Iowa DOT FHWA 2024 Safety Targets

August 2023

In March 2023, 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 2020-2024 and will be submitted as part of the State's Highway Safety Improvement Program (HSIP) annual report, due August 31, 2023. The first round of target setting for these measures occurred in 2017, and the same approach has been used each year since. 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, in the past, recommended a prediction interval of 75%. This year, due to a re-evaluation of consequences, management agreed with the recommendation to use an 85% confidence level for target setting, meaning that there would be 85% confidence that the actual number of fatalities and injuries would be lower than the targets.

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 2020-2024 safety targets.

The safety data used in the forecast can be obtained from the Iowa Crash Analysis Tool (ICAT, https://icat.iowadot.gov/) and Motor Vehicle Division daily fatality count (https://www.iowadot.gov/mvd/stats/daily.pdf).

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[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 85% confidence level used for targets. Table 1 shows fatalities from 2020-2022, the model's forecast of fatalities for 2023 and 2024, and the upper prediction interval value at different confidence levels.
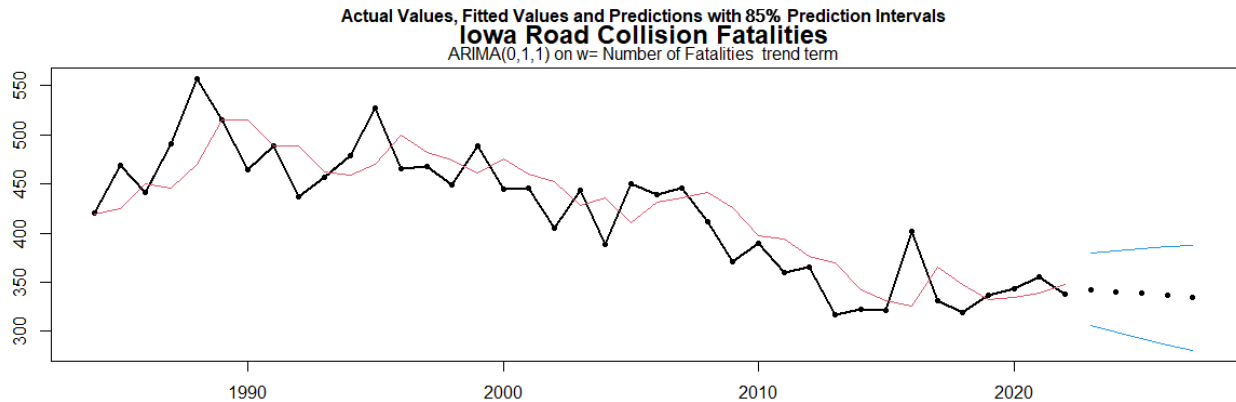
Figure 1: IMA model and forecast for annual fatalities

Table 1: Historical and forecast road fatalities with upper prediction values at selected probability levels

Year	Fatalities	Forecast	Prediction Interval – Confidence Level				
			70%	**75%**	**80%**	**85%**	**97.5%**
2020	343						
2021	356						
2022	338						
2023		343	362	367	373	380	413
2024		341	362	368	375	383	420
5-Year Rolling Average Target	344.2	348.4	349.6	351.0	**352.6**	360.0

To be 85% confident of the 2024 target value, the five-year rolling average target for 2020-2024 would be set by averaging:

- The number of fatalities for 2020 (343), 2021 (356), and 2022 (338)
- The forecast value of 343 for 2023
- The 85% PI value of 383 for 2024

The five-year rolling average target for fatalities is presented in Table 1 and all targets are 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 2024 is expected to be 33.5 billion (33,503,000,000).

Table 2: Historical and forecast road fatality rates and forecast values at selected probability levels

Year	Fatalities	HMVMT	Fatality Rate*	Forecast	Prediction Interval – Confidence Level				
					70%	75%	80%	85%	97.5%
2020	343	298.82	1.148						
2021	356	333.84	1.066						
2022	338	332.66	1.016						
2023	343	333.85		1.027	1.084	1.099	1.117	1.138	1.237
2024	341**	335.03		1.018	1.081	1.098	1.119	1.143	1.254
5-Year Rolling Average Target				1.055	1.068	1.071	1.075	1.080	1.102

Per Hundred Million Vehicle Miles Traveled (HMVMT).
**2024 fatalities value based on forecast value, not 85% prediction interval value, which is applied to the rate.*

To be 85% confident of the 2024 target value, the five-year rolling average target for 2020-2024 would be set by averaging:

- The fatality rates for 2020 (1.148), 2021 (1.066), and 2022 (1.016)
- The forecast value of 1.027 for 2023
- The 85% PI value of 1.143 for 2024

The five-year rolling average target for fatality rate is presented in Table 2 and all targets are 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.

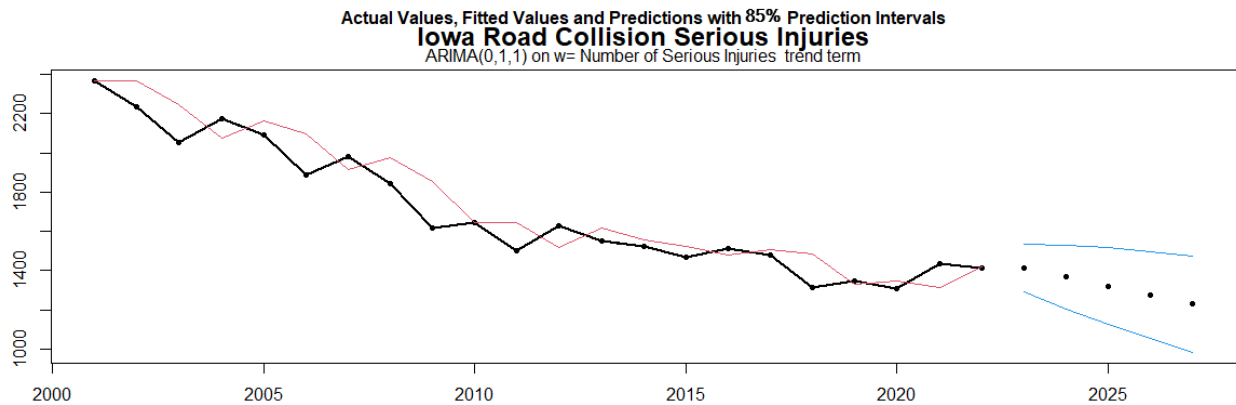*Figure 3: IMA model and forecast for serious injuries*

Actual Values, Fitted Values and Predictions with 85% Prediction Intervals
Iowa Road Collision Serious Injuries
ARIMA(0,1,1) on w= Number of Serious Injuries trend term

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

Year	Serious Injuries	Forecast	Prediction Interval – Confidence Level				
			70%	75%	80%	85%	97.5%
2020	1,308						
2021	1,435						
2022	1,412						
2023		1,414	1,475	1,492	1,512	1,535	1,642
2024		1,368	1,450	1,473	1,499	1,530	1,674
5-Year Rolling Average Target		1,387.4	1,403.8	1,408.4	1,413.6	1,419.8	1,448.6

To be 85% confident of the 2024 target value, the five-year rolling average target for 2020-2024 would be set by averaging:

- The number of serious injuries for 2020 (1,308), 2021 (1,435), and 2022 (1,412)
- The forecast value of 1,414 for 2023
- The 85% PI value of 1,530 for 2024

The five-year rolling average target for serious injuries is presented in Table 3 and all targets are 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 2024 is expected to be 33.5 billion (33,503,000,000).

Table 4: Historical and forecast road serious Injury rates and forecast values at selected probability levels

Year	Serious Injuries	HMVMT	Serious Injury Rate*	Forecast	Prediction Interval – Confidence Level				
					70%	75%	80%	85%	97.5%
2020	1,308	298.82	4.377						
2021	1,435	333.84	4.298						
2022	1,412	332.66	4.245						
2023	1,414	333.85		4.235	4.418	4.469	4.529	4.598	4.918
2024	1,368**	335.03		4.083	4.328	4.397	4.474	4.567	4.997
5-Year Rolling Average Target				4.248	4.297	4.310	4.326	4.344	4.430

Per Hundred Million Vehicle Miles Traveled (HMVMT).
***2024 fatalities value based on forecast value, not 85% prediction interval value, which is applied to the rate.*

To be 85% confident of the 2024 target value, the five-year rolling average target for 2020-2024 would be set by averaging:

- The serious injury rates for 2020 (4.377), 2021 (4.298), and 2022 (4.245)
- The forecast value of 4.235 for 2023
- The 85% PI value of 4.567 for 2024

The five-year rolling average target for serious injury rate is presented in Table 4 and all targets are 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 2013 and later.

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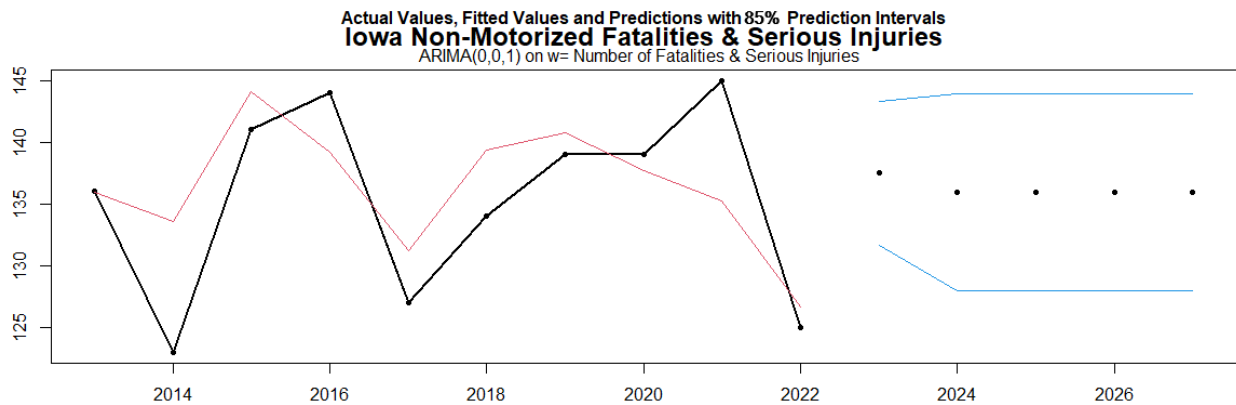

Table 5: Historical and forecast road non-motorized fatalities and serious injuries and forecast upper prediction values at selected probability levels

Year	Non-Motorized Fatalities and Serious Injuries	Forecast	Prediction Interval – Confidence Level				
			70%	75%	80%	85%	97.5%
2020	139						
2021	145						
2022	125						
2023		138	141	142	143	144	149
2024		136	140	142	143	144	151
5-Year Rolling Average Target		136.6	137.4	137.8	138	138.2	139.6

To be 85% confident of the 2024 target value, the five-year rolling average target for 2020-2024 would be set by averaging:

- The number of non-motorized fatalities and serious injuries for 2020 (139), 2021 (145), and 2022 (125)
- The forecast value of 138 for 2023
- The 85% PI value of 144 for 2024

The five-year rolling average target for non-motorized fatalities and serious injuries is presented in Table 5 and all targets are presented in Table 7.

Iowa DOT 2020-2024 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 Injury Rate	Non-motorized Serious Injuries and Fatalities	VMT (millions)
2013	317	1.005	1,545	4.898	136	31,542
2014	322	0.996	1,522	4.707	123	32,332
2015	321	0.970	1,471	4.443	141	33,109
2016	402	1.209	1,513	4.549	144	33,263
2017	332	0.984	1,480	4.385	127	33,751
2018	319	0.952	1,312	3.916	134	33,507
2019	337	0.998	1,349	3.994	139	33,779
2020	343	1.148	1,308	4.377	139	29,882
2021	356	1.066	1,435	4.298	145	33,384
2022	338	1.016	1,412	4.245	125	33,266

Table 7 shows the historical and predicted five-year rolling averages for the five targets. The highlighted numbers represent Iowa's 2020-2024 safety targets.

Table 7: 5-year rolling average actuals and 2024 targets

Five-Year Rolling Averages					
Year	Fatalities	Serious Injuries	Non-motorized Serious Injuries and Fatalities	Fatalities per Hundred Million VMT	Serious Injuries per Hundred Million VMT
2013-17	338.8	1,506.2	134.2	1.033	4.596
2014-18	339.2	1,459.6	133.8	1.022	4.400
2015-19	342.2	1,425.0	137.0	1.022	4.257
2016-20	346.6	1,392.4	136.6	1.058	4.244
2017-21	337.2	1,376.8	136.8	1.030	4.194
2018-22	338.6	1,363.2	136.4	1.036	4.166
Forecast 85% prediction interval value					
2019-23	343.4	1,383.6	137.2	1.051	4.230
2020-24 targets	352.6	1,419.8	138.2	1.080	4.344