TIRF All Hours

The time series is comprised on the monthly total number of deaths over all 24 hours for each day. Driver deaths only. The effect of the following interventions is modelled:

Cause of IV	**Date**	***T***
Graduated Licensing	June 1994	30
Administrative Suspensions	December 1996	60
Remedial Requirement & Increase in License Suspension	October 1998	82

A step intervention model defined by,

$$z_t = \mu + \delta_1 \xi_t^{(1)} + \delta_2 \xi_t^{(2)} + N_t \tag{1}$$

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,

$$\xi_t^{(1)} = \begin{cases} 0 & t < 30 \\ 1 & t \geq 30 \end{cases}$$

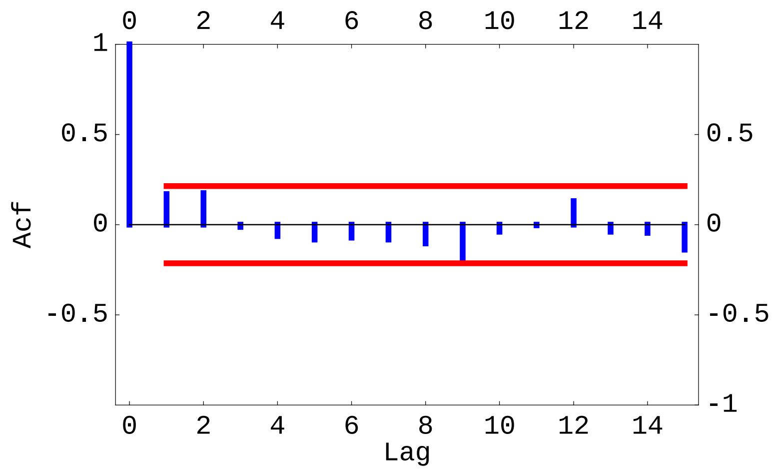
and

$$\xi_t^{(2)} = \begin{cases} 0 & t < 60 \\ 1 & t \geq 60 \end{cases}$$

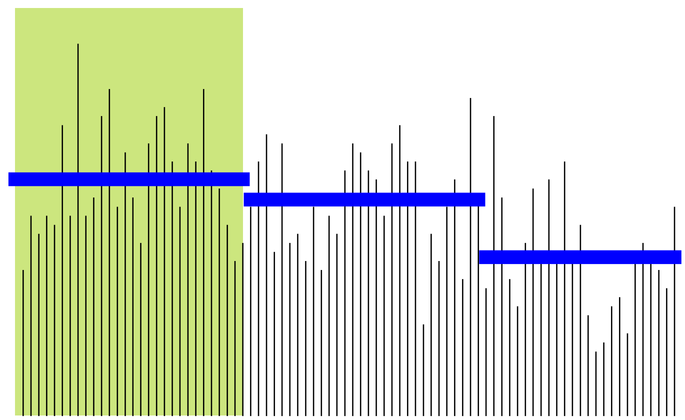
The regression result are tabulated below. Note that the PValue column is for a two-sided test. So on a one-sided test, the first intervention, Graduated Licensing is significant at about 8.5%. However Administrative Suspensions has had a much bigger effect as can be seen from the parameter estimate of -6.39 vs only -2.24.

	Estimate	**SE**	**TStat**	**PValue**
1	26.1034	1.15367	22.6265	0.
ξ1	-2.23678	1.61788	-1.38254	0.170606
ξ2	-6.38667	1.6824	-3.79616	0.000282553

As a check on the adequacy of the assumption for N_t the autocorrelation of the residuals is examined. The autocorrelation coefficients at lags one and two are nearly significant at 5%.



The graph below visually summarizes the data and the effect of the interventions. The three thick vertical lines show respectively from left to right μ, $\mu + \delta_1$, and $\mu + \delta_1 + \delta_2$.



Autocorrelated Error Model

From the autocorrelation plot it appears that there is some positive autocorrelation effect at lags one and two and possibily at the seasonal lag 12 as well. So some models were fit to eqn. (1) which allow for autocorrelation in the error term, N_t. Two models were fit,

$$N_t = a_t - \theta_1 a_{t-1} - \theta_2 a_{t-2} \qquad (2)$$

and

$$N_t = (1 - \theta_1 \mathfrak{B} - \theta_2 \mathfrak{B}^2)(1 - \Theta_1 \mathfrak{B}^{12}) \qquad (3)$$

where $a_t \sim \text{NID}(0, \sigma_a^2)$ and $\mathfrak{B}$ denotes the backshift operator on t, $\mathfrak{B} a_t = a_{t-1}$.

For the first model,

	Estimate	**SE**	**P-Value**
μ	25.832	0.872	0
δ_1	−1.734	2.025	0.392
δ_2	−6.655	2.102	0.002
θ_1	−0.148	0.107	0.165
θ_2	−0.202	0.107	0.058

And for the second model,

	Estimate	**SE**	**P-Value**
μ	25.937	0.961	0
δ_1	−2.127	2.079	0.306
δ_2	−6.408	2.148	0.003
θ_1	−0.141	0.107	0.189
θ_2	−0.195	0.107	0.069
Θ_1	−0.124	0.108	0.252

Diagnostic checks indicate that both models give acceptable fits. The first model is slightly more parsimonious and may be preferred on that grounds. But the second model has a coefficient, δ_1, which is more in line with the previous regression results.

It may be concluded that after allowing for the effect of autocorrelation, the signficance level of the first intervention due Graduated Licensing is increased and in the non-seasonal model, its effect is also lessed. The second intervention due to Administrative Suspensions remains statistically significant.