Iowa DOT FHWA 2025 Safety Targets

August 2024

In spring 2024, 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 2021-2025 and will be submitted as part of the State's Highway Safety Improvement Program (HSIP) annual report, due August 31, 2024. The first round of target setting for these measures occurred in 2017, and a similar 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 an estimate of a range within which future data points will occur, with a specific probability, based on past data. 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 recommended a prediction interval of either 75% or 85%. This year an 85% confidence level was used 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 Autoregressive Integrated Moving Average (ARIMA) model has been used since 2017. An R script was traditionally used for this analysis. A new methodological approach using a Python script was deployed this year, which uses a flexible approach for model fit by employing a grid search methodology for ARIMA model parameters. This systematically explores a range of potential models to identify the model parameters that best fit the data. A comparison of model performance criteria between the two scripts found the new method to have improved predictive accuracy and better model fit. 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 2021-2025 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).

Measure 1: Number of fatalities

Figure 1 shows the historical series (blue line), the ARIMA model (red line), the model's forecast values (black dots), and a set of prediction interval (PI) bounds (purple shading). The purple shading shown in this figure correspond to the 85% confidence level used for targets. Table 1 shows fatalities from 2021-2023, the model's forecast of fatalities for 2024 and 2025, and the upper prediction interval value at different confidence levels.

Figure 1: ARIMA model and forecast for annual fatalities

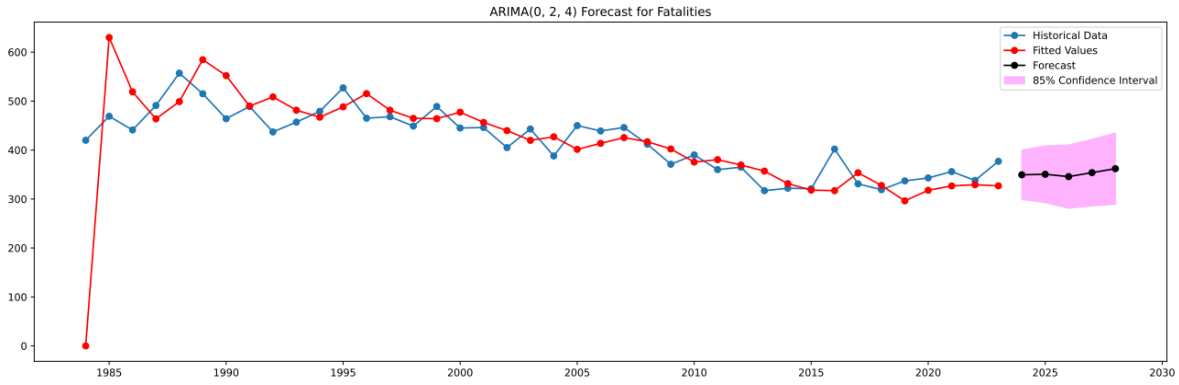

Table 1: Historical and forecast road fatalities with upper prediction values at selected probability levels

			Prediction Interval – Confidence Level				
Year	**Fatalities**	**Forecast**	**70%**	**75%**	**80%**	**85%**	**97.5%**
2021	356						
2022	338						
2023	377						
2024		349.4	385.9	389.9	394.5	400.0	428.2
2025		350.5	392.2	396.8	402.1	408.5	440.8
5-Year Rolling Average Target		354.2	362.5	363.4	364.5	365.8	372.2

To be 85% confident of the 2025 target value, the five-year rolling average target for 2021-2025 would be set by averaging:

- The number of fatalities for 2021 (356), 2022 (338), and 2023 (377)
- The forecast value of 349.4 for 2024
- The 85% PI value of 408.5 for 2025

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 2025 is expected to be 33.8 billion (33,793,000,000).

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

					Prediction Interval – Confidence Level				
Year	**Fatalities**	**HMVMT**	**Fatality Rate***	**Forecast**	**70%**	**75%**	**80%**	**85%**	**97.5%**
2021	356	333.84	1.066						
2022	338	332.66	1.016						
2023	377	336.25	1.121						
2024	*349.40*	*337.09*		1.036	1.144	1.156	1.170	1.186	1.270
2025	*350.50***	*337.93*		1.037	1.160	1.174	1.189	1.208	1.304
5-Year Rolling Average Target				1.055	1.076	1.079	1.082	1.085	1.102

**Per Hundred Million Vehicle Miles Traveled (HMVMT).*

***2025 fatalities value based on forecast value, not 85% prediction interval value, which is applied to the rate.*

To be 85% confident of the 2025 target value, the five-year rolling average target for 2021-2025 would be set by averaging:

- The fatality rates for 2021 (1.066), 2022 (1.016), and 2023 (1.121)
- The forecast value of 1.036 for 2024
- The 85% PI value of 1.208 for 2025

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 (blue line), the model (red line), the model's forecast values (black dots), and a set of prediction interval bounds (purple shading) 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: ARIMA model and forecast for serious injuries

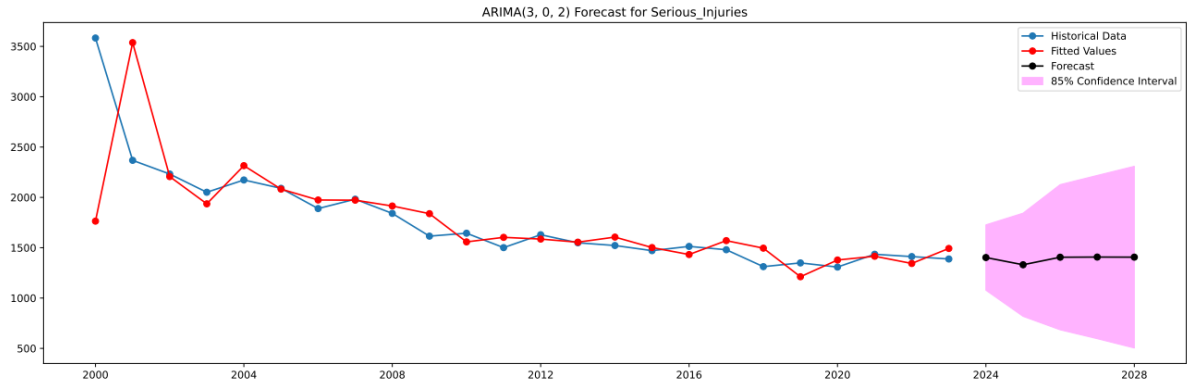

Table 3: Historical and forecast road serious injuries and forecast upper prediction values at selected probability levels

			Prediction Interval – Confidence Level				
Year	**Serious Injuries**	**Forecast**	**70%**	**75%**	**80%**	**85%**	**97.5%**
2021	1,435						
2022	1,412						
2023	1,388						
2024		1,402.5	1,636.3	1,662.0	1,691.6	1,727.2	1,908.1
2025		1,330.7	1,699.6	1,740.2	1,786.9	1,843.1	2,128.5
5-Year Rolling Average Target		1,393.7	1,467.4	1,475.5	1,484.9	1,496.1	1,553.2

To be 85% confident of the 2025 target value, the five-year rolling average target for 2021-2025 would be set by averaging:

- The number of serious injuries for 2021 (1,435), 2022 (1,412), and 2023 (1,388)
- The forecast value of 1,402.5 for 2024
- The 85% PI value of 1,843.1 for 2025

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 2025 is expected to be 33.8 billion (33,793,000,000).

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

					Prediction Interval – Confidence Level				
Year	**Serious Injuries**	**HMVMT**	**Serious Injury Rate***	**Forecast**	**70%**	**75%**	**80%**	**85%**	**97.5%**
2021	1,435	333.84	4.299						
2022	1,412	332.66	4.244						
2023	1,388	336.25	4.127						
2024	*1,402.5*	*337.09*		4.126	4.854	4.930	5.018	5.123	5.660
2025	*1,330.7***	*337.93*		3.937	5.029	5.149	5.287	5.454	6.298
5-Year Rolling Average Target				4.146	4.337	4.352	4.369	4.391	4.498

**Per Hundred Million Vehicle Miles Traveled (HMVMT).*
***2025 fatalities value based on forecast value, not 85% prediction interval value, which is applied to the rate.*

To be 85% confident of the 2025 target value, the five-year rolling average target for 2021-2025 would be set by averaging:

- The serious injury rates for 2021 (4.299), 2022 (4.244), and 2023 (4.127)
- The forecast value of 4.126 for 2024
- The 85% PI value of 5.454 for 2025

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 (blue line), the model (red line), the model's forecast values (black dots), and a set of prediction interval bounds (purple shading) 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 2004 and later.

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

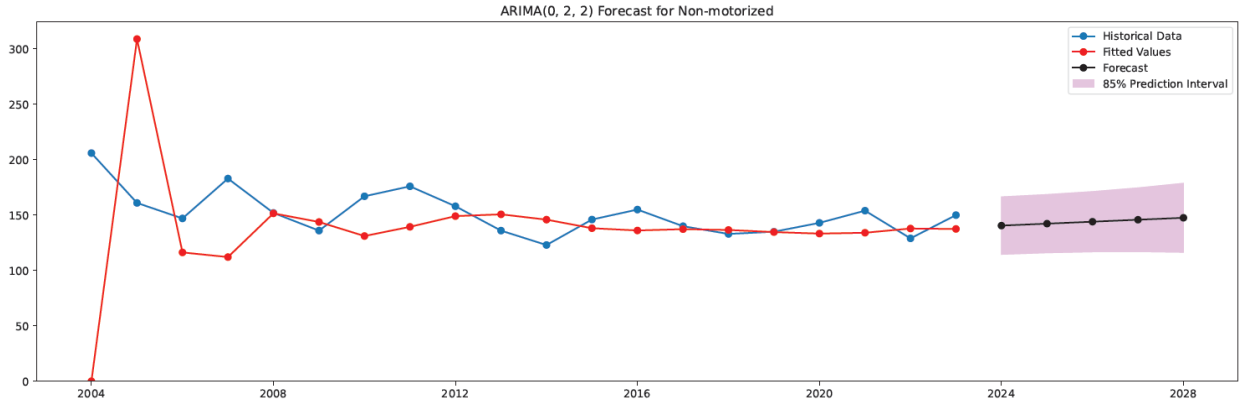

Table 5: Historical and forecast road non-motorized fatalities and serious injuries and forecast upper prediction values at selected probability levels

			Prediction Interval – Confidence Level				
Year	**Non-Motorized Fatalities and Serious Injuries**	**Forecast**	**70%**	**75%**	**80%**	**85%**	**97.5%**
2021	154						
2022	129						
2023	150						
2024		140.5	159.2	161.2	163.6	166.4	180.9
2025		142.3	161.2	163.3	165.7	168.5	183.2
5-Year Rolling Average Target		143.2	146.9	147.4	147.8	148.4	151.3

To be 85% confident of the 2025 target value, the five-year rolling average target for 2021-2025 would be set by averaging:

- The number of non-motorized fatalities and serious injuries for 2021 (154), 2022 (129), and 2023 (150)
- The forecast value of 140.5 for 2024
- The 85% PI value of 168.5 for 2025

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 2021-2025 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)
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	4.299	154	33,384
2022	338	1.016	1,412	4.244	129	33,266
2023	377	1.121	1,388	4.127	150	33,625

Table 7 shows the historical and predicted five-year rolling averages for the five targets. The highlighted numbers represent Iowa's 2021-2025 safety targets.

Table 7: 5-year rolling average actuals and 2025 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**
2014-18	339.2	1,459.6	133.8	1.022	4.400
2015-19	342.2	1,425.0	137.0	1.023	4.257
2016-20	346.6	1,392.4	136.6	1.058	4.244
2017-21	337.4	1,376.8	138.6	1.030	4.194
2018-22	338.6	1,363.2	139.0	1.036	4.166
2019-23	350.2	1,378.4	142.2	1.070	4.208
Forecast 85% prediction interval value					
2020-24	352.7	1,389.1	142.5	1.077	4.235
2021-25 targets	**365.8**	**1,496.1**	**148.4**	**1.085**	**4.391**