

Analysis of Speeding Tickets and Crashes

Project:	Analysis of Speeding Tickets and Crashes
Business Group:	Planning and Investment / Crash Analysis Team
Product / Process / Status:	[CAS system / planning / reporting / final report]

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Submitted Date	27 May 2014

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Final Review Date	22 May 2014

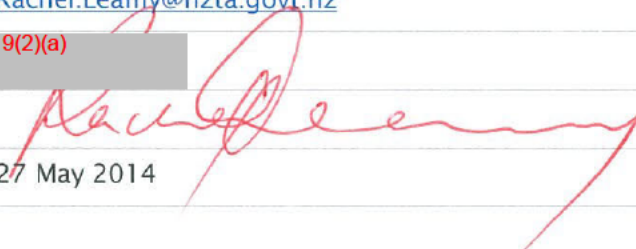
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1 Project background

Driving too fast for conditions is one of the major factors involved in motor vehicle crashes resulting in deaths and serious injuries on New Zealand roads. For the past five year period, 2009-2013, driving too fast for conditions was one of the contributing factors in 15 percent of injury crashes.

In 2011 driving too fast for conditions was a contributing factor in 78 fatal crashes, 351 serious injury crashes and 1109 minor injury crashes resulting in 86 deaths (30% of all deaths), 472 serious injuries (23% of all serious injuries) and 1693 minor injuries (16 % of minor injuries). The estimated social cost of these injury crashes in 2011 was approx. \$721 million. The social cost of a road crash or a road injury is defined as the total cost that occurs as a result of the road crash or injury (MOT, 2013).

Even if speed may not be specified by NZ Police as a contributory cause of a crash higher speeds result in higher levels of severity simply through the kinetic energy and associated with the crash speed. In order to address the problem of drivers exceeding posted speed limits the NZ Transport Agency (NZTA) invests through Road Policing Programme (RPP) to engage with NZ Police who carries out the speed enforcement activity. The NZTA investment for 2011/12 RPP was \$296.9 million, of which \$ 51 million was allocated to speed enforcement activities. The NZ Police carries out speed enforcement activities through

- directed patrols and traffic surveillance using radar/laser speed detection apparatus
- mobile and fixed speed cameras
- evaluation of photographs taken by speed cameras
- issuing infringement offence notices and prosecution follow up

The total number of tickets (Traffic Offence Notices, TONs) issued to those detected driving over the speed limit in the calendar-year 2011 was 874,673. It included both the speed camera issued tickets as well as tickets issued by the Police Officer.

Motor vehicle crash data was obtained from the Crash Analysis System (CAS) database. For the calendar year 2011, the total number of crashes reported by the police and recorded in the CAS was 32,455.

This project aims to analyze speeding ticket data and crash data for the year 2011 to achieve the objectives outlined in the next section.

2 Project objectives

- To explore correlations if any between the number of speeding tickets issued and the number of all crashes
- To explore the likelihood of speed ticketed drivers being involved in injury crashes
- To profile speed ticketed drivers who were involved in injury crashes
- To analyze the times of the day speeding tickets were issued compared to crashes
- To analyze speeding tickets and crashes in terms of posted speed limit

3 Findings

Key findings

- Very few drivers who were speed ticketed in the sample period were involved in an injury crash (one in every two hundred drivers). These drivers may not necessarily have been at-fault in these crashes and at-fault drivers in any kind of injury crash accounted for only one in every five hundred speed ticketed drivers.
- Even fewer drivers that got a speeding ticket were involved in an injury crash with “speed too fast for conditions” as a crash factor (one in every three thousand speed ticketed drivers).
- Of the speed ticketed drivers involved as an at-fault driver in an injury crash, two-thirds held a full licence, a fifth held a restricted licence and a sixteenth held a learner licence. However, on the basis of rate *per licence type* speed ticketed drivers with a restricted licence were two and half times as likely as drivers with a full licence to be involved in an injury crash as an at-fault driver.
- Time analysis showed that half of the speed related crashes and a third of all crashes happened between 6 pm and 6 am. During this time period the number of speeding tickets issued was fifteen percent however most of the speed tickets were issued between 6 am and 6 pm.

Other findings

- The regression equation shows that for each increase of one thousand speeding tickets in a fortnight there was on average a fall of nine crashes during that fortnight. Please note that this was a statistical relationship, not the cause and effect relationship.
- Between midnight and 6 am, the lowest number of speeding tickets was issued (less than 2 percent) however the reported number of all speed related crashes were nearly 20 percent during this time period.
- Most drivers who got three or more speeding tickets were male (84 percent), young drivers aged 15-24 accounted for a third and young male drivers aged 15-24 accounted for a quarter.
- Of the speed ticketed drivers who were involved in an injury crash as an at-fault driver two-thirds were Europeans and an eighth were NZ-Maori, however their rate was similar when compared with their respective population size, nearly forty per 100 thousand of their respective population size.
- The number of speeding tickets issued in urban areas was nearly three times the speed tickets issued in rural areas. The ticket density per kilometre of road length in 50 km/h zones was nearly twelve times that in 100 Km/h zones.
- Of the speed tickets issued in 50 km/h and 100 km/h areas, the percentage of speed tickets exceeding speed limit by 11 km/h to 20 km/h was similar (70 percent each). However the number of speed tickets issued exceeding the posted speed limit by 21-30 km/h in 100 km/h zones (14 percent) was double the 50 Km/h zones (7 percent).

4 Correlation analysis

In New Zealand speed limit enforcement is carried out by the NZ Police. The speed limit is the maximum legal speed a driver can travel on a given section of a road which is set by a road controlling authority. According to guidelines in the speed limit rule, if a vehicle is detected by a speed camera exceeding the speed limit plus the tolerance, speeding ticket is sent to the owner of the vehicle and if detected by the Police Officer, speeding ticket is given to the driver of the vehicle.

The tolerance of speeding is publicised as 10km/h over the speed limit in standard situations, 6km/h for heavy motor vehicles, and 4km/h in school zones. It is also publicized that the tolerance is dropped to 4km/h on some

long weekends.

Speeding ticket data used in this analysis was obtained from the NZ Police. The total number of speeding tickets issued in 2011 was 874,673, including both the speed camera issued tickets as well as tickets issued by the Police Officer.

The motor vehicle crash data was extracted from the Crash Analysis System (CAS) database. This analysis included all crashes (32,455) reported by the NZ Police that occurred during the calendar year 2011.

The analysis is based on the whole population of the data records available in both the datasets (CAS database for all crashes and all speeding tickets reported by the NZ Police), so it does not involve sampling error.

As these two official data sets are independently owned and managed by different government entities for their own business purposes, the correlation analysis carried out here will only be the statistical relationship or association between the number of speed tickets issued and number of crashes occurred during the same time. There may be or may not be the cause and effect relationship between these variables (change in one variable causing a change on the other), it is beyond the scope of this project to examine cause and effect relationship.

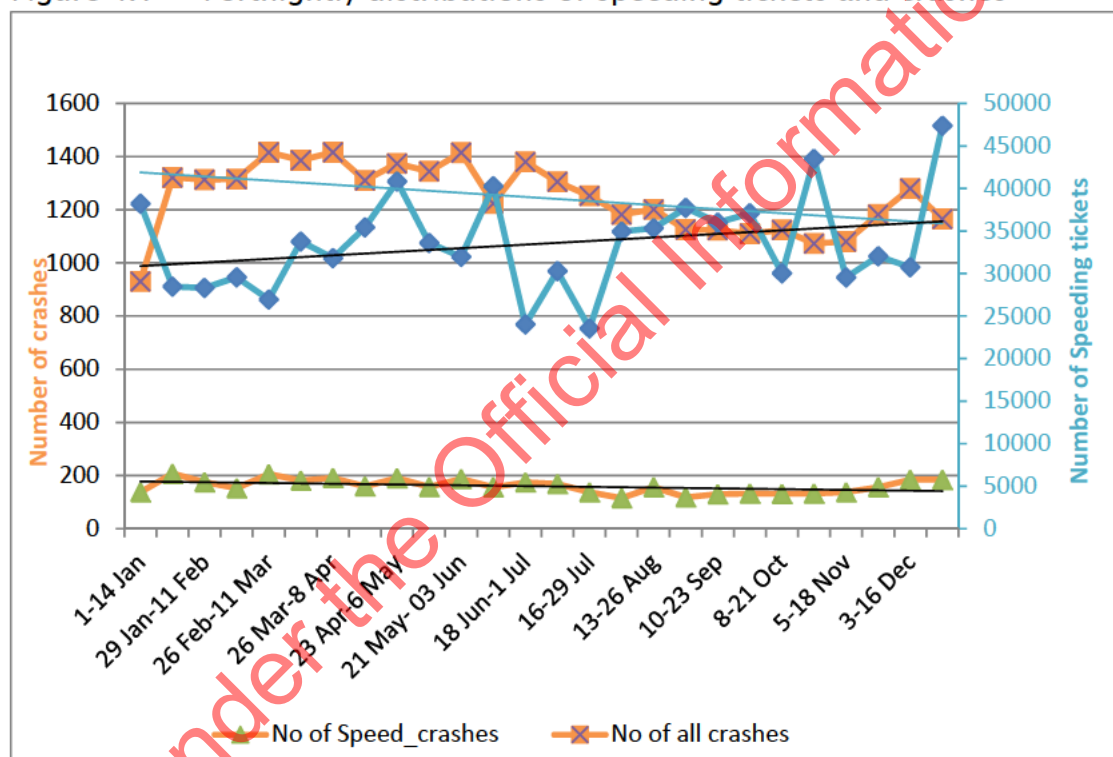
The number of speeding tickets issued in each fortnight and the number of crashes that occurred during the corresponding fortnight are given in Table 4.1 and Figure 4.1. For the year 2011, Dec 31 was the only one day left after 26th fortnight, so number of speeding tickets issued and number of crashes occurred on that day was excluded from the analysis.

Table 4.1: Fortnightly distribution of speeding tickets and crashes

Fortnights (2011)	No of speeding tickets issued	No of all crashes	No of speed related crashes
01 - 14 Jan	38,204	930	137
15 - 28 Jan	28,458	1,321	207
29 Jan - 11 Feb	28,302	1,313	175
12 - 25 Feb	29,560	1,315	152
26 Feb - 11 March	26,938	1,416	205
12 March- 25 March	33,767	1,386	181
26 March - 08 April	31,813	1,416	191
09 - 22 April	35,416	1,310	159
23 April - 06 May	40,818	1,374	190
07 - 20 May	33,602	1,344	157
21 May- 03 June	31,951	1,415	187
04 - 17 June	40,253	1,224	156
18 June- 01 July	24,018	1,380	174
02 - 15 July	30,279	1,305	168

16 - 29 July	23,553	1,252	137
30 July- 12 August	34,940	1,182	115
13 - 26 August	35,322	1,201	156
27 August- 9 Sept	37,713	1,125	118
10 - 23 Sept	35,988	1,123	130
24 Sept - 7 Oct	37,077	1,110	132
8 - 21 Oct	30,016	1,124	131
22 Oct - 04 Nov	43,476	1,073	132
05 - 18 Nov	29,535	1,080	137
19 Nov - 02 Dec	32,043	1,182	156
03 - 16 Dec	30,729	1,280	184
17 - 30 Dec	47,372	1,165	184

Figure 4.1 Fortnightly distributions of speeding tickets and crashes

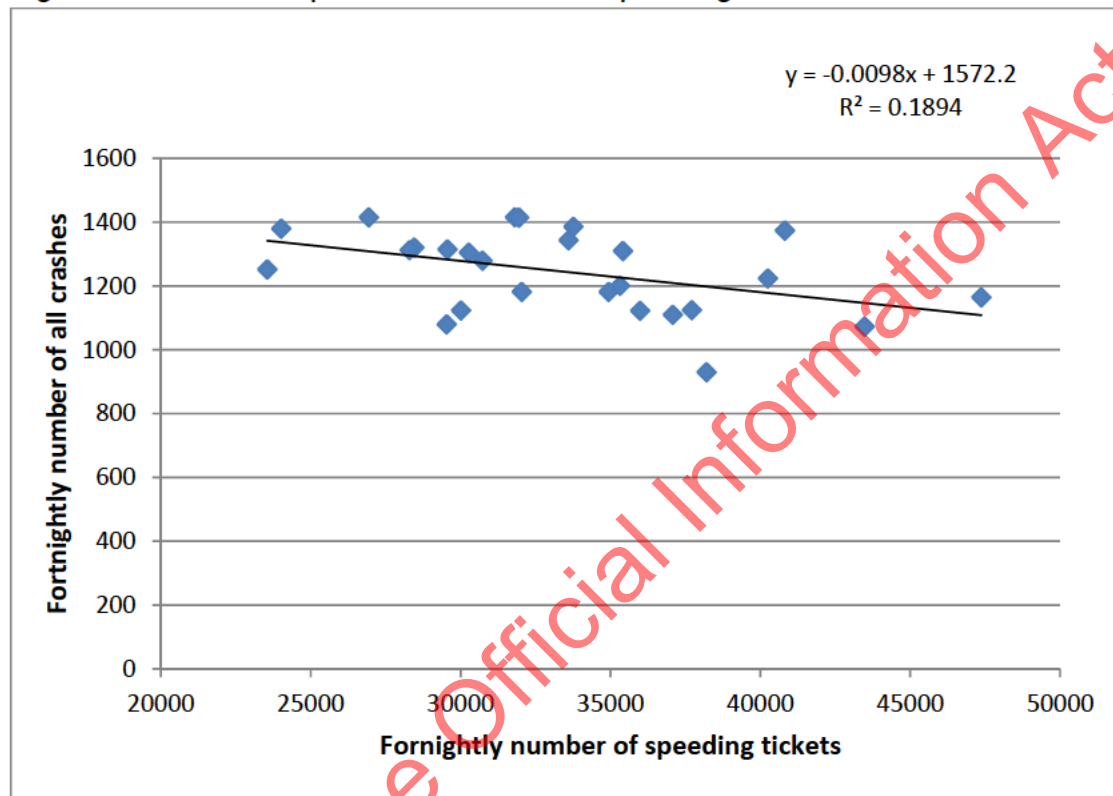


The average fortnightly number of speeding tickets issued in 2011 was 33,506 while the average number of crashes during the same period was 1,244. The number of speeding tickets issued is significantly higher during the fortnights falling on public holiday periods (Christmas, labour weekend Easter and Queens Birthday, New Year); this could be connected to the higher number of people driving on the road, reduced speed tolerance by the Police and more intensive speed enforcement activities or could also be people driving roads with unfamiliar speed limits. If we look into the trend of the number of speeding tickets issued for the whole year, it shows an upward trend with a marked rise during the holiday periods. The trend for crashes on the other hand is stable for the first six months followed by downward trend afterwards, whereas we notice gradual downward trend in speed

related crashes for the first seven months followed by an upward trend during later months of the year.

Scatter Plots are used to investigate the possible correlation between the fortnightly number of speeding tickets issued and the corresponding number of crashes as plotted in Figure 4.2 below.

Figure 4.2: Scatter plot for crashes and speeding tickets



The regression equation $y = -0.0098x + 1572.2$ shows the statistical relationship (not the cause and effect) and it means the rise of number of speeding tickets by 1,000 in a fortnight will be associated to, on average, a fall in 9 crashes in the corresponding fortnight.

Note this relationship does not mean that the increase of speeding tickets by 1,000 will cause to decrease crash numbers by nine; however it shows irrespective of the causes of crashes, the independent observations of crashes and speeding tickets are varying on average as per the regression equation given above. Correlation can reveal the nature and extent of correlation, it says nothing about causation.

The correlation coefficient often referred as Pearson's product-moment, r value measures the strength of relationship and the output of the correlation between the number of speeding tickets/fortnight and the number of crashes/fortnight for 2011 is given in the following table.

Table 4.2

	Number of speeding tickets issued/fortnight	Number of crashes/fortnight
Number of speeding tickets issued/fortnight	1	
Number of crashes/fortnight	-0.435236569	1

The correlation coefficient, r value obtained is -0.44, which means the fortnightly number of speeding tickets and the corresponding number of crashes have a negative moderate correlations (Taylor, 1990 interprets correlation coefficient, r as- if absolute value of $r = 0$ no correlations at all, $r \leq 0.35$ weak correlations, r is 0.36 to 0.67 moderate correlations, and 0.68 to 1.0 as strong correlations).

The coefficient of determination ($R^2 = 0.1894$), is a measure of how well the regression line represents the data. It is nearly 20% that means 20 percent of the data is the closest to the regression line (approximately 20 percent of the total variation in number of crashes per fortnight can be explained by the regression model, the equation of the regression line).

5 Likelihood of speed ticketed drivers being involved in injury crashes

There were altogether 874,673 speeding tickets issued by the NZ Police in 2011. The excel data file received from NZ Police containing this data was exported to MS Access as a table. This speeding ticket data included 338 tickets issued by red light cameras and thus excluded from the analysis additionally there were 2008 speeding tickets where Drive Licence field was null and these were also excluded. Out of 872,327 remaining records, those with the same Driver Licence were grouped and finally we acquired 621,843 unique drivers, these were speed ticketed were used to match with crashed drivers.

There were total 15,192 drivers involved in injury crashes in 2011 as per data extracted from the CAS. These drivers' data was exported to MS Access as a table of crashed drivers. Next 1,570 records of drivers without a driver licence were removed from the data set, giving the total number of drivers available for analysis of 13,622. After eliminating repeated driver licenses, there were 13,538 drivers involved in injury crashes.

Then 621,843 unique drivers from the speeding tickets table and 13,538 unique drivers from the crash table were linked by the driver licence number. There were 3,200 linked records where the driver licence number was matched. These records were further validated by matching the date of birth field. Thus out of the 621,843 drivers who were speed ticketed in 2011, there were 3,200 drivers who were involved in injury crashes, thus the probability of speed ticketed drivers being involved in an injury crash was 0.5 percent. That means out of 200 drivers who were speed ticketed, one driver was involved in injury crash. An important point is that the speed ticketed

drivers were not at all necessarily the at-fault or part-fault driver.

Table 5.1 below shows the reported (observed) number of crashed/not crashed drivers against the number of speeding tickets they received.

Table 5.1 Number of drivers by the number of speeding tickets they received (O =observed Values)

Number of tickets	Number of drivers			
	Crashed(O)	Did not crash(O)	Total	% Crashed
1	2,272	467,969	470,241	0.48%
2	624	103,639	104,263	0.60%
3	197	29,327	29,524	0.67%
4	65	9,624	9,689	0.67%
5	25	3,618	3,643	0.69%
>=6	17	4,466	4,483	0.38%
Total	3,200	618,643	621,843	0.51%

From the above table we can see that percentage of crashed drivers was different for drivers grouped by the number of speeding tickets they received. To test whether the involvement of drivers in injury crashes was significantly different with the number of speeding tickets they received. Chi Square Test was performed.

Null hypothesis (H0): There is no significant difference between the number of speeding tickets a driver receives and involvement in injury crashes

Alternate hypothesis (H1): There is significant difference between the number of speeding tickets a driver receives and involvement in injury crashes.

Below is the distribution of expected number of drivers assuming that null hypothesis is true and working for Chi Square test.

Table 5.2 Number of drivers by the number of speeding tickets they received (E= expected Values)

Number of tickets	Expected numbers		(O-E)		(O-E) ² /E	
	Crashed (E)	Did not crash (E)	Crashed	Did not crash	Crashed	Did not crash
1	2,419.86	467,821.14	-147.86	147.86	9.03	0.05
2	536.54	103,726.46	87.46	-87.46	14.26	0.07
3	151.93	29,372.07	45.07	-45.07	13.37	0.07
4	49.86	9,639.14	15.14	-15.14	4.60	0.02
5	18.75	3,624.25	6.25	-6.25	2.09	0.01
>=6	23.07	4,459.93	-6.07	6.07	1.60	0.01
Total	3,200.00	618,643.00	0.00	0.00	44.94	0.23

Results:

Chi Square Value = 45.17

degrees of freedom= 5

P value obtained was 1.34×10^{-8}

This is a highly significant result as for P Value is less than 0.01 at 1 percent level of significance (99 percent confidence level). So we reject the null

hypothesis.

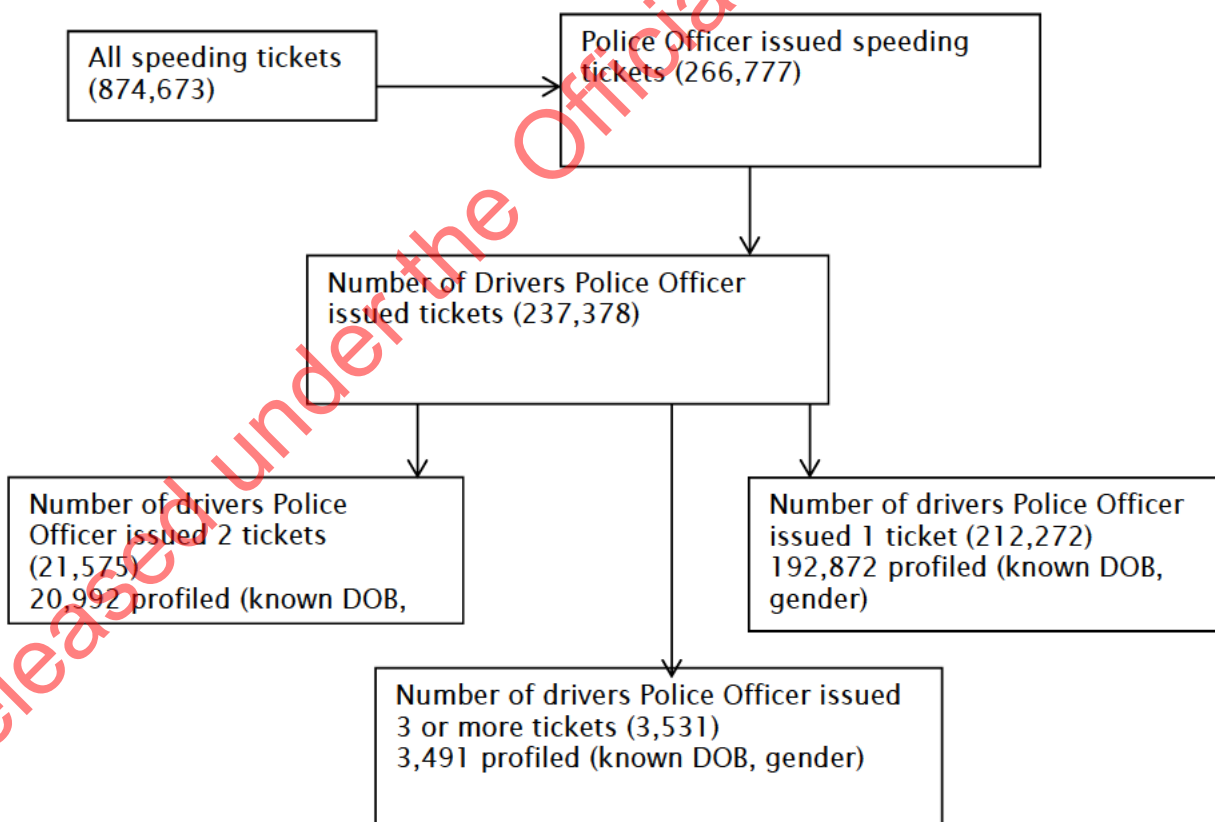
So we can say that there is a significant association between the number speeding tickets a driver receives and their involvement in an injury crash. Drivers who were speed ticketed 5 times were most likely to be involved in injury crashes, they are 1.4 times likely to involve in injury crashes than those who received one ticket. But the proportion of drivers who received 6 or more tickets and crashed was lower; this might be because of the drivers being suspended or forbidden from driving because of the high number of demerit points.

6 Driver Profile

Profile of speed ticketed drivers

There were 266,777 of speeding tickets issued by a Police Officer for speeding offences committed by 237,378 drivers in 2011; each ticketed driver received 1.1 tickets on average. Eighty-nine percent (212,272) were ticketed once, 9 percent (21,575) were ticketed two times while nearly 2 percent (3,531) were ticketed 3 to 8 times. Important characteristics such as age and gender are analyzed as below to see if there were any significant differences based on the number of speeding tickets received by a driver.

Flow diagram for speed ticketed driver profile analysis



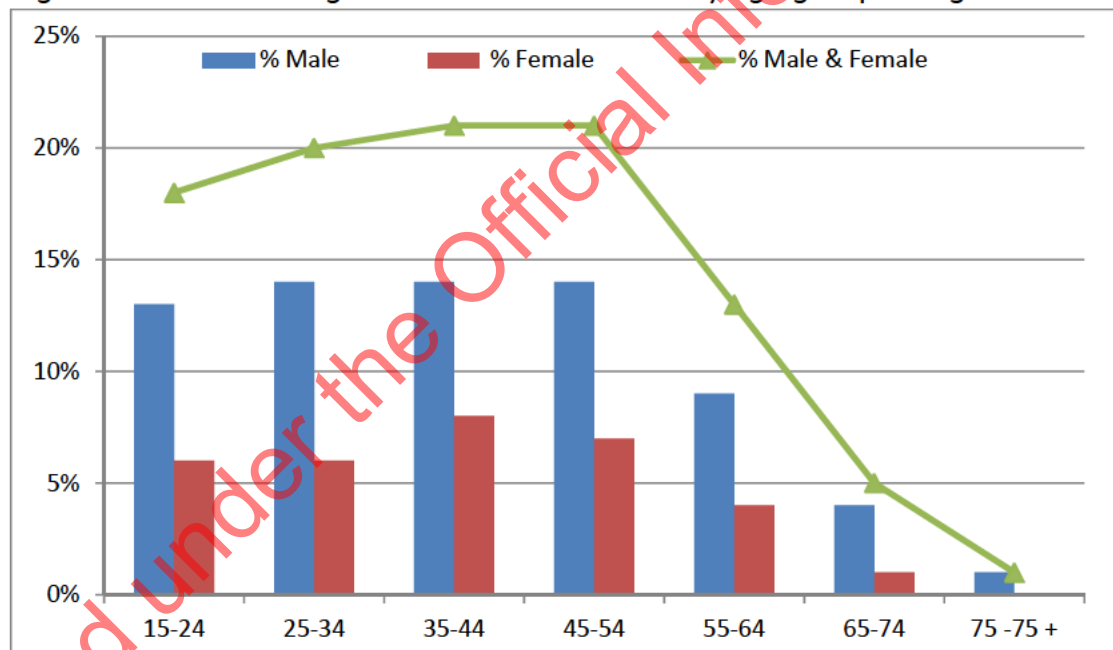
Age and gender of drivers who received one ticket

Of the 212,272 drivers who were ticketed once in 2011, the date of birth field for 689 drivers was blank, and also the gender of 18,711 drivers was missing. So 192,872 drivers (91 percent of this group) are available for analysis.

Table 6.1 Distribution of drivers by age group and gender

Age	Male	% of Total	Female	% of Total	Total	% of Total
15-24	24,504	13%	10,724	6%	35,228	18%
25-34	26,773	14%	12,459	6%	39,232	20%
35-44	26,733	14%	14,559	8%	41,292	21%
45-54	26,888	14%	13,708	7%	40,596	21%
55-64	16,821	9%	7,847	4%	24,668	13%
65-74	7,045	4%	2,830	1%	9,875	5%
75 -75 +	1,446	1%	534	0%	1,980	1%
Total	130,210	68%	62,661	32%	192,872	100%

Figure 6.1 Percentage distribution of drivers by age group and gender



Of the drivers who were speed ticketed once

- Over two-thirds were male drivers and nearly a third were female drivers
- The proportion of male and female drivers in each age group between 15 and 54 were significantly high and almost uniformly distributed (male 14 percent, female 7 percent)

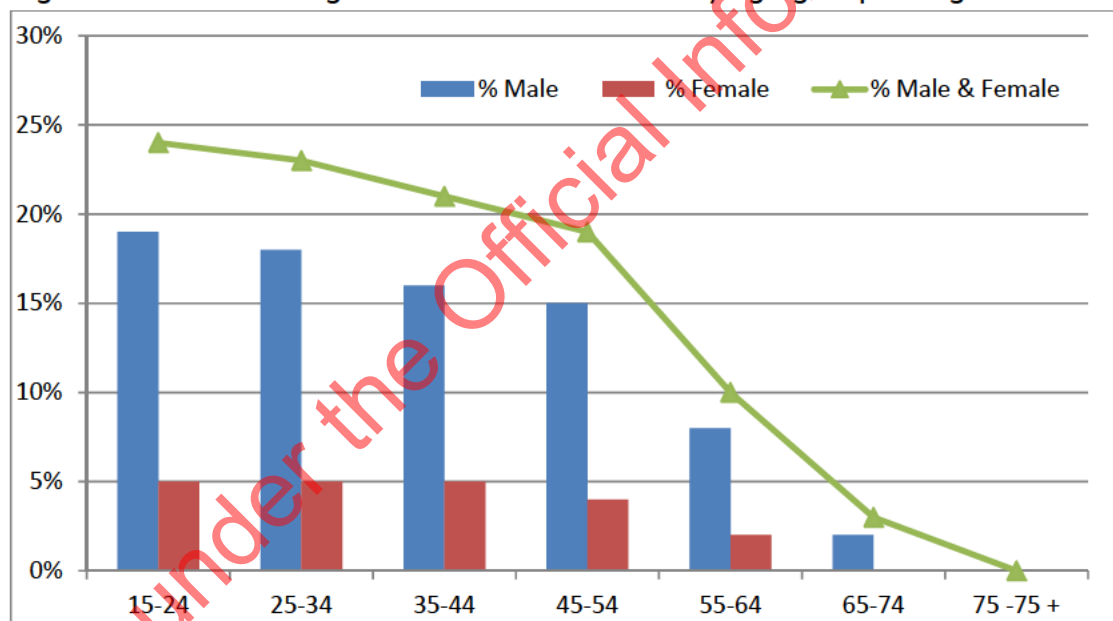
Age and gender of drivers who received two tickets

Of the 21,575 drivers who were ticketed twice in 2011, date of birth field for 56 drivers was blank, and also the gender of 527 drivers was missing. So 20,992 drivers (97 percent of this group) are available for analysis.

Table 6.2: Distribution of drivers by age group and gender

Age	Male	% of Total	Female	% of Total	Total	% of Total
15-24	4,022	19%	1,084	5%	5,106	24%
25-34	3,692	18%	1,089	5%	4,781	23%
35-44	3,314	16%	1,104	5%	4,418	21%
45-54	3,082	15%	931	4%	4,013	19%
55-64	1,585	8%	429	2%	2,014	10%
65-74	485	2%	96	0%	581	3%
75 -75 +	65	0%	14	0%	79	0%
Total	16,245	77%	4,747	23%	20,992	100%

Figure 6.2 Percentage distribution of drivers by age group and gender



Of the drivers who were speed ticketed two times

- Over three-quarters were male drivers and nearly a quarter were female drivers
- The proportion of young drivers aged 15-24 was the highest accounting for nearly a quarter, followed by a steady fall until the 45-54 age group

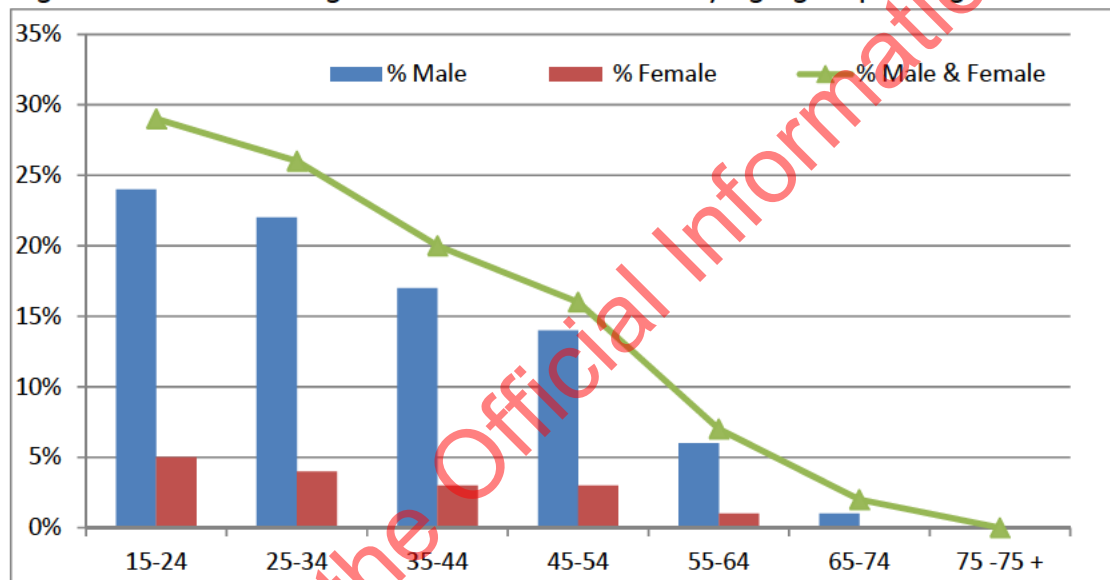
Age and sex for drivers who received three or more tickets

Of the 3,531 drivers who were ticketed more than two times in 2011, date of birth field for 18 drivers was blank, and also the gender of 22 drivers was missing. So 3,491 drivers (99 percent of this group) are available for analysis.

Table 6.3: Distribution of drivers by age group and gender

Age	Male	% of Total	Female	% of Total	Total	% of Total
15-24	829	24%	182	5%	1,011	29%
25-34	762	22%	143	4%	905	26%
35-44	607	17%	104	3%	711	20%
45-54	476	14%	92	3%	568	16%
55-64	204	6%	31	1%	235	7%
65-74	50	1%	6	0%	56	2%
75 -75 +	5	0%	0	0%	5	0%
Total	2,933	84%	558	16%	3,491	100%

Figure 6.3 Percentage distribution of drivers by age group and gender



Of the drivers who received three or more speed tickets

- 84 percent were male drivers and 16 percent were female drivers
- The proportion of young drivers aged 15-24 was the largest (29 percent) followed by a decreasing proportion among older age groups
- Young female drivers of the age group 15-24 are highly represented accounting for a third of all female drivers

Comparison of male and female drivers by age and their ticketing frequency

- Male drivers who received one ticket are the largest group in total as well as in each age group
- Young male drivers aged 15-24, receiving 3 or more tickets were proportionately the largest group as compared to all age groups and their ticketing frequency

- Among the single speed ticketed drivers, proportion of drivers increased as the age increased to a 45-54 age group. Age groups 35-44 and 45-54 were the largest group each accounting for 21 percent.
- Proportions of young drivers aged 15-24 increased as the number of speeding tickets they received increased, it was 18 percent among single speeding ticketed group, 24 percent among two speeding ticketed group and 29 percent among who received three or more speeding tickets, it shows that younger drivers are more likely to be a repeat speed offender detected by the enforcement.

Profile of speed ticketed drivers involved in injury crashes who were at fault or part fault

There were unique 13,538 drivers involved in injury crashes in 2011; some of them were involved more than once. Of these, there were 8,435 unique drivers who were at fault or part fault (all at fault/part fault drivers frequency count was 9,637).

Each of the 8,435 unique at-fault or part-fault drivers involved in injury crashes were matched against the 237,378 speed ticketed drivers. There were 1,369 matching records, while uniquely matched records were 1131. Of these drivers, the gender for nine drivers was missing. So 1,122 drivers are available for analysis.

driver data matching for at fault crashed driver who were speed ticketed

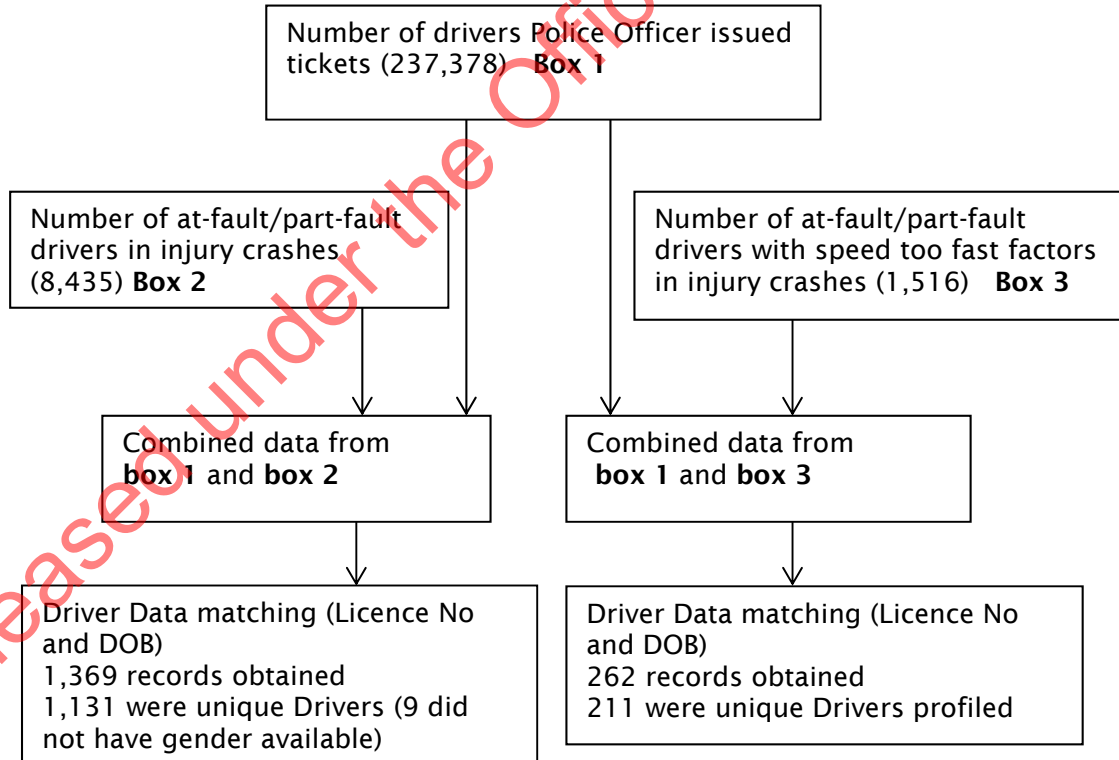
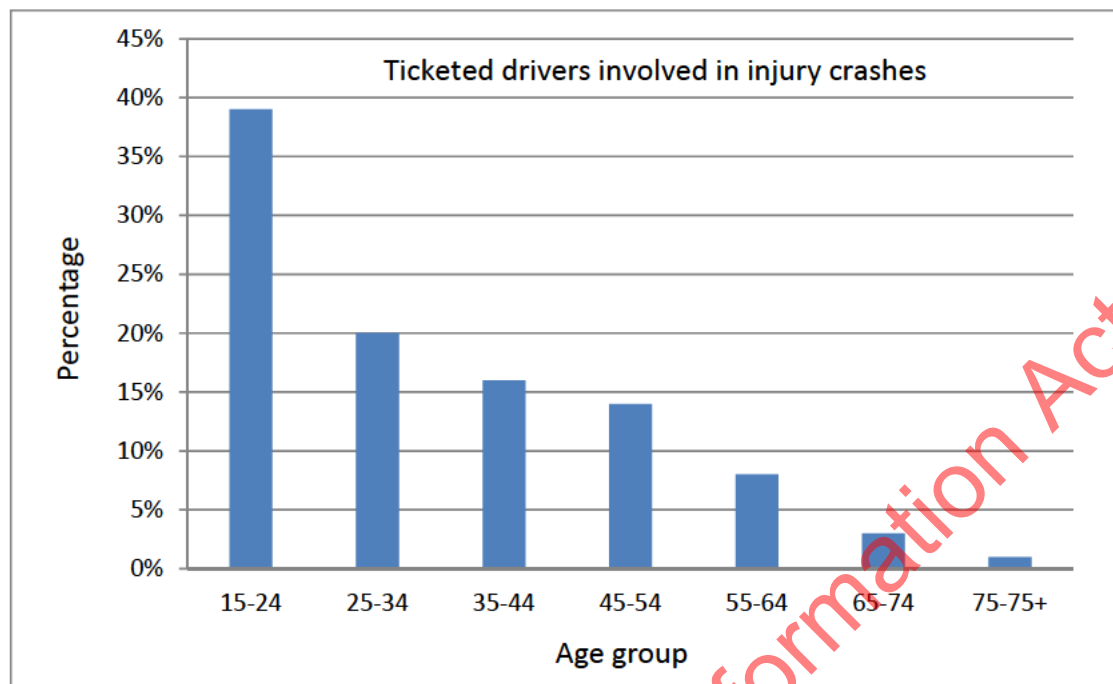


Figure 6.2 Distribution of speed tickets received by age group



The split of age groups by gender is given below.

Table 6.6: Distribution of drivers at fault or part fault in injury crashes matched against the speed ticketed drivers

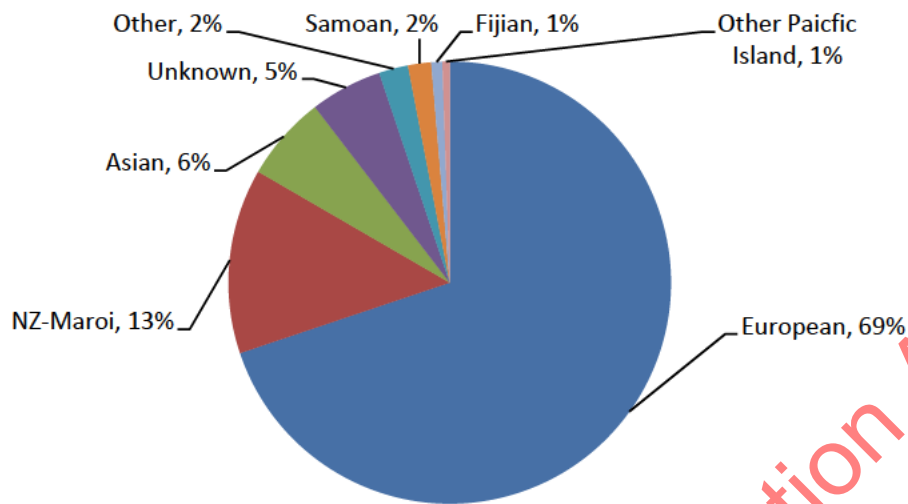
Age	Male	%	Female	%	Total	%
15-24	323	29%	112	10%	435	39%
25-34	162	14%	57	5%	219	20%
35-44	134	12%	50	4%	184	16%
45-54	122	11%	32	3%	154	14%
55-64	70	6%	16	1%	86	8%
65-74	22	2%	10	1%	32	3%
75-75+	11	1%	1	0%	12	1%
Total	844	75%	278	25%	1122	100%

- Of all the drivers, three quarters were male and a quarter were female
- Young drivers of the age group 15-24 were the largest in proportion (39 percent) followed by decreasing trend as the age group increased.
- Males aged 15-24 had the largest proportion, accounting for 29 percent of all drivers.

Driver ethnicity

Figure 6.3 shows driver ethnicity of the matched drivers as per the data obtained from the CAS. Among the drivers who were speed ticketed and also at fault or partly fault in injury crashes, the European drivers were significantly high in proportion accounting for 70 percent and followed by the Maori drivers.

Figure 6.3 Driver ethnicity

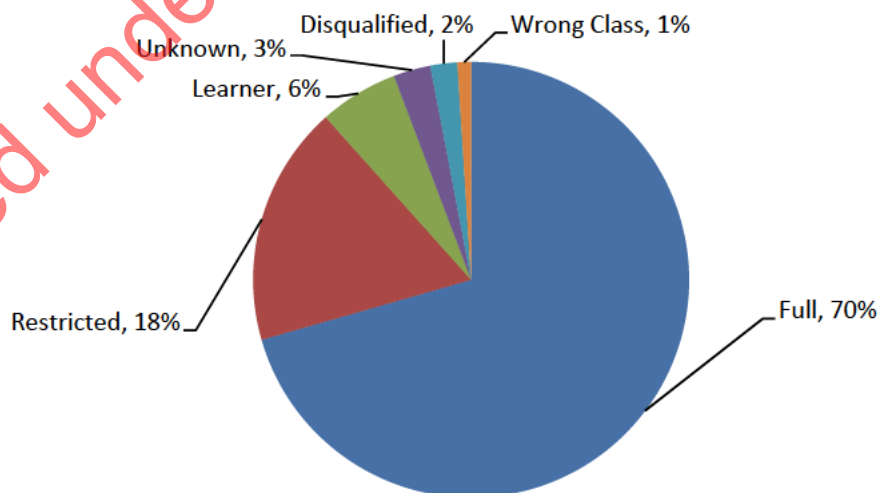


In the absence of driver ethnicity data in the driver licence register, the above ethnicity data is standardized by comparing number of drivers per 100 thousand of their respective population size from Stat NZ data (2013). European drivers were 40; NZ-Maori drivers were 35, Asian and Pacifica people drivers were 21 each per 100 thousand of their respective population.

Driver licence status

Figure 6.4 shows the licence status of the matched drivers as per the data obtained from the CAS. Full licence holders make up a large proportion of these drivers accounting for 70 percent. Restricted and learner licence holders make up nearly a quarter of these drivers.

Figure 6.4 Driver licence status



As at 31 December 2011 the number of licence holders for motor cars and light motor vehicles class 1 was 2741847 for full licence, 292915 restricted licence and 231619 for learner licence. The rate of speed ticketed drivers who were at fault or part fault in injury crashes per 100 thousand of their respective licence type, was 29 for full licence holders, 69 for restricted licence holders and 28 for learner licence holders, thus the rate per licence type for restricted licence holders was two and half times the full licence holders.

Profile of speed ticketed drivers involved in injury crashes with speed too fast for conditions as a crash factor

There were 1,516 at fault or part fault drivers involved in injury crashes with speed too fast for conditions as a factor. Of these drivers 1,327 were unique drivers. These individual drivers were matched against the 237,378 speed ticketed unique drivers; the resulting data set contained 262 drivers. Out of these 262 drivers, 211 were unique and have been analyzed as below.

Distribution of drivers at fault or part fault in injury crashes with speed too fast for conditions as a factor and matched against the speed ticketed drivers

Table 6.7

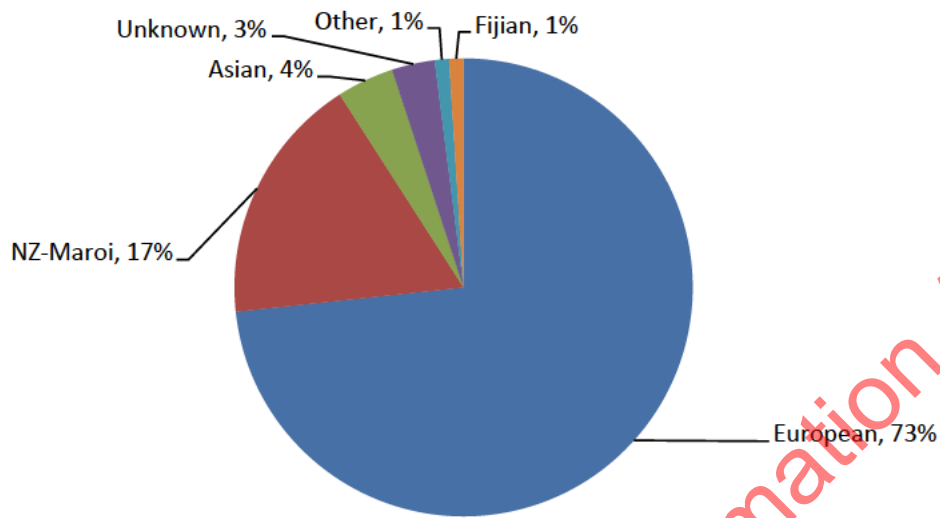
Age	Male	%	Female	%	Total	%
15-24	101	48%	18	9%	119	56%
25-34	36	17%	8	4%	44	21%
35-44	19	9%	6	3%	25	12%
45-54	12	6%	3	1%	15	7%
55-64	4	2%	1	0%	5	2%
65-74	1	0%	1	0%	2	1%
75-75+	1	0%	0	0%	1	0%
Total	174	82%	37	18%	211	100%

- Over eighty percent of all drivers were males
- Young drivers of the age group 15-24 were the largest in proportion (56 percent) followed by decreasing trend as the age group increased.
- Males aged 15-24 were nearly half of all drivers (48 percent)

Driver ethnicity

Figure 6.5 below shows driver ethnicity of the matched drivers as per the data obtained from the CAS. Among the drivers who were speed ticketed and also at fault or partly fault in injury crashes having speed too fast for conditions as a crash factor, the European drivers were significantly high in proportion accounting for nearly three quarters followed by the Maori drivers accounting nearly a fifth.

Figure 6.5 Driver ethnicity

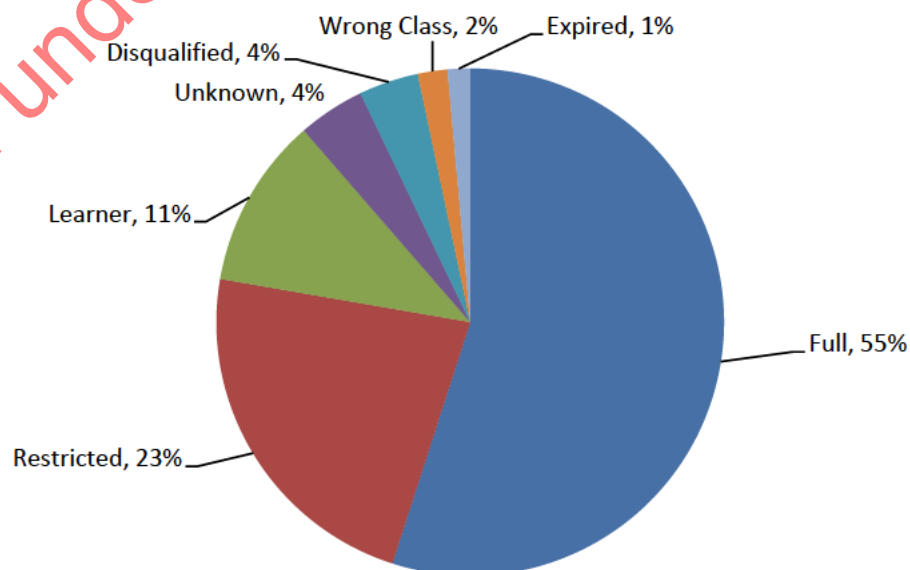


In the absence of driver ethnicity data in the driver licence register, the above ethnicity data is standardized by comparing the number of drivers per 100 thousand of their respective population size from Stat NZ data (2013). European drivers were 5; NZ-Maori drivers were 6; Asian 2 and Pacifica people drivers were 1 per 100 thousand of their respective population.

Driver licence status

Figure 6.6 below shows the licence status of the matched drivers as per the data obtained from the CAS. Majority of drivers held full licence (55 percent) while over a third of drivers held either restricted licence or a learner licence.

Figure 6.6 Driver licence status



As at 31 December 2011 the number of licence holders for motor cars and light motor vehicles class 1 was 2741847 for full licence, 292915 restricted licence and 231619 for learner licence. The rate of speed ticketed drivers, who were Involved in injury crashes as speed too fast for conditions as a crash factor, was 4 for full licence holders, 16 for restricted licence holders and 10 for learner licence holders per 100 thousand of their respective licence type. Thus the rate per licence type for restricted licence holders was four times the full licence holders.

7 Time of day analysis

Time of day analysis (crash data and speeding ticket data)

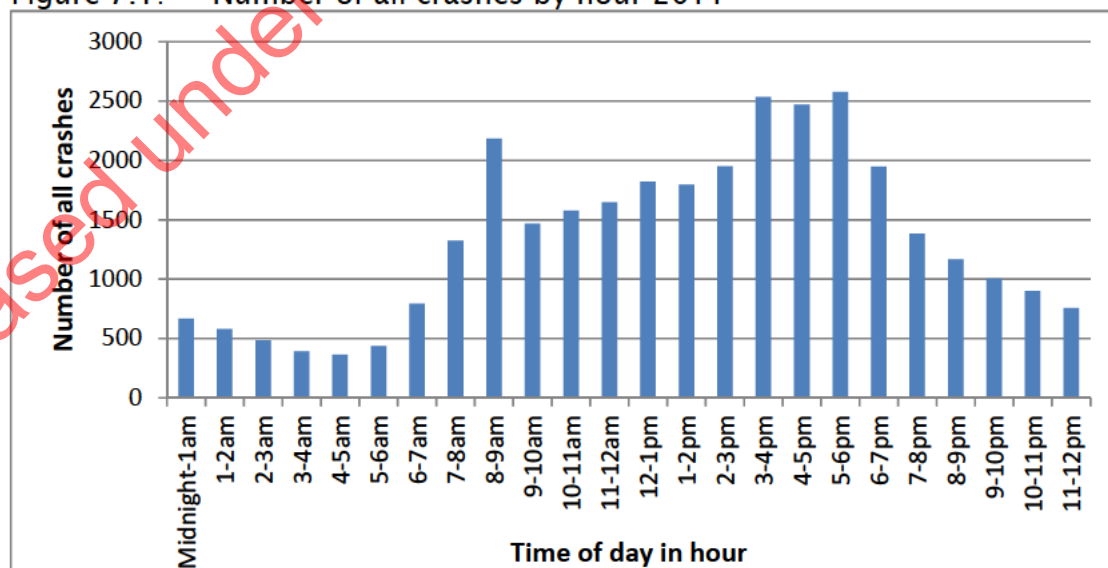
Information on timing of crashes is important for developing crash reduction or crash prevention strategies and organization of resources for the support and care of crash victims.

Comparing the timings of speeding tickets issued and timings of crashes especially speed related crashes could help to reflect on the speed enforcement activity that is carried out by NZ Police. Here speed related crashes are defined as those crashes where speed too fast for conditions was assigned as a factor contributing the crash as reported by the Police.

Crash data

In 2011 there were 32,236 reported crashes with a known time of their occurrence. Hourly distribution of the number of these crashes is shown in the chart 1 below. It shows a sharp increase after 6 am spiking during 8 am to 9 am (7 percent), then fell and gradually increased until 3 pm. During 3 pm to 6 pm, the number of reported crashes was the highest, each hour accounting for 8 percent of crashes. Then the hourly number of crashes fell until 5 am morning. Most of the crashes happened during the morning and the afternoon traffic rush hour.

Figure 7.1: Number of all crashes by hour 2011



Speed related all crashes (injury and non-injury) and speed related injury crash data

If we look into speed related all crashes (4,112 crashes reported with time of occurrence) and speed related injury crashes (1,502 crashes reported with time of occurrence) data, the hourly distributions of these crashes are shown in Figure 7.2 and Figure 7.3 below.

Figure 7.2: Number of speed related crashes by hour 2011

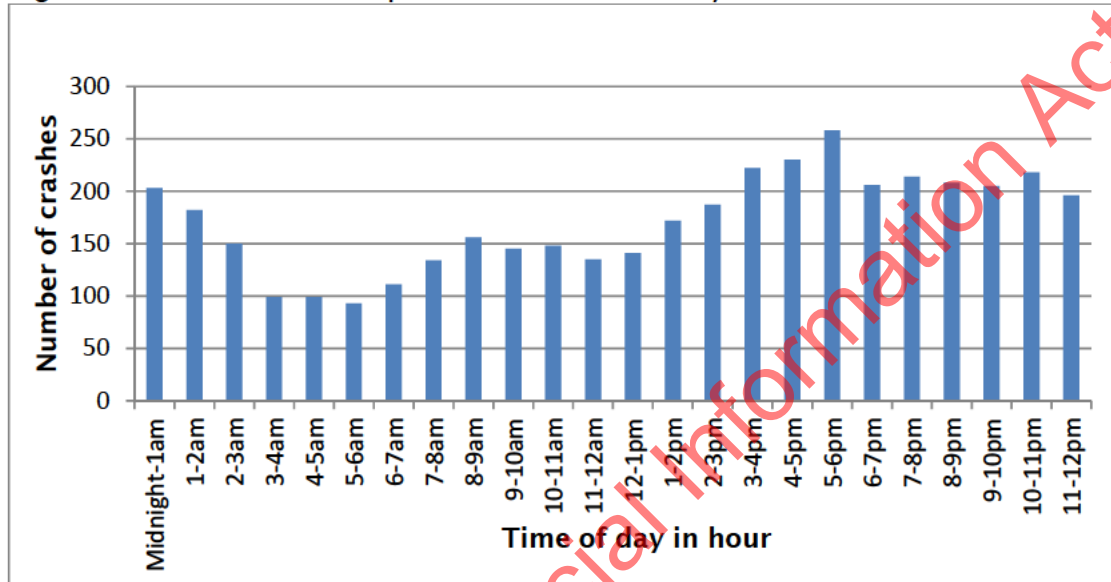
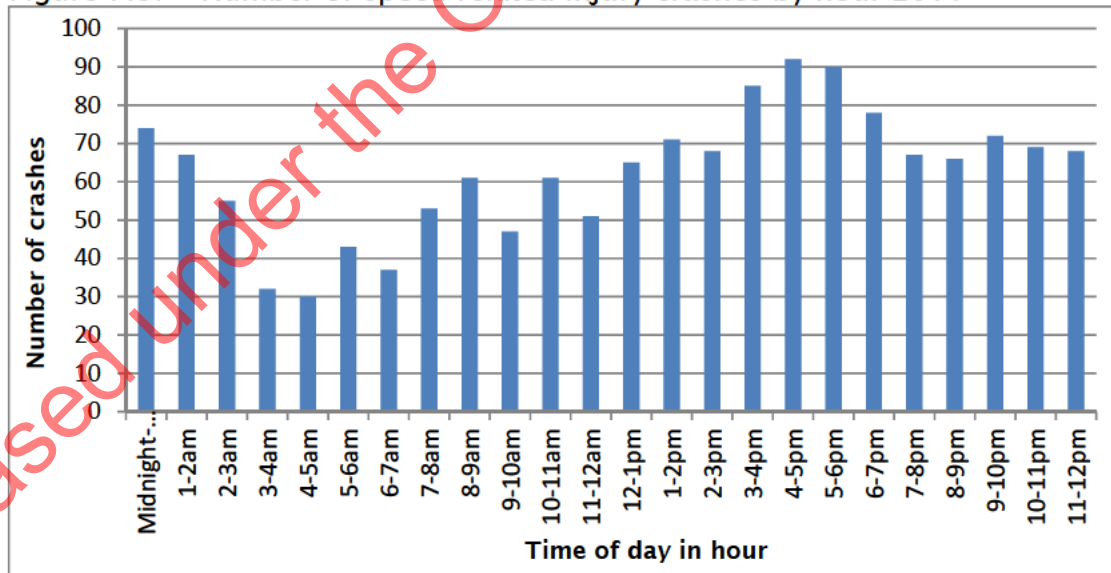


Figure 7.3: Number of speed related injury crashes by hour 2011



In both Figures we can see morning peaks are occurring during 8am to 9 am and accounted for 3.8% and 4.1% of crashes respectively while afternoon peaks are observed during 3 pm to 6pm with 17.3 percent and 17.8 percent reported crashes respectively. It is notable that the number of speed related

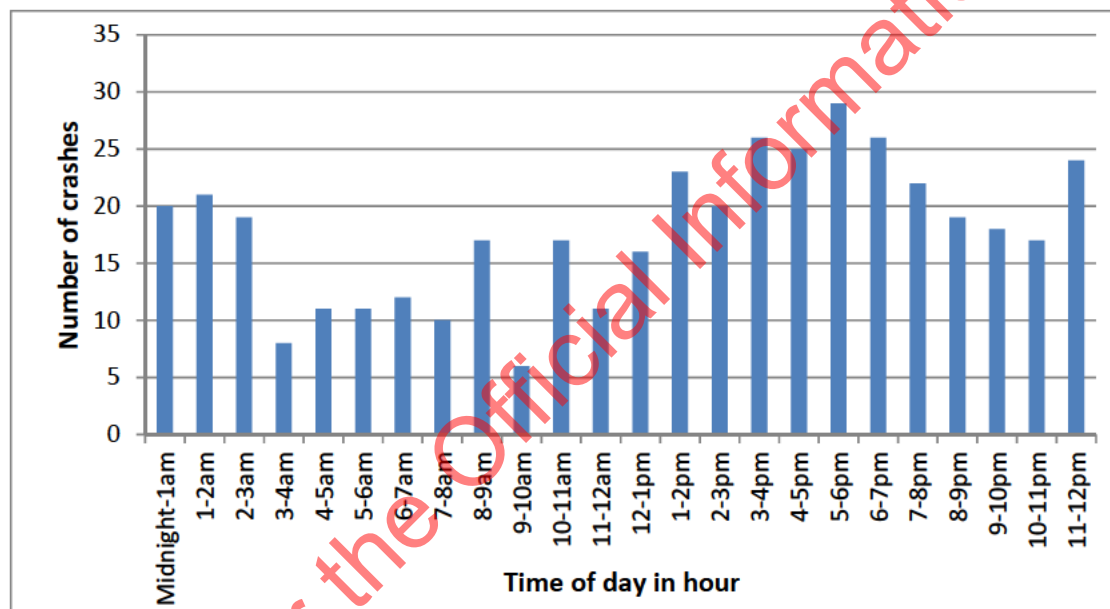
all crashes and speed related injury crashes have shifted to late evening till 1 am very uniformly.

Speed related fatal and serious crash data

If we look into speed related fatal and serious crash data (428 crashes reported with time of occurrence) the hourly distribution of these crashes (Figure 7.4) was relatively different to the hourly distribution of crash data in Figure 7.2 and Figure 7.3.

Morning peak occurred during 8 am to 9 am (4 percent crashes) which is followed by the lowest reported hour 9 am to 10 am (1.4 percent). Afternoon peak has shifted to 5 am to 6 am (6.8 percent) and crashes are significantly high in numbers during late night and early morning till 3 am.

Figure 7.4: Speed related fatal and serious crashes 2011



Speeding ticket data

In 2011 in total 874,673 speeding tickets were issued. We can see in Figure 7.5 below, the hourly percentage distribution of these tickets sharply rises after 6 am, and remained steady for four hours after 8 am reaching a peak level at 10 am to 11 am (8.9 percent) with 35 percent tickets issued during 4 hour interval from 8 am to 12 pm.

The percentage of speeding tickets fell and remained steady for another 3 hours until 3 pm (12 pm to 3 pm was 25 percent) followed by a continuous drop until it reached to the lowest at 3 am to 4 am (0.14 percent). During late nights and early mornings, percentage of speeding tickets issued was significantly low.

Figure 7.5: percent speeding tickets issued by hour

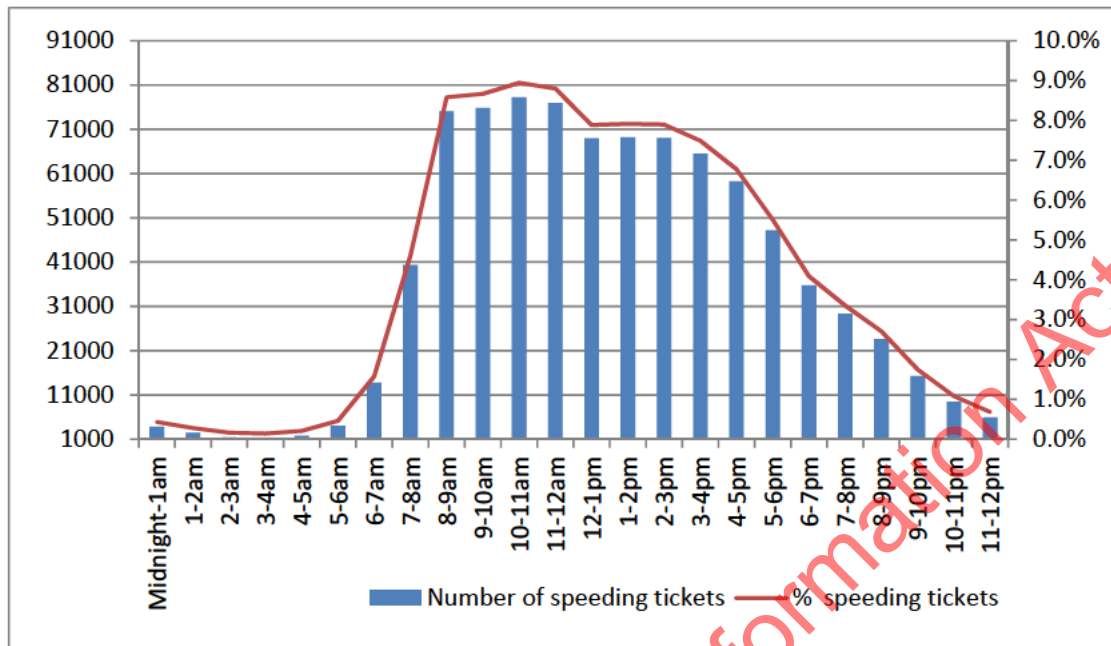
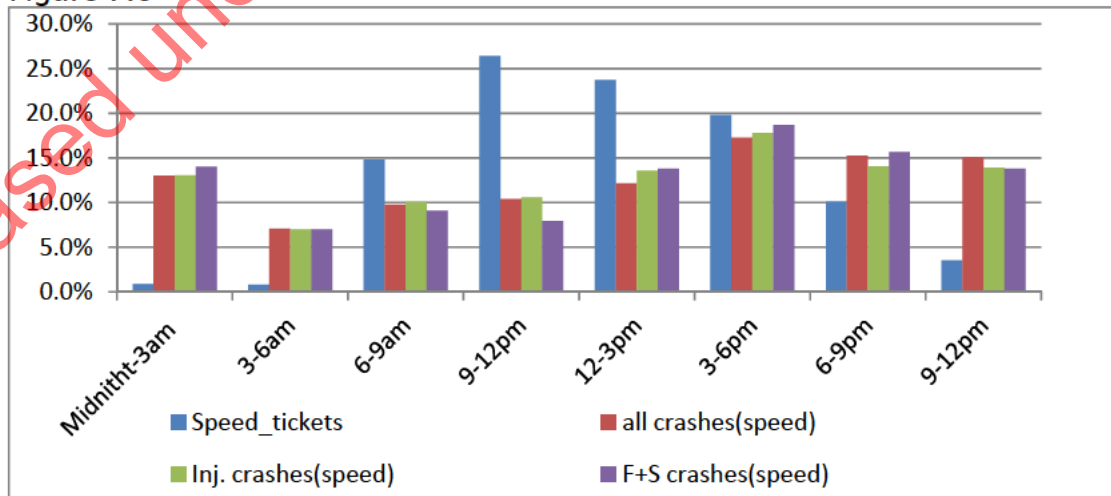


Table 7.1 and Figure 7.6 below shows the percentage distribution of crashes and speeding tickets when grouped in 3 hour time intervals.

Table 7.1

Time	Speed_tickets	all crashes(speed)	Inj. rashes(speed)	F+S crashes(speed)	All crashes
Midnight-3am	0.9%	13.0%	13.0%	14.0%	5.4%
3-6am	0.8%	7.1%	7.0%	7.0%	3.7%
6-9am	14.8%	9.8%	10.1%	9.1%	13.3%
9-12pm	26.4%	10.4%	10.6%	7.9%	14.6%
12-3pm	23.7%	12.2%	13.6%	13.8%	17.3%
3-6pm	19.8%	17.3%	17.8%	18.7%	23.5%
6-9pm	10.1%	15.3%	14.0%	15.7%	14.0%
9-12pm	3.5%	15.1%	13.9%	13.8%	8.3%
	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 7.6



Analysis of the data shows that the number of speeding tickets issued between 6 am and 6 pm was 85 percent. During the same time frame nearly half of speed related crashes and two thirds of all crashes occurred. However during 6am and 6 pm, the number of speeding tickets issued was 15 percent while speed related crashes nearly half of and a third of all crashes.

The time frame with the highest number of speed related fatal and serious crashes reported was between 3pm to 6 pm (19 percent). Nearly 20 percent of the speeding tickets were issued during the same time period.

During midnight to 6 am, the lowest number of speeding tickets was issued (nearly 2 percent) when the reported number of all types of speed related crashes was nearly 20 percent. This indicates more enforcement activity during this time period might lower the speed related crashes.

Speed related crashes as proportion by severity of crashes

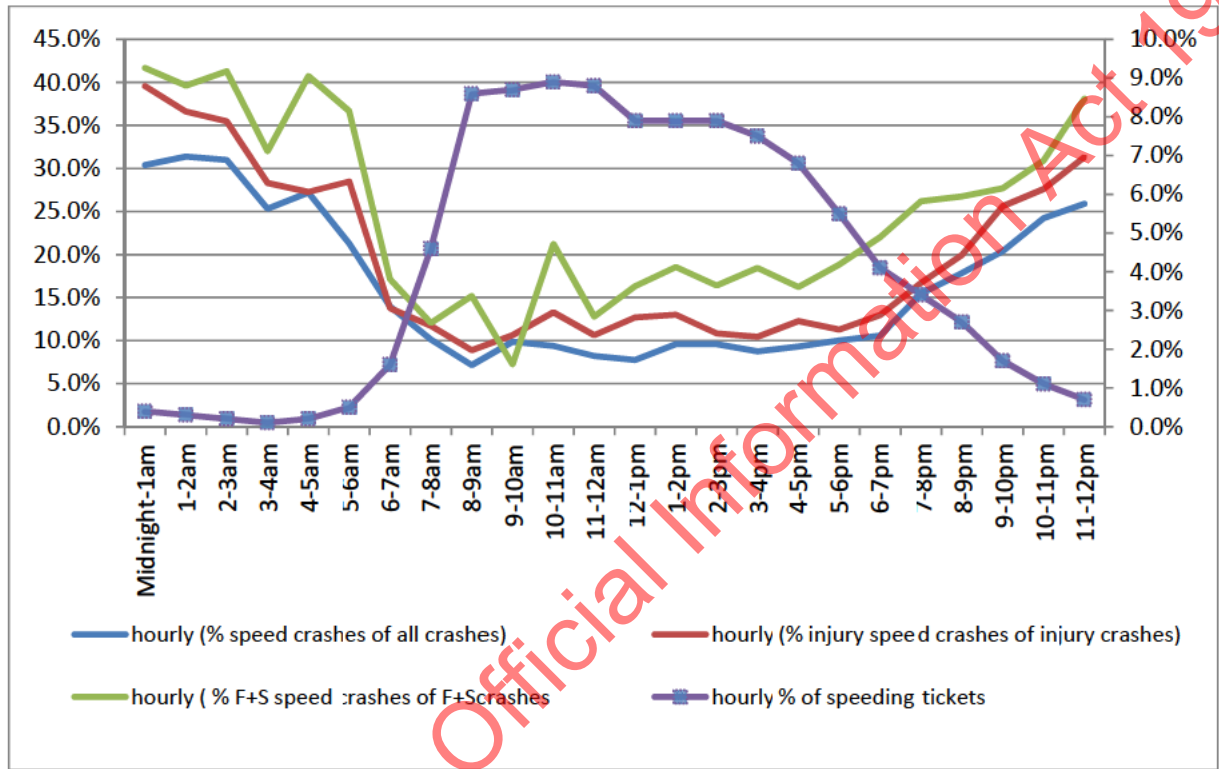
In 2011 of all the crashes reported 13 percent were speed related, of all the injury crashes reported 16 percent were speed related and of all the fatal and serious crashes 22 percent were speed related. Percentage distribution of these speed related crashes occurred during each hour of the day are given in the table below and compared with the hourly percent distribution of speeding tickets, summarized in table 7.2 and Figure 7.7 below.

Table 7.2

Time	% of speed crashes of all crashes	% of injury speed crashes of all injury rashes	% of F+S speed crashes of all F+Scrashes	hourly % of speeding tickets
Midnight-1am	30%	40%	42%	0.40%
1-2am	31%	37%	40%	0.30%
2-3am	31%	35%	41%	0.20%
3-4am	25%	28%	32%	0.10%
4-5am	27%	27%	41%	0.20%
5-6am	21%	28%	37%	0.50%
6-7am	14%	14%	17%	1.60%
7-8am	10%	12%	12%	4.60%
8-9am	7%	9%	15%	8.60%
9-10am	10%	11%	7%	8.70%
10-11am	9%	13%	21%	8.90%
11-12am	8%	11%	13%	8.80%
12-1pm	8%	13%	16%	7.90%
1-2pm	10%	13%	19%	7.90%
2-3pm	10%	11%	16%	7.90%
3-4pm	9%	10%	18%	7.50%
4-5pm	9%	12%	16%	6.80%
5-6pm	10%	11%	19%	5.50%
6-7pm	11%	13%	22%	4.10%
7-8pm	15%	17%	26%	3.40%

8- 9pm	18%	20	27%	2.70%
9- 10pm	20%	26	28%	1.70%
10- 11pm	24%	28	31%	1.10%
11- 12pm	26%	31	38%	0.70%

Figure 7.7 hourly distribution speed crashes and speeding tickets



Speed related crashes as percentage of all crashes are significantly high during late nights and early mornings, from midnight to 3 am on average each hour accounting for 41 percent of crashes. However the hourly distribution of the number of speeding tickets issued is significantly low during these times especially in relation to the higher severity levels of speed related crashes.

Hourly distribution of speed related crashes as percentage of crashes increases as the severity levels of crashes increases except during the hour from 9 am to 10 am. This is the only hour when the speed related fatal and serious crashes as percent of all fatal and serious crashes was the lowest and also recorded less than the speed related injury crashes and speed related all crashes as percentage of corresponding crashes.

8 Speed analysis

Speed Analysis: crash data and speeding ticket data

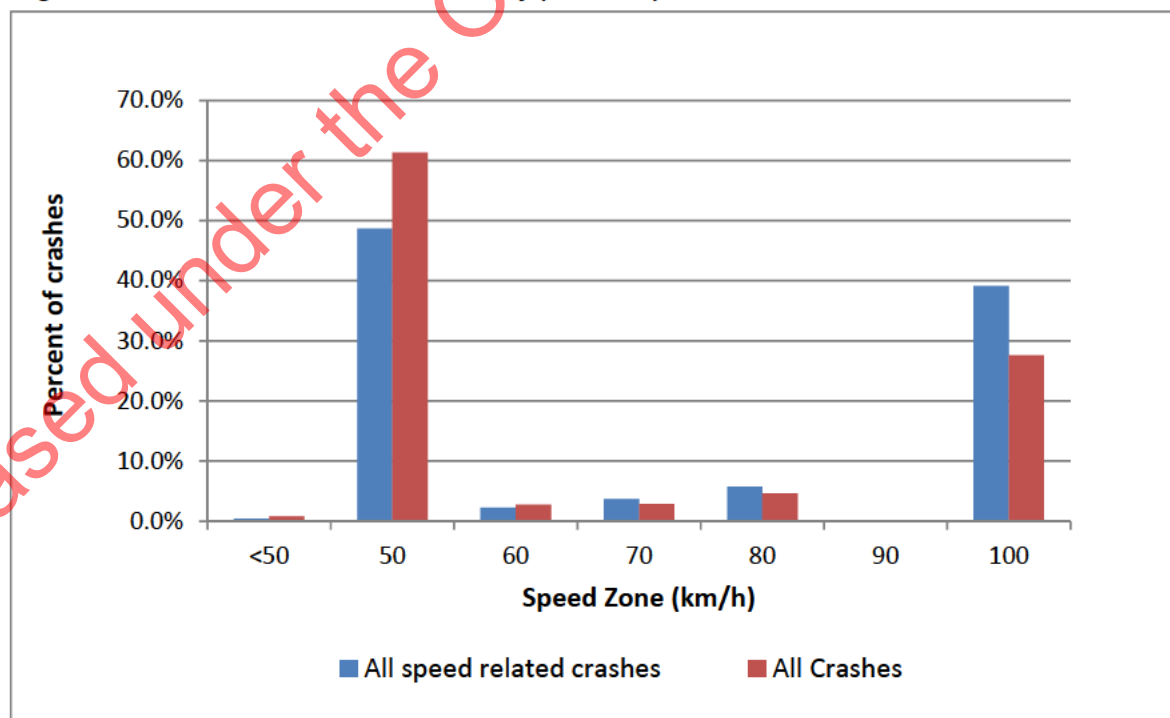
Crash data

Table 8.1 and Figure 8.1 below show the percentage distribution of all crashes (32450) and speed related all crashes (5726) by speed limit for the year 2011. It can be seen that the largest number of all crashes and speed related crashes occurred on roads with a 50 km/h speed limit, followed by a 100 km/h speed limit. A closer analysis of the data shows that nearly half (49 percent) of speed related crashes and over three-fifths of all crashes (61 percent) occurred in 50 km/h zone, while nearly two-fifths (39 percent) of speed related crashes and over a quarter of all crashes (28 percent) occurred in 100 km/h zone. As compared to all crashes, the proportion of speed related crashes in 100 km/h zone is significantly higher than in 50 km/h zone.

Table 8.1 Distribution of crashes by posted speed limit zones

Speed limit	All speed related crashes	All crashes
<50	0.5%	0.8%
50	48.7%	61.3%
60	2.3%	2.8%
70	3.7%	2.9%
80	5.8%	4.7%
90	0.0%	0.1%
100	39.2%	27.6%

Figure 8.1 Distribution of crashes by posted speed limit zones

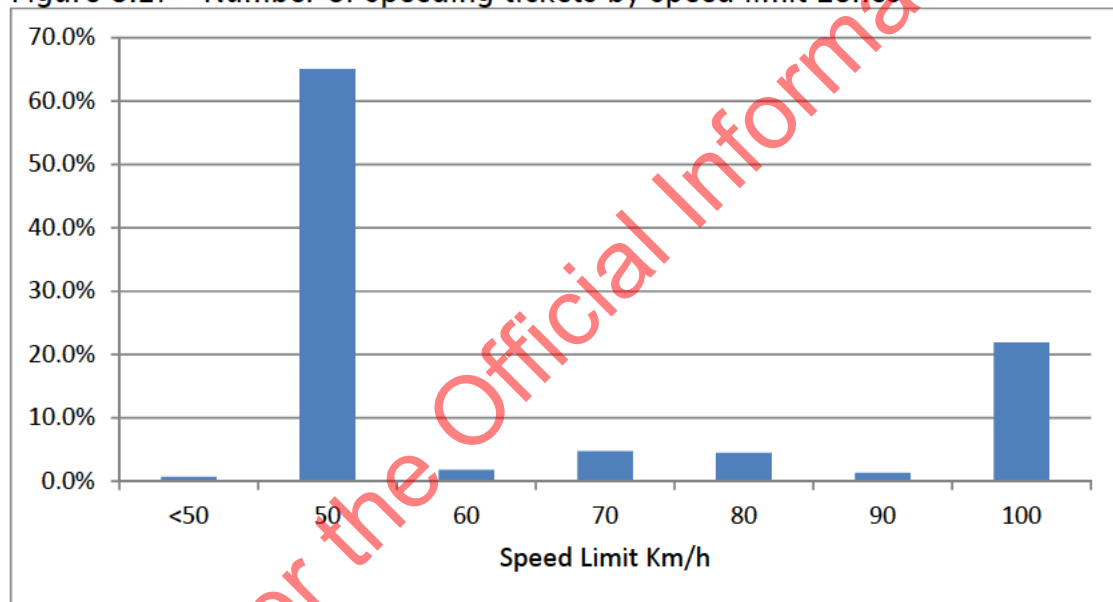


Speeding ticket data

874,330 speeding tickets were issued by the Police for exceeding the speed limit detected both by speed cameras as well as by the Police Officers in 2011. Chart below shows the distribution of these speeding tickets by speed limit zones where speed limit infringement occurred.

Nearly two thirds (65 percent) of tickets were for speed limit violations in 50 km/h speed limit zones while just over a fifth (22 percent) were in 100 km/h zones and nearly a tenth were in 70 and 80 km/h zones. This indicates that proportion of speed tickets issued in urban areas is nearly 3 times that in rural areas. The total length of roads with a 50 km/h speed limit and 100 km/h speed limit were 79,030 km and 19,570 km respectively in 2011. The Number of tickets issued in 50 km/h and 100 km/h zones were 7.19 tickets per km of road and 9.8 tickets per km of road respectively. The ticket density per km of road in 100 km/h zone is nearly 1.4 times that in 50 km/h zone.

Figure 8.2: Number of speeding tickets by speed limit zones



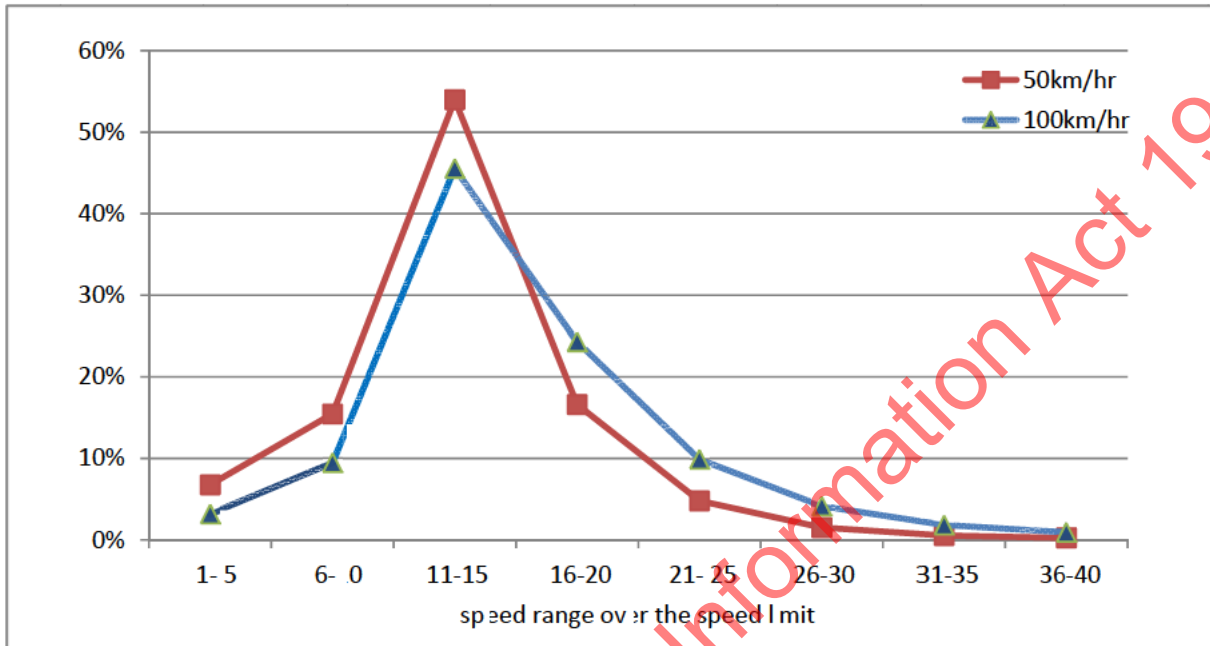
Of the speeding tickets issued on different speed zones, the table and the chart below show the distribution of speeding tickets by the range of speed over the speed limit.

Table 8.2 Speeding tickets by speed range exceeding the limit & speed zones

Exceeding speed limit by in km/h	20 km/h	30 km/h	40 km/h	50 km/h	60 km/h	70 km/h	80 km/h	90 km/h	100 km/h
1- 5	0%	0%	9%	7%	3%	3%	4%	1%	3%
6-10	2%	3%	49%	15%	10%	9%	12%	32%	9%
11-15	24%	28%	28%	54%	53%	46%	48%	39%	46%
16-20	24%	29%	10%	17%	21%	24%	23%	19%	24%
21- 25	18%	18%	3%	5%	8%	11%	8%	7%	10%
26-30	10%	10%	1%	2%	3%	4%	3%	2%	4%
31-35	8%	6%	0%	1%	1%	2%	1%	1%	2%
36-40	6%	3%	0%	0%	0%	1%	1%	0%	1%

>40	6%	4	0%	0%	0%	0%	1%	0%	1%
Total	49	3,156	3,111	568,732	15,735	41,452	19,110	11,657	191,329

Figure 8.3 Per cent of speeding ticket by speed range over the speed limit



Of the speed tickets issued in 50 km/h zones and 100 km/h zones, the percentage of speed tickets exceeding speed limit by 11 km/h to 20 km/h is identical 71% and 70 percent respectively. However the percentage of speed tickets issued exceeding speed limit by next 10 km/h (that is 21-30 km/h over the limit) in 100 km/h zones (14 percent) was two times the 50 km/h zones (7 percent). The above figure shows that the likelihood of issued speeding tickets violating the speed limit by over 10 km/h is higher in 100 km/h posted limit zones as compared to 50 km/h zones.

9 Limitations

Data used for the analysis was limited for one year (2011) period only, any crashes, speed tickets and drivers outside this period are excluded from the analysis resulting in an under estimation of crashes for speed ticketed drivers.

Correlation analysis was performed to establish the statistical relationship between the number of speeding tickets and the number of crashes. This relationship does not infer about the causal relationship between these two variables.

Drivers involved in non-injury crashes were excluded when they were matched against speed ticketed drivers as Crash data base does not record the details about the drivers in case of non-injury crashes.

Missing data field was an issue. Out of total 15,192 drivers involved in injury crashes in 2011, a tenth of drivers (1570) had a missing driver licence number which was the primary key for the data linkage between crashed drivers and speed ticketed drivers. Thus the calculated probability of speed ticketed drivers being involved in an injury crash which was (0.5 percent) was likely to be underestimated.

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