Analysis of Motorcycle Caused and Motorcycle Victim Crashes CY2010-2014 Data

by Dave Brown

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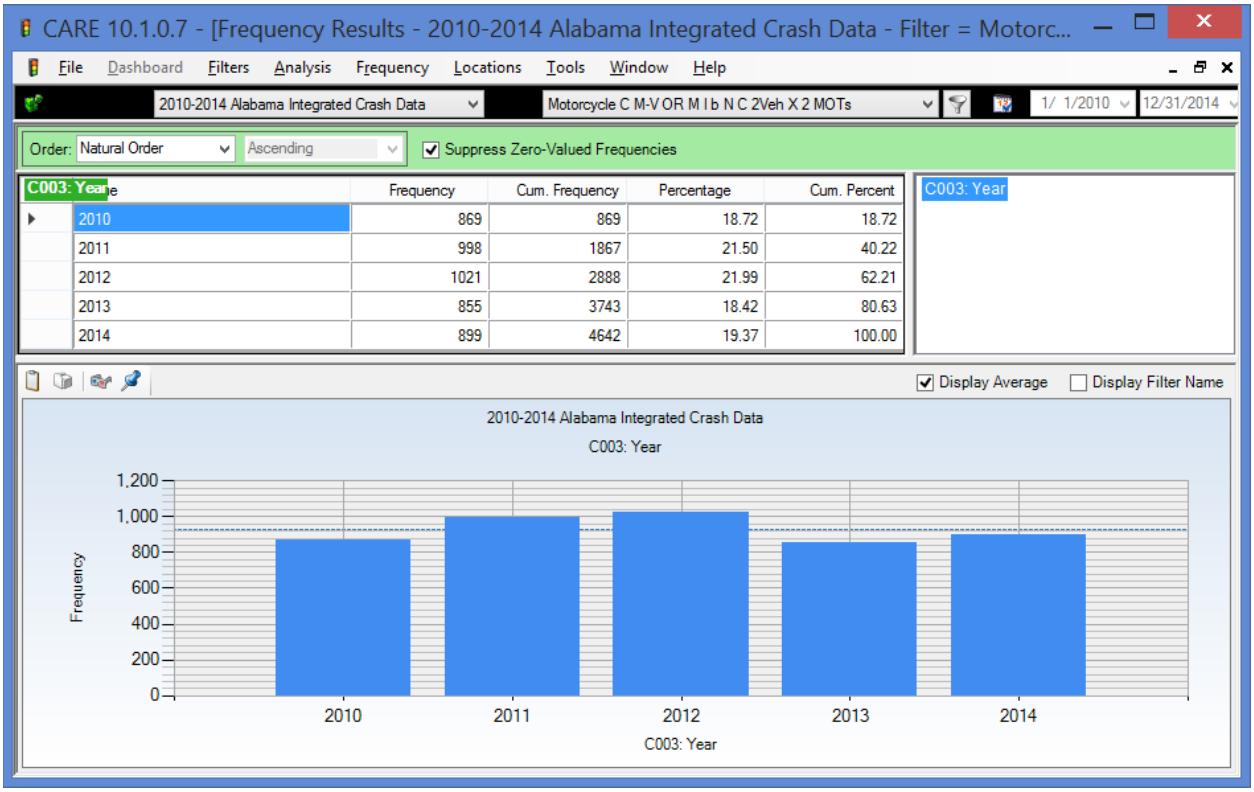
For additional motorcycle information from NHTSA and other sources, see:
http://www.safehomealabama.gov/tag/motorcycles/

Introduction

This report has the objective of presenting a problem identification that was done on motorcycle (MC) crashes with the goal of establishing and improving countermeasures for reducing these crash frequencies and severities in the future. The IMPACT displays are based on a comparison of two subsets, both restricted to multiple-vehicle crashes, and both of which involved one and only one motorcycle in the crash. In the first subset the motorcycle was listed as the cause of the crash; and in the second the other non-MC vehicle was listed as the cause.

The following display gives the frequency distribution for the overall 4,642 crashes by year for the total MC-involved subset of crashes (the combination of the two subsets defined above). The blue line is the average over the five years.



Clearly there was a significant reduction in CMV crashes in years 2013 and 2014 from the high in 2012. However, this was a regression to the mean as represented by the 2010 level. This will be discussed in more detail in light of the overall crash trend below under the Time Factors major heading, attribute C003, Year.

The reason for having MCs involved in both subsets being compared is to minimize other factors that could be influencing the outcomes. It was reasoned that such factors as driver demographics and other factors would be fairly close in both subsets since both involve one motorcycle. However, many of the results were quite surprising, indicating correlations that we unexpected.

IMPACT Outputs for MC Caused vs. Non-MC Caused Crashes

Interpretation of IMPACT displays. The following sections presents a number of IMPACT runs that surface some of the major characteristics of crashes in which CMVHTs were involved as compared to all of the rest of the crash records. For information regarding the interpretation of IMPACT outputs, see:

http://www.caps.ua.edu/software/care/

and scroll down to the bottom of the page for the IMPACT tutorial. In the charts the ***red bars represented MC-caused crash proportions*** while the ***blue bars represent the non-MC caused crash proportions.***

Output pruning. Most of the output displays in the following sections were "pruned" using an extremely valuable CARE tool that can dynamically change the filter on the subset being viewed to eliminate "noise" from IMPACT and Frequency output displays. In most cases the following were summarily eliminated as not contributing information to the outputs: Unknown, CU is Unknown, CU is Not a Vehicle, Other, Not Applicable. Important to recognize is that even if we did not have these categories, we would still be making inferences from subsets of the total reality of 100% complete and accurate reporting. In those cases where outputs were pruned the result forms an estimate of reality that is, in most cases, is more accurate in the relative distribution sense than if these categories were left in, to say nothing of their distraction from the important results. In situations where more than these were pruned, a note is made under the display.

Code interpretations. In some cases a code or an entire variable (attribute) will be preceded by either an E or a P. This indicates that the attribute value (or the entire attribute) is either exclusive to eCrash (E) or to the Paper form (P). If this does not appear then it should be concluded that the attribute or value is coded similarly enough in both modes that it can be considered essentially the same variable, and thus comparable. In some cases where there were very few P responses these were pruned from the output; in other cases where they were felt to be significant they can be combined with the E results to form an overall picture of reality. CU = Causal Unit – the unit and driver indicated by the officer to have the most cause for the crash.

Summary of output results by general IMPACT category. The following gives a brief summary of the IMPACT displays that follow:

- **Geographical Attributes**
  - C001 County (MC-caused over-represented) – counties with less than five MC-caused crashes were excluded from consideration in this and the following analyses. The counties with the highest Max Gain are listed at the top, and these correlate well with those with the highest odds ratio. Statistical significance is indicated by the asterisk after the Odds Ratio. Cells with odds rations greater than 2 are given a red background; those with 0.5 or less are given a green background.
  - C001 County (non-MC-caused over-represented) – the bottom of the IMPACT output listing gives the areas where the MCs are more under-represented, which would also be the areas where the non-MCs (e.g., passenger cars) have their highest over-representation. The greatest non-MC over-representation is at the bottom of the table, with Mobile, Jefferson and Tuscaloosa being the worst counties for non-MCs causing MC involved crashes.
  - C002 City (MC-caused over-represented) – clearly the rural areas of the counties show a pattern of the highest over-representation in MC-caused crashes.
  - C002 City (non-MC-caused over-represented) – with but few exceptions the counties characterized by urban areas are over-represented in non-MC caused crashes. This is reasonable because of the greater concentration of passenger vehicle in the urban areas.
  - C010 Rural or Urban – it comes as no surprise after seeing the results above that the rural areas are over-represented in MC-caused crashes, while the urban areas are over-represented in those caused by non-MC vehicles. The reason for this is subject for further study – recognize again that both subsets contain one MC and one non-MC per crash.
  - C010 Locale – This further confirms that those crashes caused by MCs occur more often in Open Country and Residential area as opposed to those in Shopping or Business areas, which are more often caused by non-MCs.
  - C110 Residence Distance – Consistent with the above findings, two-vehicle crashes caused by MCs tend to occur more when the MCs are traveling Greater than 25 Miles, and those caused by non-MCs when traveling Less than 25 Miles.

- **Time Factors**
  - C003 Year – The combined subset analysis was discussed above showing a total peak in 2012 that has now gone back down to the 2010 level. This analysis shows that the relative fault was more on the non-MC in 2010, and in 2013 and 2014 it was more with the MC. This trend needs to be watched; however, since none of the differences between MC and non-MC caused crashes is significant, this should not be considered as a major factor in decision-making.

- C004 Month – it seems reasonable that the number of overall MC crashes would diminish during the winter months (in this case is it quite visible for November, December, January and February. What is not intuitive is the degree to which the number of crashes drop off – clearly the total numbers of crashes (independent of cause) is well under half, and some as much as less than a third of the other months. Further analyses of these months compared to the others showed no major cause for this decline during the winter other than the fewer miles driven by motorcycle riders. The dramatic decline is probably leveraged by the fact that those who do venture out in the winter are the more proficient and experienced MC drivers who know how to evade crashes.
- C006 Day of the Week – Saturday is the worst day for both MC and non-MC caused crashes, but most pronounced and significantly higher for the MC-caused crashes. This again is probably due to these drivers on average being less experienced casual recreational MC riders leveraged by the lack of experience and skill. The Saturday effect spills over to both Friday and Sunday; Monday is a break even, and non-MC caused crashes are over-represented on Tuesday, Wednesday and Thursday. While these days are not statistically significant, we expect that if they were considered collectively, the F-S-S weekends would be collectively over-represented for MC-caused crashes, and the T-W-Th collective would be significantly over-represented for non-MC caused crashes.
- C008 Time of Day – the primary determining factor for time of day for both MC and non-MC caused crashes is the volume of MCs on the road at that time. Very few of the differences are significant. The two that are are quite telling: 5-6 PM is significantly over-represented for MC-caused, while 8-9 PM is significantly over-represented for non-MC caused. Similar to the day of the week, if we were to collect several hours in which the one or the other is over-represented, we would be able to establish statistically significant patterns. These can best be obtained intuitively by considering the chart. This is further established by the next variable.
- C031 Lighting Conditions – The only significant over-representation for MC-caused crashes is Daylight. At the other extreme there is a significant over-representation for non-MC caused crashes where it is dark but there is continuous lighting. For that matter, all of the lit areas tend to be over-represented with non-MC caused crashes indicating that a lack of visibility of motorcycles in these areas could be the cause. These lit areas rarely occur in rural areas, so that is another factor that could be in play, i.e., the density of non-MC vehicles. These results need to be combined with those above and cross-tabulations of the two variables might be able to allow for the dramatically changing dusk and dawn times with the seasons.

- **Roadway Characteristics**
  - C011 – Highway Classification – while it was expected from the results above that the non-MC caused crashes would be significantly over-represented in the urban areas, the degree to which the MC-caused are over-represented on Interstates by an odds ratio of 2.549 was not expected. Effectively what this is saying is that any given two-vehicle MC crash on an Interstate roadway would have 2.549 times the chances

of being the fault of the MC than the non-MC vehicle. This should be considered in enforcement policies on Interstates, and to a lessor extent on County roads.

- C026 – Intersection Related – because intersections are more associated with urban roadways, these significant results were expected.
- C028 – Mileposted Roads – the top of the table shows those roadways that were over-represented in MC-caused crashes, the largest over-representations being on Interstate roadways. The absence of an asterisk on a comparison that has a sample size of less than 20 in either cell does not mean that the difference is not significant – it just means that because of the low sample size no test was performed. By excluding all mileposted roadways with less than 11 MC-caused crashes, all of the remaining roadways were able to fit on one page. Thus, the bottom of this table contains those crashes in which the non-MC vehicle was more apt to be the cause, with those that were about equal in causation being in the middle (Odds Ratio = 1.000).
- C407 – CU Roadway Curvature and Grade – The first four categories show a pattern of grades and curves causing real problems in MCs causing two-vehicle crashes. Right curves are significantly more of a problem that left turns – the differences between MC-caused and non-MC caused crashes on left curves is not statistically significant. The major value for non-MC caused over-representation is Straight and Level, i.e., the curve/grade attributed was not involved in the cause, which would be expected in most urban crashes.

- **Driver Factors**
  - C015 – Primary Contributing Circumstance – by excluding those values with number of MC-caused crashes less than 10, the major PCCs can be seen in the one table. The cells at the top show some very strong and significant over-representations for MC-caused crashes – virtually all of the items in the top half of the table are quite high and significant over-representations. Working from the bottom of the table up illustrates the converse – those crash PCCs that are indicative of non-MC causes. Note that all of the Unseen Object and Failure to Yield categories indicate a visual perception problem on the part of the non-MC driver. While not the fault of the MC, defensive driving on their part should certainly take this into account. This item is probably the most important IMPACT output to be considered in countermeasure development and improvement.
  - C017 – First Harmful Event – while listed as being MC at fault, several of the items at the top of the table might be seen to be the MC avoiding a vehicle that has inadvertently strayed into their path. We are not attempting to rationalize away the fault of the MC riders, only to demonstrate that many crashes are not solely the fault of just one of the vehicles involved. Fault is usually assigned to the vehicle/driver who made the largest error in bringing about the crash. For the non-MC caused crashes, the simple first harmful even of Collision with Vehicle in Traffic is stated, and E Collision with Vehicle in (or from) Other Roadway is also over-represented for the non-MC caused crashes.

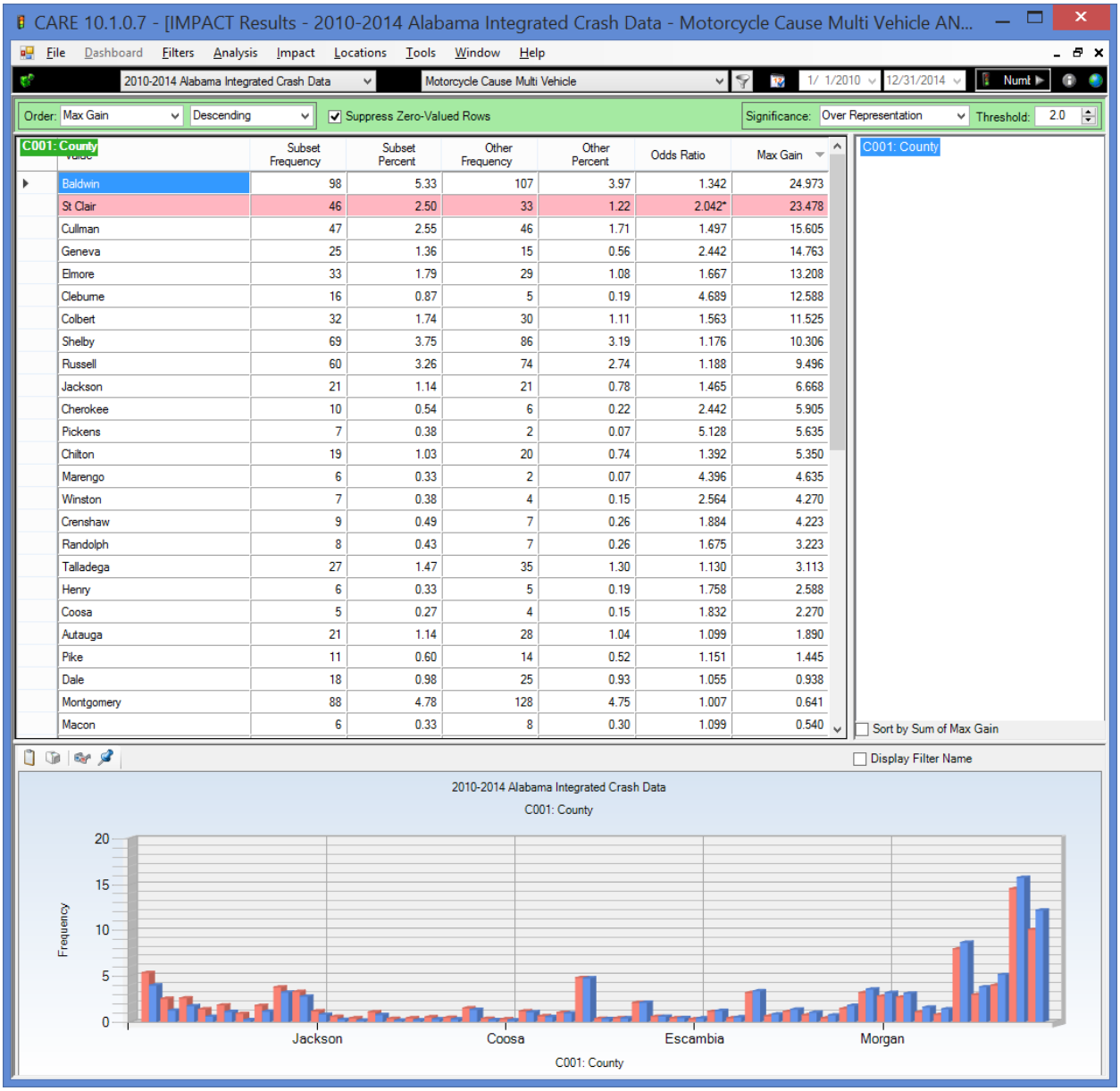
- C023 – Manner of Crash – this output was not pruned since it was felt that the low values and others that are usually pruned might be of use to the reader. Rear-end and sideswipe/angles in the same direction characterize MC-caused crashes, while the non-MC causes are heavy on the side impacts (which are more typical of the urban intersection crashes).
- C105 – Left Scene – MC-caused crashes are less likely to be hit-and-run than are those caused by non-MC vehicles. The reason for this should be obvious in that it is impossible in a relatively larger number of cases for the MC to leave the scene.
- C107 – CU Driver Raw Age – At the very early ages (14-15) the MC driver is most apt to be at fault. At 16-19 the non-MC drivers is significant over-resented. Above 10 things get choppy and no real pattern emerges until the 45-63 age group in which the MC riders collectively are significantly over-represented. This is a very interesting results and it should impact the age group toward which MC countermeasures are formulated.
- C600 – CU Driver Age Range (five year increments) – this collects the same results as given above but in five-year increments so that the collective significant results can be detected easier. The chart give a very good visualization of where the problems are by age group.
- C109 – CU Driver Gender – while it is expected that males will outnumber females in their MC ridership, the degree here and the difference in the causation is quite interesting. Males outnumber females in causing MC-caused crashes by over 17 to 1. We have no demographics to compare this with to determine if this is above or below expectation. (For example, if males drove MCs 50 times as many miles as females, then this female causation would be much higher than expected.) Comparing not with MC ridership, but with the numbers of male/female drivers involved in MC involved two-vehicle crashes, this has the female driver under-represented by a factor of about 10. The 55.26 and 44.62 percentages are roughly the male-female overall non-MC male-female driver breakdown.
- C122 – CU Driver Officer Opinion Alcohol – Alcohol was a factor about 70% more than expected for MC-caused causal drivers. While the number of crashes is not reported to be high, the relative values are more important here since it is well known and accepted that alcohol is not under-reported. Many officers will not mark this item positive unless they know they can prove it in court even though that was not the objective of this attribute.
- C123 – CU Driver Officer Opinion Drugs – The officer opinion here has an even greater problem than with alcohol. In this case the reported results show no significant difference between the MC-caused and non-MC caused subsets.
- C129 – CU Vehicle Maneuver – it is fairly easy to visualize the top items being largely caused by motorcycles while the bottom items are more often caused by the non-MC vehicle.
- C202 – CU Contributing Circumstance (MC Caused) – this is more of an elaboration of C015 above, which was produced since C015 is such an important variable to decision-making.

- C202 – CU Contributing Circumstance (non-MC Caused) – see C202 immediately above.
- C224 – CU Estimated Speed at Impact – the bar chart is quite explicit – crashes caused by non-MCs are typically of much lower speeds than those caused by non-MCs.
- C226 – CU Vehicle Damage – this is NOT a comparison between the damage to the MC vs the damage to the other vehicle – all crashes in both subsets included one MC and one non-MC. Clearly the worst severity in terms of the vehicle were those caused by MCs. This tracks to the severity variables discussed next.

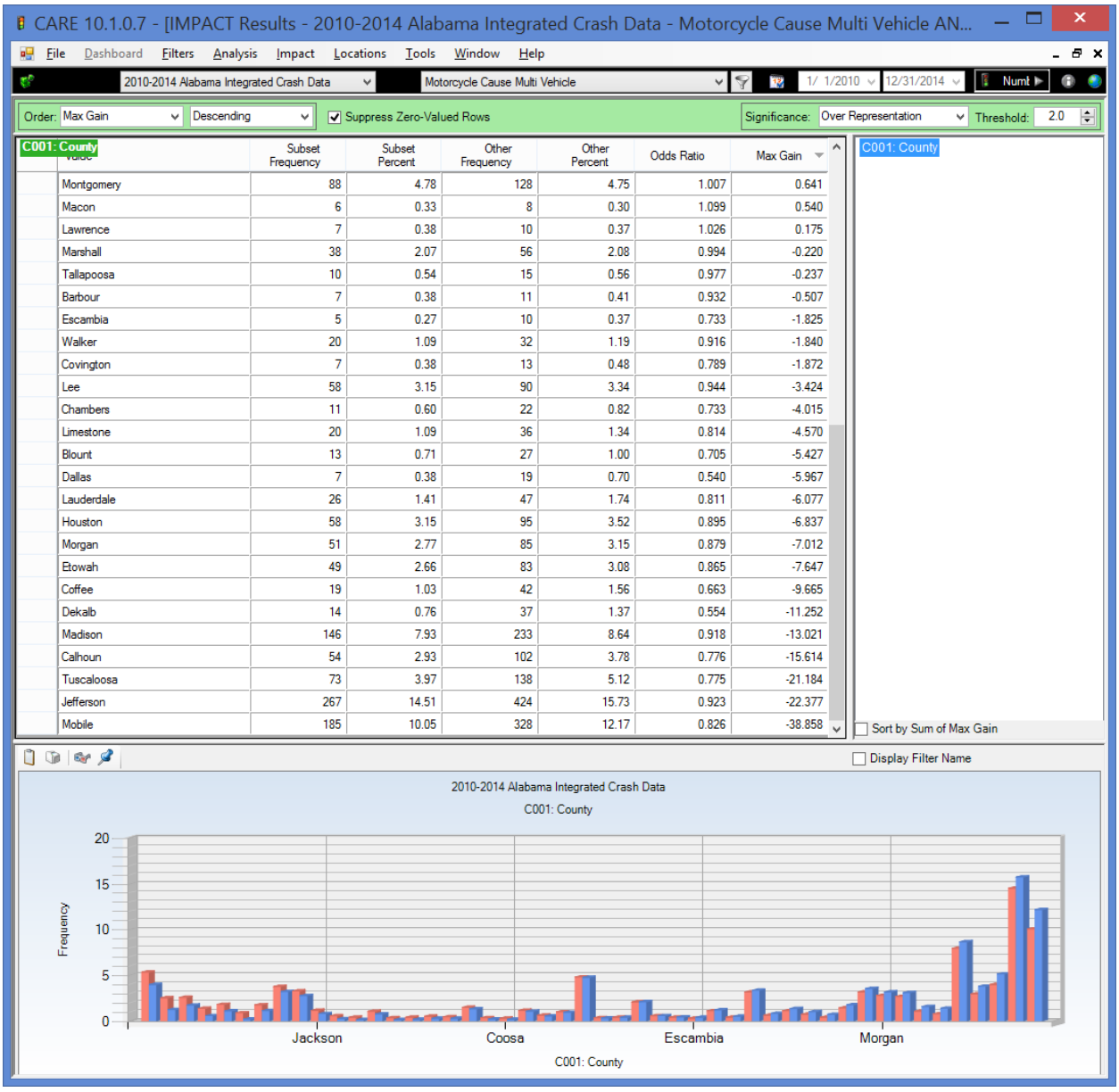
- **Severity Factors**
  - C026 – Crash Severity – this is a very mixed and non-intuitive result. When the MC is at fault fatal crashes and PDOs are significantly higher. When the non-MC is at fault all of the other severity classifications are significantly higher except Non-Incapacitating Injury. So the ones that are higher for the non-MC caused crashes are Incapacitating Injury, and Possible Injury. This is certainly worthy of additional study to try to resolve this apparent disparity. Recall other variables that would impact this, including speed at impact, rural/urban and contributing circumstances. The rural/urban also heavily affects EMS arrival delay, which is almost perfectly correlated to fatality probability, considered next.
  - C037 – EMS Arrival Delay – as indicated above, the rural nature of MC-caused clearly causes them to have longer EMS arrival delays.
  - C059 – Number Injured (Includes Fatalities) – the multiple injury categories are not significant, mostly due to their infrequency of occurrence. The contrast between zero and one, however, is interesting. Crashes caused by MCs are over-represented in no-injuries; those caused by non-MCs are over-represented in one injury.

Geographical Attributes

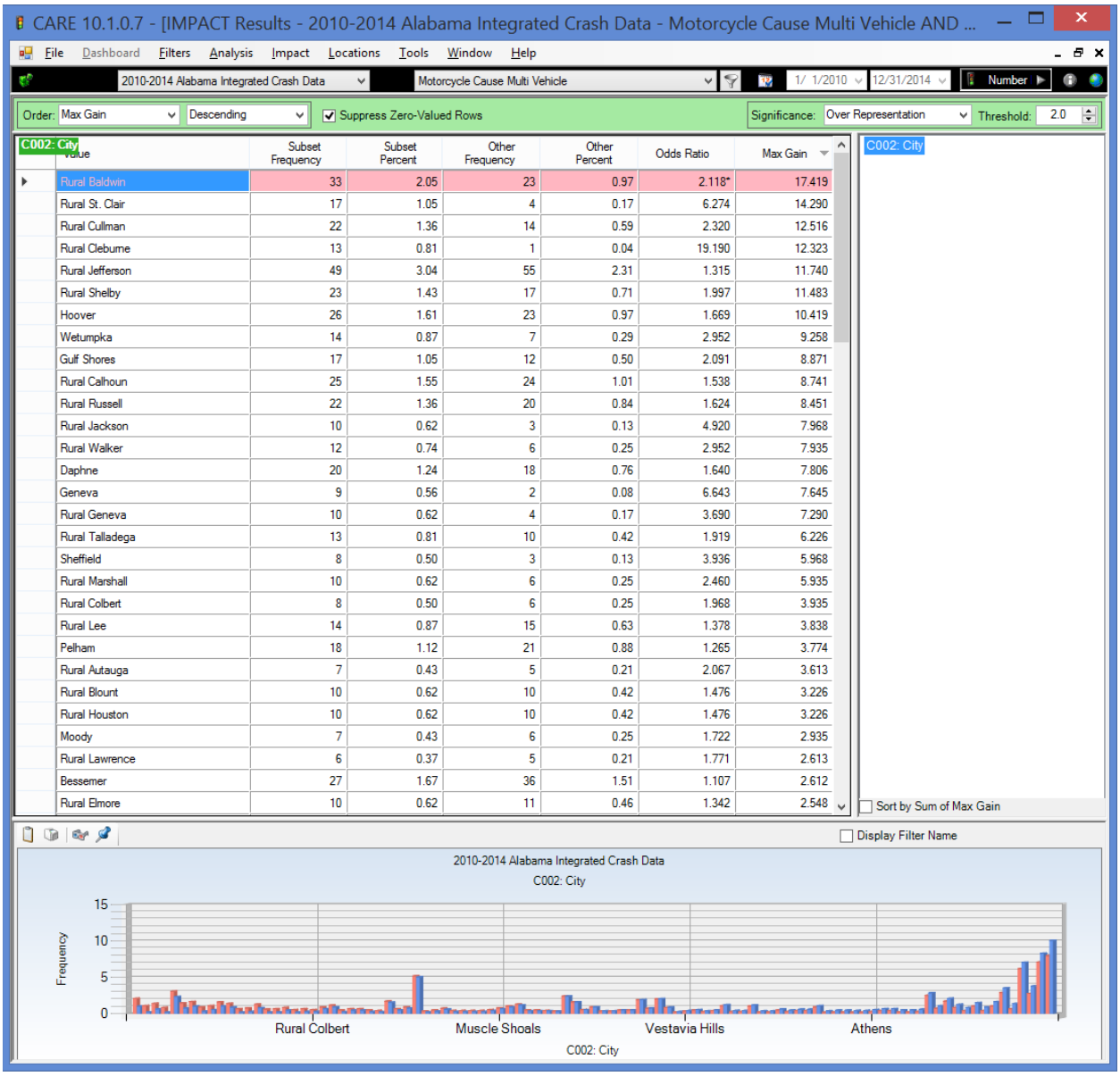
C001 County (MC caused over-represented; excluding < 5)



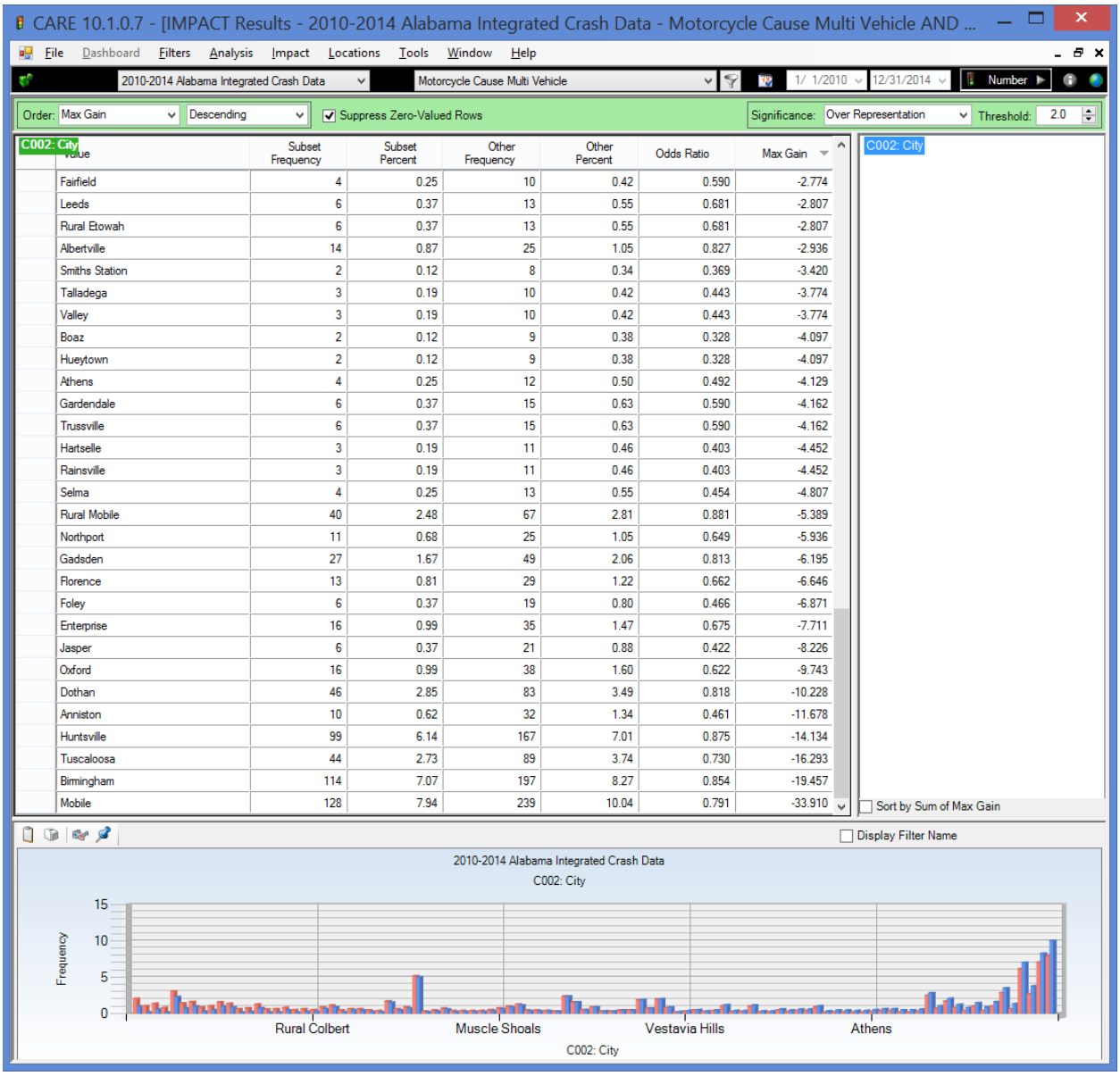
C001 County (non-MC caused over-represented; excluding < 5)



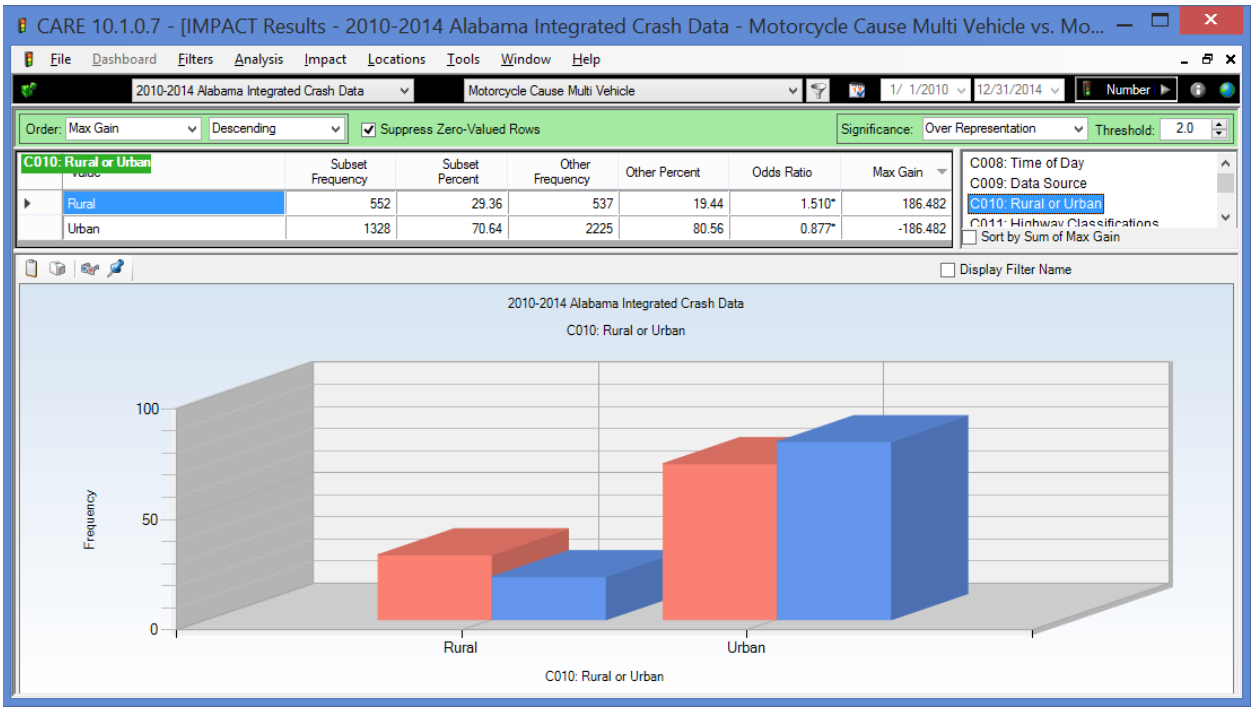
C002 City (MC caused over-represented; total < 10 excluded)



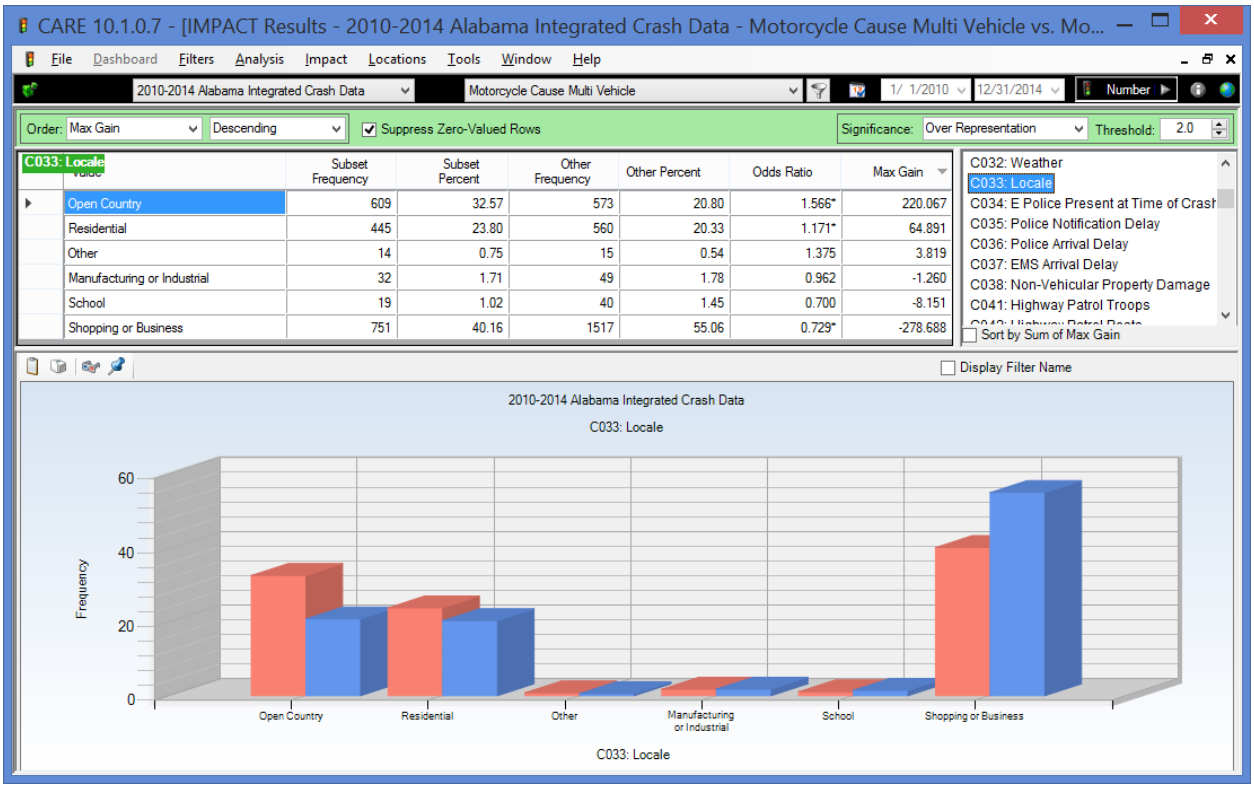
C002 City (non-MC caused over-represented; total < 10 excluded)



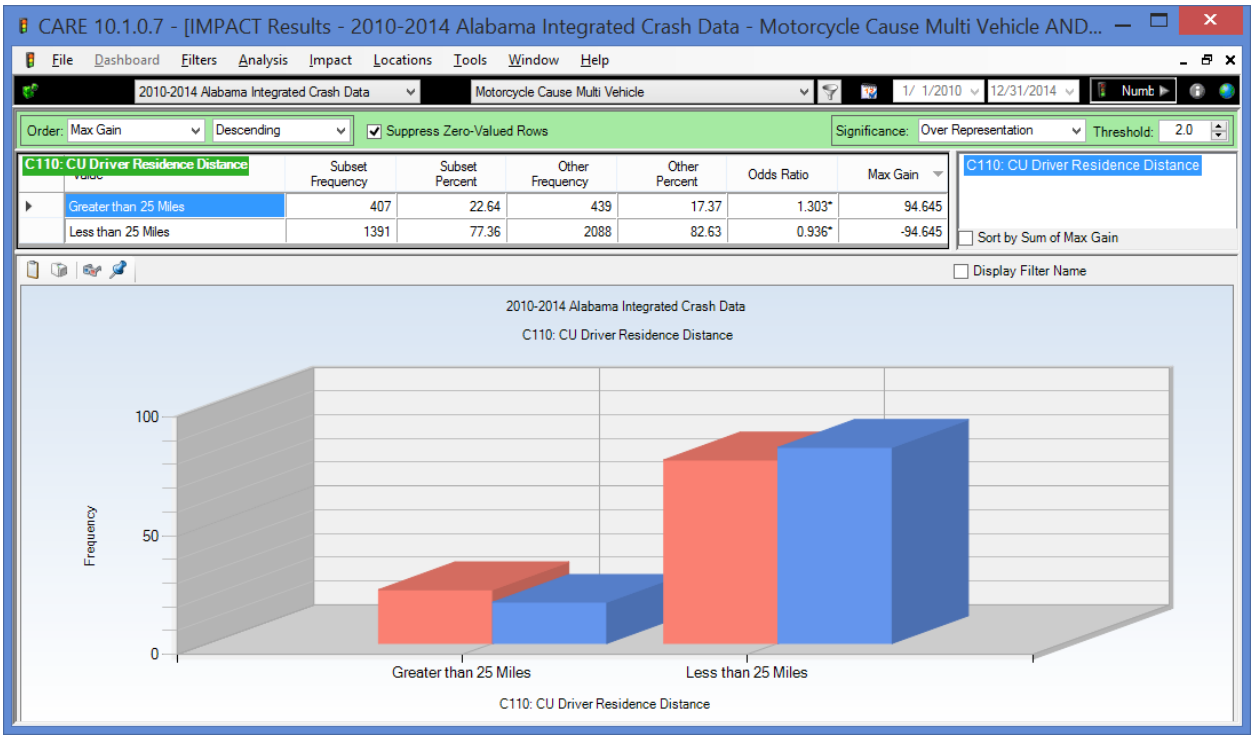
C010 Rural or Urban



C033 Locale

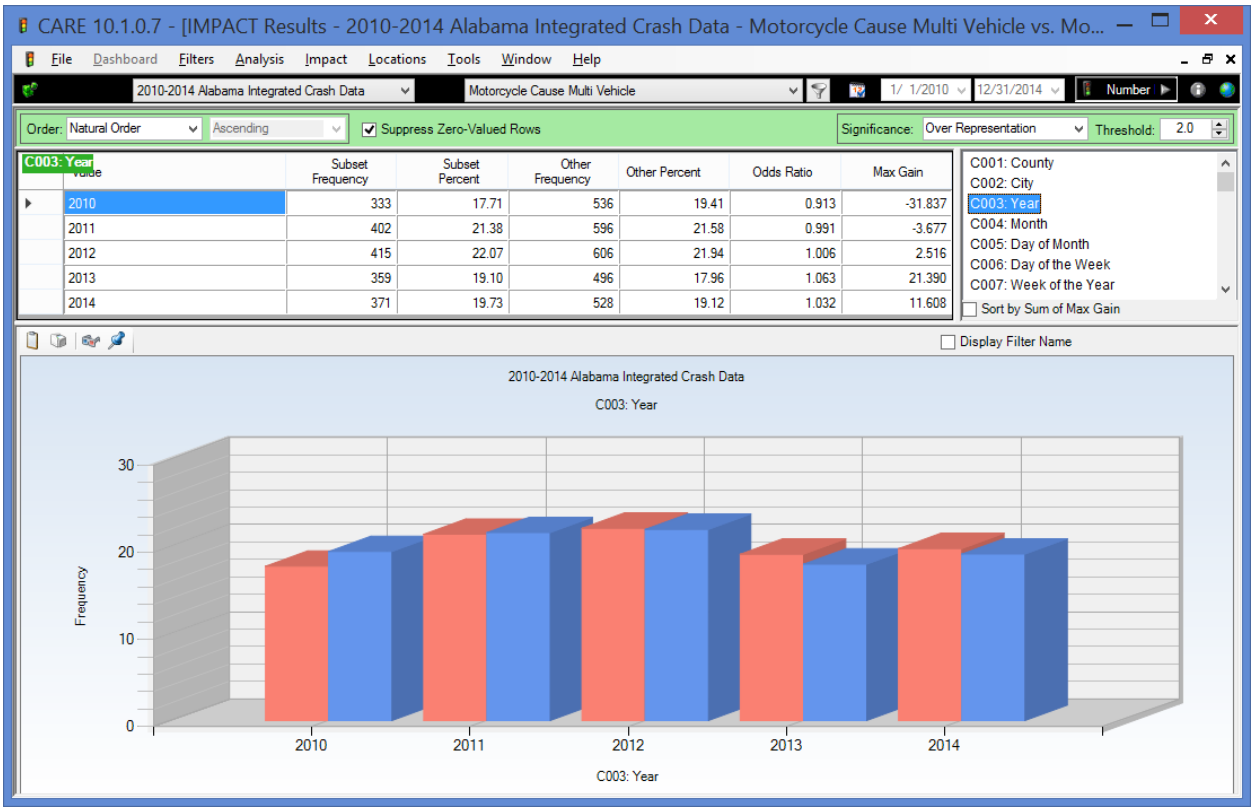

CARE 10.1.0.7 - [IMPACT Results - 2010-2014 Alabama Integrated Crash Data - Motorcycle Cause Multi Vehicle vs. Mo...
File Dashboard Filters Analysis Impact Locations Tools Window Help
2010-2014 Alabama Integrated Crash Data
Motorcycle Cause Multi Vehicle
1/ 1/2010
12/31/2014
Number
Order: Max Gain
Descending
Suppress Zero-Valued Rows
Significance: Over Representation
Threshold: 2.0
C033: Locale
Value
Subset Frequency
Subset Percent
Other Frequency
Other Percent
Odds Ratio
Max Gain
Open Country 609 32.57 573 20.80 1.566* 220.067
Residential 445 23.80 560 20.33 1.171* 64.891
Other 14 0.75 15 0.54 1.375 3.819
Manufacturing or Industrial 32 1.71 49 1.78 0.962 -1.260
School 19 1.02 40 1.45 0.700 -8.151
Shopping or Business 751 40.16 1517 55.06 0.729* -278.688
C032: Weather
C033: Locale
C034: E Police Present at Time of Crash
C035: Police Notification Delay
C036: Police Arrival Delay
C037: EMS Arrival Delay
C038: Non-Vehicular Property Damage
C041: Highway Patrol Troops
Sort by Sum of Max Gain
Display Filter Name
2010-2014 Alabama Integrated Crash Data
C033: Locale
Frequency
60
40
20
0
Open Country
Residential
Other
Manufacturing or Industrial
School
Shopping or Business
C033: Locale

C110 CU Driver Residence Distance

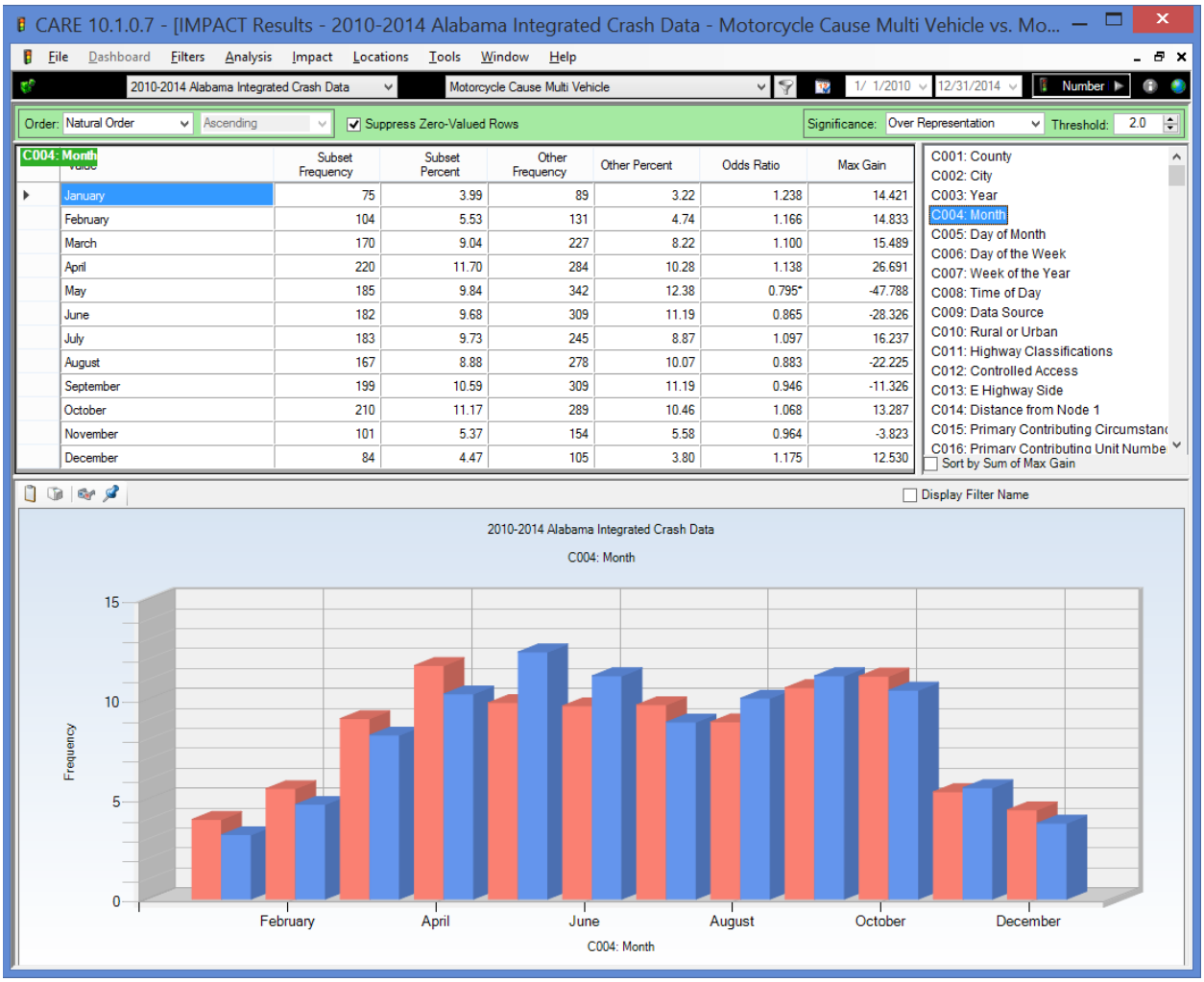


Time Factors

C003 Year



C004 Month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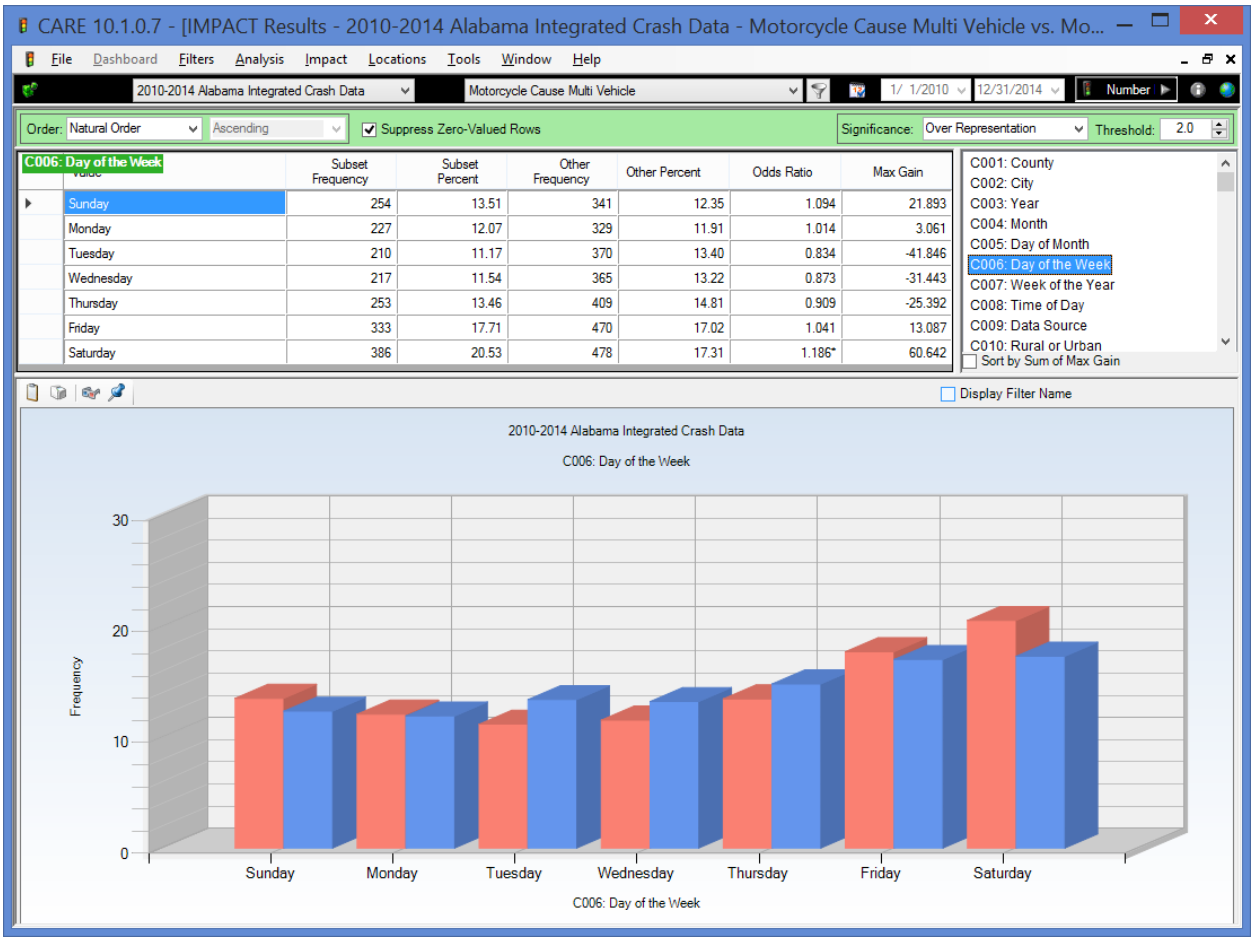
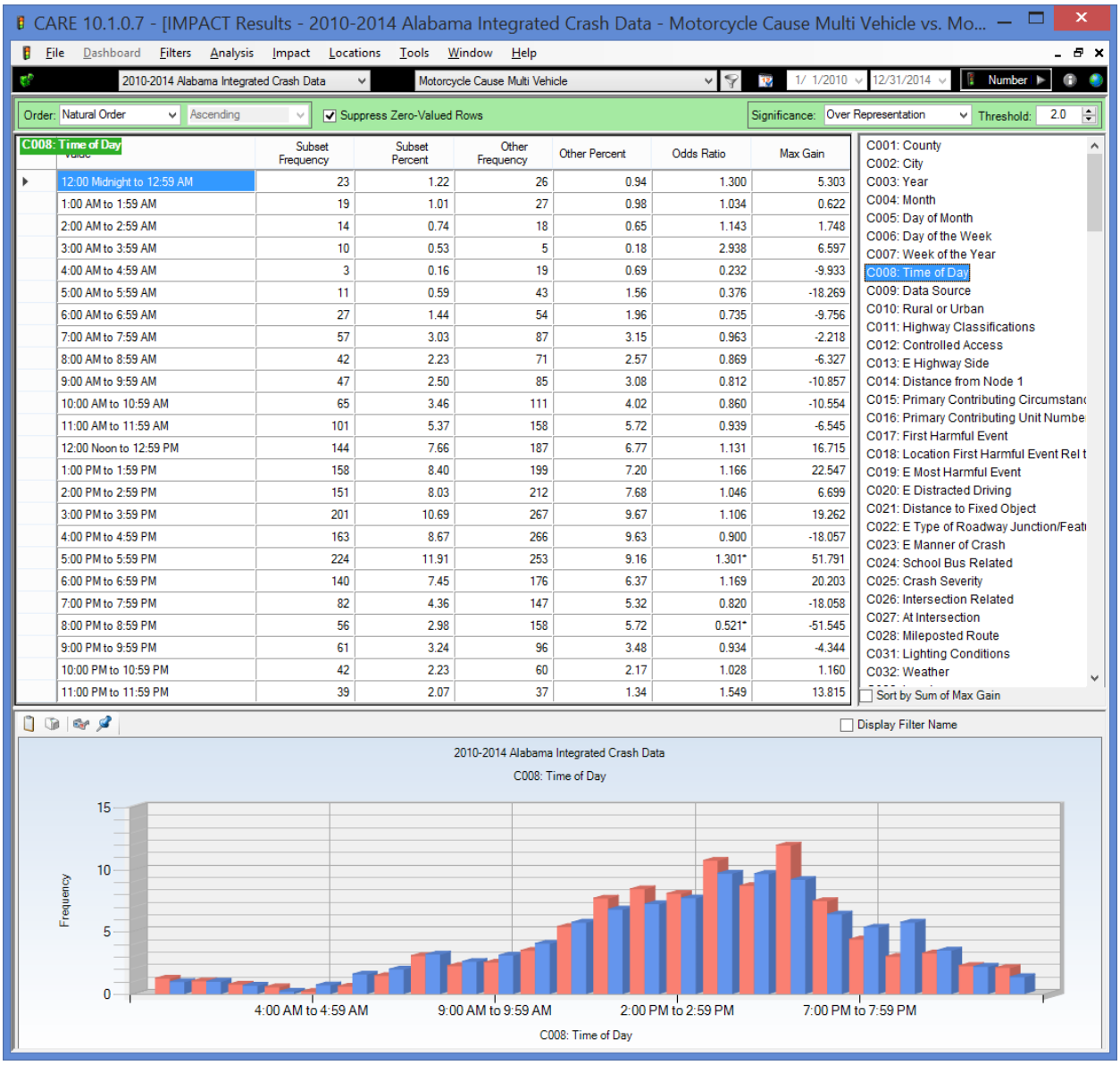
2010-2014 Alabama Integrated Crash Data
Motorcycle Cause Multi Vehicle
1/ 1/2010
12/31/2014
Number
Order: Natural Order
Ascending
Suppress Zero-Valued Rows
Significance: Over Representation
Threshold: 2.0
C004: Month
Value
Subset Frequency
Subset Percent
Other Frequency
Other Percent
Odds Ratio
Max Gain
January 75 3.99 89 3.22 1.238 14.421
February 104 5.53 131 4.74 1.166 14.833
March 170 9.04 227 8.22 1.100 15.489
April 220 11.70 284 10.28 1.138 26.691
May 185 9.84 342 12.38 0.795* -47.788
June 182 9.68 309 11.19 0.865 -28.326
July 183 9.73 245 8.87 1.097 16.237
August 167 8.88 278 10.07 0.883 -22.225
September 199 10.59 309 11.19 0.946 -11.326
October 210 11.17 289 10.46 1.068 13.287
November 101 5.37 154 5.58 0.964 -3.823
December 84 4.47 105 3.80 1.175 12.530
C001: County
C002: City
C003: Year
C004: Month
C005: Day of Month
C006: Day of the Week
C007: Week of the Year
C008: Time of Day
C009: Data Source
C010: Rural or Urban
C011: Highway Classifications
C012: Controlled Access
C013: E Highway Side
C014: Distance from Node 1
C015: Primary Contributing Circumstanc
C016: Primary Contributing Unit Numbe
Sort by Sum of Max Gain
Display Filter Name
2010-2014 Alabama Integrated Crash Data
C004: Month
Frequency
15
10
5
0
February
April
June
August
October
December
C004: Month

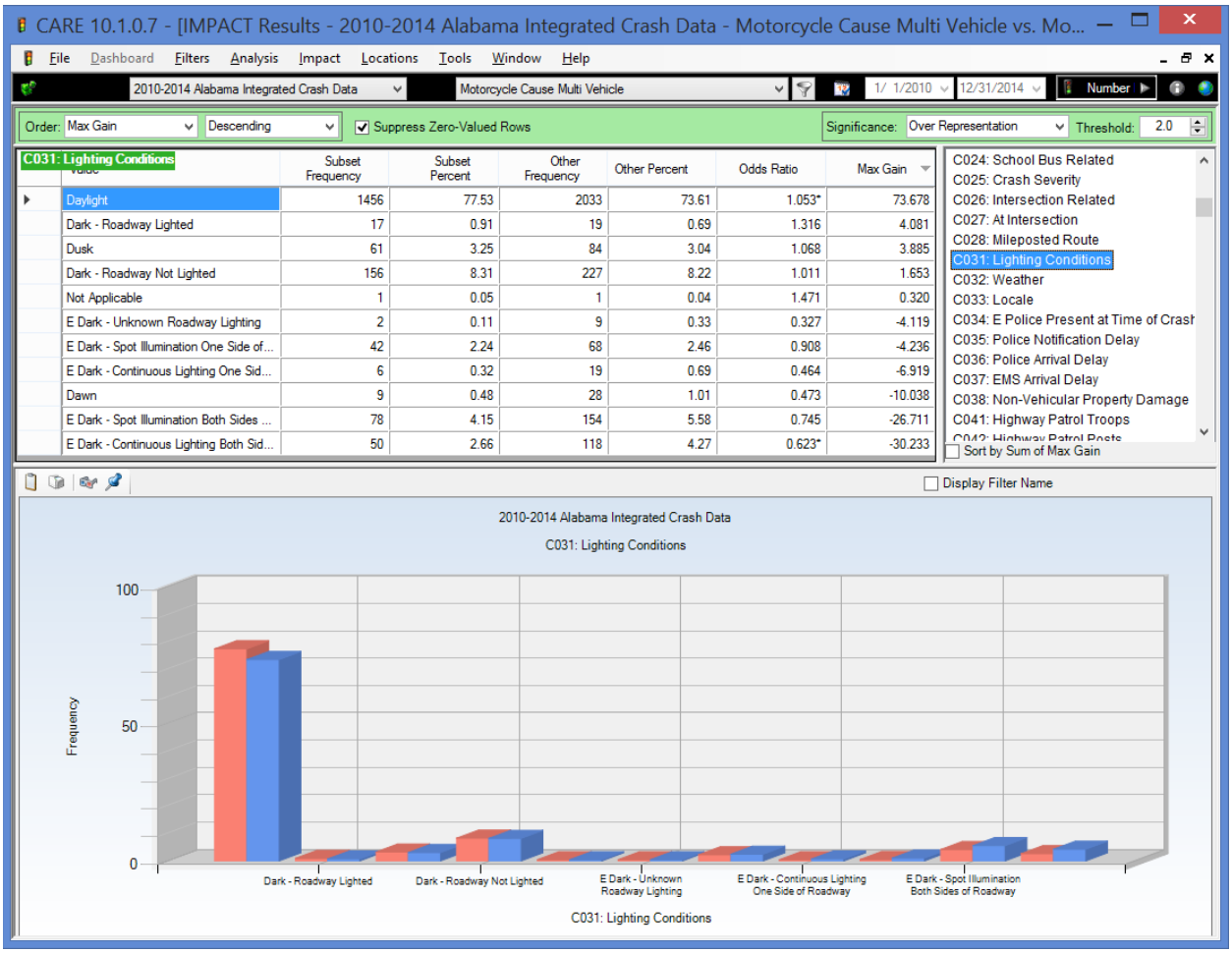
C006 Day of the Week



C008 Time of Day

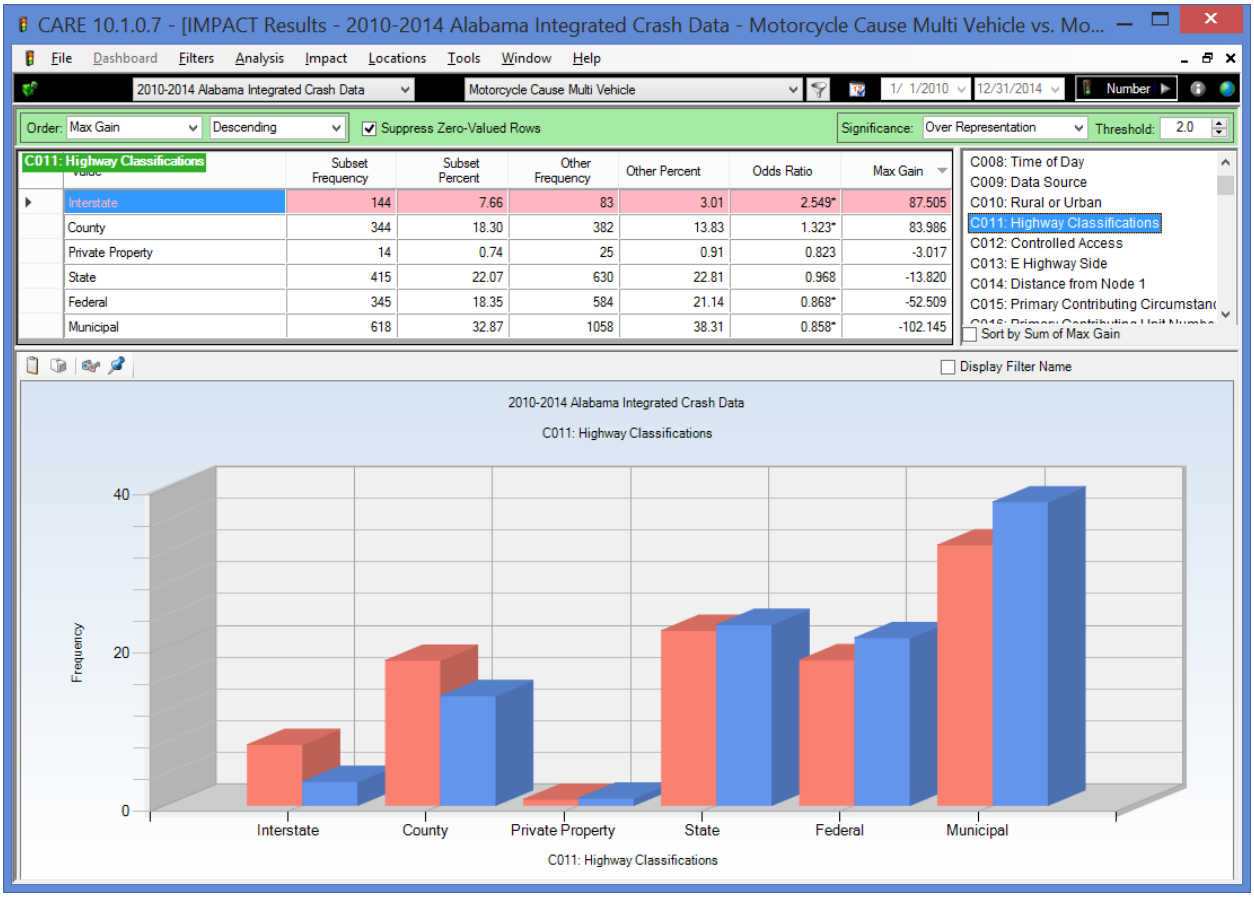


C031 Lighting Conditions

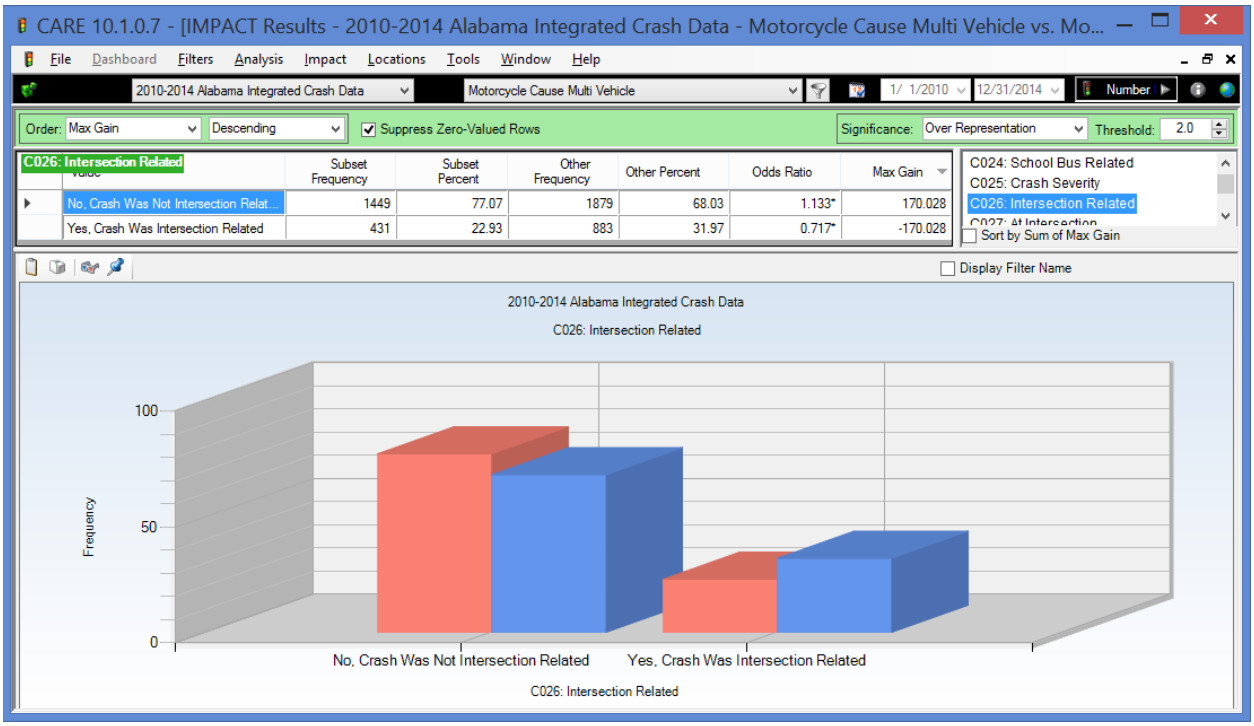


Roadway Characteristics

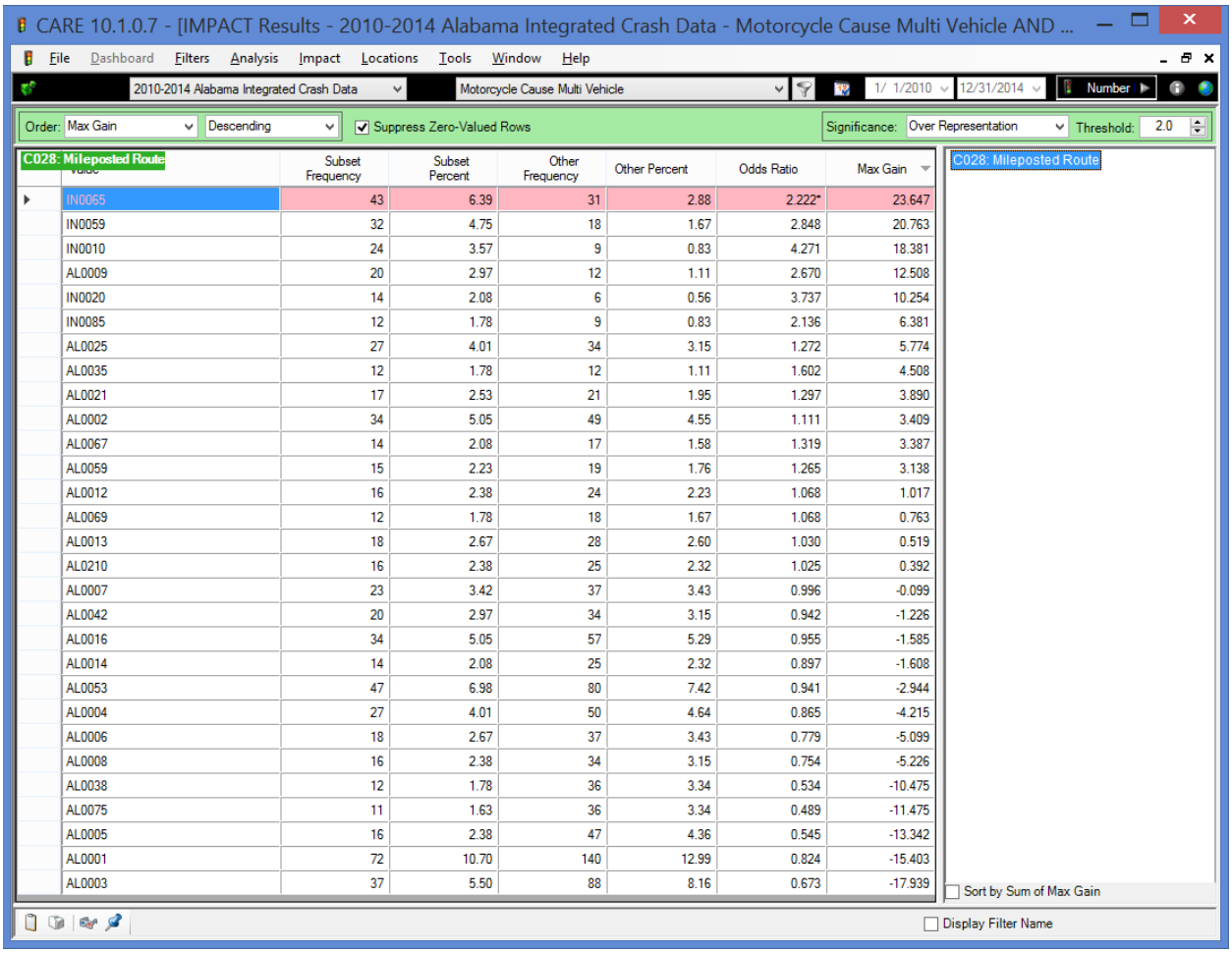
C011 Highway Classification



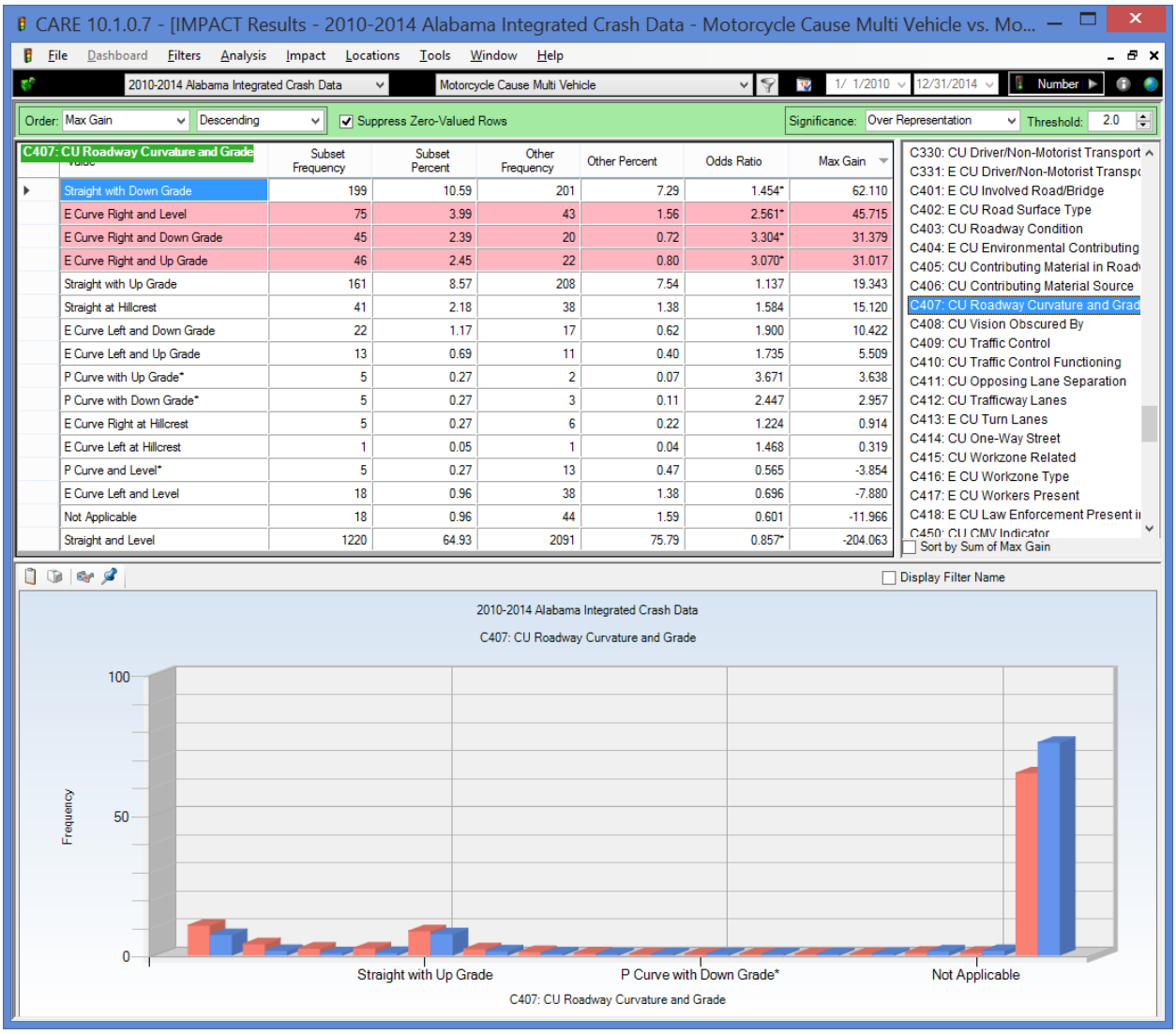
C026 Intersection Related



C028 Mileposted Roads (< 11 excluded)

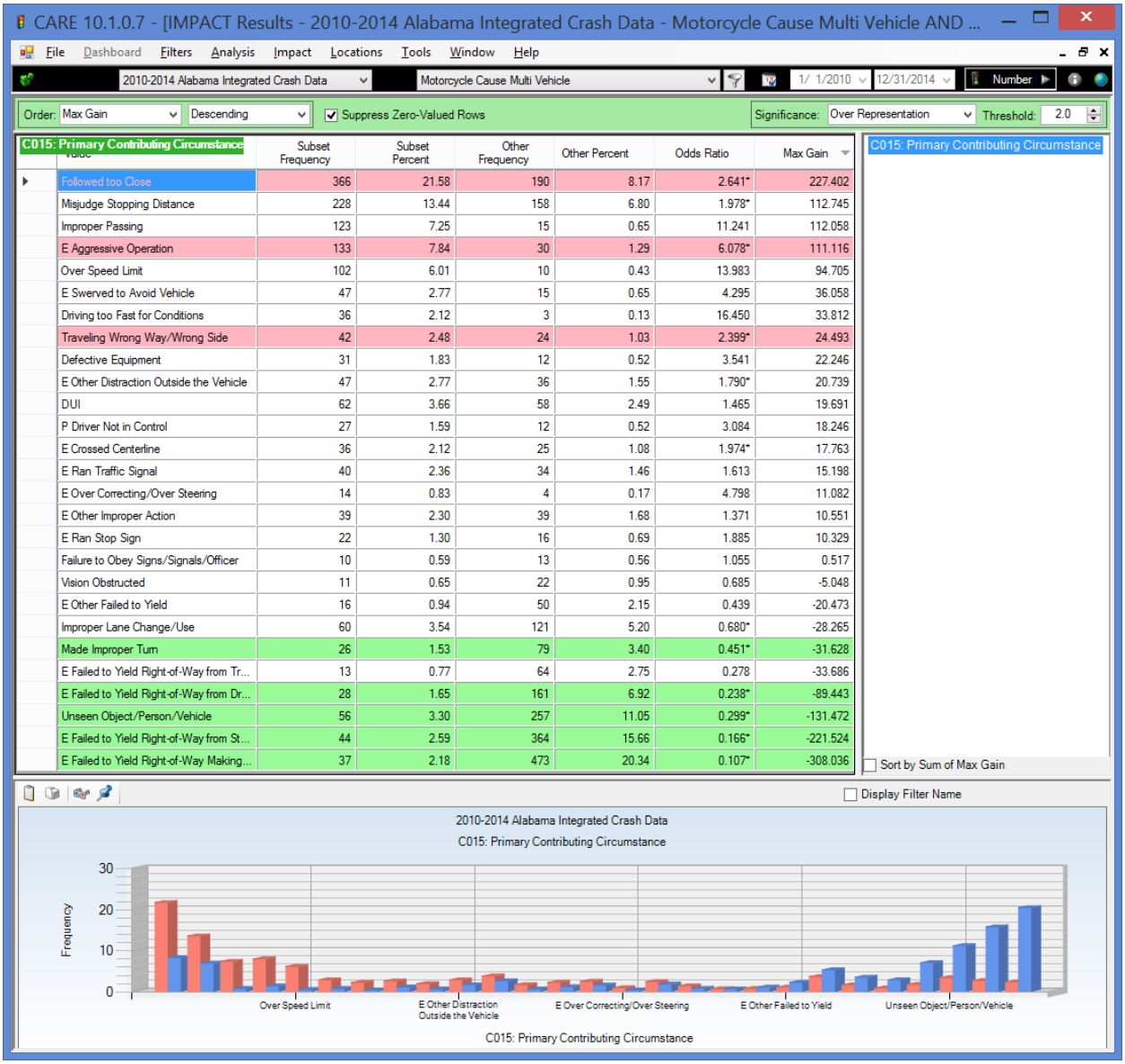


C407 CU Roadway Curvature and Grade

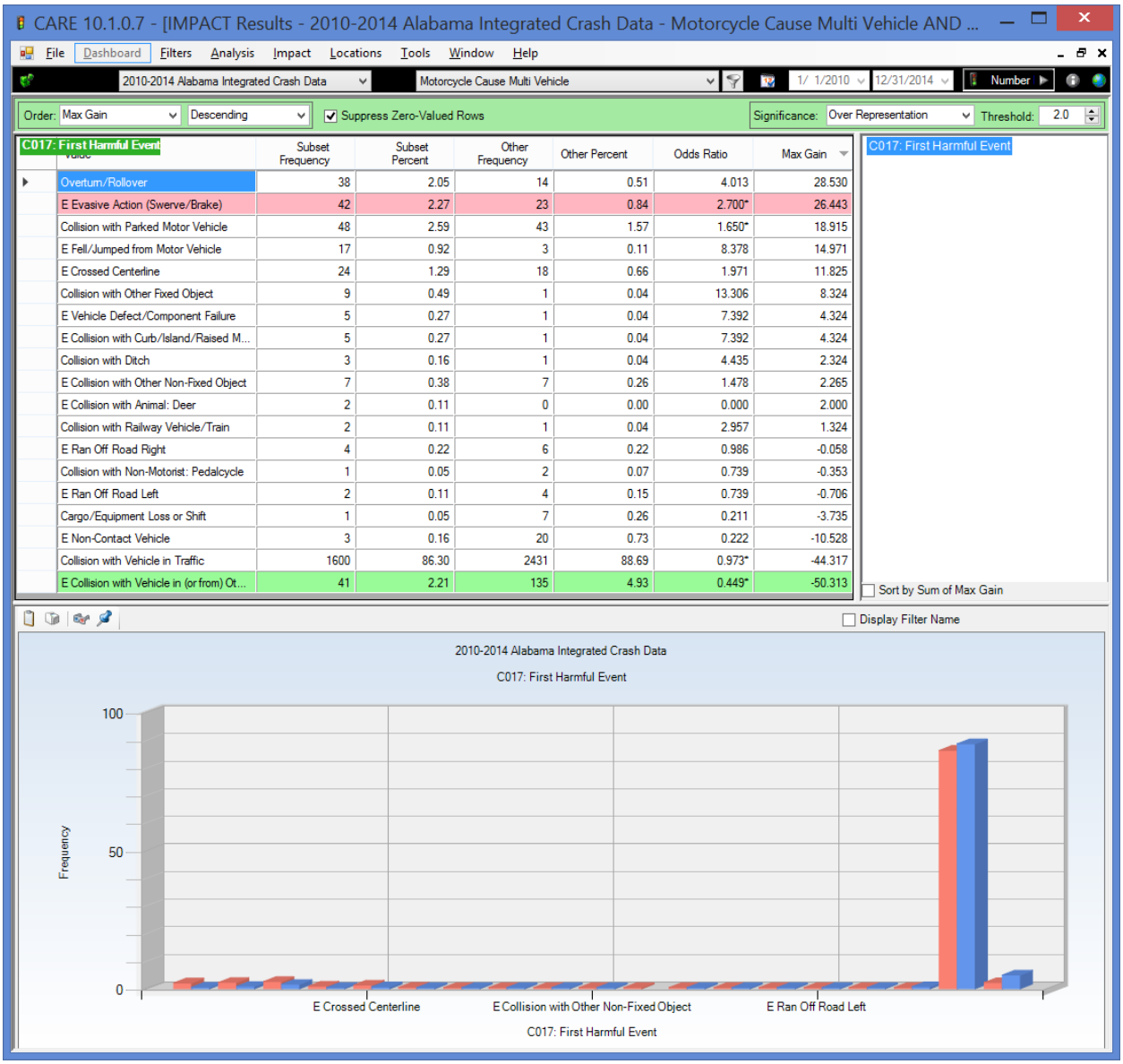


Driver Factors

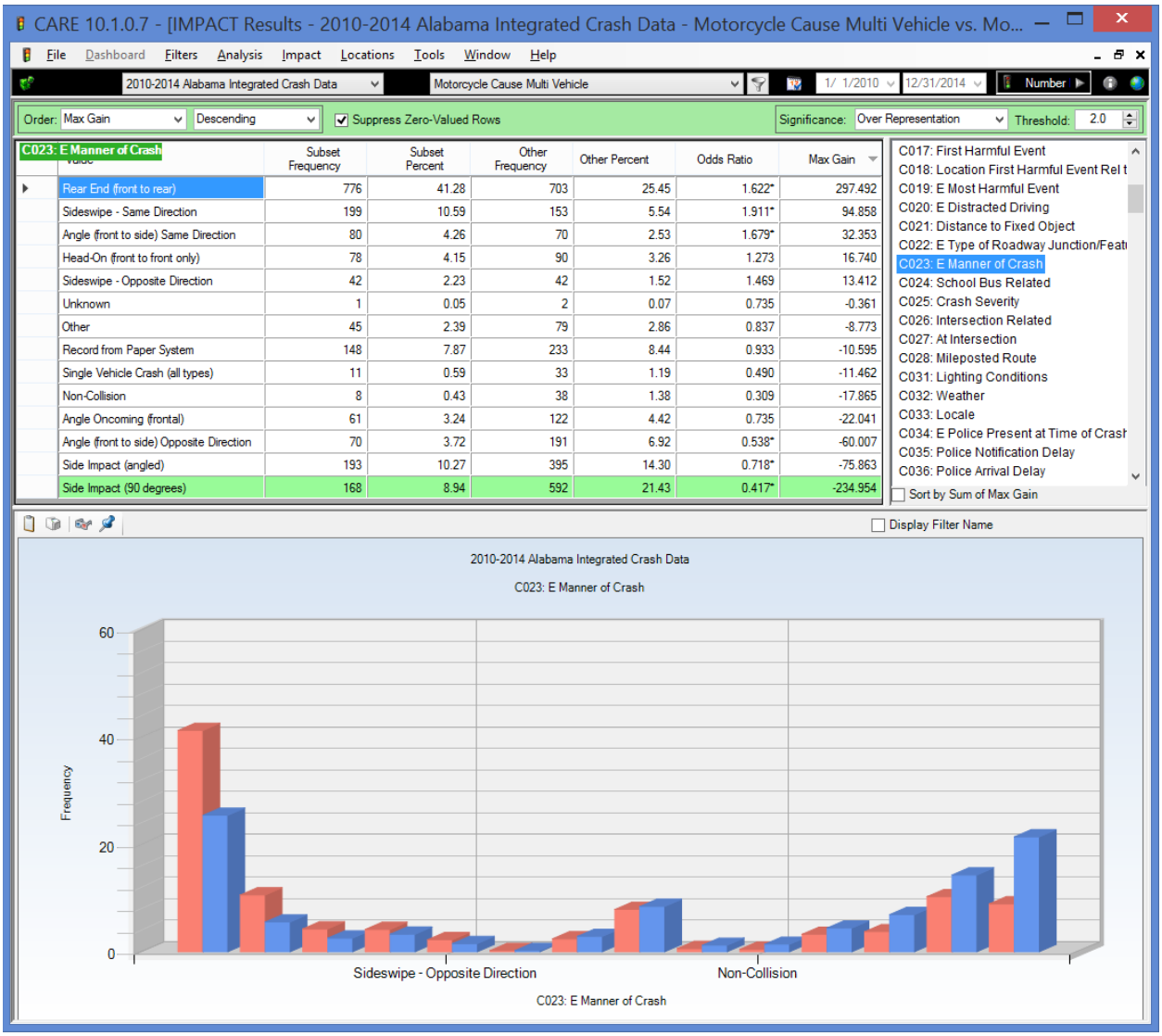
C015 Primary Contributing Circumstances (excluding < 10)



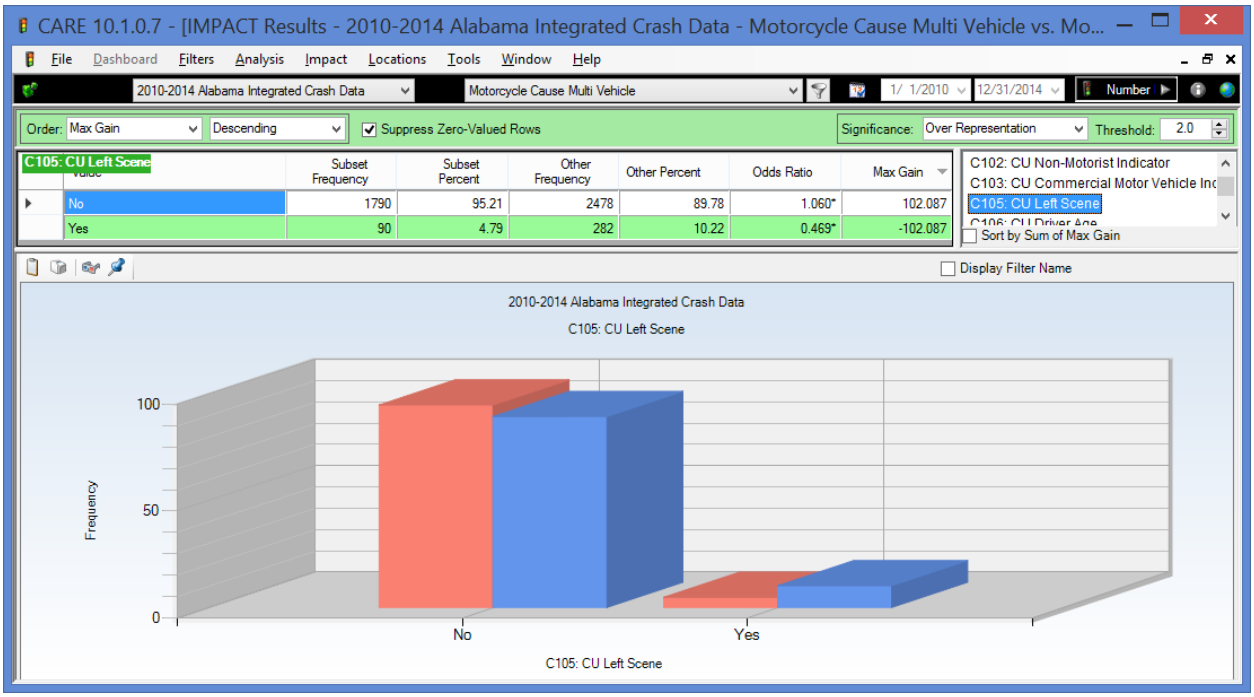
C017 First Harmful Event



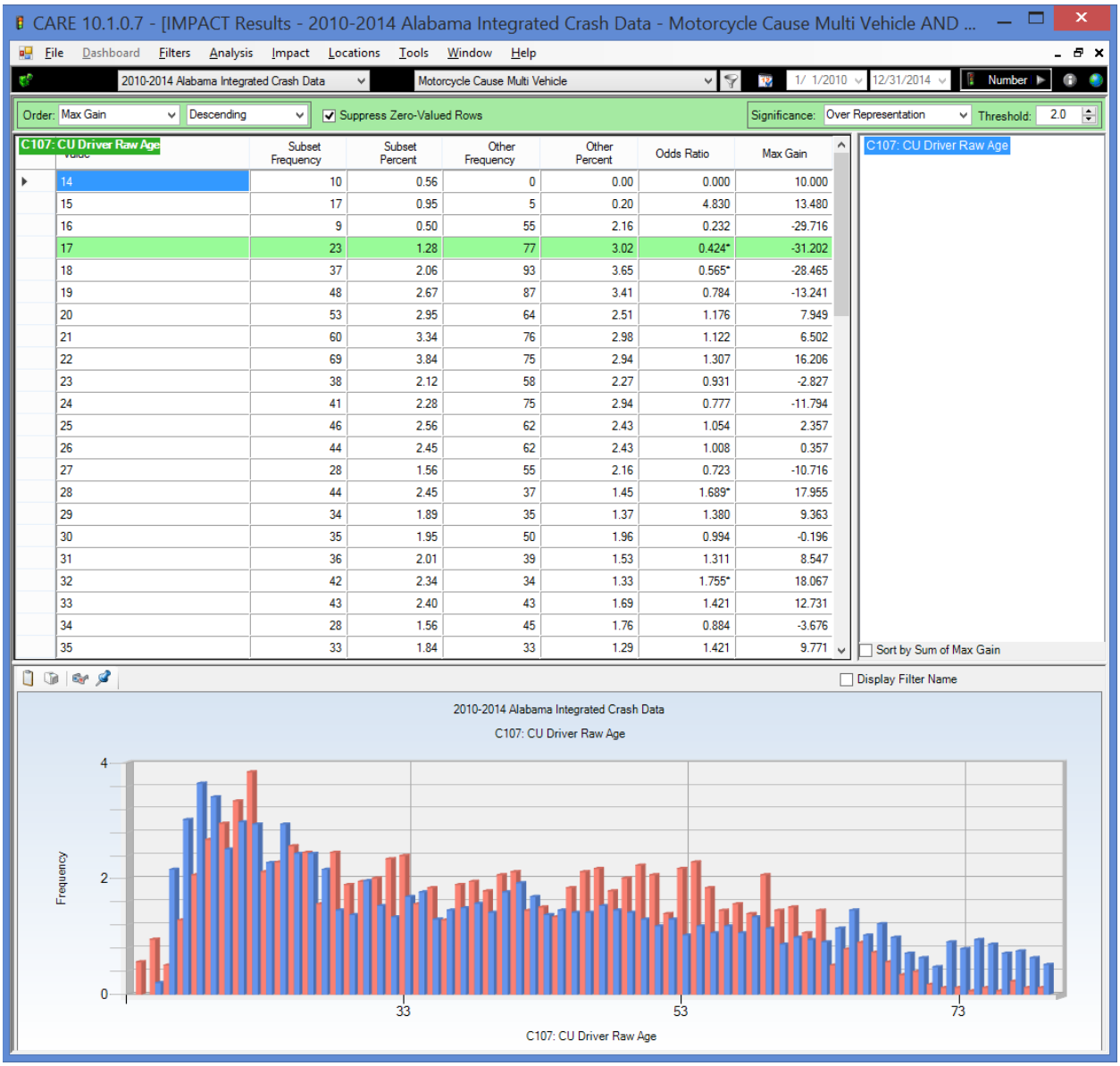
C023 Manner of Crash



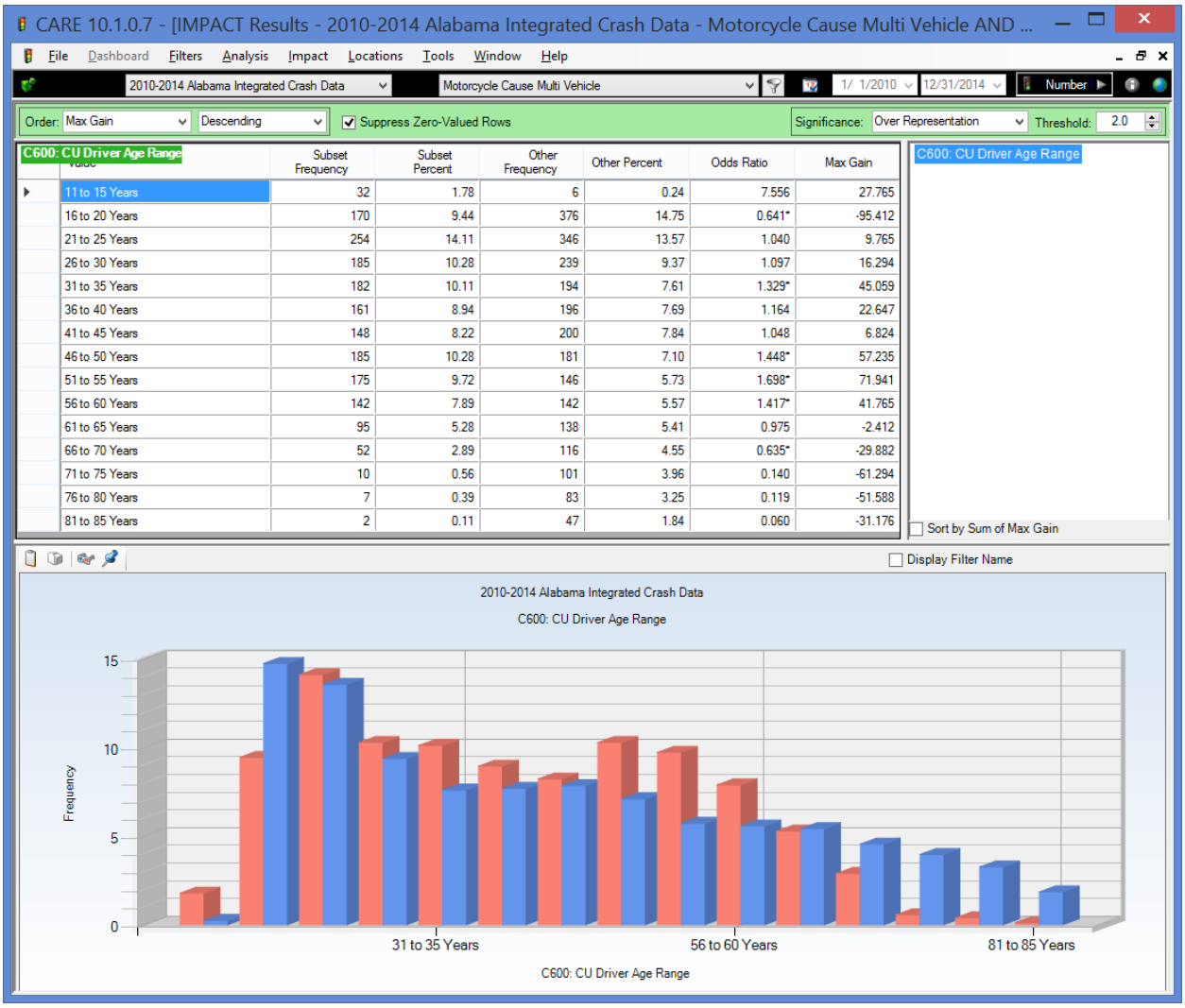
C105 Left Scene



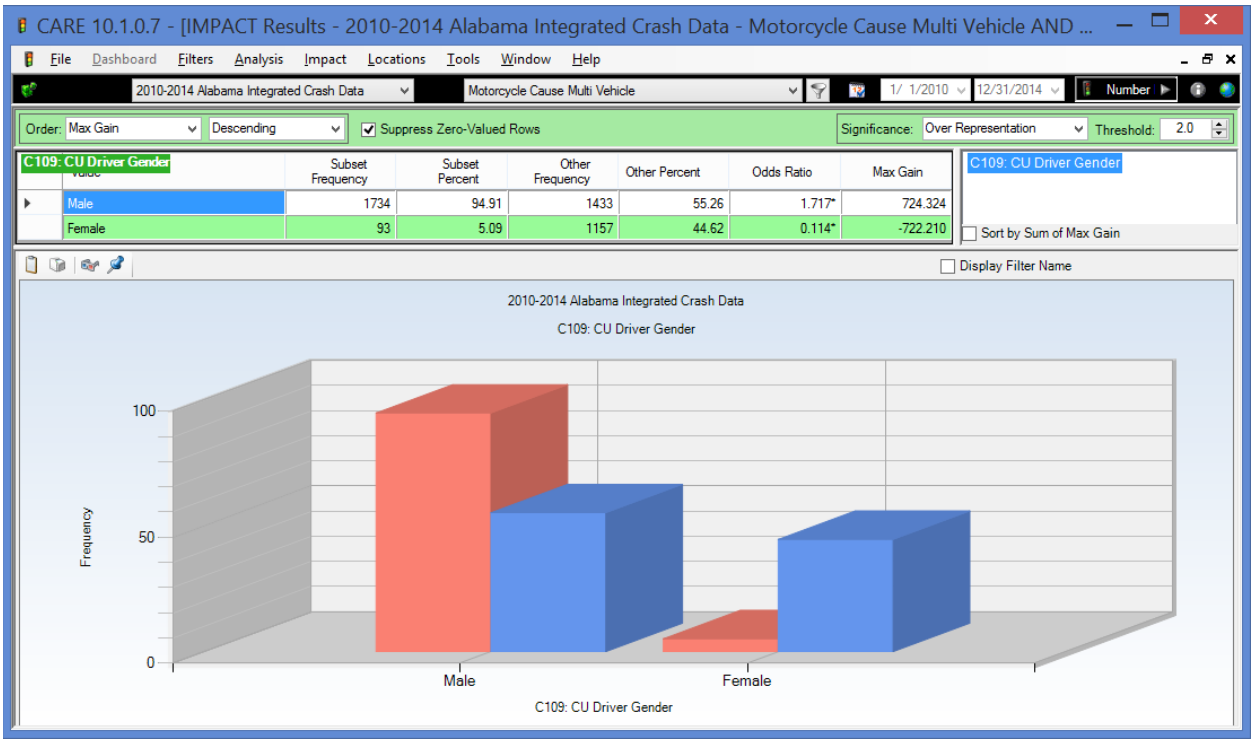
C107 CU Driver Raw Age



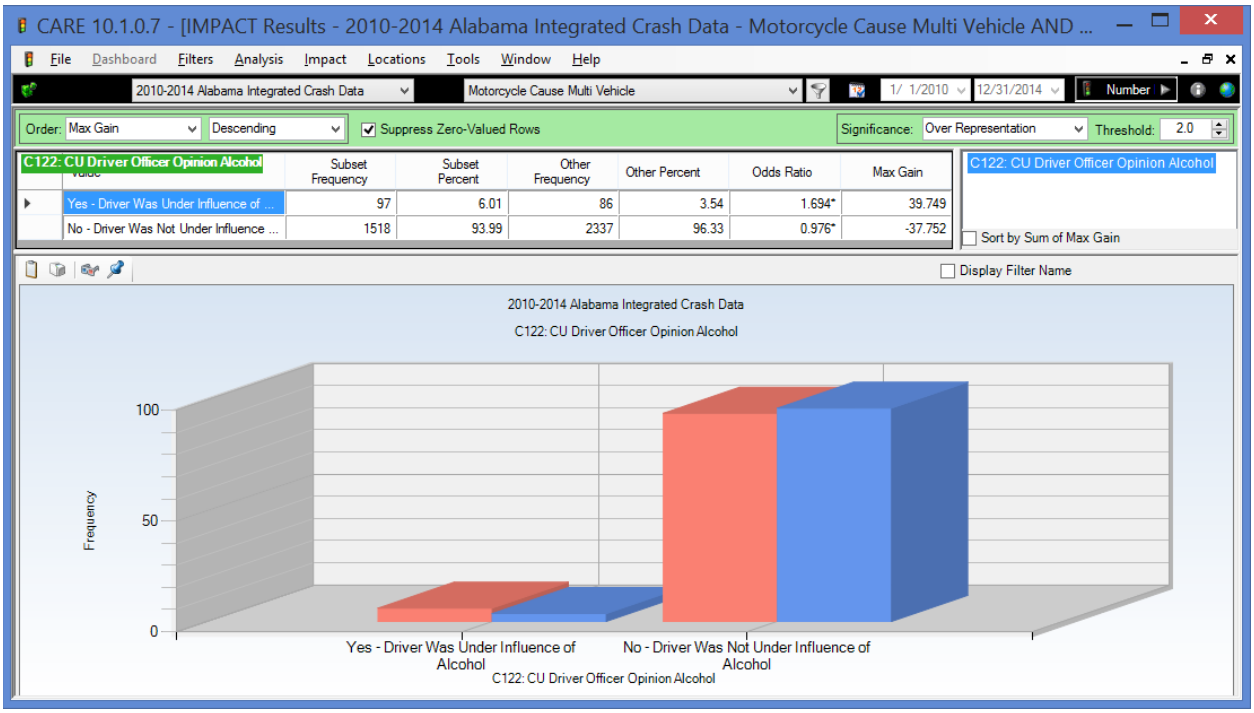
C600 CU Driver Age Range – five year intervals



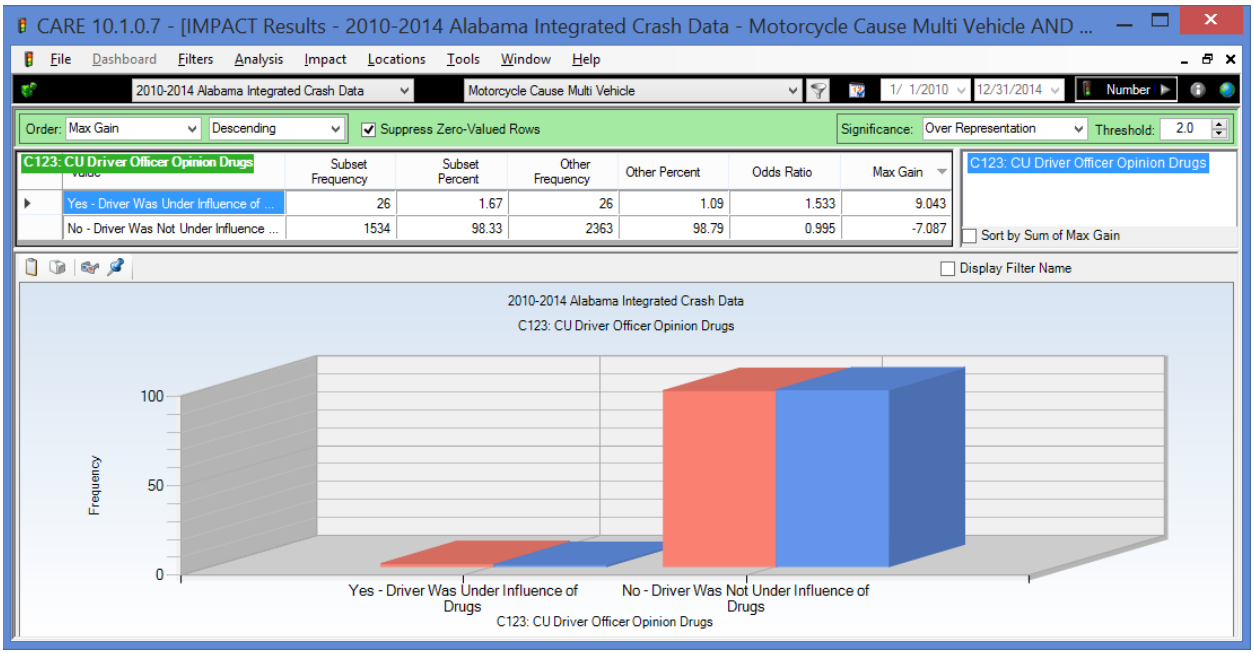
C109 CU Driver Gender



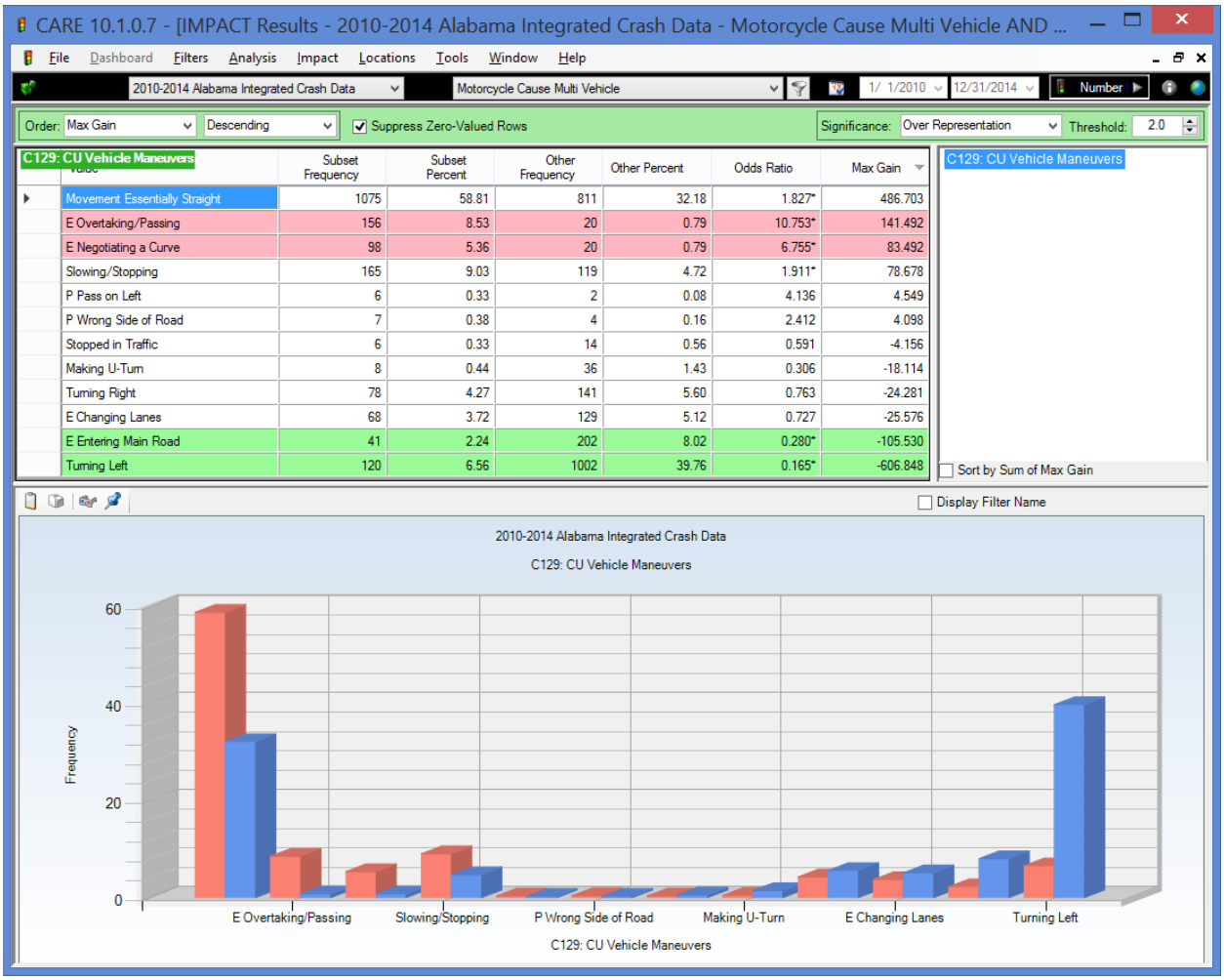
C122 CU Driver Officer Opinion Alcohol



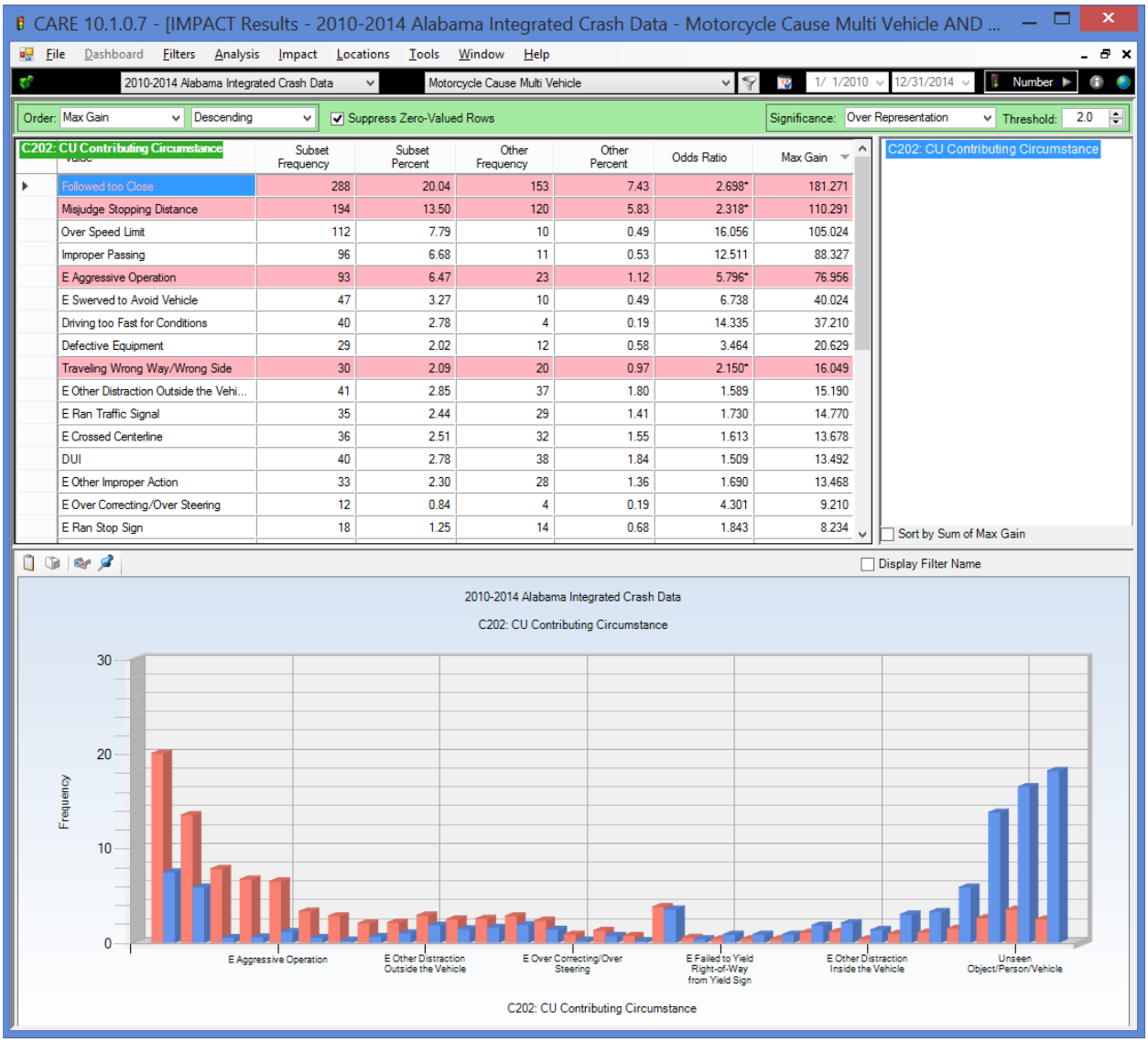
C123 CU Driver Officer Opinion Drugs



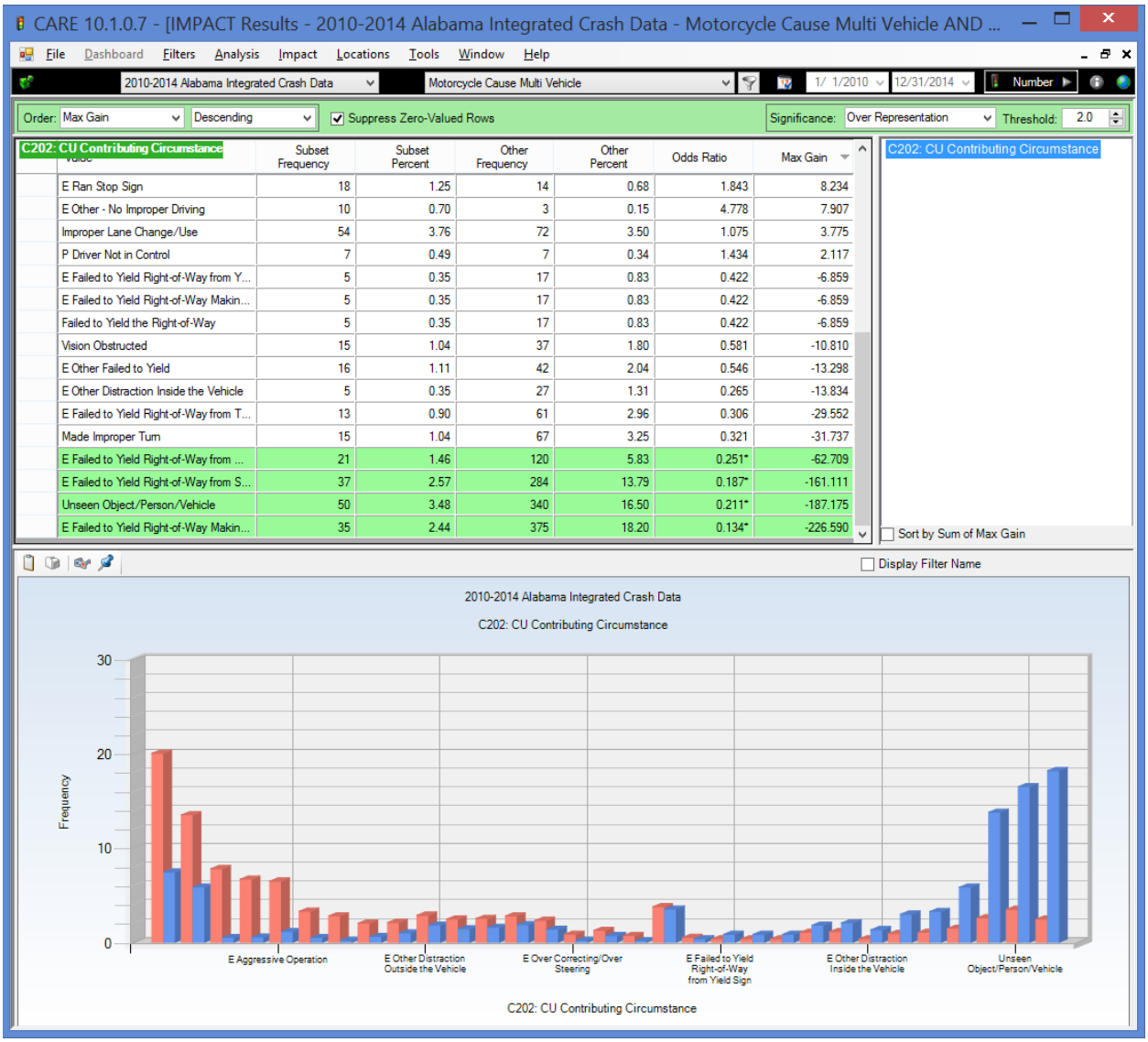
C129 CU Vehicle Maneuver



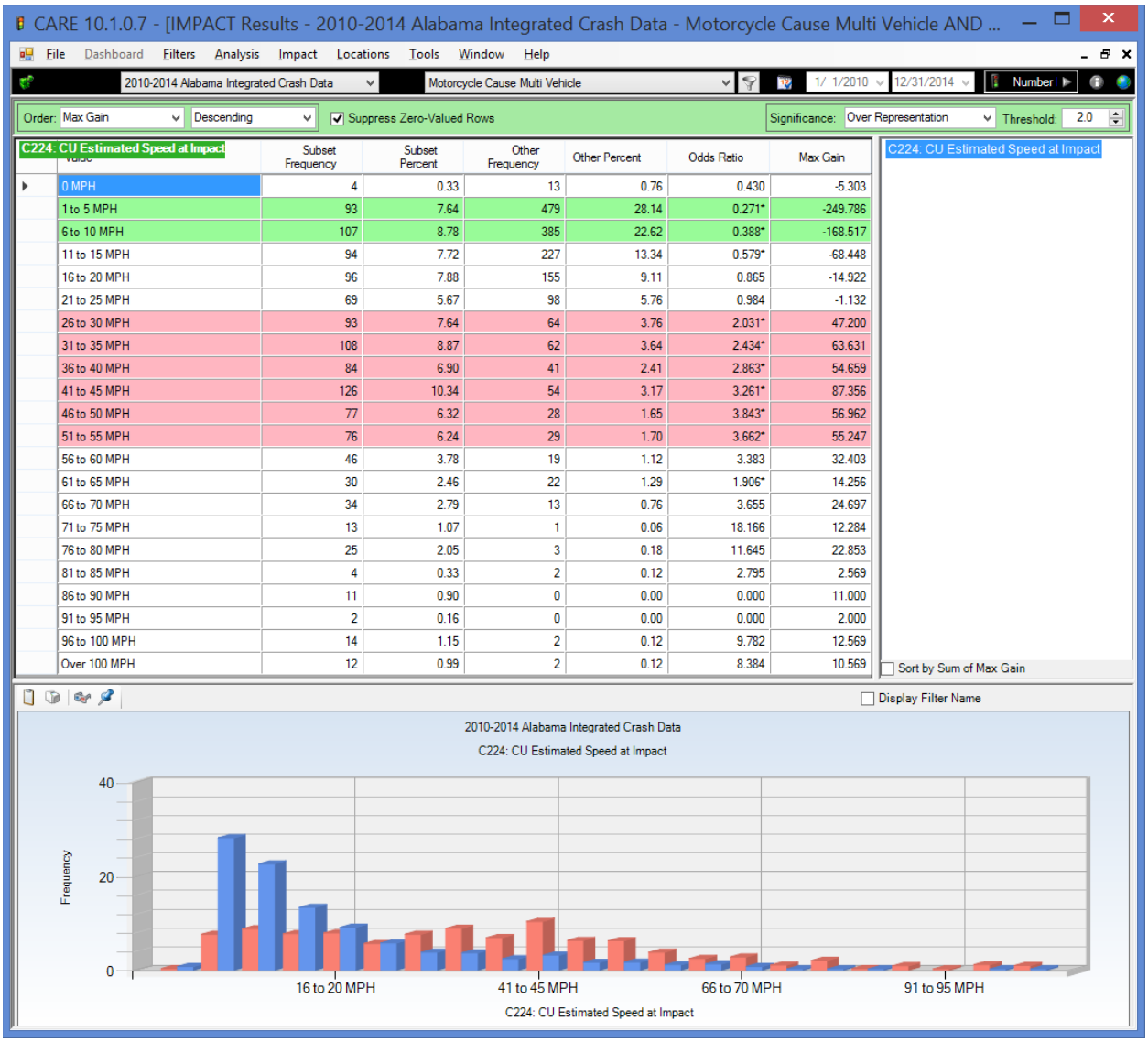
C202 CU Contributing Circumstances (MC caused; < 5 excluded)



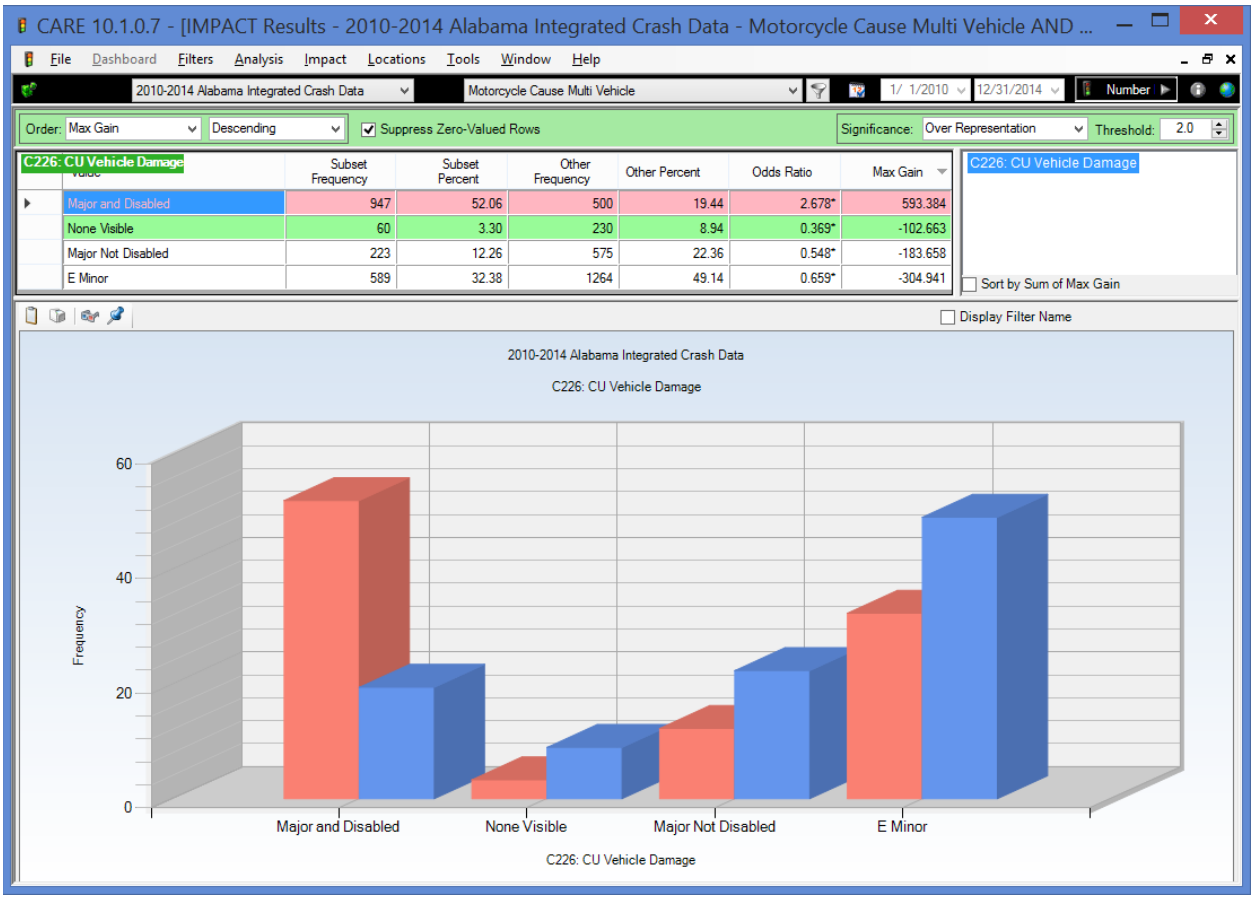
C202 CU Contributing Circumstances (MC caused; < 5 excluded)



C224 CU Estimated Speed at Impact

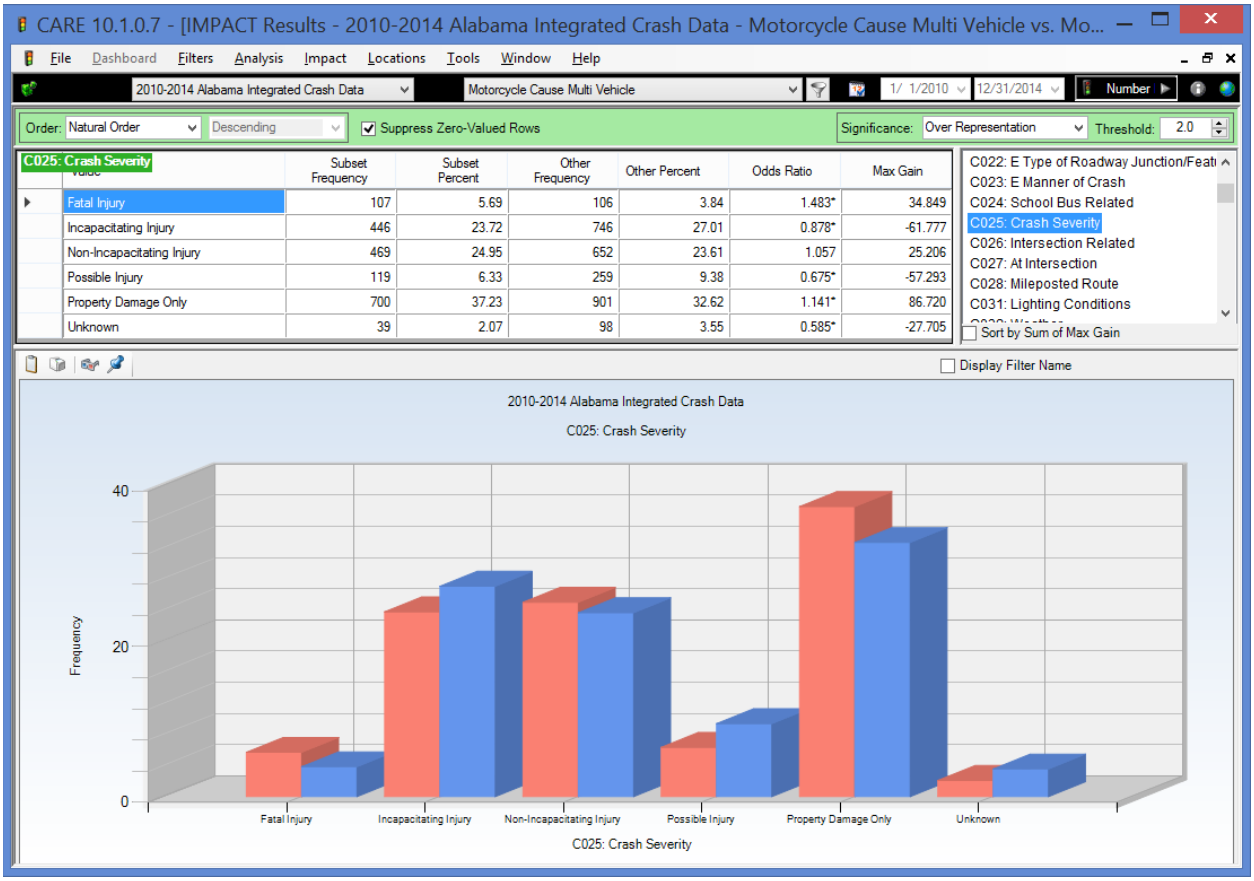


C226 CU Vehicle Damage

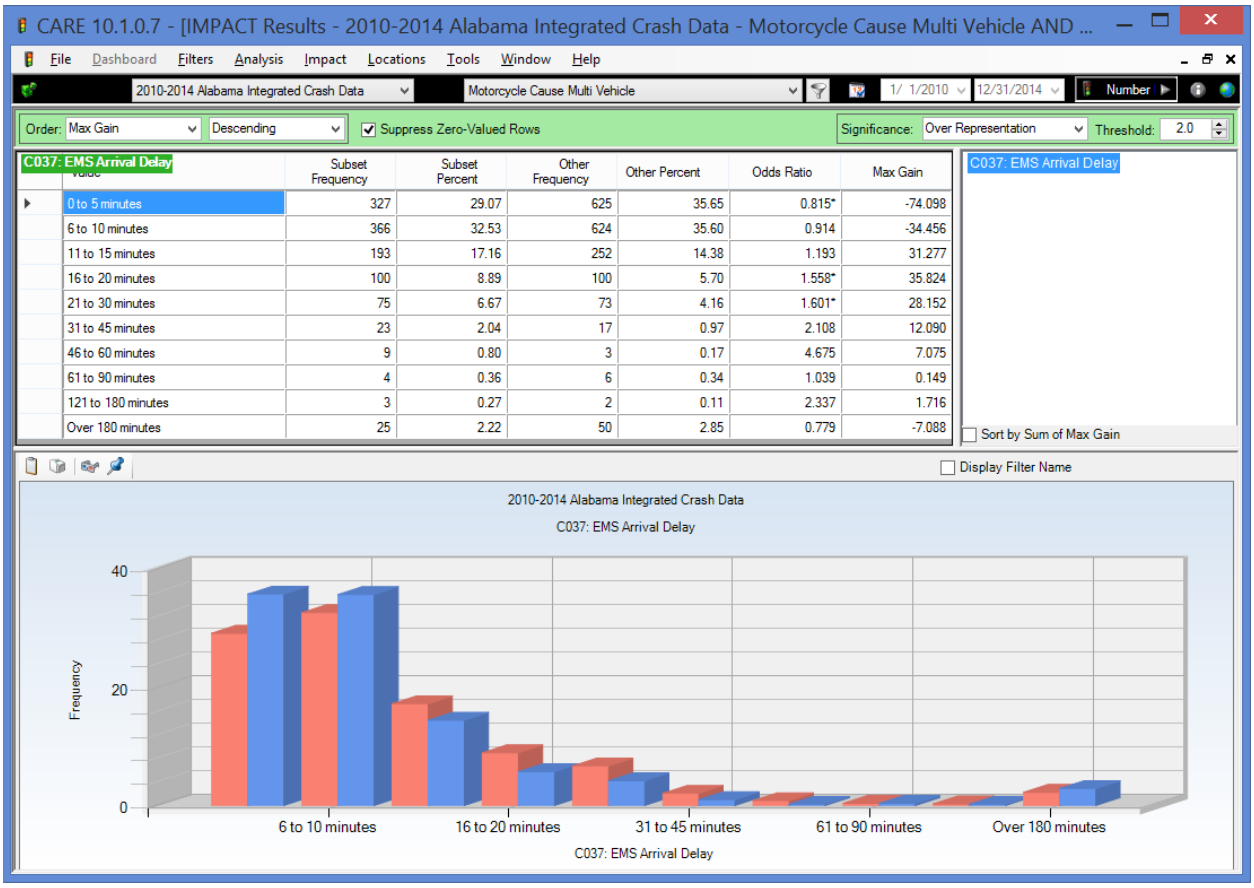


Severity Factors

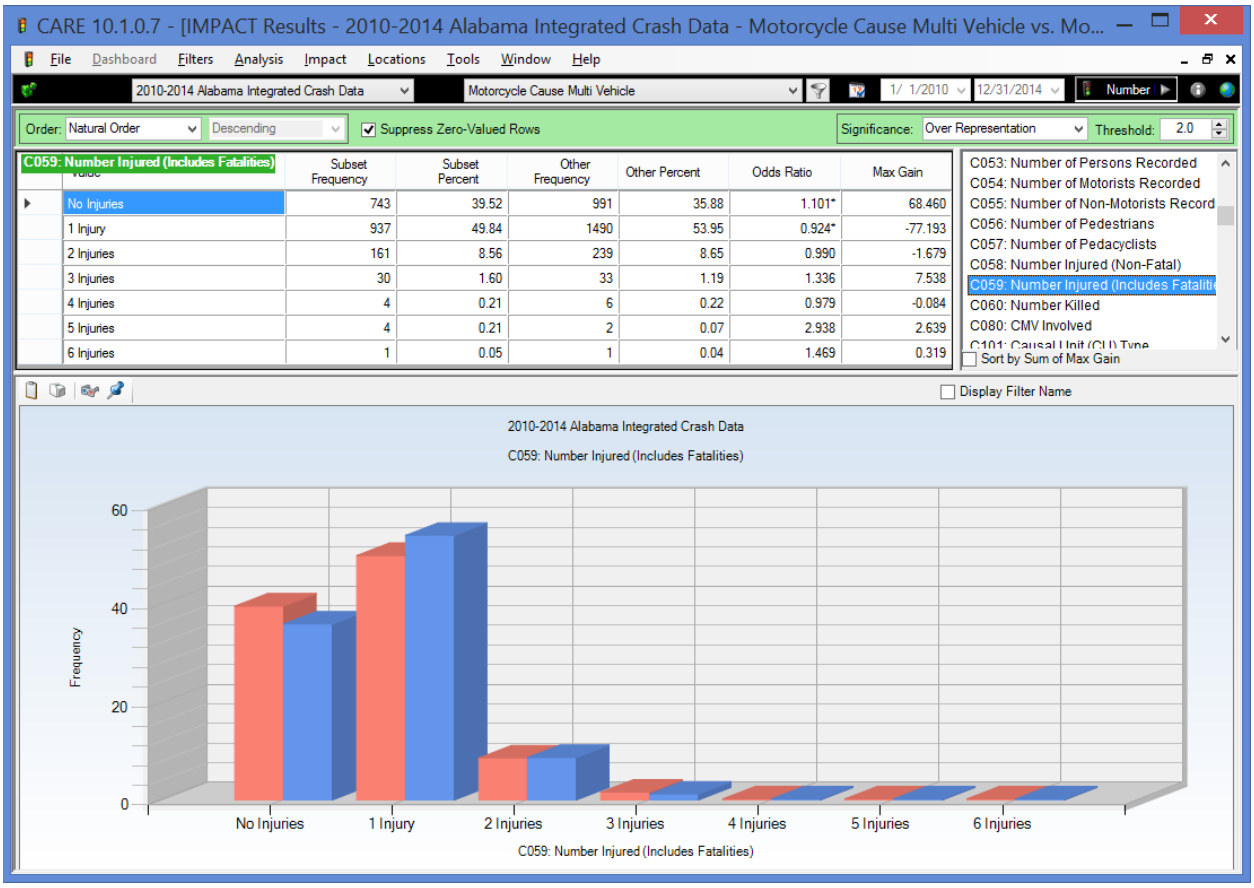
C026 Crash Severity



C037 EMS Arrival Delay



C059 Number of Injured (Includes Fatalities)



9 cases caused by motorcycles had two fatalities
4 cases caused by non-MCs had two fatalities

For additional motorcycle information from NHTSA and other sources, see:
http://www.safehomealabama.gov/tag/motorcycles/