

Appendix 3 (Fall 2016 Update)

Comprehensive Analysis of BPD Arrest Data

Stephen L. Morgan
Johns Hopkins University

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1 Introduction

For this updated analysis of BPD's arrest data, I offer comprehensive results that extend the results summarized in the report:

- Morgan, Stephen L. and Joel A. Pally. 2016. "Ferguson, Gray, and Davis: An Analysis of Recorded Crime Incidents and Arrests in Baltimore City, March 2010 through December 2015." A Report Prepared for the 21st Century Cities Initiative at Johns Hopkins University. Baltimore, MD: Johns Hopkins University, March 15, 2016. (URL: <http://socweb.soc.jhu.edu/faculty/morgan/reports.html>)

The results in the original report were based on arrest data through the end of 2015. In this Fall 2016 Update to Appendix 2, I offer models that incorporate data through Sunday, October 30th, 2016.

The basic analysis strategy is the same as in the original report. I first model the prevailing cyclical arrest trend from Monday, January 7, 2013 through Sunday, August 10, 2014. Then, I use that estimated model to predict a counterfactual arrest trend, as if the protest events and any changes in police practice from August 11, 2014 onward had not occurred. I then estimate period effects as average differences between observed and counterfactual values from August 11, 2014 onward in distinct time intervals.

Unlike the original report, with the availability of additional data it is reasonable to now divide the interval after Police Commissioner Anthony Batts was fired into (1) a transition period while Kevin Davis was the Interim Police Commissioner and (2) a final period after Kevin Davis was sworn in as Batts' permanent replacement and with a five-year contract as the city's 38th Police Commissioner. For the analysis reported here, the transition period begins with the week of Monday, July 13, 2015 and ends on Sunday, October 18, 2015. The period for Davis as commissioner encompasses the first full year of his term, from the week of Monday, October 19, 2015 (10/19/15 to 10/25/15) through the week of Monday, October 24, 2016 (10/24/16 to 10/30/16).

In addition, for this updated Appendix 3, I do not offer results for arrests that separate those arrests by type of arrest. The primary reason is that the BPD changed its categorization for the reporting of arrests at the end of July, 2016. Although it will be possible to develop a revised method for sorting arrests into categories similar to the categories used for the original report (since most of the changes appear to be different choices on the capitalization of words), for this updated appendix I have not revised the underlying code for two reasons. First, changes to the hierarchical categorization algorithm based on keyword recognition (see the description in Appendix 1 of the original report) might also change how arrests are categorized before July, 2016. These changes could result in a mismatch with the results already reported, necessitating a reconciliation effort. Second, an analysis of the results up through Sunday, July

24, 2016 (the Sunday of the last full week with the older categories) suggested that the first seven months of 2016 were "more of the same" that is already documented in the original report and in the results for the total arrest count offered in this updated Appendix 3. My conclusion, therefore, is that most of the important findings on arrests are already captured in the original report, and that the results on total arrests in this updated Appendix 3 are sufficient for now.

Descriptive Summary of the Data

The outcomes analyzed in subsequent sections are listed and summarized in Table 2.1 in the Data section, after which a breakdown of totals across all outcomes is provided by police district in Table 2.2. Finally, a five-panel figure displays the distribution of the five variables utilized to represent weather, hours of darkness, and school days for the full time series.

Results for Each Outcome

For each outcome, I first offer a table with coefficients from four estimated models:

- Model 1 is a naive model with five estimated coefficients for the period indicator variables for the full time series;
- Model 2 is a "pretreatment" model, estimated only for data prior to August 11, 2014, that fits coefficients for weather, hours of darkness, and school days;
- Model 3 is analogous to Model 1 but utilizes an outcome variable for the full time series that has been de-trended using coefficients for weather, hours of darkness, and school days estimated by Model 2 using data from the "pretreatment" period only;
- Model 4 is an alternative to Model 3 that fits coefficients for weather, hours of darkness, and school days simultaneously with coefficients for the five period indicator variables.

The period effects estimated for Model 3 are my preferred estimates, and the period effects estimated for Model 4 are plausible alternatives.

I then offer two figures that depict the fit of Model 2 as well as the variation that generates the period effects estimated for the preferred Model 3. For both figures, the black line is the predicted time series from Model 2 while the red line is an extrapolated cyclical trend, generated by forming the predictions from the coefficients for Model 2 applied to the observed values for weather, hours of darkness, and school days from August 11, 2014 onward. The first figure overlays gray dots for the observed weekly total for each outcome, and the second figure substitutes a light blue line for the three-week moving average of the observed weekly totals. The differences between the gray dots (or the light blue line) and the red line is the source of variation that generates the period effects estimated for the preferred Model 3.

Finally, for each outcome a diagnostic model is also fit to assess the extent to which the least squares estimation of Model 2 adequately represents the underlying time series up through August 10, 2014. For this alternative model, a poisson distribution is assumed for the outcome because it is a weekly count bounded by zero. In general, these alternative models support the decision to utilize the simpler Model 2 to estimate the underlying time series that structures the extrapolated counterfactual trend. In addition to R output for the estimated poisson regression, analogous figures are offered to demonstrate the near equivalence of Model 2 and its poisson regression alternative.

2 Data

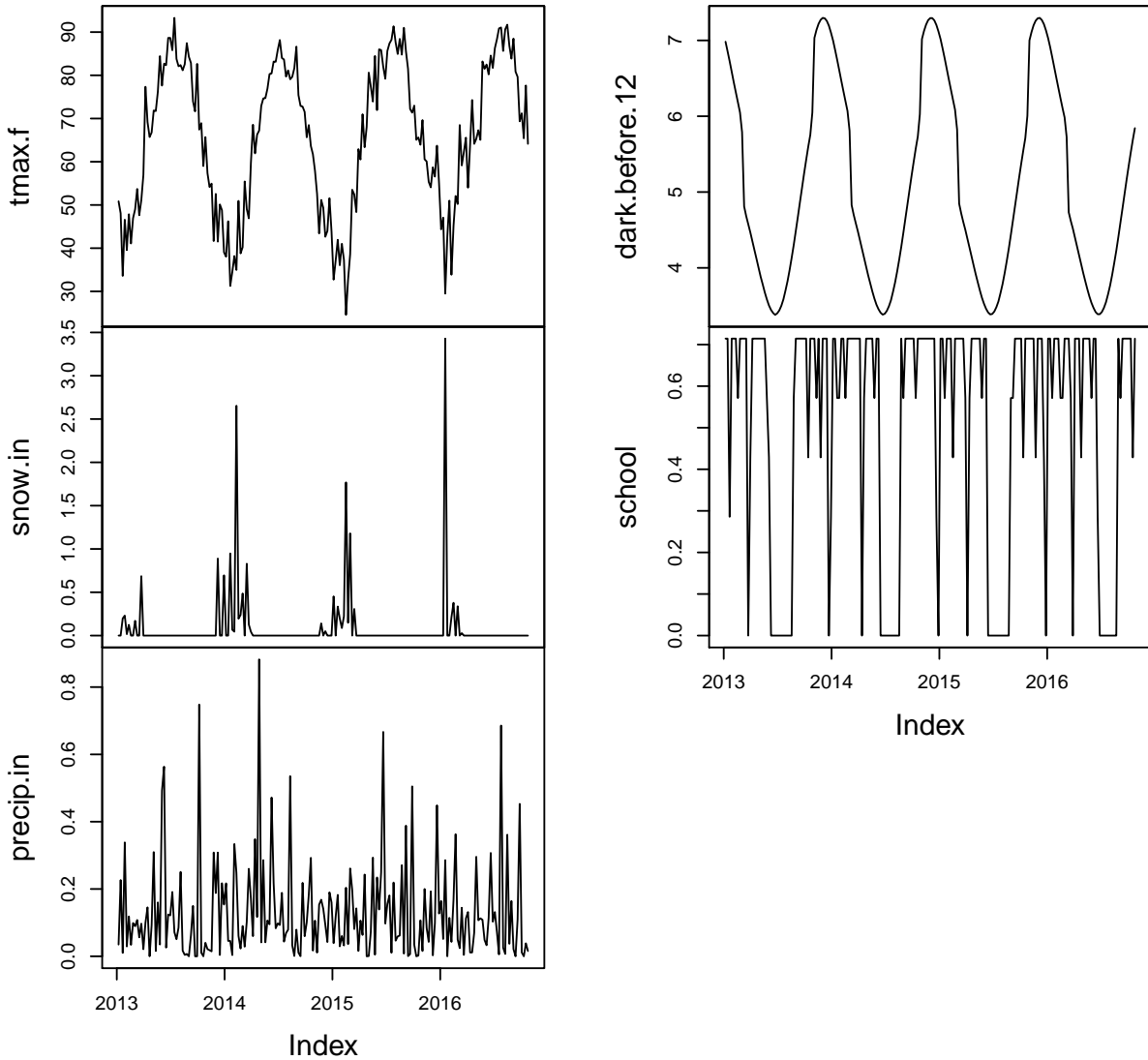
Table 2.1: Descriptive Statistics for Weekly Reported Arrests, with Breakdown by Type of Charge

Statistic	Min	Median	Max
murder.g	0	5	13
robbery	0	15	35
aggravated.assault	0	23	46
burglary	0	19	99
larceny	0	35	64
arson	0	1	5
common.assault	0	81	116
drug.distribution	0	57	116
deadly.weapon	0	16	37
non.deadly.weapon	0	1	19
property.destruction	0	6	14
police.non.compliance	0	8	27
court.non.compliance	0	101	200
drug.possession	0	112	340
driving.violation	0	11	25
prostitution	0	7	27
trespass	0	9	23
forgery.fraud.extortion	0	4	14
domestic	0	6	16
sex.offense.g	0	3	9
disorderly.conduct	0	14	184
loitering.vagabond	0	1	9
only.temp.detained	0	8	20
unknown	0	39	123
ungrouped	0	6	518
total	294	625	928

Table 2.2: Descriptive Statistics for Weekly Reported Arrests, with Breakdown by District

Statistic	Min	Median	Max
northwestern	8	31	95
northern	10	25	56
northeastern	15	39	93
western	11	48	113
central	10	39	92
eastern	11	46	116
southwestern	8	35	65
southern	12	55	109
southeastern	10	46	93
total	294	625	928

Adjustment Variables for Subsequent Models



- tmax.f is the weekly average of the daily maximum temperature, measured in degrees Fahrenheit
- snow.in is the weekly average of total daily snowfall, measured in inches
- precip.in is the weekly average of total daily precipitation, measured in inches
- dark.before.12 is the weekly average of daily hours between sunset and midnight
- school is the proportion of days of the week when school was scheduled for Baltimore City Schools

3 Results for total

3.1 Summary Values for total

Table 3.1: Descriptives for Outcome Before Ferguson Protests Begin

Statistic	N	Mean	St. Dev.	Min	Median	Max
total	83	807.735	73.469	565	819	928

Table 3.2: Descriptives for Outcome After Ferguson Protests Begin

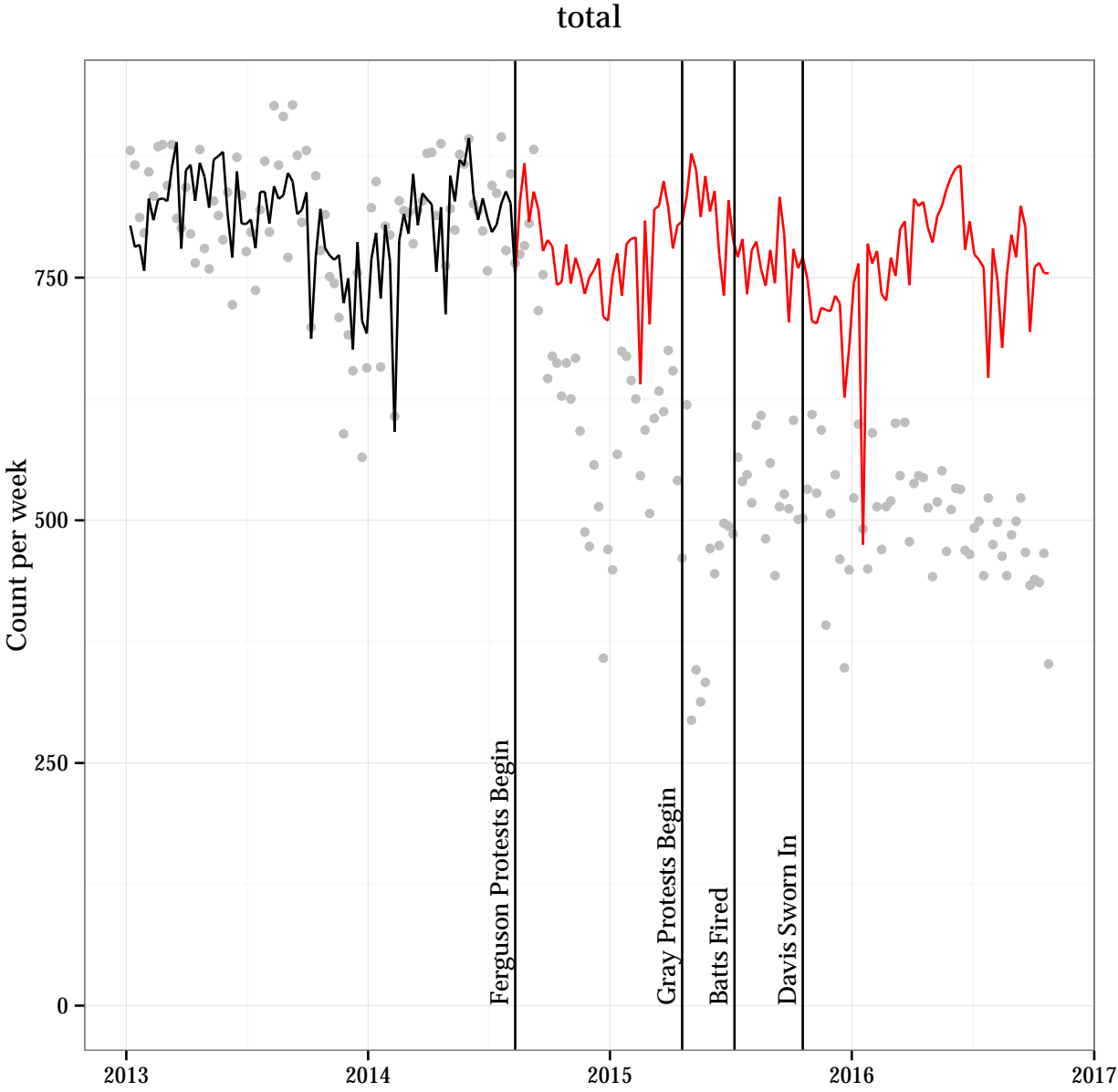
Statistic	N	Mean	St. Dev.	Min	Median	Max
total	116	535.897	102.297	294	519.5	882

3.2 Four Models for total

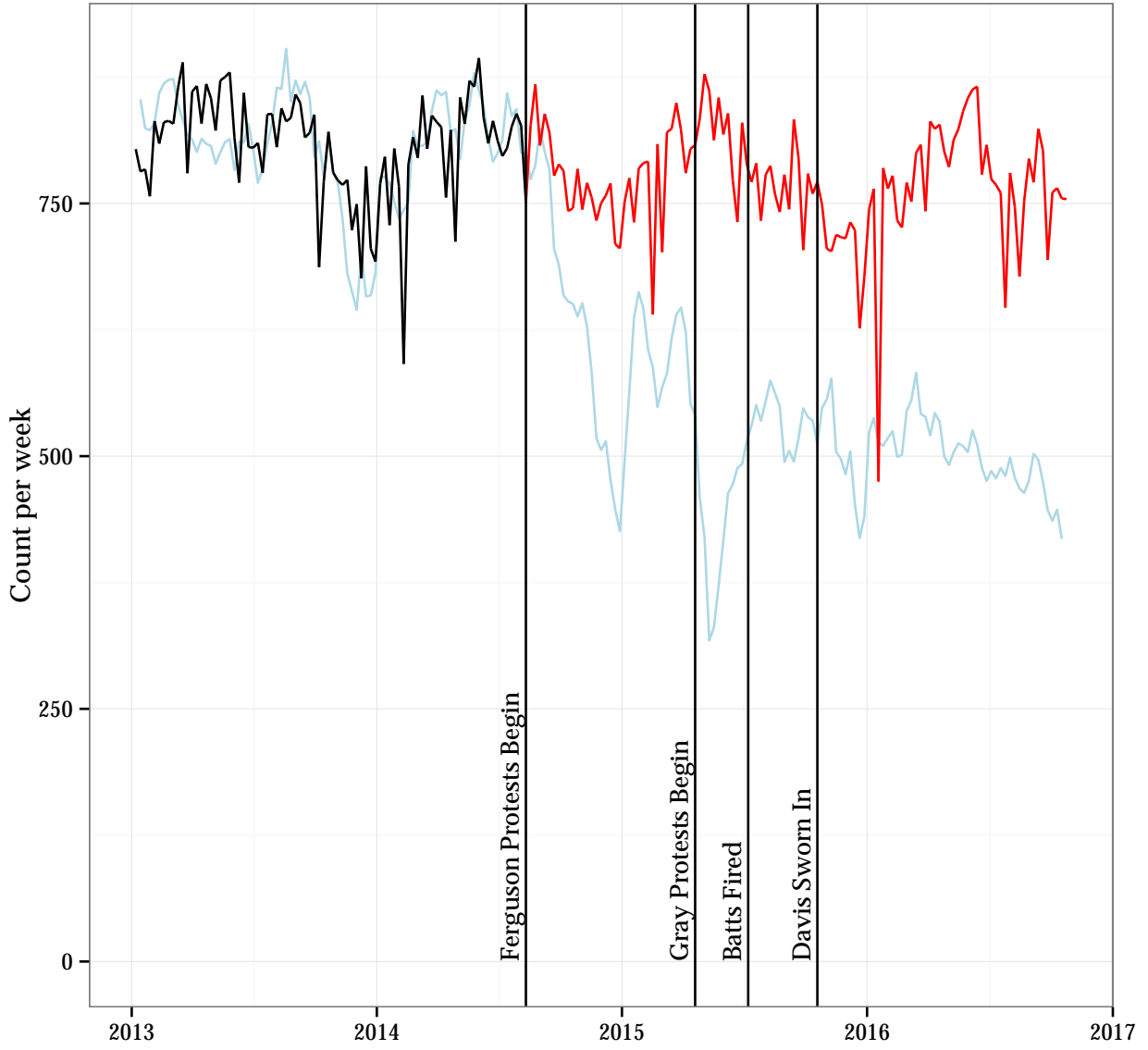
Table 3.3: Four Models that Differ on the Specification of Adjustment and Intervention Variables

	Outcome: Count Per Week			
	(1)	(2)	(3)	(4)
Time (counter in weeks)	-0.79	-0.28		-1.16
After Ferguson Protests Begin (week of 8/11/14 onward)	-136.20		-150.56	-95.49
After Gray Protests Begin (week of 4/20/15 onward)	-185.87		-247.70	-231.39
Unrest and National Guard (4/27/15 - 5/3/2015)	195.67		182.92	188.71
After Batts Fired (week of 7/13/15 onward)	127.34		166.96	162.92
After Davis Sworn In (week of 10/19/15 onward)	-11.32		-29.74	9.37
Average Maximum Temperature to 50 Degrees		-0.59		-0.49
Plus Degrees in the 50s		-2.36		2.96
Plus Degrees in the 60s		-0.48		-5.16
Plus Degrees in the 70s		8.45		5.86
Plus Degrees Greater Than 80		-11.15		-6.95
Snowfall (inches)		-75.09		-23.66
Precipitation (inches)		-158.65		-89.11
Darkness Before Midnight (hours)		-38.30		-26.68
School Days (proportion of week)		71.14		38.30
Observations	199	83	199	199
R ²	0.79	0.51	0.77	0.85

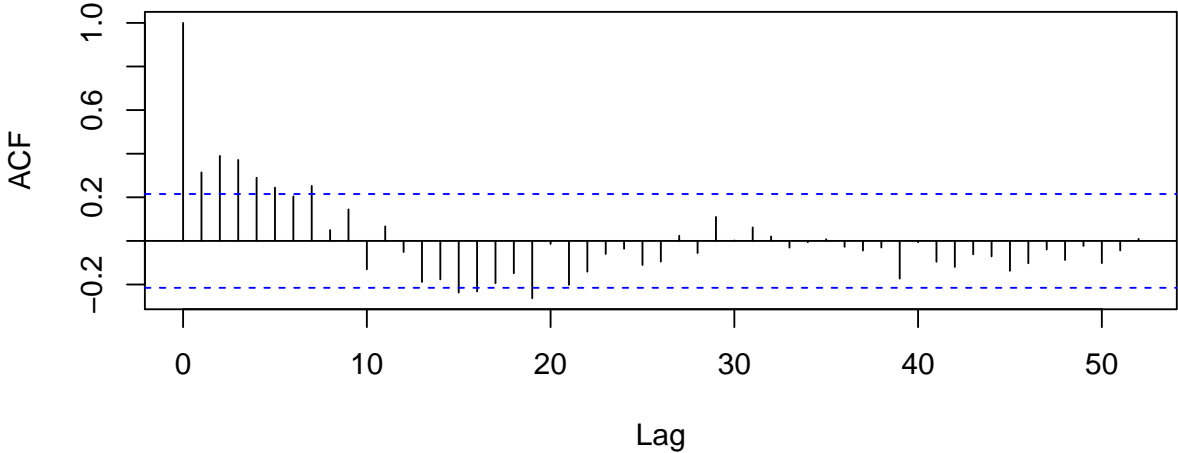
3.3 Least Squares Model (2) for total



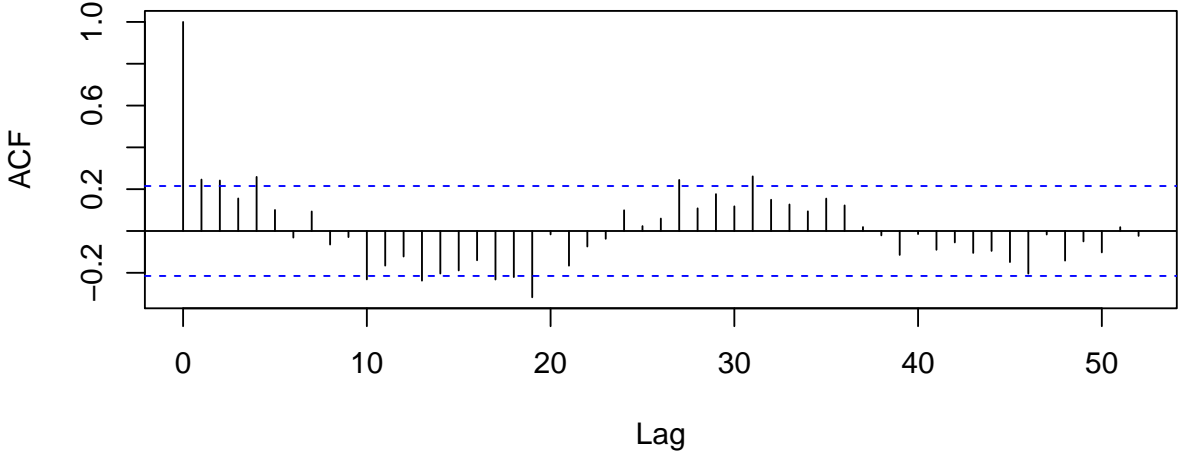
total



Autocorrelation Function for the Observed Outcome for Model (2)



Autocorrelation Function for the Residuals from Model (2)



3.4 A Poisson Regression Model as an Alternative to Model (2) for total

```
Call:
glm(formula = model.formula, family = poisson, data = df.windowed.pre)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-5.6792  -1.3057   0.3186   1.3820   2.9960

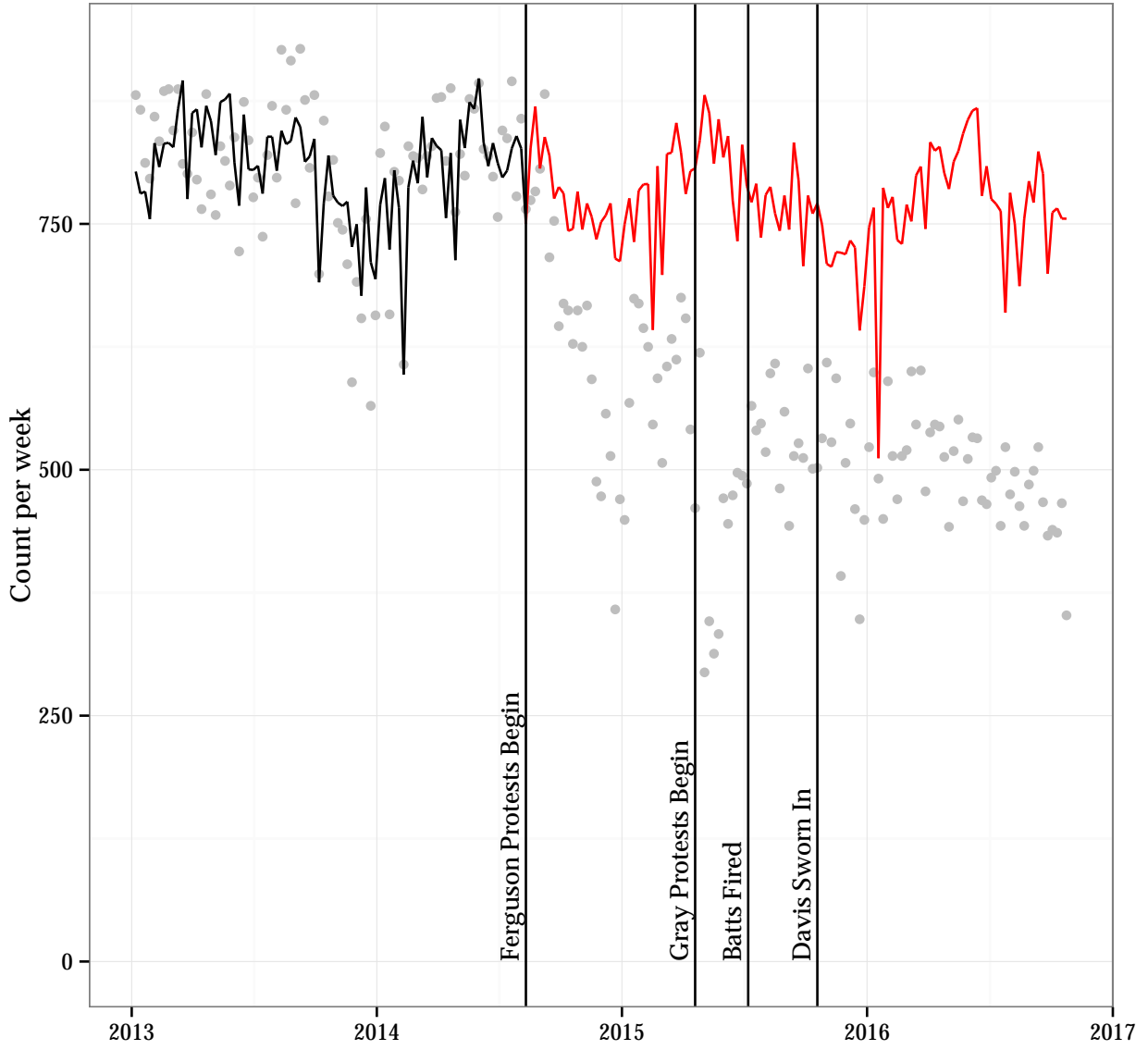
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  7.0137063  0.0747858  93.784 < 2e-16 ***
t            -0.0003348  0.0001719  -1.948 0.051445 .
tmax.f.spline1 -0.0007504  0.0013027  -0.576 0.564577
tmax.f.spline2 -0.0032712  0.0030439  -1.075 0.282521
tmax.f.spline3 -0.0002603  0.0043555  -0.060 0.952341
tmax.f.spline4  0.0104313  0.0039943   2.612 0.009013 **
tmax.f.spline5 -0.0137097  0.0035331  -3.880 0.000104 ***
snow.in       -0.1058575  0.0148175  -7.144 9.06e-13 ***
precip.in     -0.2035128  0.0256332  -7.939 2.03e-15 ***
dark.before.12 -0.0485446  0.0056064  -8.659 < 2e-16 ***
school        0.0872107  0.0172911   5.044 4.57e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

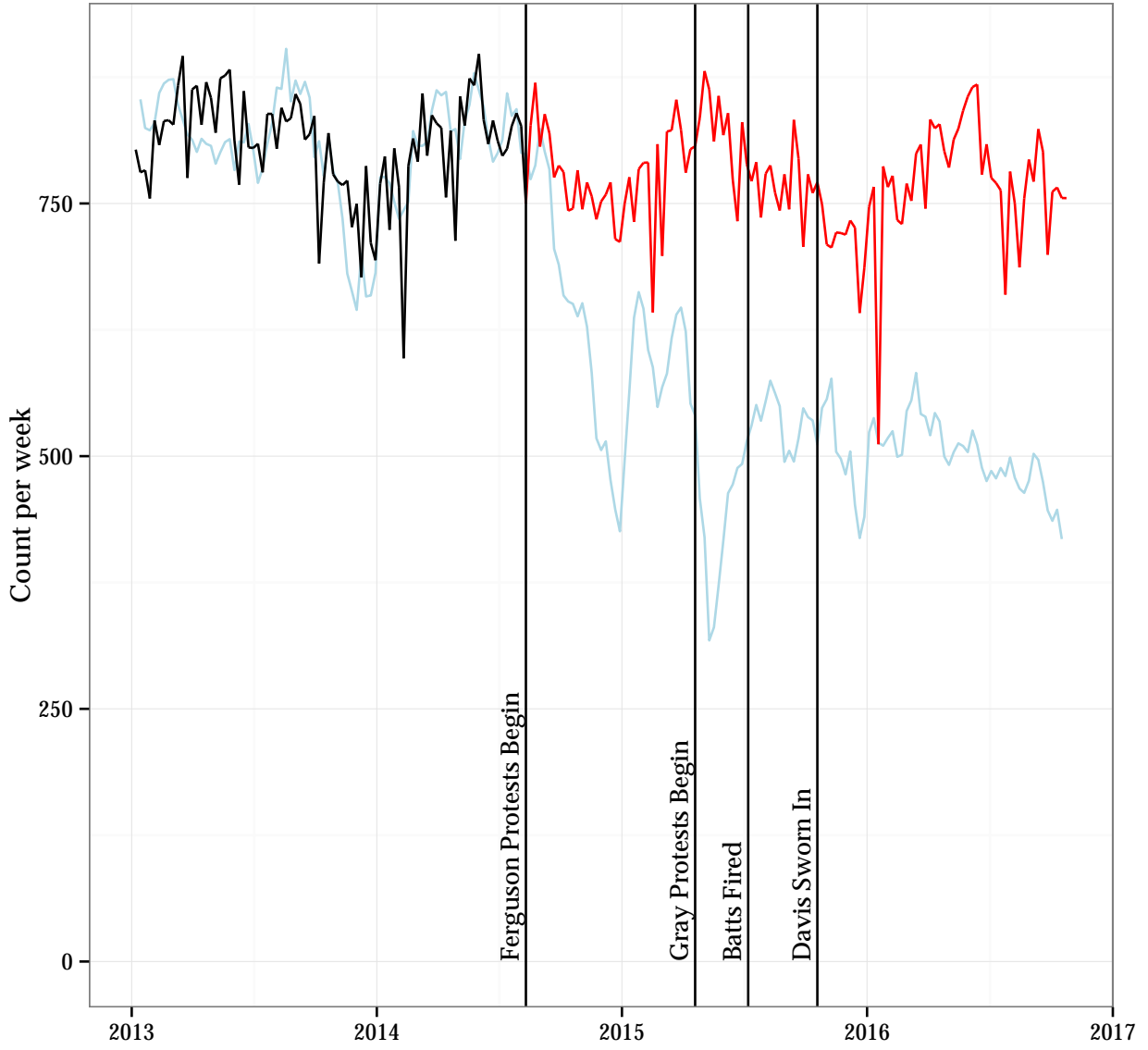
    Null deviance: 570.72  on 82  degrees of freedom
Residual deviance: 284.20  on 72  degrees of freedom
AIC: 1014

Number of Fisher Scoring iterations: 3
```

total



total



4 Results for b

4.1 Summary Values for b

Table 4.1: Descriptives for Outcome Before Ferguson Protests Begin

Statistic	N	Mean	St. Dev.	Min	Median	Max
b	83	660.663	66.281	450	674	772

Table 4.2: Descriptives for Outcome After Ferguson Protests Begin

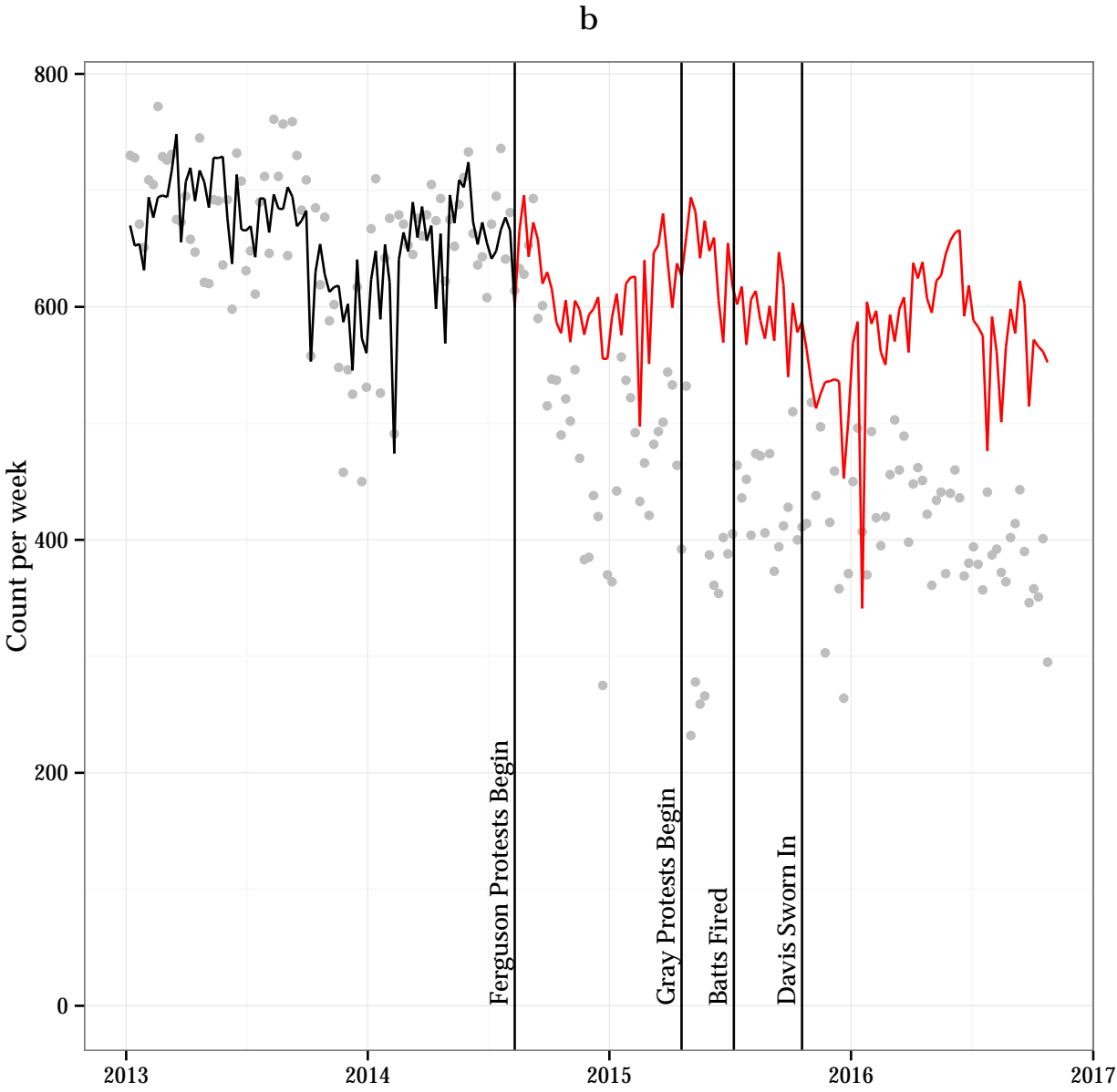
Statistic	N	Mean	St. Dev.	Min	Median	Max
b	116	435.974	83.272	232	430.5	693

4.2 Four Models for b

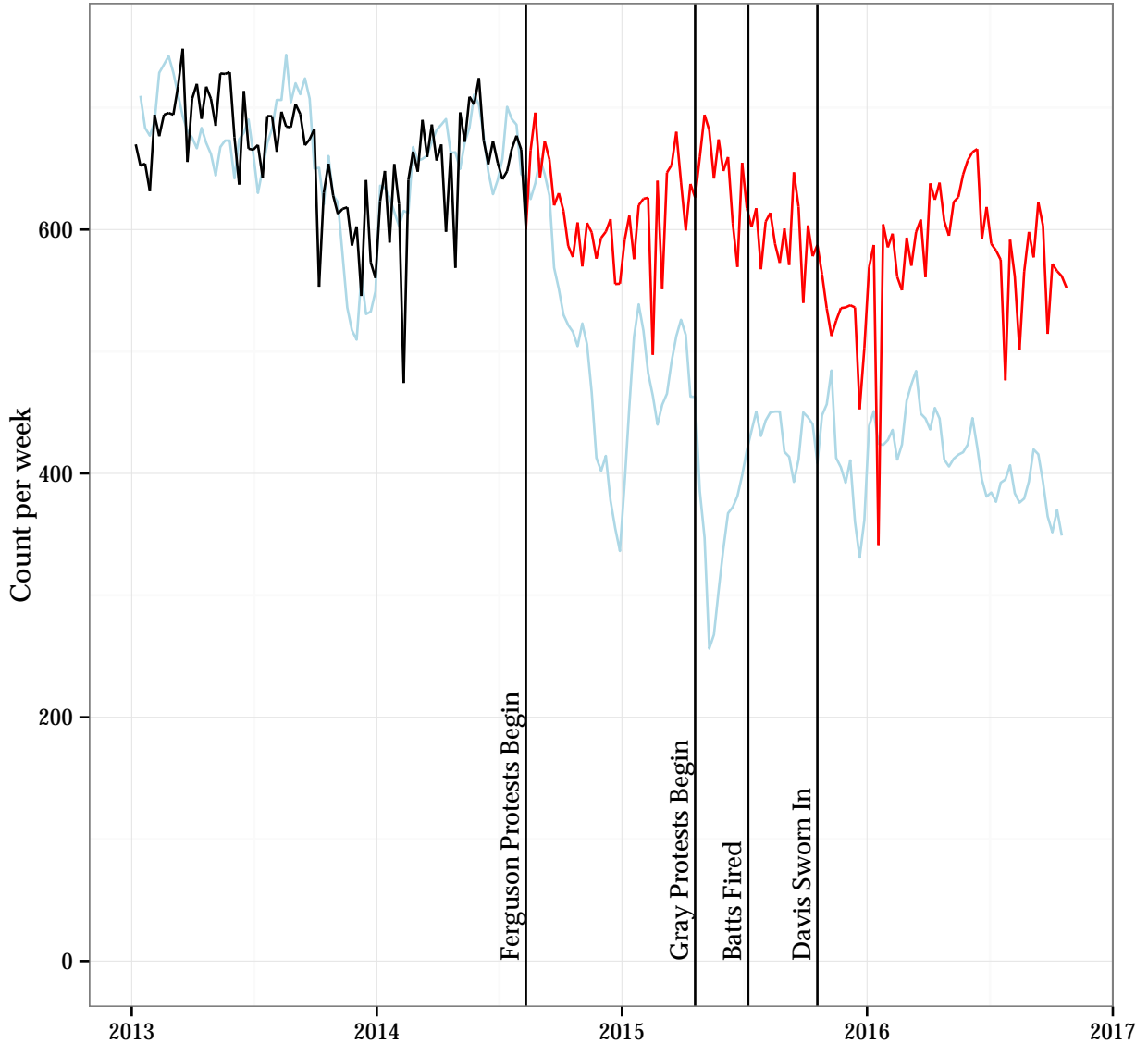
Table 4.3: Four Models that Differ on the Specification of Adjustment and Intervention Variables

	Outcome: Count Per Week			
	(1)	(2)	(3)	(4)
Time (counter in weeks)	-0.89	-0.56		-1.22
After Ferguson Protests Begin (week of 8/11/14 onward)	-106.00		-110.24	-70.34
After Gray Protests Begin (week of 4/20/15 onward)	-141.11		-194.14	-180.46
Unrest and National Guard (4/27/15 - 5/3/2015)	189.07		176.90	180.58
After Batts Fired (week of 7/13/15 onward)	108.35		145.23	140.78
After Davis Sworn In (week of 10/19/15 onward)	5.21		-3.62	23.52
Average Maximum Temperature to 50 Degrees		-0.33		-0.09
Plus Degrees in the 50s		-4.75		0.40
Plus Degrees in the 60s		4.27		-1.23
Plus Degrees in the 70s		4.42		3.09
Plus Degrees Greater Than 80		-9.01		-5.57
Snowfall (inches)		-62.90		-18.27
Precipitation (inches)		-137.37		-76.84
Darkness Before Midnight (hours)		-35.61		-24.76
School Days (proportion of week)		57.28		34.97
Observations	199	83	199	199
R ²	0.78	0.51	0.69	0.84

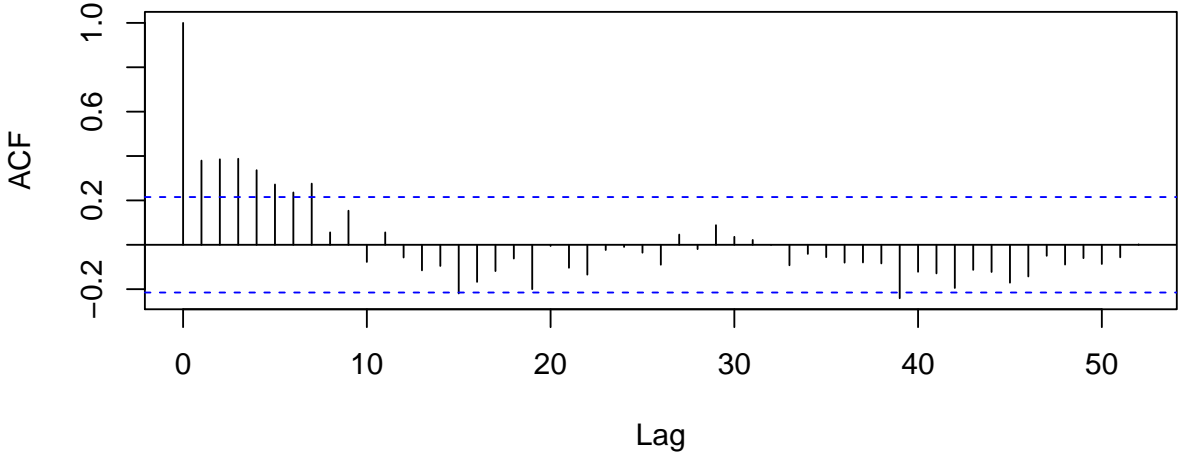
4.3 Least Squares Model (2) for b



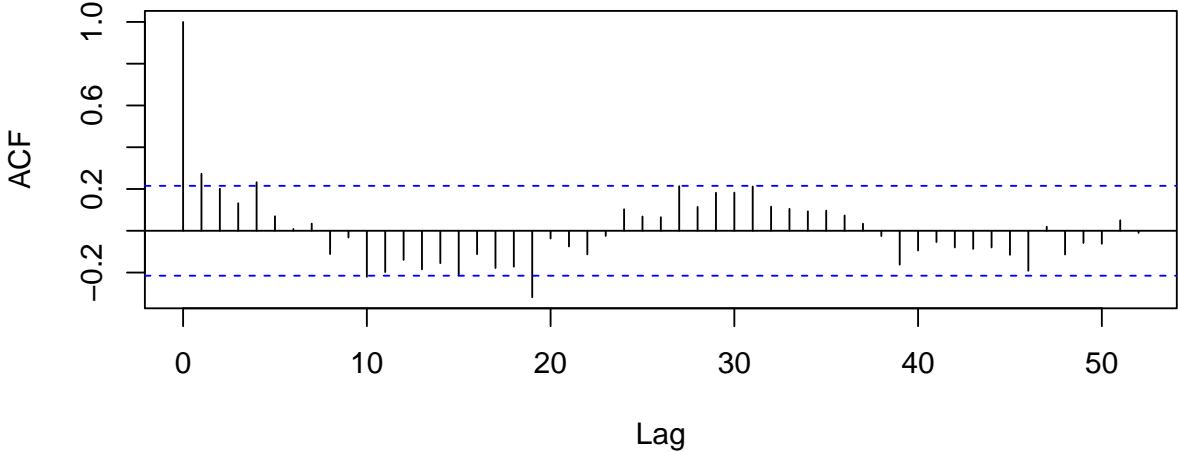
b



Autocorrelation Function for the Observed Outcome for Model (2)



Autocorrelation Function for the Residuals from Model (2)



4.4 A Poisson Regression Model as an Alternative to Model (2) for b

```
Call:
glm(formula = model.formula, family = poisson, data = df.windowed.pre)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-5.6375  -1.2823   0.3196   1.2079   2.9923

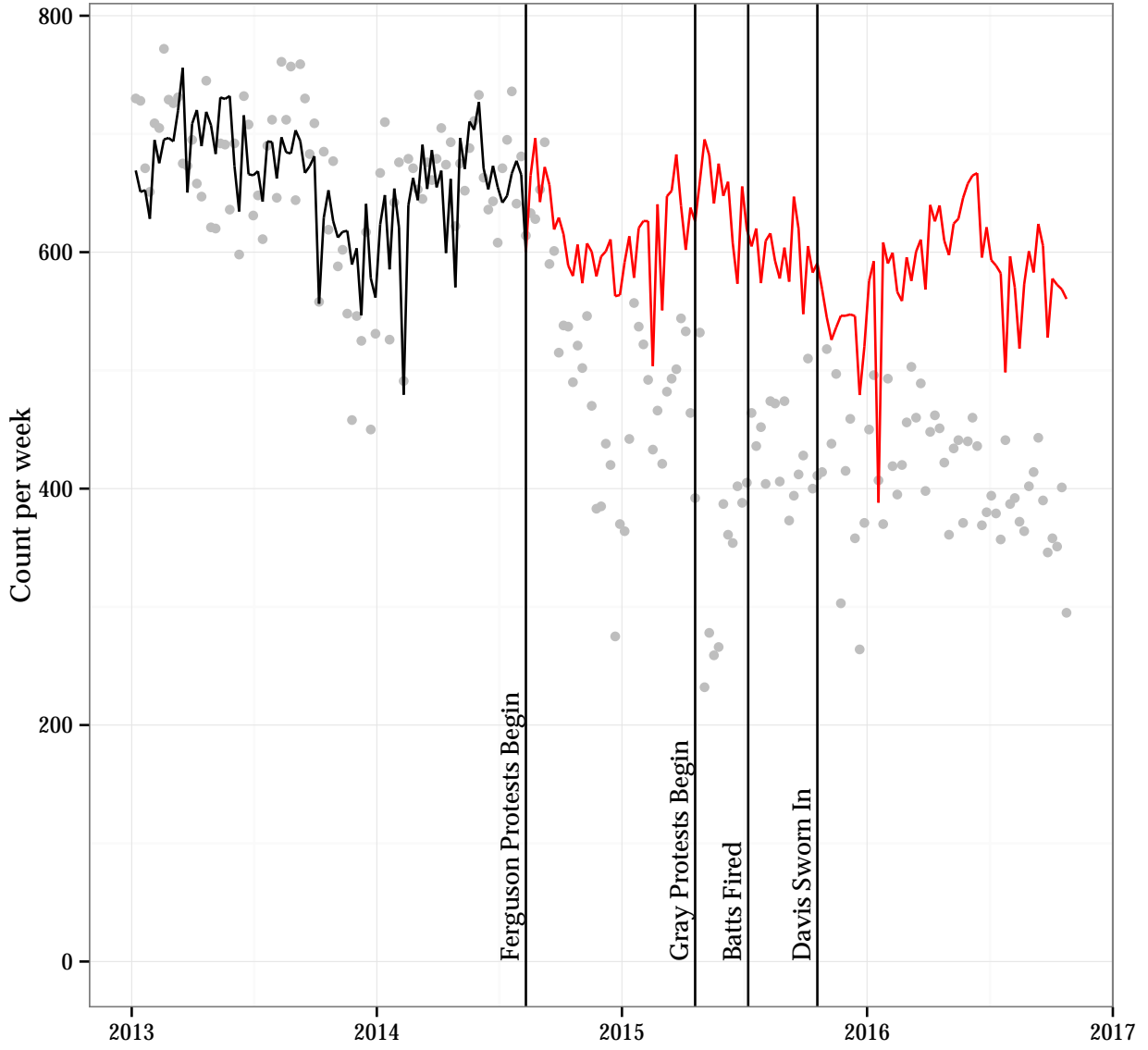
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  6.8702428  0.0827094  83.065 < 2e-16 ***
t            -0.0008309  0.0001898  -4.377 1.20e-05 ***
tmax.f.spline1 -0.0005041  0.0014389  -0.350 0.726079
tmax.f.spline2 -0.0076500  0.0033736  -2.268 0.023353 *
tmax.f.spline3  0.0069337  0.0048493   1.430 0.152764
tmax.f.spline4  0.0066753  0.0044297   1.507 0.131829
tmax.f.spline5 -0.0136070  0.0039050  -3.484 0.000493 ***
snow.in       -0.1094045  0.0164611  -6.646 3.01e-11 ***
precip.in     -0.2164387  0.0284384  -7.611 2.72e-14 ***
dark.before.12 -0.0551503  0.0062068  -8.885 < 2e-16 ***
school        0.0858198  0.0191317   4.486 7.27e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

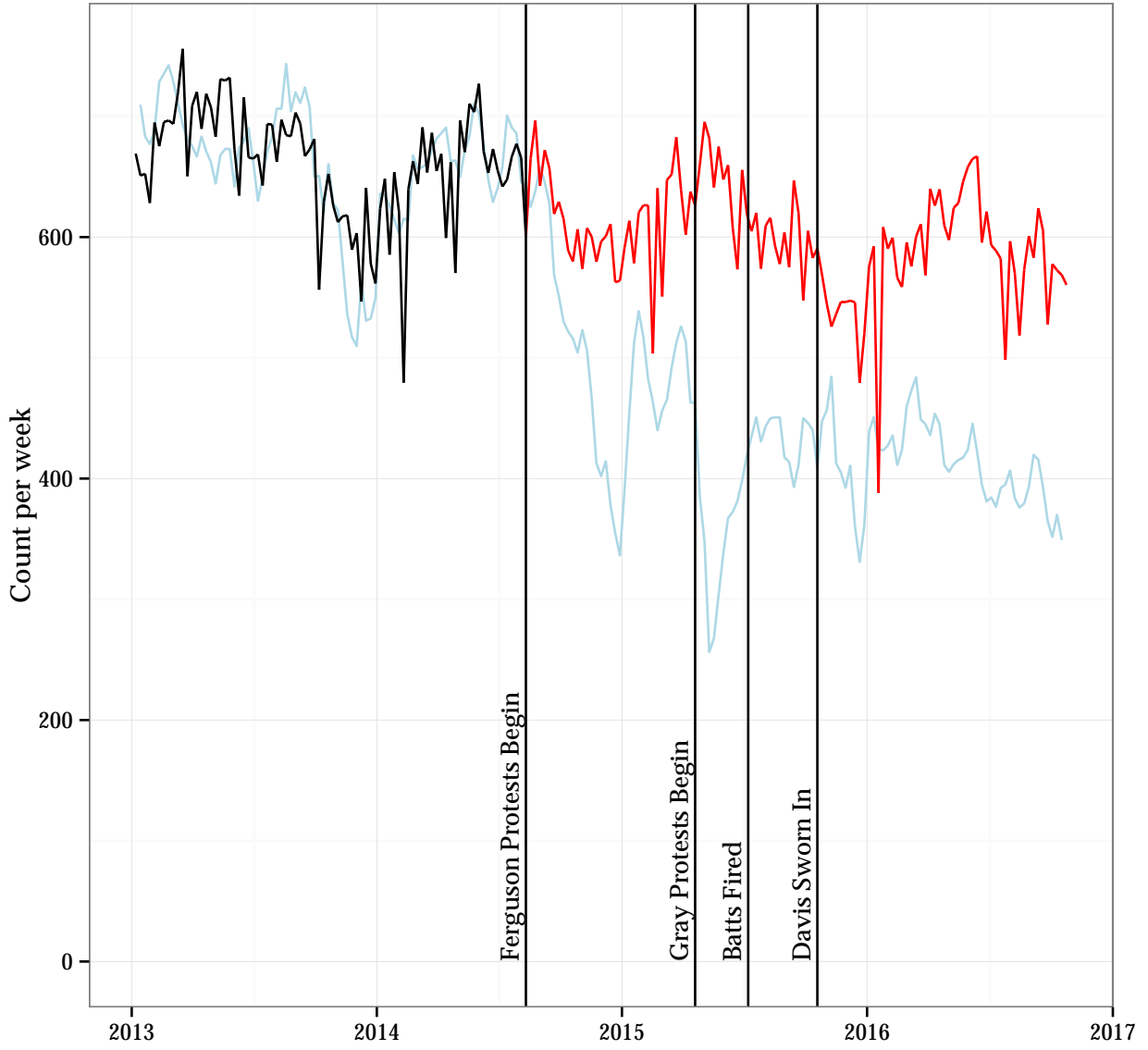
    Null deviance: 569.66  on 82  degrees of freedom
Residual deviance: 283.54  on 72  degrees of freedom
AIC: 996.59

Number of Fisher Scoring iterations: 4
```

b



b



5 Results for w

5.1 Summary Values for w

Table 5.1: Descriptives for Outcome Before Ferguson Protests Begin

Statistic	N	Mean	St. Dev.	Min	Median	Max
w	83	127.157	16.150	96	127	172

Table 5.2: Descriptives for Outcome After Ferguson Protests Begin

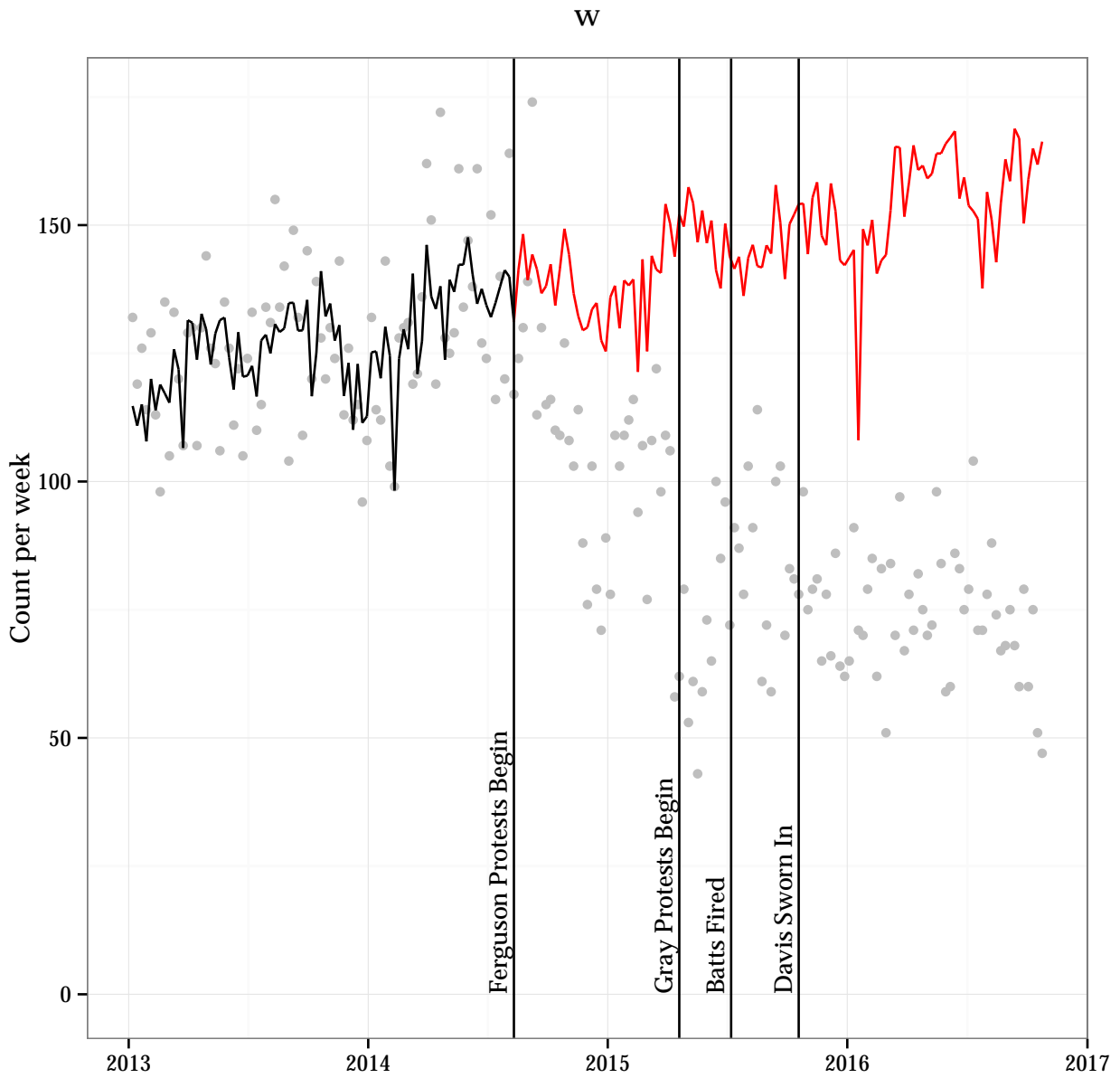
Statistic	N	Mean	St. Dev.	Min	Median	Max
w	116	85.319	22.051	43	79	174

5.2 Four Models for w

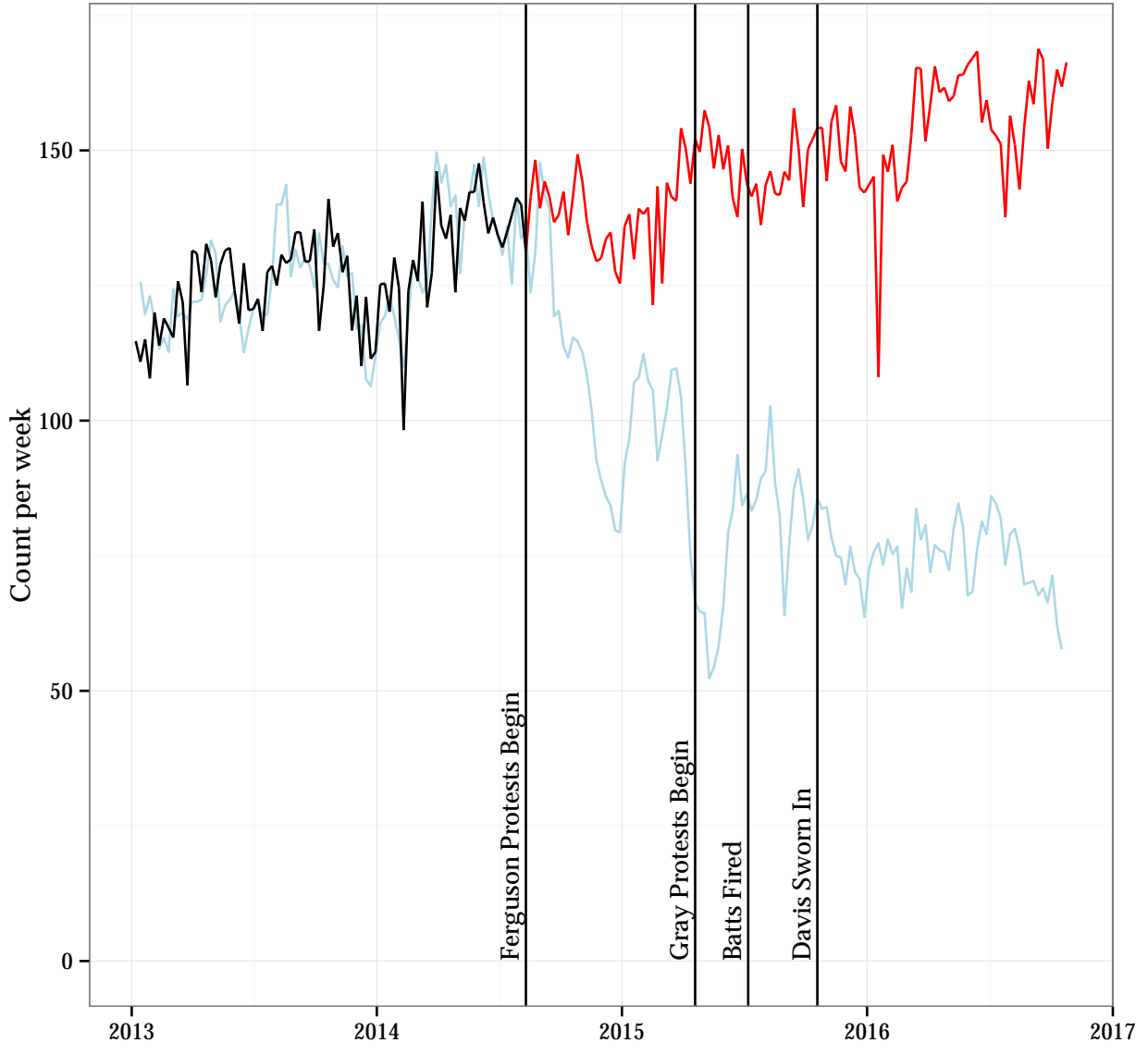
Table 5.3: Four Models that Differ on the Specification of Adjustment and Intervention Variables

	Outcome: Count Per Week			
	(1)	(2)	(3)	(4)
Time (counter in weeks)	0.07	0.20		0.01
After Ferguson Protests Begin (week of 8/11/14 onward)	-24.55		-31.29	-19.01
After Gray Protests Begin (week of 4/20/15 onward)	-38.46		-47.33	-44.78
Unrest and National Guard (4/27/15 - 5/3/2015)	9.43		7.89	9.84
After Batts Fired (week of 7/13/15 onward)	14.44		18.43	18.29
After Davis Sworn In (week of 10/19/15 onward)	-13.20		-19.74	-10.05
Average Maximum Temperature to 50 Degrees		-0.45		-0.51
Plus Degrees in the 50s		2.21		2.19
Plus Degrees in the 60s		-3.37		-2.86
Plus Degrees in the 70s		2.72		1.92
Plus Degrees Greater Than 80		-2.22		-1.19
Snowfall (inches)		-11.47		-5.96
Precipitation (inches)		-19.50		-11.80
Darkness Before Midnight (hours)		-2.63		-2.49
School Days (proportion of week)		11.24		3.85
Observations	199	83	199	199
R^2	0.68	0.36	0.83	0.73

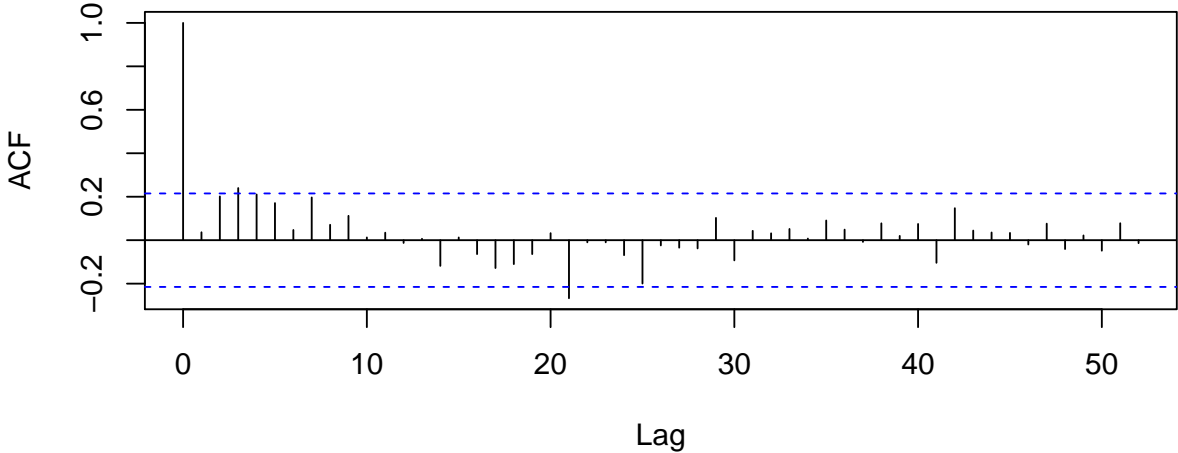
5.3 Least Squares Model (2) for w



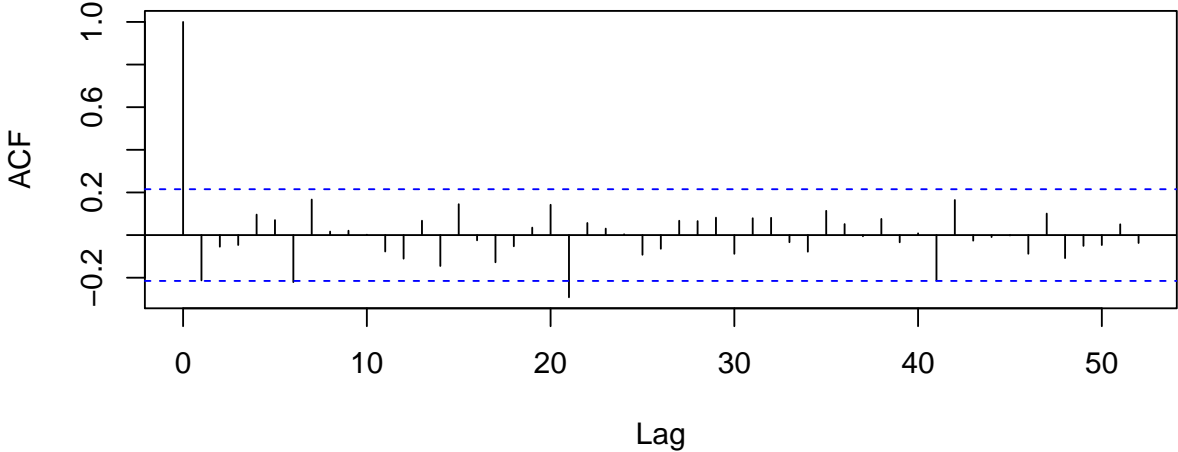
W



Autocorrelation Function for the Observed Outcome for Model (2)



Autocorrelation Function for the Residuals from Model (2)



5.4 A Poisson Regression Model as an Alternative to Model (2) for w

```
Call:
glm(formula = model.formula, family = poisson, data = df.windowed.pre)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.76063  -0.72361   0.05082   0.74250   2.75805

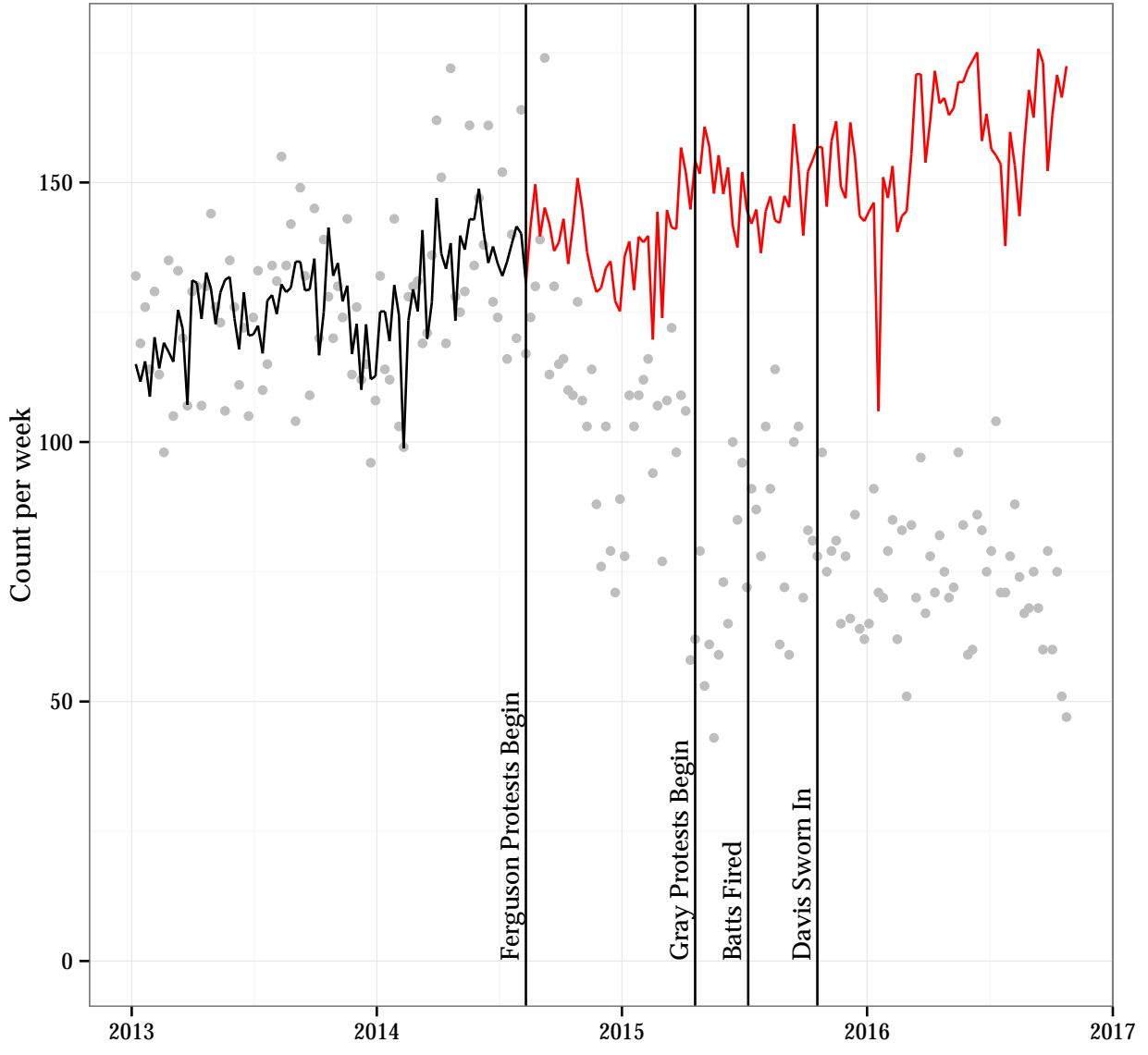
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  5.0067413  0.1889289  26.501 < 2e-16 ***
t            0.0015360  0.0004355   3.527 0.000421 ***
tmax.f.spline1 -0.0037391  0.0033118  -1.129 0.258888
tmax.f.spline2  0.0174476  0.0076614   2.277 0.022766 *
tmax.f.spline3 -0.0261183  0.0107373  -2.432 0.014996 *
tmax.f.spline4  0.0207887  0.0099293   2.094 0.036288 *
tmax.f.spline5 -0.0168691  0.0089100  -1.893 0.058321 .
snow.in       -0.0998627  0.0369768  -2.701 0.006920 **
precip.in     -0.1556834  0.0635338  -2.450 0.014270 *
dark.before.12 -0.0208139  0.0141360  -1.472 0.140913
school        0.0881013  0.0434485   2.028 0.042589 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

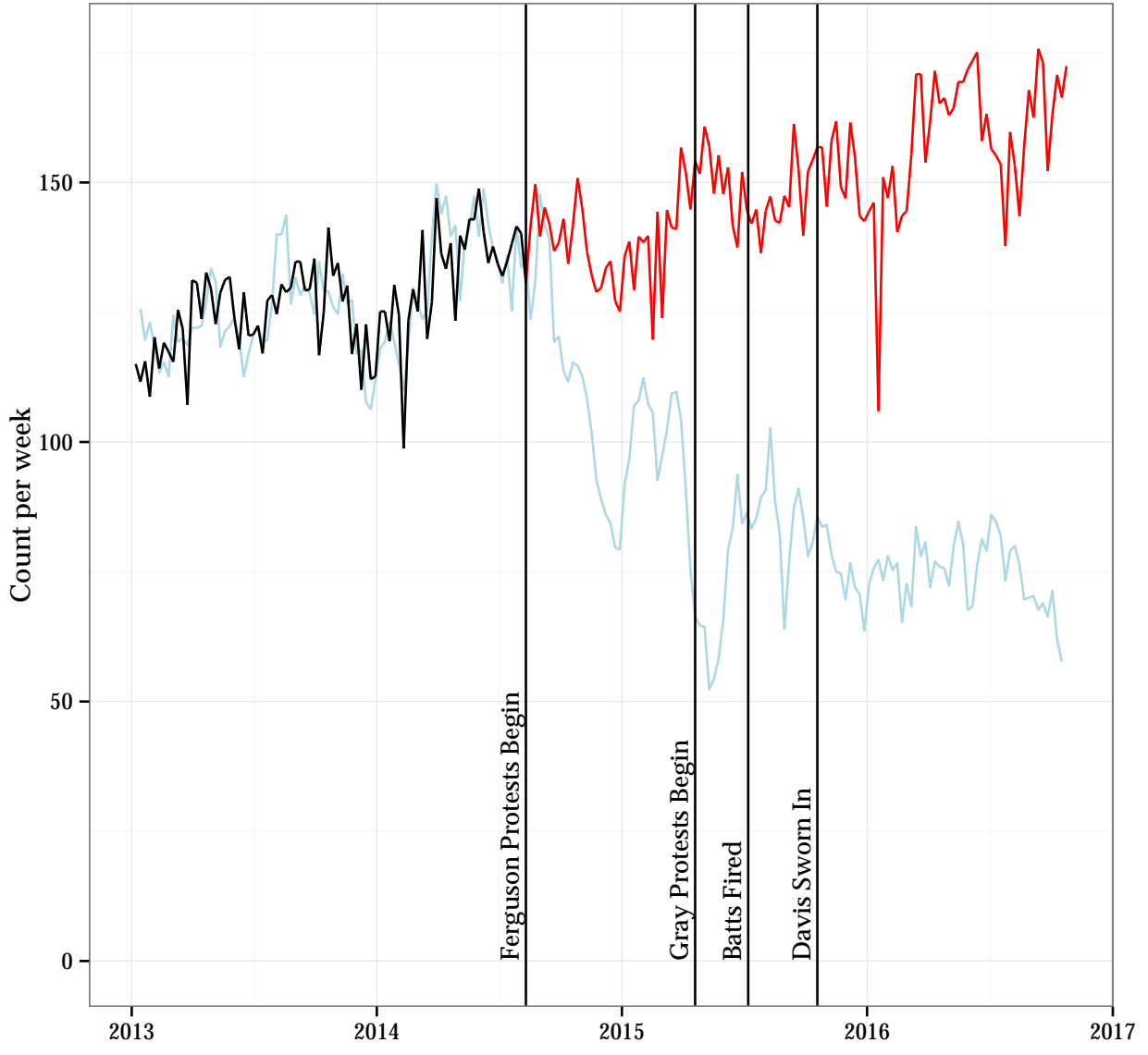
    Null deviance: 166.18  on 82  degrees of freedom
Residual deviance: 104.65  on 72  degrees of freedom
AIC: 680.82

Number of Fisher Scoring iterations: 4
```

W



W



6 Results for i

6.1 Summary Values for i

Table 6.1: Descriptives for Outcome Before Ferguson Protests Begin

Statistic	N	Mean	St. Dev.	Min	Median	Max
i	83	1.795	1.386	0	2	7

Table 6.2: Descriptives for Outcome After Ferguson Protests Begin

Statistic	N	Mean	St. Dev.	Min	Median	Max
i	116	1.922	1.653	0	2	8

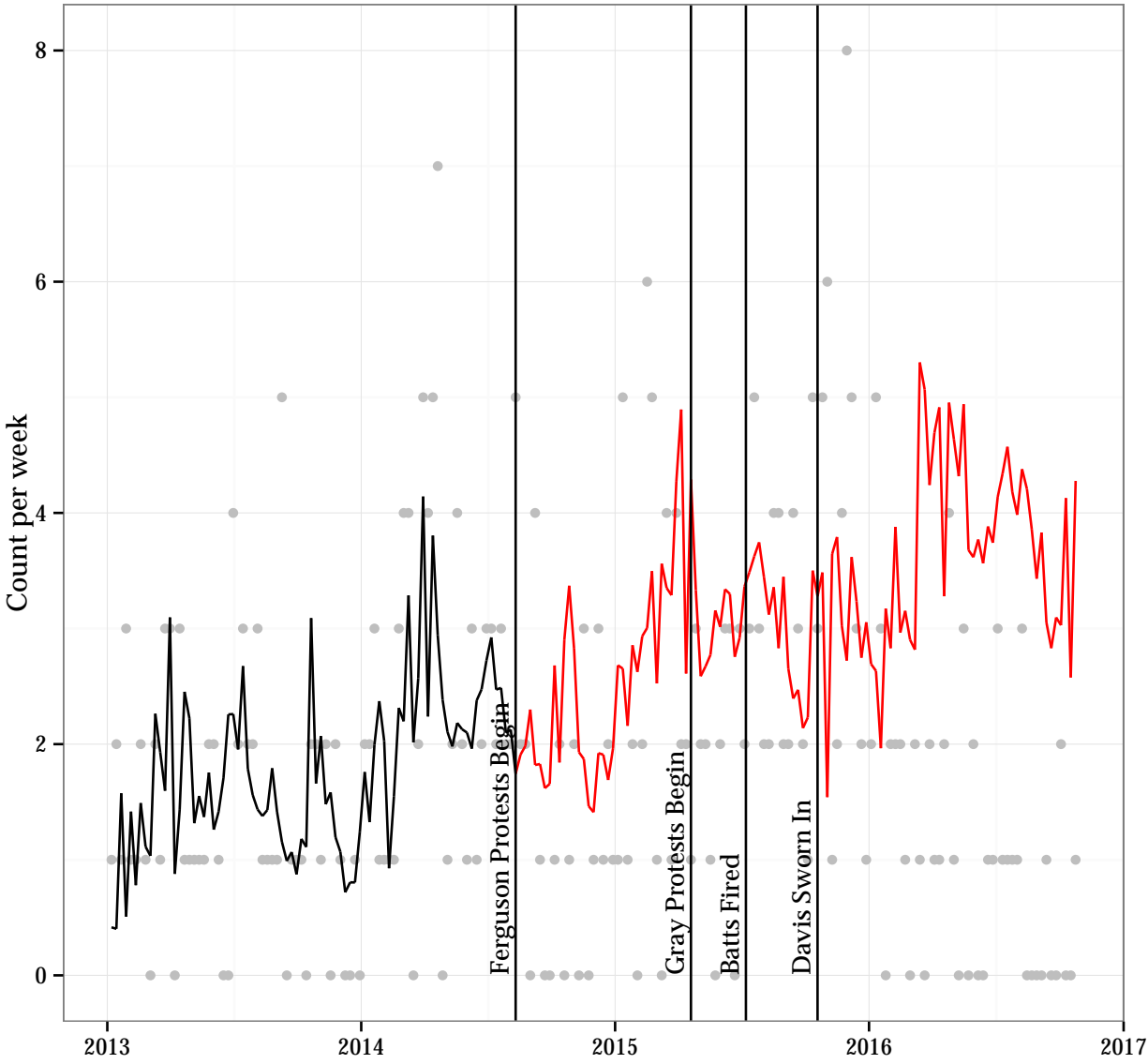
6.2 Four Models for i

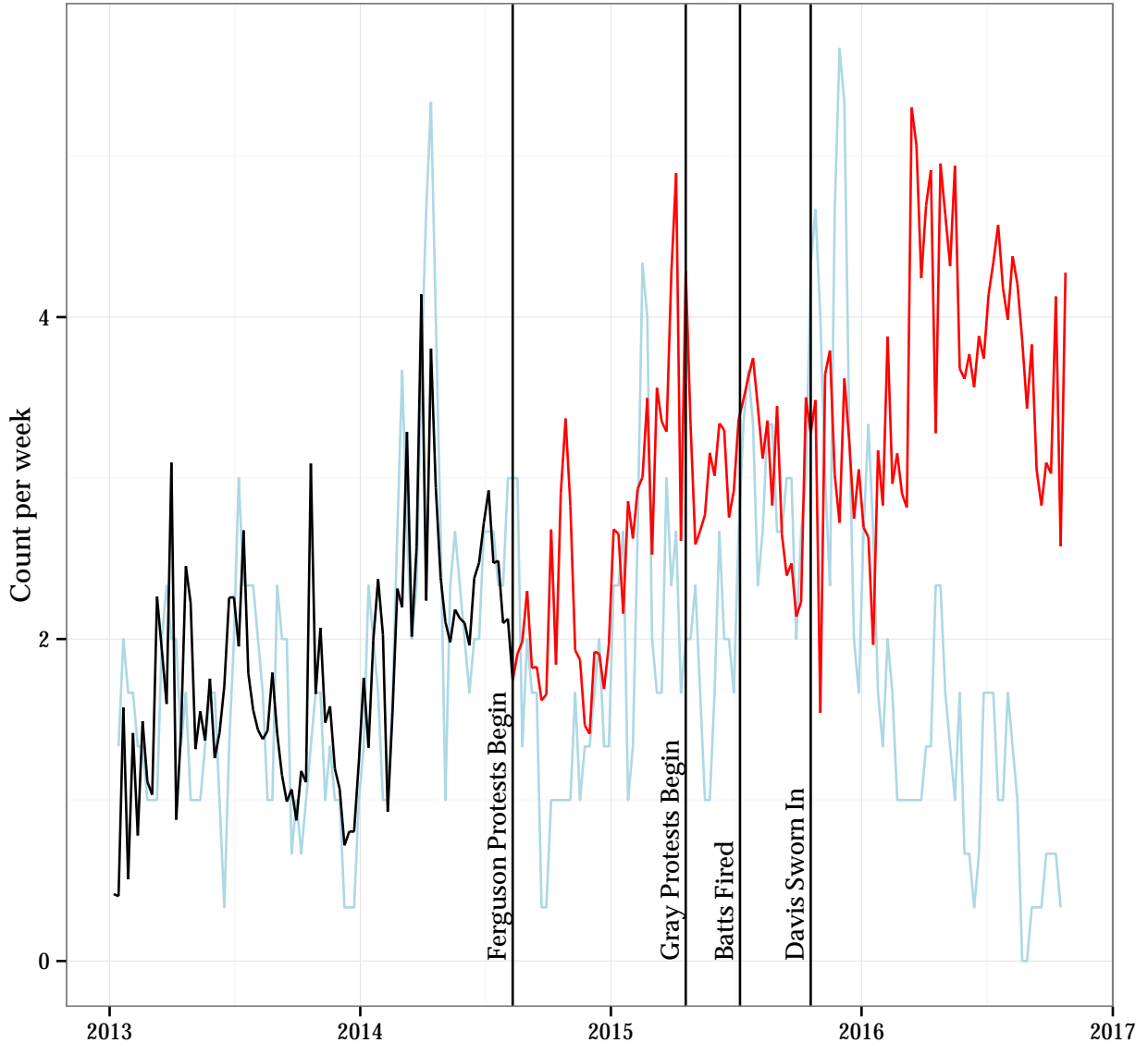
Table 6.3: Four Models that Differ on the Specification of Adjustment and Intervention Variables

	Outcome: Count Per Week			
	(1)	(2)	(3)	(4)
Time (counter in weeks)	-0.0004	0.01		-0.001
After Ferguson Protests Begin (week of 8/11/14 onward)	0.09		-0.63	0.01
After Gray Protests Begin (week of 4/20/15 onward)	-0.12		-0.75	0.18
Unrest and National Guard (4/27/15 - 5/3/2015)	1.27		1.05	0.97
After Batts Fired (week of 7/13/15 onward)	1.28		1.35	1.30
After Davis Sworn In (week of 10/19/15 onward)	-1.28		-1.89	-1.49
Average Maximum Temperature to 50 Degrees		-0.07		-0.09
Plus Degrees in the 50s		0.24		0.25
Plus Degrees in the 60s		-0.42		-0.28
Plus Degrees in the 70s		0.21		0.10
Plus Degrees Greater Than 80		0.13		-0.002
Snowfall (inches)		-0.57		-0.09
Precipitation (inches)		-0.53		-0.77
Darkness Before Midnight (hours)		-0.59		-0.08
School Days (proportion of week)		0.01		-0.86
Observations	199	83	199	199
R ²	0.05	0.28	0.21	0.13

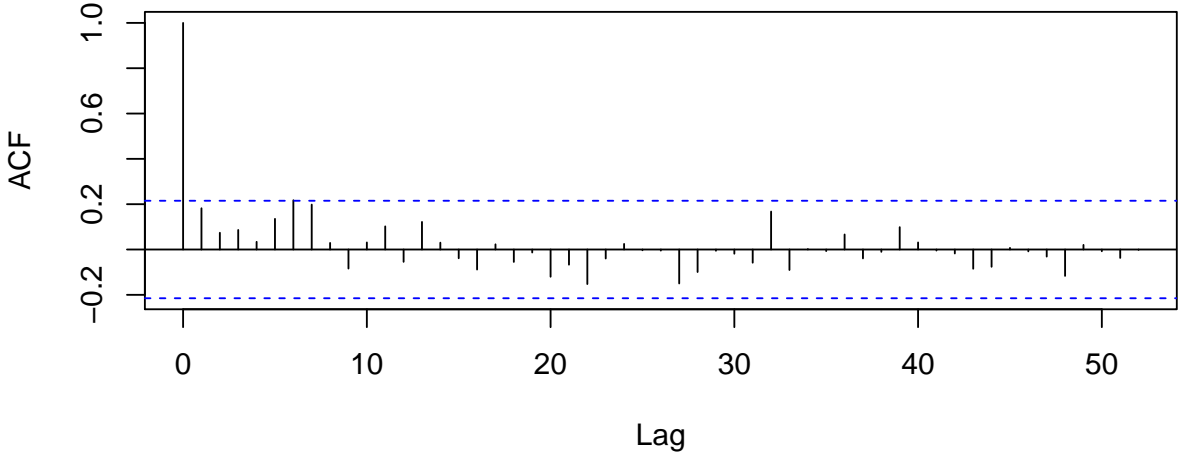
6.3 Least Squares Model (2) for i

i

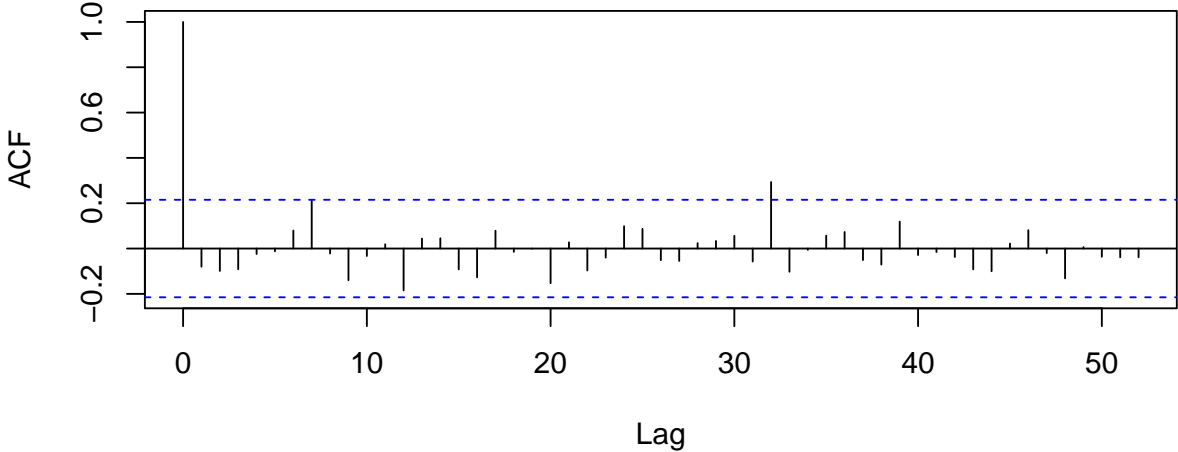




Autocorrelation Function for the Observed Outcome for Model (2)



Autocorrelation Function for the Residuals from Model (2)



6.4 A Poisson Regression Model as an Alternative to Model (2) for i

```
Call:
glm(formula = model.formula, family = poisson, data = df.windowed.pre)

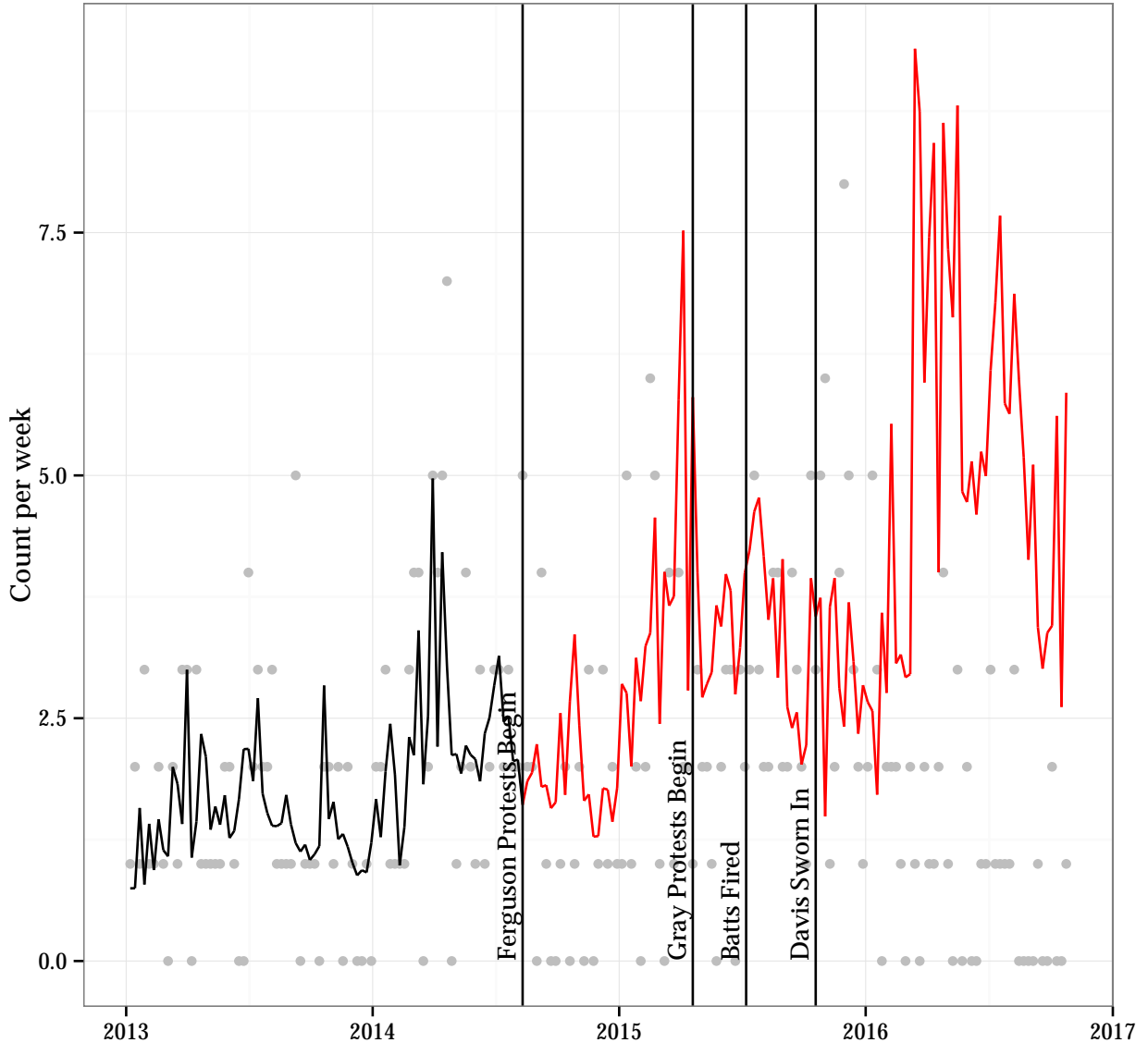
Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.08853  -0.56347  -0.05131   0.37132   2.56465

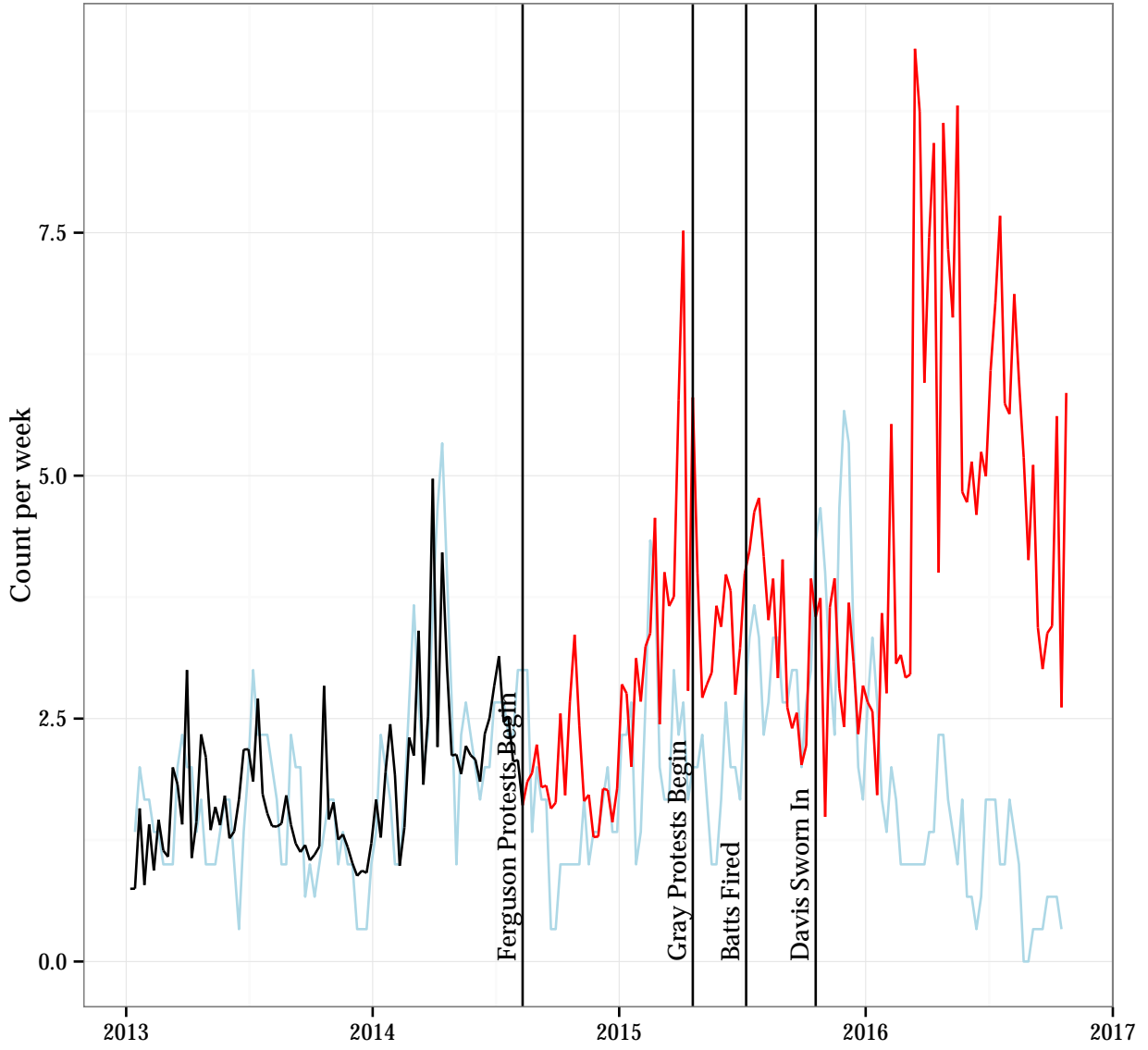
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  4.353099   1.694723   2.569  0.01021 *
t            0.007282   0.003663   1.988  0.04684 *
tmax.f.spline1 -0.047100   0.029004  -1.624  0.10439
tmax.f.spline2  0.121161   0.062676   1.933  0.05322 .
tmax.f.spline3 -0.184156   0.079903  -2.305  0.02118 *
tmax.f.spline4  0.085297   0.081399   1.048  0.29469
tmax.f.spline5  0.070959   0.071632   0.991  0.32188
snow.in       -0.347005   0.346325  -1.002  0.31636
precip.in     -0.400226   0.550359  -0.727  0.46710
dark.before.12 -0.337894   0.127653  -2.647  0.00812 **
school        0.021640   0.370220   0.058  0.95339
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 93.941  on 82  degrees of freedom
Residual deviance: 70.324  on 72  degrees of freedom
AIC: 271.69

Number of Fisher Scoring iterations: 5
```





7 Results for a

7.1 Summary Values for a

Table 7.1: Descriptives for Outcome Before Ferguson Protests Begin

Statistic	N	Mean	St. Dev.	Min	Median	Max
a	83	2.036	1.526	0	2	5

Table 7.2: Descriptives for Outcome After Ferguson Protests Begin

Statistic	N	Mean	St. Dev.	Min	Median	Max
a	116	1.457	1.295	0	1	6

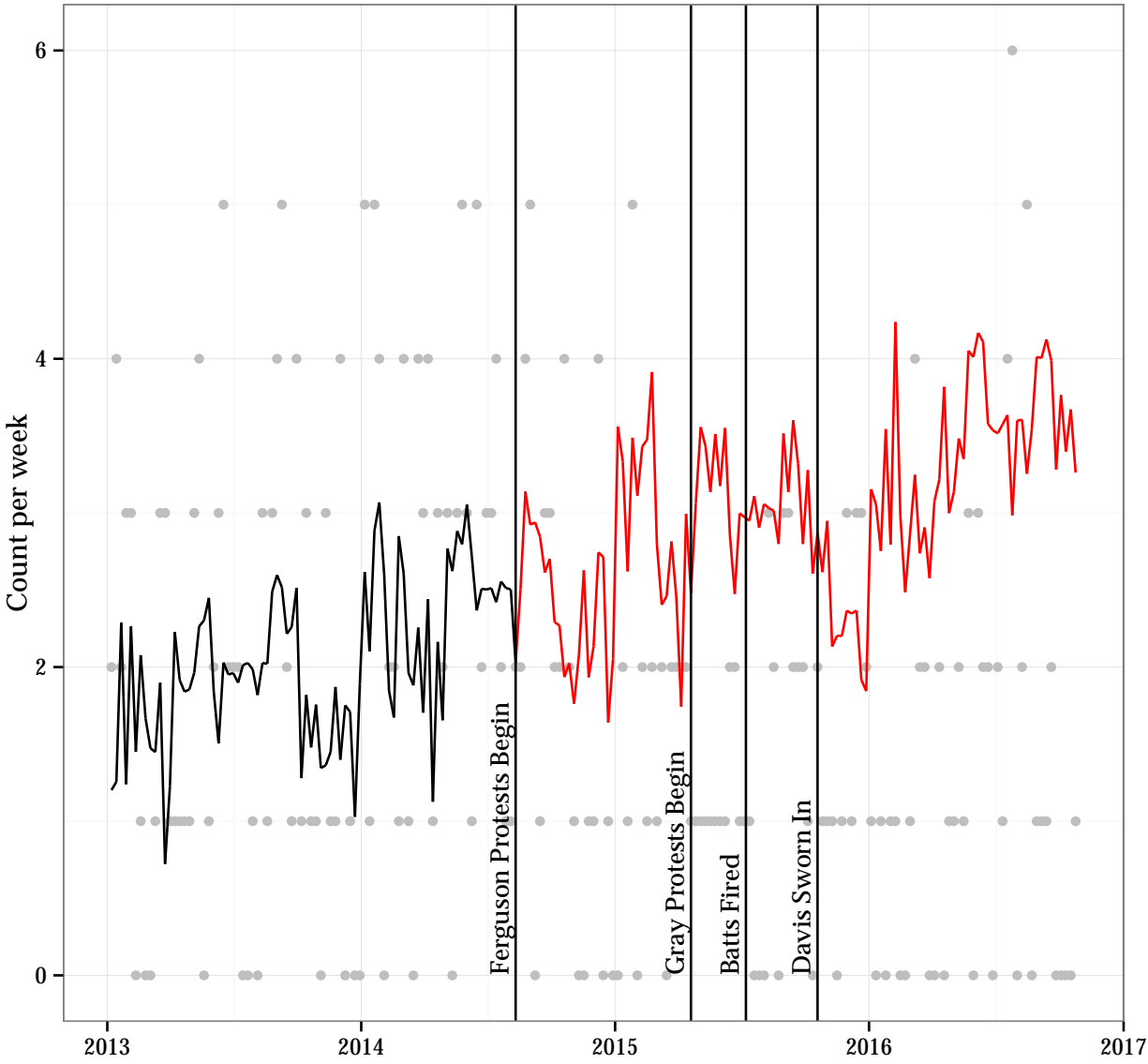
7.2 Four Models for a

Table 7.3: Four Models that Differ on the Specification of Adjustment and Intervention Variables

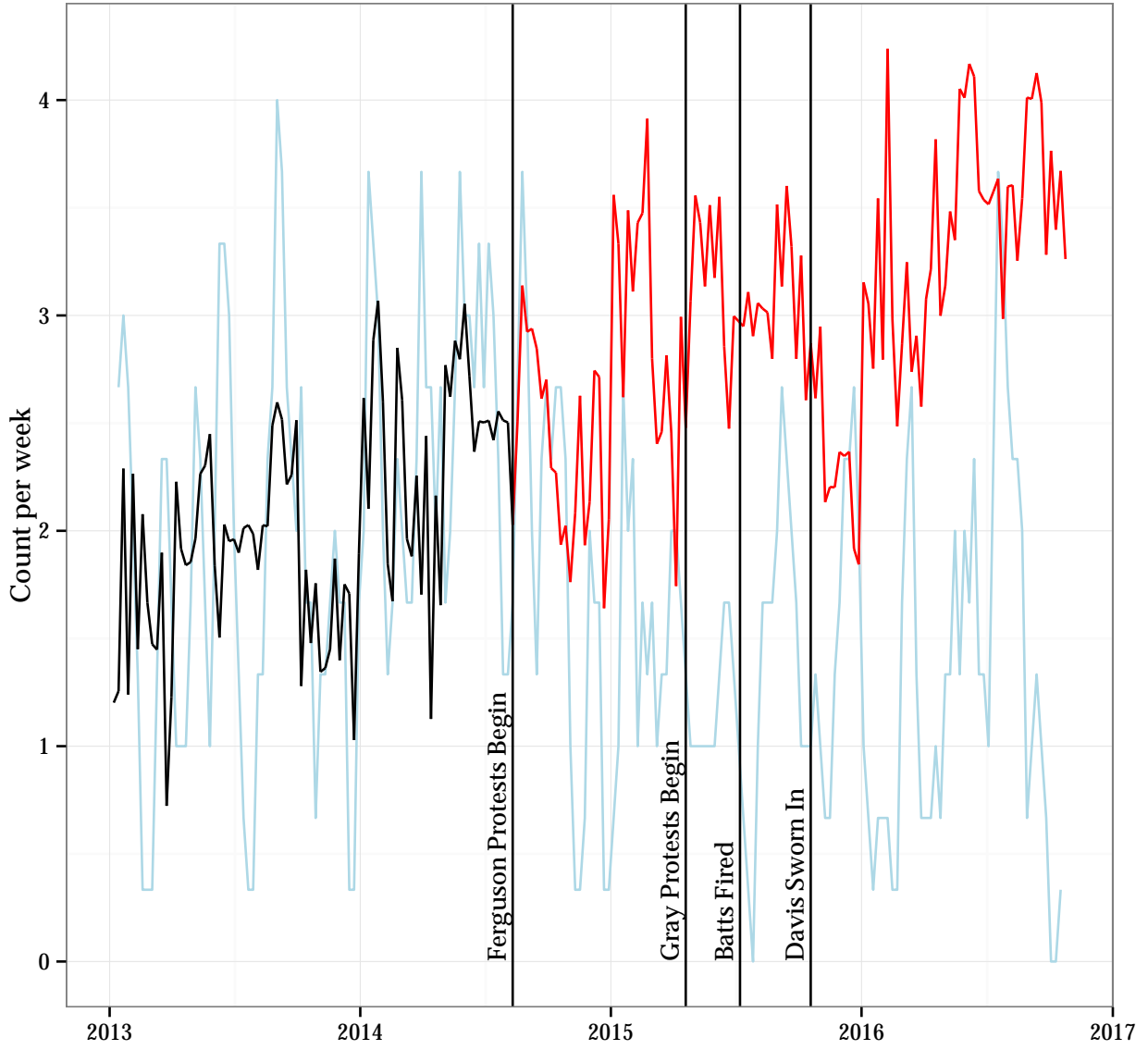
	Outcome: Count Per Week			
	(1)	(2)	(3)	(4)
Time (counter in weeks)	0.01	0.01		0.002
After Ferguson Protests Begin (week of 8/11/14 onward)	-0.69		-0.90	-0.36
After Gray Protests Begin (week of 4/20/15 onward)	-0.69		-1.02	-1.05
Unrest and National Guard (4/27/15 - 5/3/2015)	-0.15		-0.14	0.26
After Batts Fired (week of 7/13/15 onward)	0.10		0.20	-0.001
After Davis Sworn In (week of 10/19/15 onward)	-0.20		-0.11	0.33
Average Maximum Temperature to 50 Degrees		-0.09		-0.06
Plus Degrees in the 50s		0.04		0.14
Plus Degrees in the 60s		0.11		-0.09
Plus Degrees in the 70s		-0.04		0.04
Plus Degrees Greater Than 80		-0.03		0.08
Snowfall (inches)		-0.44		-0.35
Precipitation (inches)		-0.95		1.02
Darkness Before Midnight (hours)		-0.16		0.02
School Days (proportion of week)		0.85		0.93
Observations	199	83	199	199
R ²	0.06	0.11	0.26	0.15

7.3 Least Squares Model (2) for a

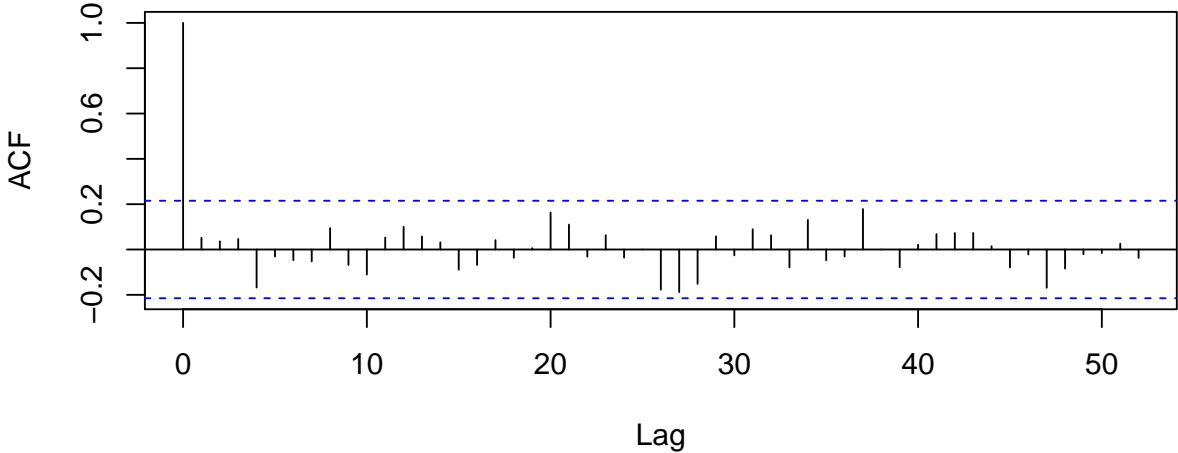
a



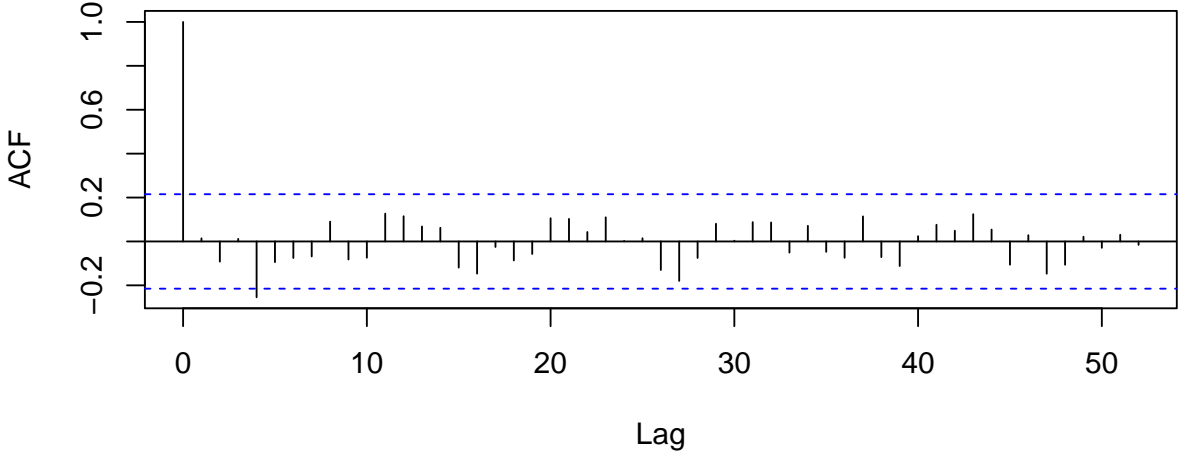
a



Autocorrelation Function for the Observed Outcome for Model (2)



Autocorrelation Function for the Residuals from Model (2)



7.4 A Poisson Regression Model as an Alternative to Model (2) for a

```
Call:
glm(formula = model.formula, family = poisson, data = df.windowed.pre)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.3014  -0.8459  -0.1450   0.7805   1.8668

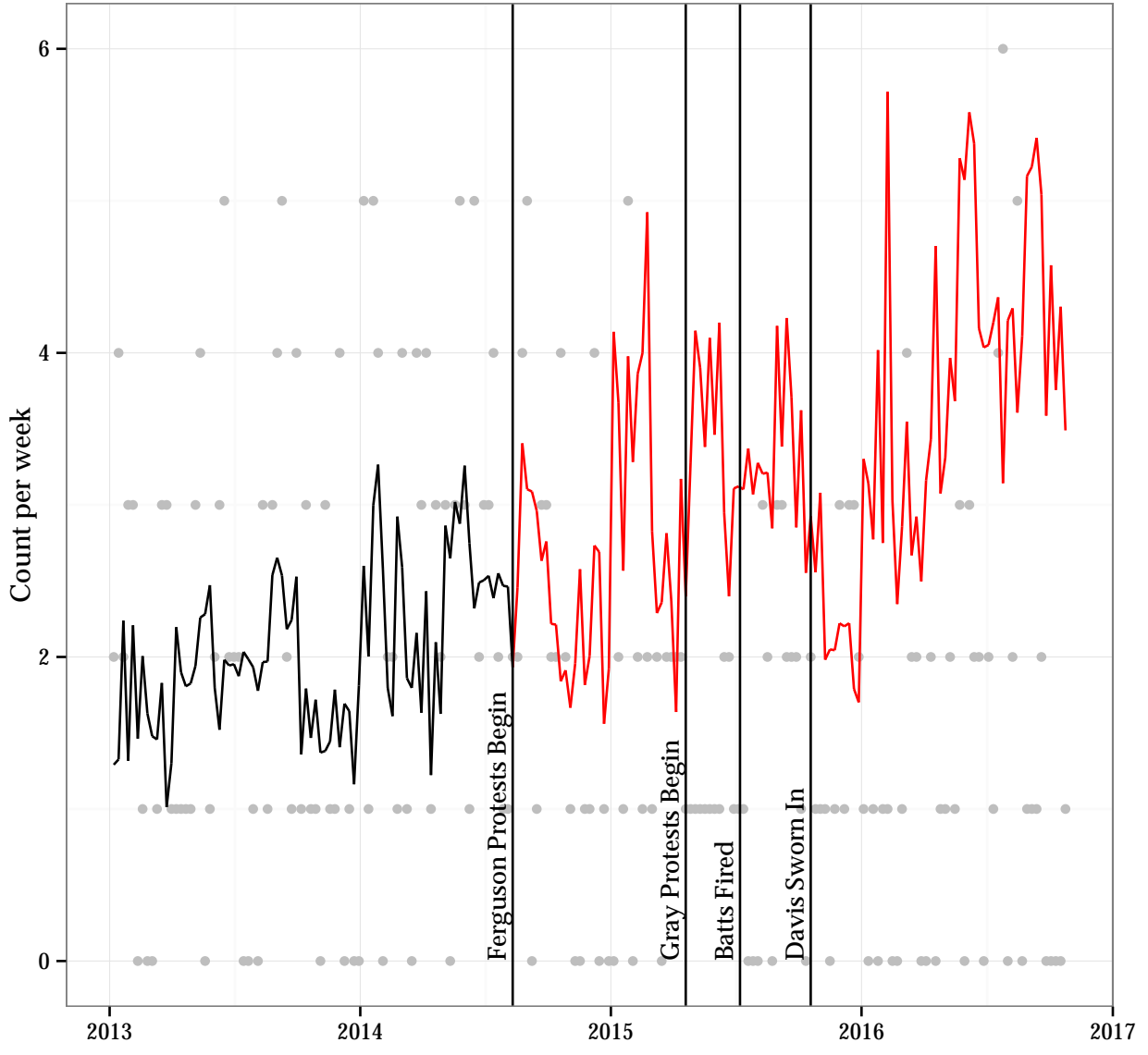
Coefficients:
                Estimate Std. Error z value Pr(>|z|)
(Intercept)    2.730313   1.489008   1.834  0.0667 .
t               0.004740   0.003439   1.379  0.1680
tmax.f.spline1 -0.043649   0.025481  -1.713  0.0867 .
tmax.f.spline2  0.021172   0.065875   0.321  0.7479
tmax.f.spline3  0.060873   0.096902   0.628  0.5299
tmax.f.spline4 -0.023830   0.082426  -0.289  0.7725
tmax.f.spline5 -0.011213   0.068545  -0.164  0.8701
snow.in        -0.213743   0.277338  -0.771  0.4409
precip.in      -0.478669   0.528627  -0.905  0.3652
dark.before.12 -0.081702   0.119813  -0.682  0.4953
school         0.432971   0.347540   1.246  0.2128
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

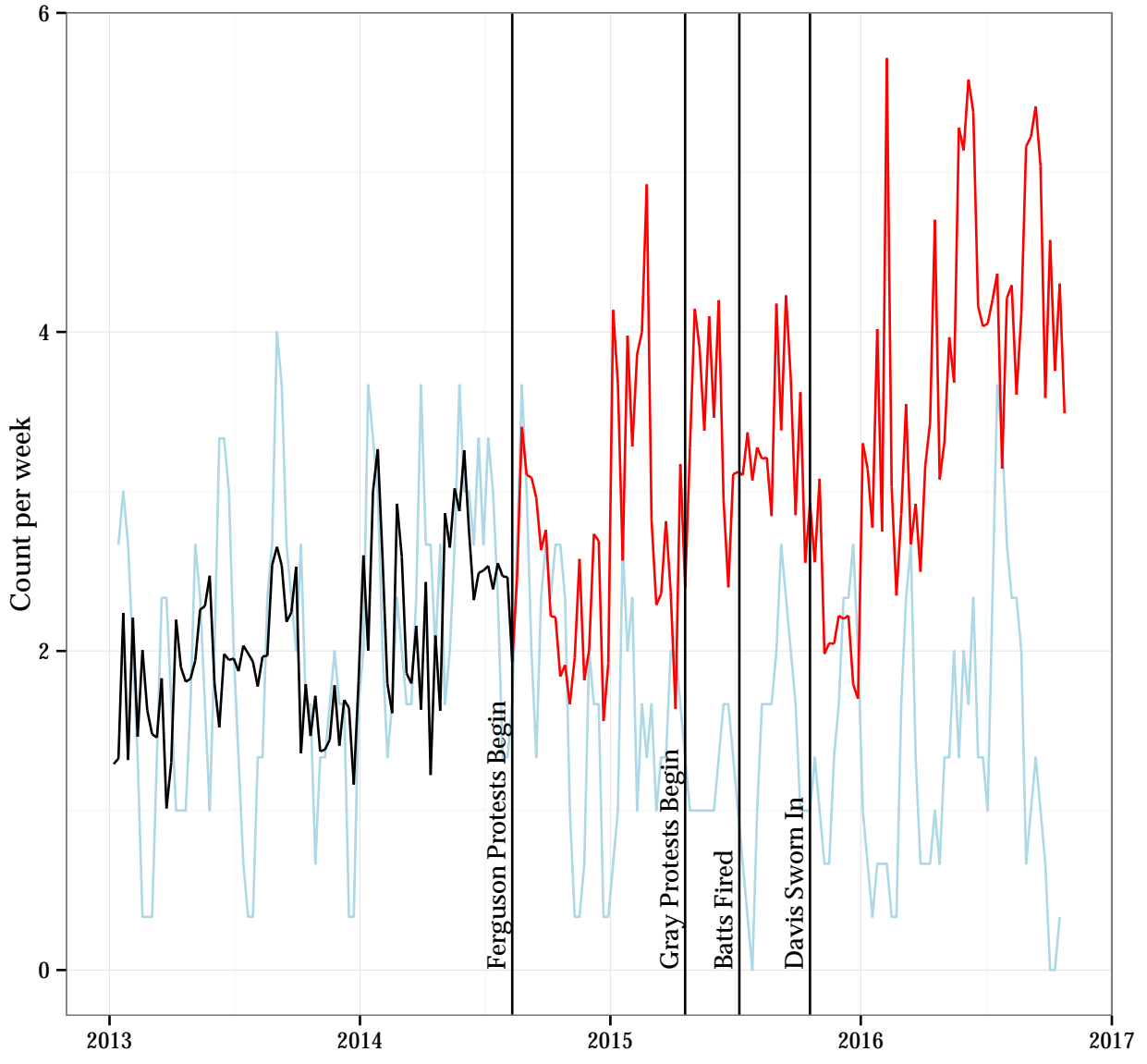
    Null deviance: 112.46  on 82  degrees of freedom
Residual deviance: 101.61  on 72  degrees of freedom
AIC: 307.38

Number of Fisher Scoring iterations: 5
```

a



a



8 Results for u

8.1 Summary Values for u

Table 8.1: Descriptives for Outcome Before Ferguson Protests Begin

Statistic	N	Mean	St. Dev.	Min	Median	Max
u	83	16.084	5.301	5	15	32

Table 8.2: Descriptives for Outcome After Ferguson Protests Begin

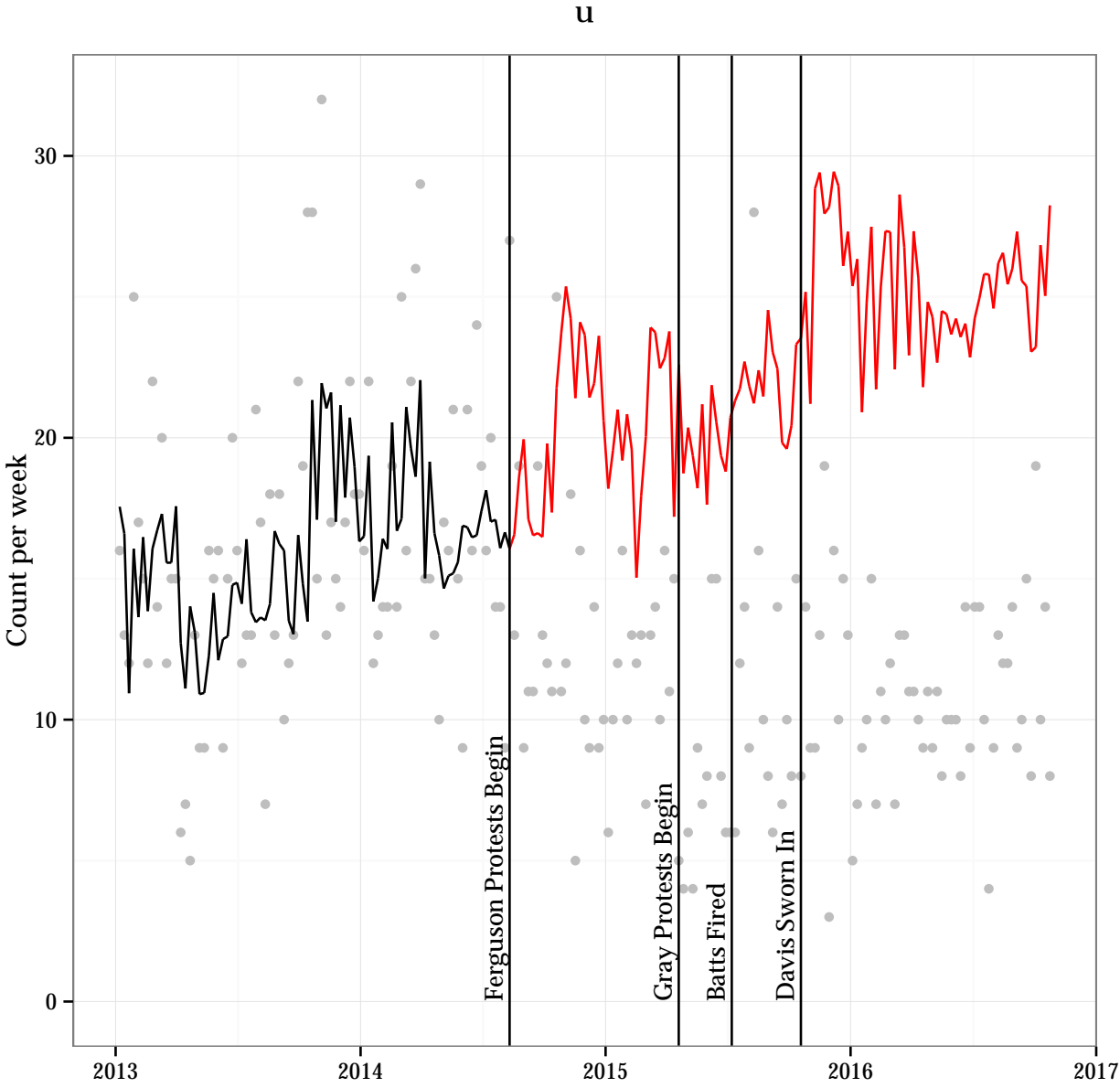
Statistic	N	Mean	St. Dev.	Min	Median	Max
u	116	11.224	4.304	3	10.5	28

8.2 Four Models for u

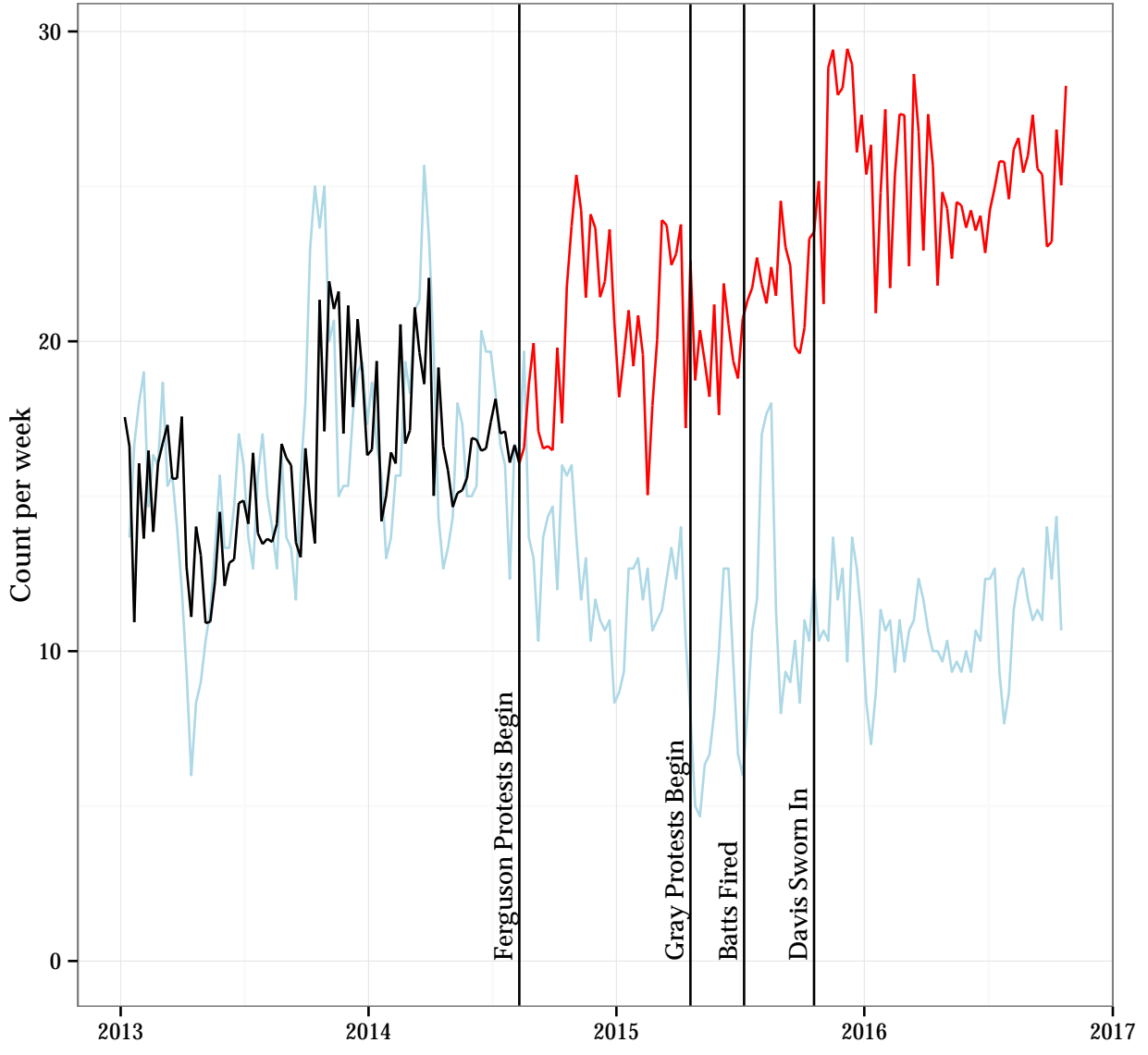
Table 8.3: Four Models that Differ on the Specification of Adjustment and Intervention Variables

	Outcome: Count Per Week			
	(1)	(2)	(3)	(4)
Time (counter in weeks)	0.03	0.06		0.04
After Ferguson Protests Begin (week of 8/11/14 onward)	-5.05		-7.50	-5.79
After Gray Protests Begin (week of 4/20/15 onward)	-5.48		-4.46	-5.28
Unrest and National Guard (4/27/15 - 5/3/2015)	-3.94		-2.77	-2.94
After Batts Fired (week of 7/13/15 onward)	3.17		1.76	2.55
After Davis Sworn In (week of 10/19/15 onward)	-1.85		-4.38	-2.95
Average Maximum Temperature to 50 Degrees		0.35		0.26
Plus Degrees in the 50s		-0.10		-0.02
Plus Degrees in the 60s		-1.08		-0.71
Plus Degrees in the 70s		1.14		0.71
Plus Degrees Greater Than 80		-0.02		-0.26
Snowfall (inches)		0.29		1.01
Precipitation (inches)		-0.31		-0.71
Darkness Before Midnight (hours)		0.69		0.62
School Days (proportion of week)		1.76		-0.58
Observations	199	83	199	199
R ²	0.26	0.25	0.65	0.33

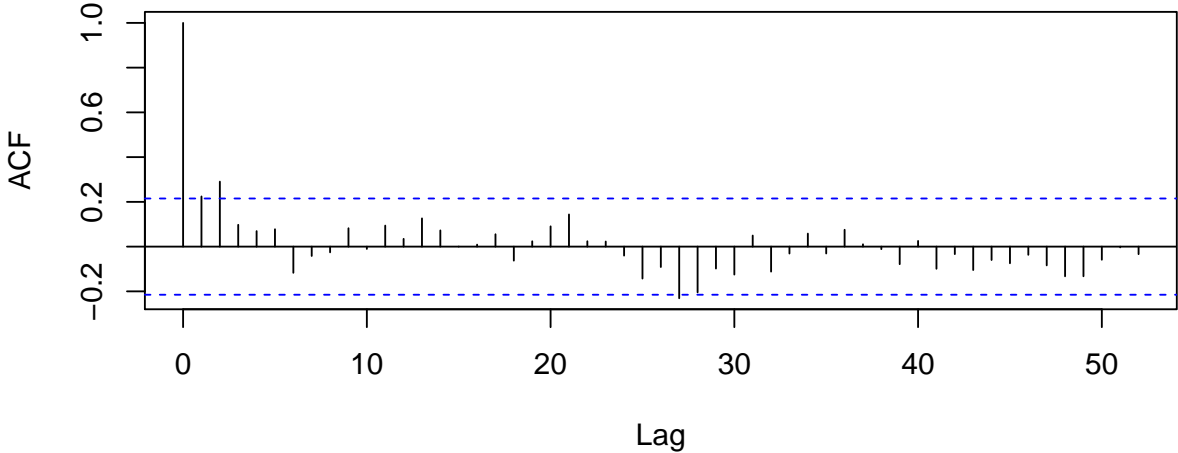
8.3 Least Squares Model (2) for u



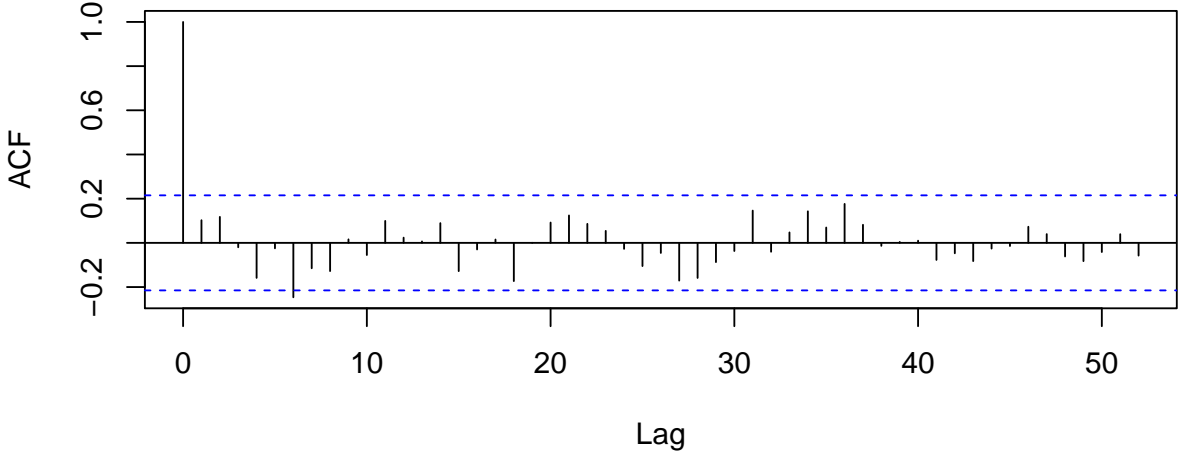
u



Autocorrelation Function for the Observed Outcome for Model (2)



Autocorrelation Function for the Residuals from Model (2)



8.4 A Poisson Regression Model as an Alternative to Model (2) for u

```
Call:
glm(formula = model.formula, family = poisson, data = df.windowed.pre)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.7169  -0.7635  -0.1975   0.7101   3.4906

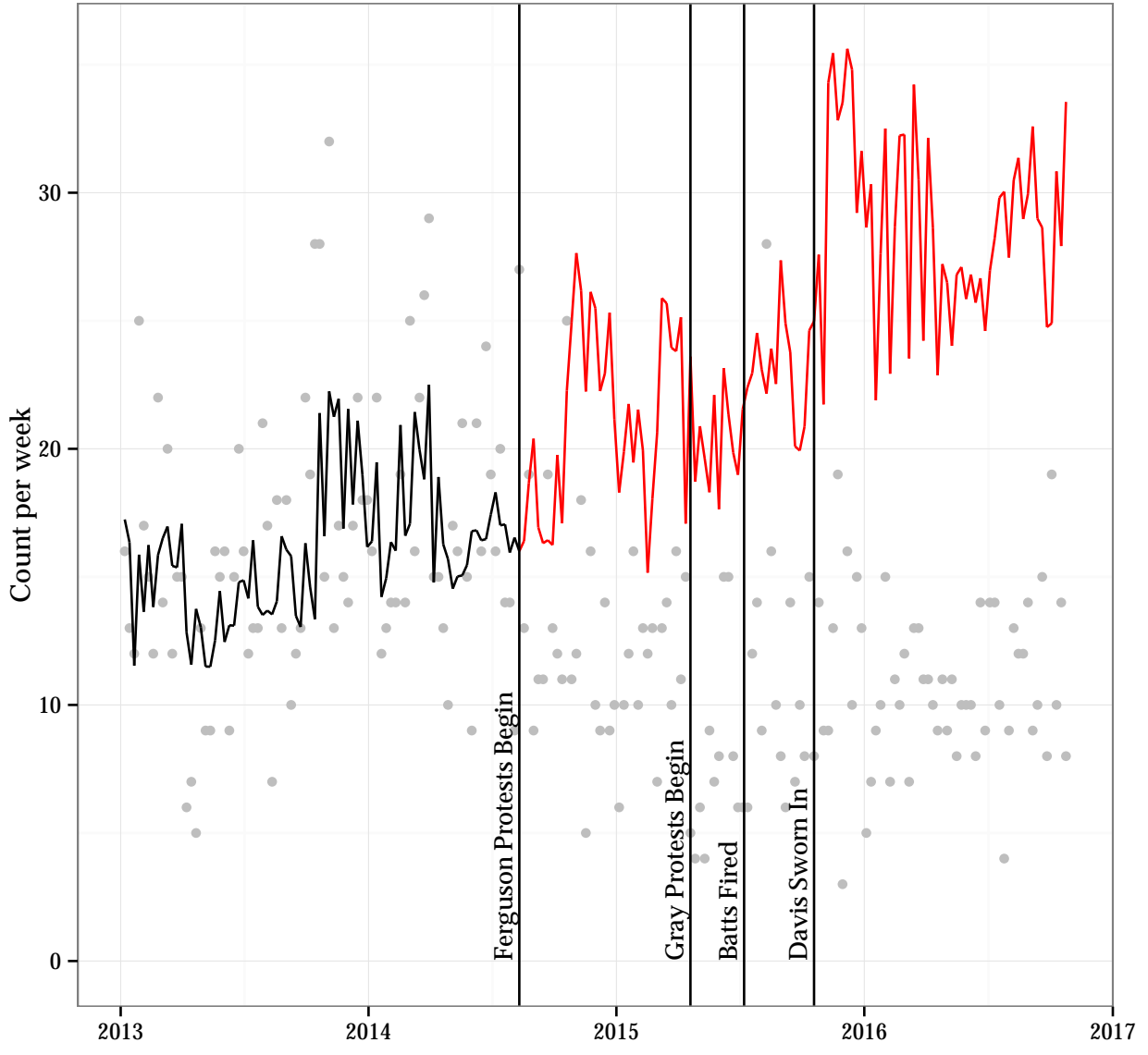
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  1.4238333  0.5205646   2.735  0.00623 **
t             0.0040732  0.0012457   3.270  0.00108 **
tmax.f.spline1  0.0210578  0.0090998   2.314  0.02066 *
tmax.f.spline2 -0.0091349  0.0202625  -0.451  0.65211
tmax.f.spline3 -0.0613775  0.0287404  -2.136  0.03271 *
tmax.f.spline4  0.0688393  0.0286229   2.405  0.01617 *
tmax.f.spline5 -0.0004767  0.0257541  -0.019  0.98523
snow.in       0.0183129  0.0953312   0.192  0.84767
precip.in    -0.0066280  0.1817279  -0.036  0.97091
dark.before.12 0.0396964  0.0377297   1.052  0.29274
school       0.1112108  0.1221802   0.910  0.36271
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 142.11  on 82  degrees of freedom
Residual deviance: 106.54  on 72  degrees of freedom
AIC: 507.95

Number of Fisher Scoring iterations: 4
```

u



u

