

# Bias-corrected State-by-state Forecasts of Covid-19 Deaths

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## Abstract

Since testing for Covid-19 infections is not at all randomized over the general population, most epidemiological model forecasts of deaths are subject to ‘selection bias.’ This paper updates and supplements Vinod and Theiss (2020), where the bias correction using generalized linear models (GLM) and inverse mills ratio (IMR) are described in detail. We include state-by-state forecasts using Poisson regression to predict one-week-ahead cumulative deaths from logarithms of current cumulative infections. We hope that the details provided here will help local governors and mayors in their opening up decisions.

Notes:

Funding: None to declare

Declaration of Interest: None to declare

## 1 An Extended Generalized Linear Model

The Covid-19 pandemic has had a profound effect on many aspects of life around the world. We focus on a statistical component of prediction and mitigation of any undesirable outcome  $Y_{it}$  at time  $t$ . For an illustration of our newer methodology, our  $Y_{it}$  is the count of deaths from Covid-19 in a state-level jurisdiction,  $i = 1, \dots, 51$ . We have 50 official states plus the District of Columbia or DC. Instead of calling them ‘state-level jurisdictions,’ we call them ‘states,’ after inserting the quotation marks as needed.

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Our panel (longitudinal) data are described later in detail in Section 2. Briefly, our data consists of various variables for 51 ‘states’ with weekly details over some ten weeks in the year 2020. We note that many variables do not change at all from week to week.

The outcomes studied in our empirical illustration are  $Y_{it}$  as counts of deaths in ‘state’ numbered  $i$  during the week  $t = 1, \dots, 10$  for weeks starting on April 20, 27, and on May 4, 11, 18, 25 and on June 1, 8, 15 and 22. A simple linear model for disease outcomes is:

$$Y_{it} = \beta_0 + \beta_1 \log(X_{i,t-1}) + \beta_2(IMR_{it}) + \epsilon_{it}, \quad (1)$$

where the key regressor is the log of lagged cumulative infection count  $X_{i,t-1}$  from the previous week. The second regressor is a measure of the bias based on inverse Mills ratio (IMR) developed in the literature from the properties of the truncated normal density.

Details regarding the construction of IMR from data involves an auxiliary regression model for predicting the probability that a randomly chosen person from state  $i$  during week  $t$  is tested for Covid-19. The prevalence of testing in a state is assumed to depend on the share of hospital employees (HES), proportion of population that is uninsured (UI), hypertension rate (HR), proportion of population commuting to work by public transit (CPT), and household income (HI) in the state. These state-level characteristics allow us to estimate the amount of testing bias quantified by IMR described in detail in Vinod and Theiss (2020).

The left-hand side of (1) is a ‘count’ of the number of deaths, which are nonnegative integers. The death count cannot be fractional or negative. In the traditional regression, the conditional expectation of the left-hand side can be fractional or negative, implying meaningless fitted values. Enter a Generalized Linear Model (GLM) with the Poisson distribution providing a so-called ‘link function’ to make sure that fitted values are positive integers.

We emphasize that we do not use traditional linear regression to estimate our coefficients  $\beta_j, j = 0, 1, 2$ . Instead, we use the R software function ‘glm’ to implement a Poisson regression. Also, the marginal effect of the key regressor on the dependent variable is estimated by the R package ‘margins,’ Leeper (2018).

Our tables in the following sections report the fitted values defined by (1)

$$\hat{Y}_{it}^{imr} = \hat{\beta}_0 + \hat{\beta}_1 \log(X_{i,t-1}) + \hat{\beta}_2(IMR_{it}). \quad (2)$$

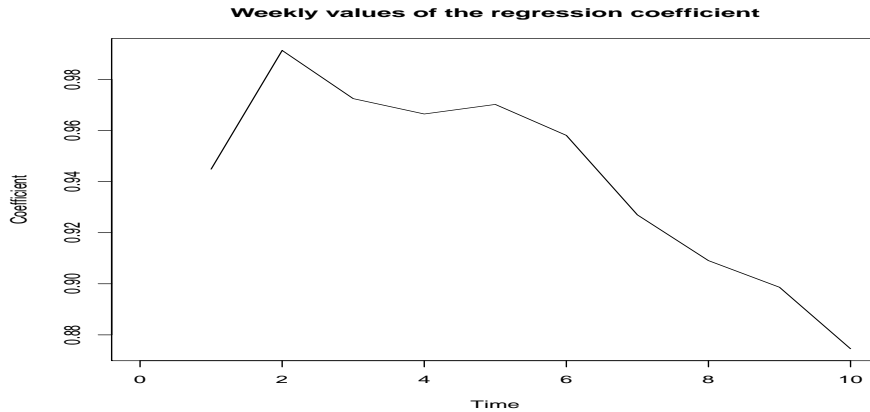
We find that the model with IMR provides a better overall forecasts of out-of-sample cumulative deaths than the following model without the IMR regressor.

$$\hat{Y}_{it} = \hat{\beta}_0^n + \hat{\beta}_1^n \log(X_{i,t-1}). \quad (3)$$

We remind the reader that these equations have an additional subscript  $k$  to represent the individual person who is tested for the virus. We have been avoiding the additional subscript to avoid clutter. It is understood that the fitted values  $\hat{Y}_{it}^{imr}, \hat{Y}_{it}$  represent averages over the  $k$  subscript for simulated individuals in the data.

It is desirable that the key coefficient  $\beta_1$  be declining over time. Figure 1 plots the fitted coefficient  $\hat{\beta}_1$  over the 10 weeks (April 20 to June 22) studied here. It is encouraging that these coefficients are declining over time.

Figure 1: Plot of  $\hat{\beta}_1$  over 10 weeks



The respective marginal effects in a model without IMR during weeks 1 to 10 are: ( 0.0642, 0.0633, 0.0628, 0.0633, 0.0628, 0.0617, 0.0604, 0.0596, 0.058, 0.0566), respectively.

By contrast, model with bias correction using IMR leads to following marginal effects: ( 0.0592, 0.0605, 0.06, 0.0597, 0.059, 0.0572, 0.0544, 0.0525, 0.05, 0.0472) for the ten weeks. This shows that bias correction slightly reduces the marginal effect of log of cumulative infections on cumulative deaths. Recall that our ten weeks start on (April 20, 27, and on May 4, 11, 18, 25, and on June 1, 8, 15 and 22), respectively.

## 2 Details of Data Sources

Table 1 describes the sources of data. Further details about the items in column entitled ‘Source’ are as follows. Data on Covid-19 testing indicator, ( $C_{it} = 0, 1$ , at time  $t$  for state  $i$ ) infection numbers and deaths were obtained from the Covid Tracking Project (CTP) (<https://covidtracking.com>). The two character codes for various ‘states’ are from the US postal service (USPS) (<https://www.usps.com/>).

The population in 2019 (POP) is from (<https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-total.html>). All relevant socioeconomic and demographic variables were obtained from the United Census Bureau (UCB) (<https://www.census.gov>), the Bureau of Labor Statistics (BLS), (<http://www.bls.gov>), American Health Rankings (AHR), (<https://www.americashealthrankings.org>) the Bureau of Transportation Statistics (BTS), (<https://www.bts.gov>) and World Population Review (WPR) (<https://worldpopulationreview.com/>).

Table 1: Description of Data and their Codes

	Code	Description	Source
1	$C_{it}$	testing indicator	CTP
2	STA	State Abbreviation	USPS
3	POP	Population in 2019	UCB
4	HES	Hospital Employee Share	BLS
5	UI	Uninsured Population	AHR
6	HR	Hypertension Rate	AHR
7	CPT	Commute Public Transit	BTS
8	HI	Household Income	WPR

## 3 State tables and cumulative death predictions made previous week for the week ending on June 29

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.

Table 2: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0629	ACD0629	Pred.on.0622	NDNI	Gov
1	AK	2.00	14.00	54.01	2.06	Rep
2	AL	78.00	919.00	1570.09	1.86	Rep
3	AR	22.00	249.00	822.06	0.69	Rep
4	AZ	237.00	1579.00	1697.23	1.32	Rep
5	CA	357.00	5872.00	6249.85	1.34	Dem
6	CO	26.00	1673.00	1361.02	1.84	Dem
7	CT	48.00	4311.00	2376.73	8.78	Dem
8	DC	13.00	548.00	1465.74	5.02	Dem
9	DE	3.00	507.00	725.57	0.62	Dem
10	FL	223.00	3489.00	3480.64	0.97	Rep
11	GA	128.00	2776.00	2624.53	1.70	Rep
12	HI	0.00	17.00	65.49	0.00	Dem
13	IA	18.00	704.00	1244.43	0.90	Rep
14	ID	1.00	90.00	201.63	0.16	Rep
15	IL	199.00	7074.00	6900.13	4.58	Dem
16	IN	63.00	2616.00	2110.51	2.86	Rep
17	KS	5.00	264.00	666.13	0.48	Dem

Table 3: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0629	ACD0629	Pred.on.0622	NDNI	Gov
18	KY	27.00	553.00	825.27	2.27	Dem
19	LA	73.00	3190.00	2588.28	2.38	Dem
20	MA	167.00	8041.00	5983.80	10.99	Rep
21	MD	83.00	3157.00	3618.27	3.23	Rep
22	ME	2.00	104.00	206.21	1.24	Dem
23	MI	56.00	6153.00	3310.44	2.99	Dem
24	MN	36.00	1452.00	1553.01	1.42	Dem
25	MO	35.00	996.00	918.40	1.79	Rep
26	MS	57.00	1035.00	1171.67	2.29	Rep
27	MT	1.00	22.00	47.10	0.76	Dem
28	NC	89.00	1312.00	2209.15	1.05	Dem
29	ND	4.00	87.00	213.32	1.89	Rep
30	NE	22.00	266.00	870.50	2.03	Rep
31	NH	26.00	365.00	338.28	13.06	Rep
32	NJ	2053.00	14948.00	8933.58	88.80	Dem
33	NM	20.00	489.00	520.10	2.38	Dem
34	NV	8.00	500.00	632.55	0.35	Dem

Table 4: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0629	ACD0629	Pred.on.0622	NDNI	Gov
35	NY	91.00	24830.00	25803.50	2.00	Dem
36	OH	100.00	2804.00	2239.64	2.52	Rep
37	OK	15.00	384.00	509.68	0.65	Rep
38	OR	10.00	202.00	351.46	0.69	Dem
39	PA	153.00	6579.00	4100.42	4.99	Dem
40	RI	24.00	927.00	986.00	6.56	Dem
41	SC	52.00	711.00	1091.55	0.82	Rep
42	SD	10.00	91.00	379.91	2.51	Rep
43	TN	53.00	584.00	1739.36	1.21	Rep
44	TX	174.00	2366.00	3588.23	0.68	Rep
45	UT	9.00	167.00	672.44	0.27	Rep
46	VA	104.00	1724.00	2719.89	2.91	Dem
47	VT	0.00	56.00	88.15	0.00	Rep
48	WA	34.00	1304.00	1432.60	1.20	Dem
49	WI	32.00	777.00	1225.37	1.50	Dem
50	WV	4.00	93.00	211.19	1.57	Rep
51	WY	0.00	20.00	78.44	0.00	Rep

## 4 State tables for predictions for the week ending on June 22

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.

Table 5: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0622	ACD0622	Pred.on.0615	NDNI	Gov
1	AK	0.00	12.00	43.84	0.00	Rep
2	AL	67.00	841.00	1299.67	1.25	Rep
3	AR	45.00	227.00	636.79	1.42	Rep
4	AZ	148.00	1342.00	1353.49	1.64	Rep
5	CA	426.00	5515.00	5831.53	2.12	Dem
6	CO	48.00	1647.00	1345.47	4.25	Dem
7	CT	59.00	4263.00	2391.63	5.16	Dem
8	DC	20.00	535.00	1258.21	4.88	Dem
9	DE	81.00	504.00	693.87	22.01	Dem
10	FL	236.00	3266.00	3105.36	1.90	Rep
11	GA	154.00	2648.00	2478.44	2.60	Rep
12	HI	0.00	17.00	56.96	0.00	Dem
13	IA	31.00	686.00	1169.37	1.50	Rep
14	ID	2.00	89.00	182.79	0.77	Rep
15	IL	368.00	6875.00	6921.36	7.77	Dem
16	IN	120.00	2553.00	2031.75	4.28	Rep
17	KS	14.00	259.00	625.45	1.82	Dem



Table 6: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0622	ACD0622	Pred.on.0615	NDNI	Gov
18	KY	21.00	526.00	752.65	1.79	Dem
19	LA	99.00	3117.00	2446.80	2.40	Dem
20	MA	227.00	7874.00	6049.46	11.00	Rep
21	MD	127.00	3074.00	3516.30	3.50	Rep
22	ME	1.00	102.00	184.56	0.45	Dem
23	MI	80.00	6097.00	3356.79	4.79	Dem
24	MN	81.00	1416.00	1469.27	3.28	Dem
25	MO	81.00	961.00	845.57	5.57	Rep
26	MS	83.00	978.00	1071.16	4.09	Rep
27	MT	2.00	21.00	39.86	3.28	Dem
28	NC	105.00	1223.00	1883.01	1.22	Dem
29	ND	6.00	83.00	193.39	2.71	Rep
30	NE	28.00	244.00	828.86	2.57	Rep
31	NH	19.00	339.00	317.35	6.29	Rep
32	NJ	219.00	12895.00	9192.31	8.40	Dem
33	NM	34.00	469.00	479.56	4.34	Dem
34	NV	27.00	492.00	555.05	1.81	Dem

Table 7: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0622	ACD0622	Pred.on.0615	NDNI	Gov
35	NY	160.00	24739.00	25583.80	3.11	Dem
36	OH	131.00	2704.00	2157.80	4.78	Rep
37	OK	10.00	369.00	440.27	0.82	Rep
38	OR	16.00	192.00	303.94	2.24	Dem
39	PA	183.00	6426.00	4106.19	7.15	Dem
40	RI	52.00	903.00	963.45	11.53	Dem
41	SC	57.00	659.00	866.83	1.25	Rep
42	SD	6.00	81.00	346.66	1.31	Rep
43	TN	48.00	531.00	1557.84	1.14	Rep
44	TX	209.00	2192.00	3269.23	1.55	Rep
45	UT	15.00	158.00	585.21	0.66	Rep
46	VA	68.00	1620.00	2652.02	1.87	Dem
47	VT	1.00	56.00	79.69	1.89	Rep
48	WA	53.00	1270.00	1341.02	2.52	Dem
49	WI	51.00	745.00	1149.41	2.69	Dem
50	WV	1.00	89.00	189.11	0.69	Rep
51	WY	2.00	20.00	67.92	2.00	Rep

## 5 State tables for predictions for the week ending on June 15

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.

Table 8: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0615	ACD0615	Pred.on.0608	NDNI	Gov
1	AK	2.00	12.00	37.05	2.08	Rep
2	AL	56.00	774.00	1155.33	2.19	Rep
3	AR	27.00	182.00	496.23	1.18	Rep
4	AZ	147.00	1194.00	1068.32	1.95	Rep
5	CA	436.00	5089.00	5400.94	2.38	Dem
6	CO	72.00	1599.00	1360.51	4.44	Dem
7	CT	120.00	4204.00	2403.65	8.88	Dem
8	DC	24.00	515.00	1120.23	4.51	Dem
9	DE	25.00	423.00	675.34	6.81	Dem
10	FL	232.00	3030.00	2886.64	2.87	Rep
11	GA	286.00	2494.00	2391.29	5.86	Rep
12	HI	0.00	17.00	54.25	0.00	Dem
13	IA	43.00	655.00	1103.32	1.88	Rep
14	ID	4.00	87.00	174.16	1.33	Rep
15	IL	405.00	6507.00	6752.40	5.12	Dem
16	IN	117.00	2433.00	1962.23	4.19	Rep
17	KS	9.00	245.00	613.06	1.41	Dem

Table 9: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0615	ACD0615	Pred.on.0608	NDNI	Gov
18	KY	33.00	505.00	667.16	2.31	Dem
19	LA	74.00	3018.00	2352.61	2.73	Dem
20	MA	294.00	7647.00	5896.84	4.41	Rep
21	MD	171.00	2947.00	3277.11	3.37	Rep
22	ME	2.00	101.00	170.78	0.84	Dem
23	MI	122.00	6017.00	3147.21	1.77	Dem
24	MN	127.00	1335.00	1404.11	4.21	Dem
25	MO	61.00	880.00	806.17	4.33	Rep
26	MS	58.00	895.00	971.00	2.88	Rep
27	MT	1.00	19.00	38.97	3.45	Dem
28	NC	112.00	1118.00	1606.98	1.55	Dem
29	ND	2.00	77.00	184.27	0.78	Rep
30	NE	28.00	216.00	792.42	1.83	Rep
31	NH	34.00	320.00	303.26	8.67	Rep
32	NJ	462.00	12676.00	9166.59	12.91	Dem
33	NM	39.00	435.00	439.53	3.12	Dem
34	NV	23.00	465.00	512.90	2.10	Dem

Table 10: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0615	ACD0615	Pred.on.0608	NDNI	Gov
35	NY	280.00	24579.00	25163.14	3.95	Dem
36	OH	169.00	2573.00	2083.29	5.92	Rep
37	OK	11.00	359.00	411.57	1.74	Rep
38	OR	12.00	176.00	276.02	1.94	Dem
39	PA	290.00	6243.00	4072.30	7.91	Dem
40	RI	52.00	851.00	948.06	7.99	Dem
41	SC	45.00	602.00	736.35	1.70	Rep
42	SD	10.00	75.00	335.50	2.29	Rep
43	TN	62.00	483.00	1404.59	1.83	Rep
44	TX	153.00	1983.00	3033.88	1.42	Rep
45	UT	19.00	143.00	518.98	0.82	Rep
46	VA	75.00	1552.00	2456.67	1.28	Dem
47	VT	0.00	55.00	74.59	0.00	Rep
48	WA	58.00	1217.00	1277.74	2.86	Dem
49	WI	40.00	694.00	1070.30	1.60	Dem
50	WV	4.00	88.00	172.47	2.94	Rep
51	WY	1.00	18.00	65.94	2.00	Rep

## 6 State tables for predictions for the week ending on June 8

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.

Table 11: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0608	ACD0608	Pred.on.0601	NDNI	Gov
1	AK	0.00	10.00	31.22	0.00	Rep
2	AL	72.00	718.00	949.72	1.98	Rep
3	AR	22.00	155.00	402.79	1.56	Rep
4	AZ	130.00	1047.00	886.54	3.65	Rep
5	CA	402.00	4653.00	4698.78	2.18	Dem
6	CO	82.00	1527.00	1252.64	3.72	Dem
7	CT	120.00	4084.00	2343.58	6.43	Dem
8	DC	23.00	491.00	981.29	3.64	Dem
9	DE	30.00	398.00	629.13	4.69	Dem
10	FL	255.00	2798.00	2700.11	5.02	Rep
11	GA	134.00	2208.00	2229.00	3.13	Rep
12	HI	0.00	17.00	50.41	0.00	Dem
13	IA	61.00	612.00	988.11	2.88	Rep
14	ID	1.00	83.00	155.44	0.47	Rep
15	IL	690.00	6102.00	6410.90	7.49	Dem
16	IN	174.00	2316.00	1820.62	5.59	Rep
17	KS	19.00	236.00	562.62	2.40	Dem

Table 12: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0608	ACD0608	Pred.on.0601	NDNI	Gov
18	KY	33.00	472.00	569.31	2.24	Dem
19	LA	143.00	2944.00	2248.86	5.65	Dem
20	MA	507.00	7353.00	5807.21	13.72	Rep
21	MD	151.00	2776.00	2988.35	2.44	Rep
22	ME	10.00	99.00	147.00	3.64	Dem
23	MI	379.00	5895.00	3065.44	14.30	Dem
24	MN	148.00	1208.00	1197.50	3.80	Dem
25	MO	46.00	819.00	733.54	3.97	Rep
26	MS	98.00	837.00	840.88	4.27	Rep
27	MT	1.00	18.00	33.60	2.50	Dem
28	NC	108.00	1006.00	1346.21	2.04	Dem
29	ND	14.00	75.00	165.36	6.83	Rep
30	NE	18.00	188.00	684.23	0.92	Rep
31	NH	41.00	286.00	268.12	8.17	Rep
32	NJ	493.00	12214.00	9201.12	8.46	Dem
33	NM	40.00	396.00	388.55	5.36	Dem
34	NV	21.00	442.00	460.05	2.60	Dem

Table 13: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0608	ACD0608	Pred.on.0601	NDNI	Gov
35	NY	340.00	24299.00	24738.98	3.80	Dem
36	OH	198.00	2404.00	1912.99	5.65	Rep
37	OK	14.00	348.00	379.34	2.90	Rep
38	OR	10.00	164.00	245.38	2.83	Dem
39	PA	386.00	5953.00	3884.49	8.19	Dem
40	RI	79.00	799.00	889.44	8.53	Dem
41	SC	57.00	557.00	623.01	2.89	Rep
42	SD	3.00	65.00	300.82	0.67	Rep
43	TN	54.00	421.00	1253.11	1.83	Rep
44	TX	152.00	1830.00	2723.69	1.71	Rep
45	UT	11.00	124.00	438.84	0.74	Rep
46	VA	85.00	1477.00	2110.93	1.11	Dem
47	VT	0.00	55.00	68.99	0.00	Rep
48	WA	41.00	1159.00	1169.72	2.19	Dem
49	WI	59.00	654.00	905.05	1.99	Dem
50	WV	9.00	84.00	148.18	3.70	Rep
51	WY	0.00	17.00	58.00	0.00	Rep

## 7 State tables for predictions for the week ending on June 1

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.



Table 14: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0601	ACD0601	Pred.on.0525	NDNI	Gov
1	AK	0.00	10.00	27.26	0.00	Rep
2	AL	84.00	646.00	764.07	3.18	Rep
3	AR	16.00	133.00	306.93	1.32	Rep
4	AZ	111.00	917.00	780.11	4.64	Rep
5	CA	456.00	4251.00	4221.71	3.23	Dem
6	CO	113.00	1445.00	1182.74	5.05	Dem
7	CT	222.00	3964.00	2198.00	8.05	Dem
8	DC	28.00	468.00	755.54	2.93	Dem
9	DE	36.00	368.00	533.53	3.29	Dem
10	FL	212.00	2543.00	2555.18	4.00	Rep
11	GA	244.00	2074.00	2069.27	4.64	Rep
12	HI	0.00	17.00	43.62	0.00	Dem
13	IA	92.00	551.00	853.18	3.51	Rep
14	ID	3.00	82.00	141.31	1.45	Rep
15	IL	528.00	5412.00	5736.05	3.40	Dem
16	IN	166.00	2142.00	1668.85	4.80	Rep
17	KS	29.00	217.00	512.09	3.30	Dem

Table 15: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0601	ACD0601	Pred.on.0525	NDNI	Gov
18	KY	48.00	439.00	490.98	5.44	Dem
19	LA	111.00	2801.00	2101.51	3.58	Dem
20	MA	430.00	6846.00	5500.92	5.92	Rep
21	MD	246.00	2625.00	2477.95	3.33	Rep
22	ME	11.00	89.00	115.74	3.05	Dem
23	MI	276.00	5516.00	3004.73	9.30	Dem
24	MN	170.00	1060.00	952.10	3.44	Dem
25	MO	88.00	773.00	675.81	7.20	Rep
26	MS	104.00	739.00	712.03	5.13	Rep
27	MT	1.00	17.00	30.95	11.11	Dem
28	NC	144.00	898.00	1106.87	2.91	Dem
29	ND	7.00	61.00	129.90	1.43	Rep
30	NE	20.00	170.00	595.78	1.12	Rep
31	NH	36.00	245.00	224.35	6.51	Rep
32	NJ	577.00	11721.00	8874.36	8.18	Dem
33	NM	39.00	356.00	338.24	3.88	Dem
34	NV	27.00	421.00	398.05	2.77	Dem

Table 16: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0601	ACD0601	Pred.on.0525	NDNI	Gov
35	NY	471.00	23959.00	24194.58	4.13	Dem
36	OH	219.00	2206.00	1722.52	5.44	Rep
37	OK	21.00	334.00	329.99	3.04	Rep
38	OR	6.00	154.00	220.53	2.29	Dem
39	PA	428.00	5567.00	3715.54	8.34	Dem
40	RI	112.00	720.00	798.78	8.82	Dem
41	SC	60.00	500.00	539.01	4.85	Rep
42	SD	12.00	62.00	266.73	2.15	Rep
43	TN	29.00	367.00	1100.29	1.12	Rep
44	TX	151.00	1678.00	2551.03	2.08	Rep
45	UT	15.00	113.00	389.09	1.32	Rep
46	VA	184.00	1392.00	1763.76	2.79	Dem
47	VT	1.00	55.00	62.94	5.56	Rep
48	WA	57.00	1118.00	1113.68	7.05	Dem
49	WI	81.00	595.00	750.22	2.80	Dem
50	WV	3.00	75.00	113.55	1.06	Rep
51	WY	5.00	17.00	48.97	5.95	Rep

## 8 State tables for predictions for the week ending on May 25

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.

Table 17: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0525	ACD0525	Pred.on.0518	NDNI	Gov
1	AK	0.00	10.00	25.18	0.00	Rep
2	AL	73.00	562.00	630.13	3.52	Rep
3	AR	17.00	117.00	255.38	2.18	Rep
4	AZ	120.00	806.00	645.72	4.30	Rep
5	CA	493.00	3795.00	3760.34	3.95	Dem
6	CO	117.00	1332.00	1115.16	5.74	Dem
7	CT	293.00	3742.00	2008.68	6.73	Dem
8	DC	48.00	440.00	611.17	5.45	Dem
9	DE	35.00	332.00	439.69	2.68	Dem
10	FL	258.00	2331.00	2315.67	4.72	Rep
11	GA	188.00	1830.00	1896.67	4.53	Rep
12	HI	0.00	17.00	42.33	0.00	Dem
13	IA	104.00	459.00	725.67	4.03	Rep
14	ID	6.00	79.00	131.01	3.17	Rep
15	IL	650.00	4884.00	4825.28	3.72	Dem
16	IN	211.00	1976.00	1475.80	5.82	Rep
17	KS	15.00	188.00	437.93	1.23	Dem

Table 18: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0525	ACD0525	Pred.on.0518	NDNI	Gov
18	KY	57.00	391.00	410.15	4.57	Dem
19	LA	127.00	2690.00	1939.97	4.39	Dem
20	MA	619.00	6416.00	5089.04	8.20	Rep
21	MD	257.00	2379.00	2118.22	4.02	Rep
22	ME	7.00	78.00	96.54	2.79	Dem
23	MI	325.00	5240.00	2816.64	7.45	Dem
24	MN	150.00	890.00	707.70	3.28	Dem
25	MO	80.00	685.00	611.72	7.79	Rep
26	MS	107.00	635.00	599.04	6.09	Rep
27	MT	0.00	16.00	29.46	0.00	Dem
28	NC	93.00	754.00	890.00	2.34	Dem
29	ND	10.00	54.00	100.30	2.42	Rep
30	NE	27.00	150.00	488.76	1.33	Rep
31	NH	37.00	209.00	197.78	8.49	Rep
32	NJ	709.00	11144.00	8611.10	8.76	Dem
33	NM	52.00	317.00	282.04	4.84	Dem
34	NV	44.00	394.00	360.02	5.84	Dem

Table 19: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0525	ACD0525	Pred.on.0518	NDNI	Gov
35	NY	759.00	23488.00	23355.45	5.30	Dem
36	OH	330.00	1987.00	1517.22	8.97	Rep
37	OK	25.00	313.00	280.70	3.18	Rep
38	OR	10.00	148.00	198.69	2.49	Dem
39	PA	634.00	5139.00	3446.83	10.74	Dem
40	RI	102.00	608.00	719.44	7.58	Dem
41	SC	49.00	440.00	463.23	3.80	Rep
42	SD	6.00	50.00	234.50	1.45	Rep
43	TN	37.00	338.00	952.93	1.50	Rep
44	TX	180.00	1527.00	2164.57	2.04	Rep
45	UT	18.00	98.00	348.96	1.76	Rep
46	VA	194.00	1208.00	1466.83	3.20	Dem
47	VT	0.00	54.00	60.59	0.00	Rep
48	WA	60.00	1061.00	1062.00	4.65	Dem
49	WI	55.00	514.00	627.63	2.42	Dem
50	WV	5.00	72.00	98.75	4.00	Rep
51	WY	4.00	12.00	42.20	4.35	Rep

## 9 State tables for predictions for the week ending on May 18

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.

Table 20: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0518	ACD0518	Pred.on.0511	NDNI	Gov
1	AK	0.00	10.00	25.20	0.00	Rep
2	AL	88.00	489.00	515.27	4.43	Rep
3	AR	6.00	100.00	222.84	1.04	Rep
4	AZ	144.00	686.00	511.19	5.85	Rep
5	CA	532.00	3302.00	3069.74	4.09	Dem
6	CO	234.00	1215.00	942.12	7.17	Dem
7	CT	441.00	3449.00	1773.15	9.85	Dem
8	DC	64.00	392.00	514.40	5.25	Dem
9	DE	72.00	297.00	364.81	5.64	Dem
10	FL	268.00	2073.00	2091.28	6.56	Rep
11	GA	201.00	1642.00	1648.88	4.41	Rep
12	HI	0.00	17.00	42.73	0.00	Dem
13	IA	84.00	355.00	578.35	3.15	Rep
14	ID	6.00	73.00	122.17	3.55	Rep
15	IL	775.00	4234.00	3947.25	5.11	Dem
16	IN	225.00	1765.00	1245.67	5.46	Rep
17	KS	15.00	173.00	330.17	0.80	Dem

Table 21: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0518	ACD0518	Pred.on.0511	NDNI	Gov
18	KY	30.00	334.00	333.61	2.29	Dem
19	LA	255.00	2563.00	1825.69	11.90	Dem
20	MA	689.00	5797.00	4571.80	7.35	Rep
21	MD	334.00	2122.00	1720.59	4.79	Rep
22	ME	6.00	71.00	81.70	2.33	Dem
23	MI	331.00	4915.00	2626.03	9.19	Dem
24	MN	149.00	740.00	446.07	3.26	Dem
25	MO	117.00	605.00	547.17	10.05	Rep
26	MS	93.00	528.00	495.02	5.17	Rep
27	MT	0.00	16.00	29.80	0.00	Dem
28	NC	111.00	661.00	710.40	3.47	Dem
29	ND	8.00	44.00	83.38	2.73	Rep
30	NE	25.00	123.00	354.32	1.04	Rep
31	NH	39.00	172.00	166.70	6.82	Rep
32	NJ	1125.00	10435.00	8004.30	9.63	Dem
33	NM	65.00	265.00	225.50	6.42	Dem
34	NV	44.00	350.00	324.37	6.66	Dem



Table 22: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0518	ACD0518	Pred.on.0511	NDNI	Gov
35	NY	1089.00	22729.00	22143.11	6.02	Dem
36	OH	300.00	1657.00	1273.37	6.97	Rep
37	OK	14.00	288.00	249.55	2.46	Rep
38	OR	8.00	138.00	169.36	1.52	Dem
39	PA	774.00	4505.00	3051.43	10.96	Dem
40	RI	76.00	506.00	619.48	4.23	Dem
41	SC	60.00	391.00	406.62	5.84	Rep
42	SD	10.00	44.00	177.83	1.06	Rep
43	TN	50.00	301.00	843.76	2.53	Rep
44	TX	247.00	1347.00	1764.50	3.28	Rep
45	UT	12.00	80.00	294.55	1.15	Rep
46	VA	164.00	1014.00	1161.82	2.94	Dem
47	VT	1.00	54.00	60.50	4.76	Rep
48	WA	70.00	1001.00	986.72	4.78	Dem
49	WI	50.00	459.00	505.00	2.29	Dem
50	WV	13.00	67.00	89.83	8.12	Rep
51	WY	1.00	8.00	38.21	1.32	Rep

## 10 State tables for predictions for the week ending on May 11

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.

Table 23: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0511	ACD0511	Pred.on.0504	NDNI	Gov
1	AK	1.00	10.00	22.99	4.00	Rep
2	AL	105.00	401.00	412.45	6.88	Rep
3	AR	13.00	94.00	191.11	2.95	Rep
4	AZ	180.00	542.00	389.88	8.17	Rep
5	CA	516.00	2770.00	2454.54	4.50	Dem
6	CO	139.00	981.00	770.16	4.35	Dem
7	CT	513.00	3008.00	1518.65	12.77	Dem
8	DC	70.00	328.00	359.20	5.48	Dem
9	DE	43.00	225.00	280.95	3.82	Dem
10	FL	382.00	1805.00	1846.48	8.03	Rep
11	GA	219.00	1441.00	1366.48	4.01	Rep
12	HI	0.00	17.00	40.22	0.00	Dem
13	IA	83.00	271.00	352.28	2.16	Rep
14	ID	3.00	67.00	112.89	1.83	Rep
15	IL	797.00	3459.00	2835.14	4.44	Dem
16	IN	276.00	1540.00	971.71	6.07	Rep
17	KS	22.00	158.00	210.38	1.15	Dem

Table 24: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0511	ACD0511	Pred.on.0504	NDNI	Gov
18	KY	51.00	304.00	260.67	4.83	Dem
19	LA	244.00	2308.00	1656.40	9.37	Dem
20	MA	1018.00	5108.00	3680.26	8.06	Rep
21	MD	364.00	1788.00	1249.02	5.26	Rep
22	ME	8.00	65.00	68.12	4.40	Dem
23	MI	535.00	4584.00	2281.19	9.32	Dem
24	MN	163.00	591.00	237.31	4.77	Dem
25	MO	130.00	488.00	449.03	8.21	Rep
26	MS	125.00	435.00	382.22	7.01	Rep
27	MT	0.00	16.00	28.92	0.00	Dem
28	NC	120.00	550.00	551.73	4.43	Dem
29	ND	11.00	36.00	63.40	3.89	Rep
30	NE	20.00	98.00	184.47	0.69	Rep
31	NH	47.00	133.00	118.88	6.49	Rep
32	NJ	1400.00	9310.00	6857.68	8.20	Dem
33	NM	49.00	200.00	161.72	4.36	Dem
34	NV	44.00	306.00	277.67	5.49	Dem

Table 25: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0511	ACD0511	Pred.on.0504	NDNI	Gov
35	NY	2225.00	21640.00	19772.58	8.25	Dem
36	OH	301.00	1357.00	1049.92	8.53	Rep
37	OK	36.00	274.00	202.51	4.71	Rep
38	OR	21.00	130.00	143.55	5.18	Dem
39	PA	1273.00	3731.00	2554.77	15.83	Dem
40	RI	89.00	430.00	488.75	4.58	Dem
41	SC	56.00	331.00	335.79	4.93	Rep
42	SD	13.00	34.00	148.75	3.07	Rep
43	TN	32.00	251.00	616.19	0.88	Rep
44	TX	216.00	1100.00	1417.86	3.07	Rep
45	UT	18.00	68.00	238.18	1.66	Rep
46	VA	166.00	850.00	808.83	2.79	Dem
47	VT	1.00	53.00	56.33	2.27	Rep
48	WA	97.00	931.00	877.38	5.69	Dem
49	WI	69.00	409.00	372.89	3.20	Dem
50	WV	4.00	54.00	76.23	2.80	Rep
51	WY	0.00	7.00	24.08	0.00	Rep

## 11 State tables for predictions for the week ending on May 4

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.

Table 26: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0504	ACD0504	Pred.on._0427	NDNI	Gov
1	AK	0.00	9.00	19.13	0.00	Rep
2	AL	74.00	296.00	305.91	5.02	Rep
3	AR	31.00	81.00	116.00	2.83	Rep
4	AZ	87.00	362.00	284.26	5.27	Rep
5	CA	499.00	2254.00	1746.93	4.00	Dem
6	CO	162.00	842.00	544.22	4.37	Dem
7	CT	497.00	2495.00	1168.47	9.11	Dem
8	DC	73.00	258.00	256.17	7.57	Dem
9	DE	57.00	182.00	175.14	4.02	Dem
10	FL	322.00	1423.00	1517.10	5.88	Rep
11	GA	251.00	1222.00	1066.43	5.05	Rep
12	HI	3.00	17.00	35.23	11.54	Dem
13	IA	61.00	188.00	183.17	2.25	Rep
14	ID	8.00	64.00	93.80	3.56	Rep
15	IL	679.00	2662.00	1945.12	4.72	Dem
16	IN	420.00	1264.00	694.56	9.82	Rep
17	KS	16.00	136.00	118.86	1.19	Dem

Table 27: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0504	ACD0504	Pred.on._0427	NDNI	Gov
18	KY	45.00	253.00	181.05	4.04	Dem
19	LA	367.00	2064.00	1479.52	14.42	Dem
20	MA	1087.00	4090.00	2679.56	7.22	Rep
21	MD	379.00	1424.00	853.71	6.53	Rep
22	ME	6.00	57.00	53.78	4.05	Dem
23	MI	642.00	4049.00	1898.08	10.34	Dem
24	MN	142.00	428.00	146.23	10.55	Dem
25	MO	70.00	358.00	348.89	5.13	Rep
26	MS	81.00	310.00	271.65	5.12	Rep
27	MT	2.00	16.00	25.50	12.50	Dem
28	NC	124.00	430.00	394.91	5.21	Dem
29	ND	6.00	25.00	38.74	1.90	Rep
30	NE	24.00	78.00	85.41	1.54	Rep
31	NH	26.00	86.00	82.62	5.51	Rep
32	NJ	1866.00	7910.00	5513.32	8.34	Dem
33	NM	52.00	151.00	104.50	5.90	Dem
34	NV	56.00	262.00	217.47	6.51	Dem

Table 28: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0504	ACD0504	Pred.on._0427	NDNI	Gov
35	NY	2112.00	19415.00	17483.11	4.75	Dem
36	OH	303.00	1056.00	782.02	7.52	Rep
37	OK	41.00	238.00	156.51	6.83	Rep
38	OR	17.00	109.00	113.18	4.27	Dem
39	PA	861.00	2458.00	2012.37	9.76	Dem
40	RI	108.00	341.00	311.07	4.14	Dem
41	SC	101.00	275.00	256.55	9.07	Rep
42	SD	10.00	21.00	104.15	1.79	Rep
43	TN	35.00	219.00	434.83	1.31	Rep
44	TX	221.00	884.00	1071.14	3.79	Rep
45	UT	9.00	50.00	173.12	0.88	Rep
46	VA	226.00	684.00	522.38	4.97	Dem
47	VT	5.00	52.00	49.45	11.90	Rep
48	WA	85.00	834.00	751.58	4.80	Dem
49	WI	59.00	340.00	265.21	3.73	Dem
50	WV	14.00	50.00	59.71	8.70	Rep
51	WY	0.00	7.00	18.45	0.00	Rep

## 12 State tables for predictions for the week ending on April 27

The states are ordered alphabetically and results for each week are split into three sets of tables. Political party abbreviations are Rep=republican and Dem=democrat.

Table 29: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0427	ACD0427	Pred.on.0420	NDNI	Gov
1	AK	0.00	9.00	19.08	0.00	Rep
2	AL	55.00	222.00	246.87	4.26	Rep
3	AR	8.00	50.00	96.05	1.56	Rep
4	AZ	88.00	275.00	207.84	6.46	Rep
5	CA	547.00	1755.00	1201.82	6.34	Dem
6	CO	258.00	680.00	416.58	12.61	Dem
7	CT	667.00	1998.00	802.71	10.37	Dem
8	DC	80.00	185.00	254.10	8.23	Dem
9	DE	53.00	125.00	120.34	4.73	Dem
10	FL	295.00	1101.00	1101.38	4.87	Rep
11	GA	238.00	971.00	708.84	4.23	Rep
12	HI	4.00	14.00	36.28	4.94	Dem
13	IA	48.00	127.00	107.09	3.31	Rep
14	ID	11.00	56.00	81.90	4.47	Rep
15	IL	634.00	1983.00	1389.86	6.69	Dem
16	IN	275.00	844.00	498.29	7.97	Rep
17	KS	20.00	120.00	89.45	3.28	Dem



Table 30: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0427	ACD0427	Pred.on.0420	NDNI	Gov
18	KY	60.00	208.00	135.47	6.02	Dem
19	LA	369.00	1697.00	1263.95	10.52	Dem
20	MA	700.00	3003.00	1821.28	4.79	Rep
21	MD	362.00	1045.00	608.21	7.62	Rep
22	ME	16.00	51.00	49.05	9.04	Dem
23	MI	939.00	3407.00	1488.76	14.75	Dem
24	MN	143.00	286.00	105.73	17.44	Dem
25	MO	111.00	288.00	271.15	7.82	Rep
26	MS	60.00	229.00	189.67	3.82	Rep
27	MT	4.00	14.00	25.73	10.26	Dem
28	NC	127.00	306.00	286.17	6.52	Dem
29	ND	6.00	19.00	23.87	2.03	Rep
30	NE	26.00	54.00	51.46	3.94	Rep
31	NH	19.00	60.00	65.16	4.67	Rep
32	NJ	1667.00	6044.00	4014.80	6.88	Dem
33	NM	44.00	99.00	73.59	7.33	Dem
34	NV	48.00	206.00	173.08	5.59	Dem

Table 31: State by State Covid-19 Death Predictions, AND=actual new deaths, ACD= actual cumulative deaths, NDNI=%new deaths to new infections, Gov=party in control

	State	AND0427	ACD0427	Pred.on.0420	NDNI	Gov
35	NY	2956.00	17303.00	14502.55	5.63	Dem
36	OH	244.00	753.00	441.34	4.11	Rep
37	OK	54.00	197.00	127.05	8.84	Rep
38	OR	17.00	92.00	98.33	4.57	Dem
39	PA	393.00	1597.00	1464.99	4.35	Dem
40	RI	58.00	233.00	199.66	2.73	Dem
41	SC	54.00	174.00	204.34	5.10	Rep
42	SD	4.00	11.00	59.58	0.49	Rep
43	TN	32.00	184.00	352.39	1.97	Rep
44	TX	168.00	663.00	702.46	3.03	Rep
45	UT	13.00	41.00	125.33	1.53	Rep
46	VA	158.00	458.00	346.18	4.87	Dem
47	VT	9.00	47.00	51.72	15.25	Rep
48	WA	120.00	749.00	650.59	6.51	Dem
49	WI	51.00	281.00	211.84	4.76	Dem
50	WV	12.00	36.00	51.46	4.35	Rep
51	WY	5.00	7.00	18.44	13.16	Rep

### 13 Results for all states

The biased data problem and its solution based on inverse Mills ratio (IMR) is described in detail in Vinod and Theiss (2020). Figure 2 shows that over the ten-week period covered so far, the accuracy of out-of-sample predictions of cumulative deaths from logs of lagged cumulative infections is improving steadily. We have compared two sets of forecasting models (2) and (3). The horizontal line at 0 represents no error in forecasting.

Figure 3 plots the evolution of the ratios of new deaths (ND) to new infections (NI) for the ten-week period covered. The plot shows an upward jump in deaths during the week starting with June 22, 2020. Since infections lead to deaths only after a time lag, it is important to also consider nationwide ratios (ND/NI) with the NI from the previous week and also (ND/NI) using NI from two weeks back. The upward tick in Figure 3 for the 10-th week is

attributed to relaxation of lock-down regimes in various states.

Figure 2: Accuracy of out-of-sample predictions of cumulative deaths from  $\log(\text{lagged cumulative infections})$  with and without IMR.

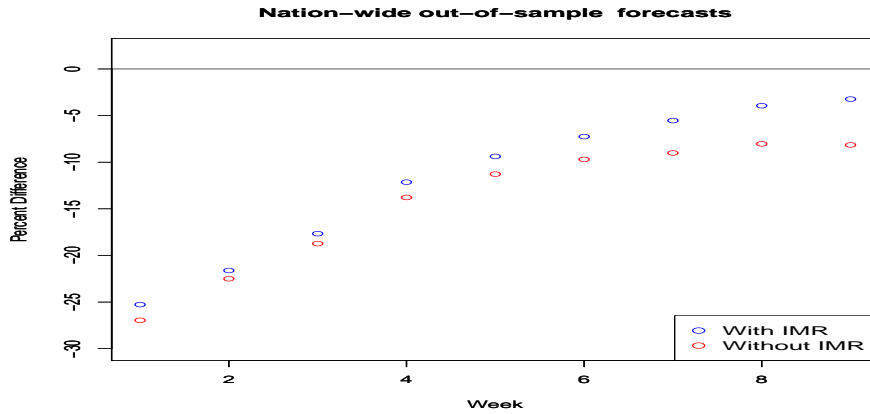
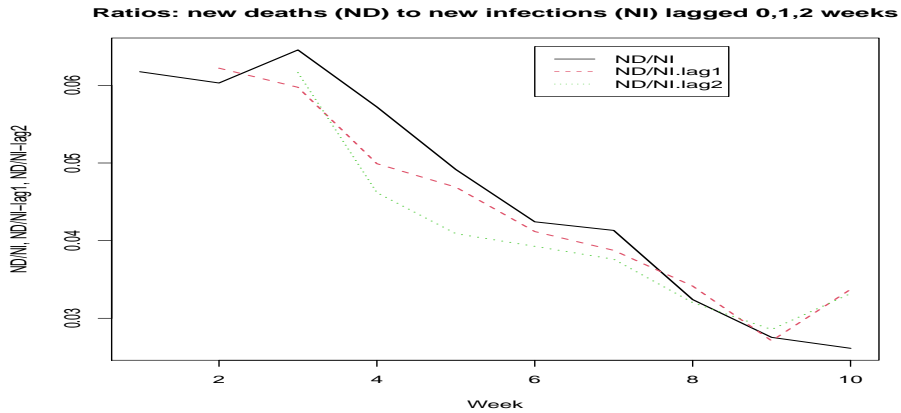


Figure 3: Plot of US wide data on ratios of new deaths to new infections during the current week, preceding week and the week before last



Vinod and López-de-Lacalle (2009) provides a tool for constructing confidence intervals for time series without having the first transform them to be stationary series by differencing or de-trending. We report 95% confidence intervals for new deaths to new infections ratios in Table 32

Table 32: Ninety five percent Confidence intervals on new deaths to previous week’s new infections ratios during the ten weeks studied

Week No.	Lower Limit	ND/NI	Upper limit
1	0.0571	0.0617	0.0694
2	0.0510	0.0603	0.0647
3	0.0600	0.0646	0.0753
4	0.0457	0.0572	0.0614
5	0.0395	0.0492	0.0576
6	0.0343	0.0424	0.0541
7	0.0309	0.0413	0.0497
8	0.0266	0.0324	0.0429
9	0.0223	0.0275	0.0356
10	0.0150	0.0261	0.0308

## 14 Final Remarks

Testing for Covid-19 infections has not been random across the population. Our approach is the only one, (to the best of our knowledge), which explicitly corrects for the testing bias by using generalized linear models (GLM) with a Poisson link function and inverse mills ratio (IMR). This document provides state-specific information regarding Covid-19 infections and deaths in the US.

Regarding nationwide results, we find that the overall trend is declining. Recall that Figure 1 had an encouraging result that a key model coefficient is declining over the ten-week period studied here. The overall trend in nationwide ratios of new death to previous week’s new infections (ND/NI) is also declining in Figure 3, except that during the week of June 22 there is an uptick, attributable to loosening of restrictions. The worst-case scenario is given by the upper limit of our 95% confidence intervals. We find that the latest week starting June 22 suggests about 3.1 new deaths for every new 100 infections.

Since a great many decisions regarding the re-opening of the various businesses is up to the local mayors and state governors, we hope that our state-by-state forecasts can be a useful input in their re-opening decisions. It would not be difficult to tailor our methods to counties or other jurisdictions, since they are based on open-source R software.

## References

- Leeper, T.J., 2018. margins: Marginal Effects for Model Objects. R package version 0.3.23.
- Vinod, H.D., López-de-Lacalle, J., 2009. Maximum entropy bootstrap for time series: The meboot R package. *Journal of Statistical Software* 29, 1–19. URL: <http://www.jstatsoft.org/v29/i05/>.
- Vinod, H.D., Theiss, K., 2020. A Novel Solution to Biased Data in Covid-19 Incidence Studies. Discussion Paper No. 2020-06-29. Department of Economics, Fordham University. URL: <http://ssrn.com/abstract=3637682>.