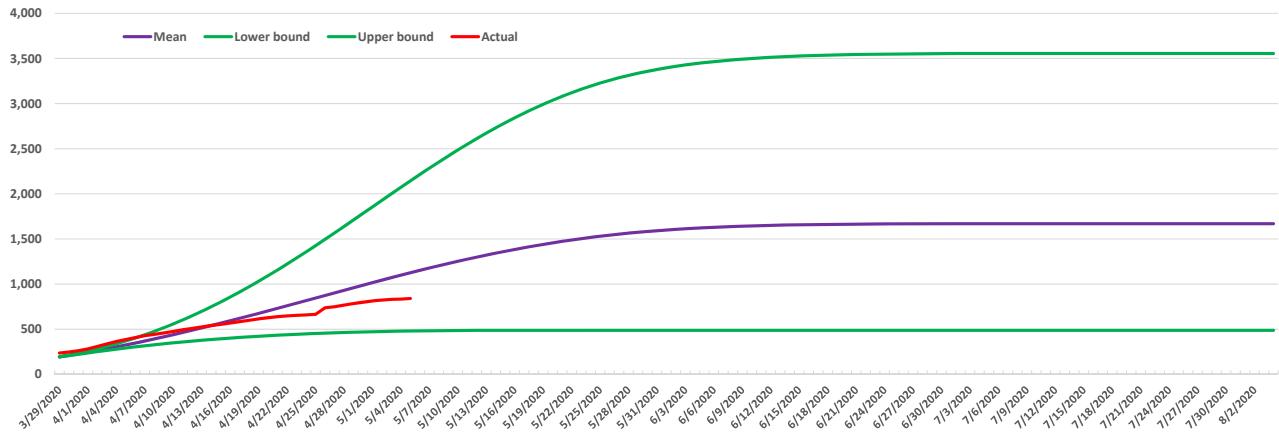
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California COVID 19 Cumulative Death Projections March 26



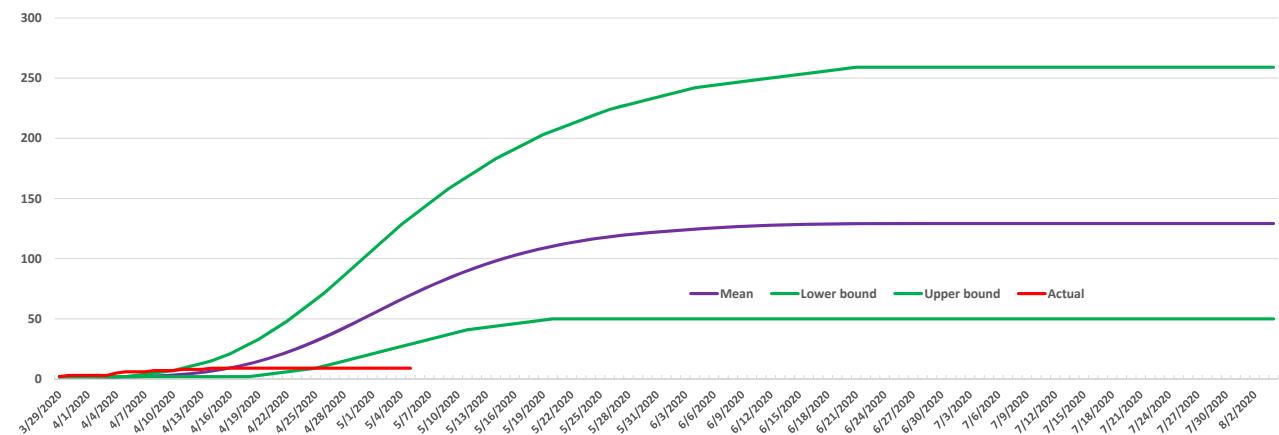
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Washington COVID 19 Cumulative Death Projections March 26



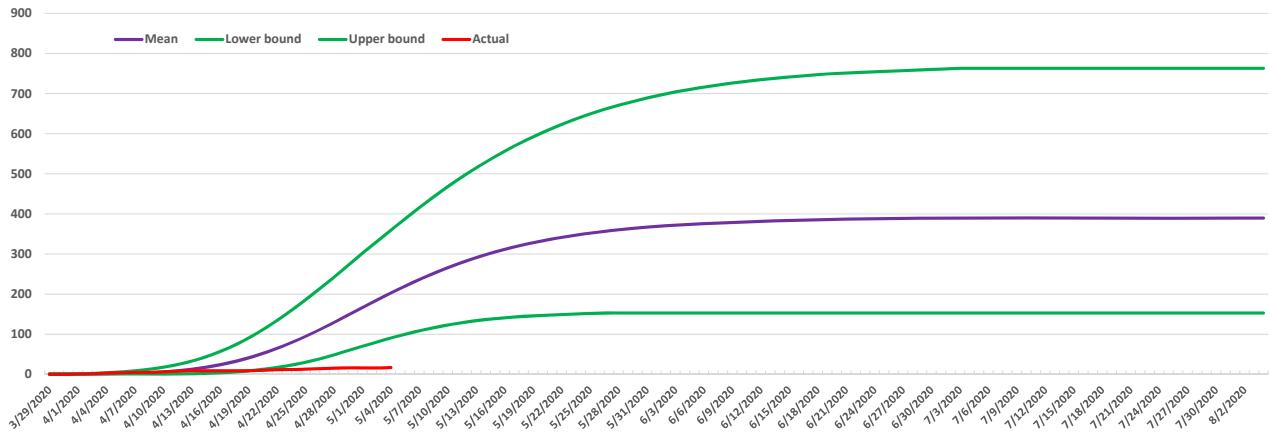
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Alaska COVID 19 Cumulative Death Projections March 26



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Hawaii COVID 19 Daily Death Projections March 26



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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 projections
 - This makes modeling extremely difficult
- Fairly large revisions to the cumulative death totals
- Adding variables to the modeling framework increases in-sample fit but does it increase out-of-sample fit?
- Are the revisions due to society flattening the curve or due to inaccurate models?



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