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Estimating the Burden of Influenza from Emergency Department Visits in Los Angeles County

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Faculty Thesis Advisor: Dr. Anne C. Spaulding, MD

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Abstract

Estimating the Burden of Influenza from Emergency Department Visits in Los Angeles County

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Currently, little is known about the holistic effect of flu on the emergency department. This study aims to explore the use of daily emergency department visits in Los Angeles County facilities from 2005-2014 to compare different models and their components to see which more accurately estimate the associated attributable burden of flu. Models for the outcomes: respiratory diseases, cardiovascular diseases, and pneumonia were fit using quasi-Poisson regression. Functions use to fit the models were 3rd degree polynomial and 40, 60, 80, and 120 knot splines. Comparisons were measured between the inclusion of both primary and secondary diagnoses codes versus primary. Each model reported a time series comparing each outcome including influenza as a predictor to excluding influenza as a predictor. The burden of influenza was found from taking the difference between the two. Both the burden estimates and standard errors were reported for each year for each model version. This methodology was also done for stratified groups of ages 1-4, 5-49, 50-64, and >=65. The 4 ages group distributions were then compared over the 9-year study period. The models selected for each outcome was then based on both graphical interpretations of model fit and level of noise and numerical interpretations of standard error. Based on the selection criteria, outcomes were fit with both diagnoses' codes. The non-stratified results respiratory disease, cardiovascular disease, and pneumonia were fit with a 60-knot spline model, 40-knot spline model, and 3rd degree polynomial model respectively. For the stratified results, all three outcomes models selected were fit with a 40-knot spline model across all 4 age groups. The 5-49 age group showed the largest distribution of influenza burden especially from 2009-2010. This study was an exploratory descriptive analysis comparing the models used to more accurately measure influenza estimates. While the selected models seemed to decently fit the outcome data, much more investigation into modeling emergency department data across different regions and time periods needs to be done. The lack of knowledge on burden also emphasizes the need for both public health related and political actions towards increasing research and testing.

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And to my little one, Archer. He stuck by me through every second of it even if he was snoring 90% of the time.

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INTRODUCTION

Approximating the burden of influenza-associated mortality is integral to public health on a national and international level. Reporting accurate counts of influenza (flu) has proven to be a challenge due to the requirement for high-quality systematic vital records and local viral surveillance data. Many believe that the WHO's previous estimate of 250,000–500,000 annual flu deaths is outdated and there are multiple issues when trying to accurately measure the true burden. (1) Influenza can easily be and quite often is mistaken for other respiratory illnesses such as respiratory syncytial virus (RSV) or other emerging viral diseases like COVID-19. Flu virus infections are often not confirmed systematically by laboratory diagnosis, and therefore flu deaths might be attributed to other comorbid conditions or secondary infections. (1)

Methods such as using mathematical and statistical models as well as epidemiological methods have been used to find more accurate estimates of baseline and influenza-associated illnesses (ILI). These methods have been improving overtime; however, influenza virus infections are seldomly confirmed in a systematic laboratory setting, and therefore influenza deaths could very well be confounded with other secondary infections or comorbid conditions. (1)

Fine tuning these models firstly involves using methods found in the literature to find the appropriate proxies for flu, the correct outcomes to measure, which covariates to include in the model, and choosing the right type and details of the model. Second, fine tuning is an iterative process which compares the different versions of the model for accuracy, adjusts its components accordingly, and repeats the process.

Currently, little is known about the holistic effect of flu on the emergency department (ED). (2) The United States has identified a severe shortage in preparedness for flu and other respiratory viruses like COVID-19. Therefore, this study aims to explore the use of daily ED visits in Los Angeles County facilities to compare different models and their components to see which more accurately estimate the associated attributable burden of flu among both stratified and non-stratified age groups.

METHODS

Study Setting and Population

Daily counts of flu, 6 outcomes and all the covariates used in the model were collected from 2005 to 2014 via records for patients who attended ED facilities in Los Angeles (LA) County, California. LAC pulled ED data from 27 facilities.

Study Design and Data Sources

This was an ecological study design based on previously collected counts of data. The model involved estimating a seasonal baseline for daily morbidity by fitting a sinusoidal function to cases of six outcomes data for periods during flu season. The ED data for outcomes and exposure were pulled from The California Office of Statewide Health Planning and Development (OSHPD) and using the 9th and 10th revisions of the International Statistical Classification of Diseases and Related Health Problems (ICD) codes (Appendix B).

The ED data itself includes encounters from hospitals that are licensed to provide emergency medical services. Reportable ED encounters only included patients who had face-to-face contact with their provider. This does not include patients who left without being seen.

<u>The Model Design</u>

Flu models count models are typically overdispersed in which case the variance is not equal to the mean. Therefore, a quasi-Poisson regression model was used compared to a standard Poisson which assumes the mean and variance are equal which would be an underestimate. The model was fit using the programming language R. There were a total of five different versions used to fit time in the model including a 3rd degree polynomial and splines with degrees of freedom equal to 40, 60, 80, and 120. All versions used cubic splines to fit the time dependent covariates. The following equations display the 3rd degree polynomial and cubic spline model respectively:

Equation1

$$
\begin{aligned}
ED_{OUTCOME(j)} = \beta_0 \\
&+ \sum_{i=1}^{3625} [\ \beta_{1i}^{FLU} + \beta_{2i}^{FED\_HOL} + \beta_{3i}^{DEC\_25} + \beta_{4i}^{DEC\_26} + \beta_{5i}^{JAN\_1} \\
&+ \sum_{k=6}^{11} \beta_{ki}^{DOW} + \beta_{11i} Spline(MAX\_TEMP, 3) \\
&+ \beta_{12i}\, Spline(MIN\_TEMP, 3) + \beta_{13i} Spline(DEWPOINT, 3) + \boldsymbol{\beta_{14i}^{TIME}} \\
&+ \boldsymbol{\beta_{15i}^{TIME^2}} + \boldsymbol{\beta_{16i}^{TIME^3}} + \beta_{17i}^{\cos\left(\frac{2\pi TIME}{356.25}\right)} \beta_{18i}^{\sin\left(\frac{2\pi TIME}{356.25}\right)} + \sum_{l=19}^{37} \beta_{li}^{FACILITY}\ ]
\end{aligned}
$$

Equation 2

$$ED_{OUTCOME(j)} = \beta_0$$

$$+ \sum_{i=1}^{3625} [\ \ \beta_{1i}^{FLU} + \beta_{2i}^{FED\_HOL} + \beta_{3i}^{DEC\_25} + \beta_{4i}^{DEC\_26} + \beta_{5i}^{JAN\_1}$$

$$+ \sum_{k=6}^{11} (\beta_{ki}^{DOW}) + \beta_{11i} Spline(MAX\_TEMP, 3)$$

$$+ \beta_{12i}\, Spline(MIN\_TEMP, 3) + \beta_{13i} Spline(DEWPOINT, 3)$$

$$+ \boldsymbol{\beta_{14i} Spline(TIME, df = m)} + \beta_{15i}^{\cos\left(\frac{2\pi TIME}{356.25}\right)}\ \beta_{16i}^{\sin\left(\frac{2\pi TIME}{356.25}\right)}$$

$$+ \sum_{l=17}^{35} (\beta_{li}^{FACILITY})\ \ ]$$

Outcomes

$ED_{OUTCOME(j)}$ represents emergency department visits for j = 6 outcomes. This includes diagnoses in two categories: total and primary. The total category includes both primary and secondary diagnosed cases of respiratory diseases (RESP), bacterial pneumonia (PNEU) a subset of RESP, and cardiovascular diseases (CVD). The primary category is only primary cases of respiratory diseases (RD1), bacterial pneumonia (PNEU1), and cardiovascular diseases (CVD1). The ICD code table found in the appendix categorizes respiratory disease as RD and bacterial pneumonia as PNEU_B. These outcomes were chosen because respiratory diseases are closely related to flu and cardiovascular diseases have been known to show high comorbidity with flu.

The primary diagnosis is the most serious during the emergency department encounter. For this study it is defined as if the patient had visited the ED for one of the 6 outcomes.

A secondary diagnosis is defined as conditions that coexist at the same time as the primary diagnosis. An example of this in the study would be if a patient came in for something other than one of the 6 outcomes such as an injury but then while in the ED tested positive for a respiratory disease in addition to their injury.

Exposure

The exposure, FLU, represents all strains of flu which is also subset of RESP. Initially, both ICD codes for flu and ILI were used as proxies to estimate the true burden but after comparing multiple versions of the models ILI did not seem to provide useful results and was excluded from the study. Other measures seen in the literature of the flu were lab counts and percent positives with some including specific subtypes. (2-16)

Covariates

The other covariates are controlled for in the model are to help establish a more accurate fit of our model. DEC_25, DEC_26, and JAN_1 represent Christmas, the day after Christmas and New Year's respectively. FED_HOL represents other historically important federal holidays like the 4th of July. These holiday variables are included due to the seasonal pattern of high transmissibility of flu during these times. The DOW represent the indicator variables for each day of the week excluding Sunday which was a cause of multicollinearity. DOW is included because there is variation of ED visits which is usually higher during the week. MAX_TEMP, MIN_TEMP, and DEWPOINT all represent the daily maximum temperature, minimum temperature, and dewpoint respectively. The meteorology variables are from NOAA's online database which were collected from airport monitors. They are included in the model due to their strong correlation to the transmission of flu as seen in the seasonal shift in cases which peak in the winter.

The Spline function seen previously represents cubic splines to account for the change over time seen in these three covariates. TIME represents each day and appears in the equation 1 (polynomial model) in the form of a 3rd degree variable. The Spline function of time in equation 2 takes represents all the time is measured using a spline function with varying degrees of freedom (df) equal to m knots. These knots include m = 40, 60, 80, and 120.

The combination of sinusoidal functions helps to better fit the model to the seasonal pattern of flu. It takes the period, multiplies it by the time, and then divides it by an approximate year for both sinusoidal functions. This helps the model mimic the shape of annual waves in flu activity. Finally, FACILITY represents indicator variables for all of locations of the emergency department facilities.

Estimating the Burden of Influenza

Calculating the burden and standard error of flu uses the same methods for both the polynomial and spline models seen in equations 1 and 2. The following equations were used to estimate the burden of flu using the previous models:

Equation 3

$$\widehat{outcome}_{FLU=FLU} \sum_{i} e^{ED(FLU=FLU)}$$

Equation 4

$$\widehat{outcome}_{FLU=0} \sum_{i} e^{ED(FLU=0)}$$

Equation 5

$$flu\ \widehat{burden} = \textstyle\sum_i E[ED_{outcome}(with\ flu)] - E\ [ED_{outcome}(without\ flu)]$$

Equation 6

$$flu\ \widehat{burden} = \sum_{i} e^{ED(FLU=FLU)} - e^{ED(FLU=0)}$$

Notice that equations 5 and 6 are equivalent. Here i represents the sum of the counts for each annual flu season. Equations 5 and 6 then take the difference between the expected value of the given predictors to estimate the outcome from the model where the predictor FLU is included and the expected value where the predictor FLU = 0. This difference is the estimated flu burden for each specific time period over i. Standard errors for the flu burden estimates were calculated using the multivariate delta method. (17) This was then used to calculate confidence intervals assuming normal 95% confidence. In addition to counts, burden estimate percentages per 100,000 individuals were reported for tables displayed for model selection. They were calculated by taking the counts and dividing them by year and age appropriate population denominators found via the LA County census and then multiplied by 100,000. Flu burden estimates were reported annually across all 6 outcomes and all 5 versions of the model from 2005-2014.

Equations 3 and 4 are simply components of equations 5 and 6 and provide the total burden of that particular outcome (RESP, CVD, PNEU) with and without flu. The predictions from equations 5 and 6 were then plotted as two separate time series against the original outcome data for each of the 6 outcomes and both the polynomial and spline versions of the model.

Stratification by Age

Flu is known to be much more prevalent than those with high risk of weaker immune systems such the infants, those with immunocompromised systems and particularly in the elderly. Due to the clear modification that age has on the effect of morbidity of flu the study looked at differences in flu burden in age stratified groups. Ages were broken into four groups: 1-4, 5-49, 50-64, and 65≤. The same methodology to estimate flu burden and outcomes as previously seen in equations 1-6 were applied to each of the four age groups.

Model Selection

There were two main metrics for model selection. The first was a graphical approach by analyzing time series of equations 3 and 4 to compare different versions of the model fit to the outcome data and volume of noise. The second involved a numeric approach by analyzing the estimate, standard error, and confidence interval values of equations 5 and

6 to compare the different model versions using the 2009-2010 flu season. The decision to use this year as a metric of comparing error came from looking at the output across flu seasons which showed similar patterns across years. The most error was typically exhibited during 2009-2010. Evaluating the model output was an iterative process of comparing different combinations of both the diagnoses codes and type of function used to create the model for each outcome over time. This selection process was done to obtain meaningful results for both the non-age-stratified and age-stratified data. The final tables and figures were created and modified using excel.

RESULTS

Model Patterns

The time series modeling respiratory disease ED visits followed an increasing seasonal sinusoidal pattern similar to flu with a clear spike in the 2009-2010 flu season period due to the H1N1 pandemic. The time series modeling cardiovascular disease ED visits followed an increasing line considering it is not a seasonal condition. Similar to respiratory disease, the time series modeling bacteria pneumonia ED visits also followed a seasonal sinusoidal pattern similar to flu with a clear spike in the 2009-2010 flu season period due to the H1N1 pandemic. This is partially expected considering pneumonia is a subset of the ICD codes of respiratory disease.

Non-Age-Stratified Results

Upon investigation of the time series and estimate outputs of the non-age-stratified data for all of the model combinations of respiratory disease had decent yet similar fits. When comparing outcomes RESP and RESP1, RESP1 appeared to display slightly more noise. Comparing 3rd polynomial to increasing splines, each increase in df gave a tighter fit. Figure 1 displays the different versions of the model for RESP and RESP1. The models for cardiovascular disease yielded similar results with all of the time series being very similar in fit and level of noise as seen with respiratory disease. The models for bacterial pneumonia, however, became more overfit to the data as it went from 3rd polynomial degree to splines and more so as it increased in df. PNEU was also a noisier outcome than PNEU1. Terminology seen in the tables and figures include SE for standard error, LL and

Lower Limit for lower confidence interval limits, UL and Upper Limit for upper confidence interval limits, and CI for confidence interval.

The time series investigation led to the second metric focusing on comparing the models for the outcomes RESP, CVD, and PNEU. Upon comparison of the burden estimates for the 2009-2010 season all of the versions of the model had reasonably small to moderate standard errors for all three outcomes. RESP had burden estimates with 95% confidence intervals of 28,218 (26,540.24-29,895.76), 7,053 (6,265.08-7,840.92), 5,109 (4,201.52-6,016.48), 5,136(4,142.28-6,129.72), and 3,003 (1,923.04, 4,082.96) for the 3rd degree polynomial and the spline models: df= 40, 60, 80, 120 respectively.

Figure 1: Time Series Comparisons of Emergency Department Visits for Resipiratory Diseases in Los Angeles County

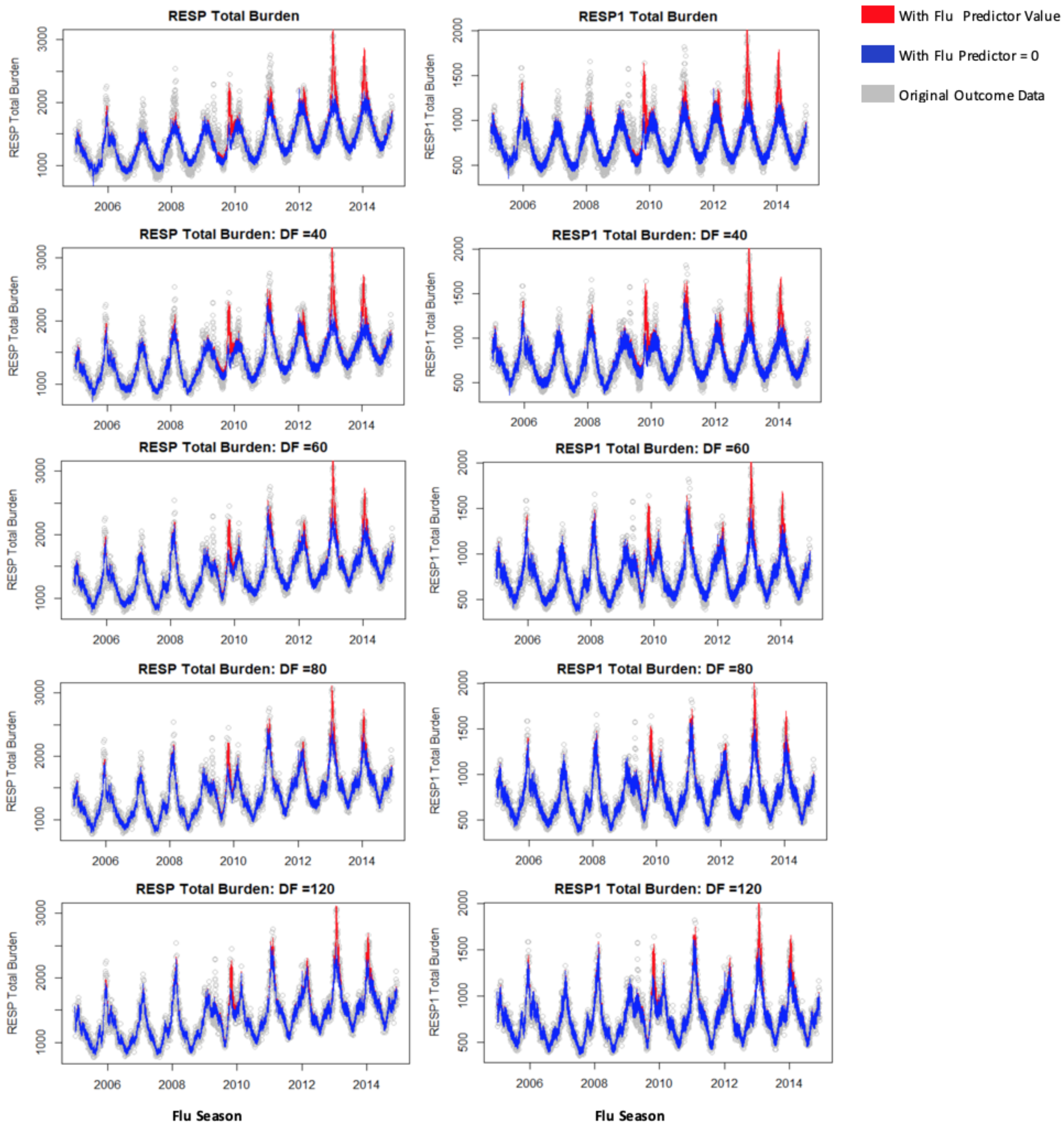


Table 1: 2009-2010 Burden of Influenza of Respiratory Disease Emergency Department Visits in Los Angeles County

Outcome	Model	Burden	SE	Lower Limit	Upper Limit	CI Width
Respiratory Disease (Primary and Secondary Diagnoses)	3rd Degree Polynomial	28,218.00	856.00	26,540.24	29,895.76	3,355.52
	Splilne, DF = 40	7,053.00	402.00	6,265.08	7,840.92	1,575.84
	Spline, DF = 60	5,109.00	463.00	4,201.52	6,016.48	1,814.96
	Spline, DF = 80	5,136.00	507.00	4,142.28	6,129.72	1,987.44
	Spline, DF = 120	3,003.00	551.00	1,923.04	4,082.96	2,159.92
Cardiovascular Disease (Primary and Secondary Diagnoses)	3rd Degree Polynomial	3,750.00	474.00	2,820.96	4,679.04	1,858.08
	Splilne, DF = 40	2,136.00	346.00	1,457.84	2,814.16	1,356.32
	Spline, DF = 60	1,583.00	415.00	769.60	2,396.40	1,626.80
	Spline, DF = 80	1,215.00	483.00	268.32	2,161.68	1,893.36
	Spline, DF = 120	-7.00	540.00	-1,065.40	1,051.40	2,116.80
Bacterial Pneumonia (Primary and Secondary Diagnoses)	3rd Degree Polynomial	629.00	35.00	560.40	697.60	137.20
	Splilne, DF = 40	217.00	25.00	168.00	266.00	98.00
	Spline, DF = 60	181.00	31.00	120.24	241.76	121.52
	Spline, DF = 80	141.00	36.00	70.44	211.56	141.12
	Spline, DF = 120	117.00	40.00	38.60	195.40	156.80

When deciding which models to compare non-age-stratified flu burden over time the spline model with df=40 was selected for RESP due to having the best balance of low standard error and best fit compared to the other models. When deciding which models to compare non-age-stratified flu burden over time the spline model with df=60 was selected for CVD. Although all the models had similar fits the it had the lowest standard error. When deciding which models to compare non-age-stratified flu burden over time the 3rd degree polynomial was selected for PNEU. Although all the models had similar standard error it had the best fit among the models. Figure 2 displays the time series for each outcome's selected model. Table 2 displays the burden estimates of flu for each outcome's selected model. The models all show trends of increasing burden over time and a particular spike in the RESP model including flu as a predictor in 2009-2010.

Figure 2: Selected Time Series of Emergency Department Visits Outcomes in Los Angeles County

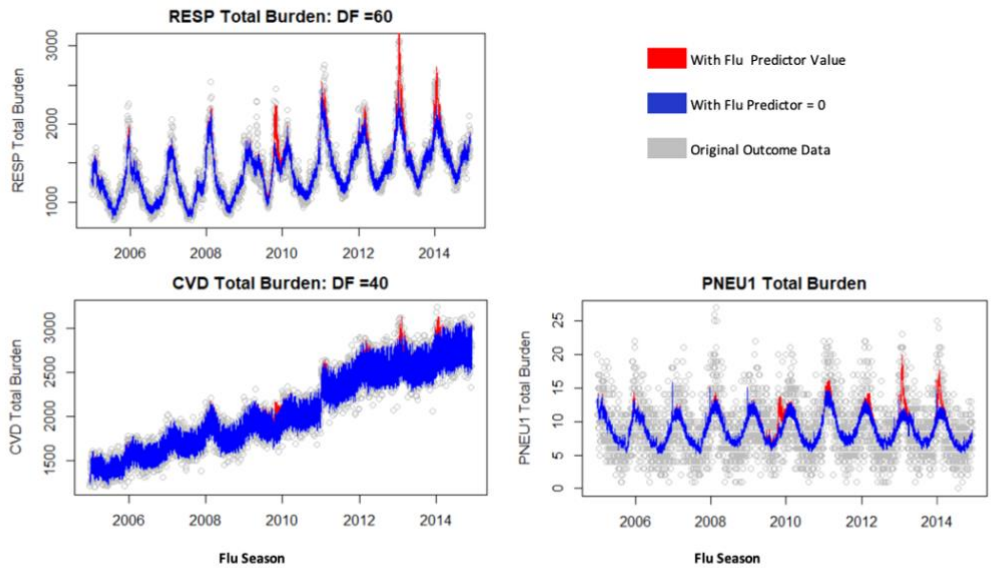


Table 2: 2005-2014 Burden of Influenza Emergency Department Visits in Los Angeles County

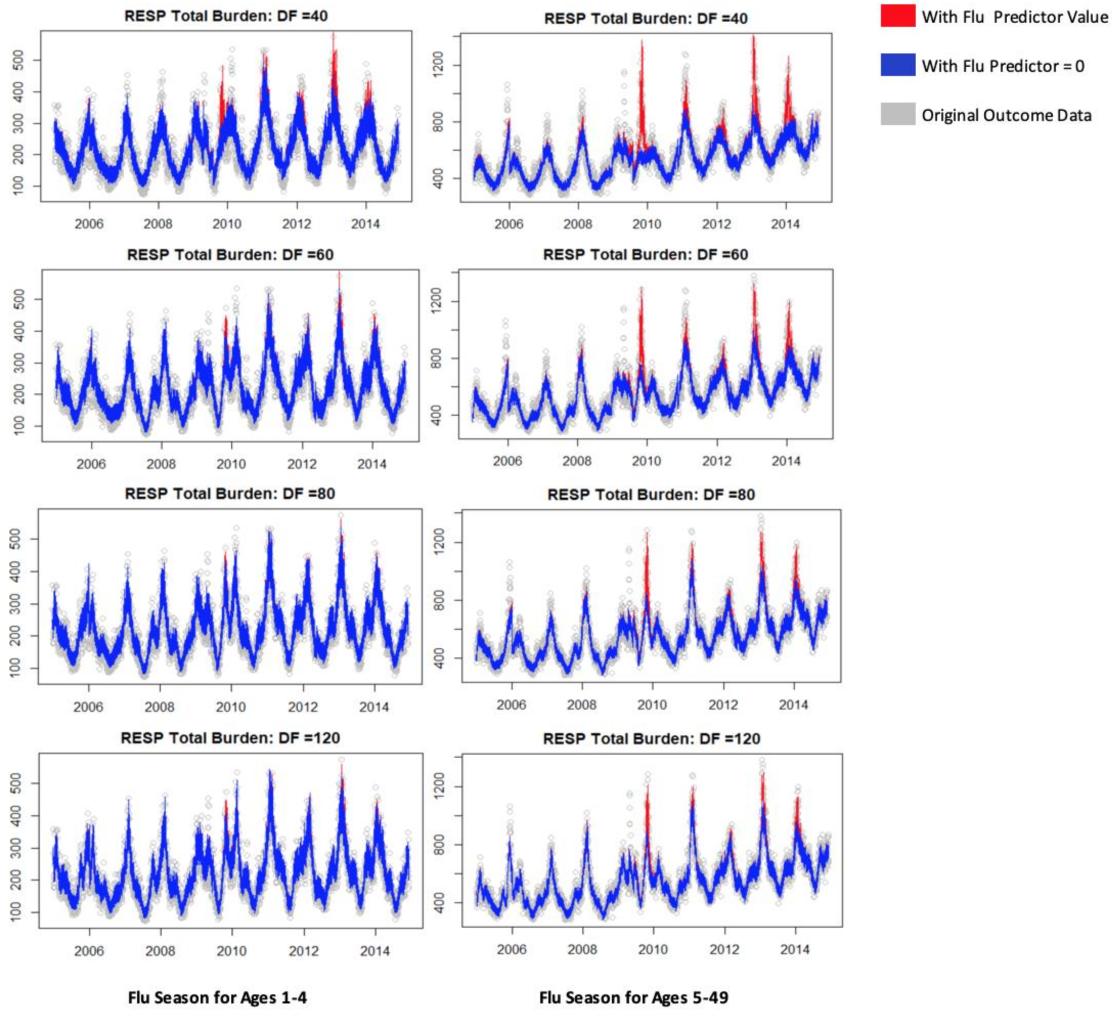
Outcome	Flu Season	Burden	SE	LL	UL	CI Width
Respiratory Disease (Primary and Secondary Diagnoses) DF=60	05-06	3.60	0.26	3.08	4.12	1.04
	06-07	4.20	0.39	3.44	4.96	1.52
	07-08	8.46	0.78	6.94	9.98	3.04
	08-09	10.94	1.00	8.97	12.91	3.94
	09-10	51.86	4.70	42.65	61.07	18.42
	10-11	26.61	2.43	21.86	31.37	9.51
	11-12	20.20	1.86	16.56	23.84	7.28
	12-13	57.25	5.13	47.20	67.30	20.10
	13-14	62.74	5.58	51.80	73.68	21.88
	Flu Season	Burden	SE	LL	UL	CI Width
Cardiovascular Disease (Primary and Secondary Diagnoses) DF=40	05-06	2.44	0.40	1.66	3.22	1.56
	06-07	1.38	0.22	0.94	1.82	0.88
	07-08	2.72	0.44	1.86	3.58	1.72
	08-09	4.46	0.72	3.04	5.87	2.83
	09-10	21.68	3.51	14.80	28.57	13.77
	10-11	10.42	1.70	7.09	13.74	6.65
	11-12	8.33	1.35	5.68	10.98	5.30
	12-13	21.37	3.45	14.60	28.14	13.53
	13-14	24.66	3.98	16.85	32.47	15.62
	Flu Season	Burden	SE	LL	UL	CI Width
Bacterial Pneumonia (Primary Diagnoses) 3rd Degree Polynomial	05-06	0.75	0.04	0.67	0.83	0.16
	06-07	0.30	0.02	0.26	0.34	0.08
	07-08	1.07	0.06	0.95	1.19	0.24
	08-09	0.68	0.04	0.60	0.76	0.16
	09-10	6.38	0.36	5.69	7.08	1.39
	10-11	2.46	0.13	2.20	2.72	0.52
	11-12	2.37	0.12	2.13	2.61	0.47
	12-13	7.33	0.42	6.50	8.15	1.65
	13-14	5.58	0.32	4.95	6.21	1.25

Age-Stratified Results

Upon investigation of the time series and estimate outputs of the age-stratified data it was apparent that disease was the only outcome that contained viable fits for the model. When broken into age groups the counts for cardiovascular disease and pneumonia were too low and caused issues with both the time series and burden estimates resulting in significantly poorly fit time series and poorly estimated and even in some cases negative values. The same is true for the 3rd degree polynomial model for respiratory disease which also resulted in poorly fit time series that were underestimated in the 5-49 and >=65 year old age groups and overestimated in the 50-64 year old age group. Therefore, to make a comparison of adequately fit models RESP was the only outcome looked at using the spline versions of the model across the four age groups.

Upon comparison of the age-stratified spline time series the 1-4 and >=65 year old age groups had decent fits with low noise volume for df=40 and then became noisier as the degrees of freedom increased. As for the 5-49 and 50-64 year old age groups, all of the time series had decent fits and were comparable to one another. Figure 1 displays the difference in noise across splines for age groups 1-4 and 5-49 years. Also, it shows the 5-49 year old age group having a much higher spike of flu burden in 2009-2010.

Figure 3: Time Series Comparisons of Emergency Department Visits by Age Group for Resipratory Diseases in Los Angeles County



Upon comparison of the burden estimates for the 2009-2010 season all of the spline versions of the model had reasonably small standard errors across the four age groups. The 1-4 age group had burden estimates of 3,822(3,292.80, 4,351.20), 1,445 (911.88, 1,978.12), 634 (108.72,1,159.28), and 1,078 (588, 1,568) for df= 40, 60, 80, 120 respectively. The 5-49 age group had burden estimates of 22,184 (20,931.56, 23,436.44), 15,674 (14,205.96, 17,142.04), 12,027 (10,425.68, 13,628.32), and 10,596 (8,937.84, 12,254.16) The 50-64 age group had burden estimates of 2,407(2,216.88, 2,597.12), 1,560 (1,340.48, 1,779.52), 996 (749.04, 1,242.96), and 882 (613.48, 1,150.52). Finally, the >=65 age group had burden estimates of 1,007 (903.12, 1,110.88), 618 (508.24, 727.76), 551(439.28, 662.72), and 511 (354.2, 667.80).

Table 3: 2009-2010 Burden of Influenza from Spline Models of Respiratory Disease Emergency Department Visits by Age Group in Los Angeles County*

Age Group	Model	Burden	SE	Lower Limit	Upper Limit	CI Width
Ages (1-4)	Splilne, DF = 40	3,822.00	270.00	3,292.80	4,351.20	1,058.40
	Spline, DF = 60	1,445.00	272.00	911.88	1,978.12	1,066.24
	Spline, DF = 80	634.00	268.00	108.72	1,159.28	1,050.56
	Spline, DF = 120	1,078.00	250.00	588.00	1,568.00	980.00
Ages (5-49)	Splilne, DF = 40	22,184.00	639.00	20,931.56	23,436.44	2,504.88
	Spline, DF = 60	15,674.00	749.00	14,205.96	17,142.04	2,936.08
	Spline, DF = 80	12,027.00	817.00	10,425.68	13,628.32	3,202.64
	Spline, DF = 120	10,596.00	846.00	8,937.84	12,254.16	3,316.32
Ages (50-64)	Splilne, DF = 40	2,407.00	97.00	2,216.88	2,597.12	380.24
	Spline, DF = 60	1,560.00	112.00	1,340.48	1,779.52	439.04
	Spline, DF = 80	996.00	126.00	749.04	1,242.96	493.92
	Spline, DF = 120	882.00	137.00	613.48	1,150.52	537.04
Ages (50-64)	Splilne, DF = 40	1,007.00	53.00	903.12	1,110.88	207.76
	Spline, DF = 60	618.00	56.00	508.24	727.76	219.52
	Spline, DF = 80	551.00	57.00	439.28	662.72	223.44
	Spline, DF = 120	511.00	80.00	354.20	667.80	313.60

*Estimates for Primary and Secondary Diagnoses

When deciding which model to compare age-stratified flu burden over time the spline model with df=40 was selected due to having both the least amount of noise in the splines and standard error when calculating estimates. Table 4 and Figure 4 show a clear trend of flu burden slightly increasing overall overtime in all age categories with a spike in 2009-2010 during the H1N1 pandemic. This also shows the largest burden is felt in the 5-49 age category especially a large majority during the 2009-2010 pandemic.

Table 4: 2005-2014 Burden of Flu (per 100,000 individuals) from Respiratory Diseases Spline Models Season by Age Group in Los Angeles County*

Ages 1-4

Flu Season	Burden	SE	LL	UL	CI Width
05-06	3.60	0.26	3.08	4.12	1.04
06-07	0.63	0.04	0.55	0.71	0.16
07-08	3.23	0.23	2.77	3.69	0.92
08-09	3.05	0.22	2.61	3.48	0.88
09-10	38.80	2.74	33.42	44.17	10.74
10-11	13.75	0.98	11.82	15.68	3.86
11-12	11.68	0.85	10.02	13.34	3.32
12-13	35.33	2.47	30.49	40.17	9.68
13-14	21.62	1.56	18.56	24.67	6.11

Ages5-49

Flu Season	Burden	SE	LL	UL	CI Width
05-06	17.76	0.56	16.66	18.86	2.19
06-07	7.99	0.25	7.51	8.47	0.96
07-08	25.20	0.79	23.66	26.74	3.08
08-09	21.76	0.68	20.43	23.10	2.67
09-10	225.18	6.49	212.47	237.90	25.43
10-11	65.62	2.00	61.70	69.54	7.84
11-12	57.11	1.77	53.65	60.57	6.93
12-13	145.69	4.33	137.21	154.17	16.96
13-14	134.16	4.11	126.09	142.22	16.12

Ages 50-64

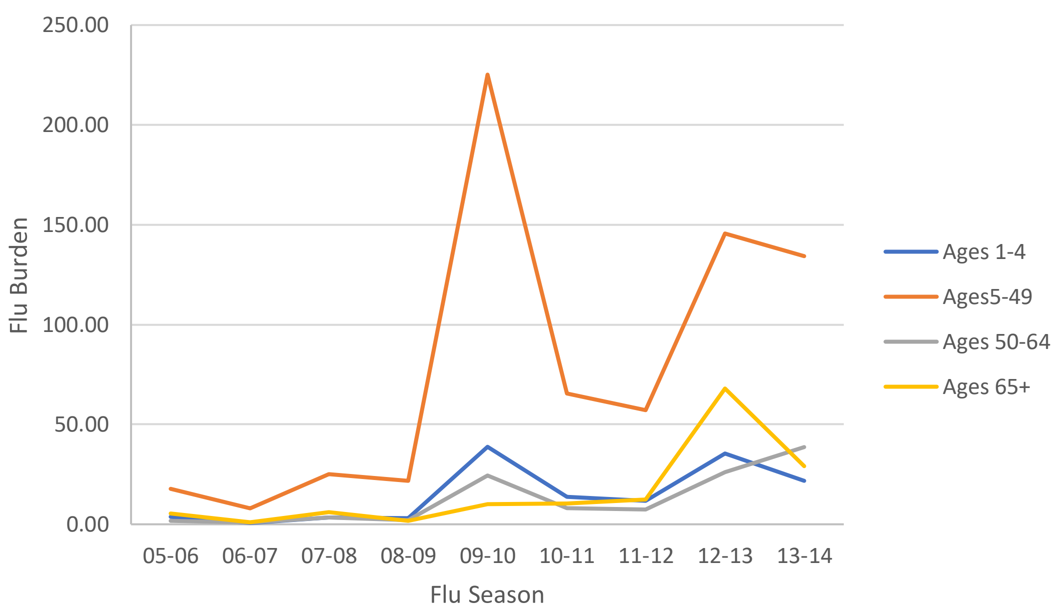
Flu Season	Burden	SE	LL	UL	CI Width
05-06	1.65	0.07	1.51	1.79	0.28
06-07	0.90	0.04	0.82	0.98	0.16
07-08	3.47	0.14	3.19	3.75	0.56
08-09	2.22	0.09	2.04	2.40	0.36
09-10	24.43	0.98	22.50	26.36	3.86
10-11	8.19	0.34	7.54	8.85	1.31
11-12	7.50	0.31	6.89	8.11	1.23
12-13	26.25	1.05	24.18	28.31	4.13
13-14	38.66	1.59	35.55	41.77	6.22

Ages >= 65

Flu Season	Burden	SE	LL	UL	CI Width
05-06	5.26	0.27	4.72	5.80	1.08
06-07	1.01	0.05	0.91	1.11	0.20
07-08	5.99	0.32	5.37	6.61	1.24
08-09	1.72	0.09	1.54	1.89	0.36
09-10	10.22	0.54	9.17	11.28	2.11
10-11	10.40	0.55	9.32	11.47	2.15
11-12	12.39	0.65	11.12	13.65	2.53
12-13	67.99	3.42	61.28	74.70	13.42
13-14	28.96	1.51	26.01	31.92	5.91

*Estimates for Primary and Secondary Diagnoses using 40 Knot Spline Models

Figure 4: 2005-2014 Burden of Influenza (per 100,000 individuals) from Spline Models of Respiratory Disease Emergency Department Visits Season by Age Group



DISCUSSION

Interpretation

This study aimed to explore the use of daily ED visits in Los Angeles County facilities to compare different models and their components to see which more accurately estimate the associated attributable burden of flu among both stratified and non-stratified age groups. All three out comes saw increasing trends of burden over time from 2005-2014 especially CVD more than doubling in size. CVD was also the noisiest of the outcomes most likely due to its wide range of related causes, however, flu did seem to be related to all three outcomes. The 2009-2010 spike seen particularly in the RESP model is most likely due the H1N1 pandemic and flu being a subset of respiratory disease.

As for model specifications, using both primary and secondary diagnoses seemed to ascertain more accurate estimates for all outcomes across all model combinations. Also, splines appear to be very useful in acquiring desired model fit in many cases however for outcomes which have sparser data such as PNEU they might overfit the data especially as increasing the number of knots. Age stratification runs the risk of actually getting unstable model estimate coefficients due to low counts of data as seen in both the CVD and PNEU outcomes. Splines, however, did fit the age-stratified models well for RESP which had a wide enough range of sizes of data. Figure 4 shows a significantly larger spike in in cases for the 5-49 age group during H1N1. This aligns with previous estimates that “globally 80 percent of (H1N1) pdm09 virus-related deaths were estimated to have occurred in people younger than 65 years of age”, which differs greatly from usually flu affected the older populations far more substantially. (18)

Limitations

There are several limitations to this study. First of all, emergency department visit data has not been examined in great detail and little is understood about how it measures the true burden of influenza. Sources such as the CDC only have symptomatic versus asymptomatic data. This illuminated the need for further data to be collected pertaining to emergency department visits.

Another limitation is the lack of available quality data. This includes surveillance and hospital data at the local level. Not only is there not sufficient research being done towards emergency department visits but also the local level surveillance particularly in the United States is lacking. Also, this study only includes data made available from public hospital facilities which could be one of the driving factors to the underestimation of flu burden. Underestimation is currently one of the largest issues pertaining to influenza which begs the need for more standard testing of the virus.

There were a number of challenges related to methodology and analysis. It was mentioned that the 2nd, 4th, and 5th polynomials were removed early in the study due to the similarity in nature, however over time of tuning models this can change. It would be interesting to look at the various age stratified estimates under versions of the model as well. Another limitation is that for preliminary model selection only the flu season of

2009-2010 during the H1N1 pandemic was used to compare standard errors between models. It could be useful to compare longer periods of time to compare statistics. The age group cut offs were based on literature but were not of equal sizes. (10) Perhaps if there were more age groups with equal interval cutoffs or population weighted distributions that would change some of the results.

Also, there are more advanced methods for model selection such as more analytical techniques for measuring the level of noise in a time series or measuring the amount of error in a model. It could also be useful for further studies to investigate changes caused by adding or removing various combinations of covariates in the models based on previous literature.

Future Implications

With the current landscape of increasing cases of influenza, an increasing world population, and an increasing distribution of older populations or "population ageing" society now has a responsibility to prepare and be educated on the dangers of a virus like flu. This has been made particularly apparent from the novel coronavirus pandemic outbreak and has a number of future public health implications.

The first implication is in relation to the public health sphere focusing on better methods. Using ED visits to measure the burden of flu is a newer method and more research is required to conduct studies to gauge their accuracy. Also, it is important to extend the methodology of this study to other regions beyond Los Angeles, California, and even the United States and compare their differences.

Unfortunately, models can only estimate but so much without the lack of sufficient data. The underestimation of flu is staggering for such a large burden and there is a clear for need for more testing and surveillance related to testing. This should include policies and funding in support of implementing rapid testing made more freely available to citizens via hospitals, clinics and organizations as well as more education on flu made available via social media and community programs. With a push in the right direction, society can not only accurately know about the true burden of influenza but also work to reduce it.

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Appendix A

A Literature Review of the Attributable Burden of Influenza

Introduction Summary

Approximating the burden of influenza-associated mortality is integral to public health on a national and international level. The burden of influenza is difficult to measure. Many believe that the WHO's previous estimate of 250,000–500,000 annual influenza deaths is outdated. A 2017 study estimated the true burden to be 290,000-650,000. (1) Estimates for influenza usually have very wide ranges. Influenza can easily be and quite often is mistaken for other respiratory illnesses such as respiratory syncytial virus (RSV). More recently emerging viral diseases like COVID-19 also can mimic influenza. This literature review aims to analyze 15 papers which evaluate the strengths of various methods used to model the burden of influenza as well as the areas in which improvements can be made.

Basic Information /Etiology

Influenza (flu) is a viral, respiratory disease that is highly contagious. Its level of severity ranges from mild to serious infection. Severe outcomes of infection can include hospitalization and death. Serious flu complications are more common in high risk groups such as younger children and the elderly. There are many different strains of influenza of animal origin, like swine flu and bird flu. In humans, however, the influenza A and B viruses are responsible for most flu illness. Both are seen in the United States each year in seasonal flu epidemics.(2)

AB Virus Types

The four types of influenza viruses are A, B, C and D. The typical flu season occurs most winters in the United States. Influenza A viruses are the only influenza viruses known to spread globally, which is referred to as a pandemic. This typically occurs when a new and very different influenza A virus emerges that can dually infect people and efficiently spread between people. Influenza type C generally only causes mild illness in humans. Mainly only cattle are affected by Influenza D viruses. (3)

How Influenza Spreads

Experts think that influenza viruses spread mainly by droplets produced from humans coughing, sneezing, singing or talking, up to approximately 6 feet away. The droplets can deposit in mouths, noses, and into lungs. Less commonly someone might also acquire flu by contact with a surface or object then transferring the virus to their own mouth, nose, or eyes. (4)

When Influenza Spreads

People with flu are most contagious in the first three to four days after the onset of illness. The range for transmission of most healthy adults is from approximately 1 day before symptoms develop and up to 5 to 7 days after onset. Those with weakened immune systems and children may pass the virus beyond 7 days.

While the incubation period varies in persons it is usually between one and four days with an average period of two days. Some infected people can be asymptomatic and still spread the virus to others. (4)

The Current Situation

The burden of influenza in the United States widely varies and is determined by a number of components including the traits of circulating viruses, duration and time of season, vaccine efficacy, and the percentage of the population vaccinated. While the impact of flu is variable, it creates a significant burden on the health of people in the United States every year. (5) “CDC estimates that influenza has resulted in between 9 million – 45 million illnesses, between 140,000 – 810,000 hospitalizations and between 12,000 – 61,000 deaths annually since 2010.” (5)

Estimating the Burden of Influenza: Motivation and Challenges Faced

In recent years, the global stage has seen surveillance systems created as part of national pandemic preparedness efforts, which have produced substantial data on the epidemiology and impact of influenza in countries where once data were sparse. Although this information has sparked interest in seasonal influenza there remains a lack of quality data on severe influenza, non-respiratory outcomes, and vulnerable demographics, as well as a need for more accurate mathematical models and economic evaluations. These limitations are the focus of research and surveillance that will help to bolster efforts in the control of influenza in the future. (6)

Obstacles of estimating burden of influenza include the difficulty of differentiating the virus from other respiratory illnesses. When lacking sufficient laboratory testing, appropriately attributing morbidity and mortality is challenging. The broad range of causes of influenza-like illnesses (ILI), combined with low-quality surveillance data, make it troublesome to capture seasonal influenza surveillance data without wide and frequent gaps of missing data. (7)

This dearth of knowledge highlights the need for achieving specific goals. Goals include providing reliable national disease burden estimates for influenza, and a more comprehensive understanding of the public health implications of influenza, particularly in high-risk communities or subpopulations such as pregnant women, people 65 years and older, young children, and people with underlying illness. Equally important is to establish informed, evidence-based decisions when distributing limited resources such as vaccinations and organizing interventions to curtail the spread of influenza and mitigate its effects. Finally, it is crucial to holistically asses the cost and benefits of these interventions and their future implications. (7)

Estimating the Burden of Influenza: The Case for Modelling

Using mathematical and statistical models as well as epidemiological methods to estimate the burden of influenza has become an increasingly popular way to address these goals. Methods to estimate baseline and influenza-associated mortality have been improving overtime; however, influenza virus infections are seldomly confirmed in a systematic laboratory setting, and therefore influenza deaths could very well be confounded with other secondary infections or comorbid conditions. (8)

Ecological models are frequently used to measure influenza-associated mortality. The International Classification of Diseases (ICD) codes for influenza using code numbers 38 and 39. Vital records include cause of death using categories commonly associated with influenza, such as respiratory or circulatory causes. Virological data is used to determine the seasonal periods of influenza circulation and to estimate influenza associated excess deaths. Including this information is paramount for modelling influenza-associated mortality due to the circulating strains of the virus subtypes varying from year to year.(8) These variations can affect annual mortality and is what these studies seek to quantify.

The success of applying these methods varies greatly from country to country depending on the quality of public health infrastructure, including the level of robustness of surveillance data. This presents challenges to communities, especially those composed of underserved and low-income populations.(8)

Spatiotemporal Setting

This literature review looked at studies which measured the burden of influenza covering a range from 1995 to 2016 with a mean of 8.2 years per study. The countries mentioned, which span the globe, are Australia, the United States, Canada, Germany, Spain, Argentina, Hong Kong, Singapore and England. (9-23)

Data Collection

Data was collected on various levels from hospital databases, surveillance systems, clinical research groups, private practices and cooperative and healthcare organizations (9-23). Methods included sentinel physicians collecting surveillance data (13, 15). The majority of the studies recorded weekly influenza case counts while some recorded counts on a monthly basis. The data collected were restricted by the definitions of influenza which will be covered in more detail below under the exposure section (9-23). The population denominators used in many cases came from data collected by statistic bureaus (9).

Exposure and Proxy Selection

An important part of measuring the burden of influenza is choosing the right proxy for influenza in the model. The various proxies used for influenza included percentage of specimens positive, count of positive specimens, ICD codes including those for both influenza as well as ILI, or a combination of multiple measures. (9-23) ILI is a category of respiratory illness that is nonspecific and defined by the presence of a cough or a sore throat as well as a fever while lacking a known cause. Clinically, until confirmed by laboratory testing a clinical diagnosis of flu is considered a diagnosis of ILI, not of confirmed influenza viral infection. (2)

Carefully identifying an appropriate proxy for influenza is crucial in updating a more accurate measure of burden. Commonly used to create a proxy for influenza was a collection of ICD 9 and ICD 10 codes based on either the case definition of influenza or the definition of ILI. (11, 12, 15, 17, 18, 20, 23).

Outcome Selection

Choosing the appropriate outcomes to measure in a model also plays an important role in producing more accurate measurements of the burden of influenza. Choosing an outcome for which there exists well known verifiable measures of burden and can also be accurately related to influenza is key when using modeling techniques. The outcomes used in the previously mentioned studies included respiratory diseases, cardiovascular diseases, otitis media, asthma, chronic obstructive pulmonary disease (COPD), and pneumonia. The most common outcomes observed were respiratory diseases, cardiovascular diseases, otitis media, and pneumonia. (4, 9-23) Some studies looked at both primary and secondary diagnoses of these outcomes in their models for comparison. (20)

Covariate Selection

The covariates are included in the models to help account a more appropriate fit of the data. Including these covariates help introduce other relationships in addition to the exposure that could also account for the outcome being measured. This helps to both mitigate forms of bias such as confounders as well as check for effect measure modification (EMM). EMM can have a synergistic effect on an outcome when combined with influenza. Adding covariates can help the model fit follow patterns and shapes distinct to the particular outcome. For instance, both respiratory diseases and influenza are seasonal and typically include sinusoidal seasonal covariates of time to more accurately fit the data.

Covariates included in the studies were influenza, often by its subtypes; RSV; ILI; asthma; time variables including various holidays related to high influenza activity and baseline and long-term seasonality trends of influenza; weather variables such as temperature and absolute humidity; and demographic variables such as age and sex. (9-23) Variables such as RSV and asthma are included in the model because they are common confounders of influenza. Variables like holidays are chosen due to the high spread of influenza during these times when people are in large groups and children are out of school. Variables like temperature and humidity are examined to analyze the relationship between climate influenza burden both at singular moments and over periods of time.

Stratification by Age

As mentioned previously, there are EMM, such as age, which are factors that have a synergistic effect with influenza, to heighten the effects of a particular outcome. Both young children and elders are vulnerable populations with heightened risks of developing complications from influenza. This is addressed in a number of the studies by stratifying the given cohort into age groups which have varying degrees of risk of complications. Modelers then apply their particular model to each group to measure and evaluate these differences (21).

Model Design

There are multiple attributes of influenza to consider when selecting an appropriate model to fit the burden. Models can measure the fixed probability that an outcome is likely to occur, or it can estimate a count. The number of flu cases is a count over time that is not only seasonal but also has a wide range from year to year.

The three main differing components of the models mentioned in the papers were type, baseline shape, and lag. The types of models chosen include multiple linear regression, Poisson regression, autoregressive, generalized additive regression, and negative binomial regression. Many models were designed using polynomial functions as well as splines. (9-23) The baseline shape of influenza takes on a sinusoidal seasonality trend over time that increases during influenza season ranging from October to May and peaking in winter months in the United States. (2) Common components in the model used to fit the seasonality included sinusoidal functions, cubic splines and serfling. (9-11, 13, 14, 16-19, 21-23) The lag represents the amount of time necessary for both testing and reporting the collected data. This is accounted for by adding a small shift to the model to variables related to influenza. The lag times used in the studies ranged from 0 to 3 weeks. (9-23)

Conclusions

The studies overwhelmingly express that the burden of influenza is underestimated and largely affects higher risk populations such as young children and the elderly. (9-23) Recognizing that direct counts are underestimates of true burden, the CDC along with other countries have turned to using statistical models. (5) The studies also show promising results in using influenza models to accurately estimate rates of outcomes such as hospitalization rates of pneumonia and asthma. (12, 14) One study reported that influenza appears to have had a greater effect on emergency department visits than was captured when relying on clinical diagnoses of either flu or ILI. (11)

Limitations

Limitations were related to study design, selection of hospitals, misclassification of influenzas and other variables, taking samples from surveillance data, and those related to the model itself. In many cases data is sourced only from public or federally funded hospitals and does not include private hospitals. Such models can underestimate disease burden. (18) Invalid estimates can also occur in studies from aggregating and extrapolating from surveillance data based on a sample population. Another common limitation is misclassifying influenza by mistaking it for another respiratory condition such as RSV. (13) Finally, the models vary in the components of their models that individually are prone to error. One study reported limitations of excluding seasonality from their model as well as not addressing autocorrelations, dispersion, or overestimation. (10) In sum choosing to include or exclude any number of variables and running insufficient statistical diagnostics in a given model can contribute to faultiness in the model's end result.

Motivation for Further Research

The conclusions from the 15 studies raise the need for more vaccination, surveillance, access to and frequency of testing, and outbreak response when it comes to influenza, especially in the older populations. The studies also highlighted a few other study design points of interest that require further research, such as including new variables to fit models. Interest in incorporating measures of climate change as well as syndromic data related to emergency department visits is increasing. The review demonstrates the general need of the public to be better informed of the severity of influenza in today's world. This year's COVID-19 pandemic has illustrated the need for accurate differentiation between estimates of influenza and other ILIs. Overall, better understanding of influenza, a virus that has such a high morbidity and mortality each year and yet still has inaccurate estimates, is required.

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Appendix B
Data and Results

ICD Codes

Outcome	**Short Name**	**ICD-9-CM Codes (for visits during 1/1/2005-9/30/2015)**	**ICD-10-CM Codes (for visits during 10/1/2015-12/31/2019)**
Cardiovascular Diseases (CVD)			
Chronic rheumatic heart disease	RHD	393-396	I05-I08
Hypertension	HT	401-405	I10-I16
Ischemic heart disease (Acute myocardial infarction)	IHD (MI)	410-414 (410)	I20-I25 (I21)
Cardiac dysrhythmia	DYS	427	I47-I49
Congestive heart failure	CHF	428	I42, I50-I51
Cerebrovascular disease (Ischemic stroke)	CBV (STK)	430-434 and 436-438 (434)	I60-I69 (I63)
Combined CVD Group	**CVD**	**RHD or HT or IHD or DYS or CHF or CBV**	
Respiratory Diseases (RD)			
Upper respiratory infections	URI	460-465, 466.0	J00-J06
Respiratory-related influenza	FLU	487.0, 487.8, 488.0, 488.01, 488.02, 488.1, 488.11, 488.12, 488.8, 488.81, 488.82	J09, J09.X1, J09.X2, J10.0, J10.00, J10.01, J10.08, J10.1, J11.0, J11.00, J11.08, J11.1
Bacterial pneumonia	PNEU_B	481, 482, 483.0, 483.1	J13, J14, J15, J16, A48.1
Culture-negative pneumonia*	PNEU_CN	485, 486	J18
Chronic obstructive pulmonary disease	COPD	491, 492, 496	J41-J44
Asthma	ASTHMA	493	J45

Table from International Statistical Classification of Diseases and Related Health Problems

RESULTS

Burden Estimates of Influenza Key
Outcome = Outcome of Interest
Seasons = Seasonal Year
Burden = Burden Estimate
LowerLimit, UpperLimit = Confidence interval Limits
DF = Degrees of Freedom (Knots Used)

Time Series of Outcome Estimates Key
Each Time Series Outcome displays 2 figures:

Figure1
Grey = Original Outcome Counts
Red = Outcome Estimates with FLU in prediction
Blue = Outcome Estimates without FLU in prediction
DF = Degrees of Freedom (None means 3rd degree polynomial)

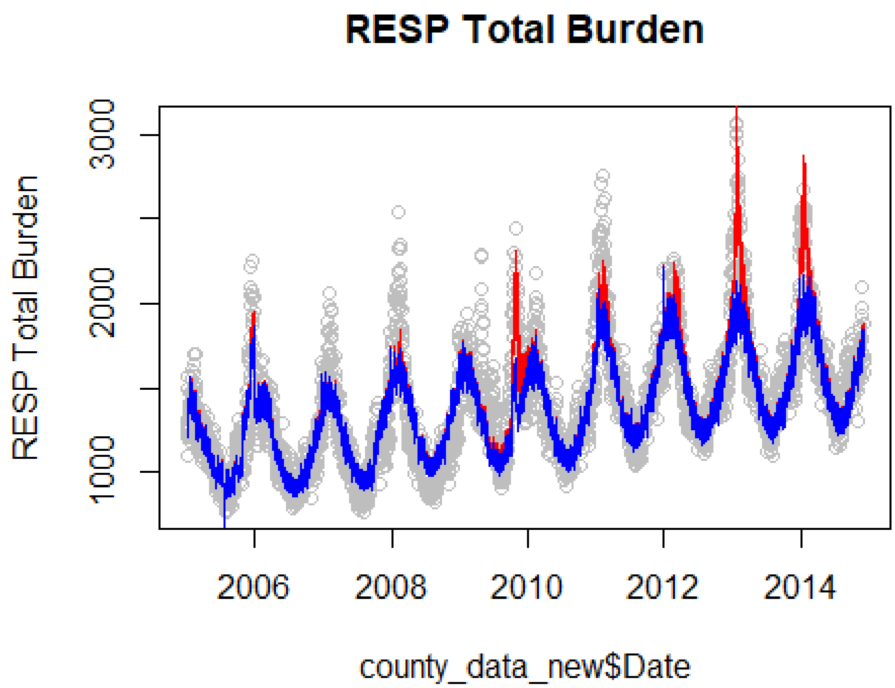
Figure 2
Blue = Burden of FLU Estimates

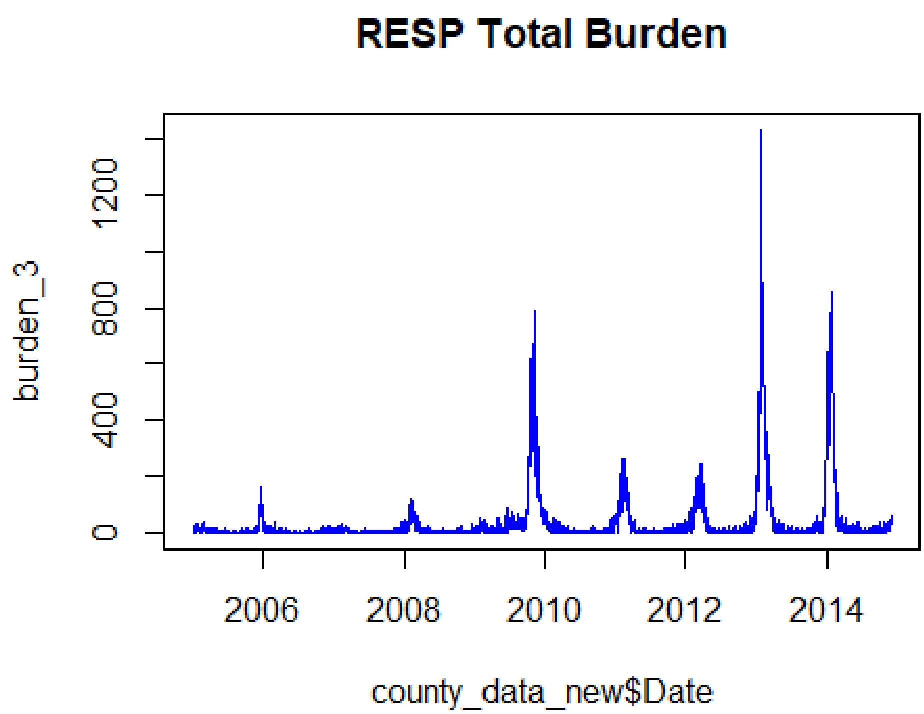
Los Angeles County 3rd Degree Polynomial Burden Estimates

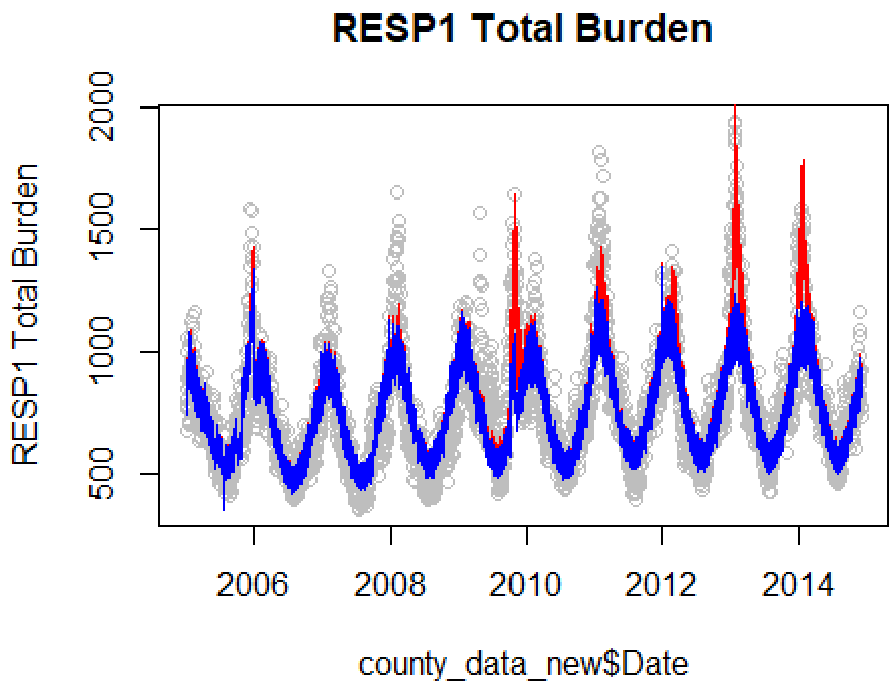
```
##                 Outcome Seasons Burden LowerLimit UpperLimit
## 1    RESP Total Burden   05-06    913     811.08    1014.92
## 2    RESP Total Burden   06-07    483     430.08     535.92
## 3    RESP Total Burden   07-08   1006     894.28    1117.72
## 4    RESP Total Burden   08-09   1342    1193.04    1490.96
## 5    RESP Total Burden   09-10   6740    5989.32    7490.68
## 6    RESP Total Burden   10-11   3534    3138.08    3929.92
## 7    RESP Total Burden   11-12   2722    2422.12    3021.88
## 8    RESP Total Burden   12-13   7013    6236.84    7789.16
## 9    RESP Total Burden   13-14   8107    7199.52    9014.48
## 10 RESP1 Total Burden   05-06    985     900.72    1069.28
## 11 RESP1 Total Burden   06-07    510     466.88     553.12
## 12 RESP1 Total Burden   07-08   1033     942.84    1123.16
## 13 RESP1 Total Burden   08-09   1207    1103.12    1310.88
## 14 RESP1 Total Burden   09-10   5965    5451.48    6478.52
## 15 RESP1 Total Burden   10-11   2954    2697.24    3210.76
## 16 RESP1 Total Burden   11-12   2015    1842.52    2187.48
## 17 RESP1 Total Burden   12-13   5386    4925.40    5846.60
## 18 RESP1 Total Burden   13-14   6113    5579.88    6646.12
## 19   CVD Total Burden   05-06     51     -13.68     115.68
## 20   CVD Total Burden   06-07     29      -8.24      66.24
## 21   CVD Total Burden   07-08     59     -17.44     135.44
## 22   CVD Total Burden   08-09     96     -27.48     219.48
## 23   CVD Total Burden   09-10    480    -129.56    1089.56
## 24   CVD Total Burden   10-11    228     -62.08     518.08
```

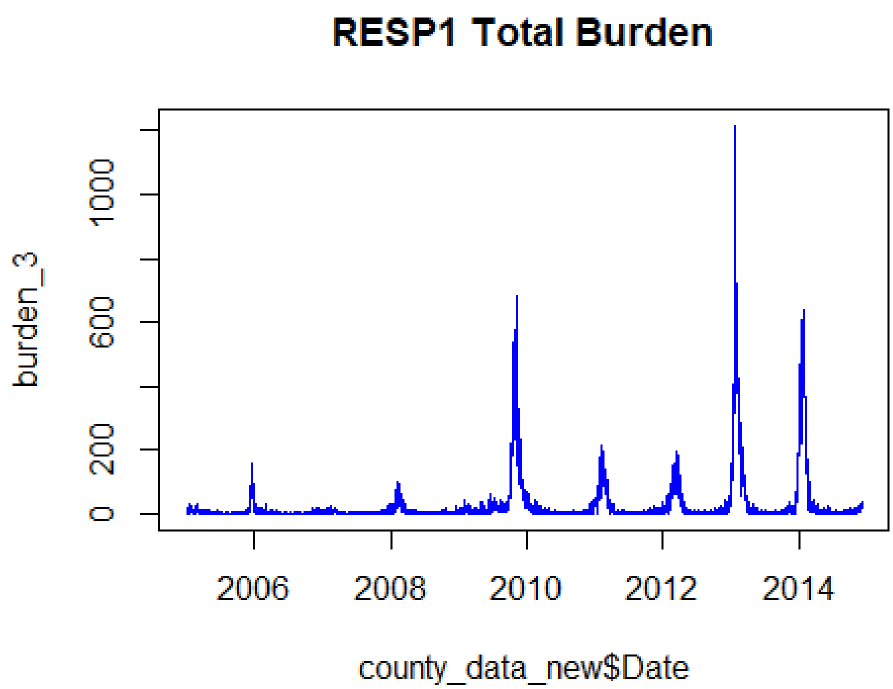
```
## 25   CVD Total Burden   11-12    183     -48.28     414.28
## 26   CVD Total Burden   12-13    461    -125.04    1047.04
## 27   CVD Total Burden   13-14    542    -145.96    1229.96
## 28  CVD1 Total Burden   05-06    -40     -67.44     -12.56
## 29  CVD1 Total Burden   06-07    -22     -37.68      -6.32
## 30  CVD1 Total Burden   07-08    -41     -68.44     -13.56
## 31  CVD1 Total Burden   08-09    -55     -92.24     -17.76
## 32  CVD1 Total Burden   09-10   -260    -434.44     -85.56
## 33  CVD1 Total Burden   10-11   -115    -191.44     -38.56
## 34  CVD1 Total Burden   11-12    -90    -150.76     -29.24
## 35  CVD1 Total Burden   12-13   -222    -370.96     -73.04
## 36  CVD1 Total Burden   13-14   -253    -423.52     -82.48
## 37  PNEU Total Burden   05-06     35      29.12      40.88
## 38  PNEU Total Burden   06-07     18      14.08      21.92
## 39  PNEU Total Burden   07-08     39      31.16      46.84
## 40  PNEU Total Burden   08-09     45      37.16      52.84
## 41  PNEU Total Burden   09-10    221     179.84     262.16
## 42  PNEU Total Burden   10-11    119      95.48     142.52
## 43  PNEU Total Burden   11-12     81      65.32      96.68
## 44  PNEU Total Burden   12-13    214     172.84     255.16
## 45  PNEU Total Burden   13-14    225     181.88     268.12
## 46 PNEU1 Total Burden   05-06     11       7.08      14.92
## 47 PNEU1 Total Burden   06-07      6       4.04       7.96
## 48 PNEU1 Total Burden   07-08     12       6.12      17.88
## 49 PNEU1 Total Burden   08-09     14       8.12      19.88
## 50 PNEU1 Total Burden   09-10     66      36.60      95.40
## 51 PNEU1 Total Burden   10-11     37      19.36      54.64
## 52 PNEU1 Total Burden   11-12     22      12.20      31.80
## 53 PNEU1 Total Burden   12-13     55      29.52      80.48
## 54 PNEU1 Total Burden   13-14     50      26.48      73.52
```

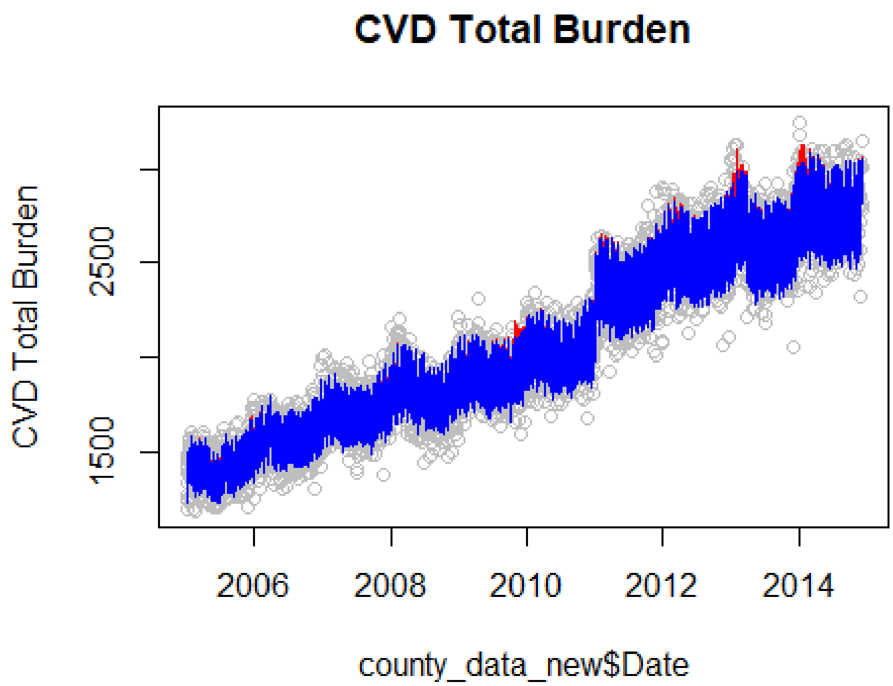
Los Angeles County 3rd Degree Polynomial Time Series

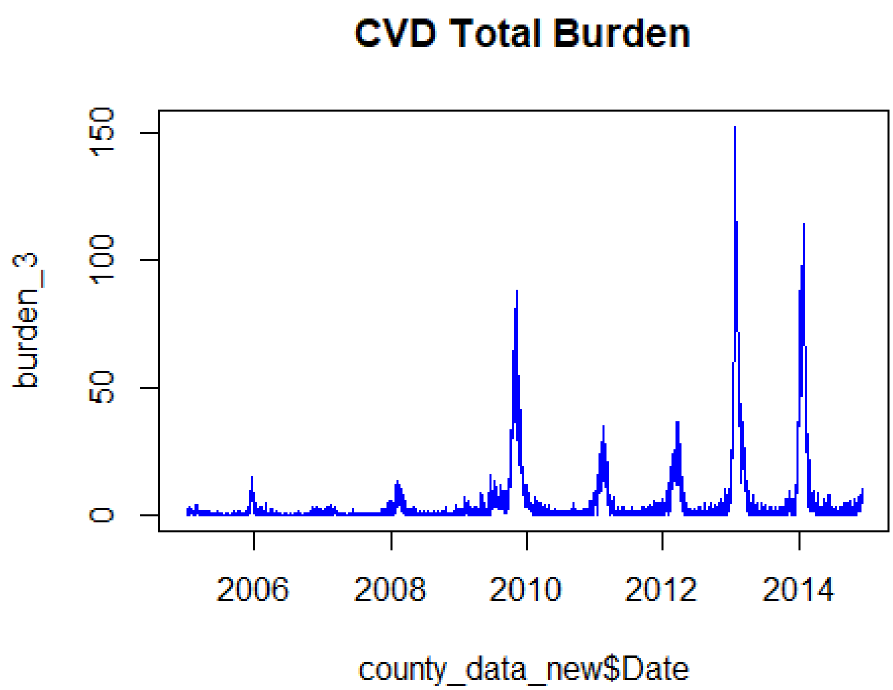


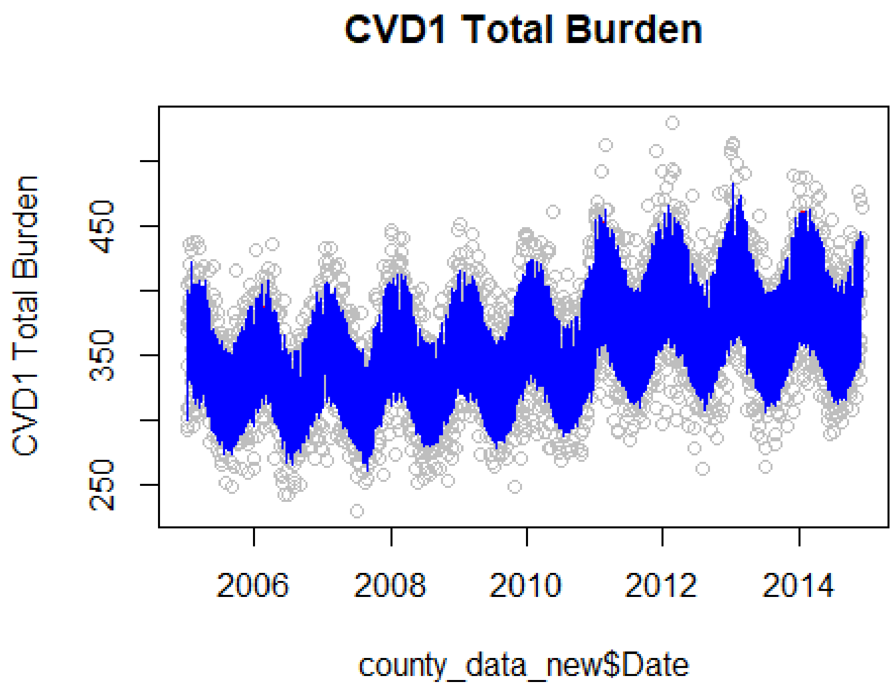


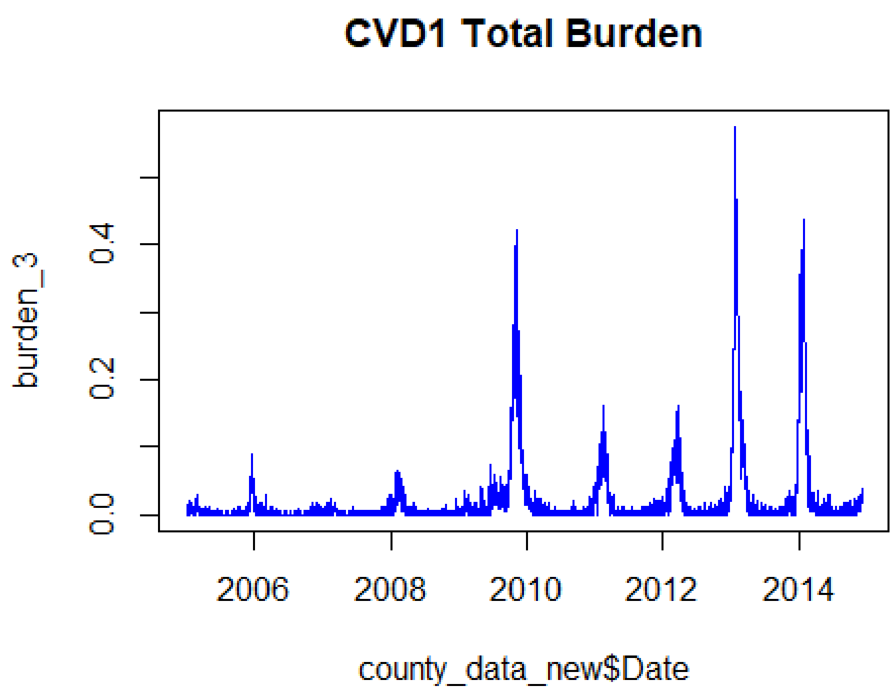

RESP1 Total Burden
RESP1 Total Burden
500
1000
1500
2000
2006
2008
2010
2012
2014
county_data_new$Date

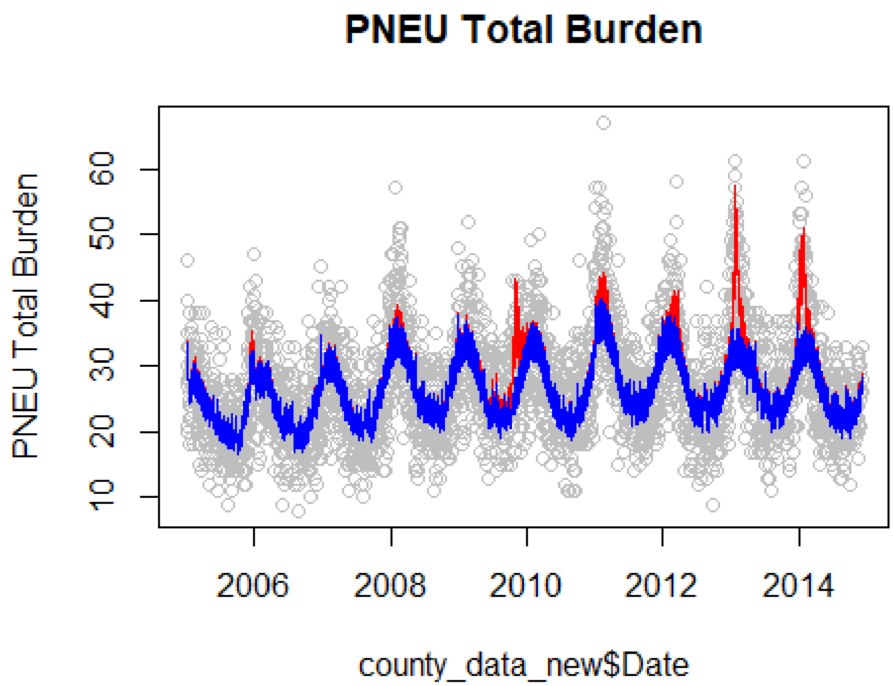

RESP1 Total Burden
burden_3
0
200
600
1000
2006
2008
2010
2012
2014
county_data_new$Date

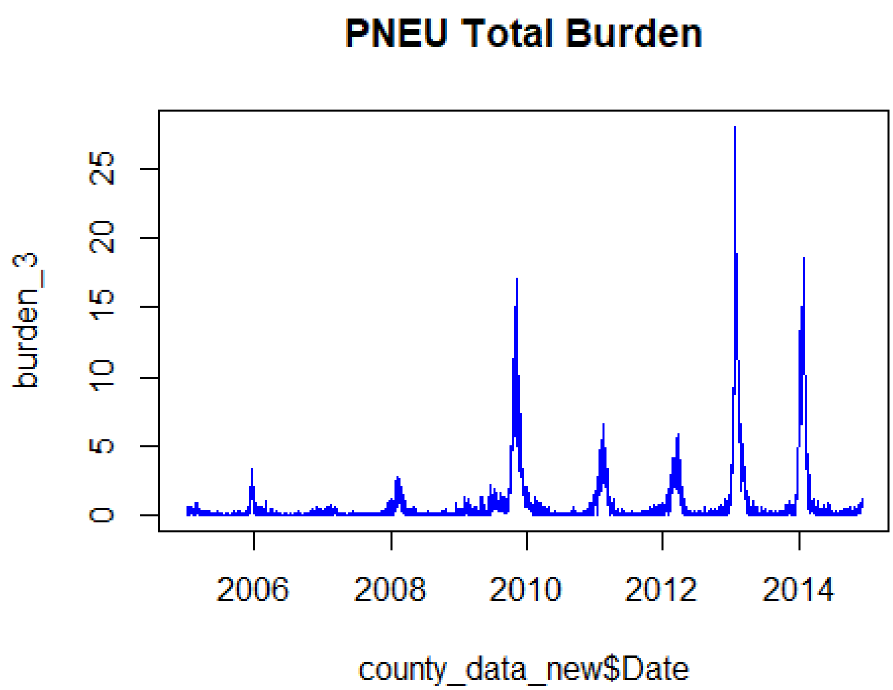

CVD Total Burden
CVD Total Burden
1500
2500
2006
2008
2010
2012
2014
county_data_new$Date


CVD Total Burden
burden_3
0
50
100
150
2006
2008
2010
2012
2014
county_data_new$Date


CVD1 Total Burden
CVD1 Total Burden
250
350
450
2006
2008
2010
2012
2014
county_data_new$Date


CVD1 Total Burden
burden_3
0.0
0.2
0.4
2006
2008
2010
2012
2014
county_data_new$Date


PNEU Total Burden
PNEU Total Burden
10
20
30
40
50
60
2006
2008
2010
2012
2014
county_data_new$Date


PNEU Total Burden
burden_3
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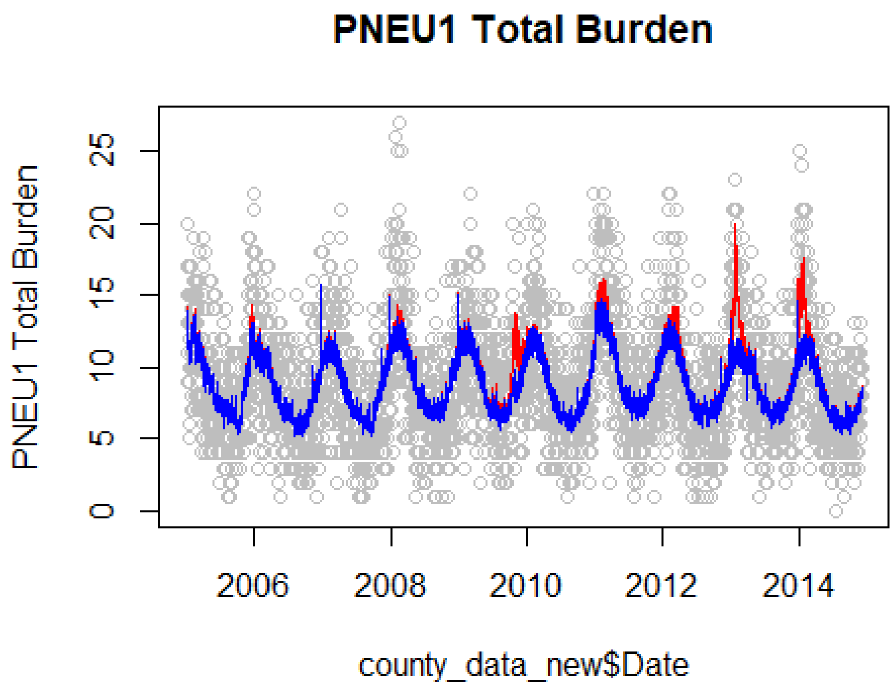
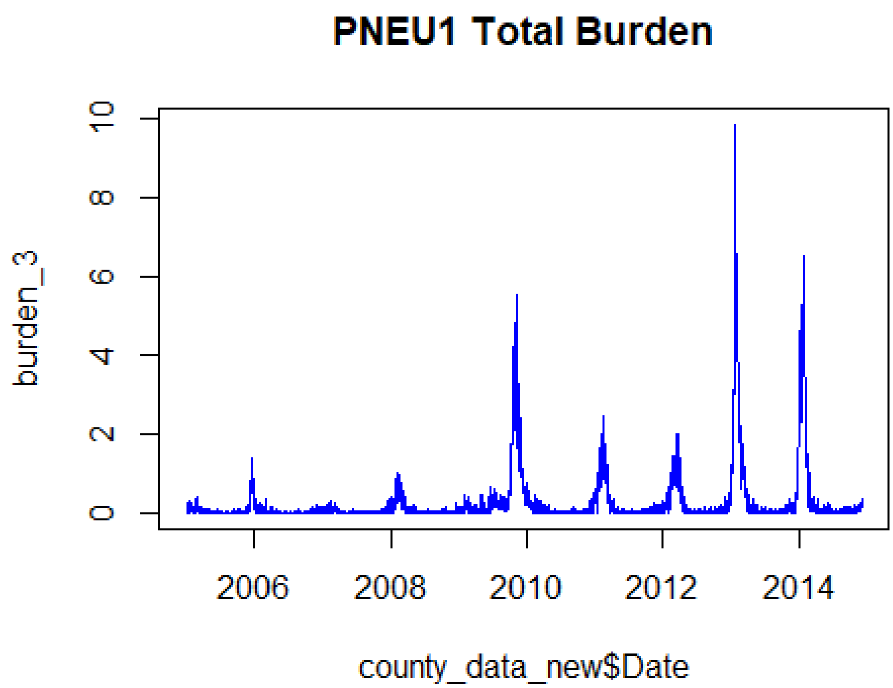
5
10
15
20
25
2006
2008
2010
2012
2014
county_data_new$Date


PNEU1 Total Burden
PNEU1 Total Burden
0
5
10
15
20
25
2006
2008
2010
2012
2014
county_data_new$Date


PNEU1 Total Burden
burden_3
0
2
4
6
8
10
2006
2008
2010
2012
2014
county_data_new$Date

Los Angeles County 3rd Degree Polynomial Burden Estimates

```
##                 Outcome  Df Seasons Burden LowerLimit UpperLimit
## 1     RESP Total Burden  40   05-06   3601    3375.60    3826.40
## 2     RESP Total Burden  40   06-07   1294    1213.64    1374.36
## 3     RESP Total Burden  40   07-08   4666    4377.88    4954.12
## 4     RESP Total Burden  40   08-09   2995    2810.76    3179.24
## 5     RESP Total Burden  40   09-10  29839   28088.72   31589.28
## 6     RESP Total Burden  40   10-11  11549   10843.40   12254.60
## 7     RESP Total Burden  40   11-12  10852   10183.64   11520.36
## 8     RESP Total Burden  40   12-13  37545   35314.52   39775.48
## 9     RESP Total Burden  40   13-14  27893   26179.96   29606.04
## 10    RESP Total Burden  60   05-06   2500    2260.88    2739.12
## 11    RESP Total Burden  60   06-07    893     808.72     977.28
## 12    RESP Total Burden  60   07-08   3317    3001.44    3632.56
## 13    RESP Total Burden  60   08-09   2115    1913.12    2316.88
## 14    RESP Total Burden  60   09-10  21360   19415.68   23304.32
## 15    RESP Total Burden  60   10-11   7987    7234.36    8739.64
## 16    RESP Total Burden  60   11-12   7726    6998.84    8453.16
## 17    RESP Total Burden  60   12-13  26868   24419.96   29316.04
## 18    RESP Total Burden  60   13-14  19891   18068.20   21713.80
## 19    RESP Total Burden  80   05-06   1847    1586.32    2107.68
## 20    RESP Total Burden  80   06-07    662     567.92     756.08
## 21    RESP Total Burden  80   07-08   2451    2104.08    2797.92
## 22    RESP Total Burden  80   08-09   1555    1335.48    1774.52
## 23    RESP Total Burden  80   09-10  16048   13870.44   18225.56
## 24    RESP Total Burden  80   10-11   6040    5193.28    6886.72
## 25    RESP Total Burden  80   11-12   5695    4895.32    6494.68
## 26    RESP Total Burden  80   12-13  20196   17448.08   22943.92
## 27    RESP Total Burden  80   13-14  15012   12965.76   17058.24
## 28    RESP Total Burden 120   05-06   2042    1718.60    2365.40
## 29    RESP Total Burden 120   06-07    729     613.36     844.64
## 30    RESP Total Burden 120   07-08   2713    2281.80    3144.20
## 31    RESP Total Burden 120   08-09   1719    1444.60    1993.40
## 32    RESP Total Burden 120   09-10  17506   14848.24   20163.76
## 33    RESP Total Burden 120   10-11   6625    5582.28    7667.72
## 34    RESP Total Burden 120   11-12   6306    5312.28    7299.72
## 35    RESP Total Burden 120   12-13  22069   18770.32   25367.68
## 36    RESP Total Burden 120   13-14  16373   13879.88   18866.12
## 37   RESP1 Total Burden  40   05-06   2947    2743.16    3150.84
## 38   RESP1 Total Burden  40   06-07    960     895.32    1024.68
## 39   RESP1 Total Burden  40   07-08   3516    3274.92    3757.08
## 40   RESP1 Total Burden  40   08-09   2172    2023.04    2320.96
## 41   RESP1 Total Burden  40   09-10  22320   20893.12   23746.88
## 42   RESP1 Total Burden  40   10-11   8552    7975.76    9128.24
## 43   RESP1 Total Burden  40   11-12   7261    6765.12    7756.88
## 44   RESP1 Total Burden  40   12-13  26867   25126.52   28607.48
## 45   RESP1 Total Burden  40   13-14  19136   17840.44   20431.56
## 46   RESP1 Total Burden  60   05-06   1925    1713.32    2136.68
## 47   RESP1 Total Burden  60   06-07    622     553.40     690.60
## 48   RESP1 Total Burden  60   07-08   2361    2100.32    2621.68
```

```
## 49  RESP1 Total Burden  60   08-09   1453    1292.28    1613.72
## 50  RESP1 Total Burden  60   09-10  15279   13683.56   16874.44
## 51  RESP1 Total Burden  60   10-11   5539    4937.28    6140.72
## 52  RESP1 Total Burden  60   11-12   4923    4385.96    5460.04
## 53  RESP1 Total Burden  60   12-13  18316   16403.04   20228.96
## 54  RESP1 Total Burden  60   13-14  13044   11670.04   14417.96
## 55  RESP1 Total Burden  80   05-06   1344    1116.64    1571.36
## 56  RESP1 Total Burden  80   06-07    436     361.52     510.48
## 57  RESP1 Total Burden  80   07-08   1650    1369.72    1930.28
## 58  RESP1 Total Burden  80   08-09   1007     836.48    1177.52
## 59  RESP1 Total Burden  80   09-10  10894    9131.96   12656.04
## 60  RESP1 Total Burden  80   10-11   3990    3319.68    4660.32
## 61  RESP1 Total Burden  80   11-12   3421    2844.76    3997.24
## 62  RESP1 Total Burden  80   12-13  13106   10979.40   15232.60
## 63  RESP1 Total Burden  80   13-14   9383    7856.16   10909.84
## 64  RESP1 Total Burden 120   05-06   1624    1345.68    1902.32
## 65  RESP1 Total Burden 120   06-07    525     434.84     615.16
## 66  RESP1 Total Burden 120   07-08   1996    1653.00    2339.00
## 67  RESP1 Total Burden 120   08-09   1219    1009.28    1428.72
## 68  RESP1 Total Burden 120   09-10  12899   10811.60   14986.40
## 69  RESP1 Total Burden 120   10-11   4775    3965.52    5584.48
## 70  RESP1 Total Burden 120   11-12   4152    3448.36    4855.64
## 71  RESP1 Total Burden 120   12-13  15501   13039.24   17962.76
## 72  RESP1 Total Burden 120   13-14  11122    9314.88   12929.12
## 73    CVD Total Burden  40   05-06    645     537.20     752.80
## 74    CVD Total Burden  40   06-07    293     244.00     342.00
## 75    CVD Total Burden  40   07-08    982     819.32    1144.68
## 76    CVD Total Burden  40   08-09    737     613.52     860.48
## 77    CVD Total Burden  40   09-10   6671    5569.48    7772.52
## 78    CVD Total Burden  40   10-11   2506    2088.52    2923.48
## 79    CVD Total Burden  40   11-12   2902    2419.84    3384.16
## 80    CVD Total Burden  40   12-13   8591    7168.04   10013.96
## 81    CVD Total Burden  40   13-14   6987    5822.76    8151.24
## 82    CVD Total Burden  60   05-06    433     301.68     564.32
## 83    CVD Total Burden  60   06-07    197     138.20     255.80
## 84    CVD Total Burden  60   07-08    663     463.08     862.92
## 85    CVD Total Burden  60   08-09    495     346.04     643.96
## 86    CVD Total Burden  60   09-10   4477    3130.48    5823.52
## 87    CVD Total Burden  60   10-11   1687    1177.40    2196.60
## 88    CVD Total Burden  60   11-12   1963    1369.12    2556.88
## 89    CVD Total Burden  60   12-13   5817    4066.72    7567.28
## 90    CVD Total Burden  60   13-14   4718    3297.00    6139.00
## 91    CVD Total Burden  80   05-06    467     312.16     621.84
## 92    CVD Total Burden  80   06-07    212     141.44     282.56
## 93    CVD Total Burden  80   07-08    714     476.84     951.16
## 94    CVD Total Burden  80   08-09    533     356.60     709.40
## 95    CVD Total Burden  80   09-10   4797    3219.20    6374.80
## 96    CVD Total Burden  80   10-11   1819    1215.32    2422.68
## 97    CVD Total Burden  80   11-12   2112    1412.28    2811.72
## 98    CVD Total Burden  80   12-13   6265    4201.12    8328.88
```

```
## 99    CVD Total Burden  80   13-14   5100    3420.28    6779.72
## 100   CVD Total Burden 120   05-06    319     107.32     530.68
## 101   CVD Total Burden 120   06-07    145      48.96     241.04
## 102   CVD Total Burden 120   07-08    488     162.64     813.36
## 103   CVD Total Burden 120   08-09    364     120.96     607.04
## 104   CVD Total Burden 120   09-10   3285    1113.32    5456.68
## 105   CVD Total Burden 120   10-11   1246     416.92    2075.08
## 106   CVD Total Burden 120   11-12   1446     483.64    2408.36
## 107   CVD Total Burden 120   12-13   4310    1468.00    7152.00
## 108   CVD Total Burden 120   13-14   3496    1183.20    5808.80
## 109  CVD1 Total Burden  40   05-06     34     -11.08      79.08
## 110  CVD1 Total Burden  40   06-07     14      -3.64      31.64
## 111  CVD1 Total Burden  40   07-08     45     -11.84     101.84
## 112  CVD1 Total Burden  40   08-09     32      -9.16      73.16
## 113  CVD1 Total Burden  40   09-10    285     -83.48     653.48
## 114  CVD1 Total Burden  40   10-11    101     -30.32     232.32
## 115  CVD1 Total Burden  40   11-12    108     -33.12     249.12
## 116  CVD1 Total Burden  40   12-13    306     -91.88     703.88
## 117  CVD1 Total Burden  40   13-14    241     -72.60     554.60
## 118  CVD1 Total Burden  60   05-06     -6     -60.88      48.88
## 119  CVD1 Total Burden  60   06-07     -2     -25.52      21.52
## 120  CVD1 Total Burden  60   07-08     -8     -78.56      62.56
## 121  CVD1 Total Burden  60   08-09     -5     -55.96      45.96
## 122  CVD1 Total Burden  60   09-10    -48    -502.72     406.72
## 123  CVD1 Total Burden  60   10-11    -17    -179.68     145.68
## 124  CVD1 Total Burden  60   11-12    -18    -192.44     156.44
## 125  CVD1 Total Burden  60   12-13    -52    -545.92     441.92
## 126  CVD1 Total Burden  60   13-14    -40    -424.16     344.16
## 127  CVD1 Total Burden  80   05-06      2     -62.68      66.68
## 128  CVD1 Total Burden  80   06-07      1     -26.44      28.44
## 129  CVD1 Total Burden  80   07-08      3     -83.24      89.24
## 130  CVD1 Total Burden  80   08-09      2     -58.76      62.76
## 131  CVD1 Total Burden  80   09-10     18    -524.92     560.92
## 132  CVD1 Total Burden  80   10-11      6    -188.04     200.04
## 133  CVD1 Total Burden  80   11-12      7    -200.76     214.76
## 134  CVD1 Total Burden  80   12-13     19    -570.96     608.96
## 135  CVD1 Total Burden  80   13-14     15    -445.60     475.60
## 136  CVD1 Total Burden 120   05-06    -34    -124.16      56.16
## 137  CVD1 Total Burden 120   06-07    -14     -51.24      23.24
## 138  CVD1 Total Burden 120   07-08    -45    -162.60      72.60
## 139  CVD1 Total Burden 120   08-09    -32    -116.28      52.28
## 140  CVD1 Total Burden 120   09-10   -284   -1032.72     464.72
## 141  CVD1 Total Burden 120   10-11   -101    -367.56     165.56
## 142  CVD1 Total Burden 120   11-12   -109    -395.16     177.16
## 143  CVD1 Total Burden 120   12-13   -310   -1127.32     507.32
## 144  CVD1 Total Burden 120   13-14   -242    -879.00     395.00
## 145  PNEU Total Burden  40   05-06     71      59.24      82.76
## 146  PNEU Total Burden  40   06-07     27      23.08      30.92
## 147  PNEU Total Burden  40   07-08    105      89.32     120.68
## 148  PNEU Total Burden  40   08-09     64      54.20      73.80
```

```
## 149  PNEU Total Burden  40   09-10    573     488.72     657.28
## 150  PNEU Total Burden  40   10-11    242     204.76     279.24
## 151  PNEU Total Burden  40   11-12    213     179.68     246.32
## 152  PNEU Total Burden  40   12-13    706     602.12     809.88
## 153  PNEU Total Burden  40   13-14    532     451.64     612.36
## 154  PNEU Total Burden  60   05-06     54      40.28      67.72
## 155  PNEU Total Burden  60   06-07     21      15.12      26.88
## 156  PNEU Total Burden  60   07-08     82      62.40     101.60
## 157  PNEU Total Burden  60   08-09     49      37.24      60.76
## 158  PNEU Total Burden  60   09-10    442     338.12     545.88
## 159  PNEU Total Burden  60   10-11    187     141.92     232.08
## 160  PNEU Total Burden  60   11-12    168     126.84     209.16
## 161  PNEU Total Burden  60   12-13    552     422.64     681.36
## 162  PNEU Total Burden  60   13-14    425     325.04     524.96
## 163  PNEU Total Burden  80   05-06     49      33.32      64.68
## 164  PNEU Total Burden  80   06-07     19      13.12      24.88
## 165  PNEU Total Burden  80   07-08     73      49.48      96.52
## 166  PNEU Total Burden  80   08-09     44      30.28      57.72
## 167  PNEU Total Burden  80   09-10    397     275.48     518.52
## 168  PNEU Total Burden  80   10-11    169     114.12     223.88
## 169  PNEU Total Burden  80   11-12    151     102.00     200.00
## 170  PNEU Total Burden  80   12-13    501     346.16     655.84
## 171  PNEU Total Burden  80   13-14    387     267.44     506.56
## 172  PNEU Total Burden 120   05-06     61      39.44      82.56
## 173  PNEU Total Burden 120   06-07     23      15.16      30.84
## 174  PNEU Total Burden 120   07-08     90      56.68     123.32
## 175  PNEU Total Burden 120   08-09     54      34.40      73.60
## 176  PNEU Total Burden 120   09-10    479     316.32     641.68
## 177  PNEU Total Burden 120   10-11    207     132.52     281.48
## 178  PNEU Total Burden 120   11-12    185     118.36     251.64
## 179  PNEU Total Burden 120   12-13    601     403.04     798.96
## 180  PNEU Total Burden 120   13-14    465     306.24     623.76
## 181 PNEU1 Total Burden  40   05-06     28      20.16      35.84
## 182 PNEU1 Total Burden  40   06-07     10       8.04      11.96
## 183 PNEU1 Total Burden  40   07-08     40      30.20      49.80
## 184 PNEU1 Total Burden  40   08-09     22      16.12      27.88
## 185 PNEU1 Total Burden  40   09-10    191     143.96     238.04
## 186 PNEU1 Total Burden  40   10-11     87      63.48     110.52
## 187 PNEU1 Total Burden  40   11-12     73      53.40      92.60
## 188 PNEU1 Total Burden  40   12-13    241     180.24     301.76
## 189 PNEU1 Total Burden  40   13-14    184     136.96     231.04
## 190 PNEU1 Total Burden  60   05-06     17       7.20      26.80
## 191 PNEU1 Total Burden  60   06-07      6       2.08       9.92
## 192 PNEU1 Total Burden  60   07-08     24      10.28      37.72
## 193 PNEU1 Total Burden  60   08-09     13       5.16      20.84
## 194 PNEU1 Total Burden  60   09-10    114      53.24     174.76
## 195 PNEU1 Total Burden  60   10-11     51      23.56      78.44
## 196 PNEU1 Total Burden  60   11-12     44      20.48      67.52
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## 198 PNEU1 Total Burden  60   13-14    114      53.24     174.76
```

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## 201 PNEU1 Total Burden  80   07-08     16        0.32       31.68
## 202 PNEU1 Total Burden  80   08-09      9        1.16       16.84
## 203 PNEU1 Total Burden  80   09-10     80        5.52      154.48
## 204 PNEU1 Total Burden  80   10-11     36        2.68       69.32
## 205 PNEU1 Total Burden  80   11-12     30        0.60       59.40
## 206 PNEU1 Total Burden  80   12-13    104        7.96      200.04
## 207 PNEU1 Total Burden  80   13-14     80        5.52      154.48
## 208 PNEU1 Total Burden 120   05-06     17        1.32       32.68
## 209 PNEU1 Total Burden 120   06-07      6        0.12       11.88
## 210 PNEU1 Total Burden 120   07-08     24        2.44       45.56
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## 212 PNEU1 Total Burden 120   09-10    117       19.00      215.00
## 213 PNEU1 Total Burden 120   10-11     53        5.96      100.04
## 214 PNEU1 Total Burden 120   11-12     45        5.80       84.20
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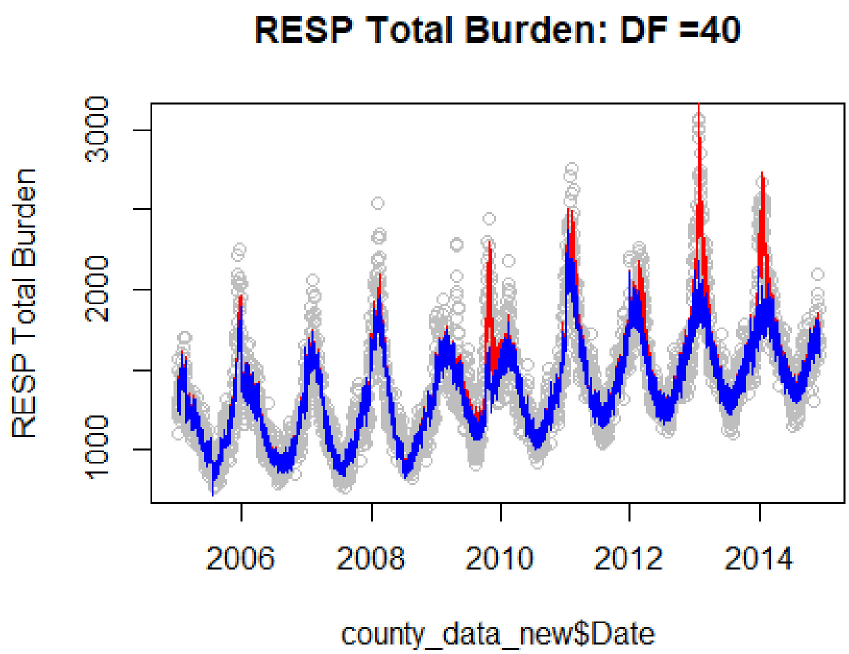
Los Angeles County Spline Time Series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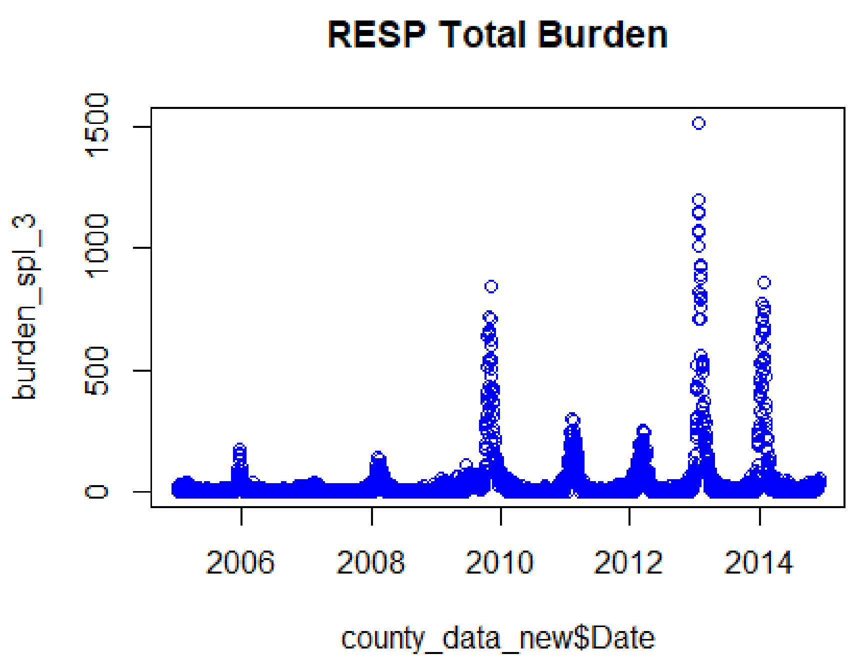
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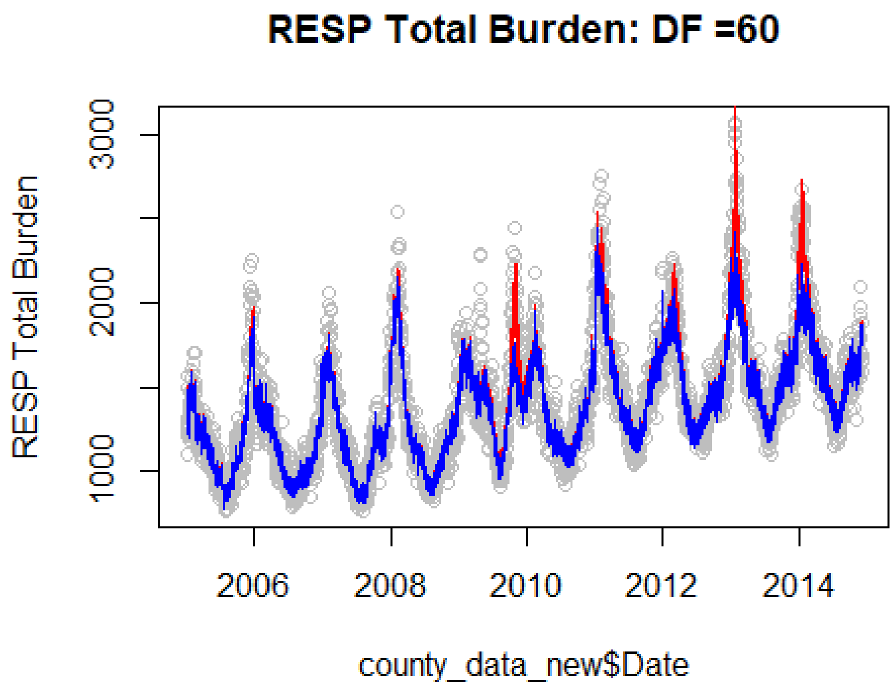
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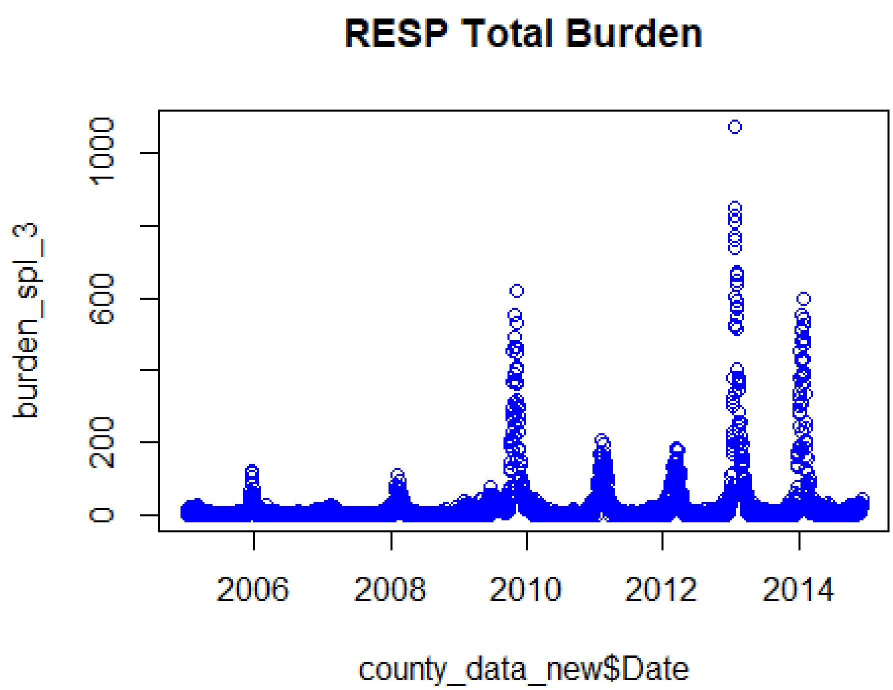
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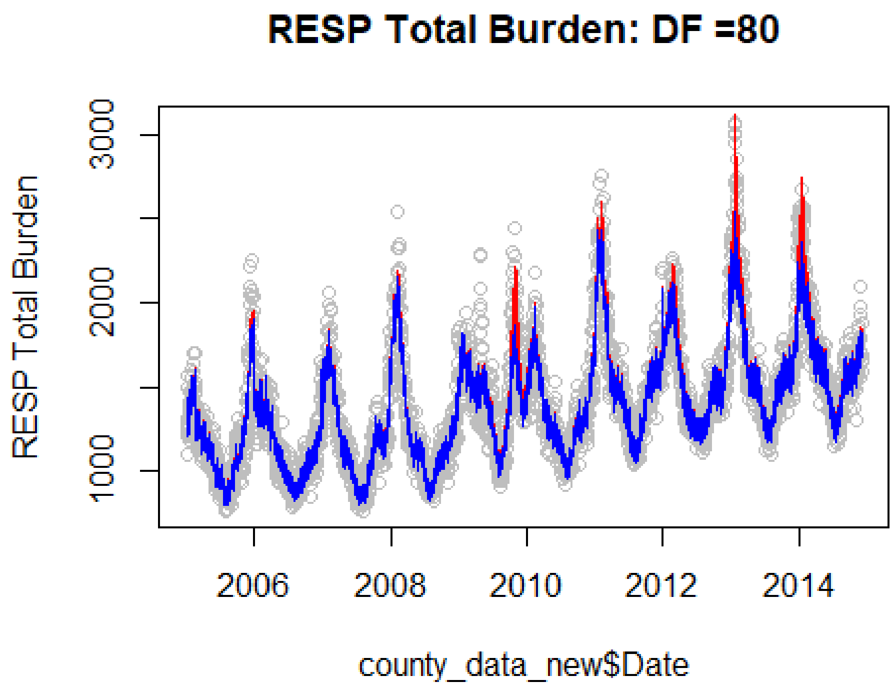
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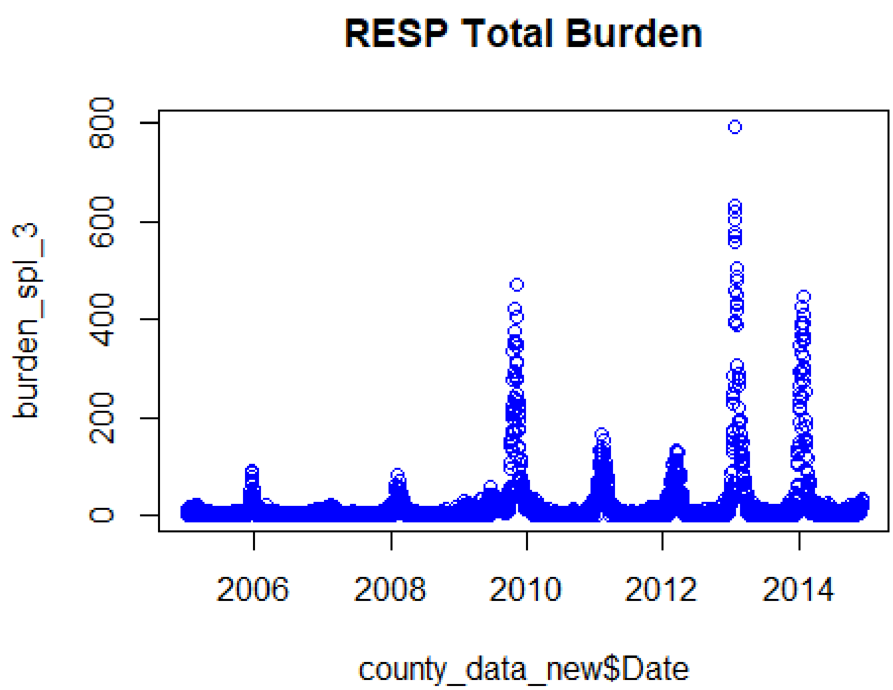
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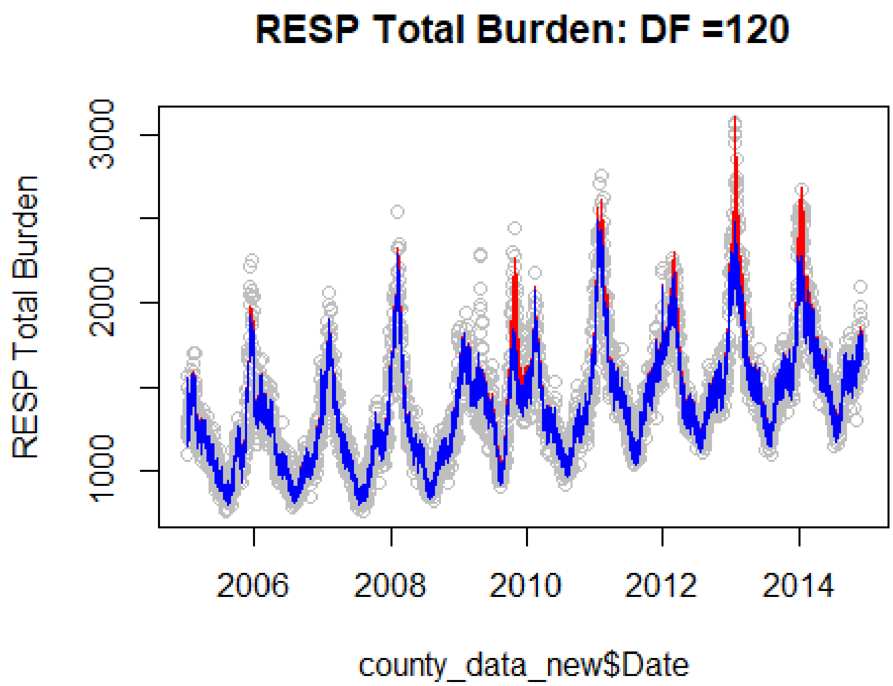
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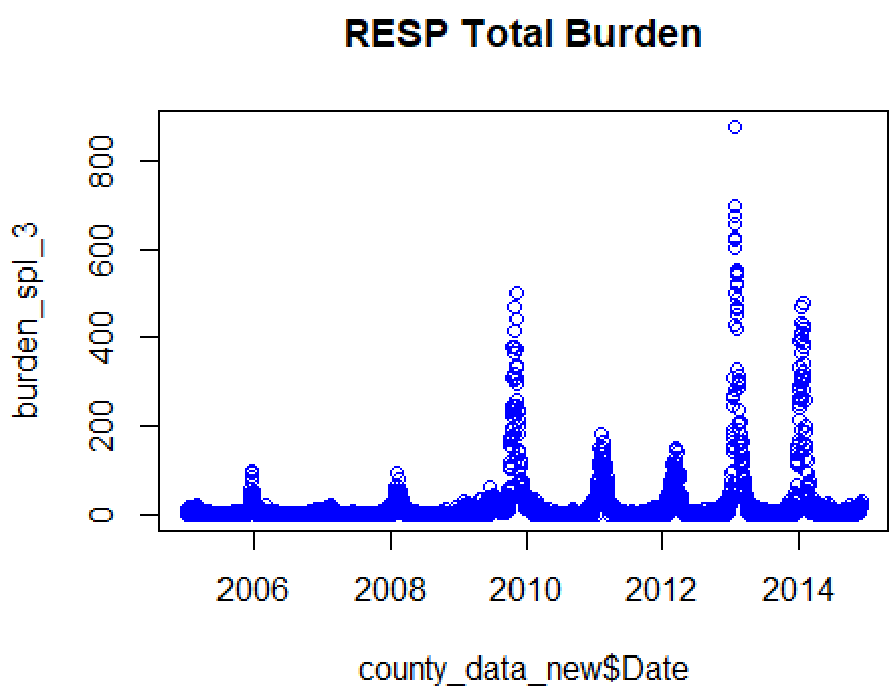
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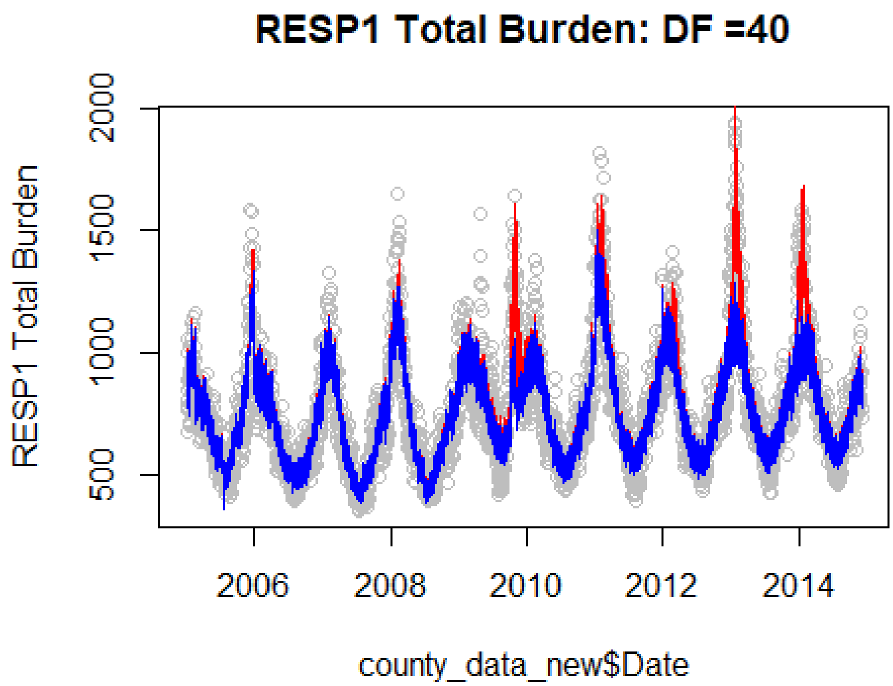
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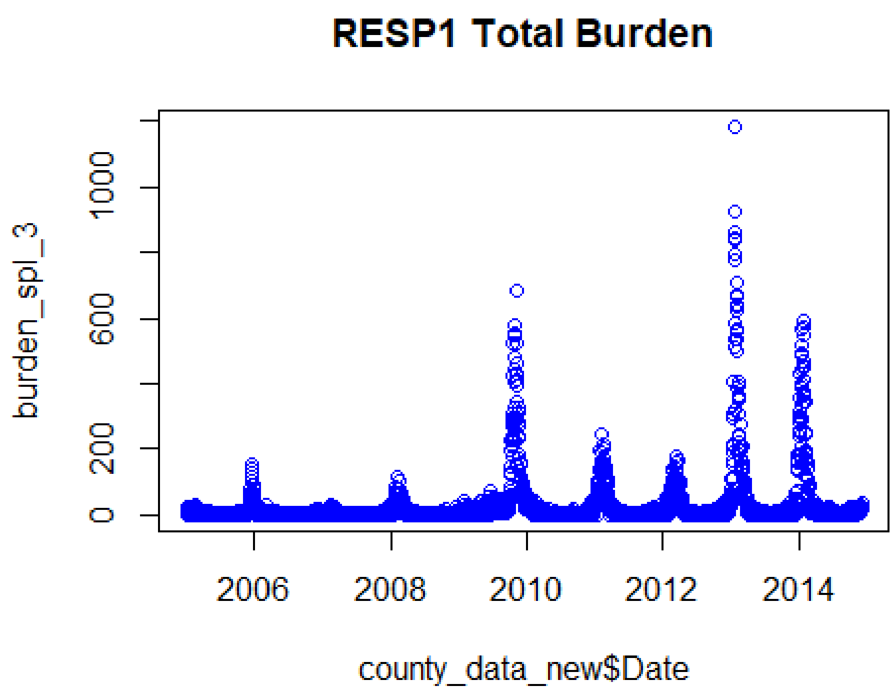
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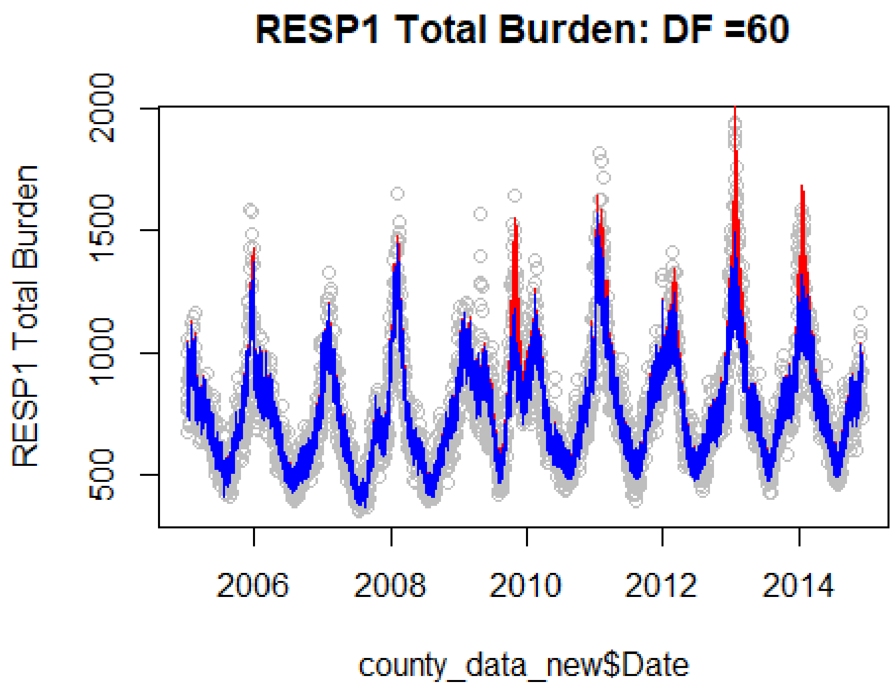
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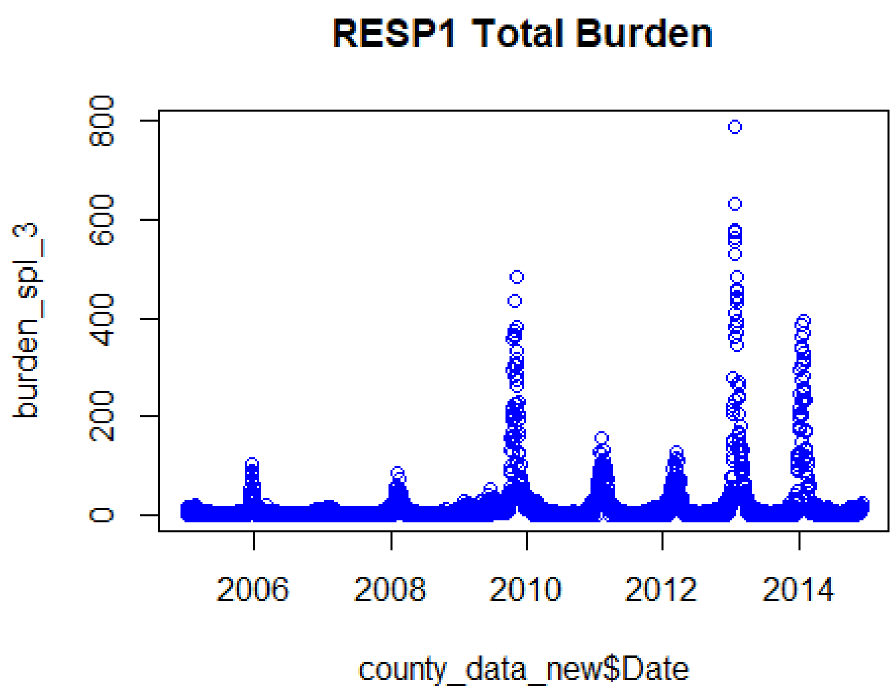
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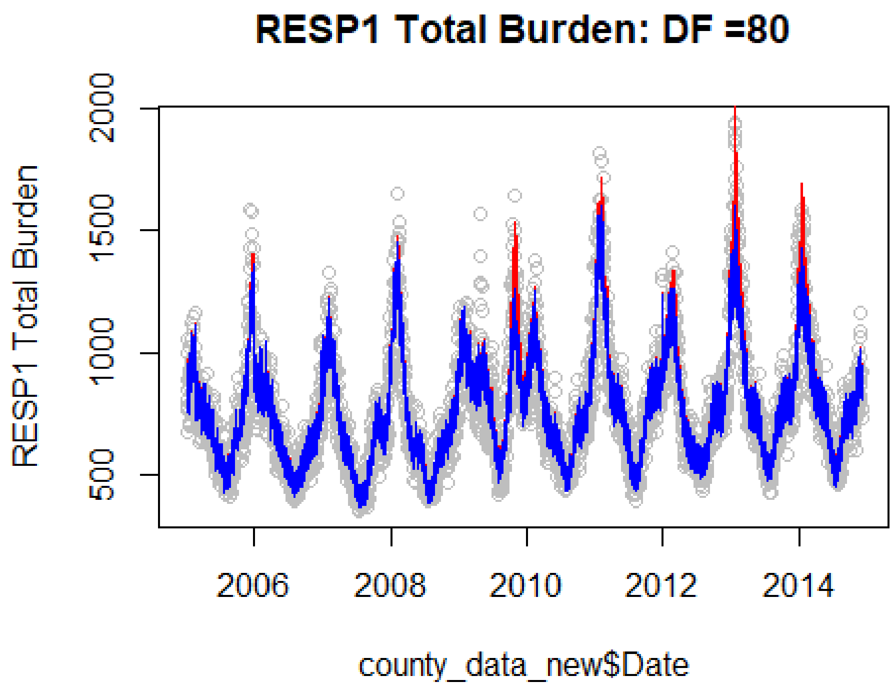
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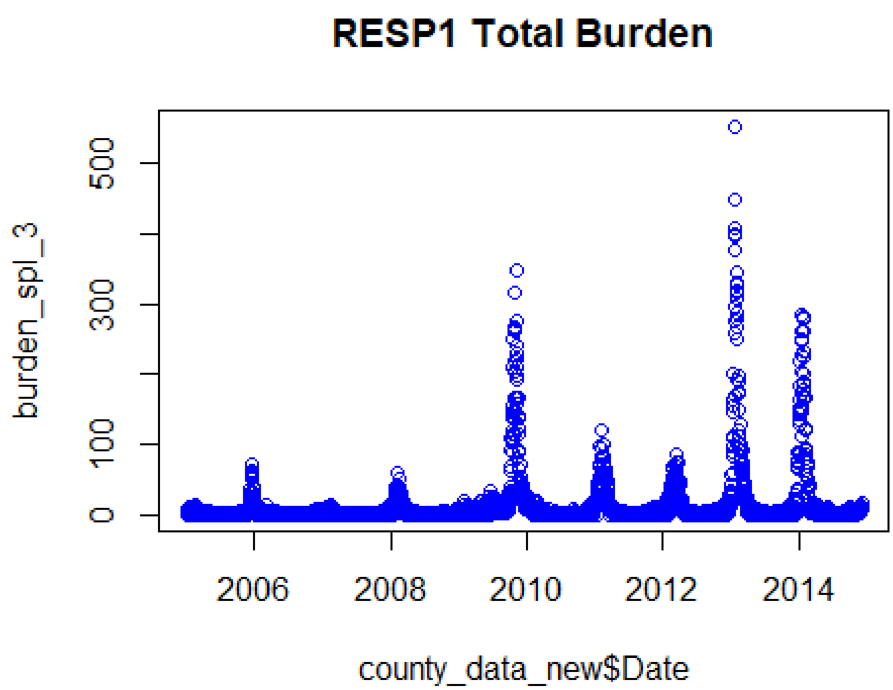
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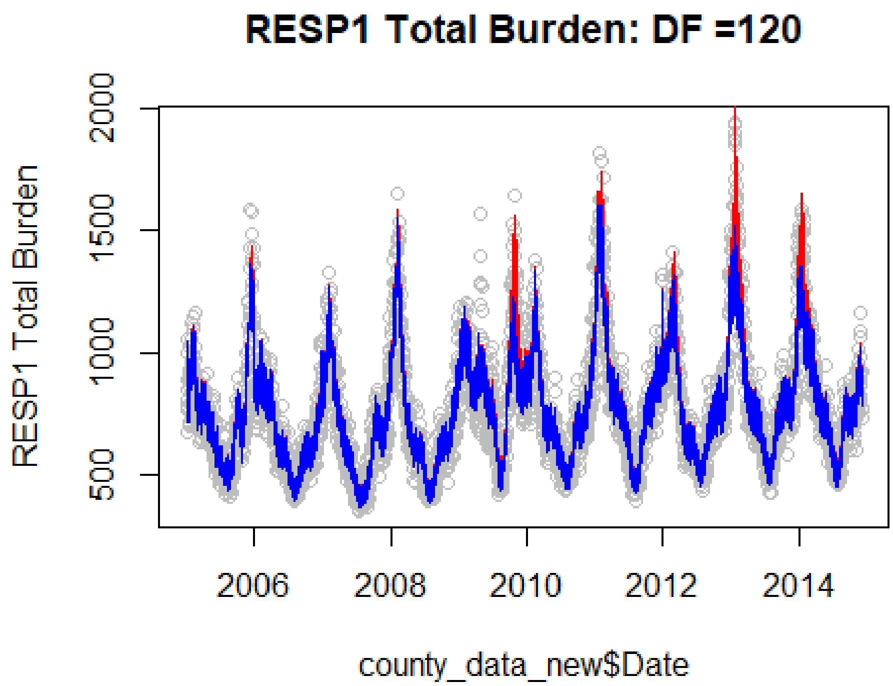
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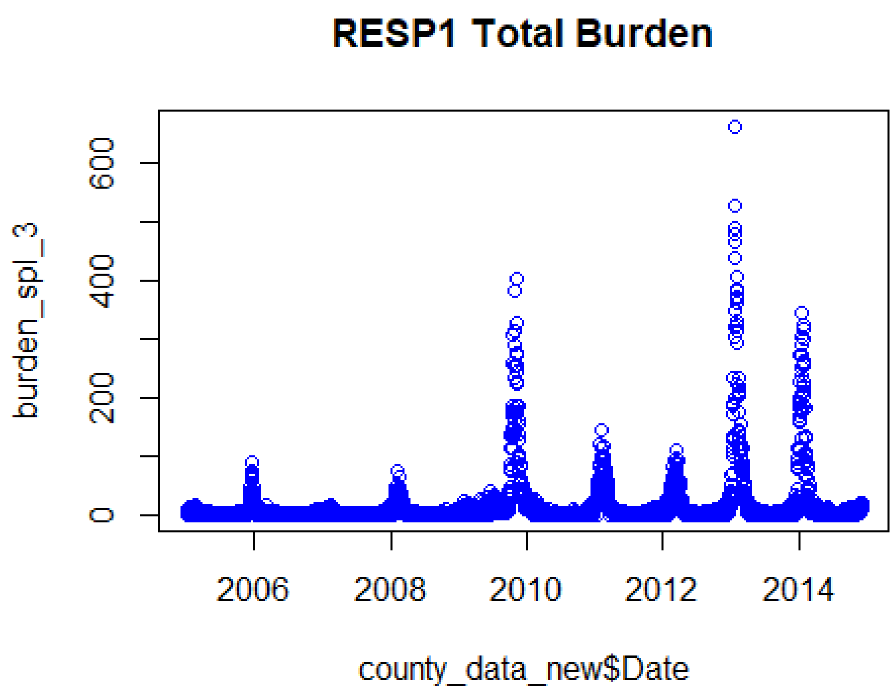
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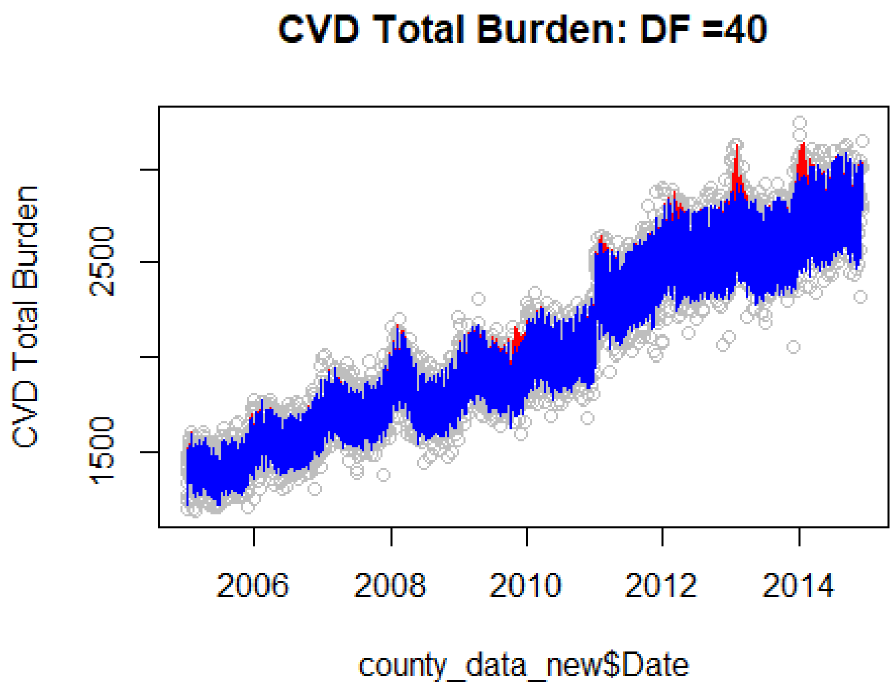
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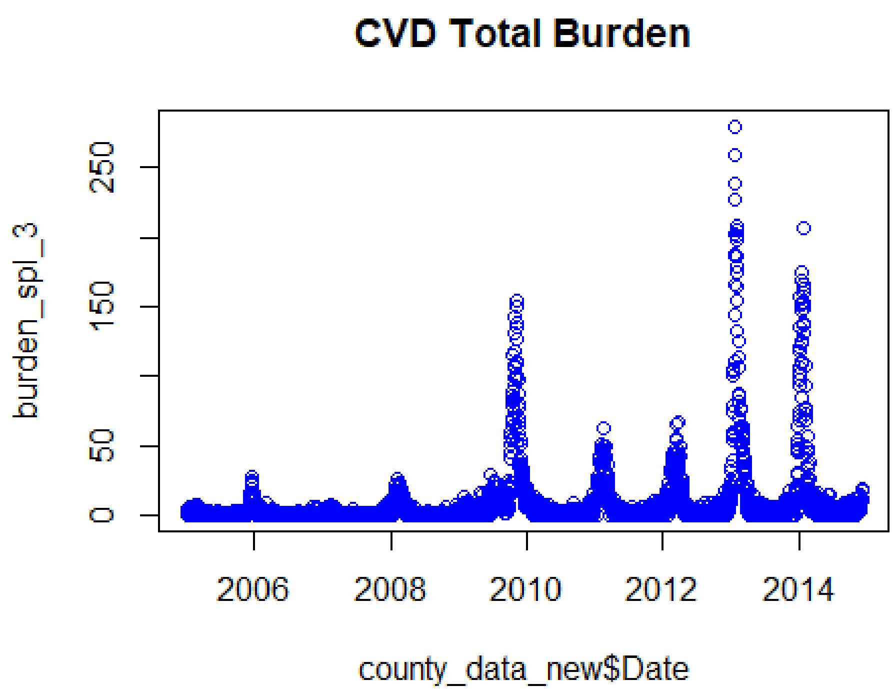
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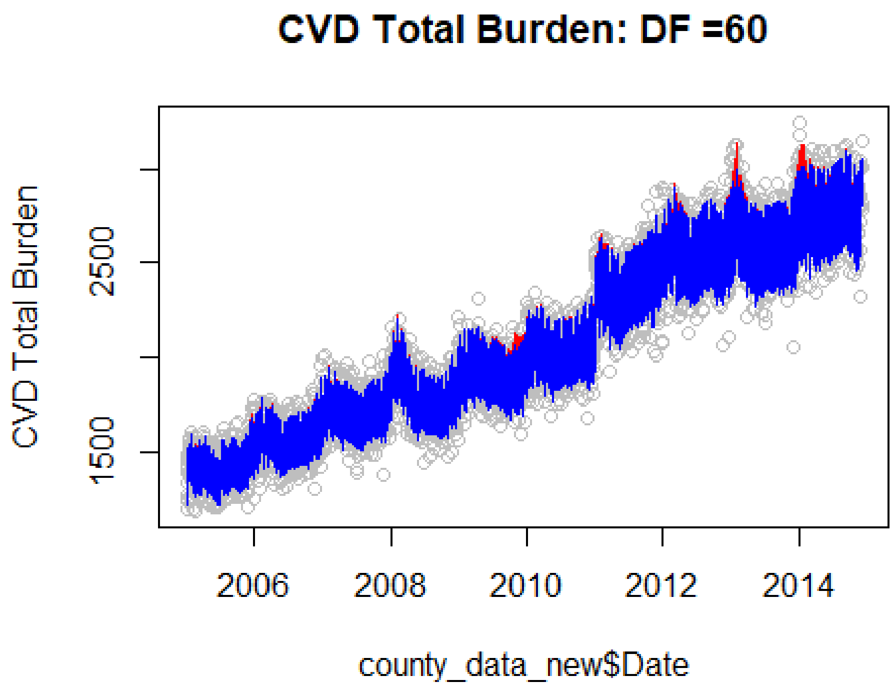
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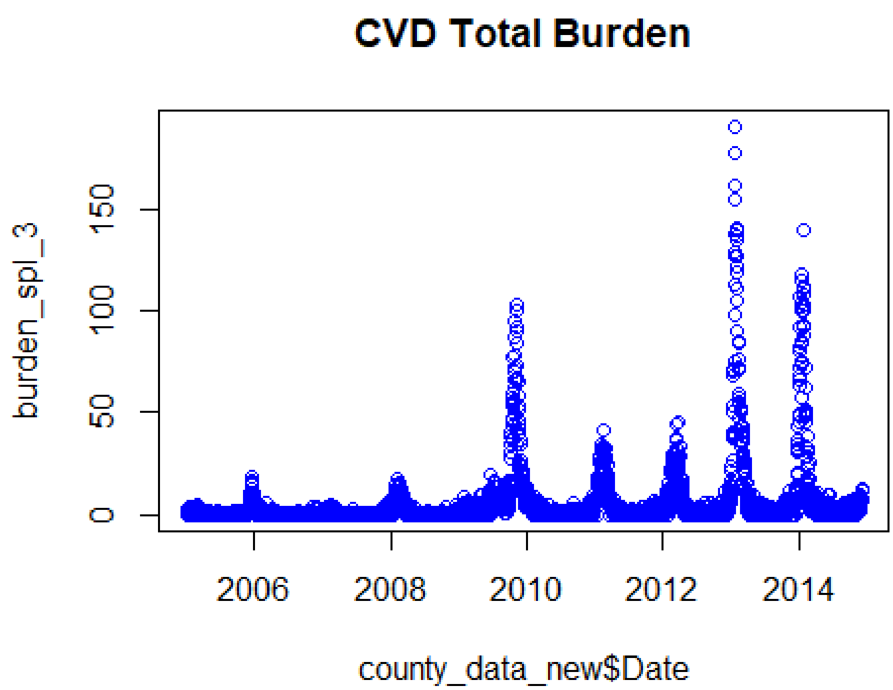
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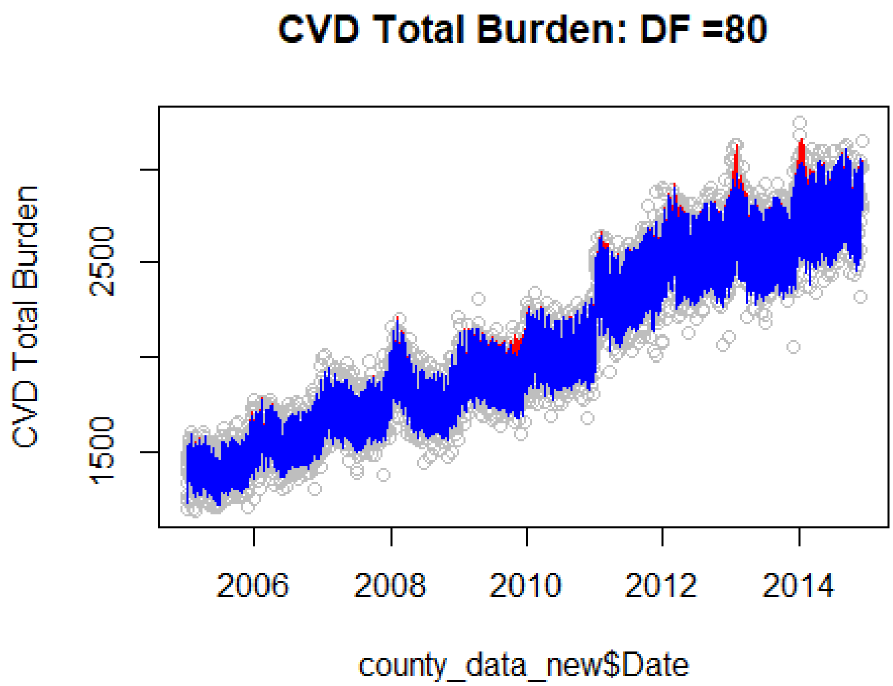
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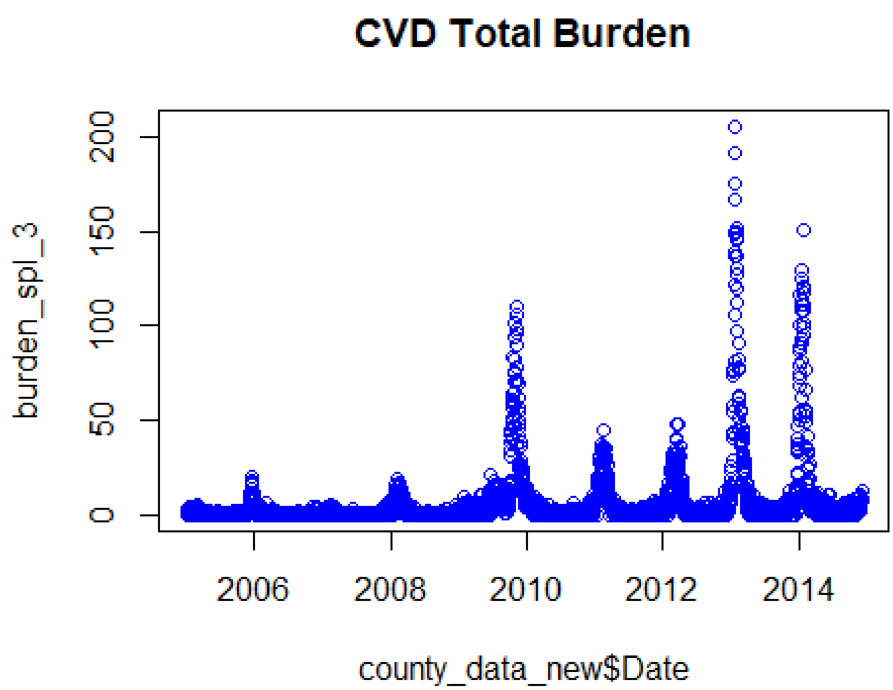
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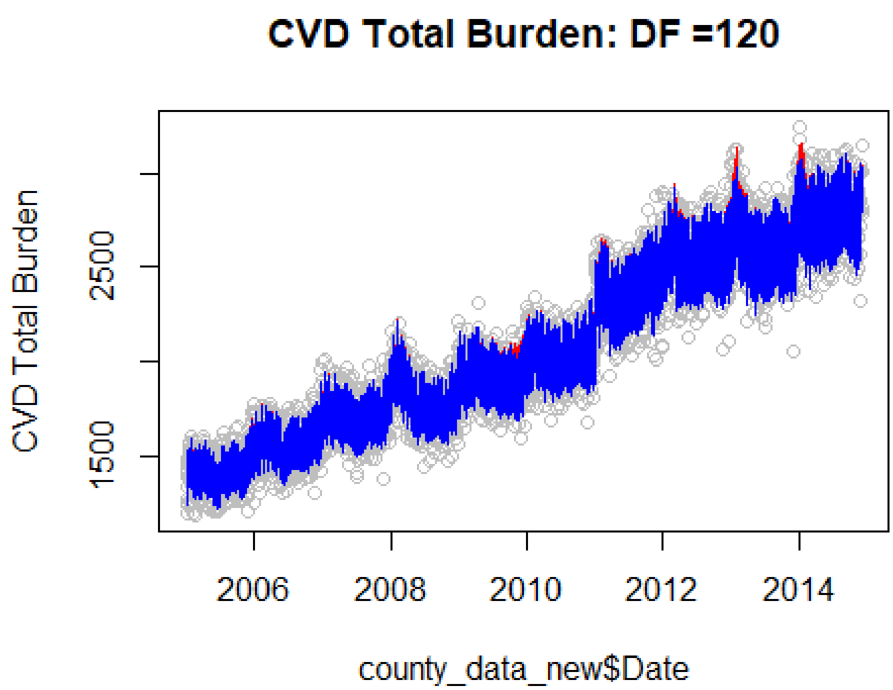
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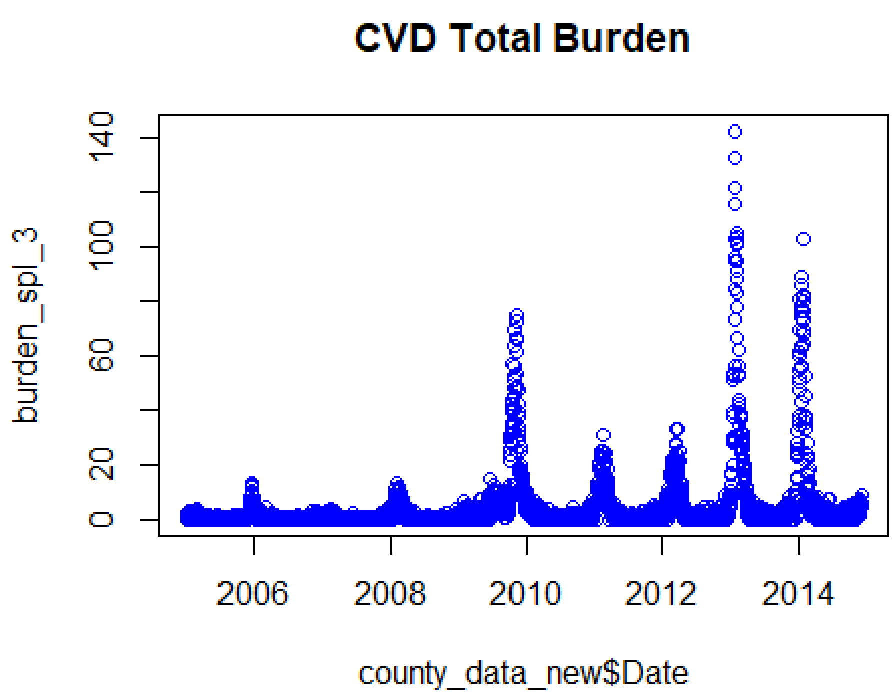
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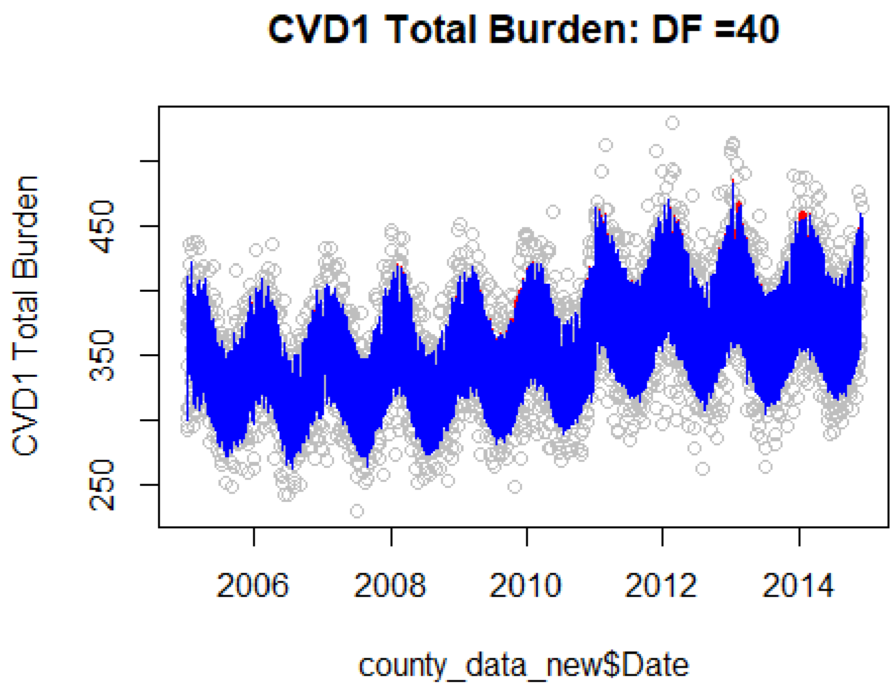
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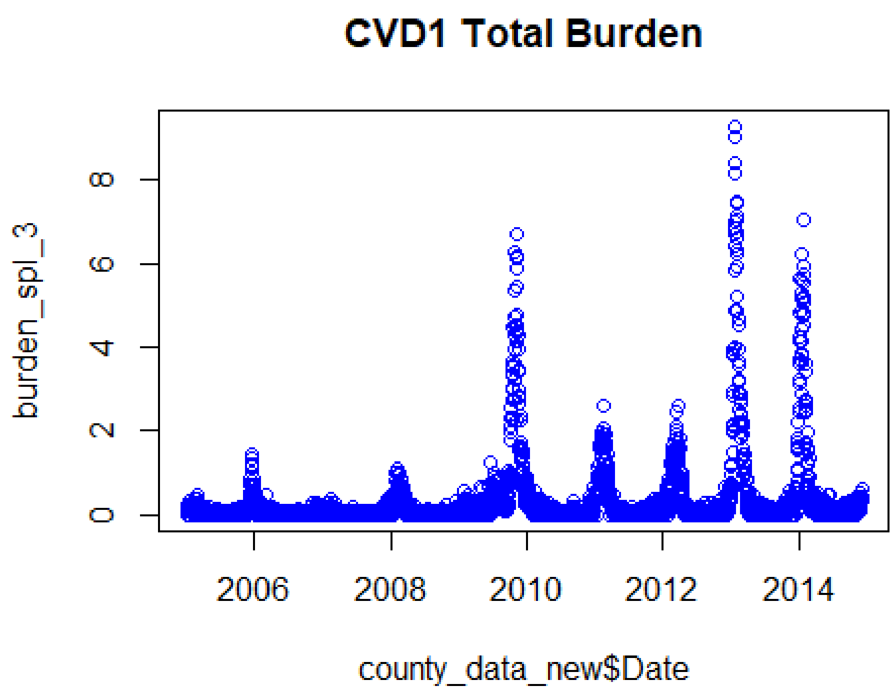
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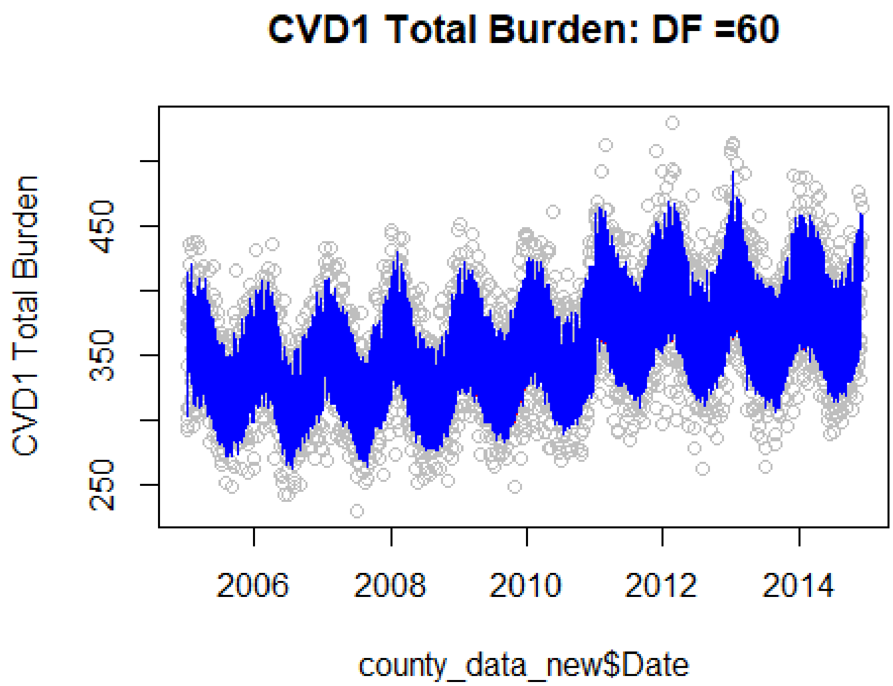
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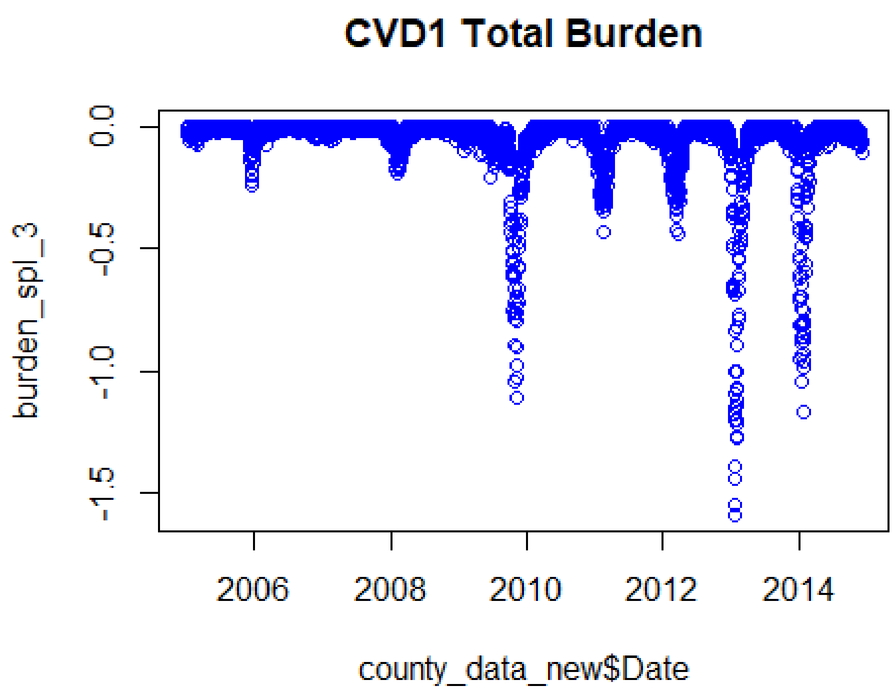
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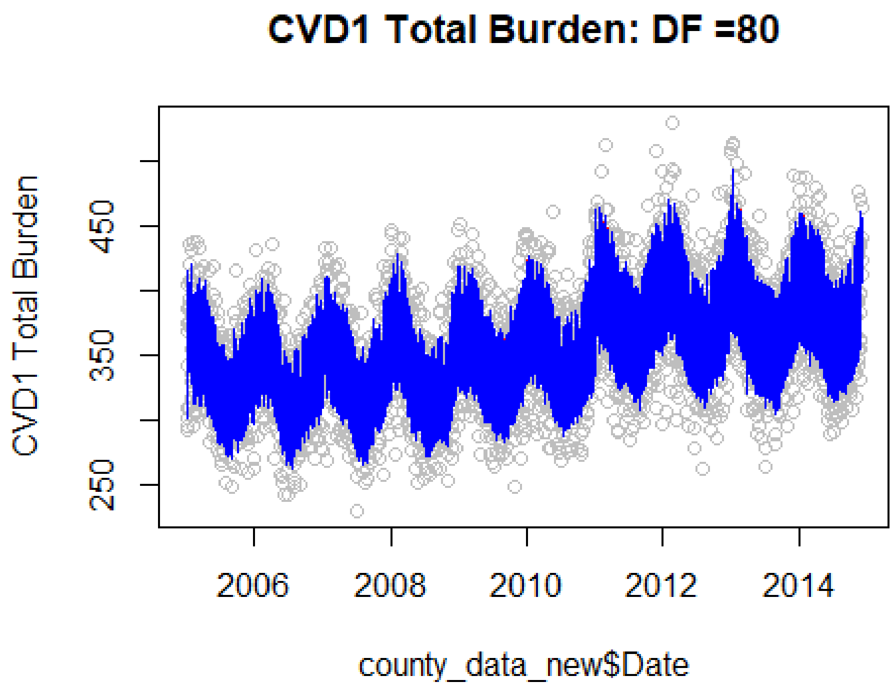
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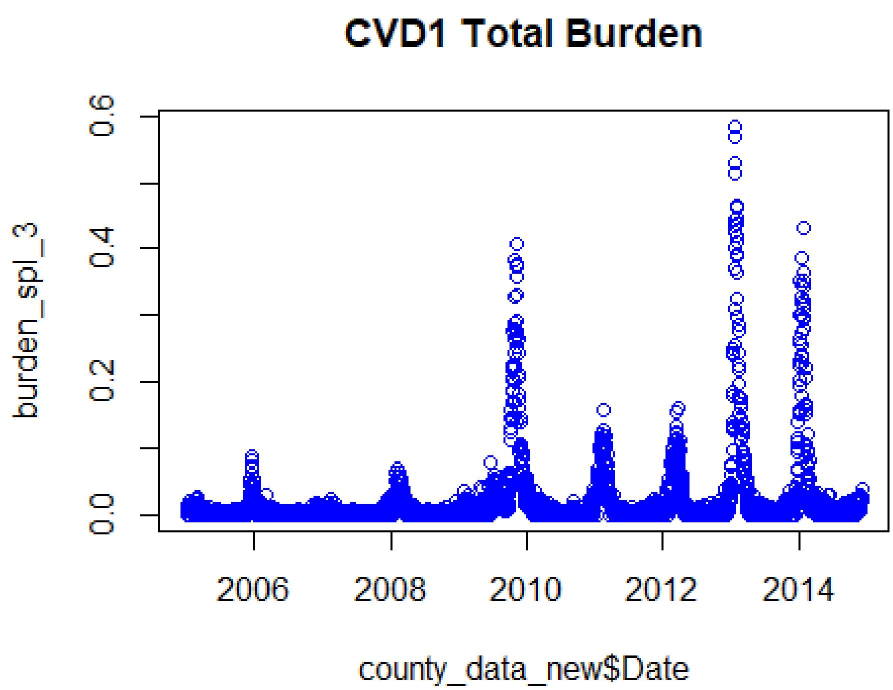
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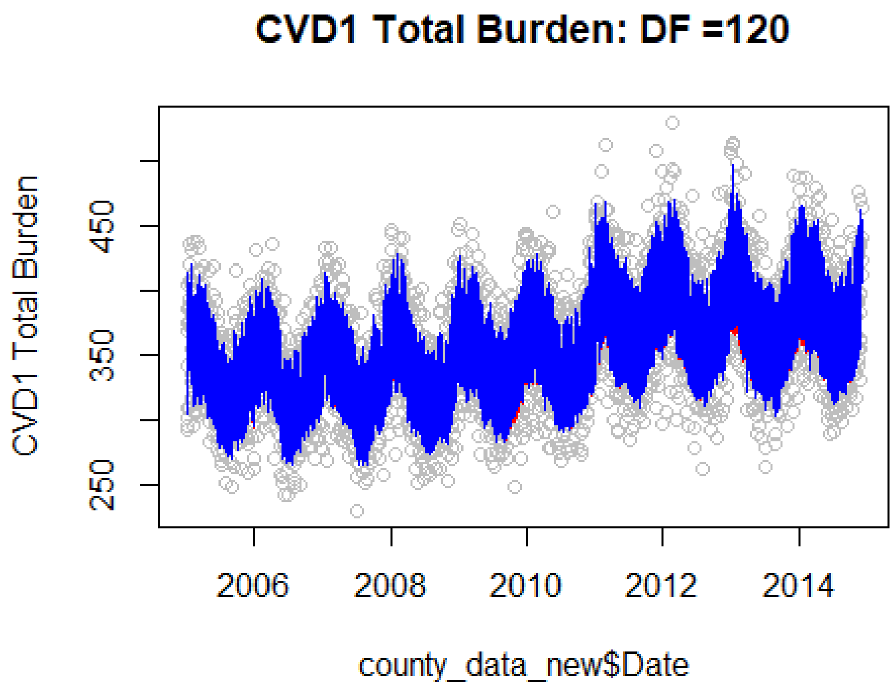
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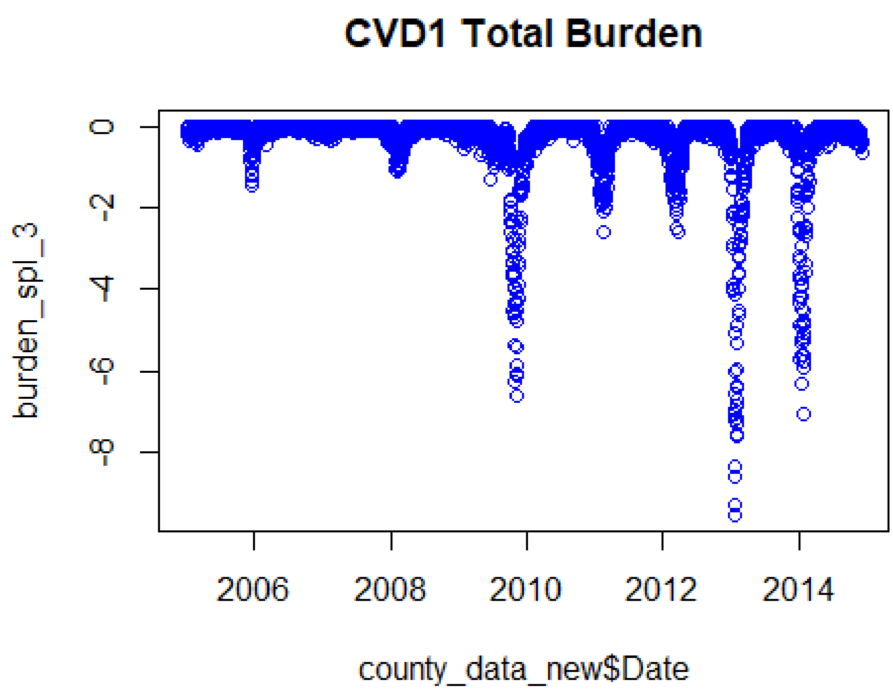
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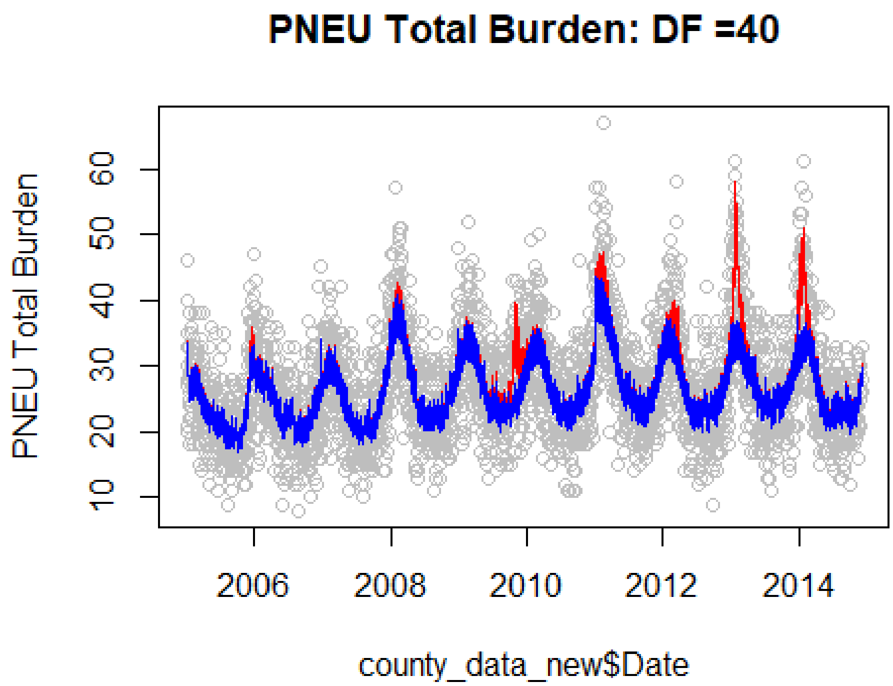
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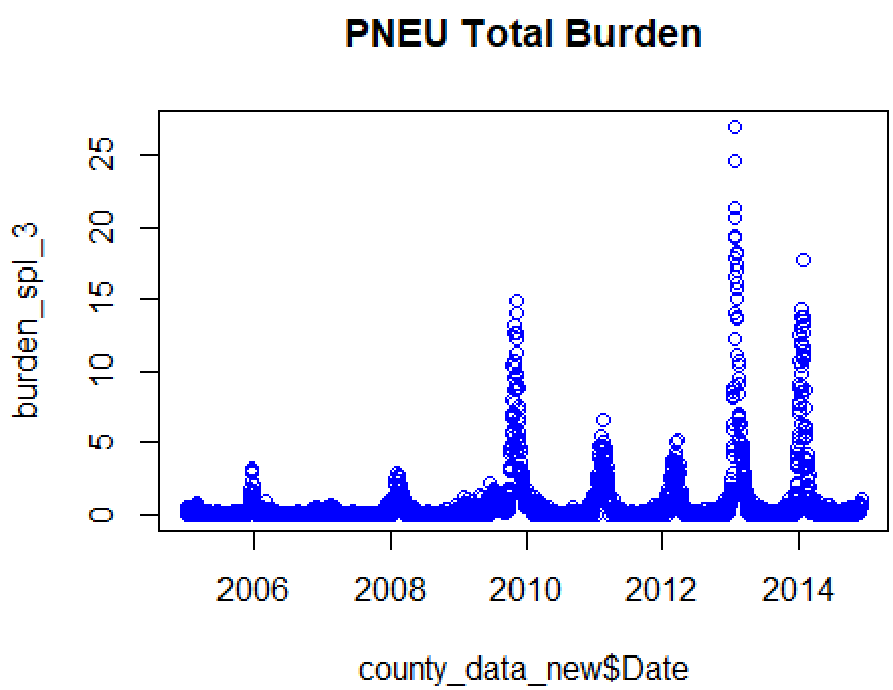
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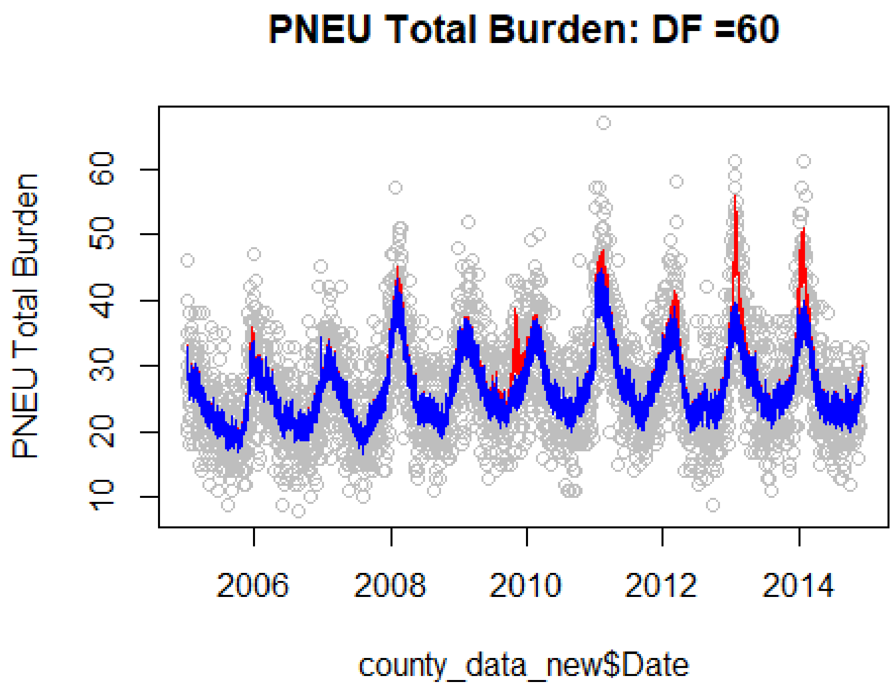
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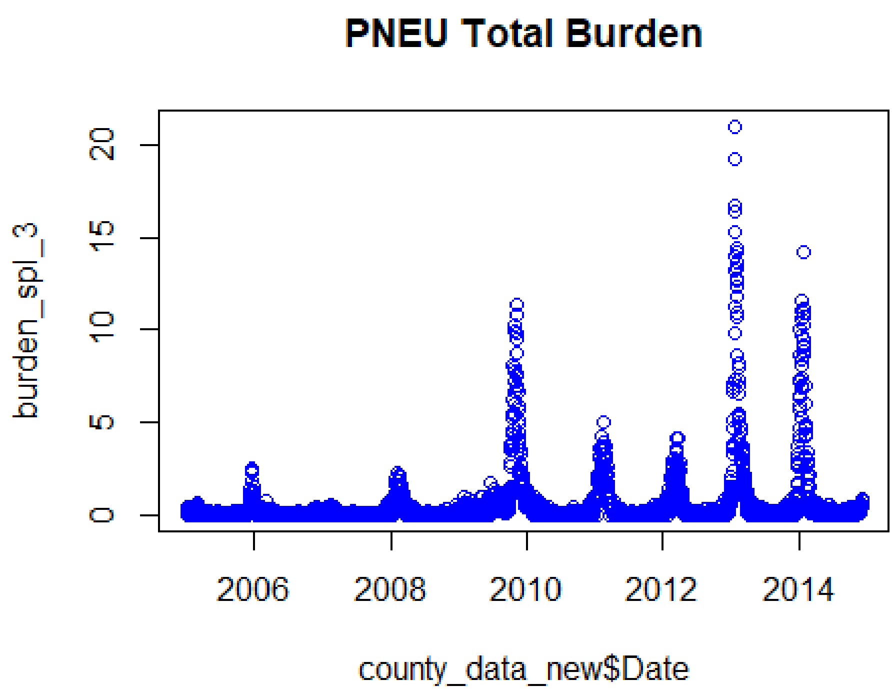
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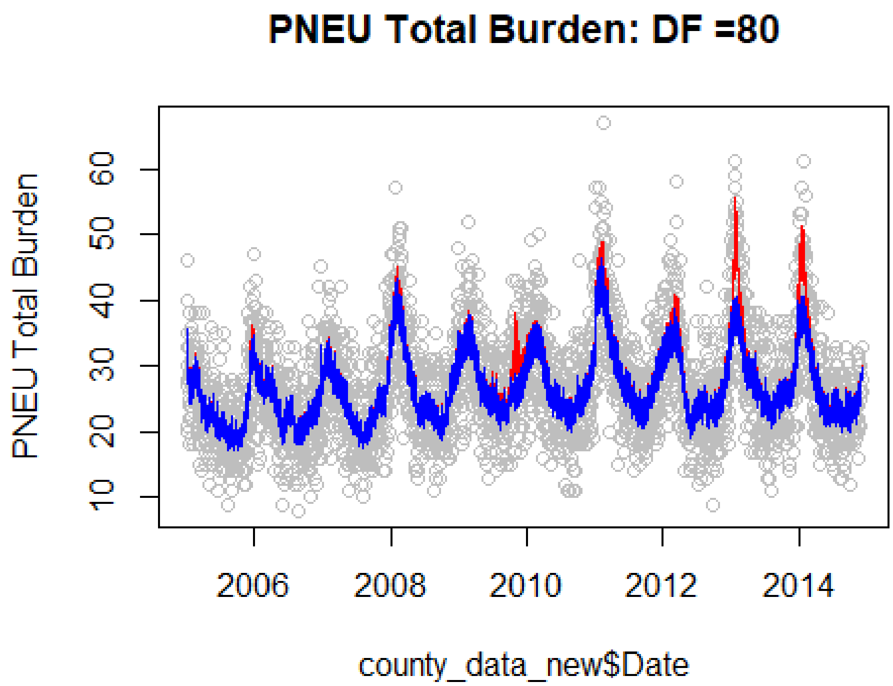
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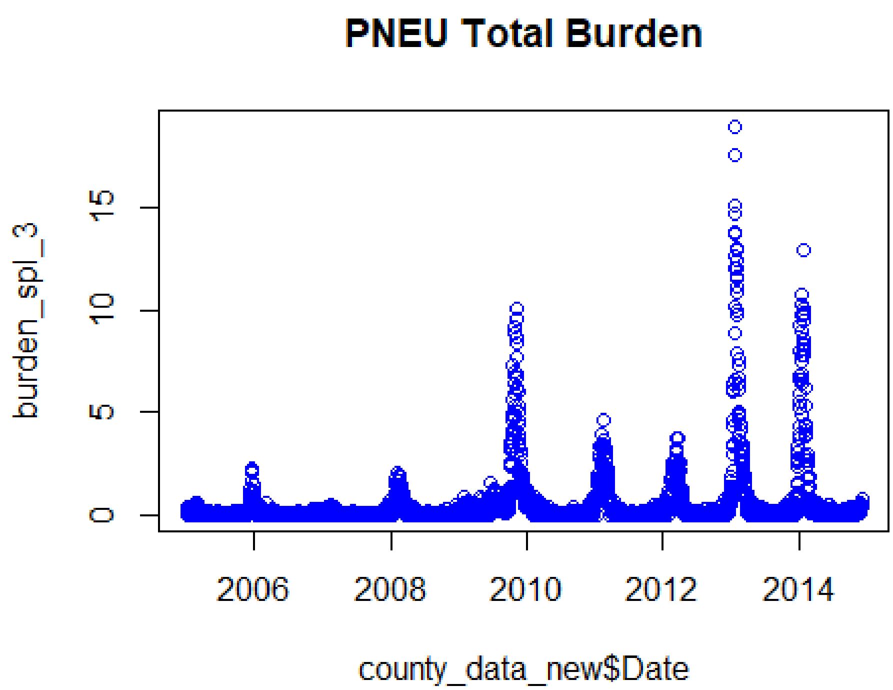
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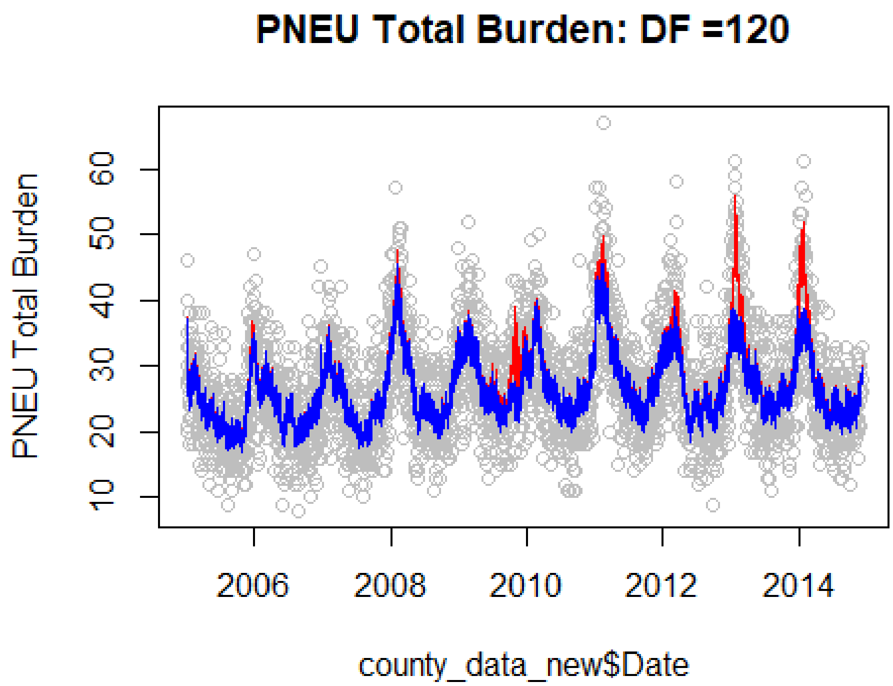
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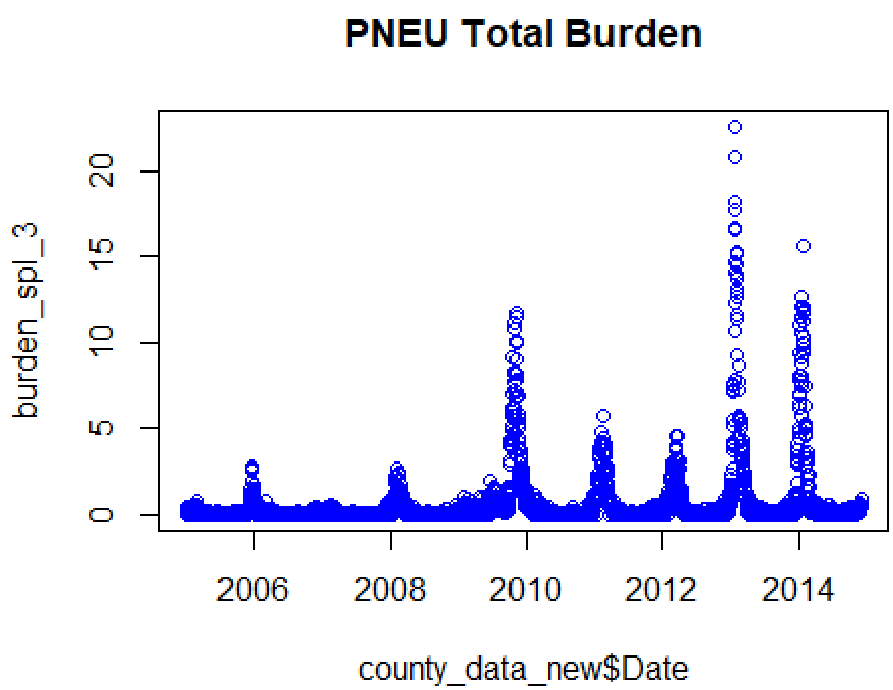
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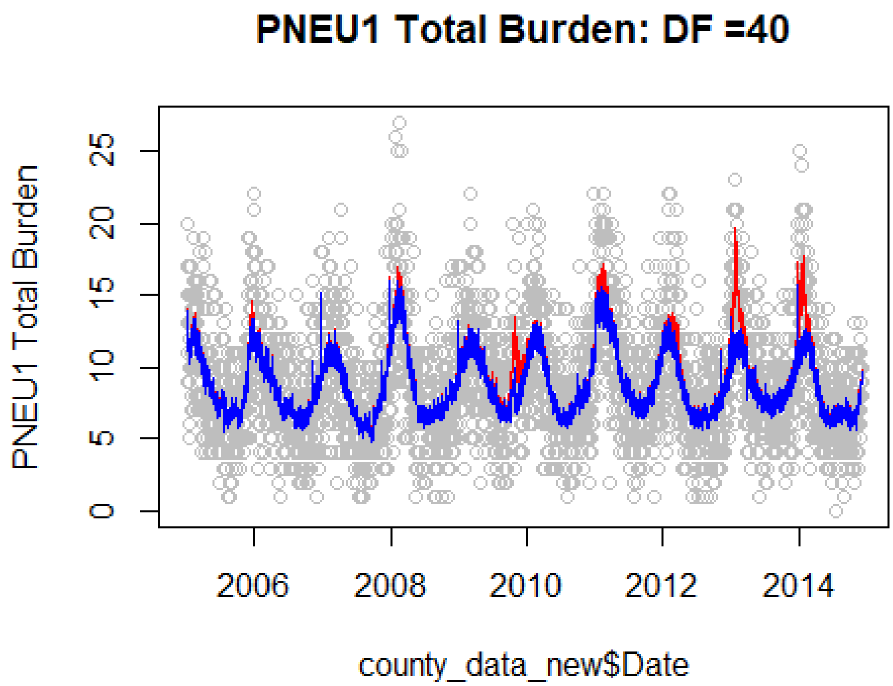
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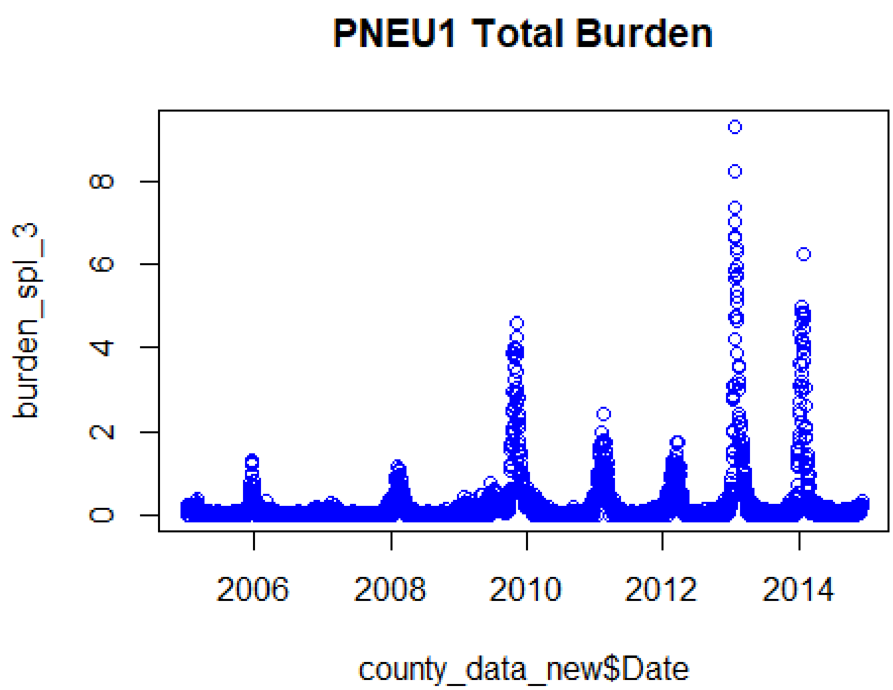
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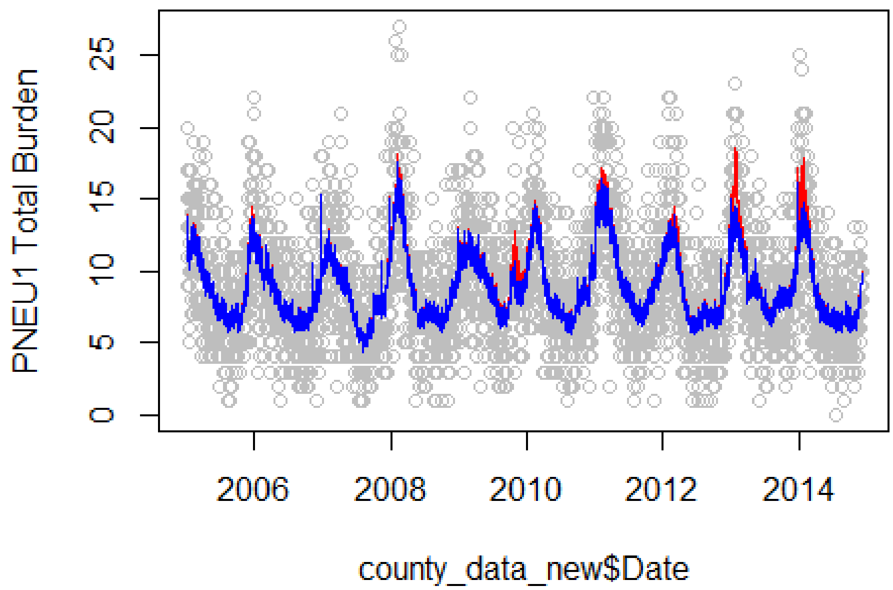

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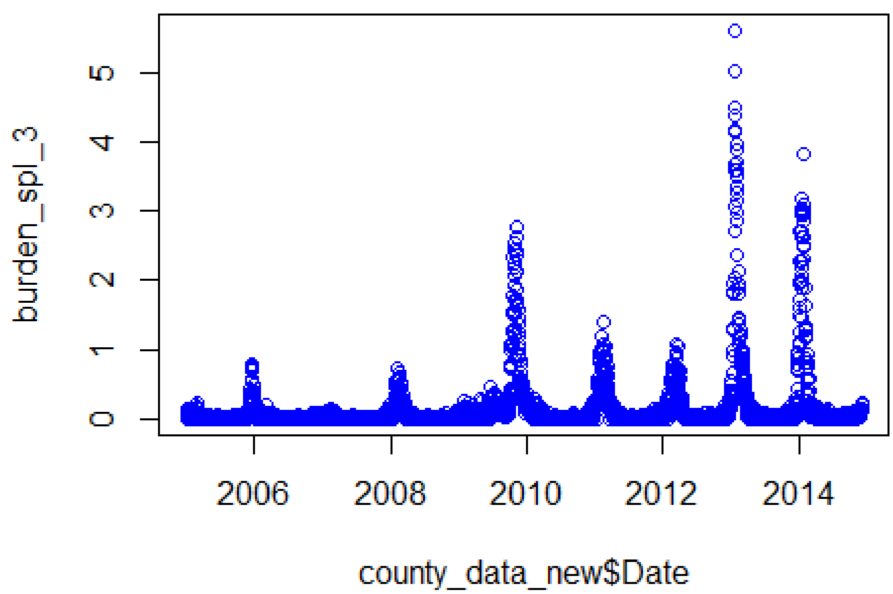

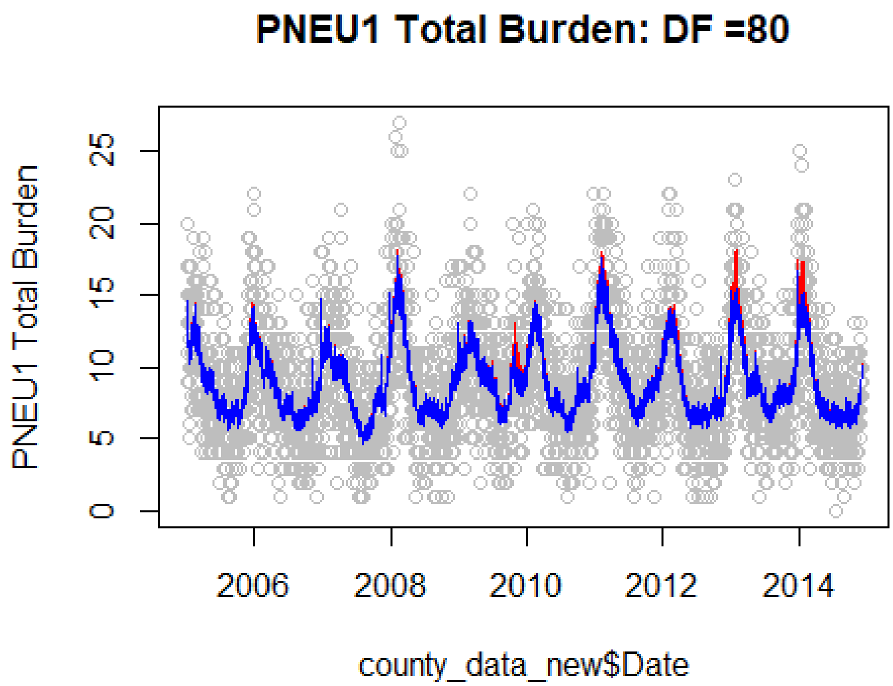
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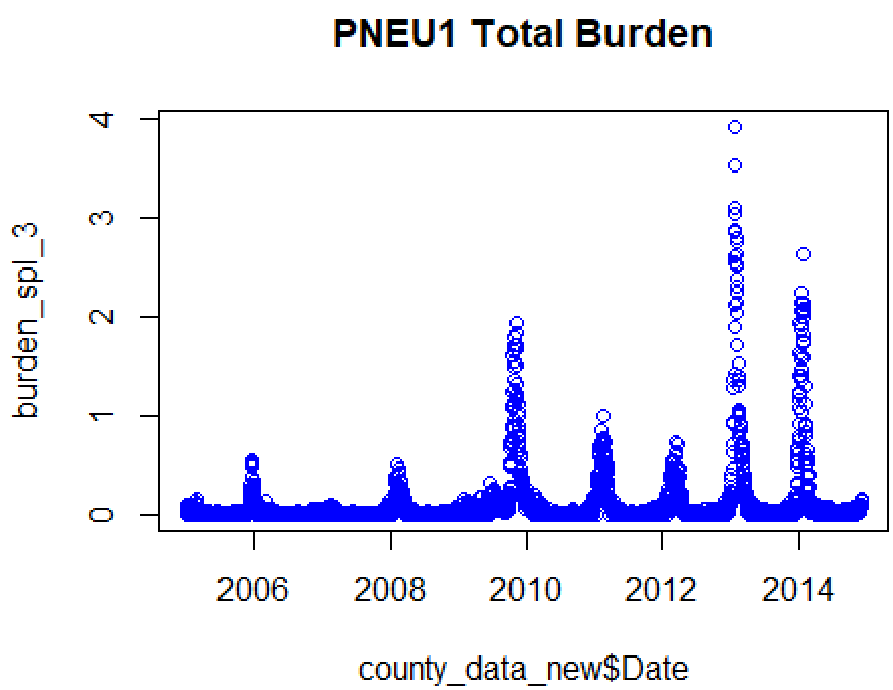
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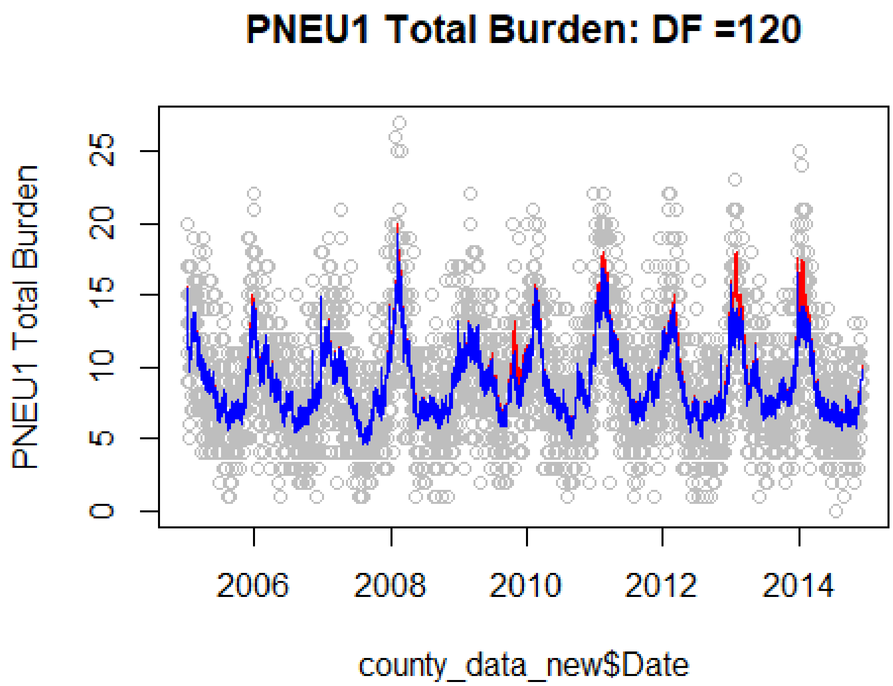
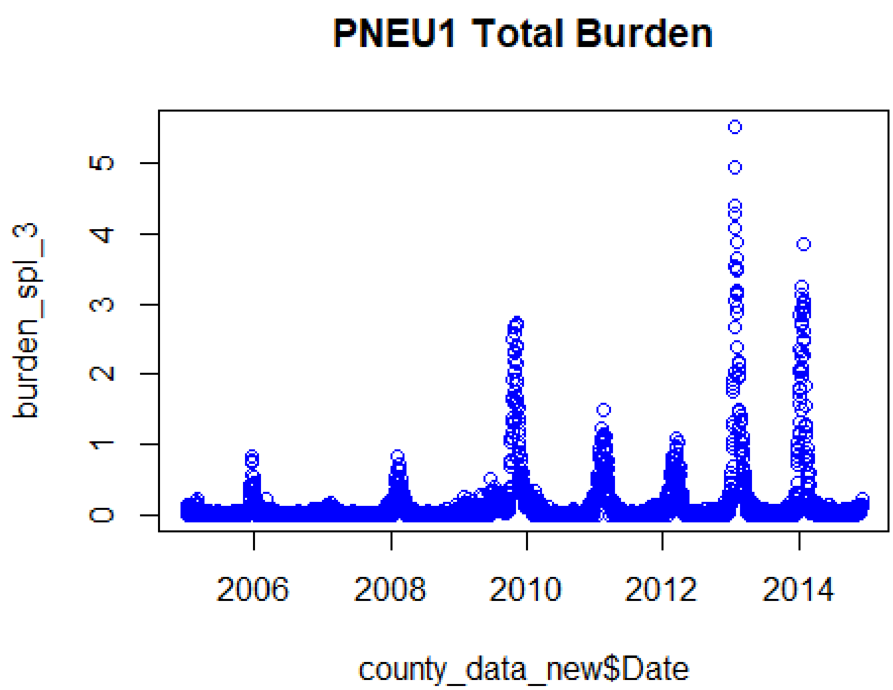




<u>Los Angeles County 3rd Degree Polynomial Time Series (Age Stratified)</u>

Ages 1-4

```
##               Outcome Seasons Burden LowerLimit UpperLimit
## 1   RESP Total Burden   05-06    336     294.84     377.16
## 2   RESP Total Burden   06-07     64      56.16      71.84
## 3   RESP Total Burden   07-08    300     262.76     337.24
## 4   RESP Total Burden   08-09    297     259.76     334.24
## 5   RESP Total Burden   09-10   3699    3216.84    4181.16
## 6   RESP Total Burden   10-11   1296    1137.24    1454.76
## 7   RESP Total Burden   11-12   1122     980.88    1263.12
## 8   RESP Total Burden   12-13   3434    3002.80    3865.20
## 9   RESP Total Burden   13-14   2291    2004.84    2577.16
## 10 RESP1 Total Burden   05-06    268     234.68     301.32
## 11 RESP1 Total Burden   06-07     50      44.12      55.88
## 12 RESP1 Total Burden   07-08    234     204.60     263.40
## 13 RESP1 Total Burden   08-09    236     204.64     267.36
## 14 RESP1 Total Burden   09-10   3020    2614.28    3425.72
## 15 RESP1 Total Burden   10-11   1026     896.64    1155.36
## 16 RESP1 Total Burden   11-12    871     759.28     982.72
## 17 RESP1 Total Burden   12-13   2716    2363.20    3068.80
## 18 RESP1 Total Burden   13-14   1839    1601.84    2076.16
```

Ages 5-49

```
##               Outcome Seasons Burden LowerLimit UpperLimit
## 1   RESP Total Burden   05-06    428     380.96     475.04
## 2   RESP Total Burden   06-07    208     184.48     231.52
## 3   RESP Total Burden   07-08    574     511.28     636.72
## 4   RESP Total Burden   08-09    499     444.12     553.88
## 5   RESP Total Burden   09-10   5126    4534.08    5717.92
## 6   RESP Total Burden   10-11   1678    1495.72    1860.28
## 7   RESP Total Burden   11-12   1354    1203.08    1504.92
## 8   RESP Total Burden   12-13   3405    3022.80    3787.20
## 9   RESP Total Burden   13-14   3306    2935.56    3676.44
## 10 RESP1 Total Burden   05-06    342     302.80     381.20
## 11 RESP1 Total Burden   06-07    162     144.36     179.64
## 12 RESP1 Total Burden   07-08    448     397.04     498.96
## 13 RESP1 Total Burden   08-09    395     349.92     440.08
## 14 RESP1 Total Burden   09-10   4173    3675.16    4670.84
## 15 RESP1 Total Burden   10-11   1321    1174.00    1468.00
## 16 RESP1 Total Burden   11-12   1049     929.44    1168.56
## 17 RESP1 Total Burden   12-13   2690    2378.36    3001.64
## 18 RESP1 Total Burden   13-14   2646    2340.24    2951.76
```

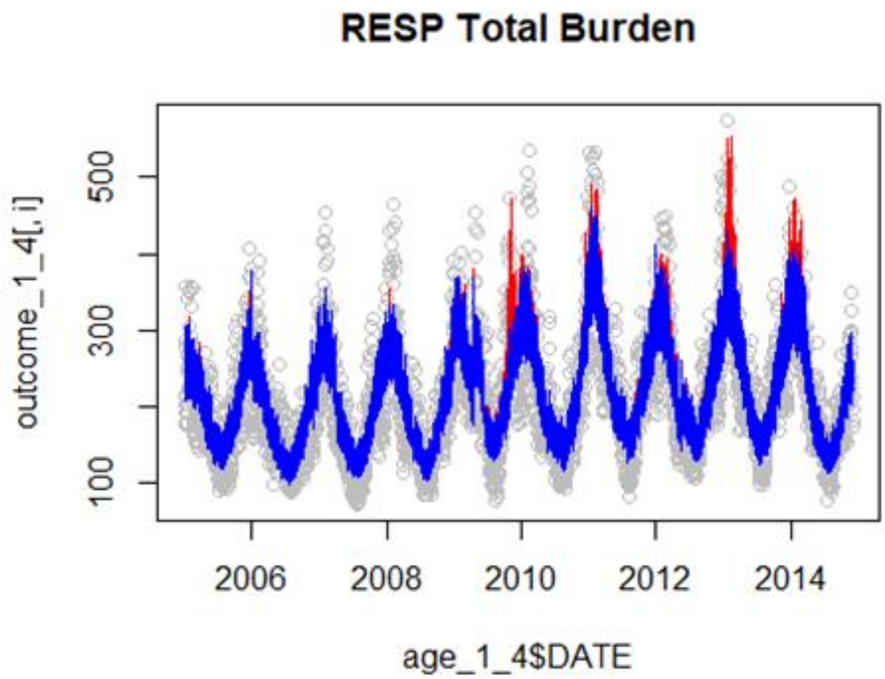
Ages 50-64

```
##               Outcome Seasons Burden LowerLimit UpperLimit
## 1   RESP Total Burden   05-06    149     119.60     178.40
## 2   RESP Total Burden   06-07     79      63.32      94.68
## 3   RESP Total Burden   07-08    253     204.00     302.00
## 4   RESP Total Burden   08-09    185     149.72     220.28
## 5   RESP Total Burden   09-10   2018    1624.04    2411.96
## 6   RESP Total Burden   10-11    735     593.88     876.12
## 7   RESP Total Burden   11-12    505     407.00     603.00
## 8   RESP Total Burden   12-13   1932    1557.64    2306.36
## 9   RESP Total Burden   13-14   2797    2242.32    3351.68
## 10 RESP1 Total Burden   05-06    117      93.48     140.52
## 11 RESP1 Total Burden   06-07     61      49.24      72.76
## 12 RESP1 Total Burden   07-08    194     154.80     233.20
## 13 RESP1 Total Burden   08-09    145     115.60     174.40
## 14 RESP1 Total Burden   09-10   1612    1280.76    1943.24
## 15 RESP1 Total Burden   10-11    570     454.36     685.64
## 16 RESP1 Total Burden   11-12    386     307.60     464.40
## 17 RESP1 Total Burden   12-13   1501    1195.24    1806.76
## 18 RESP1 Total Burden   13-14   2206    1747.36    2664.64
```

Ages >= 65

```
##               Outcome Seasons Burden LowerLimit UpperLimit
## 1   RESP Total Burden   05-06    328     269.20     386.80
## 2   RESP Total Burden   06-07     66      54.24      77.76
## 3   RESP Total Burden   07-08    314     257.16     370.84
## 4   RESP Total Burden   08-09    107      87.40     126.60
## 5   RESP Total Burden   09-10    683     559.52     806.48
## 6   RESP Total Burden   10-11    703     577.56     828.44
## 7   RESP Total Burden   11-12    662     542.44     781.56
## 8   RESP Total Burden   12-13   4039    3284.40    4793.60
## 9   RESP Total Burden   13-14   1831    1497.80    2164.20
## 10 RESP1 Total Burden   05-06    267     218.00     316.00
## 11 RESP1 Total Burden   06-07     52      42.20      61.80
## 12 RESP1 Total Burden   07-08    248     202.92     293.08
## 13 RESP1 Total Burden   08-09     87      71.32     102.68
## 14 RESP1 Total Burden   09-10    562     458.12     665.88
## 15 RESP1 Total Burden   10-11    562     460.08     663.92
## 16 RESP1 Total Burden   11-12    520     423.96     616.04
## 17 RESP1 Total Burden   12-13   3246    2626.64    3865.36
## 18 RESP1 Total Burden   13-14   1487    1210.64    1763.36
```

Los Angeles County 3rd Degree Polynomial Time Series (Age Stratified)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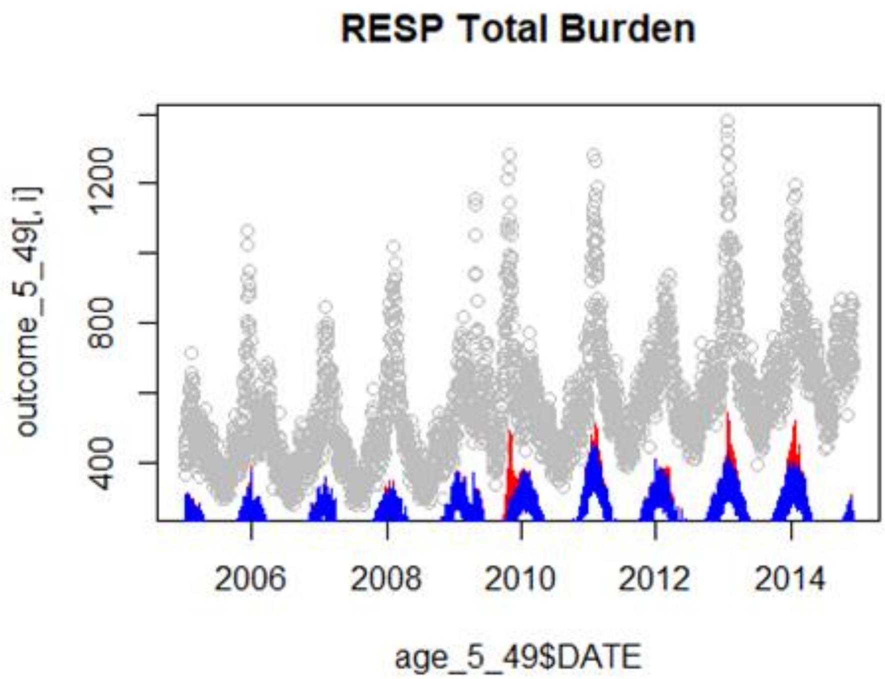
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2010
2012
2014
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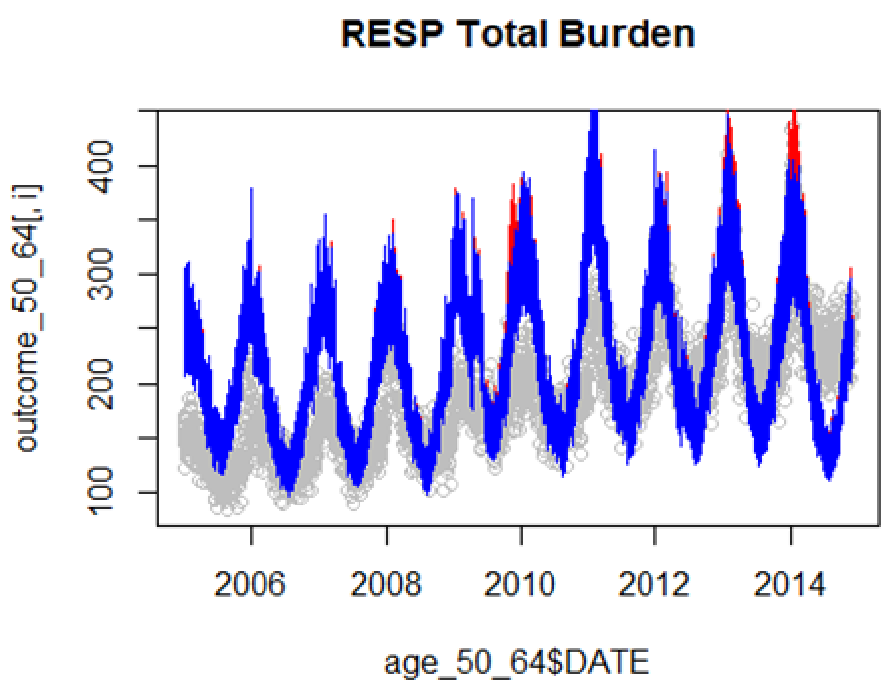
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2010
2012
2014
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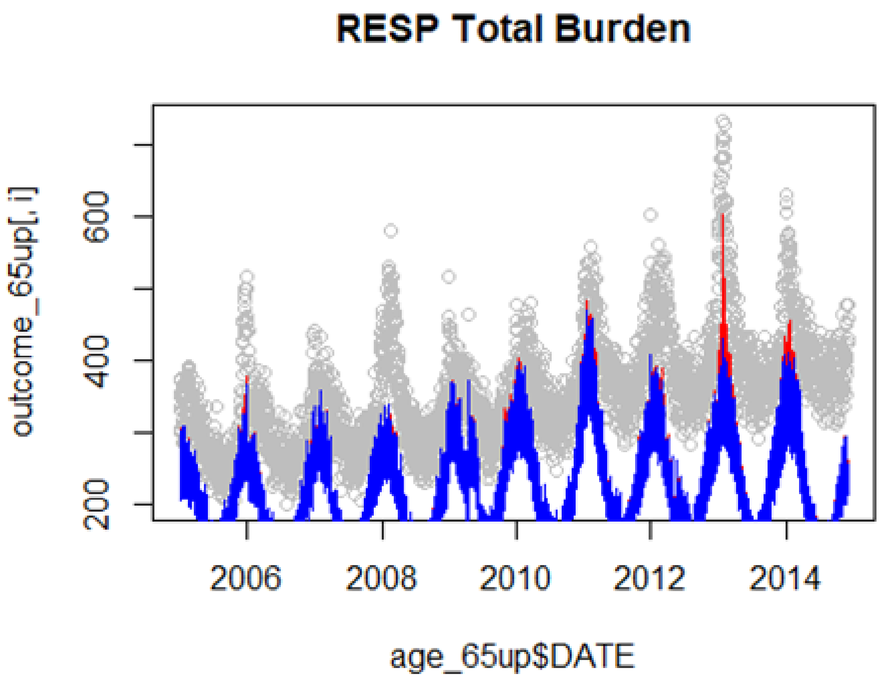
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2014
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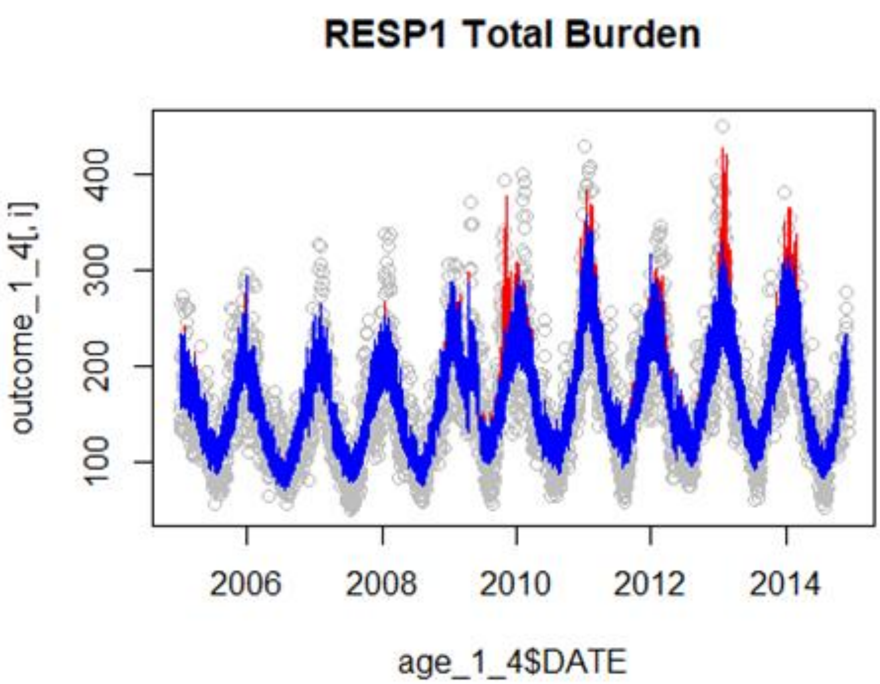
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200
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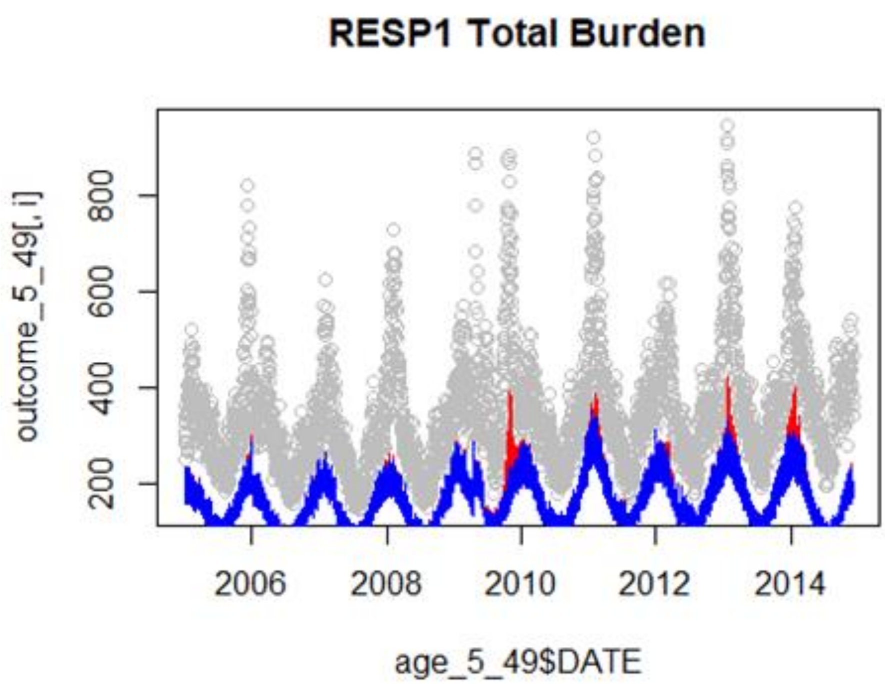
2006
2008
2010
2012
2014
age_1_4$DATE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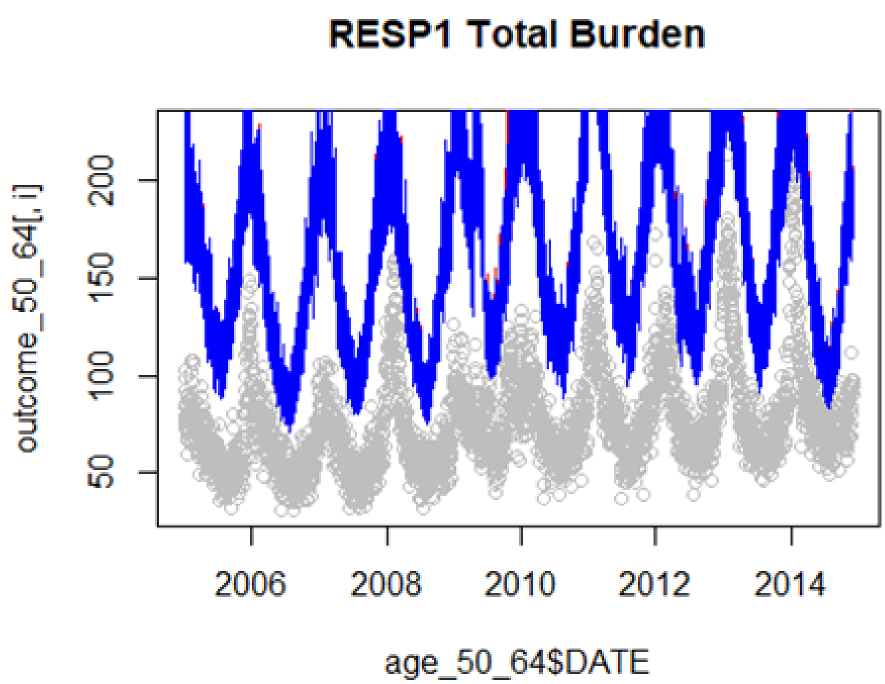
800
2006
2008
2010
2012
2014
age_5_49$DATE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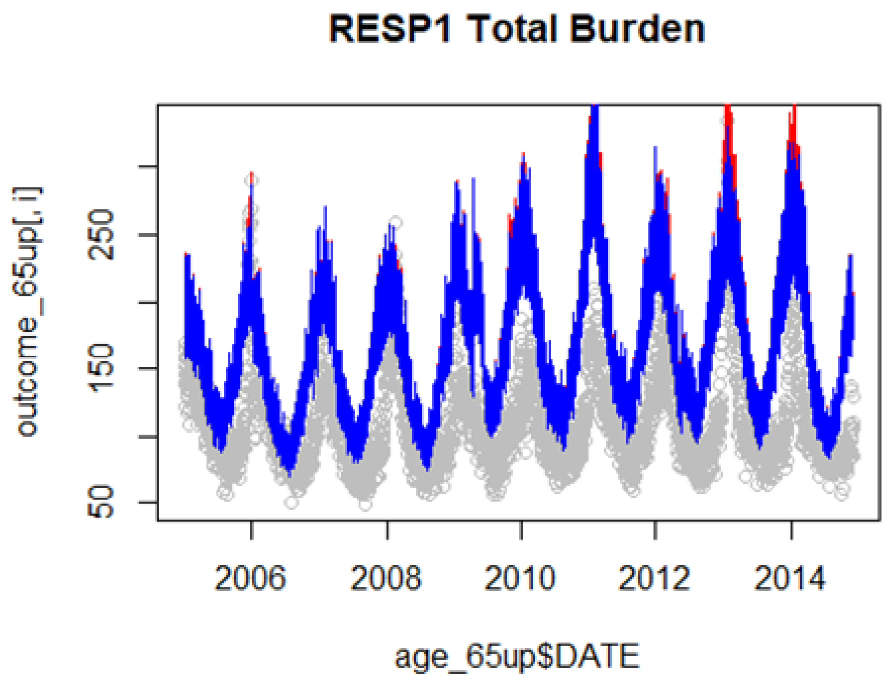
200
2006
2008
2010
2012
2014
age_50_64$DATE



Los Angeles County Spline Burden Estimates (Age Stratified)

Ages 1-4

##	Outcome	DF	Seasons	Burden	LowerLimit	UpperLimit
## 05-06	RESP Total Burden	40	05-06	354	303.04	404.96
## 06-07	RESP Total Burden	40	06-07	62	54.16	69.84
## 07-08	RESP Total Burden	40	07-08	317	271.92	362.08
## 08-09	RESP Total Burden	40	08-09	300	256.88	343.12
## 09-10	RESP Total Burden	40	09-10	3822	3292.80	4351.20
## 10-11	RESP Total Burden	40	10-11	1354	1163.88	1544.12
## 11-12	RESP Total Burden	40	11-12	1157	992.36	1321.64
## 12-13	RESP Total Burden	40	12-13	3520	3037.84	4002.16
## 13-14	RESP Total Burden	40	13-14	2165	1859.24	2470.76
## 05-061	RESP Total Burden	60	05-06	122	76.92	167.08
## 06-071	RESP Total Burden	60	06-07	21	13.16	28.84
## 07-081	RESP Total Burden	60	07-08	116	72.88	159.12
## 08-091	RESP Total Burden	60	08-09	107	67.80	146.20
## 09-101	RESP Total Burden	60	09-10	1445	911.88	1978.12
## 10-111	RESP Total Burden	60	10-11	461	288.52	633.48
## 11-121	RESP Total Burden	60	11-12	429	268.28	589.72
## 12-131	RESP Total Burden	60	12-13	1277	804.64	1749.36
## 13-141	RESP Total Burden	60	13-14	798	502.04	1093.96
## 05-062	RESP Total Burden	80	05-06	51	7.88	94.12
## 06-072	RESP Total Burden	80	06-07	9	1.16	16.84

```
## 07-082   RESP Total Burden  80   07-08    50     8.84     91.16
## 08-092   RESP Total Burden  80   08-09    46     6.80     85.20
## 09-102   RESP Total Burden  80   09-10   634   108.72   1159.28
## 10-112   RESP Total Burden  80   10-11   200    33.40    366.60
## 11-122   RESP Total Burden  80   11-12   181    30.08    331.92
## 12-132   RESP Total Burden  80   12-13   552    93.36   1010.64
## 13-142   RESP Total Burden  80   13-14   345    58.84    631.16
## 05-063   RESP Total Burden 120   05-06    90    48.84    131.16
## 06-073   RESP Total Burden 120   06-07    17     9.16     24.84
## 07-083   RESP Total Burden 120   07-08    86    46.80    125.20
## 08-093   RESP Total Burden 120   08-09    81    43.76    118.24
## 09-103   RESP Total Burden 120   09-10  1078   588.00   1568.00
## 10-113   RESP Total Burden 120   10-11   346   185.28    506.72
## 11-123   RESP Total Burden 120   11-12   318   171.00    465.00
## 12-133   RESP Total Burden 120   12-13   946   514.80   1377.20
## 13-143   RESP Total Burden 120   13-14   592   321.52    862.48
## 05-064  RESP1 Total Burden  40   05-06   274   232.84    315.16
## 06-074  RESP1 Total Burden  40   06-07    47    39.16     54.84
## 07-084  RESP1 Total Burden  40   07-08   245   209.72    280.28
## 08-094  RESP1 Total Burden  40   08-09   236   200.72    271.28
## 09-104  RESP1 Total Burden  40   09-10  3098  2653.08   3542.92
## 10-114  RESP1 Total Burden  40   10-11  1066   911.16   1220.84
## 11-124  RESP1 Total Burden  40   11-12   885   753.68   1016.32
## 12-134  RESP1 Total Burden  40   12-13  2775  2381.04   3168.96
## 13-144  RESP1 Total Burden  40   13-14  1702  1453.08   1950.92
## 05-065  RESP1 Total Burden  60   05-06    91    53.76    128.24
## 06-075  RESP1 Total Burden  60   06-07    16    10.12     21.88
## 07-085  RESP1 Total Burden  60   07-08    87    51.72    122.28
## 08-095  RESP1 Total Burden  60   08-09    82    48.68    115.32
## 09-105  RESP1 Total Burden  60   09-10  1143   690.24   1595.76
## 10-115  RESP1 Total Burden  60   10-11   351   209.88    492.12
## 11-125  RESP1 Total Burden  60   11-12   321   191.64    450.36
## 12-135  RESP1 Total Burden  60   12-13   976   587.92   1364.08
## 13-145  RESP1 Total Burden  60   13-14   610   366.96    853.04
## 05-066  RESP1 Total Burden  80   05-06    39     3.72     74.28
## 06-076  RESP1 Total Burden  80   06-07     7     1.12     12.88
## 07-086  RESP1 Total Burden  80   07-08    38     4.68     71.32
## 08-096  RESP1 Total Burden  80   08-09    36     4.64     67.36
## 09-106  RESP1 Total Burden  80   09-10   509    64.08    953.92
## 10-116  RESP1 Total Burden  80   10-11   155    17.80    292.20
## 11-126  RESP1 Total Burden  80   11-12   138    16.48    259.52
## 12-136  RESP1 Total Burden  80   12-13   430    51.72    808.28
## 13-146  RESP1 Total Burden  80   13-14   269    31.84    506.16
## 05-067  RESP1 Total Burden 120   05-06    69    35.68    102.32
```

## 06-077	RESP1 Total Burden 120	06-07	13	7.12	18.88
## 07-087	RESP1 Total Burden 120	07-08	66	32.68	99.32
## 08-097	RESP1 Total Burden 120	08-09	64	32.64	95.36
## 09-107	RESP1 Total Burden 120	09-10	870	448.60	1291.40
## 10-117	RESP1 Total Burden 120	10-11	270	136.72	403.28
## 11-127	RESP1 Total Burden 120	11-12	244	124.44	363.56
## 12-137	RESP1 Total Burden 120	12-13	742	381.36	1102.64
## 13-147	RESP1 Total Burden 120	13-14	463	237.60	688.40

Ages 5-49

```
##                    Outcome  DF Seasons Burden LowerLimit UpperLimit
## 05-06    RESP Total Burden  40   05-06   1745    1637.20    1852.80
## 06-07    RESP Total Burden  40   06-07    782     734.96     829.04
## 07-08    RESP Total Burden  40   07-08   2469    2318.08    2619.92
## 08-09    RESP Total Burden  40   08-09   2144    2012.68    2275.32
## 09-10    RESP Total Burden  40   09-10  22184   20931.56   23436.44
## 10-11    RESP Total Burden  40   10-11   6463    6076.88    6849.12
## 11-12    RESP Total Burden  40   11-12   5657    5314.00    6000.00
## 12-13    RESP Total Burden  40   12-13  14516   13671.24   15360.76
## 13-14    RESP Total Burden  40   13-14  13437   12629.48   14244.52
## 05-061   RESP Total Burden  60   05-06   1143    1025.40    1260.60
## 06-071   RESP Total Burden  60   06-07    516     463.08     568.92
## 07-081   RESP Total Burden  60   07-08   1672    1501.48    1842.52
## 08-091   RESP Total Burden  60   08-09   1466    1319.00    1613.00
## 09-101   RESP Total Burden  60   09-10  15674   14205.96   17142.04
## 10-111   RESP Total Burden  60   10-11   4357    3919.92    4794.08
## 11-121   RESP Total Burden  60   11-12   3850    3463.88    4236.12
## 12-131   RESP Total Burden  60   12-13   9832    8869.64   10794.36
## 13-141   RESP Total Burden  60   13-14   9214    8316.32   10111.68
## 05-062   RESP Total Burden  80   05-06    855     731.52     978.48
## 06-072   RESP Total Burden  80   06-07    389     332.16     445.84
## 07-082   RESP Total Burden  80   07-08   1254    1073.68    1434.32
## 08-092   RESP Total Burden  80   08-09   1110     949.28    1270.72
## 09-102   RESP Total Burden  80   09-10  12027   10425.68   13628.32
## 10-112   RESP Total Burden  80   10-11   3400    2915.88    3884.12
## 11-122   RESP Total Burden  80   11-12   2866    2456.36    3275.64
## 12-132   RESP Total Burden  80   12-13   7503    6454.40    8551.60
## 13-142   RESP Total Burden  80   13-14   7070    6093.92    8046.08
## 05-063   RESP Total Burden 120   05-06    758     630.60     885.40
## 06-073   RESP Total Burden 120   06-07    341     284.16     397.84
## 07-083   RESP Total Burden 120   07-08   1107     920.80    1293.20
## 08-093   RESP Total Burden 120   08-09    977     812.36    1141.64
## 09-103   RESP Total Burden 120   09-10  10596    8937.84   12254.16
## 10-113   RESP Total Burden 120   10-11   2962    2472.00    3452.00
## 11-123   RESP Total Burden 120   11-12   2527    2107.56    2946.44
## 12-133   RESP Total Burden 120   12-13   6662    5589.88    7734.12
## 13-143   RESP Total Burden 120   13-14   6186    5190.32    7181.68
```

```
## 05-064  RESP1 Total Burden  40   05-06   1432    1335.96    1528.04
## 06-074  RESP1 Total Burden  40   06-07    595     555.80     634.20
## 07-084  RESP1 Total Burden  40   07-08   1899    1773.56    2024.44
## 08-094  RESP1 Total Burden  40   08-09   1612    1504.20    1719.80
## 09-104  RESP1 Total Burden  40   09-10  16848   15826.84   17869.16
## 10-114  RESP1 Total Burden  40   10-11   4834    4520.40    5147.60
## 11-124  RESP1 Total Burden  40   11-12   3828    3575.16    4080.84
## 12-134  RESP1 Total Burden  40   12-13  10394    9739.36   11048.64
## 13-144  RESP1 Total Burden  40   13-14   9199    8597.28    9800.72
## 05-065  RESP1 Total Burden  60   05-06    879     775.12     982.88
## 06-075  RESP1 Total Burden  60   06-07    369     325.88     412.12
## 07-085  RESP1 Total Burden  60   07-08   1208    1064.92    1351.08
## 08-095  RESP1 Total Burden  60   08-09   1040     918.48    1161.52
## 09-105  RESP1 Total Burden  60   09-10  11373   10153.88   12592.12
## 10-115  RESP1 Total Burden  60   10-11   3059    2704.24    3413.76
## 11-125  RESP1 Total Burden  60   11-12   2470    2183.84    2756.16
## 12-135  RESP1 Total Burden  60   12-13   6667    5916.32    7417.68
## 13-145  RESP1 Total Burden  60   13-14   6014    5339.76    6688.24
## 05-066  RESP1 Total Burden  80   05-06    675     565.24     784.76
## 06-076  RESP1 Total Burden  80   06-07    286     238.96     333.04
## 07-086  RESP1 Total Burden  80   07-08    930     781.04    1078.96
## 08-096  RESP1 Total Burden  80   08-09    810     678.68     941.32
## 09-106  RESP1 Total Burden  80   09-10   8905    7589.84   10220.16
## 10-116  RESP1 Total Burden  80   10-11   2465    2073.00    2857.00
## 11-126  RESP1 Total Burden  80   11-12   1879    1579.12    2178.88
## 12-136  RESP1 Total Burden  80   12-13   5226    4412.60    6039.40
## 13-146  RESP1 Total Burden  80   13-14   4761    4029.92    5492.08
## 05-067  RESP1 Total Burden 120   05-06    598     486.28     709.72
## 06-077  RESP1 Total Burden 120   06-07    250     202.96     297.04
## 07-087  RESP1 Total Burden 120   07-08    819     666.12     971.88
## 08-097  RESP1 Total Burden 120   08-09    713     579.72     846.28
## 09-107  RESP1 Total Burden 120   09-10   7836    6479.68    9192.32
## 10-117  RESP1 Total Burden 120   10-11   2143    1747.08    2538.92
## 11-127  RESP1 Total Burden 120   11-12   1660    1352.28    1967.72
## 12-137  RESP1 Total Burden 120   12-13   4641    3813.88    5468.12
## 13-147  RESP1 Total Burden 120   13-14   4161    3418.16    4903.84
```

Ages 50-64

```
##                    Outcome  DF Seasons Burden LowerLimit UpperLimit
## 05-06    RESP Total Burden  40   05-06    162     148.28     175.72
## 06-07    RESP Total Burden  40   06-07     88      80.16      95.84
## 07-08    RESP Total Burden  40   07-08    340     312.56     367.44
## 08-09    RESP Total Burden  40   08-09    219     201.36     236.64
## 09-10    RESP Total Burden  40   09-10   2407    2216.88    2597.12
## 10-11    RESP Total Burden  40   10-11    807     742.32     871.68
## 11-12    RESP Total Burden  40   11-12    743     682.24     803.76
## 12-13    RESP Total Burden  40   12-13   2615    2409.20    2820.80
## 13-14    RESP Total Burden  40   13-14   3872    3560.36    4183.64
```

```
## 05-061   RESP Total Burden  60   05-06    104      88.32     119.68
## 06-071   RESP Total Burden  60   06-07     56      48.16      63.84
## 07-081   RESP Total Burden  60   07-08    222     190.64     253.36
## 08-091   RESP Total Burden  60   08-09    141     121.40     160.60
## 09-101   RESP Total Burden  60   09-10   1560    1340.48    1779.52
## 10-111   RESP Total Burden  60   10-11    525     450.52     599.48
## 11-121   RESP Total Burden  60   11-12    481     412.40     549.60
## 12-131   RESP Total Burden  60   12-13   1707    1465.92    1948.08
## 13-141   RESP Total Burden  60   13-14   2615    2252.40    2977.60
## 05-062   RESP Total Burden  80   05-06     66      50.32      81.68
## 06-072   RESP Total Burden  80   06-07     35      25.20      44.80
## 07-082   RESP Total Burden  80   07-08    139     103.72     174.28
## 08-092   RESP Total Burden  80   08-09     89      67.44     110.56
## 09-102   RESP Total Burden  80   09-10    996     749.04    1242.96
## 10-112   RESP Total Burden  80   10-11    336     251.72     420.28
## 11-122   RESP Total Burden  80   11-12    302     225.56     378.44
## 12-132   RESP Total Burden  80   12-13   1083     812.52    1353.48
## 13-142   RESP Total Burden  80   13-14   1709    1289.56    2128.44
## 05-063   RESP Total Burden 120   05-06     59      41.36      76.64
## 06-073   RESP Total Burden 120   06-07     31      21.20      40.80
## 07-083   RESP Total Burden 120   07-08    125      85.80     164.20
## 08-093   RESP Total Burden 120   08-09     79      55.48     102.52
## 09-103   RESP Total Burden 120   09-10    882     613.48    1150.52
## 10-113   RESP Total Burden 120   10-11    299     206.88     391.12
## 11-123   RESP Total Burden 120   11-12    270     187.68     352.32
## 12-133   RESP Total Burden 120   12-13    968     675.96    1260.04
## 13-143   RESP Total Burden 120   13-14   1532    1073.36    1990.64
## 05-064  RESP1 Total Burden  40   05-06    145     133.24     156.76
## 06-074  RESP1 Total Burden  40   06-07     65      59.12      70.88
## 07-084  RESP1 Total Burden  40   07-08    271     249.44     292.56
## 08-094  RESP1 Total Burden  40   08-09    154     142.24     165.76
## 09-104  RESP1 Total Burden  40   09-10   1750    1620.64    1879.36
## 10-114  RESP1 Total Burden  40   10-11    605     557.96     652.04
## 11-124  RESP1 Total Burden  40   11-12    496     456.80     535.20
## 12-134  RESP1 Total Burden  40   12-13   1907    1765.88    2048.12
## 13-144  RESP1 Total Burden  40   13-14   2752    2544.24    2959.76
## 05-065  RESP1 Total Burden  60   05-06     89      77.24     100.76
## 06-075  RESP1 Total Burden  60   06-07     39      33.12      44.88
## 07-085  RESP1 Total Burden  60   07-08    170     146.48     193.52
## 08-095  RESP1 Total Burden  60   08-09     95      81.28     108.72
## 09-105  RESP1 Total Burden  60   09-10   1097     950.00    1244.00
## 10-115  RESP1 Total Burden  60   10-11    376     323.08     428.92
## 11-125  RESP1 Total Burden  60   11-12    307     263.88     350.12
## 12-135  RESP1 Total Burden  60   12-13   1206    1043.32    1368.68
## 13-145  RESP1 Total Burden  60   13-14   1850    1606.96    2093.04
## 05-066  RESP1 Total Burden  80   05-06     56      42.28      69.72
## 06-076  RESP1 Total Burden  80   06-07     25      19.12      30.88
## 07-086  RESP1 Total Burden  80   07-08    107      81.52     132.48
## 08-096  RESP1 Total Burden  80   08-09     60      46.28      73.72
## 09-106  RESP1 Total Burden  80   09-10    709     544.36     873.64
```

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## 10-116  RESP1 Total Burden  80   10-11    244      185.20      302.80
## 11-126  RESP1 Total Burden  80   11-12    194      146.96      241.04
## 12-136  RESP1 Total Burden  80   12-13    771      590.68      951.32
## 13-146  RESP1 Total Burden  80   13-14   1245      962.76     1527.24
## 05-067  RESP1 Total Burden 120   05-06     54       38.32       69.68
## 06-077  RESP1 Total Burden 120   06-07     23       17.12       28.88
## 07-087  RESP1 Total Burden 120   07-08    100       72.56      127.44
## 08-097  RESP1 Total Burden 120   08-09     55       39.32       70.68
## 09-107  RESP1 Total Burden 120   09-10    648      473.56      822.44
## 10-117  RESP1 Total Burden 120   10-11    225      162.28      287.72
## 11-127  RESP1 Total Burden 120   11-12    180      131.00      229.00
## 12-137  RESP1 Total Burden 120   12-13    712      519.92      904.08
## 13-147  RESP1 Total Burden 120   13-14   1156      852.20     1459.80
```

Ages >= 65

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##                    Outcome  DF Seasons Burden LowerLimit UpperLimit
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## 06-07    RESP Total Burden  40   06-07     99      89.20     108.80
## 07-08    RESP Total Burden  40   07-08    587     526.24     647.76
## 08-09    RESP Total Burden  40   08-09    169     151.36     186.64
## 09-10    RESP Total Burden  40   09-10   1007     903.12    1110.88
## 10-11    RESP Total Burden  40   10-11   1024     918.16    1129.84
## 11-12    RESP Total Burden  40   11-12   1227    1101.56    1352.44
## 12-13    RESP Total Burden  40   12-13   6774    6105.64    7442.36
## 13-14    RESP Total Burden  40   13-14   2901    2605.04    3196.96
## 05-061   RESP Total Burden  60   05-06    323     266.16     379.84
## 06-071   RESP Total Burden  60   06-07     61      51.20      70.80
## 07-081   RESP Total Burden  60   07-08    362     297.32     426.68
## 08-091   RESP Total Burden  60   08-09    103      85.36     120.64
## 09-101   RESP Total Burden  60   09-10    618     508.24     727.76
## 10-111   RESP Total Burden  60   10-11    634     522.28     745.72
## 11-121   RESP Total Burden  60   11-12    760     626.72     893.28
## 12-131   RESP Total Burden  60   12-13   4276    3542.96    5009.04
## 13-141   RESP Total Burden  60   13-14   1838    1516.56    2159.44
## 05-062   RESP Total Burden  80   05-06    290     231.20     348.80
## 06-072   RESP Total Burden  80   06-07     54      42.24      65.76
## 07-082   RESP Total Burden  80   07-08    324     257.36     390.64
## 08-092   RESP Total Burden  80   08-09     92      72.40     111.60
## 09-102   RESP Total Burden  80   09-10    551     439.28     662.72
## 10-112   RESP Total Burden  80   10-11    567     451.36     682.64
## 11-122   RESP Total Burden  80   11-12    677     537.84     816.16
## 12-132   RESP Total Burden  80   12-13   3811    3054.44    4567.56
## 13-142   RESP Total Burden  80   13-14   1659    1323.84    1994.16
## 05-063   RESP Total Burden 120   05-06    271     186.72     355.28
## 06-073   RESP Total Burden 120   06-07     50      34.32      65.68
## 07-083   RESP Total Burden 120   07-08    302     209.88     394.12
## 08-093   RESP Total Burden 120   08-09     85      59.52     110.48
## 09-103   RESP Total Burden 120   09-10    511     354.20     667.80
```

```
## 10-113   RESP Total Burden 120   10-11    528     365.32     690.68
## 11-123   RESP Total Burden 120   11-12    633     438.96     827.04
## 12-133   RESP Total Burden 120   12-13   3553    2506.36    4599.64
## 13-143   RESP Total Burden 120   13-14   1536    1069.52    2002.48
## 05-064  RESP1 Total Burden  40   05-06    398     354.88     441.12
## 06-074  RESP1 Total Burden  40   06-07     59      53.12      64.88
## 07-084  RESP1 Total Burden  40   07-08    372     332.80     411.20
## 08-094  RESP1 Total Burden  40   08-09     92      82.20     101.80
## 09-104  RESP1 Total Burden  40   09-10    524     469.12     578.88
## 10-114  RESP1 Total Burden  40   10-11    567     506.24     627.76
## 11-124  RESP1 Total Burden  40   11-12    636     569.36     702.64
## 12-134  RESP1 Total Burden  40   12-13   4011    3619.00    4403.00
## 13-144  RESP1 Total Burden  40   13-14   1456    1303.12    1608.88
## 05-065  RESP1 Total Burden  60   05-06    224     178.92     269.08
## 06-075  RESP1 Total Burden  60   06-07     32      26.12      37.88
## 07-085  RESP1 Total Burden  60   07-08    206     164.84     247.16
## 08-095  RESP1 Total Burden  60   08-09     50      40.20      59.80
## 09-105  RESP1 Total Burden  60   09-10    290     233.16     346.84
## 10-115  RESP1 Total Burden  60   10-11    314     251.28     376.72
## 11-125  RESP1 Total Burden  60   11-12    358     287.44     428.56
## 12-135  RESP1 Total Burden  60   12-13   2335    1895.96    2774.04
## 13-145  RESP1 Total Burden  60   13-14    867     698.44    1035.56
## 05-066  RESP1 Total Burden  80   05-06    188     142.92     233.08
## 06-076  RESP1 Total Burden  80   06-07     27      21.12      32.88
## 07-086  RESP1 Total Burden  80   07-08    172     130.84     213.16
## 08-096  RESP1 Total Burden  80   08-09     41      31.20      50.80
## 09-106  RESP1 Total Burden  80   09-10    242     183.20     300.80
## 10-116  RESP1 Total Burden  80   10-11    263     200.28     325.72
## 11-126  RESP1 Total Burden  80   11-12    298     225.48     370.52
## 12-136  RESP1 Total Burden  80   12-13   1955    1504.20    2405.80
## 13-146  RESP1 Total Burden  80   13-14    739     564.56     913.44
## 05-067  RESP1 Total Burden 120   05-06    199     134.32     263.68
## 06-077  RESP1 Total Burden 120   06-07     28      18.20      37.80
## 07-087  RESP1 Total Burden 120   07-08    179     122.16     235.84
## 08-097  RESP1 Total Burden 120   08-09     43      29.28      56.72
## 09-107  RESP1 Total Burden 120   09-10    250     169.64     330.36
## 10-117  RESP1 Total Burden 120   10-11    275     186.80     363.20
## 11-127  RESP1 Total Burden 120   11-12    313     213.04     412.96
## 12-137  RESP1 Total Burden 120   12-13   2015    1411.32    2618.68
## 13-147  RESP1 Total Burden 120   13-14    762     522.88    1001.12
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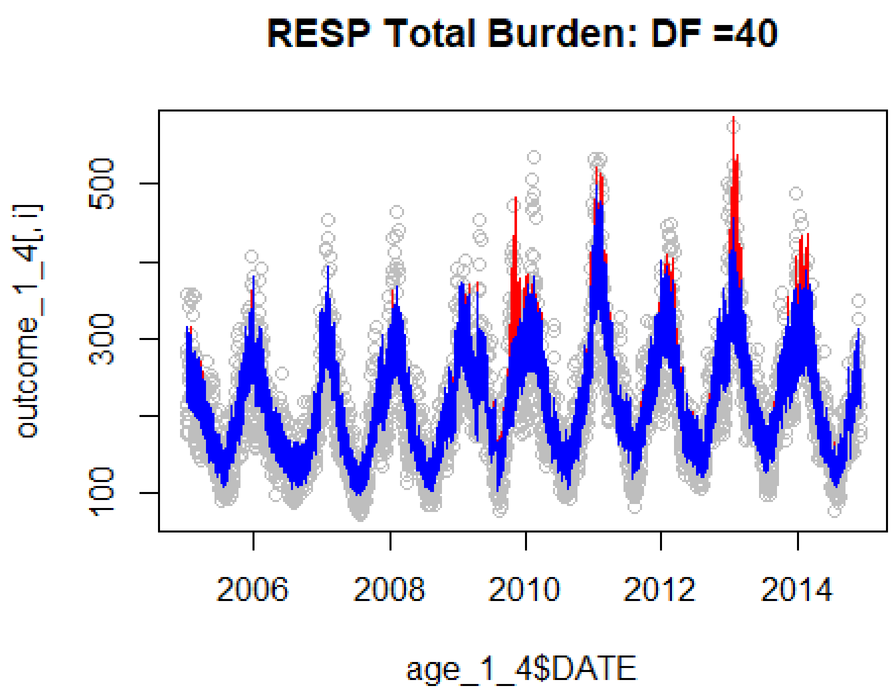
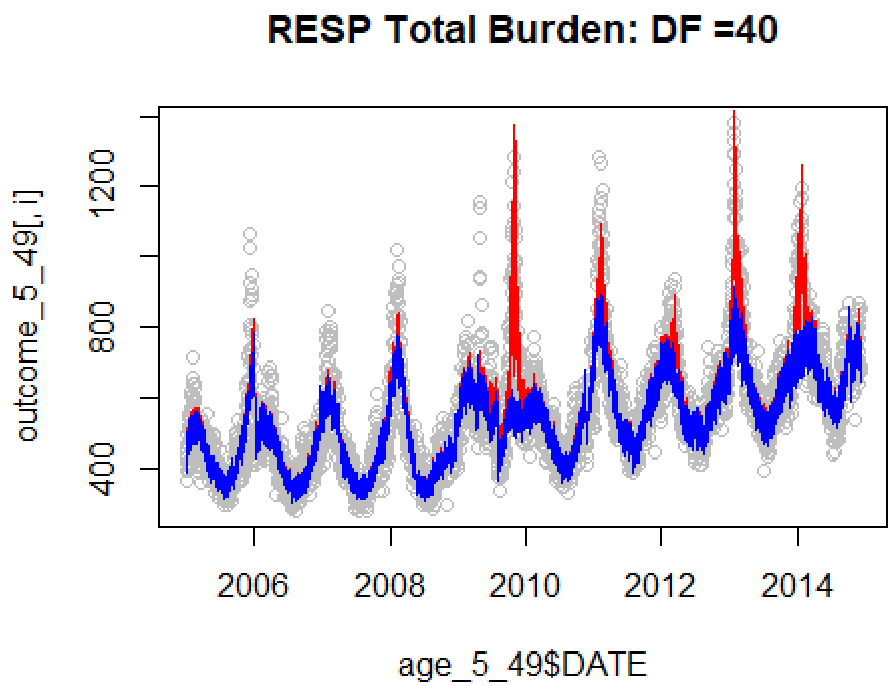
Los Angeles County Spline Time Series (Age Stratified)

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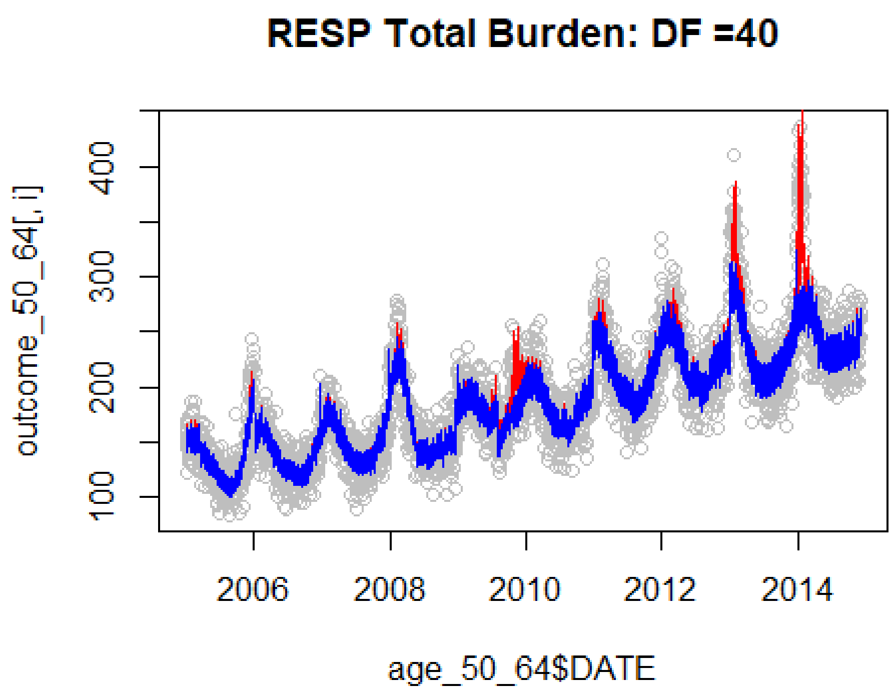
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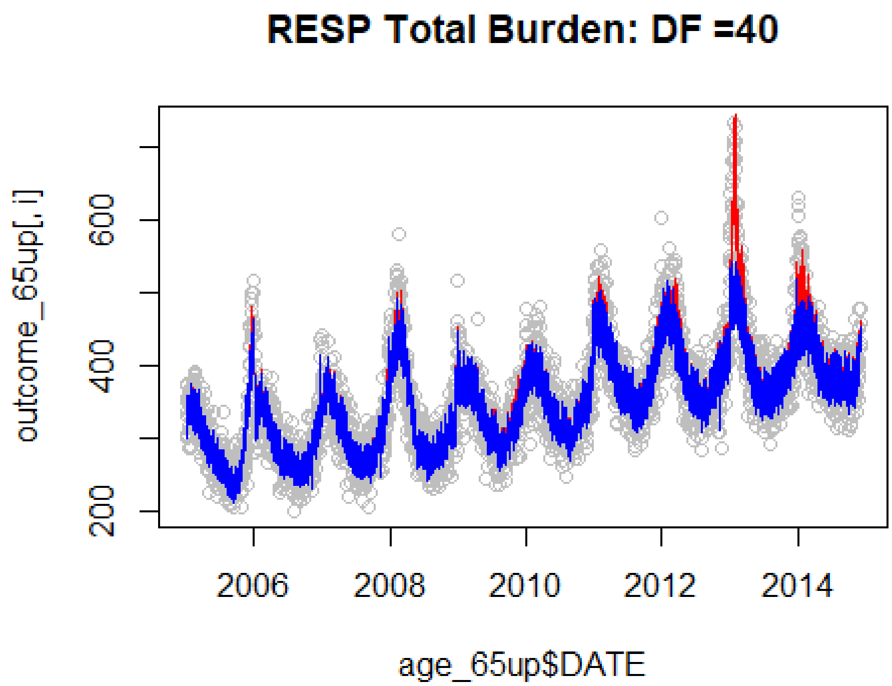
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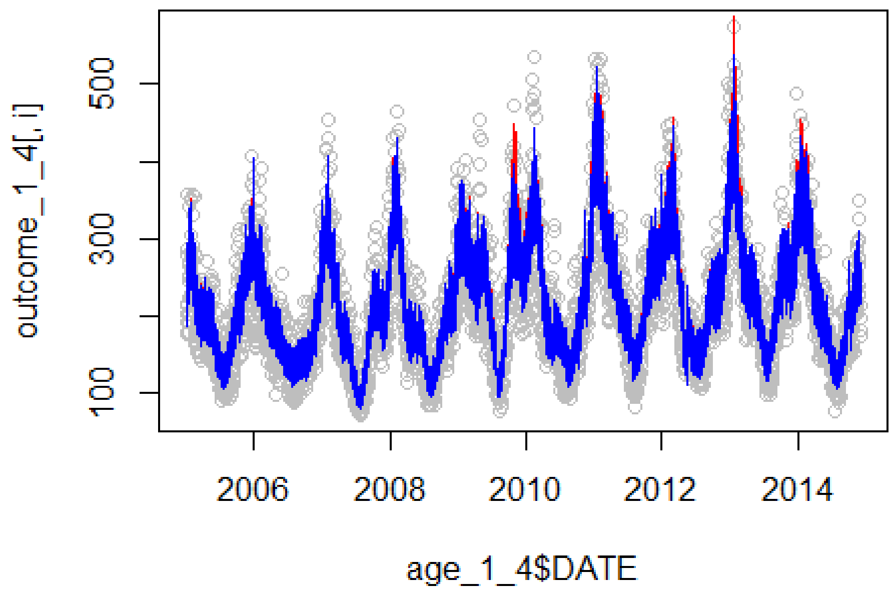

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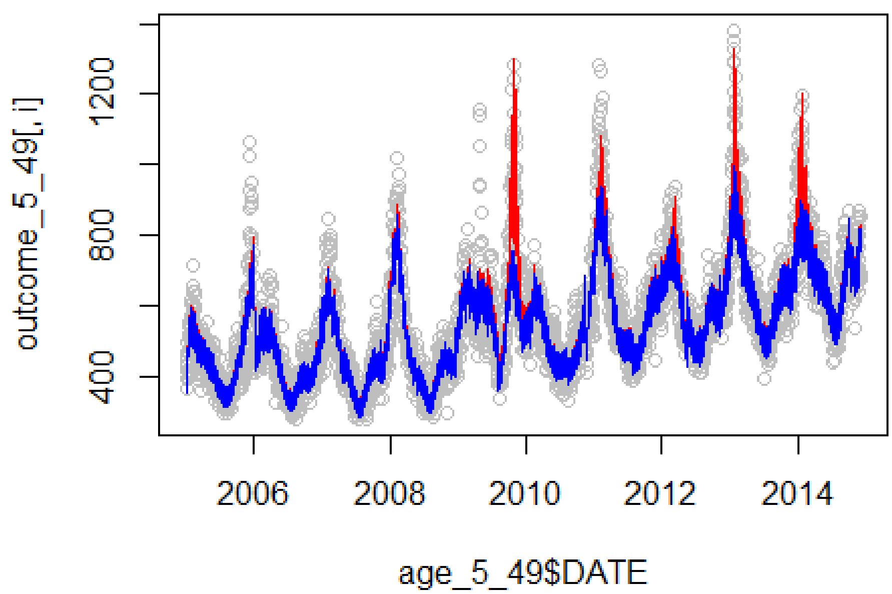

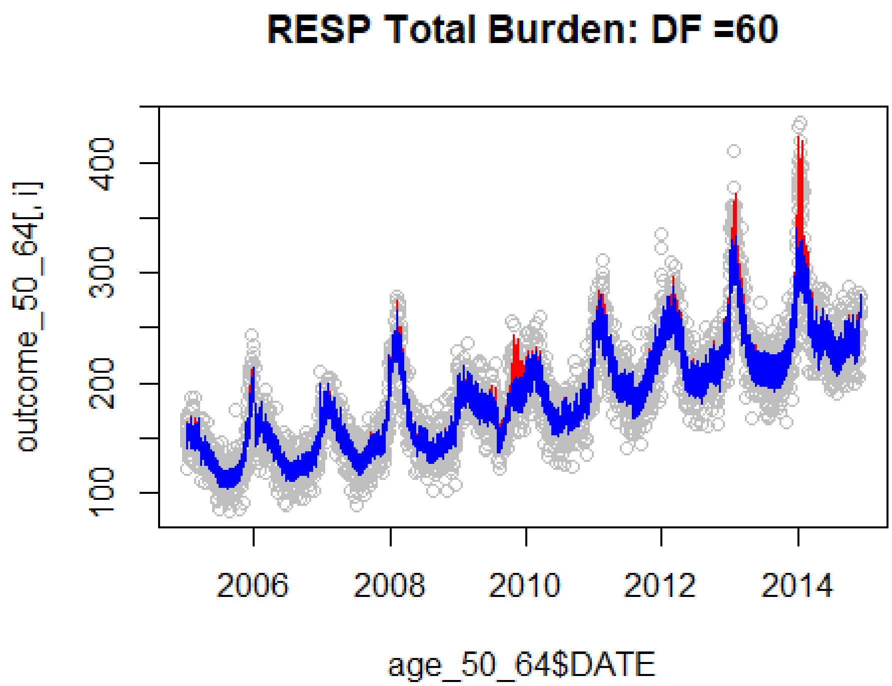
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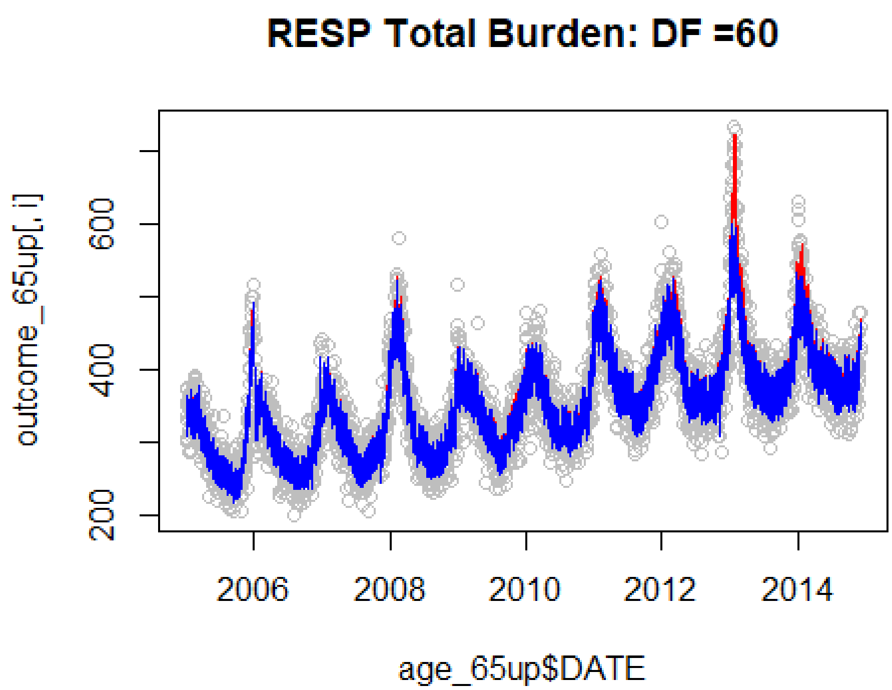
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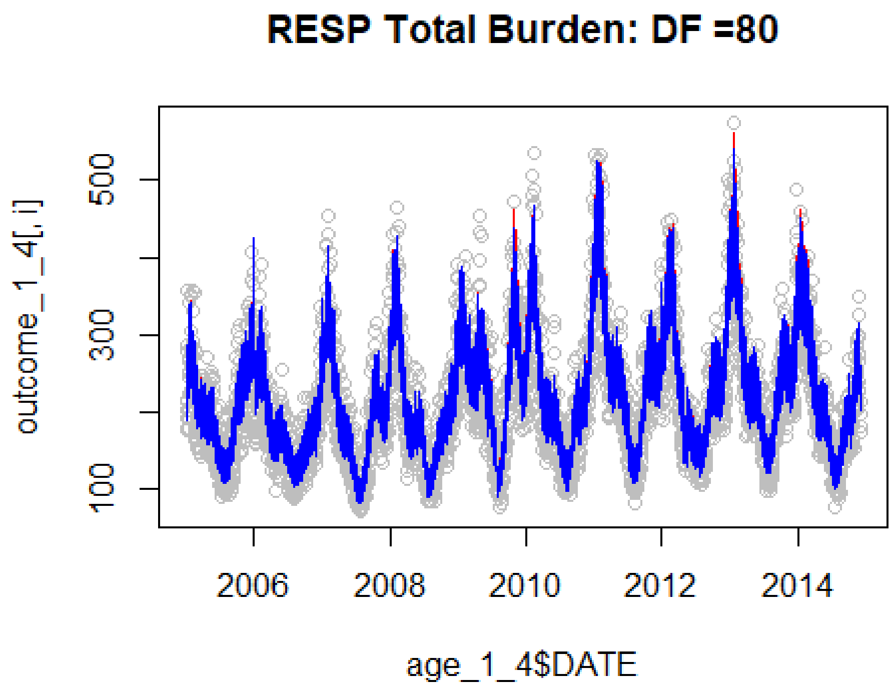
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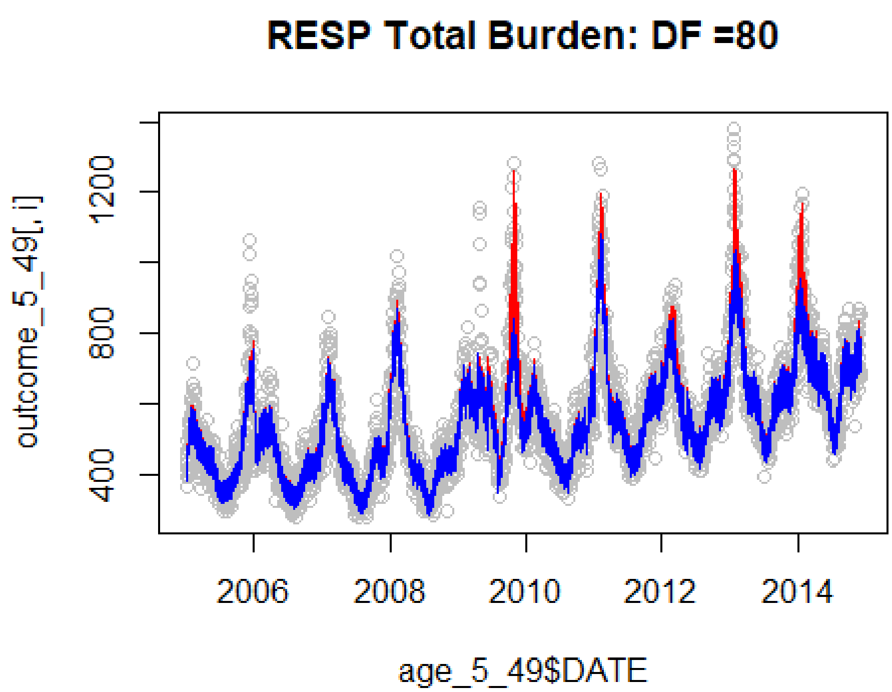
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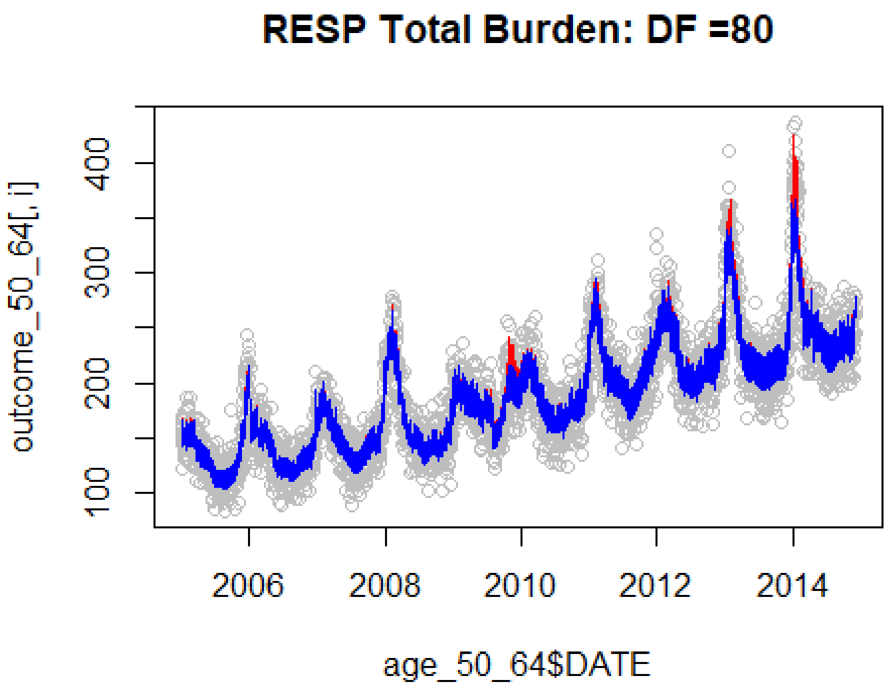
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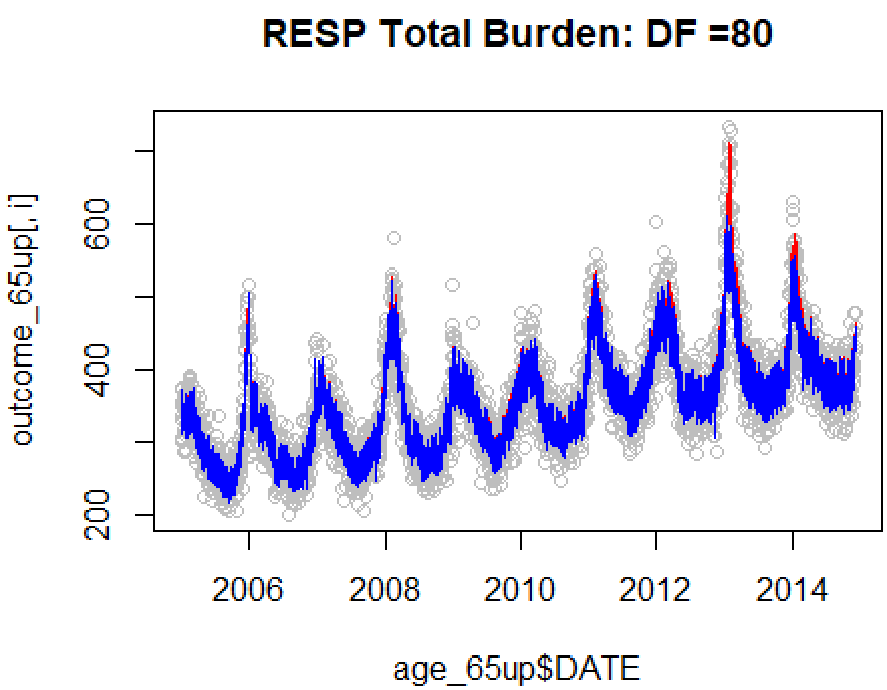
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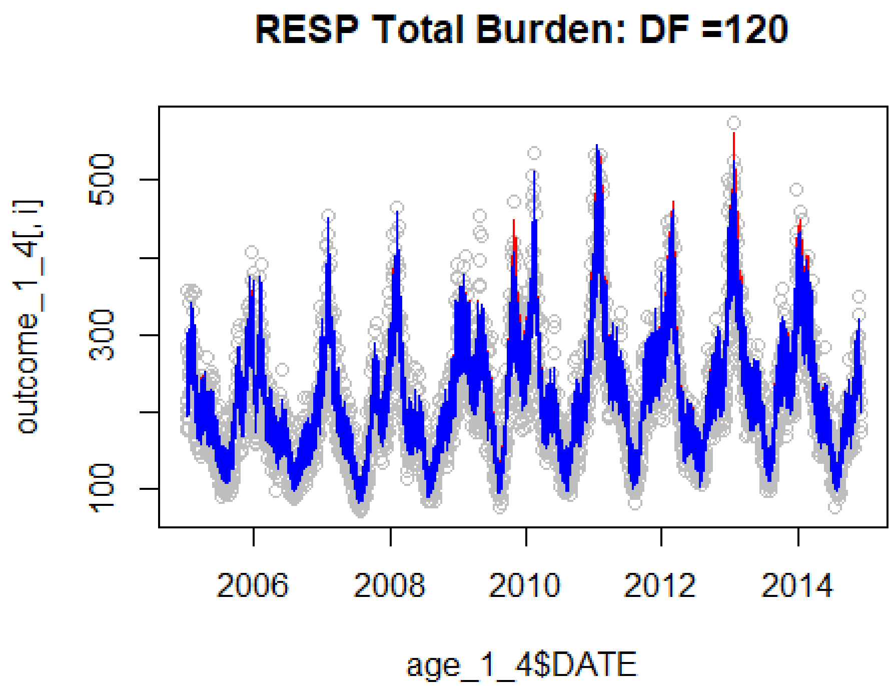
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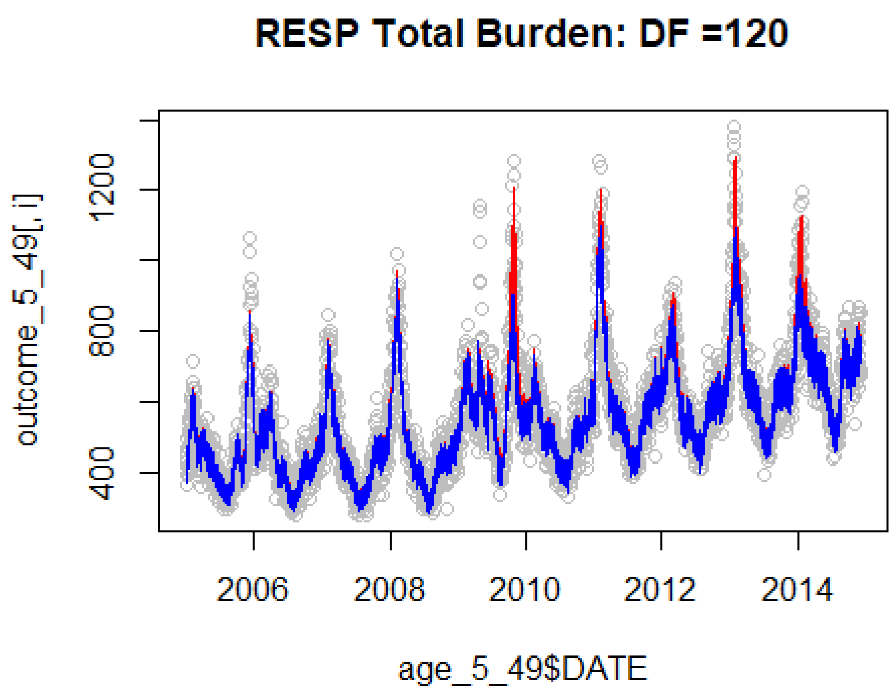
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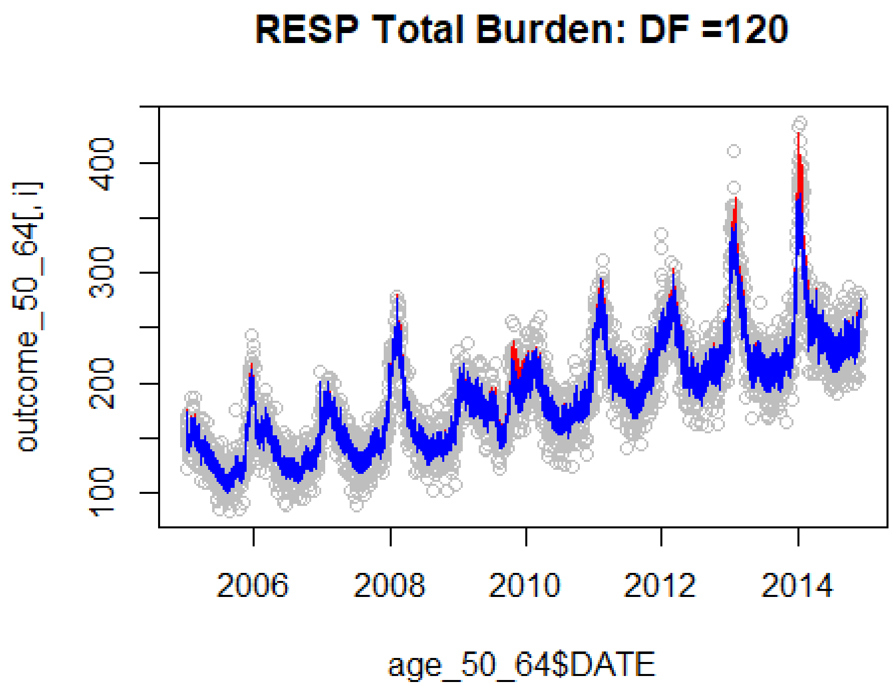
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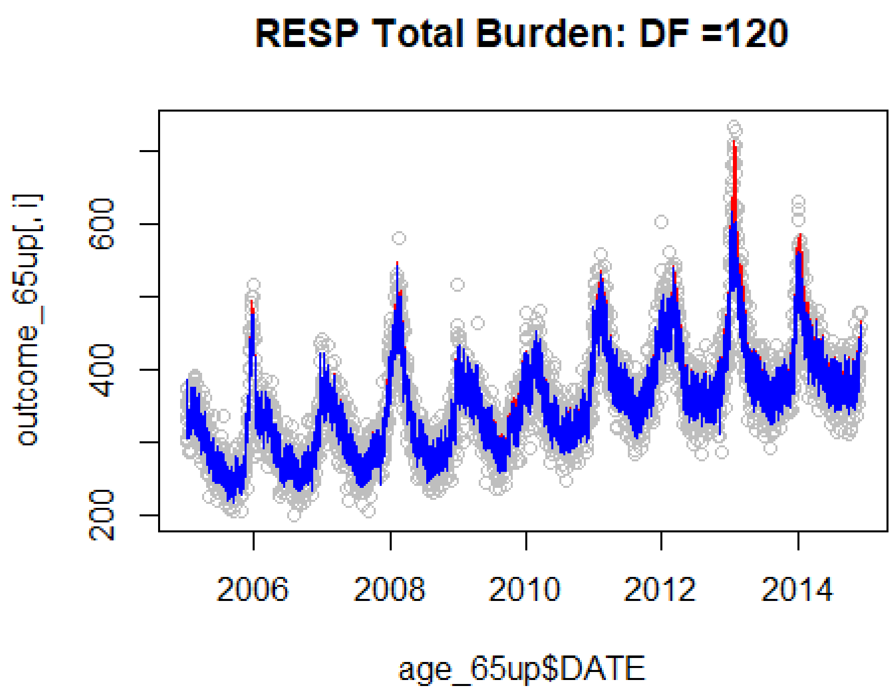
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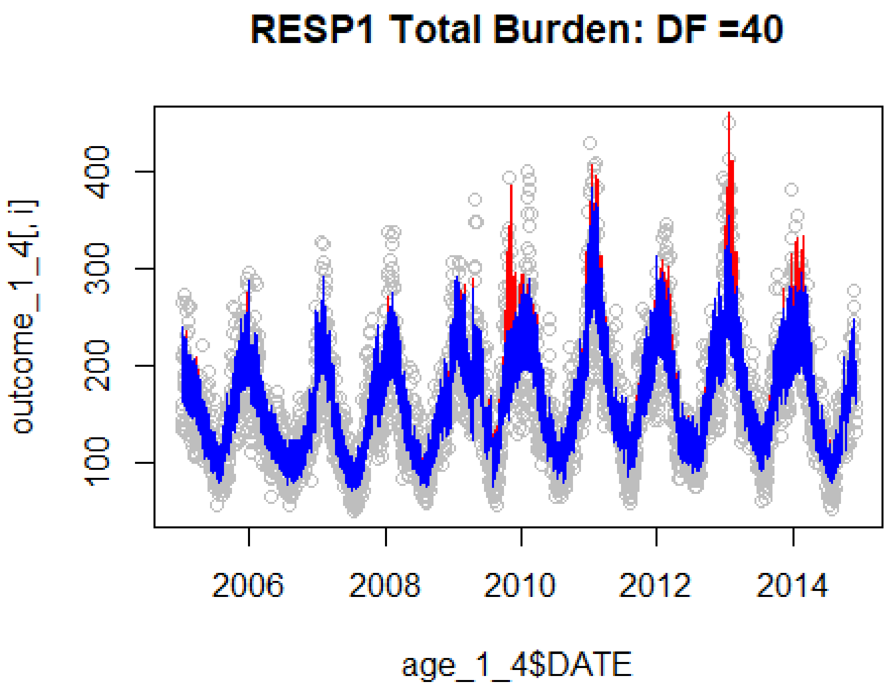
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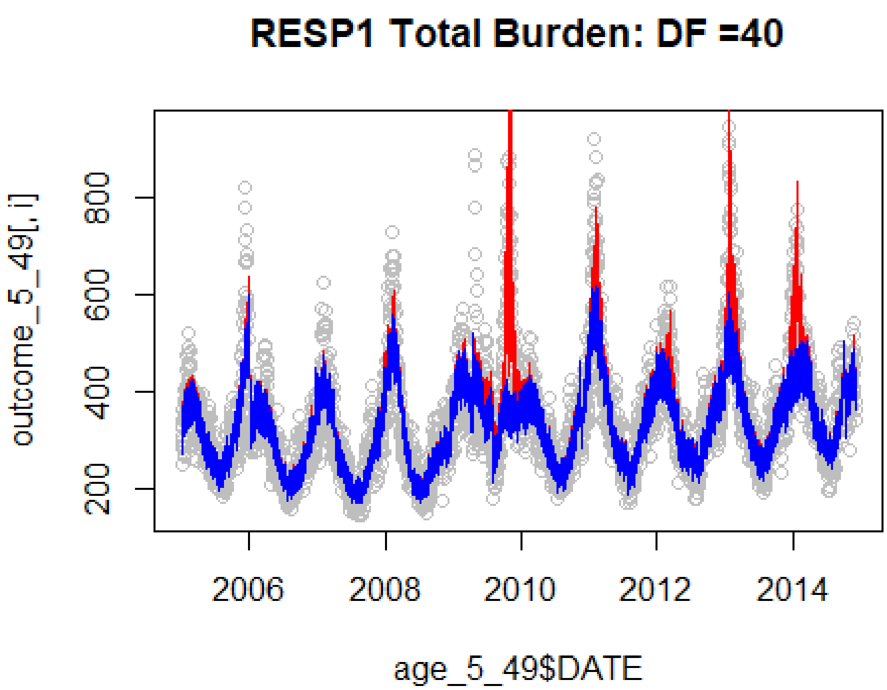
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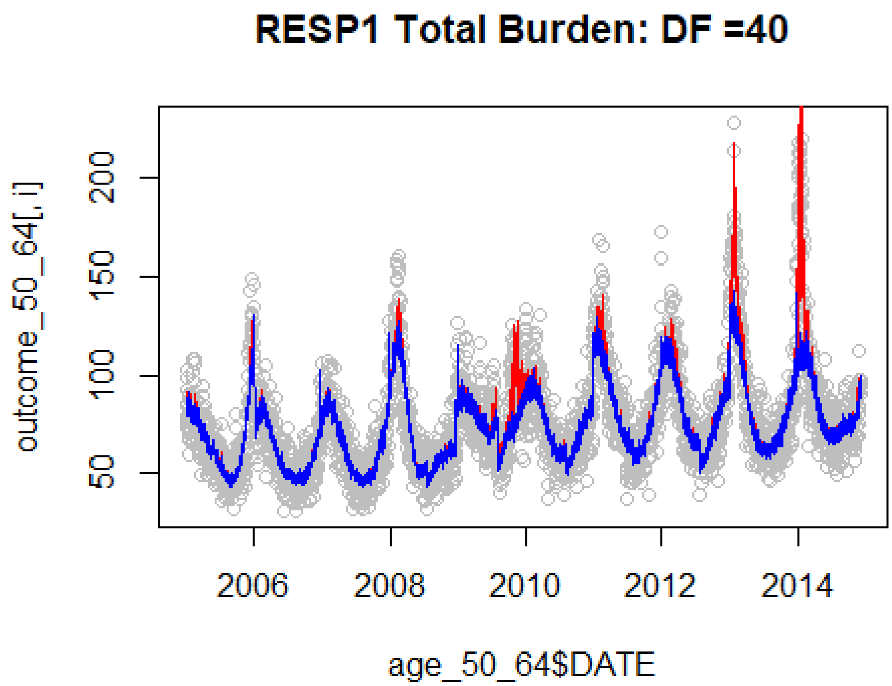
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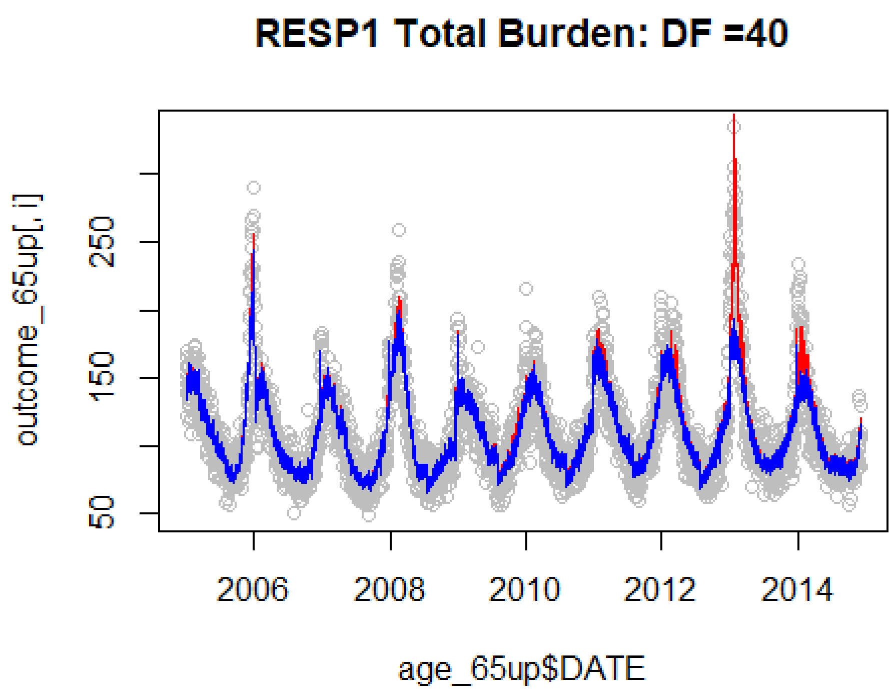
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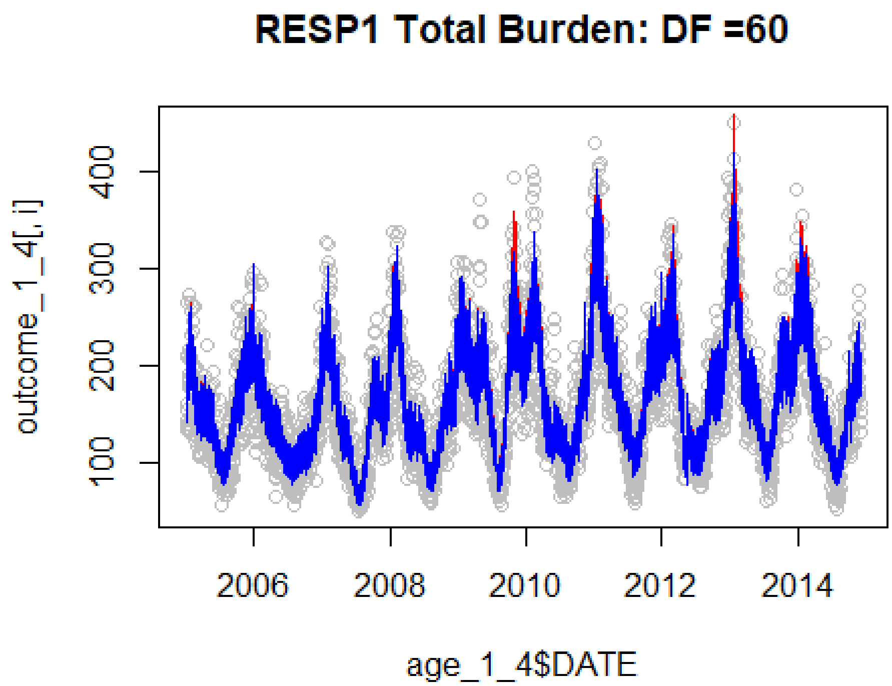
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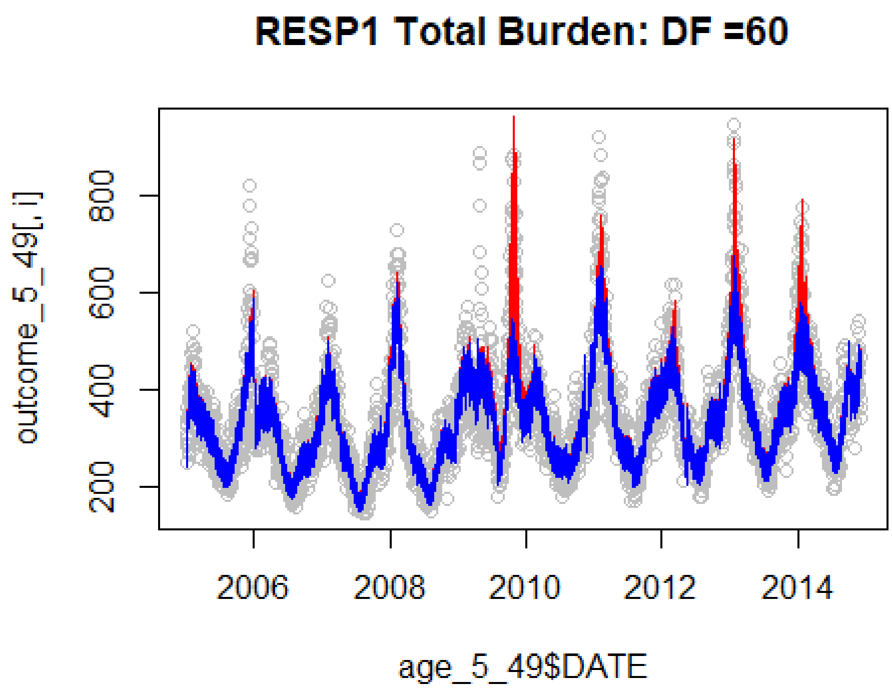
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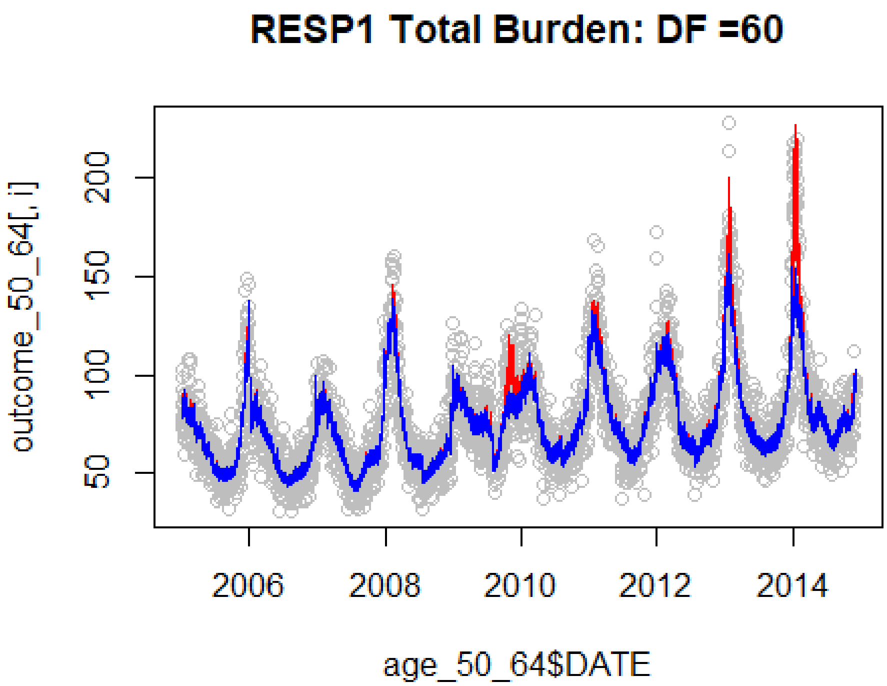
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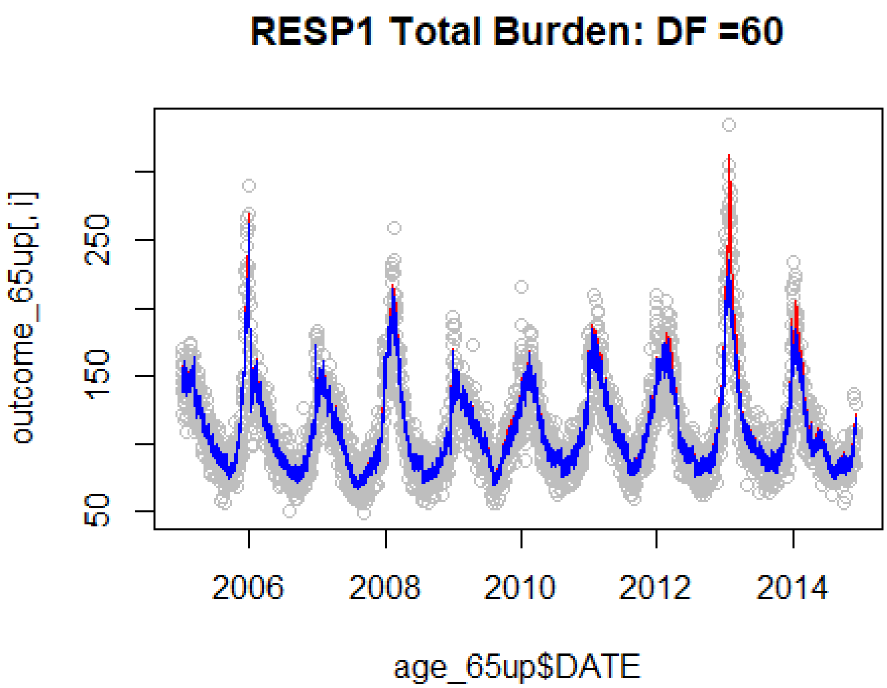
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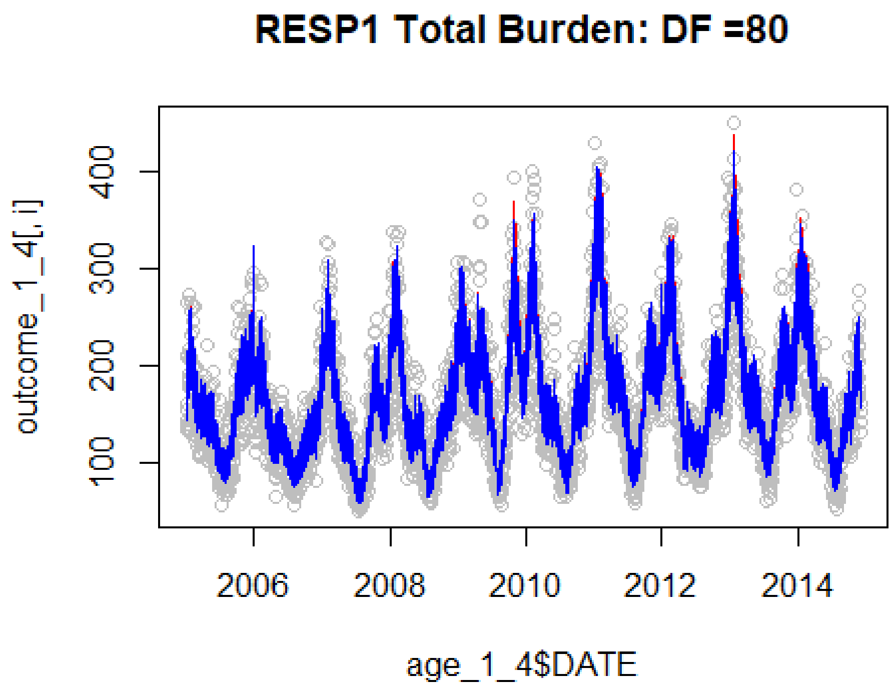
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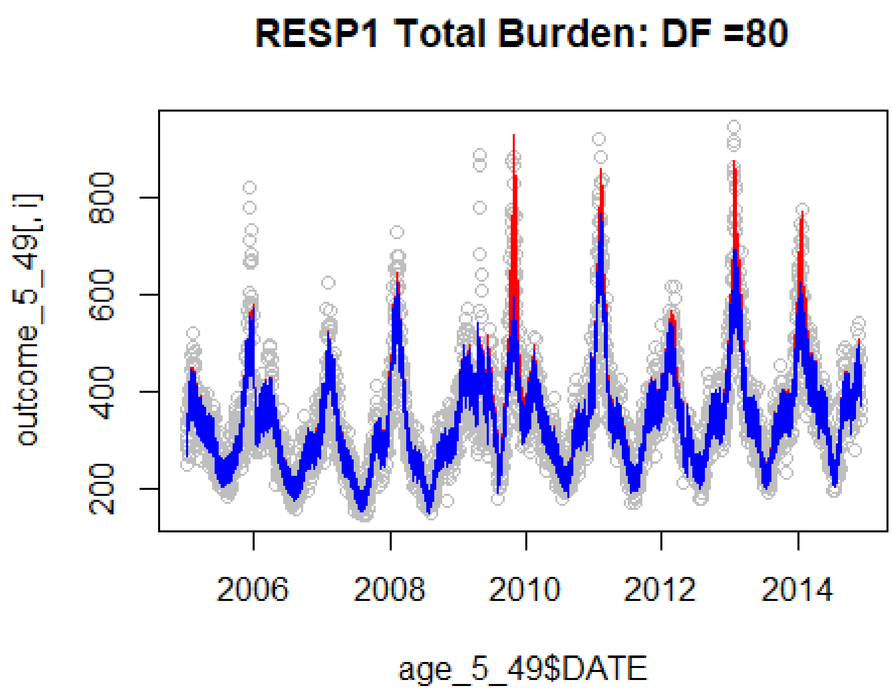
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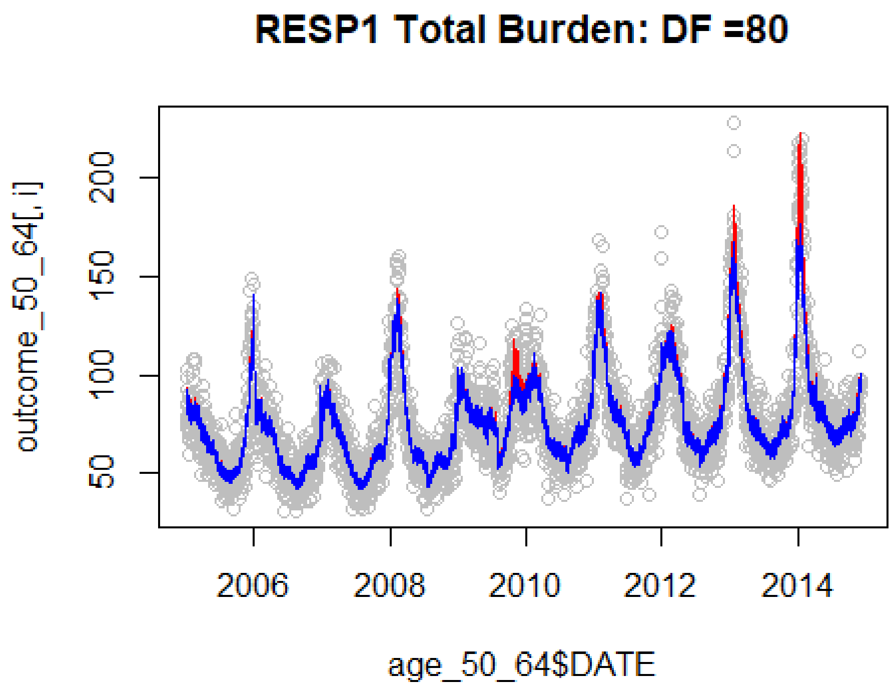
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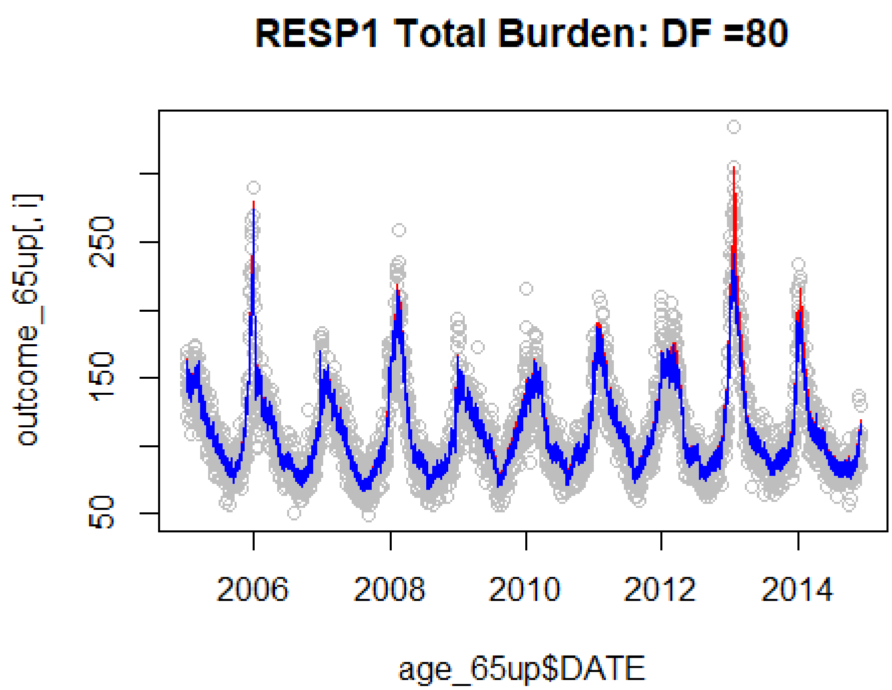
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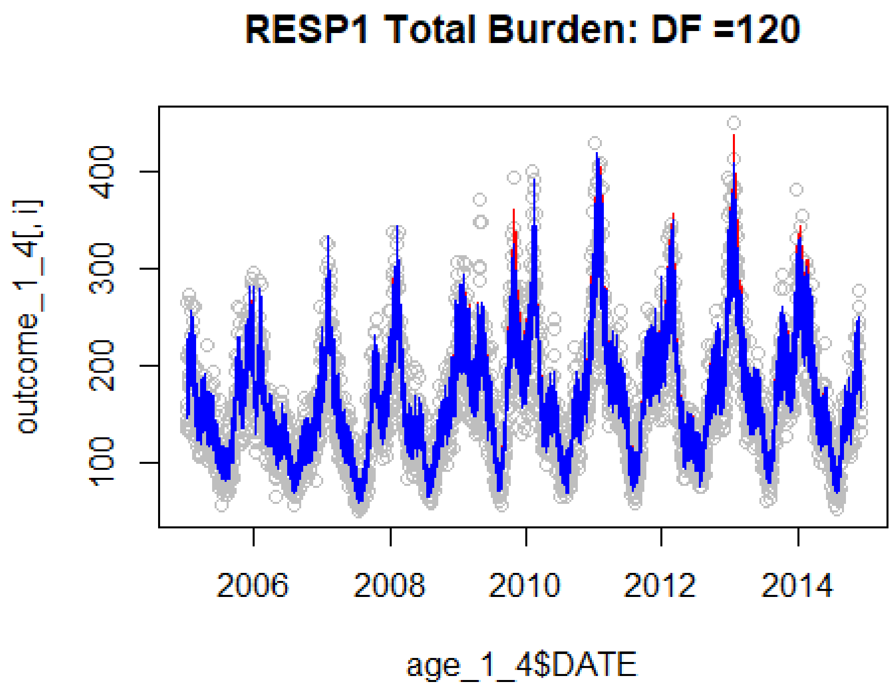
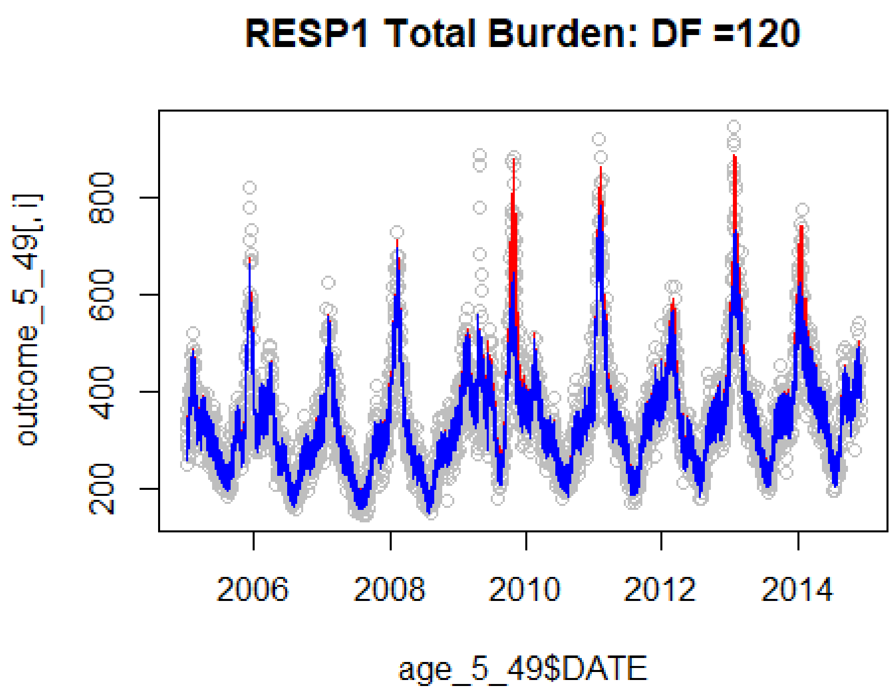
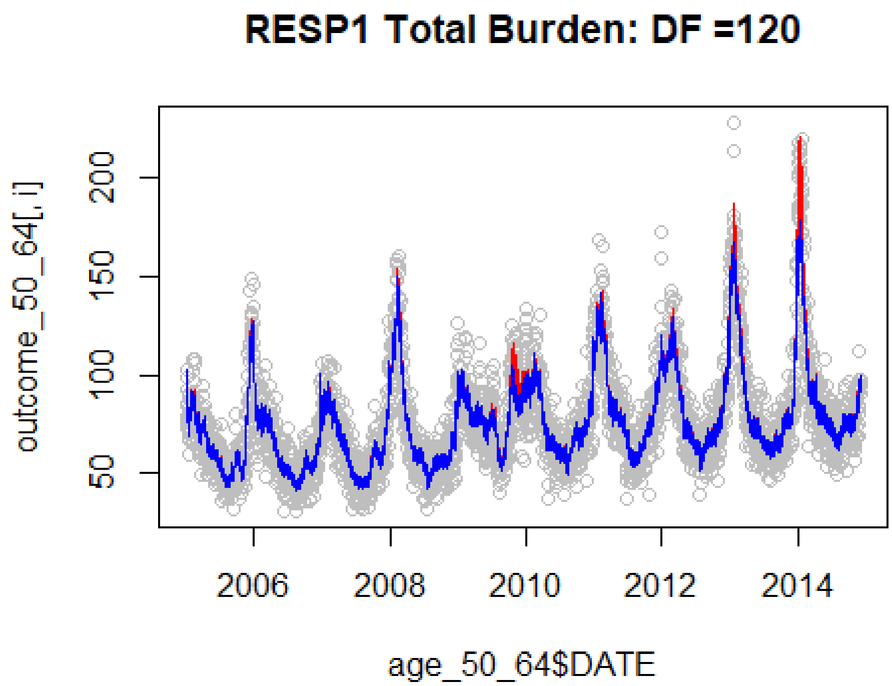
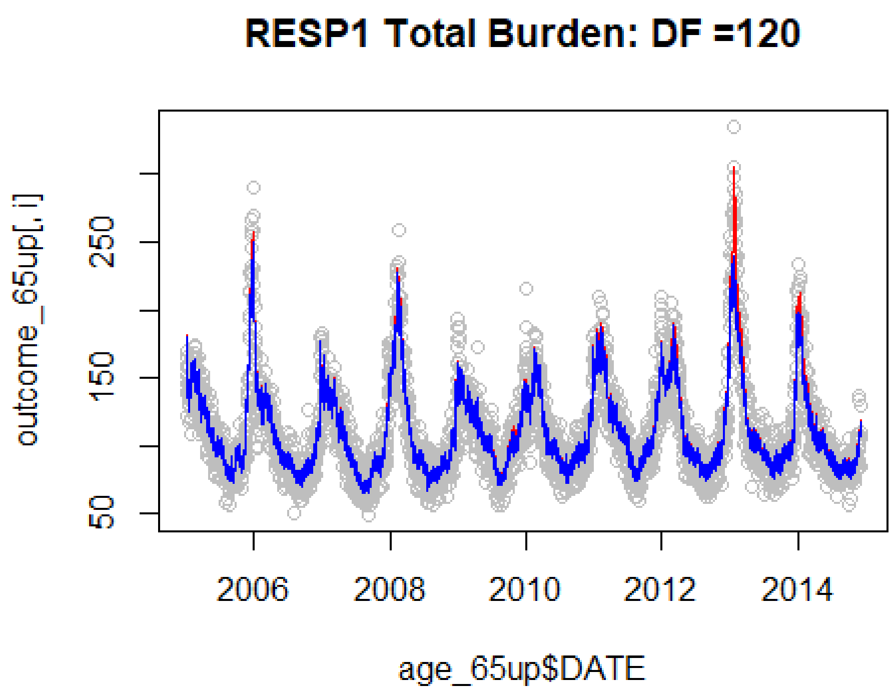
outcome_65up[, i]
50
150
250
2006
2008
2010
2012
2014
age_65up$DATE


RESP1 Total Burden: DF =120
outcome_1_4[, i]
100
200
300
400
2006
2008
2010
2012
2014
age_1_4$DATE


RESP1 Total Burden: DF =120
outcome_5_49[, i]
200
400
600
800
2006
2008
2010
2012
2014
age_5_49$DATE


RESP1 Total Burden: DF =120
outcome_50_64[, i]
50
100
150
200
2006
2008
2010
2012
2014
age_50_64$DATE


RESP1 Total Burden: DF =120
outcome_65up[, i]
50
150
250
2006
2008
2010
2012
2014
age_65up$DATE