Special Study of
Response of Various Crash Types to COVID Quarantine

Weeks Ending March 10 through July 14, 2020 Data (19 Weeks)
The first 19 Weeks of the government quarantine recommendations

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1 Introduction

This report presents the results of several analyses that have been 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.

All cases where the "Week 1" base has been changed are given in Table 1 below. Although several of these now are not close approximations to the original Week 1 values, we will still for consistency call them "Week 1." 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.* 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 two week periods 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 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 sources given at the end of this section. Thus, the results obtained have their most direct application within the state of Alabama. See credit statement at the end of this section.

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.

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, which 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.

The crash frequencies for the above for the original and updated Week 1 are given in Table 1.

Table 1. Original and Updated "Week 1" Crash Frequencies

Crash Type	Original Week 1	Updated Week 1
All Crashes	3,445	2,794
Fatal Crashes	22	14
Speeding Involved Crashes	141	207
Impaired Driving (ID/DUI) Crashes	99	97
Pedestrian Involved	19	15
Bicycle Crashes	4	3
Motorcycle Crashes	22	14
Large Truck Caused Crashes	132	104
Aggressive Driving Crashes	53	44
Crashes on Interstate Highways	435	321
Misjudged Stopping Distance	315	257
Young Driver (16-20) Caused Crashes	522	404
Rural Crashes	790	665
Urban Crashes	2,655	2,129

The Y axis measures how much the particular crash type either increased (greater than1) or decreased (less than one) from Week 1. Multiply by 100 to turn these proportions into percentage increases or decreases. Comments are given beneath each of the charts.
Section 2 is a new section that has been added to distinguish some global comparisons of COVID cases and crashes. A new line has been added to this chart to show the cumulative number of COVID fatalities in Alabama.

Section 3 presents what we are calling the standardized charts, since they have appeared in every weekly update. They have been given a dramatically new look in this update, in that the results have been smoothed by averaging every two weeks rather than showing every week as a distinct

point. We believe that even though this is less detail, the overall shape of these curves will more accurately convey the trends as compared to the individual week charts, many of which were extremely choppy.

Four additional sections appear after the standardized charts:

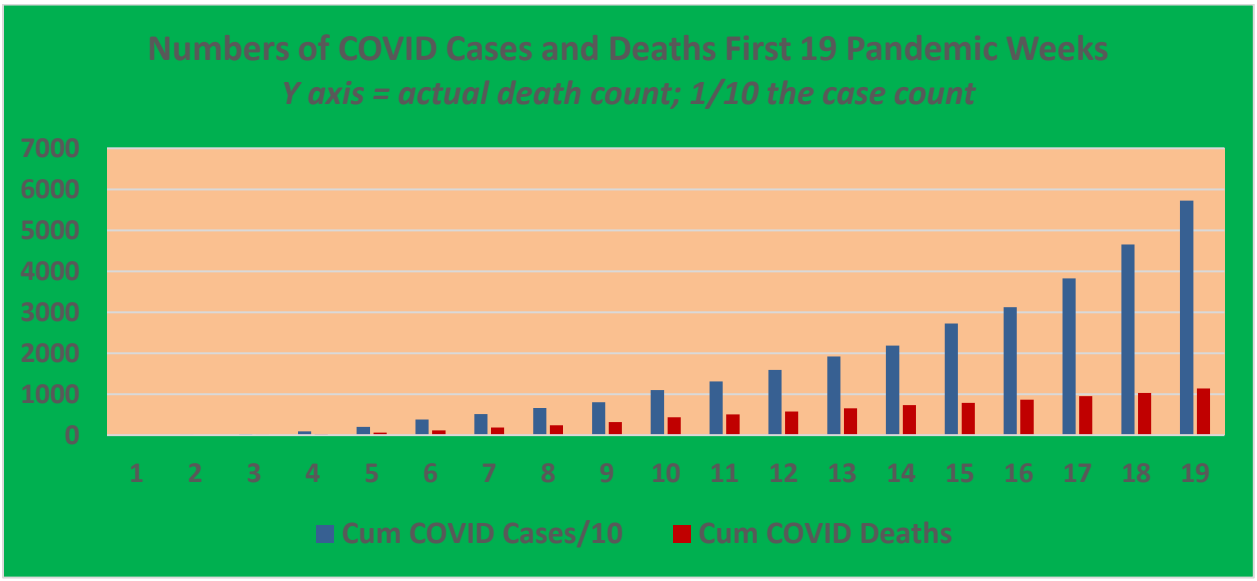
- Section 4. CARE IMPACT comparisons for several of the crash types plotted;
- Section 5. Daily comparison of fatalities in 2020 vs. 2019 starting April 1, 2020.
- Section 6. Daily comparisons, as in Section 5, but for the first months 2019 and 2020; and
- Section 7. Correlation analysis showing how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

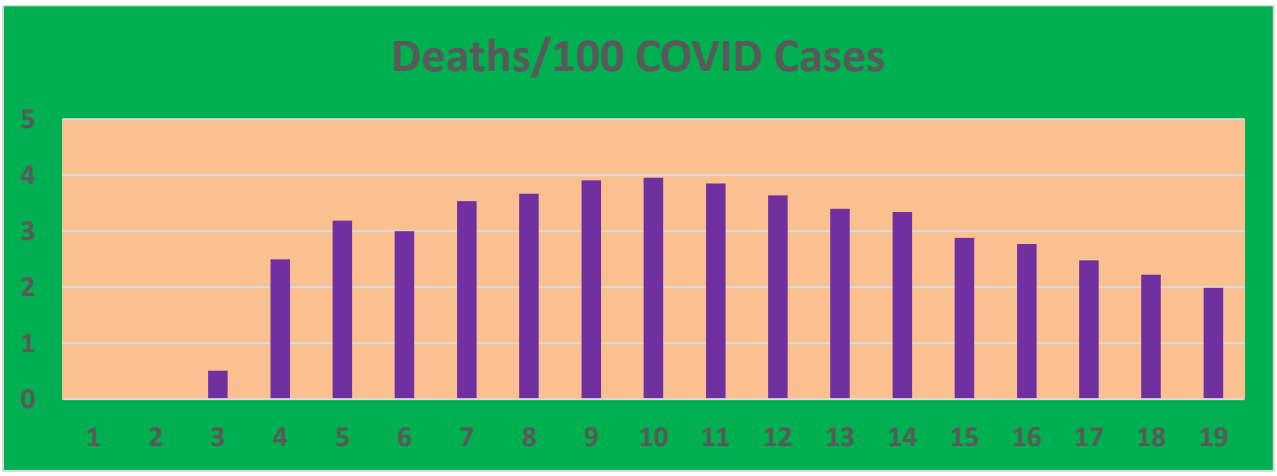
The chart in Section 7 demonstrates the very high correlation between traffic volume and crash frequency. Crash frequency is an excellent proxy measure for traffic volume, and thus the charts can be used to gauge the degree to which the drivers of the various vehicle types conformed to the COVID quarantine,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

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 19 Weeks





The top chart above shows how the cumulative (cum) number of COVID cases and the cumulative number of COVID deaths have increased in Alabama over the first 19 weeks of the pandemic. The total number of cases as of July 14, 2020 was 57,193 cases (note that the Y-axis is $1/10^{th}$ of the count in order to be able to show the number of deaths in a meaningful manner). Note how the case number has been increasing exponentially in the most recent weeks.

The second chart shows how the probability of survival has increased over the 19 weeks. The death rate got up to nearly 4 per hundred cases (4%) in weeks 9-12, but it is now down to under two in 100 cases (2%). The actual cumulative numbers in Week 19 (ended July 14, 2020) were

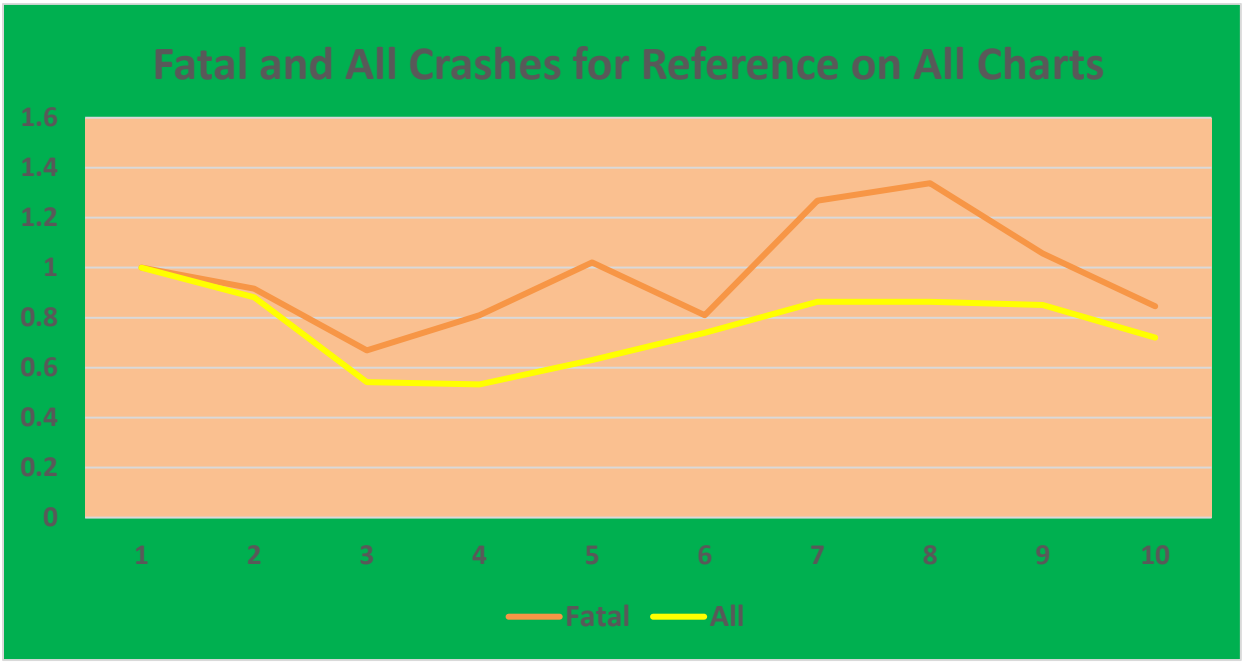
57,193 cases and 1,136 fatalities for a proportion of 1136/57193 = 0.01986, which corresponds to the chart reading of about 2 chances in 100. This shows how increased testing, the discovery of more positive cases and other medical advances have been beneficial in reducing the proportion of cases that end in death.

The most recent (Weeks 17, 18 and 19) show dramatic increases greater than 1,500 new cases per day in the most recent week, which is shown by the exponential-shaped increase in the top chart. The number of crashes is not being plotted, as it had been in the past, since it leveled out at about 2,000 crashes per week, and there has been little variation in the level over the past several weeks. It dropped somewhat in the most recent two-week period, as shown by the "All Crashes" curve on all of the charts in Section 3.

To get an idea of what lies ahead, the average of the three new COVID case average for July 15th, 16th and 17th (the first three days of Week 20) is 1,215 new COVID cases per day. Based upon these three days, we are not anticipating a significant reduction in new COVID cases for the upcoming week (ending July 21, 2020).

3 First 19 Weeks Response Temporal Displays

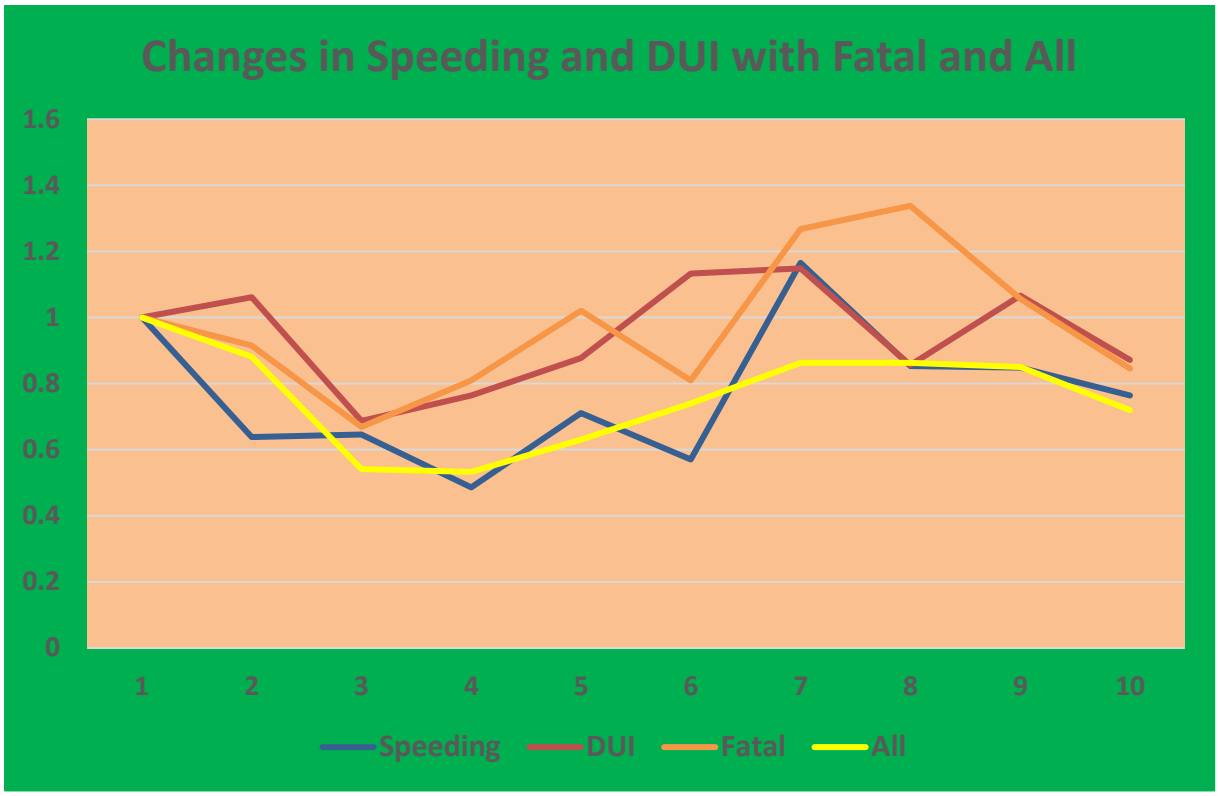
To set the stage for the comparisons to follow in this section, consider the *All Crashes* (yellow) and the *Fatal Crashes* (orange) lines in the chart displayed below. Lighter colors were chosen for these two lines so they would blend into the background of the charts that follow to prevent major distraction 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 Period 3, fatal crashes not only did not remain at its lower level, but more recently it has been well above their pre-COVID levels.



In Period 6, 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 Period 9 to nearly 40% higher than the pre-COVID level, and is now at about 12 fatal crashes per week. See Sections 5 and 6 below for comparisons of fatalities in 2020 and 2019.

Unlike the weekly points plotted on the charts in previous reports, we are now smoothing the lines with two-week averages. The numbers beneath the chart lines should be viewed as "Periods" as opposed to weeks. Generally, each numbered period consists of two weeks averaged together to smooth the curves and make them more readable. There are two exceptions to this definition: (1) Week 1, which always has the value of 1, is a single value that represents the normal (pre-COVID) crash frequency, and (2) if there is an odd number of weeks, the single recorded value during the last week is assigned for the final period value.

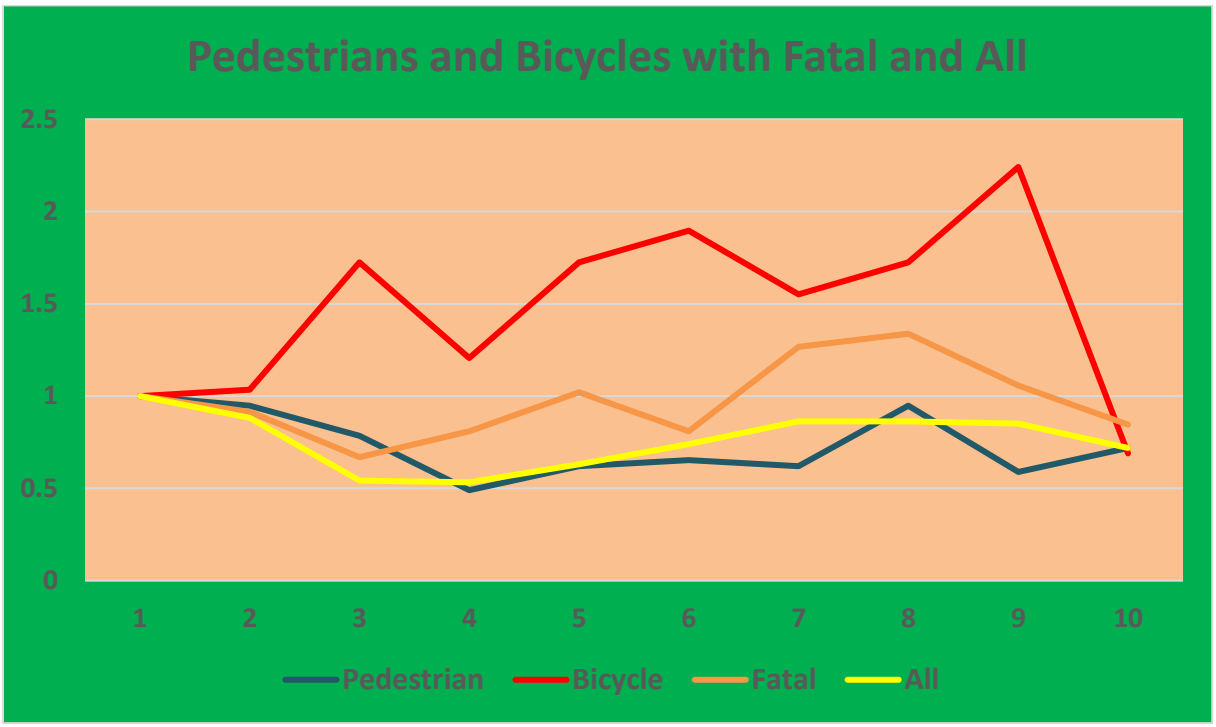
3.1 Speeding Crashes and Impaired Driving Crashes (ID/DUI)



The dark blue speeding curve almost coincided with the red DUI in Periods 7 and 8, 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 Periods 6 and 7, before recently decreasing. 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

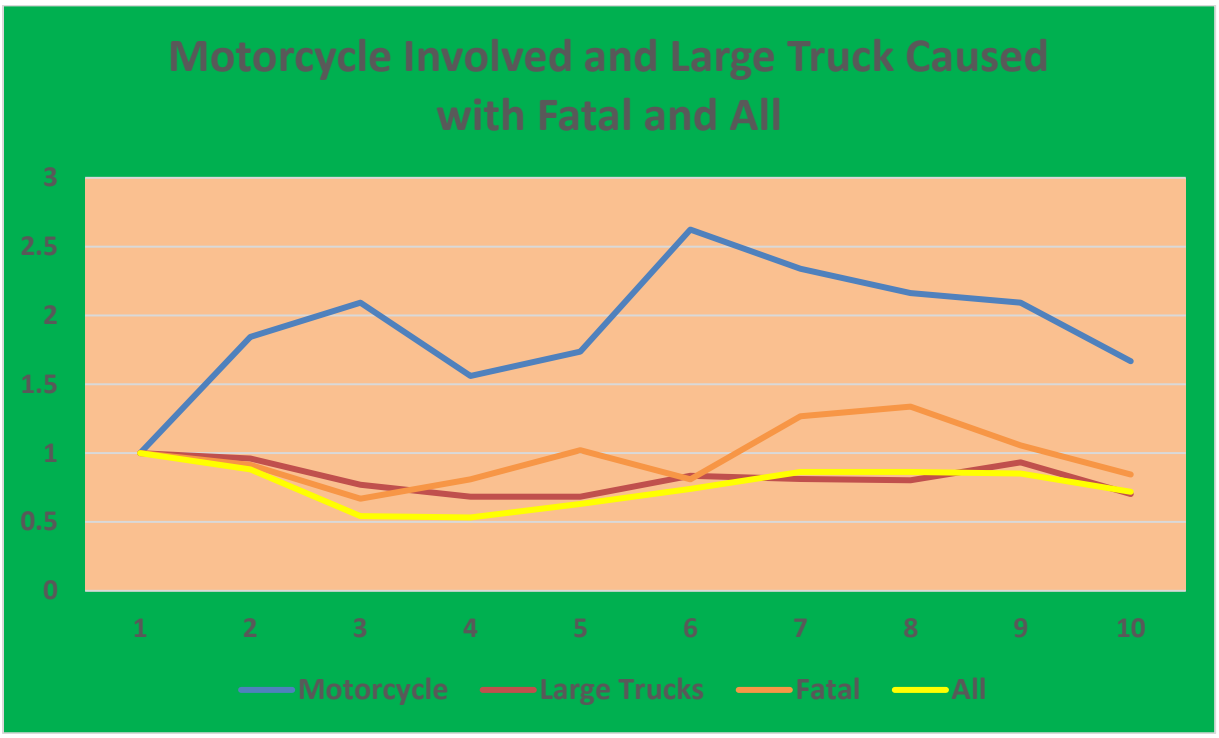


Pedestrian collisions (dark blue) had a slight rise in Period 8 but then came down to below the All Crash levels. Currently pedestrian crashes are doing about the same as All Crashes in their reductions.

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 Period 4, it has shown consistently higher levels in the other period. The most recent period is the exception, and it will be interesting to see how long this continues.

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

3.3 Motorcycles Involved Crashes and Large Truck Caused



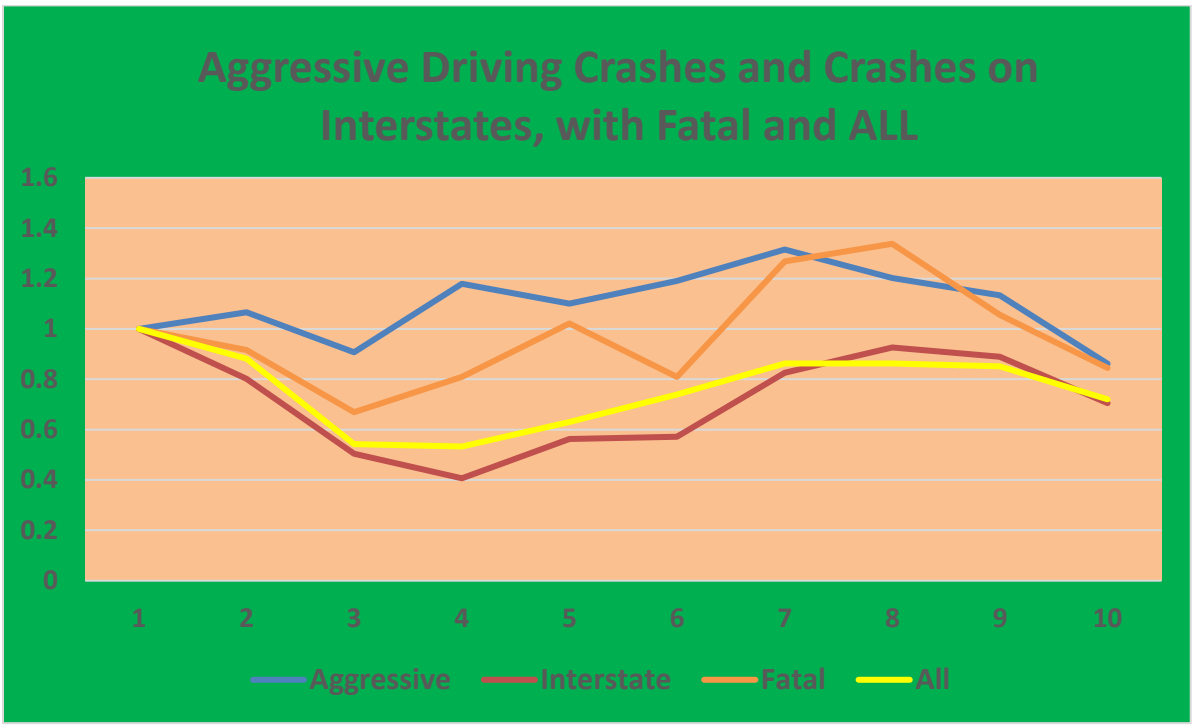
It was speculated that since the number of trucks on the road had not decreased nearly as much as passenger vehicles, that truck crashes might have relatively higher comparative proportion. This has not been the case, as can be seen by the red line on the chart. A significant proportion of two-vehicle 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

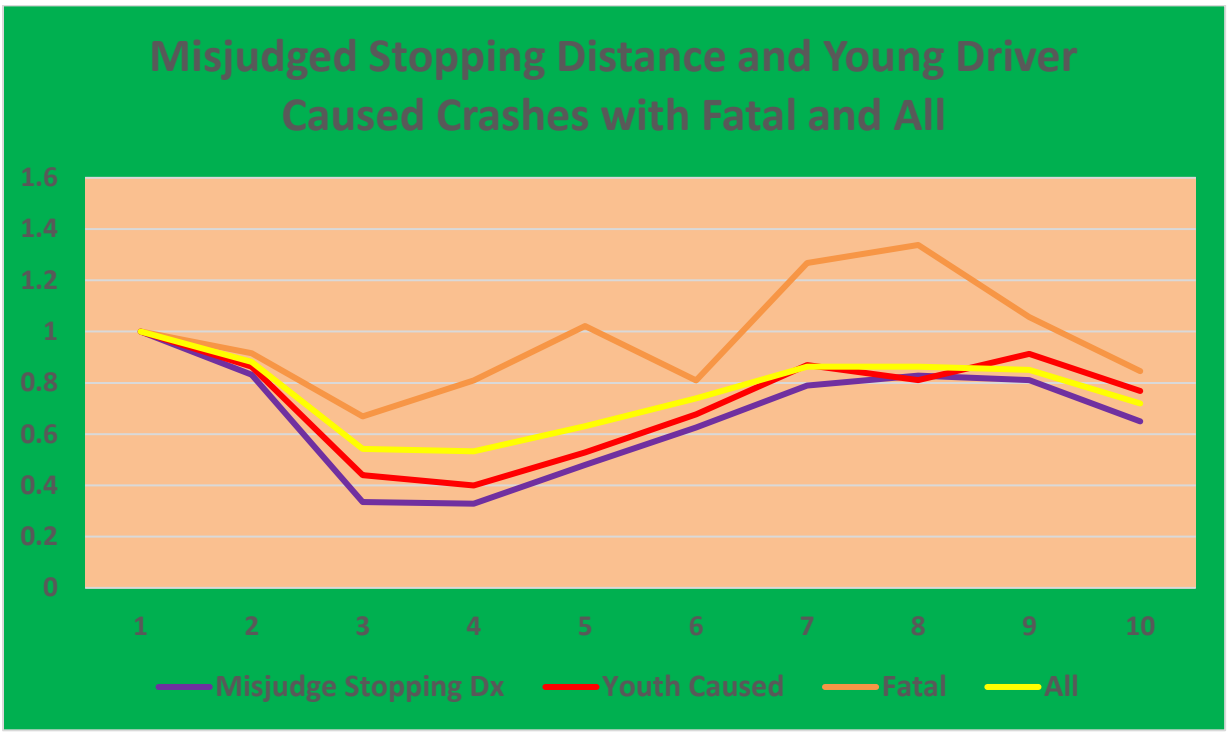


With very few exceptions, Interstate travel crashes dropped off more than either fatal crashes or total crashes, which probably indicates that fewer longer trips are being taken in the COVID period.

On the other hand, aggressive driving rose in Period 2, and then fell for the next two-week period. But after that, it has been consistently above that which might be expected (i.e., the all crash level). It has fallen favorably in the most recent two-week period.

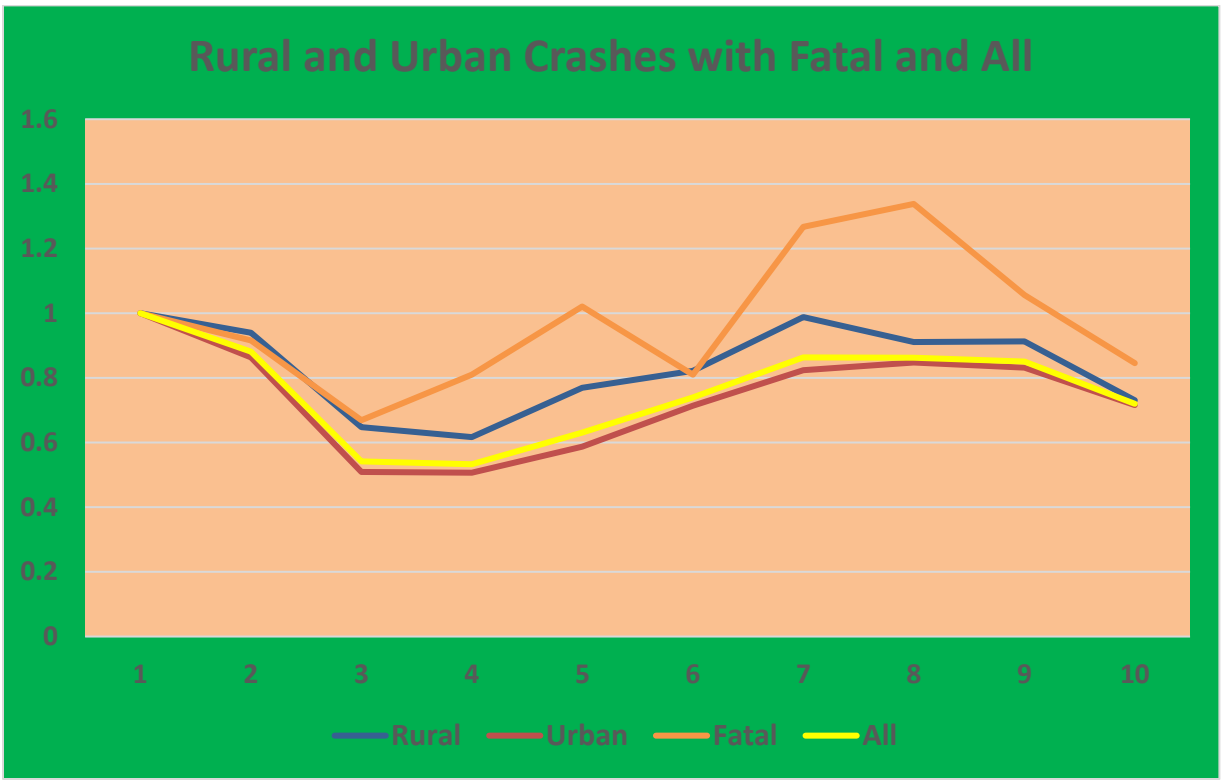
This is a time of considerable frustration on the roadways for many people. We appeal to everyone to be patient and have consideration for other drivers on the road. Driving aggressively is not going to get you there any quicker, and it might not get you there at all.

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 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-June 15, 2020) against all crashes in 2018, 2019 and 2020 up to the COVID time frame (before March 11, 2020). The last four days of the COVID time frame (June 13-16, 2020) had only partial reporting in the crash database. Total crashes per day in these four days were about 47.3% of the average crash counts for the first 12 days of June. This has no practical effect on the IMPACT comparisons.

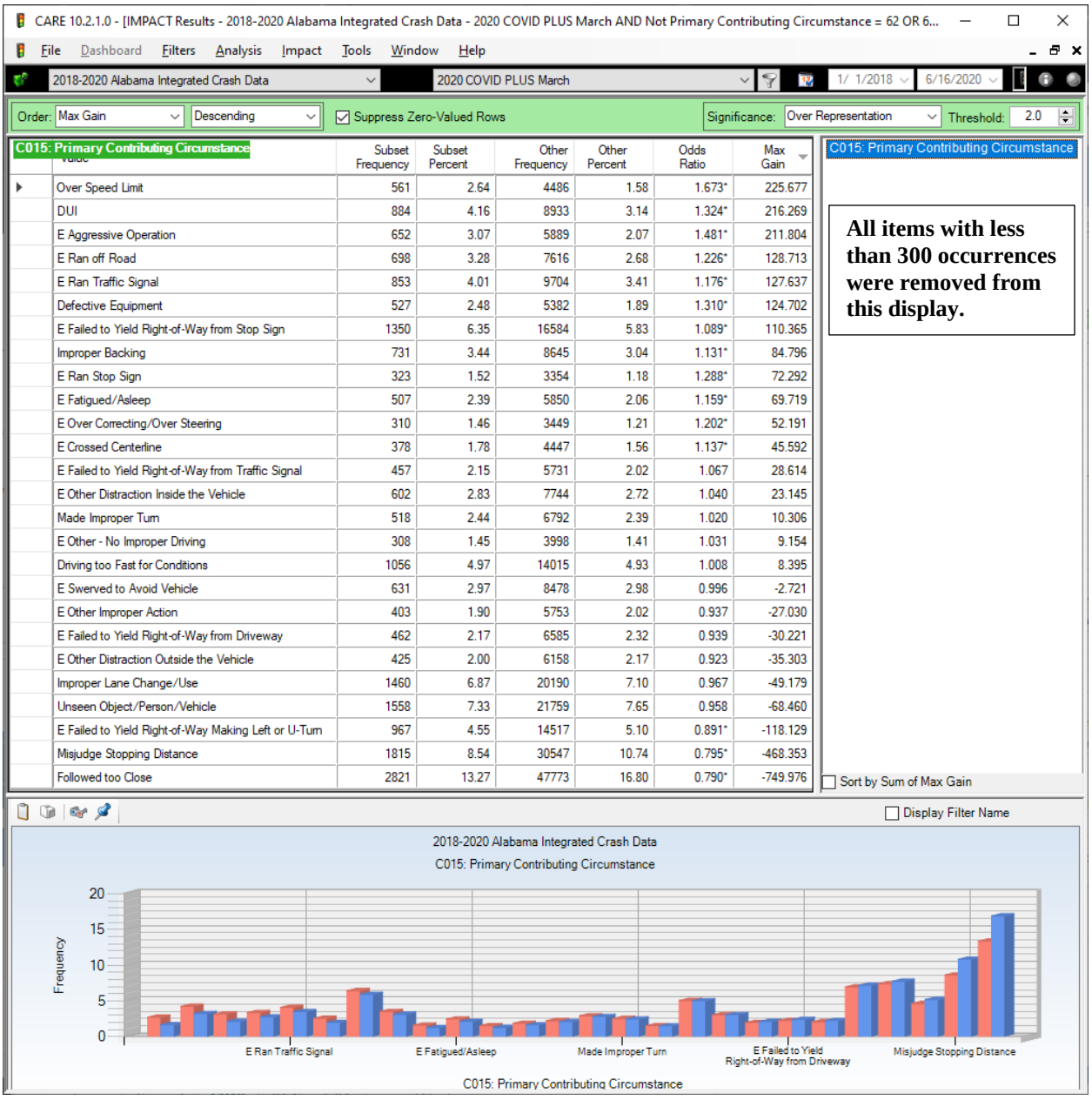
The Non-COVID time period is also referenced as "Normal" in some of the comments below.

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

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

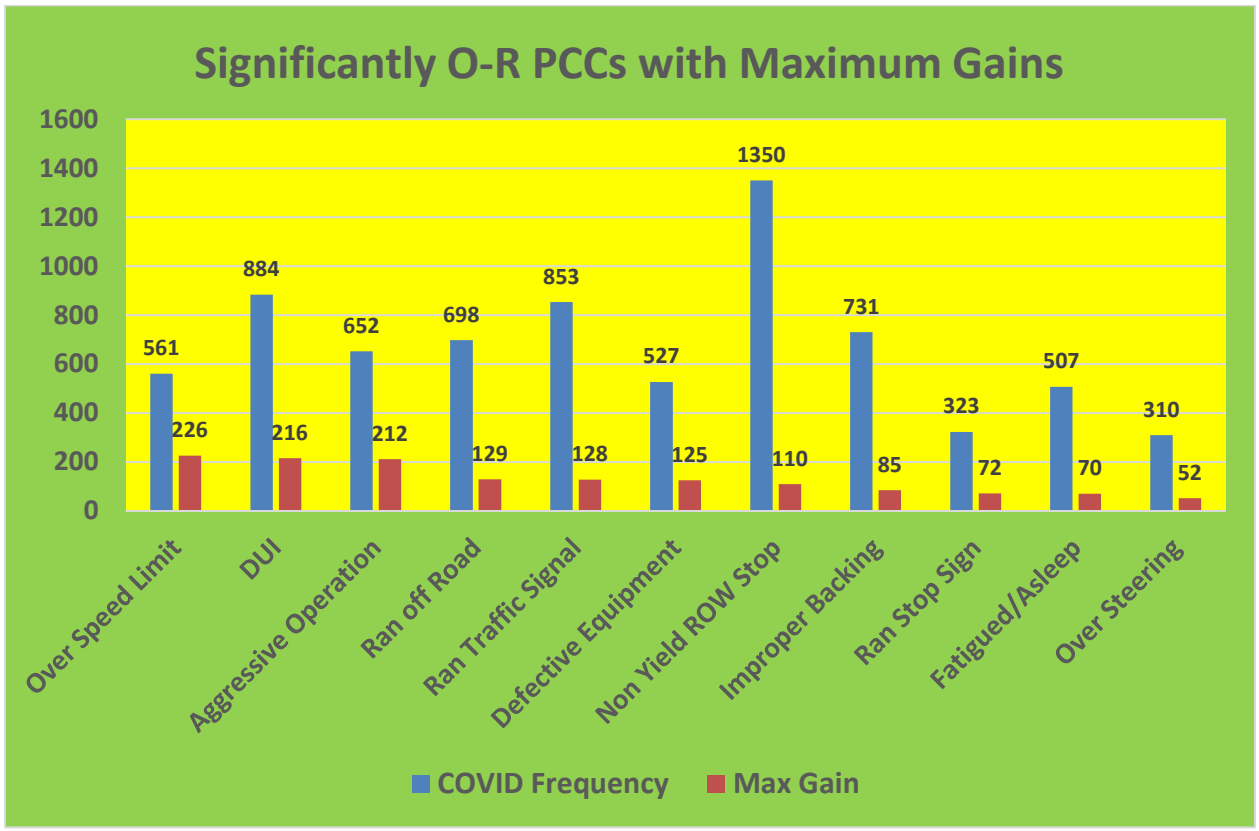
Please contact us if you have any questions or see any way we can help.

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 11 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 over-represented PCCs.

4.2 Comparison of All Significantly Over-Represented PCCs

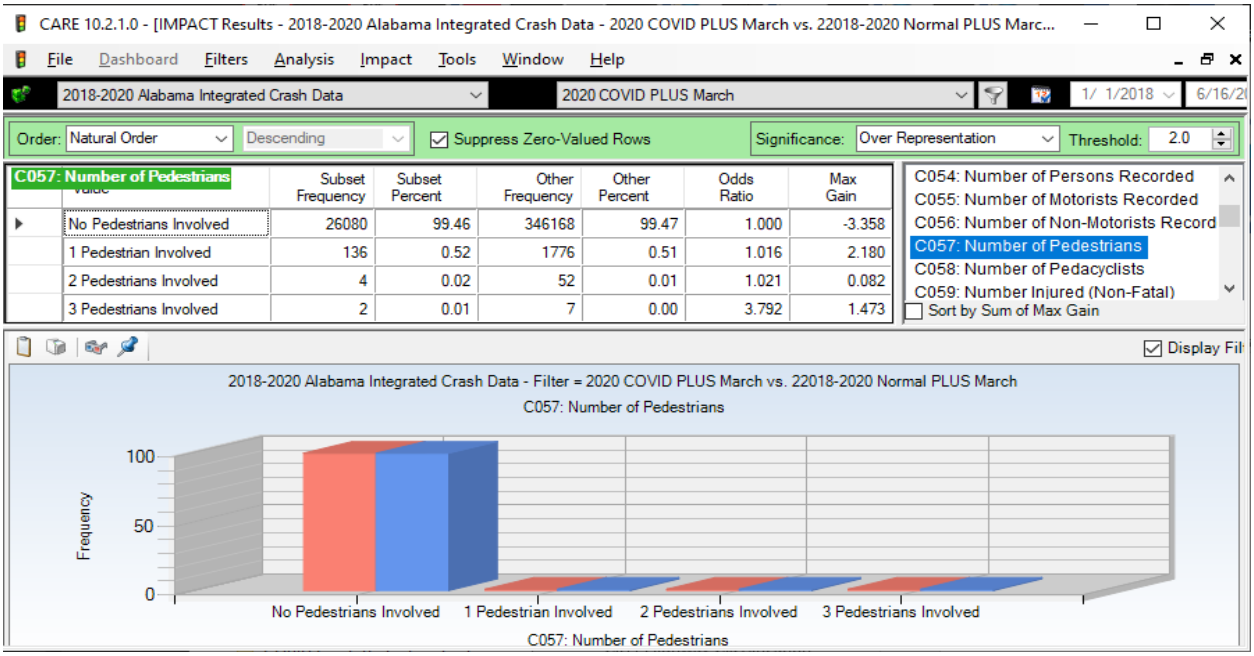


The chart above shows the PCCs ordered left to right from those that have the highest potential for crash reduction (Max Gain) to those with the least. In this application, Max Gain is defined as the number of crashes that would be reduced if drivers in the COVID time period behaved as those in the Normal time period (i.e., pre-COVID 2018, 2019 and 2020 through March 10, 2020).

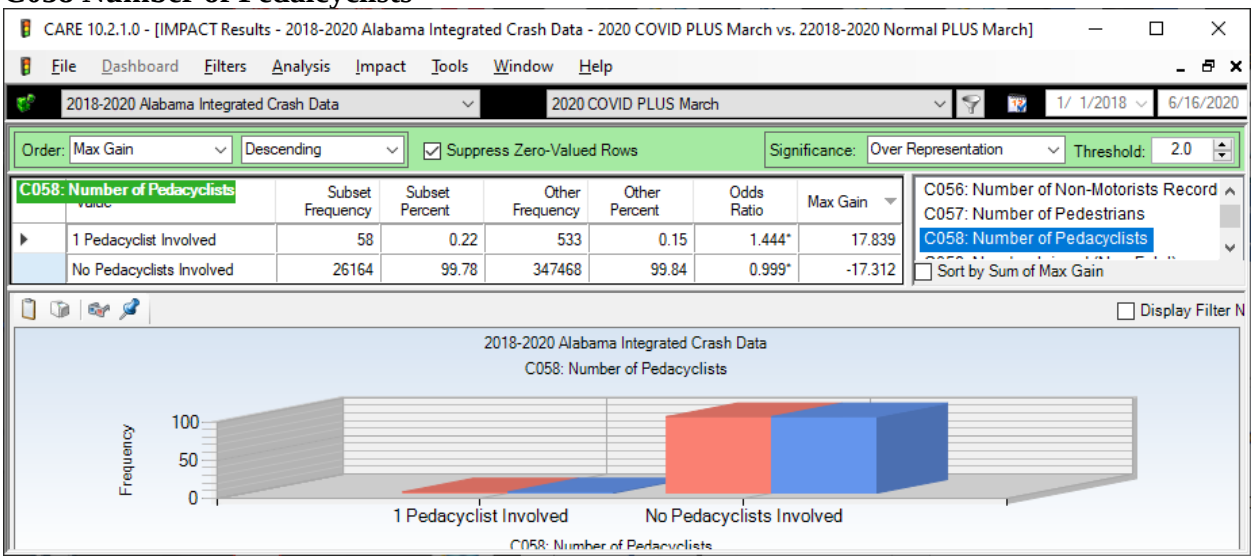
The top three (Over Speed Limit, DUI and Aggressive Operation) have over 200 crash reductions each, and they largely account for the reason that fatalities have not gone down as much as overall crashes. The next tier of three (Ran off Road, Ran Traffic Signal and Defective Equipment) also have almost identical Max Gains at about 120. Failure to Yield at a Stop Sign also shows a fairly large gain with 100 even though it is the highest frequency of all of the PCCs shown. The rest have fewer than 100 each, but their importance should not be marginalized, 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

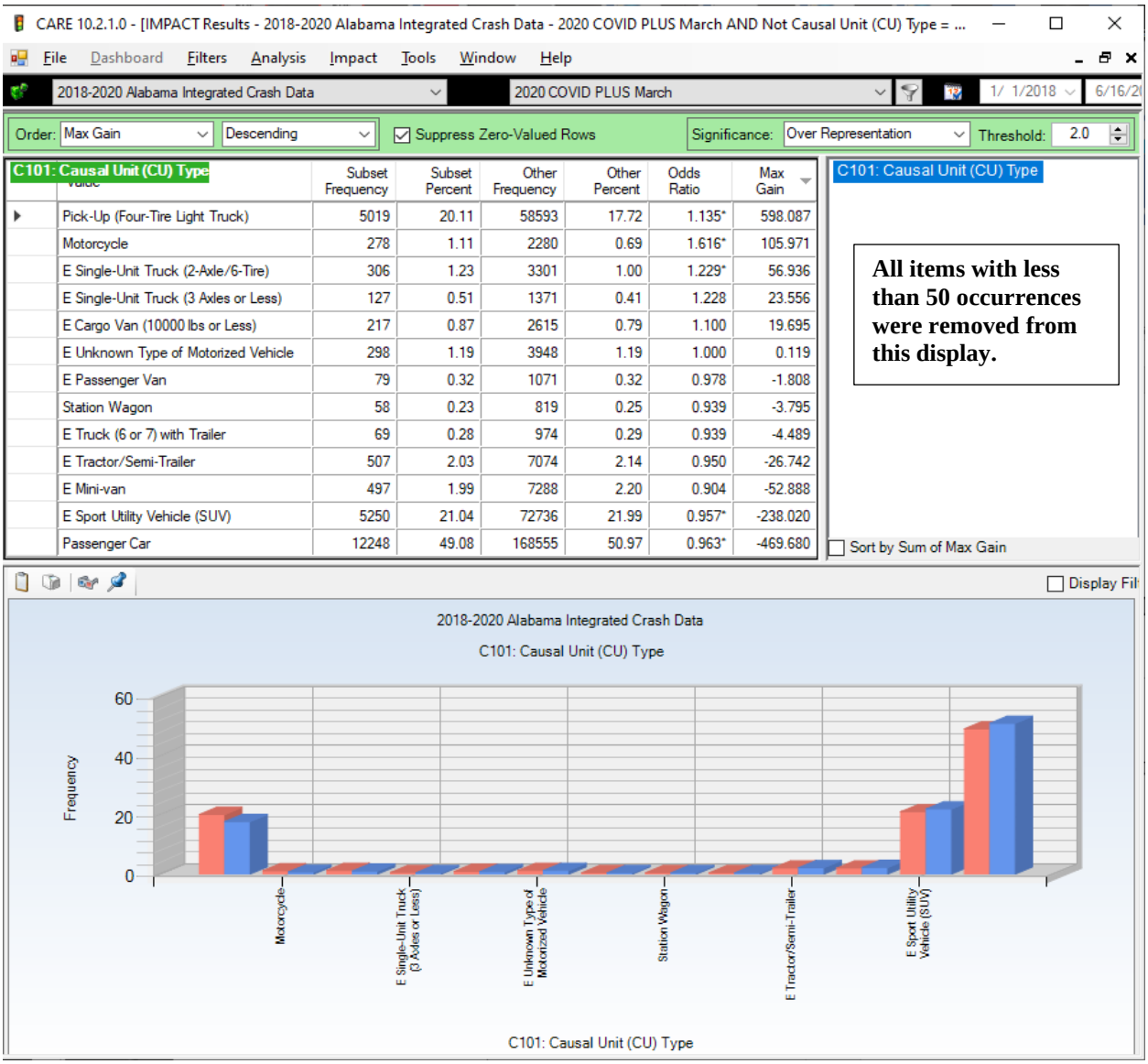


C058 Number of Pedalcyclists



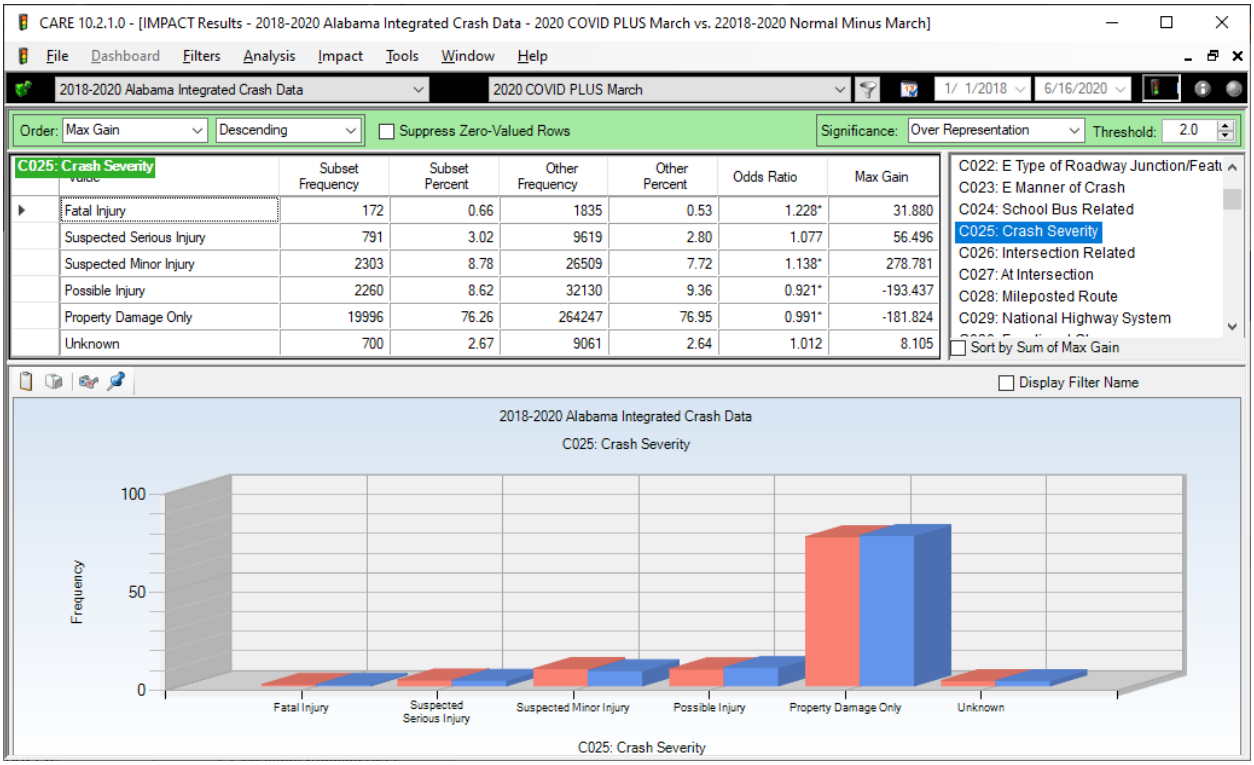
Bicycles had a much greater proportionate increase than did pedestrians as was shown in Section 3.2. Pedestrian count changes were not above what could be expected from random variation. On the other hand, the bicycle proportion increased by a factor that was 44.4% higher for the COVID period than for the Normal period.

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



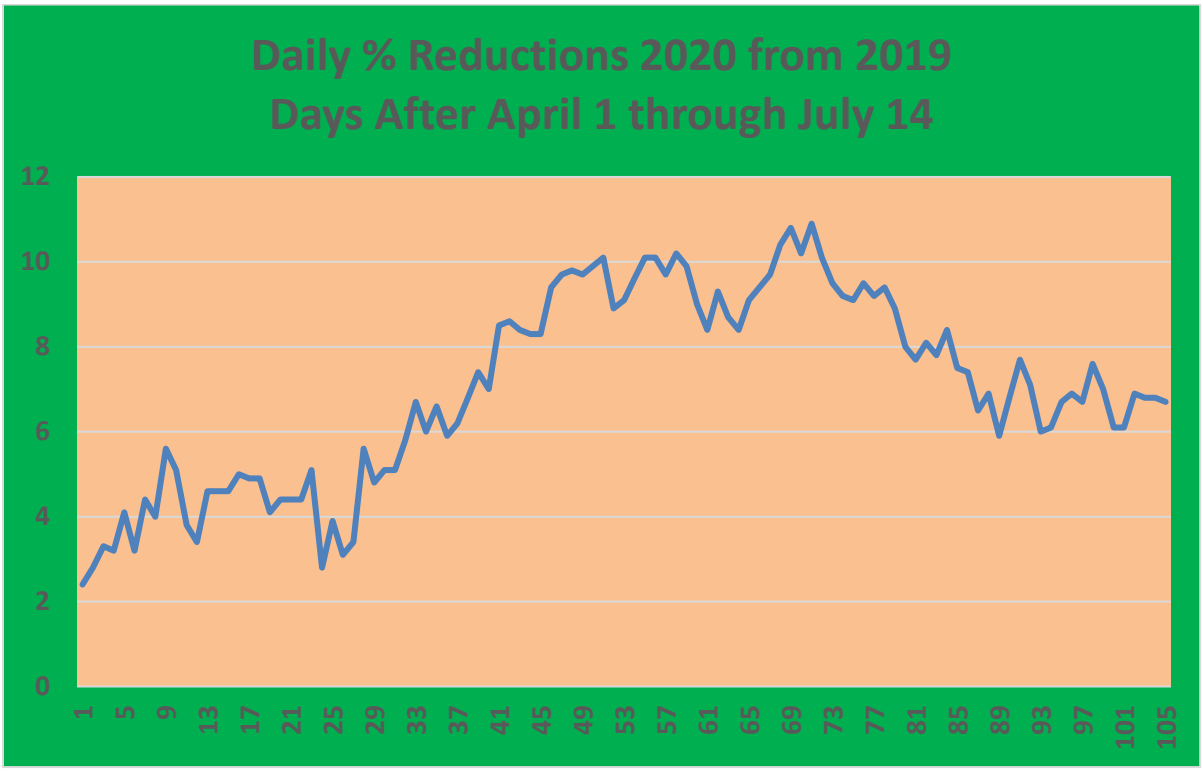
There was a significant increase in pick-ups and motorcycles; and a reduction in SUVs and passenger cars. The increase in the proportion of motorcycles was 61.6% compared to the normal time period (see Section 3.3), which was over 4 times the increase seen in pick-ups. The larger trucks did not appear 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 1.228 times that of the Normal comparison period being used for the control. The Max Gain is 31.8, which indicates that had the same driving habits and environment been in effect in the COVID period as the Normal period, about 32 fatal crashes would have been avoided. The cause of this severity increase in these crashes are given in the Primary Contributing Circumstances covered in Section 4.1. Suspected Serious Injury was also over-represented, but not to a degree that can be considered statistically significant. On the other hand, the over-representation in Suspected Minor Injury is statically significant.

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



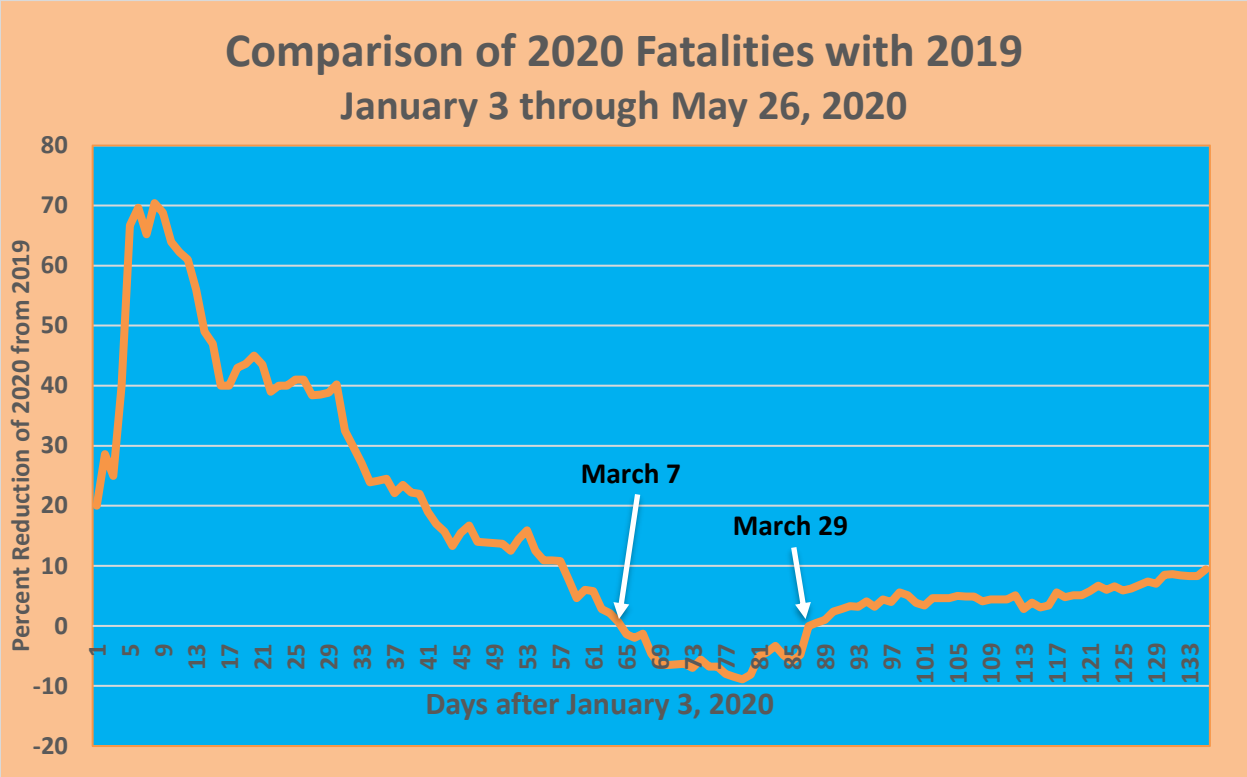
The chart above gives the percent fatality reduction for each day in 2020 compared to the identical days in 2019 from April 1 through July 14 of both years. These are *daily readings* as opposed to the charts in Section 3, which are the changes in the various types of crashes over two-week periods. This chart, as well as the one on the following page, are also reporting *actual fatalities* as opposed to *fatal crashes*, which are reported in the previous 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 days after April 1, 2020. The exact readings for July 14 were: 489 fatalities in 2019; and 456 fatalities in 2020; a reduction of 6.7% 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

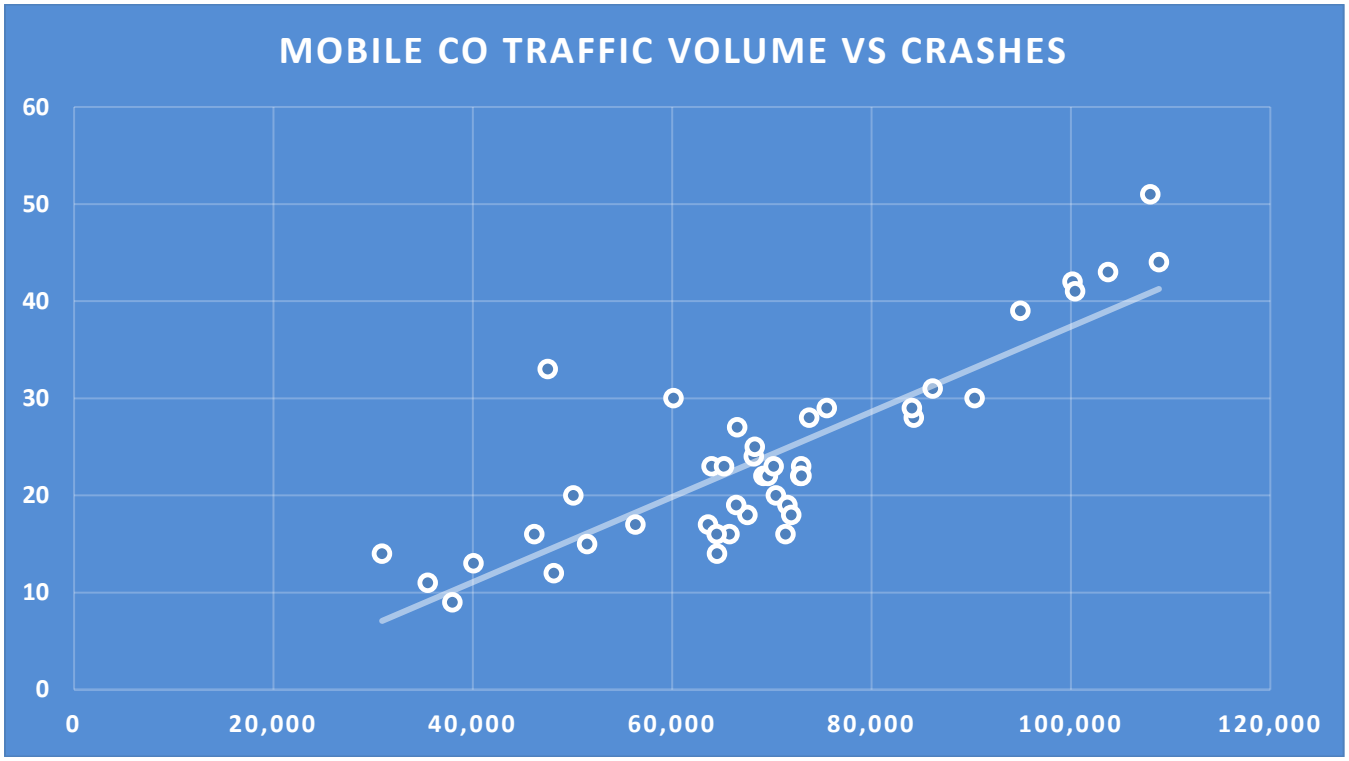
The following is for the first four months of the two years.



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.