Special Study
October Fatal Collisions IMPACT Study
Fatal October Crashes (FOCs) vs All Non-October Crashes

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Data Comparisons: Fatal October Crashes (FOCs) vs All Non-October Crashes
Study Performed Augut 2023

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0.0 Introduction

Unless otherwise stated, this document presents the results of a number of comparisons of Fatal October Crashes (FOCs) compared to Non-October Crashes over a recent five-year period (CY2018-2022). The purpose of these comparisons is to determine the causes and then reduce fatalities caused by October crashes. This is different from most of the special IMPACT studies that have been performed, which have had the goal of reducing all of a particular type of crash regardless of severity. The analytical technique employed to generate most of the displays below is a component within the Critical Analysis Reporting Environment (CARE) called Information Mining Performance Analysis Control Technique (IMPACT). For a detailed description of the meaning of each element of the IMPACT outputs, please see:
http://www.caps.ua.edu/software/care/

The main objective of performing IMPACT comparisons is to surface "over-representations." An *over-represented* attribute is found (for this study) when that attribute has a greater share of Fatal October Crashes (FOC) than would be expected if its proportion were the same as that for the non-October crashes. That is, the non-October crashes are serving as a *control* to which the Fatal October Crashes (FOCs) are being compared to determine over-representations that indicate causes.

As an example, we found that FOCs for the Day-of-the-Week attribute value of Sunday had a 65.4% higher proportion of crashes than did the Non-October crashes (Section 5.3; Odds Ratio = 1.654). When such differences are statistically significant (as in this case), this surfaces characteristics that should be given additional attention, and in some cases, further analyses are performed for countermeasure development. For example, additional selective enforcement for FOC causes (e.g., excessive speed and ID) might be performed for Sunday and other that have the highest over-representations.

Unless otherwise stated, the tables given above the charts are ordered by *Max Gain*. *Max Gain* is the improvement in FOC reduction that could be obtained if a countermeasure could be applied to reduce the proportion of the Fatal October Crashes (FOCs) to the proportion of non-October Crashes within that particular attribute (i.e., reduce the 16.35 to 9.89 in the Sunday example).

This report continues with two sections that provide a high-level summary of recommendations and findings for readers who just want an executive summary. These first two sections are called: (1) Recommendations, and (2) Summary of Findings. Section 3 is also introductory in that it provides a definition of the filters that were used to define Fatal October and non-October crashes in the analytical sections that follow. After Section 3, the comparison between FOCs and Non-October Crashes will be presented under the following headings, given here with their section numbers:

- 4. Geographic Factors,
- 5. Time Factors,

- 6. Factors Affecting Severity,
- 7. Driver and Vehicle Demographics, and
- 8. Driver Behavior.

See the Table of Contents for a guide to sections of interest.

1.0 Recommendations

The recommendations of this special study are presented first for two reasons (1) for those who do not have time to go through all of the IMPACT analyses, and/or (2) as an introduction to the more detailed IMPACT analyses. Recommendations are referenced to the more detailed analyses so that questions regarding the source of any given recommendation can be accessed easily.

Recommendations are organized into the areas of: (1.1) , (1.2) , (1.3) section numbers omitted to keep consistency with Sections 4-8, (1.4) Geographical Factors, (1.5) Time Factors, (1.6) Factors Affecting Severity, (1.7) Driver and Vehicle Demographics, and (1.8) Driver Behavior. The ordering of these recommendations, either generally or within their respective categories, is not meant to imply priority. The more detailed information given should be quite useful in the further prioritization and allocation of traffic safety resources. This process should consider all of the recommendations, which should be validated against the information presented in the IMPACT sections 4.0-8.0 (source sections are given in parenthesis).

Recommendations are made to reduce the frequency and/or severity of Fatal October Crashes (FOCs) in Alabama. They are in the same ordering as the IMPACT displays to facilitate reference to the Summaries of Findings (Section 2.0) and the IMPACT displays (Sections 4.0-8.0).

[Terminology: *Expected proportion* (AKA *expectation*) of FOCs here and below are obtained from the comparison of FOCs with the proportion for their corresponding Non-October Crashes.]

- **1.4 Geographical Factors (4.0)**
  - County (4.1, C001) – The three highest counties for October fatalities were St Clair 13, Limestone 12, and Cullman 12. Several others had from 6 to 9 fatalities. These should be given special attention for October fatality reduction. Generally, the countermeasures recommended to be applied to specific geographical areas are selective enforcement for Speed and Impaired Driving.
  - City (4.2 C002) Comparisons of FOCs to non-October crashes (viewing rural areas of counties as separate cities, i.e., virtual cities). There is little surprise in this output, which tracks the areas by traffic volume. Traffic safety professionals should look especially for any locations that fall counter to this trend. City (and rural area) Comparisons are presented for all areas that had ten or more FOCs.

The county rural areas (virtual cities) with Max Gains in excess of four FOCs over their expected numbers are (in Max Gain order):

- Rural Tuscaloosa 16
- Rural Mobile 15
- Rural Cullman 10
- Rural St. Clair 9
- Rural Limestone 9
- Rural Blount 7
- Rural Talladega 8
- Rural Montgomery 8
- Rural Calhoun 8
- Rural Walker 7
- Rural Baldwin 9

Those cities with a high frequency of October fatal crashes should be given special guidance, and perhaps additional funding, to address their October crash problems. Many such large city areas have a considerable amount of Open Country (see Section 4.6) that would tend to multiply their October fatality count.

- Overall Area Comparisons Conclusions (4.1-4.2) – Generally those rural areas that are adjacent to (or contain) significant urbanized areas are over-represented, since their urban areas generate more traffic in the proximal rural areas. Recommendations to reduce FOCs within urban areas include:
  - Whatever can be done to reduce the need for motor vehicle travel;
  - Promote shorter distances per trip;
  - Larger police presence in the most critical areas; and
  - Lower speed limits in frequent crash areas.

  Anyone wishing analysis of additional cities, counties, or other areas, please contact CAPS – email brown@cs.ua.edu.
- Rural/Urban (4.3, C010) Fatal October Crash Proportions – FOCs occurred in 62.86% (264 crashes) rural and 37.44% (158 crashes) in urban areas. Concentration for fatality reduction is recommended in Rural areas where hotspot analyses determines that there are concentrations of fatal crashes.
- Severity of Crash (4.4, C025) by Rural-Urban (C010, 4.4) – 62.56% of the FOCs occurred in rural areas, while only 37.44% of the FOCs occurred in the urban areas. Similar results were found for the highest severity non-Fatal crashes (i.e., Suspected Serious Injury and Suspected Minor Injury). This seems clearly the result of higher speeds (and thus impact speeds) in the rural areas. The presence of police units in over-represented rural areas is recommended, since this presence alone has been found in many cases to produce an average reduction of up to 10 MPH, which would cut the number of fatalities in half.
- Highway Classifications (4.5, C011) – County roads had a proportion of FOCs that was about three (2.092) times higher than their expected proportion of

crashes (as given by the Non-October Crashes). It is recommended that they be given top priority. State routes also had a proportion that was higher than expected; about 38.0% (Odds Ratio 1.380) more FOCs than expected. While these two factors are important, it is obvious that the greatest reduction will come from a general speed reduction. For example, promote the use of those roadway types that avoid county roads. The promotion of Interstates is good, but this should also contain warnings against driving over the speed limit.

- Locale (4.6, C033) – Open Country FOCs show a high level of over-representation (2.288 Odds Ratio) as compared with the more urbanized area types, especially Residential, which had only a little over two-thirds (0.669) of its expected proportion. Those countermeasures recommended to rural areas would be applicable to the Open Country areas within some city limits.
- Most Harmful Event (4.7, C019) – ordered by frequency. The following items had the largest number of fatality occurrences in the five years:

Overturn/Rollover	71
Collision with Non-motorist/Pedestrian	46
Collision with Tree	52

  Recommended is the most effective countermeasure that will reduce all three of these, which is a reduction in speed brought about by selective enforcement and general law enforcement presence.
- Roadway Curvature and Grade (4.8, C407). FOCs are dramatically over-represented on most all curve types, and especially left curves. Selective enforcement and other speed-reduction tactics (e.g., advisory speed and curve warning signs) should concentrate on left curves first. The application of Advisory Speed Limits for Curves might be improved by the recent release of GDOT_16-31 (trb.org) entitled: *An Enhanced Network-Level Curve Safety Assessment and Monitoring Using Mobile Devices*; GDOT_16-31 (trb.org). This report appears on: http://www.safehomealbama.gov/tag/road-improvements

- **1.5 Time Factors (5.0)**
  - Year (5.1, C001) – No recommendation based on year of crash.
  - Month (5.2; C004) other than October. – The highest frequencies for fatal crashes were in May and July. June was also over-represented, but with a lower number of fatalities (362), as opposed to May (401) and July (388). These three months should be given special selective enforcement concentration with geographical emphasis expressed in the other recommendations.
  - Day of the Week (5.3-5.4, C006) – Since the day of the week distribution is quite comparable to that of Impaired Driving (ID, DUI), the countermeasures for ID should be emphasized in the times and places indicate in other recommendations. These should be used as proxy measures to improve the decisions within ID countermeasures if at all possible. See Sections 8.3 and 8.4.

- Halloween Holiday (5.4a-5.7, C005) – All available enforcement resources should be applied on the day before, Halloween itself, and the day after (30th, 31st, and first of following month). This effort should take advantage of the NHTSA email alerts and warnings for Halloween, some of which start several weeks before the holiday itself. Other weekend countermeasures might need to be modified to provide the maximum support for this effort.
- Time of Day (5.5-5.6, C008) – See Day of the Week (C006) above for the similarity of this distribution with that of Impaired Driving (ID, DUI). The same recommendations effectively apply to these over-represented days. See Sections 8.3 and 8.4.
- Time of Day by Day of the Week (5.7, C008) – See Time of Day and Halloween Holiday above. Since Halloween rarely falls on a weekend, the principles of over-representation that apply to Saturday will be seen as relevant.

- **1.6 Factors Affecting Severity (6.0)**
  - FOC Crash Severity (6.1, C025) – Of necessity, the filter used for this attribute were all crashes during the month of October, as opposed to October fatalities. The rate of severe injuries and fatalities are higher in October crashes than that in non-October crashes, but these over-representations are not significant. This results in October being a prime month for fatality reduction.
  - Speed at Impact (6.2, C224) – All impact speeds above 40 MPH were over-represented with most Odds Ratios indicating statistically significance. The over-representations of FOCs increase, as expected, with increased speeds with 56-60 MPH having an Odds Ratio or 3.695, while 96-100 MPH was 42.014. Past analyses have found the general rule of thumb that for every 10 MPH increase in impact speeds, the probability of the crash being fatal doubles. This was validated in the discussion below of the cross-tabulation of impact speeds by severity (6.4). The obvious recommendation here is to perform selective enforcement and the various PI&E programs that go with it – in other words, use whatever resources are available to bring about an overall speed reduction, and especially those speeds that are in violation with speed laws. Clearing the roadsides in some areas may help reduce severity, although the data showed that in many cases the distance to the hit object was directly proportional to the vehicle travel speed.
  - Severity by Impact Speed (6.3-6.4; C025) for various Highway Classifications. Past analyses have found the general rule of thumb that for every 10 MPH increase in speeds, the probability of the crash being fatal doubles. This was further validated in the discussion of this cross-tabulation. This discussion was given elaboration in the Section 6.4 that is a discussion of the Probability of Being Killed by Speed at Impact.

- Restraint Use by Drivers in Fatal October Collisions (6.5-6.6; C323) – The FOC unrestrained occupants are over 25 (25.6) times more likely to be killed than the FOC passengers who are properly restrained. Clearly many drivers involved in FOCs lose a good part of their concept of risk when they drive impaired and/or at speeds that result in running off the road and hitting an obstacle. The subject of risk taking should be given research with special emphasis on the risk acceptance of excessive speed. One of the most critical needs to prevent fatalities is for the October drivers and their passengers to buckle up (6.5-6.6). There is much more hope of surviving a crash if this is realized, since the unrestrained odds of death is 25.6 times that of those restrained, increasing the probability of death from one in 350.8 to one in 13.7 crashes.
- Cross tabulation: Crash Severity by Restraint Use (C323) for All October Crashes. A comparison of the probability of a fatal crash indicates that a fatality is about 25.6 times more likely if the involved driver is not using proper restraints. Generally, one in 350.8 crashes are fatal if restraints are used; but without restraints, the fatal crash ratio is 1 in about 13.7 crashes, an increase in probability by well over seven times. So the combined effect of lower restraint-use and higher speeds is a devastating combination that accounts for much of the high lethality of October crashes. Current restraint-use programs are quite effective, but consideration should be given to increase their funding to make them even more effective.
- Number of Vehicles Involved (6.7, C052) – the number of single vehicle FOCs is over-represented by an Odds Ratio of 2.616 (the proportion was close to three times more than expected as compared with non-October crashes). Over half (56.87%) of the FOCs were single vehicle crashes. It I recommended that PI&E efforts give top priority to single vehicle crashes. Here is potentially useful information that lists the Primary Contributing Circumstances for all single vehicle crashes with more than five occurrences in 2018-2022: DUI (34); Aggressive Operation (23); Over the Speed Limit (37), Ran Off Road (24); Unseen Object/Person/Vehicle (12); and Improper Crossing (20 pedestrian crashes).
- Police Arrival Delay (6.8, C036) – Generally, the police response times to FOCs was not favorable. Arrival delays were quite comparable between those that were Fatal October and non-October, with the arrival time being ten minutes or less only about 31.47% of the time. All police arrival delays over 20 minutes were over-represented. There can be little doubt that this has to do with so many of them occurring in rural areas (see Section 4.3).
- Adjusted EMS Arrival Delay (6.9, C038) – The subset being evaluated is that for fatal crashes. EMS delays for these crashes were highly significantly over-represented in comparison to all non-October crashes in the 0-30-minute range.

The numbers fall off dramatically on and after the 31 to 45-minute delay. No recommendations are made for any of the times to the crash in that it is recognized first responders are currently doing an excellent job in getting the scene of a crash. Delays, if any, are usually caused be a failure to report the crash immediately.

- **1.7 Driver and Vehicle Demographics (7.0)**
  - Driver Age (7.1, C107) – Younger (16-20-year-old) drivers have a very serious problem in crash causation in general, as seen by their blue bars. This results in their FOC proportions being under-represented as can be seen by the Odds Ratios. The most over-represented age interval for FOCs is from 50-64, which can be seen in both the table and the chart. Ages are so random that no pattern can be seen upon which to base a recommendation.
  - Crash Driver Gender (7.2, C109) – the breakdown in FOC causal drivers is 61.61% male and 25.59% female. For all Non-October cashes, the percentage is 50.51% male and 37.46% female, which also tends to be a good estimate for male/female crash causes in general. These differences in proportions certainly indicate that males are a greater cause of the problems of FOCs, and if there are countermeasures that can be directed toward males, this would be much more cost-effective than those directed equally toward all drivers.
  - Cross-tabulation of Driver Gender by Speed at Impact (7.3, C109 by C224). To get better insight into the reason for male drivers being in more FOCs, this analysis shows that males had impact speeds in excess of the 70 MPH speed limit in 16.43% of their fatal crashes, while the percentage for comparable speeds for females was only at 7.55%. Thus, all of the recommendations for speed reduction apply double to males over females.
  - Causal Vehicle Type (7.4) – This analysis was based on a comparison of FOC causal unit type against the same for Non-October Crashes. Pedestrians had the highest over-representation (Odds Ratio 40.513) and Max Gain (33.161), indicating over 40 times their expected proportion in comparison with the Non-October subset. Motorcycles are in second place, reflecting the general vulnerability of motorcycle driver and passengers for all crashes in which they are involved. The other vehicle type with high frequency (80), is Pick-ups, and after that the numbers drop off considerably. It is recommended that countermeasure programs that are currently in effect be continued and some part of it might mention the special issues in October, implemented in the months prior and during October.
  - Driver License Status (7.5, C114) – No recommendations were seen to be feasible.

- Driver Employment Status (7.6, C120) –This analysis indicated that the employment rate for the FOCs was about 33.18%, while that for Non-October was 45.93%. This relationship is not surprising because of the underlying drug/alcohol root cause of many October crashes (see Sections 8.3-8.4). The correlation between not having a job and being involved in an October crash should be watched carefully going forward in that it could affect the type and location of countermeasures, and also to determine if there is some countermeasure that could be implemented in conjunction with their unemployment payments.

- **1.8 Driver Behavior (8.0)**
  - Primary Contributing Circumstances – PCC (8.1 and 8.2, C015) While clearly the problems found in this study are those of October crashes, driver behaviors that are correlated with October crashes might provide alternatives for countermeasure development. Those behaviors that had over 50% more (Odds Ratio > 2) than their expected PCC proportion for FOCs when compared to non-October Crashes are:
    - Over Speed Limit
    - Impaired Driving (DUI)
    - Improper Crossing (pedestrian)
    - Aggressive Operation
    - Ran Off Road
    - Crossed Centerline
    - No additional recommendations for these behaviors since they are covered in Speed and ID countermeasures.
  - CU Officer's Opinion Impaired Driving – Alcohol (8.3-8.4, C122-C123). We saw ample evidence for October crashes being caused by Impaired Driving (ID) in the time of day and day of the week attributes. The two ID attributes (C122 and C123) indicate the degree that ID was involved in October crashes as opposed to non-October crashes. For alcohol, the proportion of ID crashes was 5.144 times as many for FOCs as for Non-October crashes. For drugs this multiplier was even greater at 6.820. This was sufficient to verify that the Fatal October crash time over-representations reported above, were correlated very closely with ID. Recommended countermeasures to counter ID are:
    - Mandate breath-alcohol ignition interlock devices for all convicted of ID.
    - Perform an in-depth study to determine if problems exist within the current program, and how interlock devices can be expanded to be made more generally effective.
    - Since the presence of drugs/alcohol often do not reach the reporting threshold, especially in cases involving prescription drugs, more officer training to produce more complete reporting is recommended.
    - Drug/Alcohol Diversion Programs should continue (or new programs adopted) that concentrate on keeping the age 25 through 35 (typically *social*

users) from becoming habitual to the point where they become part of the 36-55-year old over-representation of predominantly *problem users* (7.1).

- Combinations of recreational or medical drugs and alcohol can be particularly lethal, and medical practitioners should warn against such problems and discourage all alcohol use for their patients who have indicated or displayed these problems, or who are taking other prescription drugs. Legalized recreational drugs are not a good alternative to alcohol use and should not be advertised as such. PI&E programs should take the opposite approach to warn drivers that legalization does not relax their responsibilities.

2.0 Summary of Findings

Note: subsection numbers 2.1, 2.2 and 2.3 have been omitted in order to keep the numbering system in this Section consistent with that of the IMPACT displays that follow. The following findings are mainly from the IMPACT analysis below that compared FOCs vs Non-October crashes over all five years (CY2018-2022):

- **2.4 Geographical Factors (4.0)**
  - County (4.1, C001) - Generally, the over-represented counties are those with combined fairly large population centers bordering on rural areas, as opposed to the highly urbanized counties or the extremely rural counties. One reason that the highly urbanized counties are under-represented is the large number of low-speed and low- severity crashes that occur in the Non-October crashes. See the rural-urban comparison below (4.3). Placed in Max Gain order, the counties with the highest potential for reduction in their expected proportions were: St. Clair, Limestone, Cullman, and DeKalb, Cherokee, Blount, Cleburne, and Walker. [Terminology: *Expected proportion* (AKA *expectation*) of FOCs here and below are obtained from the comparison of FOCs with the proportion for their corresponding Non-October Crashes.]
  - City Comparisons of FOCs to Non-October Crashes, viewing rural areas of counties as separate cities, i.e., virtual cities (4.2, C002). There is little surprise in this output, which tracks the areas by population (traffic density). City (and rural area) comparisons are presented for all areas that had seven or more FOCs. The county rural areas (virtual cities) with Max Gains in excess of five FOCs over their expected numbers are: Rural Tuscaloosa, Rural Mobile, Rural Cullman, Rural St. Clair, Rural Limestone, Rural Blount, Rural Talladega, Rural Montgomery, Rural Calhoun. And Rural Walker.
  - Overall Area Comparisons Conclusions (4.1-4.2, C002) – Generally those rural areas that are adjacent to (or contain) significant urbanized areas are over-represented, since their urban areas generate more traffic in the rural areas. Possible factors for *relatively* fewer FOCs within urban areas include:

- Less need for motor vehicle travel and shorter distances;
- Larger police presence in the metropolitan areas; and
- Lower speeds in urban areas.

Note: The city, county, and area comparisons are, of necessity, a selection of the total outputs that could be generated. They are given to illustrate the capabilities as much as to present the numerical results. Anyone wishing additional cities, counties, or other areas, please contact CAPS – email brown@cs.ua.edu.

- Rural/Urban (4.3, C010) Fatal October Crash Proportion– FOCs occurred in 62.56% rural and 37.44% urban areas. These differences between the Fatal and all Non-October crashes were significant in both the rural (over-represented) and the urban (under-represented) areas.
- Severity of Crash by Rural-Urban (4.4, C025 x C010) – 62.56% of the FOCs occurred in rural areas, while those in the urban areas, while only 37.44% of the FOCs occurred there. Similar results are found for the highest severity non-Fatal crashes (Suspected Serious Injury). This seems clearly the result of higher travel speeds (and thus impact speeds) in the rural areas. Note that additional causes of increased severity are given in the Factors Affecting Severity, see Section 6, below.
- Highway Classifications (4.5, C011) – County roads had a proportion of FOCs that was over twice (2.092) times higher than their expected proportion of crashes (as given by the Non-October crashes). State routes had about 38% (odds ratio 1.380) more FOCs than expected. All other roadway classifications were under-represented. County road characteristics no doubt contribute to the rural crash frequency (see Section 4.3). County roads are also known to be less "crashworthy" (i.e., they result in more severe crashes at comparable impact speeds). Also, their potential remote locations tend to make EMS delay times longer.
- Locale (4.6, C033) – Open Country FOCs show a high level of over-representation (2.288 Odds Ratio) as compared with the more urbanized area types, especially Residential, which only has a little over two thirds (0.699) of the control. Shopping of Business was significantly under-represented, with only about a third (0.389) of expectation.
- Most Harmful Event (4.7, C019) – *ordered by frequency*. The following items had the largest number of fatality occurrences in the five years:

Collision with Vehicle in Traffic	158
Overturn/Rollover	71
Collision with Tree	52
Collisions with Non-Motorist (Pedestrian)	46

Overturned/Rollover was a distant second with 71 Fatal October crashes and an Odds Ratio of 5.963, which showed this to be a much higher proportion than the control subset (all Non-October crashes). This was followed by Collision with

Tree, which also had a high Odds Ratio of 3.905. However, the greatest proportion over-representation was in the 46 Pedestrian crashes, which had 24.930 (Odds Ratio) times the pedestrian proportion of the control subset. This aldo reflects heavily on the proportion of pedestrian crashes that are fatal.

- Roadway Curvature and Grade (4.8, C407). FOCs are dramatically over-represented on several curve types, and especially left curves. Left Curves either Level or with Down Grades, along with Right Curves and Level had the highest over-representations. Level or Down Grades are generally more of a problem than up-grades. Straight with Down Grade, for which we would expect higher speeds, had the highest frequency (47), although not as great an Odds Ratio (1.424) as the top three over-represented items.

- **2.5 Time Factors (5.0)**
  - Year (5.1, C003) – The years 2019 and 2020 were over-represented, but not significantly so. There was no definitive trend in FOCs per year over the five years.
  - Month (5.2, C004) – *With October excluded, and ordered by monthly fatalities. The control subset was all Non-October crashes.* The highest (and only) fatality over-representation by month was in July (1.125 Odds Rario). The number of FOCs correlated very closely with the with Non-October Crashes, although several months were noticeably under-represented.
  - Day of the Week (5.3-5.4, C006) – This analysis is not only useful for the typical work week, but it also reflects the typical "holiday weekend" patterns. Traffic safety professionals will notice that the distribution throughout the week is quite similar to that of impaired driving (ID). Since many October crashes are caused by ID, that would create this distribution for FOCs as well. However, this pattern is further reinforced by holiday drivers who are not familiar with the new roads that they might be traveling, especially if these roads are in any way design deficient. Assuming that a significant number of October crashes are caused by ID, the days can be classified as follows:
    - Typical work weekday (Monday through Thursday) – these days are under-represented in FOC crashes due to the need for many drivers to go to work the following day. Wednesday was the only statistically significant under-representation.
    - Friday – The large numbers of crashes in general on Fridays causes Friday to be under-represented. The only days that had a significant over-representation were Saturday and Sunday, while Monday and Wednesday were under-represented.
    - Saturday – the "Saturday" frequency is the one of the worse for FOCs in that it has both an early morning component (like Sunday) and a late night

component (like Friday). While its frequency (71) is not as high as that of Thursday (73), its higher proportion was statistically significant with an Odds Ratio of 1.328 (Thursday's was 1.109) This is a very irregular result for Thursday.

- Sunday – since this is the last day of a holiday or weekend sequence, its over-representation is increased by those who start on Saturday night and do not complete their use of alcohol/drugs until after midnight. Sunday is the most over-represented day with close to 70% (1.654) above its expected number of FOCs.

- "Holiday Weekends" (5.4a-5.4b, C004-C005) – these can be viewed as a combined weekend-pattern sequences. For example, the Wednesday before Thanksgiving would follow the Friday pattern if most are at work on Wednesday. The Thursday, Friday and Saturday would follow the Saturday pattern, and the Sunday at the end of the weekend would follow the typical Sunday pattern. This is the reason that long holiday events (i.e., several days off) can be much more prone to all types crashes than the typical weekend. Three-day weekends typically give Monday off, so that Monday would behave like the typical Sunday, and both the Saturday and Sunday would follow the Saturday pattern.
- Time of Day (5.5-5.6, C008) – The extent to which night-time hours are over-represented is quite striking. Optimal times for FOC enforcement would start immediately following any previous day rush hour details, and would continue through at least 3:00 AM to 3:59 AM (Odds Ratio 5.375). Some of the late-night FOCs will also be due to drowsiness causing, among other things, a diminished ability to see road edge lines.
- Time of Day by Day of the Week (5.7, C008 x C006) – This quantifies the extent of the Fatal October crash concentrations on Fridays, Saturday mornings and nights, and early Sunday mornings and Sunday Evenings. This is a very useful summary for deploying selective enforcement details, especially during the weekend hours.

- **2.6 Factors Affecting Severity (6.0)**
  - FOC Crash Severity (6.1, C025) -- The rate of fatal injury crashes is close to 5% (1.047 Odds Ratio) higher for the fatal Injury classification, but other than that, the Odds Ratios show little differences for the various severities. Essentially this is saying that: with the exception of fatalities, the October severities are not significantly different from those of the other months.
  - Speed at Impact (6.2, C224) – All impact speeds above 40 MPH are over-represented with most Odds Ratios indicating statistical significance. The over-representations of FOCs increase, as expected, with increased speeds with 41-45 MPH having an odds ratio or 1.286, while 96-100 MPH being 42.014. Several

analyses have found the general rule of thumb that for every 10 MPH increase in impact speeds, the probability of the crash being fatal doubles. This was validated in the discussion below of the cross-tabulation of impact speeds by severity (6.4).

- Severity by Impact Speed (6.3-6.4, C224) for different Highway Classifications (C011). Past analyses have found the general rule of thumb that for every 10 MPH increase in speeds, the probability of the crash being fatal doubles. This was further validated in the discussion of this cross-tabulation. See further discussion in Section 6.4.
- Restraint Use by Fatal October Crash Causal Drivers (6.5, C323) – The FOC unrestrained occupants have a probability of a fatal crash of one in 146 crashes, while those who are restrained are one in 3414 crashes. This means that those who are unrestrained are over 23 (23.4) times more likely to be killed than the FOC passengers who are properly restrained. Clearly drivers involved in FOCs lose a good part of their concept of risk when they drive impaired and/or at speeds that result in deadly crashes. The numerical results of the following cross-tabulation analysis are slightly different because of the underlying numbers upon which they are bases. However, their nearly identical results reinforce this conclusion.
- 6.6 Cross tabulation: Crash Severity (C025) by Restraint Use (C323) for All October Crashes. A comparison of the probability of a fatal crash indicates that a fatality is about 25.6 times more likely if the involved driver is not using proper restraints. Generally, one in 350.8 crashes are fatal if restraints are used; but without restraints, the fatal crash ratio is 1 in about 13.7 crashes, an increase in probability of about 25.6 times. So the combined effect of lower restraint usage and higher speeds is a devastating combination that accounts for much of the high lethality of October crashes.
- Number of Vehicles Involved (6.7, C025) – the number of single vehicle FOCs is over-represented by an Odds Ratio of 2.616 (proportion was close to three times more than expected). Over half (56.87%) of the FOCs were single vehicle crashes. This is consistent with the other findings of causality.
- Police Arrival Delay (6.8, C036) – Generally, the police response times to FOCs were greater than expected, with delays over 20 minutes being over-represented, most of which were significant. There can be little doubt that this has to do with so many of them occurring in rural areas (see Section 4.3).
- EMS Arrival Delay (6.9, C039) – Probably because of the severity of the FOCs (all fatal) the delay in getting called and the urgency in getting to the scene resulted in a much shorter delay times than that of the police delays. Generally, we can conclude that very few of the fatalities were caused by excessive EMS delays.

- **2.7 Driver and Vehicle Demographics (7.0)**
  - Driver Age (7.1, C107) –A comparison of FOC causal driver age with those Non-November crashes shows the most over-represented are in the age bracket 45-60 year olds. Statistical significance is not computed for sample sizes less than 20.
  - Crash Driver Gender (7.2, C109) – the breakdown in FOC causal drivers is 61.61% male and 25.59% female. For non-Fatal October cashes, the percentage is 50.51 male and 37.46 female, which also tends to be a good estimate for male/female crash causes in general. These differences in proportions certainly indicate that males are a greater cause of the problems of FOCs, and if there are countermeasures that can be directed toward males, this would be much more cost-effective than those directed equally toward all drivers.
  - Cross-tabulation of Driver Gender (7.2, C109) by Speed at Impact (7.3, C224). To get better insight into the reason for male drivers being in more FOCs, this analysis shows that males had impact speeds in excess of the 70 MPH speed limit in 16.43% of their fatal crashes, while comparable speeds for females was only at 7.55%.
  - Causal Vehicle Type (7.4, C101) – This analysis was based on a comparison of FOC causal unit type against the same for Non-fatal October Crashes. Pedestrians had the highest frequency (34) and a huge Odds Ratio of 40.513, due to the combination of the fatal crash requirement in the FOC subset and the relative absence of pedestrian crashes in the Non-fatal October Crashes used for the control. Motorcycles have the highest motor vehicle over-representation (Odds Ratio 10.105) and Max Gain (13.203), indicating over 10 times their expected proportion in comparison with the control subset. This reflects the general vulnerability of motorcycle driver/passengers for all crashes in which they are involved. The other vehicle type with the highest frequency is Pick-Ups (80), but with a low Odds Ratio (1.105). Passenger Cars (152) and Sports Utility Vehicles – SUVs, (71) were under-represented indicating their tendency to avoid the more severe October crashes.
  - Driver License Status (7.5, C114) – FOCs are significantly over-represented in being caused by drivers without legitimate licenses. Over 15% (15.25%) of the Fatal October crash causal drivers did not have a legitimate driver's license. The following gives the highest over-represented categories along with the number of crashes (in parenthesis) that were attributed to the DL Status: Suspended (24), Unlicensed (24), Revoked (10), and Expired (8).

- Driver Employment Status (7.6, C120) – This analysis indicated that the employment rate for the FOCs was about 35.79%, while that for Non-October Crashes was 49.90%. This relationship is not surprising because of the underlying drug/alcohol root cause of many October crashes (see Sections 8.3-8.4). The correlation between not having a job and being involved in October crash should be watched carefully going forward in that it could affect the type and location of countermeasures, and also to determine if there is some countermeasure that could be implemented in conjunction with their unemployment payments.

- **2.8 Driver Behavior (8.0)**
  - Primary Contributing Circumstances – PCC (8.1 and 8.2, C015) While clearly the findings in this study are those of October fatal crashes, driver behaviors that are correlated with October fatal crashes might provide alternatives for countermeasure development. Those behaviors that had at least a frequency of 20, and over 100% more than their expected PCC proportion for FOCs when compared to Non-October crashes are:
    - Over Speed Limit (46)
    - Impaired Driving (DUI -- 50)
    - Aggressive Operation (30)
    - Improper Crossing (Pedestrian -- 22)
    - Ran Off Road (29)
    - Crossed Centerline (20)

    The above are ordered by Max Gain.
  - CU Officer's Opinion Impaired Driving – Alcohol (8.3-8.4, C122-C123). We saw ample evidence for October crashes being caused by Impaired Driving (ID) in the time of day and day of the week attributes. The two ID attributes (C122 and C123) indicate the degree that ID was involved in Fatal October crashes as opposed to Non-October Crashes. For alcohol, the proportion of ID crashes was 2.814 times as many for FOCs as for Non-October crashes. For drugs this multiplier was slightly greater at 2.971. This verified that over-represented Fatal October crash Times and Days of the Week reported above, were correlated very closely with ID. It is recognized that ID, especially in the area of drug use, tens to be under-reported.

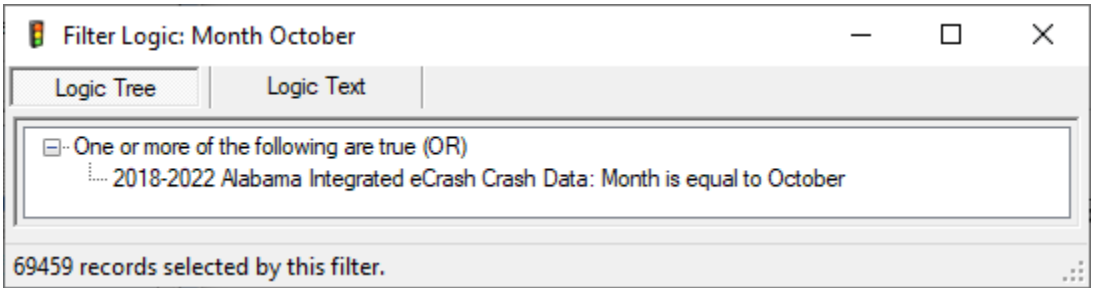
3.0 October Crashes CY2018-2022 (Fatal October vs Non-October)

Generally, (with certain limited exceptions) the analyses performed in this study will compare FY2018-2022 Fatal October Collisions crashes against all Non-October collisions over the same 5-year time period. The objective is to determine all significant differences between attributes within these two subsets of data in order to get an improved understanding as to the October fatality crash causes (who, what, where, when, how, and causal driver demographics). This is accomplished by pinpointing common factors to assess strategies that could be used to address any major inconsistencies between these two subsets of crash data. The findings that are presented should be taken into consideration when planning the large variety of countermeasures that exist to reduce both the frequency and the severity of October crashes.

This preliminary section of the report will contain some information that will be good in obtaining an overall orientation toward the IMPACT results that will follow. This will consist of: (1) Filter Definitions, (2) Overview of October crashes by Severity and Year, (3) IMPACT Analysis of October Crashes against non-October Crashes by Year, (4), and (5) Introduction to IMPACT analysis (vocabulary).

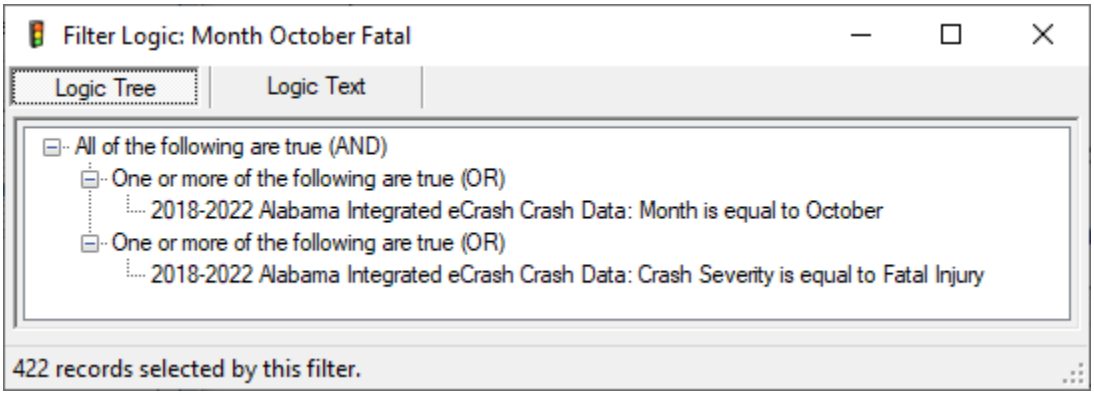
3.1 Filter Definitions (Fatal Oct Crashes – FOCs, and Non-October Crashes)

The following is the formal filter definition for all October crashes:

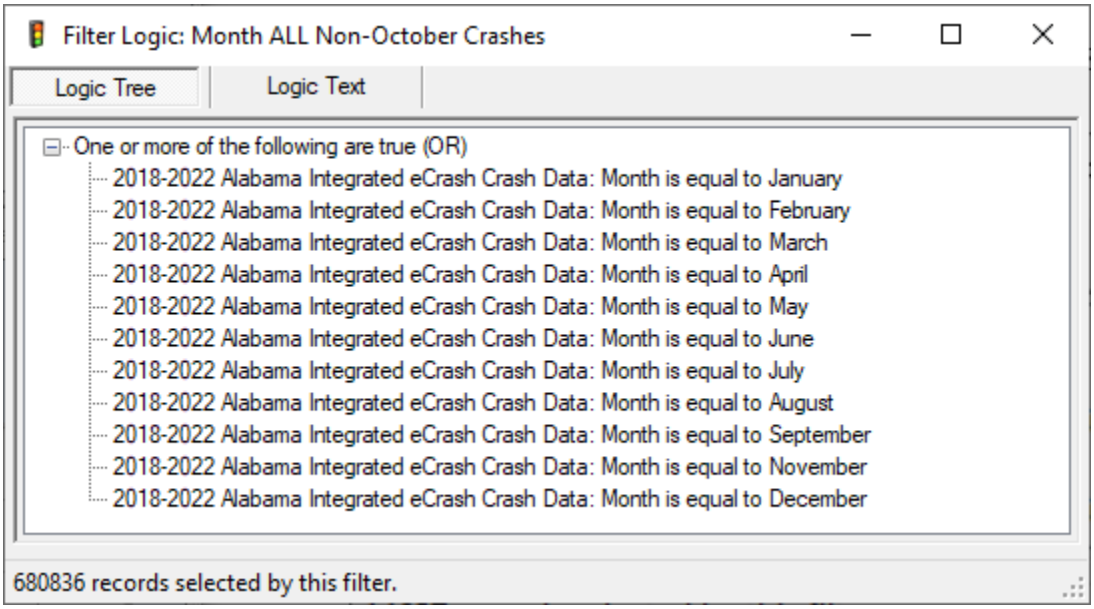


This formalizes the definition of the crashes in the October (2018-2022) subset of crash reports being considered in this study. IMPACT will only use this subset when needed. For the most part it will be comparing Fatal October Cashes (FOCs) against all crashes for the other months using the following filters:

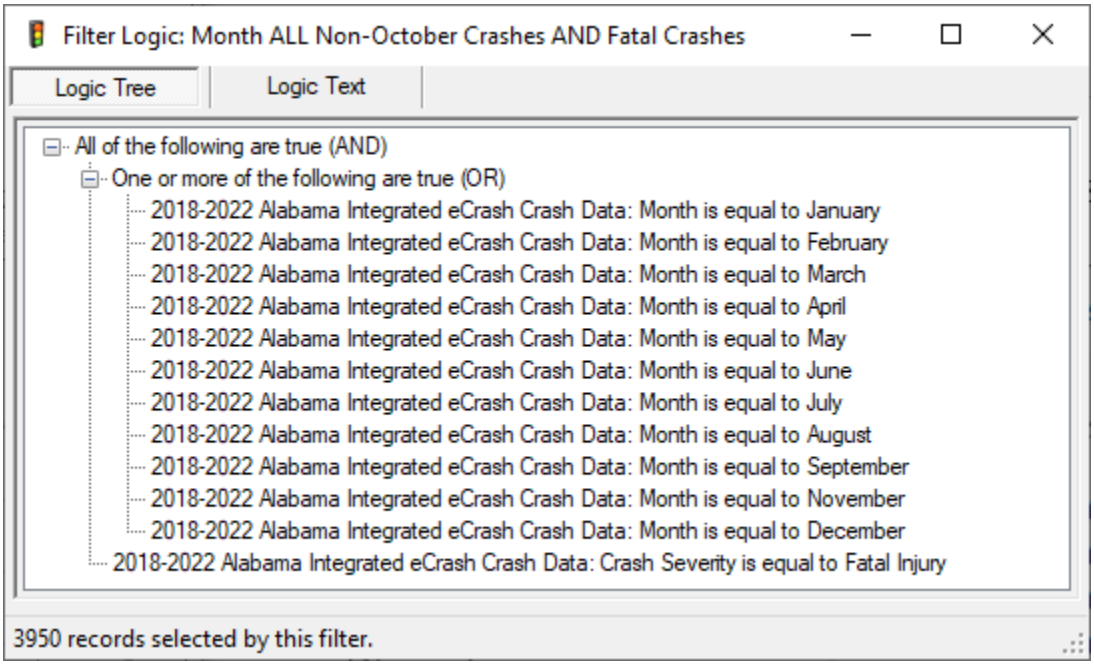
Fatal October Crashes (FOCs):



Non-October Crashes (NOCs), all crashes in the non-October months regardless of severity.:



Also of interests in a few cases will be Fatal Non-October Crashes, all fatal crashes in the non-October months:

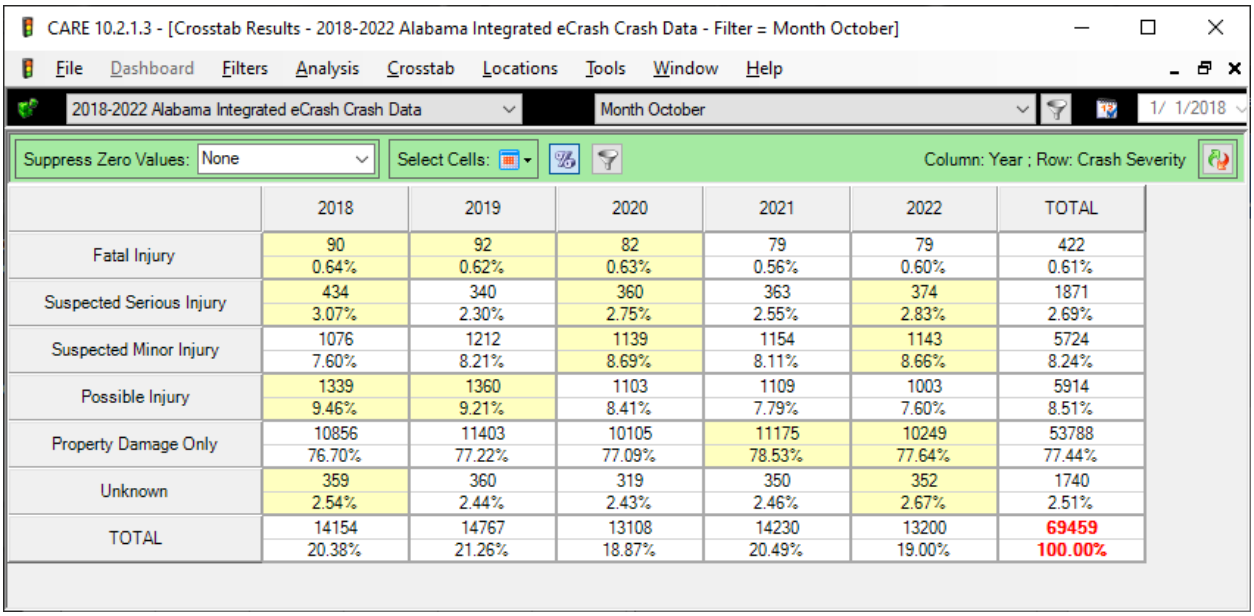


Using the filters above, the next sections will get an overall introduction to the crash and/or fatality effects before getting into the large number of IMPACT analyses.

3.2 October Overall Crashes by Severity and Year; 2018-2022 Data

It is good to get a feel for their overall difference in the crash frequencies by severity over recent years. The following gives a comparison of all October crashes by severity in CY2018-2022.

October Crashes by Severity for Calendar Years 2018-2022



	2018	2019	2020	2021	2022	TOTAL
Fatal Injury	90 0.64%	92 0.62%	82 0.63%	79 0.56%	79 0.60%	422 0.61%
Suspected Serious Injury	434 3.07%	340 2.30%	360 2.75%	363 2.55%	374 2.83%	1871 2.69%
Suspected Minor Injury	1076 7.60%	1212 8.21%	1139 8.69%	1154 8.11%	1143 8.66%	5724 8.24%
Possible Injury	1339 9.46%	1360 9.21%	1103 8.41%	1109 7.79%	1003 7.60%	5914 8.51%
Property Damage Only	10856 76.70%	11403 77.22%	10105 77.09%	11175 78.53%	10249 77.64%	53788 77.44%
Unknown	359 2.54%	360 2.44%	319 2.43%	350 2.46%	352 2.67%	1740 2.51%
TOTAL	14154 20.38%	14767 21.26%	13108 18.87%	14230 20.49%	13200 19.00%	69459 100.00%

We conclude from considering the percentage numbers at the bottom of the table that 2020 and 2022 were significantly lower in total October crashes than those in the other years. Fatal crashes during October dropped off in 2020 through 2022.

To see the rationale for the use of October, the following average number of crashes for several crash types are of interest:

Average all crashes per month for all months = 750,295/60 = 12,504.9 crashes per month

Total October crashes 2018-2022 per year = 69,459/5 = 13,891.8 crashes per month

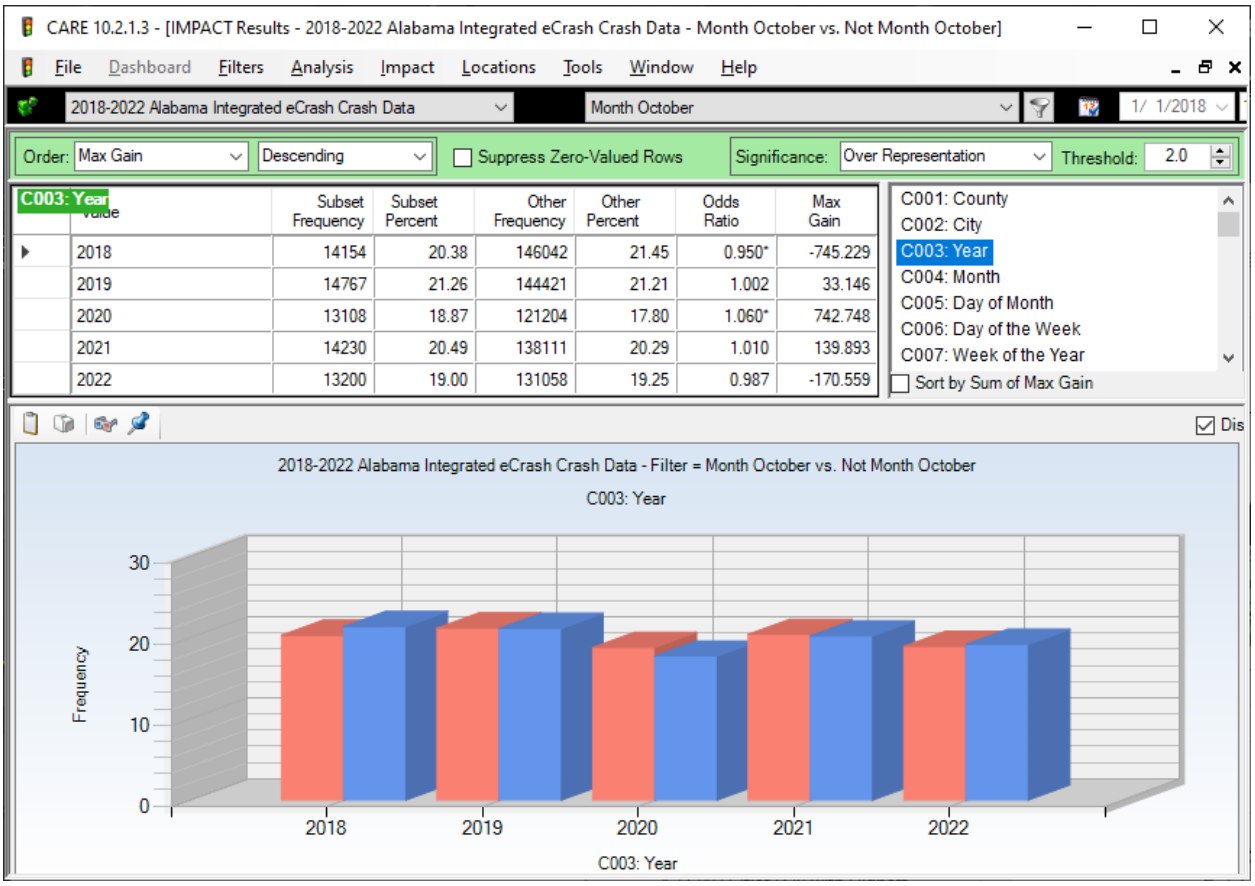
October Crashes (OCs) above average = 13,891.8 – 12,504.9 = 1,386.8 crashes per year

Average all FATAL crashes per month for all months = 4,372/60= 72.9 fatal crashes per month

Average FATAL October Crashes (FOCs) over 2018-2022 = 422/5 = 84.4 FOCs per year

FATAL October crashes (FOCs) above average = 84.4 – 72.9 = 11.5 fatal crashes/year

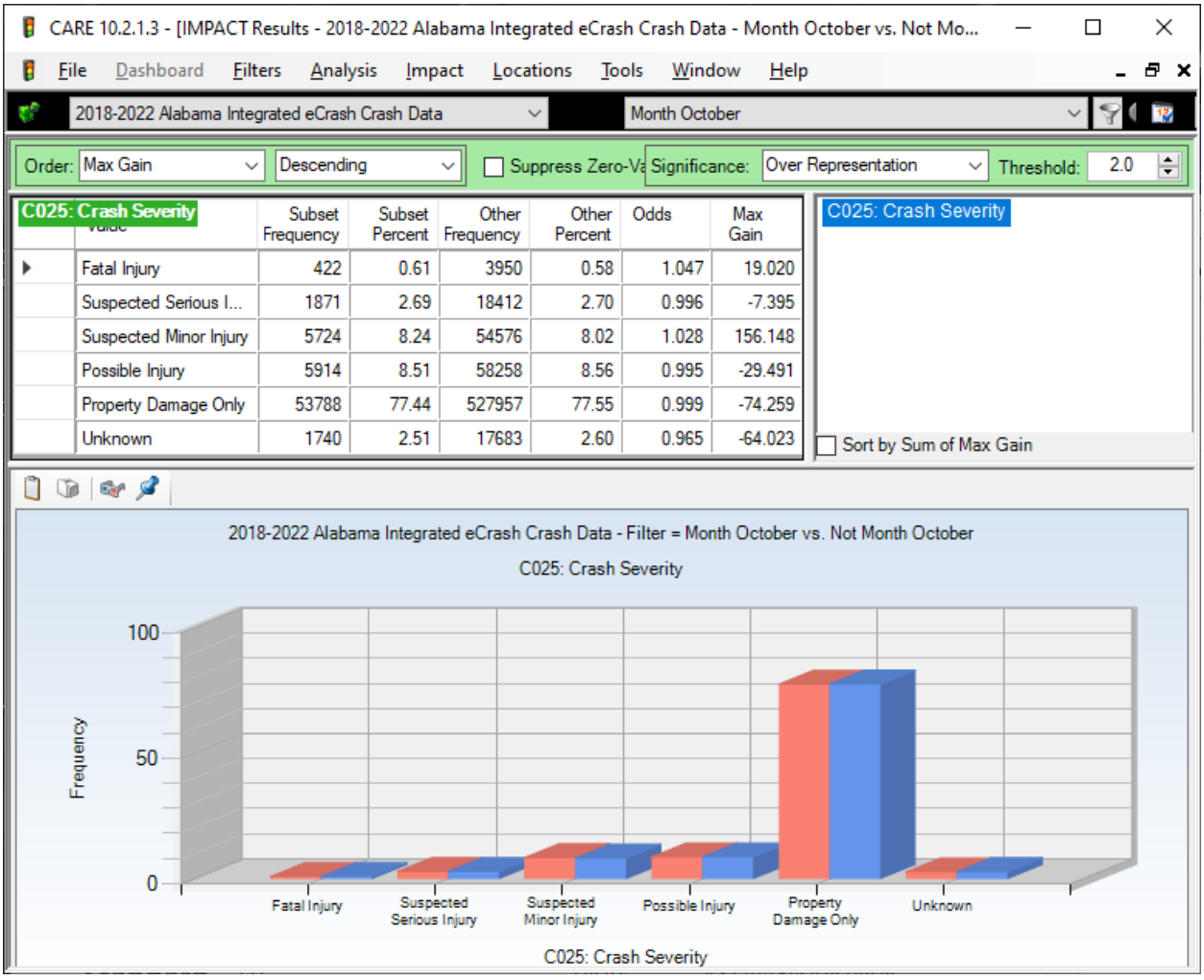
3.3 October Crashes (OCs) vs Non-OCs by Year



October crash frequencies were significantly lower in 2018, and significantly higher in 2020. They were not significantly different in the other years, 2019 and 2021, which had proportions higher than average, and 2022, which was lower (see Odds Ratios).

3.4 October Crash (OC) Severity Comparisons (October vs All Non-October)

The following presents a comparison by severity of the of October and non-October crashes over the five-year period (2018-2022). The *Subset Frequency* and *Percent* columns are for October crashes, while the *Other Frequency* and *Percent* columns are for all crashes for all other months. Comparisons must be against the percentage proportions to determine if October crashes (OCs) are more or less severe than Non-October Crashes in general.



It is clear that there is no significant severity differences between OCs and crashes in other months. However, the fatal crashes are over-represented by 4.7%, and the reduction (Max Gain) over the five years if this could be eliminated would be over 19 (19.020) fatal crashes.

3.5 Introduction to the IMPACT Analyses

The findings in the following sections (4.0-8.0) are from the IMPACT displays for the various attributes that could have an influence on countermeasure development, and especially FOCs. Unless otherwise indicated in the "Order" box, the outputs will be in highest *Max Gain* first. The *Max Gain* is a term that CARE users have assigned to indicate the number of crashes that would be reduced if the respective proportion value was not at all over-represented (had an Odds Ratio of 1.000). An *over-represented* value of an attribute is a situation found where that attribute has a greater share of crashes in October than would be expected of that attribute in Non-October Crashes. Similarly, an *under-represented* value of an attribute is a situation found where that attribute has a smaller share of crashes in October than would be expected if it were the same as that attribute in non-October crashes (non-OCs). These IMPACT comparisons will be for FOCs against their Non-October Crash counterparts.

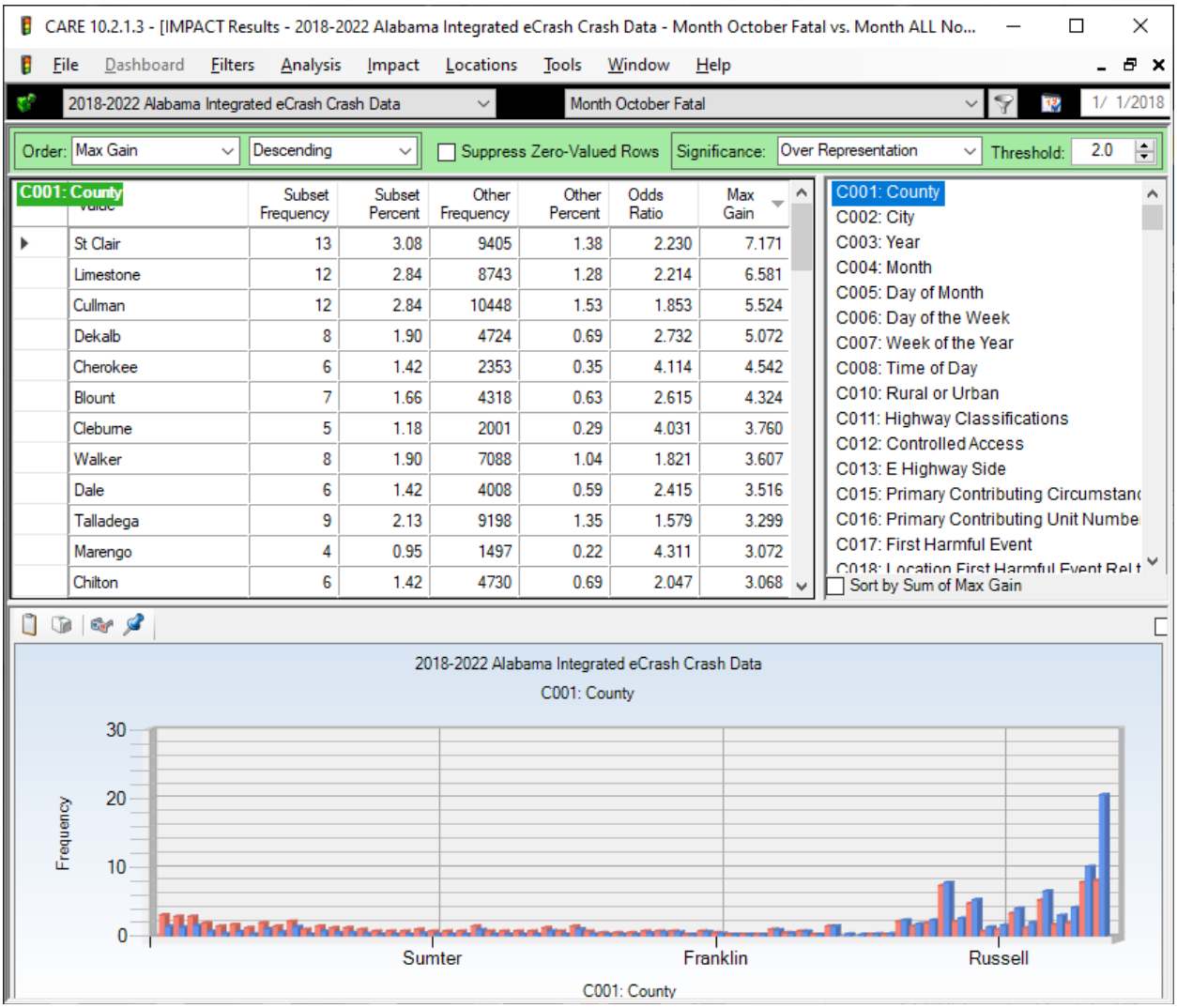
In summary, the Non-October Crashes are serving as a control to which the FOCs are being compared. In this way any inconsistencies related to the FOCs surfaces and can be subjected to further analyses. The analytical technique employed to generate most of the displays below is called Information Mining Performance Analysis Control Technique (IMPACT). For a detailed description of the meaning of each element of the IMPACT outputs, see:

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

The IMPACT analses will be grouped by five general attribute categories as follow: 1. Geographical and Harmful Events, 2. Time, 3. Severity, 4. Demographics, and 5. Driver Behavior.

4.0 Geographic and Harmful Event Factors

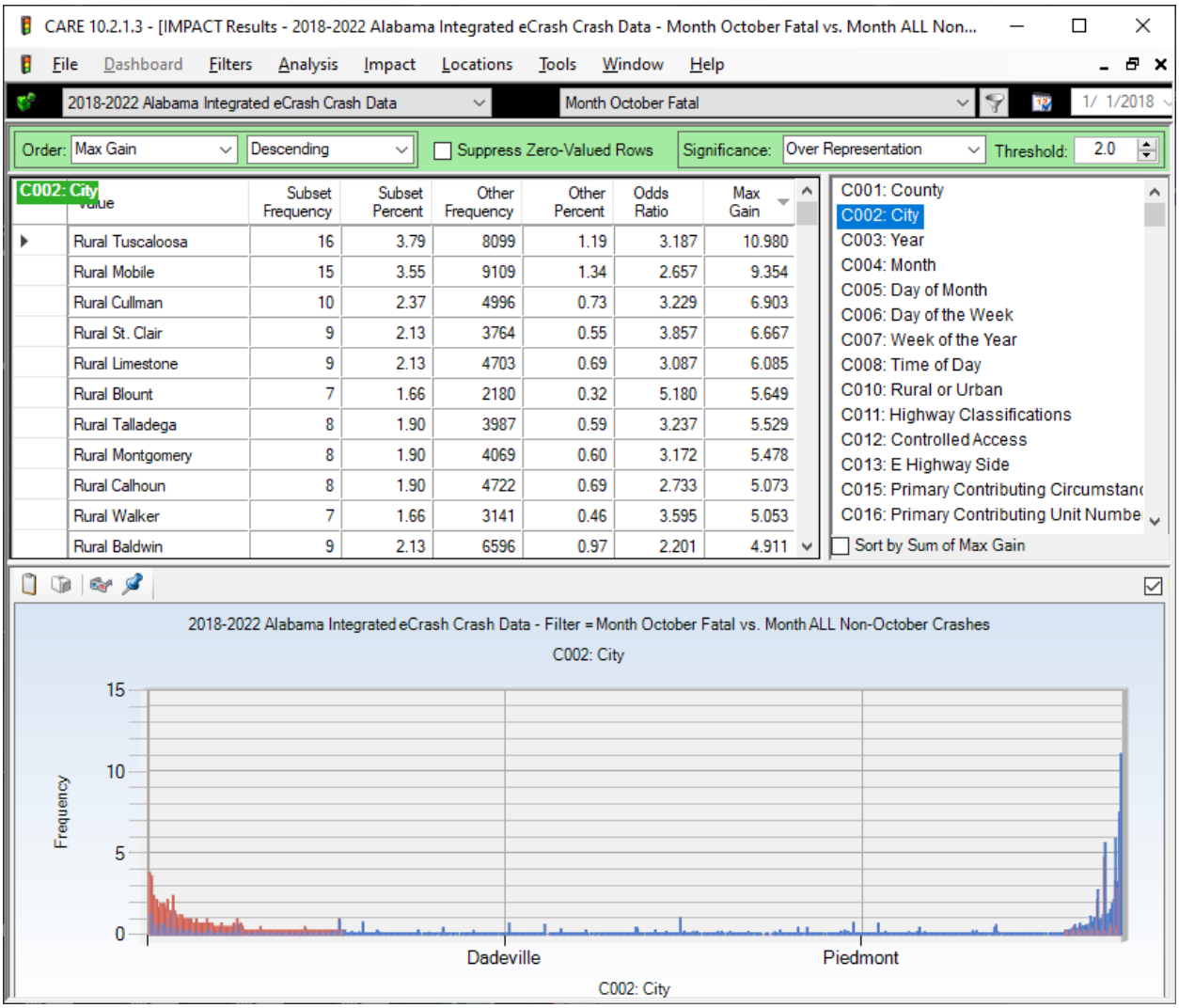
4.1 C001 County (top 12 counties)



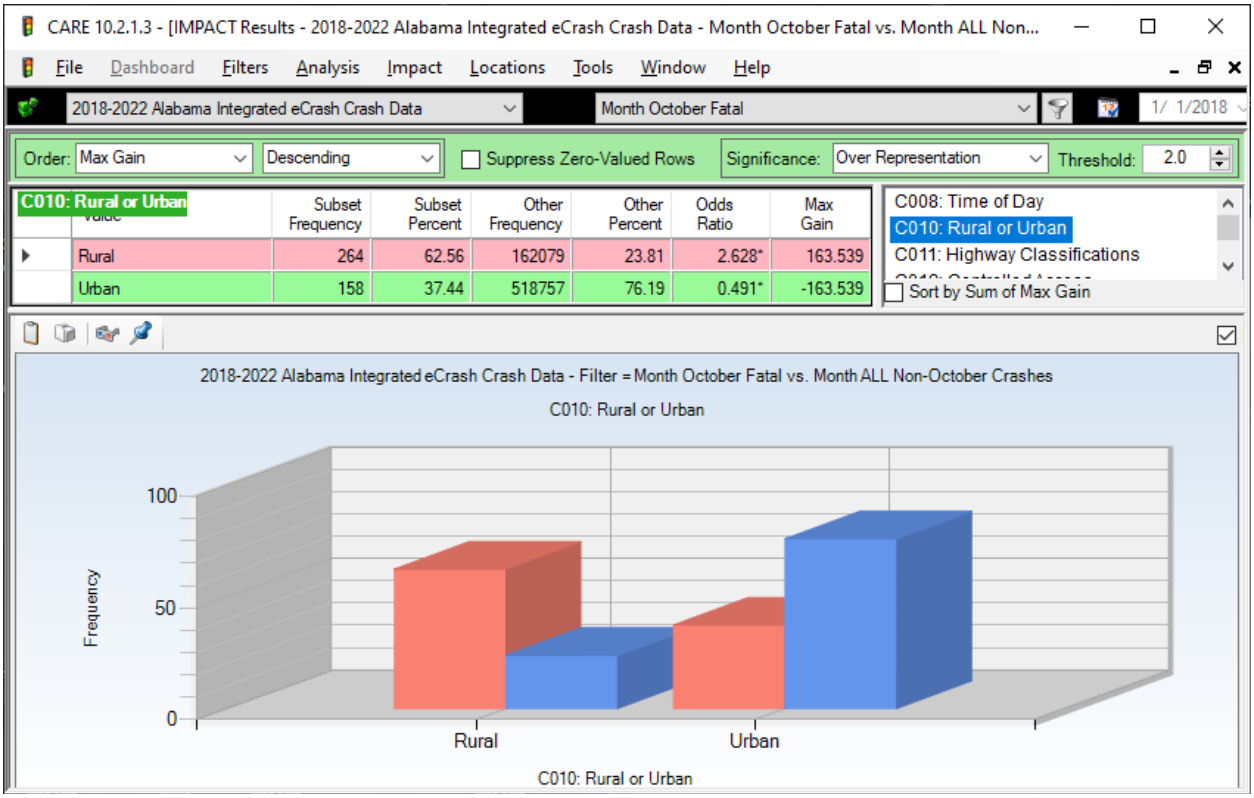
The above display has been arranged in highest Max Gain order to indicate the counties that have the highest potential for gain in reducing their October fatal over-representations. St Clair 13, Limestone 12, Cullman 12, DeKalb 8, Cherokee 6, Blount 7, Cleburne 5, and Walker 8 have the highest potentials for October fatality reductions, all with positive Max Gains. The display above contains all of the counties with Max Gains greater than 3.000.

4.2 C002 Cities (top 11) with Highest Max Gains (Rural Areas = Virtual Cities)

For comparison purposes, the rural area of a county is considered to be a "virtual city" and crashes that occur there are listed as "Rural [County Name] Crashes" so that these crashes can be effectively accounted for and compared. Generally, these rural areas are adjacent to (or partially contain) significant urban areas that have a higher traffic density. This display is in Max Gain ordering to put those (virtual) cities that have the highest potential for October Fatal crash reduction at the top.



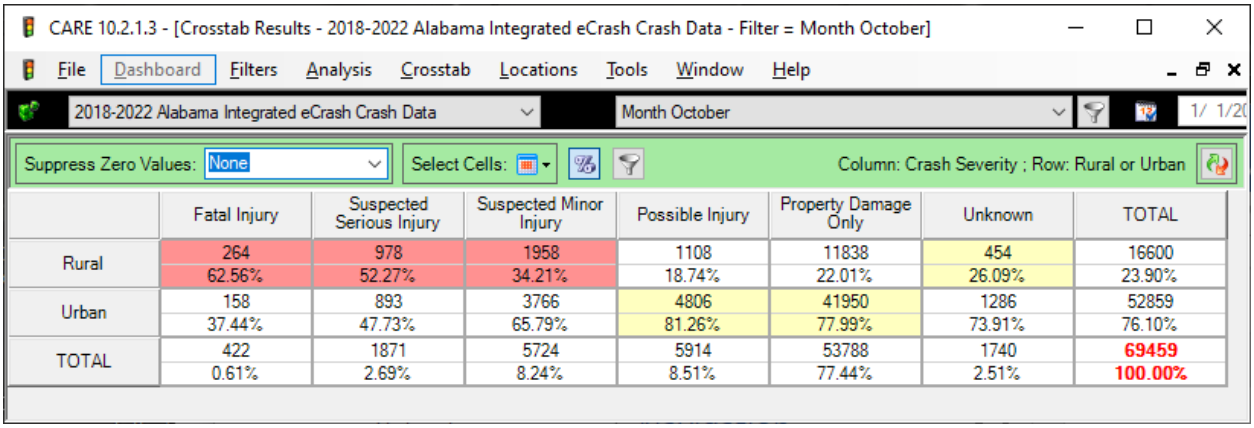
4.3 C010 Rural or Urban



Over 62% of the FOCs were in rural areas. This is attributed to the comparative speed at impact in the rural areas, which will be considered again in Section 6.2, C224 Speed at Impact. Speed not only can cause a crash, but it also dramatically increases its severity (see Section 6.0, as well as 4.4 below).

4.4 C025 Severity of Crash by C010 Rural-Urban (all severity October crashes)

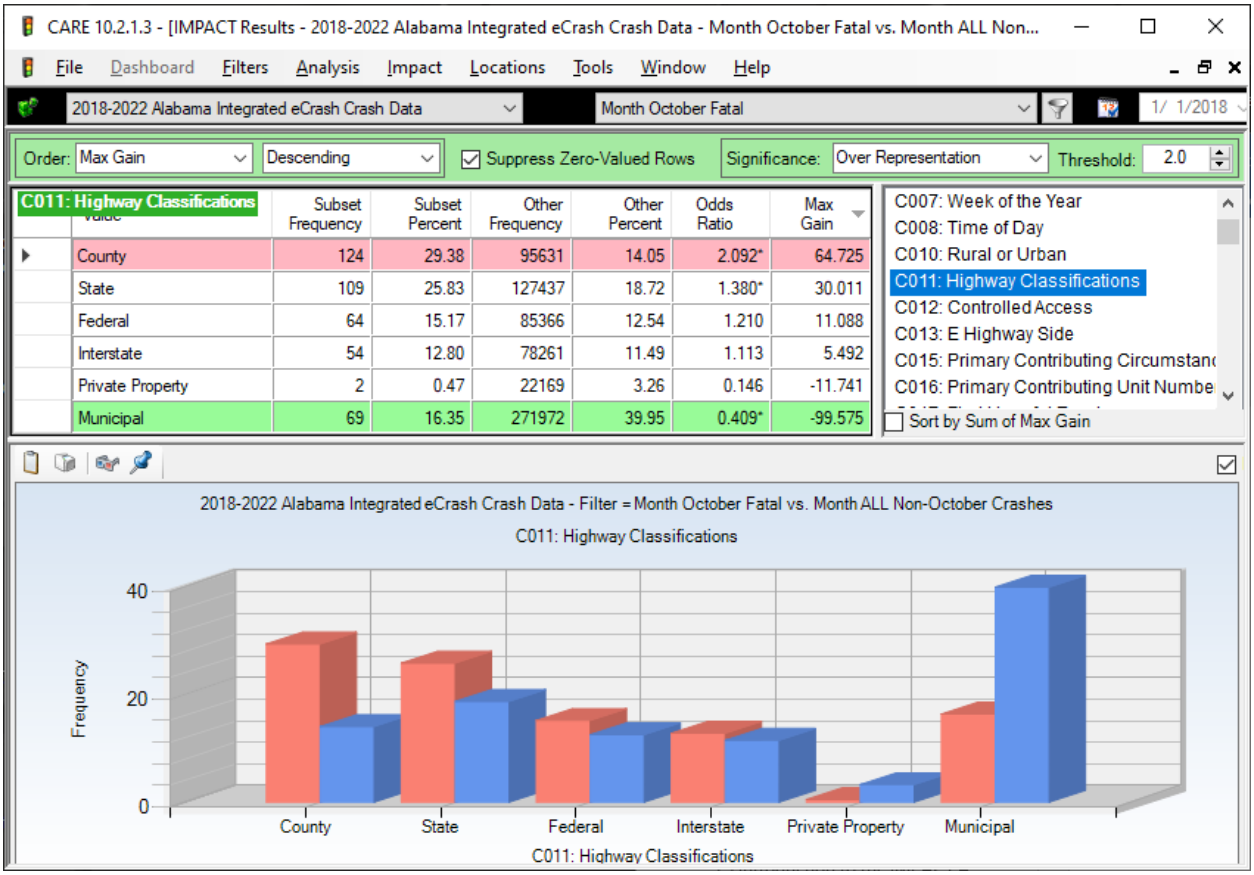
It is obvious in the above outputs that the proportion of FOCs tends to be greatly over-represented in the rural areas. It is interesting to perform a cross-tabulation for all October crashes over the rural and urban areas to determine to what extent their crashes might be resulting in more fatalities than would be expected. The following, *which is for <u>all</u> October crashes*, gives this analysis.



	Fatal Injury	Suspected Serious Injury	Suspected Minor Injury	Possible Injury	Property Damage Only	Unknown	TOTAL
Rural	264	978	1958	1108	11838	454	16600
	62.56%	52.27%	34.21%	18.74%	22.01%	26.09%	23.90%
Urban	158	893	3766	4806	41950	1286	52859
	37.44%	47.73%	65.79%	81.26%	77.99%	73.91%	76.10%
TOTAL	422	1871	5724	5914	53788	1740	69459
	0.61%	2.69%	8.24%	8.51%	77.44%	2.51%	100.00%

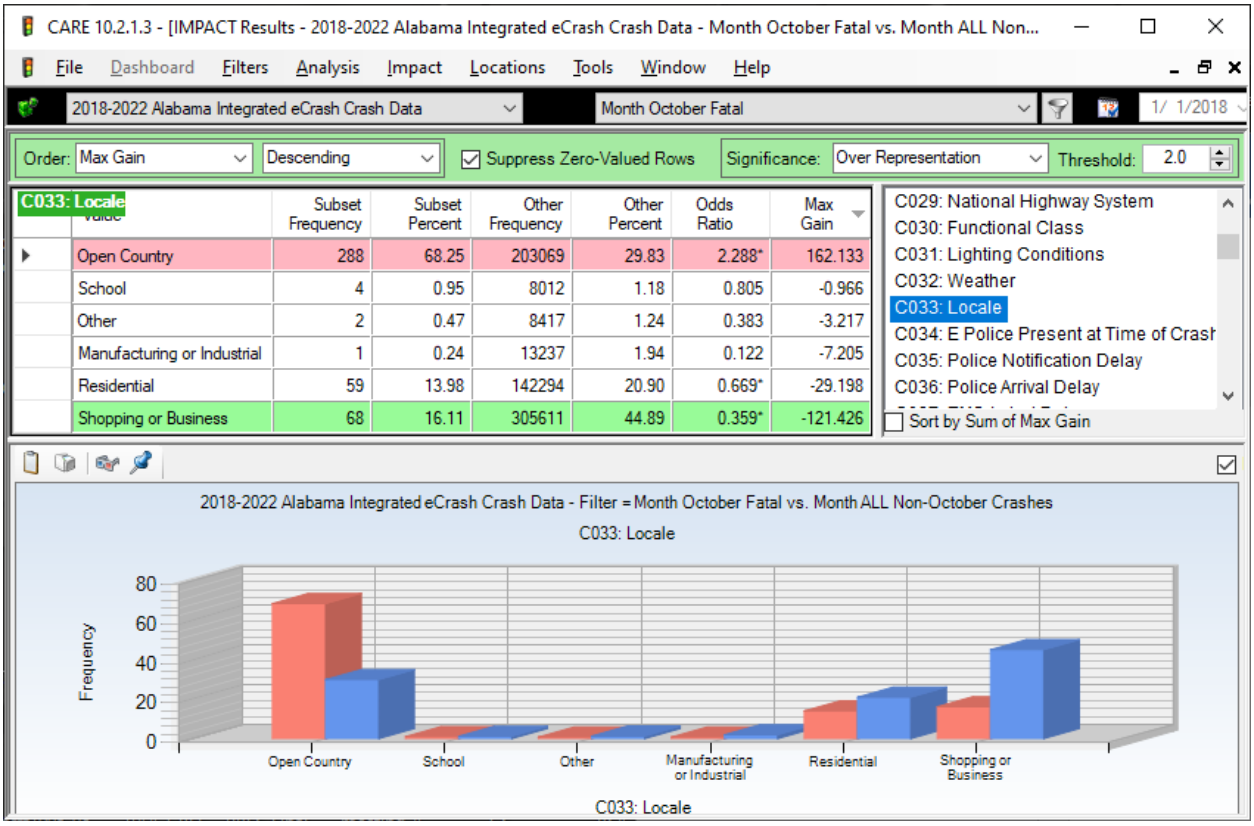
The red-backed cells in the cross-tabulation above indicate over-representation by more than 10%. Those that are over-represented, but by less than 10%, have a yellow background. For example, while 23.90% of all October fatal crashes occurred in rural areas, 62.56% of the FOCs occurred there. It is imperative to take into consideration crash severity when making geographical decisions regarding countermeasure implementation. Clearly, FOCs had their fatalities and highest severity injuries in the rural areas, since all three of the most severe crash types are over-represented.

4.5 C011 Highway Classifications



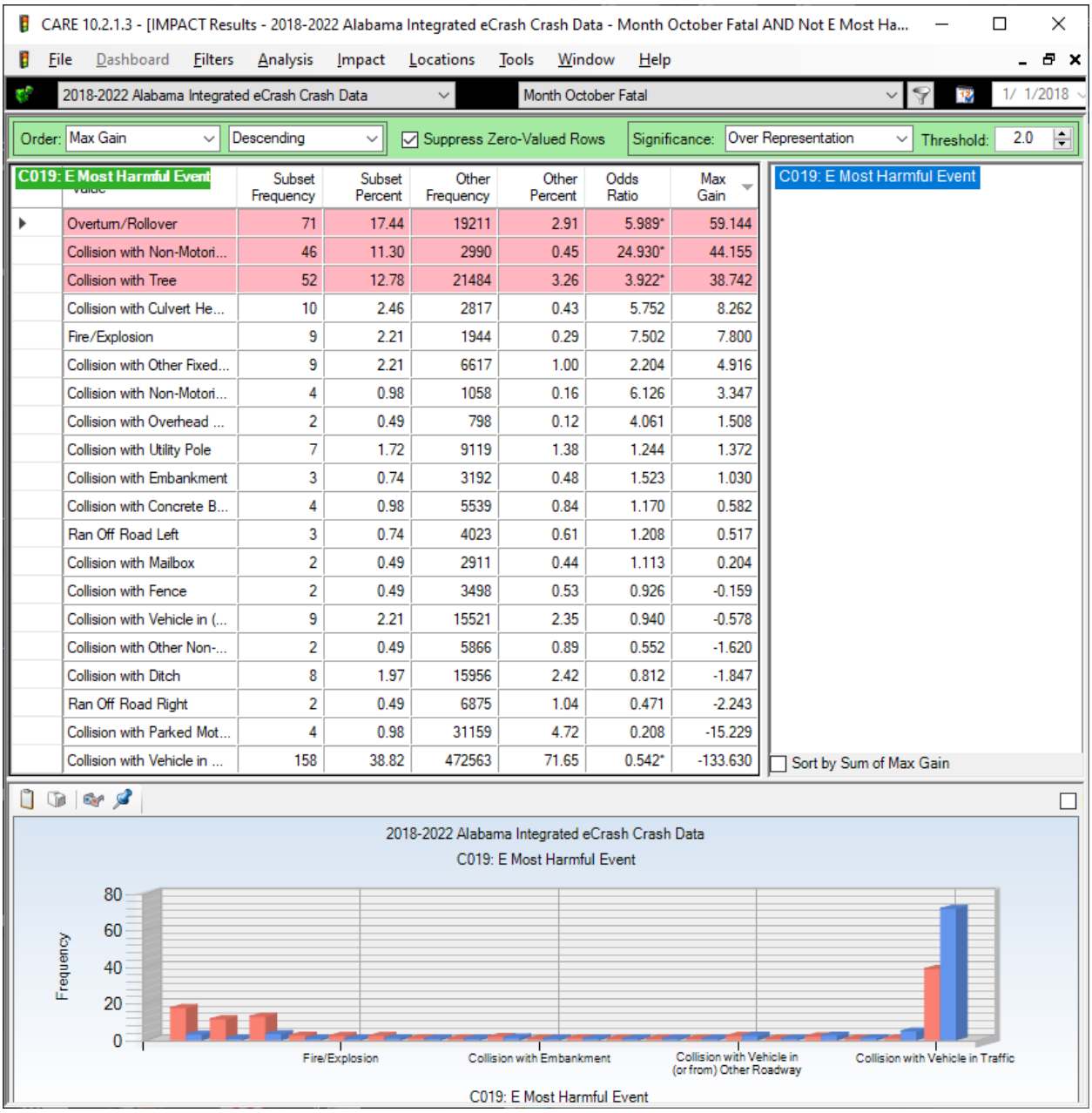
Analysis of highway classifications indicates that FOCs had their greatest over-representation on county roads (2.092, over twice that expected). State routes were also over-represented but by a much smaller degree (1.380). Federal and Interstate roads were also over-represented. It is recommended that hotspot analysis be performed to identify the specific county roads that are most highly over-represented. Law enforcement presence alone could have a large effect here, since a major problem is speed, as will be shown below (Section 6.2).

4.6 C033 Locale



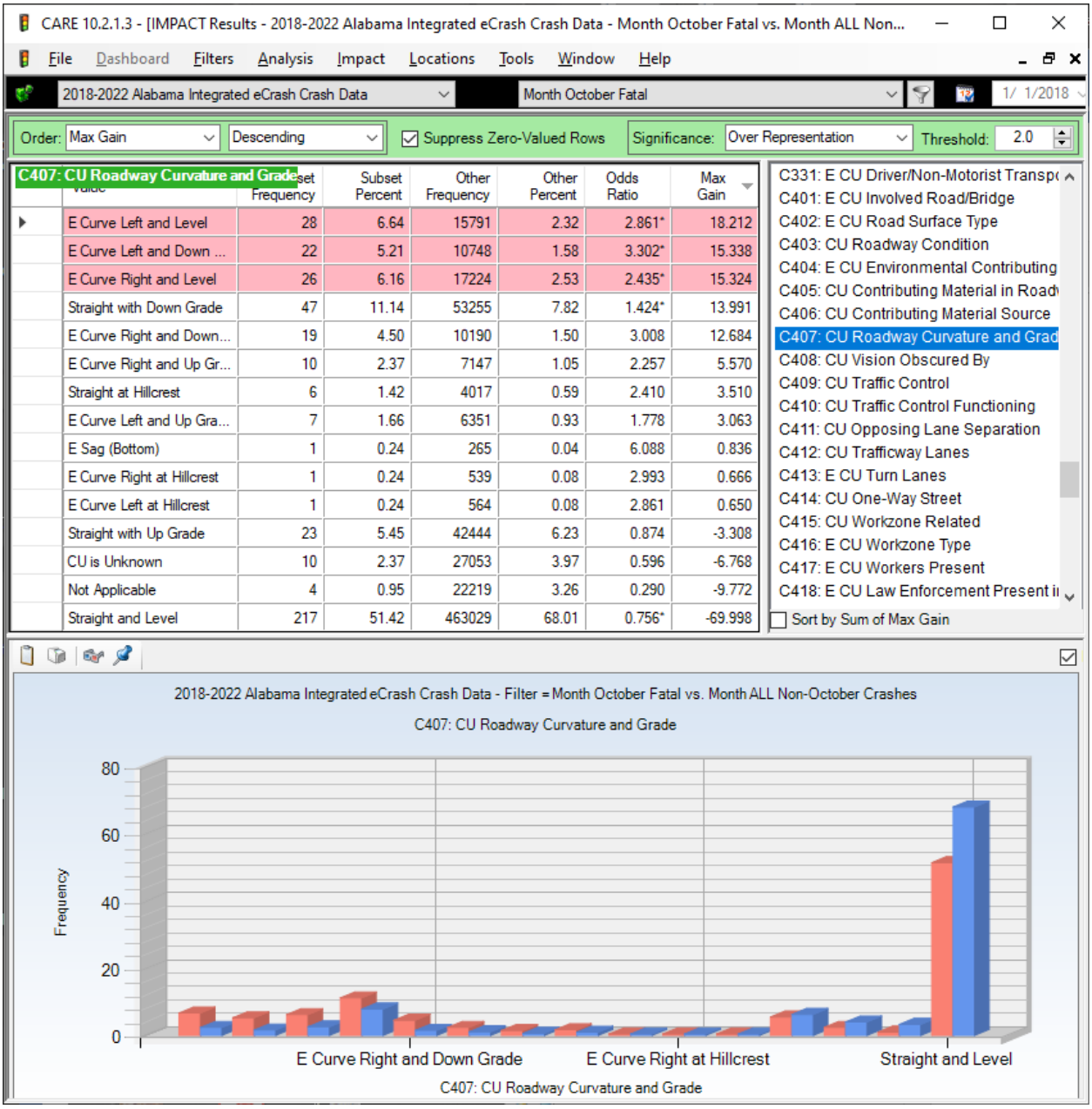
Open Country roadways show the highest level of over-representation in FOCs as compared to the more urbanized locales. This might be more useful than the rural/urban specification, which we found above to be not as definitive. There are considerable "Open Country" areas within the formal city limits of most cities, and this seems to be where a large number of the FOCs are occurring. For example, 288 FOCs occurred in urban areas classified as Open Country, while the urban number for these crashes was 264 (see Section 4.3). The collection of all areas within a city limits is considered to be urban in the urban-rural analysis, as opposed to the presence or absence of buildings.

4.7 C019 Most Harmful Event (>1; MaxGain order for FOCs)



This display is intended to show safety engineers obstacles that are being hit most often in Fatal October crashes (FOCs). This shows that Overturn/Rollovers (71 fatal crashes), Pedestrians (46 fatal crashes) and Trees (52 fatal crashes), all with Max Gains greater than 30.

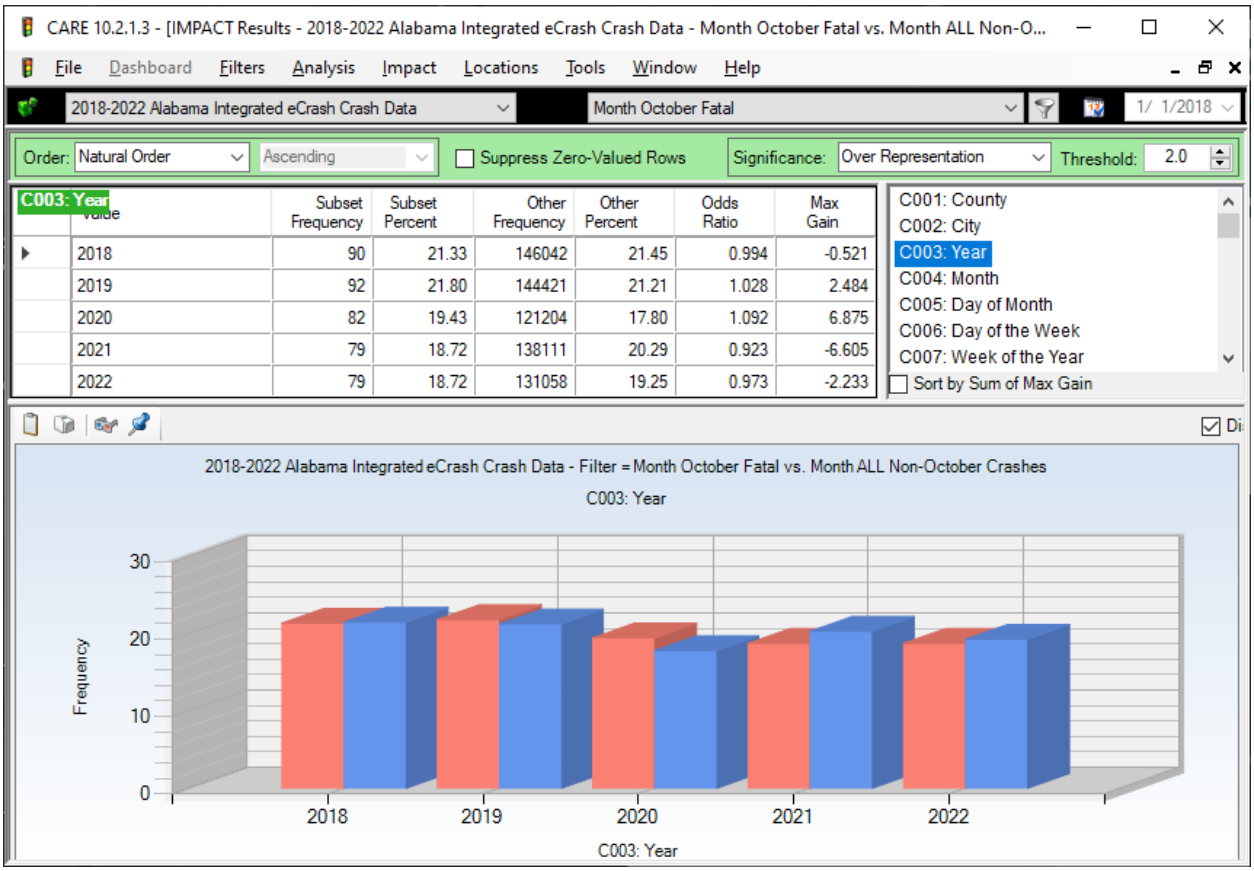
4.8 C407 CU Roadway Curvature and Grade



FOCs are over-represented on most types of curves. The following are highly significant: Curve Left and Level 28, Curve Left and Down Grade 22, and Curve Right and Level 26. Straight with Downgrade also had a very high frequency (47).

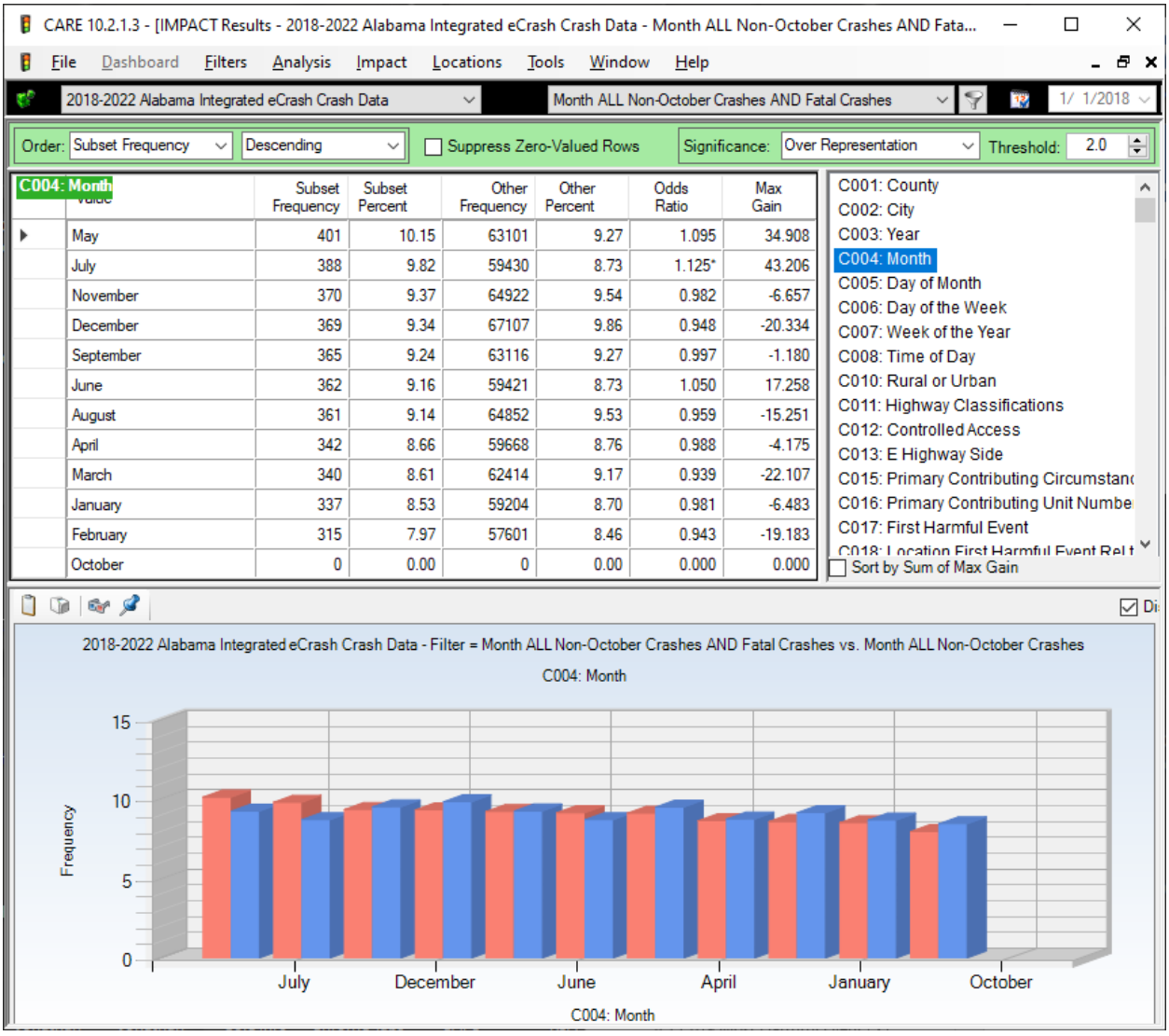
5.0 Time Factors

5.1 C003 Year



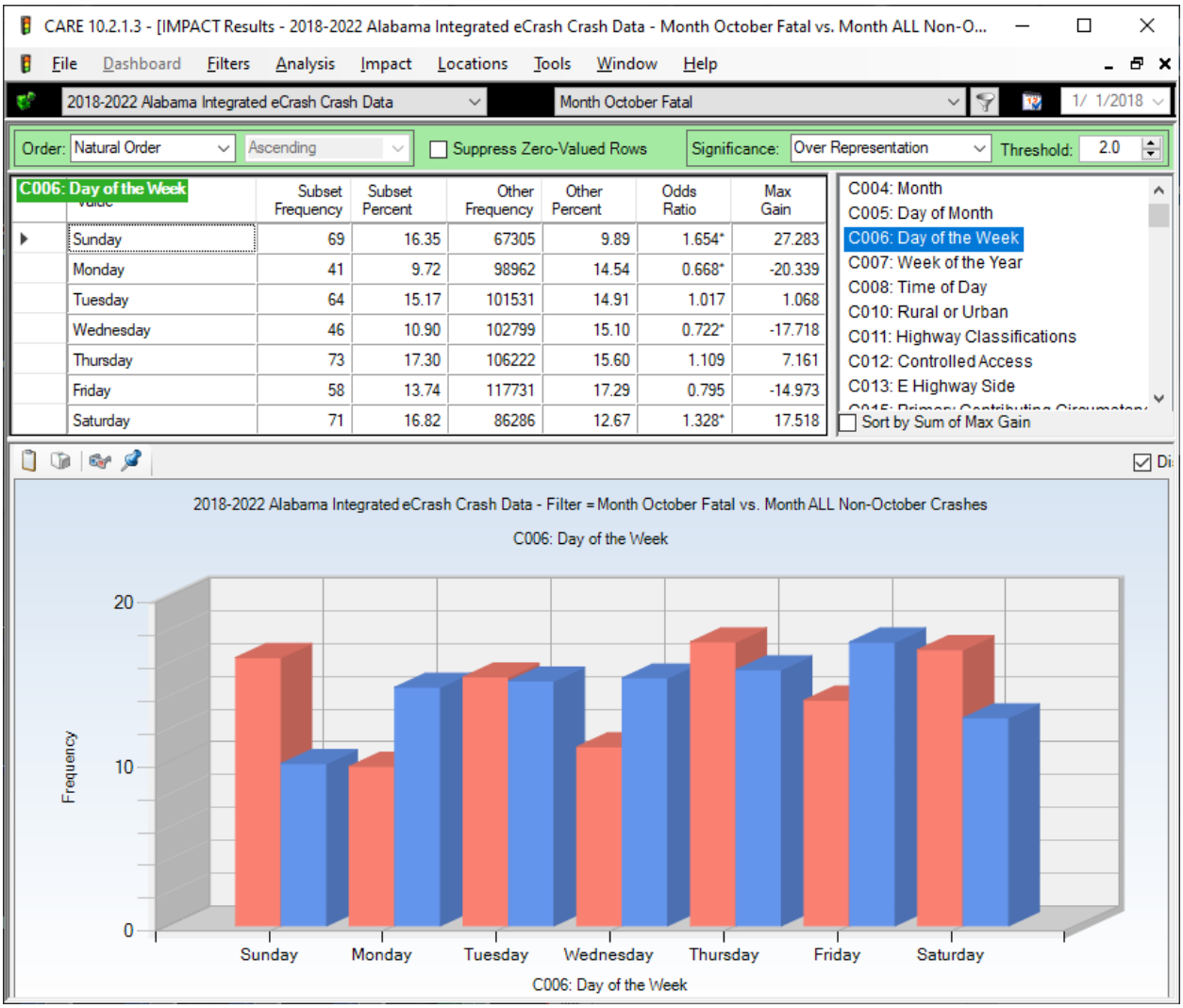
The chart above is useful for tracking the relative changes by directly comparing the number of FOCs to all Non-October Crashes by year. Years 2019 and 2020 had a larger proportion of FOCs than NOCs. The other three, 2018, 2021 and 2022 had lower proportions than expected. There is no apparent trend in any of the October proportions, as indicated by the lack of statistical significance in all of them.

5.2 C004 Fatal Non-October Non-Fatal vs Non-October (ordered by frequency)



The ordering of the displays above is by highest monthly number of fatalities at the top. May has the highest frequency, but its proportion is not significantly higher. July comes second in this ordering, and its proportion is also statistically significant in being larger than the control group (all other crashes during the month). Interesting that May and July, which are the highest on the list are not close to October. However, the next two out of three are right next to October (December is the exception).

5.3 C006 Day of the Week



The above approximates a well-established and recognized pattern for Impaired Driving (ID) crashes, with their concentrations on the weekend periods, and it confirms what was suggested above for the monthly results. A possible conclusion is that ID is a central cause for Fatal crashes in this general time of the year when parties and football are ramping up. See the further discussions below with regard to day of the week, and the involvement of alcohol and other drugs.

Fatal crashes per day in October (2018-2022) = 13.61/day
Fatal crashes per day all months (2018-2022) = 4372/365.25 = 11.97/day
Additional daily fatal crashes in October = 1.64 fatal crashes/day.

5.4 Day of the Week Discussion

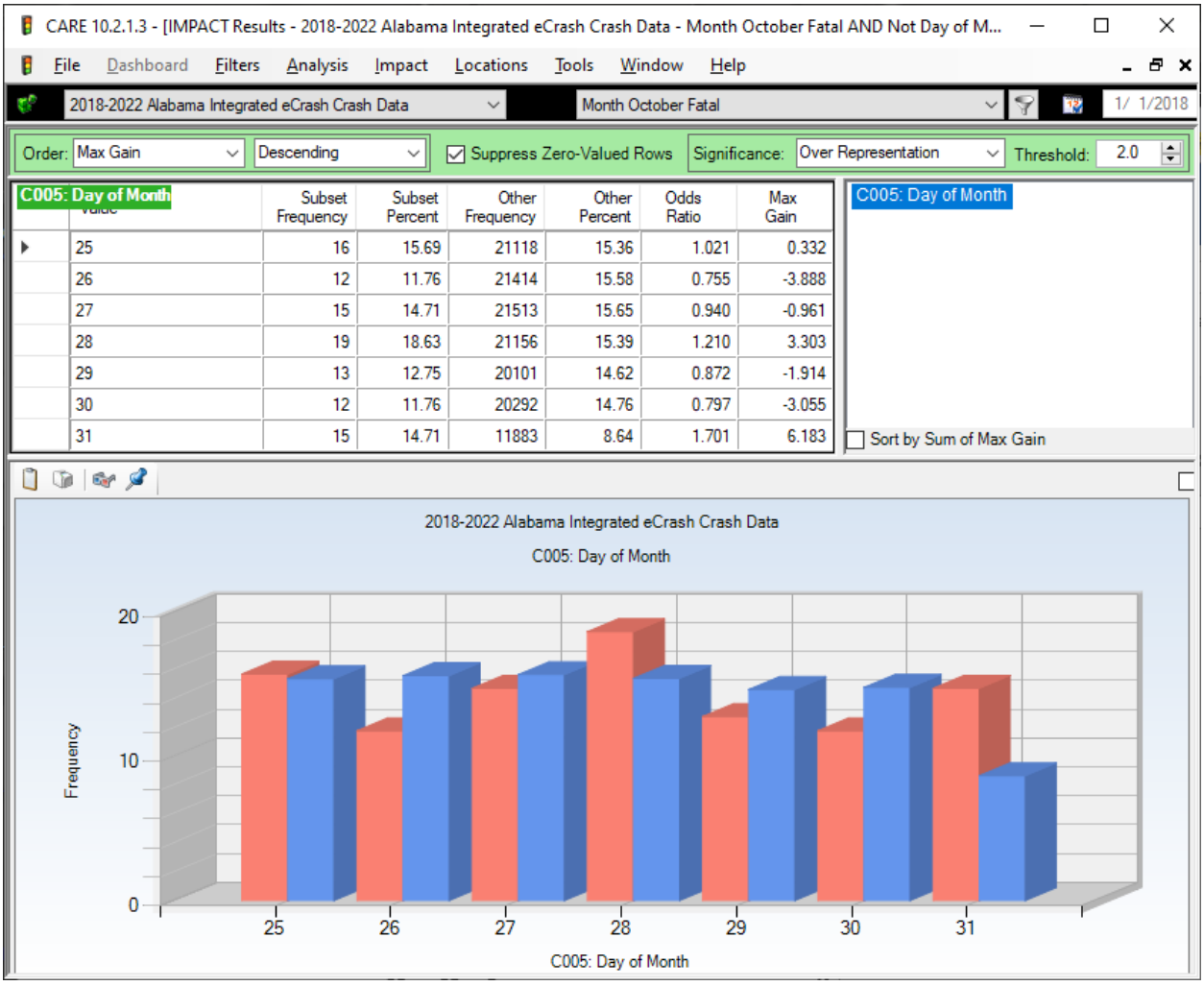
The chart above shows the typical non-holiday week pattern that has been experienced for Impaired Driving (ID) for decades. The days can be classified as follows:

- Weekday (Monday through Thursday) – these days are generally under-represented in October crashes, we surmise due to the need for many work on the days that follow.
- Friday – the day before a weekend (or holiday) before a day off work. The Friday pattern is under-represented in October crashes, not because they do not occur more frequently than weekdays, but because non-October crashes occur to an even greater extent on Fridays. Friday is both "work commuting day" and a "departure for recreation" time, causing increased traffic of combined commuters and vacationers (including short week-end vacations) that also resulting in a hazardous traffic mix. It may be only slightly denser than a typical rush hour, but it is not homogeneous and restricted to commuters as is the case during most weekday rush hours. No doubt much drug use and increased alcohol consumption is also being initiated on Friday afternoons even though.
- Saturday – the "Saturday" pattern is the worse for ID crashes in that it has both an early morning component (like Sunday) and a late (pre-midnight) night component (like Friday). So, it could be viewed as a combination of the typical Friday and Sunday, with one exception: it does not have the increased traffic mix complexity of the Friday afternoon commuters. It is significantly over-represented with a Odds Ratio of 1.328.
- Sunday – this is the last day of a holiday sequence or as given above, the weekend. Its over-representation comes mostly from those who start on Saturday night and do not complete their use of alcohol/drugs until after midnight. Its over-representation, at 1.654 is higher than that of Saturday. However, traffic in general is lighter on Sundays, which would lead to a higher over-representation if alcohol/drugs were involved.

Holidays. A holiday "weekend," such as Thanksgiving, can be viewed as a sequence of a Friday-, Saturdays- and Sunday-pattern sequence. The Wednesday before Thanksgiving would follow the Friday pattern assuming that most are at work that Wednesday. The Thursday, Friday and Saturday would follow the Saturday pattern, and the Sunday would follow the typical Sunday pattern. Holidays that fall mid-week could also be so mapped. This is the reason that long holiday events (i.e., several days off from work) can be much more prone to ID crashes than the normal weekend. There could be a cumulative effect that could show up at any time of the day for some problem abusers. Recently the trend on the pre-Thanksgiving week has been for the holiday to start earlier and earlier in the week, so that Wednesday itself is not one of the worse crash days of the year, as it had been a decade or more ago. This if favorable in reducing the concentration of the traffic and the resultant conflicts.

While the discussion above concentrates on Impaired Driving (aka DUI), it relates to October crashes in that, as the evidence indicates, a large proportion of October crashes turn out to be multiple-vehicle ID crashes.

5.4a C005 Day of the Month (for Haloween week = last week of October)



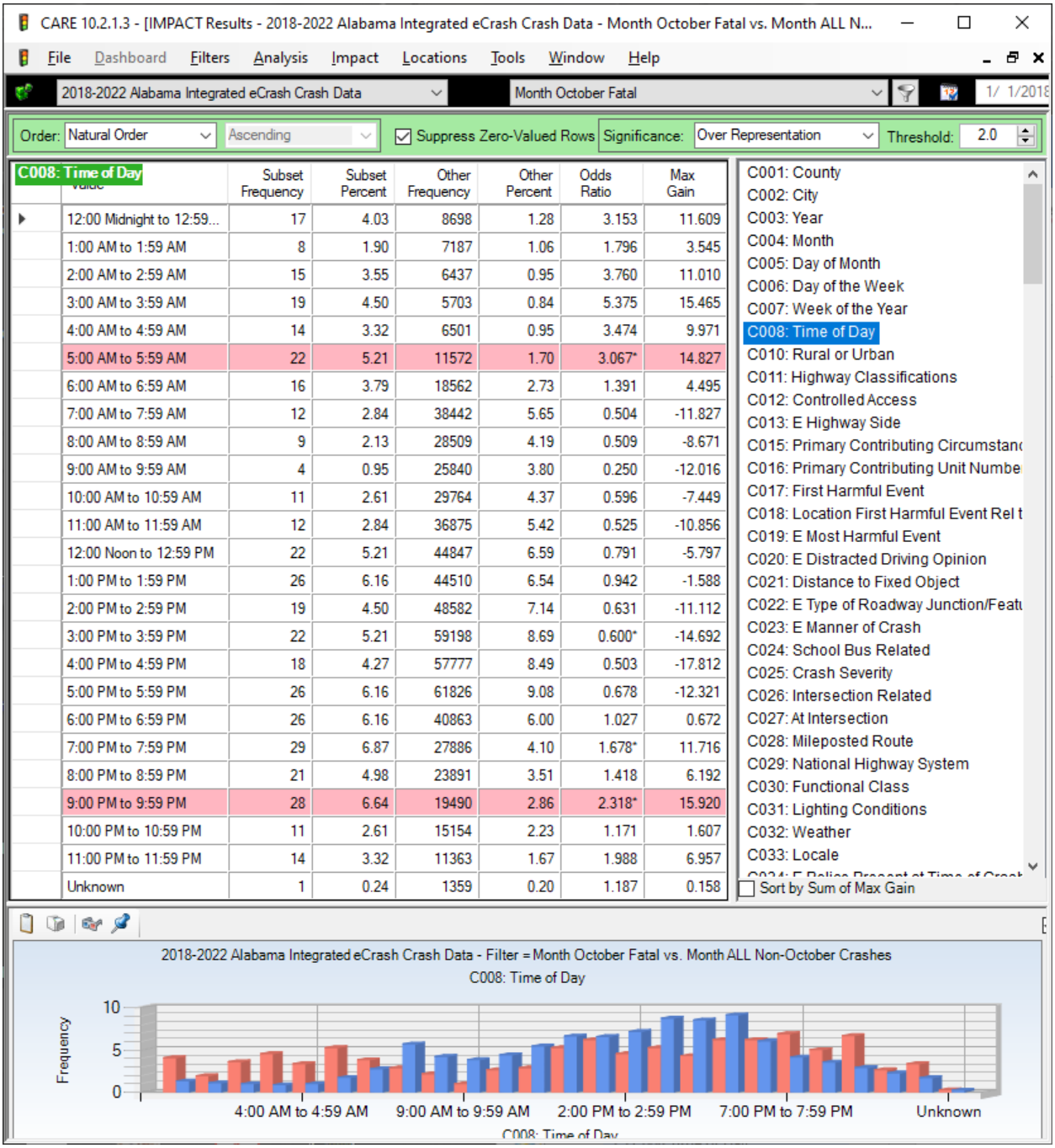
The red bars are fatalities in October; the blue bars are all crashes not in October.
Day of the week for these days:
25 Wednesday
26 Thursday
27 Friday
28 Saturday. Saturdays are typically over-represented.
29 Sunday
30 Monday
31 Tuesday Halloween. Other than the events and practices of the Halloween holiday itself, we see no reason that this day should be over-represented. Please see the next section,

5.4b Haloween

See the following NHTSA study on issues related to Halloween:

https://www.trafficsafetymarketing.gov/get-materials/drunk-driving/buzzed-driving-drunk-driving/halloween

5.5 C008 Time of Day



The morning and afternoon rush hours are under-represented, while the late evening and all-night hours are consistently over-represented, generally following the Impaired Driving (ID) pattern.

5.6 C008 Discussion on Time of Day

It is no surprise to find Fatal October Crashes (FOCs) over-represented during the late night/early morning hours, since their other correlations with aspects of Impaired Driving (ID) are clear. The following narrative was developed with regard to a special study that was done for ID. We include it here because of its relevance to October crashes.

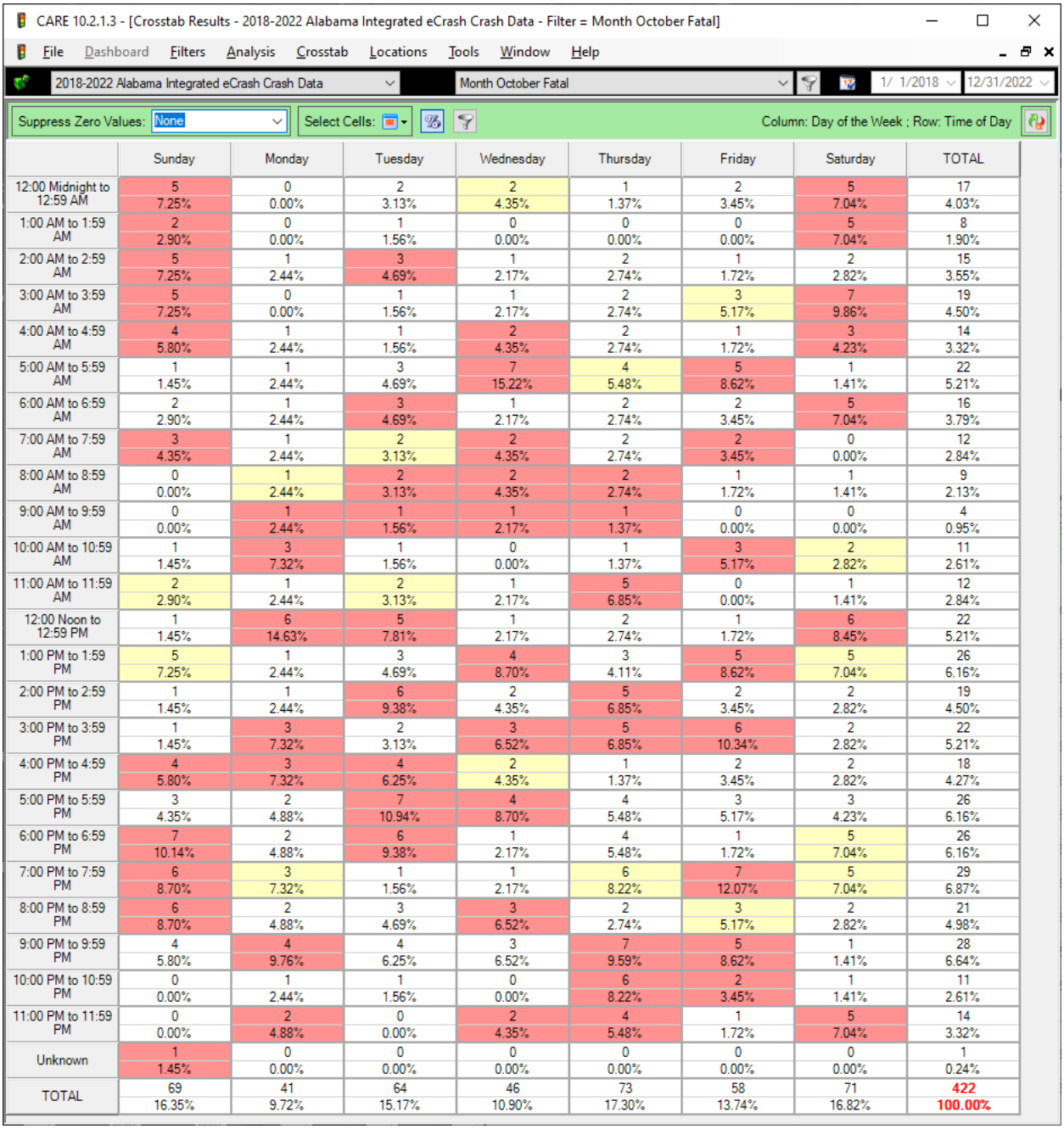
The extent of these time over-representations is quite amazing. Typical traffic patterns of high traffic results on more crashes in the morning and afternoon rush hours. IDs, and thus the IDs that occurs in October, are just getting started in the afternoon rush hours and they continue to grow through midnight and the early morning hours, not tapering off until about 7:00 AM. It is clear that if selective enforcement is going to have an effect on October crashes, it would have to be conducted at the times when these crashes are most occurring. Optimal times for Friday enforcement would start immediately following any rush hour details, and would continue through at least 3:00 AM.

The *Time of Day by Day of the Week* cross-tabulation (given in the next section for FOCs only) shows the optimal times for selective enforcement. Generally, the highest proportion of times in any day are given in red for that day. This works well for Saturday and Sunday mornings, but not too well for Friday night. The reason is that proportions on Saturday night, eclipses the Friday numbers, even though they were higher than any other day except Sunday.

This is an excellent example to demonstrate how the color coding of CARE cross-tabulations can be misleading in some special cases. The red background indicates that the over-representation of the cell is greater than expected. The expected proportion for all cells in a given row is given at the extreme right in the total row percentage for that row. If there were absolutely no over-representations across the columns, then all of the proportions for those cells would be identical to the one for the total. Notice for example, the 7 AM to 7:59 AM row has a total percentage value of 2.84% for FOCs. Those that are lower than this value have a neutral (white) background. Those that are higher, but not more than 10% of the proportion are yellow; and those above 10% more than that expected from the total (right column) are red.

One of the problems in the October analysis that was also found in the tree analysis is that the number of fatal crashes tend to be insufficient to adequately represent the times of day and days of the week. However, recognizing this problem, we can still use the data that are there productively.

5.7 C008 Time of Day x C005 Day of the Week



CARE 10.2.1.3 - [Crosstab Results - 2018-2022 Alabama Integrated eCrash Crash Data - Filter = Month October Fatal]

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

2018-2022 Alabama Integrated eCrash Crash Data | Month October Fatal | 1/ 1/2018 | 12/31/2022

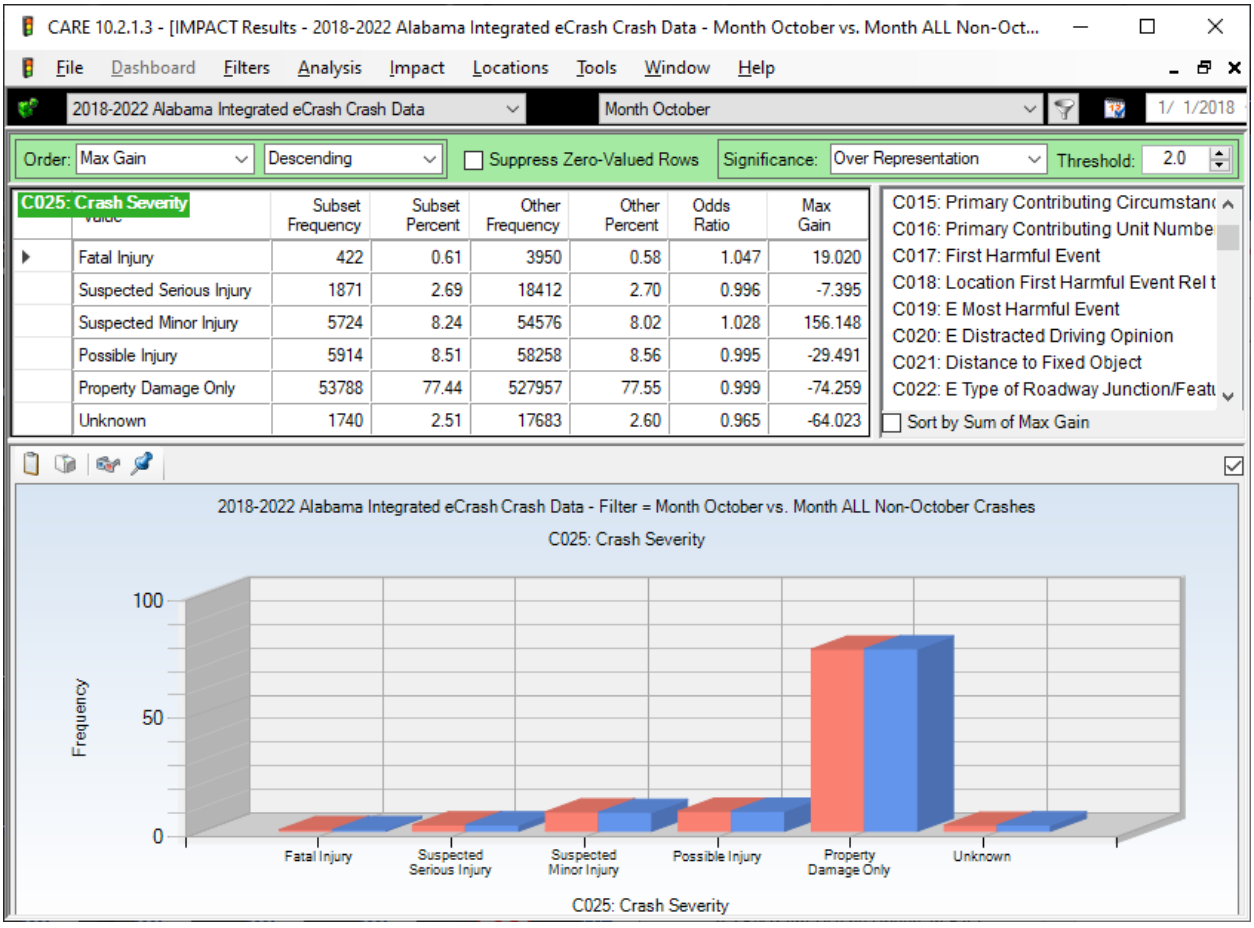
Suppress Zero Values: None | Select Cells: | Column: Day of the Week ; Row: Time of Day

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	TOTAL
12:00 Midnight to 12:59 AM	5 7.25%	0 0.00%	2 3.13%	2 4.35%	1 1.37%	2 3.45%	5 7.04%	17 4.03%
1:00 AM to 1:59 AM	2 2.90%	0 0.00%	1 1.56%	0 0.00%	0 0.00%	0 0.00%	5 7.04%	8 1.90%
2:00 AM to 2:59 AM	5 7.25%	1 2.44%	3 4.69%	1 2.17%	2 2.74%	1 1.72%	2 2.82%	15 3.55%
3:00 AM to 3:59 AM	5 7.25%	0 0.00%	1 1.56%	1 2.17%	2 2.74%	3 5.17%	7 9.86%	19 4.50%
4:00 AM to 4:59 AM	4 5.80%	1 2.44%	1 1.56%	2 4.35%	2 2.74%	1 1.72%	3 4.23%	14 3.32%
5:00 AM to 5:59 AM	1 1.45%	1 2.44%	3 4.69%	7 15.22%	4 5.48%	5 8.62%	1 1.41%	22 5.21%
6:00 AM to 6:59 AM	2 2.90%	1 2.44%	3 4.69%	1 2.17%	2 2.74%	2 3.45%	5 7.04%	16 3.79%
7:00 AM to 7:59 AM	3 4.35%	1 2.44%	2 3.13%	2 4.35%	2 2.74%	2 3.45%	0 0.00%	12 2.84%
8:00 AM to 8:59 AM	0 0.00%	1 2.44%	2 3.13%	2 4.35%	2 2.74%	1 1.72%	1 1.41%	9 2.13%
9:00 AM to 9:59 AM	0 0.00%	1 2.44%	1 1.56%	1 2.17%	1 1.37%	0 0.00%	0 0.00%	4 0.95%
10:00 AM to 10:59 AM	1 1.45%	3 7.32%	1 1.56%	0 0.00%	1 1.37%	3 5.17%	2 2.82%	11 2.61%
11:00 AM to 11:59 AM	2 2.90%	1 2.44%	2 3.13%	1 2.17%	5 6.85%	0 0.00%	1 1.41%	12 2.84%
12:00 Noon to 12:59 PM	1 1.45%	6 14.63%	5 7.81%	1 2.17%	2 2.74%	1 1.72%	6 8.45%	22 5.21%
1:00 PM to 1:59 PM	5 7.25%	1 2.44%	3 4.69%	4 8.70%	3 4.11%	5 8.62%	5 7.04%	26 6.16%
2:00 PM to 2:59 PM	1 1.45%	1 2.44%	6 9.38%	2 4.35%	5 6.85%	2 3.45%	2 2.82%	19 4.50%
3:00 PM to 3:59 PM	1 1.45%	3 7.32%	2 3.13%	3 6.52%	5 6.85%	6 10.34%	2 2.82%	22 5.21%
4:00 PM to 4:59 PM	4 5.80%	3 7.32%	4 6.25%	2 4.35%	1 1.37%	2 3.45%	2 2.82%	18 4.27%
5:00 PM to 5:59 PM	3 4.35%	2 4.88%	7 10.94%	4 8.70%	4 5.48%	3 5.17%	3 4.23%	26 6.16%
6:00 PM to 6:59 PM	7 10.14%	2 4.88%	6 9.38%	1 2.17%	4 5.48%	1 1.72%	5 7.04%	26 6.16%
7:00 PM to 7:59 PM	6 8.70%	3 7.32%	1 1.56%	1 2.17%	6 8.22%	7 12.07%	5 7.04%	29 6.87%
8:00 PM to 8:59 PM	6 8.70%	2 4.88%	3 4.69%	3 6.52%	2 2.74%	3 5.17%	2 2.82%	21 4.98%
9:00 PM to 9:59 PM	4 5.80%	4 9.76%	4 6.25%	3 6.52%	7 9.59%	5 8.62%	1 1.41%	28 6.64%
10:00 PM to 10:59 PM	0 0.00%	1 2.44%	1 1.56%	0 0.00%	6 8.22%	2 3.45%	1 1.41%	11 2.61%
11:00 PM to 11:59 PM	0 0.00%	2 4.88%	0 0.00%	2 4.35%	4 5.48%	1 1.72%	5 7.04%	14 3.32%
Unknown	1 1.45%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	1 0.24%
TOTAL	69 16.35%	41 9.72%	64 15.17%	46 10.90%	73 17.30%	58 13.74%	71 16.82%	422 100.00%

6.0 Factors Affecting Severity

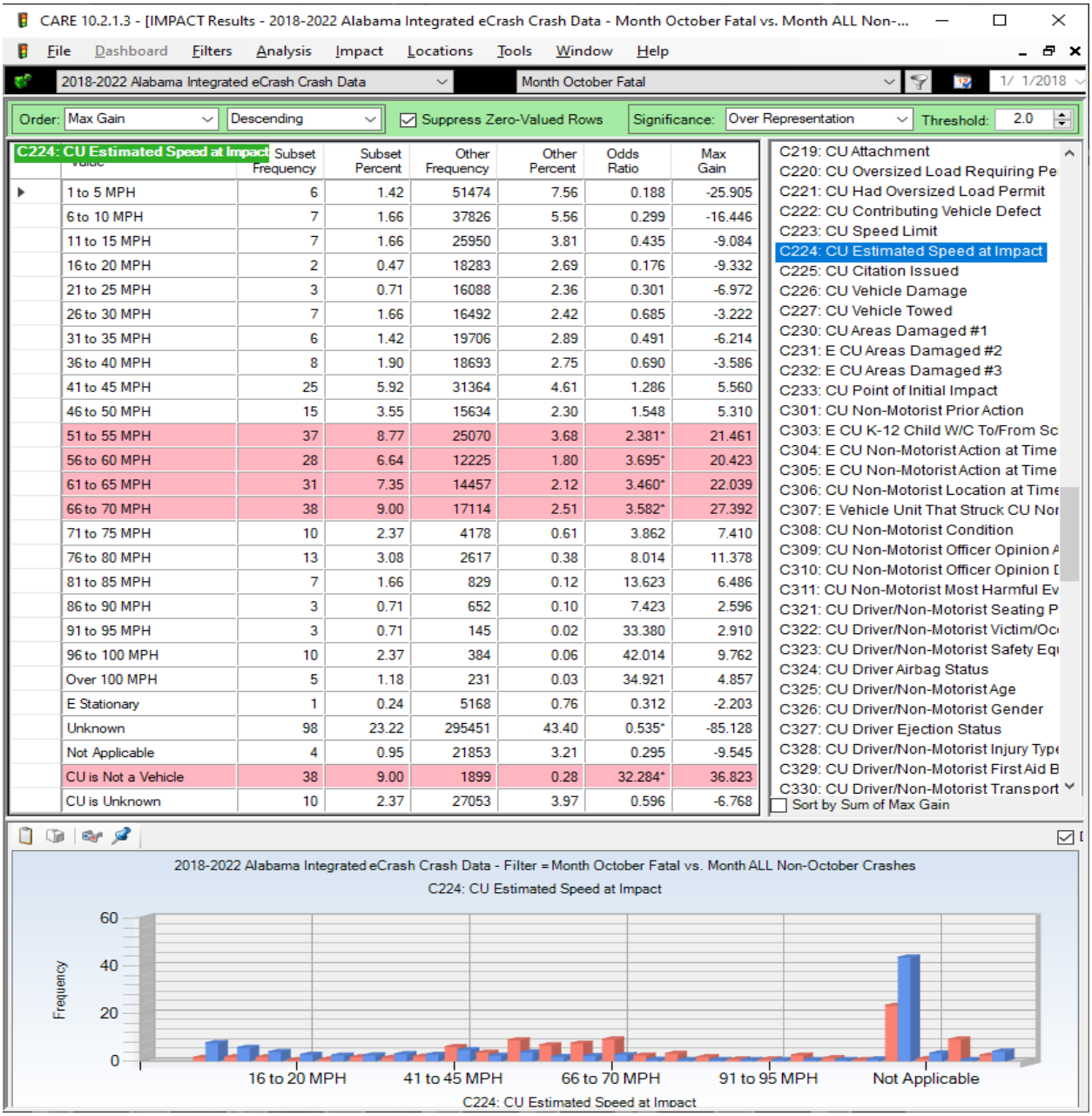
6.1 C025 October Crash Severity (All October vs. All Non-October)

The following IMPACT display compares crash severities for October (Subset, red bars) vs. Non-October crashes (Other, blue bars below table). *Note that this is different from most of the IMPACT displays that compare Fatal October Crashes (FOCs) with all non-October crashes.*



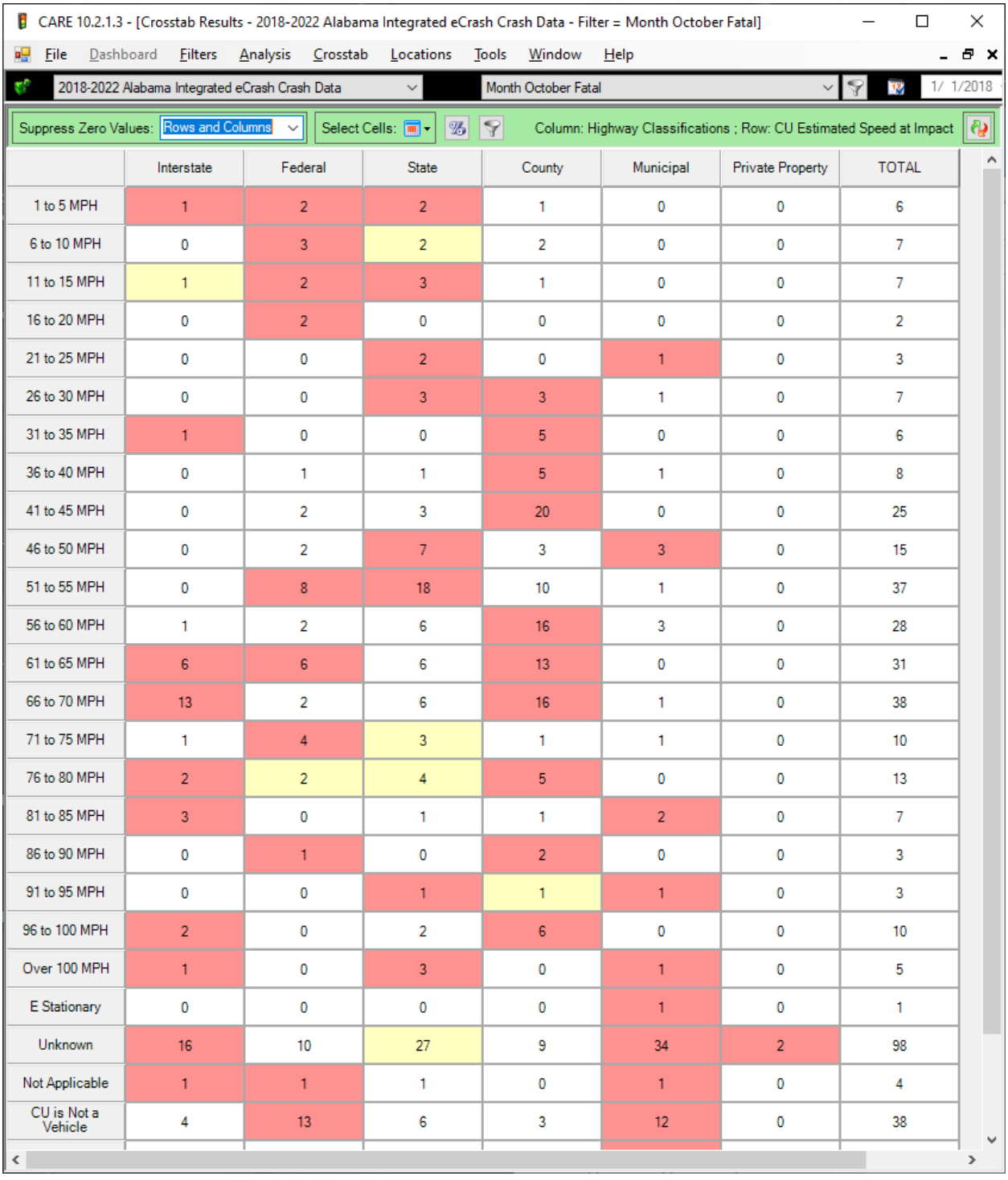
The rate of fatal injury crashes is close to 5% (1.047 Odds Ratio) higher for the Fatal Injury classification, but other than that, the Odds Ratios show little differences for the various severities. Essentially this is saying that: with the exception of fatalities, the October severity proportions are not significantly different from those of the other months. See Section 3.2 for the overall statistics that indicate the reason that October was chosen for this study, which mainly had to do with the relatively high number of fatal crashes during October.

6.2 C224 Speed at Impact (back to the FOC vs Non-October comparison)



The comparison above is fatal October crashes against all Non-October Crashes (some of which are fatal). It should be noted that the speed limit on County roads is generally 45 MPH, and it is generally lower on Municipal roads. For the Fatal October Crashes (FOCs), all impact speeds above 40 MPH are over-represented, with the 51 to 70 being highly significant. This trend continues as the probabilities of fatal injury generally to rise with impact speeds.

6.3 Highway Classification (C011) by Speed at Impact (C224) Cross-Tabulation



CARE 10.2.1.3 - [Crosstab Results - 2018-2022 Alabama Integrated eCrash Crash Data - Filter = Month October Fatal]

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

2018-2022 Alabama Integrated eCrash Crash Data | Month October Fatal | 1/ 1/2018

Suppress Zero Values: Rows and Columns | Select Cells: | Column: Highway Classifications ; Row: CU Estimated Speed at Impact

	Interstate	Federal	State	County	Municipal	Private Property	TOTAL
1 to 5 MPH	1	2	2	1	0	0	6
6 to 10 MPH	0	3	2	2	0	0	7
11 to 15 MPH	1	2	3	1	0	0	7
16 to 20 MPH	0	2	0	0	0	0	2
21 to 25 MPH	0	0	2	0	1	0	3
26 to 30 MPH	0	0	3	3	1	0	7
31 to 35 MPH	1	0	0	5	0	0	6
36 to 40 MPH	0	1	1	5	1	0	8
41 to 45 MPH	0	2	3	20	0	0	25
46 to 50 MPH	0	2	7	3	3	0	15
51 to 55 MPH	0	8	18	10	1	0	37
56 to 60 MPH	1	2	6	16	3	0	28
61 to 65 MPH	6	6	6	13	0	0	31
66 to 70 MPH	13	2	6	16	1	0	38
71 to 75 MPH	1	4	3	1	1	0	10
76 to 80 MPH	2	2	4	5	0	0	13
81 to 85 MPH	3	0	1	1	2	0	7
86 to 90 MPH	0	1	0	2	0	0	3
91 to 95 MPH	0	0	1	1	1	0	3
96 to 100 MPH	2	0	2	6	0	0	10
Over 100 MPH	1	0	3	0	1	0	5
E Stationary	0	0	0	0	1	0	1
Unknown	16	10	27	9	34	2	98
Not Applicable	1	1	1	0	1	0	4
CU is Not a Vehicle	4	13	6	3	12	0	38

6.4 Dicussion: C025 Probability of being killed x C224 Speed at Impact

The display above presents information on the effect of increased impact speed on the severity of October crashes. Notice the red in the Fatality and Serious Injury cells as speeds increase. What is more enlightening is the probability that the crash results in a fatality as a function of impact speed. This is given in the following table:

Speed at Impact	Fatality Odds (1 in …)	Increase Probability above 31-35
31-35	2118/6 = 353.0	1 in 353.0 = 1.0
36-45	5194/33 = 157.4	1 in 353/157.4= 2.2
46-55	4045/52 = 77.8	1 in 353/77.8= 4.5
56-65	2581/59 = 43.7	1 in 353/43.7= 8.1
66-75	2056/48 = 42.8	353/42.8 = 8.2
76-85	309/20 = 15.4	353/15.4 = 22.8
86-95	57/6 = 9.5	353/9.5 = 37.2
Above 95	49/15 = 3.3	353/3.3= 108.0

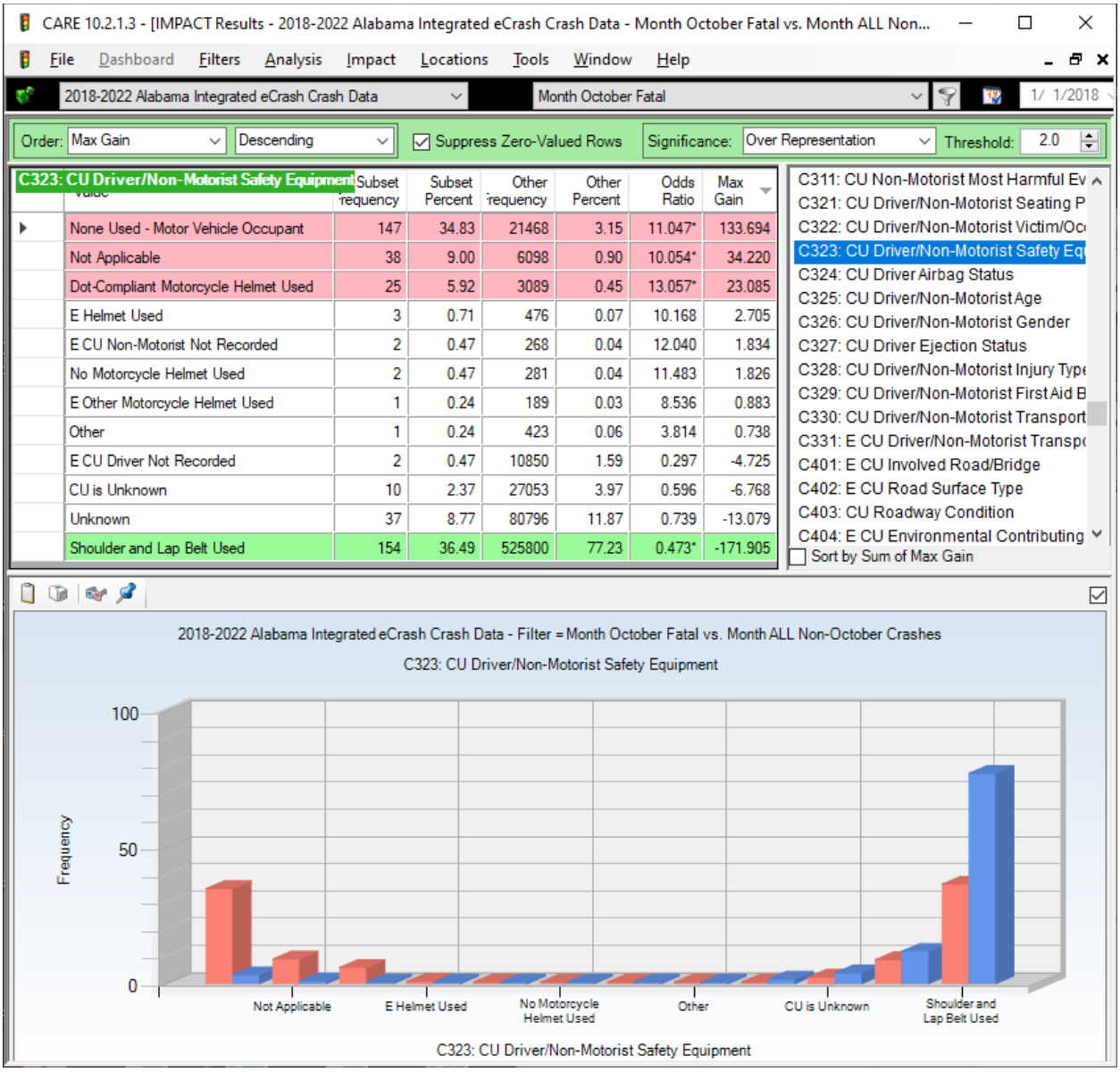
The last column gives the fatality probability multiplier based on the lowest probability (31-35 MPH), to which was assigned a relative value of 1.0 (not a probability). The probabilities in the form of 1 in X are given in the middle column. For example, the probability of a crash at 46-55 MPH being fatal is one in 77.8 crashes at this speed. In the extreme case of crashes Above 95 MPH, the chances of being killed are one in 3.3. The final column transforms the second column into a multiplier of the 31-35 MPH probability. For the examples that we gave, the 46-45 MPH probability is 4.5 times that of the 31-35 MPH probability, and the "Above 95" is 108.0 times that of the 31-35 MPH probability.

Obviously, speed kills, and a reduction in speed at impact by as little as 5 MPH can have a major effect on whether or not that crash is fatal. A reduction in impact speeds by 10 MPH would cut the number of fatal crashes in half. This is one reason that selective enforcement is effective – even officer presence generally causes some speed reduction.

However, there is another major factor in effect here as well – the failure of FOC drivers to be properly restrained, which will be covered in the next separate attribute below (6.5; Restraint Use by Causal Drivers in October Crashes), which is also correlated with Impaired Driving because Impaired Drivers have a much lower restraint use than those not impaired.

6.5 C323 Restraint Use by Drivers in Fatal October Collisions

The following display presents a comparison of FOC driver safety belt use compared to all other crashes, over the same five-year time period.



Fatal risk-taking involved in most of the October crashes does not stop with excess speed; it extends to being not properly restrained. The above analysis demonstrates that a Fatal October crash has a probability of death that increases by a factor of 23.4 when restraints are not used. The next analysis also demonstrates how this contributes to crashes becoming fatal.

6.6 Crosstabulation: C025 Crash Severity x C323 Restraint Use

CARE 10.2.1.3 - [Crosstab Results - 2018-2022 Alabama Integrated eCrash Crash Data - Filter = Month October]

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

2018-2022 Alabama Integrated eCrash Crash Data | Month October | 1/ 1/2018

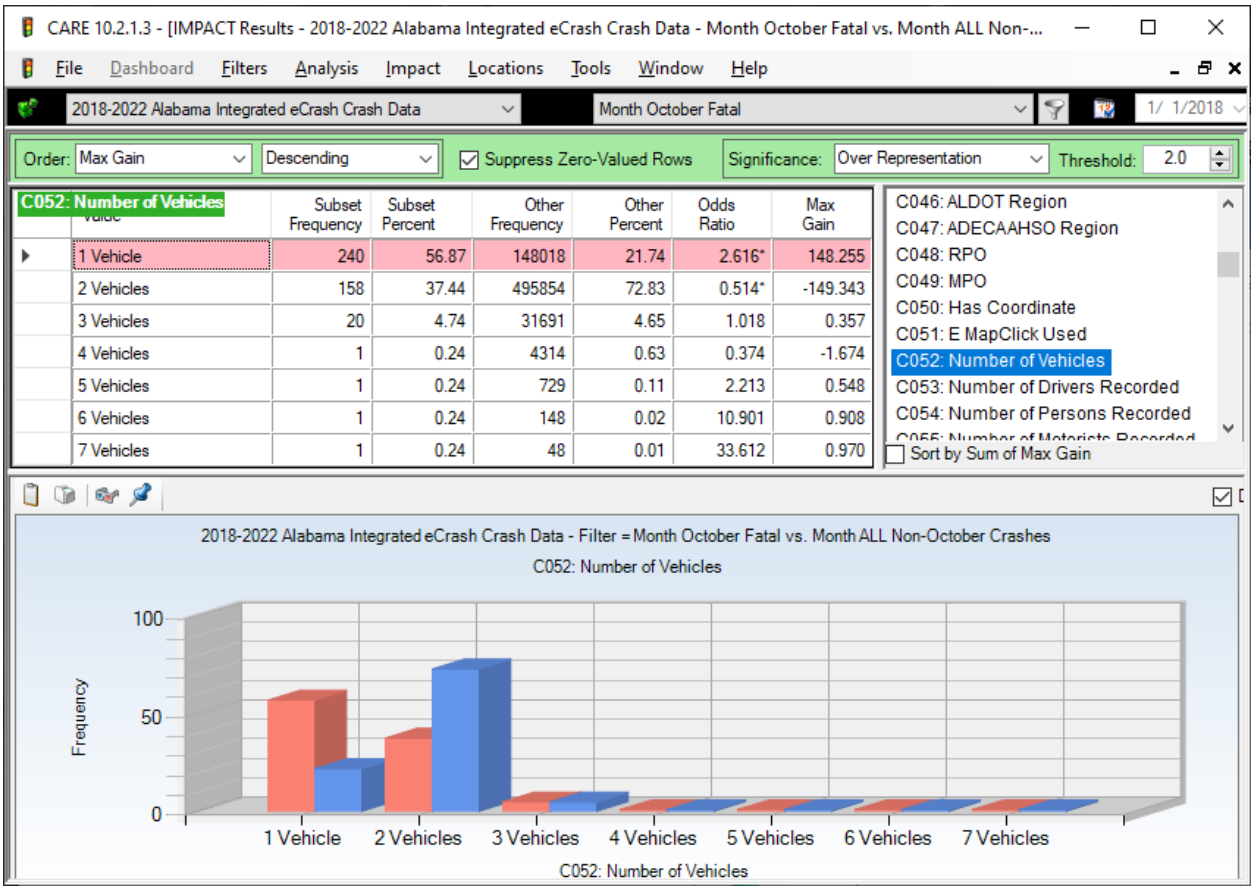
Suppress Zero Values: Rows and Columns | Select Cells: | Column: Crash Severity ; Row: CU Driver/Non-Motorist Safety Equipment

	Fatal Injury	Suspected Serious Injury	Suspected Minor Injury	Possible Injury	Property Damage Only	Unknown	TOTAL
None Used - Motor Vehicle Oc	147	391	471	212	750	46	2017
Shoulder and Lap Belt Used	154	1085	4253	4800	42703	1025	54020
Lap Belt Only Used	0	5	13	14	146	10	188
Shoulder Belt Only Used	0	3	18	17	173	17	228
E Forward Facing Child Safety Seat	0	0	0	0	4	0	4
E Rear Facing Child Safety Seat	0	0	0	2	1	1	4
E Forward Facing Child Safety Seat	0	0	0	0	1	0	1
E Unknown Child Restraint Type	0	0	0	0	0	1	1
E Child in Arms of Restrained Adult	0	0	0	0	2	0	2
Dot-Compliant Motorcycle Helme	25	84	125	35	73	6	348
E Helmet Used	3	8	10	1	13	2	37
E Protective Pads Used (Elbows/Kn	0	1	0	0	0	0	1
Reflective Clothing (Jacket/B	0	0	1	0	0	0	1
E Lighting Used by Non-Motorist	0	2	0	0	1	0	3
E Other Safety Equipment Used	0	0	2	0	0	0	2
E Other Motorcycle Helme	1	9	6	1	4	2	23
No Motorcycle Helmet Used	2	14	7	**2**	3	1	29
Other	1	0	3	2	28	4	38
Unknown	37	143	480	476	6459	381	7976
Not Applicable	38	69	103	50	329	32	621
CU is Unknown	10	43	196	248	2255	117	2869
E CU Driver Not Recorded	2	11	26	46	835	94	1014
E CU Non-Motorist Not Reco	2	3	10	8	8	1	32
TOTAL	422	1871	5724	5914	53788	1740	**69459**

Odds of death not using restraints = 2017/crashes/147 deaths = one in 13.7 crashes.
Odds of death using restraints = 54,020 crashes/154 deaths = one in 350.8 crashes.
Risk of death is approximately increased by a factor of 25.6 when not using proper restraints.

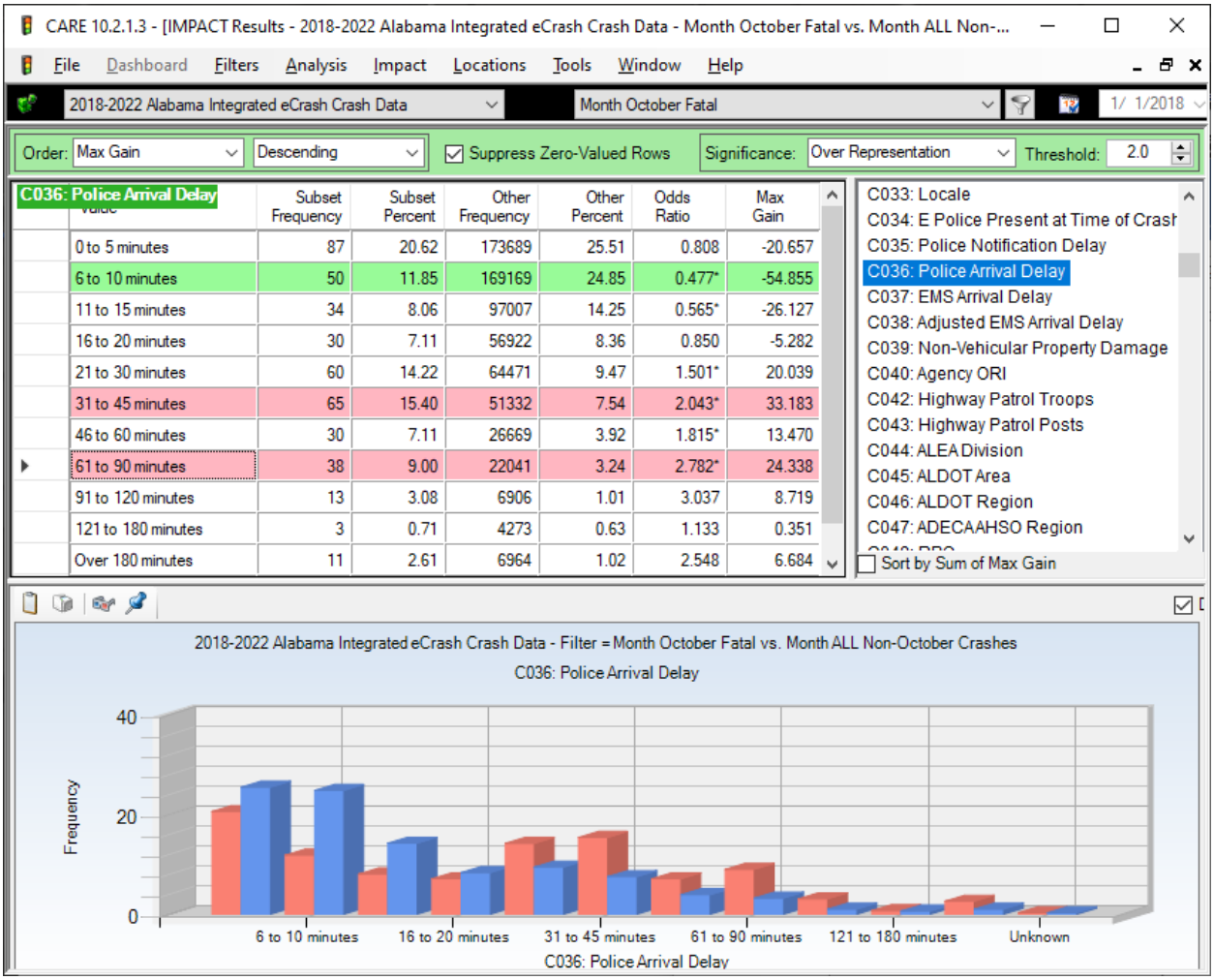
6.7 C052 Number of Vehicles Involved

The following display presents a comparison of the number of vehicles in FOCs against number of vehicles in non-October crashes over the five-year time period of the study.



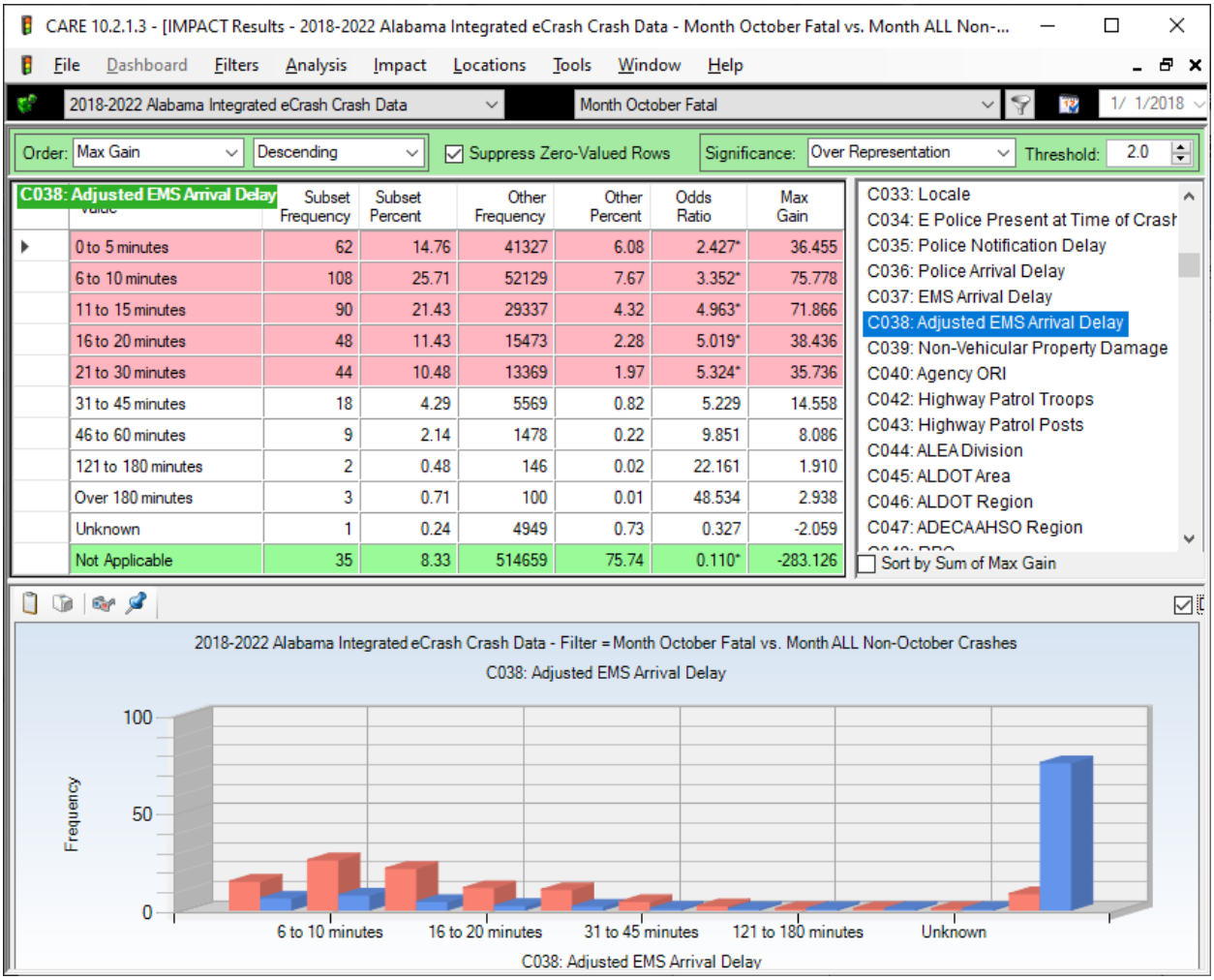
Single vehicle fatal October crashes are over-represented by a factor close to three (2.616).

6.8 C036 Police Arrival Delay (FOCs)



October Fatal Crash police arrival delays reflect the rural nature of October crashes. All delay times above 21 minutes are over-represented with high Odds Ratios. The analysis below shows how this correlates with EMS arrival time, which is a comparison of only those crashes that included injuries, and thus would generally call for an EMS response.

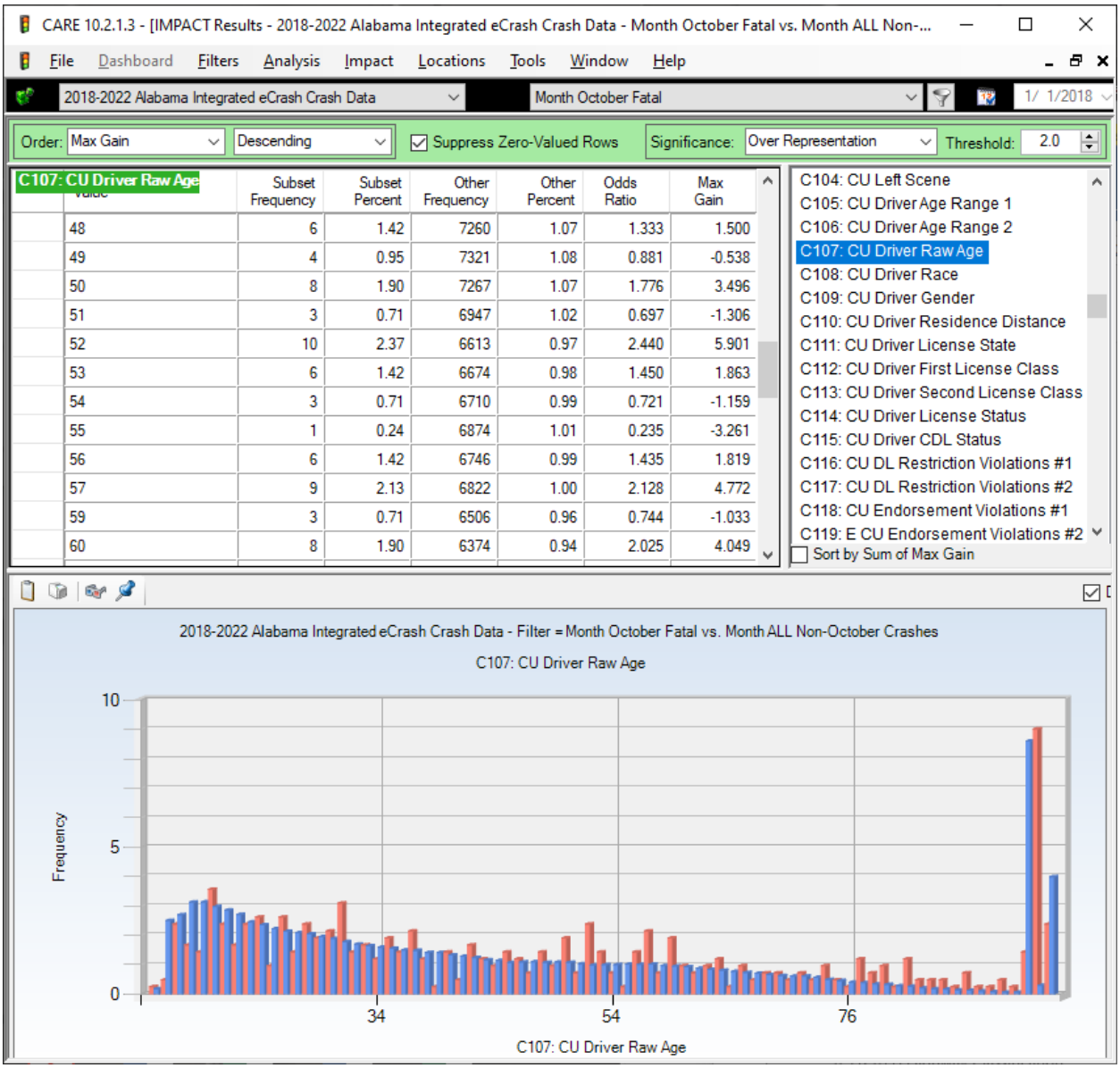
6.9 C038 Adjusted EMS Arrival Delay



All of the October crashes were fatal, as opposed to the comparison subset that reflected injury crashes in general for the rest of the year. Since fatal crashes tend to generate a much faster response in reporting and response, the 1-30 delay times are all highly over-represented. It is clear that any increases in fatalities in October are not the fault of delayed response times.

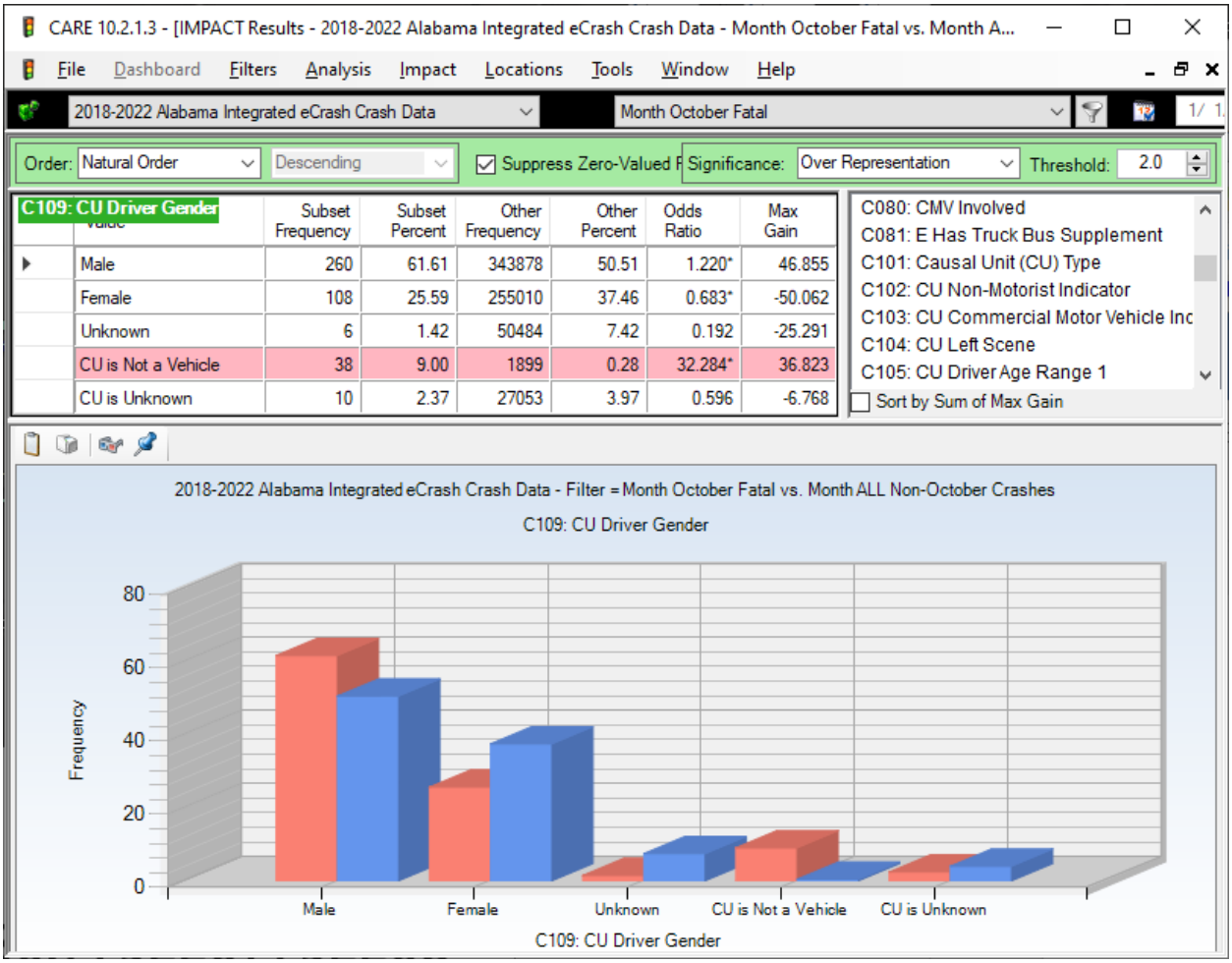
7.0 C107 Driver and Vehicle Demographics

7.1 C107 Driver Raw Age



The table display above presents a comparison of Fatal October crash causal driver ages against the same for all non-October crashes. The blue (Non-October) bars illustrate the problems that 16-20-year-old drivers have in all crashes, but these are generally not over-represented in FOCs. The most over-represented age interval is in ages from 45-60, which are also shown in the table above.

7.2 C109 Fatal October Crash (FOC) Driver Gender



The male red and blue bars and the female red and blue bars each sum to 100%. So the breakdown in FOC causal drivers is 61.61% male and 25.59% female. For other than October crashes, the percentage is 50.51% male and 37.46% female. These differences in proportions certainly indicate that males are a greater cause of FOCs. If there are countermeasures that can be directed toward them, doing so would be much more cost-effective than those directed toward all drivers.

What makes women drivers so much safer in fatal crash comparisons? No doubt it has something to do with speed. See Section 7.3 immediately below.

7.3 Cross-tabulation of C109 Driver Gender x C224 Speed at Impact

CARE 10.2.1.3 - [Crosstab Results - 2018-2022 Alabama Integrated eCrash Crash Data - Filter = Month October Fatal]

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

2018-2022 Alabama Integrated eCrash Crash Data | Month October Fatal | 1/ 1/2018

Suppress Zero Values: Rows and Columns | Select Cells: | Column: CU Driver Gender ; Row: CU Estimated Speed at Impact

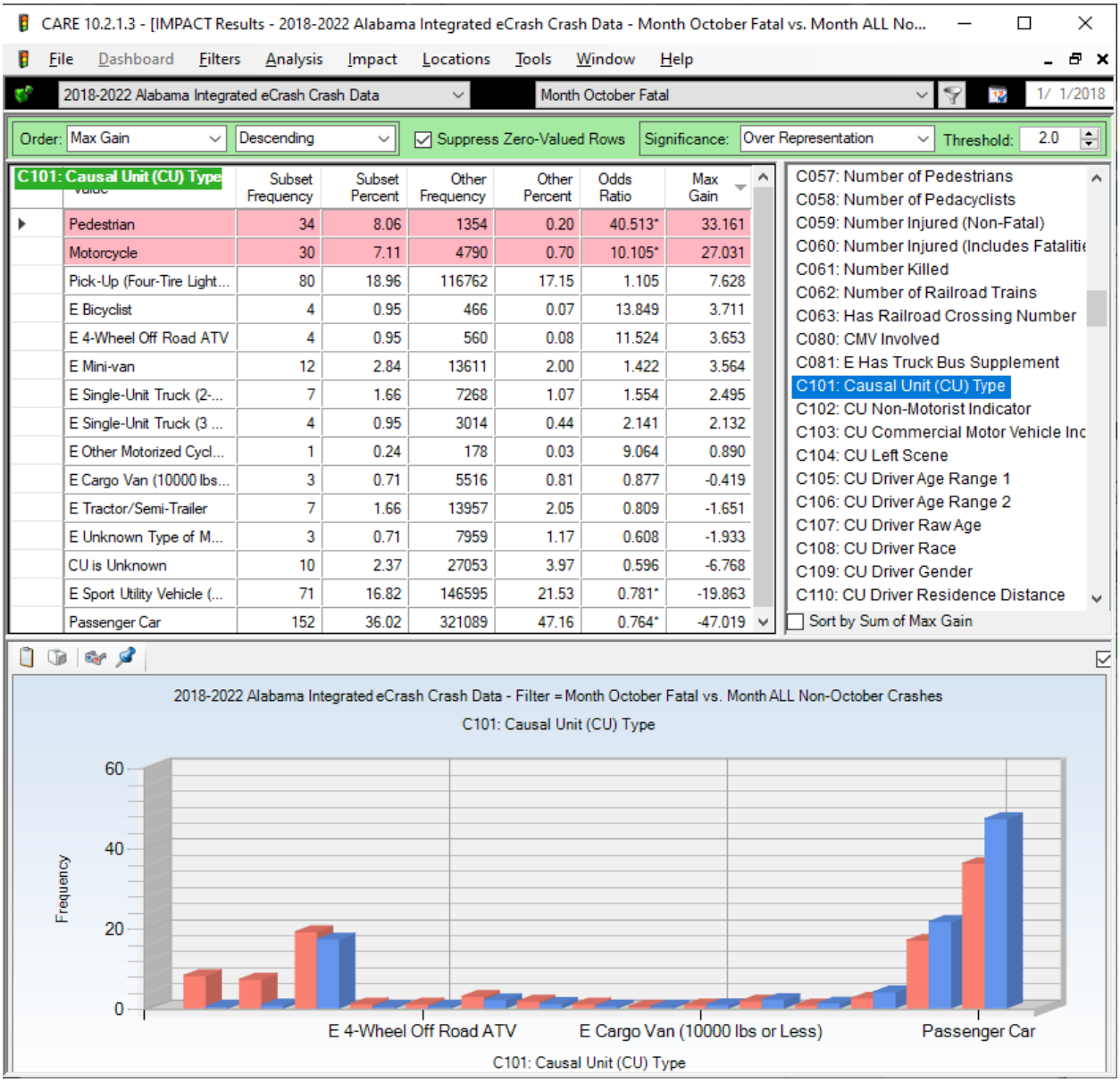
	Male	Female	Unknown	CU is Not a Vehicle	CU is Unknown	TOTAL
1 to 5 MPH	4	2	0	0	0	6
6 to 10 MPH	3	4	0	0	0	7
11 to 15 MPH	2	5	0	0	0	7
16 to 20 MPH	1	1	0	0	0	2
21 to 25 MPH	2	1	0	0	0	3
26 to 30 MPH	6	1	0	0	0	7
31 to 35 MPH	5	1	0	0	0	6
36 to 40 MPH	7	1	0	0	0	8
41 to 45 MPH	14	11	0	0	0	25
46 to 50 MPH	12	3	0	0	0	15
51 to 55 MPH	27	10	0	0	0	37
56 to 60 MPH	18	10	0	0	0	28
61 to 65 MPH	24	7	0	0	0	31
66 to 70 MPH	32	6	0	**0**	0	38
71 to 75 MPH	6	4	0	0	0	10
76 to 80 MPH	12	1	0	0	0	13
81 to 85 MPH	6	1	0	0	0	7
86 to 90 MPH	3	0	0	0	0	3
91 to 95 MPH	3	0	0	0	0	3
96 to 100 MPH	8	2	0	0	0	10
Over 100 MPH	5	0	0	0	0	5

Number and Percent male and female over the 70 MPH speed limit:

43 Male = 43/260 16.43%

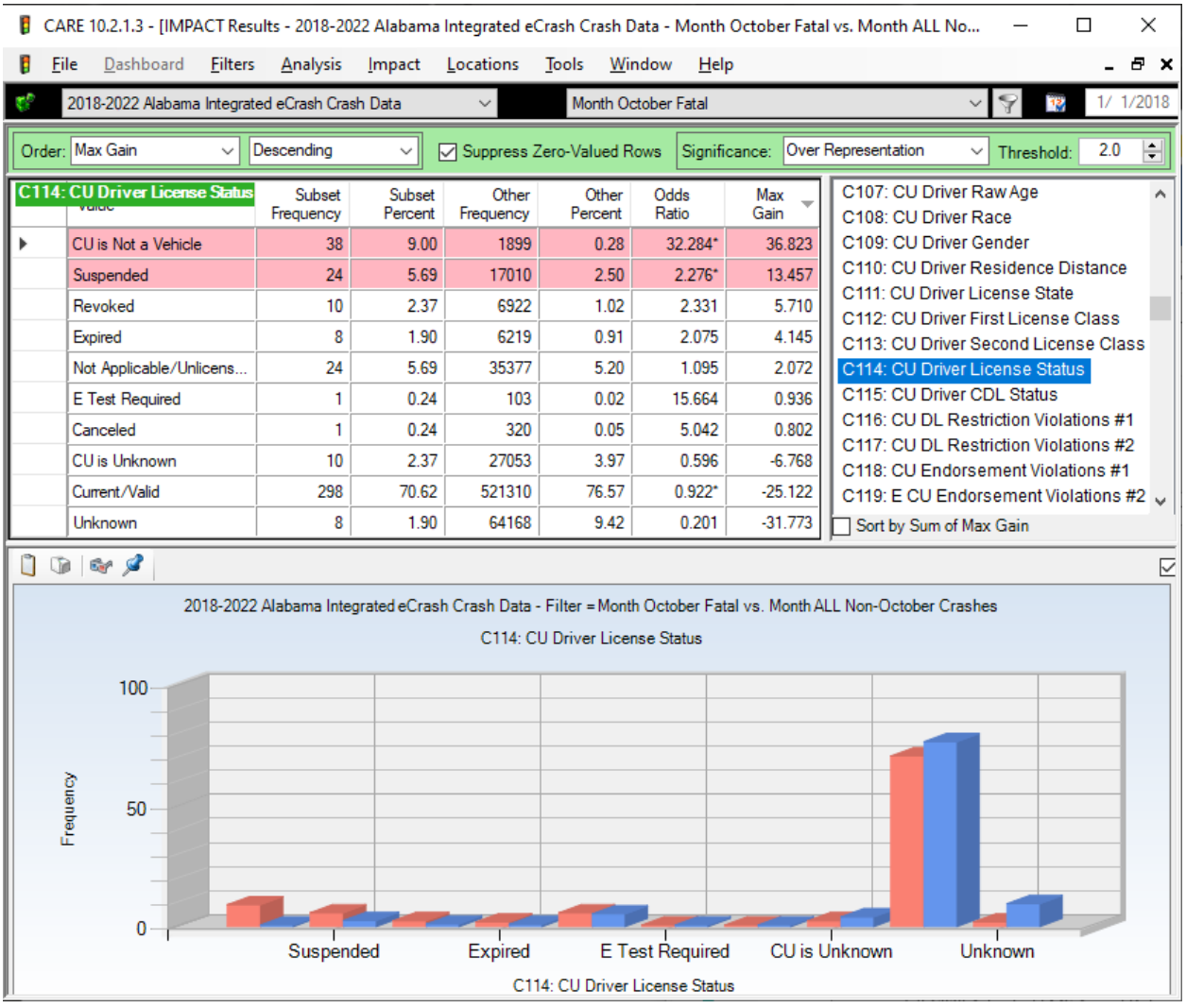
8 Female = 8/106 7.55%.

7.4 C101 Causal Vehicle Type



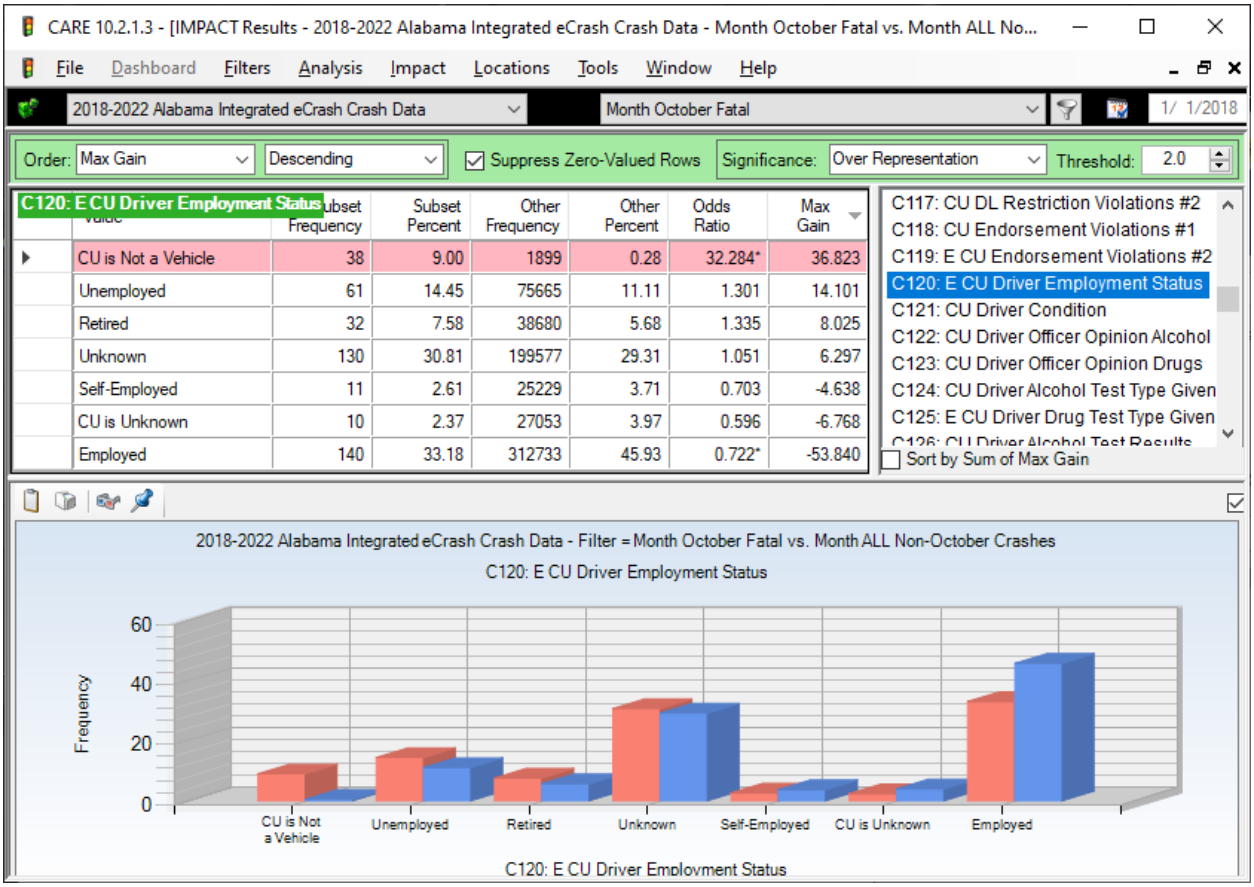
The display above presents a comparison of FOC causal unit types against the same for non-October crashes (all severities). Pedestrians have the highest over-representation (34 crashes, 40.513 Odds Ratio) and Max Gain (33.161 crashes), indicating over 40 times their expected proportion in comparison to all non-October crashes (all severities). The second and third worst vehicle types were Motorcycle (30, Odds Ratio 10.105) and Pick-Ups (80, 1.105). Some vehicles, notably Sport Utility Vehicles (SUVs) and Passenger Cars, were under-represented indicating their tendency to avoid serious October crashes.

7.5 C114 Driver License Status



FOCs are over-represented in their causal drivers not having legitimate licenses. They make up 43 of the fatal crashes, which comes out to over 10% (10.2%) of FOCs as compared to only 4.48% of the crashes not in the month of October.

7.6 C120 Driver Employment Status



In our current era when the economy is playing such a big role in traffic safety, the quantification and tracking of the employment proportion of drivers involved in all types of crashes is important. The above indicates that their employment rate is 72.2% lower than expected (Odds Ratio = 0.722). Unemployed is about 30% lower than expected (Odds Ratio = 1.301). These relationships are not surprising because of the underlying drug/alcohol root cause of many October crashes (8.3-8.4). The correlation between not having a job and being involved in an October crash should be watched carefully, in that it could affect the type and location of future countermeasures.

8.0 Driver Behavior

8.1 C015 Primary Contributing Circumstances (Items < 5 Crashes Removed)

CARE 10.2.1.3 - [IMPACT Results - 2018-2022 Alabama Integrated eCrash Crash Data - Month October Fatal AND Not Primary ...

File Dashboard Filters Analysis Impact Locations Tools Window Help

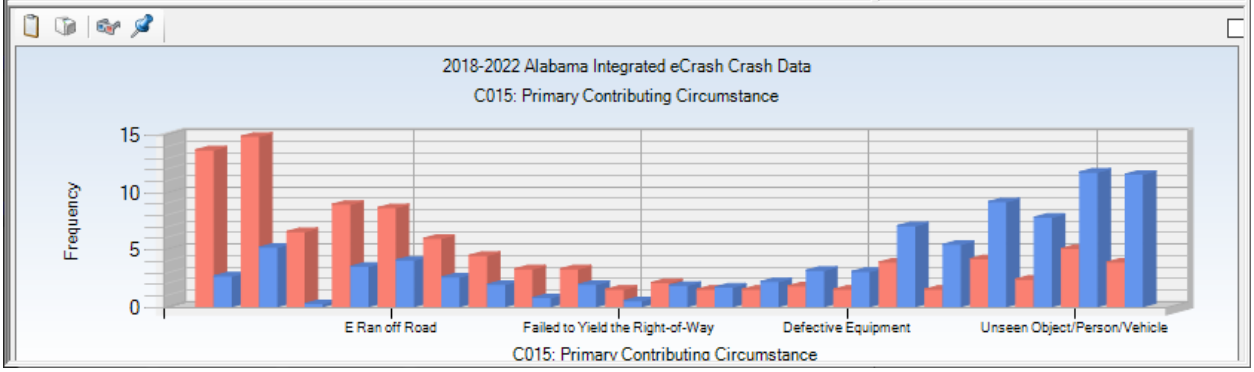
2018-2022 Alabama Integrated eCrash Crash Data | Month October Fatal | 1/ 1/2018

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

C015: Primary Contributing Circumstance	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Over Speed Limit	46	13.65	9657	2.65	5.159*	37.084
DUI	50	14.84	18828	5.16	2.876*	32.617
E Improper Crossing	22	6.53	888	0.24	26.835*	21.180
E Aggressive Operation	30	8.90	12734	3.49	2.552*	18.244
E Ran off Road	29	8.61	14730	4.04	2.132*	15.401
E Crossed Centerline	20	5.93	9339	2.56	2.320*	11.378
E Over Correcting/Over ...	15	4.45	7013	1.92	2.317	8.525
Traveling Wrong Way/...	11	3.26	2765	0.76	4.309	8.447
E Ran Stop Sign	11	3.26	6993	1.92	1.704	4.544
Failed to Yield the Right-...	5	1.48	1791	0.49	3.024	3.346
E Other Failed to Yield	7	2.08	6687	1.83	1.134	0.826
Improper Passing	5	1.48	6154	1.69	0.880	-0.682
E Other - No Improper D...	5	1.48	7858	2.15	0.689	-2.255
E Fatigued/Asleep	6	1.78	11481	3.15	0.566	-4.600
Defective Equipment	5	1.48	11084	3.04	0.489	-5.233
Driving too Fast for Con...	13	3.86	25666	7.03	0.549	-10.696
E Ran Traffic Signal	5	1.48	19716	5.40	0.275	-13.202
E Failed to Yield Right-of...	14	4.15	33314	9.13	0.455	-16.757
E Failed to Yield Right-of...	8	2.37	28373	7.77	0.305	-18.195
Unseen Object/Person/...	17	5.04	42753	11.71	0.431	-22.471
Improper Lane Change/...	13	3.86	42083	11.53	0.335	-25.852

C015: Primary Contributing Circumstance

Sort by Sum of Max Gain



8.2 Discussion of Primary Contributing Circumstances (PCC) Result Above

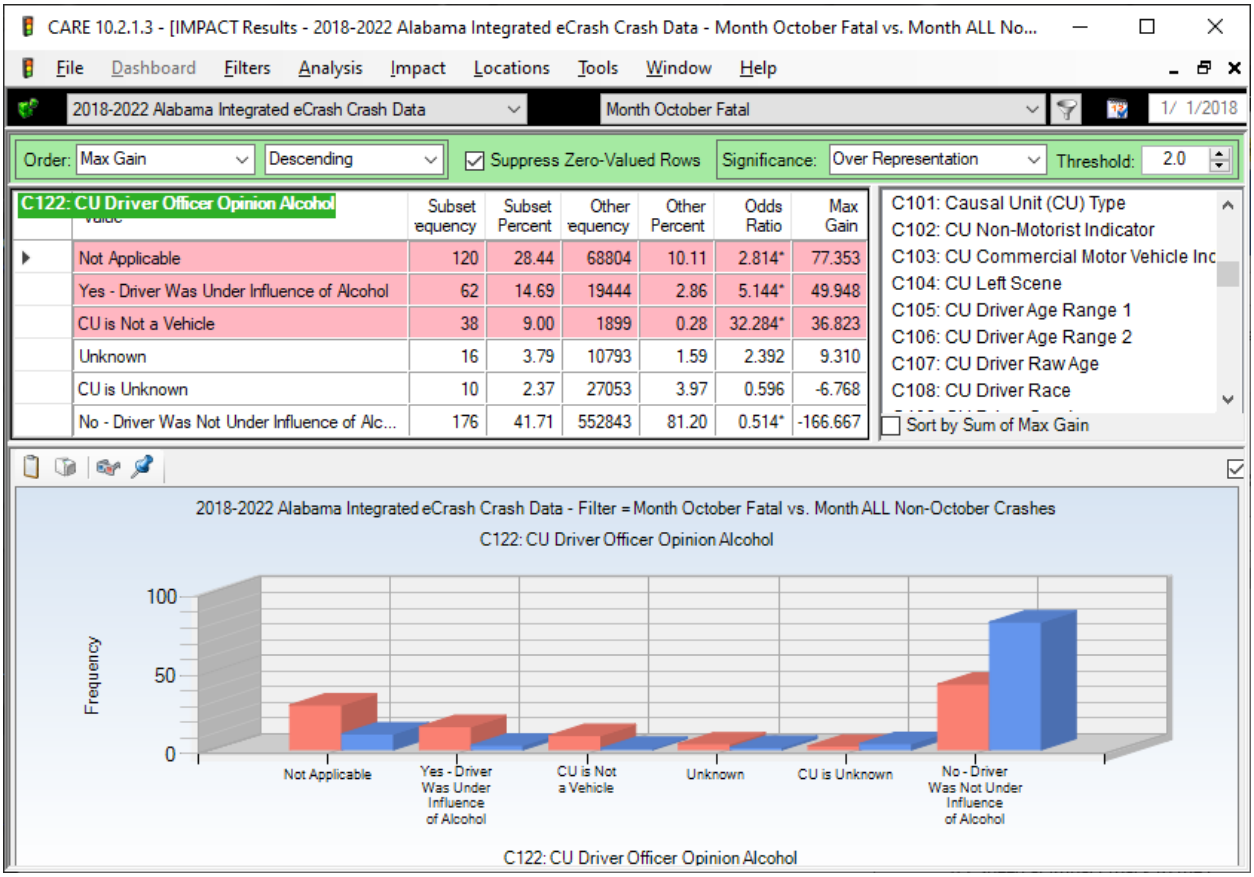
These results demonstrate the driver behaviors that accompanied FOCs as they were defined by the C015, Primary Contributing Circumstances.

FOC items over-represented in their expected proportion (when compared to non-October crashes) are ordered by Max Gain as follows:

- Over Speed Limit, 46
- ID/DUI (Impaired Driving), 50
- Aggressive Operation, 30
- Improper Crossing – Pedestrians 22
- Ran off Road, and 29
- Crossed Centerline. 20

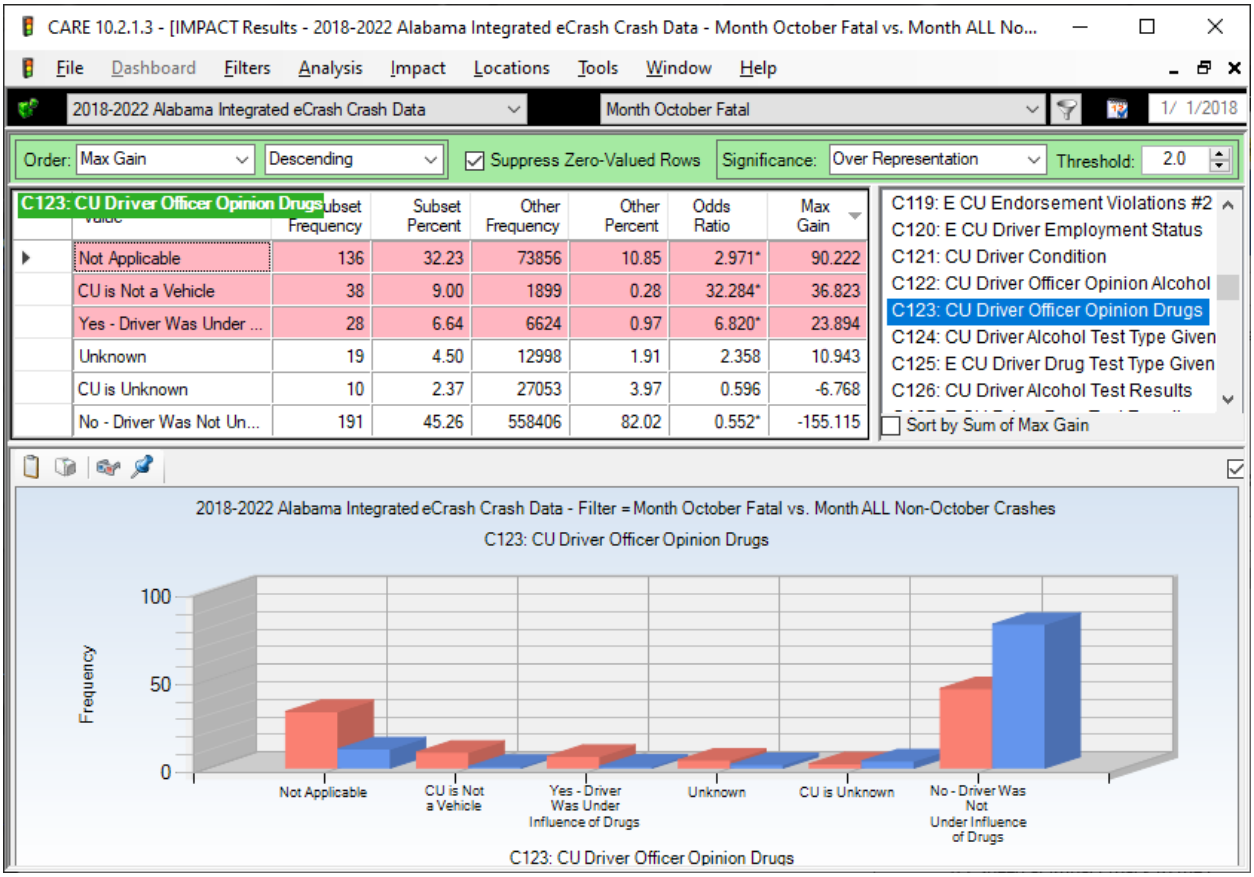
Most of the above are reasonably associated with the effects of Impaired Driving (ID). Each should be viewed in terms of their relative positions in the table as opposed to any one of them being the absolute cause.

8.3 C122 CU Driver Officer's Opinion Alcohol



While Impaired Driving/Alcohol was indicated as the cause of the crash for 14.69% of the FOCs, the fact that this proportion was over-represented by a factor of 5.144 indicates its importance. ID/DUI tends to be under-reported, and there is no doubt that its reduction would have a major impact on reducing the number of FOCs.

8.4 C123 CU Driver Officer's Opinion Drugs



The reported non-alcohol drug use in FOCs is slightly less than half of that for alcohol. The 28 cases are only about 6.64% of all FOCs. However, the Odds Ratio (6.820) indicates that it has an over-representation comparable to that of alcohol. In both cases (FOC and crashes from other months), drug use is difficult to detect compared to alcohol, which has well-established tests for the blood-alcohol level that are relatively easy to administer. Our conclusion is that both alcohol and non-alcohol drug use are major contributors to increasing the frequency of FOCs, and their use is further compounded it they choose to avoid detection by using county roads.