UMTRI-2011-31

An Examination of the Michigan 2010 Motor Vehicle Traffic Crash Fatality Increase

Carol A. Flannagan
Andrew J. Leslie
Helen K. Spradlin
Charles P. Compton
Caroline S. Lupini

September 2011

UMTRI-2011-31

An Examination of the Michigan 2010 Motor Vehicle Traffic Crash Fatality Increase

Carol A. Flannagan
Andrew J. Leslie
Helen K. Spradlin
Charles P. Compton
Caroline S. Lupini

The University of Michigan
Transportation Research Institute
Ann Arbor, MI 48109-2150
U.S.A.

September 2011

Technical Report Documentation Page

1. Report No. UMTRI-2011-31	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle An Examination of the Michigan 2010 Motor Vehicle Traffic Crash Fatality Increase		5. Report Date September 2011 *6. Performing Organization Code*
7. Author(s) Carol A. Flannagan, Andrew J. Leslie, Helen K. Spradlin, Charles P. Compton, & Caroline S. Lupini		8. Performing Organization Report No. UMTRI-2011-31
9. Performing Organization Name and Address The University of Michigan Transportation Research Institute 2901 Baxter Road Ann Arbor, Michigan 48109-2150 U.S.A.		10. Work Unit no. (TRAIS) 11. Contract or Grant No. 2011-6347
12. Sponsoring Agency Name and Address Michigan Office of Highway Safety Planning 333 South Grand Avenue P.O. Box 30634 Lansing, MI 48913-0634		13. Type of Report and Period Covered Final Parent Project 10/1/10-9/30/11 Sub-Project 7/1/11-9/30/11 14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

In 2010, national fatal crash counts went down by 3.5%, following on the heels of substantial drops in 2008 and 2009. However, in Michigan, fatal crashes were down substantially in 2009, but up by nearly 8% in 2010. This report contains an in-depth look at the patterns associated with Michigan's fatal crash increase in 2010. In particular, we present a time series analysis of fatal-crash trends over the last 40 years. In addition, we provide breakdowns of crash subcategories, focusing on alcohol and drug use by drivers, commercial vehicles, young and elderly drivers, motorcycles, and construction-zone crashes. Finally, we compare the pattern in Michigan to the patterns of fatal crashes for three other states. The primary result of these analyses is that 2009 was unusually low in fatal crashes and 2010 represents a return to normal numbers. That said, fatal-crash-involved drivers testing positive for blood THC have more than doubled in 2010. In addition, construction zone crashes have increased, though the base numbers are too low to determine whether the increase is significant. Motorcycle fatalities showed large increases in 2010, especially in collisions with other motor vehicles. In the multi-state comparison, the nearest state, Wisconsin, showed the same 2009 decrease and 2010 increase in total crashes, while more distant states of Idaho and Missouri showed steady decreases. These results are consistent with regional trends reported by NHTSA. The four states showed similar results with steady decreases in overall crashes and steady increases in drug-related fatal crashes.

17. Key Words Traffic crash, motor vehicle, fatality increase, Michigan, data trends, fatalities, fatal crashes, national		18. Distribution Statement Unlimited	
19. Security Classification (of this report) Unclassified	20. Security Classification (of this page) Unclassified	21. No. of Pages 19	22. Price

Table of Contents

Executive Summary

In 2010, national fatal crash counts went down by 3.5%, following on the heels of substantial drops in 2008 and 2009. However, in Michigan, fatal crashes were down substantially in 2009, but up by nearly 8% in 2010. This report contains an in-depth look at the patterns associated with Michigan's fatal crash increase in 2010. In particular, we present a time series analysis of fatal-crash trends over the last 40 years. In addition, we provide breakdowns of crash subcategories, focusing on alcohol and drug use by drivers, commercial vehicles, young and elderly drivers, motorcycles, and construction-zone crashes. Finally, we compare the pattern in Michigan to the patterns of fatal crashes for three other states. The primary result of these analyses is that 2009 was unusually low in fatal crashes and 2010 represents a return to normal numbers. That said, fatal-crash-involved drivers testing positive for blood THC have more than doubled in 2010. In addition, construction zone crashes have increased, though the base numbers are too low to determine whether the increase is significant. Motorcycle fatalities showed large increases in 2010, especially in collisions with other motor vehicles. In the multi-state comparison, the nearest state, Wisconsin, showed the same 2009 decrease and 2010 increase in total crashes, while more distant states of Idaho and Missouri showed steady decreases. These results are consistent with regional trends reported by NHTSA. The four states showed similar results with steady decreases in overall crashes and steady increases in drug-related fatal crashes.

Introduction

In 2010, NHTSA released a report investigating the substantial drop in fatalities in 2008 and projected (at the time) drop in 2009, relative to previous years (Longthorne, Subramanian & Chen, 2010). This report covered a variety of reasons for the drop, including enhanced vehicle crashworthiness, increased belt use, advanced crash avoidance systems (especially Electronic Stability Control, or ESC), and also a drop in vehicle miles traveled.

Like the rest of the country, Michigan experienced a substantial drop in fatalities in 2009, relative to 2008 and prior years. In 2009, there were 806 fatal crashes, down almost 12% from 915 in 2008. This gain was attributed in part to many of the same forces discussed in the NHTSA report (press release, http://www.michigan.gov/msp/0,4643,7-123-1586_1710-234135--,00.html), including increased belt use, improved crashworthiness, enforcement, and improved highway design. Vehicle miles traveled also decreased in 2009, accounting for part, but not all, of the reduction.

In 2011, NHTSA released a brief update of its 2008 report, indicating that national fatalities declined 3% in 2010, compared to 2009, although vehicle miles traveled went up slightly. Unlike 2008, regional differences were observed in 2010 where regions in the northeast quarter of the country showed fatality increases. Region 5, which includes Michigan, showed an overall increase in fatalities of 3%. However, during this same period, in Michigan alone, fatal crashes and fatalities both went up by nearly 8%.

Vehicle miles traveled continued to decline, resulting in an even greater increase in fatalities per VMT for Michigan in 2010.

This report investigates the reasons for the increase in Michigan fatalities in the context of an overall national decline. We first explore the question of whether the increase is above levels expected by chance. We then explore details of the increase in fatalities relative to subsets of the crash population. Finally, we compare Michigan to other states in the U.S. to look at how patterns are similar or different.

Michigan Motor Vehicle Traffic Crash Fatality Trends

Although an increase in fatalities of 8% seems large on the face of it, any increase must be judged in the context of random processes that lead to fatal crashes. Like the stock market, crash numbers and crash rates can rise and fall from year to year, while still exhibiting an overall decreasing trend as has been seen in the U.S. for a long time. To judge whether the increase is significant, we have to first find a model for the basic underlying trend in fatal crash rates, and then compare the current year to that model. The details of how these models were constructed can be found in Appendix A. The following discussion focuses on the results of that effort.

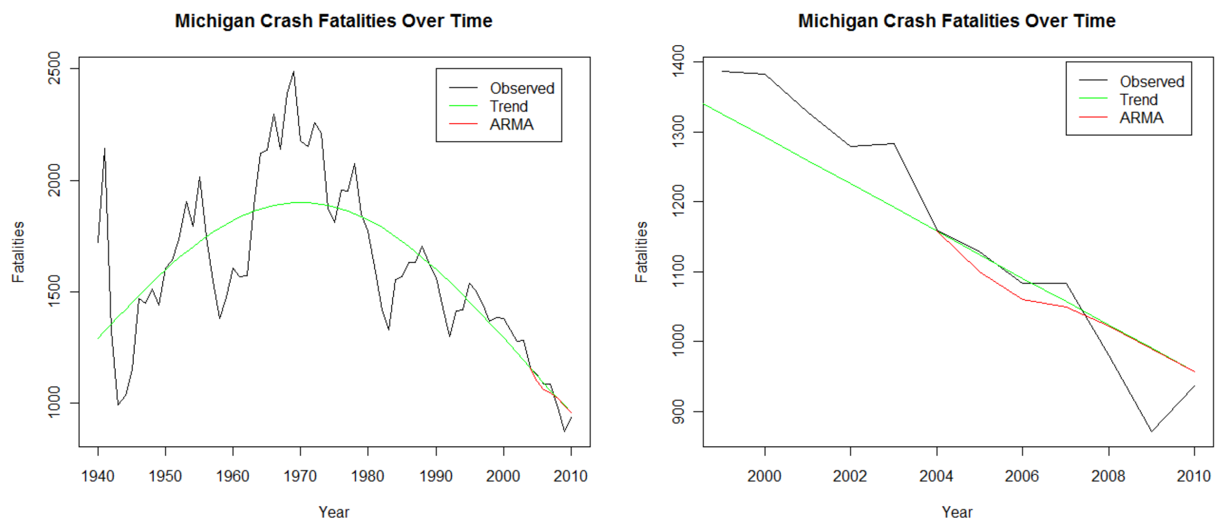

Figure 1. Long-range (left) and recent-years (right) views of Michigan crash fatalities over the last 50 years. The black line shows the year-to-year rise and fall in total fatalities. The green and red lines show two models of the underlying trends.

Figure 1 shows the behavior of Michigan crash fatalities over the time period of 1940 to 2010 (on the left) and focused on 1999-2010 (on the right). The black lines are the observed fatalities for each year while the green line indicates the trend observed over this time period. Looking at the trend line, we can see that 2010 was actually quite close to the expected number of fatalities whereas 2009 is extremely atypical, particularly as the variations from year to year appear to be much smaller in the past decade than in previous decades.

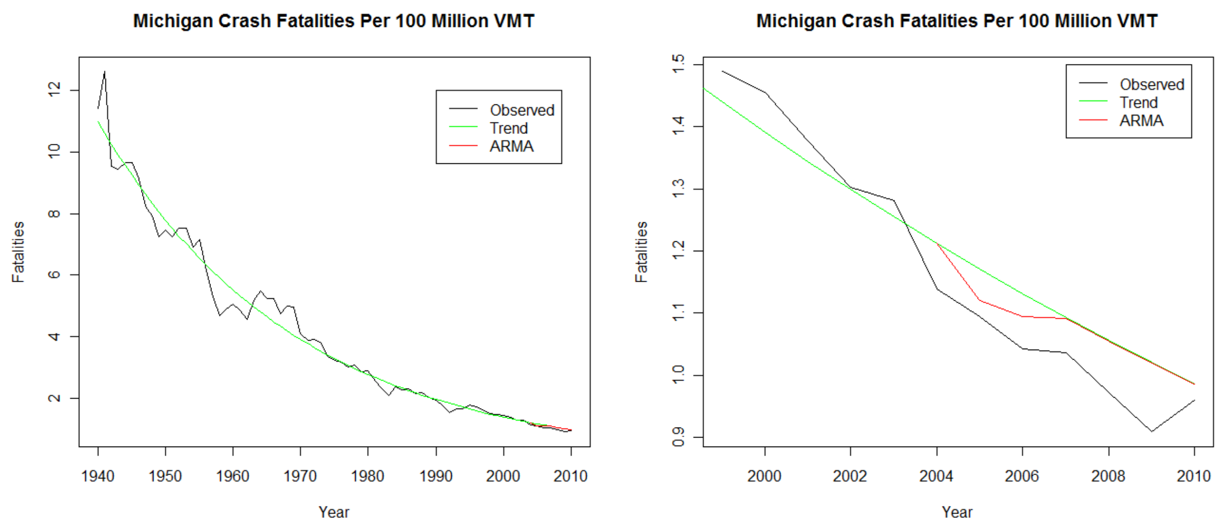

Figure 2. Long-range (left) and recent (right) fatalities per million VMT for Michigan. Black line shows annual rates. Green and red curves show two models of underlying trends.

Figure 2 shows the same pair of plots for fatalities per vehicle miles traveled (VMT) indicate that 2010 is a return to the expected trend. The plot on the right side of Figure 2 shows that even when the predicted deviation from the trend is included (the red line), 2009 is much farther from the expected value than 2010. As such, it would seem reasonable to argue that 2009 is the atypical year rather than 2010, meaning that the increase in fatalities from 2009 to 2010 is a stabilizing of the trend rather than a reversal.

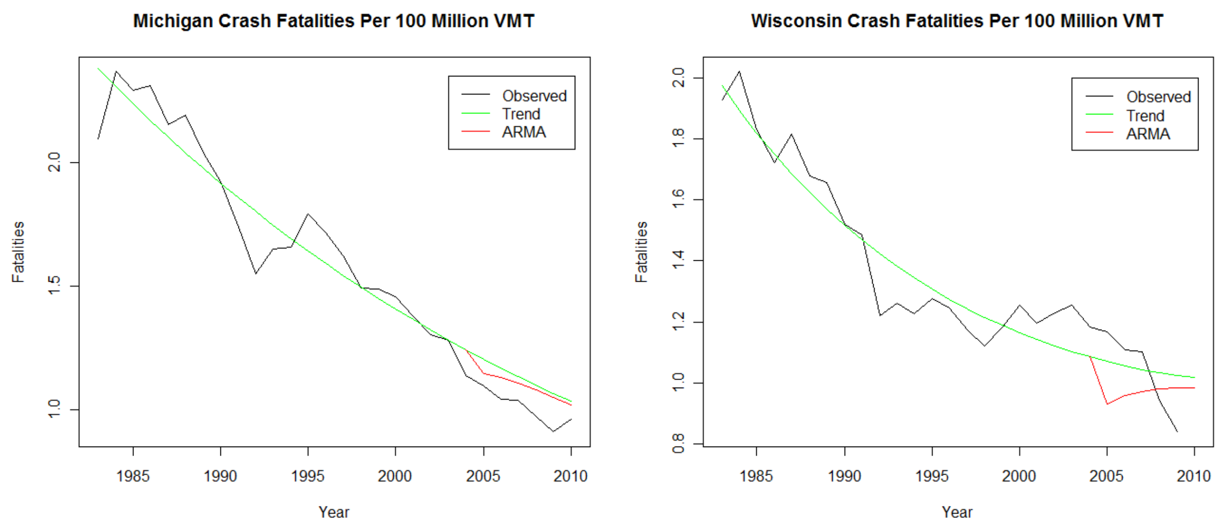

Figure 3. Comparison of Michigan fatality rate per VMT (left) and Wisconsin fatality rate per VMT (right).

Figure 3, which shows the fatality per VMT pattern for Michigan and Wisconsin side by side, demonstrates that Wisconsin experienced a similar drop off in 2009 to what was seen in Michigan. While VMT is not yet available for 2010 from Wisconsin, it is reasonable to assume that, due to the increase in fatal crashes, the 2010 corrected fatalities will exhibit a trend similar to that seen in Michigan (i.e., a return towards the expected value predicted by the trend).

Michigan Motor Vehicle Traffic Crash Fatality Influence

The time trends discussed in the previous section suggest that, overall Michigan fatalities in 2009 were more unusual than those in 2010. Nonetheless, it is worth taking a closer look at which segments of the Michigan crashing population have shown the most change. We include 2008 in our tables to see whether large increases in 2010 also correspond to large decreases in 2009.

Table 1 shows the overall numbers for Michigan crashes during the three-year period. Total crashes showed declines in both years, but fatal crashes and fatalities decreased 11% in 2009 and then rose 8% in 2010. Note that because fatality counts are small, they tend to be far more variable than total crash counts.

Table 1
Crashes and Fatalities in Michigan 2008-2010

	2008	2009	2010
Total Crashes	316,057	290,978	282,075
Fatal Crashes	915	806	868
Total Fatalities	980	871	937

Appendix B contains a table with fatality counts for a large number of subgroups of the crashing population. Key variables are discussed in the sections that follow.

Alcohol and Drug Involvement

In Michigan, fatalities associated with drunk driving decreased in both 2009 (6%) and 2010 (5%) over the previous year. However, fatalities in which the driver tested positive for some type of drug were down in 2009 and back up in 2010. The largest single category of drugs found in driver blood tests was THC. In 2009, drivers involved in fatalities tested positive for THC in 31 cases, down 20% from 39 in 2008. In 2010, there were 76 such cases, an increase of well over 200%. Drug testing in fatal crashes in general has increased only slightly over the three-year period, with 30% in 2008, 31% in 2009 and 33% of drivers tested in 2010.

Motorcycles

In 2009, motorcycle fatalities dropped from 122 (2008) to 103, but returned to 120 in 2010. Interestingly, the number of single-vehicle motorcycle crashes has gone down steadily over this time period. The increase in 2010 was entirely in multi-vehicle motorcycle crashes. This suggests that the increase is not due to inexperienced motorcyclists being on the roads in greater numbers, but is more likely due to more interactions between motorcycles and other vehicles.

Construction Zones

Although the total counts are small, construction zones showed large and steady increases over the three-year period. In 2008, there were 15 fatal crashes in either a construction zone or where a lane was closed. In 2009, there were 23, and in 2010, there were 34 such crashes. We do not have the data to determine whether this is primarily the result of increased construction on Michigan roads over that time period.

Large Trucks

Fatal crashes involving a large truck or bus decreased in 2009 and returned to 2008 levels in 2010. This follows the general pattern of all fatalities and does not indicate a particular problem with trucks.

Young and Elderly Drivers

Table 2 shows the number of fatal crashes for various categories of young and elderly drivers for the three-year window. Fatalities showed similar patterns. Fatal crashes involving the youngest drivers are generally decreasing over the three-year period, though 17-24 year olds show an increase, but less than a return to 2008 levels. In general, the increase in 2010 made up for the drop in 2009. Among elderly drivers, 2010 represented an increase to greater than 2008 levels, except in the 75-84 year old category (where there had been no drop in 2009). The total number of crashes in each category are small enough that some volatility is expected.

Table 2
Fatal Crashes Involving Young and Elderly Drivers in Michigan 2008-2010

Age Group	2008	2009	2010	08-09 Change	09-10 Change
Driver age 15 or younger	3	4	4	33%	0%
Driver age 16	19	15	13	-21%	-13%
Driver age 17	28	24	27	-14%	13%
Driver age 18-20	106	98	101	-8%	3%
Driver age 21-24	110	83	99	-25%	19%
Driver age 60-64	58	56	67	-3%	20%
Driver age 65-74	89	63	84	-29%	33%
Driver age 75-84	79	79	57	0%	-28%
Driver age 85 or older	28	24	37	-14%	54%

State Comparison

The regional differences seen in the 2010 NHTSA update suggested that a comparison of Michigan to other states within and outside of the upper Midwest might be useful. We chose Wisconsin, Missouri and Idaho for comparison. Wisconsin is in Region 5 with Michigan, and the other two states are in two different regions that showed declines. Missouri's region went down by 2.6% and Idaho's region went down by 12.0%.

Crash counts for 2008 through 2010 for all crashes, fatalities, and fatal crashes for the four states (including Michigan) are compared in Figures 4, 5, and 6. In all four states, total crashes were steady or falling over the three-year period. However, both Midwestern (Region 5) states, Michigan and Wisconsin, show a drop in fatalities and fatal crashes in 2009, followed by an increase. Figure 5 shows the fatality increase in 2010 for Michigan and to a lesser degree Wisconsin, and Figure 6 shows the same for fatal crashes. The other two states show steady drops in crashes, fatalities, and fatal crashes (Figures 4, 5, and 6). These patterns are consistent with the regional patterns in fatalities observed by NHTSA.

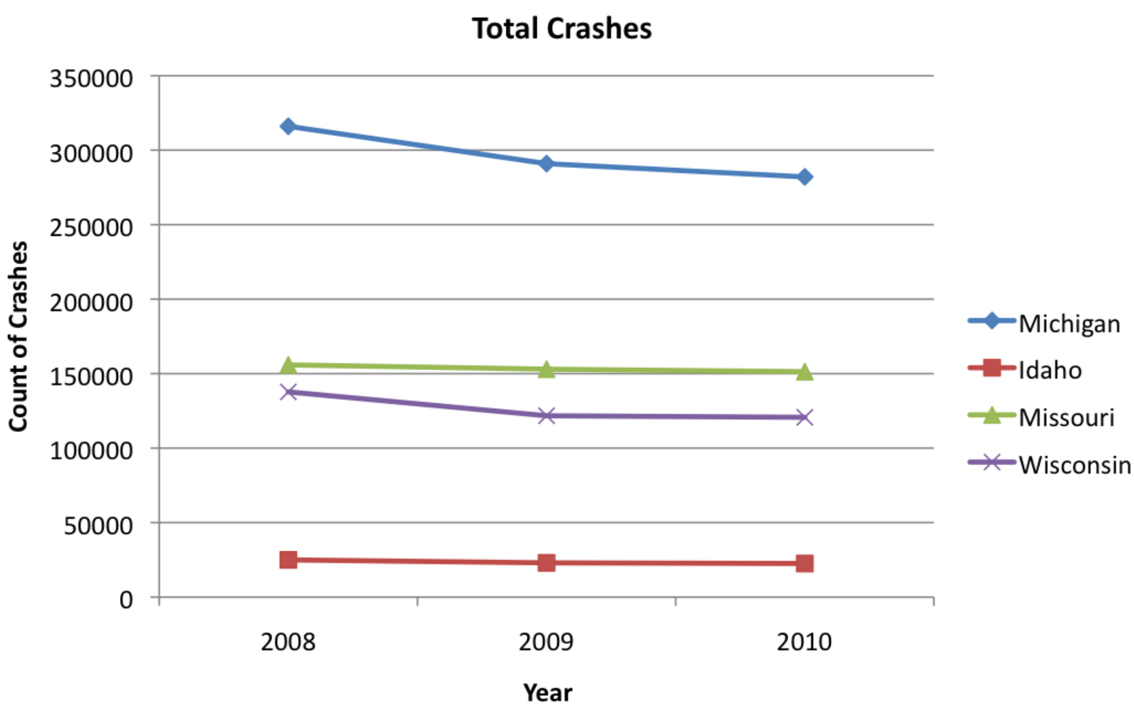

Figure 4. Total crashes for four states for the time period from 2008-2010.

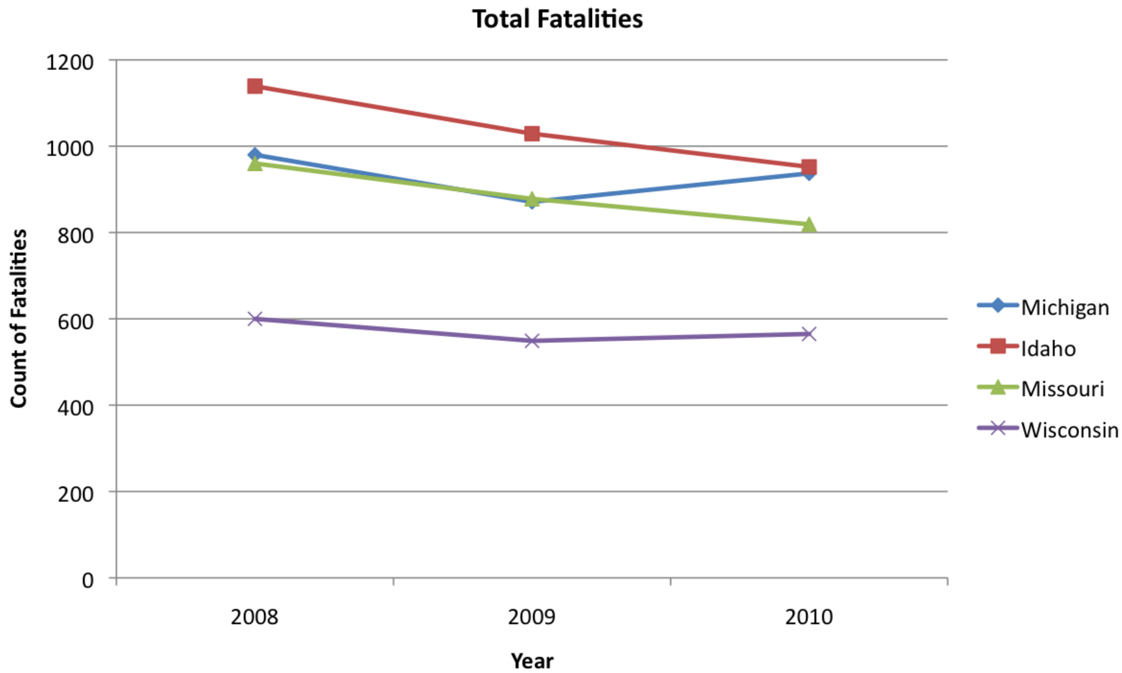

Figure 5. Total fatalities for four states for the time period from 2008-2010.

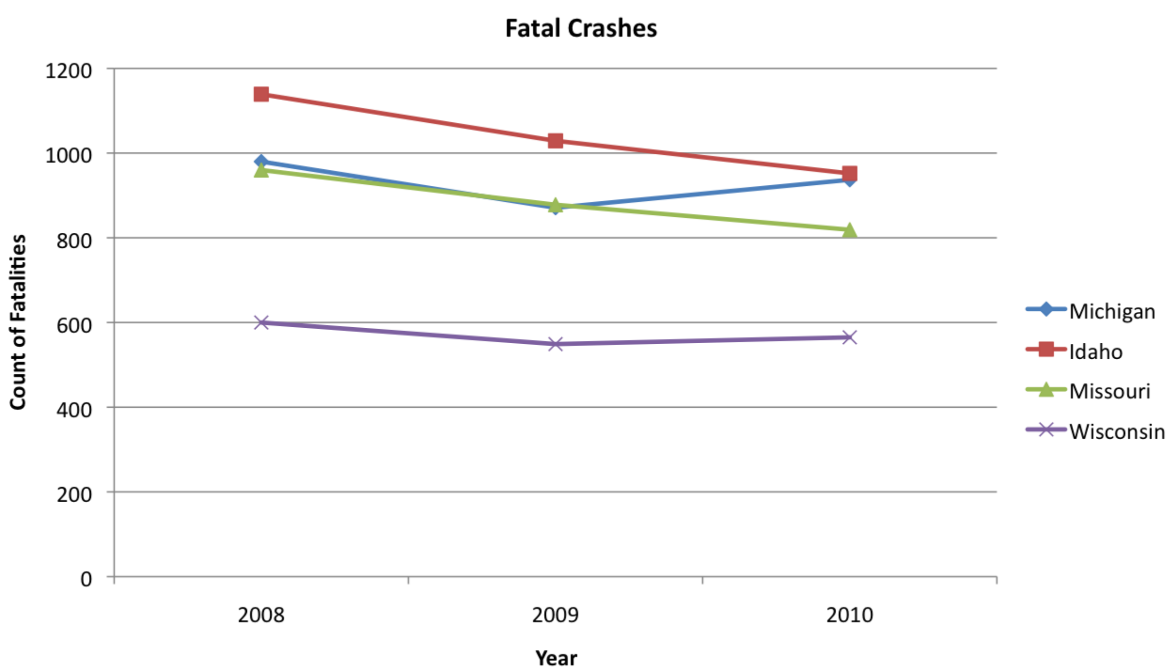

Figure 6. Fatal crash counts for four states for the time period from 2008-2010.

Truck-involved fatal crashes showed the same pattern as other fatal crashes, but drug-involved fatal crashes are rising in all four states, as shown in Figure 7. We cannot tell from these data whether this is due to increased drug testing or increased drug use in these states.

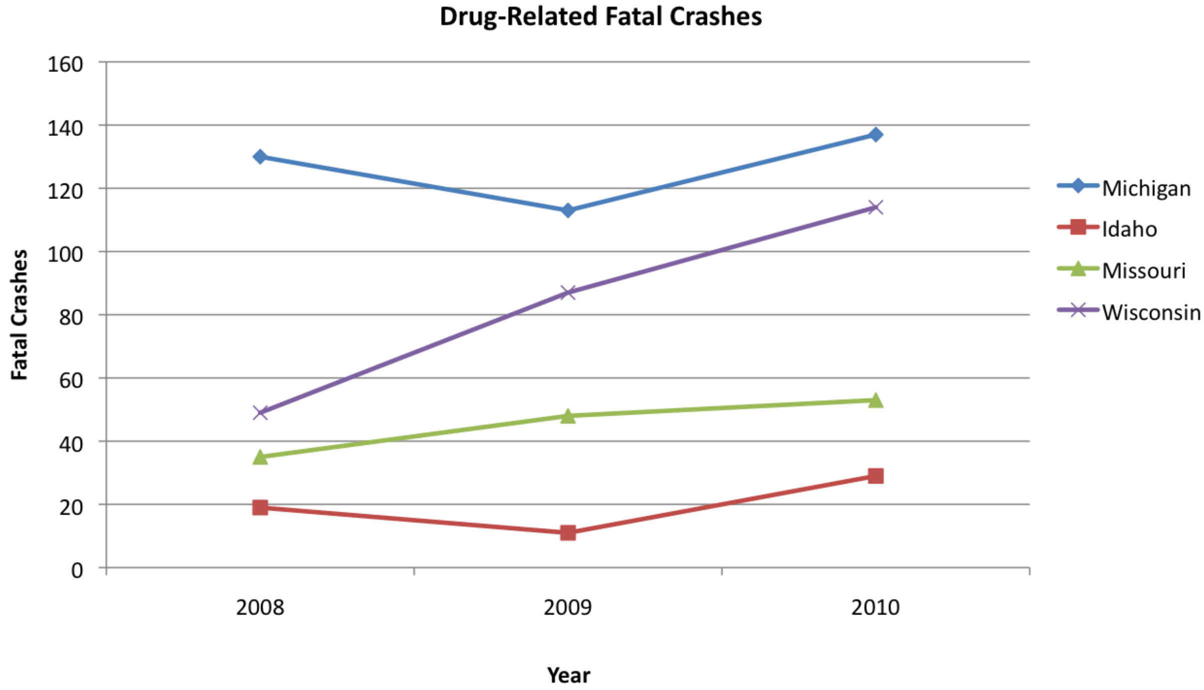

Figure 7. Drug-related fatal crashes for four states for the time period from 2008-2010.

Conclusion

This report looked closely at 2010 Michigan fatal crashes and fatalities to understand why there was an 8% increase between 2009 and 2010. The primary conclusion from this effort is that 2010 is a return to the ongoing trend of reductions in traffic fatalities over time. Because 2009 was an unusually low year in Michigan, 2010 seems worse by comparison. In fact, 2010 is not unusual and there is no major change in safety or conditions that explain the increase.

That said, there were a handful of areas that showed unusually large changes. In particular, there was a substantial rise in the number of drivers who tested positive for blood THC among drivers involved in fatal crashes. In addition, motorcycle fatalities showed large increases in 2010, especially in collisions with other motor vehicles. Finally, construction areas showed relatively large increases, but these may have been due to increased construction activity in the last few years.

Appendix A: Statistical Details of Times Series Models

Michigan Crash Fatalities

As seen in Figure A1, taking the log of the fatality data slightly decreases that change in variance over time observed in the data. This increases the R-squared of the trend model slightly indicating that this is the correct choice.

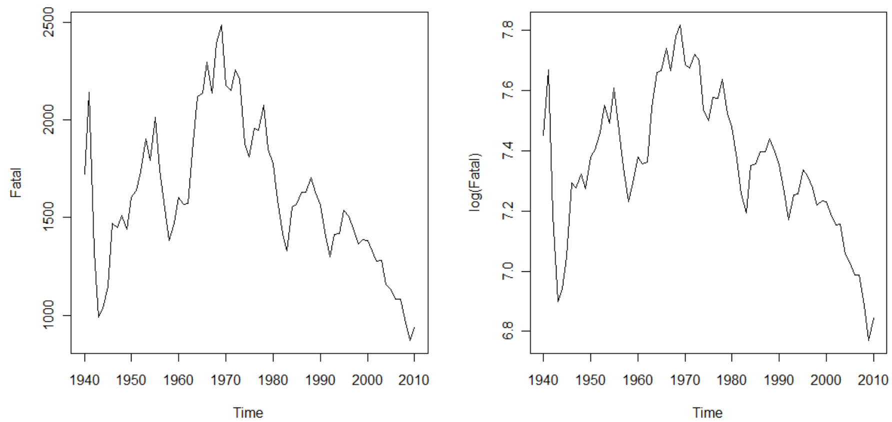

Figure A1. Comparison of time trends for fatalities (left) and log fatality count (right).

Looking at the plot of the log data (on the right), it appears that there is a clear curve to the data indicating that a time-squared term. Since the desire is to predict the behavior during the past 3 years, the de-trending model was fitted to the data from 1940 to 2004. This yields the following model:

$$\log t = -165.9 + 1.692t - 0.0004294t^2 \qquad \text{(A1)}$$

However, as seen on the autocovariance function[1] (ACF) and partial autocovariance function[2] (PACF) plots below (Figure A2), the residuals of this model are not white noise and an ARMA model should be used to remove the autocorrelation between the data points.

[1] The autocovariance function displays the correlation between data points across time. When it is outside of the blue dotted lines, it indicates that one can improve the prediction by including the information present in previous datapoints.

[2] The partial autocovariance function is similar to the ACF but discounts correlations due to intervening points (i.e., the PACF for lag 2 would show correlation between 2000 and 2002 discounting the value at 2001.

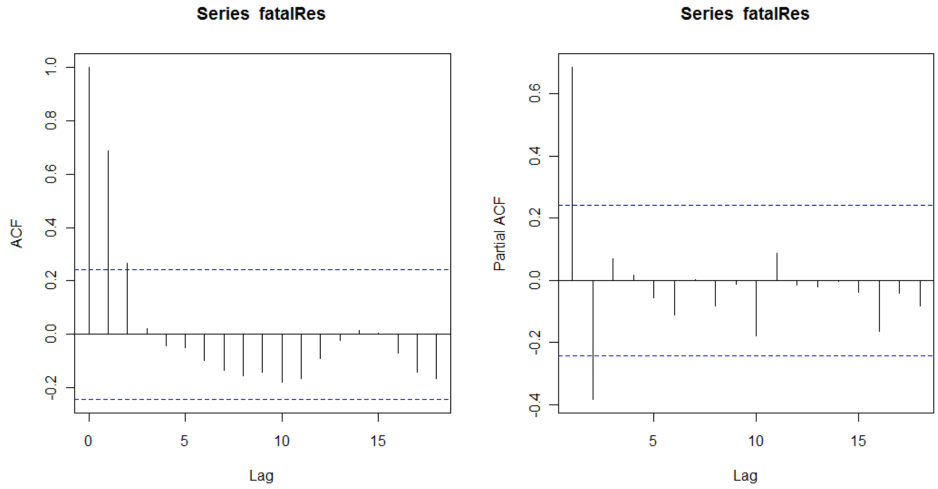

Figure A2. Autocovariance and partial autocovariance functions for model in Equation A1.

This yields the following ARMA coefficients for an ARMA(1,2) model:

$$x_t = 0.2558\, x_{t-1} + w_t + 0.6864\, w_{t-1} + 0.377\, w_{t-2} \qquad \text{(A2)}$$

After applying this model to the residuals of the linear model, the residuals are reduced to white noise as Figure A3 indicates.

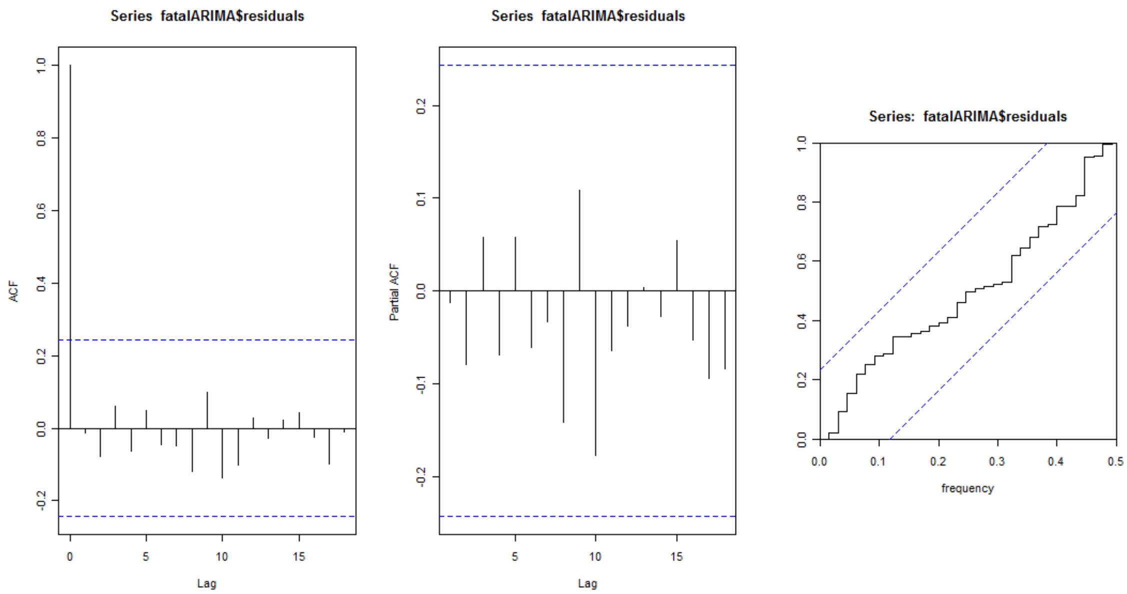

Figure A3. Diagnostic plots for residuals of ARMA model described in Equation A2.

Combining the linear model and the ARMA model, we can create the following prediction for 2005-2010, indicating that 2010 is in keeping with the trend while 2009 is very unexpected (Figure A4).

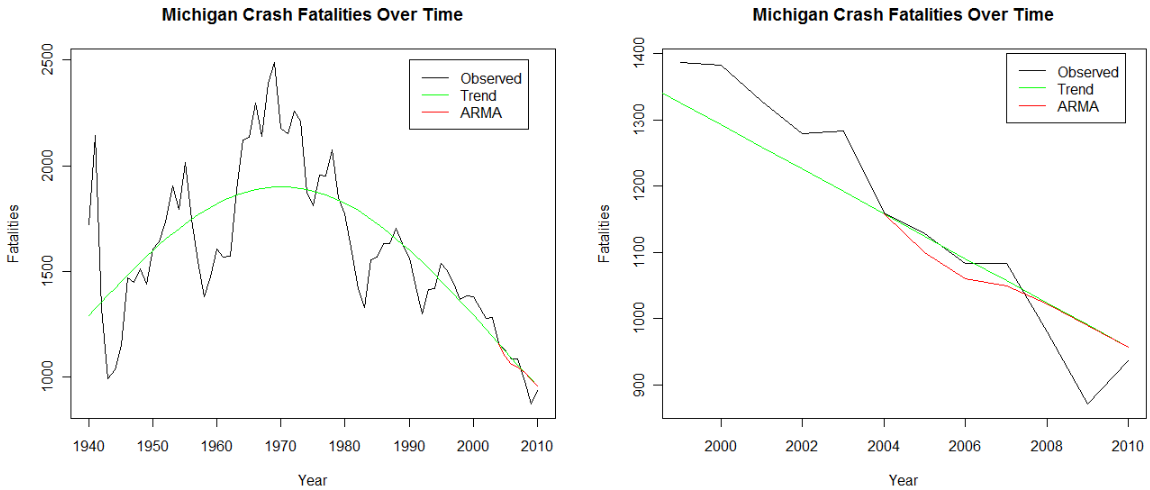

Figure A4. Model of fatalities and observed values for full time window (left) and recent years (right).

Michigan Crash Fatalities per 100 Million Vehicle Miles Traveled (VMT)

As with the raw fatality data, the logarithm of the corrected fatalities is much more fitting linear modeling, simply because it is very close to linear after the log is taken (Figure A5).

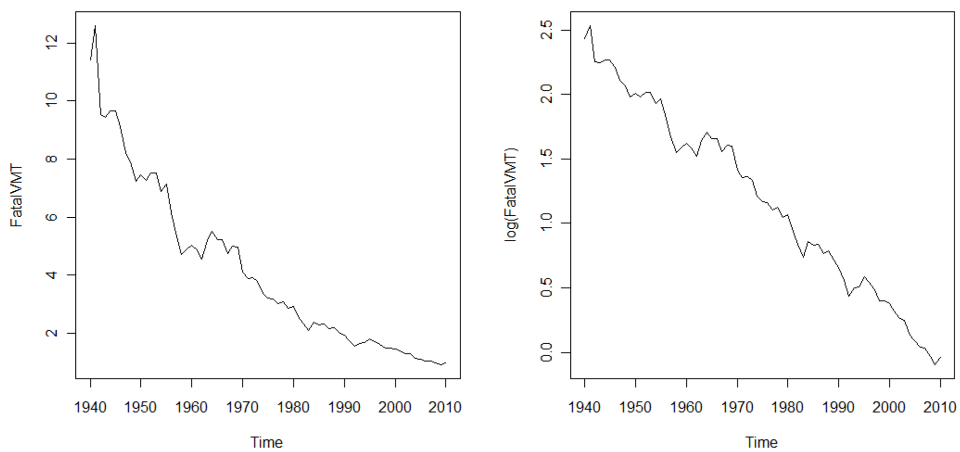

Figure A5. Comparison of time trends for fatalities (left) and log fatality count (right) in fatalities per million VMT.

This leads to the following model for the trend (again fitted to the data from 1940 to 2004), shown in Equation A3.

$$\log r = 69.18 - 0.03443 r \qquad \text{(A3)}$$

Again, though this model fits the trend very well, it does leave autocorrelation in the residuals (see Figure A6), requiring an ARMA model to correct it.

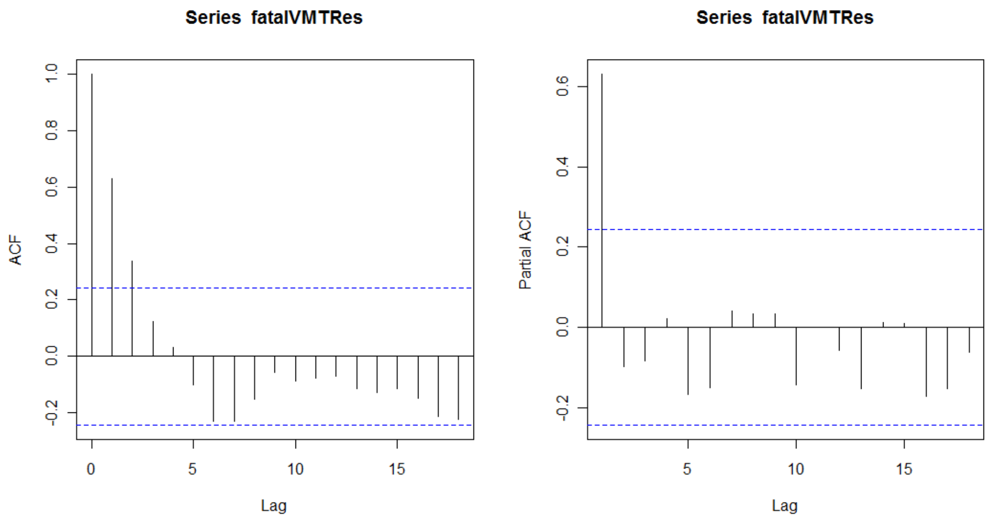

Figure A6. Autocovariance and partial autocovariance functions for model in Equation A3.

These plots and the AIC of the ARMA models indicates that an ARMA(0,2), i.e., a MA(2) model. The coefficients for this model are in Equation A4.

$$x_t = w_t + 0.6866 w_{t-1} + 0.420 w_{t-2} \qquad \text{(A4)}$$

This ARMA model reduces the residuals to white noise:

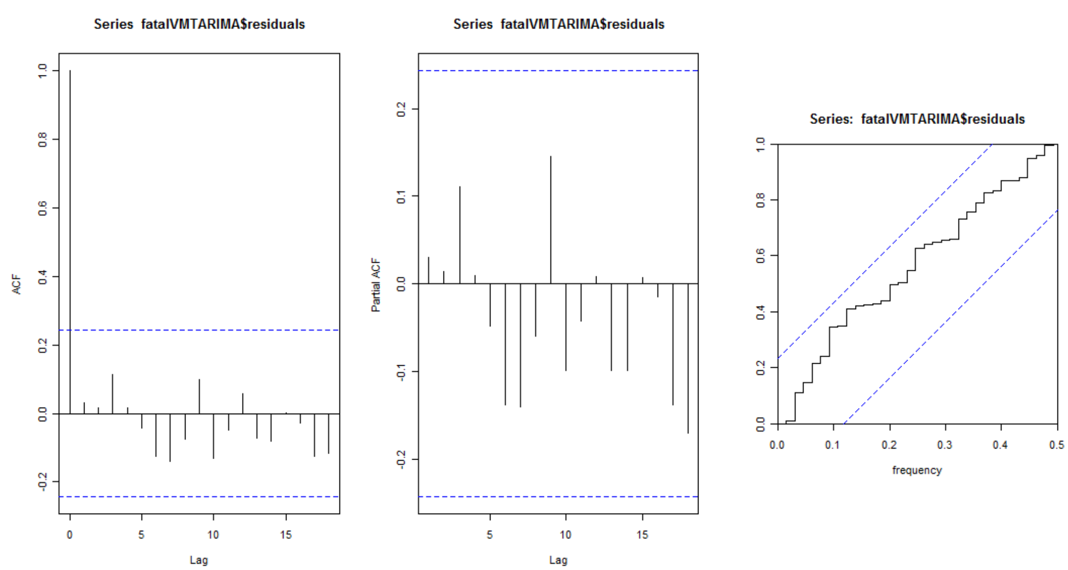

Figure A7. Diagnostic plots for residuals of ARMA model described in Equation A4.

When projecting into the period from 2005 to 2010, we can see that, as in raw fatalities, the prediction and observed data from 2010 are very close while the observed level from 2009 is less than the models predict (Figure A8).

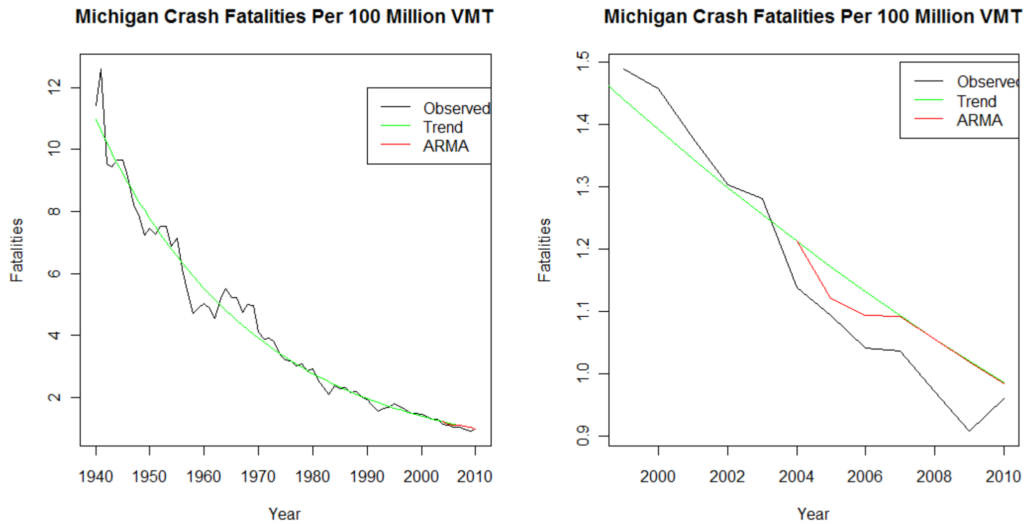

Figure A8. Model of fatalities per million VMT and observed values for full time window (left) and recent years (right).

Comparison of Michigan and Wisconsin Corrected Crash Fatalities

The process for creating the Michigan and Wisconsin 1983-2010 models was similar to what was done for the longer term Michigan Fatalities per VMT model discussed above. Unsurprisingly, both series are easier to fit a model to when logged, so this is what was done (see Figure A9).

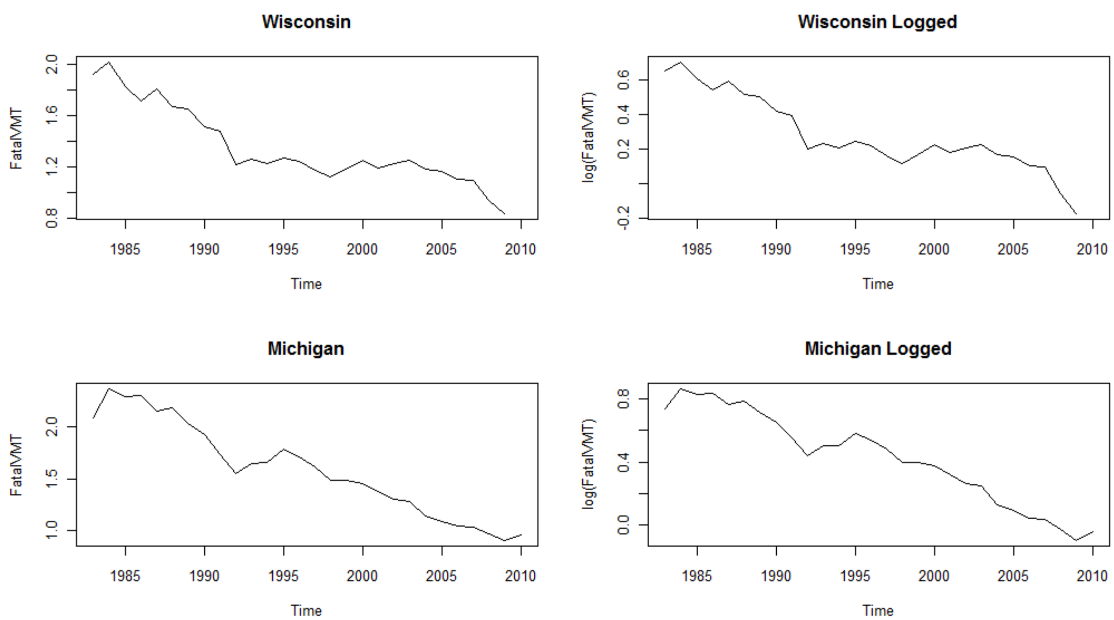

Figure A9. Comparison of raw (left) and log (right) fatalities for Michigan and Wisconsin.

This permitted fitting a linear, de-trending model to both series (excepting the last 6 years as discussed above) yielding the following results, starting with the Michigan model:

$$\log(f_{VMT,MI}) = 62.3253 - 0.03099\,t \qquad \text{(A5)}$$

After the detrending, Michigan had a very small amount of autocorrelation remaining, requiring an AR(1) model to reduce it to white noise. The coefficient for this was:

$$x_t = w_t + 0.5286\,x_{t-1} \qquad \text{(A6)}$$

Wisconsin's model is slightly more complex, including a quadratic term, as seen below:

$$\log(f_{VMT,WI}) = 2640 - 2.620\,t + 0.00065\,t^2 \qquad \text{(A7)}$$

The residuals of the model were very similar to those of the Michigan model and also required an AR(1) model, this time with the following coefficient:

$$x_t = w_t + 0.6723\,x_{t-1} \qquad \text{(A8)}$$

With these models fitted to the data and autocorrelations in the residuals adjusted for, we can compare the models and see that Wisconsin has had similar behavior to Michigan in recent years with the observed number of corrected fatalities falling below what would be expected from the model (see Figure A10). Despite the lack of 2010 VMT data for Wisconsin, we know that fatalities have increased in the state from 2009 to 2010 (from 488 to 517). As such, barring a very large increase in VMT for the year, it seems probable that the 2010 behavior of the state will prove to be similar to that seen in Michigan.

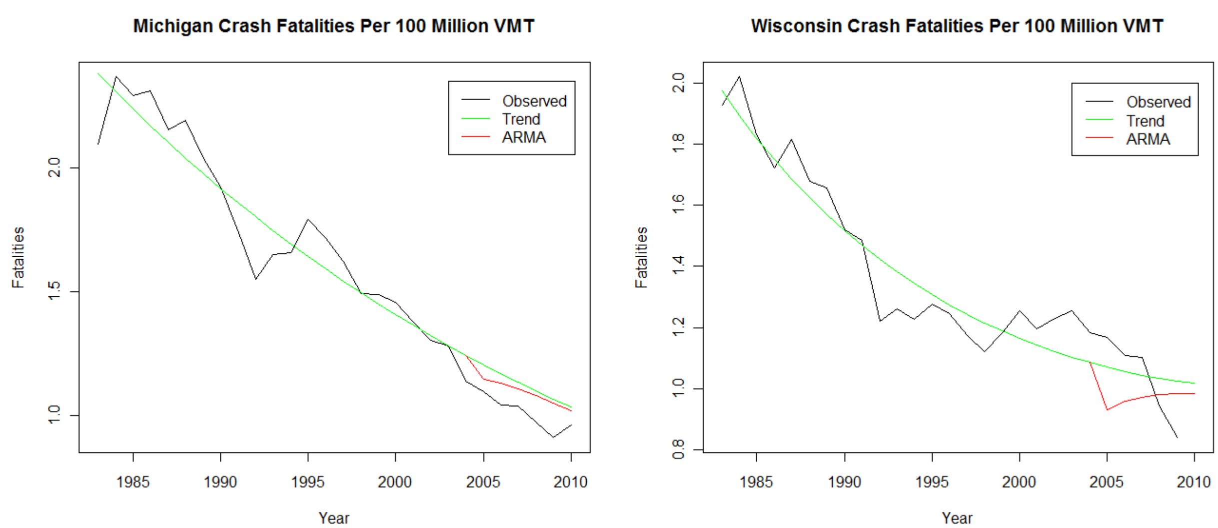

Figure A10. Michigan (left) and Wisconsin (right) plots of observed fatalities per 100 million VMT against models for 1983-2010.

Appendix B: Detail on Michigan Fatal Crashes and Fatalities 2008-2010

Variable	Level	2008	2009	2010	Percent Change 2009 vs. 2008	Percent Change 2010 vs. 2009
Crash Level	**Fatal Crashes**	**915**	**806**	**868**	**-12%**	**8%**
Construction lane closed	Lane closed	4	6	13	50%	117%
Construction type	Construction/maintenance	11	17	21	55%	24%
Crash Type	Head-on	132	101	88	-23%	-13%
Bicyclist	Bicyclist involved	25	20	31	-20%	55%
Farm equipment	Farm equipment involved	7	3	1	-57%	-67%
Hit-and-run	Hit-and-run	52	49	37	-6%	-24%
Lane departure	Multiple vehicle	136	105	93	-23%	-11%
	Parked vehicle	11	8	2	-27%	-75%
Pedestrian	Pedestrian involved	113	121	132	7%	9%
Truck or bus	Truck or bus involved	97	71	90	-27%	27%
Day of week	Monday	116	109	115	-6%	6%
	Tuesday	114	89	110	-22%	24%
	Wednesday	118	98	134	-17%	37%
	Thursday	120	99	106	-18%	7%
Highway class	US route	87	67	66	-23%	-1%
	Interstate route	91	67	93	-26%	39%
	County road, city street, or unknown	518	468	505	-10%	8%
Light	Dark unlighted	273	216	245	-21%	13%
Number of traffic lanes	2 lanes	613	498	533	-19%	7%
Road conditions	Dry	673	590	679	-12%	15%
	Icy	56	43	35	-23%	-19%

Variable	Level	2008	2009	2010	Percent Change 2009 vs. 2008	Percent Change 2010 vs. 2009
Vehicle Level	**Vehicles with Fatalities**	**927**	**815**	**880**	**-12%**	**8%**
Construction lane closed	Lane closed	4	6	13	50%	117%
Construction type	Construction/maintenance	11	18	21	64%	17%
Crash type	Head-on	33	36	31	9%	-14%
Bicyclist	Bicyclist involved	25	20	31	-20%	55%
Drinking	Drinking involved	300	281	268	-6%	-5%
Farm equipment	Farm equipment involved	7	3	1	-57%	-67%
Hit-and-run	Hit-and-run	53	51	37	-4%	-27%
Young Driver	Driver age 18-20	107	98	104	-8%	6%
	Driver age 21-24	111	85	101	-23%	19%
Day of week	Wednesday	119	98	138	-18%	41%
Highway class	Interstate route	93	68	93	-27%	37%
	US Route	89	67	68	-25%	1%
	Michigan route	207	191	185	-8%	-3%
Number of traffic lanes	1 lane	10	15	17	50%	13%
	2 lanes	622	506	541	-19%	7%
	Dry	683	596	691	-13%	16%
Road conditions	Icy	57	43	35	-25%	-19%
	Snowy	46	43	35	-7%	-19%
	Slushy	14	7	7	-50%	0%
Total motor vehicles	2 units	388	340	344	-12%	1%
	3 units	52	45	48	-13%	7%
Driver condition alcohol	Yes, driver was drinking	130	108	105	-17%	-3%
Driver drinking	Driver drinking	270	239	237	-11%	-1%

Variable	Level	2008	2009	2010	Percent Change 2009 vs. 2008	Percent Change 2010 vs. 2009
Person Level	**Persons Killed**	**980**	**871**	**937**	**-11%**	**8%**
Construction lane closed	Lane closed	4	6	14	50%	133%
Crash type	Head-on	151	117	105	-23%	-10%
	Rear-end left turn	2	3	12	50%	300%
Bicyclist	Bicyclist involved	25	20	31	-20%	55%
Drinking	Drinking involved	317	299	283	-6%	-5%
Elderly driver	Driver age 60-64	65	61	77	-6%	26%
Farm equipment	Farm equipment involved	7	3	1	-57%	-67%
Hit-and-run	Hit-and-run	55	58	37	5%	-36%
Day of week	Monday	121	126	122	4%	-3%
	Wednesday	122	103	148	-16%	44%
	Saturday	179	152	139	-15%	-9%
Highway class	Michigan route	217	203	195	-6%	-4%
Number of traffic lanes	1 lane	10	16	18	60%	13%
	2 lanes	663	539	584	-19%	8%
Road conditions	Icy	62	47	37	-24%	-21%
	Snowy	48	47	38	-2%	-19%
	Slushy	17	9	7	-47%	-22%
Total motor vehicles	2 units	409	373	374	-9%	0%
Party type	Pedestrian	114	121	131	6%	8%
Person restraint	Both lap & shoulder belts used	335	295	306	-12%	4%
	No belts used	242	195	206	-19%	6%
	Child restraint used	5	4	6	-20%	50%

Bibliography

Longthorne, A. (2010, June). *An Analysis of the Significant Decline in Motor Vehicle Traffic Crashes in 2008.* DOT HS 811 346. Washington, DC: National Highway Traffic Safety Administration. Available at http://www-nrd.nhtsa.dot.gov/Pubs/811346.pdf.

NHTSA. (2011, April). *Early Estimate of Motor Vehicle Traffic Fatalities in* 2010 DOT HS 811 451. Crash* Stats Traffic Safety Facts. Washington, DC: National Highway Traffic Safety Administration. Available at http://www-nrd.nhtsa.dot.gov/Pubs/811451.pdf