Intersection Fatal Collision IMPACT Special Study
Intersection Fatal Crashes (IFCs) vs Intersection Non-Fatal Crashes (INFCs)

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See http://www.safehomealabama.gov/caps-special-studies/ for all CAPS Special Studies.

0.0 Introduction

Over the five years of data (CY2018-2022) used in this study, there were 470,984 motor vehicle crashes either at, or related to, Intersections. Of these, resulted in the following crash severities:

Severity of Intersection Crashes

Severity	Intersection	Non-Intersection	Percent of All Crashes
Fatal Injury	1587	4372	36.30%
Suspected Serious Injury	9179	20283	45.25%
Suspected Minor Injury	34733	60300	57.60%
Possible Injury	42297	64172	65.92%
Property Damage Only	368358	581745	63.32%
Unknown	14830	19423	76.35%

The purpose of this report is to provide information by which the total number of intersection crashes may be reduced and to reduce those crashes that do occur so that fewer of them result in fatalities. The primary analytical technique employed to generate most of the displays for this purpose (in Sections 4-8) 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/

Sections 4-8 present the results of a number of IMPACT evaluations of Intersection Fatal Crashes (IFCs) compared to Intersection Non-Fatal Crashes (INFCs) over a recent five-year period (CY2018-2022). The purpose of these comparisons is to determine the causes of fatal crashes that might distinguish those that occur at Intersections from Intersection Non-Fatal Crashes (INFCs). This is different from many of the other Special Studies that have been performed, which had the goal of reducing all of a particular type of crash regardless of severity, and not just those that were fatal.

IMPACT works by surfacing "over-representations." An *over-represented* attribute is found when that attribute has a greater share of Intersection Fatal Crashes (IFCs) than would be expected if its proportion were the same as that for Intersection Non-Fatal Crashes (INFCs). That is, the INFC crashes are serving as a *control* to which the IFCs are being compared to determine over-representations that indicate causes.

As a first example, over the five years of the crash data studied (CY2018-2022), we found that IFCs for the Highway Classification attribute value of "Federal" had an 82.9% higher proportion of crashes than did the Non-Fatal Federal crashes (details in Section 2.3). 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 IFCs causes (e.g., excessive speed and Impaired Driving**) might be performed on Federal roads. The Time of Day and Day-of-the-Week attributes (Sections 5.4-5.6) are also used to focus optimal times for enforcement implementation.

Unless otherwise stated, the tables given above the charts in the IMPACT displays are ordered by *Max Gain*. *Max Gain* is the improvement in IFC reduction that could be obtained if a countermeasure could be applied to reduce the proportion of the Intersection Fatal Crashes (IFCs) to the proportion of Intersection Non-Fatal Crashes (INFCs) for the particular attribute under consideration (i.e., reduce the 22.28% to 12.16% in the Federal Road example; see Section 2.3). The Max Gain for each attribute value can be found in the extreme right column of the table.

This report continues with three sections that provide a high-level summary of the IMPACT results and a more detailed explanation of their specifics. These are called: (1.0) Summary of Findings and Recommendations, (2.0) Filter and IMPACT Set-ups, and (3.0) Fatal Crash Comparison by Year. Section 3 is also introductory in that it provides another IMPACT example, a comparison for the Year attribute. After Section 3, the IMPACT comparisons between IFCs and INFCs are presented under the following headings, given here with their section numbers:

- 4.0 Geographic Factors,
- 5.0 Time Factors,
- 6.0 Factors Affecting Severity,
- 7.0 Driver and Vehicle Demographics, and
- 8.0 Driver Behavior.

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

1.0 Summary of Findings and Recommendations

This section comes right after the Introduction in this report 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 studies. These summaries are referenced to the more detailed analyses so that any questions regarding their sources can be accessed easily. The following section numbers: (1.1), (1.2), and (1.3), have been omitted in Section 1 to maintain consistency with the analytical sections (in Sections 4-8).

Findings and recommendations are organized into the areas of: (1.4) Geographical Factors, (1.5) Time Factors, (1.6) Severity Factors, (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. However, the more detailed information given should be quite useful in the further prioritization and allocation of traffic safety resources. This process of optimization should consider all of the recommendations, which should be validated against

the information presented in the IMPACT Sections 4.0-8.0 (source section references for these summaries are given in parenthesis). Recommendations are given for the reduction of frequency and/or severity of Fatal Crashes (both IFCs and INFCs) in Alabama. They are in the same ordering as the IMPACT displays to facilitate references to Sections 4.0-8.0. For the special report on traffic safety resource optimization, please see:
http://www.safehomealabama.gov/wp-content/uploads/2019/03/Traffic-Safety-Innov-2017-04.pdf

Terminology: *Expected proportions* (AKA *expectations*) of either the IFCs or INFCs below are obtained from the comparison of their proportions with the proportions for their corresponding INFC control classifications. The IMPACT analyses in this study enables the determination of over-representations in either the IFCs or the INFCs.

Note: subsection numbers 1.1, 1.2 and 1.3 have been omitted below in order to keep the numbering system in this Section consistent with that of the IMPACT displays that follow. Findings are from the IMPACT analyses in Sections 4-8 that compare IFCs vs INFCs over the five years of the study (CY2018-2022). Recommendations, which will be given for each of the findings, are given in the bulleted list below:

- **1.4 Geographical Factors (4.0)**
    - County (4.1, C001) - Generally, the over-represented counties are rural with (or near) large population centers. The large population centers increase the traffic and thus the crashes, while being rural generally make a larger proportion of these crashes fatal. Placed in Max Gain order, the IFC-over-represented counties with the highest potential for fatality reduction are (with their frequencies): Baldwin 86, Limestone 33, Calhoun 34, Lawrence 20 and Dekalb 19. The INFC-over-represented counties with the highest potential for fatality reduction with their frequencies are: Jefferson 225, Madison 117, Shelby 39, Lee 27, Tuscaloosa 76, and Montgomery 110. It is recommended that these and other over-represented counties be given special attention for both fatality and crash reduction. Generally, the countermeasures recommended to be applied to specific geographical areas, determined by hotspot analysis, are selective enforcement for Speed and Impaired Driving, since these two violations have the highest correlation with fatal crashes.
    - City (4.2, C002) -- Comparisons of IFCs to INFCs viewing rural areas of counties as separate virtual cities. There is little surprise in the number of rural areas in this output. City (and rural virtual city) comparisons are presented in the IMPACT table for all areas that had Max Gains greater than 10. The top 7 IFC-over-represented Cities had very high statistically significant Odds Ratios. And were: Rural Mobile 84, Rural Baldwin 62, Rural Jefferson 59, Rural Tuscaloosa 35, Rural Madison 33, Rural Montgomery 23, and Rural Limestone 22. The top 5 INFC-over-represented Cities with their expected fatal crash numbers are: Birmingham 124, Mobile 55, Huntsville 80, Tuscaloosa 33, and Montgomery 87.

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

- Rural/Urban (4.3, C010) Intersection Fatal Crash (IFC) Proportion – IFCs occurred in 46.50% rural and 53.50% urban areas. This attribute is determined by the city limits boundaries as opposed to the speed limits or other environmental factors (see Locale immediately below). For INFCs, these proportions came out to be 13.55% Rural and 86.45% Urban. Concentration for fatality reduction is recommended in Rural areas where hotspot analyses determines that there are concentrations of fatal crashes. Recommendations to reduce fatalities within any of these areas include:
    - Implement a larger police presence in the more critical areas; and
    - Lower the speed limits in frequent crash areas.

  Anyone wishing analysis of additional cities, counties, or other areas, please contact CAPS – email brown@cs.ua.edu.
- Locale (4.4, C033) – Open Country shows a high level of over-representation in the IFCs (823). Those countermeasures recommended to rural areas would be applicable to Open Country areas within city limits, which are effectively rural areas, as illustrated in the next display in Section 4.5. While their proportions were not over-represented, the following had very high frequencies: Shopping or Business 408, and Residential 273.
- Cross-tabulation of Locale (4.5, C033) by Rural/Urban (C010) for IFCs (fatal crashes). The largest number of fatalities were in the Rural, Open Country specifications, with 632 fatal crashes. This illustrates that the Locale attribute is more definitive in specifying the surrounding areas of crashes that is the Rural/Urban attribute. Recommendations for rural areas apply equally to Open Country Locales.
- Highway Classifications (4.6, C011) – in order of Odds Ratio, the largest was Federal 1.829*, State 1.561, County 1.474 and lowest positive was Interstate 1.308). These frequencies are correlated with the number of intersections per mile on the respective Highway Classification, since the Odds Ratios are comparing the Intersection Fatal Crashes (IFCs) against the Intersection Non-Fatal Crashes (INFCs)
- Most Harmful Event (4.7, C019) – ordered by Max Gain. The following items had the largest number of fatality occurrences in the five years (listed with their frequencies):

  INTERSECTION FATAL CRASH (IFC) OVER-REPRESENTED

Collision with Non-Motorist: Pedestrian	143
Collision with Tree	149
Overturned/Rollover	134

INTERSECTION NON-FATAL CRASH (INFC) OVER-REPRESENTED

Collision with Vehicle in Traffic	353,921 non-fatal
Collision with Parked Motor Vehicle	22,098 non-fatal

Pedestrian training needs to be increased to include the advantages of walking against traffic, wearing of reflective clothing at night, and all the other rules for pedestrian safety, including a strong prohibition of walking while intoxicated with either alcohol or other drugs. For more details on Pedestrian crashes, see: http://www.safehomealabama.gov/wp-content/uploads/2023/05/Ped-SS-Using-2018-22-Data-v04.pdf

- Roadway Curvature and Grade (4.8, C407). The following items were the most significantly over-represented (given with frequencies):

INTERSECTION FATAL CRASHES (IFCs) OVER-REPRESENTED

Curve Left and Level	63*
Straight with Up Grade	114*
Straight with Down Grade	134*
Curve Left and Up Grade	26*
Curve Left and Down Grade	29*
Curve Right and Level	51*

Recommendations include selective enforcement and speed-limit-reduction (e.g., advisory speed and curve warning signs) concentrating most on left curves. The application of Advisory Speed Limits for Curves might be improved by considering 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

Other engineering recommendations should evaluate curves at Intersections based on hotspot analyses, especially left curves.

- **1.5 Time Factors (5.0)**
  - Year (3.1, C003) – all of the annual proportions were statistically significant with the exception of 2021. The early years (2018 and 2019) were significantly lower than their non-fatal crash comparisons. Two of the latter years (2020 and 2023) were significantly higher than their respective controls. This is an indication that the proportions of fatal crashes per intersection are increasing over time.
  - Month (5.2, C004) – The number of IFCs and INFCs correlated very closely in all months (no significant over-representations). July, September, and October, which had the highest Odds Ratios, might be given special selective enforcement concentration, with specific locations determined by hotspot analyses.
  - Day of the Week (2.3, 5.7 C006) – Saturday and Sunday were the only over-represented days of the week. However, Wednesday and Thursday were significantly under-represented. Since this 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 indicated by hotspot analysis. Consideration might be given to using Intersection Fatal Crashes (IFCs) as a proxy measure to improve ID decisions. See Sections 8.3 and 8.4 for the ID analyses.

- Time of Day (5.5-5.6, C008) – In *Natural Time Order*. In addition to Impaired Driving (ID). some of the late-night crashes will be due to drowsiness, causing among other things, a diminished ability to see road edge lines. See Day of the Week (2.3, 5.7, C006) above for the similarity of this distribution with that of Impaired Driving (ID, DUI). The ID recommendations effectively apply to these over-represented times. For more ID information, See Sections 8.3 and 8.4.
- Time of Day by Day of the Week (5.7, C008 x C006) – *For all fatal crashes.* This quantifies the extent of the fatal crash concentrations on Fridays, Saturday mornings and nights, and Sunday mornings and Sunday Evenings. This is a very useful summary for deploying selective enforcement details, especially during the weekend hours. Recommendations here are to adjust the selective enforcement times to the days of the week and times of day using this cross-tabulation.

- **1.6 Factors Affecting Severity (6.0)**
  - Severity for All Highway Classifications (6.1, C025, C011) – This Cross-tabulation was performed for <u>*all intersection crash records*</u> so that the various severities on the different Highway Classifications could be seen. Note the high fatal over-representations on Interstate, Federal, State and County roads. For intersection fatality reduction, the enforcement priority is on the State, Federal and County roads. If drivers have the option, this chart will be helpful in assisting them in choosing the safest routes for their trips.
  - Speed at Impact (6.2, C224) – Impact speeds above 41 MPH are generally over-represented for IFCs. INFCs are over-represented at slower impact speeds. So it is clear that speed is a larger problem in the IFCs than in the INFCs. 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 (Section 6.4). The recommendation here is to perform selective enforcement along with 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 violating speed laws. At the same time, additional enforcement is essential to eliminate the dangerous driver behaviors to be discussed in Section 8.
  - Crash Severity (C025) by Impact Speed (6.3, C224). <u>*for all intersection crashes.*</u> This cross-tabulation gives an idea of the risks involved with increased speed on

any of the highway classifications. The red backgrounds indicate those that had a relatively higher number of fatal crashes.

- Discussion of severity by Impact Speed (6.4. C025, C244). The speed to death relationship was further validated in the discussion of this cross-tabulation. This topic was given elaboration in the Section 6.4, which is a discussion of the Probability of Being Killed crossed by Speed at Impact. The recommendation here is that the information of Section 6.4 be an essential part of the training in all traffic safety educational programs, and especially to those involving younger drivers.
- Restraint Use by Drivers in Fatal Collisions (6.5, C323) – Restraint use programs have been quite successful in Alabama. Consideration should be given to increasing financial support to these programs to assure that their effectiveness will continue. In particular, special concentration needs to be given to convince all drivers of their additional vulnerability at intersections, and how severity might be abated by seatbelts when crashes occur. See Section 6.6 for more information on the effectiveness of restraints.
- Cross tabulation: Crash Severity (6.6, C025) by Restraint Use (C323) for All Injury Crashes. A comparison of the probability of a fatal crash indicates that a fatality in an injury crash is on average 8.0 times more likely if the involved occupants are not using proper restraints (see text under the cross-tabulation in Section 6.6). This multiplier would increase as speeds of impact increase. Because current restraint-use programs are quite effective, consideration should be given to increase their funding to make them even more universal and effective. Restraint effectiveness information should be part of all traffic safety educational programs, and consideration should be given to increasing the fines of being unrestrained.
- Number of Vehicles Involved (6.7, C052) – the proportion of single vehicle fatal crashes is over-represented for IFCs by an Odds Ratio of 3.285, indicating that its proportion was over three times more than expected. Close to half (40.77%) of the IFCs were single vehicle crashes. This is consistent with the other findings of causality. It is recommended that PI&E efforts give top priority to single vehicle crashes. The following is potentially useful information from a list of the highest Primary Contributing Circumstances <u>*for all single vehicle crashes*</u> with more than five occurrences (from 2018-2022 data): 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). This reflects the "unforced errors" of single vehicle crashes, and it provides additional reasons that they are over-represented for IFCs.
- Police Arrival Delay (6.8, C036) – Police response times to IFCs were greater than 20 minutes in 39% of the IFC police runs. There can be little doubt that this

has to do with their being located in rural areas. The shorter police responses would generally be in the urban areas.

  - EMS Arrival Delay (6.9, C039) – Probably because of (1) the severity of the crashes (all being fatal for the test column), (2) the swiftness/urgency in getting called, and (3) the urgency in getting to the scene, much shorter delay times were recorded than that of the police delays. Generally, we can conclude that very few of the fatalities were caused by excessive EMS delays, since the frequencies drop off rapidly after 30 minutes. It is recognized that first responders are currently doing an excellent job in getting to the scene of the crash as quickly as possible without jeopardizing safety. Delays, if any, are usually caused be a failure to report the crash immediately. Encouraging quicker notification should be worked into relevant PI&E efforts.

- **1.7 Driver and Vehicle Demographics (7.0)**
  - Driver Age Range 2 (7.1, C106) –A comparison of IFC causal driver age with the INFCs shows the most under-represented in the IFCs are in 16-30 years of age, while the most over-represented IFC causal driver ages are 51-90 years of age. Although not over-represented, it is clear from the chart that ages 16-45 have a relatively high proportion of IFCs. It is recommended that, to the extent possible, that PI&E efforts focus on the age concentrations of:16-45 and 51-90.
  - Crash Driver Gender (7.2, C109) – the breakdown in IFC causal drivers is 62.26% male and 24.51% female. For INFC cashes, the percentage is 48.62% male and 38.75% female. These gender differences certainly indicate that males are a greater cause of the fatal crashes at intersections (as they are in most crash types), and the recommendation is that, 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) for *All Intersection Crashes*. To get better insight into the reason for male drivers causing more fatal crashes, this analysis shows that males had impact speeds in excess of the 70 MPH in 0.80% of their Intersection crashes, while comparable speeds for females was only at 0.35%. Thus, all of the recommendations for speed reduction apply doubly to males over females.
  - Causal Unit (Vehicle) Type (7.4, C101) – This analysis was based on a comparison of IFC Causal Unit Type against the same for INFCs. It is recommended that countermeasure programs that are currently in effect be continued and augmented to emphasize the special issues with the following vehicle types at Intersections (given with frequencies in Max Gain order): Pedestrian 124, Motorcycle 94, Pick-up 261, Sport Utility Vehicle 263, and Passenger Car 637, Pedestrian programs should include warnings against

Impaired Walking (walking along the roadway after alcohol or other drugs), and the many other errors addressed in most pedestrian safety programs. Pedestrian fatalities are statistically significantly over-represented in the INFCs, indicating that more emphasis might be warranted for divided and four-lane roadways. Additional pedestrian fatality study is warranted; see Section 7.5 below.
  - Number of Pedestrians (7.5, C058) – Single vehicle Intersection Fatal pedestrian crashes occur at a proportion of about 31.288% times greater than their Intersection Non-Fatal counterparts. This is consistent with what has been found in most pedestrian studies. Both ID (Impaired Driving) and Impaired Walking, contribute to this, as well as pedestrians not taking the maximum means for being seen at night. Wearing reflective clothing, and keeping a flashlight on to be seen of vehicle drivers are two of the most important recommendations since lack of visibility was cited for several pedestrian fatal crashes. Pedestrian programs need to be emphasized in the lower school grades and continue to be emphasized through the young adult years. Additional pedestrian recommendations are in: http://www.safehomealabama.gov/wp-content/uploads/2023/05/Ped-SS-Using-2018-22-Data-v04.pdf
  - Driver License Status (7.6, C114) – These results were insufficient to base any recommendations.
  - Driver Employment Status (7.7, C120) – This analysis indicated that the employment rate for the IFCs was about 28.10%, while that for INFCs was 44.35%. Lower than average employment rates are not surprising because of the underlying drug/alcohol root cause of many fatal crashes (see Sections 8.3-8.4). The correlation between not having a job and being involved in a fatal crash should be watched carefully going forward in that it could affect the type and location of countermeasures. It is also recommended that research be performed to determine if there are some incentives that could be implemented in conjunction with unemployment payments.

- **1.8 Driver Behavior (8.0)**
  - Primary Contributing Circumstances – PCC (8.1 and 8.2, C015) Driver behaviors that are correlated with Intersection Fatal crashes might provide alternatives for countermeasure development. Those behaviors that were over-represented in IFCs are given below with their IFC and INFC percentages:

IFCs PCC Overrepresented	IFCs %	INFCs %
Aggressive Operation	9.73%	2.16%
DUI	9.34%	2.60%
Improper Crossing (pedestrian)	6.25%	0.13%
Over Speed Limit	6.56%	0.74%
Ran Stop Sign	5.87%	1.99%
Ran off Road	5.56%	1.81%
Failed to Yield ROW at Stop Sign	13.13%	9.43%
Crossed Centerline	3.71%	1.38%

  - Traveling Wrong Way/Wrong Side 2.32% 0.40%
  - Not Visible (most often pedestrian) 1.31% 0.04%
  - Failed to Yield the Right-of-Way 1.62% 0.36%
  - Driving too Fast for Conditions 3.63% 3.06%
  - Over Correcting/Over Steering 1.47% 0.97%
  - Failed to Yield ROW Left or U-Turn 6.95% 6.46%
  - Other Failed to Yield 1.70% 1.26%
  - Fatigued/Asleep 1.47% 1.14%
  - Failed to Yield ROW Uncon Intersection 0.93% 0.69%

  Recommendation: That these behaviors should be given special attention for enforcement, especially those that are in violation of state laws.
- CU Officer's Opinion Impaired Driving – CU Officer's Opinion Impaired Driving – Alcohol (8.3-8.4, C122-C123). We saw ample evidence for fatal 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 crashes. For alcohol, the proportion of ID fatal crashes was 5.216 times as many for IFCs as for INFCs. For drugs this multiplier was 7.128. Recommended countermeasures to reduce both ID types are:
  - Additional ID enforcement at Intersections.
  - Mandate breath-alcohol ignition interlock devices for all convicted of ID.
  - Perform an in-depth study to determine if problems exist within the current programs, e.g., how the use of 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, continue officer training to produce more complete reporting, especially for non-alcohol drugs.
  - 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* (see 7.1 for driver ages).
  - Combinations of recreational or medical drugs and alcohol can be particularly lethal, and medical practitioners should warn against such problems and discourage all alcohol and additional drug use for their patients who have indicated either of these combinations, or who are taking other prescription drugs.
  - Provide additional publicity on the fact that legalized recreational drugs are not a good alternative to alcohol use. The advertising as such should be outlawed. PI&E programs should take the opposite approach to warn drivers that legalization does not relax their responsibilities.

2.0 Filter and IMPACT Set-ups

Generally, the analyses performed in this study used IMPACT (See Section 2.1) to compare Intersection Fatal Crashes (IFCs) against Intersection Non-Fatal Crashes (INFCs) over a 5-year time period (FY2018-2022). The objective was to determine all significant differences between attributes within these two subsets of data in order to get an improved understanding as to the fatality crash causes (who, what, where, when, how, causal driver demographics, etc.). This is accomplished by pinpointing common factors 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 crash frequency and severity at Intersections.

Sections 2 and 3 of this report contain information that will be useful in obtaining a high level orientation toward the IMPACT results that will follow (in Sections 4-8). This introduction will consist of: (2.1) Introduction to IMPACT, (2.2) Definitions of Filters Used, (2.3) Example IMPACT: Day of the Week, and (2.4) Overall Fatal Crashes by Severity. Section 3 presents another IMPACT example for purposes of further orientation.

2.1 Introduction to IMPACT

The findings of Sections 4.0-8.0 are in displays of comparisons for the various attributes that might have an influence on crash, and especially fatal crash, countermeasure development. The CARE analytical technique employed to generate these comparisons is called Information Mining Performance Analysis Control Technique (IMPACT). Unless otherwise indicated in the IMPACT "Order" box, the outputs will be listed in the order of highest *Max Gain* first. *Max Gain* is a term that CARE users have assigned to indicate the number of crashes that would be reduced if the respective attribute proportion was not over-represented (i.e., 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 (proportion) of crashes in the Intersection (IFCs) than would be expected from that given in the INFCs. Similarly, an *under-represented* value of an attribute is a situation found where that attribute has a smaller share of crashes than what would be expected.

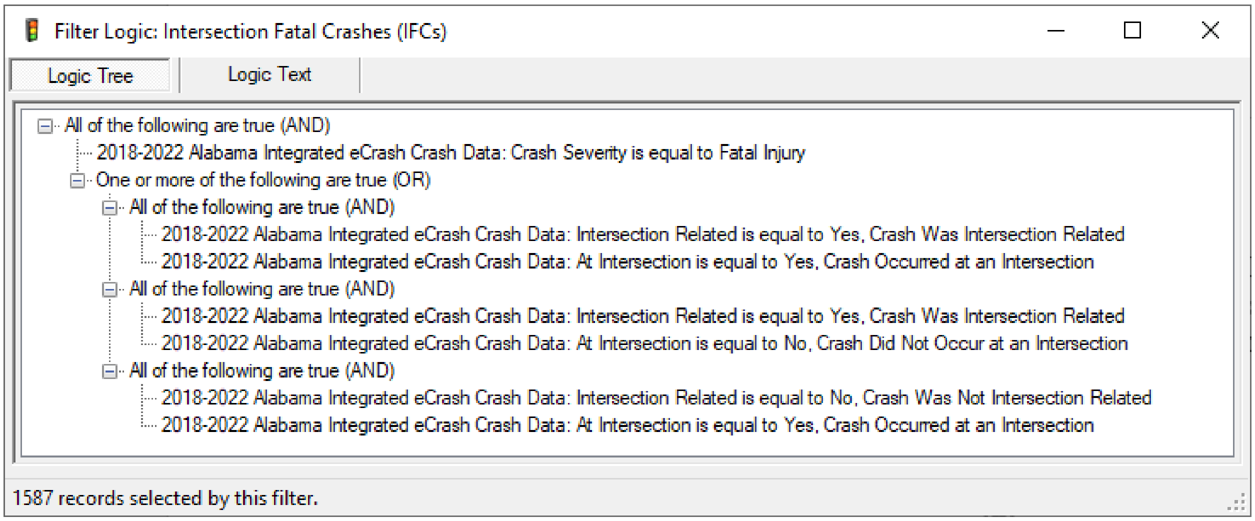
IMPACT will display comparisons of IFCs against their INFC counterparts. In summary, the INFC Crashes are serving as a control to which the IFCs are being compared. In this way any inconsistencies related to the IFCs surfaces, and this can be subjected to further analyses. For a detailed description of the meaning of each element of the IMPACT outputs, see:
http://www.caps.ua.edu/software/care/

The IMPACT analses will be grouped as follow in Sections: 4. Geographical and Harmful Events, 5. Time, 6. Severity, 7. Demographics, and 8. Driver Behavior.

2.2 Filter Definitions for the IMPACT Analyses

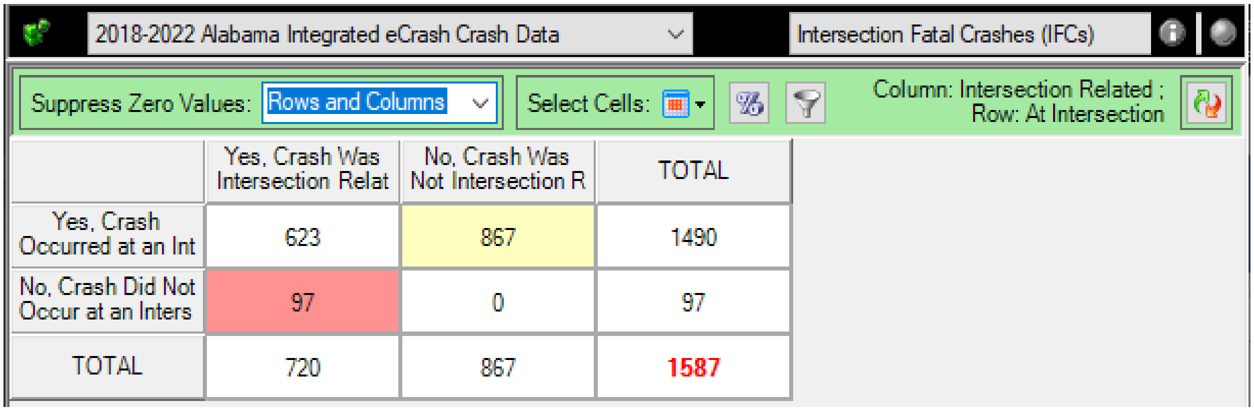
The IMPACT analyses will compare Intersection Fatal Crashes (IFCs) vs Intersection Non-Fatal Crashes (INFCs). The standard filter for all fatal crashes based on C025 Crash Severity was applied, and separate filters for the IFCs and INFCs were obtained, as exemplified in the IMPACT displays in the next few pages. The formal definitions for these two filters are given below:

Formal Definition of Intersection Fatal Crashes (IFCs)



In plain English, the above indicates that all of the test crashes to be compared by IMPACT have the following characteristics:

1. They must all be fatal crashes;
2. They must all occur at an Intersection;
3. They also qualify if they were Intersection-related even if they did not occur at an intersection.
   1,587 Crashes Qualified for FY2018-2022

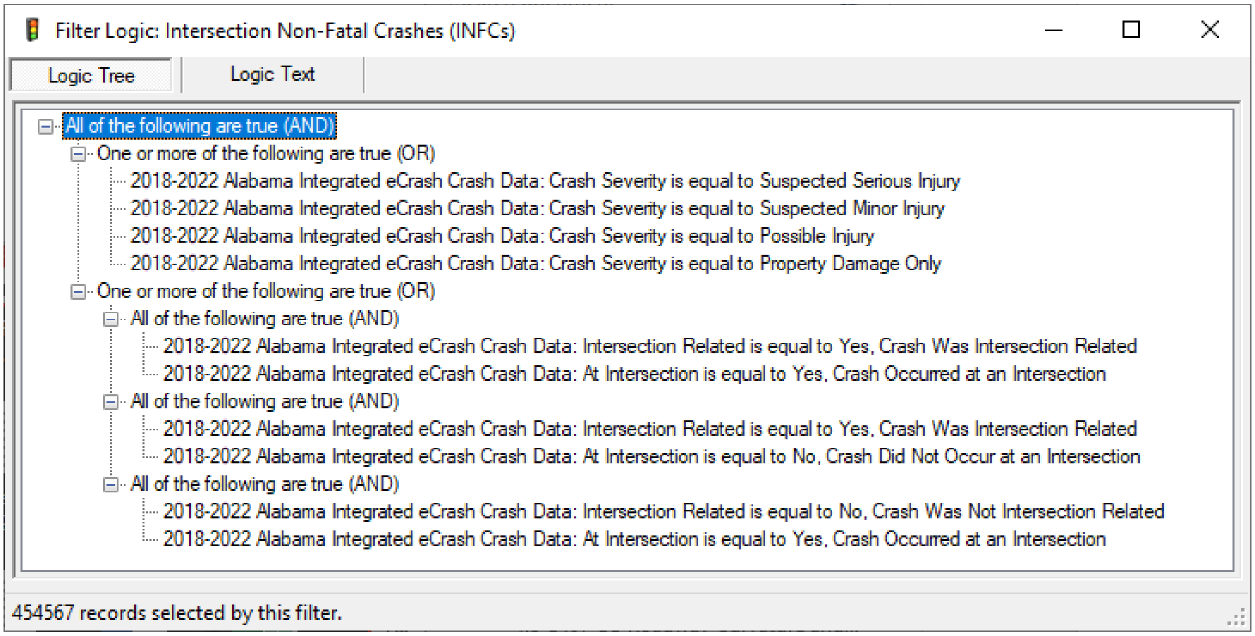


2018-2022 Alabama Integrated eCrash Crash Data | Intersection Fatal Crashes (IFCs)

Suppress Zero Values: Rows and Columns | Select Cells: | Column: Intersection Related ; Row: At Intersection

	Yes, Crash Was Intersection Relat	No, Crash Was Not Intersection R	TOTAL
Yes, Crash Occurred at an Int	623	867	1490
No, Crash Did Not Occur at an Inters	97	0	97
TOTAL	720	867	**1587**

Formal Definition of Intersection Non-Fatal Crashes (INFCs)



Filter Logic: Intersection Non-Fatal Crashes (INFCs)

Logic Tree | Logic Text

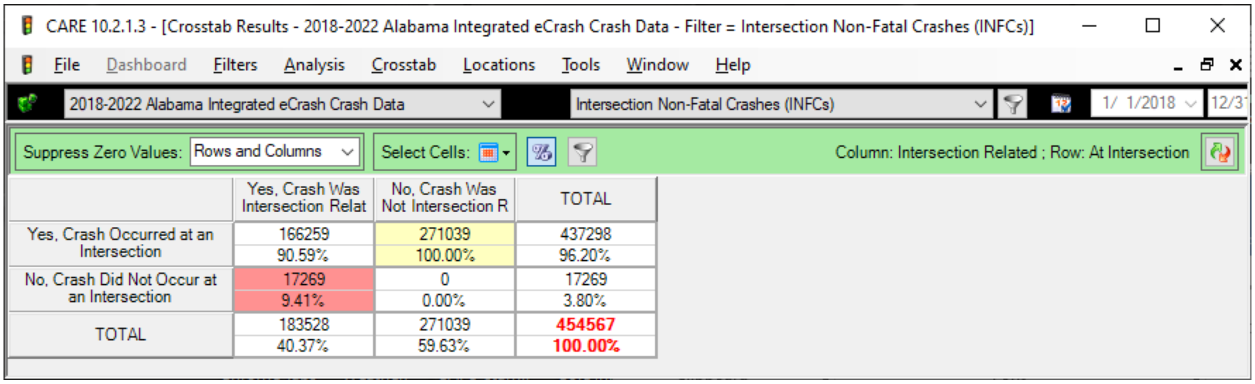
- All of the following are true (AND)
  - One or more of the following are true (OR)
    - 2018-2022 Alabama Integrated eCrash Crash Data: Crash Severity is equal to Suspected Serious Injury
    - 2018-2022 Alabama Integrated eCrash Crash Data: Crash Severity is equal to Suspected Minor Injury
    - 2018-2022 Alabama Integrated eCrash Crash Data: Crash Severity is equal to Possible Injury
    - 2018-2022 Alabama Integrated eCrash Crash Data: Crash Severity is equal to Property Damage Only
  - One or more of the following are true (OR)
    - All of the following are true (AND)
      - 2018-2022 Alabama Integrated eCrash Crash Data: Intersection Related is equal to Yes, Crash Was Intersection Related
      - 2018-2022 Alabama Integrated eCrash Crash Data: At Intersection is equal to Yes, Crash Occurred at an Intersection
    - All of the following are true (AND)
      - 2018-2022 Alabama Integrated eCrash Crash Data: Intersection Related is equal to Yes, Crash Was Intersection Related
      - 2018-2022 Alabama Integrated eCrash Crash Data: At Intersection is equal to No, Crash Did Not Occur at an Intersection
    - All of the following are true (AND)
      - 2018-2022 Alabama Integrated eCrash Crash Data: Intersection Related is equal to No, Crash Was Not Intersection Related
      - 2018-2022 Alabama Integrated eCrash Crash Data: At Intersection is equal to Yes, Crash Occurred at an Intersection

454567 records selected by this filter.

In plain English, the above indicates that all of the control (Other) crashes to be compared by IMPACT have the following characteristics:

1. They must all be non-fatal crashes;
2. They must either occur at or be related to an Intersection.

454,567 Crashes Qualified as Intersection Non-Fatal Crashes (INFCs) in FY2018-2022.



	Yes, Crash Was Intersection Relat	No, Crash Was Not Intersection R	TOTAL
Yes, Crash Occurred at an Intersection	166259 90.59%	271039 100.00%	437298 96.20%
No, Crash Did Not Occur at an Intersection	17269 9.41%	0 0.00%	17269 3.80%
TOTAL	183528 40.37%	271039 59.63%	454567 100.00%

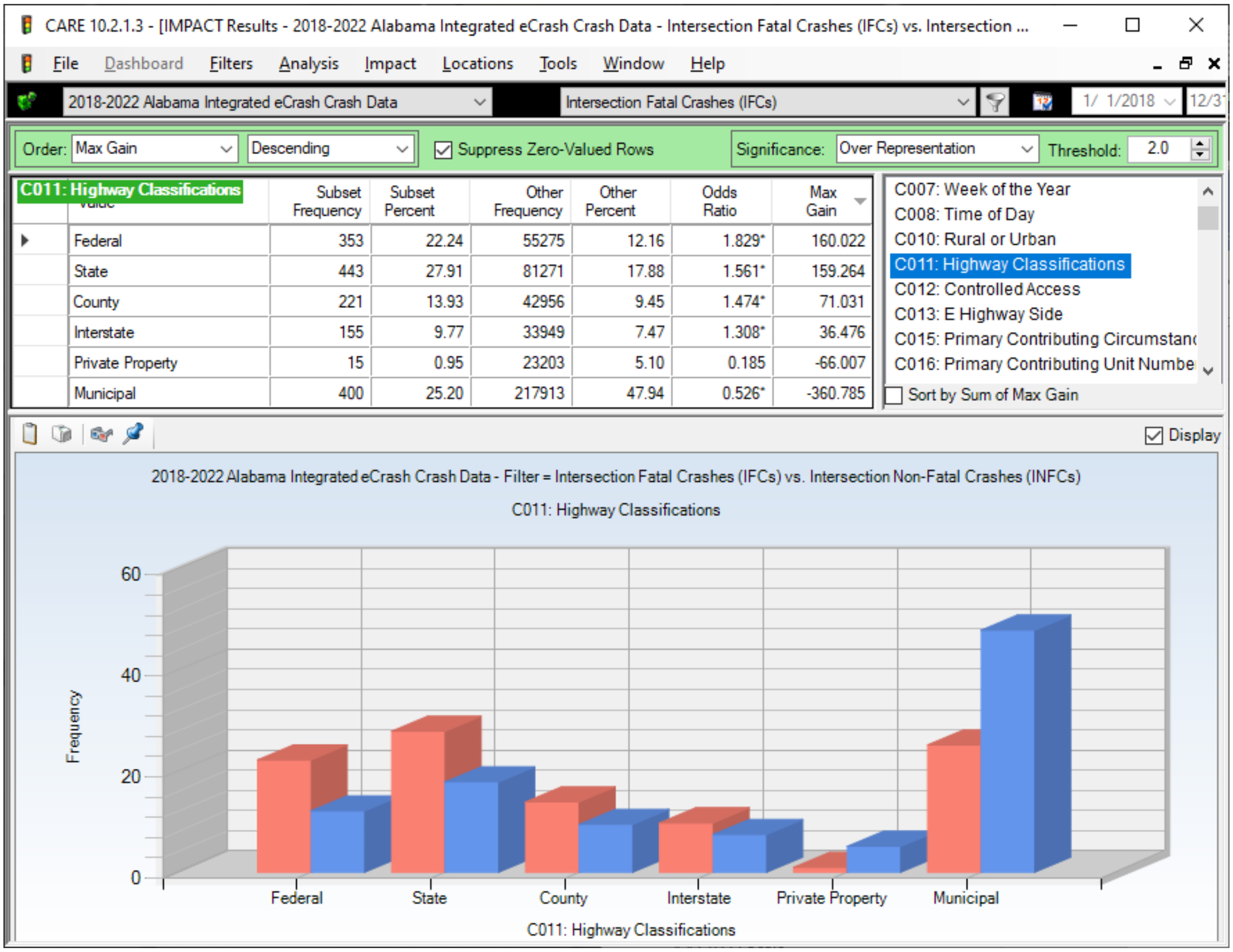
The IMPACT analyses in Section 4-8 below will compare the 1,587 IFCs with the corresponding attributes of the 454,567 INFCs in order to pinpoint the attributes that are most likely to be causing the fatal crashes at intersections

The following provide reasons for selecting IFCs as the *test subset* and INFCs as the *control subset* (called "Other" in the IMPACTs):

- To determine what causes fatal crashes, the fatal crashes have to be compared against non-fatal crashes.
- The test subset was all fatal crashes either at intersections or related to intersections (or both).
- The control subset was all non-fatal crashes either at intersections or related to intersections (or both).

Note the filter of this IMPACT is IFCs and the comparative "Other" subset is INFCs. These comparisons are different from most IMPACT analyses we have done in the past, because here both the Subset crashes and the "Other" crashes consist only of intersection crashes. Thus, they are comparable to each other.

2.3 Highway Classification (4.6, C011); Comparison of IFCs and INFCs



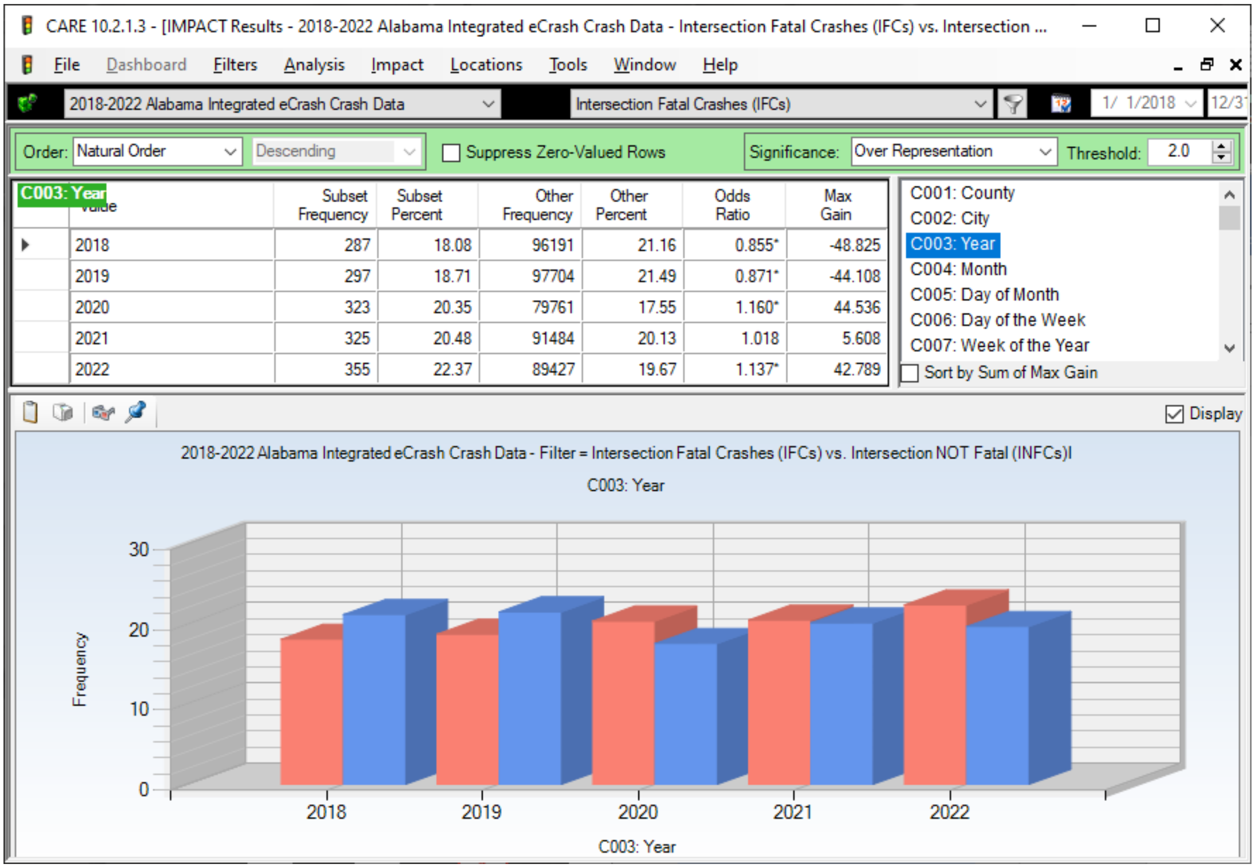
C011: Highway Classifications	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Federal	353	22.24	55275	12.16	1.829*	160.022
State	443	27.91	81271	17.88	1.561*	159.264
County	221	13.93	42956	9.45	1.474*	71.031
Interstate	155	9.77	33949	7.47	1.308*	36.476
Private Property	15	0.95	23203	5.10	0.185	-66.007
Municipal	400	25.20	217913	47.94	0.526*	-360.785

Reminder: IFCs=Intersection Fatalities=**Red bars**; INFCs=Intersection Non-Fatal=**Blue bars**.

In this IMPACT display, as well of those in Sections 4 through 8, the Subset (given by the red bars) is the Intersection Fatal Crashes (IFCs). The "Other" crashes are those that were Non-Fatal and occurred at Intersections (INFCs). This IMPACT (and those below) will use both of the filters defined above to compare the IFCs directly with the INFCs. The above shows that all highway classifications except Municipal and Private Property are significantly are over-represented in IFCs. Municipal is significantly under-represented. Federal and State highways are over-represented in their proportions and also in their frequencies (353 and 443, respectively). The IFC filter will be used to define the "Subset," while INFC filter will define the "Other," which is mainly used as a control.

3.0 Fatal Crash Comparison by Year (IFCs vs INFCs)

Intersection Fatal Crashes (IFCs) vs Intersection Non-Fatal Crashes (INFCs) by Year



Quick reminder: IFCs= Intersection Fatal=**Red bars**; INFCs=Intersection Non-Fatal=**Blue bars**.

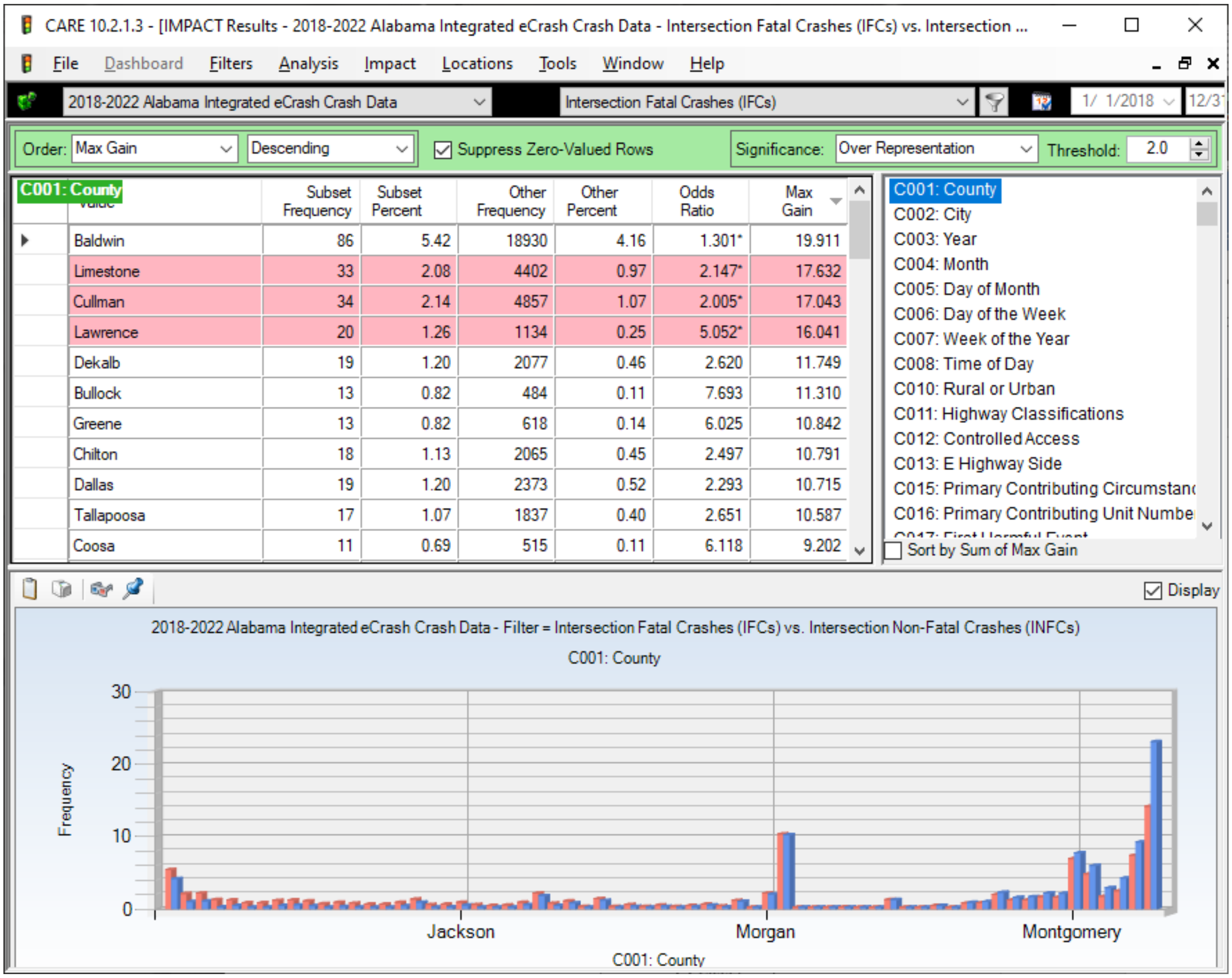
This is an example that further demonstrate the IMPACT displays. All of the years except 2021 were found to have statistically significant differences. It is also clear that there is a significant upward trend in IFCs compared to INFCs. The Pearson correlation coefficient for the two five-year sets is -0.54645.

Statistically significant results for a given attribute are indicated by an asterisk (*) that will appear on the Odds Ratio for the attribute value under consideration.

See Section 5.1 for additional comments on changes by year.

4.0 Geographic and Harmful Event Factors

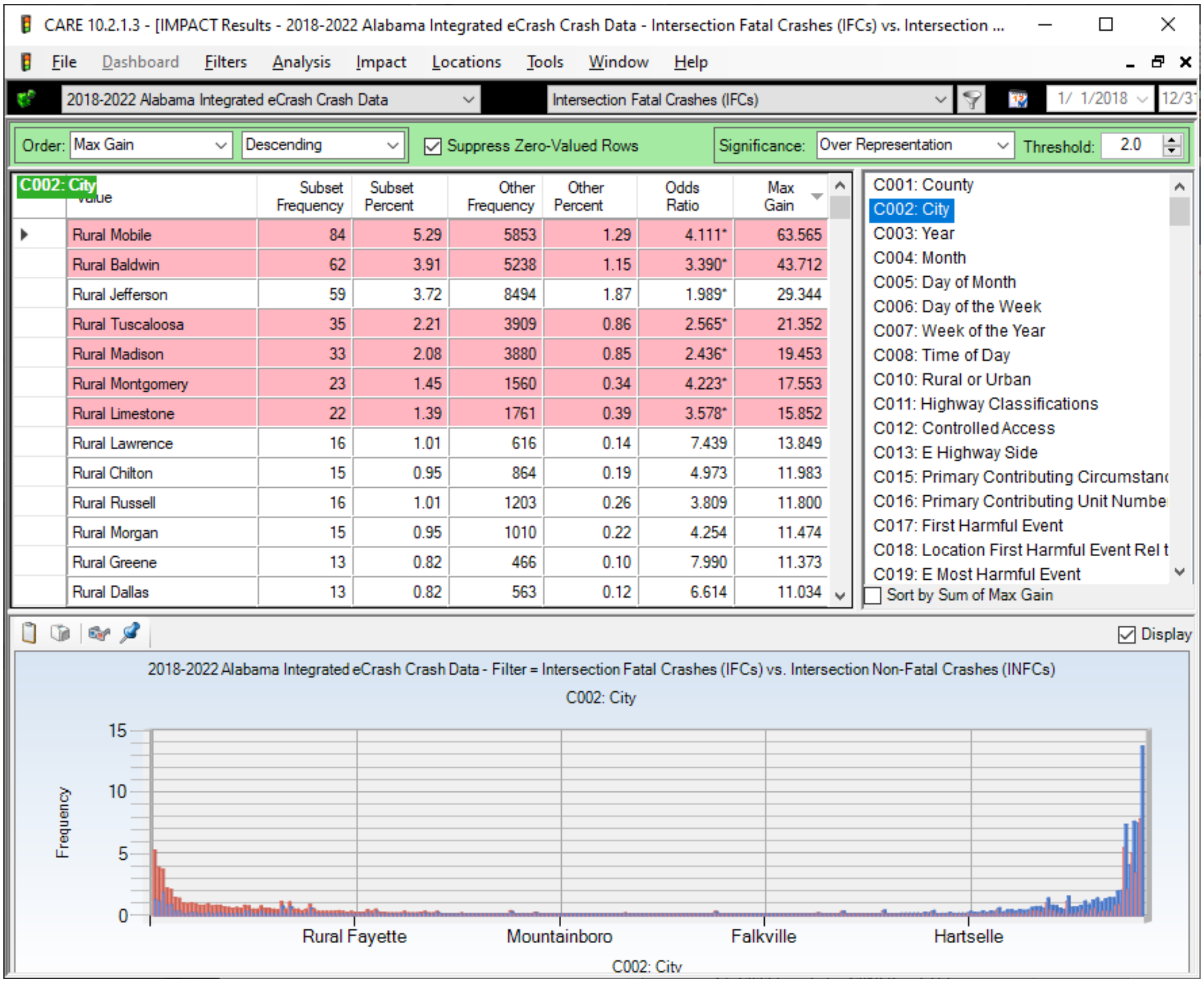
4.1 C001 Intersection (top 11 counties) ordered by Max Gain; IFCs vs INFCs



C001: County	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Baldwin	86	5.42	18930	4.16	1.301*	19.911
Limestone	33	2.08	4402	0.97	2.147*	17.632
Cullman	34	2.14	4857	1.07	2.005*	17.043
Lawrence	20	1.26	1134	0.25	5.052*	16.041
Dekalb	19	1.20	2077	0.46	2.620	11.749
Bullock	13	0.82	484	0.11	7.693	11.310
Greene	13	0.82	618	0.14	6.025	10.842
Chilton	18	1.13	2065	0.45	2.497	10.791
Dallas	19	1.20	2373	0.52	2.293	10.715
Tallapoosa	17	1.07	1837	0.40	2.651	10.587
Coosa	11	0.69	515	0.11	6.118	9.202

Each line of table above gives both IFC and INFC crashes. So, Baldwin at the top had 86 Intersection Fatal Crashes (IFCs) and 18,930 Intersection Non-Fatal Crashes (INFCs). The respective proportions (5.42 and 4.16) are compared to obtain the Odds Ratio of 1.301. These proportions are calculated from the attribute (Baldwin) frequency divided by the total number of crashes (in both the Subset and the Other). The Max Gain (19.911) is the number of Intersection Fatal Crashes (IFCs) that would be reduced if somehow the 5.42 was reduced to 4.16. 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 IFC proportions as opposed to their INFC proportions. The display above contains all of the counties with Max Gains greater than 9.000.

4.2 C002 Cities (top 13) with Highest Max Gains (Rural Areas = Virtual Cities)

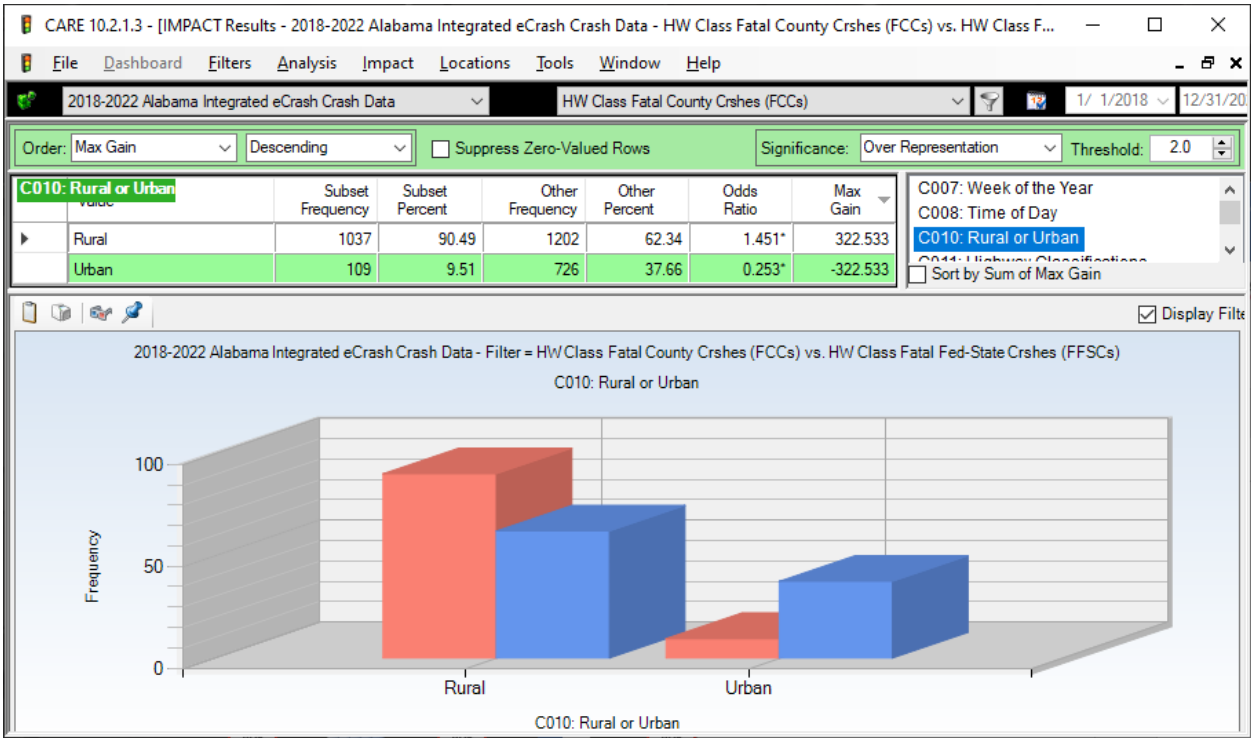


C002: City Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Rural Mobile	84	5.29	5853	1.29	4.111*	63.565
Rural Baldwin	62	3.91	5238	1.15	3.390*	43.712
Rural Jefferson	59	3.72	8494	1.87	1.989*	29.344
Rural Tuscaloosa	35	2.21	3909	0.86	2.565*	21.352
Rural Madison	33	2.08	3880	0.85	2.436*	19.453
Rural Montgomery	23	1.45	1560	0.34	4.223*	17.553
Rural Limestone	22	1.39	1761	0.39	3.578*	15.852
Rural Lawrence	16	1.01	616	0.14	7.439	13.849
Rural Chilton	15	0.95	864	0.19	4.973	11.983
Rural Russell	16	1.01	1203	0.26	3.809	11.800
Rural Morgan	15	0.95	1010	0.22	4.254	11.474
Rural Greene	13	0.82	466	0.10	7.990	11.373
Rural Dallas	13	0.82	563	0.12	6.614	11.034

For comparison purposes, the rural areas of counties are considered to be "virtual cities," and crashes that occur there are listed as "Rural [County Name]" so that these crashes can be effectively accounted for and compared.

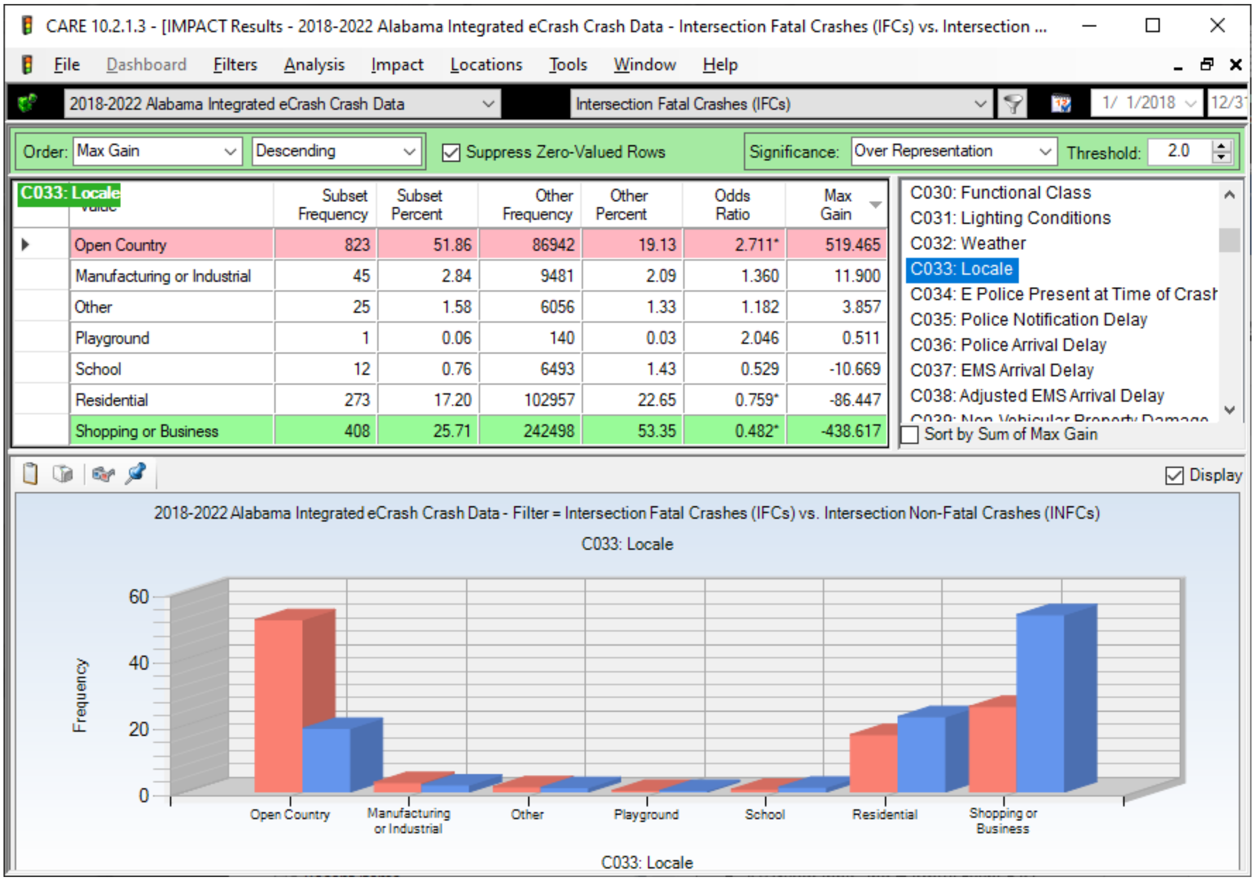
The high rural areas are generally adjacent to (or partially contain) significant urban areas that have a high traffic density. This display is in Max Gain ordering to put those (possibly virtual) cities that have the highest potential for Intersection Fatal [road] Crash (IFC) reduction at the top. The display is for all Max Gains > 10. It is no surprise that the rural areas have relatively more fatal crashes than their urban city counterparts, as will be shown in the next attribute below.. The five highest (virtual) cities are: Rural Mobile 84, Rural Baldwin 62, Rural Jefferson 59, Rural Tuscaloosa 35, and Rural Madison 33.

4.3 C010 Rural or Urban



The Intersection crashes had 46.50% of the IFCs in rural areas, while this percentage was 13.55% for Rural INFCs. The INFCs were predominately urban, with 86.45% in the urban areas. Both results illustrate how much more lethal rural crashes are then those on urban roadways. This is attributed to the comparative speed at impact on the rural roads. Speed 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 4.4 below). Significant differences were found between the Intersection Fatal and Intersection Non-Fatal Crashes in both the rural and urban differences.

4.4 C033 Locale

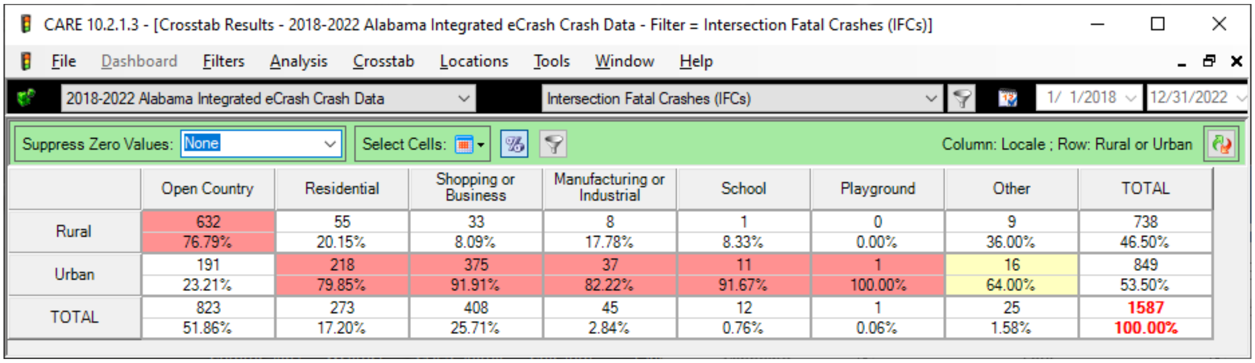


Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Open Country	823	51.86	86942	19.13	2.711*	519.465
Manufacturing or Industrial	45	2.84	9481	2.09	1.360	11.900
Other	25	1.58	6056	1.33	1.182	3.857
Playground	1	0.06	140	0.03	2.046	0.511
School	12	0.76	6493	1.43	0.529	-10.669
Residential	273	17.20	102957	22.65	0.759*	-86.447
Shopping or Business	408	25.71	242498	53.35	0.482*	-438.617

Open Country showed significant differences between IFCs and INFCs. The IFC proportion for Open Country was 51.86, and its Odds Ratio was 2.711. Residential and Shopping or Business were significantly under-represented, although both had high frequencies (408 for Shopping or Business and 273 for Residential). But the proportions for these were significantly lower than thos of the INFCs. This demonstrates a significantly larger proportion of Open Country in the applicable roadway system, even though the number of intersections would not be as large as in the urban areas. The two factors that contribute to the Open Country results are its being proximal to urban areas that increase the traffic flow, and the greater speeds on the rural roads that increase the number of fatalities.

4.5 C033 Locale by C010 Rural-Urban for IFCs

It is obvious in the above outputs that both IFCs are greatly over-represented in the rural areas. It is interesting to perform a cross-tabulation for Locale over the Rural and Urban areas to further define this relationship. The following, *which is only for IFCs*, gives one such analysis.

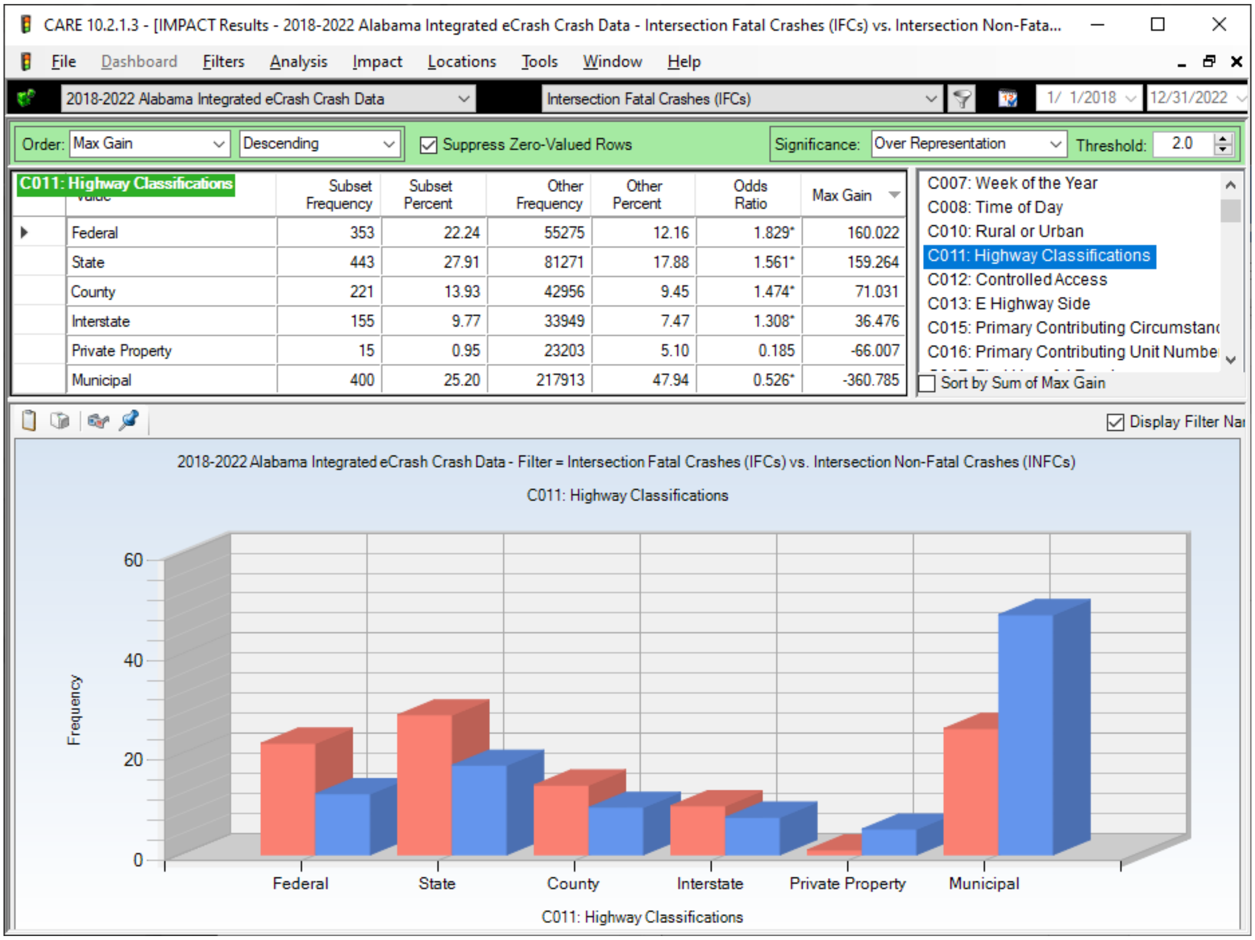


	Open Country	Residential	Shopping or Business	Manufacturing or Industrial	School	Playground	Other	TOTAL
Rural	632 76.79%	55 20.15%	33 8.09%	8 17.78%	1 8.33%	0 0.00%	9 36.00%	738 46.50%
Urban	191 23.21%	218 79.85%	375 91.91%	37 82.22%	11 91.67%	1 100.00%	16 64.00%	849 53.50%
TOTAL	823 51.86%	273 17.20%	408 25.71%	45 2.84%	12 0.76%	1 0.06%	25 1.58%	1587 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. If under-represented, there will be a white background. For example, while 53.50% of all IFCs were Urban, 79.85% (218) occurred in Residential Locale. Since this is greater than a 10% difference, it has a red background.

This shows that the Rural/Urban attribute may not be as definitive as Locale in categorizing crash locations.

4.6 C011 Highway Classifications

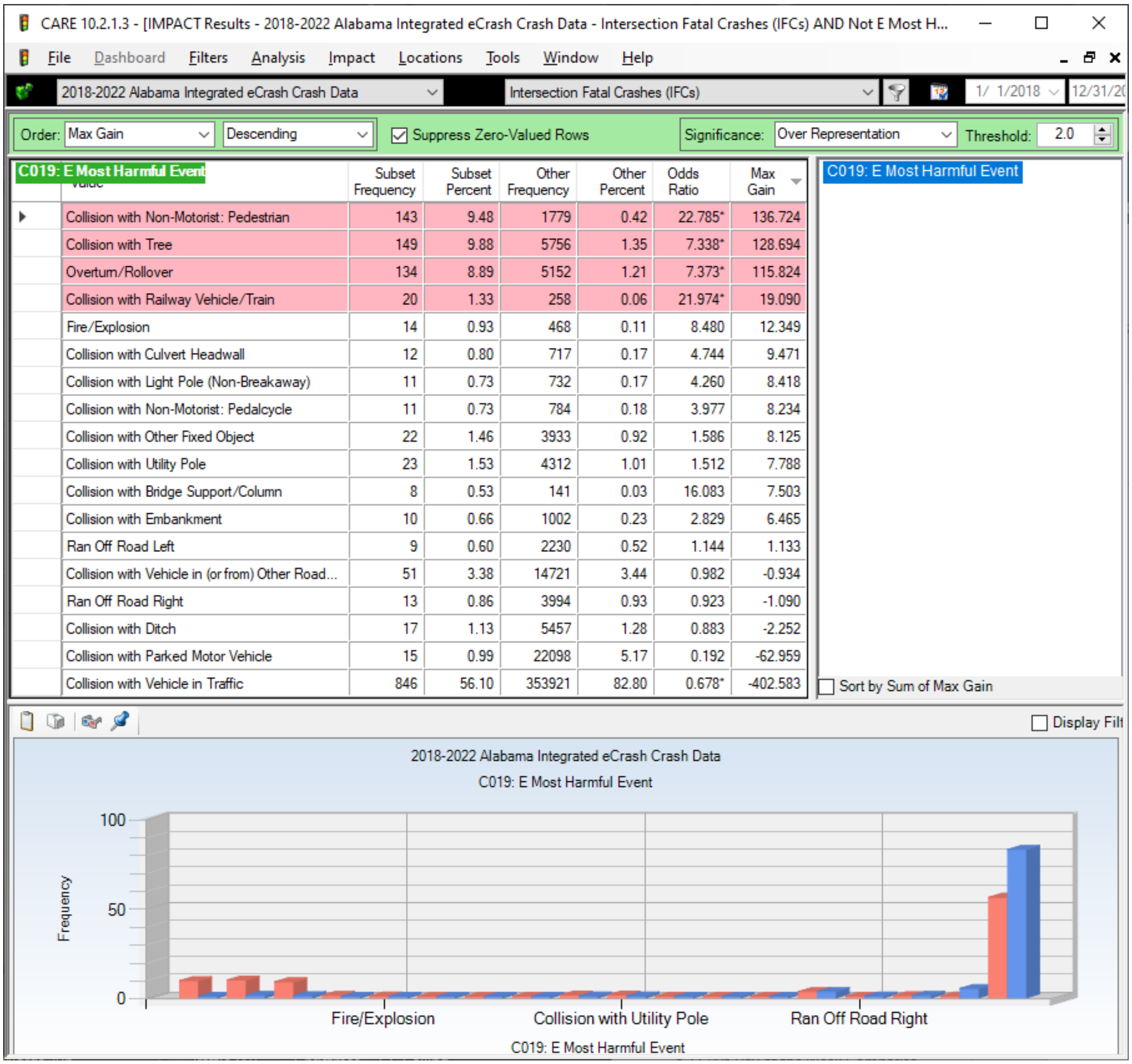


C011: Highway Classifications	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Federal	353	22.24	55275	12.16	1.829*	160.022
State	443	27.91	81271	17.88	1.561*	159.264
County	221	13.93	42956	9.45	1.474*	71.031
Interstate	155	9.77	33949	7.47	1.308*	36.476
Private Property	15	0.95	23203	5.10	0.185	-66.007
Municipal	400	25.20	217913	47.94	0.526*	-360.785

This display was introduced in Section 2.3, but little was said of it ramifications. Clearly State routes have the largest number of fatal crashes at intersection (443). The second and third are Federal (353) and County (221). Interstates (with few intersections) had only 155, with the lowest Odds Ratio of 1.308. While significantly under-represented (0.526*) from the proportion point of view, the Highway Classification with the highest frequency was Municipal (400).

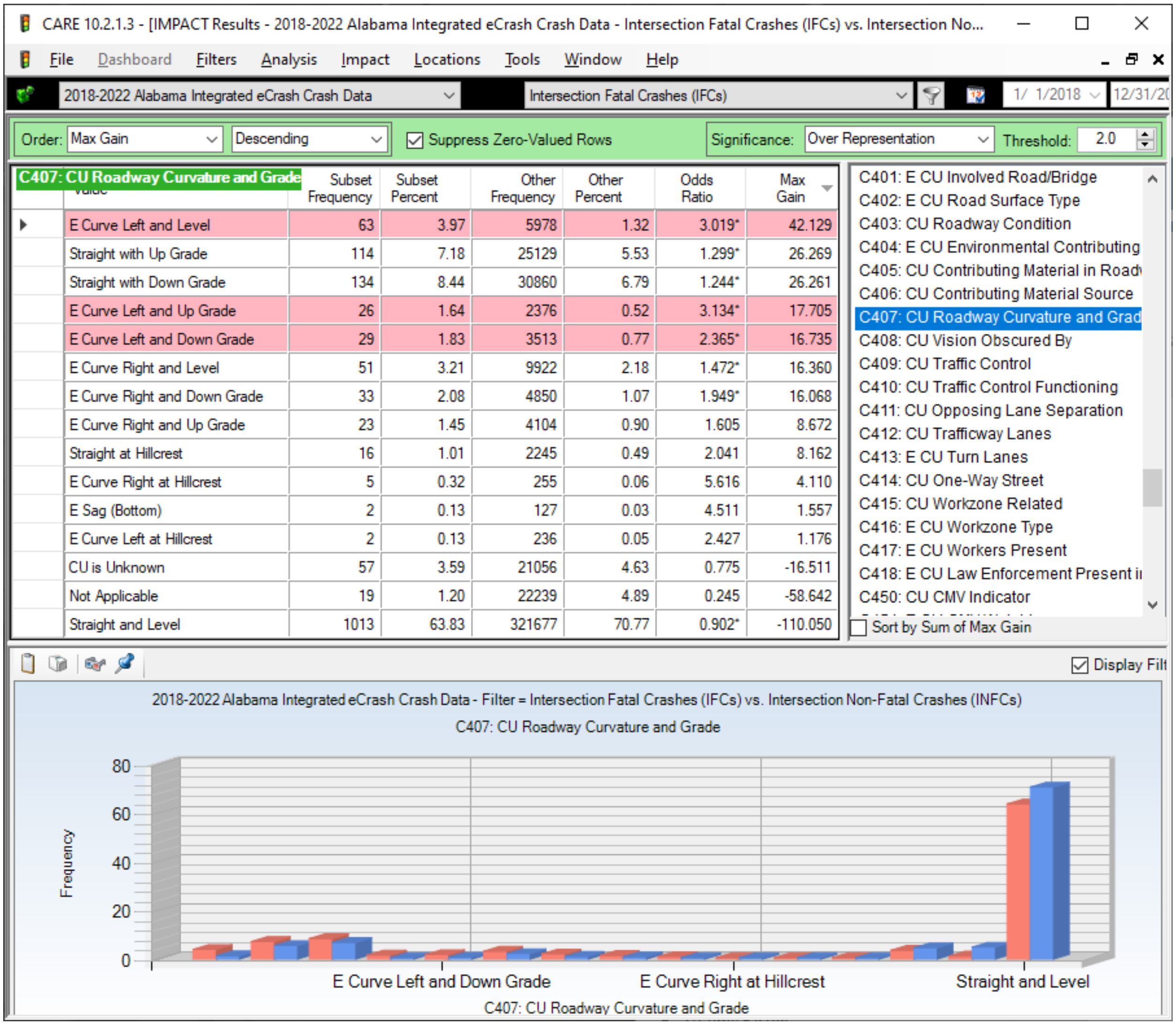
4.7 C019 Most Harmful Event (>7 in MaxGain order)

The following display is intended to show safety engineers obstacles that are being hit most often in Fatal Intersection Crashes, with a differential between Intersection Fatal and Intersection Non-Fatal crashes. The most over-represented FDC is Collision with Non-Motorist Pedestrian. The statistical algorithm does not consider items with frequencies less than 20, so there could be other significant differences in the list. At the bottom of the table it can be seen that for INFC over-representations, Collisions with Vehicle in Traffic (846 IFCs; 353,921 INFCs) had the highest over-representation.



C019: E Most Harmful Event	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Collision with Non-Motorist: Pedestrian	143	9.48	1779	0.42	22.785*	136.724
Collision with Tree	149	9.88	5756	1.35	7.338*	128.694
Overturn/Rollover	134	8.89	5152	1.21	7.373*	115.824
Collision with Railway Vehicle/Train	20	1.33	258	0.06	21.974*	19.090
Fire/Explosion	14	0.93	468	0.11	8.480	12.349
Collision with Culvert Headwall	12	0.80	717	0.17	4.744	9.471
Collision with Light Pole (Non-Breakaway)	11	0.73	732	0.17	4.260	8.418
Collision with Non-Motorist: Pedalcycle	11	0.73	784	0.18	3.977	8.234
Collision with Other Fixed Object	22	1.46	3933	0.92	1.586	8.125
Collision with Utility Pole	23	1.53	4312	1.01	1.512	7.788
Collision with Bridge Support/Column	8	0.53	141	0.03	16.083	7.503
Collision with Embankment	10	0.66	1002	0.23	2.829	6.465
Ran Off Road Left	9	0.60	2230	0.52	1.144	1.133
Collision with Vehicle in (or from) Other Road...	51	3.38	14721	3.44	0.982	-0.934
Ran Off Road Right	13	0.86	3994	0.93	0.923	-1.090
Collision with Ditch	17	1.13	5457	1.28	0.883	-2.252
Collision with Parked Motor Vehicle	15	0.99	22098	5.17	0.192	-62.959
Collision with Vehicle in Traffic	846	56.10	353921	82.80	0.678*	-402.583

4.8 C407 CU Roadway Curvature and Grade



C407: CU Roadway Curvature and Grade	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
E Curve Left and Level	63	3.97	5978	1.32	3.019*	42.129
Straight with Up Grade	114	7.18	25129	5.53	1.299*	26.269
Straight with Down Grade	134	8.44	30860	6.79	1.244*	26.261
E Curve Left and Up Grade	26	1.64	2376	0.52	3.134*	17.705
E Curve Left and Down Grade	29	1.83	3513	0.77	2.365*	16.735
E Curve Right and Level	51	3.21	9922	2.18	1.472*	16.360
E Curve Right and Down Grade	33	2.08	4850	1.07	1.949*	16.068
E Curve Right and Up Grade	23	1.45	4104	0.90	1.605	8.672
Straight at Hillcrest	16	1.01	2245	0.49	2.041	8.162
E Curve Right at Hillcrest	5	0.32	255	0.06	5.616	4.110
E Sag (Bottom)	2	0.13	127	0.03	4.511	1.557
E Curve Left at Hillcrest	2	0.13	236	0.05	2.427	1.176
CU is Unknown	57	3.59	21056	4.63	0.775	-16.511
Not Applicable	19	1.20	22239	4.89	0.245	-58.642
Straight and Level	1013	63.83	321677	70.77	0.902*	-110.050

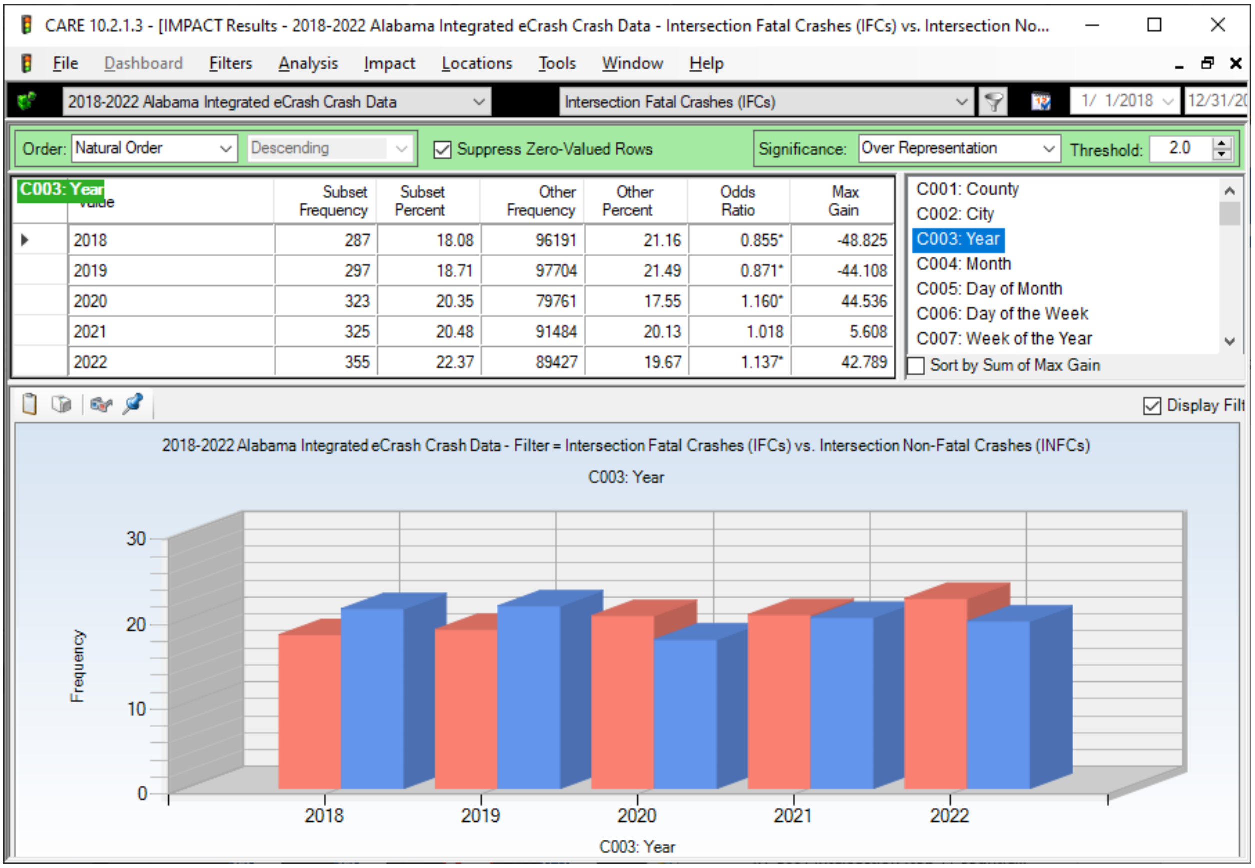
IFCs are over-represented in the vast majority of curve types. Their proportional difference from INFCs were seen to be significantly higher in seven comparisons (see the top seven in the table).

OVER-REPRESENTED IFCs: Straight with Up Grade 114, and Straight with Down Grade 134. Most intersections are not on curves.

5.0 Time Factors

5.1 C003 Year – copied from Section 3.0 for ease of reference

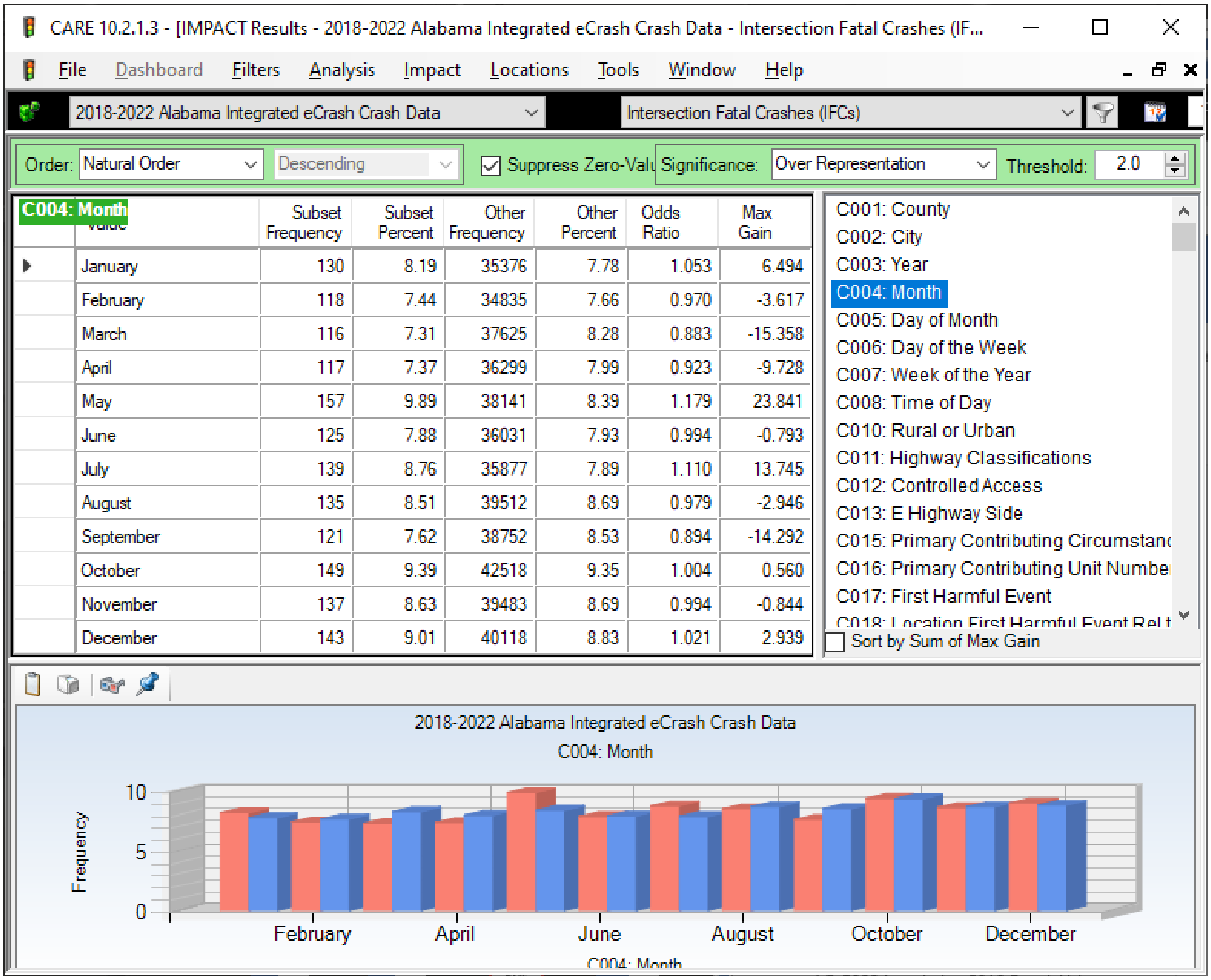
Intersection Fatal Crashes (IFCs) vs Intersection Non-Fatal Crashes (INFCs) by Year



C003: Year Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
2018	287	18.08	96191	21.16	0.855*	-48.825
2019	297	18.71	97704	21.49	0.871*	-44.108
2020	323	20.35	79761	17.55	1.160*	44.536
2021	325	20.48	91484	20.13	1.018	5.608
2022	355	22.37	89427	19.67	1.137*	42.789

Variations from year to year were significant in all years except 2021. IFCs were under-represented in 2018 and 2019, but they became over-represented in 2020-2022. The correlation coefficient between the raw frequencies of IFCs and INFCs was significant, but not exceedingly large, at 0.54645. The reason for these increased IFC proportions is not definitive, but this consistent increase should be watched to determine a cause in future years.

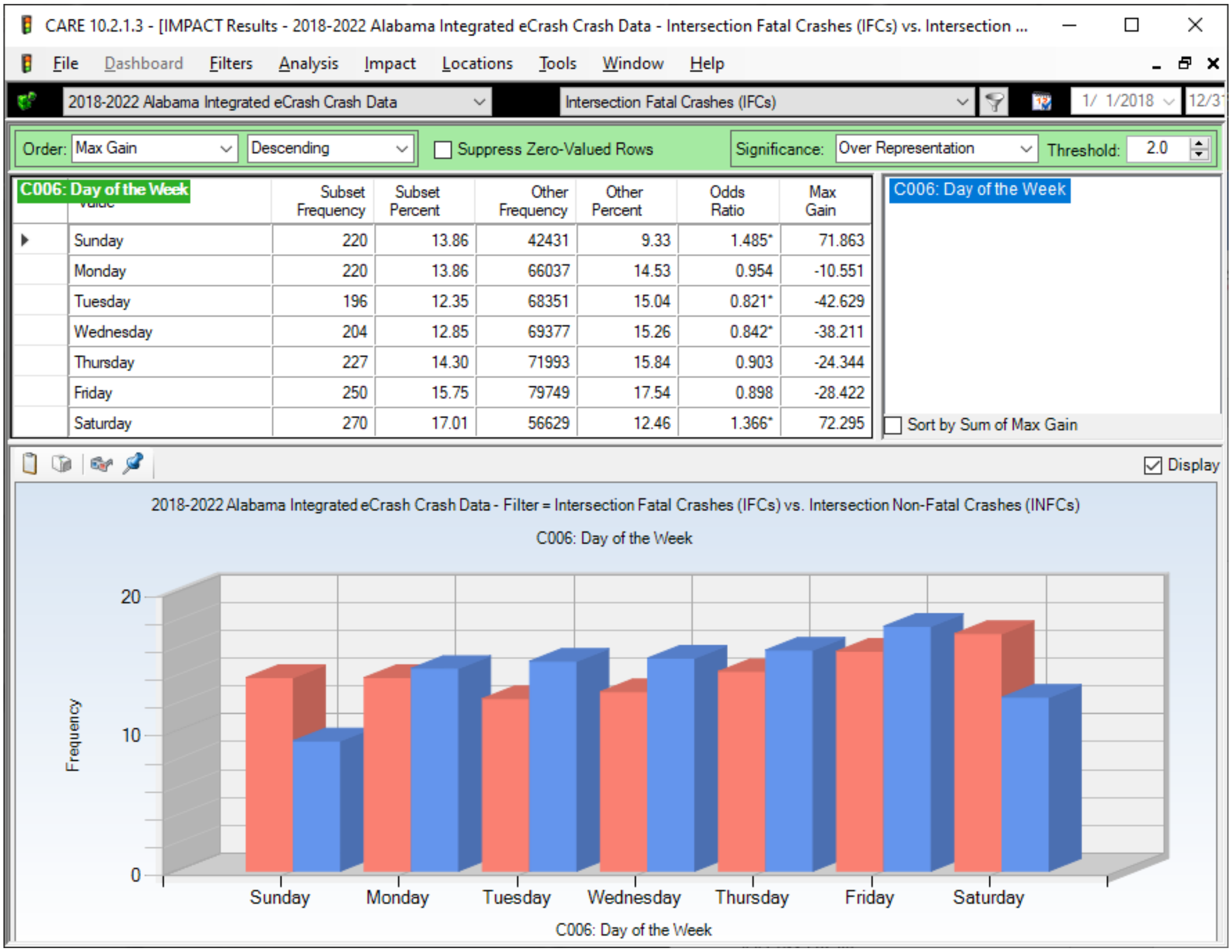
5.2 C004 Month



C004: Month Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
January	130	8.19	35376	7.78	1.053	6.494
February	118	7.44	34835	7.66	0.970	-3.617
March	116	7.31	37625	8.28	0.883	-15.358
April	117	7.37	36299	7.99	0.923	-9.728
May	157	9.89	38141	8.39	1.179	23.841
June	125	7.88	36031	7.93	0.994	-0.793
July	139	8.76	35877	7.89	1.110	13.745
August	135	8.51	39512	8.69	0.979	-2.946
September	121	7.62	38752	8.53	0.894	-14.292
October	149	9.39	42518	9.35	1.004	0.560
November	137	8.63	39483	8.69	0.994	-0.844
December	143	9.01	40118	8.83	1.021	2.939

The ordering of the displays above is according to the natural ordering of months. No months had any statistically significant over-representations or under-representations. IFC months generally fell in line with their INFC counterparts. The largest over-representation was in May.

5.3 C006 Day of the Week Comparison IFCs and INFCs



C006: Day of the Week	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Sunday	220	13.86	42431	9.33	1.485*	71.863
Monday	220	13.86	66037	14.53	0.954	-10.551
Tuesday	196	12.35	68351	15.04	0.821*	-42.629
Wednesday	204	12.85	69377	15.26	0.842*	-38.211
Thursday	227	14.30	71993	15.84	0.903	-24.344
Friday	250	15.75	79749	17.54	0.898	-28.422
Saturday	270	17.01	56629	12.46	1.366*	72.295

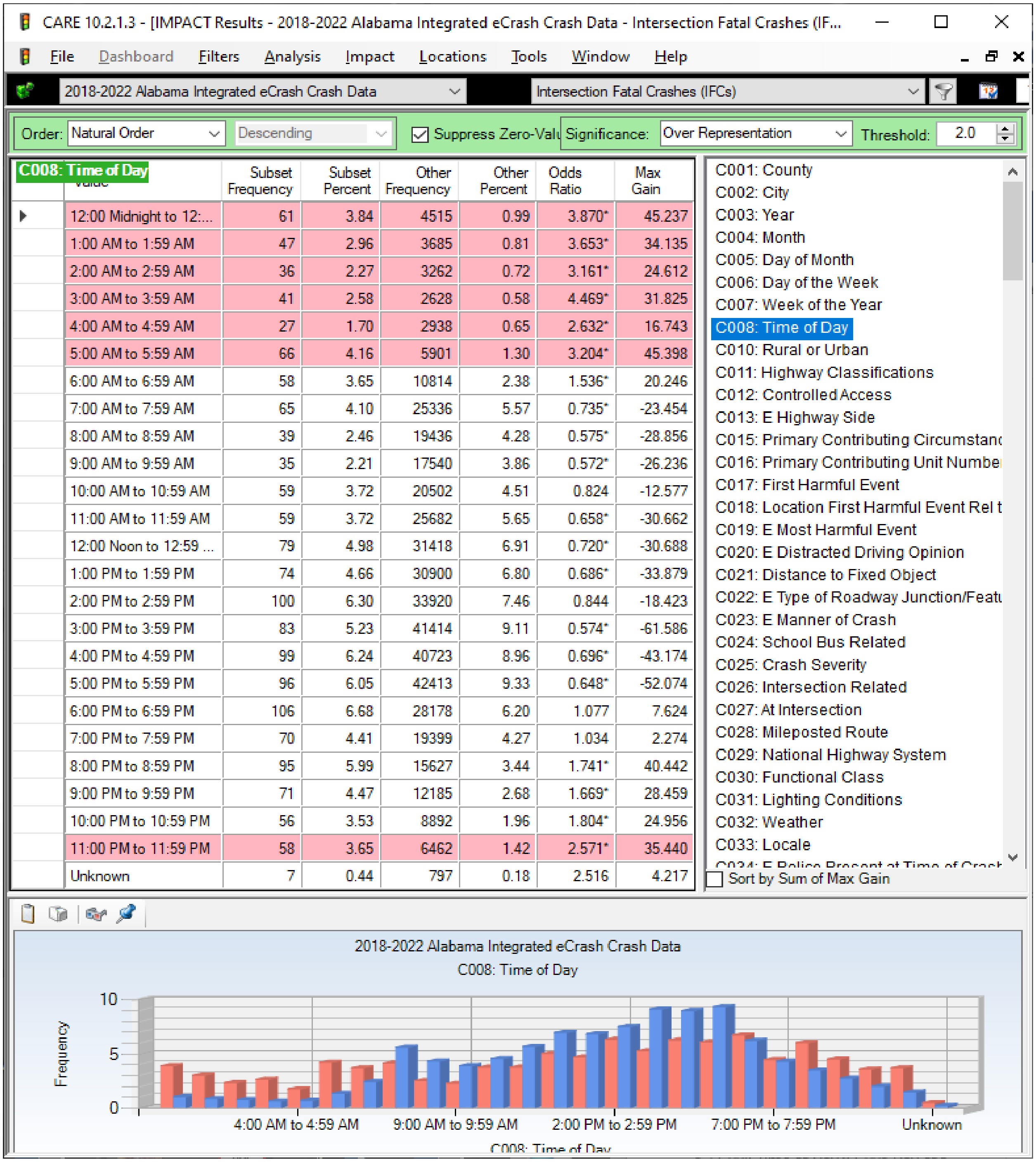
The following presents Days of the Week with significant over-representations displayed.

Over-rep Fatal Intersection	Over-rep Non-Fatal Intersection
Sunday 1.485*	Tuesday 0.821*
Saturday 1.366*	Wednesday 0.842*
*Statistically Significant	

5.4 Day of the Week Discussion [covered above.]

Also, all relevant Day of the Week information is given in Section 5.6.

5.5 C008 Time of Day



Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
12:00 Midnight to 12:...	61	3.84	4515	0.99	3.870*	45.237
1:00 AM to 1:59 AM	47	2.96	3685	0.81	3.653*	34.135
2:00 AM to 2:59 AM	36	2.27	3262	0.72	3.161*	24.612
3:00 AM to 3:59 AM	41	2.58	2628	0.58	4.469*	31.825
4:00 AM to 4:59 AM	27	1.70	2938	0.65	2.632*	16.743
5:00 AM to 5:59 AM	66	4.16	5901	1.30	3.204*	45.398
6:00 AM to 6:59 AM	58	3.65	10814	2.38	1.536*	20.246
7:00 AM to 7:59 AM	65	4.10	25336	5.57	0.735*	-23.454
8:00 AM to 8:59 AM	39	2.46	19436	4.28	0.575*	-28.856
9:00 AM to 9:59 AM	35	2.21	17540	3.86	0.572*	-26.236
10:00 AM to 10:59 AM	59	3.72	20502	4.51	0.824	-12.577
11:00 AM to 11:59 AM	59	3.72	25682	5.65	0.658*	-30.662
12:00 Noon to 12:59 ...	79	4.98	31418	6.91	0.720*	-30.688
1:00 PM to 1:59 PM	74	4.66	30900	6.80	0.686*	-33.879
2:00 PM to 2:59 PM	100	6.30	33920	7.46	0.844	-18.423
3:00 PM to 3:59 PM	83	5.23	41414	9.11	0.574*	-61.586
4:00 PM to 4:59 PM	99	6.24	40723	8.96	0.696*	-43.174
5:00 PM to 5:59 PM	96	6.05	42413	9.33	0.648*	-52.074
6:00 PM to 6:59 PM	106	6.68	28178	6.20	1.077	7.624
7:00 PM to 7:59 PM	70	4.41	19399	4.27	1.034	2.274
8:00 PM to 8:59 PM	95	5.99	15627	3.44	1.741*	40.442
9:00 PM to 9:59 PM	71	4.47	12185	2.68	1.669*	28.459
10:00 PM to 10:59 PM	56	3.53	8892	1.96	1.804*	24.956
11:00 PM to 11:59 PM	58	3.65	6462	1.42	2.571*	35.440
Unknown	7	0.44	797	0.18	2.516	4.217

The over-representation of night-time hours is further confirmation of the correlation of this attribute with that of Impaired Driving (ID, DUI).

5.6 C008 Discussion on Time of Day by Day of the Week

Refer to the Day of the Week by Time of Day cross-tabulation *for all fatal crashes* given immediately below in Section 5.7.

It is no surprise to find Fatal Crashes 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 the comparison of IFCs to INFCs.

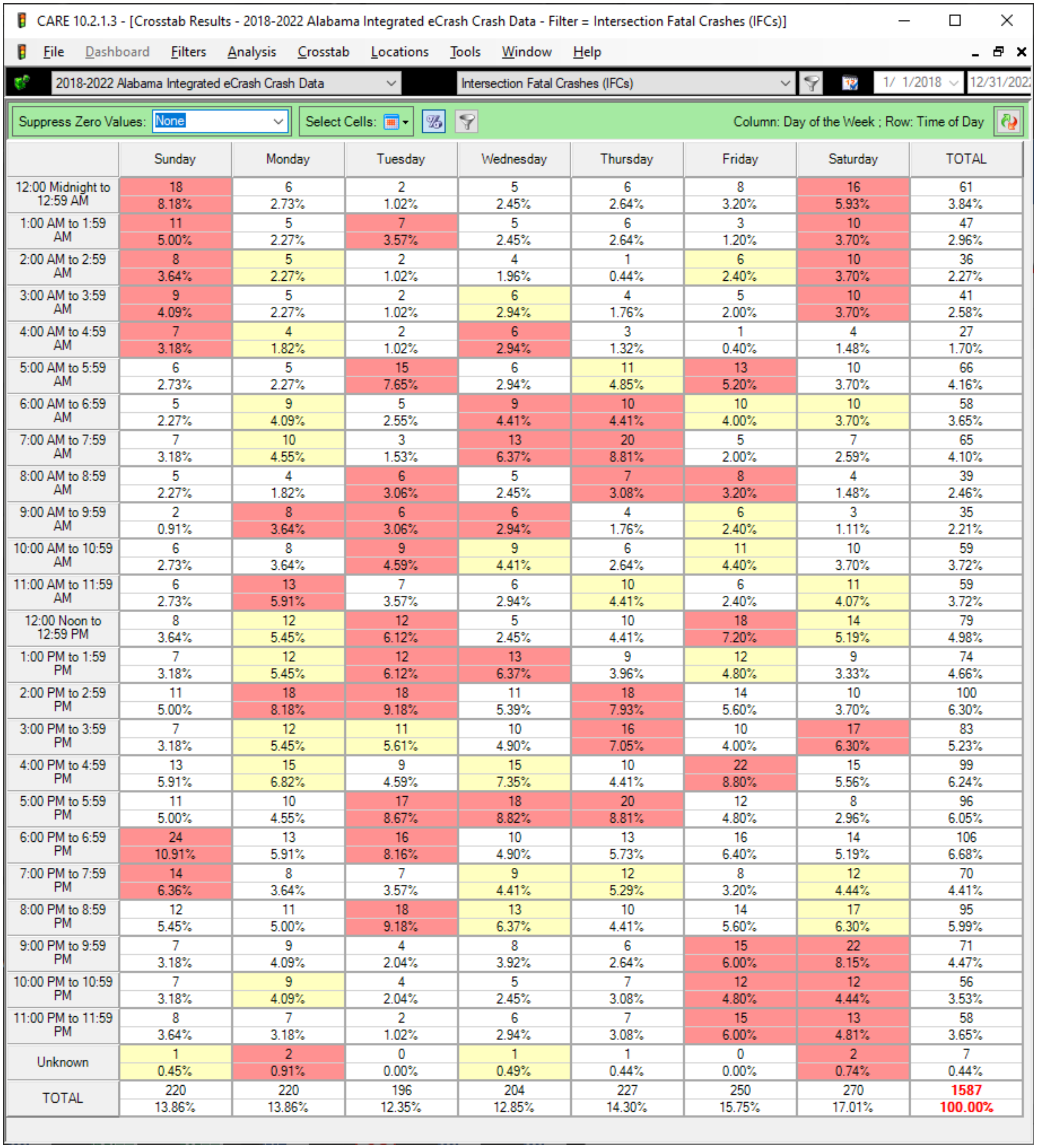
Typical traffic patterns of high traffic results on more crashes in the morning and afternoon rush hours. However, IDs, and especially the IDs that occur at night, are just getting started in the afternoon rush hours, and they continue to grow through midnight and the early morning hours, often not tapering off until about 7:00 AM the next day. It is clear that if selective enforcement is going to have an effect on Fatal Crashes, it would have to be conducted at the times when these crashes are most occurring. Optimal times that start with Friday enforcement would continue immediately following any rush hour details, and would continue through at least 8:00 AM the following Saturday or Sunday.

The *Time of Day by Day of the Week* cross-tabulation (given in the next section *for all fatal crashes* (not subdivided by IFCs and INFCs) shows the optimal times for Intersection selective enforcement on all roadways. Generally, the highest proportion of times in any day are given in red for that day. Notice that this works well for Friday Nights, Saturday mornings, Saturday nights, and Sunday mornings.

The expected proportion for all cells in a given row is given at the extreme right in the total row percentage column for each row. If there were absolutely no over-representations across the columns (days), then all of the proportions for those cells would be identical to the one for the total. Notice for example, the 2 AM to 2:59 AM row has a total percentage value of 2.27% for these fatal crashes. The red cells to the left have percentages of 3.64% and 3.70%. The two yellow cells have percentages of 2.27% and 2.40, which are les than 10% higher than the average. All the rest of the cells have white background indicating that their percentages are less than 2.27%.

Cells that are lower than the average value (given in the TOTAL column) 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.

5.7 C008 Time of Day x C005 Day of the Week (for Intersection Fatal Crashes)



	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	TOTAL
12:00 Midnight to 12:59 AM	18 8.18%	6 2.73%	2 1.02%	5 2.45%	6 2.64%	8 3.20%	16 5.93%	61 3.84%
1:00 AM to 1:59 AM	11 5.00%	5 2.27%	7 3.57%	5 2.45%	6 2.64%	3 1.20%	10 3.70%	47 2.96%
2:00 AM to 2:59 AM	8 3.64%	5 2.27%	2 1.02%	4 1.96%	1 0.44%	6 2.40%	10 3.70%	36 2.27%
3:00 AM to 3:59 AM	9 4.09%	5 2.27%	2 1.02%	6 2.94%	4 1.76%	5 2.00%	10 3.70%	41 2.58%
4:00 AM to 4:59 AM	7 3.18%	4 1.82%	2 1.02%	6 2.94%	3 1.32%	1 0.40%	4 1.48%	27 1.70%
5:00 AM to 5:59 AM	6 2.73%	5 2.27%	15 7.65%	6 2.94%	11 4.85%	13 5.20%	10 3.70%	66 4.16%
6:00 AM to 6:59 AM	5 2.27%	9 4.09%	5 2.55%	9 4.41%	10 4.41%	10 4.00%	10 3.70%	58 3.65%
7:00 AM to 7:59 AM	7 3.18%	10 4.55%	3 1.53%	13 6.37%	20 8.81%	5 2.00%	7 2.59%	65 4.10%
8:00 AM to 8:59 AM	5 2.27%	4 1.82%	6 3.06%	5 2.45%	7 3.08%	8 3.20%	4 1.48%	39 2.46%
9:00 AM to 9:59 AM	2 0.91%	8 3.64%	6 3.06%	6 2.94%	4 1.76%	6 2.40%	3 1.11%	35 2.21%
10:00 AM to 10:59 AM	6 2.73%	8 3.64%	9 4.59%	9 4.41%	6 2.64%	11 4.40%	10 3.70%	59 3.72%
11:00 AM to 11:59 AM	6 2.73%	13 5.91%	7 3.57%	6 2.94%	10 4.41%	6 2.40%	11 4.07%	59 3.72%
12:00 Noon to 12:59 PM	8 3.64%	12 5.45%	12 6.12%	5 2.45%	10 4.41%	18 7.20%	14 5.19%	79 4.98%
1:00 PM to 1:59 PM	7 3.18%	12 5.45%	12 6.12%	13 6.37%	9 3.96%	12 4.80%	9 3.33%	74 4.66%
2:00 PM to 2:59 PM	11 5.00%	18 8.18%	18 9.18%	11 5.39%	18 7.93%	14 5.60%	10 3.70%	100 6.30%
3:00 PM to 3:59 PM	7 3.18%	12 5.45%	11 5.61%	10 4.90%	16 7.05%	10 4.00%	17 6.30%	83 5.23%
4:00 PM to 4:59 PM	13 5.91%	15 6.82%	9 4.59%	15 7.35%	10 4.41%	22 8.80%	15 5.56%	99 6.24%
5:00 PM to 5:59 PM	11 5.00%	10 4.55%	17 8.67%	18 8.82%	20 8.81%	12 4.80%	8 2.96%	96 6.05%
6:00 PM to 6:59 PM	24 10.91%	13 5.91%	16 8.16%	10 4.90%	13 5.73%	16 6.40%	14 5.19%	106 6.68%
7:00 PM to 7:59 PM	14 6.36%	8 3.64%	7 3.57%	9 4.41%	12 5.29%	8 3.20%	12 4.44%	70 4.41%
8:00 PM to 8:59 PM	12 5.45%	11 5.00%	18 9.18%	13 6.37%	10 4.41%	14 5.60%	17 6.30%	95 5.99%
9:00 PM to 9:59 PM	7 3.18%	9 4.09%	4 2.04%	8 3.92%	6 2.64%	15 6.00%	22 8.15%	71 4.47%
10:00 PM to 10:59 PM	7 3.18%	9 4.09%	4 2.04%	5 2.45%	7 3.08%	12 4.80%	12 4.44%	56 3.53%
11:00 PM to 11:59 PM	8 3.64%	7 3.18%	2 1.02%	6 2.94%	7 3.08%	15 6.00%	13 4.81%	58 3.65%
Unknown	1 0.45%	2 0.91%	0 0.00%	1 0.49%	1 0.44%	0 0.00%	2 0.74%	7 0.44%
TOTAL	220 13.86%	220 13.86%	196 12.35%	204 12.85%	227 14.30%	250 15.75%	270 17.01%	1587 100.00%

6.0 Factors Affecting Severity

6.1 C011 Highway Classification by C025 Severity (for all Intersection crashes)

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

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

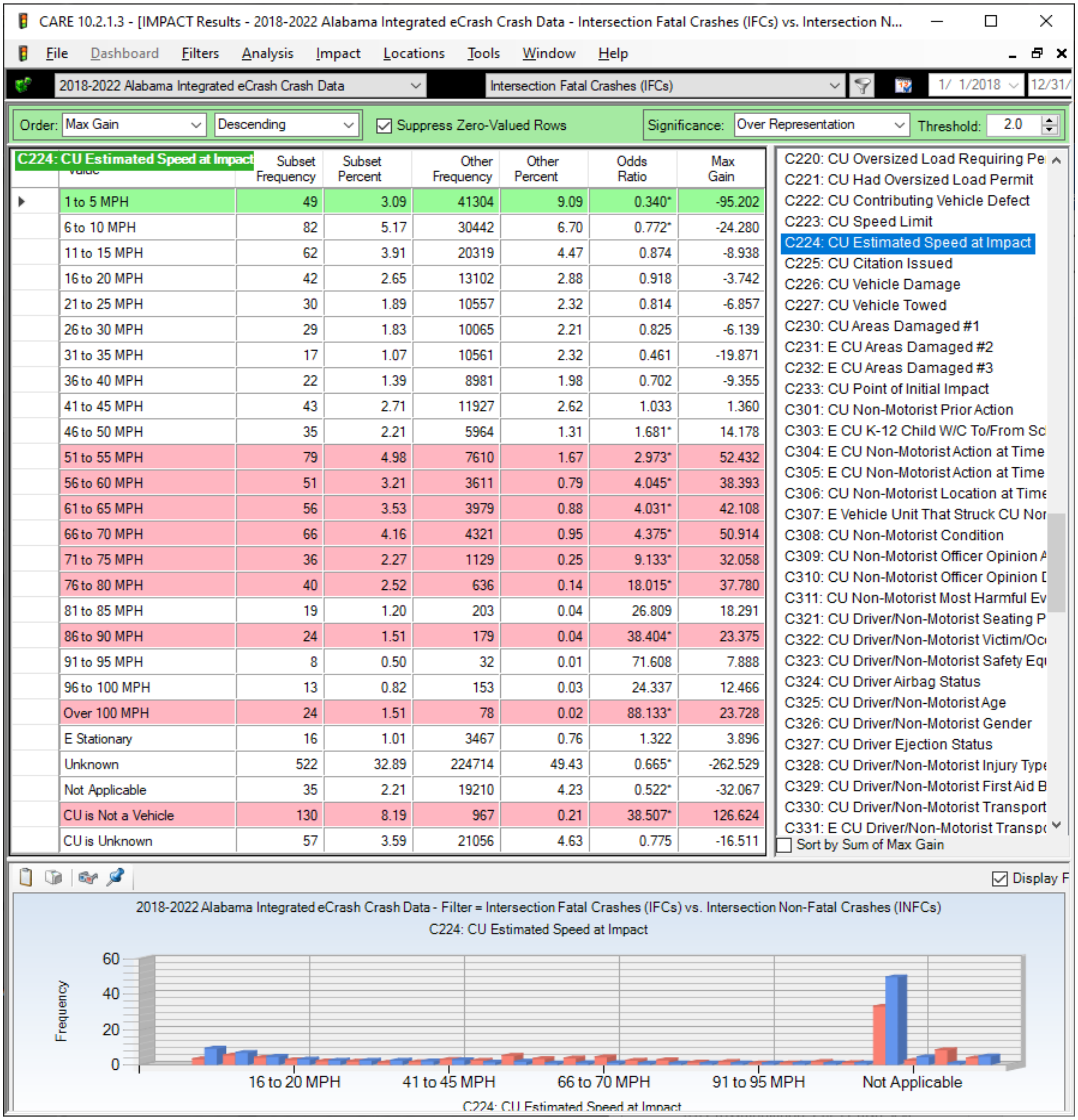
2018-2022 Alabama Integrated eCrash Crash Data | Intersection ALL | 1/ 1/2018

Suppress Zero Values: Rows and Columns | Select Cells: | Column: Highway Classifications ; Row: Crash Severity

	Interstate	Federal	State	County	Municipal	Private Property	TOTAL
Fatal Injury	155 0.44%	353 0.62%	443 0.52%	221 0.48%	400 0.18%	15 0.06%	1587 0.34%
Suspected Serious Injury	663 1.90%	1747 3.09%	2379 2.82%	1299 2.83%	2965 1.32%	126 0.52%	9179 1.95%
Suspected Minor Injury	2250 6.46%	5296 9.35%	7569 8.96%	3984 8.67%	15039 6.68%	595 2.47%	34733 7.37%
Possible Injury	2571 7.38%	6055 10.70%	8476 10.04%	3494 7.61%	20966 9.32%	735 3.05%	42297 8.98%
Property Damage Only	28465 81.66%	42177 74.50%	62847 74.41%	34179 74.42%	178943 79.53%	21747 90.18%	368358 78.21%
Unknown	752 2.16%	984 1.74%	2749 3.25%	2751 5.99%	6698 2.98%	896 3.72%	14830 3.15%
TOTAL	34856 7.40%	56612 12.02%	84463 17.93%	45928 9.75%	225011 47.77%	24114 5.12%	470984 100.00%

Notice that the basis for this cross-tabulation is all 470,984 Intersection crashes, not just fatal crashes. Fatal Intersection Crashes only would restrict this output to just the top row. This does verify the results presented for fatal intersection crashes in Section 4.6, but it also shows comparable results for the lesser severities for all of the Highway Classifications.

6.2 IFCs vs INFCs for C224 Speed at Impact



C224: CU Estimated Speed at Impact	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1 to 5 MPH	49	3.09	41304	9.09	0.340*	-95.202
6 to 10 MPH	82	5.17	30442	6.70	0.772*	-24.280
11 to 15 MPH	62	3.91	20319	4.47	0.874	-8.938
16 to 20 MPH	42	2.65	13102	2.88	0.918	-3.742
21 to 25 MPH	30	1.89	10557	2.32	0.814	-6.857
26 to 30 MPH	29	1.83	10065	2.21	0.825	-6.139
31 to 35 MPH	17	1.07	10561	2.32	0.461	-19.871
36 to 40 MPH	22	1.39	8981	1.98	0.702	-9.355
41 to 45 MPH	43	2.71	11927	2.62	1.033	1.360
46 to 50 MPH	35	2.21	5964	1.31	1.681*	14.178
51 to 55 MPH	79	4.98	7610	1.67	2.973*	52.432
56 to 60 MPH	51	3.21	3611	0.79	4.045*	38.393
61 to 65 MPH	56	3.53	3979	0.88	4.031*	42.108
66 to 70 MPH	66	4.16	4321	0.95	4.375*	50.914
71 to 75 MPH	36	2.27	1129	0.25	9.133*	32.058
76 to 80 MPH	40	2.52	636	0.14	18.015*	37.780
81 to 85 MPH	19	1.20	203	0.04	26.809	18.291
86 to 90 MPH	24	1.51	179	0.04	38.404*	23.375
91 to 95 MPH	8	0.50	32	0.01	71.608	7.888
96 to 100 MPH	13	0.82	153	0.03	24.337	12.466
Over 100 MPH	24	1.51	78	0.02	88.133*	23.728
E Stationary	16	1.01	3467	0.76	1.322	3.896
Unknown	522	32.89	224714	49.43	0.665*	-262.529
Not Applicable	35	2.21	19210	4.23	0.522*	-32.067
CU is Not a Vehicle	130	8.19	967	0.21	38.507*	126.624
CU is Unknown	57	3.59	21056	4.63	0.775	-16.511

Generally, the travel speeds at roads that have the most Intersections have speed limits under 45, and it is these speeds that are over-represented for the INFCs. 45 and above are over-represented in those crashes that were fatal, and the Odds Ratios increase systematically with these increases in speed.

6.3 Cross-tab: C025 Severity by C224 Speed at Impact (all Intersection crashes)

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

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

2018-2022 Alabama Integrated eCrash Crash Data | Intersection ALL | 1/ 1/2018

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

	Fatal Injury	Suspected Serious Injury	Suspected Minor Injury	Possible Injury	Property Damage Only	Unknown	TOTAL
1 to 5 MPH	49 3.09%	368 4.01%	1699 4.89%	2770 6.55%	36467 9.90%	659 4.44%	42012 8.92%
6 to 10 MPH	82 5.17%	584 6.36%	2312 6.66%	2700 6.38%	24846 6.75%	425 2.87%	30949 6.57%
11 to 15 MPH	62 3.91%	497 5.41%	1781 5.13%	2027 4.79%	16014 4.35%	289 1.95%	20670 4.39%
16 to 20 MPH	42 2.65%	296 3.22%	1197 3.45%	1300 3.07%	10309 2.80%	208 1.40%	13352 2.83%
21 to 25 MPH	30 1.89%	240 2.61%	958 2.76%	1121 2.65%	8238 2.24%	217 1.46%	10804 2.29%
26 to 30 MPH	29 1.83%	191 2.08%	950 2.74%	1163 2.75%	7761 2.11%	182 1.23%	10276 2.18%
31 to 35 MPH	17 1.07%	239 2.60%	1138 3.28%	1253 2.96%	7931 2.15%	245 1.65%	10823 2.30%
36 to 40 MPH	22 1.39%	246 2.68%	1071 3.08%	1126 2.66%	6538 1.77%	203 1.37%	9206 1.95%
41 to 45 MPH	43 2.71%	483 5.26%	1679 4.83%	1433 3.39%	8332 2.26%	261 1.76%	12231 2.60%
46 to 50 MPH	35 2.21%	294 3.20%	873 2.51%	665 1.57%	4132 1.12%	118 0.80%	6117 1.30%
51 to 55 MPH	79 4.98%	530 5.77%	1207 3.48%	766 1.81%	5107 1.39%	136 0.92%	7825 1.66%
56 to 60 MPH	51 3.21%	290 3.16%	557 1.60%	367 0.87%	2397 0.65%	85 0.57%	3747 0.80%
61 to 65 MPH	56 3.53%	307 3.34%	550 1.58%	337 0.80%	2785 0.76%	57 0.38%	4092 0.87%
66 to 70 MPH	66 4.16%	279 3.04%	501 1.44%	309 0.73%	3232 0.88%	43 0.29%	4430 0.94%
71 to 75 MPH	36 2.27%	77 0.84%	159 0.46%	88 0.21%	805 0.22%	14 0.09%	1179 0.25%
76 to 80 MPH	40 2.52%	79 0.86%	107 0.31%	53 0.13%	397 0.11%	13 0.09%	689 0.15%
81 to 85 MPH	19 1.20%	32 0.35%	42 0.12%	23 0.05%	106 0.03%	2 0.01%	224 0.05%
86 to 90 MPH	24 1.51%	40 0.44%	27 0.08%	18 0.04%	94 0.03%	2 0.01%	205 0.04%
91 to 95 MPH	8 0.50%	7 0.08%	7 0.02%	4 0.01%	14 0.00%	2 0.01%	42 0.01%
96 to 100 MPH	13 0.82%	34 0.37%	24 0.07%	14 0.03%	81 0.02%	7 0.05%	173 0.04%
Over 100 MPH	24 1.51%	14 0.15%	16 0.05%	9 0.02%	39 0.01%	1 0.01%	103 0.02%
E Stationary	16 1.01%	60 0.65%	206 0.59%	242 0.57%	2959 0.80%	120 0.81%	3603 0.76%
Unknown	522 32.89%	3207 34.94%	14594 42.02%	21109 49.91%	185804 50.44%	9265 62.47%	234501 49.79%
Not Applicable	35 2.21%	233 2.54%	1132 3.26%	1112 2.63%	16733 4.54%	1330 8.97%	20575 4.37%
CU is Not a Vehicle	130 8.19%	237 2.58%	407 1.17%	209 0.49%	114 0.03%	36 0.24%	1133 0.24%
CU is Unknown	57 3.59%	315 3.43%	1539 4.43%	2079 4.92%	17123 4.65%	910 6.14%	22023 4.68%
TOTAL	1587 0.34%	9179 1.95%	34733 7.37%	42297 8.98%	368358 78.21%	14830 3.15%	**470984 100.00%**

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 <u>all crashes</u>. Notice the red in the Fatality and Serious Injury cells as speeds increase. What is more interesting is the probability that an injury crash results in a fatality as a function of impact speed. This is given in the following table using 31-35 MPH as the base speed for the third column, which is the fatality probability multiplier from this base as the speeds increase.

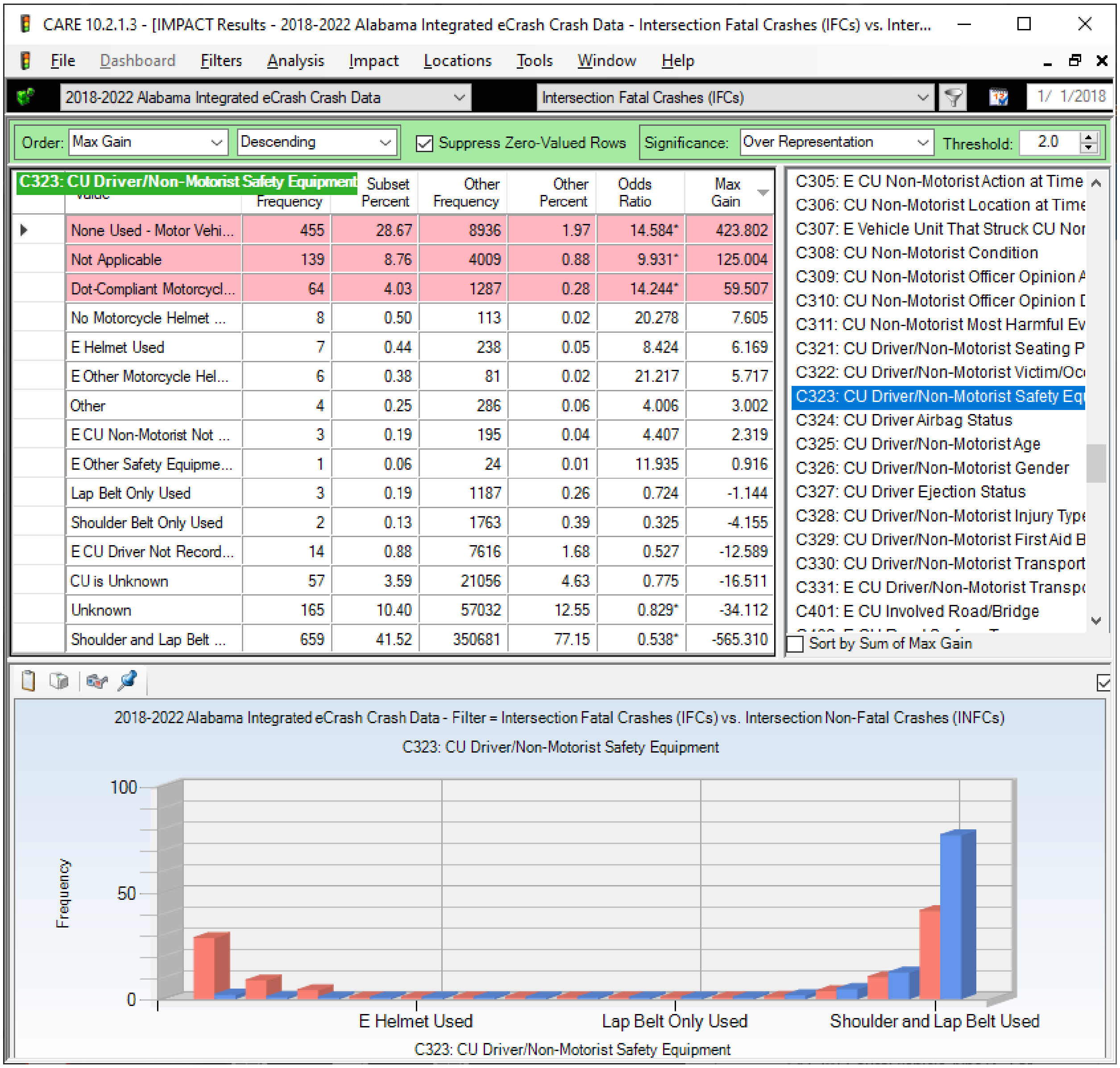
Speed at Impact	Fatality Odds (1 in …)	Increase Probability above 31-35
31 to 35 MPH	636.6	1
36 to 40 MPH	418.5	1.5
41 to 45 MPH	284.4	2.2
46 to 50 MPH	174.8	3.6
51 to 55 MPH	99.1	6.4
56 to 60 MPH	73.5	8.7
61 to 65 MPH	73.1	8.7
66 to 70 MPH	67.1	9.5
71 to 75 MPH	32.8	19.4
76 to 80 MPH	17.2	37.0
81 to 85 MPH	11.8	53.0
86 to 90 MPH	8.5	74.9
91 to 95 MPH	5.3	*
96 to 100 MPH	13.3	*
Over 100 MPH	4.3	*

The last column of the above table gives the fatality probability multiplier based on the lowest probability (31-35 MPH), to which was assigned a <u>relative value</u> 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 46-50 MPH being fatal is one in 174.8. This is 3.6 times that probability if the impact speed were in the 31 to 35 range, as given in the third column. Speeds 91 and over had too few occurrences to be reliable estimates.

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. On average, the reduction in impact speeds by 10 MPH 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 IFC and INFC drivers to be properly restrained, which will be covered in the next separate attribute below (6.5; Restraint Use by Causal Drivers in Fatal Collisions). This is also correlated with Impaired Driving because Impaired Drivers have been found to have a much lower restraint use than those not impaired

6.5 C323 Restraint Use by Drivers in Intersection Collisions (IFCs vs INFCs)

The following display presents a restraint-use comparison of IFCs driver safety belt use compared that for all drivers in INFCs, over the same five-year time period.



C323: CU Driver/Non-Motorist Safety Equipment Value	Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
None Used - Motor Vehi...	455	28.67	8936	1.97	14.584*	423.802
Not Applicable	139	8.76	4009	0.88	9.931*	125.004
Dot-Compliant Motorcycl...	64	4.03	1287	0.28	14.244*	59.507
No Motorcycle Helmet ...	8	0.50	113	0.02	20.278	7.605
E Helmet Used	7	0.44	238	0.05	8.424	6.169
E Other Motorcycle Hel...	6	0.38	81	0.02	21.217	5.717
Other	4	0.25	286	0.06	4.006	3.002
E CU Non-Motorist Not ...	3	0.19	195	0.04	4.407	2.319
E Other Safety Equipme...	1	0.06	24	0.01	11.935	0.916
Lap Belt Only Used	3	0.19	1187	0.26	0.724	-1.144
Shoulder Belt Only Used	2	0.13	1763	0.39	0.325	-4.155
E CU Driver Not Record...	14	0.88	7616	1.68	0.527	-12.589
CU is Unknown	57	3.59	21056	4.63	0.775	-16.511
Unknown	165	10.40	57032	12.55	0.829*	-34.112
Shoulder and Lap Belt ...	659	41.52	350681	77.15	0.538*	-565.310

The proportion of failure to use proper restraints is 28.67% (Odds Ratio = 14.3584) higher for Intersection Fatal Crashes than for Non-Fatal Intersection crashes according the comparable fatal crash statistics (percent non-use = 1.97%). Shoulder and Lap Belt Used is over-represented in INFCs by about 54% (Odds Ratio 1/0.538 = 1.86 times the expected use in comparison to Fatal Intersection Crash seatbelt usage). Clearly, not being restrained contributed to these fatalities.

6.6 Crosstabulation: C025 Crash Severity x C323 Restraint Use (all injury)

CARE 10.2.1.3 - [Crosstab Results - 2018-2022 Alabama Integrated eCrash Crash Data - Filter = Injury Crashes (including Fatalities)]

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

2018-2022 Alabama Integrated eCrash Crash Data | Injury Crashes (including Fatalities) | 1/ 1/2018

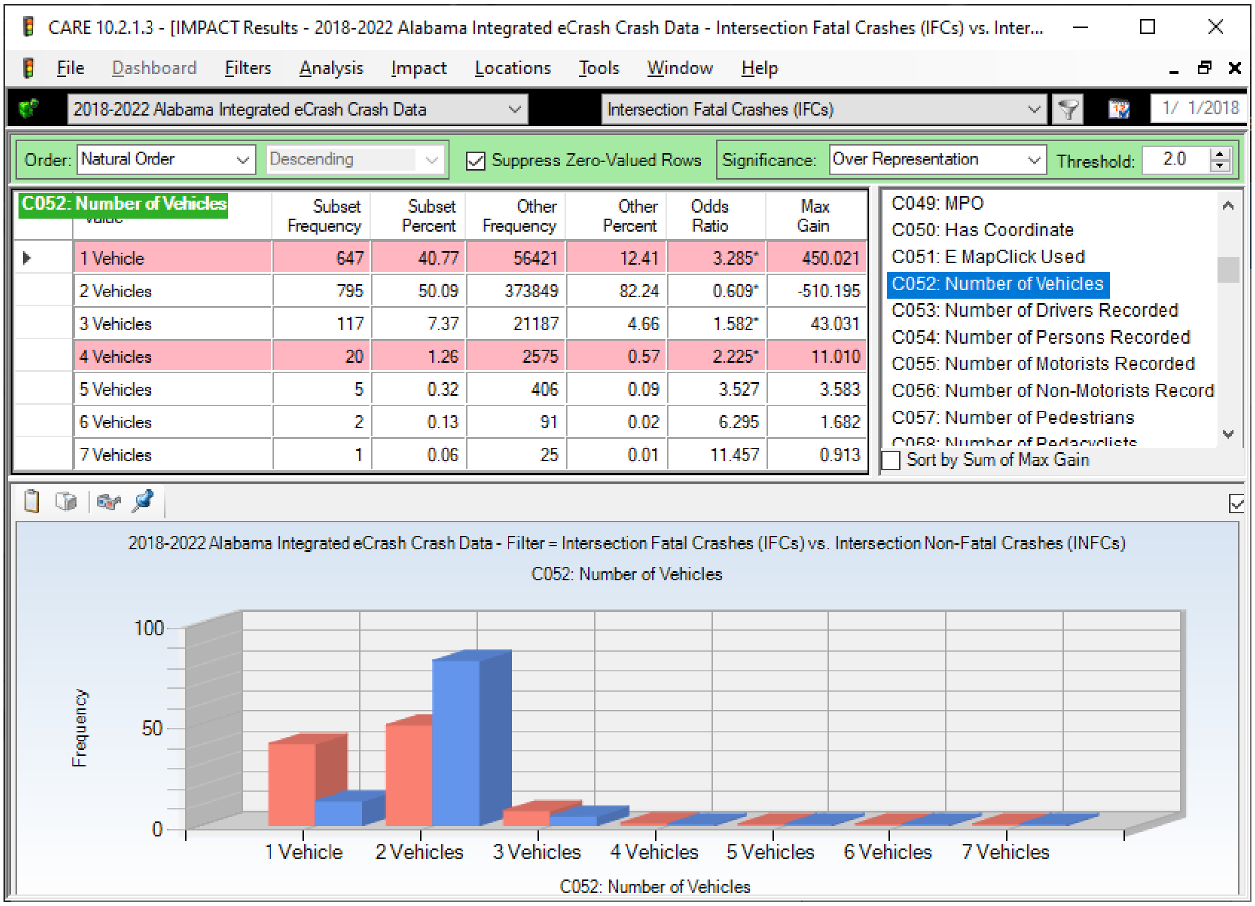
Suppress Zero Values: Rows and Columns | Select Cells: | Column: Crash Severity ; Row: CU Driver/Non-Motorist Safety Equipment

	Fatal Injury	Suspected Serious Injury	Suspected Minor Injury	Possible Injury	TOTAL
None Used - Motor Vehicle Oc	1596 36.51%	4412 21.75%	5240 8.69%	2510 3.91%	13758 9.23%
Shoulder and Lap Belt Used	1581 36.16%	11626 57.32%	44825 74.34%	51783 80.69%	109815 73.64%
Lap Belt Only Used	7 0.16%	42 0.21%	123 0.20%	154 0.24%	326 0.22%
Shoulder Belt Only Used	7 0.16%	32 0.16%	156 0.26%	188 0.29%	383 0.26%
E Forward Facing Child Safety Seat	0 0.00%	1 0.00%	3 0.00%	0 0.00%	4 0.00%
E Rear Facing Child Safety Seat	0 0.00%	0 0.00%	0 0.00%	3 0.00%	3 0.00%
E Rear Facing Child Safety Seat	0 0.00%	0 0.00%	2 0.00%	0 0.00%	2 0.00%
E Child in Arms of Restrained Adult	0 0.00%	0 0.00%	2 0.00%	0 0.00%	2 0.00%
Dot-Compliant Motorcycle Helme	201 4.60%	955 4.71%	1118 1.85%	351 0.55%	2625 1.76%
E Helmet Used	18 0.41%	102 0.50%	177 0.29%	51 0.08%	348 0.23%
E Protective Pads Used (Elbows/Kn	0 0.00%	1 0.00%	0 0.00%	0 0.00%	1 0.00%
Reflective Clothing (Jacket/B	1 0.02%	6 0.03%	7 0.01%	0 0.00%	14 0.01%
E Lighting Used by Non-Motorist	1 0.02%	3 0.01%	3 0.00%	2 0.00%	9 0.01%
E Other Safety Equipment Used	1 0.02%	5 0.02%	10 0.02%	8 0.01%	24 0.02%
E Other Motorcycle Helme	24 0.55%	69 0.34%	62 0.10%	13 0.02%	168 0.11%
No Motorcycle Helmet Used	32 0.73%	111 0.55%	94 0.16%	26 0.04%	263 0.18%
Other	9 0.21%	23 0.11%	56 0.09%	38 0.06%	126 0.08%
Unknown	351 8.03%	1581 7.79%	4982 8.26%	5459 8.51%	12373 8.30%
Not Applicable	385 8.81%	716 3.53%	1066 1.77%	546 0.85%	2713 1.82%
CU is Unknown	116 2.65%	437 2.15%	1948 3.23%	2554 3.98%	5055 3.39%
E CU Driver Not Recorded	32 0.73%	110 0.54%	340 0.56%	414 0.65%	896 0.60%
E CU Non-Motorist Not Reco	10 0.23%	51 0.25%	86 0.14%	72 0.11%	219 0.15%
TOTAL	4372 2.93%	20283 13.60%	60300 40.44%	64172 43.03%	**149127** **100.00%**

Calculations are based on all injury (including fatal) crashes.
Odds of death not using restraints = 13,758 fatal crashes/1,596 deaths = one in 8.6 injury crashes.
Odds of death using restraints = 109,815 fatal crashes/1,581 deaths = one in 68.8 injury crashes.
Risk of death is increased by an average factor of 8.0 when not using proper restraints.

6.7 C052 Number of Vehicles Involved (IFCs vs INFCs)

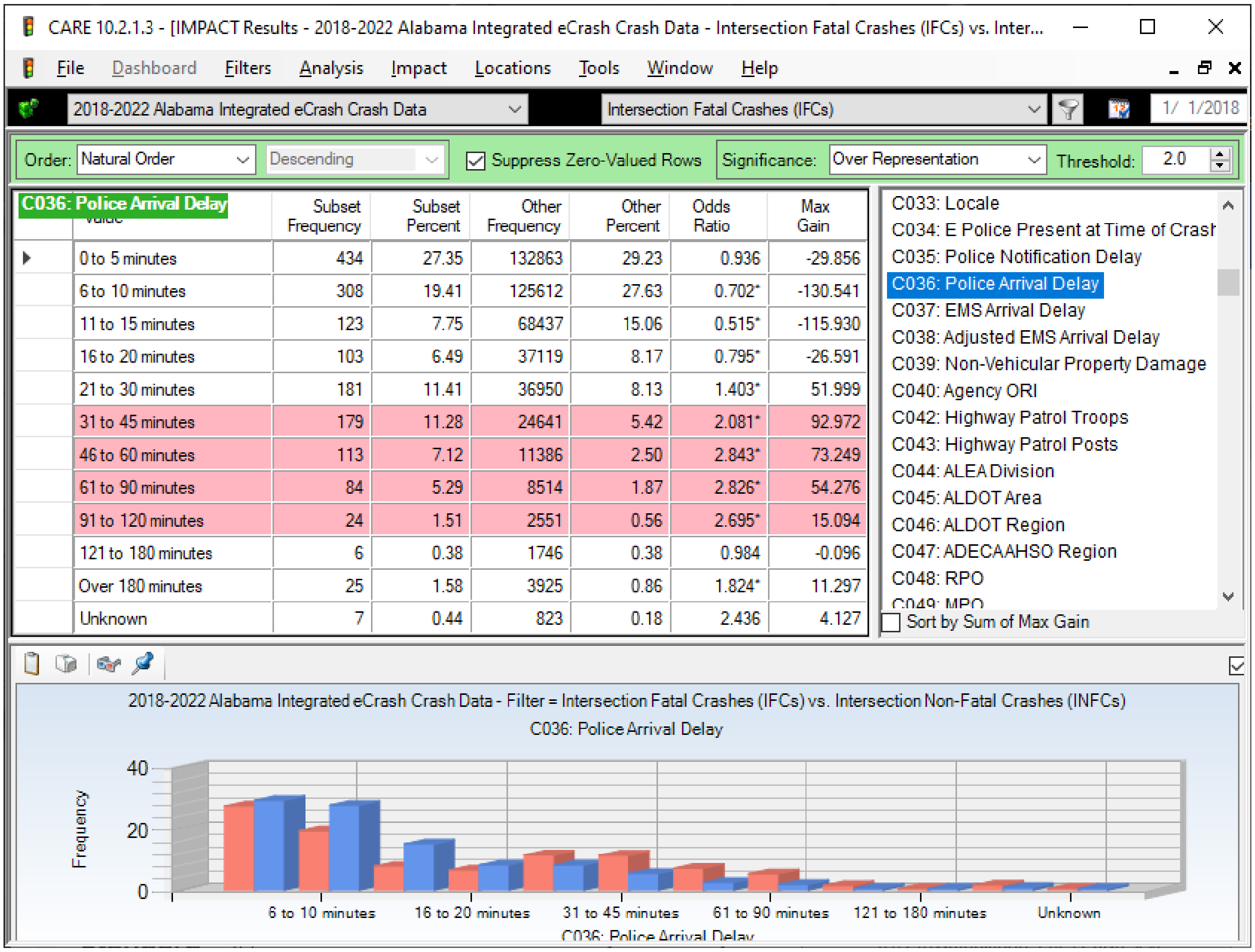
The following display presents a comparison of the number of vehicles in IFCs against number of vehicles INFCs over the five-year time period of the study.



C052: Number of Vehicles Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1 Vehicle	647	40.77	56421	12.41	3.285*	450.021
2 Vehicles	795	50.09	373849	82.24	0.609*	-510.195
3 Vehicles	117	7.37	21187	4.66	1.582*	43.031
4 Vehicles	20	1.26	2575	0.57	2.225*	11.010
5 Vehicles	5	0.32	406	0.09	3.527	3.583
6 Vehicles	2	0.13	91	0.02	6.295	1.682
7 Vehicles	1	0.06	25	0.01	11.457	0.913

Single vehicle IFCs (including 195 pedestrian crashes) are over-represented by a factor of 3.285, or over three times the number expected from INFCs. The two-vehicle crashes are significantly over-represented in INFCs by factors of 1/609=1.64 . This illustrates that unforced errors (i.e., single vehicle crashes) are much more prevalent in causing IFCs than INFCs.

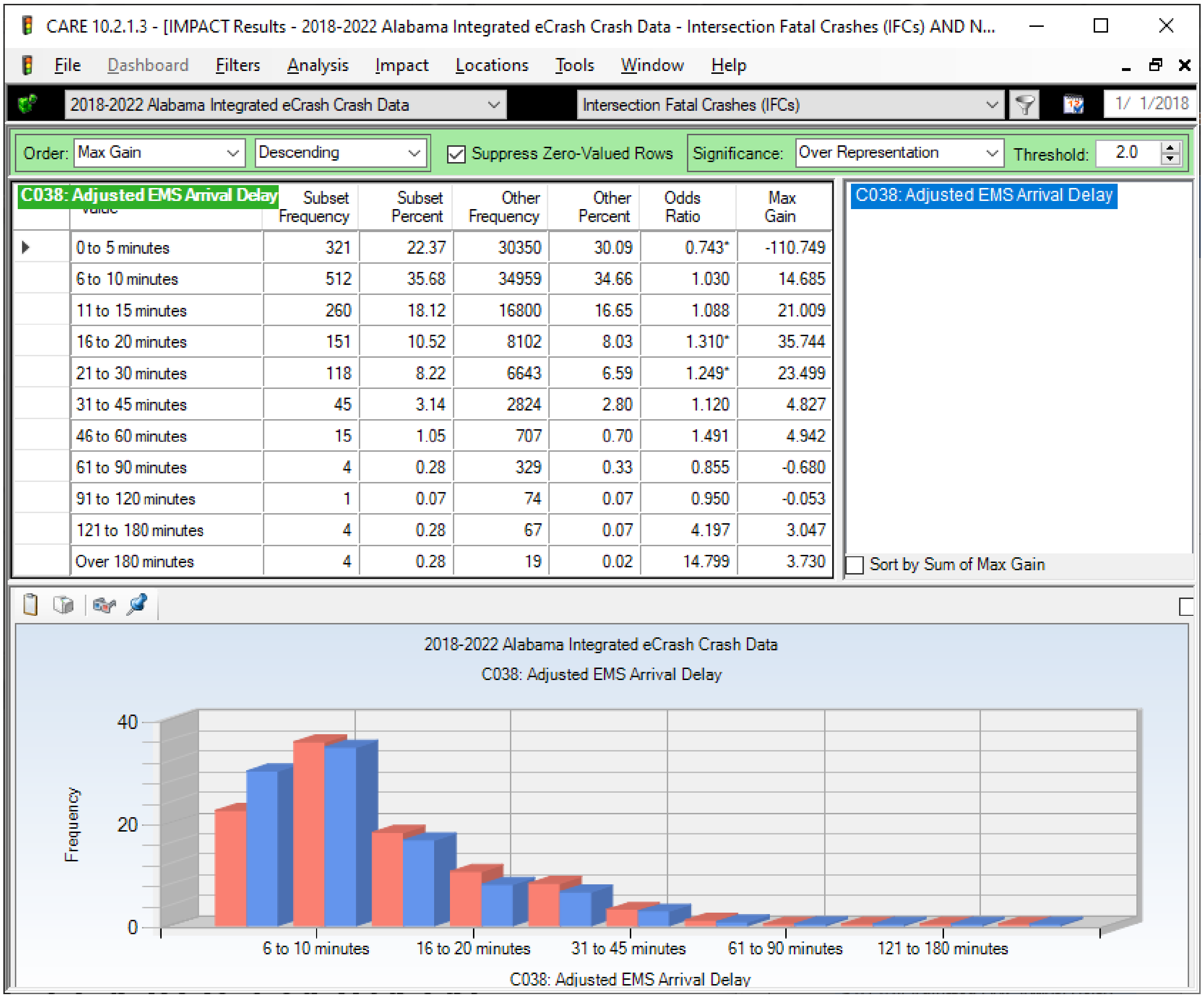
6.8 C036 Police Arrival Delay (IFCs vs INFCs)



C036: Police Arrival Delay	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
0 to 5 minutes	434	27.35	132863	29.23	0.936	-29.856
6 to 10 minutes	308	19.41	125612	27.63	0.702*	-130.541
11 to 15 minutes	123	7.75	68437	15.06	0.515*	-115.930
16 to 20 minutes	103	6.49	37119	8.17	0.795*	-26.591
21 to 30 minutes	181	11.41	36950	8.13	1.403*	51.999
31 to 45 minutes	179	11.28	24641	5.42	2.081*	92.972
46 to 60 minutes	113	7.12	11386	2.50	2.843*	73.249
61 to 90 minutes	84	5.29	8514	1.87	2.826*	54.276
91 to 120 minutes	24	1.51	2551	0.56	2.695*	15.094
121 to 180 minutes	6	0.38	1746	0.38	0.984	-0.096
Over 180 minutes	25	1.58	3925	0.86	1.824*	11.297
Unknown	7	0.44	823	0.18	2.436	4.127

IFC police arrival delays reflect the issues in finding out about the crash and getting to the scene at night. All but one of the delay times above 21 minutes were over-represented for IFCs with high Odds Ratios. Six of these higher times were statistically significant. The analysis below shows how this correlates with EMS arrival times.

6.9 C038 Adjusted EMS Arrival Delay

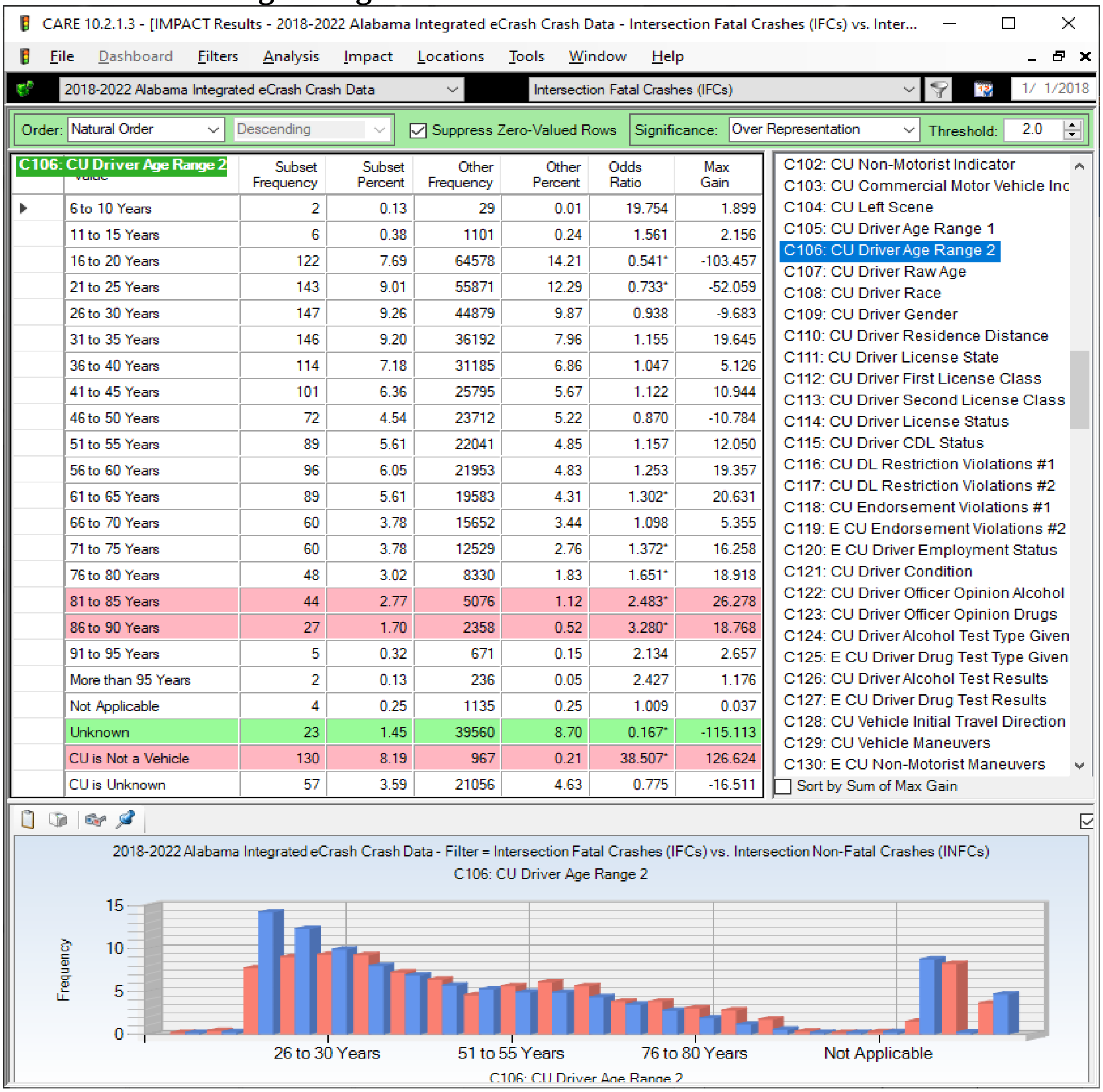


C038: Adjusted EMS Arrival Delay Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
0 to 5 minutes	321	22.37	30350	30.09	0.743*	-110.749
6 to 10 minutes	512	35.68	34959	34.66	1.030	14.685
11 to 15 minutes	260	18.12	16800	16.65	1.088	21.009
16 to 20 minutes	151	10.52	8102	8.03	1.310*	35.744
21 to 30 minutes	118	8.22	6643	6.59	1.249*	23.499
31 to 45 minutes	45	3.14	2824	2.80	1.120	4.827
46 to 60 minutes	15	1.05	707	0.70	1.491	4.942
61 to 90 minutes	4	0.28	329	0.33	0.855	-0.680
91 to 120 minutes	1	0.07	74	0.07	0.950	-0.053
121 to 180 minutes	4	0.28	67	0.07	4.197	3.047
Over 180 minutes	4	0.28	19	0.02	14.799	3.730

Intersection Non-Fatal Crashes are significantly over-represented in the 0 to 5-minute response. Fatal Intersection Crashes are significantly over-represented in the 6 to 60 minute categories. All the times above 60 minutes are over-represented for Non-Fatal Intersection Crashes, and very few Intersection Fatal Crashes fell in these categories.

7.0 Driver and Vehicle Demographics

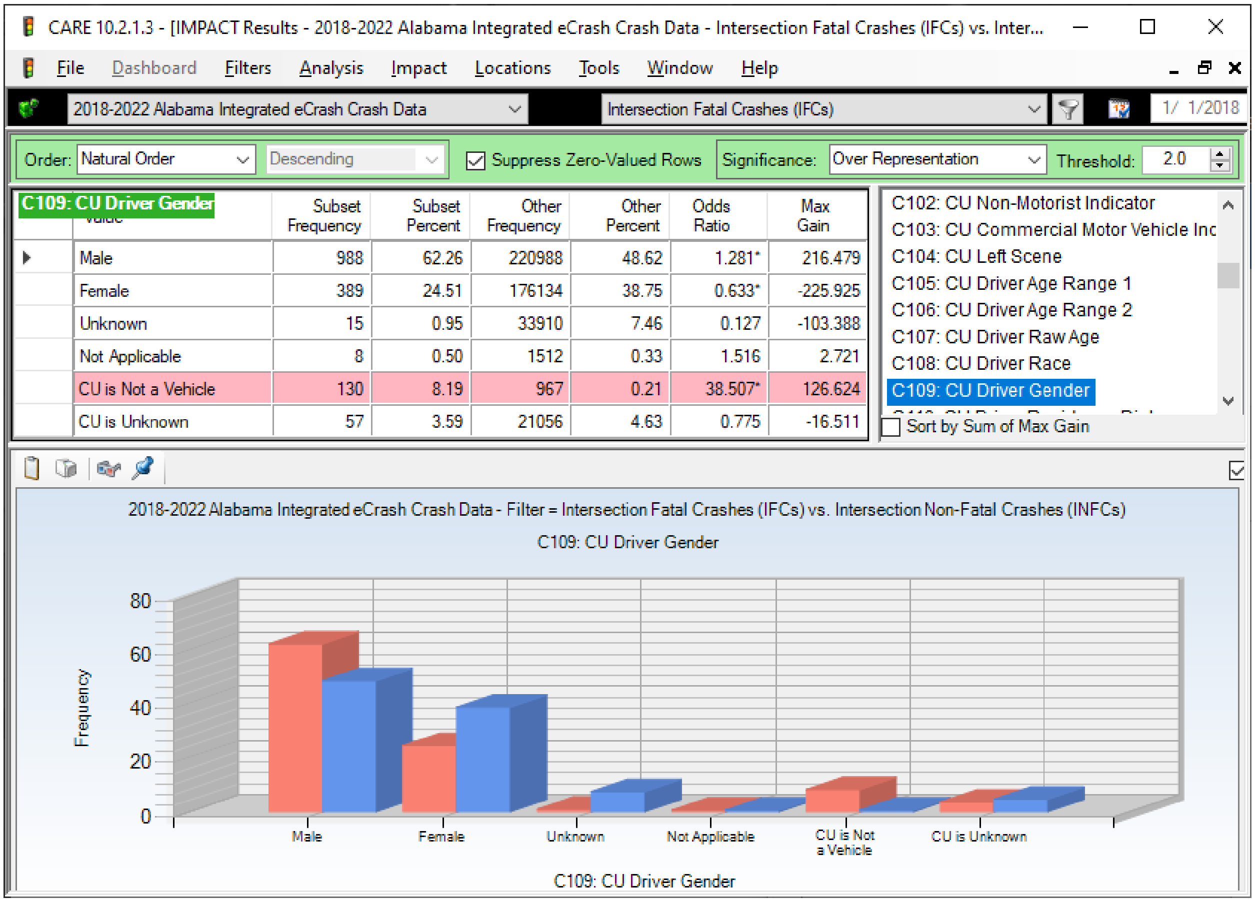
7.1 C106 Driver Age Range 2



C106: CU Driver Age Range 2 Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
6 to 10 Years	2	0.13	29	0.01	19.754	1.899
11 to 15 Years	6	0.38	1101	0.24	1.561	2.156
16 to 20 Years	122	7.69	64578	14.21	0.541*	-103.457
21 to 25 Years	143	9.01	55871	12.29	0.733*	-52.059
26 to 30 Years	147	9.26	44879	9.87	0.938	-9.683
31 to 35 Years	146	9.20	36192	7.96	1.155	19.645
36 to 40 Years	114	7.18	31185	6.86	1.047	5.126
41 to 45 Years	101	6.36	25795	5.67	1.122	10.944
46 to 50 Years	72	4.54	23712	5.22	0.870	-10.784
51 to 55 Years	89	5.61	22041	4.85	1.157	12.050
56 to 60 Years	96	6.05	21953	4.83	1.253	19.357
61 to 65 Years	89	5.61	19583	4.31	1.302*	20.631
66 to 70 Years	60	3.78	15652	3.44	1.098	5.355
71 to 75 Years	60	3.78	12529	2.76	1.372*	16.258
76 to 80 Years	48	3.02	8330	1.83	1.651*	18.918
81 to 85 Years	44	2.77	5076	1.12	2.483*	26.278
86 to 90 Years	27	1.70	2358	0.52	3.280*	18.768
91 to 95 Years	5	0.32	671	0.15	2.134	2.657
More than 95 Years	2	0.13	236	0.05	2.427	1.176
Not Applicable	4	0.25	1135	0.25	1.009	0.037
Unknown	23	1.45	39560	8.70	0.167*	-115.113
CU is Not a Vehicle	130	8.19	967	0.21	38.507*	126.624
CU is Unknown	57	3.59	21056	4.63	0.775	-16.511

The table display above presents IFCs compared to INFCs given in 5-year age increments. The blue (INFC) bars illustrate the problems that 16- to 25-year-old drivers have at Intersections in general. The widest over-represented age interval for IFCs is in ages from 51-90. Older drivers have more problems at intersection due to vision issues.

7.2 C109 Driver Gender IFCs vs INFCs



Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Male	988	62.26	220988	48.62	1.281*	216.479
Female	389	24.51	176134	38.75	0.633*	-225.925
Unknown	15	0.95	33910	7.46	0.127	-103.388
Not Applicable	8	0.50	1512	0.33	1.516	2.721
CU is Not a Vehicle	130	8.19	967	0.21	38.507*	126.624
CU is Unknown	57	3.59	21056	4.63	0.775	-16.511

The male and female red and blue bar proportions each individually sum very close to 100%. So the breakdown in IFCs causal drivers is 62.26% male and 24.51% female. For "Other," INFCs, the percentage is 48.62% male and 38.75% female. These differences in proportions certainly indicate that males are a greater cause of Intersection Fatal Crashes (IFCs). If there are countermeasures that can be directed toward males, doing so would be much more cost-effective than those directed toward all drivers.

The highly significant over-representation in "CU is Not a Vehicle" is largely due to pedestrians being coded in this category. Obviously, pedestrians are not always the causal unit. For more definitive specifications, see Sections 7.4 and 7.5.

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-tab C109 Driver Gender x C224 Speed at Impact (all intersection)

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

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

2018-2022 Alabama Integrated eCrash Crash Data | Intersection ALL | 1/ 1/2018

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

	Male	Female	Unknown	Not Applicable	CU is Not a Vehicle	CU is Unknown	TOTAL
1 to 5 MPH	22489	19240	224	59	0	0	42012
6 to 10 MPH	15948	14728	246	27	0	0	30949
11 to 15 MPH	10895	9591	167	17	0	0	20670
16 to 20 MPH	7018	6187	137	10	0	0	13352
21 to 25 MPH	5900	4763	134	7	0	0	10804
26 to 30 MPH	5721	4457	89	9	0	0	10276
31 to 35 MPH	6081	4632	101	9	0	0	10823
36 to 40 MPH	5385	3693	109	19	0	0	9206
41 to 45 MPH	7301	4731	188	11	0	0	12231
46 to 50 MPH	3743	2254	114	6	0	0	6117
51 to 55 MPH	4852	2790	175	8	0	0	7825
56 to 60 MPH	2382	1255	103	7	0	0	3747
61 to 65 MPH	2659	1316	116	1	0	0	4092
66 to 70 MPH	2833	1380	210	7	0	0	4430
71 to 75 MPH	**779**	353	45	2	0	0	1179
76 to 80 MPH	484	157	46	2	0	0	689
81 to 85 MPH	161	52	10	1	0	0	224
86 to 90 MPH	148	38	19	0	0	0	205
91 to 95 MPH	35	6	1	0	0	0	42
96 to 100 MPH	137	24	12	0	0	0	173
Over 100 MPH	**88**	13	2	0	0	0	103

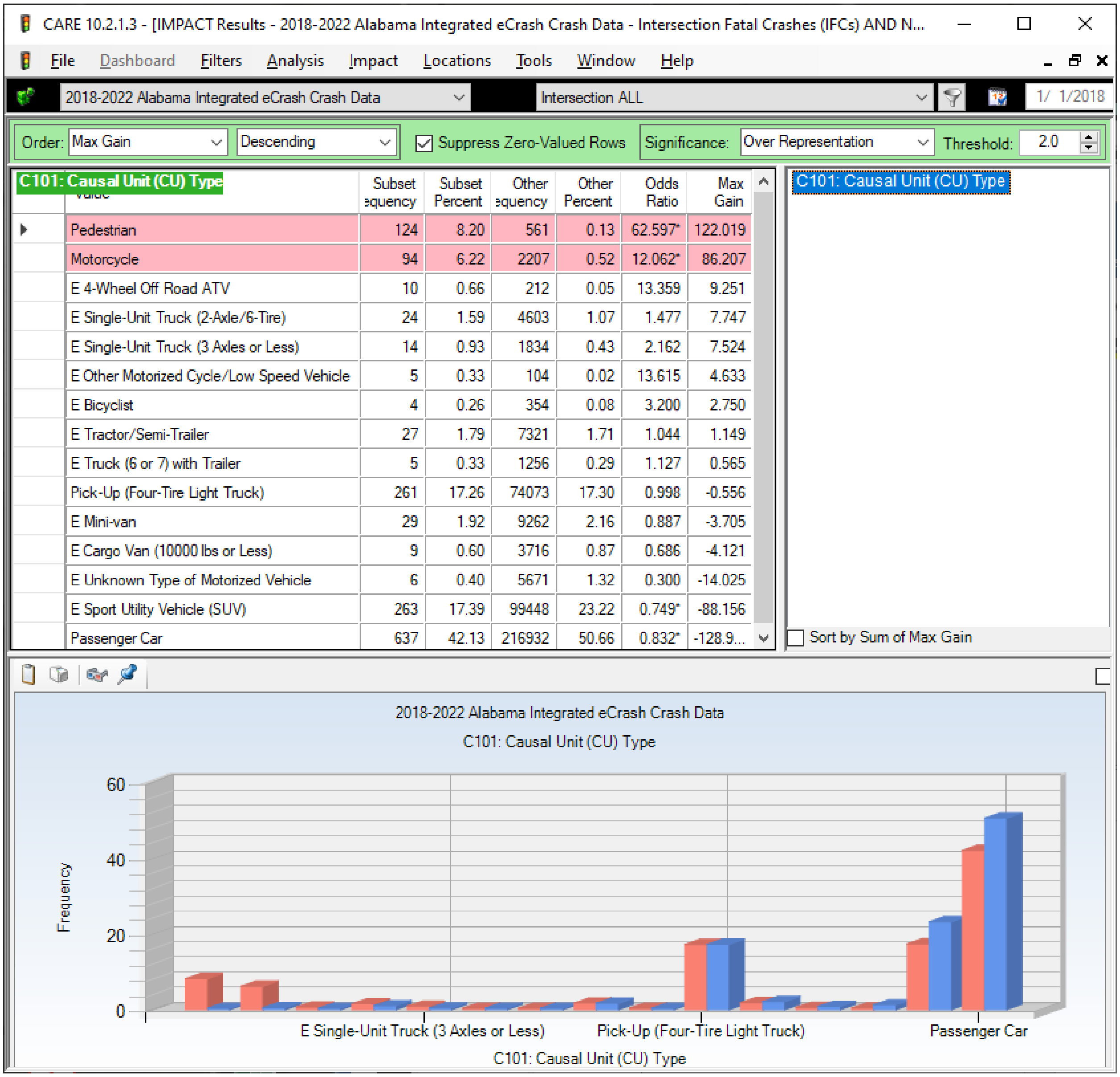
Number and Percent males and females involved in fatal crashes over 75 MPH:

1,832 Male = 1832/228,615 = 0.80%

643 Female = 643/181,424 = 0.35%.

The proportion of male fatal crashes over 75 MPH is 2.29 times that of the females.

7.4 C101 Causal Vehicle Type (> 2 or more crashes) IFCs vs INFCs

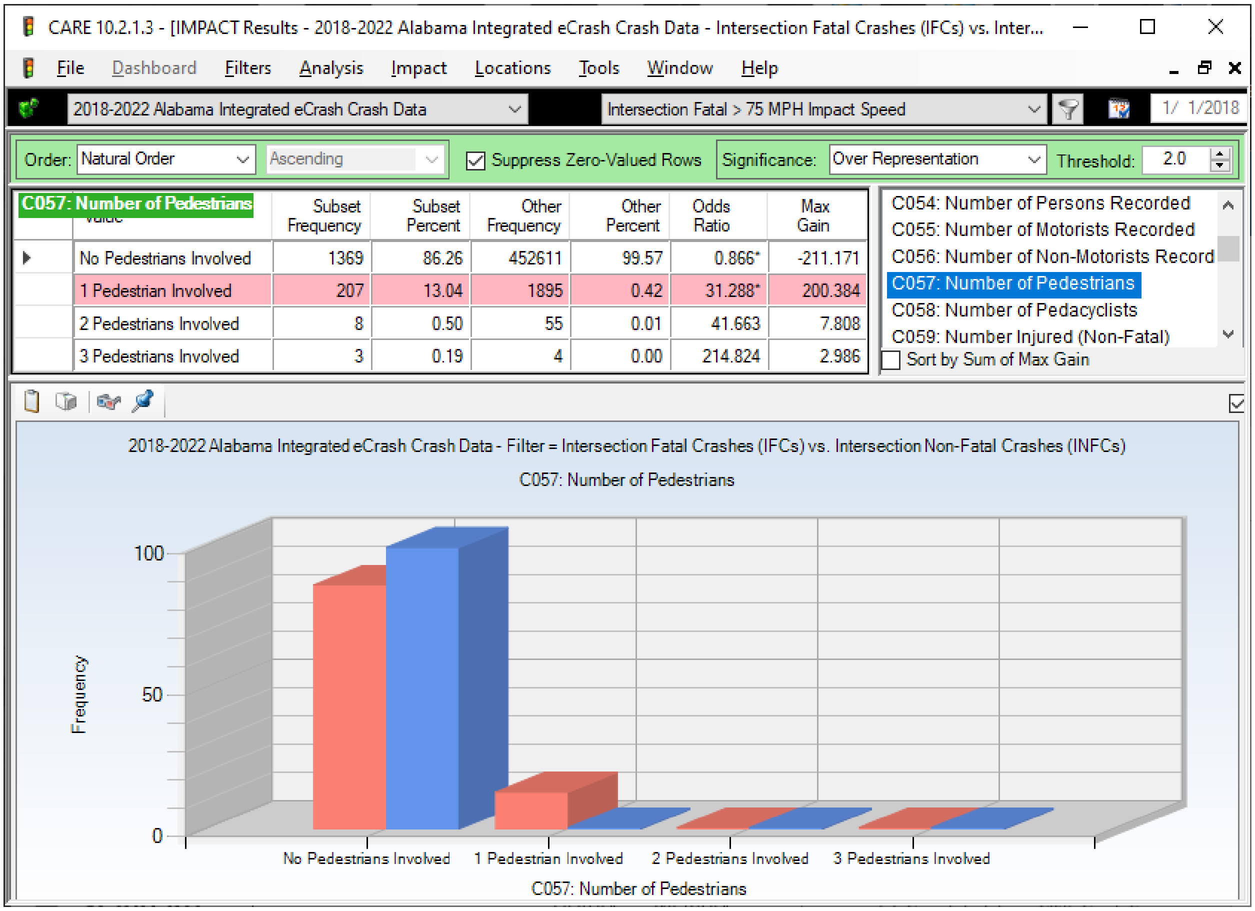


C101: Causal Unit (CU) Type	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Pedestrian	124	8.20	561	0.13	62.597*	122.019
Motorcycle	94	6.22	2207	0.52	12.062*	86.207
E 4-Wheel Off Road ATV	10	0.66	212	0.05	13.359	9.251
E Single-Unit Truck (2-Axle/6-Tire)	24	1.59	4603	1.07	1.477	7.747
E Single-Unit Truck (3 Axles or Less)	14	0.93	1834	0.43	2.162	7.524
E Other Motorized Cycle/Low Speed Vehicle	5	0.33	104	0.02	13.615	4.633
E Bicyclist	4	0.26	354	0.08	3.200	2.750
E Tractor/Semi-Trailer	27	1.79	7321	1.71	1.044	1.149
E Truck (6 or 7) with Trailer	5	0.33	1256	0.29	1.127	0.565
Pick-Up (Four-Tire Light Truck)	261	17.26	74073	17.30	0.998	-0.556
E Mini-van	29	1.92	9262	2.16	0.887	-3.705
E Cargo Van (10000 lbs or Less)	9	0.60	3716	0.87	0.686	-4.121
E Unknown Type of Motorized Vehicle	6	0.40	5671	1.32	0.300	-14.025
E Sport Utility Vehicle (SUV)	263	17.39	99448	23.22	0.749*	-88.156
Passenger Car	637	42.13	216932	50.66	0.832*	-128.9...

Pedestrians 124 and Motorcycles 94 were significantly over-represented IFCs. The proportion of Sport Utility Vehicles (17.39%, 263) and Passenger Cars (42.13%, 637) resulted in their placement at the bottom of the list, indicating an under-representation in IFCs. Pick-ups had a high frequency (261), but neither of their proportions (17.26% and 17.30%) resulted in no over-representations.

See Section 7.5 for more information on Pedestrians.

7.5 C058 Number of Pedestrians



C057: Number of Pedestrians	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
No Pedestrians Involved	1369	86.26	452611	99.57	0.866*	-211.171
1 Pedestrian Involved	207	13.04	1895	0.42	31.288*	200.384
2 Pedestrians Involved	8	0.50	55	0.01	41.663	7.808
3 Pedestrians Involved	3	0.19	4	0.00	214.824	2.986

There were a total of 232 fatal pedestrian crashes at intersections. Most (207) of them were single pedestrian incidents.

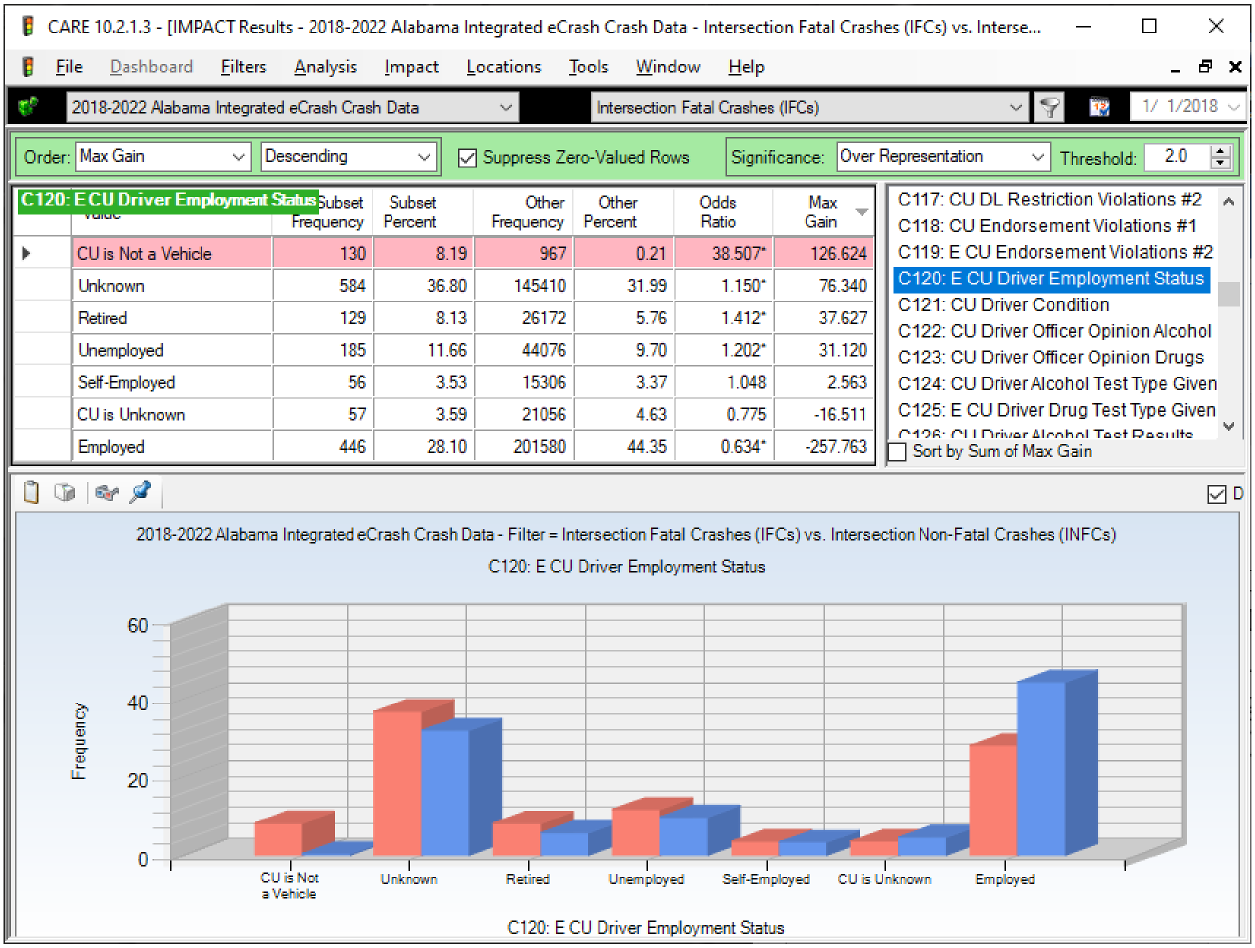
Both ID and Impaired Walking, contribute to this, as well as pedestrians not taking the maximum provisions for being seen at night.

For a detailed study of pedestrian crashes, please see:
http://www.safehomealabama.gov/wp-content/uploads/2023/05/Ped-SS-Using-2018-22-Data-v04.pdf

7.6 C114 Driver License Status

IFCs were over-represented in their causal drivers having legitimate licenses. Revoked and Suspended licenses were encountered too few times to provide the basis any conclusions.

7.7 C120 Driver Employment Status

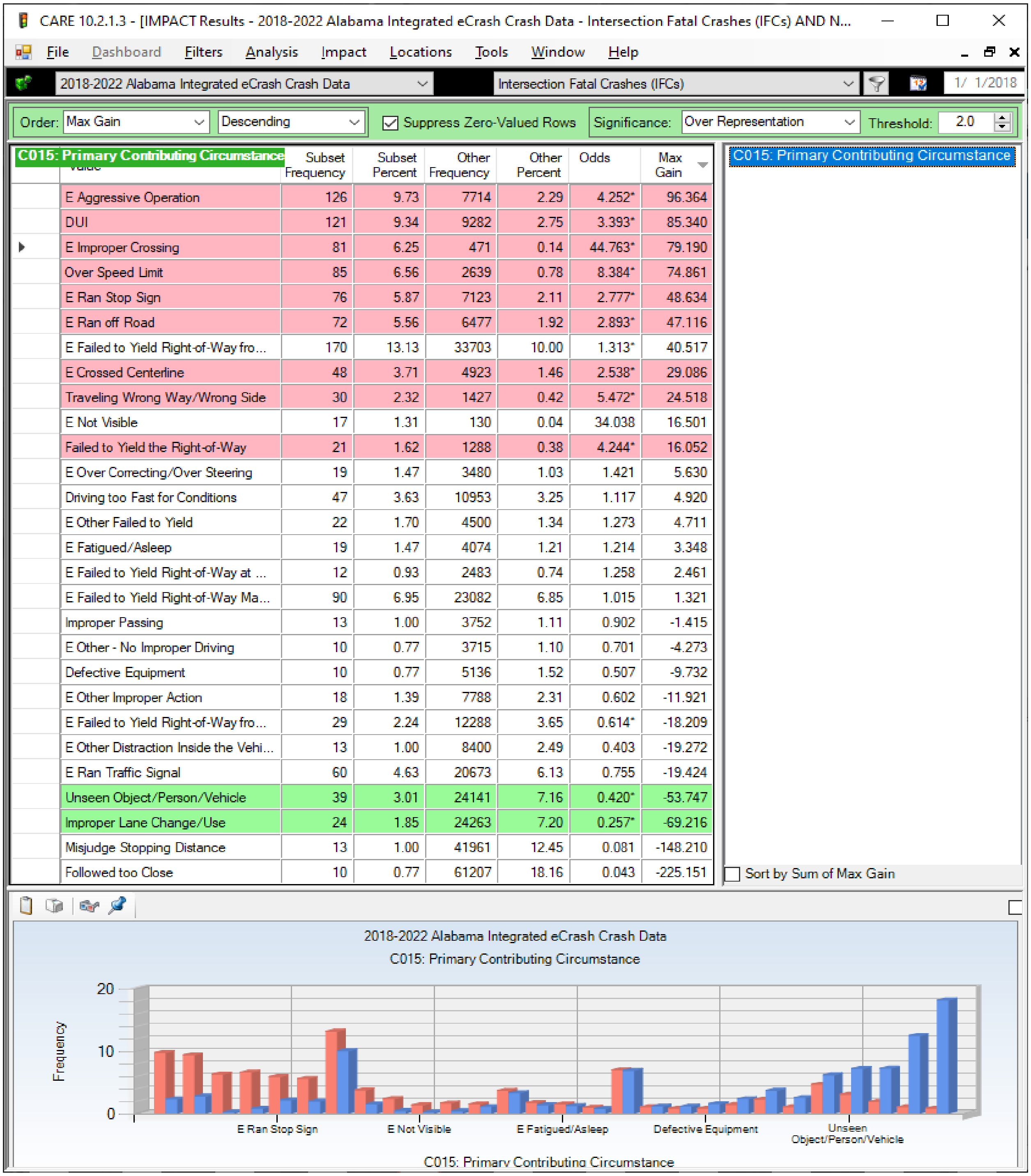


This analysis indicated that the unemployment rate for the IFCs was about 11.66%, while that for INFCs was 9.70%. The following gives the proportion comparisons for IFCs and INFCs, with over-representation indicated by (*):

Status	**IFCs**	**INFCs**	**ODDS RATIO**
Retired	8.13%	5.76%	1.412*
Unemployed	11.66%	9.70%	1.202*
Self-Employed	3.53%	3.37%	1.048
Employed	28.10%	44.35%	0.634*

8.0 Driver Behavior

8.1 C015 Primary Contributing Circumstances (Items < 10 Crashes Removed)



C015: Primary Contributing Circumstance Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds	Max Gain
E Aggressive Operation	126	9.73	7714	2.29	4.252*	96.364
DUI	121	9.34	9282	2.75	3.393*	85.340
E Improper Crossing	81	6.25	471	0.14	44.763*	79.190
Over Speed Limit	85	6.56	2639	0.78	8.384*	74.861
E Ran Stop Sign	76	5.87	7123	2.11	2.777*	48.634
E Ran off Road	72	5.56	6477	1.92	2.893*	47.116
E Failed to Yield Right-of-Way fro...	170	13.13	33703	10.00	1.313*	40.517
E Crossed Centerline	48	3.71	4923	1.46	2.538*	29.086
Traveling Wrong Way/Wrong Side	30	2.32	1427	0.42	5.472*	24.518
E Not Visible	17	1.31	130	0.04	34.038	16.501
Failed to Yield the Right-of-Way	21	1.62	1288	0.38	4.244*	16.052
E Over Correcting/Over Steering	19	1.47	3480	1.03	1.421	5.630
Driving too Fast for Conditions	47	3.63	10953	3.25	1.117	4.920
E Other Failed to Yield	22	1.70	4500	1.34	1.273	4.711
E Fatigued/Asleep	19	1.47	4074	1.21	1.214	3.348
E Failed to Yield Right-of-Way at ...	12	0.93	2483	0.74	1.258	2.461
E Failed to Yield Right-of-Way Ma...	90	6.95	23082	6.85	1.015	1.321
Improper Passing	13	1.00	3752	1.11	0.902	-1.415
E Other - No Improper Driving	10	0.77	3715	1.10	0.701	-4.273
Defective Equipment	10	0.77	5136	1.52	0.507	-9.732
E Other Improper Action	18	1.39	7788	2.31	0.602	-11.921
E Failed to Yield Right-of-Way fro...	29	2.24	12288	3.65	0.614*	-18.209
E Other Distraction Inside the Vehi...	13	1.00	8400	2.49	0.403	-19.272
E Ran Traffic Signal	60	4.63	20673	6.13	0.755	-19.424
Unseen Object/Person/Vehicle	39	3.01	24141	7.16	0.420*	-53.747
Improper Lane Change/Use	24	1.85	24263	7.20	0.257*	-69.216
Misjudge Stopping Distance	13	1.00	41961	12.45	0.081	-148.210
Followed too Close	10	0.77	61207	18.16	0.043	-225.151

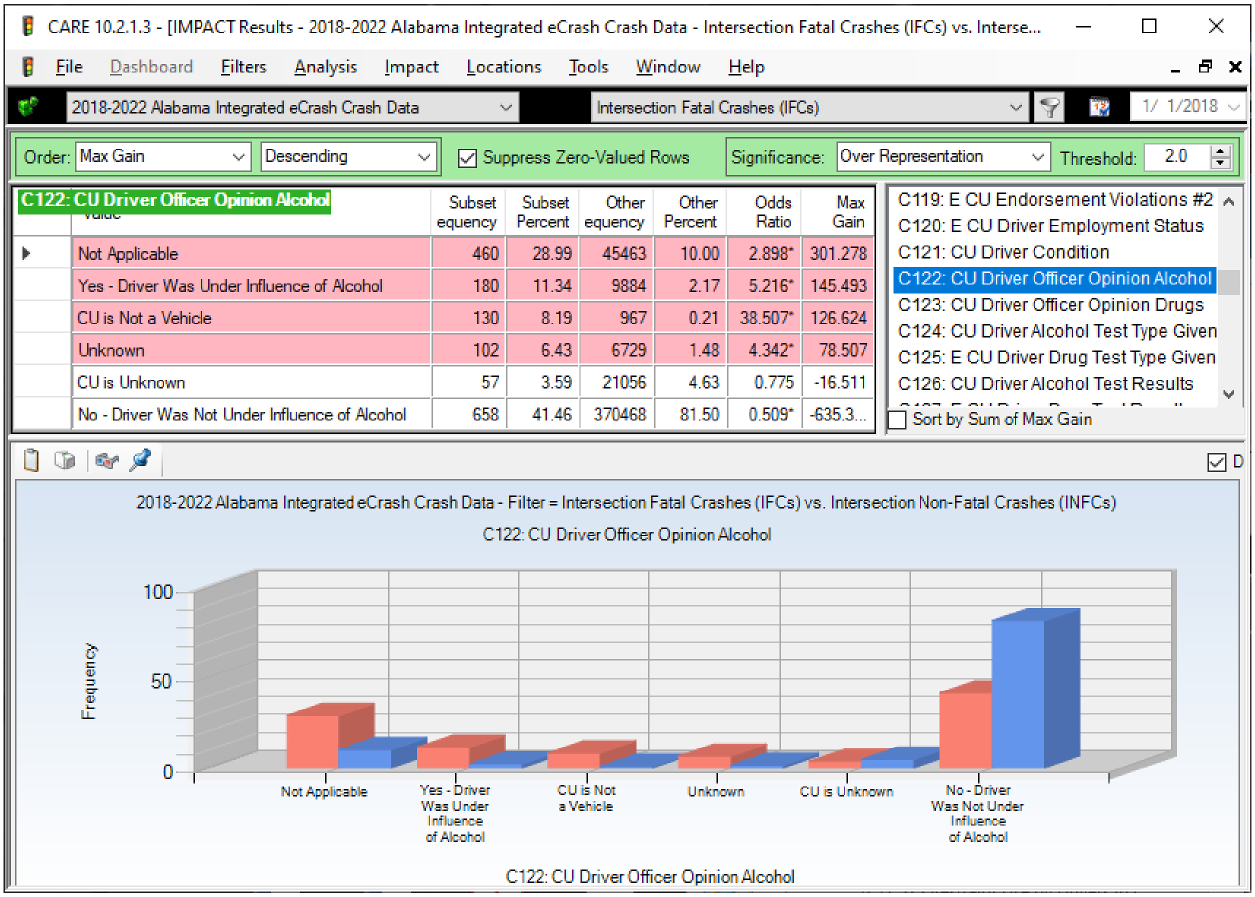
8.2 Discussion of Primary Contributing Circumstances (PCC) Results Above

These results demonstrate the driver behaviors as they were defined by the C015, Primary Contributing Circumstances (PCCs), which accompanied IFCs and INFCs. All IFC over-representations in their expected proportion are as follows, with percentages:

IFCs PCC Overrepresented	Frequency	IFC%
○ Aggressive Operation	9.73%	2.16%
○ DUI	9.34%	2.60%
○ Improper Crossing (pedestrian)	6.25%	0.13%
○ Over Speed Limit	6.56%	0.74%
○ Ran Stop Sign	5.87%	1.99%
○ Ran off Road	5.56%	1.81%
○ Failed to Yield ROW at Stop Sign	13.13%	9.43%
○ Crossed Centerline	3.71%	1.38%
○ Traveling Wrong Way/Wrong Side	2.32%	0.40%
○ Not Visible (most often pedestrian)	1.31%	0.04%
○ Failed to Yield the Right-of-Way	1.62%	0.36%
○ Driving too Fast for Conditions	3.63%	3.06%
○ Over Correcting/Over Steering	1.47%	0.97%
○ Failed to Yield ROW Left or U-Turn	6.95%	6.46%
○ Other Failed to Yield	1.70%	1.26%
○ Fatigued/Asleep	1.47%	1.14%
○ Failed to Yield ROW Uncon Intersection	0.93%	0.69%

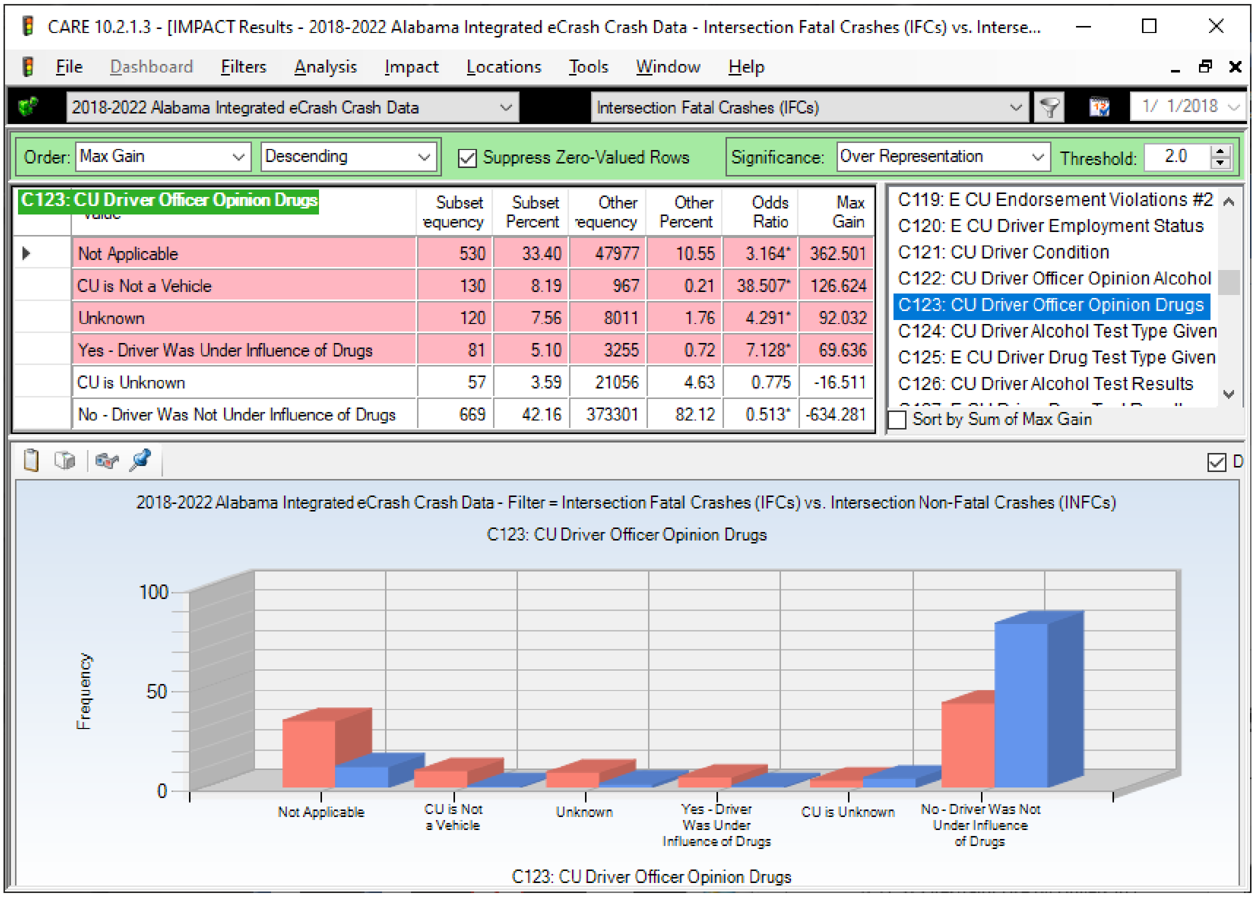
None of the items listed here or in the IMPACT table are necessarily mutually exclusive from the others. Each should be viewed in terms of their relative positions in the table as opposed to any one of them being the absolute cause.

8.3 C122 CU Driver Officer's Opinion Alcohol



Impaired Driving/Alcohol was indicated as one cause of the crash for 11.34% of the IFCs, and 2.17% of the INFCs. This gives an ID Odds Ratio of 5.216. 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 fatal crashes, both day and night. From the positive perspective, 81.50% of the INFCS were not ID alcohol, but only 41.46% of the IFCs were sober in this regard.

8.4 C123 CU Driver Officer's Opinion Drugs (other than alcohol)



C123: CU Driver Officer Opinion Drugs	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Not Applicable	530	33.40	47977	10.55	3.164*	362.501
CU is Not a Vehicle	130	8.19	967	0.21	38.507*	126.624
Unknown	120	7.56	8011	1.76	4.291*	92.032
Yes - Driver Was Under Influence of Drugs	81	5.10	3255	0.72	7.128*	69.636
CU is Unknown	57	3.59	21056	4.63	0.775	-16.511
No - Driver Was Not Under Influence of Drugs	669	42.16	373301	82.12	0.513*	-634.281

The reported non-alcohol drug use proportions in IFCs was about half (5.10/11.34) of that for alcohol. In both cases (IFCs and INFCs), drug use is difficult to detect compared to alcohol, which has well-established tests for the blood-alcohol level that are much easier to administer. Our conclusion is that both alcohol and non-alcohol drug use are major contributors to increasing the frequency of fatal crashes.

From the positive perspective, 82.12% of the INFCS were not Under the Influence of Non-Alcohol Drugs, but only 42.16% of the IFCs were sober in this regard. This is amazingly consistent to the comparable results for Alcohol. In both cases it indicates the increased probability of a crash being fatal if the causal driver is Impaired.