

Iowa DOT FHWA Safety Targets

August 2018

In January 2018, the Iowa DOT began the process of reviewing data to set performance targets for the five safety performance measures required by FHWA in 23 CFR 490 (also referred to as “PM1”). For the safety area, these targets are required to be five-year rolling averages and must be set annually. The five required measures are:

1. Number of fatalities
2. Rate of fatalities per 100 million vehicle miles traveled (VMT)
3. Number of serious injuries
4. Rate of serious injuries per 100 million VMT
5. Number of non-motorized fatalities and non-motorized serious injuries

These targets must be set as five-year rolling averages for 2015-2019, and will be submitted as part of the State’s Highway Safety Improvement Program (HSIP) annual report, due August 31, 2018. The first round of target setting for these measures occurred in 2017, and the same approach was used again in 2018. Because of the relatively short-term nature of the targets, the methodology being utilized focuses on historical information and creates a forecast based on trends. The approach relies on the use of prediction intervals around the trend model forecast to inform a “risk-based” target setting method.

A prediction interval is defined as: “In statistical inference, specifically predictive inference, a prediction interval is an estimate of an interval in which future observations will fall, with a certain probability, given what has already been observed.”¹ A prediction interval approach enables a focus on the acceptable risk of meeting, or failing to meet a target, which allows stakeholders at all levels of the organization to understand the targets in better context. In 2017, the safety targets working group evaluated several prediction intervals and recommended a prediction interval of 75%, meaning that there would be 75% confidence that the actual number of fatalities and injuries would be lower than the targets. Management agreed with the use of a 75% confidence level. This level is being used again in 2018 for target setting.

For each measure, a time-series model was developed. An integrated moving average model was used in both 2017 and 2018. The following pages show the model’s output and predictions at various confidence levels for each measure. This helps illustrate the level of risk associated with various confidence levels, as well as the fact that higher confidence levels lead to more conservative targets. The final page shows the 2015-2019 safety targets.

The safety data used in the forecast can be obtained from the Iowa Crash Analysis Tool (ICAT) and Motor Vehicle Division daily fatality count from the following URLs:

ICAT: <https://saver.iowadot.gov/>

Fatality Report: <https://www.iowadot.gov/mvd/stats/daily.pdf>

¹ https://en.wikipedia.org/wiki/Prediction_interval, 2018-Mar-09

Measure 1: Number of Fatalities

Figure 1 shows the historical series (black line), the integrated moving average (IMA) model (red line), the model's forecast values (black dots), and a set of prediction interval bounds (blue lines). The blue lines shown in this figure correspond to the 75% confidence level used for targets. Table 1 shows the model's forecast of fatalities for 2018 and 2019 and the upper prediction interval value at different confidence levels.

Figure 1: IMA model and forecast for annual fatalities

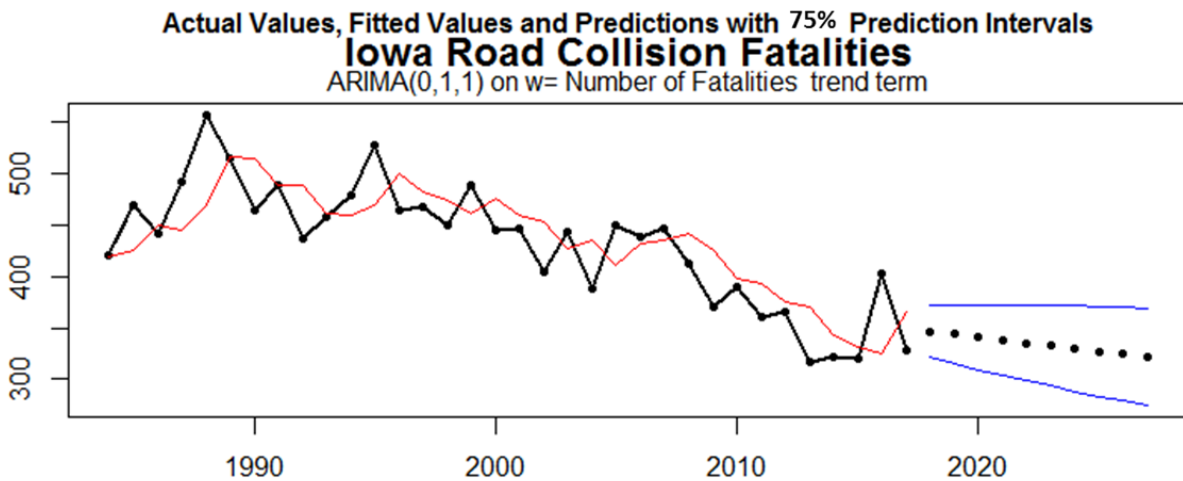
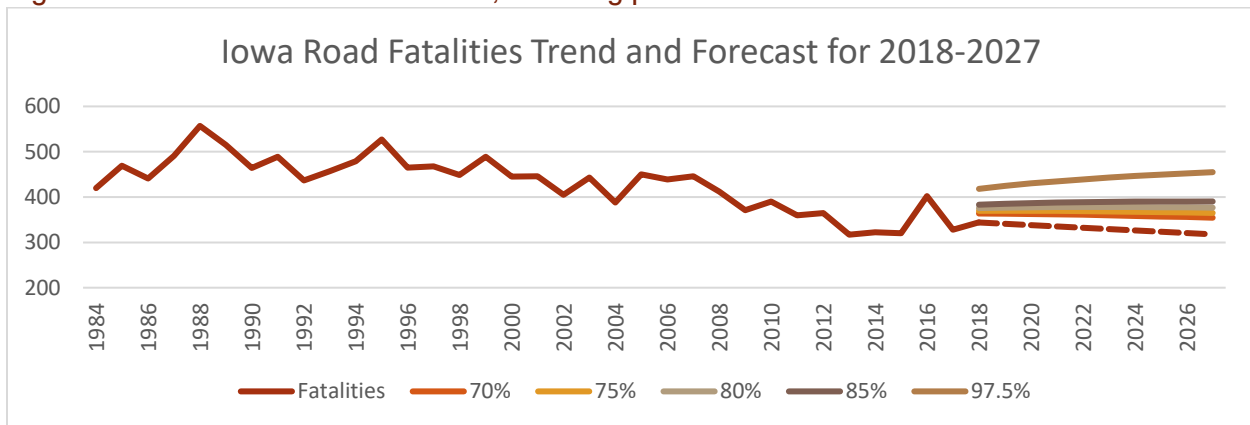


Table 1: Forecast road fatalities and upper prediction values at selected probability levels

Year	Forecast	70%	75%	80%	85%	97.5%
2018	346	366	372	378	385	420
2019	344	366	372	379	388	427

Figure 2: Fatalities trend and forecast, including prediction interval bounds



To be 75% confident of the 2019 target value, the five-year rolling average target for 2015-2019 would be set by using the forecast value of 346 fatalities for 2018 and the 75% PI value of 372 as the 2019 value. The five-year rolling average target is presented in Table 7.

Measure 2: Fatalities Per Hundred Million Vehicle Miles Traveled

This measure is a rate conversion, using the forecast developed for Measure 1 and the estimated VMT for the forecast period. The forecast values of VMT were provided by the Office of Systems Planning using their preferred methodology, linear ETS, which is an exponential smoothing approach. The linear ETS method provides the most reasonable results and adjustment for seasonality or fluctuations in the data. The annual VMT forecasted by this method for 2019 is expected to be 34,653,330,000.

Table 2: Fatality rate forecast at selected probability levels

Year	VMT Forecast (x100M)	Forecast Fatality Rate	70%	75%	80%	85%	97.5%
2018	34,209.06	1.0127	1.0704	1.0870	1.1054	1.1269	1.2286
2019	34,653.33	0.9917	1.0561	1.0746	1.0951	1.1190	1.2325

To be 75% confident of the 2019 target value, the five-year rolling average target for 2015-2019 would be set by using the forecast value of 1.0127 fatalities per hundred million VMT for 2018 and the 75% PI value of 1.0746 for 2019 along with the actual rates from 2015-2017. The five-year rolling average target is presented in Table 7.

Measure 3: Number of Serious Injuries

The figure below shows the historical series (black line), the model (red line), the model's forecast values (black dots), and a set of prediction interval bounds (blue lines) for the number of serious injuries resulting from collisions. In this case, due to a discontinuity between 2000 and 2001, the model is constructed using only data from 2001 and later.

Figure 3: IMA model and forecast for serious injuries

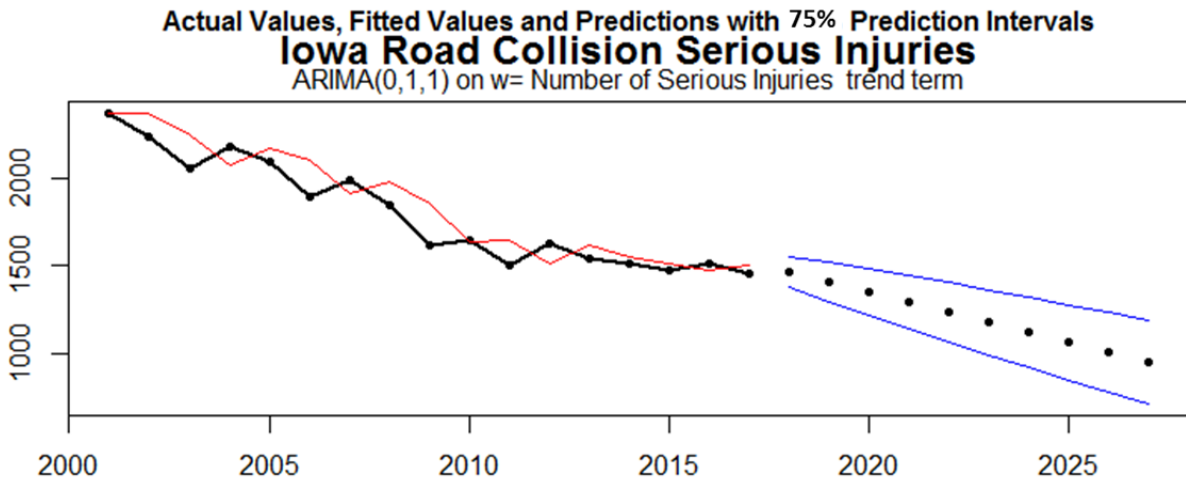
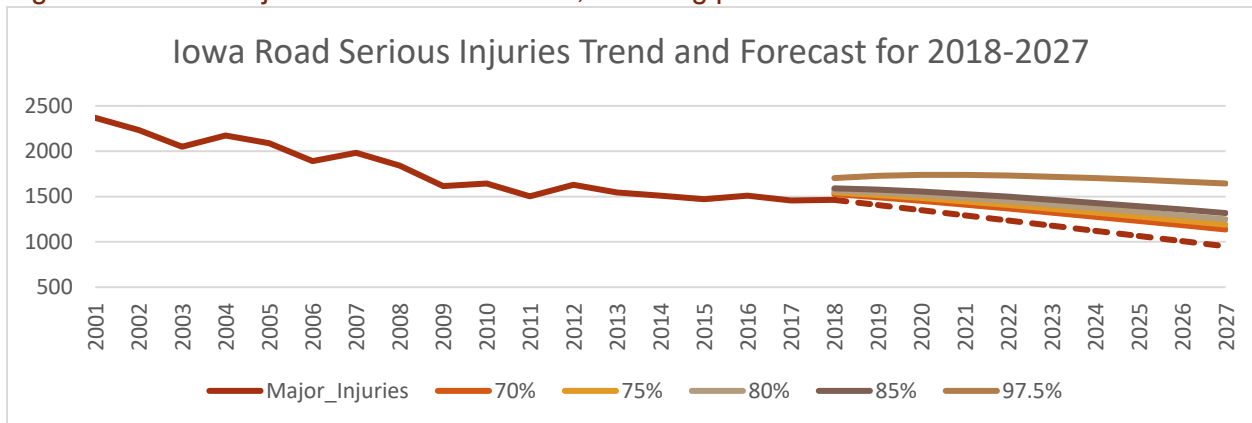


Table 3: Forecast road serious injuries and upper prediction values at selected probability levels

Year	Forecast	70%	75%	80%	85%	97.5%
2018	1,463	1,527	1,546	1,566	1,590	1,704
2019	1,406	1,493	1,517	1,545	1,577	1,730

Figure 4: Serious Injuries trend and forecast, including prediction interval bounds



To be 75% confident of the 2019 target value, the five-year rolling average target for 2015-2019 would be set by using the forecast value of 1,463 for 2018 and the 75% PI value of 1,517 for 2019. The five-year rolling average target is presented in Table 7.

Measure 4: Serious Injury Rate per Hundred Million Vehicle Miles Traveled

This measure is a rate conversion, using the forecast developed for Measure 3 and the estimated VMT for the forecast period. The forecast values of VMT were provided by the Office of Systems Planning using their preferred methodology, linear ETS, which is an exponential smoothing approach. The linear ETS method provides the most reasonable results and adjustment for seasonality or fluctuations in the data. The annual VMT forecasted by this method for 2019 is expected to be 34,653,330,000.

Table 4: Serious Injury rate forecast at selected probability levels

Year	VMT Forecast (x100M)	Forecast Serious Injury Rate	70%	75%	80%	85%	97.5%
2018	34,209.06	4.2763	4.4647	4.5186	4.5787	4.6487	4.9804
2019	34,653.33	4.0574	4.3074	4.3790	4.4587	4.5516	4.9920

To be 75% confident of the 2019 target value, the five-year rolling average target for 2015-2019 would be set by using the forecast value of 4.2763 serious injuries per hundred million VMT for 2018 and the 75% PI value of 4.3790 for 2019 along with the actual rates from 2015-2017. The five-year rolling average target is presented in Table 7.

Measure 5: Number of Non-Motorized Fatalities & Serious Injuries

The figure below shows the historical series (black line), the model (red line), the model's forecast values (black dots), and a set of prediction interval bounds (blue lines) for the number of non-motorized fatalities and serious injuries resulting from collisions with a vehicle. The model is constructed using all available data from 2008 and later.

Figure 5: IMA model and forecast for annual non-motorized fatalities and serious injuries

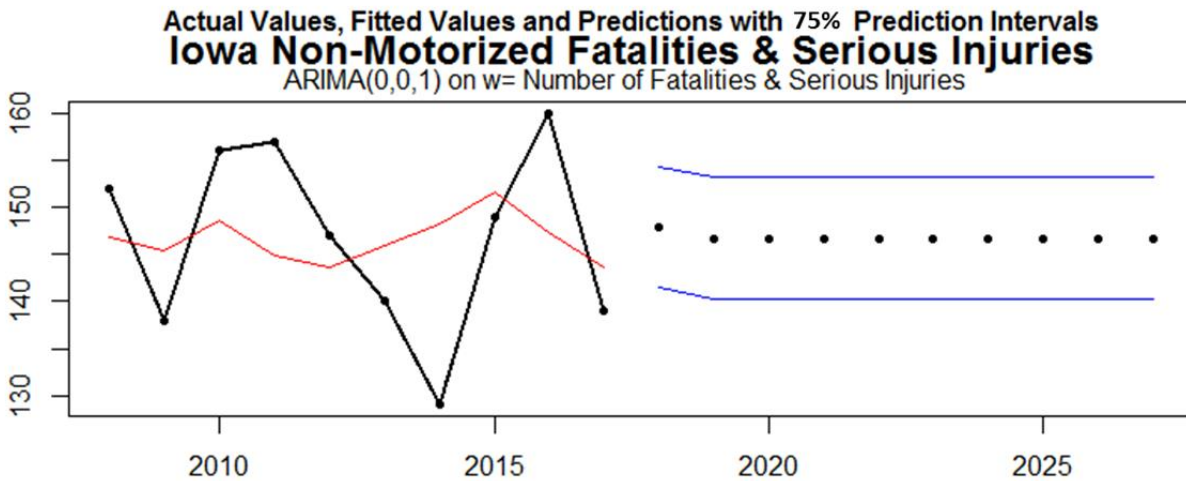
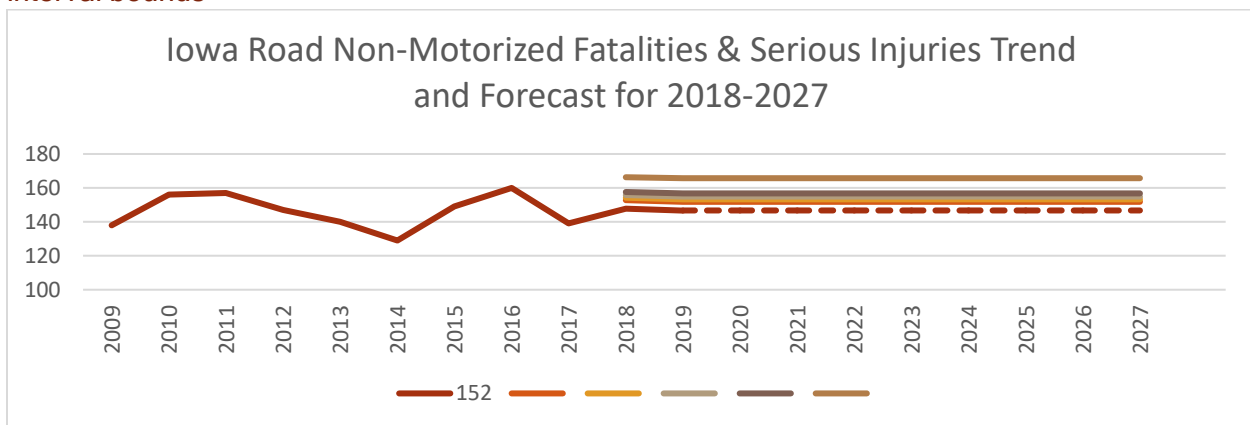


Table 5: Forecast non-motorized fatalities and serious injuries, and upper prediction values at selected probability levels

Year	Forecast	70%	75%	80%	85%	97.5%
2018	148	153	154	156	158	166
2019	147	152	153	155	157	166

Figure 6: Non-Motorized Fatalities and Serious Injuries trend and forecast, including prediction interval bounds



To be 75% confident of the 2019 target value, the five-year rolling average target for 2015-2019 would be set by using the forecast value of 148 for 2018 and the 75% PI value of 153 for 2019. The five-year rolling average target is presented in Table 7.

Iowa DOT 2015-2019 Safety Targets

While the preceding forecasts were developed for each year, the targets are required to be set as five-year rolling averages, as crashes are subject to significant year-to-year variability. The following table gives the actual numbers of fatalities, serious injuries, non-motorized injuries and fatalities, and the VMT for each respective year, which are the basis for the five year rolling averages presented in Table 7.

Table 6: Annual data summary, 2011-2017

Year	Fatalities	Serious Injuries	Non-Motorized Injuries and Fatalities	VMT (Million)
2011	360	1,501	157	31,411
2012	365	1,629	147	31,581
2013	317	1,545	138	31,542
2014	322	1,509	126	32,332
2015	320	1,470	153	33,109
2016	402	1,510	165	33,263
2017	329	1,460	150	33,765

Table shows the historical and predicted five-year rolling averages for the five targets. The highlighted numbers represent Iowa's 2015-2019 safety targets.

Table 7: Historical 5-year rolling averages, forecast values, and 2015-2019 targets

Five-Year Rolling Averages					
Year	Fatalities	Serious Injuries	Non-Motorized Injuries and Fatalities	Fatalities per hundred million VMT	Serious Injuries per hundred million VMT
2004-08	427.0	1,995.0	Data not available	Data not available	Data not available
2005-09	423.6	1,883.4			
2006-10	411.6	1,794.2			
2007-11	395.8	1,716.6			
2008-12	379.6	1,646.0	150.0	1.053	4.785
2009-13	360.6	1,586.8	147.6		
2010-14	350.8	1,565.6	145.8		
2011-15	336.8	1,530.8	144.2		
2012-16	345.2	1,532.6	145.8		
2013-17	338.0	1,498.8	146.4	1.027	4.568
Forecast 75% Prediction Interval Value					
2014-18	348.8	1,498.6	146.2	1.046	4.497
2015-19	353.6	1,483.7	149.8	1.047	4.391
2016-20	358.5	1,464.0	149.4	1.049	4.284
2017-21	346.3	1,424.3	146.7	0.999	4.113
2018-22	348.3	1,383.2	148.3	0.992	3.944