Youth Fatal Crashes IMPACT Special Study

Youth Fatal Crashes (YFCs) vs Youth Non-Fatal Crashes (YNFCs)
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0.0 Introduction

Over the five years of data (CY2018-2022) used in this study, there were 108,409 youth (aged 16-20) caused motor vehicle crashes. These resulted in the following crash severities:

Relative Severity of Youth Caused Crashes

Severity	Youth	Non-Youth	Totals	Percent Youth Crashes
Fatal Injury	393	3,979	4,372	8.98%
Suspected Serious Injury	2,704	17,579	20,283	13.33%
Suspected Minor Injury	9,486	50,814	60,300	15.73%
Possible Injury	10,038	54,134	64,172	15.64%
Property Damage Only	83,582	498,163	581,745	14.37%
Unknown	2,206	17,217	19,423	11.36%
TOTALS	108,409	641,886	750,295	14.45%

In this report the word Youth will be used to refer to Youth-Caused. The purpose of this report is to provide information by which the total number of Youth Fatal Crashes (YFCs) may be reduced, and to reduce the severity of the *potential* YFCs that will 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 through 8 present the results of a number of IMPACT evaluations of Youth Fatal Crashes (YFCs) compared to Youth Non-Fatal Crashes (YNFCs) 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 involve Youth Fatal Crashes (YFCs) from Youth Non-Fatal Crashes (YNFCs). This is different from many of the other Special Studies that have been performed, which had the goals of reducing all of a particular type of crash regardless of severity, not concentrating on those that were fatal.

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

As a first example, over the five years of the crash data studied (CY2018-2022), we found that YFCs for the Highway Classification attribute value of "County" had almost two (1.940) times higher proportion of crashes than did the Youth Non-Fatal Crashes (YNFCs) on County roads (details in Section 2.3). The Odds Ratio was 1.940*, where the * indicates that the difference in the proportions is statistically significant. The Odds Ratios are calculated from the corresponding proportions, which for this example were 34.61% for YFCs and 17.84% for YNFCs (e.g., 34.61/17.84=1.940). When such differences are statistically significant (as in this case), this is evidence that this attribute should be given additional attention, and in some cases, further analyses are performed to obtain information for *countermeasure* development. For example, additional *selective enforcement* for YFC-related violations (e.g., excessive speed, seatbelts, and Impaired Driving) might concentrate more on County roads than they have in the past.

Unless otherwise stated, the items within the tables given above the charts in the IMPACT displays are ordered by *Max Gain*. *Max Gain* is the improvement by YFC reduction that could be obtained if a countermeasure were applied to reduce the proportion of the Youth Fatal Crashes (YFCs) to the proportion of Youth Non-Fatal Crashes (YNFCs) for the particular attribute under consideration. In the Highway Classification example, this would reduce the 34.61% to 17.84%, which would produce the gain of a reduction of 69.894 fatal crashes. (For the complete IMPACT display see Section 2.3). This potential reduction in fatal crashes is called Max Gain because it is generally the maximum gain that could be expected by implementation of the most effective countermeasures. The Max Gain for each attribute value can be seen in the extreme right column of the IMPACT display tables.

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) Youth Fatal Crash Comparison by Year. Section 2.3, as introduced above, is also introductory in that it provides more details of the IMPACT example given above -- a comparison for the Highway Classification attribute that gives us a high-level insight into where the YFCs are occurring.

Section 3 is an IMPACT comparison of the year attribute between fatal and non-fatal Youth crashes (YFCs vs YNFCs). It provides a high level view of how these two factors are increasing/decreasing each year in comparison to one another. After Section 3, the IMPACT comparisons between YFCs and YNFCs are presented, for most relevant attributes, under the following headings, given here with their section numbers:

- 4.0 Geographic and Harmful Event 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 immediately 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), are omitted in this section to maintain consistency with the numbering of the analytical sections (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 detailed information given should be quite useful in the further prioritization and allocation of traffic safety resources. This process of optimization should consider balancing costs of all of the recommendations, which can be validated against the information presented in the IMPACT Sections 4.0-8.0 (source section references for these summaries are given in this section in parenthesis). For a 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 the YFCs are obtained from the comparison of their proportions with the proportions for their corresponding YNFC control classifications. The IMPACT analyses in this study enables the determination of over-representations in either the YFCs or the YNFCs, which would be an under-representation of the YFCs,

Note: subsection numbers 1.1, 1.2 and 1.3 have been omitted below in order to keep the subsection 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 YFCs vs YNFCs over the five years of the study (CY2018-2022). Recommendations for each of the findings are given in the bullet list below:

- **1.4 Geographical Factors (4.0)**
    - County (4.1, C001) - Generally, the over-represented fatal crashes in 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 six YFC-over-represented counties with the highest Max Gain – potential for fatality reductions – are (with their frequencies): Geneva 8, Cullman 13, Dekalb 9, Dallas 7, Randolph, and Walker 9. (Note that the ordering by Max Gain often does not necessarily match the ordering by frequency.) The YNFC-over-represented

counties with the highest potential for fatality reduction with their fatal crash frequencies are: Jefferson 22, Madison 14, Shelby 9, Montgomery 12, Tuscaloosa 18 and Mobile 31. It is recommended that these and the over-represented counties be given special attention for both fatality and crash reduction. Generally, the countermeasures recommended to be applied to specific geographical areas, to be determined by hotspot analysis, are selective enforcement for Speed, Seatbelts, and Impaired Driving, since these three violations have the highest fatal crash causation. Other driver faults are given in Section 8.

- City (4.2, C002) -- Comparisons of YFCs to YNFCs view rural areas of counties as separate "virtual cities." There is little surprise in the number of rural areas in this output. In Section 4.2, City (and rural virtual city) comparisons are presented in the IMPACT table for all areas that had Max Gains greater than 4.5. The top 6 YFC-over-represented Cities are: Rural Mobile 12, Rural Cullman 12, Rural Lee 9, Rural Geneva 7, and Rural Baldwin 10. The top five YNFC-over-represented Cities with their expected fatal crash numbers are: Mobile 8, Birmingham 10, Huntsville 8, Montgomery 7, and Tuscaloosa 6. It is recommended that the cities with a high frequencies of fatal crashes be given special guidance, and perhaps additional funding, along with the most over-represented cities. Many such large city areas have a considerable amount of Open Country that tends to increase their fatality count, as will be discussed in the Locale attribute in Section 4.4.
- Rural/Urban (4.3, C010) Youth Fatal Crash (YFC) Proportion – YFCs occurred in 68.70% Rural and 31.30% 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 YNFCs, these proportions came out to be 24.05% Rural and 74.95% 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,
  - Lower the speed limits in frequent crash areas, and
  - Add special speed yellow warning signs in speed-vulnerable areas.

  Anyone wishing analysis of different 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 YFCs (288, 73.20%). Those countermeasures recommended for rural areas would be applicable to Open Country areas within city limits, which are literal 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 35, and Residential 55.
- Cross-tabulation of Locale (4.5, C033) by Rural/Urban (C010) for YFCs (fatal crashes). The largest number of fatalities were in the Rural, Open Country

specifications, with 246 YFCs. This illustrates that the Locale attribute is more definitive in specifying the surrounding areas of crashes than is the Rural/Urban attribute. Recommendations for rural areas apply equally to Open Country Locales.

- Highway Classifications (4.6, C011) – in order of Max Gains, the largest was County 136, followed by Federal 74, State 94, and Interstate 32, which was under-represented. These results are closely related to the number of Fatal Crashes per mile on the respective Highway Classifications.
- Most Harmful Event (4.7, C019) – ordered by Max Gain. The following items had the largest number of fatality occurrences (listed in Max Gain order with their fatal crash frequencies):

YOUTH FATAL CRASH (YFC)	**FREQUENCY**
Collision with Tree	101
Overturn/Rollover	68
Collision with Non-Motorist: Pedestrian	16
Fire/Explosion	12
Collision with Utility Pole	11

Recommendations to reduce the various most harmful events need to be quite broad to cover all of the various types of crashes listed. For more information on this, see the Driver Behavior recommendations in Sections 8.1-8.4.

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

Youth Fatal Crashes (YFCs)	**FREQUENCY**
Curve Left and Downgrade	28
Straight with Down Grade	53
Curve Right and Down Grade	22
Curve Left and Level	25
Curve Right and Level	21
Curve Right and Upgrade	13

Recommendations include selective enforcement and speed-limit-reduction (e.g., advisory speed and curve warning signs) concentrating on all of the curve types given above. 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 at:

http://www.safehomealbama.gov/tag/road-improvements

Other engineering recommendations should evaluate crashes at curves based on hotspot analyses, especially those curves with grades.

- **1.5 Time Factors (5.0)**
    - Year (5.1, C003) – Variations from year to year were not significant in any years. However, their becoming over-represented in 2020-2022 show a fairly consistent increase. The reason for these increased YFC proportions is not definitive, but it is recommended that this consistent increase should be watched to determine a cause in future years, since this might be an early indication that the proportions of Youth Fatal Crashes (YFCs) per year are increasing over time.
    - Month (5.2, C004) – The proportions of YFCs and YNFCs correlated with each other closely in all months (no significant over-representations found). March, May, June, August, October, and November all had positive Odds Ratios. March and June were the highest, and it is recommended that they be given special selective enforcement concentration, with specific Youth locations determined by hotspot analyses.
    - Day of the Week (2.3, 5.7 C006) – Sunday had the highest significant over-representation, with Saturday following with a lower Odds Ratio, although still statistically significant. The over-representations on Saturday and Sunday would give some indication of Impaired Driving (Alcohol and/or Non-Alcohol Drugs) being involved, and the low sample sizes for the YFCs could account for the absence of significance for other days. Tuesday had a significant under-representation. It will be shown in Sections 8.3 and 8.4 the degree that ID accounts for some of the higher proportions of weekend fatal crashes. This being the case, it is recommended that: (1) the countermeasures for ID be emphasized in the times and places indicated by hotspot analysis; and (2) consideration be given to using Youth Fatal Crashes (YFCs) as a proxy measure to improve ID decisions. See Sections 8.3 and 8.4 for further 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 are due to drowsiness causing, among other things, a diminished ability to see road edge lines. The ID recommendations apply particularly to these over-represented times. See Sections 5.6- 5.7 next for more on time of day implications.
    - Time of Day by Day of the Week (5.6-5.7, C008 x C006) – *For all Youth fatal crashes.* This quantifies the extent of the fatal crash concentrations on Friday nights, Saturday mornings and nights, and Sunday mornings. 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 along with hotpot analysis. See further discussion of these findings in Section 5.6.

- **1.6 Factors Affecting Severity (6.0)**
    - Severity for All Highway Classifications (6.1, C025, C011) – This cross-tabulation was performed for *all Youth crash records* so that the various severities on the different Highway Classifications could be seen. Note the high fatal over-representations on Federal, State and County roads. For Youth fatality reduction, the enforcement priority is recommended on the State, Federal and County roads. If drivers have the option, this chart could be helpful in assisting them in choosing the safest routes for their trips.
    - Speed at Impact (6.2, C224) – Impact speeds below 41 MPH are generally over-represented for YNFCs. YNFCs are over-represented at slower impact speeds, and the low sample sizes for the YFCs at these speeds prevent their statistical tests for these speeds. Above 40 MPH, it becomes clear that fatal crash probability is increasing exponentially with speed. Several analyses over the past decade have found the general rule of thumb that for every 10 MPH increase in impact speeds, the probability of the crash being fatal doubles. Thus, the reduction in just 5-10 MPH impact speed will have a major reduction in fatalities. 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 other dangerous driver behaviors, which are discussed in Section 8.
    - Crash Severity (C025) by Impact Speed (6.3, C224). *for all Youth crashes.* This cross-tabulation gives an idea of the risks involved with increased speed on all highway classifications. The red backgrounds in the first column (Fatal Injury) indicates those speeds that had a significantly 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 is given elaboration in 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 those involving younger drivers. Emphasize: to save lives, slow down to the speed limit and have all passengers fasten their seat belts. The rule of thumb is that each additional 10 MPH of speed doubles the probability of the crash being a fatality.
    - Restraint Use by Drivers in Youth Collisions (6.5, C323) – Restraint use programs have been quite successful in Alabama. It is recommended that the financial support to these programs be increased to assure that their effectiveness

will continue. In particular, special concentration needs to be given to convince all drivers of their additional vulnerability, and how severity might be abated by seatbelts when crashes occur. The probability of a crash causing death is 1 in 8.6 crashes when restraints are not used – it is 1 in 68.8 crashes when using restraints. So the chances of death are 8 times greater when not restrained. 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 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 universally effective. Restraint effectiveness information should be part of all traffic safety educational programs, and consideration should be given to increasing the fines of having unrestrained passengers.
- Number of Vehicles Involved (6.7, C052) – the number of vehicles involved ranged from two to five, but the large majority were either one- or two-vehicle crashes. The Odds Ratios indicate that generally, the more vehicles involved, the greater the probability that the crash is a fatality. However, single-vehicle crashes had the most proportion and frequency of fatal crashes. We know of no way for drivers to control how many vehicles will be involved, and so no recommendations are being made for this attribute. Avoiding a 2-car crash also avoids all other higher number vehicles being involved.
- Police Arrival Delay (6.8, C036) – Police response times to YFCs were less than 20 minutes in 41.98% of the YFC police runs. There can be little doubt that the longer delay times has to do with the proportion of these crashes that were located in rural areas (see C033) and at night. The shorter police responses would generally be expected in those responses to crashes in the urban areas. Recommended is that PI&E programs stress the need to call first responders without delay.
- 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 YFC 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 by a

failure to report the crash immediately. Recommendation: PI&E programs should promote quicker notification to EMS and law enforcement.

- **1.7 Driver and Vehicle Demographics (7.0)**
  - Driver Age Range 2 (7.1, C106) – All Youth drivers are aged 16-20. This comparison of YFC causal driver age with those of the YNFCs looks at the specific ages. None of these ages were significantly different for the two subsets. Both show increases in over-representation with age, which is probably highly correlated with miles driven.
  - Crash Driver Gender (7.2, C109) – the breakdown in YFC causal drivers is 76.84% male and 23.16% female. For YNFC cashes, the percentage is 55.00% male and 44.91% female. These gender differences certainly indicate that males are a greater cause of the fatalities in Youth Crashes (as they are in most crash types), and the recommendation is that, if there are countermeasures specifically for fatal crashes 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 Youth Fatal 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 60 MPH in 119 of their Youth Fatal crashes, while the female number for comparable speeds was 30. Thus, all of the recommendations for speed reduction apply much more to males than to females.
  - Causal Unit (Vehicle) Type (7.4, C101) – This result was based on a comparison of YFC Causal Unit Type against the same for YNFCs. The highest over-representations for YFCs were Pick-Ups 85, Motorcycles 10, 4-WheelOff Road ATVs 7. and Mini-vans 6. The proportion of Sport Utility Vehicles (18.07%, 71) and Passenger Cars (52.16%, 205) resulted in their placement at the bottom of the list, indicating that they were under-represented in YFCs despite their high frequency numbers (reason: their YNFC proportions were even greater). It is recommended that countermeasure programs that are currently in effect be continued and augmented to emphasize the special issues that the vehicle types noted above have in Youth crashes.
  - Number of Pedestrians (7.5, C057) – Single pedestrian YFC pedestrian crashes occur at a proportion 3.56%. which is 24.476 times greater than their Youth Non-Fatal proportion. See the reference at the end of this blurb for a study that concentrated on pedestrians. Both ID (Impaired Driving) and Impaired Walking, contribute to pedestrian collisions, as well as pedestrians not taking the maximum means for being seen at all times, but especially at night. Wearing reflective clothing, and keeping a flashlight lit at night to be seen of vehicle drivers are two

of the most important recommendations since lack of visibility was cited for several pedestrian fatal crashes. Both day and night visibility needs to be emphasized in the lower school grades and continued through the young adult years. 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. 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) – YFC drivers were under-represented in their causal drivers having Current/Valid drivers' licenses. Not Applicable/Unlicensed was significantly over-represented with an Odds Ratio of 1.837. However, very few were Revoked 1, Suspended 7, or Expired 1, so no conclusions can be drawn with regard to their relative proportions. This would lead us to believe that a relatively few (about 46) of those who caused fatal crashes were not operating within the law.
- Driver Employment Status (7.7, C120) – This analysis indicated that the employment rate for the YFCs was about 39.69%, while that for YNFCs (same ages) was 55.57%. 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 or being in school and being involved in a fatal crash should be watched carefully going forward in that it could affect the type and location of countermeasures.

- **1.8 Driver Behavior (8.0)**
  - Primary Contributing Circumstances – PCC (8.1 and 8.2, C015) Driver behaviors that are concurrent with Youth Fatal Crashes might provide ideas for countermeasure development. Those behaviors that were most highly over-represented in YFCs are given below with their YFC and YNFC percentages:

YFCs PCC Overrepresented/Freq	YFC%	YNFC%
Over Speed Limit 76	23.31%	3.67%
DUI 44	13.50%	1.84%
Aggressive Operation 45	13.80%	2.53%
Crossed Centerline 25	7.67%	1.12%
Ran off Road 26	7.58%	3.43%

** Highly significant difference (> 10%)

It is recommended that special consideration in training and enforcement be given to the issues above. Other information for DUI is given in Sections 8.3 and 8.4.

Risk-Taking. It is important to recognize that this age group (and especially seen in males) is quite susceptible to the tendency of risk-taking. This is partially caused because the part of their brains that has a realistic perception of the consequences of risk-taking is

not developed until age 25 for most people. It is recommended that the detailed study of risk-taking be given special consideration; this was conducted and is available at: http://www.safehomealabama.gov/wp-content/uploads/2019/10/Youth-Risk-Taking-Analysis-v08.pdf Recommendations are given in the categories of: family, schools, peer groups, legislation and law enforcement, and the Traffic Safety Community.

- 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 (alcohol, C122 and non-alcohol drugs C123) indicate the degree that ID was involved in fatal crashes. For alcohol, the proportion of ID fatal crashes was 10.052 times as many for YFCs as for YNFCs. For drugs this number was 13.562 times as many in crashes that were fatal (YFCs). It is quite clear that both ID types dramatically increase the probability of the crash resulting in a fatality. For alcohol, the ID multiplier is 17.77 times the probability that the crash will result in a fatality. For non-alcohol drugs, the multiplier is even worse, at 23.31 times as many. The traffic safety community has long since described the problem as be a combination of inexperieced drivers and inexperienced drinkers, to which we can now add inexperienced drug user.

  Recommended countermeasures to reduce both ID types are:
  - Perform additional ID enforcement at locations determined by Youth hotspot analysis as well as general ID hotspot analysis.
  - 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 accurate 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 attributes of Youth Fatal Crashes (YFCs) against the same attributes of Youth Non-Fatal Crashes (YNFCs) 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 (i.e., 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 optimizing the large variety of countermeasures that exist to reduce both crash frequency and severity for YFCs.

Sections 2 and 3 of this report contain information that will be useful in obtaining a high level orientation toward the IMPACT results that follow (in Sections 4 through 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 (3.0) Annual 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. (Time attributes are often in their Natural Order.) *Max Gain* is 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 YFCs than would be expected from that given in the YNFCs. 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. Please notice that *expectations* involve a comparison of proportions, not frequencies.

IMPACT will display comparisons of YFCs against their YNFC counterparts. In summary, the YNFC Crashes are serving as a control to which the YFCs are being compared. In this way any inconsistencies related to the YFCs surfaces, and this can be subjected to further analyses. For a detailed description of the meaning of each element of the IMPACT outputs, see:

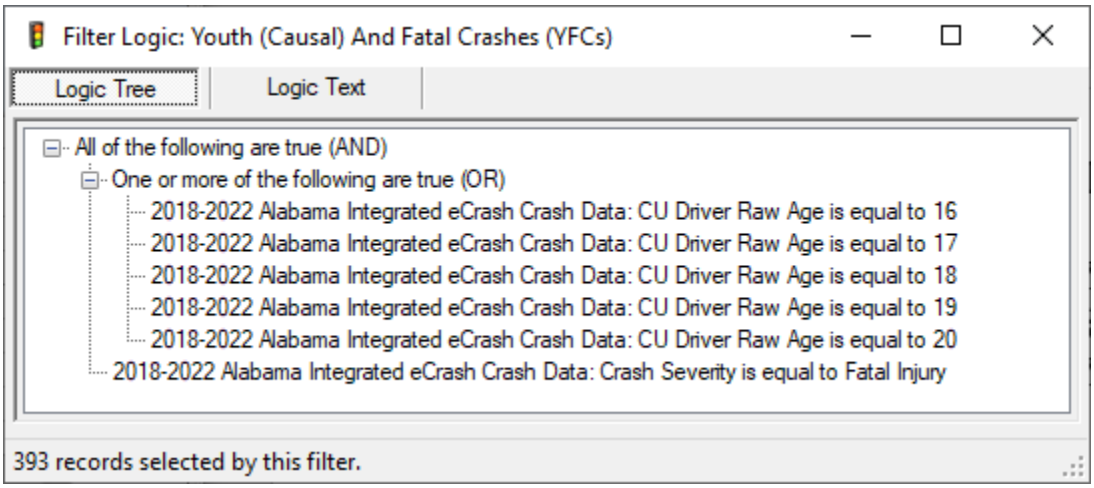
http://www.caps.ua.edu/software/care/

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

2.2 Filter Definitions for the YFC IMPACT Analyses

The IMPACT analyses will compare Youth Fatal Crashes (YFCs) vs Youth Non-Fatal Crashes (YNFCs). The standard filter for all fatal crashes based on C025 Crash Severity was applied, and separate filters for the YFCs and YNFCs were obtained, where the formal definitions for these two filters are given below.

Formal Definition of Youth Fatal Crashes (YFCs)

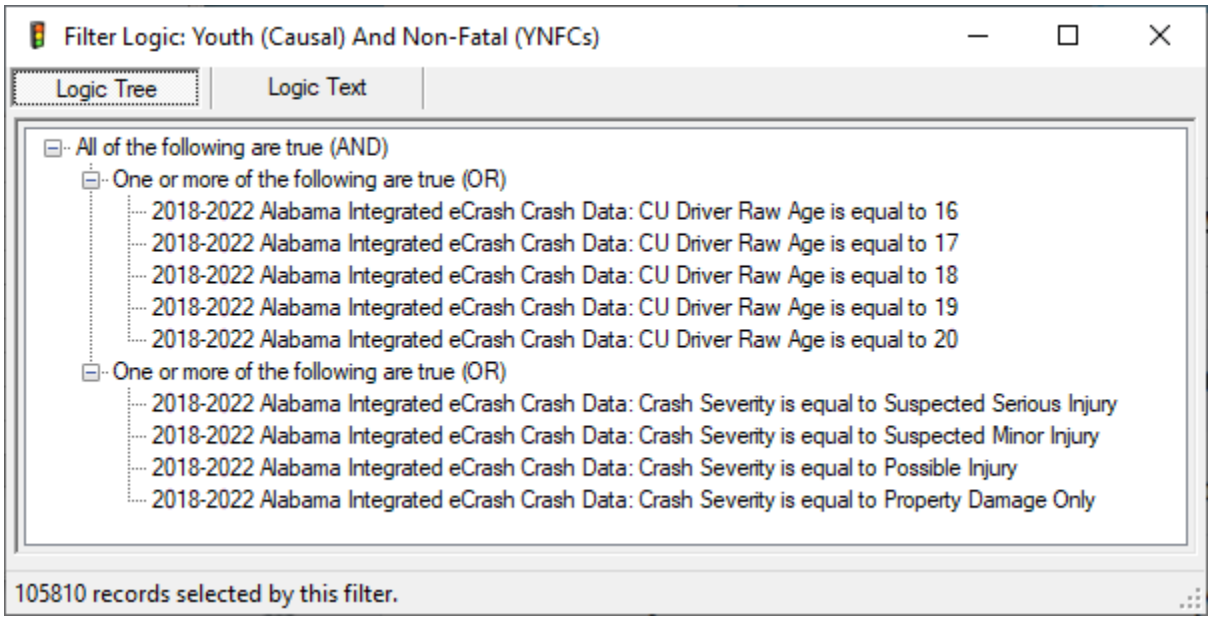


In plain English, the above indicates that all of the *test* crashes (YFCs) to be compared by IMPACT have the following characteristics:

1. They must all be fatal crashes; and
2. They must all be caused by drivers 16 to 20 years of age.

393 Crashes Qualified as YFCs for FY2018-2022

Formal Definition of Youth Non-Fatal Crashes (YNFCs)



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 *injury* or Property Damage Only (PDO) crashes; and
2. They must all be caused by drivers in the 16-20 age range.

105,810 Crashes Qualified as YNFCs in FY2018-2022.

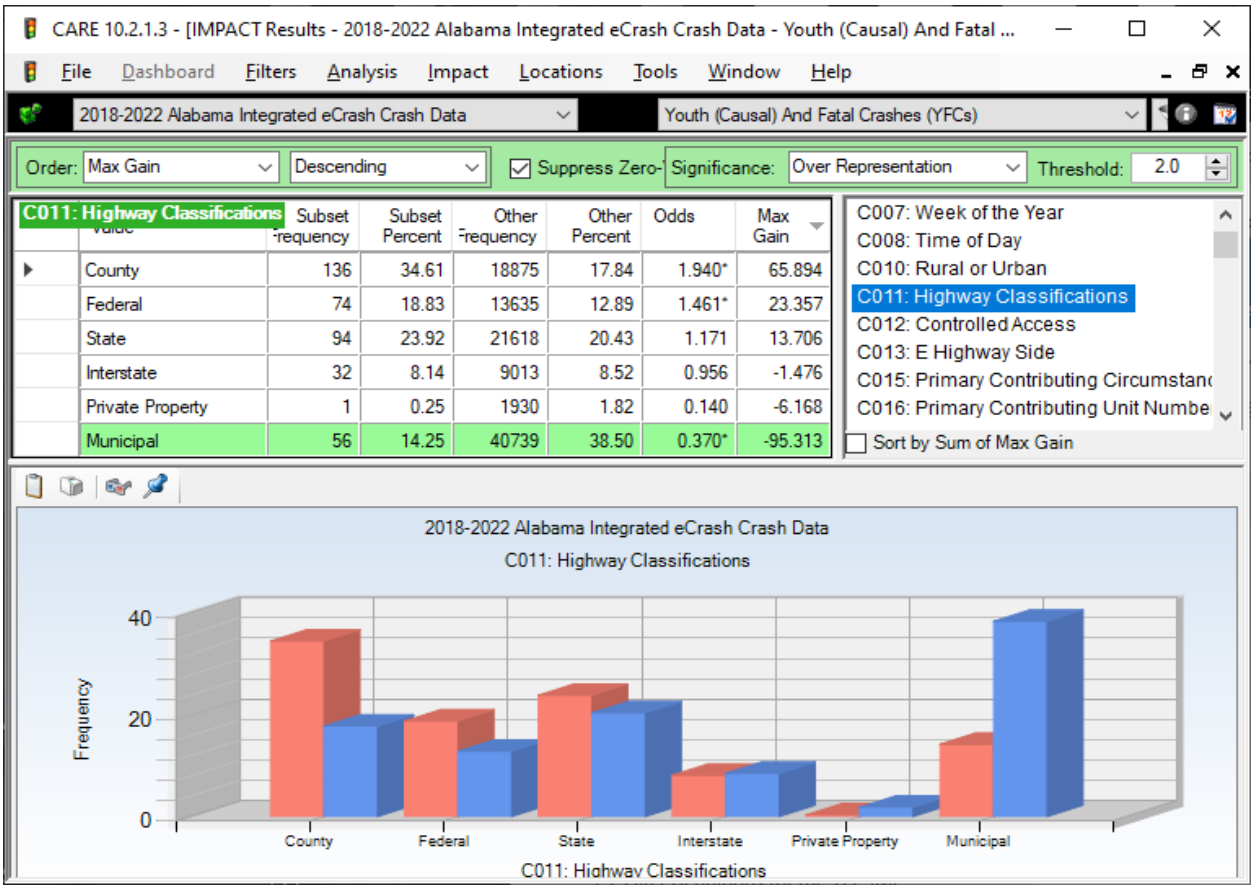
The IMPACT analyses in Section 4 through 8 below will compare the 393 YFCs with the corresponding attributes of the 105,810 YNFCs in order to pinpoint the attributes that are most likely to be causing death in Youth-caused Crashes.

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

- To determine what causes fatal crashes, the fatal crashes have to be compared against similar non-fatal crashes.
- The test subset was all Youth Fatal Crashes (YFCs).
- The control subset was all Youth Non-Fatal Crashes (YNFCs).

Note the filter of the IMPACT analyses two *subset* columns in Sections 4 through 8 are YFCs, and the comparative "Other Subsets" (also called the *control* subsets) are YNFCs. These comparisons are different from many IMPACT analyses CAPS has done in the past, because here both the Subset crashes and the "Other" crashes consist of Youth crashes. Thus, they are quite comparable to each other.

2.3 Highway Classification (4.6, C011); Comparison of YFCs and YNFCs



Reminder: Youth Fatal Crashes (YFCs) = **Red bars**;

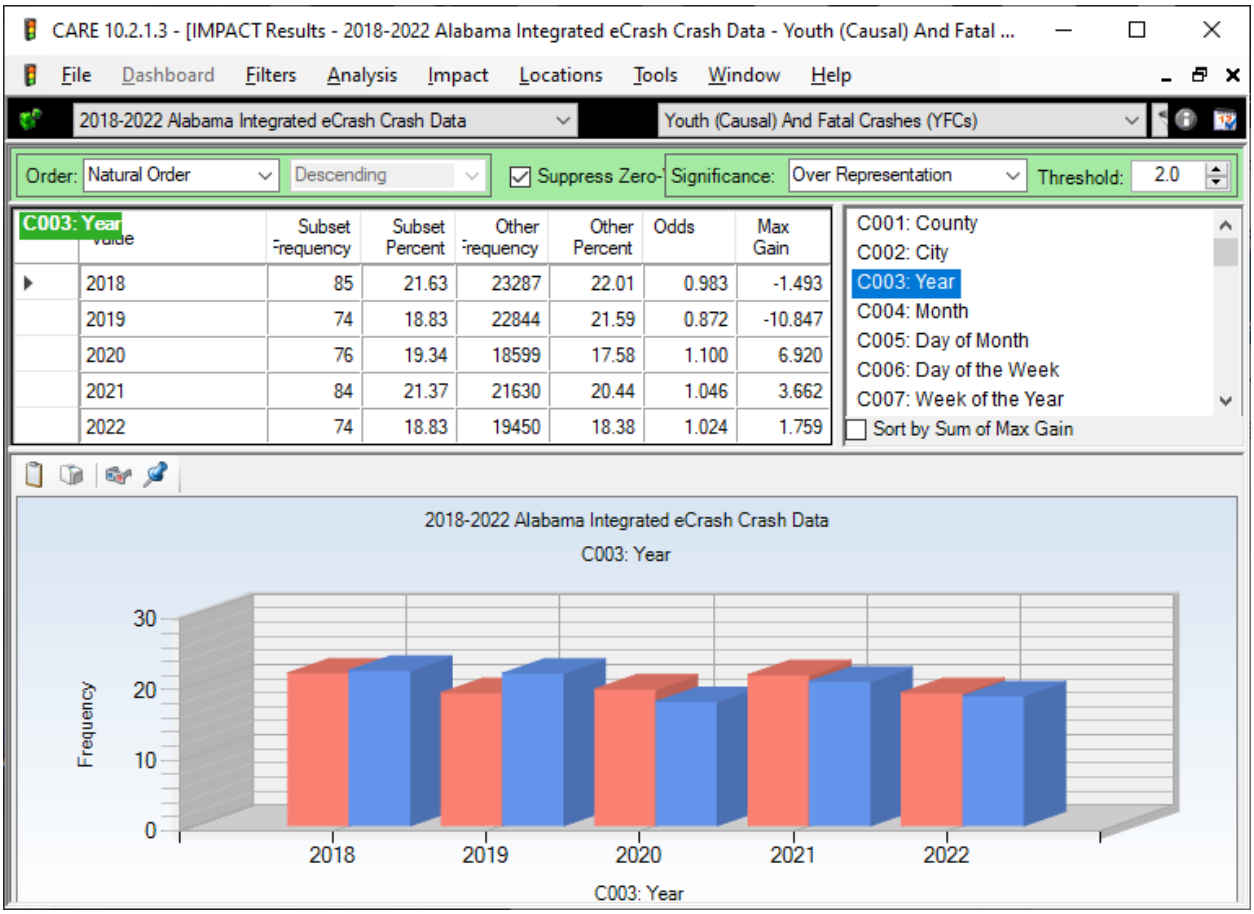
Youth Non-Fatal Crashes (YNFCs) = **Blue bars**.

In this IMPACT display, as well of those in Sections 4 through 8, the Subset (given by the red bars) is the Youth Fatal Crashes (YFCs). The "Other" crashes are those that were Youth Non-Fatal Crashes (YNFCs). This IMPACT (and those below) will use both of the filters defined above to compare the YFCs directly with the YNFCs. The above shows that County and Federal highway classifications are significantly over-represented in YFCs, as shown by the asterisk (*) on their Odds Ratios. State routs are also over-represented, but their difference do not rise to the level of statistical significance. Interstate highways are under-represented, while Municipal roads are highly significantly under-represented, as indicated not only by the asterisk but also by the green background. If any of the roadway classifications were highly significantly over-represented, they would have red backgrounds.

These IMPACT results will be given additional discussion in Section 4.6.

3.0 Fatal to Non-Fatal Youth Crash Comparison by Year

YFCs vs YNFCs by Year



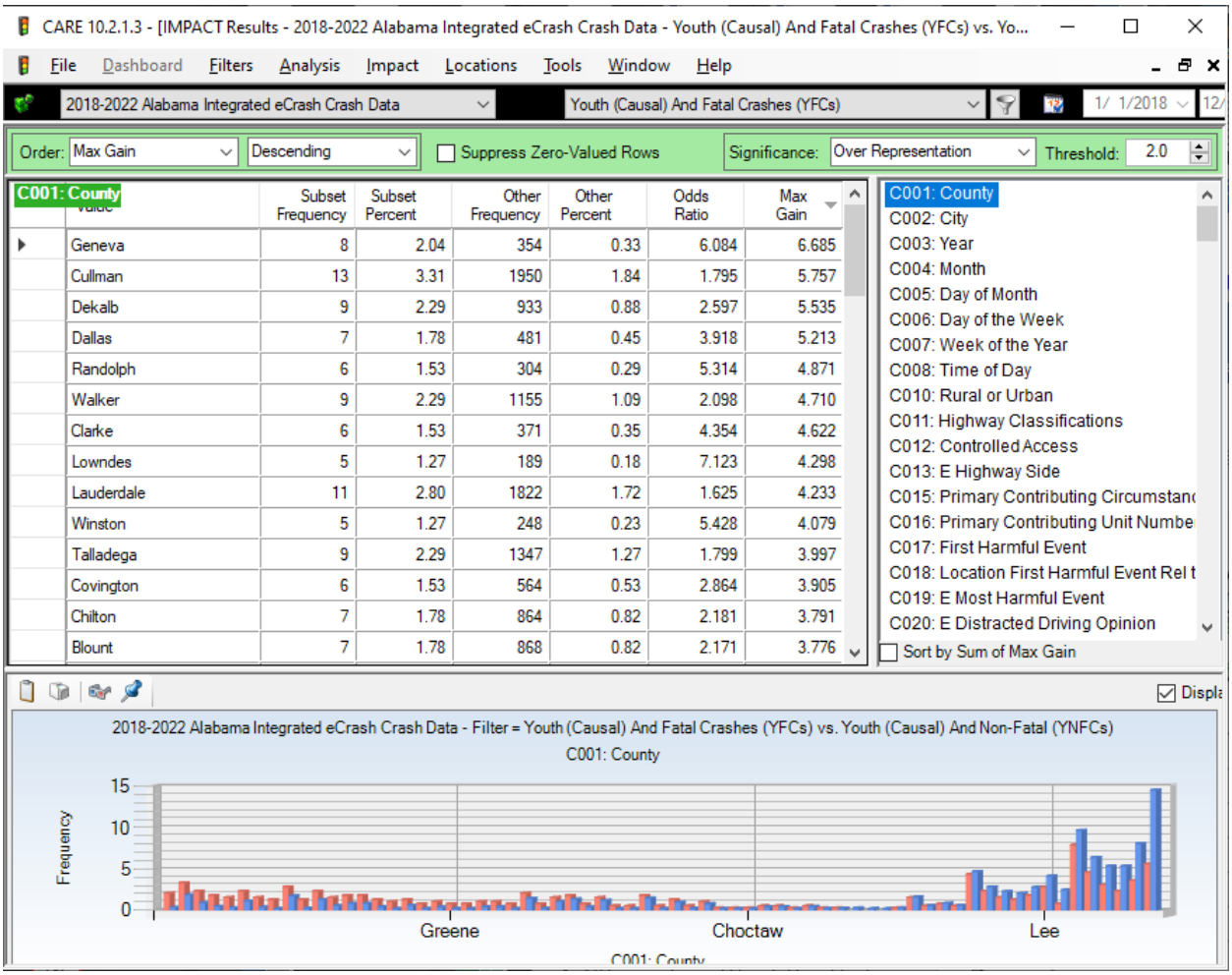
Reminder: YFCs= Youth Fatal=**Red bars**; YNFCs=Youth Non-Fatal=**Blue bars**.

This is an example to further demonstrate the IMPACT displays. None of the years show any statistically significant differences between the fatal and non-fatal crashes. The years 2018 and 2019 are under-represented in fatal crashes, meaning the proportion of YFCs is lower than the proportion of YNFCs. The other three years, 2020-2022 are over-represented, but none of the years are statistically significantly.

See Section 5.1 for additional comments on changes by year.

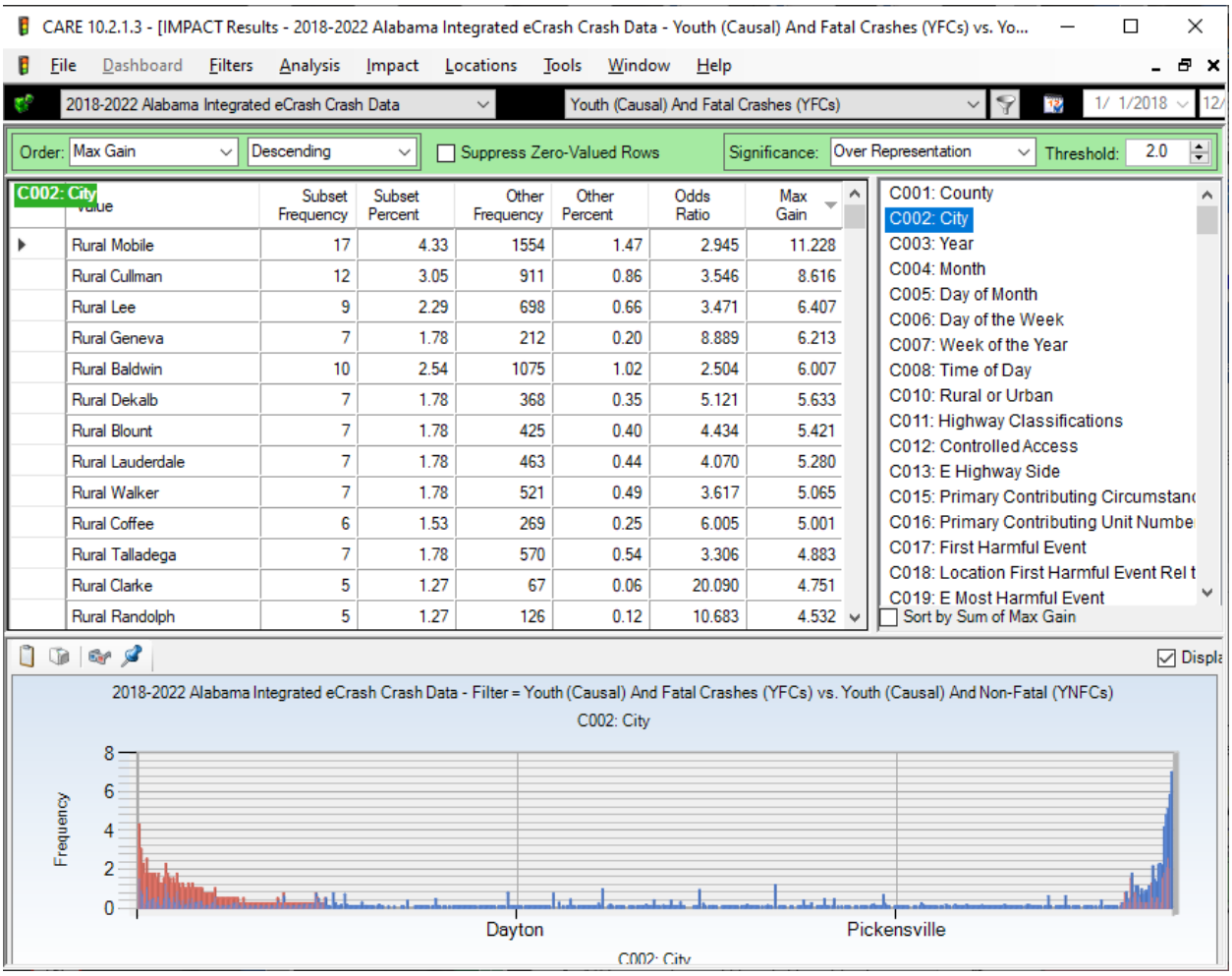
4.0 Geographic and Harmful Event Factors

4.1 C001 County YFCs vs YNFCs (top 14 counties) ordered by Max Gain



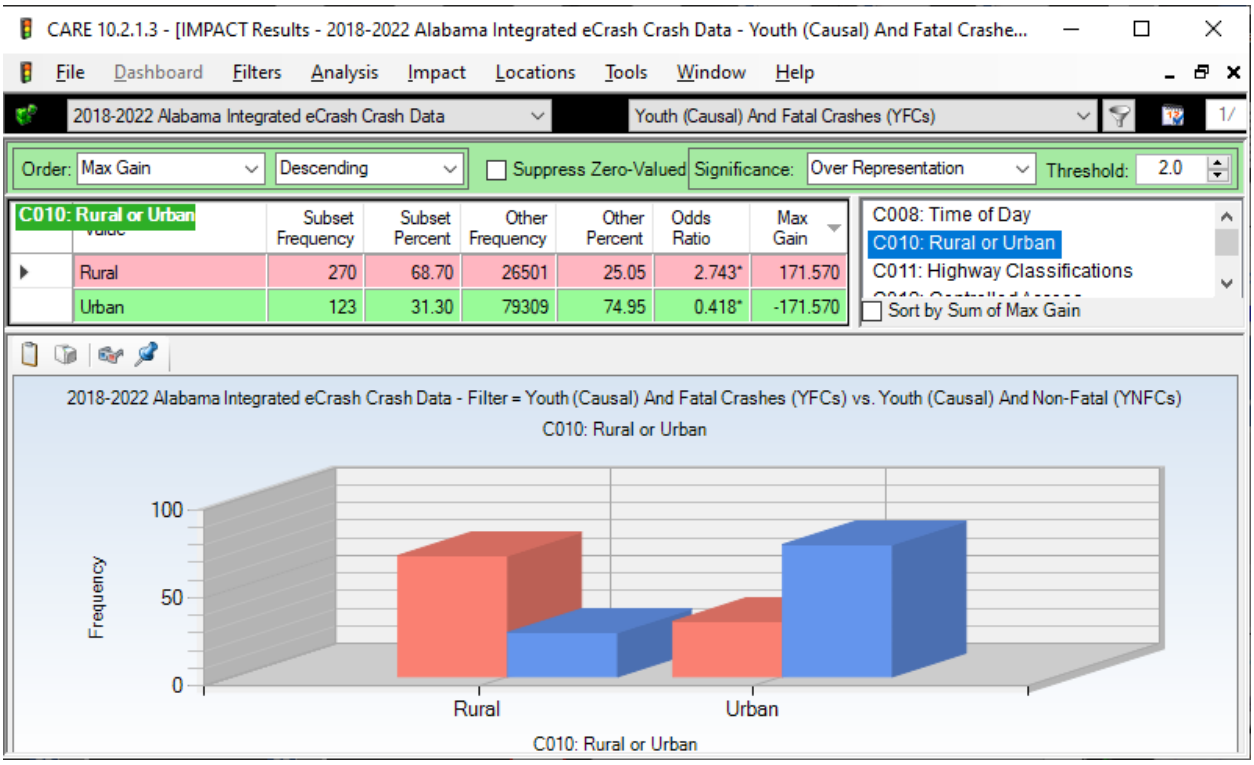
Each line of table above gives both YFC and YNFC crashes. So, Cullman County, second to the top. had 13 Youth Fatal Crashes (YFCs) and 1,950 Youth Non-Fatal Crashes (YNFCs). Their proportions (3.31% and 1.84%) are used to obtain the Odds Ratio of 1.795. Statistical significance is not calculated if either of the frequencies are less than 20. Proportions are calculated from the attribute frequency divided by the total number of crashes in each column. The Max Gain (5.757) is the number of Youth Fatal Crashes (YFCs) that would be reduced if the 3.31% was reduced to 1.84%. The above display has been arranged in Max Gain order to indicate the counties that have the highest potential for gain in reducing their YFC proportions to their YNFC proportions. The display above contains all of the counties with Max Gains greater than 3.500.

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



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. The display for this is in Max Gain ordering to put those (possibly virtual) cities that have the highest potential for Youth Fatal Crash (YFC) reduction at the top. The display is for all Max Gains > 4.500. 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 six highest (virtual) cities according to their Max Gains are: Rural Mobile 17, Rural Cullman 12, Rural Lee 9, Rural Geneva 7, Rural Baldwin 10, and Rural Dekalb 7. The next three also had 7 fatal crashes: Blount, Lauderdale, and Walker. Mobile 8, Birmingham 10 and Huntsville 8 also had high frequencies, but their proportions were less than the YNFCs in these cities.

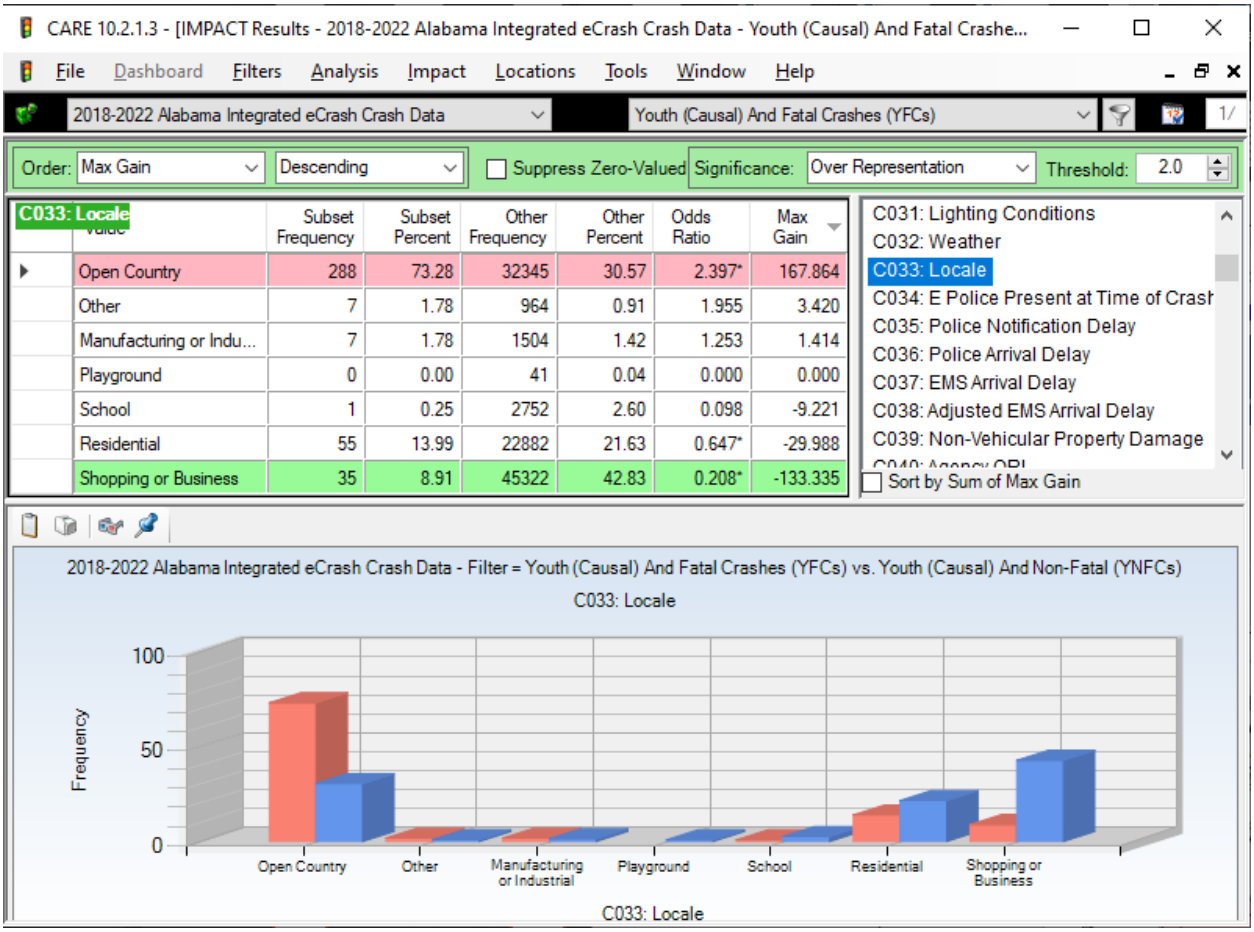
4.3 C010 Rural or Urban



The Youth Fatal Crashes (YFCs) had 68.70% of their fatal crashes in Rural areas, as compared to only 25.05% in the Urban areas. The YNFCs were highly urban, with 79.95% of their crashes in the urban areas. Both results were highly significant, and they illustrate how lethal Rural crashes generally are, as compared to 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.

Some Open Country areas are within city limits (see Sections 4.4 and 4.5 below).

4.4 C033 Locale

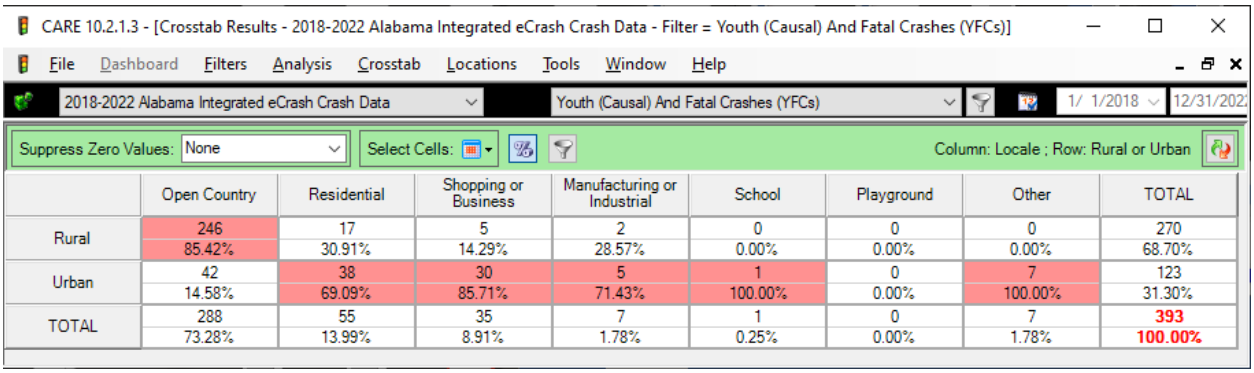


Open Country showed significant differences between YFCs and YNFCs. The YFC proportion for Open Country was 73.28%, and its Odds Ratio was 2.397. Business was significantly under-represented in fatal crashes, although both had fairly high frequencies (35 for Shopping or Business and 55 for Residential). But the proportions for these were considerably lower than those of their corresponding YNFCs. This demonstrates a significantly larger proportion of Open Country in the urban roadway system. The two factors that contribute to the Open Country results are its being proximal to urban areas, which increase the traffic flow, and the greater speeds on the rural roads, which increase the number of fatalities.

See Section 4.5 below for a breakdown of Open Country by Rural/Urban.

4.5 C033 Locale by C010 Rural-Urban for YFCs

It is obvious in the above outputs that YFCs are greatly over-represented in the Rural and Open Country 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 YFCs*, gives one such analysis.

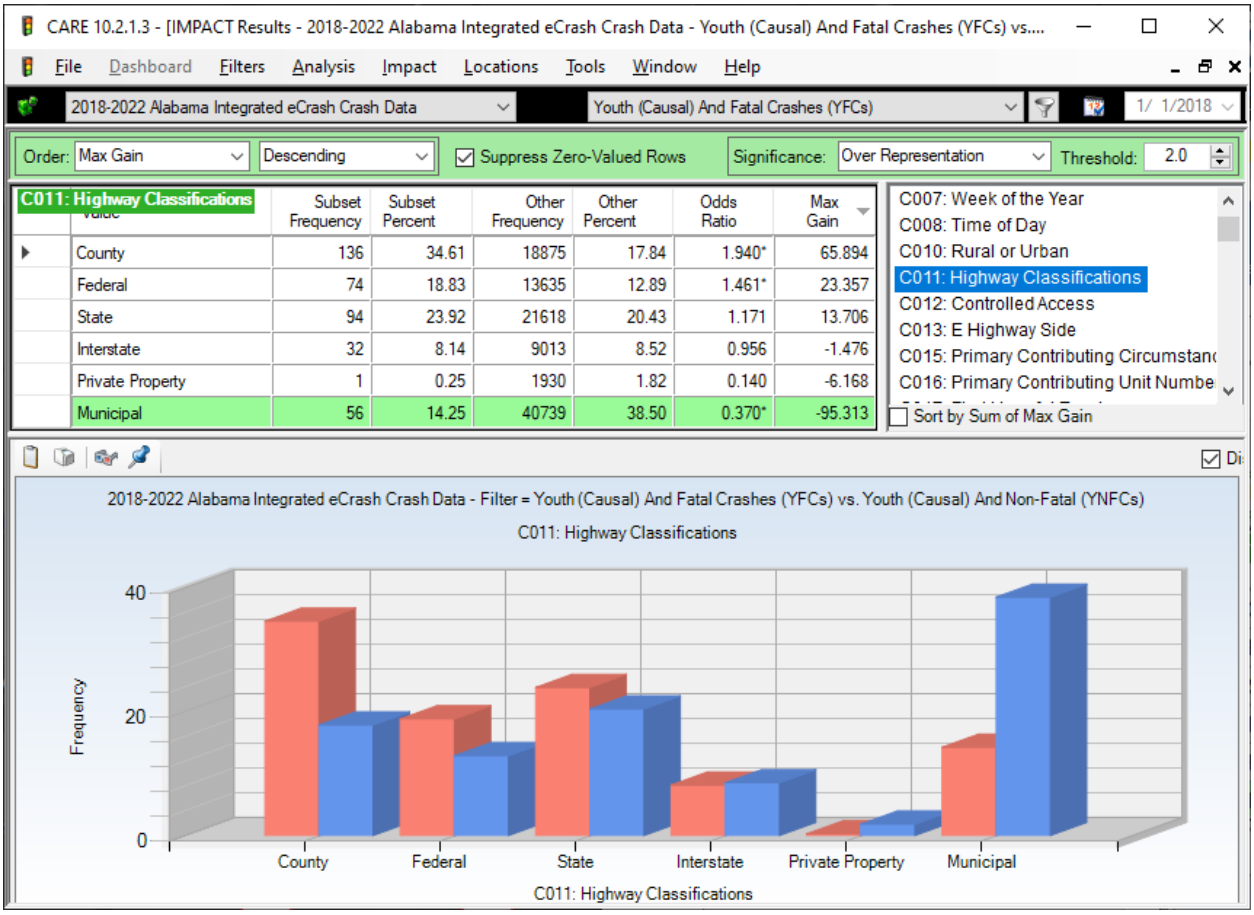


	Open Country	Residential	Shopping or Business	Manufacturing or Industrial	School	Playground	Other	TOTAL
Rural	246 85.42%	17 30.91%	5 14.29%	2 28.57%	0 0.00%	0 0.00%	0 0.00%	270 68.70%
Urban	42 14.58%	38 69.09%	30 85.71%	5 71.43%	1 100.00%	0 0.00%	7 100.00%	123 31.30%
TOTAL	288 73.28%	55 13.99%	35 8.91%	7 1.78%	1 0.25%	0 0.00%	7 1.78%	393 100.00%

The red-backed cells in CARE cross-tabulations indicate a cell over-representation by more than 10%. Those that are over-represented, but by less than 10% would have a yellow background (none qualify here). The white background indicates that the cell is under-represented. For example, while 31.30% of all YFCs were Urban, only 69.08% (38) occurred at the Open Country Locale. Since this is greater than a 10% difference, it has a red background.

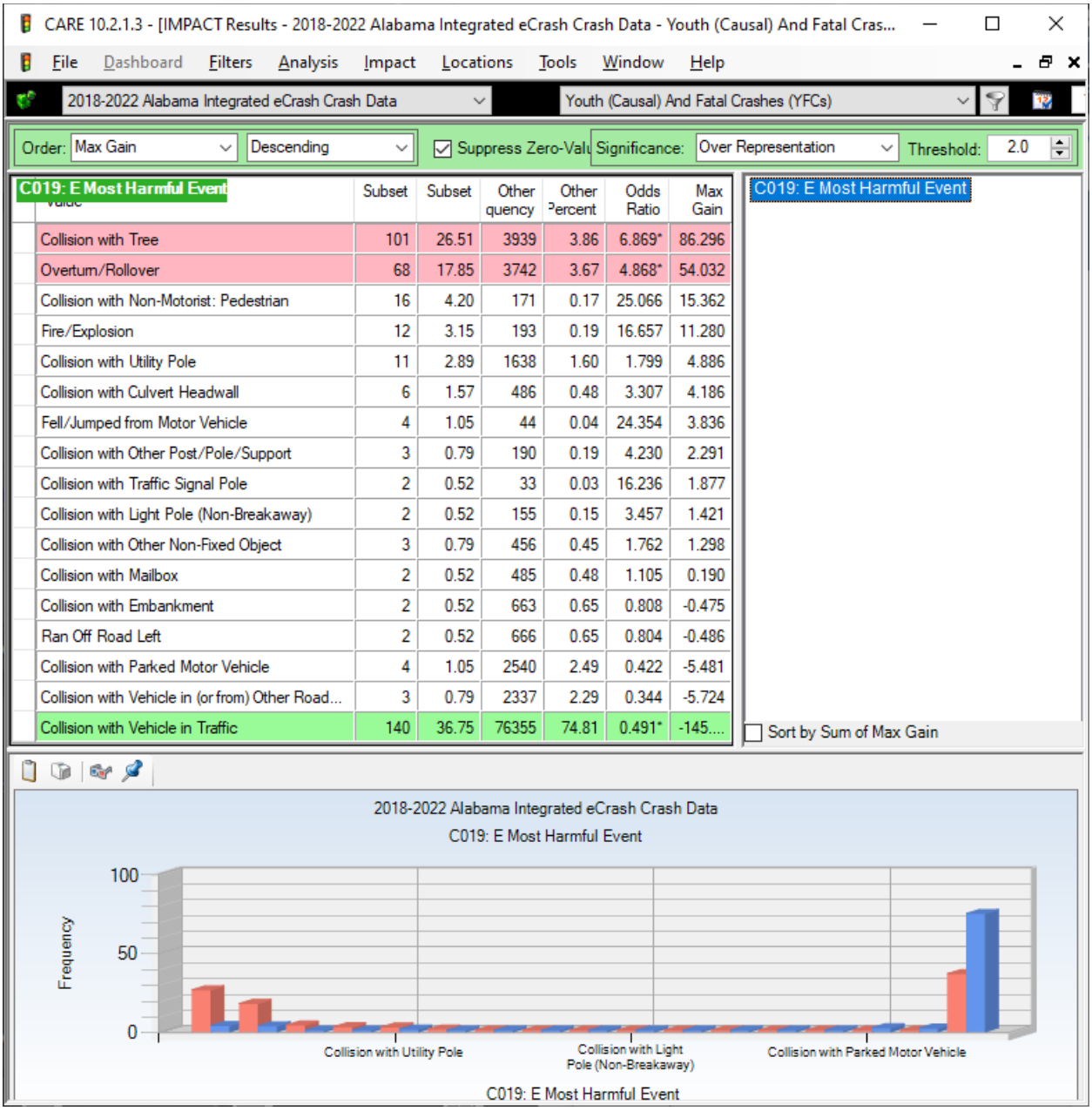
This shows that the Rural/Urban attribute may not be as definitive as is Locale in categorizing crash locations by their general environmental factors. The speed limit within some city limits would cause this in Open Country areas.

4.6 C011 Highway Classifications



This display was introduced in Section 2.3, but little was said of its countermeasure ramifications. Clearly County (236 frequency) routes have the largest number and proportion (34.61%) of Youth Fatal Crashes (YFCs). The other major roadway systems fall in the following max gain order (given with the frequencies): Federal (74), State (94), and Interstate (32). Federal was significantly over-represented. Federal was over-represented, but not significantly. Intertate was under-represented, having a higher proportion of YNFCs than YFCs. While significantly under-represented (0.370*) from its proportion point of view (13.25%), Municipal still had a substantial number of fatal crashes (56), which was more than Interstate.

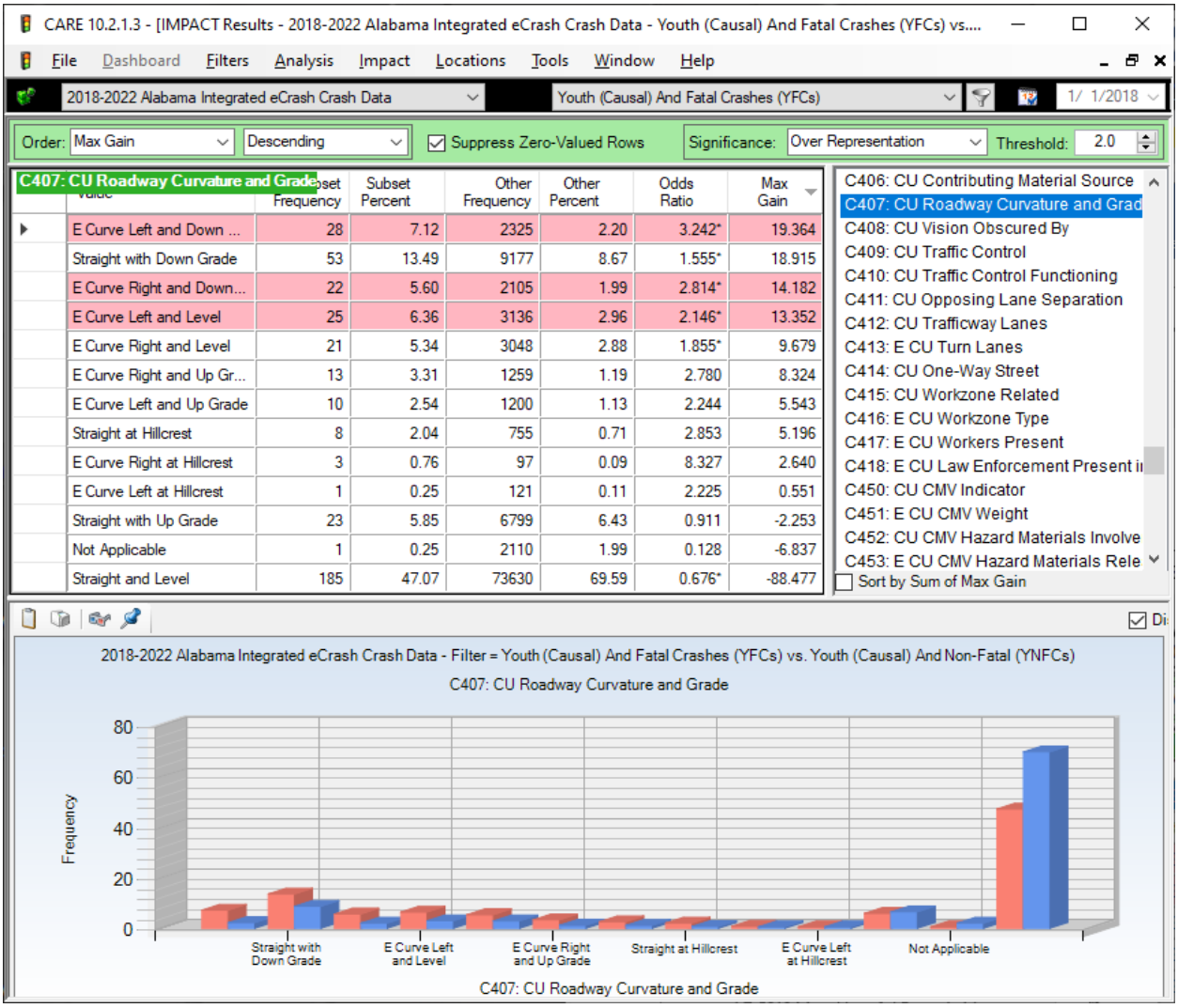
4.7 C019 Most Harmful Event (>1 in MaxGain order)



C019: E Most Harmful Event	Subset	Subset	Other quency	Other Percent	Odds Ratio	Max Gain
Collision with Tree	101	26.51	3939	3.86	6.869*	86.296
Overturn/Rollover	68	17.85	3742	3.67	4.868*	54.032
Collision with Non-Motorist: Pedestrian	16	4.20	171	0.17	25.066	15.362
Fire/Explosion	12	3.15	193	0.19	16.657	11.280
Collision with Utility Pole	11	2.89	1638	1.60	1.799	4.886
Collision with Culvert Headwall	6	1.57	486	0.48	3.307	4.186
Fell/Jumped from Motor Vehicle	4	1.05	44	0.04	24.354	3.836
Collision with Other Post/Pole/Support	3	0.79	190	0.19	4.230	2.291
Collision with Traffic Signal Pole	2	0.52	33	0.03	16.236	1.877
Collision with Light Pole (Non-Breakaway)	2	0.52	155	0.15	3.457	1.421
Collision with Other Non-Fixed Object	3	0.79	456	0.45	1.762	1.298
Collision with Mailbox	2	0.52	485	0.48	1.105	0.190
Collision with Embankment	2	0.52	663	0.65	0.808	-0.475
Ran Off Road Left	2	0.52	666	0.65	0.804	-0.486
Collision with Parked Motor Vehicle	4	1.05	2540	2.49	0.422	-5.481
Collision with Vehicle in (or from) Other Road...	3	0.79	2337	2.29	0.344	-5.724
Collision with Vehicle in Traffic	140	36.75	76355	74.81	0.491*	-145....

The display above is intended to show safety engineers factors that are involved with youth collisions. The top five over-represented crash types (with frequencies) are: Collision with Tree 101, Overturn/Rollover 68, Collision with Non-Motorist: Pedestrian 16, Fire/Explosion 12 and Collision with Utility Pole 11. Collision with Vehicle in Traffic had higher frequency (140), but its proportion (36.75%) was considerably less than that of YNFCs (74.81%)

4.8 C407 CU Roadway Curvature and Grade



YFCs are over-represented in all curve types except Straight with Up Grade and Straight and Level. Over-represented YFCs with the highest frequencies (in Max Gain order):

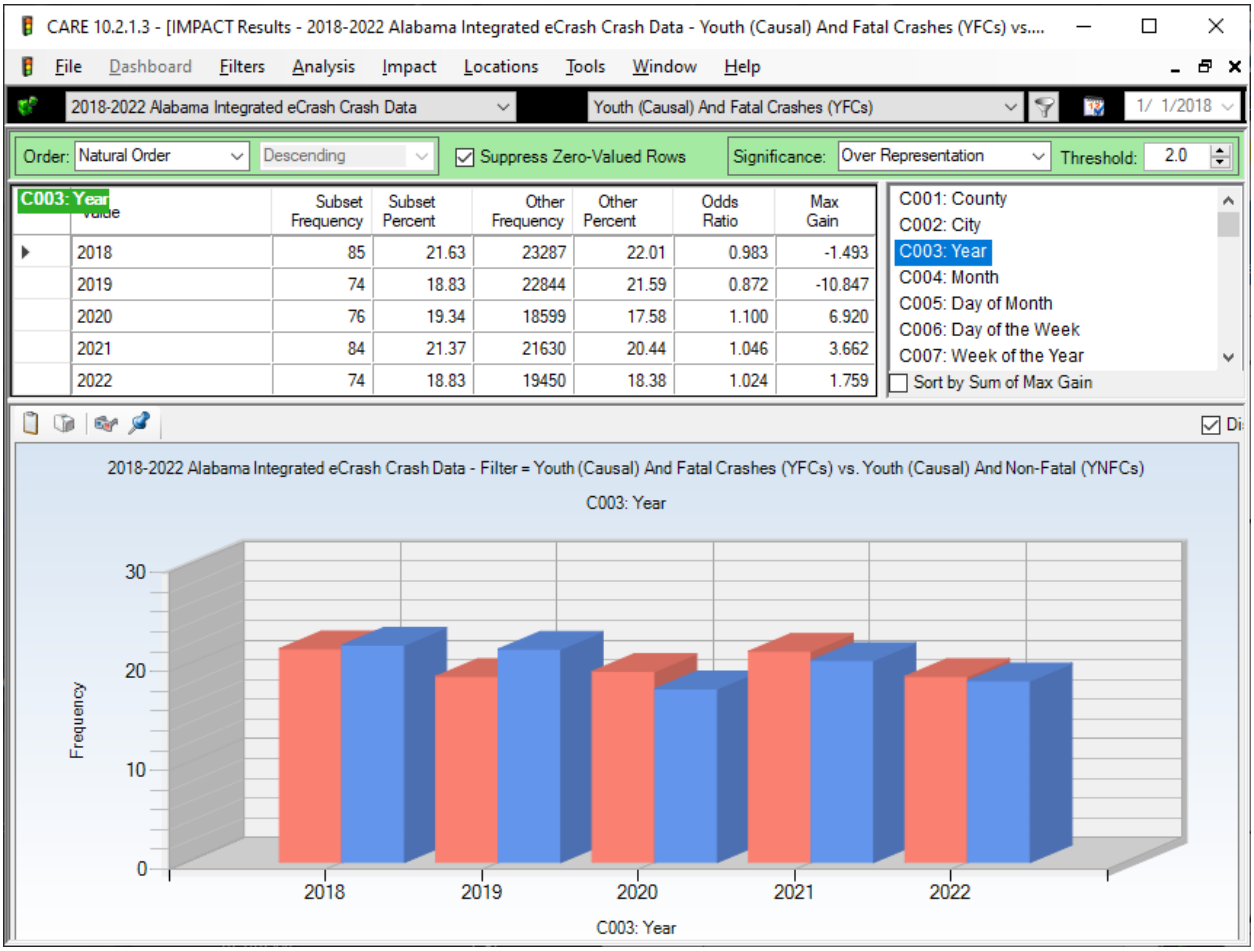
Curve Left and Down Grade	28
Straight with Down Grade	53
Curve Right and Down Grade	22
Curve Left and Level	25
Curve Right and Level	21
Curve Right and Up Grade	13

The only curvatures that were under-represented in YFCs were Straight with Upgrade 23, and Straight and Level 262. Clearly these had the most combined YFCs but their fatality proportions were lower than their YNFC proportions.

5.0 Time Factors

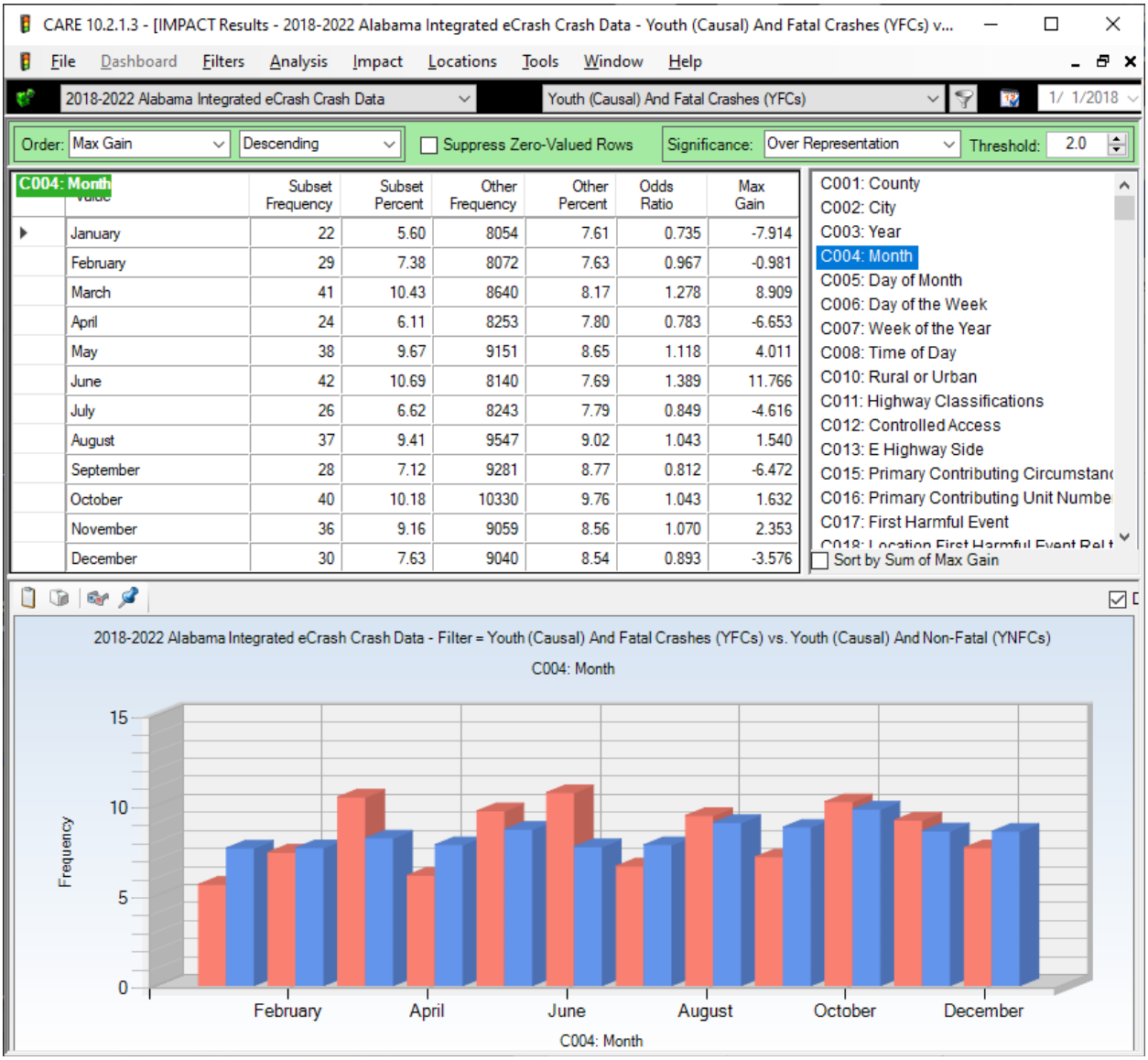
5.1 C003 Year – IMPACT duplicated from Section 3.0 for ease of reference

Year: Youth Fatal Crashes (YFCs) vs Youth Non-Fatal Crashes (YNFCs)



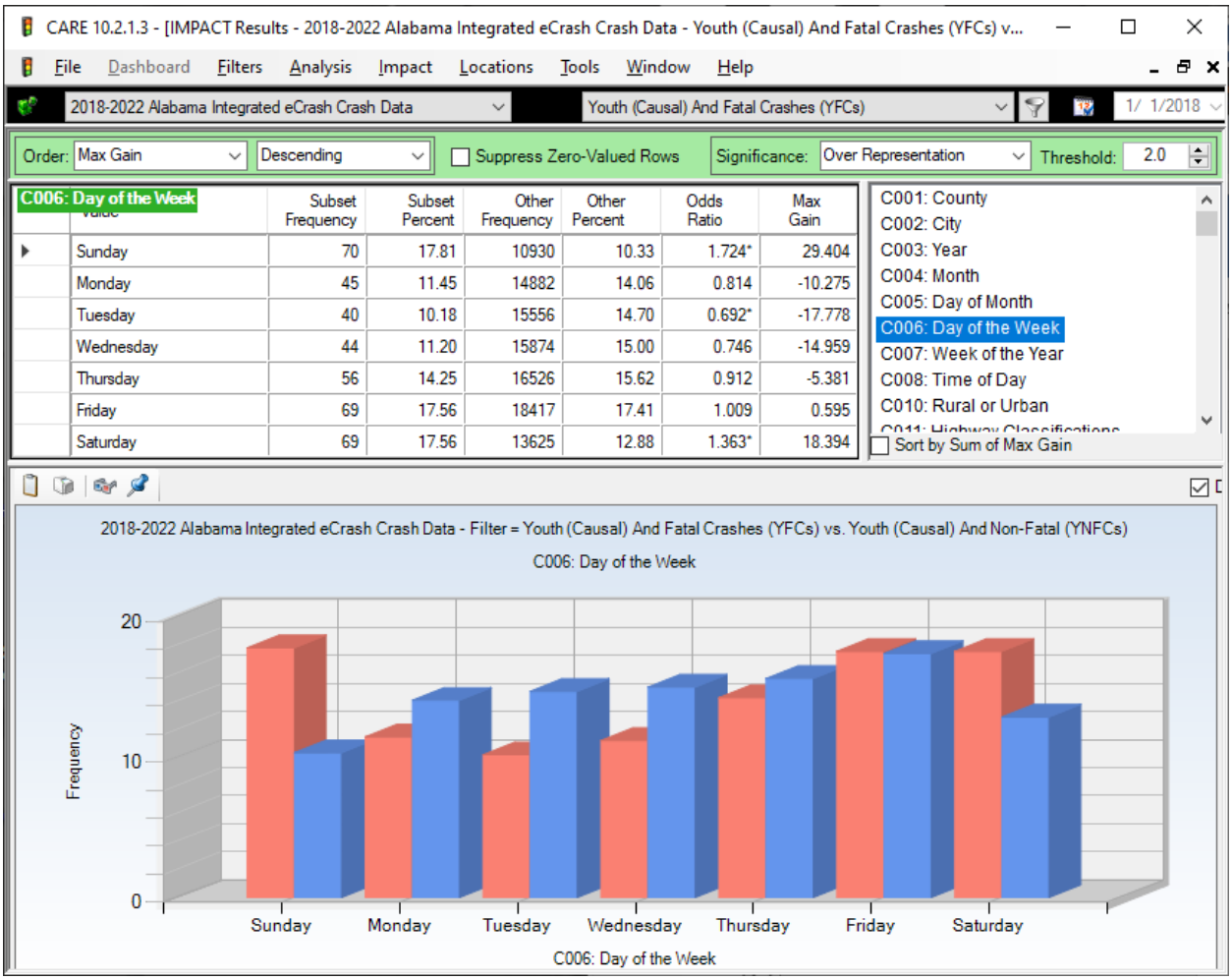
Variations in proportions between the YFCs and the YNFCs were not found to be significant in any of the years. However, there seems to be a growth in the YFC proportions in 2020 through 2022. While under-represented in 2018 and 2019, they became over-represented in years 2020-2022. The reason for these increased YFC proportions is not definitive, but this consistent increase should be watched to determine the cause in future years. Year 2020 has the highest over-representation, but this seems to regress to the mean in 2021 and 2022.

5.2 C004 Month



The ordering of the displays above is according to the natural ordering of months. None of the months had statistically significant over-representations or under-representations, although it is obvious that March and June noteworthy. YFC months generally fell in line with their YNFC counterparts. The largest over-representations were in March and June, which had Odds Ratios of 1.278 and 1.389, which were relatively large, but not large enough to qualify as statistically significant. No sequential collective over-representations were found. This indicates that the times of year do not seem to cause any increases in Youth crashes being fatal. The low YFC sample sizes also work against statistical significance.

5.3 C006 Day of the Week Comparison YFCs and YNFCs

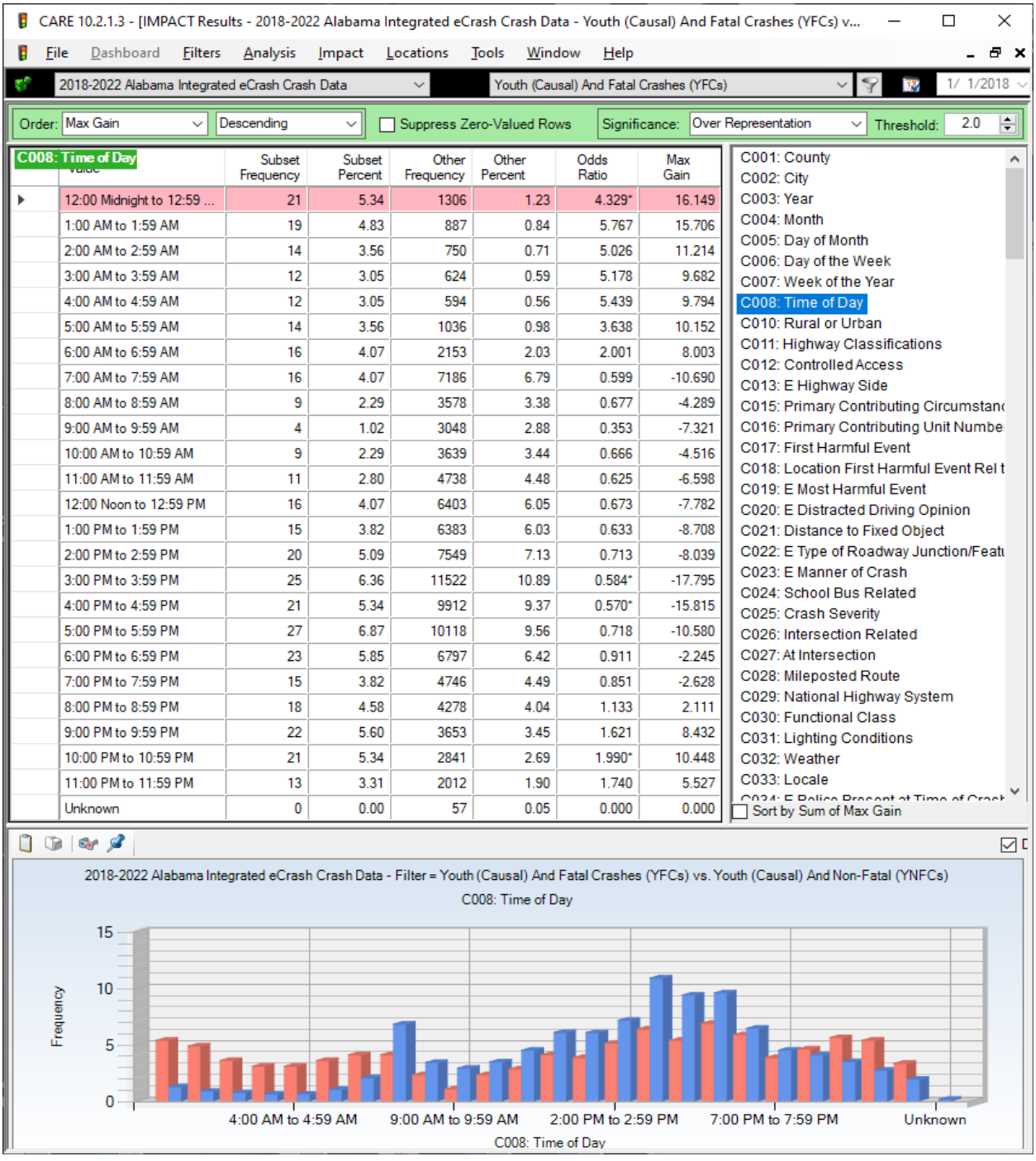


Sunday and Saturday were significantly over-represented in YFCs as compared to their YNFC counterparts. The only other day with a difference of statistical significance was Tuesday, which was significantly under-represented. Friday and Saturday are identical in frequency, and while the Friday proportion is high, it is not high enough to be significant. Because weekends are over-represented in ID (DUI Alcohol or Drugs) this gives us an early indication that YFCs might have an ID causation. This will be validated in Section 8.

5.4 Day of the Week Discussion [covered above.]

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

5.5 C008 Time of Day



The time of day distribution pattern is consistent with the hours that are typically associated with Impaired Driving (ID). See the further discussion in Section 5.6.

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

Refer to the Time of Day (Section 5.5 above) and the Day of the Week by Time of Day cross-tabulation *for all youth fatal crashes* displays (Section 5.7 below). The large Time of Day over-representations on 8:00 PM to 6:59 AM are indicative of ID, fatigue and lack of sleep. The lack of significance indicators could be attributed to the sample sizes being less than 20 for the YFCs.

The *Time of Day by Day of the Week* cross-tabulation (given in the next section *for all fatal crashes* (not subdivided by YFCs and YNFCs) shows the optimal times for Youth selective enforcement. 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. In addition to ID, these and other over-represented hour are times when drivers might take liberties to drive late at night because they do not have work responsibilities the following day (e.g., on vacations).

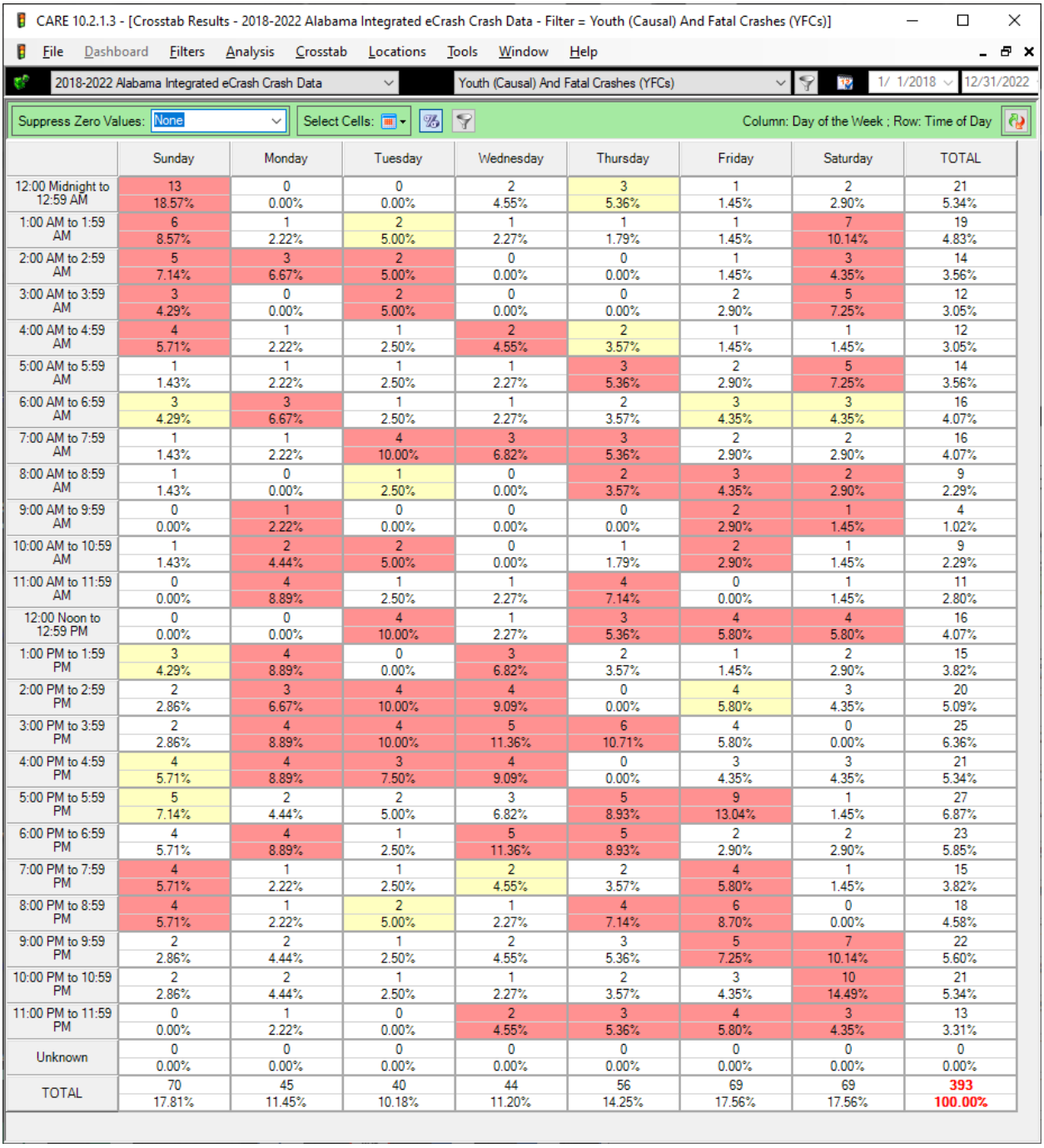
The interpretation of the cross-tabulation in Section 5.7 shows a strong ID component. However, the following additional factors might help to explain the concentrations:

- Friday Night/Saturday Morning – ID, but also fatigue and sleep,
- Saturday Night/Sunday Morning – Same as above.
- Sunday 4:00 PM to 11:59 PM – Fatigue getting home after weekends.
- Weekdays 10:00 AM to 7:59 PM – Fatigue during long drives during the day.

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.
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.

For example, the 12 Midnight to 12:59 AM row has a total percentage value of 5.34% for the fatal crashes during this hour. The red cells to the left (Sunday) has percentages of 18.57%. The yellow cell has a percentage of 5.36%, which is more than 5.34% but less than 10% greater than that average. All the rest of the cells have white background indicating that their percentages are less than 5.34%.

5.7 C008 Time of Day x C005 Day of the Week for YFCs



CARE 10.2.1.3 - [Crosstab Results - 2018-2022 Alabama Integrated eCrash Crash Data - Filter = Youth (Causal) And Fatal Crashes (YFCs)]

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

2018-2022 Alabama Integrated eCrash Crash Data | Youth (Causal) And Fatal Crashes (YFCs) | 1/ 1/2018 | 12/31/2022

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

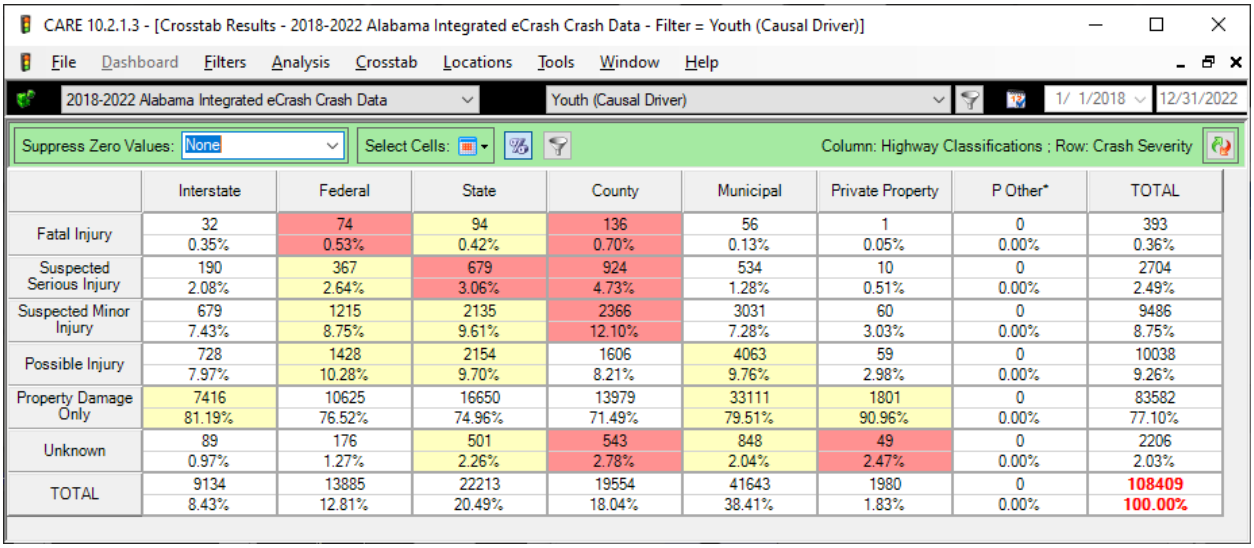
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	TOTAL
12:00 Midnight to 12:59 AM	13 18.57%	0 0.00%	0 0.00%	2 4.55%	3 5.36%	1 1.45%	2 2.90%	21 5.34%
1:00 AM to 1:59 AM	6 8.57%	1 2.22%	2 5.00%	1 2.27%	1 1.79%	1 1.45%	7 10.14%	19 4.83%
2:00 AM to 2:59 AM	5 7.14%	3 6.67%	2 5.00%	0 0.00%	0 0.00%	1 1.45%	3 4.35%	14 3.56%
3:00 AM to 3:59 AM	3 4.29%	0 0.00%	2 5.00%	0 0.00%	0 0.00%	2 2.90%	5 7.25%	12 3.05%
4:00 AM to 4:59 AM	4 5.71%	1 2.22%	1 2.50%	2 4.55%	2 3.57%	1 1.45%	1 1.45%	12 3.05%
5:00 AM to 5:59 AM	1 1.43%	1 2.22%	1 2.50%	1 2.27%	3 5.36%	2 2.90%	5 7.25%	14 3.56%
6:00 AM to 6:59 AM	3 4.29%	3 6.67%	1 2.50%	1 2.27%	2 3.57%	3 4.35%	3 4.35%	16 4.07%
7:00 AM to 7:59 AM	1 1.43%	1 2.22%	4 10.00%	3 6.82%	3 5.36%	2 2.90%	2 2.90%	16 4.07%
8:00 AM to 8:59 AM	1 1.43%	0 0.00%	1 2.50%	0 0.00%	2 3.57%	3 4.35%	2 2.90%	9 2.29%
9:00 AM to 9:59 AM	0 0.00%	1 2.22%	0 0.00%	0 0.00%	0 0.00%	2 2.90%	1 1.45%	4 1.02%
10:00 AM to 10:59 AM	1 1.43%	2 4.44%	2 5.00%	0 0.00%	1 1.79%	2 2.90%	1 1.45%	9 2.29%
11:00 AM to 11:59 AM	0 0.00%	4 8.89%	1 2.50%	1 2.27%	4 7.14%	0 0.00%	1 1.45%	11 2.80%
12:00 Noon to 12:59 PM	0 0.00%	0 0.00%	4 10.00%	1 2.27%	3 5.36%	4 5.80%	4 5.80%	16 4.07%
1:00 PM to 1:59 PM	3 4.29%	4 8.89%	0 0.00%	3 6.82%	2 3.57%	1 1.45%	2 2.90%	15 3.82%
2:00 PM to 2:59 PM	2 2.86%	3 6.67%	4 10.00%	4 9.09%	0 0.00%	4 5.80%	3 4.35%	20 5.09%
3:00 PM to 3:59 PM	2 2.86%	4 8.89%	4 10.00%	5 11.36%	6 10.71%	4 5.80%	0 0.00%	25 6.36%
4:00 PM to 4:59 PM	4 5.71%	4 8.89%	3 7.50%	4 9.09%	0 0.00%	3 4.35%	3 4.35%	21 5.34%
5:00 PM to 5:59 PM	5 7.14%	2 4.44%	2 5.00%	3 6.82%	5 8.93%	9 13.04%	1 1.45%	27 6.87%
6:00 PM to 6:59 PM	4 5.71%	4 8.89%	1 2.50%	5 11.36%	5 8.93%	2 2.90%	2 2.90%	23 5.85%
7:00 PM to 7:59 PM	4 5.71%	1 2.22%	1 2.50%	2 4.55%	2 3.57%	4 5.80%	1 1.45%	15 3.82%
8:00 PM to 8:59 PM	4 5.71%	1 2.22%	2 5.00%	1 2.27%	4 7.14%	6 8.70%	0 0.00%	18 4.58%
9:00 PM to 9:59 PM	2 2.86%	2 4.44%	1 2.50%	2 4.55%	3 5.36%	5 7.25%	7 10.14%	22 5.60%
10:00 PM to 10:59 PM	2 2.86%	2 4.44%	1 2.50%	1 2.27%	2 3.57%	3 4.35%	10 14.49%	21 5.34%
11:00 PM to 11:59 PM	0 0.00%	1 2.22%	0 0.00%	2 4.55%	3 5.36%	4 5.80%	3 4.35%	13 3.31%
Unknown	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%
TOTAL	70 17.81%	45 11.45%	40 10.18%	44 11.20%	56 14.25%	69 17.56%	69 17.56%	393 100.00%

See the discussion in Section 5.6 above.

6.0 Factors Affecting Severity

6.1 C011 Highway Classification by C025 Severity (all Youth crashes)

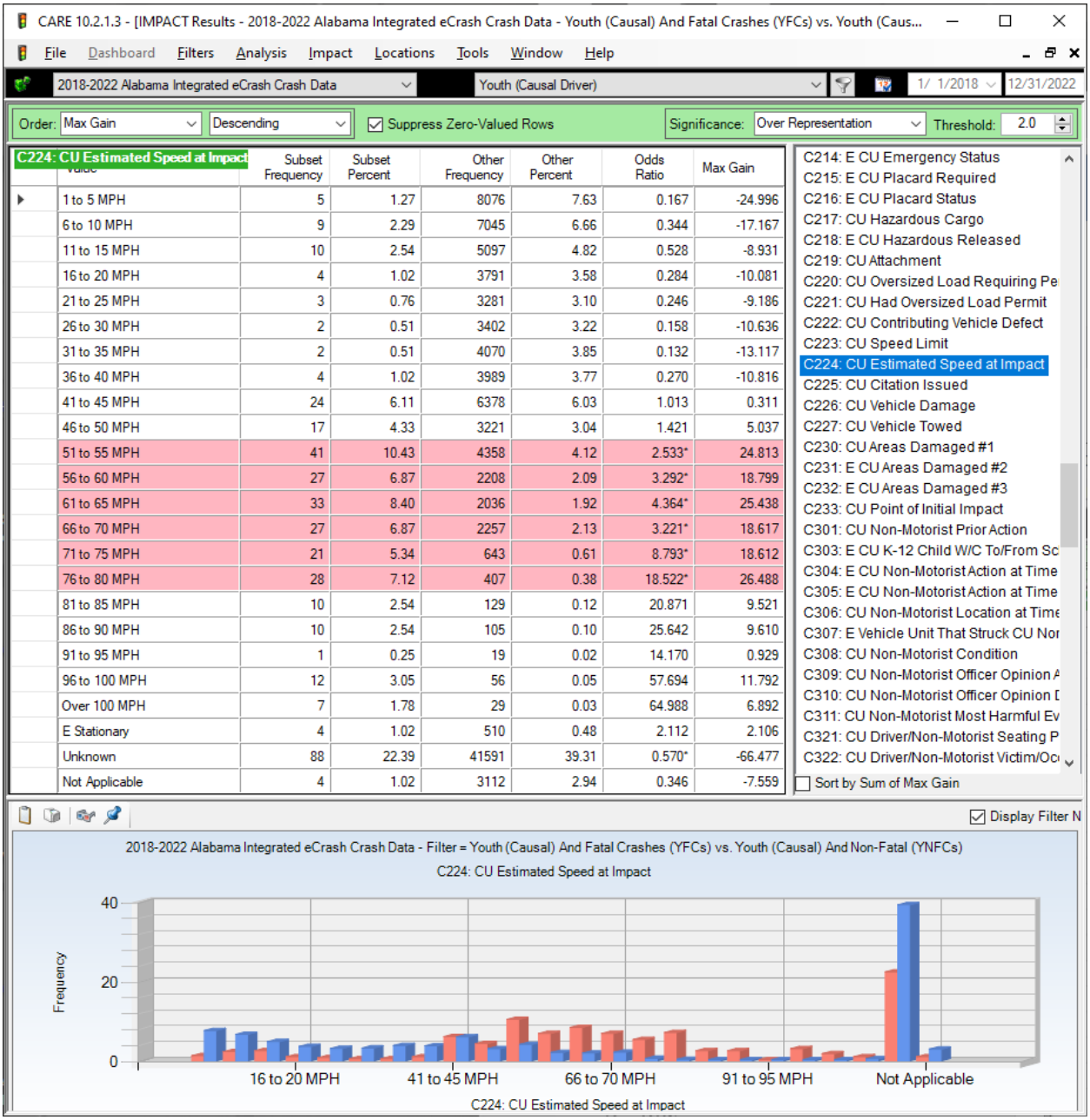
This is performed to get an initial feeling for the severity of crashes on the different Highway Classifications.



	Interstate	Federal	State	County	Municipal	Private Property	P Other*	TOTAL
Fatal Injury	32 0.35%	74 0.53%	94 0.42%	136 0.70%	56 0.13%	1 0.05%	0 0.00%	393 0.36%
Suspected Serious Injury	190 2.08%	367 2.64%	679 3.06%	924 4.73%	534 1.28%	10 0.51%	0 0.00%	2704 2.49%
Suspected Minor Injury	679 7.43%	1215 8.75%	2135 9.61%	2366 12.10%	3031 7.28%	60 3.03%	0 0.00%	9486 8.75%
Possible Injury	728 7.97%	1428 10.28%	2154 9.70%	1606 8.21%	4063 9.76%	59 2.98%	0 0.00%	10038 9.26%
Property Damage Only	7416 81.19%	10625 76.52%	16650 74.96%	13979 71.49%	33111 79.51%	1801 90.96%	0 0.00%	83582 77.10%
Unknown	89 0.97%	176 1.27%	501 2.26%	543 2.78%	848 2.04%	49 2.47%	0 0.00%	2206 2.03%
TOTAL	9134 8.43%	13885 12.81%	22213 20.49%	19554 18.04%	41643 38.41%	1980 1.83%	0 0.00%	108409 100.00%

Notice that the basis for this cross-tabulation is all 108,409 Youth crashes, for all severities, not just fatal crashes. Fatal Youth Crashes *only* would restrict this output to just the top row. This verifies the results presented for fatal Youth crashes in Section 4.6, and it also shows the comparable results for the lesser severities for all of the Highway Classifications. Speed and the failure to wear seatbelts are the primary cause of fatalities caused by all ages. These will be given additional consideration in the attributes described below.

6.2 YFCs vs YNFCs for C224 Speed at Impact



Generally, the travel speeds at roads that have the most YNFCs have speed limits of 45 MPH or lower, and it is the speeds below 41 MPH that are under-represented for the YFCs (thus, over-represented for YNFCs). Those speeds above 41 MPH are over-represented in fatal crashes (YFCs), and the Odds Ratios generally increase systematically as these speeds increase. Insufficient data exists above 90 MPH. Speed relationship to fatality is discussed below.

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

CARE 10.2.1.3 - [Crosstab Results - 2018-2022 Alabama Integrated eCrash Crash Data - Filter = Youth (Causal Driver)]

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

2018-2022 Alabama Integrated eCrash Crash Data | Youth (Causal Driver) | 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	5 1.27%	66 2.44%	342 3.61%	545 5.43%	7123 8.52%	115 5.21%	8196 7.56%
6 to 10 MPH	9 2.29%	112 4.14%	532 5.61%	588 5.86%	5813 6.95%	93 4.22%	7147 6.59%
11 to 15 MPH	10 2.54%	92 3.40%	414 4.36%	494 4.92%	4097 4.90%	59 2.67%	5166 4.77%
16 to 20 MPH	4 1.02%	55 2.03%	269 2.84%	353 3.52%	3114 3.73%	45 2.04%	3840 3.54%
21 to 25 MPH	3 0.76%	61 2.26%	252 2.66%	296 2.95%	2672 3.20%	51 2.31%	3335 3.08%
26 to 30 MPH	2 0.51%	48 1.78%	251 2.65%	333 3.32%	2770 3.31%	49 2.22%	3453 3.19%
31 to 35 MPH	2 0.51%	93 3.44%	375 3.95%	412 4.10%	3190 3.82%	69 3.13%	4141 3.82%
36 to 40 MPH	4 1.02%	77 2.85%	422 4.45%	441 4.39%	3049 3.65%	59 2.67%	4052 3.74%
41 to 45 MPH	24 6.11%	247 9.13%	880 9.28%	653 6.51%	4598 5.50%	66 2.99%	6468 5.97%
46 to 50 MPH	17 4.33%	137 5.07%	442 4.66%	348 3.47%	2294 2.74%	37 1.68%	3275 3.02%
51 to 55 MPH	41 10.43%	287 10.61%	753 7.94%	452 4.50%	2866 3.43%	41 1.86%	4440 4.10%
56 to 60 MPH	27 6.87%	224 8.28%	373 3.93%	200 1.99%	1411 1.69%	20 0.91%	2255 2.08%
61 to 65 MPH	33 8.40%	169 6.25%	351 3.70%	174 1.73%	1342 1.61%	16 0.73%	2085 1.92%
66 to 70 MPH	27 6.87%	163 6.03%	297 3.13%	199 1.98%	1598 1.91%	4 0.18%	2288 2.11%
71 to 75 MPH	21 5.34%	50 1.85%	97 1.02%	47 0.47%	449 0.54%	0 0.00%	664 0.61%
76 to 80 MPH	28 7.12%	56 2.07%	66 0.70%	39 0.39%	246 0.29%	5 0.23%	440 0.41%
81 to 85 MPH	10 2.54%	24 0.89%	26 0.27%	13 0.13%	66 0.08%	1 0.05%	140 0.13%
86 to 90 MPH	10 2.54%	20 0.74%	23 0.24%	13 0.13%	49 0.06%	0 0.00%	115 0.11%
91 to 95 MPH	1 0.25%	6 0.22%	4 0.04%	4 0.04%	5 0.01%	1 0.05%	21 0.02%
96 to 100 MPH	12 3.05%	16 0.59%	8 0.08%	5 0.05%	27 0.03%	0 0.00%	68 0.06%
Over 100 MPH	7 1.78%	6 0.22%	6 0.06%	4 0.04%	13 0.02%	0 0.00%	36 0.03%
E Stationary	4 1.02%	13 0.48%	42 0.44%	32 0.32%	423 0.51%	14 0.63%	528 0.49%
Unknown	88 22.39%	652 24.11%	3049 32.14%	4181 41.65%	33709 40.33%	1294 58.66%	42973 39.64%
Not Applicable	4 1.02%	30 1.11%	212 2.23%	212 2.11%	2658 3.18%	167 7.57%	3283 3.03%
TOTAL	393 0.36%	2704 2.49%	9486 8.75%	10038 9.26%	83582 77.10%	2206 2.03%	108409 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 all Youth crashes. 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	2070.5	1
36 to 40 MPH	1013.0	2.0
41 to 45 MPH	269.5	7.7
46 to 50 MPH	192.6	10.8
51 to 55 MPH	108.3	19.1
56 to 60 MPH	83.5	24.8
61 to 65 MPH	63.2	32.8
66 to 70 MPH	84.7	24.4
71 to 75 MPH	31.6	65.4
76 to 80 MPH	15.7	131.7
81 to 85 MPH	14.0	147.9
86 to 90 MPH	11.5	180.0
91 to 95 MPH	****	****
96 to 100 MPH	5.7	365.4
Over 100 MPH	5.1	402.6

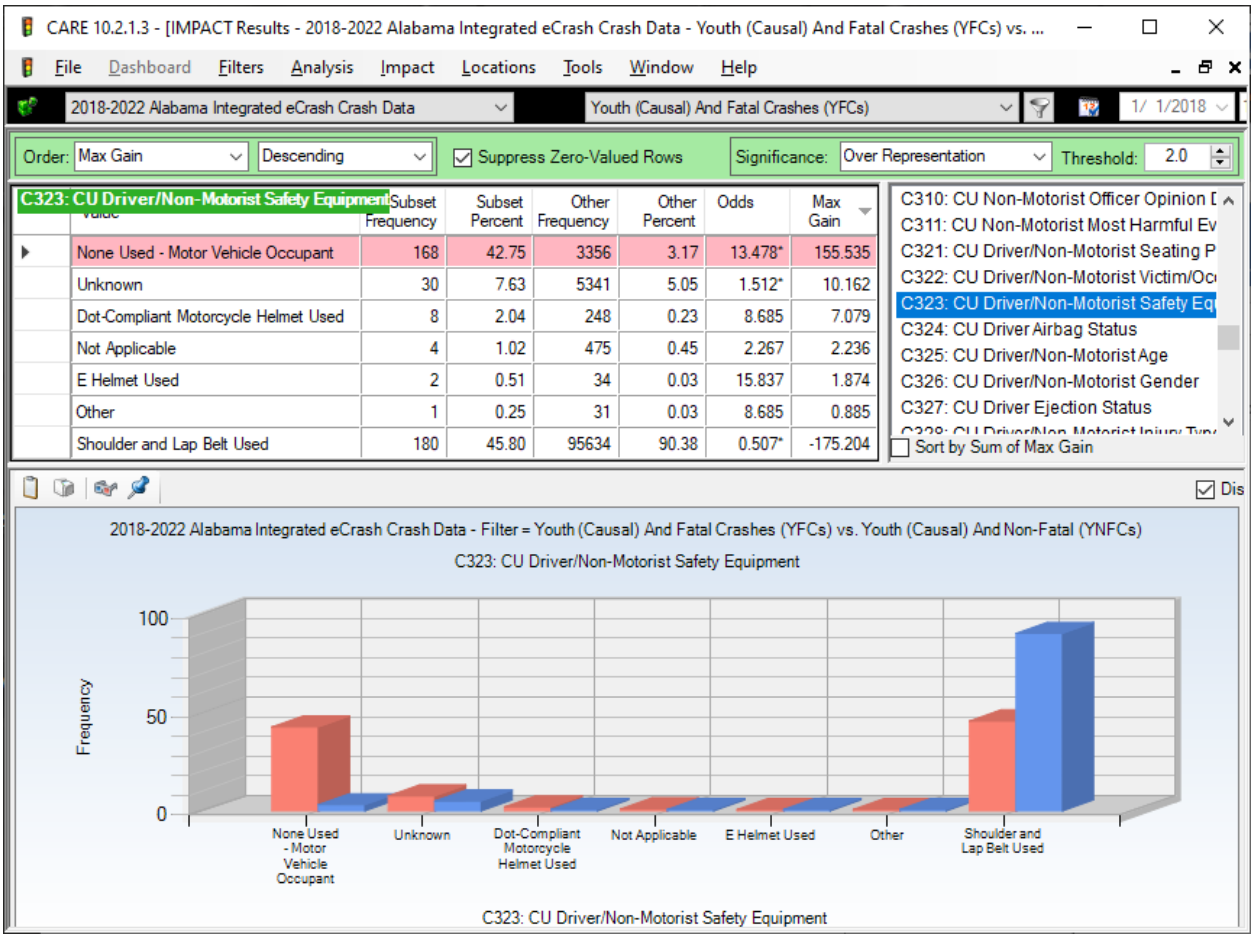
**** Insufficient Data to Calculate

The last column of the above table gives the fatality probability multiplier based on the lowest probability (31-35 MPH), to which the relative value of 1.0 (not a probability) was assigned. The probabilities in the form of "**1 in X"** are given in the middle column. For example, the probability of a Youth crash at 46-50 MPH being fatal is one in 192.6 Youth crashes. This is 10.8 times that probability of the impact speed in the 31 to 35 range. A crash at over 100 MPH has over 400 time the probability of being fatal as does one at 31-35 MPH.

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 cuts 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 YFC and YNFC drivers to be properly restrained, which will be covered in the next separate attribute below (6.5; Restraint Use by Causal Drivers …). This is further multiplied by 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 YFCs vs YNFCs

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



The proportion of failure to use proper restraints is 42.75% for Youth Fatal Crashes. The Odds Ratio is a large 13.478, showing that their failure to use restraints is over 13 times that of the Non-Fatal Youth crashes. Shoulder and Lap Belt Used is over-represented by YNFCs in about double (Odds Ratio 1/0.507 = 1.97 times the expected use in comparison to Fatal Youth Crash (YFC) seatbelt usage. Clearly, being unrestrained contributes heavily to chances of a youth crash resulting in death.

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

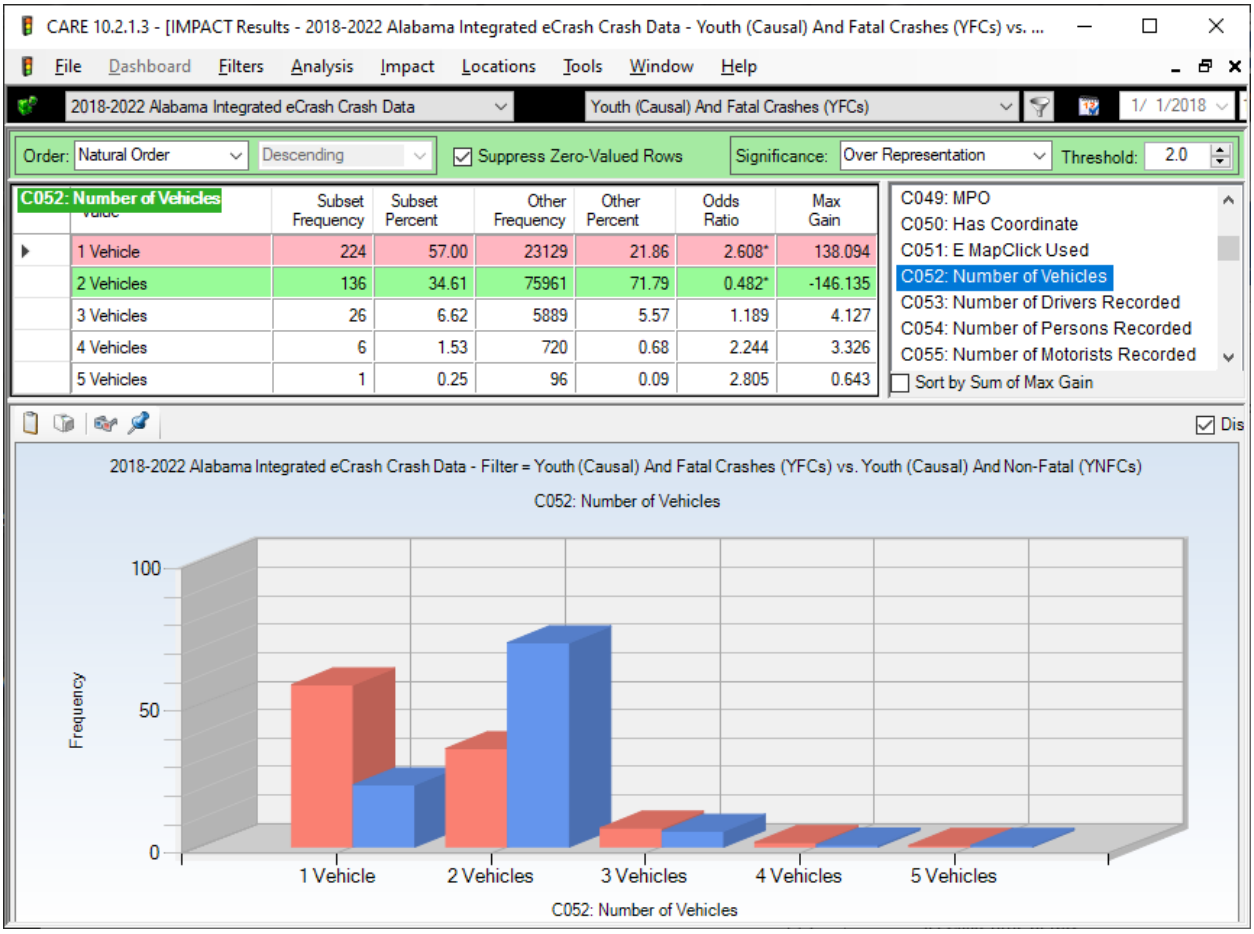
2018-2022 Alabama Integrated eCrash Crash Data | Injury Crashes (including Fatalities) | 1/ 1/2018

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%

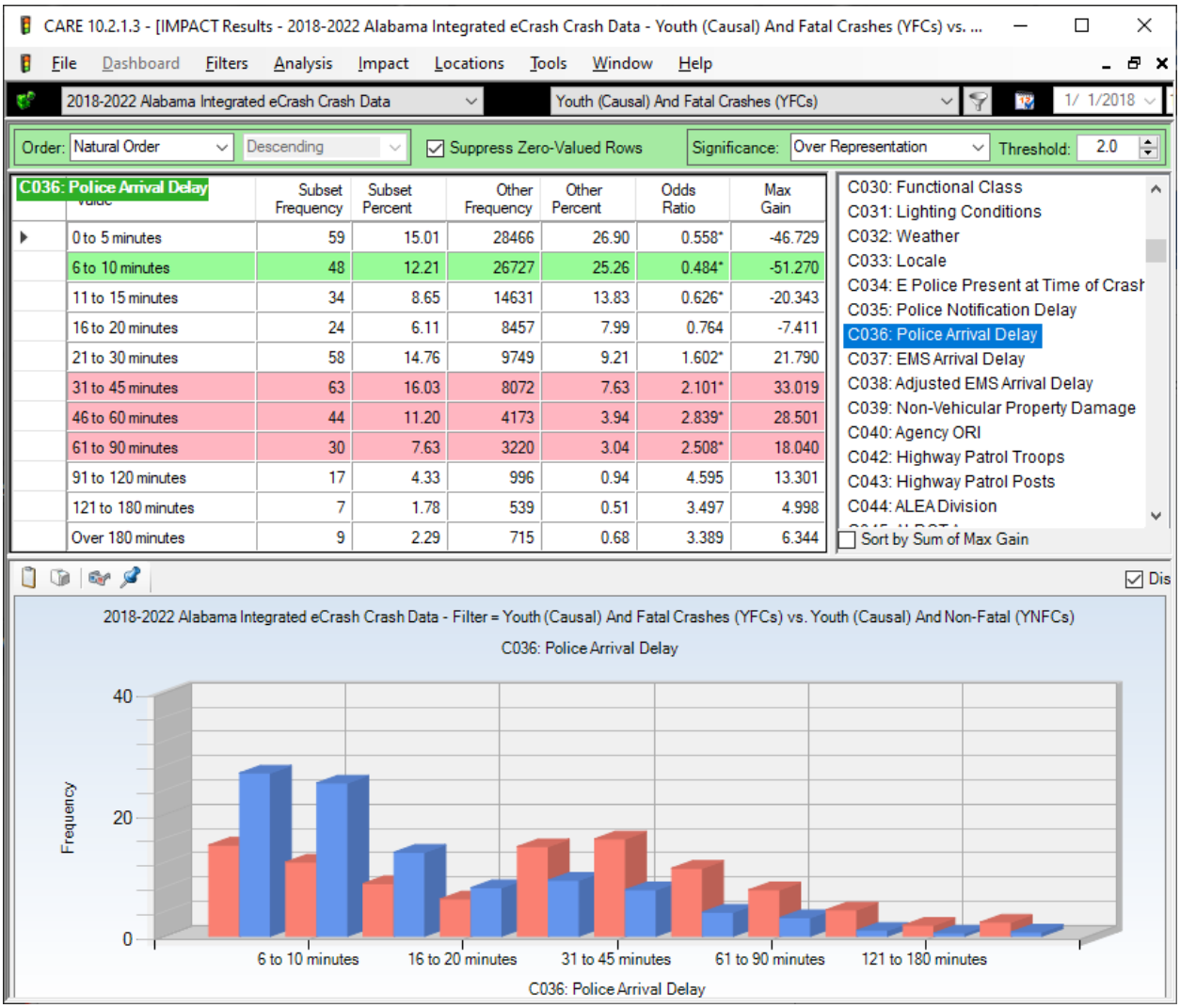
Calculations are based on <u>all injury</u> (including fatal) crashes and all ages.
Odds of death <u>not using</u> restraints = 13,758 fatal crashes/1,596 deaths = one in 8.6 injury crashes.
Odds of death <u>using</u> restraints = 109,815 fatal crashes/1,581 deaths = one in 68.8 injury crashes.
Risk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

6.7 C052 Number of Vehicles Involved (YFCs vs YNFCs)



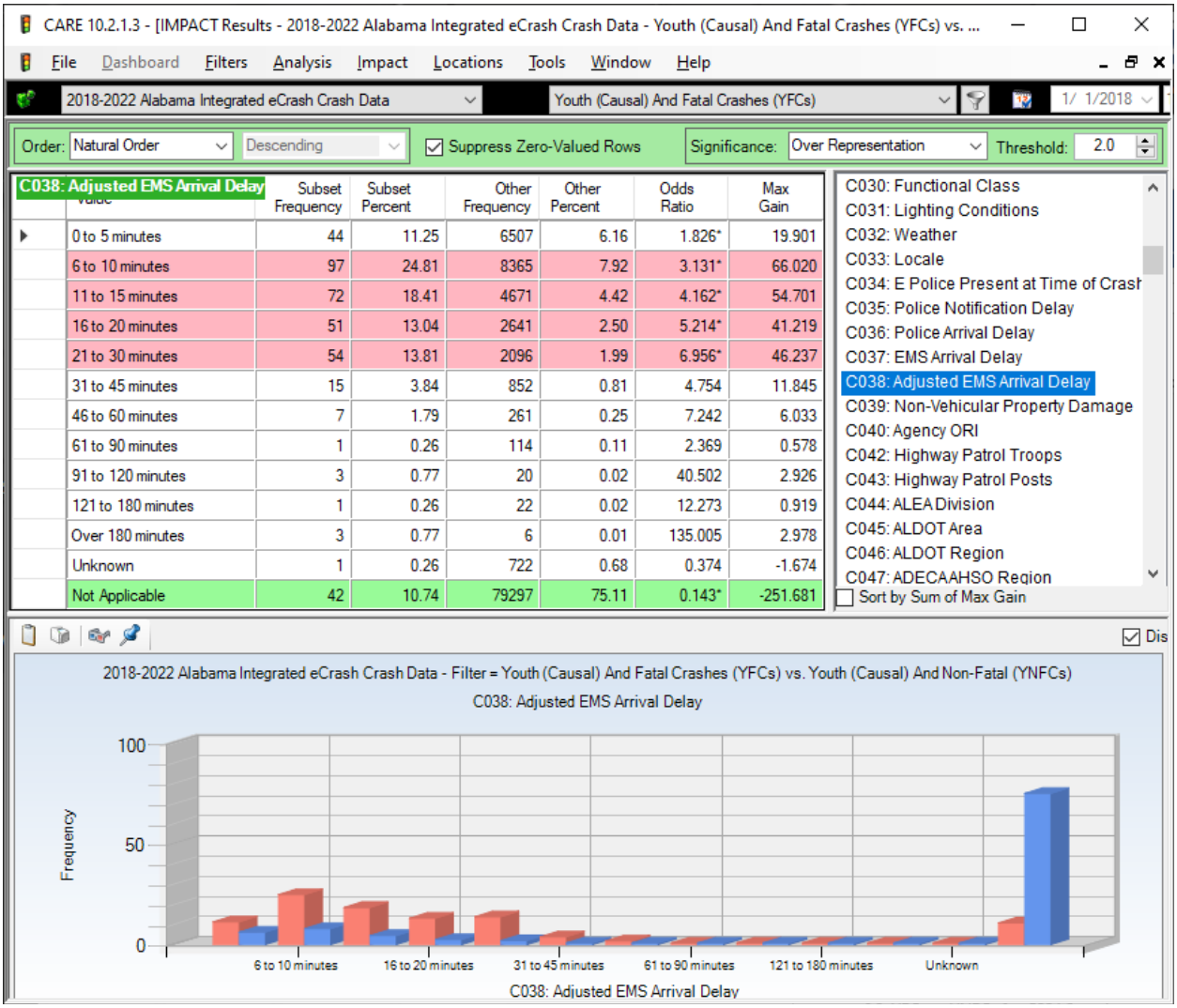
The Numbers of Vehicles in the table above are in their natural order. One and two vehicle crashes both showed significant differences, but for the opposite reason. Two vehicles had fewer YFCs than expected, while single vehicle crashes had more than expected. This is not calculated if the sample size is less than 20. However, the Odds Ratio is an indication of the probability of a crash being fatal, and it generally increases with the number of vehicles involved in the crash.

6.8 C036 Police Arrival Delay (YFCs vs YNFCs)



YFC police arrival delays reflect the issues in finding out about the crash and getting to the scene, especially at night. All of the delay times of 21 minutes or more were over-represented for YFCs, most with high Odds Ratios. YFCs are under-represented in all delay times below 16 minutes, of which four of the five were statistically significant. The analysis below shows that this correlates fairly well with EMS arrival times.

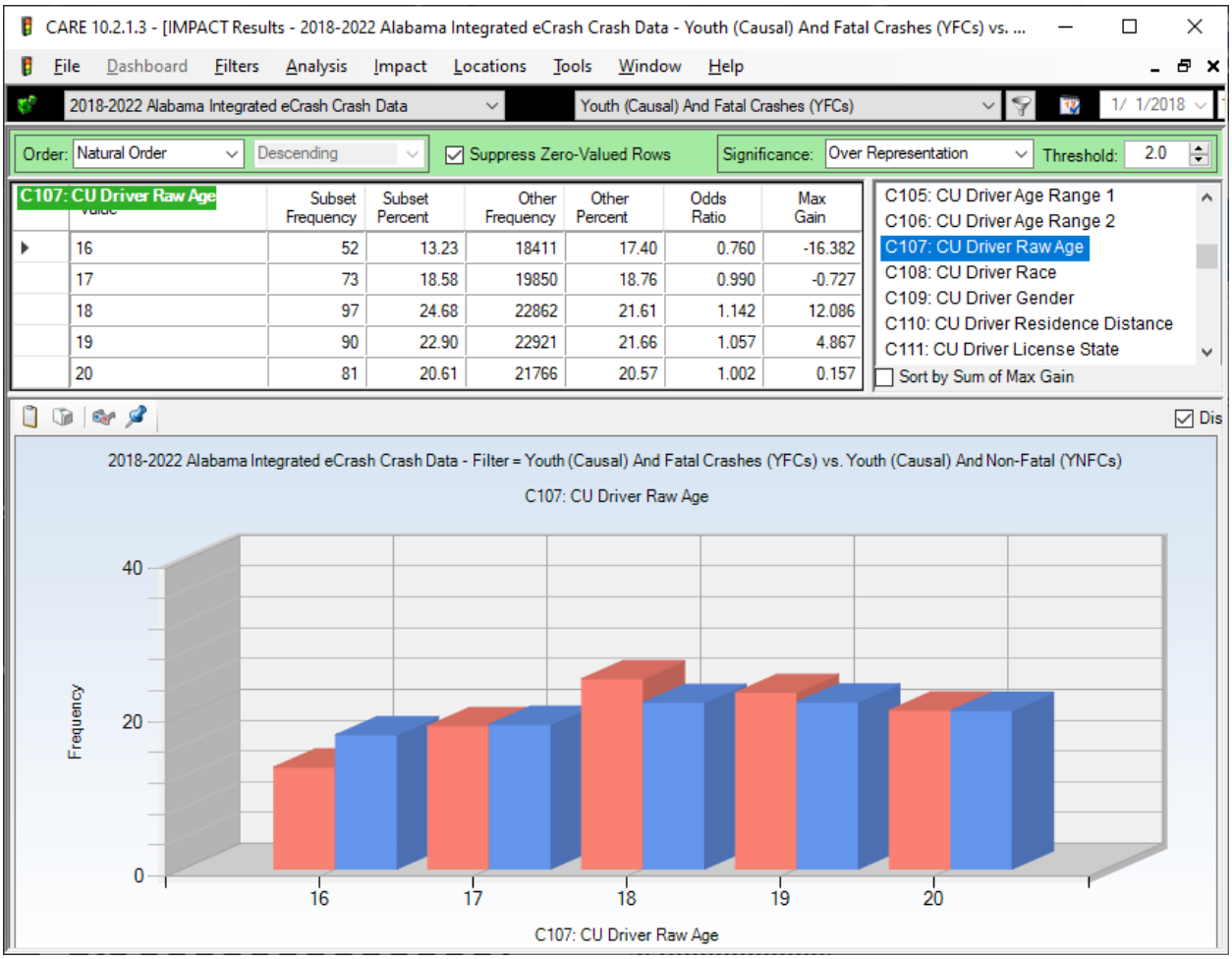
6.9 C038 Adjusted EMS Arrival Delay



The vast majority of the ambulance delay times for YFCs are statistically significant in having proportions in the 11- to 30-minute range. YNFCs were over-represented in the 0 to 10 minute range, probably attributed to the fact that most of them occurred in urban areas. Those few in the higher delay ranges probably occurred later on into the night, and some might not have been immediately discovered. A cross-tabulation of EMS delay times by roadway lighting conditions showed that 112 of the crashes with delay times over 10 minutes occurred in the Dark with the Roadway Not Lighted.

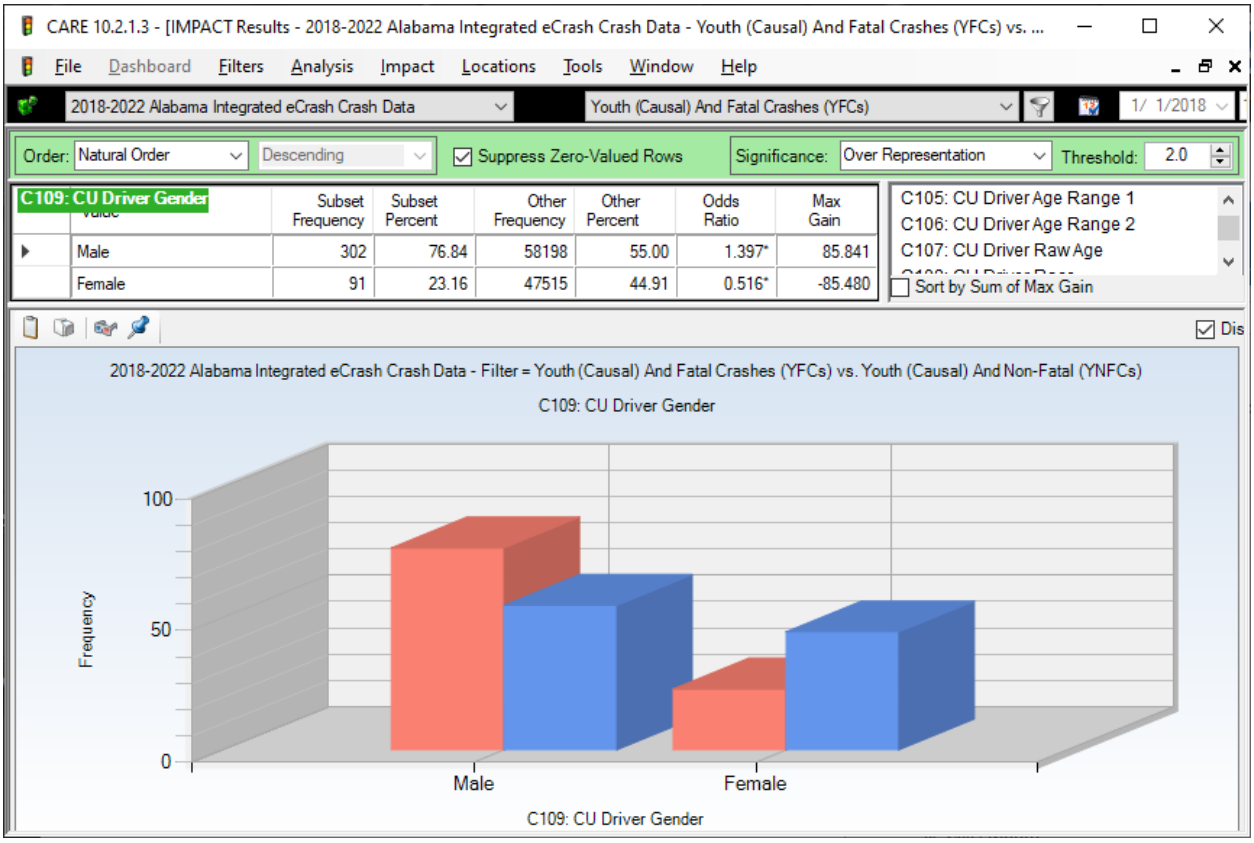
7.0 Driver and Vehicle Demographics

7.1 C107 Driver Raw Age



The table display above presents YFCs compared to YNFCs given in single-year age increments. No significant over- or under-representation were found. However, the chart above indicates that 16-year-olds were the most under-represented and 18 year-olds had the highest over-representation.

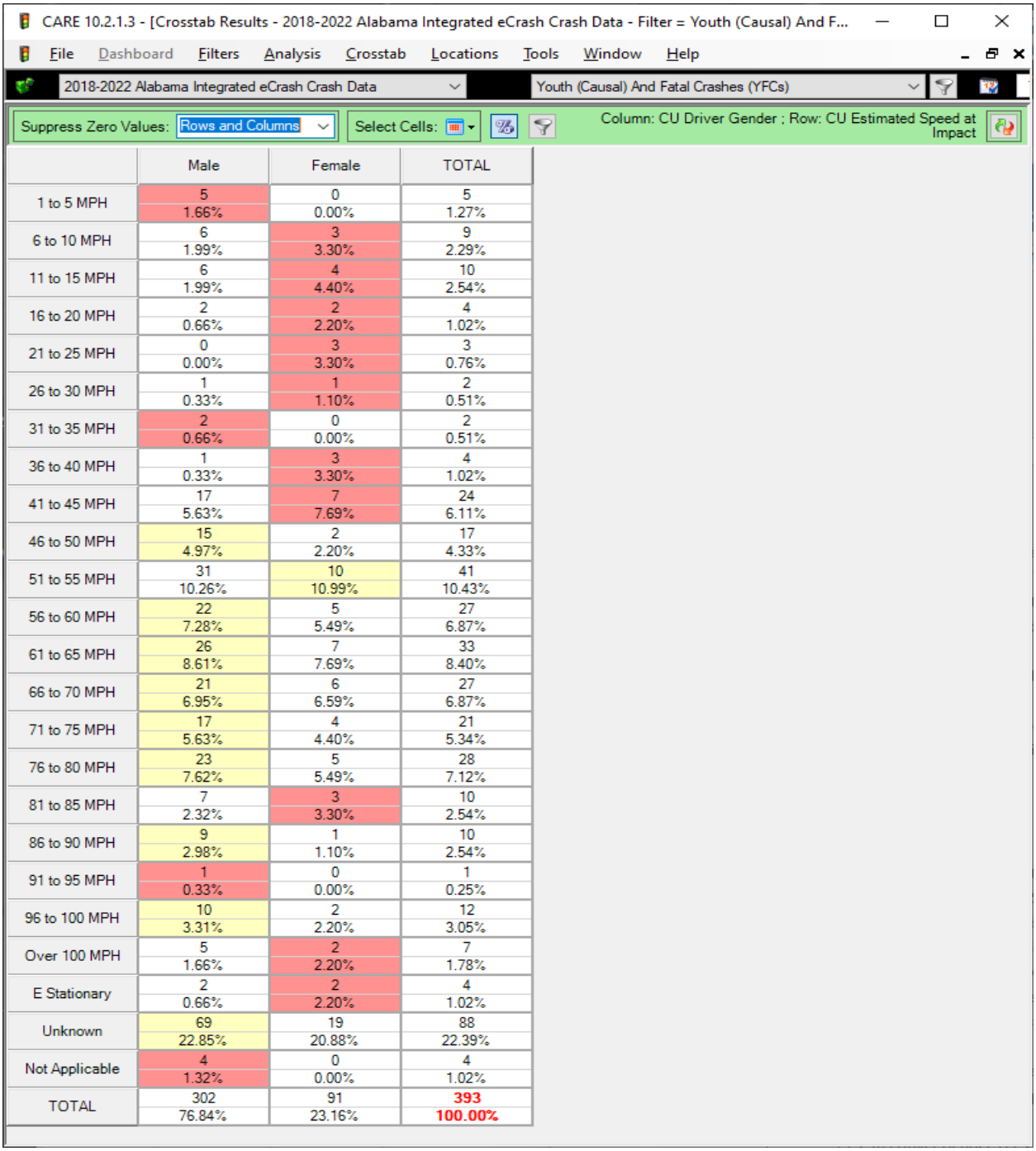
7.2 C109 Driver Gender YFCs vs YNFCs



The male and female red and blue bar proportions each individually sum very close to 100%. So the breakdown in YFCs causal drivers is 76.84% male and 23.16% female. For "Other," YNFCs, the percentage is 55.00% male and 44.91% female. These differences in proportions certainly indicate that males are a greater cause of Youth Fatal Crashes (YFCs) than crashes in general, although their proportion of causing crashes in general is also quite high. If there are countermeasures that can be directed toward males, 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.

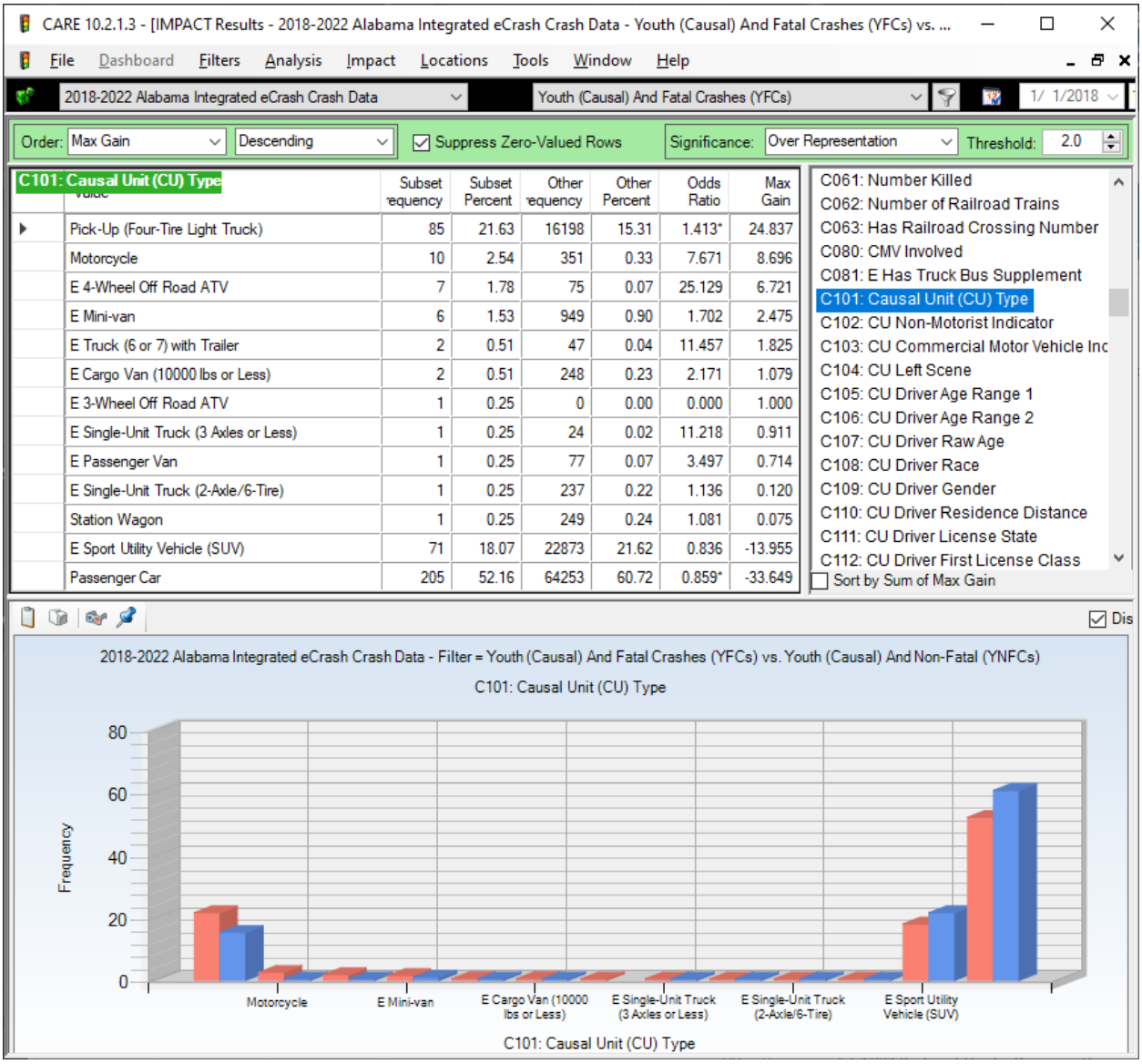
7.3 Cross-tab C109 Driver Gender x C224 Speed at Impact (all YFCs)



	Male	Female	TOTAL
1 to 5 MPH	5 1.66%	0 0.00%	5 1.27%
6 to 10 MPH	6 1.99%	3 3.30%	9 2.29%
11 to 15 MPH	6 1.99%	4 4.40%	10 2.54%
16 to 20 MPH	2 0.66%	2 2.20%	4 1.02%
21 to 25 MPH	0 0.00%	3 3.30%	3 0.76%
26 to 30 MPH	1 0.33%	1 1.10%	2 0.51%
31 to 35 MPH	2 0.66%	0 0.00%	2 0.51%
36 to 40 MPH	1 0.33%	3 3.30%	4 1.02%
41 to 45 MPH	17 5.63%	7 7.69%	24 6.11%
46 to 50 MPH	15 4.97%	2 2.20%	17 4.33%
51 to 55 MPH	31 10.26%	10 10.99%	41 10.43%
56 to 60 MPH	22 7.28%	5 5.49%	27 6.87%
61 to 65 MPH	26 8.61%	7 7.69%	33 8.40%
66 to 70 MPH	21 6.95%	6 6.59%	27 6.87%
71 to 75 MPH	17 5.63%	4 4.40%	21 5.34%
76 to 80 MPH	23 7.62%	5 5.49%	28 7.12%
81 to 85 MPH	7 2.32%	3 3.30%	10 2.54%
86 to 90 MPH	9 2.98%	1 1.10%	10 2.54%
91 to 95 MPH	1 0.33%	0 0.00%	1 0.25%
96 to 100 MPH	10 3.31%	2 2.20%	12 3.05%
Over 100 MPH	5 1.66%	2 2.20%	7 1.78%
E Stationary	2 0.66%	2 2.20%	4 1.02%
Unknown	69 22.85%	19 20.88%	88 22.39%
Not Applicable	4 1.32%	0 0.00%	4 1.02%
TOTAL	302 76.84%	91 23.16%	393 100.00%

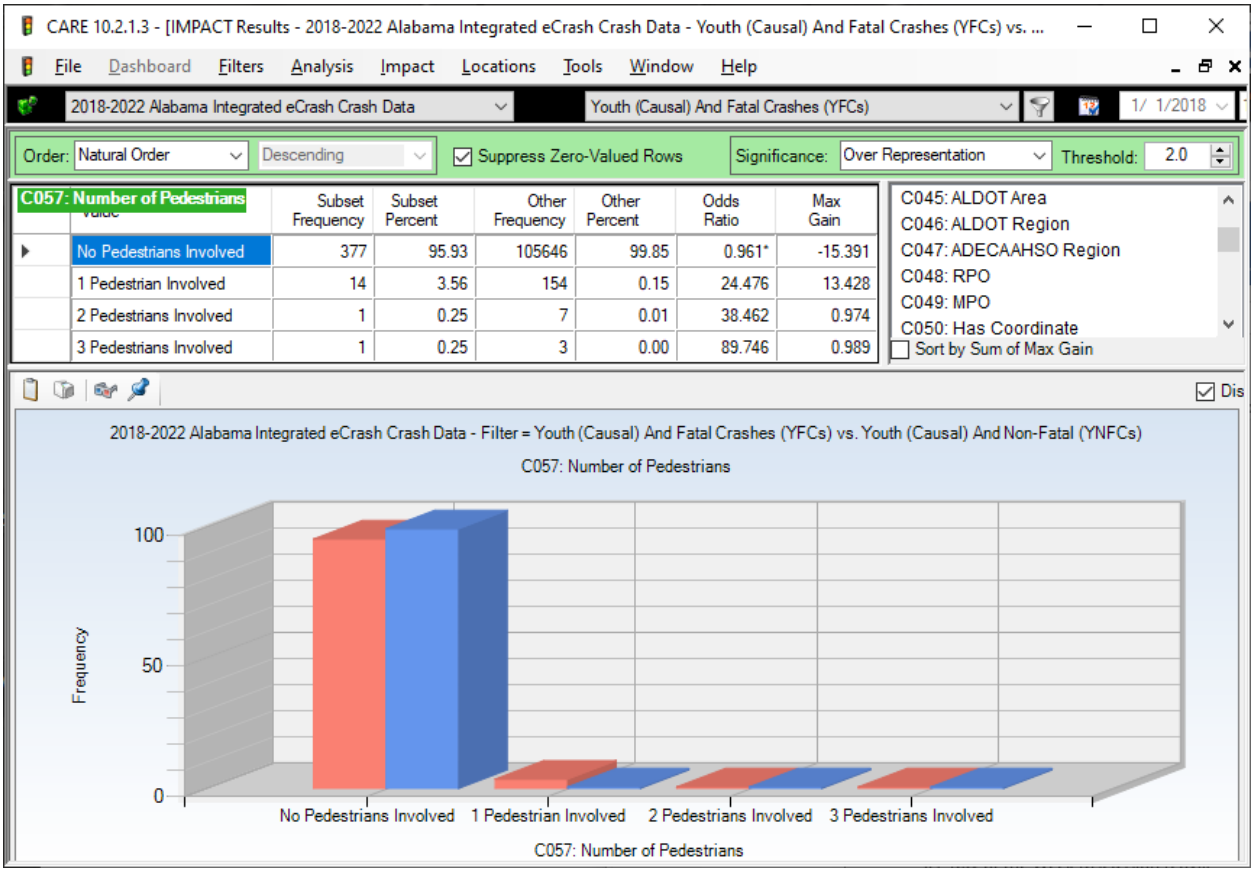
Number of males and females involved in YFCs over 60 MPH: 119 Male and 30 Female. The number of male fatal crashes over 60 MPH is 3.97 times than that of the females.

7.4 C101 Causal Vehicle Type YFCs vs YNFCs



Pick Ups 85 and Motorcycles 10 had the highest proportional over-representations for YFCs. The proportion of Sport Utility Vehicles (18.07%, 71) and Passenger Cars (52.16%, 205) resulted in their placement at the bottom of the list, indicating that they were under-represented in YFCs despite their high frequencies.

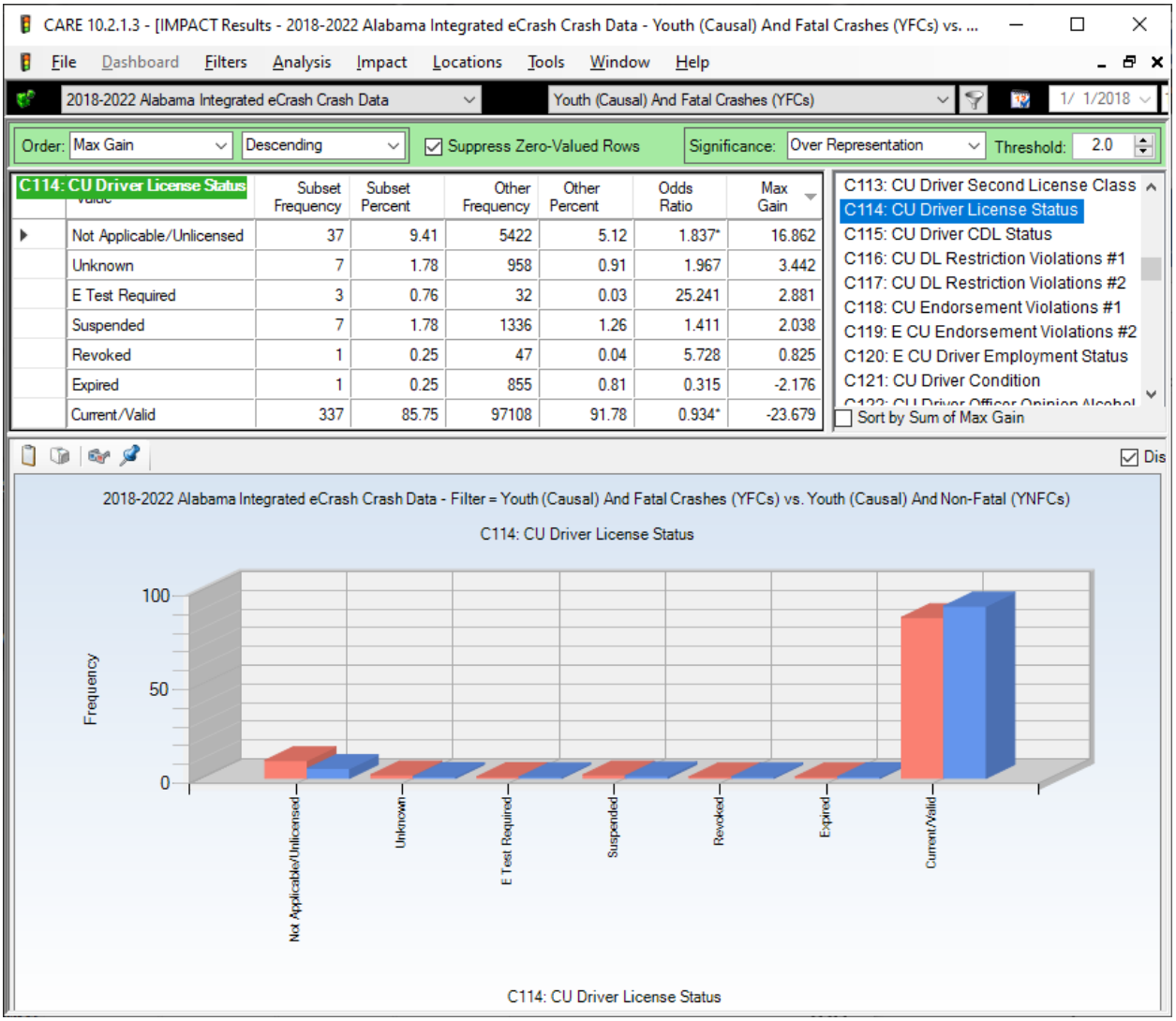
7.5 C057 Number of Pedestrians



There were a total of 19 Youth pedestrian fatality crashes, and 177 pedestrian-involved crashes were recorded as not fatal.

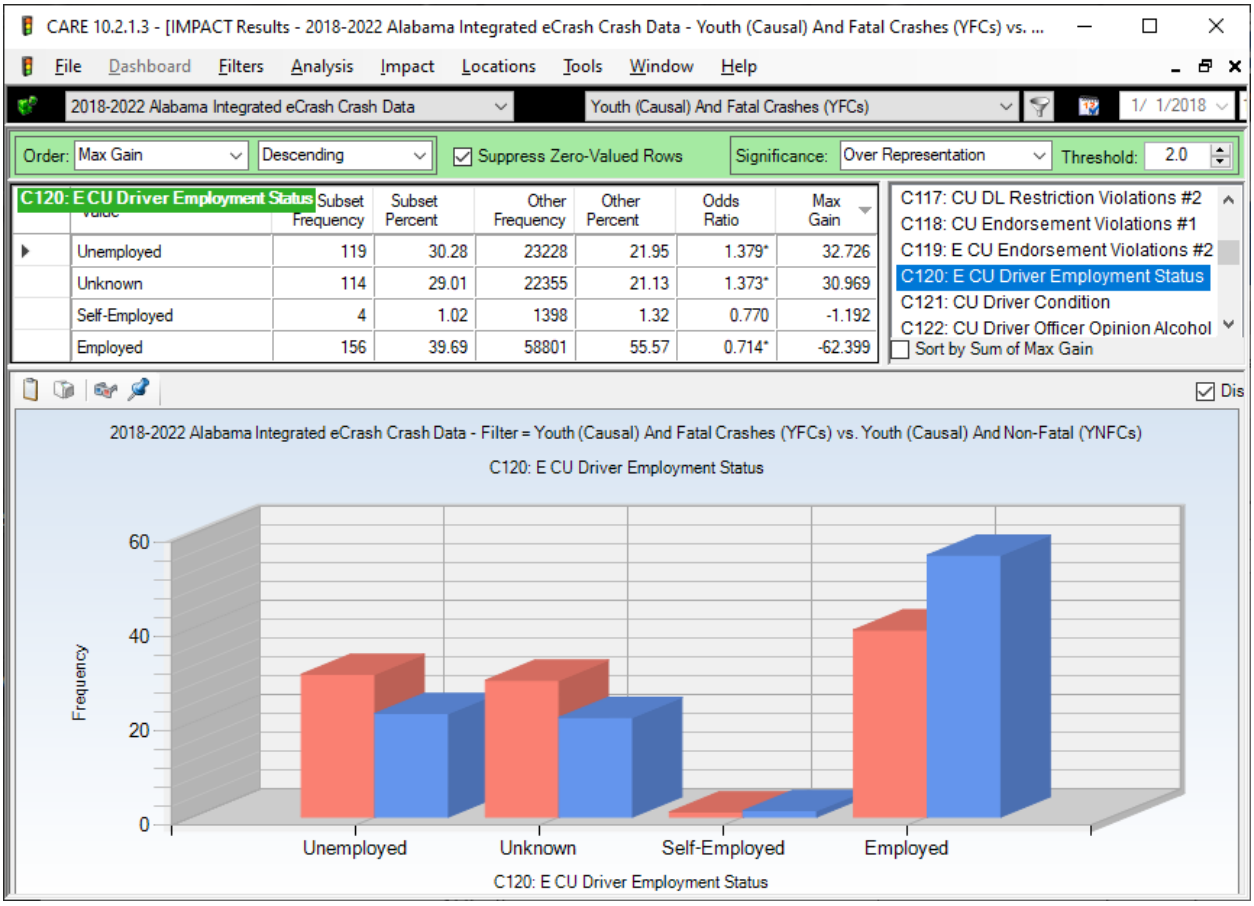
For a detailed study of pedestrian crashes in Alabama, please see:
http://www.safehomealabama.gov/wp-content/uploads/2023/05/Ped-SS-Using-2018-22-Data-v04.pdf

7.6 C114 Driver License Status



YFC drivers were under-represented in their causal drivers having Current/Valid drivers' licenses, which indicates that many of these have had a problem in obeying the driving rules. The percentage of Current/Valid for YFCs was 88.75%, while it was 91.78% for YNFCs. In addition, Not Applicable/Unlicensed was significantly over-represented with an Odds Ratio of 1.837. Very few were Revoked 1, Suspended 7, or Expired 1, so no conclusions can be drawn with regard to their relative proportions. This would lead us to believe that a relatively few (about 46) of those who caused fatal crashes were not operating within the law.

7.7 C120 Driver Employment Status

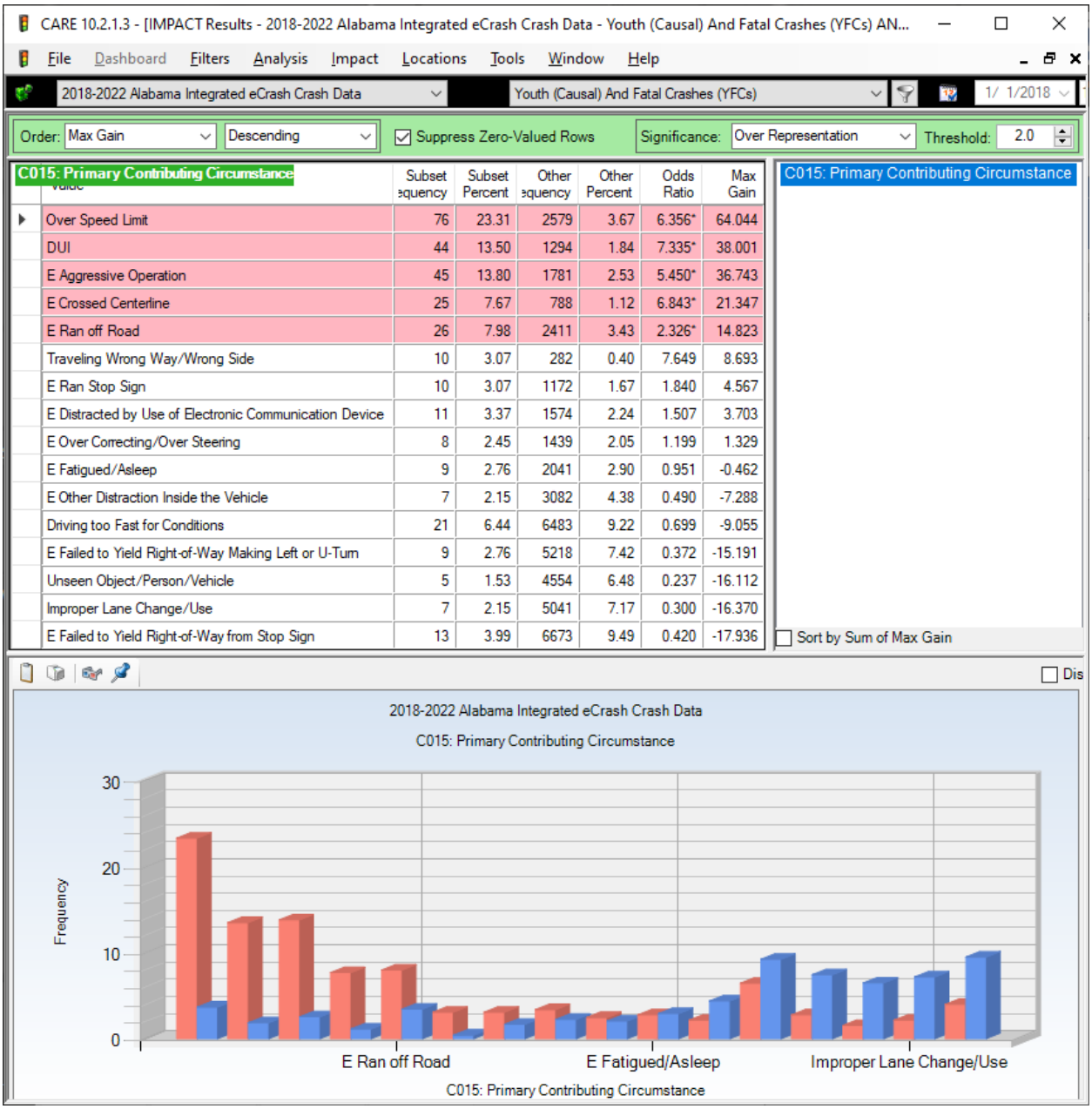


This analysis indicated that the employment rate for the YFCs was about 39.69%, while that for YNFCs was 55.57%. The following gives the proportion comparisons for YFCs and YNFCs, with over-representation indicated by (*):

Status	**YFCs**	**YNFCs**	**ODDS RATIO**
Unemployed	30.28%*	21.95%	1.379
Self-Employed	1.02%	3132%	0.770
Employed	39.69%	55.57%*	0.714

8.0 Driver Behavior

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



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 YFCs and YNFCs. All YFC over-representations in their expected proportion are as follows, with percentages:

YFCs PCC Overrepresented/Freq	YFC%	YNFC%
Over Speed Limit 76	23.31%	3.67%
DUI 44	13.50%	1.84%
Aggressive Operation 45	13.80%	2.53%
Crossed Centerline 25	7.67%	1.12%
Ran off Road 26	7.58%	3.43%
Traveling Wrong Way/Side 10	3.07%	0.40%
Ran Stop Sign 10	3.07%	1.67%
Distracted Communication Dev 11	3.37%	2.24%
Over Correcting/Over Steering 8	2.45%	2.05%

* Statistically significant difference
** Highly significant difference (more than 10%)

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.

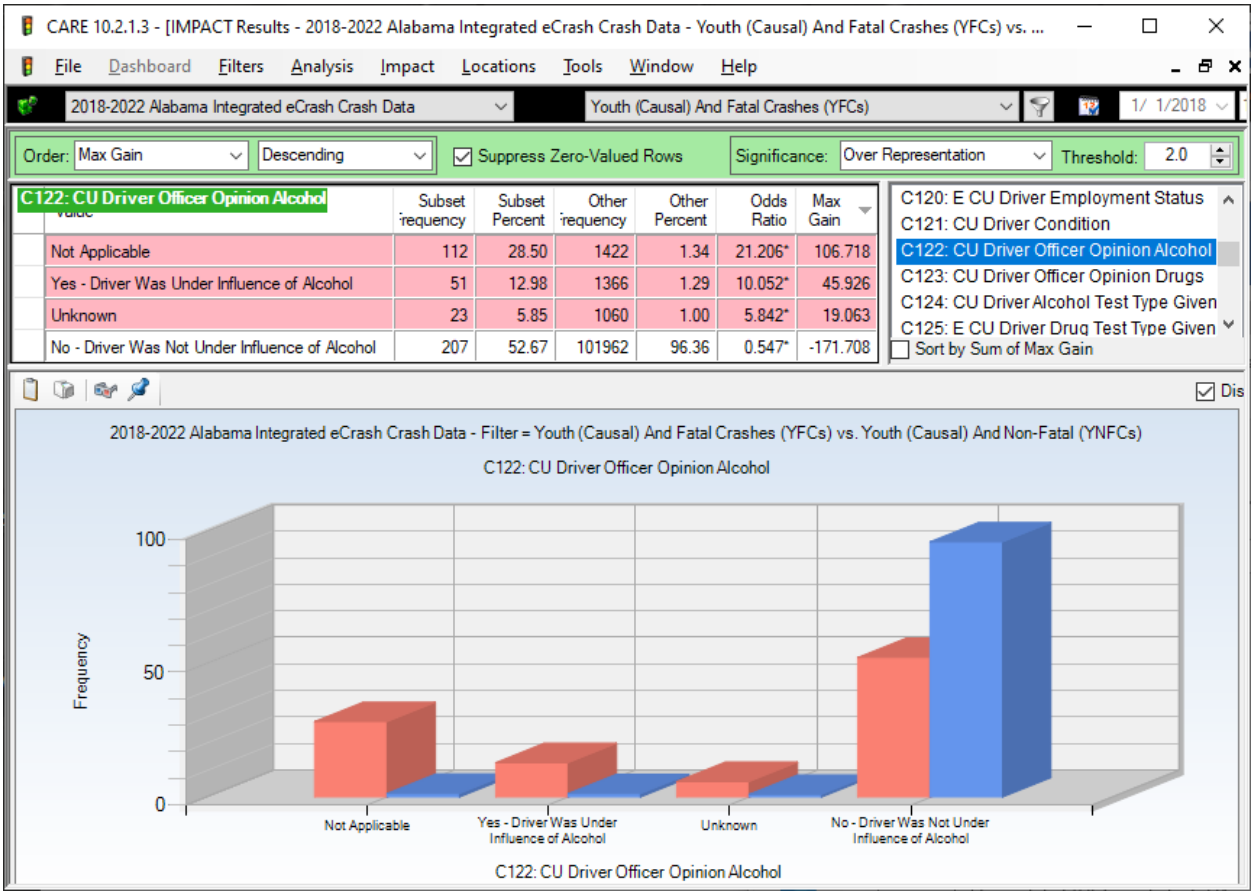
It is clear that the big killers are Over Speed Limit, DUI (ID), Aggressive Operation, Crossed Centerline, and Ran off Road. The others (lower on the list) have less than half the frequency and proportions. There are some high frequency items lower down on the list, but their proportions are not as high as the corresponding YNFCs.

Risk-Taking. It is important to recognize that this age group (and especially seen in males) is quite susceptible to the tendency of risk-taking. This is partially caused because the part of their brains that has a realistic perception of the consequences of risk-taking is not developed until age 25 for most people. A detailed study of this was conducted and is available at:

http://www.safehomealabama.gov/wp-content/uploads/2019/10/Youth-Risk-Taking-Analysis-v08.pdf

Recommendations are given in the categories of: family, schools, peer groups, legislation and law enforcement, and the Traffic Safety Community.

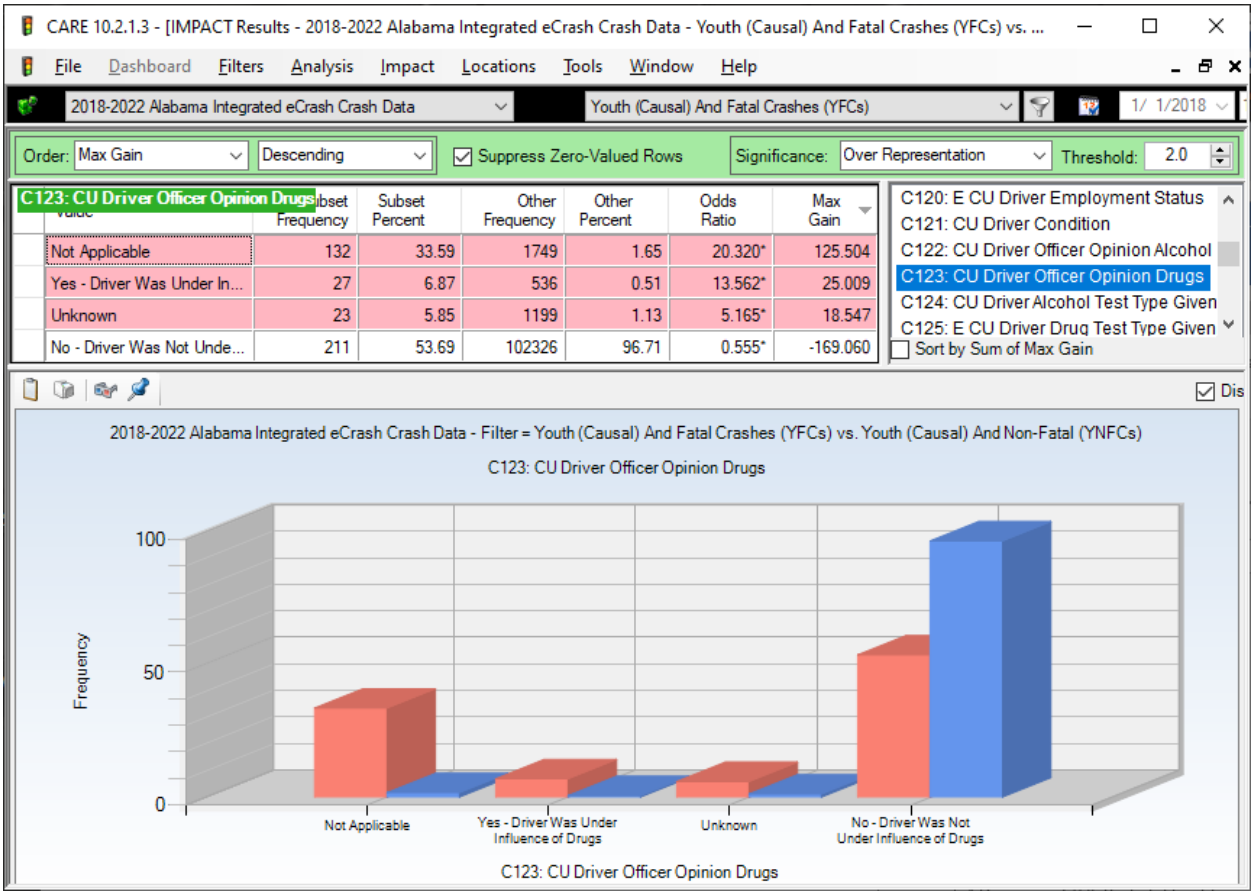
8.3 C122 CU Driver Officer's Opinion Alcohol



Impaired Driving/Alcohol was indicated as one cause of the crash for 12.98% of the YFCs, and 1.29% of the YNFCs. This gives an Odds Ratio of 10.052. 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 at all hours of the day. From the positive perspective, 96.36% of the YNFCS were reported to be not ID alcohol, but only 52.67% of the YFCs were sober in this regard.

Probability of crash being fatal if causal driver is alcohol impaired (51+1366)/51 = one in 27.78. Probability of fatal if CU driver is not alcohol impaired = (207+101962)/207 one in 493.57. Alcohol ID Multiplier = 493.57/27.78 = 17.77 times the non-alcohol probability.

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



The reported drug use proportion in YFCs (6.87%) was considerably less than that for alcohol (12.98%). In both cases (YFCs and YNFCs), 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 and severity of Youth fatal crashes.

From the positive perspective, 96.71% of the YNFCS were not Under the Influence of Non-Alcohol Drugs, but only 53.69% of the YFCs were sober in this regard. This is amazingly consistent to the comparable results for Alcohol. Both cases indicate the increased probability of a crash being fatal if the causal driver (or pedestrian) is Impaired. Probability of crash being fatal if driver is drug impaired = (27+536)/27 = one in 20.85. Probability of fatal if driver is not drug impaired = (211+102326)/211 one in 485.96. This results in a Drug ID Multiplier of 23.31. This indicates that the non-alcohol drugs multiplier (23.31) is much higher than the alcohol multiplier (which given above was 17.77). Potential reason indicated for this is that the effects

of Drugs in a youth collision tends to be much deadlier than those of alcohol as far as survival is concerned.

9.0 Risk Taking

This section was also added to the Senior Fatal Crashes special study.

This part of the study involved a comparison of Young vehicle drivers against Senior vehicle drivers to quantify the age group differences in risk acceptance. The comparison used IMPACT to compare the two subsets, where the crash subsets compared were 353 Youth Fatal Crashes (YFCs) and 507 Senior Fatal Crashes (SFCs). The table below presents a summary of the findings. It gives the values of the attributes. A consistent pattern of Youth Driver risk acceptance becomes clear. There are a few that might indicate that the Senior Drivers took some risks. These exceptions are marked with an asterisk, and they will be given additional consideration below.

Comparison of Youth and Senior Risk Indicators

Attribute	Youth Risk Indicator Over-Represented	Senior Risk Indicator Over-Represented
*C025 Crash Severity Fatal	353	507 (44% > than YFCs)
C008 Time of Day	8:00 PM – 6:59 PM	7:00 AM – 7:59 PM
C010 Rural or Urban	Rural	Urban
C011 Highway Classification	County & Interstate	State & Federal
*C015 Pri Contrib Circumstances	Speed, Aggression, DUI	Failure to Yield …
*C017 First Harmful Event	Tree, Rollover, Pedestrian	Coll Vehicle in Traffic
C023 Manner of Crash; C052	Single Vehicle Crash	Two-Vehicle Crash
C022 Manner of Crash	Single Vehicle	Side Impact
*C026 Intersection Related?	No	Yes
C032 Weather	Rain, Fog, Mist	Clear, Cloudy
C033 Locale	Open Country, Residential	Shopping or Business
C057 Pedestrians Involved	14	7
*C101 Causal Vehicle Type	205 Passenger Cars	146 Pick Ups
C104 Left Scene – Yes	6	1
C121 Driver Condition DUI	57 Under Influence	25 Under Influence
C122 Officer Opinion Alcohol	51 Yes DUI Alcohol	32 Yes DUI Alcohol
C123 Officer Opinion Drugs	27 Yes DUI Drugs	10 Yes DUI Drugs
*C129 Maneuver Left Turn	21	86
C129 Maneuver Curve	95	69
C203 1st Harmful Event Location	Roadside 130	On Roadway 208
C224 Speed at Impact > 61 MPH	149 (2.53 times 59)	59
C323 Seatbelt Use	180 Used 45.80%	301 Used 59.37%
C326 Driver Gender	302M 91F 23.16%F	353M 154F 30.37%F

C327 Total Ejected from Vehicle	63 16.03%	29 5.72%

*Exception to the youth driver risk acceptance pattern.

Discussion on Attributes that May be Ambiguous

Attributes were selected at random, and none were rejected because they did not demonstrate the risk-taking nature of either the older or younger drivers. This section will go through those attributes that need further explanation.

***C025 Crash Severity Fatal.** This attribute is shown to establish the framework for this part of the analysis. It could be reasoned (falsely) that because there are more SFCs than YFCs, that the Senior drivers are more prone to take risks. But recognize that there are only five age years in the YFCs, while there are 100-66 = 34 years in the SFCs. Even if we cut off all above 90, this still gives 24 years, so the number of fatal crashes per year is 507/24 = a little over 21 SFCs per driver in this subset. For the YFCs, this works out to 353/5 = 70.6 fatal crashes per driver age. The bottom line is that we should expect any numerical indicators to be higher for the Senior drivers than for the Youth drivers because there are more of them.

First three indicators. Just to get things started, let's take the first three attributes, which we believe clearly show the risk-taking nature of the YFC drivers. These are:

- C008 Time of Day. The risk indicator is in that the Youth drivers seem to prefer the late-night and early morning hours. As opposed to that, senior drivers are over-represented in the daytime hours.
- C010 Rural or Urban. Younger drivers have the vast majority (68.70%) of their fatal crashes on the rural roads, which typically involve more risk-taking that the urban roads, which are over-represented by the Senior drivers.
- C011 Highway Classification. While Interstate routes are the safest on a per-mile basis, youth driver over-representation (1.404 Odds Ratio) on county roads shows their risk-taking tendencies.

These are just a few examples to provide an understanding of the items in the table. While there are some exceptions that we will consider, over-representations in most of the attributes demonstrate the risk-taking tendencies of the youth drivers (ages 16-20 years).

Exceptions. The old adage "the exception proves the rule" may seem to be a contradiction in terms. However, if what seems to be a contradiction can be explained in terms of the rule, then it would provide further. We marked those attributes with an asterisk (*) if the interpretation of the results given might be ambiguous. These are the attributes we thought would warrant additional explanations:

- *C015 Primary Contributing Circumstances. Those most over-represented by the Youth subset were Speed, Aggressive Behavior and DUI. These in themselves are more than ample evidence of risky behavior. Failure to Yield the Right-of-Way might also be considered risky, but it is also possible that this error could be caused by some other physical limitations as opposed to risk-taking, on the part of the Senior drivers.

- *C017 First Harmful Event. Young drivers were over-represented in their striking trees, rolling over and striking pedestrians, all of which are evidence of risk acceptance. On the other hand, Collision with Vehicles in Traffic could well be a shared fault with the other vehicle involved and it would not carry the risk-taking implications that the Youth over-representations imply.
- *C026 Intersection Related? Similar reasoning might apply as we see the Senior drivers over-represented in intersection crashes, while this is not an over-representation for the Younger drivers. Any vision problems that Senior drivers might have could cause problems at intersections without their necessarily taking risks. Those that are not intersection related would indicate an unforced error.
- *C101 Causal Vehicle Type. This is not to infer that we believe Passenger Cars are more risky than Pickups, but since there was a major difference in the results of this attribute, we felt it would be of interest to include it.
- *C129 Maneuver Left Turn. Left turns are particularly difficult, and it is important that the drivers possess all of their capabilities, especially those related to vision. We see this as a problem of incapacity as opposed to risk taking. While the same thing might be true of curves in general, the significantly larger number of young driver crashes on curves would be an indication of risk-taking, and in particular, a failure to slow down.
- The two remaining that might be given special attention are Speed at Impact and Seatbelt Use, both of which show risk acceptance by the younger drivers.

While some of the attributes may be difficult to use in drawing conclusions, it should be obvious that those with clear implications show that younger drivers tend to be risk acceptors while the older drivers tend to be more risk averse.

It is important to recognize that the 16-20-year-old age groups (especially males) are quite susceptible to the tendency of risk-taking. This is partially caused by the parts of their brains that have a realistic perception of the consequences of risk-taking are not fully developed for most people until age 25.

A detailed study of risk-taking was conducted and is available at:

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Recommendations were given in the categories of: family, schools, peer groups, legislation and law enforcement, and the Traffic Safety Community. If this subject is of interest to you, please read this special study and provide us with feedback (brown@cs.ua.edu).