Restraint Use Issues Problem Identification

University of Alabama Center for Advanced Public Safety
Special Study for the 2018 Highway Safety Plan
July 2017

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1 Introduction

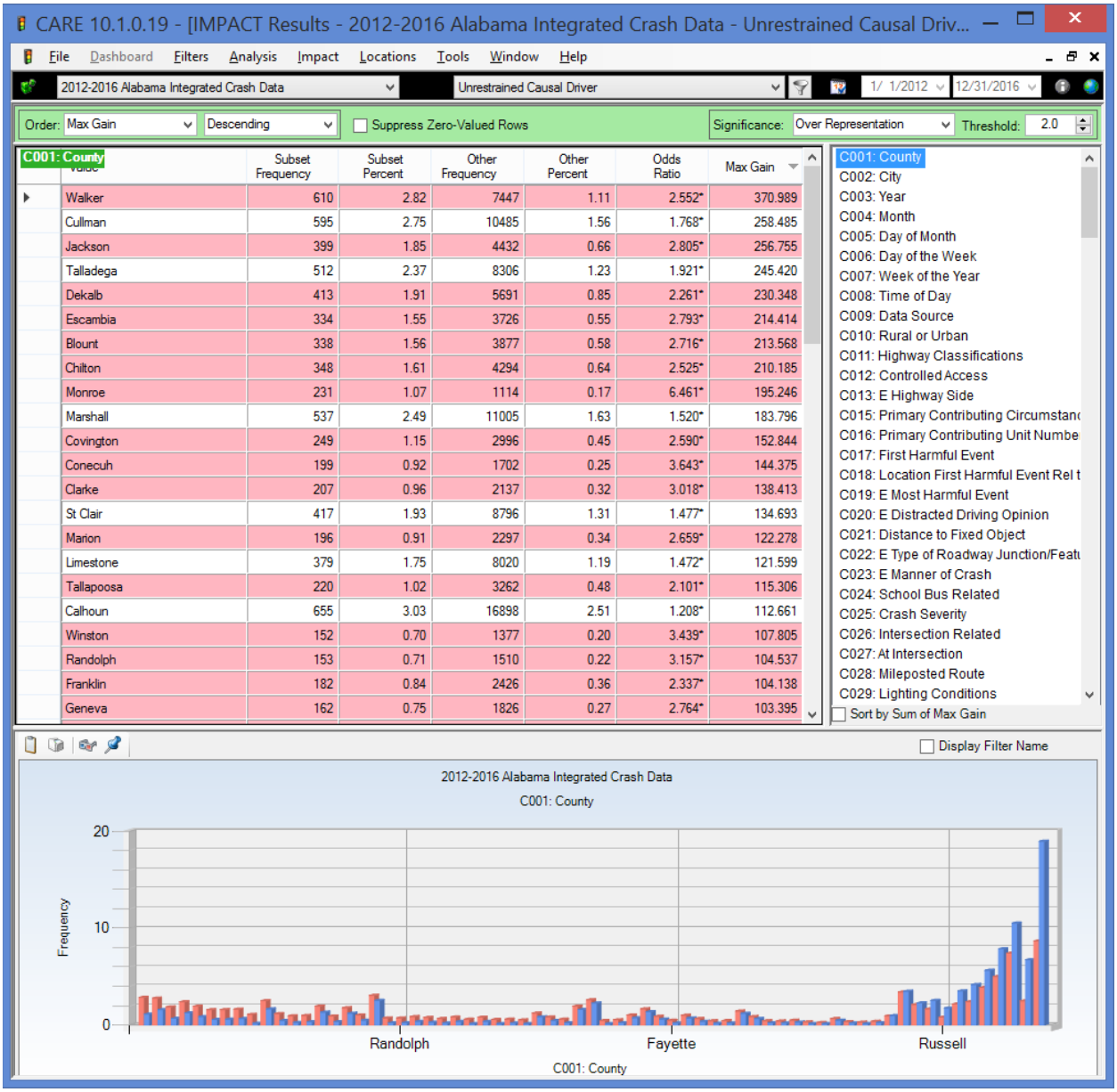
The goal of this problem identification is to assure that the restraint enforcement program considered by the state throughout FY 2018 is completely evidence-based, the evidence being derived from past data obtained from crash records.

A problem identification study was conducted based on data that were consistent with that used in the FY 2018 HSP, calendar years 2012-2016. CARE is used to display the information. The comparisons made were between those crashes in which the causal drivers were not restrained (generally represented by the red bars in the charts) and those which were reported to be restrained (generally represented by the blue bars in the charts). The use of proper restraints by causal drivers is seen to be an excellent proxy for proper restraint use by all passengers in the vehicle.

2 Geographical Factors

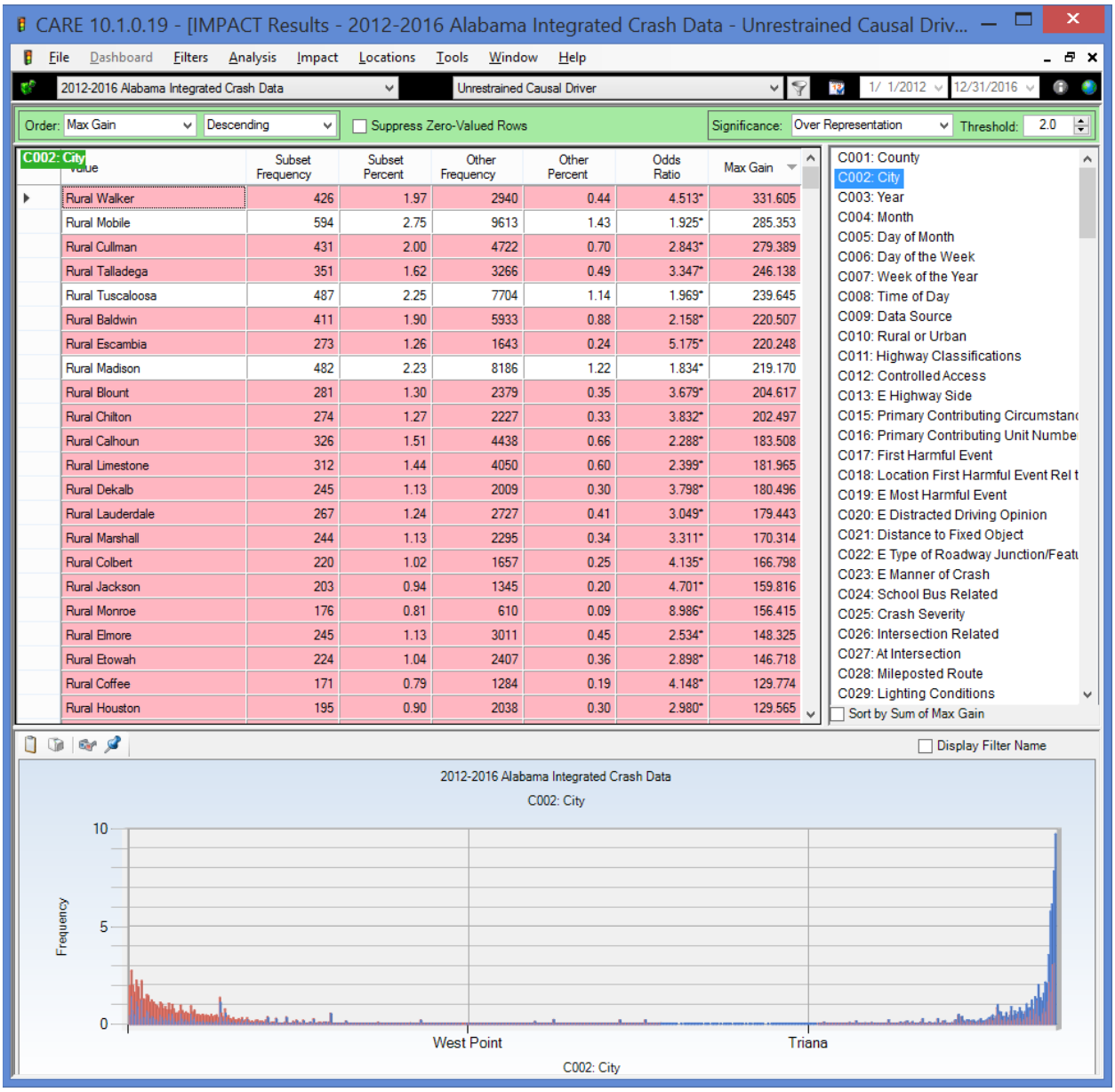
Geographical factors were analyzed in order to determine which areas are overrepresented for crashes involving drivers who did not use restraints. In order to determine these problem areas, geographical factors were analyzed in the following categories: county, city, rural versus urban, highway classification and locale.

2.1 County



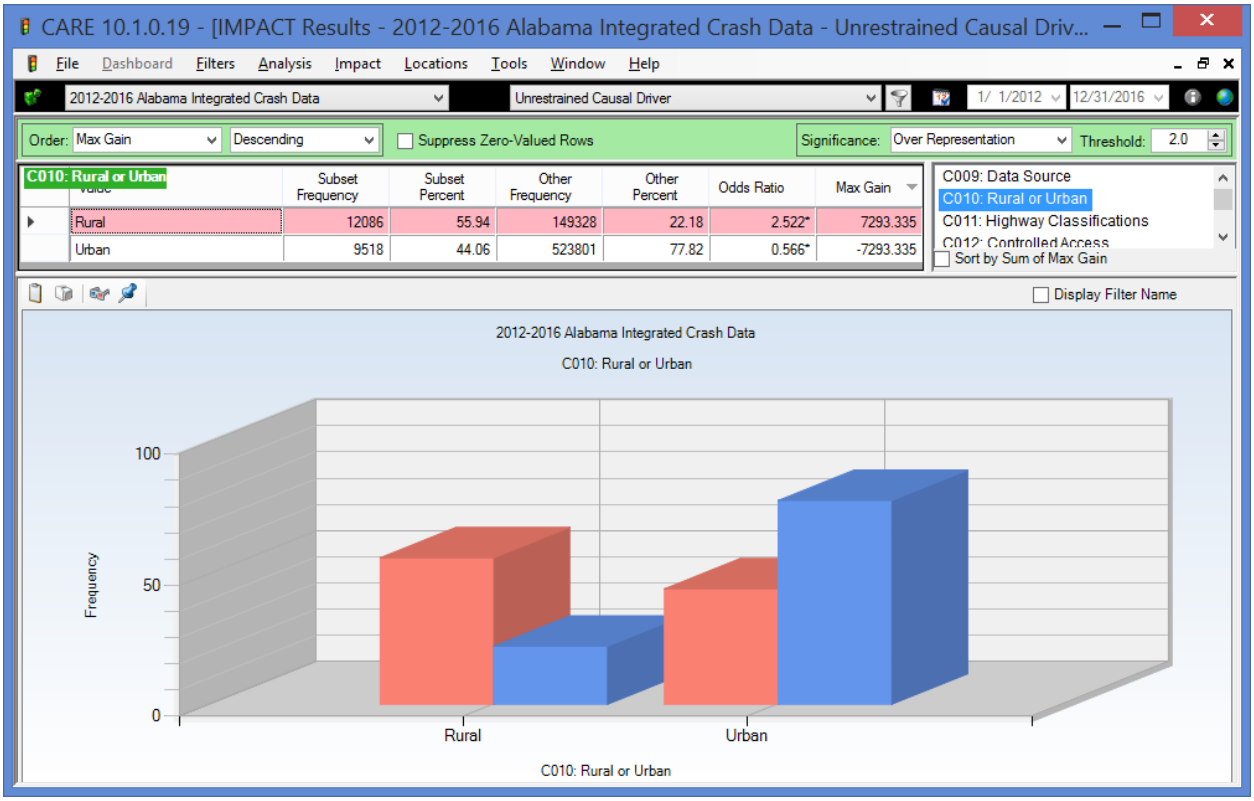
The counties with the greatest overrepresentation factors for crashes in which the driver failed to use restraints include Walker, Cullman, Jackson, Talladega, DeKalb and Escambia. The more populated urbanized counties generally showed the highest occupant restraint use.

2.2 City



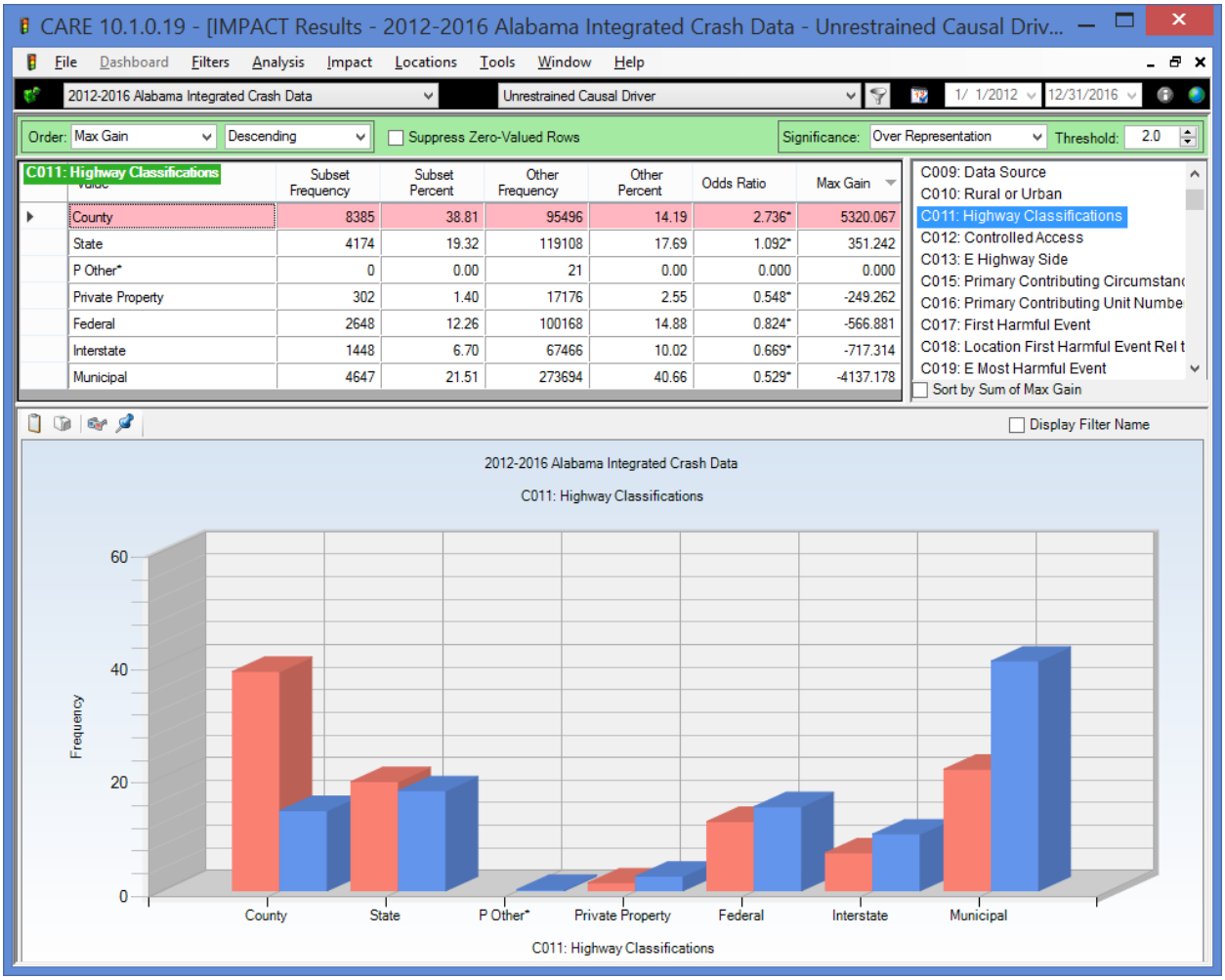
Overrepresented cities and county rural areas listed in the order of maximum gain are: rural Walker, rural Mobile, rural Cullman, and rural Talladega. Almost all of the overrepresentation occurs in the rural county areas. The most under represented cities in order of “best” first are as follows: Birmingham, Mobile, Montgomery, Huntsville and Tuscaloosa.

2.3 Rural/Urban



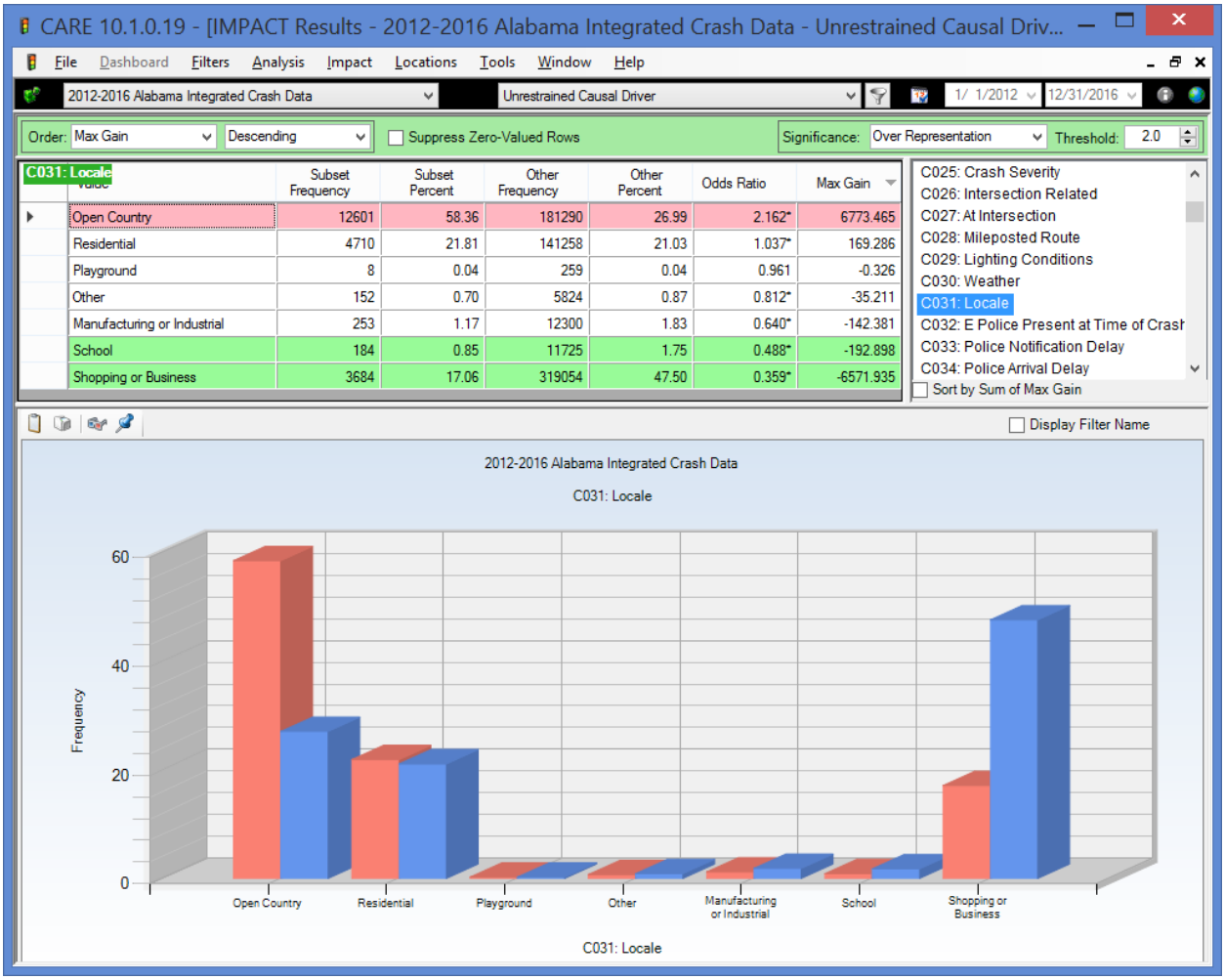
As expected from the city results above, the proportion of crashes involving drivers who use no restraints is greatly overrepresented in rural areas, being well over double what it is in the urban areas. The increased number of crashes in which restraints were used in urban areas might be attributed to greater police presence, newer vehicles, public information and education efforts, and the demographics of urban drivers in general. Speeds are generally much higher in the rural area and thus there is also a very high correlation of fatalities to rural driving.

2.4 Highway Classification



Crash incidents in which no restraints were used are greatly overrepresented on county highways with over 2.736 times the expected number of crashes. The proportion of crashes in which restraints were used is greater on federal, interstate, and municipal highway areas.

2.5 Locale

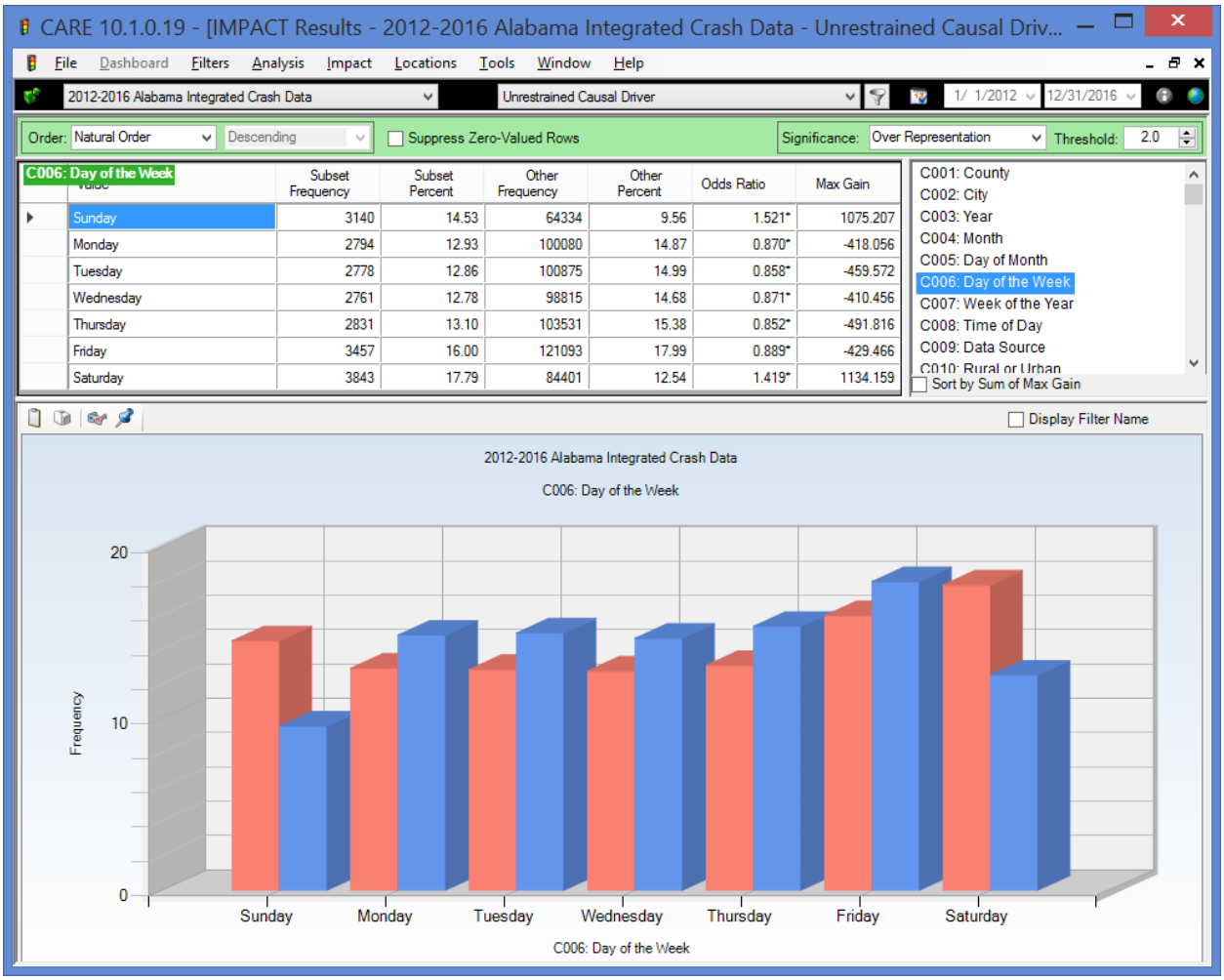


The crash incidents involving no restraints are overrepresented in open country areas. However, school and shopping areas are significantly underrepresented, indicating that crashes in these areas generally involve drivers who were much more apt to use their restraints. This gives the general type of locations at which restraint enforcement will be most effective.

3 Time Factors

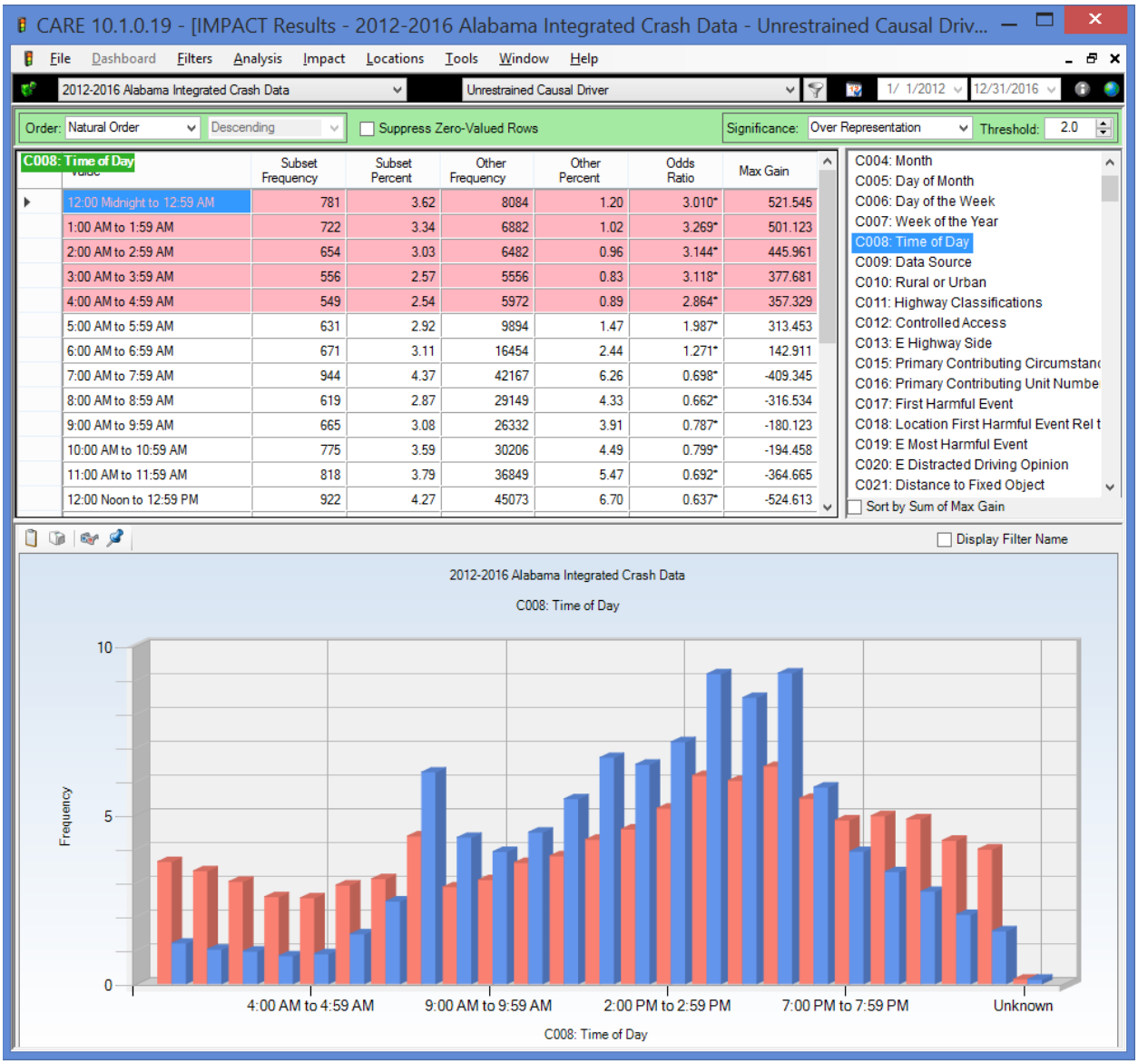
Time factors were also analyzed in several different categories to determine overrepresentation for day of the week and time of day. Analysis of these time factors allows for the determination of particular days of week and time of day combinations in which more crashes occur with drivers who are not properly restrained, and thus, those times in which enforcement would be more impactful.

3.1 Day of the Week



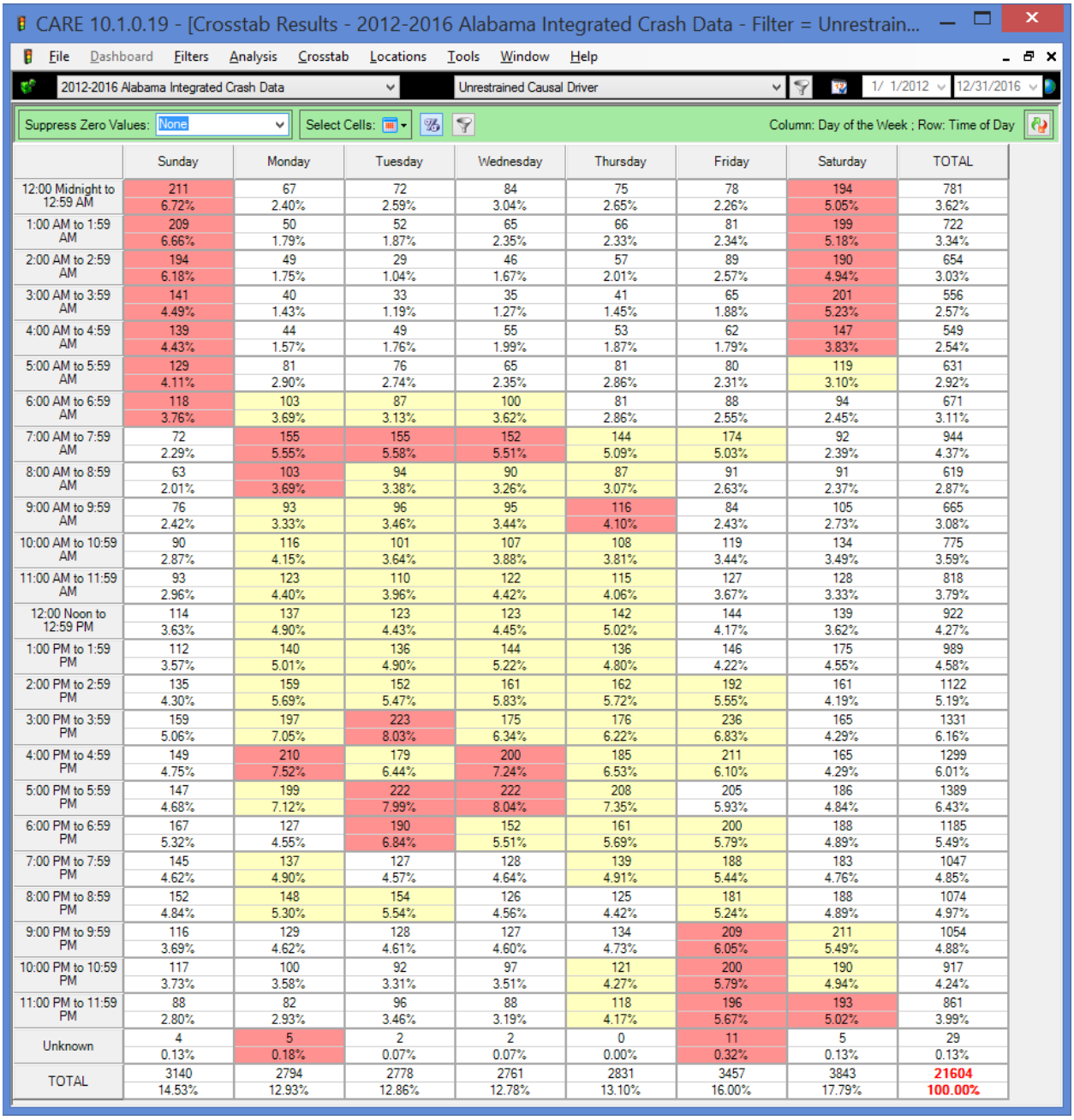
The weekend is overrepresented for crashes involving causal drivers who failed to use restraints, demonstrating a heavy correlation with alcohol-involved crashes. Saturday and Sunday averaged out to about 1.5 times the expected number of crashes involving causal drivers who failed to use restraints.

3.2 Time of Day



The relative probability of crashes involving no restraints is generally greater before and after standard work and rush hours. Overrepresentation peaks during the 12 PM to 5 AM period and then tapers off, falling back below crashes involving causal drivers who use restraints in the 7 AM to 8 AM time period. This chart has a very strong resemblance to its DUI counterpart and the fatality study completed for 2016 showed clearly the lack of restraints correlated heavily with DUI (alcohol or other drugs).

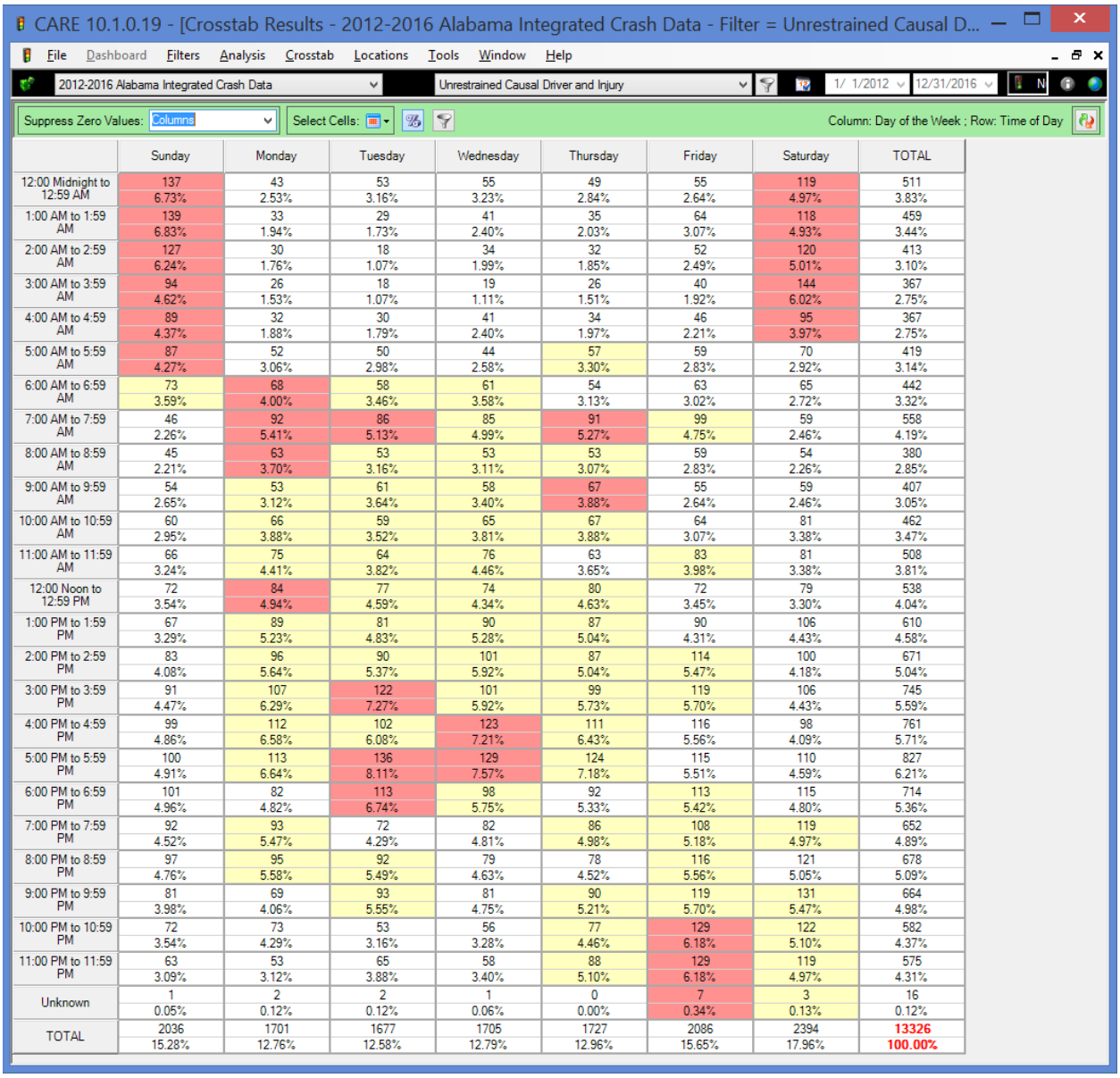
3.3 Time of Day by Day of the Week for all Unstrained Causal Driver Crashes



	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	TOTAL
12:00 Midnight to 12:59 AM	211 6.72%	67 2.40%	72 2.59%	84 3.04%	75 2.65%	78 2.26%	194 5.05%	781 3.62%
1:00 AM to 1:59 AM	209 6.66%	50 1.79%	52 1.87%	65 2.35%	66 2.33%	81 2.34%	199 5.18%	722 3.34%
2:00 AM to 2:59 AM	194 6.18%	49 1.75%	29 1.04%	46 1.67%	57 2.01%	89 2.57%	190 4.94%	654 3.03%
3:00 AM to 3:59 AM	141 4.49%	40 1.43%	33 1.19%	35 1.27%	41 1.45%	65 1.88%	201 5.23%	556 2.57%
4:00 AM to 4:59 AM	139 4.43%	44 1.57%	49 1.76%	55 1.99%	53 1.87%	62 1.79%	147 3.83%	549 2.54%
5:00 AM to 5:59 AM	129 4.11%	81 2.90%	76 2.74%	65 2.35%	81 2.86%	80 2.31%	119 3.10%	631 2.92%
6:00 AM to 6:59 AM	118 3.76%	103 3.69%	87 3.13%	100 3.62%	81 2.86%	88 2.55%	94 2.45%	671 3.11%
7:00 AM to 7:59 AM	72 2.29%	155 5.55%	155 5.58%	152 5.51%	144 5.09%	174 5.03%	92 2.39%	944 4.37%
8:00 AM to 8:59 AM	63 2.01%	103 3.69%	94 3.38%	90 3.26%	87 3.07%	91 2.63%	91 2.37%	619 2.87%
9:00 AM to 9:59 AM	76 2.42%	93 3.33%	96 3.46%	95 3.44%	116 4.10%	84 2.43%	105 2.73%	665 3.08%
10:00 AM to 10:59 AM	90 2.87%	116 4.15%	101 3.64%	107 3.88%	108 3.81%	119 3.44%	134 3.49%	775 3.59%
11:00 AM to 11:59 AM	93 2.96%	123 4.40%	110 3.96%	122 4.42%	115 4.06%	127 3.67%	128 3.33%	818 3.79%
12:00 Noon to 12:59 PM	114 3.63%	137 4.90%	123 4.43%	123 4.45%	142 5.02%	144 4.17%	139 3.62%	922 4.27%
1:00 PM to 1:59 PM	112 3.57%	140 5.01%	136 4.90%	144 5.22%	136 4.80%	146 4.22%	175 4.55%	989 4.58%
2:00 PM to 2:59 PM	135 4.30%	159 5.69%	152 5.47%	161 5.83%	162 5.72%	192 5.55%	161 4.19%	1122 5.19%
3:00 PM to 3:59 PM	159 5.06%	197 7.05%	223 8.03%	175 6.34%	176 6.22%	236 6.83%	165 4.29%	1331 6.16%
4:00 PM to 4:59 PM	149 4.75%	210 7.52%	179 6.44%	200 7.24%	185 6.53%	211 6.10%	165 4.29%	1299 6.01%
5:00 PM to 5:59 PM	147 4.68%	199 7.12%	222 7.99%	222 8.04%	208 7.35%	205 5.93%	186 4.84%	1389 6.43%
6:00 PM to 6:59 PM	167 5.32%	127 4.55%	190 6.84%	152 5.51%	161 5.69%	200 5.79%	188 4.89%	1185 5.49%
7:00 PM to 7:59 PM	145 4.62%	137 4.90%	127 4.57%	128 4.64%	139 4.91%	188 5.44%	183 4.76%	1047 4.85%
8:00 PM to 8:59 PM	152 4.84%	148 5.30%	154 5.54%	126 4.56%	125 4.42%	181 5.24%	188 4.89%	1074 4.97%
9:00 PM to 9:59 PM	116 3.69%	129 4.62%	128 4.61%	127 4.60%	134 4.73%	209 6.05%	211 5.49%	1054 4.88%
10:00 PM to 10:59 PM	117 3.73%	100 3.58%	92 3.31%	97 3.51%	121 4.27%	200 5.79%	190 4.94%	917 4.24%
11:00 PM to 11:59 PM	88 2.80%	82 2.93%	96 3.46%	88 3.19%	118 4.17%	196 5.67%	193 5.02%	861 3.99%
Unknown	4 0.13%	5 0.18%	2 0.07%	2 0.07%	0 0.00%	11 0.32%	5 0.13%	29 0.13%
TOTAL	3140 14.53%	2794 12.93%	2778 12.86%	2761 12.78%	2831 13.10%	3457 16.00%	3843 17.79%	21604 100.00%

The over-represented times for improperly restrained drivers is almost a perfect correlation with DUI (alcohol or other drugs). The correlation with age and DUI is also extremely high. If seatbelts are going to expand in their life-saving capabilities, some way will have to be found to get the impaired drivers to buckle up. In the past there has been a tendency to give up on these drivers, and this is the result.

3.4 Time of Day by Day of the Week: INJURY Unstrained Causal Driver Crashes



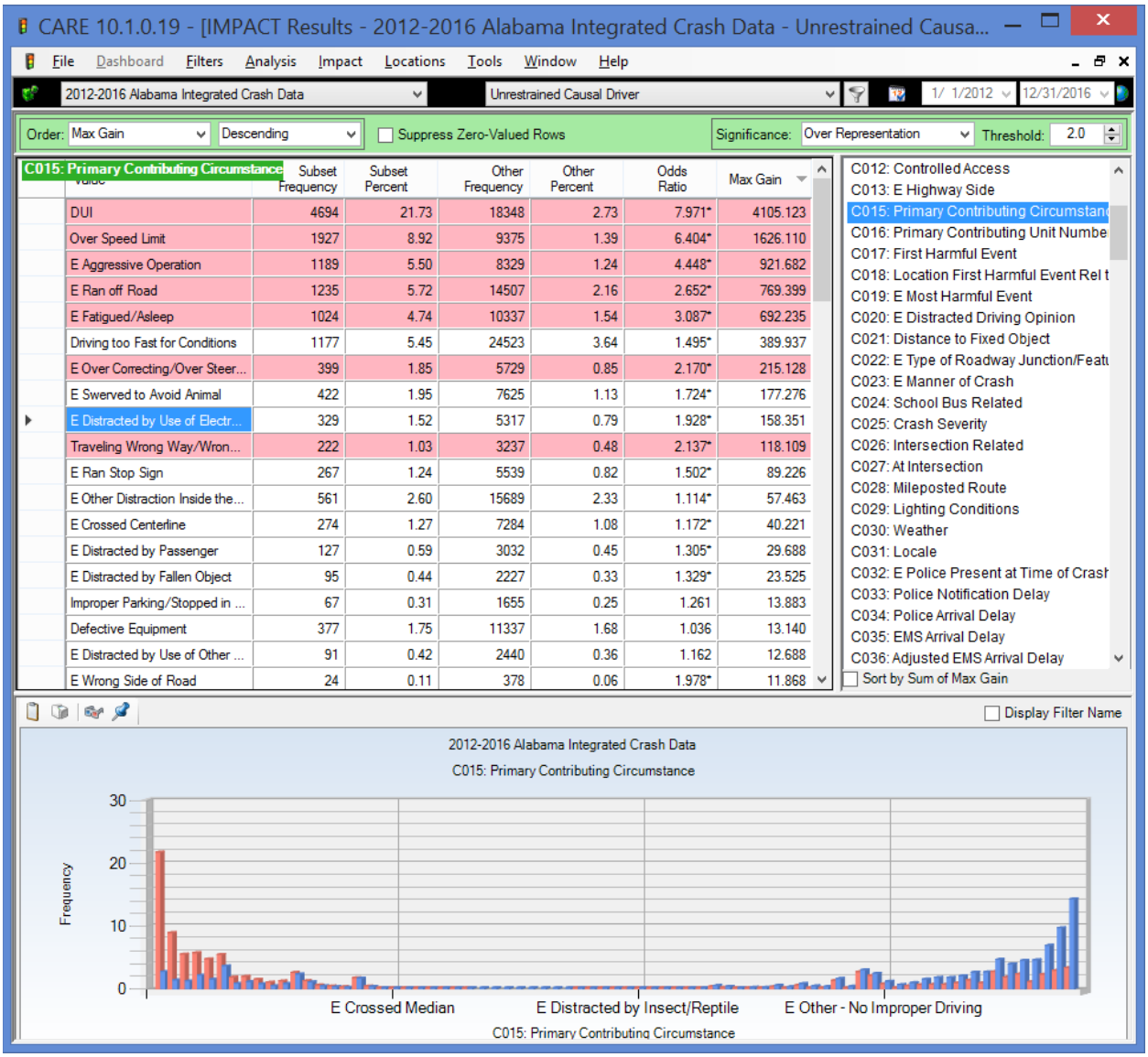
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	TOTAL
12:00 Midnight to 12:59 AM	137 6.73%	43 2.53%	53 3.16%	55 3.23%	49 2.84%	55 2.64%	119 4.97%	511 3.83%
1:00 AM to 1:59 AM	139 6.83%	33 1.94%	29 1.73%	41 2.40%	35 2.03%	64 3.07%	118 4.93%	459 3.44%
2:00 AM to 2:59 AM	127 6.24%	30 1.76%	18 1.07%	34 1.99%	32 1.85%	52 2.49%	120 5.01%	413 3.10%
3:00 AM to 3:59 AM	94 4.62%	26 1.53%	18 1.07%	19 1.11%	26 1.51%	40 1.92%	144 6.02%	367 2.75%
4:00 AM to 4:59 AM	89 4.37%	32 1.88%	30 1.79%	41 2.40%	34 1.97%	46 2.21%	95 3.97%	367 2.75%
5:00 AM to 5:59 AM	87 4.27%	52 3.06%	50 2.98%	44 2.58%	57 3.30%	59 2.83%	70 2.92%	419 3.14%
6:00 AM to 6:59 AM	73 3.59%	68 4.00%	58 3.46%	61 3.58%	54 3.13%	63 3.02%	65 2.72%	442 3.32%
7:00 AM to 7:59 AM	46 2.26%	92 5.41%	86 5.13%	85 4.99%	91 5.27%	99 4.75%	59 2.46%	558 4.19%
8:00 AM to 8:59 AM	45 2.21%	63 3.70%	53 3.16%	53 3.11%	53 3.07%	59 2.83%	54 2.26%	380 2.85%
9:00 AM to 9:59 AM	54 2.65%	53 3.12%	61 3.64%	58 3.40%	67 3.88%	55 2.64%	59 2.46%	407 3.05%
10:00 AM to 10:59 AM	60 2.95%	66 3.88%	59 3.52%	65 3.81%	67 3.88%	64 3.07%	81 3.38%	462 3.47%
11:00 AM to 11:59 AM	66 3.24%	75 4.41%	64 3.82%	76 4.46%	63 3.65%	83 3.98%	81 3.38%	508 3.81%
12:00 Noon to 12:59 PM	72 3.54%	84 4.94%	77 4.59%	74 4.34%	80 4.63%	72 3.45%	79 3.30%	538 4.04%
1:00 PM to 1:59 PM	67 3.29%	89 5.23%	81 4.83%	90 5.28%	87 5.04%	90 4.31%	106 4.43%	610 4.58%
2:00 PM to 2:59 PM	83 4.08%	96 5.64%	90 5.37%	101 5.92%	87 5.04%	114 5.47%	100 4.18%	671 5.04%
3:00 PM to 3:59 PM	91 4.47%	107 6.29%	122 7.27%	101 5.92%	99 5.73%	119 5.70%	106 4.43%	745 5.59%
4:00 PM to 4:59 PM	99 4.86%	112 6.58%	102 6.08%	123 7.21%	111 6.43%	116 5.56%	98 4.09%	761 5.71%
5:00 PM to 5:59 PM	100 4.91%	113 6.64%	136 8.11%	129 7.57%	124 7.18%	115 5.51%	110 4.59%	827 6.21%
6:00 PM to 6:59 PM	101 4.96%	82 4.82%	113 6.74%	98 5.75%	92 5.33%	113 5.42%	115 4.80%	714 5.36%
7:00 PM to 7:59 PM	92 4.52%	93 5.47%	72 4.29%	82 4.81%	86 4.98%	108 5.18%	119 4.97%	652 4.89%
8:00 PM to 8:59 PM	97 4.76%	95 5.58%	92 5.49%	79 4.63%	78 4.52%	116 5.56%	121 5.05%	678 5.09%
9:00 PM to 9:59 PM	81 3.98%	69 4.06%	93 5.55%	81 4.75%	90 5.21%	119 5.70%	131 5.47%	664 4.98%
10:00 PM to 10:59 PM	72 3.54%	73 4.29%	53 3.16%	56 3.28%	77 4.46%	129 6.18%	122 5.10%	582 4.37%
11:00 PM to 11:59 PM	63 3.09%	53 3.12%	65 3.88%	58 3.40%	88 5.10%	129 6.18%	119 4.97%	575 4.31%
Unknown	1 0.05%	2 0.12%	2 0.12%	1 0.06%	0 0.00%	7 0.34%	3 0.13%	16 0.12%
TOTAL	2036 15.28%	1701 12.76%	1677 12.58%	1705 12.79%	1727 12.96%	2086 15.65%	2394 17.96%	13326 100.00%

Crosstab analysis of time of day by day of the week for crashes involving injury in which restraints were not used helps target specific times in which officers should increase patrols in order to prevent these crashes. The above applies to all injury crashes in which the causal driver was not properly restrained.

4 Crash Causal Factors

Analysis of crash causal factors determines which factors are the most likely contributors to crashes in which drivers did not use restraints. The primary contributing circumstances of the crashes were analyzed, and overrepresentation values indicate certain risk-taking behaviors associated with this type of crash. Vehicle model year and speed at impact were also evaluated to characterize factors that are consistently associated with crashes in which drivers are not properly restrained.

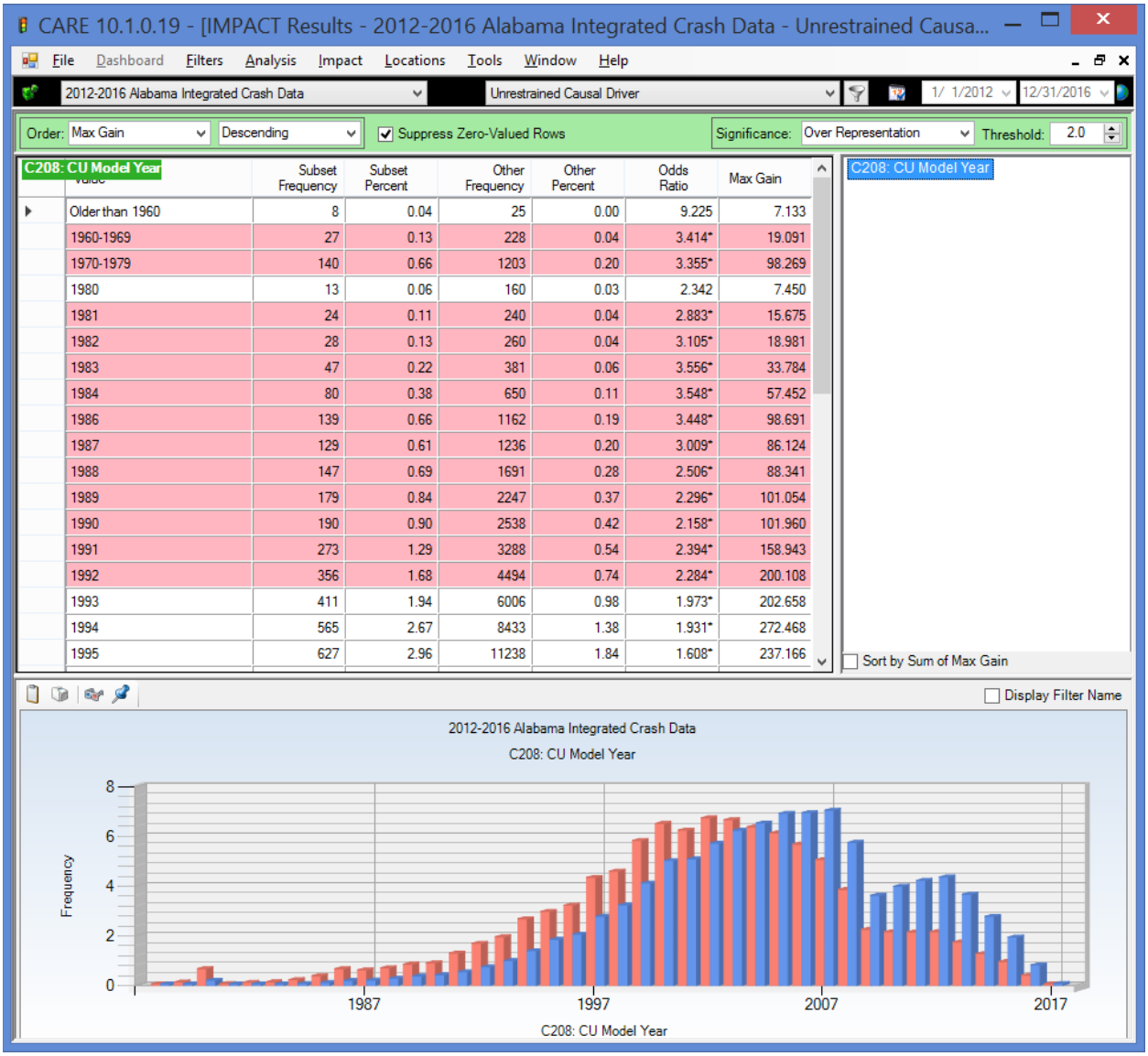
4.1 Primary Contributing Circumstance



Overrepresentation factors indicate that certain risk-taking behaviors are associated with the crashes in which drivers do not use restraints. In order of maximum potential expected gain (Max Gain), these include: DUI, over the speed limit (ranked even higher when combined with "Driving too Fast for Conditions"), aggressive operation, running off the road and fatigued/asleep. DUI for non-restrained drivers was determined to be about eight times the proportion that it was for restrained drivers, further reinforcing the findings with regard to impaired driving given above. Other overrepresented contributing circumstances include several things that are correlated with impairment: over correcting, swerving, traveling the wrong way, and the collection of all failure to yield categories. Distracted driving is also an issue with the proportion of unrestrained drivers being almost double that of those properly restrained.

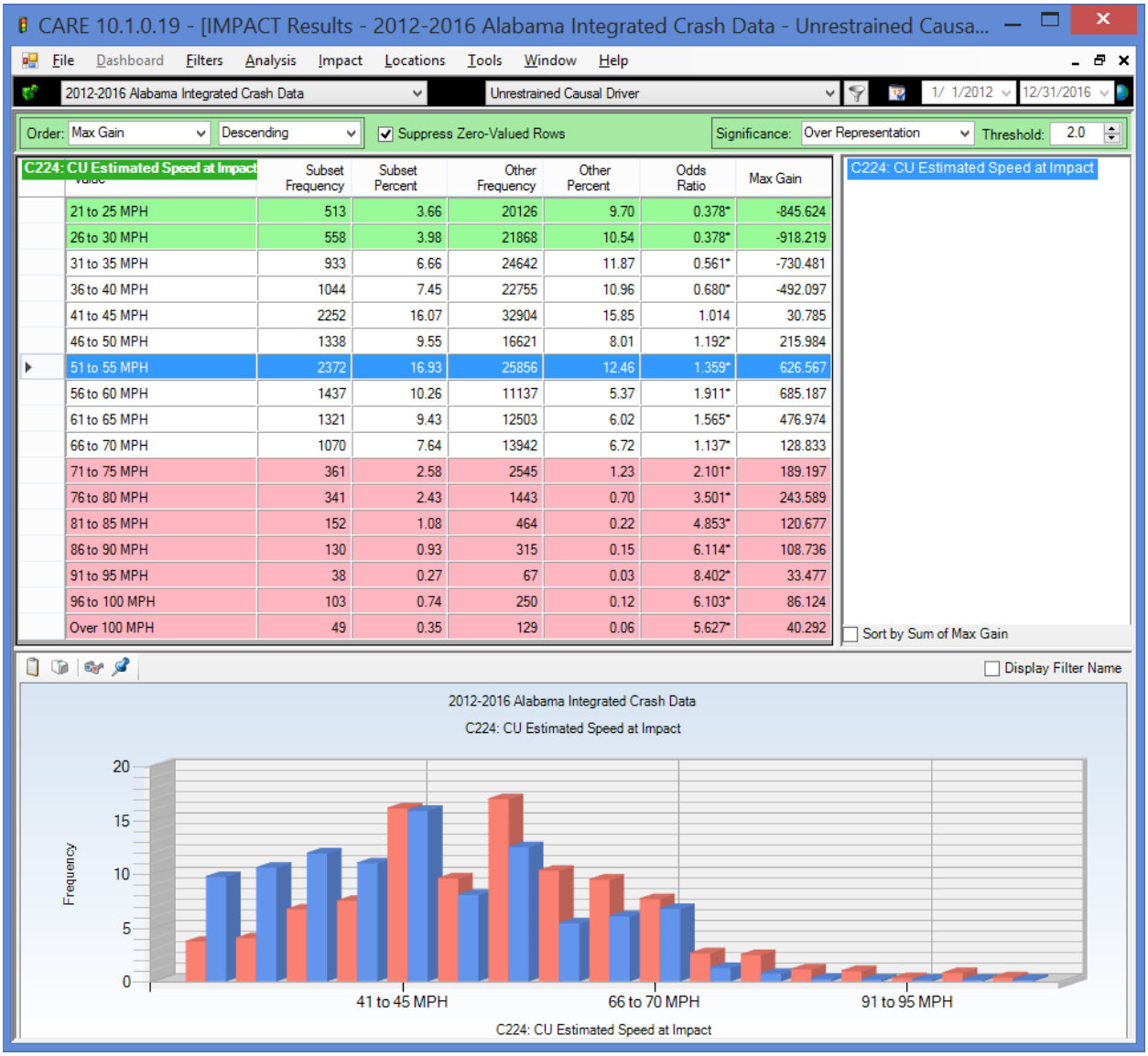
It is obvious that the presence of seat belts will not have a large impact on the causation of these crashes, although the increased ability to maintain control in adverse situations should not be minimized as a benefit of restraints. However, the correlation here would be the result of risk acceptance in general, and the inability or unwillingness of those who are impaired to consider the life-saving benefits of restraint use. Additionally, analysis of other contributing circumstances presented similar risk-taking behaviors associated with crashes in which causal drivers did not use restraints.

4.2 Vehicle Age – Model Year



Crashes attributed to drivers who used no restraints are greatly overrepresented in vehicles with model years 1960-2003. This might be attributed to the lack of current safety restraints in the older model vehicles. Vehicles with model years 2004 and later indicate that the proportion involving restraints surpasses those involving drivers who did not use restraints very significantly. One factor that would increase the rural problem could well be the economic disadvantages of those in the rural areas, and thus their use of older vehicles.

4.3 Speed at Impact



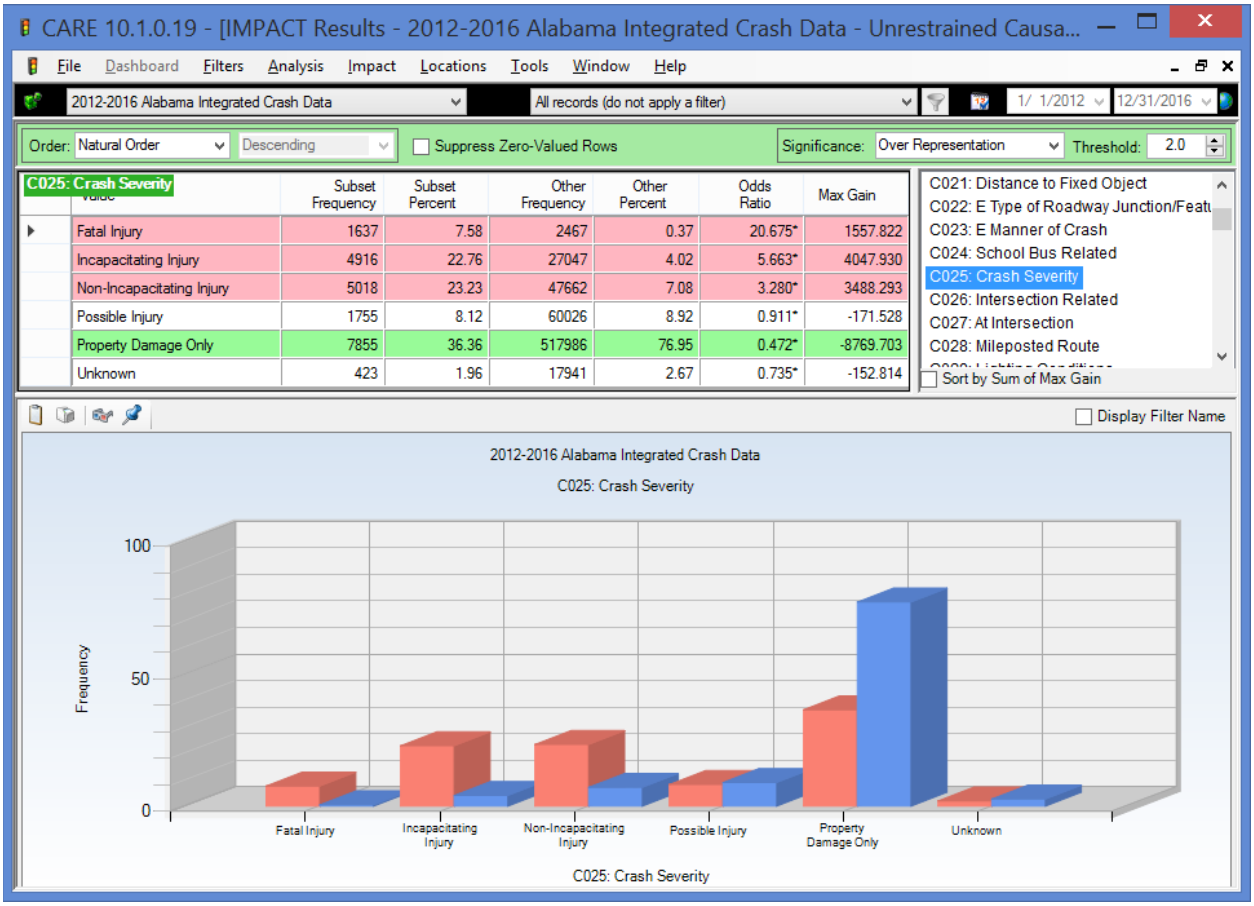
Speed at impact for crashes in which drivers failed to use restraints is most highly overrepresented in the range of 71 MPH and over. This is a major change from the previous year's observation where the mid-speed ranges, 51-65 MPH, were also highly over-represented. This is consistent with the findings of the recent fatality study that indicated speeds increasing overall by several crash and citation metrics. Crashes in which restraints are not used consistently occur at higher speeds than crashes in which restraints were used by the causal driver. This confirms the rural-urban finding, in that speeds are generally higher in the rural areas, and since speed is an excellent proxy for risk-taking, shows the correlation between improper restraints and other risk-taking items. It also exacerbates the problem, resulting in

greater severity caused by the high-speed, unrestrained situations. Severity factors are considered immediately below.

5 Severity Factors

Generally restraints do not prevent crashes, although on rare occasions they might help to keep the driver behind the wheel and in a position to avoid a crash. But in general occupant restraints serve to reduce the severity of crashes when they occur. Severity factors were analyzed in several different categories to determine to what extent the use of restraints affects the safety of the drivers. These factors analyzed include crash severity, crash severity in urban versus rural areas, number injured, number killed, driver ejection status, and driver injury type.

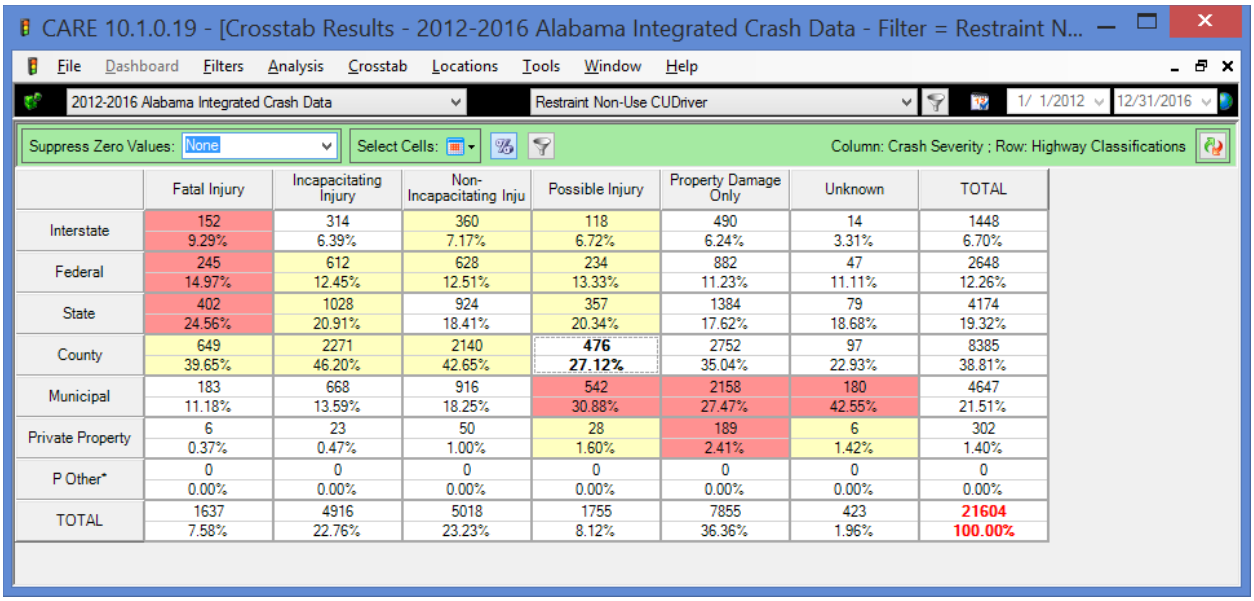
5.1 Crash Severity



Fatal, incapacitating, and non-incapacitating injuries are all extremely overrepresented in crashes that occurred without the use of restraints, as given by the Odds Ratios that show the proportions of fatal, Incapacitation Injury and Non-incapacitating injury were about 21, 6 and 3 times expected, respectively. While overrepresentations were certainly expected, these results further

quantify the effects of the benefits of restraint use. Property damage only was far more common in crashes in which drivers employed the use of restraints.

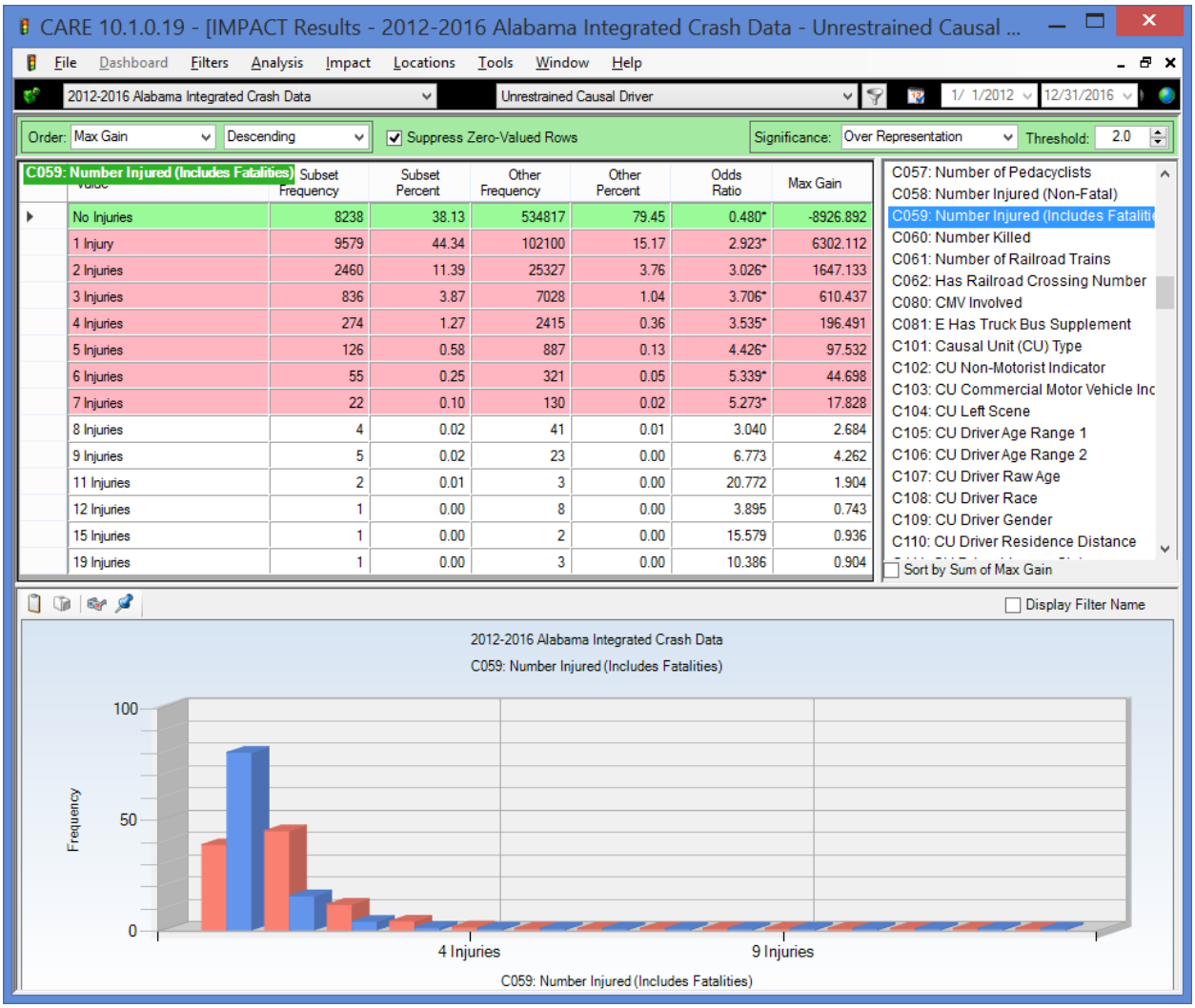
5.2 Crash Severity by Highway Classification for Driver Not Restrained



	Fatal Injury	Incapacitating Injury	Non-Incapacitating Inju	Possible Injury	Property Damage Only	Unknown	TOTAL
Interstate	152 9.29%	314 6.39%	360 7.17%	118 6.72%	490 6.24%	14 3.31%	1448 6.70%
Federal	245 14.97%	612 12.45%	628 12.51%	234 13.33%	882 11.23%	47 11.11%	2648 12.26%
State	402 24.56%	1028 20.91%	924 18.41%	357 20.34%	1384 17.62%	79 18.68%	4174 19.32%
County	649 39.65%	2271 46.20%	2140 42.65%	**476** **27.12%**	2752 35.04%	97 22.93%	8385 38.81%
Municipal	183 11.18%	668 13.59%	916 18.25%	542 30.88%	2158 27.47%	180 42.55%	4647 21.51%
Private Property	6 0.37%	23 0.47%	50 1.00%	28 1.60%	189 2.41%	6 1.42%	302 1.40%
P Other*	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%
TOTAL	1637 7.58%	4916 22.76%	5018 23.23%	1755 8.12%	7855 36.36%	423 1.96%	**21604** **100.00%**

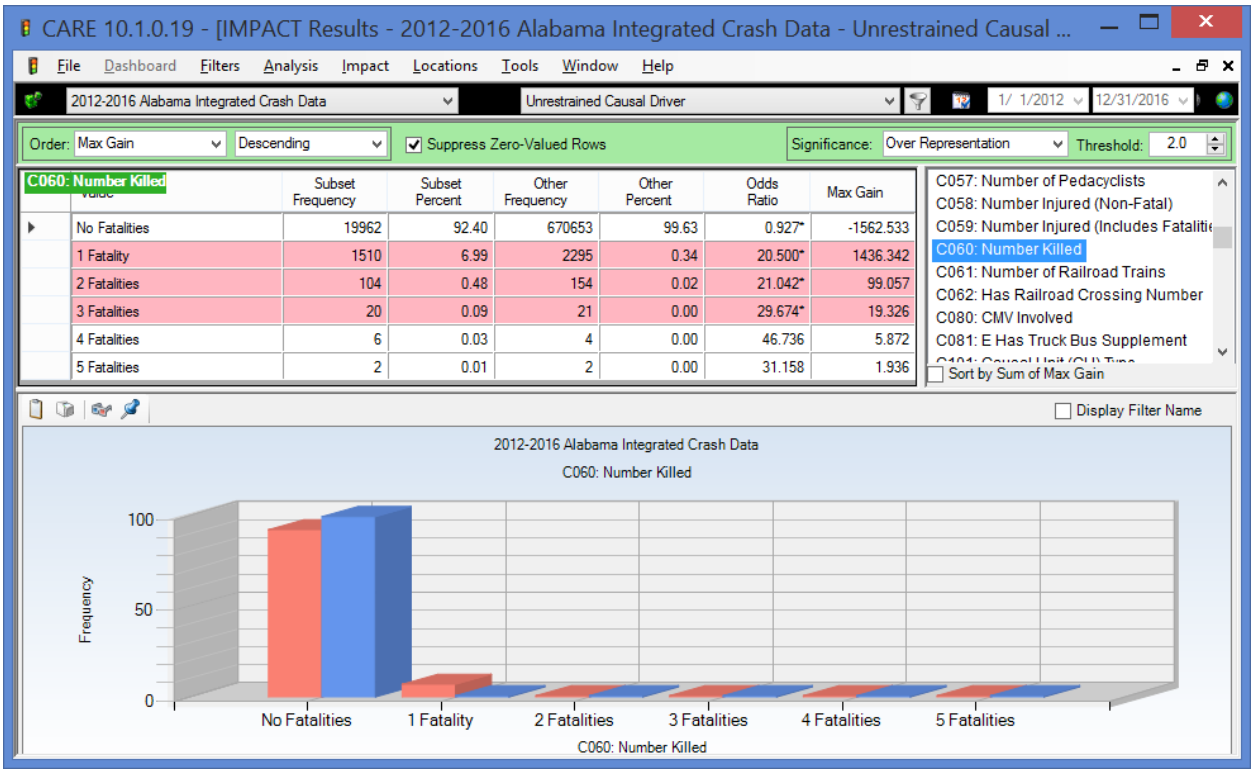
Analysis of crash severity by highway classification for crashes in which the causal driver did not use restraints shows that fatal injuries are overrepresented on Interstate, Federal and State roadways. Possible injuries and Property Damage Only were overrepresented on municipal highways.

5.3 Number Injured



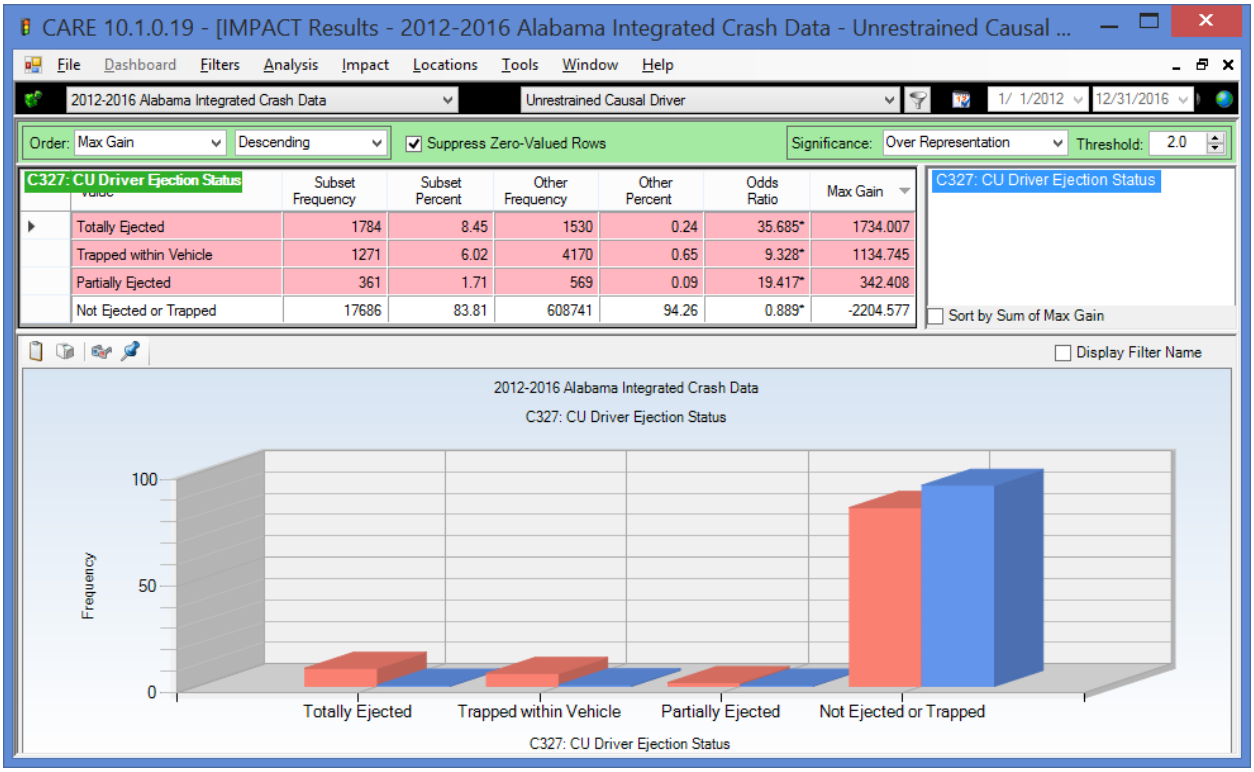
The proportion of injuries (including fatalities) in crashes in which no restraints were used is overrepresented by more than a factor of two when there were 1 to 7 injuries per crash. In the 6 and 5 injury crashes, it is over-represented by a factor of over 5. These results show quite plainly that crashes in which the causal driver was not restrained are much more severe in their effects to all passengers and not just the causal driver. The overrepresentation of multiple injuries in the causal vehicle might also indicate a tendency of unrestrained drivers to travel with multiple individuals in the vehicle. This also demonstrates that the use of a seat belt by the driver is an excellent proxy for seat belt use in general in the corresponding vehicle.

5.4 Number Killed



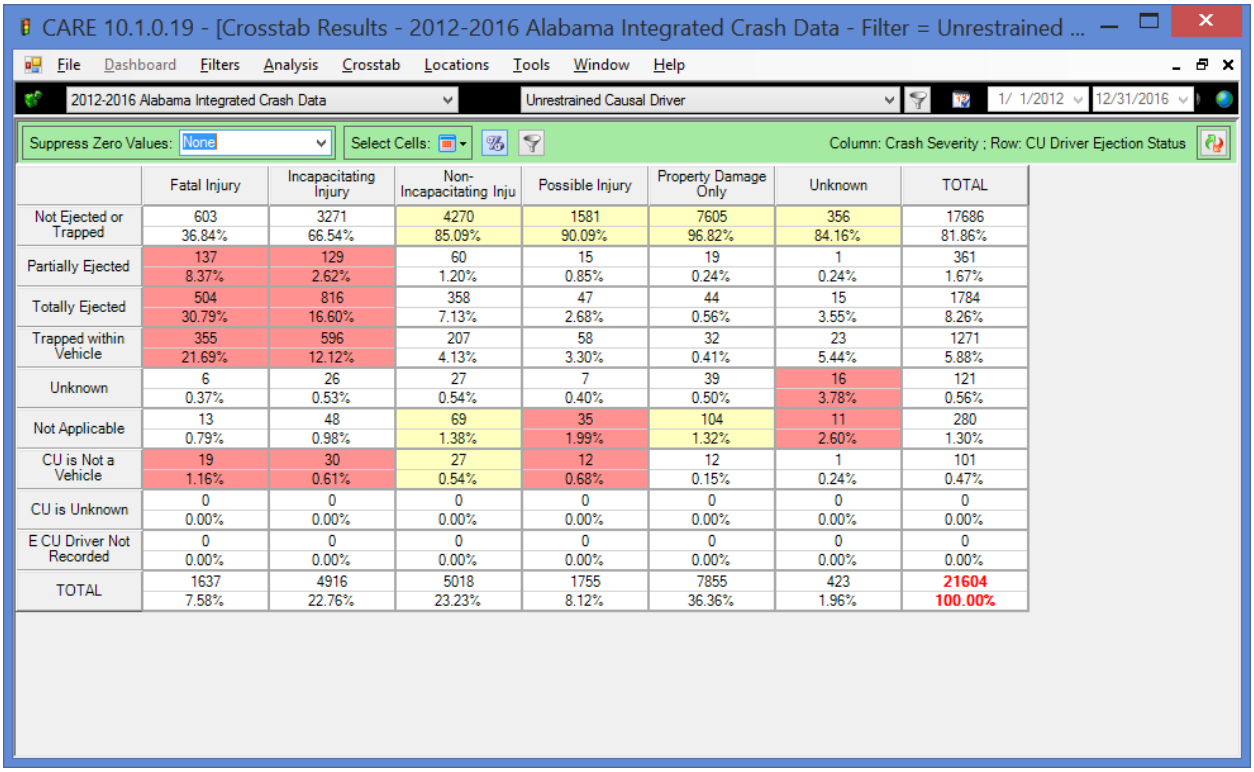
The proportion of fatalities in general as well as the proportion of multiple fatality crashes is dramatically overrepresented when restraints are not used in the causal vehicle. Multiple fatality crashes were found to be a large factor in the increase of fatalities in 2016. This was especially true in the 4 and 5 fatality crashes; 4 fatalities went from 3 to 6 in 2012-2016 from 2011-2015, and 5 fatalities doubled from 1 to 2. Of course, the largest increase was in the single fatality crashes, which went from 1423 in 2011-2015 to 1510 in the 2012-2016

5.5 Driver Ejection Status



Driver Totally Ejected is overrepresented by a factor of over 36 in crashes in which the driver did not use restraints, indicating another cause for many fatalities. This means that the probability of being ejected is 36 times higher when restraints are not used. Partial ejection, total ejection, or entrapments in the vehicle are also greatly over-represented, which is expected in crashes in which safety equipment is not properly utilized.

5.6 Ejection Status by Severity



	Fatal Injury	Incapacitating Injury	Non-Incapacitating Inju	Possible Injury	Property Damage Only	Unknown	TOTAL
Not Ejected or Trapped	603 36.84%	3271 66.54%	4270 85.09%	1581 90.09%	7605 96.82%	356 84.16%	17686 81.86%
Partially Ejected	137 8.37%	129 2.62%	60 1.20%	15 0.85%	19 0.24%	1 0.24%	361 1.67%
Totally Ejected	504 30.79%	816 16.60%	358 7.13%	47 2.68%	44 0.56%	15 3.55%	1784 8.26%
Trapped within Vehicle	355 21.69%	596 12.12%	207 4.13%	58 3.30%	32 0.41%	23 5.44%	1271 5.88%
Unknown	6 0.37%	26 0.53%	27 0.54%	7 0.40%	39 0.50%	16 3.78%	121 0.56%
Not Applicable	13 0.79%	48 0.98%	69 1.38%	35 1.99%	104 1.32%	11 2.60%	280 1.30%
CU is Not a Vehicle	19 1.16%	30 0.61%	27 0.54%	12 0.68%	12 0.15%	1 0.24%	101 0.47%
CU is Unknown	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%
E CU Driver Not Recorded	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%
TOTAL	1637 7.58%	4916 22.76%	5018 23.23%	1755 8.12%	7855 36.36%	423 1.96%	21604 100.00%

All crashes in the above cross-tabulation involved drivers who were not properly restrained. In evaluating crash severity by ejection status, data show that fatal and incapacitating injuries were significantly overrepresented in crashes in which the driver was partially ejected, totally ejected, or trapped within the vehicle. Because the ejection status is strongly associated with the use of restraints, this data indicates that failure to use restraints results in greater severity of injuries in crashes. The table given above quantifies this increase in severity. The probability of any given crash being fatal over the five years (2012-2016) of the study was 0.59% (including all crashes whether the driver/passengers were restrained or not). The following table give the multipliers to this probability (0.59%) of a crash being a fatal crash for the various ejection conditions.

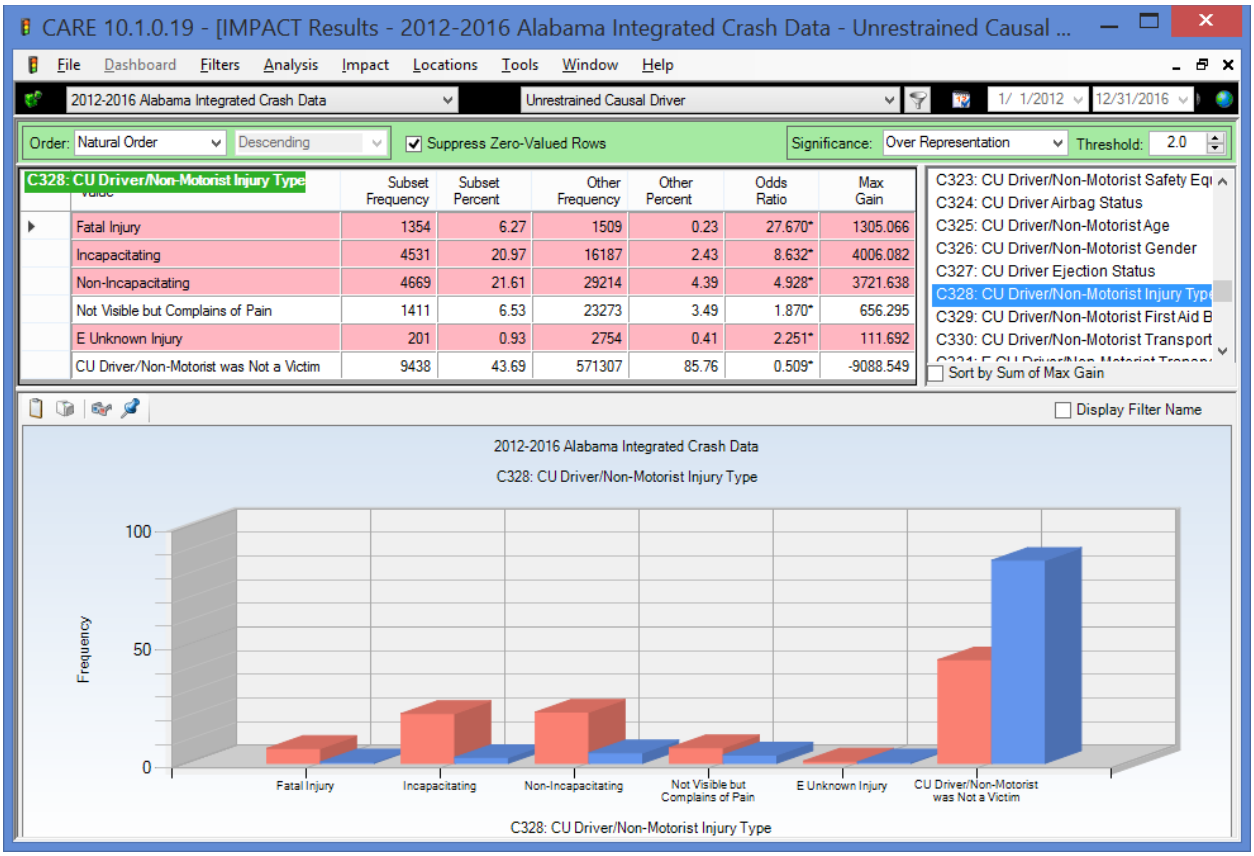
Fatality Multipliers for Unrestrained Drivers

Ejection Status	Probability of Fatality	Multiplier from All Crashes
Not Ejected	3.40%	5.78
Partially Ejected	37.95%	64.32
Totally Ejected	28.25%	47.88
Trapped in Vehicle	27.93%	47.34

The non-ejection has a multiplier of 5.78 because it is being compared to all crashes, of which a large number (over 90% of passengers) are restrained. Partial ejection is the worst case scenario

with a multiplier of over 64. For totally ejected or trapped causal vehicle drivers this is reduced to the 47-48 range, but is still dramatically worse than not being ejected even if unrestrained.

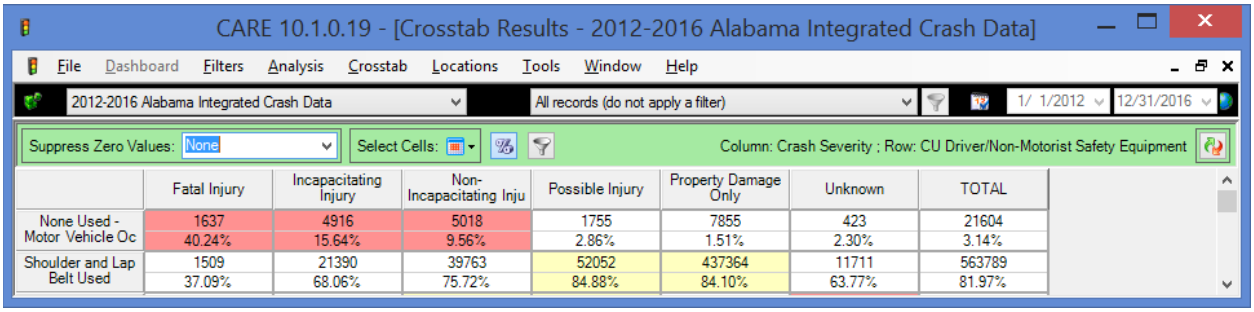
5.7 Driver Injury Type



Various types of driver injuries, including fatalities, are consistently overrepresented in crashes where no restraints were used by the driver. Fatalities in these crashes are overrepresented by a factor of over 27.670. In crashes in which safety restraints were used, drivers and non-motorists were far less likely to be injured.

5.8 Fatality Probability by Restraint Use

The following is for all crashes over the 2012-2016 time frame.



	Fatal Injury	Incapacitating Injury	Non-Incapacitating Inju	Possible Injury	Property Damage Only	Unknown	TOTAL
None Used - Motor Vehicle Oc	1637 40.24%	4916 15.64%	5018 9.56%	1755 2.86%	7855 1.51%	423 2.30%	21604 3.14%
Shoulder and Lap Belt Used	1509 37.09%	21390 68.06%	39763 75.72%	52052 84.88%	437364 84.10%	11711 63.77%	563789 81.97%

The probability that any given crash will be classified as a fatal crash is calculated by the number in any specific category divided by the total number in that general category. From the above, the probability of a fatality of those who are properly restrained is given by:

1509 Fatal Crashes / 563,789 Total Crashes = 0.002677 = 0.002677% (1 in every 374.62 crashes).

The same calculation for the None Used row is:

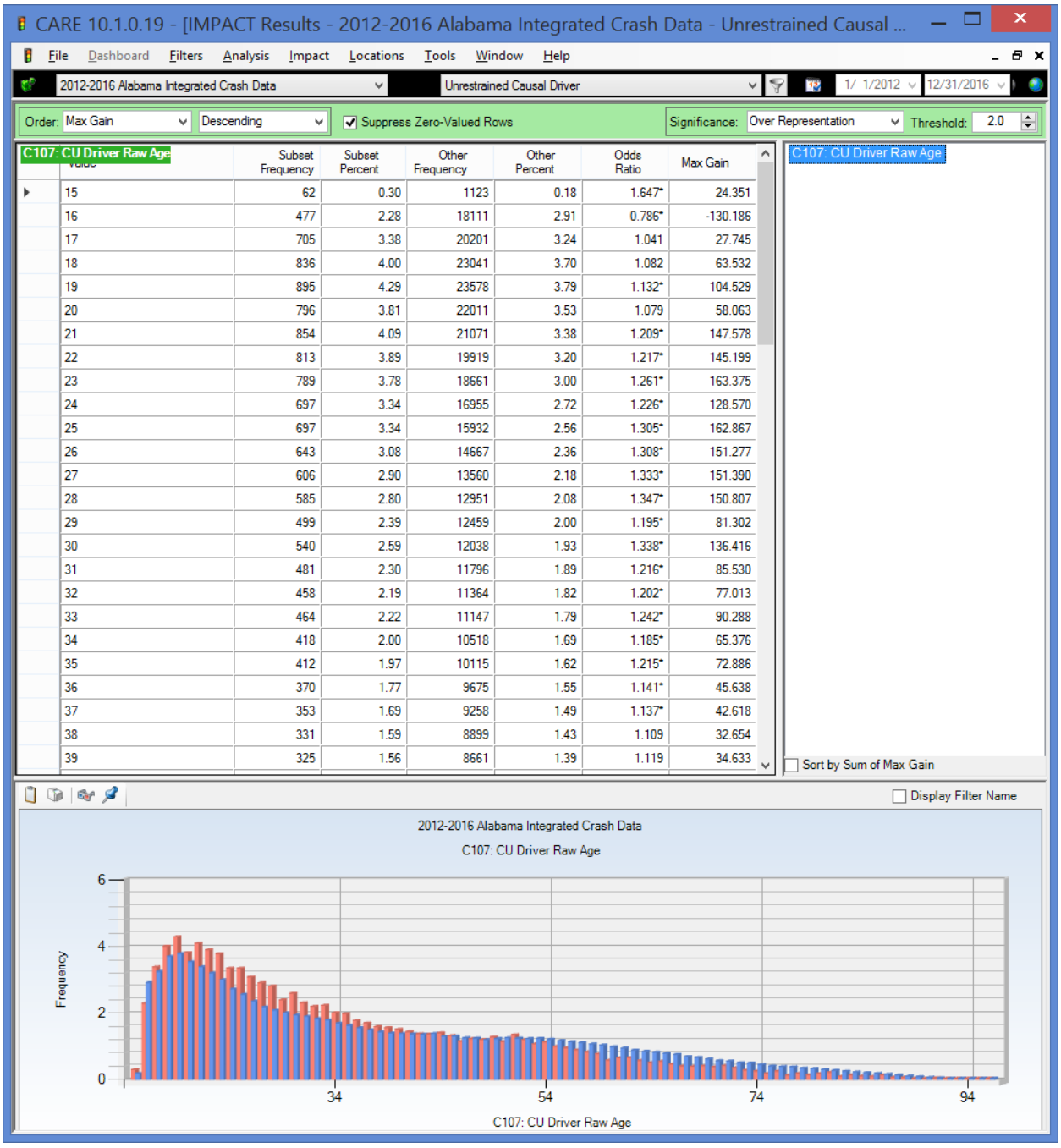
1637 Fatal Crashes / 21,604 Total Crashes = 0.075773 = 7.5773 (1 in every 13.20 crashes).

These figures show that the probability of being killed in a crash goes up by a factor of 374.62/13.20 = 28.3 times the probability of being killed given proper restraints.

6 Driver Demographics

The study of driver demographics provides information about which gender or age groups are more likely to be involved in these crashes in which no restraints are used. Determination of overrepresentation can help to target the gender or age group that is more likely to be involved in this type of crash.

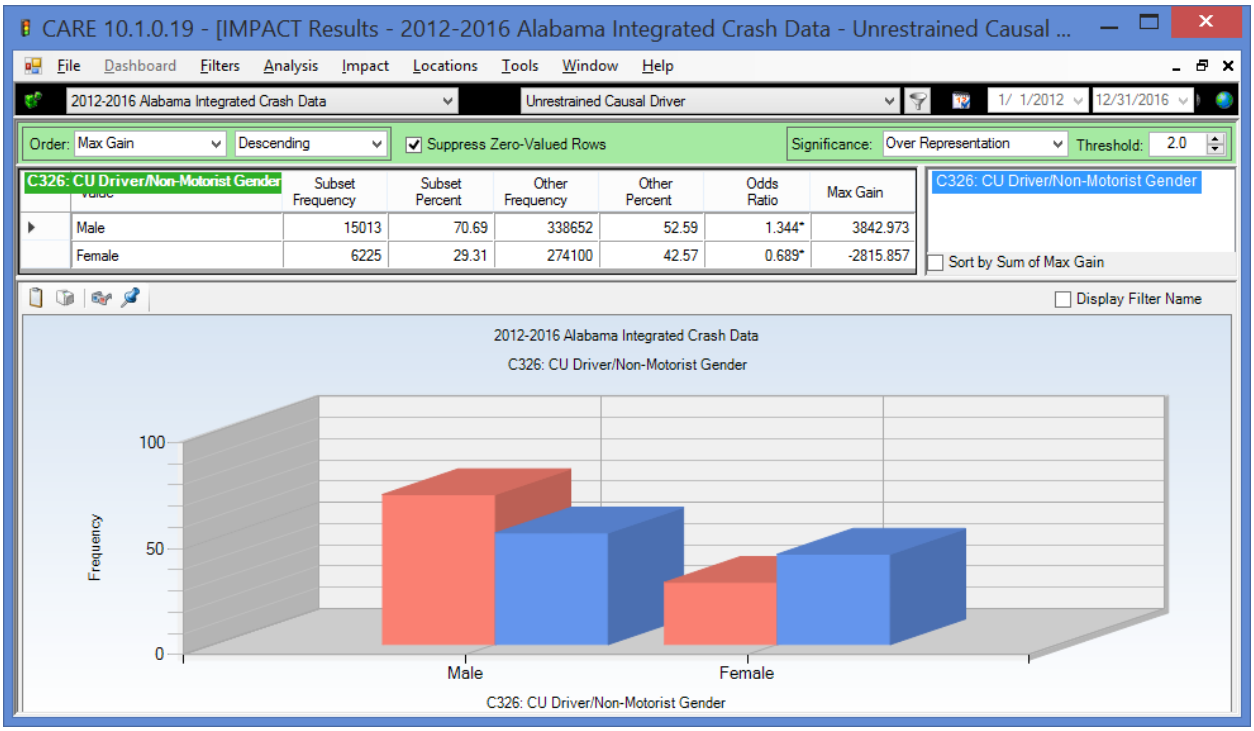
6.1 Driver Age



Analysis of individual driver ages indicates that crashes involving no restraints are overrepresented in the years above the teen-drivers (age range 19-37). While it appears that 16-18 teen-aged drivers are more likely to use safety equipment (perhaps due to the emphasis on it

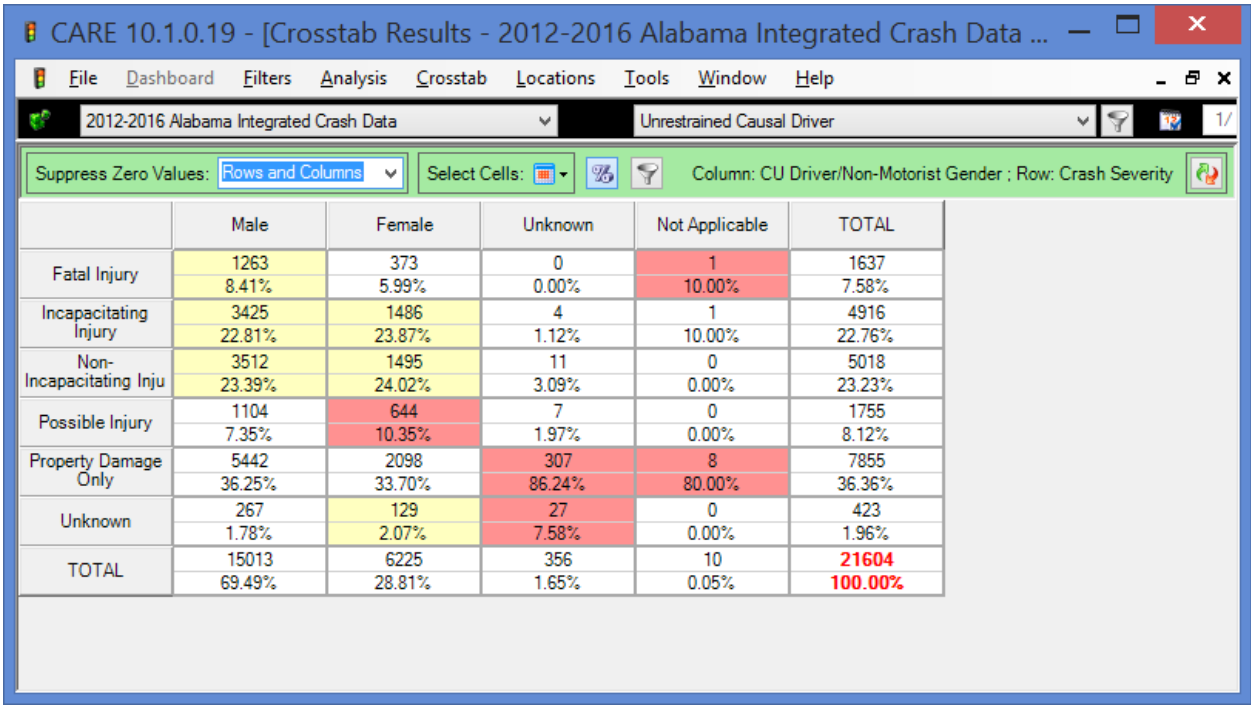
placed during training), there is still a very large proportion that are unrestrained, and this problem is multiplied by their overrepresentation in crashes in general (note that, for crashes in general, they are at least twice the average of the other ages). The tendency toward risk-taking is generally thought to end at age 25. This distribution correlates very strongly with crashes in which the causal driver was impaired by drugs (including alcohol).

6.2 Driver Gender



Males account for 70.69% of crashes in which restraints are not used, and they are overrepresented by a factor of 1.344. Since males also do the majority of the driving, they become a clear target for restraint countermeasures.

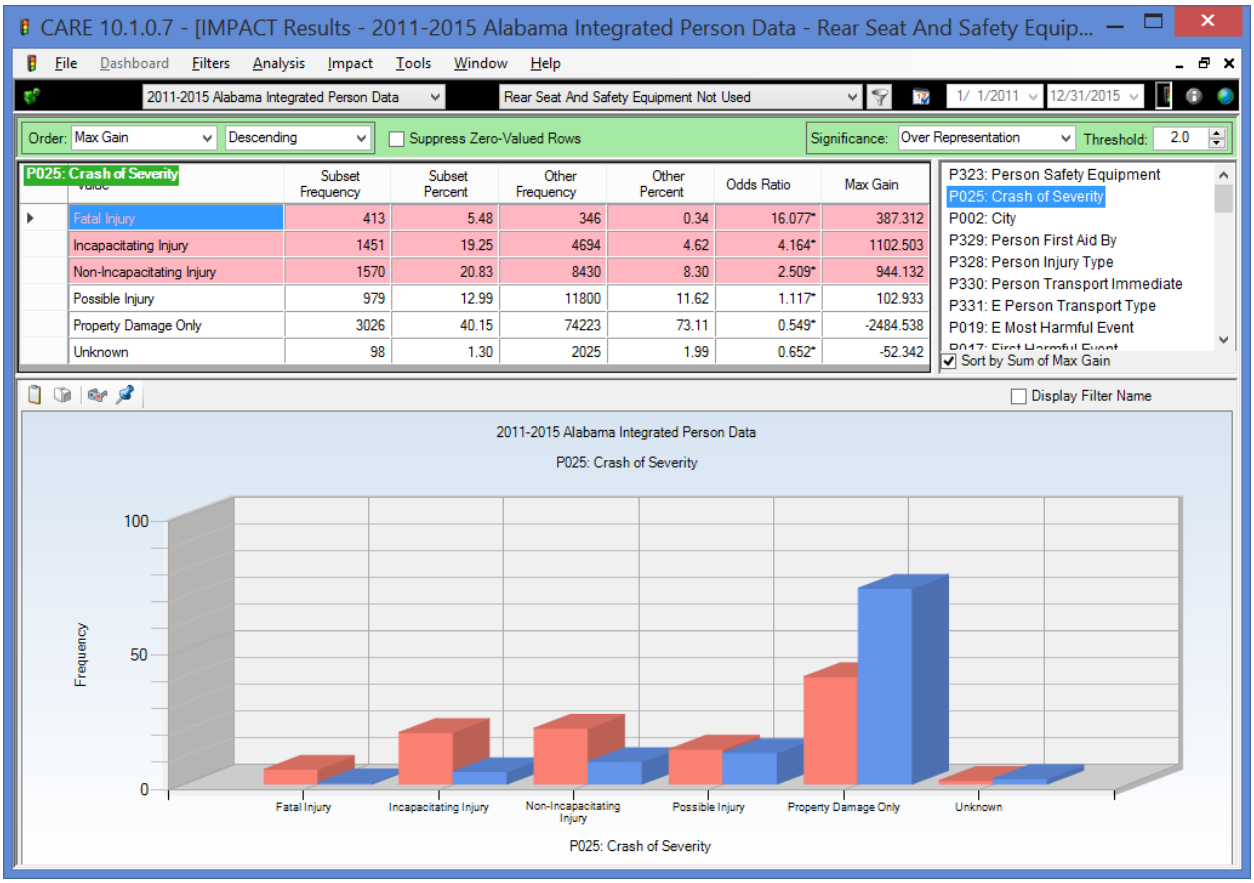
6.3 Driver Gender by Severity for Unrestrained Causal Drivers



	Male	Female	Unknown	Not Applicable	TOTAL
Fatal Injury	1263 8.41%	373 5.99%	0 0.00%	1 10.00%	1637 7.58%
Incapacitating Injury	3425 22.81%	1486 23.87%	4 1.12%	1 10.00%	4916 22.76%
Non-Incapacitating Inju	3512 23.39%	1495 24.02%	11 3.09%	0 0.00%	5018 23.23%
Possible Injury	1104 7.35%	644 10.35%	7 1.97%	0 0.00%	1755 8.12%
Property Damage Only	5442 36.25%	2098 33.70%	307 86.24%	8 80.00%	7855 36.36%
Unknown	267 1.78%	129 2.07%	27 7.58%	0 0.00%	423 1.96%
TOTAL	15013 69.49%	6225 28.81%	356 1.65%	10 0.05%	21604 100.00%

When driver gender by severity was studied, data indicate that “Possible Injuries” are overrepresented for female drivers in crashes where the female causal driver was not restrained. Generally, the distribution of severity is skewed toward more severe injuries for unrestrained male drivers. The probability that any of these (unrestrained driver) crashes resulted in a fatality was 8.41% for male drivers and 5.99% for female drivers.

7 Analysis of Back Seat Occupants



Back seat occupants who are not properly restrained have close to 17 times the probability of being killed as do those who are properly restrained. The other highest two severity classifications are also greatly increased, although not by as great of multipliers: 4.370 for Incapacitating Injury and 2.515 for Non-Incapacitating Injury.

Looking at the numbers, over the five year period, there were 423 back seat occupants killed, which is about 83 per year. Question: how many of these would have been saved had they been properly restrained? Applying the 0.34% (probability of being killed if restrained) to the total unrestrained (sum of the Subset Frequency column, which is 7,430) as opposed to the actual 5.69% yields 25.12 total fatalities. This means that the total fatality savings over the five years would have been 423-25=398 fatalities, the saving of about 80 lives per year.

8 Summary and Conclusions

The following summarizes the findings of the analysis:

- Geographical Factors
    - Counties with the greatest overrepresentation factors for unrestrained driver crashes include Walker, Cullman, Jackson, Talladega, DeKalb and Escambia.
    - The number of crashes involving drivers who use no restraints is greatly overrepresented in rural areas in comparison to the urban areas. The odds ratio for rural areas is well over twice what would be expected if rural and urban restraint use were the same.
    - The most overrepresented (worst) areas are the rural county areas in Walker, Mobile, Cullman, Talladega Counties.
    - The most underrepresented (best) cities are Birmingham, Mobile, Montgomery, Huntsville and Tuscaloosa.
    - Crash incidents with no driver restraints being used are greatly overrepresented on county highways, with 2.7 times the expected number of crashes. County and State were the only roadway classification that were overrepresented.
    - In the analysis of locale, crashes involving no restraints are most commonly overrepresented in open country areas.

- Time Factors
    - The weekend days are the most overrepresented days of the week for crashes in which drivers did not use restraints. This correlates highly with impaired driving crashes.
    - In the evaluation of time of day, overrepresentation peaks during the 12 Midnight to 5 AM period and then tapers off, falling back below crashes involving causal drivers who use restraints in the 7 AM to 7 PM time periods. Additional cross-tabulations were performed for crashes involving injury.

- Analysis of Time of Day by Day of Week.
    - Crosstab analyses of time of day by day of the week of crashes in which restraints were not used enables officers to determine target times and days to enforce restraint laws so that severe crashes may be prevented. Three analyses were performed and compared for three target groups: rural crashes, crashes caused by drivers 16-20, and crashes caused by drivers 21-25. While the rural and 21-25 crosstabs were expected to correlate very heavily with impaired driving, it was found that the 16-20 year old causal drivers were not very much different. It

seems clear that while they might not be involved with alcohol or drugs, they are out and engaged in risk-taking practices at the same time as the impaired driving by their older driver counterparts, further compounding the problem at these times. The drivers 16-20 would also reasonably be expected to be overrepresented in the week-day after school hours in the proximity of their schools and after-school activities.
    - The cross-tabulation of time of day by day of the week that was restricted to injury crashes only showed a very high resemblance to the same analysis for impaired driving (alcohol and other drugs involvement).

- Crash Causal Factors
    - The overrepresentation factors indicate that certain risk-taking behaviors are often associated with crashes in which restraints are not used, including DUI, over the speed limit, aggressive operation, running off the road, and fatigue/sleep.
    - Crashes attributed to drivers who used no restraints are greatly overrepresented in vehicles with model years 1960-2003, which could be attributed to the lack of standard safety restraints in some of these older model vehicles, or perhaps the removal of these safety devices over time.
    - The speed at impact for crashes for this type of crash is overrepresented in all of the categories above 40 MPH, indicating that these crashes consistently occur at higher speeds than crashes in which restraints were used by the causal driver.

- Severity Factors
    - Fatal, incapacitating, and non-incapacitating injuries are all overrepresented in crashes where drivers were not restrained; this analysis quantified the benefits of the restraint use.
    - Fatal injuries in crashes where no restraints are used are highly overrepresented on interstate, federal and state roadways. "Possible Injuries" were highly overrepresented on municipal highways.
    - Analysis of injuries shows that the proportion of injuries (including fatalities) in unrestrained driver crashes is overrepresented from 1 to 7 injuries per crash. Crashes without restraints are clearly causing much more severe injuries and a greater number of injuries and fatalities per crash.
    - The proportion of fatalities in general as well as the proportion of multiple fatality crashes is dramatically overrepresented in crashes where the causal driver is unrestrained.
    - As expected, ejection of the unrestrained driver is overrepresented, indicating one major cause for many fatalities in which safety equipment is not properly utilized.

    - All types of injuries, including fatalities, are consistently overrepresented in crashes where no restraints were used.

- Driver Demographics
    - Analysis of individual driver ages indicates that crashes involving no restraints are overrepresented in drivers in and immediately above the teen driver classification (age range 19-38).
    - Male drivers account for a majority of crashes in which restraints are not used, and they are overrepresented by a factor of 1.344.

- Ejection and Back Seat Analysis
    - The non-restrained person is about 50 times more likely to be ejected than those who are properly restrained.
    - If all back-seat occupants were properly restrained it would result in a saving of 80 lives per year.