Northamptonshire Speed Cameras: Post Switch-Off Collision Analysis

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Northamptonshire Speed Cameras: Post Switch-Off Casualty Trend Analysis

Introduction

Northamptonshire saw a rapid expansion in speed enforcement technology during the early part of the last decade with 46 cameras installed at 41 separate sites between August 2000 and October 2004. This was made possible due to a pilot scheme setup by the Government that allowed local partnerships; comprising of police forces, local authorities and the courts; the ability to recovers enforcement costs directly from fine income. This cost recovery system ended in 2007 and with increased pressure on local authorities for funding the Northamptonshire speed cameras were switched off in April 2011.

Government-sponsored research carried out by University College London and published in 2005 indicated that there had been a reduction in collisions where someone was killed or seriously injured (KSI) of 47.9%, and for all personal injury collisions (PIC) of 54.2%[1]. These results compared well with the national averages for other areas that had installed cameras, where there was around 42% fewer KSIs at cameras sites and 22% fewer PICs.

The aim of this study was to review the casualty reduction performance of the Northamptonshire sites post-switch off compared to the period immediately prior to April 2011, and to compare these results with the trends for all other Northamptonshire roads.

How we analysed the data

Information about the location of the cameras was collected from Northamptonshire County Council and site boundaries plotted using a computerised mapping system[2]. Information about collisions was sourced via www.crashmap.co.uk which provides public access to the official DfT dataset of recorded injury collisions[3], and the collisions were then matched to the individual camera sites. Finally the data for the whole of Northamptonshire was obtained from MAST Online[4] which is used by local authorities, police forces and other roads safety organisations to review collision and casualty trends.

[1] The national safety camera programme Four-year evaluation report - December 2005
[2] For information about how site boundaries were created please see Appendix 1
[3] Data can be downloaded and verified at www.data.gov.uk
[4] www.roadsafetyanalysis.org

The results

We used data from April 2007 to March 2011 (inclusive) as the 'before' period and April 2011 to March 2015 as the 'after' period.

	Northamptonshire		Camera Sites	
	All	*KSI*	*All*	*KSI*
Before	7293	1628	90	29
After	5189	1193	71	16
Change	-29%	-27%	-21%	-45%
Chi-squared approx	*0.4*	*0.8*		

Table 1 – Pre- and Post-Switch-Off Results

In Northamptonshire, away from camera sites, there has been a reduction in KSI casualties over the four-year period of 29 percent compared to 21% at the switched-off locations. The statistical analysis of the results are reviewed in the next section of this report in some detail but it is worth noting here that **the changes between the two periods for Northamptonshire's roads and the speed camera sites are not statistically significant**.

There are two types of speed camera systems installed in the county, fixed speed cameras (FSC) which detect speeds at a single point on the road, and average speed cameras (ASC) which calculate speed between two points. We reviewed performance at these two different types of sites to see if there was a change in collision rates.

	Average Speed	Fixed Speed
Before	30	60
After	19	52
Change	37%	13%

Chi-squared approx 0.8

Table 2 – Changes in PIC casualties at different site types

Although the results appear to show a substantial difference with a much lower drop in collisions at the fixed sites, the small sample sizes make it impossible concluded that a significant difference has occurred.

Statistical testing

For testing the difference between two related sets of variables (paired, repeated or matched), the most common and appropriate test is **Paired T-test**. The variables must be continuous and there must be a distribution similar to normal of the difference between the cases of the two sets. Paired T-test is used to compare the means of the two samples of related data in terms of statistical significance. We approached the two camera sites differences from two perspectives. First as a difference between the numbers of PIC for the sites, pre-post switching off the cameras. The second approach analysed the difference between the ratios of PIC per Km pre-post switching off the cameras.

For both cases we used slightly different figures to those for the main analysis and selected Northamptonshire's A and B roads rather than the all Northamptonshire road figures. The aim of this was to see if there had been a significant change on roads of generally the same type as those where cameras were present. Also for this analysis, we did not include the results from the ASC sites as they are different in nature from the FSC sites both in the way they control speed and site length. We also excluded one fixed camera that was located on an unclassified road to ensure the sample was as homogenous as possible.

The four cases analysed were as follows:

1. Average PIC
2. Average PIC per Km
3. Average PIC ratio
4. Average PIC per Km ratio

The third and fourth analyses express the changes in collisions by transforming them into a ratio of the area mean for similar roads in Northamptonshire.

In all cases the null hypothesis was accepted as the 95% confidence interval was not reached. The full testing methodology and results are included in Appendix 2.

Limitations

The collision data obtained via www.crashmap.co.uk is of a slightly lower quality than that held by both Northamptonshire County Council and Northamptonshire Police. Specifically the accuracy of collision locations could be reduced by up to 10 metres due to national reporting standards which are lower than those used locally. Furthermore it has not been possible to exclude collisions at sites on dual carriageways where a collision took place on the opposite, unenforced carriageway. Both of these limitations are true for the before and after data however.

What do the results mean

Given the significant reduction in collisions immediately following the installation of the cameras up to 15 years ago, many would expect collisions to rise again once they were switched off. What these results show is the collisions have actually reduced in the post-switch-off period and that the variation in reductions against the Northamptonshire average of all other roads is not significant. It could therefore be said that the cameras have continued to 'work' despite their inactivity.

The main reason for this could be that drivers have not changed their behaviour at camera sites over the last four years. Anecdotal evidence from residents suggests that the vast majority of drivers still stick to the limit when passing camera sites, although there may be a small majority who choose to flout the law in the knowledge a ticket will not arrive in the post.

Motorists may still be under the impression that the cameras are working as the housings are regularly maintained and not covered in bags stating they are out of use. Previous, unpublished research by the author has shown that bagged cameras have an immediate impact on vehicles speeds, which return to normal once the bags are removed.

The most significant outcome from this analysis is that fixed speed cameras do not need to be loaded regularly to achieve casualty reduction. This could significantly change how cameras are operated nationally with the potential to reduce costs associated with the loading and processing of offences. The savings could be used to support more widespread deployment of enforcement cameras in more locations with lower loading ratios.

Further research

Although the differences in casualty reductions are very far from being statistically significant at the 95% confidence level, with an enhanced dataset from other areas that also turned off their speed cameras; such as Avon and Somerset, and the West Midlands, it may be possible to achieve greater sample sizes and test the null hypothesis further.

Previous studies of speed camera sites have also looked at changes in vehicle speeds. If speed surveys have been collected continuously at camera sites and were made available then it would be possible to understand more about driver behaviour at these locations.

The author is aware of previous research that attempted to investigate the impact on casualty reduction of different loading ratios. A full study into the effects of this, together with speed enforcement thresholds (the minimum speed at which a ticket is issued), may provide the basis for national guidelines on the most cost-effective way to ensure continued casualty reduction.

About RSA

Road Safety Analysis (RSA) has established itself as a leading supplier of analysis, research and intervention design in the road safety sector. Built on the principles of social enterprise, this not-for-profit company is focussed on developing, delivering and disseminating research projects with a particular focus on engaging the public and supporting the profession. RSA have invested heavily in infrastructure to support these ambitions with analytical platforms, survey tools, web architecture, app development and social media capacity that add significant extra value to their research and intervention design capabilities.

The RSA team have significant experience of analysing the effectiveness of road safety interventions from the three main areas of engineering, education and enforcement. Previous research topics have covered links between deprivation and road risk, rural young drivers, pedestrians and the night-time economy, older drivers, drink-driving, and much more.

About the Author

Richard Owen is a nationally renowned road safety specialist with experience in the public and private sector delivering pioneering and award winning projects. Before entering the field Richard worked in data management with a focus on spatial analysis and complex databases. These skills help him lead the analysis of enforcement activities and establish national best practice in evaluating the efficacy of these interventions. He has a proven ability to lead large multi-agency partnerships, achieve consensus and progress the joint aims of diverse agencies.

As a Director of Road Safety Analysis he has overseen exciting new developments and innovations, with many successes in visualising complex datasets and opening up big data to the public. He has worked with a number of clients and policy groups on a range of media campaigns which provided excellent exposure for clients and road safety topics. In his former role as Operations Manager of the Thames Valley Safer Roads Partnership, Richard was responsible for speed enforcement policy and evaluation of road safety interventions. Richard is a member of the PACTS Road Environment Working Party.

Report Team

Richard Owen	Project designer and author
George Ursachi	Statistical analysis
Paul Griffith	Spatial analysis
Andrew Hartley	GIS consultant

Appendix 1a – Site creation and collision matching

In order to analyse collisions near camera sites we had to create a mapping polygon to act as a selection tool. Determining the extent of the polygon for fixed 'spot' cameras and average speed cameras is always a subjective task and we have therefore adopted the following set of rules:

1. The polygons will cover the full width of the carriageway, plus a buffer of at least 15 metres to ensure collisions are matched correctly
2. The distance along the carriageway will be set according to the speed limit using a time / distance calculation. The extents are limited to the distanced travelled either side of the camera or cameras at the speed limit for 15 seconds e.g. 202.5 metres at 30mph.
3. Where a give way marking is reached before the equivalent 15 seconds of journey time is reached the site will terminate at this point.

Collisions were allocated to the camera site solely on the basis of their spatial location. No further checks were carried out on road numbers, direction of travel or accident descriptions to ensure that those allocated to a site were done so correctly. Furthermore no checks were carried out on collisions close to the site extents either.

Appendix 2 – Statistical Results

For testing the difference between two related sets of variables (paired, repeated or matched), the most common and appropriate test is Paired T-test. The variables must be continuous and there must be a distribution similar to normal of the difference between the cases of the two sets.
Paired T-test is used to compare the means of the two samples of related data in terms of statistical significance.
We approached the two camera sites differences from two perspectives. First as a difference between the numbers of PIC for the sites, pre-post switching off the cameras. The second approach analysed the difference between the ratios of PIC per Km pre-post switching off the cameras. For both cases we calculated the average for 4 years before and 4 years after the switching off.

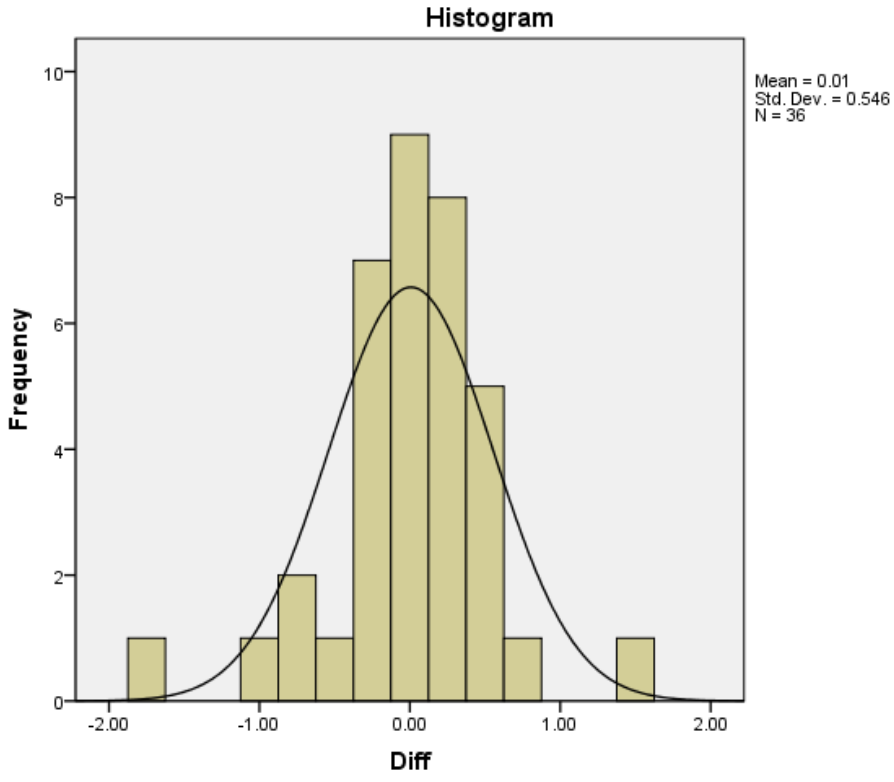
Case 1 – Average PIC

Site name or location	AvgB (before)	AvgA (after)	Difference
A14	0.5	0.5	0
A14 (2)	0	0.75	-0.75
A422	0	0	0
A428	0.25	0	0.25
A43	0.5	0	0.5
A43 (2)	0.5	0	0.5
A43 (3)	1	0.5	0.5
A508	0.5	0.75	-0.25
A5080	0.25	1	-0.75
A5123	0	1	-1
A5193	0.25	0	0.25
A605	0.75	0	0.75
A605 (2)	0.25	0	0.25
B4525	0	0	0

Banbury Road	0.5	0.25	0.25
Banbury Road (2)	0	0	0
Barrack Road	0.75	2.5	-1.75
Harborough Road	0.25	0	0.25
Harlestone Road	0.25	0.25	0
Harlestone Road (2)	0.5	0	0.5
Kettering Road	0	0.25	-0.25
Kettering Road (2)	1.5	0	1.5
Kingsthorpe Road	1	1.25	-0.25
Main Road, Wilby	0	0.5	-0.5
Oakley Road	1.5	1.5	0
Pytchley Road	0	0.25	-0.25
Rockingham Hill	0.5	0.25	0.25
Rushmere Road	0.25	0.5	-0.25
Stamford Road	0	0.25	-0.25
Stratford Road	0.75	0.25	0.5
Talavera WAy	0	0	0
Towcester Road	0.5	0.25	0.25
Welford Road	0	0	0
Wellingborough Road	0.75	0.5	0.25
Wellingborough Road (2)	0.25	0.5	-0.25
Welsh Lane	0	0	0
Mean	**0.39**	**0.38**	**0.01**
Northamptonshire mean	**0.56**	**0.46**	**0.10**

Before analysing the significance of the difference between the means of the two sets we need to analyse the distribution of the differences between cases. This distribution should be close to normal in order for the analysis to be robust.

From the above



Histogram we can easily conclude that the distribution of the differences is normal and we can proceed with the Paired T-test.

Hypotheses

The ***null hypothesis***:
H0: There is no difference in mean before and after for Average PIC for the analysed sites.
And an ***alternative hypothesis*** might be:
H1: There is difference in mean before and after for Average PIC for the analysed sites.

In order for H0 to be accepted at the level of confidence of 95%, p value (Sig. (2-tailed) from the output) must be > 0.05.

Output

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	AvgB - AvgA	.00694	.54604	.09101	-.17781	.19170	.076	35	**.940**

Conclusion

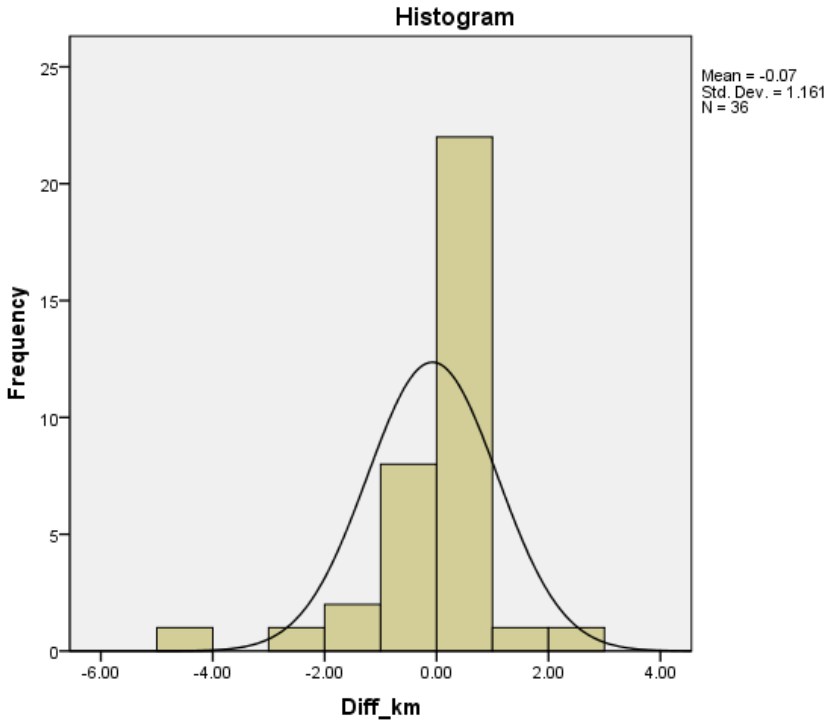
Because p value is 0.940 > 0.05, the null hypothesis is accepted, ***'There is no difference in mean before and after for Average PIC for the analysed sites'.*** *This means that the difference between the two sets could have arisen by chance very easily indeed.*

Case 2 – Average PIC per Km

Site name or location	AvgB_Km (before)	AvgA_Km (after)	Difference_Km
A14	0.53	0.53	0
A14 (2)	0	0.79	-0.79
A422	0	0	0
A428	0.62	0	0.62
A43	0.53	0	0.53
A43 (2)	0.53	0	0.53
A43 (3)	1.06	0.53	0.53
A508	0.75	1.12	-0.37
A5080	0.63	2.50	-1.88
A5123	0	2.47	-2.47
A5193	0.74	0	0.74
A605	0.82	0	0.82
A605 (2)	0.46	0	0.46
B4525	0	0	0

Banbury Road	1.23	0.62	0.62
Banbury Road (2)	0	0	0
Barrack Road	1.85	6.17	-4.32
Harborough Road	0.31	0	0.31
Harlestone Road	0.62	0.62	0
Harlestone Road (2)	0.93	0	0.93
Kettering Road	0	0.62	-0.62
Kettering Road (2)	2.78	0	2.78
Kingsthorpe Road	2.47	3.09	-0.62
Main Road, Wilby	0	1.23	-1.23
Oakley Road	2.80	2.80	0
Pytchley Road	0	0.62	-0.62
Rockingham Hill	1.49	0.75	0.75
Rushmere Road	0.62	1.23	-0.62
Stamford Road	0	0.62	-0.62
Stratford Road	1.85	0.62	1.23
Talavera WAy	0	0	0
Towcester Road	1.23	0.62	0.62
Welford Road	0	0	0
Wellingborough Road	1.85	1.23	0.62
Wellingborough Road (2)	0.62	1.23	-0.62
Welsh Lane	0	0	0
Mean	**0.76**	**0.83**	**-0.07**
Northamptonshire mean	**1.03**	**0.85**	**0.18**

Before analysing the significance of the difference between the means of the two sets we need to analyse the distribution of the differences between cases. This distribution should be close to normal in order for the analysis to be robust.



From the above Histogram we can easily conclude that the distribution of the differences is normal and we can proceed with the Paired T-test.

Hypotheses

The ***null hypothesis***:
H0: There is no difference in mean before and after for Average PIC per Km for the analysed sites.
And an ***alternative hypothesis*** might be:
H1: There is difference in mean before and after for Average PIC per Km for the analysed sites.

In order for H0 to be accepted at the level of confidence of 95%, p value (Sig. (2-tailed) from the output) must be > 0.05.

Output

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	AvgB_km - AvgA_km	-.07450	1.16149	.19358	-.46749	.31849	-.385	35	**.703**

Conclusion

Because p value is 0.703 > 0.05, the null hypothesis is accepted, ***'There is no difference in mean before and after for Average PIC per Km for the analysed sites'.*** *This means that the difference between the two sets could very easily have arisen by chance.*

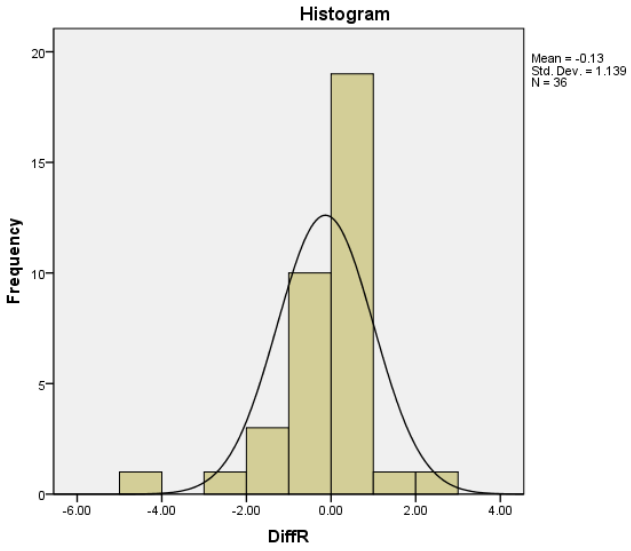
For taking in account the area trend we computed these values by transforming them into a ratio of the area mean (Northamptonshire mean) for the same categories of roads for each period analysed.

Case 3 – Average PIC ratio

Site name or location	AvgB ratio (before)	AvgA ratio (after)	Ratio Difference
A14	90.03%	109.24%	-19.21%
A14 (2)	0.00%	163.86%	-163.86%
A422	0.00%	0.00%	0.00%
A428	45.02%	0.00%	45.02%
A43	90.03%	0.00%	90.03%
A43 (2)	90.03%	0.00%	90.03%
A43 (3)	180.07%	109.24%	70.83%
A508	90.03%	163.86%	-73.83%

A5080	45.02%	218.48%	-173.47%
A5123	0.00%	218.48%	-218.48%
A5193	45.02%	0.00%	45.02%
A605	135.05%	0.00%	135.05%
A605 (2)	45.02%	0.00%	45.02%
B4525	0.00%	0.00%	0.00%
Banbury Road	90.03%	54.62%	35.41%
Banbury Road (2)	0.00%	0.00%	0.00%
Barrack Road	135.05%	546.21%	-411.16%
Harborough Road	45.02%	0.00%	45.02%
Harlestone Road	45.02%	54.62%	-9.60%
Harlestone Road (2)	90.03%	0.00%	90.03%
Kettering Road	0.00%	54.62%	-54.62%
Kettering Road (2)	270.10%	0.00%	270.10%
Kingsthorpe Road	180.07%	273.10%	-93.04%
Main Road, Wilby	0.00%	109.24%	-109.24%
Oakley Road	270.10%	327.73%	-57.62%
Pytchley Road	0.00%	54.62%	-54.62%
Rockingham Hill	90.03%	54.62%	35.41%
Rushmere Road	45.02%	109.24%	-64.22%
Stamford Road	0.00%	54.62%	-54.62%
Stratford Road	135.05%	54.62%	80.43%
Talavera WAy	0.00%	0.00%	0.00%
Towcester Road	90.03%	54.62%	35.41%
Welford Road	0.00%	0.00%	0.00%
Wellingborough Road	135.05%	109.24%	25.81%
Wellingborough Road (2)	45.02%	109.24%	-64.22%
Welsh Lane	0.00%	0.00%	0.00%
Mean	**70.03%**	**83.45%**	**-13.42%**
Northamptonshire mean	**100%**	**100%**	**0**

Before analysing the significance of the difference between the means of the two sets ratios, we need to analyse the distribution of the differences between cases. This distribution should be close to normal in order for the analysis to be robust.



From the above Histogram we can easily conclude that the distribution of the differences is normal and we can proceed with the Paired T-test.

Hypotheses

The ***null hypothesis***:
H0: There is no difference in mean before and after for Average PIC ratio for the analysed sites.
And an ***alternative hypothesis*** might be:
H1: There is difference in mean before and after for Average PIC ratio for the analysed sites.

In order for H0 to be accepted at the level of confidence of 95%, p value (Sig. (2-tailed) from the output) must be > 0.05.

Output

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	RatioB - RatioA	-.13422	1.13867	.18978	-.51949	.25105	-.707	35	**.484**

Conclusion

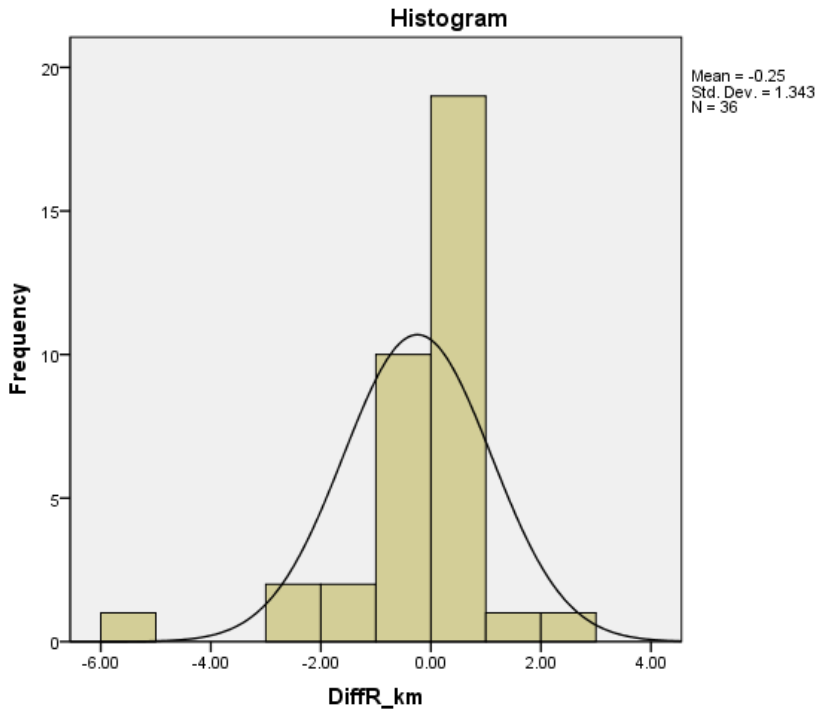
Because p value is 0.484 > 0.05, the null hypothesis is accepted, ***'There is no difference in mean before and after for Average PIC ratio for the analysed sites'.*** *This means that the difference between the two sets could easily have arisen by chance.*

Case 4 – Average PIC per Km ratio

Site name or location	AvgB_Km ratio (before)	AvgA_Km ratio (after)	Ratio_km Difference
A14	51.85%	62.92%	-11.06%
A14 (2)	0.00%	93.38%	-93.38%
A422	0.00%	0.00%	0.00%
A428	60.18%	0.00%	60.18%
A43	51.85%	0.00%	51.85%
A43 (2)	51.85%	0.00%	51.85%
A43 (3)	103.71%	62.92%	40.79%
A508	72.75%	132.41%	-59.66%
A5080	60.93%	295.71%	-234.78%
A5123	0.00%	292.06%	-292.06%
A5193	71.68%	0.00%	71.68%
A605	79.47%	0.00%	79.47%
A605 (2)	45.13%	0.00%	45.13%

B4525	0.00%	0.00%	0.00%
Banbury Road	120.35%	73.02%	47.34%
Banbury Road (2)	0.00%	0.00%	0.00%
Barrack Road	180.53%	730.15%	-549.62%
Harborough Road	30.46%	0.00%	30.46%
Harlestone Road	60.18%	73.02%	-12.84%
Harlestone Road (2)	91.11%	0.00%	91.11%
Kettering Road	0.00%	73.02%	-73.02%
Kettering Road (2)	270.80%	0.00%	270.80%
Kingsthorpe Road	240.71%	365.08%	-124.37%
Main Road, Wilby	0.00%	146.03%	-146.03%
Oakley Road	273.33%	331.64%	-58.31%
Pytchley Road	0.00%	73.02%	-73.02%
Rockingham Hill	145.50%	88.27%	57.23%
Rushmere Road	60.18%	146.03%	-85.85%
Stamford Road	0.00%	73.02%	-73.02%
Stratford Road	180.53%	73.02%	107.52%
Talavera WAy	0.00%	0.00%	0.00%
Towcester Road	120.35%	73.02%	47.34%
Welford Road	0.00%	0.00%	0.00%
Wellingborough Road	180.53%	146.03%	34.50%
Wellingborough Road (2)	60.18%	146.03%	-85.85%
Welsh Lane	0.00%	0.00%	0.00%
Mean	**74.00%**	**98.60%**	**-24.60%**
Northamptonshire mean	**100%**	**100%**	**0**

Before analysing the significance of the difference between the means of the two sets we need to analyse the distribution of the differences between cases. This distribution should be close to normal in order for the analysis to be robust.



From the above Histogram we can easily conclude that the distribution of the differences is normal and we can proceed with the Paired T-test.

Hypotheses

The ***null hypothesis***:

H0: There is no difference in mean before and after for Average PIC ratio per km for the analysed sites.

And an ***alternative hypothesis*** might be:

H1: There is difference in mean before and after for Average PIC ratio per km for the analysed sites.

In order for H0 to be accepted at the level of confidence of 95%, p value (Sig. (2-tailed) from the output) must be > 0.05.

Output

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	RatioB_km - RatioA_km	-.24600	1.34317	.22386	-.70046	.20847	-1.099	35	**.279**

Conclusion

Because p value is 0.279 > 0.05, the null hypothesis is accepted, ***'There is no difference in mean before and after for Average PIC ratio per km for the analysed sites'.*** *This means that the difference between the two sets could easily have arisen by chance.*

No matter how we analyse the sample, taking into account the trend for Northamptonshire for similar roads (A and B) or not, reporting the casualties as per site or per km, the changes between the two periods, 4 years before and 4 years after the switch off, are not statistically significant. This is consistent with the cameras still being effective by a certain extent, even after switching off.

One more important aspect to mention is that for all cases analysed, the average scores for the camera sites are situated below the average for Northamptonshire for similar roads, but only by very narrow margins after switch-off according to measures 2 and 4.