Special Study of
Response of Various Crash Types to COVID Quarantine

Weeks Ending March 10 through July 28, 2020 Data (21 Weeks)
The first 21 Weeks of the government quarantine recommendations

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1 Introduction

This report presents the results of several analyses that were performed during and subsequent to the COVID quarantine actions. The base week (Week 1 on all charts) was originally the crash results from the week of March 4-10, 2020. This week was used in the original studies, since this was the last week in which the traffic volume and mix were considered to be "normal."

It was determined by a review of the findings for Week 15 that some of the estimates for Week 1 were outliers in the sense that they were either significantly higher or significantly lower than the average over the first 10 weeks of 2020. It was determined that the average over the ten weeks itself would be a much better "Week 1" comparison. For this reason, the original Week 1 (represented by a value of 1 in the charts) has been adjusted to be the average number of crashes of each type over the first 10 weeks of 2020, i.e., the weeks before the COVID advisories were issued. We feel that the results given in this report are an improvement over those prior to Week 15, and we will continue to attempt to improve the information presented in any way that comes to our attention. For more information on this change, please see the reports for Week 14 and Week 15.

So think of the Week 1 crash frequency as *the closest number that we could derive that approximates the crash levels of the various crash types in 2020 prior to the COVID quarantine actions (March 10, 2020).* The charts answer the questions as to how the various types of crashes were reduced (or increased) with the decline in traffic after Week 1. This is now given in each of the charts by two-week average time periods. Unless otherwise noted, the numbers under the chart lines in Section 3 indicate the number of weeks after Week 1. Week 1 is the name we are giving to the baseline average chosen to gauge relative increases and decreases in the various types of crashes. Thus, "Week 1" represents crash frequency (of various types) under normal (pre-COVID) conditions.

Many things have been written regarding traffic volume ramifications of the COVID-19 virus. If this report contradicts any of those reported findings, this should not infer that either this or other sources are incorrect. They are most likely based on different state or federal data sources, which could vary considerably from state to state. The data source for the results in this report are Alabama crashes as reported by eCrash, and COVID cases in Alabama from Alabama Department of Public Health (ADPH) as well as sources given at the end of this section. Thus, the results obtained have their most direct application within the state of Alabama.

How can metrics of extremely different crash types (e.g., all crashes and bicycle crashes) be compared on the same chart? The answer is that the raw *numbers of crashes* for each are not being compared. What are being compared are the *proportions* by which the number of crashes increased or decreased in the time periods following the initiation of COVID quarantine guidance. These proportions (e.g., 0.9, 0.8, 1.2, etc.) are given on the Y axis. Too turn them into percentages, multiply by 100.

All of the crash charts contain two lines representing *fatal* and *all crashes* in order to provide a common frame of reference for comparing how the various crash types changed. In addition to all crashes and fatal crashes that are in all of the charts, the following crash types were also compared (each independently, two lines per chart);

- Speeding Crashes and ID/DUI Crashes
- Pedestrian Crashes and Bicycle Crashes
- Motorcycle Crashes and Large Truck Crashes
- Aggressive Driving and Interstate Travel
- Young Driver Crashes and Federal/State Travel
- Rural Crashes and Urban Crashes.

Their crash frequencies for the original and updated Week 1 are given in the Week 15 report.

Section 2 is a new section that has been added to show the growth of COVID cases and deaths in Alabama. Section 3 presents the crash charts that have appeared in every weekly update. The results have been smoothed by averaging every two weeks rather than showing every week as a distinct point. Even though this is less detail, the overall shape of these curves more accurately conveys the trends as compared to the weekly charts, many of which were extremely choppy.

Four additional sections appear after the standardized charts:

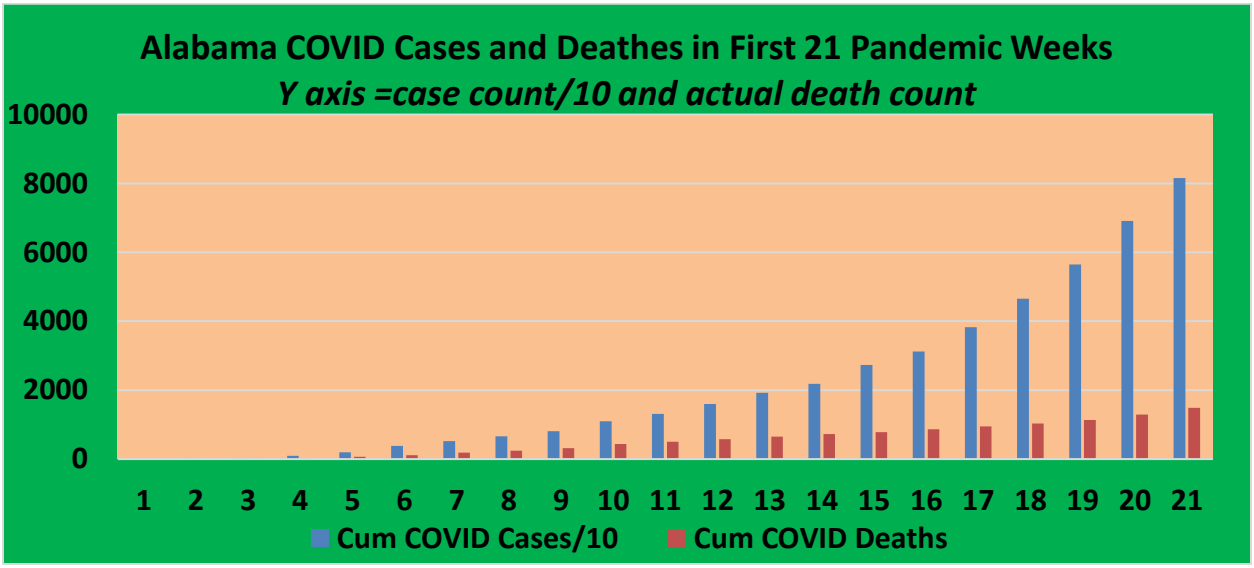
- Section 4. CARE IMPACT comparisons for several of the crash types plotted;
- Section 5. Daily comparison of fatalities in 2020 vs. 2019 starting April 1, 2020.
- Section 6. Same as Section 5, but for the first months 2019 and 2020; and
- Section 7. Correlation analysis showing how total crashes predict AADT.

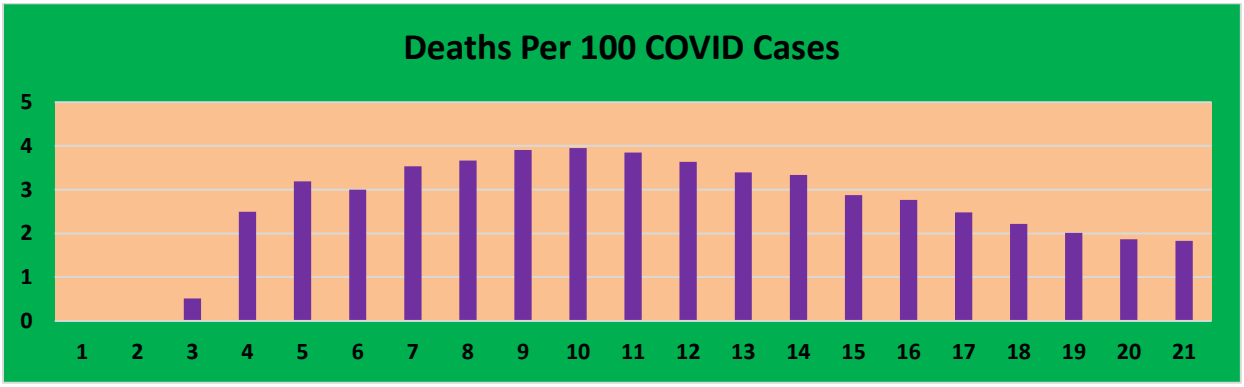
The chart in Section 7 demonstrates the very high correlation between traffic volume and crash frequency. Crash frequency is an excellent proxy measure for traffic volume, and thus the charts can be used to gauge the degree to which the drivers of the various of various demographics and vehicle types conformed to the COVID quarantine.

Credits for data sources:

(1) We appreciate the efforts of the Alabama Law Enforcement Agency (ALEA) and local law enforcement agencies in collecting these data, and ALEA's role in maintaining the crash records.
(2) We also appreciate the daily annual (2020 vs 2019) comparison of fatalities maintained by CAPS.
(3) We are updating the new Sate COVID case numbers with data from Bing:
https://www.bing.com/search?q=number+covid+fatalities+in+United+states&FORM=BAWPGLM&u=&redir=2&frb=1
(4) *Some of the early COVID fatality numbers were obtained from: John Hopkins CSSE, CDC Testing Report;* https://covidusa.net/?autorefresh=1&state=Alabama.

2 COVID Case Fatality Rate Change Over the 21 Weeks.



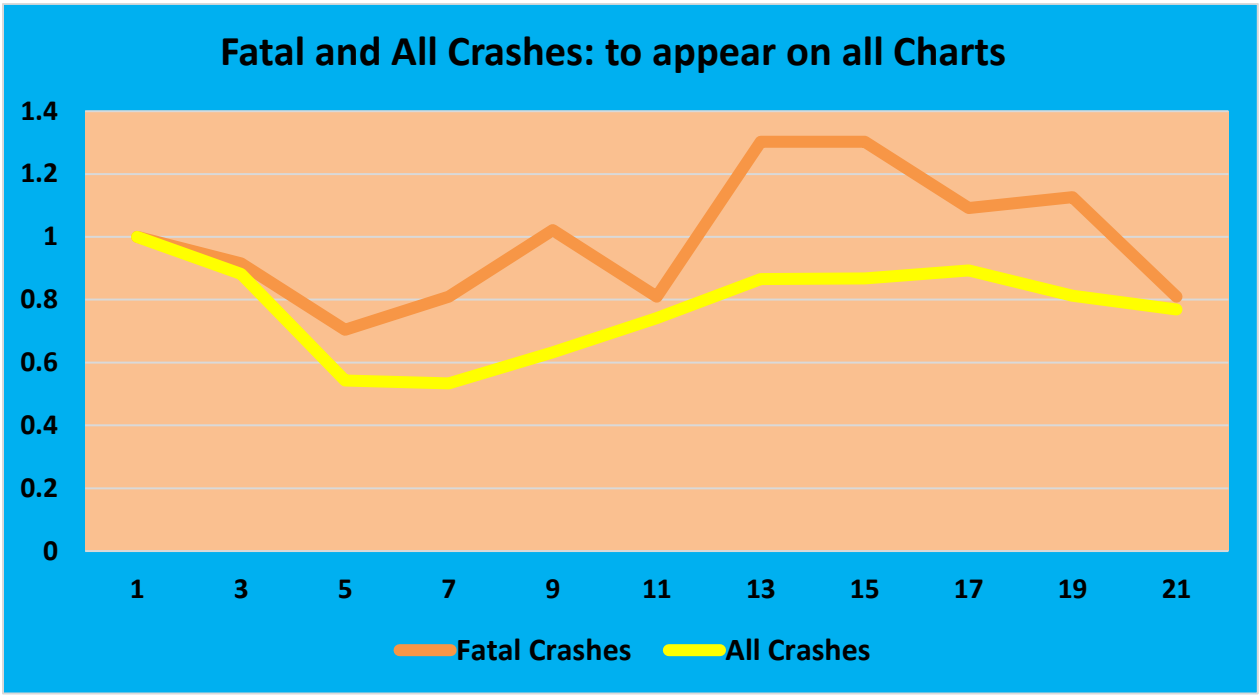


The top chart above shows how the cumulative number of COVID cases and the cumulative number of COVID deaths have increased in Alabama over the first 21 weeks of the pandemic. Note that, while the Y-axis gives the number of deaths, *it is only 1/10th of the case count.* This was done so that the cases and deaths could be shown on the same chart. Note how the case number has been increasing exponentially, especially in the most recent weeks.

The second chart shows how the probability of survival has changed over the 21 weeks. The death rate got up to nearly 4 per hundred cases (4%) in weeks 9-11, but it is now down to under two in 100 cases (2%). The actual cumulative numbers for Week 21 (ended July 28, 2020) were 81,572 cases and 1,491 fatalities for a proportion of 1491/81572 = 0.0183, which corresponds to the chart reading shown to be under 2 chances in 100. This shows how increased and better testing and other medical advances have been beneficial in reducing the proportion of cases that end in death.

3 First 21 Weeks Response Temporal Displays

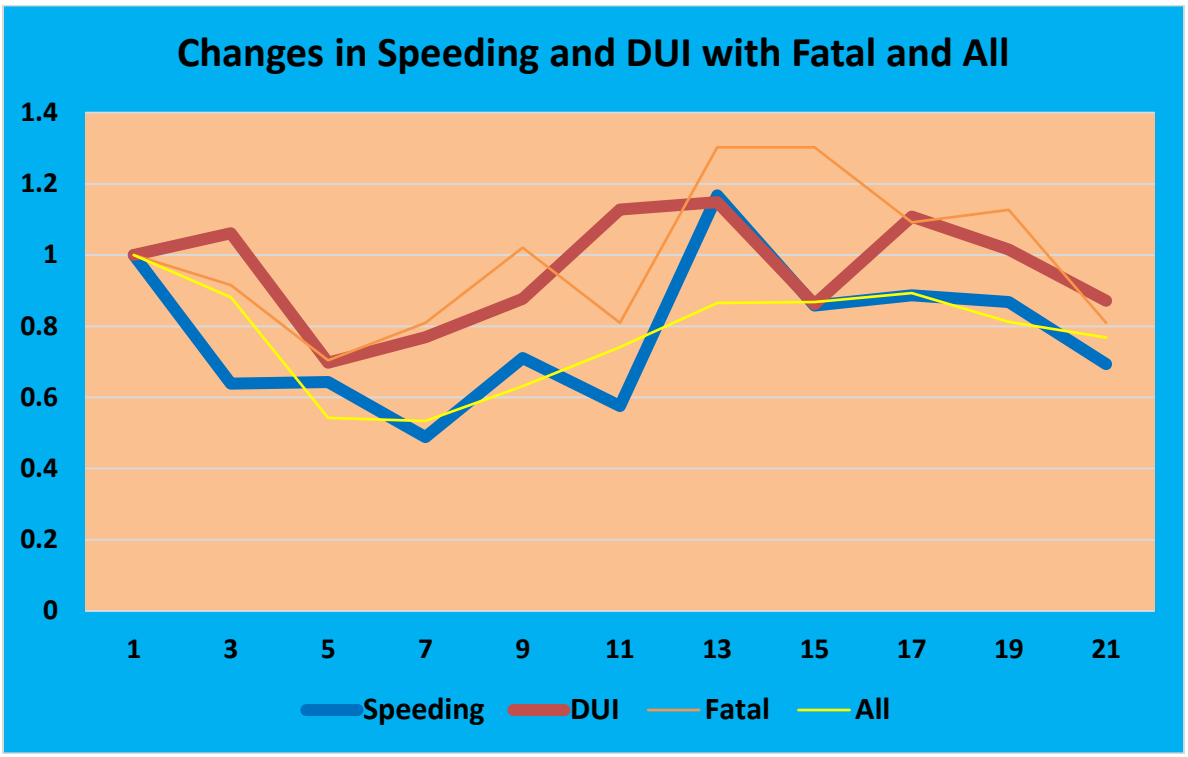
To set the stage for the comparisons to follow in this section, consider the *All Crashes* (yellow) and the *Fatal Crashes* (orange) lines in the chart displayed below. Lighter colors were chosen for these two lines so they would blend into the background of the charts that follow to prevent major distraction from the other two lines on each of these charts. Consistent with what has been observed in most states, All Crashes came down to about 50% of their pre-COVID levels. However, after Week 5, fatal crashes not only did not remain at its lower level, but more recently, it exceeded the pre-COVID levels. And, after Week 7 "All Crashes" regressed toward their pre-COVID level, and have now leveled-out at about 80% of the pre-COVID level.



In Week 11, both curves are close to 80% of the pre-COVID levels. The "All Crashes" line has now leveled out to about 80%, which is about 2000 crashes per week. Fatal crashes rose in Weeks 12 and 13 to nearly 40% higher than the pre-COVID level, and they remained at that level until Week 17. It is now at about 12 fatal crashes per week. See Sections 5 and 6 below for comparisons of fatalities in 2020 and 2019.

The following subsections will present the changes in the various crash types. The All and Fatal crash lines have been displayed with a thin line so that they do not distract from the main objectives of the charts.

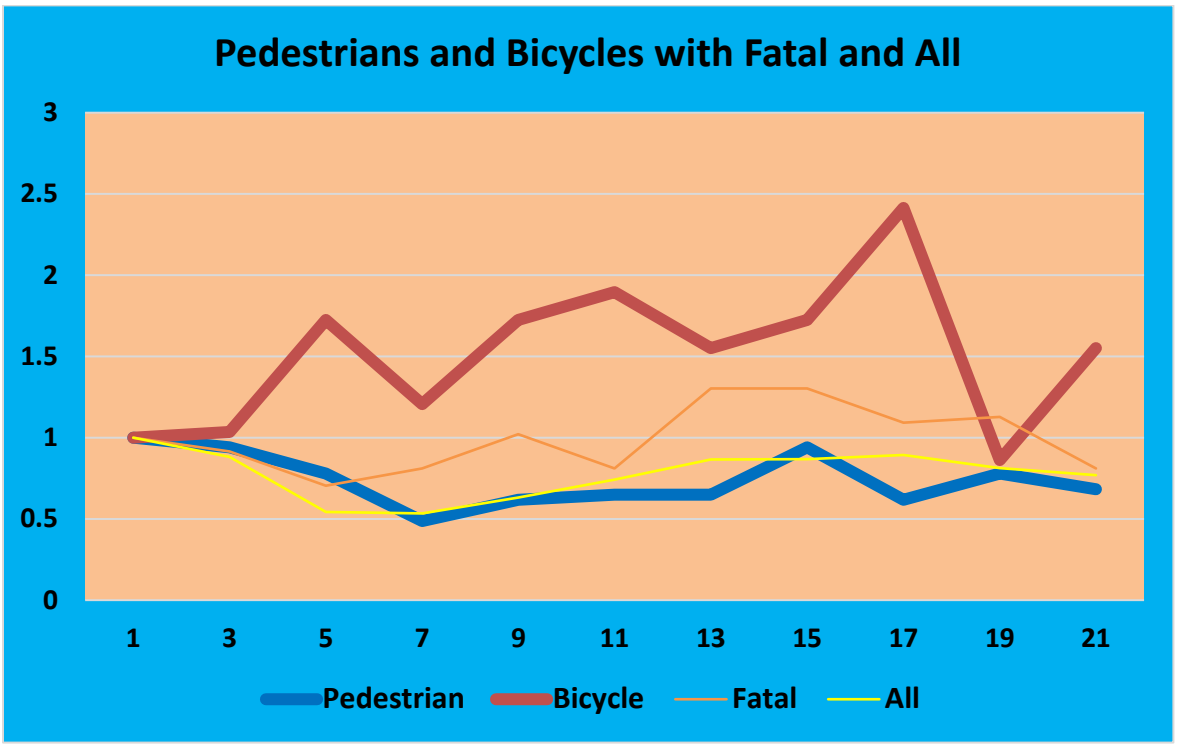
3.1 Speeding Crashes and Impaired Driving (DUI) Crashes



The dark blue speeding curve almost coincided with the red DUI in Weeks 13-15, and right after that it coincided with the All Crashes line. It is interesting to see the correlation between the Speeding and Fatal crash lines. Very few fatal crashes do not involve some degree of excessive speed. ID/DUI crashes increased in the first week, and while they decreased for a few weeks after that, it was higher than its pre-COVID proportion from Weeks 11-3 and also 17, before its recent decrease. For more details on Speeding and ID/DUI crashes, please see Section 4.1.

According to Alabama crash reports, traffic deaths as of July 14, 2020 were 6.7% lower than this day in 2019. However, the fatality rate per mile increased significantly, as it has in all states according to the National Safety Council. The total crash frequency through the end of May 2020 was 51,243, as compared to 65,898 for the end of May in 2019. This is a 22.2% reduction in total crashes, which provide an excellent proxy for traffic volume (see Section 7 of this report). However, the fatal crashes through the end of May 2019 was 333 as opposed to the end of May 2020, which was 297. This 10.8% reduction is less than half of the overall crash reduction of 22.2%. See Section 4.5 for more information on crash severity.

3.2 Pedestrians and Bicycles

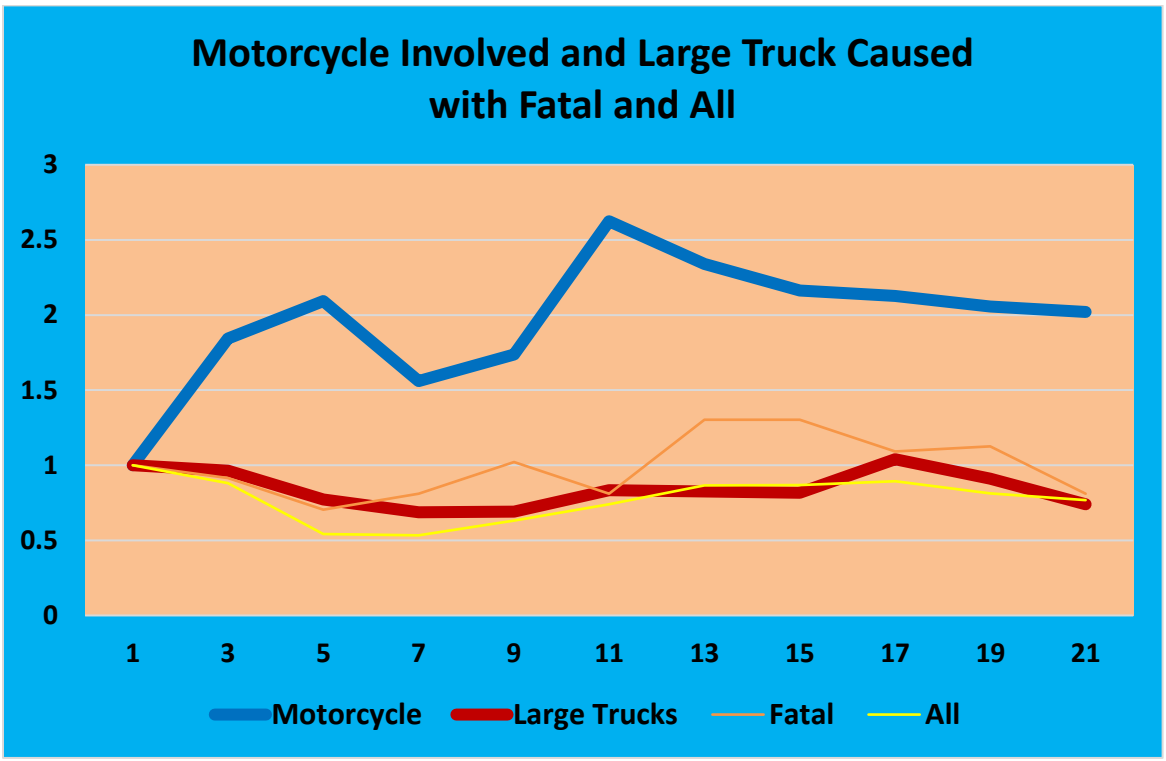


Pedestrian collisions (dark blue) had a slight rise in Week 15 but then came down to below the All Crash levels. Currently pedestrian crashes are doing about the same as All Crashes in their reductions.

Bicycles (red line), on the other hand, had a dramatic increase in crashes relative to the other crash proportions, which might indicate that a large number of new bicyclists are engaging in this activity without the normal crash avoidance habits of more experienced bicyclists. While this came down somewhat in Week 7, it has shown consistently higher levels in all of the other weeks except Week 19.

For more details on Pedestrian and Bicycle crashes, please see Section 4.3.

3.3 Motorcycles Involved Crashes and Large Truck Caused



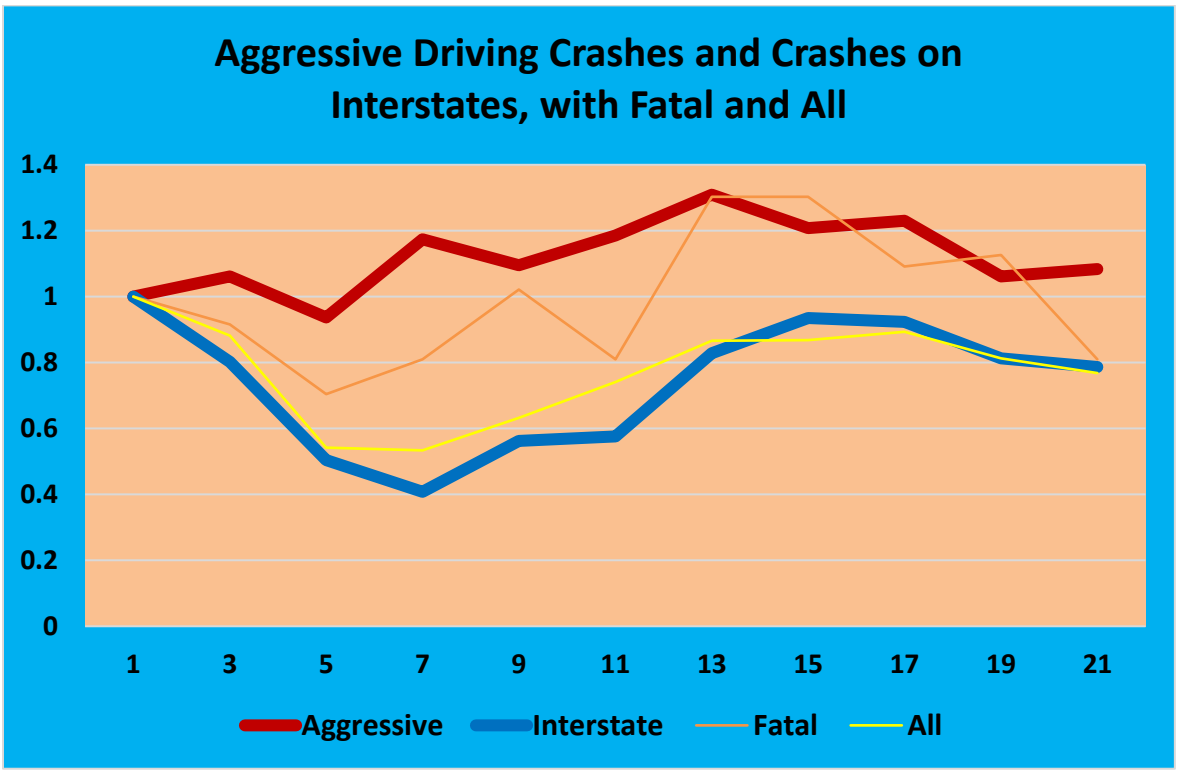
It was speculated that since the number of trucks on the road had not decreased nearly as much as passenger vehicles, that truck crashes might have relatively higher comparative proportion. This has not been the case, as can be seen by the red line on the chart. A significant proportion of two-vehicle truck crashes have historically been caused by passenger cars (especially at the higher severity levels), so fewer cars on the road would help to reduce large truck crashes. For a study of causative vehicle types in disparate two-vehicle crashes for a large variety of vehicle types and all severity classifications, please see:

http://www.safehomealabama.gov/wp-content/uploads/2018/12/At-Fault-Analyses-Discussion-v04.pdf

Clearly motorcycles (blue) have a much different pattern, and we suspect that the cause would be much the same as that discussed for bicycles above. That is, a larger number of inexperienced motorcyclists are on the road. The proportion of motorcycle crashes are well above their pre-COVID levels, and this has contributed to a relatively higher fatal crash rate. As of June 30, 2020, there were 13 fatal crashes caused by motorcycles during the COVID period.

For more information on causal unit types, please see Section 4.4.

3.4 Aggressive Driving Crashes and Interstate Crashes

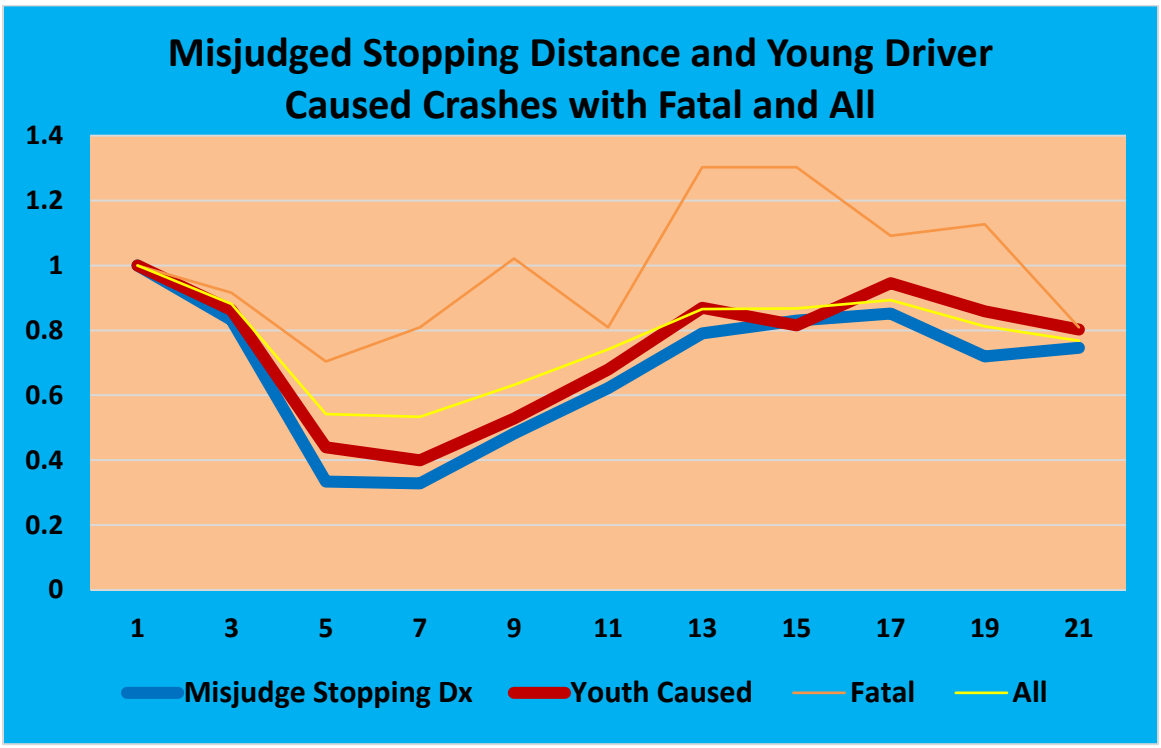


With few exceptions, Interstate travel crashes dropped off more than either fatal crashes or total crashes, which probably indicates that fewer longer trips are being taken in the COVID period.

On the other hand, aggressive driving rose after Week 5, and it has stayed the expected all crash level. It has fallen favorably in the most recent two-week period.

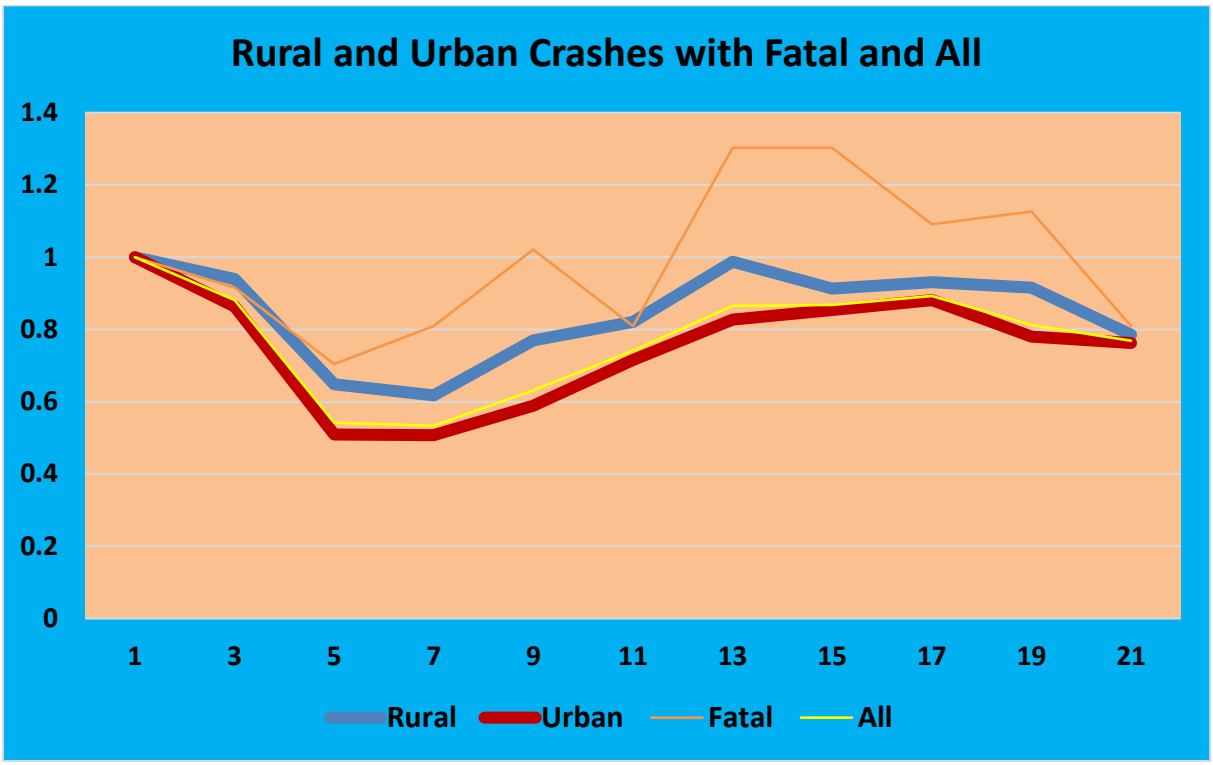
This is a time of considerable frustration on the roadways for many people. We appeal to every-one to be patient and have consideration for other drivers on the road. Driving aggressively is not going to get you there any quicker, and it might not get you there at all.

3.5 Misjudge Stopping Distance and Young (16-20) Driver Caused Crashes



Misjudging stopping distance and youth driver (aged 16-20) caused crashes were quite close, both followed the general All Crash trend in their reductions, as far as the shapes of the curves are concerned. Both of these generally had a greater proportionate reduction than the overall crashes. It is good to see that, generally, younger drivers are not causing more than their expected number of crashes in these critical times.

3.6 Rural and Urban



Since the total of Urban and Rural crashes equals All-Crashes, it is expected that one of these will be above, and the other below, the yellow (All Crash) line. Since Week 1, the Rural crashes have been above this line, and the Urban crashes have been below it. This indicates that rural driving did not fall off as much as city driving, a fact that could be out of the need for rural dwellers in securing the necessities of life.

4 CARE IMPACT Comparisons Relative to the Temporal Graphs

Unless otherwise stated, the IMPACT displays in this section are comparisons of identical crash attributes for the COVID time frame in 2020 (March 11-July 14, 2020) against all crashes in 2018, 2019 and 2020 up to the COVID time frame (before March 11, 2020). The last three days of the COVID time frame (July 12-14, 2020) had only partial reporting in the crash database. Total crashes per day in these three days averaged only about 35.4% of the average crash counts for the first 11 days of July. This has no practical effect on the IMPACT comparisons.

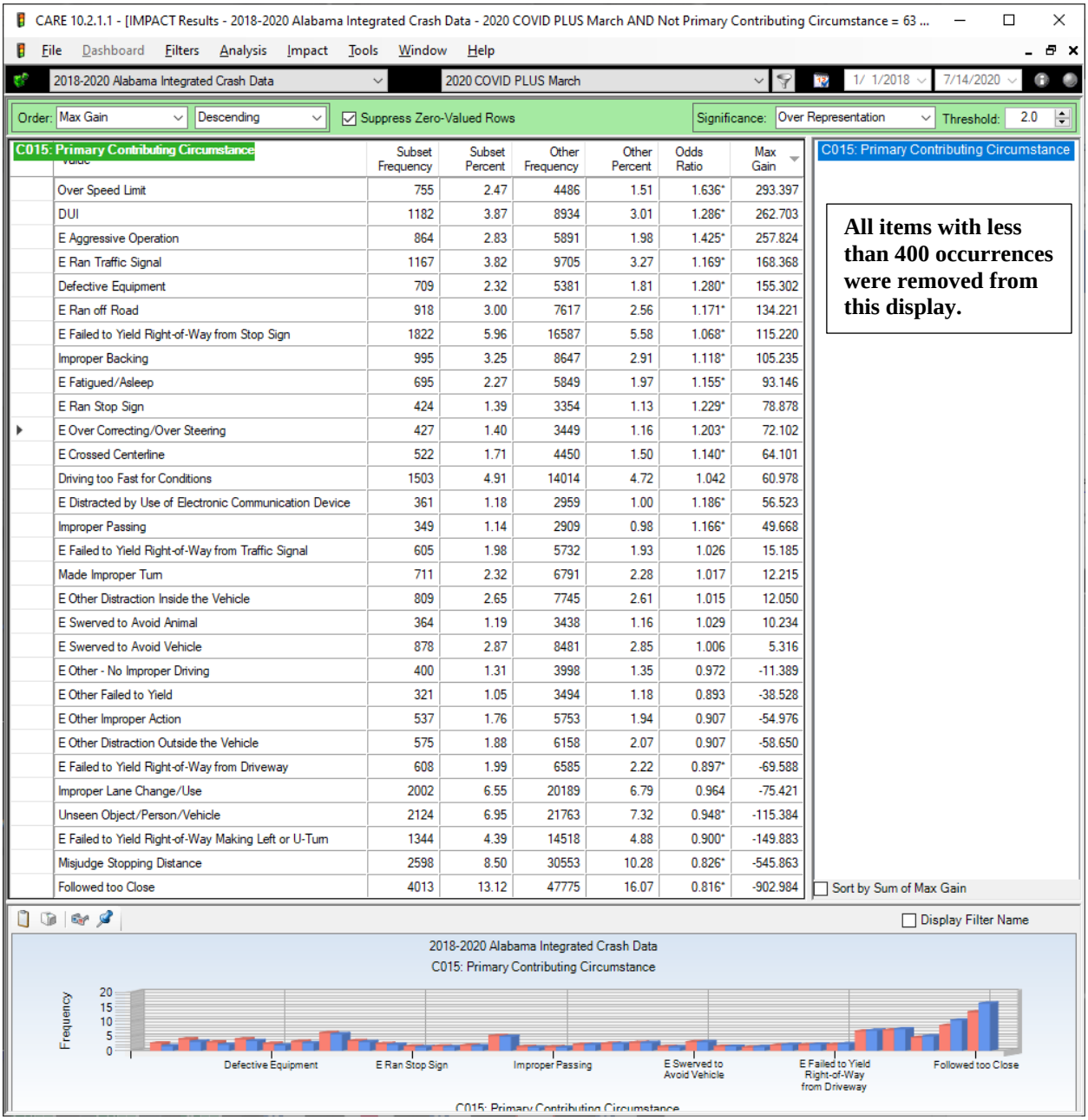
The Non-COVID time period is also referenced as "Normal" in some of the comments below.

For instructions on reading and use of IMPACT, please click here:

https://www.technolytix.net/uploads/2/2/7/6/22761914/description_of_care_impact_output.pdf

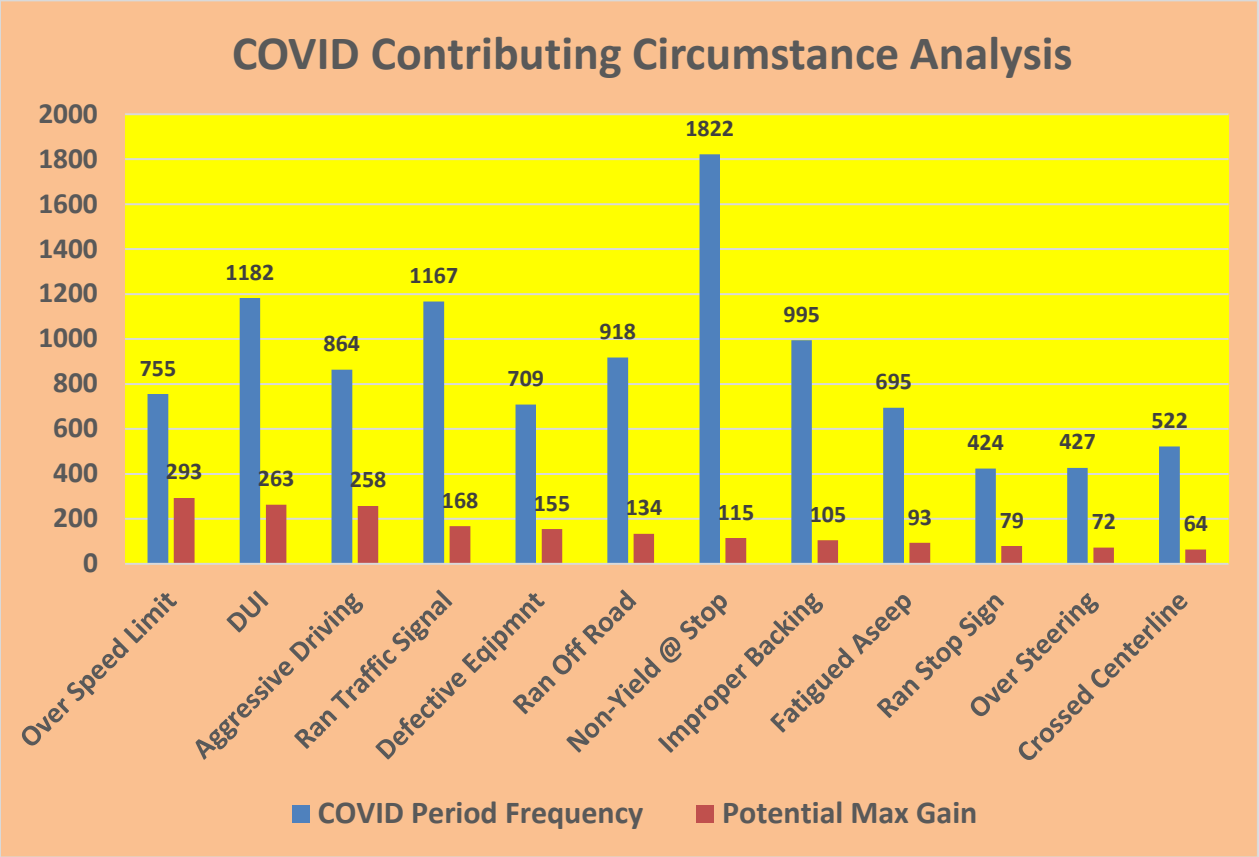
Please contact us if you have any questions or see any way we can help.

4.1 C015 Primary Contributing Circumstances (PCC) – See 2.1 and 2.4



The most significant over-representations are seen in Speed, DUI and Aggressive Operation, which is consistent with the graphs in Sections 3.1 and 3.4. An asterisk (*) on the Odds Ratio value indicates that there is a significant difference in this item between the COVID and the Normal periods. There were 12 items that showed significant over-representations, the top three were Speed, DUI and Aggressive Operation. See the graph in the next section for a comparison of all of the significantly over-represented PCCs.

4.2 Comparison of All Significantly Over-Represented PCCs.

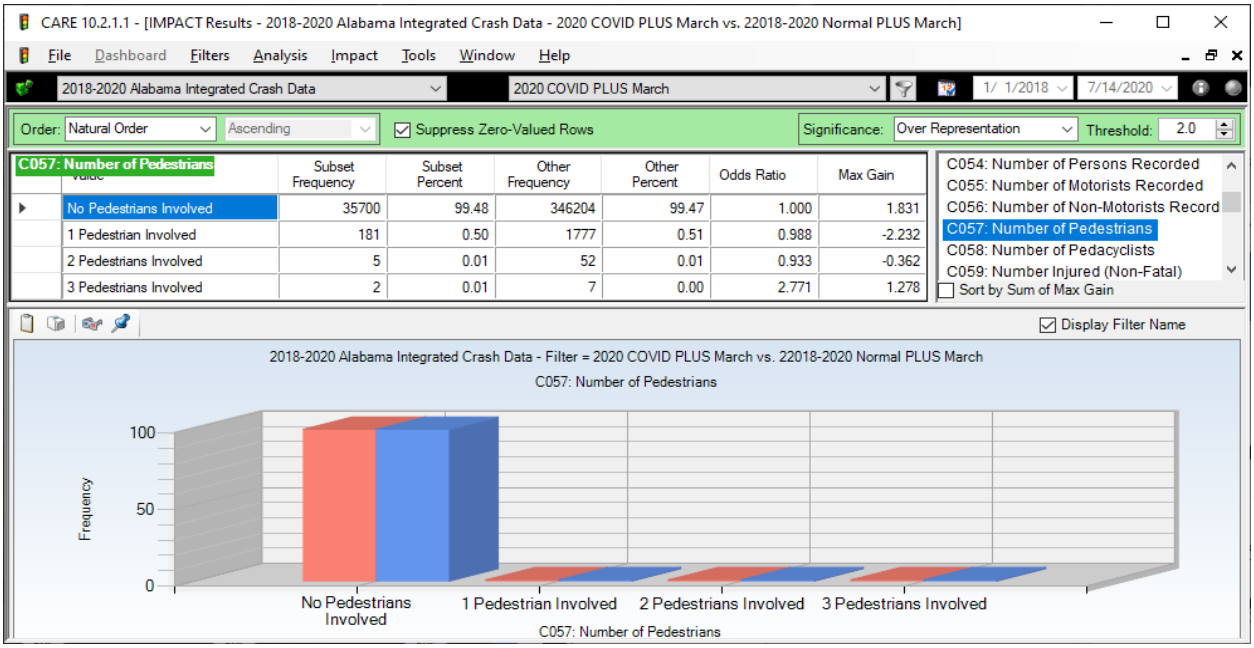


This chart has been updated with data to the middle of July, with reporting drop-off on July 12, 13 and 14 due to reports not getting into the system at the end of the period. The over-represented PCCs are ordered left to right from those that have the highest potential for crash reduction (Max Gain) to those with the least. In this application, Max Gain is defined as the number of crashes that would be reduced if drivers in the COVID time period behaved as those in the Normal time period (i.e., pre-COVID 2018, 2019 and 2020 through March 10, 2020).

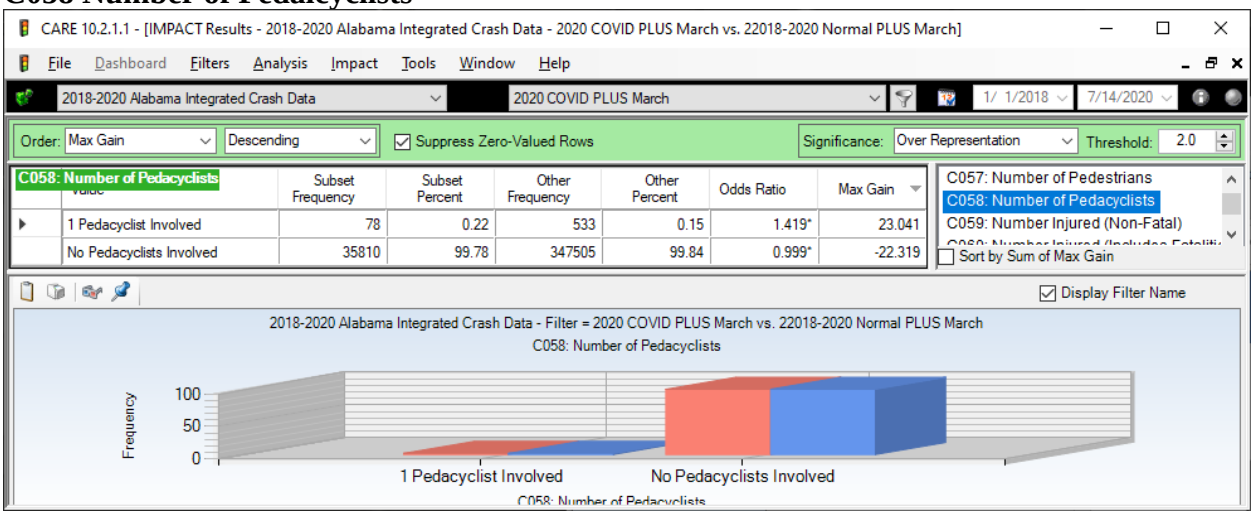
The top three (Over Speed Limit, DUI and Aggressive Operation) have over 200 potential crash reductions each, and they largely account for the reason that fatalities have not gone down as much as overall crashes have. The next tier of three (Ran Traffic Signal, Defective Equipment, and Ran off Road) also have nearly identical Max Gains at 166, 154 and 133. Failure to Yield at a Stop Sign also shows a fairly large gain with 112, even though it has the highest frequency of all of the PCCs shown. The rest have fewer than 100 each, but their importance should not be disregarded, since they still represent significantly more occurrences in the COVID time period than in the Normal pre-COVID period.

4.3 C057 and 58 Pedestrians and Bicycles Involved – Compare with 3.2

C057 Number of Pedestrians

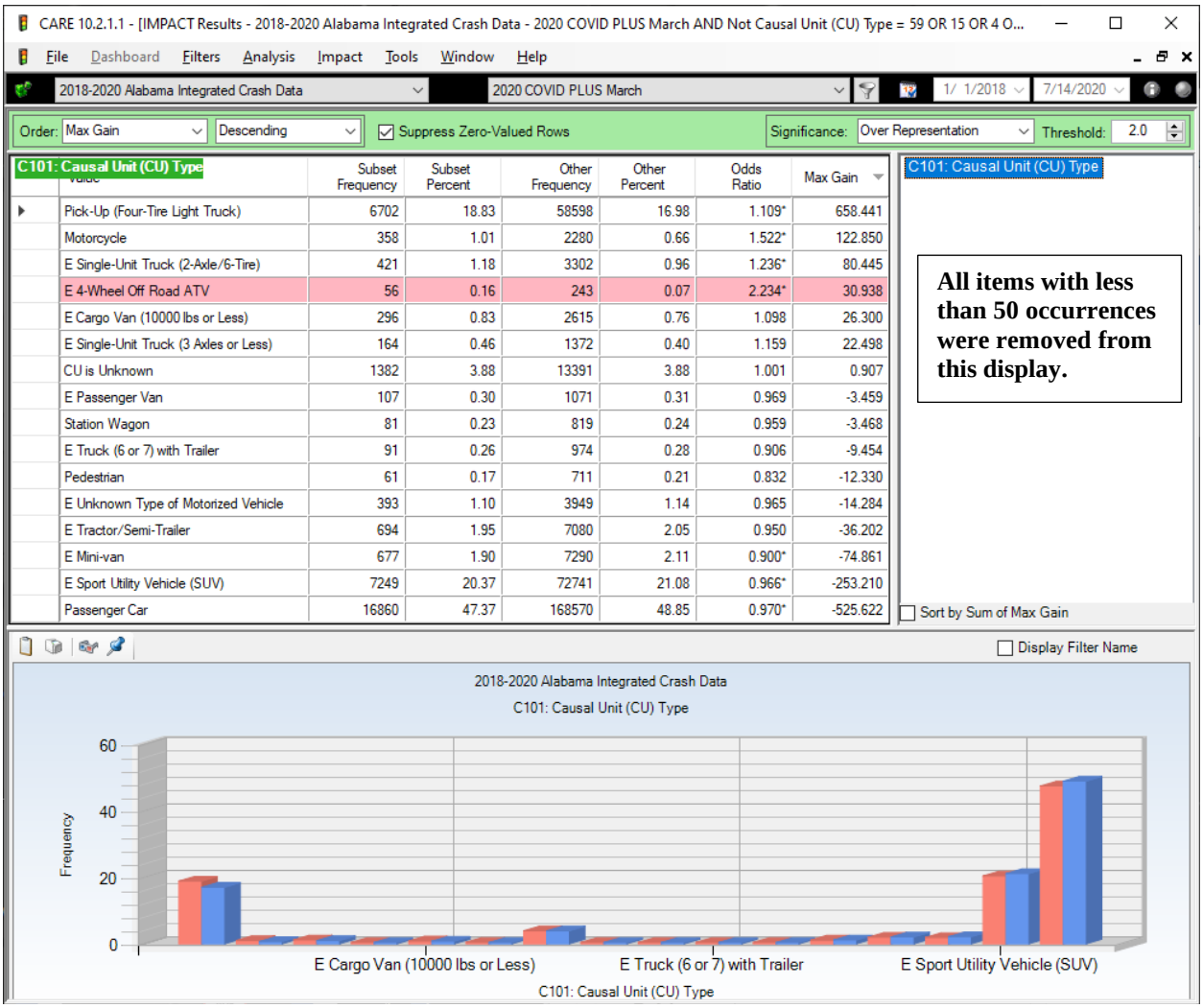


C058 Number of Pedalcyclists



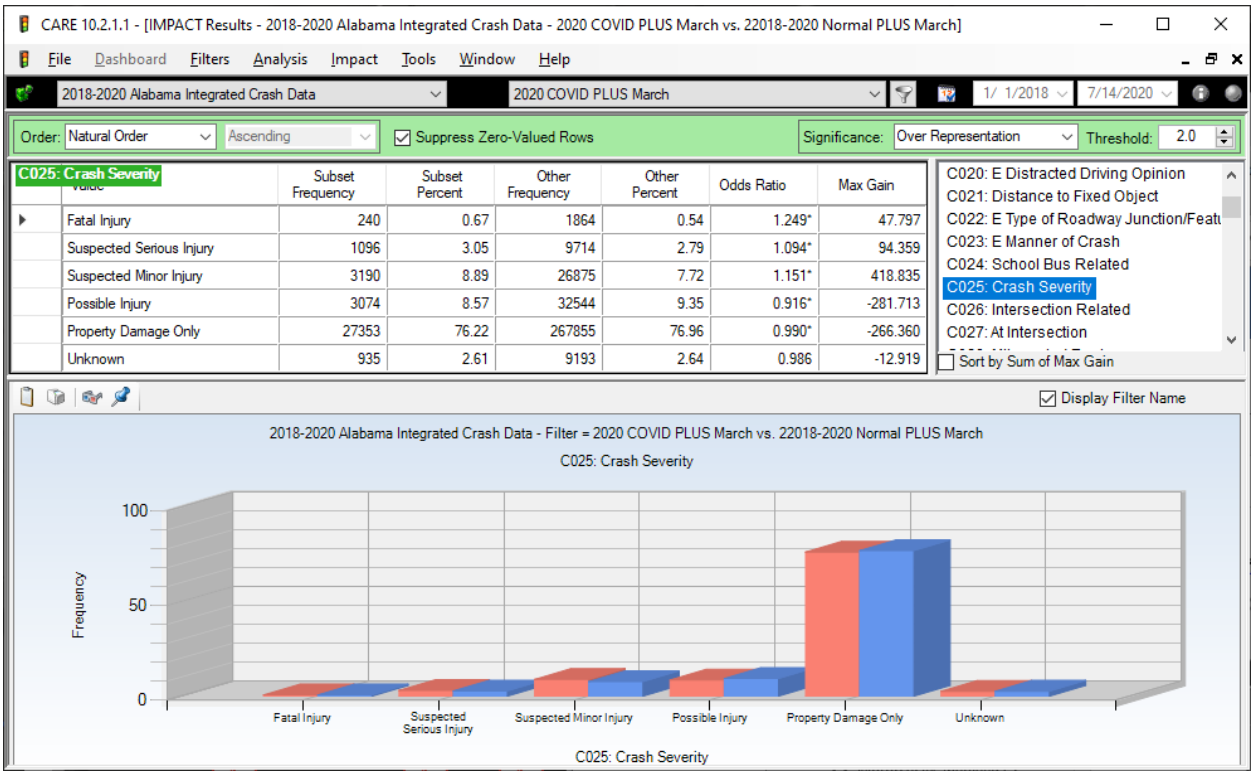
Bicycles had a much greater proportionate increase than did pedestrians as was shown in Section 3.2. Pedestrian count changes were not above what could be expected from random variation. On the other hand, the bicycle proportion increased by a factor that was 41.9% higher for the COVID period than for the Normal period, which is shown as a statistically significant increase.

4.4 C101 Causal Unit (CU) Type – Compare with 3.3



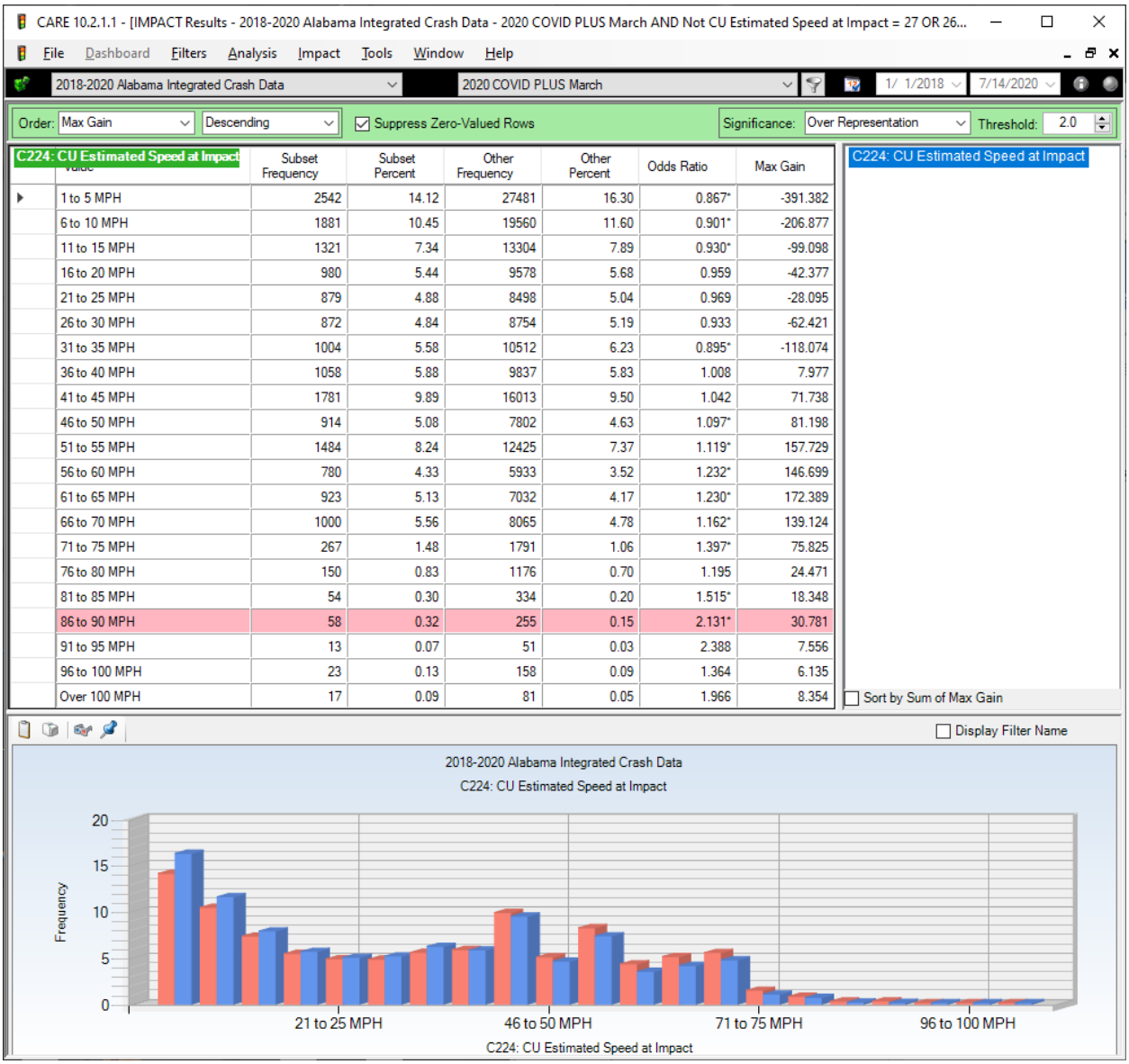
There was a significant increase in pick-ups and motorcycles; and a reduction in SUVs and passenger cars. The increase in the proportion of motorcycles was and additional 52.2% compared to the normal time period (see Section 3.3), which was over 4 times the increase seen in pick-ups. The larger trucks did not appear to have significant increases, as was shown in Section 3.3.

4.5 Crash Severity



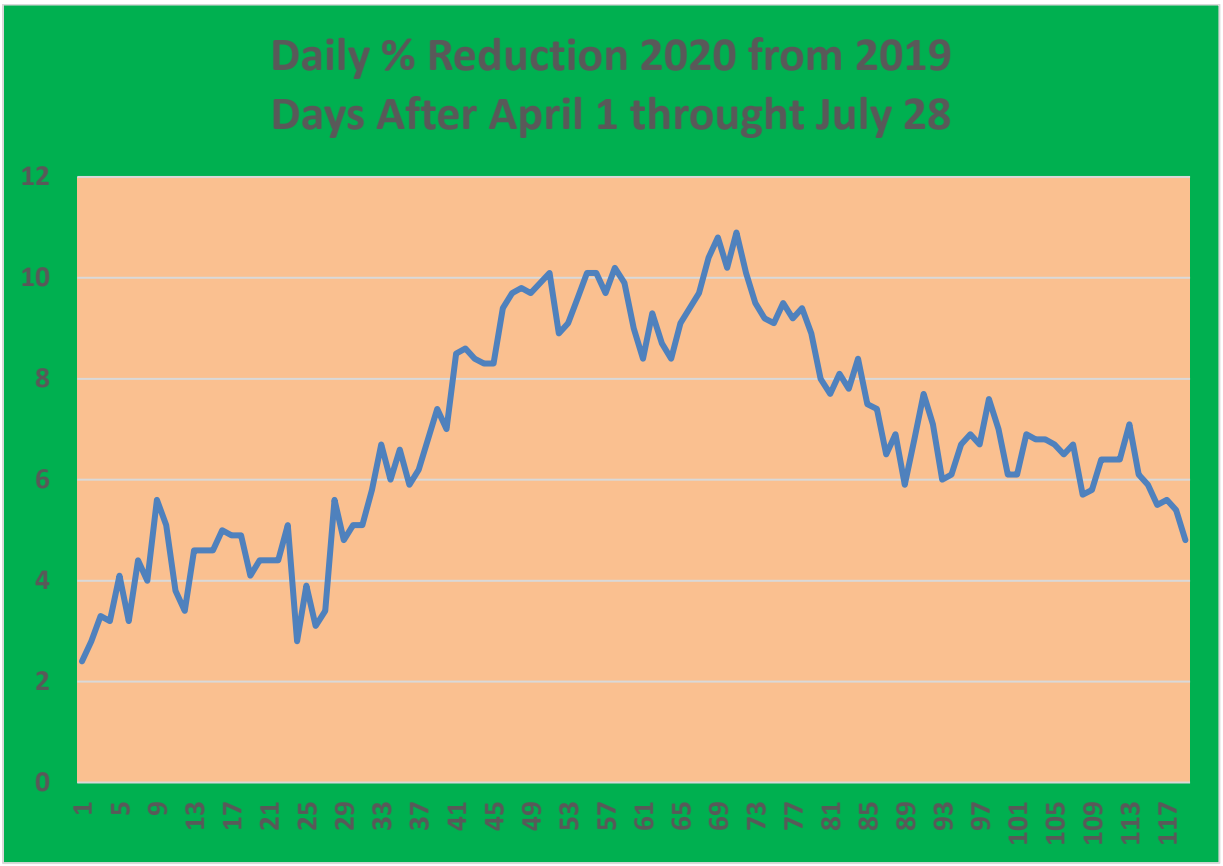
This result indicates that the proportion of fatal injury crashes for the COVID period it 1.249 times that of the Normal comparison period being used for the control. Its Max Gain is 47.8, which indicates that had the same driving habits and environment been in effect in the COVID period as the Normal period, about 48 fatal crashes would have been reduced. The cause of this severity increase in these crashes are given by the Primary Contributing Circumstances covered in Section 4.1. Suspected Serious Injury and Suspected Minor Injury were both over-represented, adding more evidence that the COVID period crashes produced greater injury than Normal. On the other hand, the under-representation in Possible Injury and Property Damage Only were both statically significant.

4.6 Causal Unit Estimated Speed at Impact



Alabama data has shown that for every ten miles per hour of impact speed over 45 MPH, the probability that the crash will be fatal doubles. There can be no doubt that impact speeds during the COVID period have been significantly higher than than Normal. All of the impact speed above 46-50 (effectively 50 MPH) show significant increases in their proportions. The only exceptions are the bottom three, two for which significance is not calculate (less than 20 sample size). However, these Odds Ratios are quite high, and the Max Gains show the consequences of such excessive speeds.

5 Daily % Reductions in Crash Fatalities after April 1, 2020.



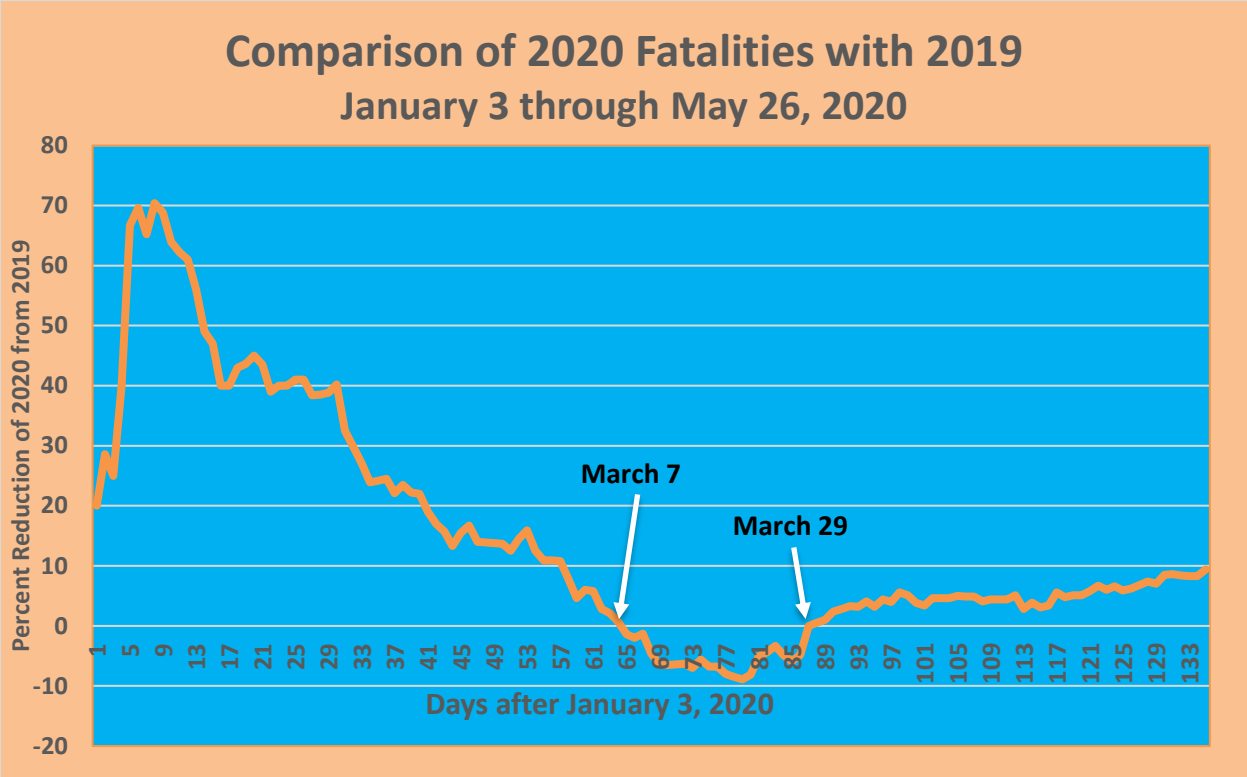
The chart above gives the percent fatality reduction for each day in 2020 compared to the identical days in 2019 from April 1 through July 28 of both years. These are *daily readings* as opposed to the charts in Section 3, which are the changes in the various types of crashes over two-week periods. This chart, as well as the one on the following page, are also reporting *actual fatalities* as opposed to *fatal crashes*, which are what is reported in the charts in Section 3.

Rather than starting on January 3, 2020 (as is true of the graph in the next section, this chart starts in April 1, 2020. The numbers on the X-axis here are the number of <u>days</u> after April 1, 2020. The exact readings for July 28 were: 524 fatalities in 2019; and 499 fatalities in 2020; a reduction of 4.8% as of that date. Unfortunately, the general trend of this metric is down from over 10% in June 11, 2020. We are quite hopeful that this trend is reversed soon.

See the next section for a review of the same metric. but from the beginning of the year until May 26, 2020.

6 Percent Reduction in 2020 Traffic Fatalities vs. 2019.

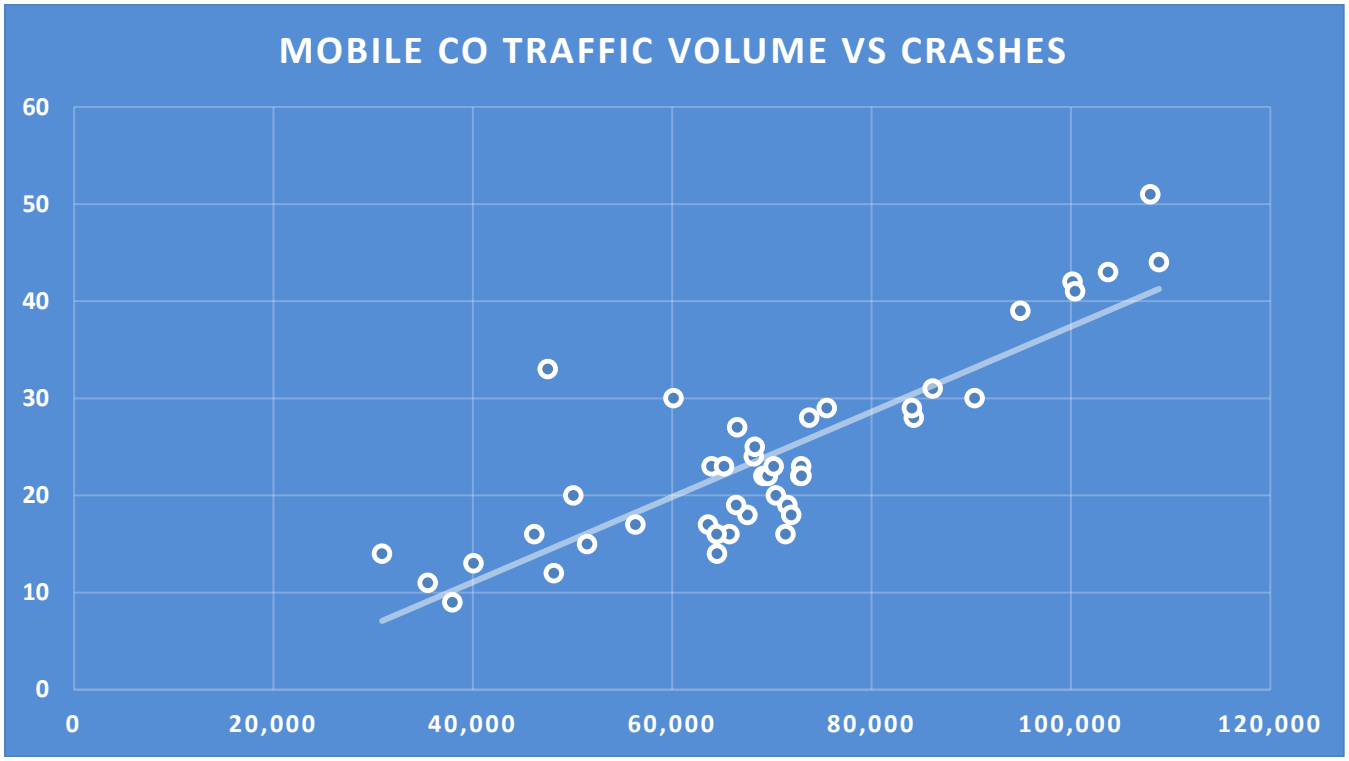
The following is for the first four months of the two years.



Alabama started off year 2020 with major reductions in fatalities compared to 2019. At one point it had a 70% reduction, but this was early in the year before there were enough daily numbers to do any reasonable statistical comparison. From this high, it slid down in almost a straight line until March 7, when it reached the zero break-even point (same in both years). At that point in time the 2020 fatalities numbered exactly what they did in 2019 – no percent reduction.

March 7 is within our "Week 1" (March 3-9, 2020) for the charts in Section 3. Recall that Week 1 was the last week before the COVID quarantines took effect, but the number of crashes for the comparisons have been updated to be the average of the first ten weeks in 2020. It is strictly coincidental that this was the week in which the fatality counts for 2019 and 2020 became identical. As can be seen from the chart, the 2020 increase in fatalities continued past March 7, and it was not zero again until March 29, well after the first quarantines had taken effect. This chart extends until May 16, 2020, and it will not be updated.

7 Correlation Analysis: Relationship between ADT and Crash Frequency.



The regression above, with a correlation coefficient = 0.8430, indicates a nearly perfect relationship between Crashes and Average Daily Traffic (ADT). This analysis, which considered the identical roadway and a similar traffic mix, was performed where the differences in traffic volumes were due solely to the quarantine caused by COVID. Volume and crashes were compared over 43 days from 3/9/2020 to 4/23/2020, and the correlation coefficient of the resulting least-squares regression line was 0.8430, which indicates an extremely high correlation. The sample of traffic volume was obtained from I-10 at Milepost 3.

The conclusion that can be drawn from this is that the major portion (virtually all) of the variations experienced after Week 1 (March 3-9) were due to the reduction in traffic volume. The only other cause of it could have been that the drivers remaining on the road (after the COVID quarantine went into effect) were of superior skill and experience. While we believe this is true, and that it had some effect, its effect would be relatively small compared to the reduction in traffic volume.