Alternative Report on GoSafe Speed Camera Data

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Methodology

The data for 274 fixed and mobile speed cameras were extracted from the Access database provide by GoSafe. The primary data consists of monthly frequencies of PICs and FSCs at each site (in the Casualty History file) and made up of 60493 records or site-months with the earliest records being for April 1993 and the latest December 2013. Other sources gave the site IDs, the start and end dates of the Operational Case Period and the Date Approved for each site, and the site type (mobile or fixed camera). Data were obtained from the Road Safety Wales website on the annual totals of PICs and FSCs and, by means of interpolation, monthly values were estimated for all months from January 1993 to December 2013, to provide the means of allowing for trend in the subsequent modelling. In total there are 9996 PICs and 1428 FSCs across the 274 sites.

It seemed likely that the "Operational Case Period" (OCP, which is 3 years in length in all cases) represents what is usually referred to as the Site Selection Period (SSP). The collision frequencies will generally be appreciably higher during the SSP compared with the periods before and after, due to bias by selection or regression to the mean (RTM). In estimating the effectiveness of the cameras it is essential to avoid including any part of the SSP in what is regarded as the before period; failure to do this will result in an exaggerated estimate of the camera benefit. The date approved is, on average, about 12 months after the end of the SSP, although this varies from site to site (the most frequent gap is found to be 16 months). However there are 19 sites where the date approved is eight months *before* the end of the Operational Case Period.

Figure 1 shows an idealised form of graph of what is expected to occur at any site over time (with adjustment for trend having been made). It can be seen that there are four periods: the before or pre-SSP period, the SSP, the ASBIC (after selection but before installation of the camera), and the after period. Immediately after the end of the SSP, the level reverts to that prevailing in the before period. This means that if the SSP can be identified, we can use a combination of the pre-SSP and the ASBIC periods as the baseline for comparison of the level in the after period, in order to estimate the camera effect (that is, the factor by which the collision rate is multiplied after installation).

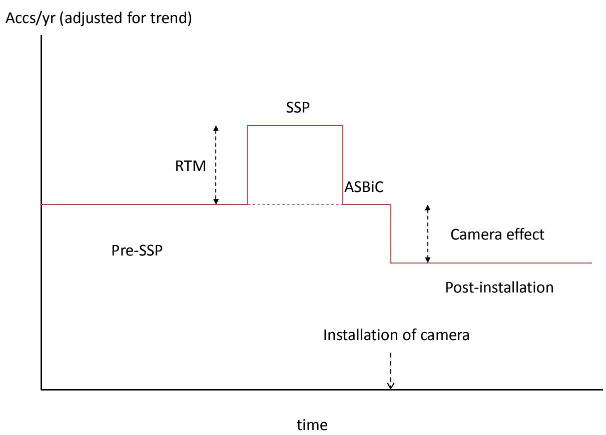

Figure 1: idealised form of plot of crashes per unit time, adjusted for trend

To check on the validity of the use of the OCP as the SSP we firstly fit a model of the following form:

$$E(y_{it}) = k_i\, R_t\, F_{t-s(i)}$$

where $E(y_{it})$ is the expected number of collisions at site *i* in month *t*, R_t is the regional total of collisions in month *t* (to allow for trend), and *F* is a factor to allow for the month *t* relative to the month of the start of the Operational Case Period *s*(*i*) at site *i*. This is in effect to time-shift the collision data (allowing for trend) so that the start months of the OCP Period for all sites line up. The value of *d* = *t* – *s*(*i*) is then grouped into 20 (mainly) six-month blocks, to give stability in the outputs. So the twenty blocks are: <-36, (-36, -31), … (0, 5), … (66, 71) and > 71. So blocks 8 to 13 inclusive cover the Operational Case Period (*d* = 0, 1, … 35). We fit a Poisson model with log link, and log(R_t) as offset, and have a factor *F* that takes separate values for each block of values of *d*, with block 1 (< -36) acting as the base level. The plots below show the estimates of the factor *F* for FSCs (left) and PICs (right).

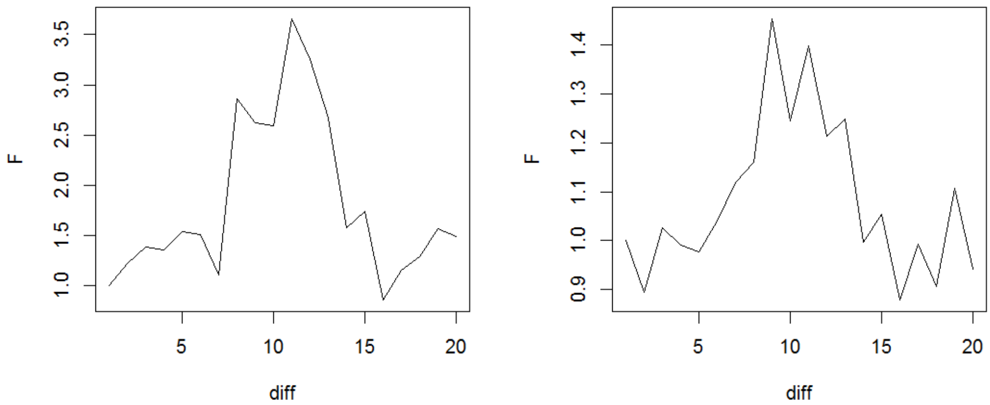

Figure 2: plots of the factor *F* for FSCs (left) and PICs (right)

These show clear evidence of the expected raised levels over the three-year period of the Operational Case Period, showing the RTM effect, and confirming that this period can indeed be taken as the SSP. Therefore we now know that when estimating the camera effect we need to compare the frequency in the after period with that in the combined before / ASBIC period. It is understood that the "date approved" specified for each site in the database may be taken to be the date of installation of the camera.

Estimates of camera benefits

We now fit models using the three periods (before / ASBIC, SSP and after) to estimate the mean change in collision rate (allowing for trend). We use the monthly data in the Casualty History file combined with the monthly (interpolated) national collision totals to give trend, and the site details (whether fixed or mobile, the date the camera was installed, and the start and end of the SSP).

$$E(y_{it}) = k_i\, P_{it}\, R_t$$

where y_{it} is the number of collisions at site i in month t, R_t is the total regional collisions in month t and P_{it} is the period factor (that is, at site i which of the before / ASBIC, SSP or after periods month t falls into).

Note the following differences between the method and data used here and those used in the Local Government Data Unit (LGDU) report:

- Here we use monthly data instead of annual data. As many of the dates (start and end of the SSP and date approved) are not at the start or end of a year, this allows more precise determination of the period (before, SSP, ASBIC or after) and the use of more data.
- The LGDU report said that it had excluded sites that had more than one camera location. Although there seemed no obvious reason why such sites *should* be excluded from the analysis, as the cameras appeared to have the same dates for the OCP and date approved, nevertheless the same procedure was followed here. As a result the modelling was done using data from the 238 sites with only one camera location. Of these, 61 were fixed and the remaining 177 were mobile cameras.
- However, I did not exclude sites from the fitting process on the grounds that they did not have at least six years data before installation *and* at least two years data after installation (see paragraph 18 of the LGDU report). The ASBIC period provides effectively the same information as the before data, and in any case we are not carrying out any analysis on individual sites, but only in aggregate. Sites with more limited before or after data (*eg* just one year's after data) will still contribute to the overall estimation process, albeit with more limited weight than sites with more after data. The modelling process works perfectly well with such sites left in and as a general rule it is not a good idea to discard relevant and useful data. The effective sample size decreases if they are omitted and the precision with which estimates can be made is poorer (*ie* confidence intervals become wider).
- Also, it is unclear whether the LGDU models combined the before and ASBIC periods to produce a three period model or left them separate, so that the principal comparison was between before and after periods.

The table below shows the estimated percentage change in collision rate (FSCs and PICS) from before to after for (i) fixed and mobile cameras (*N* = 238); (ii) fixed cameras (*N* = 61); and (iii) mobile cameras (*N* = 177), together with the associated 95% confidence intervals. Statistically significant decreases are shown with an asterisk alongside.

Table 1: estimates of % change (before to after) and 95% confidence intervals

	PICs		**FSCs**	
	estimate	**95% CI**	**estimate**	**95% CI**
Fixed and mobile	-2.1%	(-7.2%, +3.4%)	+15.2%	(-0.1%, +32.9%)
Fixed	-28.1%*	(-34.2%, -21.3%)	-13.6%	(-33.4%, +12.2%)
Mobile	+16.4%	(+8.7%, +24.7%)	+29.9%	(+9.4%, +54.2%)

As expected the estimates are more precise and the CIs are narrower when more data is used. There is therefore more possibility of producing statistically significant results (that is, showing that the percentage change is significantly less than zero, or equivalently that the 95% CI does not include zero) the larger the sample size is.

The results show that although there are no significant decreases in FSCs, there is a significant decrease in PICs for fixed camera sites (-28%).

Table 2 shows, for comparison, the equivalent estimates and confidence intervals quoted in the LGDU report. There is broad similarity for PICs but very little for FSCs (except that none of the results show a significant decrease in FSCs). The width of the CIs in Table 1 can be seen to be considerably narrower than the corresponding ones in Table 2, showing that the estimates produced here are more precise due to the use of monthly data in place of annual data.

Table 2: estimates of camera effect quoted in the LGDU report

	PICs		**FSCs**	
	estimate	**95% CI**	**estimate**	**95% CI**
Fixed and mobile	-3.2%	(-12.0%, +6.5%)	-17.2%	(-37.9%, +10.6%)
Fixed	-23.3%*	(-36.5%, -7.5%)	-46.2%	(-71.5%, +1.4%)
Mobile	-4.1%	(-30.7%, +32.7%)	+6.2%	(-4.9%, +18.6%)

Summary

Data for monthly collisions have been extracted from the Access database provided by GoSafe. Because most of the 3-year Operational Case Periods did not cover whole calendar years, and the Dates Approved were at a variety of times across the year, it was felt that it was best to keep the collision data in monthly form in order to get the most out of the available data.

An initial exercise (illustrated in Figure 2) confirmed that the OCP could be safely taken as the SSP for each site. This is a major advantage in the modelling as it means that the problem of RTM that arises in the use of many other similar datasets (where the SSPs are not generally known) can be more easily avoided. The period between the end of the SSP and the date of installation of the camera is then what is known as the ASBIC period. For the most efficient use of the available data, we should then compare the collisions in the after period with those in the combined before and ASBIC periods (allowing for trend, of course).

The modelling carried out is of the same general form as that used in Allsop's RACF report: a multiplicative Poisson model, with three periods: before/ASBIC, SSP and after. The main focus is on the camera effect (comparison of the after with the combined before/ASBIC period).

Overall the results from the modelling show that there is a significant decrease in PICs at fixed sites and, as a consequence, at all (fixed and mobile) sites, albeit marginally. The results here for PICs are in broad agreement with the corresponding ones in the LGDU report, although those here are stronger. It should be noted that the executive summary in the LGDU report claimed evidence of a decrease in PICS at *all* sites whilst the detailed results inside (paragraph 23) show this not to be the case. The significant decrease applied only to fixed sites.

The results here show no significant decreases in FSCs for any set of sites. The executive summary in the LGDU report claimed there was evidence of a 17% reduction in FSCs at cameras sites, but this was not supported by the detailed results (paragraph 35) within the report.