CARE Weather-Fatality Relationship Update
Applied to 2016 and 2018 Data
CY2014-2018 Source Data

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Introduction, Background and Project Approach

The purpose of this report is to update the quantitative relationships between wet weather (and resulting wet pavement) on crash frequency and severity that were original reported in a Power Point presentation in 2014:

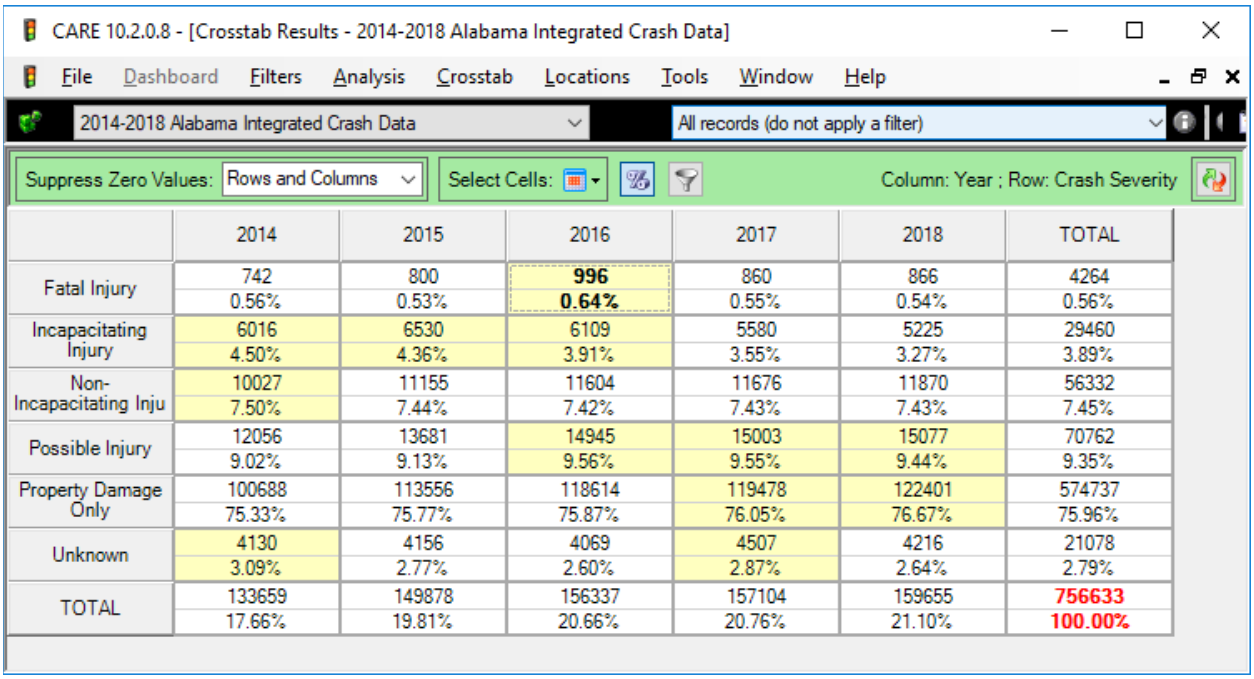
http://www.safehomealabama.gov/wp-content/uploads/2018/12/Weather-9Jan2014-TRCC-v06-WComp-v04-v07.pdf

These findings were updated in a report CARE Weather-Fatality Relationship Update dated May 6, 2019 that used 2014-2018 data, and it can be accessed here:

http://www.safehomealabama.gov/wp-content/uploads/2019/05/Weather-Combine-Binder1.pdf

This previous update was accomplished by subdividing 2018 days into those that were primarily dry and those primarily wet. This was done by creating two cross-tabulations of daily (month by day of the month) for exclusively wet crashes and for exclusively dry crashes. The average numbers of all crashes (wet and dry) was calculated to be 437 crashes per day for the 2014-2018 reporting period. Half of this number rounded up was 219, and this number was used to determine if any particular day was majority wet or majority dry, or what we will call just "wet days" or "dry days" for shorter terminology.

The objective of this second update is to determine the degree to which the dramatic increase in fatal crashes in CY2016 (illustrated in **bold** in the cross-tabulation below) was affected by weather. To do this the exact same approach used to assess the 2018 data was applied to the 2016 data.



	2014	2015	2016	2017	2018	TOTAL
Fatal Injury	742 0.56%	800 0.53%	**996** **0.64%**	860 0.55%	866 0.54%	4264 0.56%
Incapacitating Injury	6016 4.50%	6530 4.36%	6109 3.91%	5580 3.55%	5225 3.27%	29460 3.89%
Non-Incapacitating Inju	10027 7.50%	11155 7.44%	11604 7.42%	11676 7.43%	11870 7.43%	56332 7.45%
Possible Injury	12056 9.02%	13681 9.13%	14945 9.56%	15003 9.55%	15077 9.44%	70762 9.35%
Property Damage Only	100688 75.33%	113556 75.77%	118614 75.87%	119478 76.05%	122401 76.67%	574737 75.96%
Unknown	4130 3.09%	4156 2.77%	4069 2.60%	4507 2.87%	4216 2.64%	21078 2.79%
TOTAL	133659 17.66%	149878 19.81%	156337 20.66%	157104 20.76%	159655 21.10%	**756633** **100.00%**

Summary of Findings

A filter was created of the wet and dry days for each of the years (2016 and 2018) that enabled a comparison to be made between wet and dry days for each year in terms of total crashes and fatal crashes per day. The following is a summary of the findings:

General Overall Parameters from 2014-2018:

- Overall number of crashes per day (2014-2018): 437.
- Number of crashes to qualify for a majority dry or wet day = 437/2 = 219 (rounded up).
- Some days that did not have 219 crashes could not be classified as either majority wet or dry, so the sum of the two "usable days" does not add to 365.

Analysis for 2018:

- Number of wet and dry days in 2018:
  - 48 wet days
  - 300 dry days (total of 348 useable days)
- Average number of crashes per day for 2018:
  - On Wet days: 344
  - On Dry days: 356
  - Increase number of crashes on dry days = 3.5%
- Total number of fatal crashes in 2018
  - On Wet days: 78
  - On Dry days: 608
- Average number of fatal crashes per day in 2018:
  - On Wet days: 1.625
  - On Dry days: 2.027
  - Increase average number of fatal crashes on dry days = 24.7%
- Estimate of the 608 dry day fatal crashes that would be saved *if all days were wet days* = 150 fatal crashes = about 25% of the 608 fatal crashes.

Corresponding Analysis for 2016:

- Number of wet and dry days in 2016:
  - 35 wet days
  - 323 dry days (totals 358 useable days)
- Average number of crashes per day for 2016:
  - On Wet days: 312
  - On Dry days: 360
  - Increase number of all crashes on dry days = 13.2%
- Total number of fatal crashes in 2016
  - On Wet days: 55
  - On Dry days: 811
- Average number of fatal crashes per day in 2016:

    - On Wet days: 1.571
    - On Dry days: 2.511
    - Increase average number of fatal crashes on dry days = 59.8%
- Estimate of the 811 dry day fatal crashes that would be saved *if all days were wet days* = 485 fatal crashes = 59.8% of the 811 fatal crashes.
- If 2016 had the same number of wet days as 2018 (48 instead of the 35 that it had), it would have saved 1.598 fatal crashes per day or 1.598*13 = about 21 fatal crashes over the entire year.

Practical Conclusions and Recommendations from the Analysis

It could be reasoned that we cannot control the weather, so what good is the analysis given above. This reasoning is fallacious in that there are countermeasures that can be brought to bear other than that of controlling the weather. Consider the following:

- Increased enforcement on dry weather days, especially when the weather has been dry for several days. It has been shown that a characteristic known as *speed adaption* occurs when drivers get used to the higher speeds and fail to realize the risks. It can be expected that such might occur over a long period of time in which the weather has not served to slow them down.
- Increased perception of officer presence on dry days. It is the perceived possibility of getting stopped that slows drivers down as opposed to actually getting stopped, since a relatively small number of speeders actually get apprehended. Even slowing the average speed of travel down by 5 MPH could have a dramatic effect on reducing the number of crashes as well as the severity when a crash occurs.
- Concentrated enforcement on extreme speeders. The exact cut-off points and locations might be established by research, since it is reasonable that enforcement will be more effective at the times and places where extreme speeds are encountered, as opposed to just a few MPH over the speed limits. The eCite system might be a database that can be processed to find the locations where extreme speeding takes place.
- Education on the consequences of increasing speed by 10 MPH, and the potential benefits of the incremental reduction of speeds. Some graphical demonstrations might be of use to illustrate the effect that a 10 MPH increase in impact speed has on doubling the probability of any crash resulting in at least one fatality.
- Increased penalties for higher speeds. To some extent the increased fines and points for speeding in excess of 15 MPH is a step in the right direction. However, the speeds we are seeing are much in excess of 15 MPH over the speed limit, and some sanctions should be considered for revoking the license as soon as it is judicially and administratively possible when speeds exceed a given limit (such as 90 MPH). It is expected that this would have an overall effect on reducing speeds since many drivers are not aware of their specific speed when it gets this high.

Appendix – CARE IMPACT Results

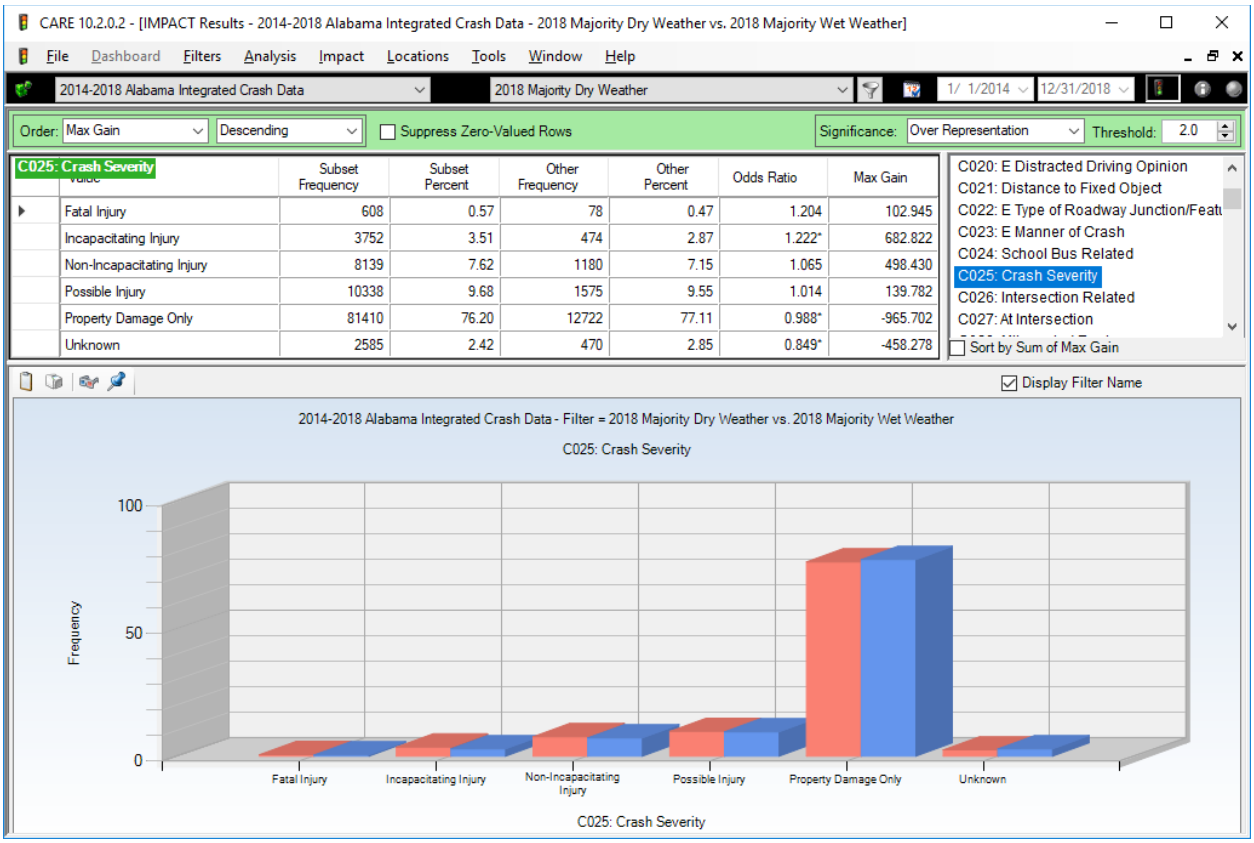
Three further IMPACT analyses for each of the two years (2016 and 2018) were performed to pinpoint the primary cause of the increases in fatality crashes in dry weather:

1. Comparisons of severity for the wet and dry days;
2. Comparisons of Primary Contributing Circumstances for wet and dry days;
3. Comparisons of Speeds of Impact for the wet and dry days; and
4. Replication of each of these done for 2018 again for 2016.

Note: 2018 analyses will be given first since that year is more indicative of what can be expected in the immediate future. Compare the results of the 2016 against the 2018 analyses to determine any difference between these two time periods. Discussions will be given beneath the IMPACT output displays.

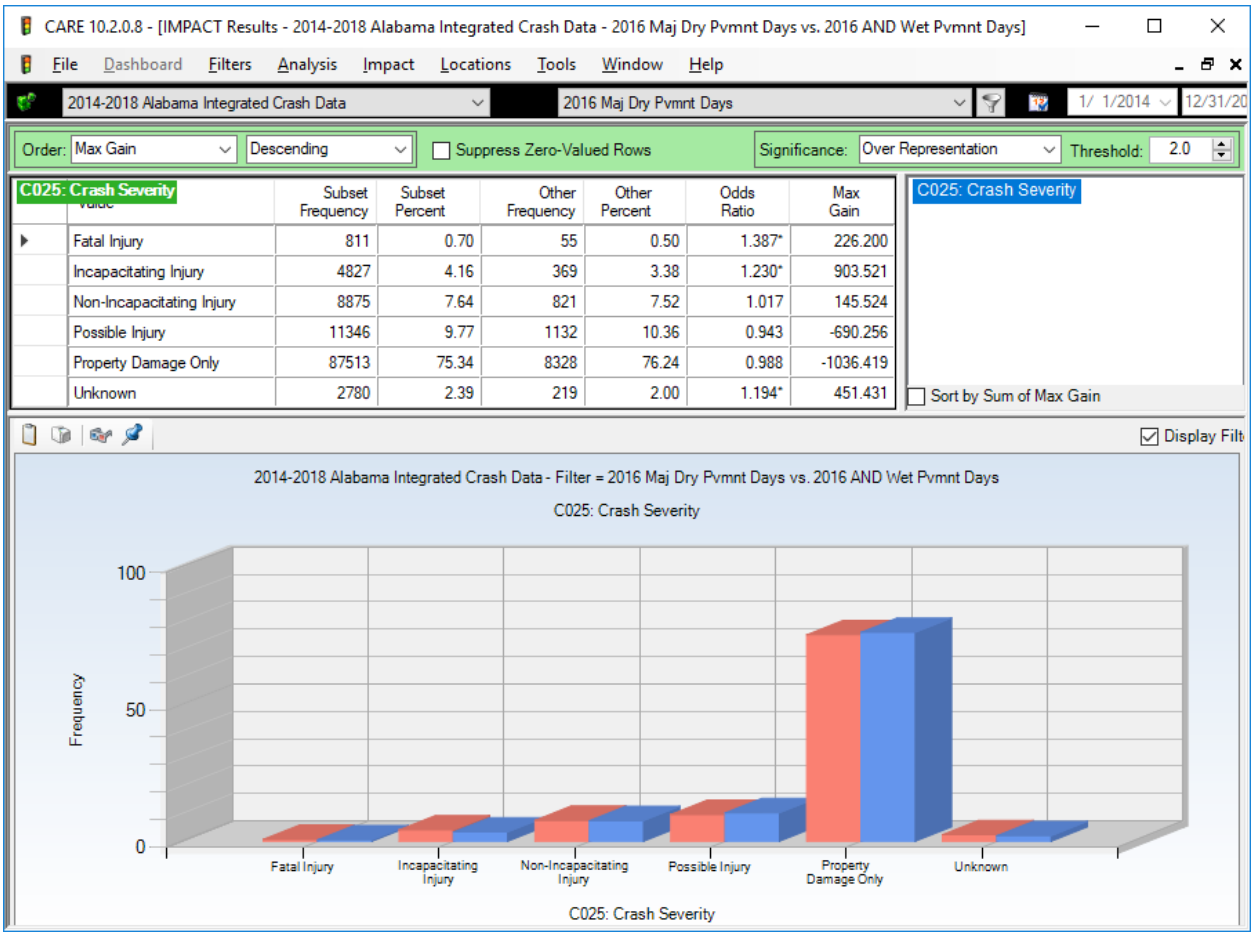
Severity Comparisons: Majority Dry Days vs. Majority Wet Days

2018 Severity Comparison



Odds ratios show that the increase in the proportion in wet weather of both Fatal and Incapacitating Injury crashes was over 20% above that which would be expected if the dry weather proportion were in effect. The only severity classification that is under-represented was Property Damage Only, which accounted for over three quarters of the crashes.

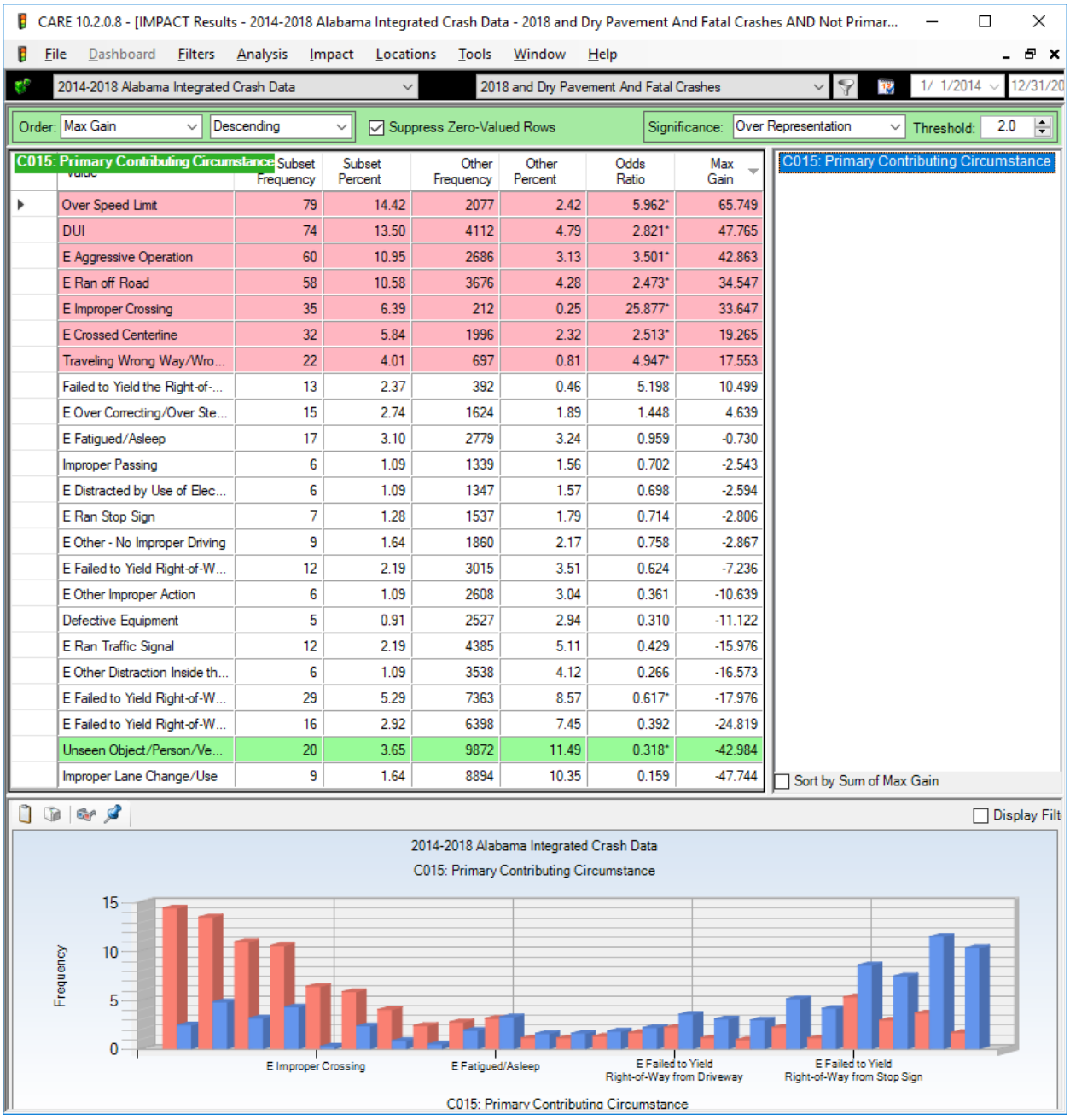
2016 Severity Comparison



The results for 2016 are quite comparable to those for 2018, with a major exception. The degree of over-representation in the fatal injury classification is about twice that of the 2018 results. This indicates a greater proportion of fatal crashes than in 2018. The severe injury classification has about the same over-representation, as given by the Odds Ratios.

Primary Contributing Circumstances: Dry Days Fatal Crashes vs All in Year

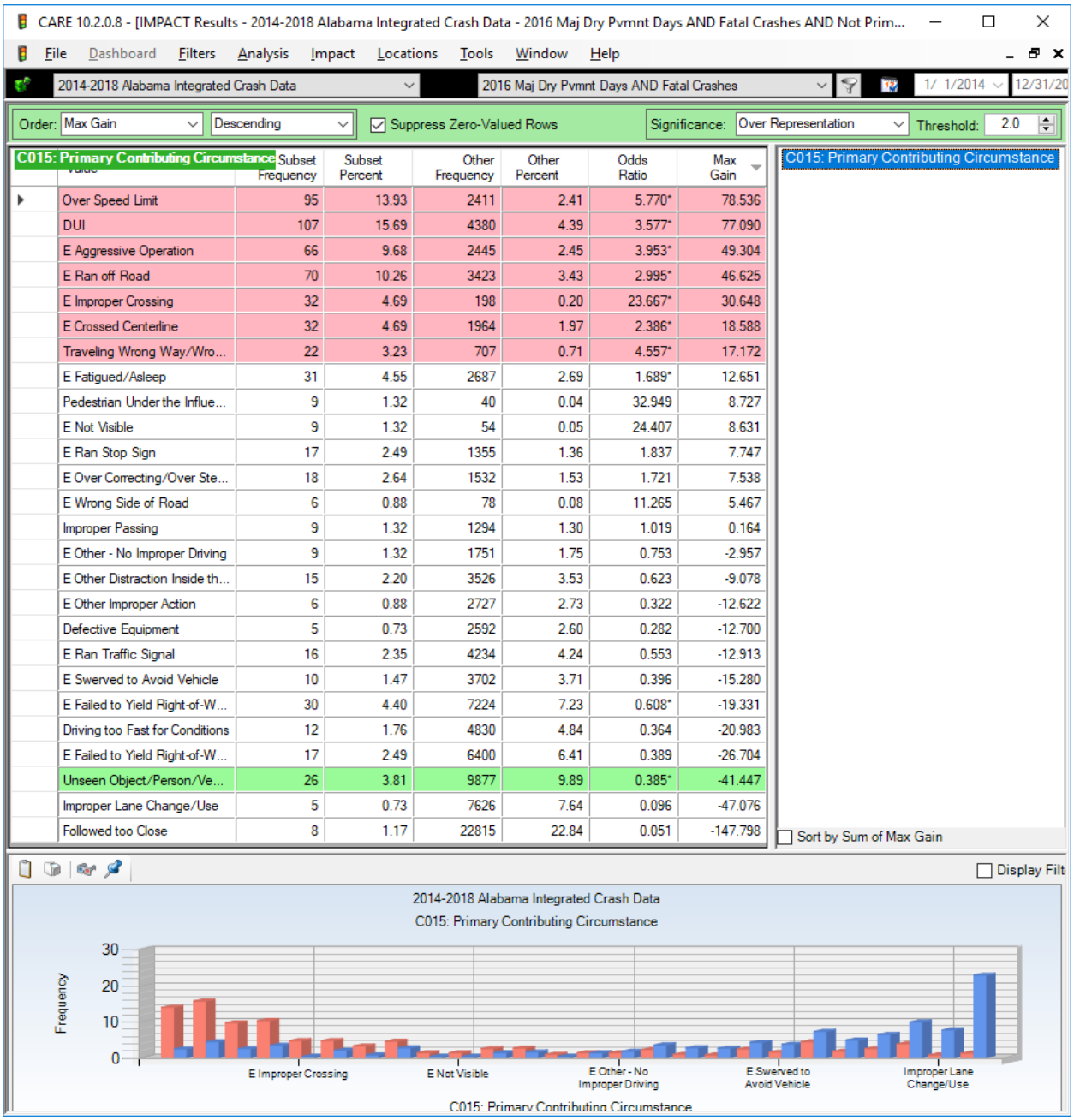
2018 PCC Comparisons for Categories with at Least 5 Occurrences



C015: Primary Contributing Circumstance	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Over Speed Limit	79	14.42	2077	2.42	5.962*	65.749
DUI	74	13.50	4112	4.79	2.821*	47.765
E Aggressive Operation	60	10.95	2686	3.13	3.501*	42.863
E Ran off Road	58	10.58	3676	4.28	2.473*	34.547
E Improper Crossing	35	6.39	212	0.25	25.877*	33.647
E Crossed Centerline	32	5.84	1996	2.32	2.513*	19.265
Traveling Wrong Way/Wro...	22	4.01	697	0.81	4.947*	17.553
Failed to Yield the Right-of-...	13	2.37	392	0.46	5.198	10.499
E Over Correcting/Over Ste...	15	2.74	1624	1.89	1.448	4.639
E Fatigued/Asleep	17	3.10	2779	3.24	0.959	-0.730
Improper Passing	6	1.09	1339	1.56	0.702	-2.543
E Distracted by Use of Elec...	6	1.09	1347	1.57	0.698	-2.594
E Ran Stop Sign	7	1.28	1537	1.79	0.714	-2.806
E Other - No Improper Driving	9	1.64	1860	2.17	0.758	-2.867
E Failed to Yield Right-of-W...	12	2.19	3015	3.51	0.624	-7.236
E Other Improper Action	6	1.09	2608	3.04	0.361	-10.639
Defective Equipment	5	0.91	2527	2.94	0.310	-11.122
E Ran Traffic Signal	12	2.19	4385	5.11	0.429	-15.976
E Other Distraction Inside th...	6	1.09	3538	4.12	0.266	-16.573
E Failed to Yield Right-of-W...	29	5.29	7363	8.57	0.617*	-17.976
E Failed to Yield Right-of-W...	16	2.92	6398	7.45	0.392	-24.819
Unseen Object/Person/Ve...	20	3.65	9872	11.49	0.318*	-42.984
Improper Lane Change/Use	9	1.64	8894	10.35	0.159	-47.744

It is no exaggeration to say that speed is *always* a factor in fatal crashes. Of those that are over-represented by more than 2.0 (red background), most are related to excessive speeds.

2016 PCC Comparisons for Categories with at Least 5 Occurrences



C015: Primary Contributing Circumstance	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
Over Speed Limit	95	13.93	2411	2.41	5.770*	78.536
DUI	107	15.69	4380	4.39	3.577*	77.090
E Aggressive Operation	66	9.68	2445	2.45	3.953*	49.304
E Ran off Road	70	10.26	3423	3.43	2.995*	46.625
E Improper Crossing	32	4.69	198	0.20	23.667*	30.648
E Crossed Centerline	32	4.69	1964	1.97	2.386*	18.588
Traveling Wrong Way/Wro...	22	3.23	707	0.71	4.557*	17.172
E Fatigued/Asleep	31	4.55	2687	2.69	1.689*	12.651
Pedestrian Under the Influe...	9	1.32	40	0.04	32.949	8.727
E Not Visible	9	1.32	54	0.05	24.407	8.631
E Ran Stop Sign	17	2.49	1355	1.36	1.837	7.747
E Over Correcting/Over Ste...	18	2.64	1532	1.53	1.721	7.538
E Wrong Side of Road	6	0.88	78	0.08	11.265	5.467
Improper Passing	9	1.32	1294	1.30	1.019	0.164
E Other - No Improper Driving	9	1.32	1751	1.75	0.753	-2.957
E Other Distraction Inside th...	15	2.20	3526	3.53	0.623	-9.078
E Other Improper Action	6	0.88	2727	2.73	0.322	-12.622
Defective Equipment	5	0.73	2592	2.60	0.282	-12.700
E Ran Traffic Signal	16	2.35	4234	4.24	0.553	-12.913
E Swerved to Avoid Vehicle	10	1.47	3702	3.71	0.396	-15.280
E Failed to Yield Right-of-W...	30	4.40	7224	7.23	0.608*	-19.331
Driving too Fast for Conditions	12	1.76	4830	4.84	0.364	-20.983
E Failed to Yield Right-of-W...	17	2.49	6400	6.41	0.389	-26.704
Unseen Object/Person/Ve...	26	3.81	9877	9.89	0.385*	-41.447
Improper Lane Change/Use	5	0.73	7626	7.64	0.096	-47.076
Followed too Close	8	1.17	22815	22.84	0.051	-147.798

The over-represented PCCs for 2016 are essentially identical to those for 2018, and they are heavily influenced by Speed, DUI or a combination of the two. Improper Crossing refers to pedestrian fatalities in the Subset Frequency column. Pedestrian Under the Influence accounts for 9 fatal crashes in 2016, but was less than 5 in 2018.

Estimated Speed at Impact Dry Days Fatal Crashes vs All in the Year

2018 Impact Speed Comparisons

CARE 10.2.0.8 - [IMPACT Results - 2014-2018 Alabama Integrated Crash Data - 2018 and Dry Pavement And Fatal Crashes AND Not CU Esti...

File Dashboard Filters Analysis Impact Locations Tools Window Help

2014-2018 Alabama Integrated Crash Data | 2018 and Dry Pavement And Fatal Crashes | 1/ 1/2014 | 12/31/20

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

C224: CU Estimated Speed at Impact	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1 to 5 MPH	9	2.09	12744	15.07	0.139	-55.955
6 to 10 MPH	13	3.02	9083	10.74	0.281	-33.295
11 to 15 MPH	11	2.55	6134	7.25	0.352	-20.264
16 to 20 MPH	10	2.32	4507	5.33	0.435	-12.972
21 to 25 MPH	8	1.86	4027	4.76	0.390	-12.525
26 to 30 MPH	13	3.02	4170	4.93	0.612	-8.254
31 to 35 MPH	7	1.62	4952	5.86	0.277	-18.240
36 to 40 MPH	11	2.55	4583	5.42	0.471	-12.359
41 to 45 MPH	22	5.10	7369	8.71	0.586*	-15.559
46 to 50 MPH	29	6.73	3717	4.40	1.531*	10.055
51 to 55 MPH	65	15.08	5790	6.85	2.203*	35.489
56 to 60 MPH	30	6.96	2746	3.25	2.143*	16.004
61 to 65 MPH	58	13.46	3164	3.74	3.597*	41.873
66 to 70 MPH	53	12.30	3681	4.35	2.825*	34.238
71 to 75 MPH	25	5.80	812	0.96	6.041*	20.861
76 to 80 MPH	23	5.34	527	0.62	8.563*	20.314
81 to 85 MPH	10	2.32	147	0.17	13.347	9.251
86 to 90 MPH	8	1.86	108	0.13	14.533	7.450
91 to 95 MPH	5	1.16	22	0.03	44.590	4.888
96 to 100 MPH	14	3.25	79	0.09	34.769	13.597
Over 100 MPH	7	1.62	35	0.04	39.239	6.822

C224: CU Estimated Speed at Impact

Sort by Sum of Max Gain

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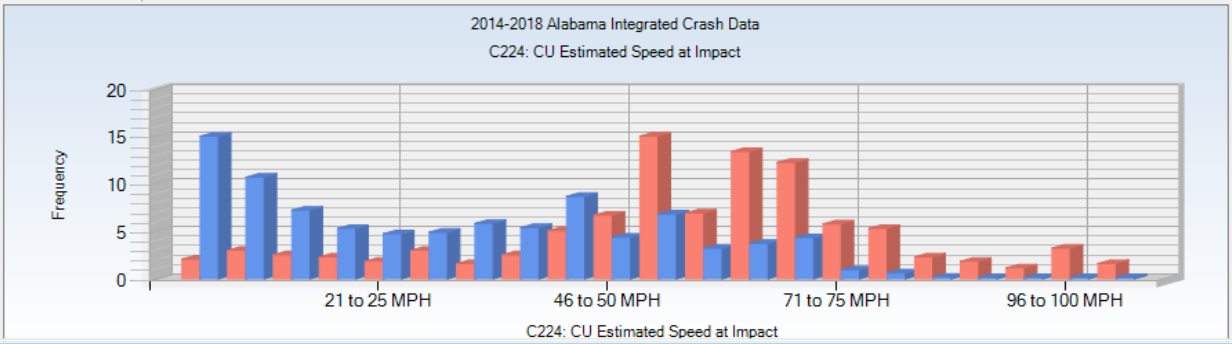
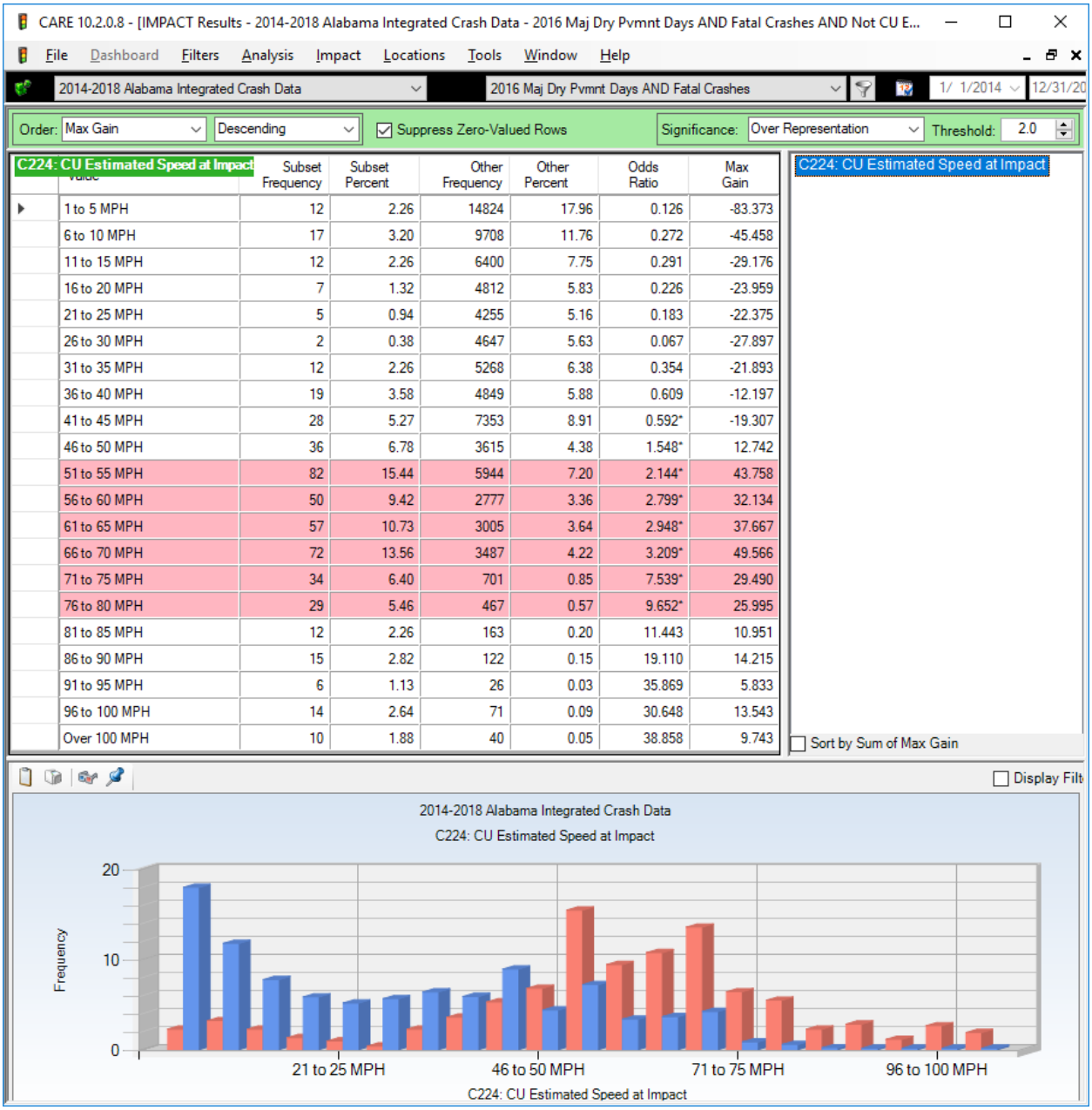


Note especially the extreme speeding categories (above 80 MPH). Dry day fatalities had 44 (about 10%) crashes in those categories, while the control group had less than 1%. The probability of a crash being fatal doubles (approximately) for every 10 MPH increase in impact speeds.

2016 Impact Speed Comparisons



C224: CU Estimated Speed at Impact	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
1 to 5 MPH	12	2.26	14824	17.96	0.126	-83.373
6 to 10 MPH	17	3.20	9708	11.76	0.272	-45.458
11 to 15 MPH	12	2.26	6400	7.75	0.291	-29.176
16 to 20 MPH	7	1.32	4812	5.83	0.226	-23.959
21 to 25 MPH	5	0.94	4255	5.16	0.183	-22.375
26 to 30 MPH	2	0.38	4647	5.63	0.067	-27.897
31 to 35 MPH	12	2.26	5268	6.38	0.354	-21.893
36 to 40 MPH	19	3.58	4849	5.88	0.609	-12.197
41 to 45 MPH	28	5.27	7353	8.91	0.592*	-19.307
46 to 50 MPH	36	6.78	3615	4.38	1.548*	12.742
51 to 55 MPH	82	15.44	5944	7.20	2.144*	43.758
56 to 60 MPH	50	9.42	2777	3.36	2.799*	32.134
61 to 65 MPH	57	10.73	3005	3.64	2.948*	37.667
66 to 70 MPH	72	13.56	3487	4.22	3.209*	49.566
71 to 75 MPH	34	6.40	701	0.85	7.539*	29.490
76 to 80 MPH	29	5.46	467	0.57	9.652*	25.995
81 to 85 MPH	12	2.26	163	0.20	11.443	10.951
86 to 90 MPH	15	2.82	122	0.15	19.110	14.215
91 to 95 MPH	6	1.13	26	0.03	35.869	5.833
96 to 100 MPH	14	2.64	71	0.09	30.648	13.543
Over 100 MPH	10	1.88	40	0.05	38.858	9.743

As seen from a comparison of the charts and the red background items in the table (those with more than double their expected proportions, these results are quite comparable. Again in 2016, the impact speeds in excess of 80 MPH play a large part, in this case with 58 (as opposed to 44 in 2018). Clearly, the drier weather in 2016 led a great number of drivers to exceed the speed limits and also participate in extremely risky behaviors.