General Special Study of Large Truck (Including CMVs)

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Introduction

For ease of reference, the following gives the subjects covered in this document in the order of their occurrence (major section numbers).

1.0 Some high level statistics on CMVs to put the entire document in perspective.

2.0 Comparisons of CMV with Non-CMV Large Trucks, where Non-CMV are all large trucks that are not classified as CMVs. This section gives an idea of where each of these subsets is having their crash problems compared to the other.

3.0 All of the comparisons in this major section are crashes caused by CMVs (note filter name) against all other crashes (Non-CMVs), including cars, non-CMV large trucks and all other motor vehicles where a CMV was not the causal vehicle. The filter definition for this is given in S

4.0 See the five year comparison in Section 3.3. The results there indicate that 2019 had a significant increase over 2016-2018. It was determined to eliminate 2020 from this analysis because the effects of COVID would make it non-typical. This section compares CMV-Caused crashes in 2019 (test; red bars) against CMV-Caused crashes in 2016-2018 (control; blue bars) in an attempt to surface any significant differences that may have caused the increase in 2019.

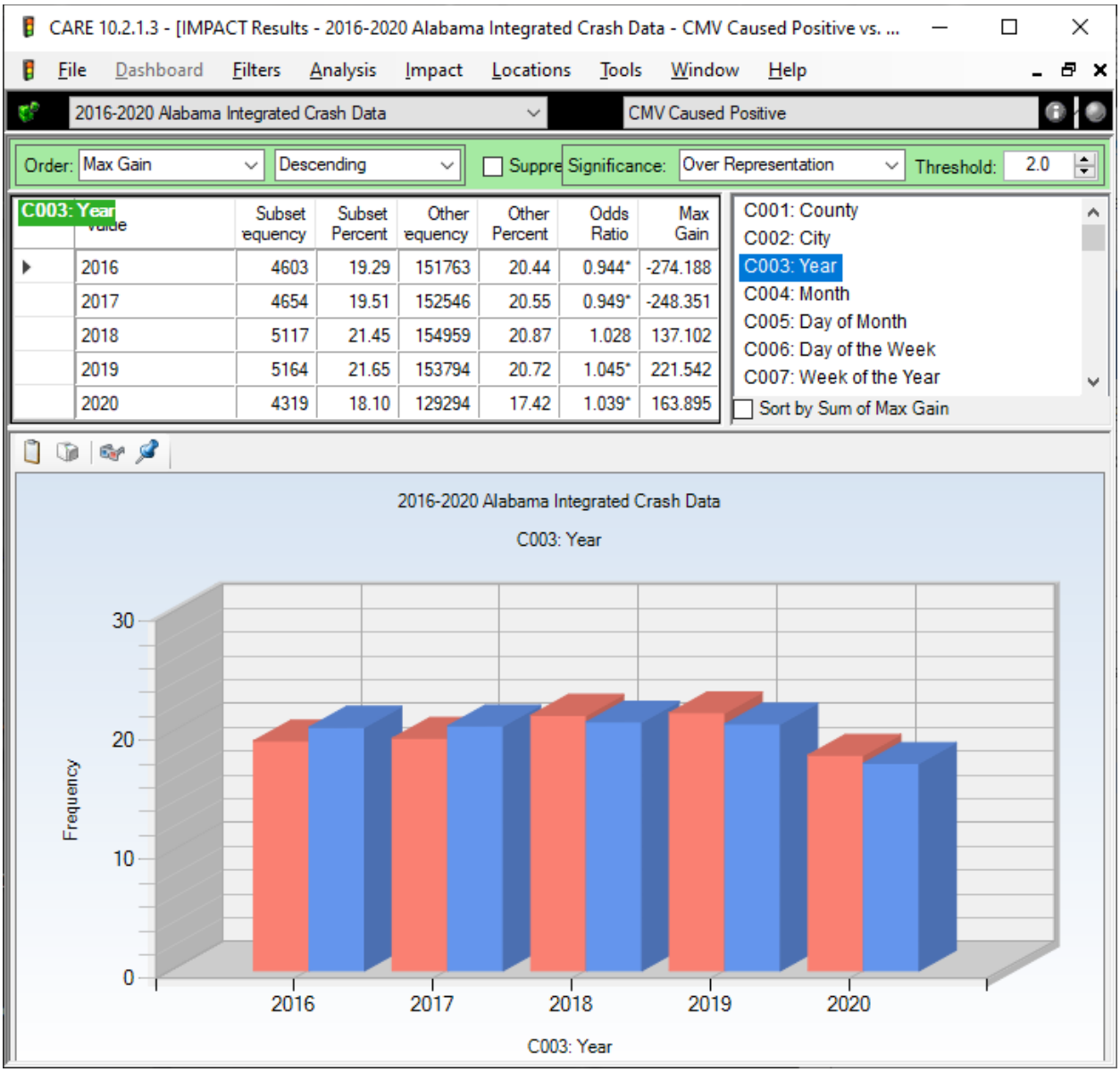
5.0 This section concentrated on the largest issue that was found in at least four attributes, and that was Improper Lane Change (ILC). ILC in these four closely-related attributes were ORed together to form the test subset. The control subset was all CMV Caused crashes. See Section 5.0 for details of filter creation.

6.0 This is a preliminary set of requirements that illustrate how the Selective Enforcement Assistant (SEA) is envisioned to operate. This is a first step in the creation of these requirements.

1.0 CMV and Non-CMV Large Truck Crashes General Comparisons

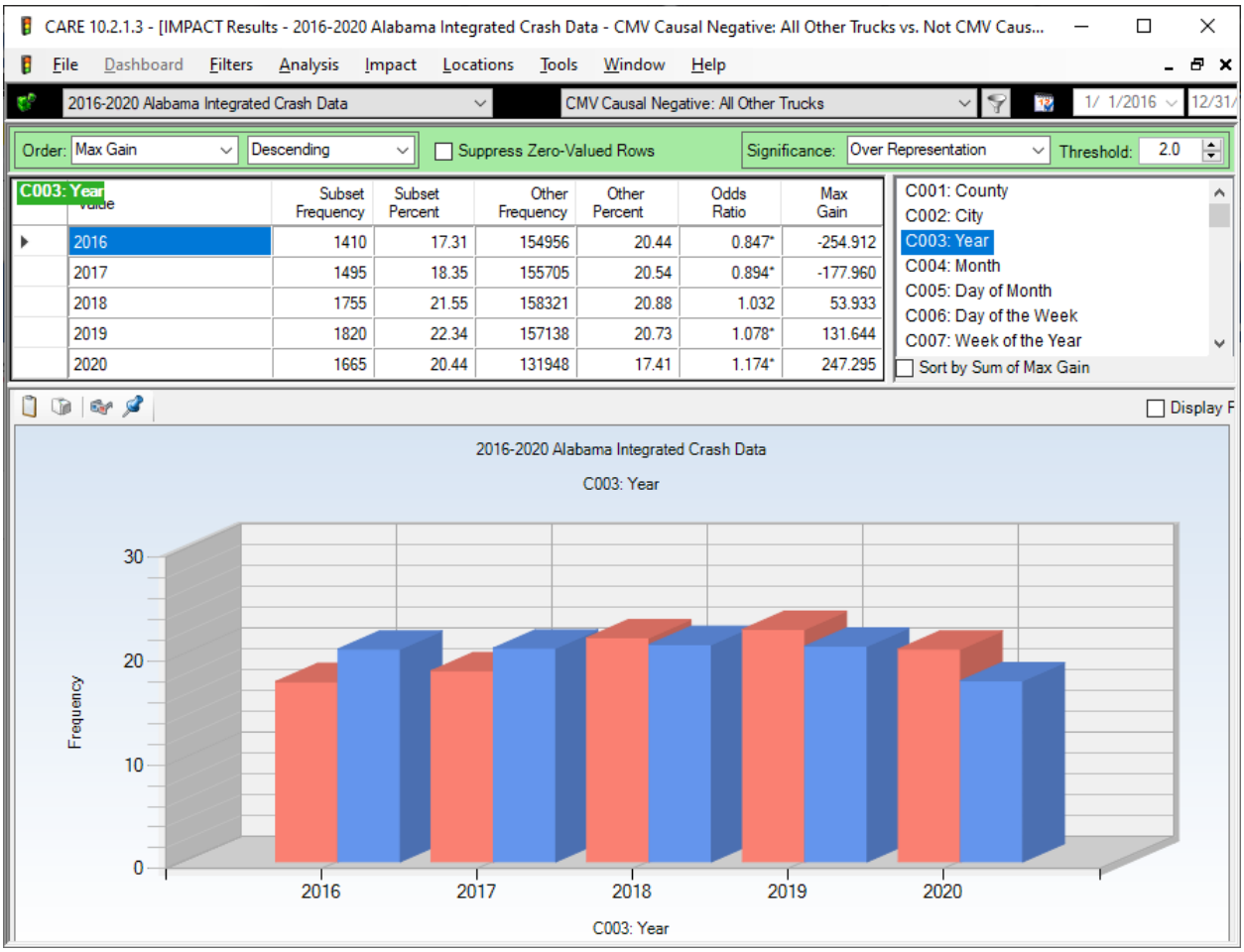
1.1 CMV vs All Other Crashes Per Year

Comparing CMV crashes (red) against all other crashes (blue).



CMV crash frequencies were over-represented in years 2018-2020 compared to non-CMV. The total Max Gain for these three years is 523 crashes. The severity of these crashes was generally lower than those of 2016 and 2017.

1.2 Non-CMV Large Truck Crashes by Year



Large truck crashes of non-CMV trucks were also significantly higher in 2019 and 2020. They were also over-represented in 2018, but not of statistical significance. Combining these three years as we did above for CMVs indicates an additional 433 crashes over that which would be expected compared to all other crashes.

1.3 CMV Crashes Top Primary Contributing Circumstances (PCC)

All items less than 200 crashes during the 5-year period were omitted from the display below. Comparisons are between all CMV and all non-CMV involved vehicles.

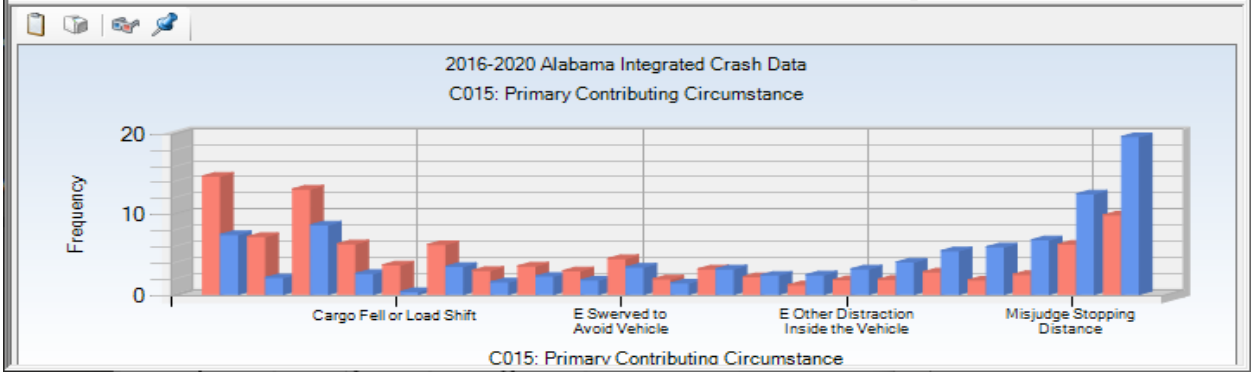
2016-2020 Alabama Integrated Crash Data — CMV Caused Positive

Order: Max Gain — Descending — Suppre — Significance: Over Representation — Threshold: 2.0

C015: Primary Contributing Circumstance	Subset equency	Subset Percent	Other equency	Other Percent	Odds Ratio	Max Gain
Improper Lane Change/Use	2846	14.69	39324	7.43	1.976*	1405....
Defective Equipment	1389	7.17	10889	2.06	3.483*	990.237
Unseen Object/Person/Vehicle	2535	13.09	45645	8.63	1.517*	863.448
Made Improper Turn	1214	6.27	13573	2.57	2.442*	716.947
Cargo Fell or Load Shift	707	3.65	1784	0.34	10.822*	641.669
Improper Backing	1199	6.19	18342	3.47	1.785*	527.303
E Other - No Improper Driving	576	2.97	7986	1.51	1.970*	283.547
E Other Improper Action	681	3.52	11864	2.24	1.567*	246.532
E Crossed Centerline	567	2.93	9387	1.77	1.649*	223.241
E Swerved to Avoid Vehicle	861	4.44	17767	3.36	1.323*	210.360
E Over Correcting/Over Steering	369	1.90	7373	1.39	1.367*	98.996
E Ran off Road	610	3.15	16672	3.15	0.999	-0.540
E Fatigued/Asleep	423	2.18	12587	2.38	0.918	-37.945
E Other Distraction Outside the Ve...	221	1.14	12824	2.42	0.471*	-248.6...
E Other Distraction Inside the Vehi...	347	1.79	16654	3.15	0.569*	-262.8...
E Ran Traffic Signal	357	1.84	21112	3.99	0.462*	-416.1...
Driving too Fast for Conditions	537	2.77	28603	5.41	0.513*	-510.4...
E Failed to Yield Right-of-Way Ma...	343	1.77	31083	5.88	0.301*	-795.2...
E Failed to Yield Right-of-Way from...	478	2.47	35782	6.76	0.365*	-832.3...
Misjudge Stopping Distance	1204	6.22	66020	12.48	0.498*	-1213....
Followed too Close	1907	9.84	103692	19.60	0.502*	-1890....

C015: Primary Contributing Circu

Sort by Sum of Max Gain

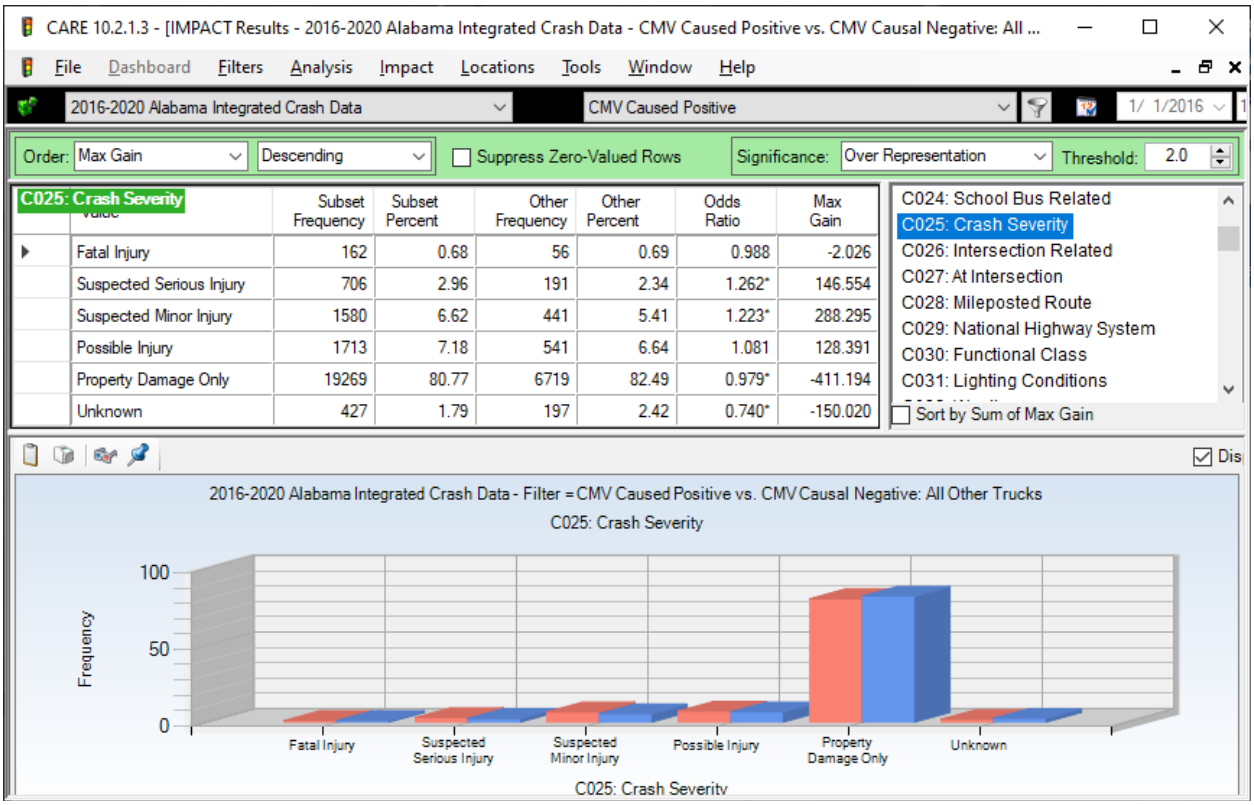


The significantly over-represented items that could be attributed to driver faults are (in order of over-representation as measured by Max Gain): Improper Lane Change/Use, Defective Equipment, Made Improper Turn, Cargo Fell or Load Shift, Improper Backing, Crossed Centerline, Swerved to Avoid Vehicle and Over Correcting/Over Steering.

2.0 CMV vs Non-CMV Large Trucks

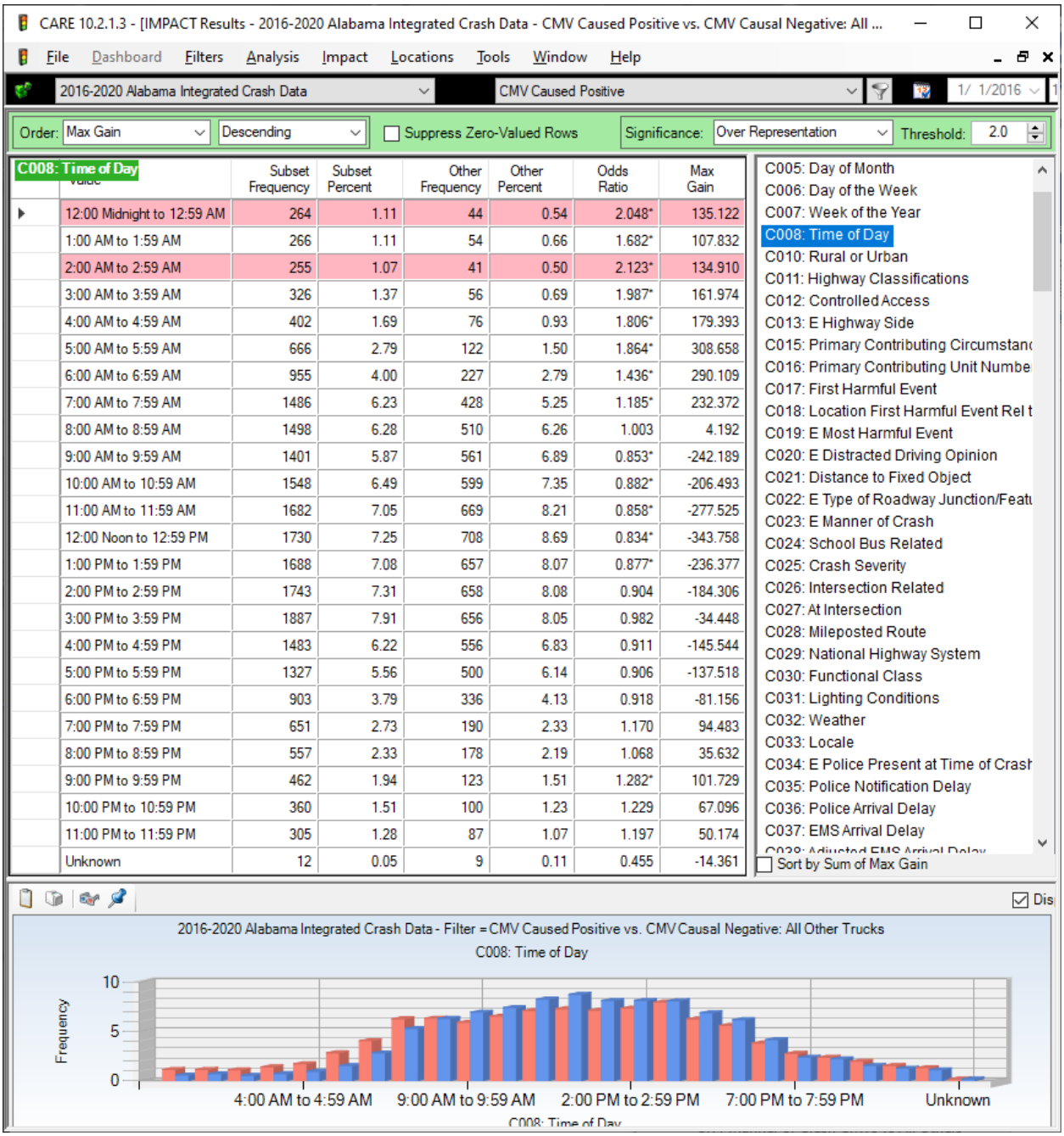
Comparisons above were against all other vehicles. Comparisons in this section will be against the two types of trucks: CMV and non-CMV (both large trucks). The total number of CMVs in the samples being compared were about three times the Non-CMV Large Trucks. The following will be compared in this major section: (1) Severity, (2) Time of Day, (3) Rural/Urban, (4) Highway Classifications, (5) First Harmful Event and (6) Manner of Crash.

2.1 Severity CMV vs Non-CMV Large Trucks



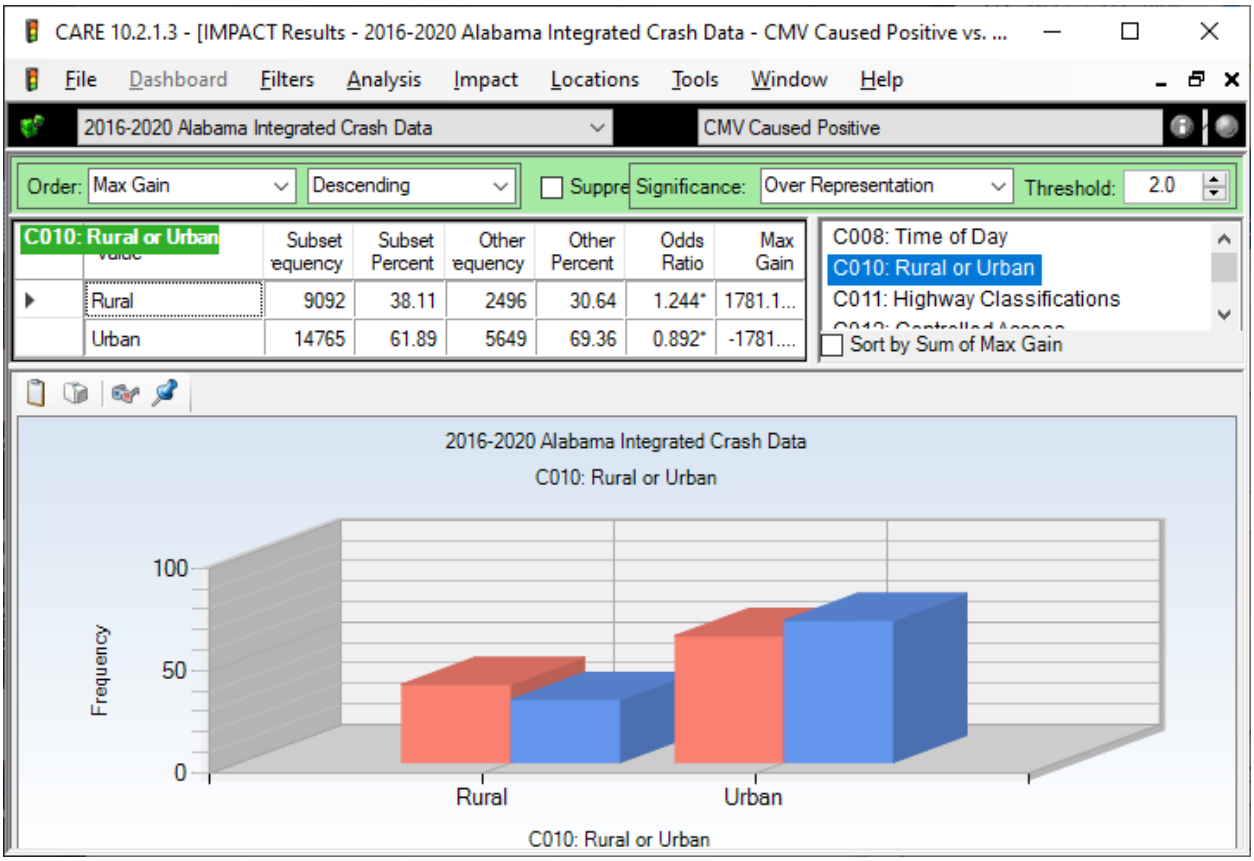
CMV and Non-CMV vehicles had a nearly-identical proportion of Fatal Injury crashes. However, the next highest serious severities were clearly over-represented by the CMVs. The only cause that was postulated for this is that the CMVs were generally in service over a greater period of time leading to greater exposure.

2.2 Time of Day CMV vs Non-CMV Large Trucks



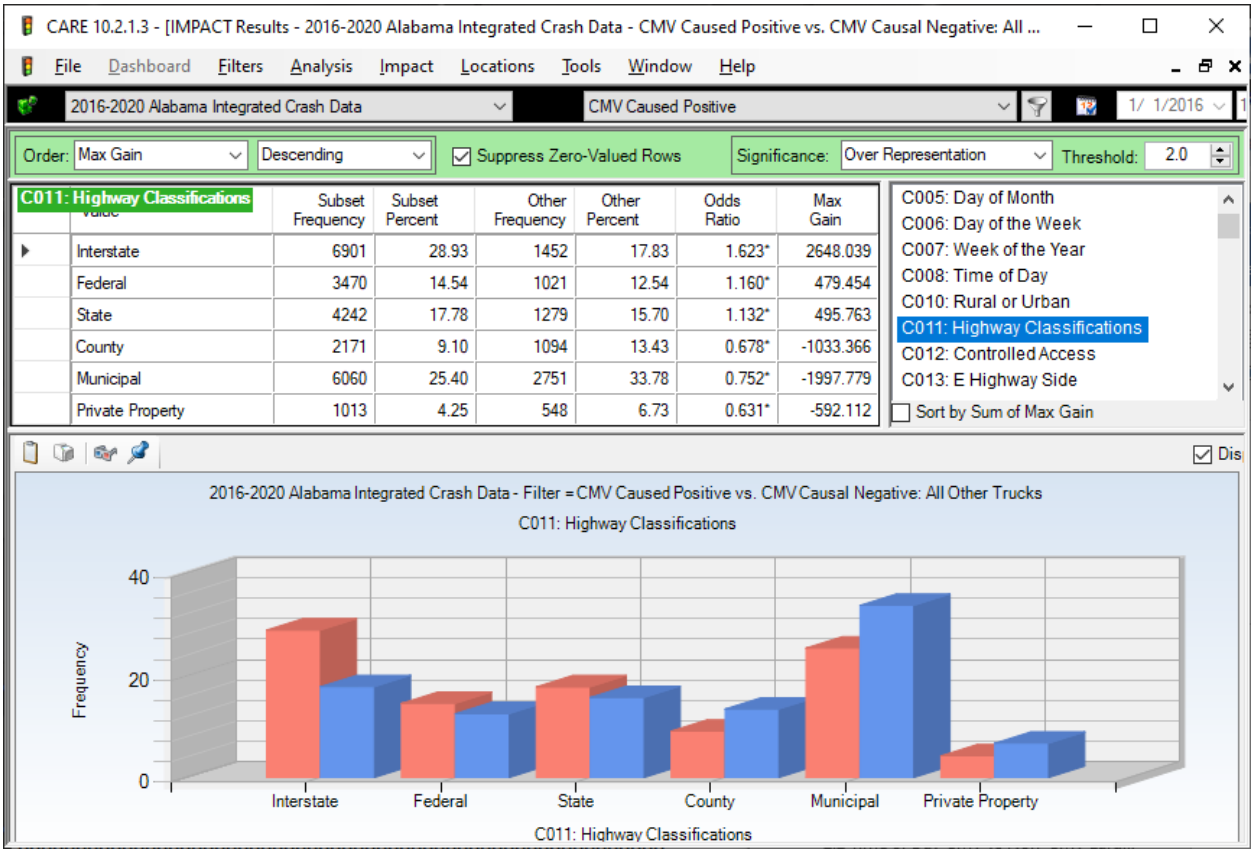
CMVs are working the early-morning hours more at twice their non-CMV counterparts for mid-night to 12:59 AM an 2:00 AM to 2:59 AM. Several of the other Odds Ratios are very close to 2 in the very early morning, indicating some cause.

2.3 Rural-Urban CMV vs Non-CMV Large Trucks



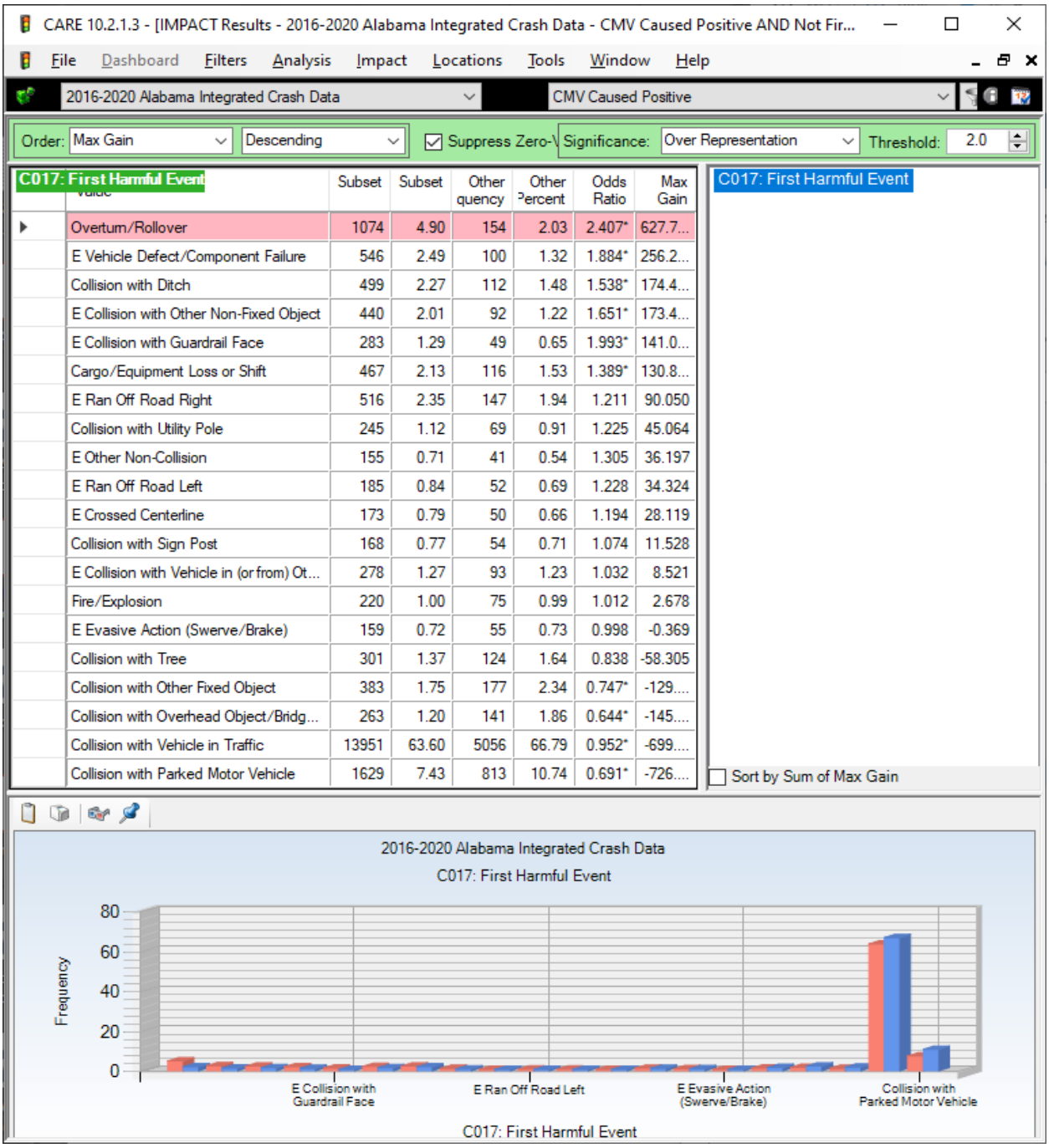
CMVs have a greater proportion of crashes in the rural areas probably because they spend more of their time on the Interstates. This is shown by the next attribute as well.

2.4 Highway Classification; CMV vs Non-CMV



Interstate highways have about 62.3% greater proportion of CMV than non-CMV traffic. CMVs are also over-represented on Federal and State Roads with 0.160 and 1.132 greater than expected, respectively (see Odds Ratios).

2.5 First Harmful Event CMV vs Non-CMV Large Trucks



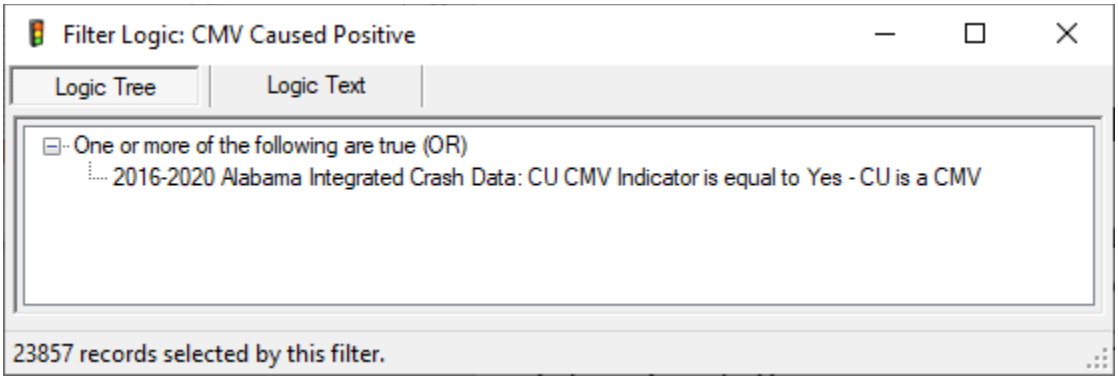
C017: First Harmful Event	Subset	Subset	Other quency	Other Percent	Odds Ratio	Max Gain
Overturn/Rollover	1074	4.90	154	2.03	2.407*	627.7...
E Vehicle Defect/Component Failure	546	2.49	100	1.32	1.884*	256.2...
Collision with Ditch	499	2.27	112	1.48	1.538*	174.4...
E Collision with Other Non-Fixed Object	440	2.01	92	1.22	1.651*	173.4...
E Collision with Guardrail Face	283	1.29	49	0.65	1.993*	141.0...
Cargo/Equipment Loss or Shift	467	2.13	116	1.53	1.389*	130.8...
E Ran Off Road Right	516	2.35	147	1.94	1.211	90.050
Collision with Utility Pole	245	1.12	69	0.91	1.225	45.064
E Other Non-Collision	155	0.71	41	0.54	1.305	36.197
E Ran Off Road Left	185	0.84	52	0.69	1.228	34.324
E Crossed Centerline	173	0.79	50	0.66	1.194	28.119
Collision with Sign Post	168	0.77	54	0.71	1.074	11.528
E Collision with Vehicle in (or from) Ot...	278	1.27	93	1.23	1.032	8.521
Fire/Explosion	220	1.00	75	0.99	1.012	2.678
E Evasive Action (Swerve/Brake)	159	0.72	55	0.73	0.998	-0.369
Collision with Tree	301	1.37	124	1.64	0.838	-58.305
Collision with Other Fixed Object	383	1.75	177	2.34	0.747*	-129....
Collision with Overhead Object/Bridg...	263	1.20	141	1.86	0.644*	-145....
Collision with Vehicle in Traffic	13951	63.60	5056	66.79	0.952*	-699....
Collision with Parked Motor Vehicle	1629	7.43	813	10.74	0.691*	-726....

Considerable differences between CMVs and non-CMVs in first 10 items.

3.0 CMVs vs All Other Vehicles

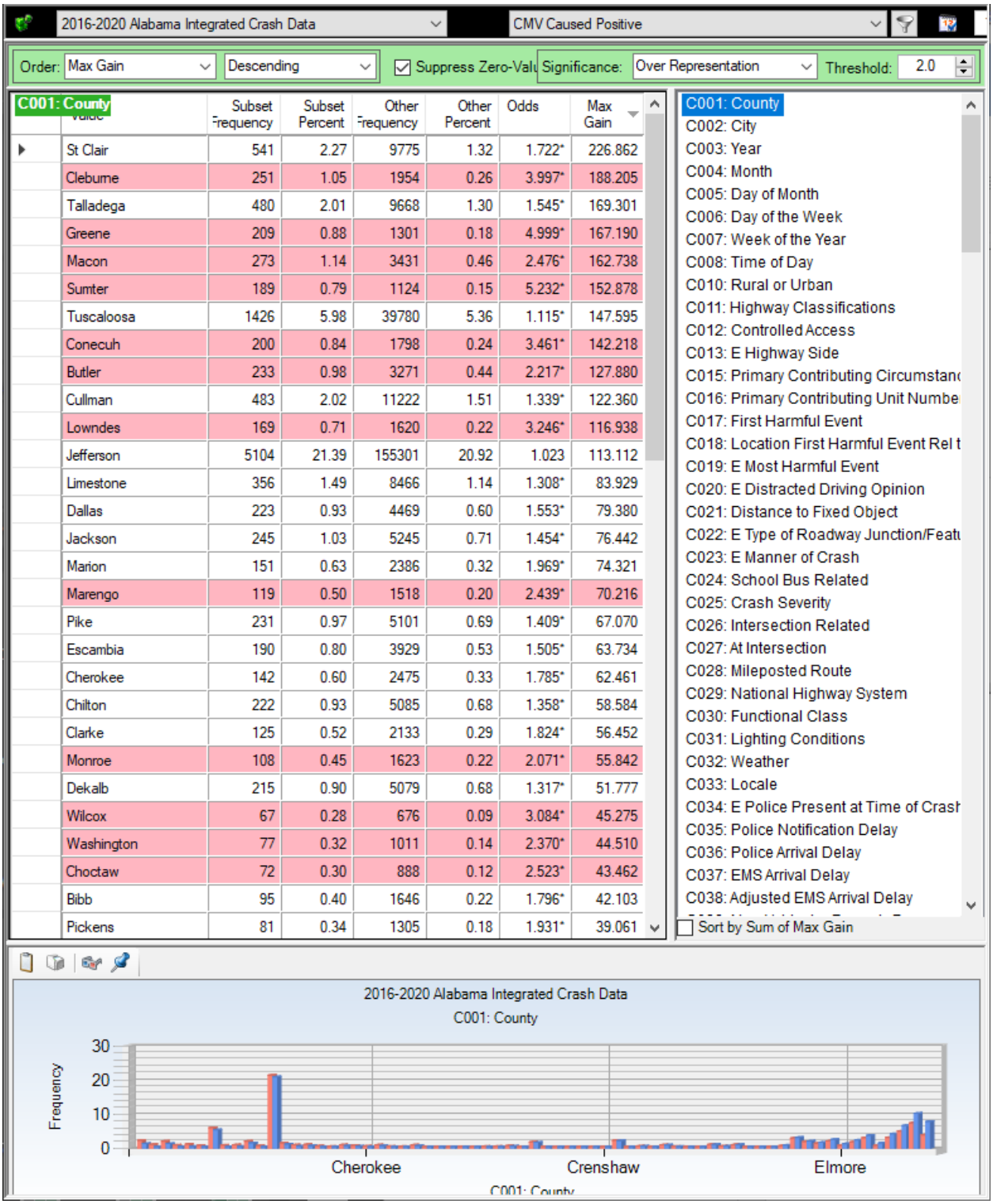
This will answer the question: what types of crashes do CMVs get into that are different from those encountered by all other types of vehicles

All of the comparisons in this major section will be crashes caused by CMVs (note filter name) against all other crashes (All Others), including cars, non-CMV large trucks and all other motor vehicles where a CMV was not the causal vehicle. The filter called "CMV Causal Positive" is defined as follows:

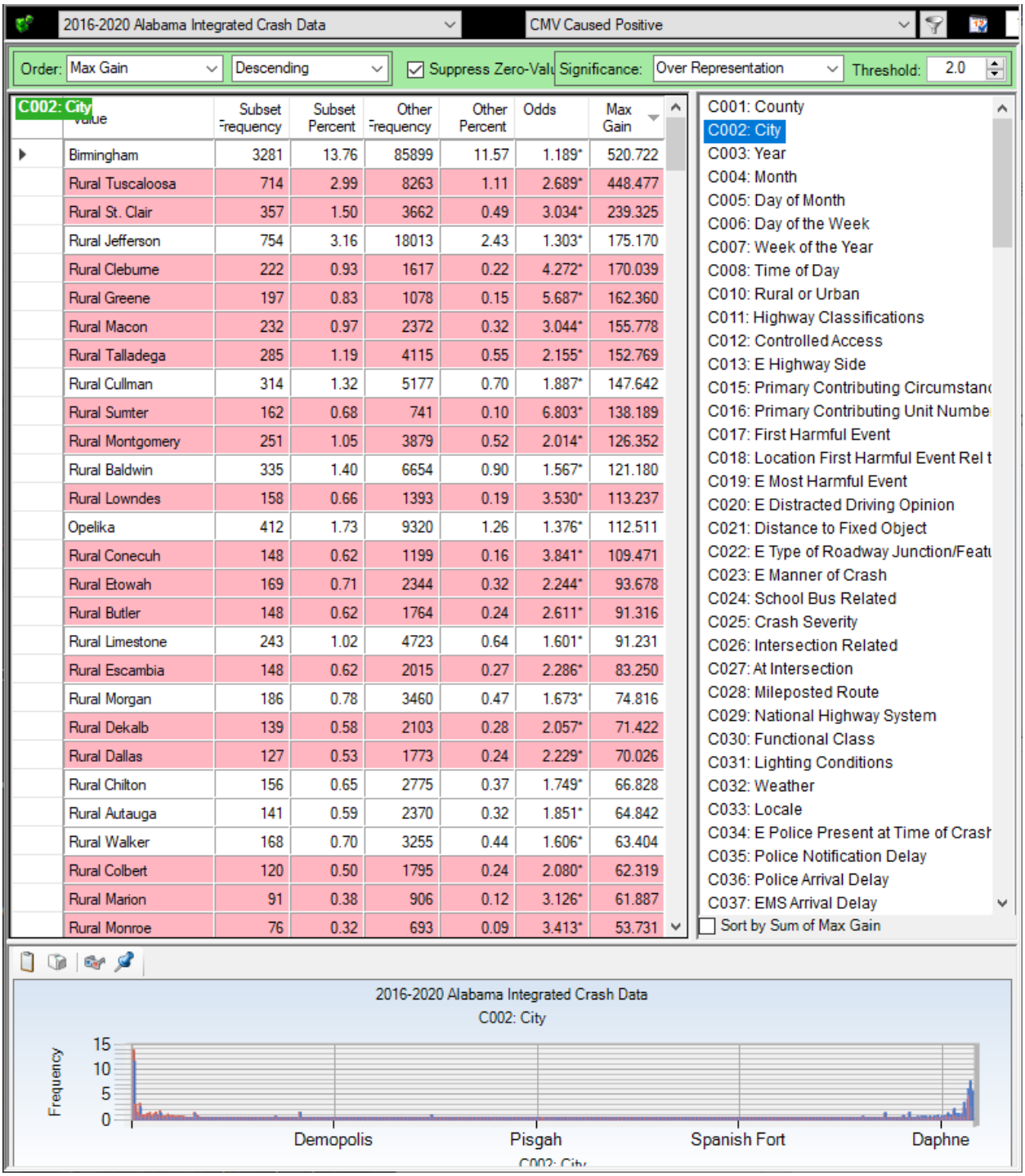


Simply put, it just states that the causal vehicle in any crash included in the dataset will be a CMV.

3.1 County CMVs vs Non-CMVs (MaxGain > 40)

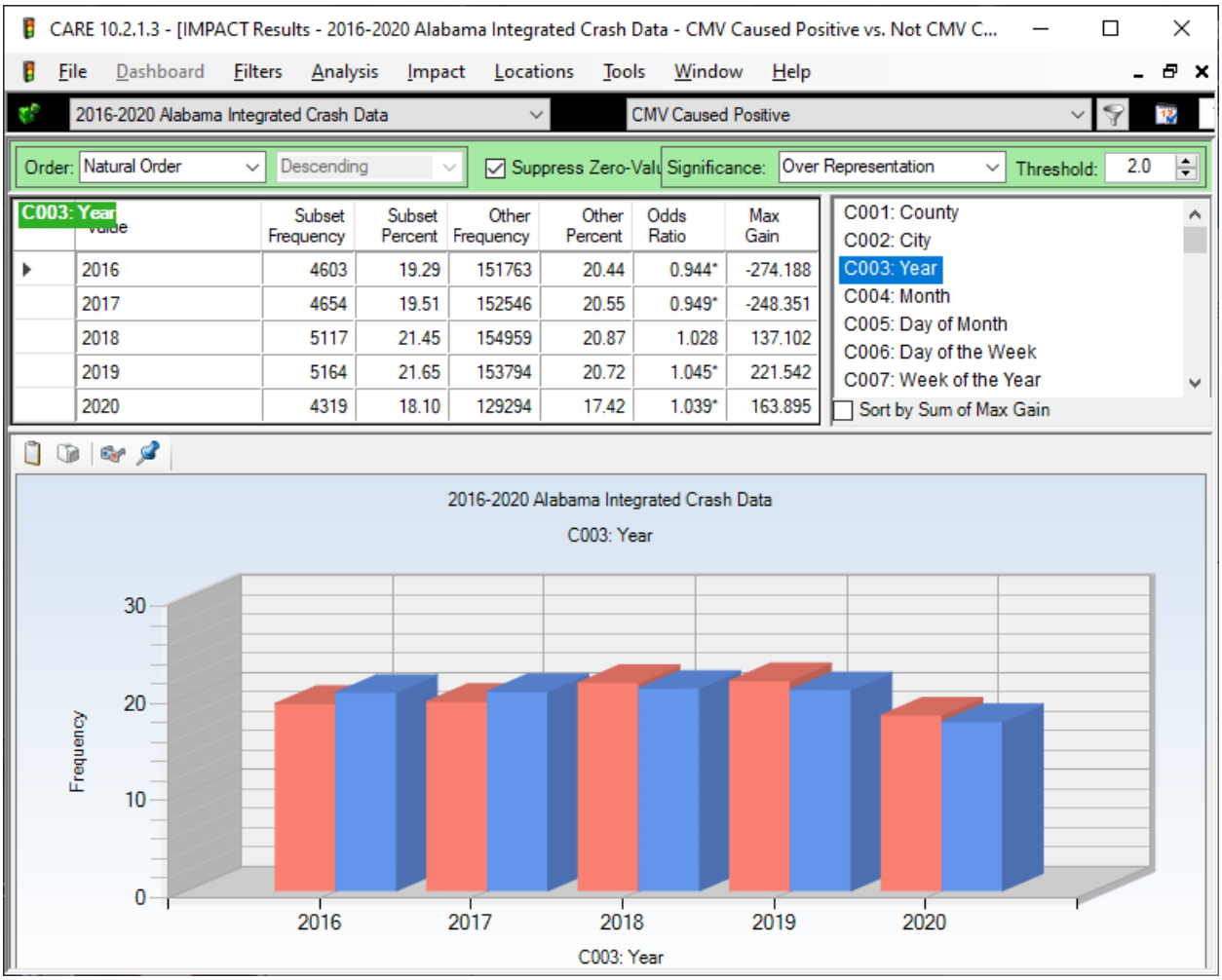


3.2 City CMVs vs Non-CMVs (Max Gain >60)



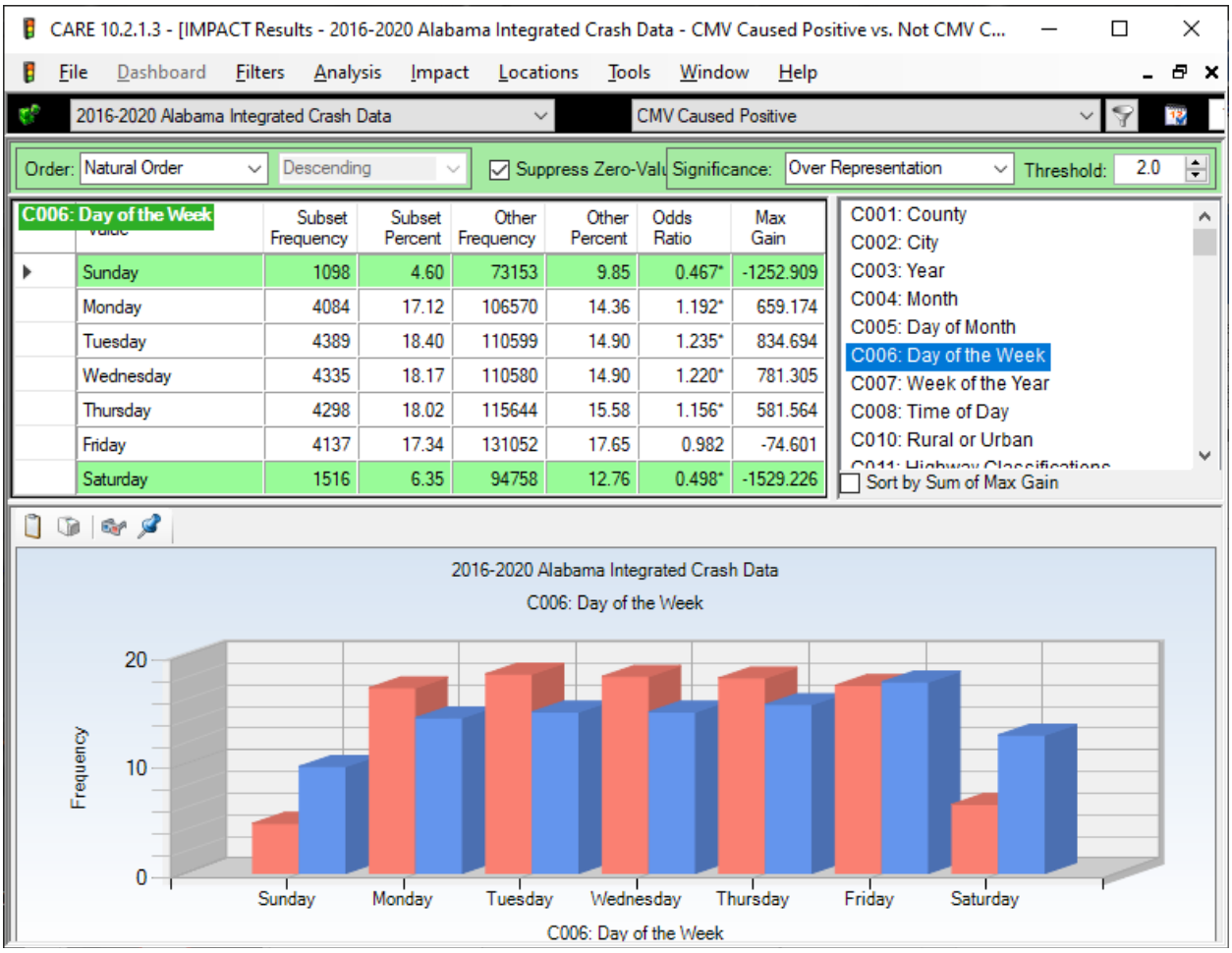
Crashes tend to occur in the rural areas of the counties – they are designated as virtual cities.

3.3 Year CMVs vs Non-CMVs (all vehicle types)



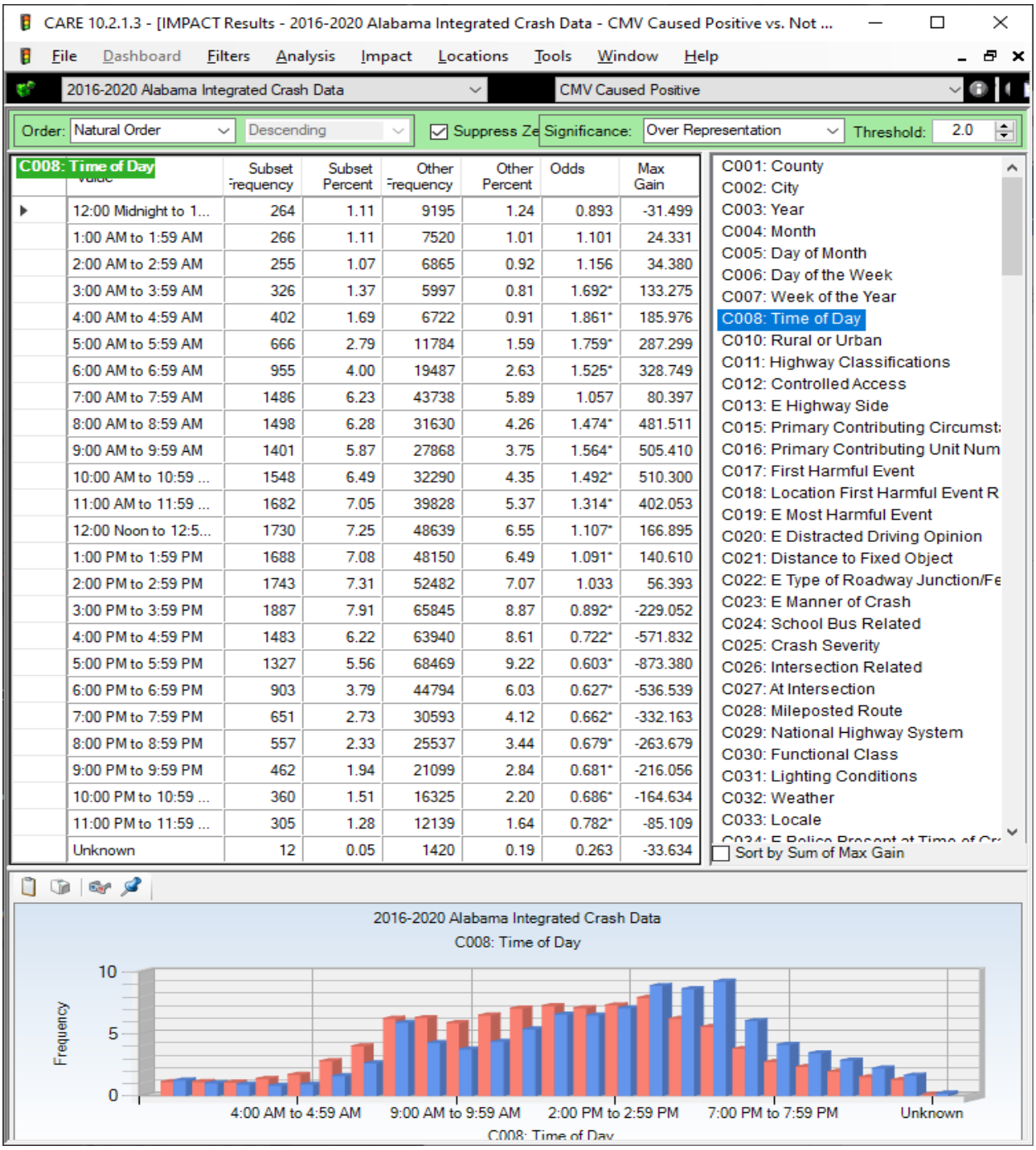
CMV crash frequencies were over-represented in years 2018-2020. The total Max Gain for these three years is 523 over the three years. The severity of these crashes was generally lower than those of 2016 and 2017.

3.4 Day of the Week; CMVs vs Non-CMVs



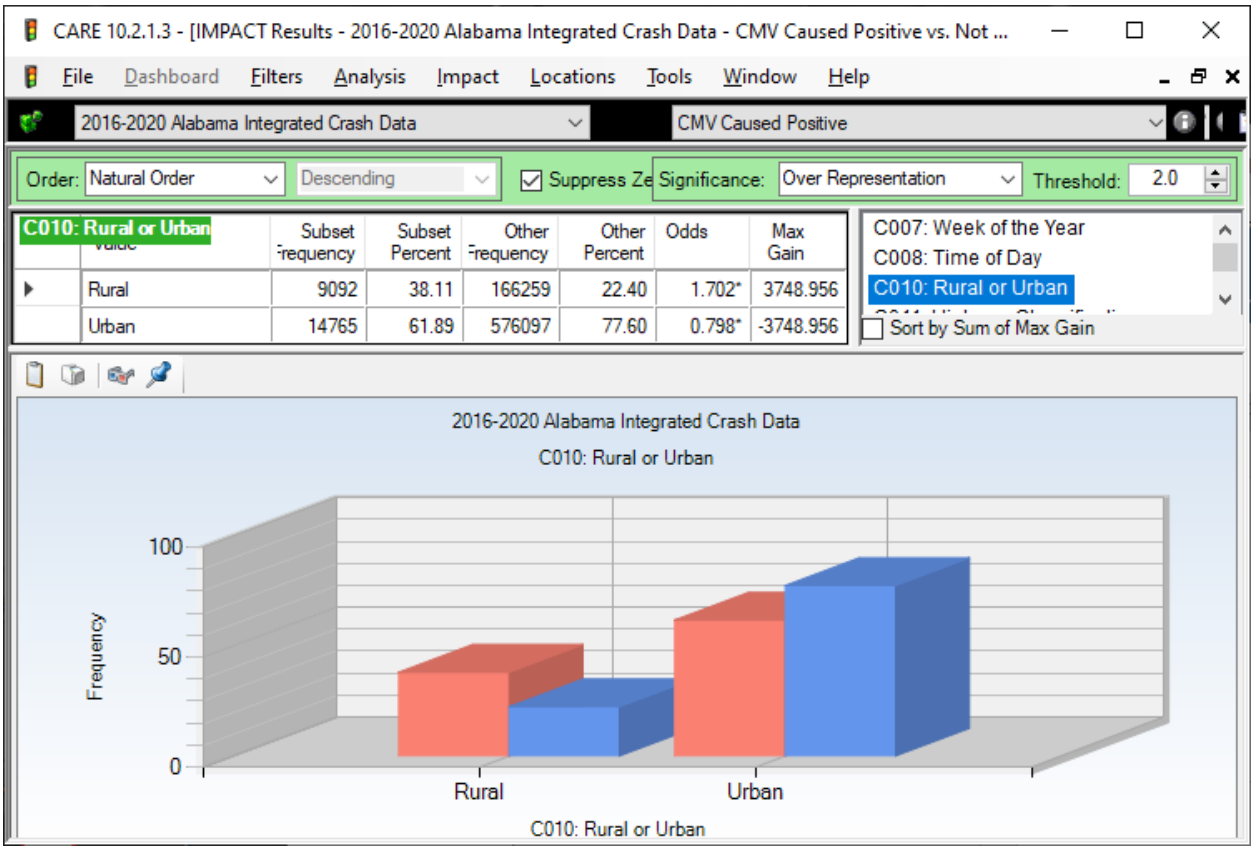
This distribution is as expected for truckers who work more during the week than on weekends.

3.5 Time of Day; CMVs vs Non-CMVs



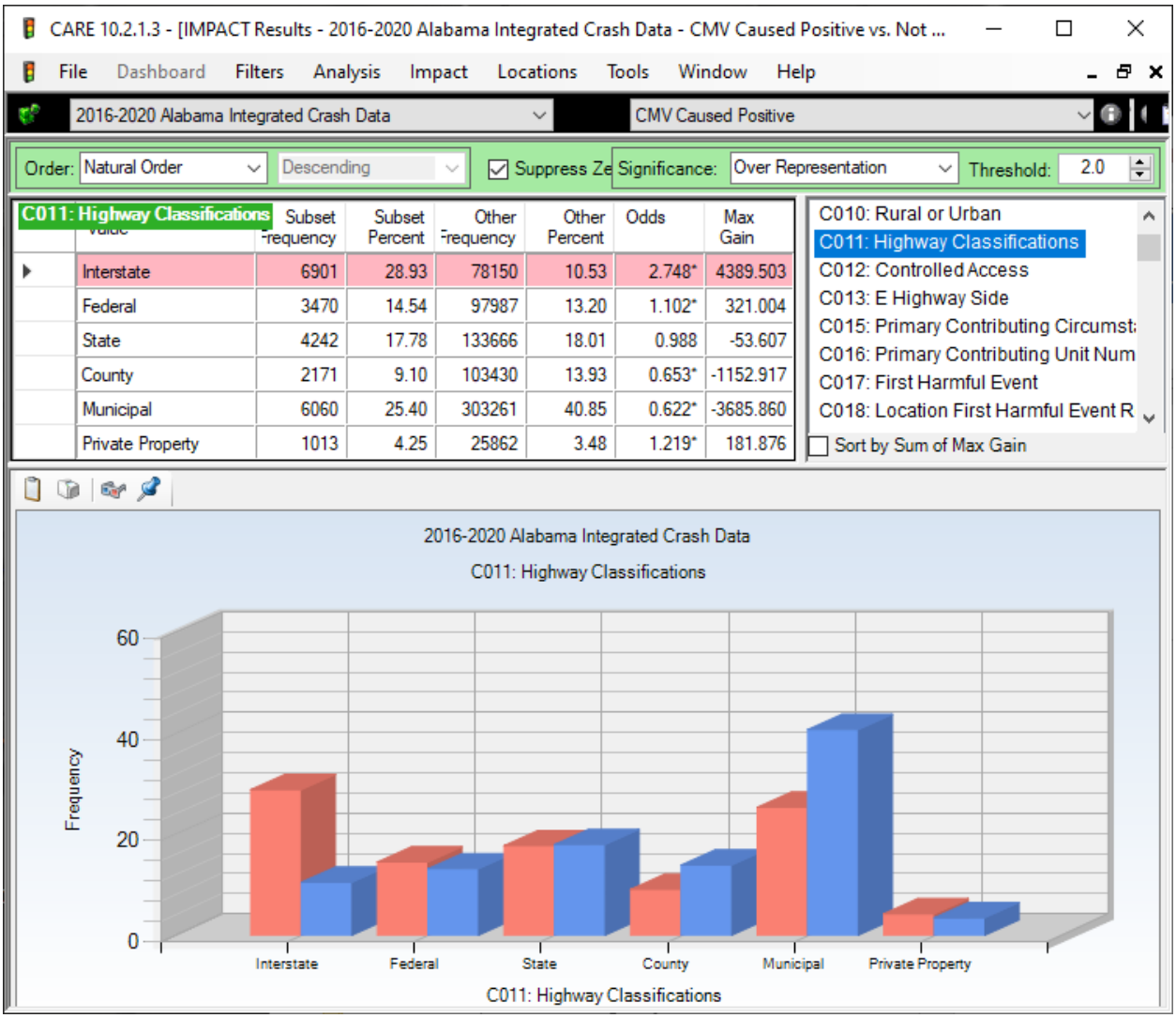
This also reflects the times that CMVs are on the road. Afternoons are probably affected by the daily hourly limitations placed on the drivers.

3.6 Rural/Urban CMVs vs Non-CMVs



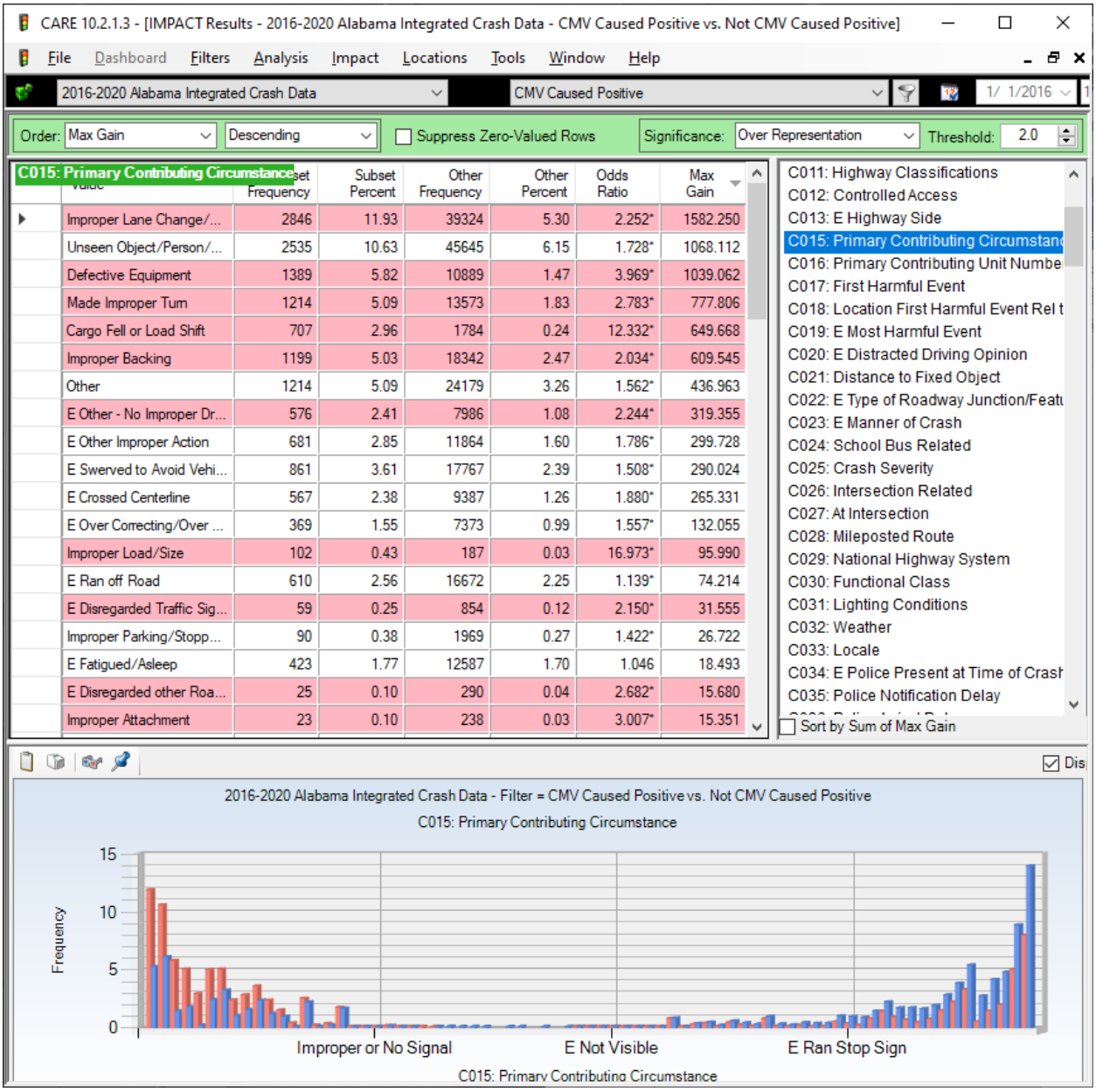
CMVs are more rural probably because they are more on the Interstates. See next.

3.7 Highway Classification CMVs vs Non-CMVs



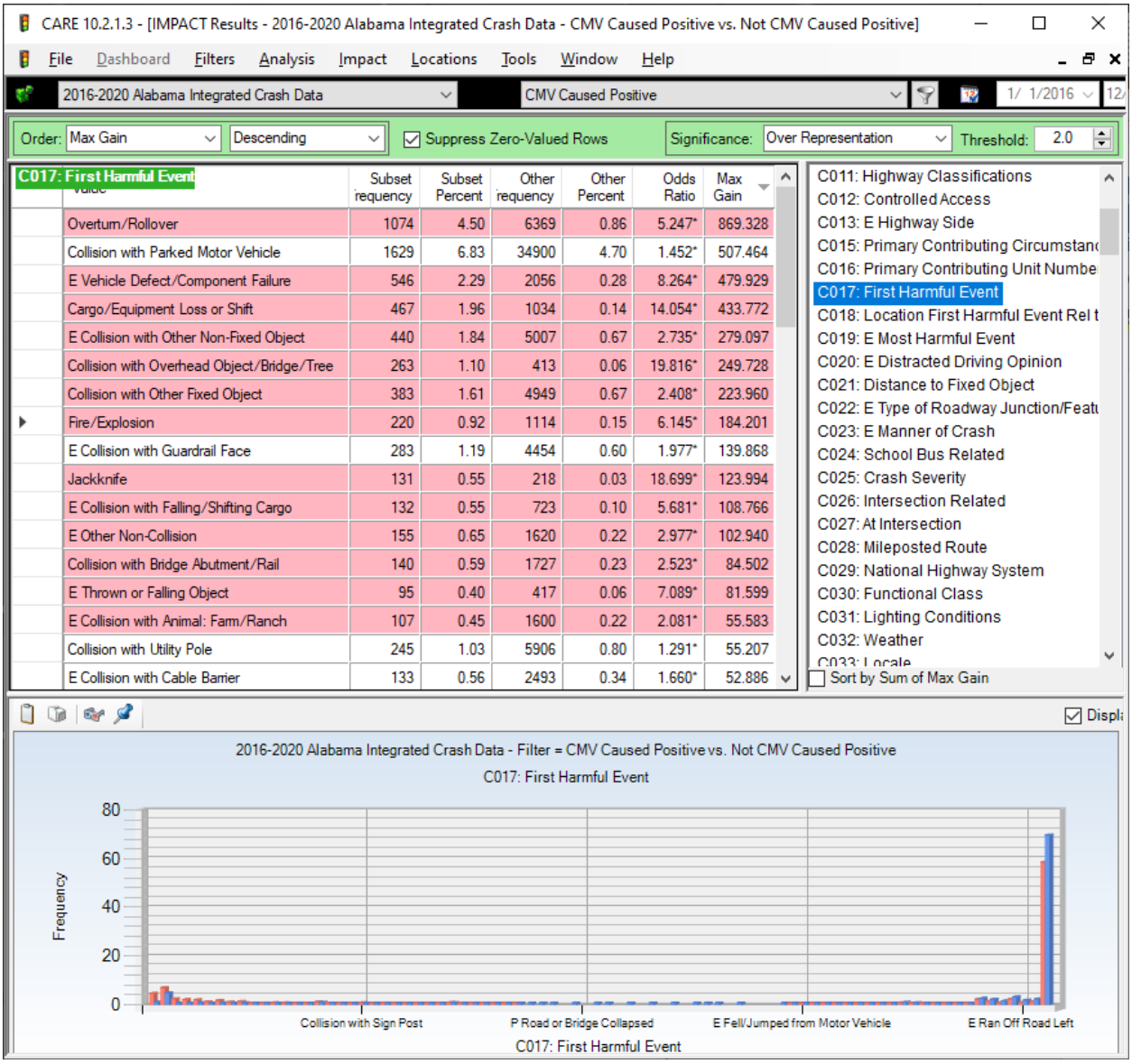
CMVs are close to three times the proportion of other vehicles on interstates. Federal is also significantly higher than expected, but only by a little over 10%. All other roadway classifications are under-represented for CMS.

3.8 Primary Contributing Circumstances (PCCs) CMVs vs Non-CMVs



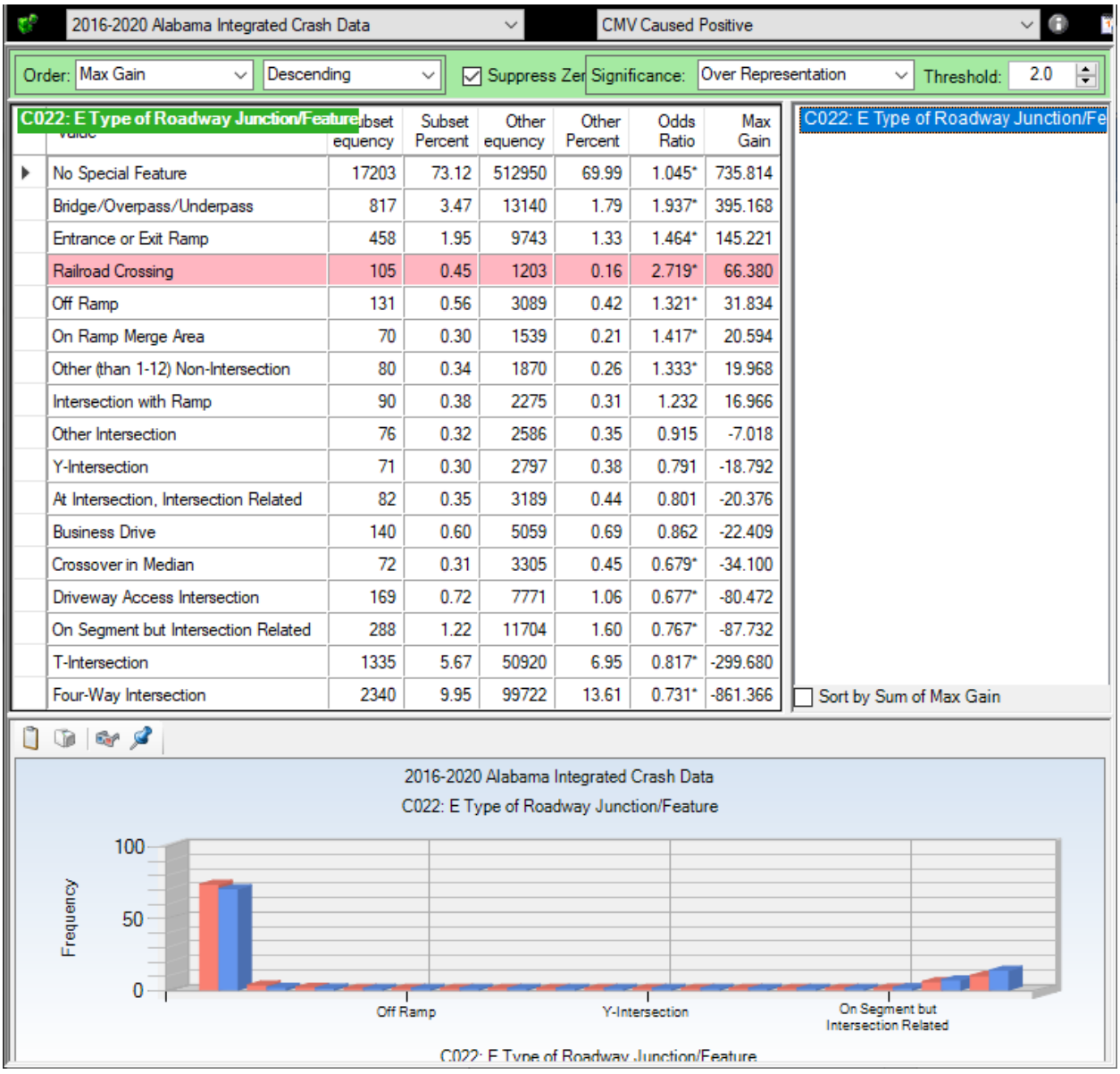
This analysis will indicate problems that CMVs have that are not as typical in other motor vehicles. The above is for all PCCs that are twice the expected from all other non-CMV vehicles, the Max Gain for all of them is above 15 crashes over the five years. Improper Lane Change/Use has the highest Max Gain of 1,582, which is well over 300 crashes per year, The major problems being faced by CMVs is Improper Lane Change and Unseen Object/Person (which could be a vehicle in the CMV's blind spot.).

3.9 First Harmful Event CMVs vs Non-CMVs (Max Gains > 50 Crashes in 5 Years)



This display is for all items that had a Max Gain of greater than 50 crashes over the five years of the study. Notice that some items near the top of the list apply to trucks much more than to cars. Apart from these, this attribute generally answers that question: What did CMVs most often hit first when they crashed?

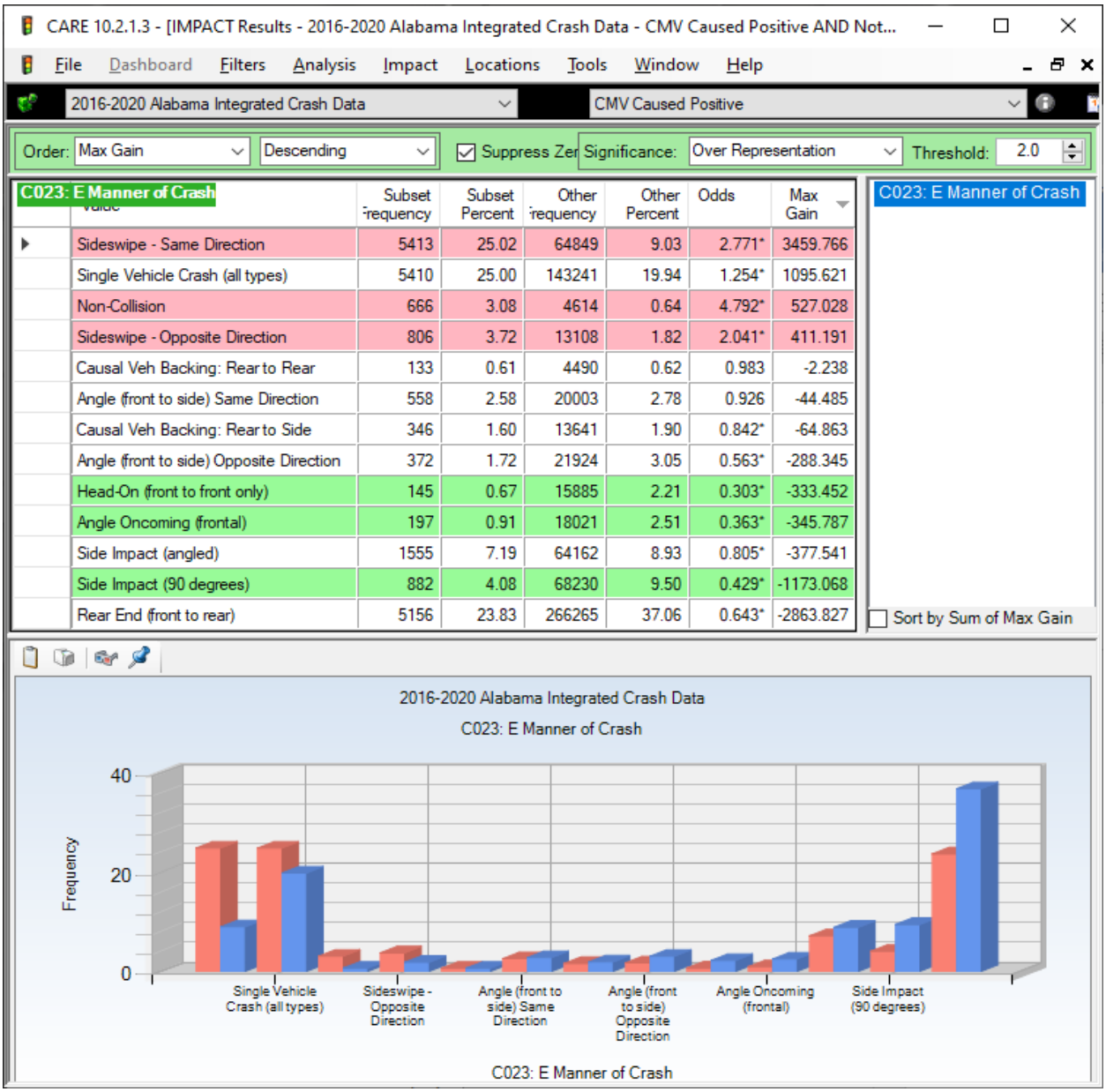
3.10 Type of Junction/Intersection CMVs vs Non-CMVs (Items > 50 Crashes in 5 Years)



	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
No Special Feature	17203	73.12	512950	69.99	1.045*	735.814
Bridge/Overpass/Underpass	817	3.47	13140	1.79	1.937*	395.168
Entrance or Exit Ramp	458	1.95	9743	1.33	1.464*	145.221
Railroad Crossing	105	0.45	1203	0.16	2.719*	66.380
Off Ramp	131	0.56	3089	0.42	1.321*	31.834
On Ramp Merge Area	70	0.30	1539	0.21	1.417*	20.594
Other (than 1-12) Non-Intersection	80	0.34	1870	0.26	1.333*	19.968
Intersection with Ramp	90	0.38	2275	0.31	1.232	16.966
Other Intersection	76	0.32	2586	0.35	0.915	-7.018
Y-Intersection	71	0.30	2797	0.38	0.791	-18.792
At Intersection, Intersection Related	82	0.35	3189	0.44	0.801	-20.376
Business Drive	140	0.60	5059	0.69	0.862	-22.409
Crossover in Median	72	0.31	3305	0.45	0.679*	-34.100
Driveway Access Intersection	169	0.72	7771	1.06	0.677*	-80.472
On Segment but Intersection Related	288	1.22	11704	1.60	0.767*	-87.732
T-Intersection	1335	5.67	50920	6.95	0.817*	-299.680
Four-Way Intersection	2340	9.95	99722	13.61	0.731*	-861.366

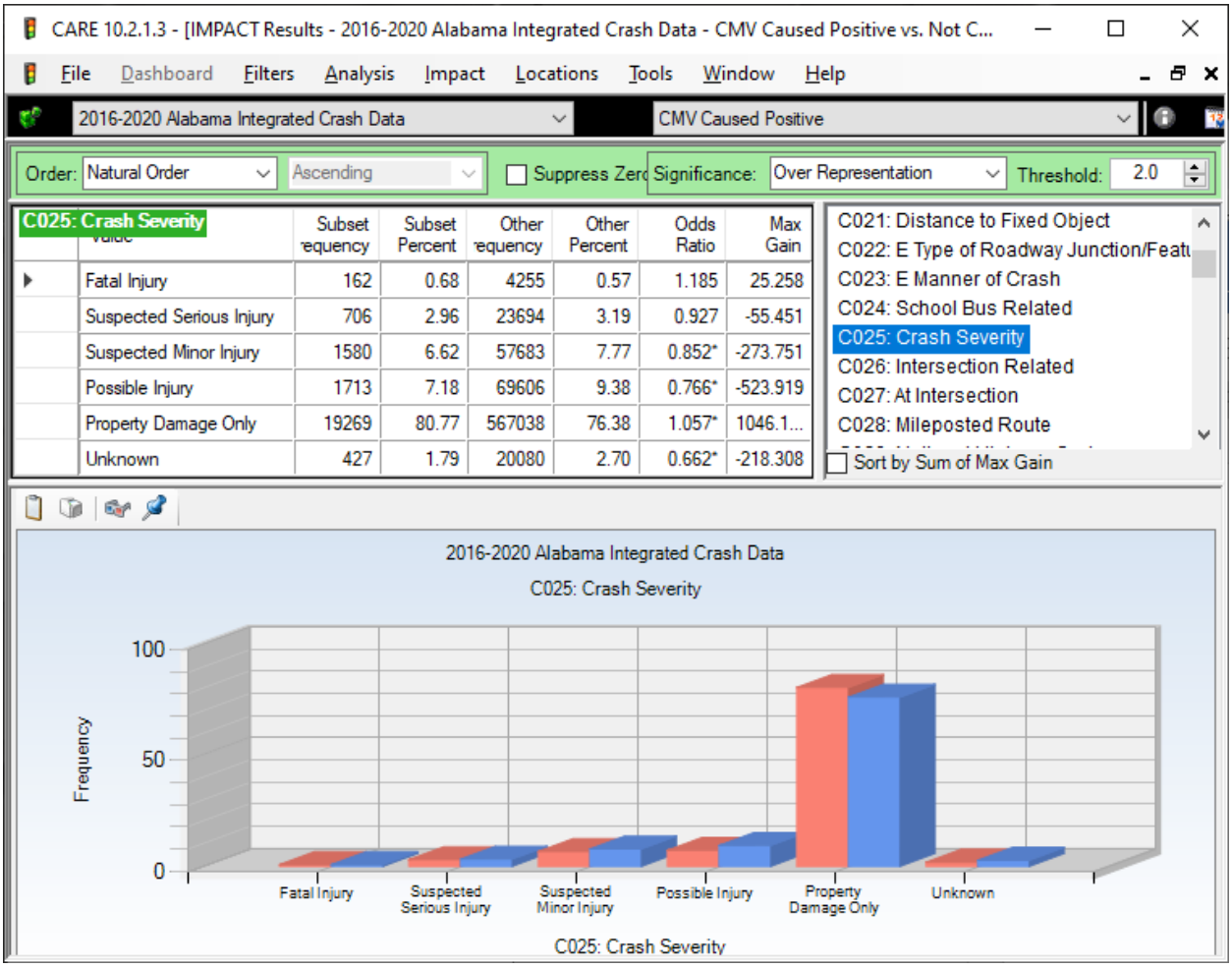
The over-representation of CMVs at Railroad Crossings is the most surprising finding for this attribute. While these are less than a half of a percent of CMV crashes, they are of concern because of the severity of such crashes. The general "Intersection Related" attributes (C026 and C027) indicated that CMVs were involved in fewer than expected crashes at intersections. CMVs are also significantly over-represented on the following Roadway Junctions: Bridge/Overpass/Underpass, Entrance or Exit Ramp, Railroad Crossing, Off Ramp, Tunnel, and On Ramp Merge Area.

3.11 Manner of Crash; CMVs vs All Non-CMVs



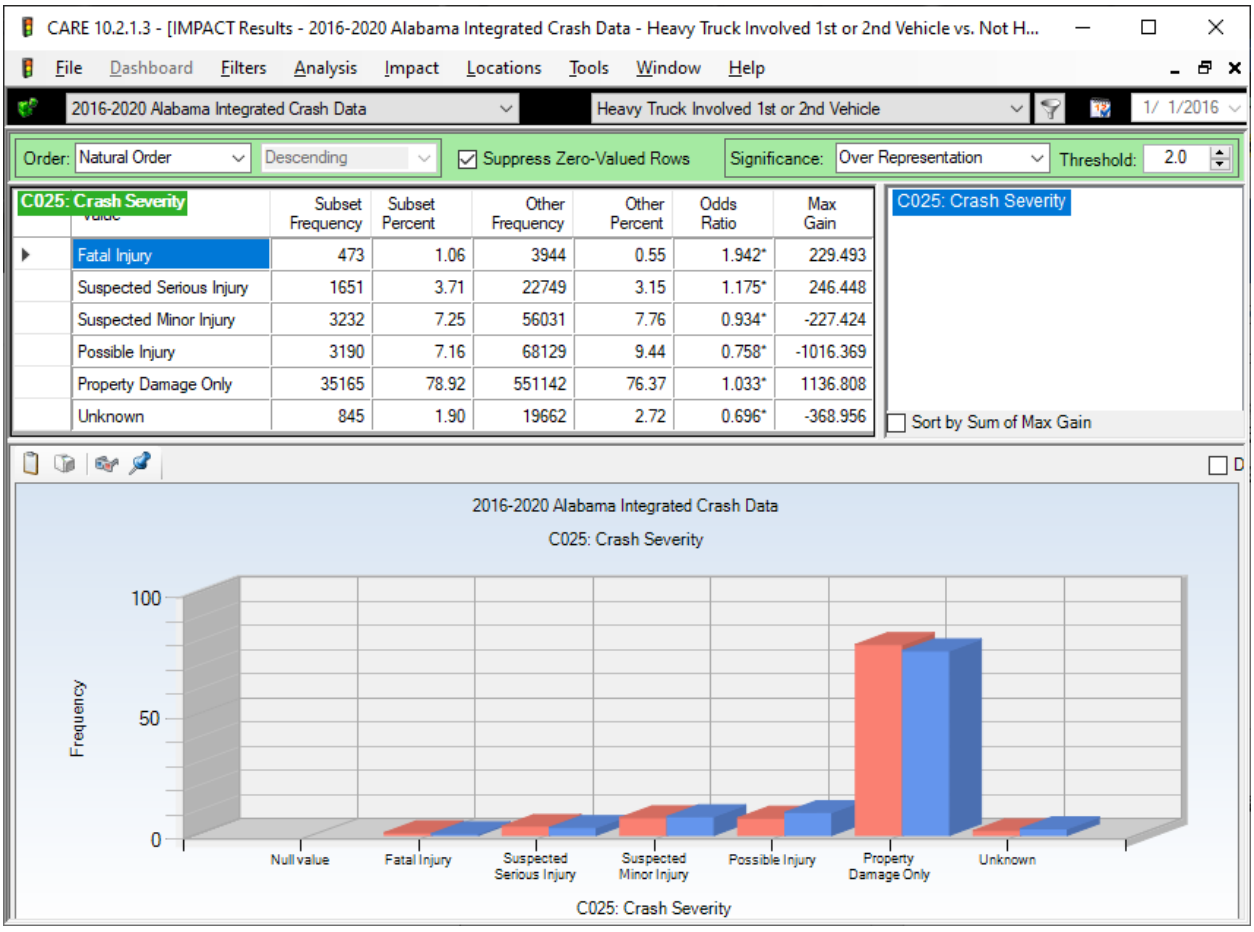
The following crash types were the only that were over-represented (crash frequencies): Side-swipe - Same Direction (5,413), Single Vehicle Crash - all types (5,410), Non-Collision (666), and Sideswipe - Opposite Direction (806). The largest non-collision crash PCCs that had any meaning were: Defective Equipment (237), Cargo Fell or Load Shift (125), and Ran off Road (25).

3.12a Crash Severity CMVs vs Non-CMVs



The only over-represented injury category is Fatal Injury and even that is not statistically significant. Other studies on vehicle type causes indicated that large trucks, while generally causing more than 50% of 2-vehicle crashes, are under-represented (significantly less than 50%) for fatal crashes. In other words, in the majority of cases it is the other vehicle (usually a much smaller vehicle) that causes a fatal crash with the CMV.

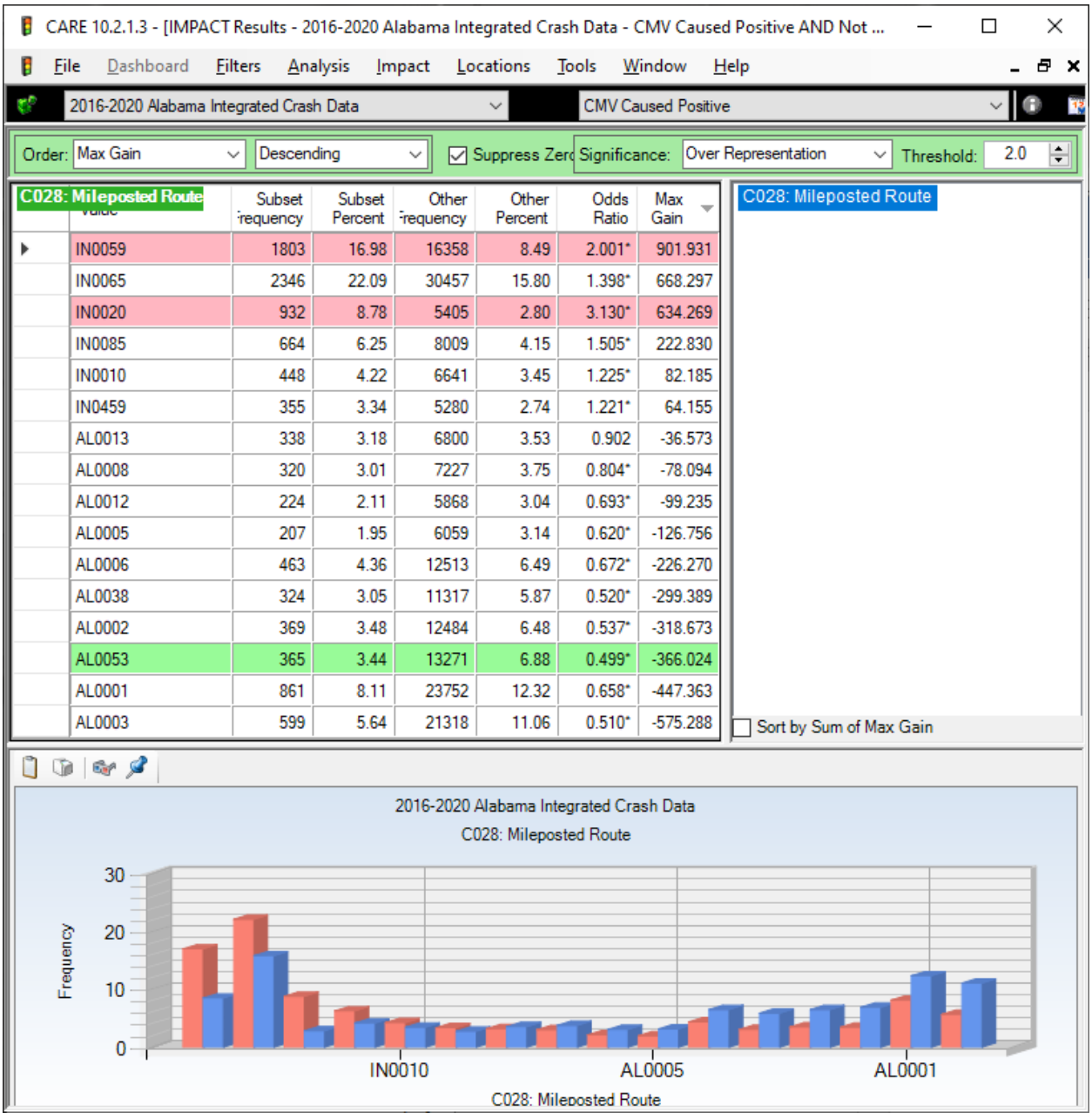
3.12b Crash Severity All Large Truck Involved (1st or 2nd Veh) vs Smaller Vehicles



This comparison was for all large trucks, not just CMVs. It included large trucks as either the first (usually causal) or the second vehicle.

The above shows that crashes involving large trucks generally result in more fatal crashes. However, past research has shown that most of the fatal crashes are not caused by the large trucks.

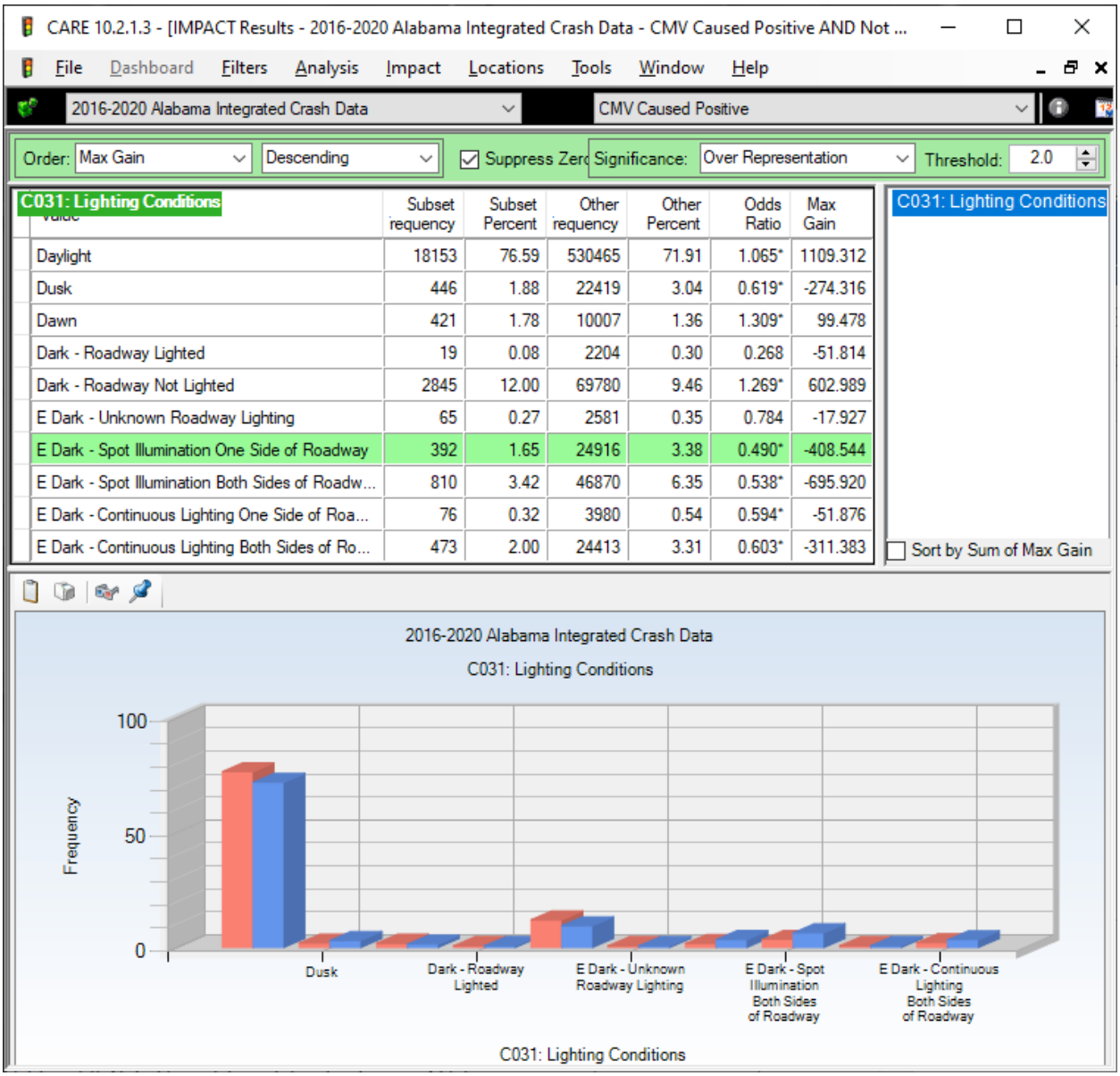
3.13 Mileposted Routes CMVs vs Non-CMV (Crashes > 200)



C028: Mileposted Route	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
IN0059	1803	16.98	16358	8.49	2.001*	901.931
IN0065	2346	22.09	30457	15.80	1.398*	668.297
IN0020	932	8.78	5405	2.80	3.130*	634.269
IN0085	664	6.25	8009	4.15	1.505*	222.830
IN0010	448	4.22	6641	3.45	1.225*	82.185
IN0459	355	3.34	5280	2.74	1.221*	64.155
AL0013	338	3.18	6800	3.53	0.902	-36.573
AL0008	320	3.01	7227	3.75	0.804*	-78.094
AL0012	224	2.11	5868	3.04	0.693*	-99.235
AL0005	207	1.95	6059	3.14	0.620*	-126.756
AL0006	463	4.36	12513	6.49	0.672*	-226.270
AL0038	324	3.05	11317	5.87	0.520*	-299.389
AL0002	369	3.48	12484	6.48	0.537*	-318.673
AL0053	365	3.44	13271	6.88	0.499*	-366.024
AL0001	861	8.11	23752	12.32	0.658*	-447.363
AL0003	599	5.64	21318	11.06	0.510*	-575.288

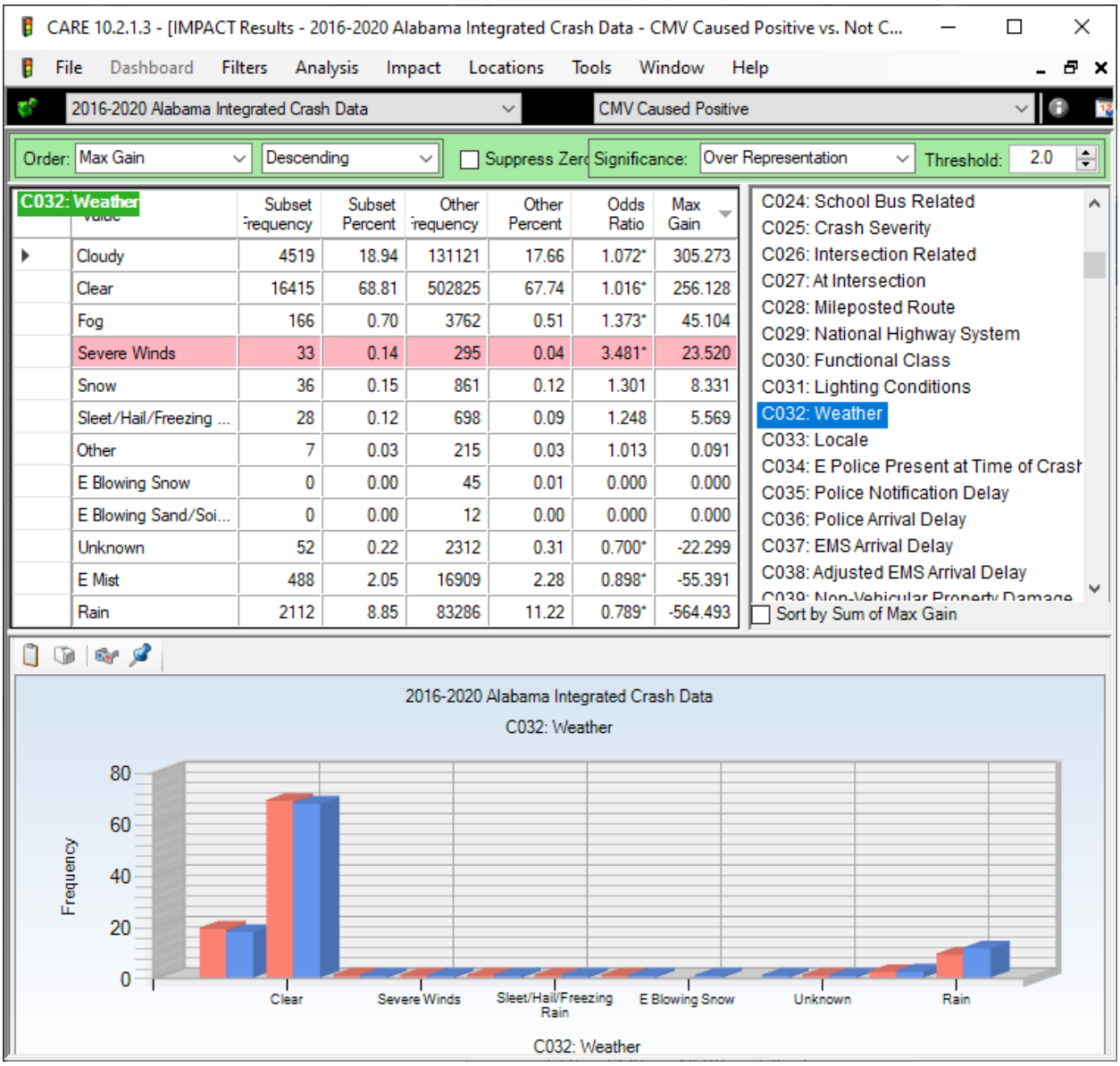
I-59 and I-20 each had over-representations greater than twice the expected from non-CMV vehicles, even though I-65 had more crashes than the sum of both of them. This analysis does not take into account miles driven except in comparison to vehicles that are not CMVs. It has been well demonstrated, however, that the crash rate on a given road is proportional to the miles driven on that road.

3.14 Lighting Conditions CMVs vs Non-CMVs



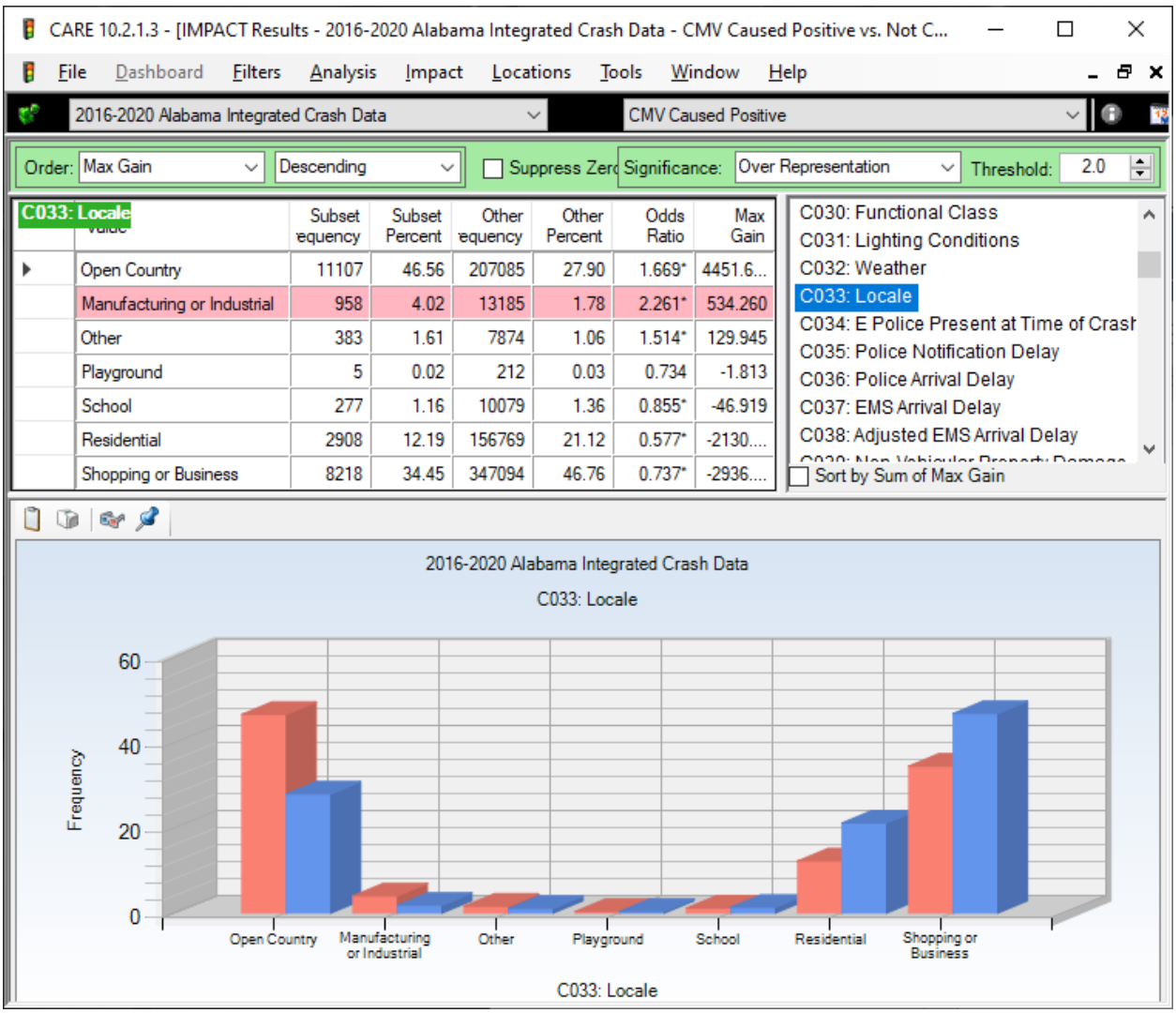
These results correspond closely to the time of day results in Section 3.5.

3.15 Weather CMVs vs Non-CMVs



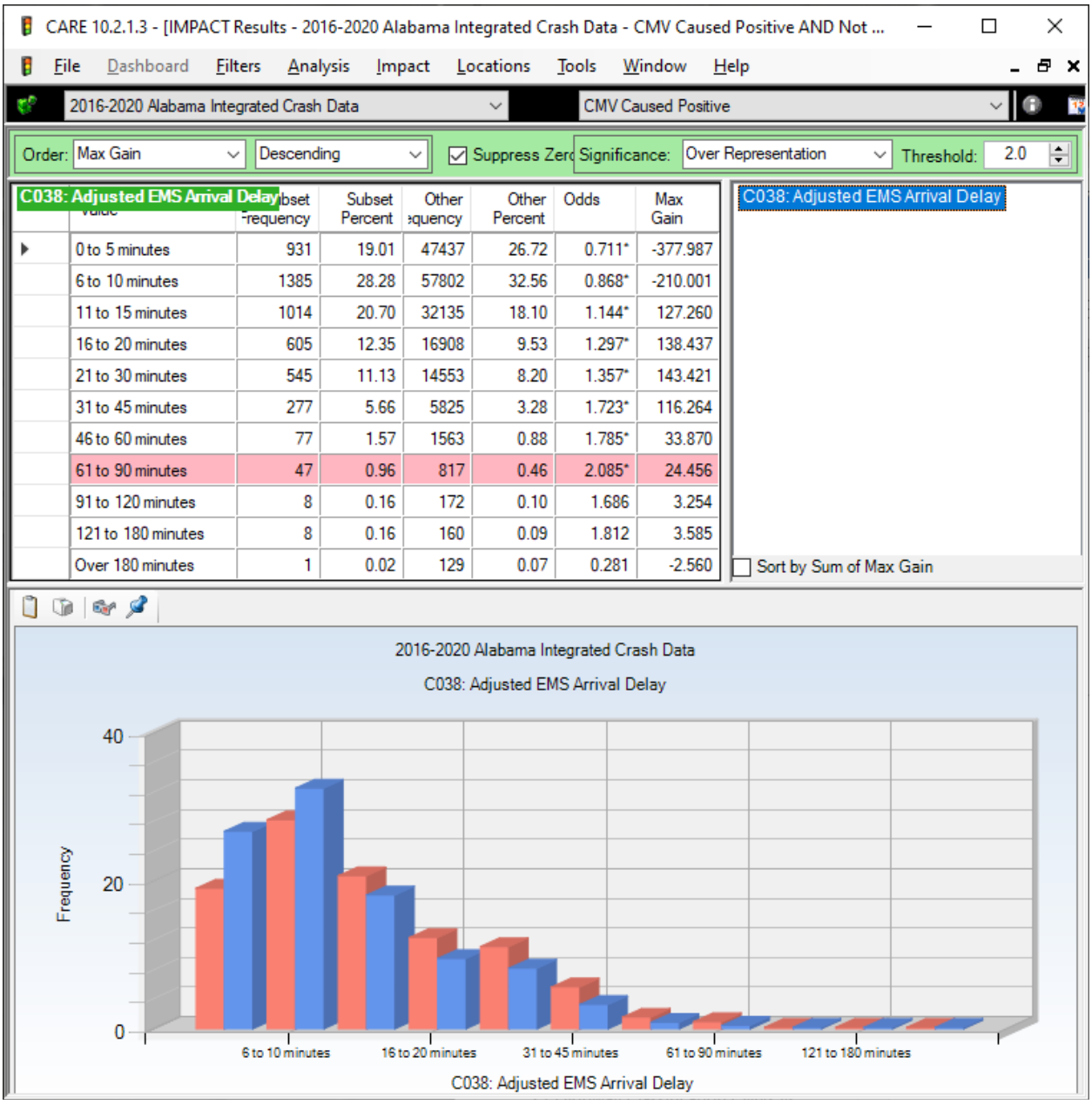
Severe winds appear to be the only Weather feature that is dramatically over-represented. The other over-representations are probably due to CMVs being required to be out in those weather conditions.

3.16 Locale CMVs vs Non-CMVs



Open Country corresponds to Rural in Section 3.6; however, there are some technically Urban areas (i.e., within city limits) that are also open country. In all of the IMPACTs we have done, CMVs are the only vehicles that we have found that have more than a double over-representation in Manufacturing or Industrial areas.

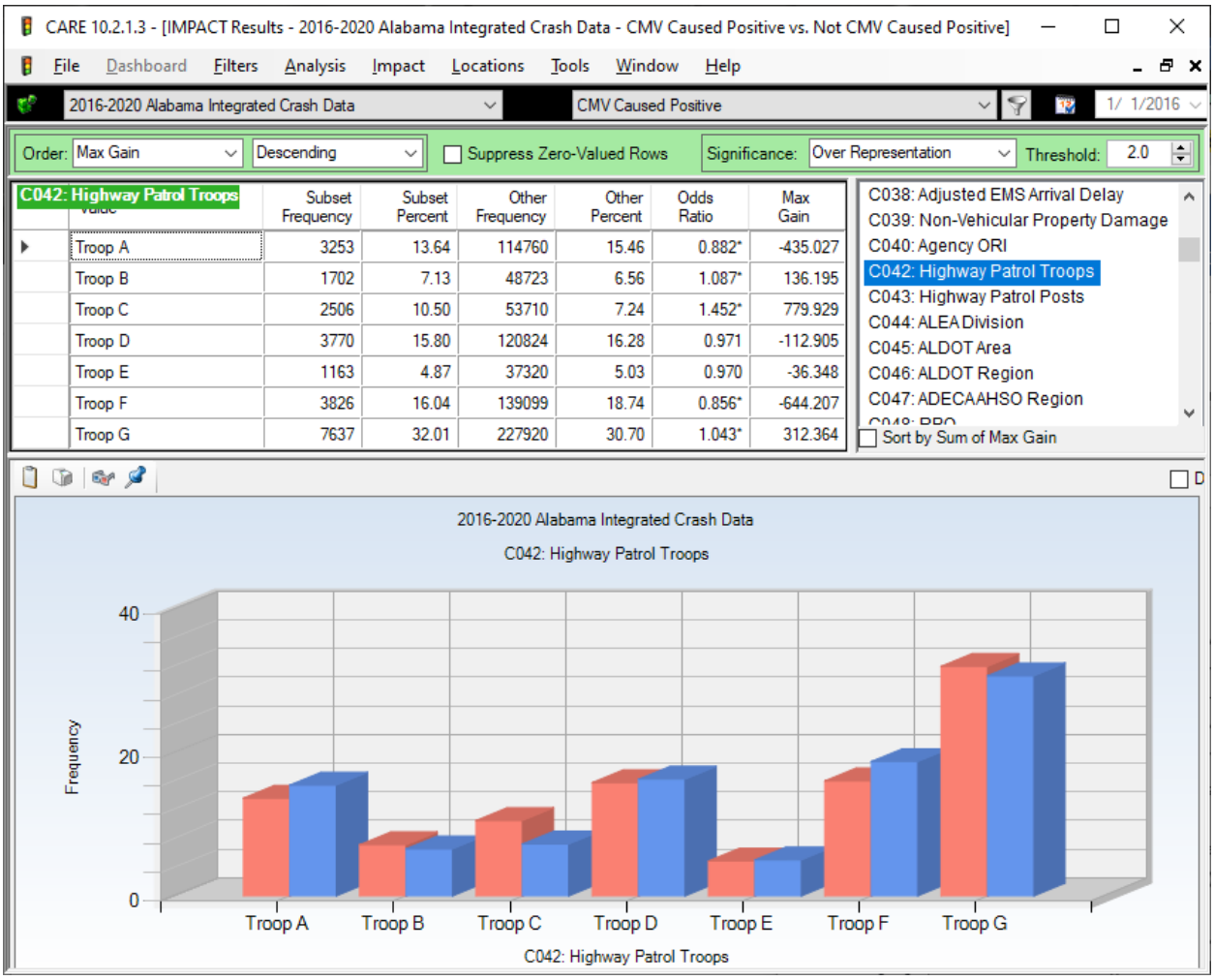
3.17 Adjusted EMS Arrival Delay CMVs vs Non-CMVs



C038: Adjusted EMS Arrival Delay	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds	Max Gain
0 to 5 minutes	931	19.01	47437	26.72	0.711*	-377.987
6 to 10 minutes	1385	28.28	57802	32.56	0.868*	-210.001
11 to 15 minutes	1014	20.70	32135	18.10	1.144*	127.260
16 to 20 minutes	605	12.35	16908	9.53	1.297*	138.437
21 to 30 minutes	545	11.13	14553	8.20	1.357*	143.421
31 to 45 minutes	277	5.66	5825	3.28	1.723*	116.264
46 to 60 minutes	77	1.57	1563	0.88	1.785*	33.870
61 to 90 minutes	47	0.96	817	0.46	2.085*	24.456
91 to 120 minutes	8	0.16	172	0.10	1.686	3.254
121 to 180 minutes	8	0.16	160	0.09	1.812	3.585
Over 180 minutes	1	0.02	129	0.07	0.281	-2.560

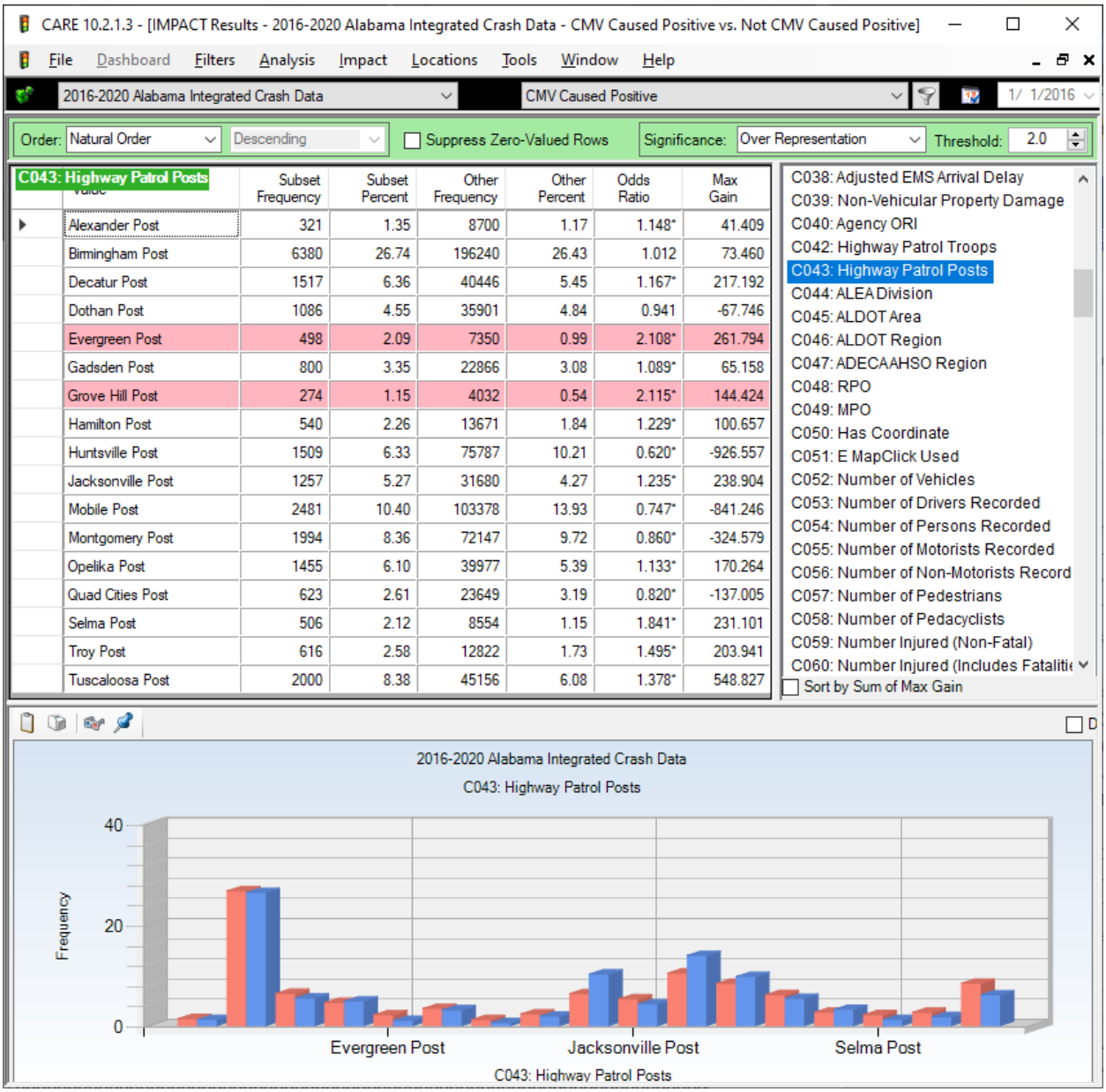
The degree of over-representation (Odds Ratio) generally increases with the increase in arrival time. This shows that the pattern is for crashes that involve CMVs to be in the more remote areas for which EMS access is delayed.

3.18 Highway Patrol Troops CMVs vs Non-CMVs



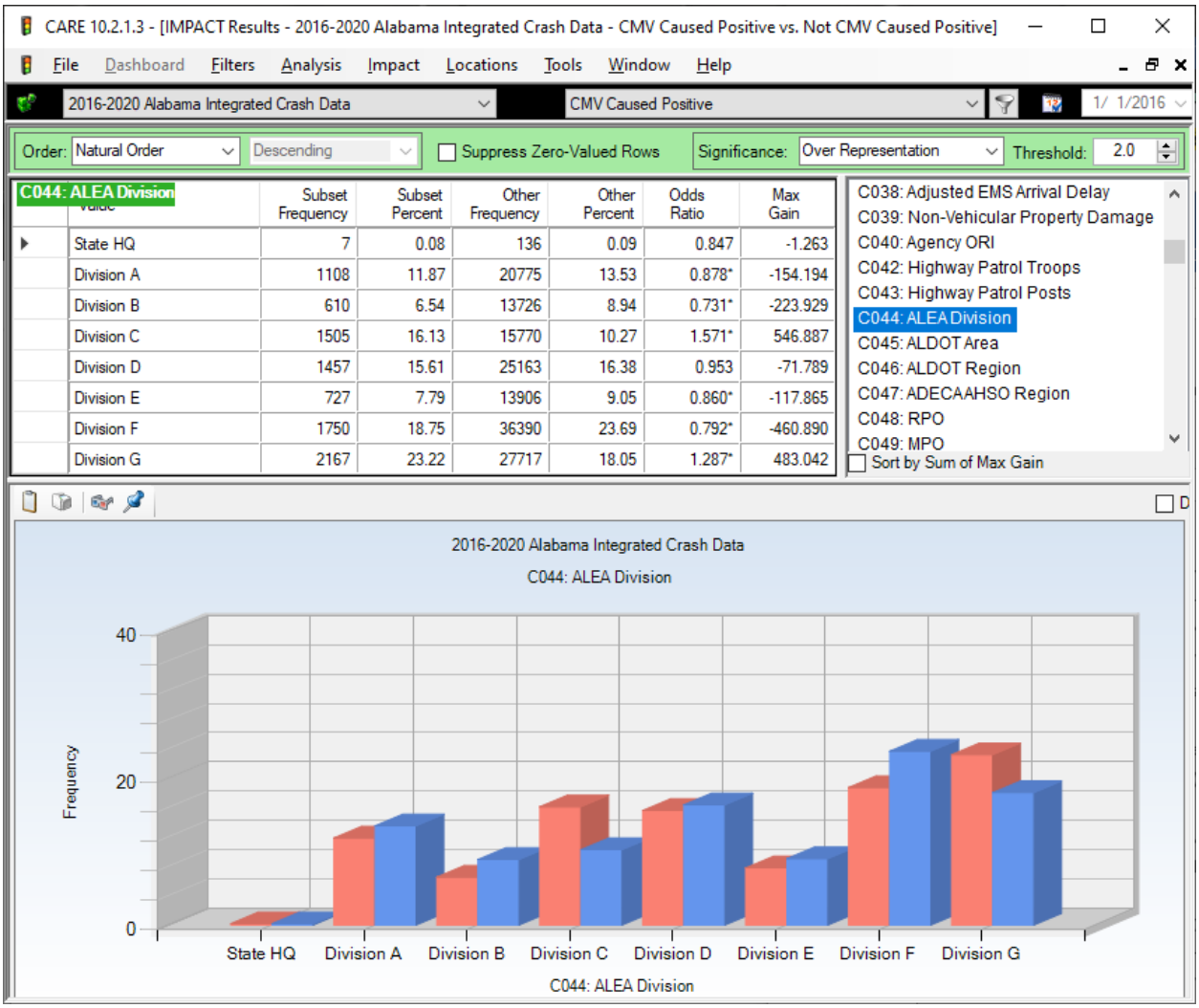
Troop C is the most over-represented in CMV-Caused Crashes. This may be of importance to assist in planning the tactics of each troop.

3.19 Highway Patrol Posts CMVs vs Non-CMVs



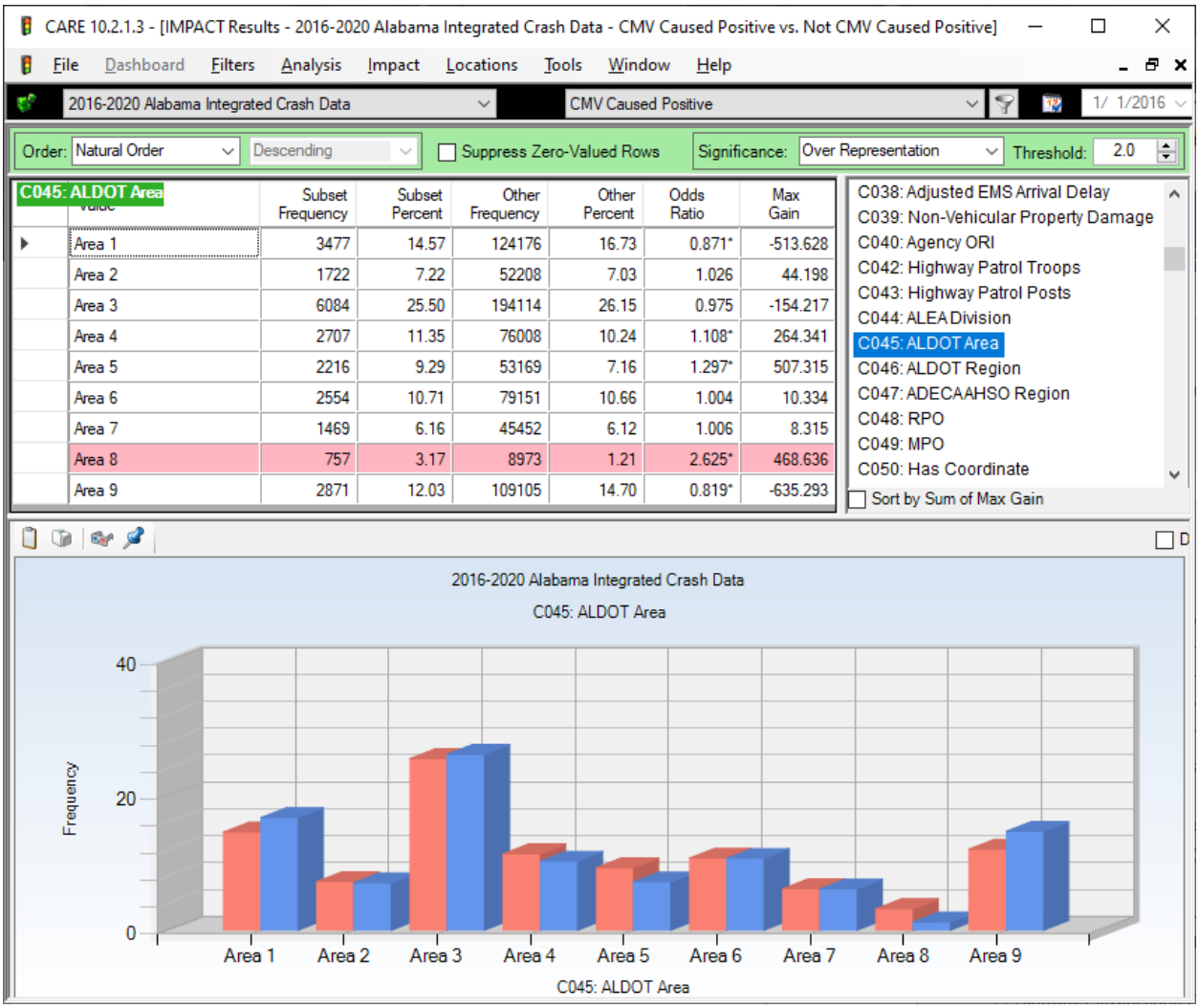
The Evergreen and Grove Hill posts have nearly the same over-representations. The Selma post comes in next.

3.20 ALEA Divisions CMVs vs Non-CMS



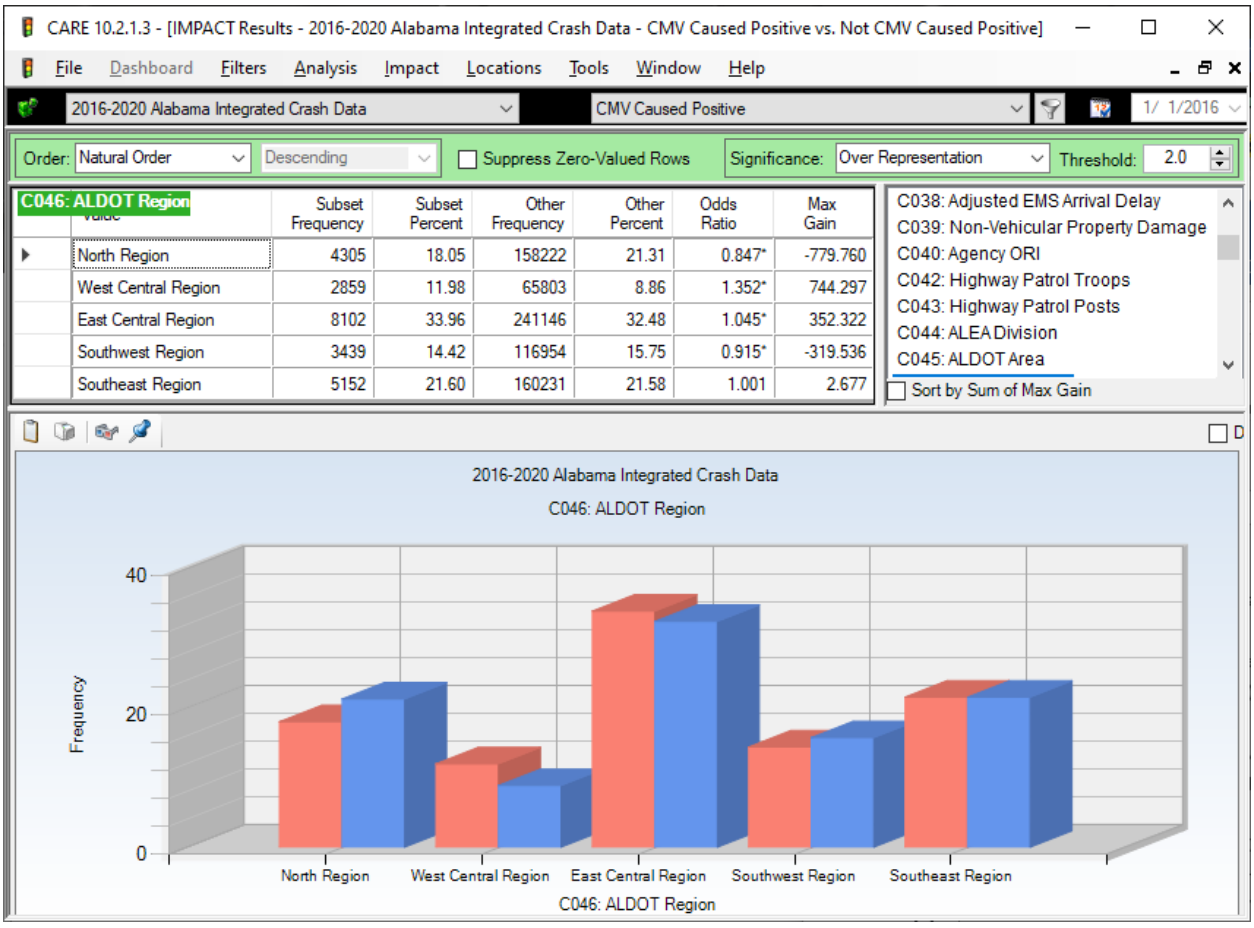
Division C has the highest over-representation followed by Division G.

3.21 ALDOT Areas CMVs vs Non-CMVs



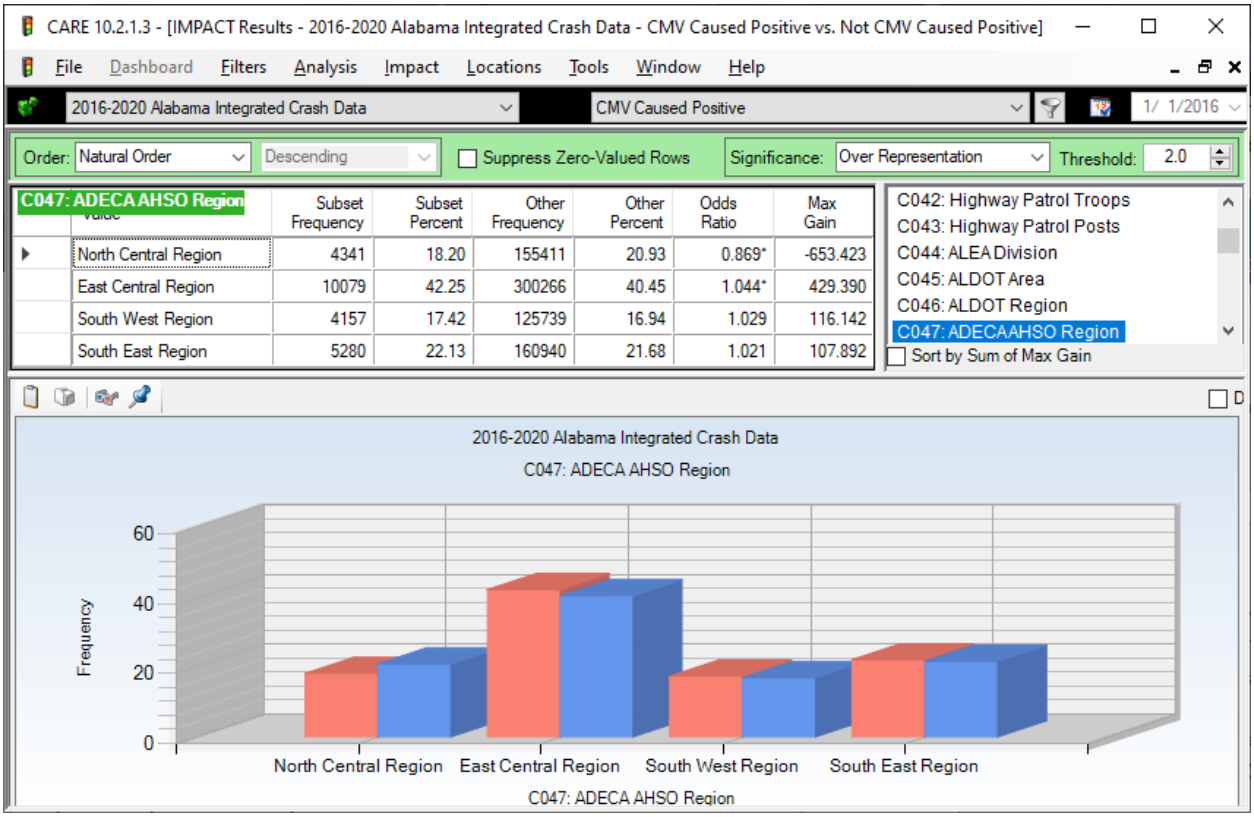
While Area 8 has the highest over-representation, it is also apparently the area with the least traffic. It also has the second highest Max Gain, with Area 5 having the largest.

3.22 ALDOT Regions CMVs vs Non-CMVs



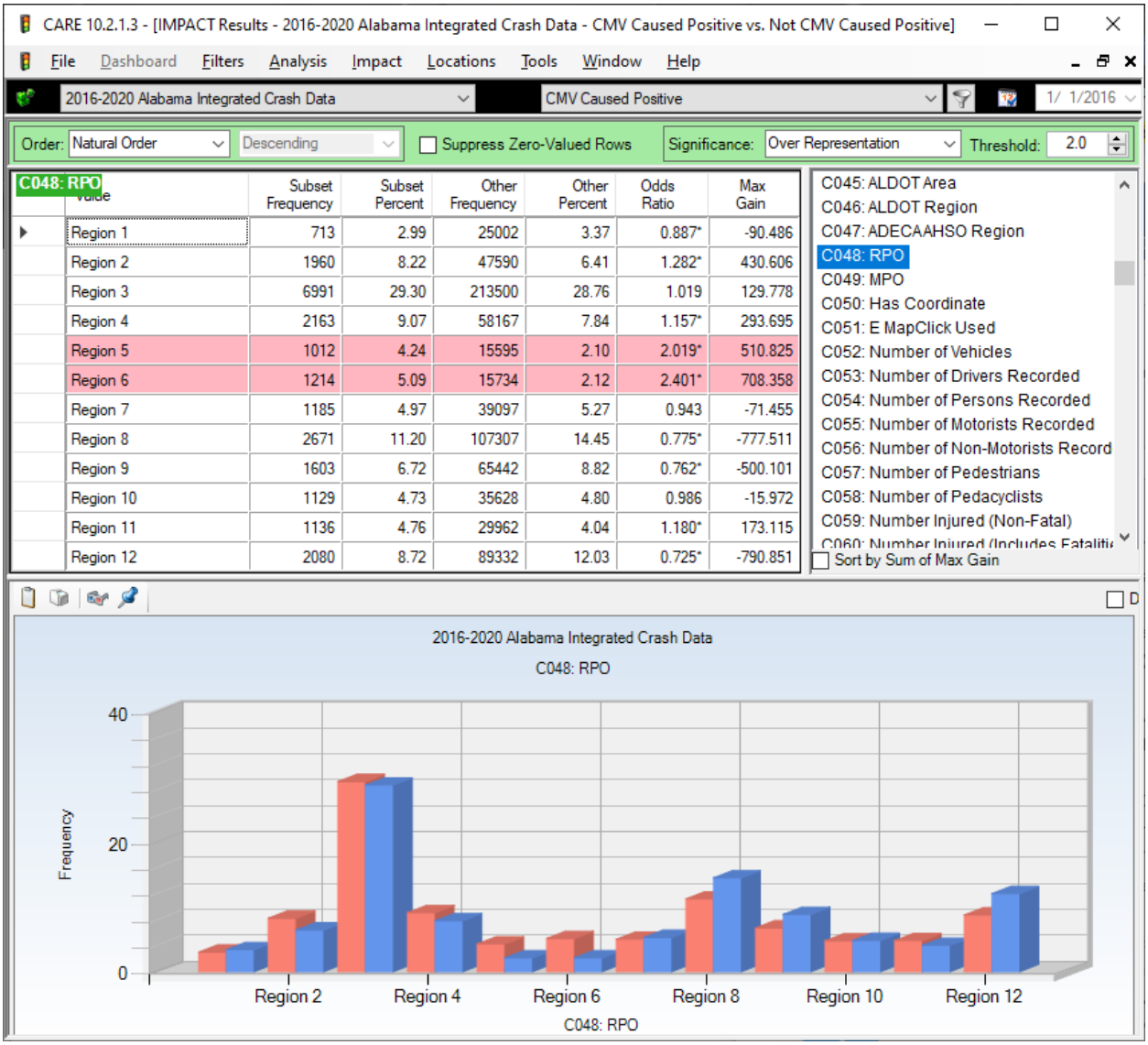
The ALDOT West Central Region is the only one with a large over-representation.

3.23 ADECA-AHSO Regions CMVs vs Non-CMVs



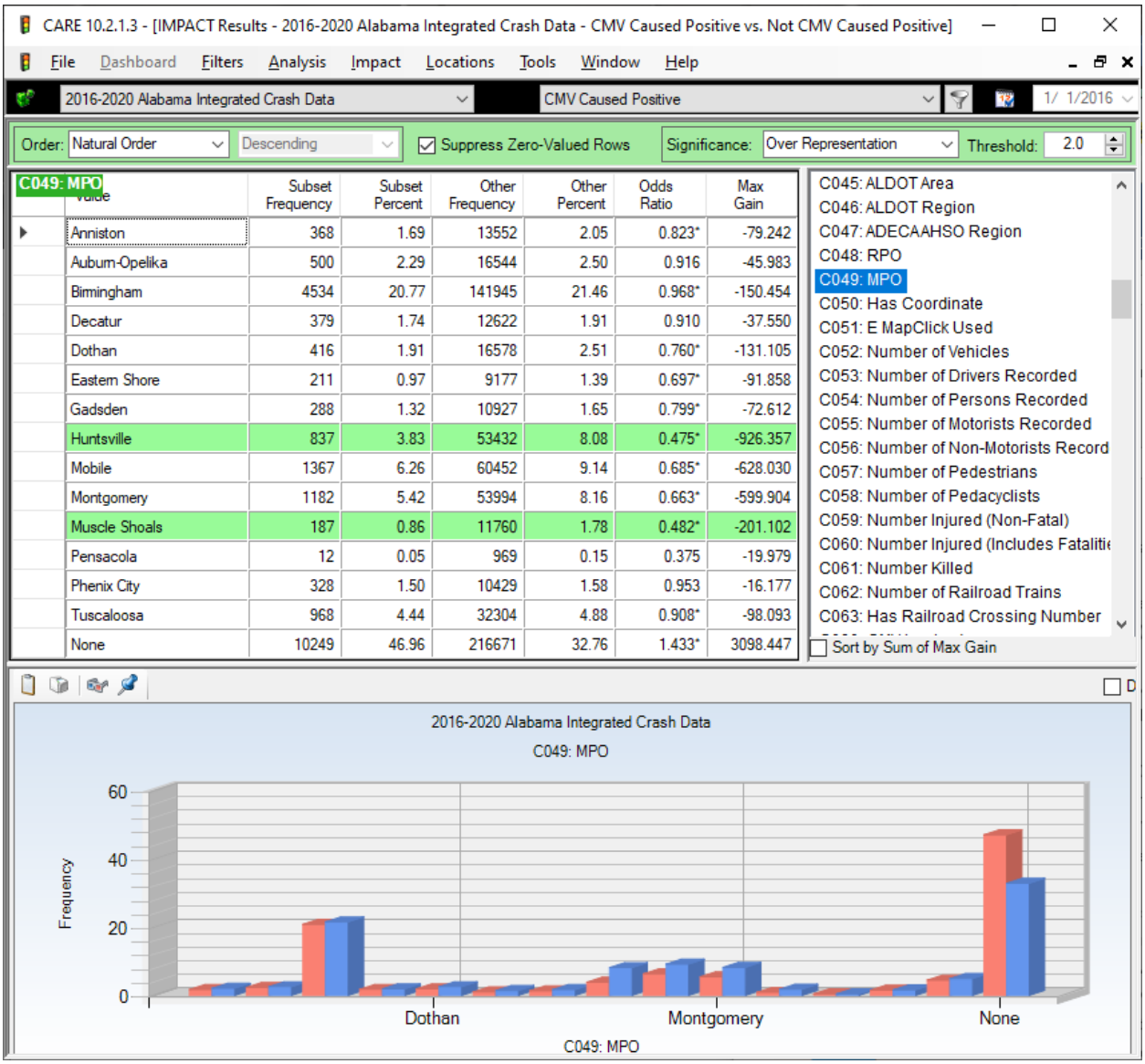
None of these regions shows an extraordinarily high level of over-representation of CMV caused crashes.

3.24 RPO Regions CMVs vs Non-CMVs



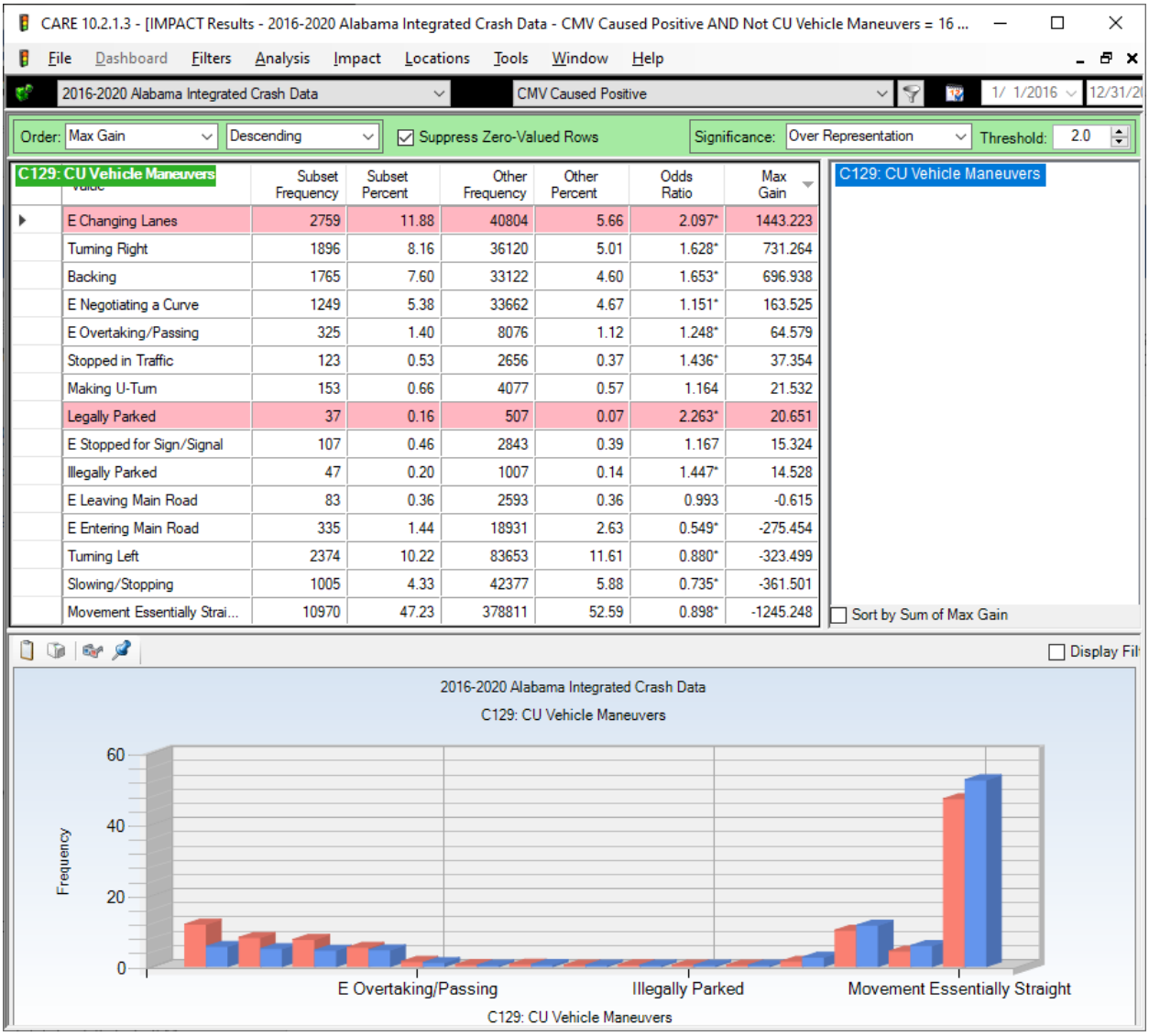
Regions 5 and 6 have over twice their expected proportion of CMV caused crashes when compared to the non-CMV crashes that are occurring in the regions.

3.25 MPO Areas CMVs vs Non-CMVs



Of those assigned an MPO name, none show any over-representations.

3.26 Vehicle Maneuver

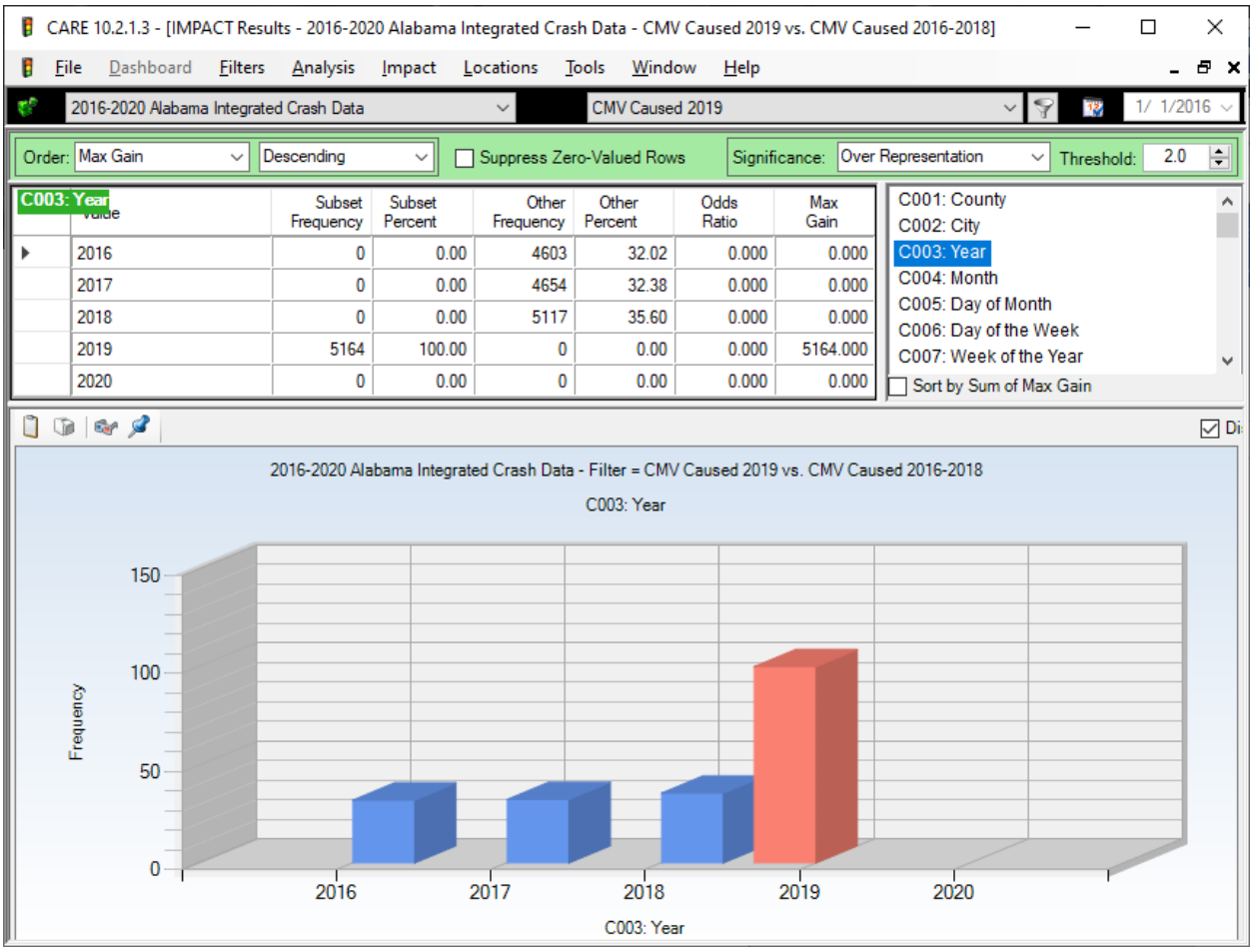


The following had Max Gains in excess of 50 crashes: Changing Lanes, Turning Right, Backing, Negotiating a Curve, and Overtaking/Passing. Changing Lanes was almost double the next highest Max Gain.

4.0 Year 2019 against the three previous years (2016-2018)

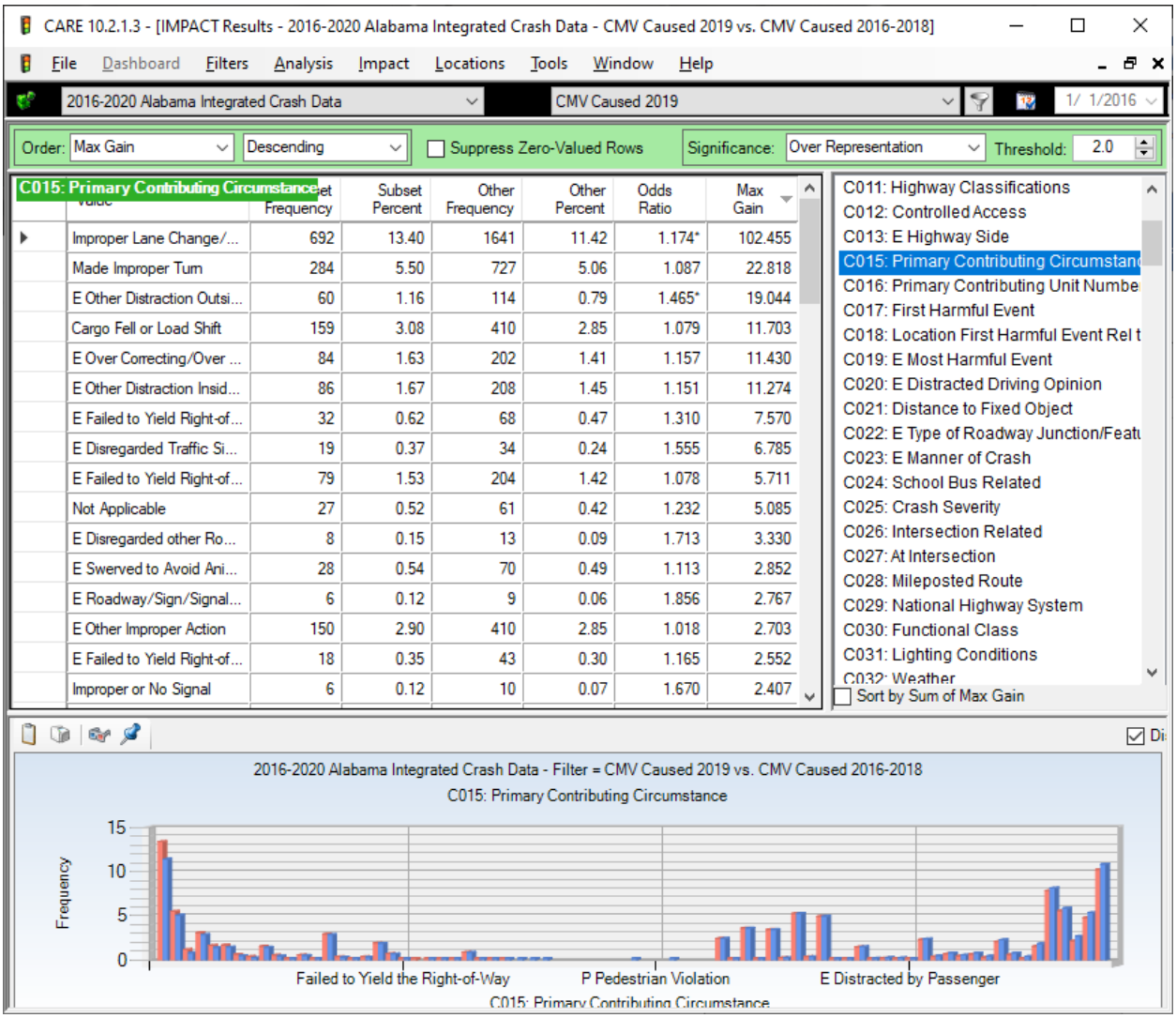
See the five year comparison in Section 3.3. The results there indicate that 2019 had a significant increase over 2016-2018. It was determined to eliminate 2020 from this analysis because the effects of COVID would make it non-typical. This section compares CMV-Caused crashes in 2019 (test; red bars) against CMV-Caused crashes in 2016-2018 (control; blue bars) in an attempt to surface any significant differences that may have caused the increase in 2019.

4.1 Year CMV-Caused 2019 vs CMV-Caused 2016-2018 (filter definitions)



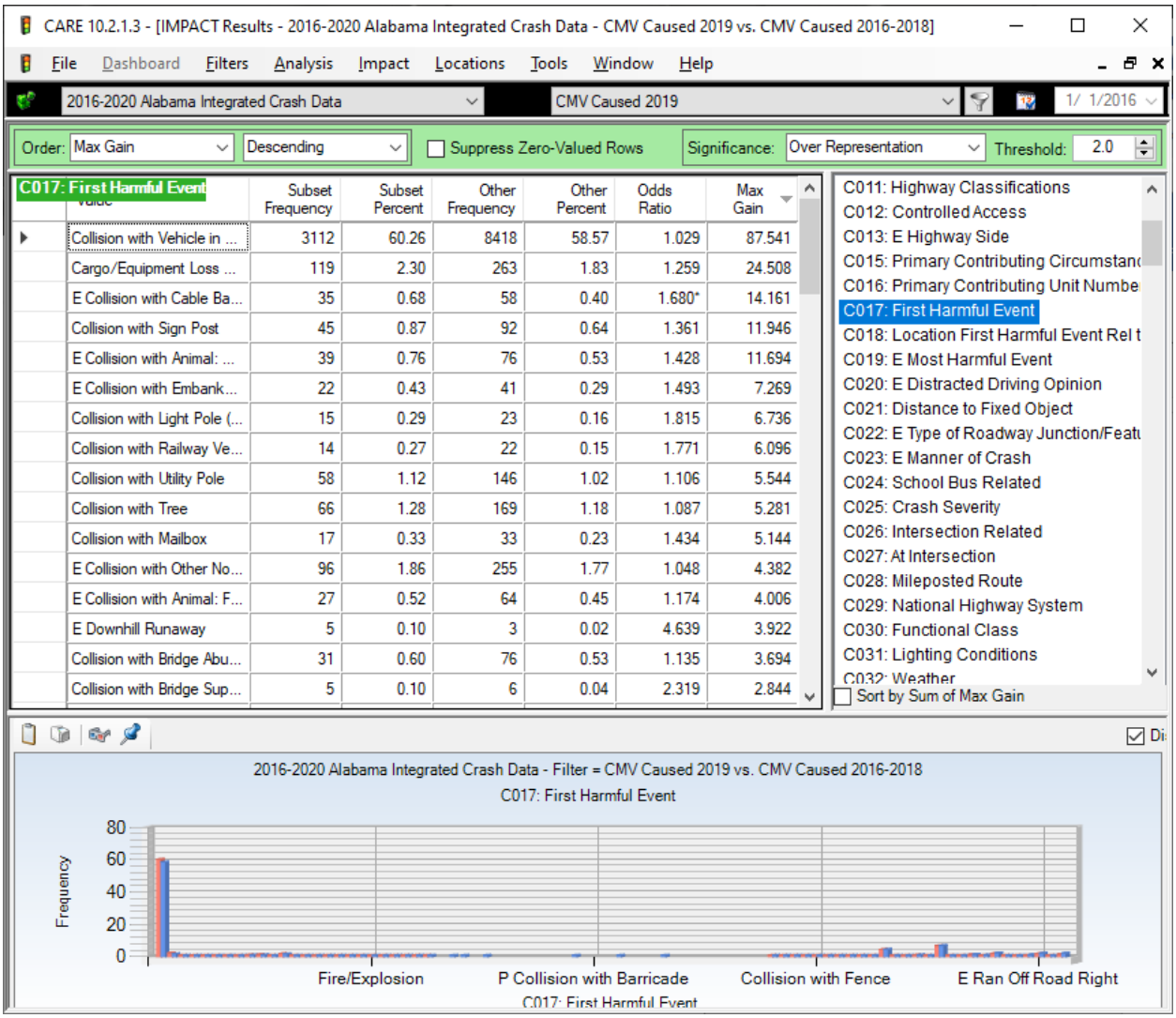
The above shows the test (Subset) and the control (Other) produced by the filters that are forming the basis for the comparison of the CMV-caused crashes over the 2016-2019 years. These filters will be in effect for the rest of this section in order to attempt to establish the reason that 2019 had a higher than expected proportion of crashes.

4.2 Primary Contributing Circumstances CMV-Caused 2019 vs 2016-2018



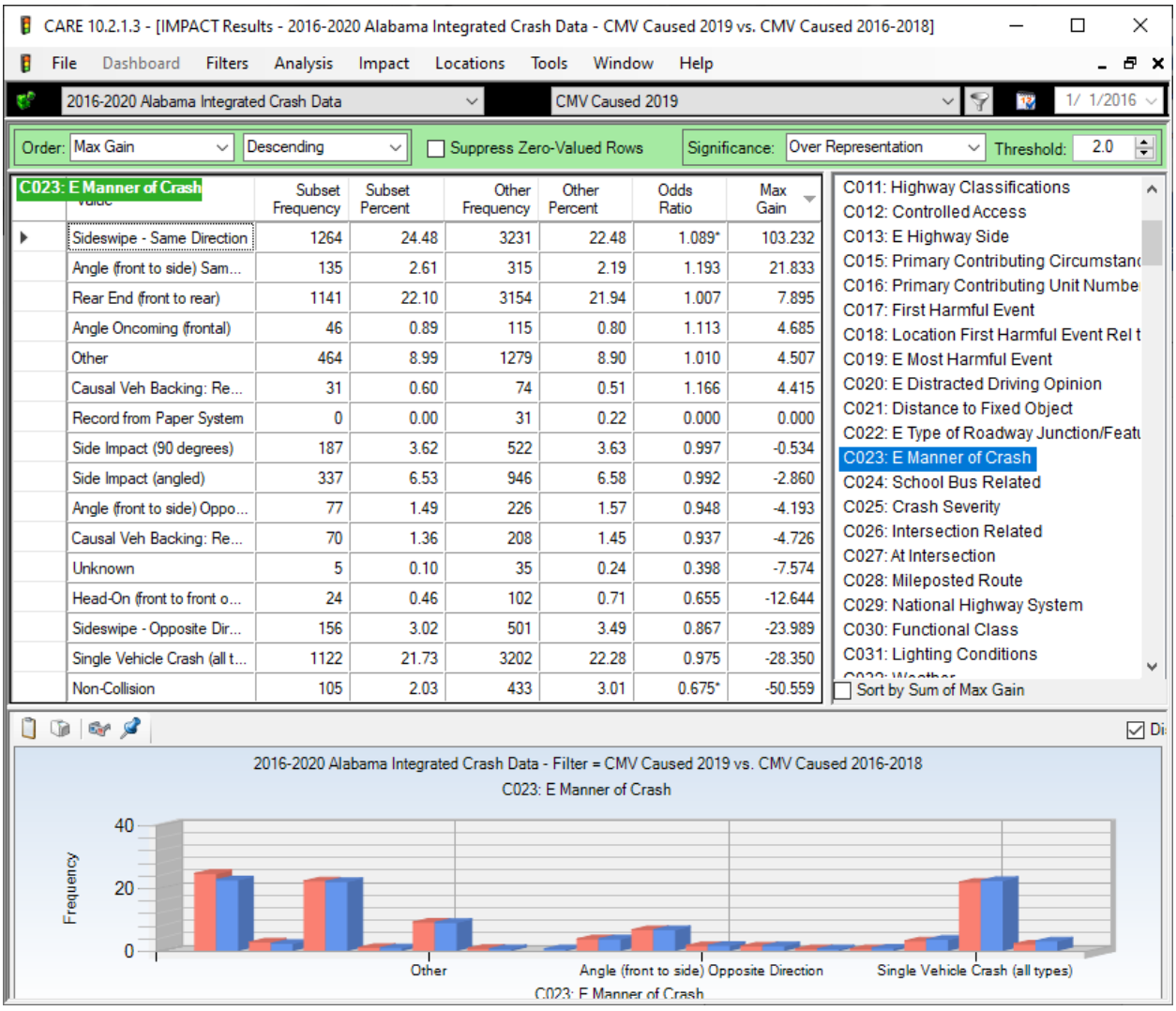
Improper Lane Change definitely became more of a problem in 2019 than it had been in the prior three years. The Max Gain indicates that the difference was about 102 crashes. Improper turns and other distractions outside the vehicle would account for a few more, although the numbers drop off quickly. Primary emphasis here should be on Improper Lane Change.

4.3 First Harmful Event CMV-Caused 2019 vs 2016-2018



The only item with a significant difference is Collision with a Cable Barrier, and we would expect the large truck would be attempting to avoid a pedestrian, animal or other vehicle. The Max gain is only a little over 14. So there is little of significance here.

4.4 Manner of Crash CMV-Caused 2019 vs 2016-2018



Sideswipe in the same direction further reinforces the findings of Section 4.2 – Improper Lane Change/Use. This would be the manner of crash that would result from an encroachment into the lane of another vehicle. It is interesting that, while these two crash causes/results (Improper Lane Change and Sideswipe – Same Direction) have major differences in frequencies, their Max Gains are practically the same. If only 100 crashes were reduced by some countermeasure to these two items, it would be a significant reduction in the total crashes for 2019.

5.0 Improper Lane Change Analysis

The following table indicates how "Improper Lane Change" is recorded in its various attributes.

#	Attribute	Value	Number	
C015	Primary Contributing Circumstance (PCC)	Improper Lane Change	2846	
C023	Manner of Crash	Sideswipe Same Direction	5413	
C129	CU Vehicle Maneuver	Changing Lanes	2759	
C202	CU Contributing Circumstance	Improper Lane Change	2091	

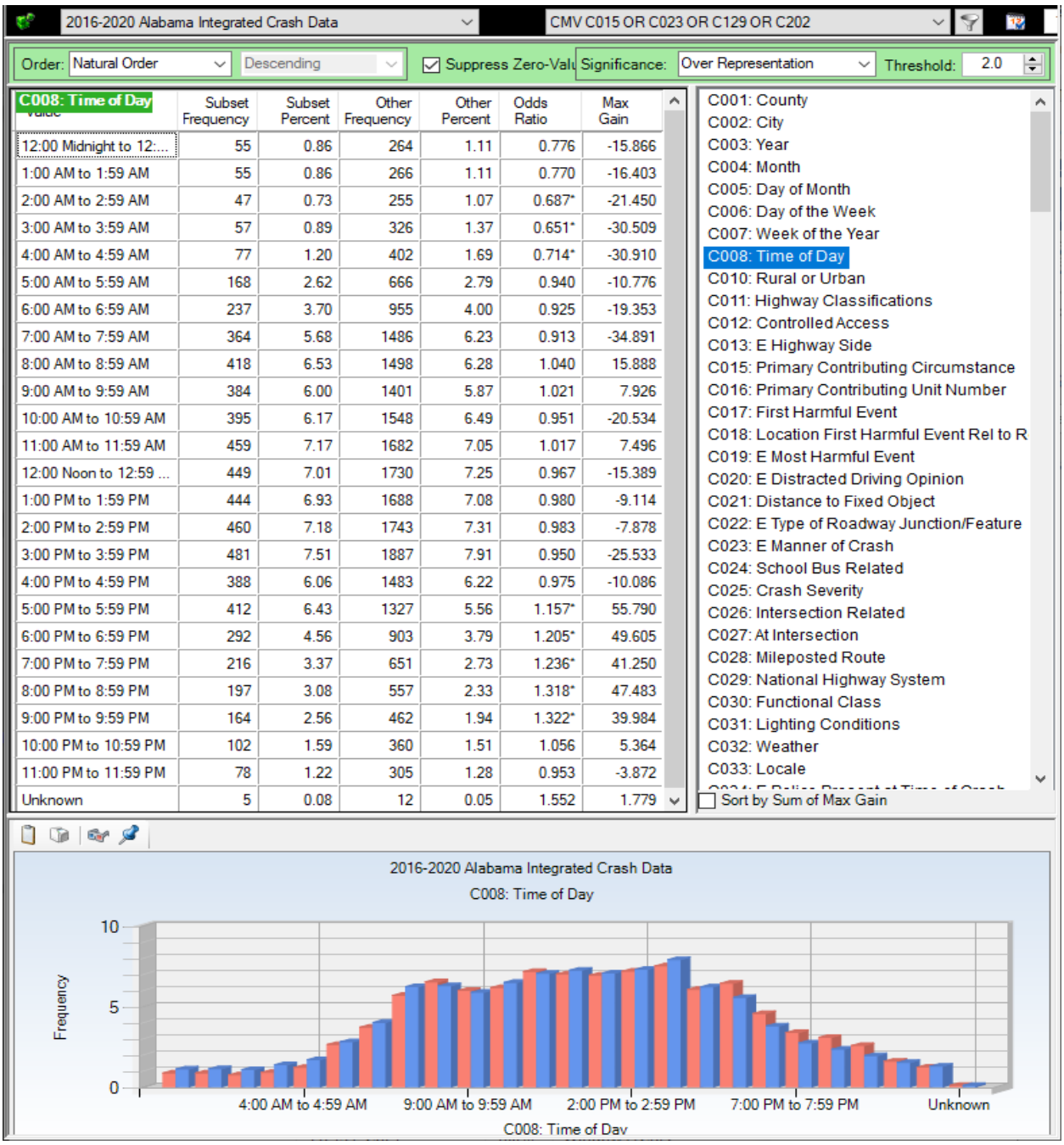
For simplicity, we will refer to all of these as "Improper Lane Change" or ILC. These are not intended to be mutually exclusive. Recording officers may select any combination of these for a given crash.

The nominal Causal Unit (CU) will be the CMV in all crashes in the ILC subset because the intent of this analysis is to uncover information to reduce CMV crashes. This was determined by C450 CU CMV Indicator = Yes – CU is a CMV.

IMPACTS showing significance and/or difference from general CMV Caused:
C008 C010 C011 C015* C022 C023* C028 C031 C033 C040-049
6.12 C052 6.13 C101 6.14 C104 6.15 C105 6.16 C106 6.17 C107 6.18 C108
6.19 C129* 6.20 C202* 6.21 C208 6.22 C224 6.23 C412 6.24 C413 6.25 C415 C451-465

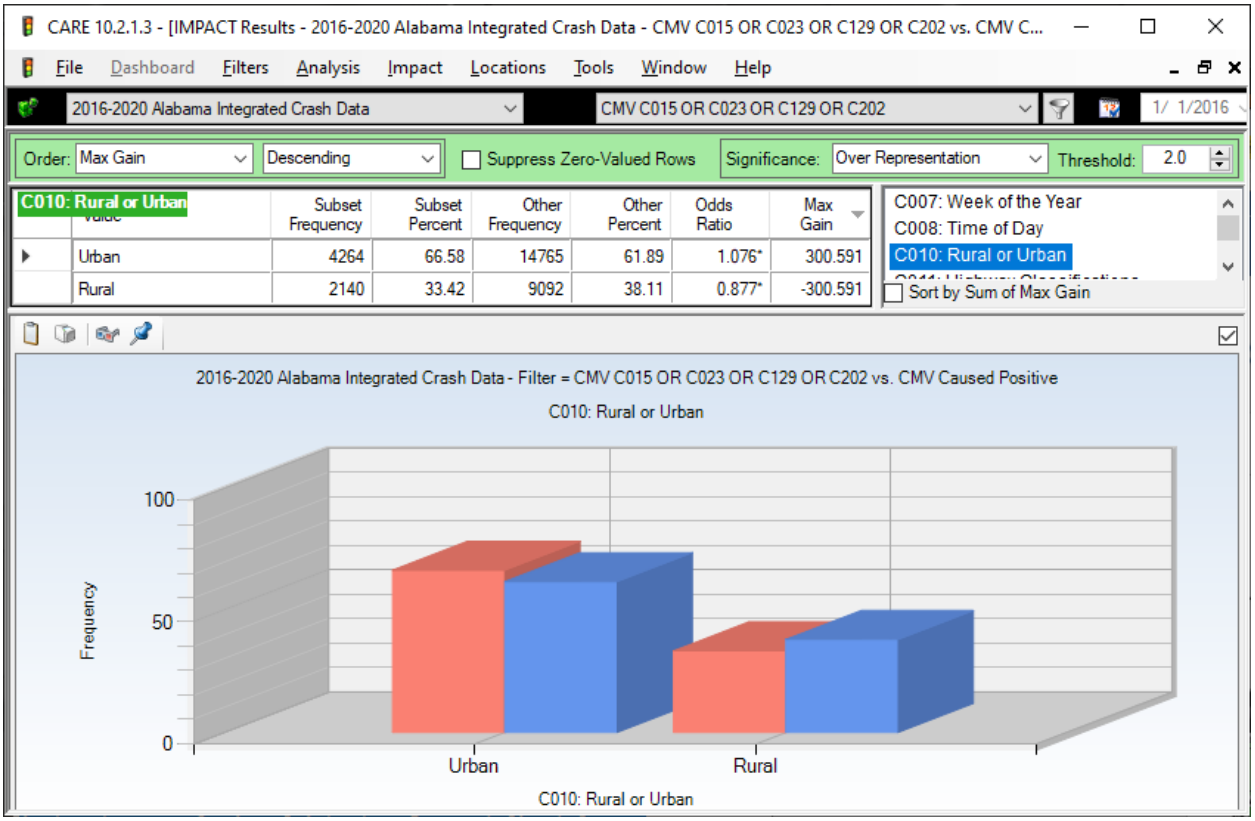
The following IMPACT displays will compare a crash subset of all of the 4 ILCs above ORed together against the CMV Caused subset. This control subset (CMV Caused) was used to determine how ILC crashes were different from CMV-caused crashes in general.

5.1 Time of Day; ILC vs All CMV Caused



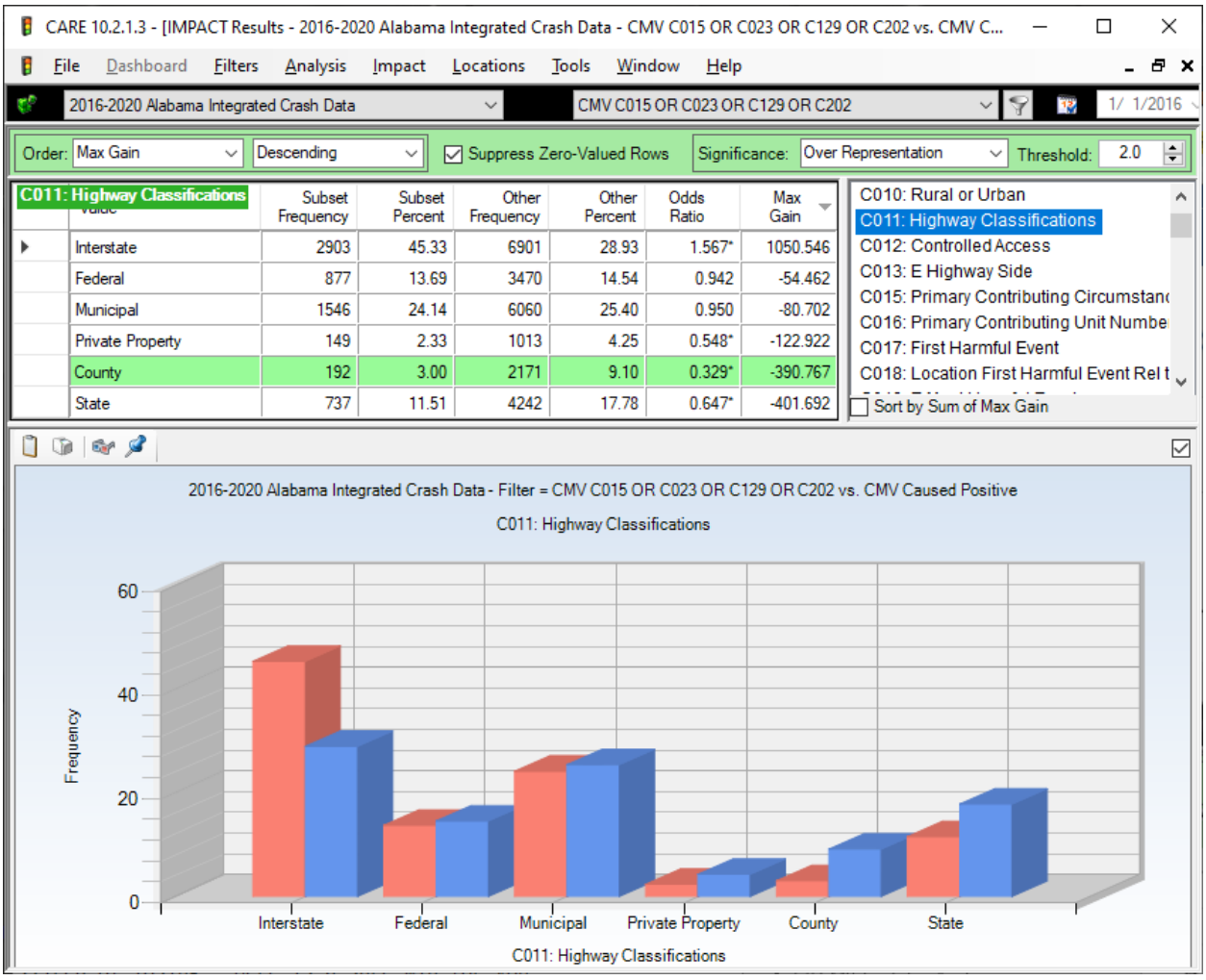
The time of day distribution for ILCs is generally not significantly different from CMV Caused crashes in general. However, there are several hours that are significantly over-represented in the late afternoon, 5:00 PM through 9:59 PM.

5.2 Rural/Urban; ILC vs All CMV Caused



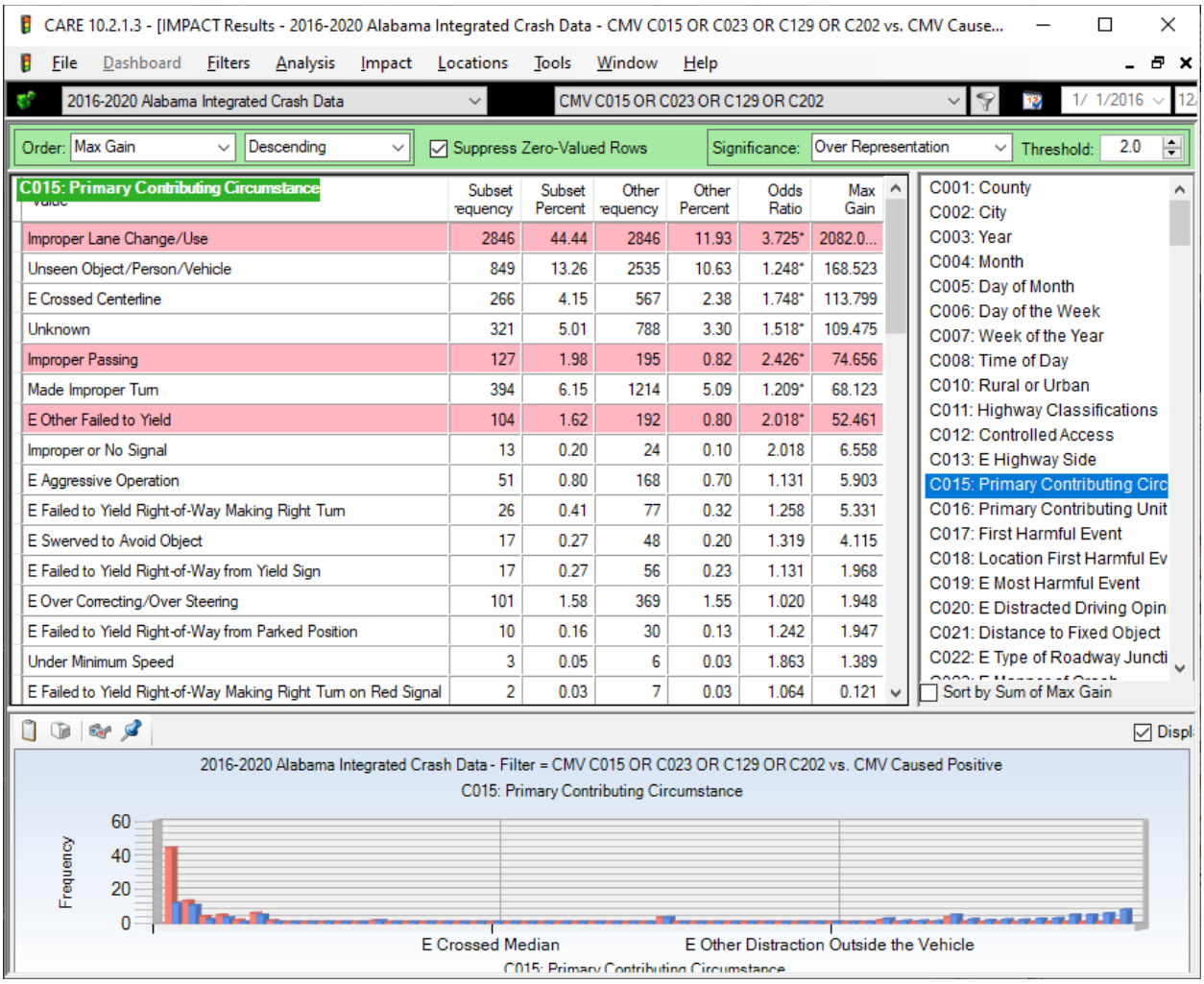
Unlike CMV Caused in general, ILC crashes occur significantly more in the Urban than the Rural roadways. About twice as many crashes occur in the Urban as in the Rural areas. Please see the discussion in this regard in Section 5.10, Locale.

5.3 Highway Classification; ILC vs All CMV Caused



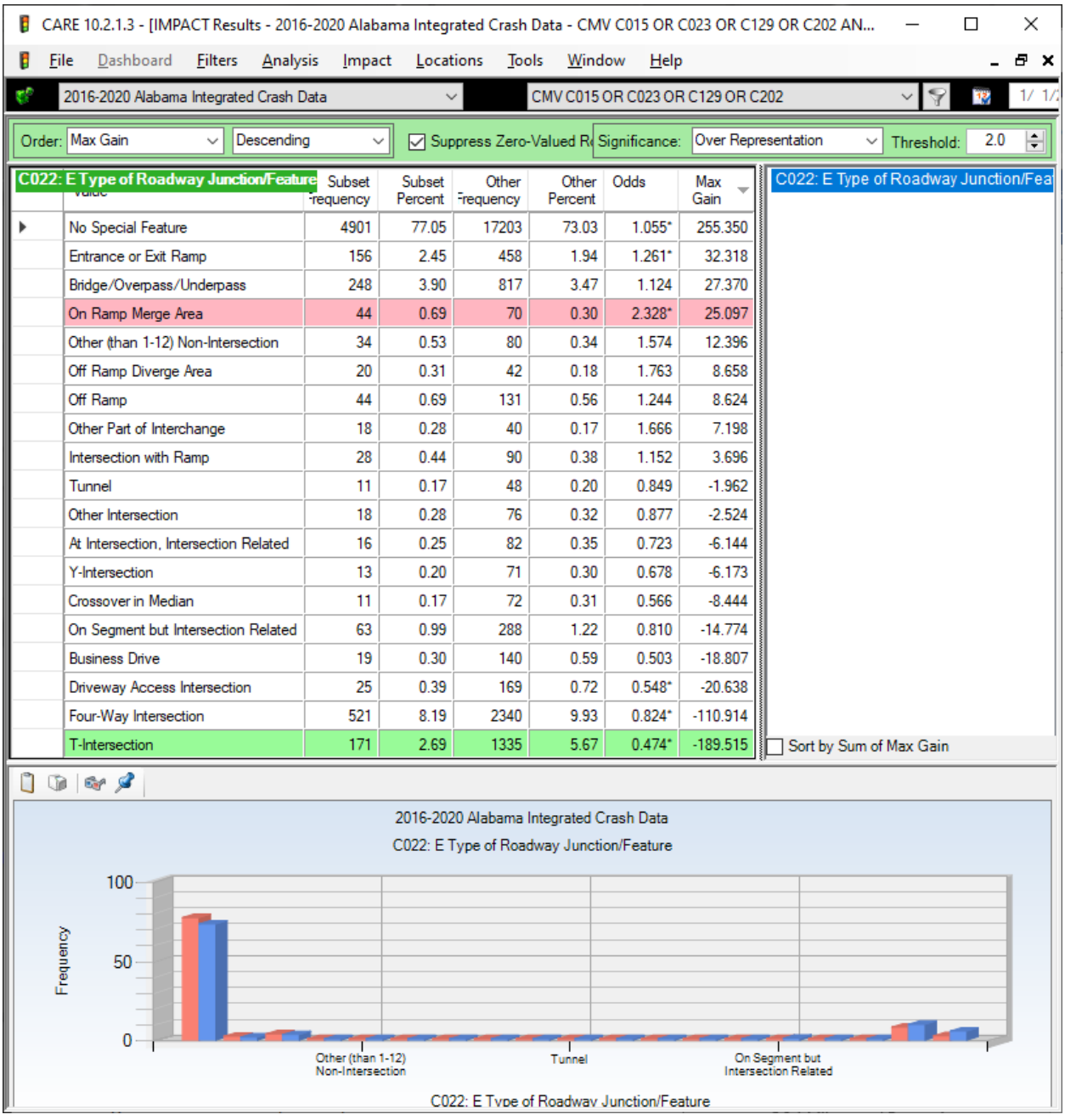
CMVs are have a little over 45% of their ILC crashes on Interstates, which is over-represented in comparison to all CMV Caused crashes by 56.7%. See Section 5.10, which indicates that a large proportion of these Interstate crashes are close to urban areas as opposed to open country. Although slightly under-represented, the proportion of crashes on Municipal Roadways is second only to Interstates, further reflecting the tendency of ILC crashes to be in or near urban areas.

5.4 Primary Contributing Circumstances (PCCs); ILC vs All CMV Caused; C015 = part of ILC filter (see Section 5.0)



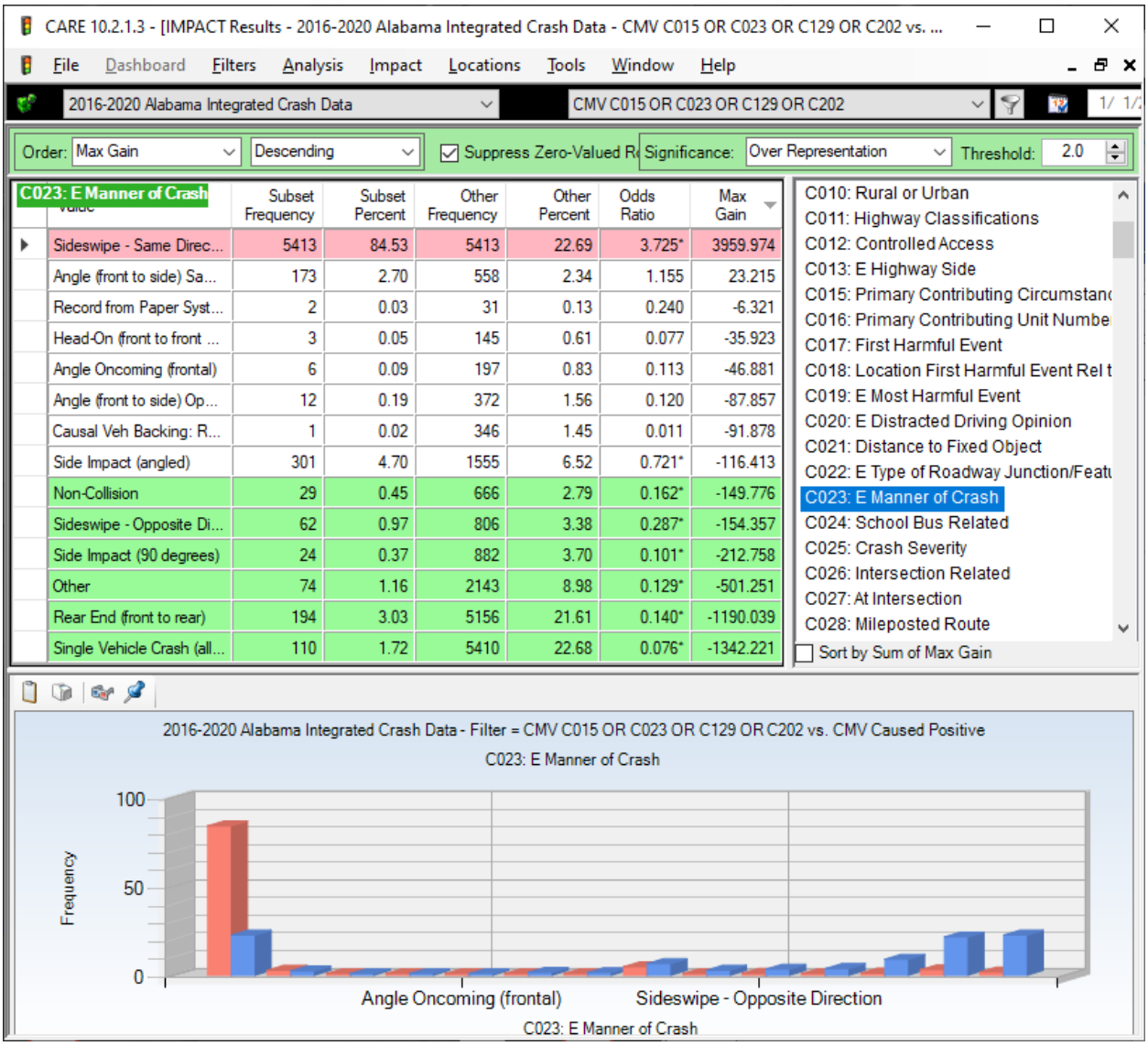
The 2846 ILC crashes in this attribute were used as part of the ILC definition process, along with three other attributes that indicated ILC (see Section 5.0 for the detailed definition). Thus, the remaining items listed for this attribute cannot be considered to be a reflection of anything except the residual crashes that were not filtered out by the other three attribute values. This does provide some important subjective information even if it cannot be quantified. For example, 849 crashes were recorded to be "Unseen Object/Person/Vehicle." It is reasonable to expect that a large number of crashes occurred when one of the drivers failed to see the other vehicle. This, and the other values as well, provide valuable insights into potential ILC crash causes.

5.5 Type of Junction/Intersection; ILC vs All CMV Caused (Items > 50 Crashes in 5 Years)



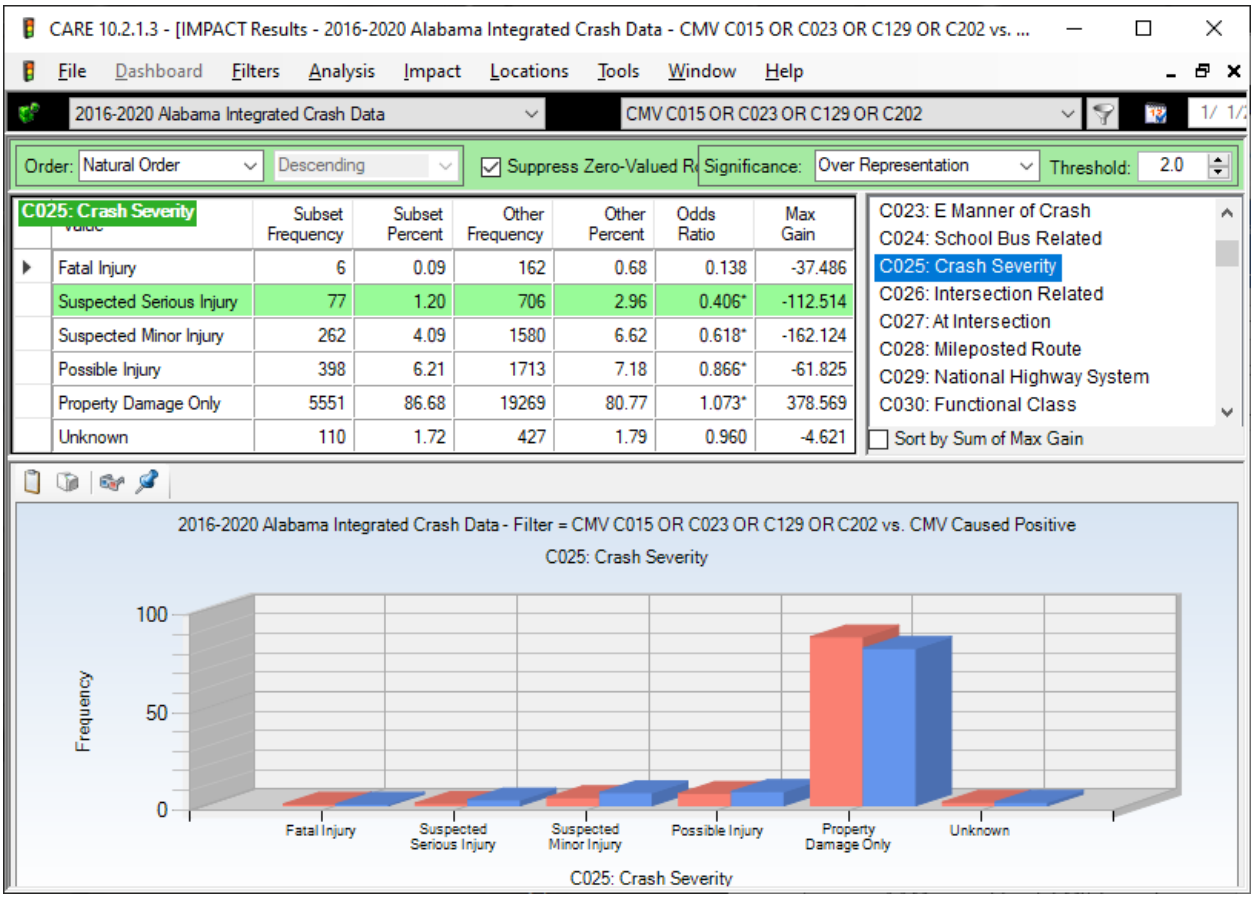
The general "Intersection Related" attributes (C026 and C027) indicated that CMV Caused crashes were involved in fewer than expected crashes at intersections. These two attributes showed even proportionately fewer ILC crashes at intersections. The two intersection types that were significantly over-represented were "Entrance or Exit Ramp" and "On Ramp Merge Area."

5.6 Manner of Crash; ILC vs All CMV Caused; C023 = part of ILC



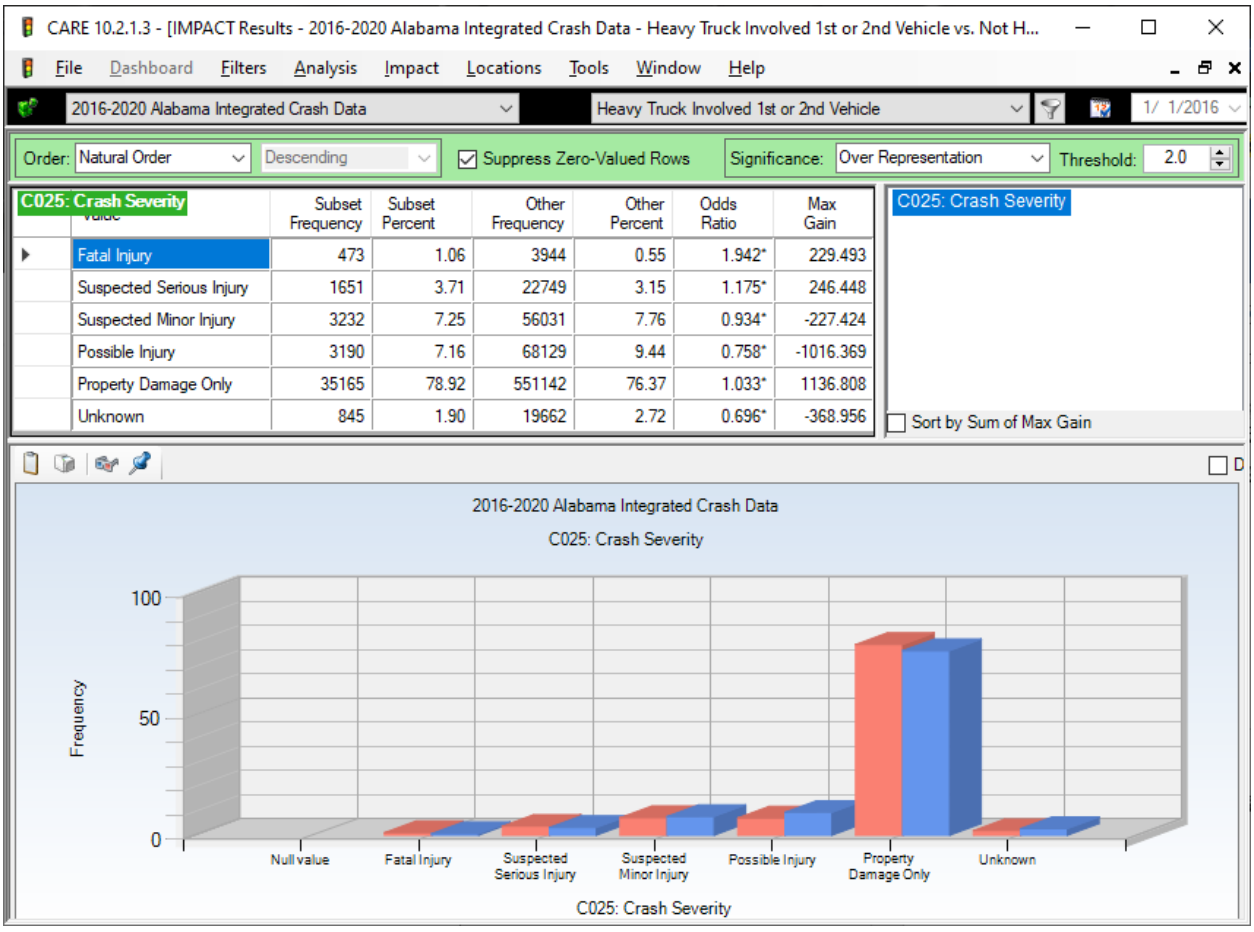
This attribute was also used to define the ILC filter; in this case Sideswipe – Same Direction was considered to be in indicator of ILC. A comparison with the results for CMV Caused vs all other crashes indicate the following frequencies in the C023 attribute that were filtered out:
Single Vehicle Crash - all types (was 5,410; now 110), Non-Collision (was 666; now 29), and Sideswipe - Opposite Direction (was 806; now 62).

5.7a Crash Severity; ILC vs All CMV Caused



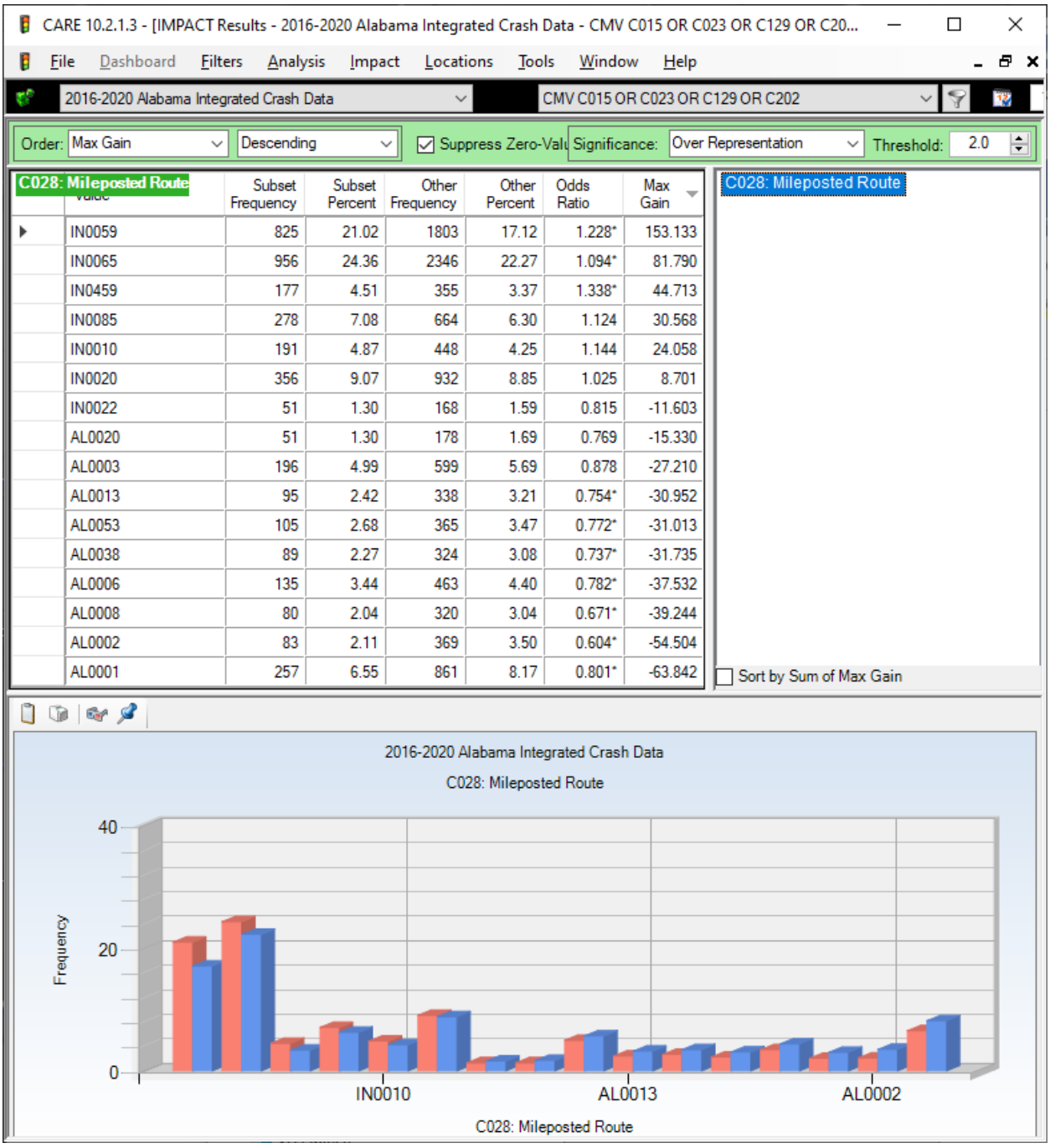
The above indicates that the severity of the defined ILC is considerably lower than that of CMV Caused crashes in general. The cause of the lower severity is probably the urban nature of the crashes coupled with their slower impact speeds (see Section 5.15). The analysis giving next shows the extent to which crashes involving large trucks result in higher severities.

5.7b Crash Severity; <u>All Large Truck Involved (1st or 2nd Vehicle)</u> vs Non-CMVs



The above shows that crashes involving large trucks generally result in more fatal crashes. However, past research has shown that most of the fatal crashes are not caused by the large trucks but by the lighter vehicle. Obviously, any crash of a large heavy vehicle and one that is considerably lighter has the potential to cause serious harm.

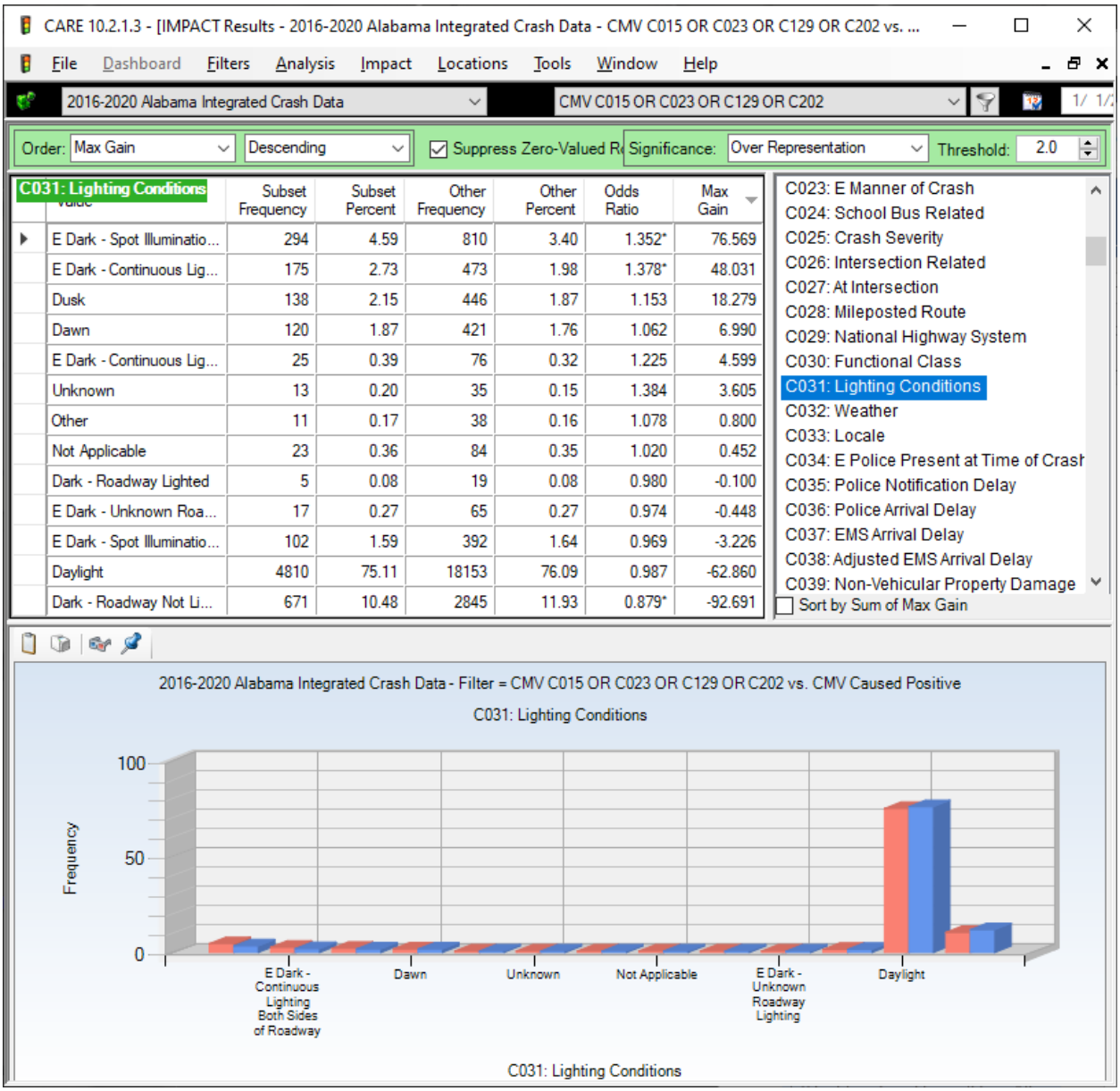
5.8 Mileposted Routes; ILC vs All CMV Caused (Crashes > 50)



C028: Mileposted Route	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
IN0059	825	21.02	1803	17.12	1.228*	153.133
IN0065	956	24.36	2346	22.27	1.094*	81.790
IN0459	177	4.51	355	3.37	1.338*	44.713
IN0085	278	7.08	664	6.30	1.124	30.568
IN0010	191	4.87	448	4.25	1.144	24.058
IN0020	356	9.07	932	8.85	1.025	8.701
IN0022	51	1.30	168	1.59	0.815	-11.603
AL0020	51	1.30	178	1.69	0.769	-15.330
AL0003	196	4.99	599	5.69	0.878	-27.210
AL0013	95	2.42	338	3.21	0.754*	-30.952
AL0053	105	2.68	365	3.47	0.772*	-31.013
AL0038	89	2.27	324	3.08	0.737*	-31.735
AL0006	135	3.44	463	4.40	0.782*	-37.532
AL0008	80	2.04	320	3.04	0.671*	-39.244
AL0002	83	2.11	369	3.50	0.604*	-54.504
AL0001	257	6.55	861	8.17	0.801*	-63.842

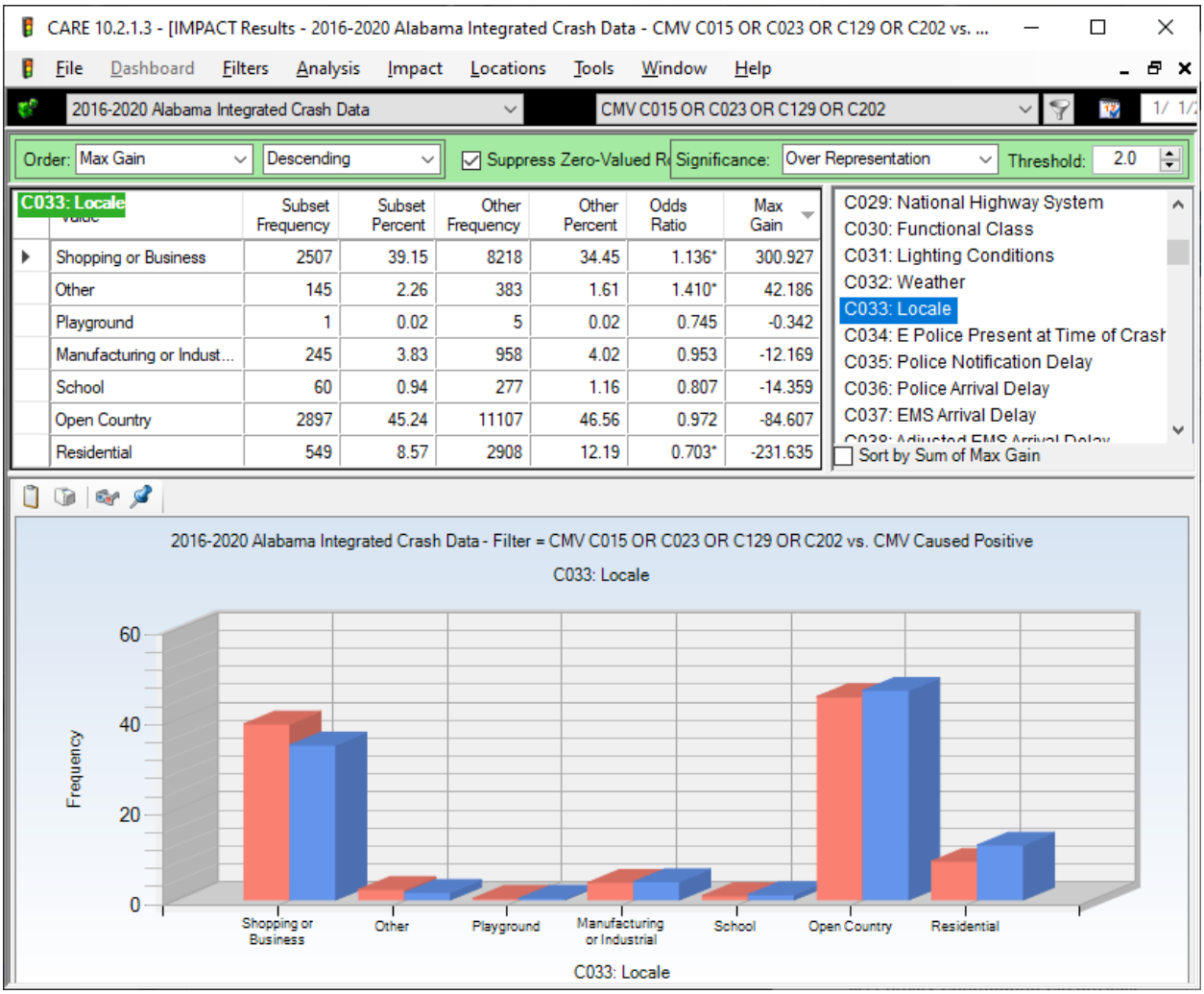
I-59, I65 and I-459 significant over-representations. Those at the bottom of the list were generally significantly under-represented, although some had well over 50 ILC crashes.

5.9 Lighting Conditions; ILC vs All CMV Caused



These results correspond closely to the time of day results in Section 5.1. This would especially be true in the time-change months of November and December, which were found to be over-represented, although not significantly.

5.10 Locale; ILC vs All CMV Caused

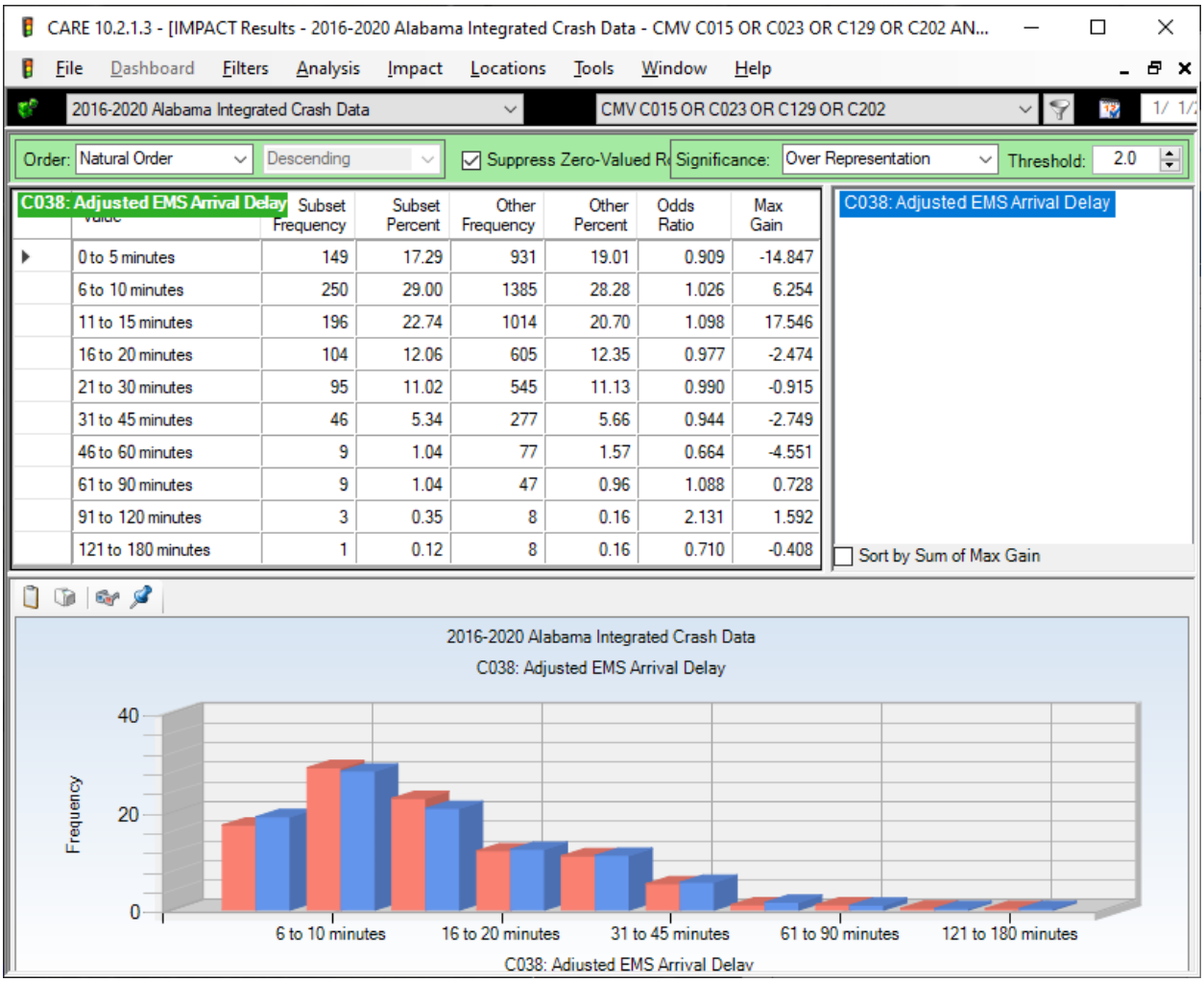


Open Country, which was the top of the over-representation list for all CMV Caused, is now shown to be under-represented for ILC crashes. The following attributes further support this outcome (over-representations in parentheses):

Section	**Attribute**	
5.2	Rural or Urban	(Urban)
5.3	Highway Classification	(I)
5.16	Trafficway Lanes	(Three or more lanes)
5.17	Turn Lanes	(Both right- and left-turn lanes)
5.10	Locale (shown above)	(Shopping or business)

Before drawing any conclusion on the general concentration of ILC crashes, all of these attributes should be examined and compared.

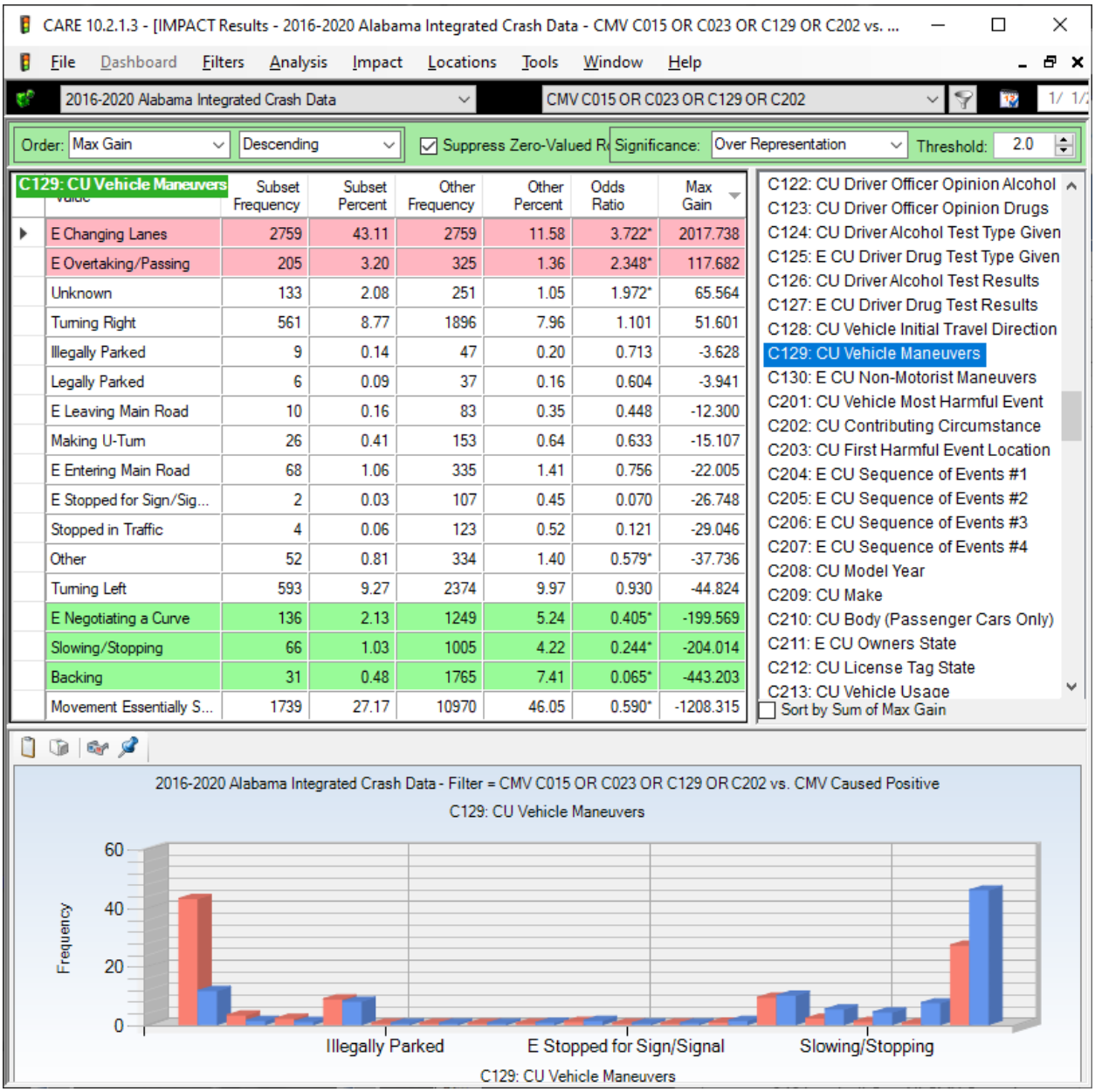
5.11 Adjusted EMS Arrival Delay; ILC vs All CMV Caused



There are no significant differences in the ambulance arrival time between the ILC and the CMV Caused crashes in general. See Section 3.17 for the contrast between CMVs and all other vehicles.

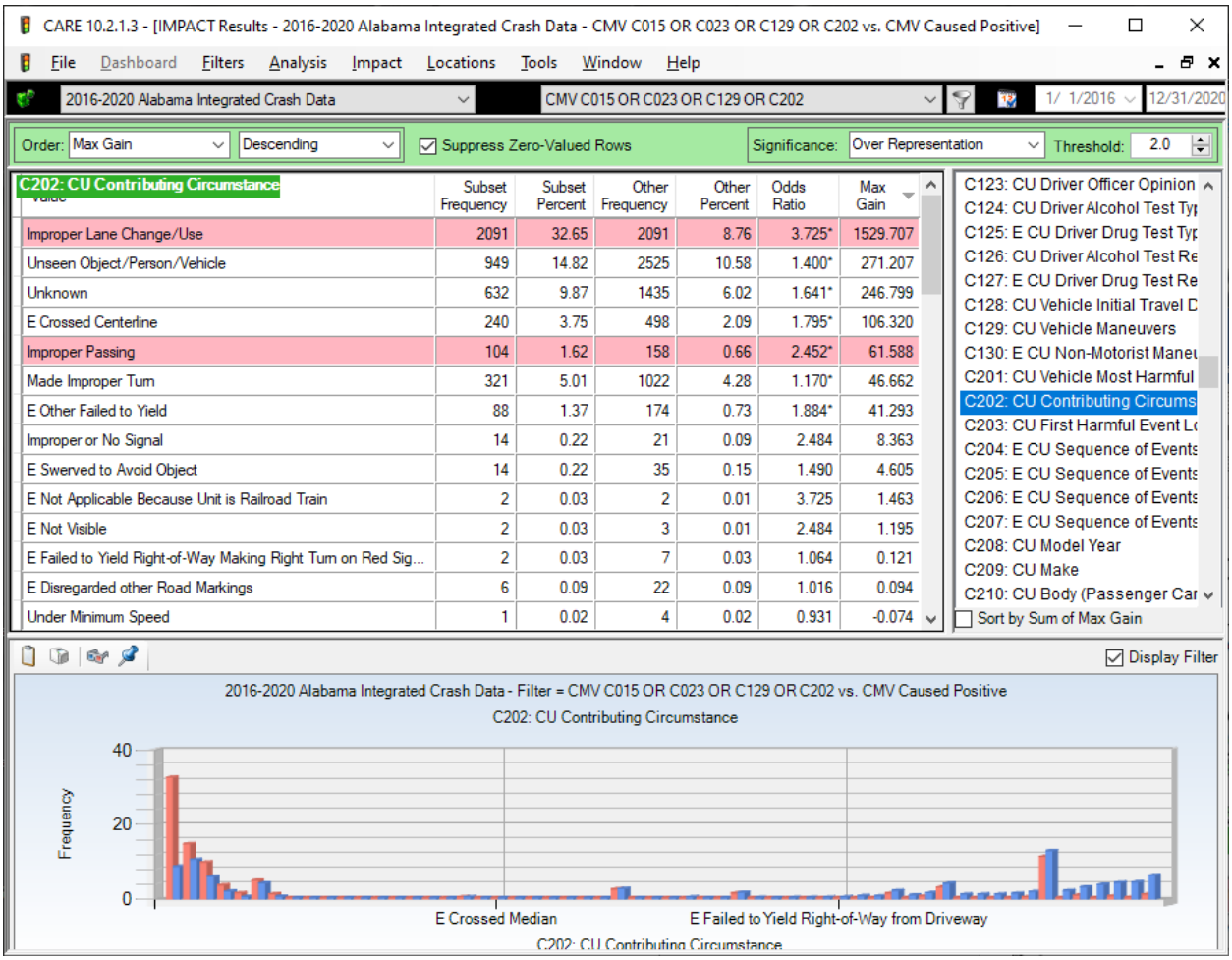
C040-C049 have been omitted since they were determined not to provide any information in addition to the results given in Sections 3.18-3.25.

5.12 C129 Vehicle Maneuvers; ILC vs All CMV Caused; C129 = part of ILC filter



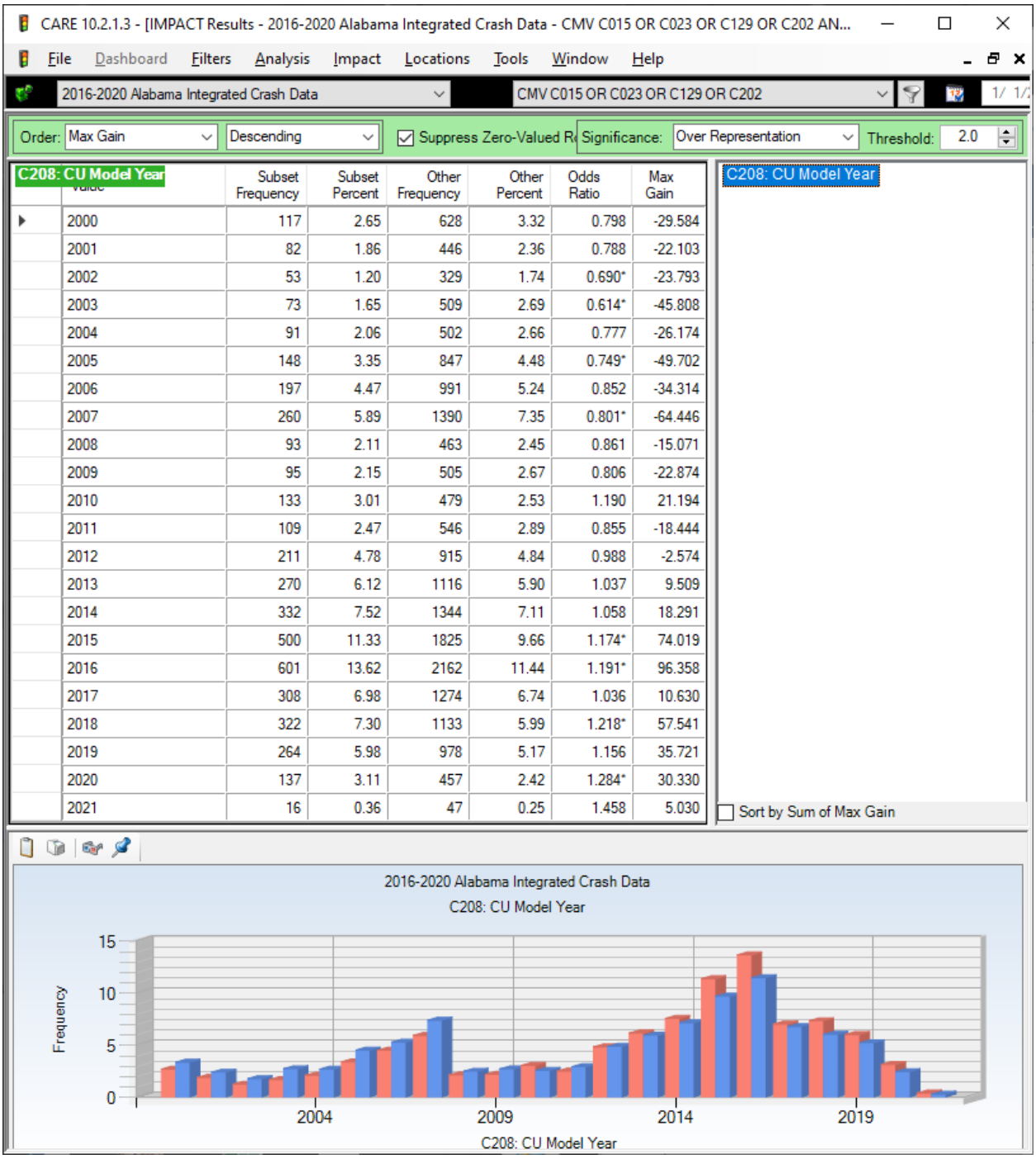
The following had Max Gains in excess of 50 crashes: Changing Lanes, Overtaking/Passing, and Turning Right. These are shown for their subjective use, since the numbers given above are not indicative of their absolute frequency due to this attribute being part of the ILC filter.

5.13 C202 CU Contributing Circ ILC vs All CMV Caused; C202 part of ILC filter



Like C129 (discussed immediately above this one), the results here are only good for obtaining an indication of other factors that might have influenced the crashes, since C202 Improper Lane Change/Use was used in creating the ILC filter. The other factors that rose to the top are quite interesting, and it can be seen how they would affect the ILC crashes. They are: Unseen Object/Person/Vehicle, Crossed Centerline, Improper Passing, Made Improper Turn, Other Failed to Yield. These are all significantly over-represented in their comparison with the CMV Caused crash subset.

5.14 C208 CU Model Year ILC vs All CMV Caused



C208: CU Model Year	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
2000	117	2.65	628	3.32	0.798	-29.584
2001	82	1.86	446	2.36	0.788	-22.103
2002	53	1.20	329	1.74	0.690*	-23.793
2003	73	1.65	509	2.69	0.614*	-45.808
2004	91	2.06	502	2.66	0.777	-26.174
2005	148	3.35	847	4.48	0.749*	-49.702
2006	197	4.47	991	5.24	0.852	-34.314
2007	260	5.89	1390	7.35	0.801*	-64.446
2008	93	2.11	463	2.45	0.861	-15.071
2009	95	2.15	505	2.67	0.806	-22.874
2010	133	3.01	479	2.53	1.190	21.194
2011	109	2.47	546	2.89	0.855	-18.444
2012	211	4.78	915	4.84	0.988	-2.574
2013	270	6.12	1116	5.90	1.037	9.509
2014	332	7.52	1344	7.11	1.058	18.291
2015	500	11.33	1825	9.66	1.174*	74.019
2016	601	13.62	2162	11.44	1.191*	96.358
2017	308	6.98	1274	6.74	1.036	10.630
2018	322	7.30	1133	5.99	1.218*	57.541
2019	264	5.98	978	5.17	1.156	35.721
2020	137	3.11	457	2.42	1.284*	30.330
2021	16	0.36	47	0.25	1.458	5.030

The more recent truck model years are over-represented along with other years after 2013, and especially 2015 and 2016. To a large extent, these reflect ages of vehicles on the road.

5.15 C224 CU Estimated Speed at Impact ILC vs All CMV Caused

CARE 10.2.1.3 - [IMPACT Results - 2016-2020 Alabama Integrated Crash Data - CMV C015 OR C023 OR C129 OR C20...

File Dashboard Filters Analysis Impact Locations Tools Window Help

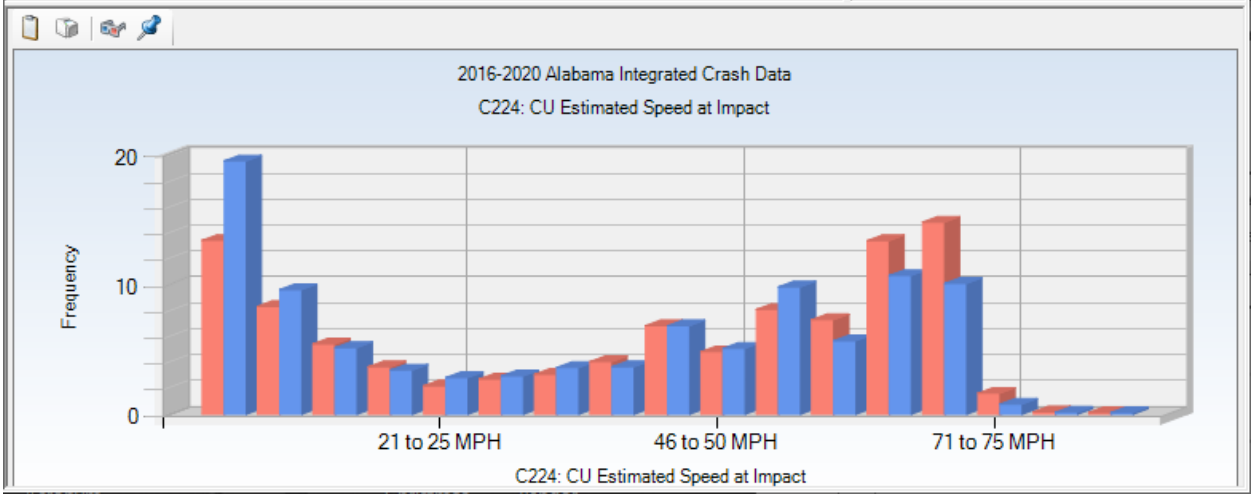
2016-2020 Alabama Integrated Crash Data | CMV C015 OR C023 OR C129 OR C202

Order: Max Gain | Descending | Suppress Zero-Valu | Significance: Over Representation | Threshold: 2.0

C224: CU Estimated Speed at Impact	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max
1 to 5 MPH	440	13.43	2840	19.56	0.686*	-201.000
6 to 10 MPH	273	8.33	1397	9.62	0.866	-42.309
11 to 15 MPH	178	5.43	747	5.14	1.056	9.399
16 to 20 MPH	120	3.66	495	3.41	1.074	8.276
21 to 25 MPH	72	2.20	411	2.83	0.776	-20.764
26 to 30 MPH	89	2.72	429	2.95	0.919	-7.827
31 to 35 MPH	101	3.08	523	3.60	0.856	-17.043
36 to 40 MPH	133	4.06	532	3.66	1.108	12.925
41 to 45 MPH	224	6.84	992	6.83	1.000	0.101
46 to 50 MPH	158	4.82	738	5.08	0.949	-8.570
51 to 55 MPH	265	8.09	1427	9.83	0.823*	-57.080
56 to 60 MPH	239	7.29	824	5.68	1.285*	53.020
61 to 65 MPH	439	13.40	1555	10.71	1.251*	88.030
66 to 70 MPH	486	14.83	1467	10.10	1.468*	154.892
71 to 75 MPH	53	1.62	113	0.78	2.078*	27.495
76 to 80 MPH	6	0.18	21	0.14	1.266	1.260
86 to 90 MPH	1	0.03	1	0.01	4.431	0.774

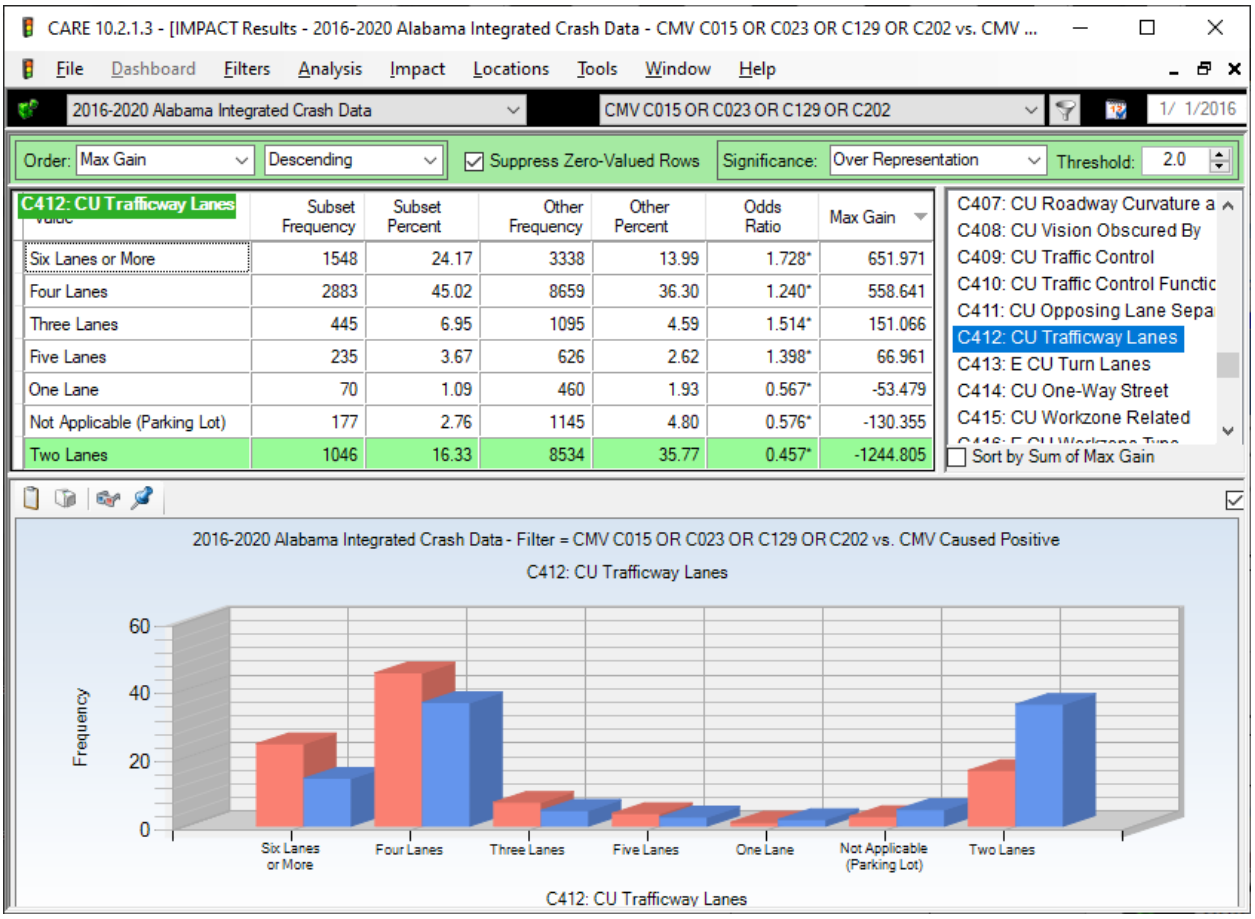
C224: CU Estimated Speed at Impact

Sort by Sum of Max Gain



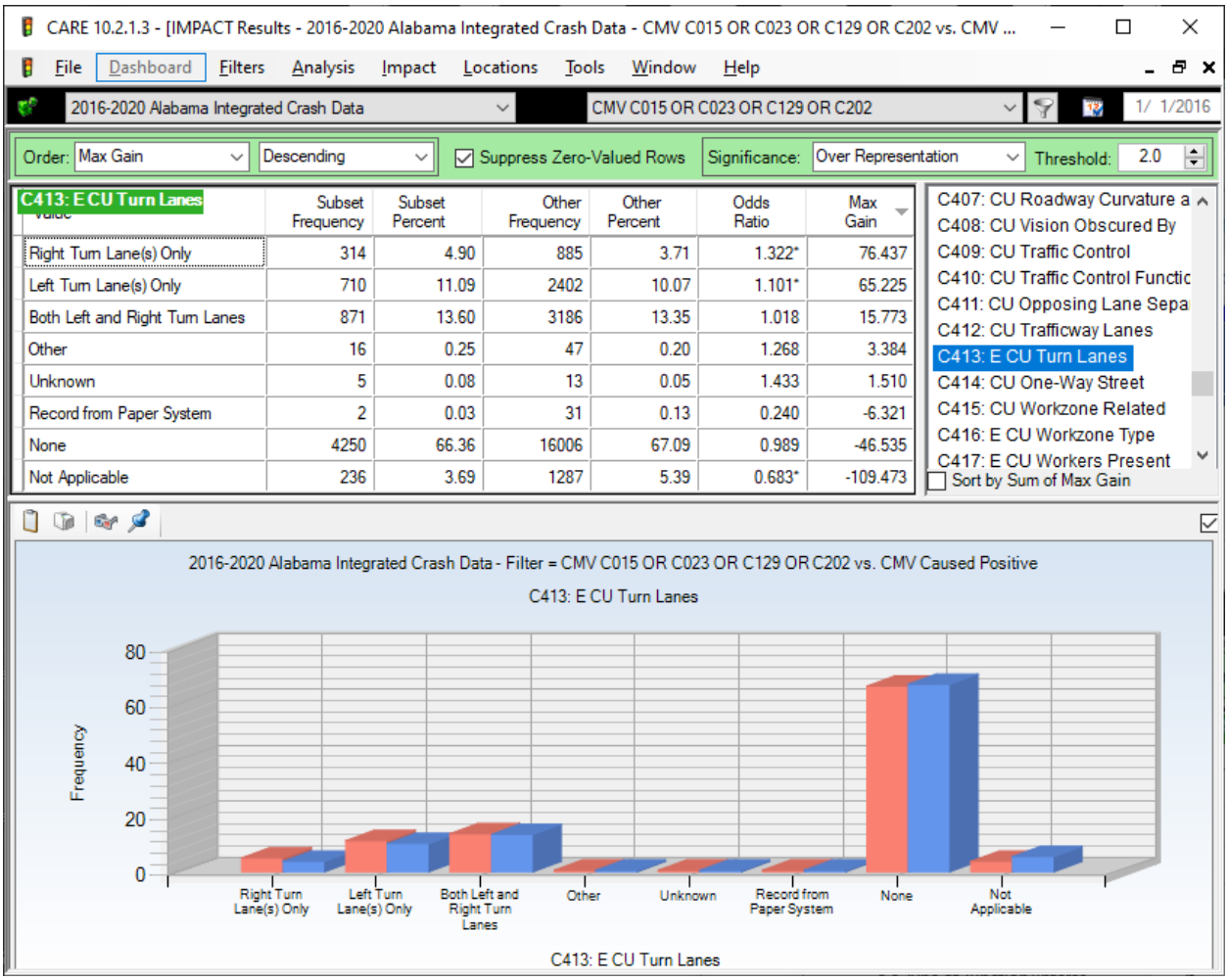
The high impact speeds abouve 56 MPH indicate that these crashes were more likely to have occurred on Interstate highways, some possibly going through relatively urbanized areas.

5.16 C412 CU Trafficway Lanes ILC vs All CMV Caused



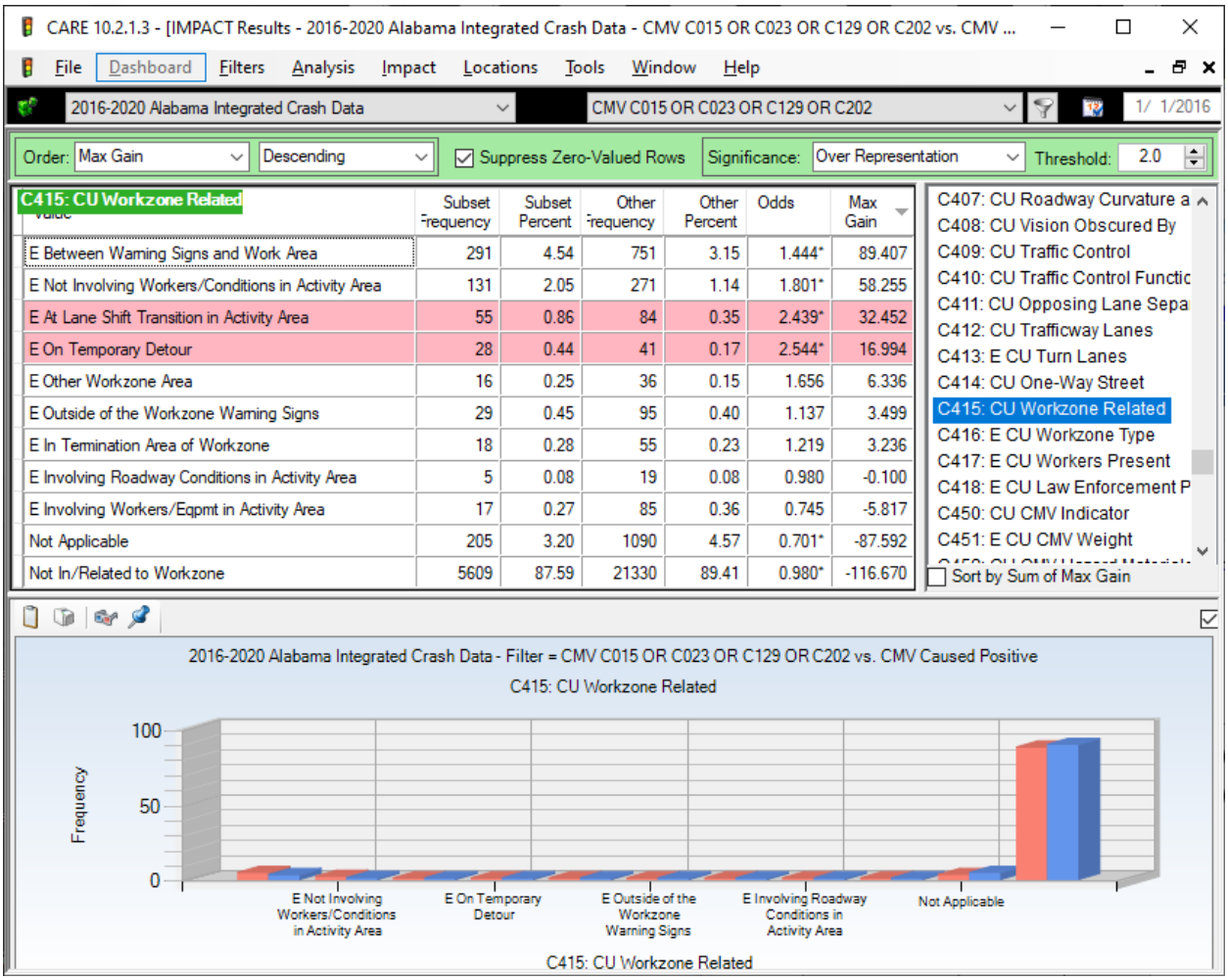
All of the number of lanes of three lanes or more are over-represented. This indicates that the more lanes that are active, the greater the chance of an ILC crash, which is reasonable.

5.17 C413 CU Turn Lanes ILC vs All CMV Caused



While right turn lanes have a higher over-representation (Odds Ratio = 1.322), the number of ILC crashes occurring was about double in the left turn lanes. Both of these would seem to be hazardous, resulting in more ILC crashes than what would be expected in CMV crashes in general.

5.18 C415 CU Workzone Related ILC vs All CMV Caused



The areas of the workzone that seem to have the greatest vulnerability to ILC crashes are: (1) Between Warning Signs and Work Area; (2) At Lane Shift Transition in Activity Area; and (3) On Temporary Detour.

5.19 CMV Items C451 to 465

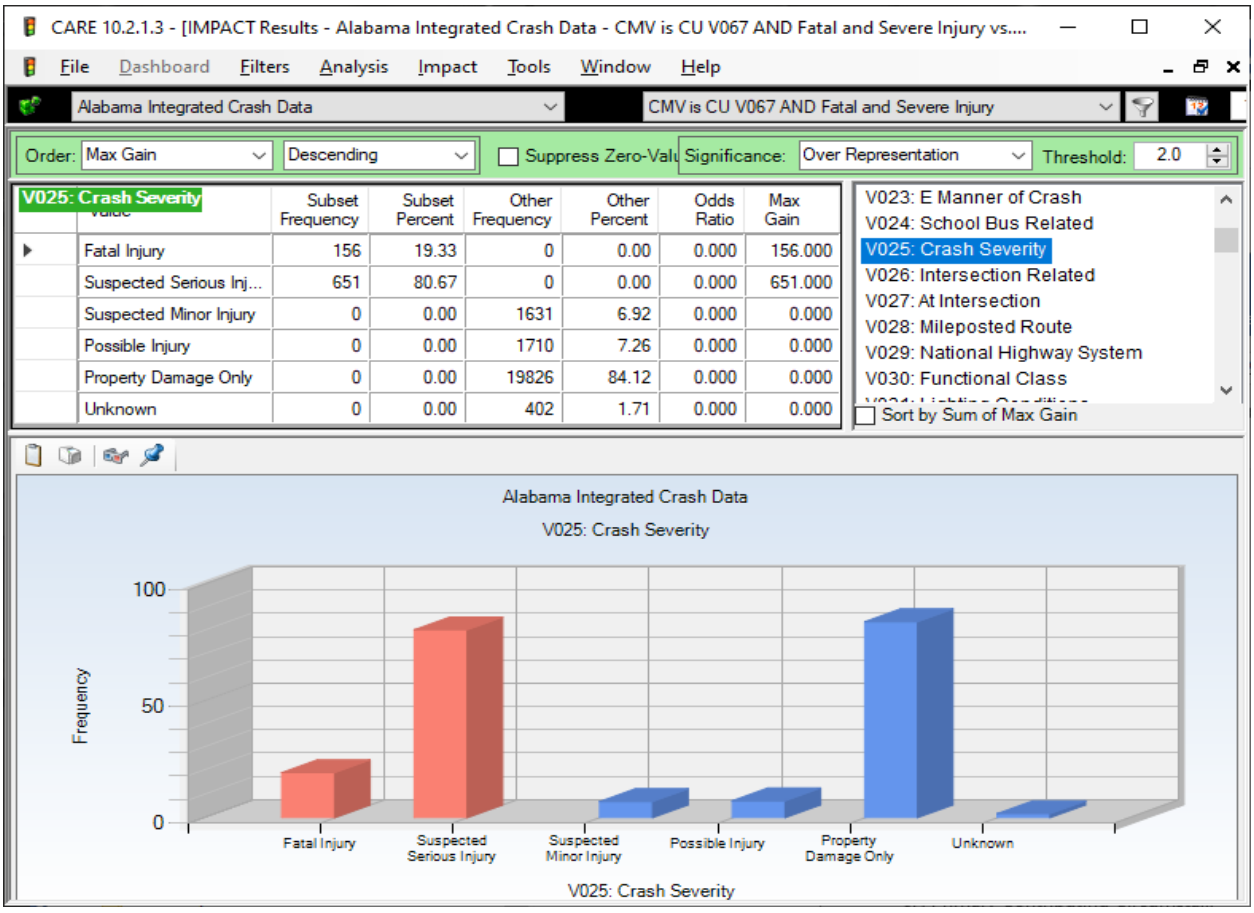
All of these attributes indicated that for the most part (usually above 90%), the “crashes were not qualified.” We interpret this to mean that they were not qualified to use these attributes that, for the most part, are reserved for CMV use.

6.0 CMV Crash Analyses for the Selective Enforcement Assistant (SEA)

The purpose of this section is to determine for CMV-caused crashes the specific causes for (1) all crashes and (2) fatal and severe injury crashes. The IMPACT comparison for the first is between all CMV caused crashes against all other crashes (i.e., that were not caused by CMVs). For the second (fatal and severe) the IMPACT comparison was between the combined CMV caused fatal and severe injury crashes and *all other CMV-caused crashes.*

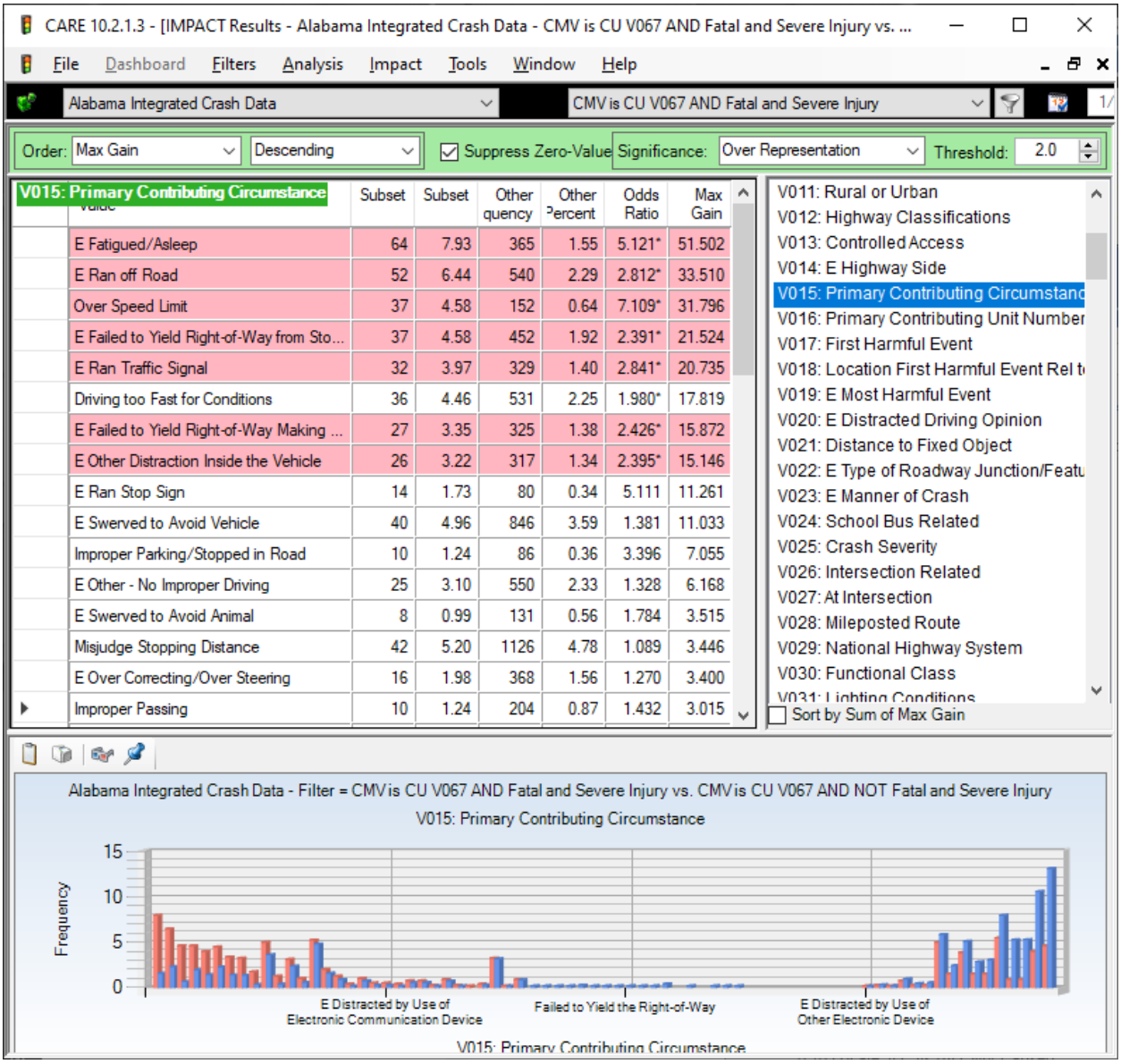
This information will be useful in further developing the Selective Enforcement Assistant (SEA), software that will highlight locations that had (1) higher numbers of CMV crashes than expected, and (2) higher numbers of CMV fatal crashes than expected.

6.1 V025 Crash Severity; CMV Fatal and Severe Crash vs All Other CMV Caused



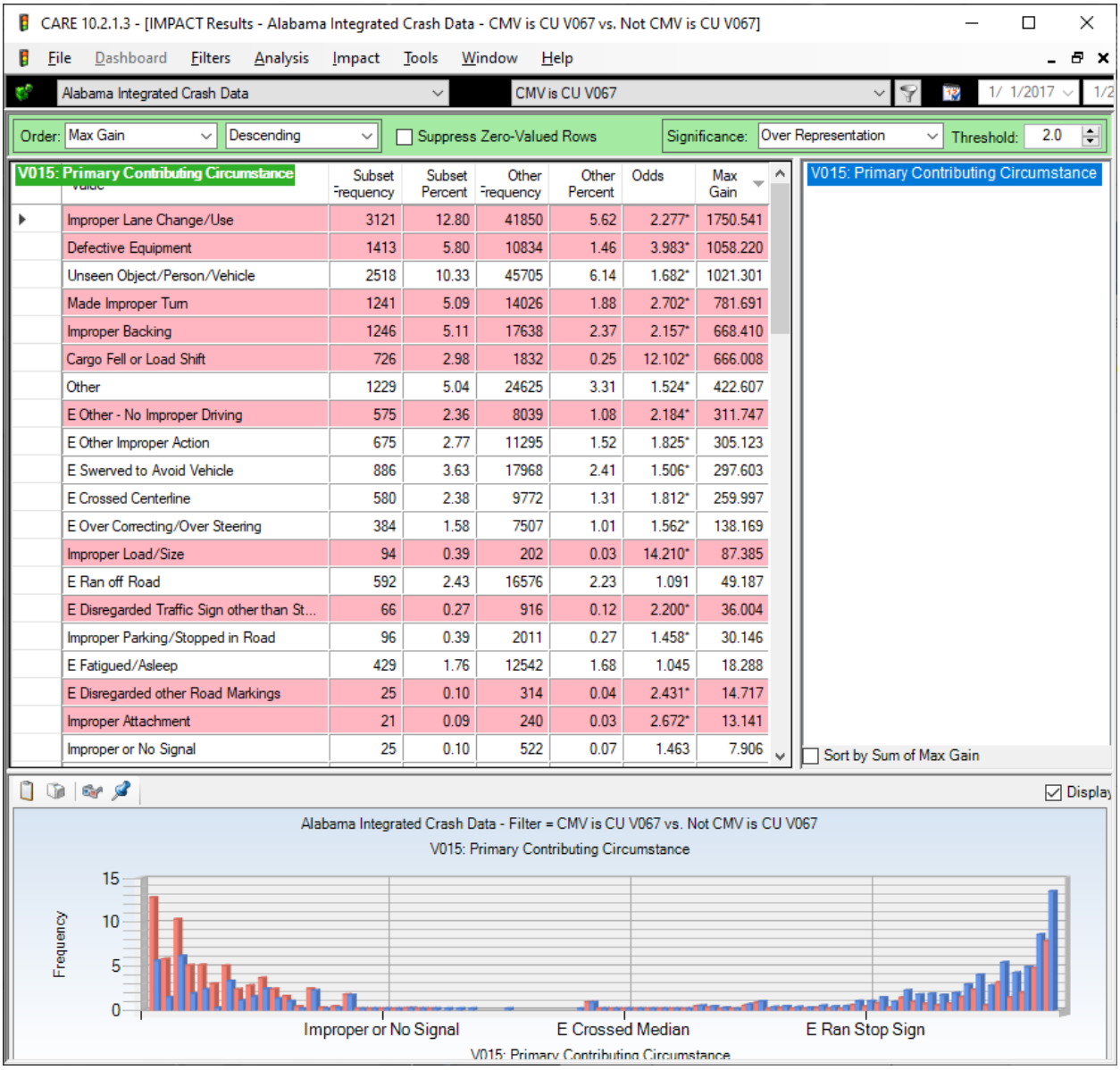
The purpose of this display is to show the number of fatal and Suspected Serious Injury crashes that are under consideration in the remainder of this section.

6.2 V015 Primary Contrib Circ; CMV Fatal and Severe Crash vs All Other CMV Caused



See the summaries in Section 6.4.

6.3 V015 Primary Contrib Circ; All CMV Caused Crashes vs All Other Crashes



V015: Primary Contributing Circumstance	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds	Max Gain
Improper Lane Change/Use	3121	12.80	41850	5.62	2.277*	1750.541
Defective Equipment	1413	5.80	10834	1.46	3.983*	1058.220
Unseen Object/Person/Vehicle	2518	10.33	45705	6.14	1.682*	1021.301
Made Improper Turn	1241	5.09	14026	1.88	2.702*	781.691
Improper Backing	1246	5.11	17638	2.37	2.157*	668.410
Cargo Fell or Load Shift	726	2.98	1832	0.25	12.102*	666.008
Other	1229	5.04	24625	3.31	1.524*	422.607
E Other - No Improper Driving	575	2.36	8039	1.08	2.184*	311.747
E Other Improper Action	675	2.77	11295	1.52	1.825*	305.123
E Swerved to Avoid Vehicle	886	3.63	17968	2.41	1.506*	297.603
E Crossed Centerline	580	2.38	9772	1.31	1.812*	259.997
E Over Correcting/Over Steering	384	1.58	7507	1.01	1.562*	138.169
Improper Load/Size	94	0.39	202	0.03	14.210*	87.385
E Ran off Road	592	2.43	16576	2.23	1.091	49.187
E Disregarded Traffic Sign other than St...	66	0.27	916	0.12	2.200*	36.004
Improper Parking/Stopped in Road	96	0.39	2011	0.27	1.458*	30.146
E Fatigued/Asleep	429	1.76	12542	1.68	1.045	18.288
E Disregarded other Road Markings	25	0.10	314	0.04	2.431*	14.717
Improper Attachment	21	0.09	240	0.03	2.672*	13.141
Improper or No Signal	25	0.10	522	0.07	1.463	7.906

See the summaries in Section 6.4.

6.4 Preliminary Requirement for SE Assistant (SEA) Prototype

The crash types and numbers given below are to illustrate how the SEA will work – they do not map to any actual locations. The crash types given are for example causes determined by actual Primary Contributing Circumstances that would be run for the particular area for which the analysis is being conducted. Similarly, the numbers are for small areas in which the selective enforcement is being considered.

Set area: area will default to that last set (from a map) by the user. It will remain the area summarized until the area covered is changed.

Severity/Cause	**Recent**	**Past**	**Past**	**Past**
All Crashes	**(Set Time/Area)**	**3 mo**	**6 mo**	**9 mo**
Improper Lane Change	62	16	31	47
Unseen Object/Vehicle	50	13	25	38
Defective Equipment	28	7	14	21
Made Improper Turn	25	6	12	18
Swerved: Veh or Animal	21*	5	10	15
Fatal Crashes	**Statewide 2021**			
Failed to Yield ROW	21*	5	10	16
Excessive Speed	15*	4	7	11
Fatigued/Asleep	13	3	7	10
Ran Off Road	10	3	5	8
Swerved: Veh or Animal	10**	3	5	8

Set Time – Set by the user (default one year, for area assumed to be 0.1 of state). This will be a dropdown of times of crashes for the current SE area, which can also default to statewide. Time in this column is currently set for this example as the most recent year.

*Indicates that the number is a sum of two or more other items.

**Swerved: Veh or Animal = Swerved to Avoid Vehicle + Swerved to Avoid Animal

For fatal crashes:
*Excessive Speed = Over the Speed Limit + Driving Too Fast for Conditions
*Failure to Yield ROW = … from Stop Sign + Ran Traffic Signal + Making Left/U + driveway