Special Study
License Deficiency (LD) Crashes IMPACT Study

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Data Comparisons: CY2016-2020 LD vs Non-LD
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0.0 Introduction

This document presents the results of a comparison of License Deficient (LD) crashes compared to non-LD crashes over a recent five-year period (CY2016-2020). Whether or not a crash was LD or not was determined by whether the causal driver in the crash had a license that was either Revoked, Canceled, Denied, Expired or Suspended recorded in the Driver License Status attribute (C114). Any of these five values will be referenced as a *license deficiency*. The terms *LD crash* and *LD driver* will be used accommodatively to indicate a *crash* in which the causal driver had a License Deficiency, and/or a *driver* who had a license deficiency. Unlike most special studies, being LD is not something that causes a crash – it is a characteristics of past driving performance. However, it is obvious that countermeasures should be developed to reduce LDs just like all other crash types.

The analytical technique employed to generate most of the displays below is a component within the Critical Analysis Reporting Environment (CARE) called Information Mining Performance Analysis Control Technique (IMPACT). For a detailed description of the meaning of each element of the IMPACT outputs, please see: http://www.caps.ua.edu/software/care/

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

As an example, we found that LD crashes for the Day-of-the-Week attribute value of Sunday had 15.6% higher proportion of crashes than did the non-LD crashes (Section 5.3; Odds Ratio = 1.156). [Note: the asterisk (*) after the Odds Ratio number indicates that the difference in the proportions are statistically significant at a very high level.] When such differences are found to be statistically significant (as in this case), this surfaces characteristics that should be given attention, for countermeasure development, which in some cases should be supported by further analyses. For example, additional selective enforcement for LD crash causes (e.g., excessive speed) might be performed on Sunday and other days and times at which they have their highest over-representations. Unless otherwise stated, the output tables given above the charts in the displays of Sections 4-8 are in *Max Gain* order. The *Max Gain* is the gain in crash reduction that could be obtained if somehow a countermeasure could be applied to reduce the proportion of the LD crashes to the proportion of non-LD crashes within that particular attribute value.

This report continues with two short sections that provide a high-level summary of recommendations and findings for those who just need an executive summary. The sections are called: (1) Executive Summary and Recommendations, and (2) Summary of Findings. Section 3 is also introductory in that it provides a detailed definition of the filter that was used to define LD crashes in the analytical sections that follow. After Section 3, the comparison between LD and non-LD crashes will be presented under the following headings with their section numbers:

- Section 4. Geographic and Harmful Event Factors,
- Section 5. Time Factors,
- Section 6. Factors Affecting Severity,
- Section 7. Driver and Vehicle Demographics, and
- Section 8. Driver Behavior and Citations.

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

1.0 Executive Summary and Recommendations

The recommendations of this special study are presented first for two reasons (1) for those who do not have time to go through all of the IMPACT analyses, and/or (2) as an introduction to the more detailed analyses that follow. Recommendations are referenced to the more detailed IMPACT analyses so that questions regarding the source of any given recommendation can be easily accessed. It may also help to read the Summary of Findings in Section 2. LD crashes are crashes caused by drivers who have a license deficiency as defined in Section 3.1.

Recommendations are organized into the three areas of: (1) Training to reduce frequency and severity, (2) Law enforcement concentration and direction, (3) Legal and judicial countermeasure development, and (4) PI&E information on LD content. The ordering of these, 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 should consider all of the recommendations, which should be validated against the information presented in the IMPACT sections 4.0-7.0 (referenced sections will be given in parenthesis).

The following recommendations are made to reduce the frequency and/or severity of License Deficient (LD) crashes in Alabama:

- **License Deficient (LD) frequency and severity mitigation**
  - **Roadside modifications.** Most of the IMPACT analyses (after Section 3) concentrate on driver behavior modifications. It is reasonable that many crashes could either be avoided or their severity reduced by crash cushioning, or other roadway modifications, just as was found in the Roadside special study. These recommendations will not be repeated here.
  - **Grade and Curvature.** LD crashes are significantly over-represented on all types of curves. This information should be made part of any training that is performed as a requirement to restore the errant drivers' license status. This would not be different from that training given to Impaired Drivers in general. Left curves either level or with a downgrade are generally more of a problem than

right curves with the same grades. Level and down grades are more of a problem than up-grades.

    - **Training.** Any remedial training for LD drivers should systematically include the crash frequency and severity causes. For example, emphasis should be placed on Impaired Driving, Aggressive operation, Speed and other Primary Contributing Circumstances (8.1-8.2) that were found to be over-represented in LD crashes.

- **Law enforcement concentration and direction**
    - **General publication of results.** Increased recognition is essential, both on the part of law enforcement and the general public, that the relatively high deadly combination in LD crashes is caused by their comparatively high impact speeds (6.1, 6.2) coupled with a failure of some LD crash drivers and their passengers to use restraints (6.5, 6.6). Seek out new ways to increase law enforcement methods to address these issues, both of which stem from the acceptance of risk-taking behaviors, especially on the part of younger drivers. For LD drivers this would be in the age range of 23-45.
    - **Impaired Driving (ID).** Since a relatively large proportion of LD crashes are caused by Impaired Driving (ID), accentuating all of the ID countermeasures (8.1, 8.2) would be helpful for LD crash reduction. Hotspot analyses should be performed to determine where LD selective enforcement will be most effective, and consideration should be given to using LD as a proxy for ID. The ID Special Study is at: http://www.safehomealabama.gov/wp-content/uploads/2021/12/Impaired-Dr-SS-Prob-Id-2016-2020-data-v05.pdf
    - **Drug detection.** More effective drug detection techniques (5.8) should be identified, and law enforcement officers need increased training in their use.
    - **Law enforcement training** should focus on the concentration on the times of day, days of the week (5.3-5.5), and the particular over-represented vehicle types e.g., Passenger Cars and Motorcycles (7.3). The training needs to focus on the specific driver over-representations:
        - 1) males (7.2),
        - 2) age groups (7.1), ages 23-45,
        - 3) the locations that these over-represented groups (determined by hotspot analyses); and
        - 4) the over-represented times (5.2-5.5).
    - **Over-represented counties.** Counties with a combination of medium to large metropolitan areas and fairly large rural areas (4.3, 4.6) should generally be given additional emphasis in LD selective enforcement programs (4.1, 4.2). These should be evaluated on a county-by-county basis taking the population and traffic volume crash rates into consideration. Over-represented cities and counties should be subjected to Hotspot analyses to obtain the specific roadway segments. This should be coupled with and compared against ID Hotspot analyses.
    - **The rural areas** (4.6) of these counties, and especially the County Roads (4.5) should be given special consideration for enforcement, since that is where relative increased fatalities occur (4.4).

- **Over-represented cities.** Those cities with a high frequency of LD crashes (4.2) should be given special guidance and perhaps additional funding to address their LD crash problems. Many such large city areas have a considerable amount of Open Country (4.6) that would tend to multiply their LD crash severity. It should be recognized that Residential areas of these cities also have a significant LD over-representation, but it is only about 2/3 the over-representations of Open Country areas (4.6).
- **Hotspot analysis.** Additional hotspot analysis needs to be done to surface those County Roads (4.5) that account for the 32.8% over-representation in crash proportion, in order to focus law enforcement presence on these roads. Investigations are needed to determine the extent to which impaired LD causal drivers are using the county roads in attempts to avoid being apprehended. LD might be combined with ID and or Roadside crashes to determine if such will lead to a richer data subset for Hotspot analysis.
- **Days off.** Additional emphasis needs to be given to the recognized LD over-represented days, Saturday, Sunday, and to some extent Friday (5.3). Special 3-day holiday attention needs to address irregular days such as Sunday, which behave as a "virtual Saturday" when the three-day holiday weekend includes Monday (5.4-5.7). Consideration should be given to the number of persons not working on a given day, some of whom would tend to over-indulge the night (and early morning) before their day off (5.3-5.4).
- **Spring and summer.** The increase in LD crashes in the spring and summer months (5.2) should be recognized in general law enforcement strategic planning.
- **Selective enforcement times optimization.** Time for enforcement might be optimized by local culture, but for the average statewide picture, if workers are typically "off" the following day, the optimal times for enforcement would begin shortly after the Friday afternoon (or its equivalent) rush hour and continue through at least 3 AM (5.5-5.6).

- **Legal and judicial countermeasure development**
  - **Drug/Alcohol Diversion Programs** should continue and be strengthened to concentrate on keeping the age 25 through 35 (typically *social users*) from becoming habitual to the point where they become part of the 36-55-year old over-representation of predominantly *problem users* (7.1).
  - **Unemployment.** The role that unemployment plays should be considered in formulating remedial measures (7.6). Methods should be explored to communicate with appropriate individuals through their respective unemployment offices. The relationship between LD crashes and unemployment is not surprising because of the underlying drug/alcohol cause of many LD crashes (5.7-5.8). The correlation between not having a job and being involved in an LD crash should be watched carefully going forward in that it could affect the type and location for countermeasure implementation.
  - **Improving and expanding ignition interlocks.** Ideally, breath-alcohol ignition interlock devices are greatly reducing the problem caused by problem drinkers in

Alabama. An in-depth study needs to be conducted to determine if problems exist within the current program, and how this countermeasure can be expanded to be made more generally effective. While the data do not show a high level of drugs/alcohol causing LD crashes directly, (5.7-5.8) the fact that they are highly over-represented is an indication that this could be a cause even if the presence of drugs/alcohol do not always reach the reporting threshold. This would especially apply to cases involving prescription and non-prescription drug combinations (e.g., alcohol).

- **PI&E information content on LD crashes**
  - **Drug (including alcohol) combinations.** Combinations of recreational or medical drugs (including alcohol) can be particularly lethal, and medical practitioners should warn against such problems and discourage all alcohol use for their patients who have indicated or displayed these problems, or who are taking other prescription drugs.
  - **Recreational drugs.** Legalized recreational drugs are not a good alternative to alcohol use and should not be advertised as such. PI&E programs should take the opposite approach to warn drivers that legalization does not relax their responsibilities or legal liabilities.
  - **Re-routing.** Promote the use of routes (e.g., to sporting events) that avoid county roads, which have 32.8% more LD than non-LD crashes. While State routes are also over-represented (by 5.2%), the largest cause of these crashes is Driving too Fast for Conditions and other speed-related behaviors. These are driver errors that can be avoided easily. While the promotion of Interstates should contain warnings against speeding even though they were found to be under-represented for LD crashes.
  - **Restraints.** One of the most critical needs is for the LD drivers and their passengers to buckle up (6.5). There is much smaller chances of surviving a crash for those who fail to realize this, regardless of who caused the crash. This is seen not only in increased fatal crashes, but in the number injured in two-vehicle crashes (6.6).
  - **Driver behaviors** (8.1-8.2) that are correlated with LD should be considered in all countermeasure development. These behaviors are:
    - Aggressive Operation,
    - Traveling Wrong Way/Wrong Side,
    - Over Speed Limit,
    - Fatigued/Asleep,
    - Ran Stop Sign and
    - Crossed Centerline.
  - **Citation Issued** (8.3) – the citations issued to LD drivers at the time of an LD crash. The use of Citation Issued data is primarily for law enforcement.
    - The following are related to those items in the LD filter [crash frequency is given in brackets over the five years of the study]:

        - (1) Driving While Suspended [7,152],
        - (2) Driving While Revoked [2,954],
        - (3) No Driver License [839],
        - (4) Improper Tag or Expired Tag [49].
    - The following are related to Impaired Driving (DUI):
        - (1) Driving Under the Influence [1,825],
        - (2) Driving Under the Influence of Drugs [273],
        - (3) Dvng Under Influence of Alcohol and Drugs [168], and
        - (4) Driving Under the Influence of Any Substance [138].
    - The following are other miscellaneous violations:
        - (1) No Proof of Insurance [2,891],
        - (2) Leaving the Scene of an Accident [762],
        - (3) Eluding Police [214], and
        - (4) Violation of Restrictions [26].

2.0 Summary of Findings

Note: subsections 2.1, 2.2 and 2.3 have been omitted below in order to keep the numbering system in this Section consistent with the section numbers of the IMPACT displays that follow. The following findings are mainly from the IMPACT analysis below that compared LD vs Non-LD crashes for all five years (CY2016-2020); but in some cases additional supplementary cross-tabulations were performed:

- **2.4 Geographical Factors (4.0)**
    - County (4.1) - Generally, the over-represented counties are those with combined fairly large population centers bordering on rural areas, as opposed to the highly urbanized counties or the extremely rural counties. See the rural-urban comparison in Section 4.3, and the Locale comparison in Section 4.6. Placed in Max Gain order, the ones with the highest potential for reduction were: (1) Montgomery, (2) Mobile, (3) Morgan, (4) Pike, and (5) Walker. [Terminology: *Expected proportions* (AKA *expectations*) here and below are obtained from the proportion for non-LD crashes.]
    - City Comparisons of LD to Non-LD crashes (4.1 and 4.2), including rural areas of counties (virtual cities). City (and rural area) comparisons are presented for all areas that had a Max Gain in excess of 85 LD crashes over the five-year period of the study. The county rural areas (virtual cities) with Max Gains in excess of 85 LD crashes over their expected numbers are: Rural Mobile, Rural Jefferson, Rural Walker, Rural Madison, Rural Talladega, and Rural Pike. Some of the largest cities in the state were under-represented, as shown in Section 4.2b.
    - Rural/Urban LD Crash Proportion (4.3) – Rural LD crashes have a proportion that is 30% higher than the comparable non-LD crashes. LD crashes occurred in

29.35% rural and 70.65% urban areas. The number of LD crashes is mainly determined by the traffic volume and not any characteristics of the rural or urban environments. However, the rural environment consistently results in more severe crashes for both restrained and unrestrained occupants. The following table gives the differences *based on all crashes 2016-2020*. This will be useful assessing the combined effects of rural/urban speed differences and seatbelt use.

Seatbelt Use	Rural Odds	Urban Odds	Rural Multiplier
No Restraint Used	1 in 13	1 in 23	1.8
Shoulder and Lap Belt	1 in 252	1 in 1666	6.6
No-Restraint Multiplier	19.4	72.4	

- Severity of Crash by Rural-Urban (4.4) – The distinction between rural and urban becomes much more relevant when severity is considered. While only 29.35% of crashes occurred in rural areas, 66.35% of the fatal LD crashes occurred there. Similar results are found for the highest severity non-fatal crashes. This is obviously the result of higher impact speeds in the rural areas. Note that additional causes of increased severity are given in the Factors Affecting Severity, Section 6, below.
- Highway Classifications (4.5) – County roads had a proportion of LD crashes that was 32.8% higher than their expected proportion of crashes (as given by the non-LD crashes), and State routes had about 5.2% more than expected. Municipal Roads, which had 38.30% of all of the LD crashes, were significantly under-represented in comparison to their non-LD counterparts, which accounted for 40.47% of all non-LD crashes. All roadway classifications except County and State were significantly under-represented. County road characteristics no doubt contribute to the crash frequency (see Section 4.4). County roads are also known to be less "crashworthy" (i.e., they result in more severe crashes at comparable impact speeds).
- Locale (4.6) – Residential and Open Country roadways show a high level of over-representation (1.193 and 1.125 Odds Ratios, respectively) as compared with the more urbanized area types, especially Shopping or Business, which had 15.7% less than its expected proportion.
- Most Harmful Event (4.7) – ordered by frequency. The goal of ordering by frequency is to indicate where the removal of License Deficient obstacles might be most effective (4.9). The following items were fixed License Deficient obstacles that have over 400 occurrences in five years (at least 80 per year):

Overturn/Rollover	1,926
Collision with Tree	1,825
Collision with Parked MV	1.219

Collision with Ditch	1,211
Collision with Utility Pole	873
Collision with Veh from Other Road	731
Collision with Other Fixed Object	471
Ran Off Road Right	443

- Roadway curvature and Grade (4.8). LD crashes are dramatically over-represented on all types, and especially left curves. Left curves either Level or with Down Grades are generally more of a problem than right curves with the same grades. Level and down grades are more of a problem than up-grades.

- **2.5 Time Factors (5.0)**
  - Year (5.1) – Since the years 2017, 2018 and 2019 were under-represented, while 2016 and 2020 were over-represented, there seems to be no pattern in LD crashes over the five years.
  - Month (5.2) – January, October and November were significantly under-representations, while the only month that was significantly over-represented was July. The number of LD crashes correlated fairly well with non-LD crashes during the rest of the months.
  - Day of the Week (5.3) – This analysis is not only useful for the typical work week, but it also reflects the typical "holiday weekend" patterns. Traffic safety professional will notice that the distribution throughout the week is quite similar to that of impaired driving, but not as extreme. Since many LD crashes are caused by ID, that would create this distribution for LD as well. Assuming that a significant number of LD crashes are caused by ID, the days can be classified similar to ID as follows:
    - Typical work weekday (Monday through Thursday) – these days are under-represented in LD crashes due to the need for many users to go to work the following day.
    - Friday – this pattern is also reflected in the day before a weekend (or holiday), i.e., before a day off. The high LD frequency on this day is due to those who are getting an early substance abuse start to the weekend, recognizing that they have no work responsibilities the following day. However, the large numbers of non-LD crashes on Fridays causes Friday to be statistically under-represented in LD crash proportion compared to non-LD crashes. This is the typical Friday general increase due to the normal rush hours coupled with individuals leaving for vacations and weekend activities.

    - Saturday – the "Saturday" pattern is the worse for LD crashes in that it has both an early morning component (like Sunday) and a late night component (like Friday). So, it could be viewed as a combination of the typical Friday and Sunday.
    - Sunday – since this is the last day of a holiday sequence or weekend, its over-representation comes mainly from those who start on Saturday night and do not complete their use of alcohol/drugs until after midnight. Sunday is the most over-represented day with over twice its expected number of LD crashes; however, the low number of non-LD crashes on Sunday also contributes to this proportional over-representation.
- Time of Day (5.4-5.5) – The extent to which night-time hours are over-represented is quite striking. Optimal times for LD enforcement would start immediately following any rush hour details, and would continue through at least 4:00 to 4:59 AM (odds ratio 1.515). The 5 to 5:59 hour is also significantly over-represented, but with lower odds ratio of 1.094. Some of the late-night LD crashes will also be due to drowsiness and/or the diminished ability to see road edge lines.
- Time of Day by Day of the Week (5.5-5.6) – This quantifies the extent of the crash concentrations on Friday nights, Saturday mornings, Saturday nights and early Sunday mornings. This is a very useful summary for deploying selective enforcement details, especially during the weekend hours. Please see the discussion in Section 5.5 as they related to the cross-tabulation in Section 5.6.
  [Note: Because the discussions above on crash times heavily inferred the involvement of alcohol and/or drugs, the next two bullets will be dedicated to the effect of impaired driving on LD crashes even though these are not directly in time factors categories.]
- CU Officer's Opinion Impaired Driving – Alcohol (5.7). We saw ample evidence for LD crashes being caused by Impaired Driving (ID) in the time of day and day of the week. The two ID attributes (C122 and C123) indicate the degree that ID was involved in LD crashes as opposed to non-LD crashes. For alcohol, the proportion of ID crashes was 4.123 times as many for LD crashes as for non-LD crashes. For drugs this multiplier was even greater at 5.717. This was sufficient to verify that the LD time over-representations reported above, were caused by ID/DUI.
- CU Officer's Opinion Impaired Driving – Non-alcohol Drugs (8.4). The reported non-alcohol drug cases for LD crashes is less than half of that for alcohol. The 1,601 non-alcohol drug ID cases were only 5.42% of all LD crashes. However, the Odds Ratio indicates that it has an over-representation comparable to alcohol. In both cases (LD and non-LD), drug use is difficult to detect compared to alcohol, which has well-established tests for the blood-alcohol level that are accurate and relatively easy to administer. Our conclusion is that both alcohol and non-alcohol drug use are major contributors to increasing the frequency of LD crashes,

and their use and severity is further compounded by using county roads to avoid detection.

- **2.6 Factors Affecting Severity (6.0)**
  - LD Crash Severity (6.1) -- The rate of injuries and fatalities are consistently higher in LD crashes than that of non-LD crashes. Fatality crashes are nearly three times their expected proportion (Odds ratio =2.899), while the next highest non-fatal injury classifications has over twice its expected values (2.218) when compared with non-LD crashes. All of the injury categories are significantly over-represented except for Property Damage Only (no injury).
  - Speed at Impact (6.2) – All impact speeds above 30 MPH are significantly over-represented. The over-representations increase, as expected, with increased speed with 70-75 MPH having an odds ratio or 2.024, while for 96-100 MPH being 5.562. This was validated in the discussion below of the cross-tabulation of impact speeds by severity (6.4). See the next attribute for the effect this has on fatalities.
  - Severity by Impact Speed (6.3-6.4) –Past analyses have found the general rule of thumb that for every 10 MPH increase in speeds, the probability of the crash being fatal doubles. This is further validated in the discussion the cross-tabulation. In the 31-35 MPH impact speed the probability is only a little over one in every 315 crashes. As impact speeds climb to the 46-55 MPH, this probability more than doubles to one in about 52 crashes. At 76-85 MPH it increases again (exponentially) to one in about every 10 crashes, and at above 95 it is about one in five, which is about double again. There can be no doubt that these high impact speeds account for the high LD crash severity, including a large number of fatalities.
  - Restraint Use by LD Crash Causal Drivers (6.5) – there was no practical difference between setbelt use by the LD drivers as compared to their non-LD counterparts. Thus, the severity increase is mostly attributable to the increased speeds discussed above. We speculate that those with license deficiencies are trying to avoid further infractions.
  - Number of Vehicles Involved (6.6) – the number of single vehicle LD crashes is over-represented by an Odds Ratio of 1.148. However, this accounted for only about 24.42% of the LD crashes. Most of them (70.22%) were two-vehicle, although the non-LD crashes had and even higher percentage of two-vehicle crashes (73.14%). The conclusion is that there is no practical difference in the number of vehicles involved in LD crashes.
  - Police Arrival Delay (6.7) – LD crash police arrival delays were favorable in the 0-5 minute category, reflecting the proportion (27.38%) that occurred in or near a location served by proximal police agencies. However, the over-representation in rural LD crashes was reflected in both the under-representation in 6 to 20 minute

delays, and the over-representations in those longer than 20 minutes. Above 30 minutes was also significantly over-represented.

  - EMS Arrival Delay (6.9) – EMS arrival delays were significantly under-represented for LD crashes in the 0-5 and 6-10 minute categories. Generally, all longer delay times were significantly over-represented. There were relatively few in these very long categories (over 90 minutes), which were probably caused by the vehicles not being discovered late night.

- **2.7 Driver and Vehicle Demographics (7.0)**
  - Driver Age (7.1) – Younger (16-20-year-old) drivers were significantly under-represented in LD crashes. Consider the contrast between 22 and 23, which went from an under-representation to over-representation (both significant). This shows the dramatic change that can occur in just one year. The problem is in the 23-40 year olds, all of whom have significant over-representations. This increase by age continues somewhat, but to a lesser degree to 48. Above 48, LD crashes diminish with increasing age. In many cases, it takes years to accumulate the number of citations necessary for license deficiencies to occur, which may contribute to the older ages being over-represented when compared to non-LD crashes.
  - LD Crash Driver Gender (7.2) – The gender breakdown in LD causal drivers is about 65% male and 35% female. For non-LD, the percentage cannot be determined as accurately because of the large number of unknowns, but the estimate is about 50% males. These differences in proportions certainly indicate that males are a greater cause of the LD problems, and if there are countermeasures that can be directed toward males, doing so would be much more cost-effective than those directed equally toward all drivers.
  - Causal Vehicle Type (7.3) – Passenger Cars have the highest for potential crash reduction according to the Max Gain. However, Motorcycles have a much higher over-representation (2.206 Odds Ratio), indicating over twice their expected proportion as compared to their non-LD crash proportion. ATVs were over-represented, although they only had 61 crashes. None of the other classifications have significant over-representations, indicating that their proportions are about as expected. Some vehicles, notably Tractor/Semi-Trailers, Mini-vans, Pick-Ups and Sport Utility Vehicles (SUVs) are ***under***-represented indicating their tendency to have a relatively smaller proportion of LD drivers.
  - Number of Pedestrians (7.4). Pedestrians are generally under-represented in LD crashes, so it is recommended that data from other crash types (e.g. Impaired Driving) be used to reduce the serious pedestrian injury and fatal crash problems that occur in Alabama.

- Driver License Status (7.5) – This is included for completeness and it gives a listing of the various Drivers' License Status values that were used in the filter to create the LD crash subset (see also Section 3.1).
- Driver Employment Status (7.6) – This indicates that the LD driver unemployment rate of about 33.37%, and it has a proportion that is over twice that expected in comparison to non-LD drivers involved in crashes. This relationship is not surprising since drugs and alcohol are the primary cause of many LD crashes (8.3-8.4). The correlation between not having a job and being involved in an LD crash (i.e., driving LD) should be watched carefully going forward in that it could affect the type and location for countermeasures. For example, sanctions could be imposed to motivate the unemployed to get a job, or some LD PI&E programs might consider involving the unemployment office.

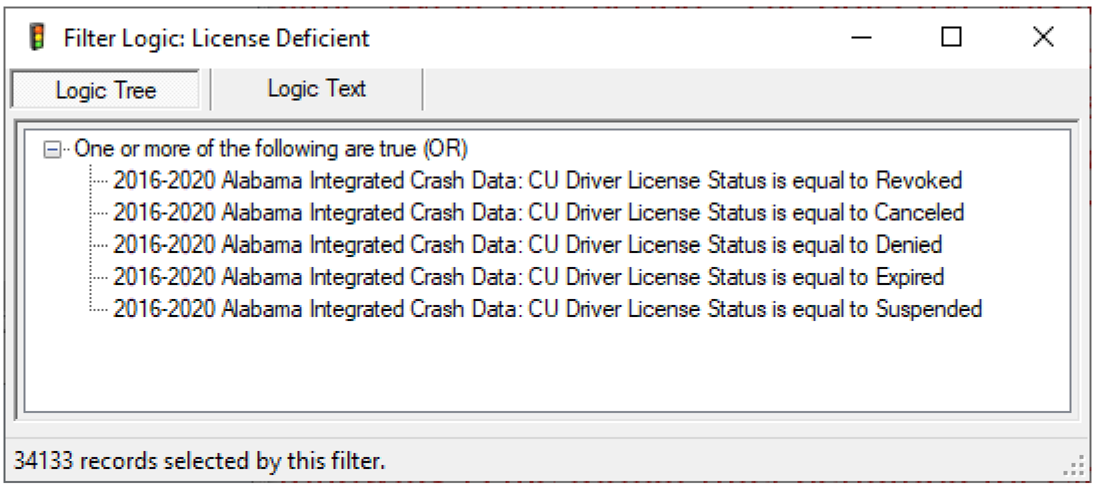
- **2.8 Driver Behavior (8.0)**
  - Primary Contributing Circumstances (8.1-8.2). While clearly the problems found in this study are those of LD drivers, behaviors (8.2) that are correlated with LD provide alternatives for countermeasure development. Those behaviors that had over twice their expected PCC proportion when compared to non-LD crashes are:
    - Impaired Driving (DUI)
    - Aggressive Operation, and
    - Over Speed Limit.
  - Citation Issued (8.3) – the citations issued to LD drivers at the time of an LD crash. The use of Citation Issued data is primarily for law enforcement.
    - The following are related to those items in the LD filter [crash frequency is given in brackets over the five years of the study]:
      - (1) Driving While Suspended [7,152],
      - (2) Driving While Revoked [2,954],
      - (3) No Driver License [839], and
      - (4) Improper Tag or Expired Tag [49].
    - The following are related to Impaired Driving (DUI):
      - (1) Driving Under the Influence [1,825],
      - (2) Driving Under the Influence of Drugs [273],
      - (3) Dvng Under Influence of Alcohol and Drugs [168], and
      - (4) Driving Under the Influence of Any Substance [138].
    - The following are other miscellaneous violations:
      - (1) No Proof of Insurance [2,891],
      - (2) Leaving the Scene of an Accident [762],
      - (3) Eluding Police [214], and
      - (4) Violation of Restrictions [26].

3.0 License Deficient (LD) Driver Caused Crashes CY2016-2020

As part of the ongoing Alabama Office of Traffic Safety (AOTS) problem identification efforts, UA-CAPS and ATI compared FY2016-2020 License Deficient (LD) crashes against non-LD crashes over this same 5-year time period. The objective was to determine all significant differences between these two subsets of data in order to pinpoint common factors and assess strategies that could be used to combat any major inconsistencies between these two subsets of crash data. The findings are presented to be taken into consideration when planning the large variety of countermeasures that exist to reduce the frequency and/or severity of LD crashes.

3.1 LD Filter Definition

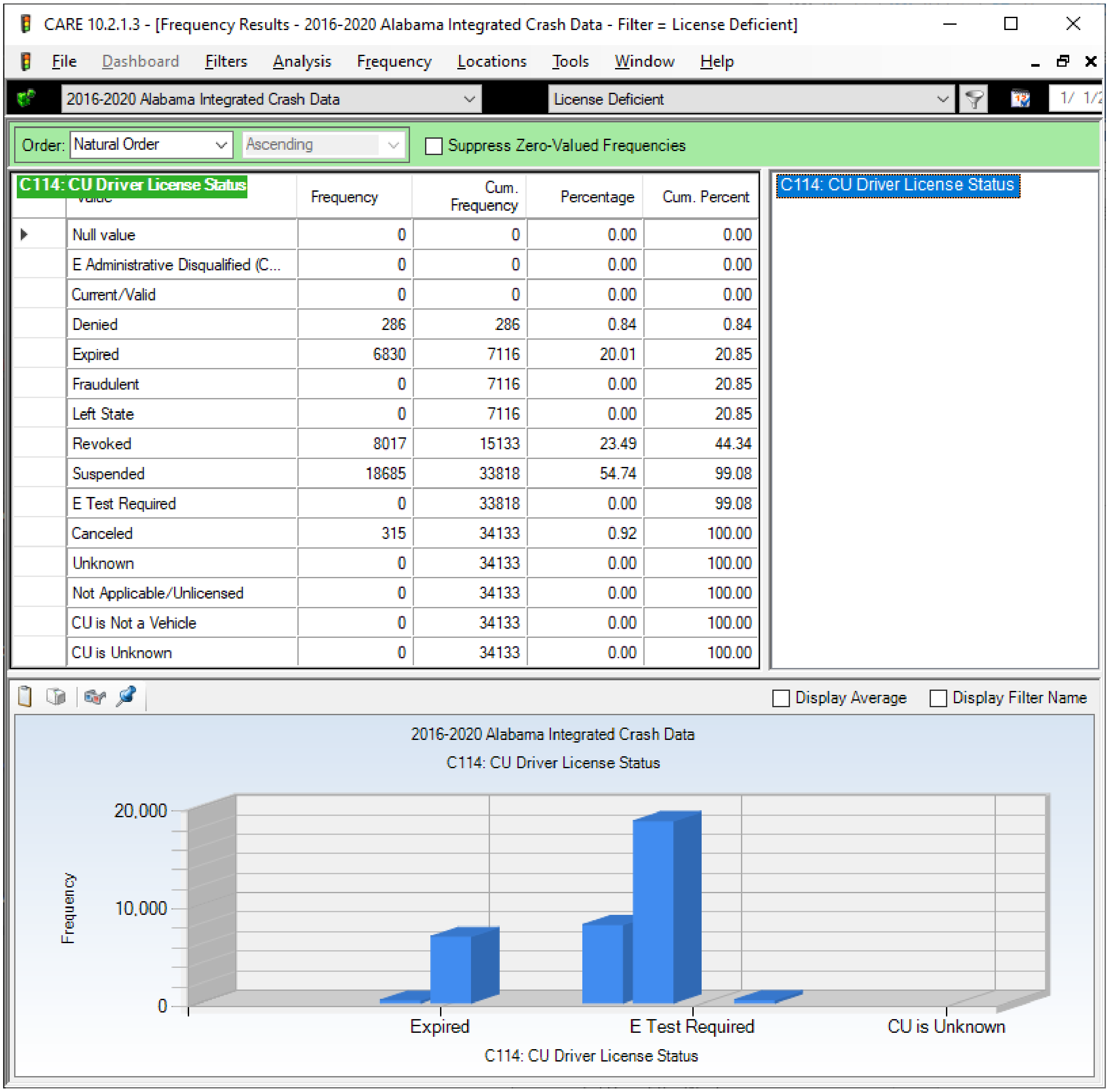
The following is the formal filter definition for License Deficient (LD) crashes:



This formalizes the definition of the crashes in the LD subset of crash reports being considered here. As mentioned above, these crashes are those reported in which the causal driver had a license that was either Revoked, Canceled, Denied, Expired or Suspended. The number of reports that have Not Applicable/Unlicensed had 34,953 cases, and obviously some of those were deficiencies on the part of the causal driver as well. However, they were not included since they would include a large number of pedestrians, non-licensable vehicles, and other cases that might unnecessarily skew the results. It is felt that the subset obtained from the values given above produced a good sampling of LD drivers for this study.

3.1.1 C114 CU Driver License Status

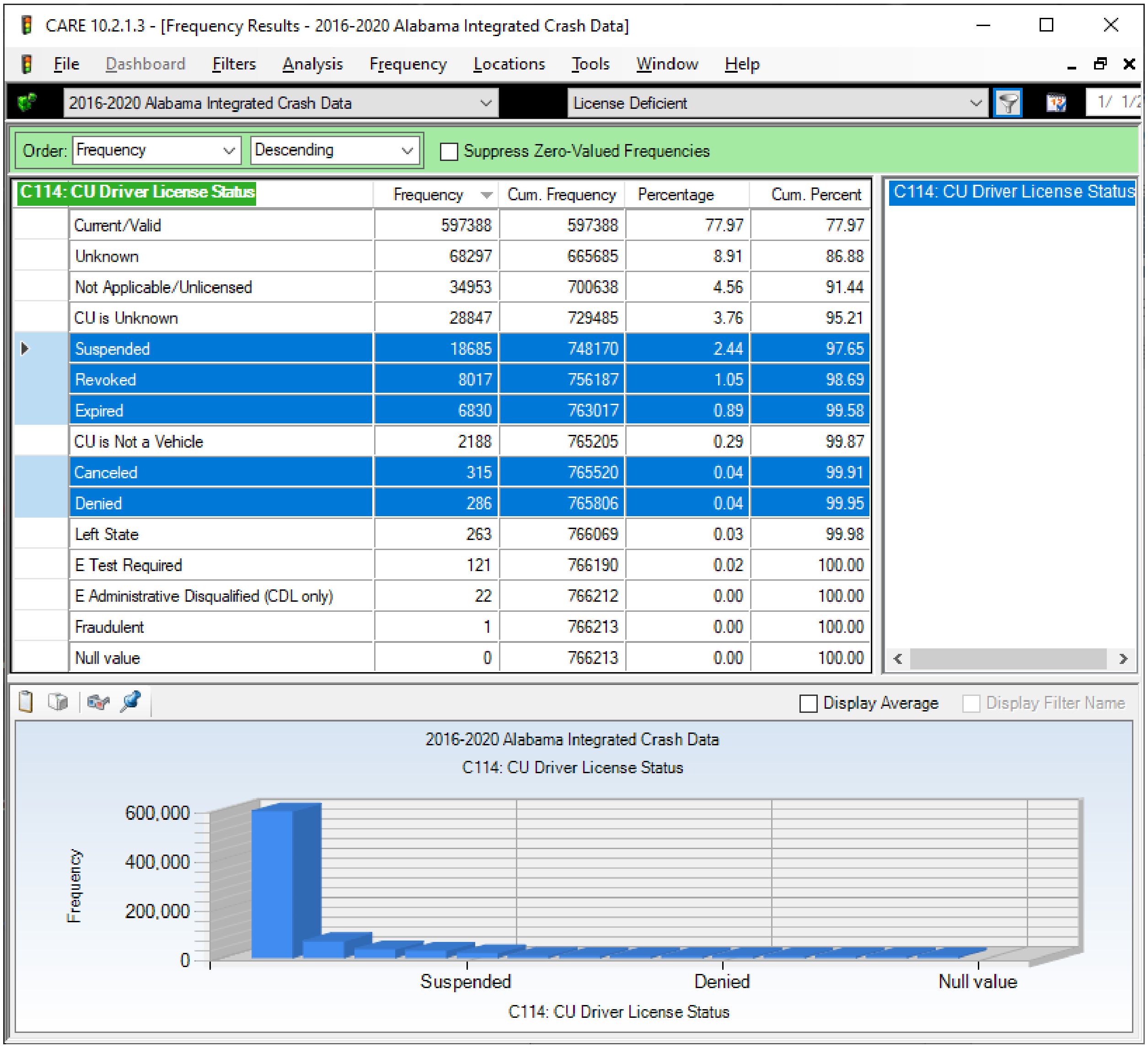
With the LD filter in effect, we will now present the frequency distributions for the attribute that appears in the filter (C114). The values for the deficiencies are ORed together, so if any one of them showed LD, that record will be included in the LD subset. The output here is in Natural Order, which is the same as it appears in the eCrash data collection system. Those values with zero frequency do not appear in the filter. There were a total of 34,133 crash records over the five year period that were LD, which is 4.45% of all of the 766,213 crash records for that time.



C114: CU Driver License Status	Frequency	Cum. Frequency	Percentage	Cum. Percent
Null value	0	0	0.00	0.00
E Administrative Disqualified (C...	0	0	0.00	0.00
Current/Valid	0	0	0.00	0.00
Denied	286	286	0.84	0.84
Expired	6830	7116	20.01	20.85
Fraudulent	0	7116	0.00	20.85
Left State	0	7116	0.00	20.85
Revoked	8017	15133	23.49	44.34
Suspended	18685	33818	54.74	99.08
E Test Required	0	33818	0.00	99.08
Canceled	315	34133	0.92	100.00
Unknown	0	34133	0.00	100.00
Not Applicable/Unlicensed	0	34133	0.00	100.00
CU is Not a Vehicle	0	34133	0.00	100.00
CU is Unknown	0	34133	0.00	100.00

3.1.2 C114 CU Driver License Status for all Drivers (Unfiltered)

For purposes of comparison with the result above, the following gives the C114 items before any filtering, and in descending order by frequency. Those values that are in the LD filter have a blue background.

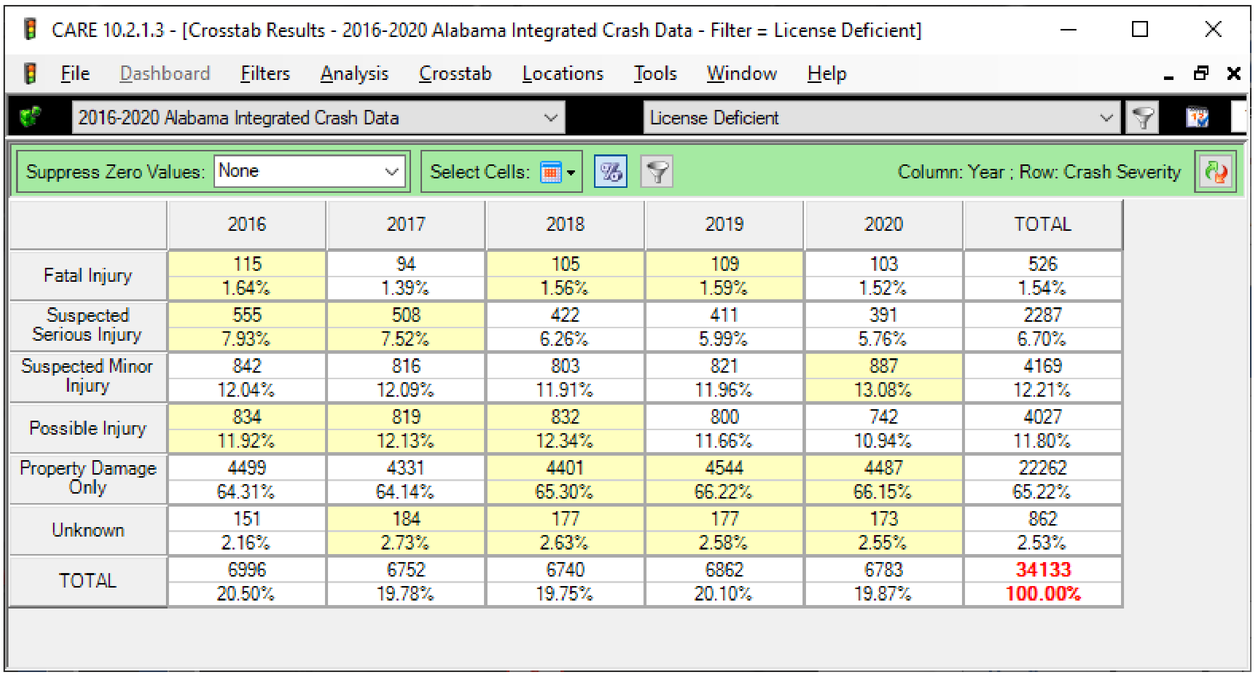


C114: CU Driver License Status	Frequency	Cum. Frequency	Percentage	Cum. Percent
Current/Valid	597388	597388	77.97	77.97
Unknown	68297	665685	8.91	86.88
Not Applicable/Unlicensed	34953	700638	4.56	91.44
CU is Unknown	28847	729485	3.76	95.21
Suspended	18685	748170	2.44	97.65
Revoked	8017	756187	1.05	98.69
Expired	6830	763017	0.89	99.58
CU is Not a Vehicle	2188	765205	0.29	99.87
Canceled	315	765520	0.04	99.91
Denied	286	765806	0.04	99.95
Left State	263	766069	0.03	99.98
E Test Required	121	766190	0.02	100.00
E Administrative Disqualified (CDL only)	22	766212	0.00	100.00
Fraudulent	1	766213	0.00	100.00
Null value	0	766213	0.00	100.00

3.2 Overall LD Crashes by Year and Severity; 2016-2020 Data

Before analyzing the LD subset, it is good to get a feel for the overall difference in the crash frequencies by severity over the past years. The following table gives a comparison of total LD crashes over 2016-2020 by severity.

LD Crashes by Severity for Calendar Years 2016-2020



CARE 10.2.1.3 - [Crosstab Results - 2016-2020 Alabama Integrated Crash Data - Filter = License Deficient]

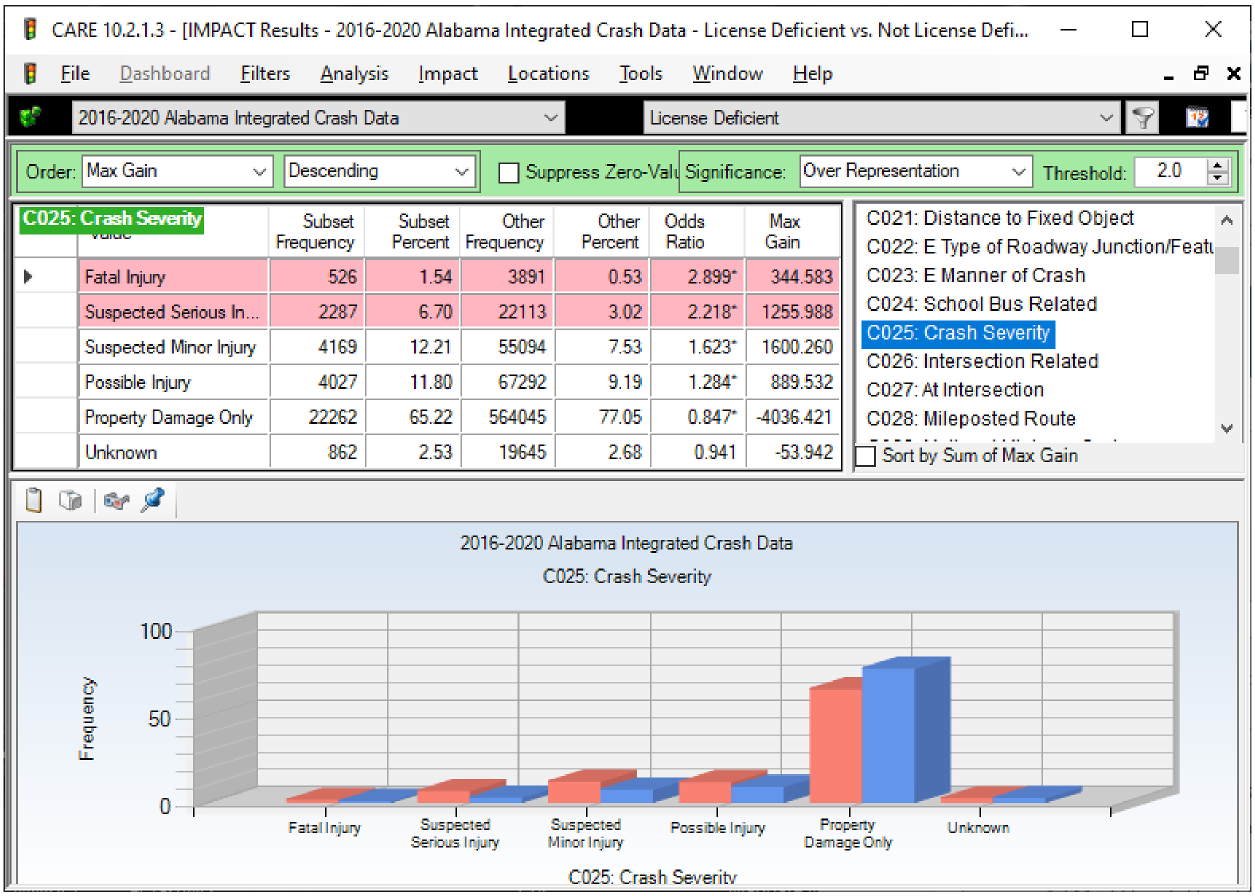
Column: Year ; Row: Crash Severity

	2016	2017	2018	2019	2020	TOTAL
Fatal Injury	115 1.64%	94 1.39%	105 1.56%	109 1.59%	103 1.52%	526 1.54%
Suspected Serious Injury	555 7.93%	508 7.52%	422 6.26%	411 5.99%	391 5.76%	2287 6.70%
Suspected Minor Injury	842 12.04%	816 12.09%	803 11.91%	821 11.96%	887 13.08%	4169 12.21%
Possible Injury	834 11.92%	819 12.13%	832 12.34%	800 11.66%	742 10.94%	4027 11.80%
Property Damage Only	4499 64.31%	4331 64.14%	4401 65.30%	4544 66.22%	4487 66.15%	22262 65.22%
Unknown	151 2.16%	184 2.73%	177 2.63%	177 2.58%	173 2.55%	862 2.53%
TOTAL	6996 20.50%	6752 19.78%	6740 19.75%	6862 20.10%	6783 19.87%	34133 100.00%

The yellow background cells are higher than the average over the rows (given in the TOTAL column to the very right). None of these over-represented cells exceeded 10% more than that in the right column. If so, they would have a red background. There do not appear to be any major disparities by year, although, we will revisit the in Section 5.1 where these numbers will be compared against their non-LD counterparts.

3.3 Overall Severity Comparisons

The following presents a comparison of the severities of all LD crashes over the five-year period (2016-2020) against non-LD crashes. The *Subset Frequency* and *Percent* are for LD crashes, while the *Other Frequency* and *Percent* are for the non-LD crashes. Comparisons of LD and non-LD crashes are made using the percentage proportions since the raw frequencies are not comparable because of the frequency differences in the two subsets. This comparison is sufficient to determine if LD crashes tend to have greater severities that non-LD crashes.



The table and chart above show clearly that all injury types (except PDO) are over-represented for LD crashes, and the higher the severity, the greater the over-representation. This certainly provides ample justification for the detailed analyses of the rest of this study. All four of the injury values are over-represented, and the two top most severe have at least twice the proportion of the non-LD crashes. For fatal crashes the Odds Ratio multiplier is well over double (2.899), and close to three times its expected value. In the other injury severities, there is still a very significant increase in both the Suspected Minor Injury and the Possible Injury. The probability of a fatal crash for the 28,380 LD crashes was 1.54%, which was about three times the probability of a fatal crash for the 34133 non-LD crashes (0.053%), both over the past five years.

3.4 Introduction to Sections 4-8

The following sections (4.0-8.0) provide the IMPACT displays for the various attributes that could have an influence on countermeasure development. Unless otherwise indicated in the "Order" box displayed, the outputs will be ordered by 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 there was no over-representation, and thus the LD proportion was exactly the same as the non-LD proportion (i.e., had an Odds Ratio of 1.000). Thus, the higher the Max Gain, the greater that attribute value has for crash reduction.

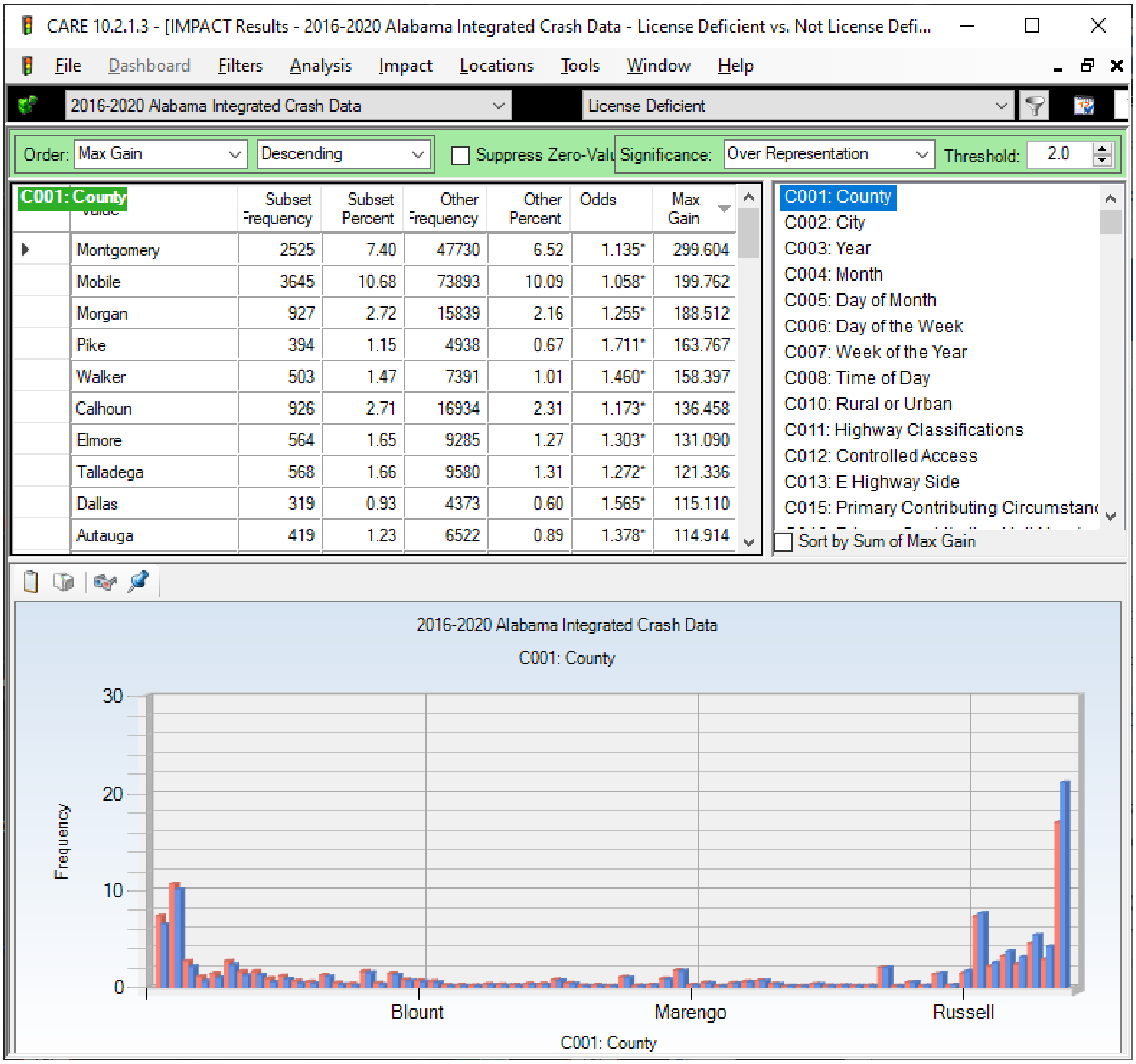
An *over-represented* value of an attribute is a situation found where that attribute value has a greater share of LD crashes than would be expected if it were the same as that attribute value in non-LD crashes. So, the non-LD crashes are serving as a control to which the LD crashes are being compared. In this way anything different about LD crashes surfaces and can be subjected to further analyses and perhaps countermeasure development.

The analytical technique employed to generate most of the displays below is called Information Mining Performance Analysis Control Technique (IMPACT). For a detailed description of the meaning of each element of the IMPACT outputs, see:

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

4.0 Geographic and Harmful Event Factors

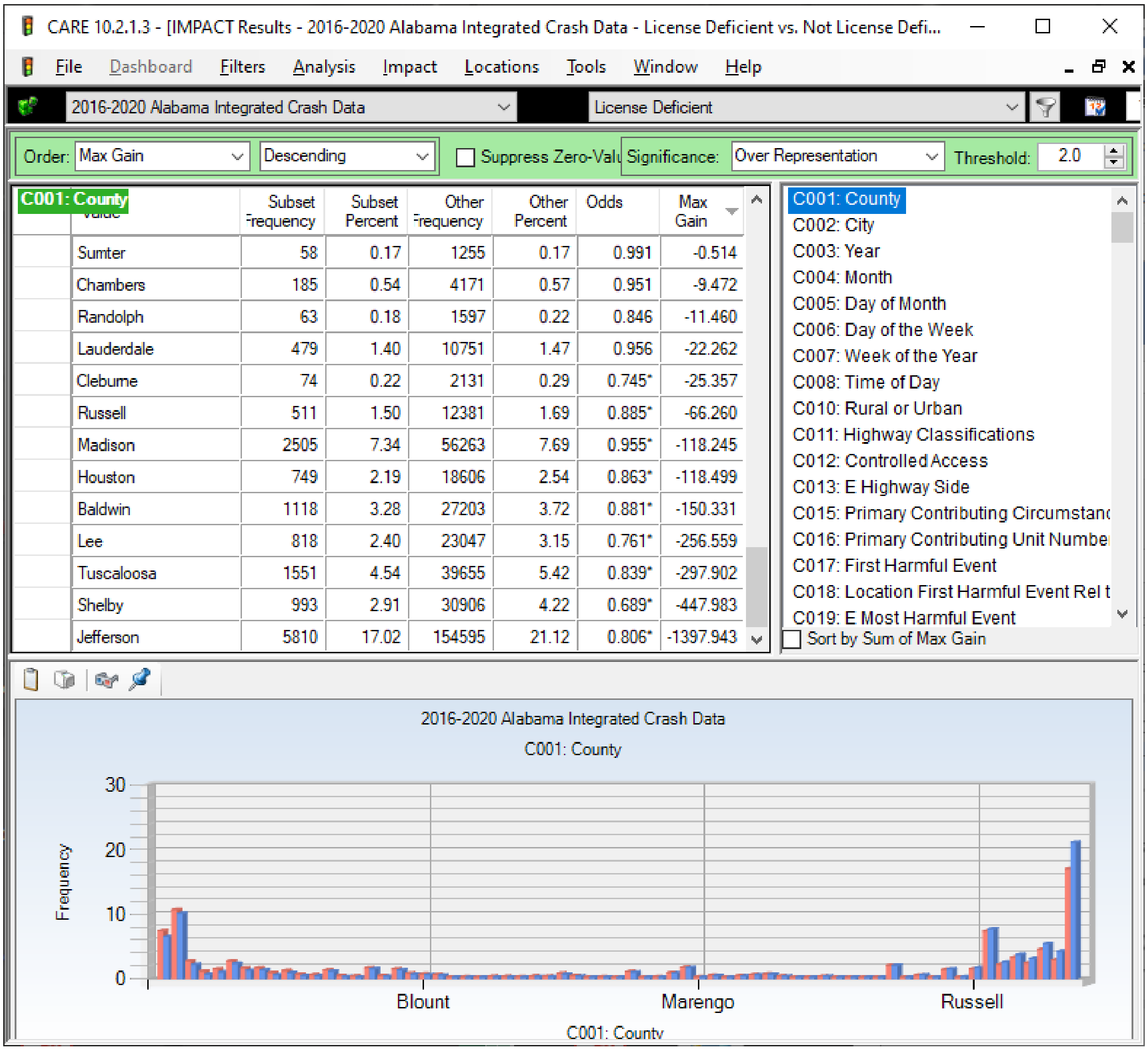
4.1a Counties with Max Gains > 100 LD Crashes



The above has been arranged in highest Max Gain order to indicate the counties that have the highest *potential* for reducing their LD over-representations. Montgomery, Mobile, Morgan, Pike, and Walker top the list. This would also be a metric to estimate the relative proportion of LD drivers who are on the roads in these counties. Of course, all do not crash, but the number and proportion of LD crashes is a good estimator of their proportion in that geographical area.

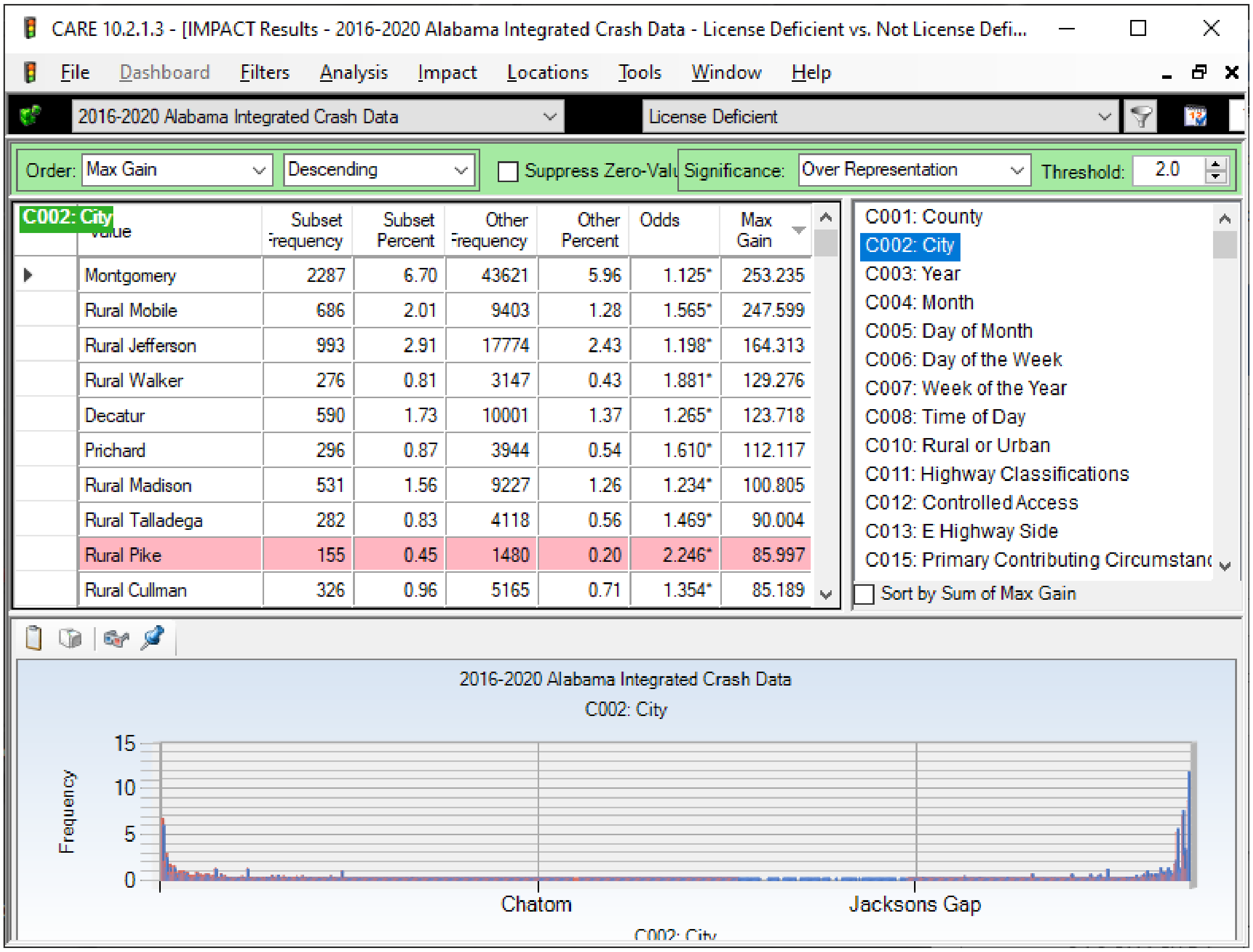
4.1b Counties with Negative Max Gains

The table in the following display list all of the counties that had a negative Max Gain, which indicated that the county had *fewer* LD crashes than the proportion of non-LD crashes indicated. The counties that seem to be doing best, with at least 150 LD crashes fewer than expected were: Jefferson, Shelby, Tuscaloosa, Lee and Baldwin. We might conclude that drivers within these counties that get into crashes are relatively conscientious in keeping their drivers' incenses current and valid.



C001: County Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds	Max Gain
Sumter	58	0.17	1255	0.17	0.991	-0.514
Chambers	185	0.54	4171	0.57	0.951	-9.472
Randolph	63	0.18	1597	0.22	0.846	-11.460
Lauderdale	479	1.40	10751	1.47	0.956	-22.262
Cleburne	74	0.22	2131	0.29	0.745*	-25.357
Russell	511	1.50	12381	1.69	0.885*	-66.260
Madison	2505	7.34	56263	7.69	0.955*	-118.245
Houston	749	2.19	18606	2.54	0.863*	-118.499
Baldwin	1118	3.28	27203	3.72	0.881*	-150.331
Lee	818	2.40	23047	3.15	0.761*	-256.559
Tuscaloosa	1551	4.54	39655	5.42	0.839*	-297.902
Shelby	993	2.91	30906	4.22	0.689*	-447.983
Jefferson	5810	17.02	154595	21.12	0.806*	-1397.943

4.2a Cities Over-represented by Highest Max Gains (Including Rural Areas)



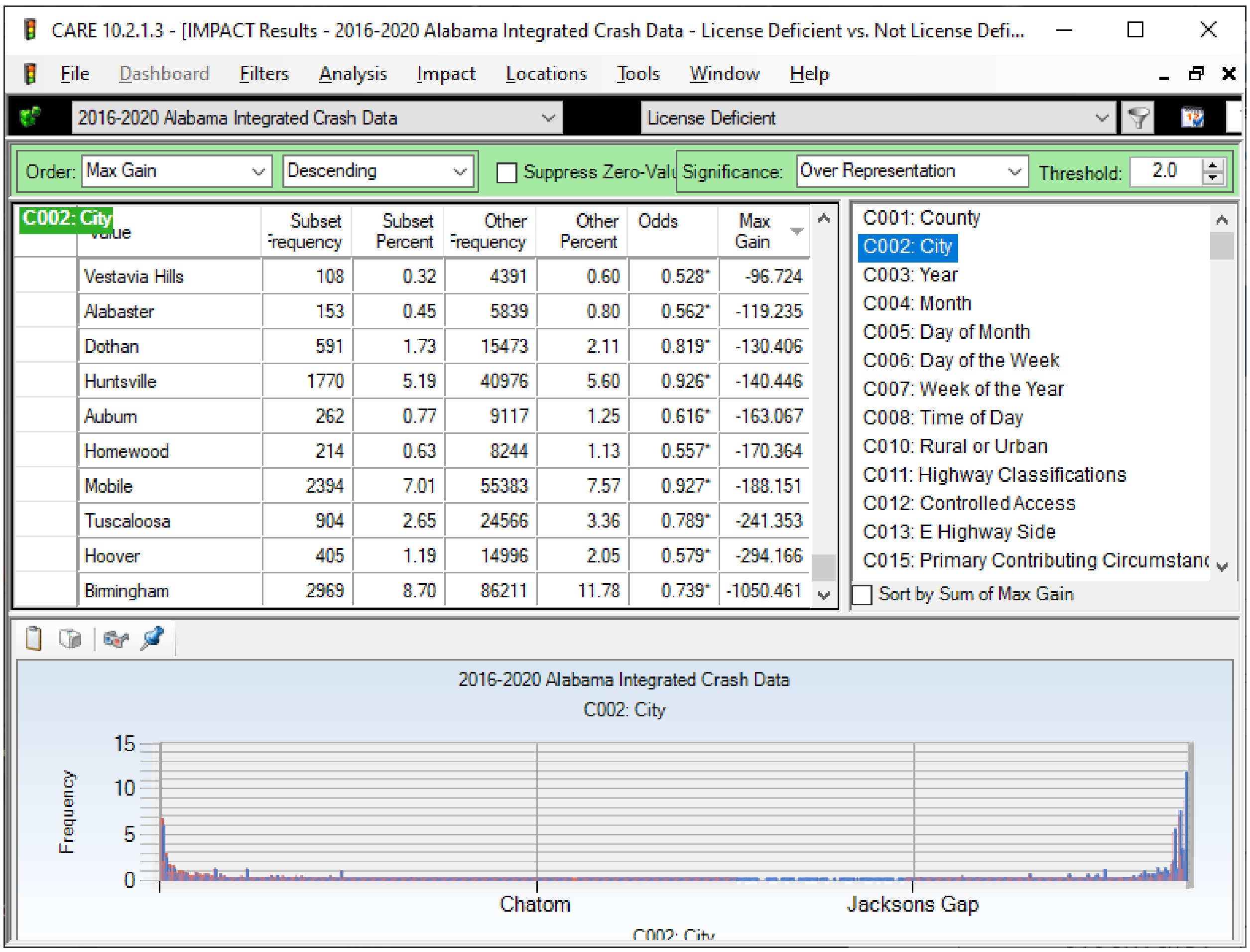
Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds	Max Gain
Montgomery	2287	6.70	43621	5.96	1.125*	253.235
Rural Mobile	686	2.01	9403	1.28	1.565*	247.599
Rural Jefferson	993	2.91	17774	2.43	1.198*	164.313
Rural Walker	276	0.81	3147	0.43	1.881*	129.276
Decatur	590	1.73	10001	1.37	1.265*	123.718
Prichard	296	0.87	3944	0.54	1.610*	112.117
Rural Madison	531	1.56	9227	1.26	1.234*	100.805
Rural Talladega	282	0.83	4118	0.56	1.469*	90.004
Rural Pike	155	0.45	1480	0.20	2.246*	85.997
Rural Cullman	326	0.96	5165	0.71	1.354*	85.189

For comparison purposes, the rural areas of counties are considered to be “virtual cities” in that crashes that occur there are listed as “Rural County Crashes,” so that the location of these crashes can be effectively accounted for and compared. In many cases these rural areas are adjacent to (or contain) significant urban areas. In the listing given above, we see seven rural (virtual) cities in the highest over-represented with at least 85 or more crashes.

The output display above is a list of what are considered to be the most critical cities and county rural areas (virtual cities) because of their high Max Gains, which indicate the potential for crash reduction. The criterion for this list was a Max Gain of 100 or more crashes. The red background indicates that the Rural Pike (virtual) city areas had over twice its expected proportion of LD crashes (Odds Ratio). This display is in Max Gain ordering to put those cities that have the highest potential for LD crash reduction at the top. Note that Max Gain considers the size of the city (in terms of total LD and non-LD crashes) as well as the proportion reduction.

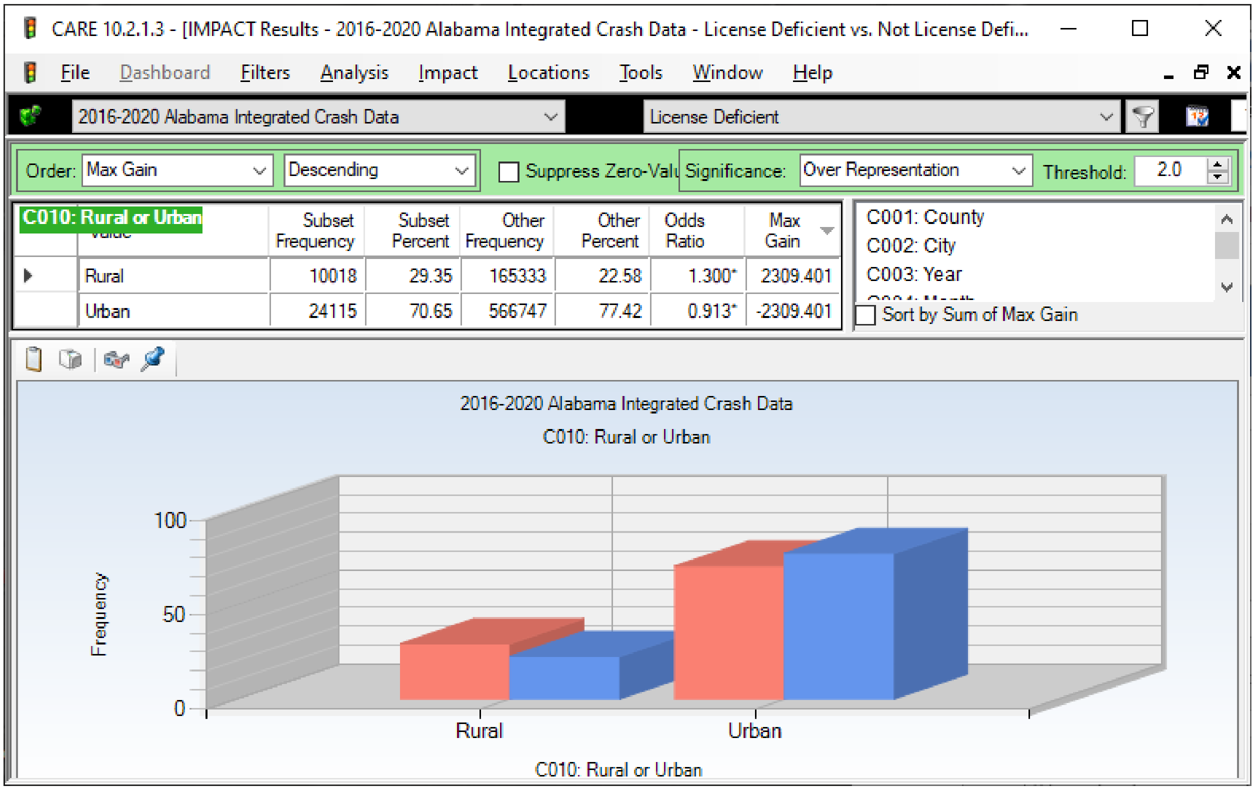
4.2b Cities Under-represented; with Max Gain of -96 Crashes or Less

Contrasted with the finding above, there were significant under-representations for License Deficient (LD) crashes in some of the state's largest cities (e.g., Birmingham, Hoover, Tuscaloosa, Mobile, Homewood, Auburn, Huntsville, and Dothan). See the display below. The large negative Max Gain indicates that these cities are favorable in their LD proportions when compared to the non-LD crashes in the same cities. We do not at this time have an explanation for the reason that some cities do much better than others.



Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds	Max Gain
Vestavia Hills	108	0.32	4391	0.60	0.528*	-96.724
Alabaster	153	0.45	5839	0.80	0.562*	-119.235
Dothan	591	1.73	15473	2.11	0.819*	-130.406
Huntsville	1770	5.19	40976	5.60	0.926*	-140.446
Auburn	262	0.77	9117	1.25	0.616*	-163.067
Homewood	214	0.63	8244	1.13	0.557*	-170.364
Mobile	2394	7.01	55383	7.57	0.927*	-188.151
Tuscaloosa	904	2.65	24566	3.36	0.789*	-241.353
Hoover	405	1.19	14996	2.05	0.579*	-294.166
Birmingham	2969	8.70	86211	11.78	0.739*	-1050.461

4.3 Rural or Urban



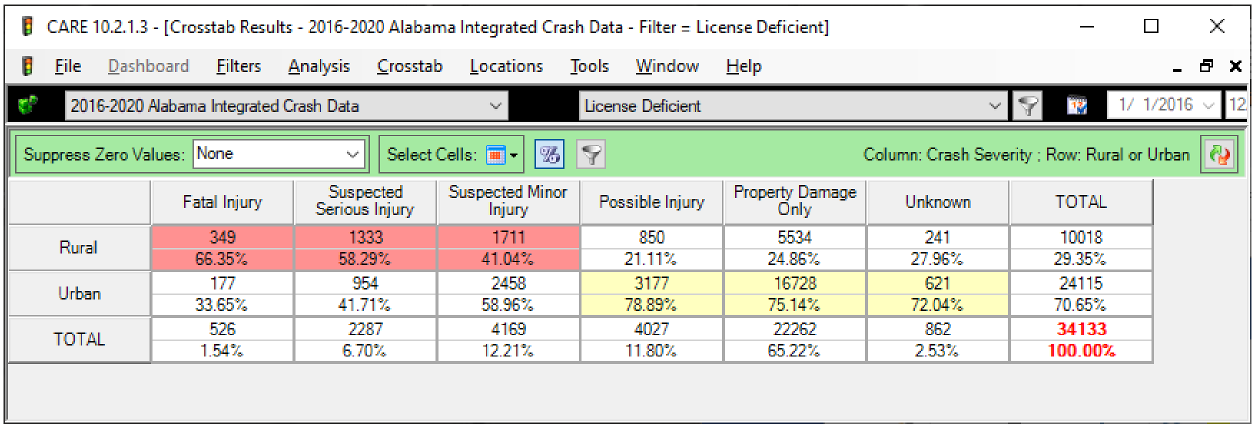
Clearly, the rural areas have a proportion of LD crashes that is 30% higher than the proportion of non-LD crashes. So there is a tendency for the rural crashes to have a higher chance of their drivers being LD. While the raw numbers indicate that the Urban LD crashes are well over twice the frequency of their Rural crashes, they are under-represented because of the even larger proportion of non-LD crashes in the urban areas. The analysis in Section 4.4 will show the negative effects of the rural crashes in terms of their being of a higher severity.

The table below is *for all crashes.* It gives an idea of how rural/urban and the use/non-use of seatbelts affects the severity. The "Multiplier" is the number of times that rural areas or non-use of seatbelts multiplies (increases) the probability of the crash being fatal.

Seatbelt Use	Rural Odds	Urban Odds	Rural Multiplier
No Restraint Used	1 in 13	1 in 23	1.8
Shoulder and Lap Belt	1 in 252	1 in 1666	6.6
No-Restraint Multiplier	19.4	72.4	

4.4 Severity of Crash by Rural-Urban

It is obvious in the above outputs that the proportion of LD crashes is greater in rural than in the more urbanized areas. It is interesting to perform a cross-tabulation over the rural and urban areas to determine to what extent their crashes might be causing more fatalities than would be expected from just a comparison of their crash frequencies. The following, *which is strictly for LD crashes*, gives this analysis.

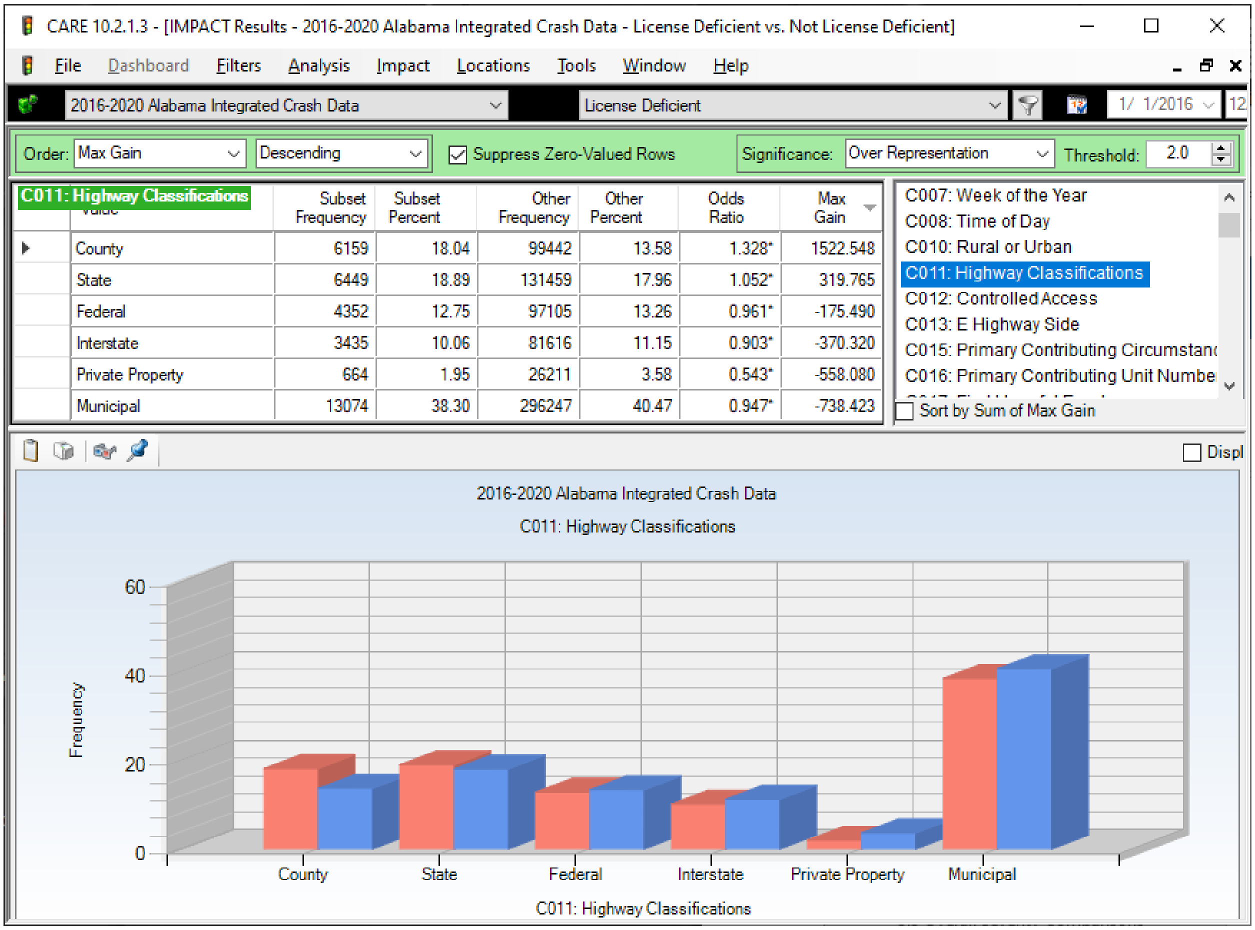


	Fatal Injury	Suspected Serious Injury	Suspected Minor Injury	Possible Injury	Property Damage Only	Unknown	TOTAL
Rural	349 66.35%	1333 58.29%	1711 41.04%	850 21.11%	5534 24.86%	241 27.96%	10018 29.35%
Urban	177 33.65%	954 41.71%	2458 58.96%	3177 78.89%	16728 75.14%	621 72.04%	24115 70.65%
TOTAL	526 1.54%	2287 6.70%	4169 12.21%	4027 11.80%	22262 65.22%	862 2.53%	34133 100.00%

The red cells in the cross-tabulation above indicate over-representation by more than 10%. For example, while 29.35% of crashes occurred in rural areas, 66.35% of the fatal crashes occurred there. It is imperative to take into consideration crash severity when making geographical decisions regarding countermeasure implementation. Meaningful information might be forthcoming by restricting any of the analyses shown in this report to only fatal crashes or some combination of fatal and severe injury crashes.

Clearly fatalities and the higher non-fatal severities of injuries are over-represented in the rural areas. The reason for this is that the higher speeds in the rural areas result in higher impact speeds (see Section 6.2), as well as the inferior design attributes for rural roads (especially for county roads). We will also see, especially where drugs (alcohol or other) are involved, drivers are willing to take the risks of not being properly restrained.

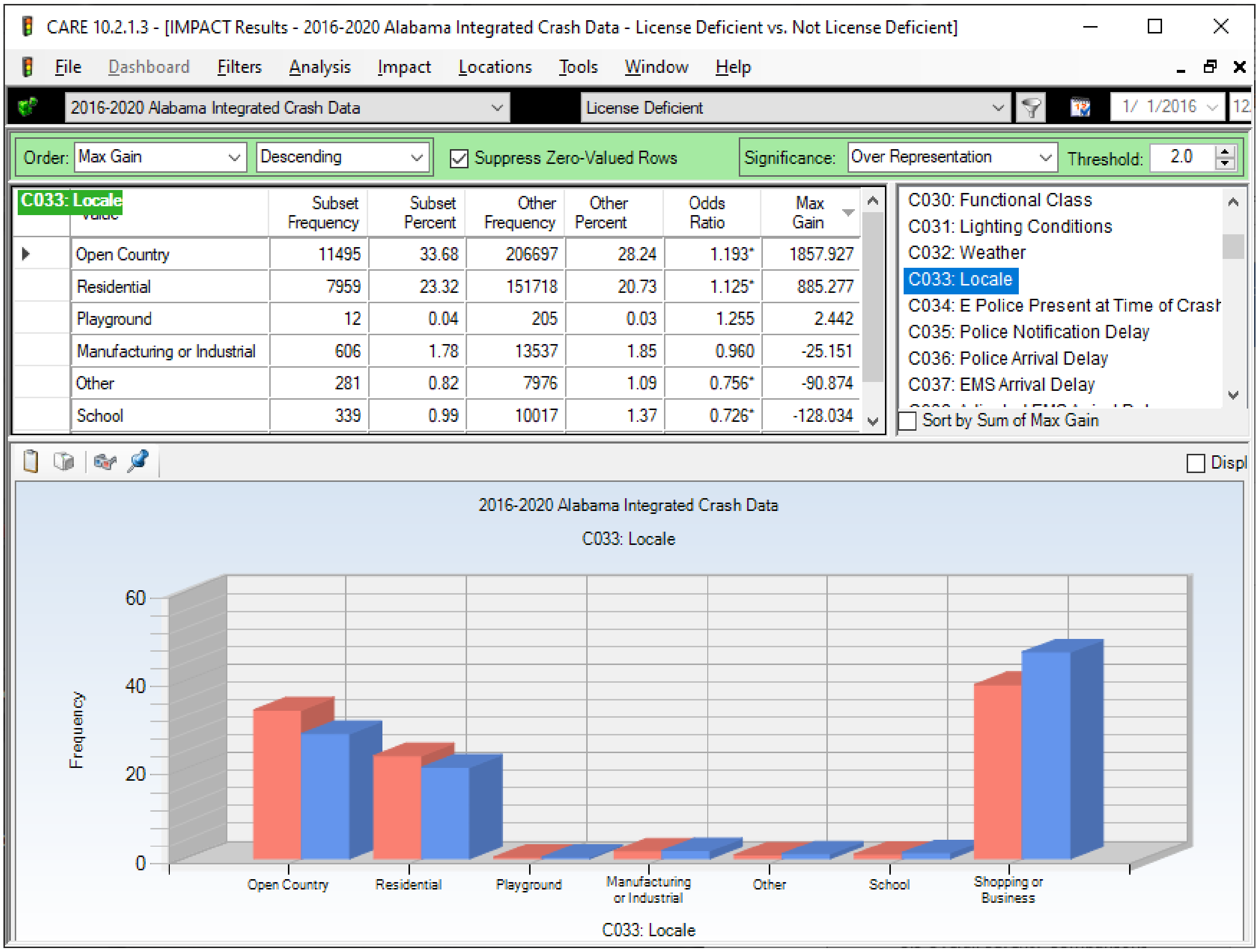
4.5 Highway Classifications



C011: Highway Classifications	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
County	6159	18.04	99442	13.58	1.328*	1522.548
State	6449	18.89	131459	17.96	1.052*	319.765
Federal	4352	12.75	97105	13.26	0.961*	-175.490
Interstate	3435	10.06	81616	11.15	0.903*	-370.320
Private Property	664	1.95	26211	3.58	0.543*	-558.080
Municipal	13074	38.30	296247	40.47	0.947*	-738.423

Analysis of highway classifications indicates that LD crashes had their greatest over-representation on county roads (32.8% higher than expected). State routes were also over-represented but by much smaller Odds Ratio (1.052, indicating a 5.2% above the expectation from the non-LD crashes). It is recommended that hotspot analysis be performed to identify the specific county roads that are most highly over-represented, and that some enforcement activities be conducted on the county roads in an attempt to move this traffic onto the safer (more forgiving) roadways. Law enforcement presence alone could have a major effect here, since a major problem is speed, as will be shown below (Section 6.2).

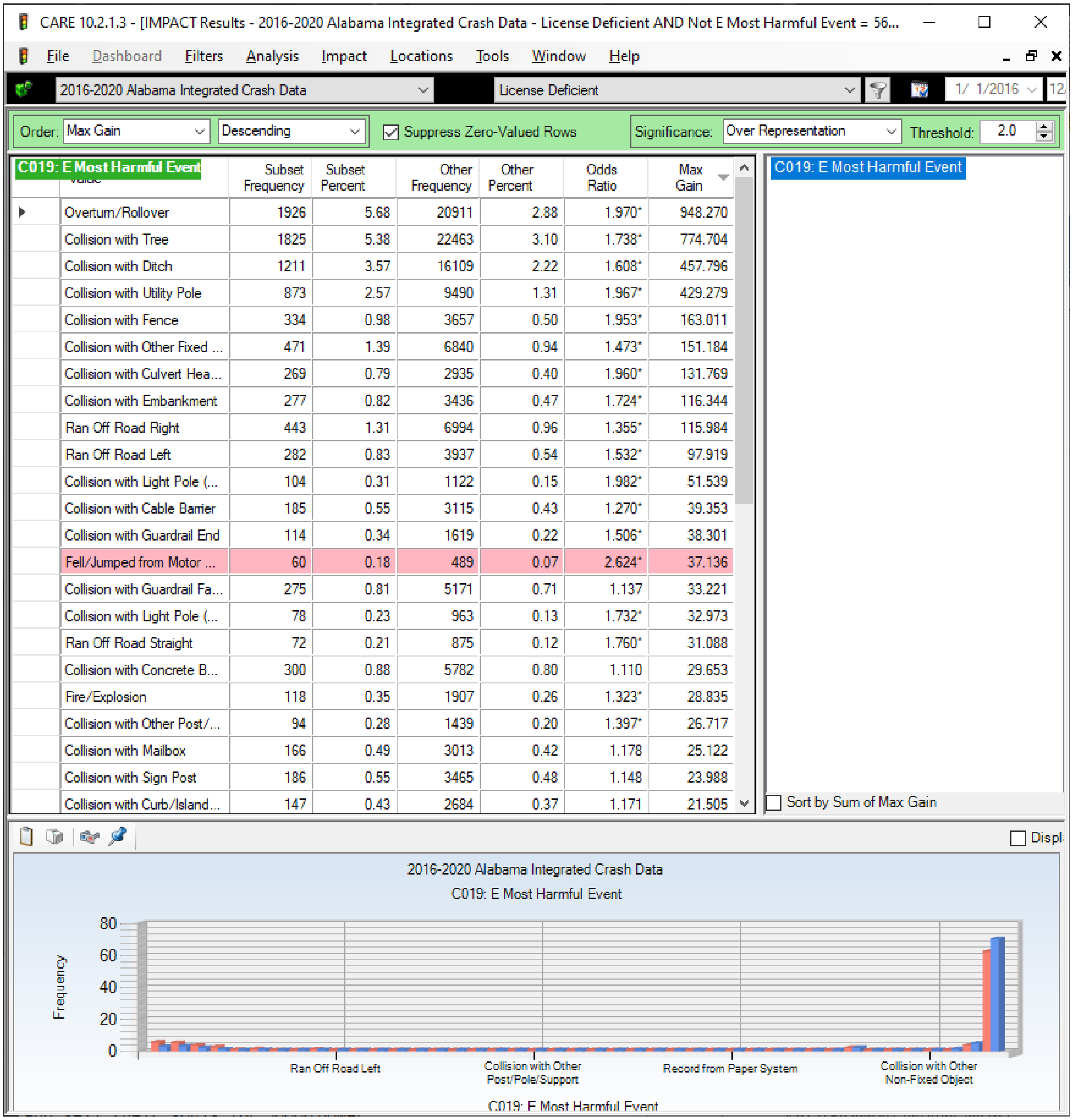
4.6 Locale



Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Open Country	11495	33.68	206697	28.24	1.193*	1857.927
Residential	7959	23.32	151718	20.73	1.125*	885.277
Playground	12	0.04	205	0.03	1.255	2.442
Manufacturing or Industrial	606	1.78	13537	1.85	0.960	-25.151
Other	281	0.82	7976	1.09	0.756*	-90.874
School	339	0.99	10017	1.37	0.726*	-128.034

Residential and Open Country roadways show a higher level of over-representation for LD crashes as compared to the more urbanized roadways. This might be more useful than the flat rural/urban specification, which we found in Section 4.3. There are considerable "Open Country" areas within the formal city limits of most cities, and this seems to be where a large number of the LD crashes are occurring. The higher speeds on these sections of roadway make fatal crashes much more probable. A cross-tabulation of Severity by Locale showed that 381 (72.43%) fatal crashes occurred in open country, as opposed to only 145 (27.57%) elsewhere. So it is the speed limit and the willingness of LD drivers to exceed the speed limits that result in the fatal crashes (as opposed to whether a crash occurs within a city limit of not).

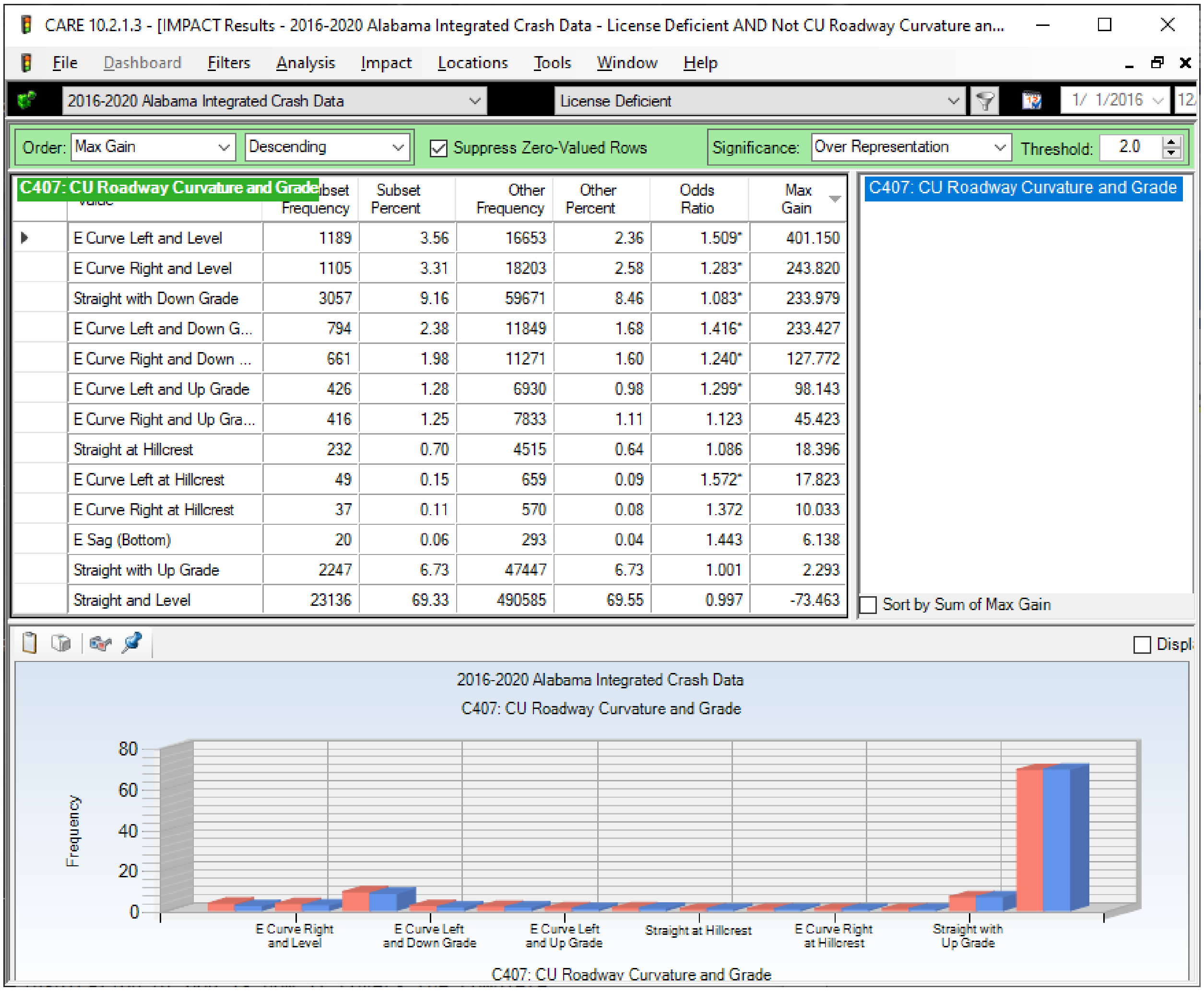
4.7 Most Harmful Event



C019: E Most Harmful Event	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Overturn/Rollover	1926	5.68	20911	2.88	1.970*	948.270
Collision with Tree	1825	5.38	22463	3.10	1.738*	774.704
Collision with Ditch	1211	3.57	16109	2.22	1.608*	457.796
Collision with Utility Pole	873	2.57	9490	1.31	1.967*	429.279
Collision with Fence	334	0.98	3657	0.50	1.953*	163.011
Collision with Other Fixed ...	471	1.39	6840	0.94	1.473*	151.184
Collision with Culvert Hea...	269	0.79	2935	0.40	1.960*	131.769
Collision with Embankment	277	0.82	3436	0.47	1.724*	116.344
Ran Off Road Right	443	1.31	6994	0.96	1.355*	115.984
Ran Off Road Left	282	0.83	3937	0.54	1.532*	97.919
Collision with Light Pole (...	104	0.31	1122	0.15	1.982*	51.539
Collision with Cable Barrier	185	0.55	3115	0.43	1.270*	39.353
Collision with Guardrail End	114	0.34	1619	0.22	1.506*	38.301
Fell/Jumped from Motor ...	60	0.18	489	0.07	2.624*	37.136
Collision with Guardrail Fa...	275	0.81	5171	0.71	1.137	33.221
Collision with Light Pole (...	78	0.23	963	0.13	1.732*	32.973
Ran Off Road Straight	72	0.21	875	0.12	1.760*	31.088
Collision with Concrete B...	300	0.88	5782	0.80	1.110	29.653
Fire/Explosion	118	0.35	1907	0.26	1.323*	28.835
Collision with Other Post/...	94	0.28	1439	0.20	1.397*	26.717
Collision with Mailbox	166	0.49	3013	0.42	1.178	25.122
Collision with Sign Post	186	0.55	3465	0.48	1.148	23.988
Collision with Curb/Island...	147	0.43	2684	0.37	1.171	21.505

The above displays only those items that had a Max Gains greater than 20 crashes. Since there is no rationale for why an LD driver would hit one obstacle rather than another, this distribution tends to reflect the roadside, and it can give safety engineers a general knowledge of what is being hit most often, and thus what obstacles might need to be removed or cushioned.

4.8 CU Roadway Curvature and Grade

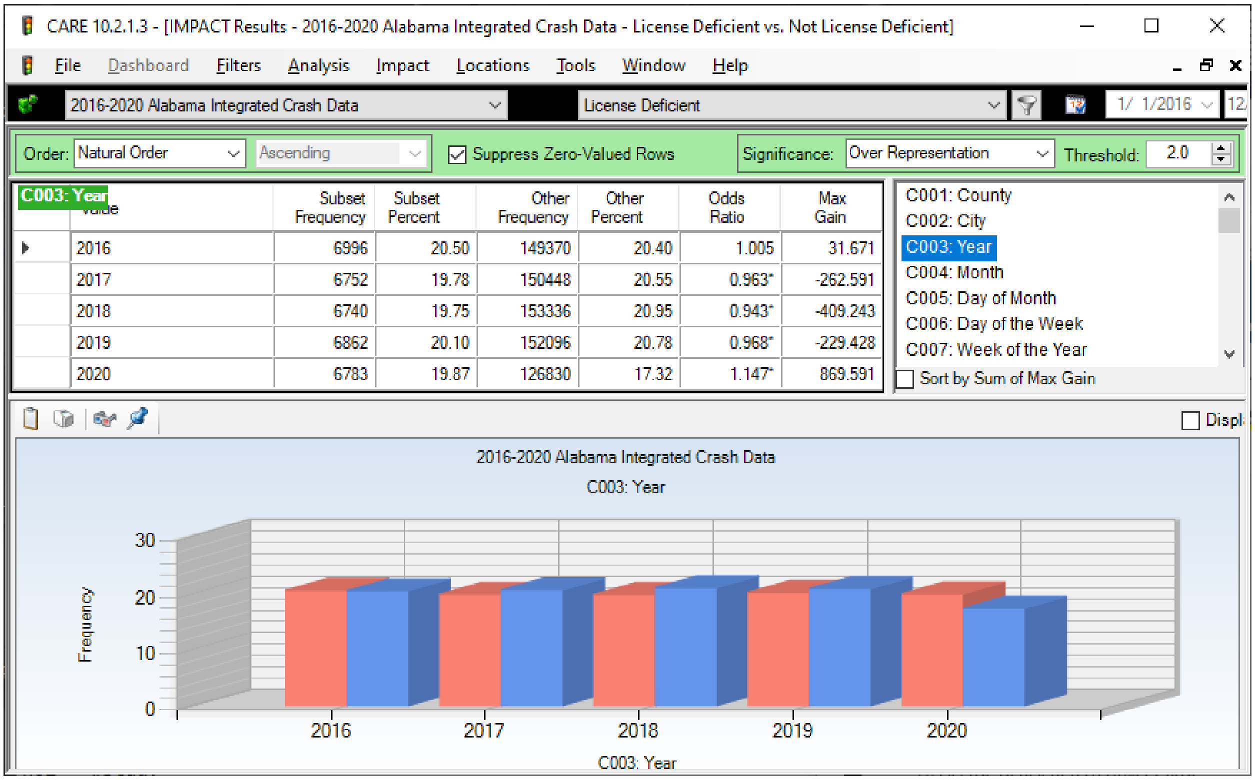


C407: CU Roadway Curvature and Grade Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
E Curve Left and Level	1189	3.56	16653	2.36	1.509*	401.150
E Curve Right and Level	1105	3.31	18203	2.58	1.283*	243.820
Straight with Down Grade	3057	9.16	59671	8.46	1.083*	233.979
E Curve Left and Down G...	794	2.38	11849	1.68	1.416*	233.427
E Curve Right and Down ...	661	1.98	11271	1.60	1.240*	127.772
E Curve Left and Up Grade	426	1.28	6930	0.98	1.299*	98.143
E Curve Right and Up Gra...	416	1.25	7833	1.11	1.123	45.423
Straight at Hillcrest	232	0.70	4515	0.64	1.086	18.396
E Curve Left at Hillcrest	49	0.15	659	0.09	1.572*	17.823
E Curve Right at Hillcrest	37	0.11	570	0.08	1.372	10.033
E Sag (Bottom)	20	0.06	293	0.04	1.443	6.138
Straight with Up Grade	2247	6.73	47447	6.73	1.001	2.293
Straight and Level	23136	69.33	490585	69.55	0.997	-73.463

LD crashes are significantly over-represented on all types of curves. Left curves either level or with a downgrade are generally more of a problem than right curves with the same grades. Level and down grades are more of a problem than up-grades. The display above contains all items that had a positive Max Gain.

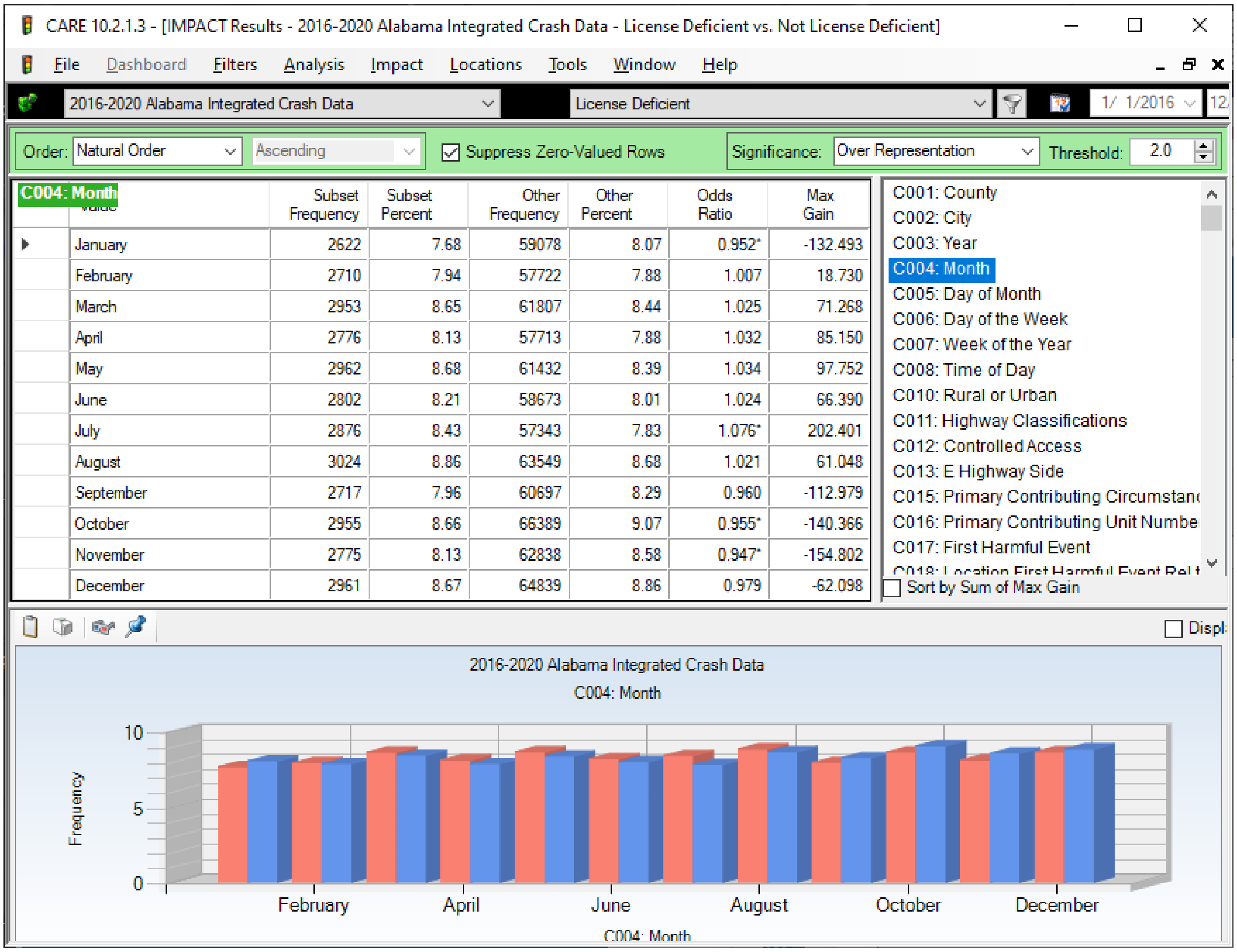
5.0 Time Factors

5.1 Year



The chart above is useful for tracking the relative changes by directly comparing the number of LD crashes to the non-LD crashes by year. All of the comparisons except 2016 were significantly different from the non-LD crashes, but the results are quite mixed. Years 2016 and 2020 had a larger proportion than the non-LD. The other three, 2017, 2018 and 2019 had smaller proportions than expected. Since the difference in 2016 was not significant, it could be reasoned that there is a possible increase over the last four years. However, the low proportion of non-LD crashes in 2020 is probably chargeable to the COVID pandemic.

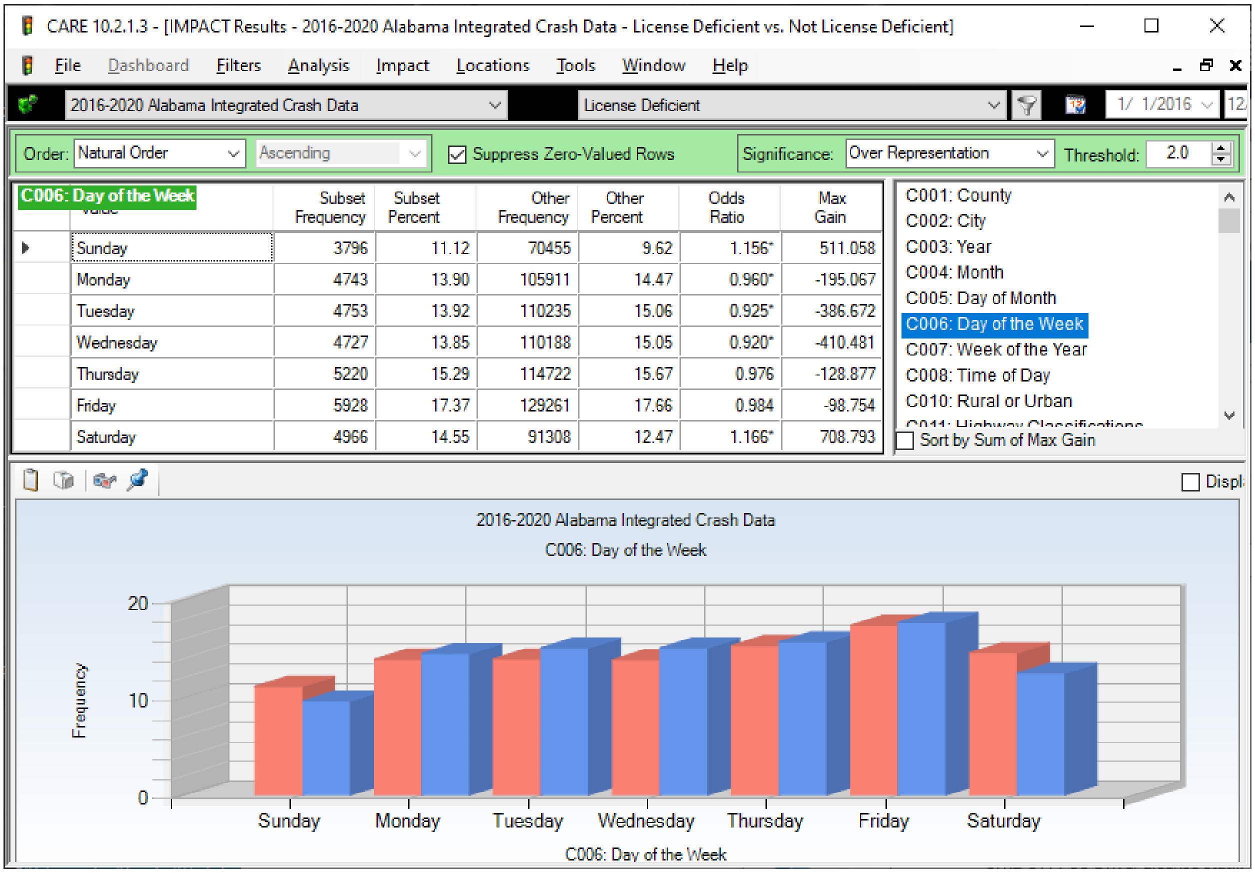
5.2 Month



Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
January	2622	7.68	59078	8.07	0.952*	-132.493
February	2710	7.94	57722	7.88	1.007	18.730
March	2953	8.65	61807	8.44	1.025	71.268
April	2776	8.13	57713	7.88	1.032	85.150
May	2962	8.68	61432	8.39	1.034	97.752
June	2802	8.21	58673	8.01	1.024	66.390
July	2876	8.43	57343	7.83	1.076*	202.401
August	3024	8.86	63549	8.68	1.021	61.048
September	2717	7.96	60697	8.29	0.960	-112.979
October	2955	8.66	66389	9.07	0.955*	-140.366
November	2775	8.13	62838	8.58	0.947*	-154.802
December	2961	8.67	64839	8.86	0.979	-62.098

The only significantly over-representrd month was July, but that was only by 2.4%. Significantly under-represented months were the winter months of October, November and January. The reason for these differences should be sought in the basic causes of LD crashes, which most often stem from speed and/or Impaired Driving.

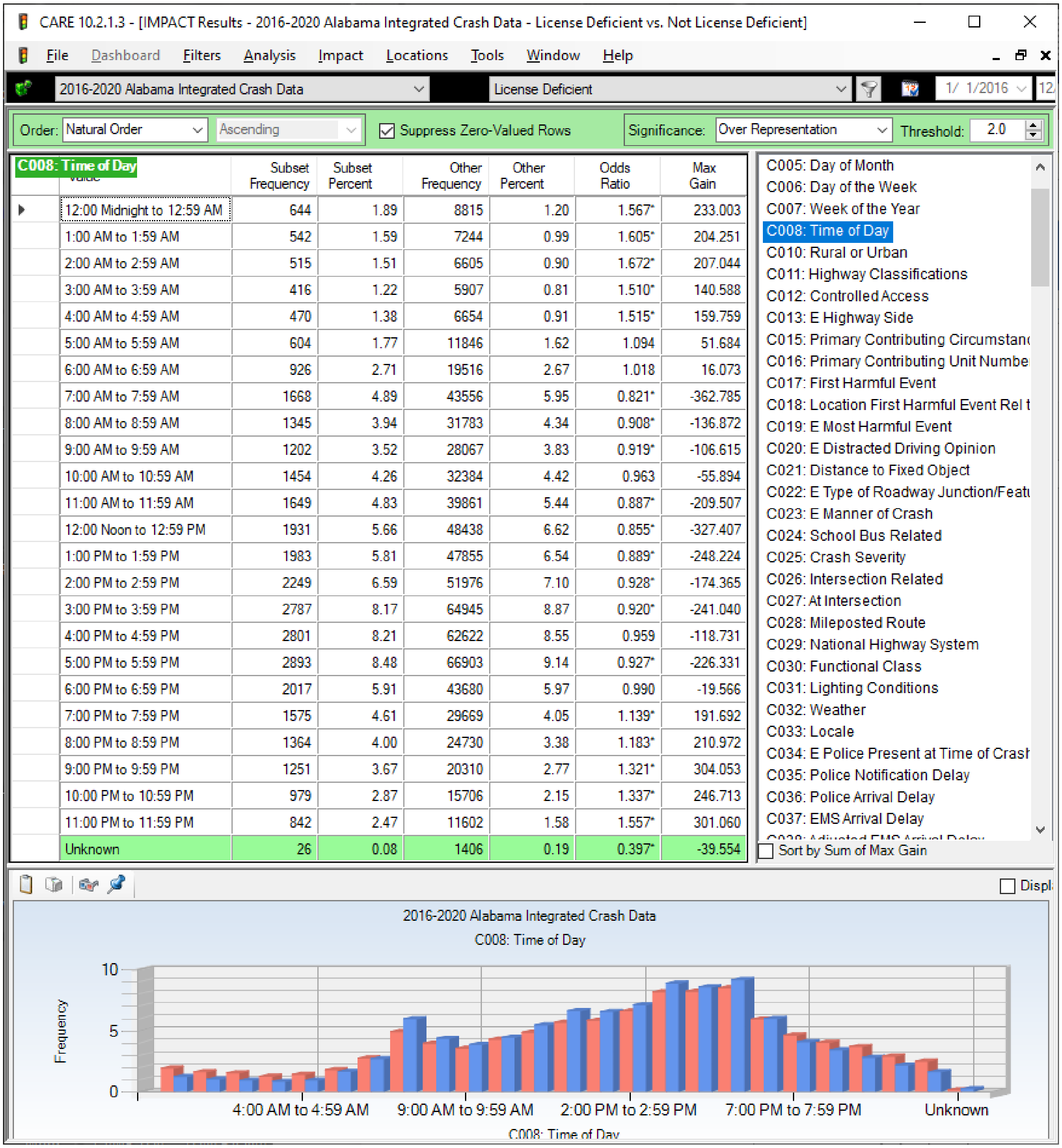
5.3 Day of the Week



C006: Day of the Week	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Sunday	3796	11.12	70455	9.62	1.156*	511.058
Monday	4743	13.90	105911	14.47	0.960*	-195.067
Tuesday	4753	13.92	110235	15.06	0.925*	-386.672
Wednesday	4727	13.85	110188	15.05	0.920*	-410.481
Thursday	5220	15.29	114722	15.67	0.976	-128.877
Friday	5928	17.37	129261	17.66	0.984	-98.754
Saturday	4966	14.55	91308	12.47	1.166*	708.793

While not as pronounced for LD as for other crash types (e.g., running off the road), the above is a well-established and recognized pattern for Impaired Driving crashes, with their concentrations on the weekend periods. This correlation will be explored further in Sections 5.4 through 5.8. It will be noticed that the weekends are not as pronounced as for ID since there are many, perhaps even a majority of LD cases that are independent of substance abuse.

5.4 Time of Day



C008: Time of Day	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
12:00 Midnight to 12:59 AM	644	1.89	8815	1.20	1.567*	233.003
1:00 AM to 1:59 AM	542	1.59	7244	0.99	1.605*	204.251
2:00 AM to 2:59 AM	515	1.51	6605	0.90	1.672*	207.044
3:00 AM to 3:59 AM	416	1.22	5907	0.81	1.510*	140.588
4:00 AM to 4:59 AM	470	1.38	6654	0.91	1.515*	159.759
5:00 AM to 5:59 AM	604	1.77	11846	1.62	1.094	51.684
6:00 AM to 6:59 AM	926	2.71	19516	2.67	1.018	16.073
7:00 AM to 7:59 AM	1668	4.89	43556	5.95	0.821*	-362.785
8:00 AM to 8:59 AM	1345	3.94	31783	4.34	0.908*	-136.872
9:00 AM to 9:59 AM	1202	3.52	28067	3.83	0.919*	-106.615
10:00 AM to 10:59 AM	1454	4.26	32384	4.42	0.963	-55.894
11:00 AM to 11:59 AM	1649	4.83	39861	5.44	0.887*	-209.507
12:00 Noon to 12:59 PM	1931	5.66	48438	6.62	0.855*	-327.407
1:00 PM to 1:59 PM	1983	5.81	47855	6.54	0.889*	-248.224
2:00 PM to 2:59 PM	2249	6.59	51976	7.10	0.928*	-174.365
3:00 PM to 3:59 PM	2787	8.17	64945	8.87	0.920*	-241.040
4:00 PM to 4:59 PM	2801	8.21	62622	8.55	0.959	-118.731
5:00 PM to 5:59 PM	2893	8.48	66903	9.14	0.927*	-226.331
6:00 PM to 6:59 PM	2017	5.91	43680	5.97	0.990	-19.566
7:00 PM to 7:59 PM	1575	4.61	29669	4.05	1.139*	191.692
8:00 PM to 8:59 PM	1364	4.00	24730	3.38	1.183*	210.972
9:00 PM to 9:59 PM	1251	3.67	20310	2.77	1.321*	304.053
10:00 PM to 10:59 PM	979	2.87	15706	2.15	1.337*	246.713
11:00 PM to 11:59 PM	842	2.47	11602	1.58	1.557*	301.060
Unknown	26	0.08	1406	0.19	0.397*	-39.554

5.5 Discussion on Time of Day

It is no surprise to find LD crashes over-represented during the late night/early morning hours, since their other correlations with aspects of Impaired Driving (ID) are clear. While not all, it is expected that the reason that a fairly large proportion of the drivers have license deficiencies has something to do with their being found guilty of ID. 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 LD crashes.

The timing of LD over-representations is very similar to that of ID. The blue bars above follow the typical traffic patterns of high traffic in the morning and afternoon rush hours. ID, and thus LD crashes, are just getting started in the afternoon rush hours and they continue to grow through midnight and the early morning hours, not tapering off until about 7:00 AM. It is clear that if selective enforcement is going to have an effect on LD crashes, it would have to be conducted at the times when these crashes are most occurring. As with ID, optimal times for Friday enforcement would start immediately following any rush hour details, and would continue through at least 3:00 AM.

The *Time of Day by Day of the Week* cross-tabulation is given in the next section for *LD crashes only*. It shows the optimal times for LD selective enforcement. Significant over-representations begin on Friday afternoons at 1:00 PM. Note that these are the highest numbers for the week, and they continue through 7:59 PM. At that point only the Saturday night numbers are higher, and the red indicates that their percentages exceed the average given in the Total column by more than 10%. The Friday night momentum continues through 4:59 AM. Friday afternoon is worst than Saturday afternoon, but Saturday takes the lead after 8 PM. That continues into Sunday morning, although the numbers are greatly diminished in the early morning hours.

There are some odd over-represented groupings. We know of no way to account for 7:00 AM through 8:59 AM on Tuesday through Thursday, except that this might be a normal part of the morning rush hours. Also notice all of the frequencies in the 400s in the afternoon rush hours (3:00 PM through 5:59 PM).

5.6 Time of Day by Day of the Week

CARE 10.2.1.3 - [Crosstab Results - 2016-2020 Alabama Integrated Crash Data - Filter = License Deficient]

File Dashboard Filters Analysis Crosstab Locations Tools Window Help

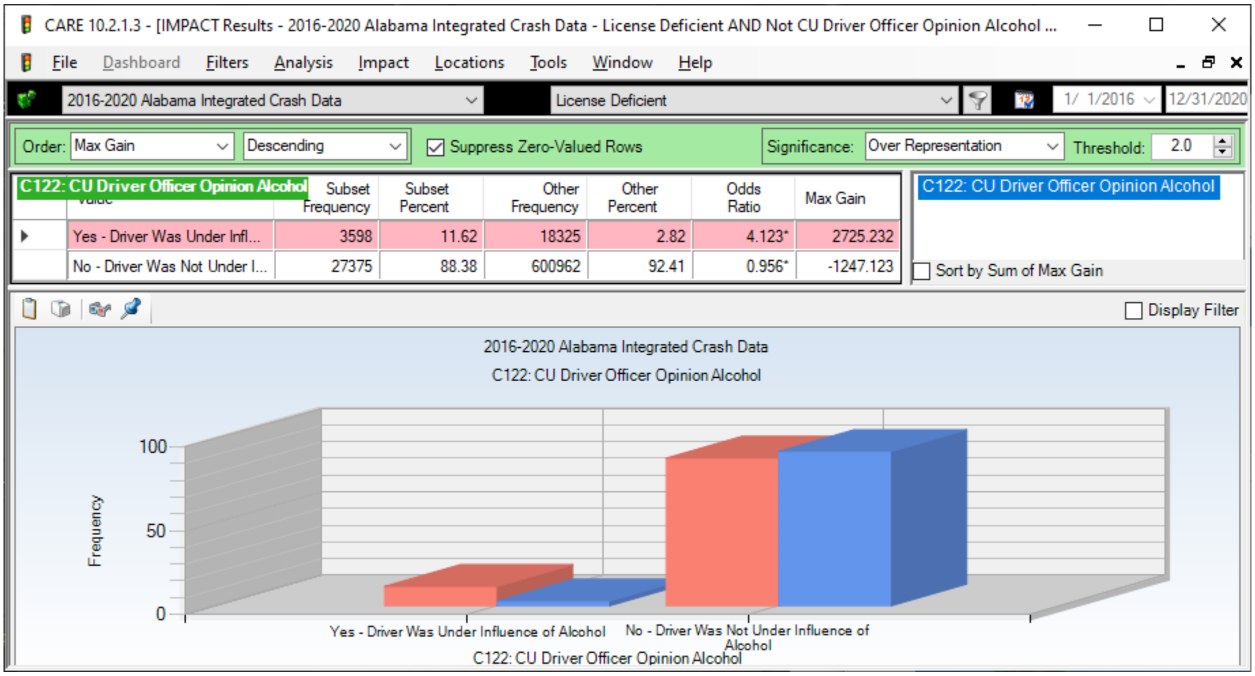
2016-2020 Alabama Integrated Crash Data | License Deficient | 1/ 1/2016 | 12/31/2020

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	159 4.19%	84 1.77%	56 1.18%	69 1.46%	68 1.30%	65 1.10%	143 2.88%	644 1.89%
1:00 AM to 1:59 AM	130 3.42%	55 1.16%	57 1.20%	52 1.10%	62 1.19%	72 1.21%	114 2.30%	542 1.59%
2:00 AM to 2:59 AM	131 3.45%	44 0.93%	38 0.80%	56 1.18%	47 0.90%	70 1.18%	129 2.60%	515 1.51%
3:00 AM to 3:59 AM	112 2.95%	44 0.93%	33 0.69%	35 0.74%	35 0.67%	47 0.79%	110 2.22%	416 1.22%
4:00 AM to 4:59 AM	87 2.29%	51 1.08%	56 1.18%	48 1.02%	57 1.09%	57 0.96%	114 2.30%	470 1.38%
5:00 AM to 5:59 AM	84 2.21%	98 2.07%	88 1.85%	78 1.65%	64 1.23%	87 1.47%	105 2.11%	604 1.77%
6:00 AM to 6:59 AM	77 2.03%	136 2.87%	147 3.09%	148 3.13%	167 3.20%	141 2.38%	110 2.22%	926 2.71%
7:00 AM to 7:59 AM	109 2.87%	263 5.55%	308 6.48%	304 6.43%	311 5.96%	259 4.37%	114 2.30%	1668 4.89%
8:00 AM to 8:59 AM	92 2.42%	213 4.49%	245 5.15%	218 4.61%	246 4.71%	210 3.54%	121 2.44%	1345 3.94%
9:00 AM to 9:59 AM	115 3.03%	180 3.80%	180 3.79%	154 3.26%	202 3.87%	198 3.34%	173 3.48%	1202 3.52%
10:00 AM to 10:59 AM	157 4.14%	191 4.03%	209 4.40%	221 4.68%	212 4.06%	234 3.95%	230 4.63%	1454 4.26%
11:00 AM to 11:59 AM	139 3.66%	245 5.17%	248 5.22%	225 4.76%	247 4.73%	277 4.67%	268 5.40%	1649 4.83%
12:00 Noon to 12:59 PM	200 5.27%	259 5.46%	266 5.60%	295 6.24%	303 5.80%	332 5.60%	276 5.56%	1931 5.66%
1:00 PM to 1:59 PM	252 6.64%	280 5.90%	258 5.43%	245 5.18%	326 6.25%	347 5.85%	275 5.54%	1983 5.81%
2:00 PM to 2:59 PM	241 6.35%	330 6.96%	321 6.75%	310 6.56%	326 6.25%	415 7.00%	306 6.16%	2249 6.59%
3:00 PM to 3:59 PM	238 6.27%	405 8.54%	412 8.67%	403 8.53%	447 8.56%	552 9.31%	330 6.65%	2787 8.17%
4:00 PM to 4:59 PM	233 6.14%	411 8.67%	412 8.67%	426 9.01%	465 8.91%	554 9.35%	300 6.04%	2801 8.21%
5:00 PM to 5:59 PM	277 7.30%	454 9.57%	462 9.72%	441 9.33%	465 8.91%	511 8.62%	283 5.70%	2893 8.48%
6:00 PM to 6:59 PM	243 6.40%	304 6.41%	260 5.47%	271 5.73%	300 5.75%	355 5.99%	284 5.72%	2017 5.91%
7:00 PM to 7:59 PM	194 5.11%	202 4.26%	195 4.10%	191 4.04%	243 4.66%	287 4.84%	263 5.30%	1575 4.61%
8:00 PM to 8:59 PM	173 4.56%	165 3.48%	168 3.53%	160 3.38%	197 3.77%	246 4.15%	255 5.13%	1364 4.00%
9:00 PM to 9:59 PM	143 3.77%	141 2.97%	138 2.90%	165 3.49%	188 3.60%	231 3.90%	245 4.93%	1251 3.67%
10:00 PM to 10:59 PM	103 2.71%	109 2.30%	109 2.29%	117 2.48%	128 2.45%	194 3.27%	219 4.41%	979 2.87%
11:00 PM to 11:59 PM	101 2.66%	76 1.60%	82 1.73%	90 1.90%	109 2.09%	186 3.14%	198 3.99%	842 2.47%
Unknown	6 0.16%	3 0.06%	5 0.11%	5 0.11%	5 0.10%	1 0.02%	1 0.02%	26 0.08%
TOTAL	3796 11.12%	4743 13.90%	4753 13.92%	4727 13.85%	5220 15.29%	5928 17.37%	4966 14.55%	34133 100.00%

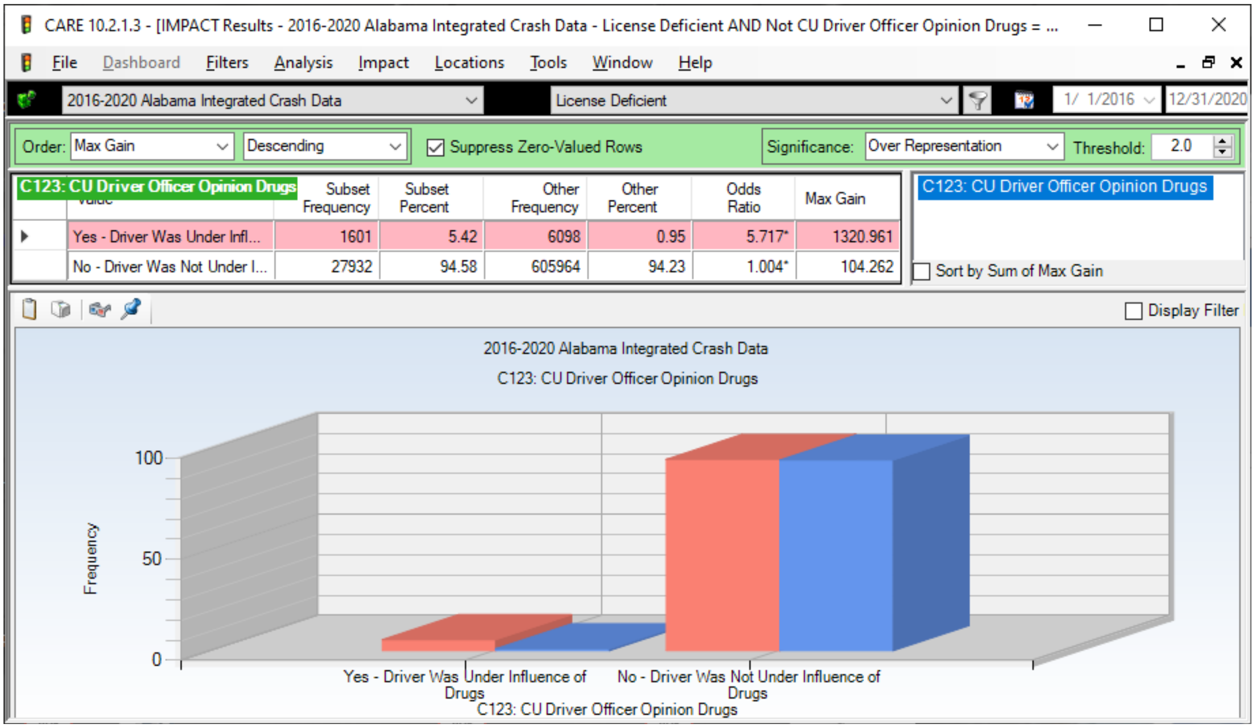
Because the discussions above on times heavily inferred the involvement of alcohol and/or drugs, the next two sections will be dedicated to the effect of impaired driving on LD crashes.

5.7 CU Driver Officer's Opinion Alcohol



While Impaired Driving/Alcohol was indicated as the cause of the crash for only 11.62% of the LD crashes, the fact that this proportion was over-represented by a factor of 4.123 (over 4 times the expected from the non-LD crashes) indicates its importance. ID/DUI tends to be under-reported, and there is no doubt that its reduction would have a major impact on reducing the number of LD crashes. This result not only tells the cause (frequency and severity) for these crashes, but it also indicates the reason that so many drivers are LD.

5.8 CU Driver Officer's Opinion Drugs

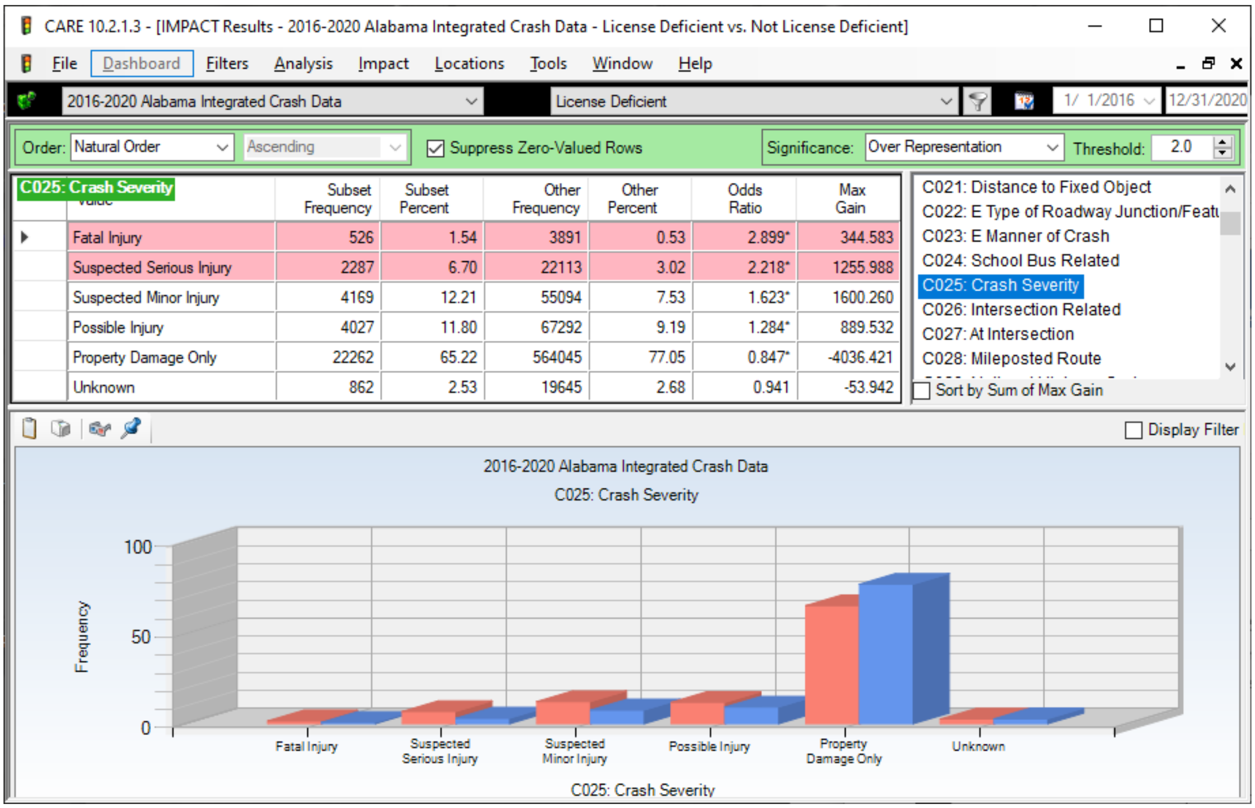


The reported non-alcohol drug cases for LD crashes is less than half of that for alcohol. The 1,601 cases are only about 5.42% of all LD crashes. However, the Odds Ratio indicates that it has an over-representation greater than alcohol. In both cases (LD and non-LD), drug use is difficult to detect compared to alcohol, which has well-established tests for the blood-alcohol level that are relatively easy to administer. Our conclusion is that both alcohol and non-alcohol drug use are major contributors to increasing the frequency of LD crashes, and the consequences of their use is amplified if they choose to avoid detection by using county roads.

6.0 Factors Affecting Severity

6.1 LD Crash Severity

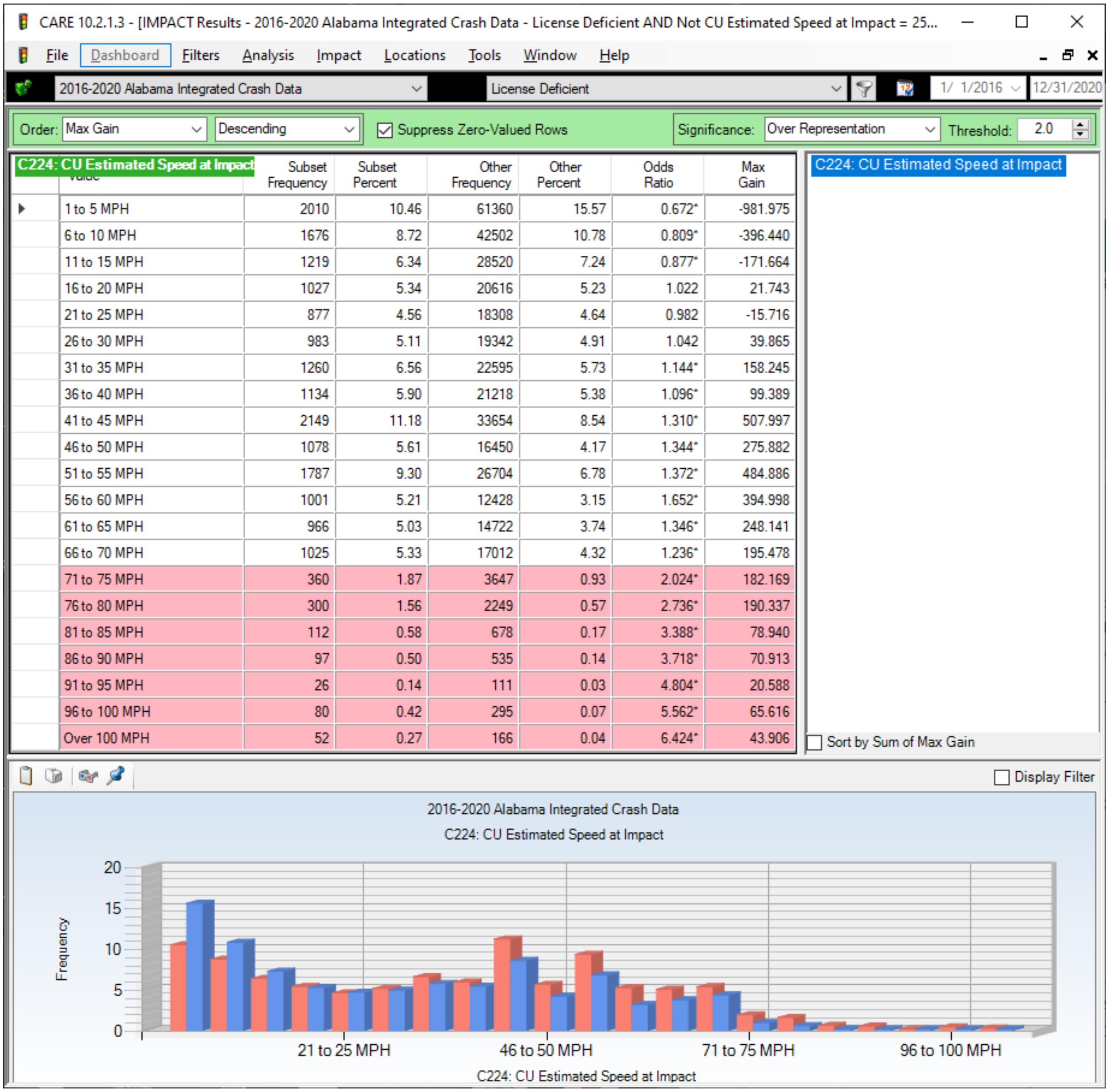
We repeat the display from Section 3.3 for severity of LD crashes, since this section will describe some of the factors that increase (and can decrease) the severity of LD crashes (or all crashes for that matter). The following compares crash severities for LD (Subset, red bars) vs. Non-LD crashes (Other, blue bars below table).



C025: Crash Severity	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Fatal Injury	526	1.54	3891	0.53	2.899*	344.583
Suspected Serious Injury	2287	6.70	22113	3.02	2.218*	1255.988
Suspected Minor Injury	4169	12.21	55094	7.53	1.623*	1600.260
Possible Injury	4027	11.80	67292	9.19	1.284*	889.532
Property Damage Only	22262	65.22	564045	77.05	0.847*	-4036.421
Unknown	862	2.53	19645	2.68	0.941	-53.942

The proportion of fatal and all of the other injury crashes are consistently higher in LD crashes than that of non-LD crashes. Fatality crashes have 2.899 times their expected proportion, while the two highest non-fatal injury classifications have 2.218 and 1.623 times their expected proportions when compared with non-LD crashes. The Speed-at-Impact variable, considered next, indicates one of the primary reasons for this high severity. However, another major factor that must be recognized as a cause of LD increased severity and death in many crashes is the lack of proper restraints (see Section 6.5).

6.2 Speed at Impact



C224: CU Estimated Speed at Impact Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1 to 5 MPH	2010	10.46	61360	15.57	0.672*	-981.975
6 to 10 MPH	1676	8.72	42502	10.78	0.809*	-396.440
11 to 15 MPH	1219	6.34	28520	7.24	0.877*	-171.664
16 to 20 MPH	1027	5.34	20616	5.23	1.022	21.743
21 to 25 MPH	877	4.56	18308	4.64	0.982	-15.716
26 to 30 MPH	983	5.11	19342	4.91	1.042	39.865
31 to 35 MPH	1260	6.56	22595	5.73	1.144*	158.245
36 to 40 MPH	1134	5.90	21218	5.38	1.096*	99.389
41 to 45 MPH	2149	11.18	33654	8.54	1.310*	507.997
46 to 50 MPH	1078	5.61	16450	4.17	1.344*	275.882
51 to 55 MPH	1787	9.30	26704	6.78	1.372*	484.886
56 to 60 MPH	1001	5.21	12428	3.15	1.652*	394.998
61 to 65 MPH	966	5.03	14722	3.74	1.346*	248.141
66 to 70 MPH	1025	5.33	17012	4.32	1.236*	195.478
71 to 75 MPH	360	1.87	3647	0.93	2.024*	182.169
76 to 80 MPH	300	1.56	2249	0.57	2.736*	190.337
81 to 85 MPH	112	0.58	678	0.17	3.388*	78.940
86 to 90 MPH	97	0.50	535	0.14	3.718*	70.913
91 to 95 MPH	26	0.14	111	0.03	4.804*	20.588
96 to 100 MPH	80	0.42	295	0.07	5.562*	65.616
Over 100 MPH	52	0.27	166	0.04	6.424*	43.906

The speed limit on County roads is generally 45 MPH, and it is generally lower on Municipal roads where a plurality of LD crashes occurs. All impact speeds above 21 MPH are significantly over-represented, and the over-representation generally increases with the increase in impact speeds. The next section quantifies how this relates to the severity of LD crashes.

6.3 Severity by Impact Speed Cross-Tabulation

2016-2020 Alabama Integrated Crash Data | License Deficient | 1/ 1/2016

Suppress Zero Values: None | 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
0 MPH	0 0.00%	0 0.00%	0 0.00%	1 0.02%	0 0.00%	0 0.00%	1 0.00%
1 to 5 MPH	5 0.95%	39 1.71%	112 2.69%	169 4.20%	1653 7.43%	32 3.71%	2010 5.89%
6 to 10 MPH	3 0.57%	60 2.62%	125 3.00%	150 3.73%	1322 5.94%	16 1.86%	1676 4.91%
11 to 15 MPH	9 1.71%	52 2.27%	97 2.33%	130 3.23%	913 4.10%	18 2.09%	1219 3.57%
16 to 20 MPH	6 1.14%	37 1.62%	92 2.21%	120 2.98%	755 3.39%	17 1.97%	1027 3.01%
21 to 25 MPH	3 0.57%	37 1.62%	90 2.16%	95 2.36%	635 2.85%	17 1.97%	877 2.57%
26 to 30 MPH	4 0.76%	40 1.75%	112 2.69%	125 3.10%	690 3.10%	12 1.39%	983 2.88%
31 to 35 MPH	4 0.76%	53 2.32%	157 3.77%	147 3.65%	874 3.93%	25 2.90%	1260 3.69%
36 to 40 MPH	13 2.47%	83 3.63%	149 3.57%	123 3.06%	745 3.35%	21 2.44%	1134 3.32%
41 to 45 MPH	21 3.99%	231 10.10%	371 8.90%	256 6.36%	1238 5.56%	32 3.71%	2149 6.30%
46 to 50 MPH	14 2.66%	116 5.07%	203 4.87%	120 2.98%	611 2.75%	14 1.62%	1078 3.16%
51 to 55 MPH	67 12.74%	262 11.46%	344 8.25%	200 4.97%	893 4.01%	21 2.44%	1787 5.24%
56 to 60 MPH	36 6.84%	163 7.13%	198 4.75%	96 2.38%	495 2.22%	13 1.51%	1001 2.93%
61 to 65 MPH	50 9.51%	189 8.27%	177 4.25%	82 2.04%	459 2.06%	9 1.04%	966 2.83%
66 to 70 MPH	46 8.75%	169 7.39%	171 4.10%	96 2.38%	536 2.41%	7 0.81%	1025 3.00%
71 to 75 MPH	23 4.37%	52 2.27%	67 1.61%	44 1.09%	172 0.77%	2 0.23%	360 1.05%
76 to 80 MPH	28 5.32%	71 3.11%	66 1.58%	21 0.52%	112 0.50%	2 0.23%	300 0.88%
81 to 85 MPH	13 2.47%	26 1.14%	23 0.55%	11 0.27%	39 0.18%	0 0.00%	112 0.33%
86 to 90 MPH	8 1.52%	25 1.09%	21 0.50%	7 0.17%	35 0.16%	1 0.12%	97 0.28%
91 to 95 MPH	6 1.14%	5 0.22%	7 0.17%	1 0.02%	6 0.03%	1 0.12%	26 0.08%
96 to 100 MPH	12 2.28%	21 0.92%	10 0.24%	5 0.12%	32 0.14%	0 0.00%	80 0.23%
Over 100 MPH	14 2.66%	7 0.31%	5 0.12%	7 0.17%	18 0.08%	1 0.12%	52 0.15%
E Stationary	5 0.95%	14 0.61%	33 0.79%	24 0.60%	164 0.74%	4 0.46%	244 0.72%
Unknown	133 25.29%	515 22.53%	1483 35.58%	1940 48.19%	9250 41.56%	536 62.18%	13857 40.61%
Not Applicable	3 0.57%	19 0.83%	55 1.32%	56 1.39%	609 2.74%	61 7.08%	803 2.35%
CU is Not a Vehicle	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%
CU is Unknown	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%
TOTAL	526 1.54%	2286 6.70%	4168 12.21%	4026 11.80%	22256 65.22%	862 2.53%	34124 100.00%

6.4 Discussion of Severity vs Impact Speed Cross-Tabulation

The display above presents data on the effect of increased impact speed on the severity of LD crashes. Notice the red in the Fatality and Serious Injury cells as speeds increase. What is more definitive is the probability that any given crash results in a fatality as a function of speed at impact. The *rule of thumb* that we might test is that "a 10 MPH increase in impact speed doubles that probability of the crash being fatal." An evaluation of the data in the cross-tabulation above is given in the following table:

Speed at Impact	Fatality Odds (1 in …)	Increase Probability above 31-35
31-35	315	1.0
36-45	95	3.3*
46-55	52	6.1*
56-65	24	13.1*
66-75	19	16.6
76-85	10	31.5*
86-95	8	39.4
Above 95	5	63.0*

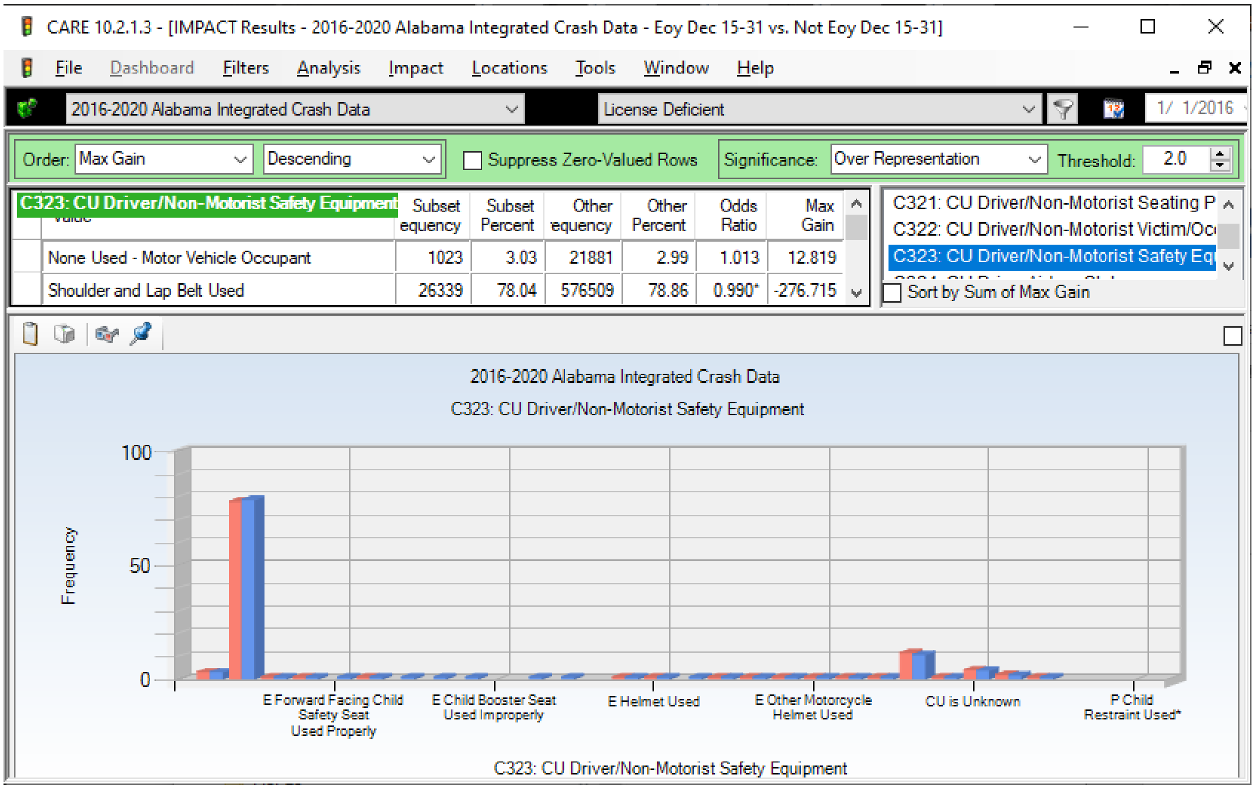
* indicates approximate doubling of probability by a 10 MPH increase in impact speed.

While the data here are not designed to perform a precise evaluation of the rule of thumb, the fact that it tends to work out in several of the increments proves the concept if not the exact precise interpretation of the rule. The data here are limited to LD crashes, which are not expected to be a random sample.

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 will be fatal. A general reduction in impact speeds by 10 MPH would cut the number of fatal crashes in half. This is the reason that selective enforcement is so effective.

6.5 Restraint Use by Drivers in LD Crashes

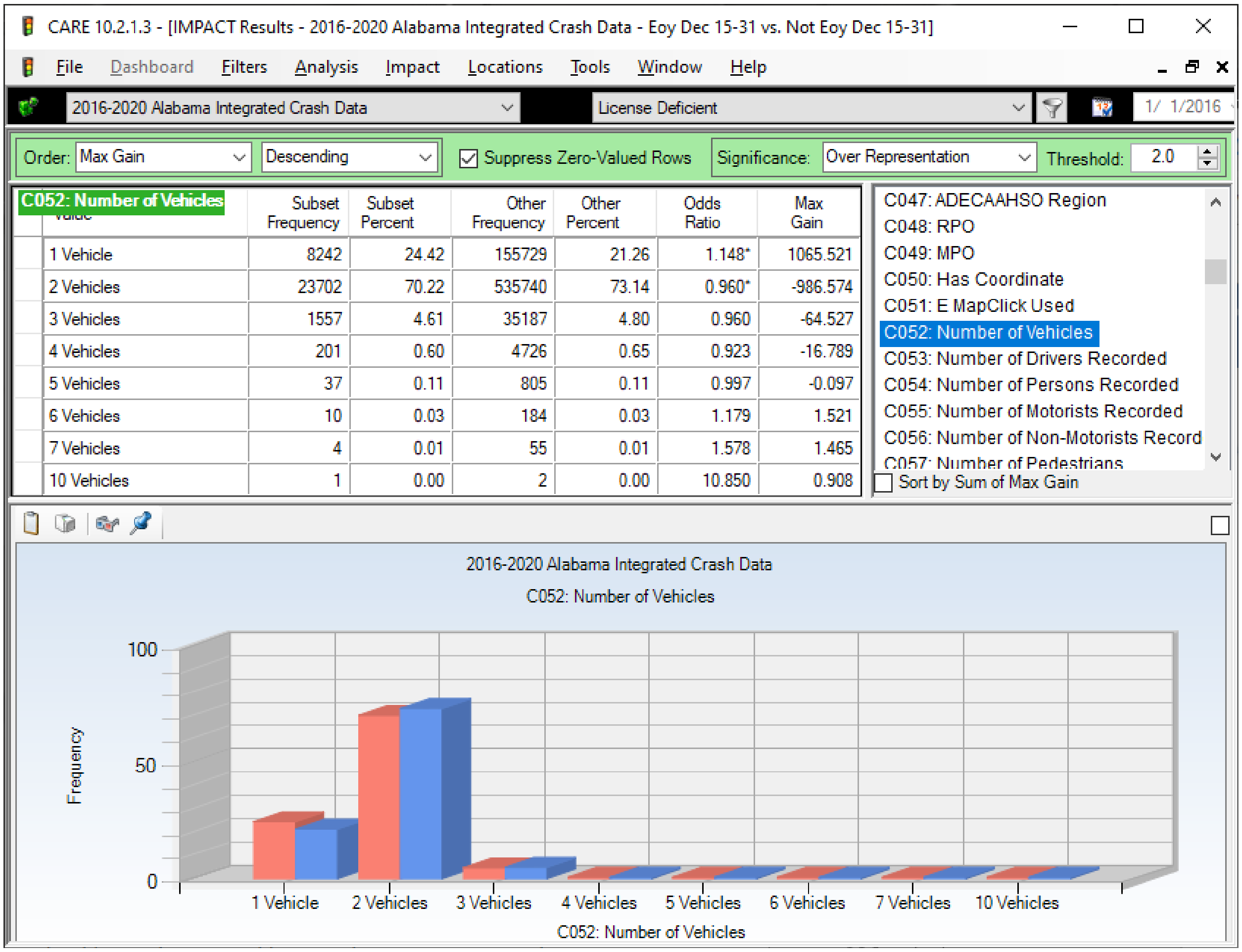
The following display presents a comparison of LD-crash driver safety belt use against those who were not LD over the same five-year time period.



This indicates that there is no practical difference between setbelt use by LD drivers as compared to their non-LD counterparts. This does not mean that all LD drivers have all of their passengers buckled up. The consequences discussed are for those who fail to use proper restraints.

6.6 Number of Vehicles Involved

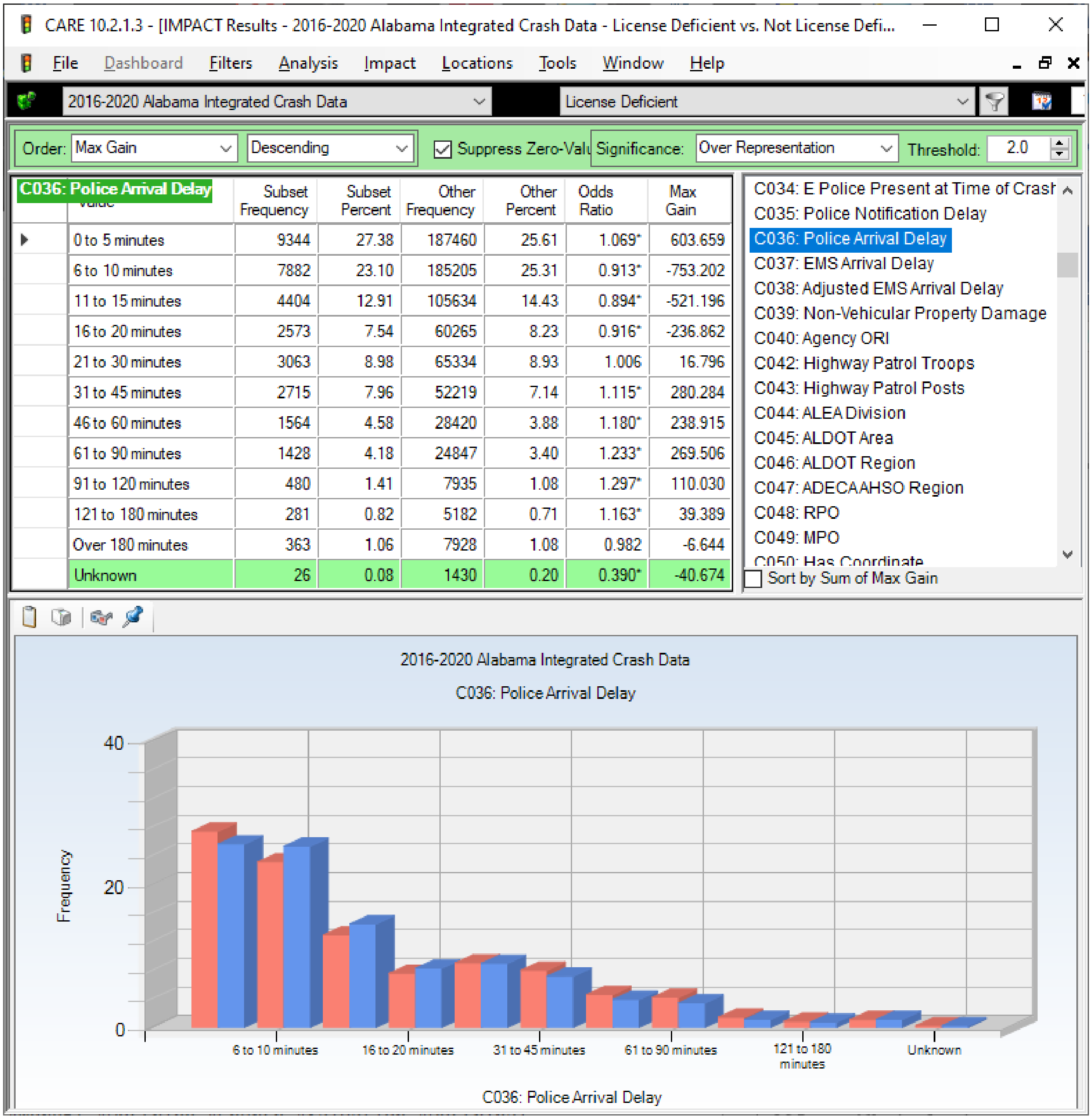
The following display presents a comparison of LD crash number of vehicles against number of vehicles in non-LD crashes over the five-year time period of the study.



C052: Number of Vehicles	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1 Vehicle	8242	24.42	155729	21.26	1.148*	1065.521
2 Vehicles	23702	70.22	535740	73.14	0.960*	-986.574
3 Vehicles	1557	4.61	35187	4.80	0.960	-64.527
4 Vehicles	201	0.60	4726	0.65	0.923	-16.789
5 Vehicles	37	0.11	805	0.11	0.997	-0.097
6 Vehicles	10	0.03	184	0.03	1.179	1.521
7 Vehicles	4	0.01	55	0.01	1.578	1.465
10 Vehicles	1	0.00	2	0.00	10.850	0.908

Most (over 70%) of the LD crashes involved two vehicles; however, this was slightly under-represented because over 73% of the non-LD crashes involved two vehicles. Single vehicle crashes, while much lower in frequency, had close to 15% (Odds Ratio = 1.148) more single vehicle crashes than were expected. None of the higher multi-vehicle items were statistically significant.

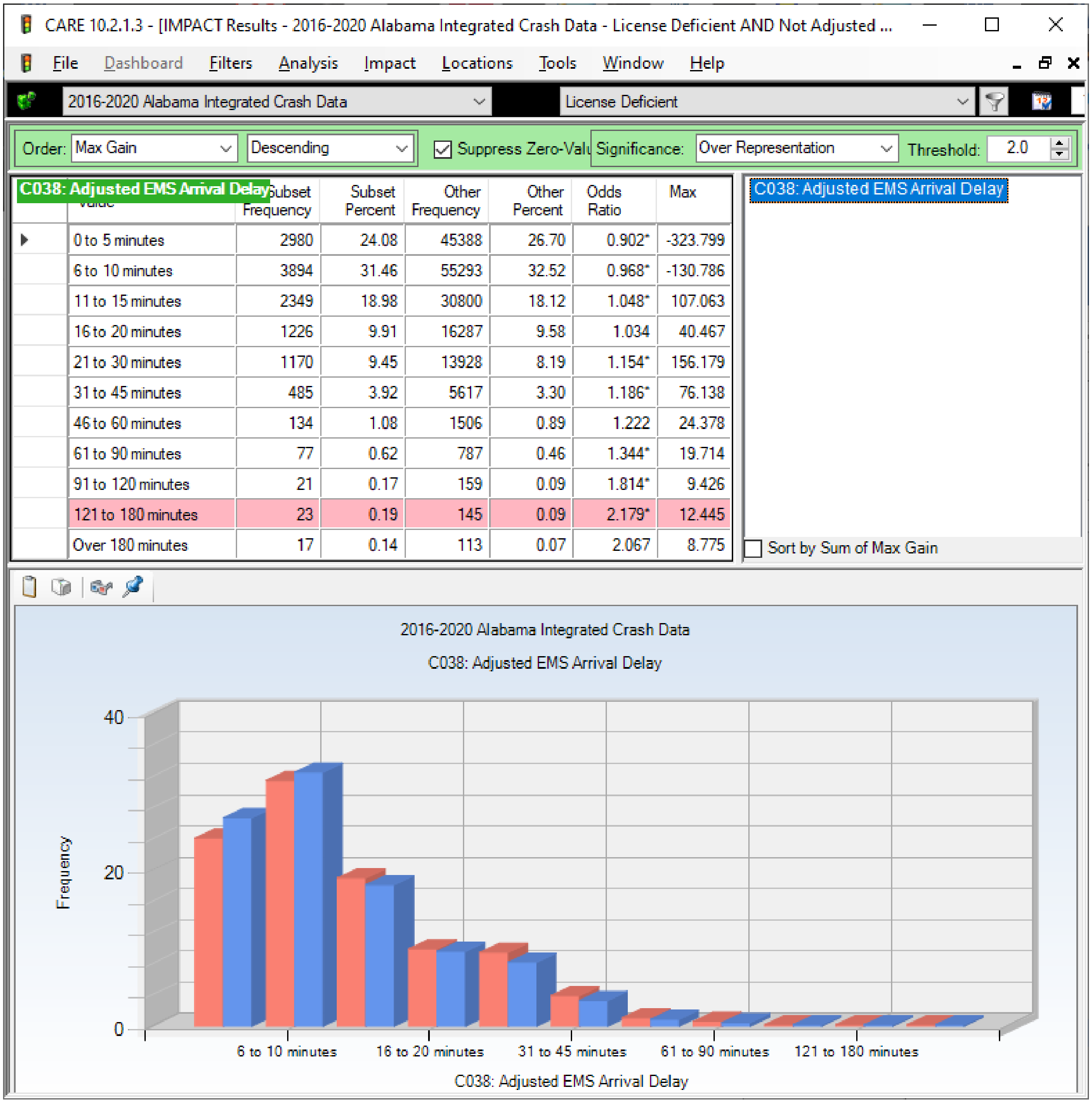
6.7 Police Arrival Delay



C036: Police Arrival Delay Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
0 to 5 minutes	9344	27.38	187460	25.61	1.069*	603.659
6 to 10 minutes	7882	23.10	185205	25.31	0.913*	-753.202
11 to 15 minutes	4404	12.91	105634	14.43	0.894*	-521.196
16 to 20 minutes	2573	7.54	60265	8.23	0.916*	-236.862
21 to 30 minutes	3063	8.98	65334	8.93	1.006	16.796
31 to 45 minutes	2715	7.96	52219	7.14	1.115*	280.284
46 to 60 minutes	1564	4.58	28420	3.88	1.180*	238.915
61 to 90 minutes	1428	4.18	24847	3.40	1.233*	269.506
91 to 120 minutes	480	1.41	7935	1.08	1.297*	110.030
121 to 180 minutes	281	0.82	5182	0.71	1.163*	39.389
Over 180 minutes	363	1.06	7928	1.08	0.982	-6.644
Unknown	26	0.08	1430	0.20	0.390*	-40.674

LD crashes police arrival delays were favorable in the 0-5 minute category, reflecting those that were of urban location. However, the over-representation in rural LD crashes was reflected in both the under-representation in 6 to 20 minute delays, and the over-representations in those longer than 20 minutes. Above 30 minutes were significantly over-represented.

6.8 EMS Arrival Delay

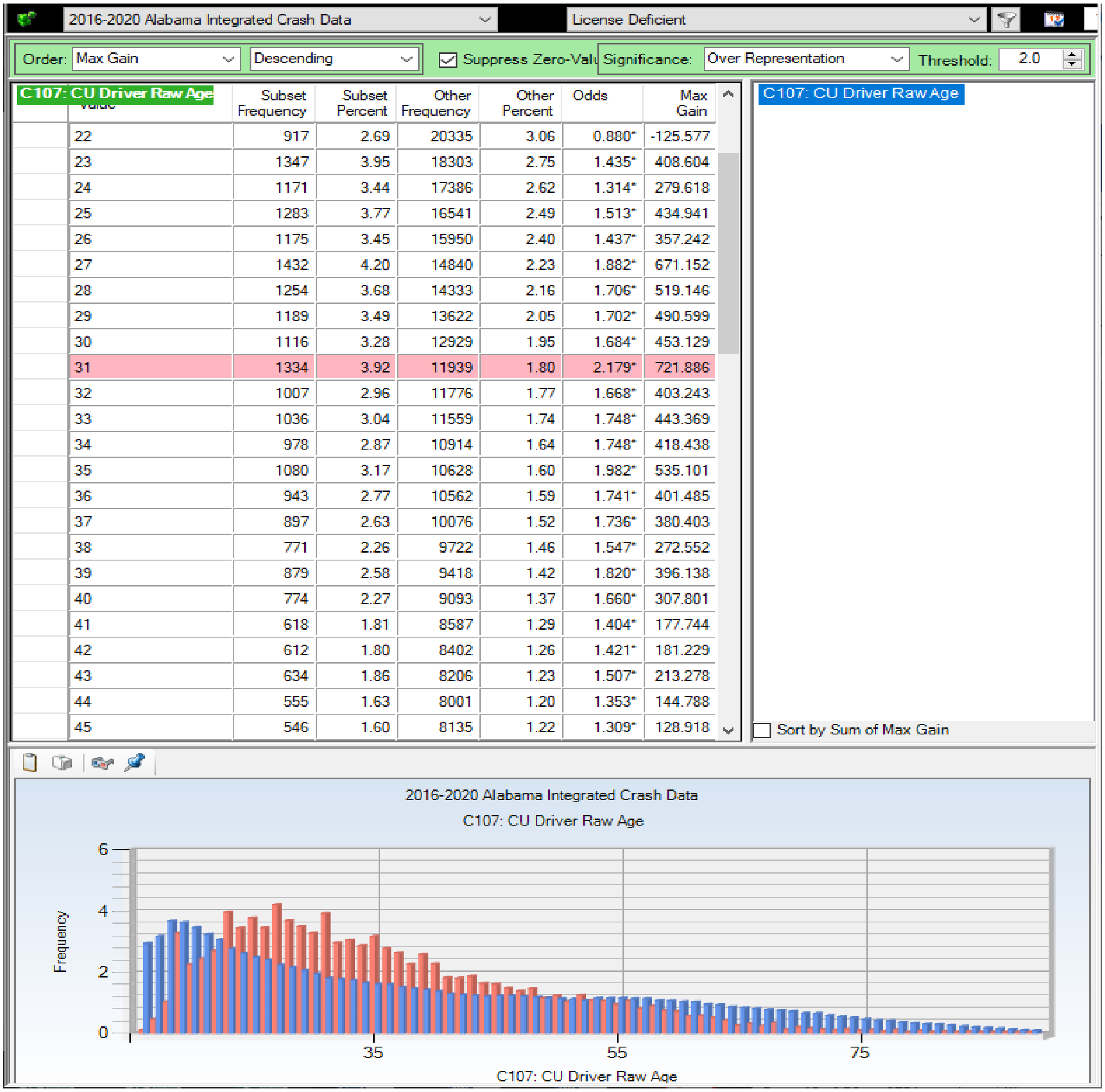


C038: Adjusted EMS Arrival Delay Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max
0 to 5 minutes	2980	24.08	45388	26.70	0.902*	-323.799
6 to 10 minutes	3894	31.46	55293	32.52	0.968*	-130.786
11 to 15 minutes	2349	18.98	30800	18.12	1.048*	107.063
16 to 20 minutes	1226	9.91	16287	9.58	1.034	40.467
21 to 30 minutes	1170	9.45	13928	8.19	1.154*	156.179
31 to 45 minutes	485	3.92	5617	3.30	1.186*	76.138
46 to 60 minutes	134	1.08	1506	0.89	1.222	24.378
61 to 90 minutes	77	0.62	787	0.46	1.344*	19.714
91 to 120 minutes	21	0.17	159	0.09	1.814*	9.426
121 to 180 minutes	23	0.19	145	0.09	2.179*	12.445
Over 180 minutes	17	0.14	113	0.07	2.067	8.775

EMS arrival delays were significantly under-represented for LD crashes in the 0-5 and 6-10 minute categories. Generally, all longer delay times were significantly over-represented. There were relatively few in these very long categories (over 90 minutes), which were probably caused by the vehicles not be discovered late night.

7.0 Driver and Vehicle Demographics

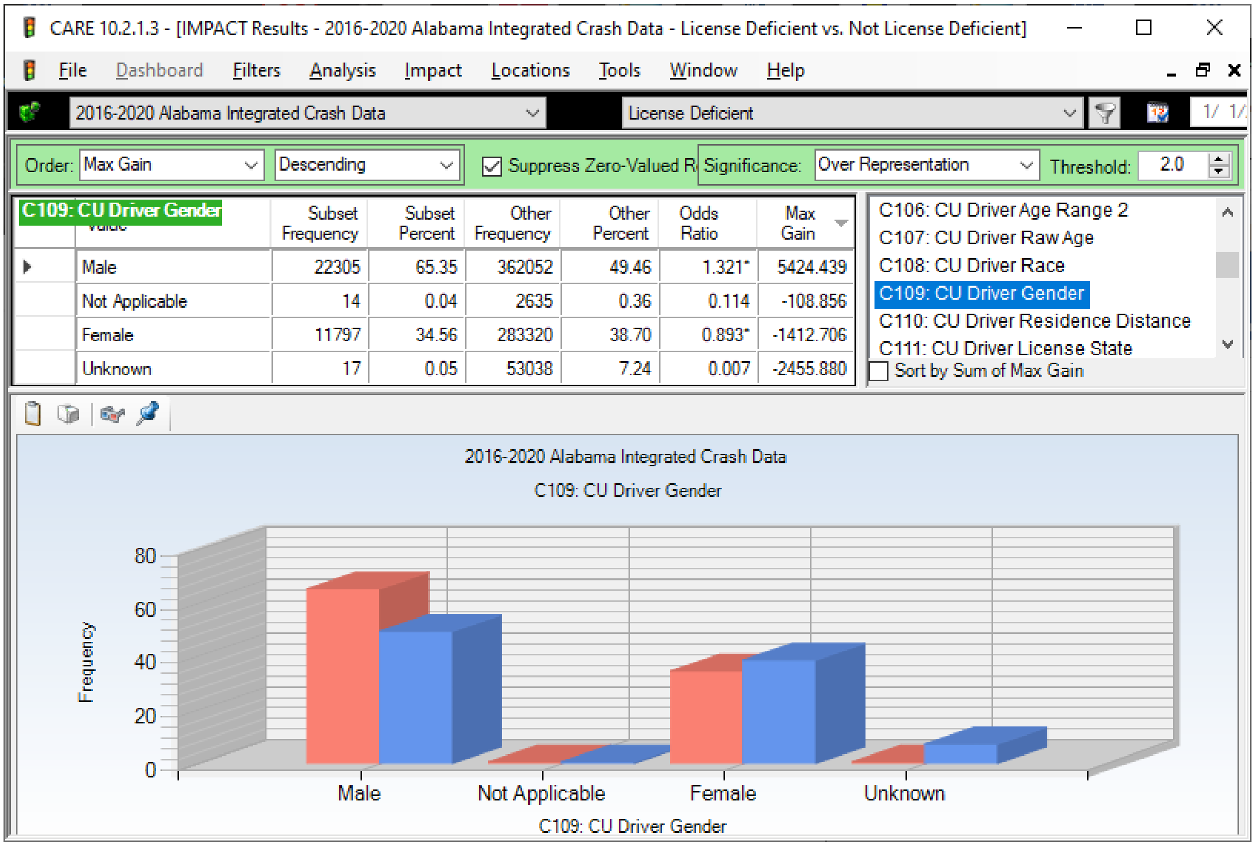
7.1 Driver Age



C107: CU Driver Raw Age Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds	Max Gain
22	917	2.69	20335	3.06	0.880*	-125.577
23	1347	3.95	18303	2.75	1.435*	408.604
24	1171	3.44	17386	2.62	1.314*	279.618
25	1283	3.77	16541	2.49	1.513*	434.941
26	1175	3.45	15950	2.40	1.437*	357.242
27	1432	4.20	14840	2.23	1.882*	671.152
28	1254	3.68	14333	2.16	1.706*	519.146
29	1189	3.49	13622	2.05	1.702*	490.599
30	1116	3.28	12929	1.95	1.684*	453.129
31	1334	3.92	11939	1.80	2.179*	721.886
32	1007	2.96	11776	1.77	1.668*	403.243
33	1036	3.04	11559	1.74	1.748*	443.369
34	978	2.87	10914	1.64	1.748*	418.438
35	1080	3.17	10628	1.60	1.982*	535.101
36	943	2.77	10562	1.59	1.741*	401.485
37	897	2.63	10076	1.52	1.736*	380.403
38	771	2.26	9722	1.46	1.547*	272.552
39	879	2.58	9418	1.42	1.820*	396.138
40	774	2.27	9093	1.37	1.660*	307.801
41	618	1.81	8587	1.29	1.404*	177.744
42	612	1.80	8402	1.26	1.421*	181.229
43	634	1.86	8206	1.23	1.507*	213.278
44	555	1.63	8001	1.20	1.353*	144.788
45	546	1.60	8135	1.22	1.309*	128.918

Things to notice in the display above: (1) 16-20 are significantly under-represented, (2) look at the contrast between 22 and 23, (3) the problem is in the 23-40 year olds, (4) it continues on to a lesser degree to age 48, (5) after that, it further diminishes with increasing age. In most cases, it takes years to accumulate the number of citations necessary for deficiencies to occur, which explains some of the under-representation in the lowest driver ages.

7.2 Driver Gender of LD Crashes



The red bars and the blue bars each sum to 100%. So the breakdown in LD causal drivers is about 65% male and 35% female. For non-LD, the percentage cannot be determined as accurately because of the large number of unknowns, but the estimate is about 50% males. These differences in proportions certainly indicate that males are a greater cause of the LD problems, and if there are countermeasures directed toward them, doing so would be much more cost-effective than that directed equally toward all drivers.

7.3 Causal Vehicle Types with 20 or more Crashes

CARE 10.2.1.3 - [IMPACT Results - 2016-2020 Alabama Integrated Crash Data - License Deficient AND Not Causal Unit (C...

File Dashboard Filters Analysis Impact Locations Tools Window Help

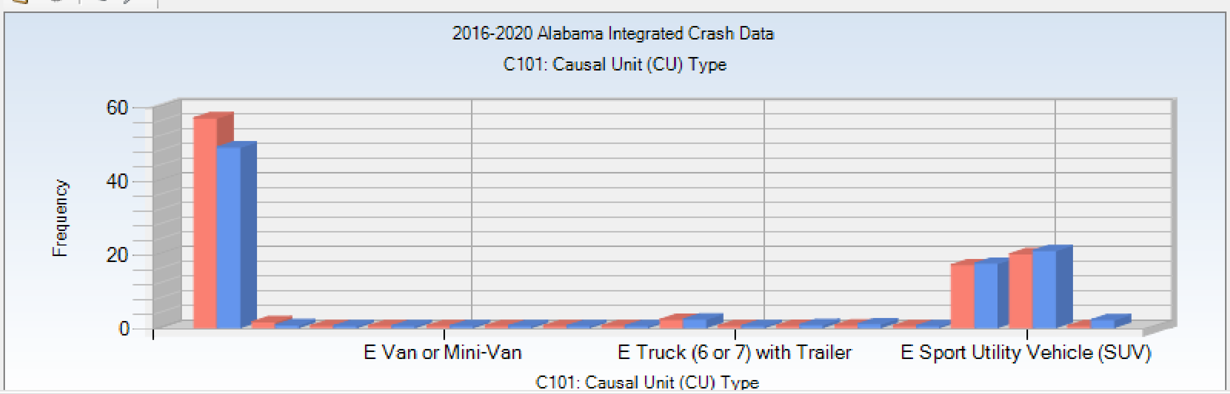
2016-2020 Alabama Integrated Crash Data | License Deficient

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

C101: Causal Unit (CU) Type Value	Subset requency	Subset Percent	Other requency	Other Percent	Odds Ratio	Max
Passenger Car	19408	56.99	353211	49.04	1.162*	2706.567
Motorcycle	514	1.51	4928	0.68	2.206*	280.982
E 4-Wheel Off Road ATV	61	0.18	520	0.07	2.481*	36.412
Station Wagon	96	0.28	1804	0.25	1.125	10.699
E Van or Mini-Van	28	0.08	715	0.10	0.828	-5.808
E Other Heavy Truck (Cannot Classify)	24	0.07	665	0.09	0.763	-7.444
E Passenger Van	101	0.30	2360	0.33	0.905	-10.592
E Other Passenger Vehicle	21	0.06	966	0.13	0.460*	-24.677
E Mini-van	716	2.10	15874	2.20	0.954	-34.595
E Truck (6 or 7) with Trailer	37	0.11	2060	0.29	0.380*	-60.406
E Cargo Van (10000 lbs or Less)	176	0.52	5405	0.75	0.689*	-79.573
E Single-Unit Truck (2-Axle/6-Tire)	207	0.61	6920	0.96	0.633*	-120.209
E Single-Unit Truck (3 Axles or Less)	22	0.06	3016	0.42	0.154*	-120.610
Pick-Up (Four-Tire Light Truck)	5787	16.99	125352	17.40	0.976	-140.216
E Sport Utility Vehicle (SUV)	6792	19.94	150213	20.86	0.956*	-310.758
E Tractor/Semi-Trailer	67	0.20	14747	2.05	0.096*	-630.306

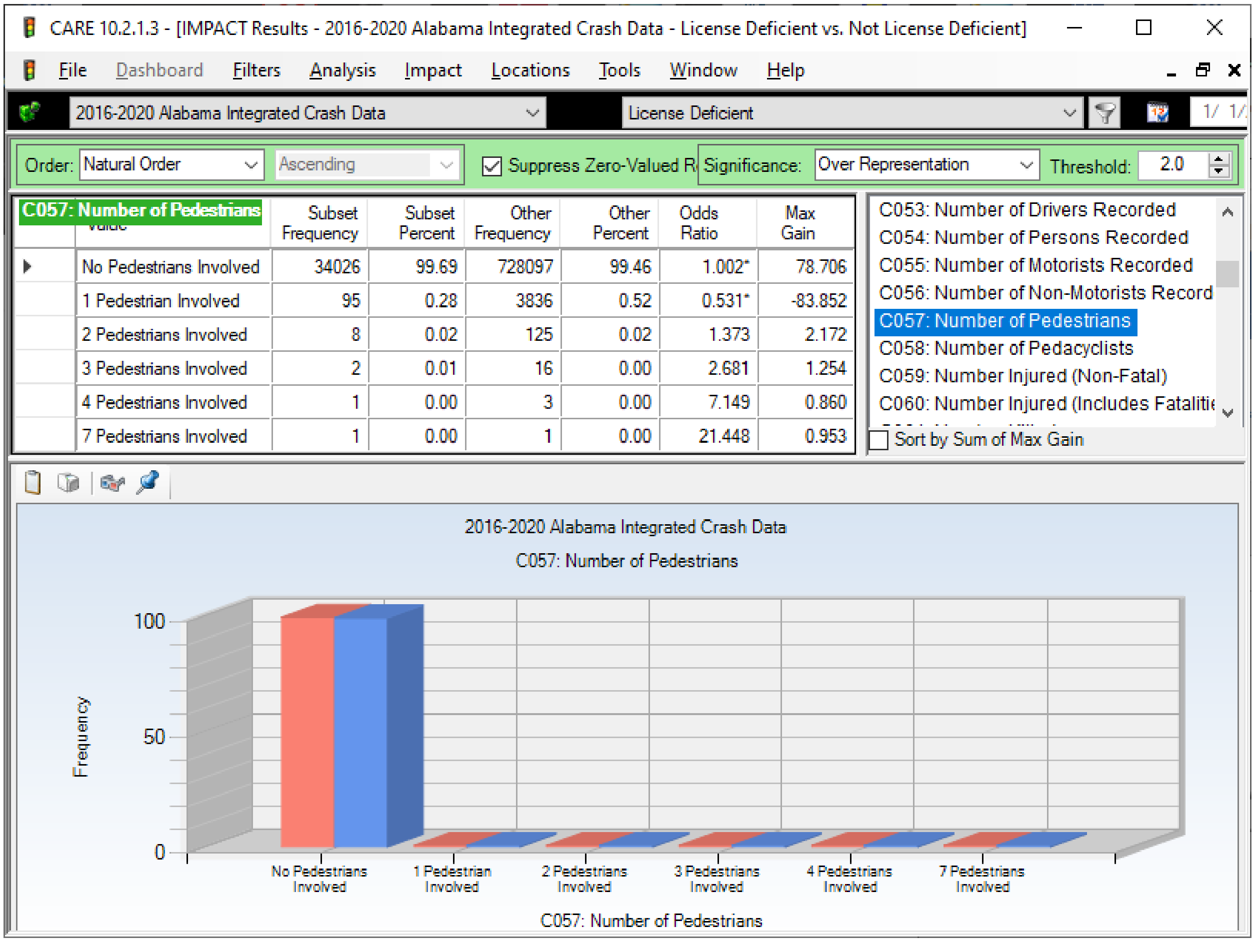
C101: Causal Unit (CU) Type

☐ Sort by Sum of Max Gain



The display above presents a comparison of LD crash causal unit type against the same for crashes that were non-LD. Vehicles types with less than 20 crashes in the LD dataset were removed for the above display. Passenger Cars have the highest for potential crash reduction according to the Max Gain. However, Motorcycles have a much higher over-representation (2.206), indicating well over twice the expected proportion. Some vehicles, notably Tractor/Semi-Trailers, Mini-vans, Pick-Ups and Sport Utility Vehicles (SUVs) were under-represented indicating their tendency to avoid being LD.

7.4 Number of Pedestrians

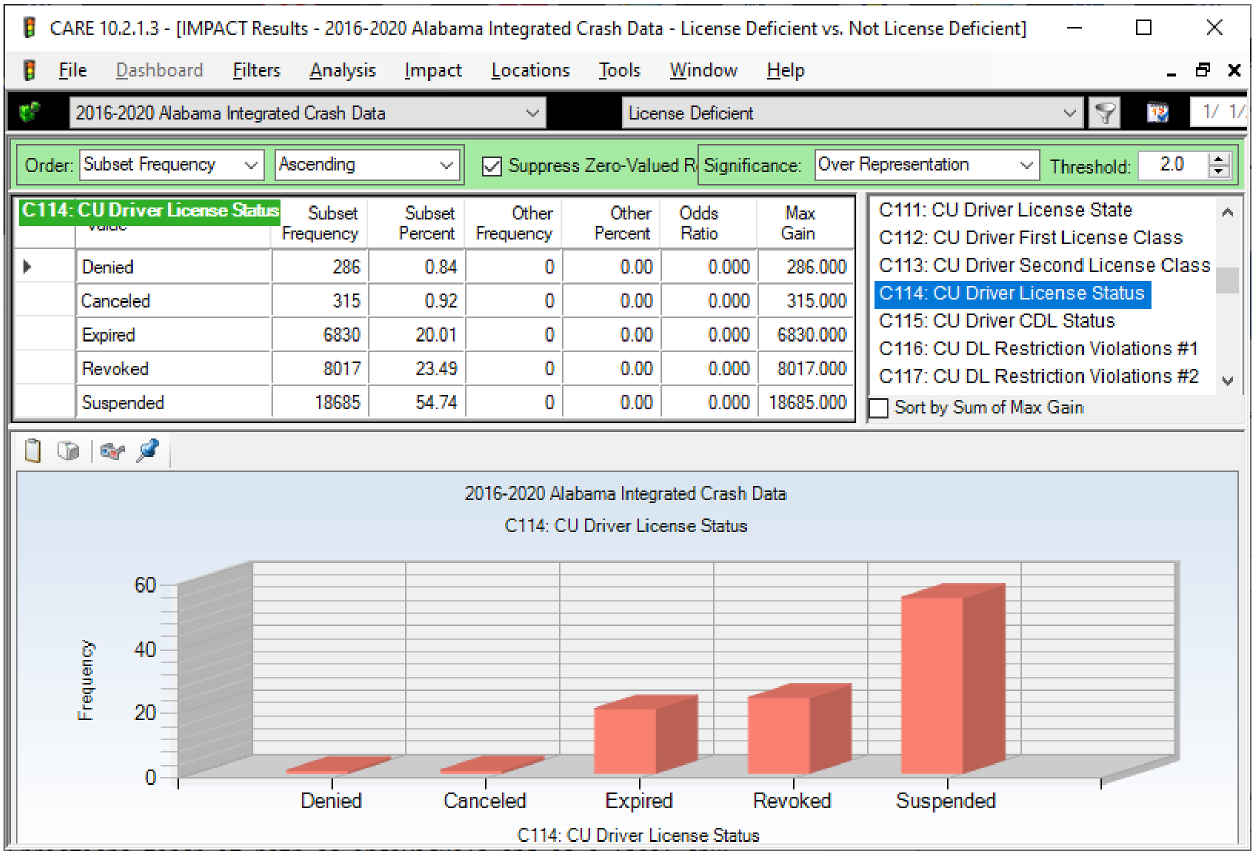


C057: Number of Pedestrians	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
No Pedestrians Involved	34026	99.69	728097	99.46	1.002*	78.706
1 Pedestrian Involved	95	0.28	3836	0.52	0.531*	-83.852
2 Pedestrians Involved	8	0.02	125	0.02	1.373	2.172
3 Pedestrians Involved	2	0.01	16	0.00	2.681	1.254
4 Pedestrians Involved	1	0.00	3	0.00	7.149	0.860
7 Pedestrians Involved	1	0.00	1	0.00	21.448	0.953

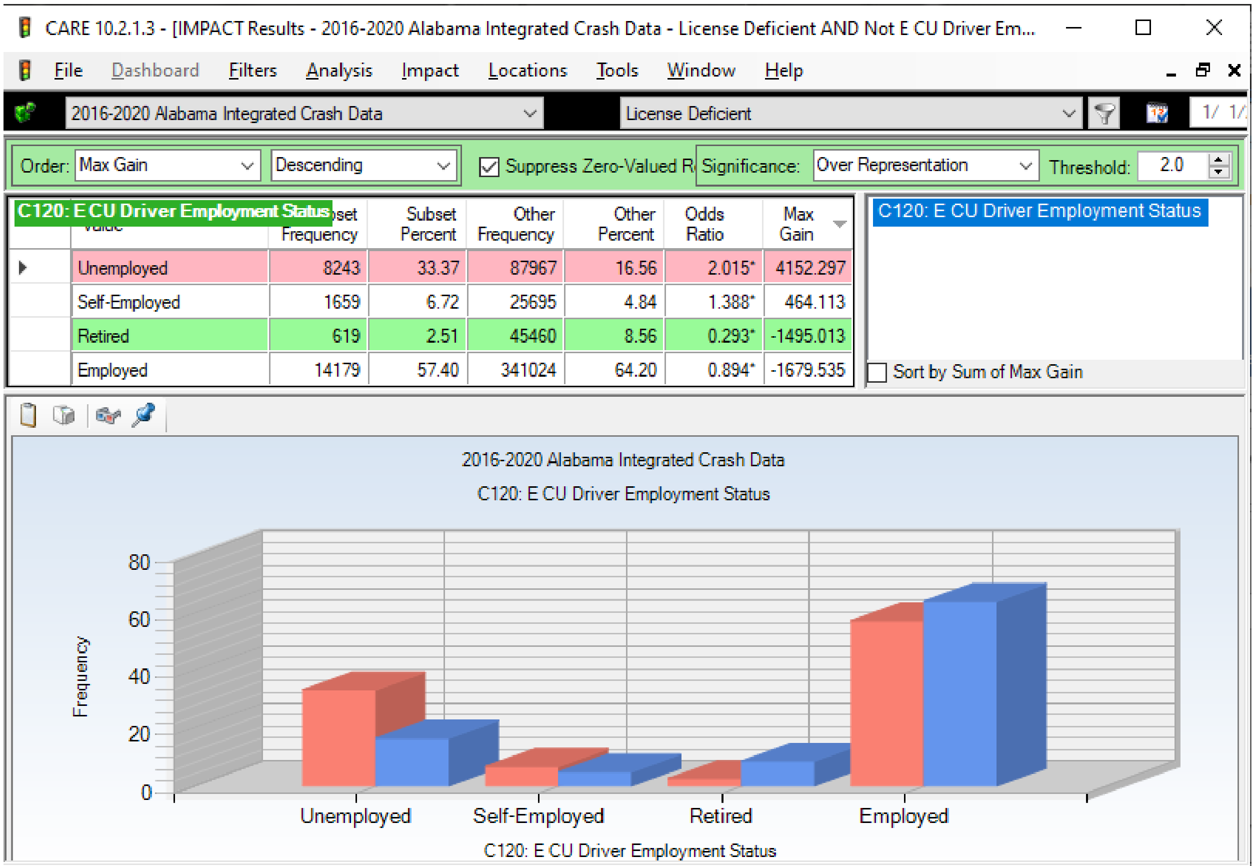
Pedestrians are generally under-represented in LD crashes. This positive finding may be useful in developing pedestrian countermeasures, but it is probably caused more by the proportion of rural LD crashes than anything else.

7.5 Driver License Status

This is a review of Sections 3.1.1 and 3.1.2, which we include here for completeness and reference.



7.6 Driver Employment Status



In our current era when the economy is playing such a big role in traffic safety, the quantification and tracking of the employment proportion of drivers involved in LD crashes is important. The display above indicates that their unemployment rate of about 33.37%, and it has a proportion that is over twice that expected in comparison to non-LD drivers involved in crashes. This relationship is not surprising since drugs and alcohol are involved in many LD crashes (8.3-8.4). The correlation between not having a job and being involved in an LD crash should be watched carefully going forward in that it could affect the type and location for countermeasures. For example, sanctions could be imposed to motivate the unemployed to seek employment.

8.0 Driver Behaviors and Citations

8.1 Primary Contributing Circumstances (Items < 300 Crashes Removed)

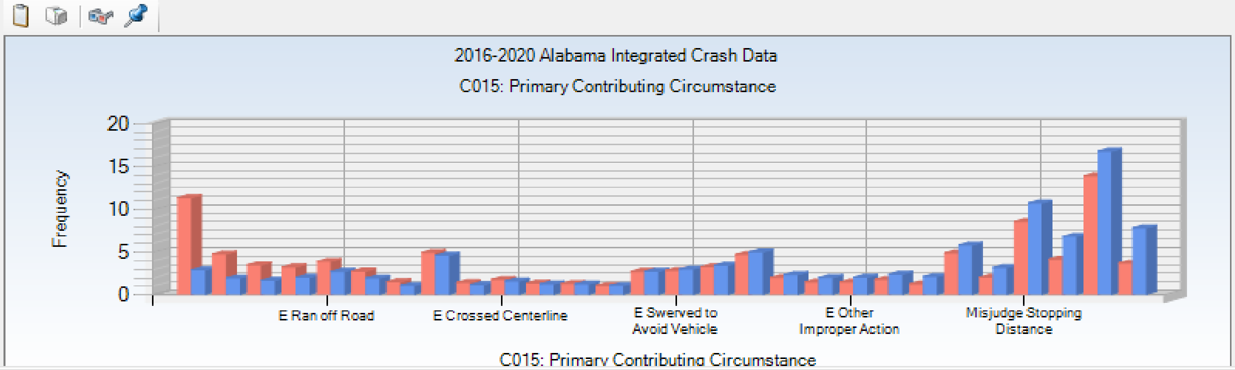
2016-2020 Alabama Integrated Crash Data | License Deficient

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

C015: Primary Contributing Circumstance Value	Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
DUI	3383	11.28	17194	2.83	3.983*	2533.646
E Aggressive Operation	1414	4.71	11619	1.91	2.464*	840.042
Over Speed Limit	1027	3.42	9912	1.63	2.097*	537.364
E Fatigued/Asleep	952	3.17	12058	1.99	1.598*	356.356
E Ran off Road	1149	3.83	16133	2.66	1.442*	352.058
Defective Equipment	809	2.70	11469	1.89	1.428*	242.451
E Distracted by Use of ...	443	1.48	6269	1.03	1.431*	133.322
Driving too Fast for Co...	1466	4.89	27674	4.56	1.072*	98.952
E Ran Stop Sign	412	1.37	6886	1.13	1.211*	71.844
E Crossed Centerline	521	1.74	9433	1.55	1.118*	55.026
E Swerved to Avoid An...	394	1.31	7402	1.22	1.078	28.354
E Over Correcting/Ove...	373	1.24	7369	1.21	1.025	8.984
Improper Passing	307	1.02	6263	1.03	0.992	-2.381
E Other Distraction Insi...	796	2.65	16205	2.67	0.994	-4.499
E Swerved to Avoid Ve...	830	2.77	17798	2.93	0.944	-49.190
E Ran Traffic Signal	953	3.18	20516	3.38	0.940	-60.455
E Failed to Yield Right-...	1392	4.64	30034	4.95	0.938*	-91.628
E Failed to Yield Right-...	583	1.94	13954	2.30	0.846*	-106.303
E Failed to Yield Right-...	434	1.45	11893	1.96	0.739*	-153.494
E Other Improper Action	431	1.44	12114	1.99	0.720*	-167.411
Made Improper Turn	520	1.73	14267	2.35	0.738*	-184.765
E Other Distraction Out...	361	1.20	12684	2.09	0.576*	-265.568
E Failed to Yield Right-...	1447	4.82	34813	5.73	0.841*	-272.702
Improper Backing	595	1.98	18946	3.12	0.636*	-340.900
Misjudge Stopping Dist...	2542	8.47	64682	10.65	0.796*	-653.179
Improper Lane Change...	1231	4.10	40939	6.74	0.609*	-791.316
Followed too Close	4144	13.81	101455	16.71	0.827*	-867.701
Unseen Object/Person...	1088	3.63	47092	7.75	0.468*	-1238.263

C015: Primary Contributing Circumstance

Sort by Sum of Max Gain



8.2 Discussion of Primary Contributing Circumstances (PCC) Result Above

These results demonstrate the driver behaviors that were involved in LD crashes. The display above is for those LD crash PCCs that had 300 or more occurrences.

Items over-represented by over twice their expected proportion (when compared to non-LD crashes) are ordered by Max Gain as follows:

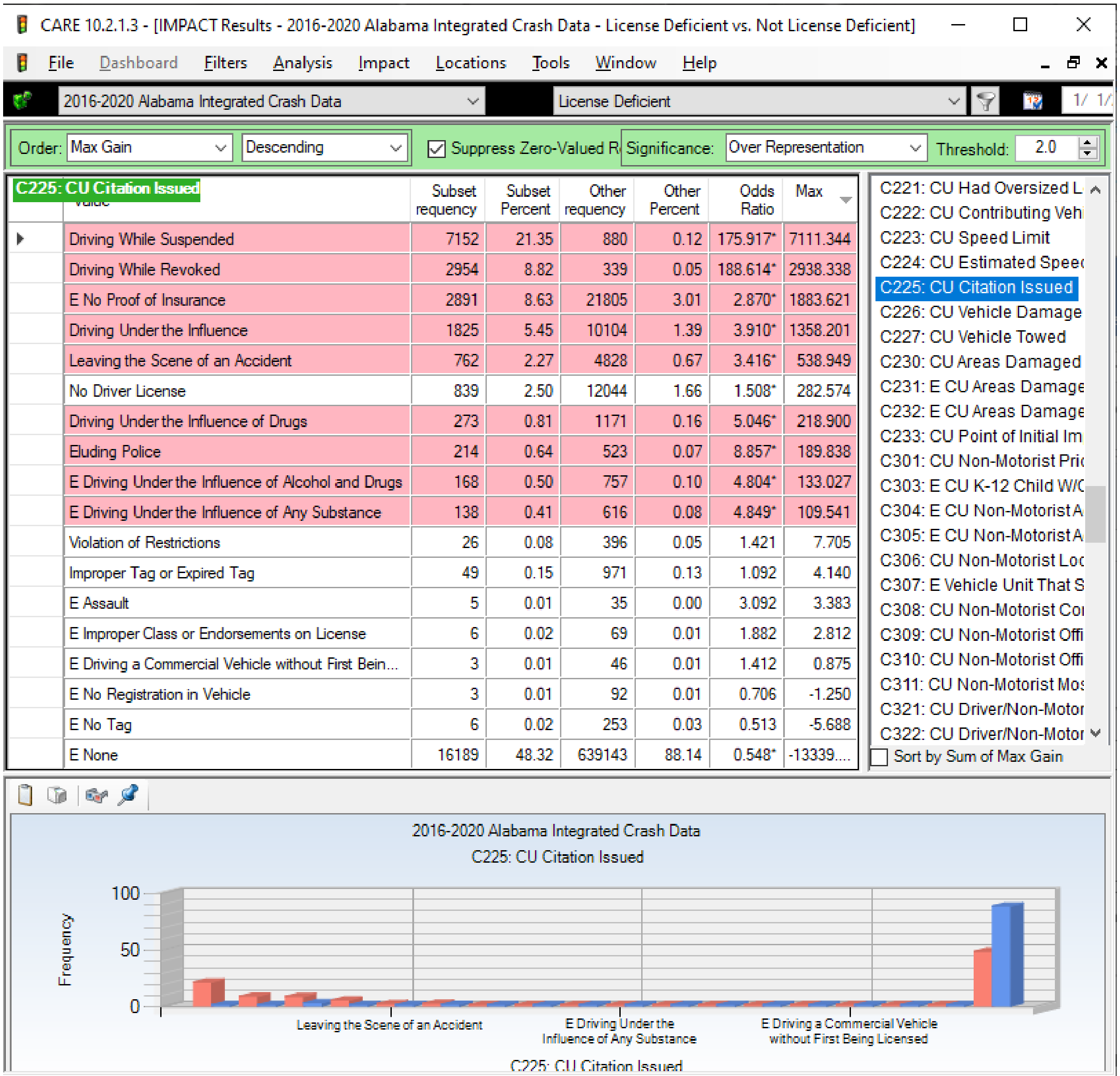
- DUI (Impaired Driving),
- Aggressive Operation, and
- Over Speed Limit,

In addition, the following significantly over-represented near the top of the list tend to support the items given above:

- Fatigued/Asleep,
- Ran off Road,
- Driving too Fast for Conditions,
- Ran Stop Sign, and
- Crossed Centerline.

Speed and Impaired Driving seem to account for a large number of LD crashes; however, the other PCC items listed show that there are not the only issues.

8.3 Citation Issued



C225: CU Citation Issued	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max
Driving While Suspended	7152	21.35	880	0.12	175.917*	7111.344
Driving While Revoked	2954	8.82	339	0.05	188.614*	2938.338
E No Proof of Insurance	2891	8.63	21805	3.01	2.870*	1883.621
Driving Under the Influence	1825	5.45	10104	1.39	3.910*	1358.201
Leaving the Scene of an Accident	762	2.27	4828	0.67	3.416*	538.949
No Driver License	839	2.50	12044	1.66	1.508*	282.574
Driving Under the Influence of Drugs	273	0.81	1171	0.16	5.046*	218.900
Eluding Police	214	0.64	523	0.07	8.857*	189.838
E Driving Under the Influence of Alcohol and Drugs	168	0.50	757	0.10	4.804*	133.027
E Driving Under the Influence of Any Substance	138	0.41	616	0.08	4.849*	109.541
Violation of Restrictions	26	0.08	396	0.05	1.421	7.705
Improper Tag or Expired Tag	49	0.15	971	0.13	1.092	4.140
E Assault	5	0.01	35	0.00	3.092	3.383
E Improper Class or Endorsements on License	6	0.02	69	0.01	1.882	2.812
E Driving a Commercial Vehicle without First Bein...	3	0.01	46	0.01	1.412	0.875
E No Registration in Vehicle	3	0.01	92	0.01	0.706	-1.250
E No Tag	6	0.02	253	0.03	0.513	-5.688
E None	16189	48.32	639143	88.14	0.548*	-13339....

The following are related to those items in the LD filter: (1) Driving While Suspended, (2) Driving While Revoked, (3) No Driver License, (4) Improper Tag or Expired Tag. The following are related to Impaired Driving (DUI): (1) Driving Under the Influence, (2) Driving Under the Influence of Drugs, (3) Driving Under the Influence of Alcohol and Drugs, and (4) Driving Under the Influence of Any Substance. The following are miscellaneous violations: (1) No Proof of Insurance, (2) Leaving the Scene of an Accident, (3) Eluding Police, and (4) Violation of Restrictions.