

2021 Iowa DOT FHWA Safety Targets

August 2020

In February 2020, 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 2017-2021 and will be submitted as part of the State’s Highway Safety Improvement Program (HSIP) annual report, due August 31, 2020. The first round of target setting for these measures occurred in 2017, and the same approach was used again in 2018 and 2019. 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. Since 2017, the safety targets working group has annually evaluated several prediction intervals and continued to recommend 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, and it is being used again in 2020 for target setting.

For each measure, a time-series model was developed. An integrated moving average (IMA) model has been used since 2017. 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 2017-2021 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 websites.

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

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

¹ https://en.wikipedia.org/wiki/Prediction_interval, 2019-May-02

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 (PI) 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 2020 and 2021 and the upper prediction interval value at different confidence levels.

Figure 1: IMA model and forecast for annual fatalities

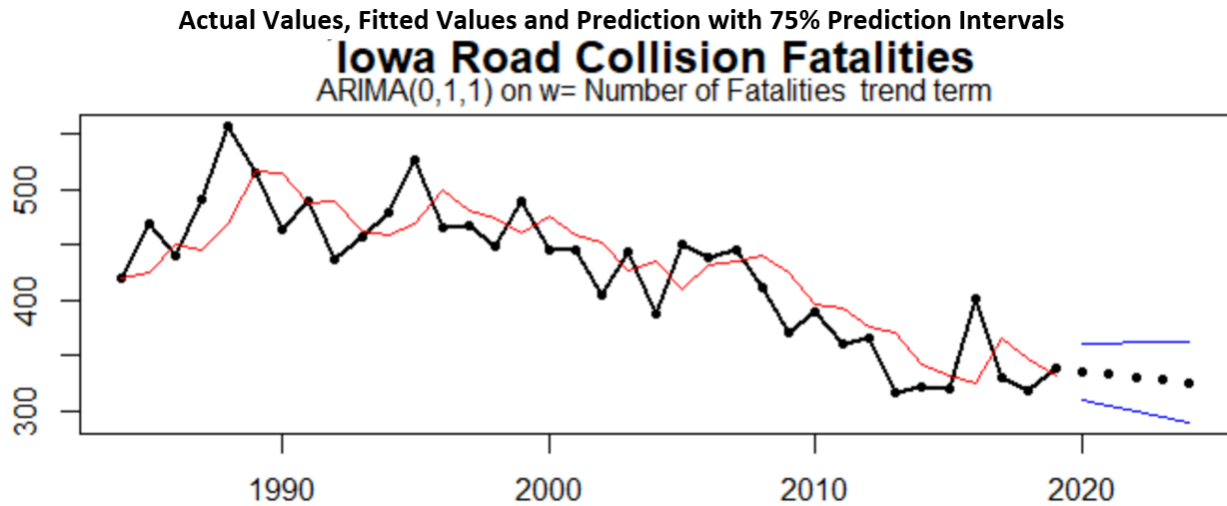


Table 1: Forecast road fatalities and upper prediction values at selected probability levels

Year	Forecast	70%	75%	80%	85%	97.5%
2020	335	355	360	366	374	408
2021	333	355	361	368	376	415

To be 75% confident of the 2021 target value, the five-year rolling average target for 2017-2021 would be set by averaging the forecast value of 335 fatalities for 2020 and the 75% PI value of 361 as the 2021 value along with the actual fatalities for 2017, 2018, and 2019. The five-year rolling average target for fatalities 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 Systems Planning Bureau using their preferred methodology, linear ETS, which is an exponential smoothing approach. The linear ETS method provides the most reasonable results and adjusts for seasonality or fluctuations in the data. The annual VMT forecast by this method for 2021 is expected to be 35.1 billion (35,059,220,000).

Table 2: Fatality rate forecast at selected probability levels

Year	VMT forecast (x100M)	Forecast fatality rate	70%	75%	80%	85%	97.5%
2020	34,685.59	0.9658	1.0234	1.0378	1.0551	1.0782	1.1762
2021	35,059.22	0.9498	1.0125	1.0296	1.0496	1.0724	1.1837

To be 75% confident of the 2021 target value, the five-year rolling average target for 2017-2021 would be set by averaging the forecast value of 0.9658 fatalities per hundred million VMT for 2020 and the 75% PI value of 1.0296 for 2021 along with the actual fatality rates for 2017, 2018, and 2019. The five-year rolling average target for fatality rate 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

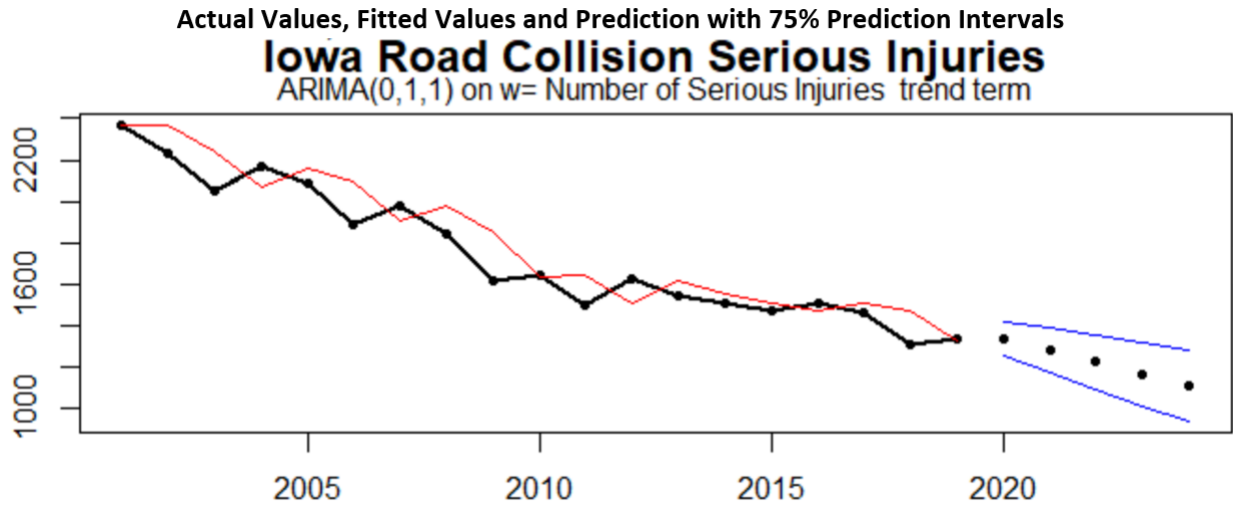


Table 3: Forecast road serious injuries and upper prediction values at selected probability levels

Year	Forecast	70%	75%	80%	85%	97.5%
2020	1,340	1,403	1,422	1,442	1,466	1,578
2021	1,283	1,369	1,394	1,421	1,453	1,605

To be 75% confident of the 2021 target value, the five-year rolling average target for 2017-2021 would be set by using the forecast value of 1,340 for 2020 and the 75% PI value of 1,394 for 2021 along with the actual serious injuries for 2017, 2018, and 2019. The five-year rolling average target for serious injuries 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 Systems Planning Bureau using their preferred methodology, linear ETS, which is an exponential smoothing approach. The linear ETS method provides the most reasonable results and adjusts for seasonality or fluctuations in the data. The annual VMT forecast by this method for 2021 is expected to be 35.1 billion (35,059,220,000).

Table 4: Serious Injury rate forecast at selected probability levels

Year	VMT forecast (x100M)	Forecast serious injury rate	70%	75%	80%	85%	97.5%
2020	34,685.59	3.8632	4.0449	4.0996	4.1573	4.2265	4.5494
2021	35,059.22	3.6595	3.9048	3.9761	4.0531	4.1444	4.5779

To be 75% confident of the 2021 target value, the five-year rolling average target for 2017-2021 would be set by averaging the forecast value of 3.8632 serious injuries per hundred million VMT for 2020 and the 75% PI value of 3.9761 for 2021 along with the actual serious injury rates for 2017, 2018, and 2019. The five-year rolling average target for serious injury rate 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 2009 and later.

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

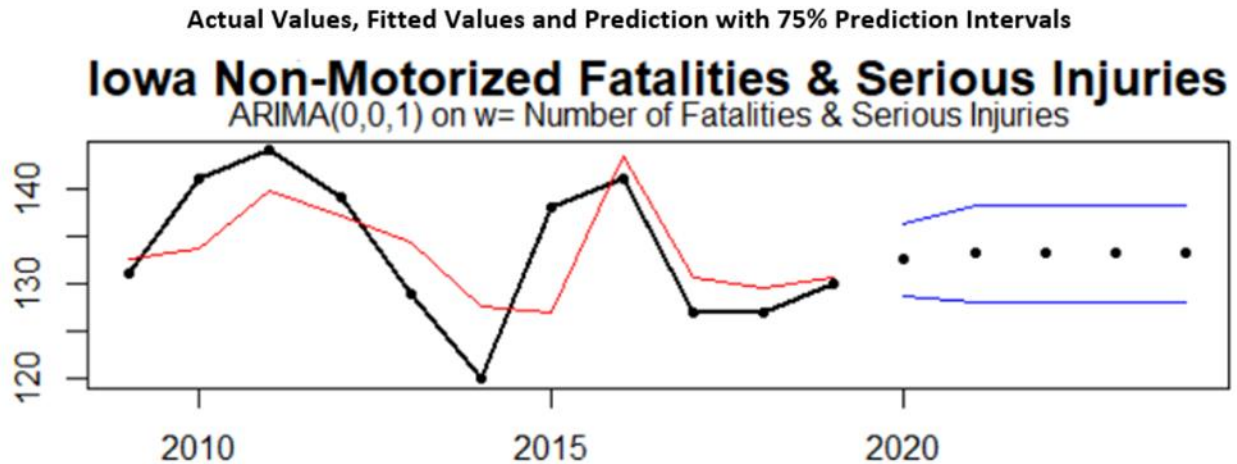


Table 5: Forecast non-motorized fatalities and serious injuries, and upper prediction values at selected probability levels

Year	Forecast	70%	75%	80%	85%	97.5%
2020	133	135	136	137	138	143
2021	133	137	138	140	141	148

To be 75% confident of the 2021 target value, the five-year rolling average target for 2017-2021 would be set by using the forecast value of 133 for 2020 and the 75% PI value of 138 for 2021 along with the actual non-motorized fatalities and serious injuries for 2017, 2018, and 2019. The five-year rolling average target for non-motorized fatalities and serious injuries is presented in Table 7.

Iowa DOT 2017-2021 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 vehicle miles traveled (VMT, in millions) for each respective year, which are the basis for the five-year rolling averages presented in Table 7.

Table 6: Annual data summary

Year	Fatalities	Fatality rate	Serious injuries	Serious injuries rate	Non-motorized injuries and fatalities	VMT
						(millions)
2012	365	1.156	1,629	5.158	139	31,581
2013	317	1.005	1,545	4.898	129	31,542
2014	322	0.996	1,509	4.667	120	32,332
2015	320	0.967	1,470	4.440	138	33,109
2016	402	1.209	1,510	4.540	141	33,263
2017	331	0.981	1,467	4.347	127	33,751
2018	319	0.952	1,312	3.916	127	33,507
2019	338	0.985	1,341	3.908	130	34,312

Table 7 shows the historical and predicted five-year rolling averages for the five targets. The highlighted numbers represent Iowa's 2017-2021 safety targets.

Table 7: 5-year rolling average actuals and 2021 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
2008-12	379.6	1,646.0	Data not available	1.211	5.250
2009-13	360.6	1,586.8	136.8	1.146	5.040
2010-14	350.8	1,565.6	134.6	1.108	4.942
2011-15	336.8	1,530.8	134.0	1.054	4.788
2012-16	345.2	1,532.6	133.4	1.066	4.741
2013-17	338.4	1,500.2	131.0	1.131	4.578
2014-18	338.8	1,453.6	130.6	1.021	4.382
2015-19	342.0	1,420.0	132.6	1.019	4.230
Forecast 75% prediction interval value					
2016-20	350.0	1,410.4	132.2	1.033	4.162
2017-21 targets	336.8	1,370.8	131.0	0.983	4.002