

Primary_Analysis_A

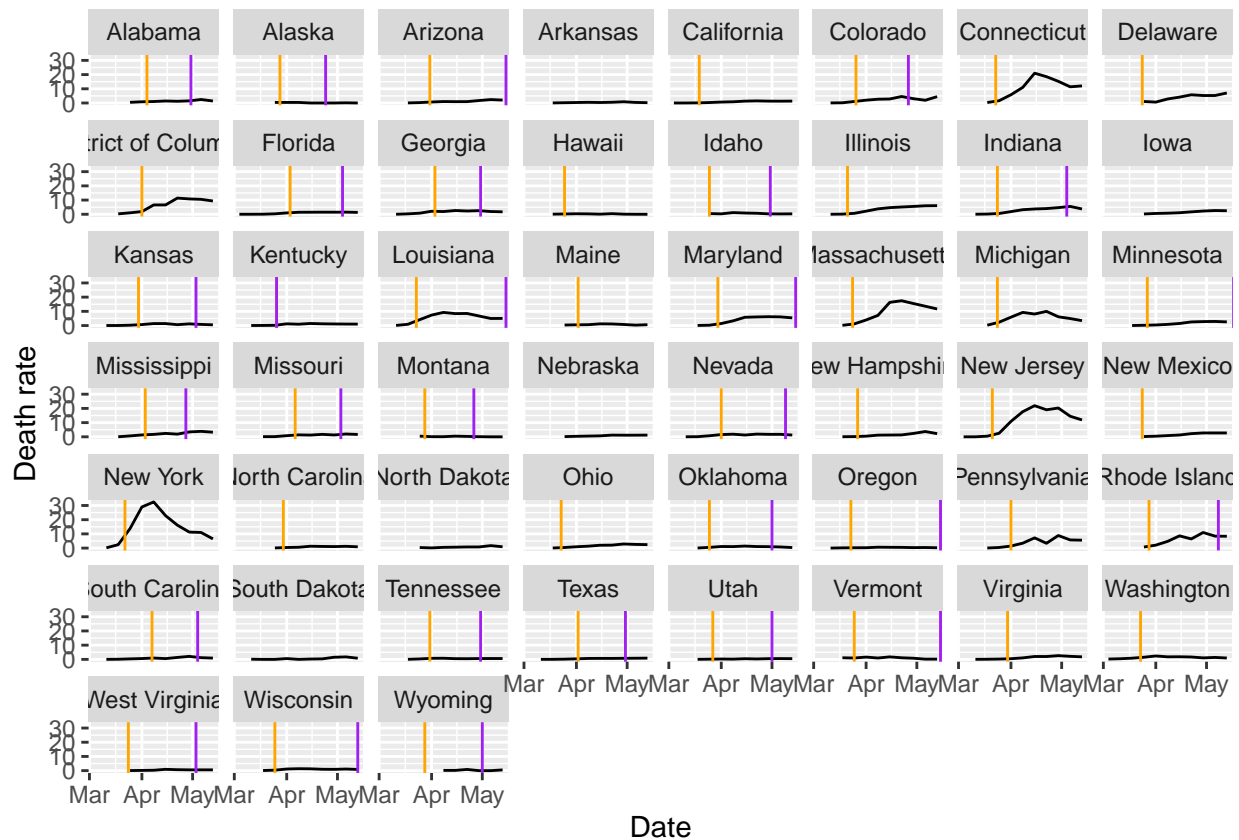
JLee

5/23/2020

The death rate by state with the start of stay-at-home order and the end of it

Warning: Removed 43 rows containing missing values (geom_vline).

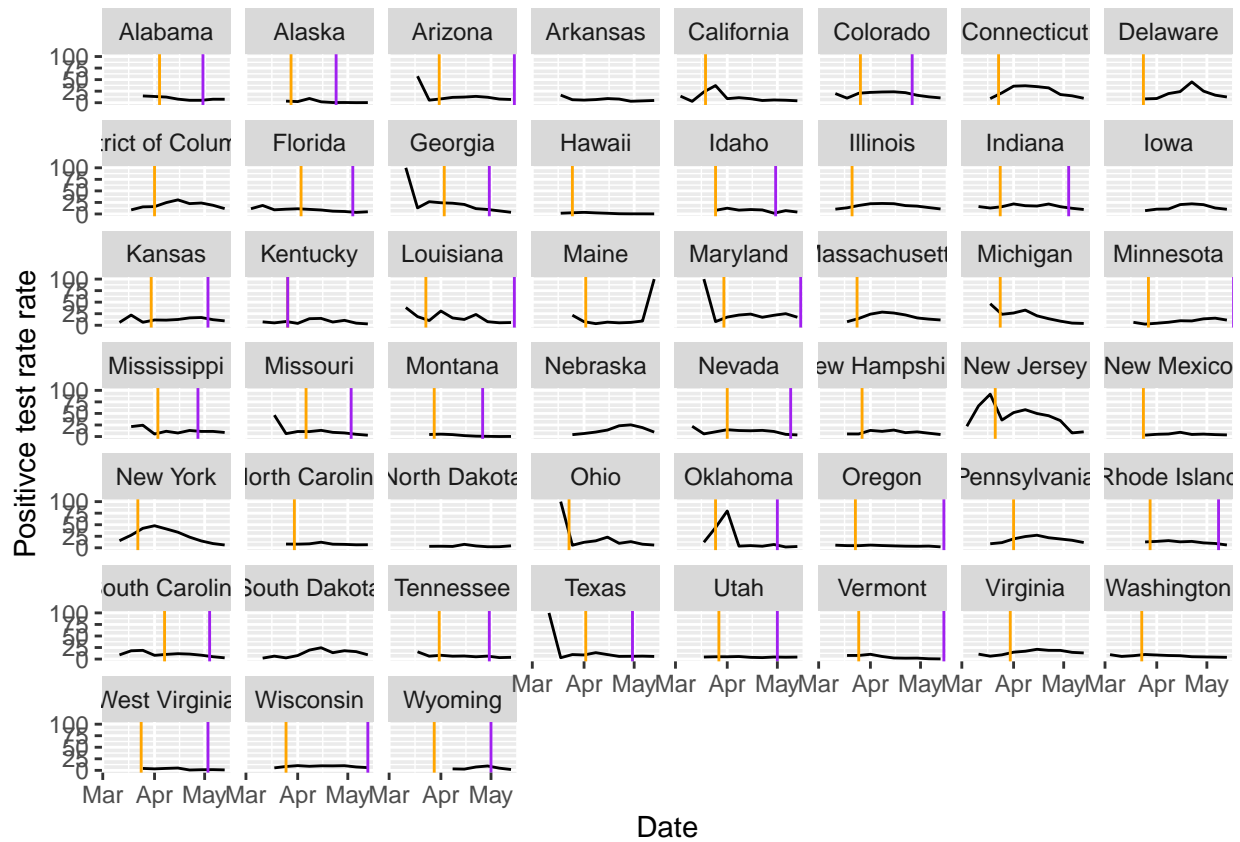
Warning: Removed 43 rows containing missing values (geom_vline).



The positive test rate by state with the start of stay-at-home order and the end of it

Warning: Removed 43 rows containing missing values (geom_vline).

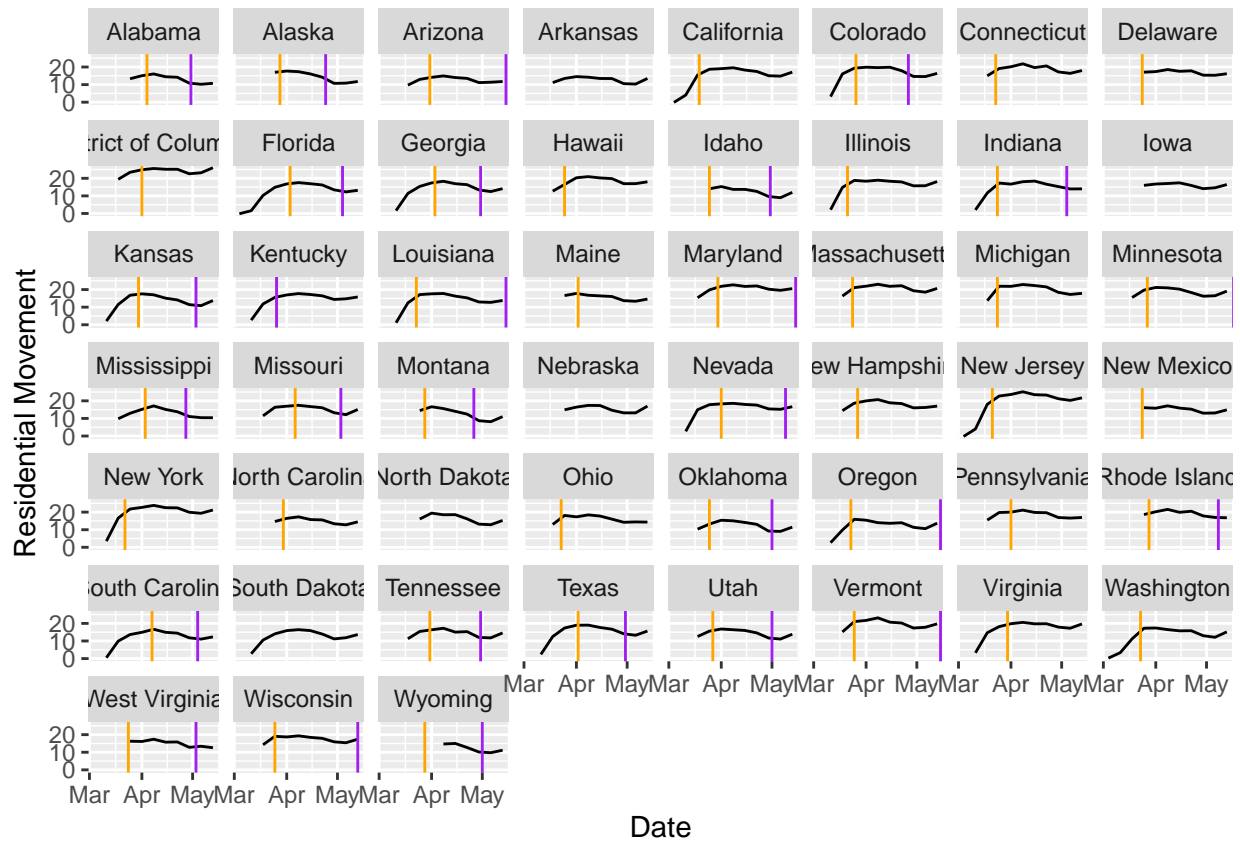
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The residential movement by state with the start of stay-at-home order and the end of it

Warning: Removed 43 rows containing missing values (geom_vline).

Warning: Removed 43 rows containing missing values (geom_vline).



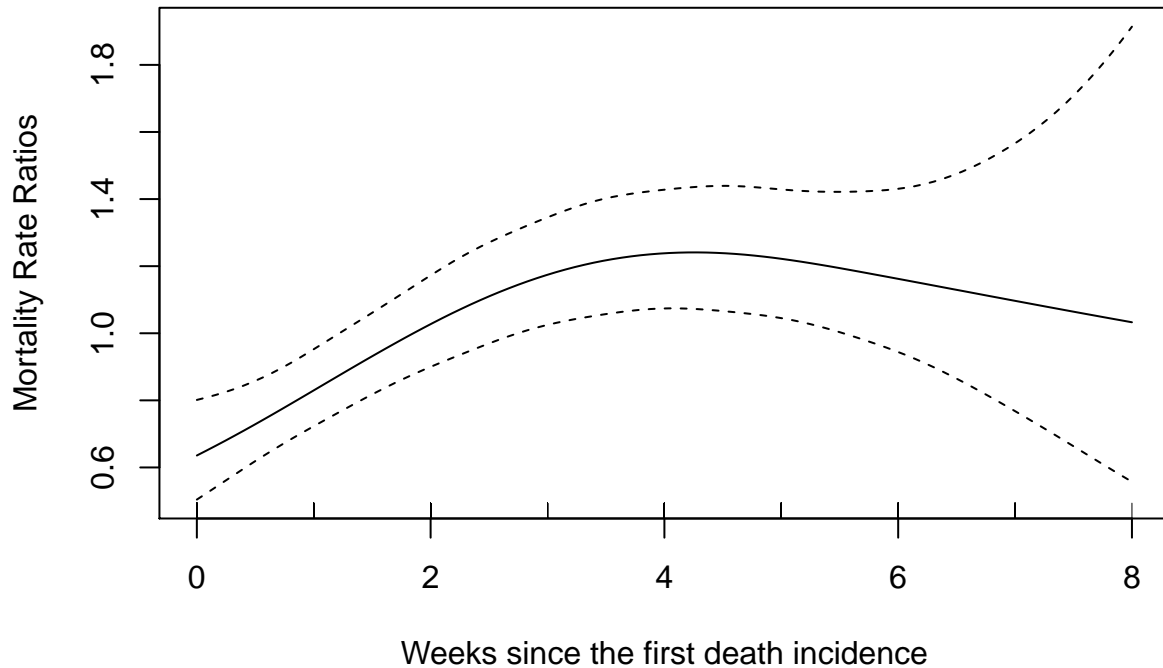
PCA

```
## Standard deviations (1, ..., p=6):
## [1] 2.1419732 0.9367656 0.4522873 0.3875618 0.3425385 0.2496407
##
## Rotation (n x k) = (6 x 6):
##           PC1      PC2      PC3      PC4      PC5
## retail_rec    0.4381783 -0.030532218 -0.3343747  0.6501823 -0.5208385
## grocery_pharmacy 0.4301725  0.055599816 -0.7194615 -0.4975839  0.2041634
## parks         0.2216006  0.931830515  0.1708041  0.1305770  0.1875090
## transit       0.4378991  0.006198744  0.4459564 -0.5172864 -0.5721553
## work          0.4340864 -0.274806226  0.3328454  0.1049789  0.3464152
## residential   -0.4400659  0.228279323 -0.1781334 -0.1844371 -0.4522386
##           PC6
## retail_rec    -0.03537347
## grocery_pharmacy -0.07044890
## parks         -0.03465588
## transit       0.11992452
## work          -0.70302237
## residential   -0.69567399
##
## Importance of components:
##           PC1      PC2      PC3      PC4      PC5      PC6
## Standard deviation    2.1420 0.9368 0.45229 0.38756 0.34254 0.24964
## Proportion of Variance 0.7647 0.1462 0.03409 0.02503 0.01956 0.01039
## Cumulative Proportion 0.7647 0.9109 0.94502 0.97006 0.98961 1.00000
```

Model 1

(1) $\text{Weekly_death} \sim s(\text{days_since_first}) + \text{scaled independent variables}$

```
##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ s(weeks_since_first, k = 8, bs = "cr") + factor(q_popdensity) +
##   scale(Age_gp1) + scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) +
##   scale(Black_perc) + scale(Hispanic.or.Latino_perc) + scale(temp) +
##   scale(perc) + scale(Bachelor_orhigher_perc) + scale(bed_rate) +
##   scale(smoke_perc) + scale(obese_perc) + offset(log(population))
##
## Parametric coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -11.30696     0.36111  -31.312   < 2e-16 ***
## factor(q_popdensity)2      0.25942     0.34661    0.748  0.45418
## factor(q_popdensity)3      0.38975     0.41869    0.931  0.35192
## factor(q_popdensity)4      0.29310     0.43727    0.670  0.50267
## factor(q_popdensity)5      1.66622     0.54029    3.084  0.00204 **
## scale(Age_gp1)             0.45153     0.23367    1.932  0.05332 .
## scale(Age_gp3)             0.46885     0.18500    2.534  0.01127 *
## scale(Age_gp4)            -0.03128     0.21949   -0.143  0.88666
## scale(poverty_perc)        0.26982     0.20376    1.324  0.18542
## scale(Black_perc)          0.45557     0.20368    2.237  0.02531 *
## scale(Hispanic.or.Latino_perc) 0.15423     0.22194    0.695  0.48712
## scale(temp)               -0.55586     0.20858   -2.665  0.00770 **
## scale(perc)               -0.06361     0.23372   -0.272  0.78549
## scale(Bachelor_orhigher_perc) 0.19262     0.25622    0.752  0.45219
## scale(bed_rate)            0.07727     0.11663    0.663  0.50762
## scale(smoke_perc)          -0.22200     0.21019   -1.056  0.29087
## scale(obese_perc)          0.20150     0.18782    1.073  0.28335
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##               edf Ref.df Chi.sq p-value
## s(weeks_since_first) 2.297  2.297   16.8 0.000568 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.663
## glmer.ML = 64.433 Scale est. = 1          n = 287
```

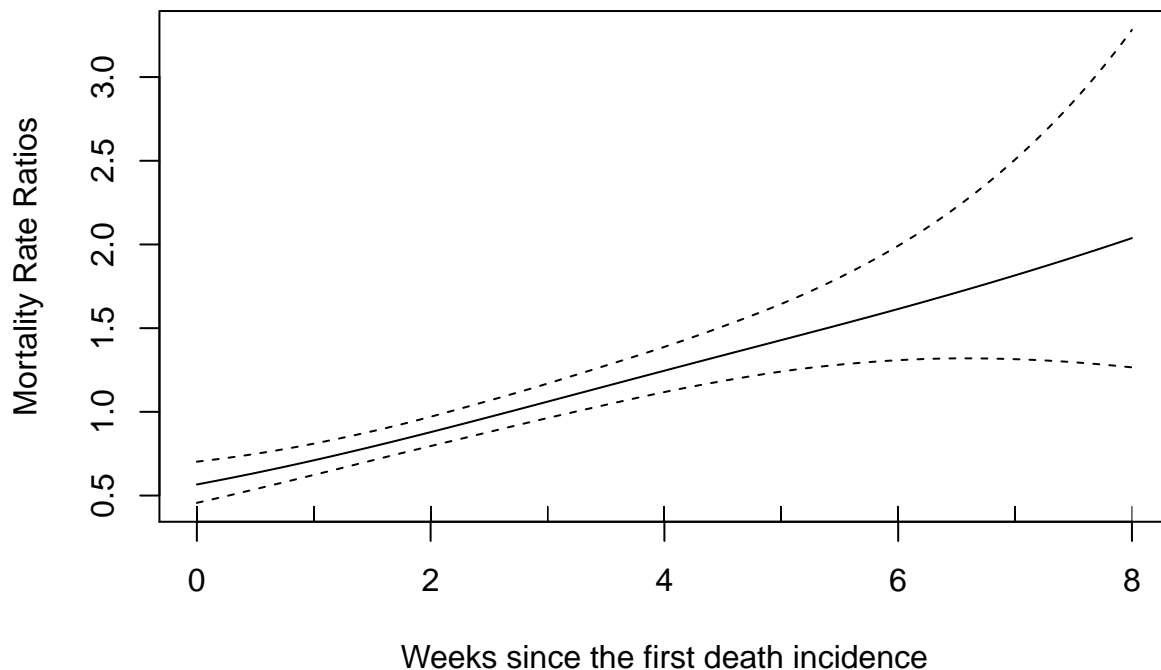


(2) $\text{Weekly_death} \sim \text{s}(\text{days_since_first}) + \text{scaled independent variables} + \text{positive_test_ratio}$ with 3 weeks lag + random intercept

```
##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ s(weeks_since_first, k = 8, bs = "cr") + factor(q_popdensity) +
##   scale(Age_gp1) + scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) +
##   scale(Black.perc) + scale(Hispanic.or.Latino.perc) + scale(temp) +
##   scale(perc) + scale(Bachelor_orhigher_perc) + scale(bed_rate) +
##   scale(smoke_perc) + scale(obese_perc) + rptest + ptest_weeks_ago1 +
##   ptest_weeks_ago2 + ptest_weeks_ago3 + offset(log(population))
##
## Parametric coefficients:
##
```

	Estimate	Std. Error	z value	Pr(> z)
## (Intercept)	-1.136e+01	2.943e-01	-38.603	< 2e-16 ***
## factor(q_popdensity)2	-1.688e-01	2.888e-01	-0.584	0.559028
## factor(q_popdensity)3	-7.695e-02	3.466e-01	-0.222	0.824316
## factor(q_popdensity)4	-2.895e-01	3.614e-01	-0.801	0.423198
## factor(q_popdensity)5	4.339e-01	4.834e-01	0.898	0.369307
## scale(Age_gp1)	1.541e-01	1.942e-01	0.793	0.427590
## scale(Age_gp3)	2.337e-01	1.565e-01	1.494	0.135300
## scale(Age_gp4)	-4.237e-03	1.741e-01	-0.024	0.980584
## scale(poverty_perc)	3.253e-01	1.623e-01	2.004	0.045019 *
## scale(Black.perc)	2.906e-01	1.636e-01	1.776	0.075783 .
## scale(Hispanic.or.Latino.perc)	-2.558e-02	1.778e-01	-0.144	0.885625
## scale(temp)	-3.856e-01	1.662e-01	-2.320	0.020355 *
## scale(perc)	1.572e-01	1.903e-01	0.826	0.408636
## scale(Bachelor_orhigher_perc)	-3.731e-02	2.095e-01	-0.178	0.858663
## scale(bed_rate)	-4.085e-02	9.470e-02	-0.431	0.666244
## scale(smoke_perc)	-3.774e-01	1.699e-01	-2.221	0.026327 *

```
## scale(obese_perc)                2.571e-02  1.508e-01   0.170 0.864625
## rptest                          3.324e-02  8.563e-03   3.882 0.000104 ***
## ptest_weeks_ago1                1.297e-02  6.533e-03   1.986 0.047083 *
## ptest_weeks_ago2                3.312e-03  4.697e-03   0.705 0.480714
## ptest_weeks_ago3                9.089e-04  3.841e-03   0.237 0.812945
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##                edf Ref.df Chi.sq  p-value
## s(weeks_since_first) 1.576  1.576  23.98 3.47e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.868
## glmer.ML = 80.775  Scale est. = 1          n = 287
```



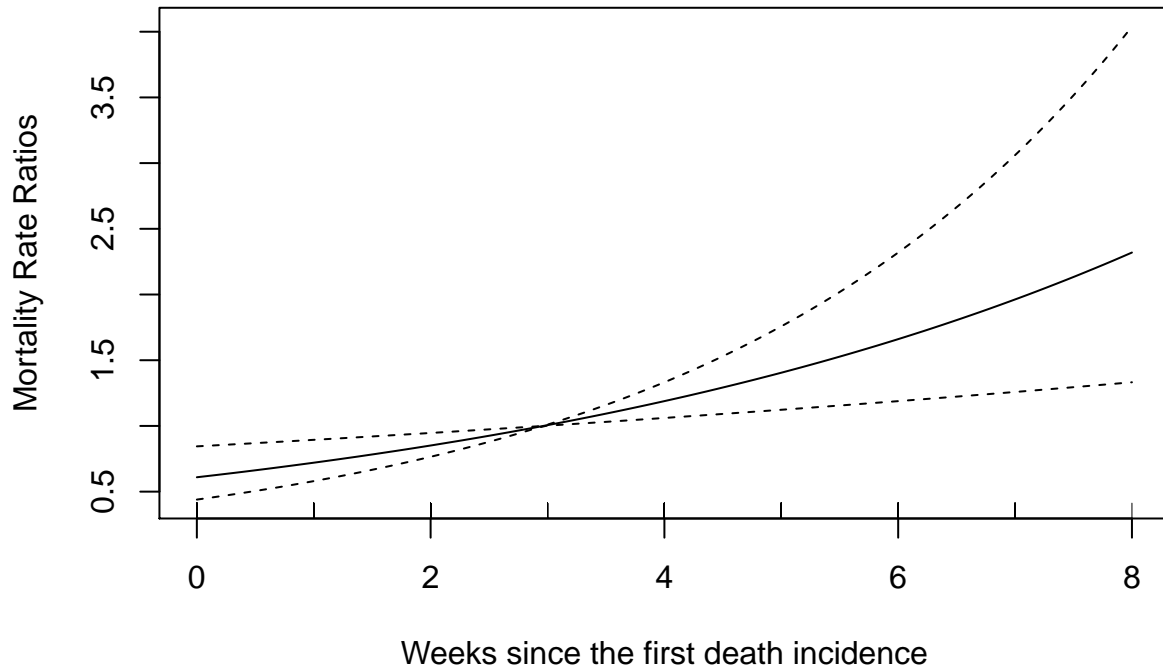
- (3) $\text{Weekly_death} \sim s(\text{days_since_first}) + \text{scaled independent variables} + \text{the current positive test ratio} + \text{the PCA of movement} + \text{the time since the mask policy with 3 levels} + \text{random intercept}$

```
##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ s(weeks_since_first, k = 8, bs = "cr") + factor(q_popdensity) +
##   scale(Age_gp1) + scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) +
##   scale(Black.perc) + scale(Hispanic.or.Latino.perc) + scale(temp) +
##   scale(perc) + scale(Bachelor_orhigher_perc) + scale(bed_rate) +
##   scale(smoke_perc) + scale(obese_perc) + rptest + PC1 + PC2 +
##   factor(f_mask) + offset(log(population))
##
## Parametric coefficients:
```

```

##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)      -11.579956   0.445398 -25.999 < 2e-16 ***
## factor(q_popdensity)2      -0.073428   0.296896  -0.247  0.8047
## factor(q_popdensity)3      -0.023794   0.374809  -0.063  0.9494
## factor(q_popdensity)4      -0.214177   0.378639  -0.566  0.5716
## factor(q_popdensity)5       0.524490   0.503300   1.042  0.2974
## scale(Age_gp1)           0.239232   0.219647   1.089  0.2761
## scale(Age_gp3)           0.260888   0.153842   1.696  0.0899 .
## scale(Age_gp4)           0.010299   0.186444   0.055  0.9559
## scale(poverty_perc)       0.350585   0.163356   2.146  0.0319 *
## scale(Black_perc)        0.250018   0.173511   1.441  0.1496
## scale(Hispanic.or.Latino_perc) -0.037712  0.184225  -0.205  0.8378
## scale(temp)             -0.358025   0.202447  -1.768  0.0770 .
## scale(perc)              0.161106   0.191366   0.842  0.3999
## scale(Bachelor_orhigher_perc) -0.035580  0.215663  -0.165  0.8690
## scale(bed_rate)          -0.037089   0.096311  -0.385  0.7002
## scale(smoke_perc)        -0.336675   0.174652  -1.928  0.0539 .
## scale(obese_perc)         0.012256   0.155333   0.079  0.9371
## rptest                 0.042224   0.007951   5.310 1.1e-07 ***
## PC1                    -0.078976   0.076411  -1.034  0.3013
## PC2                     0.008061   0.137931   0.058  0.9534
## factor(f_mask)1          0.339500   0.215757   1.574  0.1156
## factor(f_mask)2          0.358649   0.318538   1.126  0.2602
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##               edf Ref.df Chi.sq p-value
## s(weeks_since_first)  1      1  9.209 0.00241 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.855
## glmer.ML = 81.566 Scale est. = 1          n = 287

```

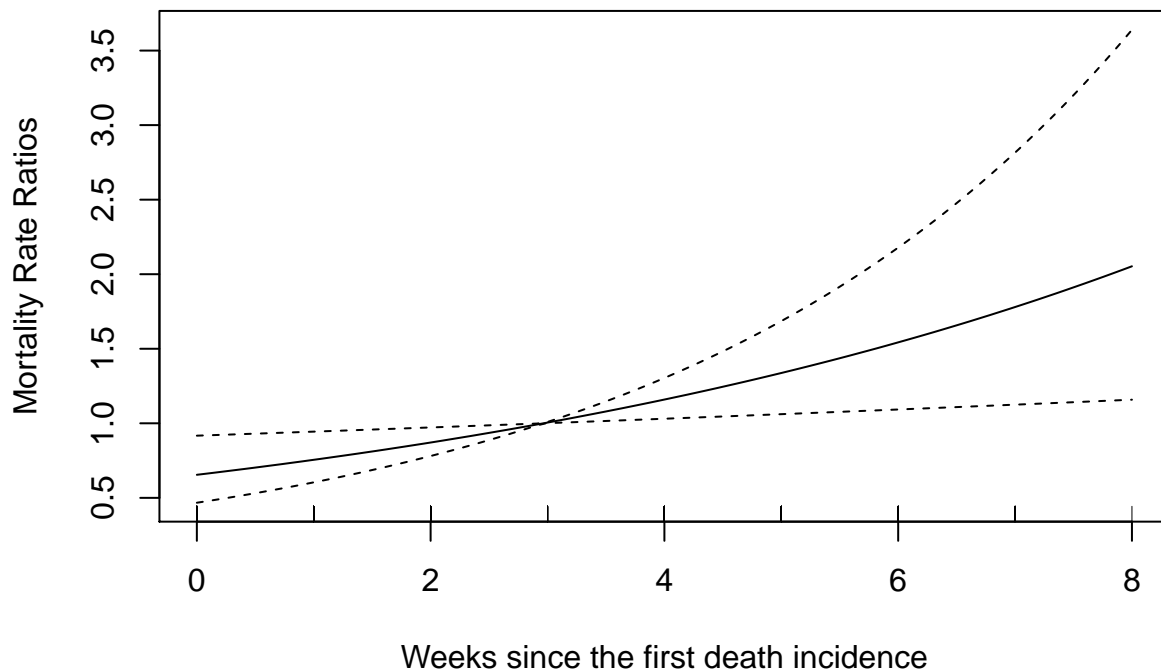


- (4) $\text{Weekly_death} \sim s(\text{days_since_first}) + \text{scaled independent variables} + \text{the positive test ratio with 1 week lag} + \text{the PCA of movement} + \text{the time since the mask policy with 3 levels} + \text{random intercept}$

```
##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ s(weeks_since_first, k = 8, bs = "cr") + factor(q_popdensity) +
##   scale(Age_gp1) + scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) +
##   scale(Black.perc) + scale(Hispanic.or.Latino.perc) + scale(temp) +
##   scale(perc) + scale(Bachelor_orhigher_perc) + scale(bed_rate) +
##   scale(smoke_perc) + scale(obese_perc) + ptest_weeks_ago1 +
##   PC1 + PC2 + factor(f_mask) + offset(log(population))
##
## Parametric coefficients:
##
```

	Estimate	Std. Error	z value	Pr(> z)
## (Intercept)	-11.403189	0.459403	-24.822	< 2e-16 ***
## factor(q_popdensity)2	-0.006982	0.314164	-0.022	0.9823
## factor(q_popdensity)3	0.061372	0.396940	0.155	0.8771
## factor(q_popdensity)4	-0.107929	0.402726	-0.268	0.7887
## factor(q_popdensity)5	0.780829	0.528279	1.478	0.1394
## scale(Age_gp1)	0.290771	0.230755	1.260	0.2076
## scale(Age_gp3)	0.289553	0.163674	1.769	0.0769 .
## scale(Age_gp4)	0.023047	0.198401	0.116	0.9075
## scale(poverty_perc)	0.293509	0.174352	1.683	0.0923 .
## scale(Black.perc)	0.347139	0.183871	1.888	0.0590 .
## scale(Hispanic.or.Latino.perc)	0.041443	0.195623	0.212	0.8322
## scale(temp)	-0.424570	0.212784	-1.995	0.0460 *
## scale(perc)	0.108966	0.204621	0.533	0.5944
## scale(Bachelor_orhigher_perc)	0.034153	0.227283	0.150	0.8806
## scale(bed_rate)	-0.014652	0.103207	-0.142	0.8871
## scale(smoke_perc)	-0.315466	0.185406	-1.701	0.0889 .


```
## scale(obese_perc)          0.087478  0.164894  0.531  0.5958
## ptest_weeks_ago1          0.029002  0.005972  4.856  1.2e-06 ***
## PC1                       -0.048194  0.079527 -0.606  0.5445
## PC2                       0.031154  0.140516  0.222  0.8245
## factor(f_mask)1           0.222103  0.218419  1.017  0.3092
## factor(f_mask)2           0.093205  0.323292  0.288  0.7731
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##              edf Ref.df Chi.sq p-value
## s(weeks_since_first)  1      1   6.32  0.0119 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.73
## glmer.ML = 78.289  Scale est. = 1          n = 287
```



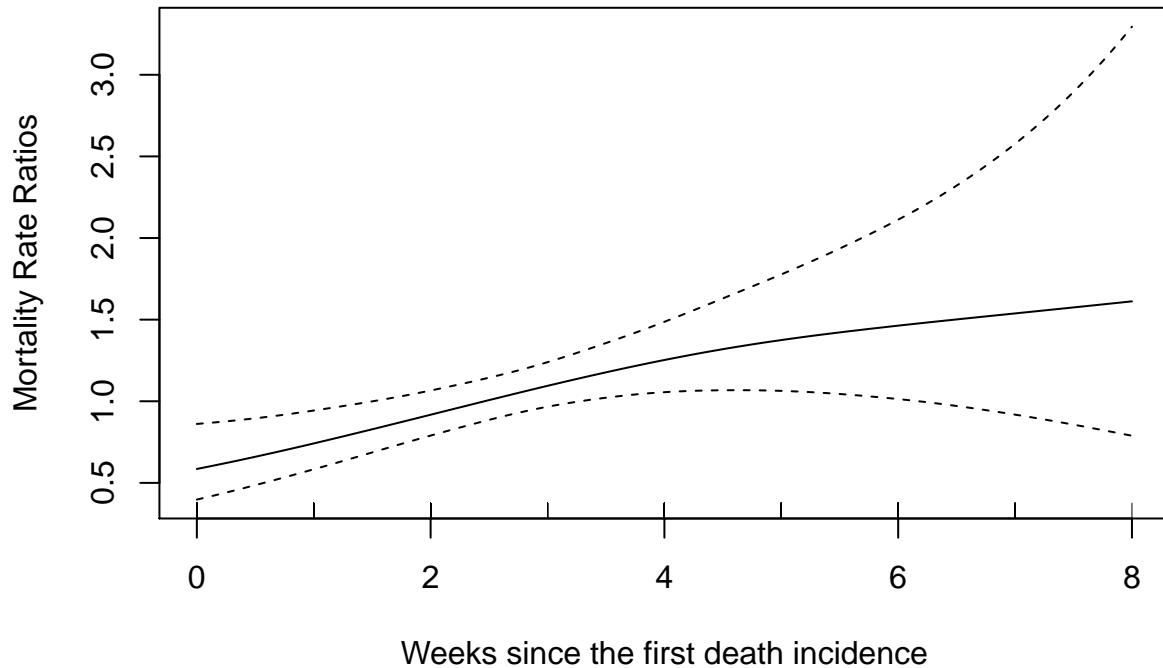
- (5) $\text{Weekly_death} \sim s(\text{days_since_first}) + \text{scaled independent variables} + \text{the positive test ratio with 2 week lag} + \text{the PCA of movement} + \text{the time since the mask policy with 3 levels} + \text{random intercept}$

```
##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ s(weeks_since_first, k = 8, bs = "cr") + factor(q_popdensity) +
##   scale(Age_gp1) + scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) +
##   scale(Black_perc) + scale(Hispanic.or.Latino_perc) + scale(temp) +
##   scale(perc) + scale(Bachelor_orhigher_perc) + scale(bed_rate) +
##   scale(smoke_perc) + scale(obese_perc) + ptest_weeks_ago2 +
##   PC1 + PC2 + factor(f_mask) + offset(log(population))
##
```

```

## Parametric coefficients:
##
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -11.177039   0.491489 -22.741  <2e-16 ***
## factor(q_popdensity)2      0.071445   0.340208   0.210   0.8337
## factor(q_popdensity)3      0.070336   0.429658   0.164   0.8700
## factor(q_popdensity)4     -0.005489   0.436498  -0.013   0.9900
## factor(q_popdensity)5      1.089042   0.570762   1.908   0.0564 .
## scale(Age_gp1)            0.439625   0.245440   1.791   0.0733 .
## scale(Age_gp3)            0.353868   0.178734   1.980   0.0477 *
## scale(Age_gp4)            0.045637   0.214710   0.213   0.8317
## scale(poverty_perc)        0.283148   0.189811   1.492   0.1358
## scale(Black_perc)          0.371763   0.199234   1.866   0.0620 .
## scale(Hispanic.or.Latino_perc) 0.090916   0.211989   0.429   0.6680
## scale(temp)               -0.528976   0.228311  -2.317   0.0205 *
## scale(perc)                0.085360   0.224475   0.380   0.7037
## scale(Bachelor_orhigher_perc) 0.118365   0.245640   0.482   0.6299
## scale.bed_rate            0.037927   0.110790   0.342   0.7321
## scale(smoke_perc)         -0.227628   0.200295  -1.136   0.2558
## scale(obese_perc)          0.112926   0.179881   0.628   0.5301
## ptest_weeks_ago2          0.007215   0.004481   1.610   0.1074
## PC1                      -0.093016   0.081357  -1.143   0.2529
## PC2                      -0.010616   0.144405  -0.074   0.9414
## factor(f_mask)1           0.169552   0.241752   0.701   0.4831
## factor(f_mask)2           0.040790   0.343088   0.119   0.9054
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##               edf Ref.df Chi.sq p-value
## s(weeks_since_first) 1.77   1.77  5.613  0.0279 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.673
## glmer.ML = 71.397  Scale est. = 1          n = 287

```

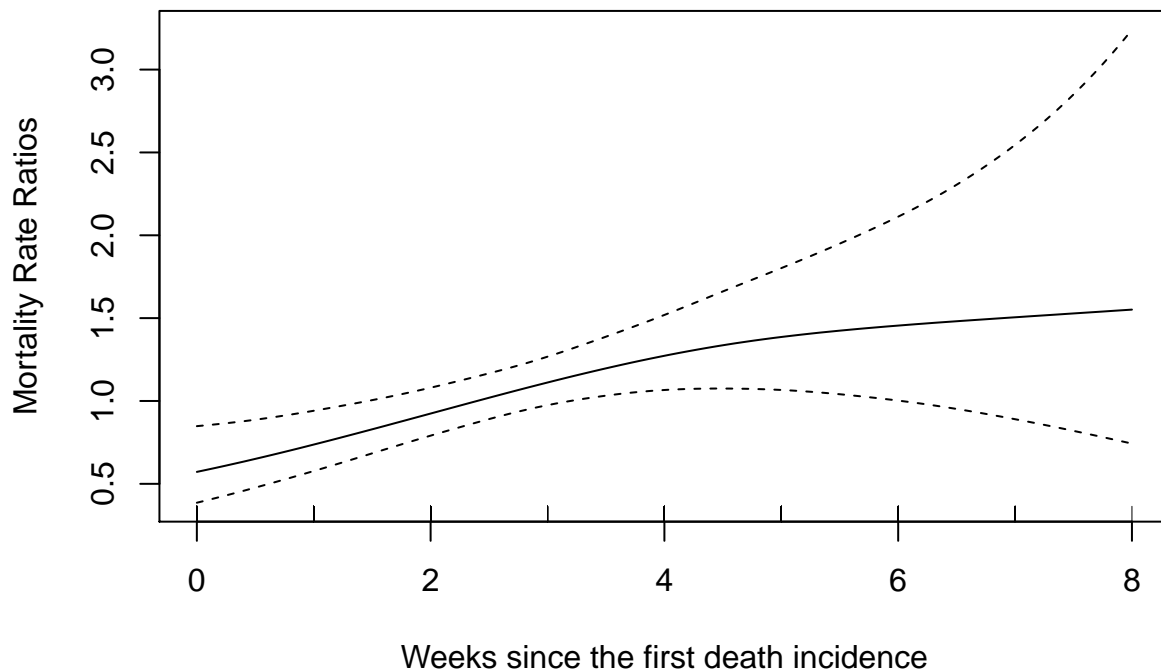


(6) $\text{Weekly_death} \sim s(\text{days_since_first}) + \text{scaled independent variables} + \text{the positive test ratio with 3 week lag} + \text{the PCA of movement} + \text{the time since the mask policy with 3 levels} + \text{random intercept}$

```
##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ s(weeks_since_first, k = 8, bs = "cr") + factor(q_popdensity) +
##   scale(Age_gp1) + scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) +
##   scale(Black.perc) + scale(Hispanic.or.Latino.perc) + scale(temp) +
##   scale(perc) + scale(Bachelor_orhigher_perc) + scale(bed_rate) +
##   scale(smoke_perc) + scale(obese_perc) + ptest_weeks_ago3 +
##   PC1 + PC2 + factor(f_mask) + offset(log(population))
##
## Parametric coefficients:
##
```

	Estimate	Std. Error	z value	Pr(> z)
## (Intercept)	-11.134337	0.498074	-22.355	<2e-16 ***
## factor(q_popdensity)2	0.111605	0.348322	0.320	0.7487
## factor(q_popdensity)3	0.100505	0.440727	0.228	0.8196
## factor(q_popdensity)4	0.044071	0.447769	0.098	0.9216
## factor(q_popdensity)5	1.183026	0.585480	2.021	0.0433 *
## scale(Age_gp1)	0.476582	0.250245	1.904	0.0568 .
## scale(Age_gp3)	0.376283	0.183076	2.055	0.0398 *
## scale(Age_gp4)	0.056214	0.220313	0.255	0.7986
## scale(poverty_perc)	0.280863	0.195358	1.438	0.1505
## scale(Black.perc)	0.380806	0.204133	1.865	0.0621 .
## scale(Hispanic.or.Latino.perc)	0.096320	0.217577	0.443	0.6580
## scale(temp)	-0.537445	0.233773	-2.299	0.0215 *
## scale(perc)	0.062502	0.230903	0.271	0.7866
## scale(Bachelor_orhigher_perc)	0.142867	0.251411	0.568	0.5699
## scale(bed_rate)	0.057722	0.113146	0.510	0.6099
## scale(smoke_perc)	-0.224319	0.206184	-1.088	0.2766

```
## scale(obese_perc)          0.126017  0.184630  0.683  0.4949
## ptest_weeks_ago3          0.003115  0.003763  0.828  0.4077
## PC1                       -0.094472  0.082799 -1.141  0.2539
## PC2                       -0.011662  0.145645 -0.080  0.9362
## factor(f_mask)1           0.134477  0.242332  0.555  0.5789
## factor(f_mask)2          -0.001420  0.344258 -0.004  0.9967
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##              edf Ref.df Chi.sq p-value
## s(weeks_since_first) 1.877  1.877   6.49  0.0206 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.647
## glmer.ML = 68.224  Scale est. = 1          n = 287
```



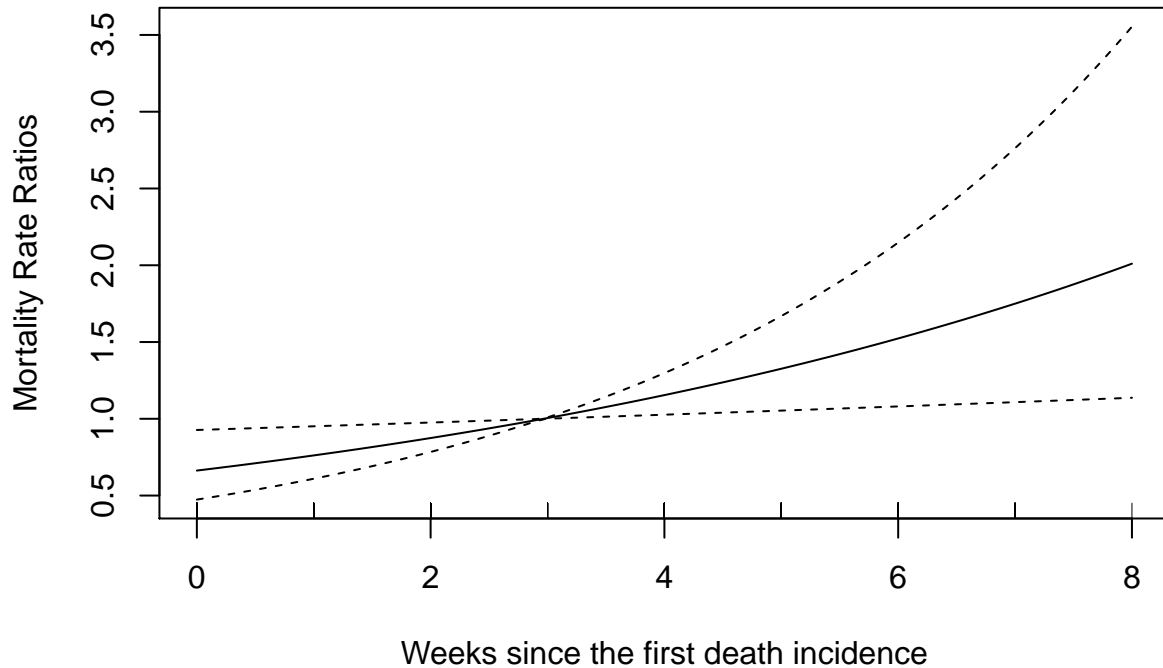
- (7) `Weekly_death ~ s(days_since_first) + scaled independent variables + positive test ratio with only 1-3 weeks lag without the current positive test ratio + the PCA of movement + the time since the mask policy with 3 levels + random intercept`

```
##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ s(weeks_since_first, k = 8, bs = "cr") + factor(q_popdensity) +
##   scale(Age_gp1) + scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) +
##   scale(Black_perc) + scale(Hispanic.or.Latino_perc) + scale(temp) +
##   scale(perc) + scale(Bachelor_or_higher_perc) + scale(bed_rate) +
##   scale(smoke_perc) + scale(obese_perc) + ptest_weeks_ago1 +
##   ptest_weeks_ago2 + ptest_weeks_ago3 + PC1 + PC2 + factor(f_mask) +
```

```

##      offset(log(population))
##
## Parametric coefficients:
##
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      -11.464550   0.460525 -24.895 < 2e-16 ***
## factor(q_popdensity)2      -0.054804   0.313471  -0.175  0.8612
## factor(q_popdensity)3       0.010680   0.396170   0.027  0.9785
## factor(q_popdensity)4      -0.168684   0.401788  -0.420  0.6746
## factor(q_popdensity)5       0.661732   0.535629   1.235  0.2167
## scale(Age_gp1)         0.242895   0.233518   1.040  0.2983
## scale(Age_gp3)         0.246995   0.166142   1.487  0.1371
## scale(Age_gp4)         0.022834   0.196490   0.116  0.9075
## scale(poverty_perc)      0.280727   0.173165   1.621  0.1050
## scale(Black_perc)       0.343695   0.182336   1.885  0.0594 .
## scale(Hispanic.or.Latino_perc) 0.050380   0.193788   0.260  0.7949
## scale(temp)            -0.439424   0.211003  -2.083  0.0373 *
## scale(perc)             0.153429   0.205863   0.745  0.4561
## scale(Bachelor_orhigher_perc) 0.006253   0.226788   0.028  0.9780
## scale(bed_rate)        -0.030254   0.102537  -0.295  0.7679
## scale(smoke_perc)      -0.326848   0.184553  -1.771  0.0766 .
## scale(obese_perc)       0.077008   0.163590   0.471  0.6378
## ptest_weeks_ago1       0.027477   0.006138   4.477 7.58e-06 ***
## ptest_weeks_ago2       0.003487   0.004776   0.730  0.4653
## ptest_weeks_ago3       0.002408   0.003912   0.615  0.5382
## PC1                    -0.039460   0.079934  -0.494  0.6215
## PC2                     0.025478   0.140124   0.182  0.8557
## factor(f_mask)1        0.277112   0.225022   1.231  0.2181
## factor(f_mask)2        0.146945   0.325447   0.452  0.6516
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##              edf Ref.df Chi.sq p-value
## s(weeks_since_first)  1      1  6.005  0.0143 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.726
## glmer.ML = 78.927 Scale est. = 1          n = 287

```

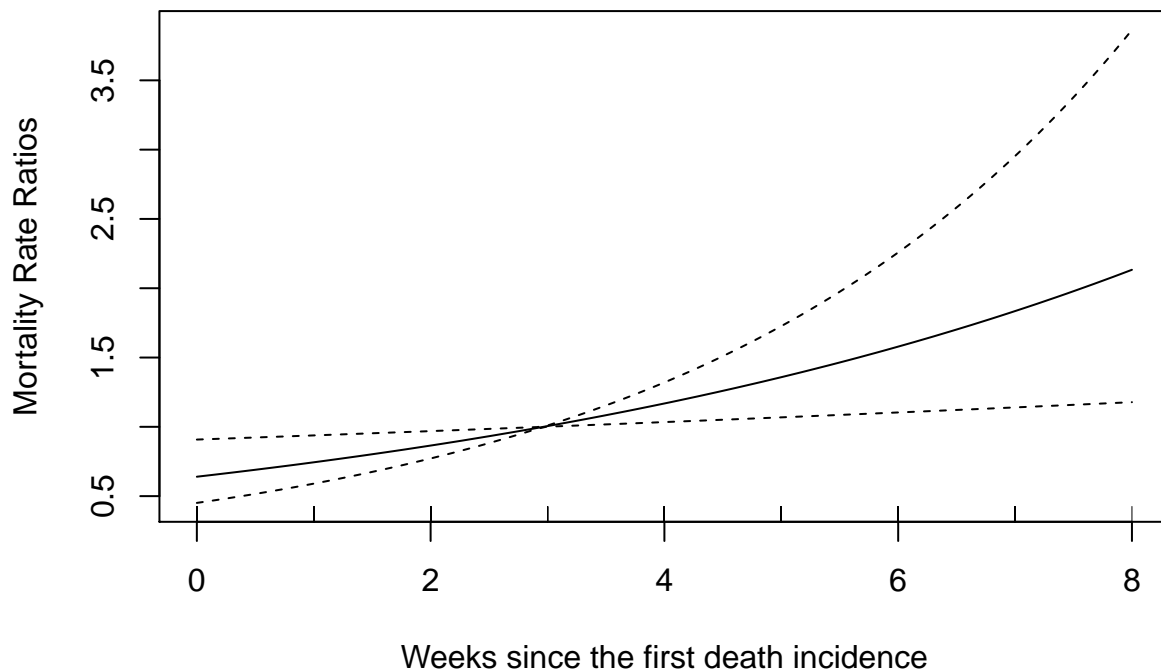


- (8) $\text{Weekly_death} \sim s(\text{days_since_first}) + \text{scaled independent variables} + \text{positive test ratio with only 1-3 weeks lag without the current positive test ratio} + \text{the residential movement with 3 weeks lag} + \text{the time since the mask policy with 3 levels} + \text{random intercept}$

```
##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ s(weeks_since_first, k = 8, bs = "cr") + factor(q_popdensity) +
##   scale(Age_gp1) + scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) +
##   scale(Black.perc) + scale(Hispanic.or.Latino.perc) + scale(temp) +
##   scale(perc) + scale(Bachelor_orhigher_perc) + scale(bed_rate) +
##   scale(smoke_perc) + scale(obese_perc) + ptest_weeks_ago1 +
##   ptest_weeks_ago2 + ptest_weeks_ago3 + residential + resident_weeks_ago1 +
##   resident_weeks_ago2 + resident_weeks_ago3 + factor(f_mask) +
##   offset(log(population))
##
## Parametric coefficients:
##
```

	Estimate	Std. Error	z value	Pr(> z)
## (Intercept)	-12.256814	0.821970	-14.912	< 2e-16 ***
## factor(q_popdensity)2	-0.104250	0.316195	-0.330	0.7416
## factor(q_popdensity)3	-0.095045	0.399732	-0.238	0.8121
## factor(q_popdensity)4	-0.285414	0.407317	-0.701	0.4835
## factor(q_popdensity)5	0.418042	0.548832	0.762	0.4462
## scale(Age_gp1)	0.198306	0.203525	0.974	0.3299
## scale(Age_gp3)	0.134605	0.173847	0.774	0.4388
## scale(Age_gp4)	0.077311	0.187919	0.411	0.6808
## scale(poverty_perc)	0.290321	0.172062	1.687	0.0915 .
## scale(Black.perc)	0.299167	0.181194	1.651	0.0987 .
## scale(Hispanic.or.Latino.perc)	0.019060	0.197148	0.097	0.9230
## scale(temp)	-0.401126	0.192327	-2.086	0.0370 *
## scale(perc)	0.231941	0.203507	1.140	0.2544

```
## scale(Bachelor_orhigher_perc) -0.044924 0.224186 -0.200 0.8412
## scale(bed_rate) -0.086410 0.105835 -0.816 0.4142
## scale(smoke_perc) -0.315816 0.179618 -1.758 0.0787 .
## scale(obese_perc) 0.011236 0.165926 0.068 0.9460
## ptest_weeks_ago1 0.025024 0.006098 4.104 4.06e-05 ***
## ptest_weeks_ago2 0.002890 0.004801 0.602 0.5472
## ptest_weeks_ago3 0.003399 0.003921 0.867 0.3860
## residential -0.014963 0.053432 -0.280 0.7794
## resident_weeks_ago1 0.063485 0.065299 0.972 0.3309
## resident_weeks_ago2 0.026817 0.041567 0.645 0.5188
## resident_weeks_ago3 0.002368 0.040520 0.058 0.9534
## factor(f_mask)1 -0.155978 0.520641 -0.300 0.7645
## factor(f_mask)2 -0.233772 0.610579 -0.383 0.7018
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##              edf Ref.df Chi.sq p-value
## s(weeks_since_first) 1      1 6.507 0.0107 *
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) = 0.757
## glmer.ML = 73.319 Scale est. = 1          n = 287
```



- (9) $\text{Weekly_death} \sim \text{linear days_since_first} + \text{scaled independent variables} + \text{positive test ratio with 3 weeks lag} + \text{random intercept} + \text{random slope for days_since_first}$

```
##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
```

```

## weekly_death ~ weeks_since_first + factor(q_popdensity) + scale(Age_gp1) +
##   scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) + scale(Black.perc) +
##   scale(Hispanic.or.Latino.perc) + scale(temp) + scale(perc) +
##   scale(Bachelor_orhigher_perc) + scale.bed_rate) + scale(smoke_perc) +
##   scale(obese_perc) + rptest + ptest_weeks_ago1 + ptest_weeks_ago2 +
##   ptest_weeks_ago3 + offset(log(population))
##
## Parametric coefficients:
##
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)      -1.188e+01  3.047e-01 -39.003  < 2e-16 ***
## weeks_since_first    1.729e-01  3.180e-02   5.438 5.38e-08 ***
## factor(q_popdensity)2 -1.717e-01  2.890e-01  -0.594  0.5524
## factor(q_popdensity)3 -8.941e-02  3.467e-01  -0.258  0.7965
## factor(q_popdensity)4 -2.989e-01  3.616e-01  -0.827  0.4085
## factor(q_popdensity)5  4.087e-01  4.833e-01   0.846  0.3978
## scale(Age_gp1)       1.403e-01  1.944e-01   0.722  0.4705
## scale(Age_gp3)       2.296e-01  1.566e-01   1.466  0.1426
## scale(Age_gp4)      -6.864e-03  1.743e-01  -0.039  0.9686
## scale(poverty_perc)   3.273e-01  1.625e-01   2.015  0.0439 *
## scale(Black.perc)     2.830e-01  1.638e-01   1.727  0.0841 .
## scale(Hispanic.or.Latino.perc) -3.164e-02  1.780e-01  -0.178  0.8589
## scale(temp)          -3.763e-01  1.664e-01  -2.262  0.0237 *
## scale(perc)          1.564e-01  1.905e-01   0.821  0.4117
## scale(Bachelor_orhigher_perc) -4.323e-02  2.098e-01  -0.206  0.8367
## scale.bed_rate)      -4.159e-02  9.480e-02  -0.439  0.6609
## scale(smoke_perc)     -3.734e-01  1.701e-01  -2.196  0.0281 *
## scale(obese_perc)     1.670e-02  1.510e-01   0.111  0.9119
## rptest               3.405e-02  8.539e-03   3.988 6.66e-05 ***
## ptest_weeks_ago1     1.403e-02  6.523e-03   2.151  0.0315 *
## ptest_weeks_ago2     3.292e-03  4.695e-03   0.701  0.4833
## ptest_weeks_ago3     8.046e-04  3.841e-03   0.210  0.8341
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## R-sq.(adj) =  0.863
## glmer.ML = 82.583  Scale est. = 1          n = 287

```

(10) Weekly_death ~ linear days_since_first + scaled independent variables + positive test ratio with only 1-3 weeks lag without the current positive test ratio + random intercept + random slope for days_since_first

```

##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ weeks_since_first + factor(q_popdensity) + scale(Age_gp1) +
##   scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) + scale(Black.perc) +
##   scale(Hispanic.or.Latino.perc) + scale(temp) + scale(perc) +
##   scale(Bachelor_orhigher_perc) + scale.bed_rate) + scale(smoke_perc) +
##   scale(obese_perc) + ptest_weeks_ago1 + ptest_weeks_ago2 +
##   ptest_weeks_ago3 + offset(log(population))
##
## Parametric coefficients:

```



```

##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)      -11.751982   0.314715 -37.342 < 2e-16 ***
## weeks_since_first    0.127274   0.030089   4.230 2.34e-05 ***
## factor(q_popdensity)2 -0.032495   0.303386  -0.107  0.91470
## factor(q_popdensity)3  0.075548   0.365447   0.207  0.83622
## factor(q_popdensity)4 -0.106310   0.381436  -0.279  0.78047
## factor(q_popdensity)5  0.771776   0.499626   1.545  0.12242
## scale(Age_gp1)        0.235998   0.204322   1.155  0.24808
## scale(Age_gp3)        0.272480   0.164444   1.657  0.09753 .
## scale(Age_gp4)        0.006325   0.184993   0.034  0.97272
## scale(poverty_perc)    0.281569   0.172167   1.635  0.10196
## scale(Black.perc)     0.361217   0.173136   2.086  0.03695 *
## scale(Hispanic.or.Latino.perc) 0.049573   0.187929   0.264  0.79195
## scale(temp)          -0.453851   0.176000  -2.579  0.00992 **
## scale(perc)           0.108475   0.201799   0.538  0.59089
## scale(Bachelor_orhigher_perc) 0.030821   0.220787   0.140  0.88898
## scale(bed_rate)      -0.014153   0.100382  -0.141  0.88788
## scale(smoke_perc)     -0.329942   0.179666  -1.836  0.06630 .
## scale(obese_perc)     0.090448   0.159090   0.569  0.56967
## ptest_weeks_ago1      0.030857   0.005967   5.171 2.33e-07 ***
## ptest_weeks_ago2      0.002626   0.004710   0.558  0.57715
## ptest_weeks_ago3      0.002061   0.003855   0.535  0.59289
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## R-sq.(adj) =  0.656
## glmer.ML = 82.134  Scale est. = 1          n = 287

```

- (11) Weekly_death ~ linear days_since_first + scaled independent variables + positive test ratio with only 1-3 weeks lag without the current positive test ratio + the PCA of movement + the time since the mask policy with 3 levels + random intercept + random slope for days_since_first

```

##
## Family: Negative Binomial(1)
## Link function: log
##
## Formula:
## weekly_death ~ weeks_since_first + factor(q_popdensity) + scale(Age_gp1) +
##   scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) + scale(Black.perc) +
##   scale(Hispanic.or.Latino.perc) + scale(temp) + scale(perc) +
##   scale(Bachelor_orhigher_perc) + scale(bed_rate) + scale(smoke_perc) +
##   scale(obese_perc) + ptest_weeks_ago1 + ptest_weeks_ago2 +
##   ptest_weeks_ago3 + PC1 + PC2 + factor(f_mask) + offset(log(population))
##
## Parametric coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)      -11.886263   0.383940 -30.959 < 2e-16 ***
## weeks_since_first    0.139259   0.056630   2.459  0.0139 *
## factor(q_popdensity)2 -0.049817   0.314422  -0.158  0.8741
## factor(q_popdensity)3  0.015961   0.397131   0.040  0.9679
## factor(q_popdensity)4 -0.159965   0.402579  -0.397  0.6911
## factor(q_popdensity)5  0.667035   0.536510   1.243  0.2138
## scale(Age_gp1)        0.246558   0.234160   1.053  0.2924
## scale(Age_gp3)        0.247839   0.166353   1.490  0.1363

```

```
## scale(Age_gp4)          0.026158  0.196942  0.133  0.8943
## scale(poverty_perc)     0.281525  0.173594  1.622  0.1049
## scale(Black.perc)       0.346247  0.182828  1.894  0.0582 .
## scale(Hispanic.or.Latino.perc) 0.049316  0.194347  0.254  0.7997
## scale(temp)             -0.439614  0.211525 -2.078  0.0377 *
## scale(perc)             0.151048  0.205903  0.734  0.4632
## scale(Bachelor_orhigher_perc) 0.007461  0.227576  0.033  0.9738
## scale(bed_rate)        -0.029674  0.102764 -0.289  0.7728
## scale(smoke_perc)       -0.330693  0.184934 -1.788  0.0737 .
## scale(obese_perc)       0.077641  0.163919  0.474  0.6357
## ptest_weeks_ago1       0.027405  0.006154  4.453 8.46e-06 ***
## ptest_weeks_ago2       0.003490  0.004779  0.730  0.4652
## ptest_weeks_ago3       0.002447  0.003916  0.625  0.5320
## PC1                    -0.038911  0.080044 -0.486  0.6269
## PC2                    0.025641  0.140231  0.183  0.8549
## factor(f_mask)1        0.280497  0.225464  1.244  0.2135
## factor(f_mask)2        0.149401  0.326078  0.458  0.6468
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
```

```
##
```

```
## R-sq.(adj) = 0.726
```

```
## glmer.ML = 78.332 Scale est. = 1 n = 287
```

- (12) Weekly_death ~ linear days_since_first + scaled independent variables + positive test ratio with only 1-3 weeks lag without the current positive test ratio + the residential movement with 3 weeks lag + the time since the mask policy with 3 levels + random intercept + random slope for days_since_first

```
##
```

```
## Family: Negative Binomial(1)
```

```
## Link function: log
```

```
##
```

```
## Formula:
```

```
## weekly_death ~ weeks_since_first + factor(q_popdensity) + scale(Age_gp1) +
##   scale(Age_gp3) + scale(Age_gp4) + scale(poverty_perc) + scale(Black.perc) +
##   scale(Hispanic.or.Latino.perc) + scale(temp) + scale(perc) +
##   scale(Bachelor_orhigher_perc) + scale(bed_rate) + scale(smoke_perc) +
##   scale(obese_perc) + ptest_weeks_ago1 + ptest_weeks_ago2 +
##   ptest_weeks_ago3 + residential + resident_weeks_ago1 + resident_weeks_ago2 +
##   resident_weeks_ago3 + factor(f_mask) + offset(log(population))
```

```
##
```

```
## Parametric coefficients:
```

```
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -12.723786   0.819398 -15.528 < 2e-16 ***
## weeks_since_first  0.152048   0.059257  2.566  0.0103 *
## factor(q_popdensity)2 -0.093912   0.319332 -0.294  0.7687
## factor(q_popdensity)3 -0.085927   0.403206 -0.213  0.8312
## factor(q_popdensity)4 -0.267281   0.410509 -0.651  0.5150
## factor(q_popdensity)5  0.430727   0.552625  0.779  0.4357
## scale(Age_gp1)     0.208512   0.205286  1.016  0.3098
## scale(Age_gp3)     0.139169   0.174953  0.795  0.4263
## scale(Age_gp4)     0.084282   0.189547  0.445  0.6566
## scale(poverty_perc) 0.291404   0.173668  1.678  0.0934 .
## scale(Black.perc)  0.304468   0.183038  1.663  0.0962 .
## scale(Hispanic.or.Latino.perc) 0.016443   0.199065  0.083  0.9342
```

```

## scale(temp) -0.400720 0.194170 -2.064 0.0390 *
## scale(perc) 0.223956 0.204633 1.094 0.2738
## scale(Bachelor_orhigher_perc) -0.040801 0.226697 -0.180 0.8572
## scale(bed_rate) -0.082639 0.106707 -0.774 0.4387
## scale(smoke_perc) -0.322817 0.181290 -1.781 0.0750 .
## scale(obese_perc) 0.013002 0.167362 0.078 0.9381
## ptest_weeks_ago1 0.024703 0.006133 4.028 5.62e-05 ***
## ptest_weeks_ago2 0.002897 0.004809 0.602 0.5469
## ptest_weeks_ago3 0.003470 0.003931 0.883 0.3774
## residential -0.015821 0.053543 -0.295 0.7676
## resident_weeks_ago1 0.063576 0.065403 0.972 0.3310
## resident_weeks_ago2 0.028244 0.041617 0.679 0.4973
## resident_weeks_ago3 0.001314 0.040588 0.032 0.9742
## factor(f_mask)1 -0.144582 0.521100 -0.277 0.7814
## factor(f_mask)2 -0.222861 0.611123 -0.365 0.7154
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## R-sq.(adj) = 0.756
## glmer.ML = 71.18 Scale est. = 1 n = 287

```