WPS Impaired

The WPS impaired driving charges time series are comprised of $n = 60$ monthly observations beginning January 1994 and ending December 1998. Ten time series were created corresponding the two weekgroup variables SunWed and ThuSat and the five hour one hour periods beginning at 11PM, 12AM, 1AM, 2AM and 3AM. For brevity we will refer to these time series using the codes S11, S12, S1, S2, S3, T11, T12, T1, T2 and T3. We are primarily interested in testing to see if a change occurred starting effective with May 1996, the 29th observation.

May 1996 corresponds to observation #29 in this series. A step intervention model defined by,

$$z_t = \mu + \delta \xi_t + N_t \quad (1)$$

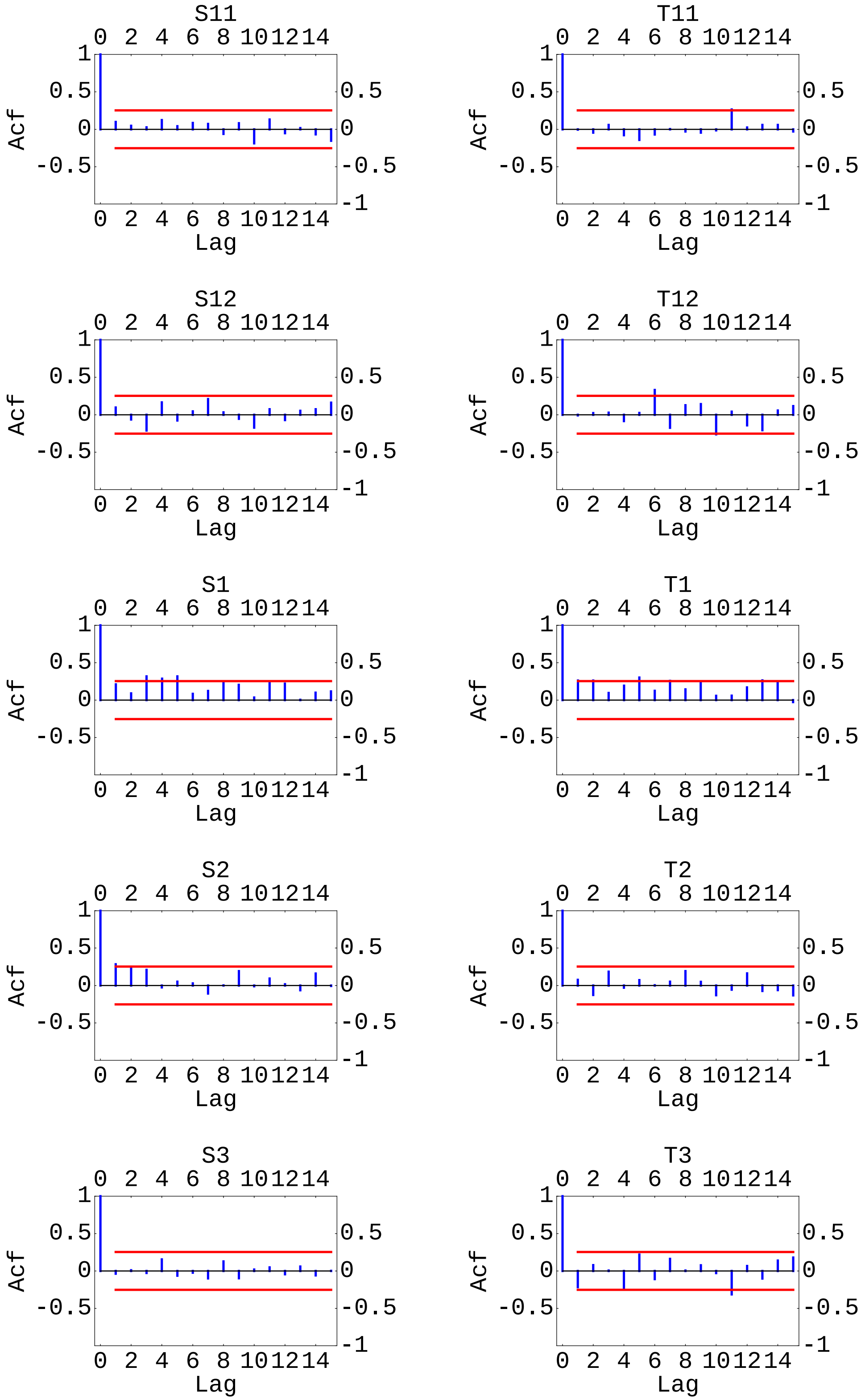
where N_t is the error term. Based on the pre-intervention data we assume initially that N_t is normal and independent, so ordinary multiple linear regression can be used. The intervention series are defined by,

$$\xi_t = \begin{cases} 0 & t < 29 \\ 1 & t \geq 29 \end{cases}$$

The term N_t represents the disturbance or error term and it has been tentatively identified as Gaussian white noise, that is $N_t = a_t$, where $a_t \sim \text{NID}(0, \sigma^2)$.

Autocorrelation Function

There does not seem to be any strong autocorrelations at either lag one or lag twelve across the entire series, $n = 60$. So we can model the intervention using regression and check that there is no autocorrelation remaining in the residuals.


S11
T11
S12
T12
S1
T1
S2
T2
S3
T3
Acf
Lag

Parameter Estimates

S11		Estimate	SE	TStat	PValue
	1	3.07143	0.425174	7.22393	1.23247×10^{-9}
	ξ	-0.665179	0.582194	-1.14254	0.257925

S12		Estimate	SE	TStat	PValue
	1	4.32143	0.57989	7.45215	5.09419×10^{-10}
	ξ	**-1.57143**	**0.794048**	**-1.97901**	**0.0525691**

S1		Estimate	SE	TStat	PValue
	1	10.0714	0.727315	13.8474	0.
	ξ	**-4.41518**	**0.995918**	**-4.43328**	**0.0000418896**

S2		Estimate	SE	TStat	PValue
	1	3.78571	0.622143	6.08495	9.86758×10^{-8}
	ξ	**2.15179**	**0.851905**	**2.52585**	**0.0142952**

S3		Estimate	SE	TStat	PValue
	1	1.42857	0.35514	4.02256	0.000168637
	ξ	**1.04018**	**0.486295**	**2.13899**	**0.0366585**

T11		Estimate	SE	TStat	PValue
	1	3.28571	0.347926	9.44372	2.47802×10^{-13}
	ξ	-0.598214	0.476417	-1.25565	0.214277

T12		Estimate	SE	TStat	PValue
	1	5.46429	0.499053	10.9493	8.88178×10^{-16}
	ξ	-0.839286	0.683357	-1.22818	0.22434

T1		Estimate	SE	TStat	PValue
	1	11.5	0.848245	13.5574	0.
	ξ	**-6.375**	**1.16151**	**-5.48856**	**9.33453×10^{-7}**

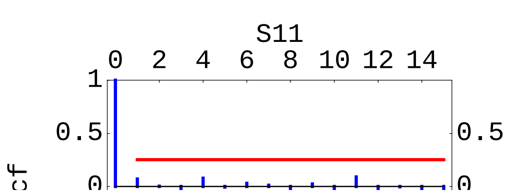
T2		Estimate	SE	TStat	PValue
	1	6.10714	0.7828	7.80167	1.3176×10^{-10}
	ξ	**3.17411**	**1.07189**	**2.96122**	**0.00443452**

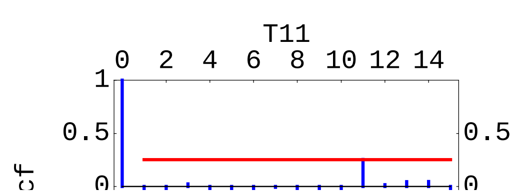
T3		Estimate	SE	TStat	PValue
	1	2.53571	0.375663	6.74997	7.69926×10^{-9}
	ξ	0.620536	0.514398	1.20633	0.232586

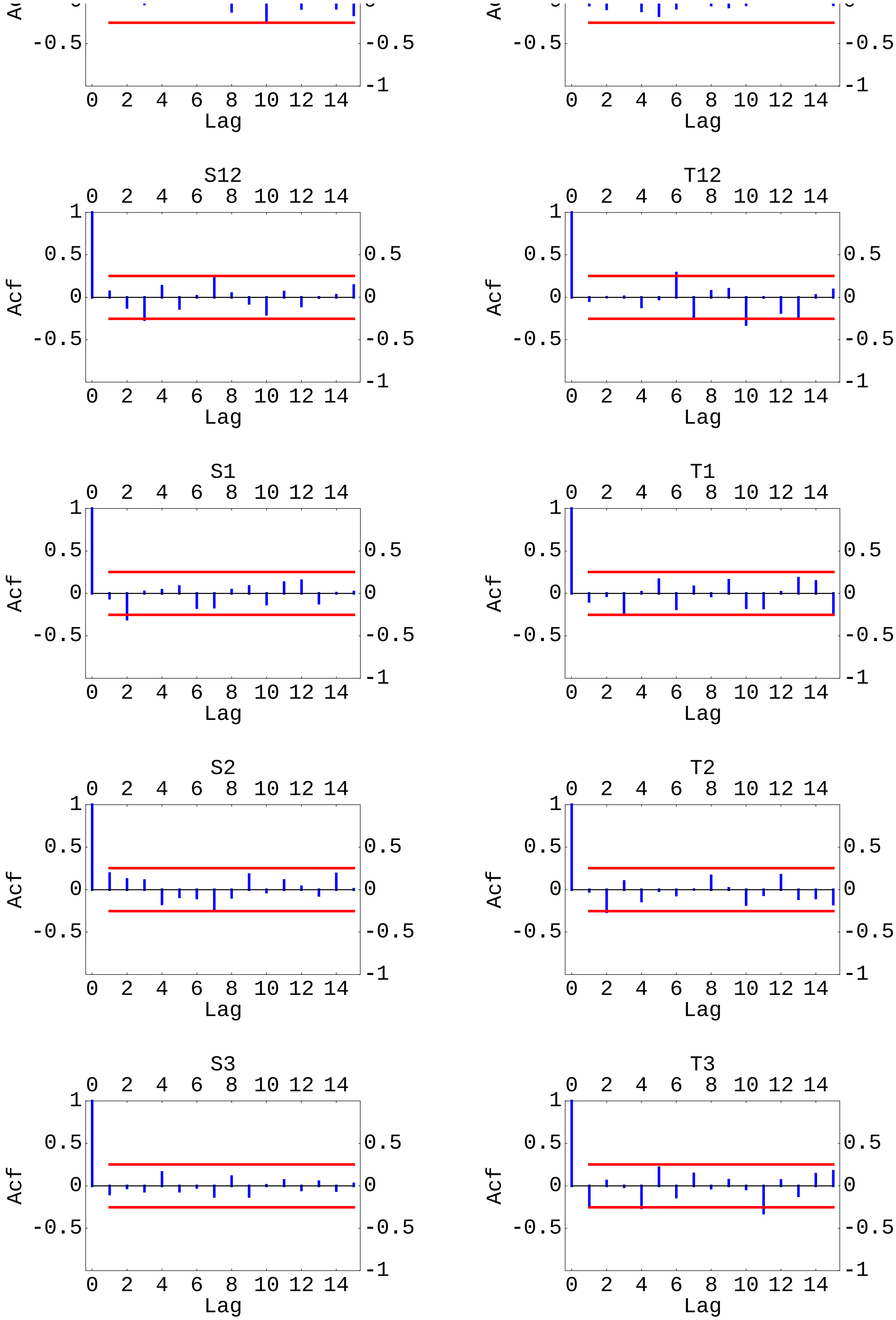
Using a one-sided test, the intervention parameter is significant at <5% for S12, S1, S2, S3, T1 and T12.

Residual Autocorrelation Analysis

The autocorrelation in the residuals is examined particularly at lag one and lag twelve. Everything looks reasonable except perhaps for T3 has a large negative autocorrelation at lag one.

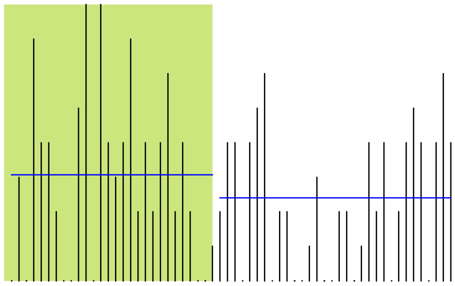




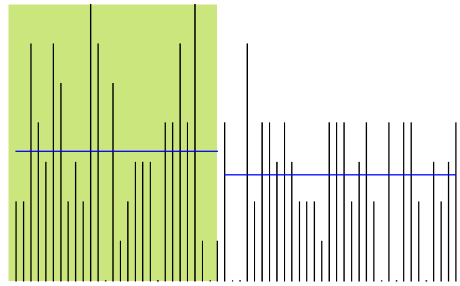


■ Visualization

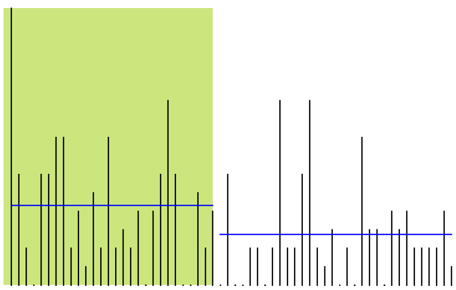
S11



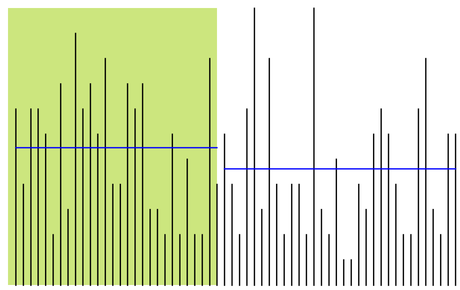
T11



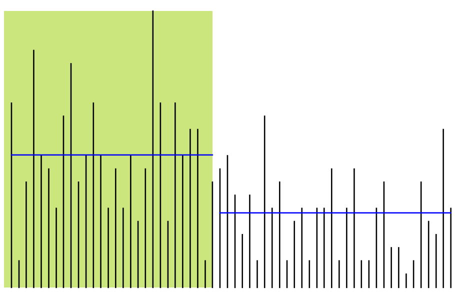
S12



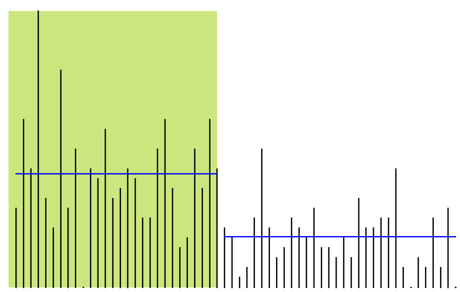
T12



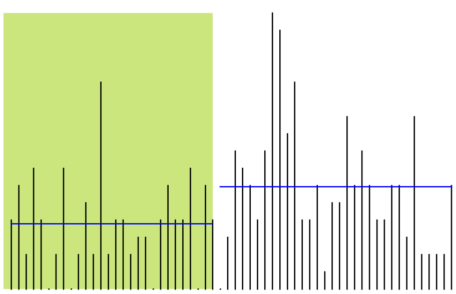
S1



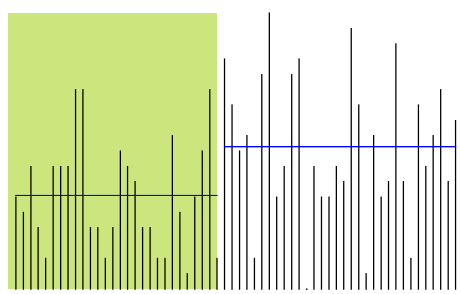
T1



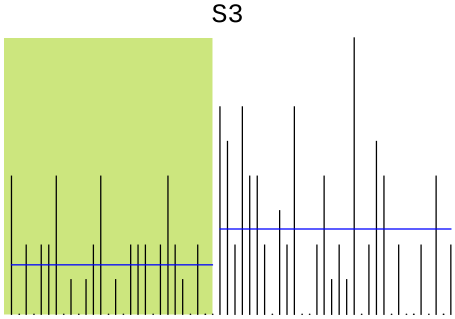
S2



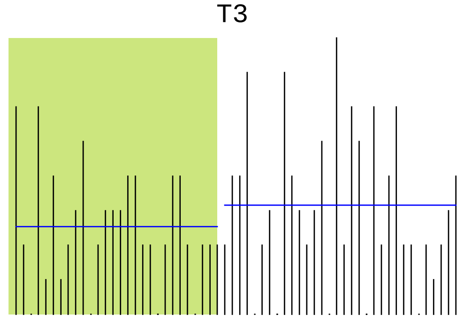
T2



S3



T3



Additional Fitting

T3 ARIMA (0, 0, 1)

The residual autocorrelation analysis indicated a negative lag one autocorrelation for the T3 series. Refitting with an ARIMA(0,0,1) error term, the intervention is now statistically significant at 5% on a one-sided test.

	Estimate	SE	P-Value
μ	2.505	0.18	0
δ	**0.647**	**0.366**	**0.078**
θ_1	0.262	0.125	0.036