Analysis of the Most Critical Factors in Young (16-20 Year Old) Driver-Caused Vehicle Crashes

Base Study: CY2011-2015; Updated with CY2016 Data

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1.0 Introduction

For more general NHTSA and other information on young drivers, please see:
http://www.safehomealabama.gov/tag/young-drivers/

1.1 The IMPACT Studies in General (CY 2011-2015)

The goal of this problem identification is to assure that the young driver program considered by the state throughout FY 2018 is completely evidence-based, the evidence being derived from data obtained from crash records. This study was initially conducted based on data from calendar years 2011-2015, and it was updated for any changes that were observed in CY 2016 data.

CARE IMPACT displays are used to display the information, and the corresponding findings are explained with each display. The comparisons made were between those crashes in which the causal drivers were in the age group of 16-20 years (generally represented by the red bars in the charts) and those older drivers (generally represented by the blue bars in the charts). By comparing these two age groups those problems that are unique to 16-20 year old drivers can be identified.

Terminology: to make the narrative flow easier, the term ***young drivers*** will be applied to drivers of age 16-20 years. The term ***older drivers*** will refer to those older than 20 years in the context of this document.

Please observe the following aspects of the IMPACT outputs:

- Values prefixed by an E are strictly from the eCrash system; while those prefixed by a P are from the paper forms based system of crash reporting. Value descriptors that have no prefix indicate that the descriptor is common to both the E and P systems. Most of variable unique to the paper reports have evolve out since the conversion to eCrash was initiated in mid-2009. However, a few jurisdictions continued to submit on the paper forms making this designation essential.
- The two "Subset" columns (Frequency and Percent) for this analysis were created by a filter that only allowed 16-20 aged driver (young driver) caused crashes. An alternative would be to look at all crashes that involved young drivers, but much better results are obtained by considering only those young drivers that caused the crash, since the inclusion of victim drivers in this age group would tend to dilute the results. Countermeasures to be considered are those that apply directly to young driver caused crashes.
- The "Other" columns provide a control to which the "Subset" columns are compared. In this case the "Other" columns represent the subset formed from all crashes that were not caused by *young drivers* (caused by *older drivers* according to the definitions above).

- For example, we compared Primary Contributing Circumstances (PCC) of crashes caused by young drivers to the PCC of crashes that were not caused by young drivers. The rationale for this comparison is that it highlights where young drivers are doing things differently from their older driver counterparts, and this would indicate where countermeasures are to be applied that are different from those applied to traffic safety in general.
- The Odds Ratio column indicates the extent of the difference found. It is just the "Subset Percentage" divided by the "Other Percentage." As an example, a 2.00 in the "Over the Speed Limit" row would indicate that younger drivers were two times more likely to be reported to be "Over the Speed Limit" by the reporting officer than those caused by older drivers.
- The asterisk (*) on some of the Odds Ratios is an indication that these particular characteristics had a statistically significant difference found between the young drivers and the older drivers. This indicates that young drives are behaving in a statistically significant different way when it comes to these crash attributes, i.e., the differences observed are not just due to chance.
- Max Gain. This column indicates the number of crashes that could be saved over the five years of the study had young drivers had the same percentage of crashes of the corresponding attribute value that older drivers had. The ordering of the output is generally based on this column, with the exception of those attributes that are more understandable if they are presented in a natural ordering (e.g., time of day, month, number of injuries, etc.)

The findings of the problem identification will be presented in the following numbered order:

1. Introduction – this section.
2. Crash Causal Factors – listed first in that it was considered to be the most important in developing countermeasures for young driver caused crashes.
3. Severity Factors – given that a crash has occurred, its consequences can only be mitigated by a reduction in injury severity; and these factors are considered as equally important as the causation factors in reducing fatalities.
4. Driver Demographics – for purposes of evidence-based enforcement, the driver demographics, time factors and geographical factors are essential to determine the who, what, when, where, how and why or young driver crashes.
5. Time Factors – year, month, day of the week and time of day.
6. Geographical Factors – cities and counties as well as other geographical characteristics found to be over-represented.
7. Roadway and Vehicle Factors – there are less of a cause than driver characteristics, but may be useful especially in determining roadway and vehicle attributes that give young drivers their greatest problems.
8. Summary and Conclusions – ordered according to the list above.

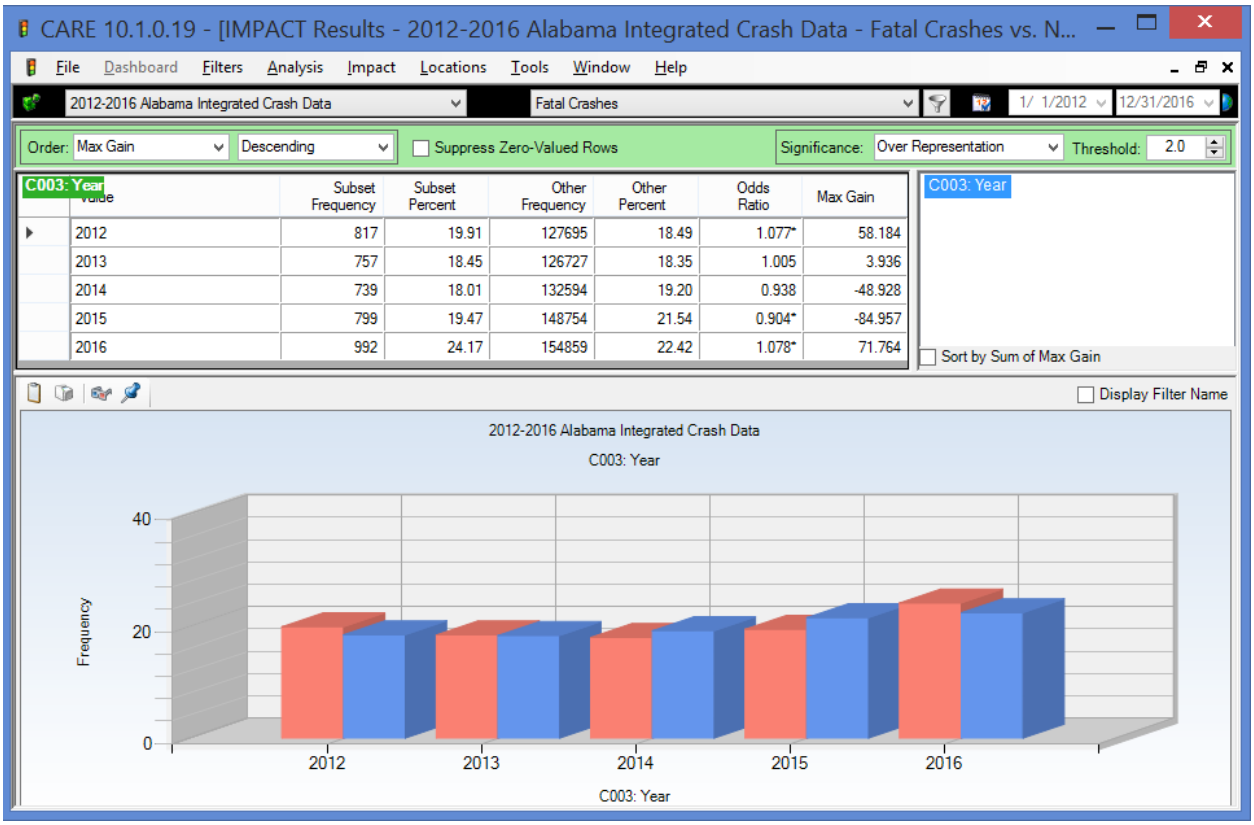
1.2 The CY 2016 Update to the 2011-2015 Study

The primary reason for conducting an update using the more recent CY 2016 data is to determine if there were any significant changes in CY 2016 that should alter the original findings. It might be noted that IMPACT study results, especially those over multiple years, are fairly stable. By

this we mean that they do not tend to change from year to year. For example, the over-representation of young drivers in speed-related crashes is not expected to change from year to year in that there are few, if any, effective countermeasure being implemented to dissuade young people from their risk-taking tendencies. We certainly encourage the development and implementation of such countermeasures, and such would be of great benefit to traffic safety in general, but that is not the point being made here. The point is that very little change is expected in the distribution of youth-caused speed related crashed in the 2016 data than what was found in 2011-2015.

As a result of this stability, the results of the 2016 update are documented by exception in this report. If no difference are found in the 2016 data, then the 2011-2015 results will be allowed to stand without comment. If differences are found they will be documented appropriately.

That said, we must add that 2016 was not a "usual" year. The major difference was in the number of fatalities that were recorded. Consider the following IMPACT analysis of fatal vs. non-fatal crashes by year:



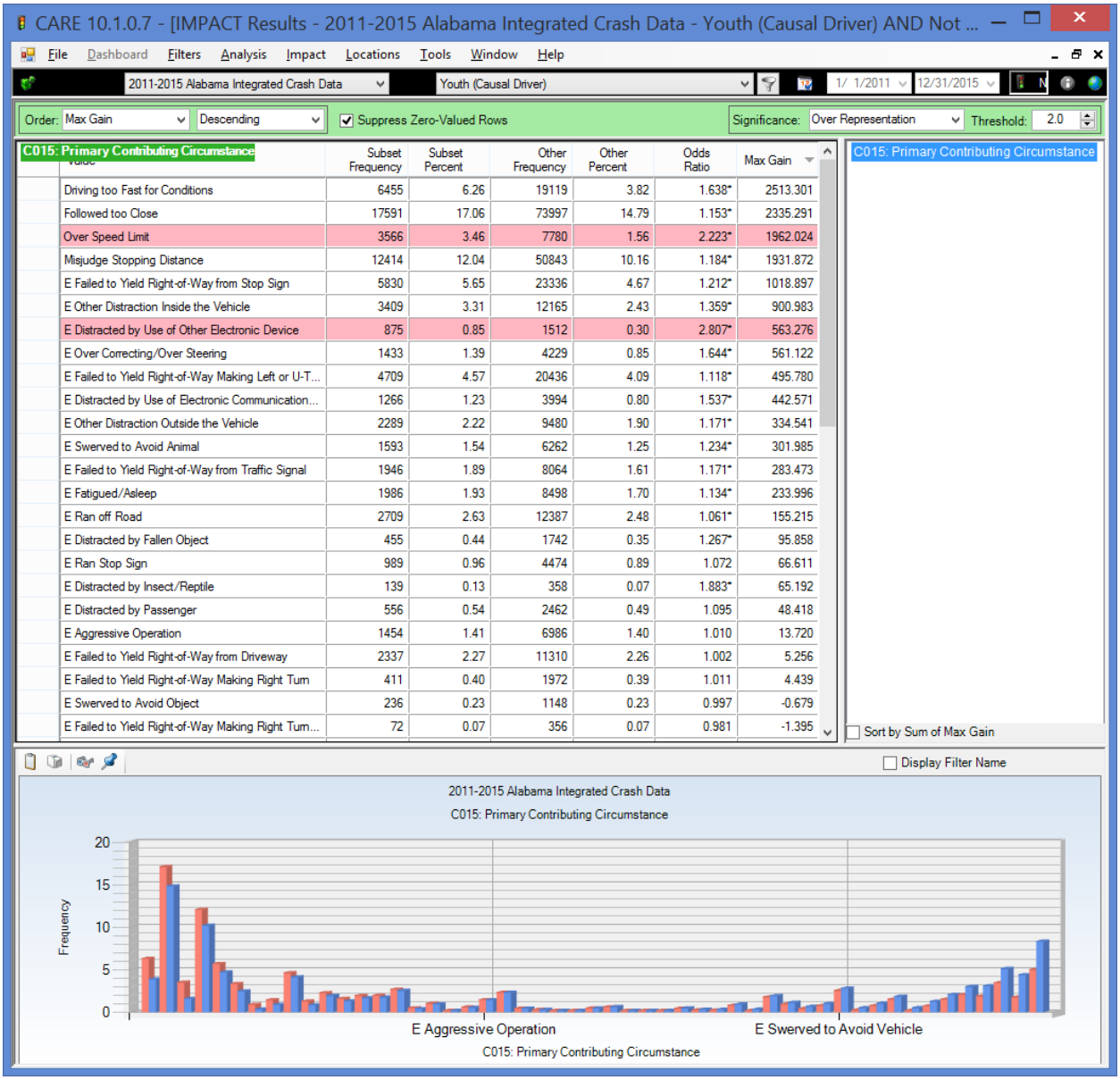
The 2016 fatal crash count increased by 193 additional fatal crashes in 2016 than 2015, an increase of over 24%. It is an even greater percentage (27.5%) increase over the average of the previous four years (2012-2015). It is obvious that something different was occurring on the roadways in 2016 than in previous years, and these difference as they affected or were caused by younger drivers is the major motivation for this update.

The approach to check the 2011-2105 findings will be to perform the corresponding IMPACTs for 2016 and compare the results. If there is no notable changes, that will be indicated.

2.0 Crash Causal Factors

Analysis of crash causal factors determines those factors that are the most likely contributors to crashes caused by young drivers. The primary contributing circumstances of the crashes were analyzed, and overrepresentation values generally indicate behaviors that are the result of risk-taking and inexperience.

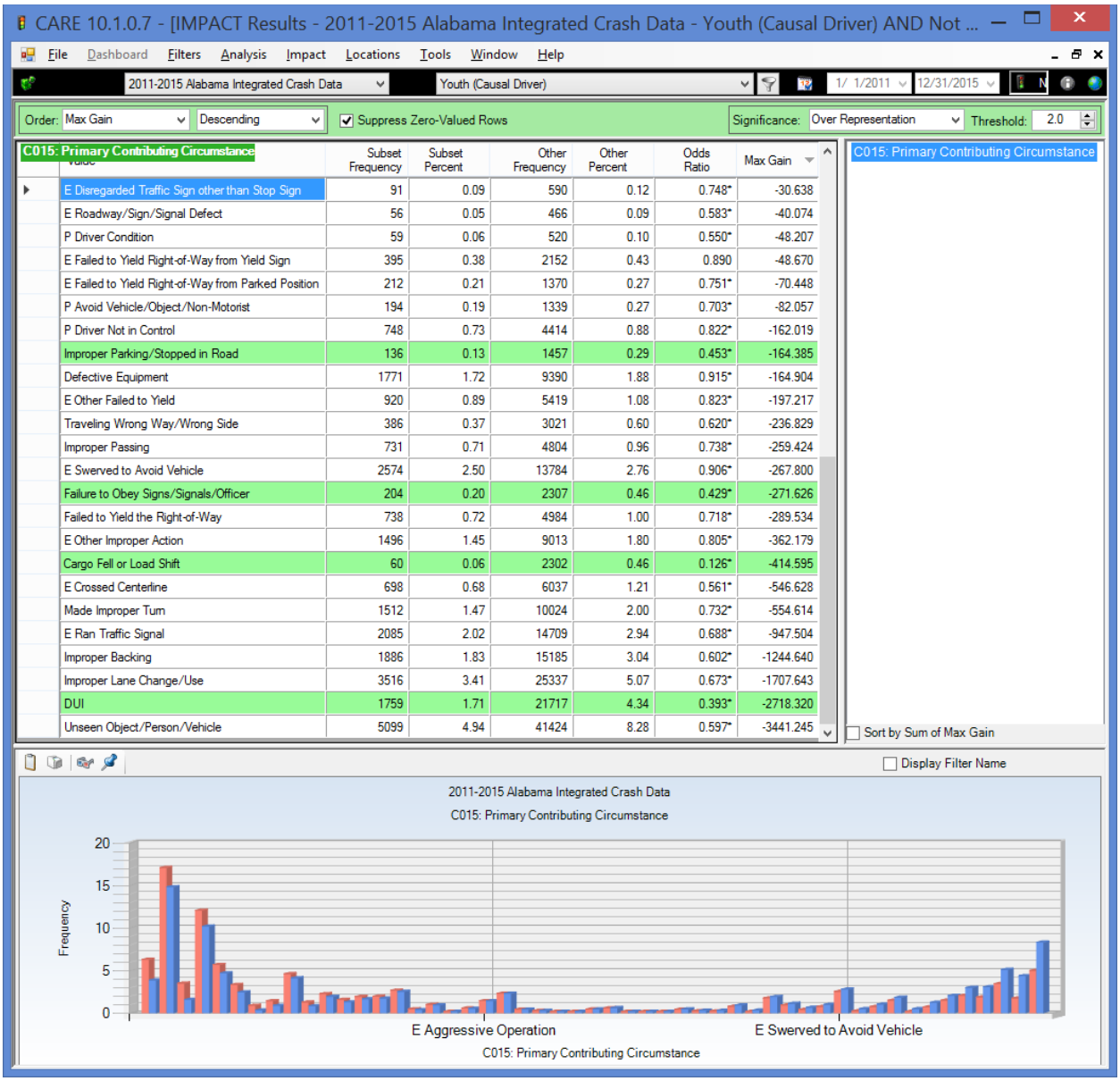
2.1a Primary Contributing Circumstance – Items of Over-Representation



Over-represented items are largely risk-taking behaviors that are highly associated with younger drivers. In order of maximum potential expected gain (Max Gain), these include: Driving too Fast for Conditions, Following too Close, Over the Speed Limit, Misjudge Stopping Distance,

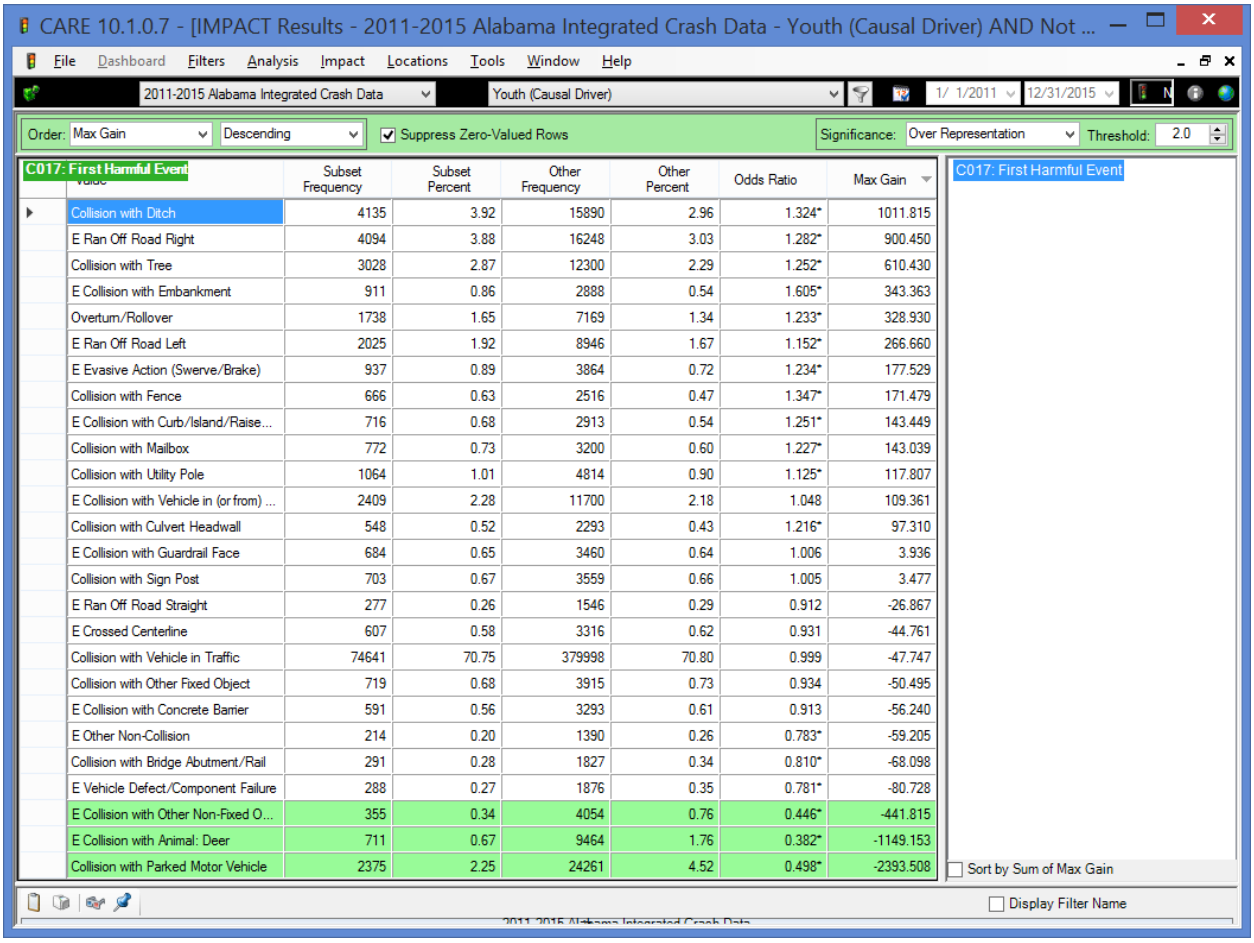
and Failure to Yield that Right of Way. No major changes were found in the CY2016 data distribution for this attribute.

2.1b Primary Contributing Circumstance – Items of Under-Representation



In developing an optimal set of countermeasures, it is equally important to know where resources are not needed. Those at the bottom of the table above have the greatest under-representation. While some have high frequencies, reducing these much further is not very practical. Young drivers are notably under-represented in their DUI, thanks to the 21 year old legal drinking age law. There are other under-represented items that might be attributed to their recent training and passing the drivers' test, and in some cases the effects of the Graduate Drivers Licensing (GDL) acts. No major changes were found in the CY2016 data distribution for this attribute.

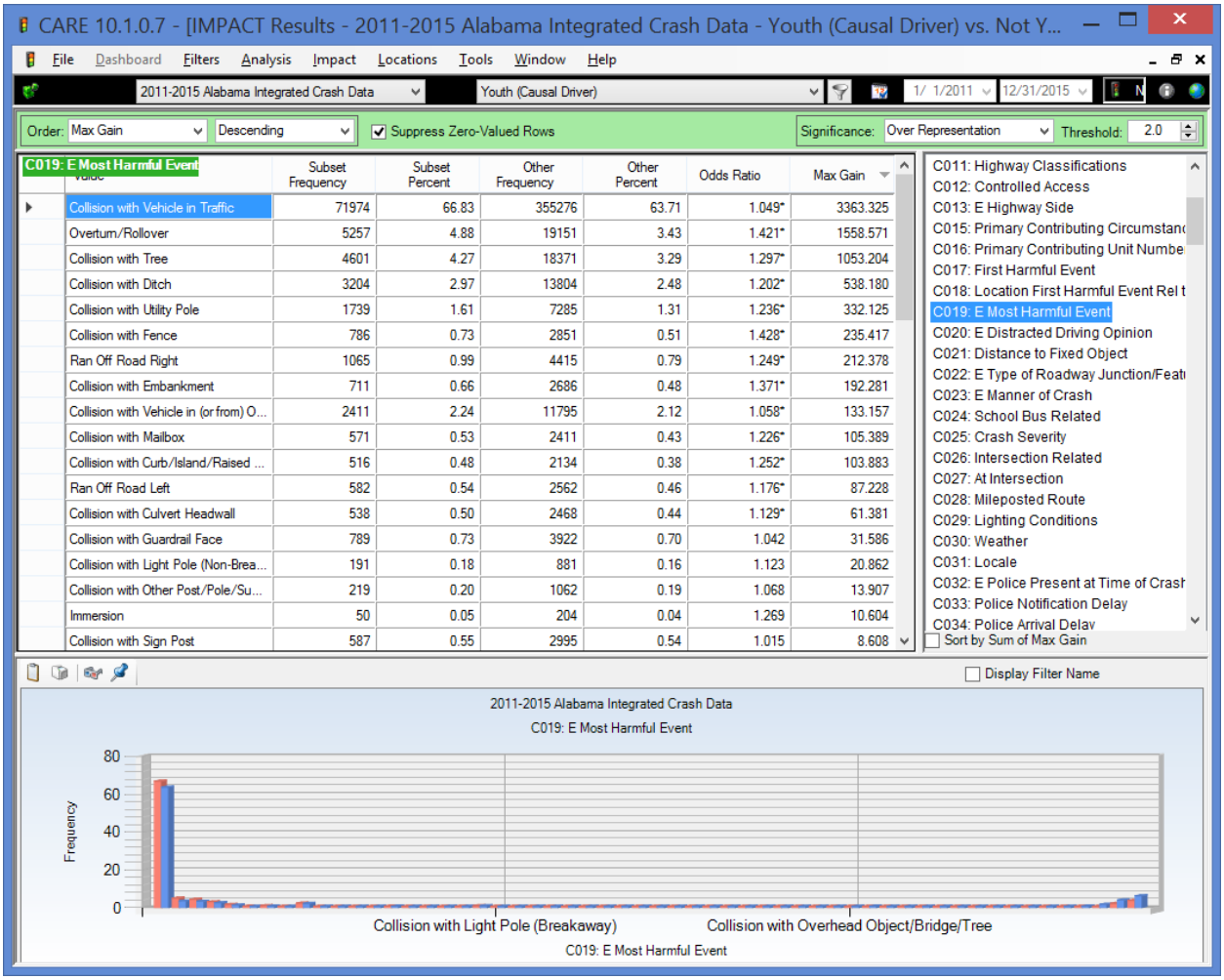
2.2 First Harmful Event



C017: First Harmful Event	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Collision with Ditch	4135	3.92	15890	2.96	1.324*	1011.815
E Ran Off Road Right	4094	3.88	16248	3.03	1.282*	900.450
Collision with Tree	3028	2.87	12300	2.29	1.252*	610.430
E Collision with Embankment	911	0.86	2888	0.54	1.605*	343.363
Overturn/Rollover	1738	1.65	7169	1.34	1.233*	328.930
E Ran Off Road Left	2025	1.92	8946	1.67	1.152*	266.660
E Evasive Action (Swerve/Brake)	937	0.89	3864	0.72	1.234*	177.529
Collision with Fence	666	0.63	2516	0.47	1.347*	171.479
E Collision with Curb/Island/Raise...	716	0.68	2913	0.54	1.251*	143.449
Collision with Mailbox	772	0.73	3200	0.60	1.227*	143.039
Collision with Utility Pole	1064	1.01	4814	0.90	1.125*	117.807
E Collision with Vehicle in (or from) ...	2409	2.28	11700	2.18	1.048	109.361
Collision with Culvert Headwall	548	0.52	2293	0.43	1.216*	97.310
E Collision with Guardrail Face	684	0.65	3460	0.64	1.006	3.936
Collision with Sign Post	703	0.67	3559	0.66	1.005	3.477
E Ran Off Road Straight	277	0.26	1546	0.29	0.912	-26.867
E Crossed Centerline	607	0.58	3316	0.62	0.931	-44.761
Collision with Vehicle in Traffic	74641	70.75	379998	70.80	0.999	-47.747
Collision with Other Fixed Object	719	0.68	3915	0.73	0.934	-50.495
E Collision with Concrete Barrier	591	0.56	3293	0.61	0.913	-56.240
E Other Non-Collision	214	0.20	1390	0.26	0.783*	-59.205
Collision with Bridge Abutment/Rail	291	0.28	1827	0.34	0.810*	-68.098
E Vehicle Defect/Component Failure	288	0.27	1876	0.35	0.781*	-80.728
E Collision with Other Non-Fixed O...	355	0.34	4054	0.76	0.446*	-441.815
E Collision with Animal: Deer	711	0.67	9464	1.76	0.382*	-1149.153
Collision with Parked Motor Vehicle	2375	2.25	24261	4.52	0.498*	-2393.508

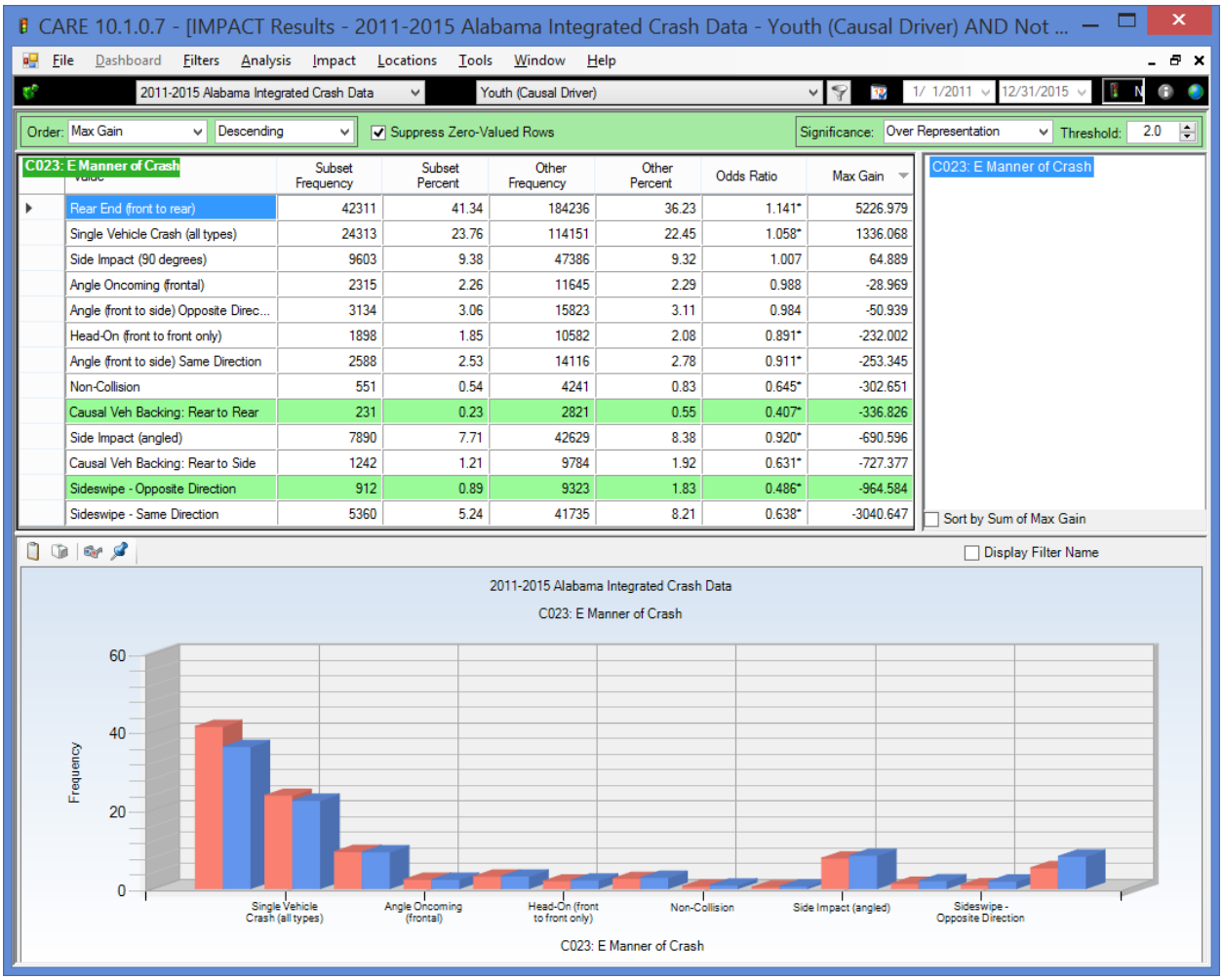
It is impossible to separate these first harmful events from speeding and other risk-taking behaviors. No major changes were found in the CY2016 data distribution for this attribute.

2.3 Most Harmful Event



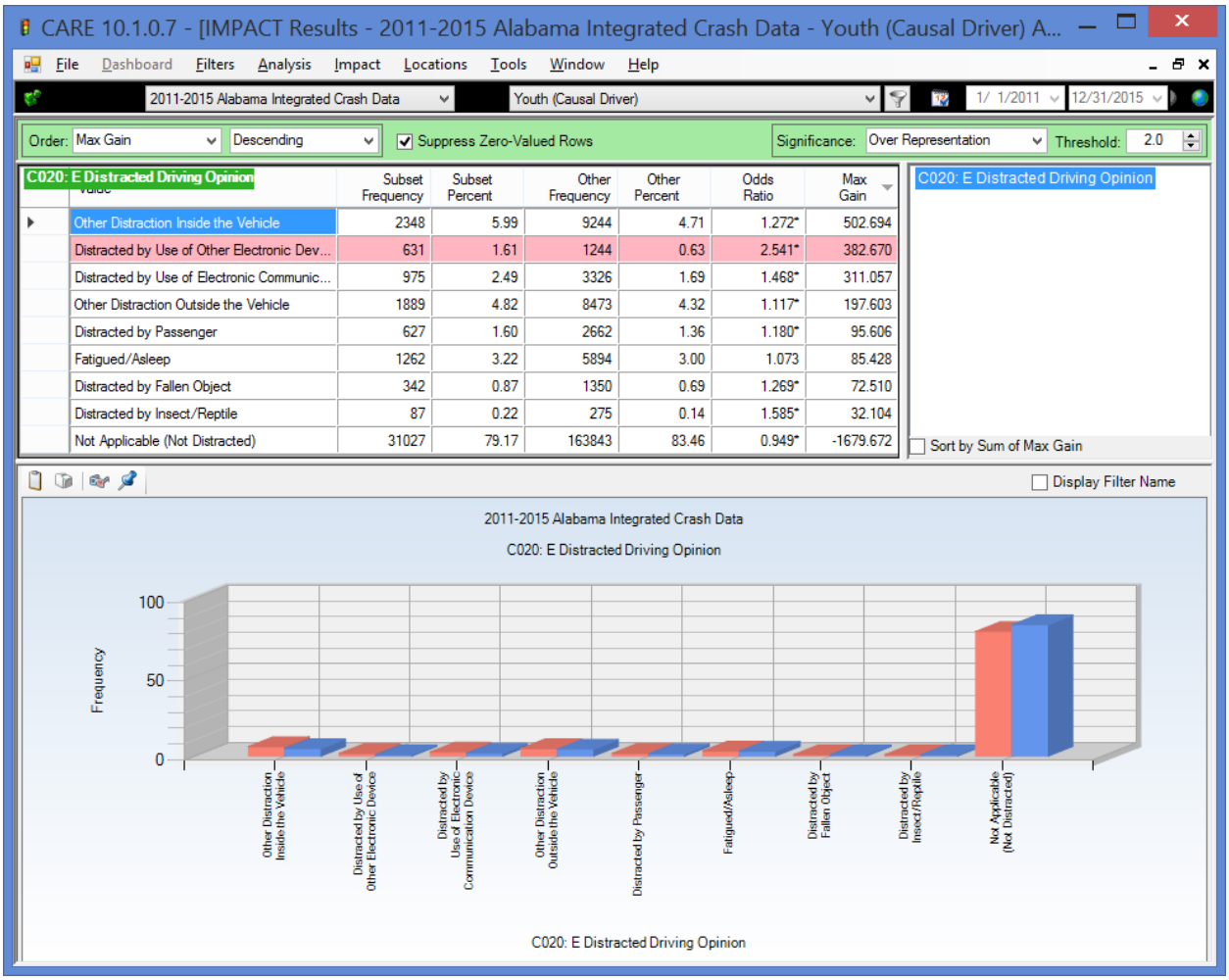
The Most Harmful Event attribute indicates more what caused harm as opposed to what caused the crash. Two-thirds of young drivers' crashes involve two or more vehicles. This is only a few percentage above the older drivers, but the difference is significant – a net of 3363 crashes more than what would be expected in this category over the five year period (542 more in 2016). No major changes were found in the CY2016 data distribution for this attribute.

2.4 Manner of Crash



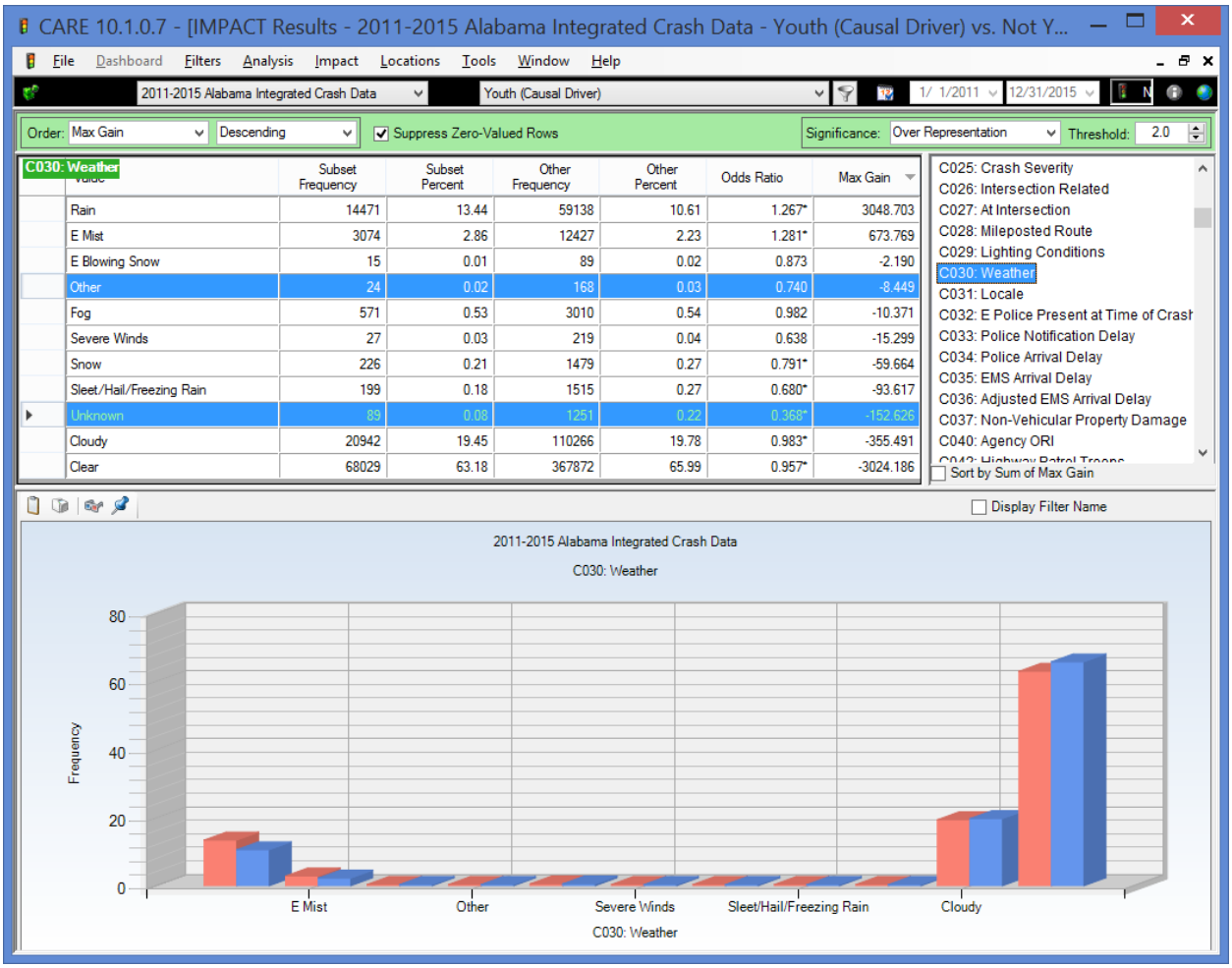
Additional clues regarding the causes of the crash can be seen from the Manner of Crash. Rear End crashes reflect poor estimation of stopping distance (inexperience). The over-representation of single vehicle crashes show an excess of unforced errors and risk-taking. These are the only two categories that are significantly over-represented (both in the five year analysis and the 2016 update). No major changes were found in the CY2016 data distribution for this attribute.

2.5 Distracted Driving – Officer's Opinion



Distracted driving under-reporting. It is clear to all traffic safety professionals that the reported incidence of distracted driving is far less than that occurring in reality on the roadway. For example, if a conservative estimate of 20% of drivers at any time are involved with an electronic device, then we would expect the percentage of crashes to be affected would be 20%. In reality, most drivers perceive from their informal observations that this proportion to be well above 30%. It is a valid assumption, however, that officers would not report this attribute for young drivers any differently than they would for older drivers. This means that while the absolute numbers give are almost certain to be lower than reality, they do form a representative random sample of all distracted driving occurring for both the younger and the older causal drivers. That being the case, the comparison of the two subsets is quite valuable in determining the affinity of distractions to the younger drivers. The only under-represented category is "Not Applicable (Not Distracted)." Other Distractions Inside the Vehicle have the highest Max Gain; these should not be assumed to be other passengers, since there is another category for that, which is also over-represented, showing the value of the GDL in restricting the number of passengers. Electronic devices are quite high as well, which is certainly expected. No major changes were found in the CY2016 data distribution for this attribute.

2.6 Weather

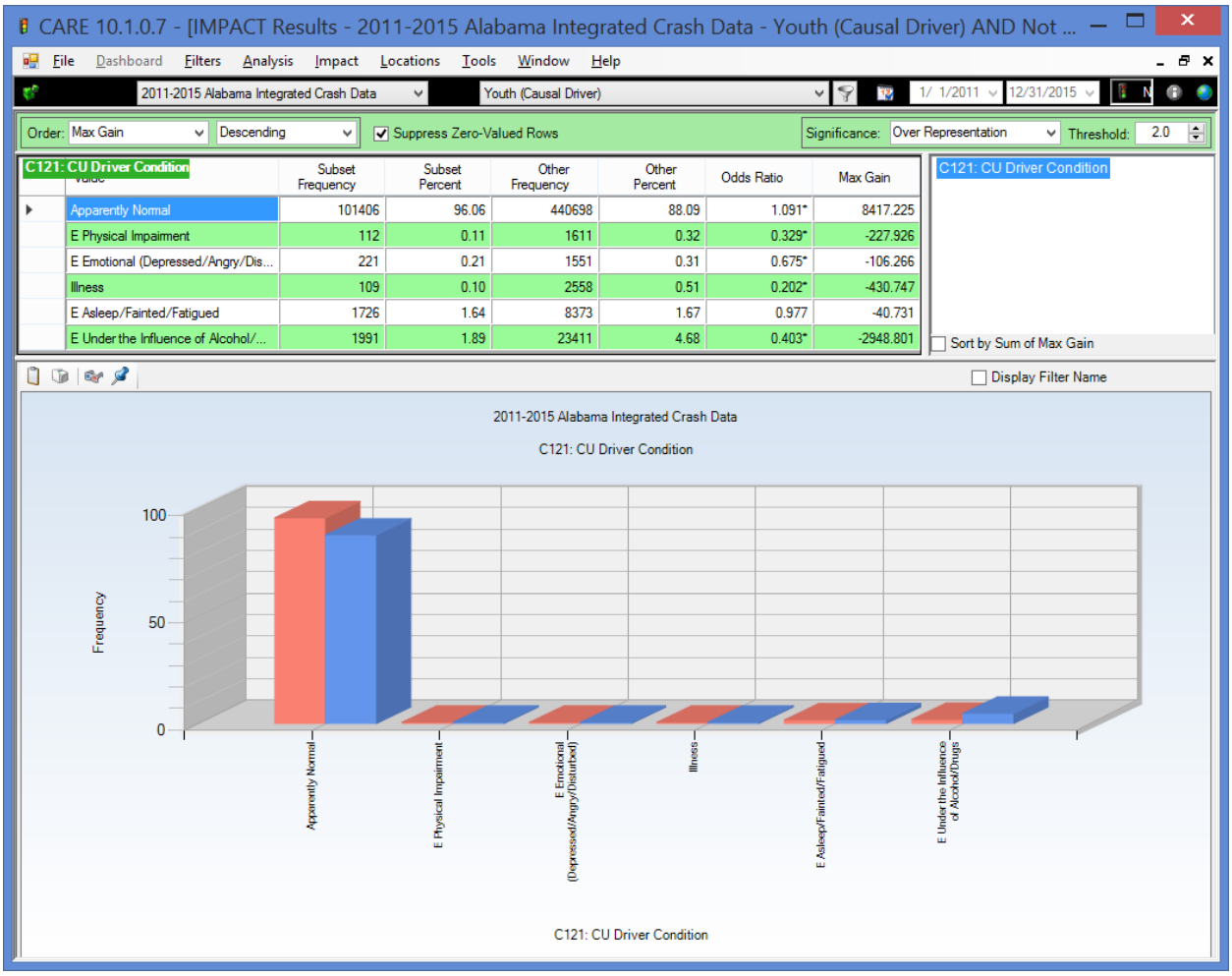


We are including weather as a major causal factor mainly because our analysis of the 2015 general increase in all crashes was largely attributed to the increase in rainfall days in 2015. Studies in Alabama have shown that the effect of rain on visibility and surface condition can increase the frequency of crashes by as much as 40%. See:

http://www.safehomealabama.gov/SafetyTopics/Weather.aspx

This display shows that rain is a particular issue for young drivers, their having over 26% more than their expected number of crashes in the rain. This is definitely a subject that needs to be given more attention in training and testing. The combination of inexperience (they may not have had a serious scary skid at this point), and their inclinations to take risks in any event is a bad combination in the rain. See the 2016 IMPACT output on the next page for the 2016 update. No major changes were found in the CY2016 data distribution for this attribute.

2.7 CU Driver Condition



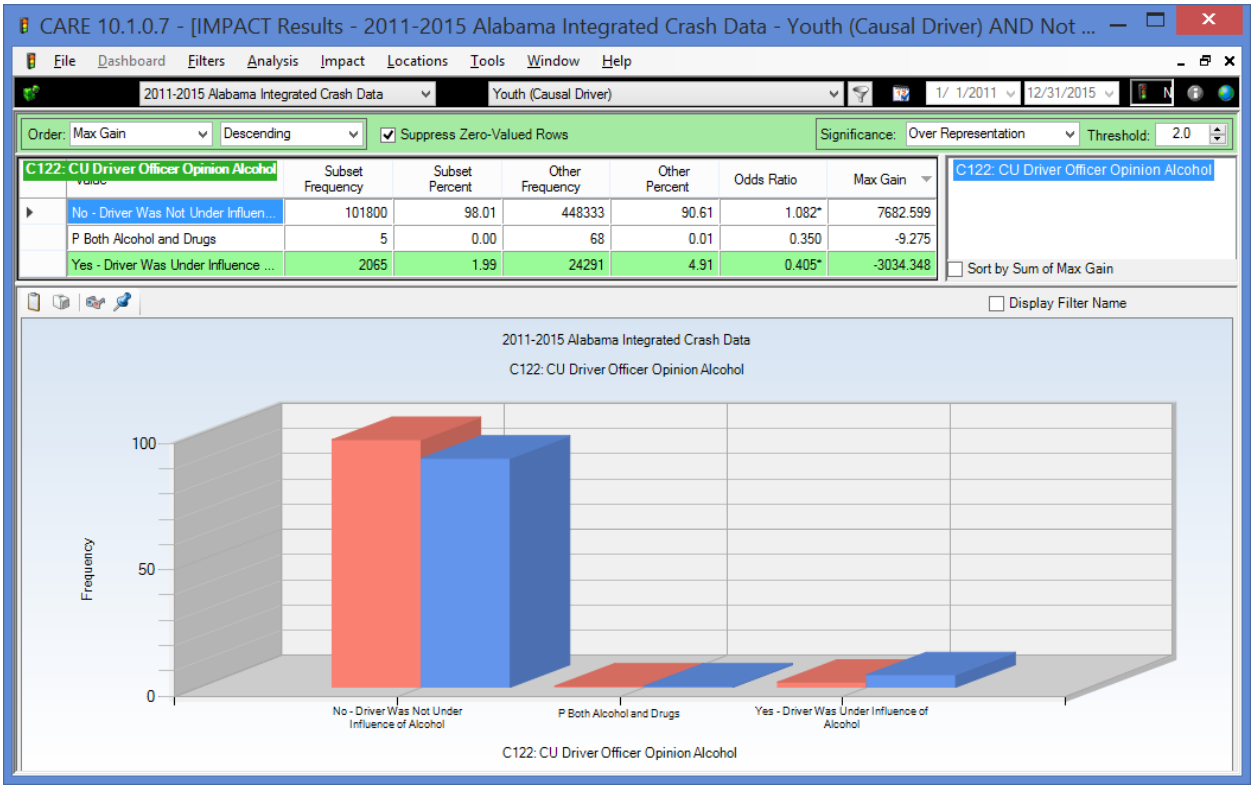
This and then next attribute show a very positive characteristic of younger drivers – the fact that they have not yet gotten into drinking and driving. We say not yet because this problem does build with each year of age, and it becomes over-represented at age 21 and stays that way well into the 30s. We attribute this to the age 21 drinking law, and any suggestion that this age should be lowered (as was made a few years ago by some university presidents) is absurd on the surface and should be opposed by all serious traffic safety advocates.

Our state is not yet plagued with the massive use of marijuana that is sweeping those states that have legalized its use. See "Marijuana's Effect on Your Driving" here:

http://www.safehomealabama.gov/SafetyTopics/DriverIssues/ImpairedDriving.aspx

No major changes were found in the CY2016 data distribution for this attribute.

2.8 CU Driver Officer Opinion Alcohol

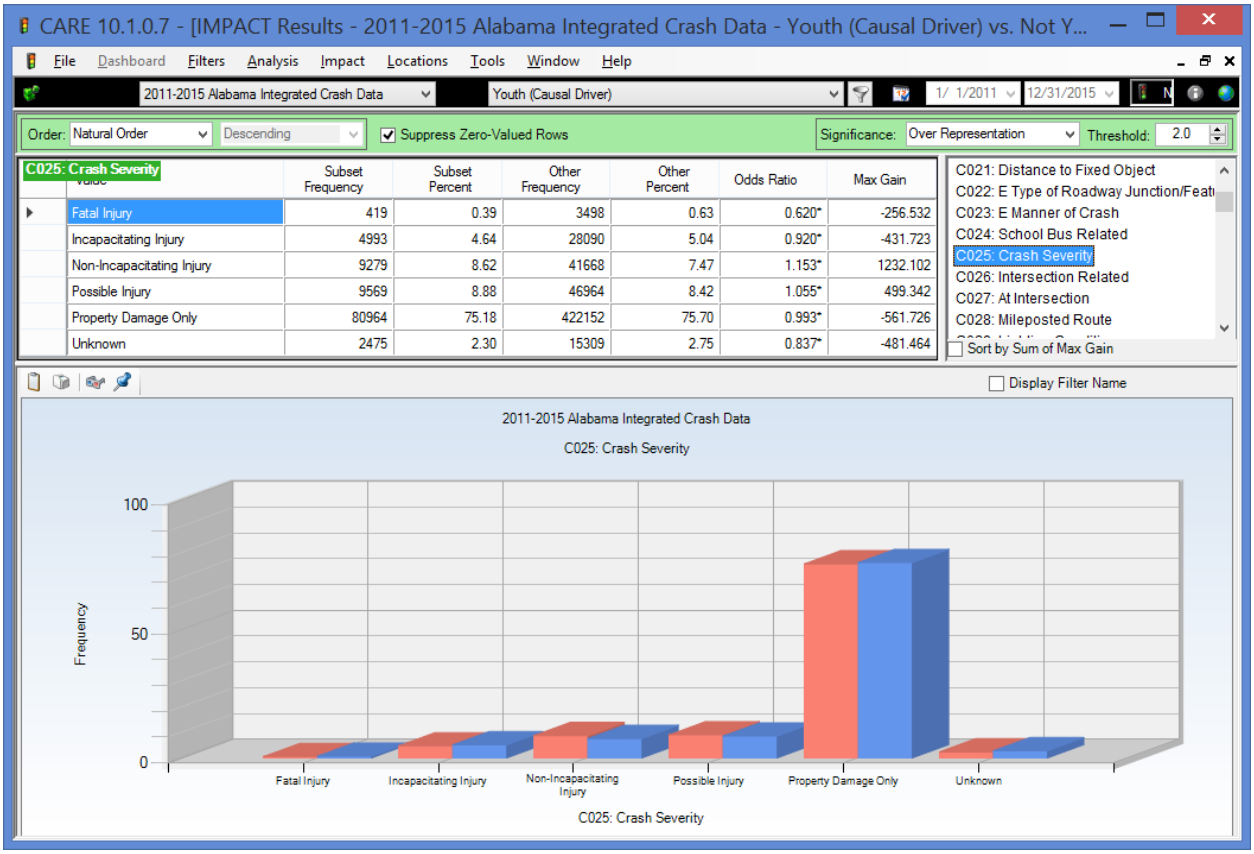


No major changes were found in the CY2016 data distribution for this attribute.

3.0 Severity Factors

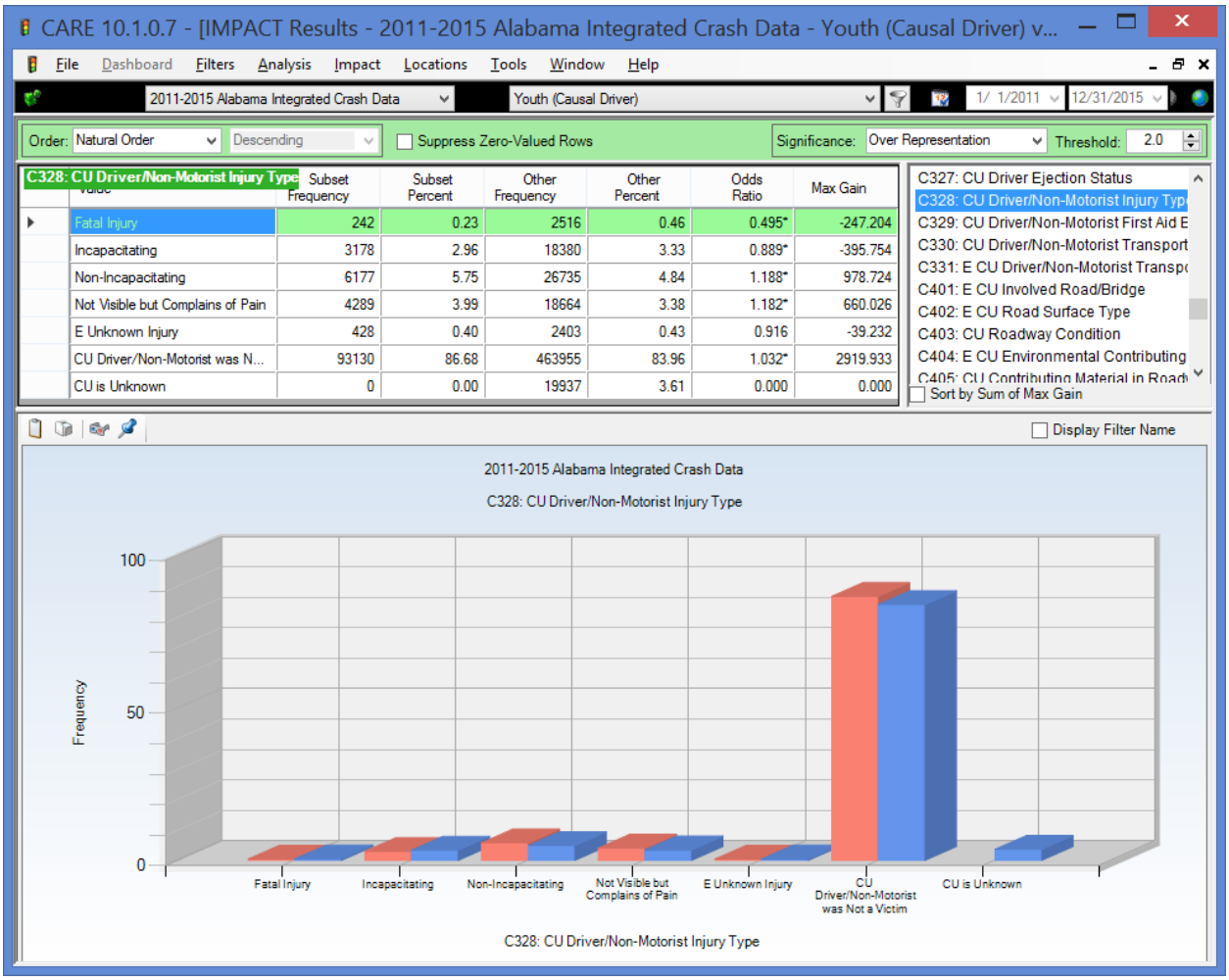
Severity factors were analyzed in several different categories to determine to what extent crashes caused by younger drivers produce severities different from older driver caused crashes.

3.1 Crash Severity



This attribute is the severity of the worse injured person in the crash, not just the causal driver. It is clear that fatal and incapacitating injury are significantly under-represented. The over-representation that balances these out are the two lessor injury categories. The younger drivers and their typically younger passengers have a far greater survival rate than older drivers under the identical circumstances. The proportion of fatal to all crashes for young drivers increased from its 2011-2015 average, given in the table above, of 0.39% to 0.44%. This contributed to the overall increase in fatal crashes in 2016, but it is not statistically significant. Other than this possible change, no changes of interest were found in the CY2016 data distribution for this attribute.

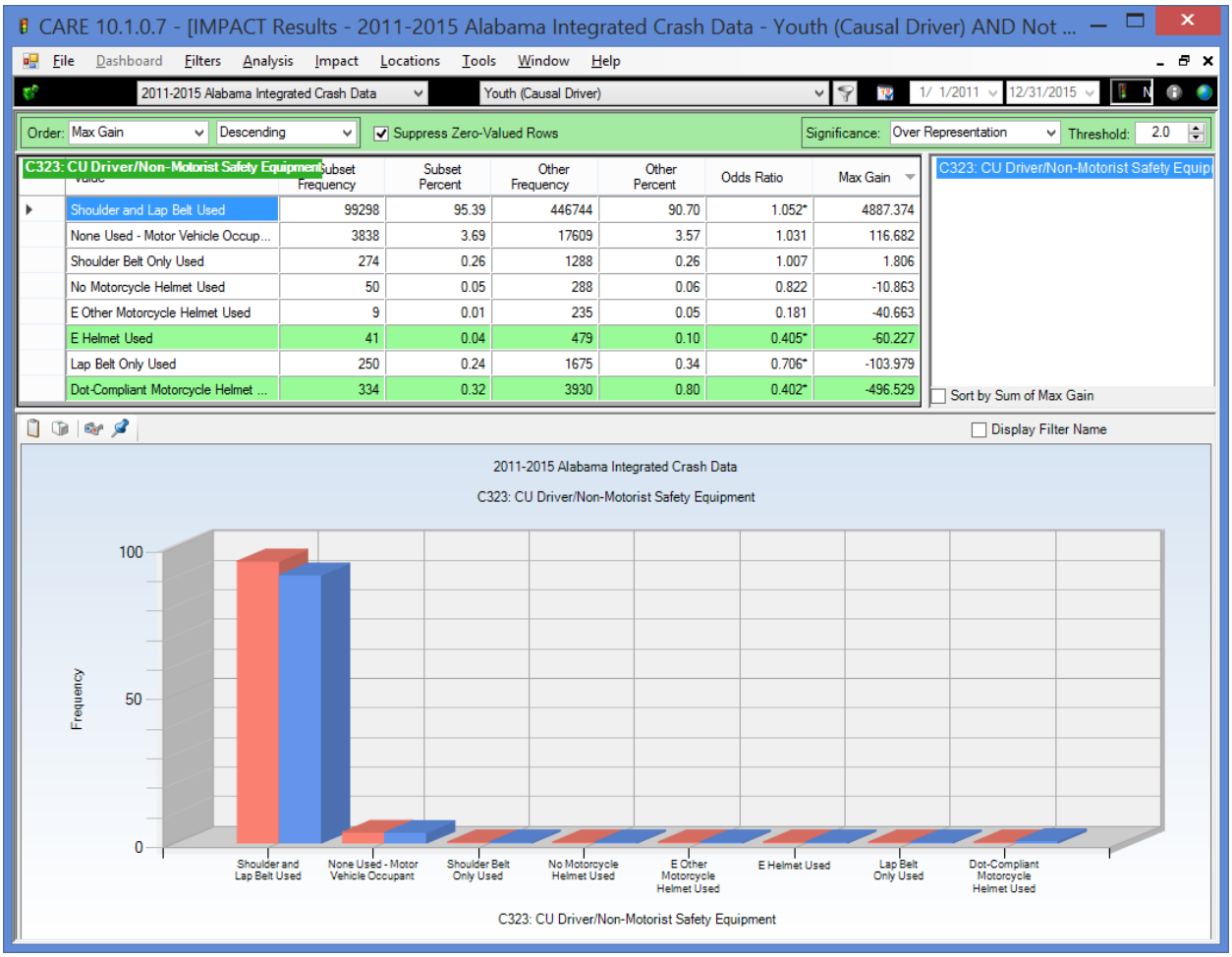
3.2 CU Driver Injury Type



The favorable youth severity results for all crash occupants is greatly multiplied for the causal drivers, in that we know that all causal drivers in the subset are of ages16-20 inclusive. Thus, for example, the under-representation goes from 0.620 for all persons in the crash to 0.495 when just referring to causal drivers. Interesting here in comparing these two displays, since there were 419 fatal crashes in general, and 242 of them were the causal drivers, this leaves 177 crashes in which persons were killed other than the 16-20 causal driver.

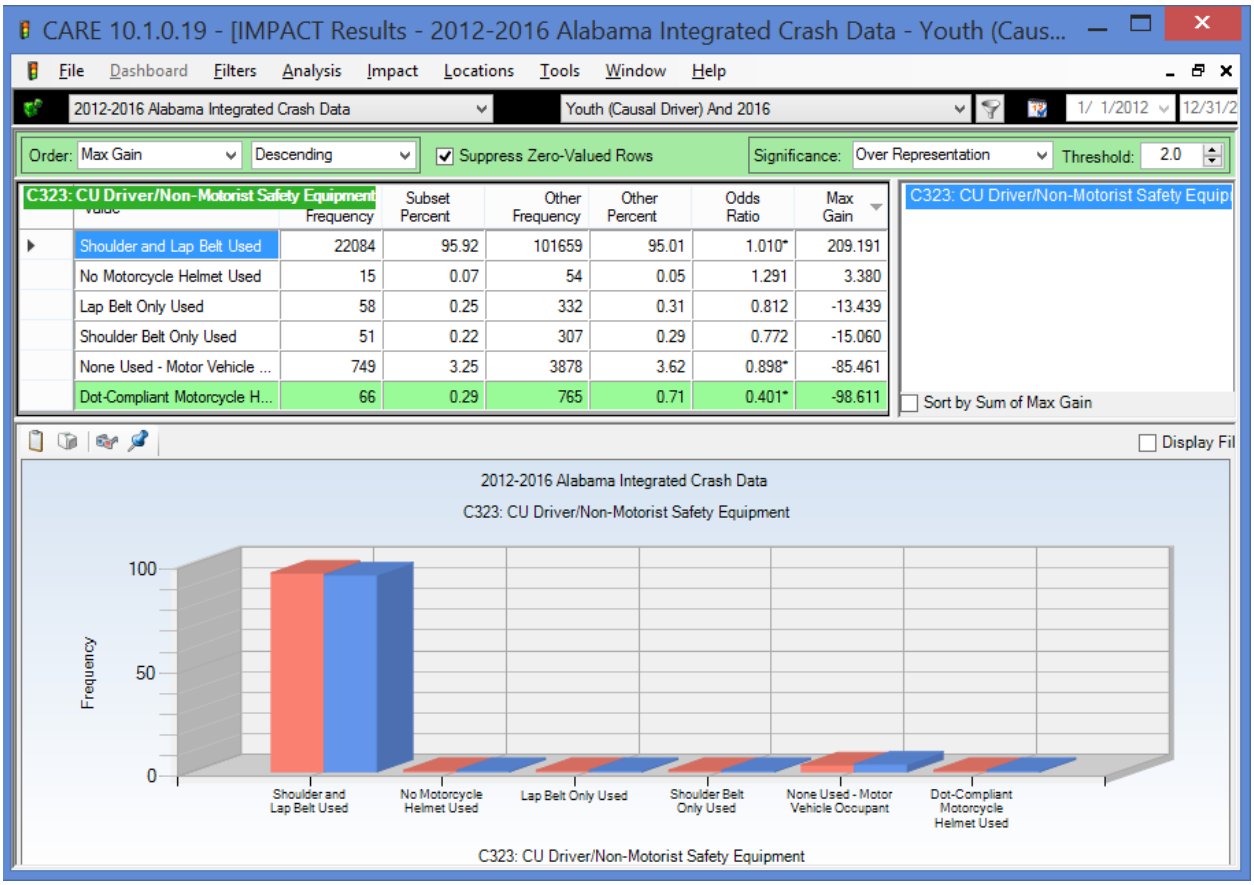
The only interesting change in proportions in 2016 was an increase of the proportion from 0.23% to 0.26%, a small increase that would probably not be statistically significant. However, it does amount to 7 additional young drivers involved in fatal crashes since applying the 0.23% proportion to the 2016 total for young drivers would have resulted in 55 fatal crashes rather than the actual 62. This is consistent with the overall increase in fatal crashes in 2016 as well as that discussed in Section 3.1.

3.3 CU Driver Safety Equipment (Seatbelt Use)



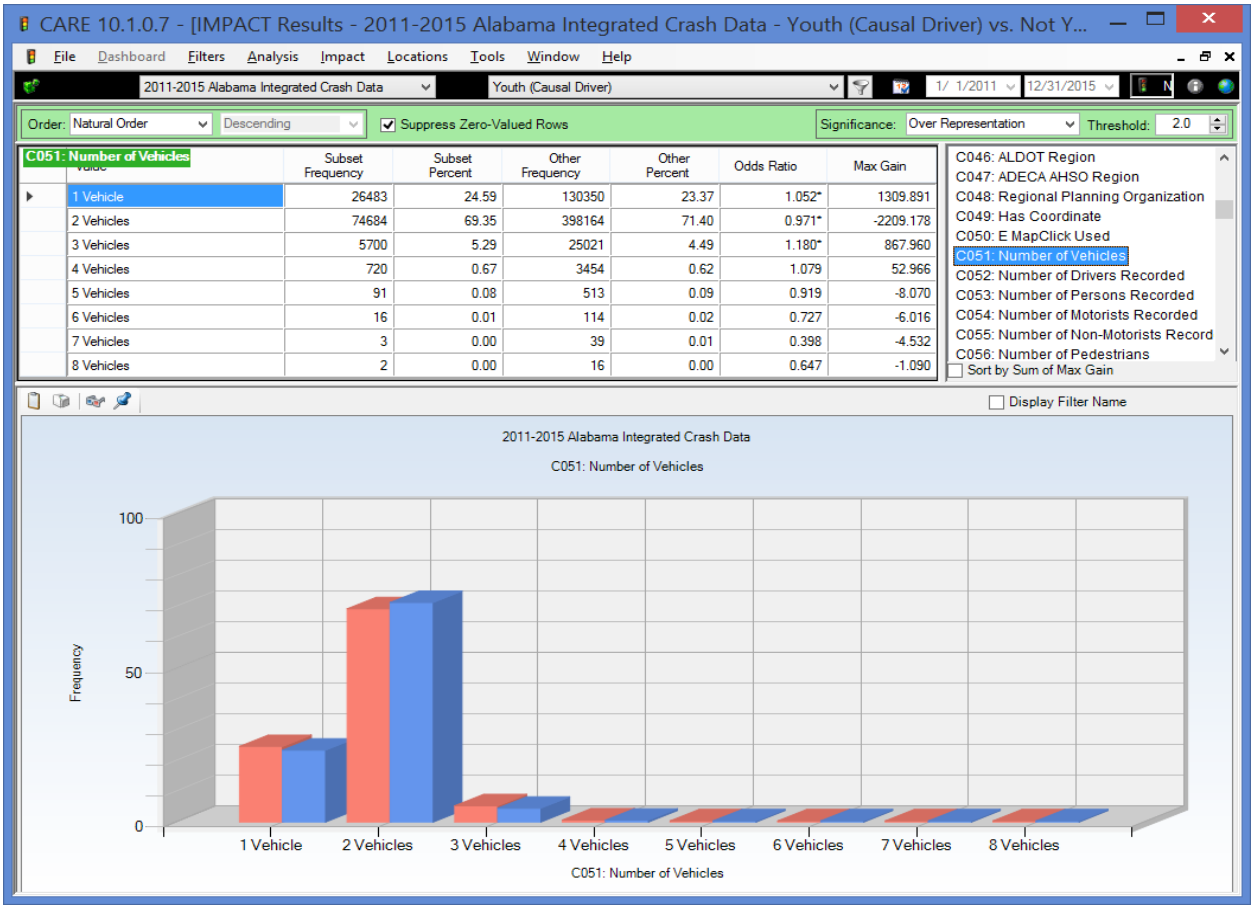
Younger drivers seem to be doing a relatively good job in buckling up, as they are significantly over-represented in this category. This probably reflects their general training throughout their school years, both in the schools and the families.

An improvement in reported seatbelt use for young drivers in 2016 is shown in the IMPACT on the next page.



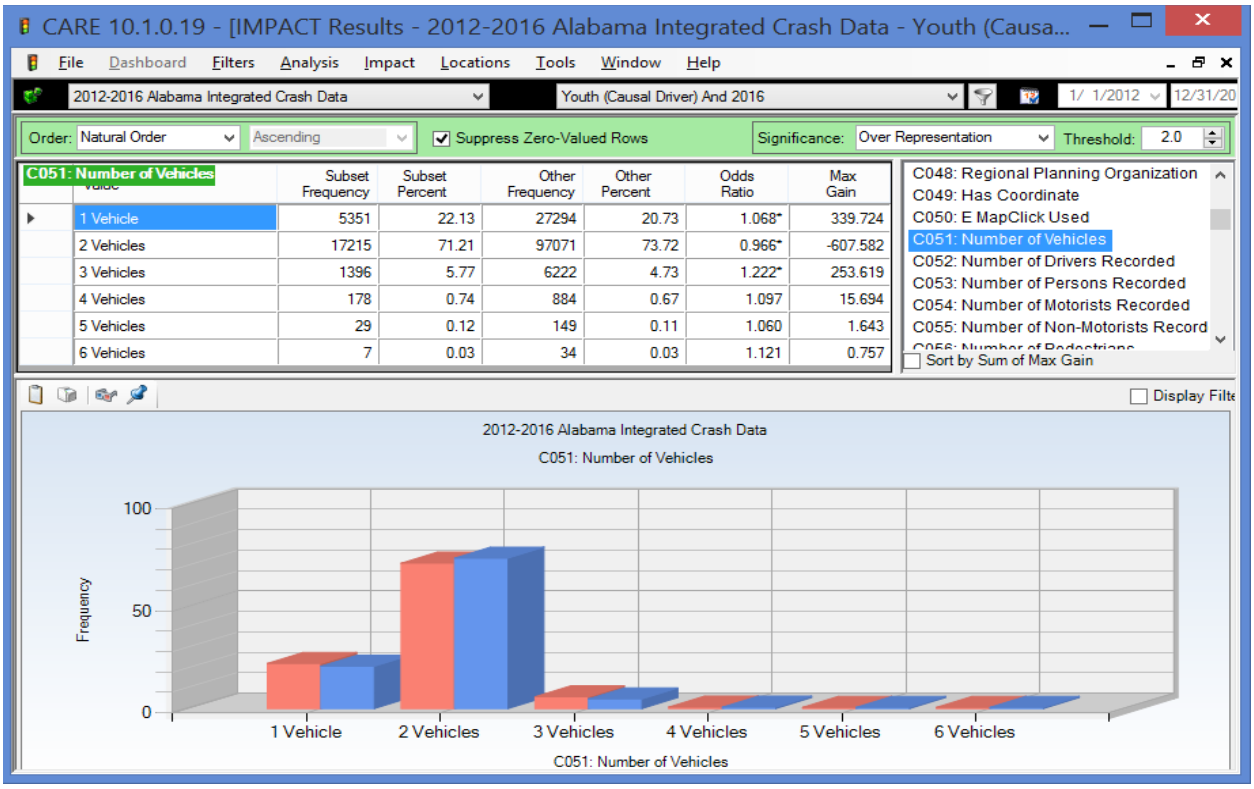
In particular, the reported seatbelt usage rate for young drivers increased from its 2011-2015 average of 95.39% to 95.92%. The non-use rate of 3.69%, which was over-represented for 2011-2015 is now shown to be an under-represented value of 3.25%. The bad news is that it is being compared to 3.62% for older drivers (as opposed to their previous 3.57%). So according to reports the seatbelt use rage in the older driver population has dipped, which could further account for the increase in fatalities in 2016. It is not possible to quantify what these changes did as far as fatality causation, but it is a good sign to see any increase in seatbelt use on the part of younger drivers.

3.4 Number of Vehicles



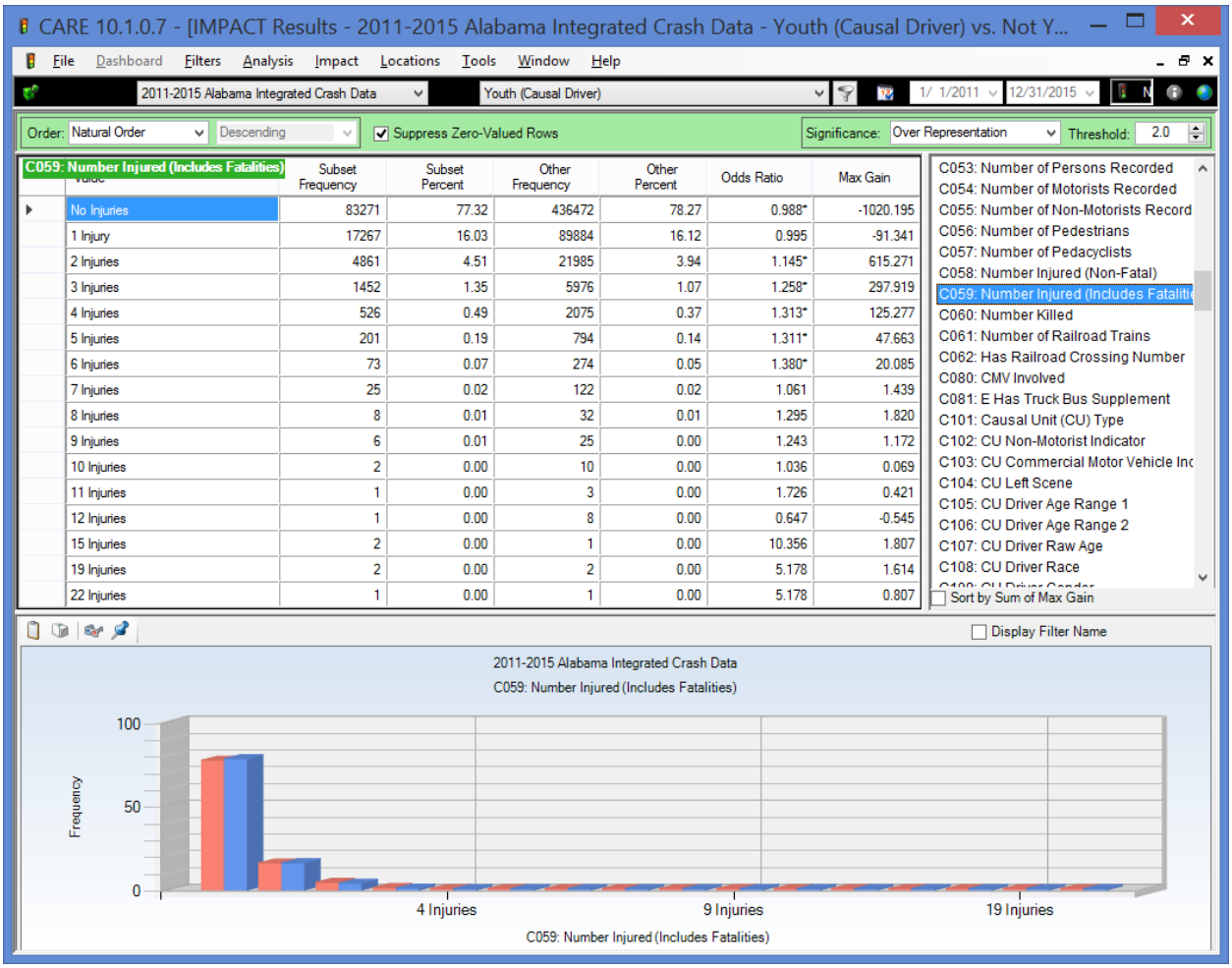
This display is presented to put the counts in the following attributes into perspective. Generally young drivers have (about 5%) more than their share of single-vehicle crashes.

The comparison for 2016 is given on the next page.



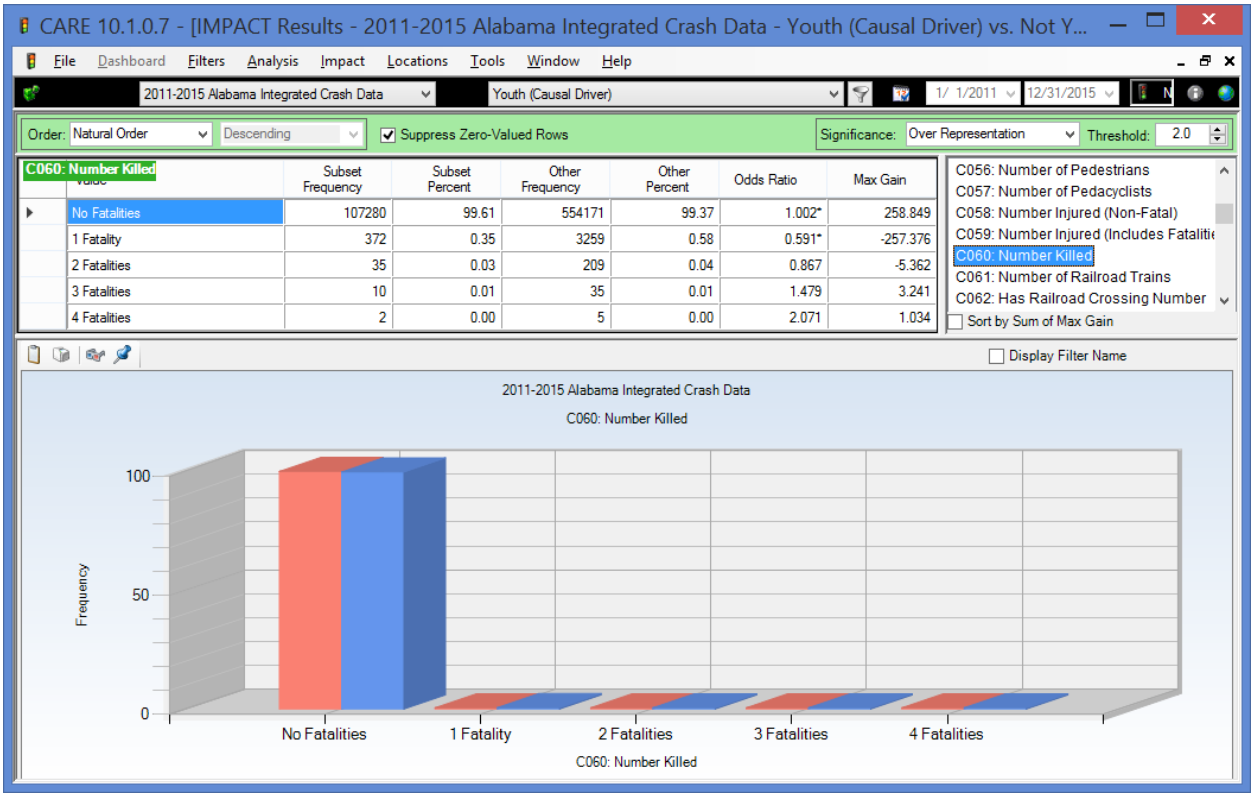
Compared to 2011-2015, in 2016 the proportion of single vehicle crashes went down from 24.59% to 22.13%, and there was a corresponding increase in 2-vehicle crashes from 69.35% up to 71.21%. Changes in the three-or-more categories seem random (no obvious pattern). The increase in multiple-vehicle crashes may have an effect on the number of persons involved, and thus on the fatality count.

3.5 Number Injured (Includes Fatalities)



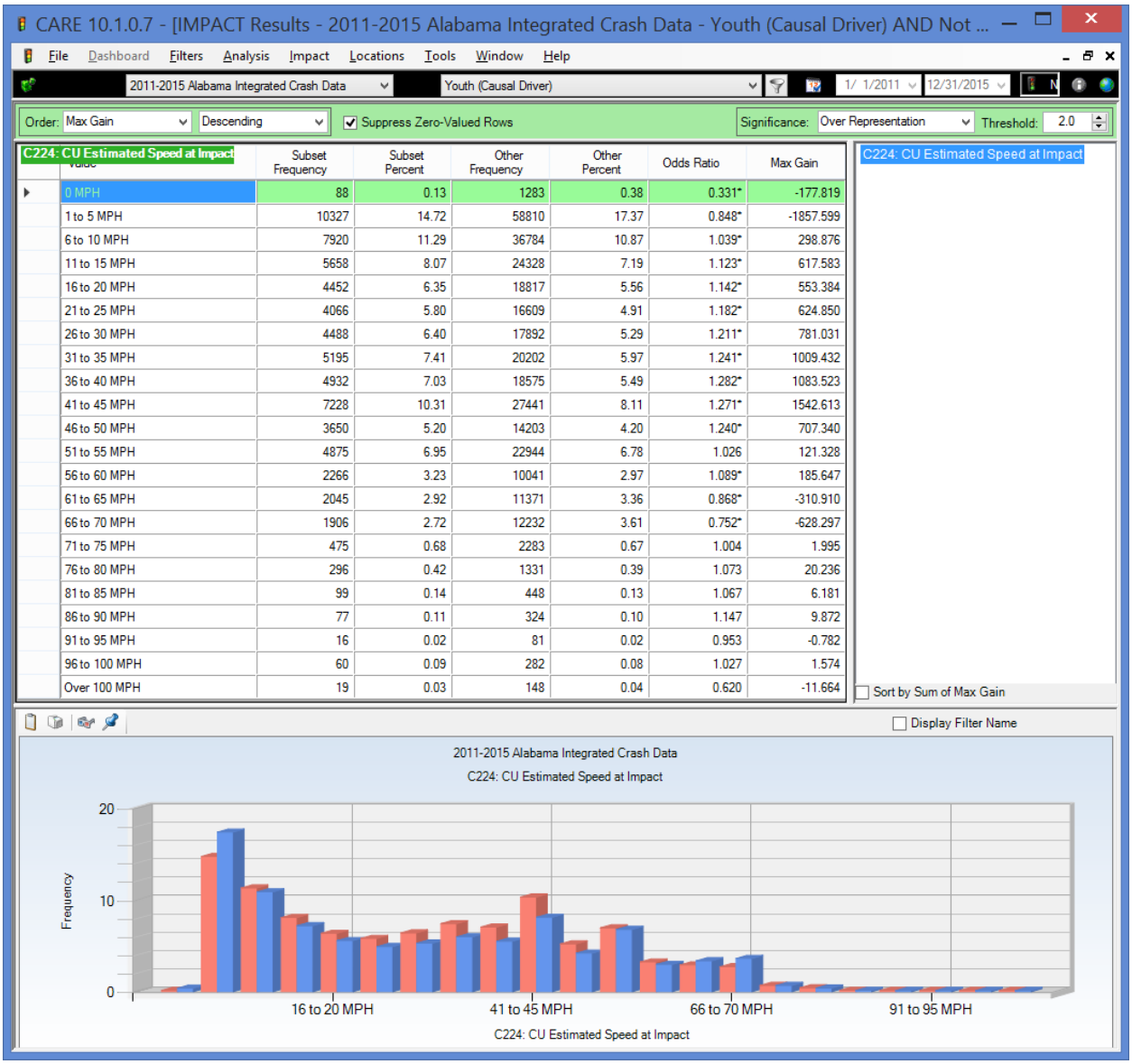
This display shows that crashes with no injuries are significantly under-represented for younger drivers. The single injury crashes are only slightly less than what would be expected, and this should not be considered at all significant. However, the 2-6 injury classifications are all over-represented, which is alarming. Taking all of the information in Section 3 above collectively, we can say that while any give crash may not have as high a severity, there are more people involved in being injured in the younger-driver caused crashes. The 2016 distribution for number of injuries was very close to that given above, and so no major changes were found in the CY2016 data distribution for this attribute.

3.6 Number Killed



As indicated above, the number of fatalities caused by younger drivers is fewer than expected (in comparison with older drivers), and so the No Fatalities category is significantly over-represented. Correspondingly, the one and two fatality categories are under-represented, although this is not significant for the two fatality category. The three and four fatality categories are both over-represented (no significance is calculated when there are less than 20 crashes in either subset). News reports have shown that some young drivers have caused some horrific crashes causing death not only to their own passengers but to those in other vehicles. While these crashes get high coverage, fortunately, they are relatively few in number. But that is of no solace to the families who have lost loved ones, including the families of the causal drivers. In all but a few exceptional cases the most severe of these crashes involve a very high level of risk acceptance, and in some cases the intent to increase risk, usually by high speeds. Countermeasures to prevent these types of incidents have clearly not been as successful as traffic safety professionals would like, and research must continue in this area. It should be recognized that warning young drivers against specific risky behaviors is not an effective countermeasure if, in fact, it is their inclination to take risks. The warnings might have just the opposite effects. No major changes were found in the CY2016 data distribution for this attribute.

3.7 Speed at Impact



The above is reinforced by the over-representations at the extreme high speeds, in this case all speeds above 71 are over-represented, with just a couple of exceptions. While these are not determined to be statistically significant, each one of these cases is significant from a practical point of view in that the chances for severe injury and death is dramatically increase. It has been found that above 45 MPH, every ten miles per hour of impact speed effectively doubles the probability of being killed. See:

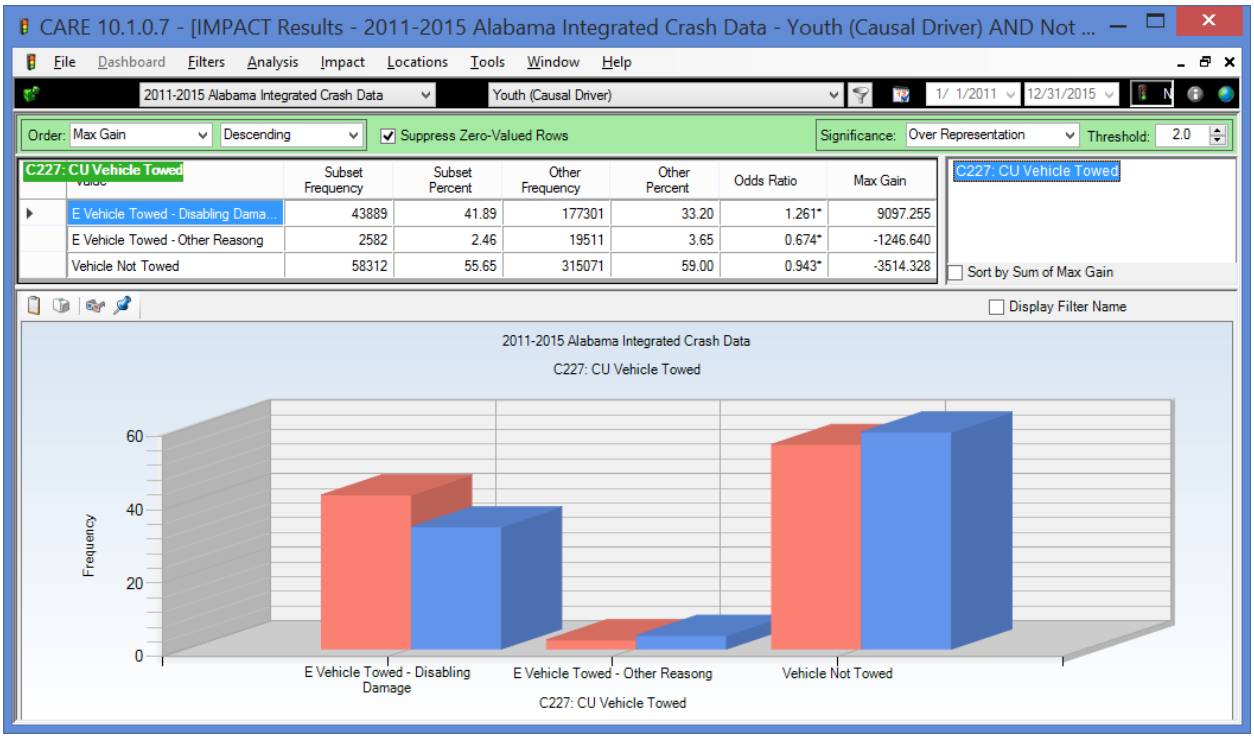
http://www.safehomealabama.gov/SafetyTopics/Enforcement/EnforcementStudies.aspx

So, the chances that crashes above 80 MPH will cause death is extremely high, making each one of these crashes quite significant from a life-saving point of view. A comparison with the results found for 2016 are given on the next page.

C224: CU Estimated Speed at Impact % Comparisons				
Est. Impact Speed	**2016 Number**	**2016 %**	**2011-2015 %**	**Odds Ratio**
0 MPH	6	0.04%	0.13%	0.31
1 to 5 MPH	2096	14.20%	14.72%	0.96
6 to 10 MPH	1618	10.96%	11.29%	0.97
11 to 15 MPH	1185	8.03%	8.07%	0.99
16 to 20 MPH	936	6.34%	6.35%	1.00
21 to 25 MPH	837	5.67%	5.80%	0.98
26 to 30 MPH	884	5.99%	6.40%	0.94
31 to 35 MPH	1082	7.33%	7.41%	0.99
36 to 40 MPH	1035	7.01%	7.03%	1.00
41 to 45 MPH	1566	10.61%	10.31%	1.03
46 to 50 MPH	739	5.01%	5.20%	0.96
51 to 55 MPH	1063	7.20%	6.95%	1.04
56 to 60 MPH	511	3.46%	3.23%	1.07
61 to 65 MPH	469	3.18%	2.92%	1.09
66 to 70 MPH	461	3.12%	2.72%	1.15
71 to 75 MPH	122	0.83%	0.68%	1.22
76 to 80 MPH	82	0.56%	0.42%	1.32
81 to 85 MPH	27	0.18%	0.14%	1.31
86 to 90 MPH	17	0.12%	0.11%	1.05
91 to 95 MPH	7	0.05%	0.02%	2.37
96 to 100 MPH	11	0.07%	0.09%	0.83
Over 100 MPH	11	0.07%	0.03%	2.48

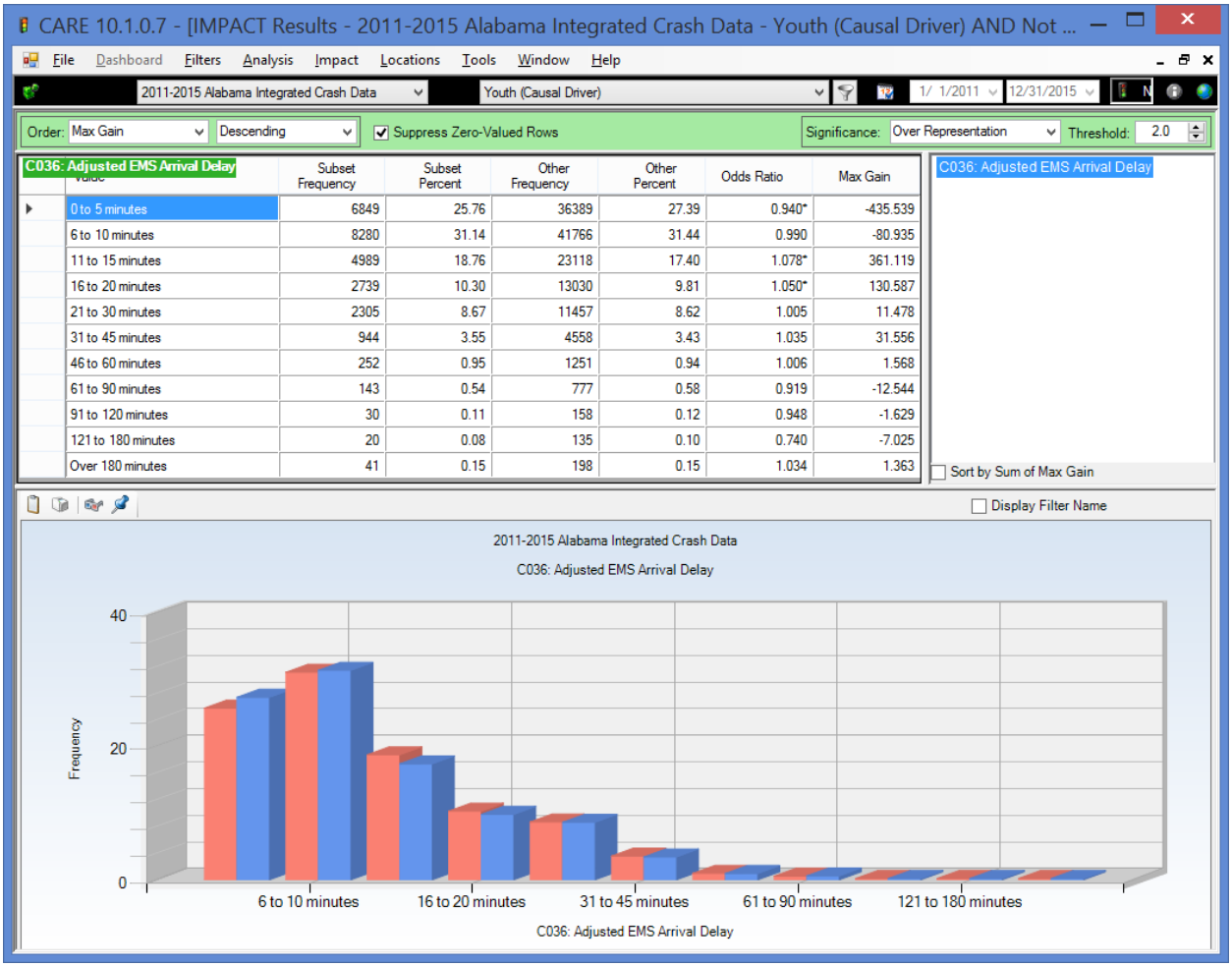
The table above contains the frequency and percentages for the CY 2016 impact speeds. To this has been added a column for the 2011-2015 impact speed percentages. These are compared with an Odds Ratio which is the 2016 percent divided by the 2011-2015 percent. Thus, any Odds Ratio that is greater than 1.00 indicates an increase in 2016. Any Odds Ratio greater than 1.10 should be considered practically significant. Increases, many of them significant, occur in all of the impact speeds greater than 50 MPH, with the exception of the 96-100 MPH classification. This is a clear indication of greater impact speeds in the younger age group for their crashes in 2016 as compared to the previous five years. As discussed above, this has no other possible outcome than to increase the severity of the crashes.

3.8 CU Vehicle Towed



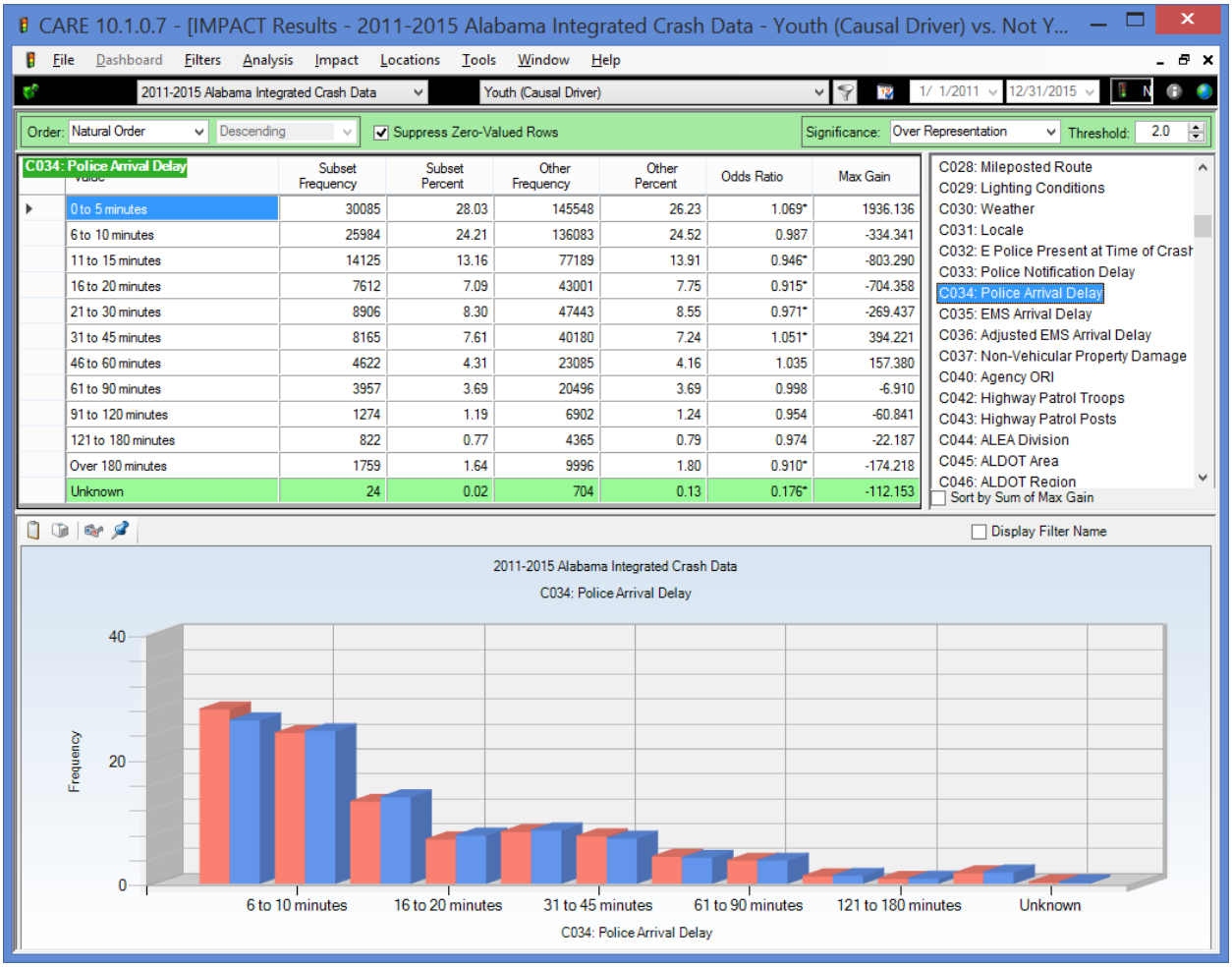
This is another indicator that young-driver caused crashes are more severe than those caused by older drivers. This is an objective indicator that is not affected by the fact that younger occupants are more durable. The proportion of Towed – Disabling Damage increased from the above 2011-2015 figure of 41.88% to 42.13% for 2016. While this increase is not statistically significant, it does reflect the increased speeds that are discussed above in Section 3.7.

3.9 Adjusted EMS Arrival Delay



EMS arrival is an indicator of the extent to which the severity of a crash can be mitigated. EMS personnel effectiveness is almost completely determined by how quickly they can get to the scene of the crash. The effect is exponential and after a certain amount of time elapses, there is very little that can be done in life-threatening situations. In this case there is an under-representation in the shortest two categories, while the 11-20 minute categories are significantly over-represented. The two factors that affect arrival delay most are the location of the crash and the delay in reporting (which is correlated with the time of the crash). If this is considered to be a major factor in fatality reduction, additional analytics can be applied to determine all of the factors involved. No major changes were found in the CY2016 data distribution for this attribute.

3.10 Police Arrival Delay

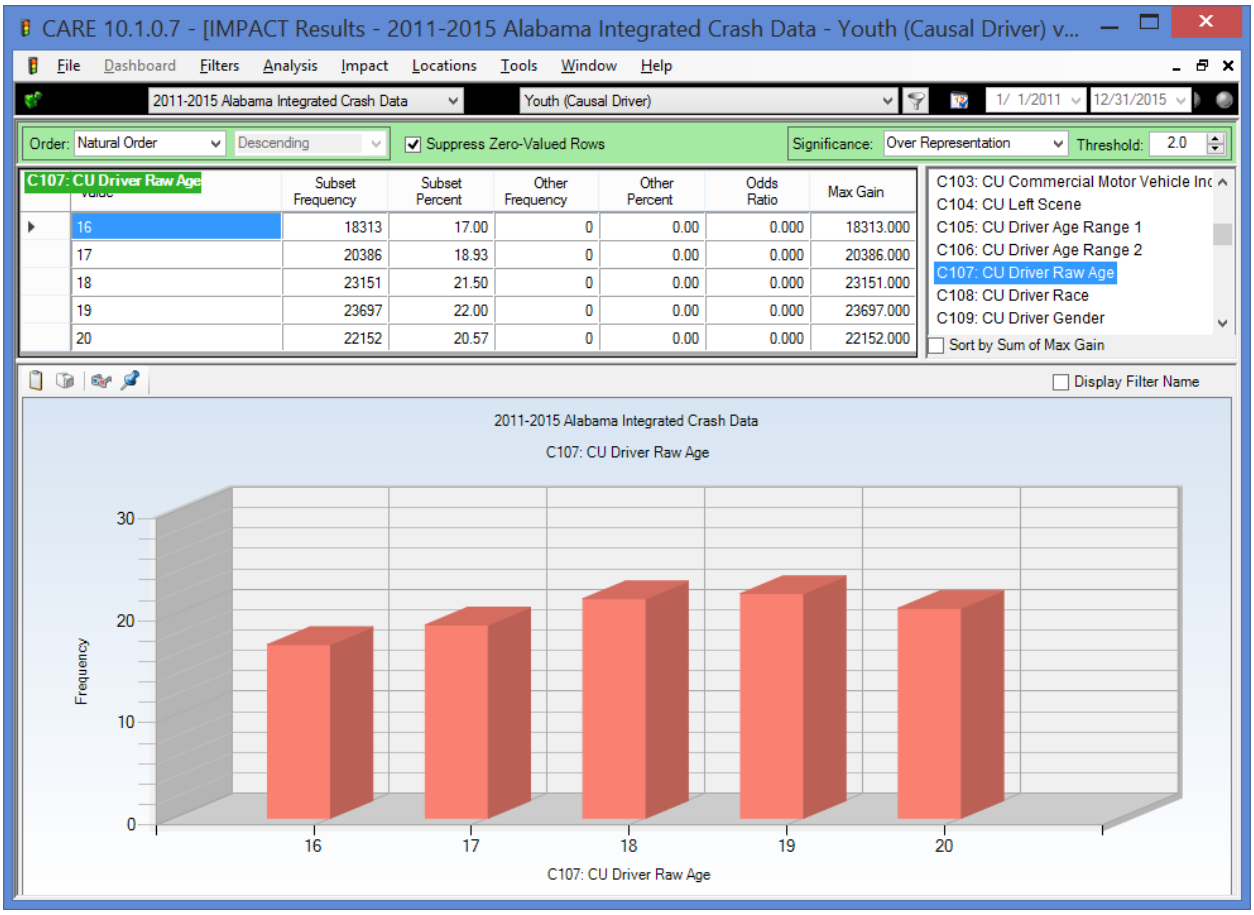


Police arrival delay gives an indication of the delay in reporting the crash, and also its location as far as distance from law enforcement. Law enforcement can also administer first aid and stabilize the situation while waiting for EMS to arrive. This is a separate research topic from young drivers, although it is interesting to see how their delay times vary from those of older drivers. No major changes were found in the CY2016 data distribution for this attribute.

4.0 Driver Demographics

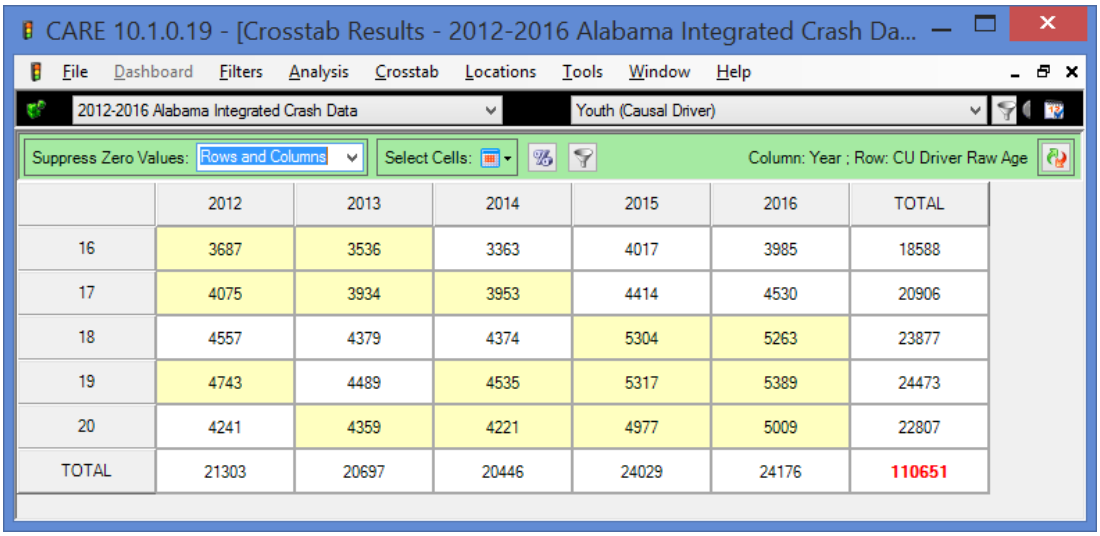
A knowledge of driver demographics provides information that helps to target many counter-measures.

4.1 Causal Unit Driver Age



The number of crashes at the different ages within the 16-20 driver age range would be expected to grow as the number of drivers grows. This is generally the case with an average 1.25% per age year up until and including age19. At that point there is a 1.43% drop in the comparative total percentage. Assuming that there is no drop in the number of licensed drivers at age 20, we would attribute this to an improvement in their experience level and perhaps an increase in their aversion to taking risks. No major changes were found in the CY2016 data distribution for this attribute.

Cross-Tabulation of Age by Year, 2012-2016, All Crashes



	2012	2013	2014	2015	2016	TOTAL
16	3687	3536	3363	4017	3985	18588
17	4075	3934	3953	4414	4530	20906
18	4557	4379	4374	5304	5263	23877
19	4743	4489	4535	5317	5389	24473
20	4241	4359	4221	4977	5009	22807
TOTAL	21303	20697	20446	24029	24176	110651

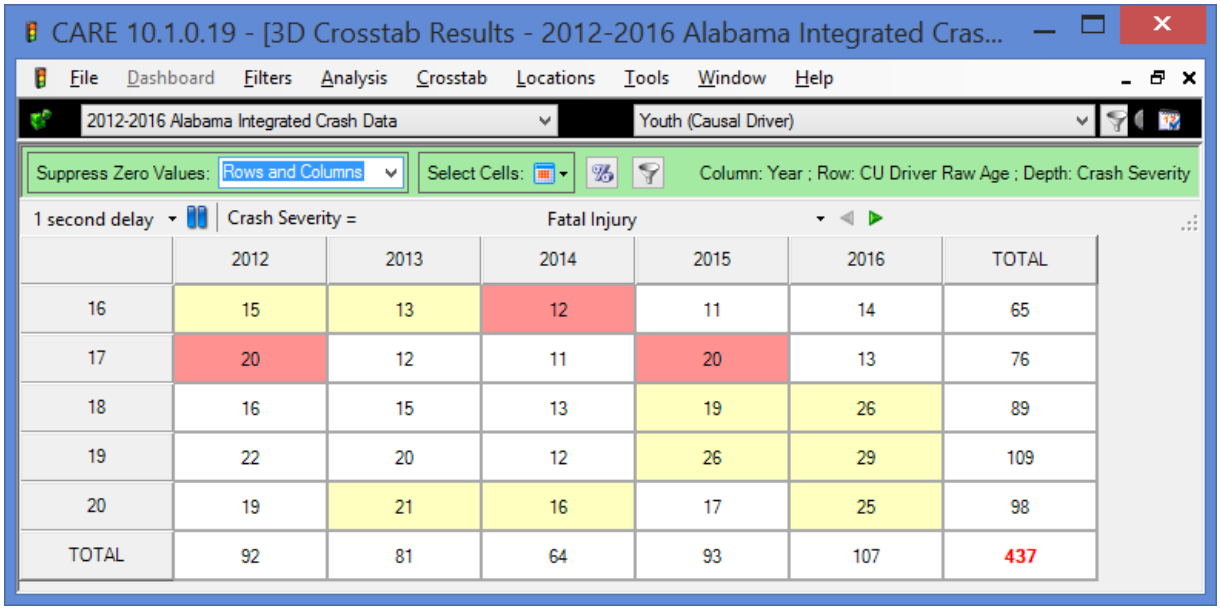
Comparison of 2016 Against the Overall 5-Year Average

	2016	TOTAL	5 Yr Avg	2016 Dif
16	3985	18588	3717.6	267.4
17	4530	20906	4181.2	348.8
18	5263	23877	4775.4	487.6
19	5389	24473	4894.6	494.4
20	5009	22807	4561.4	447.6
TOTAL	24176	110651	22130.2	2045.8

The cross-tabulation above shows an overall increase in young driver crashes over the past five years. Below it is a comparison of 2016 against the average of the five years, which shows an increase in all ages, and generally a greater increase with increasing age.

The picture for young drivers causing fatal crashes is even worse, with the 2016 total number of fatal crashes approaching almost double what is was in 2014.

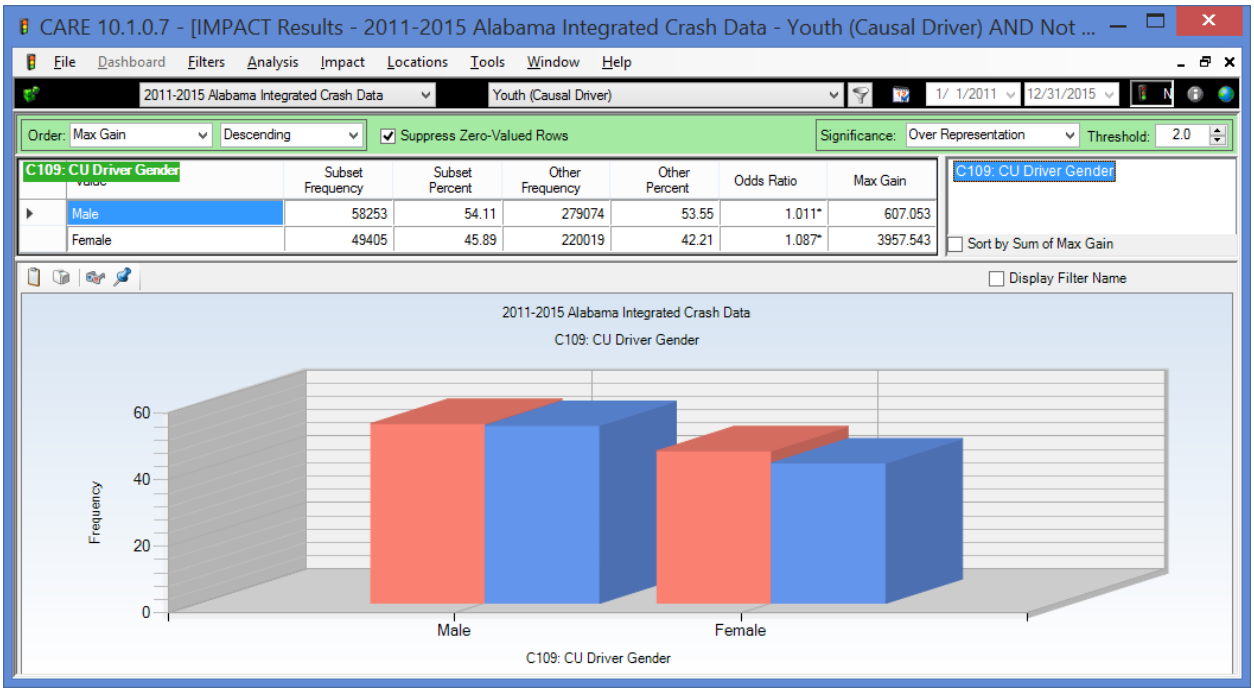
Cross-Tabulation of Age by Year, 2012-2016, Fatal Crashes



	2012	2013	2014	2015	2016	TOTAL
16	15	13	12	11	14	65
17	20	12	11	20	13	76
18	16	15	13	19	26	89
19	22	20	12	26	29	109
20	19	21	16	17	25	98
TOTAL	92	81	64	93	107	437

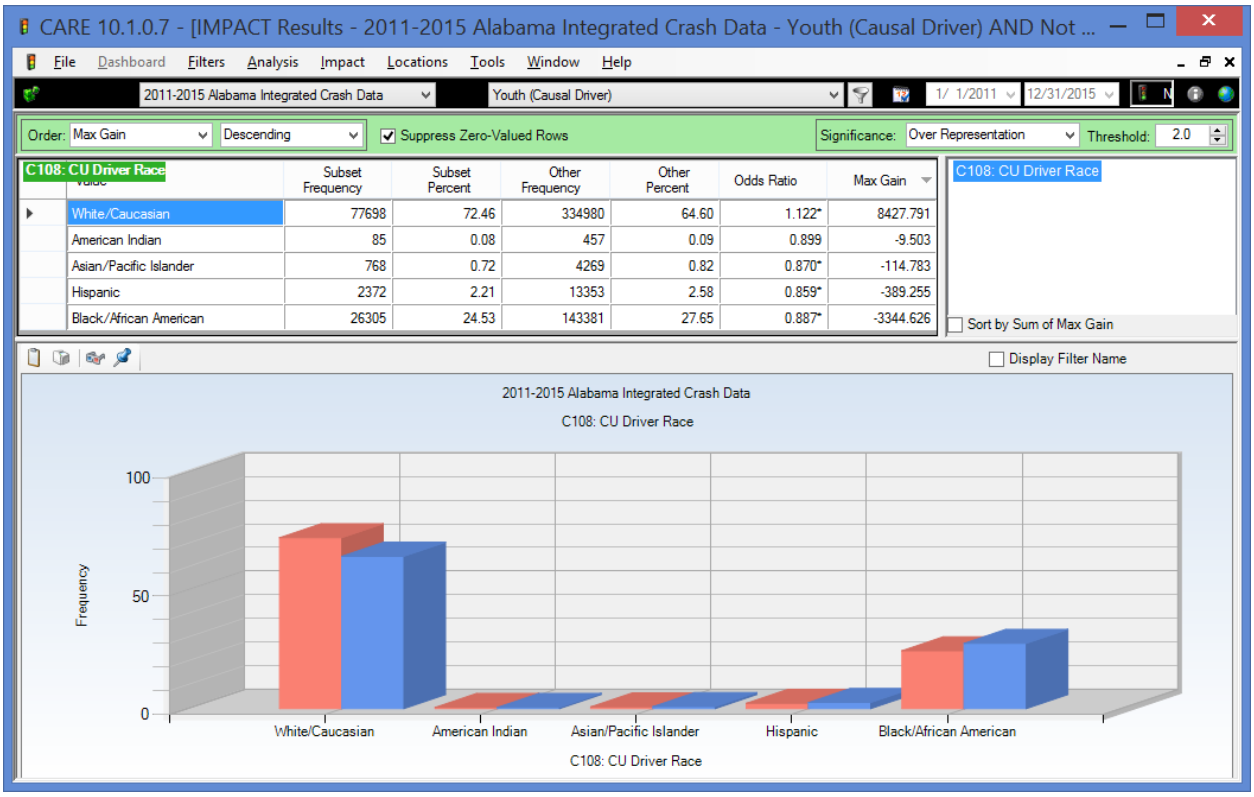
For other time factors, see Section 5.0.

4.2 Driver Gender



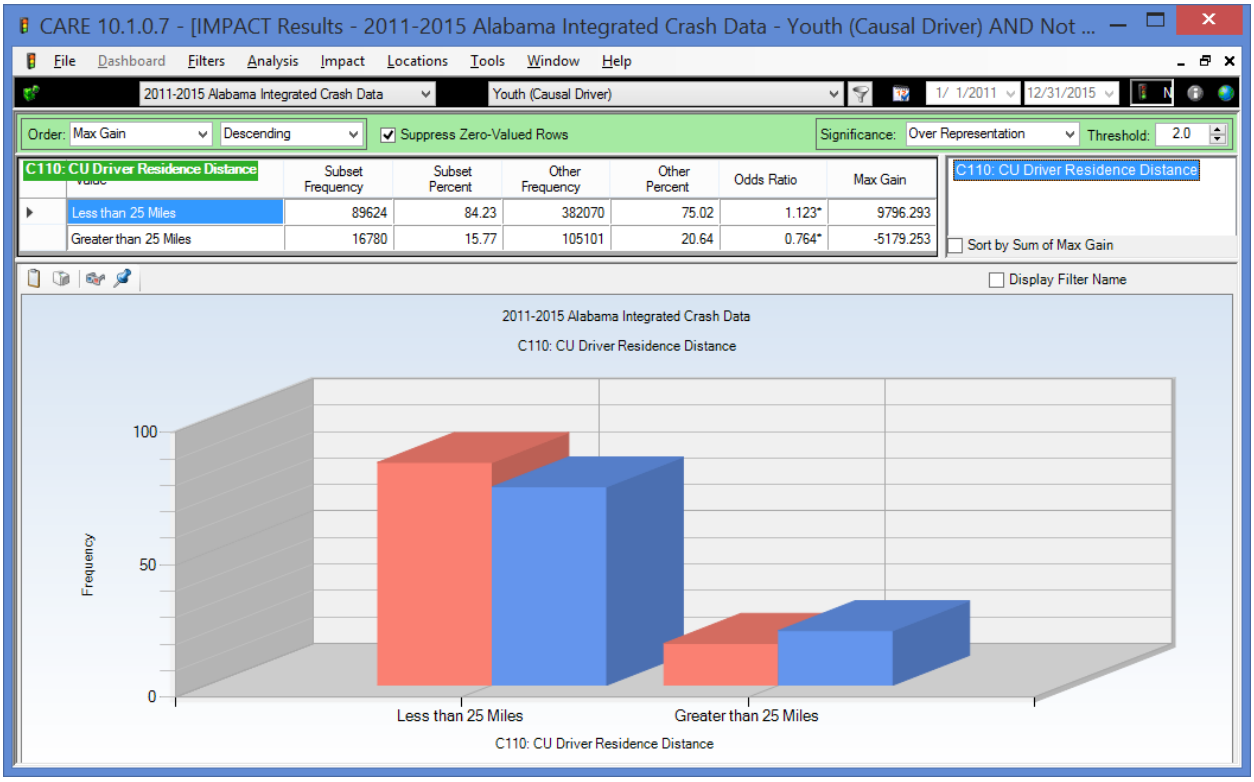
Males account for about 54.11% of crashes which involved young drivers. This would be expected to reflect the numbers that have drivers' licenses plus the amount of driving that they do. Overall, this does not lead to any major conclusions. Generally males have had a much higher over-representation in crashes where risk-taking was involved, e.g., those involving speeding. The updated numbers for 2016 were 53.60 male and 46.40 female, which, while not being significantly different does highlight the fact that females are catching up to males in many categories, and they this should be watched in the future.

4.3 Causal Unit Driver Race



Caucasians were over-represented in the young driver crashes over the other racial categories. No major changes were found in the CY2016 data distribution for this attribute.

4.4 CU Driver Residence Distance



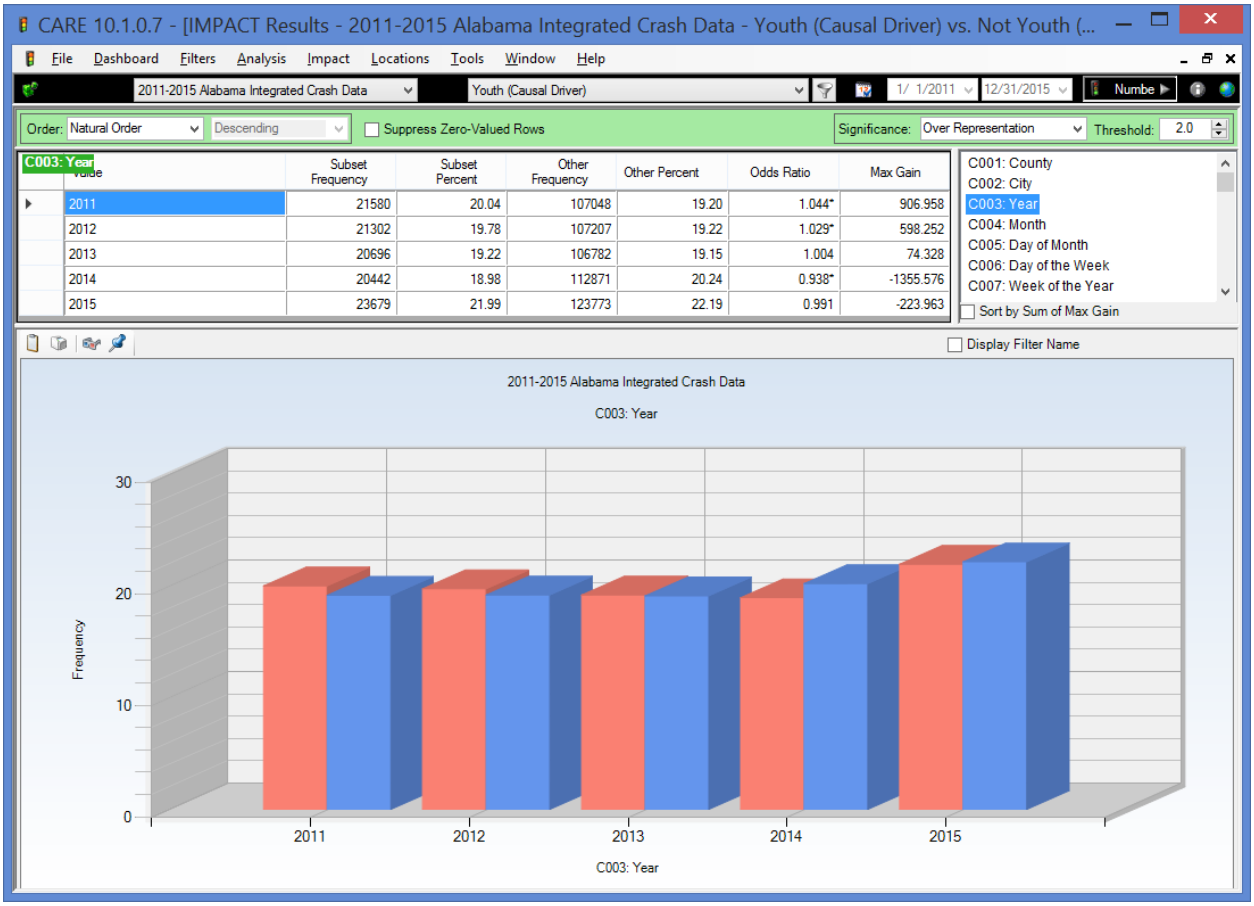
It is expected that younger drivers would be driving closer to home on average, compared to the older drivers. No major changes were found in the CY2016 data distribution for this attribute.

5.0 Time Factors

Time factors were analyzed in several different categories to determine overrepresentation for Year, Month, Day of the Week and Time of Day. Analysis of these time factors allows for the determination of particular days of week or times of day in which more crashes occur for younger drivers, and thus, those times in which enforcement would be more fruitful. This is part of the state's evidence-based enforcement efforts.

5.1 Year

Comparison of Young Drivers (red) with Older Drivers (blue) by Year (2011-2015)

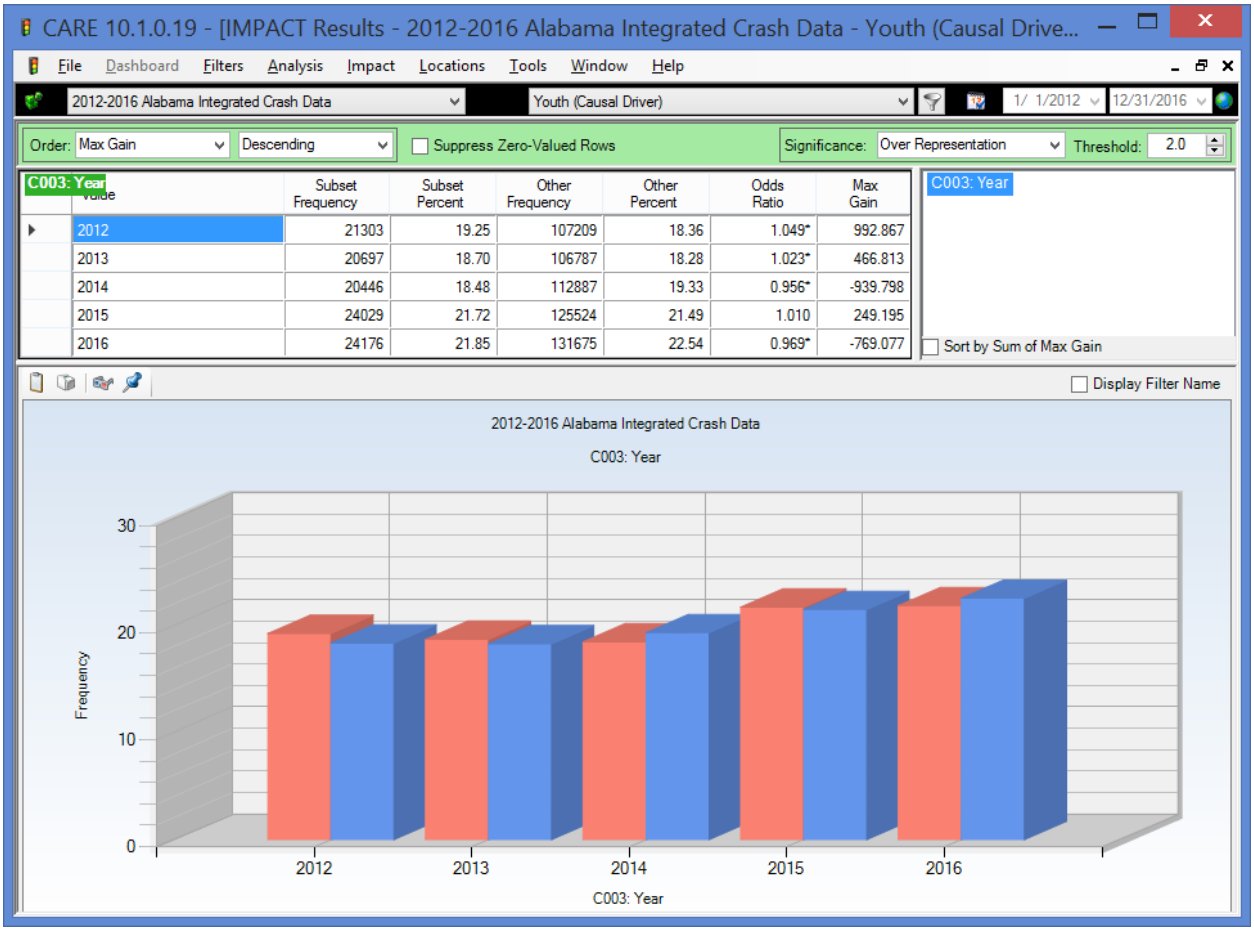


First note that crashes in general have been increasing on an average of 0.60% per year, with a drop in 2013, and a surge in 2015. Young driver crashes have not tracked this trend. In a sense they have not increased as much as the older drivers, their increase from 2011 to 2015 being only 0.39% per year. However, it is the years in between that are of concern. There was a major decrease of 1.06 between 2011 and 2014. But then a regression to the mean resulted in an overall increase of 3.01% between 2014 and 2015. This increase is largely what motivated this entire study. To a large extent this increase was caused by an increase in rainy weather, but since the

increase in the older drivers was less than 2% (1.95%), there is probably more than just weather involved.

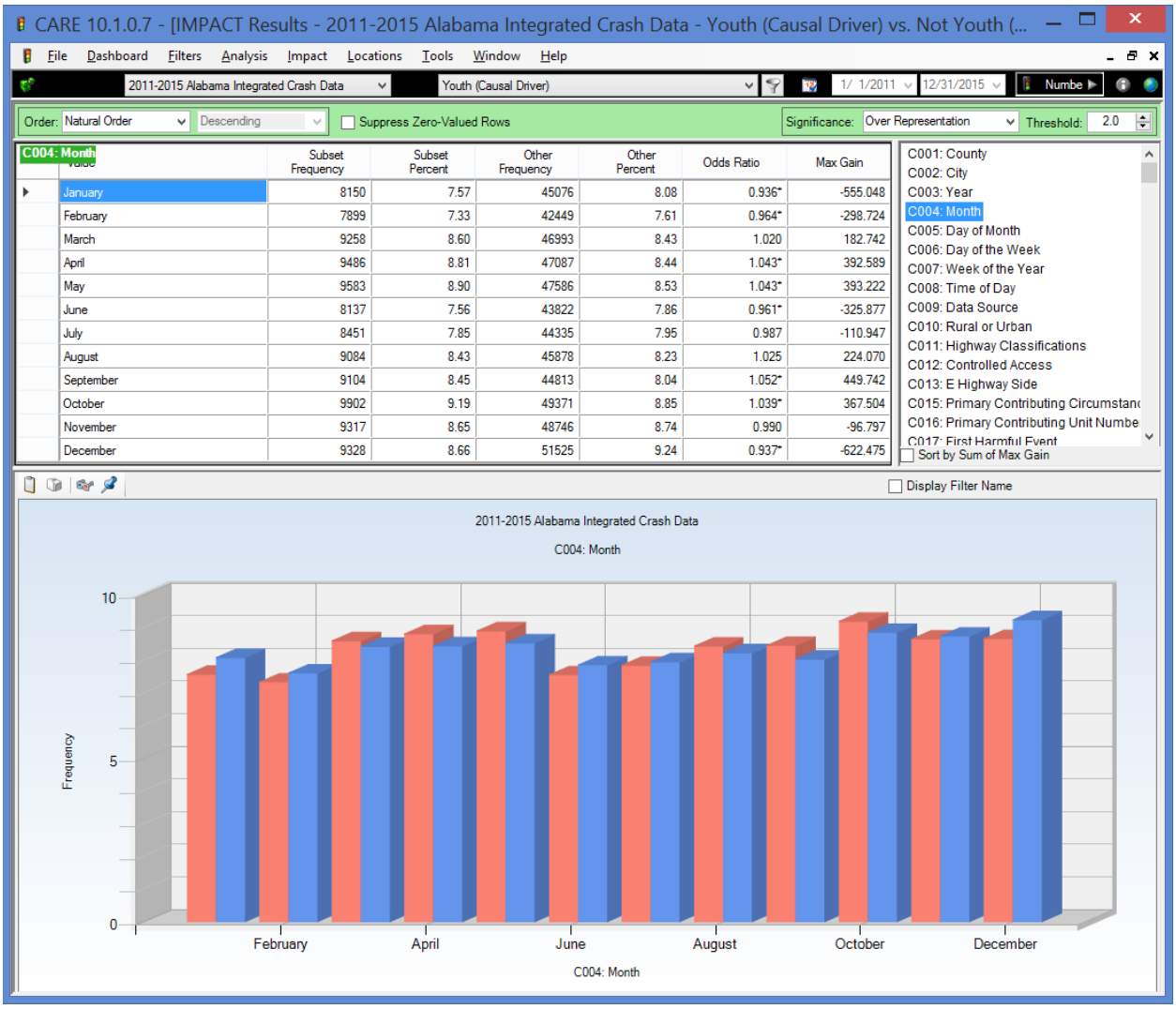
The following shows the same chart updated with 2016 data.

Comparison of Young Drivers (red) with Older Drivers (blue) by Year (2012-2016)



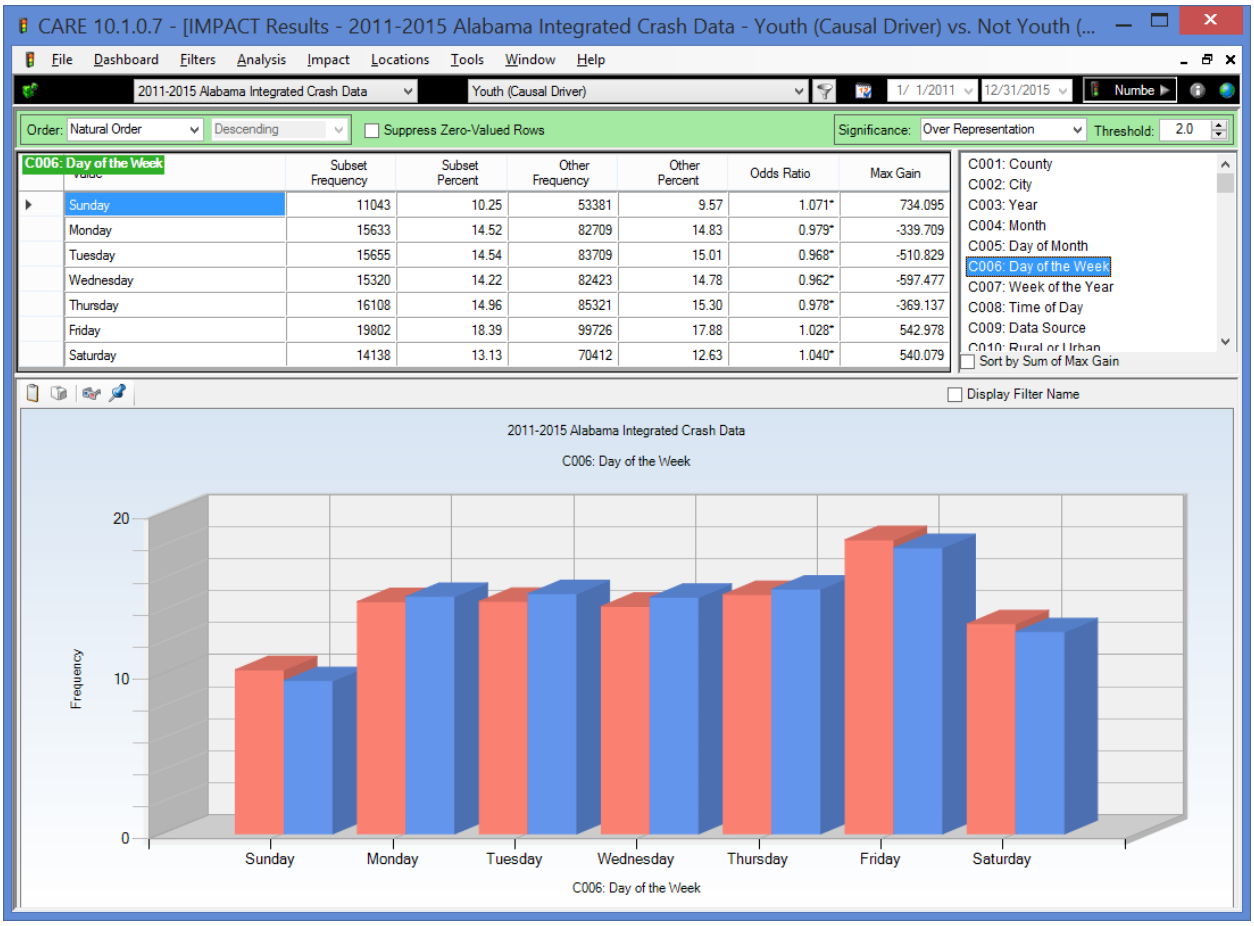
This shows a leveling off of young drivers' crashes in 2016, although it increased slightly. It did not increase in the percentage that the older drivers increased, and for that reason it became significantly under-represented in 2016.

5.2 Month



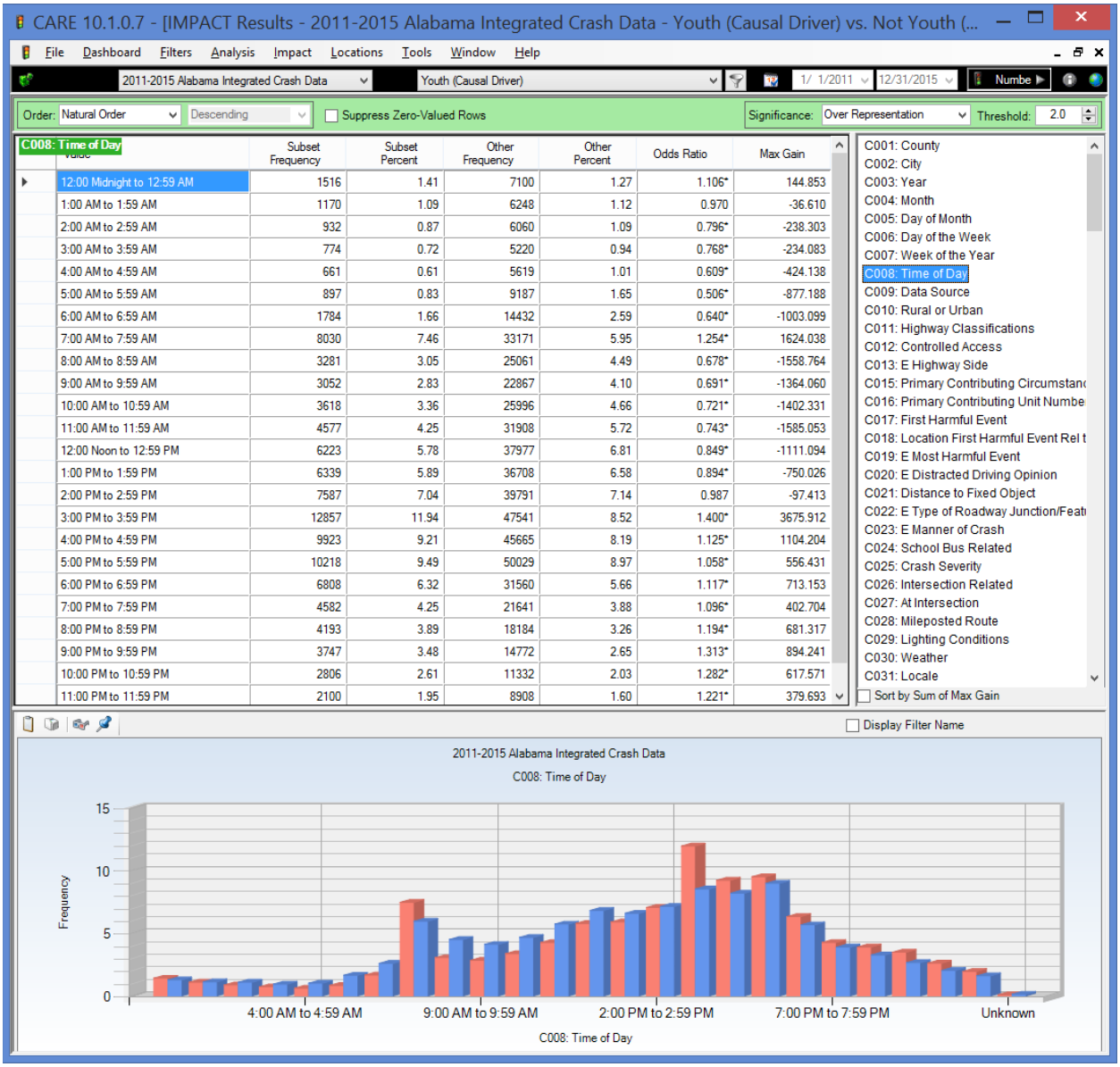
Reinforcing the statements with regard to rain above, the young drivers are not necessarily over-represented in the months with the greatest rainfall, which would be December-February, and September and October are particularly dry months. Patterns of over-representation appear to be in the months of March-May and August-October. No major changes were found in the CY2016 data distribution for this attribute over and above what would occur due to the variation in weather. The 2016 data showed over-representations in the months of March, April, May and August.

5.3 Day of the Week



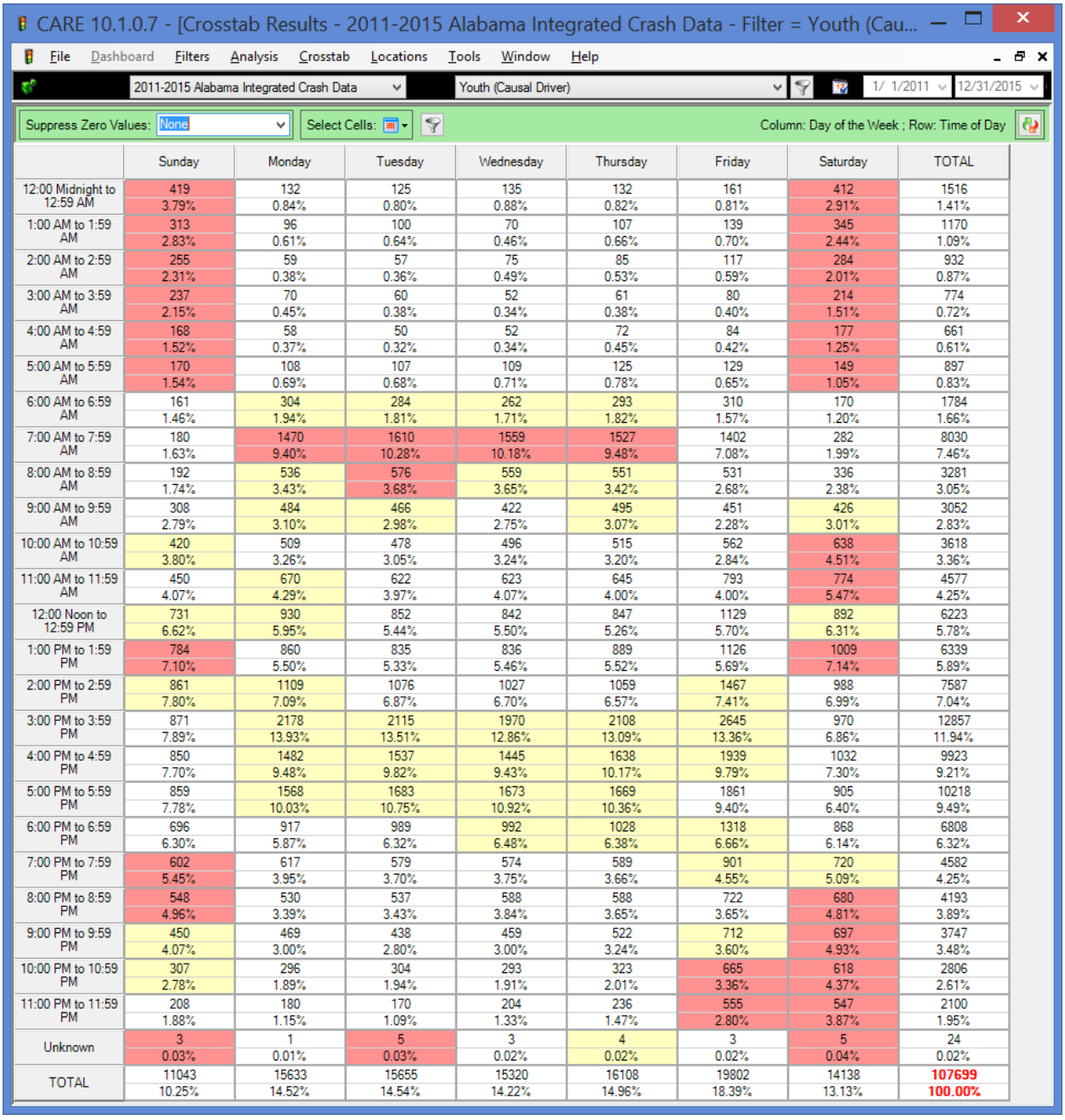
The Fridays and the weekend are over-represented for crashes involving young drivers, as would be expected. Over-representation needs to be coupled with the raw frequency to get the whole picture. For example, while Sunday is significantly over-represented, it only had 11,043 young driver crashes, which is considerably lower than the weekdays. Similarly, Saturday, while higher is still below the average over the week. Contrasted with this is Friday, which has both the highest number and a significant over-representation. Increased afternoon traffic on Fridays, and the various "Friday-night" events push these numbers up. No major changes were found in the CY2016 data distribution for this attribute.

5.4 Time of Day



It is quite clear from this chart just when it is that the younger drivers are putting in their highest milages. Before and after school pop up significantly greater than the normal rush hours, and the significant over-representations continue through the midnight hour. The most over-represented hours are from 9PM through to 1 AM. No major changes were found in the CY2016 data distribution for this attribute.

5.5 Time of Day by Day of the Week



	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	TOTAL
12:00 Midnight to 12:59 AM	419 3.79%	132 0.84%	125 0.80%	135 0.88%	132 0.82%	161 0.81%	412 2.91%	1516 1.41%
1:00 AM to 1:59 AM	313 2.83%	96 0.61%	100 0.64%	70 0.46%	107 0.66%	139 0.70%	345 2.44%	1170 1.09%
2:00 AM to 2:59 AM	255 2.31%	59 0.38%	57 0.36%	75 0.49%	85 0.53%	117 0.59%	284 2.01%	932 0.87%
3:00 AM to 3:59 AM	237 2.15%	70 0.45%	60 0.38%	52 0.34%	61 0.38%	80 0.40%	214 1.51%	774 0.72%
4:00 AM to 4:59 AM	168 1.52%	58 0.37%	50 0.32%	52 0.34%	72 0.45%	84 0.42%	177 1.25%	661 0.61%
5:00 AM to 5:59 AM	170 1.54%	108 0.69%	107 0.68%	109 0.71%	125 0.78%	129 0.65%	149 1.05%	897 0.83%
6:00 AM to 6:59 AM	161 1.46%	304 1.94%	284 1.81%	262 1.71%	293 1.82%	310 1.57%	170 1.20%	1784 1.66%
7:00 AM to 7:59 AM	180 1.63%	1470 9.40%	1610 10.28%	1559 10.18%	1527 9.48%	1402 7.08%	282 1.99%	8030 7.46%
8:00 AM to 8:59 AM	192 1.74%	536 3.43%	576 3.68%	559 3.65%	551 3.42%	531 2.68%	336 2.38%	3281 3.05%
9:00 AM to 9:59 AM	308 2.79%	484 3.10%	466 2.98%	422 2.75%	495 3.07%	451 2.28%	426 3.01%	3052 2.83%
10:00 AM to 10:59 AM	420 3.80%	509 3.26%	478 3.05%	496 3.24%	515 3.20%	562 2.84%	638 4.51%	3618 3.36%
11:00 AM to 11:59 AM	450 4.07%	670 4.29%	622 3.97%	623 4.07%	645 4.00%	793 4.00%	774 5.47%	4577 4.25%
12:00 Noon to 12:59 PM	731 6.62%	930 5.95%	852 5.44%	842 5.50%	847 5.26%	1129 5.70%	892 6.31%	6223 5.78%
1:00 PM to 1:59 PM	784 7.10%	860 5.50%	835 5.33%	836 5.46%	889 5.52%	1126 5.69%	1009 7.14%	6339 5.89%
2:00 PM to 2:59 PM	861 7.80%	1109 7.09%	1076 6.87%	1027 6.70%	1059 6.57%	1467 7.41%	988 6.99%	7587 7.04%
3:00 PM to 3:59 PM	871 7.89%	2178 13.93%	2115 13.51%	1970 12.86%	2108 13.09%	2645 13.36%	970 6.86%	12857 11.94%
4:00 PM to 4:59 PM	850 7.70%	1482 9.48%	1537 9.82%	1445 9.43%	1638 10.17%	1939 9.79%	1032 7.30%	9923 9.21%
5:00 PM to 5:59 PM	859 7.78%	1568 10.03%	1683 10.75%	1673 10.92%	1669 10.36%	1861 9.40%	905 6.40%	10218 9.49%
6:00 PM to 6:59 PM	696 6.30%	917 5.87%	989 6.32%	992 6.48%	1028 6.38%	1318 6.66%	868 6.14%	6808 6.32%
7:00 PM to 7:59 PM	602 5.45%	617 3.95%	579 3.70%	574 3.75%	589 3.66%	901 4.55%	720 5.09%	4582 4.25%
8:00 PM to 8:59 PM	548 4.96%	530 3.39%	537 3.43%	588 3.84%	588 3.65%	722 3.65%	680 4.81%	4193 3.89%
9:00 PM to 9:59 PM	450 4.07%	469 3.00%	438 2.80%	459 3.00%	522 3.24%	712 3.60%	697 4.93%	3747 3.48%
10:00 PM to 10:59 PM	307 2.78%	296 1.89%	304 1.94%	293 1.91%	323 2.01%	665 3.36%	618 4.37%	2806 2.61%
11:00 PM to 11:59 PM	208 1.88%	180 1.15%	170 1.09%	204 1.33%	236 1.47%	555 2.80%	547 3.87%	2100 1.95%
Unknown	3 0.03%	1 0.01%	5 0.03%	3 0.02%	4 0.02%	3 0.02%	5 0.04%	24 0.02%
TOTAL	11043 10.25%	15633 14.52%	15655 14.54%	15320 14.22%	16108 14.96%	19802 18.39%	14138 13.13%	107699 100.00%

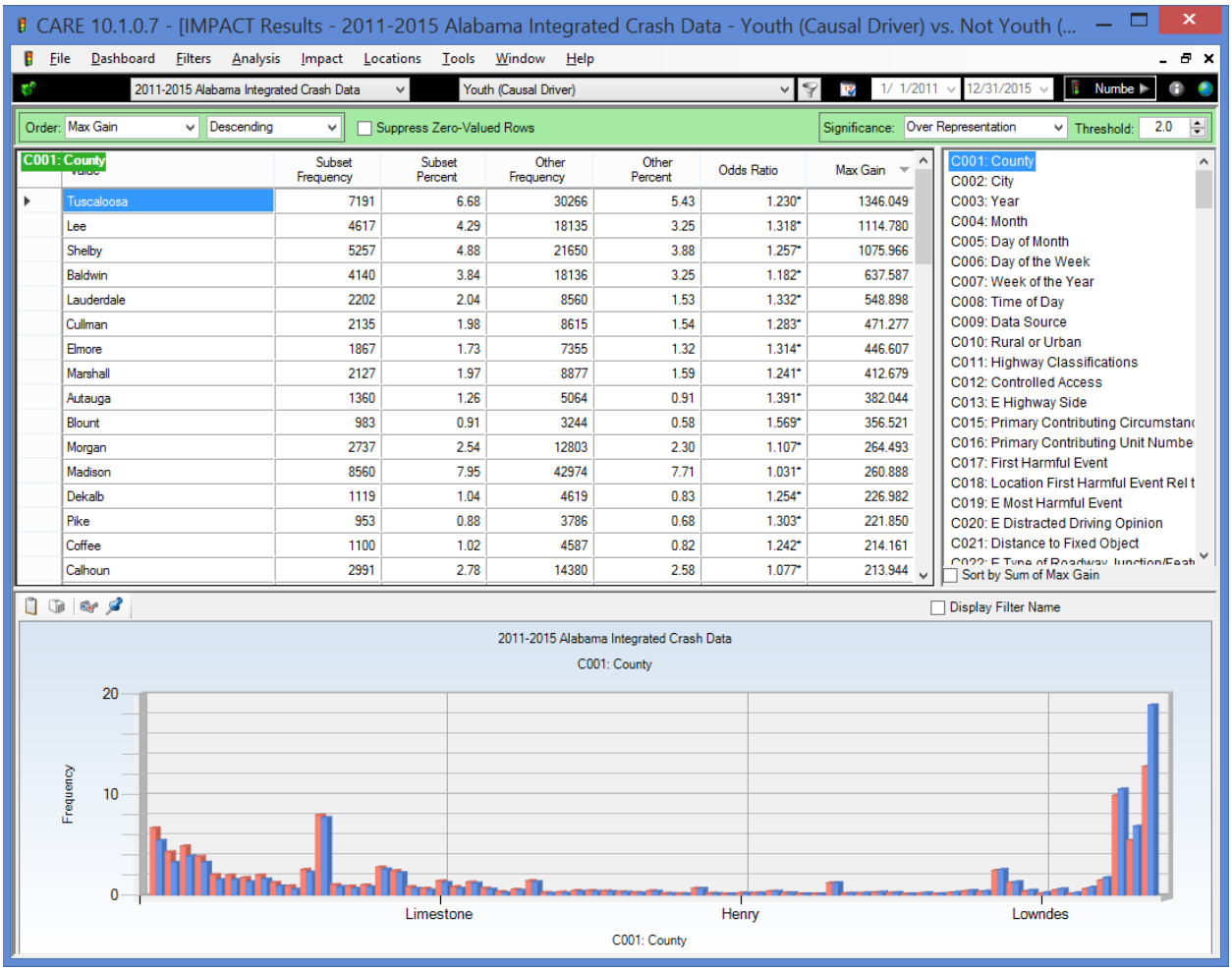
The time of day by day of the week for young drivers is quite enlightening and shows just when these over-representations occur. Note the red starting somewhat on Friday night, going into Saturday morning, and then Saturday night going into Sunday morning. While the red makes these look like the worst times, the coloring is based on percentages across the days, and the fact that these times are over-represented on weekends is largely because there are so few crashes at these times on week days. So it is very important to check the numbers. For example, while the Saturday and Sunday mornings are over-represented, the number of crashes in these hours only

range from about 150 to a little over 400. Contrasted with this is the 7 AM weekday hours that average over 1,500 crashes. Even the 8 AM and 9 AM hours on these days average above 500, many of them are not red because those overall hours has a very high percentage of the crashes. Even worse, consider the 5PM weekday hours, which average close to 1,700 crashes each. So use the colors and the numbers in getting a feel for the best times for enforcement. No major changes were found in the CY2016 data distribution for this attribute.

6.0 Geographical Factors

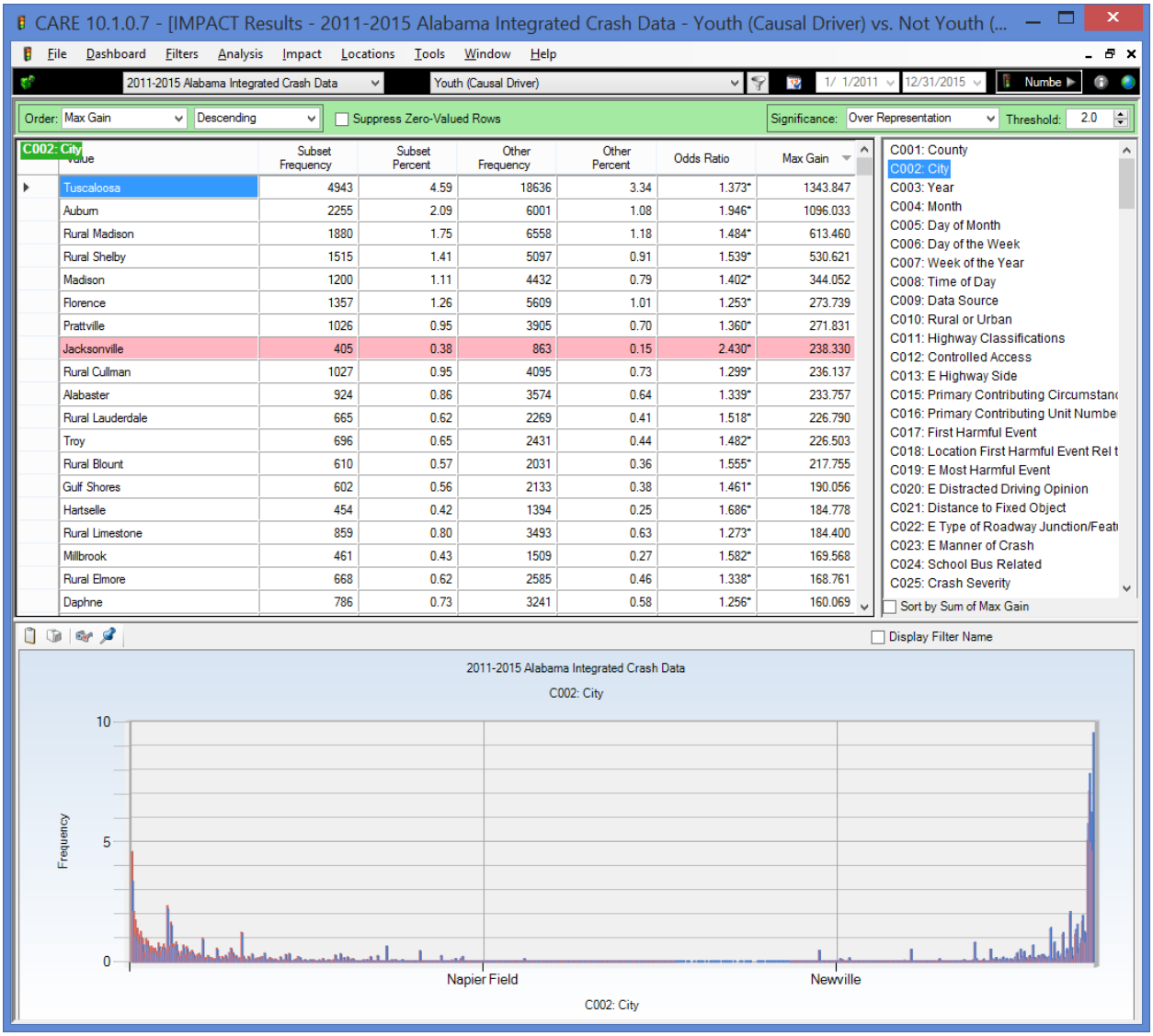
Geographical factors were analyzed in order to determine which areas are overrepresented for crashes involving young drivers. In order to determine these problem areas, geographical factors were analyzed in the following categories: county, city, rural versus urban, highway classification and locale.

6.1 County



The counties with the greatest overrepresentation factors for young-driver caused crashes include first the two "college towns" Tuscaloosa and Lee, followed by Shelby, Baldwin, Lauderdale and Cullman. There is nothing inherently unsafe about these geographical areas – the number of crashes is an excellent proxy for the number of young drivers in the counties. No major changes were found in the CY2016 data distribution for this attribute.

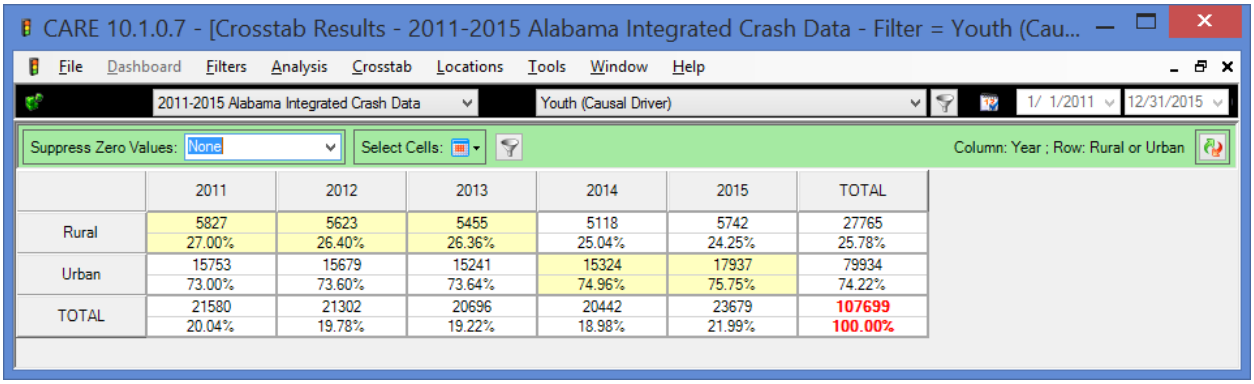
6.2 City



Over-represented cities also reflect the amount of driving that is being done by young drivers within these various cities and rural areas (which are considered to be virtual cities for comparative purposes). No major changes in patterns were found in the CY2016 data distribution for this attribute.

6.3 Rural/Urban

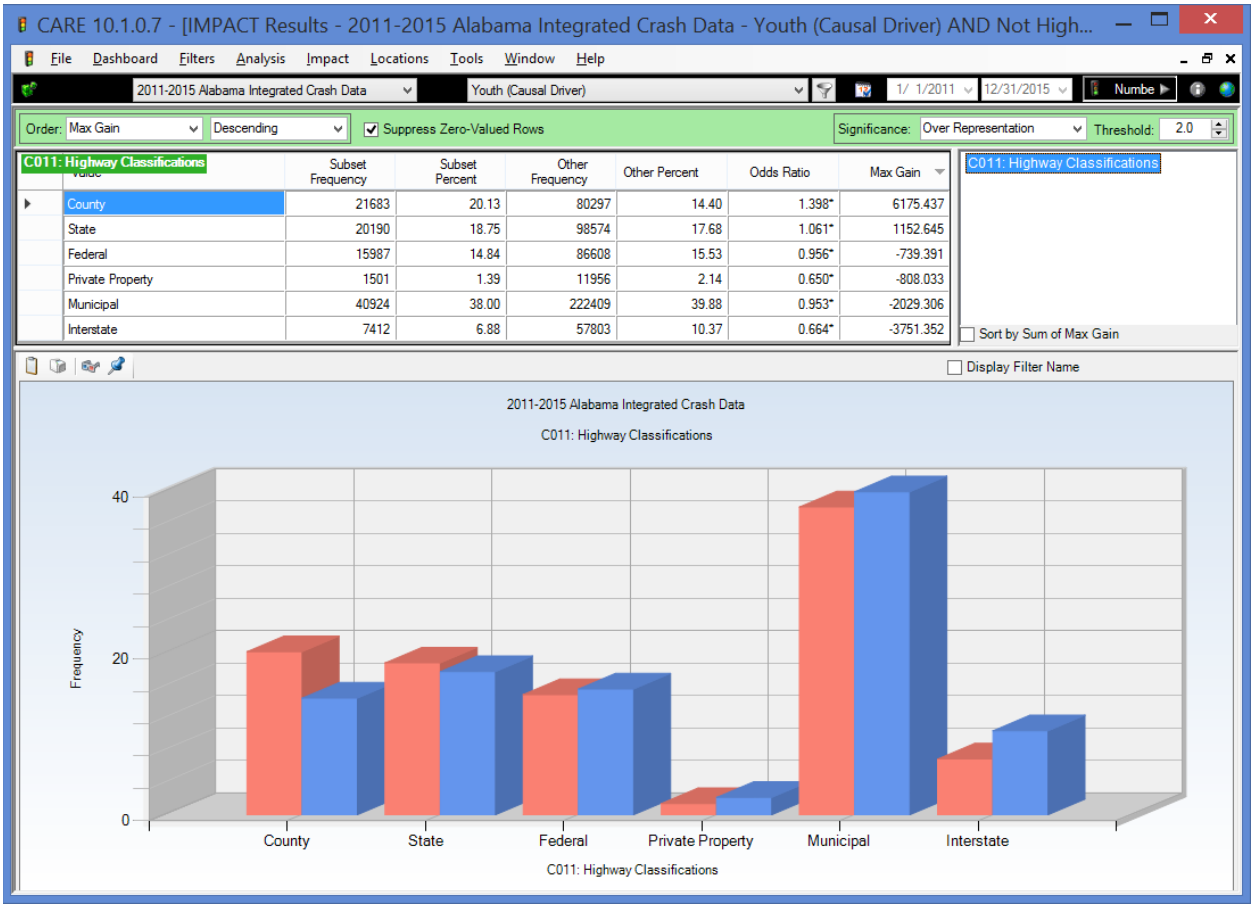
There has been a recent trend toward urban area driving and a corresponding increase in crashes in the urban areas. The following cross-tabulation that is restricted to ONLY young drivers indicates that the above is the result of years 2011 through 2013 as opposed to the two most recent years.



	2011	2012	2013	2014	2015	TOTAL
Rural	5827 27.00%	5623 26.40%	5455 26.36%	5118 25.04%	5742 24.25%	27765 25.78%
Urban	15753 73.00%	15679 73.60%	15241 73.64%	15324 74.96%	17937 75.75%	79934 74.22%
TOTAL	21580 20.04%	21302 19.78%	20696 19.22%	20442 18.98%	23679 21.99%	107699 100.00%

It is clear that in years 2014 and 2015, the young drivers have participated in this shift to the urban areas, which is particularly emphasized by the 17,937 urban crashes in 2015. To update this to 2016, the proportions for rural and urban were 23.78% and 76.22%, which confirms the continued trend of increased young drivers' travel in the urban areas.

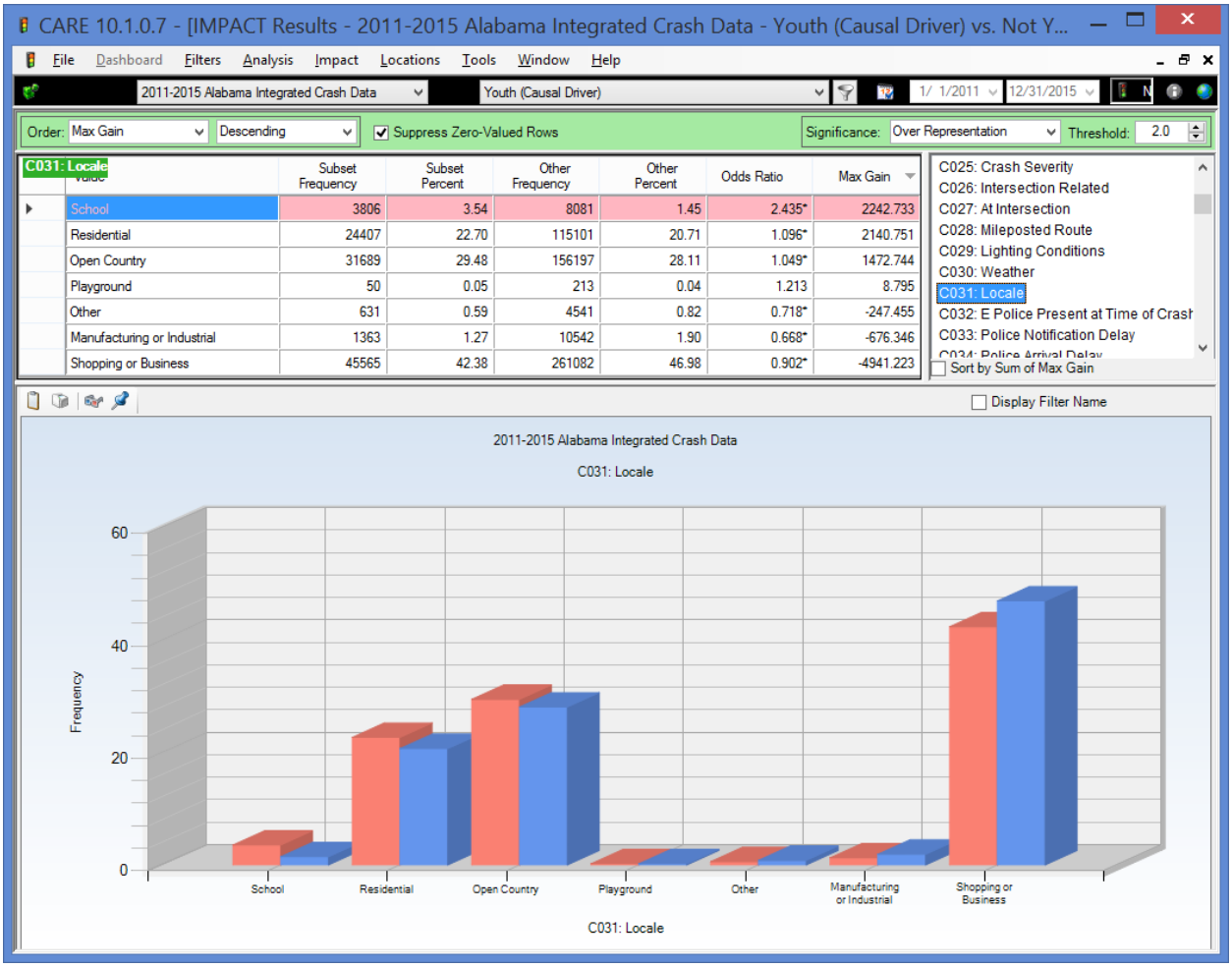
6.4 Highway Classification



Crashes caused by young drivers are greatly over-represented on county highways, with nearly 1.4 times the expected number of crashes. State routes were also over-represented. Interstates were under-represented indicating the tendency of younger drivers to drive locally. It is interesting that Municipal roads were significantly under-represented. More analysis needs to be performed if this rural/urban breakdown is seen to be a major factor in countermeasure development. This should focus on the two most recent years, since the trend toward urban driving is masked by the earlier years.

In 2016 there was a decrease in the County Road crash proportion to 18.00% (about a 2% decrease. The corresponding increase was in the Municipal Roads from 38.00% above to 39.42% in 2016. This further confirms that results of the Rural/Urban trend toward more urban driving.

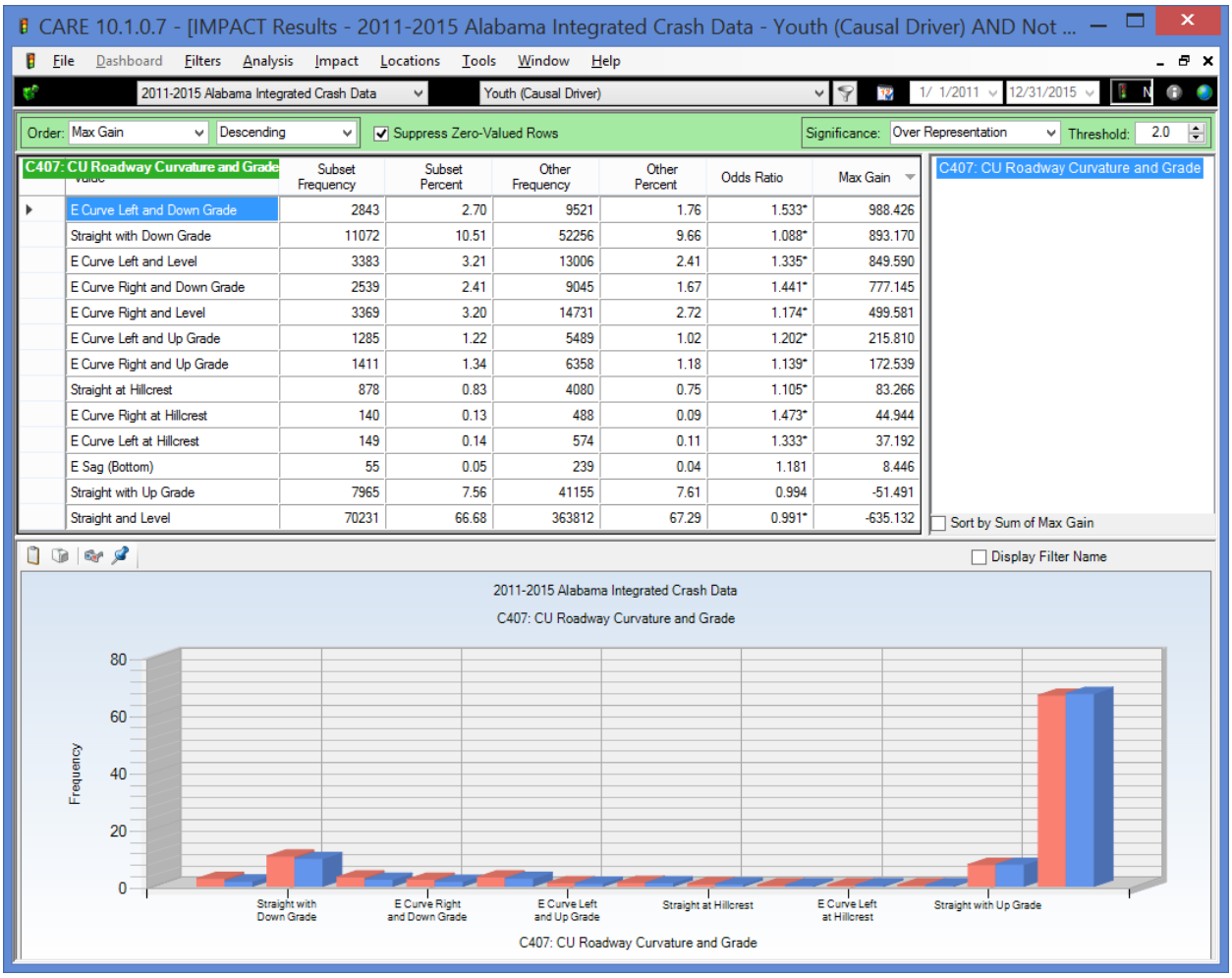
6.5 Locale



Crashes caused by younger drivers are overrepresented in School, Residential and Open Country areas. This same basic pattern was replicated in 2016, with a slight down-tick of the Open Country areas from 29.48% above to 28.89% in 2016, which further confirmed the gradual increase in young driver urban travel.

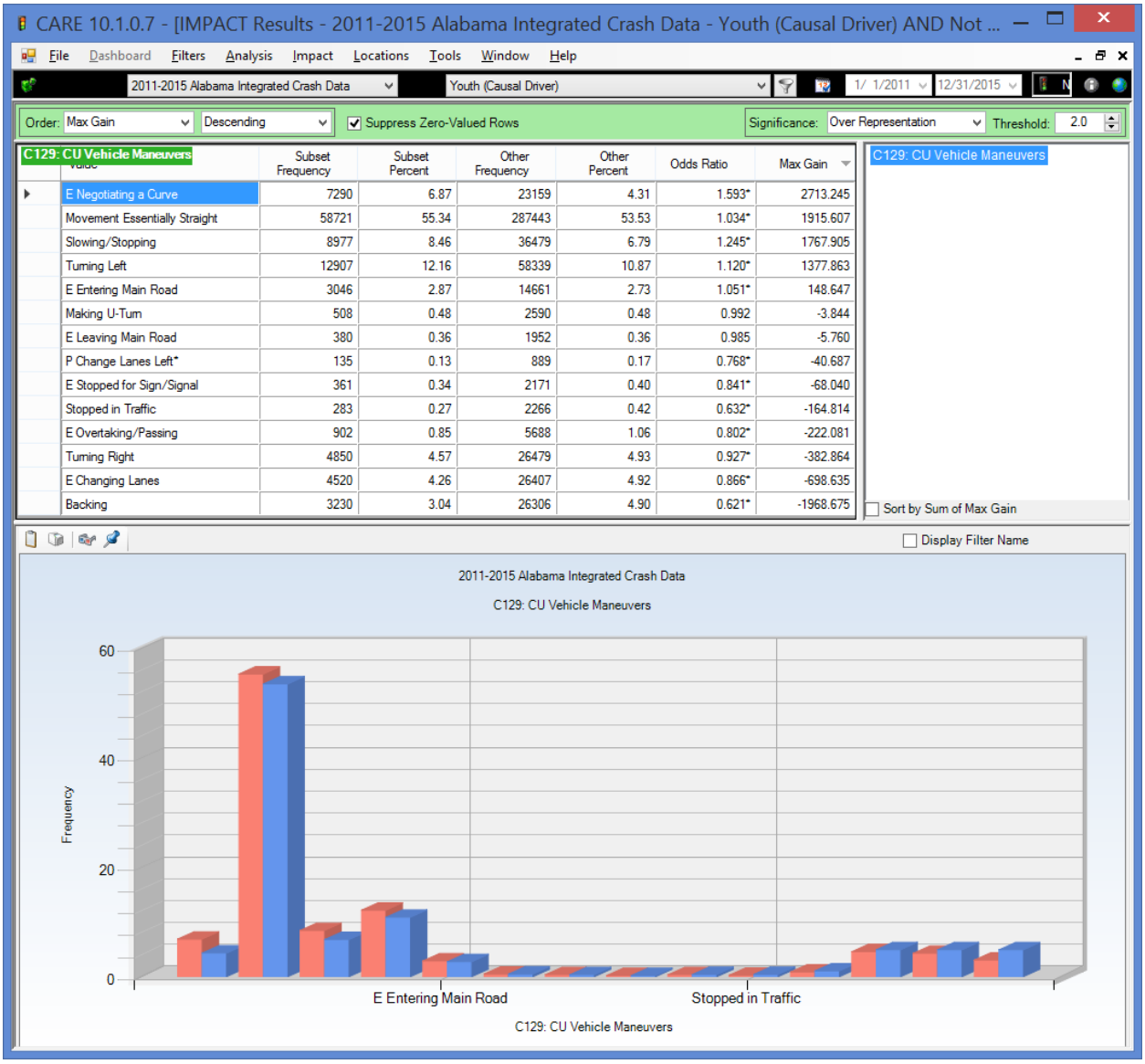
7.0 Roadway and Vehicle Factors

7.1 CU Roadway Curvature and Grade



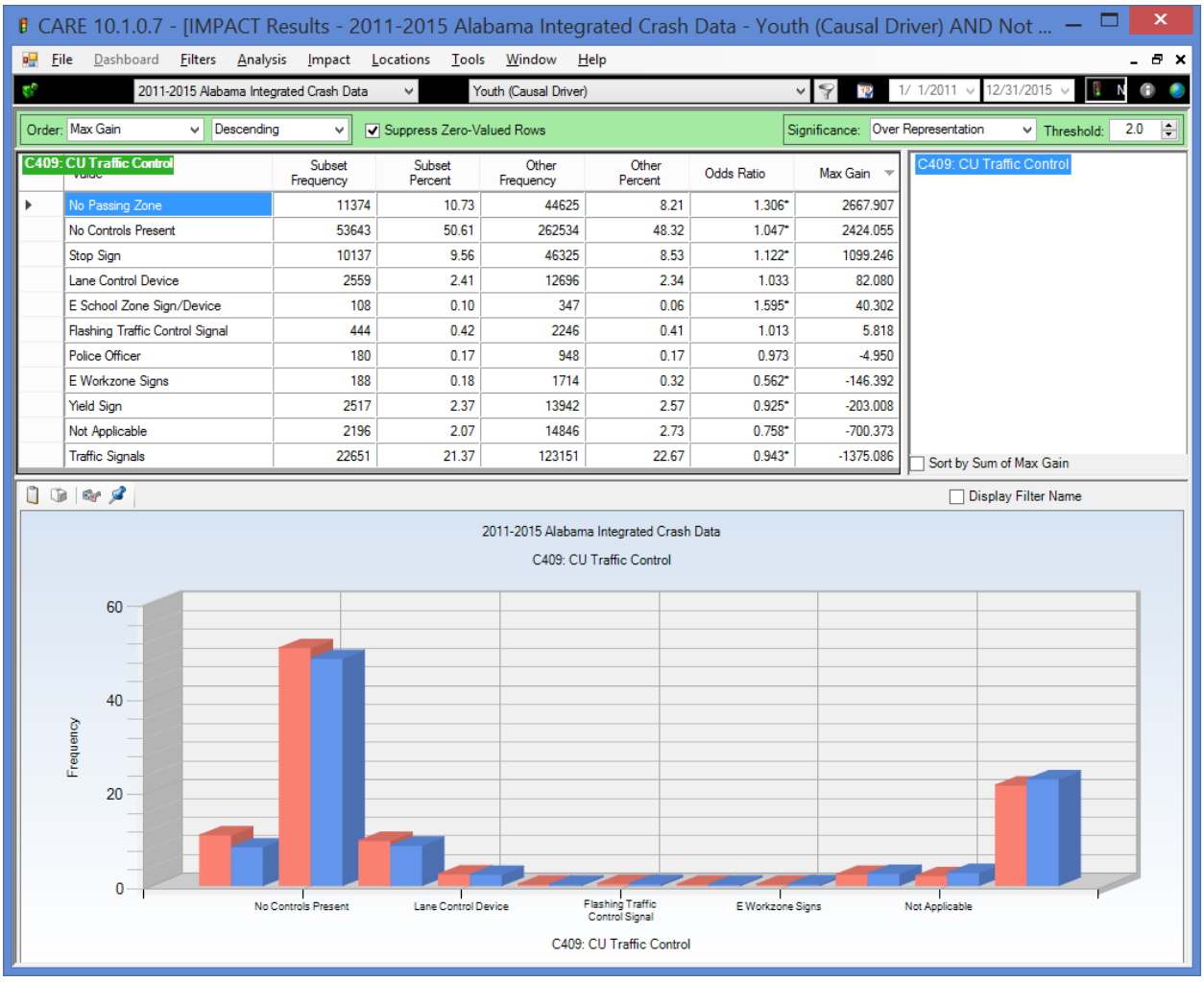
Curve and Down Grades are particularly problematic for young drivers who have not yet experienced the fact that braking might take twice as long on a down slope, something that usually takes a few near-miss incidents to make a lasting impression on the brain. This is particularly a problem with wet pavements, which was a major issue in 2015. Note that three out of the top four Max Gain categories include down grades. No major changes were found in the CY2016 data distribution for this attribute.

7.2 CU Vehicle Maneuvers



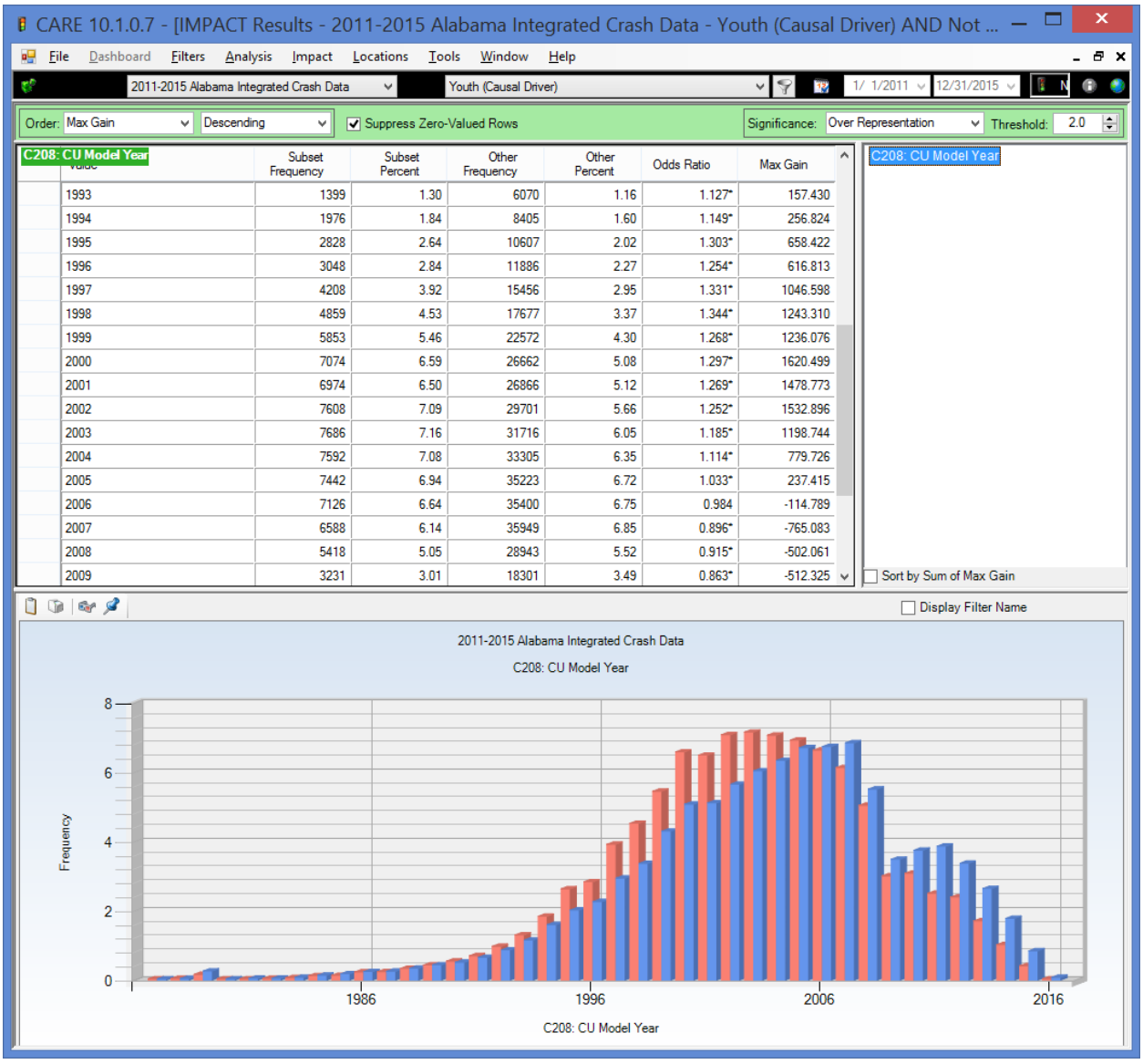
Vehicle maneuvers gives an indication as to how the driver responded to the roadway conditions given in the previous section. Negotiating a Curve and Slowing/Stopping both reflect on the findings given above. Movement Essentially Straight is a large over-represented category that shows that inexperienced drivers really do not need a roadway condition to have a problem; but in fairness the differential between the young and older drivers is really not that large – this is just a large category, which moves it up in the Max Gain ordered list. No major changes were found in the CY2016 data distribution for this attribute.

7.3 Traffic Control



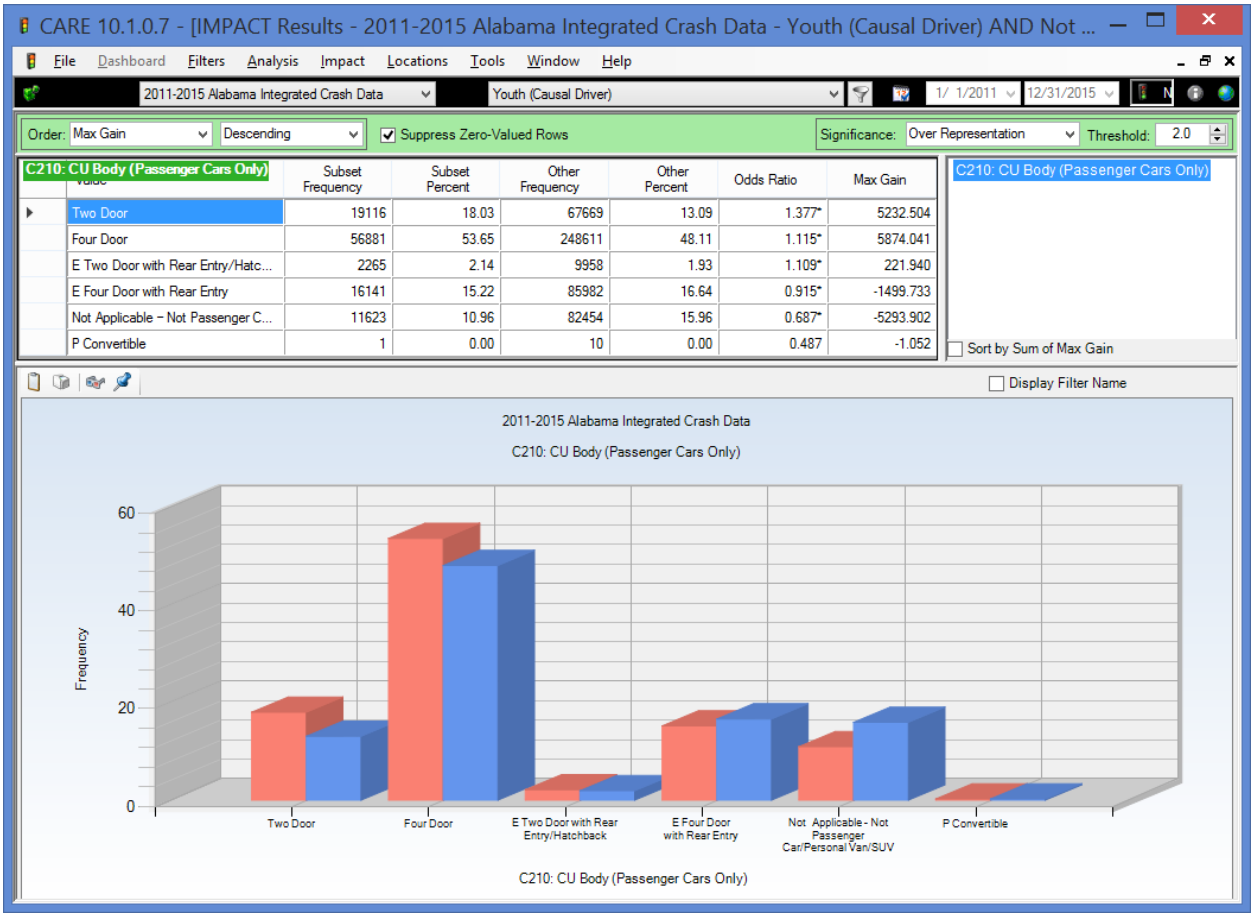
The No Passing Category, and No Controls Present would both indicate typical rural area conditions, while most of those further down on the list are more related to urban areas. Young drivers' under-representations in Workzones, and at Yield Signs and Traffic Signals are all positive indicators. No major changes were found in the CY2016 data distribution for this attribute.

7.4 Vehicle Age – Model Year



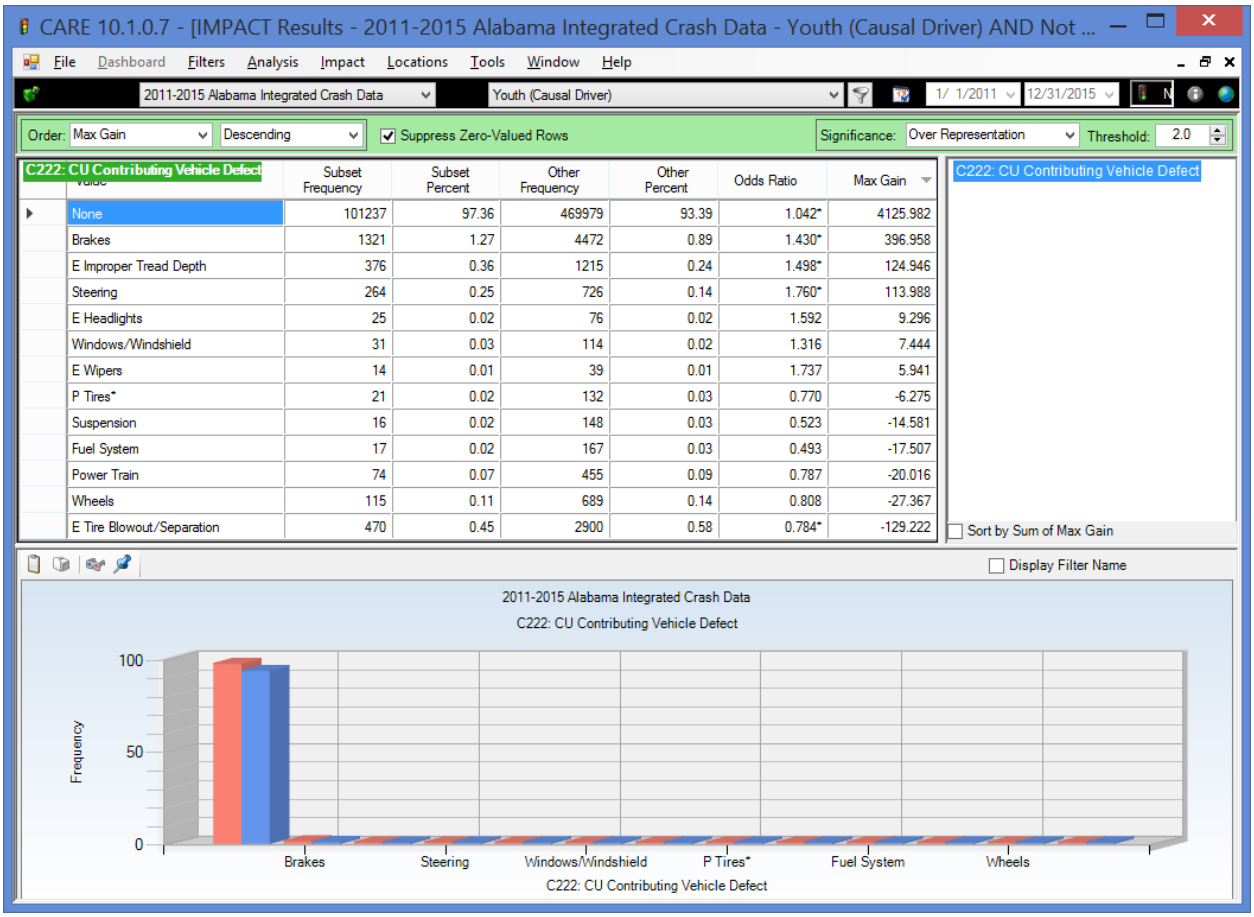
Crashes caused by young drivers are greatly overrepresented in vehicles with model years 1993-2005. That they are driving older vehicles might make the seatbelt and air bags to be in disrepair, and these vehicles may be harder to handle. All of this should be taken into consideration in driver training and PI&E programs directed at younger drivers. See below for vehicle defects, which also would be related to older model vehicles. The 2016 comparison indicated essentially the same pattern with 2006, 2007 and 2008 also being significantly over-represented, which would be expected since the update IMPACT run was for young driver crashes in 2016 only.

7.5 CU Vehicle Body Type



This gives an idea of what type of vehicle the young drivers are operating – this attribute is for the causal drivers only. The 2016 update indicated that in 2016 the proportion of four door vehicles involved in young driver crashes increased to 57.39%, which is statistically significant. However, the proportion of older drivers moving to four-door vehicles also increased from 48.11% above to 52.73% (which is again quite significant). This would seem reasonable since a large proportion of younger drivers borrow their parents' vehicles. The trend toward larger cars and SUVs is a logical product of the improvement in the economy.

7.6 CU Contributing Vehicle Defects



Young drivers in general do not have more vehicle defect issues – they are over-represented in the None category, which is good. However, this enables us to see what issues they have when problems do arise. Brakes, Improper Tread Depth and Steering seem to be their greatest issues. No major changes were found in the CY2016 data distribution for this attribute.

8.0 Summary and Conclusions

The following summarizes the findings of the analysis:

- **Crash Causal Factors**
  - Over-represented items are largely risk-taking behaviors that are highly associated younger drivers: Driving too Fast for Conditions, Following too Close, Over the Speed Limit, Misjudge Stopping Distance, and Failure to Yield that Right of Way.
  - Young drivers are notably under-represented in their DUI and other forms of impaired driving.
  - Two-thirds of young drivers' crashes involve two or more vehicles. However, their over-representation in single vehicle crashes show an excess of unforced errors and risk-taking.
  - Electronic devices have the highest causal rank among distracted driving types that are defined.
  - Rain was a particular issue for young drivers, their having over 26% more than their expected number of crashes in the rain (in comparison with older drivers).
- **Severity Factors**
  - Fatal and incapacitating injury are significantly under-represented in young driver caused crashes, reflecting the fact that typically younger drivers (and their passengers) have a far greater survival rate than older drivers under the identical circumstances.
  - Younger drivers seem to be doing a relatively good job in buckling up, as they are significantly over-represented in this category.
  - Crashes with no injuries are significantly under-represented for younger drivers. The single injury crashes are only slightly less than what would be expected.
  - The 2-6 injury classifications are all over-represented for the younger causal drivers.
  - Taking all of the information in Section 3 collectively, we can say that while any given crash may not have as high a severity, there are more people involved in being injured in the younger-driver caused crashes.
  - Crashes with impact speeds from 70 to 90 MPH were over-represented for young driver caused crashes.
  - Necessity for young-driver caused crashes to be towed is over-represented by 26%, indicating that these crashes are more severe in the physics involved than those caused by older drivers.
  - Younger driver caused crashes requiring EMS had an under-representation in the shortest two categories, while the 11-20 minute categories are significantly over-represented.
  - Police arrival delay indicate that the problem could be a delay in calling 911, but more study is required if this is considered to be an important factor.
- **Driver Demographics**
  - Causal unit driver ages showed a rise from 16-19 and then a drop off for 20 year olds.

- Males account for about 54.11% of crashes which involved young drivers.
- Caucasians were over-represented in the young driver crashes over the other racial categories.
- About 9% more of the younger drivers (than older drivers) are having their crashes within 25 miles of home, as compared to older drivers.

- **Time Factors**
  - Year. Crashes in general have been increasing on an average of 0.60% per year, with a drop in 2013, and a surge in 2015. Young driver crashes have not tracked this trend. In a sense they have not increased as much as the older drivers, their increase from 2011 to 2015 being only 0.39% per year. However, it is the years in between that are of concern. There was a major decrease of 6% between 2011 and 2014. But then a regression to the mean resulted in an overall increase of 3.01% between 2014 and 2015
  - Month. Patterns of over-representation appear to be in the months of March-May and August-October.
  - Day of the Week. Fridays and the weekends are over-represented for crashes caused by young drivers.
  - Time of Day. Before and after school are significantly greater than the normal rush hours, and the significant afternoon over-representations continue through the midnight hour. The most over-represented hours are from 9PM through to 1 AM.
  - Time of Day by Day of the Week. Friday night, early Saturday morning, and Saturday night, early Sunday morning were over-represented hours. However, far more crashes occur before and after school hours.
- **Geographical Factors**
  - Both county and city crash frequencies are excellent proxies for the locations where most young drivers are operating their vehicles so no causality other than that should be assigned.
  - Rural areas predominated for young drivers' crashes from 2011-2013, but in 2014 and 2015, these crashes were over-represented in the urban areas.
  - Young drivers on county highways had nearly 1.4 times the expected number of crashes. State routes were also over-represented. Interstates were under-represented indicating the tendency of younger drivers to drive locally.
  - Crashes caused by younger drivers are overrepresented in School, Residential and Open Country areas.
- **Roadway and Vehicle Factors**
  - Curve and Down Grades are particularly problematic for young drivers who have not yet experienced the fact that braking might take twice as long on a down slope.
  - Three out of the top four Max Gain categories for roadway curvature/grade included down grades.
  - Over-represented vehicle maneuvers included Negotiating a Curve and Slowing/Stopping.
  - Over-represented traffic controls for young driver caused crashes included No Passing Category, and No Controls Present.

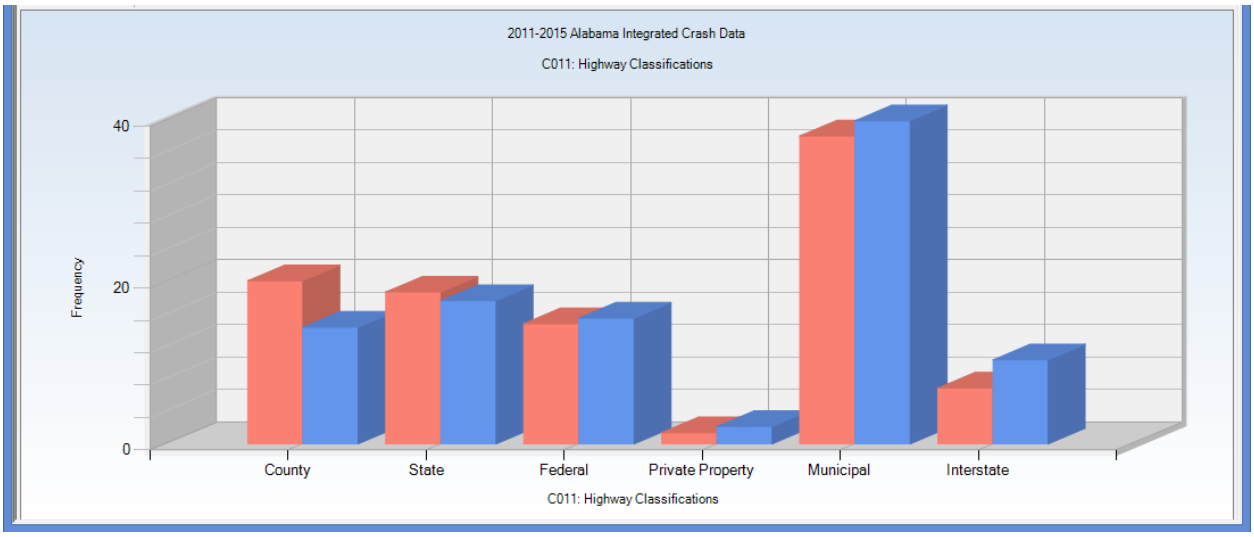
- Crashes caused by young drivers are greatly overrepresented in vehicles with model years 1993-2005.
- Brakes, Improper Tread Depth and Steering seem to be the greatest vehicle defect issues for younger drivers.

9.0 Most Relevant Conclusions

The following are considered to be the most important findings of this study from the point of view or countermeasure development:

- **Crash Causal Factors**
  - Over-represented items are largely risk-taking behaviors that are highly associated younger drivers: Driving too Fast for Conditions, Following too Close, Over the Speed Limit, Misjudge Stopping Distance, and Failure to Yield that Right of Way.
  - Two-thirds of young drivers' crashes involve two or more vehicles. However, their over-representation in single vehicle crashes show an excess of unforced errors and risk-taking.
  - Electronic devices have the highest causal rank among distracted driving types that are defined.
  - Rain was a particular issue for young drivers, their having over 26% more than their expected number of crashes in the rain (in comparison with older drivers).
- **Severity Factors**
  - Crashes with impact speeds from 70 to 90 MPH were over-represented for young driver caused crashes.
  - Necessity for young-driver caused crashes to be towed is over-represented by 26%, indicating that these crashes are more severe in the physics involved than those caused by older drivers.
- **Time Factors**
  - Year. A regression to the mean resulted in an overall increase of 3.01% between 2014 and 2015, a trend that needs to be watched carefully.
  - Day of the Week. Fridays and the weekends are over-represented for crashes caused by young drivers.
  - Time of Day. Before and after school are significantly greater than the normal rush hours, and the significant afternoon over-representations continue through the midnight hour. The most over-represented hours are from 9 PM through to 1 AM.
  - Time of Day by Day of the Week. Friday night, early Saturday morning, and Saturday night, early Sunday morning were over-represented hours. However, far more crashes occur before and after school hours.
- **Roadway and Vehicle Factors**
  - Curve and Down Grades are particularly problematic for young drivers who have not yet experienced the fact that braking might take twice as long on a down slope.

- Over-represented vehicle maneuvers included Negotiating a Curve and Slowing/Stopping.
- Young drivers on county highways had nearly 1.4 times the expected number of crashes. State routes were also over-represented. Interstates were under-represented indicating the tendency of younger drivers to drive locally. The red bars below represent young (16-20) drivers, while the blue bars represent all drivers older than 20.



For more general NHTSA and other information on young drivers, please see:
http://www.safehomealabama.gov/tag/young-drivers/