CARE IMPACT Study Failure to Yield and Ran (FtY)

2015-2019 Data

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1. Introduction

According to a Road and Track magazine articles by Benjamin Preston (May 6, 2013), Failure to Yield the Right of Way is "One of the leading causes of accidents, hands down. The Insurance Institute for Highway Safety says that it's the top cause of accidents among drivers aged 70 and older, particularly on freeway merge ramps. In Uncommon Carriers, his book about long haul truckers, John McPhee points out that space cadets in the merge lane are a constant source of teeth-grinding anxiety for the people driving 80,000-pound big rigs. Another facet of failure to yield that's more prevalent in cities is running stop signs and red lights. Drivers coming from other directions expect the intersection to be clear when the light on their end turns green. Once again, predictability is good."

Failure to Yield and "Ran" crashes (henceforth FtY, which also includes running of traffic lights and stop signs) accounted for 18.7% of all crashes in Alabama over the past five years (2015-2019). Due to their predominance in urban areas and the slower speeds in these areas the number of fatal crashes over this period at 563 was less than the percentage of all crashes, but at 12.9% of the fatal crashes in the state, this is still a major problem. The purpose of this special study is to explore the various attributes of FtY in order to better develop countermeasures against it and thus reduce its effects.

To see the full impact of FtY, over the five calendar years of 2015-2019, crash reports recorded 563 Fatal Injury crashes; 6,190 Incapacitating Injury crashes; 15,565 Non-Incapacitating Injury crashes; 20,533 Possible Injury crashes; and 100,059 Property Damage Only crashes, and 3,215 of unknown severity, for a total of 146,125 crashes over the five-year period. This averages to 29,225 FtY crashes in Alabama per year. Additional information on crash severity is given in Section 6 below.

The table below indicates the actual number of crashes in each year of the study. This is further discussed in conjunction with attribute C003 (Crashes per Year) within Section 4.

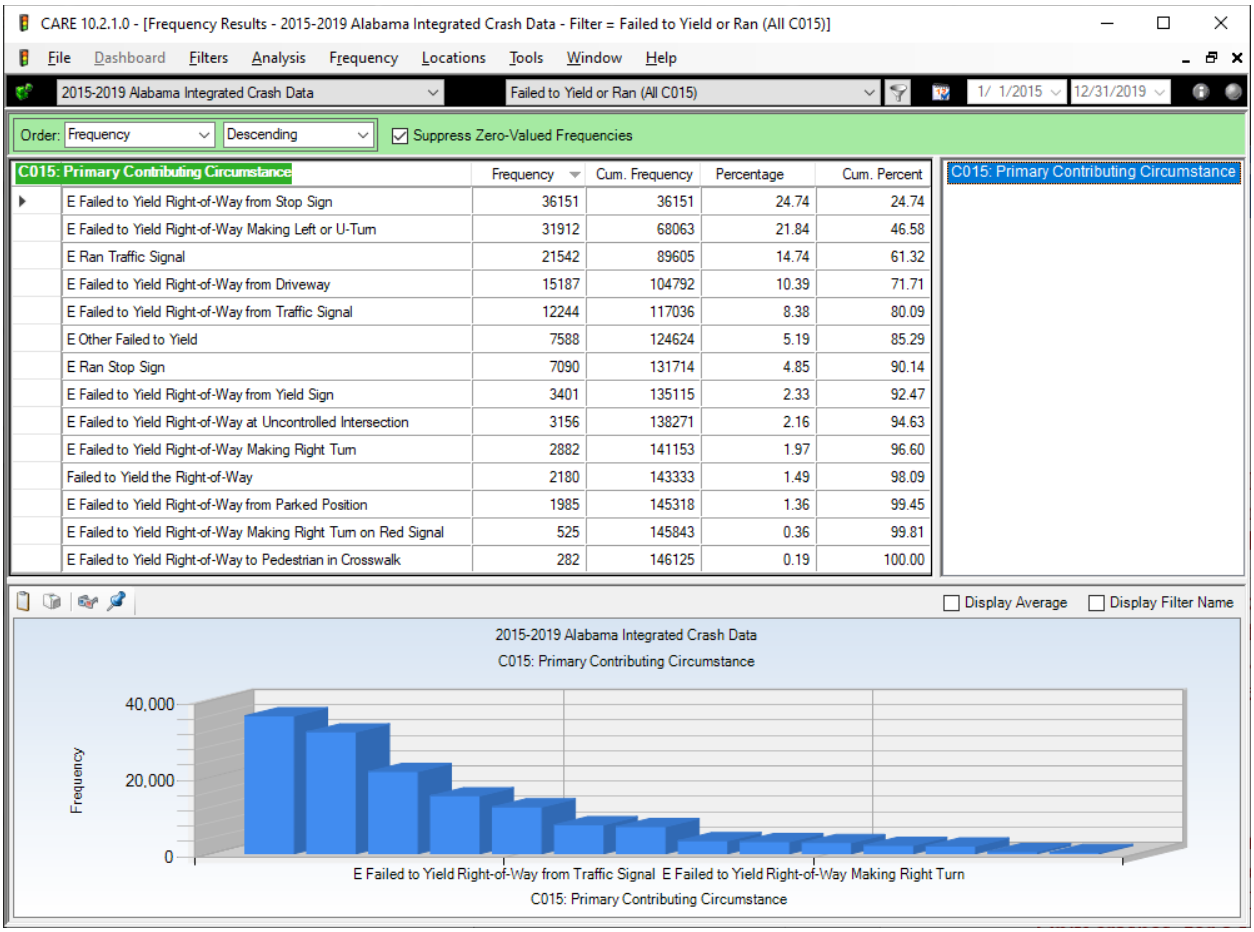
Frequency of FtY Crashes by Year

Year	Number	% of Total
2015	27,333	18.7%
2016	28,987	19.8%
2017	29,026	19.9%
2018	29,750	20.3%
2019	31,029	21.2%
Total	146,125	100.00%

This shows a 13.5% increase from 2015 to 2019. The overall increase in crashes during this same time span was only about 5.7%, indicating that the growth of FtY crashes is significantly higher than the growth of crashes in general.

The following table illustrate the items within the C015, Primary Contributing Circumstance (PCC) that were used to create the filter for this study, ordered by PCC item frequency.

Frequency Distribution C015 Used to Create Failed to Yield/Ran Filter



Additional failure to yield cases may have been obtained from the Causal Unit Contributing Circumstances. However, it was determined best to use what the reporting officers considered to be the "Primary," or most central, circumstance for the entire crash event. Note the presence of two "ran" PCCs included in this filter: (1) Ran Traffic Signal, and (2) Ran Stop Sign. These were included to be comprehensive, since the difference between these and other "Failed to yields …" might be ambiguous to some officers. This report continues by presenting the major findings organized by the following major groupings of the attributes: Geographical, Time and Weather, Driver Related, Severity and Vehicles. A final section presents an example of hotspot outputs that can be generated for FtY hotspots over the state.

2. Major Findings and Recommendations

The details for the summaries in this section are given in the several sections that follow, referenced by general classification and crash attribute numbers (Cnnn). The acronym we will use for Failure to Yield will be FtY, although it should be recognized that it also includes those crashes caused by vehicles running stop signs or traffic signals.

Geographical Findings (Section 3)

- C010 Rural or Urban. As expected, urban areas had a proportion that was about 14% greater than what would be the expected from the comparison with non-FtY crashes. The reason for this is fairly obvious since urban areas have a greater concentration of intersections. The positive aspect of this is that speeds are generally lower in the urban areas, which reduces the severity of crashes (see C025).
- C011 Highway Classification. This reflects the rural/urban finding above. Over 51% of the FtY crashes were on Municipal roadways. However, some federal, State and County roads go through urban areas, and the crashes are distributed accordingly along with the intersection and interchanges in the rural areas.
- C027 At Intersection. The vast majority of FtY crashes will be at or near intersections – this result shows 78.54. Those that are not at intersections could be at interchanges where yielding is required, e.g., failure to properly merge.
- C028 Mileposted Routes. Shown are those with the highest Odds Ratios, those that are greater than 2.0 and thus have a red background. The Odds Ratios show how much higher the proportion of FtY crashes are as compared to the non-FtY. For example, the first one on the list, AL0202 has an Odds Ratio of 4.061, which indicates that there are over 4 times the proportion of FtY crashes on this roadway as there are non-FtY. Visualize that 0.30 is over 4 times 0.07. All of these are Alabama state roads and we would expect that they are fairly heavily in urban areas.
- C033 Locale. As expected Shopping or Business and School locales were the only ones with significantly over-representations.
- C110 Driver Residence Distance. The fact that the Odds Ratios are not as high for this attribute is an indication that this is fairly close to the normal distances that most travel takes place.

Time and Weather Findings (Section 4)

- C003 Year. Examining the Subset Frequency column shows an increase of 3,696 FtY crashes over the five years. The largest part of the rate of increase was in 2016. There was very little increase in 2017. However, the increases in both 2018 and 2019 were quite significant, as was the overall increase of 13.5%, while total crashes increase only about 4%. There can be little doubt that FtY crashes are increasing and need to be given more attention.
- C004 Month. September and October might be explained by more urban traffic getting back to school, as well as football traffic. March is more of a mystery and we will need to

keep an eye on that in the future. The under-representation in the summer months is due to vacation and recreational traffic being more in rural areas.

- C006 Day of the Week. Clearly, the work days are over-represented and the weekend days are under-represented, again a reflection of the proportion of traffic which would be rural as opposed to urban. Selective enforcement at intersections should concentrate on week-days and especially those later on in the week.
- C008 Time of Day. Over-represented times are primarily week-days from 9 AM through 8 PM, with the largest over-representations being during the afternoon rush hours of 3 PM through 6 PM. It is often difficult to do selective enforcement during rush hours (especially on Fridays) since there are so many crashes and other emergencies that distract from it. The chart gives a good indication of time of day concentrations.
- C031 Lighting Conditions. The general conclusion that we might obtain from this display is that people are inclined to take fewer FtY chances when their sight is limited. Perhaps there is perceived need on the part of some to make sure that there is no law enforcement officer on or near the scene. Or it might be a type of fear of the unknown when vision is limited.
- C032 Weather. Chances are good that the same reasoning that applies to darkness also applies to bad weather. Since sight is limited there is a reluctance to take a chance on either running or ignoring the need to yield. This might tend to confirm the reasons given above for the relative drop off in the proportion of FtY crashes in darkness.

Driver Related Findings (Section 5)

- C017 First Harmful Event. Collisions with Vehicle in Traffic were removed since they dwarfed all of the other categories. The remaining items emphasize the problems to be mainly at intersections. Pedestrian and Bicycle crashes are significantly over-represented. With these data we cannot determine if the motorist driver is at fault, or if the fault is with the pedestrian or bicyclist. General analyses of fault have been performed and are in the list of Special Studies on SafeHomeAlabama.gov. They generally show that the pedestrian or bicyclist are not at fault in most crashes; however, the fault shifts to them heavily in fatal crash events. See "At Fault," http://www.safehomealabama.gov/caps-special-studies/ under Vehicle Related.
- C023 Manner of Crash. The major finding here is obviously that FtY crashes are largely either pure or partial T-bones, front to side. Crash avoidance might be the reason that some of the other angle crashes occur. Some officers might code cut-off type of crashes (where the causal driver does not stay properly in the lane) as FtY, since if a vehicle is coming up quickly on the side, it is safest to give that vehicle the right of way until it gets past.
- C052 Number of Vehicles. The vast majority (93.97%) are two-vehicle crashes, with more than three being quite rare. Three-vehicle crashes were only 4.01%. This makes sense, since it is hard to see how a FtY can end up in a single vehicle crash, and when one does occur, other vehicles can usually avoid the crash. Of course, there are always exceptions.

- C104 Causal Unit (CU) Left Scene. The proportion of FtY crashes where the causal driver left the scene is about half of that of non-FtY crashes. One reason could be that the vast majority of them involve two or more vehicles.
- C107 CU Driver Raw Age. The youngest drivers (aged 16-17) are either significantly over-represented (16-17) perhaps due to lack of experience (not necessarily risk taking, although this could enter into it). After these, the younger ages become under-represented up until age 59. Age 59 and older are significantly over-represented. This is an important factor to recognize since it is quite consistent, and the over-representation increases with age. Our studies of risk taking have shown that this is not a matter of their taking risks – it is a lack of perception capabilities on their parts. Eyesight is a major concern in this age group as well. Older drivers are more apt to be in later model vehicles; those that are more apt to have some type of Automated Driver Assistance System (ADAS) features.
- C109 CU Driver Gender. This is one of the few crash types where we have found females over-represented. Clearly countermeasures oriented toward the female drivers are warranted. We feel one major cause of this is that women are more apt than men to be driving in urban areas.
- C115 CU Driver CDL Status and C080 CMV Involved. These two attributes are considered together to give the most accurate possible picture of CMV involvement. CMV operation requires a Commercial Drivers' License (CDL), which is the subject of C115. Adding the Not Applicable with the Unknown gives about 92% that are not CMV, from which CMV involvement can be inferred to be about 8%. This is confirmed from the C080 value of 3.56% for C080 where CMV Involved is indicated. This does not appear to be a large percentage, but it must be compared to the proportion of their crashes in general (in this case their non-FtY crashes). In both cases we see that the proportion of CMV involvement in FtY crashes is significantly lower than that expected. It is slightly above 60% lower proportion as given by the C080 result.
- C122 CU Officer Opinion Alcohol. The effect of alcohol and drugs on creating failure to yield cannot be disputed. However, the proportion of those who were using alcohol is significantly lower for FtY crashes than for crashes in general. Both this result and the one for drugs immediately below can be traced to the age and gender of those who are over-represented in FtY crashes, given above: females, and drivers who are 59 years and older.
- C123 CU Officer Opinion Drugs. (Non-alcohol) drugs are about the same in their under-representation than that found for alcohol. The proportion of FtY drivers who were drug free was about one-sixth of non-FtY drivers.
- C129 Vehicle Maneuvers. The following were the most over-represented vehicle maneuvers (all statistically significant):

Turning Left	59058
Entering Main Road	13781
Turning Right	9982
Making U-Turn	1727

These results are reasonable given the finding below for C027, which indicates that close to 80% of these crashes occur at intersections.

Severity Findings (Section 6)

- C025 Crash Severity. While Fatal Injury crashes are under-represented at about two thirds of the proportion of non-FtY crashes, all the other injury categories are significantly over-represented, and Property Damage Only crashes are significantly under-represented. Two possible reasons for these results may be: (1) slower impact speeds – see C224 below, and (2) urban locations where EMS is readily available (see C038 below). While the fatality rate in these crashes is down, the number of people injured in the two worst non-fatal injury categories were over 21,000, assuming at least one injury per crash.
- C038 Adjusted EMS Arrival Delay Time. The 0 to 5-minute and the 6 to 10-minute delay from crash time to ambulance arrival are significantly over-represented. After that, all of the delay categories are under-represented. The excessively delayed arrival times are very highly significantly under-represented. It would seem that this is one of the primary reasons that so many lives are saved in these crash types.
- C060 Two things account for the large number of multiple injury crashes, which are all very highly significantly over-represented above two injuries. First the vast majority of these crashes involve two vehicles. Next is the vehicle usage, which was close to 90% personal, and at the times of occurrence a large number of them would have been the transport of children to and from school. The single injury category, while not as high a proportionate over-representation, was still well over 25% greater than expected, and was also statistically significant.
- C224 CU Estimated Speed at Impact. This is the largest single factor that determines whether a crash results in a fatality. In this case the average speed at impact of the FtY crashes was 16.4 MPH, while that of the non-FtY crashes was 35.0.6 MPH. The numbers in Display C025 show that the probability of an FtY crash being fatal is 0.39%, while that same probability for a non-FtY crash is only 0.60%. As an interesting comparison, the speed of non-FtY crashes is 2.13 times the speed of FtY crashes, and the probability of a fatality in a non-FtY crash is 1.55 times that of FtY crashes.

Vehicle Related Findings (Section 7)

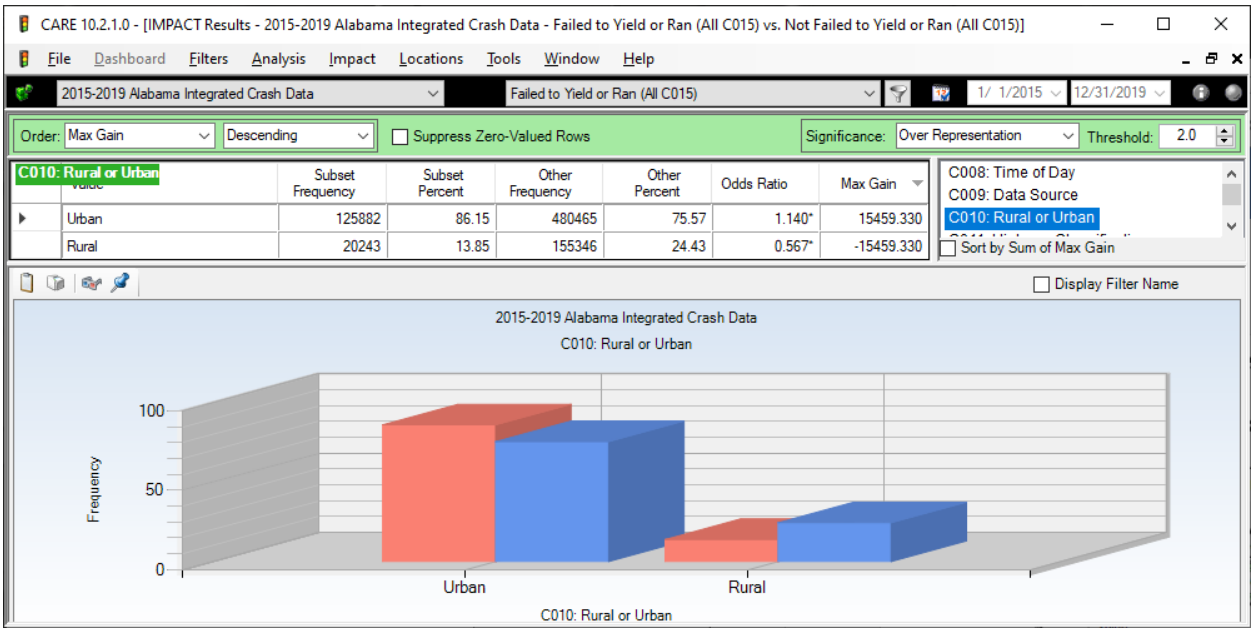
- C101 Causal Unit (CU) Type. The vast majority of FtY crashes (77.04%) are caused by the drivers of Passenger cars (55.3%) and Sport Utility Vehicles (21.7%), both of which are significantly over-represented when compared to their expected numbers in the non-FtY population. Surprisingly, the largest under-representation, from the Max Gain measurement, is in Pick-Ups (Four Tire Light Trucks).
- C208 CU Model Year. Vehicle years that are over-represented start at 2010 and later. All previous model year are under-represented. Recall from C107 that older drivers tended to be over-represented in FtY crashes. A cross-tabulation of age by model year showed a very strong over-representation of 56-80-year old drivers of model years after 2010.

Hotspot Analysis (Section 8)

- Hotspot analyses can be performed using a FtY filter for any type of roadway in Alabama. Such a filter will only allow FtY crashes to be considered in determining the locations that have high crash frequencies.
- Municipal (51.5%), State (20.2%), Federal (16.0%) and County (10.6%) classifications effectively account for 99% of the proportion of FtY. Interstates have slightly under 1.0%.
- Examples are given limiting the analysis to intersections with more than 75 FtY crashes in Section 8.1. They are arranged in descending crash frequency. Note the second column: 127, 99, 99, 99, … etc., which gives the total number of crashes.
- The example in Section 8.2 considers all mileposted roadways in the state with a criterion of 75 crashes in 0.5 miles. A total of 92 such locations were found on 30 routes, none of which were Interstates.

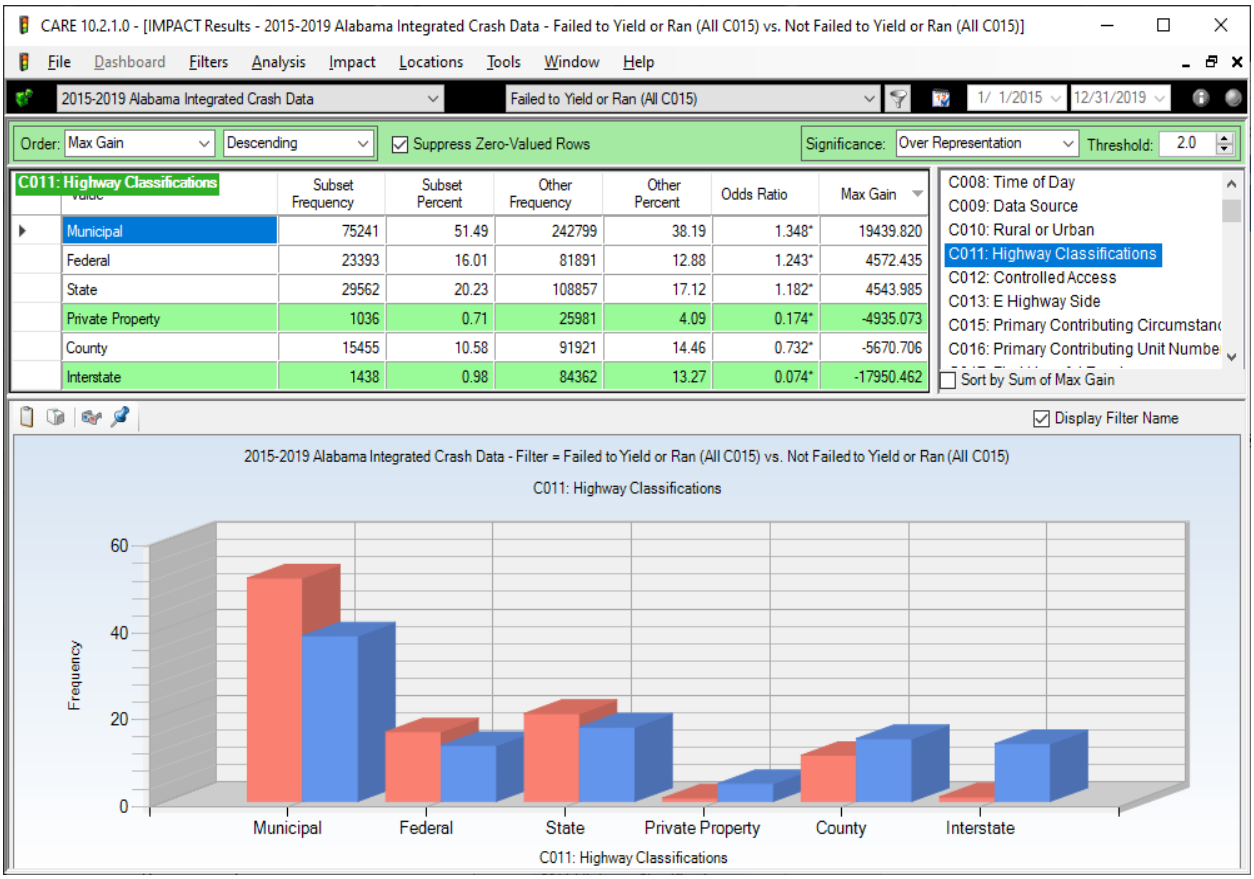
3. Geographical/Roadway IMPACTs – 10, 11, 13, 27, 28, 33, 110

C010 Rural or Urban

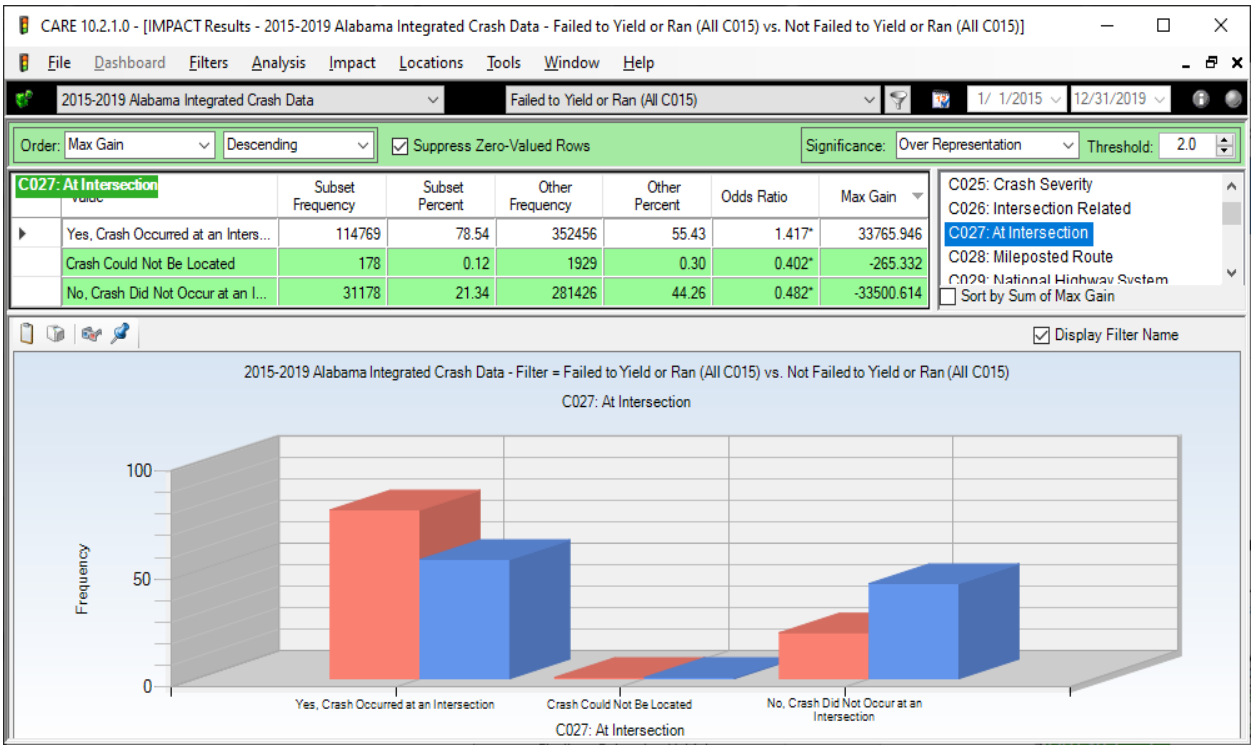


Urban proportion is about 14% higher than expected as compared to the non-FtY crashes.

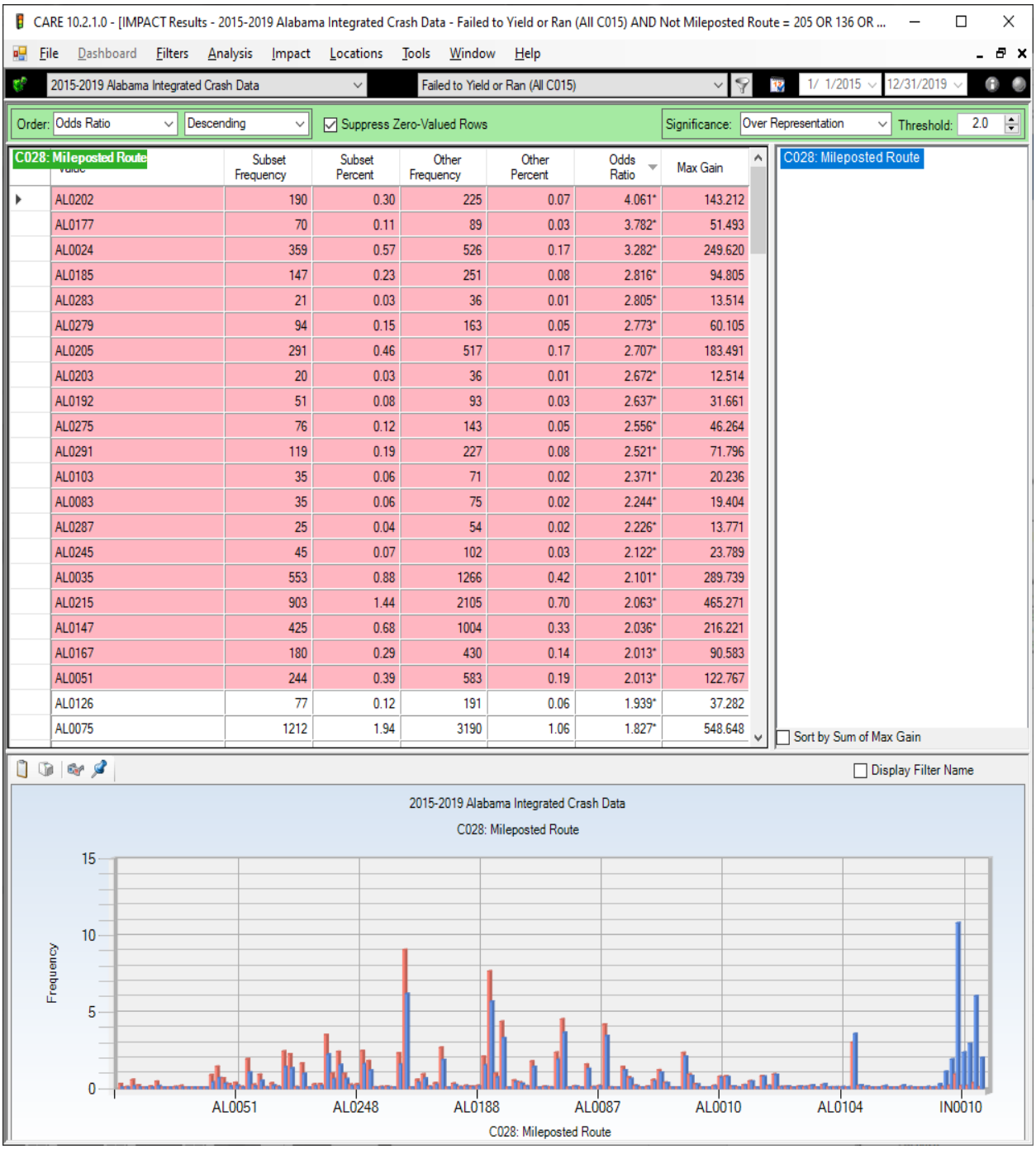
C011 Highway Classification



C027 At Intersection

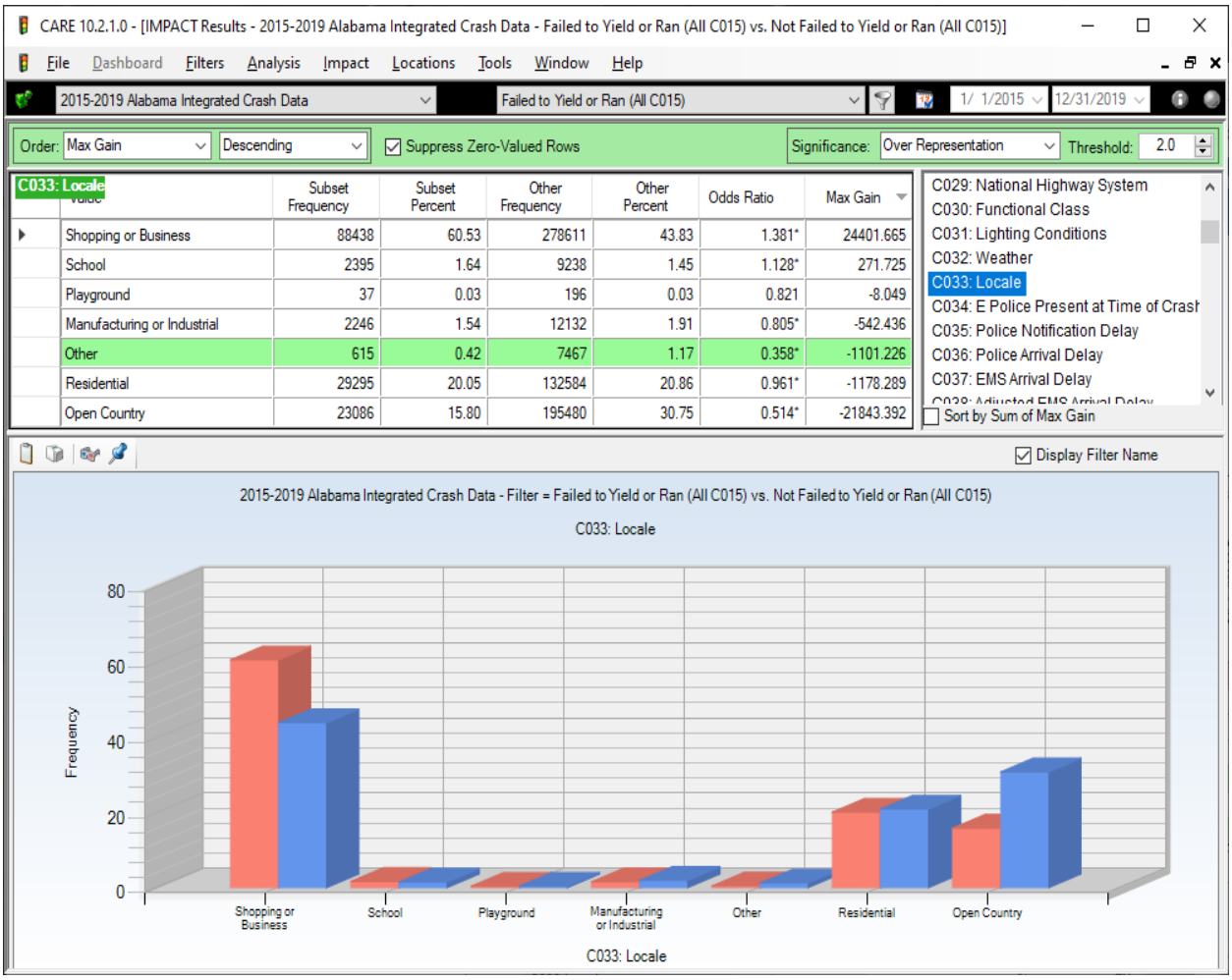


C028 Mileposted Routes



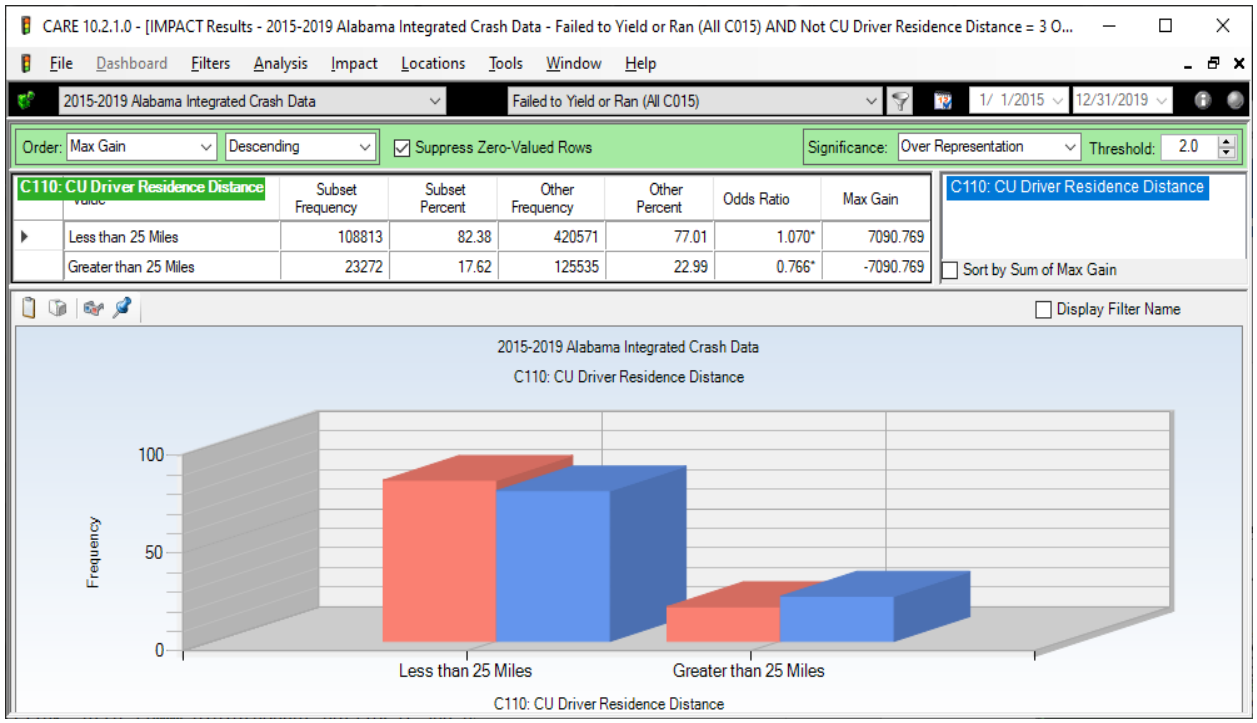
All roadways with less than 20 FtY crashes were eliminated from consideration, and the result was sorted by Odds Ratio. Interstates had the best records (blue bars on the chart to the right).

C033 Locale



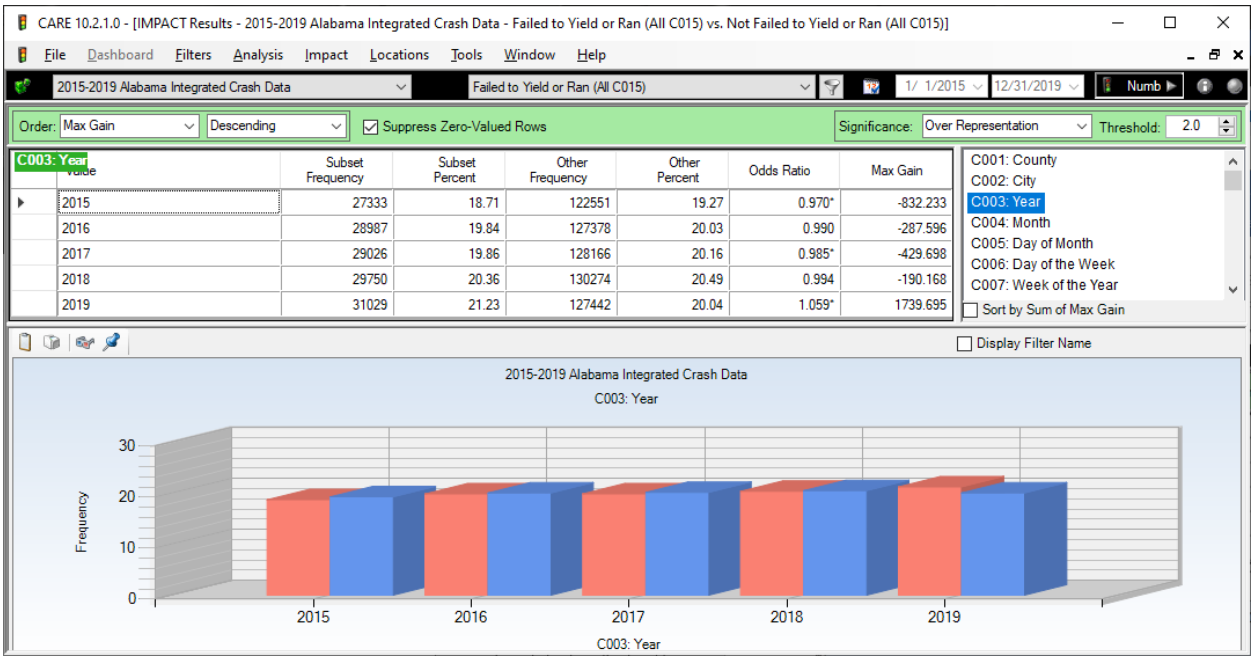
Failure to Yield potential locations will obviously be in areas where there are traffic signals and signs (Yield and Stop).

C110 CU Driver Residence Distance



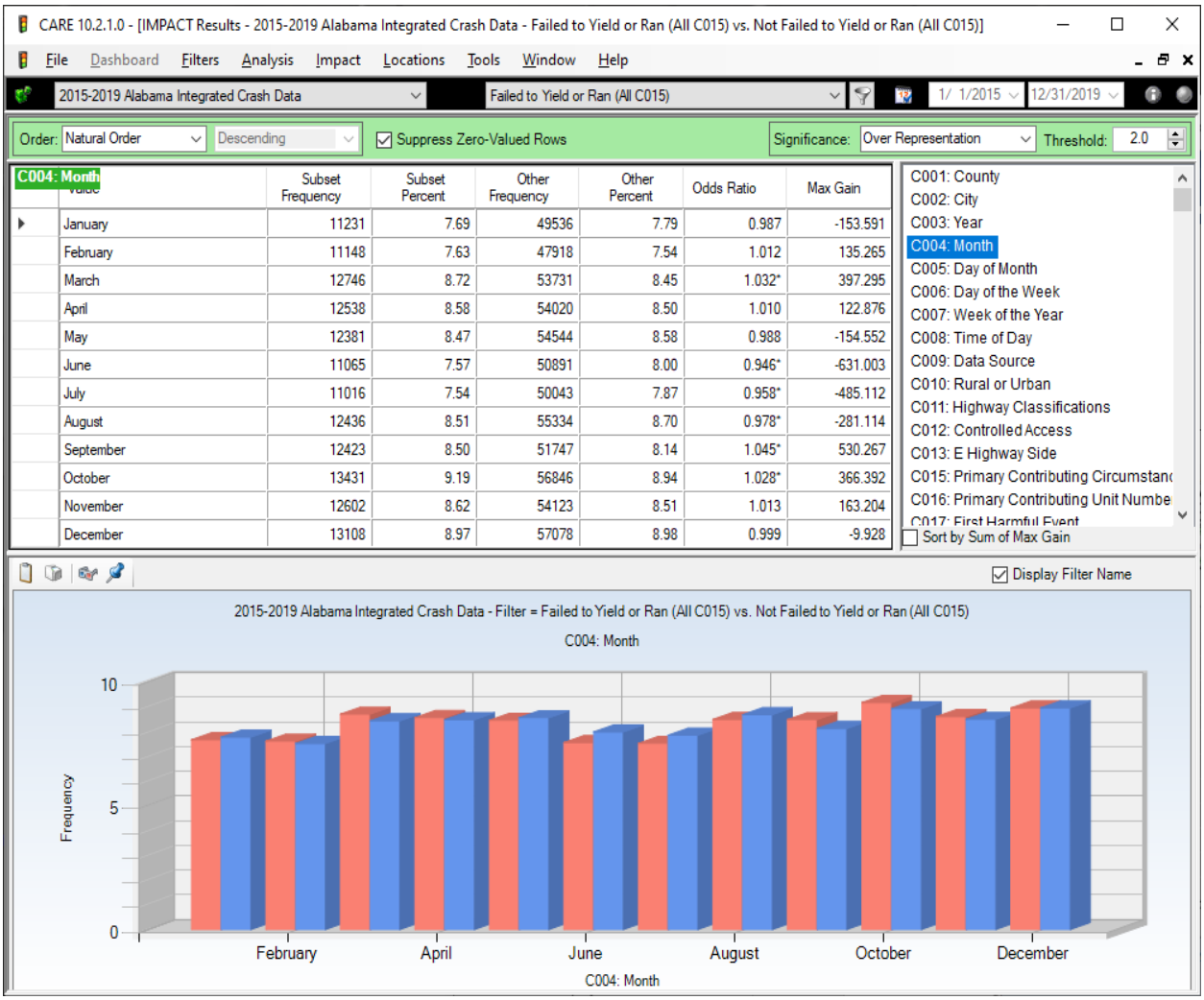
4. Time, Weather and Lighting IMPACT Displays – 3-8, 31-32

C003 Year



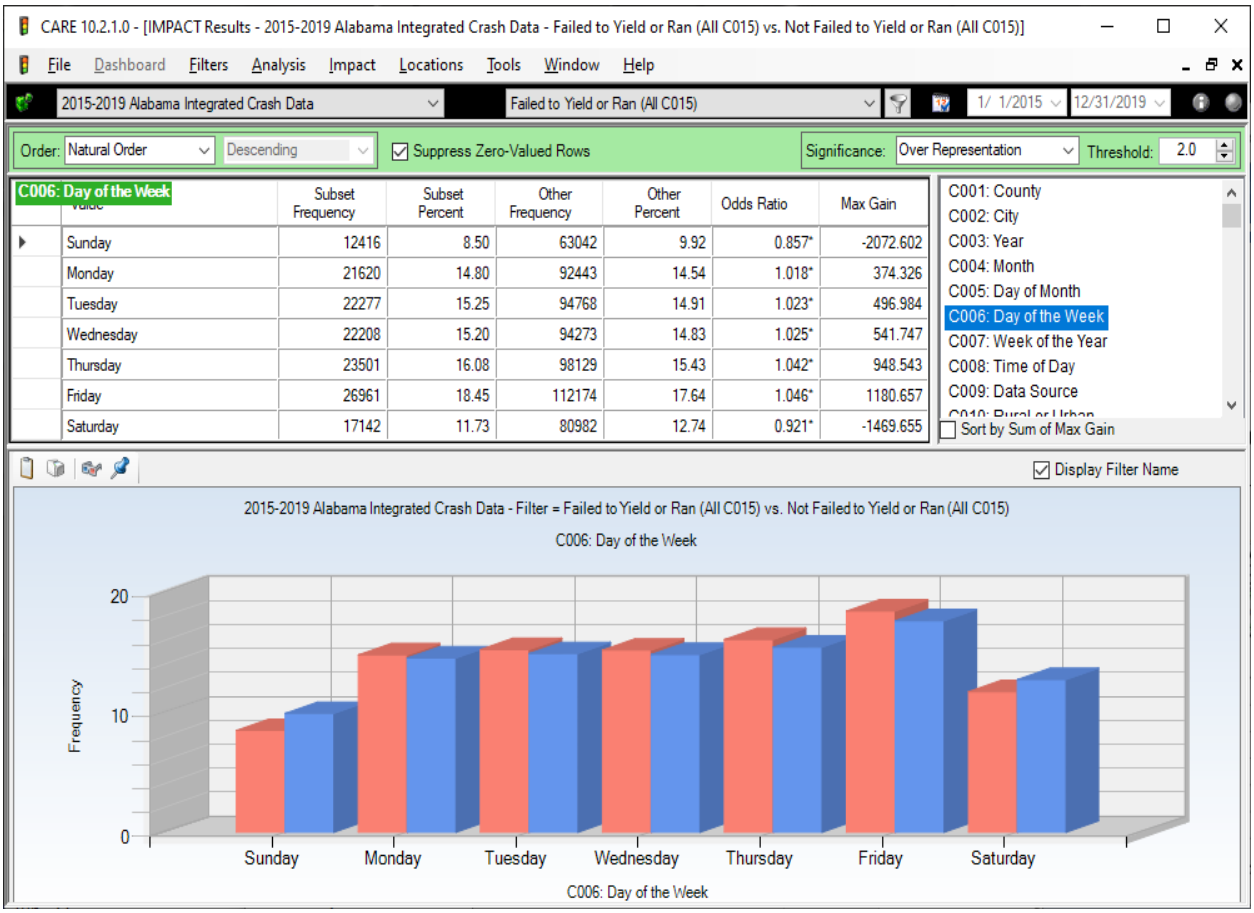
Increase from 2015 to 2019 was 13.5%, while the non-FtY only increased about 4.0%.

C004 Month



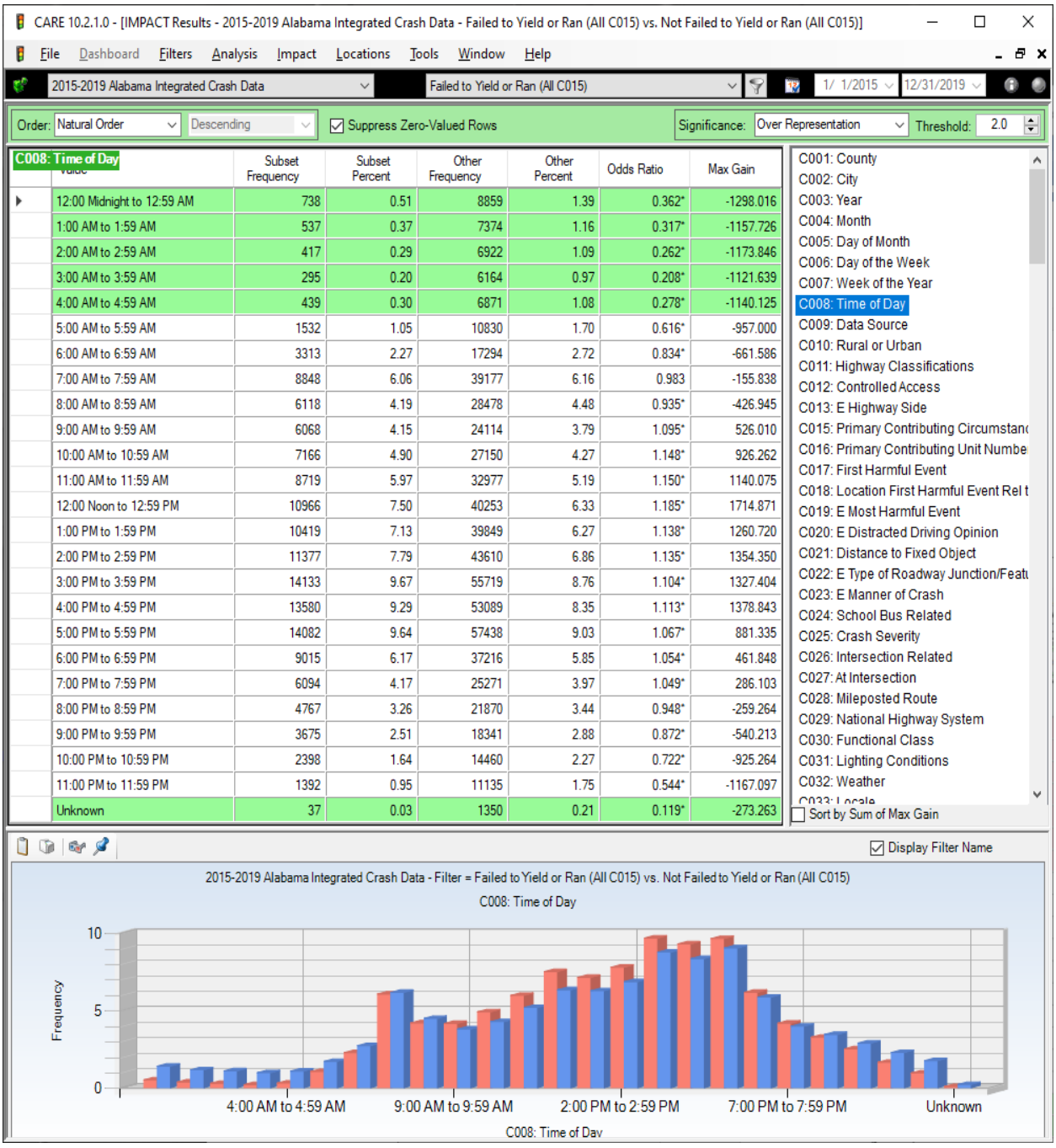
Significantly over-represented: March, September and October.
Significantly under-represented: June, July and August (summer months).

C006 Day of the Week



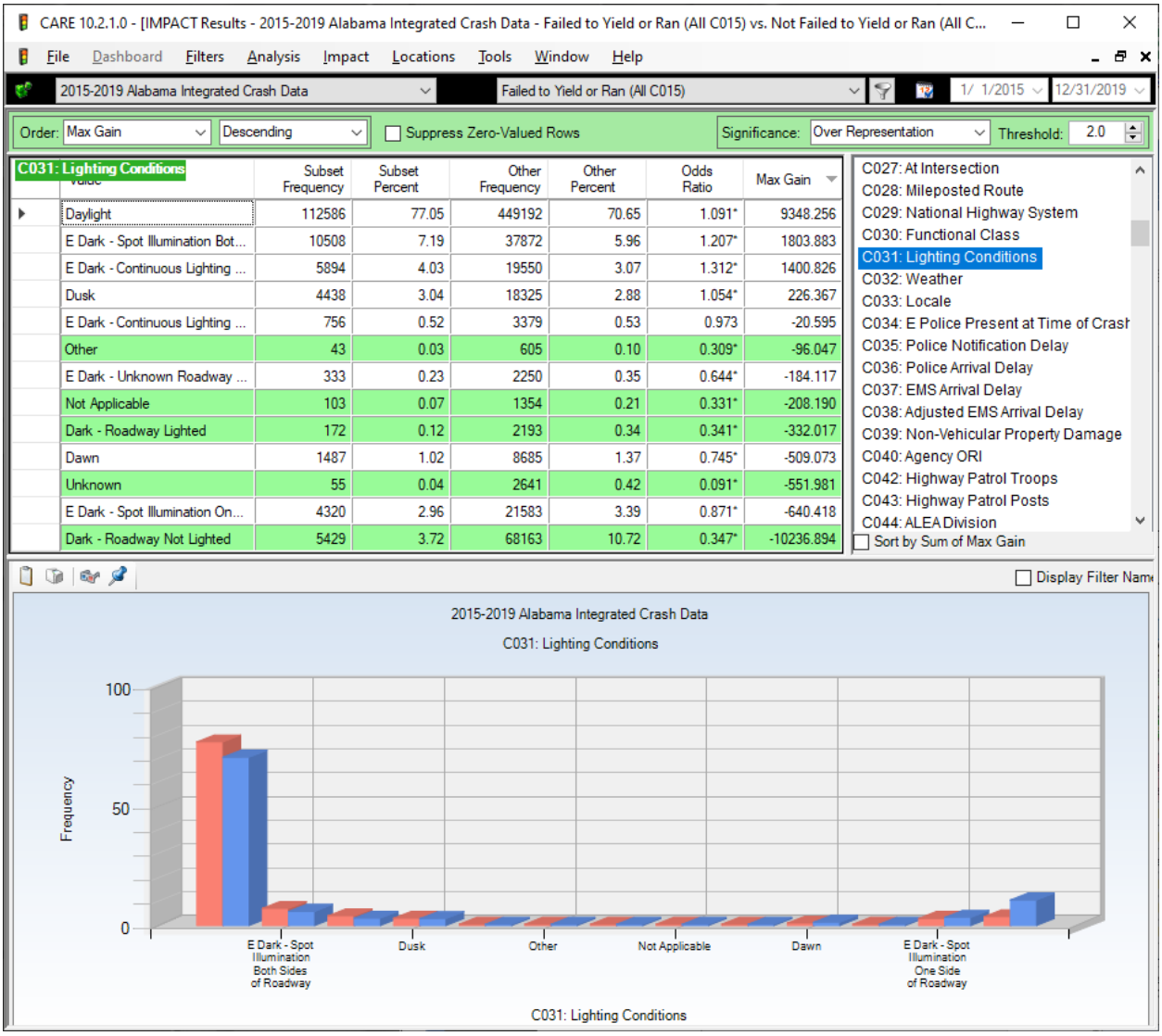
Clearly, the work days are over-represented and the weekend days are under-represented.

C008 Time of Day

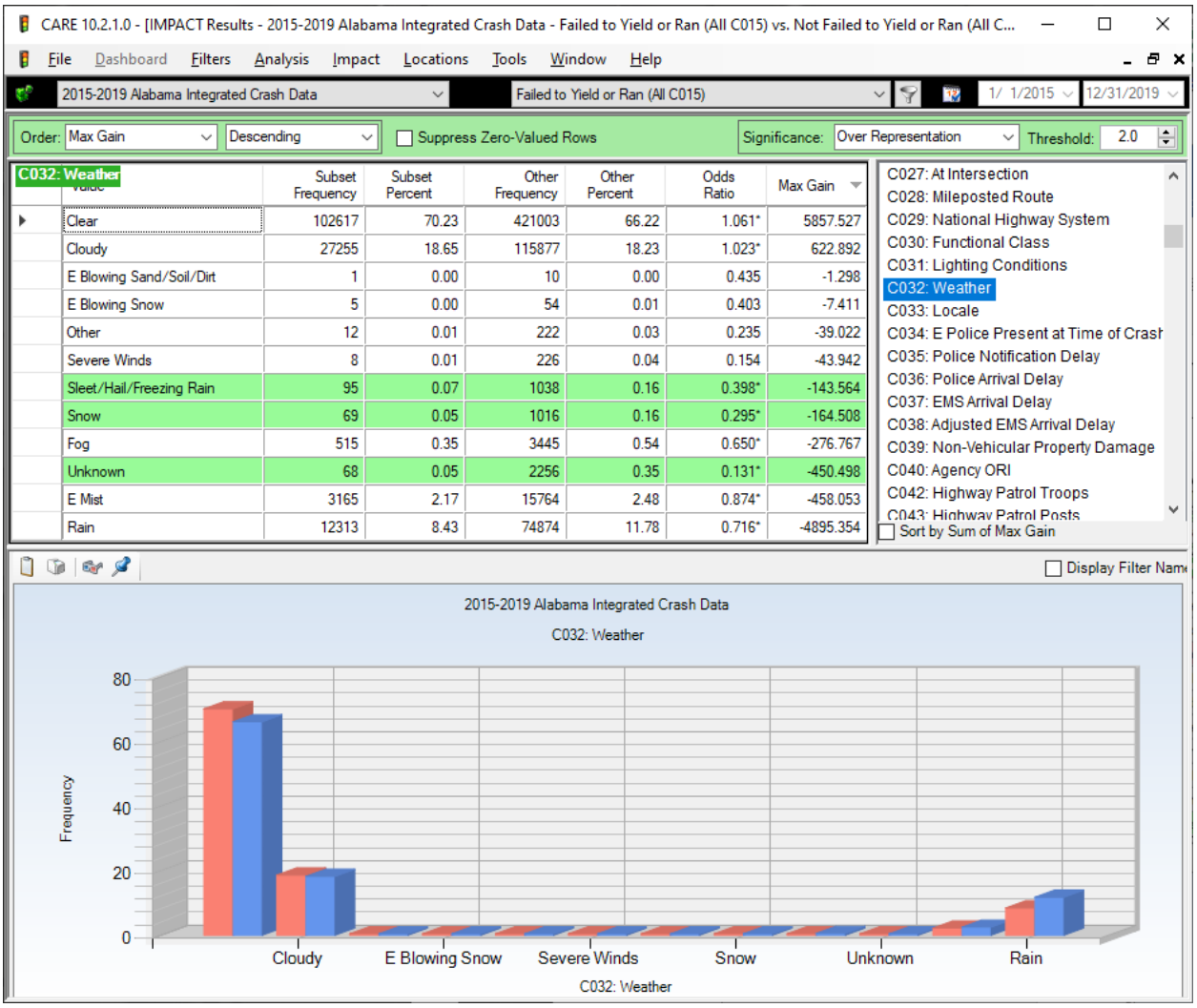


Over-represented times are each day from 9 AM through 8 PM, with the largest over-representations being during the afternoon rush hours of 3 PM through 6 PM.

C031 Lighting Conditions



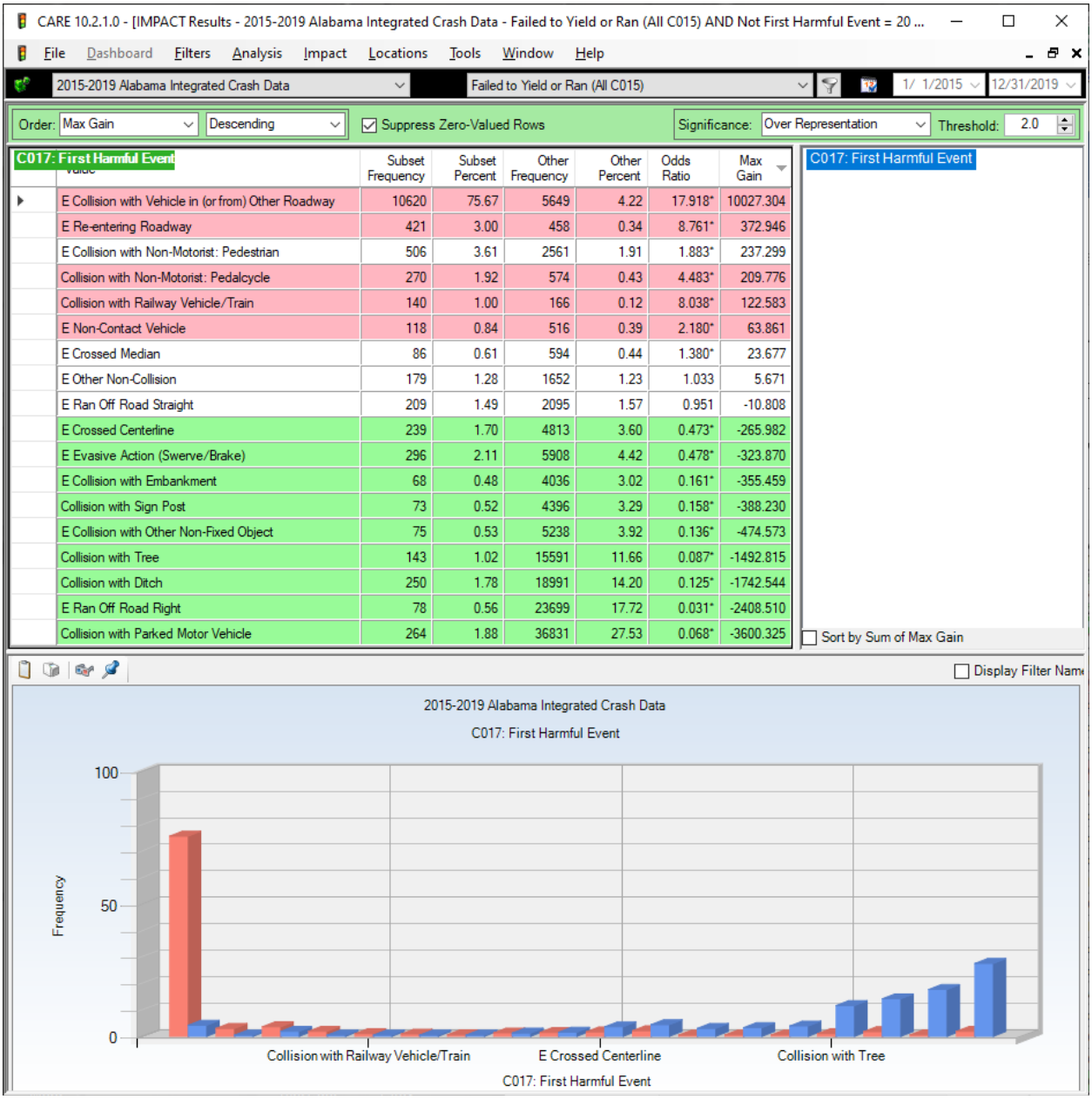
C032 Weather



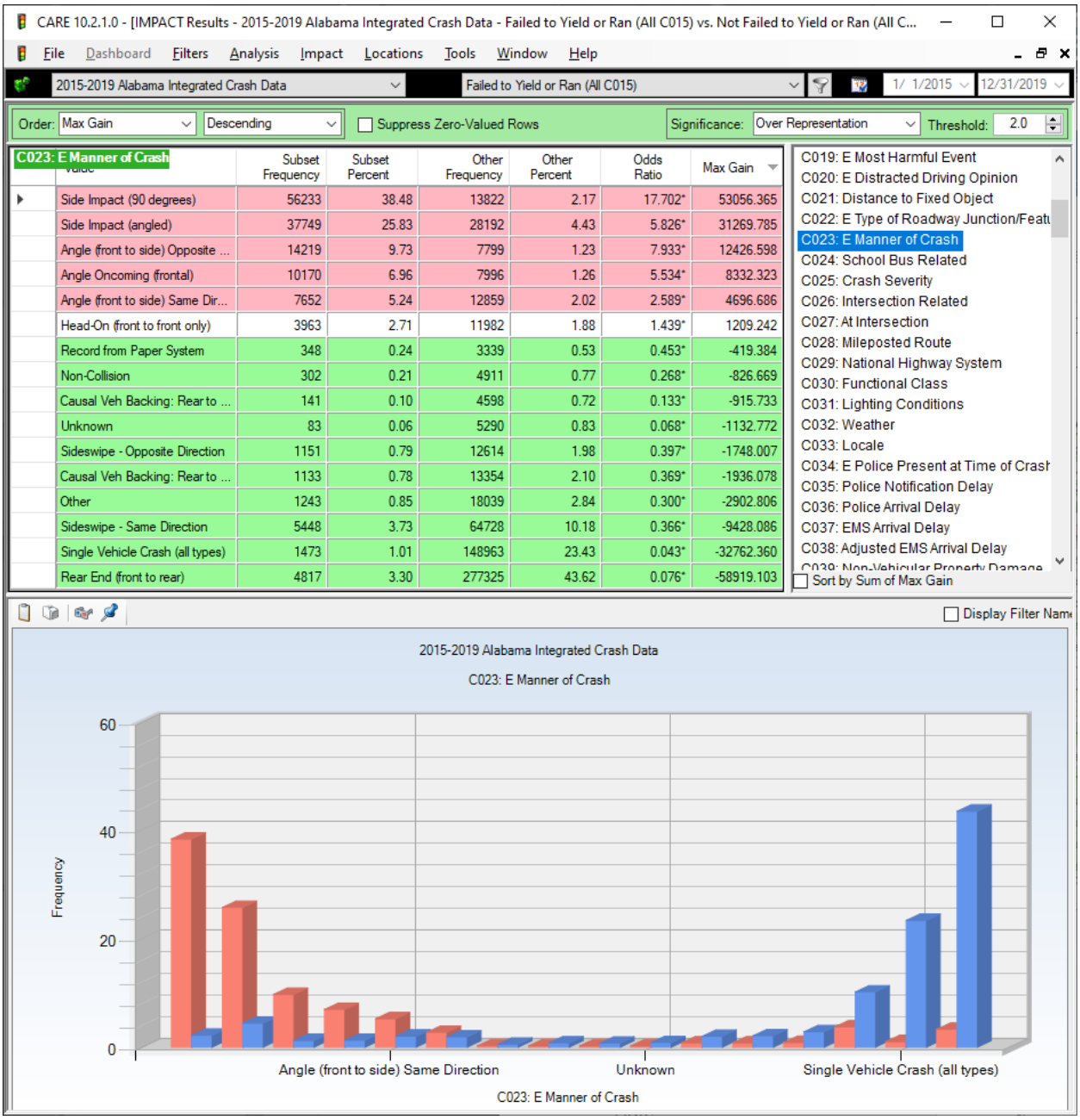
5. Driver IMPACT Displays – 17, 23, 52, 104, 107, 109, 115, 122-123, 204

C017 First Harmful Event

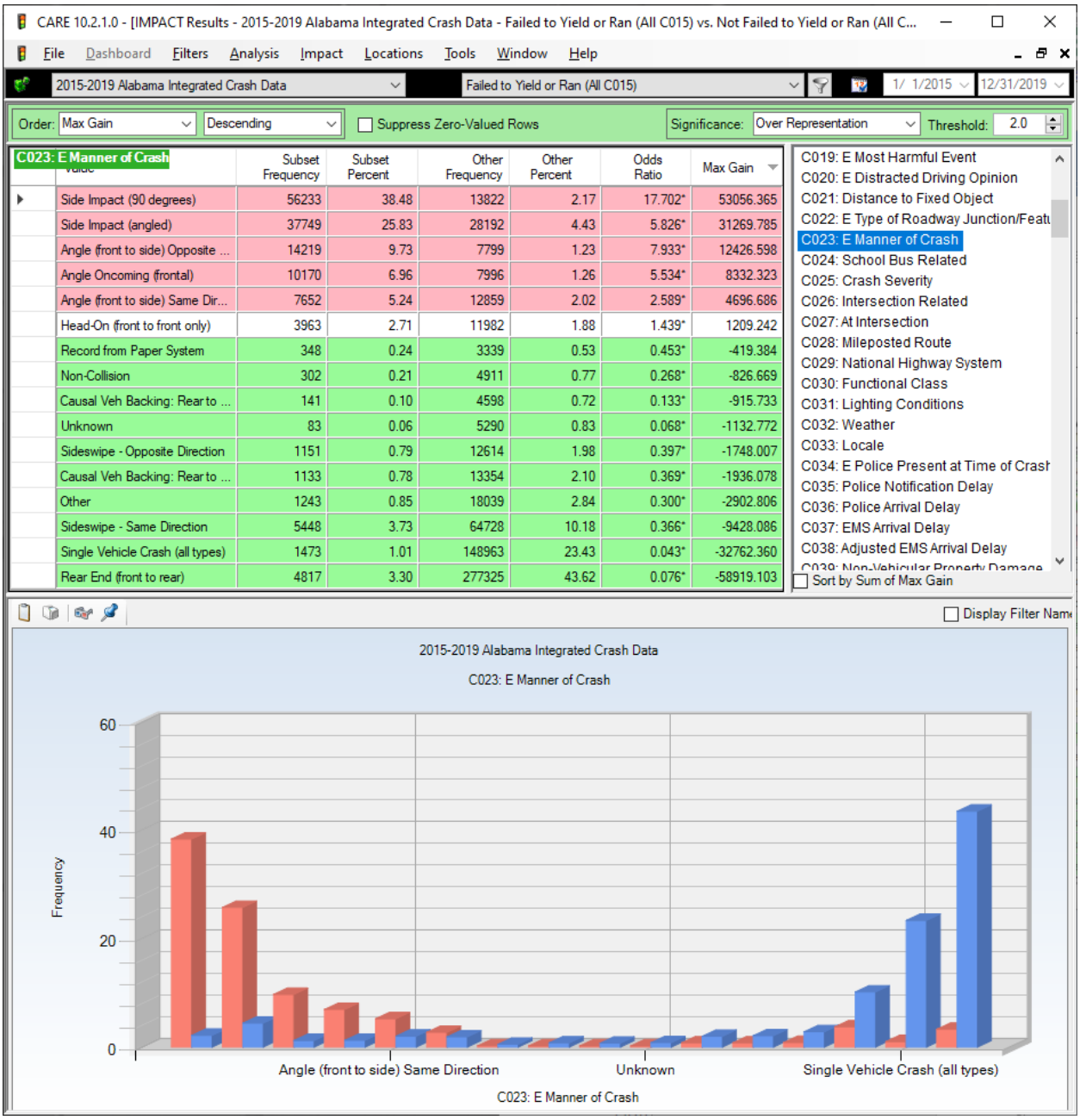
Removed: all items with less than 50 crashes in subset; also Motor Vehicle in Traffic (131,667 occurrences).



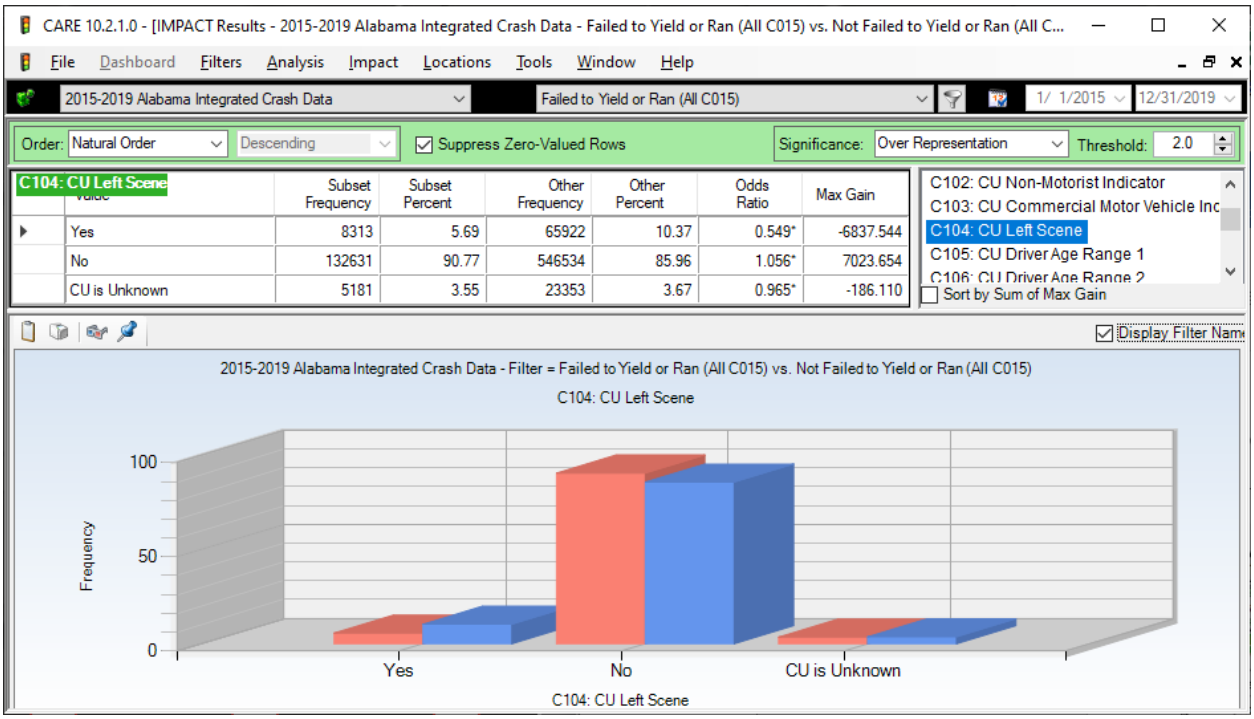
C023 E Manner of Crash



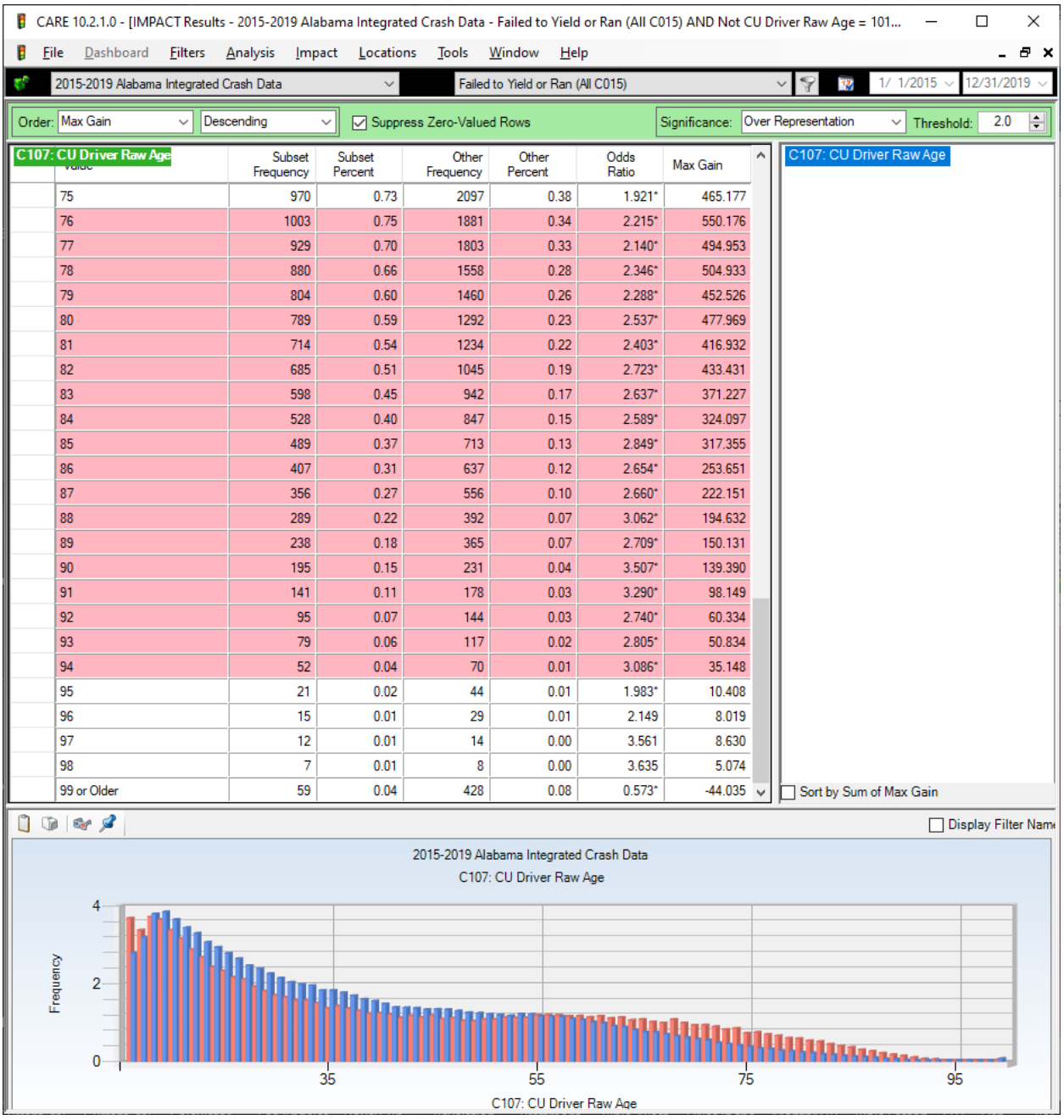
C052 Number of Vehicles



C104 CU Left Scene

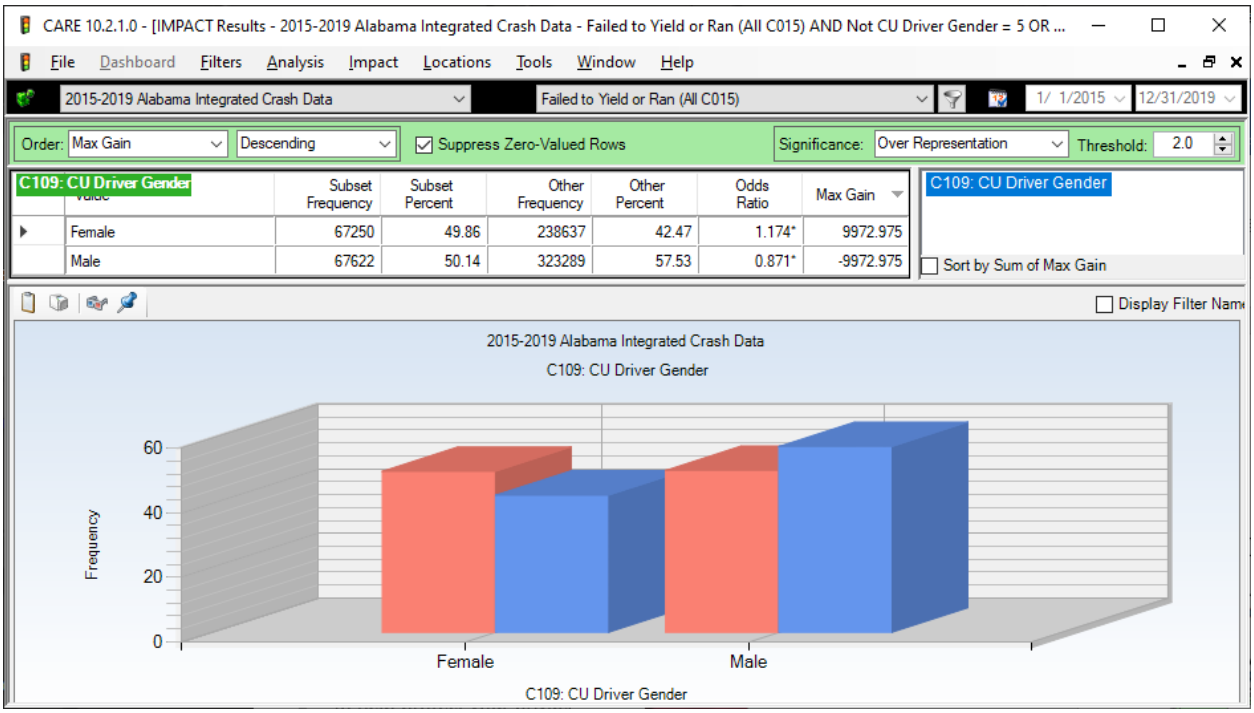


C107 CU Driver Raw Age



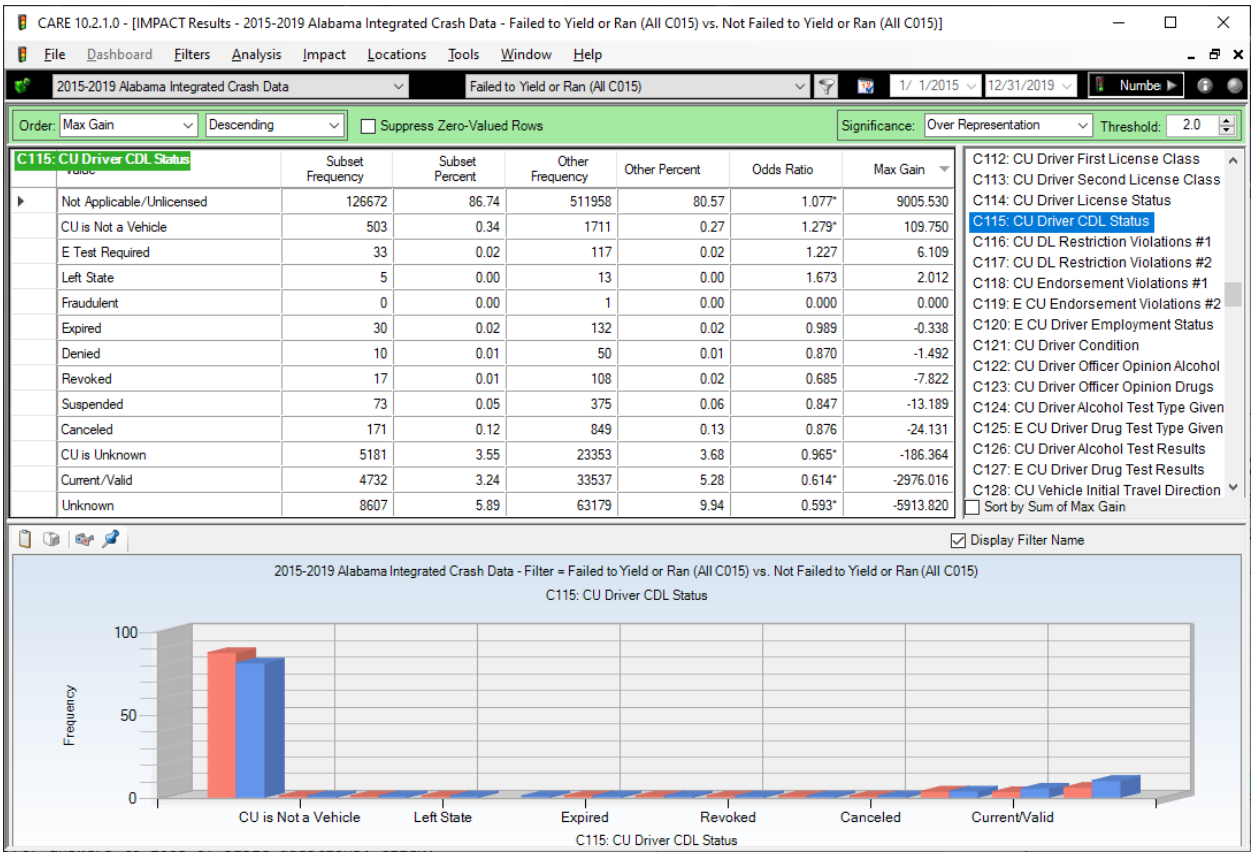
The youngest age group (16) is over-represented by about a third higher than would be expected from the non-FtY crash proportion. This drops down considerably in the 17 year olds and becomes under-represented in 18-54. Significant over-representations are in the ages 59 and above, and they increase to become over twice the expected in the ages 74 and above.

C109 CU Driver Gender

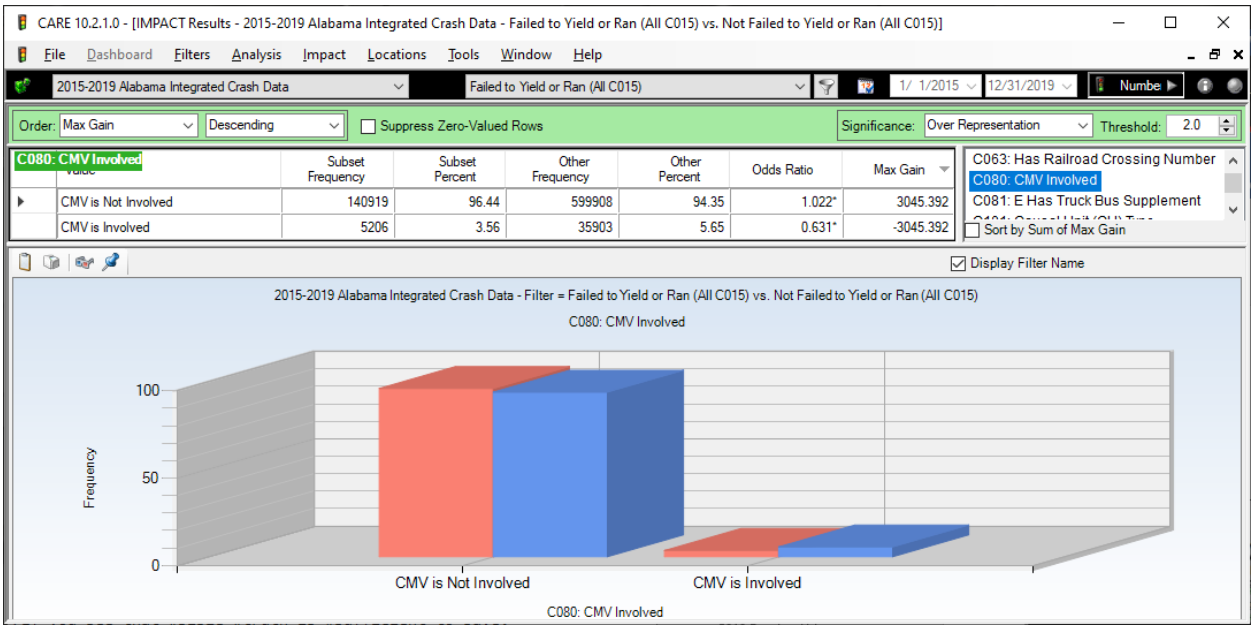


A cross-tabulation of age by gender was performed to determine in what age groups these gender differences show themselves. There is little difference in the16-20, which would tend to lead us to believe that this is a problem with inexperience as opposed to risk-taking. The largest difference of women over men was found to be in the 21-40 age groups, while men had significantly more FtY crashes in the age groups of 58 and above. The discrepancy of females in the 21-40-year-old age group could be due to their concentration of driving in urban areas compared to men. Such an explanation should not cause us to disregard this finding – rather, it should focus the necessity of countermeasures that concentrate on *women in the urban areas*.

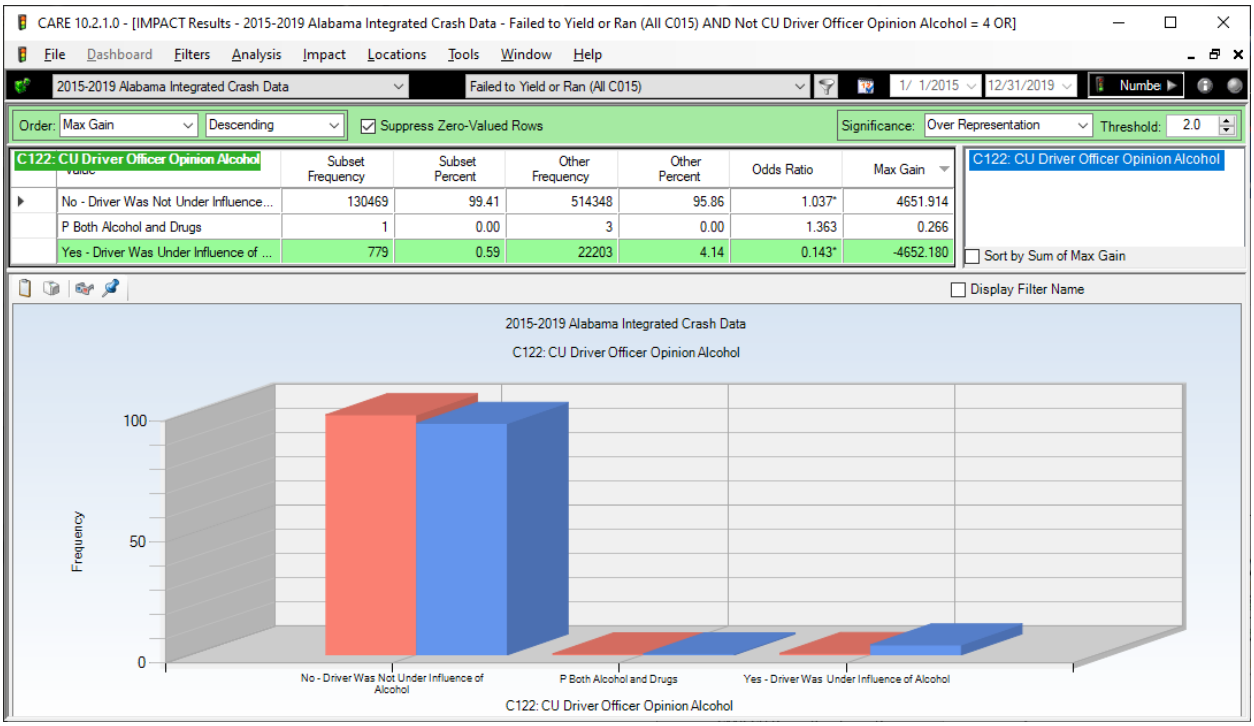
C115 CU Driver CDL Status



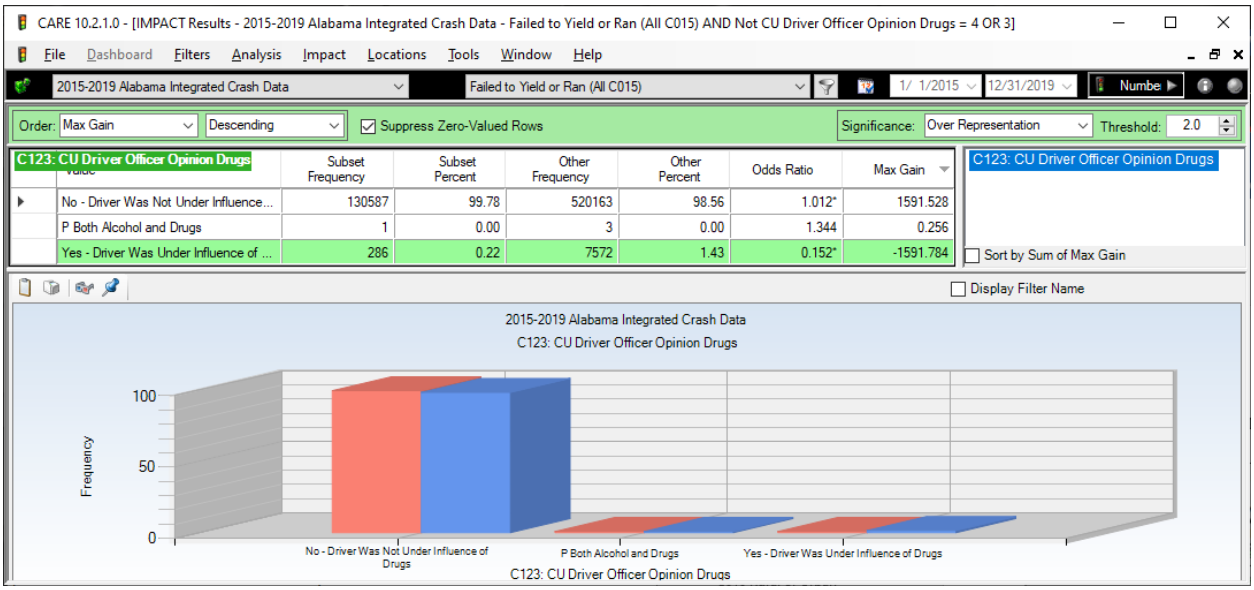
C080 CMV Involved



C122 CU Driver Officer Opinion Alcohol

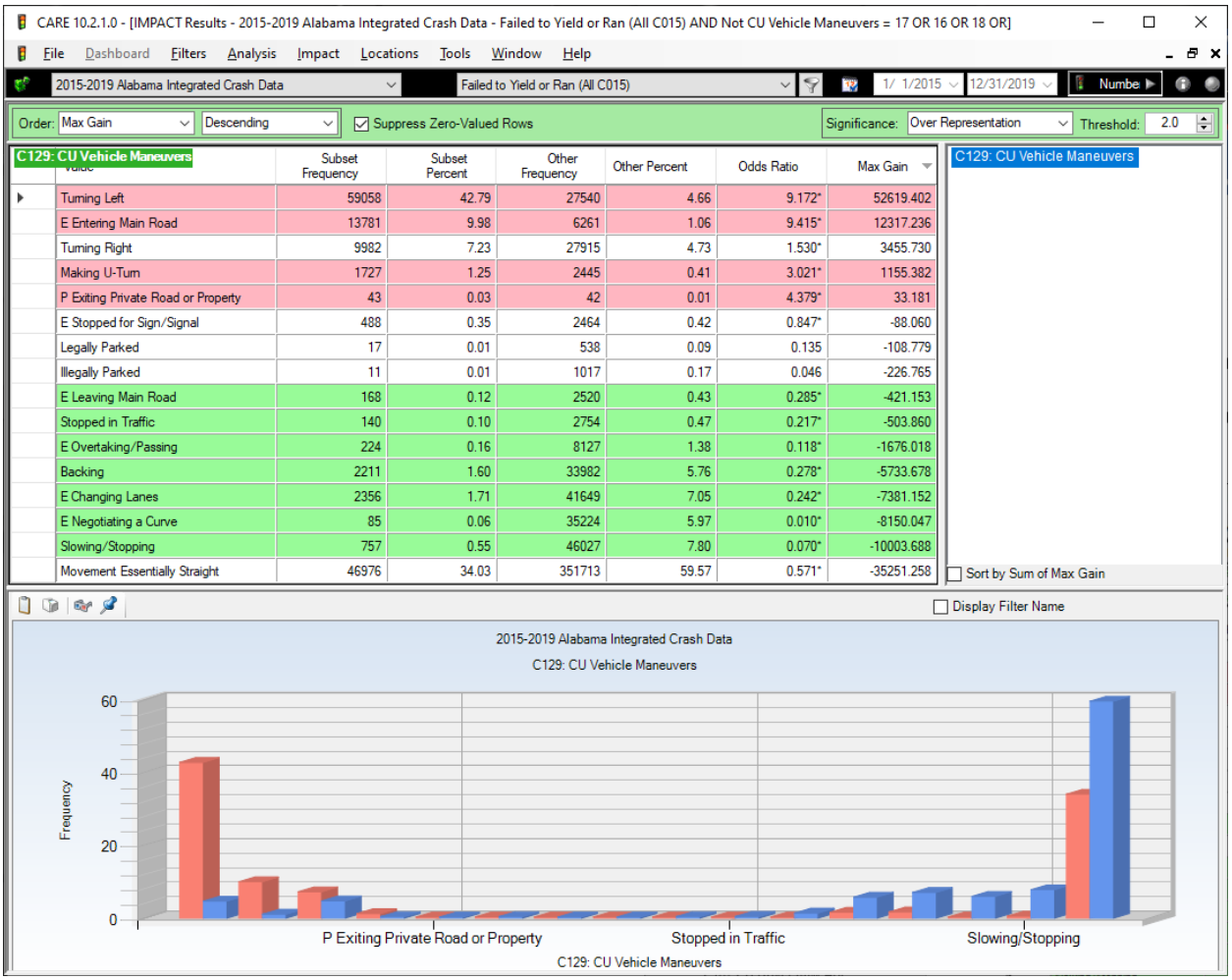


C123 CU Officer Opinion Drugs



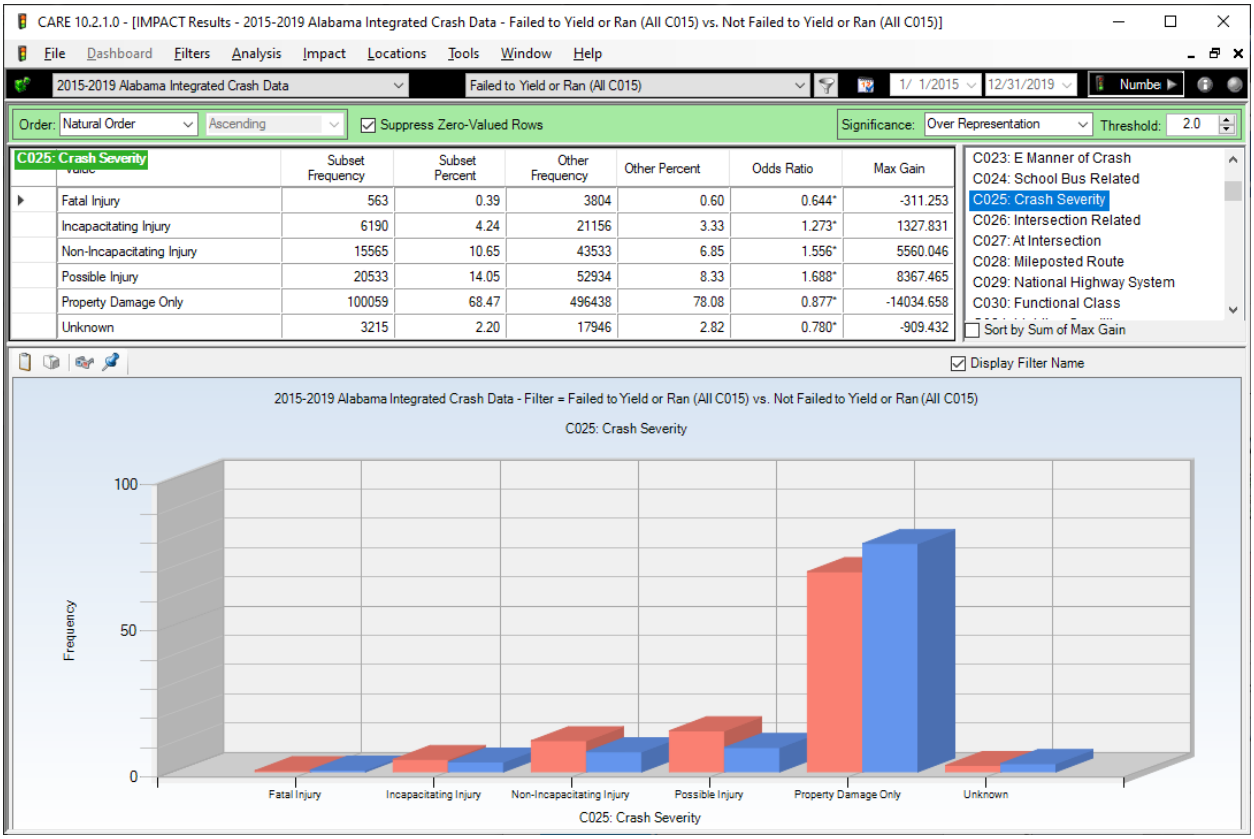
C129 CU Vehicle Maneuvers

The following was reduced by removing all of the cases in which there were zero or less than 10 FtY crashes recorded.

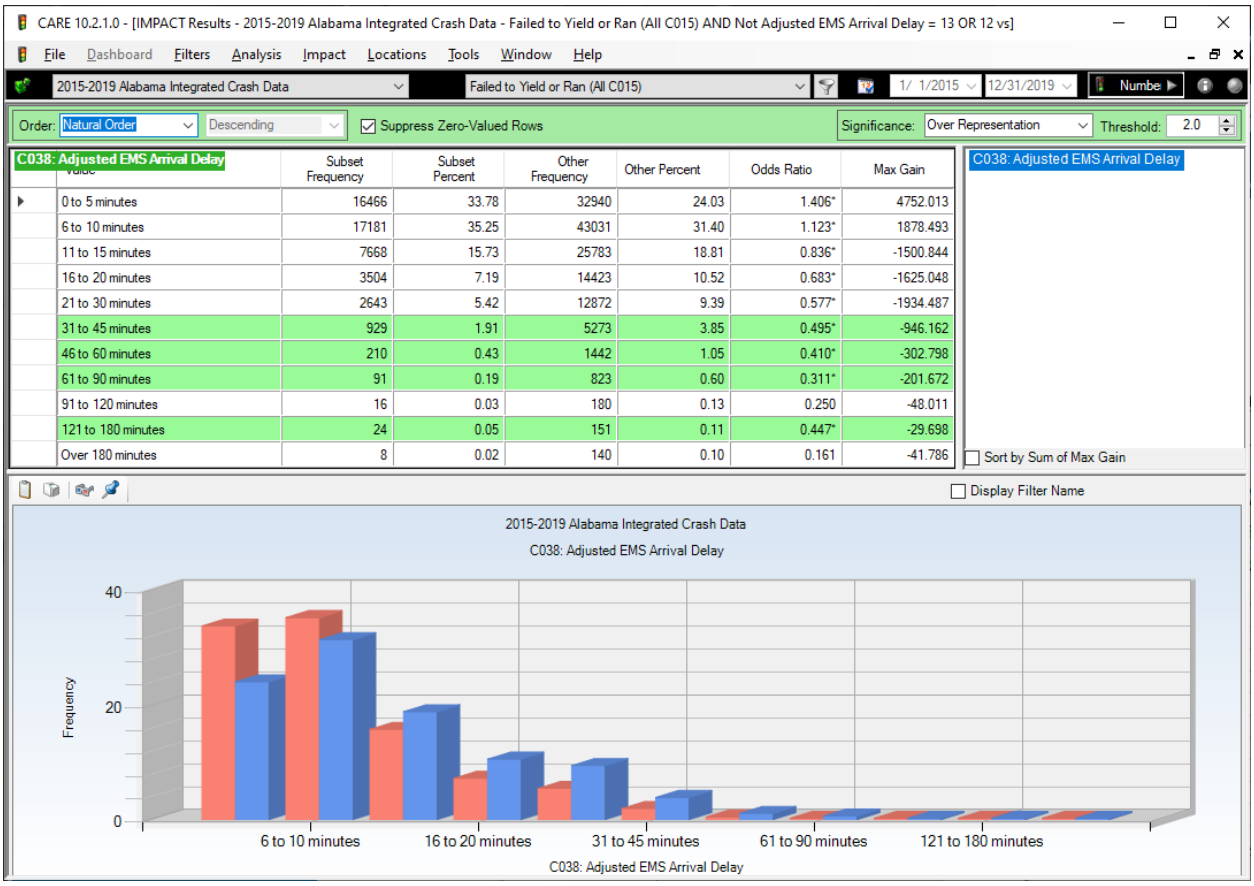


6. Severity IMPACT Displays – 25, 38, 60, 224

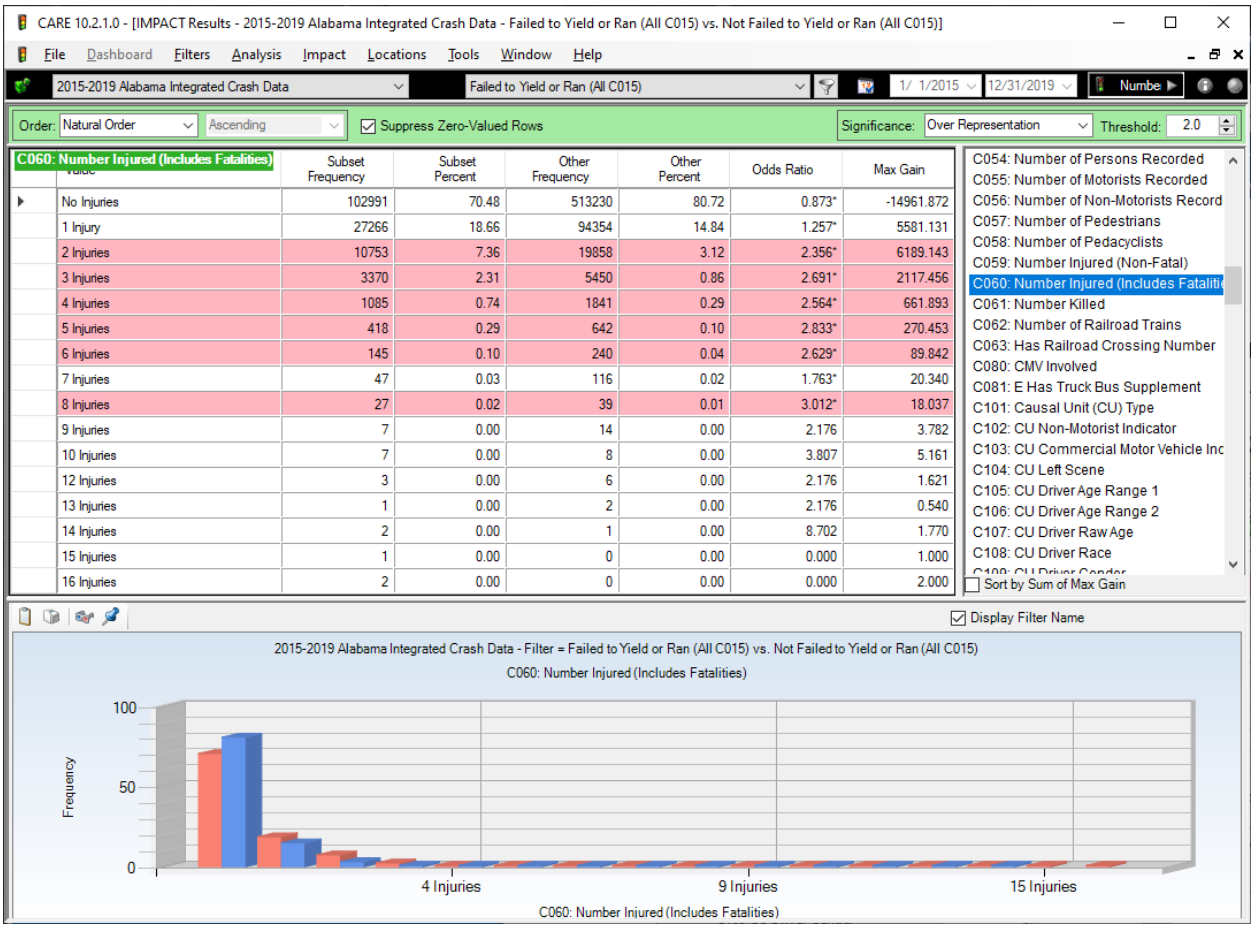
C025 Crash Severity



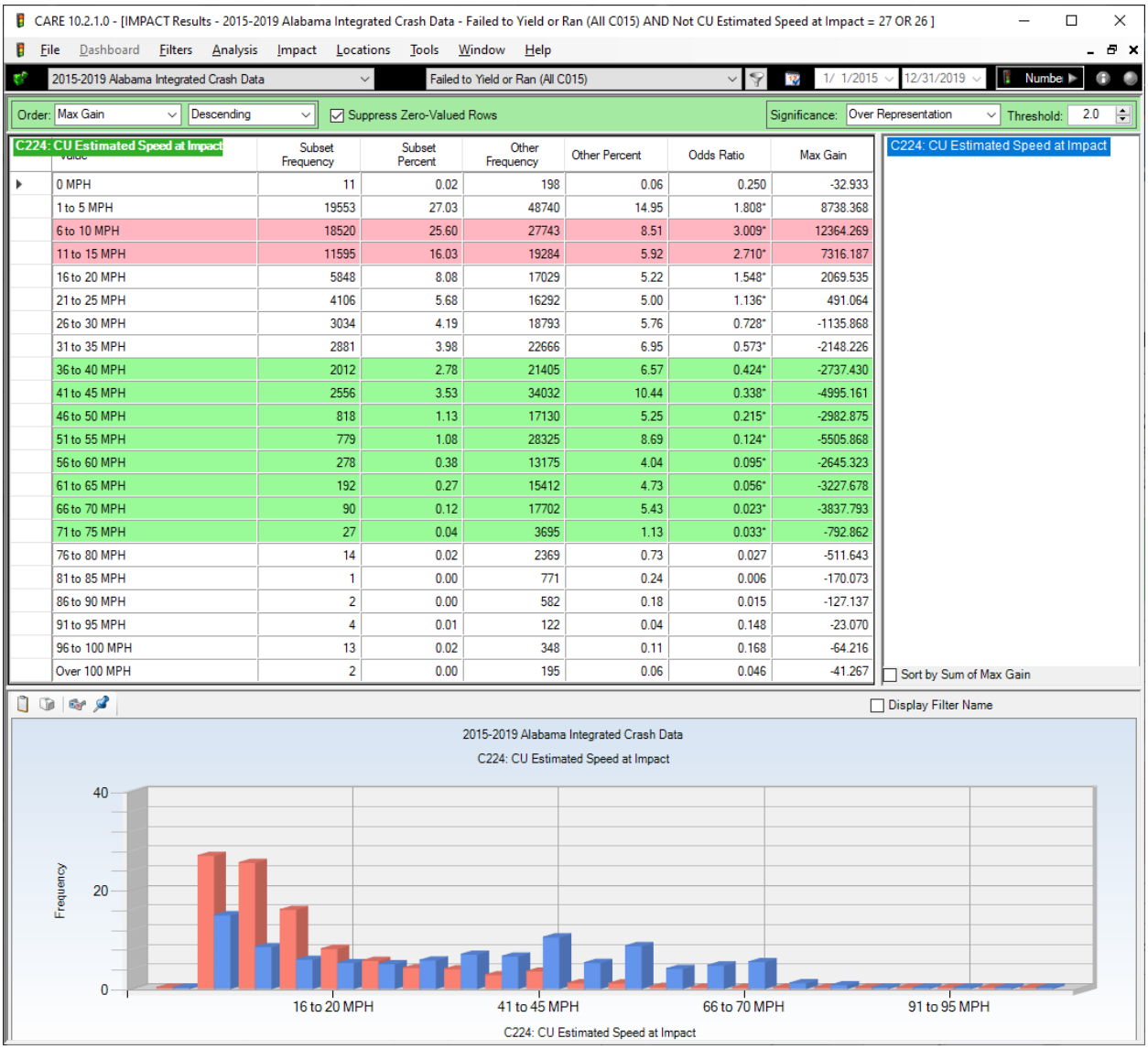
C038 Adjusted EMS Arrival Delay



C060 Number Injured (Including Fatalities)



C224 CU Estimated Speed at Impact

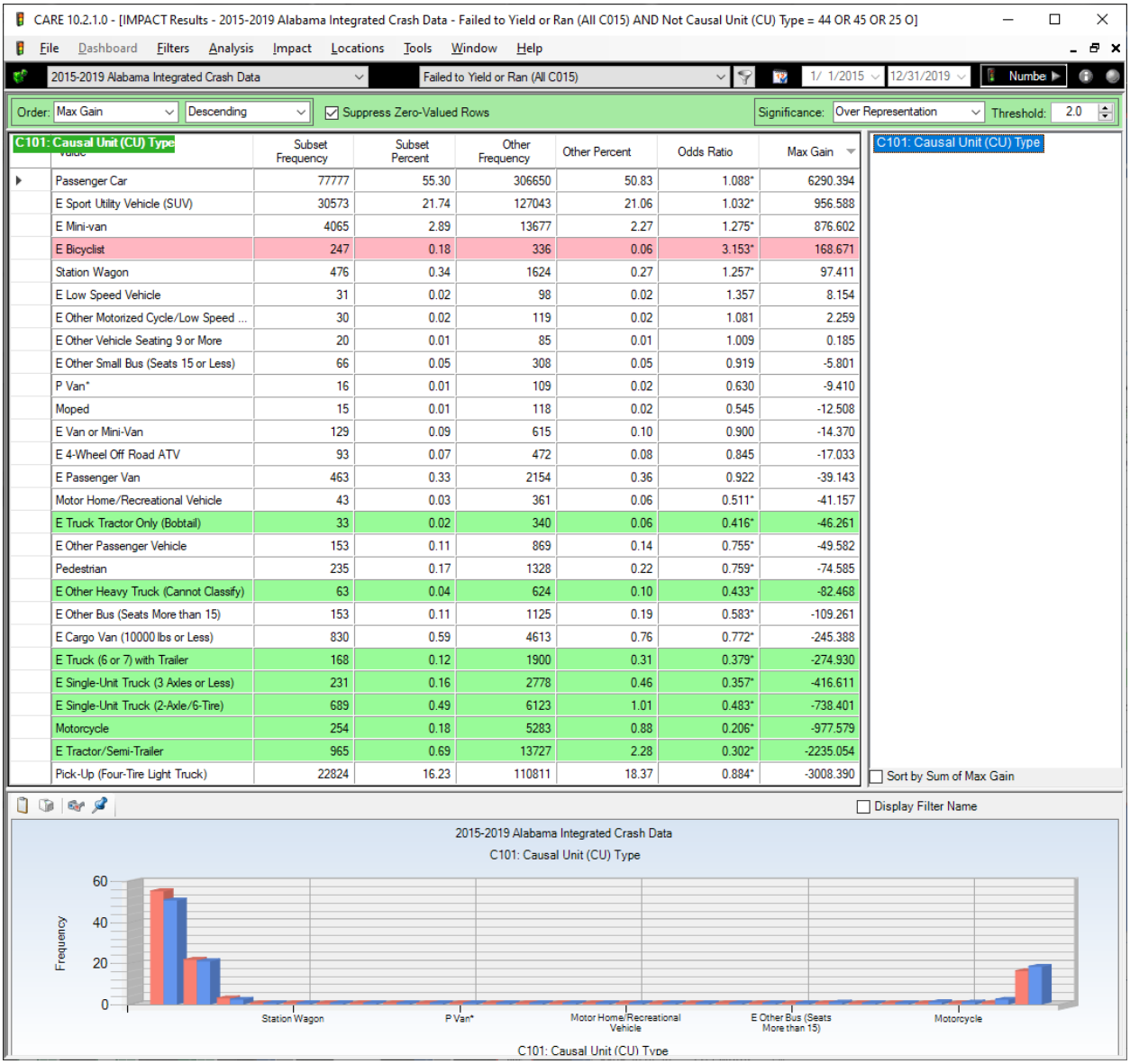


As would be expected (in all but the “Run” category), the speeds at impact are relatively low compared to their non-FtY counterparts.

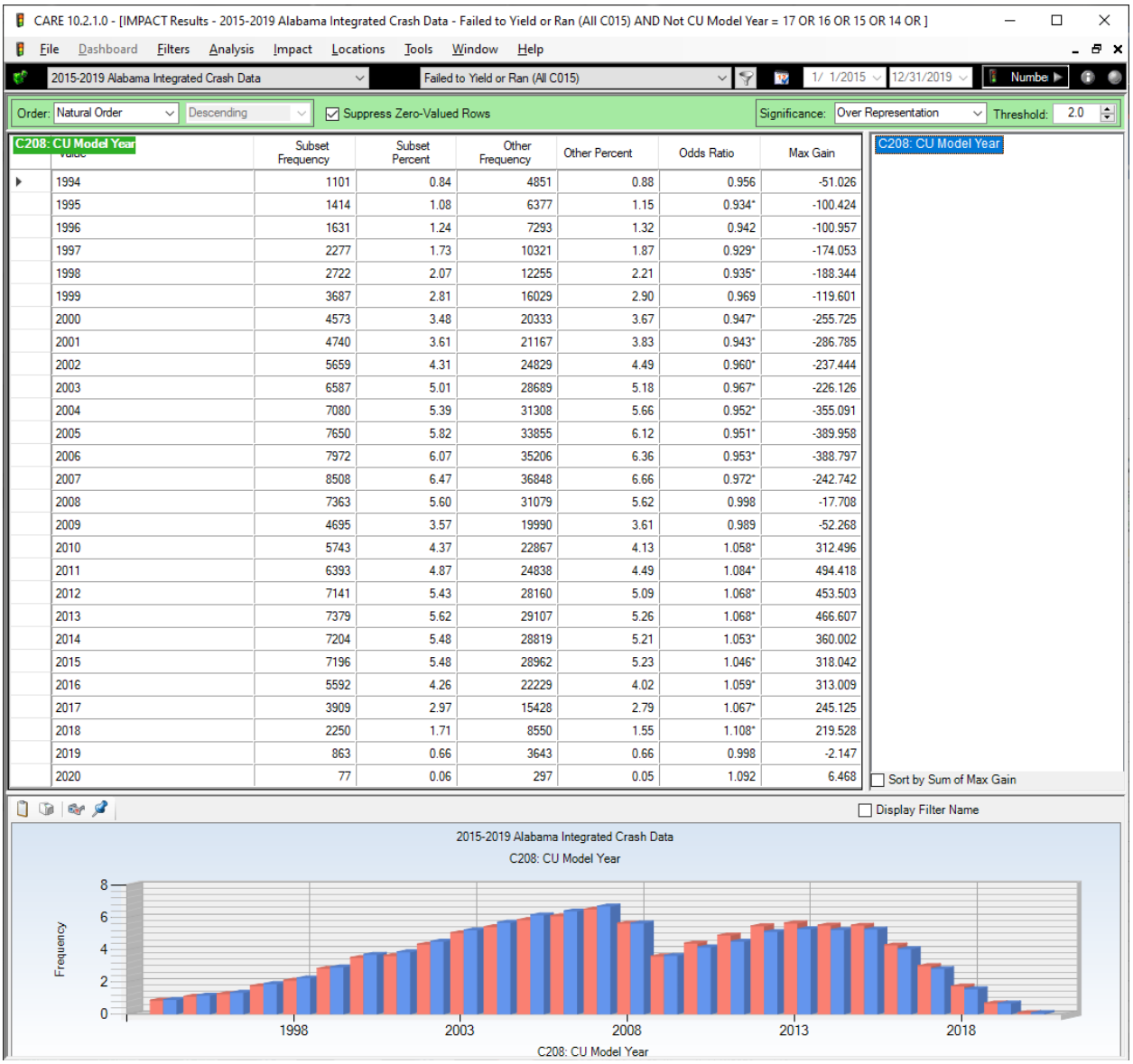
7. Vehicle IMPACT Displays – 80, 101, 129, 208

C101 Causal Unit (CU) Type

All items with less than 10 crashes in the subset were removed.



C208 CU Model Year

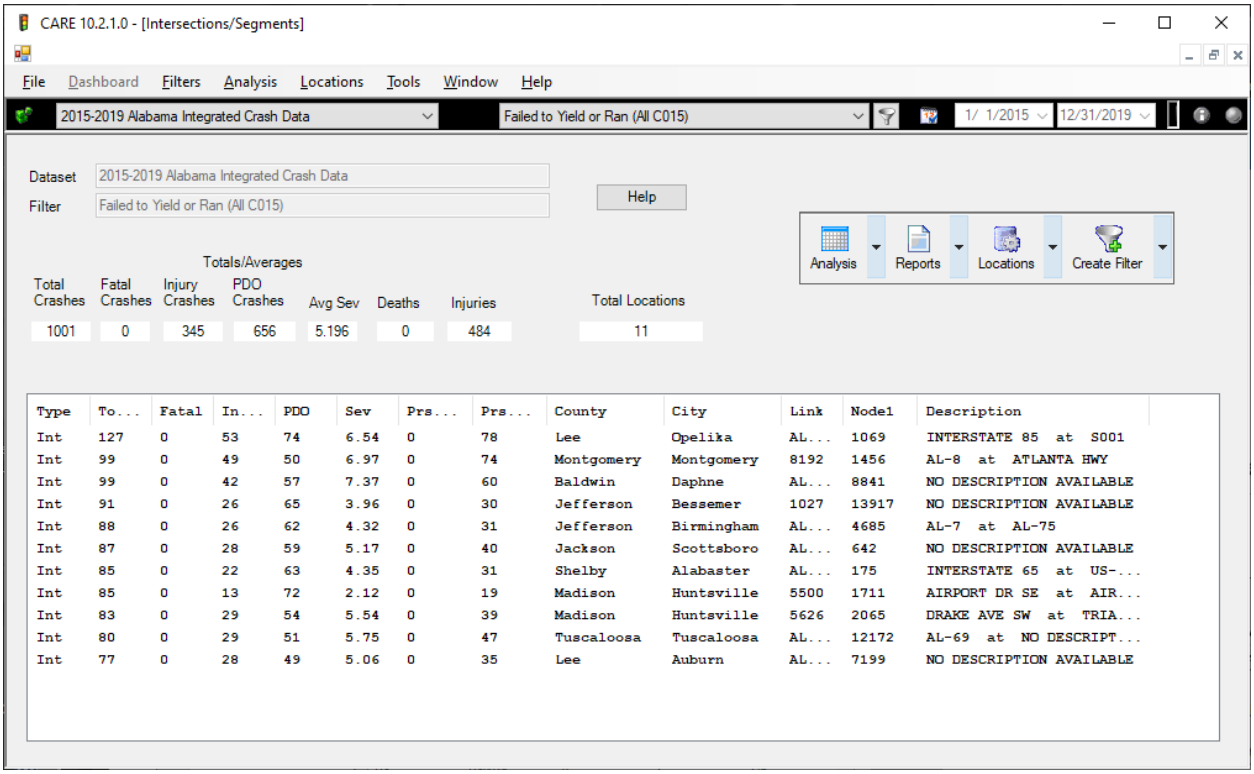


C208: CU Model Year	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1994	1101	0.84	4851	0.88	0.956	-51.026
1995	1414	1.08	6377	1.15	0.934*	-100.424
1996	1631	1.24	7293	1.32	0.942	-100.957
1997	2277	1.73	10321	1.87	0.929*	-174.053
1998	2722	2.07	12255	2.21	0.935*	-188.344
1999	3687	2.81	16029	2.90	0.969	-119.601
2000	4573	3.48	20333	3.67	0.947*	-255.725
2001	4740	3.61	21167	3.83	0.943*	-286.785
2002	5659	4.31	24829	4.49	0.960*	-237.444
2003	6587	5.01	28689	5.18	0.967*	-226.126
2004	7080	5.39	31308	5.66	0.952*	-355.091
2005	7650	5.82	33855	6.12	0.951*	-389.958
2006	7972	6.07	35206	6.36	0.953*	-388.797
2007	8508	6.47	36848	6.66	0.972*	-242.742
2008	7363	5.60	31079	5.62	0.998	-17.708
2009	4695	3.57	19990	3.61	0.989	-52.268
2010	5743	4.37	22867	4.13	1.058*	312.496
2011	6393	4.87	24838	4.49	1.084*	494.418
2012	7141	5.43	28160	5.09	1.068*	453.503
2013	7379	5.62	29107	5.26	1.068*	466.607
2014	7204	5.48	28819	5.21	1.053*	360.002
2015	7196	5.48	28962	5.23	1.046*	318.042
2016	5592	4.26	22229	4.02	1.059*	313.009
2017	3909	2.97	15428	2.79	1.067*	245.125
2018	2250	1.71	8550	1.55	1.108*	219.528
2019	863	0.66	3643	0.66	0.998	-2.147
2020	77	0.06	297	0.05	1.092	6.468

8. FtY Hotspot Analysis Examples

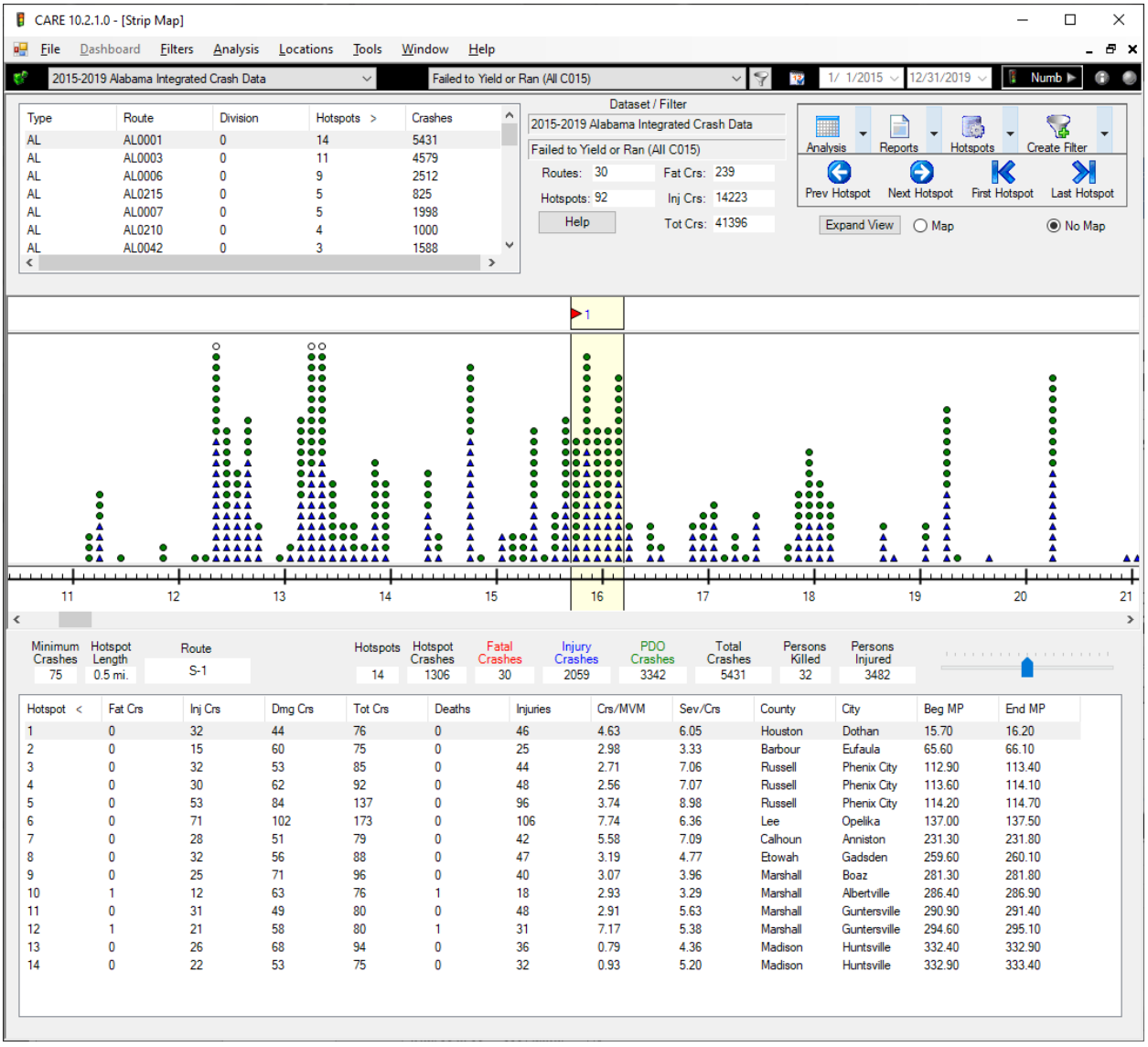
8.1 Example for Highest Intersections in the State

The criteria for this example is 70 FtY crashes at any intersection. There were 11 such hotspots found on 7 counties, for a total of 1,001 FtY crashes found on all road classifications. Of these none were fatal and 345 were non-fatal injury crashes, resulting in 484 injuries.



8.3 Example for Mileposted Roads: Minimum 75 FtY Crashes in 0.5 Miles

For all mileposted routes over the state, 30 routes met the minimum qualifications, with 92 hotspots. The total number of crashes for these hotspots were 41,396 crashes, of which 239 were fatal. Note how the problems occur at fixed intervals, indicating the presence of intersections or interchanges.



Type	Route	Division	Hotspots	Crashes
AL	AL0001	0	14	5431
AL	AL0003	0	11	4579
AL	AL0006	0	9	2512
AL	AL0215	0	5	825
AL	AL0007	0	5	1998
AL	AL0210	0	4	1000
AL	AL0042	0	3	1588

Hotspot	Fat Crs	Inj Crs	Dmg Crs	Tot Crs	Deaths	Injuries	Crs/MVM	Sev/Crs	County	City	Beg MP	End MP
1	0	32	44	76	0	46	4.63	6.05	Houston	Dothan	15.70	16.20
2	0	15	60	75	0	25	2.98	3.33	Barbour	Eufaula	65.60	66.10
3	0	32	53	85	0	44	2.71	7.06	Russell	Phenix City	112.90	113.40
4	0	30	62	92	0	48	2.56	7.07	Russell	Phenix City	113.60	114.10
5	0	53	84	137	0	96	3.74	8.98	Russell	Phenix City	114.20	114.70
6	0	71	102	173	0	106	7.74	6.36	Lee	Opelika	137.00	137.50
7	0	28	51	79	0	42	5.58	7.09	Calhoun	Anniston	231.30	231.80
8	0	32	56	88	0	47	3.19	4.77	Etowah	Gadsden	259.60	260.10
9	0	25	71	96	0	40	3.07	3.96	Marshall	Boaz	281.30	281.80
10	1	12	63	76	1	18	2.93	3.29	Marshall	Albertville	286.40	286.90
11	0	31	49	80	0	48	2.91	5.63	Marshall	Guntersville	290.90	291.40
12	1	21	58	80	1	31	7.17	5.38	Marshall	Guntersville	294.60	295.10
13	0	26	68	94	0	36	0.79	4.36	Madison	Huntsville	332.40	332.90
14	0	22	53	75	0	32	0.93	5.20	Madison	Huntsville	332.90	333.40