CARE IMPACT Study of Drowsy Driving (DrD)

2014-2018 Data

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Introduction

According to a NCSDR report (NCSDR): "NHTSA data indicate that in recent years there have been about 56,000 crashes reported by police annually that cited driver drowsiness/fatigue [Drowsy Driving, which we are calling DrD]. Annual averages of roughly 40,000 nonfatal injuries and 1,550 fatalities result from these crashes. It is widely recognized that these statistics underreport the extent of these types of crashes. These statistics also do not deal with crashes caused by driver inattention, which is believed to be a larger problem." These statistics were checked against those obtained in Alabama and accessed by CARE (discussed below), and our conclusion is that the NCSDR articles is still quite applicable.

To bring the above home to Alabama, over the five calendar years of 2014-2018, law enforcement crash records recorded 204 Fatal Injury crashes; 1,864 Incapacitating Injury crashes; 3,073 Non-Incapacitating Injury crashes; 1,886 Possible Injury crashes; and 10,208 Property Damage Only crashes, for a total of 17,658. This averages to 3,532 DrD crashes in Alabama per year. 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) below.

Frequency of DrD Crashes by Year

Year	Number	% of Total
2014	3,052	17.28%
2015	3,502	19.83%
2016	3,746	21.21%
2017	3,638	20.60%
2018	3,720	21.07%
Total	17,658	100.00%

This report will continue by presenting the major findings organized by the following major groupings of the attributes: Geographical, Time and Weather, Driver Related, Severity and Vehicles. The findings from these CARE IMPACT studies are presented first after which there is a section for references. The next five sections present the displays for each IMPACT run. A final section presents an example of the hotspot outputs that can be generated for DrD hotspots over the state. These high crash locations are quite important since it has been determined (SJ) that characteristics of *the roadway itself can tend to produce an affinity toward drowsiness.*

Major Interesting Findings and Recommendations

The details for the summaries in this section are given in the sections that follow, referenced by the crash attribute numbers (Cnnn). The acronym we will use for Drowsy Driving will be DrD, to distinguish it from that commonly used for Distracted Driving (DD). References are given in the next major section.

Geographical Findings

- C010 Rural or Urban. Rural areas had over twice their expected proportion with over half of the DrD crashes being in rural areas, while the non-DrD crashes only had about 22% in the rural areas. The reason for this is fairly obvious – observations tend to get uninteresting when the roadside scenery is not changing, and rural areas tend to involve longer trips. The recommendation here would be to place some type of diversion on those highways that are exhibiting excessive DrD crashes. See C028 below. [The red background on an IMPACT item indicates that it has an Odds Ratio of at least 2; this means that the proportion of the DrD crashes is twice that of the non-DrD crashes, which is extremely statistically significant. Just notifying drivers of the fact that these roads exhibit more than expected DrD crashes would seem to go a long way to reducing DrD crashes on them.
- C011 Highway Classification. This reflects the rural/urban finding above. Interstates have been found to be particularly vulnerable to DrD-caused crashes. However, in Alabama, State and County roads are also significantly over-represented. It may be for different reasons. The boring nature of driving on Interstates is obvious; however, they may be much more forgiving than State and County roads when it comes to vehicles veering off the roadway.
- C027 At Intersection. Intersections occur much more often in urban areas, so the rural tendency of DrD crashes is supported by the finding of under-representation at intersections. It might also be reasoned that the intersection itself provides a "wake-up call" for the driver.
- C028 Mileposted Routes. This is one of the most important findings in that it differentiates the particular roadways that exhibit a proclivity toward DrD. The SJ report (referenced below) showed clearly that some roadway types are more prone to create the conditions for DrD than others. Findings from Alabama confirm this result, showing that some roadways have up to five times the relative proportion of DrD crashes than those of their non-DrD crashes. The IMPACT display C028 below shows the top 27 DrD Max Gain roadways, where the Max Gain is the number of crashes that would be reduced if the proportion of DrD crashes was reduced to the same as the proportion of non-DrD crashes. The highest of these was I-65, which had a max gain of over 500 crashes (over the five-year period of the study). Recognize that the Max Gain will be affected by the length and volume of traffic on the subject roadway. This sensitivity to ADT and segment length does not affect the Odds Ratio, which compares the proportion of DrD against non-DrD crashes on that same roadway. An example Hotspot analysis for DrD

crashes on I-65 is given in the final section of this report. This is an excerpt of the analysis that is available to all law enforcement in Alabama via CARE. Recall that the red background for lines in the table indicates that the item's DrD proportion is at least twice that of its non-DrD proportion.

- C033 Locale. As expected Open Country is the only Locale that is significantly over-represented.
- C110 Driver Residence Distance. While not as large an Odds Ratio as many of the items given above, the Greater than 25 Miles (from home) is over a third higher than what would be expected from the proportion of non-DrD crashes, which is still statistically significant at a high level.

Time and Weather Findings

- C003 Year. Examining the Subset Frequency column shows an increase of nearly 700 DrD crashes over the five years. The good news is that the rate of increase was primarily up to 2016, and it has dropped off since then. The Odds Ratios being close to 1 indicate that the proportion to DrD crashes has remained stable over the five-year period – it has neither increased nor decreased more than the overall non-DrD crash proportion, which is a good proxy for overall traffic volume.
- C004 Month. It would be expected that the months of the longer trips would be over-represented in DrD crashes. This over-representation starts in April, but the difference is not significant. It becomes significant for May, June, July and August, which are the expected vacation months. Public PI&E warnings regarding the dangers of drowsy driving should be timed appropriately. However, the average DrDs per month is 1471.5 DrD crashes, and even the lowest months have well over 1000 DrD crashes, so it is important to keep the recognition of this problem in front of the public all year round.
- C006 Day of the Week. Clearly Saturday and Sunday are the bad days for DrD crashes, which would be expected since the bulk of the traffic during the week is for commuting and delivery. Also, see C122 and C123, which show the high correlation of DrD with Impaired Driving (ID/DUI).
- C008 Time of Day. Ten PM and after, and the later hours, including late early morning until 8 AM. The chart is totally informative. DrD happens during the day, but not nearly as much as late night and early morning. This also shows the correlation with ID/DUI
- C031 Lighting Conditions. It is not just the time, but also the presence or absence of light. Note Dark-Roadway Lighted. But this must be qualified by the fact that these conditions exist mainly in the urban rather than the rural areas. These things all work together, and it is difficult to analyze each of them independently.
- C032 Weather. What is it about rain that keeps us awake? – perhaps the fear that if we doze off the consequences will be obvious. It would be good if we could move this fear into clear weather as well. For right now it appears that bad weather is a positive factor in reducing the number of DrD crashes.

Driver Related Findings

- C017 First Harmful Event. There is nothing unexpected here. When a person loses consciousness behind the wheel, the results are random. If there happens to be a vehicle in its path, hitting it may be avoided in some cases by evasive action on the part of the other driver – perhaps taking any evasion, even if resulting in a crash – to avoid the perceived worst case scenario. Thus, this attribute generally demonstrates the objects that are the first thing encountered by a vehicle that randomly departs the roadway.
- C023 Manner of Crash. The major finding here is obviously that DrD crashes are dominated by single vehicle crashes, which is consistent with many of the findings above. Even though there are some large numbers on some of the two-vehicle Manner of Crash types, most of them are under-represented, indicated by an Odds Ration less than 0.5.
- C052 Number of Vehicles. This quantifies the dominance of single-vehicle crashes at 68.71% of all DrD crashes. Those that do involve more than one vehicle are distributed over the number of vehicles involved as would be expected for non-DrD crashes.
- C104 Causal Unit (CU) Left Scene. The proportion of DrD crashes where the causal driver left the scene is one of the lowest found for all crash types. Perhaps this is due to their not being fully cognizant of what went on prior to the crash. Also, the increased severity of DrD crashes would make many of them impossible to drive away from.
- C107 CU Driver Raw Age. The youngest drivers (aged 16-18) are either significantly under-represented (16-17) or as expected (18). After that, from aged 19 through 29, they are all over-represented. This is evidence of a correlation with alcohol and drugs, and it also indicates that the 16-18 year olds are typically not be driving on the longer trips in which DrD becomes problematic. We would also expect the very youngest drivers to have a high level of excitement from driving that would make sleep less likely.
- C109 CU Driver Gender. Very clearly, males are significantly over-represented in DrD crashes, with an Odds Ratio of about 40% higher than expected. The reason for this is not clear, but it probably is related to males being the primary drivers on longer trips and those that go late into the night (see time of day C008).
- 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 94% that are not CMV, from which CMV involvement can be inferred to be about 6%. This is confirmed from the C080 value of 5.95% 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-DrD crashes). In both cases we see that the CMV involvement in DrD crashes is significantly higher than that expected. It is slightly above 15% higher proportion as given by the C080 result. C115 indicates that this over-representation is much higher for those whose licenses are not Current/Valid. While we might expect professional drivers to have relatively fewer DrD crashes, we must recognize that they are generally involved in far more longer trips than is true of non-CDL drivers. The conclusion here is that DrD countermeasures need to be emphasized as much with CMV

drivers as with anyone else; and perhaps the laws requiring them to rest at certain intervals need to be better observed and enforced.

- C122 CU Officer Opinion Alcohol. The effect of alcohol and drugs on creating drowsy drivers cannot be disputed. Here the proportion of those who were using alcohol is close to 60% higher for DrD crashes than for crashes in general.
- C123 CU Officer Opinion Drugs. (Non-alcohol) drugs are even more over-represented than is alcohol. The proportion of DrD drivers using drugs is estimated to be over three times that of non-DrD drivers.
- C129 Vehicle Maneuvers. Falling asleep at the wheel can be described as an unforced error (in tennis terminology). After that, what happens, happens. It seems that if that event is a curve, there is an excellent chance it will result in a crash (Odds Ratio = 2.357). Even worse is if the vehicle departs the roadway (Odds Ratio 3.672). But the overwhelming proportion of DrD crashes (81.93%) are on straight and level roadways.

Findings Related to Severity

- C025 Crash Severity. All of the highest injury categories (Fatal, Incapacitation and Non-Incapacitating) are highly over-represented by over twice the proportion that occurs for non-DrD crashes. Fatal is the smallest of these, but its proportion is still 2.103 times the non DrD crashes. Some possible reasons for these higher severity will be given in the next attributes considered in this section. We also postulate that the consequences of crashes are more severe when drivers do not have awareness to take defensive actions once the inevitable crash event sequences are in process.
- C038 Adjusted EMS Arrival Delay Time. The 0 to 5-minute delay from crash time to ambulance arrival is significantly under-represented, as is the 6-10-minute delay. After that, all of the delay categories are over-represented. Items with less than 20 occurrences are not processed with a statistical test, but it seems likely that all of the delay times above 10 minutes are significantly over-represented. We expect that this is due to the rural nature of the large majority of these crashes. The times being analyzed here are from the crash report to the time that the ambulance arrives. There is no accounting for the delay between the crash itself and when it is reported. This is especially relevant in late night crashes, which characterize DrD crashes. Certainly rural roads that have relatively few vehicles late at night would be susceptible to this problem.
- C060 Number Injured Including Fatalities. Single injury crashes have the highest over-representation. However, all of the multiple injury classifications are over-represented up to and including 4 injuries.
- C224 CU Estimated Speed at Impact. This is the largest single factor that determines whether crashes result in fatalities or not. In this case the average speed at impact of the DrD crashes was 48.5 MPH, while that of the non-DrD crashes was 28.6 MPH. It has been determined in a large number of former studies within Alabama that, above 40 MPH, each increase in the impact speed of 10 MPH doubles the probability of any given crash being fatal. Since this doubling is from its next lower 10 MPH-lower speed estimate, this is an exponential increase. So, for example, if the probability of a crash being fatal at 40 MPH is 1%, the probability at 50 MPH would be 2%, the probability at 60

MPH would be 4% , and the probability at 70 MPH would be 8%, doubling from its previous value for each increase in 10 MPH (hypothetical numbers for illustration only). This reflects the laws of physics and kinetic energy. Display C025 shows that the probability of a DrD crash being fatal is 1.16%, while that same probability for a non-DrD crash is only 0.55%.

Findings Related to Vehicles

- C101 Causal Unit (CU) Type. Other than light pick-ups, there does not seem to be a vehicle that is causing or necessarily avoiding DrD crashes. If anything, it would be the drivers that are prone to use these vehicles that might be over- or under-represented, as opposed to the vehicles themselves.
- C208 CU Model Year. Vehicle years that are over-represented start at 1996 and go through 2006, with 2004 being the last of these that are statistically significant. Under-representation significance starts at 2008 and continues through 2011. Above that, nothing is statistically significant. It might be reasoned that vehicles from 2007 and after have additional safety features that could prevent crashes.

Hotspot Analysis

- Hotspot analyses can be performed using a DrD filter for any type of roadway in Alabama. Such a filter will only allow DrD crashes to be considered in the analysis.
- Since Interstates and other mileposted routes tend to have more DrD crashes, hotspot analyses on these roadway types is considered to be most fruitful.
- An example is given in the last section of this report. It is the first segment found on I-65 (starting with milepost 0.0 near Mobile) that had more than 50 DrD crashes in a ten mile span.
- It is interesting that the first such hotspot could not be found on I-65 in less than 100 miles from Mobile. This is not saying that no DrD crashes occurred; they just were not of such a concentration to qualify according to the criterion given above. Perhaps it takes 100 miles for most drivers to become drowsy, and taking a break every 100 miles would be an excellent recommendation.

References

SJ: National Article Reference:
https://www.sleepjunkie.org/falling-asleep-wheel/

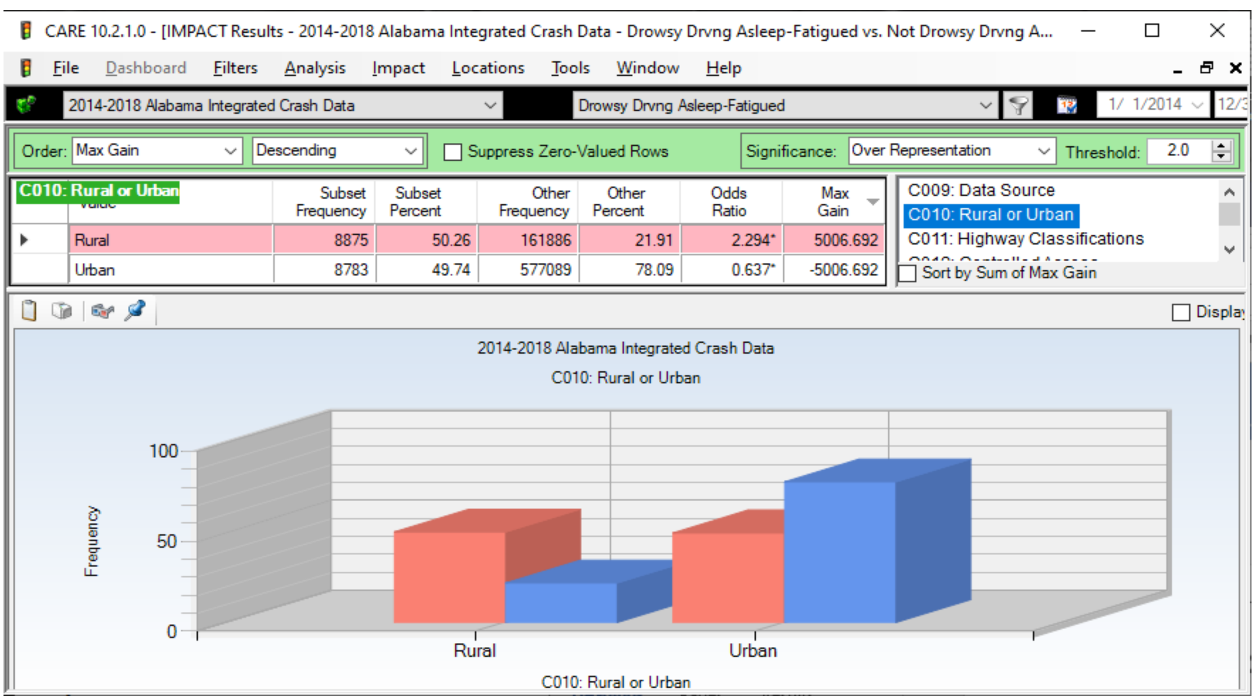
WRBL: Local News Referencing the Article Above:
https://www.wrbl.com/news/highway-to-south-texas-rated-worst-for-sleepy-driver-deaths-holiday-travelers-warned/?utm_medium=social&utm_source=facebook_WRBL_News_3

NCSDR: National Center on Sleep Disorders Research (NCSDR) and NHTSA:
Drowsy Driving and Automobile Crashes; NCSDR/NHTSA Expert Panel on Driver Fatigue and Sleepiness; https://one.nhtsa.gov/people/injury/drowsy_driving1/drowsy.html#EXECUTIVE%20SUMMARY

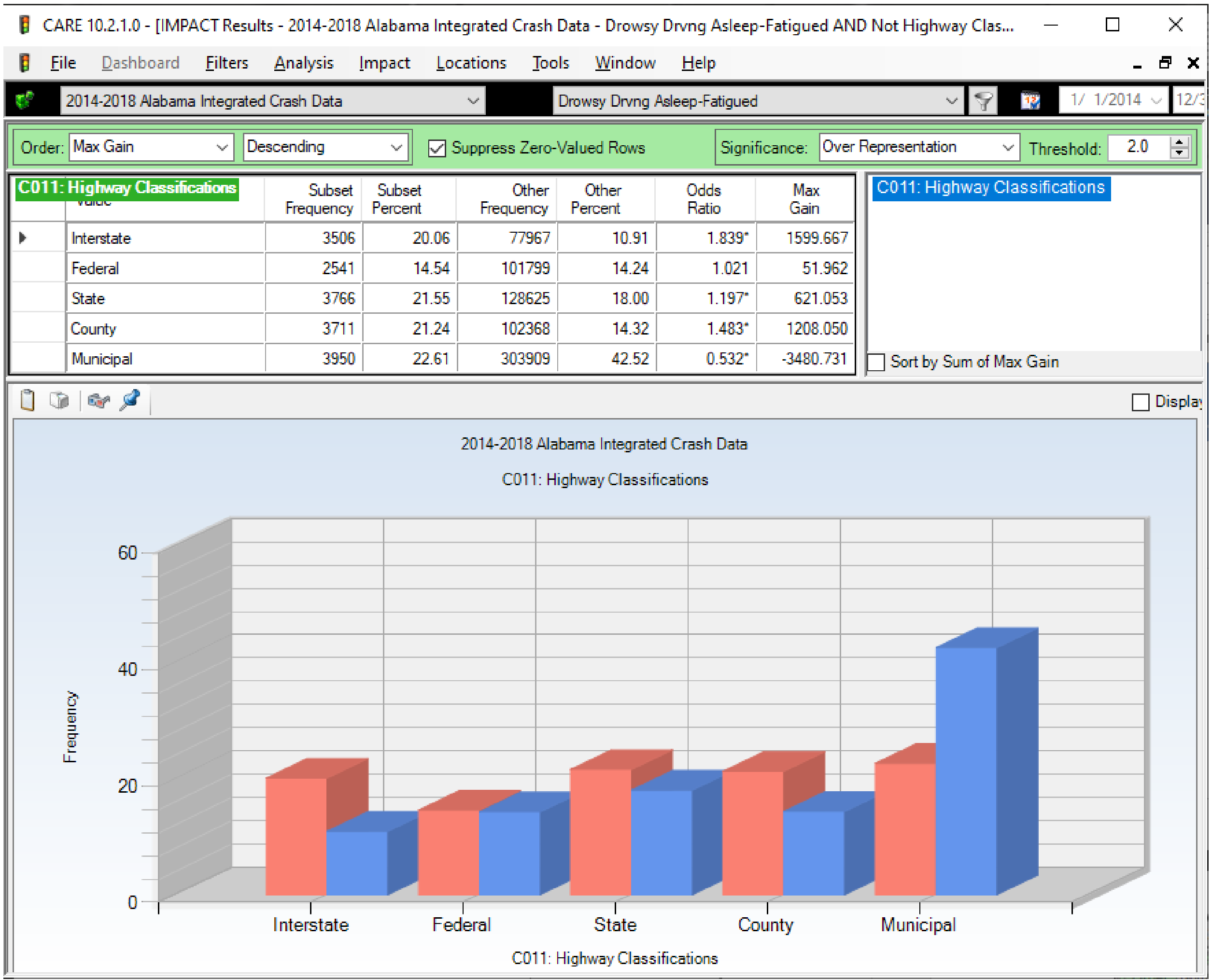
NHTSA: NHTSA home page for drowsy driving (links to research):
https://one.nhtsa.gov/Driving-Safety/Drowsy-Driving/Research-on-Drowsy-Driving

IMPACT Displays – Geographical/Roadway 10, 11, 13, 27, 28, 33, 110

C010 Rural or Urban

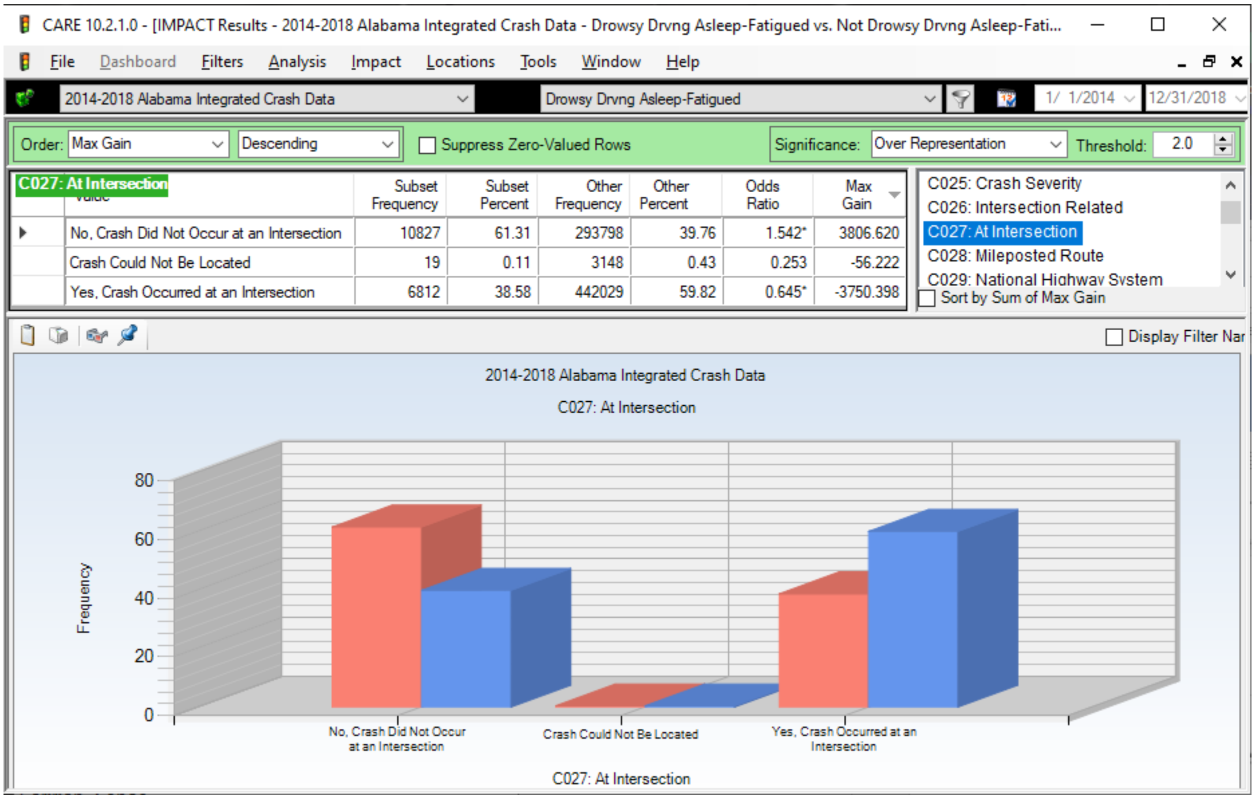


C011 Highway Classification

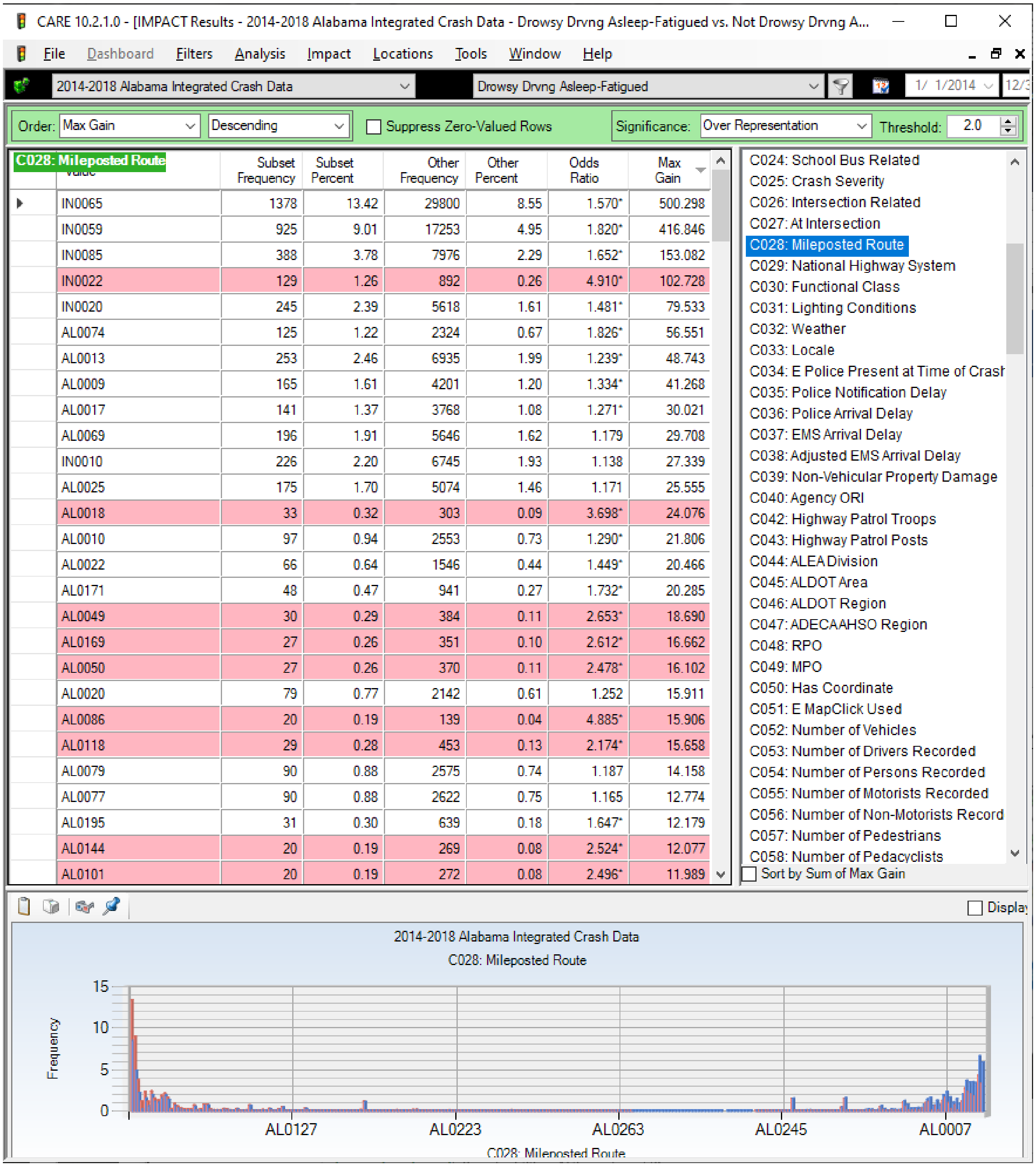


C011: Highway Classifications	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Interstate	3506	20.06	77967	10.91	1.839*	1599.667
Federal	2541	14.54	101799	14.24	1.021	51.962
State	3766	21.55	128625	18.00	1.197*	621.053
County	3711	21.24	102368	14.32	1.483*	1208.050
Municipal	3950	22.61	303909	42.52	0.532*	-3480.731

C027 At Intersection

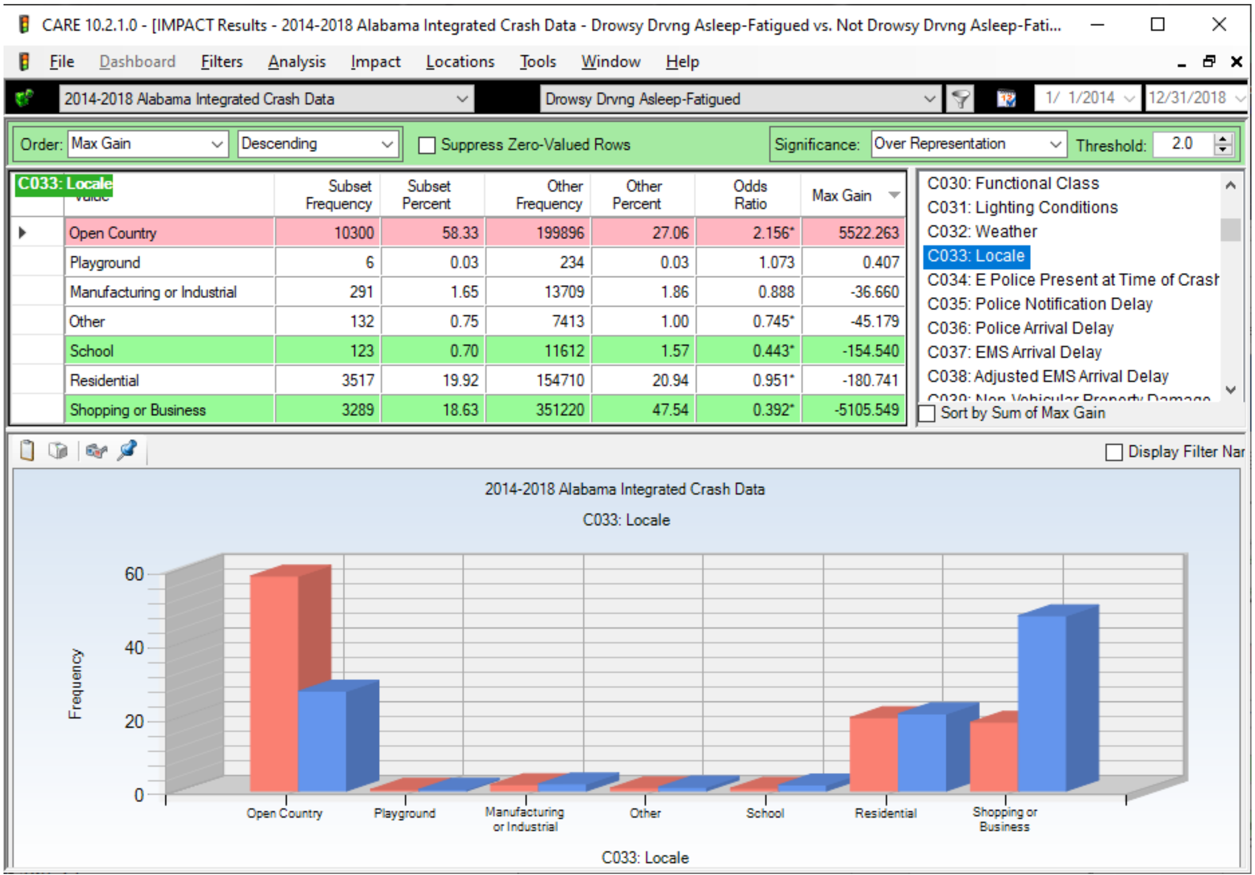


C028 Mileposted Routes



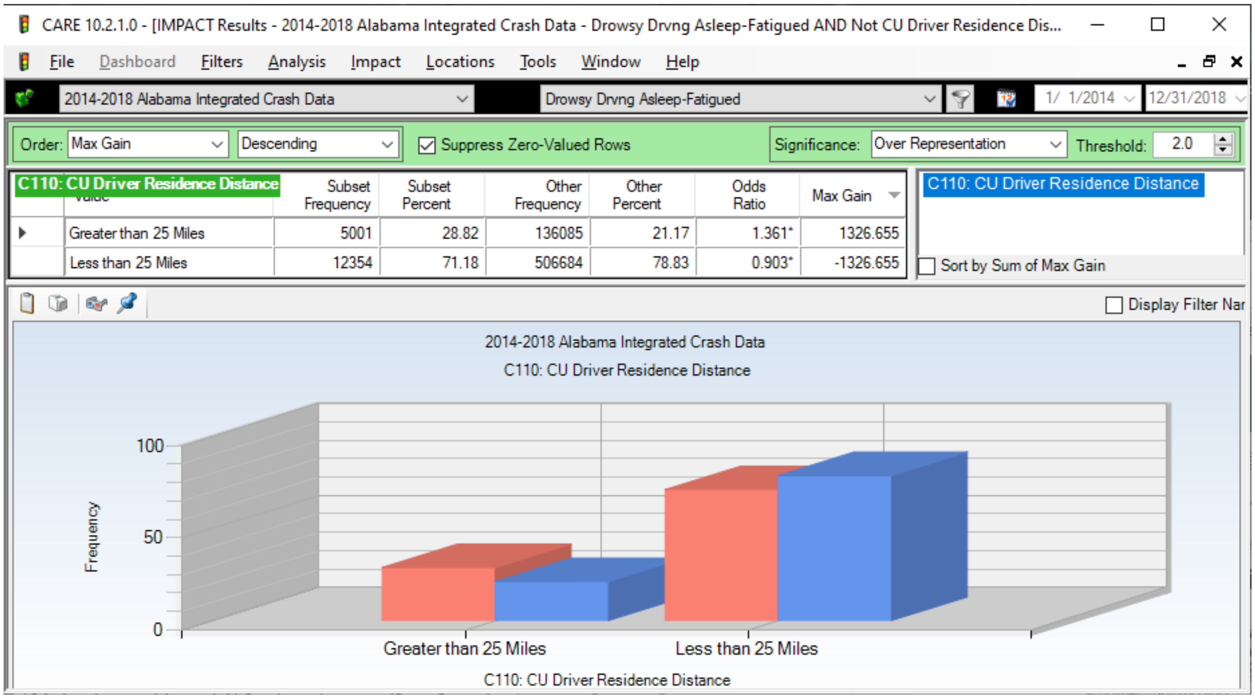
C028: Mileposted Route	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
IN0065	1378	13.42	29800	8.55	1.570*	500.298
IN0059	925	9.01	17253	4.95	1.820*	416.846
IN0085	388	3.78	7976	2.29	1.652*	153.082
IN0022	129	1.26	892	0.26	4.910*	102.728
IN0020	245	2.39	5618	1.61	1.481*	79.533
AL0074	125	1.22	2324	0.67	1.826*	56.551
AL0013	253	2.46	6935	1.99	1.239*	48.743
AL0009	165	1.61	4201	1.20	1.334*	41.268
AL0017	141	1.37	3768	1.08	1.271*	30.021
AL0069	196	1.91	5646	1.62	1.179	29.708
IN0010	226	2.20	6745	1.93	1.138	27.339
AL0025	175	1.70	5074	1.46	1.171	25.555
AL0018	33	0.32	303	0.09	3.698*	24.076
AL0010	97	0.94	2553	0.73	1.290*	21.806
AL0022	66	0.64	1546	0.44	1.449*	20.466
AL0171	48	0.47	941	0.27	1.732*	20.285
AL0049	30	0.29	384	0.11	2.653*	18.690
AL0169	27	0.26	351	0.10	2.612*	16.662
AL0050	27	0.26	370	0.11	2.478*	16.102
AL0020	79	0.77	2142	0.61	1.252	15.911
AL0086	20	0.19	139	0.04	4.885*	15.906
AL0118	29	0.28	453	0.13	2.174*	15.658
AL0079	90	0.88	2575	0.74	1.187	14.158
AL0077	90	0.88	2622	0.75	1.165	12.774
AL0195	31	0.30	639	0.18	1.647*	12.179
AL0144	20	0.19	269	0.08	2.524*	12.077
AL0101	20	0.19	272	0.08	2.496*	11.989

C033 Locale



C033: Locale Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Open Country	10300	58.33	199896	27.06	2.156*	5522.263
Playground	6	0.03	234	0.03	1.073	0.407
Manufacturing or Industrial	291	1.65	13709	1.86	0.888	-36.660
Other	132	0.75	7413	1.00	0.745*	-45.179
School	123	0.70	11612	1.57	0.443*	-154.540
Residential	3517	19.92	154710	20.94	0.951*	-180.741
Shopping or Business	3289	18.63	351220	47.54	0.392*	-5105.549

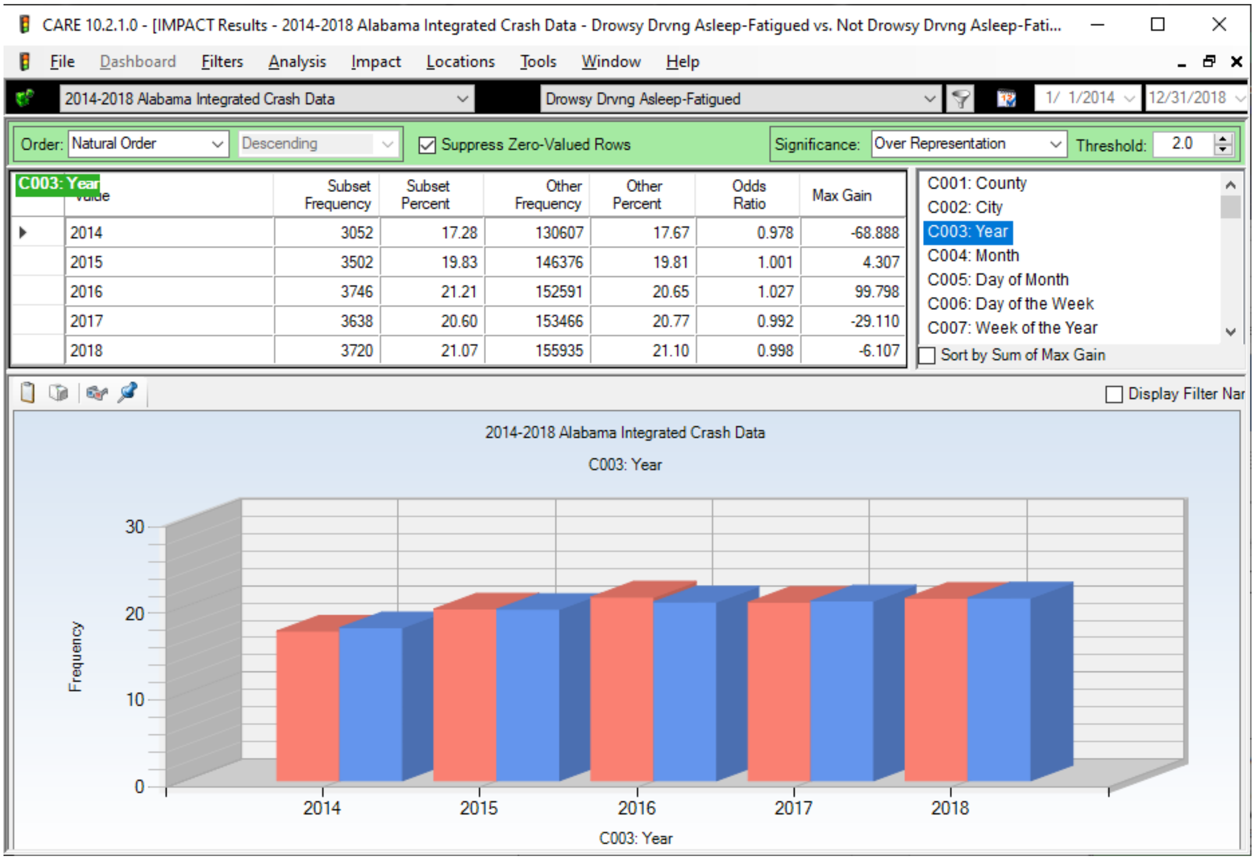
C110 CU Driver Residence Distance



C110: CU Driver Residence Distance Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Greater than 25 Miles	5001	28.82	136085	21.17	1.361*	1326.655
Less than 25 Miles	12354	71.18	506684	78.83	0.903*	-1326.655

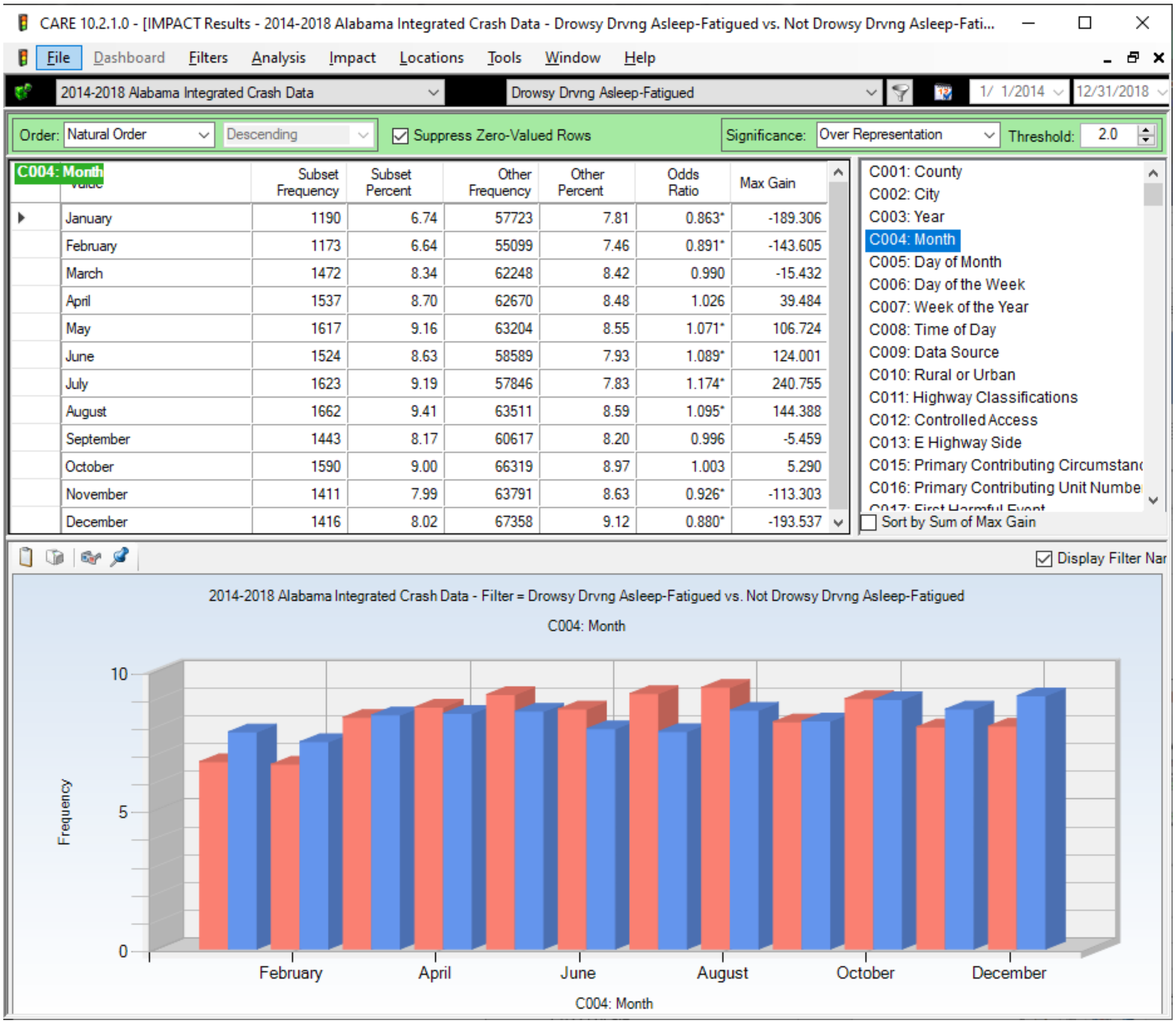
IMPACT Displays – Times, Weather and Lighting 3-8, 31-32

C003 Year



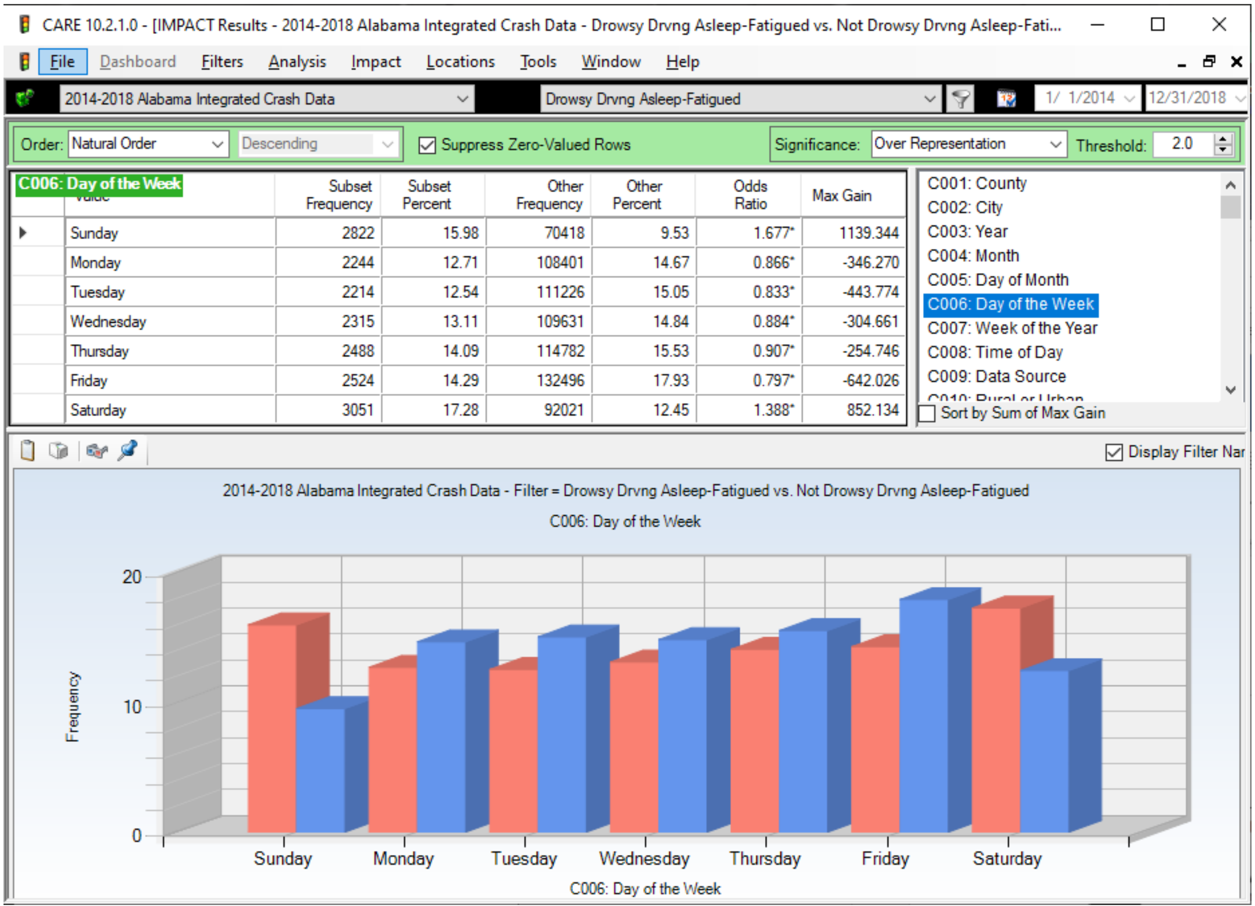
C003: Year Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
2014	3052	17.28	130607	17.67	0.978	-68.888
2015	3502	19.83	146376	19.81	1.001	4.307
2016	3746	21.21	152591	20.65	1.027	99.798
2017	3638	20.60	153466	20.77	0.992	-29.110
2018	3720	21.07	155935	21.10	0.998	-6.107

C004 Month



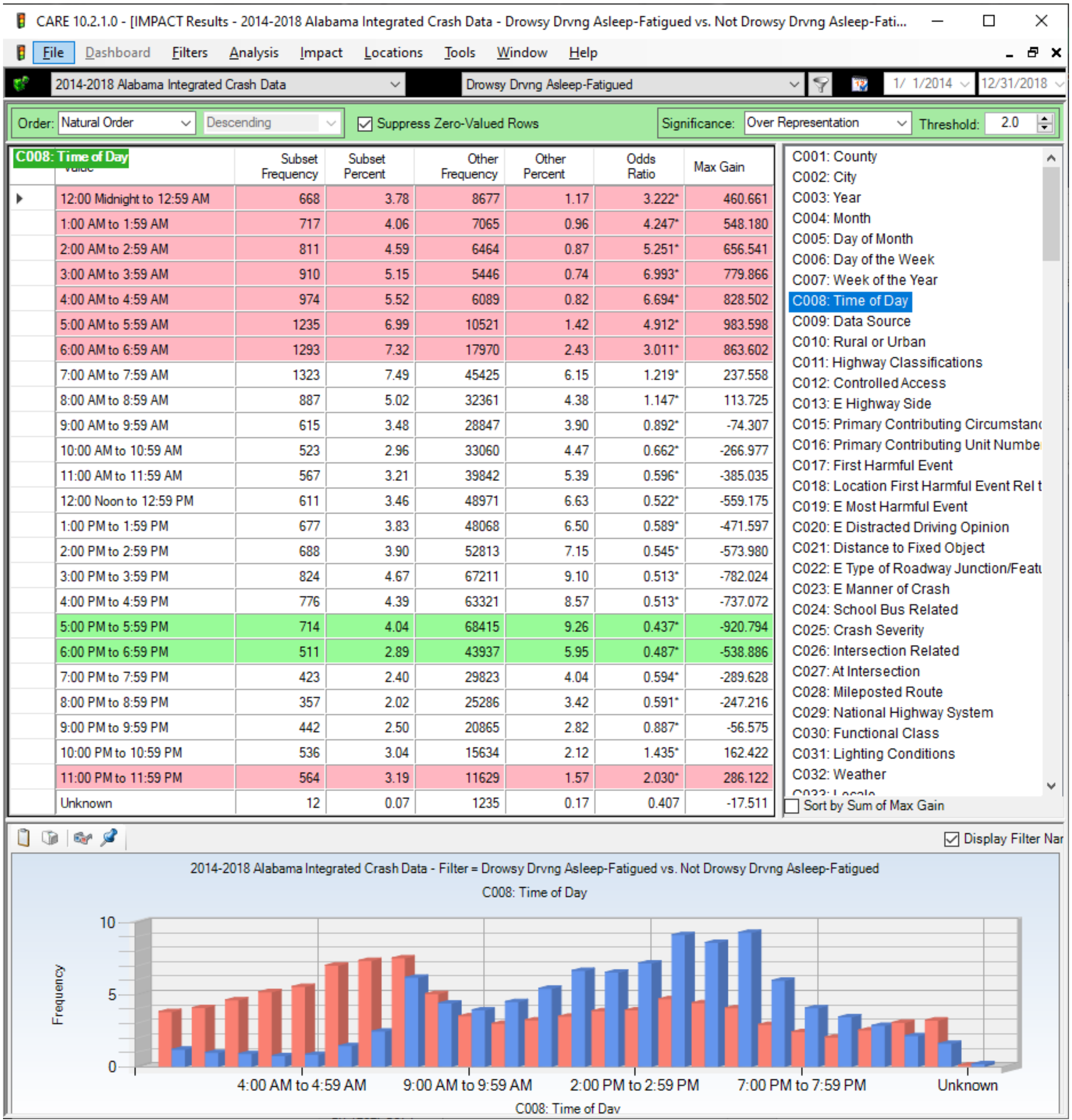
C004: Month Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
January	1190	6.74	57723	7.81	0.863*	-189.306
February	1173	6.64	55099	7.46	0.891*	-143.605
March	1472	8.34	62248	8.42	0.990	-15.432
April	1537	8.70	62670	8.48	1.026	39.484
May	1617	9.16	63204	8.55	1.071*	106.724
June	1524	8.63	58589	7.93	1.089*	124.001
July	1623	9.19	57846	7.83	1.174*	240.755
August	1662	9.41	63511	8.59	1.095*	144.388
September	1443	8.17	60617	8.20	0.996	-5.459
October	1590	9.00	66319	8.97	1.003	5.290
November	1411	7.99	63791	8.63	0.926*	-113.303
December	1416	8.02	67358	9.12	0.880*	-193.537

C006 Day of the Week



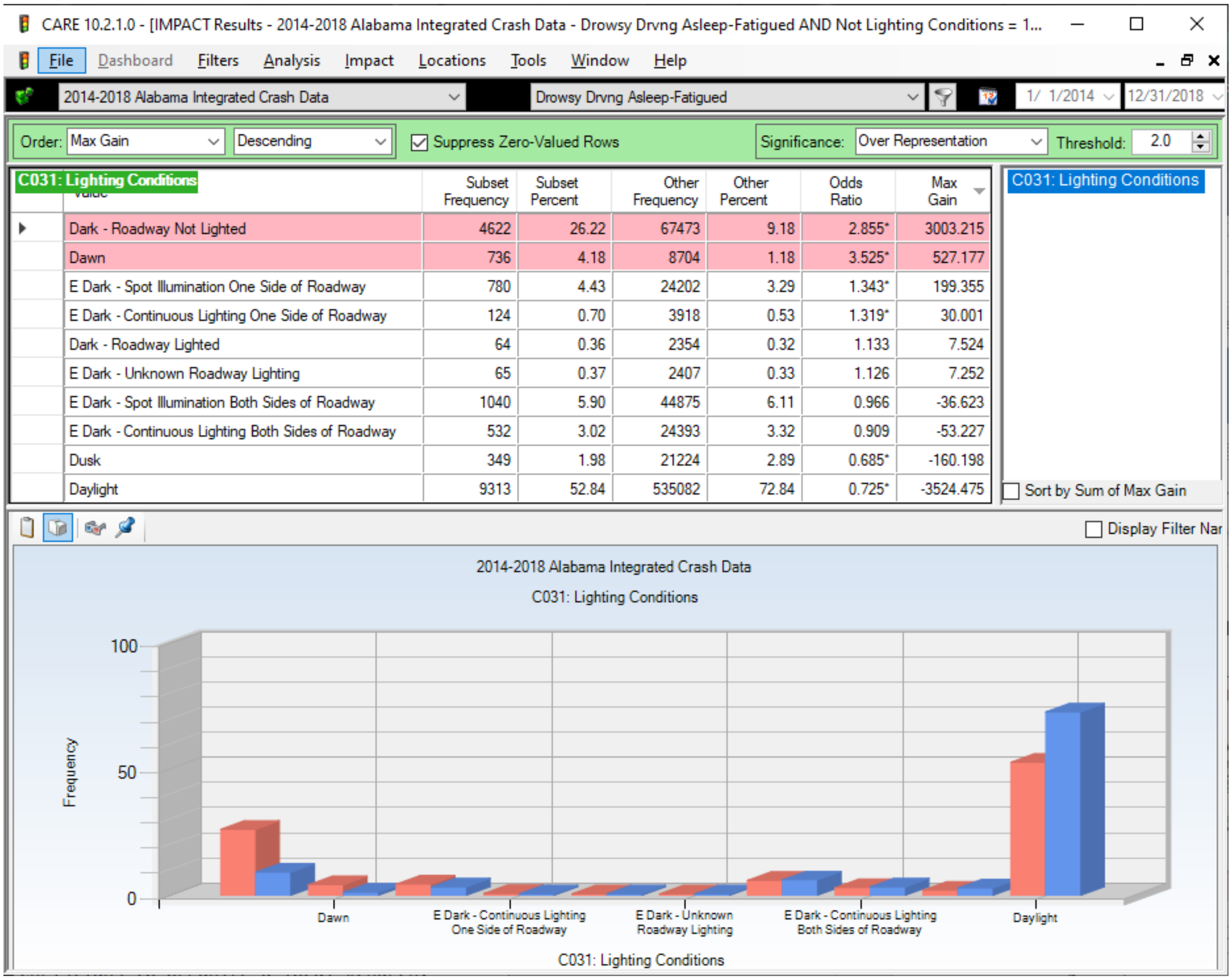
C006: Day of the Week Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Sunday	2822	15.98	70418	9.53	1.677*	1139.344
Monday	2244	12.71	108401	14.67	0.866*	-346.270
Tuesday	2214	12.54	111226	15.05	0.833*	-443.774
Wednesday	2315	13.11	109631	14.84	0.884*	-304.661
Thursday	2488	14.09	114782	15.53	0.907*	-254.746
Friday	2524	14.29	132496	17.93	0.797*	-642.026
Saturday	3051	17.28	92021	12.45	1.388*	852.134

C008 Time of Day



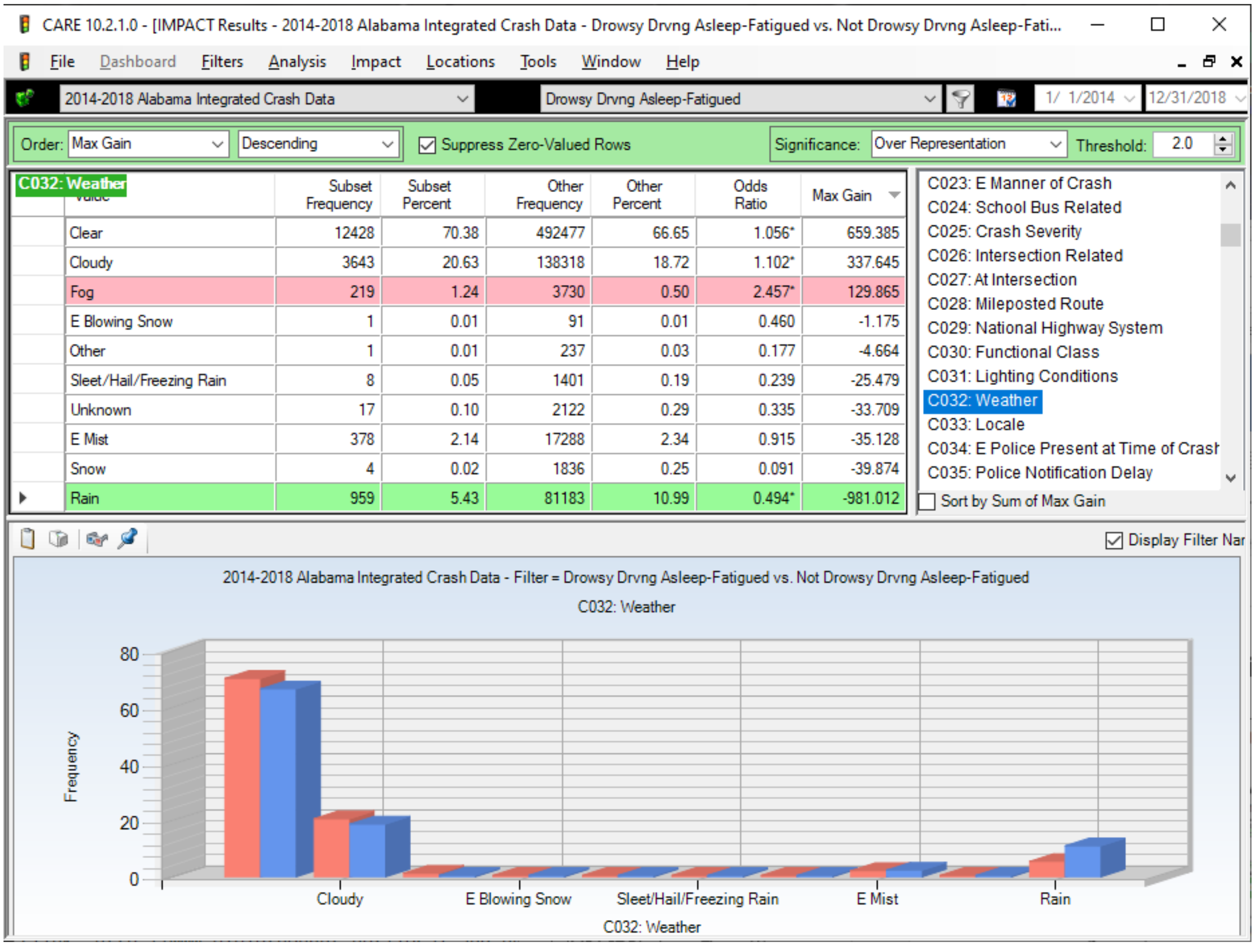
C008: Time of Day Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
12:00 Midnight to 12:59 AM	668	3.78	8677	1.17	3.222*	460.661
1:00 AM to 1:59 AM	717	4.06	7065	0.96	4.247*	548.180
2:00 AM to 2:59 AM	811	4.59	6464	0.87	5.251*	656.541
3:00 AM to 3:59 AM	910	5.15	5446	0.74	6.993*	779.866
4:00 AM to 4:59 AM	974	5.52	6089	0.82	6.694*	828.502
5:00 AM to 5:59 AM	1235	6.99	10521	1.42	4.912*	983.598
6:00 AM to 6:59 AM	1293	7.32	17970	2.43	3.011*	863.602
7:00 AM to 7:59 AM	1323	7.49	45425	6.15	1.219*	237.558
8:00 AM to 8:59 AM	887	5.02	32361	4.38	1.147*	113.725
9:00 AM to 9:59 AM	615	3.48	28847	3.90	0.892*	-74.307
10:00 AM to 10:59 AM	523	2.96	33060	4.47	0.662*	-266.977
11:00 AM to 11:59 AM	567	3.21	39842	5.39	0.596*	-385.035
12:00 Noon to 12:59 PM	611	3.46	48971	6.63	0.522*	-559.175
1:00 PM to 1:59 PM	677	3.83	48068	6.50	0.589*	-471.597
2:00 PM to 2:59 PM	688	3.90	52813	7.15	0.545*	-573.980
3:00 PM to 3:59 PM	824	4.67	67211	9.10	0.513*	-782.024
4:00 PM to 4:59 PM	776	4.39	63321	8.57	0.513*	-737.072
5:00 PM to 5:59 PM	714	4.04	68415	9.26	0.437*	-920.794
6:00 PM to 6:59 PM	511	2.89	43937	5.95	0.487*	-538.886
7:00 PM to 7:59 PM	423	2.40	29823	4.04	0.594*	-289.628
8:00 PM to 8:59 PM	357	2.02	25286	3.42	0.591*	-247.216
9:00 PM to 9:59 PM	442	2.50	20865	2.82	0.887*	-56.575
10:00 PM to 10:59 PM	536	3.04	15634	2.12	1.435*	162.422
11:00 PM to 11:59 PM	564	3.19	11629	1.57	2.030*	286.122
Unknown	12	0.07	1235	0.17	0.407	-17.511

C031 Lighting Conditions



C031: Lighting Conditions	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Dark - Roadway Not Lighted	4622	26.22	67473	9.18	2.855*	3003.215
Dawn	736	4.18	8704	1.18	3.525*	527.177
E Dark - Spot Illumination One Side of Roadway	780	4.43	24202	3.29	1.343*	199.355
E Dark - Continuous Lighting One Side of Roadway	124	0.70	3918	0.53	1.319*	30.001
Dark - Roadway Lighted	64	0.36	2354	0.32	1.133	7.524
E Dark - Unknown Roadway Lighting	65	0.37	2407	0.33	1.126	7.252
E Dark - Spot Illumination Both Sides of Roadway	1040	5.90	44875	6.11	0.966	-36.623
E Dark - Continuous Lighting Both Sides of Roadway	532	3.02	24393	3.32	0.909	-53.227
Dusk	349	1.98	21224	2.89	0.685*	-160.198
Daylight	9313	52.84	535082	72.84	0.725*	-3524.475

C032 Weather

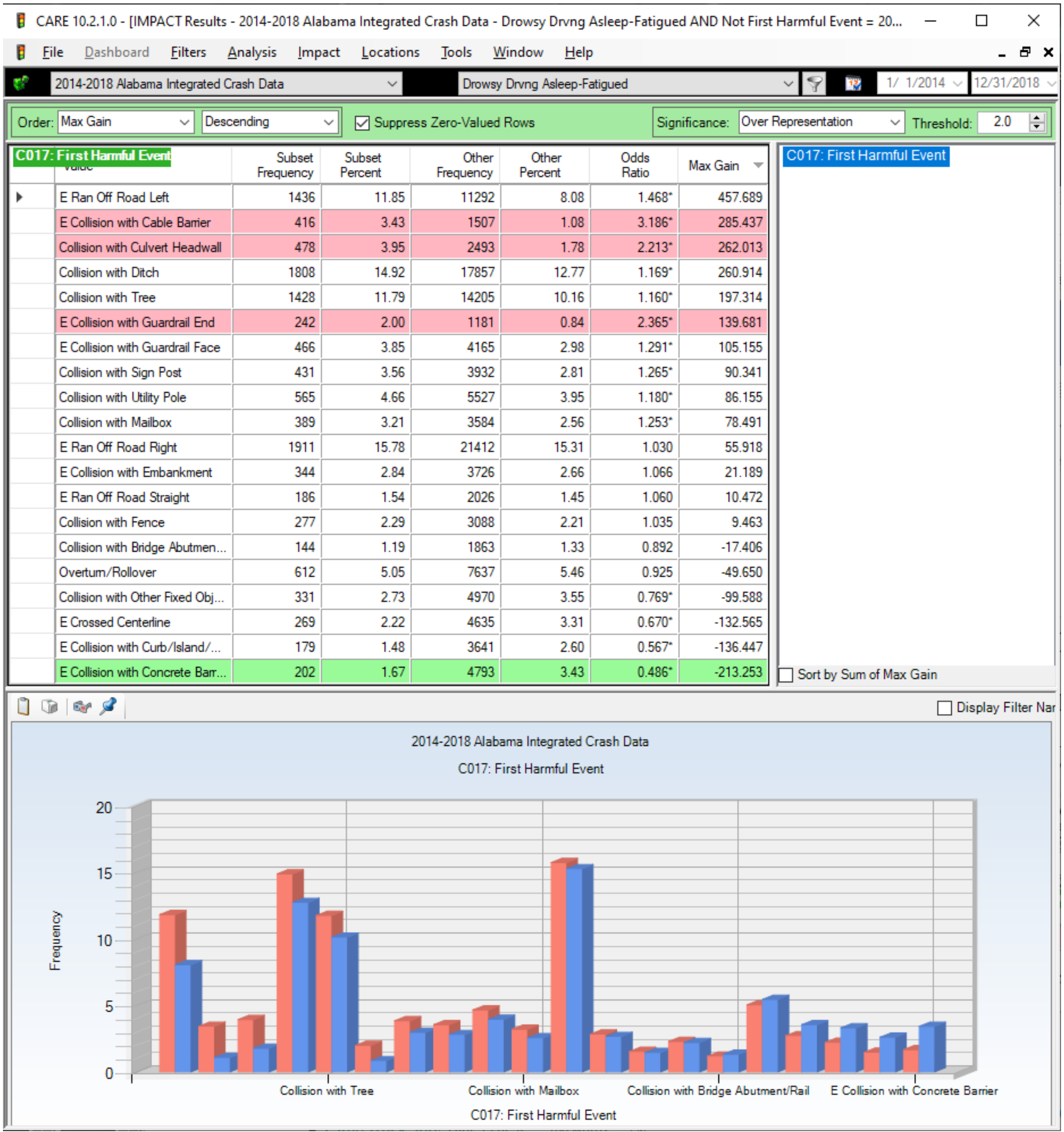


Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Clear	12428	70.38	492477	66.65	1.056*	659.385
Cloudy	3643	20.63	138318	18.72	1.102*	337.645
Fog	219	1.24	3730	0.50	2.457*	129.865
E Blowing Snow	1	0.01	91	0.01	0.460	-1.175
Other	1	0.01	237	0.03	0.177	-4.664
Sleet/Hail/Freezing Rain	8	0.05	1401	0.19	0.239	-25.479
Unknown	17	0.10	2122	0.29	0.335	-33.709
E Mist	378	2.14	17288	2.34	0.915	-35.128
Snow	4	0.02	1836	0.25	0.091	-39.874
Rain	959	5.43	81183	10.99	0.494*	-981.012

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

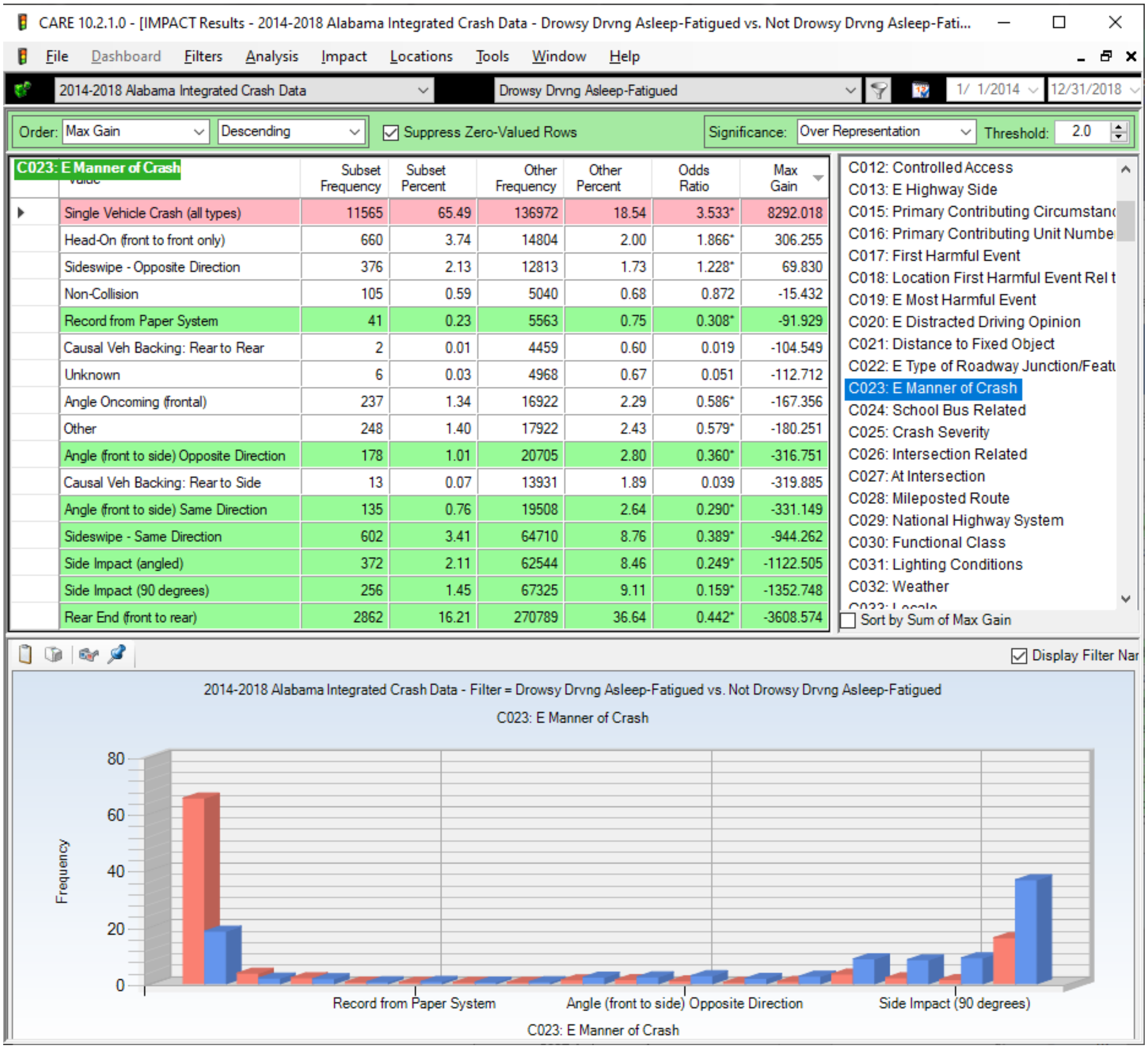
C017 First Harmful Event

Removed: all items with less than 100 crashes in subset; also MV in traffic and parked MV.



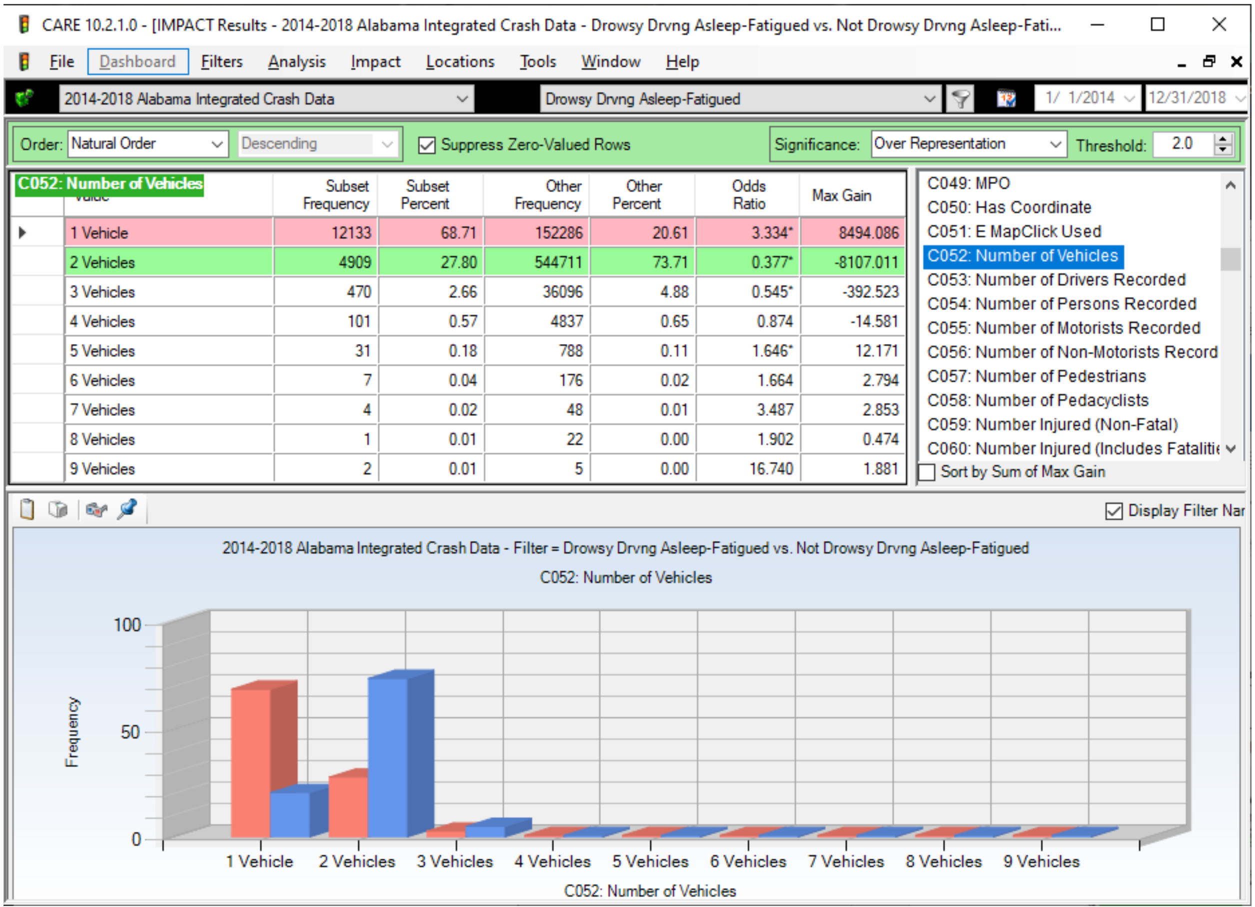
C017: First Harmful Event	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
E Ran Off Road Left	1436	11.85	11292	8.08	1.468*	457.689
E Collision with Cable Barrier	416	3.43	1507	1.08	3.186*	285.437
Collision with Culvert Headwall	478	3.95	2493	1.78	2.213*	262.013
Collision with Ditch	1808	14.92	17857	12.77	1.169*	260.914
Collision with Tree	1428	11.79	14205	10.16	1.160*	197.314
E Collision with Guardrail End	242	2.00	1181	0.84	2.365*	139.681
E Collision with Guardrail Face	466	3.85	4165	2.98	1.291*	105.155
Collision with Sign Post	431	3.56	3932	2.81	1.265*	90.341
Collision with Utility Pole	565	4.66	5527	3.95	1.180*	86.155
Collision with Mailbox	389	3.21	3584	2.56	1.253*	78.491
E Ran Off Road Right	1911	15.78	21412	15.31	1.030	55.918
E Collision with Embankment	344	2.84	3726	2.66	1.066	21.189
E Ran Off Road Straight	186	1.54	2026	1.45	1.060	10.472
Collision with Fence	277	2.29	3088	2.21	1.035	9.463
Collision with Bridge Abutmen...	144	1.19	1863	1.33	0.892	-17.406
Overturn/Rollover	612	5.05	7637	5.46	0.925	-49.650
Collision with Other Fixed Obj...	331	2.73	4970	3.55	0.769*	-99.588
E Crossed Centerline	269	2.22	4635	3.31	0.670*	-132.565
E Collision with Curb/Island/...	179	1.48	3641	2.60	0.567*	-136.447
E Collision with Concrete Barr...	202	1.67	4793	3.43	0.486*	-213.253

C023 E Manner of Crash



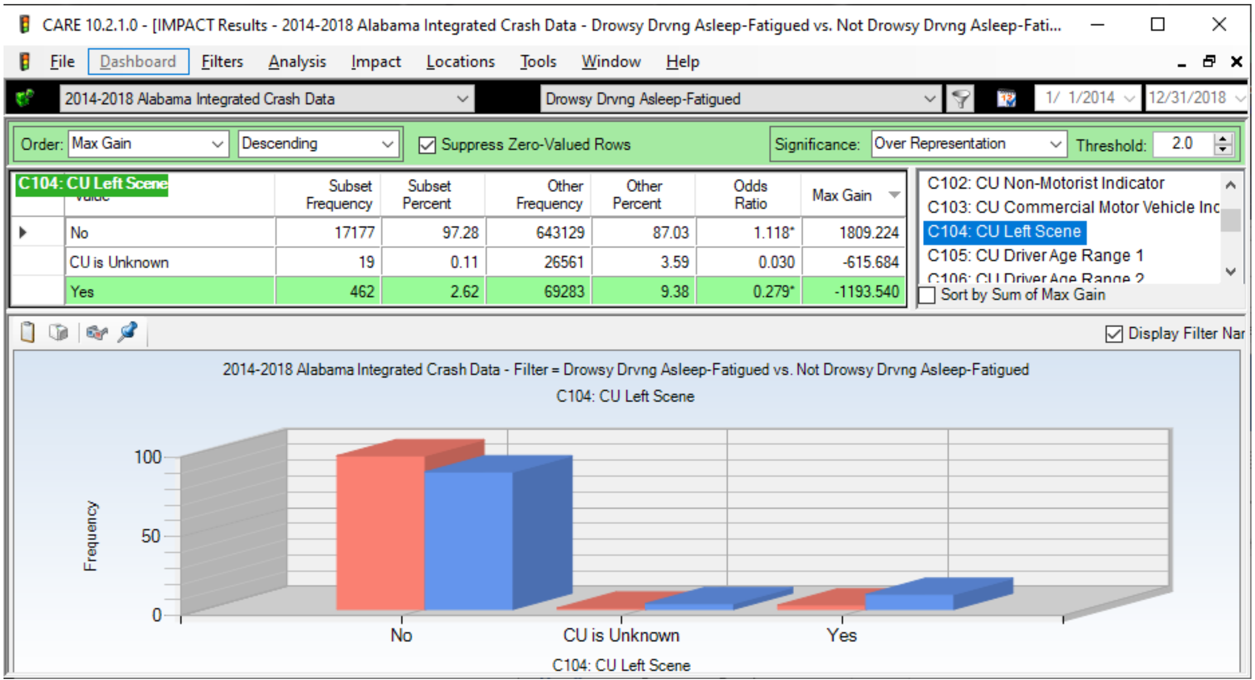
C023: E Manner of Crash	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Single Vehicle Crash (all types)	11565	65.49	136972	18.54	3.533*	8292.018
Head-On (front to front only)	660	3.74	14804	2.00	1.866*	306.255
Sideswipe - Opposite Direction	376	2.13	12813	1.73	1.228*	69.830
Non-Collision	105	0.59	5040	0.68	0.872	-15.432
Record from Paper System	41	0.23	5563	0.75	0.308*	-91.929
Causal Veh Backing: Rear to Rear	2	0.01	4459	0.60	0.019	-104.549
Unknown	6	0.03	4968	0.67	0.051	-112.712
Angle Oncoming (frontal)	237	1.34	16922	2.29	0.586*	-167.356
Other	248	1.40	17922	2.43	0.579*	-180.251
Angle (front to side) Opposite Direction	178	1.01	20705	2.80	0.360*	-316.751
Causal Veh Backing: Rear to Side	13	0.07	13931	1.89	0.039	-319.885
Angle (front to side) Same Direction	135	0.76	19508	2.64	0.290*	-331.149
Sideswipe - Same Direction	602	3.41	64710	8.76	0.389*	-944.262
Side Impact (angled)	372	2.11	62544	8.46	0.249*	-1122.505
Side Impact (90 degrees)	256	1.45	67325	9.11	0.159*	-1352.748
Rear End (front to rear)	2862	16.21	270789	36.64	0.442*	-3608.574

C052 Number of Vehicles

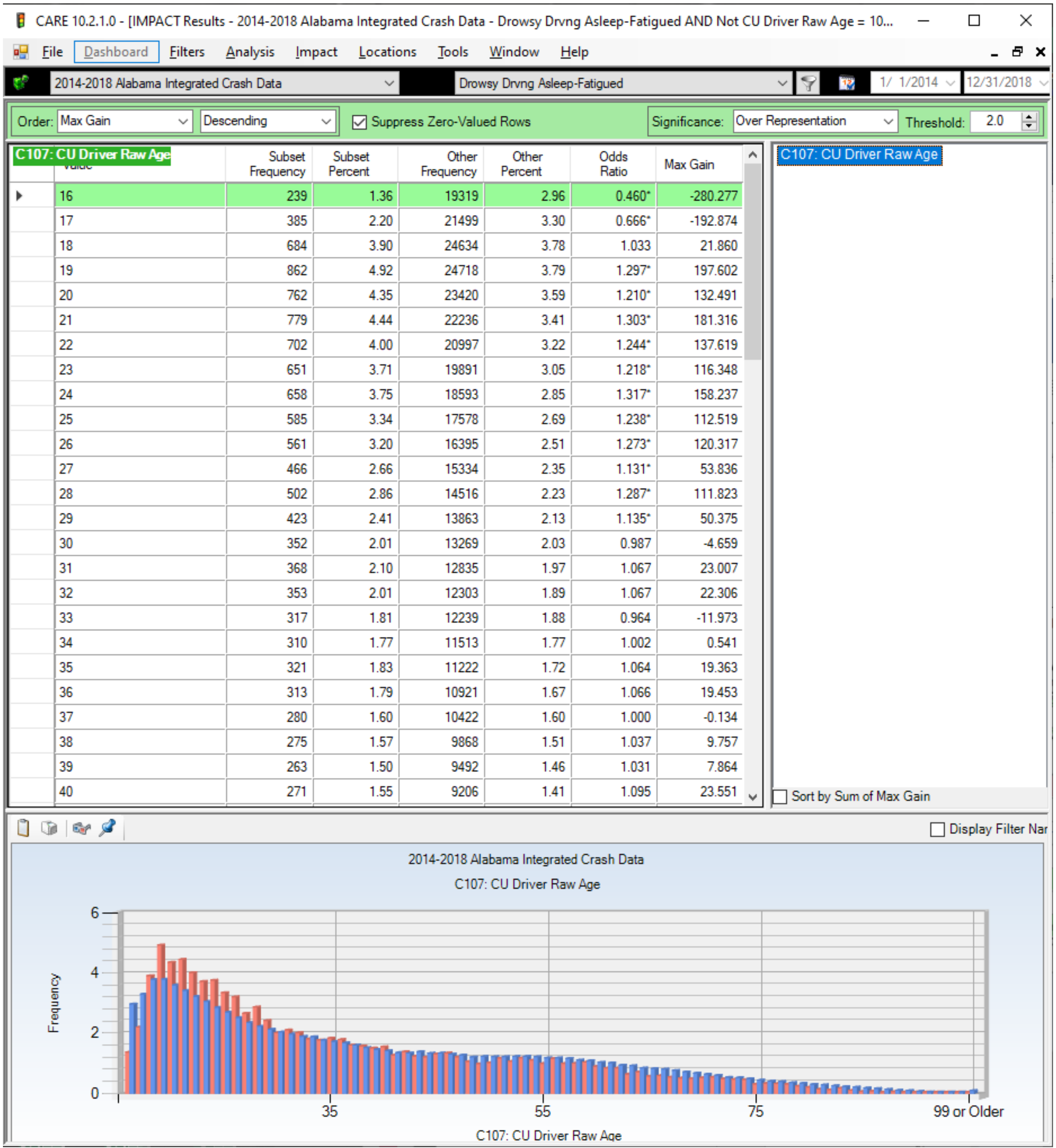


Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1 Vehicle	12133	68.71	152286	20.61	3.334*	8494.086
2 Vehicles	4909	27.80	544711	73.71	0.377*	-8107.011
3 Vehicles	470	2.66	36096	4.88	0.545*	-392.523
4 Vehicles	101	0.57	4837	0.65	0.874	-14.581
5 Vehicles	31	0.18	788	0.11	1.646*	12.171
6 Vehicles	7	0.04	176	0.02	1.664	2.794
7 Vehicles	4	0.02	48	0.01	3.487	2.853
8 Vehicles	1	0.01	22	0.00	1.902	0.474
9 Vehicles	2	0.01	5	0.00	16.740	1.881

C104 CU Left Scene



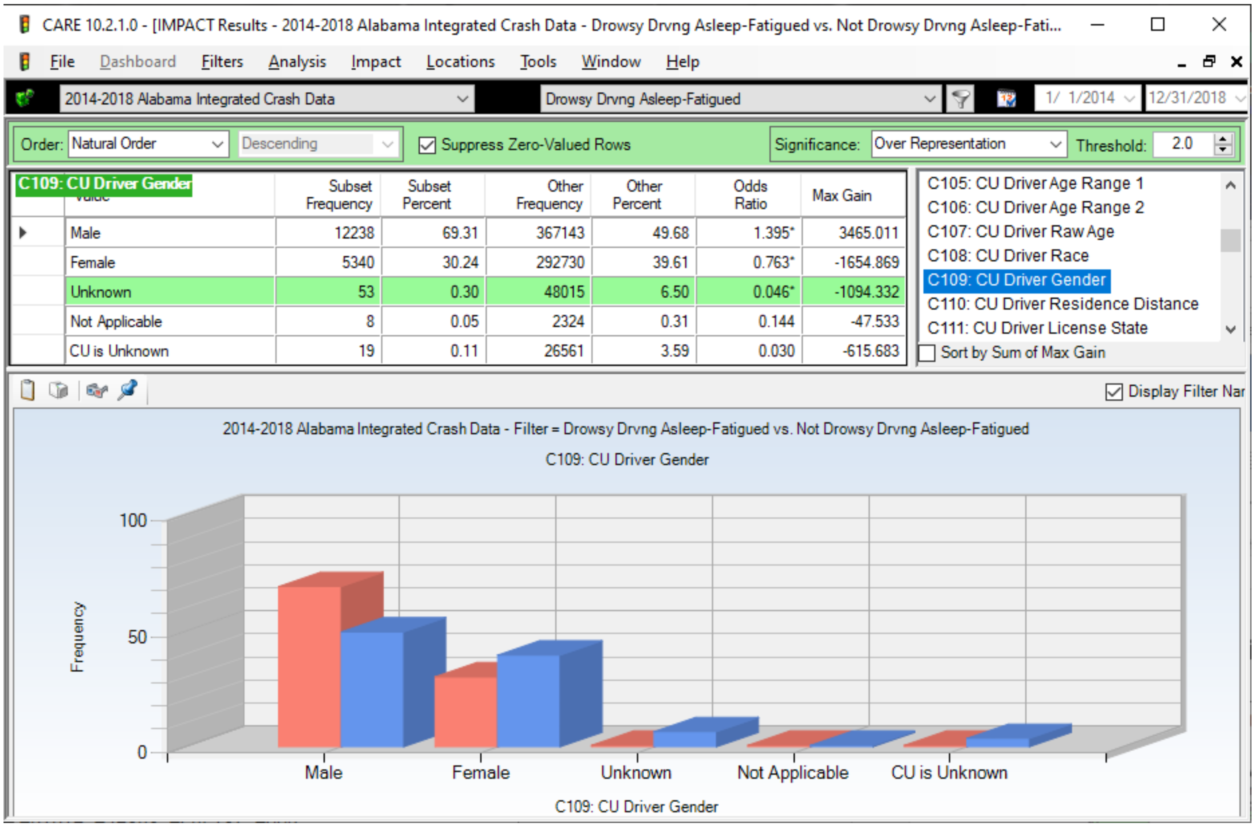
C107 CU Driver Raw Age



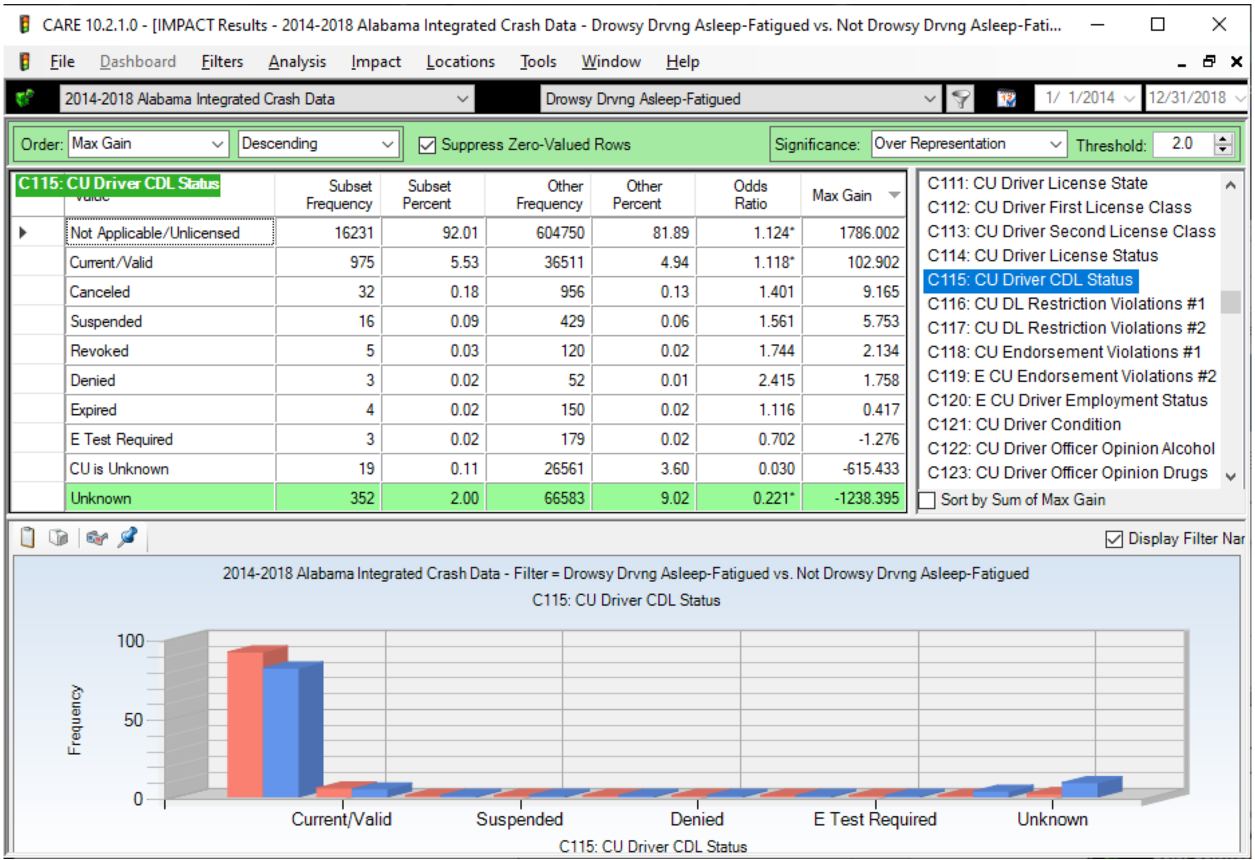
C107: CU Driver Raw Age Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
16	239	1.36	19319	2.96	0.460*	-280.277
17	385	2.20	21499	3.30	0.666*	-192.874
18	684	3.90	24634	3.78	1.033	21.860
19	862	4.92	24718	3.79	1.297*	197.602
20	762	4.35	23420	3.59	1.210*	132.491
21	779	4.44	22236	3.41	1.303*	181.316
22	702	4.00	20997	3.22	1.244*	137.619
23	651	3.71	19891	3.05	1.218*	116.348
24	658	3.75	18593	2.85	1.317*	158.237
25	585	3.34	17578	2.69	1.238*	112.519
26	561	3.20	16395	2.51	1.273*	120.317
27	466	2.66	15334	2.35	1.131*	53.836
28	502	2.86	14516	2.23	1.287*	111.823
29	423	2.41	13863	2.13	1.135*	50.375
30	352	2.01	13269	2.03	0.987	-4.659
31	368	2.10	12835	1.97	1.067	23.007
32	353	2.01	12303	1.89	1.067	22.306
33	317	1.81	12239	1.88	0.964	-11.973
34	310	1.77	11513	1.77	1.002	0.541
35	321	1.83	11222	1.72	1.064	19.363
36	313	1.79	10921	1.67	1.066	19.453
37	280	1.60	10422	1.60	1.000	-0.134
38	275	1.57	9868	1.51	1.037	9.757
39	263	1.50	9492	1.46	1.031	7.864
40	271	1.55	9206	1.41	1.095	23.551

Over-representations 19 and above are significant up to and including age 29.

C109 CU Driver Gender

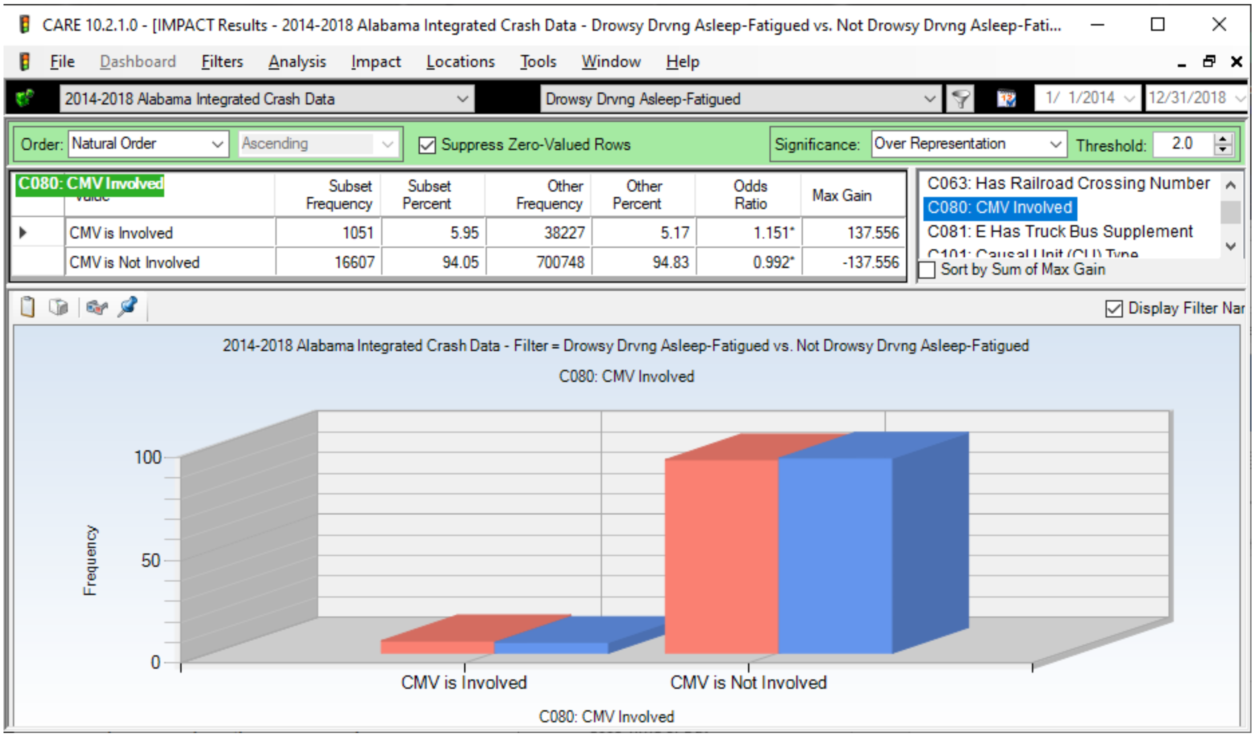


C115 CU Driver CDL Status

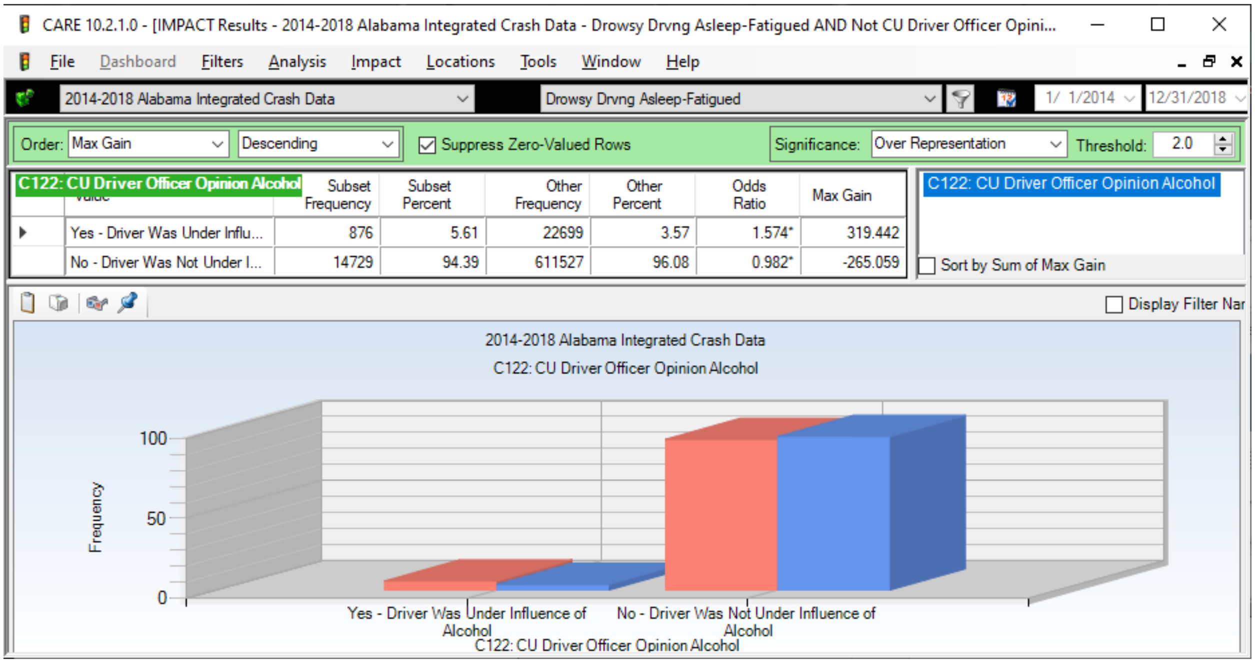


C115: CU Driver CDL Status Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Not Applicable/Unlicensed	16231	92.01	604750	81.89	1.124*	1786.002
Current/Valid	975	5.53	36511	4.94	1.118*	102.902
Canceled	32	0.18	956	0.13	1.401	9.165
Suspended	16	0.09	429	0.06	1.561	5.753
Revoked	5	0.03	120	0.02	1.744	2.134
Denied	3	0.02	52	0.01	2.415	1.758
Expired	4	0.02	150	0.02	1.116	0.417
E Test Required	3	0.02	179	0.02	0.702	-1.276
CU is Unknown	19	0.11	26561	3.60	0.030	-615.433
Unknown	352	2.00	66583	9.02	0.221*	-1238.395

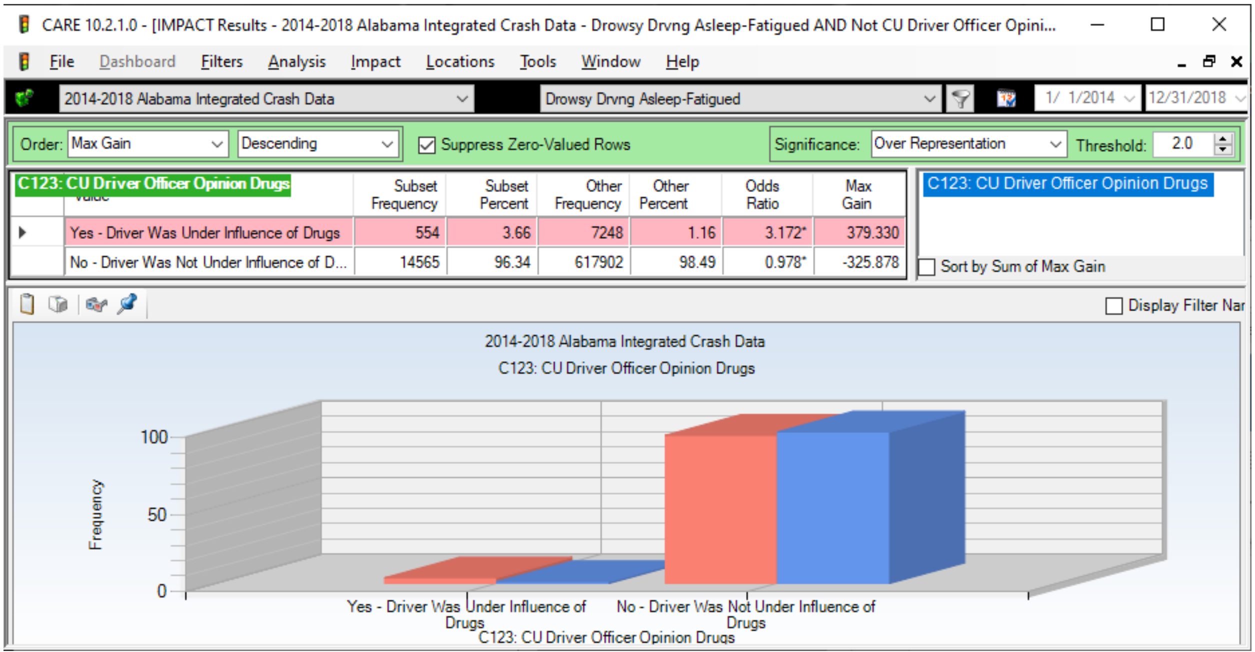
C080 CMV Involved



C122 CU Driver Officer Opinion Alcohol

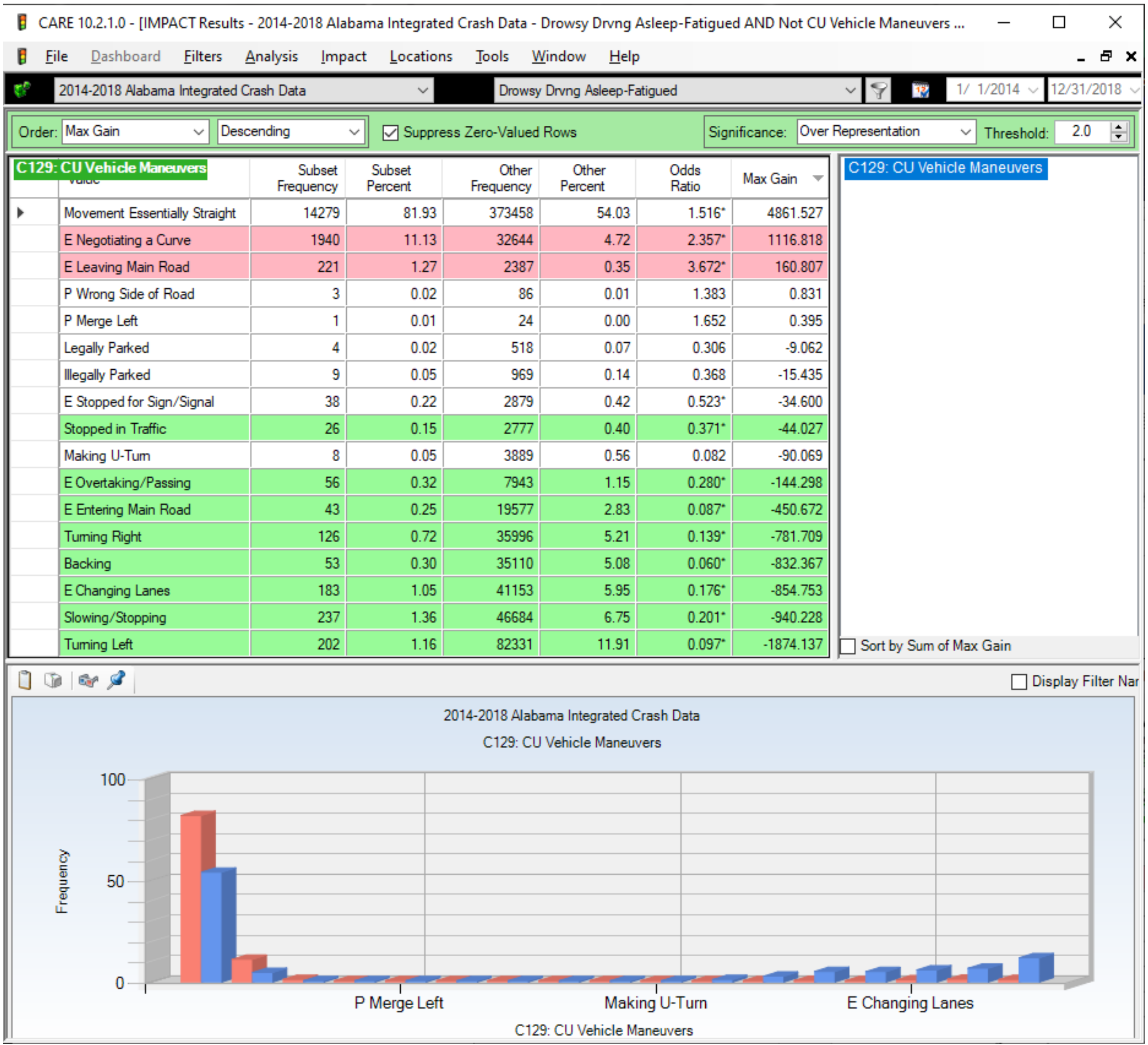


C123 CU Officer Opinion Drugs



C129 CU Vehicle Maneuvers

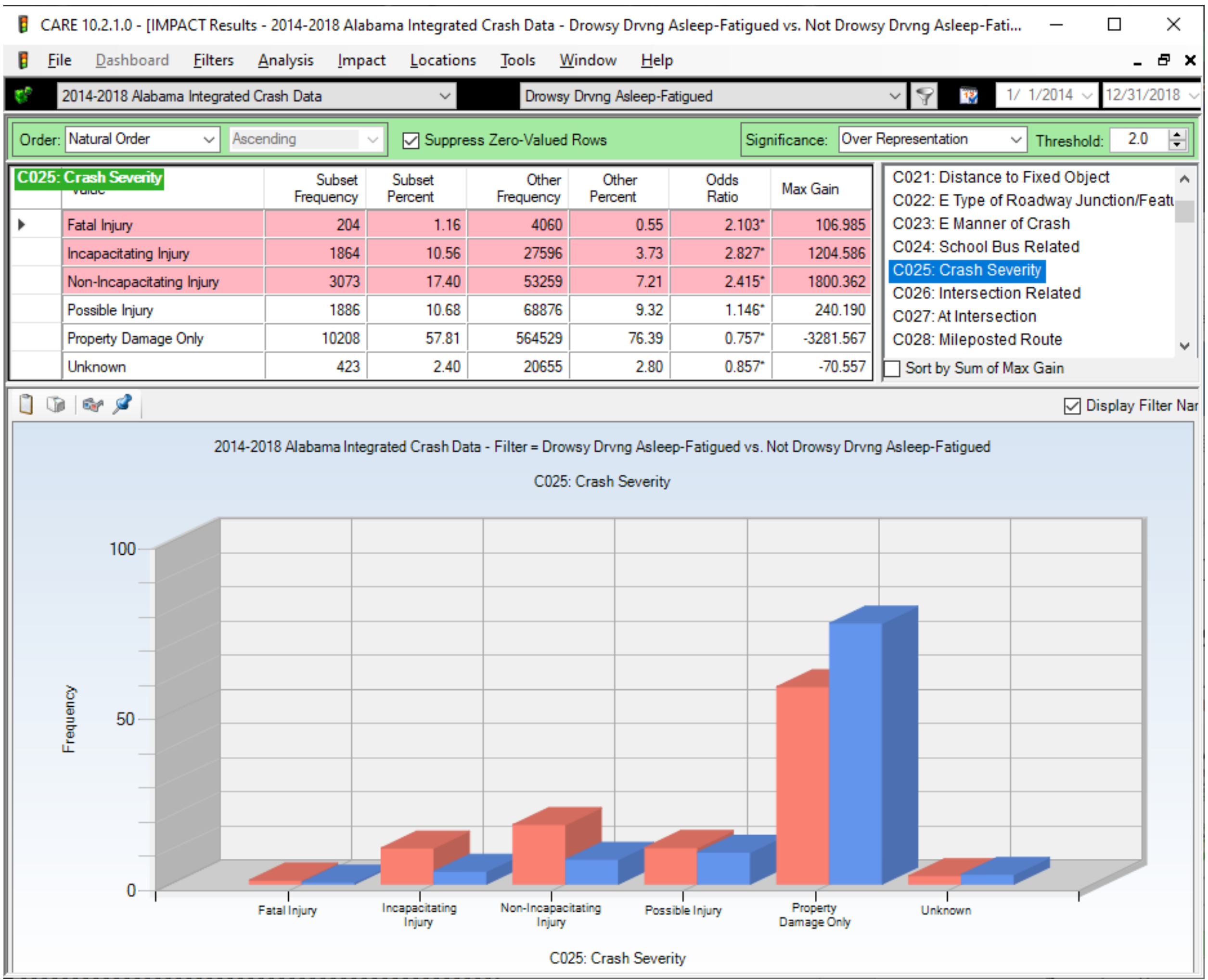
The following was reduced by removing all of the cases in which there were zero DrD crashes recorded.



C129: CU Vehicle Maneuvers	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Movement Essentially Straight	14279	81.93	373458	54.03	1.516*	4861.527
E Negotiating a Curve	1940	11.13	32644	4.72	2.357*	1116.818
E Leaving Main Road	221	1.27	2387	0.35	3.672*	160.807
P Wrong Side of Road	3	0.02	86	0.01	1.383	0.831
P Merge Left	1	0.01	24	0.00	1.652	0.395
Legally Parked	4	0.02	518	0.07	0.306	-9.062
Illegally Parked	9	0.05	969	0.14	0.368	-15.435
E Stopped for Sign/Signal	38	0.22	2879	0.42	0.523*	-34.600
Stopped in Traffic	26	0.15	2777	0.40	0.371*	-44.027
Making U-Turn	8	0.05	3889	0.56	0.082	-90.069
E Overtaking/Passing	56	0.32	7943	1.15	0.280*	-144.298
E Entering Main Road	43	0.25	19577	2.83	0.087*	-450.672
Turning Right	126	0.72	35996	5.21	0.139*	-781.709
Backing	53	0.30	35110	5.08	0.060*	-832.367
E Changing Lanes	183	1.05	41153	5.95	0.176*	-854.753
Slowing/Stopping	237	1.36	46684	6.75	0.201*	-940.228
Turning Left	202	1.16	82331	11.91	0.097*	-1874.137

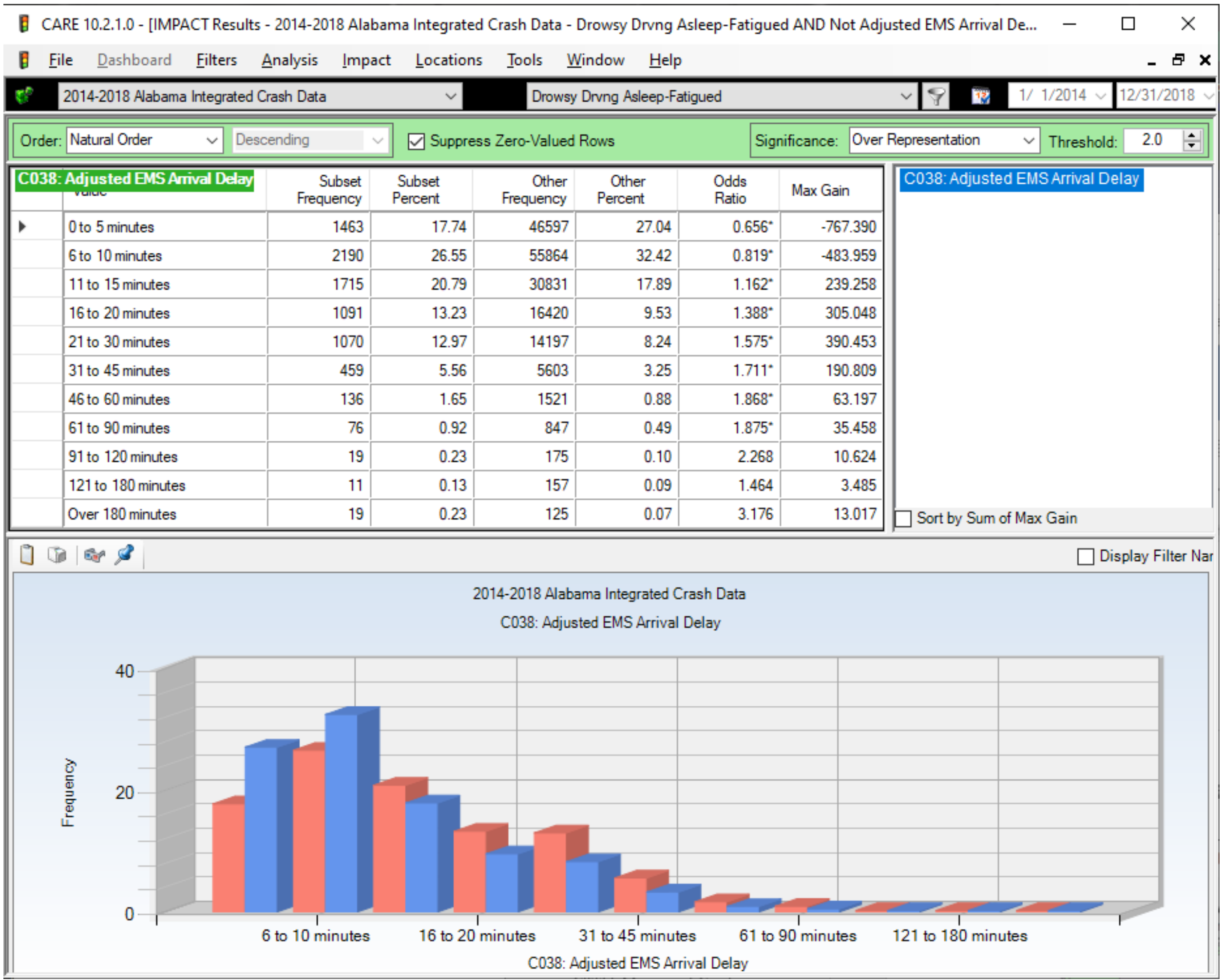
IMPACT Displays – Severity 25, 38, 60, 224

C025 Crash Severity



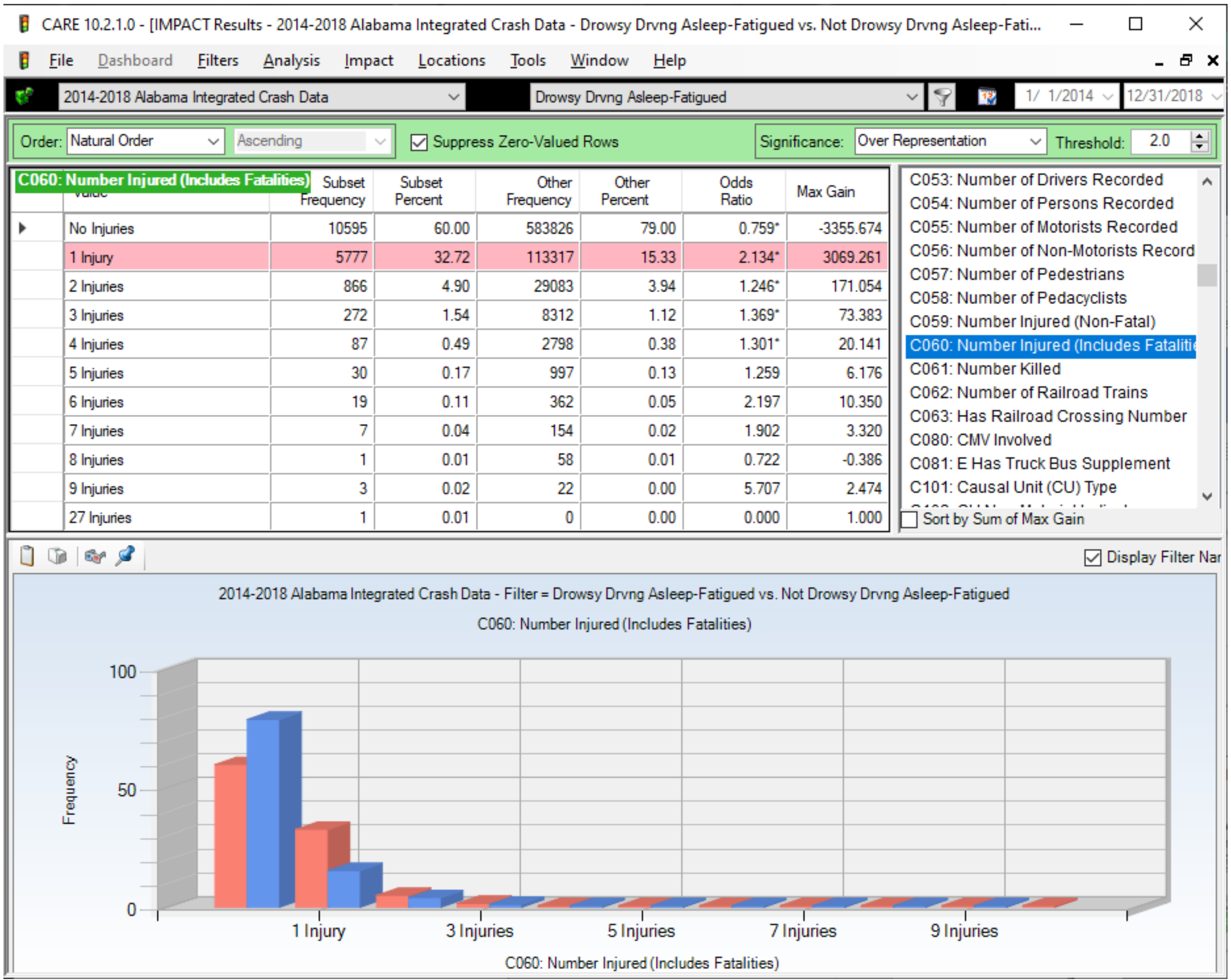
C025: Crash Severity	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Fatal Injury	204	1.16	4060	0.55	2.103*	106.985
Incapacitating Injury	1864	10.56	27596	3.73	2.827*	1204.586
Non-Incapacitating Injury	3073	17.40	53259	7.21	2.415*	1800.362
Possible Injury	1886	10.68	68876	9.32	1.146*	240.190
Property Damage Only	10208	57.81	564529	76.39	0.757*	-3281.567
Unknown	423	2.40	20655	2.80	0.857*	-70.557

C038 Adjusted EMS Arrival Delay



C038: Adjusted EMS Arrival Delay Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
0 to 5 minutes	1463	17.74	46597	27.04	0.656*	-767.390
6 to 10 minutes	2190	26.55	55864	32.42	0.819*	-483.959
11 to 15 minutes	1715	20.79	30831	17.89	1.162*	239.258
16 to 20 minutes	1091	13.23	16420	9.53	1.388*	305.048
21 to 30 minutes	1070	12.97	14197	8.24	1.575*	390.453
31 to 45 minutes	459	5.56	5603	3.25	1.711*	190.809
46 to 60 minutes	136	1.65	1521	0.88	1.868*	63.197
61 to 90 minutes	76	0.92	847	0.49	1.875*	35.458
91 to 120 minutes	19	0.23	175	0.10	2.268	10.624
121 to 180 minutes	11	0.13	157	0.09	1.464	3.485
Over 180 minutes	19	0.23	125	0.07	3.176	13.017

C060 Number Injured (Including Fatalities)



C060: Number Injured (Includes Fatalities)	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
No Injuries	10595	60.00	583826	79.00	0.759*	-3355.674
1 Injury	5777	32.72	113317	15.33	2.134*	3069.261
2 Injuries	866	4.90	29083	3.94	1.246*	171.054
3 Injuries	272	1.54	8312	1.12	1.369*	73.383
4 Injuries	87	0.49	2798	0.38	1.301*	20.141
5 Injuries	30	0.17	997	0.13	1.259	6.176
6 Injuries	19	0.11	362	0.05	2.197	10.350
7 Injuries	7	0.04	154	0.02	1.902	3.320
8 Injuries	1	0.01	58	0.01	0.722	-0.386
9 Injuries	3	0.02	22	0.00	5.707	2.474
27 Injuries	1	0.01	0	0.00	0.000	1.000

C224 CU Estimated Speed at Impact

CARE 10.2.1.0 - [IMPACT Results - 2014-2018 Alabama Integrated Crash Data - Drowsy Drvng Asleep-Fatigued AND Not CU Estimated Speed at I...

File Dashboard Filters Analysis Impact Locations Tools Window Help

2014-2018 Alabama Integrated Crash Data | Drowsy Drvng Asleep-Fatigued | 1/ 1/2014 | 12/31/2018

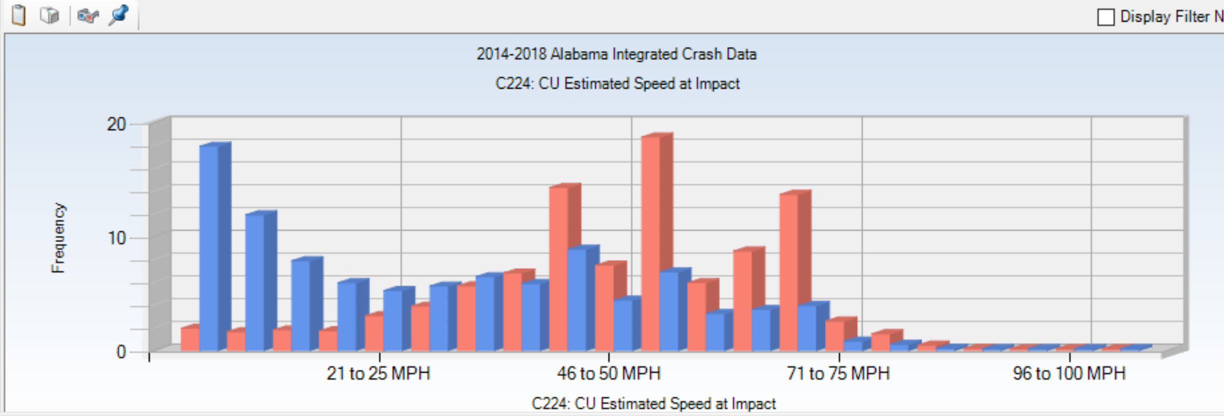
Order: Natural Order | Descending | Suppress Zero-Valued Rows | Significance: Over Representation | Threshold: 2.0

C224: CU Estimated Speed at Impact Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1 to 5 MPH	247	1.93	69257	17.92	0.108*	-2044.484
6 to 10 MPH	208	1.63	45996	11.90	0.137*	-1313.855
11 to 15 MPH	228	1.78	30384	7.86	0.227*	-777.306
16 to 20 MPH	219	1.71	22916	5.93	0.289*	-539.214
21 to 25 MPH	387	3.03	20258	5.24	0.577*	-283.270
26 to 30 MPH	495	3.87	21797	5.64	0.686*	-226.190
31 to 35 MPH	724	5.66	24979	6.46	0.876*	-102.472
36 to 40 MPH	868	6.79	22654	5.86	1.158*	118.454
41 to 45 MPH	1828	14.29	34281	8.87	1.612*	693.756
46 to 50 MPH	956	7.48	16972	4.39	1.702*	394.453
51 to 55 MPH	2396	18.74	26580	6.88	2.724*	1516.556
56 to 60 MPH	759	5.94	12402	3.21	1.850*	348.659
61 to 65 MPH	1116	8.73	13845	3.58	2.436*	657.915
66 to 70 MPH	1751	13.69	15107	3.91	3.503*	1251.160
71 to 75 MPH	329	2.57	3106	0.80	3.201*	226.233
76 to 80 MPH	185	1.45	1969	0.51	2.840*	119.852
81 to 85 MPH	58	0.45	640	0.17	2.739*	36.825
86 to 90 MPH	19	0.15	501	0.13	1.146	2.424
91 to 95 MPH	4	0.03	111	0.03	1.089	0.327
96 to 100 MPH	10	0.08	354	0.09	0.854	-1.713
Over 100 MPH	1	0.01	190	0.05	0.159	-5.286

C224: CU Estimated Speed at Impact

Sort by Sum of Max Gain

Display Filter Nar



IMPACT Displays – Vehicle 80, 101, 129, 208

C101 Causal Unit (CU) Type

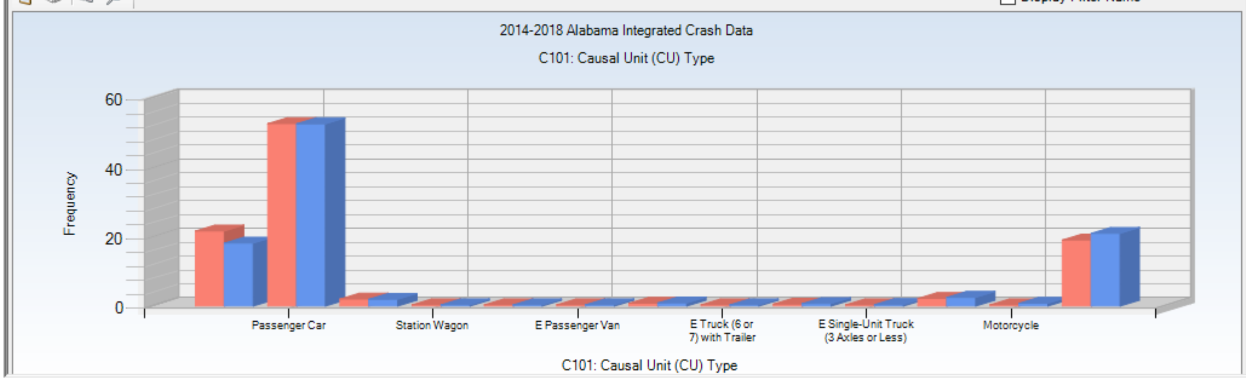
All items with less than 10 crashes in the subset were removed.

CARE 10.2.1.0 - [IMPACT Results - 2014-2018 Alabama Integrated Crash Data - Drowsy Drvng Asleep-Fatigued AND Not Causal Unit (CU) Type = 45 OR 12 OR 10 O...

2014-2018 Alabama Integrated Crash Data | Drowsy Drvng Asleep-Fatigued | 1/ 1/2014 | 12/31/2018

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

C101: Causal Unit (CU) Type Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Pick-Up (Four-Tire Light Truck)	3806	21.65	126434	18.16	1.192*	613.327
Passenger Car	9251	52.62	365950	52.56	1.001	10.141
E Tractor/Semi-Trailer	354	2.01	13654	1.96	1.027	9.213
Station Wagon	54	0.31	2156	0.31	0.992	-0.443
E Van or Mini-Van	10	0.06	761	0.11	0.520	-9.217
E Passenger Van	48	0.27	2583	0.37	0.736	-17.225
E Single-Unit Truck (2-Axle/6-Tire)	138	0.78	6157	0.88	0.888	-17.475
E Truck (6 or 7) with Trailer	26	0.15	1900	0.27	0.542*	-21.978
E Cargo Van (10000 lbs or Less)	97	0.55	4872	0.70	0.788*	-26.026
E Single-Unit Truck (3 Axles or Less)	33	0.19	2884	0.41	0.453*	-39.826
E Mini-van	385	2.19	17365	2.49	0.878*	-53.496
Motorcycle	30	0.17	5561	0.80	0.214*	-110.425
E Sport Utility Vehicle (SUV)	3350	19.05	145993	20.97	0.909*	-336.571



C208 CU Model Year

CARE 10.2.1.0 - [IMPACT Results - 2014-2018 Alabama Integrated Crash Data - Drowsy Drvng Asleep-Fatigued AND Not CU Model Year = 48 OR ...

File Dashboard Filters Analysis Impact Locations Tools Window Help

2014-2018 Alabama Integrated Crash Data | Drowsy Drvng Asleep-Fatigued | 1/ 1/2014 | 12/31/2018

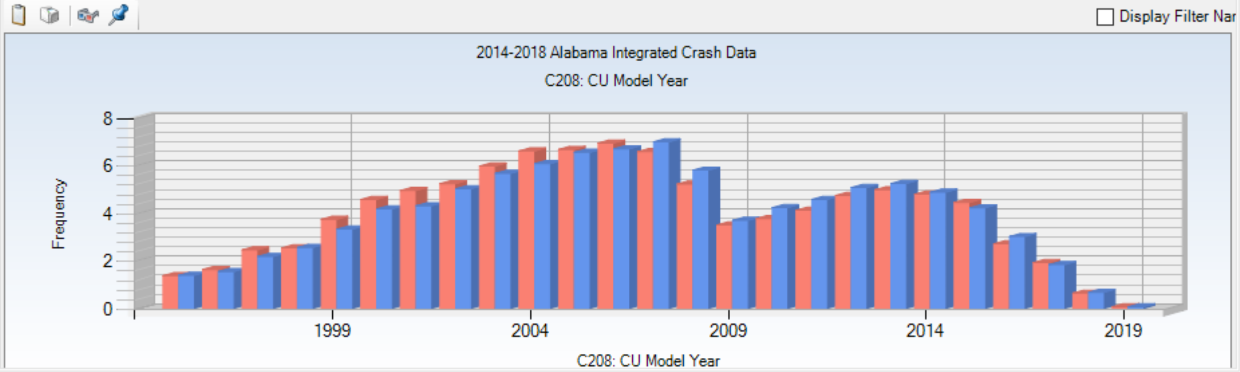
Order: Max Gain | Descending | Suppress Zero-Valued Rows | Significance: Over Representation | Threshold: 2.0

C208: CU Model Year Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1995	230	1.36	8829	1.38	0.989	-2.557
1996	274	1.63	9874	1.54	1.054	13.918
1997	413	2.45	13920	2.18	1.126*	46.346
1998	427	2.53	16337	2.55	0.992	-3.318
1999	629	3.73	21246	3.32	1.124*	69.378
2000	770	4.57	26680	4.17	1.096*	67.246
2001	833	4.94	27533	4.30	1.149*	107.778
2002	882	5.23	32111	5.02	1.043	36.193
2003	1006	5.97	36249	5.66	1.054	51.198
2004	1113	6.60	38879	6.08	1.087*	88.924
2005	1124	6.67	41889	6.55	1.019	20.640
2006	1169	6.93	42865	6.70	1.035	39.932
2007	1108	6.57	44713	6.99	0.941	-69.745
2008	879	5.21	37101	5.80	0.899*	-98.244
2009	589	3.49	23605	3.69	0.947	-32.758
2010	635	3.77	27020	4.22	0.892*	-76.709
2011	693	4.11	29238	4.57	0.900*	-77.132
2012	798	4.73	32422	5.07	0.934	-55.998
2013	838	4.97	33508	5.24	0.949	-44.604
2014	807	4.79	31159	4.87	0.983	-13.731
2015	749	4.44	26992	4.22	1.053	38.028
2016	456	2.71	19257	3.01	0.899	-51.231
2017	323	1.92	11706	1.83	1.048	14.663
2018	106	0.63	4288	0.67	0.938	-6.946
2019	6	0.04	352	0.06	0.647	-3.272

C208: CU Model Year

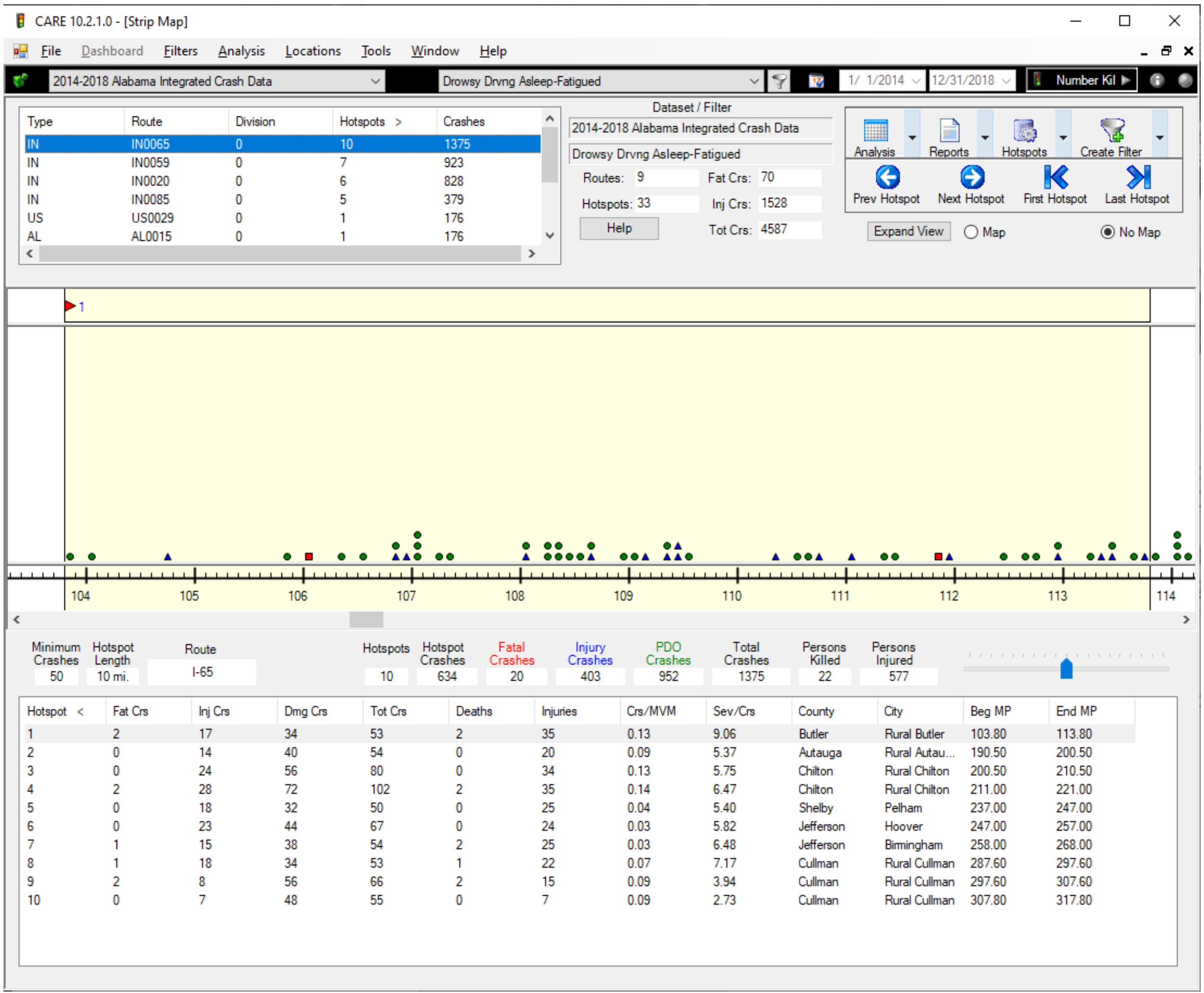
Sort by Sum of Max Gain

Display Filter Nar



DrD Hotspot Analysis Example Excerpt from I-65

The criteria for this example is 50 DrD crashes in any 10 mile segment. There were 33 such hotspots found on 9 routes, for a totally of 4,587 DrD crashes found on the mileposted routes under consideration. Of these 70 were fatal and 1,528 were non-fatal injury crashes.



Hotspot	Fat Crs	Inj Crs	Dmg Crs	Tot Crs	Deaths	Injuries	Crs/MVM	Sev/Crs	County	City	Beg MP	End MP
1	2	17	34	53	2	35	0.13	9.06	Butler	Rural Butler	103.80	113.80
2	0	14	40	54	0	20	0.09	5.37	Autauga	Rural Autau...	190.50	200.50
3	0	24	56	80	0	34	0.13	5.75	Chilton	Rural Chilton	200.50	210.50
4	2	28	72	102	2	35	0.14	6.47	Chilton	Rural Chilton	211.00	221.00
5	0	18	32	50	0	25	0.04	5.40	Shelby	Pelham	237.00	247.00
6	0	23	44	67	0	24	0.03	5.82	Jefferson	Hoover	247.00	257.00
7	1	15	38	54	2	25	0.03	6.48	Jefferson	Birmingham	258.00	268.00
8	1	18	34	53	1	22	0.07	7.17	Cullman	Rural Cullman	287.60	297.60
9	2	8	56	66	2	15	0.09	3.94	Cullman	Rural Cullman	297.60	307.60
10	0	7	48	55	0	7	0.09	2.73	Cullman	Rural Cullman	307.80	317.80

Interesting that the first hotspot, which is shown on the strip map is not in the dense traffic in Mobile (which is typical of most hotspot filters for I-65), but is shown at Milepost 103.80, over 100 miles north, giving drivers adequate time to become drowsy.